

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HAWAII 96843



March 21, 1990

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KAZU HAYASHIDA
Manager and Chief Engineer

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

Dear Dr. ^{Marv} Miura:

Subject: Environmental Impact Assessment for Kalihi
Valley Exploratory Well, Kalihi Valley, Oahu,
Hawaii, TMK: 1-4-18: 06

We request that our proposed project be published in the
OEQC Bulletin as a Negative Declaration.

Attached are four copies of the assessment for your use.

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

Very truly yours,

KAZU HAYASHIDA
Manager and Chief Engineer

Attachment

SM:jy

cc: K. Hayashida
Engineering
L. Whang

1990-04-08-0A-FEA

OEQC

FINAL SUBMITTAL

Environmental Assessment
for
*** Kalihi Valley Exploratory Well ***
Kalihi Valley, Oahu, Hawaii



BOARD OF WATER SUPPLY
Honolulu, Hawaii

March 1990

ENVIRONMENTAL IMPACT ASSESSMENT
FOR EXPLORATORY WELL II
AT KALIHI VALLEY, OAHU, HAWAII
Tax Map Key: 1-4-18:06

Proposing Agency:

BOARD OF WATER SUPPLY
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96843
Contact: Lawrence Whang, Tel.
527-6138

Prepared by:

WILSON OKAMOTO & ASSOCIATES, INC.
1150 South King Street, Suite 800
Honolulu, Hawaii 96814

March 1990

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CHAPTER 1

INTRODUCTION

Chapter 343, Hawaii Revised Statutes (HRS), requires that proposed actions be assessed to determine potential adverse environmental impacts, and that these impacts be documented. Chapter 200 of Title 11, State of Hawaii Department of Health Environmental Impact Statement Rules, sets forth the requirements for documentation of the environmental impacts. [Ref. 1 and Ref. 2]

This Environmental Assessment (EA) has been prepared to meet the requirements of Chapter 343 HRS and Chapter 200 of Title 11 by documenting the environmental effects from the development of the Kalihi Valley Exploratory Well II project proposed by the City and County of Honolulu Board of Water Supply (BWS). Agency and public consultation on this project is documented in Appendix A.

The environmental impacts from construction and operation of this well have been previously examined in the Final Regional Environmental Impact Statement (EIS) for Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu, Hawaii (accepted September 1986). Relevant portions of the EIS are incorporated by reference in this EA.

CHAPTER 2

PROJECT DESCRIPTION

2.1 INTRODUCTION

The BWS is responsible for the management, control and operation of the municipal water system for certain areas of Oahu. As part of this responsibility, the BWS first identifies potential well sites based on the subsurface geologic and groundwater characteristics of the area. If the site appears promising as a source of groundwater, the BWS then conducts exploratory drilling and certain tests to determine the suitability of the well for eventual production of potable water. The Kalihi Valley Well II site has been identified as such a potential source.

2.2 PROJECT LOCATION

Kalihi is located in Honolulu at the Ewa edge of the primary downtown commercial district. The Kalihi Valley Well II site is about 75 feet above Kalihi Stream and north of the suburban residential area at about 550 feet elevation, 800 feet south of Likelike Highway. This well site is located within the Honolulu Watershed Forest Reserve area owned by the City and County of Honolulu Board of Water Supply (BWS). Access to the site is via Kalihi Street and then an unimproved road maintained by the BWS. Figure 1 shows the project location and Figure 2 the well site as seen from the BWS road.

Since the well site is already accessible by an existing road, a separate BWS access road for equipment and supplies used in the exploratory drilling and testing will not be required.

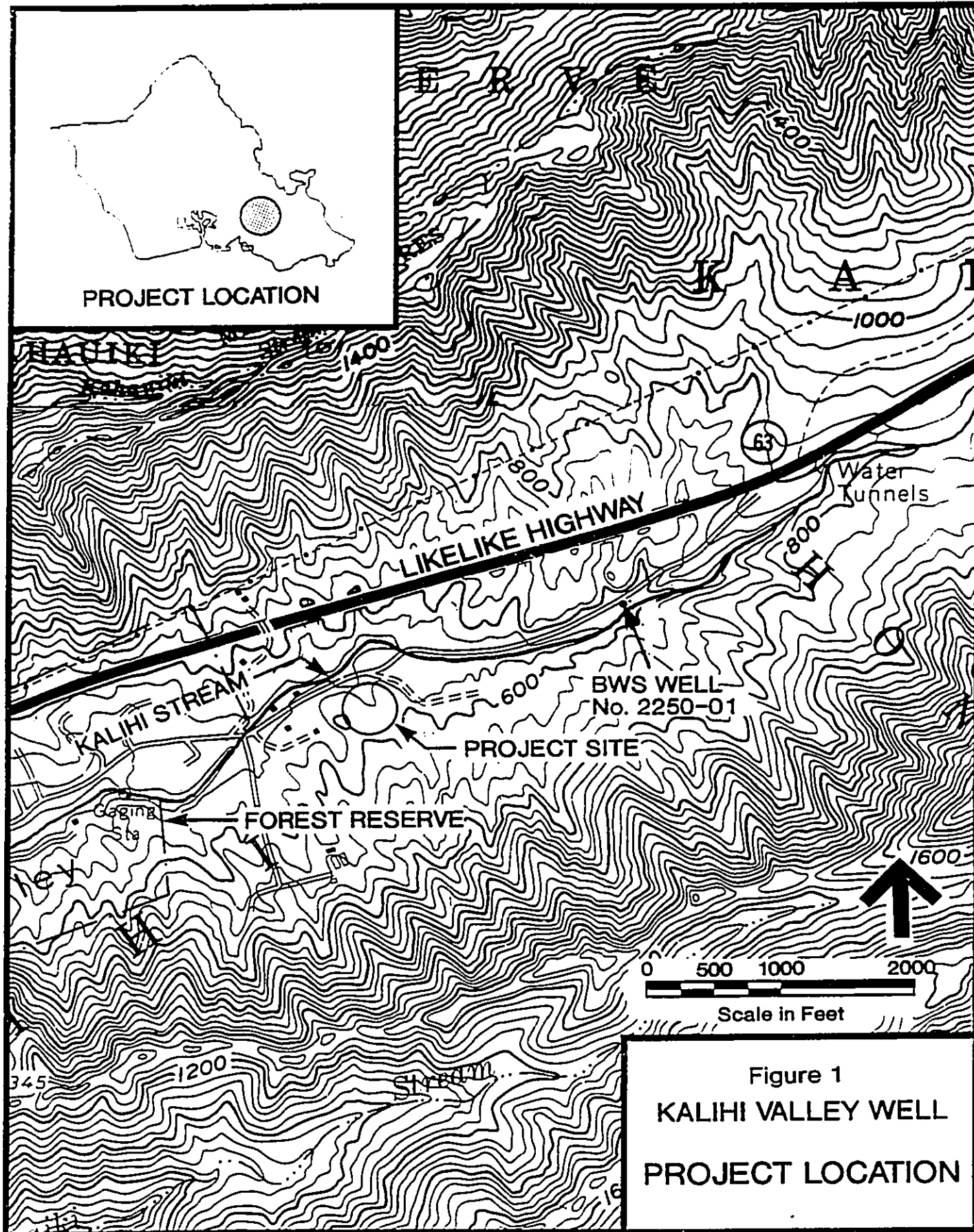


Figure 1
 KALIHI VALLEY WELL
 PROJECT LOCATION



View of project site to the right as seen from the BWS access road gate.



View of the project site looking down the road. The gate can be seen at far right.



Interior view of the site.

Figure 2

2.3 PROJECT FEATURES

The following table describes the features of this exploratory well site.

<u>Item</u>	<u>Kalihi Valley Well II</u>
Tax Map Key (TMK)	1-4-18:06
Total parcel area (acres)	287.309
Flood Insurance Rate Map (FIRM) Flood Zone	Undetermined
State Land Use District	Conservation
State Water Management Area	Honolulu
City and County of Honolulu Development Plan	Preservation
City and County of Honolulu Development Plan Public Facilities Map	Not designated
City and County of Honolulu Zoning	Preservation (P-1)
Approximate depth to aquifer	150 [±] - 300-350 FT
Estimated yield of production well	.25 mgd*
Type of Aquifer	Perched
Land Owner	BWS
Nearest Access	BWS Road

* million gallons per day

2.4 PROJECT CONSTRUCTION

An area of about .75 to 1.0-acre will be cleared and graded at the project site to accommodate well drilling and support equipment and necessary supplies. All excess material from the clearing and grading the project site will be disposed at an approved location for this type of material. Once the area has been cleared, a temporary fence may be erected to secure the project site.

