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LAND USE & CODES ADM.
COUNTY OF MAUI

ENVIRONMENTAL ASSESSMENT
UNIT IV OF THE WAIEHU HEIGHTS DEVELOPMENT
WAIEHU, MAUI

Prepared by George A. L. Yuen, P.E.
Registered Civil, Structural, & Sanitary Engineer
(State of Hawaii)
Diplomate, American Academy of Environmental Engineers

May 1, 1983

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INTRODUCTION

Unit IV of the Waiehu Heights Subdivision is about 55 acres in area and is located roughly south of the Waiehu golf course. Much of its easterly boundary is the Waiehu Beach Road. West of it is the Kahekili Highway, while the Waiehu Stream forms a good part of its southerly boundary. The land elevation ranges from approximately 10 feet above sea level at the Waiehu Beach Road to an elevation of about 175 feet at its highest point.

The proposed development is located in the so-called Central Maui isthmus where much of the area is devoted to sugar cane cultivation. The development is located only a few miles from Wailuku-Kahului and its major air terminal and deep draft harbor.

The climate in the Waiehu area is generally sunny and pleasantly mild, being cooled by northeasterly tradewinds. Rainfall is low, with an average of about 35 inches per year. In contrast, the windward slopes of eastern and western Maui receive from 200 to 400 inches of rain per year. Temperatures range from the low 60's to highs exceeding 90°F.

WAIEHU HEIGHTS SUBDIVISION, UNIT IV
ENVIRONMENTAL ASSESSMENT

A. WETLANDS

Unit IV of the Subdivision contains one area which is defined as a wetland by the U. S. Corps of Engineers. The site, which is roughly 250' x 580' in area, is located along Waiehu Beach Road, just south of the Waiehu Golf Course (incl. 1 & 2 of attached report by U. S. Corps of Engineers). Actually, it is a small marsh lying in a slight depression nestling between a rolling sand hill to the west and the road embankment (Waiehu Beach Road) to the east. It is located roughly between the 10 - 15 feet contours. The detailed boundaries of the wetland will be determined later by the Engineering and Operations Division of the Corps of Engineers.

Vegetation in the marsh is predominantly umbrella sedge (*Cyperus alternifolius*) which is in the form of a dense growth 5 to 7 feet tall. Scattered among the umbrella sedge are growths of Great Bulrush (*Scirpus validres*). In the wetter areas of the marsh may be found *Ludwigia octivalvis*, the Kamole, and *Commelina difussa* or the honohono. The soil underlying the marsh is a dark organic muck mixed with sand in some areas. (Please note attached photographs on page 3a showing vegetation in marsh.)

Vegetation in the surrounding areas is typical of dry areas. It includes koa haole (*Leucaena lencocephala*), kiawe (*Prosopis pallida*), lantana (*Lantana camara*), and beach naupaka (*Scavevala taccada*). (Please note attached photographs on page 3b.)

The marsh is not fed by streams, and ponds are absent. Moisture in it may be due to a fluctuating water table or underground springs. According to residents, very little water is in the marsh most of the time. Furthermore, the vegetation appears to be brown in color and suffering from a lack of water.

A survey conducted in 1977 by Elliot and Hall for the Corps of Engineers listed the species of plants in the Waiehu wetland as follows:

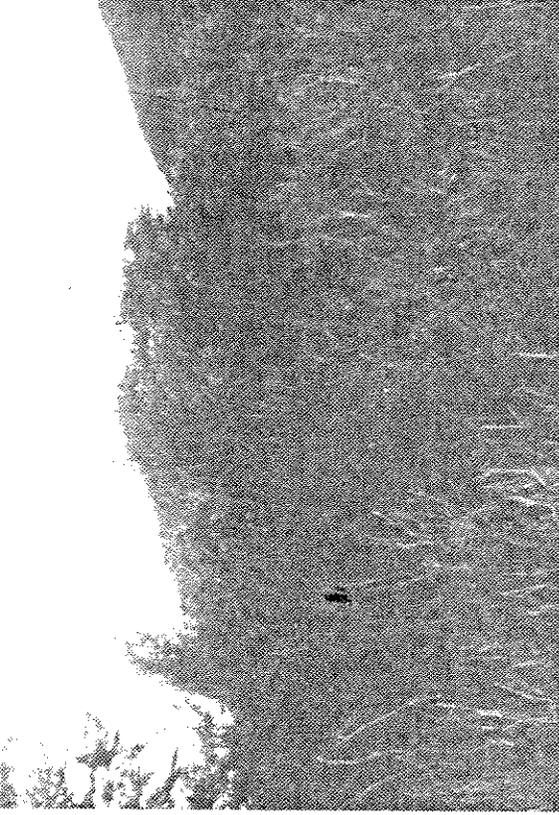
MONOCOTYLEDONAE		<u>Cover</u>	<u>Abundance</u>
COMMELINACEAE			
* <u>Commelina diffusa</u>	Honohono	2	F
CYPERACEAE			
* <u>Cyperus alternifolius</u>	Umbrella sedge	5	V
** <u>Scirpus validus</u>	Great bulrush	1	O
GRAMINEAE			
<u>Pennisetum clandestinum</u>	Kikuyu grass	1	O
DICOTYLEDONAE			
ACANTHACEAE			
<u>Thunbergia erecta</u>	Bush thunbergia	1	R
COMPOSITAE			
* <u>Pluchea indica</u>	Indian pluchea	1	R
CONVOLVULACEAE			
<u>Ipomoea brasiliensis</u>	Beach morning glory	1	R
ONAGRACEAE			
** <u>Ludwigia octivalvis</u>	Kamole	2	F
PASSIFLORACEAE			
<u>Passiflora foetida</u>	Scarlet-fruited passion flower	1	R

** Obligate species

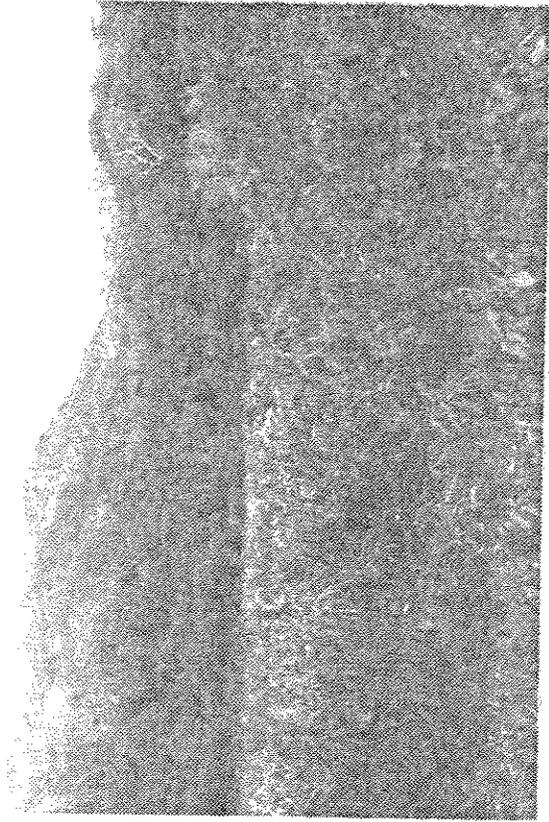
* Faculative species



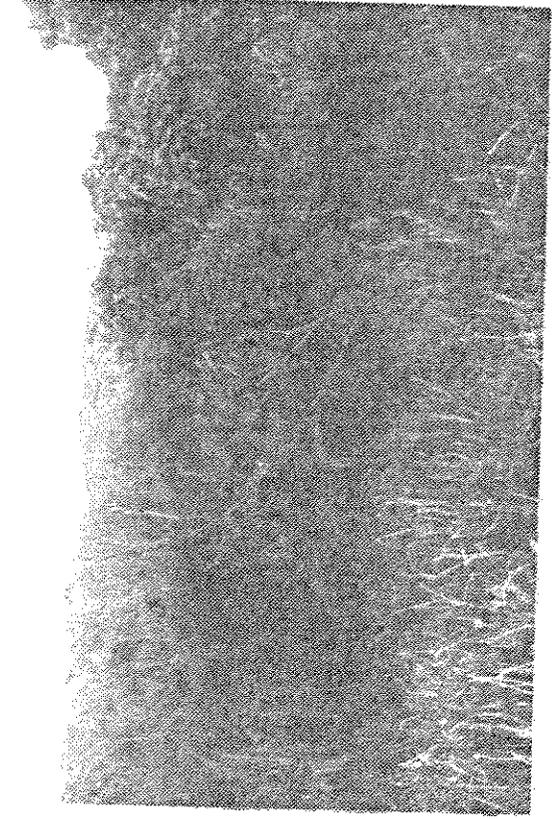
Note Umbrella Sedge (*Cyperus alteonifolius*) in foreground.



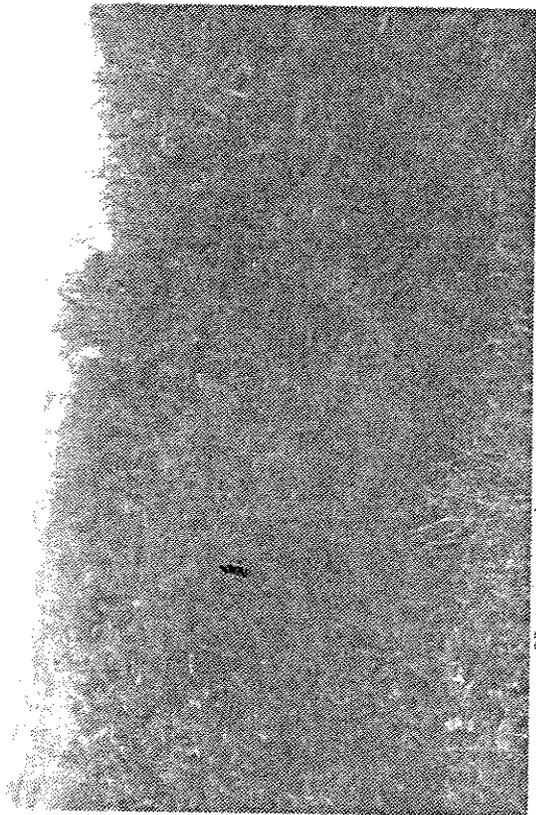
Note honohono (*Commelina diffusa*) in foreground.



Vegetation at edge of marsh.



Umbrella Sedge - center of photo.
Sand dunes in background.



Vegetation at edge of marsh.
(note haolekoa)

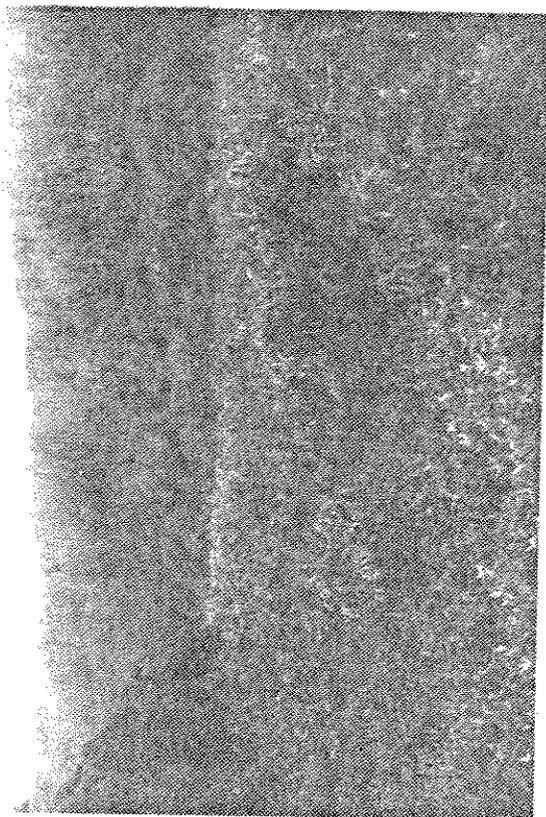
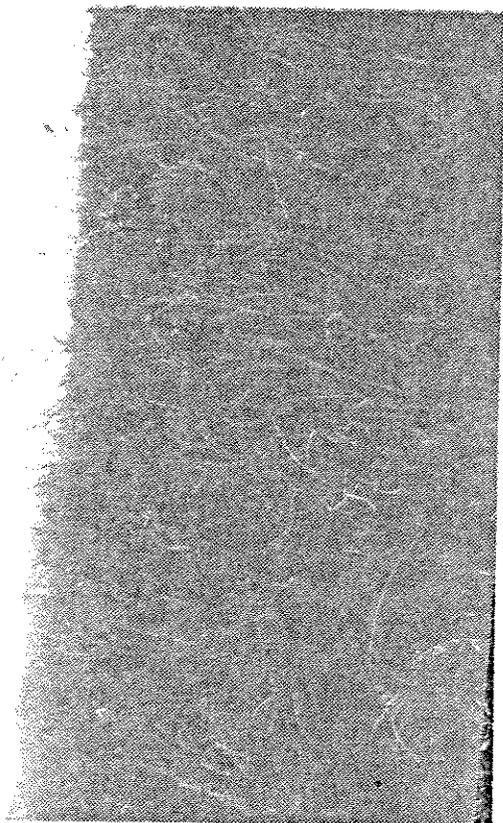


Photo showing kiawe in
upper background.



Vegetation beyond marsh.
(principally kiawe and haolekoa)



Vegetation some distance from marsh.
(note haolekoa)

1 = 5% cover; 2 = 5-25%; 3 = 26-50%; 4 = 51-75%; 5 = 76-100%

R = Rare; O = Occasional; F = Frequent; A = Abundant;

V = Very Abundant

According to the survey conducted by the Corps of Engineers, no rare or unusual wildlife was sighted in the marsh. It was also believed that the marsh contains no rare or endangered species of plant life.

It would be desirable to make certain improvements to the wetland area and to incorporate the wetland into a park development.

Improvements would include a general cleanup, partial fill of the wetland area, development of a small pond with running water and aquatic plants, and beautification and landscaping of the area.

According to the Corps of Engineers and the state biologist, no endangered species of plant life inhabit the marsh. Leaving the park in an uncontrolled state would give rise to odor and mosquito problems.

The proposed pond would be fed by water from a spring located in the northwest portion of the wetland area. If the spring flows are inadequate to maintain water levels in the pond, natural drainage or water from the municipal water system may be used as supplementary sources. No structures should be built in the fill area.

A-1 Air Quality

The ambient air quality in the Waiehu area is affected by agricultural activities, pollution from specific industrial

sources, pollution from natural sources and construction activities. Pollution from agricultural activities is primarily from field burning and dust generated by field preparation. The latter is difficult to control but particulate matter generated by field burning can be controlled by adherence to State Department of Health regulations and guidelines.

Industrial pollution is largely due to emissions from sugar mill boilers and the Maui Electric facility in Kahului. Control of this type of pollution is dependent upon the enforcement of state and federal air quality standards.

Natural air pollutants include dust, particulate matter from forest and brush fires and ocean salt spray. Dust resulting from construction activities presents a short term problem and is usually controlled by compliance with state and county regulations. Water sprinkling systems are useful in controlling dust caused by construction activities.

A-2 Ambient Noise Levels

Since the proposed development is located in a predominantly agricultural area, the noise levels in the vicinity are relatively low. Traffic noise should not be a problem while noise due to construction activities would be temporary in duration and not excessive. Noise due to the surf and wind may be somewhat higher but this type of noise is intermittent and short-lived.

A-3 Impact on Utilities and Urban Environment

The entire Waiehu Heights Development was conceived and designed with full recognition of possible impact on water resources, various public facilities and activities and related public services. Existing water sources are adequate to serve the development, during and after construction. No significant impact on wastewater disposal facilities, power system or telephone service is anticipated. Public facilities, such as schools, parks, harbors, airports and highways are not expected to be adversely affected. No significant negative impact is anticipated relative to police and fire protection. The contractor for the development will be responsible for storage and security of equipment and materials, as well as disposal of refuse and debris resulting from the project.

B. ARCHAEOLOGICAL CONSIDERATIONS

At the request of Kay Abdul Realtors of Maui, Ms. Toni Han of the Dept. of Anthropology of the Bishop Museum conducted an archaeological reconnaissance survey of the area designated as Phase IV of the Waiehu Heights Subdivision on December 19, 1978. The purpose of the survey was to determine the presence or absence of archaeological/historical sites prior to commencement of construction activities. Ms. Han's report, dated February 9, 1979, is attached for reference. On page 3 of the report, certain actions were recommended prior to commencement of work. They are as follows:

- (1) Detailed in situ mapping, removal, and relocation of the burial;
- (2) Detailed mapping and test excavations in the platform, to determine age and function, and to formulate recommendations for any further work that may be necessary.
- (3) Exact locations of the reported quarry should be established. If found, preservation and registration as a Historic Site will be recommended.

In addition, it was further recommended that

"Because of the possibility that subsurface remains, particularly burials, may be encountered during construction, it is also recommended that arrangements be made to have an archaeologist "on call" for any additional recording or recovery of cultural materials that may be necessary."

On September 28, 1982, a meeting was held with Ms. Han to discuss the findings in her report. At that time, her thoughts on her 1979 findings were as follows:

1. Relocation of burial: the remains have been determined by the Bishop Museum to be prehistoric. Public notice was duly posted and no public response was noted. The remains are now in the custody of the Bishop Museum pending a final decision as to their disposition.
2. Mapping and test excavation of the platform: according to the Bishop Museum, the platform has no historical significance and accordingly, mapping and test excavations no longer are necessary.
3. Quarry: the existence of a "limestone" quarry sometime in history still remains questionable. No human remains were found at the reported site. It was felt that it would be inadvisable to register the site as a Historic Site.

The Bishop Museum indicated that a final report would be submitted shortly which will include amplification of some of the thoughts mentioned above.

In December, 1982, the Bishop Museum submitted a final report on its investigations of the Unit IV portion of the Waiehu Heights Development. The report was prepared by Toni L. Han of the Museum's Department of Anthropology. A copy of the report is attached for reference.

