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STATE OF HAWAI'I
DEPARTMENT OF HAWAIIAN HOME LANDS

P.O. BOX 1879
HONOLULU, HAWAI'I 96805

December 21, 2010

Director
Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu HI 96813

Dear Director:

Subject: Draft Environmental Assessment (EA) Prepared by TEC Inc., for Kalaeloa Solar One, Island of Oahu

The Department of Hawaiian Home Lands, State of Hawai'i, has reviewed the draft environmental assessment for the subject project, and anticipates a Finding of No Significant Impact (FONSI) determination. Please publish notice of availability for this project in the next available edition of the *Environmental Notice*. We have enclosed the following:

- One hard copy of the Draft EA
- A CD containing the PDF file for the EA, the OEQC transmittal documents, including publication form, distribution list, and project summary

Please contact Ms. Faith Caplan, AICP, Senior Associate, TEC Inc., at (808) 528-1445, if you have any questions.

Aloha and mahalo,

Linda Chinn, Administrator
Land Management Division

Enclosures: One (1) copy of Draft EA, OEQC Publication Form and EA Distribution List
One (1) CD of Draft EA

Draft
Environmental Assessment

Kalaeloa Solar One and Two

Tax Map Key [1] 9-1-13: Parcel 28
Kapolei, Hawaii

January 2011

Prepared for:
Keahole Solar Power, LLC
2660 Waiwai Loop
Honolulu, Hawaii 96819

Prepared by:
TEC Inc.
1003 Bishop Street
Pauahi Tower, Suite 1550
Honolulu, Hawaii 96813

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DRAFT
ENVIRONMENTAL ASSESSMENT
KALAELOA SOLAR ONE AND TWO
OAHU, HAWAII

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List of Acronyms and Abbreviations

°F	degrees Fahrenheit
ac	alternating current
ac	acre
ACM	Asbestos Containing Material
ACOE	Army Corps of Engineers
agl	above ground level
AIRFA	American Indian Religious Freedom Act
ALISH	Agricultural Lands of Importance to the State of Hawaii
AMP	Archaeological Monitoring Plan
amsl	above mean sea level
ARPA	Archaeological Resources Protection Act
BMPs	Best Management Practices
BRAC	Base Realignment and Closure
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH_4	methane
CIP	Campbell Industrial Park
CO	carbon monoxide
CO_2	carbon dioxide
CO_{2e}	CO_2 equivalent
	County City and County of Honolulu
CSP	concentrating solar power
CWA	Clean Water Act
CWB	Hawaii Department of Health Clean Water Branch
cy	cubic yard
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Program
dB	Decibels
dBA	A-weighted Sound Level
dc	direct current
DHHL	Department of Hawaiian Home Lands
DLNR	Hawaii Department of Land and Natural Resources
DNI	Direct Normal Irradiance
DNL	day-night average sound level
DOE	Department of Education
DoD	Hawaii Department of Defense
DOFAW	Division of Forestry and Wildlife
DOH	Hawaii Department of Health
DoN	Department of the Navy
DOT	Hawaii Department of Transportation
DPP	Department of Planning and Permitting
DPW	Department of Public Works
EA	Environmental Assessment
EDR	Environmental Data Report
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FDA	Food and Drug Administration
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Signification Impact
FR	Federal Register
ft	feet/foot
ft^2	square foot/square feet
H2S	hydrogen sulfide
HAAQS	Hawaii Ambient Air Quality Standards
HAR	Hawaii Administrative Rules
HB	House Bill
HBMP	Hawaii Biodiversity and Mapping Program
HCDA	Hawaii Community Development Authority
HCEI	Hawaii Clean Energy Initiative
HECO	Hawaiian Electric Company, Inc.
HPP	Historic Preservation Plan
HRS	Hawaii Revised Statutes
IARII	International Archaeological Research Institute
KSP	Keahole Solar Power, LLC
LBP	Lead-Based Paint
lbs.	pounds
lf	linear feet/linear foot
MBTA	Migratory Bird Treaty Act
mgd	million gallons per day
MSL	Mean Sea Level
MW	megawatt
NO2	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NASBP	Naval Air Station Barbers Point
NAGPRA	Native American Graves and Repatriation Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPDES	National Pollution Discharge Elimination System
O_3	Ozone
OEQC	Office of Environmental Quality Control
ORTP	Oahu Regional Transportation Plan
PCB	polychlorinated biphenyl
PCPI	Per Capita Personal Income
PHNWR	Pearl Harbor National Wildlife Refuge
PMP	Preservation and Monitoring Plan
PMx	Particulate matter of size X
POL	Petroleum Oil and Lubricant
PUC	Public Utilities Commission
PURPA	Public Utility Regulatory Policies Act
PV	photovoltaic
RCRA	Resource Conservation and Recovery Act
RPS	Renewable Portfolio Standard
SEL	Sound Exposure Level
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SMA	Special Management Area
SO_2	sulfur dioxide
SSA	Shoreline Setback Area

TCLP	Toxicity Characteristic Leaching Procedure
TMK	Tax Map Key
TSCA	Toxic Substances Control Act
UIC	Underground Injection Control
U.S.	United States of America
USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WRCC	Western Regional Climate Center
WWII	World War II
WWTP	Waste Water Treatment Plant

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Project Summary

***Project Name*:**	Kalaeloa Solar One and Two
***Proposed Action*:**	Develop two on-grid 5 megawatt (MW) solar power generating facilities: Kalealoa Solar One, using Sopogy™ concentrating solar power thermal technology; Kalaeloa Solar Two, using alternating current SunPower™ photovoltaic technology.
Applicant/Developer:	Keahole Solar Power, LLC 2660 Waiwai Loop Honolulu, Hawaii 96819 Attn: Sheldon Char, Project Executive
Tax Map Key:	[1]9-1-013:028 (portion)
Location:	Kalaeloa, Honouliuli, Ewa District, Oahu, Hawaii
Property Owner:	State of Hawaii, Department of Hawaiian Home Lands
Lessee:	Kalaeloa Solar One
Approving Agency:	State of Hawaii, Department of Hawaiian Home Lands
State Land Use District:	Urban
Community/ Development Plan:	Ewa Development Plan, Kalaeloa Special Area
County Zoning:	F-1 Military and Federal Preservation on zoning maps, subject to P-2 General Preservation development standards subsequent to Navy conveyance of land in 1999.
Special Designations:	Kalaeloa Community Development District managed by Hawaii Community Development Association. Adoption of Master Plan and administrative rules are pending.
HRS Chapter 343 Trigger:	Use of State Land
Summary:	Keahole Solar Power, LLC is proposing to develop two 5MW renewable energy projects in Kalaeloa, Oahu, Hawaii. Kalaeloa Solar One would utilize concentrating solar power (CSP) thermal technology and Kalaeloa Solar Two would be an alternating current photovoltaic (PV) power generating facility. Each system would generate 5 MW of electricity that would be provided to HECO via two power purchase agreements. The electricity would feed into the existing Hawaiian Electric Company (HECO) power grid. The project supports the State of Hawaii Clean Energy Initiative goal of having 70 percent of the States' energy come from renewable sources by

2030. Currently, the electrical load profile on the island of Oahu is 350 MW peak, with approximately 80 MW of electricity generated from renewable sources, most of which is from solar powered PV panels.

The proposed project location is in the northeast portion of the Kalaeloa Community Development District, the redevelopment of which is the responsibility of Hawaii Community Development Authority. The approximately 80-acre site is owned by State Department of Hawaiian Home Lands (DHHL).

The project would include a solar thermal array of approximately 10,800 Sopogy™ CSP collectors (Kalaeloa Solar One) and approximately 18,600 SunPower™ PV modules (Kalealoa Solar Two) with minor support facilities.

The CSP collectors and PV panels track the sun east to west during the day. The CSP collectors focus the sunlight on the absorber pipe that is filled with organic thermal oil that increases temperature while being conveyed through the rows of CSP collectors. The heated fluid drives an engine to produce electricity for the existing HECO power grid. The PV panels provide electricity directly to the existing power grid. Approximately 30 full time employees would be required to operate the CSP facility seven days per week throughout the year. The PV facility would be operated remotely and no onsite employees are required.

The proposed action includes vegetation removal and minor grading, assembling and mounting the CSP collectors and PV modules, and constructing two CSP support buildings, concrete pads for equipment, perimeter fencing and a substation on site.

The project would have socioeconomic beneficial impacts. No significant adverse impacts are anticipated to air quality, biology, noise, geology and soils, land use, socioeconomics and traditional cultural practices, hazardous materials and waste, utilities and public services, or visual resources. With implementation of best management practices and adherence to existing laws and regulations, potential impacts to water, would be minimized. Archaeological sites have been identified within the proposed development area and consultation with State Historic Preservation Division (SHPD) is ongoing. No negative impacts to significant archaeological resources are anticipated under the proposed action, since the approach is to maintain the integrity of the sites for interpretation through a combination of preservation and data recovery. Archaeological monitoring and inadvertent burial treatment measures during construction are proposed. A Finding of No Significant Impact is anticipated.

SECTION 1
PURPOSE AND NEED FOR THE PROPOSED ACTION

1.1 INTRODUCTION

Kalaeloa Solar Power, LLC (KSP) is proposing to develop two 5 megawatt (MW) solar power generating facilities in Kalaeloa, Oahu, Hawaii. The two facilities would be independently owned and operated. The Kalaeloa Solar One would be owned and operated by Kalaeloa Solar One LLC utilizing Sopogy™ concentrating solar power (CSP) thermal technology. Kalaeloa Solar Two would be owned and operated by SunPower Corporation and utilize SunPower™ photovoltaic (PV) systems. The two facilities would each generate 5 MW to be sold to Hawaii Electric Company (HECO) through two power purchase agreements approved by the Public Utilities Commission.

The CSP collectors use mirrors and optics to concentrate the energy from the sun. The thermal energy heats organic oil in a pipe at the center of each CSP collector that is conveyed through other units and ultimately drives an engine to generate electricity.

The PV panels covert solar radiation into direct current electricity using solar panels with modules of polycrystalline. The modules are protected by tempered glass. The direct current is ultimately converted onsite to alternating current. The CSP and PV collectors follow the sun east to west throughout the day.

1.2 PURPOSE AND NEED FOR THE PROPOSED ACTION

The purpose of the proposed project is to reduce Oahu's dependence on fossil-fuel for power generation. The proposed action would employ two different renewable energy technologies to produce a total of 10 MW of that would feed into HECOs existing power grid. The collective power generated would provide electricity to power approximately 2,500 homes, result in the offset of 452,460 tons of emissions over 30 years and eliminate the need 35,075 barrels of oil per year. The proposed action would assist the state in reaching the Hawaii Clean Energy Initiative (HCEI) goal of having 70 percent of the State's energy come from renewable sources by 2030. As part of the HCEI, an agreement was signed on October 20, 2008 by the key stakeholders: Hawaiian Electric companies, the Sate Governor, State DEBDT and the State Hawaii Consumer Advocate. One component of the agreement is Hawaiian Electric companies will integrate up to 1,000 MW of renewable energy resources on Oahu. Other initiatives include:

- Hawaii Greenhouse Gas Emissions Reduction Law, Act 234 2007. Establish a policy to reduce the greenhouse gas emissions to 1990 emissions levels by 2020.
- Act 95. 2004 and House Bill (HB) 1464 2009. Act 95 Requires Hawaii's utilities to make renewable energy account for an increasing percentage of their power generation portfolio. HB increased the percentages of renewable energy. For example: 15 percent of net energy sales by December 31, 2015.

The reduced dependence on fossil fuels for energy generation has the following benefits to Hawaii's environment:

- reduction in green house gas emissions;
- reduction in dependency on foreign imports of fossil fuel and associated price volatility; and
- reduction in volume and associated risk of spills of fossil fuel transport and storage.

1.3 ENVIRONMENTAL REVIEW

Chapter (Ch) 343, Hawaii Revised Statutes (HRS), as amended, Environmental Impact Statements, requires that a government agency or private developer proposing to undertake a project consider the environmental impacts of the proposed project. Use of State lands is among the criteria in HRS Ch 343 that triggers the need for an Environmental Assessment (EA). The project would be located on approximately 80 acres of land leased from the State of Hawaii Department of Hawaiian Home Lands (DHHL). This EA has been prepared in accordance with HRS Ch 343, as amended, and Hawaii Administrative Rules Title 11 (HAR 11-200-17), State of Hawaii Department of Health (DOH), Chapter 200, Environmental Impact Statement Rules.

1.3.1 Pre-EA Assessment Consultation

In preparation of this Draft EA, a pre-assessment consultation letter was sent to agencies and organizations on August 6, 2010. The distribution list and correspondence received is included as Appendix A to this EA. Key issues raised included:

- presence of threatened and endangered plants, and anchialine pools,
- presence archaeological resources and burials,
- impact of reflectivity and thermal currents on air navigation,
- potential impacts to navigable waters of the U.S., and
- prevailing land use zoning.

Additional communication occurred with:

- State Department of Transportation (DOT), Airports,
- Federal Aviation Administration (FAA),
- State Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW),
- State Historic Preservation Division (SHPD), and
- Kapolei Hawaiian Civic Club.

1.3.2 Draft EA Review

The Hawaii Office of Environmental Quality Control (OEQC) published DHHL's anticipated Finding of No Significant Impact (FONSI) as a Draft EA in *The Environmental Notice*, which initiates a 30-day comment period. *The Environmental Notice* is posted online (http://oeqc.doh.hawaii.gov/Shared%20Documents/Environmental_Notice) and contains a link to the Draft EA. Comments are to be sent to TEC Inc., as the applicant's representative.

In addition to being available on the OEQC website and at the Kapolei Library, the Draft EA was provided to the following for review and comment:

1.3.2.1 Federal Agencies

Copies of the Draft EA were sent to the following Federal agencies for review:

- Federal Aviation Administration (FAA),
- Department of the Army, Regulatory Branch,
- Naval Facilities Engineering Command,
- U.S. Fish and Wildlife Service (USFWS), and

- U.S. Coast Guard.

1.3.2.2 State Agencies

Copies of the Draft EA were sent to the following State agencies for review:

- Department of Agriculture,
- Department of Accounting and General Services,
- Department of Business, Economic Development and Tourism (DEBDT), Office of Planning,
- DEBDT, Energy Division,
- Department of Defense,
- Department of Education,
- Department of Health (DOH), Environmental Planning Office,
- DOH, Hazard Evaluation and Emergency Response Office,
- Hawaii Community Development Authority (HCDA),
- Department of Human Services,
- Department of Labor and Industrial Relations,
- Department of Land and Natural Resources (DLNR), Land Division,
- DLNR, State Historic Preservation Division (SHPD),
- DLNR, Division of Forestry and Wildlife (DOFAW),
- DLNR, Oahu Island Burial Council,
- Department of Transportation,
- Department of Transportation, Airports Division,
- University of Hawaii, Environmental Center,
- Housing Finance and Development Corporation, and
- Office of Hawaiian Affairs.

1.3.2.3 City and County of Honolulu Agencies

Copies of the Draft EA were sent to the following City and County of Honolulu agencies for review:

- Fire Department,
- Police Department,
- Board of Water Supply,
- Department of Planning and Permitting (DPP),
- Department of Design and Construction,
- Department of Environmental Services,
- Department of Facility Maintenance,
- Department of Parks and Recreation, and
- Department of Community Services.

1.3.2.4 Other

Copies of the Draft EA were sent to the following non-governmental agencies for review:

- Hawaiian Electric Company (HECO),
- Hawaiian Telecom, and
- Ahahui Siwila Hawaii O Kapolei, Neighborhood Board #34.

1.3.3 Final EA

Draft EA comments will be considered in preparation of the Final EA and agency decision. Comment letters and responses will be included in an Appendix of the Final EA. DHHL's determination will be published in the OEQC *Environmental Notice*.

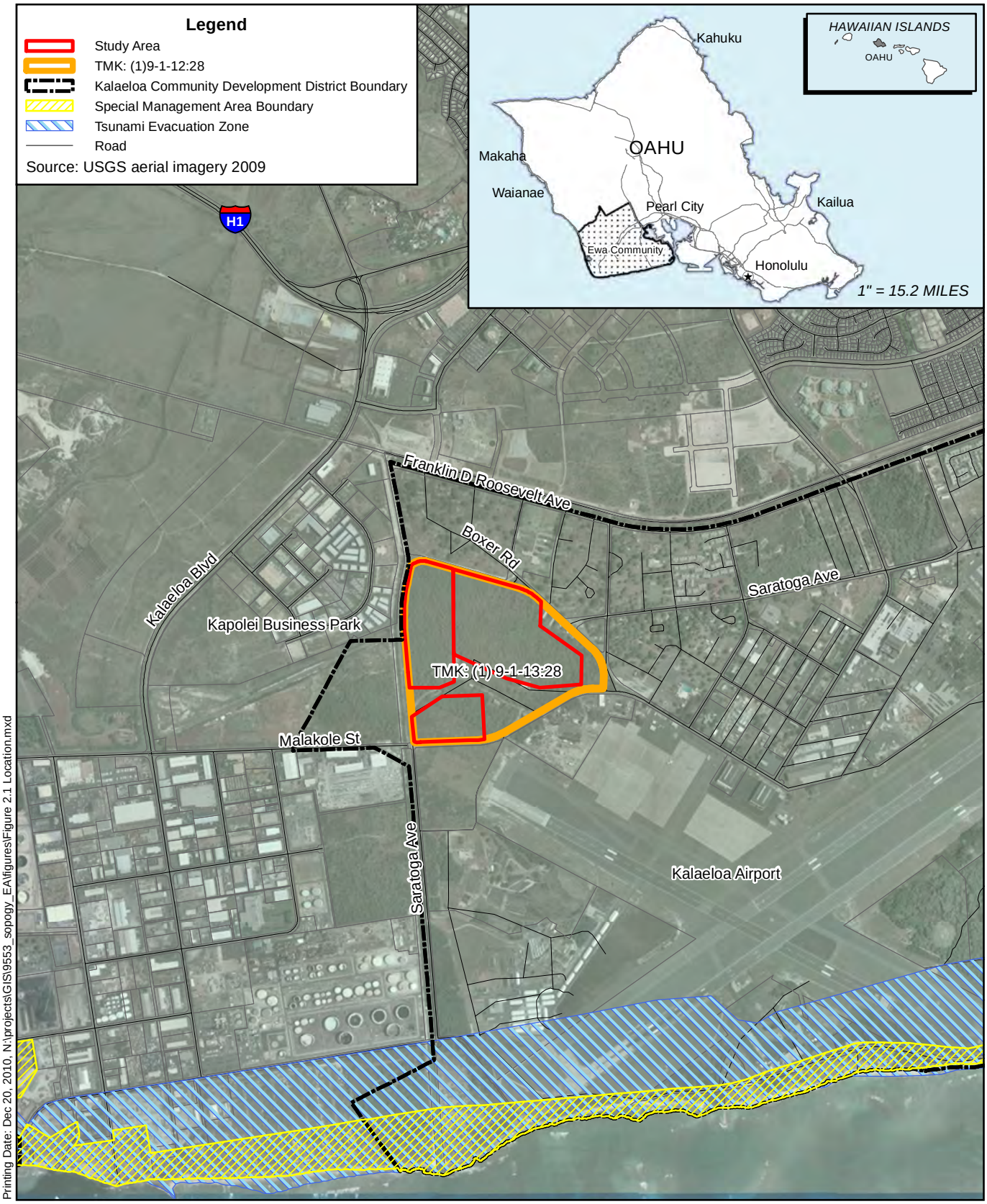
SECTION 2
PROPOSED ACTION

2.1 LOCATION

The project site is located within the *ahupua‘a* of Honouliuli on the southwestern portion of the island of Oahu, in the district of Ewa (Figure 2.1). It is in the northwest area of the former Naval Air Station Barbers Point (NASBP) that was closed in 1999. NASBP is currently the Kalaeloa Community Development District managed by the HCDA. The Navy has retained some NASBP lands, but most have been conveyed to others. The proposed project site is undeveloped, and has no known physical address. The site is void of structures, roads, or other obvious improvements. It consists of about 80 acres within Tax Map Key (TMK): (1) 9-1-13: parcel 028, which is 137 acres. DHHL owns the parcel. The CSP portion of the site is notionally sited within the northeast polygon as shown on Figure 2.2. The PV portion of the site would be within the two other non-contiguous polygons. The project areas shown on Figures 2.1 and 2.2 are larger than 80 acres and represent the study areas for the EA.

The boundaries of the proposed lease area have not been finalized. The final lease boundary would avoid archaeological sites, to the extent practical. Previously identified archaeological sites in the vicinity of study area have been field-verified (Section 3.7). The final lease boundary will be determined based on negotiation with DHHL. The actual lease area would be less than the study area assessed in this EA. The final EA will present the final lease boundaries.

Access to the study areas north of Munda Street is from H-1 via Kalaeloa Boulevard and Saratoga Road (Figure 2.2). There is no existing formal access to the site, but it can be accessed from adjacent unpaved roads to the north and west borders of the site. There is a fence and canal aligned parallel to the west boundary of the site (Figure 2.2). Although access to the unpaved road is blocked off at its intersections with Boxer Road in the north and Saratoga Avenue in the south, there are off-road trails around each roadblock. The area south of Munda Street can be accessed from Midway Road and Munda Street, but there is no paved road that extends into the study area. The study area is covered by dense kiawe and lowland scrub vegetation, except the southernmost portion is graded. The site is about 46 feet above mean sea level with a general gradient topographic slope south-southwesterly direction.

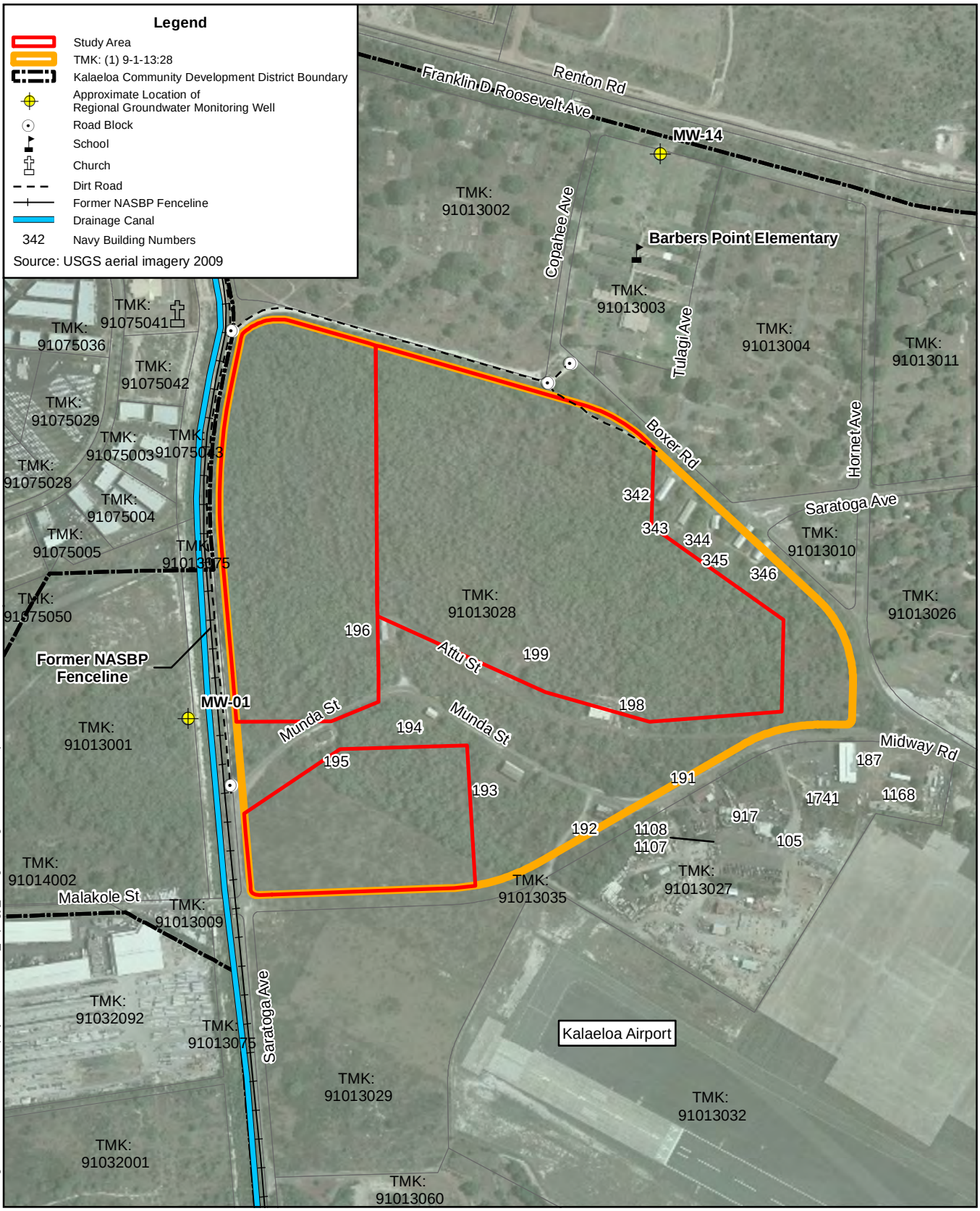


Printing Date: Dec 20, 2010, N:\projects\GIS\9553_sopogy_EA\figures\Figure 2.1 Location.mxd

Feet
0 1,150 2,300
0 275 550
Meters

Figure 2.1
Location Map
Kalaeloa Solar One and Two

N
W E
S



Printing Date: Dec 20, 2010, N:\projects\GIS\9553_sopogy_EA\figures\Figure 2.2 Site Map.mxd

Feet 0 360 720
0 100 200 Meters

Figure 2.2
Site Map
Kalaeloa Solar One and Two

N W E S

2.2 CONSTRUCTION

KSP is proposing to construct two 5 MW power generating facilities in Kalaeloa using two renewable energy technologies: CSP and PV.

Vegetation would be removed with minimal grading required. The site is relatively flat and no dirt would be brought to or removed from the site. Security fencing (chain-link) and entrance gate(s) would be constructed at the perimeter of the site. Entrance to the site has notionally been sited, subject to consultation with HCDA, who is preparing an infrastructure master plan for Kalaeloa (Figure 2.3).

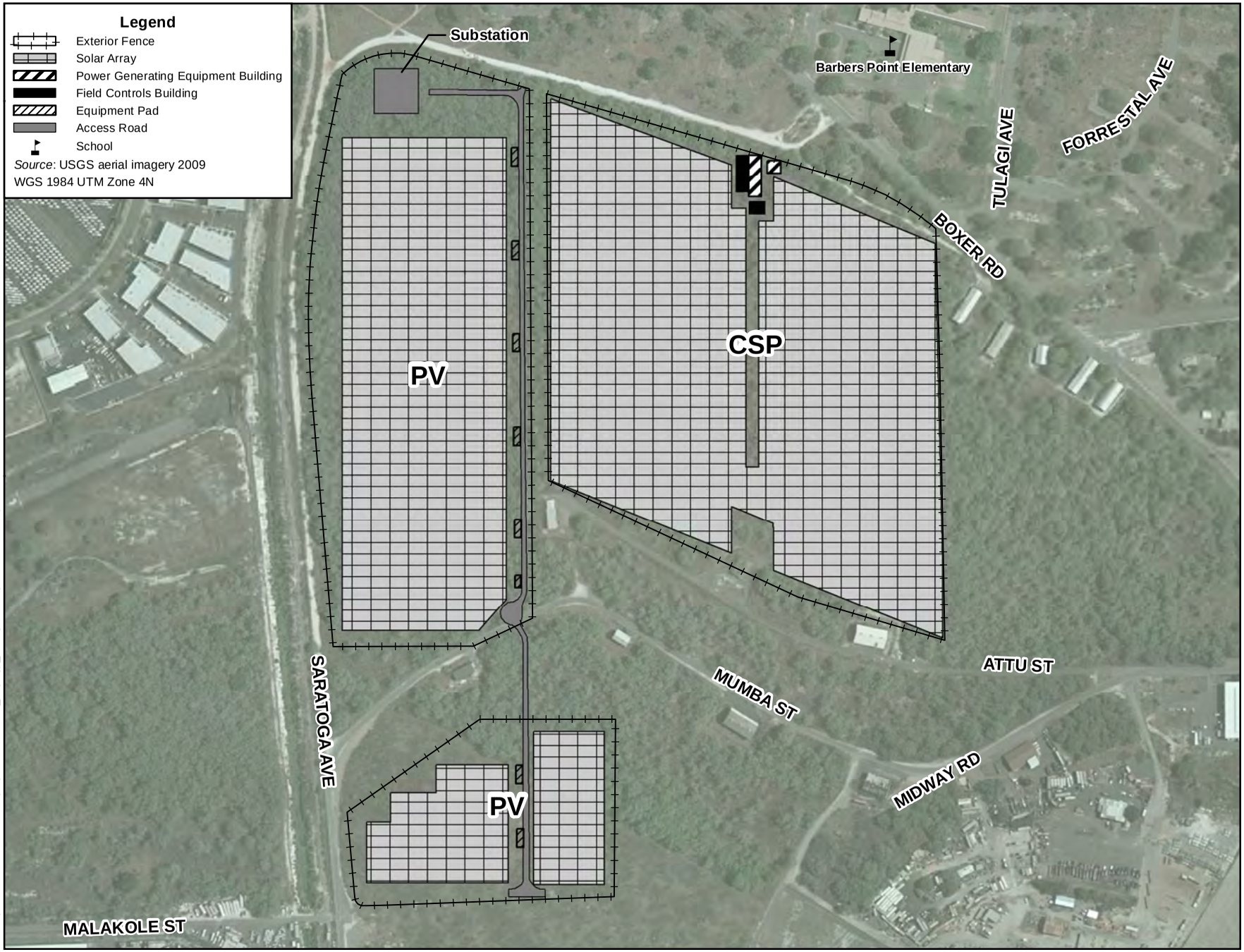
The point of connection to the HECO power grid would be a developer provided substation at the northwest corner of the site (Figure 2.3).

2.2.1 CSP Facilities

There would be approximately 10,800 CSP collectors aligned north-south in 450 rows of 24 collectors per row. The collectors would be mounted to concrete anchors on grade and assembled in rows connected by carbon steel piping to a power block. The installation has a wind-resistant rating of 125 mph. Other operating equipment that would be installed includes a storage tank for the thermal fluid, pumps, flow meters, and temperature sensors.

Two support buildings would be pre-engineered structures on concrete slab on grade. The Controls Office and Storage Building would be two stories in height. It would measure 20 ft by 15 ft, for a total footprint of 300 square feet (ft^2). It would house the interconnection equipment, electrical equipment, controls equipment, a restroom and a storage area on the first floor. The second floor would have a control room and conference room. The second support building is the Power Generating Equipment Building and would be one story. It would measure 80 ft by 40 ft for a total footprint of 3,200 ft^2 and would house power generating equipment and electrical equipment. The two buildings would be constructed near each other and the northern boundary of the site. A conceptual plan is shown on Figure 2.3. The plan is subject to revision and modification based on the negotiated lease and agency consultation.

The heat source sub-system is a closed loop thermal system where the heat transfer fluid, in this case a Food and Drug Administration (FDA) approved organic mineral oil, is heated using solar collectors. MicroCSP™ parabolic trough collectors concentrate the thermal energy from the sun. Due to the curved shape of the CSP collectors the sun's rays are concentrated onto the central absorber pipe (concentration ratio of 60:1), located at approximately one foot above the bottom of the panel, as shown in Figure 2.4. The curved shape also collects the sun's rays to the point where there is minimal external reflection or thermal currents created.



Printing Date: Dec 7, 2010, N:\projects\GIS\9553_sopogy_EA\figures\Figure 2.3 Site Layout.mxd

Feet
0 230 460
0 60 120
Meters

Figure 2.3
Conceptual Layout
Kalaeloa Solar One and Two

N
W E
S

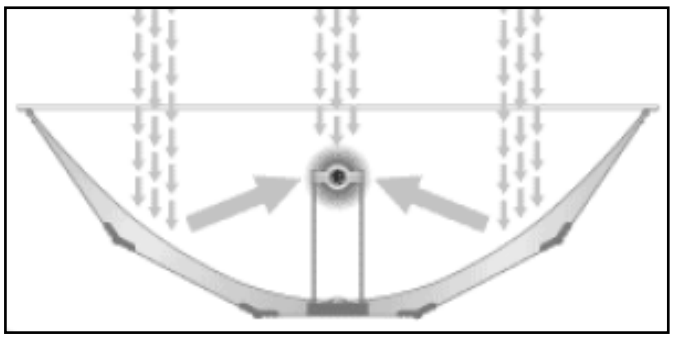


Figure 2.4. Cross-sectional Schematic of the CSP Collector

The heat transfer fluid is heated in the absorber pipe located inside the parabolic trough (Figure 2.4). The pipe conveys the heat transfer fluid through the CSP collectors. A pump is used to circulate the heat transfer fluid from the CSP collectors to the Power Generating Building where the 300-500º F thermal fluid 1) generates steam to drive a steam turbine generator and generate alternating current (AC) electricity, or 2) is temporarily retained in a storage tank before being conveyed to the engine block. The thermal fluid is cooled and recycled through the CSP collectors. The cooling process would rely on water.

Benefits to having a storage tank for the thermal fluid include an uninterrupted electricity supply in the eventuality of clouds or rain where there could be very little or no solar energy.

MicroCSP™ employs a single axis tracking mechanism to maximize the amount of radiant energy captured. The CSP collectors are aligned on a north-south axis and track the sun from east to west throughout the day. Because the purpose of the collectors is to focus the full energy of sun's rays onto the heat absorber pipe, the reflective mirrors are aligned and calibrated to absorb all incoming rays. Most reflective rays would be directed to the lower portion of the CSP collector. Figure 2.5 is a photograph of the Holaniku installation on the Island of Hawaii. It shows the CSP collector directed to the ground when not in use.

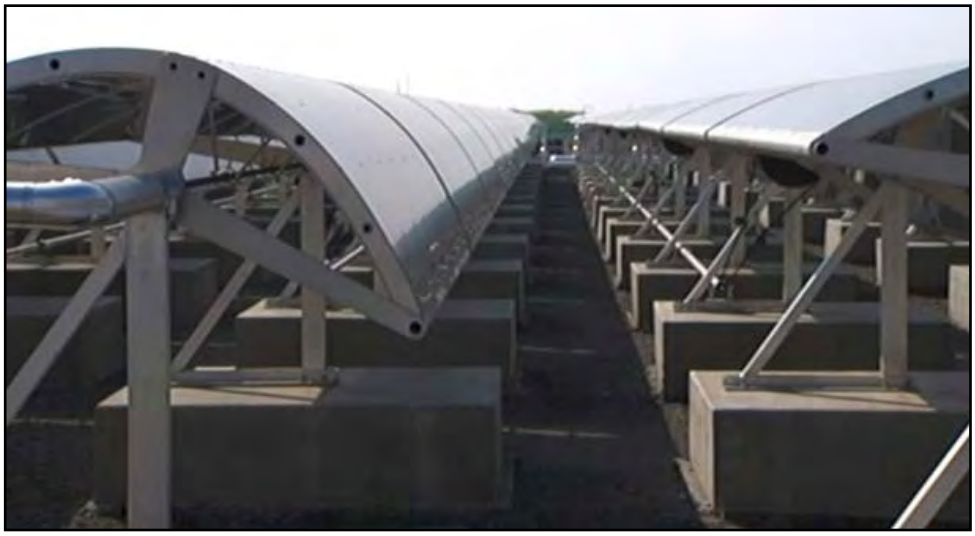


Figure 2.5. Photo of Sopogy™ CSP Installation

The system that moves the mirrors to track the sun uses electric motors on each row to drive them. There is one motor for every four collectors, as well as an inclinometer (to sense the current angle of each row) and a pair of limit switches to prevent the row from turning too far in either direction. There is one controller for every 21 collectors. This device is mounted in the middle of the third row, and power runs from it to each of the six rows. The row controller is responsible for calculating the angle of the sun, and driving each motor one at a time until it is pointed directly at the sun.

Each morning, HECO-supplied power would be used to heat the oil to operating temperature. The system is self-sufficient for the remainder of the day. Additional HECO power is required in the evening for the computer server. Five (5) MW is the anticipated net output to HECO. The CSP system is a closed loop and no air emissions are anticipated.

The connection to HECO's system would be at a new substation onsite that would be shared with the PV facility.

2.2.2 PV Facilities

The PV modules are polycrystalline, aligned north-south and rotate to track the daily east-west movement of sun. Approximately, 18,600 ground-mounted modules are proposed to provide 5 MW of electricity. The rows are linked together as "building blocks" of 250 kW with a single controller and drive unit. The drive unit is a ½ horsepower alternating current (AC) motor (Figure 2.6, left). Approximately 25 drive motors are required. The collectors would be mounted to square corrosion resistant galvanized steel torque tubes that are stabilized and secured to a rigid frame. The installation is designed for 105 mph wind resistance. Three-phase inverters are used to supply AC power from Direct Current (DC) solar modules (Figure 2.6, right). There is protection against back-feeding of the system-generated power to the grid in the event of a utility outage. Integrated with the inverter is the data acquisition system that includes a data logger and sensors to record AC power and equipment to record ambient temperature, irradiance, and wind speed. The data can be monitored remotely.

Figure 2.6. SunPower™ Installation: Drive Unit (left), Equipment Pad and PV Units (right)

The system would be interconnected with a substation (150 ft by 150 ft) at the site that would be shared by the CSP system. A conceptual site plan is shown on Figure 2.3 and is subject to change pending final lease negotiations.

No air emissions or waste material would be generated onsite. Minimal grading would be required.

2.2.3 Labor and Schedule

There would be a peak of 135 workers onsite for the PV facility and approximately 60 for the CSP facility. The construction of the two facilities would likely overlap to some extent over the anticipated 5 month duration; however, the facilities would be constructed independently. Permits for the facilities would be obtained independent of each other. Construction would begin after all necessary permits and approvals have been obtained for each facility (Section 4.2). Construction would be during daylight hours, Monday through Friday. Funding for the proposed action is private. No federal, state or county funding is proposed.

2.3 OPERATIONS

The CSP and PV facilities would operate independently. The intent is to be operational by December 2011 and to operate seven days per week throughout the year. There would be no evening operations. The CSP component would require 30 full-time employees. No onsite employees would be required for the PV component.

The PV operations would require a small auxiliary load for tracker motors, data acquisition and meteorological stations, but the net power generation would be 5 MW of alternating current (ac). The CSP component may rely on HECO power for starting the system every morning, but the net power generated would also be 5 MW.

The Navy is exploring options for conveying the Kalaeloa water system to another service provider (see Section 3.11 for more detail). The City and County of Honolulu (County) would provide sanitary wastewater services, and fire and police protection. Communications (internet and telephone) would be provided to the site. Stormwater would be managed onsite.

Minimal quantities of lubricants would be stored and used onsite in accordance with local and Federal regulations.

2.4 MAINTENANCE

CSP collectors require annual washing for efficient collection of solar radiation. The PV modules are rinsed by rainfall but occasionally may require washing. Pumps and other moving parts require semi-annual lubrication.

2.5 ALTERNATIVES ELIMINATED FROM CONSIDERATION

2.5.1 CSP Facilities

The proposed site at Kalaeloa was not the only site considered for the proposed action. A key requirement is the need for adequate solar energy, ruling out Oahu's windward shores and inland areas, which tend towards overcast and rainy conditions due to the geology of the island. For the fastest implementation possible, agriculturally-zoned parcels were ruled out because zoning laws require a special land use permit to develop agriculturally zoned land, which can take one year or more.

The siting criteria include:

- Average Direct Normal Irradiance (DNI) or direct solar radiation of at least 5.5 $kWh/m^2/day$;

- Access to water for the condenser cycle;
- Access to existing transmission and distribution infrastructure suitable for project size
- Ability to achieve south or near south-facing exposure
- Flat land with less than one degree slope; and
- Area free of shading from mountains, buildings, or trees.

Based on these criteria, sites were limited to sections of Central, South and West Oahu. Central Oahu, which includes the Kunia district, is mostly zoned for agricultural use. Renewable energy projects sited on agricultural land require special use land permits that needs about a year for processing and approval. This applies to grade A and B soil types, which makes up most of this former pineapple plantation. Central Oahu also has a tendency toward cloud cover in the afternoon, making it less desirable for solar power generation than coastal areas on the South or West coasts of Oahu.

On the west side of Oahu, the only available parcel that met the criteria for establishing a solar thermal project was land owned by the DHHL in Maile (TMK:(1)-8-7-10-007). The land has a relatively flat area with good solar resources and access to power lines and a water source. Though this area was identified as a good site for solar energy collection, issues were raised regarding the land utilization for purposes that would not directly benefit the community. With the growing homeless situation spreading on the west side of Oahu, concerns were voiced about the community opposition toward a project which uses land that does not directly address the homeless problem.

Since the parcel already houses a transitional shelter, there are plans to expand the units to alleviate the number of residents living on the beaches. Under these circumstances, gaining community support may pose a significant challenge that could extend the approval process, increasing the costs and undermining the project viability.

The power generating from the facility would reduce the amount of oil the utility burns to generate electricity. However, it would not reduce the electricity rates for the residents on the Waianae and Maile coast. The utility infrastructure at the Waianae Parcel is not ideal, because Waianae is located at the end of line of the current power grid. For all of these reasons, the Waianae Parcel was considered as an alternative, but not carried forward.

2.5.2 PV Facilities

PV technology shares similar siting criteria to CSP technology with respect to slope, solar radiation, south-facing exposure, shading, and proximity to existing transmission and distribution infrastructure. Project site evaluations were similar to areas listed for CSP.

Several sites within Kalaeloa were considered within the State Department of Transportation (DOT) – Airports and FAA jurisdiction at the Kalaeloa Airport, which is south and southeast of the currently proposed site. One of many proposals included the use of a fix tilt PV system. The PV panels would be elevated 12 to15 ft on a steel structure. This would create shaded parking areas for general aviation aircraft. The power generated from the facility would be sold to HECO via a power purchase agreement with a predetermined contract rate and DOT-Airports would receive rent income from general aviation tenants for the shaded tie down stalls beneath the elevated PV system. Current lease rate parameters that

guide the DOT-Airports/FAA have not been developed for this dual use concept and the site was considered infeasible, at this time.

2.6 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, the PV and CSP solar energy farm would not be constructed. 10 MW of renewable energy would not be provided to HECO from the site. There would be a lost opportunity to assist the state in meeting its HCEI goal of having 70 percent of the state's energy come from renewable sources by 2030. Consequently, the alternative does not meet the purpose and need and is not a feasible alternative. It represents existing conditions and is useful as a baseline, against which to measure the impacts of the proposed action.

SECTION 3
AFFECTED ENVIRONMENT AND POTENTIAL IMPACTS

This section describes the existing conditions for each resource that may be impacted by the proposed action or the No-Action Alternative.

Analysis includes potential construction and operations, and direct and indirect impacts. Indirect impacts are defined in HAR 11-200-2 as "effects which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable." Indirect effects could include induced changes in the pattern of land use and related effects on air and water and other natural systems.

3.1 LAND USE

Land use includes existing, and planned land uses. Zoning regulations and planning guidance are also described in this section.

3.1.1 Existing Conditions

3.1.1.1 Land Ownership

In 1941, land owner James Campbell leased what became the NASBP to the U.S. Navy (U.S. Navy 1992). NASBP was recommended for closure by the Base Realignment and Closure (BRAC) of 1993, and was officially closed in 1999.

As of 2006, 25 percent (929 ac) of the former NASBP was retained by the Navy, 44 percent (1,621 ac) was conveyed to government or private owners, and 31 percent (1,146 ac) remained pending conveyance (HCDA 2006). The project site is located on a portion of TMK: (1):9-1-13:28, which is currently owned by DHHL. KSP proposes to enter into a 20 year lease for the project site.

3.1.1.2 Regional Land Use

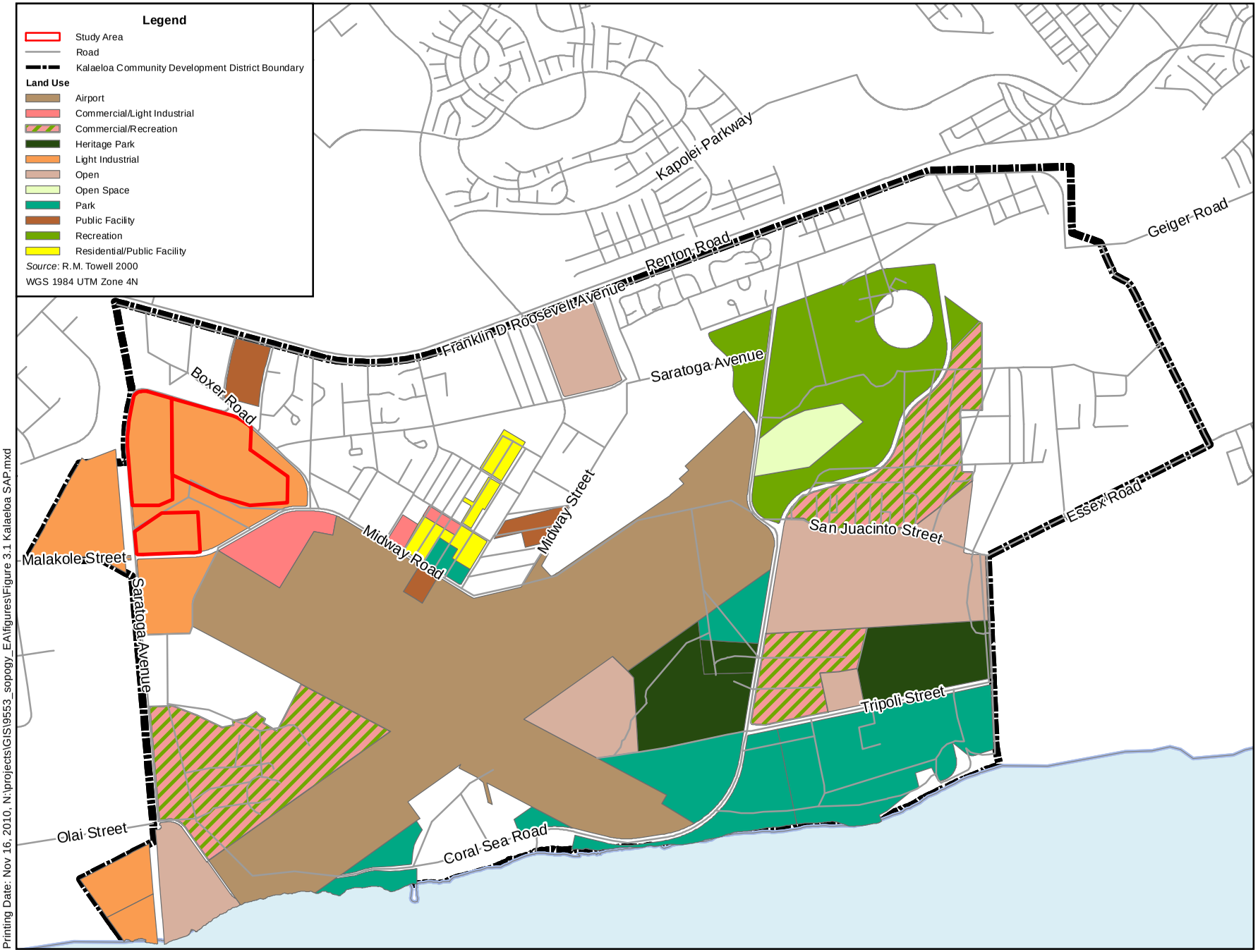
The Ewa Development Plan was written by the County Planning Department in 1997, and was updated in 2008 to guide land use in the region. The NASBP Redevelopment Commission was formed in 1994 and developed a Community Redevelopment Plan in 1997 that was adopted by the Navy and is in compliance with the County's Ewa Development Plan. The County adopted the Kalaeloa Redevelopment Plan as a Special Area Plan of the Ewa Development Plan dated December 2000.

The 2008 DHHL Kapolei Regional Plan does not include goals for the project area.

3.1.1.3 Kalaeloa Land Use and Zoning

Currently, the site is undeveloped and vegetated. Based on a review of historical photographs, the site was vacant throughout the NASBP operations (TEC Inc. 2010a and b).

The Special Area Plan designates the project site (and entire TMK parcel) as Parcel 4 intended for light industrial land uses (Figure 3.1) and the I-1 zoning classification would apply; however, the proposed zoning was never adopted in the official zoning maps.



Printing Date: Nov 16, 2010, N:\projects\GIS\9553_sopogy_EA\figures\Figure 3.1 Kalaeloa SAP.mxd

Feet
0 1,250 2,500
0 325 650
Meters

Figure 3.1
Kalaeloa Special Area Plan
Kalaeloa Solar One and Two

N
W E
S

The County zoning maps continue to show the project site as F1- Military and Federal preservation, but the site is no longer federal land and the default zoning is P-2 General Preservation (Appendix A, County Pre-assessment Consultation letter).

The proposed action would conform to the County's P-2 General Preservation. The County has determined this project is considered a power generation project, which are considered "Utility Installations, Type B", and subject to a minor conditional use permit (Appendix A, County's pre-assessment consultation letter).

In July 2002, Act 184 of the 2002 Hawaii State Legislature transferred redevelopment responsibility from the NASBP Redevelopment Commission to the HCDA. The Kalaeloa Master Plan was prepared in 2006 (HCDA 2006), and designated land to be used for residential, light industrial, eco-industrial, military, and parks and recreation purposes (Figure 3.2). Neither the Master Plan nor administrative rules for development standards have been officially adopted. Once they are adopted, the County would defer to HCDA for development approvals within the Kalaeloa Development District. In the interim, P-2 General Preservation development standards apply to the project.

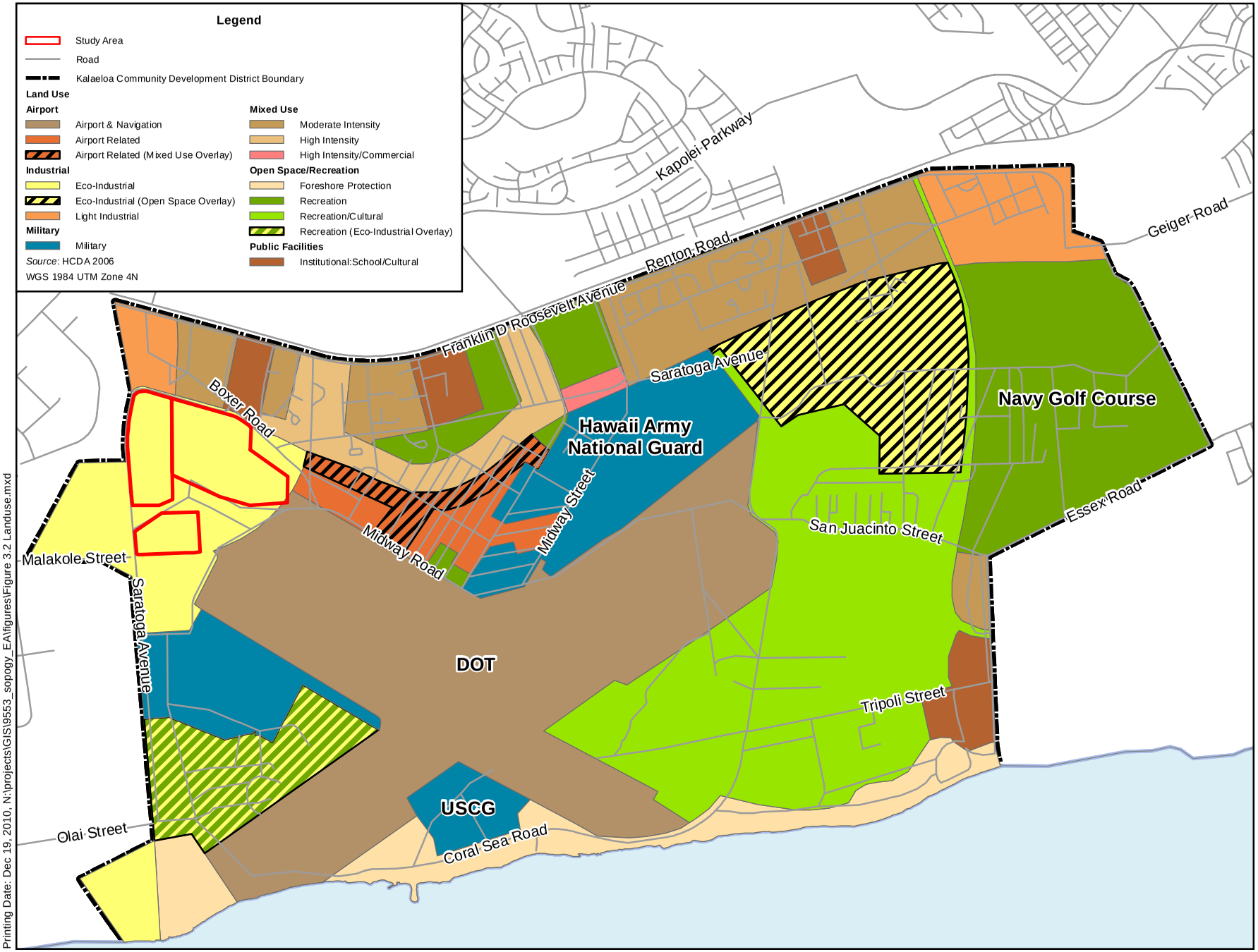
Under the proposed Kalaeloa Master Plan, the project site (and entire TMK parcel) is located within parcels 1N and 1Q, designated for eco-industrial land use. These parcels are specifically intended to contribute to reducing the state's dependence on fossil fuels (HCDA 2006). Eco-industrial uses are defined as environmentally compatible industries that benefit the entire population of Oahu. Solar energy is specifically named in the Master Plan (2006) as a permitted use. HCDA will review the EA for consistency with the rules that are being developed.

The adjacent properties north, east, south, and southwest are within the HCDA Kalaeloa Community Development District boundaries. Residential areas were historically located north of the project site. The housing was demolished and is area is overgrown with vegetation. Barbers Point Elementary School occupies a parcel north of the project site and Boxer Road (Figure 2.2). Outside of the project site but within the same TMK parcel are warehouse-type buildings (Figure 2.2).

West of the site, Saratoga Avenue and the drainage canal are Kapolei Business Park, including offices, warehouses, a church and a portion of Kalaeloa that is undeveloped (TEC Inc. 2010a and b) (Figure 2.2).

3.1.1.4 Land Use Constraints

The Kalaeloa Airport was transferred the State Department of Transportation (DOT) under a public benefit conveyance. There are two parallel runways (4R-22L and 4L-22L approximately aligned northeast-southwest and an intersecting cross wind runway (11-29) approximately aligned northwest-southeast. The southernmost project site boundary is near the end of Runway 11. For noise abatement, Runway 11 is used for departures only and Runaway 29 arrivals only. The overflight is to avoid residential areas and schools located north and east of the airport (FAA 2010). The airport is a reliever airport and would serve 60 percent of the small single-engine and light twin engine propeller aircraft forecasted to be based in Honolulu and about 50 percent of the general aviation aircraft projected to be based at Dillingham Airfield in 2020 (DOT 2010). The airfield is also the U.S. Coast Guard's primary aviation Search and Rescue facility for 12 million square miles of the Central Pacific Region (Appendix A, U.S. Coast Guard letter).



Printing Date: Dec 19, 2010, N:\projects\GIS\9553_sopogy_EA\figures\Figure 3.2 Landuse.mxd

Feet
0 1,250 2,500
0 325 650
Meters

Figure 3.2
Land Use
Kalaeloa Solar One and Two

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There are development restrictions near airports: Horizontal Zones and Approach Zones. The site is within the 180-ft height limit Horizontal Zone generated by Kalaeloa Airport runways. The southwest corner of the site is within the Approach Zone of Runway 11, where the height limitation is between 60 and 100 ft. (Figure 3.3).

The site is not within the County's Special Management Area (SMA), as shown on Figure 2.1 and is not subject to SMA development standards. Other constraints associated with flood zones and Tsunami zones are addressed under Water Resources.

3.1.2 Impacts

For the purposes of this EA, the land use impacts are considered significant if the proposed land use:

- is inconsistent or in compatible with existing land-use plans,
- precludes an existing land use activity, or
- is inconsistent or incompatible with planned land uses.

3.1.2.1 Proposed Action

Land Ownership

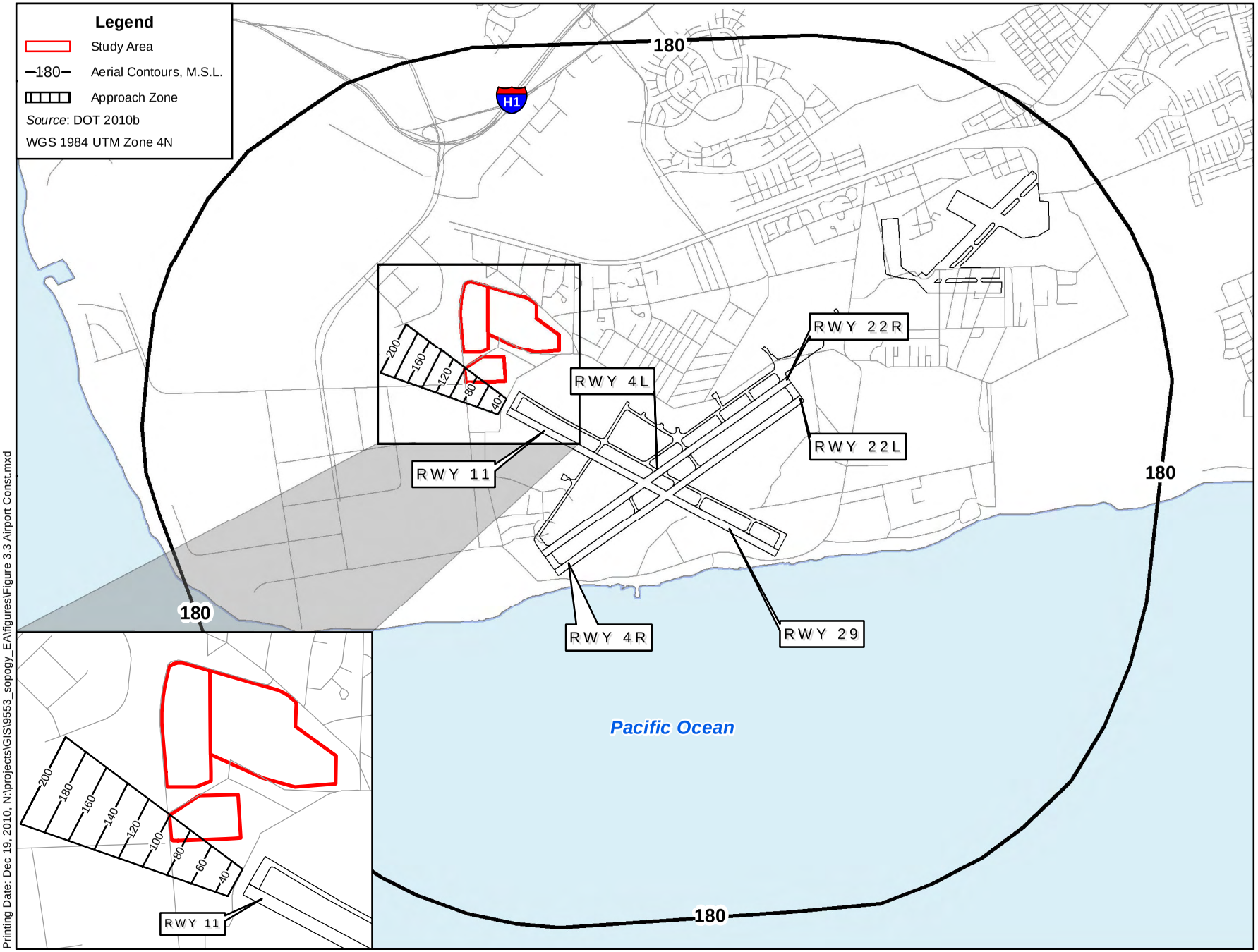
The site is vacant and there would be no pre-existing land use to relocate. The landowner would continue to be DHHL.

Regional and Kalaeloa Land Use and Zoning

Under the existing P-2 General Preservation zoning, this project would be a Utility Installation, Type B and would require a Minor Conditional Use Permit from the County, according to the September 14, 2010 pre-assessment consultation letter from the County DPP (Appendix A).

The proposed action is consistent with the Ewa Development Plan, Kalaeloa Community Redevelopment Plan, Special Area Plan Light Industrial zoning designation and the HCDA Kalaeloa Master Plan, Eco-industrial land use designation. But these zoning designations have not been adopted and administrative rules for the HCDA Kalaeloa Community Development District are pending.

The surrounding land uses are generally vacant, commercial or airfield related. Notable exceptions are the Barbers Point Elementary School to the north and a church in Kapolei Business Park. Neither of these shares a boundary with the project site. The project is essentially a field of solar collectors and panels and is compatible with surrounding land uses. The solar farm is an eco-industrial use that is consistent with the Kalaeloa Master Plan land use designations of planned light industrial, or mixed use - moderate intensity in the north, east, south and southwest. Similarly, it is consistent with the Ewa Development Plan land use designation of Industrial.



Printing Date: Dec 19, 2010, N:\projects\GIS\9553_sopogy_EA\figures\Figure 3.3 Airport Const.mxd

Feet
0 2,050 4,100
0 590 1,180
Meters

Figure 3.3
Airport Constraints
Kalaeloa Solar One and Two

N
W E
S

Land Use Constraints

The greatest facility height proposed is the two-story (approximately 30 ft) Controls Office and Storage Building and it would not exceed the 180 ft horizontal zone (Figure 3.3) limit that DOT mentioned in their letter (Appendix A). These facilities are notionally sited at the northern boundary of the site and would not be within the runway visual approach zones. The southernmost portion of the site is within the runway 11-29 visual approach zone (Figure 3.3), but there are no structures proposed that would exceed the 60 to 100 ft height restriction. The portion of the PV facility that would be within the approach zone would be less than 10 ft in height.

The US Coast Guard pre-assessment consultation letter (Appendix A) expressed concern that 1) the thermal currents near the site could create hazardous turbulence, and 2) the reflected light from the solar panels could impact visibility (Appendix A). The state DOT also expressed concern about the reflectivity of the solar panels (Appendix A). KSP meet with FAA and DOT-Airports, and filed Form 7460-1: Notice of Proposed Construction or Alteration and response is pending. Based on similar installations near other airports, no adverse impact to air navigation is expected from reflectivity of the CSP or PV panels or the generation of thermal air currents. FAA will review the application materials and determine if there is an impact to air navigation. The Final EA is anticipated to include an FAA Determination of No Hazard for Air Navigation.

There are no DOT standards for assessing reflectivity or thermal currents. Airports have not established zones or guidelines for siting solar farms and FAA makes its determination on a case by case basis.

The shape of the CSP collector would not produce significant glare or reflection that would pose a distraction to aviation. The focal point created by the parabolic mirror would not allow concentrated rays to escape. The reflected incident rays of the sun would be generally directed to the lower portion of the CSP collector and aircraft flying above would not be exposed to reflected incident rays.

The thermal current issue was addressed at larger installations of the CSP technology in California. In those particular examples, at approach altitude (200-300 ft) the four observers in two aircraft experienced no unusual turbulence or thermal plume rising from the solar array. The turbulence above and downwind was similar to overflight of smooth water (State of California 2007).

The flat PV panels are designed to capture and retain as much of the solar spectrum as possible. The glass is less reflective than water, galvanized steel (used in industrial roofs) or window glass. Previous SunPower™ installations near airports have received a Determination of No Hazard to Air Navigation from FAA.

In the event that a situation occurred that caused a reflection or generated thermal currents with impacts on air navigation, both the CSP and PV collectors' glass surfaces could be redirected to the ground within a minute of activation.

No other potential land use constraints were identified at the site. No indirect impacts to land use in the area surrounding the project site would occur. The project is consistent and compatible with existing and planned surrounding land uses. No significant impacts to land ownership or use would occur as a result of the proposed action. No cumulative land use impacts were identified.

3.1.2.2 No-Action Alternative

Under the No-Action Alternative, no changes to the proposed site would occur. DHHL would continue to own the land. Therefore, there would be no significant impact to land ownership or use under the No-Action Alternative.

3.2 AIR QUALITY

Air quality is defined as the ambient air concentrations of pollutants determined by the U.S. Environmental Protection Agency (USEPA) to be of concern to the health and welfare of the general public. The designated criteria pollutants include:

- ozone (O_3),
- carbon monoxide (CO),
- nitrogen dioxide (NO_2),
- sulfur dioxide (SO_2),
- particulate matter less than 2.5 microns in diameter ($PM_{2.5}$),
- particulate matter less than 10 microns in diameter (PM_{10}), and
- lead.

The Clean Air Act (CAA) of 1970 established air quality regulations and National Ambient Air Quality Standards (NAAQS). The State of Hawaii Department of Health (DOH) enforces air pollution regulations and sets guidelines to maintain the NAAQS and Hawaii Ambient Air Quality Standards (HAAQS) within the State of Hawaii.

Table 3.1 lists NAAQS and HAAQS. These are the maximum allowable concentrations of criteria pollutants that are considered safe to protect human health and welfare. NAAQS have both primary and secondary standards. Primary standards are aimed at protected human health, in areas that are considered sensitive, such as residential neighborhoods, churches, libraries, schools and parks. Secondary NAAQS are aimed at protection of plants and animals.

Table 3.1 National and Hawaii State Ambient Air Quality Standards

Criteria Pollutant	*Averaging Time*	*HAAQS*	*NAAQS*	
			Primary	*Secondary*
Hydrogen Sulfide	1-Hour Maximum	0.025 ppm (35 µg/m^3)	--	--
Ozone	8-Hour Maximum	0.08 ppm (157 µg/m^3)	0.075 ppm (147 µg/m^3)	0.075 ppm (147 µg/m^3)
Carbon Monoxide	1-Hour Maximum	9 ppm (10 mg/m^3)	35 ppm (40 mg/m^3)	--
	8-Hour Maximum	4.4 ppm (5 mg/m^3)	9 ppm (10 mg/m^3)	--
Lead	Average Over 3 Months	--	0.15 µg/m^3	0.15 µg/m^3
	Quarterly Average	1.5 µg/m^3	1.5 µg/m^3	1.5 µg/m^3
Nitrogen Dioxide	Annual Mean	0.04 ppm (75 µg/m^3)	0.053 ppm (100 µg/m^3)	0.053 ppm (100 µg/m^3)
Particulate Matter (PM_{10})	Annual Mean	50 µg/m^3	--	--
	24-Hour Average	150 µg/m^3	150 µg/m^3	150 µg/m^3
Particulate Matter ($PM_{2.5}$)	Annual Mean	--	15.0 µg/m^3	--
	24-hour Average	--	35 µg/m^3	--

Criteria Pollutant	*Averaging Time*	*HAAQS*	*NAAQS*	
			Primary	*Secondary*
Sulfur Dioxide	Annual Mean	0.03 ppm (80 µg/m^3)	0.03 ppm (80 µg/m^3)	--
	24-Hour Maximum	0.14 ppm (365 µg/m^3)	0.14 ppm (365 µg/m^3)	--
	3-Hour Maximum	0.5 ppm (3,000 µg/m^3)	--	0.5 ppm (3,000 µg/m^3)
Note: HAAQS = Hawaii Ambient Air Quality Standards; NAAQS = National Ambient Air Quality Standards				

Air quality can be affected by both stationary and mobile sources. Examples of stationary sources include combustion and industrial stacks. Mobile sources include vehicular traffic and aircraft. Areas that exceed ambient air quality standards are designated as nonattainment areas and areas that comply with ambient air quality standards are designated as attainment areas. Areas without data to determine whether they are in attainment or nonattainment status are considered unclassified and are assumed to be in attainment.

The DOH Clean Air Branch (CAB) regulates stationary sources of air pollutants and issues permits. Permits limit emissions of pollutants and require monitoring. The state does not regulate mobile sources; however, these sources must meet NAAQS.

3.2.1 Existing Conditions

Winds are generally northeasterly trade winds. The nearest air quality monitoring station run by the DOH-CAB is located in Kapolei, and measures CO, NO_2, PM_{10}, $PM_{2.5}$, and SO_2. The Kapolei area is in attainment with both the HAAQS and NAAQS for all criteria pollutants and is not subject to the CAA General Conformity Rule.

Campbell Industrial Park is likely the largest source of stationary air emissions on the island of Oahu, yet is within an attainment area. There are no significant stationary air emission sources at Kalaeloa and mobile sources, such as motor vehicles are not likely to significantly degrade air quality.

3.2.2 Impacts

Clean Air Act requirements (Table 3.1), are used to determine if impacts of the proposed action are significant. Since the area is currently in attainment, any emissions causing any criteria pollutant to rise above attainment levels would be significant. Additionally, air emissions that would expose sensitive receptors (e.g., schools, housing, childcare centers, etc.) to substantial pollutants or create odors are also considered significant.

3.2.2.1 Proposed Action

During the construction phase, emissions would be generated by heavy machinery powered by fossil-fuels and dust emissions as a result of grading and operation of equipment on cleared soil. Construction emissions would be temporary (less than two months for grading).

Best management practices (BMPs) would be required by the County grading and grubbing permit conditions to control dust during construction. BMPs include dust fences to keep the dust on-site, and watering to minimize the amount of dust produced. All construction activities would comply with

regulations for fugitive dust control under HAR Section 11-60.1-33 that require reasonable precautions to prohibit visible fugitive dust beyond the property line. If generators are used, a stationary source permit would be obtained from the DOH-CAB.

Emissions are not expected to exceed the CAA major source threshold of 250 tons per year for construction. Construction emissions would be less than significant with implementation of the proposed action.

Operational emissions associated with the proposed action would be limited to employee vehicular traffic at the CSP project area. No other operational emissions are anticipated. During operations, there would be a beneficial indirect impact resulting from the reduction in the dependence on fossil fuel to generate electricity. There would be a reduction in criteria pollutants generated. Operation and construction impacts on air quality would be less than significant under the proposed action. Construction BMPs would minimize direct and indirect impacts to ambient air quality. There would be no additive adverse cumulative impact on air quality during operations.

3.2.2.2 No-Action Alternative

Under the No-Action Alternative, no changes to the proposed site would occur. Therefore, there would be no significant impact to air quality under the No-Action Alternative.

3.3 NOISE

Noise is defined as unwanted or annoying sound. Sound is made up of sound waves that travel to the auditory organs. Sound, often described by the relative term "loudness," is measured in decibels (dB). A decibel is a logarithmic ratio, thus an increase of 10 dB is perceived as a 100 percent increase in sound. Noise can be generated by both natural and human-created sources. Noise can have negative effects on physical and psychological health, affect workplace productivity, and degrade quality of life.

Human perception of sound is accounted for by factors other than the actual sound level, including the duration of the sound, the frequency of the sound, and fluctuations in the sound level. The human ear can recognize frequencies between 20 and 20,000 hertz, but is most sensitive to frequencies of 1,000 to 8,000 hertz. Because there are multiple factors contributing to perception of sound, sound levels are weighted. A-weighted sound levels (dBA) place emphasis on frequencies between 1,000 and 8,000 hertz (Newman 1984). Table 3.2 shows sound levels and their associated noise impacts.

Table 3.2. Sound Levels

Sound Level (dBA)	*Noise Impact Level*
60	Average Urban Noise
70	Noise level of minor concern
75	Noise level of moderate concern
80	Intrusive noise level
85	Problematic noise level
90	Noise level to be avoided
Source: Newman et al. 1984	

Sound exposure level (SEL) is another weighted measure of sound that incorporates the duration of a sound event with the sound level.

The day-night average sound level (DNL) is the average sound level of all SEL values within a 24-hour period. Because humans are more sensitive to noise annoyance at night, a 10-dBA penalty assigned to noise occurring from10:00 pm to 7:00 am. The FAA uses the DNL to measure impacts associated with air traffic, and the DNL is used in environmental analysis because it has proved to be a consistent measure of noise annoyance.

Construction noise, often created by heavy machinery, is generally limited to day-time hours. Construction requires a permit from the DOH. The maximum acceptable sound level for construction at is 78 dB. Construction noise may be generated Monday through Friday between 7:00 am and 6:00 pm and Saturday between 9:00 am and 5:00 pm. Construction generating more than 78 dB during these hours requires a noise permit from the DOH. Construction occurring outside the designated hours requires a community noise variance from the DOH.

3.3.1 Existing Conditions

Existing noise in the Kalaeloa area is predominantly created by roadway and air traffic. Roadway traffic in the vicinity of the proposed action site is relatively light and does not create a noise disturbance. The Kalaeloa Airport is southeast of the proposed site and is used daily by the US Coast Guard, the Honolulu Community College, and the University of North Dakota flight school. The proposed site is outside the projected 60 dB contour for the airports (DOT 2010), and is located under the final approach path for Honolulu International Airport. The Kalaeloa Airport annual aircraft operations for 2020 are projected to be 203,600 (DOT 2010).

3.3.2 Impacts

The primary factors considered in determining the significance of potential noise impacts is the extent or degree to which implementation of the proposed action would alter the current noise environment and affect sensitive receptors in the area. Potential changes in the noise environment can be beneficial (i.e., if the number of sensitive noise receptors exposed to unacceptable noise levels is reduced), negligible (i.e., if the total area exposed to unacceptable noise levels is essentially unchanged), or adverse, (i.e., if they result in increased exposure to unacceptable noise levels).

3.3.2.1 Proposed Action

Construction of the proposed action would require a noise permit from the DOH if it exceeds 78 dB Monday through Friday between 7:00 am and 6:00 pm and Saturday between 9:00 am and 5:00 pm. Construction occurring outside the designated hours is not anticipated, therefore a community noise variance from the DOH would not be required. Noise levels would be typical of standard construction activities, would cease with the completion of proposed construction activities, and would only occur during normal working hours. Construction workers would be subject to Federal and local safety regulations requiring hearing protection. There would be no significant impacts from noise on the nearest sensitive receptors, namely the Barbers Point Elementary School to the north or the church to the west of the project site in the Kapolei Business Park area.

Operations at the site would not generate noise that exceeds the acceptable noise levels beyond the site boundaries. The CSP engine would generate noise but would be housed in a building. There would be no significant short-term or long-term impacts on ambient noise associated with the proposed action.

3.3.2.2 No-Action Alternative

Under the No-Action Alternative, no changes to the proposed site would occur. Therefore, there would be no significant impact to ambient noise under the No-Action Alternative.

3.4 GEOLOGY AND SOILS

Geology describes the characteristics of surface and subsurface materials that make up land. These characteristics include stability, slope, compatibility, shear strength, and productivity. Soil characteristics determine the ability for the ground to support structures and facilities and determine likelihood of erosion and run-off. Topography describes surface features of an area and is usually described with respect to elevation, slope, aspect, and landforms.

3.4.1 Existing Conditions

3.4.1.1 Geology

The underlying geology of the Ewa Plain is composed of basalt from the lava flows of the Waianae Volcanic Series that originally created the west side of the island some three million years ago (Macdonald et al. 1970:423), The coral reef limestone overlies the basalt, and is found in a layer lying 50 to 1,000 feet below the surface of the land. Fluctuations in sea level produced alternating layers of terrestrial sedimentary rock types in the coastal plain areas (NAVFAC Pacific [Naval Facilities Engineering Command, Pacific Division] 1994).

Sinkholes, depressions in the surface of the earth where there is little fill over the coral reef limestone, are found across the Ewa Plain. Unique anchialine pools, which are sinkholes that connect to the ocean through cracks in the substrate, are preserved at the Kalaeloa Unit of the Pearl Harbor National Wildlife Refuge, approximately 8 miles east of the proposed action site.

3.4.1.2 Soil

Soil in the Kalaeloa area is limited to a thin layer of topsoil and is reddish in color (U.S. Department of Agriculture 1972). The site is covered predominantly by soil categorized as Coral outcrop and Mamala stony silty clay loam (USDA 2010) (Figure 3.4). Coral outcrop consists of calcerous coral sand. Mamala stony silty clay loam consists of coral stones in the reddish-brown loam surface, underlain by coral limestone. Run-off is slow, and the erosion rate of Mamala stony silty clay loam is low.

In 1975, the U.S. Department of Agricultural Soil Conservation Service (now Natural Resources Conservation Service) initiated a nationwide inventory of soils to identify soils that were considered prime, unique or other farmlands of state-wide and local importance. The State of Hawaii developed a similar classification adopted by the State Department of Agriculture under the title “Agricultural Lands of Importance to the State of Hawaii” (ALISH). Prime agricultural lands are best suited for food, forage and timber crops. Unique agricultural land is defined as land other than prime, used for production of food, feed, fiber, and forage crops. Other agricultural land is for the production of food, feed, fiber and forage crops, but not classified as prime or unique.

According to the 1977 ALISH Ewa area map, the project site is not classified as prime, unique or agricultural land. The site is not currently used for agriculture. Neither of the types of soil found on the

proposed site qualifies as Prime Farmland (USDA 2010). Both soils are well drained; meaning standing water is unlikely to be found after rainfall.

3.4.1.3 Topography

The proposed action site is located at an elevation of approximately 46 feet above sea level (Figure 3.4). The Kalaeloa area has a maximum elevation of 65 ft along the northern border to sea level at the southern coast, with a general surface gradient to the south.

3.4.2 Impacts

Potential impacts to geology and soils include soil erosion, degradation of unique geological features, significant change in topography, or use of prime farmlands. Measures taken during the construction process can prevent significant impacts to soil.

3.4.2.1 Proposed Action

Soil at the proposed site is not considered Prime or Important for agriculture by the USDA. Both Coral Outcrop and Mamala Stony Silty Clay Loam are well drained and sufficient to support the structures as described in the Proposed Action.

Solar panels would be mounted to concrete anchors or other stabilizing structure on grade. Minimal grading and soil disruption would occur for the installation of the panels. Building foundations would total approximately 27,200 ft^2, including equipment pads, substations and support buildings. Minimal subsurface excavation would be required to set the footings and slab foundations for the buildings. This would displace a small amount of soil relative to the 80-acre site and create a minor amount of new impervious surface.

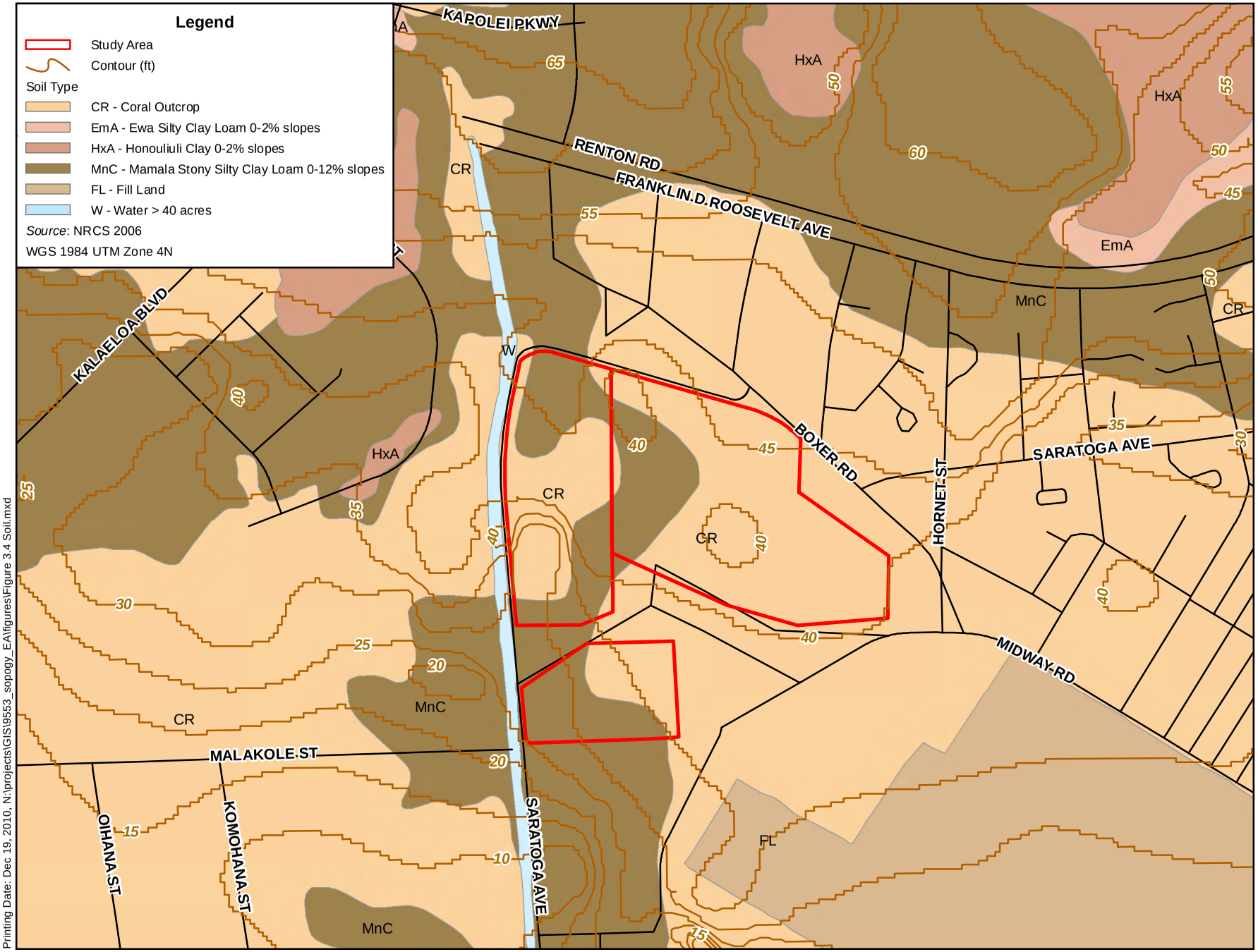
A topographic survey of the site is in progress. Any sinkholes discovered would be avoided. A grading and grubbing permit would be required from the County DPP prior to construction. Because of the relatively flat topography of the proposed site, grading would be minimal. A grading plan is being prepared.

BMPs to prevent erosion and potential stormwater runoff to surrounding areas would be implemented during the construction process.

There would be no anticipated significant direct or indirect impacts to geology and soil resources during operation of the proposed action. Stormwater would be managed onsite. There would be no additive cumulative impact on geology or soils.

3.4.2.2 No-Action Alternative

Under the No-Action Alternative, no changes to the proposed site would occur. Therefore, there would be no significant impact to geology or soil under the No-Action Alternative.



Printing Date: Dec 19, 2010, N:\projects\GIS\9553_sopogy_EA\figures\Figure 3.4 Soil.mxd

Feet
0 485 970
0 130 260
Meters

Figure 3.4
Topography and Soils
Kalaeloa Solar One and Two

N
W E
S

3.5 WATER RESOURCES

Water resources include surface water, groundwater, nearshore water and wetlands. Surface water includes all water found on land, such as stormwater, lakes, canals, streams and rivers. Groundwater is found in aquifers beneath the surface of the earth, and its quality is of great importance because it is often used for potable water. For the purposes of this document, nearshore waters are defined as coastal waters extending from the shore to a depth of 60 ft.

In 1972, the Clean Water Act (CWA) was enacted to protect water resources. The U.S. Army Corps of Engineers (ACOE) is the enforcing agency of the CWA. The purpose of the CWA is to restore and maintain the health of water resources in the U.S. by preventing pollution and assisting in proper wastewater management (USEPA 2010). Wetlands are addressed in Section 3.6.

3.5.1 Existing Conditions

3.5.1.1 Surface and Nearshore Water

Kalaeloa is relatively dry, with an annual precipitation averaging of 20.3 inches (HCDA 2006). Because there is little precipitation and the soils in the area are well-drained, there are no streams or rivers in the Kalaeloa area. Stormwater ponding is rare at the proposed site because rainfall readily permeates into the sub-surface aquifer. Stormwater from the surrounding watersheds, Honouliuli and Ewa Beach, drains into Pearl Harbor.

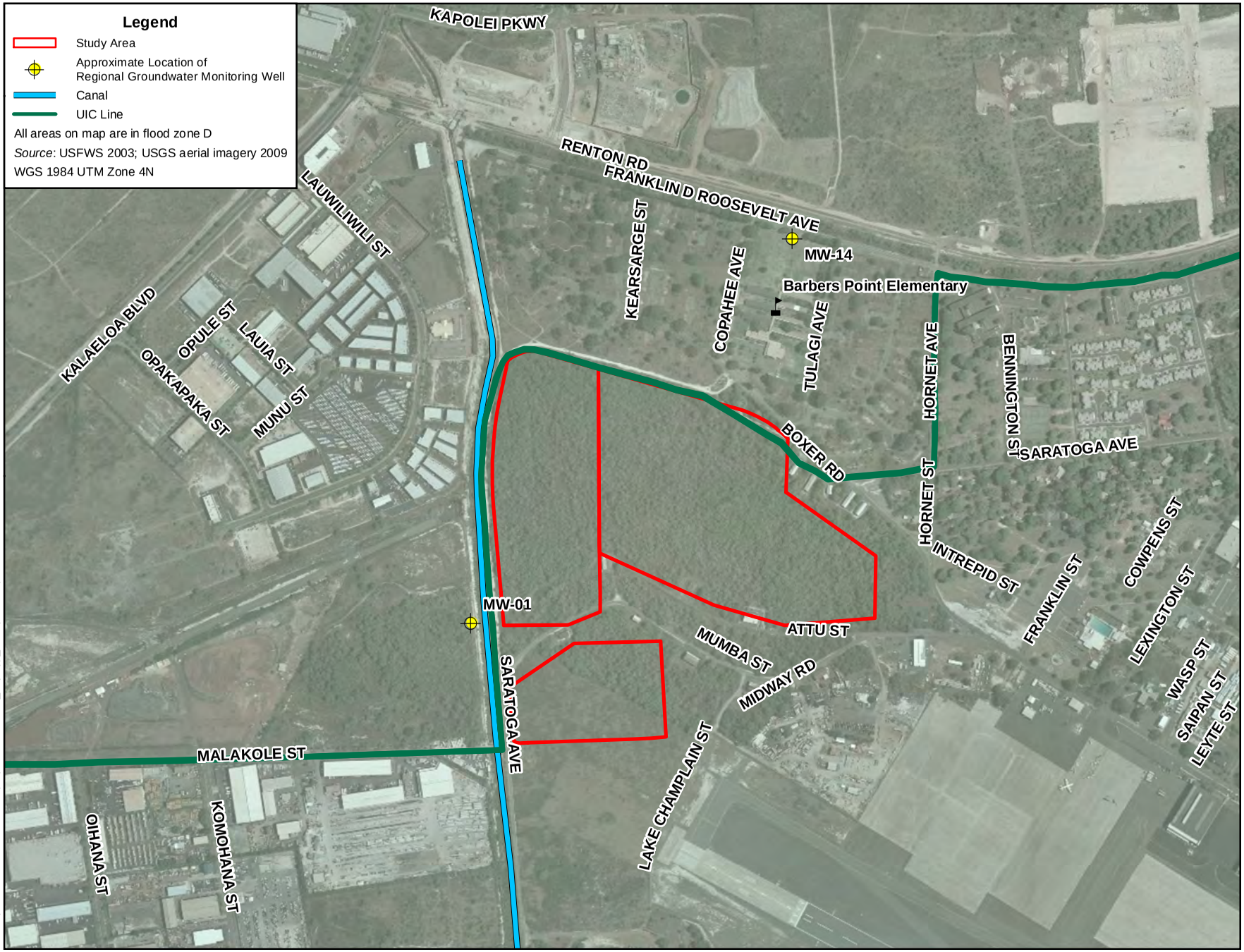
There are no surface waters at the project site. There is an unnamed drainage canal that is aligned parallel to the western boundary of Saratoga Avenue and site. It is located approximately 33 ft west of the site perimeter. The drainage canal terminates at the Pacific Ocean, a traditionally navigable water, and as such is a water of the U.S. subject to ACOE jurisdiction and permitting requirements (Appendix A, ACOE letter).

Ordy Pond is located approximately 1.5 miles southeast of the proposed site. The proposed site is more than one mile north of the coastline.

3.5.1.2 Flood and Tsunami Zones

Flood plains are low-lying areas that may be subject to flooding. The proposed site is located in Federal Emergency Management Agency (FEMA) Area D, where flood hazards are undetermined but possible. However, the proposed site lies outside of the 100-year floodplain (Figure 3.5). Regional stormwater management has historically resulted in flooding at the northern boundary of Kalaeloa. The Navy installed drywells north of the project site to address the stormwater in the family housing area. See Section 3.11 regarding drainage. No record of flooding at the site was identified.

The site is located approximately one mile from the ocean. The proposed site is not located within the Tsunami Inundation Zone (Figure 3.1).



Printing Date: Dec 19, 2010, N:\projects\GIS\9553_sopogy_EA\figures\Figure 3.5 Water.mxd

Feet
0 485 970
0 140 280
Meters

Figure 3.5
Water Resources
Kalaeloa Solar One and Two

N
W E
S

3.5.1.3 Ground and Potable Water

Groundwater in Hawaii is stored in a caprock-confined aquifer. The groundwater at the site is within the Ewa aquifer system of the Pearl Harbor Aquifer sector. There is a deeper confined aquifer in a deep layer of basalt a shallow unconfined aquifer in the overlying caprock. The groundwater in the confined aquifer is brackish with a chloride content ranging from 250 to 1,000 milligrams per liter. In the Kalaeloa area, the underlying aquifer meets Federal but not State of Hawaii drinking water standards, thus it is not used for potable water (TEC Inc. 2010a and b).

The shallow aquifer in the Kalaeloa area is also brackish with chloride content ranging from 1,000 to 5,000 milligrams per liter. The water is not suitable for consumption or irrigation without desalination (TEC Inc. 2010a and b).

The Navy Public Works provides water to the areas surrounding the proposed site from a well located three miles north of Kalaeloa. The potable water system is private, and the water meets state and federal drinking water standards. The well has the ability to pump 6,000 gallons per minute and two reservoirs for a total storage capacity of two million gallons (Earth Tech 1998). The Navy is in the process of divesting of the water system, as described in Section 3.11. There are two regional groundwater monitoring wells (Figure 3.5).

The underground injection control (UIC) line (Figure 3.5), established by the state as the boundary between potable and non-potable groundwater sources, runs along the northern border of the study area and extends down the western border parallel to the canal. Since the study area is directly adjacent to the ocean side (makai) of the UIC line, groundwater beneath the study area is not considered a potential drinking water source. Although the groundwater flow under the study area has not been studied directly, groundwater tends to flow from higher elevations to lower elevations; therefore, groundwater under the study area is anticipated to flow from north to south toward the ocean (TEC Inc. 2010a and b).

3.5.1.4 Stormwater

During Navy operations, approximately 216 dry wells were installed at NASBP. They were primarily for regional stormwater drainage. No wells were identified at the project site (NAVFAC PAC 1994). Approximately ten wells were identified topographically upgradient of the project site (NAVFAC PAC 1994). Stormwater would be retained at the site during construction and operations. See Section 3.11, Utilities Drainage section of this EA. for more information.

3.5.2 Impacts

Potential impacts to water resources analyzed in this section include impacts to surface, nearshore, and ground water. Impacts to water would be significant if contamination of the groundwater, high levels of runoff into nearshore waters, or discharge affecting surface water in the vicinity were to occur as a result of an action. Impacts would also be deemed significant if changes to flood hazards occurred as a result of the proposed action.

3.5.2.1 Proposed Action

Surface and Nearshore Water

Temporary BMPs would be implemented during construction to contain surface flows within the project site. HAR Chapter 11-55 requires a National Pollution Discharge Elimination System (NPDES) Permit for construction activities disturbing an acre or more of land. The NPDES Permit process requires submittal of a stormwater management plan prior to commencement of construction, which would include a list of BMPs to be implemented and any additional plans to prevent an increase in runoff.

