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KAHUAWAI SPRING

HONOLULU, OAHU, HAWAII

BOARD OF WATER SUPPLY / CITY AND COUNTY OF HONOLULU





EXECUTIVE CHAMBERS
HONOLULU

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JOHN WAIHEE
GOVERNOR

February 18, 1987

Honorable John C. Lewin
Director
Department of Health
1250 Punchbowl Street
Honolulu, Hawaii 96813

Dear Dr. Lewin:

Based on the recommendation of your office, I am pleased to accept the final environmental impact statement for the Kahuawai Spring, Honolulu, Hawaii, as satisfactory fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes.

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

When the decision is made regarding the proposed action itself, I expect the proposing agency to weigh carefully whether the societal benefits justify the environmental impacts which will likely occur. These impacts are adequately described in the statement, and, together with the comments made by reviewers, provide a useful analysis to the proposed action.

With kindest regards,

Sincerely,

JOHN WAIHEE

cc: Board of Water Supply

STATE OF HAWAII
OFFICE OF THE GOVERNOR

FEB 23 1987

DEPARTMENT OF HEALTH

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BOARD OF WATER SUPPLY
CITY AND COUNTY OF HONOLULU

This Environmental Document is Submitted
Pursuant to Chapter 343, HRS

FINAL (REVISED)
ENVIRONMENTAL IMPACT STATEMENT

KAHUAWAI SPRING

Honolulu, Oahu, Hawaii

TMK: 2-2-41:3

PROPOSING AGENCY:

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

ACCEPTING AGENCY:

Governor, State of Hawaii


Kazu Hayashida Date
Manager and Chief Engineer

Board Members:

Donna B. Goth, Chairman
Ernest A. Watari, Vice Chairman
Milton J. Agader
Sister M. Davilyn AH Chick, O.S.F.
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Edward Y. Hirata

Prepared by:

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SUMMARY

Project Description

The Board of Water Supply (BWS) of the City and County of Honolulu proposes to install improvements necessary to capture, disinfect, store and transmit water at Kahuawai Spring in Pauoa Valley, Oahu. As proposed, the project is to consist of the following component improvements:

- . collection chamber (coffer dam and sump)
- . pump facilities
- . 20,000 gallon reservoir
- . chlorinator unit
- . ancillary and appurtenant piping

The project is estimated to cost \$600,000.

Affected Environment

The project site is located approximately 150 yards beyond the mauka limit of Booth Road. Passing beyond a fence which restricts public entry, an unpaved roadway leads to the project site and Kahuawai Spring; and further to Booth Spring.

Within the forest reserve and State Conservation district, the project site is forested with various plant species and is probably inhabited by various animal life.

Water from Booth Springs contributes to Pauoa Stream flow although its contribution is sometimes interrupted during the dry season.

Climatic conditions are considered cool and pleasant, with rainfall averaging 120 inches annually and temperatures in the 59^o - 77^o range. Winds are predominantly northeasterly trades.

The spring site is in an area where there is a gently rising slope at about the 600-foot elevation. A steeper bank rises on a portion of the site from Kahuawai Spring to an existing chlorinator station and access road. Steeper topography occurs on the easterly side of the access road as the valley walls rise to meet Tantalus Drive.

Soil in the project area is well-drained, where runoff potential is medium and erosion hazards slight.

Streamlife in Pauoa Stream and the small channel carrying outflow of Kahuawai Stream consists primarily of species common to streams throughout the island. Among them are frogs, snails, tadpoles, shrimp, crayfish, o'opu, topminnows, dojo and mosquito larvae.

There are no endangered plants or animals within the immediate project area.

Kahuawai Spring

Kahuawai Spring emerges from the ground in a circular pond approximately 7 to 8 feet in diameter. Water from the spring flows along a shallow channel and a number of small tributaries to Pauoa Stream. Before reaching Pauoa Stream, a portion of the water spills over a terraced area, and another portion is diverted by a local resident for the cultivation of some watercress.

Geologically, the spring results from perched groundwater associated with lava and cinders from volcanic vents on Tantalus. The cinders and interbedded lava overlie older alluvium and soils which are superimposed on Koolau lava.

Kahuawai Spring generally flows at approximately 230,000 gallons of water per day (.23 mgd). In the past 10 years, monthly flow records indicate output ranging from .180 mgd to .372 mgd.

Land Use Designations

State Land Use designation for the site is conservation. The Development Plan (City and County) designates the site for preservation, and the site zoning is P-1.

Infrastructure and Utility Services

Booth Road as it approaches the project area is narrow and in poor condition. Eighteen residences are located along this final section of Booth Road before further passage is restricted by a BWS fence.

The project area is unsewered. An existing 8-inch sewer main terminates at a point approximately 800 feet west of the project area.

Power and communication service is provided through overhead lines along Booth Road.

Emergency services are available to the project area.

Fire protection is not available to the upper portions of Booth Road. The last fire hydrant is located next to 2911 Booth Road.

Potential Environmental Impacts

Short-term impacts were identified as those related to construction. The following adverse short-term impacts were identified:

- . vegetation loss due to sitework.
- . temporary increases in the turbidity of water.
- . noise.
- . exhaust fumes.
- . traffic inconveniences

Mitigation of the above impacts are possible, since they are only temporary impacts.

Long-term adverse impacts identified were those which could be expected to affect the visual environment of the project site, and localized stream environment of the Spring area.

The reservoir of the project may be visible from residential areas on the east slope of Pacific Heights, and the west slope of Tantalus if the reservoir is constructed above ground. Forest vegetation is expected to quickly regenerate and mitigate a portion of this visibility. An alternative would be to install the tank underground. However, the pumps, chlorinator building, and master control center would still be installed above ground and may be visible.

The long-term adverse effects of the project relating to the stream environment were anticipated to be a consequence of reduced flow, especially during dry months.

Vegetative growth into the channel (from the Spring) could occur if flow is reduced for a sufficient period. Reduction in flow could also cause cessation of watercress cultivation by one local resident.

During periods of reduced streamflow, aquafauna can adapt to the changing stream conditions similar to that occurring. Under dry weather conditions, stream biota are sustained in small pools. No endangered species were found in Pauoa Stream.

No long-term adverse effects are expected on the surrounding urban environment.

Long-term benefits to the socio-economic environment are anticipated. The new water system would provide a more reliable water supply to the eighteen residences along Booth Road.

The project will also benefit the BWS in providing another source of potable water to meet the growing demand for water. The positive impact of this project is further enhanced by the use of a previously "lost" resource.

SECTION 1

DESCRIPTION OF THE PROPOSED PROJECT

The Board of Water Supply, City and County of Honolulu, proposes to install a collection chamber, reservoir and ancillary facilities at Kahuawai Spring, Honolulu, Hawaii. As shown on Figure 1, Kahuawai Spring (aka Rose Apple Spring) is located at the 600-foot elevation in Pauoa Valley.

Improvements to the existing water distribution system would: (1) provide a more reliable water supply for the eighteen residences along the upper (mauka) portion of Booth Road; and (2) supplement the water yield from an adjacent source, Booth Spring.

Booth Spring is one of several water sources serving Pacific Heights and Pauoa Valley. Water is transmitted via a 6-inch main from Booth Spring to the Pacific Heights 578' reservoir. From the reservoir, water is distributed throughout the service area via 6-inch and 8-inch lines. The existing system is shown on Figure 2.

A. Technical Characteristics

The following components comprise the proposed project: construction of a coffer dam, sump and pump facilities at Kahuawai Spring, erection of a 20,000 gallon reservoir, and installation of necessary transmission lines connecting the spring to the existing distribution system. A building to house chlorinator and electrical equipment will also be constructed.

A concrete coffer dam, similar to one at Booth Spring, would be constructed around Kahuawai Spring to capture an estimated .25 million gallons per day of spring water. An influent line would convey spring water to a collection chamber. Water would then be disinfected by a new chlorinator unit before being pumped into the reservoir. Approximately 2700± lineal feet of pipe would be installed for this segment of the project.

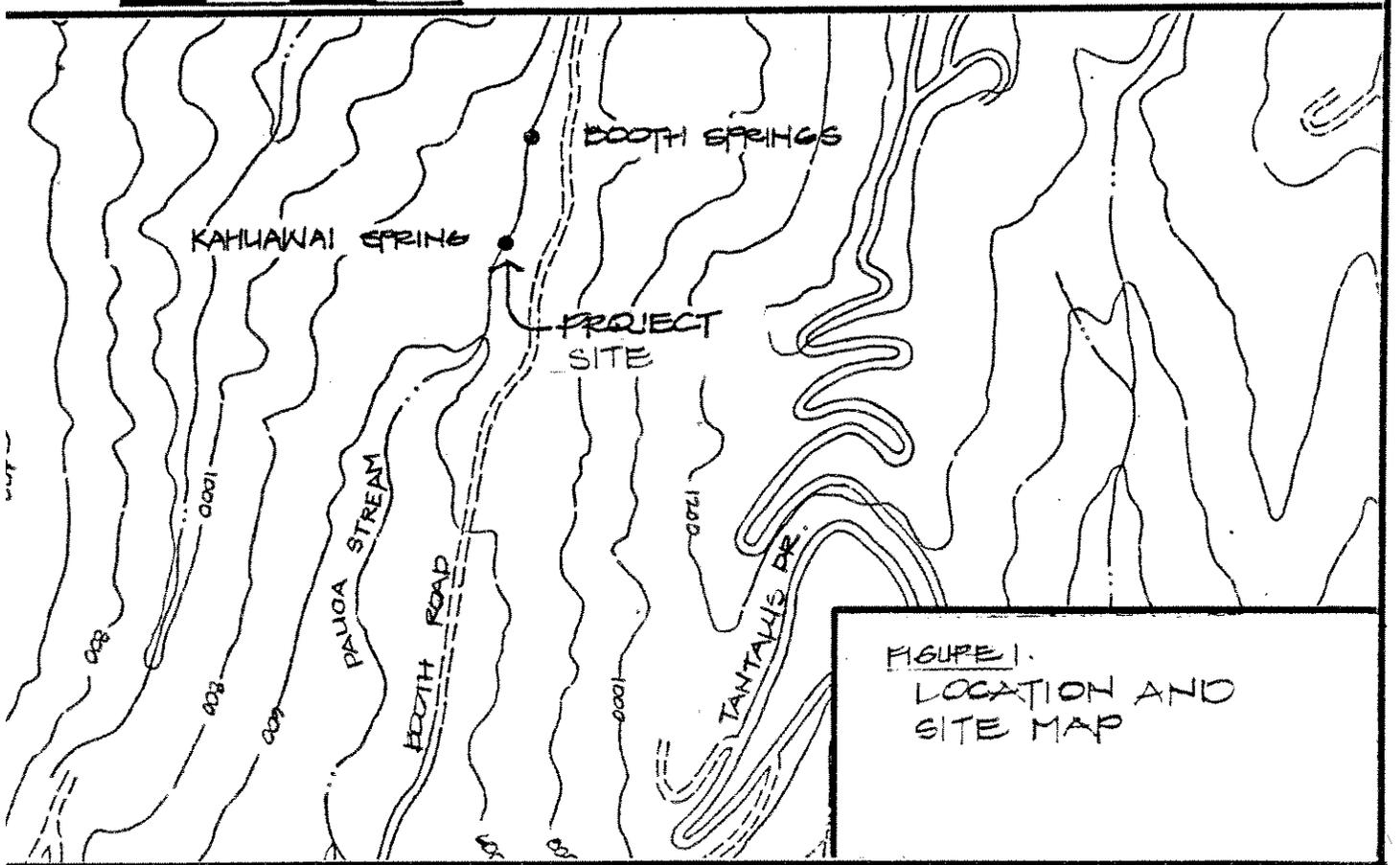
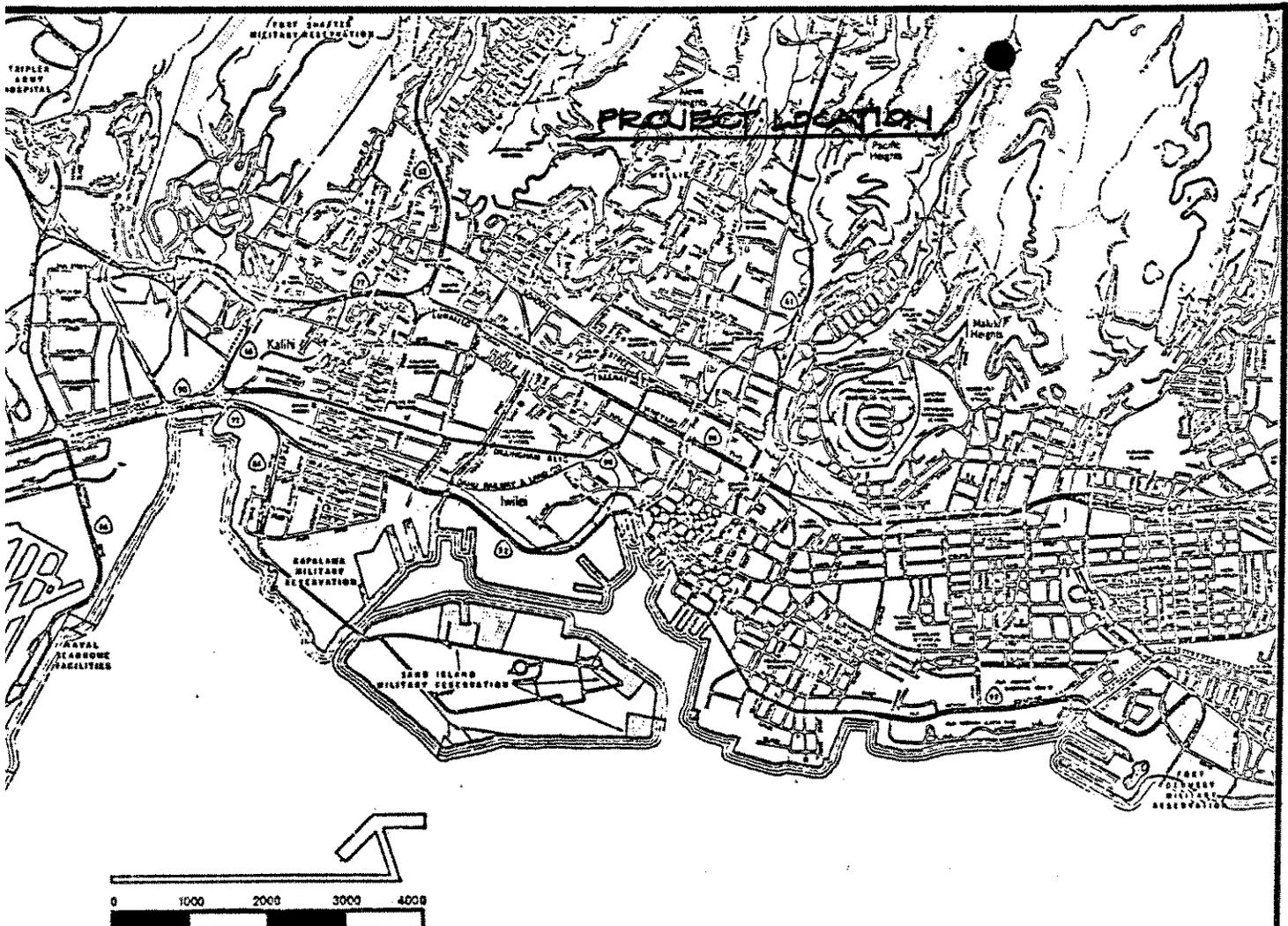
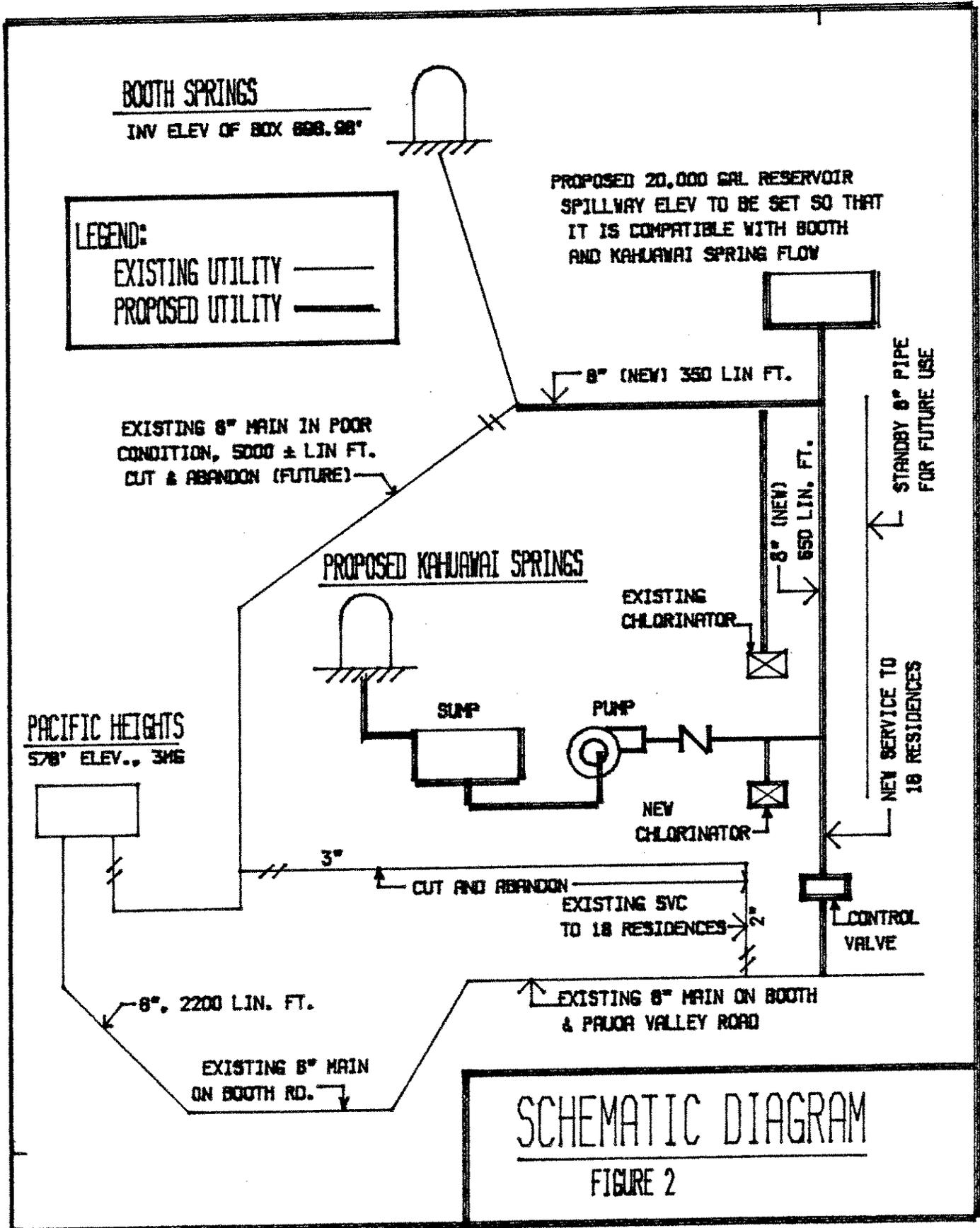