Recommendations

On pages 44 and 45 of the final report, four recommendations were made based on archaeological research and investigations.

Recommendations regarding the burial grounds (site 50 - Ma - C10 - 15) and the walled terrace (site 50 - Ma - C10 - 16) require no further disposition. The skeletal remains uncovered in the burial grounds are now in the custody of the Bishop Museum and are to remain there permanently. Sufficient work has been done relative to the walled terrace and no further investigation is necessary.

The third recommendation is on the quarry (site 50 - Ma - C10 - 17) while the fourth relates to a reputed fish pond. These two recommendations were discussed with Dr. Paul Cleghorn of the Bishop Museum on February 2, 1982. According to Dr. Cleghorn, these recommendations were intended merely to give the museum an opportunity to collect samples, if uncovered during site work by the developer, for further evaluation. This should not hold up work on the development for any length of time. After further consultation with the Bishop Museum, it is further recommended that the quarry not be registered as a Historic Site.

With respect to the possible uncovering of subsurface remains during construction, it is strongly recommended that an archaeologist, possibly from the Bishop Museum, be retained by the developer on an "on call" basis so that appropriate evaluation and recordation may be made prior to final disposition.

C. FLORA-FAUNA

1. Flora: plant life in the wetland area has already been described. Vegetation in the other areas of Unit IV is typical of the vegetation in the general vicinity of Waiehu. It is predominantly koa haole and kiawe with lesser quantities of lantana and beach naupaka. Much of this type of vegetation was found in the other units of the development and adjacent subdivisions. The plant life found in the area is widespread on Maui and the various species are considered common varieties. No endangered species of plant life has been noted. The development of Unit IV is not expected to adversely affect plant life in the area.

2. Wildlife: (a) Birds. According to the state district biologist, birds normally found in the area are lace-necked doves (*Streptopelia chinensis*), barred doves (*Geopelia striata*), American cardinal (*Cardinalis cardinalis*), house finch (*Carpodacus mexicanus frontalis*), rice birds (*Lonchura punctulata*), Japanese white-eye (*Zosterops japonica japonica*), common mynah (*Acridotheres tristis*), sparrows (*Passer domesticus*), grey francolins (*Francolinus pondercerianus*), and possibly the black-crowned night heron (*Nycticorax nycticorax hoactli*). Two endangered species, the Hawaiian stilt

and the Hawaiian mudhen (coot) are not known to inhabit the area.

(b) Mammals. One species of mammal commonly seen in the area is the Indian mongoose (*Herpestes auro-punctatus*). Also reportedly seen are brown rats (*Rattus rattus*), Polynesian rats (*Rattus exulans*) and house mice (*Mus musculus*). Wild dogs and Axis deer have not been seen in the area.

(c) Amphibians and Reptiles. Reportedly seen are three species of reptiles and two species of amphibians. The reptiles are the mourning gecko (*Lepidodactylus lugulris*), fox gecko (*Hemidactylus garnotli*) and the snake-eyed skink (*Ablephorus boutoni poecilopleurus*). The amphibians noted are the giant toad (*Bufo marinus*) and the common frog.

No known endangered species of plant or wildlife inhabit the area. Since the species of plant and wildlife noted are common varieties on Maui, development of the area will not have any adverse affect on their existence.

(d) Coastal Ecosystems. According to the National Marine Fisheries, development of Unit IV will not significantly affect marine life along the shoreline and immediately offshore. Drainage from the development will be through an existing ditch located south of the marsh.

The only problem which must be dealt with is possible massive silting during construction. This can be adequately controlled by observance of grading ordinances during construction. There should be no problem after construction. If silting is heavy and prolonged, it is remotely possible that the green turtle may be affected. Humpback whales are found far offshore and should not be affected. Other forms of marine life should not be adversely affected.

(e) Coastal Hazards. Flood problems in the Unit IV area may be due to storm runoff affecting the carrying capacity of Waiehu Stream and high surf conditions or tsunamis near the coastal areas. Most of the property is situated within an area of minimal flooding, that is, an area which is not a regulatory flood plain or special flood hazard area.

Small portions of the property are located within the coastal flood plain or tsunami inundation area designations (incl. 3 of Corps of Engineers Report). The approximate 100-year tsunami elevation in the area is between 13 to 16 feet Mean Sea Level. In general, the inland tsunami limit at the project site is at the 15 feet contour. No construction should be done below this contour.

Some of the property is also located in the Waiehu Stream flood plain, or more specifically, the stream floodway which is the channel of Waiehu stream and adjacent land areas to be reserved for discharging the base flood (incl. 4 of Corps of Engineers

Report). As designated this floodway is subject to 100 years riverine flooding.

Summary and Recommendations

1. The small wetland area should be filled, relandscaped and converted into a park with a small pond for aquatic plants. The water source for the pond may be the existing spring located in the northwest portion of the area.
2. The human remains discovered by Bishop Museum staff should remain in the permanent custody of the museum.
3. No further mapping or test excavation of the platform should be made.
4. The "limestone" quarry should not be registered as a Historic Site.
5. An archaeologist should be retained on an "on call" basis during construction to record and evaluate any subsurface remains which may be found, particularly with respect to the quarry and the so-called fish pond.
6. No known endangered species of plant or wildlife inhabit the area.
7. With proper observance of grading ordinances, marine life should not be adversely affected.
8. No construction should be permitted below the 15 feet contour nor within the Waiehu stream floodway.

9. No significant impairment of air quality resulting from the development is anticipated. Dust generated by construction activities would be transient and could be mitigated by sprinkling by the contractor.
10. No significant noise problems are expected from the proposed development. Noise generated by construction activities would be temporary and not excessive.
11. No significant impact is anticipated with respect to water availability, waste water disposal, utilities, public facilities and services.

PERSONS CONSULTED

Toni Han	Bishop Museum
Dr. Paul Cleghorn	Bishop Museum
Gene Dashiell	Corps of Engineers, Ft. Shafter
Jim Managos	Corps of Engineers, Ft. Shafter
Don Jay	Corps of Engineers, Ft. Shafter
Katie Tamashiro	Corps of Engineers, Ft. Shafter
Marge Elliott	Corps of Engineers, Ft. Shafter
Dr. Robert Shallenberger	Federal Fish and Wildlife
Kisuk Cheung	Corps of Engineers, Ft. Shafter
Stan Arakaki	Corps of Engineers, Ft. Shafter
John Emerson	Corps of Engineers, Ft. Shafter
David Kern	Corps of Engineers, Ft. Shafter
Dr. Darryl Herbst	Federal Fish and Wildlife
John Naughton	National Marine Fisheries
Meyer Ueoka	State District Biologist
Doak Cox	UH Env. Res. Center
Manabu Tagomori	State Department of Land & Natural Resources
Mel Koizumi	Deputy Director of Environmental Health, State Dept. of Health

REFERENCES

1. Wetlands & Wetland Vegetation of Hawaii, Margaret Elliott and Erin Marie Hall (Sept. 1977).
2. Archaeological Investigations of a Porting of the Waiehu Dune Area, Waiehu, Hawaii (1982), Toni L. Han.
3. EIS - Central Main Water Transmission System, Board of Water Supply, County of Maui (July, 1976).
4. Report of U.S. Corps of Engineers, dated October 25, 1982.

Addendum A

Water Supply For Waiehu Heights Development

Waiehu, Maui

George A. L. Yuen
Registered Civil, Structural, & Sanitary Engineer
State of Hawaii
Member, American Academy of Environmental Engineers

WATER SUPPLY FOR WAIEHU HEIGHTS DEVELOPMENT

THROUGH the far sighted efforts of Waiehu Heights Associates, the Waiehu Heights Development is assured of a reliable source of high quality water. John F. Mink, a widely - recognized hydrologist-geologist, was retained to study the water resources in the area and to make a recommendation as to the site location, dependable yield and how the water is to be developed and managed.

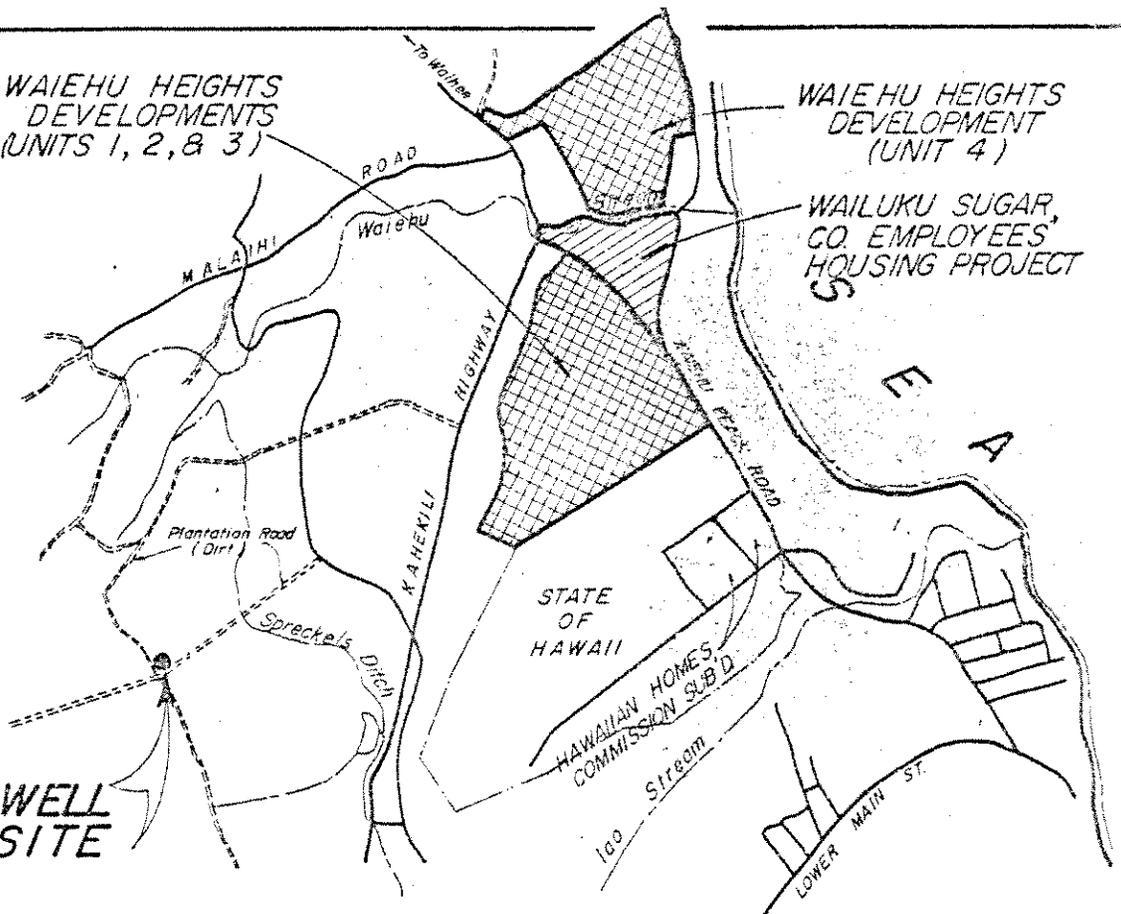
The sites for two wells were located on a ridge between two small valleys just west of the development. The two wells, each with a capacity of 1,250 gallons per minute, were drilled from about the 335-ft. elevation to about 200 ft. below sea level, with the well intake (bottom of casing) located at about 130 ft. below sea level. The wells extend into a deep aquifer where the basal head initially stood at about 20 ft. above sea level. Two pumps with capacities of 1,250 gpm each were designed to lift the water into a 300,000-gallon concrete reservoir located at the 360 ft. elevation. Water is piped from the well site to the development through a 16-inch main. The site of the project is shown in fig. 1A. A more detailed layout is shown in fig. 1B.

WAIIEHU HEIGHTS DEVELOPMENTS (UNITS 1, 2, & 3)

WAIIEHU HEIGHTS DEVELOPMENT (UNIT 4)

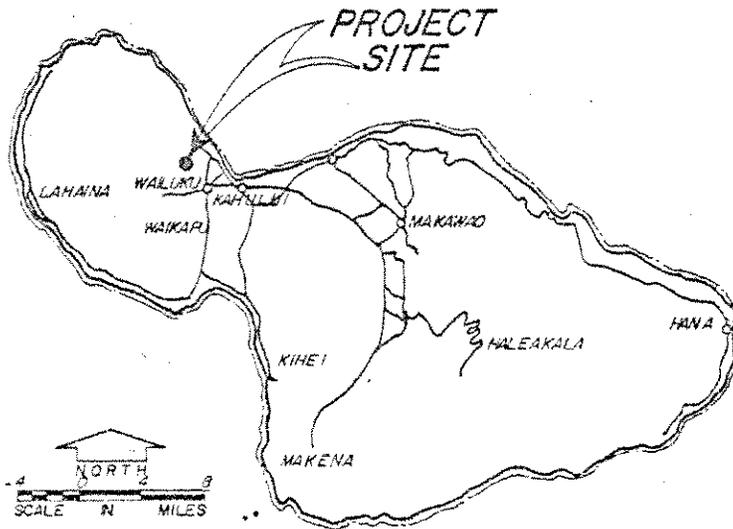
WAILUKU SUGAR, CO. EMPLOYEES' HOUSING PROJECT

WELL SITE



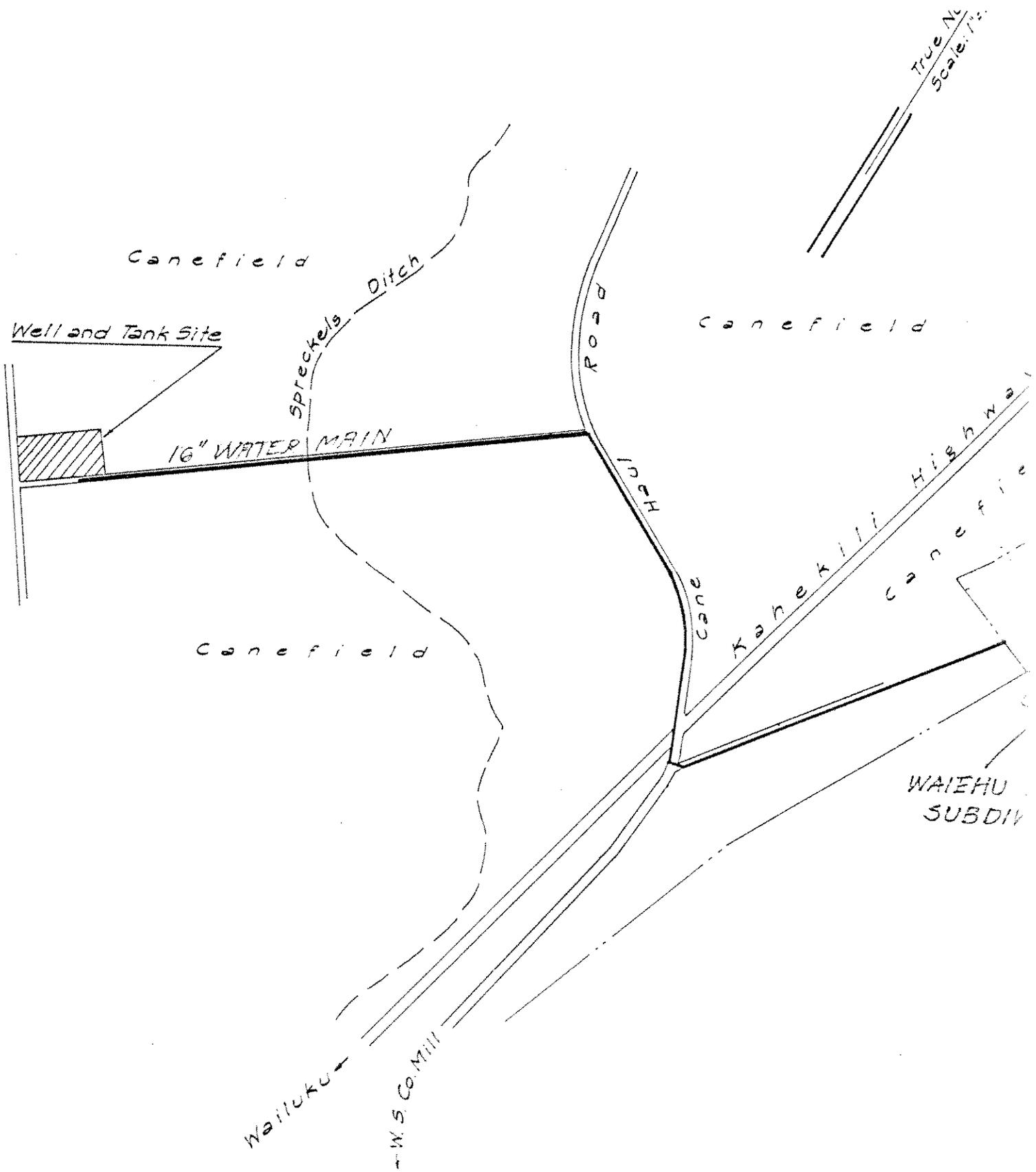
LOCATION MAP

TMK 3-3-02-1



ISLAND OF MAUI

FIG. 1A



LAYOUT OF PROJECT
FIG. 1B

The quality of the developed water is excellent. Initially, the chloride content of the water was slightly less than 30 ppm. After a period of sustained pumpage from both wells, chlorides rose to 40 ppm and slightly higher. However, present demands require pumpage from only one well and as a result, chlorides decreased to less than 40 ppm. This is considered very good quality water. Under present operational procedures, the second pump is being used as a standby unit.

The following is a summary of the size and cost of the well system which was completed in 1976:

	<u>COST</u>
1. Two 14" wells	\$243,000
2. Two 1,250 gpm pumps	118,640
3. Equipment and piping, including standby diesel generator	147,750
4. 300,000 gal. concrete reservoir	136,700
5. 16" offsite main	<u>215,373</u>
TOTAL	\$861,763

The entire system, the cost of which was borne by the developers, has been turned over to the Maui County Board of Water Supply for operation, maintenance and management. Water quality and head levels are being monitored jointly by

the State Department of Land and Natural Resources and the Board of Water Supply. Head levels have remained fairly steady at somewhat less than 20 ft. above sea level.