Operations at the site would cause a minimal increase in impervious surface. Stormwater would be retained on the site and allowed to permeate the surface. In addition, the annual rainfall is low for the area. Given the low rainfall levels of the area, the stormwater within the site would not have significant impact to surrounding surface water resources.

There are no activities proposed at the site that would result in the discharge of dredged or fill material into the drainage canal located west of the site. No tributaries were identified that might feed into the canal from the site. There would be no anticipated impact to the waters of the drainage canal located west of the project site. No U.S. Army Corps of Engineers permits would be acquired.

With implementation of BMPs associated with construction permits, there would be no anticipated significant impacts to surface and nearshore water resources.

Flood and Tsunami Zones

The proposed site is not within the 100-year floodplain, nor is it in the Tsunami Inundation Zone (Figure 3.5). There would be no increase in flood or tsunami hazards as a result of the proposed action. There are potential impacts of regional stormwater flow onto the site, but these will be addressed in the site drainage plan, as discussed in Section 3.11.

Groundwater

No hazardous material use or disposal is anticipated at the site. Regulated materials such as diesel fuel would be stored in compliance with current regulations.

Groundwater resources would not be adversely impacted by construction or operation under the proposed action.

3.5.2.2 No-Action Alternative

Under the No-Action Alternative, no changes to the proposed site would occur. Therefore, there would be no significant impact to water resources under the No-Action Alternative.

3.6 BIOLOGICAL RESOURCES

Biological resources are defined as plant and animal species and their habitat. For the purposes of this EA, special consideration is given to plants and animals that are crucial to the ecosystem or protected by federal or state law. The Endangered Species Act (ESA) was established in 1973 to protect threatened and

endangered plants and animals. The ESA is enforced by the USFWS and National Oceanic and Atmospheric Association. Biological resources are split into vegetation, wildlife, special-status species, and unique habitat and areas of special concern in this EA. Special-status species include those listed as threatened or endangered under the ESA or state law. The unique habitat and areas of special concern include wetlands and other especially important habitat types that have been identified. Marine biological resources were not included as they would not be impacted by the proposed action that is located inland.

Biological resources are discussed for the entire former NASBP but the focus for the description in this EA is the area within one-half mile of the project site.

3.6.1 Existing Conditions

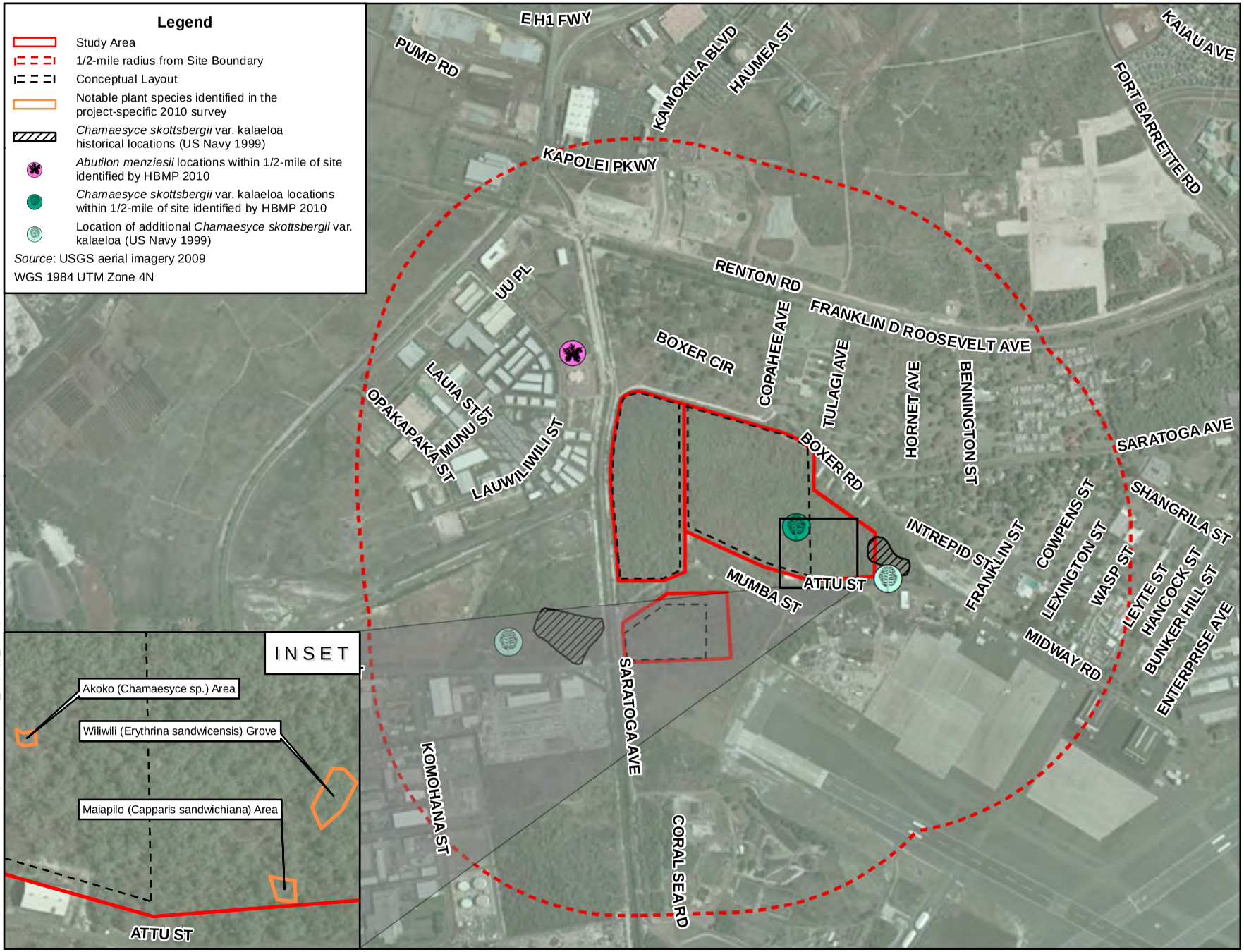
3.6.1.1 Vegetation

Vegetation for the former NASBP was described in a botanical survey conducted for the entire base (Botanical Consultants 1984). Flora at NASBP included approximately 170 plant species. The dominant vegetation types were kiawe scrub-koa haole with an understory of various introduced grasses and forbs and strand vegetation along the beach area. Koa haole is *Leucaena leucocephala* and kiawe is *Prosopis pallida*. Within these general habitat types on NASBP are several sites that support endangered plant species as described in the Special-Status Species Section 3.6.1.3.

Within the proposed project site the vegetation was mapped in the 1984 survey as kiawe-koa haole scrub. This was confirmed in a botanical survey conducted for the proposed project area in October 2010 (Appendix C). Either one or a mix of the two dominant tree species, kiawe and koa haole, was observed throughout the entire parcel. A small grove of approximately ten living (and a few dead) endemic wiliwili (*Erythrina sandwicensis*) trees were present in the eastern portion of the study area and outside of the conceptual layout for the solar array (Figure 3.6). Other non-native trees were scattered throughout with the most common being Chinese banyan (*Ficus microcarpa*). The understory was dominated by the non-native Buffelgrass (*Cenchrus ciliaris*). The primary native understory species present were the shrub ilima (*Sida fallax*) and the vine *Cassytha filiformis.* A few individuals of the endemic shrub maiapilo (*Capparis sandwichiana*) were observed in the southern portion of the eastern side of the study area and outside of the conceptual layout for the solar farm (Figure 3.6). This endemic shrub, while not a listed species, is noted as vulnerable to extinction (Wagner et al. 1999).

3.6.1.2 Wildlife

Birds were the dominant wildlife identified on the former NASBP (Botanical Consultants 1984). Twenty-three (23) species were identified during that survey conducted in 1984, of which 17 were ubiquitous, introduced species; five were indigenous; and one, the Oahu elepaio (*Chasiempis sandwichensis ibidis*), was endemic. The 1984 survey reported that the elepaio was found in an area of mangrove forest. The species is no longer present in the area (USFWS 2006). Within the proposed project site only a few birds were observed during the October 2010 botanical survey and during another reconnaissance visit to the site in July 2010. Species that were observed included a single barn owl (*Tito alba*), northern cardinal (*Cardinalis cardinalis*), spotted dove (*Streptopelia chinensis*), red-vented bulbul (*Pycnonotus cafer*), and gray francolin (*Francolinus pondicerianus*).



Printing Date: Dec 20, 2010, N:\projects\GIS\9553_sopogy_EA\figures\Figure 3.6 Endangered Plants.mxd

Figure 3.6
Location of Plant Species of Special Interest
Kalaeloa Solar One and Two

Given the current highly disturbed condition of the site and lack of native vegetation, any other birds that might be using the area would most likely be non-native species or indigenous species common throughout Oahu such as the kolea (Pacific golden plover; *Pluvialis fulva*).

The Migratory Bird Treaty Act (MTBA) of 1918, enforced by the USFWS, protects migratory birds (USFWS 2010a). The MTBA implements the United States' commitment to international agreements with Canada, Japan, Mexico, and Russia that protect selected species of migratory birds and their parts. All birds native to any part of the U.S. are covered under the MBTA. Birds not protected by the MBTA include non-native species intentionally or unintentionally introduced into the United States or its territories with human assistance as well as certain other groups of birds (FR 75(39): 9295). The only birds observed on the project site during the botanical survey in October 2010 that are covered under the MBTA are the red cardinal and the barn owl, neither of which are native to Hawaii.

The nearby Kalaeloa Airport has a formal agreement with the U.S. Department of Agriculture. The agreement with Animal and Plant Health Inspection Services and Wildlife Services allows for the controlled eradication of birds that create a hazard to planes. Airport personnel are trained in bird hazing and keep records of all bird strike incidences. The airport exchanges bird information with the USFWS, State DLNR, DOFAW and The Audubon Society (Ramos 2010).

The only mammals likely to be found at the proposed project site given the disturbed nature of the area were the introduced Indian mongoose (*Herpestes auropunctatus*), rodents and feral cats. A feral cat was observed during the botanical survey in October 2010 and evidence of rodents chewing on bark of trees was also observed.

3.6.1.3 Special-Status Species

The Hawaii Biodiversity and Mapping Program (HBMP) provided information for occurrences within one-half mile of the proposed site (Figure 3.6) based on a site-specific request (HBMP 2010). They reported locations for two listed plant species, the Ewa Plains akoko (*Chamaesyce skottsbergii* var. *kalaeloana*, also called var. *skottsbergii* in some studies and also known historically as *Euphorbia skottsbergii*) and red ilima (*Abutilon menziesii*). Both of these species are federal-and state-listed endangered. The HBMP reported up to 24 Ewa Plains akoko in two studies conducted in 1984 and 1993. Specific locations for the Ewa Plains akoko were mapped in the 1999 NASBP Closure EIS (U.S. Navy 1999) and these are shown on Figure 3.6. Some or all of these locations may have been grouped together in the HBMP (2010) site-specific report.

Additional information on the Ewa Plains akoko is provided in the latest USFWS 5-Year Review for this species (USFWS 2007). The description for the plants found in historical studies at the proposed project site location, taken from the 5-Year Review, is quoted below:

> *In 1979, 18 of these plants were recorded at the northwest corner of the Air Station* (Char and Balakrishnan 1979*). In a 1993 survey of this area only seven plants were found (*Whistler 1993*), with four additional plants recorded in another part of this area in 1994. In a 1998 survey for C. skottsbergii var. kalaeloana, only one plant was located in the northwestern corner of the Air Station* (Whistler 1998).

Subsequent to these studies, Whistler (2008) conducted a survey of the proposed study area (DHHL parcel), as well as other parcels, during a wet period (from December 18, 2007 to February 10, 2008) and found no Ewa Plains akoko or any other listed plants. A project-specific botanical survey was conducted over the entire study area from October 18-21, 2010 (Appendix C) and a small area with *Chamaesyce* sp. plants was identified (Figure 3.6 inset). Some of the plants were dead. The live plants were identified as *C. hypericifolia*. One of the dead plants was quite large, upright, and woody at the base; however this plant was also determined to be a specimen of *C. hypericifolia*, based on examination of the plant by Bishop Museum staff (Imada 2010). No federal- or state-listed species were identified in the proposed development area.

HBMP (2010) also provided data showing that approximately 700 feet to the northwest of the proposed study area is a reported occurrence of red ilima (*Abutilon menziesii*), a federal- and state-listed endangered species, in an old canefield. No information was supplied on numbers of individuals in this occurrence.

In addition to the species discussed above, the USFWS (2010b) noted that the following federally-listed species are known to occur near the proposed project location: round-leafed chaff-flower or ‘Ewa hinahina (*Achyranthes splendens* var. *rotundata*) and two species that potentially occur in anchialine pools, opae ula (*Halocaridinia rubra*), and the orange-black damselfly (*Megalagrion xanthomelas*). The federal- and state-endangered round-leafed chaff-flower is found approximately 1.0 miles south of the proposed study area along the coast. This species is now on land managed by the USFWS (see further discussion in the next section).

There are no anchialine pool species of concern since this habitat does not occur in the study area (see Section 3.6.1.4)

3.6.1.4 Unique Habitat and Areas of Special Concern

The only wetlands identified on the former NASBP is Ordy Pond, an anchialine pool approximately two miles from the study area, and a seasonal freshwater wetland along the western boundary of the former NASBP that is approximately 1,500 feet south of the southern-most parcel of the study area (U.S. Navy 1999). Several other wetlands and deepwater habitats were mapped in the area for the USFWS National Wetland Inventory. These include the canal adjacent to the west end of the study area and small areas located over 2,000 feet from the study area.

Two unique ecological features or sites, Ordy Pond and the Pearl Harbor National Wildlife Refuge (PHNWR) are greater than one mile from the study area. Ordy Pond is a highly eutrophic, brackish, coastal, anchialine pond located off of Tripoli Street east of the Kalaeloa airport runways. It is the only permanent water body on the former NASBP lands and comprises approximately 3 acres with less than one acre of open water. The pond is surrounded by American mangrove (an introduced species) and supports mosquito fish that are potential food for the Hawaiian black-necked stilt, (*Himantopus mexicanus knudseni*) an endangered species, as well as various migratory birds (U.S. Navy 1999). The Navy transferred the area to the University of Hawaii after the BRAC for research and study purposes (U.S. Navy 1999).

The Pearl Harbor National Wildlife Refuge (PHNWR) consists of two wetland units and one coastal upland unit (USFWS 2010c). The wetland units are located greater than 5 miles east from the study area.

The 38-acre Kalaeloa unit, approximately one mile south of the proposed study area, contains raised limestone coral reef and has the last remaining native coastal dryland plant communities that were once widespread throughout the Ewa plain (USWFS 2008, 2009). The site is unique because of its rare anchialine pools consisting of sinkholes that are connected to the groundwater and experience tidal influence. This habitat also supports native coastal plants such as the endangered plant species *Achyranthes splendens* (USWFS 2008, 2009). The Kalaeloa unit is closed to the general public. No anchialine pools are present on the proposed project parcels based on historical surveys and none were observed during the site-specific botanical survey conducted for this project.

In addition to the habitats described above, it is also noted that there a many sinkholes located in the study area, primarily in the eastern portion of the CSP project area and in the northeastern portion of the southern project area (the portion not bulldozed). These areas are located outside of the proposed development area. A sinkhole preserve was established in 2008 on Kapolei Property Development land to the west of the study area because of research on these sinkholes by Dr. Alan Ziegler and the recognized importance of the sinkholes in preserving a rich fossil record, particularly of extinct Hawaiian bird species.

3.6.2 Impacts

Potential impacts to biological resources are significant if they affect an important, sensitive, or unique resource, a large portion of a biological resource, or cause long-term impacts to biological resources. Special-status species are protected by law and any impact to those species is significant.

3.6.2.1 Proposed Action

<u>Vegetation</u>

Construction associated with the proposed action within the proposed development area would permanently remove the vegetation that is present in the study area. The plant communities on the study area are dominated by non-native species and are common in lowland coastal areas in Hawaii.

The small grove of ten native wililwili trees are outside the development area and are likely to be outside of the final lease area and would not be disturbed by construction or operations. This species is not a protected species but numbers have been reduced due to loss of habitat from development and a non-native gall wasp that has recently (2005) infested all *Erythrina* spp. in Hawaii, and has resulted in further loss of wiliwili trees (HEAR 2010). The few maiapilo shrubs present would also be retained and not disturbed. This species is somewhat uncommon, particularly on Oahu, but it has no official protected status. Wagner et al. (1999) note that it is vulnerable to extinction.

With these avoidance measures, the proposed project would not result in a significant adverse impact to vegetation.

<u>Wildlife</u>

The barn owl and cardinals observed in the study area are protected by the Migratory Bird Treaty Act. Neither of these species is native to Hawaii. No native bird species is likely to regularly use the study area. Given the presence of other similar habitat in the area, it is likely that the non-native birds present on

the study area would move to another location. In any event, there would be no significant impact to the population of these species on Oahu. No rare or wildlife species of conservation concern have been reported or observed in the proposed project area. Based on this information there would be no significant impact to wildlife from the proposed action.

Special Status Species

Three federal and state-listed endangered plant species, Ewa Plains akoko (*Chamaesyce skottsbergii* var. *kalaeloana*), red ilima (*Abutilon menziesii*), and Ewa hinahina (*Achyranthes splendens* var. *rotundata*), have been found in the vicinity based on surveys conducted or recorded by the HBMP (see Section 3.6.1 for findings of these studies), but only Ewa Plains akoko was reported in the project study area. The botanical surveys conducted in December 2007 to February 2008 and October 2010 did not positively identify any of these species in the proposed development area. No other special-status species are known to occur in the study area. Therefore, no impact to special status species was identified for the proposed action.

Unique Habitat and Areas of Special Concern.

The only features of special concern in the study area are the numerous sinkholes present, generally in the eastern portion of the site outside of the development area. Sinkholes are abundant in this area of Oahu and a nearby preserve has been established (see Section 3.6.1). There are no known features of these sinkholes that are unique to only this area. No listed species are known from sinkholes in the study area. Large sinkholes that were identified in the eastern portion of the study area during the survey would be excluded from the lease. Sinkholes within the development area are further described in Section 3.7. Based on the features known to be present in the development area, there would be no significant impact to unique habitat or areas of special concern.

3.6.2.2 No-Action Alternative

Under the No-Action Alternative, no changes to the development area would occur. Therefore, there would be no significant impact to biological resources under the No-Action Alternative.

3.7 ARCHAEOLOGICAL RESOURCES

Cultural resources are the historic districts, sites, structures, artifacts, or other evidence of human activity considered important to a culture or community for scientific, traditional, religious, or various other reasons.

Cultural Resources include historic properties as defined by the National Historic Preservation Act of 1966 (NHPA), cultural items as defined by the Native American Graves and Repatriation Act (NAGPRA), archeological resources as defined by Archaeological Resources Protection Act (ARPA), sacred sites as defined by Executive Order 13007 to which access is afforded under American Indian Religious Freedom Act (AIRFA), and collections and associated records as defined in 36 Code of Federal Regulations (CFR) 79. In Hawaii, the SHPD maintains a database of previously recorded archaeological sites and historic structures; refers interested parties to native and indigenous groups including Hawaiian organizations; and facilitates consultation with those who may hold expertise with respect to cultural, traditional and customary uses and practices.

Cultural resources can be divided into three major categories: archaeological resources, architectural resources, and traditional cultural resources.

1. *Archaeological resources* are areas of physical evidence of human alteration of the earth, including but not limited to: roads, fences, trails, and battlegrounds.

2. *Architectural resources* are structures of historic significance, including but not limited to: dwellings and other buildings, canals, dams, and bridges.

3. *Traditional cultural resources* can include archaeological resources, topographic features, habitats, plants, animals, and minerals that Native Hawaiian groups consider essential for the continuance of traditional culture. Traditional cultural resources can also include important archaeological resources such as human burials.

Under NHPA, significant cultural resources need to be considered for potential adverse impacts from the Proposed Action. Archaeological and architectural resources generally must be greater than 50 years old and features must be preserved and recognizable to be considered eligible to the National Register of Historic Places (NRHP). To be determined a significant cultural resource, archaeological or architectural resources must meet one or more criteria as defined in 36 CFR 60.4 for inclusion in the NRHP:

> *The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:*
>
> *(a) That are associated with events that have made a significant contribution to the broad patterns of our history; or*
>
> *(b) That are associated with the lives of persons significant in our past; or*
>
> *(c) That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or*
>
> *(d) That have yielded or may be likely to yield information important in prehistory or history.*

NRHP Criteria are sometimes also applicable to cemeteries, birthplaces, graves of historical figures, religious properties, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years if they fall under the following (NPS 1997):

> *(a) A religious property deriving primary significance from architectural or artistic distinction or historical importance; or*
>
> *(b) A building or structure removed from its original location but which is primarily significant for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or*

(c) A birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building associated with his or her productive life; or

(d) A cemetery that derives its primary importance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events; or

(e) A reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived; or

(f) A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own exceptional significance; or

(g) *A property achieving significance within the past 50 years if it is of exceptional importance.*

The SHPD administers HRS Chapter 6E, Historic Preservation. All projects that have potential to impact historic resources are subject to SHPD review.

3.7.1 Existing Conditions

The Ewa Plain was described by early missionaries as a desolate wasteland, although it was periodically inhabited by native Hawaiians who cultivated dryland plants during times of high rainfall and harvested marine resources on a more regular basis (Handy et al. 1972). The proposed project area is located within the Honouliuli ahupua`a of Oahu that is believed to have once supported a semi- permanent population in pre-Euro-American contact Hawaiian society (Davis 1979). Evidence suggests that the lowland, coastal portion of the Ewa Plain was inhabited as early as 1,000 A.D. (Athens et al. 1997) and utilized into the early twentieth century for cattle ranching, sisal production, and sugarcane planting (Davis et al. 1986).

The U.S. Marines purchased 206 acres at Kalaeloa in 1932 and the property became the NASBP. Construction on the base began in November 1941, but the Navy revised the building plans to make the buildings bombproof following the Japanese attacks on Pearl Harbor December 7, 1941. The Navy commissioned NASBP on April 15, 1942, and the 3,700-acre installation was manned by 12,000 Navy servicemen.

After WWII ended, NASBP became the primary Naval Air Station for Naval operations in the Pacific throughout the Cold War era until its close in 1989. NASBP closed in 1999 in accordance with a recommendation from BRAC. Since then, the former NASBP installation has had ongoing redevelopment by federal, state, and county agencies, as well as military and private organizations.

Archaeological surveys have identified numerous sites of significance at NASBP ranging from pre-Euro-American contact Hawaiian to WWII-era sites, including sites with human skeletal remains present (Helber, Hastert, and Fee 1997). NASBP also contains Category I and Category II historic buildings that are significant from the installation’s history during WWII and the early Cold War Era. Sinkholes, depressions in the surface of the earth where there is little fill over the coral reef limestone bedrock, are found across the Ewa Plain. These sinkholes were used by Hawaiians, who cultivated crops in the floor of larger pits and sometimes buried family members within the sinkholes (McAllister 1933).

Modern archaeological investigations in Honouliuli include those conducted along the coast from Ewa beach to Barbers Point (Dunn et al. 1991; Jourdane 1979; Hommon and Ahlo, Jr. 1983; Davis 1979, 1995; Davis et al. 1986; Miller 1993), and others conducted in residential developments and golf courses within former sugarcane fields between Ewa and the H-1 Freeway (Davis 1988; Jayatilaka et al. 1992); what is now termed the "Second City". For the purposes of this discussion, only previous investigations within the NASBP (Haun 1991; Welch 1987; Tuggle and Tomonari-Tuggle 1994; Tuggle 1997) are described below.

Within the KSP study area, the Bishop Museum (Haun 1991) recorded ten habitation complexes, including potential burials and sinkholes. The Haun 1991 and Tuggle 1997 inventory surveys were submitted to and approved by SHPD. They are included in Appendix B. All ten sites were considered eligible for the NRHP under Criterion D for sites which have yielded, or may be likely to yield, information important in prehistory or history. Based on the mapping and the descriptions of the sites within the two inventory surveys, TEC Inc. re-located the ten sites in October 2010 and recorded the boundary of sites using Geographic Positioning System. These GPS boundaries are shown on Figure 3.7 and briefly described, based on the inventory surveys (Appendix B), as follows:

- Site 50-80-12-1717 (Site 1717) - a residential complex with three habitations, two agricultural walls, and one possible burial platform;
- Site 1718 - a residential complex with four habitations, one agricultural mound, and one possible burial platform;
- Site 1719 - a residential complex with three habitations, one agricultural enclosure, and one possible burial cairn;
- Site 1720 - a residential complex with one habitation enclosure, and one agricultural mound;
- Site 1721 - a residential complex with three habitation enclosures, one utilized sinkhole, and one feature remnant;
- Site 1722 - a residential complex with two habitations, one agricultural enclosure, four possible burial or storage or agricultural cairns, and three feature remnants;
- Site 1723 - a residential complex with one habitation, two agricultural sinkholes, four burial sinkholes, and one modified sinkhole;
- Site 1724 - a residential complex with five habitations, one agricultural enclosure, one alignment, v modified sinkhole, and one burial sinkhole;
- Site 1726 - a non-residential complex with one boundary wall, one burial or agricultural cairn, and one burial platform; and
- Site 1727 - one utilized sinkhole.

Evidence of presumed burial architecture has been previously documented for seven of the ten sites (Sites 1717, 1718, 1719, 1722, 1723, 1724, and 1726) (Figure 3.7); however, this supposition has yet to be verified archaeologically. Several natural sinkholes in the vicinity were found to contain human burials, suggesting there is potential for inadvertent discovery of additional human remains at the project site.

A return to habitation sites in 1995 by the International Archaeological Research Institute, Inc. (IARII) confirmed that some of the area had been mechanically deforested during WWII development of the NASBP (Tuggle 1997). The IARII 1997 study is included in Appendix B. Also documented were a number of isolated walls, linear stacked rocks, enclosures, sinkholes, modified rock outcrops, mounds, and multi-component features both historic and military or prehistoric in origin (Tuggle 1995). During the 2010 TEC field visit, the archaeologist observed more recent mechanical disturbances that post-date the 1995 survey, resulting in negative impacts to Sites 1719, 1722, and 1723.

Given the ethnohistoric documentation of native Hawaiian settlement of the Ewa coast and utilization of the nearby Ewa Plain in the late 1700s to early 1800s, it is likely the ten habitation sites and many of the smaller features in the project area are late pre-Contact in date. Also of potential importance, if present, would be cultural and faunal deposits within the sinkholes noted during the 2010 reconnaissance of the project area, as some of these natural features may harbor not only human burials, but also evidence of birds and land snails now extinct due to habitat loss and early predation.

3.7.2 Impacts

Federal regulations (36 CFR § 800.5 of the NHPA) characterize a significant impact as any change in integrity to a resource that is eligible for the National Register if the characteristics that make the resource eligible are altered. Damage, alteration of the resource, sale of property, or other degradation of the resource would be considered significant. In addition to analysis of known cultural resources, the potential for discovery of further resources, including human remains, is analyzed in this section.

State of Hawaii environmental impact significance criteria are listed in HAR Title 11, 200-12, including, "1. Involves an irrevocable commitment or loss or destruction of any natural or cultural resource." Section 5.2 lists all the criteria and summarizes the impacts.

3.7.2.1 Proposed Action

For planning flexibility, the study area included a larger area than would be required for project development. Based on the inventory surveys (Appendix B) and the 2010 reconnaissance of previously identified sites, KSP determined the project could avoid potential impact to Sites 1723, 1724, 1726 and 1727 by reducing the development footprint. The conceptual layout boundary is shown as a dashed line on Figure 3.7. These sites will be excluded from the final DHHL lease and there would be no impact on these cultural resources associated with proposed action.

The remaining six sites (Sites 1717, 1718, 1719, 1720, 1721, 1722) are likely to be included in the final lease area. An Integrated Archaeological Mitigation Plan for the Proposed Kalaeloa Solar One and Two Projects (Plan) was submitted to SHPD in December 2010 for review and the response is pending. The Plan, subject to SHPD approval, proposes preservation of Sites 1717 and 1722 within the CSP development area, and Site 1721 within the PV development area. A combination of preservation and data recovery is proposed at Sites 1718 and 1719 that are located within the CSP development area.

The areas proposed for preservation have a higher potential, collectively, than those proposed for data recovery for interpretation and research on the range of traditional Hawaiian activities once pursued in this portion of the Ewa Plain. Preservation is proposed for two habitation enclosures identified as Feature 'A' of Site 1718 and Feature B of Site 1719. The preservation measures include detailed mapping of the site, routine maintenance, establishment of a protective buffer around the site, and opportunity for community access for cultural or education purposes.

Some data recovery within the CSP development area is proposed to avoid expansion of the area of potential effect to the east, which is characterized by sinkholes and Sites 1723, 1724 and 1726. By limiting the development footprint, fewer cultural resources would be impacted.

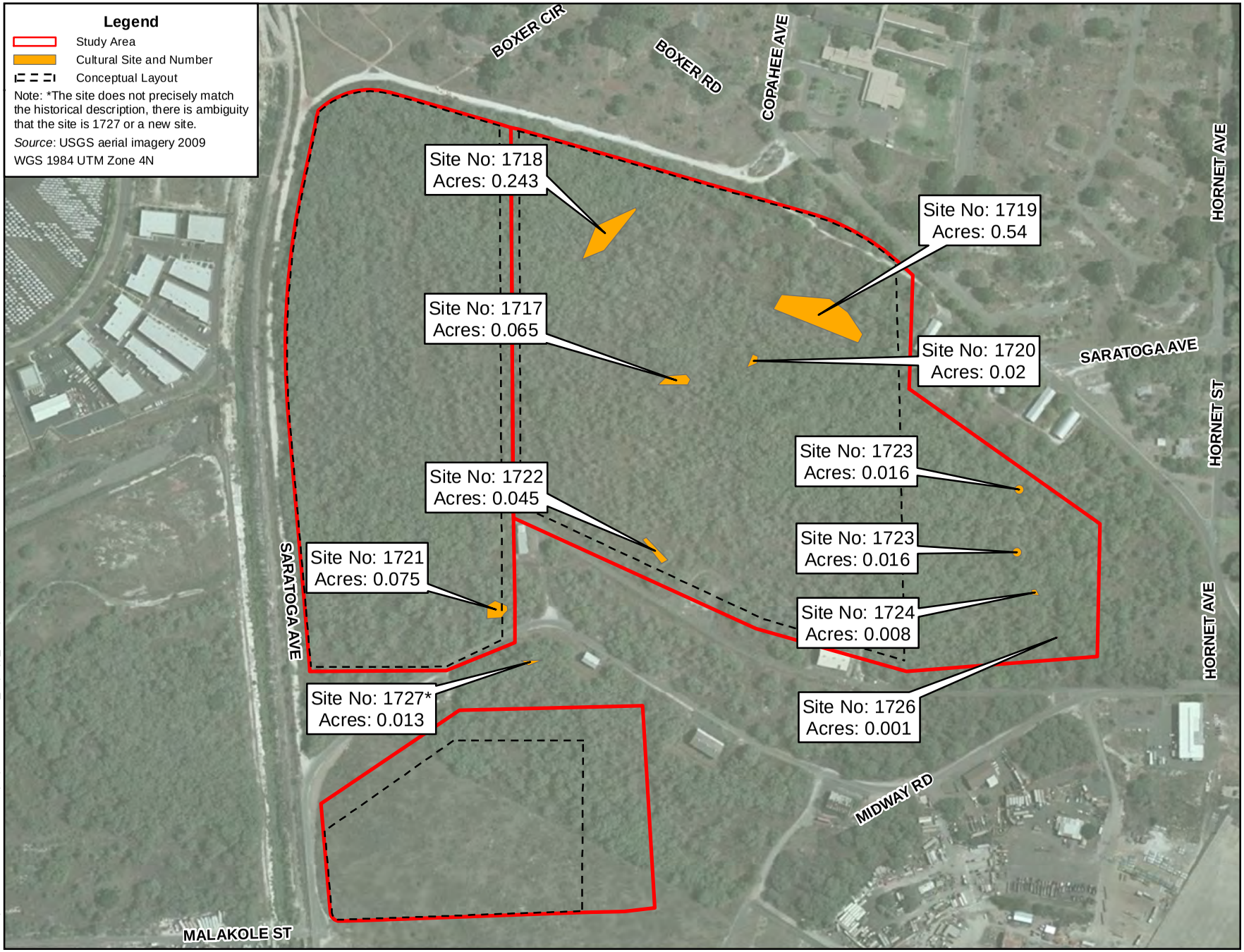
Data recovery is recommended at the remaining agricultural features of Sites 1718 and 1719 that have lesser integrity and lower interpretive or research potential than those sites proposed for preservation. Features previously suspected of possibly containing human remains in these two larger sites did not appear to be likely burials during 2010 field visits by TEC and Pacific Consulting Services Inc. (PCSI), but will be tested during data recovery. The standard archaeological recording procedures to be used during data recovery (i.e., mapping, detailed site descriptions, detailed excavation notes and drawing, and the data recovery report) ensure that the information is not lost.

Archaeological monitoring of clearing and ground-altering construction in the development area and inadvertent burial treatment procedures are proposed in the Plan.

No negative impacts to significant archaeological resources are anticipated under the proposed action, since the approach is to maintain the integrity of all six sites for interpretation through a combination of preservation and data recovery. Archaeological monitoring and inadvertent burial treatment measures are described in the Plan and will ensure that no significant adverse impacts occur to cultural resources during construction. Consultation with SHPD is ongoing.

3.7.2.2 No-Action Alternative

Under the No-Action Alternative, proposed construction activities would not occur. However, the public and other businesses in the area have access to the historic sites and there is potential for in advertent disturbance of the sites or vandalism. Therefore, there would be a potential for significant adverse impact if the sites are left unprotected.



Printing Date: Dec 19, 2010, N:\projects\GIS\9553_sopogy_EA\figures\Figure 3.7 Cultural.mxd

Feet
0 237.5 475
0 70 140
Meters

Figure 3.7
Approximate Location of Known Cultural Resources
Kalaeloa Solar One and Two

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3.8 SOCIOECONOMICS AND CULTURAL ENVIRONMENT

Socioeconomics describes human activity and population characteristics, focusing on measures of economic activity. Often socioeconomics are studied to determine the impact of an economic change on human activity. Development can impact community services, local employment levels, and housing availability.

3.8.1 Existing Conditions

3.8.1.1 Socioeconomics

The population of the State of Hawaii was 1,211,537 in 2000 (USCB 2000). The proposed site is located on Oahu Census Tract 85. In 2000, year of the last available U.S. census data, the Ewa area population was 68,000 (DPW 2008). The Ewa region is being developed as a new urban center with community facilities, roads, commercial areas, and housing developments. The projected population for the Ewa area by 2030 is 177,000 (DPP 2008).

Employment in the region is largely industrial, commercial and retail. Approximately 15,000 jobs were in the Ewa Region in 2000 and that number is projected to grow to 64,000 in 2020 (HCDA 2010). About one third of the residents work in the region but that is expected to increase with the projected economic growth. There are recent and planned housing projects planned that include affordable housing. There is a demand for housing from households earning between $35,000 and $55,000 (HCDA 2010).

The project site is currently vacant and does not contribute to the region's employment or housing statistics. The site is owned by DHHL, but does not provide revenue to support DHHL's mission. It is unsuitable for housing development, due in part to proximity to the airport. The site is heavily vegetated and there is no formal access. There are no recreational facilities at the site and no evidence of recreational activities (i.e., hiking trails, ballfields) were observed during the biological and archaeological surveys. No traditional (or modern Hawaiian) cultural activities were identified that occur at the project site today.

3.8.1.2 Traditional Practices and Settlement Patterns

Articles IX and XII of the State Constitution of Hawaii (Ch 343, HRS) require government agencies to promote and preserve cultural beliefs, practices, and resources of Native Hawaiians and other ethnic groups. Environmental impact assessments and statements need to assess the impacts of a proposed action on cultural practices and features associated with a project site. Act 50 (April 26, 2000), Section (HRS 343-2) further amends the definition of environmental impact statement to include "effects of a proposed action on the economic welfare, social welfare, and cultural practices of the community and State."

Traditional native Hawaiian cultural practices and settlement patterns in the Ewa Plain likely reflected its proximity to Pearl Harbor and its aquatic resources, rather than the allure of the plain itself which was described by Vancouver in 1798 as "one barren, rocky waste, nearly destitute of verdure, cultivation or inhabitants…" (Handy and Handy 1972). The name Ewa, if translated as meaning "crooked" (Pukui, Elbert, and Mookini 1974), is a reference lost in the past.

Prior to European contact, the plain of Kaupe'a was known to Hawaiian travelers as a place of "spirits without good intentions" (I'i 1963) in which the goddess Pele's sister Hi'iaka was told that local residents only grow *'uala* or sweet potatoes and plait *pilipili'ula* grasses into meager coverings (Maly 1996). Other cultural practices associated with the demi-god Kamapua'a and the sacred hill of Pu'uokapolei situated at the *mauka* edge of the plain include solar observation rituals and *hula* (Kamakau 1976), while legendary near-coastal practices included the planting of the first breadfruit tree in the islands from the ancestral homeland of Kahiki within a sinkhole in Kualaka'i (Beckwith 1970).

Sterling and Summers (1978) describe this unidentified site as where "Tradition credits the introduction of the breadfruit tree in these islands to Kahai, a son of Moikeha, who brought a species from Upolu in the Samoan group on his return voyage from Kahiki, and planted same at Puuloa, Oahu".

After its agricultural transformation was begun in the early twentieth century, McAllister (1933) mentions the remains of traditional farming observed on the Ewa Plain as "holes and pits in the coral were formerly used by the Hawaiians" and that "the soil on the floor of the larger pits was used for cultivation, and even today one comes upon bananas and Hawaiian sugar cane still growing in them".

More recently in a report entitled, *Report on Archaeological Survey of the Proposed 'Ewa-Marina Community Development Ewa Beach, Oahu Island*, Davis (1979), concluded that "the number of cultural features, the size of individual habitation structures, and the extent of the sited areas now indicate that the whole of the coastal portion of the Ewa plain once supported a large and possibly permanent resident prehistoric population." Coastal or lowland settlement was assumed to have occurred as early as A.D. 600 (Davis et al. 1986), with upland settlement occurring later.

In contrast, his report on the proposed Ewa Gentry project area (Davis 1988) concluded that the lack of human habitation sites inland may be the result of this portion of the Ewa plain having been an "exposed windswept grassland subject to possibly the driest conditions in the region. As such, this would not have been a particularly suitable locale for anything but the shortest of short-term occupations."

This interpretation of traditional settlement patterns has been further refined in recent years by Tuggle (1997) in which he sees a strong correlation between cyclical climatic ossilations favorable to human occupation of the Ewa plain and clusterings of radiocarbon dates within three broad periods: A.D. 1300-1450, 1450-1700, and after 1700. Tuggle interprets the archaeological evidence of short-term occupation in habitation sites such as 50-80-12-1724 (Figure 3.7) as indicative of periodic reoccupation of certain locales located near sinkhole complexes, and not seasonal occupation on a yearly basis.

Since the 1930s and the development of NASBP, remains of traditional settlement patterns in the proposed KSP project area have been impacted to differing degrees (Tuggle 1995), while access to pursue traditional cultural practices has been curtailed by military fencing of the property. There is an interest among Hawaiian civic organizations to re-establish traditional cultural practices in Kalaeloa.

Kalaeloa Heritage Park has been established in Kalaeloa and is intended to be part of a cultural landscape throughout Kalaeloa. The goal is to establish partnerships among the civic organizations, HCDA, landowners and developers for the protection of known and newly discovered archaeological sites for possible inclusion in an expanded Kalaeloa Heritage Park.

3.8.2 Impacts

Impacts are deemed significant if a proposed action adversely impacts the economic welfare, social welfare, and cultural practices of the community.

3.8.2.1 Proposed Action

Construction activities would have a short-term beneficial impact on the economic welfare in the region. There would be construction labor and increase spending in the area. Operation under the proposed action would result in one to two employees with a slight beneficial impact on the economy.

The project would not benefit housing or other community service such as schools, recreational areas; nor would it have an adverse impact on these services. No appreciable, long-term regional economic changes would occur upon implementation of the proposed action. Spending patterns in the community would not be affected. Therefore, minimal impacts to local or regional socioeconomic characteristics would result from the proposed action.

The proposed action would have beneficial indirect impacts on DHHL's mission through the collection of lease fees. In addition, there is a condition in the lease that would commit 1 percent of the lessee net annual profit to fund a renewable energy program benefitting native Hawaiians, such as:

- developing a vocational curriculum administered through the Hawaiian language Immersion Schools,
- Establishing a short-certification course for students interested in learning about renewable energy
- Making presentations to school children on alternative energy and provide career opportunity information.

These efforts and the lease fee would have social and economic beneficial impact to the Hawaiian community.

The impact on traditional practices at the site would be discussed in conjunction with SHPD consultation. Some or all of the sites identified in the vicinity of the project may be suitable for incorporation into the Kalaeloa Heritage Park. This would be dependent on partnership agreements with HCDA, DHHL, and Hawaiian civic organizations.

3.8.2.2 No-Action Alternative

Under the No-Action Alternative, proposed construction activities would not occur. The opportunity for lease revenue to benefit the DHHL mission and the Hawaiian community would be lost. Therefore, there would be adverse impacts to socioeconomics with implementation of the No-Action Alternative.

3.9 HAZARDOUS MATERIALS AND WASTES

Hazardous wastes and materials include a wide range of liquids, gases, and solid waste and materials that can potentially harm humans, animals, and the environment. Chemicals or materials released unsafely or in abundance into the community can become hazards to the community, and in certain forms, can cause serious injury, health problems, property damage, and death (FEMA 2010).

Federal regulations that enforce proper storage and disposal of hazardous materials and wastes include:

- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA),
- Resource Conservation and Recovery Act (RCRA),
- Toxic Substances Control Act (TSCA),
- Federal Water Pollution Control Act,
- Clean Air Act,
- Clean Water Act,
- Safe Drinking Water Act,
- Federal Insecticide, Fungicide and Rodenticide Act, Emergency Planning and Community Right-to-Know Act, and
- Pollution Prevention Act.

3.9.1 Toxic Materials

Toxic materials are specific hazardous materials identified in regulations. Toxic materials include asbestos, lead-based paint, and polychlorinated biphenyls (PCBs). Asbestos are minerals that have historically been a commonly used construction material because of their insulating properties and durability. However, when asbestos-containing material is inhaled it can lead to asbestosis and lung cancer.

Historically, lead pigment increased the lifespan of paint and decreased corrosion. In 1978, the federal government banned the use of lead-based paint (LBP). Buildings constructed prior to 1978 currently need to be inspected for LBP. Health risks from exposure to LBP can include permanent damage to the central nervous system; young children are at the greatest risk of exposure. Ingestion of paint chips or dust is the most common method of exposure.

PCBs are chemical compounds with low flammability, high heat capacity, and low electrical conductivity that were historically used as heat insulating materials and as dielectric fluids in electrical transformers and capacitors. PCBs are known to cause skin irritation and cancer and are highly persistent in the environment. In 1979, the USEPA banned most uses of PCBs. In addition, effective controls have been mandated related to existing PCB-containing equipment.

3.9.2 Hazardous Wastes

Hazardous wastes are specifically defined or determined as such based on their ignitability, corrosiveness, reactivity, and toxicity. Toxic materials include: products used for various maintenance or repairs and identified as hazardous on manufacturer material safety data sheets; petroleum, oils, and lubricants (POL); antifreeze; and miscellaneous other waste streams.

RCRA, as amended by the Hazardous and Solid Waste Amendments (and corresponding Hawaii HARs), define hazardous waste as:

- A solid waste not specifically excluded from being classified as a hazardous waste under 40 CFR 261.4(b) that exhibits any of the characteristics (i.e., ignitability, corrosivity, reactivity, toxicity) described in 40 CFR 261; or
- Is listed in 40 CFR 261 Subpart D; or
- Is a mixture containing one or more listed hazardous wastes from 40 CFR 261 Subpart D.

Any combination of wastes that poses a substantial present or potential hazard to human health or the environment that has been discarded or abandoned is a hazardous waste.

RCRA requires that hazardous waste be tracked from cradle-to-grave. This hazardous waste tracking system mandates the collection and retention of key information including: the generator of the waste, how the waste is routed to the receiving facility, a description of the waste, the quantity of the waste, identification of the facility that receives the waste, and other relevant data.

EPA and Hawaii universal waste regulations streamline hazardous waste management standards for federally-designated "universal wastes," which include batteries, pesticides and mercury-containing materials. Universal wastes are considered hazardous however they are unique in that they are not considered in the determination of generator status.

3.9.3 Existing Conditions

The 2010 Environmental Site Assessment (TEC Inc. 2010a and b) researched the history of the property and conducted a site investigation and interviews with those who may have information on the history of the proposed site. No evidence of releases of hazardous substances, pollutants, or contaminants was identified. However, there was unauthorized dumping of household items, car tires and other rubbish off the roadways.

The site was vacant during Navy use of the land (1940s to 1999) and in a 1928 topographic map and no structures were identified at the site from historical photos. There was no evidence that the site contains asbestos or lead-based paint or PCBs. The lease agreement with DHHL would specifically exclude the buildings on TMK parcel 9-1-013:028 that may be affected by asbestos or PCB. Historical environmental reports for the NASBP did not identified potential environmental concerns for the project site (TEC Inc. 2010a and b).

3.9.4 Impacts

3.9.4.1 Proposed Action

Any hazardous materials or wastes generated during construction or operation would be stored and disposed of according to federal and local regulations. A spill-prevention plan would be implemented during the construction process to address potential for leaks of fuels required by heavy construction equipment.

No hazardous or regulated materials are likely to be used at the site in large quantities during operations. The organic thermal oil and minor quantities of lubricants would be managed and stored in accordance with federal and local regulations.

With implementation of the procedures described above, there would be no significant direct, indirect or cumulative impacts from hazardous materials and waste.

3.9.4.2 No-Action Alternative

Under the No-Action Alternative, proposed construction activities would not occur. Therefore, there would be no significant impacts from hazardous materials and wastes with implementation of the No-Action Alternative.

3.10 VISUAL RESOURCES

3.10.1 Existing Conditions

There are no special scenic vistas or views in the Kalaeloa area. The topography of the area is relatively flat and there are no ocean views or views of other special land or architectural features from the proposed site. The project area is relatively flat and undistinguished with no discernable gradient. Being entirely within an industrial park, there are no scenic resources in the immediate area.

The Ewa Development Plan's list of visual landmarks and significant vistas in the Ewa area includes the following:

- Distant vistas of the shoreline from the H-1 Freeway above the Ewa Plain,
- Views of the ocean from Farrington Highway between Kahe Point and the boundary of the Waiʻanae Development Plan Area,
- Views of the Waiʻanae Range from H-1 Freeway between Kunia Road and Kaloʻi Gulch and from Kunia Road,
- Views of napuʻu at Kapolei, Pālailai, and Makakilo,
- *Mauka* and *makai* views, and
- Views of central Honolulu and Diamond Head.

3.10.2 Impacts

In accordance with HAR 11-200-12, impacts would be significant if the proposed project "substantially affects scenic vistas and view planes identified in county or State plans or studies."

3.10.2.1 Proposed Action

The Ewa Development Plan's visual landmarks are upland of the proposed action and there would be no impact from the project during construction or operation. No scenic vistas or view planes have been identified in the area of the proposed action. No existing landmarks, mountains, buildings, or shorelines would be altered.

During construction, there would likely be temporary obstruction of views by construction fencing and dust control fabric. There is very little traffic in the area that might be affected by a change in view. Exceptions are traffic associated with the Barbers Point elementary school to the north of the site and various warehouse buildings in the vicinity.

Development of the property is consistent with the Kalaeloa Master Plan (HCDA 2006). Buildings planned would not exceed the height limitations specified in the Kalaeloa Master Plan and would be in accordance with architectural guidelines and preferences for the area if they are identified and finalized during the project development. The project development would be visible from adjacent roadways;

however it would be low to the ground and not obstruct views through the site, except for the two support buildings.

Based on this analysis, there would be no significant direct, indirect or cumulative impacts to visual resources during operation or construction of the proposed action.

3.10.2.2 No-Action Alternative

Under the No-Action Alternative, the proposed construction would not occur, thus there would be no impact to visual resources.

3.11 UTILITIES AND PUBLIC SERVICES

3.11.1 Utilities: Affected Environment and Impacts

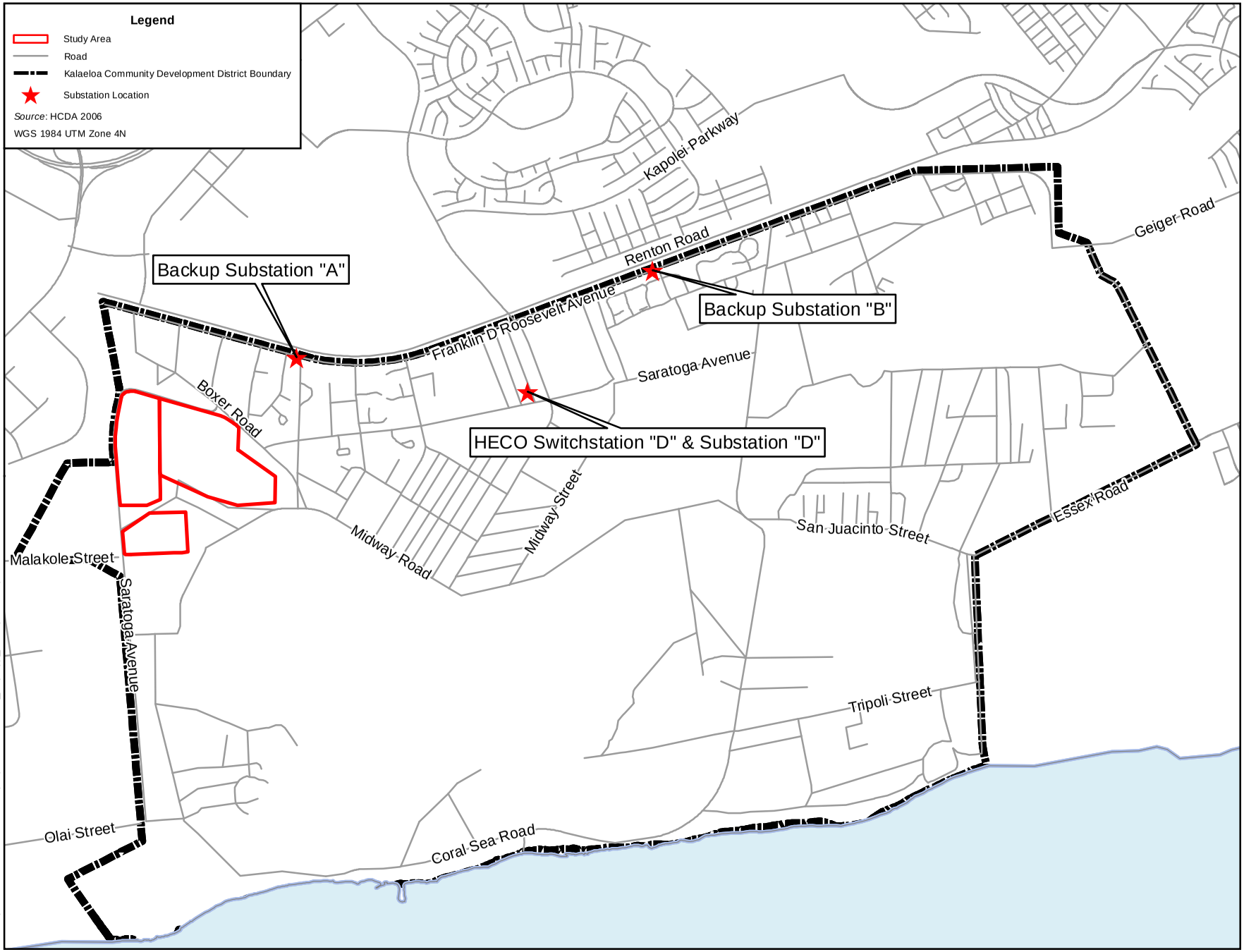
Potential impacts to utilities and public services would be deemed significant if substantial changes are required to current systems to support the proposed action.

The infrastructure in the vicinity of the site is owned by the Navy. The Navy no longer needs the utility systems (i.e., potable water source, storage and transmission infrastructure, wastewater, electrical distribution and telecommunications systems) and associated easements. Installation roadways have already been conveyed to the State of Hawaii and County and the wastewater system is being conveyed to the County. Commander Navy Region Hawaii prepared an EA for the *Conveyance of Navy Retained Land and Utility Systems, Kalaeloa, Oahu, Hawaii*, dated July 2008. The affected environment information in this section is based on the Navy 2008 EA. HCDA is preparing an infrastructure master plan that would address roadways and utility service for the area.

3.11.1.1 Electricity

The existing electrical distribution system at Kalaeloa is owned and operated by the Navy. Electrical power is provided through a Hawaiian Electric Company (HECO) substation located near the main gate (Figure 3.8) along the northern property line. Secondary substations reduce the 46-kilovolt (kv) power for local distribution stations. Substation A is closest to the project site and steps the power down to 11.5 kv. It is a back-up substation for emergency use (Navy Region Hawaii 2008).

The distribution is through a combination of 11.5 kv and 46 kv overhead and underground power lines. The Kahe Power Plant is the primary power-generating facility for the island of Oahu and is located approximately four miles northwest of Kalaeloa (Navy Region Hawaii 2008).



Printing Date: Dec 19, 2010, N:\projects\GIS\9553_sopogy_EA\figures\Figure 3.8 Power.mxd

Feet
0 1,250 2,500
0 325 650
Meters

Figure 3.8
Existing Substations
Kalaeloa Solar One and Two

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The Kalaeloa Master Plan (HCDA 2006) acknowledges that the electrical system would need to be upgraded. HCDA is developing and infrastructure master plan and an installation charge for improvements would be assessed to the developer.

Under the proposed action, operation of the two power-generating facilities would provide a total of 10 MW of electricity to the existing power grid. This electricity would provide a renewable source of energy to supplement Kahe Power Plant. The proposed action would beneficially impact electric supply.

3.11.1.2 Telecommunications

Telephone systems in Kalaeloa are currently owned by the Navy. Telephone service is provided through an agreement with Hawaiian Telecom, Inc using military telephone infrastructure (Navy Region Hawaii 2008). Both Hawaiian Telcom and the federal Oahu Telephone System lines serve the existing infrastructure at in the Kalaeloa area. Hawaiian Telcom services all of the lines.

Telephone and computer service would be provided at the site. The proposed action would require minimum telecommunications infrastructure to service the Controls Office (Building 1), therefore no significant impact is anticipated.

3.11.1.3 Potable Water

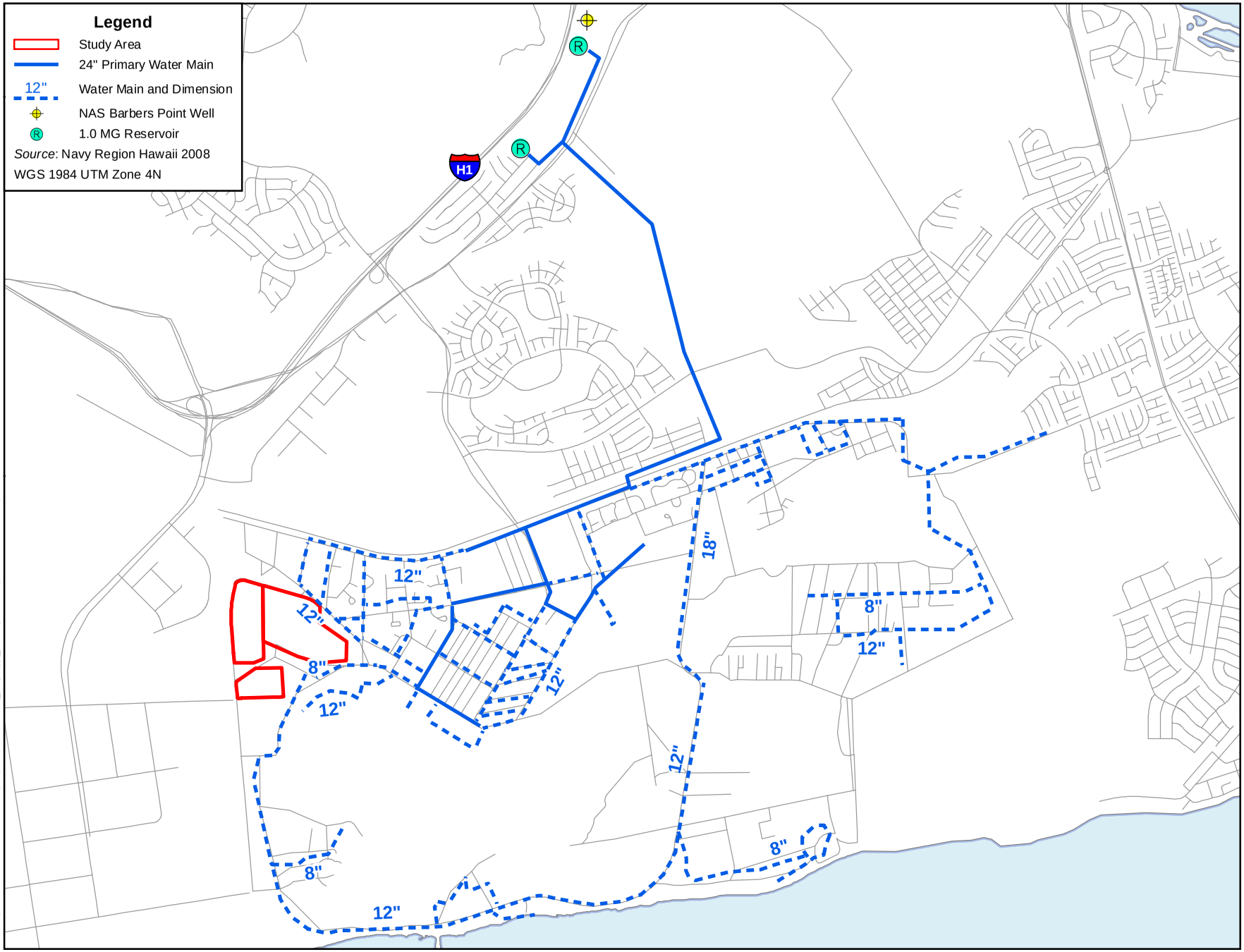
Potable water source and distribution system at Kalaeloa is currently owned and operated by the Navy. The Navy water supply system was largely constructed in the WWII era and is in relatively poor condition. The system is comprised of (Figure 3.9):

- A Navy well, pumping station and one million gallon underground concrete reservoir tanks located approximately two miles north of Kalaeloa near Makakilo;
- The distribution system, including 24-inch, 18-inch, 12-inch and 8-inch water distribution mains (Navy Region Hawaii 2008).

Non-potable water is available in the form of reclaimed water from the County's Honouliuli Wastewater Treatment Plant (WWTP). The distribution lines extend along the north and west boundaries of Kalaeloa and provide irrigation water to the Barbers Point Golf Course (Navy Region Hawaii 2008).

The Kalaeloa Master Plan identifies system improvements including two primary east-west 'backbone' water lines aligned alone Roosevelt Road and Saratoga Road. In addition, there would be a loop line that is aligned along the eastern, southern and western lines. Developers would be required to pay connection charges.

The water requirements would be minimal. There would be no significant impact to potable water supply or distribution.



Printing Date: Dec 19, 2010, N:\projects\GIS\9553_sopogy_EA\figures\Figure 3.9 Water System.mxd

Feet
0 1,625 3,250
0 450 900
Meters

Figure 3.9
Existing Potable Water System
Kalaeloa Solar One and Two

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3.11.1.4 Wastewater

The existing wastewater collection system is owned by the Navy and operated under license by the County Department of Environmental Services and is in the process of being transferred to the County as a public benefit conveyance. The system is old and the existing pumping stations do not meet County standards; it consists of (Figure 3.10):

- 15.3 miles of gravity sewers that range in size from 6 to 30 inches,
- 12 lift stations, and
- 7.3 miles of force mains ranging in size from 4 to 16 inches (Navy Region Hawaii 2008).

The wastewater is conveyed to Honouliuli WWTP, which has a capacity of 38 million gallons per day (mgd). The existing inflow is estimated at 25 mgd. 13 mgd is processed by advanced primary treatment for non-potable use. The remainder of primary treated waste is discharged to the ocean. The Navy purchased 2.66 mgd of the 38 mgd to serve Kalaeloa and other Navy land in the vicinity. The current allocation for Kalaeloa is 1.5 mgd.

The Kalaeloa Master Plan (HCDA 2006) acknowledges the inadequacies of the existing system and is preparing an infrastructure master plan to outline improvements that are subject to County approval. Developers would be assessed sewer fees by the County.

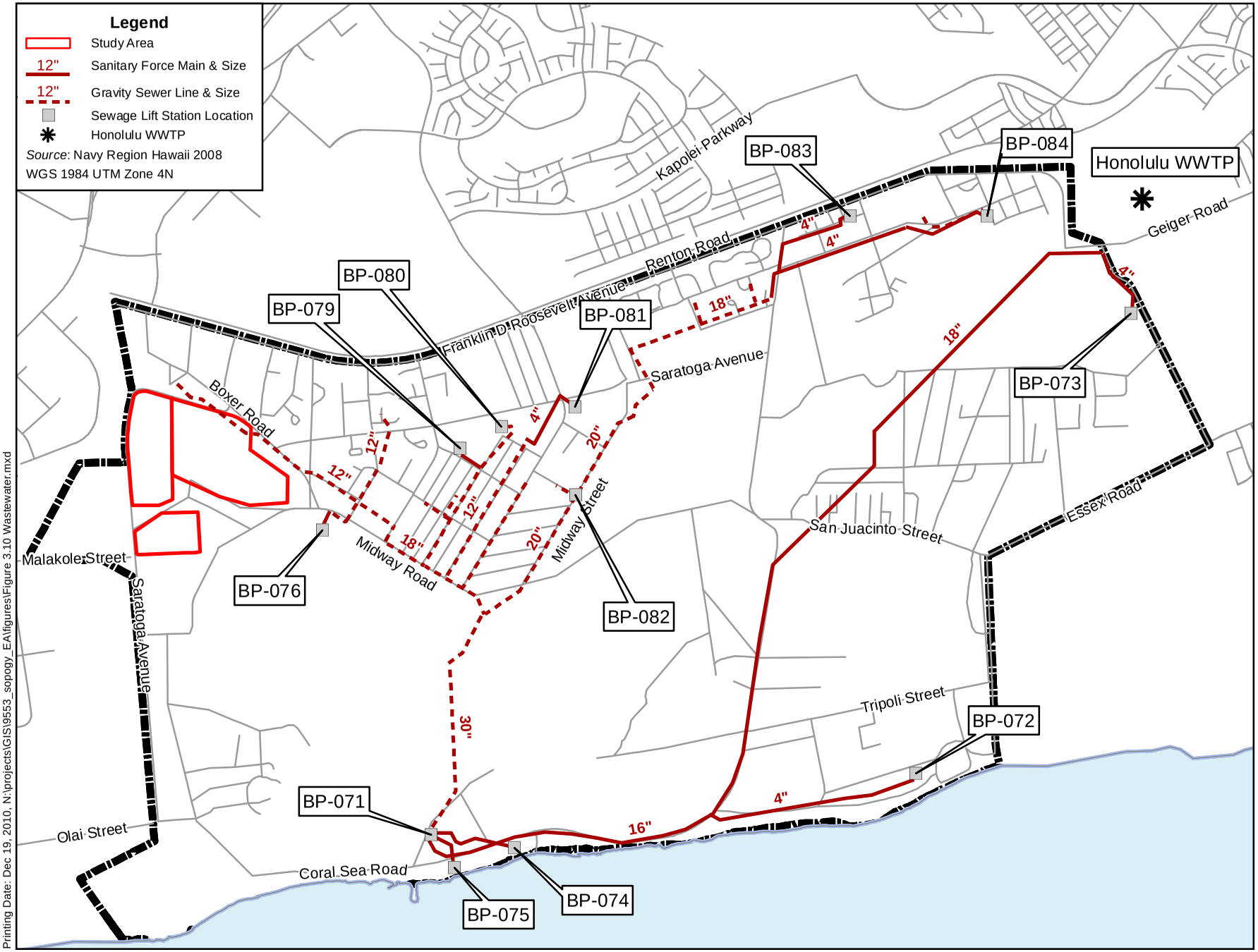
The project action would have minimal impact on wastewater utilities. There would be one restroom for employees. The capacity of Honouliuli WWTP is sufficient to accommodate any potential increases in wastewater flow resulting from the proposed action, thus impacts on the wastewater utility would not have a significant impact.

3.11.1.5 Solid Waste

The County Department of Public Works (DPW) has two main disposal facilities: the 1,800 ton/day H-POWER refuse to energy plant at Campbell Industrial Park and the Waimanalo Gulch Landfill in Ewa. There are no existing landfills at Kalaeloa (US Navy 1999). There is currently no solid waste service at the site.

Construction debris would be generated and disposed of in accordance with State and county requirements. Whenever possible, materials would go to a recycler. When not possible, materials generated would go to a debris landfill such as the PVT Landfill in Nanakuli, Hawaii.

Operation under the proposed action would not generate significant amounts of solid waste. A private waste contractor would provide solid waste collection and disposal services for the Proposed Action. Recycling would be implemented. Bins would be set up to recycle cardboard, aluminum cans, plastic, white paper, and newspaper. Waste and recycled materials would be delivered to, and disposed of properly, at a Honolulu permitted county facility.



Printing Date: Dec 19, 2010, N:\projects\GIS\9553_sopogy_EA\figures\Figure 3.10 Wastewater.mxd

Feet
0 1,250 2,500
0 325 650
Meters

Figure 3.10
Existing Wastewater System
Kalaeloa Solar One and Two

3.11.1.6 Drainage

There are two regional drainage basins that affect the Kalaeloa Community Development District: the Kapolei Drainage Basin and Kaloi Drainage Basin. There is coral pit near the intersections of Franklin D. Roosevelt Road and Fort Barrette Road that collects water from an infiltration canal located parallel to the northern boundary of Kalaeloa and the railroad tracks. During heavy rains, there is potential for the capacity of the canal to be exceeded and there have been overflow events onto Roosevelt Road resulting in localized flooding within the Kalaeloa boundary. The Kalaeloa Master Plan suggests the regional drainage system is inadequate to handle runoff from a modeled 100-year storm event (HCDA 2010).

Stormwater runoff within the Kalaeloa District is discharged to numerous Navy dry wells, none of which are located at the site. These drywells do not conform to County standards. There are no stormwater controls at the site and rain percolates through the soil. The Kalaeloa Master Plan suggests establishment of a special drainage district subject to County approval that would allow the use of drywells, swales, and retention basins.

Stormwater would be managed on site. Regional stormwater issues would be considered in the preparation of stormwater management plans. Specific storm management controls have not been developed, but they may include berms along the southern edge of the site. Rain would infiltrate the ground, except for approximately 27,200 ft^2 of impervious surfaces at the equipment pads, substation and support buildings. This is a minor amount of new impervious surface relative to the acreage at the site (approximately 80 acres). The proposed action would not have a significant impact on stormwater drainage at the site or in the vicinity.

3.11.2 Public Services: Affected Environment and Impacts

3.11.2.1 Schools

Currently, there are four elementary schools (Mauka Lani, Makakilo, Kapolei and Barbers Point), plus Kapolei Middle School and High School in the Kalaeloa area. All are part of the State Department of Education's (DOE) Leeward District Kapolei Complex. Due to rapid residential growth in the area, the DOE is planning eight new elementary schools, three middle schools, and one high school for the area by 2030 (DPP 2008).

The proposed action would not induce population growth into the area and would not result in an increased in attendance at existing schools. The Kalaeloa Master Plan (HCDA 2006) has designated an area for Instructional/School/Cultural Center land use at the Barbers Point Elementary School site. The proposed action would have no impact on the existing or planned schools.

3.11.2.2 Police, Fire, and Emergency

Kalaeloa law enforcement falls under the jurisdiction of the Kapolei office of the County Police Department. County Fire Department Stations in the area that service the Kalaeloa area include the Kapolei and the Makakilo Stations of Battalion 4, West Oahu. Additional fire services for Navy and Coast Guard facilities in the area are provided by Federal Fire Department Station 12.

Emergency services are provided by ambulance located at both the Kapolei and Makakilo Fire Stations. Hawaii Medical Center West, located on Fort Weaver Road northeast of the project site, is the only hospital in the Kalaeloa area.

During construction, standard safety and security precautions (e.g., security fencing) would be implemented. During both construction and operation under the proposed action, security as necessary would be provided by the developer so that the Honolulu police would only be needed in an emergency. During the Pre-assessment consultation, the County Police Department indicated there would be no anticipated impact to their services due to the project (Appendix A). Existing and planned Honolulu Fire Department capabilities are adequate for the area.

3.11.2.3 Roadways and Traffic

Kalaeloa has 20 miles of existing roadways (HCDA 2006). The two major thoroughfares in the vicinity are H-1 and Farrington Highway (State Route 93). H-1 is located north of the proposed site, and runs east-west. H-1 is used to reach the Ewa Plain from Honolulu. Farrington Highway runs parallel to H-1 and merges with H-1 directly north of the proposed site. Kalaeloa Boulevard runs north-south, connecting H-1 and Farrington Highway with the proposed site.

Due to the rapid residential development of the Kalaeloa area, traffic problems have increased. Roadways have not been modified, nor have new roads been created, quickly enough to keep up with increased population. Studies have been conducted to provide a solution to traffic problems on the Ewa region, and have identified projects to improve travel within Kalaeloa. Long-term plans include more bus lines and buses to link to the planned mass-transit rail system, and would improve access to Kalaeloa and the proposed site.

The Kalaeloa Master Plan proposes a major east-west spine road that would realign and connect the existing portions of Saratoga Road along the northern boundary of the project site (Figure 3.12). There is a proposed extension of Kamokila Boulevard south through the project site and an extension of Midway Street through the site approximately east-west. The infrastructure plans are being developed and may be influenced by the proposed action.

Construction traffic would likely use Kamokila Boulevard and Saratoga Avenue to access the site. During the construction phase, there would be increased traffic to the area, including privately-owned vehicles of construction workers, trucks, and heavy equipment. However, the increase would be temporary and would present a marginal increase in the regional traffic. There would be minimal impact on local traffic because there are few land uses adjacent to the site. Operation under the proposed action will be seven days per week and would require about 30 full-time employees for the CSP facility. The PV site is operated remotely and would not contribute to local traffic. No significant adverse impact to traffic was identified. Regionally, there would be a slight additive cumulative impact on traffic.

HCDA is preparing an infrastructure master plan and a preliminary plan is included in the Kalaeloa Master Plan (Figure 3.12). The plan shows a new roadway through the proposed site. This would not be compatible with the proposed development and was likely based on planned smaller lease areas.

There would be no significant adverse direct or indirect impacts to existing roadways and traffic during operations. Regionally, there would be a slight additive cumulative impact on regional traffic during construction, but the impact would not be significant.

3.11.2.4 Proposed Action

The proposed action would not have an impact on public services during construction or operations. Although there are unknowns with respect to potable water service provider and site access, the project would be consistent with the Kalaeloa infrastructure master plan and would be subject to service provider approval. No significant adverse impact on utilities is anticipated.

3.11.2.5 No-Action Alternative

Under the No-Action Alternative, the proposed construction would not occur. No significant impacts to utilities and public services would occur with the No-Action Alternative.

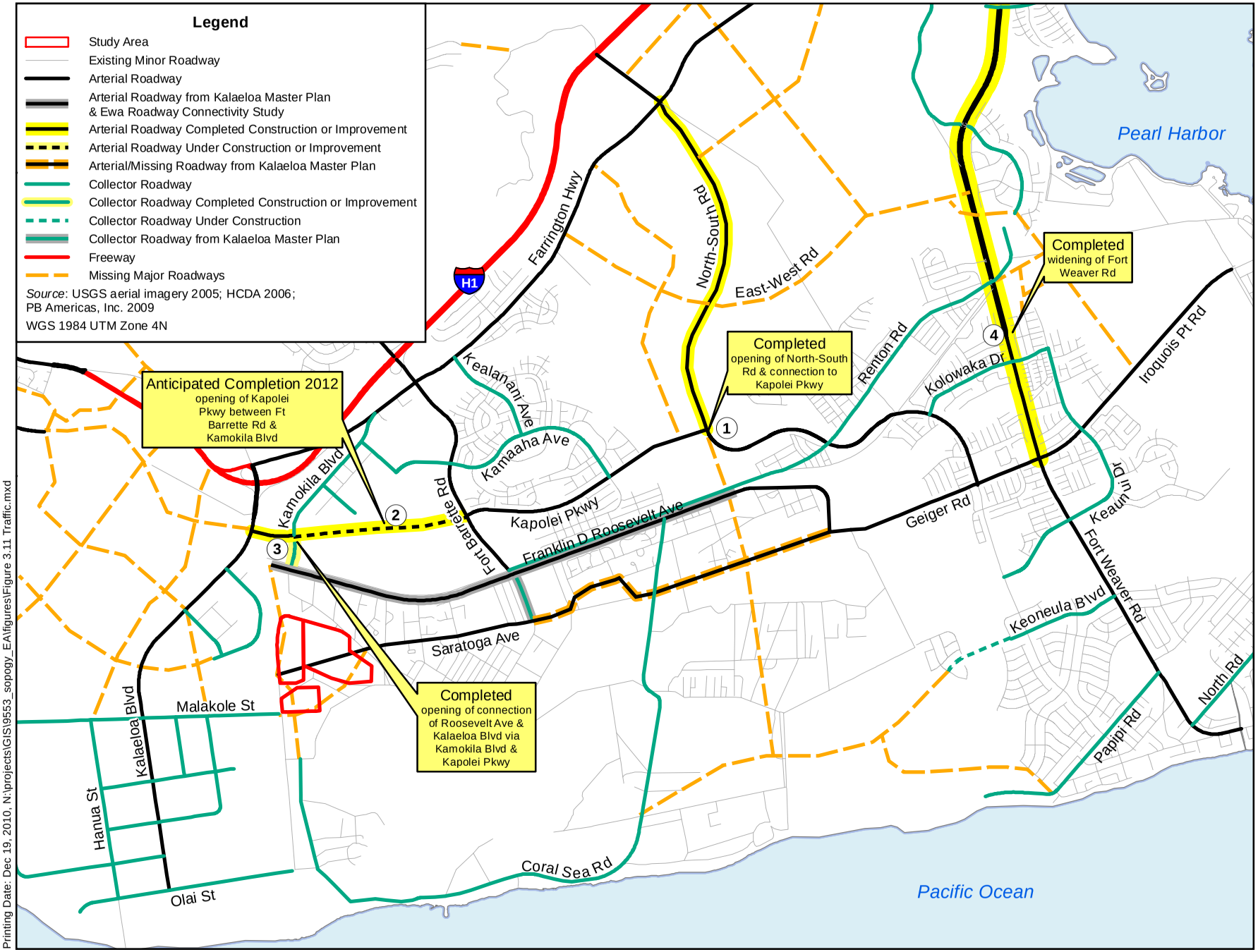


Figure 3.11
Regional Traffic Improvements
Kalaeloa Solar One and Two

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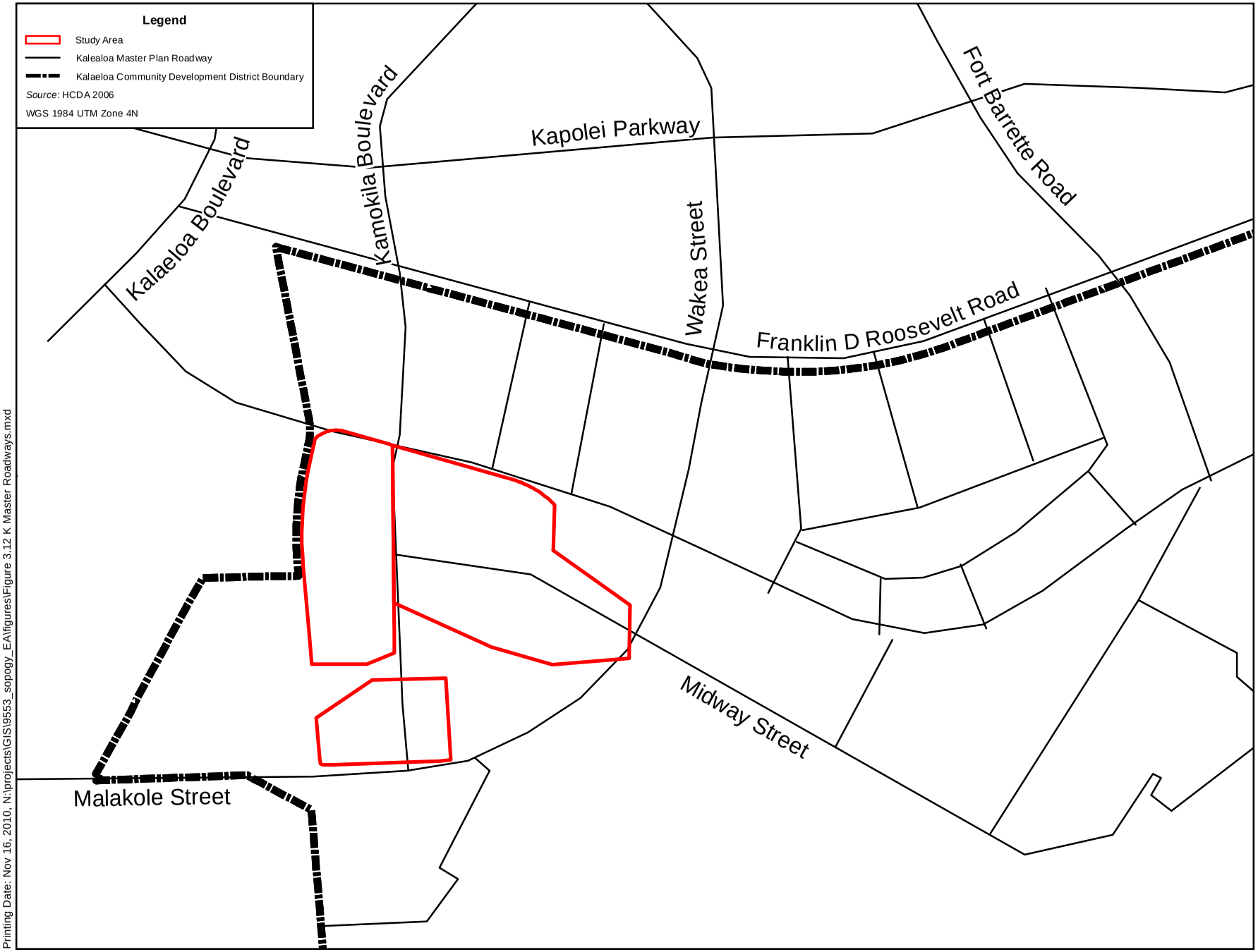

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Feet
0 600 1,200
0 160 320
Meters

Figure 3.12
Kalaeloa Master Plan Roadways
Kalaeloa Solar One and Two

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W E
S

3.12 CUMULATIVE IMPACTS

Cumulative impacts can result from incremental impacts of an action when added to other past, present and reasonably foreseeable future actions regardless of what agency or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (HAR 11-200). Analysis of cumulative impacts was conducted on a qualitative basis, and included an assessment of known activities and developments occurring within the Kalaeloa Area. The projects listed in Sections 3.12.1 and 3.12.2 that improve infrastructure and public services and provide housing would have a net beneficial impact on the environment. New or expanded businesses that are sited in locations consistent with community plans and that provide jobs in the region would also have a net beneficial impact on the environment. Cumulatively, there could be an additive impact on air quality if all projects were constructed concurrently, but that is highly unlikely.

3.12.1 Recent Past, Present, and Future Projects at Kalaeloa

Since the closure of NASBP, there have been substantial changes in the area due to the development of the entire Ewa region of Oahu. As of 2006, 25 percent (929 ac) of the former Barbers Point was retained by the Navy, 44 percent (1,621 ac) was conveyed to government or private owners, and 31 percent (1,146 ac) remained pending conveyance (HCDA 2006). Several projects have occurred on the former NASBP, now called Kalaeloa, and several more are currently underway or planned, as follows:

- *Conveyance of Navy-retained Lands at Kalaeloa – Completed 2008*. Commander, Navy Region Hawaii conveyed 499 acres of land and utilities at Kalaeloa that had been retained by the Navy following the closure of NASBP. The conveyance included former NASBP utility systems (i.e., water, wastewater, electrical distribution and telecommunication systems and corresponding easements) to a private developer for potential reuse and development (Navy Region Hawaii 2008). According to the EA, foreseeable development of the subject parcels was intended to be compatible with the Kalaeloa Master Plan (HCDA 2006). Over a twenty year period, these include approximately 5,000 homes in a mixed use/transit-oriented setting, industrial and commercial uses, and public uses such as schools, parks and a public transit system.
- *Relocation of Hawaii Army National Guard to Kalaeloa – In progress and Future Planned.* Hawaii Army National Guard is planning to relocate and consolidate to its currently only partially-used 150-acre parcel north of the Kalaeloa Airport runway. The consolidation includes construction and renovation of existing buildings and an increase in personnel onsite by nearly 300.
- *Ke Kama Pono Building – Completed 2009.* Construction of five approximately 2,000 square-foot residential units on Yorktown Road in Kalaeloa, Oahu to serve as facilities for the Ke Kama Pono program which provides services and programs for at-risk youth.
- *Kalaeloa Airport Aircraft Hangers – In Progress and Future Planned*. DOT is in the process of constructing 10 T-hangars to accommodate 10 general aviation aircraft. DOT plans to construct an additional eight banks of T-hangars for 144 general aviation aircraft. They also plan to develop eight lease lots and related access roads for use by lessees on about 54 acres of previously cleared and paved land. These projects provide for housing of aircraft at the airport which is projected to result in greater usage (increased aircraft operations at Kalaeloa airport).
- *New Housing – Present to 2025*. The Kalaeloa Master Plan projected 6,352 new housing units in three phases (2007 to 2025) (HCDA 2006).
- *New Commercial Space - Present to 2025*. The Kalaeloa Master Plan (HCDA 2006) estimates a total construction of 116,583 ft^2 (2.67 ac) of commercial space, 725,028 ft^2 (16.64 ac) of office

space, 1,819,388 ft^2 (41.76 ac) of light industrial space, and 470,436 ft^2 (10.79. ac) of light industrial mixed use space over the three phases of development (2007 to 2025) for a total of 3,131,435 ft^2 (71.88 ac) of projected buildings.

- *Enterprise Energy Corridor – Planned for Construction by 2013*. There are plans to construct a 12kV energy corridor on Enterprise Street between Roosevelt Avenue and Midway Street.
- *FBI Complex - Planned for Construction by 2013* – A new building complex is planned on a 10-acre plot near Enterprise Street and Saratoga Avenue.
- *Widening of Fort Barrette Road – Unknown Construction Date*. This DOT road widening project has been planned for several years. An EA was conducted for the expansion in 2006. This project has been on hold for a number of years.
- *Desalination Project – Unknown Construction Date***.** The Board of Water Supply has plans to construct a 5 mgd desalination plant on a 20-acre parcel at Kalaeloa (DPP 2008). Capacity could be increased to 15 mgd in a second phase and even further up to 35 mgd at a later date.
- *US Coast Guard at Kalaeloa Airport Aircraft Hanger – Unknown Construction Date*. The Coast Guard plans to construct an additional hanger at the airport.
- *Fire Department Training Facility – Unknown Construction Date*. The Honolulu Fire Department has plans to establish an island-wide training facility at Kalaeloa (DPP 2008).
- *Kalaeloa Regional Park – Unknown Construction Date***.** A new park utilizing vacant land at Kalaeloa is envisioned (DPP 2008). The park is intended to be a major nucleus of community activity. The park would include sports and recreation facilities, including ocean recreation, and cover 468 acres (Honolulu Star Bulletin 2005).
- *Drainage System Improvements – Unknown Construction Date*. The drainage system for the Villages of Kapolei currently consists of a golf course retention and disposal system where stormwater is discharged into large pits and a large ditch near the Kalaeloa boundary (DPP 2008). The stormwater drainage into a coral pit at Fort Barrette Road and Roosevelt Avenue is inadequate to handle the runoff from a 100-year storm (HCDA 2006). A new system to handle stormwater runoff may be required in the future for areas within Kalaeloa.

3.12.2 Other Projects in the Region

Other projects in the region are as follows:

- *New Housing – Present to 2011*. Housing in the ‘Ewa area has been rapidly increasing. Numerous housing developments are proposed within approximately 1.5 miles of Kalaeloa. These developments are located to the north and east of Kalaeloa and include City of Kapolei and Villages of Kapolei to the North, ‘Ewa Villages, ‘Ewa Gentry Makai, and Ocean Pointe to the east. The developments, on over 1,000 acres of land, have a total of 7,200 residential units as of 2008 and are projected to have 14,400 units when built out sometime after 2011 (PB Americas 2009).
- *Schools – Present to 2030*. DOE has projected a need for eight new elementary schools, three new intermediate schools, and at least one new high school in the ‘Ewa region (DPP 2008).
- *University of Hawaii West Oahu – Unknown Future Date*. The University of Hawaii west campus is projected to have 800 faculty and staff and 7,600 students (DPP 2008).
- *Resort Development – Present to 2030*. Ko‘Olina Resort to the west and the Hoakalei Resort at Ocean Pointe (under construction) to the east are projected to include almost 9,200 visitor units by 2030 (DPP 2008). The marina at Ocean Pointe would be the region's principal recreational marina destination for local residents and visitors with over 1,100 acres (DPP 2008).
- *HECO Campbell Industrial Park Generating Station Expansion – Construction Complete*. The plan is for one 110-megawatt combustion turbine generator and auxiliary systems to be used as a

peaking unit. Construction is complete and preliminary performance testing is underway (HECO 2009).

- *H-Power Campbell Industrial Park Station Expansion – Unknown Construction Date*. H-Power proposes to expand the existing 28 acre H-Power power plant. The current processing capability of the plant is 2,160 tons-per-day of municipal solid waste which is turned into refuse-derived fuel for combustion to generate up to 57 megawatts of energy. The plan is to expand capacity of 900 tons-per-day burn and to add a new turbine generator, which would provide an additional source of renewable energy to the County (County 2009b).
- *New Fire Stations – Unknown Construction Date*. To meet projected population and economic growth by 2030, the Fire Department estimates ‘Ewa would need four new fire stations (DPP 2008).
- *Road Development – Various Construction Dates*. Numerous projects to improve or construct new roads are planned (DPP 2008; Figure 3.10-2). These include completion of the North-South Road and additional portions of Kapolei Parkway, projected for 2010.
- *Rapid Transit System – Unknown Construction Date*. An elevated or an at-grade separated rapid transit system is planned for the area and there are plans to start at a point near North-South Road and continue east. Plans further into the future allow extension of the system through Kalaeloa to the City of Kapolei, with a planned ending near the intersection of Kapolei Parkway and an extension of Hanua Street.

3.12.3 Proposed Action

Numerous projects are planned that would construct new facilities in the Kalaeloa region. The Kalaeloa Master Plan and pending development rules would guide the redevelopment of the area and serve to minimize the potential cumulative adverse impacts. Land use plans guide development to minimize cumulative impacts of individual development projects. The proposed action and other projects approved within the Kalaeloa area would be consistent with the Kalaeloa Special Area Plan and Kalaeloa Master Plan. The proposed actions would not have an additive adverse impact on air quality, ambient noise, geology and soils, water resources, biological resources, cultural resources, socioeconomics, hazardous materials and wastes, visual resources, and utilities and public services relative to the impacts of the cumulative projects.

3.12.4 No-Action Alternative

Under the No-Action Alternative, the proposed construction activities would not occur. No adverse cumulative impacts would occur under the No-Action Alternative.

3.13 IRRETRIEVABLE AND IRREVERSIBLE COMMITMENT OF RESOURCES

Resources that are committed irreversibly or irretrievably are those that cannot be recovered if the proposed action is implemented. The proposed action includes construction that would alter the landscape of approximately 80 acres of currently undeveloped land. The land is subject to a limited-term lease (20 years anticipated), and it could revert to vegetated open space. However, the Kalaeloa Master Plan designates the acreage for eco-industrial uses and the site would likely be developed in the future. The production of the CSP and PV units would result in a commitment of resources.

The proposed action is a renewable energy project that would minimize the State’s use of non-renewable resources to generate electricity. The proposed action has a net beneficial impact on resources.

SECTION 4
CONSISTENCY WITH EXISTING PLANS, POLICIES AND CONTROLS

4.1 REGULATORY OVERVIEW

The following is a discussion of the federal, State of Hawaii, and County laws and consultations that are relevant to implementing the Proposed Action.

4.1.1 Federal Regulations

4.1.1.1 Public Utilities Regulatory Policy Act of 1978

The Public Utility Regulatory Policies Act (PURPA) (16 U.S.C. Sections 2601-2645) was passed in 1978 by Congress as part of the National Energy Act. It was written to promote greater use of renewable energy. Before PURPA, only utilities could own and operate electric generating plants. PURPA required utilities to buy power from independent companies that could produce power for less than what it would have cost for the utility to generate the power, called the "avoided cost." PURPA has been effective in promoting renewable energy. The proposed action is consistent with this act.

4.1.1.2 National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966, as amended (16 USC §470), recognized the nation's historic heritage and established a national policy for the preservation of historic properties as well as the National Register of Historic Places (NRHP). Section 106 of the NHPA requires agencies to take into account the effects of undertakings on historic properties, and affords the Advisory Council on Historic Preservation a reasonable opportunity to comment on such undertakings. The project will comply with NHPA and known archaeological resources would be avoided.

4.1.1.3 Endangered Species Act

The Endangered Species Act (ESA) as amended (16 USC §1531 *et seq*.) establishes a process for identifying and listing plant and wildlife species determined to be in danger of extinction and providing specific legal protections to conserve them. The DLNR is responsible for enforcement of endangered species law. Threatened and endangered plants were recorded within the eastern area of the study area. The site design is flexible and the plants would be protected during construction and operations.

4.1.1.4 Clean Air Act

The CAA sets NAAQS for sulfur dioxide (SO_2), carbon monoxide (CO), particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}) and 2.5 microns ($PM_{2.5}$), nitrogen dioxide (NO_2), lead (Pb), and ozone (O_3). The CAA regulates construction and operation of new stationary sources and modifications of existing stationary sources in its New Source Review program. This program is divided further into non-attainment and attainment area permitting requirements. Non-attainment areas require permitting of all major pollution sources. Attainment areas require the installation of the best available control technology for all major sources and must fall within the next

increment of degradation. Major pollution sources require an air quality permit before construction. Under the proposed action, no emissions are anticipated, except steam.

4.1.1.5 Clean Water Act

The Clean Water Act (CWA) of 1972 is the primary federal law that protects the nation's waters, including lakes, rivers, wetlands and coastal areas. The primary objective of the CWA is to restore and maintain the integrity of the nation's waters. In Hawaii, oversight responsibilities lie with the DOH. The DOH reviews and certifies NPDES permit applications and the USEPA coordinates, drafts, and issues NPDES permits for storm water and point source pollution discharges.

The nearest surface water is a drainage canal approximately 0.33 miles from the western boundary of the site. The surface flow across the site is to the south. The annual rainfall is low. An NPDES permit for construction would be acquired. The NPDES Permit process requires submittal of a stormwater management plan prior to commencement of construction that would include a list of BMPs to be implemented and any additional plans to prevent an increase in runoff. During operations, rainfall would be allowed to infiltrate the site through an impervious surface. Stormwater would be retained on sited during construction and operations. NPDES permits would be acquired.