Clearing and grading operations will be restricted to hours from 7:30 AM to 3:30 PM on weekdays to minimize disturbance. No activities will occur on the project site during weekends and holidays.

Once the site has been cleared and secured, a truck or trailer-mounted well drilling rig and other support equipment will be brought to the project site for the exploratory drilling operation. The truck engine or a self-contained engine will be used to provide power for the well drilling rig. A single well hole about 16 inches in diameter will be drilled at the project site to reach the groundwater source.

One of two existing types of drilling methods, either cable tool or rotary, will be used. The cable tool drilling method is performed by repeatedly raising and dropping a heavy drill bit until the desired depth has been reached.

All waste material from the cable tool drilling operation is bailed from the hole and collected in a pit constructed on the project site or discharged on the surface. In either case, the waste material will be disposed off site in an approved manner. The waste material generated from this drilling method does not contain any contaminants. Depending on the depth and lava formations encountered, the well drilling may require up to a maximum of six months to complete.

If the rotary drilling method is used, a drill bit rotating at moderate speed will bore the well while drilling fluid is pumped down the drill stem to the bit at the bottom of the hole. The drilling fluid, bentonite, a fine clay material, is then forced back up the hole carrying drill cuttings to the surface where they are removed from the drilling mud by a screen. The mud is then collected in a mud tank mounted on the side of the drill rig. The collected mud is recirculated from the mud tank and is not considered a hazardous material. No surface runoff of the drilling mud will be permitted. When the drilling is complete, the drilling mud will be taken off the project site and disposed in an approved manner.

Once the water table is reached, instead of drilling fluid, an air compressor will be used to pump air down to the drill bit. This will ensure that the drilling fluid does not enter the aquifer. This rotary drill method of drilling may require up to three to four months to complete.

Upon completion of the drilling operation, a 12-inch diameter steel casing will be grouted into the drilled hole and a pump will be installed.

2.5 PUMPING TEST

Two types of pumping tests will be conducted after the drilling operation is completed. The initial test, a step-drawdown or yield-drawdown test, involves pumping water from the well at various pumping rates to estimate the specific capacity (number of gallons withdrawn per foot of drawdown) of the well. The drawdown will be measured for each pumping rate. Once the drawdown has stabilized, the pumping rate will be changed and a new drawdown measured. A step-drawdown test may last up to five hours, and will be performed from about 9:00 AM to 2:00 PM on a weekday.

After the step-drawdown test has been completed, a five-day sustained pumping test will be undertaken. The well will be pumped 8 hours per day for four days, and 5 hours on the fifth day. This test is designed to determine the sustainable capacity of the well, monitor water quality, and to measure aquifer parameters by monitoring BWS Well No 2250-01, located about 1/2 northeast, or upstream, of the well site. (The sustainable capacity of a well is the rate at which the well can be continuously pumped without affecting nearby existing wells.)

In addition to monitoring the nearby well, Kalihi Stream will be monitored to identify adverse effects from the pumping. The BWS has contracted the U.S. Department of Interior Geological Survey (USGS) to conduct this monitoring during the test period. USGS Gage No. 2290, located about 2,400 feet downstream of the well site, will be used for this monitoring.

Water pumped during the pumping test will be collected and tested for organic compounds as required by the U.S. Environmental Protection Agency (EPA); heavy metals; minerals; hazardous materials; coliform and standard plate count for bacteria. The tests are performed by the BWS and, in some cases, by the State of Hawaii Department of Health. The water pumped during the five-day test will be disposed into Kalihi Stream. The water will not be considered a source of drinking water according to the State of Hawaii Department of Health (DOH) Potable Water Systems Regulation set forth in Title 11, Chapter 20, DOH Rules.

Upon completion of the five-day pumping test, the well-driller will then remove the pump, cap the well, and clean the area, removing all excess materials and wastewater withdrawn during test pumping. The well will be capped after testing to prevent misuse of the well such as for disposal of hazardous wastes, sewage, or household garbage. According to the U.S. Environmental Protection Agency (EPA) Underground Injection Control Section, unplugged or improperly abandoned water wells can easily become receptacles for the disposal of waste which may contaminate the groundwater aquifer.

2.6 PROJECT SCHEDULE

The project schedule will depend upon approval of required permits and other necessary licenses. For planning purposes, the BWS estimates the exploratory well drilling at Kalihi Valley will occur within the Fiscal Year (FY) 1989-90.

CHAPTER 3

AFFECTED ENVIRONMENT

3.1 PHYSICAL ENVIRONMENT

3.1.1 Geology

The Island of Oahu is composed of the remnants of two elongated shield volcanoes, the Waianae and Koolau ranges, which are connected by the Schofield plateau. The Koolau volcano is the younger of the two and emerged east, sending lava flows westward to overlap and bank against the Waianae flank. In later periods, changes in sea level and the deposition of sediments contributed to the building of flat coastal plains.

Kalihi Valley is the product of extensive rain and spring water erosion on the Leeward side of the Koolau Shield Volcano. Koolau basalt makes up the valley walls. Dense vesicular jointed a'a and pahoehoe flows of basalt which generally floor valleys along the Koolau Range are found down the middle of Kalihi Valley, about 10 to 300 feet thick. Much of this basalt has been incised by Kalihi Stream, exposing the permeable rock above stream level. [Ref. 3]

3.1.2 Soils

Soil at the Kalihi well site is classified by the U.S. Department of Agriculture Soil Conservation Service as Lolekaa silty clay, 15 to 25 percent slope (LoD). The Lolekaa series are well-drained soils most often found on side slopes of terraces and along drainage ways. These soils develop from old, gravelly colluvium and alluvium. Soil runoff of LoD is medium, and the erosion hazard is moderate. [Ref. 4]

3.1.3 Climate and Air Quality

The average rainfall in the State is 73 inches per year. Due to its higher elevation, rain gage measurements (State Key No. 776.00) taken in upper Kalihi Valley indicate the site receives a mean annual rainfall of approximately 140 inches. There is little variation in rainfall on a month to month basis. Tropical storms occasionally bring heavy rains while the rest is orographic or comes from Kona storms, or those which approach from the southwest. [Ref. 5]

January is the coldest month, averaging 72 degrees Fahrenheit, and August is the warmest, averaging 78 degrees Fahrenheit. Average relative humidity is 72 percent in the mornings and 57 percent in the afternoons. [Ref. 6]

Air quality on most areas of Oahu is generally affected by vehicle traffic, stationary sources, and the prevailing tradewinds. High volumes of vehicle traffic pass within 800 feet of the well site but trees and undergrowth provide a dense barrier against air currents. This factor, coupled with the freshening effects of normal tradewind conditions, produces relatively good air quality at the well site. No agricultural activities occur nearby which might otherwise be a source of air pollutants.

3.1.4 Hydrology

3.1.4.1 Surface Water

There are no surface water sources, flood plains, or wetlands on the well site. However, Kalihi Stream has its source above the well site and lies about 75 feet below the road adjacent to the site. This stream is continuous flowing and is designated "Construct-Alter" by the DOH. According to this water quality standard, the stream has low environmental

and biological quality and may be restricted to the public for health and safety reasons. [Ref. 6]

Stream flow data is compiled by the USGS at specific points along some individual streams. Kalihi Stream is one of those gaged by the USGS (Gage 2290) within the Honolulu District. The data obtained on Kalihi Stream gage located about 2,400 feet downstream of the well site is summarized in Table 1. [Ref. 6 and Ref. 7]

The well site is included in the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM). It is designated as Flood Zone D-- an area of undetermined, but possible, flood hazard. [Ref. 6]

3.1.4.2 Groundwater

The Koolau basalt, the principal aquifer in the Honolulu District, underlies a layer of Kalihi basalt and alluvium in the area of the well site. Recharge is transmitted and stored in open spaces within lava tubes, vesicles, and cooling cracks. Infiltrated rain water can also be perched atop layers of impermeable material such as dense lava flows, solidified ash, or clay-rich sediments. This is the nature of perched water located below the Kalihi Well II site. [Ref. 6]

The closest existing groundwater source to the well site is BWS Well No. 2250-01, an artesian well, located about 1/2 mile to the northeast (upstream). The latest records show water withdrawals of .1 mgd at this well. [Ref. 8] Water from this source is used by the BWS system.