FIGURE 1.
LOCATION AND
SITE MAP



Specific design of the reservoir is not yet available. However, preliminary alternatives for the siting analysis of the reservoir indicate that its location would best be on the east side of the existing roadway. As such, siting of the reservoir will probably be on State owned conservation district lands.

Other transmission line improvements are proposed to tie the new facilities into the existing system. (See Figure 2). Pipeline alignments have not been determined.

Water from Booth Springs currently being piped across the valley to the Pacific Heights 578' reservoir would be connected to Kahuawai Spring.

Eighteen residences along Booth Road presently draw water from a 2-inch line connected to Booth Springs. These eighteen residences would now be serviced by a new 6-inch or 8-inch line from the Kahuawai reservoir, which would then be connected (using a control valve) to the 8-inch main leading to the Pacific Heights 578' reservoir, at a point beyond the residences.

The 6-inch or 8-inch main leading from Kahuawai Spring to the eighteen residences would be buried at a minimum of 3 feet below the roadway surface. The new water line between the Booth Spring 6-inch main and the new 20,000 gallon reservoir would be laid on the surface.

B. Economic and Social Characteristics

The cost of the project is estimated at \$600,000. A timetable for commencing and completing the project has not been set, pending a finalization of reservoir and system designs. Funds from the Board's Capital Improvement Program will be used for this project.

Most of the properties committed to this project are owned by the City and County of Honolulu. The exceptions are the affected portion of Booth Road owned by the State of Hawaii but maintained by the City and County of Honolulu, the possibility of the reservoir site being on State conservation district land, and the overflow line traversing private property.

C. Statement of Objectives

The Board of Water Supply of the City and County of Honolulu has initiated this project as part of its continuing program to provide adequate water supply to the public. Kahuawai Spring presents an efficient and readily available source of water for Honolulu.

SECTION 2

DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. Project Site

The proposed project is composed of several elements, each located in close proximity, and within a general area of Kahuawai Spring. This area will be referred to as the project site.

The project site is located approximately 150 yards beyond the mauka end of Booth Road. Near its mauka limit, Booth Road narrows to a one-lane roadway, passing seven residences before being blocked by a chain link gate beyond which the general public is not permitted. Beyond this point, the roadway is unpaved and leads to the project site and Booth Spring.

The project site lies within the forest reserve boundary and within the State conservation district.

1. Kahuawai Spring (Roseapple Spring)

Kahuawai Spring emerges from the ground forming a circular pond, approximately 7 to 8 feet in diameter and between 12 to 18 inches in depth. Overflow from this pond is through a metal weir with a v-notch outlet. Flow through the notch is normally about 6 inches. The bottom of the pond is mostly coarse sand and pebbles with a few larger rocks.

Board of Water Supply records indicate that Kahuawai Spring discharge can vary from an estimated 0.180 mgd to 0.372 mgd, based on a ten-year monthly record. Discharge runs along a poorly maintained channel, parallel and between the access road and Pauoa Stream. Usually only a few inches deep, flow from this channel seeps across several terraces alongside its path. Most of the flow reaches portions of Pauoa Stream a few hundred yards downstream at a location where the residences begin. Here, a portion (less than one-half) of the flow has been diverted by a nearby resident for the cultivation of watercress.

2. Pauoa Stream

The main body of Pauoa Stream is the accumulation of a series of small tributaries along the western slope of Tantalus. The stream flows over volcanic deposits derived from relatively late eruptions (geologically) of Tantalus, which partially filled the more ancient Pauoa Valley. A waterfall now represents the edge of the uppermost Tantalus lava flow.

"Flow in the upper reaches of Pauoa Stream (above Booth Spring) is interrupted. Water which percolates into the basalt and cinder of the Tantalus eruption seeps downward until it encounters the much older and more or less impermeable surface of the alluvial fill of the ancient valley. This groundwater then moves along the point of contact between the older Ko'olau rocks and the younger Tantalus flows, emerging as springs in the valley (Wentworth, 1941). Booth Spring and Rose Apple Spring (Kahuawai) are two of the major springs in upper Pauoa Valley." (excerpt from Appendix A).

"Nearly all of the permanent flow in Pauoa Stream derives from the several springs in upper Pauoa Valley. The largest spring appears to be Booth Spring - a part of which is capped with a cement cistern and the flow diverted by the Honolulu Board of Water Supply. However, the cistern leaks, and captures only a portion of the seepage from the yielding stratum which cuts across the width of the stream bed as small disconnected pools. Flow in this section presumably occurs only during and following significant rainfall events. In the vicinity of and downstream from Booth Spring, water flows over a natural bedrock channel in upper Pauoa Valley, then through a lined channel in upper Pauoa Valley, then through a lined channel in a portion of middle Pauoa Valley and around the western side of Punchbowl (Puowaina) cone. The stream empties into Nuuanu Stream just inland from Beretania Street (Wentworth, 1941; Timbol and Maciolek, 1978)" (excerpt from Appendix A).

B. Climate

Climatic conditions can be considered cool and pleasant although the area is quite damp.^c Rainfall averages 120 inches annually. Relative humidity ranges from lows of 55% during summer months to highs of 85% during the winter. Temperatures range from a low of 59° to a high of 77°F. Winds blow from the northeast quadrant about 90% of the time at speeds between 9-13 mph.

C. Topography

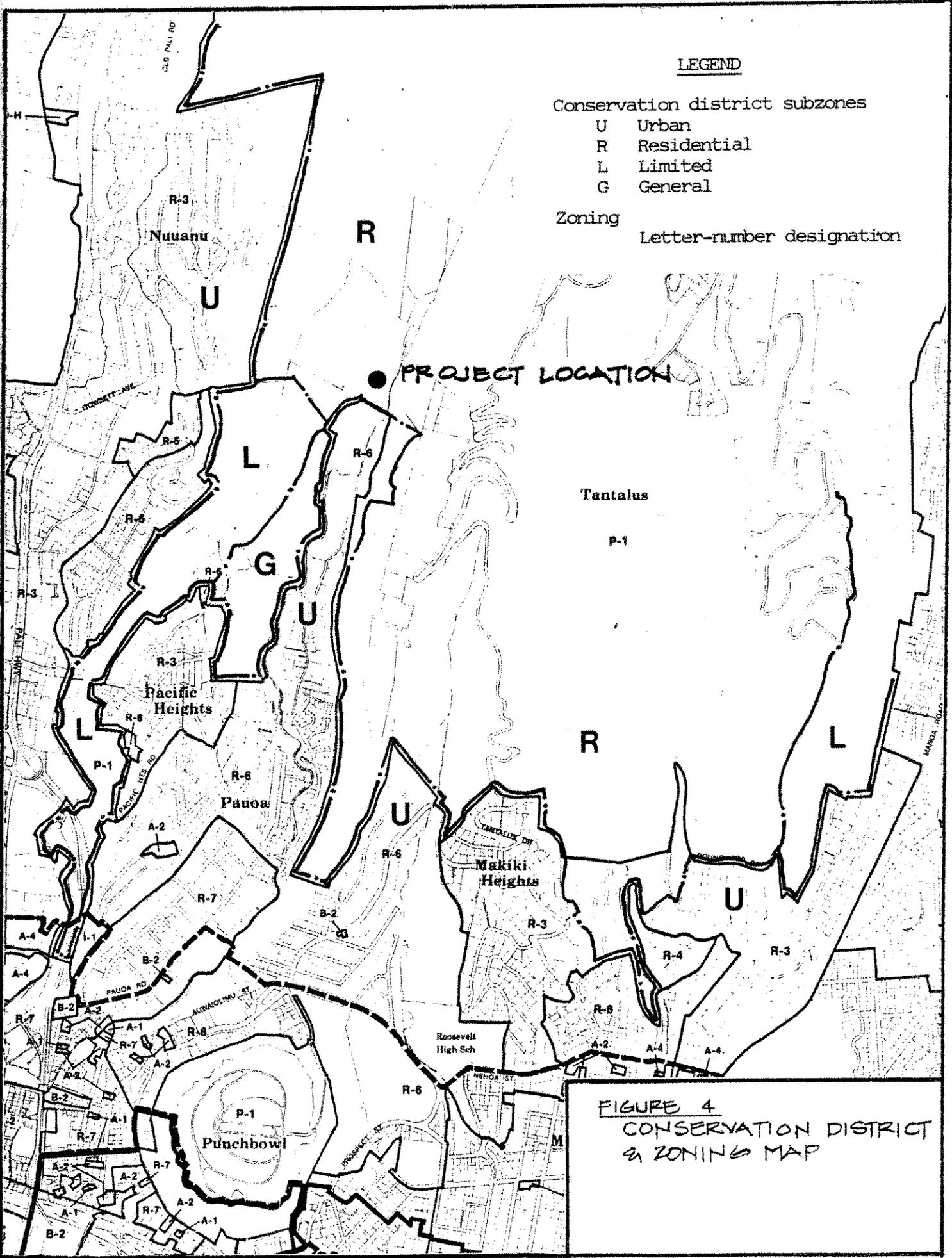
Located at the 600-foot elevation, the area surrounding Kahuawai Spring is gently sloped. The steepest slopes are encountered between Kahuawai Spring, which lies in a gulch, and an existing chlorinating tank atop one bank adjacent to the access road. Here slopes average 30% for a distance of 120-130 feet. Topography again rises steeply beyond and to the east of the access road toward Tantalus Drive.

D. Soils

Soil Conservation Service (1973) soil maps indicate one soil type---Tantalus silt loam, 15 to 40 percent slopes---within the project area. This is a well drained soil developed in volcanic ash and material weathered from cinders. The runoff potential is medium and erosion hazard is moderate.

E. Flora

The flora of the project area falls within Ripperton and Hosaka's vegetation zone D (Ripperton and Hosaka, 1942), characterized in part by an annual rainfall of 60 inches or more. Depending on land utilization and elevation this zone is divided into three phases. The vegetation in the project site is generally indicative of the low phase which consists of shrubs and closed forests and species such as guava, Boston fern, Hilo grass, basket grass, and honohono.