4.1.1.6 Coastal Zone Management Act

The Federal Coastal Zone Management Act (CZMA) was created in 1972 to protect coastal resources in the U.S. Federal consistency (codified at 15 CFR 930) is the CZMA requirement that federal actions that have reasonably foreseeable effects on any land or water use or natural resource of the coastal zone (also referred to as coastal uses or resources, or coastal effects) must be consistent with the enforceable policies of a coastal state's federally-approved Coastal Zone Management (CZM) Program. The proposed action is not a federal action and a consistency determination is not required. See Section 4.1.2 for a discussion of the State of Hawaii CZM program.

4.1.2 State of Hawaii

4.1.2.1 Hawaii Endangered Species Law

Under HRS 195D-1 – 32, Hawaii endangered species law any species of aquatic life, wildlife, or land plant that has been determined to be an endangered species pursuant to the federal ESA shall be deemed to be an endangered species in the State of Hawaii. Also, any indigenous species of aquatic life, wildlife, or land plant that has been determined to be a threatened species shall be deemed to be a threatened species in the State of Hawaii. In addition to species that have been determined to be endangered or threatened pursuant to the ESA, the State of Hawaii may determine any indigenous species of aquatic life, wildlife, or land plant to be an endangered species or a threatened species in order to further protect Hawaii's unique ecosystem. Hawaii's endangered species law prevents removal, possession, or sale of endangered or threatened species. DLNR is responsible for enforcement of endangered species law. No impacts to threatened or endangered species were identified.

4.1.2.2 Hawaii Coastal Zone Management Program

In 1977, the Hawaii CZM Program was enacted as Chapter 205A HRS in response to the Federal CZMA of 1972 described in an earlier section of this EA. The State CZM area encompasses all the land including

the project site. The proposed action is consistent with the 10 policy objectives (*italics*) of the State CZM Program as noted below:

1. *Recreational Resources. To provide coastal recreational opportunities accessible to the public and protect coastal resources uniquely suited for recreational activities that cannot be provided elsewhere.* The project site is more than a mile from coastal areas and would not impact coastal recreational resources.

2. *Historic Resources. To protect, preserve, and where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.* Historic resources have been identified in the vicinity of the site and the project would avoid those sites.

3. *Scenic and Open Space Resources. To protect, preserve, and where desirable, restore or improve the quality of coastal scenic and open space resources.* The proposed action is not on the coast and would not impact scenic coastal views. The site development would represent a loss of vegetated open space but construction would be low to the ground with the exception of minor support buildings.

4. *Coastal Ecosystems. To protect valuable coastal ecosystems, including reefs, from disruption and to minimize adverse impacts on all coastal ecosystems.* The proposed action is not on the coast and would have no adverse impact on coastal ecosystems.

5. *Economic Uses. To provide public or private facilities and improvements important to the State's economy in suitable locations; and ensure that coastal dependent development such as harbors and ports, energy facilities, and visitor facilities, are located, designed, and constructed to minimize adverse impacts in the coastal zone area.* There would be economic benefits associated with construction and operation of the new power generating facility. The renewable energy project is appropriately sited at the eco-industrial area of the Kalaeloa Community Development District.

6. *Coastal Hazards. To reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.* The proposed action would not increase the environmental risk associated with the hazards listed.

7. *Managing Development. To improve the development review process, communication, and public participation in the management of coastal resources and hazards.* This EA supports the managing development objective and policies by providing opportunity for public and agency review and comment on the Draft EA.

8. *Public Participation. To stimulate public awareness, education, and participation in coastal management; and maintain a public advisory body to identify coastal management problems and provide policy advice and assistance to the CZM program.* This EA supports this objective by providing opportunity for public and agency review and comment on the Draft EA.

9. *Beach Protection. To protect beaches for public use and recreation; locate new structures inland from the shoreline setback to conserve open space and to minimize loss of improvements due to*

erosion. The proposed action is more than a mile from the nearest beach and would have no impact on beaches.

10. *Marine Resources. To implement the State's ocean resources management plan.* The proposed action would have no impact on ocean resources.

The CZM program also establishes a permit/approval system to control development in Special Management Areas (SMAs) that are managed by each county and the State Office of Planning. The proposed action is located more than a mile inland of the SMA (Figure 2.1). The program has a federal consistency provision that requires federal activities, permits and financial assistance would be consistent with the Hawaii CZM program. The proposed action does not require federal permits, or financial assistance and does not require a federal consistency determination. The project is consistent with the CZM program objectives. The Office of Planning was provided a copy of this Draft EA for review and comment.

4.1.2.3 Hawaii Clean Energy Initiative

The U.S. Department of Energy and the State of Hawaii signed a Memorandum of Understanding (MOU) in 2008 establishing the HCEI. The purpose of the MOU was to increase Hawaii's renewable energy production capabilities and to transition exclusively to renewable energy use on the smaller islands.

Hawaii established a renewable energy goal in 2001, which was later replaced with an enforceable Renewable Portfolio Standard (RPS) under Senate Bill 2474 in June 2004. Hawaii's RPS was expanded when HB 1464 was signed in 2009, increasing renewable electrical energy generation required by utilities to reach 40 percent by 2030 (State of Hawaii HB 1464).

The RPS schedule requires that each company that sells electricity in Hawaii must sell the following percentages of renewable electrical energy:

- 10 percent of its net electricity sales by December 31, 2010,
- 15 percent of its net electricity sales by December 31, 2015,
- 25 percent of its net electricity sales by December 31, 2020, and
- 40 percent of its net electricity sales by December 31, 2030.

Under the HCEI, renewable energy is defined as:

- wind,
- sun,
- falling water,
- biogas, including landfill and sewage digester gas,
- geothermal,
- ocean water, currents, and waves, including ocean thermal energy,
- biomass, including crops, agricultural and animal wastes and municipal solid waste,
- biofuels, and
- hydrogen produced by renewable sources.

Renewable electrical energy is any electricity generated using renewable energy, or electrical energy savings brought on by use of renewable displacement or off-set technologies (State of Hawaii HB 1464).

Hawaii Public Utilities Commission

The Hawaii Public Utilities Commission (PUC) establishes the standards determining the percentage of the RPS that should be met by each type of renewable electrical energy source. By January 1, 2015, a minimum of 50 percent of the RPS must be met with electricity generated using renewable energy. The PUC would enforce the standards by penalizing the utilities that fail to reach them. The PUC works with the Hawaii Natural Energy Institute to conduct a peer-reviewed study each five years. The standard would be evaluated in 2013, with the findings reported to the legislature before the 2014 legislative session. The PUC created a rate system that sets price guarantees for electricity generated from solar, wind and hydroelectric sources that acts as an incentive to investors to pursue renewable energy development.

Healthy Community Design Smart Growth Checklist

The State of Hawaii has developed a *Healthy Community Design Smart Growth Checklist* of principles to apply to development (http://hawaii.gov/health/environmental/env-planning/landuse/hcdchecklist.pdf). The checklist items are more relevant to the entire Kalaeloa Community Development District, than to this one development proposal. The proposed action is consistent with those items that are relevant. One of the four principles is relevant to the proposed action: *Promote clean air by making transit convenient and comfortable, minimizing petroleum fueled car and truck use and minimizing fossil energy use.* The proposed action would minimize fossil fuel use for energy production.

4.2 PERMITS AND APPROVALS REQUIRED

4.2.1 Permits

The permits that may be required before implementation of the project are listed below.

State of Hawaii Permits

- NPDES Notice of Intent, Appendix C (NOI-C) Permit, DOH. Stormwater associated with construction activities.
- Community Noise Control, DOH. A noise variance permit would also be required if work is required during evenings and weekends.
- Sanitary wastewater permit.

County Permits

- Building and renovation permits from DPP.
- Minor conditional use permit for utility installation Type B from DPP, per pre-Assessment consultation letter (Appendix A).
- Grading permit from DPP.

4.2.2 Approvals

Plan review and approval would be required by the following agencies:

- County Department of Environmental Services – for solid waste management.
- Federal Aviation Administration – Determination of No Hazard for Air Navigation
- SHPD – per HRS §6E-8, DHHL shall consult with SHPD regarding the effect of the project upon historic property or a burial site.
- DHHL – as land owner, is the approving agency for this EA.

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SECTION 5
ANTICIPATED DETERMINATION

5.1 COMPARISON OF THE ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

The proposed action would construct two 5 MW renewable power-generating facilities in Kalaeloa. A summary of potential impacts and mitigation measures are listed in Table 5.1. Environmental protection measures that are required by law or as conditions to permits are not considered mitigation but are considered part of the proposed action.

Table 5.1. Summary of Impacts and Potential Mitigation

Resource	*Proposed Action Potential Impacts*	*Mitigation Proposed for Consideration*	*No Action*
Land Use	No significant adverse impact impact. Consistent and compatible with existing and planned land uses for overall beneficial impact.	Not applicable	No impact
Air Quality	No significant adverse impact with construction BMPs	Not applicable	No impact
Noise	No significant adverse impact	Not applicable	No impact
Geology and Soils	No significant adverse impact with BMPs and adherence to permit conditions to control erosion	Not applicable	No impact
Water Resources	No significant adverse impact with BMPs to control stormwater onsite and adherence to permit conditions	Not applicable	No impact
Biological Resources	No adverse impact identified within the proposed development area.	Not applicable	No impact
Cultural Resources	Resources within the development area would be affected by the proposed action.	Implement *An Integrated Archaeological Mitigation Plan for the Proposed Kalaeloa Solar One and Two Projects* or other mitigation developed in consultation with SHPD	Potential for inadvertent disturbance or vandalism of sites
Socioeconomics and Cultural Environment	Beneficial impact on DHHL mission through collection of lease fees. No significant adverse impact on socioeconomics or cultural environment.	Not applicable	Lost economic and social opportunity to collect lease revenue.
Hazardous Materials and Waste	No significant impact with adherence to applicable laws and regulations	Not applicable	No impact
Visual Resources	No significant impact	Not applicable	No impact
Utilities and Public Services	No significant impact	Not applicable	No impact

5.2 SIGNIFICANCE CRITERIA

The Significance Criteria in HAR Title 11, 200-12 for environmental impacts were reviewed and the proposed project was assessed for significant impacts. The evaluation included all phases of the proposed action, both direct and indirect impacts and short-term and long-term effects, and the cumulative effects. Short-term is considered to be construction phase and long-term is the operational phase in the discussion below. Each of the significance criteria listed below is followed by the evaluation.

1. Involves an irrevocable commitment or loss or destruction of any natural or cultural resource.

The proposed action would not result in an irrevocable commitment, loss or destruction of any protected natural resource. No threatened or endangered species were identified within the development area or proposed final lease area (See Section 3.6). Negotiations with DHHL for the lease boundaries are ongoing.

There are cultural sites within the development area and the proposed final lease area (See Section 3.7). KSP proposes to preserve those features and sites that together have the highest integrity for interpretation and research on the range of traditional Hawaiian activities once pursued in this portion of the `Ewa Plain. Those sites that remain in the lease area would be preserved or investigated according to the terms of *An Integrated Archaeological Mitigation Plan for the Proposed Kalaeloa Solar One and Two Projects* or other mitigation plan developed in consultation with SHPD.

No negative impacts to significant archaeological resources are anticipated under the proposed action, since the approach is to maintain the integrity of all six sites for interpretation through a combination of preservation and data recovery. Archaeological monitoring and inadvertent burial treatment measures are described in the Plan and will ensure that no significant adverse impacts occur to cultural resources during construction. Consultation with SHPD is ongoing.

During operation, there would be no irrevocable commitment or loss or destruction of any identified natural or cultural resource. There would be a commitment to protect those resources within the lease area resulting in a beneficial impact. There would be no significant cumulative adverse impact on natural and cultural resources.

2. Curtails the range of beneficial uses of the environment.

The proposed action would not affect the range of beneficial uses of the environment. The land that would be used is currently vacant; however, the site is designated for development and eco-industrial use in the Kalaeloa Master plan. The proposed renewable energy project is an eco-industrial use. The Master Plan is a roadmap to guide development that collectively meets community goals for land use. The site is not suitable for developments greater than 180 ft in height because of proximity to Kalaeloa Airport. The proposed action would not curtail the range of beneficial uses of the environment in the short or long-term.

3. Conflicts with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders.

The proposed action supports the state's long term environmental policies or goals in Ch 344, HRS. Specifically:

HRS §344-3 *Conserve the natural resources, so that land, water, mineral, visual, air and other natural resources are protected by controlling pollution, by preserving or augmenting natural resources, and by safeguarding the State's unique natural environmental characteristics in a manner which would foster and promote the general welfare, create and maintain conditions under which humanity and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of the people of Hawaii.*

The renewable energy project would indirectly reduce Hawaii's reliance on fossil fuels to produce energy and reduce the amount of greenhouse gases generated from energy production. It would not have direct adverse impacts land, water, mineral, visual, air and other natural resources.

The HRS §344-4 guidelines are generally not relevant to the proposed action; however, the proposed action is consistent with those that are relevant, as listed below:

HRS §344-4 *Guidelines*

(2) Land, water, mineral, visual, air, and other natural resources.

(A) Encourage management practices which conserve and fully utilize all natural resources;

(3) Flora and fauna.

(A) Protect endangered species of indigenous plants and animals and introduce new plants or animals only upon assurance of negligible ecological hazard;

(5) Economic development.

(A) Encourage industries in Hawaii which would be in harmony with our environment;

(7) Energy.

(A) Encourage the efficient use of energy resources.

The proposed action would not have a significant adverse impact on the environment. It would be consistent with the State of Hawaii's long-term environmental policies, goals, and guidelines. Additionally, the proposed action contributes to statewide goals to increase energy produced by renewable sources.

4. Substantially affects the economic or social welfare of the community or State.

The proposed action has beneficial impacts on socioeconomics during construction related to employment opportunity and purchase of materials. During operations, the benefit to social welfare of the community and State would be realized cumulatively as other renewable energy projects are developed decreasing the State's reliability on fossil fuels for energy production. There would be new fulltime jobs created. There would be a beneficial indirect impact on the Hawaiian community through the collection of lease fees by

the DHHL. In addition, there would a provision in the lease agreement for a portion of the net annual profits to go to renewable energy projects and education to benefit the Hawaiian community.

5. Substantially affects public health.

During both construction and operation of the proposed facility, no adverse impacts to public health are anticipated. Construction and operation would be compliance with all federal, State, and county regulations. Beneficial impacts to public health would be realized cumulatively as other renewable energy projects are developed, reducing dependence on power generated with fossil fuel and associated air emissions.

6. Involves substantial secondary impacts, such as population changes or effects on public facilities.

The proposed action would not induce population growth or adversely impact public infrastructure. There would be minimal increase in commuter traffic associated with the work force at the site.

7. Involves a substantial degradation of environmental quality.

During construction, there would be short-term air quality and noise impacts. The BMPs required as permit conditions would be implemented to minimize construction impacts. During operations, there would be minimal adverse impact on environmental quality. The minimal amounts of hazardous and regulated materials used onsite would be managed in accordance with applicable regulations. The decreased dependence on fossil fuel would be an indirect beneficial impact on environmental quality. Therefore, no substantial degradation of environmental quality is anticipated.

8. Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions.

The cumulative impacts associated with the proposed action would be beneficial to the environment. As an eco-industrial use, it is consistent with the Kalaeloa Master Plan. A value of Master Plans is that they guide future development to minimize adverse cumulative impacts and to meet community goals for land use.

9. Substantially affects a rare, threatened, or endangered species or its habitat.

No rare, threatened or endangered species was identified in the proposed development area (Figure 3.6, Section 3.6). The lease agreement for the proposed site boundary has not been finalized, but it will likely approximate the exterior fenceline shown on Figure 3.6. No direct, indirect or cumulative impacts to these species or habitats were identified.

10. Detrimentally affects air or water quality or ambient noise levels.

During the construction phase, there would be short-term air quality and ambient noise impacts. To minimize air quality impacts during construction, dust control measures would be implemented to minimize wind-blown emissions. Noise impacts from construction would be minimized by limiting construction activities to daylight hours and by following all applicable regulations. During operations, there would be minimal impacts to air and noise and these impacts are unlikely to be unnoticeable beyond the property boundary.

No stormwater would leave the site during construction or operation. BMPs would be implemented as part of permit conditions to protect water resources. The nearest water body is an unnamed channel west of the site. Stormwater would be retained onsite.

While there are a number of construction projects proposed in Kalaeloa, it is unlikely they would occur concurrently in the same vicinity. No detrimental construction phase cumulative impacts on air, water or noise are anticipated. The proposed action would no additive adverse cumulative impacts during the operational phase. See Sections 3.2, 3.5 and 3.3 for more discussion on the potential impact to air, water quality and ambient noise, respectively.

11. Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters.

The proposed action is not located in any of the environmentally sensitive areas listed. No increased risk to or from the development is anticipated. No indirect or cumulative impacts are anticipated on environmentally sensitive areas.

12. Substantially affects scenic vistas and view planes identified in county or State plans or studies.

The proposed action would not directly or indirectly affect any identified scenic views or view planes as described in Section 3.10. No cumulative impacts to visual resources are anticipated.

13. Requires substantial energy consumption.

The proposed action would require energy during construction, but would generate energy during operation. The proposed action would have a beneficial impact on energy supply by providing electricity to HECO.

5.3 ANTICIPATED DETERMINATION

Based on analysis of the 13 significance criteria listed in Section 5.3, the proposed action would not result in significant adverse environmental impacts. There are environmental protection measures that are to be determined in consultation with various agencies during the Draft EA review period. DHHL anticipates a FONSI.

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SECTION 6
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APPENDIX A

PRE-ASSESSMENT CONSULTATION

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APPENDIX A
PRE-ASSESSMENT CONSULTATION

In preparation of this Draft EA, a pre-assessment consultation letter was sent to agencies and organizations on August 6, 2010. The distribution list and correspondence received is included in this Appendix and summarized in Table A.1. Key issues included:

- presence of threatened and endangered plants, and anchaline pools;
- presence archaeological resources and burials;
- impact of reflectivity and thermal currents on air navigation;
- potential impacts to navigable waters of the U.S.; and
- prevailing land use zoning.

If a date is not noted in that column, then TEC has not received a reply from that party. Response letters are included in this Appendix after Table A-1. The comments were considered during preparation of the Draft EA.

Table A.1. Distribution List for Pre-Assessment Consultation Letter

Date of Response - If Any	***Addressees***
Federal Parties	
	Manager Honolulu Airports District Office Federal Aviation Administration 300 Ala Moana Blvd., Box 50244 Honolulu, HI 96850-0001
	Commander Naval Facilities Engineering Command Pacific 258 Makalapa Drive, Suite 100 Pearl Harbor, Hawaii 96860-3134
August 31,2010	U.S. Fish and Wildlife Service Pacific Islands Fish and Wildlife Office 300 Ala Moana Blvd., Room 3-122 Box 50088 Honolulu, HI 96813
August 18, 2010	Commander and Division Engineer U.S. Army Corps of Engineers Pacific Ocean Division, Building 230 Fort Shafter, HI 96858-5440
September 8, 2010	Commander U.S. Coast Guard 14th Coast Guard District 300 Ala Moana Blvd. Honolulu, HI 96850
	Director of Water Programs U.S. Geological Survey 677 Ala Moana Blvd. #415 Honolulu, HI 96813
	Region 9, Pacific Islands Office U.S. Environmental Protection Agency P.O. Box 50003 Honolulu, HI 96850

Date of Response - If Any	***Addressees***
State Parties	
	Governor Linda Lingle Office of the Governor State Capitol Honolulu, HI 96813
	Hawaii Community Development Authority 677 Ala Moana Blvd., Suite 1001 Honolulu, Hawaii 96813
	Hawaii Coastal Zone Management Program Office of Planning P.O. Box 2359 Honolulu, HI 96804
	Hawaii State Department of Health Office of Environmental Quality Control 235 S. Beretania Street, Suite 702 Honolulu, HI 96813
	State of Hawaii Dept. of Business, Economic, Development & Tourism Land Use Commission PO Box 2359 Honolulu, HI 96804
	State of Hawaii Department of Health Hazard Evaluation and Emergency Response Office 919 Ala Moana Blvd., Room 206 Honolulu, HI 96814
	Headquarters Hawaii Air National Guard 3949 Diamond Head Road Honolulu, HI 96816
August 18, 2010	State of Hawaii Department of Health, Environmental Planning Office PO Box 3378 Honolulu, HI 96801
August 12, 2010 from Commission of Water Resources Management	State of Hawaii Department of Land and Natural Resources, Land Division 1151 Punchbowl St, Room 220 Honolulu, HI 96813
	State Historic Preservation Division Department of Land & Natural Resources 601 Kamokila Blvd. Kapolei, HI 96707
	State of Hawaii Department of Planning 235 S. Beretania Street, #600 Honolulu, HI 96813
September 14, 2010	State of Hawaii Department of Transportation 869 Punchbowl Street Honolulu, HI 96813
	Director UH Manoa Environmental Center 2500 Dole, Krauss Annex 19 Honolulu, HI 96822

Date of Response - If Any	***Addressees***
City and County Parties	
	Mayor Mufi Hannemann 530 S. King Street Honolulu, HI 96813
August 16, 2010	Police Chief City and County of Honolulu Police Department 801 South Beretania Street Honolulu, HI 96813
September 14, 2010	City & County of Honolulu Department of Planning and Permitting 650 South King Street Honolulu, HI 96813
	Department of Parks and Recreation 1000 Uluohia Street, Suite 309 Kapolei, Hawaii 96707
Utilities and Services	
August 23, 2010	Chief Engineer Board of Water Supply 630 South Beretania Street Honolulu, HI 96813
	Hawaiian Electric Company PO Box 2750 Honolulu, HI 96740
	Honolulu Department of Environmental Services 1000 Uluohia Street, Suite 308 Kapolei, HI 96707
Local Organizations	
	Ahahui Siwila Hawaii O Kapolei Hawaiian Civic Club PO Box 700007 Kapolei HI 96709-007
	Hawaiian Homes Commission Department of Hawaiian Home Lands PO Box 1879 Honolulu, HI 96801
	Historic Hawaii Foundation Dole Cannery Dole Office Building Tower, Suite 690 680 Iwilei Road Honolulu, HI 96817
	Office of Hawaiian Affairs 711 Kapiolani Blvd., Suite 500 Honolulu, HI 96813
August 30, 2010	Oahu Island Burial Council Department of Land & Natural Resources P.O. Box 621 Honolulu, HI 96809
	Housing and Community Development Corporation of Hawaii 1002 North School Street Honolulu, Hawaii 96817

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
2010-TA-0436

AUG 31 2010

Ms. Rachael Ross
TEC Incorporated
Pauahi Tower
1003 Bishop Street, Suite 1550
Honolulu, Hawaii 96813

Subject: Preparation of an Environmental Assessment for the Kalaeloa Solar One Power Generating Facility, Kalaeloa, Oahu [TMK (1) 9-1-013:028 portion]

Dear Ms. Ross:

This letter acknowledges the U.S. Fish and Wildlife Service's (Service) receipt of your letter on August 10, 2010, in which you requested assistance regarding the preparation of a draft Environmental Assessment (DEA) for the proposed Kalaeloa Solar One four megawatt solar power generating facility on the island of Oahu. The facility is proposed to be built on undeveloped land on the former Barbers Point Naval Air Station [TMK (1) 9-1-013:028 portion] managed by the Hawaii Community Development Authority.

We have reviewed the information you provided and pertinent information in our files, including data compiled by the Hawaii Biodiversity and Mapping Program and the Hawaii GAP Program. Two federally endangered plants, Ewa hinahina (*Achyranthes splendens* var. *rotundata*) and Ewa plains akoko (*Chamaesyce skottsbergii* var. *kalaeloana*) are known to occur near the proposed project location. In addition, this area also has a high concentration of unique limestone anchaline pool communities. The anchaline pools support opae ula (*Halocaridina rubra*) at risk anchialine pool shrimp and *Metabetaeus lohena* an anchialine pool shrimp that is a candidate for listing under the Endangered Species Act (ESA). Additionally, there are restored pools near your location that have begun translocation of the orangeblack damselfly (*Megalagrion xanthomelas*), also a candidate species.

We offer the following recommendations to assist you with your environmental review. We recommend that a knowledgeable botanist survey for federally listed plant species during the wettest portion of the year (November to April) within your proposed project area. The project location should also be surveyed for the presence of anchaline pools.

TAKE PRIDE IN AMERICA

Ms. Rachael Ross 2

If it is determined that the proposed project may affect federally listed species, we recommend you contact our office early in the planning process so that we may assist you with the ESA compliance. If the proposed project is funded, authorized, or permitted by a Federal agency, then that agency should consult with us pursuant to section 7(a)(2) of the ESA. If no Federal agency is involved with the proposed project, the applicant should apply for an incidental take permit under section 10(a)(1)(B) of the ESA. A section 10 permit application must include a habitat conservation plan that identifies the effects of the action on listed species and their habitats, and defines measures to minimize and mitigate those adverse effects.

If you have questions, please contact Aaron Nadig, Fish and Wildlife Biologist, Consultation and Habitat Conservation Program (phone: 808-792-9466; fax: 808-792-9581).

Sincerely,

for Loyal Mehrhoff
Field Supervisor

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

REPLY TO ATTENTION OF:

August 18, 2010

Regulatory Branch

File Number POH-2010-0211

TEC Inc.
Attention: Rachel Ross
1003 Bishop Street
Suite 1550, Pauahi Tower
Honolulu, Hawaii 96813

Dear Ms. Ross:

We have you applicant's letter dated July 26, 2010 requesting the Department of the Army review and comment on the proposed Kalaeloa Solar One Facility at TMK (1) 9-1-013:028, Kalaeloa, Island of Oahu, Hawaii. We have assigned the project the reference number **POH-2010-0211**. Please cite the reference number in any future correspondence concerning this project. We completed our review of the submitted document pursuant to Section 10 of the Rivers and Harbors Act of 1899 (Section 10) and Section 404 of the Clean Water Act (Section 404).

Section 10 requires that a Department of the Army (DA) permit be obtained from the U.S. Army Corps of Engineers (Corps) prior to undertaking any construction, dredging and other activities occurring in, over, or under navigable waters of the U.S. The line of jurisdiction extends to the Mean High Water Mark (MHWM) for tidal waters. Section 404 requires that a DA permit be obtained for the discharge (placement) of dredge and/or fill material into waters of the U.S., including wetlands. The line of jurisdiction extends to the Mean Higher High Water Mark (MHHWM) for tidally influenced waters, the Ordinary High Water Mark (OHWM) for non-tidal waters and the approved delineated boundary for wetlands.

Based on the information the applicant provided, the project site appears to be absent of navigable waters subject to Corps jurisdiction. Therefore, Section 10 authorization may not be required. It appears the project site is also absent of waters of the U.S., subject to Corps jurisdiction, therefore, it appears a **DA permit is not required**. Be advised, the project site abuts an unnamed drainage canal with end terminus in the Pacific Ocean, a traditionally navigable water, and as such, is a water of the U.S. subject to Corps jurisdiction. To avoid unintentional violation to federal regulation and law, we advise the applicant contact our office prior to conducting any activity that may result in the discharge of dredged and/or fill material into this water body, as Section 404 authorization may be required for this action. Also be advised that any tributaries discharging into this drainage canal may also be subject to Corps jurisdiction. The Corps does not have sufficient information to determine if the project site encompasses additional unidentified waters of the U.S. or whether such waters are proposed for impact, which may also require authorization under Section 404.

Only the Corps of Engineers has the authority to determine if any of these aquatic features are or are not waters of the U.S., potentially subject to regulations under Section 10 and/or Section 404. To avoid unintentional violation to Federal law and regulations, we encourage the landowner to submit a request for an approved jurisdictional determination (JD) for these water bodies. Your request to the Corps should include descriptions of aquatic features, including any wetlands, drainage ditches, gulches, gullies, streams, etc., on-site, especially those that may be impacted by any of the proposed project components, flow duration of each feature and the flow path of each feature into navigable waters. For instance: "the unnamed ditch contains flow for two consecutive weeks annually and from the project impact site, flows for 700 linear feet prior to discharge into X Stream. X Stream flows year-round and flows 1,200 feet prior to discharge into the Pacific Ocean." For wetlands, you should submit a wetland delineation conducted in accordance with the Corps of Engineers 1987 Wetland Delineation Manual and the Hawai'i and Pacific Islands Regional Supplement. In addition, include sufficient information concerning the scope of work, including the use of Best Management Practices, i.e. silt fences and sandbag berms within the vicinity and in close proximity to potentially regulated bodies of water. We recommend the applicant also include a vicinity map, map of the water bodies and flow paths and on-site photographs so the Corps may conduct an approved JD, if necessary.

If any water bodies are determined to be waters of the U.S., the applicant must obtain authorization from the Corps prior to discharge of dredged or fill material into these water bodies. Fill material, permanent or temporary, may include, but is not limited to: rock, dirt, sand, sandbags, silt fences or concrete. The applicant should contact the Corps to determine if any of the proposed work constitutes a "discharge of fill" and submit an application and associated drawings that meet our drawing recommendations found at *http://poh.usace.army.mil/EC-R/EC-R.htm*. The Corps will then review the application to ensure it complies with all necessary federal laws and regulations. Note that if the fill results in the loss of waters of the U.S. and/or associated functions, the applicant may be required to provide compensatory mitigation for any unavoidable impacts. A request for an approved JD can be submitted prior to, or concurrently with, an application for the proposed work.

Thank you for contacting us regarding this project and providing us with the opportunity to comment. Should you have any questions, please contact Ms. Jessie Pa'ahana at *808.438.0391* or via email at *Jessie.K.Paahana@usace.army.mil*. Please be advised you can provide comments on your experience with the Honolulu District Regulatory Branch by accessing our web-based customer survey form at *http://per2.nwp.usace.army.mil/survey.html*.

Sincerely,

George P. Young, P.E.
Chief, Regulatory Branch

U.S. Department of Homeland Security
United States Coast Guard

Commander
Fourteenth Coast Guard District

300 Ala Moana Boulevard, #9116
Honolulu, HI 96850-4982
Staff Symbol: dm
Phone: (808) 535-3255
Fax: (808) 535-3284
Email: john.k.lee@uscg.mil

11000
September 8, 2010

TEC, Inc.
ATTN: Rachel Ross
1003 Bishop Street, Suite 1550, Pauahi Tower
Honolulu, HI 96813

SUBJECT: PRE-ASSESSMENT CONSULTATION, POWER-GENERATING FACILITY, KALAELOA, HAWAII

Dear Ms. Ross,

The Coast Guard's main concern with the proposed Kalaeloa power-generating facility is how it will affect our operations at Kalaeloa Airport:

The proposed site is in close proximity to the traffic patterns for runways 4L/22R and 11/29. Reflected sunlight from solar panels may affect Coast Guard aircrew visibility and create a potential for runway closures and operating restrictions.

Coast Guard Air Station Barbers Point (ASBP) is the primary aviation Search and Rescue (SAR) facility for more than 12 million square miles of the Central Pacific region. Our aircraft must be able to respond to emergencies, at any moment to render assistance. If the proposed facility results in interrupted use of runways at Kalaeloa Airport, the outcome of SAR missions may be adversely affected

The potential for the production of thermal currents near the site could create hazardous turbulence and compromise the safety of aircrews.

Ms. Ross, we look forward to participation in the Environmental Assessment and thank you for the opportunity to provide preliminary comments. If you have any questions, please contact Mr. John Lee at the phone number or addresses shown above.

Sincerely,

J.M. BROCKUS
Commander, U.S. Coast Guard
Chief, Resource Management Staff
By Direction

Copy: USCG Air Station Barbers Point

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

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

In reply, please refer to:
File
EPO-I-3300

August 18, 2010

TEC Inc.
Ms. Rachel Ross
1003 Bishop Street, Suite 1550
Pauahi Tower
Honolulu, Hawaii 96813

Dear Ms. Ross:

SUBJECT: Pre-Assessment Consultation and Notice of Preparation of an Environmental Assessment for Kalaeloa Solar One proposal to construct a 4 MW power generating facility at Kalaeloa, Oahu, Hawaii

Thank you for allowing us to review and comment on the subject document. The document was routed to the various branches of the Environmental Health Administration. We have no comments at this time, but reserve the right to future comments. We strongly recommend that you review all of the Standard Comments on our website: www.hawaii.gov/health/environmental/env-planning/landuse/landuse.html. Any comments specifically applicable to this application should be adhered to.

The same website also features a Healthy Community Design Smart Growth Checklist (Checklist). The Hawaii State Department of Health, Built Environment Working Group, recommends that State and county planning departments, developers, planners, engineers and other interested parties apply the healthy built environment principles in the Checklist whenever they plan or review new developments or redevelopments projects. We also ask you to share this list with others to increase community awareness on healthy community design.

If there are any questions about these comments please contact the Environmental Planning Office at 586-4337.

Sincerely,

GENEVIEVE SALMONSON, Acting Manager
Environmental Planning Office

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RECEIVED SEP 0 2 2010

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

August 30, 2010

TEC Inc.
1003 Bishop Street Suite 1550
Pauahi Tower
Honolulu, Hawaii 96813

Attention: Ms. Rachel Ross

Ladies and Gentlemen:

Subject: Pre-Assessment Consultation and Notice of Preparation of an Environmental for 4 MW power generating facility

Thank you for the opportunity to review and comment on the subject matter. The Department of Land and Natural Resources' (DLNR), Land Division distributed or made available a copy of your report pertaining to the subject matter to DLNR Divisions for their review and comment.

Other than the comments from Commission on Water Resource Management, Land Division-Oahu District, the Department of Land and Natural Resources has no other comments to offer on the subject matter. Should you have any questions, please feel free to call our office at 587-0433. Thank you.

Sincerely,

for Morris M. Atta
Acting Administrator

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

August 12, 2010

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
__Div. of State Parks
x Commission on Water Resource Management
__Office of Conservation & Coastal Lands
x Land Division –Oahu District
x Historic Preservation

FROM: Charlene Unoki, Assistant Administrator
SUBJECT: Pre-Assessment Consultation and Notice of Preparation of an Environmental Assessment for 4 MW power generating facility
LOCATION: Island of Oahu
APPLICANT: Kalaeloa Solar One

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by August 30, 2010.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
(✓) We have no comments.
( ) Comments are attached.

Signed:
Date: August 13th, 2010

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

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STATE OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

August 12, 2010

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
__Div. of State Parks
x Commission on Water Resource Management
__Office of Conservation & Coastal Lands
x Land Division –Oahu District
x Historic Preservation

RECEIVED
COMMISSION ON WATER
RESOURCE MANAGEMENT
2010 AUG 13 AM 11:51

FROM: Charlene Unoki, Assistant Administrator
SUBJECT: Pre-Assessment Consultation and Notice of Preparation of an Environmental Assessment for 4 MW power generating facility
LOCATION: Island of Oahu
APPLICANT: Kalaeloa Solar One

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by August 30, 2010.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

(✓) We have no objections.
( ) We have no comments.
( ) Comments are attached.

Signed:
Date: 8/13/10

FILE ID: MD.27123
DOC ID: 67921

LINDA LINGLE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

BRENNON T. MORIOKA
DIRECTOR

Deputy Director
MICHAEL D. FORMBY
FRANCIS PAUL KEENO
GRO A. SUMADA

IN REPLY REFER TO:

STP 8.0231

September 14, 2010

Ms. Rachel Ross
TEC Inc.
1003 Bishop Street, Suite 1550
Pauahi Tower
Honolulu, Hawaii 96813

Dear Ms. Ross:

Subject: Kalaeloa Solar One
Pre-Assessment Consultation for Draft Environmental Assessment (DEA)

Thank you for requesting the State Department of Transportation's (DOT) review of the subject project, which proposes to construct and operate a 4 MW power generating facility consisting of the solar array and field control buildings. The project will include 13,824 collectors aligned in 192 rows of 72 collectors per row. Other operating equipment includes an expansion tank, pumps, flow meters, temperature sensors, and a cooling tower. The subject project is located on lands under the jurisdiction of the Hawaii Community Development Authority (HCDA).

Given the project location, DOT's nearby State airport (Kalaeloa Airport) and highway facilities will be impacted. DOT offers the following comments:

1. The DEA should evaluate impacts to the State highways facilities in the area. If the evaluation findings indicate that the subject project will create any significant impacts, then a traffic assessment will be required. The traffic assessment, if warranted, shall address the impacts and identify required mitigation measures.

2. The DEA should address any reflectivity impacts from the collectors to aircraft operations at Kalaeloa Airport and Honolulu International Airport.

3. Because of the close proximity of the facility to Kalaeloa Airport, DOT recommends that the applicant file Federal Aviation Administration (FAA) Form 7460-1: Notice of Proposed Construction or Alteration. This is the website for filing FAA Form 7460-1: https://www.oeaaa.faa.gov/oeaaa/external/portal.jsp.

4. The DEA should provide information about the height of the structures. The horizontal zone above the property is 180 feet above sea level. Further, the total land area to be occupied should be addressed.

Ms. Rachel Ross STP 8.0231
Page 2
September 14, 2010

DOT appreciates the opportunity to provide comments. If there are any questions, including the need to meet with DOT Airports Division or Highways Division staffs, please contact Mr. David Shimokawa of the DOT Statewide Transportation Planning Office at telephone number (808) 587-2356.

Very truly yours,

BRENNON T. MORIOKA, Ph.D., P.E.
Director of Transportation

POLICE DEPARTMENT
CITY AND COUNTY OF HONOLULU
801 SOUTH BERETANIA STREET · HONOLULU, HAWAII 96813
TELEPHONE: (808) 529-3111 · INTERNET: www.honolulupd.org

LOUIS M. KEALOHA
CHIEF

DELBERT T. TATSUYAMA
RANDAL K. MAGADANDANG
DEPUTY CHIEFS

OUR REFERENCE DMK-DK

August 16, 2010

Ms. Rachel Ross
TEC Inc.
Pauahi Tower, Suite 1550
1003 Bishop Street
Honolulu, Hawaii 96813

Dear Ms. Ross:

This is in response to a letter from Kalaeloa Solar One requesting comments on a Pre-Consultation and Notice of Preparation of an Environmental Assessment regarding their proposal to construct a 4 MW power-generating facility in Kalaeloa.

This project should have no significant impact on the facilities or operations of the Honolulu Police Department.

If there are any questions, please call Major Michael Moses of District 8 (Kapolei/ Waianae) at 692-4253.

Sincerely,

LOUIS M. KEALOHA
Chief of Police

By
DAVE M. KAJIHIRO
Assistant Chief of Police
Support Services Bureau

Serving and Protecting With Aloha

DEPARTMENT OF PLANNING AND PERMITTING
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 7TH FLOOR • HONOLULU, HAWAII 96813
PHONE: (808) 768-8000 • FAX: (808) 768-6041
DEPT. WEB SITE: www.honoluludpp.org • CITY WEB SITE: www.honolulu.gov

KIRK W. CALDWELL
ACTING MAYOR

DAVID K. TANOUE
DIRECTOR

ROBERT M. SUNITOMO
DEPUTY DIRECTOR

September 14, 2010

Ms. Rachel Ross
TEC Inc.
1003 Bishop Street
Pauahi Tower, Suite 1550
Honolulu, Hawaii 96813

Dear Ms. Ross:

Subject: Pre-Assessment Consultation and Notice of Preparation of Environmental Assessment
Kalaeloa Solar One Facility
Kalaeloa Community Development District
Tax Map Key 9-1-13: Portion 028, Honouliuli, Ewa, Oahu, Hawaii

This is in response to your letter of July 26, 2010 requesting comments on the subject project.

Kalaeloa Community Development District is under the jurisdiction of the Hawaii Community Development Authority (HCDA), State of Hawaii. As such, the Department of Planning and Permitting (DPP) will defer to HCDA regarding planning requirements. However, we understand that the DPP permits are required, including a Conditional Use Permit-Minor (CUPm), grading, grubbing, and building permits, if applicable.

For your information, we offer the following additional comments:

1. The project area is outside of the Special Management Area.

2. According to the City's adopted Kalaeloa Special Area Plan (SAP), the site is identified as Parcel No. 4 and is intended for limited industrial uses and should conform to the City's I-1 Light Industrial District zoning classification. The SAP also indicates that the project area contains archaeological sites. We suggest that the State Department of Land and Natural Resources be consulted.

3. The site was formerly a part of Naval Air Station Barber Point (NASBP). NASBP was closed under the federal base re-alignment and closure process and the project area was released from federal jurisdiction. Since the HCDA has not adopted rules governing development in the Kalaeloa Community Development District, under the City's zoning code, the project area is subject to P-2 General Preservation

development standards. Under the Land Use Ordinance, power generation projects with potential major impacts including visual, noise, and traffic impacts, are considered "Utility Installations, Type B," and subject to obtaining a (CUPm). We find that the proposed use falls under this use and permit.

Our guideline for preparing the required CUPm is available online at:

http://www.honoluludpp.org/download/permits/permitlistings.asp?p_TypeID=2

Thank you for the opportunity to comment. If you have any questions, please contact Raymond Young of our staff at 768-8049.

Very truly yours,

David K. Tanoue, Director
Department of Planning and Permitting

DKT:lh

cc: Kirk W. Caldwell, Acting Mayor

BOARD OF WATER SUPPLY

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

August 23, 2010

KIRK W. CALDWELL, Acting Mayor

RANDALL Y. S. CHUNG, Chairman
WILLIAM K. MAHOE
THERESIA C. McMURDO
ADAM C. WONG

JEOFFREY S. CUDAMAT, Ex-Officio
BRENNON T. MORIOKA, Ex-Officio

WAYNE M. HASHIRO, P.E.
Manager and Chief Engineer

DEAN A. NAKANO
Deputy Manager

Ms. Rachel Ross
TEC, Incorporated
1003 Bishop Street
Pauahi Tower, Suite 1550
Honolulu, Hawaii 96813

Dear Ms. Ross:

Subject: Letter Dated July 26, 2010 Requesting Comments for the Environmental Assessment for the Proposed Kalaeloa Solar One 4 MW Power Generating Facility In Kalaeloa

This site is served by a private water system. Water service for this development should be coordinated with the U.S. Navy who is providing water to this area.

If you have any questions, please contact Robert Chun at 748-5443.

Very truly yours,

PAUL S. KIKUCHI
Chief Financial Officer
Customer Care Division

Water for Life Ka Wai Ola

From: Ross, Rachel S.
To: Carlan, Faith R.
Subject: FW: OIBC: Kalaeloa Solar One
Date: Wednesday, September 29, 2010 3:27:39 PM

Rachel Ross
TEC Inc.
808.528.1445

From: Kawika McKeague [mailto:kmckeague@group70int.com]
Sent: Monday, August 30, 2010 10:39 AM
To: Ross, Rachel S.
Cc: shad kane
Subject: OIBC: Kalaeloa Solar One

Aloha Ms. Rachel Ross-

I received a notice letter from Darren Kimura for the Kalaeloa Solar One project. As the OIBC Chair and one of two OIBC representatives from the 'Ewa moku district, I'm interested to learn more about the project and specifically understanding the nature and extent of proposed land use activities that will possibly require extensive grading/excavation. Subsequently, what then is your planned approach for identifying and investigating the project's impacts to archaeological and cultural resources, including potential for iwi kupuna encounters?

If you feel it may be beneficial to do a presentation before the OIBC, I welcome your attendance. I am setting the agenda for our monthly scheduled meeting that occurs every 2nd Wednesday of the month. I'll have to set the agenda for the upcoming meeting on 9/8 by this Wed. (9/1). If you feel that a presentation to full Council is not necessary at this time, I would recommend that perhaps you consider a meeting/presentation with Mr. Shad Kane and I as the 'Ewa representatives. Mahalo nui for your time and consideration.

Ola na Iwi,
Kawika

Kawika McKeague
Senior Planner
Group 70 International, Inc.
925 Bethel Street, Fifth Floor
Honolulu, Hawaii 96813
(808) 523-5866 phone
(808) 523-5874 fax
www.group70int.com

H'ialoakuapapa Sustainable Marketplace of the Pacific
www.sustainablemarketplacepacific.com/

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APPENDIX B

ARCHAEOLOGICAL INVENTORY SURVEYS

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APPENDIX B: ARCHAEOLOGICAL INVENTORY SURVEYS

The following archaeological inventory surveys were reviewed by SHPD and relied upon for the Environmental Assessment (EA) impact assessment, specifically Section 3.7 (Archaeological Resources):

1. Haun, A.1991. An Archaeological Survey of the Naval Air Station, Barbers Point, Oahu, Hawaii. BPBM, Honolulu. September.
2. Tuggle, D. with contributions by Gail Murakami and Jerome Ward. 1997. Archaeological Inventory Survey for Construction Projects at Naval Air Station Barbers Point, Oahu, Hawaii. IARII, Honolulu. January.

These reports are included[1] in their entirety in this Appendix. The reports address a larger geographic area than the proposed action of the EA. The relevant sites that may be included in the final lease area are as follows:

- 1717
- 1718
- 1719
- 1720
- 1721
- 1722

[1] Due to the length of the documents, they are provided electronically on CD in the hardcopy versions of the EA.

MS 091791

AN ARCHAEOLOGICAL SURVEY OF THE NAVAL AIR STATION, BARBER'S POINT, O'AHU, HAWAI'I

by

Alan E. Haun, Ph.D.
Project Director

with

NOTES ON THE HISTORY OF HONOULIULI

by

Marion Kelly
Historian

for

Commander, Pacific Division
Naval Facilities Engineering Command
Pearl Harbor, Hawai'i 96860
Contract No. N62742-84-R-0075

September 1991

Applied Research Group
Bishop Museum
Honolulu, Hawai'i

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PREFACE

This archaeological survey of the Naval Air Station, Barber's Point, was conducted under a contract between the Department of Anthropology, Bernice Pauahi Bishop Museum, and the Pacific Division of the Naval Facilities Engineering Command (Contract No. N62742-84-R-0075). I would like to acknowledge the cooperation and assistance of Dr. Robert J. Hommon, Staff Archaeologist, Planning Division, PACNAVFACENGCOM, in the conduct of the project, and wish to thank the many military personnel at the Naval Air Station for their assistance and cooperation.

The archaeological field crews are commended for their diligent and careful work. The field crews consisted of James Landrum III, Ernest May, Jennie Peterson, and Patty Spears, as Field Assistants, and Mikk Kaschko and Jerry Watson, as very capable Field Supervisors. Landrum, Watson and Kaschko also assisted with laboratory analyses.

At the Bishop Museum, my special appreciation goes to Dr. Yosihiko Sinoto, Chairman of the Department of Anthropology, for giving me the opportunity to conduct the research. Dr. Paul Cleghorn, and later Tom Dye, in their joint capacity as museum supervisors, provided helpful advice and reviewed various documents prepared in connection with the project. Dr. Paul Cleghorn and Dr. Pat McCoy field-checked the research.

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ABSTRACT

The Department of Anthropology, Bishop Museum, under contract to the Pacific Division of the Naval Facilities Engineering Command (Contract No. N62742-84-R-0075) conducted an archaeological survey of the Naval Air Station at Barber's Point, O'ahu. The survey area totaled approximately 1230 acres. A total of 43 archaeological sites, comprised of 385 discrete features, have been recorded. Of these, approximately 73% are most likely pre-Contact sites, and 27% are most likely historical. Approximately 47% of the pre-Contact sites are probably related to habitation activities. Most of these sites are architecturally complex, suggesting occupational permanence.

Subsurface testing in the form of shovel probes was conducted in three of the recorded sites. These excavations were principally designed to recover datable material for radiocarbon age determinations, providing information relating to the chronology of settlement in this area. Two radiocarbon age determinations were obtained. One was less that 160 years before present or more recent than A.D. 1790. The other had multiple adjusted ranges, but arguable dates to the period between A.D. 1415-1815. It appears then that the Barber's Point Air Station sites date from at least the 15th century A.D.

INTRODUCTION

This report, prepared for the Commander, Pacific Division, Naval Facilities Engineering Command, details the results of an archaeological survey of the Naval Air Station, Barber's Point (NAS BARPT), O'ahu, Hawai'i. The report complies with the general specifications outlined in Contract No.N62742-84-C-0075, the recommendations of Dr. Robert J. Hommon, Staff Archaeologist, Naval Facilities Engineering Command, Planning Division, and all pertinent military and executive orders and legislative acts (National Historic Preservation Act, National Environmental Policy Act, Executive Order 11593, OPNAVINST 5090.1, and NAVFACENGCOMINST 11010.70).

The archaeological survey was designed to identify and evaluate the potential significance of cultural resources (both prehistoric and historic) within specified areas (Fig. 1). Evaluating significance requires sufficient data recovery to determine eligibility of sites for nomination to the National Register of Historic Places. The results of the survey are "intended to serve as a baseline for cultural resource planning as part of land management, primarily for agricultural outlease" (Contract No. N62742-84-C-0075, Section C, p.3).

A preliminary reconnaissance was conducted between 17 and 20 September 1984. This provided data for the preparation of a research design, which was submitted to the Planning Division on 5 October 1984. After the Navy accepted the Research Design fieldwork was conducted between 19 November 1984 and 28 January 1985, and involved a total of c. 150 person days. Field personnel included Michael Kaschko and Jerry Watson as Field Supervisors; James Landrum III, Ernest May, Jennie Peterson, and Patty Spears as Field Assistants; and the author as Project Director. Senior archaeologists from Bernice Pauahi Bishop Museum, Drs. Paul Cleghorn and Patrick McCoy, field-checked the work as did Dr. Robert J. Hommon, Staff Archaeologist, Planning Division, Naval Facilities Engineering Command. Bertell Davis served as an archaeological consultant.

A total of 385 archaeological features at 42 sites was identified during the survey at Barber's Point. The sites and features identified represent some of the best preserved and most extensive prehistoric remains known for the 'Ewa Plain.

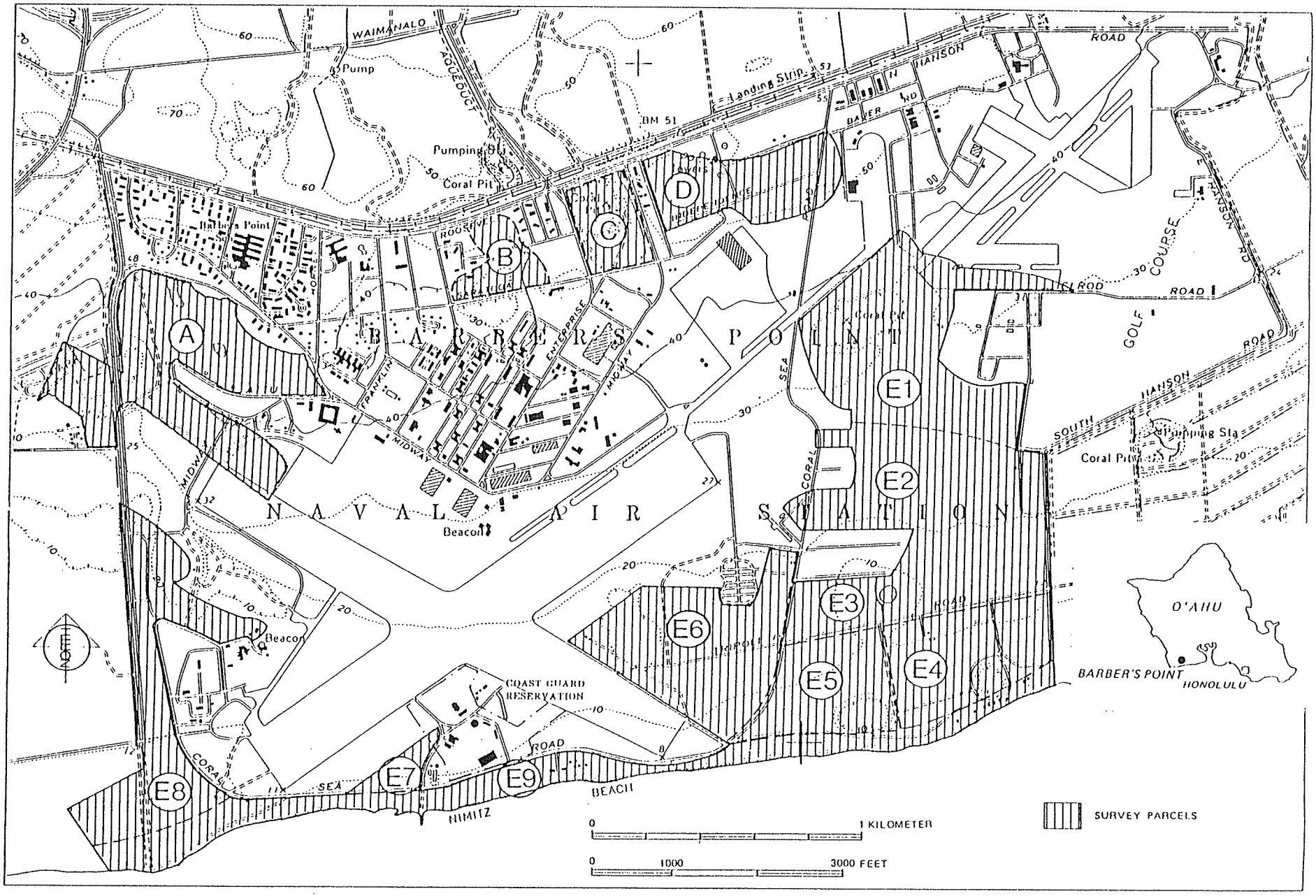

Fig. 1. Barber's Point Survey Parcels.

Three subsurface probes at Barber's Point provided datable charcoal and volcanic glass. Small samples of midden and artifacts were also collected in the probes.

Field notes, photographic negatives, specimens, and all other material collected in the execution of the contract are curated at the Department of Anthropology, Bishop Museum. Copies of these materials, photographic contact sheets, and an inventory of specimens will be provided to the Navy.

Report organization follows guidelines specified in the contract. This introductory section, includes a Background Section that provides a general descripton of the environment and a summary of prehistory. The next section is entitled Research Design which includes (1) a summary of previous archaeological research in the area, (2) research objectives and theoretical orientation of the project, (3) site and feature definitions, (4) rationale for the survey method, (5) discussion of the criteria for evaluation of damage susceptibility, and (6) the development of a predictive model for site survey. A Field Methods section describes the survey methodology and evaluates the success of site discovery procedures. An Inventory of Cultural Properties lists and describes all recorded sites in the survey areas. The inventory provides data concerning the condition of each site and its status with regard to the National Register of Historic Places. The shovel probes, midden, and artifacts are discussed in the next three sections, followed by the Summary and Analysis section. This section summarizes the survey data, and relates them to the research objectives. The final section, Recommendations, offers general recommendations for cultural resource management.

Appendix A, prepared by Marion Kelly, summarizes ethnographic and ethnohistoric materials for Barber's Point and discusses land-use patterns based on a survey of documents and records.

BACKGROUND

General Description of the Research Area

The NAS BARPT research area covers 3,615 acres of land situated along the southwestern coast of O'ahu, between 'Ewa Beach to the east and Barber's Point to the west. Hanson Road forms the inland boundary of the facility. Five parcels within this area, totaling 1,310* acres, were transect surveyed.

The research area lies within the 'Ewa Plain, which falls within the Coastal Plain geomorphic province of O'ahu. The Coastal Plains on O'ahu are composed of relatively recent lava flows and pyroclastic deposits, fossil coral reefs, and terrestrial and marine alluvial deposits. The 'Ewa Plain formed on part of a larger coral reef, nearly 5 mi. in breadth, that became partially exposed by post-Pleistocene sea-level subsidence. The NAS BARPT portion of the 'Ewa Plain is composed mainly of weathered, fossiliferous, calcareous marine deposits, primarily emergent coral reef, that are overlain in the inland-most areas by terrestrial sedimentary deposits. Numerous cavities, caverns, and depressions are scattered across the coralline limestone surface, and are remnants of the original reef structure.

The topography of NAS BARPT is very gently sloping to level. Elevations range from sea level at the coast to about 50 ft inland. There are no surface streams; however, one brackish-water-filled depression and a seasonally wet marshy depression are present just inland from Tripoli Road. Although surface water is limited, Davis (Ms.:6) suggested that ground water is accessible via cavities in the coral outcrop near the coast where the water table lies within a few meters of the surface. Davis reported that this water is potable.

Barber's Point is characterized by a dry leeward climate. The annual weather pattern is dominated by the northeasterly trade winds. These winds are least active between October and April, when occasional heavy showers can occur. These periods of precipitation account for the majority of the rainfall, which average about 20 inches per year.

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*Areas of survey parcels are based upon the average of three measurements using a Tamaya Planex Digital Planimeter. It should be noted that the resulting totals for the RTF, NAVMAG, and NAS BARPT are consistently less than those specified in the contract (No. N62742-84-R-0075) by approximately 4-8%. Dr. Robert J. Hommon was notified of this situation, and he indicated that our figures should be used.

The Lualualei Fill-land Ewa association is the only major soil association present at NAS BARPT. This association consists of deep, well-drained soils on nearly-level to moderate slopes. Coral outcrop makes up the largest percentage, with minor areas of Ewa and Mamala soils. The later soils formed in alluvium carried by flooding and sheetwash. This association includes Lualualei clay soils, Ewa silty clay soils, and fill land, with the remainder composed of Mamala stony silty clay loam soils and Pulehu clay loam soils (Foote et al. 1972).

Today the vegetation is characterized by *kiawe* (*Prosopis pallida*) and *koa haole* (*Leucaena glauca*) forests. Shrubs, grasses, and a grove of ironwood trees (*Casuarina equisetifolia*) border the coast. Sisal (*Agave sisalana*), a remnant from earlier, historic cultivation, is found in some areas, particularly the inland-most parts of the Naval Air Station. Scattered *wiliwili* (*Erythrina sandwicensis*) trees are some of the few remnants of the earlier native vegetation. *Noni* (*Morinda citrifolia*) and ti (*Cordyline terminalis*) plants usually grow from sinkholes, and provide a partial record of aboriginally-introduced economic species. Banyon (*Ficus* spp.) trees are also encountered growing in sinkholes.

Summary of Hawaiian Prehistory

The earliest archaeological evidence for settlement of O'ahu and the Hawaiian Islands dates to about A.D. 300 to 500 (Kirch and Kelly 1975; Pearson, Kirch, and Pietrusewsky 1971). The settlers who came at that time originated from an unspecified island in Eastern Polynesia. Initial settlement is believed to have occurred along the wetter and more fertile windward coasts where "conditions were optimal for marine and terrestrial exploitation along lines followed previously in the Eastern Polynesian homeland" (Green 1980:71). This exploitation involved a variety of techniques for obtaining fish and shellfish from the sea, gardening, animal husbandry, and utilization of the natural terrestrial flora and fauna (Kirch and Kelly 1975; Pearson, Kirch, and Pietrusewsky 1971).

The settlement pattern consisted of a series of widely-spaced, permanent, home settlements that are thought to have gradually given way to a nearly continuous series of settlements along the windward coasts as the population grew. Leeward settlement is believed to have begun only after windward areas were settled. It is currently unclear whether the earliest leeward coastal settlements were permanent or seasonal/temporary. Inland leeward settlement, at least on a permanent basis, is thought to have occurred only after the

development of inland dryland agriculture techniques. Evidence currently available indicates that inland leeward settlement did not occur until 600 to 900 years after initial settlement (between A.D. 1100 and 1400 [Green 1980; Hommon 1976]).

Hypothetical reconstructions based on data from archaeology, linguistics, and ethnology suggest that early Hawaiians were organized in a typical Polynesian conical clan pattern in which individual status was based on genealogical ranking (Green 1980:72). Kinship formed a basis for regional and island-wide societal integration; however, the most important social subsistence unit was the localized territorial community-based corporate kin group. Leadership within this group fell to the "highest ranking individual of the locally dominant, socially ranked lineage" (ibid.:73). This individual acted as the local chief, overseeing the social, political, and economic functioning of the community.

The subsequent development of a uniquely Hawaiian innovation, the *ahupua'a*, resulted in a more complex level of social and political integration (Hommon 1976; Green 1980). The *ahupua'a* is a traditional land division ideally extending from the coast to the mountains, often corresponding with a valley drainage. The chief or manager (*konohiki*) of an *ahupua'a* extracted rents or tribute from the people (commoners or *maka'ainana*) who worked the land. The chief was a member of a non-localized ruling elite (*ali'i*). Thus, the earlier kinship-based relationship between a chief and his local community no longer existed. This new Hawaiian socio-political organization may be classified as a complex chiefdom or primitive state.

Green's (1980) summary of the prehistory of Mākaha Valley and the probable pattern of adaptation by Polynesians to the Hawaiian high-island ecosystem is of direct relevance for understanding the prehistory of the Barber's Point research area. Mākaha prehistory begins with a hypothesized coastal settlement in the late first milleninum A.D. Although the nature of coastal settlement is unknown because of land modifications and the lack of archaeological investigations on the coast, it is thought to have consisted of habitation structures associated with garden areas nearby (Green 1980:74). Marine exploitation is thought to have played a prominent role in the subsistence economy. The presence of a small *heiau* (stepped-stone platform) is thought to reflect the existence of a lineage-based system of local chiefly leadership.

Beginning in the 12th to 14th centuries, if not before, cultivation of inland areas, remote from the coast, began. Dryland field systems marked by

stone walls appear, on current evidence, to be associated with small field shelters (C-shapes and other enclosure types) that were used on a temporary basis by people tending the fields, but who lived permanently in the coastal settlement (Green 1980).

Irrigated terrace systems were in use by the 15th century in the uppermost part of Mākaha Valley. Permanent inland settlement is thought to have begun by this time period; however, exemplary habitation sites have not been excavated or dated (Green 1980:76).

There is abundant evidence for permanent inland habitation in the 17th century, including rectangular dwellings, religious structures (stepped-stone platforms, shrines, and other specialized architecture). Large-scale construction of irrigation works and the rebuilding and expansion of an inland *heiau* indicate that, by the mid-1600s, Mākaha had become an *ahupua'a* unit in the "larger scale, complex rank social systems typical of Hawai'i at the time of contact" (Green 1980:76).

Barber's Point, like Mākaha, is characterized by a dry leeward climate. However, the combination of low rainfall, relatively high temperatures, and the coralline limestone terrain at Barber's Point represents a unique set of ecological circumstances. Adaptation to this comparatively marginal environment must have posed problems for the early settlers.

Inland settlement (0.5-1.0 km inland) appears to have occurred late in the prehistoric period. Age determinations derived from basaltic glass hydration-rind measurements place the earliest inland occupation sites in the 15th century. Dates from coastal sites are currently lacking.

Marine exploitation played a significant role in the pre-historic subsistence economy at Barber's Point. Evidence for manufacture and use of a variety of fishing gear is reported from surface and subsurface contexts. Food remains recovered during survey and excavation commonly consist of a wide range of shellfish, fish, echinoderms, and crustacea. Many sites are located close to a variety of marine habitats. Sites interpreted as fishing shrines also appear to reflect the importance of marine resources.

Evidence for exploitation of the land is limited. The presence of a few feral prehistoric cultigens (usually growing from pits or sinkholes) and a variety of surface modifications, including mounds of limestone, cleared areas, soil horizons, and small terraces, has been interpreted as evidence for the cultivation of tree and root crops. Lithic materials, such as basaltic

glass flakes and basalt adzes, waste flakes, and cores, may potentially represent agricultural activities (i.e., clearing and soil preparation). The extent of gardening and the relative contribution of agriculture to the overall subsistence pattern is not well understood.

A wide range of site/feature types has been reported for the Barber's Point area. Unmodified cavities or sinks containing cultural debris, walled sinks, C-shape enclosures, other enclosure types (rectangular and L-shape), walls, wall segments, and *ahu* were commonly encountered. Less frequently reported site/features include platforms, terraces, cairns, modified caves, paved areas, and burials. These feature types often occur in clusters thought to represent complexes of habitation and activity-specific structures.

The overall settlement pattern is characterized by dispersed clusters or complexes of functionally integrated habitation and subsistence-related features, which may represent multi-household residential groups, as suggested by Davis and Griffin (1978). A notable difference between Barber's Point and most other areas of Hawai'i is the apparent lack of larger politico-religious sites (i.e., *heiau*).

The suggestion has been made that the low population levels recorded during early historic times may have resulted from the reduced carrying capacity of the area due to environmental degradation (Davis ms.). While it is clear that major vegetation changes occurred, the impact of them on the human population has yet to be documented.

Finally, the discovery of assemblages of bird bones in pits or sinkholes in coral outcrops is an important result of previous archaeological investigations in the Barber's Point area. Several species represented are now extinct. The relationship between human occupation and the extinction of bird species is unclear; however, it is possible that humans played a part in some of the extinctions.

RESEARCH DESIGN

Previous Investigations of Archaeology

More than twenty separate archaeological projects have been conducted in the Barber's Point area, extending from 'Ewa Beach to West Beach. The most notable recent projects include those by Barrera (1975, 1979, 1984), Davis (1980), Davis and Griffin (1978), Hammatt and Folk (1981), Lewis (1970), and Sinoto (1976, 1978, 1979).

The earliest reference to archaeological remains in the area (Thrum 1907:46) mentions the earlier presence of a *heiau* situated on Kapolei Hill one to two miles north of the survey area in 'Ewa. The site was destroyed for it's stones, either for use in constructing fences, or crushed for building materials (McAllister 1933), and nothing is known concerning it's original size or type.

McAllister (1933) listed many sites for Honouliuli; however, most are located at Pearl Harbor, or high on the ridges of the Wai'anae Range. The Barber's Point area and much of the 'Ewa Plain are subsumed under his site number 1946. Concerning this site he stated:

> "Ewa coral plains, throughout which are the remains of many sites. The great extent of old stone walls, particularly near the Puuloa Salt Works, belongs to the ranching period of about 75 years ago. It is probable that the holes and pits in the coral were formerly used by the Hawaiians. Frequently the soil on the floor of the larger pits was used for cultivation and even today one comes upon bananas and Hawaiian sugar cane still growing in them" [McAllister 1933:109].

He reported a rock shelter located on the same hill (*Kapolei*) as the *heiau* noted by Thrum where the pig-god, Kamapua'a, is said to have resided with his grandmother (McAllister 1933:108). A well-preserved house site and possible *heiau* located on the western part of the 'Ewa Plain, adjacent to Kalaeloa Boulevard were examined by Emory (1993; Bishop Museum Site Files). Both structures were constructed of stacked limestone slabs and uprights, and were destroyed subsequently by sugar cane planting.

In 1959 William Kikuchi removed twelve to sixteen incomplete human burials to Bishop Museum from a limestone sinkhole (Site 50-Oa-B6-10) prior to

the construction of the Standard Oil refinery (Oahu Sites Folder 01.1 and Site Card in Department of Anthropology, Bishop Museum).

In 1962 Lloyd Soehren recorded a burial at the Naval Air Station (Bishop Museum Sites Files). The burial, a secondary interment, was found in a sinkhole located near house sites and modified pits.

In 1966 Soehren recorded and excavated a possible fishing shrine that was to be destroyed by the construction of a barge harbor (Site 50-Oa-B6-13); Oahu Sites Folder 01.1 and Site Card in Department of Anthropology, Bishop Museum). Excavation revealed a preconstruction layer containing large amounts of fish scales. Dog, fish, shellfish remains, and a one-piece rotating fishhook were recovered from the architectural fill.

A beach midden site (50-Oa-B6-14) located south of the barge harbor in Camp Malakole was recorded by Roger Green for the Bishop Museum in 1969. This site was discovered during construction of a pipeline that cut through the site. Green collected artifacts from the surface including a bone awl, a coral file, a one-piece fishhook point fragment, and a piece of cut bone. The site was subsequently relocated and tested by Davis (1978). The tests revealed two components that were characterized by charcoal-stained sand, charcoal, fire-cracked rocks, burned coral, and artifacts. The upper layer showed pit features containing ash and charcoal.

Lewis (1970) summarized the available historical data for the Barber's Point area and the 'Ewa Plain. These indicated a sparse population at European contact, which was further reduced shortly thereafter. Early travelers made few comments about the region. The native Hawaiians avoided the area, preferring to follow trails further inland.

Lewis also conducted the first extensive archaeological survey and excavations in an area inland from Malakole Road in 1969 and 1970. He summarized his archaeological research as follows:

> For our area we find many kinds of sites-houses and house compounds; cairns mounds, ahus of myriad size and shape; pits that may have has cultural uses; walls of several types. It is obvious that the people at some time adapted themselves to life on this near-barren coral expanse. Though much of the land has been put under cane or concrete, there is yet a large area in which we may expect to find many additional sites to the few we have. Thus

> there is hope that we can define something of the past life of the Hawaiians who lived in such a seemingly un-Hawaiian place [Lewis 1970:42].

Lewis considered the area to be so marginal that it would only have been settled after more desirable locations, and that one should not ascribe patterns of adaptation, known from other parts of the islands, to west 'Ewa. The primary food source was thought to be the sea and reef. The possibility of raising fish (mullet) in brackish-water ponds, and limited agriculture associated with pits and mounds is noted. Trade is suggested as a potential means for obtaining nonmarine foods.

The Department of Anthropology, Bishop Museum conducted a reconnaissance of c. nine hundred acres at Barber's Point in 1975 (Barrera 1975). Inland areas were examined to relocate sites recorded by Lewis in 1969 and 1970, and to locate additional sites. Seaward areas were examined to determine extent and density of surface remains. A total of twenty-four sites was located, and historic sources were researched. Nine of Lewis's sites were relocated within the survey area, three probably relocated, and one could not be found. At least five of Lewis's sites had been destroyed. Twelve new sites were recorded. Site types included limestone sinkholes, house sites, walls, cairns, enclosures, shelters, a terrace, a midden deposit, a paved area, a burial cave, and many mounds. The latter are typically constructed of coralline limestone boulders and cobbles. A triangular basalt adze was found on the surface within an enclosure.

Barrera (1975) concluded that prehistoric occupation of the Barber's Point area was demonstrated by the presence of midden and artifacts. Fishing was considered to be the primary use of the area by the prehistoric inhabitants, and was evidenced by fish bones and scales, fishhooks, and sinkers. No indications of agricultural activities were present, but Barrera suggested that some of the mounds may have been used for cultivation of ti (*Cordyline terminalis* <L.> Kunth) and sweet potato (*Ipomoea batatas* ,L.> Lam), and recommended further survey and excavations to document this.

The settlement pattern was described as "dispersed clusters of residences, surrounded by a relatively open and little-inhabited area" (Barrera 1975:18). The Barber's Point locality was considered a potentially important locale for archaeological research because it represents "the pre-historic Hawaiian adaptation to a unique set of ecological circumstances (raised reef, low rainfall, and immediate proximity to deep ocean)" (Barrera 1975:18).

Sinoto (1976) provided a list of sites and features recorded for Barber's Point in four survey areas designated A through D. A total of 97 sites was identified, including 17 previously recorded by Lewis (1970) and 36 reported by Barrera (1975). All sites were assigned Bishop Museum site numbers (50-Oa-B6-22 through 50-Oa-B6-137; 50-Oa-B6-58 through 50-Oa-B6-137 added by A. Sinoto). The most common features recorded were unmodified limestone sinkholes (80 total), walled sinks (17), rectangular enclosures (18), C-shape enclosures (12), wall segments (14), and *ahu* (15+). Other infrequent sites/features included cairns, complexes of walls and enclosures, an L-shape wall, a ramp associated with a sinkhole, a filled sinkhole, railroad tracks, a crypt, a trail, platforms (2), and culturally modified caves (three).

Sinoto (1976) excavated a total of 27 sites. An important result of the excavations was the discovery of fossil bird bones in the limestone sinkholes, potentially important for palaeontological research. A total of 6 fossil bird sites was recorded.

In 1977 an archaeological and palaeontological salvage project was conducted by the Department of Anthropology, Bishop Museum, to mitigate the impact of the deep-draft harbor at Barber's Point (Sinoto 1978). Five archaeological and thirteen palaeontological sites were excavated.

The excavations at the five archaeological sites produced portable artifacts (25), and midden, soil, and land snail samples (Sinoto 1978). Basaltic glass from one site (Site 50-Oa-B6-70) was hydration-rind dated to the 17th century (A.D. 1612-1650). Artifacts consisted of single specimens of the following artifact categories: adze, adze chip, basalt flake, basalt hammerstone, coral abrader, coral file, fishhook fragment (Type S-IA/B-HT 4 after Emory, Bonk, and Sinoto 1959), modified bird bone, and polished hematite. A total of 10 pieces of basaltic glass and 3 unmodified basalt flakes were also forthcoming from the excavations.

Midden materials consisted primarily of mollusca, echinodermata, and crustacea, which commonly occur in nearby shallow water, reef, and surge zone habitats. Fish and bird bones were scarce and unidentified, except for tuna (Scombridae sp.). Mammal bones were primarily those of rodent, with minor amounts of human bone.

In general, a high degree of disturbance was evident in the excavations. Sinoto (1978) noted only a single component, or cultural stratum, in the excavated sites.

Several trends in prehistoric utilization of the area as evidenced by the archaeological remains were discussed by Sinoto (1978). Construction of surface architectural features incorporated natural features such as outcrops surrounding low lying areas. Habitation-related structures were oriented in a manner that offered protection from the prevailing winds (i.e., walls etc. on the northeast side). Sinkholes, when sufficiently large, showed evidence of habitation, and were often modified and incorporated into clusters of surface structures. The prehistoric utilization of the area was interpreted as short-term, temporary, or seasonal and/or specialized on the basis of consistently thin cultural stratigraphic units, absence of internal features such as fire-places, and low artifact and midden densities. The stratigraphic consistency and a range of dates from Sites 50-Oa-B6-58 and 50-Oa-B6-70 are taken as evidence that the cultural sites represent a "coeval occupation". The artifacts, midden, and the presence of *ahu* considered to be fishing shrines were interpreted as evidence for an emphasis on fishing-oriented activities for the areas's inhabitants.

Davis and Griffin (1978b) discussed previous research in the Barber's Point area. They recognized the tentative nature of earlier conclusions by Lewis (1970) and Sinoto (1976) as resulting from small site samples and the preliminary nature of the research; however, they felt some conclusions were misleading. These conclusions concerned the permanence of occupation and the possibility of plant cultivation. Davis and Griffin suggested that another plausible interpretation of the existing data is that the sites may represent a focus of activities over an extended period of time. Furthermore, contrary to Lewis' assertion that adaptive strategies available elsewhere in the Pacific were not available to the prehistoric inhabitants of Barber's Point, they suggest that techniques for cultivating atoll environments could have been readily applied to the environmental situation at Barber's Point. Intensive practices involving mulching and tapping the subterranean brackish-water lens would have permitted small-scale food production.

Sinoto (1979) conducted survey and test excavations in an 80-acre parcel adjacent to the area he surveyed in 1976. The area was considered a continuation of the adjoining parcels because there was no spatial hiatus in surface architecture and no new architectural types were present (the same types reoccurred). Sinoto (1979:32) did note variation in the "intensity in the exploitation of the two areas" marked by a lower frequency (15% vs. 30% of "larger, more structurally complex forms, such as enclosures and platforms". The comparative material was limited to the earlier, 1976 data collected by Sinoto. Architecturally simpler structures--mainly C-shapes, *ahu*, and modified natural features--were more common. The lower frequency was thought

to indicate that the area was marginal to the larger complexes of architecture towards the northwest. These conclusions are regarded by Sinoto as tentative because of the potential sampling problems posed by extensively cleared or otherwise altered areas.

Sinoto's research also focused on continued evaluation of palaeontological significance. In addition to locating over 500 testable limestone sinkholes using a systematic quadrant sampling design, Sinoto tested 24 sinkholes. Sinkholes were more abundant in this survey area than in previously surveyed areas. Sixteen percent of excavated sinkholes were found to contain extinct avifaunal remains. Sinoto (1979:34) outlines four categories of significance for the avifaunal inventory:

(1) species of birds that are totally extinct in the Hawaiian Islands with no historic record of extinction

(2) species of birds that still exist today in the Hawaiian Islands but occupy a totally different type of habitat from that of Barber's Point

(3) species of birds that are extinct on O'ahu Island

(4) species of birds that are totally extinct in the Hawaiian Islands today, with a historic record of extinction.

RESEARCH OBJECTIVES

Reconnaissance proved that the survey area had considerable variation in degrees of disturbance. The landscape was modified by historic ranching and agricultural activities; another important change is the near complete replacement of the native flora by historically-introduced exotics; and military-related construction has also altered the landscape. Despite these modifications, sufficient relatively undisturbed areas were present to produce a sample of archaeological data that would permit meaningful comparisons with other areas, and provide a data base for reconstructing the prehistory of Barber's Point.

The theoretical orientation of the research was drawn from a broader anthropological perspective that sought to test hypotheses concerned with patterns of cultural development. The research area offered a specific example of agricultural change, and the development of socio-political complexity. These two processes of cultural change are often causally linked to each other, to demographic change, and to the environment. The latter two

factors can also be addressed by the data base generated by the project. Specifically, the data can be used to reconstruct these variables and/or processes, and to test hypotheses about the nature of interrelationships.

The following problems or topics, addressed by the present research, are important for expanding our understanding of prehistory at a local and regional level, and for Hawai'i in general. These emphasize the adaptation of the early Hawaiians to leeward environments. This study also attempted to establish a chronology for this adaptation. Other foci included technologic, economic, and settlement pattern reconstructions.

Chronology. The contract provided for a maximum of 12 C^{14} determinations. Although the selection of sites for dating was largely determined by factors outside our control (i.e., the requirement that samples were to be obtained from exposed site features and from small subsurface probes), an attempt was made to date inland and coastal habitation features at Barber's Point in order to determine the time frame for settlement in the vicinity of the Naval Air Station. Dating of temple sites and agricultural features would have also added significantly to the data base; however, these types of sites are less likely to yield easily obtainable materials for dating.

Aside from absolute age determinations, relative dating of sites may be possible based upon architectural style and surface artifacts. Although the latter were not usually collected, field observation was thought sufficient for this purpose.

Technology. Evidence for tool manufacturing and artifact types was noted during the survey. Although analysis of artifactual materials was primarily limited to field study, this was sufficient to gain an understanding of the types and extent of various aspects of prehistoric technology. Field examination of surface artifacts can also provide clues relating to various aspects of the economy and social life (i.e., fishing gear, food processing tools, ceremonial objects, etc.)

Economy. The prehistoric Hawaiian subsistence economy consisted of three primary components: marine exploitation, agriculture, and hunting and gathering. Survey data on feature types and location, and on surface artifacts and midden can provide a means for reconstructing various aspects of the economy. Marine exploitation is evidenced at sites/features proximal to these resources by the presence of marine food midden remains (shells, fish bone, etc.) and artifacts used for exploiting the marine environment (e.g., fishhooks). Types

of midden and artifacts can provide evidence of the specific marine environment exploited (i.e., brackish, intertidal, deep sea).

Agricultural activities in leeward environments in the Hawaiian Islands are typically represented by a variety of landscape modifications and feature construction. Mounds and cleared areas are present at Barber's Point, and the probable use of cavities or sinkholes in the coral outcrop was noted. Information derived from survey data on the size, configuration, and distribution of agricultural features with respect to various environmental factors and habitation sites provides a basis for reconstructing the agricultural component of the prehistoric economy.

Settlement Patterns: A variety of topics relating to Hawaiian settlement patterns were addressed by the project. Elsewhere in Hawai'i clustering of functional sets of architectural features have been interpreted as habitation sites, agricultural complexes, and sites reflecting social-political and/or religious functions. Also important were questions relating to evidence for coastal versus inland settlement and the relative permanence of occupation. Although interpretations of data relative to these concerns was limited to surface remains, which reduced the certainty of feature function determinations, comparison with feature types from other, better known areas served as a basis for inferences.

Site/Feature Definitions

For purposes of the present survey, an archaeological site usually consists of one or more features. An archaeological feature is defined as the non-portable remains of past human activity. This may be a structure (wall, terrace, etc.), a concentration of artifactual materials or midden (food remains), or natural features containing evidence of human activities (caves). Subfeatures may be designated as necessary to refer to nonportable feature subunits. Typical subfeatures include hearths, entryways, and storage compartments found within an architectural or other type of feature. Artifacts or midden (food remains), portable remains of past human activity, may also make up a site in the absence of architectural features.

An archaeological site is an interpretatively defined unit that, as noted above, is composed of one or more features. A cluster of features is referred to as a complex. In general, there is an assumption of functional and temporal association between features; however, in some instances sites may include more than one such association. For example, within a complex of

prehistoric habitation features (e.g., several habitation terraces or platforms clustered with agricultural features and subsidiary features, such as cooking areas and burials, there may be other features dating to another time period with a different function, such as historic cattle pens and house sites. These temporal associations are referred to as components.

Added to the above basis for site definition is the site's spatial distribution. A site can usually be defined on the basis of a single local topographic unit, such as a saddle or the end of a ridge. Constituent features are usually within close proximity.

Most of the structures identified during the survey are constructed of drywall (mortarless) stone masonry. Unless otherwise noted, construction materials at Barber's Point consist of locally available coralline limestone, cobbles, and boulders that vary in shape from irregular chunks to flat slabs.

Structural features encountered during the survey range from single upright stones to large enclosures consisting of several attached enclosures. The following feature definitions were used during the survey (Hommon and Ahlo 1983:32-38):

> The simplest structural element noted here is an 'upright', usually an elongate or lozenge-shaped boulder larger than most building stones that appears to have been deliberately set with its long axis at or near vertical. Uprights are relatively rare and in some structural contexts may have represented a sacred concept or being (such as a 'fish god'). In some cases, the presence of a large, elongate stone on a feature is noted as a 'fallen upright', since it is considered likely that each once stood vertically [Hommon and Ahlo 1983:32-38].

Many structures at Barber's Point have what is here referred to as upright-slab facings. The wall faces are formed by limestone slabs set on edge, adjacent to a wall. These "uprights" are therefore not free-standing. The upright stones referred to above are free-standing.

> A structure consisting of a straight or curved line of stones is termed an alignment. Alignments, which are always only one stone high, often serve to delimit an area that may have been set off for a particular purpose [Hommon and Ahlo 1983:33].

Alignments at Barber's Point typically form the borders of a trail or the foundation of a structure.

> A pavement is defined as being a planar structure of stones usually no more than one stone high (Hommon and Ahlo 1983:33).

Pavements are frequently interpreted as dwelling foundations.

> A stone wall is at least two stones high and longer than it is wide. A single stacked wall is only one stone in thickness. A multiple stacked wall is at least two stones in thickness and in cross-section and consists of stones of about the same size range throughout. A core-filled wall is similar to a multiple stacked wall except that the stones forming the exterior faces of the wall are significantly larger than those in the interior or 'core' [Hommon and Ahlo 1983:33].

Walls at Barber's Point usually form a variety of structures such as L-shapes, C-shapes, or enclosures (see below).

> Curving walls or sets of contiguous walls form structures termed L- shapes, C-shapes, and enclo-sures. The first two types of structures are named after the upper-case letters they resemble in plan. L-shapes and C-shapes only partially enclose their floor space. A rule of thumb that would apply in the present survey areas would be that to be an enclosure, a feature must be walled around at least 75% of its periphery [Hommon and Ahlo 1983:33-34].

L- and C-shapes and most small enclosures are usually interpreted as dwelling foundations upon which pole and thatch structures were constructed. Occasionally an enclosure may include several smaller units (enclosures and C-shapes). Large enclosures (greater than c. 150-200 m^2) are often considered to represent garden areas delimited by the walls. In these cases the walls may have also served to exclude pigs, and historically cattle, from cultivated plots. Several walls recorded at Barber's Point do not form obvious enclosures, as they extend for long distances in a relatively straight line. These walls are usually interpreted as historic ranch walls that served as fences or property boundaries, possibly forming extremely large enclosures, whose complete extent lies beyond the survey areas.

> A terrace is a relatively flat-topped feature whose periphery is in part flush with [the] adjacent ground surface and in part raised above it. The

> raised side(s) of terraces are usually marked with retaining walls and/or alignments [Hommon and Ahlo 1983:34].

Terraces in Hawai'i are usually interpreted as agricultural features, dwelling foundations, or parts of temples (*heiau*), depending upon their form and construction. Terraces at Barber's Point are relatively rare because the terrain is nearly level.

> A platform is a relatively flat-topped stone structure at least two stones high around its entire periphery. Certain of the small relatively high stone platforms recorded during the survey are termed cairns. These structures have relatively small upper surfaces [compared to platforms].... The formal difference between a platform and a stone mound is that the sides and upper surface of a mound are irregular, displaying neither vertical or horizontal facing [Hommon and Ahlo 1983:34].

Platforms at the Naval Air Station are frequently interpreted as either dwelling foundations or burials. Dwelling foundation platforms are relatively low in height and large in surface area. Burial platforms are often high and small in surface area, and are usually designated as cairns.

For the present survey additional feature types included the U-shape (similar to C-shapes and L-shapes) and modified sinkholes. Sinkholes are natural cavities in the emerged coralline reef that make up much of the 'Ewa Plain. In most cases these are actually remnants of the original reef structure that have been enlarged or otherwise structurally altered through solution by ground water, thus they are not classic karst features. However, use of the term is accepted in the archaeological literature and is therefore used here for consistency. Modification, unless otherwise noted, consists of a low wall or mound of stones partially or completely surrounding the sinkhole opening.

Other feature types referred to in this report include cupboards, hearths, and trails. Cupboards are small (usually less than 1 m^3) stone-lined boxes that are often constructed into dwelling structure walls, and are thought to represent storage features as the name implies. Hearths are areas where fires were made for heat, light, and/or cooking, and are usually formed by excavation of a small pit that is lined with stones, often set on edge. Trails are walkways or paths often bordered on one or both sides by an alignment; frequently surface stones have been cleared from the trail, or added to form a level surface if the trail is paved.

Rationale for Survey Method

The contract specified that five separate land parcels at Barber's Point be archaeologically surveyed (Fig. 2). Forty percent of the research area was to be surveyed by transects spaced 30 ft apart, 20% by 90-ft transects, and 40% by 180-ft transects. Intervals of 10 m, 30 m, and 60 m were used with the approval of Dr. Robert J. Hommon, Staff Archaeologist, NAVFACENGCOM.

Because data from a variety of environmental situations, as defined by elevation, soils, and slope data, are important for evaluating hypotheses concerning agricultural activities and settlement patterns, each parcel was characterized in terms of acreage, elevation range, soil types, and slope range (Table 1). Information derived from existing topographic, soils, and slope data (PACNAVFACENGCOM 1975; U.S.G.S. Quads.) was used in the characterization process.

Survey intensity decisions were guided by: (1) a desire to produce comparable parcel survey data from the full range of environmental variation exhibited in each research area; (2) the degree of disturbance; and (3) probable site density. Observations relating to site density and surface disturbance derived from the reconnaissance are provided in Table 2, and a listing of the parcels by proposed level of survey intensity (Fig. 2) is given in Table 3.

SUBSURFACE PROBES

The contract specified that test probes be "conducted for site discovery or for the site boundary determination in exceptional cases." Several areas were proposed for test probes, including sinkholes, beach sites, and other selected sites and features.

Probes were proposed for testing the pits and cavities (sinkholes) known to be common at Barber's Point. Previous archaeological work (Sinoto 1978, 1979; Davis and Griffin 1978) confirmed the presence of prehistoric cultural materials and fossil and subfossil bird-bone assemblages. The latter have been shown to have palaeontological significance. Because these pits often lack any surface indication of their content, subsurface testing is necessary to determine the presence of cultural and/or palaeontological remains.

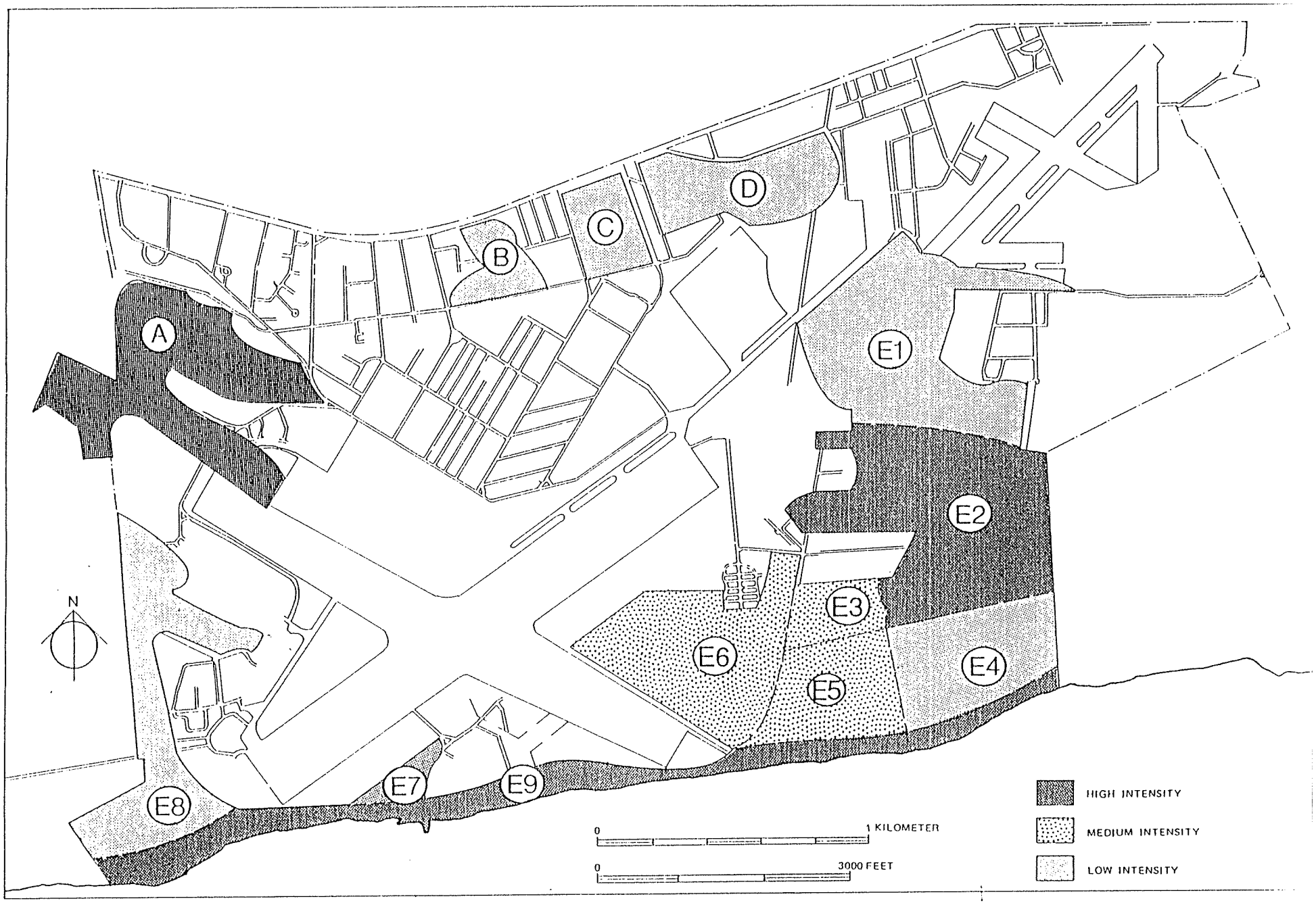


Fig. 2. Barber's Point Survey Intensity.

Table 1
SURVEY AREA SIZE, ELEVATION RANGE, SOIL TYPE, AND SLOPE

Survey Area Designation	Area in Acres	Elevation Range (ft)	Soil Type*	Slope Rating**
A	163.0	10-45	M,C	1
B	32.1	30-50	M,C,E	1
C	34.7	10-45	M,C,E	1
D	53.7	40-50	M,C,E	1
E1	151.8	20-30	C	1
E2	200.0	10-25	C	1
E3	28.5	10-15	C	1
E4	93.4	3-10	C	1
E5	74.2	3-10	C	1
E6	127.0	3-20	C	1
E7	10.8	3-15	C	1
E8	121.4	3-20	C	1
E9	138.4	0-3	B	1

*L = Lualualei clay soils, P = Pulehu clay loams, T = Tropohumults-Dystrandepts Association, R = rock land, S = stony land, and C = coral outcrop, E = Ewa silty clay soils, H = Haleiwa silty clay soils, M = Mamala stony silty clay loam soils, B = beach sand.