There are a series of BWS water tunnels (Nos. 2249-01 to 04) constructed during the 1930's located about 1 mile northeast, or upstream, of the well site. Water recovered from these tunnels is moving through the Kalihi basalt and alluvium toward the floor of the valley. Although the latest water use records indicate withdrawals of about .27 million gallons per

STREAM FLOW DATA for KALIHI STREAM

USGS GAGE NO. 2290

ELEVATION: 464 FEET

YEAR ENDING	NO. DAYS MEASURED	MEDIAN MONTHLY MEAN DISCHARGE*	LOWEST MONTHLY MEAN DISCHARGE*	LOWEST RECORDED DISCHARGE
9/88	365	2.81	0.93	.50
9/87	N/A	--	--	--
9/86	365	3.17	0.52	.26
9/85	365	1.13	0.19	.15
9/84	365	.94	0.19	.15
9/83	N/A	--	--	--
9/82	365	4.52	2.71	1.42
9/81	365	1.34	0.61	.32
9/80	365	6.59	0.50	.23
9/79	365	1.52	0.49	.28
9/78	365	.87	0.22	.10
9/77	N/A	--	--	--
9/76	365	1.57	0.60	.23
9/75	365	1.89	0.27	.16
9/74	365	3.36	0.99	.28
9/73	365	1.18	0.42	.19

*Million gallons per day

N/A: Not Available

[Ref. 7]

day (MGD) from these tunnels, they are no longer used by the BWS as a source of groundwater. [Ref. 9]

3.1.5 Noise

In most areas of Oahu, including the Kalihi valley area, vehicle traffic is the primary source of noise. At the well site, noise sources consist of birds, running water from Kalihi Stream, and the distant sounds of traffic on Likelike Highway.

3.2 BIOLOGICAL ENVIRONMENT

3.2.1 Flora

A botanical survey of the well site was conducted in December, 1989 (See Appendix B). According to this survey, the well site is densely covered with introduced bamboo. Two indigenous taxa, hau and kamani trees, also appear at the site, as they do in many other low land sites on all the Hawaiian Islands. The ground cover consists of bamboo leaves and rose apple seedlings.

All other flora were found along the unimproved road adjacent to the well site. They include occasional oak fern, sword fern, laua'e, taro vine, syngonium, palm grass, red ginger, octopus tree, wedelia, sweet potato, Coster's curse, Moreton bay fig, chinese banyan, strawberry guava, thimble berry, coffee, glorybower, and cayenne vervain. More common flora found along the roadway include taro, koka, and rose apple. (See Appendix B).

None of these species found during the survey is a Federal (U.S. Department of the Interior Fish and Wildlife Service) or State of Hawaii listed or candidate threatened or endangered plant species. [Ref. 10 and Ref. 11]

3.2.2 Fauna

Although a site survey for wildlife was not undertaken, an extensive population of wildlife most likely does not occur on the site. During the field survey, no wildlife or trace of significant fauna was observable. However, the well site could conceivably provide habitat for rats, mice, mongoose, feral pigs, feral cats, and feral dogs. None of these species is a Federal or State of Hawaii listed or candidate threatened or endangered species.

3.3 SOCIAL ENVIRONMENT

3.3.1 Population

The regional population of Kalihi Valley in 1985 was 17,696, an increase of about 0.5 percent from the 1980 figure of 17,613 persons. These data compare to about 811,100 persons on Oahu in 1985, an increase of 6.7 percent from the 1980 figure of 762,534 persons. [Ref. 12]

Within Census Tract No. 65 encompassing the upper Kalihi valley area, the resident population in 1985 was 4,114 persons, an increase of 1.9 percent from the 1980 figure of 4,037 persons. [Ref. 12] Two residences are located in the immediate area at the edge of the forest reserve, thereby fronting the well site.

3.3.2 Scenic and Visual Resources

The well site is located at the end of Kalihi Street just beyond the gate which establishes the beginning of the State Forest Reserve area. The well site is mostly bamboo interspersed with a variety of mature trees and other vegetation. Although there are two nearby residences, most other residential areas are located in the lower portion of the valley.

The hillsides and dense vegetation of the well site provide a visual relief from the intense urban development along Kalihi Street and other areas of Kalihi. The hillside location and dense vegetation means that the well site will not be visible from most of the lower areas of Kalihi and from Likelike Highway.

3.3.3 Archaeological and Historical Resources

An archaeological survey was conducted in January, 1989 and is included in Appendix C. This field investigation revealed no archaeological or historic structures, remains, objects, or artifacts at the well site. There are no structures on the well site listed on the National or State of Hawaii Register of Historic Places.

3.4 LAND USE, LAND USE PLANS, POLICIES, AND CONTROLS

3.4.1 Land Use

The well site is within the Honolulu Watershed Forest Reserve and does not contain any buildings or structures. Other nearby land uses include an unimproved access road, two residences, and BWS well no. 2250.01.

3.4.2 Land Use Policies and Controls

The well site is located within the State Conservation Land Use District. Under this designation, any development requires approval by the State of Hawaii Board of Land and Natural Resources through a Conservation District Use Application (CDUA) Permit. The intent of the Board approval and CDUA is to assure the judicious development and utilization of Conservation Lands.

The Kalihi Valley II exploratory well does not appear on the City and County of Honolulu Development Plan Public Facilities (DPPF) Map. The

exploratory well does not require an amendment to the DPPF Map. However, an amendment will be required if a production well is to be constructed.

The well site is zoned P-1, Preservation, by the City and County of Honolulu. According to the City's Land Use Ordinance, a public facility such as the exploratory well is a permitted use in all zoning designations.

The well site is within the Honolulu Water Management Area (WMA). This designation is made by the State Commission on Water Resource Management when it can be reasonably determined that the water resources in an area may be threatened by existing or proposed withdrawals or diversions.

CHAPTER 4

POTENTIAL IMPACTS AND MITIGATIVE MEASURES

4.1 PHYSICAL ENVIRONMENT

4.1.1 Geology

The exploratory well will require a bore hole to be placed into the subsurface basalt rock to reach the perched water source. Once the exploratory well has been constructed and the five-day pumping test completed, the well will be capped. Once capped, there will be no adverse affects to the geologic resources of the area.

4.1.2 Soils

The well site will be cleared of all existing vegetation prior to the well drilling. According to the U.S. Department of Agriculture Soil Conservation Service, soils on the well site are classified as Lolekaa silty clay, 15 to 25 percent slope (LoD). The Lolekaa series are well-drained soils most often found on side slopes of terraces and along drainage ways. These soils develop from old, gravelly colluvium and alluvium. Soil runoff of LoD is medium, and the erosion hazard is moderate. [Ref. 4] Clearing of the site may cause some erosion.

4.1.3 Climate and Air Quality

The site clearing, well drilling and testing will take approximately six months to complete. These activities will create increased dust from clearing and grading the well site, and pollutant emissions from operation of vehicles and equipment. To mitigate the effects of site clearing activities, dust control measures, such as water sprinkling, will be implemented by the contractor to reduce dust levels, as necessary.

4.1.4 Hydrology

4.1.4.1 Surface Water

Kalihi Stream flows along the opposite side of the access road to the well site. Impacts to Kalihi Stream could occur from decreased flow during the five-day pumping test. Stream flow will be monitored during development of the exploratory well. The BWS has contracted the U.S. Department of Interior Geological Survey to monitor streams and other water bodies during the test period.

If the monitoring shows stream flow in Kalihi Stream is adversely affected, *mitigative measures acceptable to both the State Department of Land and Natural Resources and the U.S. Fish and Wildlife Service* will be implemented.

This stream is continuous flowing and is designated "Construct-Alter" by the State of Hawaii Department of Health. According to this water quality standard, the stream has low environmental and biological quality and may be restricted to the public for health and safety reasons. [Ref. 6]

4.1.4.2 Groundwater

The groundwater resource below the Kalihi Valley well II site is perched and pumping from the resource may affect the existing nearby BWS well, water tunnels, and possibly Kalihi Stream. However, analysis of past stream flow data show the existing BWS well has not affected flows in Kalihi Stream.