Under agreement between the developers of Waiehu Heights and Maui County, the allocation of water developed is such that the Waiehu Heights Development shall have first priority of all water developed, with any excess going to the County. However, the quantity of water pumped from one well is more than sufficient to serve the needs of the development to date. Excess water is now being pumped into the County distribution system.

Under present pumping conditions, excellent quality water in ample quantities is available to the development. The aquifer from which the water is drawn is broad and deep. With judicious management by the Maui County Board of Water Supply, there should be sufficient quantities of good quality water to meet all foreseeable needs of the development.



DEPARTMENT OF THE ARMY
PACIFIC OCEAN DIVISION, CORPS OF ENGINEERS
FT. SHAFTER, HAWAII 96858

PODED-PF

25 October 1982

Mr. George A. L. Yuen
Environmental Engineer
Warren S. Unemori Engineering, Inc.
1914 South King Street, Suite 205
Honolulu, HI 96826

Dear Mr. Yuen:

This is in reference to your meeting with our Flood Plain Management Section staff on 1 October 82, and your subsequent letter dated 4 October 1982 requesting flood hazard information and the determination of the flood plain in the vicinity of the Waiehu Heights Subdivision-Unit 4 in Waiehu, Wailuku, Island of Maui, Hawaii. In response to your request, we have prepared a Flood Hazard Evaluation of the particular project site (Incl 1) based on the Flood Insurance Study for the island of Maui, prepared by the Federal Insurance Administration (FIA) for Maui County. Our evaluation of the site is as follows:

a. The subdivision site is designated by specific Tax Map Key 3-2-13:30, identifying Lot 2 of lands described and registered under Land Commission Award 8559B:21, and situated within the Hawaiian land division "Ili" of Kapoio in Waiehu.

b. An approximate delineation of the property site is shown on the Flood Insurance Rate Map (FIRM) prepared as part of the FIA flood study and attached as part of the inclosure. The FIRM identifies the flood-prone areas in Waiehu by designated flood hazard zones.

c. Most of the property is situated within an area of minimal flooding of Zone C designation. Zone C areas are not regulatory flood plain or special flood hazard areas.

d. Small portions of the property are situated within the coastal flood plain or tsunami inundation area of Zone V23 and Zone A4 designations. The approximate 100-year tsunami elevation in the area is 13 to 16 feet Mean Sea Level. The 100-year event has a one percent chance of being equalled or exceeded in any given year. Generally, the inland tsunami limit at the project site is at the 15-foot contour interval shown on your topographic map of the Waiehu Heights Subdivision (Incl 2).

PODED-PF

25 October 1982

Mr. George A. L. Yuen

e. A portion of the property is also located in the Waiehu Stream flood plain, and more specifically, within the floodway or restricted area of development. The floodway is defined as the channel of a river or other watercourse and adjacent land areas that must be reserved to discharge the base flood. This portion of the property is designated Zone A8 and is subject to 100-year riverine flooding.

We recommend you coordinate your development with the County of Maui, Department of Public Works for compliance with the flood hazard ordinances recently adopted by the County. We hope the information and inclosures provided assist you in your particular requirements for your subdivision.

Sincerely,



KISUK CHEUNG
Chief, Engineering Division

2 Inclosures
As stated

Copy Furnished: w/incl
Mr. Aaron Shinmoto, Administrator
Division of Land Use and Codes
Administration
Department of Public Works
County of Maui
200 South High Street
Wailuku, Maui, Hawaii 96732



United States Army Corps of Engineers

... Serving the Army
... Serving the Nation

FLOOD HAZARD EVALUATION

DATE: 19 October 82

REQUESTOR

NAME Mr. George Yuen
ADDRESS 1914 So. King Street, #205
CITY, STATE Honolulu, HI 96826
PHONE _____

REFERENCE

- LETTER OF INQUIRY DATED 4 Oct 82
- TELEPHONE INQUIRY OF _____
- OFFICE VISIT ON 1 Oct 82

CATEGORY

- PRIVATE INDIVIDUAL
- BUILDER, DEVELOPER, REALTOR
- INDUSTRIAL OR COMMERCIAL CORPORATION
- ASSOCIATION, SOCIETY
- INSURANCE COMPANY (NON-FIA)
- LENDING INSTITUTION, BANK, APPRAISER
- A/E FIRM (Warren S. Unemori Engineering, Inc.)
- ATTORNEY
- COUNTY AGENCY
- STATE AGENCY
- FEDERAL AGENCY
- REGIONAL PLANNING COMMISSION
- OTHER AUTHORITIES _____

LOCATION

TAX MAP KEY 3-2-13:30
ISLAND Maui (Waiehu)
COUNTY Maui

4 INCLOSURES

- TAX MAP KEY (2)
- FLOOD BOUNDARY AND FLOODWAY MAP, OR
- FLOOD INSURANCE RATE MAP; PREPARED BY THE US FEDERAL EMERGENCY MANAGEMENT AGENCY, FEDERAL INSURANCE ADMINISTRATION (FIA), AS PART OF THE FLOOD INSURANCE STUDY FOR THE ISLAND OF Maui COMMUNITY-PANEL NO. 150003-0180B

- MINIMUM DESIGN CRITERIA AND CONSTRUCTION STANDARDS FOR BUILDING IN FLOOD ZONES, AS PUBLISHED IN FEDERAL REGISTER, VOLUME 41, NUMBER 207 DATED 26 OCTOBER 1976.

REMARKS: Project: Waiehu Heights Subdivision. Portions of the property are located in coastal or riverine flood plains.

FLOOD HAZARD DESIGNATION

- ^{MOST OF} THE PROPERTY IS NOT SUBJECT TO FLOODING FROM THE 100-YEAR FLOOD* AND IS DESIGNATED ZONE C OR AREA OF MINIMAL FLOODING.
- THE PROPERTY IS NOT SITUATED WITHIN ANY KNOWN FLOOD HAZARD AREAS AND IS DESIGNATED ZONE D OR AREA OF UNDETERMINED, BUT POSSIBLE, FLOOD HAZARDS.
- OTHER _____

TSUNAMI DATA

- A PORTION OF THE PROPERTY IS SUBJECT TO FLOODING FROM THE 100-YEAR TSUNAMI FLOOD* AND IS DESIGNATED ZONES V23 and A4, tsunami inundation area.
- THE APPROXIMATE 100-YEAR TSUNAMI ELEVATION NEAR THE SHORELINE IS 13-16 FEET, REFERRED TO MEAN SEA LEVEL.

RIVERINE DATA

- THE PROPERTY IS SUBJECT TO FLOODING FROM THE 100-YEAR RIVERINE FLOOD* AND IS DESIGNATED ZONE A8, Waiehu Stream flood plain and floodway.
- THE 100-YEAR WATER SURFACE ELEVATIONS ALONG _____ RANGES FROM _____ TO _____ FEET, REFERRED TO MEAN SEA LEVEL.
- THE AVERAGE DEPTH OF FLOW ALONG _____ FOR THE 100-YEAR FLOOD IS APPROXIMATELY _____ FEET.

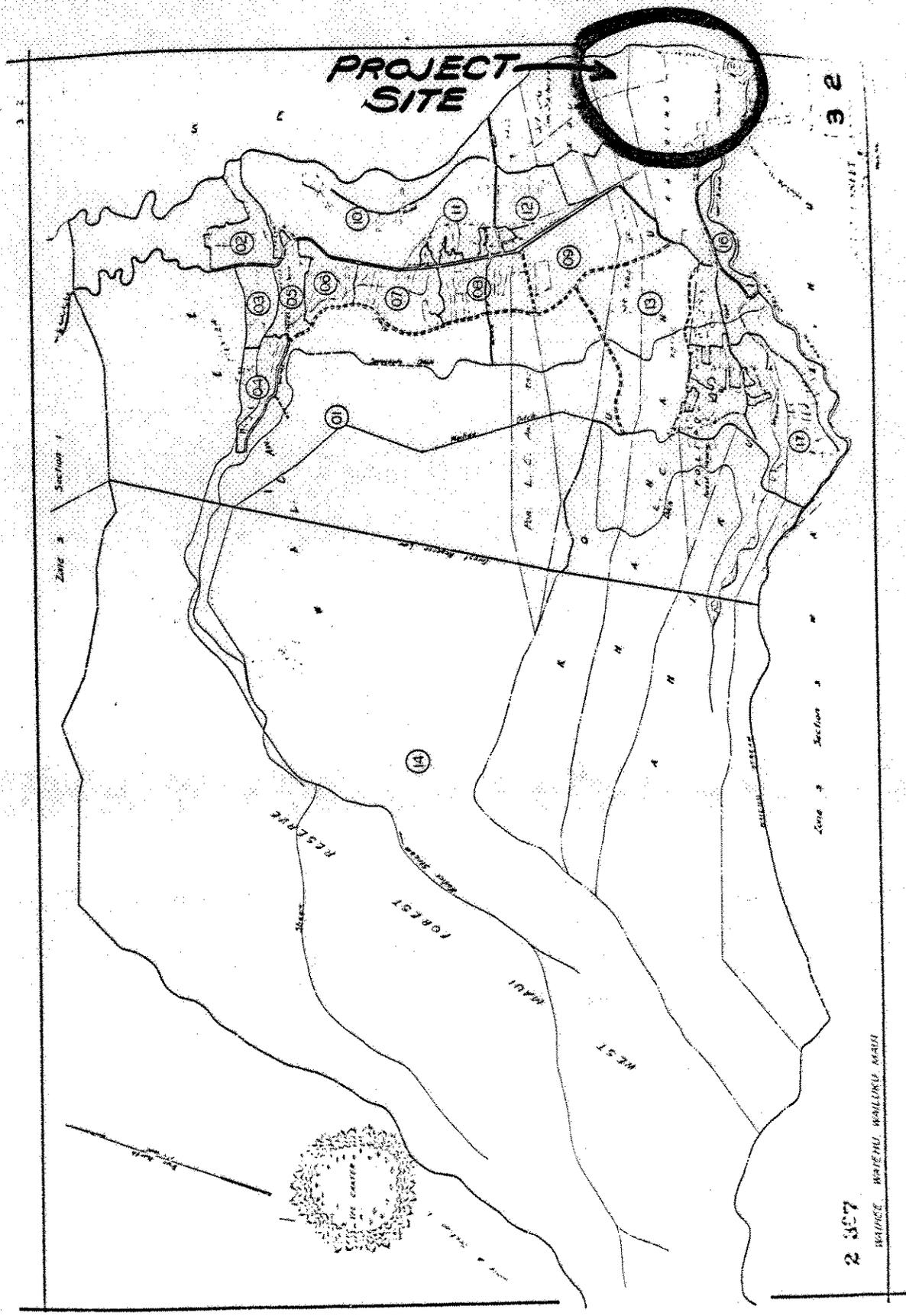
*THE 100-YEAR FLOOD REFERS TO A FLOOD HAVING A ONE PERCENT CHANCE OF BEING EQUALLED OR EXCEEDED IN ANY GIVEN YEAR.

SOURCE OF INFO

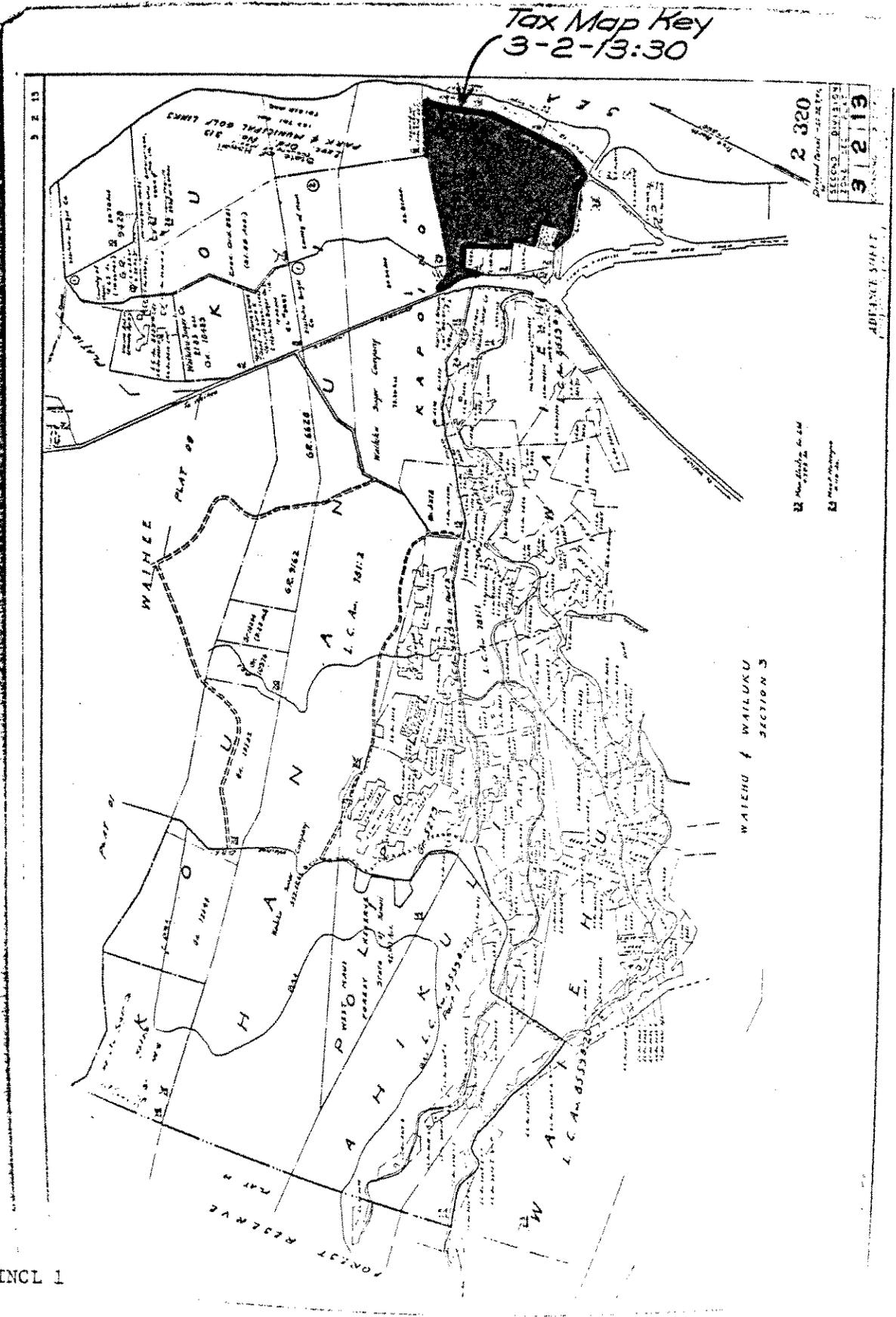
- FLOOD INSURANCE STUDY (June 81)
- REPORT _____
- OTHER _____

FOR FURTHER INQUIRIES OR ADDITIONAL DATA PERTINENT TO FLOOD BOUNDARY LIMITS, YOU MAY REFER TO THE FLOOD PLAIN MANAGEMENT SECTION AT (808) 438-2883, K. Tamashiro.