**1 = 0-10%, 2 = 10-20%, 3 = 20-30%, 4 = >30%.

Table 2
EVALUATION OF PROBABLE SITE DENSITY AND DISTURBANCE

Survey Area Designation	Density of Cultural Remains*	Type of Disturbance**	Degree of Disturbance*	Basis for Determination***
A	M	D,B,M,	M	R
B	L	Q,D,F,B,M	H	R
C	L	Q,D,F,B,M,A	H	R
D	L	D,F,B,M,A	H	R
E1	L	Q,D,F,B,M	H	R
E2	M	B,M	M	R
E3	M	B,M	M	C
E4	M	D,B,M	M	R
E5	M	B,M	M	C
E6	H	F,B	M	R
E7	L	B,M	H	R
E8	L	Q,D,F,B,M	H	R
E9	H	D,F,B,M,R	H	R

*H = high, M = moderate, L = low.

**Q = quarrying, D = dumping of refuse, F = filling, B = bulldozer cuts or cleared areas, G = grazing impacts from livestock and fence construction, M = military-relate constructions (i.e., buildings, roads, pipelines, fences, etc.), A = Probable historic field agriculture (i.e., sugarcane), E = erosion and/or deposition.

***R = field reconnaissance, C = comparison to adjacent reconnaissance areas.

Table 3

LEVEL OF SURVEY INTENSITY FOR SURVEY PARCELS

	High Intensity		Medium Intensity		Low Intensity	
A	163.0		E3	28.5	B	32.1
E2	200.0		E5,E6	201.1	C,D	88.4
E9	138.4		E7	10.8	E1,E4,E8	366.6
Total	501.4	(40.8%)	240.4	(19.6)	487.1	(39.6)

The field reconnaissance identified extensive beach/dune sites along the coast at the NAS BARPT. The lateral (coast-wise) extent of these sites is determinable by examination of wave-eroded banks and dunes. However, the inland extent of these sites is much more difficult to determine for several reasons: beach areas are heavily used for recreational purposes; house and park construction, and associated landscaping, usually obscure surface indications; beach/dune sites frequently lack surface architectural remains; and undeveloped areas are generally overgrown with vegetation. Therefore, probes were proposed to identify the inland extent of the coastal sites.

Subsurface probing was proposed for one additional area. The provision for C^{14} dates specified that samples for dating could be obtained from probes. It was proposed that a small number of probes be conducted in site features in order to determine their vertical boundaries or depth, and to obtain datable samples. The C^{14} samples additionally permitted a temporal boundary of the sites occupation to be established (see following section on dating for addition details).

Dating

The contract allowed for the submission of a maximum of twelve radiocarbon dates (from both Lualualei and Barber's Point). Samples for dating were collected from erosion-exposed site features and the subsurface probes. A minimum of three samples was required from each site to be dated. The last provision was considered excessive in the case of subsurface probes. The limited size of these probes greatly reduced the probability of obtaining even a single sample let alone three. This contract specification was subsequently modified in consultation with Dr. Hommon, such that a single sample from a site was all that was necessary for dating. However, a concerted effort was made to obtain additional samples to be retained for future dating, if necessary.

The provision for radiocarbon dating was a valuable aspect of this project because relatively few C^{14} dates are presently available for Barber's Point. Prior to the project there were no radiocarbon dates available for the research area. Specific chronological objectives were as follows:

(1) Determine the temporal range of exposed cultural features along the beach at Barber's Point. The exposure of earth ovens and fire pits makes the potential for obtaining sufficient samples very good. At present there are no dated beach sites on the 'Ewa Plain, and such chronological information will greatly expand our understanding of the time frame for coastal settlement of leeward O'ahu.

(2) Inland habitation features (stone architecture) at Barber's Point should be dated. At present only volcanic glass dates are available, and these need to be independently verified. Samples should be obtained from shovel probes conducted in site features likely to contain sufficient charcoal for dating (i.e., cooking areas or fire pits).

Criteria for Evaluation of Site Susceptibility to Damage

Criteria that are generally applicable to the evaluation of site susceptibility to damage are: (1) site/feature type; (2) state of preservation; and (3) integrity (intactness of site and surroundings). These specific criteria must be refined on the basis of the nature and extent of damage sources. Past and on-going sources of damage were noted during the fieldwork in order to better develop these criteria.

Sources of damage to sites in the project area include human, natur and animal agents. Human agents include ranching activities (wall/fence support structure construction and clearing of vegetation), tree planting and cutting, field agriculture, road and building construction, recreational activities, erosion and deposition caused by the above activities, and acts of intentional and unintentional vandalism (e.g., removal of artifacts and destruction of structures).

Natural agents include vegetation growth, natural erosion and deposition, and deterioration of midden, artifacts, and structures (e.g., limestone building stone decomposition). Animal sources of damage include disturbance by foraging cattle and pigs and by burrowing mammals.

Development of a Predictive Model for Site Survey

For a systematic interval (transect) archaeological survey of the type employed during this project, site discovery depends upon three factors: site size, site prominence, and vegetation. The latter two factors are discussed in the section entitled, *Environment and Estimate of Success of Site Discovery*. The relationship between expected site size and transect interval is discussed here because it is most directly relevant to the deve-lopment of a predictive model.

As noted previously, three levels of survey intensity were used during the survey: 10 m, 30 m, and 60 m intervals. In an extreme case, if site discovery is limited to the transect lines, then sites less than 100 m^2 could be missed by a 10 m interval transect, less than 900 m^2 for a 30 m interval, and less than 3,600 m^2 for a 60 m interval.

For sites recorded during the survey at the Naval Air Station, site sizes range from less than 10 m^2 to greater than 140,000 m^2. A total of five sites (12%) are less than 100 m^2, twelve sites (29%) are less than 900 m^2, and eighteen sites(43%) are less than 3,600 m^2. Thus, in a hypothetical case, 12% of the sites could be missed by 10 m interval transects, 29% by 30 m transects, and 43% by 60 m transects. Conversely, one would expect to discover 88%, 71%, and 57% of the sites for 10 m, 30 m, and 60 m transects, respectively.

In reality, the relative success of site discovery is much higher because site discovery is not limited to transect lines. Archaeological surveyors can identify sites on either side of the transect line for considerable distances

depending upon vegetation and site prominence. For the present survey, site discovery is close to 100% for 10 m and 30 m transect intervals. It is only with the 60 m interval that a number of sites may have been missed.

As noted above, the development of a predictive model must be based on knowledge of the probable size range for sites in a particular region. A sample of sites in excess of thirty would be necessary for the ranges to have statistical reliability. The total of forty-two sites recorded during the present survey marginally satisfies this requirement.

A predictive model for the Barber's Point area can be derived as follows:

(1) 10 m interval transects will discover c. 88% of all sites, and can be expected to miss c. 12% in the most extreme situation where site discovery is limited to the transect lines;

(2) 30 m interval transects will discover c. 71% of all sites and can be expected to miss c. 29% in the same situation; and

(3) 60 m interval transects will discover only c. 57% of all sites; missing c. 43%.

Again, it should be stressed that these figures represent an extreme case where survey is restricted to transect lines, and that much higher percentages should be expected from normal survey procedures.

FIELD METHODS

The initial survey strategy (approved in the Research Design) combined site recording with the transect surveys. This required halting the survey to record sites as they were encountered. Following recording, survey team members returned to their transect lines and proceeded with the survey. It quickly became apparent that this procedure would be much too time consuming for several reasons: (a) the extent of sites was difficult to assess without having first completely surveyed each area; (b) site sizes varied considerably, along with the concomitant requirements for crew size necessary for recording, and completed surveys for each area would enable a more efficient allocation of personnel for recording; (c) the slow rate of progress achieved using this original strategy would have greatly reduced the total area covered in the time allotted for the survey. For these reasons it was decided that the transect surveys should be completed for the entire area prior to detailed recording.

Another alteration of the original contract and approved Research Design concerned the prohibition of surface artifact collecting. During the survey certain artifact types considered to be in imminent danger of loss or destruction were collected in order to prevent their physical loss and the loss of significant archaeological data. Most of the artifacts collected are relatively rare in public collections because of private collecting and/or their susceptibility to damage. The archaeological survey, including the erection of temporary and permanent site markers, greatly increased civilian and military personnel awareness of the presence and location of archaeological remains and, hence, increased the potential for their unauthorized collection. Another consideration in changing the original specification was to afford the artifacts protection from damage or loss through military activities in the interim between the survey and the initiation of historic properties management.

Several factors affected the rate and degree of survey completion. Delays and problems occurred due to rain and changes in vegetation. When the survey began, site/feature visibility was excellent due to the previous two years of drought. Small surface sites were easily recognized. However, the return of a normal weather pattern in November brought considerable rain which resulted in a sudden resurgence of vegetation growth. In December and January the vegetation increasingly caused problems for relocation of sites for detailed recording. The increased vegetation also resulted in greater amounts of labor being expended in clearing activities prior to detailed recording.

Site Numbering

Each site was assigned three numbers: a temporary number consisting of the survey parcel letter designation and a sequential number (i.e., A-1 for the first site located in survey parcel A), and two permanent numbers. The first number was assigned in the field and marked on the permanent site tag. The State of Hawai'i number was the second number assigned, and is composed of four parts separated by hyphens (e.g., 50-80-07-1179). These four parts refer to the state of Hawai'i (50), the island of O'ahu (80), the 7.5 minute U.S.G.S. quadrangle (in the above example 07 for Schofield Barracks), and a sequential site number (1179). The Bishop Museum number was the third number assigned, and is composed of four parts separated by hyphens (e.g., 50-Oa-B6-238). These four parts refer to the state of Hawai'i (50), the island of O'ahu (Oa), the *ahupua'a* (B6 for Honouliuli), and a sequential site number (238).

Assignment of permanent state numbers was not made until after the field phase. This was because boundaries of site complexes, and even a single feature site such as a long historic wall, were best determined after overall distributions were analyzed.

Site Location and Recording

Each site identified in the field was assigned a primary site datum. The datum, which is the location of the permanent site tag, is shown on the site sketch map, and was plotted using an enlarged (1 in. = 1,000 ft) U.S.G.S. aerial photo on an acetate overlay twice the scale of the standard U.S.G.S. quadrant map. Locations were plotted using one or more of the following methods: tape measurements and compass bearings from known points; compass triangulation; and comparison with vegetation, man-made features, or topography shown on ortho-photos and U.S.G.S. quadrant maps.

Site recording consisted of the completion of site/feature forms, the preparation of a tape-and-compass sketch map, and the taking of a minimum of two photographs. The information gathered for each site is sufficient for preparation of National Register of Historic Places nomination forms.

Site Markers

Sites were marked with a thin 1/2 inch wide strip of stainless-steel tape that was imprinted with the temporary site number using a Dymo-mite brand tape marker. The strips were attached with steel wire to stakes made from 3/8 inch diameter steel reinforcing rods.

Environment and Estimate of Success of Site Discovery

Hommon and Ahlo's (1983:126-129) discussion of survey reliability estimates for an area of Moloka'i, Hawai'i, are generally applicable here. They identify two primary factors that influence site discovery and, hence, survey reliability: "(1) site prominence (how readily a site is recognized relative to other site types), and (2) vegetation density" (ibid.:126).

For their survey area Hommon and Ahlo recognized four general site types with differing degrees of prominence (listed in order of increasing site prominence): isolated artifact; surface midden scatter; terrace; and "wall or

stone structure two or more stones high" (ibid.:127). Terraces are generally absent from the Barber's Point area, however, one additional site type common to the area is the sinkhole or subsurface cavity/cave. This type should be added in place of terrace, resulting in the following site types for the Barber's Point area (in order of increasing prominence): (1) isolated artifact, (2) midden scatter, (3) sinkhole, and (4) wall or stone structure two or more stones high.

Vegetation, the other primary factor influencing site discovery, is limited to five categories for the survey areas at the Naval Air Station (under conditions of extreme drought):

(1) Mature *kiawe* forest mixed with *koa haole* and no ground cover.

(2) Immature *koa haole* forest with scattered *kiawe* and no ground cover.

(3) Grass and shrub covered sand dunes.

(4) Beach and eroded dune faces; no vegetation.

(5) Ironwood forest with moderate shrub and vine cover; restricted to back-dune areas along the east (ocean) side of the survey areas.

Probability estimates of site discovery can be derived, following the method employed by Hommon and Ahlo, relative to a "best case" situation in which the vegetation factor is controlled (ibid.:128-129). Thus, in the absence of vegetation the following probabilities (expressed as excellent, very good, good, fair, and poor) can be applied to the site categories:

VEGETATION ABSENT	
Site Type	Probability of Discovery
isolated artifact	fair to good
surface midden scatter	good to very good
sinkhole	very good to excellent
wall or other structure	excellent

Using the no vegetation situation as a standard, the following relative estimates can be derived for the five vegetation categories:

VEGETATION PRESENT					
	Vegetation Category				
Site Type	1	2	3	4	5
isolated artifact	P-F	P-F	P	E	P
surface midden scatter	F-G	G-VG	P-F	E	P-F
sinkhole	F-G	G-VG	NA	NA	NA
wall or other structure	G-VG	VG-E	G-VG	E	F-G

E = Excellent; VG = Very Good; G = Good; F = Fair; P = Poor; NA = not applicable, site type is not present.

INVENTORY OF CULTURAL PROPERTIES

Previously Recorded Sites

A total of four archaeological sites were previously recorded for the Naval Air Station, Barber's Point. One of these is McAllister's Site 146, which refers to a large area including Barber's Point and much of the 'Ewa Plain. McAllister's "site" applies to the entire 'Ewa plain and is much too broad to be of any practical significance for purposes of cultural resource management.

State of Hawai'i Site 50-80-12-532 is located on the seaward side of Coral Sea Road, across from the Coast Guard Reservation. This site was recorded by Hawai'i State Historic Preservation Office personnel on 13 August 1974. The site consisted of a single, flexed, human burial found in a sandy deposit, c. 20 cm below the surface. The site area falls within the boundaries of Bishop Museum Site 50-Oa-B6-275 (State Site 50-80-07-532).

The nearly complete burial was thought to be that of an individual about 20 years of age. During the excavation of the burial a fireplace feature was also recorded. The feature was not considered to be associated with the burial, although two fire-cracked stones were found with the skeletal remains.

During the survey the approximate location of this burial was searched for evidence of the earlier excavation; however, nothing was found. The area does contain surface evidence of a buried habitation deposit consisting of fire-cracked rock, charcoal, and midden. The area appears to be part of the Feature A area of Site 50-Oa-B6-275. Recommendations regarding the significance of this site are given below under the entry for Site B6-275.

Bishop Museum Site 50-Oa-B6-9 is the previously noted human burial reported by Lloyd Soehren in 1962 (Bishop Museum Site Files). The burial, described as a secondary interment, was cached in a "coral pit," presumably a sinkhole. Based on the locational information provided (estimate of latitude and longitude coordinates), this site falls within the newly-recorded Site 50-Oa-B6-270 (State Site 12-1753). At this newly-recorded site, Feature I is a sinkhole containing human skeletal remains that may be Soehren's Site 9; however, no maps or descriptions sufficient to verify this hypothesis are available. Soehren's very brief site notes make reference to "house sites" and "walled pits" in the vicinity, and these are present in the new site area. The significance of this site/feature is discussed below under the entry for Site B6-270.

Tuggle (PACNAVFACENGCOM 1984) describes nine features in four areas of a fifteen acre parcel of land in the NAS BARPT Runway 11, clear zone, outlease parcel, located southeast of Hawai'i Raceway Park. The features include three "sinkholes", two coral vaults, a quadrangular coral alignment, and several features associated with historic ranching and military occupation. The coral vaults and two "sinkholes" are considered to have been prehistorically utilized. Excavations in the "sinkholes" revealed bird and fish bone and charcoal fragments.

The features recorded by Tuggle were visited during the survey, and no further recording was deemed necessary. The feature area is contiguous with Site B6-242 (State Site 1725), and may therefore be subsumed under that site number.

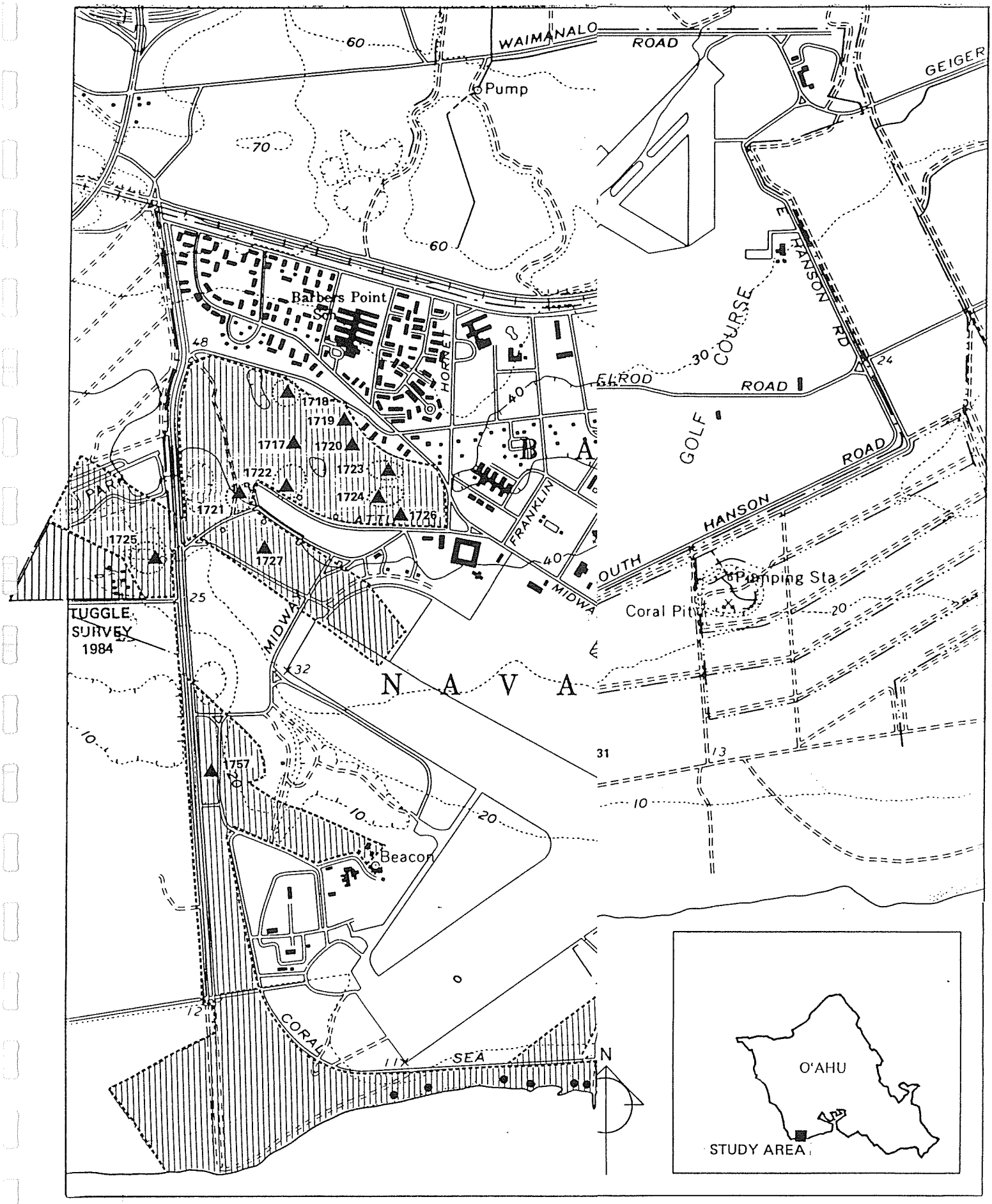
New Archaeological Sites

The following listing of sites identified and recorded during the survey is organized as follows:

Site Number provides the permanent Bishop Museum and State of Hawai'i numbers, followed by the temporary site number, which is marked on the permanent site marker.

Location lists the survey area designation (A-E9), the approximate site elevation above sea level, and the *ahupua'a* (Fig. 3).

Topography contains a brief description of the terrain.


WAIMANALO ROAD
GEIGER
Pump
Barbers Point
School
HENRY
FRANKLIN
MIDWAY
ELROD ROAD
GOLF COURSE
HANSON RD
HANSON ROAD
SOUTH
Pumping Sta
Coral Pit
TUGGLE SURVEY 1984
N A V A
B A
CORAL SEA
Beacon
1718
1719
1717
1720
1722
1723
1724
1721
1726
1727
1725
1757
O'AHU
STUDY AREA
N

Vegetation lists the principal components of the vegetation in the vicinity of the site.

Dimensions gives the maximum length and width of an imaginary rectangle that would include the entire site area. The orientation of the long axis relative to magnetic north is given in parentheses following the length.

Description provides an overall site function interpretation and the total number of features included in the site.

Under Description is a complete listing of the site's constituent features. For each feature a probable function is listed in parentheses after the feature letter designation. Functional designations are either probable, possible, or unknown. Possible functions are indicated by a question mark after the possible function (e.g., agricultural?). Unknown functions are indicated by a question mark alone. Probable functions lack a question mark. In a number of instances more than one possible function is suggested (e.g., agricultural?, burial?).

Unless otherwise indicated the archaeological features recorded at the Naval Air Station are considered to represent the remains of past aboriginal or indigenous Hawaiian activities. While most of these features are probably prehistoric (prior to contact with Europeans who first arrived in 1778), the term indigenous is not intended to have temporal significance. The term refers to evidence of cultural patterns that lack evidence of non-Polynesian influence, either architectural of artifactual.

Nonindigenous archaeological features are designated as either historic or military. Historic features (post-1778) reflect previous use of the area, usually for ranching and other agricultural activities. Historic features are typically associated with nonindigenous artifacts (metal, glass, etc.), and are architecturally different from typical indigenous features. The most common historic features are large well-preserved walls that served as livestock fences and corrals.

Indigenous features are assigned to eight functional categories: habitation, agricultural, burial, religious, storage, water source, boundary, or unknown. Habitation features represent domestic or residential activities. Typically these include architectural or portable remains of dwellings, food consumption or processing, and/or artifact manufacturing.

Agricultural features range from low amorphous mounds of stone, thought to result from the process of clearing areas for cultivation, to modified sinkholes, which provided protection from the wind and access to sufficient soil and moisture for certain crops.

Burial feature designations are tentative unless human skeletal remains were observed. Burials were noted in several sinkholes. Many other features, typically small, well-constructed platforms (usually designated as cairns), are thought to represent burial monuments, based upon their formal attributes.

While no features were assigned a probable religious function, several were designated as possibly religious. These included uprights and several large structures (enclosures) that do not appear to be typical habitation features. Although not designated as such, burials can be considered as having a religious aspect, because treatment of the dead is culturally intertwined with religious beliefs. Thus, when evaluating site significance, the presence of burials at a site is taken as evidence that the site may possess information important for an understanding of indigenous religious practices.

Features assigned a storage function are the small stone boxes referred to as cupboards. However, these features are usually part of a habitation feature, and are not differentiated as being specifically for storage; only when they occur in isolation from habitation features are they designated as storage features.

The designation "water source" is assigned to several deep sinkholes that either contain standing potable water or are considered deep enough to do so on a seasonal basis. These natural features usually show some evidence of modification either in the form of structural additions to facilitate access or to mark their location.

A "boundary" function was assigned to stone alignments (usually incorporating uprights) and stone walls that are not structurally similar to historic walls associated with ranching. These "boundary" features appear to enclose garden plots and/or habitation features.

Function is followed by the formal feature type. Next, the feature's dimensions are presented as maximum length, orientation of long axis, maximum width, and maximum height or depth.

The state of preservation or condition of each feature is given next, using a scale from very poor to excellent. Condition is followed by a brief description of the feature, noting aspects of construction, presence of surface artifacts or midden, context relative to other features, and any unusual or distinguishing attributes of the feature.

Significance evaluates the potential eligibility of the site for nomination to the National Register of Historic Places.

INVENTORY OF CULTURAL PROPERTIES

Site number*: BPBM 234; State 1717; Temporary B-A-1
Location: survey area A; elevation c. 12.0 m (39.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 84.0 m (41°) x 30.0 m (2520.00 m^2)
Description: small habitation complex (4 features)

Feature A (habitation) L-shape
Dimensions: 3.0 m (165°) x 2.2 m x 0.5 m high
Condition: poor
Feature is associated with clearing mounds.

Feature B (agricultural) wall
Dimensions: 3.0 m (79°) x 1.0 m x 0.5 m high
Condition: fair
Feature may be part of a larger enclosure, possibly agricultural.
Area contains many agricultural clearing mounds.

Feature A (habitation) L-shape
Dimensions: 3.0 m (165°) x 2.2 m x 0.5 m high
Condition: poor
Feature is associated with clearing mounds.

Feature B (agricultural) wall
Dimensions: 5.0 m (79°) x 1.0 m x 0.5 m high
Condition: fair
Feature may be part of a larger enclosure, possibly agricultural.
Area contains many agricultural clearing mounds.

Feature C (burial?) circular platform
Dimensions: 3.0 m diameter x 0.9 m high
Condition: fair
Feature has upright-slab facing.

Feature D (habitation) enclosure
Dimensions: 4.5 m (248°) x 2.5 m x 0.4 m high
Condition: fair
Well made with stacked slab walls. Interior is level soil.

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* In this section, the first three components of the numbering systems are understood to be "50-Oa-B6" for Bishop Museum site numbers and "50-80-08" for State site numbers.

Significance: BPBM 234; State 1717 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain, religious practices related to treatment of the dead, and indigenous physical anthropology.

Site number: BPBM 235; State 1718; Temporary B-A-2 (Figs. 4 and 5)
Location: survey area A; elevation c. 12.0 m (39.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, herbs
Dimensions: 84.0 m (315°) x 76.0 m (6384.00 m^2)
Description: habitation complex (6 features)

Feature A (habitation) rectangular enclosure
Dimensions: 6.0 m (259°) x 4.0 m x 0.7 m high
Condition: very good
Upright slabs used in wall faces. An internal slab-lined hearth is present. The interior floor has two levels separated by an alignment.

Feature B (agricultural?) elongate mound
Dimensions: 2.4 m (182°) x 1.9 m x 0.5 m high
Condition: fair

Feature C (habitation?) L-shape
Dimensions: 2.5 m (189°) x 3.0 m x 0.5 m high
Condition: poor-fair
Feature C is located adjacent to a C-shape (Feature D).

Feature D (habitation) C-shape
Dimensions: 4.00 m (240°) x 3.50 m x 0.65 m high
Condition: good
Feature D is well constructed with substantial walls.

Feature E (burial?) platform
Dimensions: 2.50 m (260°) x 2.00 m x 0.25 m high
Condition: fair
Feature E is located in an area of small mounds.

Feature F (habitation?) C-shape, remnant
Dimensions: 3.0 m (221°) x 1.5 x 0.5 m high
Condition: poor
Feature F is filled and paved with cobbles. It is roughly square in plan.

Significance: Site BPBM 235; State 1718 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous utilization and settlement of the 'Ewa Plain, indigenous

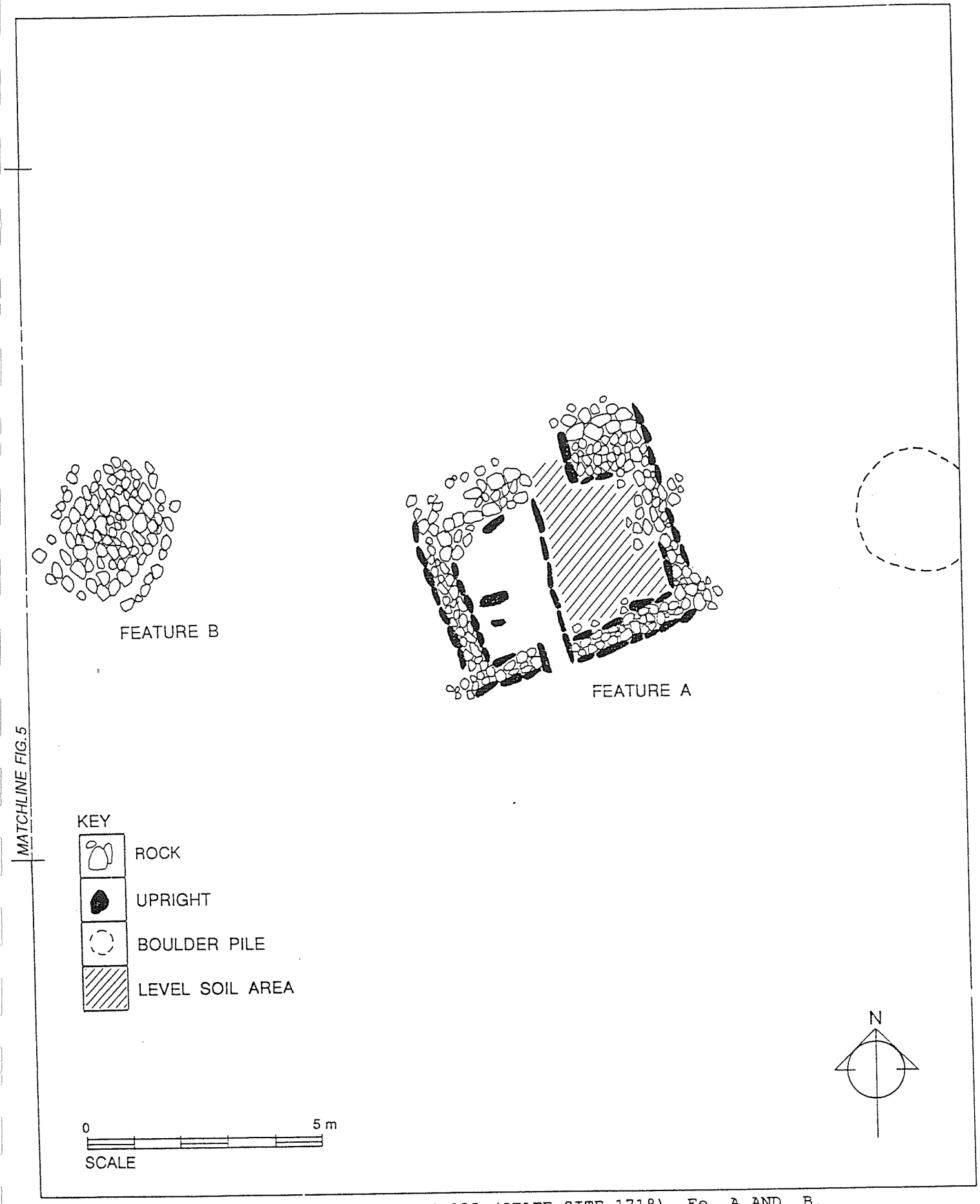


Fig. 4. SITE 50-Oa-B6-235 (STATE SITE 1718), Fe. A AND B.

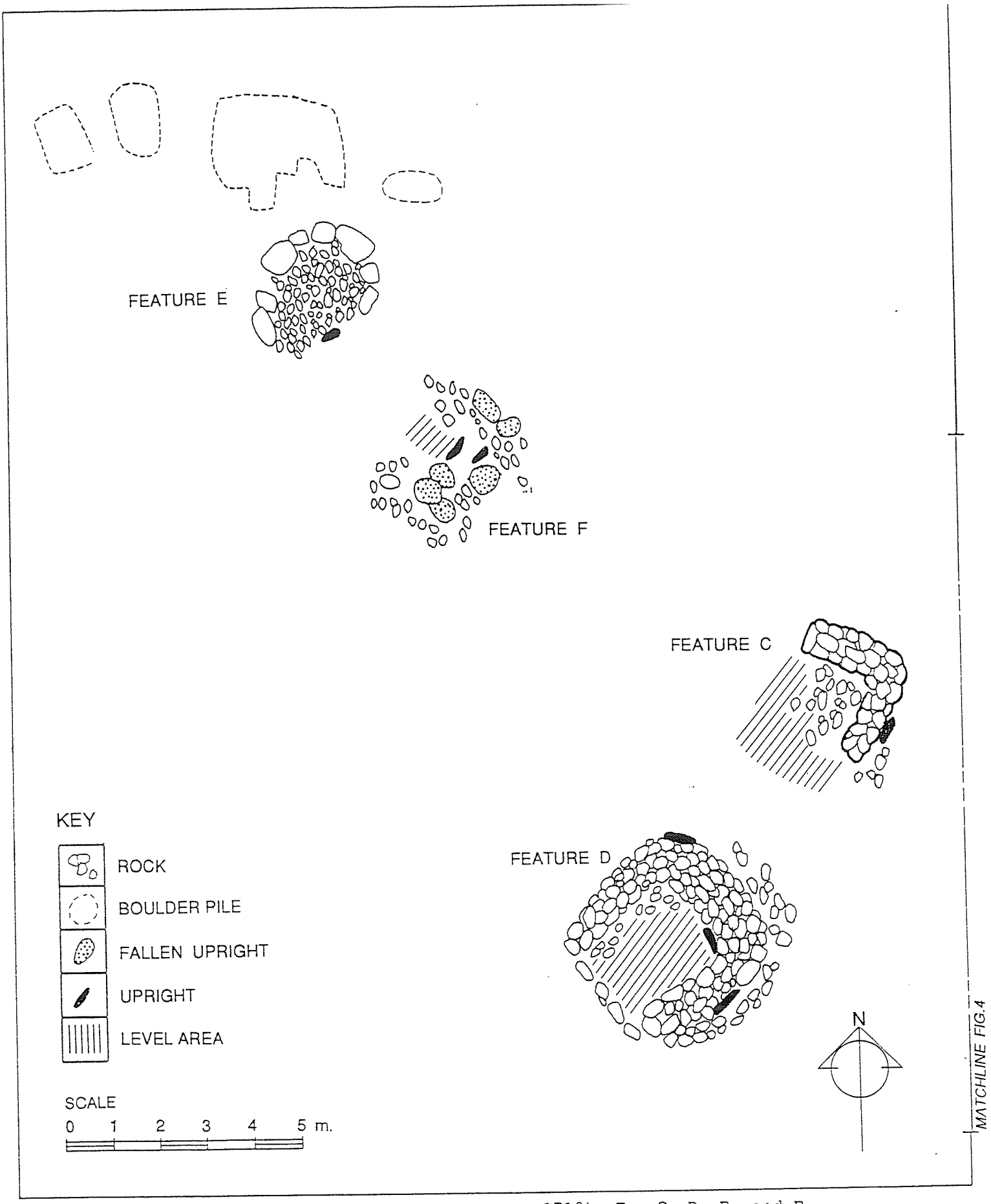


Fig. 5. SITE 50-Oa-B6-235 (STATE SITE 1718), Fe. C, D, E, and F.

religious practices related to treatment of the dead, and indigenous physical anthropology.

Site number: BPBM 236; State 1719; Temporary B-A-3 (Fig. 6)
Location: survey area A; elevation c. 12.0 m (39.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 49.0 m (80°) x 33.0 m (1617.00 m^2)
Description: habitation complex (5 features)

Feature A (habitation?) C-shape
Dimensions: 4.0 m (50°) x 3.0 m x 0.7 m high
Condition: good
Feature A is well constructed with substantial walls.

Feature B (habitation) enclosures
Dimensions: 17.0 m (60°) x 10.0 m x 0.9 m high
Condition: good
Feature consists of a large rectangular enclosure with two or three smaller interior enclosures constructed adjacent to the large enclosures. A cupboard is present in the outer wall next to smaller enclosures. Feature is well constructed with occasional upright slabs incorporated into the wall faces.

Feature C (habitation) enclosure
Dimensions: 13.00 m (60°) x 11.50 m x 0.55 m high
Condition: good
The enclosure is constructed of stacked slabs. Interior is sporadically faced with upright slabs. There is a filled sinkhole inside the enclosure and an unmodified sinkhole outside the enclosure. Bulldozer disturbance is present next to the feature. Feature E is less than 2.0 m away.

Feature D (agricultural) irregular enclosure
Dimensions: wall is 2.80 m (70°) x 2.30 m x 0.45 m high
Condition: good
Feature consists of an irregular shaped area enclosed by a wall. Several upright are used in the wall faces. A large cupboard is present in the wall. A filled sinkhole is located inside the enclosure.

Feature E (burial?) cairn
Dimensions: 2.50 m (155°) x 1.25 m x 0.80 m high
Condition: good
Interior chamber is exposed and has a soil deposit. Cairn is located on level soil with *kiawe* trees growing around it.

Significance: Site BPBM 236; State 1719 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain.

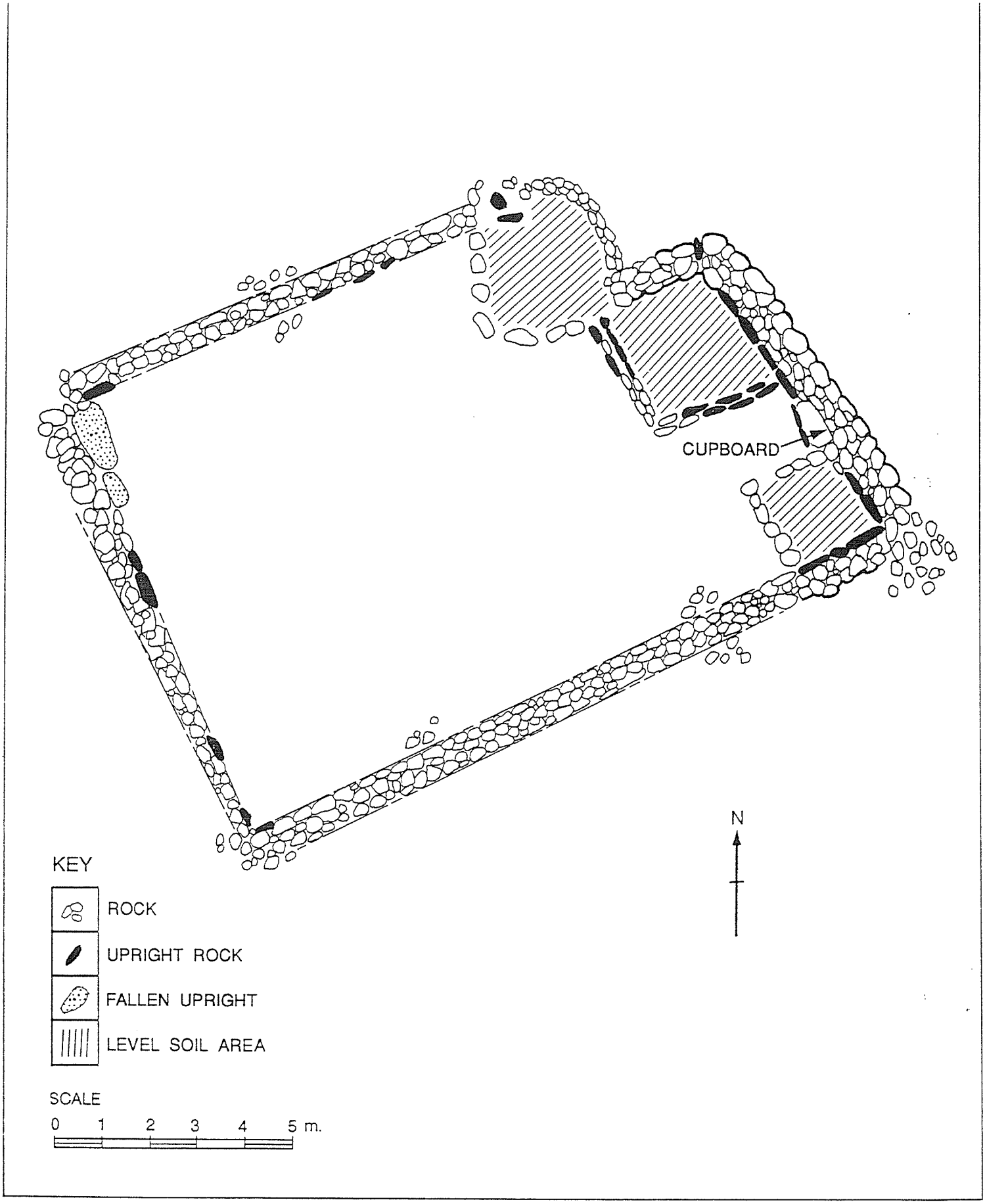


Fig. 6. SITE 50-Oa-B6-236 (STATE SITE 1719), Fe. B.

Site number: BPBM 237; State 1720; Temporary B-A-4

Location: survey area A; elevation c. 12.0 m (39.0 ft); Honouliuli

Topography: emerged reef

Vegetation: *haole koa*, *kiawe*, vines, herbs, young banyans, and morning glory

Dimensions: 13.0 m (148°) x 7.0 m (91.00 m^2)

Description: Possible habitation and agricultural features (2 features)

Feature A (agricultural?) circular platform or mound
Dimensions: 2.0 m (148°) x 2.0 m x 0.2 m high
Condition: poor-fair
To the south-southeast of this feature, within a 50 m radius, are many large mounds (1 to 2 m in diameter). Interspersed among the mounds are pockets of burnt limestone pebbles and cobbles.

Feature B (habitation?) enclosure
Dimensions: 5.0 m (148°) x 4.0 m x 0.6 m high
Condition: poor-fair
The wall's interior facing is formed by upright slabs. Floor is possibly slab-paved. Walls average 1 m in thickness. Enclosure is three-sided.

Significance: BPBM Site 237; State 1720 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and agriculture on the 'Ewa Plain.

Site number: BPBM 238; State 1721; Temporary B-A-5 (Fig. 7)

Location: survey area A; elevation c. 12.0 m (39.0 ft); Honouliuli

Topography: emerged reef

Vegetation: *haole koa*, *kiawe*, vines, and herbs

Dimensions: 76.0 m (241°) x 59.0 m (4484.00 m^2)

Description: habitation complex (5 features)

Feature A (habitation?) sinkhole
Dimensions: 2.75 m (100°) x 2.00 m x 1.30 m deep
Condition: good
Possible platform inside sinkhole. Fill is a mixture of soil and gravel and may be deep. Enclosure wall (Feature B) surrounds sinkhole. Parts of sinkhole seem blocked off, or collapsed.

Feature B (habitation) enclosure wall
Dimensions: 15.0 m (348°) long x 0.47 m high
Condition: fair
This meandering wall surrounds Feature A. Wall is stacked with frequent uprights.

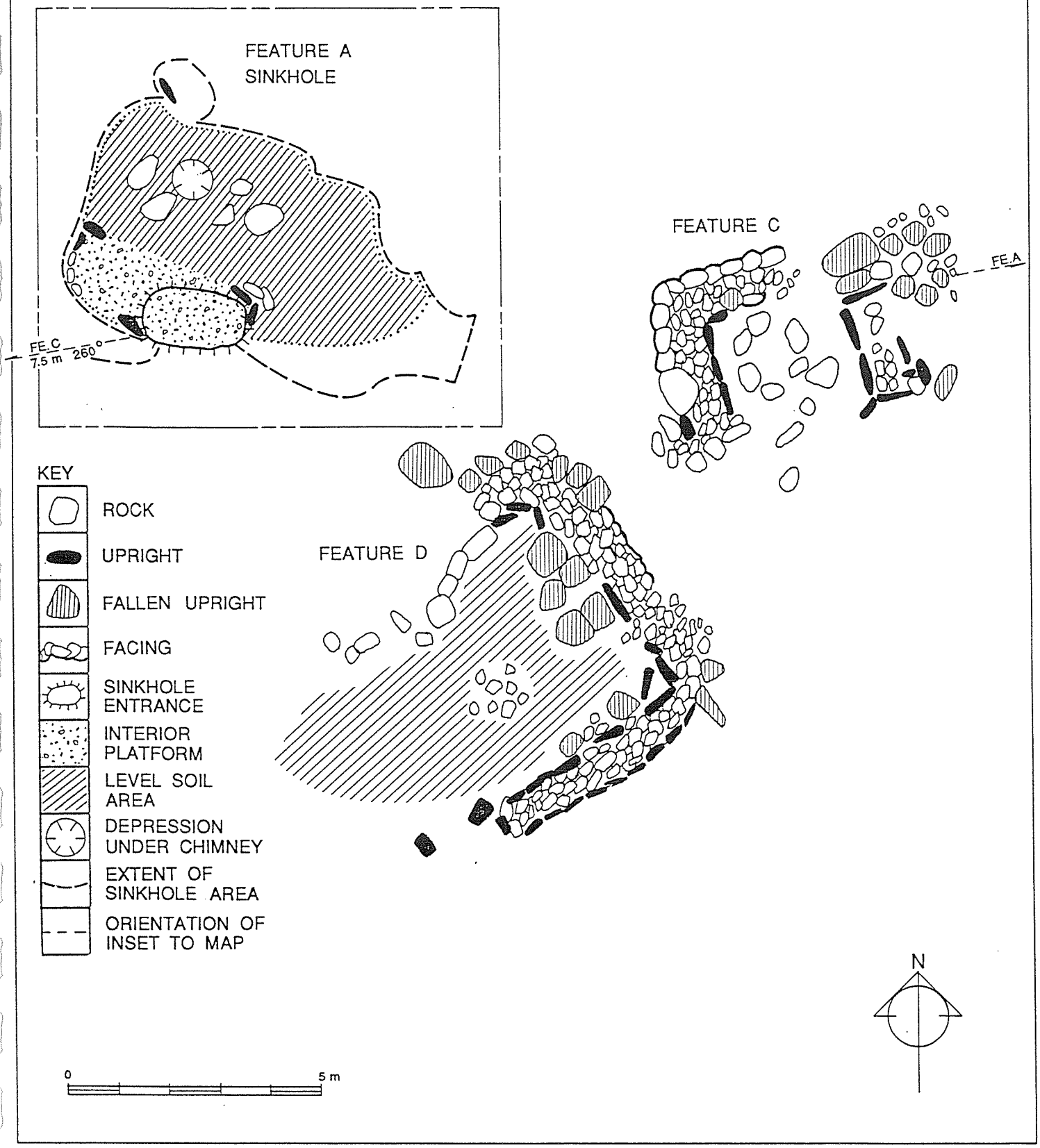


Fig. 7. SITE 50-Oa-B6-238 (STATE SITE 1721), Fe. A, C, AND D.

Feature C (habitation) L-shape
Dimensions: 7.25 m (314°) x 5.60 m x 0.68 m high
Condition: fair-good
Upright slab facing on interior and exterior. Upright slabs on interior are three times larger than exterior uprights. Interior surface is soil covered and generally free of rocks. Burned and fire-cracked limestone is present.

Feature D (habitation?) enclosure
Dimensions: 5.0 m (240°) x 3.7 m x 0.6 m high
Condition: fair
There is no wall on SE side. Constructed of large boulders with upright slabs in interior faces. Average wall thickness is 1.1 m, and average width is 1.1 m. Interior is mostly soil covered.

Feature E (?) feature remnant
Dimensions: 2.5 m (184°) x 1.4 m x 0.7 m high
Condition: poor
Feature may be either a cairn, a corner segment of an enclosure, or a wall remnant. Construction is stacked, irregular-shape, cobble-size, limestone, with upright slab facing on west side. Feature may be associated with filled sinkhole nearby.

Significance: BPBM Site 238; State 1721 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation of the 'Ewa Plain.

Site number: BPBM 239; State 1722; Temporary B-A-6
Location: survey area A; elevation c. 12.0 m (39.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, herbs
Dimensions: 125.0 m (170°) 50.0 m (6250.00 m^2)
Description: habitation complex (10 features)

Feature A (habitation) L-shape
Dimensions: 5.0 m (175°) x 4.0 m x 0.7 m high
Condition: poor
Feature is constructed around a sinkhole opening. Stacked walls with occasional upright-slab facing. Interior is depressed c. 51 cm below surrounding ground level. Sinkhole is not filled. Artifacts include historic lumber and recent beer bottles.

Feature B (habitation) enclosure
Dimensions: 5.0 m (33°) x 4.0 m x 0.5 m high
Condition: good
Large, square enclosure with cupboard and slab-lined entrance. Well constructed, with thick walls averaging 1.25 m in thickness. Interior is level soil with two *kiawe* trees growing in it. Exterior wall face is lower than interior wall, averaging 0.25 m.

Feature C (?) feature remnant
Dimensions: 3.0 m (177°) x 2.0 m x 0.6 m high
Condition: poor-fair
Collapsed remains of a structure with internal upright slab alignment. A modified outcrop is nearby to the west, and it is possible that the outcrop, Feature C, and Feature D were once all one feature (enclosure?).

Feature D (?) stacked slabs
Dimensions: 4.00 m (135°) x 2.00 m x 0.42 m high/deep
Condition: poor-fair
Upright slab facing on west side. Possible cupboard is present.

Feature E (agricultural) enclosure
Dimensions: 70.00 m (125°) x 21.0 m x 0.56 m high
Condition: fair-good
Wall construction varies, with both stacking and uprights. Feature was disturbed by military clearing in the area and military debris is present. Enclosed area contains mounds, slab piles, and feature remnants.

Feature F (burial? storage?) cairn remnant
Dimensions: 1.6 m x 1.6 m x 0.6 m high
Condition: poor
Exterior is faced with upright slabs. A number of small cairns are scattered throughout Site 239 that are smaller than those at other sites.

Feature G (burial? storage?) cairn
Dimensions: 1.5 m x 1.5 m x 0.3 m high
Condition: very poor
Collapsed cairn with facing of large upright slabs. Interior chamber is empty.

Feature H (?) elongate feature remnant
Dimensions: 2.90 m (341°) x 1.60 m x 0.45 m high
Condition: poor
Upright slabs occur at each end. Several small cairns occur in the vicinity.

Feature I (burial? agricultural?) cairn
Dimensions: 1.3 m x 1.3 m x 0.6 m high
Condition: fair
Small cairn with upright slab facing.

Feature J (burial? agricultural?) cairn
Dimensions: 1.3 m x 1.3 m x 0.5 m high
Condition: fair
Small cairn with small upright slab facing.

Significance: BPBM Site 239; State 1722 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of

indigenous occupation and use of the 'Ewa Plain, indigenous religious practices related to treatment of the dead, and indigenous physical anthropology.

Site number: BPBM 240; State 1723; Temporary B-A-7
Location: survey area A; elevation c. 12.0 m (39.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 92.0 m (78°) x 59.0 m (5428.00 m^2)
Description: habitation complex (8 features)

Feature A (habitation) C-shape
Dimensions: 5.0 m (162°) x 4.0 m x 0.82 m high
Condition: good
Incorporates an outcrop and large upright slabs in construction. Feature is surrounded by sinkholes, both modified and unmodified (Features B, C, D, E, F, H). Interior is level soil with an area of 2.0 m x 2.5 m.

Feature B (burial?) modified sinkhole
Dimensions: 1.75 m x 1.40 m x 1.85 m deep
Condition: good
Sinkhole contains an upright slab set in place along sink-shaft opening. Sinkhole has a possible bell-shape interior; interior not examined as shaft is too small for entry.

Feature C (burial) sinkhole
Dimensions: 1.70 m x 0.70 m x 1.85 m deep
Condition: fair
Sinkhole contains an infant or juvenile burial. Floor is level soil. It is possible that sinkhole was covered at one time, but is now collapsed. Interior is irregular and semi-bell-shaped.

Feature D (agricultural) modified (?) sinkhole
Dimensions: 1.73 m x 1.00 m x 1.27 m deep
Condition: good
Sink has a large ti plant growing from it. A vague but possible wall around the sinkhole is evidenced by a scatter of limestone slabs. Sinkhole interior is irregular in shape.

Feature E (burial) sinkhole
Dimensions: 1.27 m x 1.07 m x 3.00 m
Condition: fair
Two human long bones in sinkhole, and one unidentified piece of bone on surface adjacent to sinkhole. Interior is c. 2.0 x 3.0 m in size, and connects to another large sinkhole 3.0 m to SW, which contains burnt model toys, indicating disturbance by children.

Feature F (agricultural) modified(?) sinkhole
Dimensions: 1.00 m x 1.00 m x 1.52 m deep
Condition: poor

Possible modification consisting of an alignment on floor, but questionable. Floor is level soil, with bird bone and a mongoose skull on surface. This sinkhole connects to another nearby sinkhole via a narrow natural chamber.

Feature G (burial?) platform
Dimensions: 3.40 m (65°) x 3.00 m x 0.35 m high
Condition: fair
Constructed of slab and chunk material of consistent medium cobble size; no uprights, corners, or facings. Surface level. May be constructed over a filled sinkhole. Adjacent to the SE and NE is a bare, cleared area (bulldozed?), which borders this side of site area.

Feature H (habitation?) sinkhole
Dimensions: 1.6 m x 1.5 m x 2.7 m deep
Condition: good
Sink contains fish bone, bird bone, teeth, coral, ash, charcoal and a manuport. Possible recent trash pit.

Significance: BPBM Site 240; State 1732 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of utilization and settlement on the 'Ewa Plain, indigenous religious practices related to treatment of the dead, and indigenous physical anthropology.

Site number: BPBM 241; State 1724; Temporary B-A-8
Location: survey area A; elevation c. 9.0 m (30.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 92.0 m (239°) x 50.0 m (4600.00 m^2)
Description: habitation and agricultural complex (9 features)

Feature A (habitation) C-shape
Dimensions: 3.5 m x 3.5 m x 0.6 m high
Condition: poor
Constructed of large cobble-size limestone chunks and slabs. Large *kiawe* tree growing in wall. A possible cupboard is present in wall.

Feature B (habitation) C-shape
Dimensions: 2.80 m (70°) x 1.80 m x 0.38 m high
Condition: poor
Feature is mostly collapsed. Stacked wall construction, with walls averaging 0.75 m in width. Possible wall extension to east marked by a scatter of limestone chunks. Interior floor is level soil.

Feature C (habitation) enclosure wall
Dimensions: 3.10 m (100°) x 2.80 m x 0.51 m high
Condition: fair-good
Constructed with upright slab facing around interior. Interior is roughly circular with a diameter of 1.9 m. Possible fire-stained

hearth slab at NE corner, but slab is not well set in soil. Feature D enclosure wall is attached to this feature.

Feature D (agricultural) enclosure
Dimensions: 30.00 m (325°) x 0.75 m x 0.57 m high
Condition: good
Stacked wall construction with occasional upright slabs. Interior area is level soil, relatively free of surface debris.

Feature E (burial) sinkhole
Dimensions: 1.4 m x 0.9 m x 3.3 m deep
Condition: fair
Sinkhole contains a subadult cranium; no other bones were observed. Interior floor measures 4.5 m x 2.0 m, with enough overhang room to stand in. A nearby shallow sinkhole contained historic materials, such as tin, wine bottle, iron pot, and some rusty metal fragments.

Feature F (habitation) U-shape
Dimensions: 3.10 m (233°) x 2.30 m x 0.68 m high
Condition: excellent
Stacked and faced interior and exterior; no upright slabs used in construction. Ground surface in this area is irregular, with many sinkholes. Two sinkholes adjacent, one modified. Feature G, with midden and artifacts, is 22.0 m away.

Feature G (habitation) sinkhole
Dimensions: 2.60 m x 3.30 m
Condition: excellent
Sinkhole opens into a 3.0 m^2 chamber 0.85 m x 0.68 m x 0.65 m high/deep (entrance) with no modification on the floor, (2.60 m x 3.30 m). Deposit is at least 0.1 m deep, and contains fish and mammal bone, crustacea, shell midden, echinoderm, *kukui*, coral abrader, hammerstone, basalt flakes and a cobble, and a rusty can.

Feature H (?) alignment
Dimensions: 2.31 m (123°) x 0.80 m x 0.40 m high
Condition: very poor
Collapsed alignment of uprights. Four meters from west end of alignment is a midden scatter with burnt limestone and small basalt flakes. Alignment occurs in a natural low depression. A "coffee bean" basalt sinker was found next to alignment.

Feature I (habitation) enclosure
Dimensions: 7.0 m (320°) x 3.0 m x 0.5 m high
Condition: fair
Stacked wall construction with walls averaging 0.6 m thick. Midden observed on surface, including *Nerita* sp. and *Tellina* sp.

Significance: BPBM Site 241; State 1724 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain, indigenous religious

practices related to treatment of the dead, and indigenous physical anthropology.

Site number: BPBM 242; State 1725; Temporary B-A-9
Location: survey area A; elevation c. 9.0 m (30.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 159.0 m (78°) x 109.0 m (1.73 hectares)
Description: Large habitation complex (20 features). Most feature dimensions not taken due to the presence of military ordinance.

Feature A (burial?) platform or low terrace
Dimensions: 2.9 m (340°) x 2.7 m x 1.0 m high
Condition: fair
Enclosed terrace or platform with slab-paved upper surface. A second possible terrace adjoins to one side. Also adjoining the platform is a level, possibly paved area.

Feature B (boundary ?) enclosure
Dimensions: 12.0 m (265°) x 0.5 m
Condition: fair
Roughly-constructed wall, built of uprights and stacked slabs.

Feature C (ranch wall) wall
Condition: excellent
Well-constructed wall that parallels road and drainage canal in a *mauka-makai* orientation. Appears to be a very recent construction.

Feature D (?) sinkhole
Dimensions: c. 3.5 m x 3.5 m x 4.0 m deep
Condition: good
Large sinkhole with modern wooden ladder. Floor is a large heap of ceiling collapse and recent trash.

Feature E (boundary?) wall
Orientation: 240°
Condition: fair
Long boundary (?) wall with upright slabs. Construction varies. Meanders slightly.

Feature F (?) pavement
Dimensions: no measurements taken
Condition: fair
Large, level, paved(?) surface area (B wall is on SW downslope side).

Feature G wall remnant
Dimensions: 3.0 m (305°) x 0.8 m thick
Condition: poor
Located next to Feature A.

Feature H (burial?, agricultural?) cairn/mound?
Dimensions: none taken
Condition: poor
Cairn or mound remnant. Three or more in this area.

Feature I (habitation) enclosure
Dimensions: no measurements taken
Condition: fair
Large, walled, rectangular feature.

Feature J (burial?) cairn
Dimensions: 2.4 m x 2.4 m x 1.1 m high
Condition: good
Stacked cairn with uprights or high rectangular platform. An E.P. Co. soda bottle with a metal stopper was found on the surface c. 4.0 m from this feature.

Feature K (habitation?) platform
Dimensions: 6.5 m (255°) x 4.5 m x 0.7 m high
Condition: fair
Platform with associated collapsed wall. *Turbo* sp. shell midden associated with wall.

Feature L (boundary) wall
Dimensions: (355°) x 1.0 m thick
Condition: fair
Wall segment behind (upslope from) Feature K.

Feature M (burial?) cairn
Dimensions: 2.0 m x 2.0 m x 0.8 m high
Condition: fair
This faced feature is located to the west of Feature L.

Feature N (burial?) cairn
Dimensions: 2.0 m x 2.0 m x 0.6 m high/deep
Condition: fair
Located to the SW of Feature M.

Feature O (habitation) enclosure
Orientation (265°)
Condition: not recorded
Open rectangular enclosure. The NE corner is collapsed.

Feature P (burial?, agricultural?) cairn/mound
Dimensions: 2.0 m x 2.0 m x 0.4 m high/deep
Condition: fair
Cairn or mound. Similar to Feature M and Feature N.

Feature Q (burial?, agricultural?) cairn/mound
Dimensions: none taken
Condition: not recorded
Cairn or mound constructed on a bare outcrop.

Feature R (?) feature remnant
Orientation: (41°)
Condition: not recorded
Undefined feature with combination rubble and cairn remnants.

Feature S (burial?) platform
Dimensions: 2.0 m^2
Condition: fair
Raised platform adjacent to large modified outcrop, which has an old Noxema bottle on the surface.

Feature T (habitation) C-shape
Dimensions: none taken
Condition: poor
Questionable C-shape feature.

Significance: BPBM Site 242; State 1725 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous utilization and settlement of the 'Ewa Plain, indigenous religious practices related to treatment of the dead, and indigenous physical anthropology.

Site number: BPBM 243; State 1726; Temporary B-A-10
Location: survey area A; elevation c. 12.0 m (39.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, herbs, banyan, *wiliwili*, *'ilima*, and morning glory
Dimensions: 23.0 m (195°) x 18.0 m (414.00 m^2)
Description: platform, wall, and mound (3 features)

Feature A (burial?) platform
Dimensions: 3.00 m (186°) x 2.50 m x 1.12 m high
Condition: excellent
Large, well-constructed platform with facing and square corners. Interior appears slightly depressed, possibly due to presence of interior chamber. Feature is located on fairly level terrain, relatively isolated from other features. Strong possibility for burial.

Feature B (boundary?) wall
Dimensions: 3.20 m (225°) x 0.75 m x 0.50 m high
Condition: poor
Collapsed wall segment or short alignment. Stacked construction, oriented fairly straight, but irregular in width.

Feature C (burial?, agricultural?) cairn/mound
Dimensions: 1.62 m x 0.80 m x 0.78 m high
Condition: fair
Collapsed cairn or mound, with associated wall segment. A space of 0.40 m separates the wall and the cairn, and they do not appear to

have been connected, based on construction differences. Wall segment is stacked, and 2.60 m x 0.50 m x 0.64 m high.

Significance: BPBM Site 243; State 1726 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and agriculture on the 'Ewa Plain, indigenous religious practices related to treatment of the dead, and indigenous physical anthropology.

Site number: BPBM 244; State 1727; Temporary B-A-11
Location: survey area A; elevation c. 9.0 m (30.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 14.30 m (145°) x 6.50 m floor x 2.68 m deep (150.00 m^2)
Description: modified sinkhole (1 feature)

modified sinkhole (habitation)
Dimensions: 14.30 m (145°) x 6.50 m floor x 2.68 m deep
Condition: good
Very large cave with small internal platform beneath entry. Two cow skeletons and a variety of historic artifacts are present. Marine shell midden, burnt limestone, round tapa beater, and a possible gourd fragment are present. One piece of coral found. Cultural deposit is present.

Significance: BPBM Site 244; State 1727 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous and historic occupation and use of the 'Ewa Plain.

Site number: BPBM 245; State 1728; Temporary B-B-1
Location: survey area B; elevation c. 12.0 m (39.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, herbs, and sisal
Dimensions: 88.0 m (328°) x 0.8 m thick (704.00 m^2)
Description: wall (1 feature)

Wall (historic)
Dimensions: 88.00 m (328°) x 0.80 m x 1.25 m high
Condition: poor-good
Long, linear-stacked limestone wall. Constructed of boulders and some cobbles, with some upright slabs for foundation facing. Some sections well preserved, others disturbed. Probably associated with ranching or sisal production.

Significance: BPBM Site 245; State 1728 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is

likely to yield information important for an understanding of historic ranching and/or agricultural use of the 'Ewa Plain.

Site number: BPBM 246; State 1729; Temporary B-D-1
Location: survey area D; elevation c. 15.0 m (49.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, herbs, and banyan
Dimensions: 40.0 m (58°) x 10.0 m (400.00 m^2)
Description: sinkhole area

The largest sinkhole (c. 1.5 m deep) in this area contains bird bone, and midden. The area shows much disturbance from bulldozing, construction, and military use. Area is currently used as a dump. Area includes 4-5 sinkholes.

Significance: BPBM Site 246; State 1729 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain, and may potentially be of palaeontological significance.

Site number: BPBM 247; State 1730; Temporary B-E2-1
Location: survey area E2; elevation c. 2.0 m (7.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 176.0 m (348°) x 151 m (2.66 hectares)
Description: habitation complex (18 features)

Feature A (habitation) C-shape
Dimensions: 7.5 m (212°) x 4.0 m x 0.4 m high
Condition: poor
Low feature with no evidence of facing, although slabs are used in construction. An upright slab-lined trail occurs in disturbed area near feature. The area around the feature is disturbed, and shows evidence of bulldozing.

Feature B (habitation) enclosure
Dimensions: 2.8 m (84°) x 2.6 m x 0.4 m high
Condition: fair
Stacked construction with several very large slabs and boulders used. Interior measures 1.6 m x 1.1 m, and may have been faced. Soil surface within feature is level. Possible collapsed cupboard present.

Feature C (habitation?) C-shape
Dimensions: 3.8 m (69°) x 3.8 m x 0.4 m high
Condition: poor
Collapsed C-shape with cut *kiawe* logs and stumps surrounding; interior of feature has burned *kiawe* pieces, ash, and fire-cracked limestone fragments in it.

Feature D (habitation) enclosure
Dimensions: 7.5 m (343°) x 3.0 m x 0.5 m high
Condition: poor
Rectangular enclosure with stacked construction and some interior facing. Area to east of feature has been bulldozed.

Feature E (habitation) C-shape
Dimensions: 1.70 m x 1.70 m x 0.43 m high
Condition: poor
Large slabs and boulders used in construction. Interior is level and relatively clear of debris. Possible slight depression in interior.

Feature F (burial?) collapsed cairn
Dimensions: 2.60 m x 2.60 m x 0.53 m high
Condition: poor
Collapsed cairn with large coral slab base and small to medium cobble-size fill. A bulldozer pile occurs 6 m to west, and a historic dump pile is present 12.0 m SW.

Feature G (burial?, military?) pavement
Dimensions: 10.00 m (312°) x 4.00 m x 0.15 m high
Condition: fair
Paved area with an alignment of uprights on one side, prone slabs on the other, and an upright on the end. Unusual feature, possibly military or burial. Paved surface is packed tightly and fairly level.

Feature H (historic property wall?) core-filled wall
Dimensions: 32.50 m (222°) x 1.00 m x 0.35 m high
Condition: poor
Core-filled wall remnant, possible historic association. Historic trash on surface.

Feature I (habitation) C-shape remnant
Dimensions: 8.0 m (322°) x 4.0 m x 0.4 m high
Condition: poor
Collapsed C-shape located adjacent to an alignment. Area has historic debris on the surface.

Feature J (habitation?) C-shape
Dimensions: 3.55 m (22°) x 3.55 m x 0.45 m high
Condition: poor
Roughly-stacked, medium to large cobble-size limestone chunks, with no facings. This feature is adjacent to Feature K, and both are probably remnants of some larger feature.

Feature K (habitation?) L-shape
Dimensions: 3.6 m x 3.6 m x 0.4 m high
Condition: poor
Probably remnant of larger feature, along with Feature J.

Feature L (agricultural?) C-shape and pit
Dimensions: 1.78 m (332°) x 1.78 m x 0.47 m high
Condition: good

Small C-shape around a pit. Pit is 0.64 m in diameter with a c. 0.1 m soil deposit. Looks like a firepit, but no evidence of burning within. *Kiawe* cutting evidenced in this area.

Feature M (habitation?) modified sinkhole
Dimensions: 1.7 m x 1.5 m x 1.8 m deep
Condition: fair
Sinkhole is modified by a C-shape of stacked construction around entrance. Floor of sinkhole has soil deposit containing bird bone, and crab and fossil shell.

Feature N (burial?) cairn remnant
Dimensions: 2.75 m x 2.75 m x 1.00 m high
Condition: fair
Only basal portion of this feature remains. A large, fallen *kiawe* tree lies across it. Feature is constructed of large chunks and slabs. Bulldozer and tree cutting activity evidenced in area.

Feature O (burial?) paved platform
Dimensions: 5.5 m (22°) x 3.5 m x 0.4 m high
Condition: fair
Paved platform with wall remnant atop, and adjacent paved area to south. Platform surface is 3.0 m x 4.0 m. Wall remnant is in NE corner of platform, and seems to be built on the ground and not on the platform surface.

Feature P (boundary?) core-filled wall remnant
Dimensions: 3.0 m (65°) x 1.2 m x 0.5 m high
Condition: poor
Rusty can found on wall.

Feature Q (?) modified sinkhole
Dimensions: 3.0 m x 3.0 m x 0.4 m deep
Condition: very poor
Collapsed uprights around small (0.4 m diameter) sinkhole opening. Feature is located in a disturbed area of feature remnants. Sink may have been capped/covered, then disturbed.

Feature R (transportation) stone-lined trail
Dimensions: 10.0 m (90°) x 1.0 m x 0.6 m high
Condition: poor
Remnant of upright-slab-lined trail, 80.0 m at 60° from Feature A. Area is disturbed. Surface of trail has a thin soil cover.

Significance: BPBM Site 247; State 1730 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous and historic occupation and use of the 'Ewa Plain, indigenous religious practices related to treatment of the dead, and indigenous physical anthropology. Approximately one half of the features show evidence of historical disturbance, and the majority of all the features are poorly preserved.

Site number: BPBM 248; State 1731; Temporary B-E2-2
Location: survey area E2; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 126.0 m (347°) x 50.0 m (6300.00 m^2)
Description: habitation and burial complex(?) (5 features)

Feature A (habitation) enclosure
Dimensions: 3.0 m (290°) x 2.9 m x 0.5 m high
Condition: good
Core-filled wall construction with use of upright slab facing in interior. Exterior face is tumbled/scattered. Entry at SW corner. Floor is level soil.

Feature B (habitation) enclosure
Dimensions: 3.90 m (290°) x 3.50 m x 0.55 m high
Condition: poor
Stacked and core-filled walls with no uprights, tumbled inside and out. Floor is covered with rubble. A large *kiawe* tree is growing in the east wall, possibly where original entry was. The tree has caused much damage to this feature.

Feature C (burial?) collapsed cairn
Dimensions: 2.27 m (290°) x 2.27 m x 0.83 m high
Condition: poor
Collapsed cairn with stacked construction and two small upright slabs. A cut *kiawe* log with burn marks rests on top of the feature. Not as well constructed as Feature D.

Feature D (burial?) cairn
Dimensions: 1.99 m (176°) x 1.99 m x 1.10 m high
Condition: fair
Stacked construction using boulder-size chunks and slabs, no uprights. A large, fallen *kiawe* tree lies on top of it.

Feature E (historic firepit?) circular stone-lined pit
Dimensions: 1.9 m x 1.9 m x 0.4 m deep
Condition: fair
Circular alignment of medium to large chunks loosely set in ground. A large piece of burned *kiawe* is in pit. Pit floor/interior is soil with litter. A large *kiawe* log with burnt ends is partially under the alignment.

Significance: BPBM Site 248; State 1731 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain, indigenous religious practices related to treatment of the dead, and indigenous physical anthropology.

Site number: BPBM 249; State 1732; Temporary B-E2-3 (Figs. 8, 9, 10, and 11)
Location: survey area E2; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 260.0 m (245°) x 134.0 m (3.48 hectares)
Description: habitation complex (22 features)

Feature A (habitation) enclosure
Dimensions: 14.0 m (150°) x 8.0 m x 0.7 m high
Condition: good
Very large rectangular enclosure with two attached enclosures. Core-filled and stacked construction with good facing on both interior and exterior. Interior floors of all enclosures are level soil. The two small enclosures are more disturbed than the larger.

Feature B (habitation) enclosure
Dimensions: 2.70 m (82°) x 2.35 m x 0.40 m high
Condition: poor
Remnant of square enclosure with collapsed walls. Floor is level soil.

Feature C (burial?) collapsed cairn
Dimensions: 3.10 m (90°) x 3.10 m x 0.97 m high
Condition: fair
Very large cairn now collapsed. Faced with large slabs. Burned *kiawe* on ground nearby, and evidence of cutting/dozing in area. This is one of the largest cairns recorded at the Naval Air Station.

Feature D (burial?) cairn, with alignment
Dimensions: 2.24 m (315°) x 2.24 m x 1.07 m high
Condition: fair
Cairn is constructed with large upright-slab facing. An alignment/extension c. 1.5 m long extends from cairn. A poorly stacked, low wall occurs 1.8 m to SE of Feature D.

Feature E (burial?) cairn
Dimensions: 1.56 m (300°) x 1.56 m x 1.16 m high
Condition: fair-good
Upright-slab facing; core-filled with medium to large cobble-size limestone chunks. The upper, east portion of the cairn is partially collapsed.

Feature F (?) circular alignment
Dimensions: 2.06 m (295°) x 2.06 m x 0.50 m high
Condition: fair
Small circle of upright slabs with an interior diameter of 1.2 m. Interior is level, with one upright and several chunks set into place. This feature is similar to Feature I.

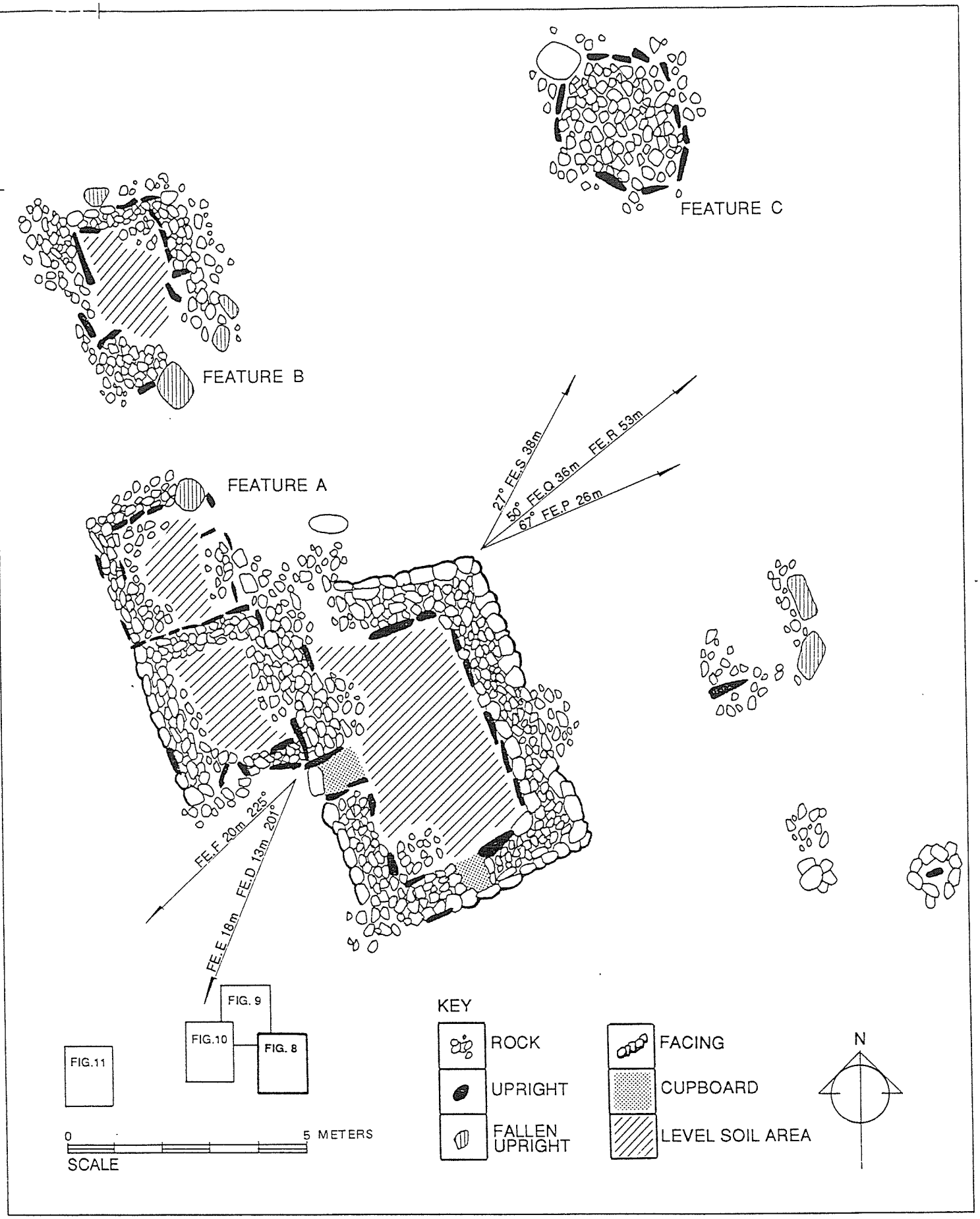


Fig. 8. SITE 50-Oa-B6-249 (STATE SITE 1732), Fe. A, B, AND C. Map 1 of 4.

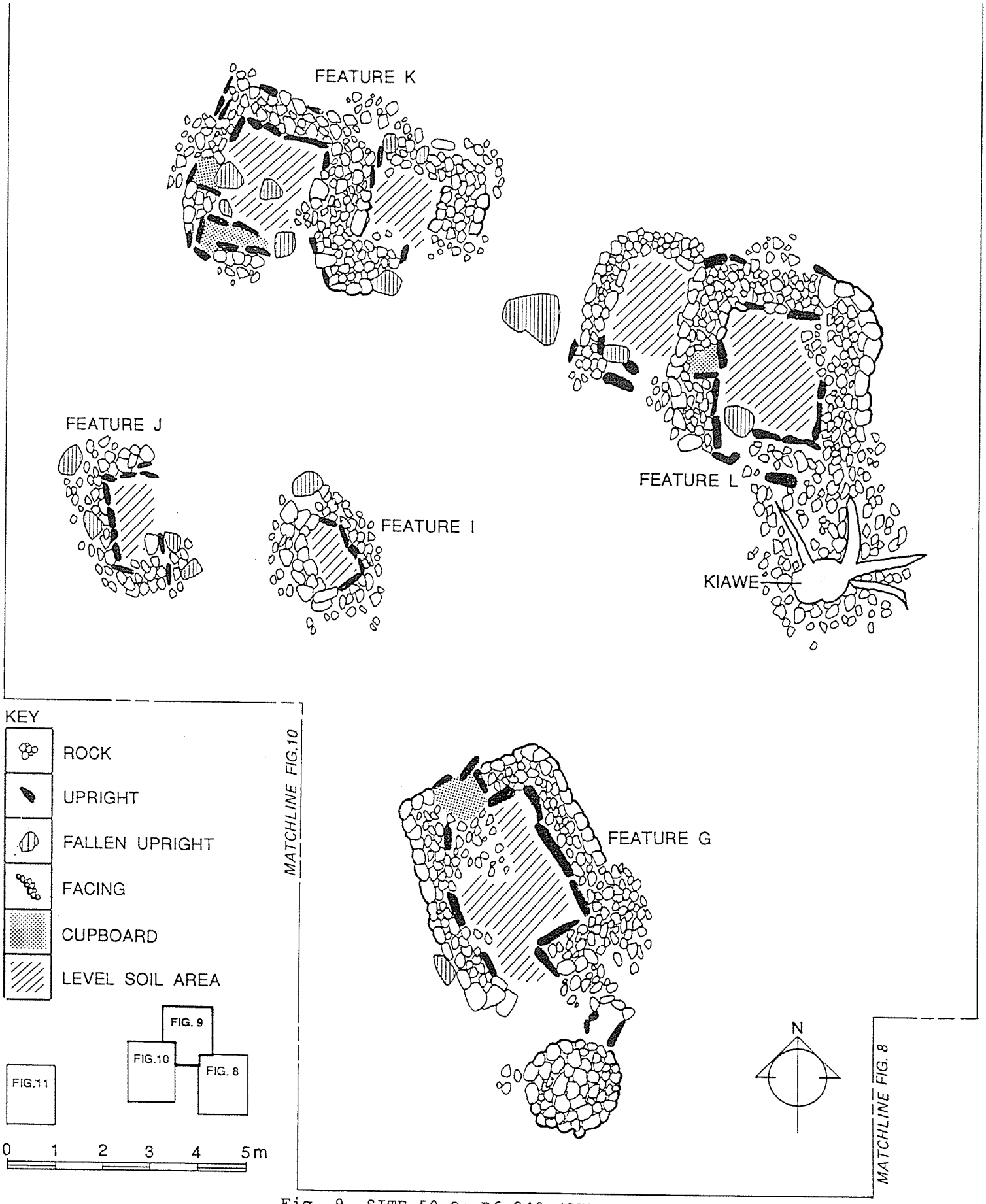


Fig. 9. SITE 50-Oa-B6-249 (STATE SITE 1732), Fe. G, I, K, AND L. Map 2 of 4.

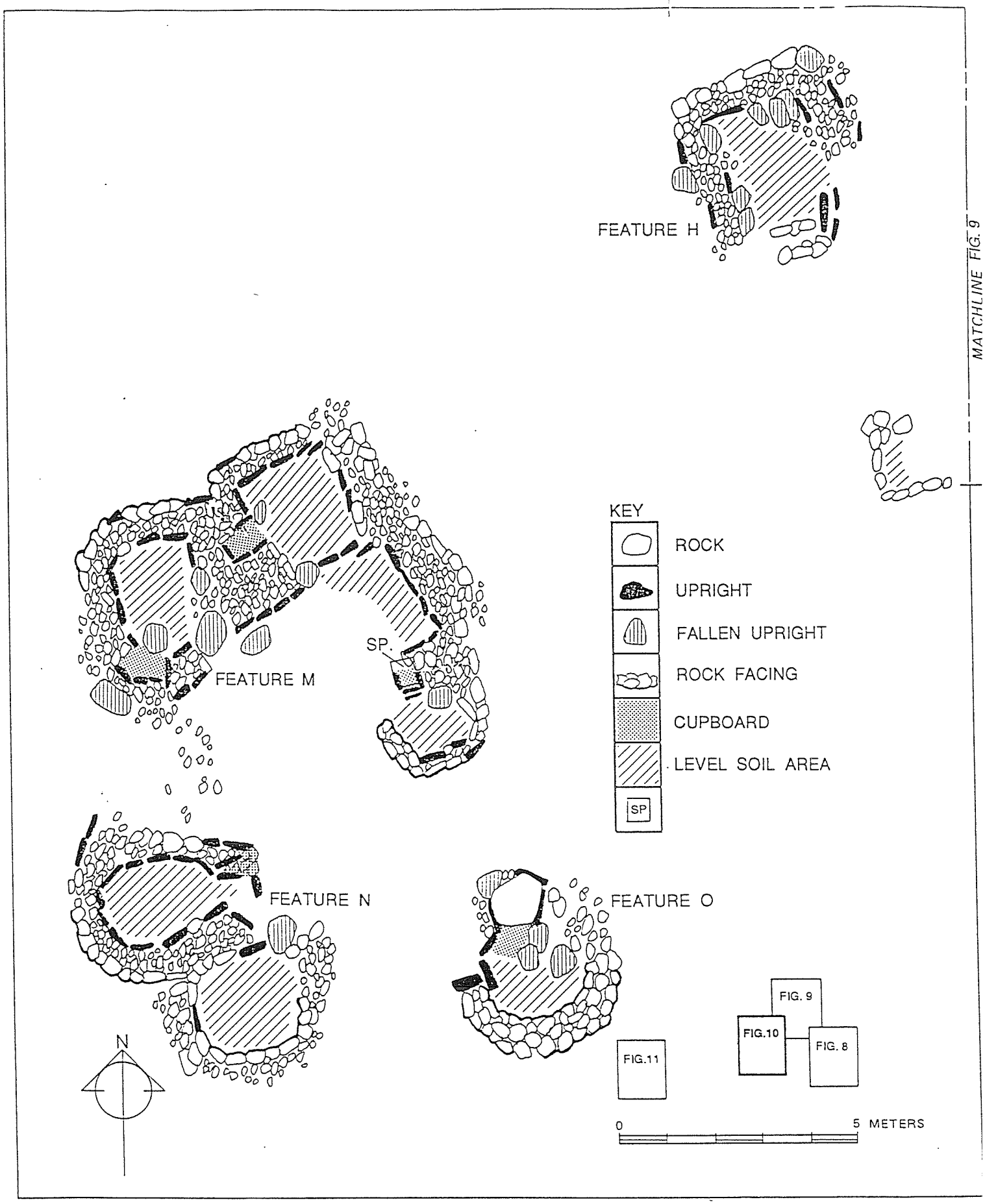


Fig. 10. SITE 50-Oa-B6-249 (STATE SITE 1732),
Fe. H, M, N, AND O. Map 3 of 4.

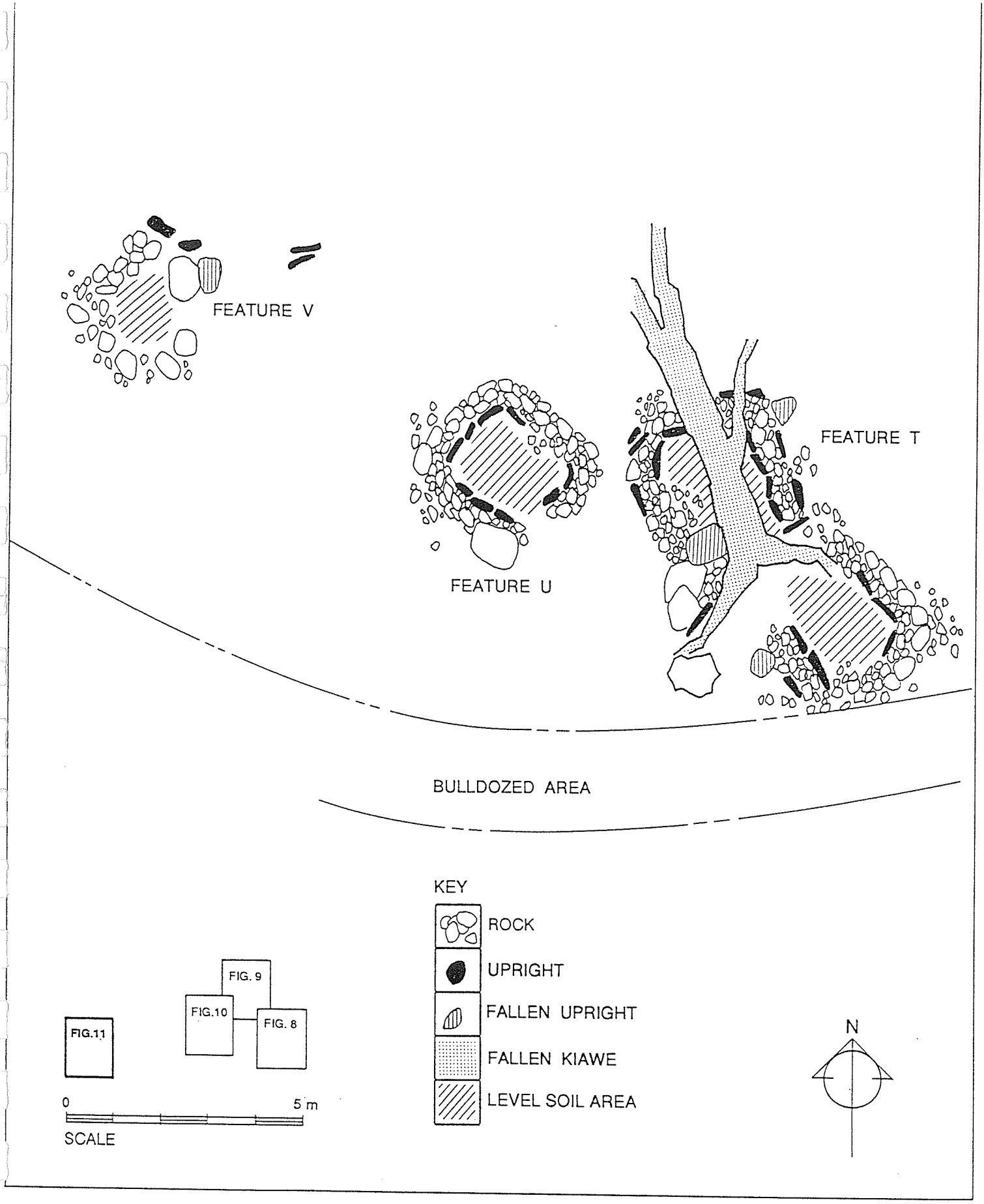


Fig. 11. SITE 50-Oa-B6-249 (STATE SITE 1732),
Fe. T, U, AND V. Map 4 of 4.

Feature G (habitation) enclosure, attached cairn
Dimensions: 4.50 m (340°) x 3.75 m x 0.58 m high
Condition: good
Elongate enclosure with collapsed cupboard and attached cairn with interior chamber. Cairn is 0.93 m high and intact. Enclosure is faced on interior with upright slabs, and has an entry. Bird and mongoose bone and a possible hammerstone observed on the surface nearby.

Feature H (habitation) enclosure
Dimensions: 3.20 m (349°) x 3.10 m x 0.42 m high
Condition: fair
Constructed with large upright-slab facing in interior; however, facings are falling in and collapsing. Stacked wall construction, some facing on exterior. Walls average 0.55 m in width. Floor is level soil.

Feature I (?) feature remnant
Dimensions: 2.72 m (57°) x 2.72 m x 0.20 m high
Condition: fair
Small slab-faced rectangular interior measuring 1.29 m x 0.81 m. Level soil floor surrounded by 10 small uprights. Could be a feature remnant, an agricultural feature, or a remnant cairn.

Feature J (habitation?) enclosure
Dimensions: 2.45 m (181°) x 2.00 m x 0.32 m high
Condition: fair
Constructed with slabs. Faced interior. Wall is core-filled with exterior sloping outward.

Feature K (habitation) enclosures
Dimensions: 6.50 m (97°) x 3.25 m x 0.60 m high
Condition: fair-good
Two contiguous enclosures. Both have upright slab-faced interiors. Larger enclosure has two cupboards in wall. Floors of both structures are level soil.

Feature L (habitation) enclosure
Dimensions: 7.00 m (185°) x 7.00 m x 0.52 m high
Condition: poor-fair
Two contiguous enclosures (one collapsed) with disturbed feature attached. Enclosure interior is faced with upright slabs. Disturbed (by uprooted *kiawe*) feature is a possible cairn remnant similar to Feature G. Floor of enclosure is level soil with a cupboard inside.

Feature M (habitation?) irregular enclosure
Dimensions: 8.0 m (78°) x 7.5 m x 0.6 m high/deep
Condition: good
Very large enclosure with four contiguous enclosures or compartments. Upright slabs provide facing on interior. Three cupboards, one of which was initially thought to be a hearth, were located. Midden is present.

Feature N (habitation) irregular enclosure
Dimensions: 4.90 m (131°) x 3.85 m x 0.60 m high
Condition: poor-fair
Two contiguous oval enclosures. Interiors are faced and floor is level soil. Cupboard in larger enclosure. Walls core filled.

Feature O (habitation) circular enclosure
Dimensions: 3.35 m (20°) x 3.35 m x 0.45 m high
Condition: good
Stacked and core-filled walls with interior and exterior facings of slabs. Northeast portion of wall is tumbled. Large, well-made cupboard in the wall. Floor is level soil, with some collapsed rubble.

Feature P (burial?, agricultural?) collapsed cairn
Dimensions: 1.92 m (190°) x 1.92 m x 0.28 m high
Condition: poor
Small foundation remnant of a collapsed cairn, with only a flat base outline remaining. An elongate rubble pile is present 2.75 m away.

Feature Q (habitation?) feature remnant
Dimensions: 2.40 m (105°) x 2.32 m x 0.40 m high
Condition: very poor
Feature may be a remnant of a square enclosure. Construction details were impossible to determine. A large up rooted *kiawe* tree has damaged this feature, and the surrounding area has been dozed and shows evidence of *kiawe* cutting.

Feature R (?) modified(?) sinkhole
Dimensions: 0.93 m (255°) x 0.65 m x 1.00 m deep
Condition: poor
Very vague semi-circular stacked wall around sinkhole. Several feature remnants that have been bulldozed, altered, or created by cutters are located nearby.

Feature S (?) modified(?) sinkhole
Dimensions: 1.0 m (70°) x 1.0 m x 1.4 m deep
Condition: poor
Possible modification of sinkhole entrance. Sinkhole is small, with a narrow passage (unexamined) that extends north. This area has been bulldozed, and shows evidence of tree cutting. A possible hammerstone was located in the sinkhole.

Feature T (habitation) enclosure
Dimensions: 6.0 m (329°) x 3.5 m x 0.4 m high
Condition: fair-good
Irregular, rectangular enclosure with stacked and core-filled walls. Faced on the interior with upright slabs. A fallen *kiawe* tree lies across the feature, and a large bulldozer berm occurs adjacent to the south.