LEGEND

Conservation district subzones

- U Urban
- R Residential
- L Limited
- G General

Zoning

Letter-number designation

Tantalus

P-1

R

L

PROJECT LOCATION

FIGURE 4
CONSERVATION DISTRICT
& ZONING MAP

Vegetation on the ridge slopes consist of christmasberry (Schinus terebinthifolius) and koa-haole (Leucaena leucocephala) while mango (Mangifera indica), avocado (Persea americana), Java plum (Eugenia cumini), rose apple (Eugenia jambos), paragrass (Brachiaria mutica), honohono (Commelina aureus), basketgrass (Oplismenus hirtellus), taro vine (Scindapsus aureus), and Xanthosoma sagittifolium are common on the valley floor. In addition, sections of the valley have been reforested with bingabing (Macaranga grandifolia), brush box (Tristania conferta), Chinese banyan (Ficus microcarpa), Albizia falcataria, and various species of Eucalyptus and Bambusa. Bingabing and Alizia have spread prolifically as has melochia (Melochia umbellata), another species that has been used in reforestation. The forest canopy in the lower portions of the valley tends to be more open with basketgrass dominating the forest floor and paragrass and honohono in the sunny, exposed areas. In the upper portion of the valley the forest is dense with thick undergrowth or high canopied trees with relatively little undergrowth.

1. Spring Site

The spring is located between the existing chlorinator station and Pauoa Stream. It emerges from beneath the canopy of a large rose apple tree and because of the dense shade created by the canopy, the immediate vicinity of the spring is sparsely vegetated. Several small plants of Chinese taro (Alocasia cucullata), Xanthosoma sagittifolium, and Cyclosorus parasiticus can be found along with numerous rose apple seedlings and several moon flower (Ipomoea alba) vines. The open-canopied forest makai of the spring consist largely of melochia, banana (Musa x paradisiaca), and bamboo (Bambusa vulgaris and B. sp.) with open areas of paragrass and honohono (Commelina diffusa). Scattered Albizia, kukui (Aleurites moluccana), avocado, and Chinese banyan can also be found makai of the spring. Maile pilau (Paederia foetida) and moon flower festoon the smaller trees and climb into the canopies of the taller trees.

The small channel draining Kahuawai Spring is overgrown with grasses and honohono. The flow crosses a terraced meadow where farfugium (Ligularia tussilaginea), pennywort (Centella asiatica), purslane (Ludwigia octovalvis) and taro (Alocasia macrorrhiza) have been observed. Crossing the meadow, heliconias, banyans (Ficus benjamina) and ferns (Adiantum hispidulum) and some watercress (Nasturtium microphyllum) occur along the flow and terraces.

Mauka of the spring the forest is taller, closed-canopied and denser consisting predominantly of rose apple, occasional avocado, Java plum and monkeypod (Samanea saman). Maile pilau and moon flower occasionally climb into the canopy.

A more complete inventory of flora is found in the survey included as Appendix A of this EIS.

2. Reservoir Site

The vegetation of the probable reservoir site is not dominated by any single species. Although the most common woody species in this area are melochia, guava and bingabing, the most notable features of the vegetation are the eucalyptus, brush box, and Toona which reach heights of at least 100 feet. Large clumps of bamboo and several tall silk oak (Grevillea robusta) are also found. These have often been used in reforestation efforts and because of the alignment of these trees, it can be assumed that they have been planted. The forest here is high canopied with a relatively open understory. The herb layer consists largely of basketgrass and honohono.

F. Fauna

An environmental survey at the project site was conducted for this EIS and identified (See Appendix A). Above Booth Spring, isolated pools were described as "harboring only tadpoles (probably Rana rugosa) and insect larvae (mostly Diptera, Chironomidae). Below Booth Spring and above Kahuawai Spring a sand bottomed pool was described as harboring tadpoles and adults of the wrinkled

frog (Rana rugosa), and O'opu nakea (Awaous stamineus) is also believed to be present. Below this point to a small waterfall, smaller pools contained tadpoles, algae (Cladophora sp.) and insect larvae (Diptera). A few crayfish (Procambarus clarki) were observed.

Below the small waterfall, pools in the stream contained more water life. Down to and beyond the confluence of Pauoa stream and the outflow of Kahuawai Spring, swordtails (Xiphophorus helleri), a snail (Lymnaea reticulata), and a shrimp (Atya bisulcata) were collected by the survey.

In the immediate Kahuawai Spring pool and the small channel which drains it, snails (Melania mauiensis), crayfish, topminnows (Gambusia affinis) and a dojo (Misgurnus auguillicaudatus)."

Animals (fauna and avifauna) were not observed on site investigations. However, it is probable that a number of animals and birds frequent the area. The project site and its immediate environs would contain many of the species of animals and birds known to exist throughout the Makiki and Tantalus area. Some identified species would more often be associated with the deeper forest areas, but are mentioned here although their visits to sites closer to urbanized areas are believed to be less frequent.

Animal species would include mongoose (Herpestes auropunctatus), rats (Rattus rattus), cats (Felis catus), dogs (Canis familiaris), bats (Lasiurus cinereus semotus), and feral pigs (Sus scrofa).

Bird species would include house finch (Carpodacus mexicanus frontalis), Brazilian cardinal (Paroaria coronata), cardinal (Richmondia cardinalis), white eye "Mejiro" (Zosterops japonica), shama thrush (Copsychis malabaricus), mockingbird (Mimus polyglottos), barred dove (Geopelia striata), spotted dove (Streptopelia chinensis chinensis), Chinese thrush (Garrulax canorus), English sparrow (Passer domesticus), and mynah (Acridotheres tristis). Some endemic species are also identified with the Tantalus area, although they are usually not associated with the Pauoa Valley area.

G. Surface Water Hydrology

Kahuawai Spring, Booth Spring (elevation 700'), and Kaaikahi Spring (elevation 280') overflow into Pauoa Stream. Spring flow for Kahuawai Spring recorded by the Board of Water Supply is shown below. These flows are generally representative of corresponding monthly spring flow for the past 10 years. The highest recorded flow was registered in October, 1975 at .372 mgd; the lowest, .180 mgd occurred in April, 1978.

<u>1979</u>	<u>Million Gallons Per Day</u>
January	.266
February	.280
March	.252
April	.239
May	.252
June	.227
July	.227
August	.252

SOURCE: Board of Water Supply

H. Historical Features

There are no recorded historic features in the project area. However, an archaeologist will be hired to monitor all grading and excavation work. The State Historic Preservation Office will be notified if any archaeological or historical find is encountered.

I. Land Use Designations

The spring and reservoir site are designated Conservation by the State Land Use Commission. The Development Plan Map, City and County of Honolulu, designates the site Preservation and it is zoned Preservation (P-1).

J. Infrastructure and Utility Services

1. Circulation: In the residential area approaching the project, Booth Road narrows to about 6-8 feet in width. Overgrown vegetation, primarily California grass and koa haole, line both sides of the road further reducing its width. Although paved, the road is in disrepair and cracks and potholes abound. Passage is generally limited to one vehicle at a time.

2. Sewer: The project area is unsewered and cesspools are probably the primary means of waste disposal. An existing and recently installed 8-inch sewer main terminates approximately 800 lineal feet west of the project area.
3. Drainage: The project area is not served by a municipal drainage system.
4. Power and Communication: Power and communication services are provided by overhead cables along Booth Road.
5. Emergency Services: Municipal fire and ambulance services are available to the project area. At present existing water supply services do not provide fire hydrants in the immediate project area. The nearest fire hydrant is located about 800 feet from the uppermost residence on Booth Road.
6. Water: Water service to the eighteen services on the upper end of Booth Road receive their water from Booth Springs. The Pacific Heights 578 System provides a temporary back-up to some of the eighteen residences.

K. Flood/Tsunami

No flood or tsunami dangers are indicated for the project site. The project site is designated Zone C on the Flood Insurance Rate Map prepared by the Federal Insurance Administration.

L. Noise

Undesirable noise levels in Pauoa Valley are minimal and when detectable, are traceable to residential activity. Ambient noises at the project site are predominately those naturally occurring in a forested environment. Mechanical noise of a detectable but minimal nature occasionally emanates from the existing chlorinator facility at the project site.

M. Air Quality

No monitoring stations within close proximity of the project site exist. Closest monitoring occurs at the Department of Health building on Beretania Street, which is an urban environment quite different from the forested surroundings of the project site. The ambient air quality of the project environment is assumed to be generally pristine and free of particulate and hydrocarbon pollution under normal weather conditions, owing to the absence of possible sources.

SECTION 3

RELATIONSHIP OF THE PROPOSED ACTIONS TO LAND USE PLANS, POLICIES, AND CONTROLS FOR THE AREA

A. Applicable Land Use Controls

The project site for the Kahuawai Spring project is subject to the following land use controls:

- . State Land Use District
 - . Oahu General Plan (Development Plan/Zoning)
 - . Comprehensive Zoning Code
1. State Land Use District: The State Land Use District designation for the site is conservation. It is within the resource subzone of the conservation district. The objective of this subzone is "to ensure sustained use of the natural resources of those areas".

 2. Oahu General Plan: The existing Oahu General Plan sets forth policy for the long-range comprehensive physical development of the City and County of Honolulu. All development and land use conforms to the General Plan. The General Plan sets the policy used in preparation of Development Plans.

Development Plans were recently adopted by the City Council. The Plan with direct applicability to the project site is the Primary Urban Center plan, which designates the site as Preservation. Zoning for the site is P-1 (Preservation). Development of the proposed project is in conformance with the DP/PF Map for the area which was adopted by Ord. No. 81-79, as amended.

 3. Comprehensive Zoning Code (CZC): The Comprehensive Zoning Code is established to implement the provisions of the General Plan, Development Plans and Zoning designations. The CZC maintains "watersheds, wells, water reservoirs and water control structures" as permitted uses in the P-1 district.

SECTION 4

POTENTIAL ENVIRONMENTAL IMPACTS AND MEASURES TO MITIGATE ADVERSE EFFECTS

The identification of impacts is distinguishable. The short-term impacts are primarily construction-related, and the long-term impacts are those which relate to the extraction of water from Kahuawai Spring.

A. Short-Term Impacts

Potential adverse short-term impacts are those which will result from construction activities at the project site. Sitework, pipeline and cofferdam installation, and equipment traffic can be expected to temporarily disturb the forest environment of the project site, the stream and to a limited extent, the surrounding residences.

1. Vegetation (flora): Sitework, including clearing, grading and excavation necessary for the construction of proposed improvements will cause the temporary loss of vegetation over portions of the project area. Clearing of smaller understory vegetation will occur for the duration of the construction period. No species of flora is expected to be endangered by construction activity and vegetation is expected to regenerate rapidly upon the completion of construction.

Air quality impacts created by equipment exhaust are not expected to adversely affect vegetation.

2. Stream: Grading activities will occur for installation of the coffer dam, pump station and reservoir. While all construction except for the dam at the Spring will not directly occur in water, movement of soil will expose various areas of the project site to runoff under heavy rains when subsequent increases in the turbidity of Pauoa Stream could occur. This condition is seen as temporary, and can be partially mitigated through the scheduling of grading operations in the dry season. No permanent adverse effect to stream fauna is anticipated as a result of temporarily muddy water caused by construction activity.

All sitework and grading operations will be performed in compliance with City grading ordinances (Chapter 23, Revised Ordinance of Honolulu 1978, as amended).

3. Surrounding Urban Environment: The immediate surrounding urban environment consists of the eighteen (18) residences along the upper portion of Booth Road. Construction-related impacts to these residences will occur primarily as noise and temporary traffic inconveniences, especially during the installation of the water main under Booth Road to serve these residences.

- a. Noise

Noise emanating from construction of the spring improvements are not expected to be acute in the area of the residences.

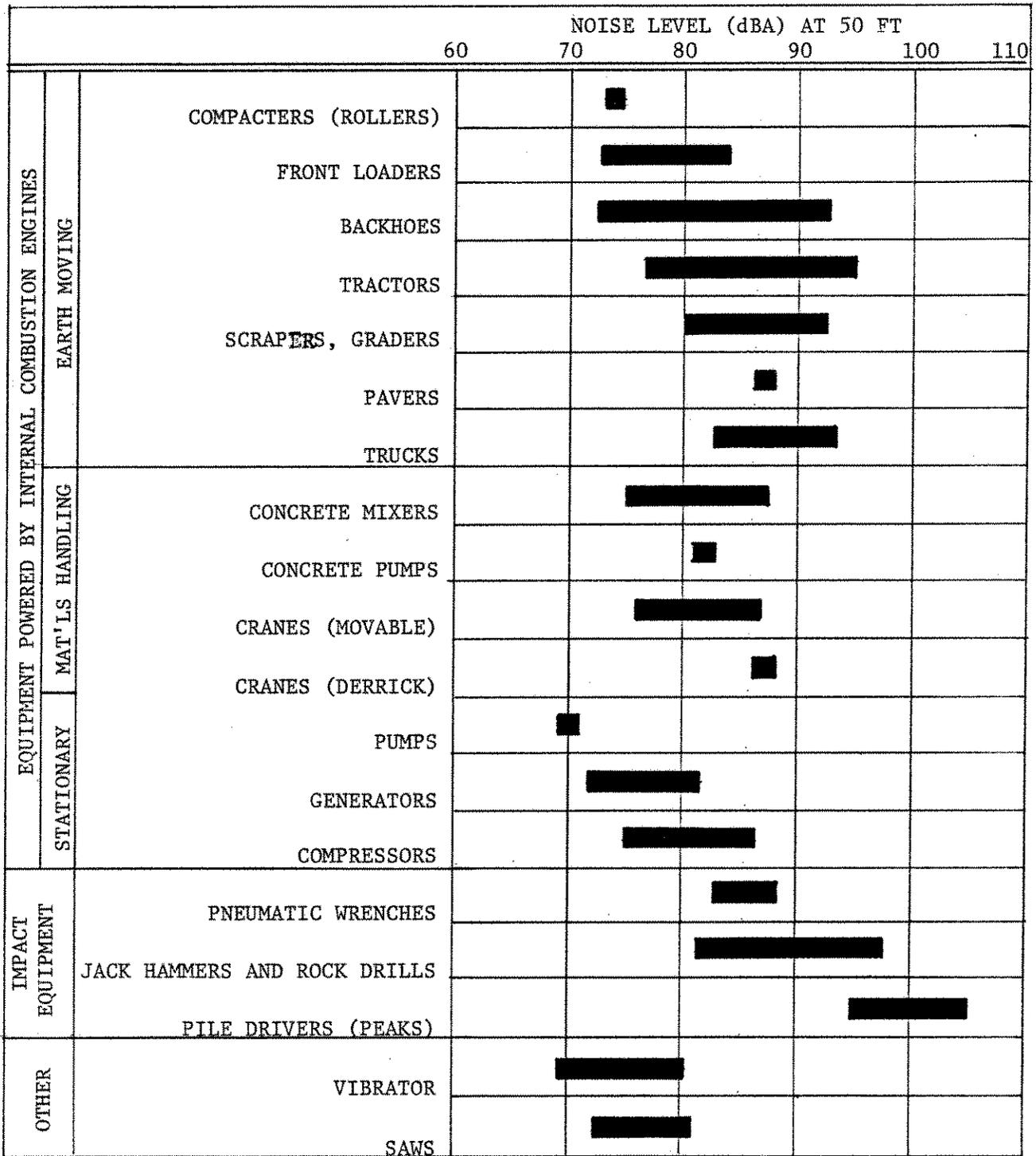
Noise is expected to be generated during all phases of construction by equipment and project-related truck traffic. Equipment noise will be most pronounced during the early stages of construction; site clearance and grading. Conventional construction equipment is expected to be used, and noises which are generated by these equipment types are defined in Table 1.