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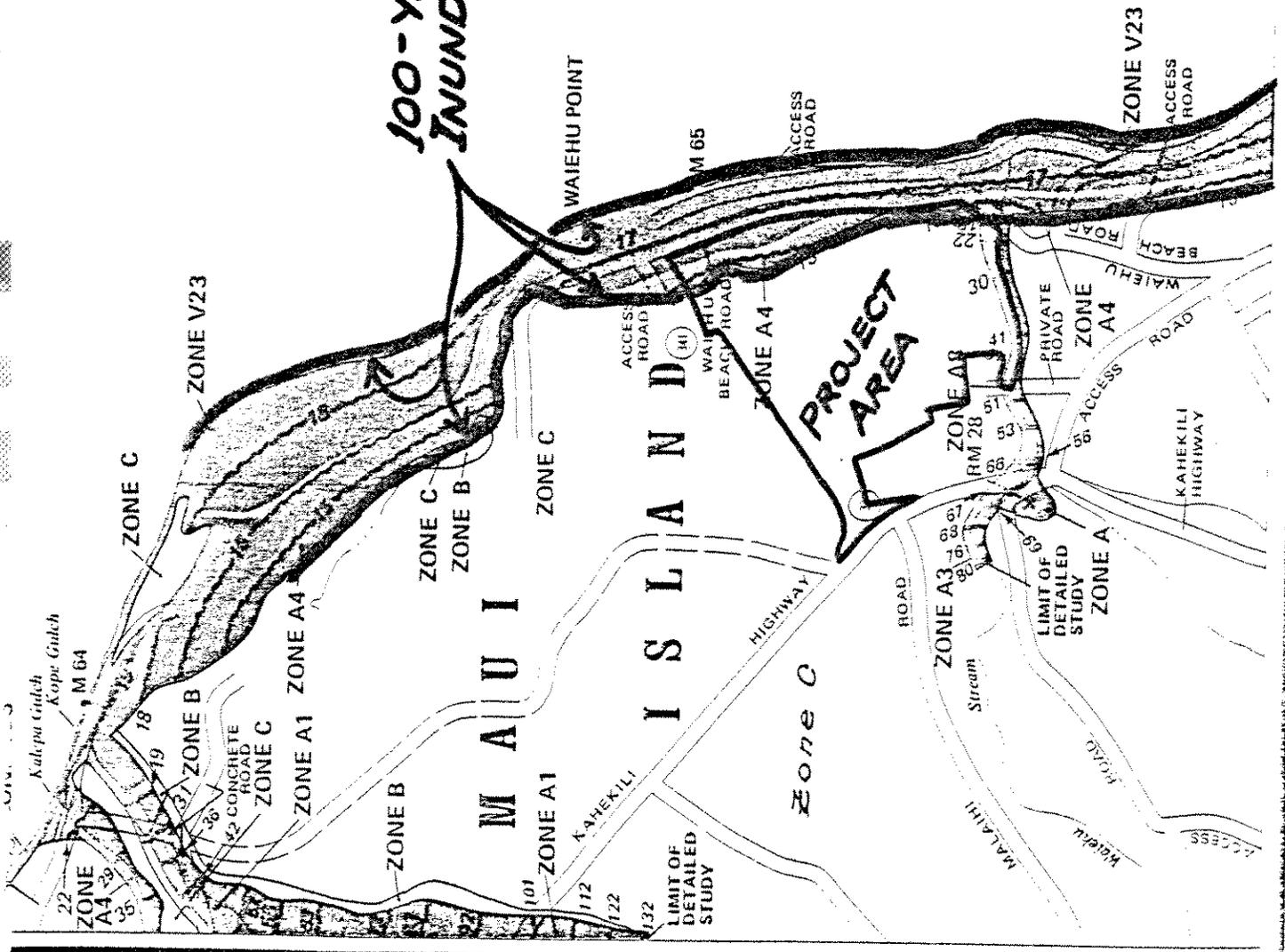


Tax Map Key
3-2-13:30



100-YR TSUNAMI INUNDATION AREA

PACIFIC OCEAN



REFERENCE:
 Flood Insurance Study for Maui County
 Flood Insurance Rate Map
 Scale: 1"=1000 ft.
 (1 June 81)

ELEVATION REFERENCE MARK

REFERENCE MARK	ELEVATION IN FT. (NGVD) ¹	DESCRIPTION
RM 28	72.1	Square cut on top of Kahekili Highway bridge

¹ National Geodetic Vertical Datum of 1929

EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
AD	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30*	Areas of 100-year flood, base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30*	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.
*	The numerals indicate the magnitude of difference between the 100-year and 10-year flood elevations. For numerals between 1-20, the difference is one half of the value; for values greater than 20, the difference is 10 less than the numerals shown. This information is used in establishing insurance rates.
-13-	100-year tsunami or riverine elevation line, with elevation in feet above mean sea level.
-----	Zone boundary line

Attachment B

Ms. 120382

ARCHAEOLOGICAL INVESTIGATIONS
OF A PORTION OF THE WAIEHU DUNE AREA,
WAIEHU, MAUI

by
Toni L. Han

Prepared for
Waiehu Heights Associates

December 1982

Department of Anthropology
BERNICE P. BISHOP MUSEUM
Honolulu, Hawai'i

ABSTRACT

Sites located in an arid sand dune area were investigated to gather data about occupation and exploitation in this type of environment. Investigation of a so-called limestone quarry did indeed reveal quarrying activities at the site. Excavation of a walled terrace revealed that it represented a house site occupied in the 20th century; no traces of an earlier occupation were discovered in the lower layers. Several incomplete burials were also discovered, lending credence to local informants' descriptions of the dune as a burial ground.

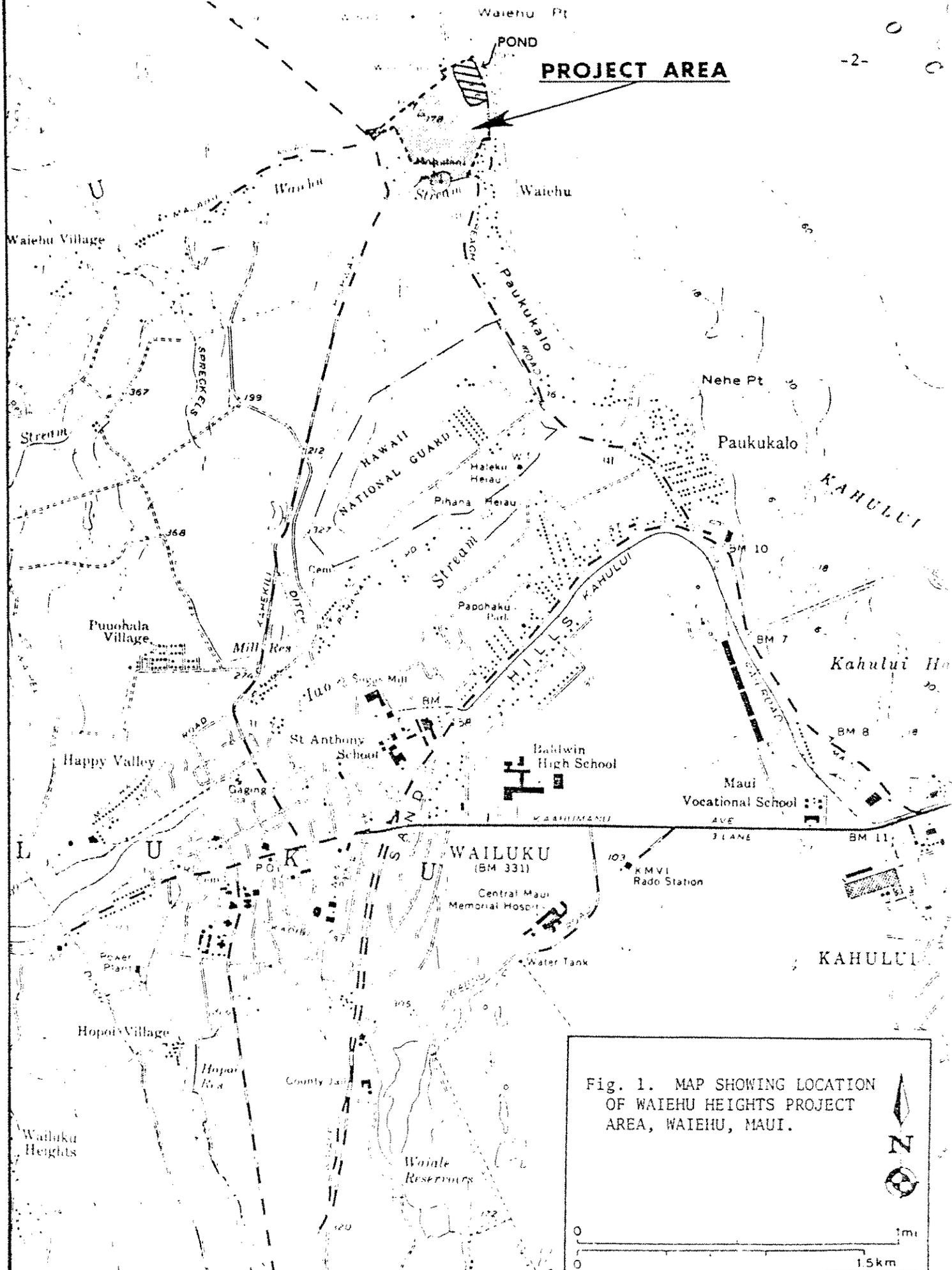
INTRODUCTION

From June 4 through June 12, 1981, B. P. Bishop Museum archaeologists Toni L. Han, Elaine Rogers-Jourdane, and Laura Carter conducted archaeological salvage excavations and transit mapping of six sites located in the Waiehu Heights Subdivision on Maui. These investigations were conducted under contract to the developers of the subdivision. The local folklore of the project area depicted it as being a place of ancient burials, and the locus of limestone quarrying activity. In order to substantiate these claims, a survey of the area was conducted in 1978 (Han 1979). Sites 50-Ma-C18-15, a burial, and C10-16, a walled terrace, were located and determined to have archaeological potential.* Location of the previously reported limestone quarry was not established with certainty at that time.

Four additional sites (Ma-C10-17, -18, -19, and -20) were located during the 1981 excavations. Sites C10-18 and -19 comprise scattered remains of human bone. Site C10-20 is a large area of scattered shell midden and a possible work area for materials from Site C10-17, determined to be the locus of the limestone quarry. Detailed descriptions for each of the sites follow.

In addition to the sites, a pond of approximately 11.5 acres is located on the northeastern boundary of the Unit IV project area. According to local informant Charles Keau, it is thought to have been an ancient fishpond. However, no information has been found to indicate that the pond was used as such. Concern about the pond's future has been expressed, and in view of this, I have presented information and recommendations for the pond following the site descriptions.

*In the Bishop Museum site numbering system, 50 = State of Hawai'i, Ma = Maui Island, C = Wailuku District, and 10 = Waiehu *ahupua'a*.



PROJECT AREA

Fig. 1. MAP SHOWING LOCATION OF WAIIEHU HEIGHTS PROJECT AREA, WAIIEHU, MAUI.



SITE LOCATION AND ENVIRONMENTAL SETTING

The project area is approximately 2 miles N of Wailuku, Maui Island. The Waiehu Heights Subdivision Unit IV (TMK 3-2-13) is located on the NE coast, bordered on the S by the Waiehu Stream and on the N by the Waiehu Golf Course, abandoned cane fields, and sand dunes. Kahekili Highway flanks the western borders, and the Lower Waiehu Beach road delineates the eastern boundary of the project area (Fig. 1). The ocean is approximately 50 meters from the eastern boundary.

Vegetative and topographic characteristics of the project area are described by Han (1979). The area is dominated by thick groves of *koa haole* (*Leucaena glauca* [L.] Benth), with beach *naupaka* (*Scaevola sericea* Vahl) along the coast.

The project area can be characterized as a dune. The soils are classified as Jaucas and Puuone. Jaucas soils have a pale-brown calcareous sand surface layer. "Their substratum is yellowish-brown sand, weathered from coral and seashells" (U.S.D.A. Soil Survey 1972:8). It was noted that the higher windswept bluffs have eroded since 1979.

Annual rainfall is 10 to 30 in.

FIELD AND LABORATORY TECHNIQUES

Exact site locations were established by transit mapping (Fig. 2). Sites were mapped using tape and compass, and a metric grid was laid over the area to be excavated. Midden material was collected by natural stratigraphic layer and screened through 1/4- or 1/8-in. wire mesh. All materials collected, such as shell and bone, were retained for analysis.

Artifacts are catalogued by an extension of the site numbering system, which also specifies grid provenience. For example, a bottle fragment from Site C10-16 is catalogued as 50-Ma-C10:TP-1-15, as the 15th artifact recorded from TP-1.

Field records and photos (roll nos. Ma(a)142 and 143) have been deposited in the archives of the Department of Anthropology, B.P. Bishop Museum (Project No. 277).

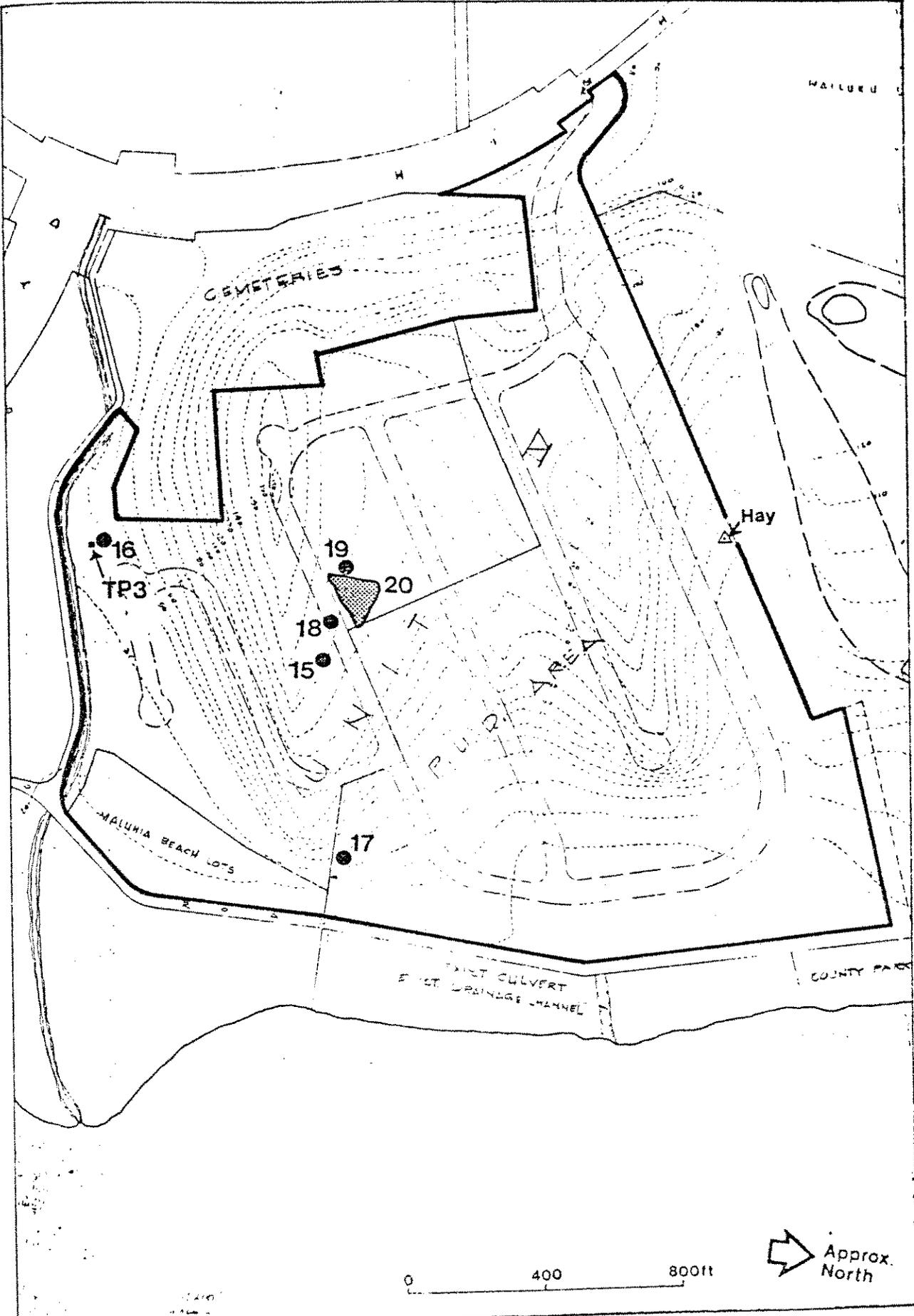


FIG. 2. MAP OF WAIIEHU HEIGHTS SUBDIVISION UNIT IV, SHOWING LOCATIONS OF SITES.

BRIEF HISTORY

Historical knowledge of the Waiehu area is sketchy. We know that the lands within the project area were once possessed by William Lunalilo (Indices...1929:20). In the recent past this land was acquired by Wailuku Sugar Plantation and subsequently purchased by Kay Abdul Associates.

Waiehu Stream, which borders the Unit IV project area, is one of four streams named in the legend of "Na Wai Eha" (Cheever 1851); the others are Waikapū, Waihe'e, and Wailuku. These streams were thought to have been named after the events of battles that transpired nearby. In this context, Waiehu means, "the water where the combatants smoked with dust and perspiration" (Cheever 1851). In 1894, Charles Stoddard (1894:161) collected a similar legend from Pa'ahao of Waihe'e. In it, Pa'ahao gives the meaning of *ehu* as "to scare away, hog and hens" or as "faint-hearted and sore-footed foes." Even at that time, Waiehu Stream was a meager rivulet; it remains so today, seeming to have wasted away under the influence of the withering epithet. Today the area has a dry, barren, windswept appearance.

Although the project area is relatively devoid of archaeological remains, the Waiehu district did contain several significant religious structures (Walker 1929, Stokes 1916). Unfortunately, most of these sites have been destroyed.

SITE 50-Ma-C10-15: BURIAL

This site, a burial, was found during the 1978 reconnaissance survey (Han 1979). It was situated atop a windswept knoll in a very shallow sand deposit, and was partially exposed due to wind erosion at the time of its discovery. During the 1979 reconnaissance survey, the burial was partially uncovered to establish if it was human and to gather as much information as possible because of its susceptibility to erosion and exposure.



Fig. 3. BURIAL, SITE C10-15, DURING EXCAVATION.

In 1981 the burial was disinterred. Very little excavation was required as the deposit was shallow (maximum 10 to 12 cm); no artificial pit was evident where the burial was placed. A stone marker had been placed on top of the remains during our two-year absence. Vehicular (motorcycles) activity not noticed during the survey phase was evidenced in 1981 as being dangerously close to the site.

The burial was incomplete and in a flexed position (Fig. 3); bones were articulated and intact, except that the skull and one of the innominate bones (pelvis) were missing. Analysis of diagnostic portions of the skeleton, such as the pelvis, revealed that this individual was probably a small male, 40+ years old. Cause of death is indeterminate, although there is a high degree of arthritic lipping on the vertebrae. The bones are in fair condition, slightly brittle but not crumbling. One fragment of an ulna (inner forearm) was collected from the surface. Exposed by erosion and bleached by the sun, it was first thought that this bone was part of the same burial; however, during the analysis it was determined that it was from another individual. Since this is an area of high erosion and subsequent deflation, it is not surprising that fragments have been displaced from the original place of burial. A survey of the immediate area was conducted and no other pieces or concentrations of bone were discovered.

This burial has been catalogued and added to the B. P. Bishop Museum Osteology collection. The ulna fragment has been stored with the C10-15 remains, but is bagged and distinguished as a separate individual.

SITE 50-Ma-C10-16: WALLED TERRACE

Site 50-Ma-C10-16, a stone-retained terrace found during the 1978 reconnaissance survey, is located along the Waiehu Stream (Fig. 4). It is situated on a small alluvial flat approximately 40 m NE of the intersection of Alakai and Pualoa streets. The alluvial flat is bordered by the stream on the southern perimeter and by a 45° sand-dune slope on the northern boundary.