Once the well has been drilled, a five-day (8 hours per day for four days and 5 hours on the fifth day) pumping test will be undertaken to determine the specific capacity, or yield, of the well. The drawdown will be measured at each pumping rate. The test is also used to determine what effect pumping will have on other sources.

4.1.5 Noise

The increased traffic from construction vehicles will not be significant, but may cause some minor inconveniences to area residents for the duration of construction. Because the nearest residences border the well site, noise generated during the drilling operations will be intrusive. If the cable tool drilling method is used, noise will result from the drill bit hitting rock (like a pile driver, only quieter) and from the operation of a diesel engine. If the rotary drilling method is used, the operation will be quieter. In either case, drilling will be restricted to hours from 7:30 AM to 3:30 PM.

Noise permits will be required from the Noise and Radiation Branch of the Department of Health and contractors must comply with the conditions issued with the permits. Mufflers for noise control will be required for all construction equipment. All noise attenuating equipment will be maintained in proper operating condition and will be repaired or replaced as needed.

4.2 BIOLOGICAL ENVIRONMENT

4.2.1 Flora

According to the botanical survey, flora at the site consists mostly of bamboo and hau trees with a ground cover of bamboo leaves and rose-apple seedlings. Along the verge of the roadway, there are a number of other species. None of the species found on the well site are Federal or State of Hawaii listed or candidate threatened or endangered species. The exploratory well will not have a significant adverse effect, loss, or destruction to the flora of this area of Hawaii.

4.2.2 Fauna

During the field survey, no wildlife or trace of significant fauna was observable. However, the well site could conceivably provide habitat for rats, mice, mongoose, feral pigs, feral cats, and feral dogs. None of these species is a Federal or State of Hawaii listed or candidate threatened or endangered species.

4.3 SOCIAL ENVIRONMENT

4.3.1 Population

The well drilling will be contracted by the BWS to a contractor who will be responsible for all aspects of the project, including supplying a drilling crew. Most likely, the crew members will come from all areas of Oahu, including some from the Kalihi area. However, the crew size is not significant when compared to the population of Kalihi. There will be no adverse effects to the population of Kalihi from the project.

4.3.2 Scenic and Visual Resources

The well site is not visible from Likelike Highway and does not present a significant adverse visual impact to the general populace. However, clearing of the site's dense growth and the ensuing construction activities will be very visible to the several residences which border the area. Visual impact to these residents will be unavoidable but will decrease over time.

4.3.3 Archaeological and Historic Resources

The archaeological field investigation revealed no archaeological or historic structures, remains, objects, or artifacts at the well site. There are no structures on the well site listed on the National or State of Hawaii Register of Historic Places. The lack of cultural resources

indicates there will be no significant adverse effects from the exploratory well.

Should any unforeseen archaeological or historical artifact be encountered during construction, all work will be stopped and the State Historic Preservation Office will be notified.

4.4 LAND USE, LAND USE PLANS, POLICIES, AND CONTROLS

4.4.1 Land Use

The proposed well site is within the Honolulu Watershed Forest Reserve and is not being used. The exploratory well will require removal of the existing vegetation for the drilling and support equipment. Once the drilling has been completed and the well capped, much of the well site can be returned in time to its natural state.

4.4.2 Land Use Plans, Policies, and Controls

The well site is within the State of Hawaii Land Use District designated as Conservation. Therefore, it will require approval by the Board of Land and Natural Resources for a Conservation District Use Application (CDUA) Permit to assure the judicious development and utilization of Conservation Lands. Approval of the CDUA will ensure the exploratory well is consistent with the policies of the Board.

The Kalihi Valley II exploratory well does not appear on the City and County of Honolulu Development Plan Public Facilities (DPPF) Map. The exploratory well does not require an amendment to the DPPF Map. In accordance with the City's Land Use Ordinance, public facilities such as the proposed water system improvements are permitted uses in all zoning designations. Thus, the exploratory well is consistent with City and County of Honolulu land use plans and policies.

CHAPTER 5

POSSIBLE ALTERNATIVES

5.1 NO ACTION

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

5.2 DELAYED ACTION

The proposed project is currently scheduled for fiscal year 1989-90. Delay of the project would likely increase the cost once construction ultimately begins. Delaying the project would not rule out its necessity in the near future.

5.3 ALTERNATE SITES

The BWS is responsible for management, control, and operation of the municipal water system for certain areas of Oahu. As part of this responsibility, the BWS must identify well sites for exploratory drilling and eventual production of water. A number of factors are considered by the BWS in the selection of potential alternative exploratory well sites, including subsurface geologic and groundwater characteristics, depth of drilling to the water resource, nearby surface water sources, elevation of the site in relation to the distribution system, ease of access, surrounding terrain, natural and cultural resources, and environmental impacts.

The Kalihi Valley well II site was selected after consideration of all of these factors. Thus, there are no alternative sites which meet the determining factors established by the BWS at this site.

CHAPTER 6

DETERMINATION

In accordance with the provisions of Chapter 343, Hawaii Revised Statutes, and the significance criteria set forth in Section 11-200-12 of Title 11 Chapter 200, this assessment has determined that the project will have no significant impact on the environment, and that an Environmental Impact Statement is not required.

REFERENCES

1. Hawaii Revised Statutes, comprising the Statutes of the State of Hawaii, Volume 5, Titles 16-19, Chapters 281-344, 1985.
2. Title 11, Chapter 200, State of Hawaii Department of Health Environmental Impact Statement Rules, 1985.
3. Stearns, Harold T. and Knute N. Vaksvik, Geology and Ground Water Resources of the Island of Oahu, Hawaii, Territory of Hawaii, Department of Public Lands, Division of Hydrography, Bulletin Prepared in Cooperation with the U.S. Geological Survey, May 1 1935.
4. Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, August 1972. U.S. Department of Agriculture, Soil Conservation Service, in cooperation with the University of Hawaii, Agricultural Experiment Station.
5. Thomas W. Giambelluca, Michael A. Nullet, and Thomas A. Shroeder, Rainfall Atlas of Hawai'i, Report R76, June 1986. Water Resources Research Center. Prepared for State of Hawaii Department of Land and Natural Resources, Division of Water and Land Development.
6. Regional Environmental Impact Assessment for Development of Wells, Reservoirs, Transmission Lines and Appurtenances at Honolulu, Hawaii, Board of Water Supply, City and County of Honolulu, prepared by Wilson Okamoto & Associates, September 1984.
7. Water Resource Data - Hawaii and Other Pacific Areas. Water Years 1973-1988, U.S. Geological Survey Water Data Report.
8. Lao, Chester. Geology Department, Board of Water Supply. Personal Communication with John Sakaguchi. Honolulu, February 1990.
9. Oahu Water Use and Development Plan, Technical Reference Document, Prepared for the City and County of Honolulu Department of General Planning, September 1989.
10. Title 13, Chapter 124, Hawaii Administrative Rules, Department of Land and Natural Resources, Indigenous Wildlife, Endangered and Threatened Wildlife and Plants, and Introduced Wild Birds.
11. U.S. Fish and Wildlife Service, Endangered and Threatened Wildlife and Plants, January 1, 1989.
12. U.S. Bureau of the Census, 1980 Census of Population and Housing, Census Tracts, Honolulu, Hawaii, Standard Metropolitan Area.