Feature U (habitation) enclosure
Dimensions: 3.75 m x 3.75 m x 0.35 m high
Condition: fair
Foundation remnant of square enclosure. Core-fill construction, with exterior walls collapsed and interior walls faced. A bulldozer berm is nearby to the south of the feature.

Feature V (habitation?) feature remnant
Dimensions: 3.0 m (245°) x 2.0 m x 0.4 m high
Condition: very poor
Only stacked boulder outline remains. Recorded as possible enclosure.

Significance: BPBM Site 249; State 1732 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain, indigenous religious practices related to treatment of the dead, and indigenous physical anthropology.

Site number: BPBM 250; State 1733; Temporary B-E2-4
Location: survey area E2; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, herbs, *wiliwili*, and banyan
Dimensions: 118.0 m (256°) x 92.0 m (1.09 hectares)
Description: habitation complex (14 features)

Feature A (water source) modified sinkhole
Dimensions: 1.3 m (150°) x 0.8 m x 4.0 m deep
Condition: good
Deep sinkhole with water source. Modifications include an interior step and facing. Muddy bottom with c. 0.05 m of clear standing water.

Feature B (habitation?, agricultural?) modified sinkhole
Dimensions: 6.0 m (45°) x 6.0 m x 0.8 m high (wall)
Condition: good
Sinkhole with a C-shape around its entrance. Constructed of upright slabs. Depth of sinkhole approximately 2 m, with level soil floor. Large beehive in sinkhole prevented examination. Uprights in C-shape are large.

Feature C (?) sinkhole
Dimensions: 1.1 m x 1.0 m x 1.1 m deep
Condition: very poor
Questionable feature located in an area of disturbed uprights and displaced boulders. Floor of sinkhole is soil covered with rubble, suggesting it was formerly covered with slabs.

Feature D (habitation?) enclosure remnant
Dimensions: 3.50 m (225°) x 3.00 m x 0.45 m high
Condition: very poor
Collapsed feature, with walls averaging 0.7 m wide.

Feature E (habitation) modified sinkhole
Dimensions: 2.0 m (220°) x 2.0 m x 1.3 m deep
Condition: fair
Sinkhole with facing on interior wall. Facing is .07 m to 1.00 m wide, and extends from the floor of sinkhole to ground surface above. Floor of sinkhole is level soil.

Feature F (burial) collapsed cairn
Dimensions: 2.7 m (145°) x 2.7 m x 0.6 m high
Condition: poor-fair
Collapsed cairn with undisturbed interior chamber. Chamber measures 1.10 m x 0.66 m. Construction is large, flat, slab stacking with core-fill of various sizes.

Feature G (habitation) C-shape
Dimensions: 2.50 m (333°) x 2.45 m x 0.50 m high
Condition: poor
Core-filled wall of medium cobble-size chunks, with one large upright slab. Floor is level soil. Interior measures 1.8 m x 1.3 m.

Feature H (burial?) collapsed cairn
Dimensions: 1.95 m (345°) x 1.95 m x 0.35 m high
Condition: poor
Collapsed cairn with internal chamber. Constructed with very large upright slabs, forming a 1 m^2 chamber, now collapsed.

Feature I (burial?) collapsed cairn
Dimensions: 2.70 m (278°) x 1.35 m x 0.38 m high
Condition: poor
Irregular-shape cairn. Constructed of various sizes of material. Possible collapsed interior chamber.

Feature J (agricultural?) stone-lined pit
Dimensions: 1.85 m (129°) x 1.85 m x 0.36 m deep
Condition: poor
Crude rock-lined pit. Irregular in shape. Composed c. six large slabs. Interior measures 1.20 m x 0.85 m.

Feature K (?) wall
Dimensions: 3.50 m (292°) x 0.80 m x 0.35 m high
Condition: very poor
Crude low wall that may be part of some other feature, as surrounding area is disturbed and has many isolated uprights and alignments.

Feature L (?) feature remnant
Dimensions: 2.0 m (28°) x 1.5 m x 0.4 m high
Condition: very poor

Possible feature remnant that has an irregular outline. An unmodified sink is 3.0 m to 4.0 m away.

Feature M (burial?) cairn
Dimensions: 1.6 m x 1.4 m x 0.6 m high
Condition: fair
Features M and N lie at the edge of this site area.

Feature N (burial?) cairn
Dimensions: 1.8 m x 1.6 m x 0.6 m high/deep
Condition: fair
Features M and N lie at the edge of this site area.

Significance: BPBM Site 250; State 1733 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain, indigenous religious practices related to treatment of the dead, and indigenous physical anthropology.

Site number: BPBM 251; State 1734; Temporary B-E2-5 (Fig. 12)
Location: survey area E2; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 151.0 m (348°) x 151.0 m (2.28 hectares)
Description: large habitation and agricultural complex (43 features)

Feature A (habitation) enclosure
Dimensions: 4.00 m (240°) x 4.00 m x 0.33 m high
Condition: fair
Feature has low core-filled walls with interior facing of upright slabs. Walls are partially collapsed and average 0.65 m in width. Floor is level soil. An entryway is located in the SE wall.

Feature B (habitation) C-shape
Dimensions: 1.8 m (260°) x 1.8 m x 0.5 m high
Condition: poor
Constructed of stacked slabs. Walls average 0.44 m in thickness.

Feature C (agricultural?) modified sinkhole
Dimensions: 2.80 m (10°) x 2.80 m x 0.55 m high (wall)
Condition: good
Sinkhole, 0.85 m deep, with a C-shape built around it (above dimensions are C-shape). Wall is stacked and faced on the exterior with flat slabs. Floor of sinkhole covered with rubble.

Feature D (agricultural) modified sinkhole
Dimensions: 3.00 m (68°) x 2.70 m x 0.35 m high
Condition: poor
Sinkhole, 0.88 m deep, surrounded by a wall (above dimensions are for wall). Wall is constructed of stacked, medium cobble-size chunks,

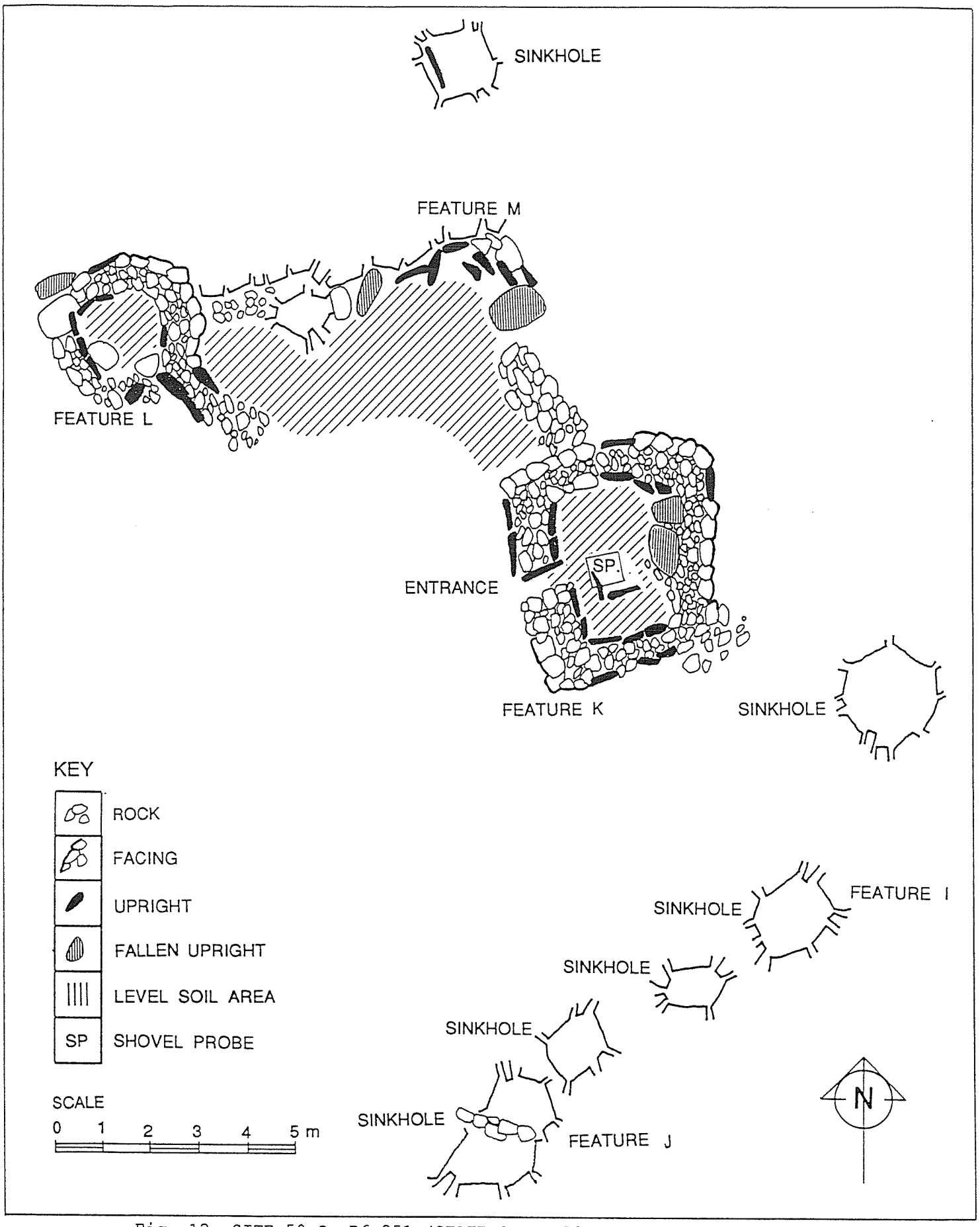


Fig. 12. SITE 50-Oa-B6-251 (STATE SITE 1734), Fe. J, K, L, and M.

built on bare limestone. Some soil in sinkhole, with young *haole koa* trees growing out of it. A possible cupboard is 0.75 m away.

Feature E (agricultural) modified sinkhole
Dimensions: 2.50 m (68°) x 2.00 m x 0.47 m high
Condition: fair
Sinkhole, 1.05 m deep, partially encircled by a stacked wall of large chunks and slabs (above dimensions are for wall). Sinkhole opening of 1.9 m x 1.0 m is slightly smaller than floor of sinkhole.

Feature F (burial?) modified sinkhole
Dimensions: 6.00 m (280°) x 6.00 m x 0.25 m high
Condition: fair
Paved area around a filled sinkhole (above dimensions are for paved area). Paving is irregular in shape, and constructed of boulders, cobbles, and an outcrop. The sinkhole is filled with boulders. Two smaller sinkholes also occur in the paving.

Feature G (?) feature remnant, paved
Dimensions: 2.40 m (152°) x 2.17 m x 0.25 m high
Condition: fair
Raised paved area in an L-shape, possibly a feature remnant. Material used in construction is smaller on the average than that used in Feature F, which is less than 2 m away. Pavement is compact and fairly level.

Feature H (burial?) collapsed cairn
Dimensions: 2.41 m (235°) x 2.41 m x 0.70 m high
Condition: poor
Poorly preserved cairn with no remaining intact facing.

Feature I (agricultural) sinkhole with ti
Dimensions: 1.7 m (56°) x 1.4 m x 1.6 m deep
Condition: ?
Deep sinkhole with ti plants growing in it. The sinkhole itself is unmodified, but is near a modified double sinkhole (Feature J) and an enclosure (Feature K). Floor of sinkhole is level soil.

Feature J (agricultural) modified sinkhole
Dimensions: 2.55 m (56°) x 1.50 m x 0.80 m deep
Condition: poor
Small sinkhole with a crude wall constructed of a boulder and irregular-shape, stacked chunks, which divide it in half. The floor of the sinkhole is level soil, with some rubble on the surface. Feature J is near (8 m at 10°) to Feature K.

Feature K (habitation) enclosure
Dimensions: 5.00 m (329°) x 4.50 m x 0.66 m high
Condition: good
Enclosure with what appears to be a slab-lined hearth and entry located in SW wall. Constructed of well-made, core-filled walls averaging 1.0 m in width. Interior is faced. Exterior is also faced, but not as completely as interior. Floor is very level soil.

Feature L (habitation) enclosure
Dimensions: 3.25 m (270°) x 2.80 m x 0.47 m high
Condition: fair
Constructed of stacked and core-filled walls using limestone chunks and slabs, with some upright-slab facing in the interior (collapsing inward). Walls average 0.7 m in width. Floor is level soil.

Feature M (agricultural) C-shape
Dimensions: 1.25 m (292°) x 1.25 m x 0.52 m high
Condition: poor
Eight very large slab-chunks forming a rough C-shape. Soil deposit (uncommon in this area) is present at open side of the feature, but probably doesn't exceed 0.2 m to 0.3 m in depth.

Feature N (agricultural?) feature remnant
Dimensions: 12.0 m (239°) x 12.0 m x 0.9 m high
Condition: very poor
High outcrop uplift area that appears to have much more surface rubble than would naturally occur. It's possible that this feature may have been an enclosure.

Feature O (agricultural) modified sinkhole
Dimensions: 1.00 m (170°) x 1.00 m x 0.91 m deep
Condition: ?
Sinkhole with an encircling wall that is 0.3 m high, 0.5 m wide, and 2.8 m in diameter. Wall has break/possible entry. Floor of sinkhole is level soil.

Feature P1 (agricultural) modified sinkhole
Dimensions: 1.3 m (136°) x 1.3 m x 0.7 m deep
Condition: fair
Sinkhole with discontinuous wall that is 0.55 m high, 0.40 m wide. Floor of sinkhole is irregular, with large *kiawe* growing in it.

Feature P2 (agricultural) modified sinkhole
Dimensions: 1.30 m (129°) x 1.30 m x 1.22 m deep
Condition: fair
Sinkhole encircled by wall, 0.5 m high, 0.5 m wide. Sinkhole has a level soil floor of irregular shape.

Feature Q (agricultural) modified sinkhole
Dimensions: 1.0 m (162°) x 1.0 m x 1.5 m deep
Condition: ?
Sinkhole partially surrounded by a low wall that is 0.53 m high, 0.52 m wide, and 1.80 m.

Feature R (agricultural) modified sinkhole
Dimensions: 2.1 m (115°) x 2.1 m x 1.4 m deep
Condition: fair
Sinkhole encircled by a 0.28 m high wall. Floor is level soil.

Feature S (agricultural) modified sinkhole
Dimensions: 1.25 m (15°) x 1.25 m x 2.00 m deep
Condition: fair
Sink with well-constructed encircling wall that is 0.5 m high and 0.4 m wide, and that consists of stacked and upright slabs. Wall completely encircles the sinkhole. Floor of sinkhole is level but lacks soil. Beehive present in sinkhole.

Feature T (habitation) C-shape
Dimensions: 2.50 m (349°) x 2.00 m x 0.46 m high
Condition: poor
This feature is the only non-sinkhole feature in this area of the site. The C-shape opens towards the west, and is constructed of a stacked boulder base with various sizes of limestone chunks on top. A large fallen *kiawe* has disturbed NW area.

Feature U (agricultural) modified sinkhole
Dimensions: 1.7 m (200°) x 1.7 m x 0.6 m deep
Condition: fair
Sink almost completely encircled by a low stacked wall that is constructed of small cobble-size material. Wall is 0.25 m high and 0.30 m wide. Floor is irregular.

Feature V (agricultural) modified sinkhole
Dimensions: 0.70 m (106°) x 0.70 m x 1.38 m deep
Condition: fair
Sink is completely encircled by a well-made wall of stacked construction that uses large cobble-size material. Wall is 0.55 m high, 0.30 m wide, and has a diameter at of 2.31 m. Floor of sinkhole is level, but lacks soil.

Feature W (agricultural) modified sinkhole
Dimensions: 1.4 m (218°) x 1.4 m x 0.6 m deep
Condition: fair
Shallow sinkhole with a rough wall around it. Wall is 0.27 m high and 0.40 m wide. Wall opens to the east. Floor of sinkhole is level soil. An overhang occurs to the west of opening, approximately 0.75 m in length.

Feature X (agricultural) modified sinkhole
Dimensions: 1.9 m (290°) x 1.9 m x 1.0 m deep
Condition: poor
Sinkhole with very poorly-preserved wall extending halfway around it. Wall is 0.33 m high and 0.43 m wide. Floor of sinkhole is level soil.

Feature Y (habitation?) enclosure remnant
Dimensions: 3.10 m (311°) x 3.10 m x 0.42 m high
Condition: poor
Enclosure remnant or C-shape, constructed of staked boulders and slabs. Walls are 0.54 m wide. Floor is level soil that is very shallow.

Feature Y1 (?) sinkhole
Dimensions: 1.2 m (305°) x 1.2 m x 0.9 m high
Condition: natural
Unmodified sinkhole, recorded because of presence of
association with other features. Soil deposit on floc

Feature Z (habitation) enclosure
Dimensions: 3.50 m (15°) x 3.50 m x 0.45 m high
Condition: good
Enclosure has an entrance in NW wall. Feature has stac
lacks upright-slab facing. Interior is exposed flat ou
little soil. Wall width is 0.6 m. This feature is bad
a fallen *kiawe* tree.

Feature AA (agricultural?) C-shape
Dimensions: 2.10 m (325°) x 1.00 m x 0.37 m high
Condition: poor
Small C-shape alignment that opens to SW. Feature is co
upright-slab alignments and some stacking.

Feature BB (habitation) enclosure
Dimensions: 6.50 m (325°) x 3.50 m x 0.65 m high
Condition: very good
Feature is well constructed with stacked and faced walls t
0.65 m wide. Interior is level soil, and free of rubble.
wall segment to the SE forms a 1.2 m diameter enclosure, w
collapsed walls and level floor.

Feature CC (agricultural) modified sinkhole
Dimensions: 2.10 m (40°) x 2.10 m x 1.17 m deep
Condition: poor
Sinkhole partially surrounded by a discontinuous, low, stac
that is 0.30 m high and 0.35 m wide. Floor of sinkhole is l
with some rubble.

Feature DD (habitation) C-shaped remnant
Dimensions: 4.00 m (280°) x 3.50 m x 0.56 m high
Condition: poor
Possible C-shape remnant that opens toward the south. The no
wall segment is best preserved. Interior is level, with very
soil.

Feature EE (habitation) C-shape
Dimensions: 3.00 m (224°) x 2.00 m x 0.04 m high
Condition: poor
Low and irregular wall that averages 0.3 m to 0.6 m in width.
outcrop is used to form SE side. Oval-shape interior with leve
Possible filled-in sinkhole 1.0 m to N. Area to NW and SW is r
covered with scattered outcrops and low mounds.

Feature FF (habitation) C-shape remnant
Dimensions: 4.0 m (224°) x 3.2 m x 0.6 m high
Condition: poor

Feature OO (burial? agricultural?) cairn
Dimensions: 1.7 m x 1.3 m x 0.5 m high
Condition: fair
Structure has stacked construction with some remnants of ou

Significance: BPBM Site 251; State 1734 appears to qualify for nom the National Register of Historic Places. The site has yie likely to yield information important for an understanding c indigenous utilization and settlement of the 'Ewa Plain, inc religious practices related to treatment of the dead, and in physical anthropology.

Site number: BPBM 252; State 1735; Temporary B-E2-6
Location: survey area E2; elevation c. 3.0 m (10.0 ft); Honouliul
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, herbs, *wiliwili*, banyan, and t
Dimensions: 176.0 m (251°) x 109.0 m (1.92 hectares)
Description: large habitation complex (25 features)

Feature A (habitation) enclosure
Dimensions: 6.0 m (352°) x 5.5 m x 0.6 m high
Condition: excellent
Well-constructed feature with an interior facing of boulders, exterior facing of cobbles and boulders. Walls are core-fille There is a slab-lined entrance into the soil-covered interior.

Feature B (?) alignment or wall remnant?
Dimensions: 7.0 m (265°) x 0.5 m x 0.5 m high
Condition: poor
Feature is an isolated alignment or wall remnant.

Feature C (habitation) C-shape, double
Dimensions: 7.0 m (323°) x 6.0 m x 0.7 m high
Condition: fair
Two C-shapes with a common wall. The interior walls are faced w upright slabs. Walls are stacked limestone with two cupboards (collapsed). Interior is soil covered with scattered rubble. To a raised area with a modified depression.

Feature D (habitation) C-shape
Dimensions: 2.25 m x 2.00 m x 0.40 m high
Condition: poor
Small C-shape with low, stacked, poorly-preserved walls. Walls average 0.6 m thick.

Feature E (agricultural) modified sinkhole
Dimensions: 2.0 m x 2.0 m x 0.7 m deep
Condition: fair
Feature includes a low wall/alignment around a bowl-shape sinkhole Wall consists of five boulders with small to medium cobble-size st

Feature M (agricultural?) modified (?) sinkhole
Dimensions: 0.8 m x 0.6 m x 1.4 m deep
Condition: poor
Very rough, low wall surrounds sinkhole.

Feature N (habitation) C-shape
Dimensions: 4.00 m (81°) x 3.50 m x 0.35 m high
Condition: poor
Feature has stacked wall construction with some upright slabs in the interior faces. Floor is soil, but not level. Walls are tumbled by uplift from roots of a nearby *kiawe* tree.

Feature O (transportation) trail
Dimensions: none taken
Condition: ?
Trail extends between Feature A and Feature J.

Feature P (agricultural?) stone-lined pit
Dimensions: 4.15 m x 4.15 m x 0.38 m deep
Condition: poor
Large limestone chunks, slabs, and some uprights form an incomplete circle around the depression. No evidence of burning. One banyan and five small *haole koa* are growing in it.

Feature Q (?) feature remnant
Dimensions: 2.40 m (30°) x 2.30 m x 0.38 m high
Condition: poor
Stacked limestone on a raised outcrop. Many sinkholes in this area, and very little soil.

Feature R (boundary) wall
Dimensions: 48.00 m (30°) x 0.50 m x 0.68 m high
Condition: fair
Long meandering wall attached to Feature T. Wall is constructed of stacked chunks and occasional uprights across bare outcrops and soil. Young ti plants grow in the vicinity.

Feature S (habitation) C-shape
Dimensions: 2.50 m x 2.30 m x 0.58 m high
Condition: fair
Small C-shape that opens to the west. Stacked walls are composed of consistent, medium cobble-size material, with a faced section of interior (no uprights used). A very large outcrop boulder is located at the opening (0.38 m high). Floor is level soil.

Feature T (habitation) enclosure
Dimensions: 4.1 m (335°) x 4.0 m x 0.7 m high
Condition: fair
Enclosure is attached to Feature R, and has stacked walls of large cobble- to small boulder-size material. Interior is faced with slabs. Floor is soil covered, and slightly depressed in middle. Fallen *kiawe* trees lie on feature. Structure has a slab-faced entry.

Feature U (burial?) platform remnant
Dimensions: 2.80 m (357°) x 2.80 m x 0.45 m high
Condition: poor
Structure is roughly circular in outline, and is located within Feature R enclosure wall.

Feature V (habitation?) U-shape
Dimensions: 2.00 m (315°) x 1.55 m x 0.58 m high
Condition: poor
Constructed of stacked limestone of various sizes, with no uprights or slabs. Interior is level soil. Back portion of feature is disturbed. Located within Feature R enclosure wall.

Feature W (water sources?) modified sinkhole
Dimensions: 2.8 m (336°) x 2.5 m x 0.9-3.5 m deep
Condition: ?
Bowl-shape sink averaging 0.9 m deep, with a shaft 3.5 m deep at bottom. A stacked wall, 0.30 m high, partially encircles it.

Feature X (habitation) C-shape
Dimensions: 1.40 m x 1.20 m x 0.33 m high
Condition: poor
Feature has low, stacked walls with rubble scattered on top and spreading to the sides. No uprights, no slabs, and no facing. Walls average 0.75 m wide. Interior is level soil. Located within Feature R enclosure wall.

Feature Y (?) feature remnant
Dimensions: 6.0 m (220°) x 5.0 m x 0.5 m high
Condition: poor
Original configuration is not discernible; short wall segment and low mound are all that remain. Feature is located within Feature R enclosure wall.

Significance: BPBM Site 252; State 1735 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain, indigenous agriculture on the 'Ewa Plain, indigenous religious practices related to treatment of the dead, and indigenous physical anthropology.

Site number: BPBM 253; State 1736; Temporary B-E2-7
Location: survey area E2; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, herbs, and *wiliwili*
Dimensions: 185.0 m (251°) x 109.0 m (2.02 hectares)
Description: large habitation complex (40 features)

Feature A (habitation) enclosure
Dimensions: 3.40 m (190°) x 2.80 m x 0.35 m high
Condition: fair

Feature A (habitation) enclosure
Dimensions: 3.40 m (190°) x 2.80 m x 0.35 m high
Condition: fair
Walls are constructed of stacked small to medium cobblesize stones. Interior is faced with one upright slab; exterior faces are collapsing. Floor is level soil, with possible ash stain. A pile of stones 1.0 m in diameter lies just outside entrance.

Feature B (habitation) enclosure
Dimensions: 3.50 m x 3.50 m x 0.72 m high
Condition: fair
Walls are narrow core-filled with stacked facings. Upright-slab facing occurs only on the interior faces. One collapsed cupboard is present. Floor is level soil. A 1.8 m deep sink is adjacent, which was possibly slab covered at one time. Possible posthole in wall.

Feature C (habitation) enclosure wall
Dimensions: 3.30 m (314°) x 2.90 m x 0.42 m high
Condition: fair-good
Constructed of neatly stacked, medium cobble-size material. Floor is level soil, with much more soil in the interior of the structure than the exterior. Collapsed cupboard is present. A piece of burned wood or corm was found on surface, but not collected.

Feature D (habitation) enclosure
Dimensions: 4.00 m (153°) x 3.00 m x 0.47 m high
Condition: fair
Feature is constructed of stacked boulders and slabs, with no facing. Floor is level and covered by a thin layer of soil. A collapsed cupboard is present. A fallen *kiawe* tree has damaged this feature, which is adjacent to a modified sinkhole (walled).

Feature E (habitation) enclosure
Dimensions: 2.25 m x 2.25 m x 0.50 m high
Condition: poor
Walls are stacked, cobble-size limestone, and the interior faces were formerly faced with slabs. Floor is level soil. Feature E occurs in a slight depression, and adjacent to the modified sinkhole near Feature D.

Feature F (agricultural?) modified sinkhole
Dimensions: 4.0 m x 4.0 m x 0.6 m high (wall)
Condition: poor
Two sinkholes are enclosed by a low wall and alignment of slabs and chunks of limestone. Sinkholes are 0.7 m and 0.9 m deep. Wall is disturbed at various points. Sinkholes have soil floors.

Feature G (habitation?) enclosure, paved
Dimensions: 3.00 m x 3.00 m x 0.35 m high
Condition: fair
Walls are stacked and incorporate some boulder-size material. Interior is level, and paved with consistently fist-size chunks of limestone. This paved enclosure is unique in the area. Feature is

located adjacent to a small sinkhole 1.5 m deep. Feature I may have been part of this feature.

Feature H (habitation) C-shape
Dimensions: 3.00 m x 3.00 m x 0.42 m high
Condition: fair
Walls are stacked with occasional core-filling of small to medium size cobbles. Interior is faced with upright slabs. Floor is level soil with some collapse from walls on it. Feature is associated with Features G and I.

Feature I (?) feature remnant
Dimensions: 2.0 m (145°) x 1.5 m x 0.2 m high
Condition: poor
All that remains of this feature is an irregular rockpile, possibly a collapsed wall segment. May have once been a component or wall section of Feature G, as it is adjacent to it. Feature is also associated with Feature H.

Feature J (enclosure?) feature remnant
Dimensions: 5.0 m (276°) x 3.0 m
Condition: very poor
This feature is severely disturbed by trees growing within it. In outline it appears to be the remnant of a rectangular enclosure. The feature is adjacent to a sinkhole (1.4 m deep).

Feature K (habitation) C-shape remnant
Dimensions: 1.6 m x 1.6 m x 0.5 m high
Condition: very poor
Low stacked walls of medium cobble-size material atop a C-shape outcrop. No uprights or slabs present. Floor is level soil, with some subsurface rocks.

Feature L (agricultural) modified sinkhole
Dimensions: 3.0 m (104°) x 2.0 m x 0.4 m deep
Condition: fair
Sink has ti growing in it, and an L-shape wall around part of exterior (wall is 0.6 m high). Wall is constructed of stacked slabs. Sinkhole diameter is 1.5 m and it is partially filled with slabs and chunks.

Feature M (?) feature remnant
Dimensions: 3.00 m (365°) x 2.00 m x 0.35 m high
Condition: poor
A very large *haole koa* tree is growing in the middle of this feature, and has disturbed it. Feature appears to be an enclosure, possibly a C-shape. The interior floor may have been paved.

Feature N (enclosure?) feature remnant
Dimensions: 7.0 m (299°) x 4.0 m x 0.3 m high
Condition: very poor
A large *kiawe* tree is growing in one corner of this very disturbed feature which may have been an enclosure.

Feature O (?) feature remnant
Dimensions: 6.0 m (180°) x 3.0 m x 0.9 m high
Condition: very poor
Feature is a V-shape outline created by large upright slabs. Feature is badly collapsed. A possible cairn foundation is attached, with scattered rubble around it. A possible collapsed cupboard is present within the feature.

Feature P (?) modified sinkhole
Dimensions: 1.25 m x 1.25 m x 1.20 m deep
Condition: good
Slab-covered sink with a circular wall around it, attached to Feature Q. The encircling wall is 3.5 m in diameter, 0.5 m wide, and 0.4 m high. Construction is stacked with some uprights. Floor of sink is dark-brown, level soil.

Feature Q (habitation) C-shape
Dimensions: 2.00 m (243°) x 1.80 m x 0.36 m high
Condition: not recorded
Feature is formed by an end-to-end boulder alignment that is attached to Feature P. Floor is level soil with rocks. Wall is 0.25 m in width.

Feature R (?) mound
Dimensions: 3.0 m (308°) x 2.0 m
Condition: poor
Irregular mound located on an outcrop, possibly covering a sinkhole or cavity. An unmodified sink, 1.7 m deep and 3.0 m to NW, contains bird bone.

Feature S (habitation?) enclosure remnant
Dimensions: 4.0 m (161°) x 2.5 m x 0.3 m high
Condition: poor
A very large, fallen *kiawe* tree disturbs this feature. It appears to be an enclosure constructed of stacked slabs with some upright slab facing. Two filled sinkholess are present less than 3.0 m to NE of this feature.

Feature T (habitation) enclosure
Dimensions: 4.6 m (250°) x 3.3 m x 0.4 m high
Condition: poor
Incomplete rectangular enclosure adjacent to a filled cavity with an irregular-shape platform constructed over it. Walls are stacked and floor is soil covered. Two basalt pebbles and unknown seed are present in a cavity/cupboard in the wall.

Feature U (habitation) U-shape
Dimensions: 2.0 m (335°) x 1.5 m x 0.5 m high
Condition: very poor
Feature has stacked walls of irregular-shape material with no uprights or slabs. Walls average 0.6 m in width. Floor is covered with rubble on level soil. This feature is closely associated with Feature T, of which it may be a part.

Feature V (agricultural) modified sinkhole
Dimensions: 2.5 m x 2.5 m x 0.5 m high (wall)
Condition: poor
Sinkhole has a roughly stacked wall built on an outcrop around it. Sinkhole is 0.6 m deep, and has a floor of 1.5 m^2 of level soil, with young *haole koa* growing in it.

Feature W (agricultural) modified sinkhole
Dimensions: 2.00 m (134°) x 0.70 m x 0.60 m high (wall)
Condition: poor
A low wall partially surrounds this sinkhole. The sinkhole is disturbed by tree roots. Its possible that the sink was formerly covered.

Feature X (agricultural) modified sinkhole
Dimensions: 2.0 m (155°) x 1.0 m x 0.4 m deep
Condition: poor
An L-shape wall next to a filled-in sinkhole that is 2.10 m in diameter. The longest wall segment is stacked and 0.50 m wide. The short segment is formed by one very large upright slab.

Feature Y (agricultural) modified sinkhole
Dimensions: 1.5 m x 0.4 m x 1.2 m deep
Condition: poor
A short wall segment 0.3 m high partially surrounds the sinkhole.

Feature Z (garden area?) enclosure wall
Dimensions: 70.00 m x 0.50 m x 0.75 m high
Condition: fair-good
Long, meandering, stacked wall constructed of medium to large cobble-size material and large uprights. Wall forms a half circle, enclosing an area of *wiliwili* trees and vague mounds, with Features AA, BB, and CC within.

Feature AA (?) modified sinkhole
Dimensions: 2.3 m x 1.0 m x 1.0 m
Condition: good
Deep sink covered by slabs. An adjacent area, 0.75 m x 0.50 m, contains four uprights, function unknown. This feature is located within the Feature Z enclosure wall.

Feature BB (storage?) cairn?
Dimensions: 2.25 m (339°) x 1.50 m x 0.40 m high
Condition: poor
Cairn or mound that occurs adjacent to one end of Feature Z, and contains a small collapsed cavity/cupboard. The feature is irregular in shape, and made of stacked limestone chunks. A large, fallen tree lies on this feature.

Feature CC (boundary) wall foundation remnant
Dimensions: 25.0 m (59°) x 0.6 m
Condition: poor

Foundation remnant of a wall. It has an L-shape corner at one end, and is tumbled and scattered. It is located within the Feature Z enclosure wall.

Feature DD (garden area) enclosure
Dimensions: 27.0 m x 17.0 m x 0.5 m high
Condition: poor-fair
Large, irregular enclosure wall that averages 0.8 m wide and is constructed like Feature Z, but with fewer up-rights. It encloses an area of soil and outcrops with many mounds. A very large cairn, possibly a burial, is adjacent.

Feature EE (habitation) enclosure
Dimensions: 6.00 m (205°) x 4.00 m x 0.45 m high
Condition: fair
Enclosure constructed of stacked and core-filled walls. The interior is faced with upright slabs. Floor is level soil. There is an irregular, rectangular feature with two subdivisions or rooms, and a low semi-circular wall attached to east. Feature EE is attached to Feature DD.

Feature FF (burial?) cairn
Dimensions: 2.9 m x 2.5 m x 0.7 m high
Condition: very good
Well-preserved feature constructed of stacked slabs that form the outer facing. The inner fill is medium cobble-size slabs. The outer wall was apparently constructed first, then filled in.

Feature GG (burial?) cairn remnant
Dimensions: 2.1 m x 2.1 m x 0.3 m high
Condition: poor
All that remain of this feature are a circular outline of boulders and a low pile of rubble.

Feature HH (agricultural) elongate mound
Dimensions: 3.6 m (312°) x 0.9 m x 0.5 m high
Condition: poor
Located inside Feature Z, and different from the other mounds because it is more neatly stacked, and consistently incorporates medium cobble-size material.

Feature II (?) feature remnant
Dimensions: 4.50 m^2
Condition: very poor
Feature forms a rough V-shape.

Feature JJ (habitation) C-shape
Dimensions: 5.0 m x 2.0 m x 0.6 m high
Condition: fair
C-shape attached to Feature DD. Constructed of very flat slabs, and contains a slab-lined cupboard. Interior floors of both the cup-board and the C-shape are level soil.

Feature KK (habitation) C-shape remnant
Dimensions: 2.60 m x 2.60 m x 0.45 m high
Condition: poor
Structure has stacked walls that are partially collapsed. The interior is partially faced with three upright slabs. Floor is level soil. Four tall, fallen uprights, 3.5 m away, may have once been a part of this feature. Cut *kiawe* logs are present in the area.

Feature LL (trashpit?) modified sinkhole
Dimensions: 0.8 m x 0.4 m (entrance) x 1.9 m deep
Condition: fair
Sinkhole contains midden and may have been covered with limestone slabs. The floor of the sinkhole is 1.0 m^2, and is covered with soil. *Nerita*, cowrie, *Brachidontis*, and fragmented bird bone are present on the floor. Three cut *kiawe* logs lie on top of feature.

Feature MM (?) modified sinkhole
Dimensions: 5.8 m (349°) x 3.5 m x 0.4 m high (wall)
Condition: good
Slab-covered sinkhole (1.1 m deep) surrounded by a C-shape of stacked construction, with an attached arrangement of four upright slabs (0.1 m high) forming another C-shape. The stacked C-shape is 0.4 m high. The C-shape and sinkhole have soil floors.

Feature NN (agricultural?) modified sinkhole
Dimensions: 2.00 m x 2.00 m x 0.38 m high (wall)
Condition: poor
Shallow sink (1.0 m deep) surrounded by a crude C-shape wall constructed on bare bedrock. The sinkhole is 1.3 m x 0.9 m in size and has an irregular floor.

Significance: BPBM Site 253; State 1736 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain.

Site number: BPBM 254; State 1737; Temporary B-E2-8 (Figs. 13 and 14)
Location: survey area E2; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 134.0 m (339°) x 126.0 m (1.69 hectares)
Description: habitation complex (21 features)

Feature A (burial?) cairn
Dimensions: 2.5 m x 2.0 m x 1.0 m high
Condition: fair
Constructed of stacked slabs, with some large upright slabs forming the exterior facing.

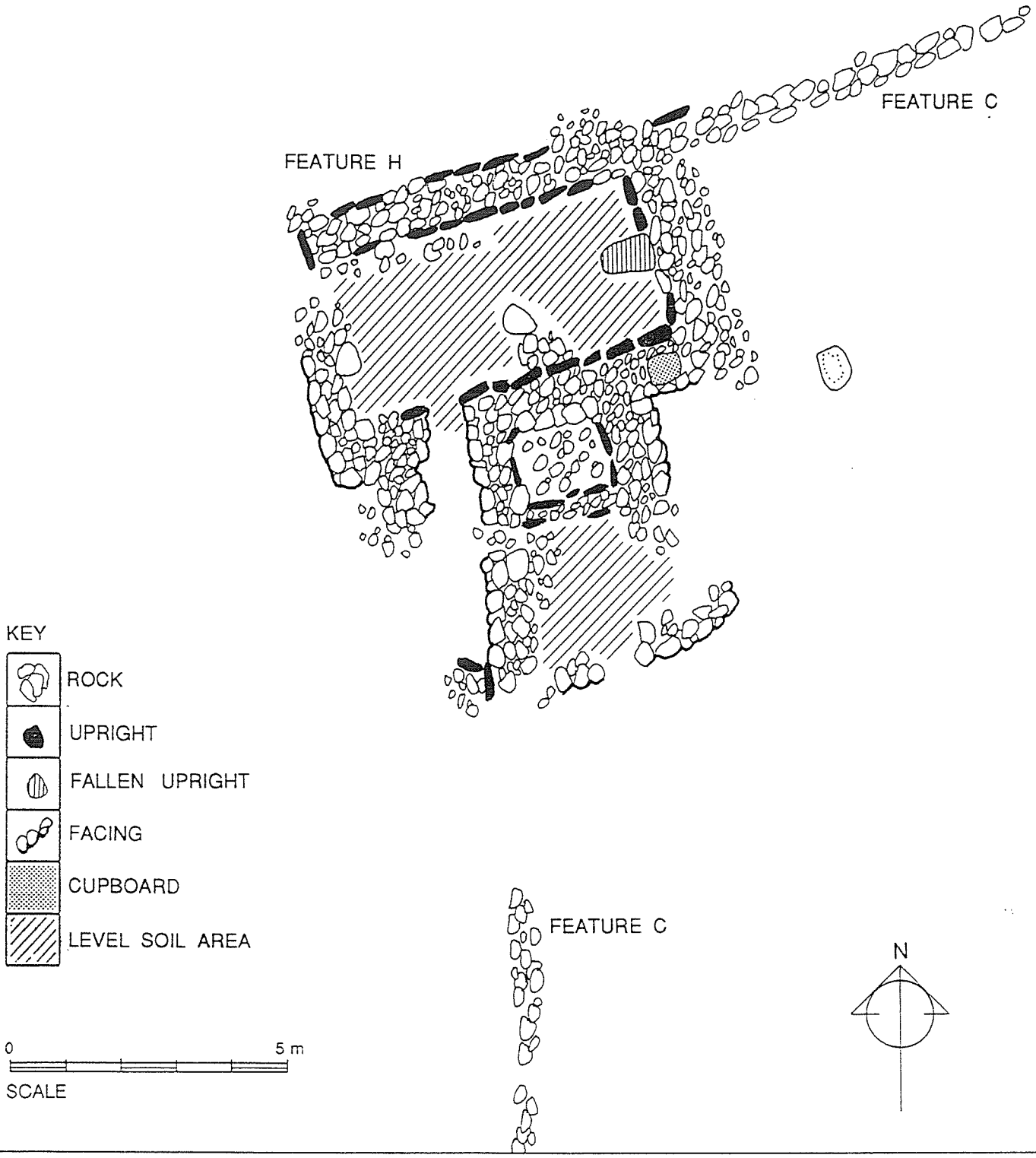


Fig. 13. SITE 50-Oa-B6-254 (STATE SITE 1737), Fe. C AND H.

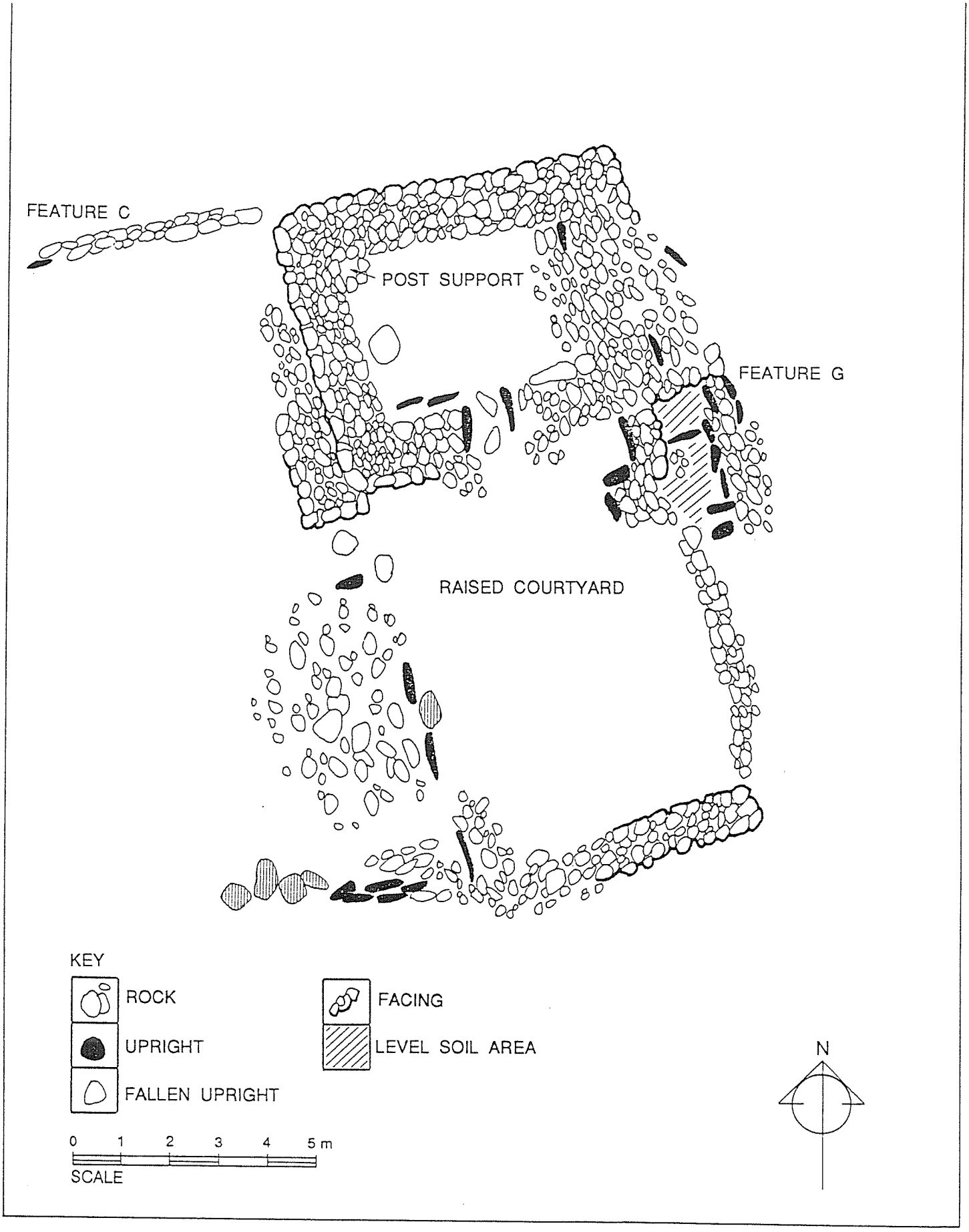


Fig. 14. SITE 50-Oa-B6-254 (STATE SITE 1737), Fe C AND G.

Feature B (?) modified sinkhole
Dimensions: 0.9 m x 0.9 m x 2.3 m deep
Condition: poor
A low wall partially surrounds this bell-shaped sinkhole. The wall measures 0.3 m high, 0.4 m wide, and 2.5 m long.

Feature C (house compound and garden area?) enclosure wall
Dimensions: 90.00 m x 90.00 m x 0.66 m high
Condition: fair-good
Wall is constructed of stacked, cobble-size material with some large basal boulders. Upright slabs occasionally occur in the wall. The wall encloses a large area that is characterized by more soil cover than the surrounding terrain. Most of the features at this site are located within this large enclosure, and often have one or two walls in common with it.

Feature D (habitation) enclosure
Dimensions: 4.0 m (83°) x 2.0 m x 0.8 m high
Condition: good
This feature is well preserved. It is constructed of neatly stacked slabs that form the interior and exterior wall faces. No upright slabs are used in its construction. The Feature C wall forms the east wall of this feature. The floor is gently sloping soil. A possible entryway is located in the SE corner of the enclosure.

Feature E (burial? storage?) cairn
Dimensions: 1.05 m x 1.05 m x 0.76 m high
Condition: fair
Small cairn constructed of stacked slabs with several very large uprights leaning against it. It is situated on an area of level soil within the Feature C enclosure wall.

Feature F (habitation) enclosure
Dimensions: 8.0 m (171°) x 6.0 m x 0.9 m high
Condition: fair
Incorporates part of the Feature C enclosing wall into its construction, like Feature D. It has well-built, stacked walls of cobble to boulder-size limestone, with some interior upright-slab facing. Floor is irregular, with soil and chunks. The structure lacks an entry.

Feature G (habitation) enclosure
Dimensions: 8.0 m (335°) x 5.0 m x 0.8 m high
Condition: fair-good
Large, thick-walled enclosure constructed of carefully stacked limestone slabs. Interior is partially faced with upright slabs. It has a slab-lined entry that opens to a raised courtyard enclosed by upright slabs and the Feature C enclosure wall. Feature G forms part of the larger Feature C enclosure as well. At least one house posthole is visible in an interior corner of Feature G. Also attached to Feature G are three, small, slab-lined compartments that are accessible from the courtyard area. Adjacent to the courtyard is a large pile of fist-size limestone cobbles, many of which are burned.

This pile is probably a "rakeout" pile from an *imu*, which would have been located in the courtyard area. Branch coral and pieces of vesicular basalt were also noted in this pile.

Feature H (habitation) enclosure
Dimensions: 10.0 m (331°) x 8.5 m x 0.7 m high
Condition: very good
Like Feature G this structure has several internal subdivisions and is incorporated into the Feature C enclosure. It has stacked walls, an interior facing of upright slabs, and a slablined entryway. A small cupboard is constructed into the outer wall face adjacent to an attached smaller enclosure that lacks an entrance. The smaller enclosure adjoins a partially enclosed, slightly raised courtyard.

Feature I (habitation) C-shape
Dimensions: 7.0 m (240°) x 3.0 m x 0.5 m high
Condition: good
Large C-shape faced on the interior and exterior with upright slabs. The walls are core-filled with cobbles and some boulders. The floor is soil covered, and fire-cracked limestone is present. Feature I was possibly disturbed by the construction of Feature J.

Feature J (burial?) cairn
Dimensions: 3.0 m (330°) x 2.0 m x 1.2 m high
Condition: fair
Constructed of stacked boulders and cobbles, with a partial exterior foundation of upright slabs. The NE corner is partially collapsed.

Feature K (burial?) cairn
Dimensions: 4.0 m (350°) x 3.0 m x 1.1 m high
Condition: good
Constructed of stacked boulders and cobbles, with some upright slab facing. There is a small faced pit in the upper surface. The feature adjoins the Feature C enclosure wall.

Feature L (habitation) enclosure
Dimensions: 4.0 m x 4.0 m x 0.6 m high
Condition: fair
Feature is constructed of roughly-stacked boulders and cobbles, with some interior, upright-slab facing. The feature is partially collapsed. Floor is soil covered. Fire-cracked limestone occurs in this feature, indicating possible cook house function.

Feature M (burial?) cairn
Dimensions: 4.0 m (200°) x 3.0 m x 0.9 m high
Condition: fair
Cairn is constructed of stacked boulders and some cobbles with a partial perimeter facing of upright slabs. Feature is partially collapsed. Cut *kiawe* stumps are present in the area. Possible burial feature.

Feature N (burial?) cairn
Dimensions: 2.5 m (120°) x 2.0 m x 0.7 m high
Condition: fair
Constructed of stacked boulders and some cobbles, with a partial perimeter facing of upright slabs.

Feature O (habitation) rectangular enclosure
Dimensions: 10.0 m (70°) x 7.0 m x 0.7 m high
Condition: good
Stacked boulder and cobble construction, with some upright-slab facing. Possible constructed cupboard. The interior floor is formed by a large flat outcrop with some soil. Fire-cracked limestone pebbles and small cobbles are present.

Feature P (habitation) L-shape remnant
Dimensions: 5.00 m (164°) x 5.00 m x 0.45 m high
Condition: poor
Badly collapsed remnant L-shape. Structure has stacked-slab construction, with large slabs and boulders on the bottom. Level soil covers the interior floor.

Feature Q (habitation) enclosure remnant
Dimensions: 5.5 m (220°) x 5.0 m x 0.8 m high
Condition: poor-fair
Contains stacked and core-filled walls incorporating large chunks and slabs. Interior has soil floor, and shows some evidence of burning, but large fallen *kiawe* tree prevented close examination. Possible cupboard constructed in one wall.

Feature R (habitation) L-shape, attached cairn
Dimensions: 6.0 m (97°) x 3.0 m x 1.2 m high
Condition: fair-good
L-shape has stacked walls with a faced exterior that lacks upright-slab facing. Cairn is stacked and faced, with some upright facing. Cairn is attached to the L-shape, and is partially collapsed. L-shape has a level soil floor.

Feature S (?) feature remnant
Dimensions: 2.0 m (295°) x 1.5 m x 0.4 m high
Condition: poor
Rectangular boulder alignment; one corner is marked by upright slabs set on an outcrop. Interior has level soil floor.

Feature T (agricultural ?) feature area
Dimensions: 3.0 m (319°) x 2.5 m
Condition: poor
An area of remnant mounds, alignments, and disturbance located within the Feature C enclosure wall.

Feature U (water source?) modified(?) sinkhole
Dimensions: 4.0 m x 4.0 m x 3.0 m(?) deep
Sinkhole opening is lined with large leaning slabs that may have

covered the sinkhole, however, the slabs appear to be recent. No water is visible, but sinkhole appears to be at least 3.0 m deep.

Significance: BPBM Site 254; State 1737 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous utilization and settlement of the 'Ewa Plain, indigenous agriculture on the 'Ewa Plain, indigenous religious practices related to treatment of the dead, and indigenous physical anthropology.

Site number: BPBM 255; State 1738; Temporary B-E2-9
Location: survey area E2; elevation c. 6.0 m (20.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 70.0 m (54°) x 50.0 m (3500.00 m^2)
Description: agricultural enclosures (2 features)

Feature A (agricultural) enclosure wall
Dimensions: 29.5 m (119°) x 29.5 m x 0.5 m high
Condition: fair
Incomplete and meandering enclosure wall constructed of stacked, medium to large chunks. The wall encloses an area without much soil, but with many mounds. Wall is 1.0 m in width.

Feature B (agricultural) enclosure wall
Dimensions: 20.0 m (150°) x 10.0 m x 0.4 m high
Condition: poor
Low, stacked wall, 0.60 m wide, constructed of small- to medium-size material. Encloses an area containing mounds and one possible cairn remnant.

Significance: BPBM Site 255; State 1738 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous agriculture on the 'Ewa Plain.

Site number: BPBM 256; State 1739; Temporary B-E2-10
Location: survey area E2; elevation c. 6.0 m (20.0 ft); Honouliuli
Topography: emerged reef
Vegetation: young *haole koa*, young *kiawe*, vines, and herbs
Dimensions: 75.0 m (140°) x 75.0 m (5625.00 m^2)
Description: cairns and military features (8 features)

Feature A (water source) sinkhole
Dimensions: 0.6 m x 0.6 m x 5.6 m deep
Condition: natural
Natural sinkhole with 1.1 m of clear standing water at the bottom of a narrow shaft. Few sinkholes are present in the surrounding area. A rusty funnel was cached in a crevice inside the upper part of the

sinkhole. Several small cairns (Features B, C, and D) in the immediate vicinity appear to mark the location of the sinkhole.

Feature B (marker?) cairn
Dimensions: 0.8 m x 0.8 m x 1.0 m high
Condition: fair
Cairn is constructed of stacked, medium-size slabs with no uprights or large boulders. Very little or no soil is present in the area. Feature is located 2.0 m from the Feature A well.

Feature C (marker?) cairn
Dimensions: 0.7 m x 0.7 m x 0.7 m high
Condition: fair
Construction is same as Feature B. Cairn is located 9.0 m from Feature A.

Feature D (marker ?) cairn
Dimensions: 0.7 m x 0.7 m x 0.7 m high
Condition: fair
Cairn is located 7.0 m from Feature A, and is constructed like Features B and C.

Feature E (military?) small C-shape
Dimensions: 1.6 m (153°) x 1.0 m x 0.4 m high
Condition: fair
Constructed of stacked, medium-size slab material, with burned limestone inside. The small size and rough construction of this feature probably indicates use as a modern hearth.

Feature F (military?) C-shape
Dimensions: 2.6 m (150°) x 1.5 m x 0.5 m high
Condition: poor
Constructed of poorly-stacked, medium-size stones; possibly a military feature, based on construction.

Feature G (military?) C-shape
Dimensions: 1.80 m (340°) x 2.50 m x 0.45 m high
Condition: poor
Wall is 0.6 m wide, and constructed of roughly-stacked small to medium stones, with some large fallen slabs. Floor is level soil. Golf ball found on feature; golf course is nearby. Feature is possibly military, based on its size and construction.

Feature H (military?) C-shape
Dimensions: 2.0 m x 2.0 m x 0.5 m high
Condition: fair
Crude, stacked wall of medium to small material; possibly a military feature, based on size and construction.

<u>Significance</u>: BPBM Site 256; State 1739 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain (well and cairns).

The remainder of the site appears to possibly represent a military camping area(?) and is not eligible, however testing is necessary to determine this fact.

Site number: BPBM 257; State 1740; Temporary B-E2-11
Location: survey area E2; elevation c. 6.0 m (20.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 69.0 m (131°) x 48.0 m (3312.00 m^2)
Description: enclosure and burials(?) (4 features)

Feature A (burial?) platform
Dimensions: 5.0 m (201°) x 1.7 m x 0.5 m high
Condition: poor
Collapsed platform constructed of stacked, medium to large limestone chunks. Upper surface is paved with flat slabs, and partially collapsed. The sides may have previously been faced with upright slabs. Barbed wire runs to the south of this feature.

Feature B (burial?, storage?) cairn remnant
Dimensions: 2.2 m (201°) x 2.0 m x 0.5 m high
Condition: fair
Constructed of stacked, medium to large limestone chunks, with upright slab facing on the sides. A depression occurs in the center of feature.

Feature C (agricultural) enclosure
Dimensions: 20.0 m (33°) x 12.0 m x 0.6 m high
Condition: poor
Low, stacked wall segments; construction material varies in size. Encloses an area of small, low mounds.

Feature D (military and ?) modified? sinkhole
Dimensions: 1.2 m x 0.8 m x 1.2 m deep
Condition: good
Sink has a possible slab cover. Floor is soil and rubble, possibly the remnant of another modification. A military slit trench (cut to bedrock) is 2.50 m to SE at 145°. The trench is 20.0 m long, 1.0 m deep, and 0.8 m wide.

Significance: BPBM Site 257; State 1740 appears to qualify for nomination to the National Register of Historic Places, with the exception of Feature D. The site has yielded and is likely to yield information important for an understanding of indigenous agriculture on the 'Ewa Plain, indigenous religious practices related to treatment of the dead, and indigenous physical anthropology.

Site number: BPBM 258; State 1741; Temporary B-E2-12
Location: survey area E2; elevation c. 6.0 m (20.0 ft); Honouliuli
Topography: emerged reef

Vegetation: *haole koa*, *kiawe*, vines, herbs, banyan, and ti
Dimensions: 11.0 m (217°) x 11.0 m (121.00 m^2)
Description: modified sinkhole (1 feature)

Feature A (agricultural ?) modified sinkhole
Dimensions: 2.8 m deep by 2.0 m diameter
Condition: very good
Sinkhole with a surrounding wall 11.00 m x 11.00 m x 0.75 m high. Wall is constructed of stacked slabs with upright-slab facing. Little soil in area; no soil inside wall. Sinkhole can probably hold water for a long time after rain. Echinoderm fragment on surface. Sinkhole may have been walled to prevent cattle from falling into it.

Significance: BPBM Site 258; State 1741 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain, and, potentially, information related to historic ranching activity. Testing would help establish site significance.

Site number: BPBM 259; State 1742; Temporary B-E2-12
Location: survey area E2; elevation c. 6.0 m (20.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, herbs, banyan, and ti
Dimensions: 4.0 m (355°) x 3.0 m (12.00 m^2)
Description: modified sinkhole (1 feature)

(agricultural?) modified sinkhole
Dimensions: 4.00 m (355°) x 0.75 m x 0.60 m high
Condition: poor
Sinkhole with wall remnant (above dimensions are for wall). Sinkhole is 2.4 m deep, opening is 0.8 m wide, floor is 1.5 m x 1.5 m. Soil on floor, but sinkhole not examined. Wall constructed of stacked, medium-size material, with some upright slabs.

Significance: BPBM Site 259; State 1742 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous agriculture on the 'Ewa Plain.

Site number: BPBM 260; State 1743; Temporary B-E2-12
Location: survey area E2; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, herbs, banyan, and ti
Dimensions: 2.0 m (220°) x 2.0 m (4.00 m^2)
Description: modified sinkhole

(agricultural) modified? sinkhole
Dimensions: 2.0 m x 2.0 m x 2.4 m deep
Sinkhole has a young banyan growing in it. There is a possible wall remnant around sink, but it is very questionable. Sinkhole floor was not examined due to presence of a beehive.

Significance: Insufficient information is available from this feature to make a determination of eligibility.

Site number: BPBM 261; State 1744; Temporary B-E2-13
Location: survey area E2; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 165.0 m (280°) x 60.0 m (990.00 m^2)
Description: small habitation complex (5 features)

Feature A (burial?) platform remnant
Dimensions: 1.70 m (339°) x 3.35 m x 0.95 m high
Condition: good
Feature is constructed of stacked slabs with faced sides. Top is collapsed. Bulldozer disturbance is present 2.0 m away.

Feature B (habitation) modified sinkhole
Dimensions: 3.9 m (346°) x 2.4 m x 1.8 m deep
Condition: good
Sinkhole has an internal overhang. Floor is soil covered. *Nerita*, *Turbo*, urchin, other marine shell fragments, and cut and burned wood are present on the floor. Ceiling is 1.5 m high.

Feature C (habitation) L-shape remnant
Dimensions: 3.0 m (322°) x 2.0 m x 0.4 m high
Condition: very poor
Walls are constructed of stacked slabs. A small, filled sinkhole is at NW corner. No soil in area. Bulldozer disturbance is 3.0 m away.

Feature D (habitation?) C-shape
Dimensions: 2.0 m x 2.0 m x 0.4 m high
Condition: poor-fair
Feature has low, stacked walls, with some interior upright-slab facing. Floor is level soil, but thin.

Feature E (habitation?) C-shape
Dimensions: 2.75 m x 2.75 m x 0.40 m high
Condition: poor
Structure has stacked, low walls, with small upright slabs forming the interior wall facing. A possible cupboard is present. Floor is level soil.

Significance: BPBM Site 261; State 1744 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is

likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain.

Site number: BPBM 262; State 1745; Temporary B-E2-14
Location: survey area E2; elevation c. 6.0 m (20.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, herbs, *wiliwili*, banyan, avocado, ti
Dimensions: 33.0 m (136°) x 10.0 m (330.00 m^2)
Description: agricultural features (?) (2 features)

Feature A (agricultural) modified sinkhole
Dimensions: 6.00 m (110°) x 3.00 m x 0.35 m high
Condition: fair
Wall of stacked construction (above dimensions are for the wall) encircles this 1.2 m deep sinkhole. The wall is built on the edge of the sinkhole, and consists of medium to large chunks (some fallen in), with a break in SW portion. Unmodified sinkhole nearby contains crab remains and bird bone.

Feature B (agricultural) walled depression
Dimensions: 9.0 m (123°) x 7.50 m x 0.6 m high
Condition: fair-good
Shallow, soil-filled depression that has remnants of a low, stacked wall of large chunk material around it. Wall is collapsed in several places where a *kiawe* tree has fallen on it. One piece of basalt was noted nearby. A nearby unmodified sink has ti growing in it.

Significance: BPBM Site 262; State 1745 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous agriculture on the 'Ewa Plain.

Site number: BPBM 263; State 1746; Temporary B-E2-15
Location: survey area E2; elevation c. 6.0 m (20.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 78.0 m (314°) x 50.0 m (3900.00 m^2)
Description: agricultural mounds and trails (4 features)

Feature A (burial?) cairn remnant
Dimensions: 2.00 m x 1.75 m x 0.50 m high
Condition: fair
Constructed of stacked material, faced with upright slabs, and core-filled. Only the base remains. Very little soil is present in the area. Many small mounds surround the feature.

Feature B (agricultural) mounds
Condition: poor
The feature designates a disturbed area of many low stone mounds. The mounds average 1.0 to 2.0 m in diameter. Area is level, with very little soil.

Feature C (transportation) stone-lined trail
Dimensions: 68.0 m x 2.0 m x 0.4 m high
Condition: fair
Trail bordered on both sides by a boulder alignment. Path is 1.2 m wide, and has soil surface. Trail meanders and intersects Feature D (another trail). The Feature B mounds are present on both sides of Feature C. Feature may be military.

Feature D (transportation) stone-lined trail
Dimensions: 67.0 m (90°) x 2.0 m x 0.4 m high
Condition: fair
Trail is formed by parallel boulder alignments. Path is 1.2 m wide, and has soil surface. Trail meanders and intersects Feature C (another trail). Feature B mounds are present on both sides of Feature D. Feature is probably military related.

Significance: BPBM Site 263; State 1746 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous agriculture on the 'Ewa Plain, indigenous religious practices related to treatment of the dead, and indigenous physical anthropology. The trail features may provide important information related to World War II.

Site number: BPBM 264; State 1747; Temporary B-E-3-1
Location: survey area E3; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 14.0 m (32°) x 9.0 m (126.00 m^2)
Description: military features and possible palaeontological site (3 features)

Feature A (military?) C-shape
Dimensions: 3.5 m (335°) x 2.4 m x 0.6 m high
Condition: fair-good
Constructed of roughly-stacked, small- to medium-size slabs and chunks, with no uprights. Floor is level soil. Construction and undisturbed condition indicates possible military or historic use.

Feature B (?) disturbed sinkhole
Dimensions: 1.0 m x 1.0 m x 1.5 m deep
Condition: very poor
Investigation showed rock filling of sink was caused by bulldozer. Sinkhole appears to have no soil on floor, and noxious fumes are coming from it.

Feature C (?) modified sinkhole
Dimensions: 3.0 m x 3.0 m x 2.2 m deep
Condition: poor
Slab-covered sinkhole containing a soil deposit in which bird bone was noted. Sinkhole opening has a diameter of 0.7 m.

Significance: BPBM Site 264, Feature C; State 1747 appears to qualify for nomination to the National Register of Historic Places. The feature has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain, and may contain avian remains of palaeontological significance. Feature A needs to be excavated before significance can be determined.

Site number: BPBM 265; State 1748; Temporary B-E4-1 (Figs. 15, 16, 17, and 18)
Location: survey area E4; elevation c. 2.0 m (7.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 65.0 m (278°) x 45.0 m (2925.00 m^2)
Description: indigenous habitation complex with historic ranching and/or military components (10 features)

Feature A (burial? military?) rectangular platform
Dimensions: 8.00 m (340°) x 6.00 m x 0.35 m high
Condition: fair
Low platform constructed of stacked chunks. The upper surface is uneven. *Turbo* shell, cowrie, and a basalt cobble are present. Surrounding area has numerous crude features, possibly disturbed agricultural features.

Feature B (habitation) C-shape remnant
Dimensions: 3.8 m x 2.0 m x 0.5 m high
Condition: poor
Stacked wall with an upright located at the entrance. Feature is disturbed on the east side. Floor is level soil. Pieces of metal are present in the area.

Feature C (?) platform
Dimensions: 7.0 m x 3.5 m x 0.4 m high
Condition: poor
Paved platform constructed of stacked slabs, with a straight wall attached to it. Tin can and some historic material noted on the surface.

Feature D (transportation, historic) stone-lined trail
Dimensions: c. .30 m (180°) x 1.30 m x 0.27 m high
Condition: good
Trail formed by two parallel alignments. Surface of trail is soil and limestone gravel. North end of trail ends at small, collapsed, wooden

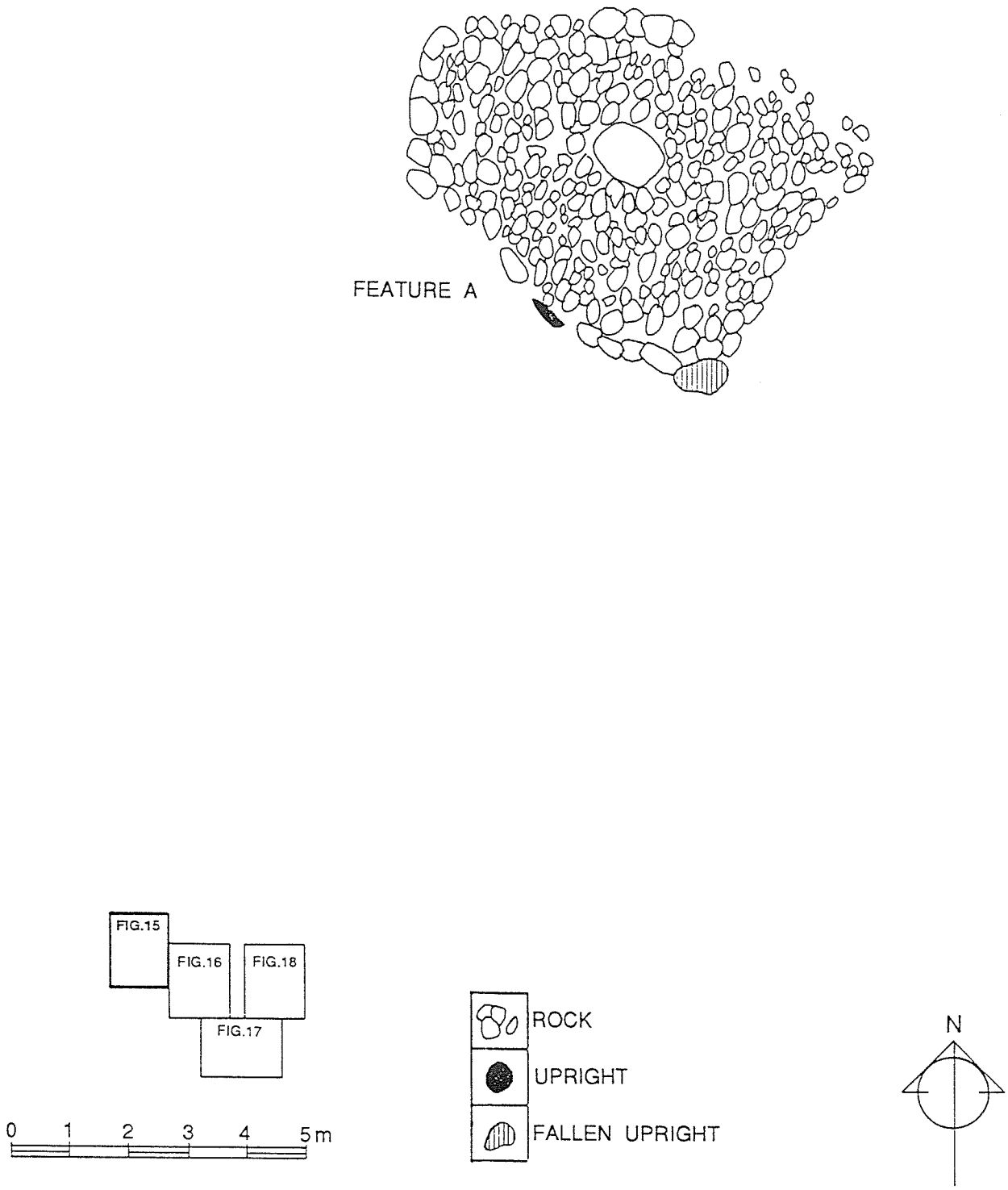


Fig. 15. SITE 50-Oa-B6-265 (STATE SITE 1748),
Fe. A. Map 1 of 4.

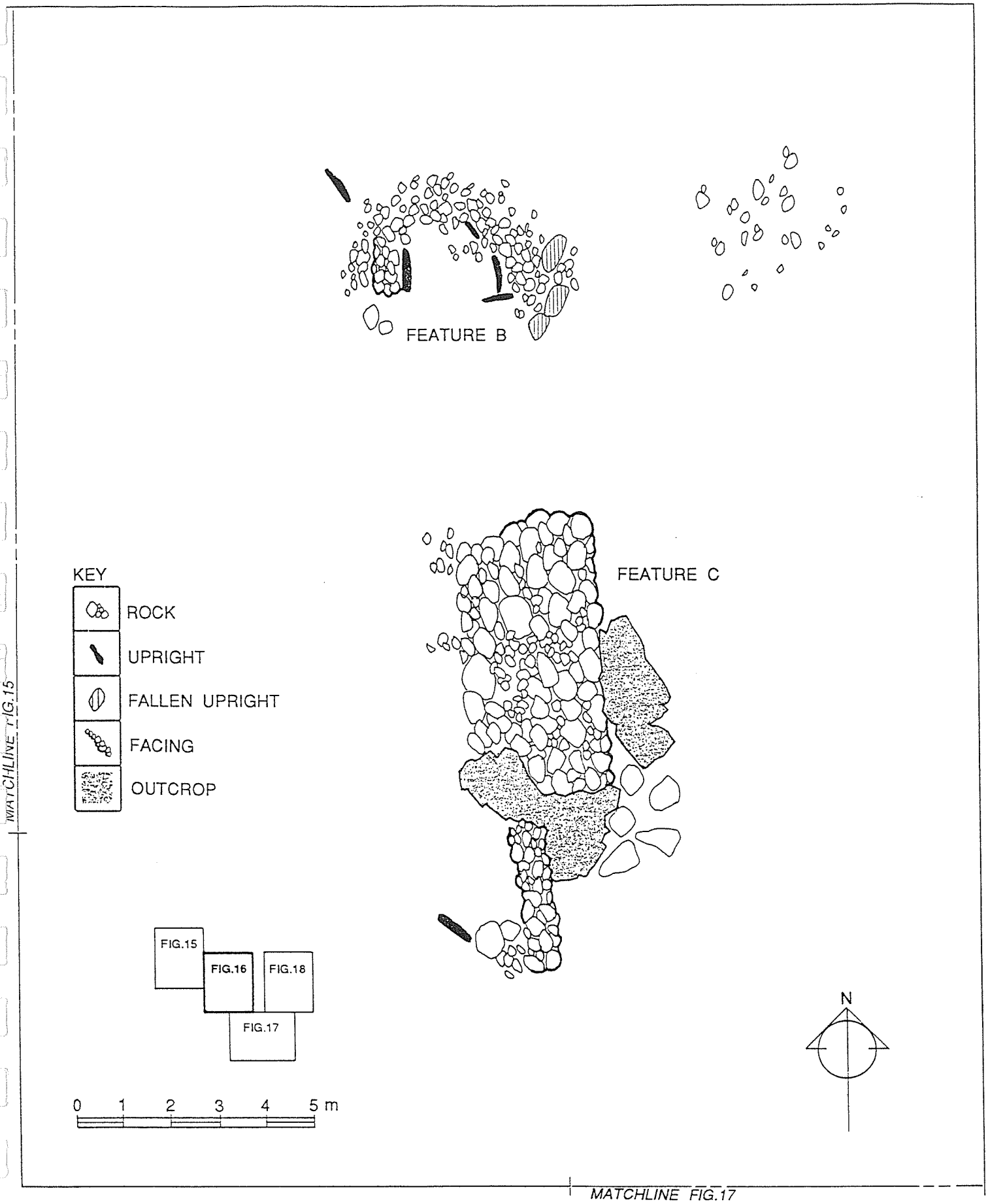


Fig. 16. SITE 50-Oa-B6-265 (STATE SITE 1748), Fe. B AND C. Map 2 of 4.

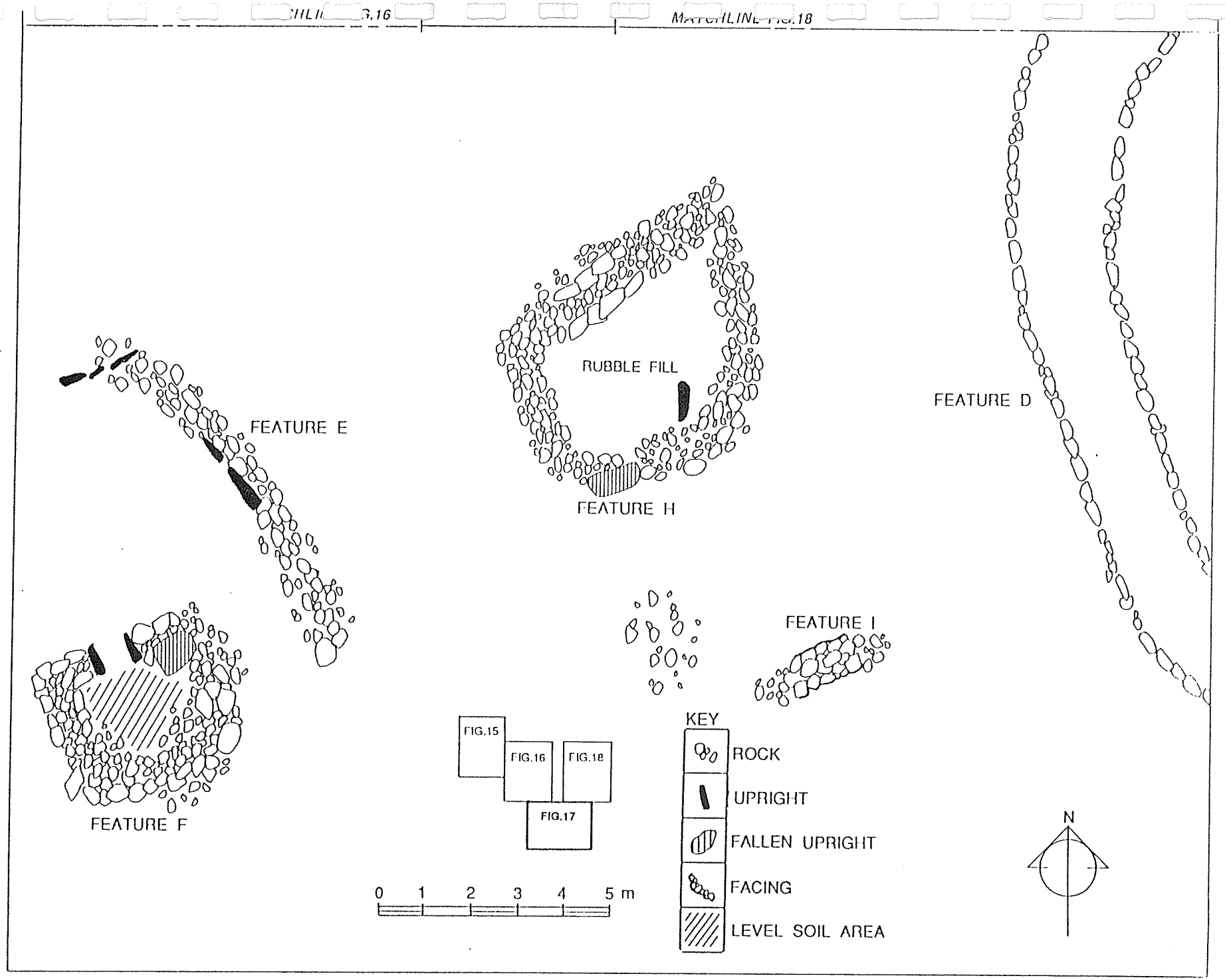


Fig. 17. SITE 50-B6-265 (STATE SITE 1748),
Fe. D, E, F, H, AND I. Map 3 of 4.

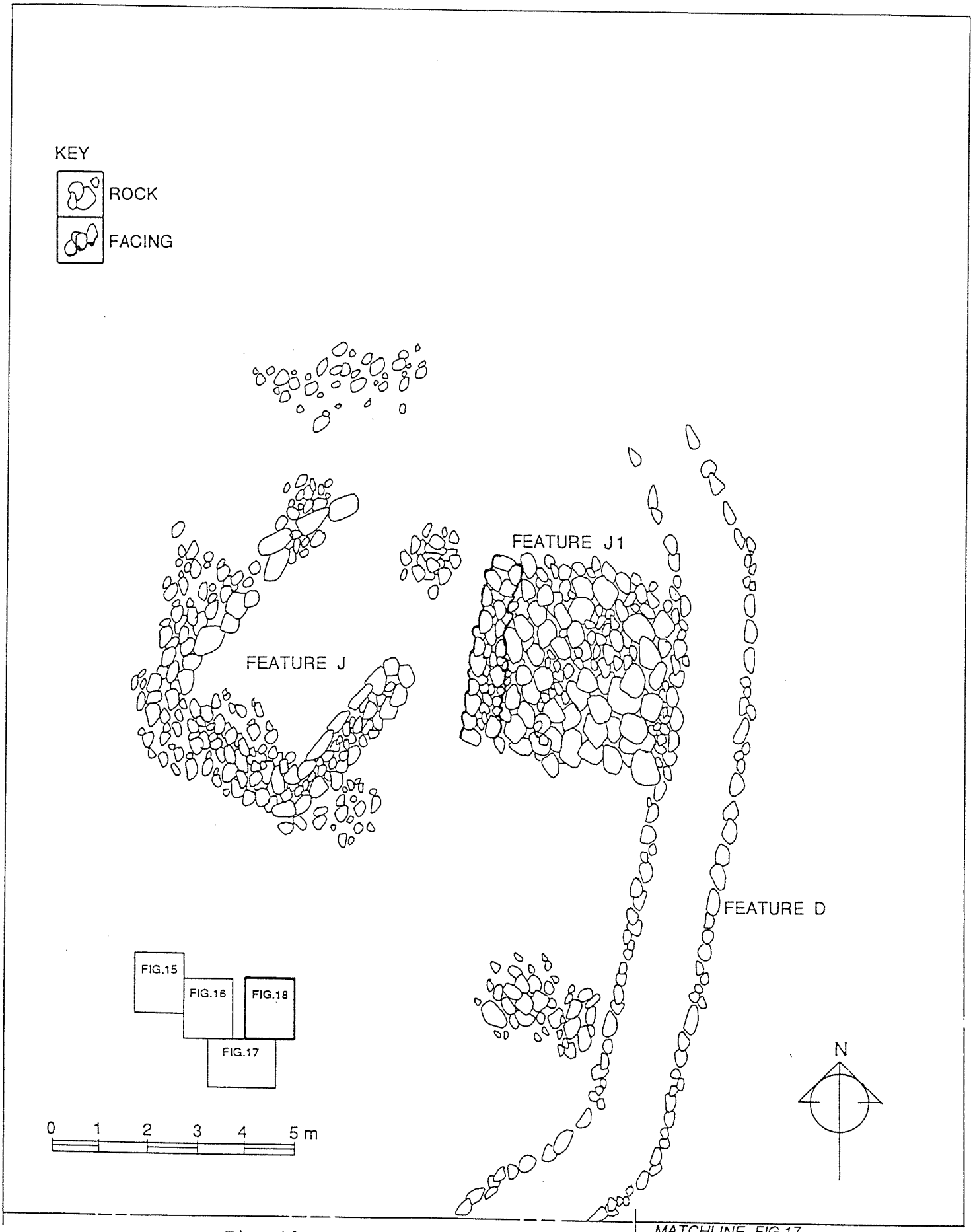


Fig. 18. SITE 50-Oa-B6-265 (STATE SITE 1748), Fe D, J, AND J1. Map 4 of 4.

structure, probably an outhouse. Trail extends to the south, past Feature F and near Features H and I.

Feature E (habitation) wall
Dimensions: 6.0 m (325°) x 1.0 m x 0.5 m high
Condition: poor
Wall is roughly stacked with some core-filled portions, and is associated with Feature F, less than 2.0 m away.

Feature F (habitation) enclosure
Dimensions: 3.5 m x 3.5 m x 0.5 m high
Condition: fair
Walls are constructed of stacked medium-size limestone chunks and boulders, with a narrow core-fill. No up-rights are present. Feature has a constructed entry, and a level soil floor.

Feature G (boundary marker) wall remnant
Dimensions: (208°) 1.75 m wide x 0.35 m high
Condition: poor
Foundation remnant of a large, core-filled wall of unknown length. Remnant consists of stacked, medium to large boulders. No uprights or slabs are used in construction. This formerly very substantial wall is similar in appearance to a wall at Site B-E6-4.

Feature H (?) rubble-filled platform
Dimensions: 6.0 m (220°) x 5.0 m x 0.6 m high
Condition: poor-fair
Poorly-preserved feature constructed on an outcrop.

Feature I wall remnant
Dimensions: 1.50 m x 0.78 m x 0.46 m high
Condition: good
Stacked and core-filled wall remnant.

Feature J (military?) rectangular enclosure
Dimensions: 11.0 m (27°) x 8.0 m x 0.3 m high
Condition: poor
Feature has stacked walls which are mostly collapsed. Feature is located very close to a trail and may be military, based on condition of construction. Historic material was found in this feature.

Feature J1 (?) platform
Dimensions: 4.0 m x 5.0 m
Condition: poor
Feature is rubble-filled. Extends from enclosure walls (Fe. J) to the east, stopping at trail side (Fe. D).

Significance: BPBM Site 265; State 1748 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain. The site may also yield information related to historic activities in the area.

Site number: BPBM 266; State 1749; Temporary B-E4-2
Location: survey area E4; elevation c. 2.0 m (7.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, herbs
Dimensions: 41.0 m (205°) x 20.0 m (820.00 m^2)
Description: historic/military complex with indigenous component (?) (6 features)

Feature A1 (?) wall
Dimensions: 13.0 m (175°) x 1.2 m x 0.7 m high
Condition: poor
Mostly-collapsed, core-filled wall that is damaged from bulldozing. Connected to Feature A2. One *'opihi* shell was found in a dozer swath. Also present is a large amount of historic and military debris.

Feature A2 (?) wall
Dimensions: 11.0 m (84°) x 1.2 m
Condition: poor
The rubble from this disturbed, core-filled wall is strewn over an area 3.0 m to 4.0 m wide. It connects to Feature A1. Features A1 and A2 intersect forming a corner.

Feature B (?) collapsed platform
Dimensions: 3.0 m^2 diameter
Condition: poor
All that remains of this feature is a circular area of rubble. A broken beer bottle is present on the surface. The vicinity shows extensive bulldozer disturbance.

Feature C (habitation?) enclosure
Dimensions: 9.0 m (150°) x 7.0 m x 0.6 m high
Condition: poor
Very poorly-preserved feature with core-filled walls and without upright-slab facing. Interior has level soil floor covered with rubble, and a possible cupboard.

Feature D (?) cairn remnant
Dimensions: 4.0 m (330°) x 2.5 m x 0.3 m high
Condition: poor
Disturbed cairn with stacked-slab construction, and some fallen uprights (slab facing). Military debris is present in the area.

Feature E (?) feature remnant
Dimensions: 6.5 m (90°) x 5.5 m x 0.6 m high
Condition: fair
Disturbed structure that appears to be the remnant of a square enclosure constructed of core-filled walls. The interior soil floor is covered with rubble. The area has a very thin soil layer, as evidenced by several fallen *kiawe*, due to lack of root support.

Significance: The significance of BPBM Site 266; State 1749 is difficult to assess due to its highly disturbed condition. Excavations would be necessary to determine the site's condition and eligibility for the National Register of Historic Places.

Site number: BPBM 267; State 1750; Temporary B-E4-3
Location: survey area E4; elevation c. 2.0 m (7.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 100.0 m (245°) x 40.0 m (4000.00 m^2)
Description: ? (5 features)

Feature A (boundary marker) wall
Dimensions: 50.0 m (187°) x 3.0 m x 0.4 m high
Condition: poor
Very disturbed, possible remnant of a core-filled wall.

Feature B (boundary marker) wall
Dimensions: 22.3 m (158°) x 0.4 m x 0.5 m high
Condition: poor
Low wall/alignment consisting of boulders and medium cobble-size limestone. Constructed over soil and bare outcrops.

Feature C (burial?) collapsed cairn
Dimensions: 3.0 m x 2.0 m x 1.0 m high
Condition: fair
Constructed of uniform, cobble-size, stacked slabs on a soil surface. The center of the upper surface is depressed, possibly indicating the presence of an internal chamber. A possible modified sinkhole is located nearby. Feature C stands out, as the only other features in the area are wall remnants and the sinkhole.

Feature D (?) modified(?) sinkhole
Dimensions: 1.5 m x 1.5 m x 1.1 m high
Condition: poor
Possible modification consists of a slab set in the wall of the sinkhole, but this could be natural. Extensive disturbance in the area.

Feature D1 (?) U-shape
Dimensions: 4.0 m (185°) x 3.0 m x 0.3 m high
Condition: poor
Possible U-shape, but it could be the result of bulldozer activity. Much burned *kiawe* is present in the vicinity.

Significance: As with BPBM Site 266; State 1749, the significance of BPBM Site 267; State 1750 is difficult to assess because of disturbed condition. The cairn, Feature C, has the potential to yield information important for an understanding of indigenous religious practices related to treatment of the dead, and indigenous physical anthropology. The walls, Features A and B, may provide information related to historic use of the area. Therefore,the site would probably qualify for nomination to the National Register of Historic Places.

Site number: BPBM 268; State 1751; Temporary B-E-5-1
Location: survey area E5; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 50.0 m (250°) x 50.0 m (2500.00 m^2)
Description: military feature (1 feature)

(military) wall
Dimensions: 50.0 m (250°) x 0.75 m x 0.5 m high
Condition: poor
Roughly-stacked boulder and slab wall. Forms a half circle, and is 0.75 m in thickness. Military debris is present in the area. The south end of the wall rests on an asphalt road.

Significance: BPBM Site 268; State 1751 does not appear to qualify for nomination to the National Register of Historic Places. The site is apparently of recent construction.

Site number: BPBM 269; State 1752; Temporary B-E6-1
Location: survey area E6; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 84.0 (160°) x 84.0 m (7056.00 m^2)
Description: habitation and religious(?) complex (12 features)

Feature A (religious?; high status habitation?) enclosure with attached platform
Dimensions: 14.0 m (350°) x 8.5 m x 0.8 m high
Condition: fair-good
Large, well-constructed structure with core-filled walls. One wall is so broad it forms a platform. The interior has a level soil floor, and is faced with upright slabs. Size and construction suggest specialized function, possibly religious-related, or a high status dwelling.

Feature B (religious) upright; possible shrine
Dimensions: 0.95 m x 0.40 m x 0.30 m high
Condition: good
Large, upright stone standing alone in the middle of the site. Several medium cobble-size, limestone chunks are set against the base of the upright. A low mound of soil and limestone pebbles is adjacent to the east. A probable religious function is assigned to this feature, based on its formal characteristics and context.

Feature C (habitation) enclosure
Dimensions: 2.60 m (245°) x 2.25 m x 0.50 m high
Condition: excellent

Well-preserved structure constructed of stacked slabs with three sides. The interior has soil covered floor with some rubble. The feature is less than 2 m from Feature D.

Feature D (habitation) enclosure
Dimensions: 3.6 m (160°) x 2.4 m x 0.6 m high
Condition: poor-good
Structure has upright-slab-faced, core-filled walls. Interior has some soil cover.

Feature E (religious? burial?) cairn
Dimensions: 1.70 m (330°) x 1.50 m x 0.95 m high
Condition: good
Cairn is well-preserved, and constructed of stacked slabs with upright-slab facing. In the center of the upper surface is a slight depression, potentially indicating the presence of an internal chamber. A small interior cavity is present on one side where slab has been removed. Possible religious function based on association with other features.

Feature F (habitation?) C-shape
Dimensions: 4.5 m (90°) x 4.0 m x 0.9 m high
Condition: good
Constructed of stacked slabs with some upright-slab facing.

Feature G (?) platform remnant
Dimensions: 8.00 m (325°) x 6.00 m x 0.75 m high
Condition: poor
Feature consists of a three-sided alignment with an internal paved area. Structure may be a damaged enclosure.

Feature H (?) feature remnant
Dimensions: 5.20 m (90°) x 1.75 m x 0.60 m high
Condition: poor
Disturbed feature that may have had core-filled walls. Original configuration is not discernible. Building materials are burned.

Feature I (burial?) cairn
Dimensions: 1.2 m x 1.2 m x 1.2 m high
Condition: good
Constructed of stacked chunks and slabs of consistent size, with smaller and flatter pieces on the top.

Feature J (agricultural) modified sinkhole
Dimensions: 1.20 m (330°) x 0.75 m x 0.65 m high
Condition: fair
Stacked wall (above dimensions are for wall) constructed of cobble to small boulder-size material surrounds sink. Sink is 0.5 m deep and 1.0 m in diameter. Floor of sinkhole covered with limestone and some soil. The sinkhole appears to contain a shallow deposit.

Feature K (?) modified sinkhole
Dimensions: 2.6 m (298°) x 2.6 m
Condition: poor
Feature consists of a stacked wall remnant around a shallow sinkhole. The sinkhole may have previously been covered, and may have been deeper, as a large slab rests on the bottom of the sinkhole.

Feature L (?) rectangular platform
Dimensions: 3.10 m (200°) x 2.30 m x 0.35 m high
Condition: fair
Constructed of boulder-size limestone chunks and slabs. Fill is composed of cobble-size material. Surface is irregular. The area shows evidence of bulldozer disturbance. Several small mounds are located nearby. A piece of coral was found adjacent to east side of platform.

Significance: BPBM Site 269; State 1752 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain, indigenous religious practices, and indigenous physical anthropology.

Site number: BPBM 270; State 1753; Temporary B-E6-2
Location: survey area E6; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, herbs, *wiliwili*, and banyan
Dimensions: 420.0 m (348°) x 201.0 m (8.44 hectares)
Description: habitation and agricultural complex (19 features)

Feature A (transportation) trail
Dimensions: 456.0 m (340°) x 1.5 m x 1.0 m high
Condition: fair
Trail bordered by parallel alignments of limestone slabs, frequently set in pairs, often on edge (uprights). Parts of the trail are disturbed by bulldozer activity. Recent bottles are present on the trail, and a barbed-wire fence crosses it. Debris from a plane crash is scattered throughout the vicinity.