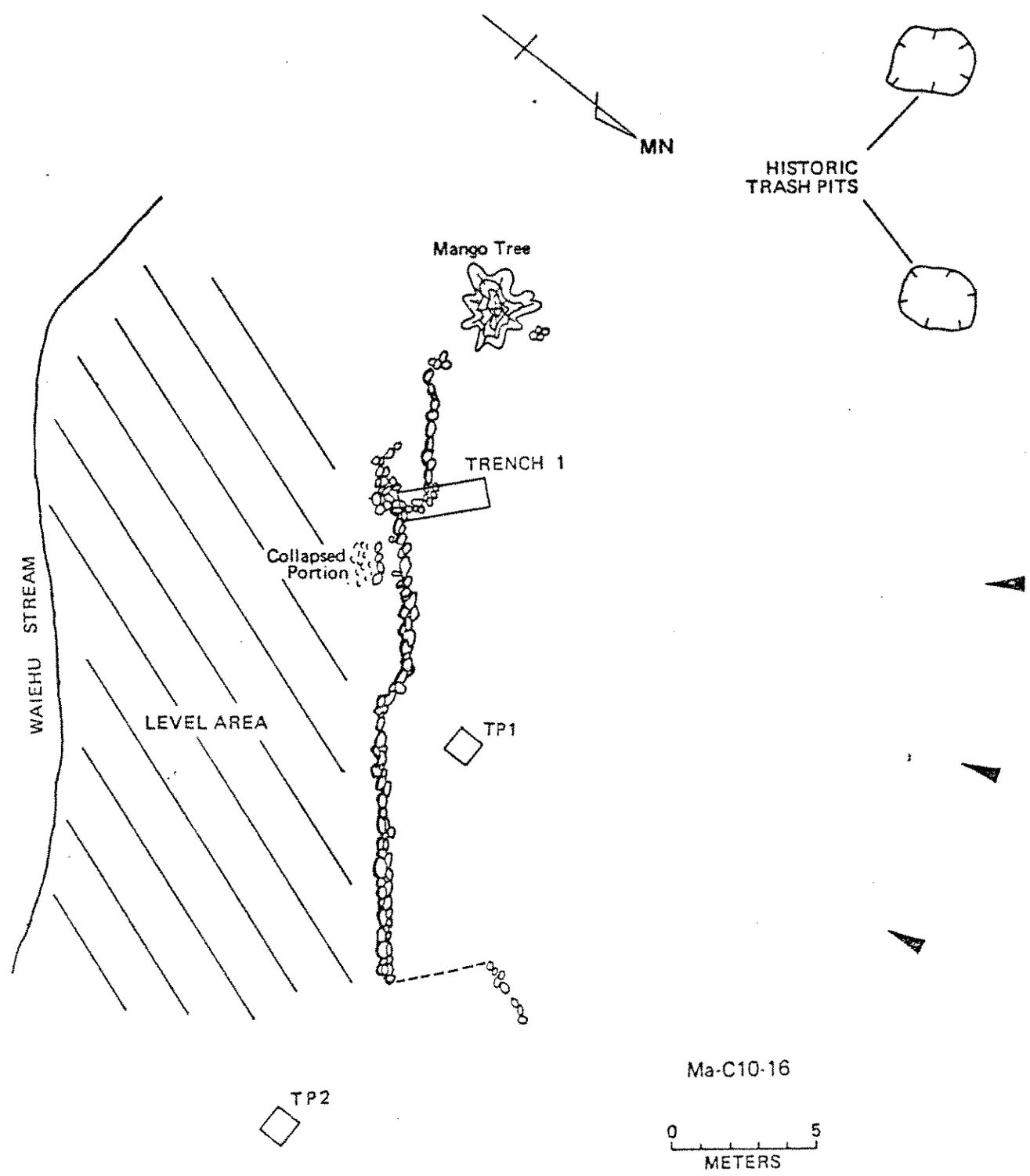


Fig. 4. MAP OF SITE C10-16 WITH TEST PITS 1 AND 2 AND TRENCH 1.

The vegetation along the stream is characterized by *hau* (*Hibiscus tiliaceus* L.), *koa haole* (*Leucaena glauca* [L.] Benth), low grasses, and shrubs. Several tall coconut trees (*Cocos nucifera* L.), are located on the western edge of the site. These appear to be 70 ft or so high and can be seen from the ridge above Site C10-17.

The terrace is retained on one side, running E-W and parallel to the stream. This wall is 21.4 m long, 40 cm wide, and 22 cm high on the W to 65 cm high on the E. It is primarily composed of limestone slabs, three to four courses high. The wall slabs range in length from 20 to 40 cm, subangular to angular in shape and averaging 10 cm thick. The lower course of the wall is constructed of waterworn river boulders, ranging in size from 25 to 50 cm long (Fig. 5). Evidence of terracing on the eastern boundary was apparent but difficult to follow, as only some of the slabs remained intact.

Because of the presence of scattered historical artifacts, such as glass, metal, and plastic fragments, strewn on the surface of the terrace, this was suspected to be a modern habitation site.

Two historic trash pits were located c. 16 m W of the western end of the terrace wall. These contained many bottles and associated caps. These were not investigated; only surface observations were noted.

EXCAVATION

Excavation of Site C10-16 consisted of two 1-m² test pits and a trench (Tr-1), 1 by 3 m. Test Pit 1 (TP-1) was excavated roughly in the middle of the main terrace, thought to be a central activity area. TP-2 was dug on the alluvial flat approximately 5.5 m from the main terrace wall or halfway between the site and the present river bank. This area was chosen as a stratigraphic control over the terrace area to determine whether the terrace was altered (filled) in any form and also to determine whether this lower area had been utilized as well. The trench was excavated perpendicular to the wall, where another smaller wall alignment parallels



Fig. 5. SITE 50-Ma-C10-16. Wall construction at most intact portion after clearing.

the main wall. This excavation was designed to investigate wall construction as well as the relationship between the larger and smaller wall. Historic debris, such as glass, plastic, and metal, was scattered on the surface throughout the site and could be seen eroding from between the wall rocks; Tr-1 cut through both of the walls (Fig. 4). All excavations were dug to a minimum depth of 1 m, where river boulders were found; this layer was considered sterile. All midden was collected for quantitative analysis.

STRATIGRAPHY

The general stratigraphic profile for Site C10-16 consists mainly of sand with differing proportions of silt content. Usually loose and easily dug, the sand was generally fine to very fine with some consolidation occurring in some layers, creating medium to coarse peds. Historic-period artifacts were seen over the entire surface of the site. It was noted that flooding had taken place since the 1979 survey.

TP-1 revealed five layers of sand-silt matrix (Fig. 6). Artifacts were found in Layers I, IIa, and IIb. Layer II was separated into IIa and IIb because there was a marked increase in charcoal content in the lower portion (IIb). Artifact differentiation did not occur within these two sublayers. No artifacts were recovered from Layers III and IV.

TP-2, located on the alluvial flat, showed a marked increase in soil-sand matrix (Fig. 7) over that in TP-1. This is not surprising, as the flat is 0.75 m below the present surface of the main terrace and is subject to flooding from the Waiehu Stream, as well as from high-wave action (Dept. Land and Natural Resources, Land Devel. Div., Water Resources Information Center). TP-2 revealed two subsurface layers. Layer II was distinguished from Layer I by the presence of large river boulders. No artifacts were present in Layer I; Layer II contained 60% of the artifacts, and 40% were recovered from the overburden layer.

Ma-C10-16 TEST PIT 1
WEST FACE

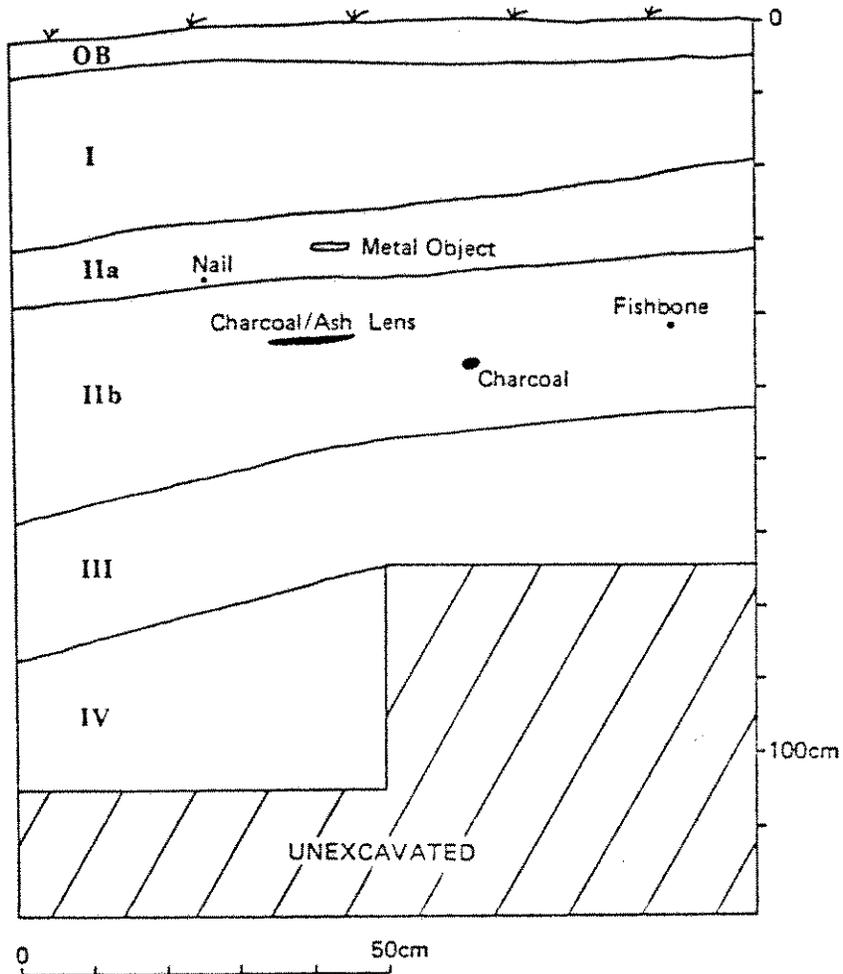


Fig. 6. PROFILE OF WEST FACE OF TP-1, SITE C10-16.

Overburden	Very dark gray-brown (10YR5/2), sandy, some silt, granular, fine to very fine.
Layer I	Brown (10YR5/3), sandy-silt, granular.
Layer IIA	Grayish-brown (10YR5/2), sandy-silt.
Layer IIB	Brown (10YR5/3), sandy-silt, granular; increased charcoal content throughout this layer.
Layer III	Light yellowish-brown (10YR6/4), sandy, granular.
Layer IV	Brown (10YR5/3), sandy silt, granular.

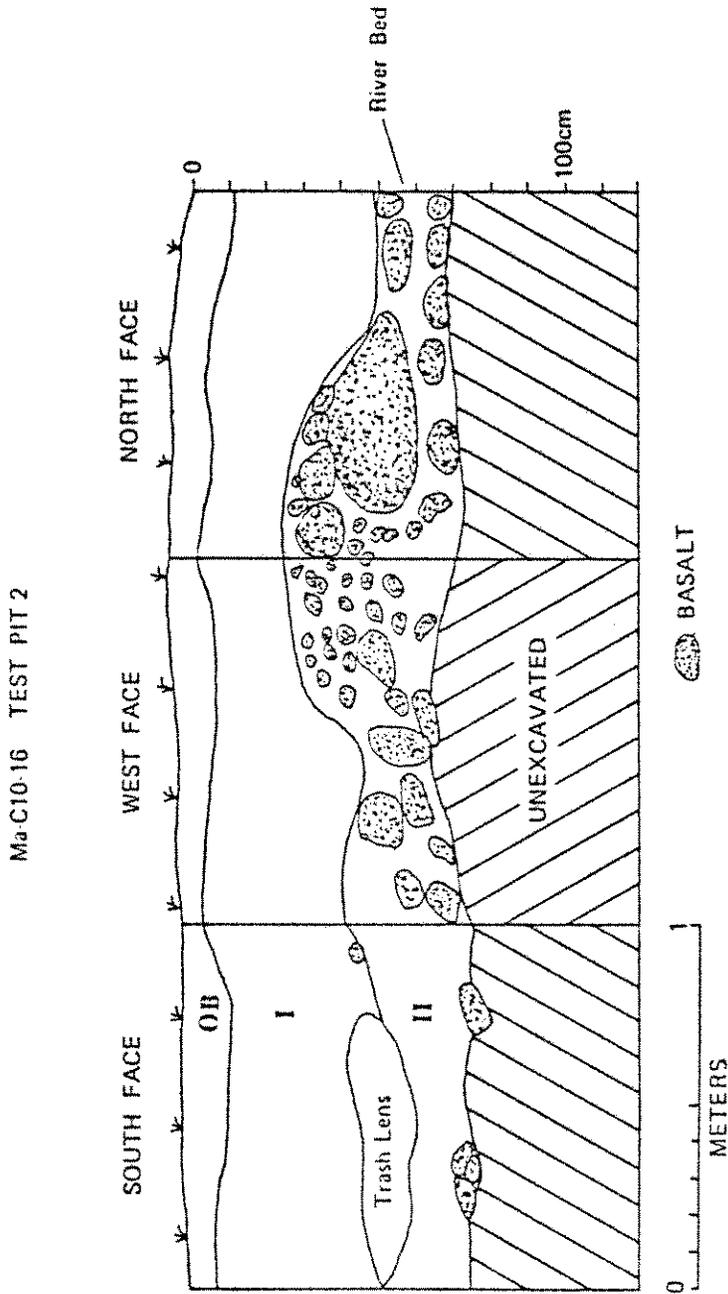


Fig. 7. PROFILE OF SOUTH, WEST, AND NORTH FACES OF TP-2, SITE C10-16.

- Overburden Very dark grayish-brown (10YR3/2), silt-loam, crumb, fine to coarse.
- Layer I Very dark grayish-brown (10YR3/2), silt-loam, crumb, fine to coarse, lesser than overburden.
- Layer II Very dark grayish-brown (10YR3/2), silt, sterile with river boulders at bottom of this layer, crumb-fine to coarse.

ARTIFACT DESCRIPTIONS

Site 50-Ma-C10-16 yielded nearly 800 artifacts. All were historic-period items such as glass products (16%), metal nails and fragments (68%), and other miscellaneous post-contact (after 1778) articles (Table 1). Artifacts occurred in all layers and, in some cases, density was greater in the lower layers.

Artifacts representing a variety of household activities are reflected in the assemblage. The presence of kitchen-associated material such as bottles, can openers, spoons, and ceramics substantiates such activities at Site C10-16. Other components, such as toys, ornamental beads, buttons, and money, lend evidence to this site being occupied well into the historic period. Remnants of nails, hinges, windowpane glass, screening, and wooden planks (not collected) indicate the presence of a structure at the site.

Bottle Glass

No whole bottles were excavated from Site C10-16. Over 60 fragmentary pieces were retrieved; 35 pieces from TP-1, 4 from TP-2, and 22 from Tr-1. However, only 21% of the collection exhibits diagnostic qualities, such as embossing, lip fragments, recognizable body shapes, and labels. While fragments were predominately amber and clear, bottle fragments of blue, green, and white were also represented (Table 2).

Much has been written about the development of bottle manufacturing, covering aspects such as color, changes in mouth or closure types, evolution of bases, and embossing. These characteristics can be isolated and used to determine relative dates for sites, since manufacturing changes have been documented (Cordy 1978:Appendix C). From such information, we can extrapolate broad occupational sequences. For example, amber and clear glass were developed around 1880 (Ward, Abbink, and Stein 1977:240). Closure fragments of crown tops (TP-1-15 and -20) were developed in 1892 (Elliot 1971:20) and are still being used today. One bottle (Tr-1-20 and -36) recognized as a Vicks Vapor Rub bottle, exhibits a continuous thread on the mouth. The continuous thread was developed in 1919 and is still being used at the present

Table 1.

DISTRIBUTION OF ARTIFACTS FROM SITE C10-16, WAIEAHU HEIGHTS, MAUI

Description	TP-1	TP-2	Tr-1	Totals
<u>Household</u>				
Bottle glass	55	4	22	61
Can opener	4		4	8
Ceramics	5	4	3	12
Clothespin coil		1		1
Crown caps	13	1	8	22
Lamp mount			1	1
Misc. caps	2		2	4
Spoon			1	1
<u>Structural</u>				
Caulk			1	1
Handles		1	1	2
Hasps	2		2	4
Hinges		1	1	2
Insulator			1	1
Misc. metal fragments	277	30	55	362
Nails, round	54	8	30	92
square	5	1	8	14
non-diagnostic	60	4	3	67
Roofing material	4			4
Screening	1			1
Washers (lead)		1	5	6
Window glass	6		42	48
<u>Personal</u>				
Buckles		3		3
Buttons	10		13	23
Clasp			1	1
Comb tooth			1	1
Eraser	1			1
Glass beads	1		7	8
Pennies			5	5
Safety pin	1			1
Shoe sole fragment		1		1
<u>Recreational</u>				
Marble	1			1
Rubber stamp			1	1
Whistle			1	1
<u>Miscellaneous</u>				
Bone	3		2	5
Bullet casing	1		1	2
Metal fishhooks	1		1	2
Metal fragments	4	10		14
Plastic		4	1	5
TOTAL				739

Table 2.
BOTTLES RECOVERED FROM SITE C10-16, WAIIEHU HEIGHTS, MAUI

Catalogue No.	Color	Part	Comments/ Markings	Associated Dates
TP-1 - 1	Amber	Non-diagnostic		1880-pres.
- 3	Clear	Body frag.		1880-pres.
-15	Clear	Neck, lip frag.	Crown top	1892-pres.
-16	Clear	Lip frag.		1880-pres.
-17	Blue tint	Body frag.		1880-1910
-18	Amber	Body frag.		1880-pres.
-19	Amber/Green	Body frag.		1880-pres.
-20	Green	Mouth frag.	Crown top	1892-pres.
-21	Clear	Base/Body	4/5 ou...,3-p.	1880-pres.
-51	Clear	Body frags.		---
-52	White	Non-diagnostic		---
-53	Dk. Amber	Body		1880-pres.
-54	Green tint	Non-diagnostic		---
-75	Amber	Body		1880-pres.
TP-2 - 9	Blue tint	Body		1880-1910
-15	Blue	Non-diagnostic		1880-1910
-16	Clear	Non-diagnostic		1880-pres.
-18	Green	Body	opium	?
TRENCH 1- 2	Clear	Base	W or M, PCGW	1902-24
-10	Amber	Body		1880-pres.
-14	Amber	Body		1880-pres.
-20	Blue	Lip, body	VICKS Continuous thread	1919-pres.
-28	Green	Body	opium	---
-36	Blue	Base	VICKS Goes with No. 20	1919-pres.
-46	Amber	Body frag.		1880-pres.
-47	Dk. Amber	Lip and body	Drug type	?
-58	Clear	Body	A	1880-pres.
-72	Amber	Body	NO DE... (deposit)	---

Table 2. (continued)

Catalogue No.	Color	Part	Comments	Associated Dates
-73	Clear	Base/lip		---
-89	Amber	Body		---
-104	Clear	Non-diagnostic		---
-74	Clear	Body		---

time (Cordy 1978:Appendix C). Two nearly complete opium bottles were also recovered (TP-2-18 and Tr-1-28) (Fig. 7).