AGENCIES CONSULTED

FEDERAL AGENCIES

1. Mr. Ernest Kosaka
Environmental Coordinator
Department of the Interior
Fish and Wildlife Service
P.O. Box 50167
Honolulu, Hawaii 96850
2. Mr. William Myer
District Chief
Department of the Interior
Geological Survey
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96815
3. Mr. Warren M. Lee
State Conservationist
Department of Agriculture
Soil Conservation Service
P.O. Box 50004
Honolulu, Hawaii 96850
- 4.* Mr. Daniel W. McGovern
Regional Administrator
U.S. Environmental Protection Agency Region IX
215 Fremont Street
San Francisco, CA 94105

STATE AGENCIES

- 1.* Mr. Bruce Anderson, Ph.D.
Deputy Director for Environmental Health
State of Hawaii
Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801
- 2.* Mr. William Paty
Chairperson
State of Hawaii
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

- 3.* Mr. Yukio Kitagawa
Director
State of Hawaii
Department of Agriculture
1428 S. King St.
Honolulu, Hawaii 96814
4. Mr. John Harrison
Environmental Coordinator
University of Hawaii at Manoa
Environmental Center, Crawford 317
2550 Campus Rd.
Honolulu, Hawaii 96822
5. Mr. L. Stephan Lau, Ph.D.
University of Hawaii
Water Resources Research Center
2540 Dole St., Holmes Hall 283
Honolulu, Hawaii 96822

CITY AND COUNTY OF HONOLULU

- 1.* Mr. John Whalen
Director
City and County of Honolulu
Department of Land Utilization
650 South King Street
Honolulu, Hawaii 96813
- 2.* Mr. Donald Clegg
Director
City and County of Honolulu
Department of General Planning
650 South King Street
Honolulu, Hawaii 96813
- 3.* Mr. Sam Callejo
Director
City and County of Honolulu
Department of Public Works
650 South King Street
Honolulu, Hawaii 96813

OTHER INTEREST GROUPS

1. Kalihi Valley Neighborhood Board No. 16
P.O. Box 19063
Honolulu, HI 96817

2. Life of the Land
250 South Hotel Street, Room 211
Honolulu, Hawaii 96813
3. Mr. Gary Anderson, Conservation Chair
Sierra Club
Honolulu Executive Committee
P.O. Box 11070
Honolulu, Hawaii 96828

* Responded. Letters included in Appendix A.

APPENDIX A
RESPONSE TO CONSULTATION



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
215 Fremont Street
San Francisco, CA 94105

JS

DEC 21 1989

In reply
refer to W-6-2

John L. Sakaguchi
Wilson Okamoto & Associates, Inc.
P. O. Box 3530
Honolulu, Hawaii 96811

RECEIVED
DEC 23 1989

Dear Mr. Sakaguchi:

WILSON OKAMOTO & ASSOCIATES

I am writing in response to your request for comments and issues that should be addressed in each of the Environmental Assessments for the proposed exploratory well projects located near Mokuleia, Kawaihoa and Kalihi Valley. Your letter was routed to our Section for reply.

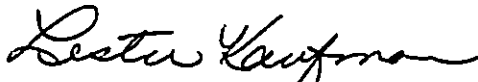
The Underground Injection Control Section of the Region IX Environmental Protection Agency is primarily concerned with protecting underground sources of drinking water from contamination as a result of fluids being placed into injection wells. Since fluids will not be injected into your wells, these exploratory well projects are not directly under our program's jurisdiction. However, the Underground Injection Control Section is concerned with potential problems which may arise if, after evaluation, the decision is made not to put these wells into production. Unplugged or improperly abandoned water wells can easily become receptacles for the disposal of wastes. Whether intentional or unintentional, misuse may occur, involving disposal of various wastes which may ultimately contaminate underground sources of drinking water. Intentional misuse may involve disposal of hazardous wastes, sewage or simply household garbage. Unintentional injection through improperly plugged and abandoned wells may consist of surface run-off drainage into a well or the establishment of hydraulic connection between aquifers of different water quality.

Since these types of situations pose a great potential threat to underground sources of drinking water, we believe that plans for proper plugging and abandonment should be addressed in the EAs. The problems which arise when these wells are not properly

plugged and abandoned become issues that must be addressed by the appropriate authorities in Hawaii or by the EPA.

Should you have any questions, please call Donna Ann Ng of my staff at (415) 744-1640 or me at (415) ~~645~~⁶⁵⁴-9275.

Sincerely,



Lester Kaufman, Chief
Underground Injection Control Section

cc: Tom Arizumi, HDOH

cc: L WHANG, BWS

2883
JC

JOHN WAIHEE
GOVERNOR OF HAWAII



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

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

In reply, please refer to:
EPHSD

November 9, 1989

RECEIVED
NOV 30 1989
WILSON OKAMOTO & ASSOCIATES

Wilson Okamoto & Associates, Inc.
1150 South King Street, Suite 800
Honolulu, Hawaii 96814

ATTENTION: John L. Sakaguchi

SUBJECT: ENVIRONMENTAL ASSESSMENT FOR EXPLORATORY WELLS
MOKULEIA, KAWAILOA, AND KALIHI VALLEY

Dear Mr. Sakaguchi:

Thank you for the opportunity to review the subject document. We have the following comments:

1. If the wells are to serve 25 or more individuals at least 60 days per year or has a minimum of 15 service connections, then the use of these wells as sources of drinking water will require compliance with the State's Potable Water Systems Regulations, Chapter 20, Title 11, Administrative Rules.
2. Department's Administrative Rules, Title 11, Chapter 20, "Potable Water Systems", Section 11-20-29 requires that any new source of potable water serving a public water system be approved by the Director of Health prior to its use. Such an approval is based primarily upon the submission of a satisfactory engineering report which addresses the requirements stated in Section 11-20-29.
3. The Mokuleia Well lies approximately one mile east of Mokuleia Homesteads Wells 1 and 2, which are drilled but presently capped. Operation of the proposed well shall not be allowed to degrade the water quality of the Mokuleia Homestead wells, should they come into production.
4. The Kalihi Valley Well will be sited about 2000 feet from the BWS Kalihi Well. Effects of the proposed well, if any, on the Kalihi Well will no doubt be scrutinized by BWS engineers.

John K. Sakaguchi
Page 2
November 9, 1989

Should you have any questions, please contact the Safe Drinking Water
Branch at 543-8258.

Sincerely yours,



BRUCE S. ANDERSON, Ph.D.
Deputy Director for
Environmental Health

AZ:la

CC: L WHANG, BWS

JOHN WAIHEE
GOVERNOR OF HAWAII



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

P. O. BOX 621
HONOLULU, HAWAII 96809

DEC 6 1989

REF:OCEA:SOR

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

DEPUTIES

LIBERT K. LANDGRAF
MANABU TAGOMORI
RUSSELL N. FUKUMOTO

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

FILE NO.: 90-242
DOC. NO.: 6895E

RECEIVED
DEC 9 7 1989

WILSON OKAMOTO & ASSOCIATES

Mr. John L. Sakaguchi
Wilson Okamoto and Associates, Inc.
1150 South King Street, Suite 800
Honolulu, Hawaii 96814

Dear Mr. Sakaguchi:

SUBJECT: Environmental Assessment for Exploratory Wells, Mokuleia,
Kawailoa, and Kalihi Valley

We have completed our review of the subject document and have the following comments to offer.

Our Division of Aquatic Resources identifies that it appears that two of the sites, in Kalihi Valley and Mokuleia, may be located near enough to streams to require some consideration for monitoring during the 5-day periods set for test operation, when runoff may be diverted into the streams. According to the documentation, the USGS will be contracted to monitor the streams during such periods and the EPA will conduct a variety of water quality tests. It is not anticipated that test operation under these conditions would represent any threat to aquatic habitats, so long as measures were taken to prevent erosion or introduction of toxins with the surface runoff.

Further, the Division of Water and Land Development concludes that well drilling and water use permits will be required.

The Historic Preservation Program finds that the Mokuleia Well site is in a sugarcane field and has never been archaeologically surveyed, as it was assumed that no historic sites would remain. There are very few recorded archaeological sites in Mokuleia, as there has been no systematic professional archaeological survey in the area. While it is probable that agricultural activities have destroyed any archaeological sites on the proposed well site, an archaeological survey of the site would provide the necessary information for an effect determination.

Mr. John L. Sakaguchi

- 2 -

FILE NO.: 90-242

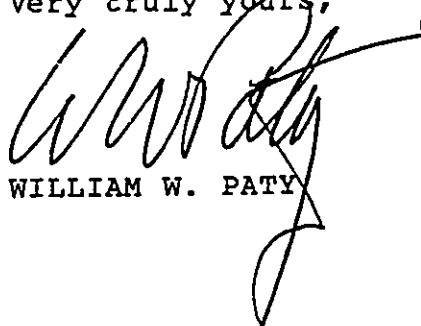
An archaeological field check was completed on the Kawaiiloa well site, and no archaeological sites were found. The archaeological report, which is included in the 1989 EIS, should also be attached to the proposed EA. A determination of "no effect" is appropriate.