Construction will occur in phases from which distinct noise impacts may be identified. Initially during sitework, noises can be expected from heavy earthmoving machinery such as bulldozers, scrapers, backhoes, dump trucks and jackhammers. In this period, noise levels could reach about 98 dB(A).

Following sitework, noise from trucks, cement mixers, compressors, and other ancillary equipment can be expected. These noises are generally lower in decibel level and frequency than those during sitework.

In general, construction noise will create only temporary nuisances to residences in the area.

FIGURE 5
CONSTRUCTION EQUIPMENT NOISE RANGES



Source: Noise From Construction Equipment and Operations, Building Equipment, and Home Appliances, EPA, 1971.

Sufficient distance and muffling of noise provided by the dense forest cover should adequately mitigate any potentially disturbing noises due to construction. Noise will be obvious only during the installation of the water main under Booth Road. Primary mitigation of noise will be to restrict construction activities to normal working hours, and to have the contractor maintain all of his equipment in good working condition.

All construction activities are to be subject to compliance with Public Health Regulations, Chapter 11-42, Vehicular Noise Control for Oahu; and Chapter 11-43, Community Noise Control for Oahu. A noise permit may be required by the Department of Health.

b. Traffic

Potential impacts due to traffic generated by the project include the introduction of slower moving trucks and other equipment, especially along the narrow portion of Booth Road fronting the last seven (7) residences. Escort vehicles may be used to lead larger, slow moving vehicles along the narrow portion of Booth Road. Additionally, when portions of the roadway will be exposed for installation of the water main, traffic will be hindered further by open trenches or temporary traffic plates.

Where appropriate, the Contractor will be expected to publicly notify motorists and residents in the immediate vicinity of the project of pending construction. Warning notices, signs and flagmen may also be necessary.

Pedestrian traffic may also be temporarily diverted at times. Barricades around hazardous areas would be required.

c. Air Quality

Impacts on air quality during the construction phase are expected to be the release of dust and exhaust emissions from equipment.

As with noise, impacts on air quality are construction-related and will be associated with sitework when the heaviest equipment are used. While it is inevitable that some air borne dust will be caused by sitework the project area is usually wet enough to substantially reduce the incidence of fugitive dust. When necessary, wetting of the site can further mitigate this possibility.

Exhaust emissions from equipment can be mitigated to a degree by the proper maintenance of equipment.

4. Socio-Economic Environment: The short-term socio-economic impacts of the project are anticipated to be the positive effects of employment for the local construction industry. The availability of work for the industry would enhance benefits to the local economy, especially during prevailing economic conditions.

Projected costs for the entire project have been estimated at \$600,000, the majority of which can be expected to be spent on local labor, materials, equipment and supplies.

B. Long-Term Impacts

Potentially adverse long-term impacts of the project include those which could be expected to affect the visual environment of the project site, and localized outflow conditions in the area of Kahuawai Spring.

Beneficial impacts are also expected in the long-term use of the spring as a consequence of the construction of the project.

1. Visual Environment: The long-term effect of the project on the visual environment of the area, will probably be the reservoir's visibility from residential areas which overlook Pauoa Valley. In varying degrees and locations, it is anticipated that the reservoir structure will be visible from points on the east face of Pacific Heights, and on the west face of

Tantalus. However, it is expected that the naturally dense forest vegetation that presently covers the site will quickly regenerate itself and mitigate any significantly obtrusive visibility of the reservoir structure. Project improvements are not expected to be visible from Booth Road or Pauoa Valley.

2. Stream Environment: The long-term effects of the project on the stream environment are anticipated to be a consequence of reduced flow when water is pumped to the reservoir. Reductions of flow would be most obvious in dry months when there would be little or no flow in the channel leading to Pauoa Stream.

Where Kahuawai Spring water presently flows across terraces to seep into the stream, there could be occasions when little or no flow would allow establishment of vegetation overgrowth into the bed of the channel. Where a portion of the Kahuawai overflow is used by a local resident to grow watercress, reduced flow may preclude growing during the drier months or longer.

A stream flow situation similar to what presently occurs below Booth Spring is eventually anticipated for the channel below Kahuawai Spring. Flow would be intermittent causing stream biota to sustain in smaller pools under dry weather conditions. The snail (Melania maniensis), crayfish (Procambarus clarkii), dojo (Misgurnus auguilicaudatus), and topminnows (Grampus affinis) were identified in the channel and their species are not expected to be endangered if they are no longer able to survive under intermittent flow conditions.

3. Surrounding Urban Environment: No long-term adverse effects to the surrounding urban environment are expected.
 - a. Noise: No noise, significantly adverse to disturb residents is expected to be generated from the normal functioning at the project.

- b. Traffic: Traffic generated by the project beyond the construction phase of the project will consist of Board of Water Supply monitoring and maintenance crews. The occurrence of such traffic is expected to be minimal and no adverse impact is anticipated.
 - c. Air Quality: The proposed project will not introduce any emissions to the ambient air of the project site. The location of the chlorinator and its use of chlorine at the site is not of sufficient quantity to pose a threat of adverse impact on air quality.
4. Socio-Economic Environment: The long-term impacts to the socio-economic environment posed by the project are positive and will extend beyond the localized environment of the immediate project area.

The new water main will provide a better service to the eighteen residences along the upper portion of Booth Road.

Beyond the immediate project area, the project will assist in the continuing effort of the government to supply the City with a consistent supply of pristine water. Growing demands and low rainfall periods recently have emphasized the need to efficiently utilize the island's available water sources. The positive impact of the utilization of Kahuawai Spring is that its extraction (as opposed to wells) is relatively low cost. Further, its use represents the recapture of a previously "lost" resource, as Kahuawai Spring water is now allowed to flow away.

SECTION 5

UNAVOIDABLE ADVERSE EFFECTS

Potentially adverse impacts which would be anticipated include those short and long-term impacts identified in previous Sections. There are, however, reasonable limits to the mitigative measures taken, beyond which impacts become unavoidable and do occur. Such impacts include:

- . Short-term construction impacts
 - noise
 - on-site vehicular traffic
 - introduction of exhaust fumes
 - turbidity (of water)
 - loss of understory vegetation
- . Long-term impacts
 - increased incidence of low flow in upper Pauoa Stream, especially during dry periods
 - interruption of watercress growing during some months for an area resident
 - reduction in total flow available to Pauoa Stream.

Notwithstanding the unavoidable impacts cited above, major items in the consideration to proceed with the project include the positive beneficial impacts and the need for the project.

- . Economic employment benefits during construction
- . Increase in the available supply of potable water
- . Better utilization of a natural resource

The project has been initiated due to the periodic "caution" level of the City's domestic water supply. As such, the project will assist and ensure the continued provision of potable water for the City's supply.

SECTION 6

ALTERNATIVES TO THE PROPOSED ACTION

Alternatives to the project considered variations of specific components of the project itself. A number of reservoir sizes and pipeline configurations were considered before the tentative project proposal was generated. The entire project is currently being designed and final pipeline configurations and reservoir location will be forthcoming at the completion of this phase.

Conceptually, the only alternative to diverting water from Kahuawai Spring is the "null" alternative of not developing this water resource. In practice, this alternative has been exercised until the initiation of the project, when new sources of water supply for the City became necessary to meet projected water demand.

SECTION 7

LONG-TERM PRODUCTIVITY VS. SHORT-TERM USES

The uses to which long-term productivity can be measured against short-term use of the site lies in its utility as a vital resource. In the short-term, the construction impacts and losses (e.g. area resident's home watercross patch) due to the diversion of water are to be considered. Alternatively the long-term productivity and benefits of a consistent, high-quality water supply must be recognized.

As a resource, in the short-term and undeveloped state, the water and its inherent value to humans in Honolulu, is lost. Developed, the site becomes valuable.

SECTION 8

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The commitment of labor, fuel and materials to the construction of proposed improvements will be permanent. Materials are irretrievable only to the extent that for reasons of economics, deterioration or adaptability, they could not be used again.

Commitment of the site and water from Kahuawai Spring are not irreversible. The on-site improvements could be removed and reforestation would occur rapidly with the site returning to its natural pre-project state. Water is a renewable resource.

SECTION 9

OFFSETTING GOVERNMENT POLICIES

This section indicates other interests and considerations in government policies thought to offset the identified impacts of the proposed project.

The Board of Water Supply of the City and County of Honolulu, maintains as its primary function, the provision of safe drinking water to the population. In evaluating the identifiable impacts of the project, the motive and rationale in developing this water resource for the "health and welfare" of the population by far offset any adversities.

SECTION 10

UNRESOLVED ISSUES

1. The actual location of reservoir has not been determined. Consequently a supplemental EIS will be required.
2. The issue of potential water rights of the resident farming watercress has been submitted for review by the City's Corporation Counsel. Counsel opinion was not available at the revision of this EIS, and this question and the companion issue of mitigation remains unresolved at this present writing.

SECTION 11

LIST OF NECESSARY APPROVALS

The following reviews or approvals are required for construction:

1. Building Permit - Building Department, City and County of Honolulu.
2. Grading Permit - Department of Public Works, City and County of Honolulu.
3. Conservation District Use Application - Department of Land and Natural Resources, State of Hawaii.
4. Approval - Department of Water and Land, State of Hawaii (Executive Order - Land Transfer).
5. Noise Permit - Department of Health.
6. Honolulu Fire Department (Fire Prevention Bureau).
7. Department of Transportation Services, City and County of Honolulu (Traffic Division).
8. Department of Health, State of Hawaii (Section 11-20-29, Chapter 20, Title 11, Administrative Rules).

SECTION 12

EIS COMMENTS AND RESPONSES

June 24, 1986



Brenner Munger, Ph.D., P.E.
Manager
Environmental Department
(808) 548-6880

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 115
Honolulu, HI 96813

Dear Ms. Uyehara:

Subject: Environmental Impact Statement for Kahuawai Spring

Since the proposed project is located in State Conservation District, any new line construction would require Conservation District Approval. 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.

In addition, the above subject will be in close proximity to existing HECO facilities which will remain energized. Consequently, the following HECO notes are to be included as part of the final construction plans.

1. The Contractor is to comply with the directions of the State of Hawaii Occupational Safety and Health Law (OSHL).
2. When trench excavation is adjacent to or under existing structures or facilities, the Contractor is responsible for properly sheeting and bracing the excavation and stabilizing the existing ground to render it safe and secure from possible slides, cave-ins and settlement, and for properly supporting existing structures and facilities with beams, struts or underpinning to fully protect it from damage.
3. Should it become necessary, any work required to relocate HECO facilities shall be done by HECO. The Contractor shall be responsible for all coordination.

Ms. Letitia N. Uyehara, Director
June 24, 1986
Page 2

4. The Contractor shall be liable for any damages to HECO's facilities.
5. The Contractor shall report any damages to HECO's facilities to the HECO Trouble Dispatch at telephone number 548-7961.
6. The provision of electrical service to the facility is adequately addressed in Paragraph J4 on Page 19 as long as DLNR prior approval is obtained.

Sincerely,

Brenner Mungel

cc: Mr. Lawrence Whang
Board of Water Supply

HEI

2. Sewer: The project area is unsewered and cesspools are probably the primary means of waste disposal. An existing and recently installed 8-inch sewer main terminates approximately 800 lineal feet west of the project area.
3. Drainage: The project area is not served by a municipal drainage system.
4. Power and Communication: Power and communication services are provided by overhead cables along Booth Road.
5. Emergency Services: Municipal fire and ambulance services are available to the project area. At present existing water supply services do not provide fire hydrants in the immediate project area. The nearest fire hydrant is located about 800 feet from the uppermost residence on Booth Road.
6. Water: Water service to the eighteen services on the upper end of Booth Road receive their water from Booth Springs. The Pacific Heights 578 System provides a temporary back-up to some of the eighteen residences.

K. Flood/Tsunami

No flood or tsunami dangers are indicated for the project site.

L. Noise

Undesirable noise levels in Pauoa Valley are minimal and when detectable, are traceable to residential activity. Ambient noises at the project site are predominately those naturally occurring in a forested environment. Mechanical noise of a detectable but minimal nature occasionally emanates from the existing chlorinator facility at the project site.

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU

630 SOUTH BERETANIA

HONOLULU, HAWAII 96843



COPI

FRANK F. FASI, Mayor

DONNA B. GOTH, Chairman
ERNEST A. WATARI, Vice Chairman
MILTON J. AGADER
RYOKICHI HIGASHIONNA
RUSSELL L. SMITH, JR.
WAYNE J. YAMASAKI

KAZU HAYASHIDA
Manager and Chief Engineer

July 9, 1986

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

Dear Dr. Munger:

Subject: Your Letter of June 24, 1986 on the Draft EIS for
Kahuawai Spring

Thank you for commenting on the environmental document for the proposed water development project.

We will include the necessary easements and work that will be performed by HECO to provide electrical power in our Conservation District Use Application for Kahuawai Springs. Your applicable notes will be added to our construction plans.

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
Phillip Yee and Associates



REPLY TO
ATTENTION OF:

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

June 26, 1986

Mr. Lawrence Whang
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96843

Dear Mr. Whang:

Thank you for the opportunity to review and comment on the EIS for Kahawai Spring, Honolulu, Hawaii. The following comments are offered:

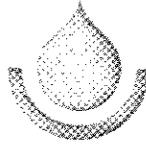
a. A Department of the Army permit is not required for the spring development project.

b. According to the Flood Insurance Rate Map prepared by the Federal Insurance Administration for the City and County of Honolulu, the proposed improvements are designated Zone C, areas of minimal flooding. Zone C areas are not considered flood plain areas.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

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COPY

July 10, 1986

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

Dear Mr. Cheung:

Subject: Your Letter of June 26, 1986 on the Draft EIS for
Kahuawai Springs

Thank you for commenting on the environmental document for our proposed water development project.