Openers

Eight metal can openers were collected in the excavations. Three of the openers are the "key" type and appear to be from one particular canned product (TP-1-44, Tr-1-18, and -56). Maximal dimensions are 67 mm long and 33 mm wide. Four openers (TP-1-34, -61 a and b, and Tr-1-38) were similar to the key type but used differently and probably for another product. This type is presently being used to open "Spam" cans. These vary in length from 51 mm to 93 mm and average 30 mm in width. The last type of opener has been referred to as a "church key" (Tr-1-17), used to open bottles with crown tops (Fig. 8).

Ceramics

A total of 12 fragmentary ceramic sherds were excavated from Site C10-16. All sherds are glazed and most are cream to white in color. TP-1 contained four (TP-1-24, -25, -41 a and b) probable body fragments and one very small rim piece (TP-1-70). Two rim sherds (TP-2-2b and c) and one base sherd (TP-2-2a) from the same plate were excavated from TP-2, as well as a patterned sherd. This piece has linear, geometric lines of dark-blue or black on a pale-blue background (TP-2-10). From Tr-1 three sherds were retrieved; a child's toy teacup (Tr-1-1) with a floral design on the exterior side, and two body sherds (Tr-1-29 and -64). These sherds were cream-colored, and one piece (Tr-1-29) has a small rim portion with silver banding on the edge.

Clothespin Coil

The metal coil part of a clothespin from TP-2 was found. Roughly square, it measures 28 mm by 17.7 mm (TP-2-3).

Crown Tops (Fig. 9)

Twenty-two crown tops were excavated at Site C10-16 (Table 1). All the caps are rusted and some are fragmentary. Complete caps measure 30.3 mm in exterior diameter. Crown tops were developed in 1892 by William Painter (Elliott 1971). These tops were created to

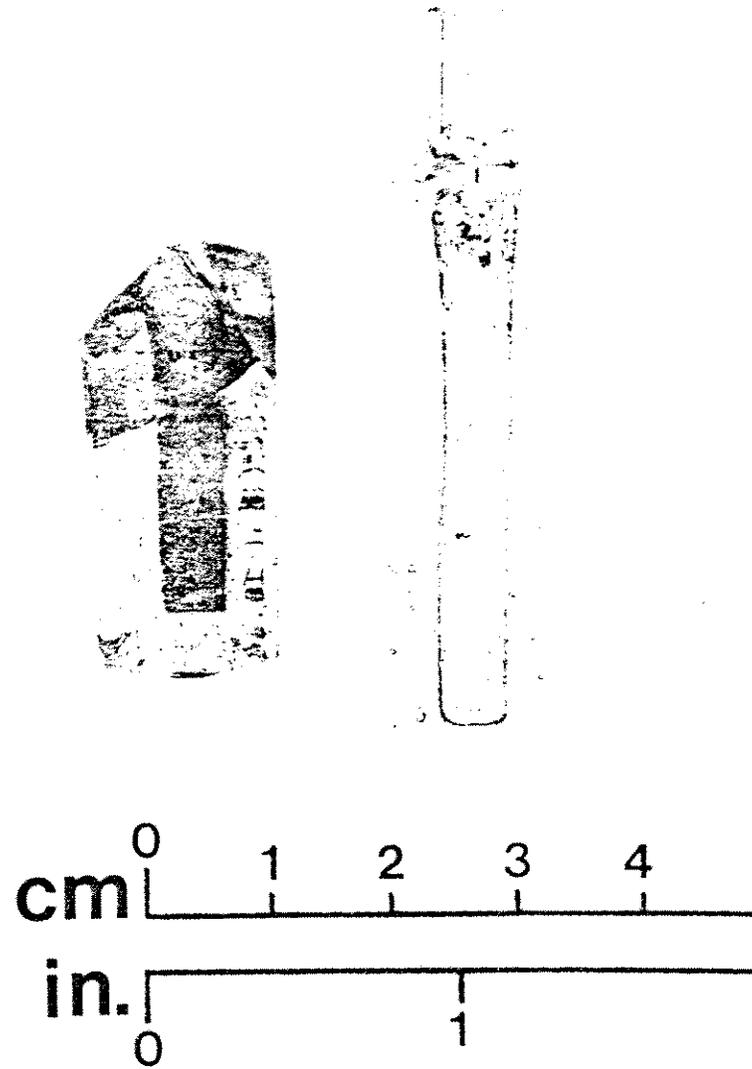


Fig. 7. OPIUM BOTTLES FROM TP-2 AND Tr-1, SITE C10-16.

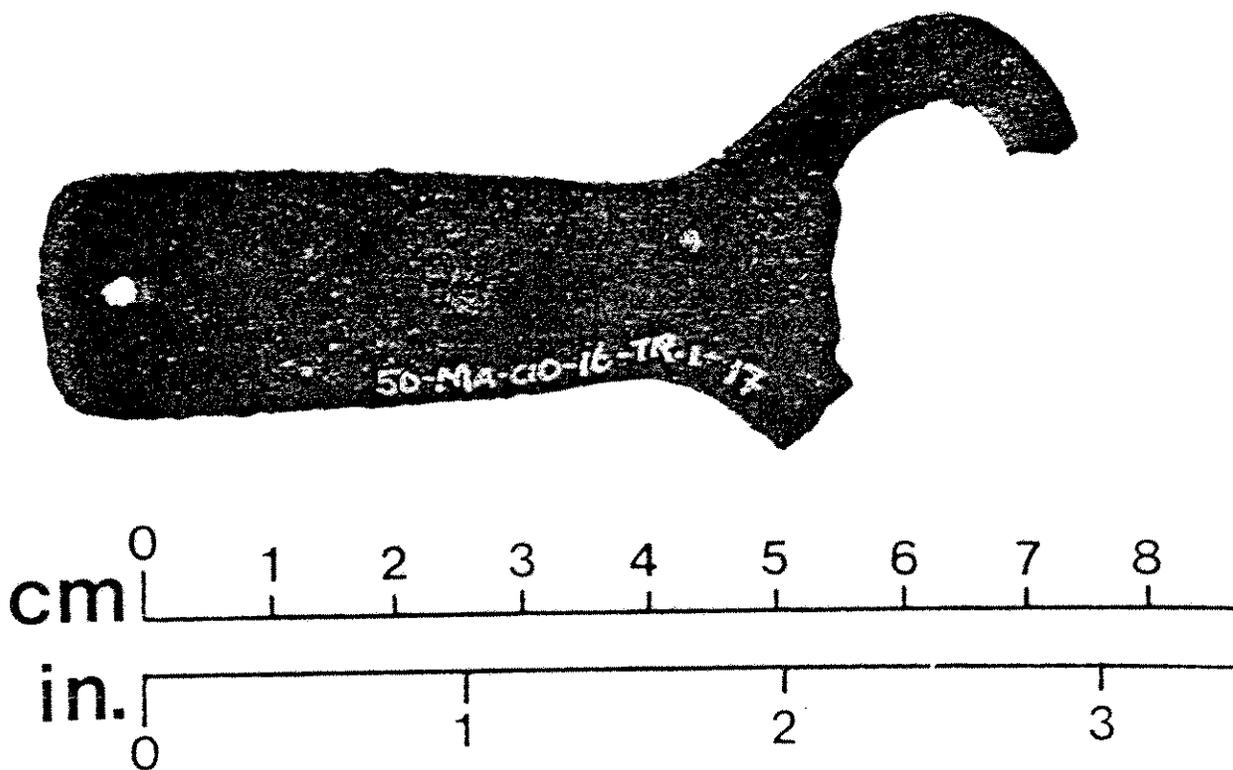


Fig. 8. "CHURCH KEY" BOTTLE OPENER FROM Tr-1, SITE C10-16.

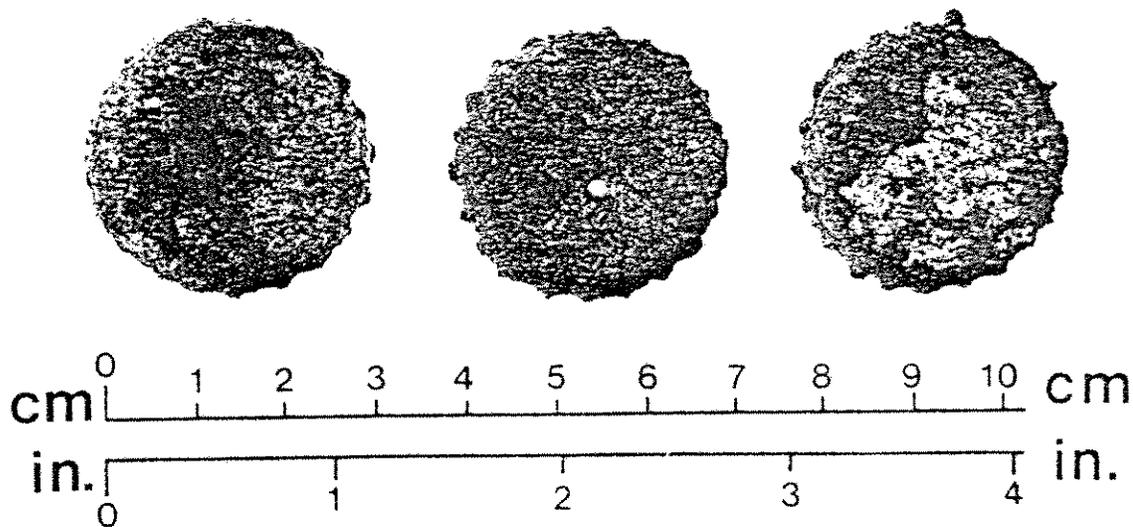


Fig. 9. CROWN BOTTLE CAPS FROM SITE C10-16.

allow carbonated drinks to be bottled. Bottles that accommodated these new tops had to have uniform lip finishes.

Lamp Mount

A metal electric lamp mount was excavated from the overburden of Tr-1. It exhibits the screw-on portion as well as the attachment section. It is 48.2 mm long and 37.5 mm in diameter (Tr-1-19).

Miscellaneous Bottle Tops

Four miscellaneous bottle tops were excavated from Site C10-16. Two tops (TP-1-37 and -56) were of the "screw top" type. These average 35 mm in exterior diameter. Specimen Tr-1-31 is a hexagonal-shaped top, composed of metal and glass and measures 47 mm in diameter. The other top (Tr-1-35) is flat, 40 mm in diameter.

Spoon

A heavily rusted metal spoon was uncovered from Layer I of Tr-1. It appears to be intact, measuring 149.4 mm by 31.5 mm (Tr-1-100).

Screening

A very fragile remnant of metal mosquito screening was excavated from Layer 1 of TP-1 (TP-1-30).

Washers

Six lead or metal washers were collected. Five (Tr-1-50, -91a and b, -101, and -113) are lead or an alloy that renders them soft and easily misshapened. The specimens excavated are gnarled out of the original circular shape. The more intact washers average 22 mm in diameter (exterior) with an average interior hole diameter measuring 10 mm. Washer no. TP-2-22 is larger in diameter than the others, although it probably served the same purpose. It is made of metal, 49 mm in diameter, and has a textured surface. These washers may have been used for various pipe fittings.

Window Glass

Forty-eight pieces of window glass were excavated. All are small fragments ranging from 11.7 mm to 100 mm in length. Some of the fragments exhibit patination.

Caulk

A small piece of plaster caulk (Tr-1-63) from Tr-1 was uncovered from between the rocks of the upper wall. This was probably used for caulking windows into a wooden frame.

Handles, Hasps, Hinges

A metal bucket handle (TP-2-25) was retrieved from Layer II of TP-2. From Tr-1, a wooden handle (Tr-1-23) was found in the overburden. It measures 114 mm long and 25 mm wide at the end.

Various parts of metal hasps were excavated from Layer III of TP-1 (TP-1-68 and -72) and the overburden of Tr-1 (Tr-1-22 and -49). Two rusted segments of hinges were uncovered, one from Tr-1 (Tr-1-16) and the other from TP-2 (TP-2-12).

Insulator

A white porcelain electrical insulator was retrieved from the overburden layer of Tr-1. It is 45.2 mm long and 28.6 mm in diameter with "Bull Dog" embossed at the top (Tr-1-11).

Metal Fragments

Metal fragments of rusted, exfoliated, amorphous shapes were the most predominant specimens collected. A total of 362 pieces were excavated, 277 from the overburden and Layers I, II, and III of TP-1, 30 pieces were from TP-2, and 55 fragments from Tr-1 (Table 1). Two fragments (Tr-1-45a and b) had embossed Japanese characters that read as "Jitsuyo" or "utility model," a type of patent design or identification for common, lower-grade household items.

Nails

A total of 173 nails were discovered, most showing some degree of corrosion and heavy rust. Some were so corroded and exfoliated

that types were not distinguishable. Two basic types of nails were found at Site C10-16; round nails, and square nails that predate the round ones. These two types were found in all layers throughout the site. No stratigraphic differentiation was present. In TP-1, 54 round and 5 square nails were retrieved; 60 are non-diagnostic because of corrosion. These range in length from 27.8 mm to 113.6 mm. TP-2 contained 13 nails; of these, 8 are round, 1 is square, and 4 were non-diagnostic. In Tr-1, 30 round and 8 square nails (Fig. 10) were uncovered; 3 are non-diagnostic. These range from 25 mm to 65.5 mm in length (Table 1).

Roofing Material

Four pieces of tar roofing material were retrieved from Layer I of TP-1 (TP-1-22). These are small, brittle, fragmentary pieces.

Buckle

Three pieces of a rusted metal belt buckle were found in TP-2, Layer II. The intact and largest piece is 53 mm long and 36 mm wide (TP-2-19).

Buttons (Fig. 11)

A total of 23 buttons was retrieved from Site Ma-C10-16. Ten buttons were excavated from the uppermost layer of TP-1. Layer III contained nine buttons; six are made of mother-of-pearl, having two or four holes (TP-1-50a through f). The other buttons from this test pit are: TP-1-71, made of bone with four holes; TP-1-73, of glass with four holes; and TP-1-76, of metal, with no holes, probably a covered snap-type. No buttons were recovered from TP-2. Tr-1 had 13 buttons: 9 are made of mother-of-pearl (TR-1-3, -4, -5, -30, -61, -66a and b, -90a and b) with two or four holes, and some appear to be handmade. Also found were 3 white glass buttons with two or four holes (TR-1-62, -65a and b). One-half of a charred bone button with three holes (TR-1-111) was uncovered from Layer IV, a layer characterized by an increased amount of charcoal particles.

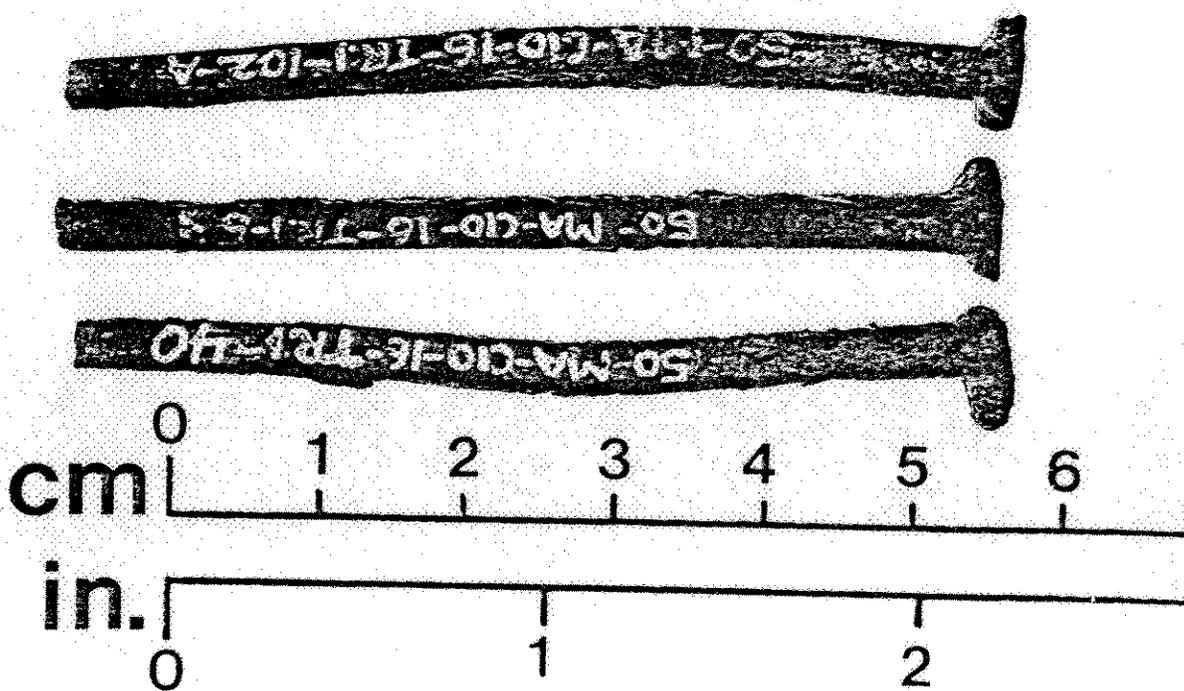


Fig. 10. SQUARE NAILS FROM Tr-1, SITE C10-16.