Feature B (agricultural?, military?) modified sinkhole
Dimensions: 4.5 m x 4.0 m x 0.8 m high
Condition: very good
Stacked wall (above dimensions are for area enclosed by wall) constructed of upright and stacked slabs encloses sinkhole (1.6 m deep, 1.9 x 1.5 m floor). Floor of sinkhole is soil; a "ballpoint pen" and several pieces of coral were on the surface. Wall is in very good condition, possibly military related.

Feature C (burial?) cairn, collapsed
Dimensions: 4.0 m (134°) x 3.0 m x 1.3 m high
Condition: poor

Large limestone slabs and chunks form the base and outline of this feature. One side is nicely faced, and the other side is collapsed. An internal chamber is visible where the side collapsed.

Feature D (habitation) irregular enclosure
Dimensions: 9.0 m (66°) x 4.0 m x 0.6 m high
Condition: poor
In plan this feature resembles two J-shape enclosures, back-to-back. Structure is constructed of stacked slabs with some core-filled portions. Upright-slab facing is present. One probable cupboard is visible.

Feature E (former enclosure wall?) L-shape wall
Dimensions: 6.0 m (160°) x 4.0 m x 0.6 m high
Condition: fair
Upright-slab-faced and core-filled wall construction characterizes this feature. A well-constructed cupboard is present in one wall.

Feature F (habitation) U-shape
Dimensions: 4.1 m (250°) x 2.5 m x 0.7 m high
Condition: good
Feature has stacked-slab walls with several upright-slab-facing stones. Floor is level soil. Historic debris is present in the area, including a plane wreck, cinder block, and lumber. A piece of lumber, probably added after construction, protrudes from one wall.

Feature G (trail marker) fallen upright (Feature A)
Dimensions: 0.6 m x 0.3 m x 1.7 m high
Condition: good
This is one of the uprights bordering the Feature A trail. It was separately recorded due to its extremely large size.

Feature H (habitation) U-shape
Dimensions: 4.60 m (274°) x 3.30 m x 0.45 m high
Condition: fair-good
Constructed of roughly-stacked large cobbles and small boulders, and opens to the west. Floor is soil covered. Mounds are present in the area (1.0 m to 2.0 m in diameter).

Feature I (burial) modified sinkhole, (possibly Soehren's [1962] Site B6-9)
Dimensions: 2.5 m (108°) x 2.0 m x 2.3 m deep
Condition: ?
Sinkhole contains a deposit with human and bird bone. Modification consists of a crude wall on the surface near the opening (1.4 m long x 0.7 m wide x 0.4 m high). Floor of sinkhole has soil deposit. The human bones appear to be those of a young adult.

Feature J (?) modified sinkhole
Dimensions: 2.5 m diameter x 0.7 m high
Condition: fair-good
Sinkhole with wall present below the opening (above dimensions are for the wall). Floor area of sinkhole is c. 3.0 m in diameter. Wall is

stacked, medium cobble-size slabs. No indication of habitation observed. A wood slat was noted on the floor of the sinkhole.

Feature K (habitation) C-shape
Dimensions: 2.3 m (5°) x 0.8 m x 0.5 m high
Condition: good
Walls are constructed of roughly stacked material, large cobble to small boulder size, on an outcrop. A soil deposit is present in the interior.

Feature L (agricultural) modified sinkhole
Dimensions: 2.0 m (240°) x 1.3 m x 0.3 m deep
Condition: fair
This shallow sinkhole has two wall segments on the east and west sides that are c. 1.0 m apart. Walled area is 3.0 m x 2.0 m x 0.30 m high. Walls are 0.6 m wide, and are constructed of stacked, large, limestone chunks and slabs. Soil deposit is present in the sinkhole.

Feature M (agricultural) modified sinkhole
Dimensions: 4.0 m (200°) x 2.0 m x 0.6 m deep
Condition: poor-fair
Sinkhole is almost completely encircled by a rough-stacked wall of large cobbles to small boulders. Wall is 0.3 m high and 0.6 m wide. A soil deposit is present in the sinkhole.

Feature N (?) wall
Dimensions: 4.50 m (256°) x 0.75 m x 0.60 m high
Condition: poor
Low, curved wall segment constructed of stacked slabs. A very large sinkhole is 5.0 m away.

Feature O (?) modified sinkhole
Dimensions: 2.4 m x 2.4 m x 0.5 m high
Condition: good
Circular wall (above dimensions are for the wall) surrounds this sinkhole, which has ti growing in it. Wall is constructed of stacked cobbles and boulders. Floor of sinkhole covered with recent trash and old crate boards.

Feature P (habitation) enclosure
Dimensions: 6.0 m (250°) x 4.0 m x 1.0 m high
Condition: excellent
Feature has stacked and core-filled walls with interior facing, an entry, and a level soil floor. There is evidence for bulldozing and *kiawe* cutting in the area. Recent beer bottles (seventeen) are present in the structure.

Feature Q (habitation?) modified sinkhole
Dimensions: 9.60 m (280°) x 9.60 m x 0.85 m high
Condition: good
Double sinkhole with a large enclosure wall around it (above dimensions are wall). Wall is stacked and faced on the interior.

Bottles, grindstone, canine skeletal material, echinoderm, and fish bone present in sinkhole.

Feature R (?) modified sinkhole
Dimensions: 5.0 m (330°) x 1.0 m x 0.3 m high
Condition: poor
Above dimensions are for a wall that partially surrounds two sinkholes. The wall is constructed of stacked slabs, and is mostly collapsed. Both sinkholes are filled with chunks and slabs, possibly from the wall.

Feature S (habitation) C-shape
Dimensions: 4.25 m (352°) x 4.25 m x 0.45 m high
Condition: good
Constructed on an outcrop of stacked small cobble to small boulder-size limestone. No uprights. Shallow soil deposit is present in the interior.

Significance: BPBM Site 270; State 1753 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous utilization and settlement of the 'Ewa Plain.

Site number: BPBM 271; State 1754; Temporary B-E6-3
Location: survey area E6; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 101.0 m (348°) x 92.0 m (9292.00 m^2)
Description: habitation complex (12 features)

Feature A (agricultural?) feature remnant
Dimensions: 1.4 m (102°) x 2.2 m x 0.4 m high
Condition: poor
Feature consists of stacked material (cobble to boulder-size) forming either one mound/platform or two mounds. The east end has four upright slabs.

Feature B (agricultural?) modified sinkhole
Dimensions: 6.00 m x 4.00 m x 0.75 m high
Condition: poor
C-shaped wall (above dimensions are for wall) around a bell-shaped sinkhole (2.5 m deep and a 0.5 m diameter opening). Wall is constructed of stacked boulders and cobbles. Floor of sinkhole is rubble, with some soil fill.

Feature C (habitation) L-shape with attached pavement
Dimensions: 8.50 m (330°) x 7.50 m x 0.75 m high
Condition: poor-good
Walls are stacked, core-filled, and faced. Pavement has a fairly level surface of tightly packed chunks, with boulder-size material around perimeter. Interior of L-shape has soil floor.

Feature D (habitation?) enclosure
Dimensions: 3.1 m (200°) x 3.0 m x 0.9 m high
Condition: good
This enclosure has an attached cairn. The walls are stacked, with upright slabs used to face the exterior. The cairn measures 2.2 m x 1.9 m x 0.7 m (L x W x H). Interior has soil fill with some rubble. Feature appears to be too small to be a habitation.

Feature E (habitation) enclosure
Dimensions: 6.0 m (66°) x 4.0 m x 0.5 m high
Condition: fair
Feature has stacked and core-filled walls of cobble to medium boulder-size material, including slabs. Interior has soil deposit, with some rubble on the surface. Feature E attached to Feature D.

Feature F (burial?) collapsed cairn
Dimensions: 2.30 m (140°) x 2.30 m x 1.35 m high
Condition: fair
Constructed of stacked limestone chunks and slabs, with some core filling and no uprights. Some wall segments have a narrow core-fill. The surrounding area is level soil, which is unusual in this vicinity. Some evidence of bulldozing in the area.

Feature G (burial?) collapsed cairn
Dimensions: 1.80 m x 1.80 m x 0.68 m high
Condition: poor
Cairn is constructed of stacked, small to medium cobble-size material. Only one portion is faced. The area around the feature is level, with some soil and many outcrops.

Feature H (agricultural) modified sinkhole
Dimensions: 7.50 m x 7.50 m x 0.95 m high
Condition: fair-good
The above dimensions define an area containing three walled, shallow sinkholes. Walls are of stacked construction. Sinkholes vary in diameter, from less than 1.0 m to 2.5 m. A young *kiawe* tree is growing from one of the sinkholes.

Feature I (habitation) enclosure
Dimensions: 5.0 m x 5.0 m x 0.5 m high
Condition: fair
Feature has stacked walls of uniform-size material, with one portion of the interior faced. A large outcrop is present at the entrance to the feature. The enclosure walls are partially collapsed. The structure may be constructed over a sinkhole.

Feature J (burial?) cairn
Dimensions: 2.3 m (280°) x 2.0 m x 0.7 m high
Condition: poor
Constructed of stacked material, with boulder-size stones used in the lower courses. The stones are darkly stained. Bulldozer disturbance is visible in the area. Several small sinks and depressions are located nearby.

Feature K (burial?) cairn
Dimensions: 1.9 m x 1.7 m x 0.9 m high
Condition: fair
Large cairn constructed of stacked limestone slabs and chunks. Structure is faced on the SW side. Surrounding area is very disturbed.

Feature L (burial?) collapsed cairn
Dimensions: 1.40 m x 1.40 m x 0.75 m high
Condition: very poor
Cairn is constructed of stacked limestone chunks and slabs. Disturbance by tree roots reveals a midden deposit 0.18 m thick, containing *Tellina*, cowrie, *Nerita*, land snails, and charcoal. A modern amber glass bottle is located nearby.

Significance: BPBM Site 271; State 1754 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation use of the 'Ewa Plain, indigenous religious practices related to treatment of the dead, and indigenous physical anthropology.

Site number: BPBM 272; State 1755; Temporary B-E6-4 (Figs. 19, 20, 21, and 22)
Location: survey area E6; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, sisal, and herbs
Dimensions: 101.0 m (258°) x 84.0 m (8484.00 m^2)
Description: habitation complex with historic component (12 features)

Feature A (religious?) enclosure
Dimensions: 4.5 m x 4.0 m x 0.8 m high
Condition: good
Large enclosure with a paved interior and no entryway. The walls are stacked, core-filled, and uniformly faced. Two fruit juice cans were found on the surface.

Feature B (habitation) enclosure
Dimensions: 7.0 m (70°) x 6.5 m x 0.7 m high
Condition: fair
The walls are stacked and well faced on the exterior. No upright slabs were used in the facings. There is an attached wall (Feature C) that is roughly stacked. Midden is exposed in the roots of a fallen *kiawe* tree, and includes coral, fish bone, land snails, echinoderms, and crustacea.

Feature C (boundary marker) enclosure wall
Dimensions: 50.00 m (335°) x 0.40 m x 0.75 m high
Condition: fair

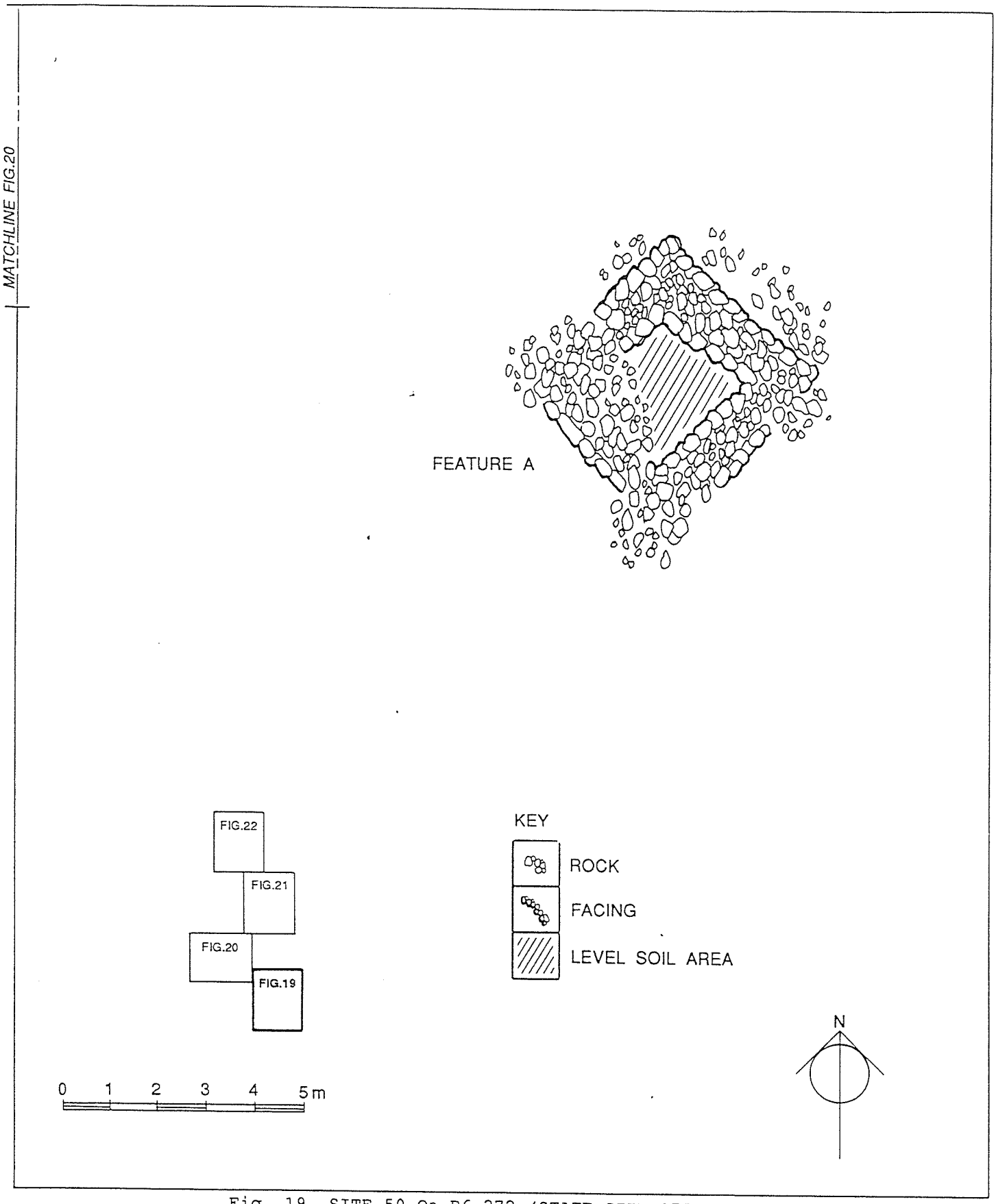


Fig. 19. SITE 50-Oa-B6-272 (STATE SITE 1755),
Fe. A. Map 1 of 4.

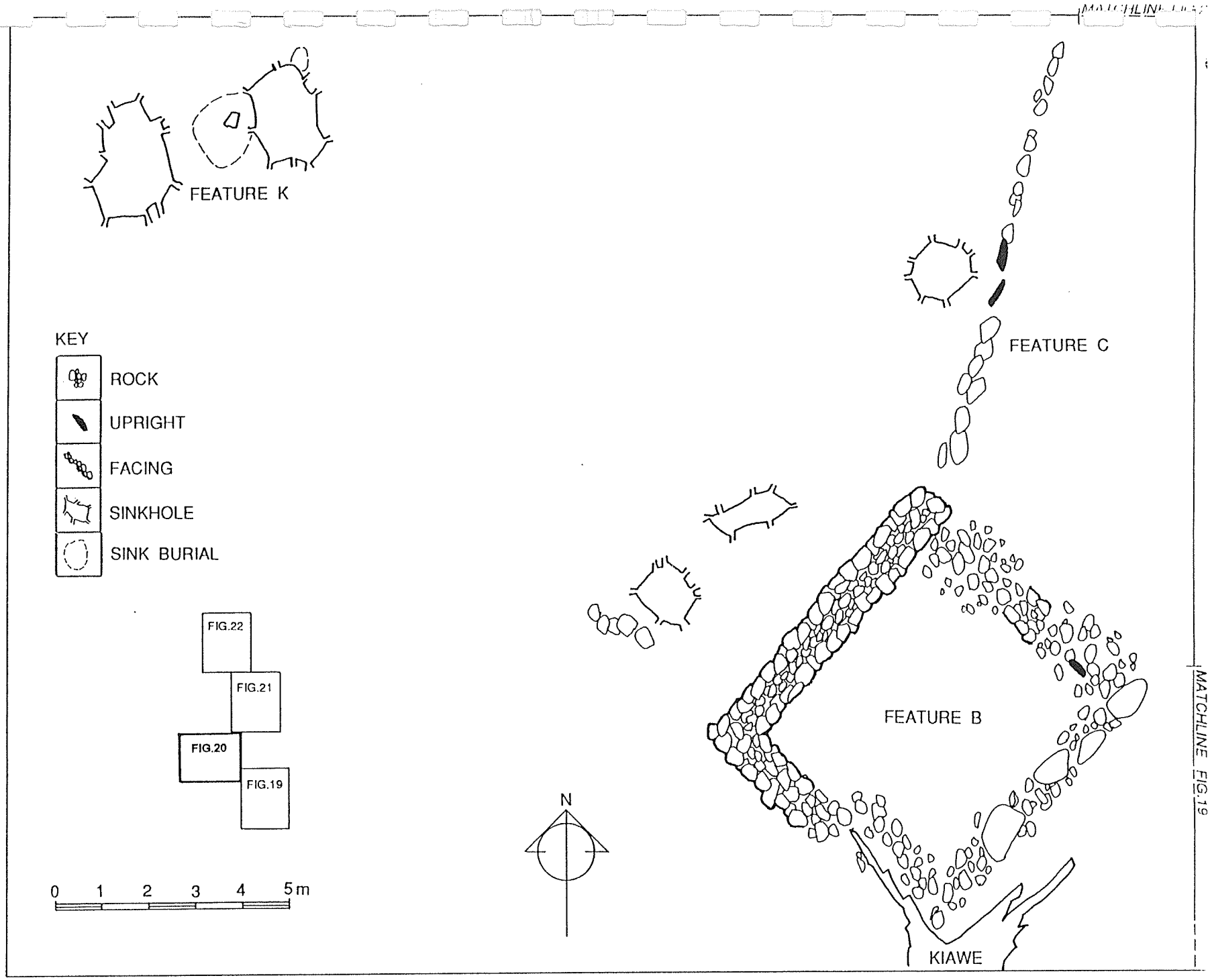


Fig. 20. SITE 50-Oa-B6-272 (STATE SITE 1755),
Fe. B, C, AND K. Map 2 of 4.

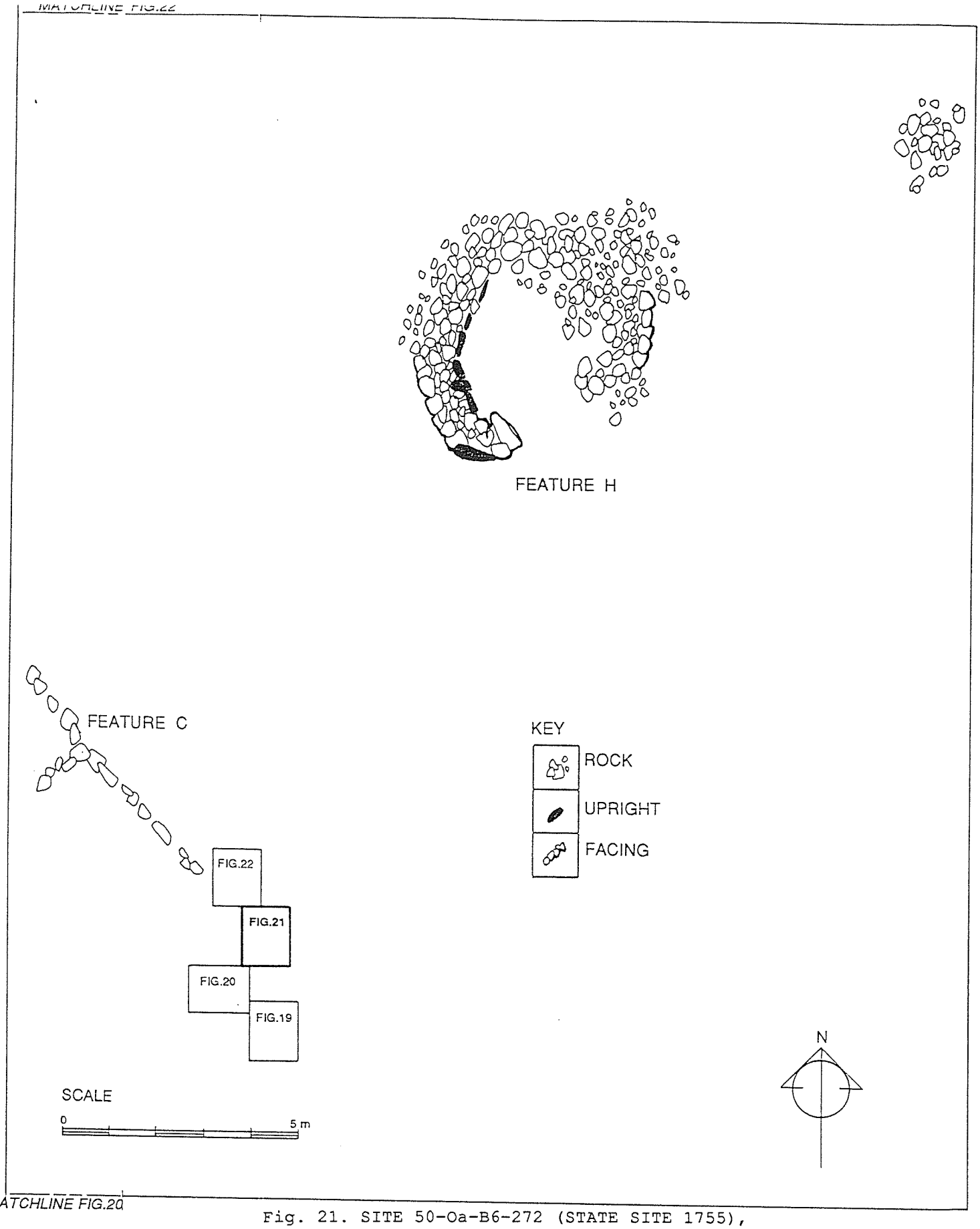


Fig. 21. SITE 50-Oa-B6-272 (STATE SITE 1755), Fe. C AND H. Map 3 of 4.

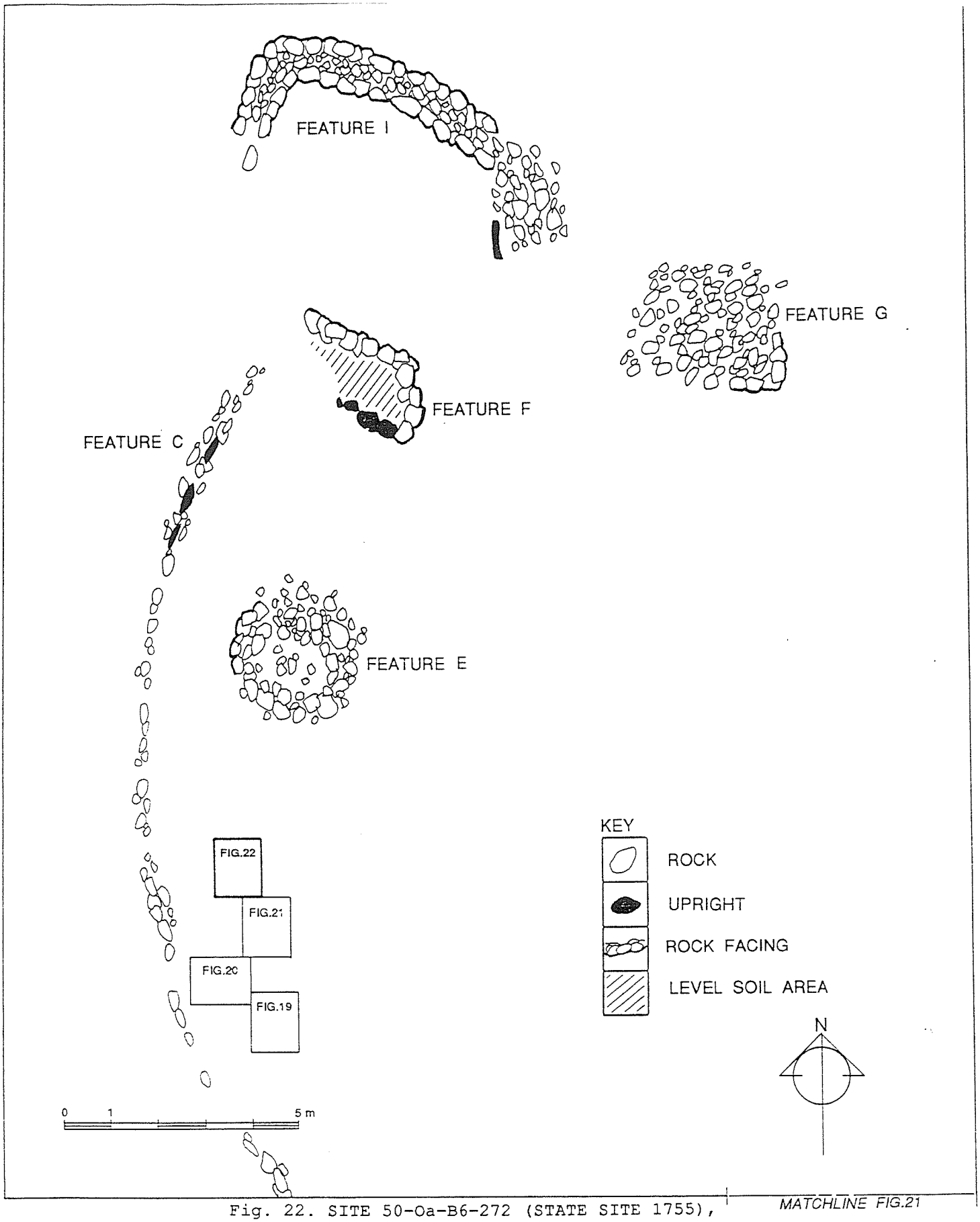


Fig. 22. SITE 50-Oa-B6-272 (STATE SITE 1755), Fe. C, E, F, G, AND I. Map 4 of 4.

The wall is constructed of stacked cobbles and small boulders, with occasional upright-slab facing. A perpendicular wall connects this wall and Feature B. Historic artifacts present near the feature include wooden planks, tin, bottles, and a half barrel. The wall has occasional breaks, and is probably historic.

Feature D (boundary marker) wall
Dimensions: 2.80 m (322°) x 0.80 m x 0.35 m high
Condition: good
This feature is a short wall segment that is crudely constructed of stacked boulders with a few cobbles.

Feature E (burial?) collapsed cairn
Dimensions: 3.10 m (135°) x 3.10 m x 0.85 m high
Condition: fair
Partially collapsed cairn constructed of stacked chunks, some slabs, and no uprights. Military and historic debris present in the area.

Feature F (habitation?) U-shape
Dimensions: 3.75 m (320°) x 1.70 m x 0.50 m high
Condition: fair
Constructed of stacked limestone chunks and slabs. An internal soil deposit is present. Historic debris is present on the surface around the feature, but none within.

Feature G (burial?) collapsed cairn
Dimensions: 3.75 m (136°) x 3.75 m x 0.70 m high
Condition: poor
Mostly-collapsed cairn constructed of stacked, medium cobble-size material. Historic debris surrounds the feature.

Feature H (habitation) C-shape
Dimensions: 7.0 m (230°) x 4.0 m x 0.7 m high
Condition: fair
Constructed of stacked, large cobbles and small boulders; some upright-slab facing in the interior. Floor is soil with some rubble.

Feature I (sisal production?) enclosure
Dimensions: 7.0 m (320°) x 3.5 m x 0.8 m high
Condition: fair
Size of stacked building stones in wall is quite varied; no upright-slab facing is present. There is much historic debris around feature, including cans and bottles. Feature is possibly related to sisal production, based on historic material around feature and sisal area 400.0 m to the north.

Feature J (sisal production) wall
Dimensions: 75.00 m (90°) x 2.00 m x 0.35 m high
Condition: poor
Multiple-stacked wall incorporating some uprights. Historic material is present on both sides of the wall and on top of it. Sisal is growing in the area.

Feature K (burial) sinkhole
Dimensions: 1.2 m x 1.2 m x 1.6 m deep
Condition: ?
An apparent burial consisting of a human skull and several vertebrae was noted in one of two adjacent sinkholes. The other sinkhole contains recent historic trash.

Feature L (?) cairn
Condition: poor
Feature is stacked, core-filled, and faced with small slabs.

Significance: BPBM Site 272; State 1755 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous occupation and use of the 'Ewa Plain, indigenous religious practices related to treatment of the dead, indigenous physical anthropology, and information related to historic agricultural use of the area.

Site number: BPBM 273; State 1756; Temporary B-E6-5
Location: survey area E6; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, and herbs
Dimensions: 67.0 m (348°) x 42.0 m (2184.00 m^2)
Description: indigenous habitation and burial(?) and historic(?) wall (3 features)

Feature A (habitation) enclosure
Dimensions: 4.0 m x 3.5 m x 0.8 m high
Condition: fair
Stacked and core-filled slab walls, interior faced. Floor is level soil, with stones fallen from the wall. South wall disturbed by fallen *kiawe* tree.

Feature B (burial?) cairn
Dimensions: 3.4 m (60°) x 3.0 m x 0.5 m high
Condition: good
Stacked/piled cobbles and small boulders, medium-size boulders around the perimeter.

Feature C (boundary marker?) wall
Dimensions: 6.00 m (360°) x 1.00 m x 0.45 m high
Condition: fair
Crudely-piled cobbles and small boulders. Another wall segment is 1.50 m to the west. It is 2.50 m long, 0.60 m wide, 0.35 m high, and bearing 326°.

Significance: BPBM Site 273; State 1756 appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for understanding indigenous utilization and settlement of the 'Ewa Plain, indigenous agriculture

on the 'Ewa Plain, indigenous religious practices related to treatment of the dead, indigenous physical anthropology, and indigenous patterns of marine exploitation along the 'Ewa Plain coast.

Site number: BPBM 274; State 1757; Temporary B-E-8-1
Location: survey area E8; elevation c. 3.0 m (10.0 ft); Honouliuli
Topography: emerged reef
Vegetation: *haole koa*, *kiawe*, vines, herbs
Dimensions: 5.0 m (348°) x 5.0 m (25.00 m^2)
Description: agricultural features (2 features)

Feature A (agricultural?) sinkhole, modified?
Dimensions: 1.0 m x 1.0 m x 0.9 m deep
Condition: poor
Sinkhole with several loose slabs around it, possibly some vague modification. *Noni* growing in sinkhole. Considerable deposit on floor; possibility of bird bone and midden being present, but not noted.

Feature B (agricultural?) sinkhole, ti
Condition: ?
Ti is growing out of sinkhole. Possibility of considerable deposit within sinkhole, with possibility of bird bone and midden, but none noted.

Significance: Significance of BPBM Site 274; State 1757 cannot be assessed with certainty without subsurface testing. The fact that traditionally cultivated and introduced plants are growing from sinkholes suggests agricultural use is a possibility. Testing would also confirm presence or absence of bird bone.

Site number: BPBM 275; State 532 ; Temporary B-E-9-1
Location: survey area E9; elevation c. 1.0 m (3.0 ft); Honouliuli
Topography: dune
Vegetation: grasses and shrubs
Dimensions: 1,678.0 m (73°) x 85.0 m (14.26 hectares)
Description: military features (eight features)

Feature A (military) bunker
Dimensions: 6.3 m x 3.2 m x 2.2 m high
Condition: fair
Reinforced concrete bunker with gun tracks. The walls are c. 0.29 m thick. The landward end is slightly higher than seaward end. This type of bunker has gun ports on both ends, and two internal rooms.

Feature B (military) bunker
Dimensions: 6.3 m (332°) x 3.2 m x 2.2 m high
Condition: fair

Reinforced concrete bunker with gun tracks. The walls are c. 0.29 m thick. The landward end is slightly higher than seaward end. This type of bunker has gun ports on both ends, and two internal rooms.

Feature C (military) bunker
Dimensions: 6.3 m x 3.2 m x 2.2 m high
Condition: fair
Reinforced concrete bunker with gun tracks. The walls are c. 0.29 m thick. The landward end is slightly higher than seaward end. This type of bunker has gun ports on both ends, and two internal rooms. Undercutting by wave action is removing sand from the front of the bunker.

Feature D (military) bunker
Dimensions: 6.3 m x 3.2 m x 2.2 m high
Condition: fair
Reinforced concrete bunker with gun tracks. The walls are c. 0.29 m thick. The landward end is slightly higher than seaward end. This type of bunker has gun ports on both ends, and two internal rooms. Undercutting by wave action is removing sand from the front of the bunker.

Feature E (military) bunker
Dimensions: 2.6 m x 2.6 m x 1.1 m high
Condition: fair
Reinforced concrete, just to west of constructed jetty, located just behind active beach zone. Has metal rungs and hooks for moving. Only bunker of this type. Walls are 0.3 m thick, has gun slits on all four sides, and depressed interior.

Feature F (military) bunker
Dimensions: 6.3 m x 3.2 m x 2.2 m high
Condition: fair
Reinforced concrete bunker with gun tracks. The walls are c. 0.29 m thick. The landward end is slightly higher than seaward end. This type of bunker has gun ports on both ends, and two internal rooms.

Feature G (military) bunker
Dimensions: 3.10 m x 3.10 m x 1.75 m high
Condition: fair
Reinforced concrete. Walls 0.31 m thick. Only bunker of this type. Eroded out onto active beach area. Front is one long gun slit; door in back. Front of bunker tilted towards the water.

Feature H (military) bunker
Dimensions: 6.3 m x 3.2 m x 2.2 m high
Condition: poor
Reinforced concrete bunker with gun tracks. The walls are c. 0.29 m thick. The landward end is slightly higher than seaward end. This type of bunker has gun ports on both ends, and two internal rooms. Bunker lies on an active beach, and has broken in to four large pieces due to undercutting by wave action.

Significance: BPBM Site 275, State 532, Feature A appears to qualify for nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of World War II military activities in the area.

Site Number: BPBM 294, State 2220; Temporary B-E-9-1

Location: survey area E9; elevation c. 1.0 m (3.0 ft); Honouliuli

Topography: dune

Vegetation: grasses and shrubs

Dimensions: undetermined (subsurface deposit)

Description: prehistoric habitation

(habitation) exposed cultural deposit
Condition: poor-excellent
Subsurface cultural deposit exposed in a wave-and tide-eroded bank. A variety of pit features and a slab-lined structure are visible. Deposit contains ash, carcoal, midden, fire-altered limestone, and a coral abrader. These deposits underlie several of the feataures of Site 275. A single 100 cm x 50 cm shovel pit was excavated.

Significance: Site 294, State 2220 appears to qualify for the nomination to the National Register of Historic Places. The site has yielded and is likely to yield information important for an understanding of indigenous utilization and settlement of the 'Ewa Plain, and indigenous patterns of marine exploitation along the 'Ewa Plain coast.

SHOVEL PROBES

Subsurface testing (shovel probes) was conducted at three sites: BM Site 50-Oa-B6-275, State Site 532, Feature A; B6-249, State Site 1732, Feature M; and BM Site B6-251, State Site 1734, Feature K. The excavations were principally designed to recover datable material (charcoal). Tests were conducted in suspected hearth features inside rectangular habitation enclosures (B6-249, State Site 1732 and B6-251, State Site 1734) and in a beach site (B6-275, State Site 532) containing ash lenses and charcoal stained fill (visible in a wave-cut bank). A description of these sites, excavations, results, and interpretations follows.

Site 50-Oa-B6-249, State Site 1732, Feature M (Shovel Probe 1)

Site B6-249, State Site 1732, is a large complex of twenty-two habitation, agricultural, and possible burial features. The site is unusual because several of the habitation structures consist of multiple adjoining enclosures, or rooms. Most of these multi-room structures have one or more limestone slab-lined cupboards, upright-slab wall facings, and slab-lined entryways.

At Site B6-249, State Site 1732, Feature M was selected for subsurface testing because it contained an apparent slab-lined hearth that was considered likely to produce datable materials. The feature is a large enclosure (8.0 m x 7.5 m) consisting of four interconnected rooms (Fig. 23). The two central rooms are square, with upright-slab faced interiors. The two attached rooms are roughly circular, and also have slab-faced interiors. Two cupboards and the probable hearth feature are constructed into the interior walls. The walls are core-filled, up to 1.0 m thick, and 0.6 m in maximum height.

The shovel probe (50 cm^2) was positioned to bisect the probable hearth. The excavation revealed the following stratigraphy (Fig. 23):

Layer I 0-6 cm	Surface layer of dark brown (7.5YR 3/2, moist) silt loam containing abundant decaying organic materials, twigs, *haole koa* seeds, land snails, and numerous fine roots.
Layer II 4-31 cm	Loosely compacted, dark brown (7.5YR 4/4, moist), very fine silt loam with angular to subangular limestone small cobbles and pebbles and land snails. Within the slab-lined area the fill is slightly darker. Cultural layer.

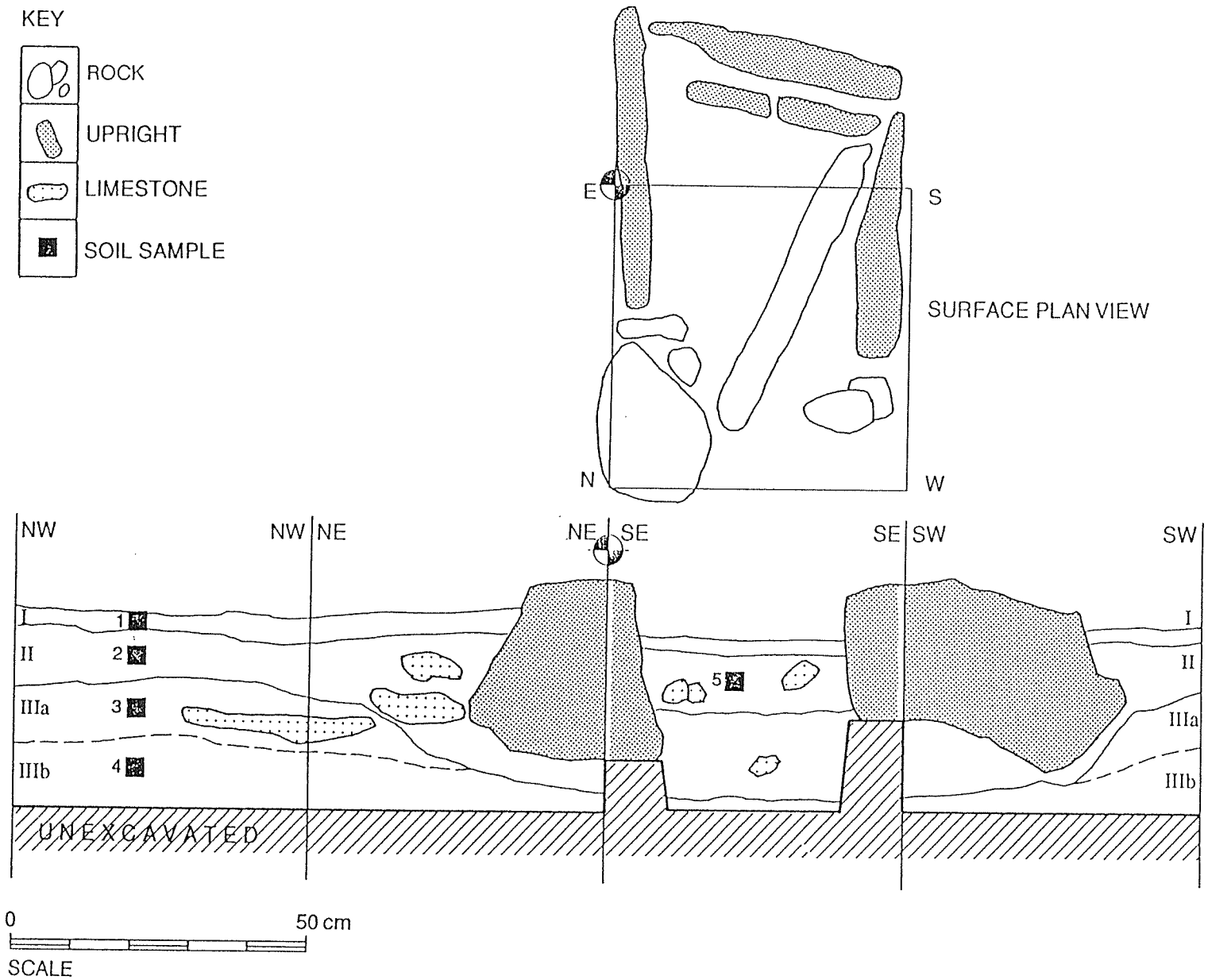


Fig. 23. SITE 50-Oa-B6-249 (STATE SITE 1732), Fe. M, SHOVEL PROBE 1.

Layer IIIA 12-28 cm — Loose, fine sandy loam, yellow (10YR 7/6, moist) containing land snails.

Layer IIIB 20-34 cm — Same as IIIa above except color is very pale brown (10YR 7/3, moist). Overlies limestone bedrock.

The apparent hearth lacked the characteristic fill containing large amounts of ash and/or charcoal, and is therefore probably not a hearth. The feature is probably another cupboard feature. The excavation did not produce sufficient charcoal for dating.

The excavation produced a variety of midden (see MIDDEN for distribution and discussion). Charcoal and coral fragments were also present. The cultural materials were primarily confined to Layers I and II; however, Layer II appears to represent the only culturally deposited stratum.

Site 50-Oa-B6-251, State Site 1734, Feature K (Shovel Probe 2)

Site B6-251, State Site 1734 is a large habitation and agricultural complex composed of 43 features. Feature K (Fig. 24) is a square enclosure with a slab-lined entryway centrally located in the SW wall. The feature is adjacent to a smaller square enclosure and to a number of sinkholes, several of which are modified.

The well-preserved Feature K enclosure has core-filled walls averaging 1.0 m in thickness and 0.66 m in height. The entire interior and most of the exterior walls are faced with upright slabs. Stacked slabs form the remainder of the exterior facing.

The shovel probe, 50 cm^2 in size, was positioned to bisect what appeared to be a slab-lined hearth, centrally located in the interior level soil floor of Feature K. The hearth is formed by two partially-burned lime-stone slabs set on edge, forming a right angle, and partially protruding above the soil surface (Fig. 24).

The excavation revealed the following stratigraphy (Fig. 24):

Layer I 0-3 cm — Moist, loosely compacted black (10YR 2.5/1, moist) silt loam, containing numerous fine roots, twigs, and decaying organic debris. Land snails are also present.

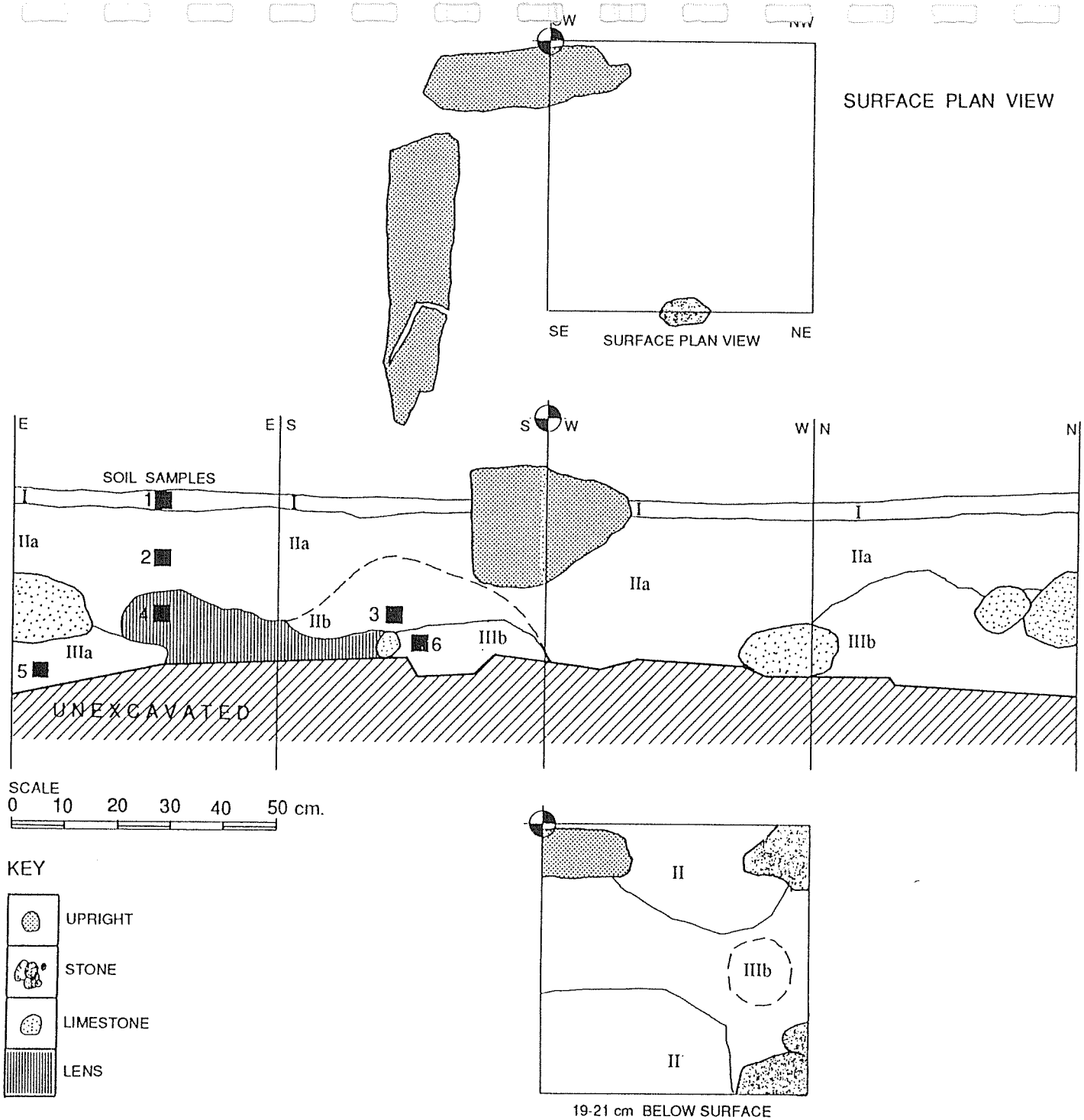


Fig. 24. SITE 50-0a-B6-251 (STATE SITE 1734), Fe. K, SHOVEL PROBE 2.

Layer IIA 2-33 cm	Moist, very friable, black (10YR 2.5/1, moist) silty clay loam, containing numerous fine and occasional medium roots. Fill includes a large amount of angular limestone gravel with some pebbles; most show evidence of fire alteration.
Layer IIB 11-26 cm	Moist, friable, very dark grayish-brown (10YR 3/2, moist) silty clay loam, containing numerous fine and occasional medium roots. Gravel and pebble content is same as IIa.
Lens A 16-30 cm	Moderately compacted black (5YR 2.5/1, moist) sandy clay to silty clay loam, containing abundant charcoal fragments; sample submitted for dating.
Layer IIIA 12-37 cm	Dark yellowish-brown (10YR 4/4, moist) sandy clay loam.
Layer IIIB 22-33 cm	Light yellowish-brown (10YR 6/4, moist) sandy clay. This layer overlies limestone bedrock.

The hearth lacked the typical ash and charcoal-laden fill usually associated with such features, suggesting that the two slabs did not mark a hearth, or that the feature was little used.

The excavation did reveal considerable evidence for use of fire in the form of scattered charcoal flecks and a lens of charcoal-stained fill and charcoal fragments (Lens A). This evidence was not restricted to the structure originally believed to be a hearth, as it extended outside and below the slab-lined area.

Lens A produced sufficient charcoal for a radiocarbon age determination. The sample produced an age of less than 160 radiocarbon years B.P. (Before Present--1950).

Midden remains from the excavation are discussed in the MIDDEN section. No historic or indigenous artifacts were forthcoming from the excavations. The cultural materials (midden, charcoal, fire-altered stones, and coral fragments) appear to be confined to Lens A and Layers IIa, IIb, and the uppermost part of Layer III. Layer II is probably the only culturally deposited stratum.

Site 50-Oa-B6-294 (State Site 2220) Feature A (Shovel Probe 3)

Feature A at this site is a subsurface cultural deposit exposed along a wave and tide-cut dune at Nimitz Beach Park (Fig. 25). The remnants of a

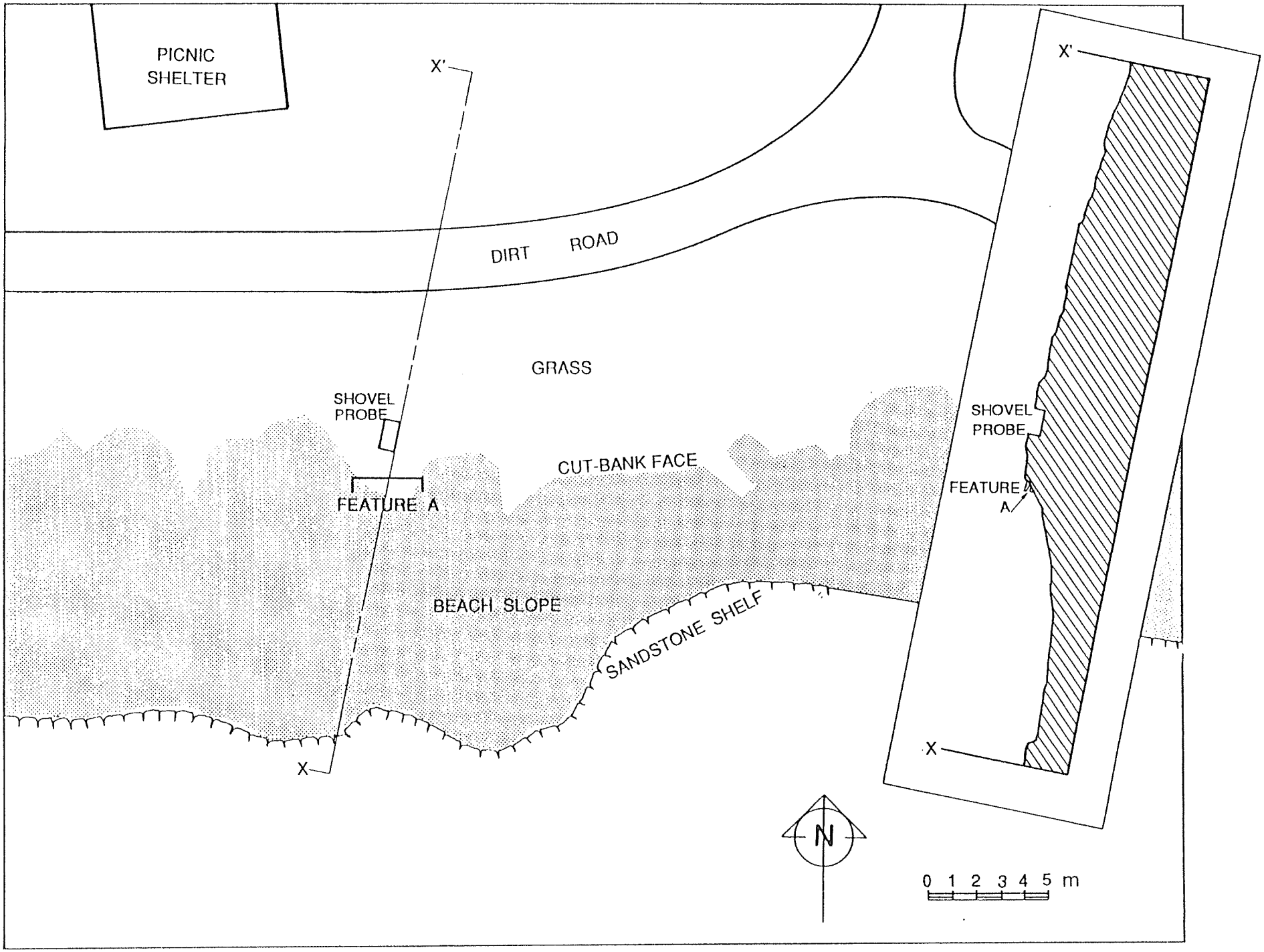


Fig. 25. SITE 50-Oa-B6-294 (STATE SITE 2220), Fe. A, SHOVEL PROBE 3.

probable limestone slab structure are visible in this eroded face (Fig. 26). The structure consists of a limestone slab pavement bounded to the west by an upright slab. Associated with the structure are two ash lenses that directly underlie the slab pavement.

The deposit contains charcoal fragments and charcoal-stained sand. Also present are angular burned limestone pebbles and small cobbles, fire-cracked vesicular basalt pebbles, and midden (fish bone, marine shell, and echinoderm remains). One coral file was removed from the cut-bank face, from just to the west of the upright slab and 15 cm below the surface.

Shovel Probe 3 (100 cm x 50 cm) was excavated into the upper surface of the deposit, 2.0 m inland from the exposed structure. The excavation was designed to determine the structure's extent, the depth and composition of the deposit, and to recover datable materials.

The excavation revealed the following stratigraphy (Fig. 27):

Layer I 0-7 cm	Loose grayish-brown (10YR 5/2, moist) very fine calcareous sand with numerous fine roots (sod layer).
Layer IIA 3-14 cm	Slightly compacted very dark grayish-brown (10YR 3/3, moist) very fine calcareous sand with numerous roots.
Layer IIB 10-23 cm	Slightly to moderately compacted very dark grayish-brown (10YR 3/3, moist) very fine calcareous sand with lighter gray to pale brown mottled areas.
Layer III 18-62 cm	Moderately compacted very dark gray (10YR 3/1, moist) to very dark grayish-brown (10YR 3/3, moist) very fine calcareous sand with scattered land snails.
Layer IV 37-71 cm	Moderately compacted very pale brown (10YR 7/3, moist) to pale brown (10YR 6/3, moist) very fine calcareous sand.

A variety of cultural materials (midden and artifacts) was recovered from the excavation. The midden types and distributions are presented in the MIDDEN section. Cultural materials from the site include the following:

0-9 cm (below surface)	Aluminum pop-top, amber beer bottle glass, sawed bone, wood stake or post) fragments, clear glass fragment, coral, and midden. (Layer I)
9-18 cm	Wood fragments, ground slate fragment, piece of amber glass, 2 chert or microcrystalline limestone flakes, charcoal, metal fragment, and midden. (Layer II)

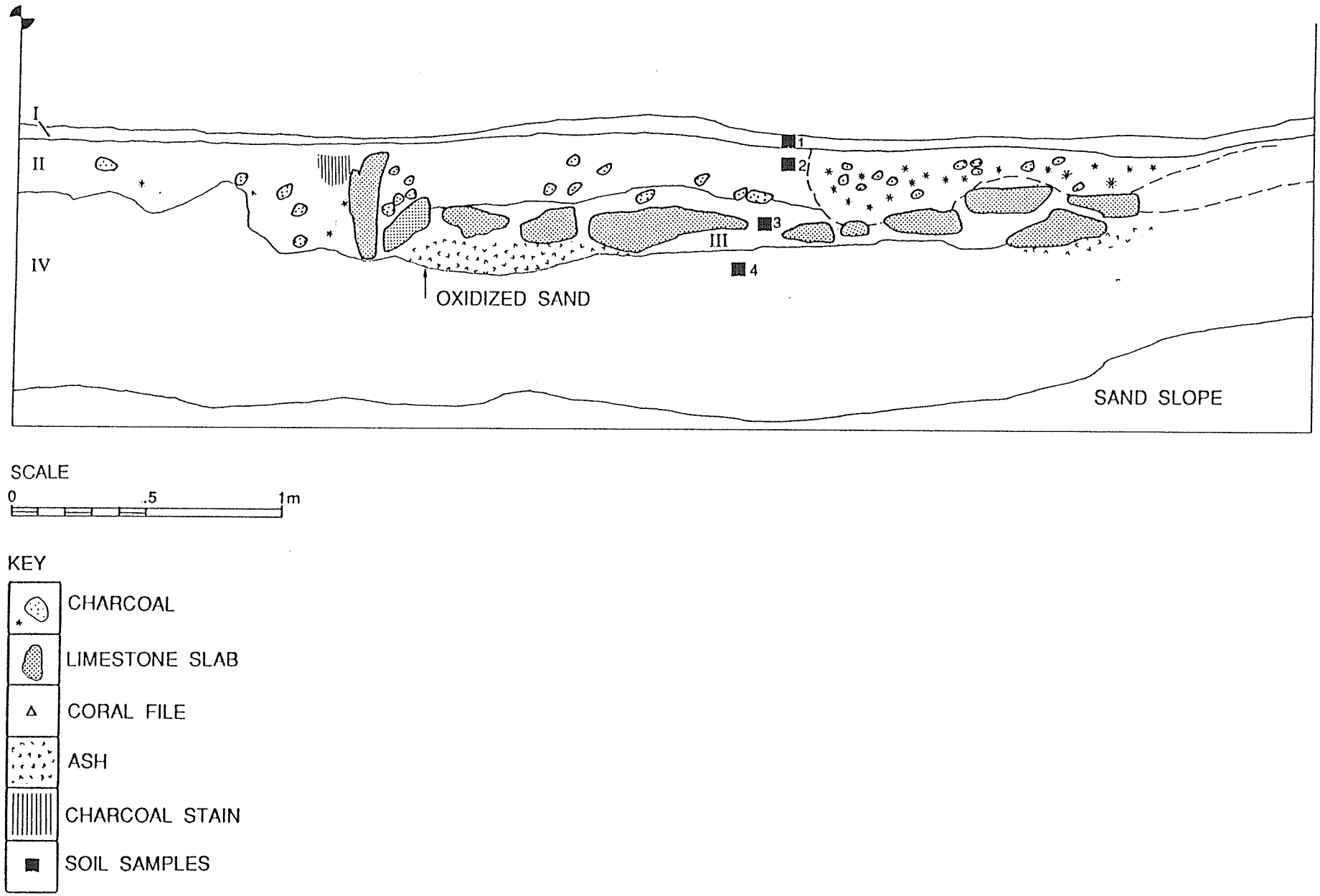
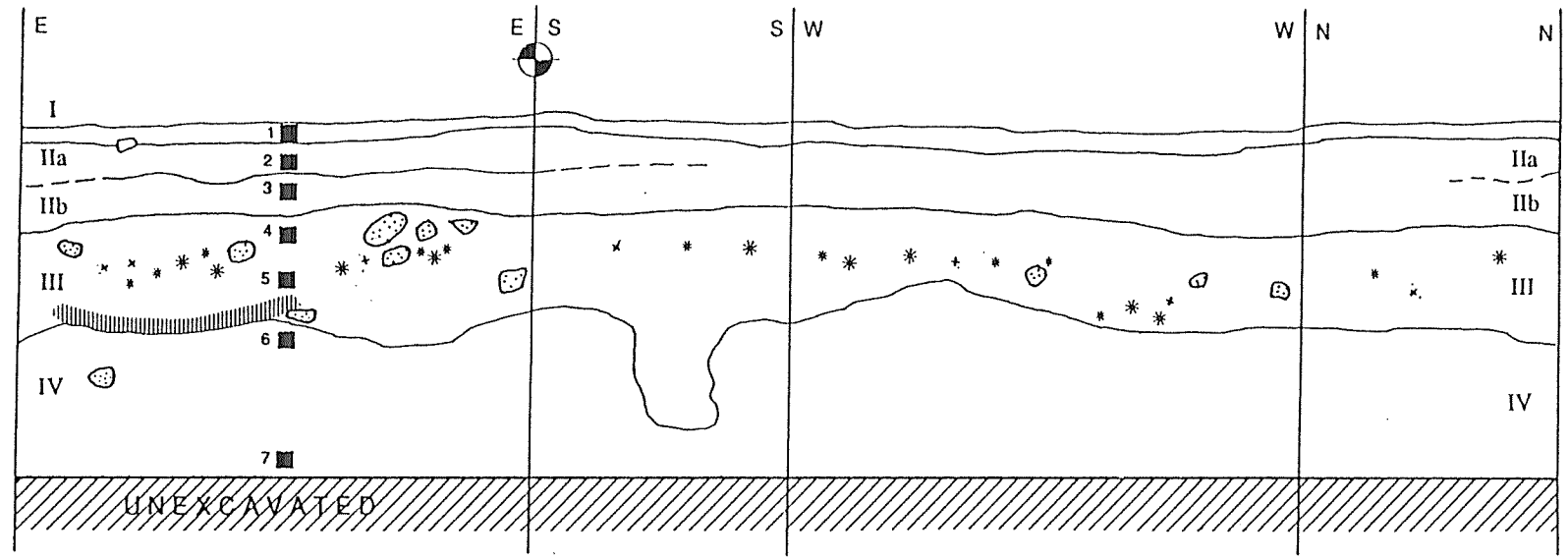
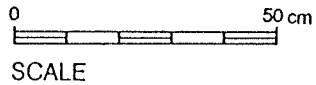
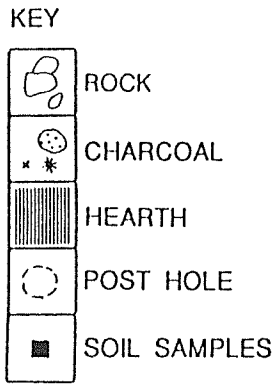
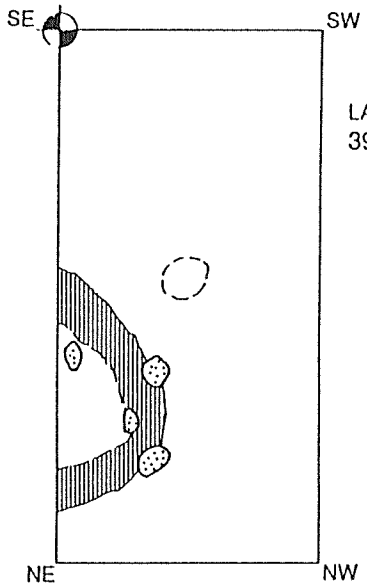


Fig. 26. SITE 50-Oa-B6-294 (STATE SITE 2220), Fe. A, WAVE-ERODED FACE.









LAYER III
39-40 cm b.d.

Fig. 27. SITE 50-Oa-B6-294, STATE SITE 2220, SHOVEL PROBE 3.

18-28 cm	Fire-altered limestone, charcoal, coral, basalt flake, chert or microcrystalline limestone flake, grindstone fragment, and midden. (Layers II and III)
28-40 cm	Charcoal, coral, and midden. (Layers III and IV)
40-51 cm	Charcoal, chert or microcrystalline limestone flake, and midden. (Layer IV)

The artifactual material from Layer I is very recent, reflecting the current recreational use of the area. Layer II, which is disturbed (mottled and truncated IIa-IIb contact), contains a mixture of historic (nonindigenous) artifacts with probable prehistoric materials (stone flakes and midden). Layer III contains only prehistoric materials and represents the earliest cultural deposition at the site. Cultural materials found in Layer IV are presumed to have originated in Layer III, as the contact between the layers is irregular, and at least one posthole originating in Layer III intrudes into Layer IV.

In the lowest portion of Layer III, at the contact with Layer IV, is a circular firepit or hearth feature, which is cross-sectioned in the east face of the excavation (see Fig. 27). The feature contained abundant charcoal, charcoal-stained sand, lighter areas of gray and white sand, and fire-altered limestone cobbles. Two probable postmolds were also noted; one is illustrated in the excavation plan (see Fig. 27), and the other is visible in the south face profile. Both appear to originate in Layer III.

The hearth feature contained enough charcoal for a radiocarbon age determination. The sample produced a C^{13}/C^{12} adjusted age of 270 $\pm$ 110 B. P. This date calibrates to three non-overlapping ranges of A.D. 1415-1815, 1840-1885, or 1915-1950 (Klein et al. 1981). The absence of historic material from the layer of the hearth supports a prehistoric age for the site, thus the earliest range is the most likely.

The shovel probe failed to intersect the limestone slab structure exposed in the wave eroded face, indicating the interior border of the structure lies somewhere in the intervening 2.0 m between the exposed face and the shovel probe. If the structure is a habitation, much of it has already eroded away.

The stratigraphy revealed in the excavation correlates well with that of the eroded face, and indicates that the landward extent of the cultural deposit continues beyond the shovel probe. The slab paving of the structure lies within a strata comparable, if not identical, to Layer III in the excavation.

MIDDEN

Small quantities of midden were forthcoming from the shovel probes. Marine invertebrate remains were not quantitatively analyzed because of the probable unrepresentativeness of the low volumes of midden and small size of the excavation units. Table 4 gives presence-absence (qualitative) data for each excavation unit by layer and depth.

A total of 10 mollusca genera are present: 7 gastropods and 3 bivalves. *Nerita* is the most common gastropod, followed by *Cypraea*, *Turbo*, *Littorina*, *Morula*, *Trochus*, and *Theodoxus*. Bivalves are represented by three genera: *Brachidontes*, *Tellina*, and *Isognomon*.

The genera present are typical midden constituents from other sites on the 'Ewa Plain, and include the most commonly utilized shellfish food resources. The genera present indicate exploitation of several marine habitats. *Isognomon* and *Brachidontes* are common in brackish-water habitats. *Nerita*, *Cypraea*, and *Isognomon* are typically found in surge zone and tidal pool marine habitats. *Trochus* is found in shallow water with a sandy substrate and scattered rocks (Key 1979:52).

Other marine invertebrates include echinoderms and crustaceans (crab). These were minimally represented at the inland sites (B6-249, State Site 1732 and B6-251, State Site 1734), and were common at the coastal site (B6-257, State Site 1740).

Fish remains, including scales and bone were recovered from Sites B6-275 (State Site 532) and B6-249 (State Site 1732). Only two fishbones were identifiable, representing at least one species of Balistidae, trigger fish. Trigger fish can be caught by a variety of methods, including angling, spearing, and netting (Kirch 1979:136).

Also present in the midden from Sites B6-257 (State Site 1740) and B6-249 (State Site 1732) were small fragments of unidentified mammal bone. These fragments were recovered from the lower levels at each site.

Surface midden scatters were noted at 22 features at 18 sites. The surface midden primarily consists of shellfish. Genera present include most of the types identified in the probes. Features associated with midden were usually either sinkholes or enclosures and were assigned habitation-related functions.

Table 4
SHOVEL PROBE MIDDEN

		B6-249 Feature M				B6-251 Feature K				B6-275 Feature A					
	Surface	I	II		III	I	II	II/III		I	II	II/III	Lens A	III/IV	IV
Midden		0-10*	10-19	19-29	29-32	0-3	3-11	11-21	21-36	0-9	9-18	18-28	35-41	28-40	40-51
MOLLUSCA															
Gastropods															
Cypraea spp.							x	x	x		x	x		x	x
Littorina sp.		x	x								x				
Morula sp.									x					x	
Nerita spp.		x	x	x	x	x	x	x	x	x	x	x	x	x	
Theodoxus spp.			x												
Trochus sp.							x								
Turbo sp.							x	x	x	x		x		x	
Bivalves (Pelecypods)															
Brachidontus				x		x	x	x	x	x	x	x	x	x	x
Isognomon				x		x	x	x	x			x	x		
Tellina sp.		x	x	x			x	x	x	x	x	x	x	x	
Unidentified															
Shell	x		x				x		x	x	x	x	x	x	x
Land snails		x	x			x	x	x	x				x	x	
CRUSTACEA (crab)							x	x			x	x	x	x	x
ECHINODERMATA			x	x	x				x	x	x	x	x	x	x
FISH															
Bone							x	x	x			x		x	
Scales							x	x	x					x	
MAMMAL (unidentified)							x					x		x	x
WOOD FRAGMENTS										x	x				
CHARCOAL			x				x	x	x		x	x	x	x	x
CORAL	x		x			x				x		x		x	
FIRE-CRACKED ROCK							x				x	x	x	x	
HISTORIC ARTIFACTS										x	x				
TRADITIONAL ARTIFACTS												x			

*Depth below surface (cm).

ARTIFACTS

A total of 19 artifacts was collected from surface and subsurface contexts at 5 sites. Uncollected artifacts were observed at 11 features at 9 sites. Table 5 lists the collected artifacts by type, site, and feature. Table 6 shows the distribution of surface artifacts that were not collected.

Tapa Beater. The most unusual artifact encountered during the survey is a well-preserved *tapa* beater (Fig. 28). This wooden artifact was found in a small cavity inside a large sinkhole that contained abundant midden. The specimen is round in cross section (45 mm in diameter; handle is 30 mm in diameter), and 360 mm in length. The beating part is longitudinally grooved at uniform intervals of c. 4 mm.

Tapa beaters are used in the production of bark cloth, usually from *wauke* (paper mulberry [*Broussonetia papyrifera*]). The grooved surface of the beater imparts a texture to the cloth. The specimen found is apparently a *hohoa*, or first stage beater. *Hohoa* are round, and are used in the initial processing of prepared bark. Second stage tapa beaters, *kuku*, are square and usually have different designs on each of their four surfaces (Pat Bacon, personal communication).

Stone Mortar. A fragment of a ground stone mortar or cup was recovered from a bulldozed area adjacent to Site B6-250 (State Site 1733). This specimen (Fig. 28) is ground on all surfaces, especially the upper surface of the lip. It is hemispherical in shape with a conical interior tapering to a hemispherical bottom. The artifact's dimensions are 82.5 mm (maximum width), 44.2 mm high, and averages 23.0 mm thick.

Three possible functions are attributed to similar artifacts by Bingham (1902:388-390), who refers to them as *kapuahi kuni 'anā'anā*: (1) to make a noise by pressing the wetted open surface against the body during dances (*hula*); (2) to do harm to an enemy by crushing a bit of the intended victim's hair, nail filings, or spittle, then casting the crushed material into his drinking water after repeating the proper incantations; or (3) as a "blistering cup" by the *kahuna lapa'au* (medical priest) for medicinal purposes.

Similar objects are known to have been used as lamps for burning *kukui* nut (candlenut [*Aleurities moluccana*]) oil. However, this specimen shows no discoloration or other evidence for this use.

Table 5
COLLECTED ARTIFACTS

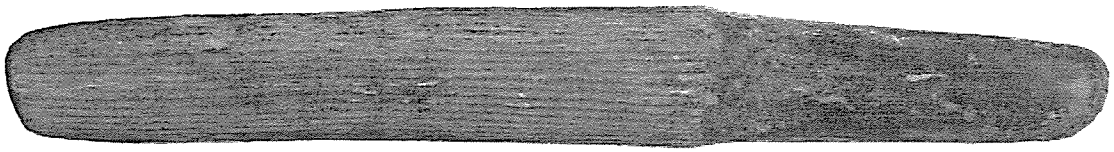
	Site (Feature)				
	241 (H)	244 (A)	250 (none)	254 (none)	294 (A)
Artifact type					
Tapa beater		1			
Stone mortar			1		
"Coffee bean" sinker	1				
Grindstone fragment					1*
Coral file/abrader					1
Flakes					
Basalt					1**
Volcanic glass				8	
Chert/microcrystalline limestone					4**
Ground Slate (Historic)					1**

*=Subsurface context
**from shovel probe

Table 6
SURFACE ARTIFACTS (NOT COLLECTED)

	Site (Feature)											
Artifact Types	238 (A)	240 (H)	241 (E)	241 (G)	242 (J)	249 (S)	251 (L)	252 (L)	254	270 (A)	270 (Q)	272 (B)
Hammerstone	1			1		1	1					
Coral abrader	3	1		1								
Scoria abrader							1					
Grindstone (Sandstone)									1		1	
Bone pick/awl	2											
Perforated *Conus* shell								1				
Flakes												
Basalt	+			+				1				
Chert/Micro-crystalline limestone	+			+								
Historic artifacts			+	+	+							

+ = more than one flake or historic item



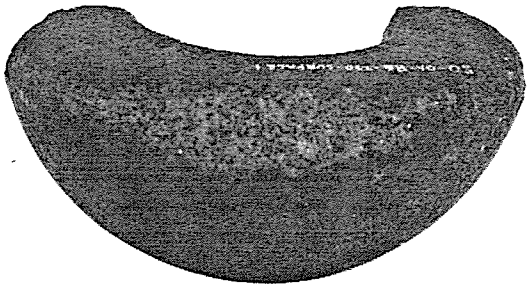


Fig. 28. ARTIFACTS FROM BARBER'S POINT. Top: Tapa Beater. Middle: Stone Mortar. Bottom: Stone Mortar, "Coffee Bean" Sinker, and Coral Abrader.

"Coffee Bean" Sinker. This artifact is ovoid in cross section, hemispherical on one side, and relatively flat on the other with a proximal groove extending completely around the long axis of the artifact (see Fig. 28). This artifact type was used as the sinker for an octopus lure. The lure is a composite device consisting of shaft and hook point lashed together with sennit. The flat side of the sinker is lashed to the shaft opposite a large perforated *Cypraea* shell, which functions as the lure.

Grindstones. A small fragment of a grindstone was recovered from the excavation at Site B6-275 (State Site 2220). This specimen is made from dense volcanic rock and is ground on two sides. Two other grindstones were observed during the survey; both are made from a sandstone-like material.

Abraders. One coral abrader was removed from the eroded bank at State Site 2000, Site B6-275 (see Fig. 28), and several more were recorded at three other sites. A scoria abrader was present at Site B6-251 (State Site 1734). These artifacts were used in the production of bone and shell ornaments and tools, especially fishhooks.

Stone Flakes. Pieces of flaked stone were recovered from surface and subsurface contexts. These materials were also observed at other sites, but were not collected. Types of stone represented include fine-grained basalt, chert or microcrystalline limestone, and volcanic glass. Flakes of the latter purposes. The other flakes are residue or detritus from the manufacture of larger stone implements.

Bone Picks. Two small bone picks or awls were observed at Site B6-238 (State Site 1721), Feature A. These were made from bird long bones.

Ornaments. One possible ornament, a *Conus* shell top with a central perforation, was recorded at Site B6-252 (State Site 1735), Feature L. The specimen is water-worn, and was probably collected by Hawaiians from along the coast.

Historic Artifacts. Only one historic artifact, a small piece of ground slate, was collected (from the shovel probe at Site B6-275 (State Site 532)). Other observed historic materials include bottles and a variety of metal objects. Military-related debris was very common and included everything from barbed wire and unexploded ordinance to fragments of aircraft.

SUMMARY AND ANALYSIS

The archaeological survey of selected areas at the Naval Air Station, Barber's Point, recorded a total of 43 sites (Bishop Museum site numbers 50-Oa-B6-234 to B6-275 and Hawai'i State site numbers 50-80-12-1717 to -1757 and -532). A total of 385 features were recorded in detail at these sites. Table 7 gives the total number of sites and features for each survey area and feature density.

Table 7
SITES AND FEATURES AT THE NAVAL AIR STATION

Survey Area	Total Sites	Total Features	Density*
A	11	73	0.45 (1.11)
B	1	1	0.03 (0.07)
D	1	1	0.02 (0.05)
E2	17	216	1.08 (2.67)
E3	1	3	0.11 (0.27)
E4	3	21	0.22 (0.54)
E5	1	1	0.01 (0.02)
E6	5	58	0.46 (1.14)
E8	1	2	0.02 (0.05)
E9	2	9	0.07 (0.17)

* Features per acre (per hectare)

Feature density ranges from a high of 1.08 features per acre (2.670 per hectare) in area E-2, to 0.01 per acre (0.02 per hectare) in area E5. The high density areas (A, E2, and E6) are the largest, relatively undisturbed areas on the facility.

As noted in the site description section, features were assigned a tentative functional designation. These designations are summarized in Table 8.

The majority of features, c. 93%, represent indigenous features. This includes features with multiple possible functions and unknown functions. Among the indigenous features for which probable or possible functions could be assigned (86% of total), 47% are habitation-related, 24% are agricultural,and 20% are burial; the remaining 9% have other functions.

Several research problems or topics were formulated in the Research Design to guide the research. These are addressed below on the basis of the available data.

Table 8
FEATURE FUNCTION CATEGORIES

Features	Probable	Possible(?) and Unknown	Total
Indigenous			
Habitation	109	25	134
Agricultural	48	19	67
Burial	6	50	56
Religious	0	4	4
Storage	0	1	1
Water Source	2	2	4
Boundary Walls/Alignments	18	0	18
Subtotal	183	101	284
Non-Indigenous			
Ranching/Agriculture	1	3	4
Military	9	6	15
Unknown	5	3	8
Subtotal	15	12	27
Multiple Possibilities		21	21
Unknown Function		53	53
Total	198	187	385

Chronology. As noted above, most of the archaeological remains recorded during the survey appear to date to before c. A.D. 1800. Previous archaeological research elsewhere at Barber's Point suggests inland occupation by the 15th century on the basis of volcanic glass dates. The results of two new radiocarbon sample analysis are now available from the present research.

The radiocarbon age of less than 160 years B.P. from Feature K at Site B6-251 (State Site 532) suggests a later time frame for interior occupation in the vicinity of the Naval Air Station, or assuming that as yet undated inland sites are as old as the apparent age of the oldest known Barbers Point site, that occupation continued for c. 300 years.

The date from the coastal midden deposit at Site B6-294 is problematic because of its multiple ranges; however, the most recent ranges (A.D. 1915-1950 and A.D. 1840-1885) can be ruled out based on the artifactual content of the dated deposit of the site (i.e., no historic artifacts). The remaining range of A.D. 1415-1815 is within the time period noted above for interior occupation elsewhere at Barber's Point.

Technology. Evidence for artifact manufacture is limited in the data available for the Naval Air Station. Artifacts (both collected and observed) reflect a variety of manufacturing activities: flaked and/or ground stone tool manufacture (flakes, hammerstones, and grindstones), fishhook or other bone or shell tool manufacture (coral and scoria abraders), and bark cloth (tapa) production (tapa beater). The two ground stone artifacts, a "coffee bean" sinker and a stone bowl, may have been locally produced, but the lack of locally available raw materials, apparent absence of significant quantities of manufacturing debris, and lack of sufficiently large grindstones for production of the stone bowl may indicate that these artifacts were manufactured elsewhere and transported to Barber's Point.

Bone picks, volcanic glass flakes, abraders, and grindstones may also testify to the fabrication of a variety products including cordage, thatch, bark cloth, and wood. They may also have been utilized for food procurement or processing.

Economy. The survey produced evidence for at least two components of the indigenous economy, agriculture and marine exploitation. Evidence for the third component, natural terrestrial faunal and floral exploitation, may also be present. The agricultural component is represented by the widespread evidence for surface modification and use of sinkholes. The former principally consists of extensive areas where the loose surface stones have been rearranged to create low mounds and cleared areas. Similar modifications elsewhere in Hawai'i are thought to indicate a combination of sweet potato and gourd cultivation. Sweet potatoes are planted in cleared areas where the soil has sufficient depth, and gourds are planted on the mounds where the stones provide a trellis for the vines and serve a water retention function by inhibiting evaporation.

The probable use of sinkholes for plant cultivation was described earlier in this century by McAllister (1933:109), who noted sugar cane and bananas still growing in them in the 1930s. Although neither of these indigenous cultigens was observed in the sinkholes at the Naval Air Station, ti and *noni* were. Ti (*Cordyline terminalis*) is an aboriginal introduction used for a variety of purposes, including thatch (leaves), raincoats, sandals, plates and food wrappers, famine food (root), and ritual (Neal 1965:203-204). *Noni* (*Morinda citrifolia*), also an aboriginally-introduced cultigen, served as a famine food and as a source of dye and medicine (ibid:804).

Probable cultivated sinkholes are usually too small for other types of habitation-related uses, contain a soil deposit, and often show some evidence

of partial walling on the surface adjacent to the opening. In general, these sinkholes are referred to as modified sinkholes, especially when walling or some other structural modification is present. The low walls are almost invariably oriented to protect the sinkhole from the prevailing winds (i.e., to the north to east side of the opening).

As noted above, tree and/or shrub crops were seen growing from the sinkholes in this century. These crops need protection from the wind, a sufficient soil deposit, and a source of moisture. The latter is facilitated by the depth of the sinkholes, which penetrate the surface of the limestone bedrock giving access either directly, or indirectly through small crevices, to the subterranean water table.

Other tree crops that may have been cultivated in the area are coconuts and *wauke* (paper mulberry). Coconuts are present in coastal areas today. The discovery of the tapa beater (used in the initial processing of bark) suggests the potential for *wauke* cultivation. This low tree or shrub could be cultivated in sinkholes, as ti and *noni* probably were.

Marine exploitation is well documented at sites elsewhere in the Barber's Point area. The evidence from the present survey area consists of a variety of marine invertebrate remains, including several species of shellfish, sea urchins, and crustaceans. As noted previously, the composition of the shellfish midden indicates that a variety of marine environments were exploited, including brackish-water ponds and sloughs, the surge zone and tide pools, and shallow nearshore, sandy bottom areas. Fish bone and scales provide direct evidence for exploitation of higher marine organisms by angling, netting, and/or spearing.

Aside from food remains, other evidence for marine exploitation is available. The "coffee bean" sinker was used to catch a larger marine invertebrate, the octopus. The admittedly meager evidence for fishhook manufacture provides additional evidence for a marine exploitation technology that included angling.

The third sphere of subsistence procurement, naturally occurring terrestrial fauna and flora, can only be inferred on very tenuous grounds. The presence of two bird bone picks at one site, and the frequent occurrence of bird bones with other habitation-related debris in some sinkholes may reflect exploitation of a variety of avian species. However, verification of this requires a much more detailed study involving extensive excavation, which is beyond the scope of the present project.

Settlement Patterns. The areas surveyed at the Naval Air Station during this project provided two of the largest continuous and relatively undisturbed land parcels surveyed at Barber's Point. Survey areas A and E2 contain a large number of well-preserved features, and each represents a slightly different set of local environmental conditions. Area A is primarily exposed coralline limestone outcrop with frequent deep sinkholes. In contrast, area E2, while still possessing a high percentage of outcrop, has fewer deep sinkholes and a more consistent soil cover.

An important question concerning the nature of settlement in the area relates to the relative permanence of occupation. Four potential indicators of permanence are: (1) architectural complexity; (2) feature density; (3) feature function variability; and (4) extent of habitation-related debris (artifacts and midden).

Many of the habitation structures discussed here are very substantial and architecturally complex (e.g., in survey area E-2) in comparison with other 'Ewa Plain sites. The often thick, carefully-constructed walls, are frequently faced with large limestone slabs (15 to 25 cm thick, and up to 1.0 m in diameter). These structures usually have one or more well-made cupboards and/or small storage rooms. Habitation structures are often composed of several units or rooms; however, the rooms sometimes appear to be additive rather than part of the original architectural design (e.g., Feature M; Site B6-249, State Site 1732). In general, these attributes indicate that many habitation features are not simple or crude "make-shift" structures, as is the case with temporary dwellings identified in areas such as interior Mākaha Valley (Green 1980). In contrast, many of the dwellings at the Naval Air Station appear to have been constructed for long-term occupation; either permanently or on a cyclical, perhaps seasonal basis.

The high density of features is another potential indicator of permanence. If, as the historical information appears to indicate, the area had a very low population density in the early to mid-1800s, and settlement began in the 15th century as suggested by archaeological data, then the majority of structures must have been constructed over a 300 to 400-year period. It is unlikely that individual complexes of features were constructed in a gradual or accretive fashion (i.e., one or two features per year) based on functional variability within the sites (see below).

Feature function variability within site complexes reflects a cohesive set of integrated functions. Most sites are composed of a large number of features, typically including habitation structures, agricultural features (in

addition to the nearly ubiquitous surface modification), possible burial features, and often a water source (deep sinkhole). These represent nearly the full range of features associated with a basic residential complex (Cordy 1981).

While potential problems exist with regard to the relative contemporaneity of features within sites, a reasonable case for coeval use can be made based on the relative state of preservation and the apparent high degree of functional integration. This inferred functional integration strongly suggests that the sites were probably occupied, on a sustained basis, for at least part of the year; possibly during a particular growing season.

One element of the pattern that does, however, appear to be lacking is specialized structures, especially large religious features. While there are a number of structures that may represent shrines, high status residences, and/or other specialized structures (such as men's houses), based on size, architectural form and/or associated materials (e.g., Features A and L, Site B6-249, State Site 1732; Feature A, Site B6-252, State Site 1735; Features G, H, and O, Site B6-254, State Site 1737; several features at Site B6-269, State Site 1752; Feature J, Site B6-265, State Site 1748; and Feature C, Site B6-266, State Site 1749), there are no features of the size and form typically considered to be large *heiau*. The nearest reported *heiau* is said to have been located on Pu'u Kapolei, c. 1 to 2 mi. inland from most sites at the Naval Air Station (McAllister 1933:108). Pu'u Kapolei is a very prominent hill on the 'Ewa Plain, and the *heiau* there may have been used by residents of the Plain.

The extent of habitation-related debris (midden and artifacts) is another potential indicator of permanence. Although this is difficult to assess without fairly extensive subsurface testing, surface evidence and the three probes do provide a basis for estimates. In general, surface midden is sparse and artifacts are rather infrequent. Cultural deposits are usually not stratified, however, at a least one site (B6-254), a substantial pile of fire-altered limestone, nearly 1.0 m high and several meters in diameter, is present. This pile probably resulted from long-term use of an *imu* (earth oven). Similar, but smaller, piles were noted at other sites.

This evidence does not appear to reflect a pattern one would expect from permanent, year-round occupation, however, it does not seem to indicate infrequent short-term occupation either. A reasonable compromise is that the extent of these materials suggests a semi-permanent, possibly seasonal, utilization of the area.

Taken together, the evidence for architectural complexity, functional variability, feature density, and the extent of midden and artifacts supports an interpretation of indigenous occupation as semipermanent, however, additional research is necessary to adequately test this.

RECOMMENDATIONS

A total of 40 sites recorded during the archaeological survey possess sufficient significance to be eligible for nomination to the National Register of Historic Places under criterion D. Two sites need to be further studied in order to make a determination. Table 9 provides a listing of eligible sites and their significance. Sites are considered to be significant if they have yielded and/or have the potential to yield information important for an understanding of one or more of the following:

(1) indigenous utilization and settlement of the region
(2) indigenous agriculture in the region
(3) indigenous patterns of marine exploitation
(4) indigenous religious practices
(5) indigenous physical anthropology
(6) historic land use (agriculture and/or ranching)
(7) World War II military history.

One other area of possible significance is the potential for palaeontological information (Significance 8 in Table 9). Fossil and subfossil bird bone assemblages, including several extinct species, have been recovered from sinkholes near the deep draft harbor on the west side of Barber's Point. Bird bone was noted in some sinkholes at the Naval Air Station, and is probably present in many more; however, subsurface testing by an avian palaeontologist would be necessary to evaluate their significance.

National Register nomination forms should be completed for all eligible sites. District nominations should be made for survey area A and one for areas E2, E6 and E4. The remaining sites should be nominated individually.

The condition or state of preservation of features at the Naval Air Station range from very poor to excellent. No determination of condition was possible for 51 features, because these are natural features, usually sinkholes, whose condition cannot be assessed without subsurface testing.

Table 9

SITE SIGNIFICANCE

Site Number 50-Oa-B6-	Significance* 1	2	3	4	5	6	7	8	Site Number 50-Oa-B6-	Significance 1	2	3	4	5	6	7	8
234	X			X	X				255		X						
235	X			X	X				256	X							
236	X								257	X			X	X		X	
237	X	X							258	X					X		
238	X								259		X						
239	X			X	X				260**								
240	X			X	X				261	X							
241	X			X	X				262		X						
242	X			X	X				263		X		X	X		X	
243	X			X	X				264	X							X
244	X					X			265	X					X		
245						X			266**								
246	X							X	267				X	X	X		
247	X			X	X	X			268	NOT ELIGIBLE							
248	X			X	X				269	X			X	X			
249	X			X	X				270	X			X	X			
250	X			X	X				271	X			X	X			
251	X			X	X				272	X			X	X	X		
252	X	X		X	X				273	X	X	X	X	X			
253	X								274	X	X	X	X	X			
254	X	X		X	X				275							X	
									294	X	X						

*(1) Indigenous utilization and settlement of the region, (2) indigenous agriculture in the region, (3) indigenous patterns of marine exploitation, (4) indigenous religious practices, (5) indigenous physical anthropology (6) historic land use (agriculture and/or ranching), (7) World War II military history, (8) potential for palaeontological information.

**Insufficient data for determination

A question mark was used for condition in the Inventory of Cultural Properties section for these features. The breakdown for conditions is as follows:

very poor	20	features	(05.0%)
poor	123	features	(32.0%)
poor to fair	16	"	(04.0%)
fair	95	"	(25.0%)
fair to good	17	"	(04.5%)
good	50	"	(13.0%)
excellent	13	"	(03.0%)
?	51	"	(13.5%)

The condition of features is a result of natural deterioration combined with the sources of damage discussed previously. In order to reduce the potential for further damage and deterioration of sites, and to ensure

compliance with all pertinent military, state, and federal orders, legislation, and guidelines, the following recommendations are offered:

(1) Restrict use of site areas to controlled pedestrian activity.
(2) Prohibit timber cutting, removal of stones, refuse dumping, any type of construction, and vehicular traffic until a determination of potential impact to sites can be made and appropriate mitigative actions taken.
(3) Protect and stabilize immediately the beach site (Feature A; Site B6-294) because it is actively eroding and being damaged by recreational use.

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NOTES ON THE HISTORY OF HONOULIULI

by Marion Kelly

The following notes on the history of land use in the area of the Naval Air Station, Barber's Point, 'Ewa District, are the results of general and specific searches for and into traditional and historical archival records; map and photographic collections; and documents recording specific agricultural ventures.

Barber's Point Naval Air Station is located in the *ahupua'a** of Honouliuli, in the district of 'Ewa, island of O'ahu, state of Hawai'i. 'Ewa District is the largest district on O'ahu, and Honouliuli, meaning literally "dark bay", is its largest *ahupua'a* (containing over 43,000 acres). The portion of Honouliuli in which Barber's Point Naval Air Station is located is the seaward portion between Kalaeloa (Barber's Point) and Pu'uloa, the land along the west side of the entrance to Pearl Harbor (Fig. A-1).

Descriptions of the land within Honouliuli between Pearl Harbor and Kalaeloa have usually agreed that the area was a dry plain that was sparsely populated. In 1839 E. O. Hall, a member of the mission, recorded his crossing of Honouliuli:

> Passing all the villages (after leaving Pearl River) at one or two of which we stopped, we crossed the barren desolate plain, at the termination of which is Barber's Point...[Hall 1839:92-112].
>
> The part of the island opposite to us was low or rather only moderately elevated, forming a level country between the mountains that compose the east [Ko'olau] and west [Wai'anae] ends of the island. This tract of land was of some extent but did not seem to be populous, nor to possess any great degree of fertility; although we were told that at a little distance from the sea, the soil is rich, and all necessaries of life are abundantly produced [Vancouver 1798(3):361-363].

**ahupua'a* = a subdistrict land division encompassing from 100 to 100,000 acres, running usually from the seashore to the mountains. In 1793 Vancouver observed the land from an anchorage off Pearl Harbor.