We will indicate in the Final EIS that the proposed Kahuawai Springs project is in an area designated as Zone C of the Flood Insurance Rate Map prepared by the Federal Insurance Administration and that no Department of the Army Permit is required for the spring development.

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

Very truly yours,

For

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Phillip Yee & Associates



University of Hawaii at Manoa

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

3 July 1986

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, Kahuawai Spring,
Honolulu, Oahu, Hawaii, TMP 2-2-41:3, June 1986

We have reviewed the subject DEIS and offer the following comment. What will become of the watercress grower (p. 10)? Does he have some rights to the flow? There will be no excess flow, since this development will capture an estimated 0.25 mgd (p. 5) and "Kahuawai Spring generally flows at approximately 230,000 gallons of water per day (.23 mgd)" (p. 2). What is the likelihood of litigation on water rights?

Thank you for the opportunity to comment. This material was reviewed by WRRC personnel.

Sincerely,

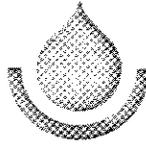
Edwin T. Murabayashi

Edwin T. Murabayashi
EIS Coordinator

ETM:jm

cc: Lawrence Whang

JUL 9 4 13 PM '86



COPY

July 22, 1986

Mr. Edwin T. Murabayashi
Water Resources Research Center
Holmes Hall 283
2540 Dole Street
Honolulu, Hawaii 96822

Dear Mr. Murabayashi:

Subject: Your Letter of July 3, 1986 on the Draft EIS
on Kahuawai Springs

We are still evaluating the text of your letter and shall send you our reply by September 1986.

It appears that a determination on the water rights issue will require the review of the City's Corporation Counsel.

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

Very truly yours,

KAZU HAYASHIDA
For Manager and Chief Engineer

cc: Office of Environmental
Quality Control
Phillip K. H. Yee & Associates



GEORGE R. ARIYOSHI
GOVERNOR

LETITIA N. UYEHARA
DIRECTOR

TELEPHONE NO.
548-6915

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

465 South King Street, #115

HONOLULU, HAWAII 96813

June 20, 1986

Mr. Lawrence Whang
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96843

Dear Mr. Whang:

Subject: Comments to Draft EIS for Kahuawai Spring

In past environmental impact statements for well development, we have stressed the importance of maintaining minimum stream flow to sustain stream fauna. According to this EIS, (page 27), well pumping would reduce the flow in Pauoa Stream such that there would be little or no flow during the dry months. The EIS further states that stream fauna may not survive under intermittent flow conditions. We suggest that the amount of pumping be reduced so that the survival of stream fauna will be insured.

Sincerely,

Letitia N. Uyehara
Director

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July 23, 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental
Quality Control
State of Hawaii
465 South King Street, #115
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Subject: Your Letter of June 20, 1986 on the Draft
Environmental Impact Statement (EIS) for
Kahuawai Spring

Thank you for your comments on the draft EIS for Kahuawai Spring.

The noted stream fauna are species commonly found in streams throughout the island and these fauna continue to persist in Pauoa Stream even though the stream experiences intermittent flows throughout the year. However, we will coordinate the development of the water source with the State Department of Land and Natural Resources to ensure that the environmental concerns that you have expressed can be resolved.

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Phillip K. H. Yee



United States Department of the Interior

GEOLOGICAL SURVEY

Water Resources Division
P.O. Box 50166
Honolulu, Hawaii 96850

July 14, 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 115
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

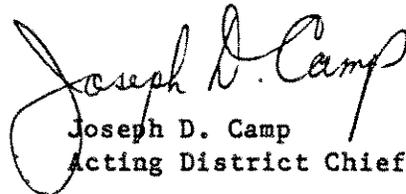
The District Office of the U.S. Geological Survey, Water Resources Division, has reviewed the draft EIS on Kahuawai Spring, Honolulu, Oahu, and offers the following comments for your consideration.

The EIS lacked any discussion on the quality of water to be developed. There is no mention of how suitable the water is for domestic use. What are the organic contents of the water, and if chlorination is needed, what is the possibility of converting organics into organochlorine compounds which can be detrimental to health?

The cost of the project seems excessive: \$600,000 to develop 230,000 gallons of water per day in order to provide a more reliable water supply to eighteen residences along Booth Road (page 4). Perhaps a statement on cost-benefit ratios could justify the project.

Thank you for the opportunity to review the document. As requested, we are returning the EIS to your office.

Sincerely,

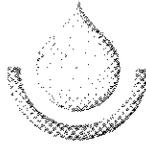

Joseph D. Camp
Acting District Chief

Enclosure

Copy to: ✓ Lawrence Whang, BWS
C&C, Honolulu

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July 23, 1986

Mr. Joseph D. Camp
Acting District Chief
Water Resources Division
U. S. Geological Survey
Department of the Interior
P. O. Box 50166
Honolulu, Hawaii 96850

Dear Mr. Camp:

Subject: Your Letter of July 14, 1986 on the Draft
Environmental Impact Statement for Kahuawai Springs

Thank you for reviewing and commenting on the environmental document for the proposed water development project.

In response to your comments, we offer the following:

1. The water quality for the spring is assumed to be of high quality requiring only chlorination. We have a similar source located deeper in the same valley which only requires chlorination.
2. The spring water is to be captured as soon as it discharges from the ground thereby minimizing the possibility of organic precursors being introduced into the water supply.
3. We are aware that chlorine combining with organic precursors can form trihalomethanes. We will periodically analyze the water for trihalomethanes as required by the Department of Health to insure compliance with safe drinking water standards.



COPY

Mr. Joseph D. Camp
Page 2

July 23, 1986

4. Cost-benefit analysis cannot be justified for this project where the health and welfare of the eighteen services are of primary concern. During dry periods, the eighteen services experience very low pressure or no pressure at all. Presently the primary source of water for these eighteen services is Booth Springs. Booth Springs is not as reliable as Kahuawai Springs because of its low flows during dry periods.

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

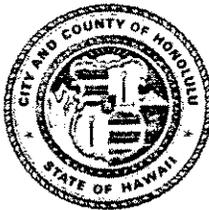
Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
Phillip Yee & Associates

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

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SD OF WATER SUPPLY
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cc: L. WHALEN



FRANK F. FASI
MAYOR

JOHN P. WHALEN
DIRECTOR

July 11, 1986

Ms. Letitia Uyehara, Director
Office of Environmental Quality Control
State of Hawaii
Kekuanaoa Building, Room 115
465 South King Street
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Draft Environmental Impact Statement
Kahuawai Spring
Tax Map Key 2-2-41: 3

The Department of Land Utilization (DLU) has reviewed the above document and has the following comments to offer:

1. The area (square footage) of the project site should be given.
2. Page 2 states that there are no endangered plants or animals within the immediate project area. What is the likelihood of the siting and alignment of the proposed improvements, or the harnessing of the water from Kahuawai Spring, affecting endangered plant or animal species not in the immediate area of the project?
3. In addition to the local resident who cultivates watercress, are there any other users of the Kahuawai Spring and Pauoa Stream water who might be adversely affected by the project? What, if any, is the anticipated economic loss to these users?
4. Page 5 states that the improvements to the existing water distribution system would (1) provide a more reliable water supply for the eighteen residences along the upper portion of Booth Road; and (2) supplement the water yield from an adjacent source, Booth Spring, which is one of several water sources serving Pacific Heights and Pauoa Valley.

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Ms. Letitia Uyehara, Director
Page 2

Why does the water supply for the eighteen residences need to be made "more reliable"? What is their present situation?

We look forward to reviewing the Final EIS for the project.

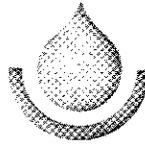
Thank you for this opportunity to comment.

Very truly yours,

JOHN P. WHALEN
Director of Land Utilization

JPW:s1
0275B

cc: ✓ Lawrence Whang, BWS



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July 25, 1986

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

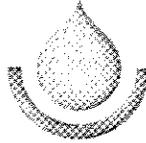
FROM: KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

SUBJECT: YOUR LETTER OF JULY 11, 1986 ON THE DRAFT ENVIRONMENTAL
IMPACT STATEMENT KAHUAWAI SPRINGS, TMK: 2-2-41:3

Thank you for your comments on the environmental document for the proposed water development project.

In response to your comments, we offer the following:

1. The approximate area needed for the project is about fifteen thousand square feet.
2. Endangered plants and animals outside of the immediate project area are not anticipated to be adversely affected. Pauoa Stream is fed by several springs, including Kahuawai Springs. No endangered species were observed downstream of the project area. For your information, Pauoa Stream becomes a concrete lined channel at its lower reaches.
3. Other than the watercress grower, we do not know of anyone using Pauoa Stream waters for commercial purposes.
4. The primary source of water for the eighteen homes at the end of Booth Road is Booth Springs. During dry weather conditions, the residents served from this system experience very low pressure and at times, receive no water at all. The Board provides the eighteen homes with water during these conditions by



COPY

Mr. John P. Whalen
Page 2

July 25, 1986

backflowing from the Pacific Heights system through an existing 6-inch pipeline. Due to high maintenance cost, the Board is considering abandoning this pipeline, which currently serves as an emergency back-up system.

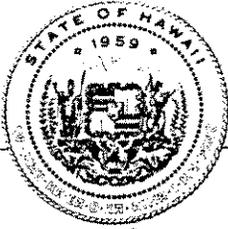
The Kahuawai Springs project will provide a more reliable water supply to the affected residents.

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

A handwritten signature in cursive script, reading "Kazu Hayashida".

KAZU HAYASHIDA

cc: Office of Environmental Quality Control
Phillip Yee and Associates



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 HIDPED

Ref. No. P-4664

July 17, 1986

P-382/86

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
335 Merchant St., Room 110, Honolulu, Hawaii 96813
FOREIGN-TRADE ZONE DIVISION
Pier 2, Hahaione, Hawaii 96813
LAND USE DIVISION
PLANNING DIVISION
RESEARCH AND ECONOMIC ANALYSIS DIVISION
OFFICES
ADMINISTRATIVE SERVICES OFFICE
INFORMATION OFFICE

MEMORANDUM

TO: Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control

FROM: *for* Kent M. Keith *Murray E. Towill*

SUBJECT: Kahuawai Spring DEIS, Honolulu

We have reviewed the subject draft environmental impact statement (DEIS) and offer the following comments.

One of the unavoidable adverse effects of the project is the interruption of watercress growing during some months for one area resident. The Final EIS should discuss the water rights involved in the disruption of the stream flow for the above-mentioned resident. In addition, the possibility of mitigating the adverse effect should be addressed.

Thank you for the opportunity to review and comment on the subject document.

cc: *✓* Mr. Lawrence Whang,
Board of Water Supply
City & County of Honolulu

Jul 22 3 35 PM '86



COPY

July 29, 1986

Mr. Kent M. Keith, Director
Department of Planning and
Economic Development
State of Hawaii
P. O. Box 2359
Honolulu, Hawaii 96804

Dear Mr. Keith:

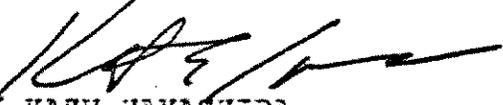
Subject: Your Memorandum of July 17, 1986 on the Draft
Environmental Statement (EIS) for Kahuawai Springs

Thank you for commenting on the environmental document for our proposed water development project.

A discussion on the water rights involving the watercross farming and the measures that may be taken to mitigate this impact will be included in the Final EIS.

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

Very truly yours,

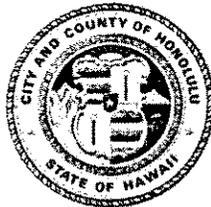

For: KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
Phillip Yee and Associates

DEPARTMENT OF GENERAL PLANNING
CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

RECEIVED
DEPT OF WATER SUPPLY
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FRANK F. FASI
MAYOR

DONALD A. CLEGG
CHIEF PLANNING OFFICER

GENE CONNELL
DEPUTY CHIEF PLANNING OFFICER

JB/DGP 6/86-8765

July 14, 1986

Ms. Letitia Uyehara, Director
Office of Environmental Quality Control
State of Hawaii
465 South King Street, Room 115
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Kahuawai Spring, Draft Environmental Impact
Statement (dEIS)--Your Letter Dated June 10, 1986

We have the following comments for your consideration.

1. The relationship of the proposed Kahuawai Spring project to the Development Plan Public Facilities (DP/PF) Map for the Primary Urban Center, not mentioned on page 21 of the dEIS, should be indicated.

Development of the proposed project is in conformance with the DP/PF Map for the area which was adopted by Ordinance No. 81-79, as amended. This information should be reflected in the dEIS.

2. Page 12 of the dEIS states:

"The runoff potential is medium and erosion hazard is slight."

This is not totally accurate.

In the Soil Survey of the State of Hawaii, August 1972, the Soil Conservation Service (SCS) describes the physical characteristics of the Tantalus silt loam (TAE) soil unit as follows:

"Runoff is medium and the erosion hazard is moderate." (Attachment - page 12) of SCS report.)

A small, handwritten mark or signature at the bottom right of the page.

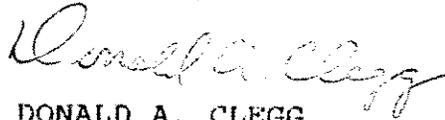
Ms. Letitia Uyehara, Director
Office of Environmental Quality Control
July 14, 1986
Page 2

Given this information, it is our feeling that page 12 of the dEIS should be revised.

3. Considering the erosion potential of the Tantalus silt loam soil unit and the rugged terrain of the valley, special care should be taken in designing the coffer dam and reservoir being proposed.
4. All grading activities will require compliance with Chapter 23, Revised Ordinance of Honolulu 1978, as amended (see attached). Page 23 of the dEIS thus should be modified to indicate this.
5. Considering the heavy rainfall which this region experiences (120 inches annually, as stated on page 12), limitation of construction activities to the summer period would seem prudent and appropriate.

Thank you for affording us the opportunity of reviewing the dEIS.

Sincerely,



DONALD A. CLEGG
Chief Planning Officer

Attachments

cc: Mr. Larry Wang /
Board of Water Supply

clay loam that is similar to Ewa soils and very dark reddish-brown clay that is similar to Lualualei soils. In places there is enough soil among the stones to provide a foothold for plants.

This land type is used for wildlife habitat and recreation. The natural vegetation consists of kiawe, lantana, koa haole, bermudagrass, and annuals. (Capability classification VII, nonirrigated)

Stony Steep Land

Stony steep land (rSV) consists of a mass of boulders and stones deposited by water and gravity on side slopes of drainageways. It occurs on the island of Oahu. The slope ranges from 40 to 70 percent. Elevations range from 100 to 1,500 feet. The annual rainfall amounts to 20 to 80 inches.

Stones and boulders cover 50 to 90 percent of the surface. There is a small amount of soil among the stones that provides a foothold for plants. Rock outcrops occur in many places.