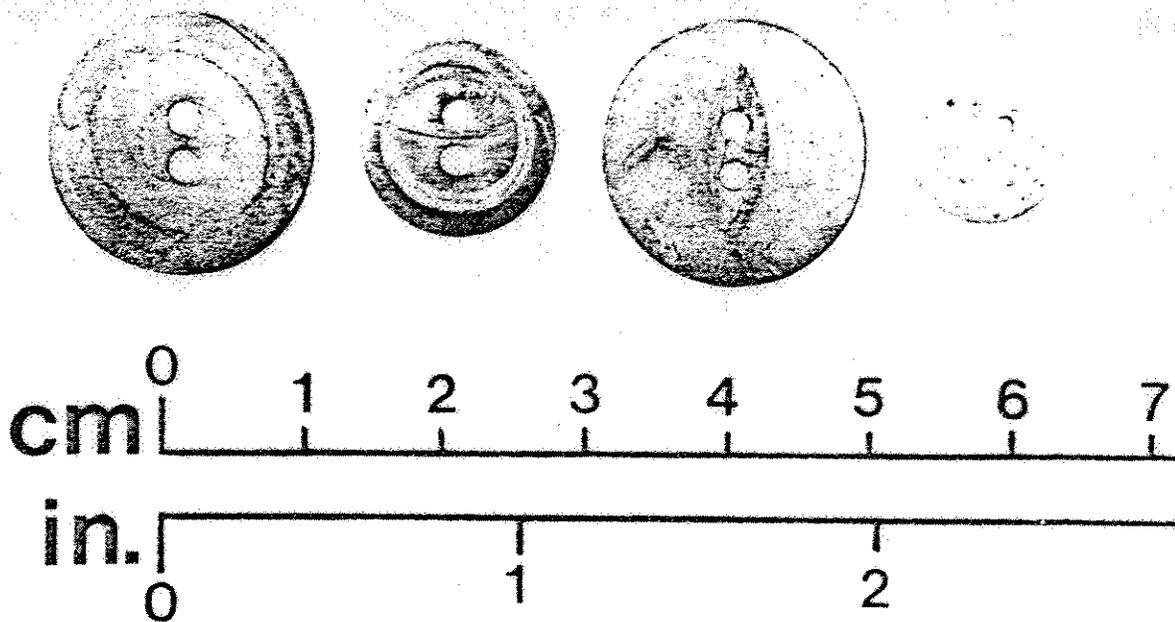


Fig. 11. BUTTONS FROM SITE C10-16. Left, three pearl-shell buttons (Tr-1-3, -4, -61); right, glass button (TP-1-73).

Clasp

A small metal necklace clasp was found in Tr-1. It is 15.8 mm long and 3.4 mm in diameter (Tr-1-86).

Comb Tooth

A small fragment of a tooth from a black plastic comb was uncovered from Tr-1, Layer I (Tr-1-87). It is 29.4 mm long and 4.0 mm wide.

Eraser

A piece of a hardened school eraser was picked up from the overburden layer of TP-1. It measures 22 mm by 17.2 mm (TP-1-4).

Glass Beads

One fragment (TP-1-59) and seven complete glass beads were retrieved from excavations (Table 3). All of the complete specimens were from Tr-1. Most appear to have been manufactured by the mandrel-wound method (Spector 1976). Three of the complete specimens (Tr-1-7, -37, and -79) are red, round, and faceted, and are probably from the same necklace.

Pennies

Five copper pennies were excavated from Tr-1. All of these were cleaned with a 5% solution of formic acid to remove corrosion from the surface, then buffed with a glass brush. Specimens Tr-1-24 (from the overburden) and Tr-1-109 (from Layer IV) were dated 1945. Penny Tr-1-59, found between the upper wall rocks, is dated 1918. The last two pennies excavated from Layer I are dated 1920.

Table 3
GLASS BEADS FROM TRENCH 1, SITE Ma-C10-16, WAIIEHU HEIGHTS, MAUI

Catalogue No.	Color	Manufacturing	Description	Diam. (mm)
Tr-1- 7	Red	Mandrel	Round-multi faceted	7.5
- 8	Black	Mandrel	Round-multi faceted	10.0
- 9	White/gold rim	Mandrel	Barrel	8.6
- 37	Red		Round-multi faceted	6.2
- 79	Red		Round-multi faceted	13.0
- 80	Tan	Hollow-can	Hexagonal	11.5
-108	White	Mandrel	Round	4.2
TP-1- 59	Greenish (fragment)		Round	--

Safety Pin

A corroded safety pin measuring 48 by 9 mm was retrieved from TP-1, Layer II (TP-1-46).

Shoe Sole Fragment

An oval-shaped remnant of a leather shoe sole was found in TP-2, Layer II (TP-2-23).

Marble

A red-and-white swirled marble was excavated from Layer I, TP-1. It is 16.2 mm in diameter (TP-1-28).

Rubber Stamp (Fig. 12)

A brittle fragment of a toy rubber stamp was found in Tr-1, Layer I. The stamp is an impression of Mickey Mouse at the helm of a ship. The Mickey Mouse motif appears to be of the earlier vintage design of Mickey (Tr-1-78).

Whistle

The reed portion of a metal whistle was excavated from Layer I of Tr-1. It is 19.7 mm long and 14.4 mm wide (Tr-1-94).

Modified Bone Material

Five pieces (TP-1-27a and b, -69, Tr-1-12, -15) of cut bone were excavated. All the cuts appear to have been made with metal tools. Striation marks can be seen on the edges. The specimens are rectangular with average dimensions of 20 mm in length and 15 mm in width. One piece (Tr-1-15) from Tr-1 is a fragment with two holes.

Bullet Casings

Two metal bullet casings were recovered from Site C10-16. Specimen TP-1-43 is a casing from a 30-06 carbine bullet. Casing Tr-1-84 is from a 30-30 bullet.

Metal Fishhooks

Two corroded metal fishhooks were found (TP-1-26, Tr-1-26).

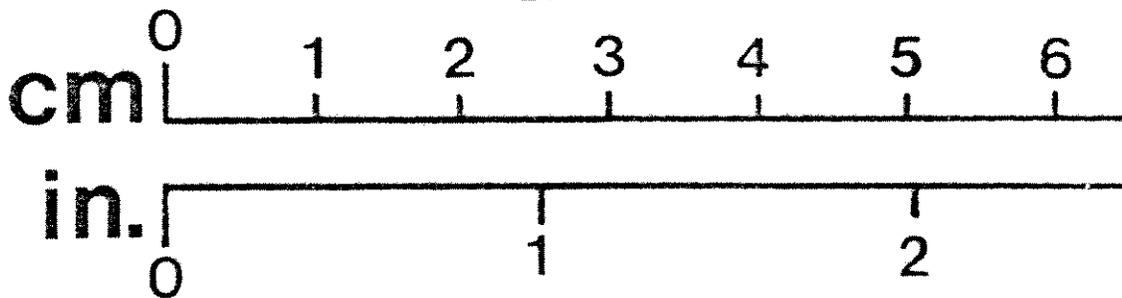
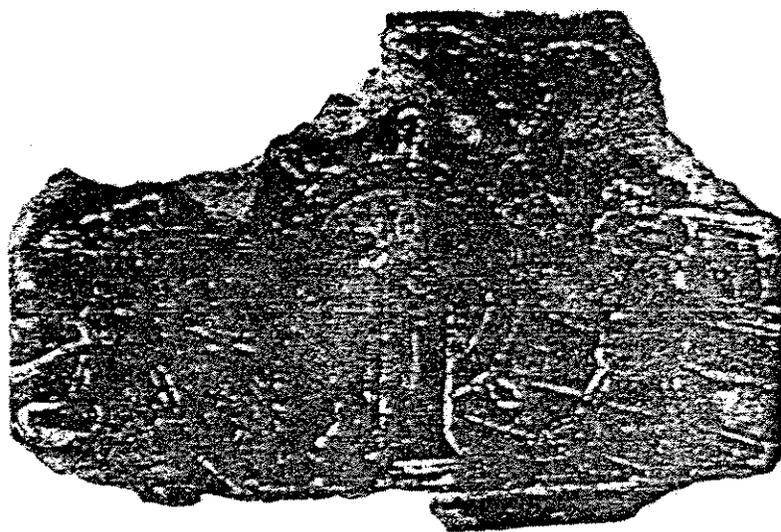


Fig. 12. RUBBER STAMP WITH MICKEY MOUSE MOTIF,
FROM TR-1, SITE C10-16.

Miscellaneous Metal Objects

Seven metal rivets (TP-2-11a and b, -20a through e) from TP-2, Layer II, were found. These are flat and circular in shape and average 13 mm in diameter.

Three circular snap components were collected from TP-2, Layer II (TP-2-21a, b, c). All are 11 mm in diameter with a hole in the middle (4.4 mm in diameter).

A small segment of metal links, such as those used for jewelry, was found in Layer III of TP-1 (TP-1-57). The segment is hexagonal in cross section.

A metal band, measuring 15 mm long and 9 mm in diameter, was found in TP-1 (TP-1-58).

Two metal coils or springs (TP-1-60a and b), 8 mm in diameter, were retrieved from TP-1.

Miscellaneous Plastic Material

Five small pieces of plastic material were found (Table 1). Four pieces from TP-2 (TP-2-1a through d) of a plastic container were collected. One of those fragments (TP-2-1d) exhibits scalloped edges. Fragment Tr-1-76 is from Layer I and is impressed with "Pat. Pending" on one surface.

MIDDEN ANALYSIS

Midden was collected from all test pits excavated at Site 50-Ma-C10-16. Soil from the test pits was screened through 1/4- or 1/8-in. wire mesh, and the resultant non-artifactual materials were collected and bagged according to test pit and layers. Midden was then brought back to the Museum, where the excess dirt was cleaned and the remaining shell and bone fragments were hand-sorted and identified. Faunal remains and soil samples have been assigned B. P. Bishop Museum Accession No. 1981.391.

Marine Shell

All shells were collected from each layer of all the excavation units at Site C10-16 (Table 4). A total of 245.1 grams of shell midden was collected, or 66% of the total midden recovered. All species are common shallow-water varieties that inhabit rocky shorelines, intertidal solution benches, and coastal brackish-water environments. *Nerita picea* (*pipipi*) was the predominant species identified (38%); this species is abundant on shorelines throughout the Hawaiian Islands. The next most prevalent (33%) species was *Theodoxus cariosus* (*pipipi-wai*). "These animals are abundant in localized brackish water pools on Hawaii and in the more saline parts of estuaries on others of the windward islands" (Kay 1979:66). Site C10-16 is located near areas of brackish water that would be conducive for this species to flourish. *Neritina granosa* represented 10% of the midden sample. This species is "diadromous, the larvae developing in the ocean and the young migrating upstream, where they settle on boulders" (Kay 1979:65). *Neritina granosa* could have migrated upstream from the mouth of the Waiehu Stream only c. 2,000 ft away from Site C10-16. Because of the small quantities of shell recovered, it can be surmised that the past occupants of this site were not dependent on the native reef and freshwater fauna for food; however, those shells identified are edible and are still being eaten today.

Faunal Midden

A very small amount of bone was recovered from the excavations at Site C10-16. Because of the small quantity, analysis was limited

DISTRIBUTION OF MIDDEN FROM SILEX CLO-16, WADSWORTH BLIGHTS, MAINT

Material	TP-1			TP-2		Trash Pit	Trench 1				Totals	
	OB	I	II	III	OB/I		II	OB	I	II		III
Gastropoda												
<i>Ampelisca plicata</i>	3.2	8.7	5.4	23.8	7.4	-	-	-	-	0.2	-	51.6
<i>Ampelisca granosa</i>	0.6	-	1.1	0.8	-	-	-	0.8	-	-	-	14.7
<i>Ampelisca polita</i>	-	-	-	2.1	-	-	-	-	-	-	3.4	5.5
<i>Chelonicum curvata</i>	0.6	-	-	1.2	-	-	-	0.2	-	-	-	2.4
<i>Planorbis labiosa</i>	0.1	-	-	1.2	-	-	-	-	1.4	1.2	0.3	5.7
<i>Strombus maculatus</i>	-	-	0.3	-	-	-	-	-	-	-	-	0.3
<i>Theodoxus cariosus</i>	-	-	-	12.9	7.4	3.4	-	0.4	2.8	2.1	0.3	45.1
Unidentified	0.1	0.1	0.2	0.4	6.5	0.3	-	-	0.1	-	0.1	10.2
Pelecypoda												
<i>Levynonon</i> sp.	0.3	2.6	0.6	0.5	-	-	-	0.5	-	-	-	5.0
<i>Chama tostoma</i>	-	-	-	8.3	-	-	-	-	-	-	-	8.3
<i>Pinetada</i> sp.	-	-	-	-	-	-	87.1	-	-	-	-	87.1
<i>Feriglypta reticulata</i>	-	-	-	-	-	-	-	-	-	-	-	9.2
Echinodermata												
<i>Colobocentrotus atratus</i>	0.2	-	-	-	-	-	-	-	-	-	-	0.2
<i>Tripneustes gratilla</i>	-	0.8	0.3	0.9	-	-	-	-	-	-	-	2.0
Land Snails												
<i>Succinea</i> sp.	-	-	-	-	-	-	-	-	0.1	-	-	0.1
Other												
Charcoal	0.3	-	-	-	-	10.7	-	0.1	-	0.6	0.1	12.3
<i>Azida</i> -nut shells	11.9	-	-	-	4.9	5.9	15.9	1.2	-	0.1	-	73.0
Unidentified seeds	0.2	-	-	1.8	-	-	2.0	-	-	-	-	4.0
Crustacea	-	7.7	1.8	1.2	-	-	-	-	1.1	-	0.9	13.5
TOTALS												368.2

Weight in grams

Table 6.
DISTRIBUTION OF LAND SNAILS FROM SITE C10-16, WAIKIHU HEIGHTS, MAUI *

Taxon	TP-1 III	TP-2 OB/I	Trench 1		IV
			I	II	
<i>Cipangopaludina chinensis</i> (fresh water snail)	1				
<i>Planaxis labiosa</i>			1		1
<i>Pleuropoma laciniosa</i>					1
<i>Tornatellides</i> sp.				1	1
<i>Anastra</i> (s.s.) <i>assimilis</i>			7		2
<i>Anastra</i> (<i>Cyclamastra</i>) <i>morticina</i>			24	7	7
<i>Leptacutina isthmica</i>			3	1	1
<i>Eridodonta</i> sp.					1
<i>Lamellaria</i> sp.			4		
<i>Succinea</i> sp.			2		1
<i>Subulina octona</i>		2			
<i>Achatina fulica</i>	8			1	11
<i>Bradybaena similaris</i>					3
Totals	9	2	41	10	97

*No. of individuals.

to a species inventory and weights were not recorded (Table 5). Most of the bones are fragmentary pieces and not classifiable except to large family groups. However, the presence of bone from advanced artiodactyls (hoofed mammals such as cattle, deer) suggests that Site C10-16 was occupied during the recent past because these animals were not introduced into Hawai'i until the historic period (Table 5). Fragments of birdbone from medium Passeriforms (order of Perching/Song Birds) and unidentifiable birds in the general size range of shearwaters and petrels to small chicken were present from Site C10-16. Only the presence and distribution of taxa are noted on Table 5.

The presence of fish bone in nearly all levels of the site is not surprising because of the proximity of the site to the ocean. Two large families could be identified, Labridae (Wrasses such as *Hinalea*) and Scaridae (Parrotfish) (Table 2). Both of these families inhabit coral reefs, feeding on coral polyps, marine algae, and smaller fish.

Terrestrial Snails

Analysis of terrestrial snails was done by Bishop Museum malacologist Dr. Carl Christensen. Soil collected from each layer was oven-dried and sifted. Snails left in the screen were hand-sorted, counted, and identified (Table 6). The predominant species from all the layers of Trench 1 was *Leptachatina isthmica*, which is an extinct native species. However, historically introduced species were also found in samples from all the layers of the trench. TP-1 (Layer III) and TP-2 (Layer OB/A and I) contained the historic species *Bradybaena similaris* and *Achatina fulica* (Table 6). Extinct native species intermixed with introduced species were present in almost all instances throughout all layers in both test pits and Trench 1. This distribution indicates that the area of Site C10-16 has undergone disturbances and secondary redeposition.

SITE 50-Ma-C10-17: QUARRY

Site 50-Ma-C10-17 is a limestone quarry located c. 100 ft up the side of a lithified dune face on the southeastern boundary of the

project area. The quarry is an overhang shelter measuring 10 m long and 3 m wide (Fig. 13). The overhang is open to the N and appears to be eroding downslope (30° to 45°). *Naupaka kahakai* (*Scaevola sericea* Vahl) and Christmasberry trees (*Schinus terebinthifolius* Raddi) are found on the slope in front of the shelter. Vegetation above the shelter is limited to low shrubs, as the wind blows steadily atop the quarry.

Space within the overhang is small and narrow. The deposit in the shelter is limited by the exposure of a sandstone shelf that dominates the back half of the overhang. The ceiling and surrounding beach rock appear platy with sharp edges. Accumulated sand fronting the shelter is loose, containing broken chunks of beach rock from the overhang. Larger chunks (50 to 100 cm) of roof material skirt the overhang edge.