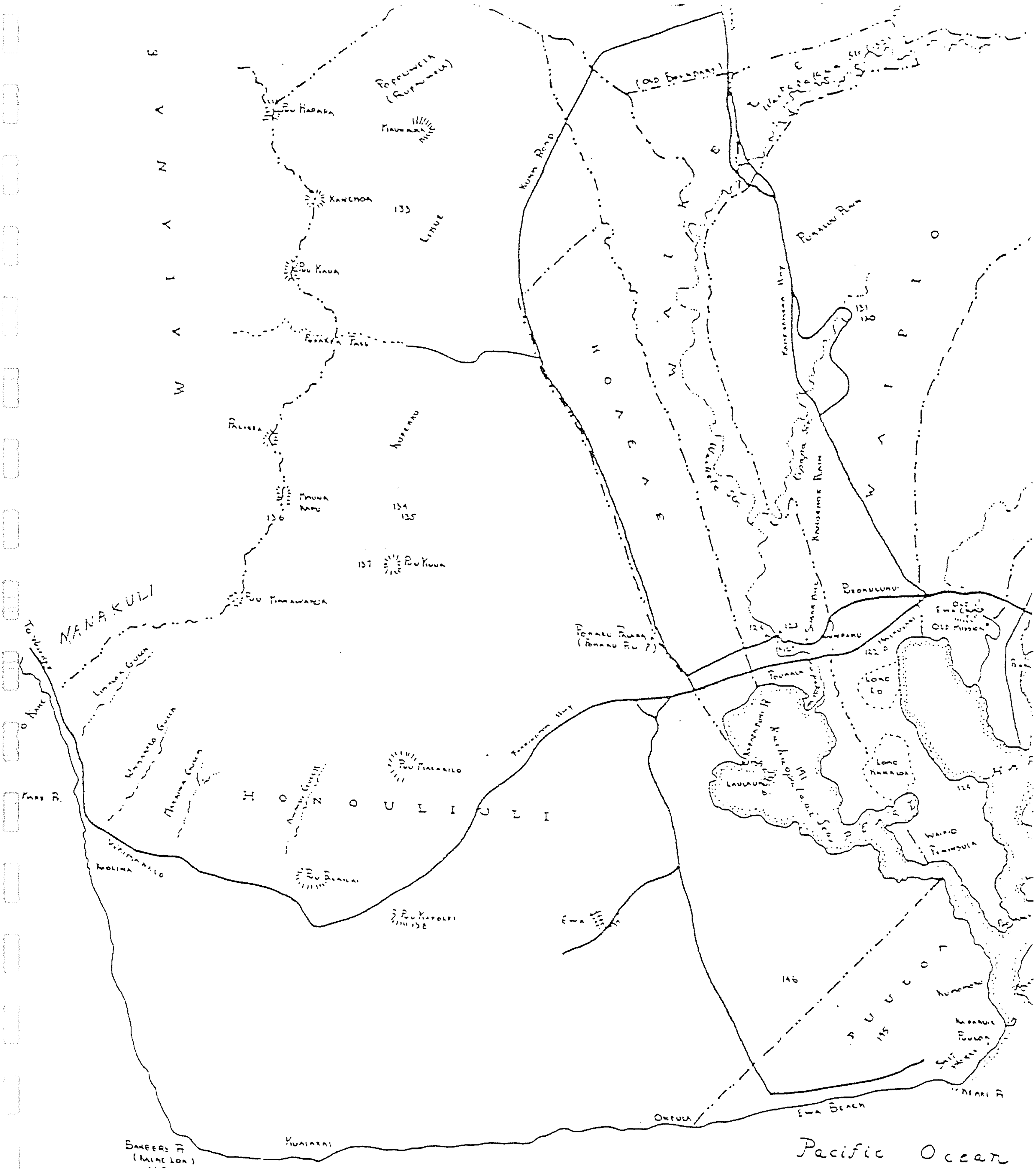

Fig. A-1. MAP OF HONOULIULI AHUPUA'A, 'EWA, O'AHU. Taken from Sterling and Summers 1978.

As his ships sailed along the coast Vancouver noted that he saw no evidence of any villages from Pu'uloa to the middle of the Wai'anae coast (ibid.). His cartographer, Lieutenant C. R. Malden, indicated on his map the presence of a few stone walls, a few trees, and enclosures in the Kualaka'i area on the southern seashore of Honouliuli (Fig. A-2).

Only one surviving early account describes the area in a rainstorm, probably a frontal *kona* storm. In 1828 missionary Levi Chamberlain was on a survey of O'ahu schools. The trip between Waimānalo [in 'Ewa] and the 'Ewa mission station, as a result of heavy rains, was made on roads that were "very muddy, and the traveling very bad....After walking three hours and most of the time in mud, we reached Honouliuli [mission station]" (Chamberlain 1957: 25-41).

ETHNOGRAPHY

Although there is very little information about how the arid plains of 'Ewa were used as a living and gardening area, the coastline of Honouliuli was once known as an area of abundant seafood: fish, lobster, crab, octopus, shellfish, and edible algae. Eleanor Williamson, whose *'ohana* (family) lived in the hamlet of Kualaka'i on the coast of Honouliuli (Fig. A-3), describes her familiarity with those seafoods.

> In the Honouliuli area the train stopped among the *kiawe* (algaroba) trees and *malina* (sisal) thickets. We disembarked with the assorted food bundles and water containers. Some of the Kualaka'i *'ohana* met us to help carry the *'ukana* (bundles) along a sandstone pathway through the *kiawe* and *malina*. The distance to the frame house near the shore seemed long.
>
> When we departed our *'ukana* contained fresh lobsters, *limu* (algae), fresh and *i'a malo'o* (dried fish)....Tutu ma (grandfolks and others) shared and ate the seafoods with great relish [Williamson n.d.].

Pu'uloa, in Honouliuli, was once an important food growing area with an attached fishery and productive fishponds and fishtraps. The finest *'o'io* (*Albula vulpes*) fish were caught at the west bank of the entrance to Pearl Harbor at Keahi Point. They were usually eaten raw, and those caught at Keahi Point were said to have a special fragrance, somewhat similar to that of *lipoa* seaweed, which is much esteemed by the older generation of Hawaiians. The

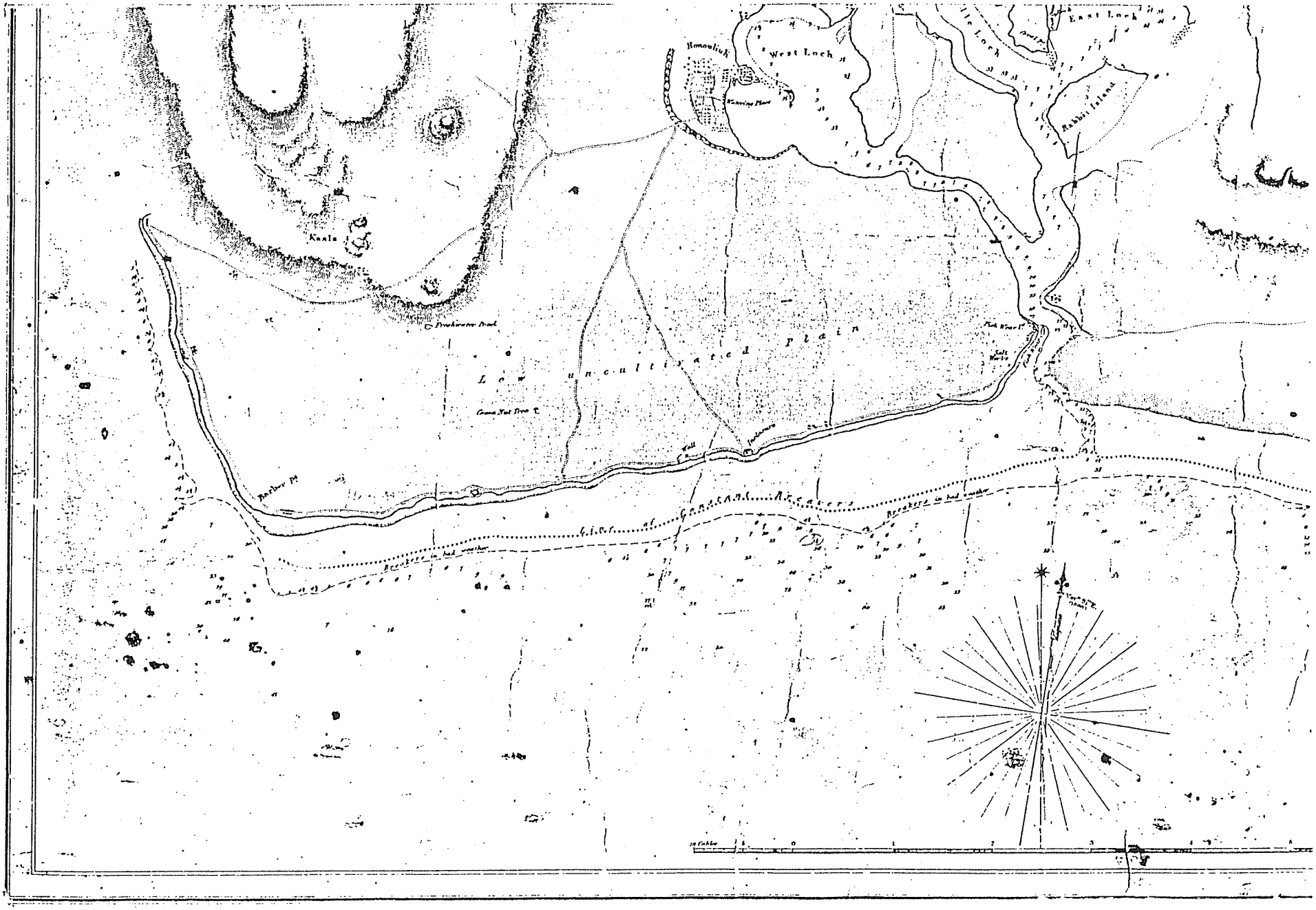

Fig. A-2. PORTION OF MAP OF SOUTH COAST OF WOAHOO, AND HONOLULU HARBOR. Surveyed by Lieutenant C.R. Malden, R.N. 1825.

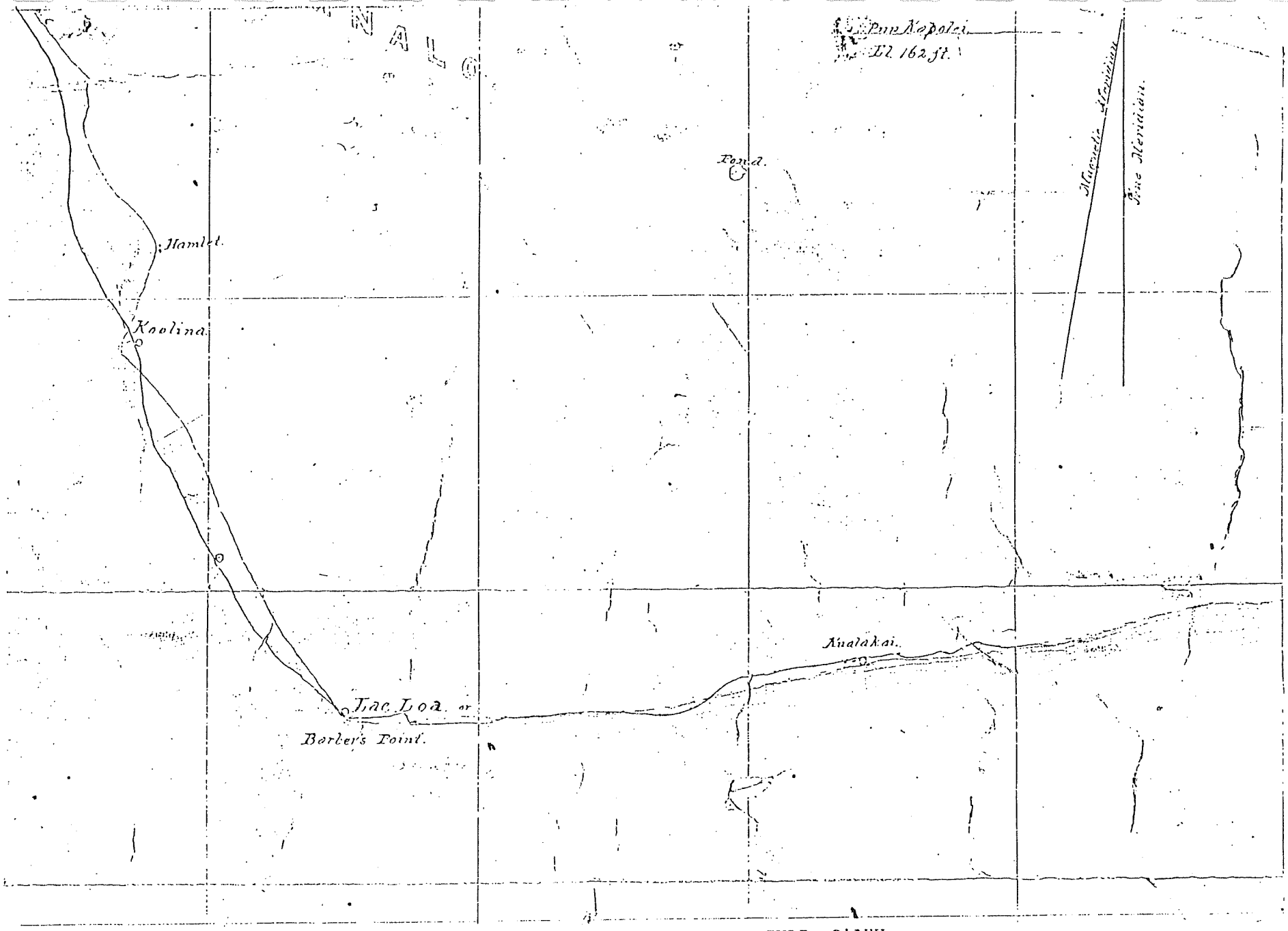

Fig. A-3. PORTION OF MAP OF HONOULIULI, O'AHU. Surveyed by W.D. Alexander, 1873. Reg. Map 405, State Survey Office.

coastal waters from Keahi Point to Kualaka'i were known as a source of *lipoa* seaweed, and are still used for that purpose. Keahi Point is also known for good surfing (Sterling and Summers 1978:44).

LEGENDARY HISTORY/FAMOUS PLACES

According to one tradition, 'Ewa District received its name from a legend about two Polynesian gods, Kane and Kanaloa, who came to O'ahu to survey the land:

> they reached Red Hill [and] saw below them the broad plains of what is now Ewa. To mark boundaries of land they would throw a stone and where the stone fell would be the boundary line. When they saw the beautiful land lying below them, it was their thought to include as much of the flat level land as possible. They hurled the stone as far as the Waianae range and it landed somewhere in the Waimanalo section. When they went to find it, they could not locate the spot where it fell. So Ewa (strayed) became known by that name. The stone that strayed [Sterling and Summers 1978:1].

The term 'Ewa, referring to the district, is spelled with a glottal stop and is defined as "crooked" (Pukui et al. 1974:28). "Strayed" is the definition given to the word *ewa* without an initial glottal stop (Pukui and Elbert 1964:39). The word *'ewa* with an initial glottal is defined as "crooked, out of shape, imperfect," which could also be applied to a stone that was thrown imperfectly, or crooked, and was therefore said to have "strayed" (ibid.).

Kalaeloa is known as a place where turtles used to inhabit (Sterling and Summers 1978:40). In one legend Pohaku-o-Kaua'i, near Kalaeloa, is said to be the home of a famous giant *kupua* (magical) fish, Uhumakaikai (ibid.:41). This fish taught Kawelo, a chief who lived in the time of the famous Kakuhihewa (mid-16th century), the art of fighting.

The arid plains of Honouliuli were marked by Hawaiian legends as the location of caves or pits (*lua*) where the hairless human beings (*'olohe*) lived when they first landed on O'ahu. These limestone caves are in the uplifted coral reef that makes up the 'Ewa Plain in the Barber's Point area, and were once found throughout the area now occupied by the Naval Air Station.

Another famous place is Pu'uokapolei, a prominent hill where the demigod Kamapua'a established the court of his grandmother, the sorceress Kamau-nui, also known as Kamaunua-niho (Beckwith 1940:202-203). She was an *ali'i* (chief) from Kahiki who came by canoe to O'ahu, and from whom the people of O'ahu, Kaua'i, and Hawai'i are said to descend. That is the reason why 'Ewa District was called the "celebrated land of the ancestors" (Kamakau 1964:68,84).

One of the most famous places in Honouliuli is the "plain of Kaupe'a" located next to Pu'uloa; located here is the *ao kuewa* or *ao 'auwana* (the realm of homeless, wandering souls). When people died and had no rightful place to go, their souls would wander "in the *wiliwili* grove of Kaupe'a on Oahu" (Kamakau 1964:47). These were friendless souls (*'uhane makamaka 'ole*) "who were not found by their family *'aumakua* [protective ancestor gods] and taken home with them or had not found the leaping places where they could leap into the nether world" (Judd and Barrere n.d.:7). These wandering souls "on the plain of Kaupe'a beside Pu'uloa...could go to catch moths (*pulelehua*) and spiders (*nanana*)" in the hope that they would be found by helpful *'aumakua* who could "save" them (ibid.:49).

It was in this area that a strange event took place in the 1920s, and was attributed to the "homeless ghosts" of the plain of Kaupe'a:

> We (my cousin, aunt and I) were walking to Kalaeloa from Pu'uloa accompanied by Teto, the dog. The dog was a native dog (not the so-called *poi* dog of today) with upright ears and a body the size of a fox terrier. For no accountable reason, Teto fell into a faint and lay still. My aunt exclaimed and sent me to fetch sea water at once, which she sprinkled over the dog saying, "*Mai hana ino wale 'oukou i ka holoholona a ke kaikamahine. Uoki ko 'oukou makemake ilio*" ("Do not harm the girl's dog. Stop your desire to have it".). Then with a prayer to her *'aumakua* for help she rubbed the dog. It revived quickly and after being carried a short way, was frisky and lively as ever. Then it was that my aunt told me of the homeless ghosts and declared that some of them must have wanted Teto that day because she was a real native dog, the kind that were roasted and eaten long before foreigners ever came to our shores [Sterling and Summers 1978:44; Pukui 1943:60-61].

One tradition names Pu'uloa in Honouliuli as the place where Kahai planted the first breadfruit tree that he brought to the Hawaiian Islands from

Samoa (Sterling and Summers 1978:41). Kahai is reputed to have lived in the middle of the 12th century (Fornander 1919-1920:313). The famous O'ahu *kahuna* (priest) Ka'opulupulu was killed by Kahahana's warriors at Pu'uloa, around 1782 (Kamakau 1961:133-134). Two of Kamehameha's chiefs, Ke-kua-manohā and Ka-uhi-wawae-ono, lived at Pu'uloa (ibid.:182). Kauhiwawaeono was known as a chief who murdered people and used their bodies for shark bait (ibid.:232), and was discovered by Kamehameha I to have plotted against him (ibid.:182). At one time Kamehameha II (Liholiho) lived at Pu'uloa with his wives. Missionary Bingham visited him there (ibid.:255).

Kalaeloa was named "Point Banks" in 1786 by Captain Nathaniel Portlock in honor of Sir Joseph Banks, the naturalist who had been on Cook's first voyage into the Pacific, and was by that time president of the Royal Society in London. Portlock had been with Cook when Cook's ships came to the islands in 1778-1779. The name "Barber's Point" was given to Kalaeloa when English sea captain Henry Barber lost his ship, *Arthur*, on the reef along the Kualaka'i coast on the evening of 31 October 1796.

POPULATION

The population of O'ahu was devastated by military strife in post-contact times, at least twice according to Hawaiian historians. One of the earliest post-contact records of strife on O'ahu is the military campaign of Kahekili, High Chief of Maui, when he conquered O'ahu in 1783. He is said to have been responsible for killing entire populations of villages in 'Ewa (Kamakau 1961:137). Subsequently, when Kamehameha I came to O'ahu to implement his plan to conquer all the islands of the Hawaiian chain, the results were also devastating to the O'ahu population. In reminiscing later about the 'Ewa-Wai'anae area on O'ahu during the Kamehameha I period, John Papa 'I'i wrote, "All of these places mentioned had large populations. The land was rich and there were many trees in olden times" ('I'i 1957:99).

About a quarter of the population of 'Ewa district lived within Honouliuli *ahupua'a*, including Pu'uloa, in the 1830s (Schmitt 1973:19, 22). In the 1831-1832 missionary census, Honouliuli had a population of 1,026 people; in the 1835-1836 census, it had only 870 people, a loss of 156 persons within four years. This loss of over 15% of the population was not unusual for these early years of contact between Hawai'i and the outside world. The population had been falling for some time previous to that. In the early 1800s, an epidemic called *ma'i'oku'u* (squatting illness) devastated the Hawaiian population from Hawai'i to Kaua'i (Malo 1951:245-246). Missionary

Lowell Smith estimated that there were from 8 to 10 deaths for every birth in 1835 in the 'Ewa district ('Ewa Station Report 1835:8).

For the year 1840, the district of 'Ewa was reported to have had a reduction in its population of over 630 people since the census of 1836 (a period of four years). For 1839, there was an excess of 71 deaths over births (118 deaths), a decrease of nearly one-fourth of the population in 1839 (Schmitt 1973:42).

In 1839 the missionaries were blaming not only bubonic plague, but also smallpox, cholera, and measles for the drastic drop in the Hawaiian population. Bishop reported that in 1853 he had vaccinated about 1,500 people for smallpox, but that the vaccine was "spurious" and about half of the population died ('Ewa Station Report 1854:1). A few years later, Kamakau wrote:

> Honouliuli had over ten school houses with their teachers. The lowest number of pupils to each school was 50, up to 200 or more. Oahu then was thickly populated. It is sad to see how in so short a time whole villages have vanished leaving not a man [Kamakau 1961:924-925].

In 1881 it was observed that Honouliuli was once the home of a considerable native population. "Old tara [taro] patches abound in the little valleys along the margins of streams, and large quantities of potatoes were raised on the dry land. Smallpox carried off the bulk of the people" (Briggs 1926:62).

OWNERSHIP OF HONOULIULI AHUPUA'A

In pre-contact Hawai'i land was not privately owned. The land and the sea, as well as everything on the land and in the sea, were believed to be the domain of the gods who had created them. Chiefs were the managers of the land for the gods. Because land was the domain of the gods, it was a resource not to be mistreated. Land was to be made productive with as little disturbance as possible. With the exceptions of the cultivation of taro in irrigated pondfields (*lo'i*), as well as the large dry land field systems in Lapakahi and Kona on the island of Hawai'i, most cultivation was done in small gardens, many of them with plantings scattered among the rocks and between natural lava outcrops.

The chiefs and the commoners all had rights in the land, use rights that were acknowledged, but no mortal "owned" the land to the exclusion of everyone else.

When Kamehameha I conquered O'ahu in 1795, he placed his own supporting chiefs as managers over the district (*moku-o-loko*) and subdistrict land divisions (*ahupua'a* and *'ili'aina*), from which they fed themselves, their families, and their supporters. Two of Kamehameha I's chiefs, Kekuamanohā and Kauhiwawaeono, resided at Pu'uloa (Kamakau 1961:182).

Because of threats by military representatives of foreign countries to take over the Hawaiian Kingdom, Kamehameha III sought help from the American missionaries. Several of them went into government service and facilitated a land registration program that did away with the Hawaiian system of undivided interest in the use of the land and replaced it with the Western system of private land ownership. They explained to Kamehameha III that with such a system the taking over of the Hawaiian Kingdom by any foreign government would not result in the loss of the privately owned land, only of the government's land.

The first step in implementing the Western system of land ownership was to divide the land between the King and the chiefs. This division was called the Mahele. The *Indices of Awards* ("Mahele Book") documents how all the lands of the Hawaiian Islands were divided between the King and 245 Hawaiian chiefs. The Mahele took place between 27 January and 7 March 1848. On 8 March 1848 the King divided the land he had set aside in the Mahele Book between himself (the King's Lands) and the government of the Hawaiian Kingdom. After these two divisions were made, the lands of the Kingdom were divided approximately as follows:

The King's Lands--approximately 1,000,000 acres
The Chiefs' Lands--approximately 1,600,000 acres
Government's Lands--approximately 1,500,000 acres.

Commoners and those chiefs who had not participated in the Mahele were permitted to send in their claims during the two years between February 1846 and 14 February 1848. Commoners (farmers) could claim a houselot of not more than one-fourth acre, and the garden area that they cultivated to feed themselves and their families. Any land on which they raised a crop for market would not be awarded. In addition, *kula* (dry plains), land such as much of Honouliuli, was not awarded to small farmers, but kept as *konohiki* (chiefs) lands.

In 1850 the Kuleana Act was passed by the legislature. Under it approximately 8,500 farmers each received one or more small parcels of land amounting to a total of about 28,600 acres throughout the eight main islands. The ninety-seven *kuleana* awards made by the Board of Commissioners to Quiet Land Titles within the *ahupua'a* of Honouliuli were typical. These ninety-seven awards totaled only 106.524 acres, an average of 1.098 acres. Of the ninety-seven awards, only six were for 5 or more acres (the largest of the six awards was 15.15 acres, and their average was 7.17 acres). Most of the awards were in the wet-land taro gardens of Honouliuli, not in the dry plain area.

According to the Mahele Book, the land of Honouliuli went to M. Kekau'onohi, granddaughter of Kamehameha I and great granddaughter of Kekaulike, high chief of Maui. The Honouliuli acreage she received is recorded as 43,250 (L.C.A 11216). Kekau'onohi sold Pu'uloa to Isaac Montgomery in 1849 (Department of Land and Natural Resources, 4:41). When she died in 1851, her widower, Levi Ha'alele'a, inherited the remainder of her lands. In 1858 Ha'alele'a sued Montgomery's brother, Daniel, to get back the fishing rights that were connected with the land of Pu'uloa (Civil Court Case No. 348). One of the bases of Montgomery's defense was that after selling Pu'uloa, Kekau'onohi withdrew her *luna* (head man) from the area and ceased to maintain any controls over that fishery (Law Equity, Admiralty and Probate, 1857-1865:1-29. Reports of a Portion of the Decisions Rendered by the Supreme Court of the Hawaiian Islands). The judge, however, ruled that Montgomery had only tenant's rights in the fishing grounds, along with all other tenants of Honouliuli (Civil Court Case No. 348:22-23).

After Isaac Montgomery purchased Pu'uloa from Kekau'onohi in 1849, he and Kamehameha III were said to have gotten rich from the highly productive saltworks they established there. The salt was traded with all the other islands (Kamakau 1961:409). By 1867 the product of these saltworks was being used by local meat packers and by the Russian settlements in the North Pacific for salmon packing (*Hawaiian Gazette*, 29 January 1867). In years previous to this some salt had been sent to California (ibid.). A saltworks was also established at Kualaka'i, the remnants of which were still visible in 1935 (Fig. A-4).

When Ha'alele'a died in 1864 (Probate No. 2415), his second wife, Anadelia Amoe, daughter of John Ena, the famous Chinese merchant of Hilo, deeded Honouliuli to her sister's husband, John H. Coney, who in turn sold it to James Campbell in September 1877 for the sum of $95,000. The deed estimated the size of Honouliuli at 43,640 acres, "or thereabouts" (Department of Land and Natural Resources, 52:201).

Fig. A-4. NATURAL SALT BEDS AT NAVAL AIR STATION, BARBER'S POINT.

RANCHING, SUGAR CANE AND A RAILROAD

When James Campbell purchased the 43,000 or so acres of land at Honouliuli in 1877, he had fences constructed, and chased out over 32,000 head of cattle that were living in the area (Briggs 1926:62). In 1881 Honouliuli was the center of a prosperous ranch that had "abundant pasturage of various kinds" (ibid.). Campbell had already leased out rice lands, fishing rights at Pearl Harbor, and a lime quarry. In addition, cattle were brought to Honouliuli ranch for fattening before being slaughtered to supply the Honolulu market. At that time about 10,000 acres of ranch land were devoted to agriculture (ibid.). *Kiawe* beans provided food for cattle, and the wood made excellent charcoal. Charcoal-making rights were rented out to bring in additional income for the ranch. Water was obtained from artesian wells, the first being drilled in Honouliuli in 1879 by James Ashley (Stearns and Vaksvik 1938:166; McCully 1882:42).

In 1889 Honouliuli was leased to Benjamin Dillingham for 50 years. Ewa Sugar Plantation was established in the lower portion of the *ahupua'a*, and Oahu Sugar Company's cane fields were developed in the upper portion (Judd and Barrere n.d.:35-36). Ewa Plantation was once said to be the "richest sugar plantation in the world" (*Paradise of the Pacific*, December 1902:19-22). The early drilling of wells and the completion of a ditch in 1916 that brought water from the Ko'olau mountains to irrigate the dry upper fields of Honouliuli enabled the development of thousands of acres of cane fields in the *ahupua'a* (Thrum 1916).

Also in 1889, Dillingham's Oahu Railway and Land Company began constructing a railroad in Honouliuli, and by 1895 it was extended to Wai'anae. In addition to providing the transportation necessary to get the beef to the Honolulu market and the bags of raw sugar to the docks for shipment to California, Oahu Railway and Land Company leased lands to the sugar plantations.

SISAL AT HONOULIULI

Sisal (*Agave sisalana*) was first imported from Florida in 1893, and planted in 1894 for cordage (*Pacific Commercial Advertiser* 1894:7) in the area southeast of Pu'ukapolei hill in Honouliuli (see Fig. A-1). Part of the Barber's Point Naval Air Station was built on the old sisal plantation (Figs. A-5 and A-6). "Favorable results of the experimental work on sisal in Hawaii

FIRE CONTROL MAP

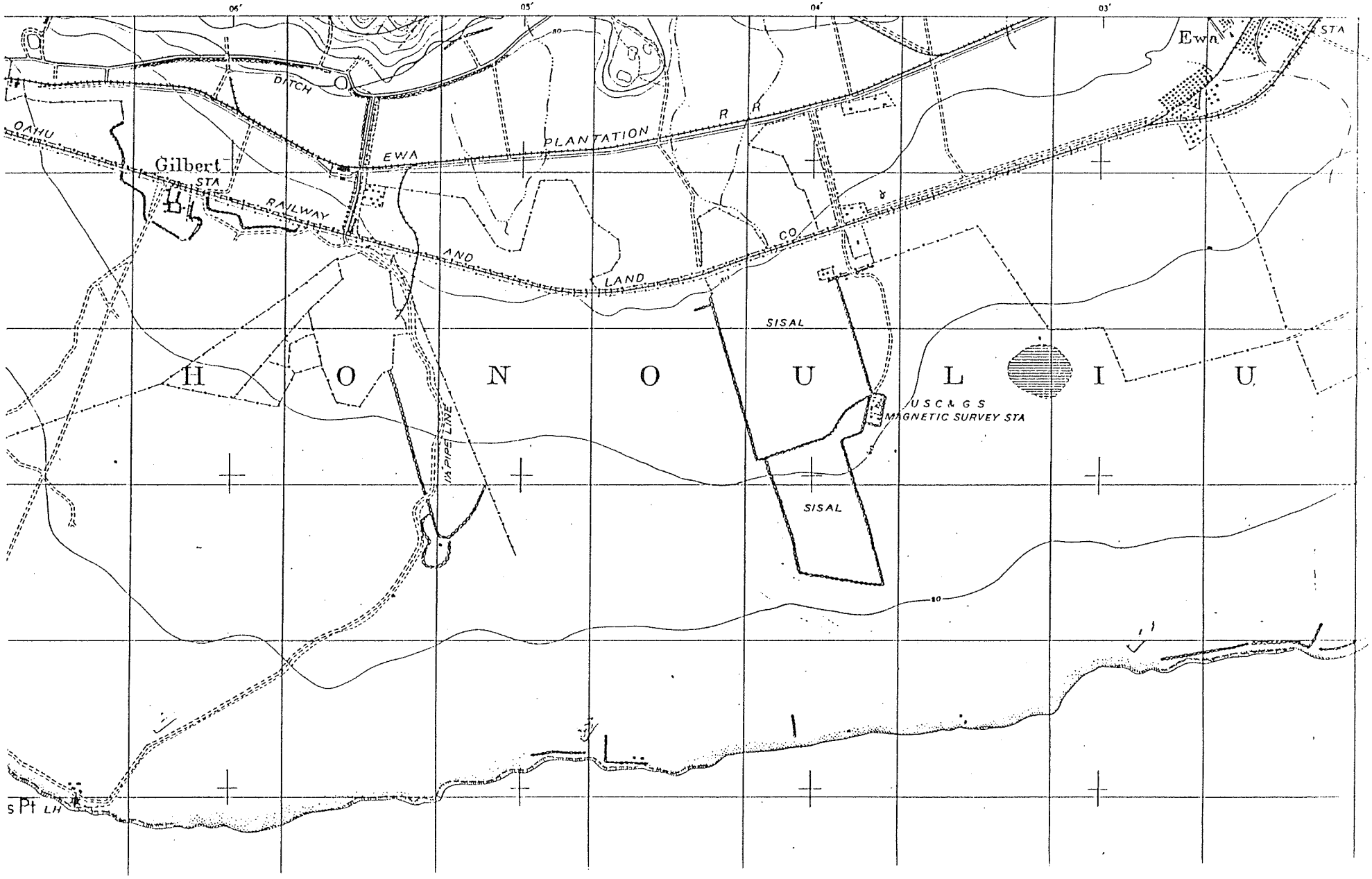

Fig. A-5. PORTION OF U.S.G.S. MAP, TERRITORY OF HAWAI'I, SHEET 11, BARBER'S POINT 1908-1913. Shows area now occupied by Barber's Point Naval Air Station.

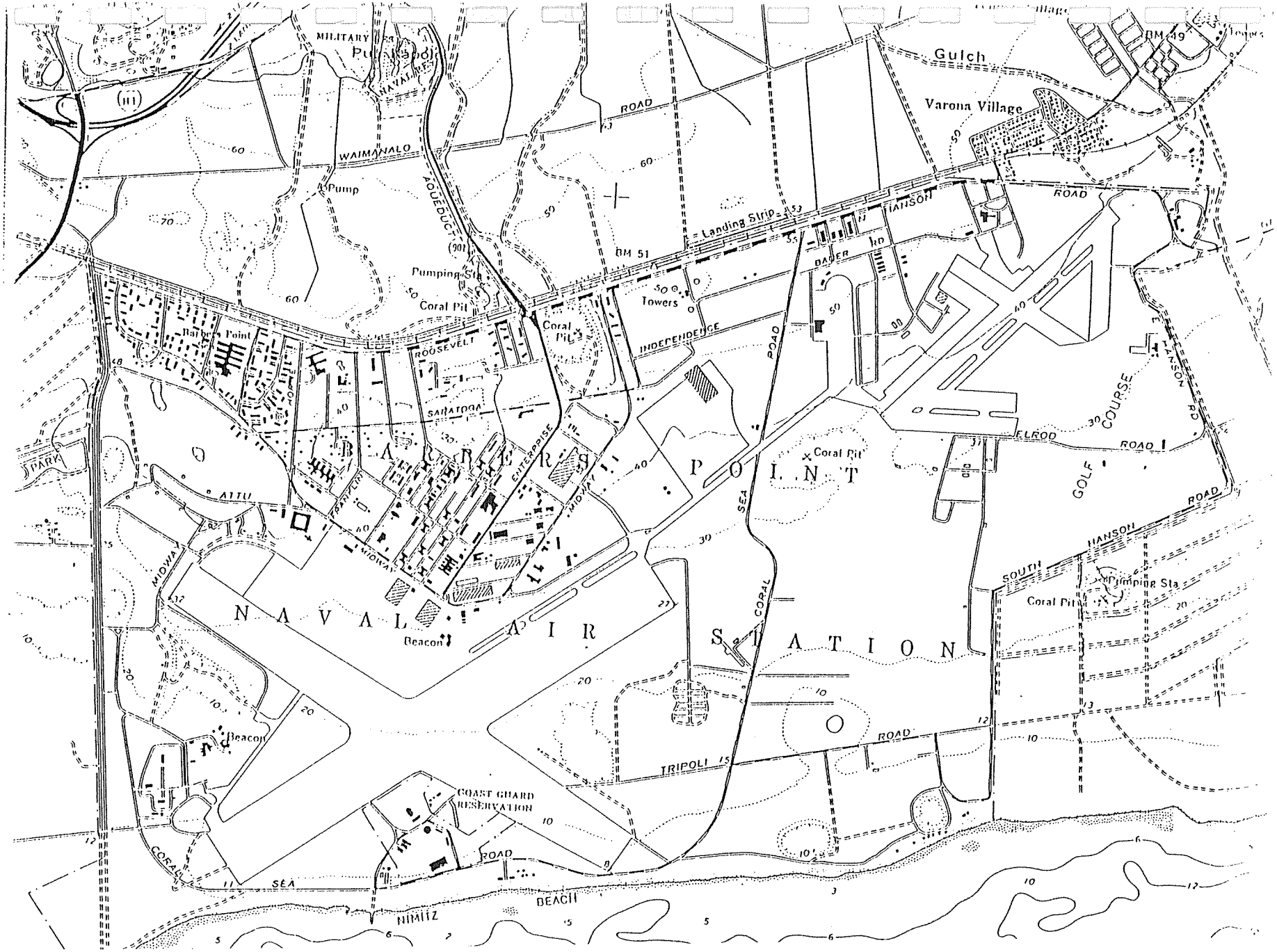

Fig. A-6. PORTION OF U.S.G.S. MAP, 'EWA QUADRANGLE, 1968.
Shows area now occupied by Barber's Point Naval
Air Station.

led to the organization, in 1898, of the Hawaiian Fibre Company" (MacCaughey and Weinrich 1918:43).

> This corporation secured about 300 acres on the coral limestone coastal plain which skirts leeward Oahu, and began planting on a commercial basis. The original investment represented about $37,000. The land controlled by this company now [1918] comprises about 3,000 acres, with a capitalization of $150,000, and an annual yield of about 500 tons. The company employs about 60 laborers, men and women; at present all are Japanese. The minimum is $1.25 per day (U. S. gold); in addition to this, living quarters, land for gardens, water, insurance, fuel, and medical attendance are furnished by the company. This gratuity represents an expenditure of over $.25 per day per laborer. These wages correspond with those of the sugar and pineapple plantation for the same classes of labor, and strikingly indicate that Hawaii, contrary to popular opinion upon the mainland, does not possess "cheap labor" [MacCaughey and Weinrich 1918:43].

The main plantations of the Hawaiian Fibre Company were at Sisal, in the 'Ewa District, and at Robinson, in the Waipahu area (Isenberg 1903:15; Wilcox and McGeorge 1912:2). In 1902 there were 600 acres planted in sisal at the Sisal and Robinson plantations (Blackman 1902:59); by 1912 there were reportedly about 2,000 acres of sisal being cultivated (Wilcox and McGeorge 1912:2). The entire output from the two plantations amounted to between 130 and 140 tons per year by 1903, and was expected to double by 1904. In 1903 Hawaiian Fibre Company sold most of its 50-ton crop for $.08 per pound (Thrum 1904:29).

In 1918 a published report on sisal claimed that, with the exception of cotton, sisal was the most extensively used fiber in the United States (MacCaughey and Weinrich 1918:42). Hawaiian sisal fiber was shipped to San Francisco, New York, and Japan, chiefly. Its main competition was Yucatan sisal, which supplied 90% of the world market (ibid.:45):

> The steadily increasing demand for sisal fibre is concomitant with the rapidly extending utilization of mechanical grain binders, using twine, throughout the world. The shipment of sisal from Hawaii

to the United States mainland for the past six years [previous to 1918], have been as follows:

Year Ending June 30	Tons	Value
1916	445	$68,764.00
1915	474	52,608.00
1914	457	59,915.00
1913	325	44,221.00
1912	334	34,499.00
1911	151	15,096.00.

THE MILITARY

During the 1930s,

> the Navy leased from Campbell Estate a piece of land 3,000 by 3,000 feet where a mooring mast was built for the dirigible *Akron*. But the records do not show that any dirigible moorings ever took place. In late 1939, or early 1940, when the original lease expired, the Navy acquired more than 3,500 acres from the same estate. On these acres were built the Marine Corps Air Station at Ewa and, later, Naval Air Station, Barber's Point [Collins 1977:33].

The 'Ewa mooring mast was a 206.6 acre grassed area (Fig. A-7) used by blimps from 1939 to 1940, but not dirigibles (*Honolulu Star-Bulletin*, Special Section, 8 March 1957:5:1).

The Marine Corps'

> Ewa strip was completed early in 1941, while plans were being implemented to expand Naval Aviation facilities at Barber's Point. The Navy had chosen had chosen the site for peacetime air training. Flying weather was virtually ideal year-round. A Honolulu surveyor began a survey of the land in July 1940. Before sights could be taken, the dense kiawe mesquite had to be cut in 400-foot sections. In October 1941, work was begun to clear the ground and lay out runways.
>
> Then came December 7. Although the Japanese attack was concentrated on Pearl Harbor and Hickam Field, the Marine Corps air station at Ewa and most of its planes were left a shambles [Collins 1977:33].

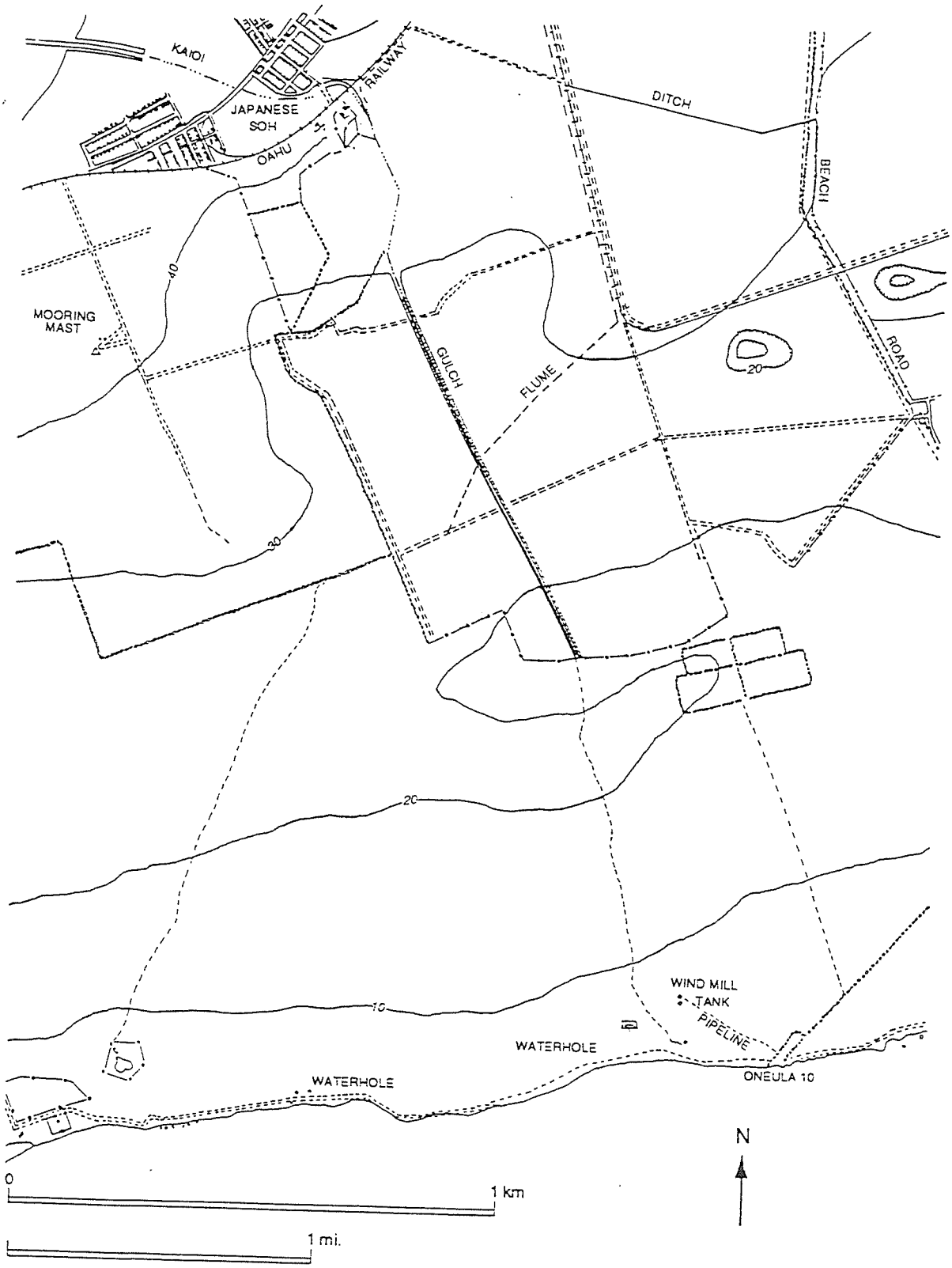

Fig. A-7. PORTION OF U.S.G.S. MAP, TERRITORY OF HAWAI'I SURVEY, 1927-28 AND 1930, 'EWA QUADRANGLE. Shows location of Mooring Mast, Near 'Ewa Japanese School.

The job of building the Naval Air Station, Barber's Point, was rushed. Heavy usage during World War II of the station was recorded even before its completion on 15 April 1942. Personnel stationed there once numbered 12,000, but by October 1947, the number was down to 1,645 officers and enlisted personnel. At that time the station was reported to have had the largest landing mat in the Pacific, and an average of 1,500 planes ascended from its landing mat daily during World War II.

The main runway in 1947 was 8,300 ft long, and 1,000 ft wide. The cross runway was 8,400 ft long and 750 ft wide.

> The size of the runway makes it the only landing strip on the island suitable for landing and dispatching huge air force B29s and the navy's P2V (Truculent Turtle) and PB4Y aircraft when fully loaded [*Honolulu Advertiser*, 27 October 1947].

During the construction of the runways in the early part of World War II, coral was excavated and "runway paving put in place while fully armed aircraft roared past on pavement still warm from the mixer" (*Honolulu Star Bulletin*, Special Section, 8 March 1957:5:1).

Over the years, housing for its personnel became an acute problem. In November 1951 ceremonies were held for the opening of "the first housing unit at Barber's Point naval air station" (*Honolulu Advertiser*, 6 November 1951: II:11:8). The units were to cost about three million dollars, and were expected to be completed by mid-April 1952. The 355 apartments were to house 278 enlisted men and 77 officers (ibid.).

In 1956 announcements were again made for additional housing units at Barber's Point. This time two million dollars was needed to accommodate the housing needs of officers and enlisted personnel. Twenty-seven units were to be for senior officers, 216 units for junior officers, and 887 for enlisted men (*Honolulu Advertiser*, 24 March 1956:A3:3).

By the following year, it was announced that the Navy would have trailer houses built by a contractor from the mainland. Three hundred units were expected to cost two million dollars. They were to be metal trailers 40 to 50 ft in length, and between 8 and 10 ft wide, with metal cabanas on the side. The contractor was to install all utilities, streets, sewers, water systems, electricity, and gas. The trailers were to be fully furnished, and were to be rented to service personnel only at a cost between $68.50 to $99.50 per month. Once the contractor's investment was returned, the ownership of the units was

to revert to the Navy. A "pilot" village of 50 trailers was to be installed within the first three months after work had begun (*Honolulu Advertiser*, 24 March 1956:A3:3).

CITY AND COUNTY OF HONOLULU LANDS

In 1974, as a result of the 1972 Facilities Requirements Evaluation, State of Hawai'i report, 56.7 acres of Federal land at Barber's Point was turned over to the City and County of Honolulu to build the Honouliuli Sewage Treatment Plant. The parcel was part of 9,500 acres identified as surplus military lands in the 1972 report (*Honolulu Advertiser*, 14 August 1974:A3:4).

DANGER ZONE

A "permanent zone" of 5,000 yards along the beach and 1,000 yards off-shore was established as a danger zone by the Naval Air Station at Barber's Point. The area was to be used by the Navy for target practice, ordnance proving, underwater demolition training, and dummy torpedo firing. The zone was to be "closed to all surface craft, swimmers, divers and fishermen" (*Honolulu Star-Bulletin*, 13 April 1966:A:1B).

LANDFILL, AT THE NAVAL AIR STATION, BARBER'S POINT

In 1983 it was reported that contaminated soil had been buried at the landfill at the Naval Air Station at Barber's Point:

> The old electroplating facilities was razed at the Pearl Harbor shipyard and soil contaminated with the chemical hexavalent chromium was found. The tainted soil was processed by a Mainland firm.... The decontaminated soil was tested by the Water Resource Research Center at the University of Hawaii and was transported to the [landfill at] N.A.S. [at] Barber's Point with approval of the Hawaii State Department of Health [*Honolulu Advertiser*, 7 January 1983:A2].

MAGNETIC OBSERVATORY

The United States Coast and Geodetic Survey Magnetic Observatory, also known as the Honolulu Observatory, was established in Honouliuli in 1902 to measure earth movement and magnetic field (see Fig. A-5). After the disastrous 1946 tsunami, construction was begun in the area on the Hawaii Tsunami Warning Center, and completed in 1948. By 1971 both weather and tsunami monitoring programs were being carried out in the area, and on 16 September 1973 the National Weather Service accepted responsibility for the Tsunami Warning System (Schana, pers. com., 1985).

SUMMARY

These notes on the history of land use in the Barber's Point area indicate that the area was known traditionally. Hawaiians retained stories about the inhabitants and events of the area and passed them from generation to generation. The area is also linked to some important chiefs of O'ahu, both traditionally and historically.

In early historic times (post-1778) activity centered on the commercial product of the natural salt pans of Pu'uloa and Kualaka'i. The early western traders used this salt to preserve their ships' stores (salt pork primarily), as well as for preserving the skins of sea-otter and other animals obtained from the Northwest Coast Indians.

Commercial use of the land in and around the Naval Air Station, Barber's Point, continued primarily for ranching, which provided beef for the Honolulu market; sugar cane growing, which involved thousands of acres in the production of raw sugar, which was then processed in California; and sisal growing, which produced tons of the fiber for the American and Japanese markets.

Use of the ocean along the coast of the Station continues to involve primarily the gathering of edible algae, fishing, and surfing.

DISCUSSION

There was apparently a long period of time (A.D. c. 500-1778) during which the face of the 'Ewa plain changed very little. Commercial ranching (c. 1820s-present) and its introduction of *kiawe* for cattle feed probably did more

to change the area of the Naval Air Station, Barber's Point, than any other single event in its history.

As planned urbanization takes place, within the next decade or two, the face of the land surrounding the Station will change considerably. The plan is to make 'Ewa into a "Second City," whose population will eventually be between 190,000 and 300,000. Campbell Estate recently petitioned for re-zoning of 6,000 acres from agriculture to urban, in the planned secondary urban center; the West Beach development will be built on approximately 1,700 acres; and the 'Ewa Marina will urbanize another 730 acres for approximately 15,000 residents. These developments will probably impact the Barber's Point area much more than anything witnessed over the past 200 years.

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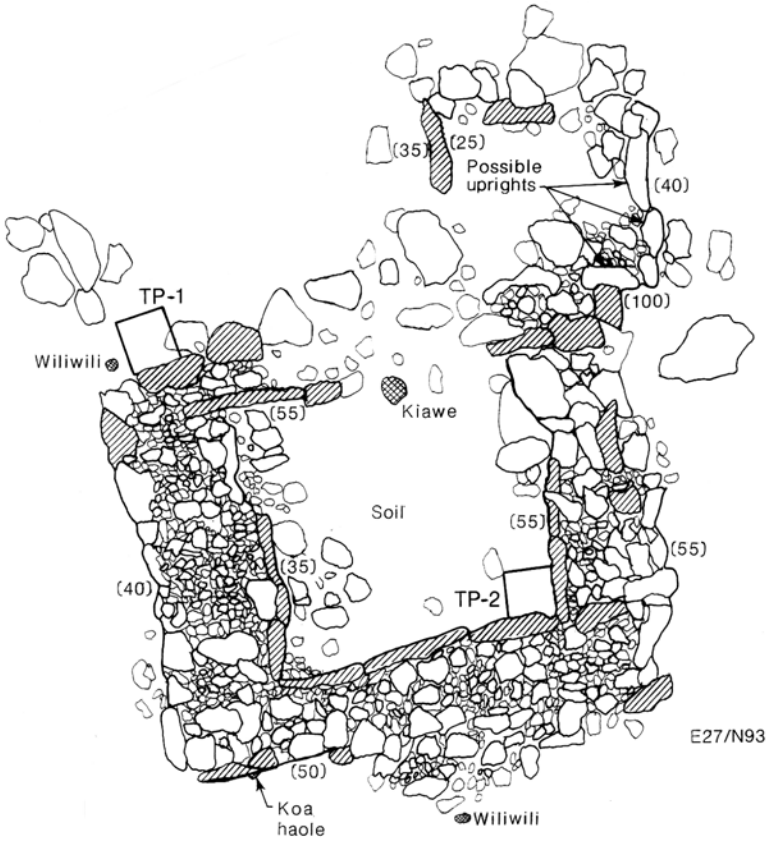
Archaeological Inventory Survey for Construction Projects at Naval Air Station Barbers Point, O‘ahu, Hawai‘i



by

H. David Tuggle

with a contributions by
Gail Murakami
Jerome V. Ward

INTERNATIONAL ARCHAEOLOGICAL RESEARCH INSTITUTE, INC.
January 1997

ARCHAEOLOGICAL INVENTORY SURVEY FOR CONSTRUCTION PROJECTS AT NAVAL AIR STATION BARBERS POINT, O‘AHU, HAWAI‘I

Phase I Survey for
Housing Project H-208,
Aviation Maintenance Training Building Project P-281, and
PATSWINGPAC Project P-255

Phase II Survey for
Family Housing Project H-208

By

H. David Tuggle, Ph.D.

With contributions by

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January 1997

This document is printed on acid-free, archival bond paper. It is intended to provide a long-term record of the cultural resources of Hawai'i.

EXECUTIVE SUMMARY

Archaeological Inventory Survey For Construction Projects at Naval Air Station Barbers Point, O‘ahu, Hawai‘i: Phase I and Phase II

At the request of Belt Collins Hawaii, International Archaeological Research Institute, Inc. (IARII) conducted a cultural resources Phase I inventory survey in three areas of Naval Air Station Barbers Point, consisting of two weeks of field work in 1992-93. Subsequently, a Phase II intensive inventory survey was conducted in a portion of the Phase I Survey Area A. Phase II consisted of four weeks of fieldwork, conducted in 1993.

Phase I Survey Area A covers 55 acres in the northwestern portion of the Station in an area being considered for family housing development. A previous archaeological survey had identified five sites with 33 features in or adjacent to this project area. The IARII Phase I survey identified a total of 274 features in the area. The majority of the features are rock mounds, small enclosures, C-shapes, and modified sinkholes, representing a Hawaiian occupation that probably dates to the pre-contact and perhaps early post-contact periods. The recorded sites and the newly identified feature complexes have the characteristics that suggest they may be eligible for the National Register of Historic Places, and should be recorded in detail by means of a Phase II inventory survey where construction projects are planned. A portion of Area A was selected for intensive Phase II survey based on current construction project boundaries.

Phase I Survey Area B is three acres in the central part of the Station planned for development of Aviation Maintenance Training facilities. Area B consists of an open bladed lot and a vegetation covered lot. No archaeological remains were identified. No further work is recommended for the open lot. The vegetated lot is recommended for vegetation clearance and additional survey.

Phase I Survey Area C is a 5,000 ft^2 lot in the northeast corner of the Station, planned for expansion of the PATSWINGSPAC building. This is a bladed parcel with no archaeological remains. No further work is recommended for the area.

A Phase II intensive survey and testing program was conducted in a 10.8 acre area in the southeastern portion of Phase I Area A, planned for family housing. The eastern portion of the Phase II area is bladed and filled. The western portion contains a continuous series of rock mounds, structures, piles of fire-cracked rock, and sinkholes that are associated with Hawaiian use dating to the pre-contact and perhaps early post-contact periods. There is some additional evidence for specialized early 20th century use and limited WW II activity. The

features of this area have been grouped into five sites, three of which use previous site numbers but with an expanded feature inventory.

One site in the Phase II area stands apart from the rest, as unrelated to early Hawaiian use. Site 4701 is a sinkhole that was capped and modified sometime in the first half of the 20th century for storage of items that were probably related to illegal alcohol production. This site is recommended as eligible to the National Register based on information content.

Three of the sites (1723, 1724, and 1726) contain 132 features. Some 55 tests (shovel tests, test pits, and rock removal) indicate that the structures and sinkholes were used for Hawaiian habitation, agriculture and burial. In addition, many of the sinkholes contain evidence related to paleoenvironmental reconstruction, including land snails and bones of extinct birds. A fourth site (4702) consists of approximately 150 low stone piles and mounds that testing suggests represent a Hawaiian dryland agricultural complex.

Based on the detailed mapping and testing Sites 1723, 1724, 1726, and 4702 are recommended as eligible to the National Register, based on information content relating to Hawaiian history and to environmental reconstruction. Recommendations are made regarding treatment of individual features that may be subject to construction project impact.

Human bone has been identified in three of the features, all sinkholes (1724-19, 1724-54, and 1726-2). In general, Hawaiian cultural practices on the ‘Ewa Plain were such that human bone may be found in any sinkhole. Appropriate consultation management planning will have to be carried out to take into account the known and potential human skeletal remains.

PREFACE

Per the scope of work, consultations were carried out throughout the project with an archaeologist of the State of Hawaii Historic Preservation Division (Dr. Tom Dye) and with the archaeologists of PACNAVFACENGCOM (Drs. Rob Hommon and Bruce Masse). PACNAVFACENGCOM was also notified, per the scope of work when one burial (1726-2) was identified in the field.

Several Phase II field decisions were made based on the consultations with Drs. Robert Hommon and Bruce Masse of PACNAVFACENGCOM. The most important of these were: [1] the western boundary of the project was treated with some flexibility due to the nature of site distribution in the area; [2] rock removal from fill and feature dismantling was classified as test pitting for purposes of the scope of work; [3] the features in the mound complex (4702) were not individually tagged; and [4] one major sinkhole (1724-47) was not tested due to the presence of a large beehive, although it was briefly examined in a post-field visit.

Spellings of Hawaiian place names follow Pukui, Elbert, and Mookini (1974); for example, "Honouliuli" does not have any glottals. "Barbers Point" is spelled without an apostrophe, following USGS map usage.

Measurements are in metric, except for 1) elevation above sea level which is given in feet, based on all of the available contour maps, and 2) sizes of project areas, which are given in the units of the scope of work, usually acres or square feet.

Except in a few places where specifically requested by the State Historic Preservation Office or the Navy archaeologist, no attempt has been made to update this report from the prefinal report submitted in February 1995. Since then an inventory survey of the air station has been completed by IARII and PHRI archaeologists as part of the environmental assessment associated with the proposed closure of NAS Barbers Point. For an understanding of how the project area sites now fit into the complete inventory of the base, the reader should consult the IARII and PHRI inventory survey reports.

ACKNOWLEDGMENTS

We appreciate the kind and always professional assistance of the following individuals: Toni Hahn, Angela Steiner, and Boyd Dixon of the Bishop Museum for access to Museum files related to the project area; Tom Dye of the State Historic Preservation Division for discussions of ‘Ewa Plain archaeology; and Ross Cordy for a draft copy of his paper on O‘ahu history. A special thanks is extended to Alan Ziegler, who conducted the faunal analysis, discussed problems of faunal extinction, and edited the sections of report text that concern analysis of faunal remains. His comments and corrections are very much appreciated.

Thanks for field visits and on-site consultations are due to Alan Ziegler, Robert Hommon and Bruce Masse of PACNAVFACENGCOM, Bertell Davis and Anne Garland, and Mikk Kaschko, Judith McNeill, David Welch, Myra Jean Tuggle, and Conrad Erkelens of IARII.

We appreciate the help of EOD Mobile Unit One of U.S. Naval Magazine West Loch for the collection of ordnance from one the project sinkholes, and especially to Boatswain’s Mate First Class Cameron Wiggins for identification of the material.

The efforts of PACNAVFACENGCOM personnel in dealing with the problem of the beehives in the project area are gratefully acknowledged.

Special thanks go to the people at IARII who contributed to the report itself: Greig Nakamura, Chris Fadden, and Joan Clarke for the lab work; Gail Murakami for the macroscopic scanning of charcoal; Judith McNeill for setting up appropriate databases; Roger Blankfein for all of the drawings; Rona Ikehara for identification of human bone; David Welch and Myra Jean Tuggle for editing; and Kimberly Wade for final report production.

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I: INTRODUCTION

At the request of Belt Collins Hawaii (formerly Belt Collins & Associates), International Archaeological Research Institute, Inc. (IARII) conducted a two phase cultural resources inventory survey of a portion of Naval Air Station, Barbers Point (NAS Barbers Point) during 1992 and 1993. The Phase I survey was based on an IARII contract letter and scope of work (1992). It involved a survey of three areas (Figs. 1 and 2); preliminary results were reported in Jones (1993). The Phase II survey was based on a scope of work dated August 5, 1993 and a contract letter of September 7, 1993. It involved a detailed Phase II inventory survey within a designated portion of the Phase I area (Fig. 3), with preliminary results reported in Tuggle (1993). The present report presents the final results for both phases of inventory survey.

Since the referenced letter reports were written, several changes have been made in site and feature designation and interpretations, based on the analysis of the survey data, but these changes have not resulted in any significance re-evaluations.

Purpose, Location, and Fieldwork

Phase I

In July 1992 Belt Collins and Associates requested that IARII submit a proposal to conduct an inventory survey of several areas on Naval Air Station, Barbers Point as part of an Environmental Assessment (EA) to be prepared for U.S. Navy Pacific Division, Naval Facilities Engineering Command (PACNAVFACENGCOM) by Belt Collins. The EA was to be prepared to evaluate the potential impacts of five construction projects to be carried out to accommodate the base closure of Naval Air Station Moffet Field in California and the movement of a P-3 squadron unit and PATWINGSPAC HQ to Barbers Point. Three of these projects, construction of a PATWINGSPAC HQ building (MILCON P-255), construction of a Consolidated Training Facility (MILCON P-261), and construction of 305 Family Housing Units (HC-208) were considered to have the potential to impact significant archaeological resources in the areas of construction. Based on a previous survey at Barbers Point (Haun 1991), it was already known that significant sites were present within the proposed housing area. A proposal and scope of work to conduct the inventory survey in two phases was prepared and submitted by IARII to Belt Collins in July 1992 and later modified in September 1992. A memorandum dated October 1, 1992 prepared by Dr. Robert Hommon, PACNAVFACENGCOM archaeologist, set forth a specific scope of work for the inventory survey. This memorandum was later amended, October 19, 1992, to take into account an increased area of potential effect of the housing project. In response to requests by Dr. Hommon and in accordance with these memoranda, IARII prepared a revised proposal dated

October 26, 1992 and a new scope of work specifically for the Phase I survey. The Phase I survey was conducted under the specifications of this scope of work.

The Phase I survey as set out in that scope of work was to consist of background research, a complete pedestrian survey of each project area, determination of the location of features, and preparation of a summary letter report and site location map. The objective of the Phase I survey was complete coverage of the three project areas in order to identify all potentially significant prehistoric and pre-World War II historical period archaeological sites on the basis of surface characteristics. Within the proposed housing project area, an evaluation was to be made of the potential impact of the project in different portions of the 55-acre area, so that the housing project, which would not utilize the entire area, could be sited to minimize adverse impacts to the cultural resources. All archaeological features would be prominently marked with flagging tape, boundaries clearly outlined, and locations determined using compass and tape to known points. The summary letter report was to include a preliminary assessment of the significance of sites in the project area and recommendations which would form the basis for Phase II survey work. Given this information, Phase II detailed survey and testing would be conducted where appropriate to make final site evaluations and management recommendations.

The three survey areas of the Phase I survey (Fig. 2) are designated A (family housing area), B (Consolidated Training Facility), and C (PATWINGSPAC Addition). Area A is approximately 55 acres in size and located in the northwest area of the station. Area B is approximately 3 acres located near Rendova and Nassau Roads in the central part of the station. Area C covers 5,000 sq ft adjacent to Building 972 in the northeast area of the station.

Survey was conducted from December 14 to 23, 1992 and January 5 and 6, 1993, with the field crew of Bruce Jones, M.A., as Project Director and Joan Clarke, Timothy Coleman, and Christine Fadden as crew members.

Phase II

The Phase II fieldwork was an intensive archaeological survey of a portion of Area A of Phase I, as identified on Enclosure (1) of the August 5, 1993 scope of work. The Phase II survey area (Fig. 3) is a section of a parcel scheduled for development as NAS Barbers Point family housing (Project H-208). The purpose of the Phase II survey was to provide a detailed archaeological inventory and evaluation of the archaeological features of the project area, and to provide management recommendations.

The Phase II survey area is a 10.8 acre parcel located on the western end of NAS Barbers Point (Fig. 3), near the junction of Midway and Boxer Roads. Survey was conducted over a period of four weeks (September 13 through October 8, 1993), with the field team of Joan Clarke, Timothy Coleman, and Christine Fadden, under the direction of Dave Tuggle, Ph.D. Field visits were made by Judith McNeill, David Welch, Mikk Kaschko, and Myra Jean Tuggle from IARII; Robert Hommon and Bruce Masse from PACNAVFACENGCOM; and

Bertell Davis, Anne Garland, and zoologist Alan Ziegler. Alan Ziegler also conducted tests in two sinkholes for a first-hand evaluation of the paleontological remains.

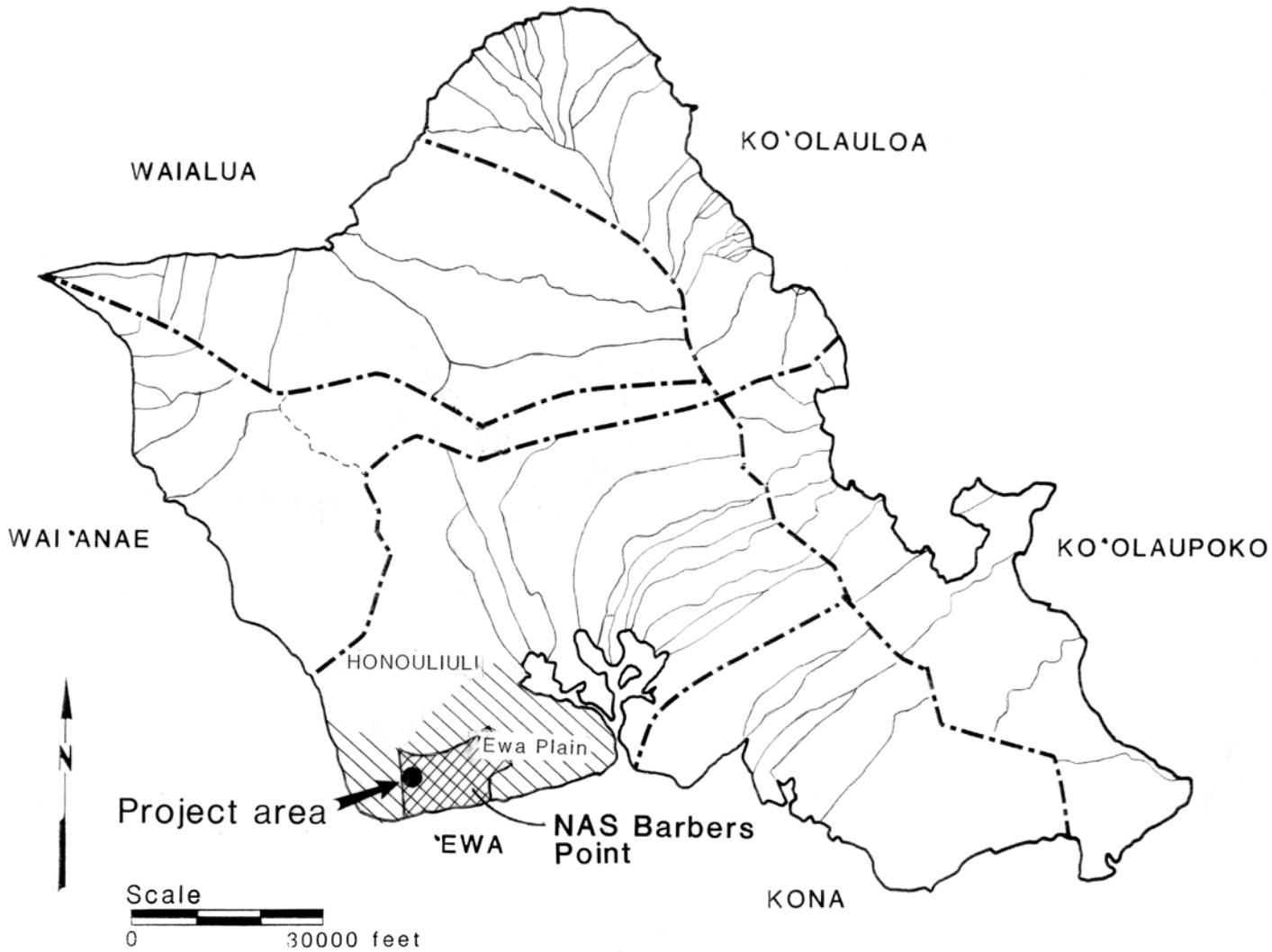

Figure 1. Island of O'ahu, with traditional land boundaries, showing the location of NAS Barbers Point.

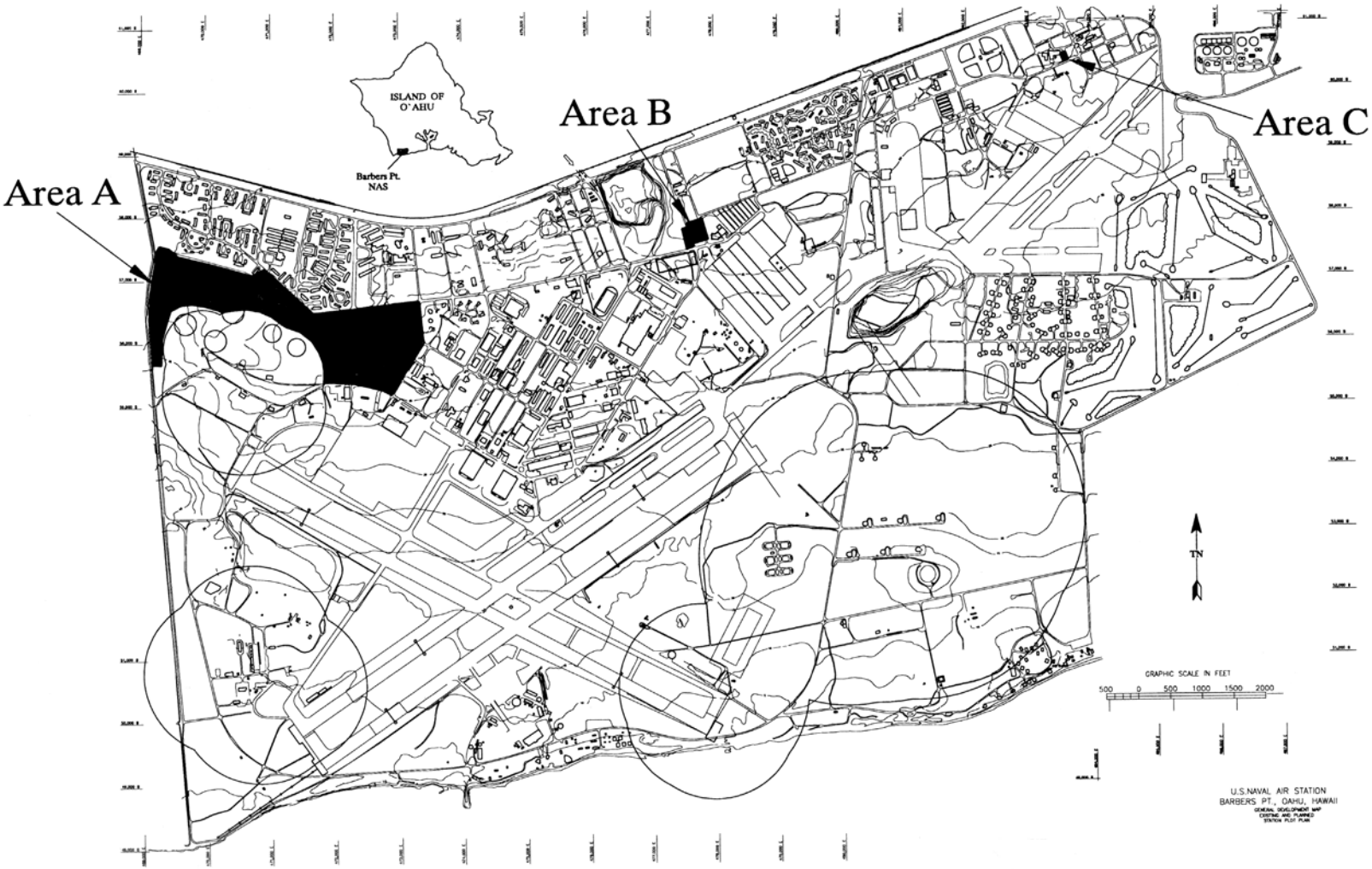

Figure 2. Phase I survey areas, NAS Barbers Point.

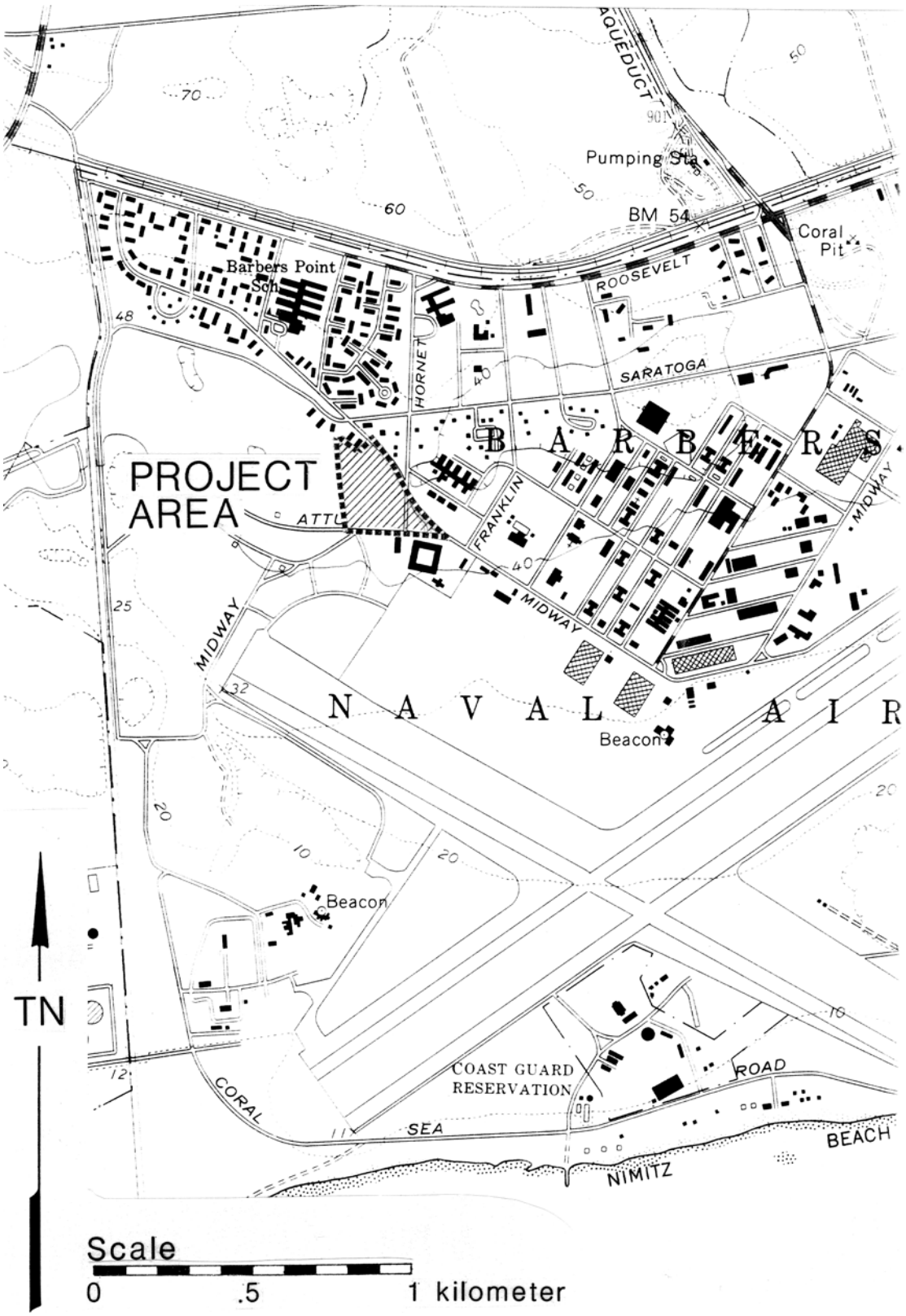

Figure 3. Phase II survey area, NAS Barbers Point.

II: GENERAL PROJECT BACKGROUND

This section provides the broad context for the project area in regard to natural and cultural environment, historical and archaeological research on the ‘Ewa Plain, and the history (pre-and post-contact) of the region. It also includes a summary of the archaeological research conducted at NAS Barbers Point. Detailed environmental description specific to the project areas is presented in Section III.

Environment

NAS Barbers Point and the project area lie on the landform known as the ‘Ewa Plain, or ‘Ewa Coral Plain (Fig. 1), an emerged reef that forms the lowland of southwestern O‘ahu from Pearl Harbor to the western side of the Wai‘anae range, an area about 16 km east-west and 6 km coastal-inland. The environment of this area has been described in detail in many sources, including Hammatt and Folk (1981), the Traverse Group (1988), Davis (1990), Cleghorn and Davis (1990), Dunn and Haun (1991), and Charvet-Pond and Davis (1992); these constitute the main sources of the following general summary, where not otherwise referenced. The specific conditions of the project area are discussed in a separate section below.

The ‘Ewa Plain slopes upward from the coast at about one-half percent gradient to an elevation of about 90 to 100 feet ASL, with no significant variation in the topography until the volcanic cone of Pu‘uokapolei is reached. The upper section of the plain has an alluvial, basaltic soil cover, but most of the lower section below about 50 feet elevation is exposed karstic topography. There are few developed drainages on the plain, where the dominant topographic characteristic is the presence of sinkholes ranging in size from a few centimeters in width and depth to 30 m wide and 5 m deep. Drainage is primarily surface sheet runoff, with exits through underground passages. The sinkholes were formed during the development and life of the original submerged reef, the bulk of which is Pleistocene in age.

Up to about 500 m from the coast, the water table is from 1 to 3 m below the surface and thus is accessible from sinkholes. It is considerably deeper on the upper level of the plain and cannot be reached in sinkholes. However, the level of the water table prior to the inland drilling of artesian wells is unknown; some estimates suggest that it has “been drained to a third of its former level” (Culliney 1988:233).

There is little dune formation along the coast, most of which is formed by low eroded limestone benches and calcareous beaches. There is a fringing reef off the south coast and along a portion of the west coast. Rainfall has an annual average of about 15 to 25 inches from the coast inland, most of which falls during the winter, brought by the leeward storms of that season.

Vegetation in undeveloped areas is dominated by *kiawe*, introduced to O‘ahu in 1827 (Nagata 1985). The spread of *kiawe* across the ‘Ewa Plain remains unclear. By the late 1800s, it was common enough in the area to have been cut commercially (Yoklavich et al. 1992:16). However, in 1881, the native *‘ilima* (*Sida fallax*) was described as growing in “endless quantities on the plains of this ranch” (referring to Honouliuli Ranch) (I.V.Briggs, as quoted in Culliney 1988:172). There are some suggestions that the kiawe was not introduced until ranching began in 1877 (Kennedy 1991:5).

Resources

Davis (1990) has evaluated the environment of the ‘Ewa Plain in terms of resources available for Hawaiian exploitation and from the standpoint of seasonality of the biotic portion of the resources.

The model for the ‘Ewa Plain during the early period of human occupation is one of an “...open savannah-like grassland” where “trees such as Pritchardia, wiliwili, noni, and kou, formed small groves in favorable locations...” (Davis 1990:342). This model is the prevailing one based on information derived from botanical data (Char and Balakrishan 1979:12), as well as from land snail analysis (Kirch and Christensen 1981).

Food plants on the ‘Ewa Plain that could be collected or cultivated include coconut palm (*Cocos nucifera*), *milo* (*Thespecia populnea*), *noni* (*Morinda citrifolia*), banana (*Musa sp.*), ti (*Cordyline fruticosa*), *pohuehue* (*Ipomoea brasilensis*). *Koali‘ai* (*Ipomoea cairica*), sugar cane (*Saccharum officinarum*), *pai‘i‘iha* (*Cyclosorus dentatus*), and *‘aheahea* (*Chenopodium oahuense*) are also found in the present project and should be added to the list of food plants. A large number of other plants would be available for wood, thatching, oil, and dyes (Davis 1990:Tables 3-7). Those plants depending on cultivation would have been planted in relation to winter rains.

Numerous reef fish would be available from the coast, with peak productivity from January through June. Archaeological remains indicate that, for inhabitants of the coast, nearshore fish were a primary food resource (Davis 1990:136).

The ‘Ewa Plain has become well-known for the recovery of extinct bird bones. The modeling of the environment for the plain indicates that vast numbers of bird colonies would have been available, at least early in the period of human colonization (Olson and James 1982). The presence of flightless species and the overlapping nesting seasons of a variety of birds would make one or more species available at any time of year (Davis 1990:136). A large number of species of these birds became extinct during the period of Hawaiian occupation, but the nature of the extinction processes and the history of bird predation by Hawaiians have become primary research issues.

One major non-biotic resource on the edge of the ‘Ewa Plain is Pu‘upalailai, which yields volcanic glass (Davis 1990:79).

Considered within the cultural context, the ‘Ewa Plain was one section of the traditional land unit (*ahupua‘a*) of Honouliuli (Fig. 4). This *ahupua‘a* had access to a section of the uplands and all of the mountain resources, as well as to one of the richest local environments in all of Hawai‘i, the fish and shellfish productivity of Pearl Harbor and the irrigable lowlands at the head of the harbor. The extensive irrigated fields of Honouliuli were a conspicuous part of the landscape as drawn by Malden in 1825 (Fitzpatrick 1986:Figure 31). The taro farmers of Honouliuli were famous for producing “blue poi” (Fornander 1916-20, II:400).

Environmental Change

The history of Hawaiian resource use and the related problems of environmental change constitute the primary regional research questions, as discussed below. There is strong evidence of significant environmental change having occurred during the pre-contact period, much of it deleterious, including bird extinction and vegetation alteration from cultivation and firewood collection. Following contact, additional environmental deterioration was related to the introduction of cattle and goats, sandalwood collection from the upland hills (Cuddihy and Stone 1990), ranching, well-drilling, and commercial cultivation of sugar and sisal.

Hawaiian Traditions and Resources

Hawaiian traditions provide additional information regarding environmental characteristics, plants, and general resources of Honouliuli and the ‘Ewa Plain. Pearl Harbor is noted as a primary food source. Kamakau (1964:83-84) describes the “blessings” of the district of ‘Ewa, including Honouliuli and the ‘Ewa Plain. These include *pipi* (pearl oyster), when after a *kapu* period, they “were found in abundance--enough for all ‘Ewa--and fat with flesh”, transparent shrimp, spiked shrimp, *mahamoe* and *‘okupe* bivalves and “many others that have now disappeared”, plus *nehu pala* and *nehu maoli*, fishes that “filled the lochs (*nuku awalau*) from the entrance of Pu‘uloa to the inland ‘Ewas”. Traditionally, the entrance to West Loch was famous for *‘o‘io* (*Albula vulpes*) and the area from West Loch to Kualaka‘i was renown for *lipoa* (*Dictyopteris*) (Kelly 1991:155), which was one of the three most favored seaweed in Hawai‘i (Pukui and Elbert 1971:192).

The productivity of the fishponds of Pearl Harbor was well-recorded. Traditions clearly connect some of the ponds of West Loch and mullet productivity specifically with Honouliuli (e.g., Fornander 1916-20, II:270). It is probable that Honouliuli took its name, meaning “blue harbor” or “dark bay” from its association with West Loch.

The ‘Ewa Plain was described as “*o ke kaha”,* a reference to sweet potato land (Fornander 1916-20, II:279). In the legend of Hi‘iaka (Emerson 1978:167), there are plants of the ‘Ewa Plain specifically mentioned for making leis: *kauna‘oa* (*Cassytha filiformis L.*), *wiliwili* (*Erythrina sandwicensis*), and *akulikuli* (*Sesuvium portulacastrum*). In fact, in the

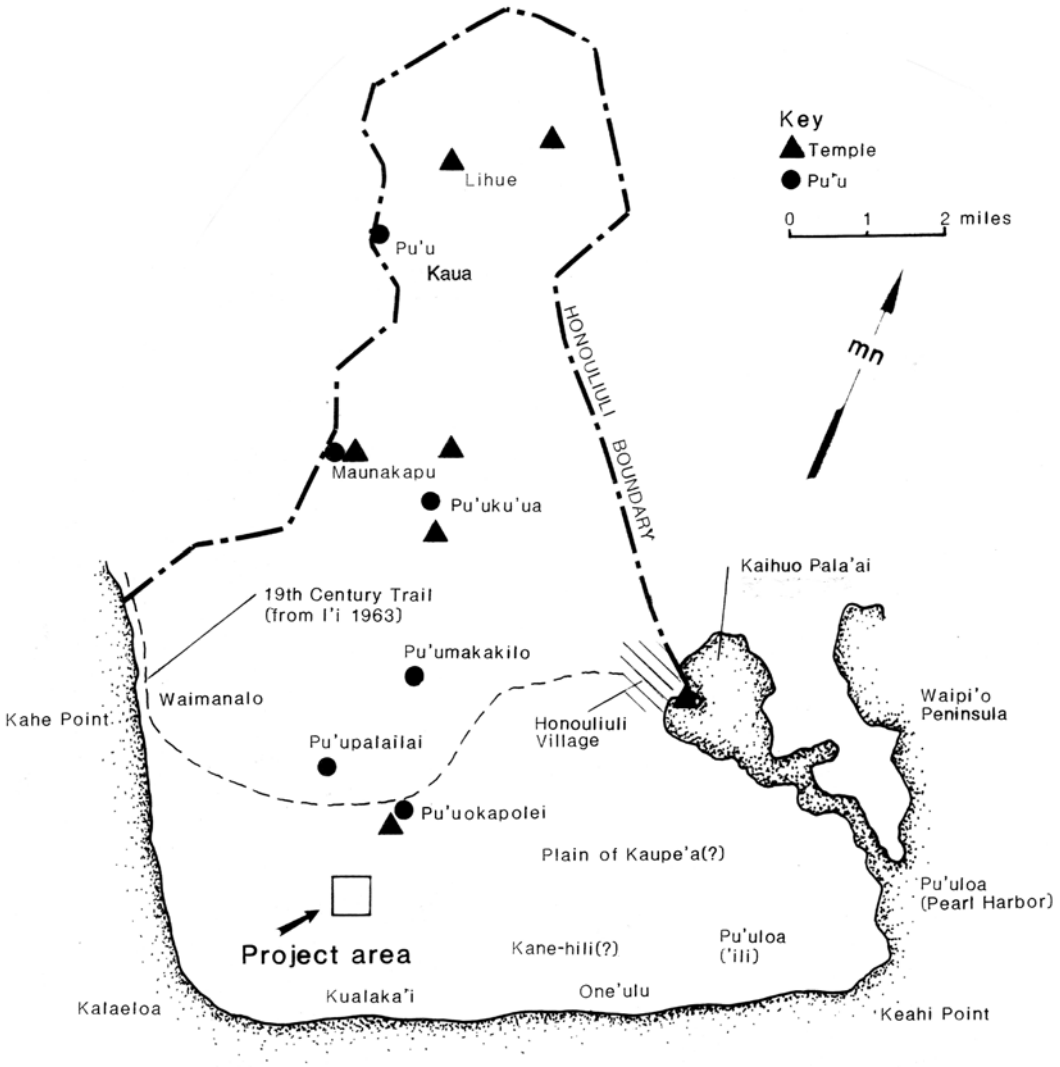

Figure 4. The *ahupua'a* of Honouliuli, with traditional places.

traditions, *wiliwili* is the plant that is probably most commonly associated with the ‘Ewa Plain. Not only is *wiliwili* noted in the Hi‘iaka myth, but in the references to the plain of Kaupe‘a, the place of wandering souls that was somewhere on the ‘Ewa Plain (Kamakau 1964:47).

In regard to water on the ‘Ewa Plain, there is little mention except for inland streams of Honouliuli. However, there is one story that refers to a spring named “Hoaka-lei” (*lei* reflection) because “Hi‘iaka picked lehua flowers here to make a lei and saw her reflection in the water” (Pukui et al. 1974:119). This spring was located at Kualaka‘i, a well-known place on the coastline immediately south of the project area (Fig. 4). Early maps show an unidentified feature at Kualaka‘i; the 1927 USGS map (Fig. 5) notes the presence of a “waterhole”. People are recorded as living at Kualaka‘i at the turn of the century (E. Williamson n.d., quoted in Kelly 1991:152), indicating that water remained available even after the beginning of upland well-drilling and sugar production.

One of the most interesting of plant references for the ‘Ewa Plain is *‘ulu* (breadfruit, *Autocarpus incisus*). The connections with ‘Ewa concern the bringing of the first breadfruit to Hawai‘i. The most commonly quoted version notes that the first breadfruit was planted at Pu‘uloa, ‘Ewa, brought by Moikeha’s grandson, Kaha‘i-a-Ho‘okamali‘i, in a round-rip voyage that began at Kalaeloa (Barbers Point) (Kamakau 1991:110). Whether “Pu‘uloa” means within the harbor itself or at the *‘ili* of Pu‘uloa at Pearl Harbor is unclear, although Sterling and Summers (1978:41) conclude that the reference is to the *‘ili*. Other versions suggest that the “Pu‘uloa” is Pu‘uloa, Kohala, not ‘Ewa (Beckwith 1970:97). Be that as it may, an argument can be made that there is a strong connection between breadfruit and a specific place on the Honouliuli coast, Kualaka‘i. As noted above. Kualaka‘i is a place with a famous spring, and it is located on the coastline directly south of the project area. This is discussed in more detail in the section on traditions, but the critical reference is Fornander’s story of Namakaokapaoo (Fornander 1916-20, II:224 ff.), a child of a chief/god from Kahiki named Kauluakahai. Namakaokapaoo is abandoned by his father at Ho‘ae‘ae, the *ahupua‘a* east of Honouliuli, and he later finds the royal garments his father left for him in a gourd at Kualaka‘i, at a breadfruit representing his father. “Kauluakahai” means “the standing breadfruit of Kaha‘i” (also “Kauluokaha‘i”, in Beckwith 1970:480; also see Fornander 1969:383). The placename “Kualaka‘i” may actually be a corruption of “Kauluakahai.” In fact, there is a story from Ka‘u with elements similar to that of Namakaokapaoo in which the godly chief from Kahiki is named “Ku-alakai (Beckwith 1970:479). But whatever the origin of the place name Kualaka‘i, breadfruit is clearly associated with this location. The symbolic aspects of this association are discussed below. (Maly [1992:E-12] interprets “Ku-alaka‘i” as Ku-the-leader, and argues that this is “an alternate name, or another form of the deity Ku‘ula (Red Ku), a god of fisher-folk”).

Breadfruit is not noted in the recent environmental summaries of ‘Ewa, but Handy and Handy (1972:153) remark that “On Oahu, breadfruit was planted mostly on the southerly side--Wailupe, Waikiki, Kalihi, ‘Ewa [and] along the coast west of the Wai‘anae Mountains...”