This land type is used for wildlife habitat and recreation. The natural vegetation consists of kiawe, koa haole, and grasses. (Capability classification VII, nonirrigated)

Tantalus Series

This series consists of well-drained soils on uplands on the island of Oahu. These soils developed in volcanic ash and material weathered from cinders. They are moderately sloping to very steep. Elevations range from 100 to 2,200 feet. The annual rainfall amounts to 50 to 150 inches. It is well distributed throughout the year. The mean annual soil temperature is 70° F. Tantalus soils are geographically associated with Makiki soils.

These soils are used for homesites, water supply, and recreation. The natural vegetation consists of ferns, *Forbesia* koa, koa haole, kukui, and eucalyptus.

Tantalus silt loam, 40 to 70 percent slopes (TAF).—This soil is on volcanic spurs and cinder cones in the uplands.

Included in mapping were small areas of Makiki soils. Also included were small cinder deposits and stony soils within the drainageways.

In a representative profile the surface layer, about 18 inches thick, is very dark brown silt loam that has subangular blocky structure. The subsoil, about 11 inches thick, is dark reddish-brown, massive very fine sandy loam. The substratum is black, unweathered, gravel-size cinders. The soil is neutral in the surface layer and subsoil.

Permeability is moderately rapid. Runoff is medium rapid, and the erosion hazard is severe. In places roots penetrate to a depth of 3 feet.

Representative profile: Island of Oahu, lat. 21°19'48" N and long. 157°49'38" W.

A1—0 to 18 inches, very dark brown (10YR 2/2) silt loam, dark brown (10YR 3/3) when dry; moderate, very fine and fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; abundant very fine and fine roots; common, very fine, interstitial pores; common, fine and very fine, sharp cinders; neutral; clear, wavy boundary. 10 to 18 inches thick.

B2—18 to 29 inches, dark reddish-brown (5YR 3/4) very fine sandy loam, reddish brown (5YR 4/4) when dry; massive; soft, very friable, slightly sticky and slightly plastic, and weakly smeary; abundant very fine and fine roots and few medium and coarse roots; many, very fine and fine, tubular pores; abundant, very fine, sharp cinders; neutral; clear, wavy boundary. 6 to 12 inches thick.

IIC—29 inches, black, unweathered, fine, gravel-size cinders.

The solum ranges from 16 to 30 inches in thickness. The A horizon ranges from silt loam to silty clay loam in texture. It ranges from 5YR to 10YR in hue and from 2 to 3 in value and chroma. The texture of the B horizon is very fine sandy loam, silt loam, or silty clay loam. The B horizon ranges from 5YR to 10YR in hue and from 2 to 4 in chroma.

This soil is used for water supply and recreation. (Capability classification VIIe, nonirrigated; pasture group 9; woodland group 8)

Tantalus silt loam, 15 to 40 percent slopes (TAE).—On this soil, runoff is medium and the erosion hazard is moderate.

This soil is used for water supply and recreation. (Capability classification VIe, nonirrigated; pasture group 9; woodland group 8)

Tantalus silty clay loam, 8 to 15 percent slopes (TCC).—On this soil, runoff is slow and the erosion hazard is slight. Included in mapping were small areas of stony soils in the drainageways.

This soil is used for homesites, water supply, and recreation. (Capability classification IIIe, nonirrigated; pasture group 9; woodland group 8)

Tantalus silty clay loam, 15 to 40 percent slopes (TCE).—On this soil, runoff is medium and the erosion hazard is moderate.

This soil is used for homesites, water supply, and recreation. (Capability classification VIe, nonirrigated; pasture group 9; woodland group 8)

Tropaquepts

Tropaquepts (TR) are poorly drained soils that are periodically flooded by irrigation in order to grow crops that thrive in water. They occur as nearly level flood plains on the islands of Oahu and Maui. Elevations range from sea level to 200 feet. The annual rainfall amounts to 20 to 150 inches.

These soils have been flooded for varying lengths of time, and soil development differs in degree from place to place. Generally, the surface layer, about 10 inches thick, consists of dark-gray, soft, mucky silt loam. This layer overlies firm to compact silty clay loam, 5 to 10 inches thick, that is mottled with gray, yellow, and brown. The mottled layer overlies friable alluvium.

Tropaquepts are used for production of taro, rice, and watercress on flooded paddies. (Capability classification IVw, irrigated or nonirrigated)

Tropaquods

Areas mapped as Tropaquods (rTO) consist of steep-walled gulches and mountainsides on uplands on the island of Molokai. There are many intermittent streams in these areas. The slope ranges from 30 to 70 percent. Elevations range from 1,800 to 5,000 feet. Rainfall amounts to 80 to 150 inches or more annually. Fog and

CHAPTER 23.
GRADING, SOIL EROSION AND SEDIMENT CONTROL.

Article 1. General Provisions.

Sec. 23-1.3. Definitions.

Wherever used in this chapter the following words shall have the meaning indicated:

- (4) "Soil and Water Conservation Districts" shall mean the legal subdivisions of the State of Hawaii authorized under Chapter 180, Hawaii Revised Statutes.
- (5) "Surveyor" shall mean a person duly registered as a professional land surveyor in the State of Hawaii.
- (6) "Conservation Program" shall mean a document submitted by a land user containing information for the conservation of soil, water, vegetation and other applicable natural resources for an area of land currently being implemented and maintained.
- (7) "Engineer's Soils Report" shall mean a report on soils conditions prepared by an engineer qualified in the practice of soils mechanics and foundations engineering.
- (8) "Permittee" shall mean the person or party to whom the permit is issued and shall be the owner or developer of the property whether it is a person, firm, corporation, partnership or other legal entity responsible for the work.
- (9) "Earth Material" shall mean any rock, coral, sand, gravel, soil or fill and/or any combination thereof.
- (10) "Erosion" shall mean wearing away of the ground surface as a result of action by wind and/or water.
- (11) "Excavation" or "Cut" shall mean any act by which earth material is cut into, dug or moved, and shall include the conditions resulting therefrom.
- (12) "Fill" shall mean any act by which earth materials are placed or deposited by artificial means, and shall include the resulting deposit of earth material.
- (13) "Grading" shall mean any excavation or fill or any combination thereof.
- (14) "Grubbing" shall mean any act by which vegetation, including tree, timber, shrubbery and plant, is dislodged or uprooted from the surface of the ground.
- (15) "Stockpiling" shall mean the temporary open storage of earth materials in excess of 100 cubic yards upon any premises except the premise upon which a grading permit has been issued for the purpose of using the material as fill material at some other premises at a future time.
(Sec. 23-1.3, R. O. 1978; Am. Ord. 81-13)

Sec. 23-1.5. Exclusions.

This chapter shall not apply to the following:

(4) Land which is being managed in accordance with soil conservation practices acceptable to the applicable soil and water conservation district directors, and that a comprehensive conservation program is being actively pursued for the entire area in the program and that the conservation program with appropriate modification is reviewed and accepted by the soil and water conservation district directors periodically but not less than once every five years and shall be made available to the City and County; provided, however, that no grading which, in the opinion of the Chief Engineer, endangers abutting properties or which alters the general drainage pattern with respect to abutting properties shall be commenced or performed without a grading permit. (Sec. 23-1.5. R.O. 1978; Am. Ord. 81-13)

Article 2. Permits; Bonds; Inspection.

Sec. 23-2.4. Permit Fees.

(a) Before issuing a grading permit, the Chief Engineer shall collect a permit fee for grading on the same site based on the volume of excavation or fill measured in place, whichever is greater, according to the following schedule:

Volume of Material	Permit Fee
1,000 cubic yards or less	\$7.50 for each 100 cubic yards or fraction thereof.
1,001-10,000 cubic yards	\$75.00 for the first 1,000 cubic yards plus \$7.50 for each additional 1,000 cubic yards or fraction thereof.
10,001 cubic yards or more	\$142.50 for the first 10,000 cubic yards plus \$4.50 per 1,000 cubic yards or fraction thereof.

The fee for a permit authorizing work additional to that under a valid permit shall be the difference between the fee paid for the original permit and the fee computed for the entire project.

(b) Before issuing a grubbing permit, the Chief Engineer shall collect a permit fee of \$15 for grubbing areas up to 15,000 square feet plus \$1.50 for each additional 1,000 square feet or fraction thereof.

(c) Before issuing a stockpiling permit the Chief Engineer shall collect a permit fee of \$7.50 for stockpiling in excess of the first 100 cubic yards plus \$1.50 for each additional 1,000 cubic yards or fraction thereof.

(d) Where work for which a permit is required by this chapter has been commenced or has been accomplished without a permit, a permit shall be obtained, and double the fees specified above shall be assessed, provided

that such work complies with or may be made to comply with the provisions of this chapter. If the grading work accomplished or commenced cannot be made to comply with the provisions of this chapter, the person or persons responsible for the initiation or accomplishment of such grading work shall restore the land to its original condition and shall obtain a certificate of completion therefor from the Chief Engineer. Notwithstanding the above, the person or persons responsible for such grading shall be deemed to have violated the provisions of this chapter by grading without a permit.

Where the grading work accomplished or commenced cannot be made to comply with the provisions of this chapter, the person or persons responsible shall post a performance bond in an amount sufficient, as determined by the Chief Engineer, to pay all costs of restoring the land to its original condition in the event that the person or persons responsible do not satisfactorily perform said restoration. Such performance bond shall be maintained in force for a period of one year after the restoration work has been completed and no certificate of completion for said work shall be issued by the Chief Engineer until one year has elapsed after the physical work of restoration has been completed.

(e) When grading, grubbing or stockpiling is performed by or on behalf of the City, State or Federal government, the Chief Engineer shall waive the collection of any permit fee required in subsections (a), (b), and (c) above.

(f) All permit fees shall be deposited in the Highway Fund. (Sec. 23-2.4, R. O. 1978; Am. Ord. 81-13)

Sec. 23-2.8. Bond.*

(b) Amount of Bond. The amount of the bond shall be in an amount equal to the cost of all work and services required to complete all of the work under the grading or stockpiling permit as approved by the Chief Engineer. Cost estimates prepared by the permittee shall be subject to approval of the Chief Engineer to determine the exact amount of the bond. The bond shall be conditioned to be payable to the Chief Engineer and upon failure of the permittee to complete all of the required work within the specified time, the Chief Engineer shall collect the monies from the bond and complete the necessary work to control soil erosion and sedimentation or all unfinished work required by the permit. The parties executing the bond shall be firmly bound to pay for this entire cost.

(c) Conditions. Each bond shall provide that the surety shall be held and firmly bound unto the City and County of Honolulu for so long as the following conditions have not been met:

(1) The Permittee shall comply with all of the terms and conditions of the permit to the satisfaction of the Chief Engineer.

(2) The Permittee shall complete all of the work authorized under the permit within the time limit specified in the permit.

(3) The surety company shall not terminate or cancel said bond until notified in writing by the Chief Engineer of any termination or cancellation.

* (c) "(Conditions)" and (d) "Period and Termination of Bond" were inadvertently left out of R. O. 1978.

(d) **Period and Termination of Bond.** The term of each bond shall begin upon the date of issuance of the permit and shall remain in effect for a period of one year after the date of completion of the work to the satisfaction of the Chief Engineer. Such completion shall be evidenced by a certificate signed by the Chief Engineer. In the event of failure to complete the work or failure to comply with all of the conditions and terms of the permit, the Chief Engineer may order the work to be completed as required by the permit and to the satisfaction of the Chief Engineer. The surety executing such bond or the cash depositor, shall continue to be firmly bound under a continuing obligation for the payment of all necessary costs and expenses that may be incurred or expended by the City and County of Honolulu, in causing any and all of such required work to be done, and said surety and the permittee assents to the completion of the work even though it is performed after the time allowed in the permit. Upon completion of such work by the City the bond shall be terminated. In the case of a cash deposit, such a deposit or any unused portion thereof not required to complete the work authorized by the permit shall be refunded to the permittee. (Sec. 23-2.8, R. O. 1978; Am. Ord. 81-13)



COPY

July 28, 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 JULY 14, 1986 ON THE DRAFT
ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR
KAHUAWAI SPRINGS

Thank you for commenting on the environmental document for our proposed water development project.

In response to your comments, we offer the following:

1. The relationship of the project to the Development Plan Public Facilities Map for the Primary Urban Center will be reflected in the Final EIS.
2. The description of Tantalus silt loam (TAE) soil will be revised to indicate that the erosion hazard is moderate.
3. The design engineer will be informed of the erosion potential of the soil and will be required to consider this information in the design of the cofferdam and reservoir.
4. The Final EIS will indicate that all grading activities shall be in compliance with Chapter 23, Revised Ordinance of Honolulu 1978, as amended.
5. We agree that the construction activities should be scheduled between March and November, the normal periods of low rainfall.

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

KAZU HAYASHIDA

cc: Office of Environmental Quality Control
Phillip K. H. Yee & Associates

Handwritten mark



GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

LESLIE S. MATSUBARA
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH

P. O. BOX 3378
HONOLULU, HAWAII 96801

In reply, please refer to:
EPHSD

July 21, 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 S. King St., Room 115
Honolulu, Hawaii 96813

Dear Ms. ^{Jish}Uyehara:

Subject: Kahuawai Spring Environmental Impact Statement, Honolulu, Oahu

Thank you for the opportunity to comment on the subject document. The project will add a new source of potable water to an existing public water system. Section 11-20-29, Chapter 20, Title 11, Administrative Rules, requires the approval of the Director of Health prior to use of the source to serve a public water system. This approval should be added to the list of necessary approvals on page 34 of the document.

Sincerely yours,

JAMES K. IKEDA
Deputy Director for
Environmental Health

cc: Mr. Lawrence Whang ✓

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COPY

July 29, 1986

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

Dear Mr. Ikeda:

Subject: Your Letter of July 21, 1986 on the Draft
Environmental Impact Statement (EIS) for
Kahuawai Springs

Thank you for commenting on the environmental document for
the proposed water development project.

An engineering report will be submitted for approval in
accordance with Section 11-20-29, Chapter 20, Title 11,
Administrative Rules before the source is used in the public
water system. This approval requirement will be noted in the
Final EIS.

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

Very truly yours,

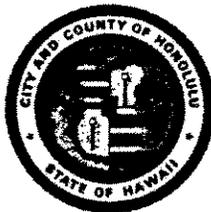

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
Phillip Yee & Associates

P-385/86

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

July 21, 1986

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)
TITLE: KAHUAWAI SPRING

The existing fire protection for this area is provided by engine companies from Kuakini and Nuuanu Fire Stations and a ladder company from Kuakini Station. Fire flow beyond 2911 Booth Road is provided by pumper relay. Because of the critical need for the hydrant at 2911 Booth Road, and access beyond, please notify our Fire Alarm Bureau at 523-4411, should the fire hydrant be out of service or the road be closed.