TP-1, a 1-m square, was excavated in the eastern half of the overhang where the greatest amount of overhead and floor space was available. The deposit revealed by the test pit was composed of one shallow and homogeneous layer of sand. Composed of loose, fine to very fine granules of sand and basaltic particles, the matrix is grayish-brown in color (Munsell Color Chart designation 10YR5/2). The deposit averaged 20 cm deep, to a maximum depth of 56 cm, and approximately 0.25 m^3 was excavated. Most of this was sand that had accumulated in a natural depression in the beachrock basal material. This depression occurred in the southwest corner of the pit; the other 75% was solid beachrock.

No cultural material was recovered from TP-1, although four lithified coral or beachrock flakes (waste byproducts of stone tool-making) were collected from the surface (Fig. 14). These flakes were found at the overhang edge; one specimen (C10-17-1) was found on top of a large boulder of parent roof material that had broken off. These flakes may have been a result of modification by man or may have been the result of the ceiling material falling to the surface.

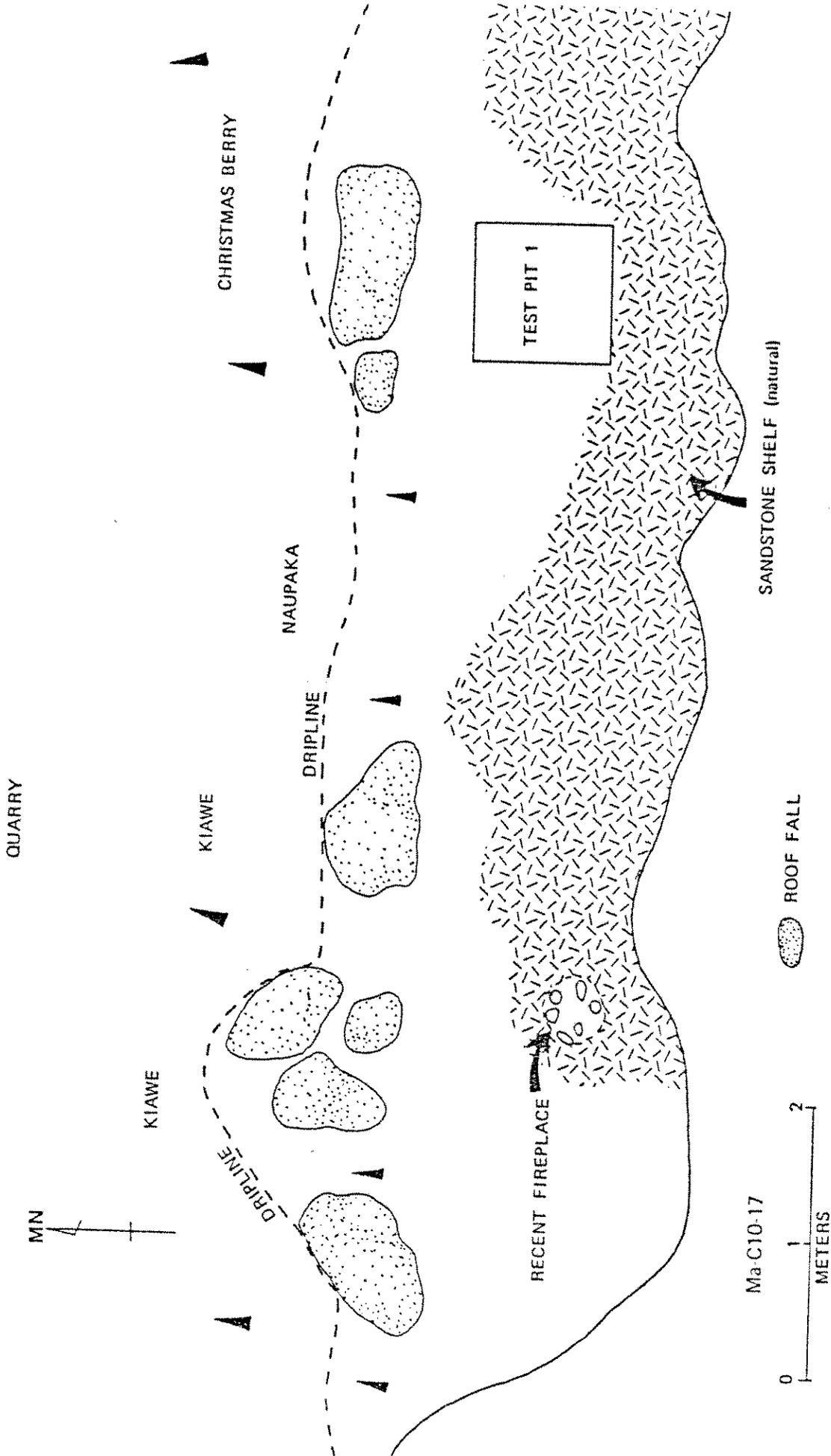


Fig. 13. PLAN VIEW OF SITE C10-17, LIMESTONE QUARRY.

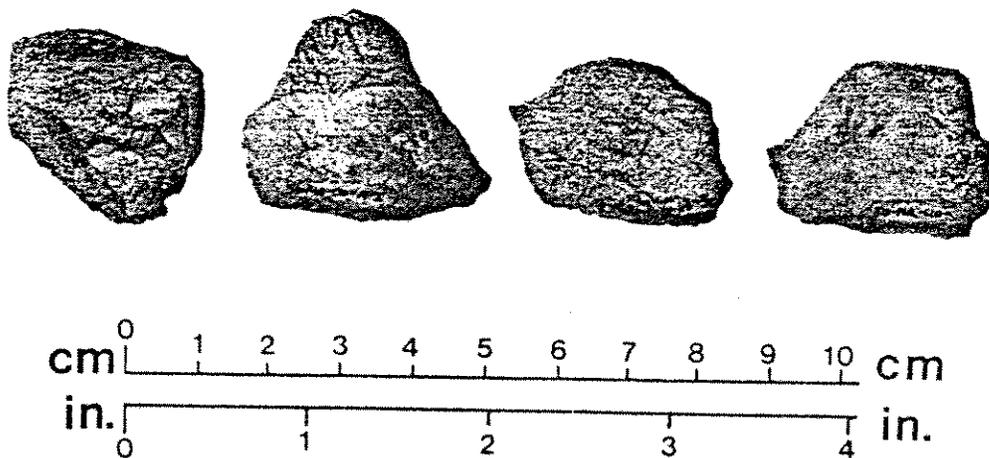


Fig. 14. BEACHROCK FLAKES RECOVERED FROM SURFACE OF SITE C10-17.

The absence of in situ debitage in the overhang shelter proper directed us to investigate the slope fronting the shelter. The terrain, varying from 30° to 45° in slope, is composed of loose sand mixed with some silt (25%) with chunks of lithified sandstone and beachrock, held together in many instances by roots. Working under these conditions was arduous but we were able to collect some samples of flakes and a possible core, as well as raw material of beachrock (calcareous sandstone). Chunks ranging in diameter from 10 to 50 cm and larger could be seen on the slope, as much as 70 ft below the shelter. These chunks appeared to have been broken off the roof of the shelter, and the roof shows scars where those chunks may have been removed. The beachrock, usually banded in between the sandstone, was apparent in 50% of the chunks examined. The banding varied in quality; some chunks showed inclusions and micro-banding of sand granules within the dense beachrock. The dense bands of beachrock ranged in thickness from 3 mm to 60 mm in some cases. Distribution of flake-like debitage appears to be limited to the slope directly in front of the shelter. Distribution becomes sparse as it radiates out toward the sides of the shelter.

Although there was no in situ deposition and no debitage was recovered from the shelter proper, the presence of flakes, a core, and raw material on the slope do indeed indicate a quarrying activity. This activity apparently was limited, as raw material is not abundant in the shelter and its surrounding cliff. However, we cannot be sure of how much lies buried on the slope under what could be 3 ft of sand, since we were not able to retrieve adequate information during the project time allotted. We can be fairly certain that quarrying activity took place but we do not have information about the effect of erosion on the site, the degree of lithic technology achieved by those using the quarry.

Although no artifactual material was excavated from the site, various artifacts have been collected from the Waiehu area in the past.

During the 1940s and 1950s a local resident collected numerous artifacts from Waiehu such as *'ulu maika*, squid lures, sinkers, and pounders. Although exact locations of the collections cannot be determined from his records (in Dept. Anthropology, B. P. Bishop Mus.), this illustrates that a variety of different types of artifacts were manufactured and or used in the Waiehu area. Present in the collection are a number of artifacts made of "sandstone, calcite, and beachrock conglomerate." These may have been produced out of material from the quarry. The B. P. Bishop Museum Ethnological collection also has some "limestone" or beachrock artifacts in its inventory. Four limestone flakes were collected from the surface of Site C10-17 (C10-17-1 through -4). These exhibit a striking platform. Flakes are considered waste-products resulting from stone tool-making or the impact of two stones struck against each other. Specimen C10-17-1 was found atop a piece of beachrock that had dropped from the roof. This flake could be the result of this impact rather than of stone tool-making. Flake C10-17-2 was found on the floor of the overhang edge.

SITE C10-18: HUMAN BONE SCATTER

This site comprises scattered fragmentary pieces of human skeletal remains eroding from a windswept sand-dune bluff 164 m W of Site C10-15 (Fig. 2). One basalt flake was found 20 cm away from the scatter. The absence of diagnostic pieces and the paucity of remains made it impossible to reach any definitive conclusions as to sex, age, or physical morphology of this individual.

SITE C10-19: HUMAN BONE SCATTER

Fragments of human skeletal remains were discovered 328 m W of Site C10-18 (Fig. 2). These were exposed as a result of erosion occurring on this windswept bluff. As in the case of Site C10-18, no definitive statements can be made for this individual.

SITE C10-20: MIDDEN SCATTER

This site is a midden scatter that covers approximately 246 m². Shells such as 'opihi (*Cellana exarata*) and pipipi (*Nerita* sp.), as well as basalt rocks, are scattered atop this slope. Distribution is sparse and no concentrations were noticeable. Waterworn basalt boulders were also scattered in the area. These were round stones ranging between 15 to 30 cm in diameter. These rocks appear randomly distributed over the surface. A basalt flake was collected on the surface (C10-20-1). The whole area is on a 20° slope and is subject to some erosion.

POND

The significance of the pond located on the northeastern boundary of the Unit IV area remains undetermined. During the survey phase (December 1979) it was virtually impossible to see the pond. Vegetation had encroached within it, as well as along the perimeters.

A local informant and resident of Waiehu, Mr. Charles Keau, remembered that the pond was visible and clear of vegetation during his childhood. Mr. Keau said that there were supposed to be walls around the pond and that it served as a fishpond during ancient times. This information was relayed to him by his uncle, Mr. Joseph Whitford. Mr. Whitford also spoke of two or three outlets for this fishpond ("loko ia") as well as associated taro patches. Mr. Keau was able to trace a name that he said is only known locally and was given to him by Mr. Whitford; that name is Ka'a.

The author was not able to substantiate the information given by Mr. Keau. All standard resource materials were consulted and no mention of this pond was found. Early maps (Monsarrat 1887, O'Shaughnessy 1899)* note the presence of a pond in this location; however, no name, walls, or associated agricultural evidence is depicted. Cobb's 1901-1902 survey of commercial fisheries does not

*The Monsarrat map was examined in the office of Harvey, Wright & Wright. The O'Shaughnessy map is in the Hawaii State Survey Office.

list Ka'a fishpond in his inventory, nor did Sterling (notes in Bishop Museum) mention the pond. It is this lack of substantiating evidence that makes the significance of the pond questionable. It may, as Mr. Keau said, be only known locally to a few people.

In the course of tracking down information about the pond, the author came across a sketch done by Monsarrat in 1887 (Fieldbook #30, p. 6) that depicts a pond located approximately 500 ft S of Waiehu Stream. A name is not listed for this pond; however, Monsarrat's map shows an "*auwai*" running from the pond to the ocean. Several names of land owners are listed for the immediate area: Wanaoa, Kapaula, and Kaawa. It is possible that Mr. Keau is referring to this pond. Aerial photographs dated August 22, 1940 (USGS M-128-72-83, Book #1), show the pond completely obscured by vegetation.

It is possible that the pond within the project area is indeed an unrecorded ancient fishpond and that there are walls around it as well as outlets to the sea. Any such features cannot be seen at the present time because of thick vegetation that covers the pond and surrounding area.

CONCLUSION

Evidence gathered through excavations of the sites found in the Unit IV project area do indeed point toward limited habitation spanning prehistoric and historic times. Although the area is not the most inviting place to live, some work activities and exploitation of available resources were evidenced by the archaeological record. Before plantation clearing, more vegetation probably flourished; old accounts and maps document intense gardening and taro cultivation in the upper areas of Waiehu Stream (Stokes 1916). No archaeological evidence of such cultivation has been found in the more coastal areas, such as that of the Unit IV project area, although agriculture may have been practiced in the vicinity of the pond. It is possible that the evidence for agriculture lies beneath the thick matting of *hau* (*Hibiscus tiliaceus* L.) and various wetland swamp vegetation. It was impossible to see anything beneath this ground cover that dominated the large area adjacent to the pond.

Excavations at Site C10-16 revealed it to represent a rather recent occupation, spanning a time period of about 30 years (1918-1945). Indications of an earlier occupational period were not present in the lower layers of the terrace. There was very little differentiation of artifact types throughout the layers. Distribution of artifacts and midden revealed no temporal sequence or pattern. All materials excavated at Site C10-16 indicate that it was a family dwelling occupied during the early to mid 1900s.

Quarrying activities were probably conducted in the sand dune area. Site C10-17 revealed some evidence of such tool-making, although the archaeological evidence is too sparse to determine the level and intensity of this activity. In the past, local residents have collected some artifacts made of beachrock from the area (Bishop Mus. Ethnology Collections), although only two possible

flakes were retrieved from excavations. The small, shallow overhang has undergone a considerable amount of erosion, which limits the possibility of in situ recovery of artifacts or other remnants of tool-making. There is virtually no deposit within the overhang. While the area directly in front of the overhang may contain substantial information, this deposit is possibly a secondary deposition and would not necessarily lend credence to temporal differentiation or distribution of quarrying activities at Site C10-17. It would, nonetheless, present us with information about the technology of beachrock exploitation for that area.

The presence of burials within the project area verifies local folklore about the area being used for burial purposes. Burials found and excavated during the project do not allow us to make statements about the "burial grounds" in terms of burial numbers, spatial and temporal distribution, and type of burial. Burial site C10-15 was an almost complete individual (the skull was missing) in the flexed position, which was the common mode during prehistoric times (Snow 1974:Appendix A). Burial sites C10-18 and C10-19 were very fragmentary remains of two individuals. Very little can be said about these two burials.

Legends tell of ancient battles fought close to streams such as Waiehu (Cheever 1851). If the vanquished were left to die on lands within the project area, one would expect to find more burials. It is possible that other burials are there but not apparent, since most early burials were not marked, although Ellis (Ellis 1969:160-161) mentions that "small heaps of stones" were sometimes used to mark graves of the victorious warriors. If any such remains are to be found, they would most likely be found where the warriors fell in battle, unlike burial C10-15, which exhibits deliberate thought and planning for interment, something that would be lacking in the face of warfare and political strife (Buck 1964:570). It is also quite

possible that the battle scene was upstream or in a number of other places along the stream, although sandy areas such as those within the Unit IV area present an optimum location and matrix for burials. Many such burials have been found in the Mōkapu dune area of O'ahu (Snow 1974).

RECOMMENDATIONS

The following recommendations are made for the Waiehu Heights Subdivision Phase IV project area. These recommendations are based on archaeological and historical evidence gathered through excavation and research of the project area.

SITE 50-Ma-C10-15: BURIAL

No further work is necessary for this burial. The skeletal remains will be incorporated into the B. P. Bishop Museum Osteology collection.

SITE 50-Ma-C10-16: WALLED TERRACE

In view of the evidence gathered during and as a result of excavation done at this site, sufficient work has been completed and no more is recommended for this site. Overwhelming evidence of historical occupation well into the 1900s, substantiated by excavated artifacts, illustrates the lifestyle that existed in the Waiehu sand dune area during the early 1900s until the 1950s.

SITE 50-Ma-C10-17: QUARRY

Previously all that was known about this site was that it was *believed* to have functioned as a quarry. Collections at the quarry were made by an independent collector during the 1940s and 1950s, but no archaeological investigations had been done prior to this project. Although no artifacts were recovered from excavations, the presence of flake debitage (waste byproducts of lithic tool-making)

and raw material on the slopes fronting the overhang is a definite sign of previous quarrying and lithic tool-making activity. Artifacts made of a similar material, referred to as beachrock, are not common but are certainly part of the material culture of the ancient Hawaiians. Adzes, octopus lures, sinkers, and *'ulu maika* made of this beachrock have been found, recorded, and collected from various sites throughout the islands. It would be presumptuous to think that these items were made of quarried material from Waiehu. There are doubtless many other locales that have beachrock that would be suitable for quarrying and manufacturing of artifacts. However, this quarry is the first of its kind to be investigated so far.

The debitage found and collected from the slope area is a result of secondary deposition attributed to erosion; in situ deposition appears to have been totally obliterated by this natural process. In view of this deposition and the degree of difficulty in excavating under the thick brush and loose sand, it is recommended that:

- (1) The overhang and the fronting slope (c. 100 ft) should be kept intact, if possible, for further controlled excavations; or
- (2) If the site cannot be avoided by the developers, a backhoe trench should be excavated before bulldozing. If in situ material is discovered in the profiles of this trench, controlled excavations extending outward should be conducted to retrieve a sample of debitage, as well as possibly obtaining datable material for chronological control. Further investigation of this site would greatly enhance our knowledge about these concerns about the technology of using beachrock for lithic artifacts.

POND

For the area of this reputed fishpond, we recommend:

- (1) Monitoring during heavy equipment bulldozing and clearing of the immediate pond area; and
- (2) In the event that submerged and covered walls are discovered during the monitoring phase, intense clearing and mapping of the pond should be conducted before it is filled or changed in any way or manner.

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