The Kalihi Valley well site may be in an area containing archaeological sites. An archaeological survey in connection with the BWS Kalihi stream crossing project is now underway, and we will soon have more information on the area. Wilson Okamoto could also contact Allan Schilz of ERC, the archaeological contractor, for more information.

Finally, we have identified that the Kalihi well site is within the State Land Use Conservation District. As such, appropriate land use permit approvals are required.

Thank you for the opportunity to comment on this matter. Should you have any questions, please feel free to contact Ed Henry at the Office of Conservation and Environmental Affairs (548-7837).

Very truly yours,



WILLIAM W. PATY

cc: Larry Whang

JOHN WAIHEE
GOVERNOR



YUKIO KITAGAWA
CHAIRPERSON, BOARD OF AGRICULTURE

SUZANNE D. PETERSON
DEPUTY TO THE CHAIRPERSON

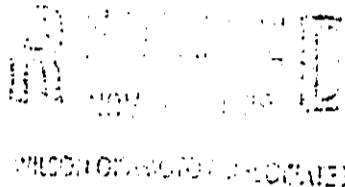
FAX: 548-6100

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

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

November 14, 1989

Wilson Okamoto and Associates, Inc.
1150 South King Street, Suite 800
Honolulu, Hawaii 96814



Attention: Mr. John L. Sakaguchi

Dear Mr. Sakaguchi:

Subject: Environmental Assessments for Exploratory Wells
Mokuleia, Kawaihoa, and Kalihi Valley - Oahu
TMK: 6-8-07: por. 2 (Mokuleia)
6-1-06: por. 1 (Kawaihoa)
1-4-18: por. 6 (Kalihi Valley)
Area: about one acre each

The Department of Agriculture has reviewed the subject proposals and offers the following comments.

Both the Mokuleia and Kawaihoa project sites are classified "Prime" according to the Agricultural Lands of Importance to the State of Hawaii (ALISH) system. The Kalihi Valley site is not classified.

* The Soil Conservation Service Soil Survey identifies the soils of the Mokuleia and Kawaihoa sites as Ewa silty clay loam (EaC) with 6 to 12 percent slopes and Wahiawa silty clay (WaB) with 3 to 8 percent slopes, respectively. Both soils are used for sugarcane cultivation and have soil capability classifications of IIIe and IIe, respectively (soils with severe and moderate erosion potential if cultivated and not protected).

The Mokuleia and Kawaihoa sites have Land Study Bureau Overall Productivity Ratings and Land Types of "A219i" and "A121", respectively. By this method of classification, both sites have fair to excellent productivity potential for most agricultural uses.



Mr. John L. Sakaguchi
November 14, 1989
Page -2-

Should you have any questions on the above, please contact
Mr. Earl Yamamoto of the Planning and Development Office at
548-7134.

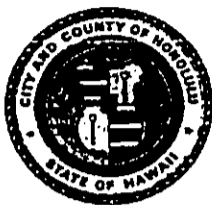
Sincerely,

Yukio Kitagawa
YUKIO KITAGAWA
Chairperson, Board of Agriculture

cc: L WANG; BWS

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

FRANK F. FASI
MAYOR



JOHN P. WHALEN
DIRECTOR

BENJAMIN B. LEE
DEPUTY DIRECTOR

LU10/89-6754(RF)

November 9, 1989

Mr. John L. Sakaguchi
Wilson Okamoto & Associates
1150 South King Street
Honolulu, Hawaii 96814

Dear Mr. Sakamoto:

Environmental Assessment for Exploratory Wells
Mokuleia, Kawaihoa, and Kalihi Valley

We have reviewed the subject Environmental Assessment and have no comment at this time.

Very truly yours,

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

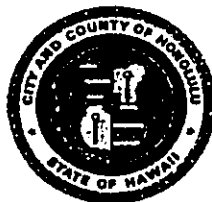
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CC: L WIKANG ; BWS

53

DEPARTMENT OF GENERAL PLANNING
CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813



FRANK F. FASI
MAYOR

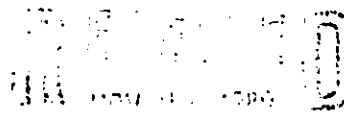
DONALD A. CLEGG
CHIEF PLANNING OFFICER

GENE CONNELL
DEPUTY CHIEF PLANNING OFFICER

CT/KK/DGP 10/89-3850

November 7, 1989

Wilson, Okamoto & Associates
1150 South King Street, Suite 800
Honolulu, Hawaii 96814



Attention: John L. Sakaguchi

Gentlemen:

Proposed Environmental Assessments for
Board of Water Supply Exploratory Wells at
Mokuleia, Kawaihoa, and Kalihi Valley

We have reviewed the material transmitted to us and offer the following comments.

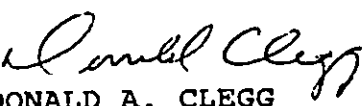
1. The regulatory controls on the land and current uses are indicated in the table on page 2. This table should also indicate the Development Plan Public Facilities (DPPF) Map designations for the projects. Two of the sites (Mokuleia and Kawaihoa) are shown on the North Shore DPPF Map as "Site Determined, Within 6 Years." The third site (Kalihi Valley) does not appear on the Primary Urban Center DPPF Map. The exploratory well project does not require a DPPF Map amendment, however, construction of a permanent well will require an amendment.
2. Soil Conservation Service soils information should be checked for possible limitations on construction of future pump houses at each site, should sustainable yields justify well development.

Wilson, Okamoto & Associates
Page 2
November 7, 1989

We have no specific information about the sites other than what you have listed on page 2 and what we have indicated about the public facilities map designations. We suggest that you contact BWS hydrology, geology or environmental staff for additional site information.

If you have any questions, contact Keith Kurahashi at 527-6051.

Sincerely,

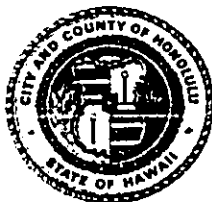

DONALD A. CLEGG
Chief Planning Officer

DAC:lh

cc: L WHANG, BWS

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813



FRANK F. FASI
MAYOR

SAM CALLEJO
DIRECTOR AND CHIEF ENGINEER
In reply refer to:
ENV 89-210(449)

November 8, 1989

Mr. John L. Sakaguchi, Planner
Wilson Okamoto and Associates
1150 South King Street
Honolulu, Hawaii 96814

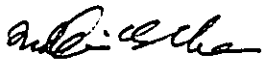
Dear Mr. Sakaguchi:

Subject: Environmental Assessment (EA) for Exploratory Wells
TMK: 1-4-18: 06; 6-1-06: 01; and 6-8-07: 02

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

1. There are no municipal sewers in the vicinity of the proposed exploratory wells.
2. We do not have any drainage comments at this time.

Very truly yours,


for SAM CALLEJO
Director and Chief Engineer

CC: L WHANG; BWS

APPENDIX B
BOTANICAL SURVEY

BOTANICAL SURVEY REPORT FOR THE KALIHI VALLEY WELL SITE

Evangeline J. Funk Ph.D.

INTRODUCTION

The Kalihi Valley well site is located immediately south of Kalihi Valley stream at about 600 feet elevation (Figure 1), in a wet, lush setting. A botanical survey was conducted on the .5 acre site on December 7, 1989. One-hundred percent of the site was examined.

RESULTS

The absence of most native vegetation on this site, its proximity to a perennial fresh water stream, and some physical evidence of clearing, indicate that the area has been farmed some time in the past. At present it is covered by a dense stand of introduced bamboo, 40 to 50 feet in height. Bamboo was planted in this area in 1956 (Skolmen 1980). The emergent trees are scattered true kamanis (*Calophyllum inophyllum* L.) which have attained a height of 60 feet or more. True kamani trees were valued and planted by prehistoric people for their medicinal properties and for their beautiful wood. The understory, aside from the bamboo, is almost entirely absent. The ground layer consists of bamboo leaves and rose apple seedlings (*Eugenia jambosa* L.). All other listed taxa were found along the unimproved road that separates the site from Kalihi Stream.

ENDANGERED SPECIES

No U. S. Government (USFWS 1989) or State of Hawaii (DLNR 1986) proposed or listed threatened or endangered species of plants were found on this site in December 1989.