Should you have any questions, please feel free to contact Captain Clement Chun at 943-3848.

Sincerely,

Frank K. Kahookano
FRANK K. KAHOOHANO
Fire Chief

FKK:sb

cc: Lawrence Whang
Board of Water Supply

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COPY

July 31, 1986

TO: FRANK K. KAHOOHANOANO, FIRE CHIEF
FIRE DEPARTMENT

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

SUBJECT: YOUR LETTER OF JULY 21, 1986 ON THE DRAFT
ENVIRONMENTAL IMPACT STATEMENT FOR KAHUAWAI SPRINGS

Thank you for commenting on the environmental document for our proposed water development project.

We will notify the Fire Alarm Bureau whenever the hydrant (Hydrant No. 3264) at 2911 Booth Road is out of service or the road is closed due to our construction.

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

KAZU HAYASHIDA
Manager and Chief Engineer

cc: Office of Environmental Quality Control
Phillip Yee & Associates

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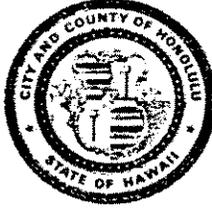
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DEPARTMENT OF TRANSPORTATION SERVICES

CITY AND COUNTY OF HONOLULU ^{JUL 22} 3 15 PM '86

HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

MGR
DEP SEC
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FRANK F. FASI
MAYOR

JOHN E. HIRTEN
DIRECTOR

JOSEPH M. MAGALDI, JR.
DEPUTY DIRECTOR

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July 21, 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental
Quality Control
465 South King Street, Room 115
Honolulu, Hawaii 96813

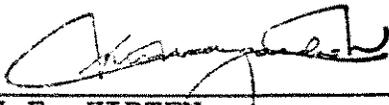
Dear Ms. Uyehara:

Subject: Kahuawai Spring
Draft Environmental Impact Statement (EIS)
TMK: 2-2-41: 3

This is in response to your letter of June 10, 1986.

We have reviewed the draft EIS for the subject project and find that the document adequately addresses our concerns. As an added precaution, we recommend that escort vehicles be used to lead larger, slow moving vehicles along the narrower portions of Booth Road.

If you have any questions, please contact Kenneth Hirata of my staff at 527-5009.


(for) JOHN E. HIRTEN

cc: ✓ Mr. Lawrence Whang
Board of Water Supply





COPY

August 4, 1986

TO: JOHN E. HIRTEN DIRECTOR
DEPARTMENT OF TRANSPORTATION SERVICES

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

SUBJECT: YOUR LETTER OF JULY 21, 1986 ON THE DRAFT
ENVIRONMENTAL IMPACT STATEMENT FOR KAHUAWAI SPRINGS

Thank you for commenting on the environmental document for the proposed water development project.

We will require the contractor to use escort vehicles when large, slow moving equipment are transported along the narrower portions of Booth Road.

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

KAZU HAYASHIDA

cc: Office of Environmental Quality Control
Phillip Yee & Associates

Nov 20 11 13 AM '86



WERO MGR
DEPT 4
916

University of Hawaii at Manoa

Environmental Center
Crawford 317 • 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (808) 948-7361

November 18, 1986

Mr. Kazu Hayashida
Board of Water Supply
City and County of Honolulu
630 South Beretania
Honolulu, Hawaii 96843

Dear Mr. Hayashida:

Response to Environmental Center Comments
Draft Environmental Impact Statement
Kahuawai Springs
Honolulu, Oahu

Thank you for your response (letter dated September 12, 1986) to our review comments on the above cited Draft Environmental Impact Statement (EIS). The Draft EIS discussed the potential impacts associated with the proposed improvements necessary to capture, disinfect, store and transmit water at Kahuawai Spring in Pauoa Valley, Oahu by the Board of Water Supply of the City and County of Honolulu.

In our review, we called attention to the need for data on the stream flow below Kahuawai Spring. Your response stated that "If such data is required, we will consider taking measurements of Pauoa Stream below the springs before we decide to proceed with the project." Careful measurements of stream flow should be a requirement of the project particularly since the flow is very irregular and only a very careful and systematic series of measurements will provide meaningful data.

We do not concur with the rationale that suggests that since "native aquatic biota is quite common in other streams" maintaining adequate stream flow in Pauoa Stream is somehow less important. It is often overlooked that many of these "other streams" are under similar kinds of development and pollution pressure. Cumulative impacts from multiple developments could eventually destroy the biota in most of these streams. We urge that the release of a portion of Kahuawai Spring water to supplement stream flow

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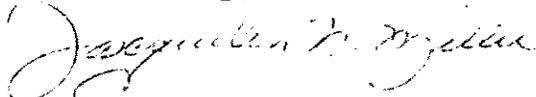
Mr. Kazu Hayashida

-2-

November 18, 1986

in Pauoa Stream, especially during dry periods, be required. The U.S. Fish and Wildlife Service should be consulted in establishing the criteria as to the stream flows needed and at what times.

Yours truly,



Jacquelin N. Miller
Acting Associate Director

cc: OEQC

Department of Land and Natural Resources
Patrick Takahashi
Stephen Lau
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December 31, 1986

Ms. Jacquelin N. Miller
Acting Associate Director
Environmental Center
University of Hawaii
Crawford 317
2550 Campus Road
Honolulu, HI 96822

Dear Ms. Miller:

Subject: Your Letter of November 18, 1986 Commenting on Our
Response to Your Questions on the Draft Environmental
Impact Statement for Kahuawai Springs

Thank you for your comments on our proposed Kahuawai Springs project. We will consult with the U.S. Fish and Wildlife Service on the feasibility of a long-term stream measurement program, should we decide to proceed with the project.

If you have any questions, please contact Lawrence Whang at 527-6130.

Very truly yours,



KAZU HAYASHIDA
Manager and Chief Engineer

cc: Wilbert Chee

LHYW:do
cc: K. Hayashida
L. Whang

86-2829

APPENDIX A

PAUOA STREAM AND ROSE APPLE SPRING ENVIRONMENT SURVEY

Introduction

A survey of the biota in and around Rose Apple (= Kahuawai) Spring and Pauoa Stream between Booth Spring and the confluence of the inflow from Rose Apple Spring was conducted on March 4, 1980. The area surveyed occurs between the 600 and 700 foot elevations in Pauoa Valley (see Figure 1).

Pauoa Stream - General Description

Pauoa Stream arises in a series of small tributaries along the western slope of Tantalus, behind the city of Honolulu. The stream flows across volcanic fill derived from relatively late eruptions of Tantalus which partially filled the ancient Pauoa Valley. A waterfall represents the western edge of the uppermost Tantalus lava flow (Wentworth, 1941). Flow in the upper reaches of Pauoa Stream (above Booth Spring) is interrupted. Water which percolates into the basalt and cinder of the Tantalus eruption seeps downward until it encounters the much older and more or less impermeable surface of the alluvial fill of the ancient valley. This groundwater then moves along the point of contact between the older Ko'olau rocks and the younger Tantalus flows, emerging as springs in the valley (Wentworth, 1941). Booth Spring and Rose Apple Spring are two of the major springs in upper Pauoa Valley.

Nearly all of the permanent flow in Pauoa Stream derives from the several springs in upper Pauoa Valley. The largest spring appears to be Booth Spring -- a part of which is capped with a cement cistern and the flow diverted by the Honolulu Board of Water Supply. However, the cistern leaks and, further, captures only a portion of the seepage from the yielding stratum which cuts across the width of the stream bed. Above Booth Spring water occurs in the stream bed as small, disconnected pools. Flow in this section presumably occurs only during and following significant rainfall events. In the vicinity of and downstream from Booth Spring water flows over a natural bedrock channel in upper Pauoa Valley, then through a lined channel in a portion of middle Pauoa Valley, and finally through an underground culvert along the remainder of its course in lower Pauoa Valley and around the western side of Punchbowl (Puowaina) cone. The stream empties into Nu'uuanu Stream just inland from Beretania Street (Wentworth, 1941; Timbol and Maciolek, 1978). At least two other springs, Rose Apple (or Kahuawai) and Ka'aikahi Spring at elevations of about 620 and 280 feet respectively, contribute water to Pauoa Stream.

Rose Apple Spring - General Description

Rose Apple (or Kahuawai) Spring arises in a circular pond some 7 to 8 feet in diameter. The pond is surrounded by a crude stone wall. Depth of the pond is between 12 and 18 inches, maintained by

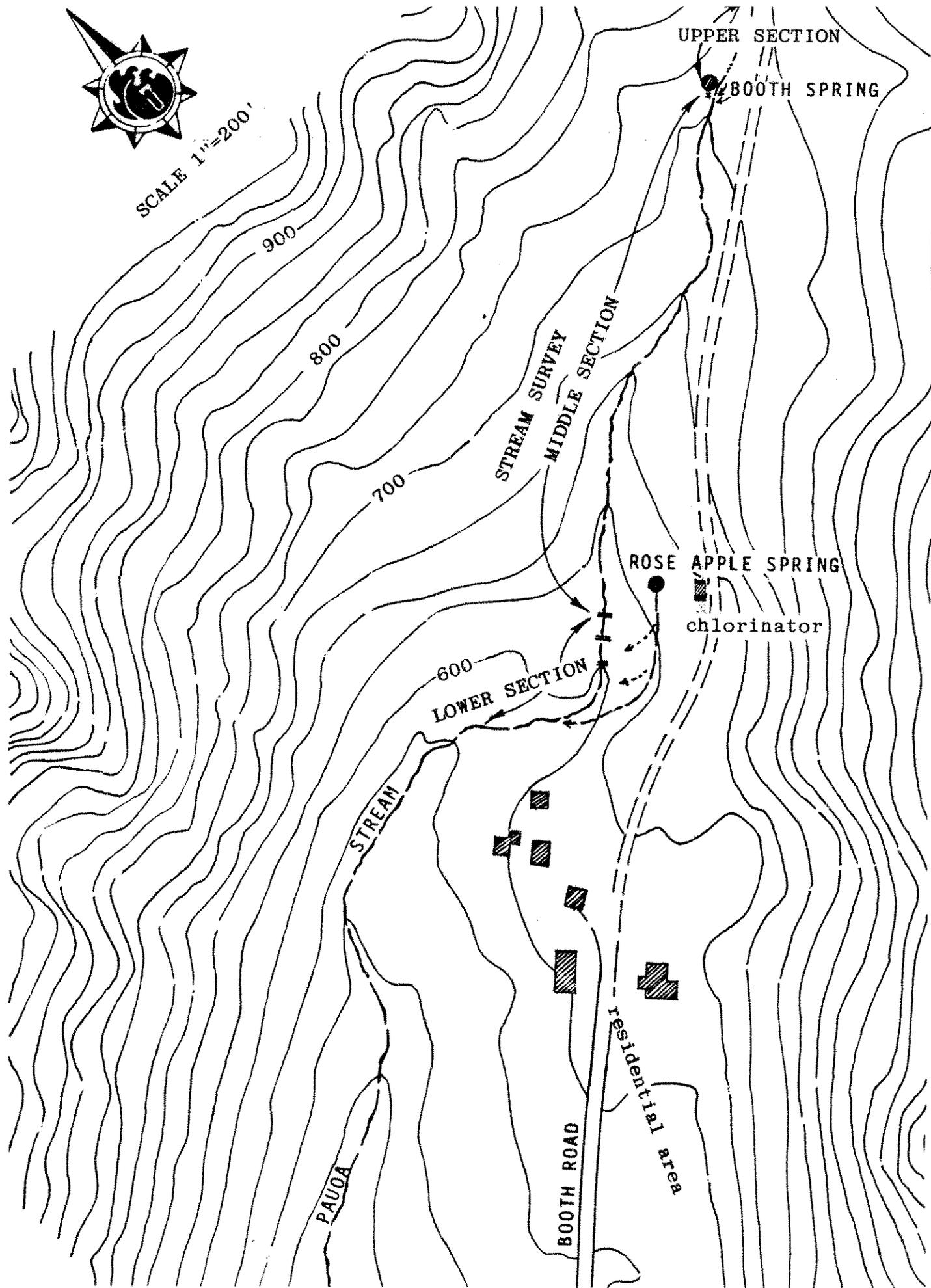


FIGURE 1. STUDY AREA IN UPPER PAUOA VALLEY

a metal wier with a v-notch outlet. At the time of the survey the outflow was 6 inches deep through the notch, a volume (around 0.29 mgd) of outflow slightly greater than the approximate 0.23 mgd which is typical for this spring throughout the year (Board of Water Supply, flow records for Kahuawai Spring since 1969). The bottom of the pond is mostly coarse sand with scattered boulders.

Outflow from Rose Apple Spring follows a poorly maintained, man-made channel paralleling Pauoa Stream between Pauoa Stream and the access road. Water in this channel is generally only a few inches deep. Portions of this flow escape across terraces to seep into Pauoa Stream at several points. Most of the flow reaches Pauoa Stream several hundred yards downstream of the Spring in the vicinity of the uppermost residences in Pauoa Valley. A portion (less than one-half) of the flow enters a terraced pond in which a local resident is growing watercress.

Pauoa Stream - Survey Results

The segment of Pauoa Stream covered by this survey can be divided into three parts (see Figure 1). A lower section extends from below the confluence with water from Rose Apple Spring to a series of low cataracts. The highest cataract represents a drop of approximately 6 feet (2 m). A middle section extends from this cataract to Booth Spring. An upper section encompasses the stream bed for a short distance above Booth Spring. Throughout all three sections the width of the stream bed varies between 10 and 20 feet. Large boulders and exposed bedrock are prominent. Boulders are generally more massive and cobble and sand less frequent in the middle and upper sections than in the lower section.

Vegetation -- The uppermost residence in Pauoa Valley is located along the stream immediately below the confluence of Rose Apple Spring and Pauoa Stream. From this point to the vicinity of Booth Spring, both sides of the narrow valley floor are marked by an extensive system of old terraces now overgrown with trees (including Aleurites moluccana, Heliocarpus popayanensis, ?Cassia sp., Eugenia sandwicensis, Ficus benjamina, Psidium guajava, Brassaia actinophylla), bamboo (mostly Bambusa vulgaris), and a variety of herbs and shrubs (Hibiscus rosa-sinensis, Musa nana, Musa sapienta, Phaeomeria magnifica, Heliconia collinsiana, Heliconia acuminata). Fairly heavily forested terraces and slope areas are floored by a luxuriant growth of basket grass (Oplismenus hirtellus). More open areas are thickly overgrown with grass (possibly Brachiaria mutica although no flowers were seen), and with honohono (Commelina diffusa) and Morning-glory vines (Ipomoea purpurea) in wetter areas. Palm grass (Setaria palmiflora), Job's tears (Coix lachryma-jobi), and ginger (mostly Hedychium coronarium and Alpinia purpurata) are common near and in the stream bed. Another morning-glory (Ipomoea alba) and stinking maile vine (Paederia foetida) are common on trees and shrubs around the margins of clearings. The lower section of Pauoa Stream and more open areas in general harbor oak fern (Dryopteris dentata). The upper section and more shaded areas harbor sword fern (Nephrolepis biserrata) and Lau'ae fern (Phymatodes scolopendria) in the larger trees. Noteworthy throughout much of

the area (but particularly the terraced lands) is the number of plants generally regarded as ornamentals. These occurrences suggest much of the area was under cultivation in the not too distant past.

Fauna -- The upper-most section of Pauoa Stream (above Booth Spring) consisted of isolated pools harboring only tadpoles (probably Rana rugosa) and insect larvae (mostly Diptera, Chironomidae). The middle section contains a good flow of water arising from Booth Spring. A short distance downstream from the cement cistern built around Booth Spring is a second cistern beside a substantial, sand-bottom pool. This pool harbors tadpoles and adults of the wrinkled frog, Rana rugosa. No fish were seen in the pool during the survey, although 'O'opu nakea (Awaous stamineus) are reported to occur in this pond. During the dry season this pool is one of the few bodies of water in the bed of upper Pauoa Stream.

Below the large pool the stream cascades over boulders with numerous smaller pools present. These are mostly inhabited by tadpoles (Rana). Algae (Cladophora sp.) and insect larvae (Diptera) are abundant. No fishes were seen. A few crayfish are present in this section of Pauoa Stream, although their abundance is much less than in the lower section or in Rose Apple Spring. The middle section of Pauoa Stream terminates in a small waterfall.

Downstream from the waterfall, small fish are common in pools in the Stream. All collected specimens were swordtails (Xiphophorus helleri). Tadpoles are not seen. Few snails are present, although one specimen of native pond snail (Lymnaea reticulata) was collected. A single native shrimp (Atya bisulcata) was captured in this lower section of Pauoa Stream.

Rose Apple Spring Biota

Rose Apple spring is well-shaded and supports no obvious aquatic vegetation. The principal inhabitants are crayfish (Procambarus clarki) and snails (Thiara granifera), both of which are abundant. A dojo (Misgurnus anguillicaudatus) was seen but not captured.

The small channel draining Rose Apple Spring is overgrown with grasses and honohono (Commelina diffusa) where the flow crosses a terraced meadow. Farfugium (Ligularia tussilaginea), pennywort (Centella asiatica), purslane (Ludwigia octovalvis), and taro (Alocasia macrorrhiza) occur along the margins of the drainage channel. The snail, Thiara granifera, is common, as are small topminnows (Gambusia affinis).

Farther downstream the flow divides across several terraces shaded by large banyan trees (Ficus benjamina). Here, heliconias and ferns (particularly Adiantum hispidulum) occur. About half of the flow enters a terraced pond in which watercress (Nasturtium microphyllum) is cultivated. The lower sections of the channel(s) are more open because of deep shade beneath several Ficus trees.

Previous Studies and Surveys in Pauoa Stream

The results of a survey of Pauoa Stream by Timbol and Maciolek (1978) is given briefly on p. 114 of their report. The location of the survey is indicated to have been well down-stream of the present survey. No native crustacea were seen, although the native (endemic) fish, Awaous stamineus ('O'opu nakea) was noted as common. Crayfish, guppies (Poecilia reticulata), and mollies (P. mexicana) were listed as abundant. Gambusia, swordtails (X. helleri), and dojo (Misgurnus anguillicaudatus) were common fishes. The Chinese catfish (Clarias fuscus) was listed as rare or occasional.

An introduced snail, Pseudosuccinea columella, has been known from the "Watercress area, Pauoa Valley, ...since at least 1952" (Morrison, 1968). The "watercress area" mentioned is presumably at or near Rose Apple Spring. A local resident volunteered that dojo (Misgurnus) could be found in the stream near Rose Apple Spring.

Discussion

The survey described herein was conducted during a period when Pauoa Stream contained substantial flow in the section below Booth Spring. The added contribution of Rose Apple Spring to this flow was not particularly obvious. However, Rose Apple Spring is remarkably constant in its output of water. Board of Water Supply records show variation from an estimated 0.227 mgd to 0.372 mgd over a ten-year period of (usually) monthly records. (The high value was recorded only once since 1969 and a more typical "maximum" would be 0.324 mgd). Thus, during dry periods when other sources contribute less water to upper Pauoa Stream, the contribution of Rose Apple Spring could constitute a significant proportion of the total flow in Pauoa Stream.

The distribution of organisms in Pauoa Stream would seem to indicate that flow in the segment above the confluence with the channel(s) from Rose Apple Spring is interrupted during some part of the year. The fact that a small cataract acts as a barrier to the exotic fishes (swordtails), excluding them from the middle and upper sections (as defined herein) of the stream, supports the contention that the flow in the middle survey section is interrupted. The lower segment may also be interrupted, although at some point (presumably below Rose Apple Spring) permanent pools enable the aquatic fauna to survive periods of low-flow. Presumably, repopulation of the lower segment occurs from these permanent pools at the onset of the wet season, and progresses upstream to the cataract. Perhaps during some years this barrier is overcome, but conditions upstream taken on a year-round basis do not permit establishment of permanent populations. Thus the small numbers of crayfish seen in the stream immediately above the cataract may represent a recent upstream migration which will prove unsuccessful as flow in the stream dries up.

Appendix I lists the flora observed during the present survey around Pauoa Stream between Booth and Rose Apple Springs. In general, the vegetation in the survey area is a mixture of native

and introduced forest trees and a higher than usual number of ornamental herbs and shrubs. The latter are attributed to plantings associated with terraces found throughout the area and probably represent agriculture (perhaps watercress farms) during the present century and abandoned sometime in the last several decades (judging from the extent of forest regrowth). Diversion of spring water will adversely affect a small plot of watercress still under cultivation by direct flow from the spring. The survival of some of the ornamental herbs in the area may be dependent on the existing seepage from Rose Apple Spring, but the encroaching forest-type vegetation is not.

The fauna of Pauoa Stream and Rose Apple Spring (see Appendix II) is a mixture of exotic and native species, with exotics being more prevalent. Three endemic species (forms found only in the Hawaiian Islands) are recorded: the 'opae kalaole (*Atya bisulcata*), a snail (*Limnaea reticulata*), and 'o'opu nakea (*Awaous stamineus*). None of these are endangered species, although their populations on O'ahu are not well off, due to a lack of pristine streams. Flow conditions during the survey preclude any direct appraisal of the effects of diversion of Rose Apple Spring waters on the fauna of Pauoa Stream. Potentially, the diversion could prove detrimental if only because it is intended to supplement water supplies when other sources are insufficient to meet needs. Thus, substantial diversion of Rose Apple Spring water will occur at those times when the Spring's contribution to Pauoa Stream life is most critical. If all of the water from Rose Apple Spring were diverted during the usual summer condition of reduced water flow in Pauoa Stream, conditions in the stream bed directly below Rose Apple (lower survey section) would probably resemble those below Booth Spring (middle survey section).

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APPENDIX I:

TAXONOMIC LISTING OF PLANTS OBSERVED IN
THE VICINITY OF PAUOA STREAM AND ROSE APPLE
(KAHUAWAI) SPRING, PAUOA VALLEY, O'AHU

ALGAE

- Cladophora sp.
Filamentous algae Common in stream, particularly
middle section.

FERNS

- Adiantum cuneatum Langd. and Fisch.
Maidenhair fern Occasional; with A. hispidulum.
Adiantum hispidulum Sw.
Five-finger maidenhair Occ. to abundant in some areas
along channel from Rose Apple Spring
and lower section of Pauoa Stream.
Cyathea australis (R.Br.) Copeland
Australian tree fern Intro. ornamental; one small plant
beneath Ficus trees.
Dryopteris dentata (Forsk.) Ching
Oak fern Occ. to common in open areas around
lower section of Pauoa Stream and
Rose Apple Spring.
Nephrolepis biserrata (Swartz) Schott
Sword fern Common in forested areas.
Phymatodes scolopendria (Burm.) Ching
Laua'e fern Occasional in trees beside middle
section of Pauoa Stream.

MONOCOTYLEDONS

GRAMINEAE

- Bambusa vulgaris Schrad. ex Wendl.
Common bamboo Abundant in upper section.
Bambusa vulgaris var. aureo-variegata Hort.
Golden-stemmed bamboo Occasional near Rose Apple Spring.
Brachiaria mutica (Forsskal) Stapf
Para grass Abundant in open field beside
outflow channel from Rose Apple
Spring (no flowers seen).
Coix lacryma-jobi L.
Jobs tears Common in stream bed and other
wet areas.
Oplismenus hirtellus (L.) Beauv.
Basket grass Ubiquitous, particularly in
shaded areas.
Setaria palmifolia (Koen.) Stapf.
Palm grass Common beside Pauoa Stream.

ARACEAE

Alocasia macrorrhiza (L.) Sweet
'Ape (taro)

Common to abundant throughout survey area.

A. cucullata (Lour.) Schott
Chinese taro

Present in area.

COMMELINACEAE

Commelina diffusa Burm. f.
Honohono

Abundant in wet open areas, particularly the meadowland below Rose Apple Spring.

MUSACEAE

Musa nana Lour.
Chinese or dwarf banana
Musa sapientum (L.) O. Ktze.
Common banana

One clump seen.

Present throughout survey area.

STRELITZIACEAE

Heliconia acuminata L.C. Rich
Heliconia collinsiana

Essentially ornamental plants presumably cultivated and still surviving in area.

Heliconia sp.

ZINGIBERACEAE

Alpinia purpurata (Vieillard) K.Schum.
Red ginger

Occasional near stream, lower section.

Hedychium coronarium Koenig
White ginger

Occasional near stream, lower section.

Phaeomeria magnifica (Roscoe) K. Schum.
Torch ginger

Ornamental growing above western bank of Pauoa Stream (middle section).

DICOTYLEDONS

MORACEAE

Ficus benjamina L.
Weeping fig

Several large trees growing above confluence of Rose Apple stream with Pauoa Stream.

CRUCIFERAE

Nasturtium microphyllum Boenn. ex Reichenb.

Watercress

Cultivated in diversion from Rose Apple Spring and noted wild in wet areas above stream banks.

LEGUMINOSAE

?Cassia sp.

Uniden. tree

Occasional large trees near Pauoa Stream, middle section.

EUPHORBIACEAE

Aleurites moluccana (L.) Willd.

Kukui

Occasional throughout survey area.

TILIACEAE

Heliocarpus popayanensis HBK

Moho

An introduced tree common around Rose Apple Spring and lower section of Pauoa Stream.

MALVACEAE

Hibiscus rosa-sinensis L.

Chinese red hibiscus

Ornamental shrub common near Booth Spring.

MYRTACEAE

Psidium guajava L.

Guava

Occasional throughout area of survey

Eugenia sandwicensis Gray

Rose apple

Tree common around Rose Apple Spring and middle section of Pauoa Stream.

ONAGRACEAE

Ludwigia octovalvis (Jacquin) Raven

Purslain

Occasional in damp areas beside channel from Rose Apple Spring.

ARALIACEAE

Brassaia actinophylla Endlicher

Octopus tree

Occasional small trees beside middle section of Pauoa Stream.

UMBELLIFERAE

Centella asiatica (L.) Urban
Asiatic pennywort

Small weed found along Rose Apple Spring channel.

CONVOLVULACEAE

Ipomoea alba L.
Moonflower

Common around Rose Apple Spring.

Ipomoea purpurea
Common morning-glory

Common in grassy field below Rose Apple Spring.

RUBIACEAE

Paederia foetida L.
Maile pilau

Vine common around margins of clearing below Rose Apple Spring

COMPOSITAE

Ligularia tussilaginea (Burm.f.) Makino
Farfugium

Ornamental herb found along channel from Rose Apple Spring.

APPENDIX II:

TAXONOMIC LISTING OF AQUATIC ANIMALS OBSERVED
AND REPORTED FROM PAUOA STREAM AND ROSE APPLE
(KAHUAWAI) SPRING, PAUOA VALLEY, O'AHU

INSECTA

CHIRONOMIDAE

Uniden. midge larvae Abundant on rocks and vegetable
matter in all parts of Pauoa
Stream surveyed.

CRUSTACEA

ATYIDAE

Atya bisulcata
Atyid shrimp ('Opae kalaole) An endemic (found only in Hawai'i)
or native shrimp. One specimen col-
lected from lower section of survey
area.

ASTACIDAE

Procambarus clarki
Crayfish Very common in Rose Apple Spring and
channel, and lower section of survey
area. Uncommon in middle section of
survey area.

MOLLUSCA

LYMNAEIDAE

Lymnaea reticulata Gould
Freshwater snail An endemic snail reported from several
streams in the slopes behind Honolulu
and elsewhere in the Islands. One
specimen found in survey, lower survey
section of Pauoa Stream.

Pseudosuccinea columella Say
Freshwater snail A small, introduced pond snail
reported from Pauoa Valley
(see Morrison, 1968).

THIARIDAE

Thiara granifera (Lam.) f. mauiensis (=Melania mauiensis Lea)
Freshwater snail Very abundant in Rose Apple
Spring and its outflow channel.
Not seen in Pauoa Stream proper.

FISHES

POECILIIDAE

Gambusia affinis (Baird and Girard)
Mosquitofish

An introduced topminnow, common in the outflow channel from Rose Apple Spring.

Poecilia mexicana Steindachuer
Shortfin molly

Reported by Timbol and Maciolek (1978) from Pauoa Stream.

Poecilia reticulata (Peters)
Guppy

Abundant in Pauoa Stream according to Timbol and Maciolek (1978).

Xiphophorus helleri Heckel
Green swordtail

A common, introduced (exotic) fish found to be abundant in large pools of the lower section of the survey area.

COBITIDAE

Misgurnus anguillicaudatus (Cantor)
Dojo; Loach

One seen in Rose Apple Spring; reported from Pauoa Stream.

GOBIIDAE

Awaous stamineus
'O'opu nakea

Endemic; reported from Pauoa Stream (Timbol and Maciolek, 1978).

CLARIIDAE

Clarius fuscus (=?C. batrachus)
Catfish

Introduced fish reported present in Pauoa Stream by Timbol and Maciolek (1978).

AMPHIBIANS

Rana rugosa Schlegel
Wrinkled frog

Tadpoles abundant in middle and upper sections of Pauoa Stream. Adults common near Booth Spring

Bufo marinus L.
Giant toad

One seen in water of middle section of Pauoa Stream