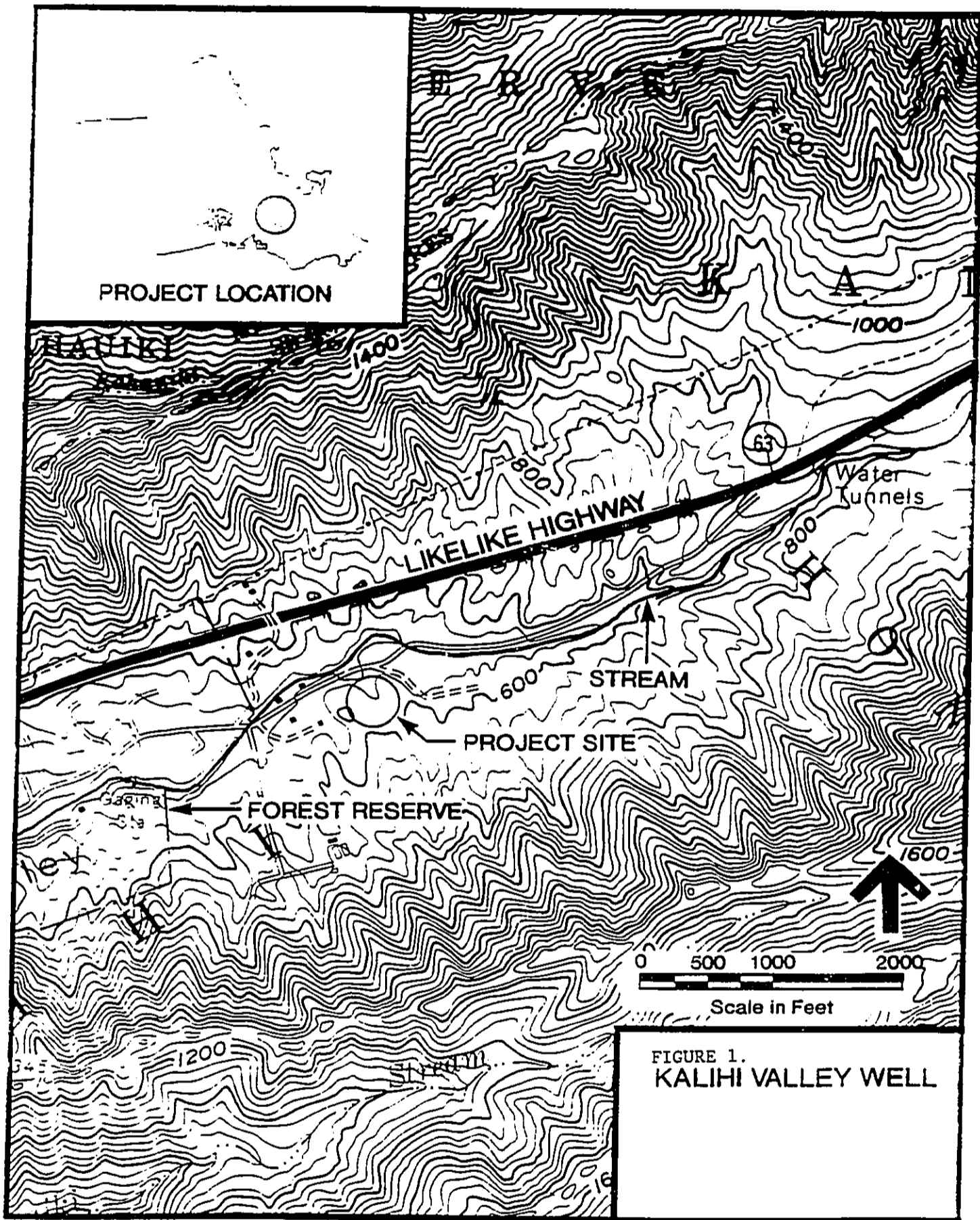


FIGURE 1.
KALIHI VALLEY WELL

CONCLUSIONS

The Kalihi Valley well site is densely covered with introduced bamboo. Two indigenous (found in Hawaii and in many other warm places) taxa, hau (*Hibiscus tiliaceus* L.), and the kamani trees, which occur on this site are found in many other low land sites on all the Hawaiian Islands.

LIMITATIONS OF THE SURVEY

This survey was carried out in December 1989. All parts of the site were visited. A species list prepared at a different time of year would probably differ slightly from the one presented here due to weather conditions and the growth habits of the plants.

LITERATURE CITED

- Degener, O. 1932 present. Flora Hawaiensis. Privately Published.
- DLNR 1986. Hawaii Administrative Rules Title 13, Subtitle 5, Part 2 Wildlife, Cpt. 124.
- Haselwood, E. L. & G. G. Motter (Eds.) 1976. Handbook of Hawaiian Weeds. Lyon Arboretum Association. Honolulu.
- Neal, M. C. 1965. In Gardens of Hawaii. Special Publication No. 50 Bishop Museum Press. Honolulu.
- St. John, H. 1973. List and Summary of the Flowering Plants of the Hawaiian Islands. Pacific Tropical Botanical Garden Memoir Number 1. Lawai, Kauai, Hawaii
- USFWS 1989. Endangered and Threatened Wildlife and Plants. 50 CFR. 17.11 & 17.12. U.S. Government Printing Office : 1989
0 - 225-765: QL 3.

SPECIES LIST

The plant families in the following species list have been alphabetically arranged within three groups, Ferns, Monocotyledons, and Dicotyledons. The genera and species are arranged alphabetically within families. The taxonomy and nomenclature follow that of Neal (1965), St. John (1973), and Haselwood and Motter (1976). For each taxon the following information is provided:

1. An asterisk before the plant name indicates a plant which has been introduced to Hawaii since the arrival of Capt. James Cook or by the Polynesians.
2. The name of the plant family to which the taxon belongs.
3. The scientific name of the taxon.
4. The Hawaiian name and or the most widely used common name.
5. Abundance ratings are for this site only and they have the following

meanings:

Uncommon - a plant that was found less than five times.

Occasional - a plant that was found between five to ten times.

Frequent - a plant that was found in widely scattered parts of the site in low numbers.

Common - a plant considered an important part of the vegetation.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

SPECIES LIST

The plant families in the following species list have been alphabetically arranged within three groups, Ferns, Monocotyledons, and Dicotyledons. The genera and species are arranged alphabetically within families. The taxonomy and nomenclature follow that of Neal (1965), St. John (1973), and Haselwood and Motter (1976). For each taxon the following information is provided:

1. An asterisk before the plant name indicates a plant which has been introduced to Hawaii since the arrival of Capt. James Cook or by the Polynesians.
2. The name of the plant family to which the taxon belongs.
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4. The Hawaiian name and or the most widely used common name.
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 - Occasional - a plant that was found between five to ten times.
 - Frequent - a plant that was found in widely scattered parts of the site in low numbers.
 - Common - a plant considered an important part of the vegetation.

CHECKLIST OF PLANTS FOUND ON THE KAHILI VALLEY WELL SITE

SCIENTIFIC NAME	COMMON NAME	ABUNDANCE
FERNS AND FERN ALLIES		
POLYPODIACEAE - Common Ferns		
* <i>Dryopteris dentata</i> (Forsk.) C. Chr.	Oak Fern	Occasional
* <i>Nephrolepis exaltata</i> (L.) Schott	Sword Fern	Occasional
* <i>Polypodium scolopendrium</i> Brum. f	Laua'e	Occasional
MONOCOTYLEDONAE		
ARACEAE - Arum Family		
* <i>Calocasia esculenta</i> (L.)	Taro	Common
* <i>Scindapsus aureus</i> Engl.	Taro Vine	Occasional
* <i>Syngonium auritum</i> (L.) Scott	Syngonium	Occasional
GRAMINEAE - Grass Family		
* <i>Bambusa</i> sp.	Bamboo	Common
* <i>Setaria palmifolia</i> (Koen.) Slapf.	Palm grass	Occasional
ZINGIBERACEAE - Ginger Family		
* <i>Alpinia purpurata</i> K. Schum	Red ginger	Occasional
DICOTYLEDONAE		
ARALIACEAE - Ginseng Family		
* <i>Brassia actinophylla</i> Endl.	Octopus tree	Occasional
COMPOSITAE - Sunflower Family		
* <i>Wedelia trilobata</i> Hitchc.	Wedelia	Occasional
CONVOLVULACEAE - Morning glory Family		
* <i>Ipomoea batatas</i> (L.) Lam.	Sweet potato	Occasional
EUPHORBIACEAE - Spurge Family		
* <i>Bischofia javanica</i> Bl.	Koka	Common
GUTTIFERAE - Mangosteen Family		
<i>Calophyllum inophyllum</i> L.	Kamani	Common
MALVACEAE - Mallow Family		
<i>Hibiscus tiliaceus</i> L.	Hau	Occasional
MELASTOMATACEAE - Melostoma Family		
* <i>Clidemia hirta</i> (L.) D. Don	Costers' curse	Occasional
MORACEAE - Fig Family		
* <i>Ficus macrophylla</i> Desc.	Moreton Bay fig	Occasional
* <i>Ficus microcarpa</i> L.	Chinese banyan	Occasional

SCIENTIFIC NAME	COMMON NAME	ABUNDANCE
MYRTACEAE - Myrtle Family		
* <i>Eugenia jambos</i> L.	Rose Apple	Common
* <i>Psidium cattleianum</i> Sabine	Strawberry guava	Occasional
ROSACEAE - Rose Family		
* <i>Rubus rosaefolius</i> Sm.	Thimble berry	Occasional
RUBIACEAE - Coffee Family		
* <i>Coffea arabica</i> L.	Coffee	Occasional
VERBENACEAE - Verbena Family		
* <i>Clerodendrum paniculatum</i> L.	Glorybower	Occasional
* <i>Stachytarpheta cayennensis</i> Vahl.	Cayenne vervain	Occasional

APPENDIX C
ARCHAEOLOGICAL SURVEY



JOSEPH KENNEDY
Archaeologist

ARCHAEOLOGICAL CONSULTANTS
of
HAWAII

59-624 Pupukea Rd.
Haleiwa, Hawaii 96712
(808) 638-7442

Mr. John Sakaguchi
Planner
Wilson Okamoto & Associates
PO Box 3530
Honolulu, Hawaii 96814

February 18, 1990

RE: Archaeological Walk-Through Examination of the Proposed Board of Water Supply Exploratory Well Site, TMK:1-4-18:06, Located in Kalihi Valley, Island of Oahu.

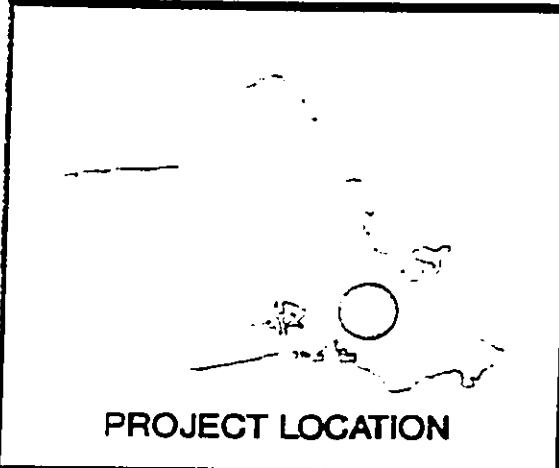
Dear Mr. Sakaguchi:

At the request of your office, Archaeological Consultants of Hawaii, Inc. has conducted a surface, walk-through examination of the property described above.

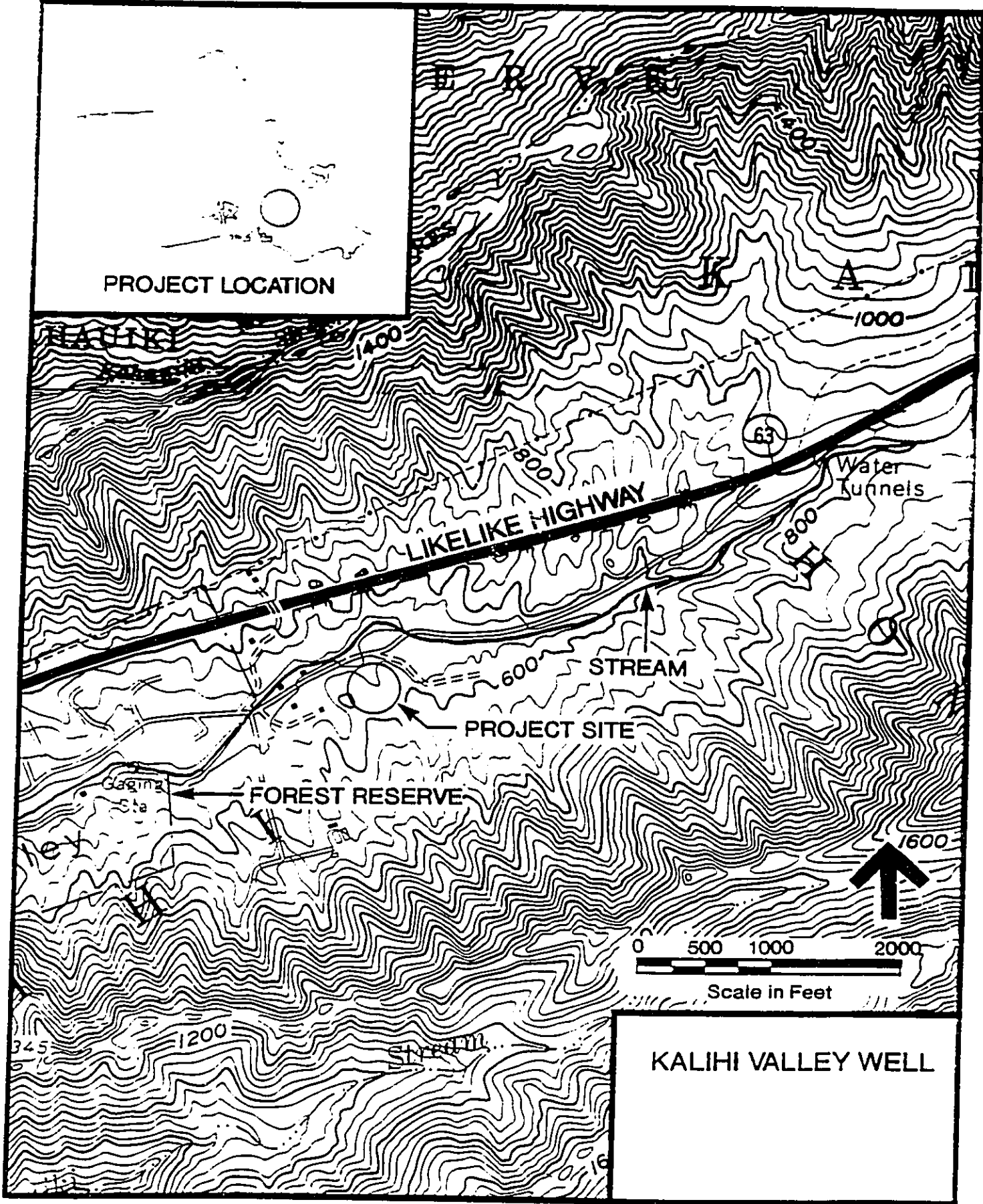
The proposed well site is located just mauka of the residential area on the Likelike Highway side of the valley. The subject property is small (10,000 square feet) and situated in the middle of a bamboo thicket. Visibility was good between the trees and it is unlikely that any features were overlooked.

A check of the records at the Department of Land and Natural Resources, Historic Sites Section, indicates that there has been no previous study of this small piece of property nor are there any previous sites recorded. Our examination failed to produce any surface indication of cultural materials.

The author is aware that a great number of sites are still located in the upper Kalihi area. These are however, located farther upstream and quite a distance from the study area. Most recently a contract archaeological firm (ERC) has been doing subsurface monitoring for Board of Water Supply stream crossings in the general area; according to a briefing presented to Wilson Okamoto & Associates dated January 27, 1990, ERC has to date, found nothing of significance.



PROJECT LOCATION



LIKELIKE HIGHWAY

STREAM

PROJECT SITE

FOREST RESERVE

Water
Tunnels

0 500 1000 2000

Scale in Feet

KALIH VALLEY WELL

J. Sakaguchi
2-18-90
Page 2.

Based on the information presented above, it is our opinion that no further archaeological work is necessary at this particular location.

If there are any further questions regarding this report, please feel free to contact me.

Aloha,


Joseph Kennedy
Consulting Archaeologist