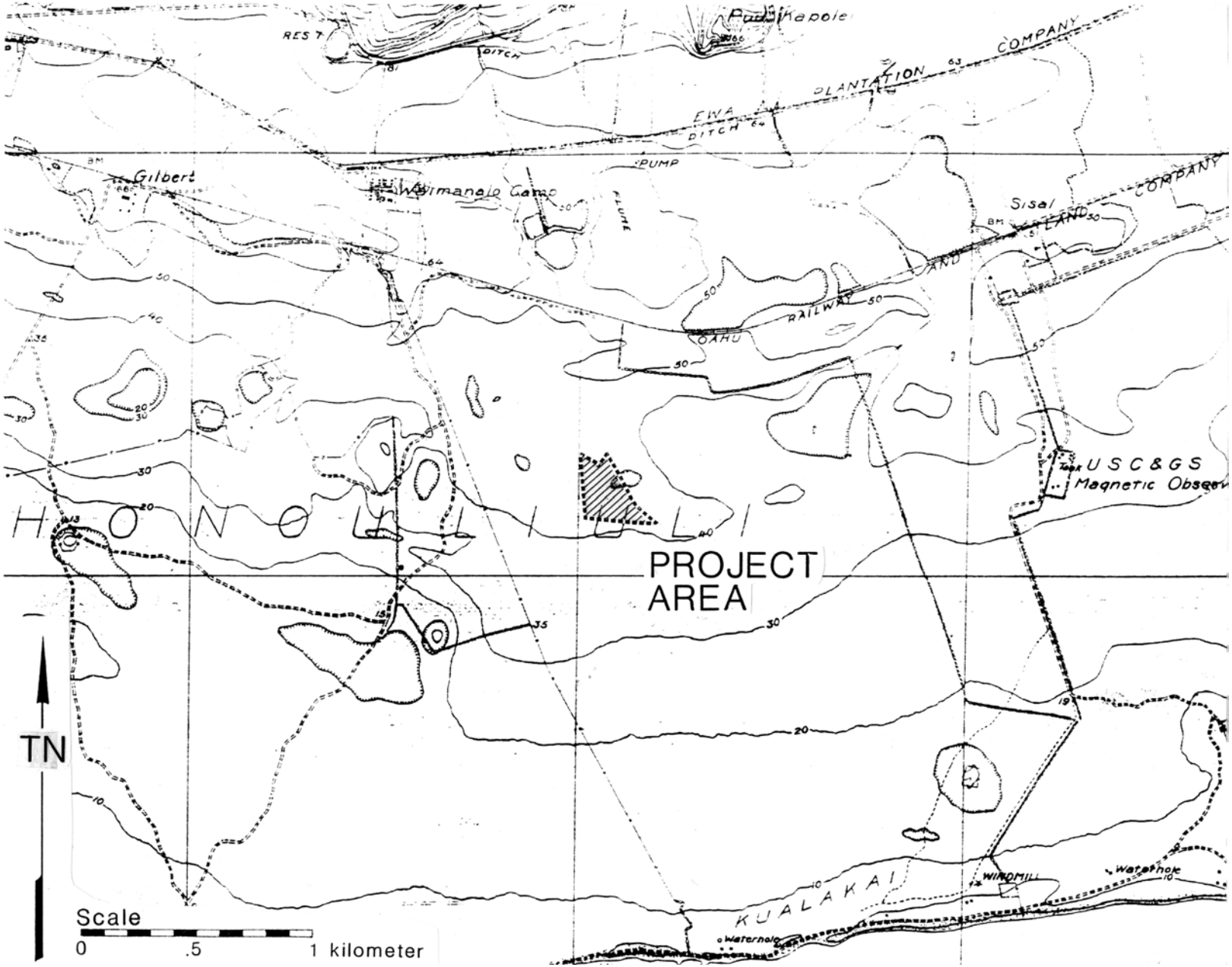

Figure 5. Portion of 1928 USGS topographic map (Barbers Point) showing project area.

Wiliwili, the *kauna'oa* vine, and *akulikuli*, some of the important plants associated in traditions with the 'Ewa Plain, are found at NAS Barbers Point (Botanical Consultants 1984; Whistler 1992). In fact, if the kiawe is disregarded, it would be seen that the project area remains a native forest of *wiliwili and kauna'oa*-draped trees (Photo 1).

Cultural History of the 'Ewa Plain

The traditions and history of Barbers Point and the 'Ewa Plain have been compiled and summarized numerous times, including Sterling and Summers (1978), Kelly (1991), Hammatt and Folk (1981), and Maly (1992). Only immediately salient points are presented here; details relevant to the project area are discussed at greater length below.

Traditional Context

Despite the many summaries of the traditions of 'Ewa, very little attention has been given to the themes of these traditions, two of which are noted here. The first is the connection with "Kahiki" and the second is the special character and relationship of the places known as Pu'uokapolei and Kualaka'i. The full development of these themes involves too much detail to present in the present report, focused as it is on a small area of the 'Ewa Plain, but this material will be presented in more detailed future studies. (A complicating factor is that much of this depends on retranslations of material in Fornander and Emerson.)

Connections with Kahiki are found in numerous placenames, traditional events, and with the beings associated with Honouliuli. For example, there are several versions of Kaha'i leaving from Kalaeloa (Barbers Point) for a trip to Kahiki to bring breadfruit back to 'Ewa (e.g. Kamakau 1991:110). There are several stories that associate places in the region with a number of deities or demi-gods, including Kamapua'a and the Hina family, as well as with Pele's sisters, all with strong connection with the traditional Polynesian homeland, Kahiki (cf. Kamakau 1991:111; Pukui et al. 1974:200).

Symbolically, the Kahiki and breadfruit motifs relate to life and renewal. This is most clearly emphasized in Fornander's Namakaokapaoo story referred to above, where the father Kauluakahai (embodied as a breadfruit at Kualaka'i) is godly royalty, a tree of life, and a spirit from Kahiki. Beckwith classes this in her pan-Polynesian theme of "stretching-tree kupua", a theme that is the "symbolic expression throughout Polynesia of the blood tie which connects a migrating people to their original ancestral line" (Beckwith 1970:487). In this regard, it is interesting to note that Kamakau (1964:84) refers to 'Ewa as the "celebrated land of the ancestors". He does not explain this comment, but Kelly suggests that it is because Kamapua'a's grandmother, Kamaunuaniho, lived in 'Ewa, and that she was one of the three migrants from Kahiki who were the "ancestors for the people of Oahu" (Kamakau 1964:64). Kelly's argument is certainly correct in the sense that this is one of a series of connections between 'Ewa and "Kahiki" ancestry for the life-force of the people of O'ahu.

Photo 1. *Wiliwili* (*Erythrina sandwicensis*) and *kaunao'a* (*Cuscuta sandwichiana*) in the project area.

The relevance of this issue to the present study becomes clear when the next point is made. This concerns the significance of Pu‘uokapolei, the volcanic cone that lies 2 km north of the project area. In brief, it can be argued that Pu‘uokapolei was one of the most important places, perhaps one of the most sacred places, in Honouliuli (see Sterling and Summers 1978:33). Pu‘uokapolei’s connections with Kahiki are emphasized when it is noted that the hill was the home of Kamapua‘a’s grandmother, Kamaunuaniho, the Kahiki ancestor to the people of O‘ahu (Fornander 1916-20, V:318; Kahiolo 1978:81, 107; Charlot 1987:62).

Pu‘uokapolei has numerous other associations that define it as a very special place. By name, it is associated with the goddess Kapo, another connection with the Pele and Kamapua‘a stories. It was the central reference point for observation of solar movement, the location for the equinox line for O‘ahu astronomers (Kamakau 1976:14). McAllister (1933:108) records that a *heiau* had been on Pu‘uokapolei, but destroyed long before his survey. No remains were found in a recent field study (Kennedy 1991). The *heiau* may have been associated with the sun (Fornander 1916-20, III:292), an unusual occurrence in Hawai‘i, but logical in this case considering the use of the hill for the equinox alignment. Pu‘uokapolei might have been the gate of the setting sun. It is of interest to note that the rising sun at the eastern gate of Kumukahi in Puna is associated with Kapo (Emerson 1978:41); there is no information about this at Pu‘uokapolei, but the place name itself (“hill of beloved Kapo”) is hard to ignore. (Confusing the issue, it should be mentioned that in some cosmologies, Ku was the god of the rising sun, so Hina should be associated with the setting sun. Hina is the mother of Kamapua‘a, and the association of the Kamapua‘a family with Pu‘uokapolei is enlarged.) Further, Pu‘uokapolei may have been a jumping-off place (also connected with the setting sun) and associated with the dead who roamed the plain of Kaupe‘a (Fornander 1916-20, III:292; Kamakau 1964:29).

Pu‘uokapolei was also the primary landmark from Pearl Harbor to the western coast, with a main trail running just inland of it. The trail was referred to as going by way of Pu‘uokapolei (I‘i 1963:27, 29; also see map in I‘i 1963:47). In fact, Pu‘uokapolei was probably the most common name used as a reference for the area of the ‘Ewa Plain in traditional Hawai‘i (cf. Nakuina 1990:54; Fornander 1916-20, II:318; E.M. Nakuina 1904, quoted in Sterling and Summers 1978:34).

The possible association of Pu‘uokapolei with the Plain of Kaupe‘a is an intriguing one. This place was one of the areas where souls without *‘aumakua* wandered endlessly. Kaupe‘a is noted as a *wiliwili* grove next to Pu‘uloa (Kamakau 1964:47,49). However, Kamakau makes at least three references to these places known as *ao kuewa*, including reference to the *wiliwili* grove of Kaupe‘a on O‘ahu (Kamakau 1964:47) and also to the “plain of Pu‘uokapolei” on O‘ahu (Kamakau 1964:29), suggesting that these are the same place. The size of these areas of Kaupe‘a and the plain of Pu‘uokapolei is uncertain, but Emerson notes two place names in the Hi‘iaka myth as referring to portions of the ‘Ewa Plain: Kane-hili and Pe‘e-Kaua, which appears again as “Kau-pe‘e” (cf. Kaupe‘a) in these same verses (Emerson 1978:167). In fact, the line refers to going downhill from Kaupe‘e to Kane-hili. This would match the inference that Kaupe‘a is the name of the area around Pu‘uokapolei, the upland border of the ‘Ewa Plain.

The final element in this picture is that the chant for Kualiʻi contains two stanzas that mention both Puʻuokapolei and Kualakaʻi (although a seemingly garbled translation obscures the meaning of the connection). Kualakaʻi and Puʻuokapolei are two of the places in ʻEwa with strong Kahiki associations. It is not unlikely that a trail physically connected these two places, and the project area would have been near this trail.

If this is a correct identification of traditional places, the project is on or near the Plain of Kaupeʻa (or Kaupeʻe), a place of lost souls. It is 2 km from Puʻuokapolei, probably a sacred place associated with the setting sun and entry to the underworld, and home of the Kamapuaʻa family. It is also two km from the famous place of Kualakaʻi, a place suitable for permanent habitation. Finally, the location of the project area lies between Kualakaʻi and Puʻuokapolei, and would probably have not been distant from any trail that connected the two.

Honouliuli at Contact

At the time of contact, the *ahupuaʻa* of Honouliuli was the largest on Oʻahu. In the 1831-32 census, it had one of the highest populations on the island, with 1,026 people recorded (Schmitt 1973:19). The population center was certainly around Pearl Harbor, with its fishponds, natural marine productivity, and the adjacent fields of irrigated taro.

Two general models of pre-contact land use have been proposed for the ʻEwa Plain or Honouliuli as a whole (Kennedy and Denham 1992:18; Tuggle 1994b). Kennedy and Denham (1992:18) suggests dense settlement based on irrigated taro located along the inner bay, a wide coastal zone settlement based on mixed marine exploitation and cultivation, a strip of banana and sugarcane cultivation along the eastern slope of the Waiʻanaes, and a barren zone over all the inland ʻEwa Plain. There are several problems with the model. It can be alternatively argued that there was probably more cultivation in all of the Waiʻanae gulches that enter the ʻEwa Plain, much more population along Pearl Harbor than noted, and permanent settlements and intensive cultivation in the upland area of Lihue (based on information in Handy and Handy 1972:263, 469; Hammatt et al. 1991:27ff). It is not clear if the Kennedy-Denham model is intended to represent Honouliuli at contact or some earlier period, but the "barren zone" of the inland ʻEwa Plain was in fact, a place of traditional Hawaiian settlement, as indicated by the work in the present project area and other inland locales (Haun 1991; Burgett and Rosendahl 1992; Sinoto 1976).

In a review of the archaeology of the ʻEwa Plain Tuggle (1994b) proposes a model of settlement expansion across the ʻEwa Plain initiated from an early occupation on the floodplain of Honouliuli Stream. The model suggests that permanent settlement first spread across the upper portion of the Plain with the use of the water sources at the base of the Waiʻanae range for cultivation. This was followed by expansion of permanent settlements along the coastlines of the plain, with a final process of filling of the interior region. The interior settlements are proposed as long-term occupations depending on cycles of rainfall and wetland availability. The end result of this pattern of expansion was a comparatively densely settled region of dryland farming households and communities, with two special areas of activity. An area of elite and

royal residence had probably developed at the entrance to West Loch (the ‘*ili* of Pu‘uloa), and a sacred area existed at Pu‘uokapolei.

The religious and political structuring of Honouliuli at contact is poorly known. No named *heiau* have been identified in the traditions of Honouliuli. Sterling and Summers (1978) record seven temples for the *ahupua‘a*, including six from McAllister’s informant-based survey (1933) and one from 1960 informant data (Sterling and Summers 1978:37). One of these seven is a *ko‘a* at Pearl Harbor, five are in the mountains or the upland area of Honouliuli, and one is at Pu‘uokapolei (also recorded by Thrum 1907:46). No local traditions related to their use or dedication are mentioned for any of these temples, except that the temple recorded in 1960 was said to be agricultural.

The political center of the district of ‘Ewa has been given little attention, but McAllister (1933:106) records a place named Lepau on the Waipi‘o Peninsula, as “a dwelling place of the *alii*”. Handy and Handy (1972:470) believe this to have been the “ali‘i” stronghold of ‘Ewa, based on the productive strength of Pearl Harbor.

The early written accounts of the ‘Ewa Plain generally describe this as a barren, unpopulated area (Vancouver 1798 (3):361-363; Ellis 1969:11). The archaeological evidence for the occupation of the interior area, including the location of the present project, is unquestionable, but it presents a historical puzzle. The issue is whether the primary occupation and abandonment of the inland area occurred during the pre-contact period, or whether occupation lasted into the 19th century, but was of a low-level of intensity or of a seasonal nature that was unnoticed by or unimportant to the early observers.

There are no traditions or placenames that would provide more information on the traditional use of the project area. It lies some 2 km from the coastline at Kualaka‘i to the south and 2 km from Pu‘uokapolei to the north, placing it in the center of the ‘Ewa Plain on a coastal-inland axis. Pu‘uokapolei and Kualaka‘i are the only nearby places with historical Hawaiian information. The geographic position of the area suggests that it was near a major coastal-inland route between these two places, although there is no historical or archaeological evidence to support this. However, this geographic model indicates that the project area was not as isolated during the pre-contact and early post-contact periods as might at first appear. At the same time, it was certainly distant from centers of power and population. The nearest circum-island trail was at Pu‘uokapolei. The major population center of Honouliuli was at the northwestern edge of Pearl Harbor about 7 km distant, and the political center at Lihue was far inland.

Archaeological Research and Pre-contact Settlement History of the ‘Ewa Plain

The summary of archaeological research for the ‘Ewa Plain is oriented to problems that have been addressed. A detailed review of this issue is presented in Tuggle (1994b).

History of Research

The archaeology of the ‘Ewa Plain has a history of surprises. Although McAllister (1933) had noted sites in the area, it was given little attention until the work of Lewis in 1970 produced the first surprise, the area’s high density of archaeological remains. The second surprise came in 1976 when the work of Sinoto (1976, 1978) revealed the presence of bones of extinct birds in the sinkholes of the plain, and raised the possibility that human colonization was a major factor in avifaunal extinction. The third surprise was the suggestion of permanent habitation at some locales (Sinoto 1976). Although this model is now in question (Charvet-Pond and Davis 1992), there is still substantial evidence for such a pattern (Haun 1991) or for a pattern of long-term seasonal occupation, perhaps unique in Hawai‘i (Davis 1990). A more recent surprise, at least in some quarters, has been very early radiocarbon dating of some occupations (Davis et al. 1986:20-22; Goodfellow 1992).

Since Lewis’ work, there has been massive development of the ‘Ewa Plain which has coincided with the effective implementation of historic preservation in Hawai‘i. As a result, there has been an extensive amount of archaeological research conducted in the process of cultural resource management. The history of this archaeological research and general conclusions have been recently summarized in a number of reports, including Davis (1990), Charvet-Pond and Davis (1992), and Miller (1993). A bibliography of research on the ‘Ewa Plain is in Kennedy and Denham (1992). The basic summary will not be repeated here, only primary points critical to the present project.

Site Types

The types of sites found on the ‘Ewa Plain are primarily habitation shelters and small enclosures, utilized sinkholes, “surface deposits”, and stone piles or mounds. The habitation structures vary in size and intensity of occupation, but most are small. Many of the small enclosures are well-built, with the appearance of intended long-term use. Most of these structures are part of complexes that also include sinkholes. There are few structures or complexes sufficiently elaborate to suggest elite residence. The main area of the ‘Ewa Plain where such structures would be expected is the inner bay of Pearl Harbor, where archaeological remains were certainly destroyed long ago.

Utilized sinkholes include a few that are large enough for habitation, but most were used for cultivation, trash deposition, human interment, or some combination of these functions. In some cases, there are no associated structures; in other cases, small semi-enclosing walls have been built on the side of the prevailing wind (northeast). Others are rock-filled, capped, or have stone piles increasing access.

Stone piles usually come in clusters, and are interpreted as agricultural features, primarily for sweet potato cultivation (Davis 1990:240-243). Surface deposits are usually of fire-cracked limestone, sometimes with associated midden. There are also areas that have been cleared of stone that may have been small agricultural plots.

Human interment has been found with some frequency on the ‘Ewa Plain, commonly occurring in sinkholes. In some cases, the interments are actually buried with the sink deposit, in other cases bones have been placed in recesses of the sink.

One of the primary functional categories of Hawaiian occupation that is conspicuous by its absence is the temple or shrine. Some fishing shrines have been recorded along the coast, but fewer than would be expected by comparison with other areas of intensive fishing use, such as the Lana‘i or Kohala coastlines. Even more striking is the absence of very many good candidates for small agricultural temples that would be expected in the inland area of habitation and cultivation.

Trails constitute another site category where there are fewer examples than would be expected.

Sinkholes have dominated the attention of archaeology of the ‘Ewa Plain, primarily because of the environmental information they have been found to contain, including pollen, land snails, land crabs, and sub-fossil avian bones. This material has proved to be a remarkable data set for reconstructing environmental change following Hawaiian colonization (Kirch 1985:117, 292).

Occupational History

The archaeological research of the ‘Ewa Plain and associated areas suggests that there was some Hawaiian occupation within the early time range of A.D. 200-600 at several sites on the western side of the ‘Ewa Plain (Davis et al. 1986:20-22; Charvet-Pond and Davis 1992:163-168; Goodfellow 1992) and at one site adjacent to Honouliuli Stream, near Pearl Harbor (Dicks et al. 1987:45, 60-66). The early ‘Ewa Plain occupations are interpreted as temporary camps for fishermen and bird hunters (Davis et al. 1986:25; Charvet-Pond and Davis 1991:75), although there is some reluctance to see this as a firm conclusion, or to eliminate the possibility that early permanent settlements occurred at other places along the leeward coast (Charvet-Pond and Davis 1992:302).

There are substantial numbers of radiocarbon dates from work on the ‘Ewa Plain that indicate increasing occupation by the second millennium A.D. The question of the nature of this occupation remains unresolved. Charvet-Pond and Davis (1992) evaluated the data from the western part of the area in regard to the possibility of increasing settlement permanence, and rejected this in favor of a model of a succession of temporary occupations over a long period of time. Others have argued that there are areas of permanent habitation on the Plain (Sinoto 1976; Haun 1991). On the eastern side of Honouliuli, permanent occupation associated with taro fields and fishponds is certain by the mid-1500s A.D. (Dicks et al. 1987).

A re-examination of the data for occupation of the ‘Ewa Plain (Tuggle 1994b) suggests that the area was an extensive dry farming cultural landscape, with long-term

occupation, depending in part on cycles of rainfall. However, the evaluation of the nature of occupation is clearly a high research priority for the region.

Problems in the History of ‘Ewa Settlement

There are two dominant research problems that have emerged from the archaeological studies of the ‘Ewa Plain. Neither is unique, but both have unique and inherently interesting elements. The first problem is the nature of the occupation of the plain, referring to the family organization and use of space of the settlements, the degree of seasonality of the occupation (and by corollary the ties to coastal settlements), and long-term change. This set of questions has the usual attendant problems regarding the functional identification of specific structures (including possible shrines), the community organization reflected by the structural use, and problems of occupational duration.

The second general problem is the reconstruction of environmental change and the development of models of the relationship between human occupation and the change.

The archaeological evidence for settlement of the ‘Ewa Plain makes it quite clear that that there was a substantial occupation of coastal and inland portions of the region. It is clear that these populations depended heavily on marine exploitation, with some support from cultivation. In both cases, exploitation may have been seasonal, but the presence of some permanent habitations cannot be excluded. It is also clear that there were no areas of royal residence on the ‘Ewa Plain, no major temples, and no other structures associated with royal occupation. The exception to this may have been on the margins of Pearl Harbor itself, but there are no archaeological or historical data to test this possibility. Overall, the data currently allow for several models of settlement history.

On-going and future research necessarily addresses this problem as one of the primary issues, including the methodological component of defining testable hypotheses or relevant data sets. A related part of the research on settlement is the problem of identifying religious structures on the ‘Ewa Plain. There are very few examples of *ko‘a* along the coast, and only a few possibilities for inland shrines related to habitation and agricultural complexes. This suggests a need to re-evaluate criteria for religious structures in the region.

The final major issue for pre-contact settlement analysis of the ‘Ewa Plain is the problem of the human impact on the environment. There is no question but that massive changes have taken place in populations of birds, land snails, and vegetation, amply documented in all of the ‘Ewa Plain research. Charvet-Pond and Davis (1992:299) summarize the three possibilities for this change: post-contact introductions and activities, pre-contact Hawaiian colonization and land use, or natural processes. The present consensus is that Polynesian-introduced species and cultivation practices precipitated significant changes in the area, including extinction or extirpation of numerous bird species, followed by a series of additional deleterious changes following the 1778 contact point.

Avifauna extinction illustrates the complexity of the issue. The presence of the Polynesian rat (*Rattus exulans*) in deposits with the subfossil remains of extinct bird species proved the post-Polynesian timing of the extinctions. Preliminary models suggested by archaeologists and biologists two decades ago involved human predation as a significant element of the extinction process. As noted above, bird hunting and collecting remains a part of the model of early human subsistence in ‘Ewa. However, there has been remarkably little evidence for predation in archaeological sites. Much of the avifaunal bone material appears to have accumulated as a result of natural processes and not as cultural deposition. In one of the projects with solid evidence for bird remains resulting from hunting and consumption, the authors nonetheless conclude that bird hunting was not widespread and “not on a scale sufficient to extirpate whole taxa” (Charvet-Pond and Davis 1992:300). The prevailing model now is that human-induced changes in habitat are the primary factors in bird extinction.

However, additional work on such sites is needed, and a critical evaluation of radiocarbon dates is also lacking[1].

The occupationally specific dating problems seriously hinders the resolution of these substantive problems. New methods for chronological control will have be devised before problems of settlement history and environmental change will be solved.

These problems and the associated working models set the specific framework for the identification of site significance in historic preservation planning for the ‘Ewa Plain. This framework has been codified in the statements of significance for archaeological districts eligible to the National Register and in the regional research design, where the problem of human-environmental interaction is defined as one of the areas of primary significance in the cultural resources management program of the state and federal governments.

Political History and Post-contact Change in Honouliuli

A brief review of the historical events of the *ahupua‘a* of Honouliuli is presented below, providing the larger socio-political context for the project area.

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[1] In general the use of radiocarbon dates in ‘Ewa Plain research has been slipshod. (For a review of these problems see Tuggle 1994). Researchers have seldom paid attention to basic principles of archaeological dating (see Dean 1978), such as making an argument about the relationships among the dated material, the event to be dated, and the dating of the site. Further, researchers have given little thought to the specifics of Hawaiian dating problems. To name a few problems common to many project reports: the dated material is seldom identified so that foreign species or long-lived trees cannot be segregated; most of the time only single dates per provenience are obtained, eliminating cross-checking (a problem of the present report, discussed below); standard deviation is used to infer occupational duration; and there is selective use of calibration ranges and conflicting sets of dates.

Pre-Contact Political History

A reconstruction of Hawaiian political history (Cordy 1993) indicates that in the early 1300s ‘Ewa was a dominant political entity, joined with Wai‘anae and Waialua under a king named Keaunui, son of Maweke and part of the Maweke-Kumuhonua line. O‘ahu unification occurred by A.D. 1400 under the king La‘akona, identified with ‘Ewa (Cordy 1993:15). Cordy suggests that at least one royal center for ‘Ewa was at Lihue in upland Honouliuli (Cordy 1993:16). There were several shifts of power from the 1500s until the early 1700s when Kuali‘i achieved control of all of O‘ahu through battle, including defeat of ‘Ewa chiefs in at least two battles. Peleioholani, a son of Kuali‘i, took control of O‘ahu as regent in 1740, and remained ruler of O‘ahu until after 1778 when Kahahana, from the ‘Ewa line of chiefs but raised in Kahekili’s Maui court, took control of O‘ahu.

The turbulent period of warfare in the late 1700s included the conquest of O‘ahu by Kahekili in 1783. After this event and the death of Kahahana, ‘Ewa chiefs plotted the death of Kahekili and the other Maui overlords. The plot fell apart and in revenge Kahekili attacked ‘Ewa and Kona. Kamakau (1961:138) records that “men, women, and children were massacred, until streams...in Kona and Kahoa‘ai‘ai in ‘Ewa were choked with the bodies of the dead...” Following Kamehameha’s conquest of O‘ahu, at least two of his chiefs lived at Pu‘uloa, and later Liholiho also had a home at Pu‘uloa (Kamakau 1961:255).

Post-Contact Change

The population of Honouliuli at the time of contact is unknown. When the 1832 missionary census was taken, a population of 1,026 was recorded, but this was, of course, after 50 years of population decline. The significance of the number is its proportion to the populations of other areas. In the 1832 census, Honouliuli contained nearly twenty-five percent of ‘Ewa’s total population. Differential population change certainly occurred, but it is probable that this represents the relatively high population density for Honouliuli before contact, a population to be expected from the size of the *ahupua‘a* and the wealth of its resources.

The post-1778 history of Honouliuli, as it bears on the project area, is summarized primarily from Kelly (1991), with other sources as noted.

Little is known of Honouliuli itself during the early 1800s, except that it suffered the population decline common to all of Hawai‘i, dropping from 1,026 in 1831 to 870 in 1835 (Schmitt 1973:19, 22). Ten missionary schools were present during that period, but these were later abandoned (Kamakau 1961:424). It is probable that the inland areas of the ‘Ewa Plain, whatever their population at contact, were abandoned by the mid-19th century, given the drastic decline in general population and the increasing population consolidation in towns. The road passing by Pu‘uokapolei would have been active during this period (Ii 1963:27), but there was no recorded habitation between the towns of Honouliuli and Waimanalo (‘Ewa). In 1839, Hall (quoted in Kelly 1991:150) referred to crossing the “barren desolate plain” of ‘Ewa. However, maps and other records suggest that small numbers of people remained at least along the coast,

and one of these places of continued occupation was probably Kualakaʻi, south of the project area.

By the mid-1800s, cattle were certainly well-established on the ʻEwa Plain, with an estimated 12,000 on Oʻahu at that time (Cuddihy and Stone 1990:59). In 1877, James Campbell is said to have chased out 32,000 head of wild cattle (Briggs 1926, quoted in Kelly 1991:162), a number that sounds exaggerated but represents the scale of the cattle presence.

During the land distribution of the mid-1800s, there were 97 *kuleana* awards for Honouliuli and "most of the awards were in the wet-land taro gardens of Honouliuli, not in the dry plain area" (Kelly 1991:160). Kelly does not say where the remainder of the claims were located, but presumably not in the area of the Naval Air Station, the geographic subject of her research. Research for the present project has found no archival evidence of *kuleana* that might have been in or near the project area. It is unlikely that any would have been awarded in this area, given its isolation, but if any had, this would have been as an inland parcel for a coastal claim, and the inland parcels in such cases seldom were surveyed or located on maps. Further, none of the archaeological sites in the project area resemble *kuleana* structures, typified by houselot enclosing walls, although the nearby Site 1719 does have that character.

The *ahupuaʻa* of Honouliuli itself was awarded to Kekauʻonohi, granddaughter of Kamehameha I (Indices 1929). The *ʻili* of Puʻuloa was sold in 1849 and a profitable salt works established (Kelly 1991:160). Kelly (1991:160) notes that there was also a saltworks at Kualakaʻi, but gives no source for the information.

Following land transfer by inheritance, Honouliuli (except the *ʻili* of Puʻuloa) was sold to James Campbell in 1877. Campbell fenced much of the land for grazing, converted 10,000 acres to agriculture, and began drilling artesian wells. In 1889, much of the agricultural land was leased for sugar cultivation. In the early 1890s, a railroad was constructed running across the center of the ʻEwa Plain at the lower boundary of the sugar cane fields, a half kilometers north of the project area. In 1894, the cultivation of sisal (*Agave sisalana*) was begun to the east of the project area. Commercial *kiawe* cutting began on the ʻEwa Plan in the 1870s, continuing in some areas until recent land development.

In the 1930s, the U.S. Navy leased a portion of the Campbell Estate, and enlarged the leased area in 1940, when the area for the Naval Air Station was surveyed and construction begun (Collins 1977, quoted in Kelly 1991:166).

Recorded Sites and Previous Research in the Project Areas and Vicinity

NAS Barbers Point has no sites that are on the National Register of Historic Places, although the Oahu Railway and Land Company right-of-way that runs along the northern boundary of the Station is a National Register site (80-12-9714). In fact, this is the only National Register site in the Barbers Point region, although two major archaeological districts have been declared eligible for the National Register or recommended to the National Register

(these are the Barbers Point Harbor Archaeological District and the Oneula Archaeological District; T. Dye, pers. comm. 1993). The importance of these archaeological districts to the present work is that they define paleontological and environmental reconstruction as part of the characteristics of eligibility for National Register status, based on the importance of providing the environmental context for "significance" of cultural resources.

Prior to a 1985 survey (Haun 1991), only four archaeological sites had been recorded on the Station: a small cluster of sinkholes with cultural material in the runway outlease area to the west of the Station (Tuggle 1984) and four isolated burials. The sinkhole cluster in the runway outlease area has been assigned to Site 1725 (Haun 1991). Of the burials, one was uncovered from a limestone cavity exposed by a drainage canal in 1984 and was collected by a State of Hawaii archaeologist; a record search has not been successful in locating additional information. One burial (Bishop Museum Site B6-9) has been incorporated into Site 1753 (Haun 1991:32). Another burial was recorded by the Hawaii State Historic Preservation Office at Kualakaʻi (Nimitz Beach) as Site 532. A fourth burial is recorded as a flexed adult male burial recovered from "Nimitz Beach", but the exact location is not known (Yoklavich et al. 1992:37).

Site numbers involving the Site 532 burial have since become confused. As recorded by the SHPD, the Site 532 burial was located in the coastal dune at Kualakaʻi (Nimitz Beach picnic area) and a subsurface firepit was also noted near the burial. In the 1985 survey (described below), the site designation 532 was peculiarly used to include not only the burial, but a set of WWII shoreline pillboxes (Haun 1991:31). A new site number, 2220, was assigned to the sub-surface cultural deposit along this stretch of beach (Haun 1991:120). Confusion over site numbers was compounded when the Bishop Museum temporary site number (B-E-9-1), rather than the State number 2220, was placed on the published survey map (Haun 1991:Figure 3). The recent summary of cultural resources at NAS Barbers Point (Yoklavich et al. 1992:48) uses State Number 1758 to include the pillboxes and the cultural deposit, but keeps the Haun report numbers (B-E-9-1 and 532) on the site map (Yoklavich et al. 1992:Figure 15). It should also be noted that the locations of the pillboxes of Haun's 1991 Site 532 have been removed from the Yoklavich et al. Figure 15 and only two are listed, without site numbers (Yoklavich et al. 1992:53) rather than the eight bunkers noted by Haun (1991).

For this report, State Number 2220 is used for the exposed cultural deposit (probably pre-contact) along the beach at Kualakaʻi. As listed in the SHPD files, Number 532 will continue to be used for the burial that was part of 2220. A new number, 5125, has been assigned to the pillboxes. Inventory survey has since confirmed the presence of nine pillboxes.

A major archaeological survey was conducted in 1984-85 at NAS Barbers Point by the Bishop Museum (Haun 1991). The Haun survey (Fig. 6) covered some 1,310 acres of the total station area of 3,615 acres (Haun 1991:4, Figure 2). The survey recorded 385 archaeological features grouped into 42 sites. Of these, 284 are identified as indigenous Hawaiian, functionally divided into habitation (134 features), agricultural (67 features), burial (6 probable and

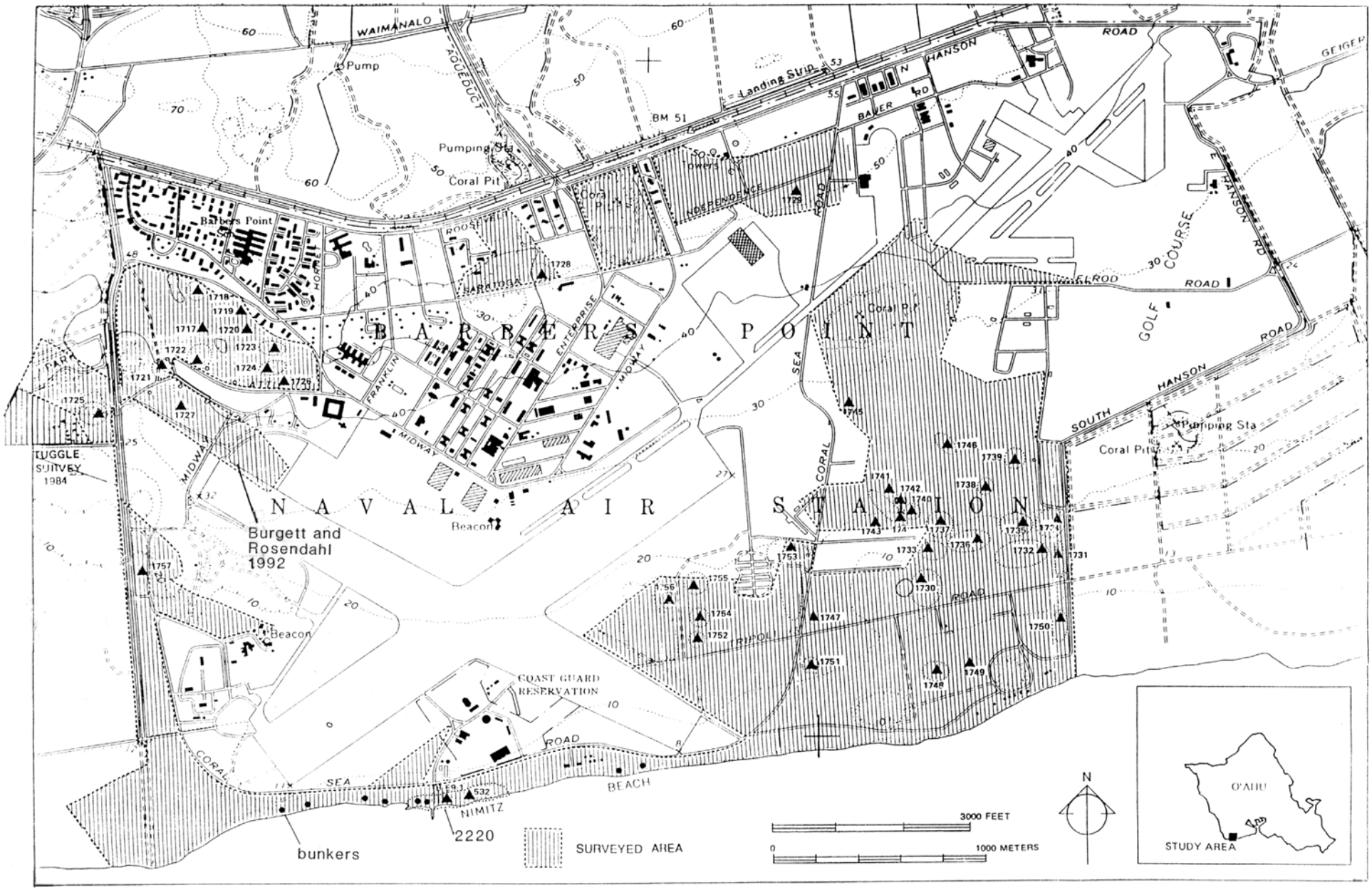


Figure 6. Areas and sites of 1985 survey (Haun 1991:Figure 3), modified with subsequent survey data from Welch (1987), Burgett and Rosendahl (1992), and Landrum (1993).

56 possible features), religious (4 features), storage (1 feature), water source (4 features), and boundary walls (18 features). In addition, four ranching features and 15 military features were recorded, with the remainder of the 385 classed as unknown (Haun 1991:Table 8).

The Haun survey recorded six sites in the area of the Phase I (area A) survey: 1718, 1719, 1720, 1723, 1724 and 1726 (Fig. 6). Three of these are also included within the present Phase II survey area: 1723, 1724 and 1726. In June 1992, prior to Phase I, a special detailed study of Site 1719 was conducted by IARII (Erkelens 1992). The site information from these two reports is included under the appropriate site descriptions. None of these six sites was tested by either Haun or Erkelens.

A reconnaissance survey just north of the Station for the development of Kapolei Town Center located no archaeological sites (Haun 1986) because the area has long been under sugar cultivation. A survey on the northeast side of the Station located three features associated with Hawaiian occupation, including a small rectangular house (Landrum 1993). Farther to the east, near the edge of the Station, an IARII survey in 1987 located four stone structures, including a C-shape and a small enclosure (Welch 1987).

In September 1992, an archaeological survey was carried out on 17 acres on the western side of the Station (Burgett and Rosendahl 1992), southwest of the present project (Fig. 6) although the actual location of the survey is uncertain (Tuggle 1994b). This survey recorded 71 features grouped into 21 sites. The features include a number of mounds, wall fragments, and modified sinkholes. The majority of the features are interpreted as agricultural. There is some evidence for temporary habitation. Burgett and Rosendahl conducted test excavations in soil depositions around mounds and in open areas, but no cultural materials were encountered.

Local Settlement Data

Many of the features recorded in Haun (1991) do not have published site maps, so a detailed settlement analysis of the NAS Barbers Point area is not possible without examination of all of the field records. However, the descriptions indicate that the sites in the southwestern clusters (Fig. 6) contain several complexes of permanent habitation and three possible religious features. These complexes are defined by the presence of well-constructed house structures (not simple C-shapes) and few agricultural features.

The map shows survey areas, but no information is available on disturbance to be able to determine if the clustering is a function of settlement clustering or residual site distribution. The “religious structures” are problematic at best. A detailed on-site re-evaluation of possible religious structures needs to be conducted.

The Burgett and Rosendahl survey area contains agricultural and temporary habitation features, but no substantial house sites suggestive of permanent habitation. However, the

limited survey area and adjacent areas of surface destruction mean that these features many represent only a portion of a larger community.

The one other site to be noted is the temple that once stood on Pu‘uokapolei, approximately 2 km to the north of the project area.

Local Chronology

Very little chronological information is available from work on the Station. Surface artifacts recorded during the Haun survey clearly indicate that most of the stone structures, modified sinkholes, and agricultural mounds were associated with an indigenous Hawaiian occupation, but without a specific age bracketing (Haun 1991:138).

Three sites were tested during the Haun survey, and two carbon samples were dated (Haun 1991:138). At Site 1734-K, on the eastern side of the Station, charcoal taken from a lens was radiocarbon dated to “less than 160 radiocarbon years B.P.” (Haun 1991:125). The beach deposit at the place known as Kualaka‘i, Site 2220, produced carbon from an unlined hearth that was dated a “C13/C12 adjusted age of 270 $\pm$ 110 B.P.” (Haun 1991:130). The hearth appears to be at the base of the earliest cultural occupation in the deposit (midden in the layer below is probably intrusive), with a basalt flake, grindstone fragment, and midden found in the associated layer. The absence of information on wood type in the dated charcoal or information on quantity of charcoal dated makes interpretation of the date problematic. The stratigraphic position of the hearth would suggest a solidly pre-contact occupation, and given traditional information about this location and early dates from adjacent regions, this deposit could well prove to be a comparatively early one. Additional work should be carried out at this site and proper dating protocols followed.

Adequate dating of the coastal occupation of Site 2220 would not, however, prove very relevant to the direct dating of the project area, which represents an entirely different type of occupation. Two sets of dates will have to be developed independently for the two areas, followed by analysis of their relationship. It is anticipated that the occupation of Site 2200 would substantially pre-date any occupation of the project area. In fact, Site 2200 should prove to be among the earliest sites on the Station.

One other set of dates was obtained from a small structure and sinkhole cultural deposit at Site 4650, east of the present project (Landrum 1993:Appendix 2). The dates are all late, falling into the range of the A.D. 1600s to present.

III: BACKGROUND TO THE SURVEY AREAS: PHASES I AND II

The details of the environment of the project areas are presented in this section, with emphasis on disturbance and its effects on the archaeological inventory.

Boundaries of the Survey Areas of Phases I and II

The cultural resources inventory for the NAS Barbers Point construction projects was carried out in two phases. Phase I covered three areas of the Station, which are designated areas A, B, and C (Fig. 2). Area A is approximately 87 acres in size located in the northwest area of the Station. Area B covers approximately 3 acres located near Rendova and Nassau Roads in the central part of the Station. Area C covers 5,000 ft^2 adjacent to Building 972 in the northeast area of the Station.

Area A and a portion of B had been surveyed previously (Haun 1991:Figure 3). The present project Phase II intensive survey was conducted in a portion of Phase I, area A.

Phase I: Survey Area A

Area A was surveyed as the first phase of investigation for family housing (Project H-208). The area is bounded on the north by Boxer and Saratoga Roads and an unnamed access road which turns south along the western boundary of the Station, defining the western limit of survey (Figs. 2, 7, and 8). The southern boundary of the survey area is Midway Road, between Attu and Franklin Roads, and the fail-safe arc which curves from the Attu-Midway intersection to the western boundary of the Station. The fail-safe arc is not marked on the ground.

On the eastern side of area A, Boxer Road is the boundary between a developed area to the east and a largely undeveloped (but not undisturbed) area to the west. The eastern section is a residential district of military housing and a cleared, grass-covered lot. The majority of area A south of Boxer Road is a dense to moderately wooded terrain of limestone bedrock with patches of shallow soil. Vegetation ranges from dense *kiawe* with thick ground cover of brush to open areas of *'ilima*, basil, and grasses. This is one of the relatively undisturbed areas of the Station, with high archaeological sensitivity. However, there is a great deal of localized disturbance, with areas of bulldozing, some trenching, and warehouse construction on landscape fill on the northeast side.

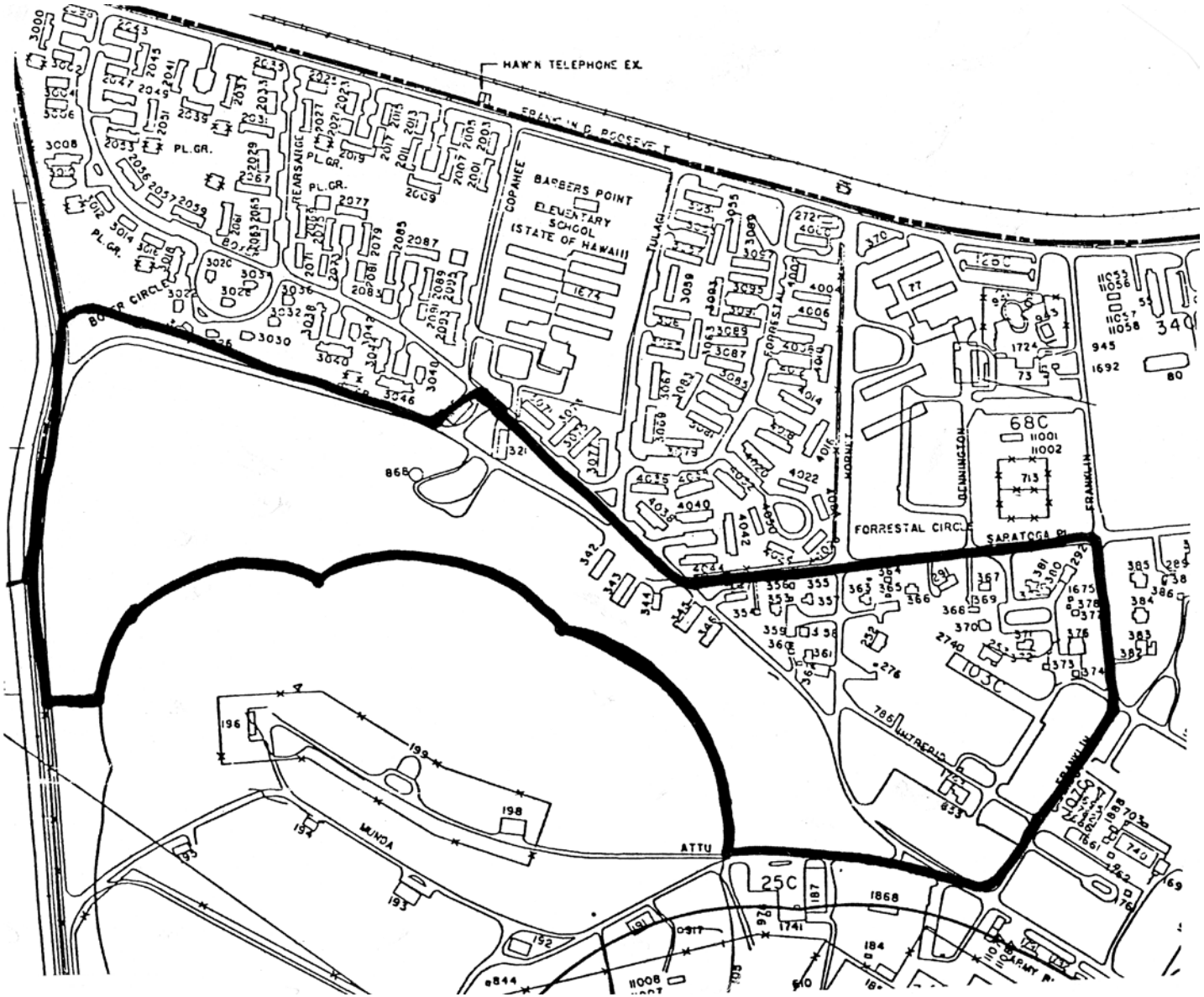


Figure 7. Phase I survey area A.

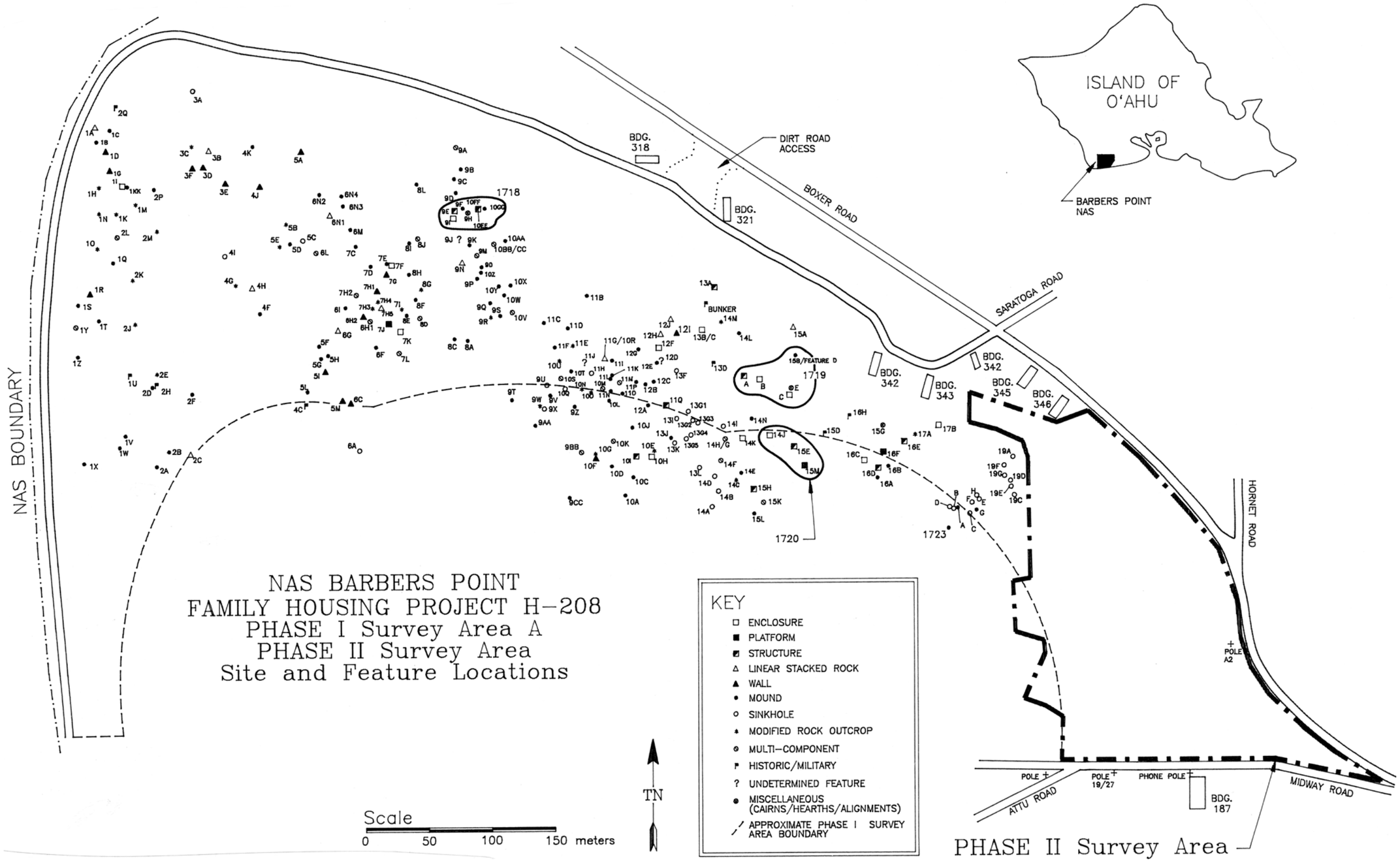


Figure 8. Sites and features of Phase I survey area A and Phase II survey area.

Phase I: Survey Area B

Survey area B was surveyed for aviation maintenance training facilities construction. This survey area of 70,000 ft^2 consists of two lots located north of Saratoga Road and west of Nassau Road (Figs. 2 and 9). The eastern lot is an open area covered with grasses, *'ilima*, scattered *kiawe*, and sisal. The western lot has dense sisal thickets, making survey difficult, with scattered *kiawe* and *'ilima*.

Phase I: Survey Area C

Survey area C is located in the northeastern corner of the Station in the area of Kasaan Bay and Vinson Roads (Figs. 2 and 10), proposed as the location of an addition to the WINGSPAC building. It is a 5,000 ft^2 lot, containing a few *kiawe* trees and landscaped bermuda grass. It is currently used for recreation.

Phase II: Survey Area

The Phase II survey area covers the eastern portion of Phase I, survey area A. This area has been chosen for development of family housing (Project H-208) and includes the area east and north of Boxer Road (Fig. 8) and the area southwest of Boxer Road. The Phase I survey found numerous archaeological features in the area southwest of Boxer Road and this area was selected for the detailed Phase II inventory (Figs. 2, 3, and 7). Phase I survey established that the area east and northeast of Boxer Road has no surface archaeological sites and very low potential for subsurface sites. Consequently, no additional survey will be conducted in this area.

The Phase II survey area (Fig. 3) consists of approximately 10.8 acres located on the western end of NAS Barbers Point, near the junction of Midway and Boxer Roads. The project area is roughly triangular in shape, with Midway Road forming the base to the south and Boxer Road the hypotenuse on the northeast. The long side of the triangle is an irregular line running north through an undeveloped area from the junction of Midway and Attu Roads to near Buildings 344 and 345, which front Boxer Road.

The western boundary for Phase II was roughly drawn in relation to the features of the area known at the time, covering the area at least 100 feet west of the construction project boundary (Fig. 11). This line specifically excludes several Phase I features, including all of the Phase I, Feature 19 series, as well as Features 21-H and 21-I. The primary purpose of the feature exclusion was to preclude testing of these two structures. They have, however, been included in the inventory for management consideration. During the Phase II survey, it was found that there was a high density of unrecorded features along the western boundary in the vicinity of Phase I, 21-H (1724-55); the survey included a portion of these features because of their relevance to establishing site significance as a whole and to management of the entire

feature complex. The housing construction boundary and the final boundary of the Phase II survey area are shown in Figure 11.

Environment of Survey Area A and Phase II Survey Area

A summary of the environmental studies and information for NAS Barbers Point is found in a report by The Traverse Group (1988) and is the background for the discussion below, supplemented as referenced.

Survey area A (including the Phase II area) lies just above the 40 ft contour, some 2 km from the coastline. The terrain of the Phase II area has a slight rise in elevation from 42 to 45 feet ASL from the southern end of the project area to the northwest side, with one nearly imperceptible swale dropping to 41 feet ASL in the southern section (Fig. 11).

Area A is a currently unused, wooded parcel. Station maps show large storage tanks on a portion of it, but these in fact were never constructed (Figs. 7 and 8). It has very little modern trash that would indicate frequent current use. During the period of Phase II fieldwork, including two Saturdays, there were no visitors from the base, including the military housing just to the north.

The limestone that constitutes the geological substrate of the ‘Ewa Plain has been described by Davis (1990:64), based on detailed study of a number of sources, and the description applies well to the project area:

> ...coral rock derived from coraline algae, collectively referred to as Lithothamnion. This coral rock also contains inclusions of coraline sand, molluscan shells, and unaltered coral masses.

The limestone of the project area is a stratified reef, with a major break occurring about 1.5 m below the surface. The elevation of the project area at 42 to 45 feet ASL places it above the reef identified with the Pleistocene Waimanalo sea stand at 25 feet ASL. This higher reef area was probably formed during the Waialae sea stand, estimated at 45 feet ASL (Macdonald and Abbott 1970:206). However Macdonald and Abbott (1970:356) and Stearns (1978:30) do not list the high ‘Ewa Plain (above 25 feet) as generated during this stand, and in fact suggest that there is little evidence for such a stand at all. Recent information on the subject will be found in Jones (1993), a dissertation that is as yet unavailable.

Soil maps class the project area not as a soil but as the land type “CR”, coral outcrop (Foote et al. 1972:29). The primary soil near the project area is Mamala stony silty clay loam lying along the inland edge of the Station. The Mamala series are “soils formed in alluvium deposited over coral limestone” (Foote et al. 1972:93). This is the primary soil of the sugar cane fields inland of the project area, and are thus the prime source of non-calcareous elements in the depositional matrix of the area.

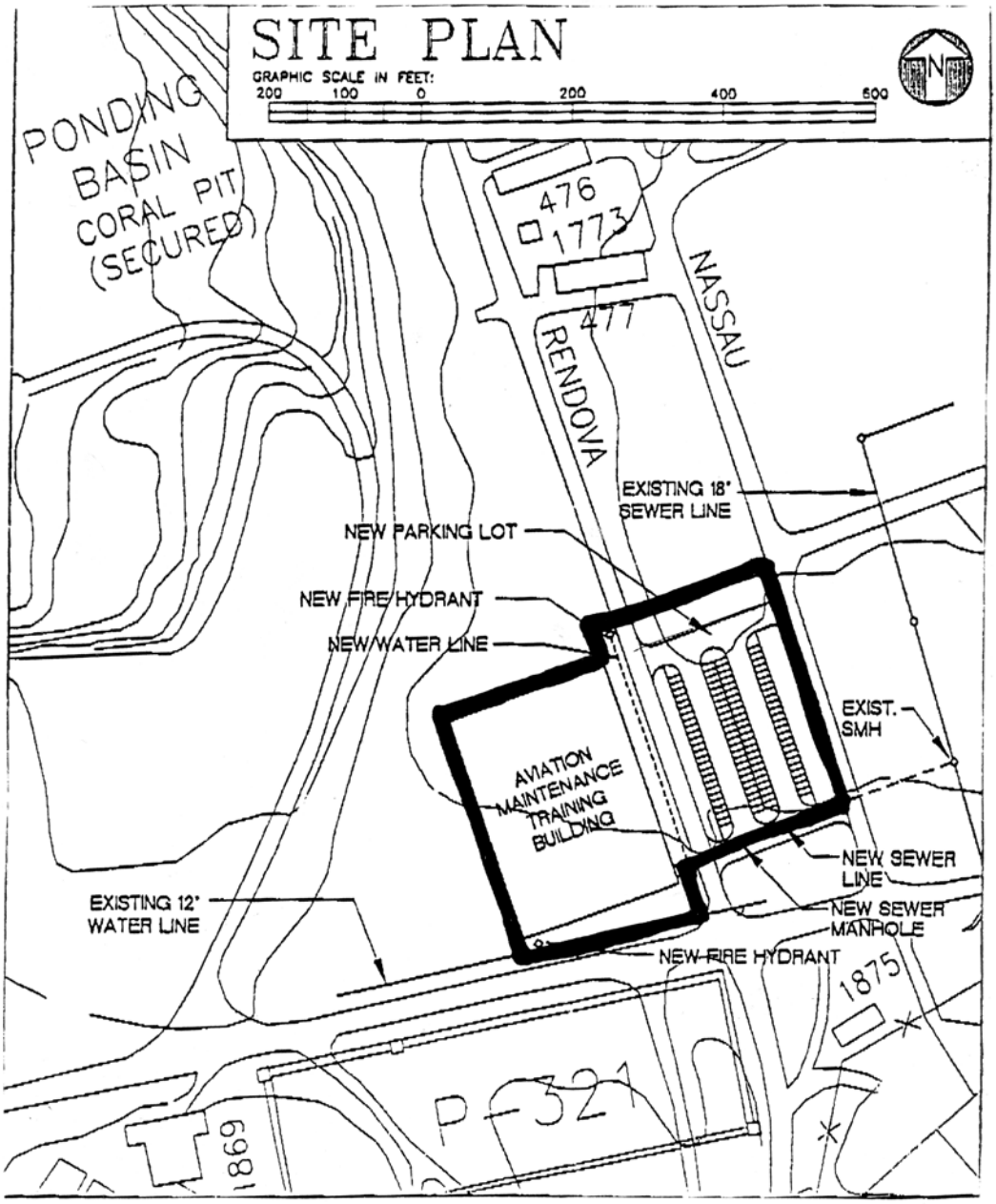


Figure 9. Phase I survey area B.

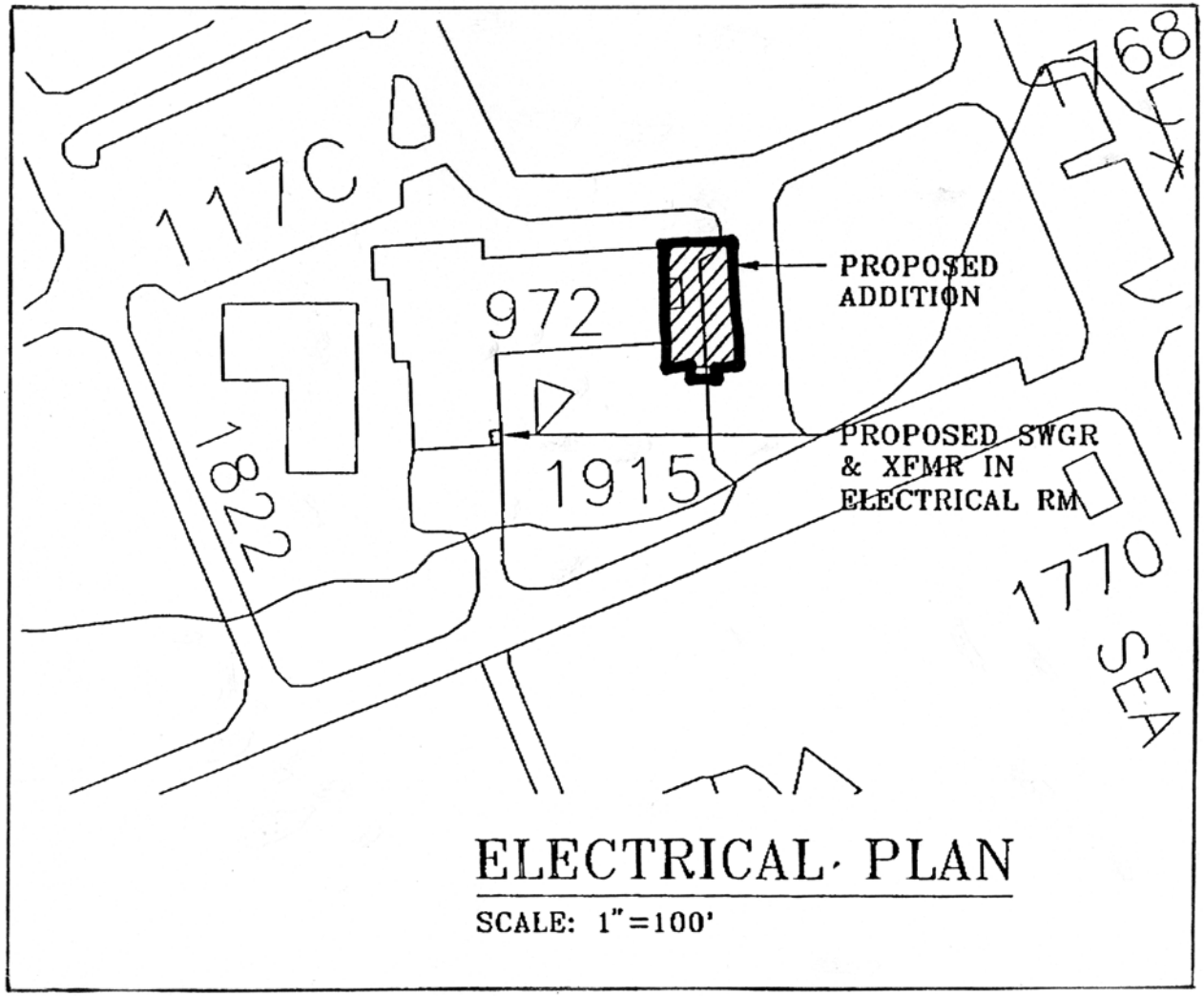


Figure 10. Phase I survey area C.

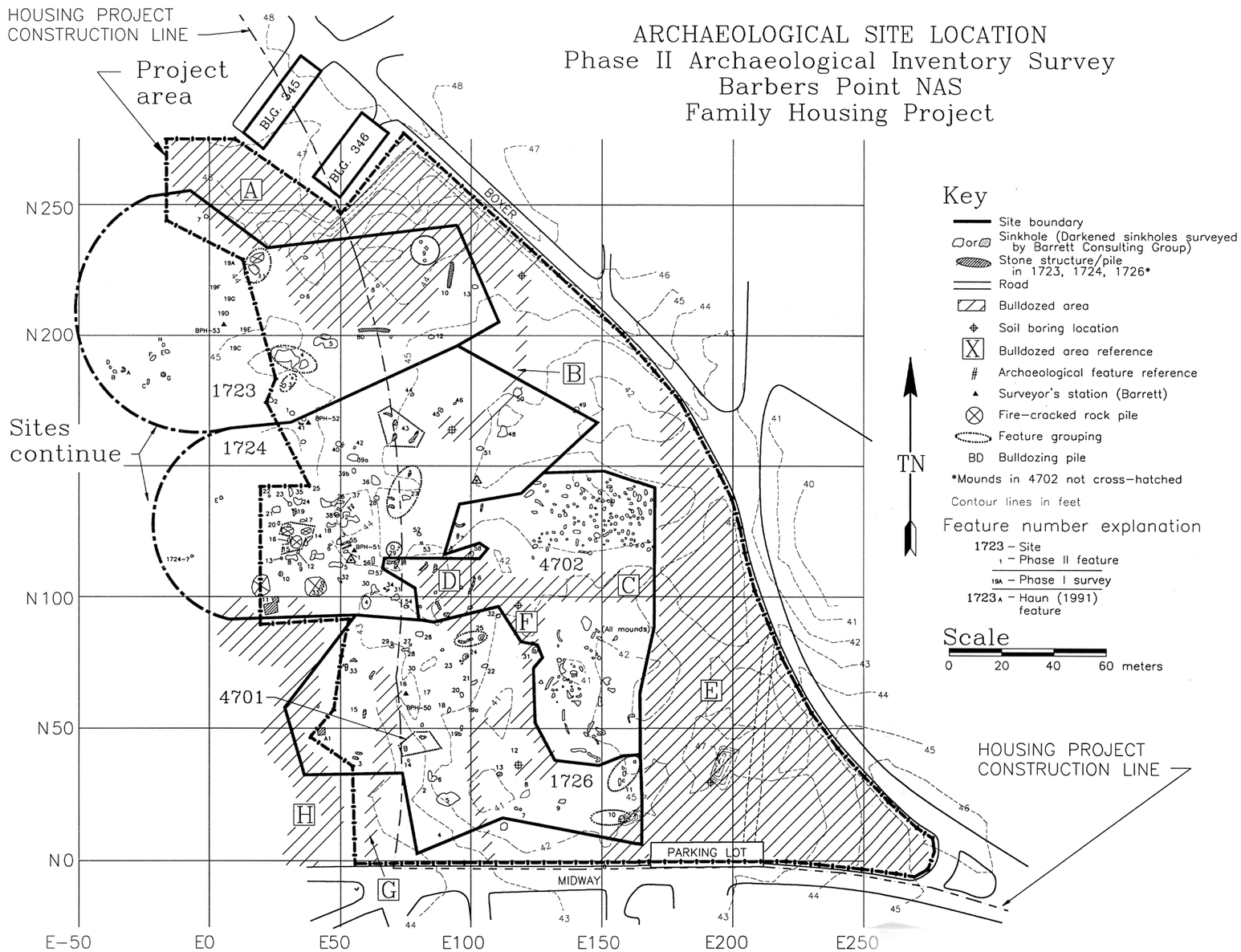


Figure 11. Phase II survey area with elevation contours and grid overlay.

Rainfall at NAS Barbers Point has an annual average of 21 inches, with January having the highest average at 4.1 inches, and June and July having the lowest monthly average at 0.3 inches (Traverse Group 1988:A-15). The water table in the project area is probably about 10 feet ASL, based on drilling just north of the Station (EIS Corp. 1977), which would make it at least 30 feet below the ground surface. The deepest sink in the area is only 11 feet below the surface (1724-23), so no natural access approaches this depth. However, it has been the observation of researchers in other areas of the ‘Ewa Plain that ground water occurs with a great deal of local variability due to natural water traps in the limestone (A. Ziegler and B. Davis, pers. comm., 1993). However, currently all of the wells at the Station have water that is classified as brackish, with chlorides greater than 500 ppm (Traverse Group 1988:A-7).

A botanical survey of the Phase II project area was carried out before the beginning of the Phase II survey (Whistler 1993). A copy of this report is included as Appendix D. There are 10 native species in the area, including ti (*Cordyline fruticosa*), *wiliwili* (*Erythrina sandwicensis Deg.*), and the Polynesian introduction *noni* (*Morinda citrifolia L*).

The dominant tree cover is *kiawe* (*Prosopis pallida*), with scattered *opiuma* (*Pithecellobium dulce*), banyan (*Ficus microcarpa L.*), octopus tree (*Schleffera actinophyla*), and *wiliwili*. Brush cover is primarily grasses and extensive stands of basil (*Ocimum gratissimum L.*). Although the *kiawe* is dominant, *wiliwili* trees are common enough that the area could be defined as a mature *wiliwili* forest, invaded by *kiawe*. The *wiliwili* stand appears to be healthy; the older trees are bearing nuts, and there are many seedlings and saplings. A 1984 botanical survey of the entire Station listed *wiliwili* occurrence as “occasional” (1984 Botanical Consultants in Traverse Group 1988, Appendix C2:5), a misrepresentation of the present project area. The presence of this remnant native dry forest has seemingly been given little attention; for example, it is ignored in the Station’s Natural Resources Management Plan (Traverse Group 1988; e.g. A-12, E-3). This is surprising since the plant traditionally associated with the ‘Ewa Plain is the *wiliwili*, as discussed in the section on traditions.

The most notable animal life in the area are honey bees, which have created hives of varying sizes in approximately 15 of the sinkholes in the Phase II project area (Photo 2).

The dynamic element of the natural system that needs more consideration than can be given here is rainfall and flood water runoff. The importance of this for the location of sites on the ‘Ewa Plain has been emphasized by Davis (1990). This is also an issue in the problem of bird bone deposition, flooding being a possible source for movement and redeposition of bone. In the immediate project area, sheet flooding and sinkhole destruction are probably the two main factors contributing to the pattern of soil distribution.

Photo 2. Site 1724-47, showing large beehive.

Local Resources

Local resources within the project area were similar to those in other non-coastal areas of the ‘Ewa Plain, except that access to ground water would have been more limited than many other areas, due to its greater general depth at this higher elevation. A pond about 1 km to the north is recorded as early as the 1825 Malden map (Kelly 1991:Figure A-2), but the nature of the water is unknown. Rainfall runoff also traps naturally in some of the depressions of the project area.

There is a source of volcanic glass reported at Pu‘uopalailai (Davis 1990), 3 km north. Two pieces of volcanic glass were found during the present project, but have not been sourced.

Growing conditions would not have been significantly different from that of other areas of the karst ‘Ewa Plain, as described above. Ti (or *kī, Cordyline fruticosa*, Photo 3) and *noni* (*Morinda citrifolia*)were observed during the Phase II project. In addition, the sinkholes are damp enough even during the dry season, to support fern (Photo 4, taxon unidentified). The stone piles of the area are interpreted as Hawaiian agricultural mounds, primarily for cultivation of sweet potato. The sinkholes are also considered a cultivation resource. The limestone itself was a major resource, used abundantly in cooking ovens as indicated by the quantities remaining on the surface today.

Finally, regarding resources, the question of bird availability needs to be mentioned. Although the extent of human predation of the nesting birds of the ‘Ewa Plain is an ongoing research problem, it is of interest that naturally deposited bird bone in the project area occurs in very low density. If this reflects bird availability, then this was a more limited resource than in most of the other investigated areas of the ‘Ewa Plain. Possible reasons for low bird populations in this area are presently unknown (Ziegler 1993).

Environment and Site Patterning

In the detailed study of the area for Phase II, there are three components of the undisturbed portion of the terrain that are closely correlated, bedrock exposure, sinkholes, and vegetation. These natural components are in turn correlated with types of features. The primary area of soil development is on the eastern side (the area defined as Site 4702). The soil is consistent over much of the area, ranging from 10 to 20 cm thick (Photo 5). There are very few sinkholes in this area and associated with this soil is the heaviest growth of grasses in the project area, the densest stands of *koa haole*, and the thinnest spread of *kiawe*. The other areas of the project have much more exposed bedrock, or small patches of thin soil, and numerous sinkholes (Photo 6). The vegetation in this area is dominated more by basil than grasses, with an overstory of *kiawe* and limited *koa haole*. Habitation features occur in this terrain.

Photo 3. Site 1723-1, with ti plant (facing southwest).

Photo 4. Sinkhole with fern, west of Phase II area.

Photo 5. Site 4702-1, TP-1, showing thin soil cover (facing west).

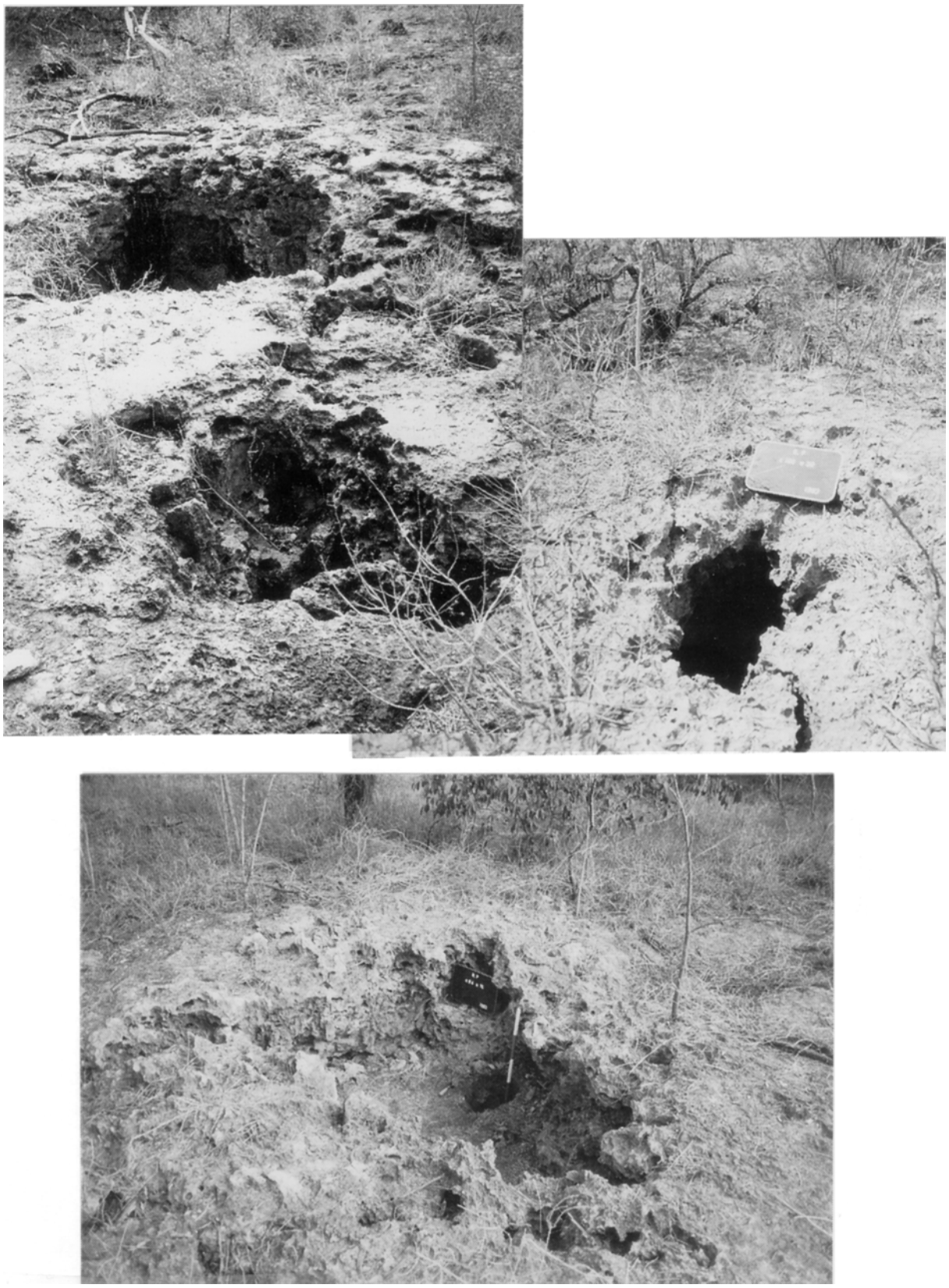


Photo 6. Sinkhole variation.

Post-Contact History and Effects on the Project Area

From at least the time of contact into the late 1800s, the village of Honouliuli (inner Pearl Harbor) and scattered locales along the coastline were the only areas of activity and population clusters anywhere near the project area. North of the project area, Pu‘uokapolei’s *heiau* had fallen into disuse, but the hill itself remained a major landmark, and the primary trail/road from Honolulu and Wahiawa ran by it.

Information is inconclusive regarding the time of Hawaiian use and abandonment of the area, but there was no significant habitation by at least the mid-1800s. In fact, abandonment could have been much earlier, and this remains a major research issue for the area. As noted above in the history of the ‘Ewa Plain, observers around 1800 (including Vancouver and Ellis) described the inland ‘Ewa Plain as deserted. The earliest map to show the area in any detail was made in 1825 by Charles Malden of the H.M.S. Blonde (the ship that returned the bodies of Liholiho and Kamamalu to Hawai‘i following their deaths in England). This map (Fitzpatrick 1986:Figure 33; Kelly 1991:Figure A-2) shows no cultural features in the vicinity of the project area, although it does place a large “pond” to the north, near Pu‘uokapolei. There is no trail from the area of Kualaka‘i north, although there are trails from two areas further east. At the same time, there is no habitation shown at Kualaka‘i, as is shown for other areas along the coast, suggesting the possibility that this area had been abandoned, and with it any trail that might have gone inland.

Additional information from the Malden map of 1825 is that all of the central area of the ‘Ewa Plain is labeled as “Low uncultivated Plain” indicating that the entire area was abandoned by 1825. The Wall map of 1873 also shows no cultural features in or near the project area (Kelly 1991:Figure A-3) but does again show the “Pond” noted by Malden, not far to the north.

There is a strong possibility that this area is part of the Plain of Kaupe‘a, as noted above, a feared place of wandering souls of the homeless dead. This suggests that the area had little or no population whenever these traditions developed. The stories of the Plain of Kaupe‘a could also have been associated with the many burials that occur in the area.

Whatever the answer regarding abandonment proves to be, in all probability the area was generally depopulated before the mid-1800s. Following abandonment, the archaeological remains of the area were then subjected to numerous sources of alteration and destruction. However, the location of the project area at 2 km from the shore places it in an area removed from any documented activities. None of the land records or maps indicate any nearby activity until the construction of the Marine Corps Air Station in the 1930s and the Naval Air Station in 1940 and 1941.

By the early 1800s, effects of post-contact changes to the landscape probably began to be felt from upland deforestation created by sandalwood cutting. Feral cattle roamed the area in the mid to late 1800s, certainly having a destructive effect on vegetation and

abandoned house sites. With the beginning of ranching in 1877, cattle walls were constructed and the area became "managed".

By the time of the survey that produced the first topographic map of the area, the USGS 1908-1913 series (Kelly 1991:Figure A-5), all the activities of the late 19th century have left their mark on the landscape. To the north of the project area, the O'ahu Railroad is now in evidence, along with sugar cultivation; to the west, near the present western boundary of the Station, there is a road running inland from Barbers Point, a ranching wall, and a "1-1/2" pipe line" that probably carried water for cattle to the coast; about a kilometer to the west of the project is a major stone-walled area of sisal cultivation. With only minor changes, all of these features are repeated on the 1927-28 USGS map of the area (Barbers Point, 1:20,000), shown in Figure 5 with the Phase II project area overlay. None of these features were located in the survey areas, except for the sisal farming that took place in survey area B. One of the early roads ran just outside the western edge of survey area A.

The maps indicate that ranching was taking place in the project areas from the late 1800s until WWII. The stone walls found in Phase I survey area A (and Phase II 1723-10) are part of the archaeological evidence of this period.

Sisal farming had a major impact on the landscape, and the feral plants dominate survey area B. In the area of the Phase II survey there is no historical record of sisal, a fact supported by the lack of remnant sisal plants in the area (Appendix D). This is an important point indicating that the stone mounds of the Phase II survey area (Site 4702) are probably not related to this activity.

The presence of *kiawe* woodcutters is not documented for the project area, but it is likely that at least some worked the area in the 19th century (see Yoklavich et al. 1992:16).

One other feature exists from the pre-war era, and this is a hidden storage room for items associated with clandestine liquor production (Site 4701). The dating of the artifacts has not been completed, but they are certainly not post-1950. There are also no military items that would indicate that this was servicemen's secret effort.

In sum, evidence shows that the pre-1940 landscape change in the project areas has resulted from *kiawe* spread, cattle disturbance, soil transport from upland commercial cultivation, ranch fencing, and sisal cultivation (limited to survey area B). In the Phase II survey area are stone piles and capped or filled sinkholes that could have been constructed during this time, but there is no historical or archaeological evidence to suggest that this was the case. It has been suggested that some of the sinkhole filling may have been for protection of cattle, but this is unlikely, given the "randomness" of these features and the numerous unfilled sinkholes. Bones of cattle and goats have been found in sinks in the survey area, probably dating to the ranching period.

Modern Disturbances

The U.S. Army Corps of Engineers map published in 1943 (Barbers Point 1:20,000) shows major construction in the project area for the first time (although the map does not show the existing runways and perhaps other features of military importance). A series of aerial photographs indicates that this construction was underway in February of 1942 and was completed by June of that year (Yoklavich et al. 1992:Figures 4 and 8). Midway, Attu, and Boxer Roads were all built at this time.

Modern disturbances, primarily bulldozing, have had a major effect on the terrain of the project area. Most of the area immediately south of survey area A has been bulldozed and leveled (Figs. 7 and 8). Details of the disturbed sections of Phase II are noted in Figure 11 in capital letters: A, C, D, G, and H are all older areas of bulldozing; E is bulldozed and leveled. All of this probably occurred during the 1940 base construction, based on aerial photographs described below. Bulldozer tracks B, F, and D were created between Phase I and II surveys for soil boring pertaining to the housing construction (Photo 7). This bulldozing was archaeologically monitored.

The originals of the 1942 photographs reproduced in Yoklavich et al. (1992) have not yet been examined for this project, but the photocopies show strips of cleared *kiawe* over the entire Station, including the project area. These are probably the "400-foot sections" of cut *kiawe*, cleared for survey lines (Collins 1977, quoted in Kelly 1991:166). It is probable that this clearing was done by bulldozers. If this is a correct reading of the photographs, this bulldozing and the adjacent road construction would have been the major source of the damage that exists in the project area, as noted above in the description of the Phase II survey area (see Fig. 11, bulldozer tracks). It is remarkable that any of the archaeological remains of the project area survived at all.

The other major source of disturbance is *kiawe* growth. The spreading roots of *kiawe* dislodge wall stones, and perhaps more significantly, they dislodge the limestone bedrock, creating alignments and piles that might appear to be cultural once the roots have deteriorated (Photo 8).

Photo 7. Bulldozer track in Phase II survey area, showing displaced limestone slabs.

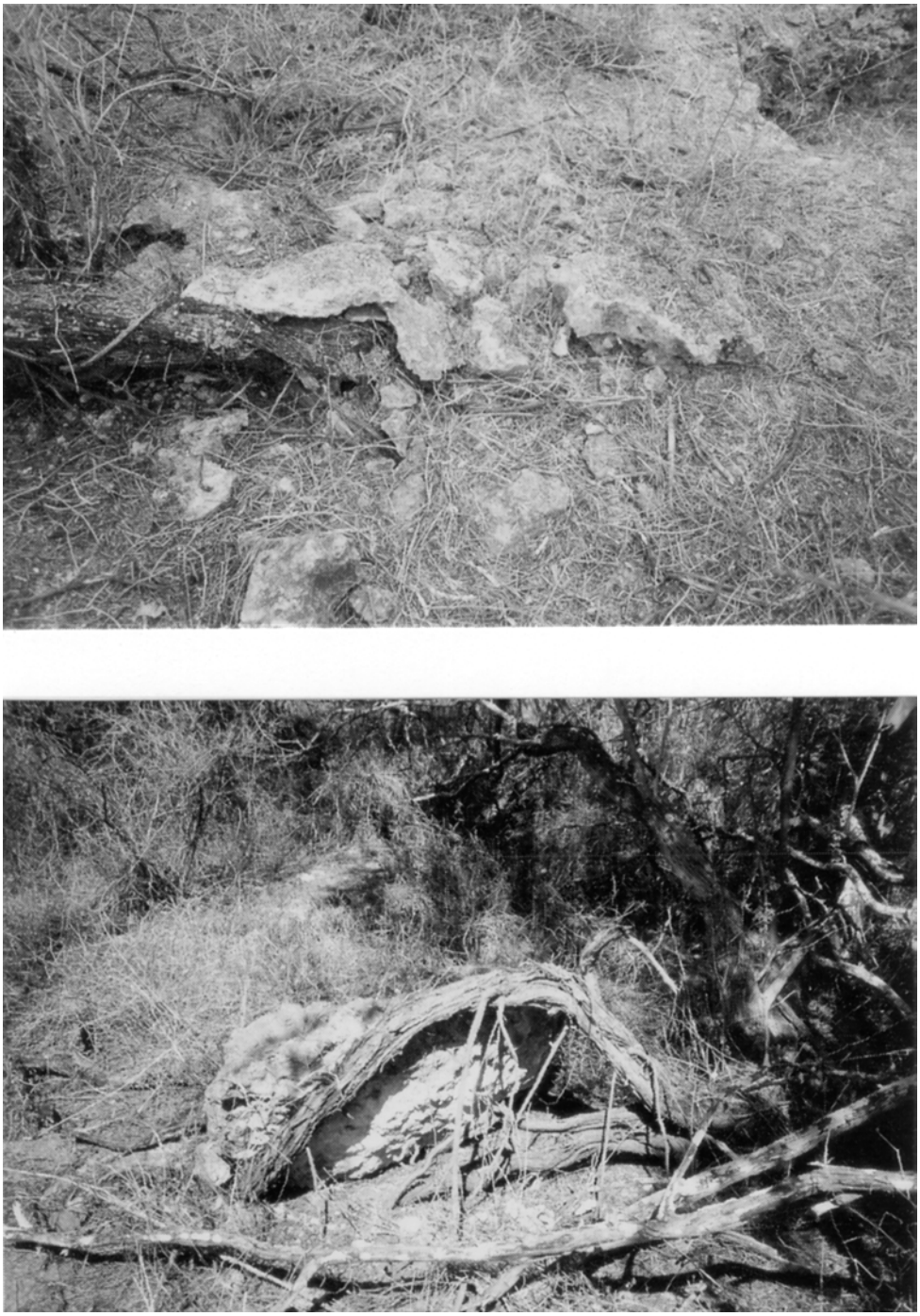


Photo 8. Limestone slab displacement by root growth, Phase II survey area.

IV: PHASE I INVENTORY SURVEY

Phase I Level of Evaluation

Phase I reconnaissance survey is intended to identify all cultural resources in the project area, but not necessarily to collect information adequate for site recording and significance evaluation. The Phase I survey is intended to provide information on cultural resources at a basic level suitable for early planning purposes. It provides a set of data establishing the presence or absence of cultural resources, an estimate of their potential significance based on criteria of eligibility to the National Register of Historic Places, and an estimate of the magnitude of additional evaluation steps. Phase I survey thus generates a listing and location of cultural features, and preliminary significance evaluations are provided for the sites of the survey area.

Phase I, Area A

Method and Results

Prior to fieldwork background discussion was conducted by Bruce Jones with Alan Haun regarding the nature and condition of the archaeological remains in the area, based on Haun's 1985 survey (1991). At the initiation of fieldwork, in-field discussions concerning Site 1719 were held during a site visit by IARII archaeologist Conrad Erkelens, who had previously conducted detailed recording and mapping at that site in connection with the planned development of an interpretive trail.

The walk-through survey of area A in the developed portion east of Boxer Road produced no archaeological remains. Subsequently this area was monitored during mechanical soil coring with the result that no archaeological materials were identified.

The portion of Area A south and west of Boxer Road was surveyed by means of a total of 28 north-south transects at 5-10 m intervals. The spacing was dependent on vegetation cover which ranged from open *'ilima* meadows to dense *kiawe* stands with thick understory. All features were marked with red flagging tape and given a temporary field number based on the transect number. Following the flagging, features were revisited for description and their locations were established by tape and compass to known points, including buildings and utility poles.

Area A contains 274 recorded archaeological features (Appendix A:Tables A-1, A-2, and Fig. 8). Five sites previously recorded (Haun 1991) were relocated in this area: 1718,

1719, 1720, 1723, and 1726. The Phase I feature correspondence with the recorded sites is shown in Appendix A. The many additional features recorded in Phase I survey area A resulted from a more intensive survey than was conducted by Haun (1991), and a more consistent recording of military and ranching features. All of the features in the Phase I survey area are shown in Figure 7, except for those that fall into the Phase II area. These were subsumed under the State site numbers assigned to all of the features in the Phase II area (Fig. 11).

For Survey Area A, the survey team covered the entire project area on foot and, based on the results of the more intensive Phase II survey of a portion of the area, close to 100 percent of the surface constructions were identified. Heavy vegetation may have resulted in the crew missing a very few features. However it should be noted that other types of features present in the project area were not all identified during the Phase I survey. Unmodified sinkholes, scatters of fired rock, and low mounds were not completely recorded. In some cases this was simply a matter of not recording every observed feature in a group. However the results of the Phase II survey indicated that many additional features of these types were present in a 10 acre portion of the 55 acre area. It should be anticipated that the remainder of the largely unmodified portion of the survey area also includes more features of these types than were recorded in the Phase I survey.

Feature types recorded in area A include linear alignments, circular mounds, elongated mounds, modified outcrops, enclosures, sinkholes, C-, U-, and L-shaped structures, platforms, cairns, hearth and linear stacked rock, the majority of which are related to pre-contact and early post-contact Hawaiian occupation. Features from the 19th and 20th centuries were also recorded, including wall sections, a stone-lined irrigation ditch, concrete cistern, and a cattle tank made of stone. Military features include a concrete bunker and trash scatters.

The pattern of the Hawaiian features indicates habitations associated with agricultural mounds and sinkholes that may have been used for cultivation. Sites 1718, 1719, 1724, and 1726 are tentatively proposed as habitation clusters in a cultural landscape. These sites (redefined by newly recorded features) should be investigated within this framework in any future inventory and data recovery. The Phase II inventory of one portion of survey area A utilized this framework to provide details on this settlement data adequate for significance evaluation, and to establish a baseline for any future data recovery.

Following completion of the Phase I survey, a Site Engineering Investigation was conducted of the portion of Survey Area A selected as the family housing construction area. All clearing of machine paths and borings were monitored by IARII archaeologists Conrad Erkelens and Roger Blankfein.

Cultural Resource Classification and Management Recommendations

The preliminary significance evaluation of the features located in area A are presented in Appendix A, Table A-1 This assessment includes the category of "not significant" due to lack of integrity (0), and "significant" due to potential information content identified according to areas of research potential (1-8). In addition, the research potential classification includes two types of features that may be significant for cultural value or outstanding examples of type (5=possible religious structure; 6=possible human burial).

The range of resources in area A indicates that any areas of potential project impact should be subject to a detailed (Phase II) inventory level survey and significance evaluation. The potential magnitude of the survey and subsequent mitigation actions is indicated by the site and feature distribution density (Fig. 8) and by the preliminary significance evaluation in Appendix A. Potential mitigation actions for future project impacts are implied in Appendix A by the classifications: features in categories 1, 2, 3, and 4 would probably be subject to data recovery; categories 5 and 6 might be subject to preservation or special mitigation actions; features in categories 0, 7, and 8 would probably be adequately recorded in the final inventory process of a Phase II survey and not subject to future actions.

These preliminary assessments are made for long-range planning purposes, with the recognition that the Phase I level of information is not adequate for final evaluation of significance. The next formal step in the process of cultural resources management for any areas of potential project development ("undertaking") is a Phase II inventory level survey. Such an inventory provides the data for significance recommendations and the basis for mitigation actions, if any, related to future project impacts. Such a Phase II survey was conducted for a portion of survey area A (Fig. 8), with the results reported below.

Phase I, Area B: Method, Results, and Recommendations

Phase I, survey area B (Figs. 2 and 9) was divided into two sections for survey. The eastern section, an open lot, was surveyed by personnel sweeps at 10 m intervals. The heavily overgrown western half could not be surveyed by systematic sweeps due to the dense stands of sisal and *kiawe*. Consequently, it was surveyed by a systematic examination of all open areas.

The eastern section has been bladed, but allowed to become overgrown with wild grasses. The western section has overgrown with sisal and *kiawe*. The sisal growth is probably a remnant of the sisal farming from the early part of the 20th century, or spread from the feral plants remaining from this farming.

No archaeological remains, artifacts, or other indications of cultural resources were found in either area. However, some archaeological features have been found in another sisal-covered area on the Station (Welch 1987), so there is some possibility that the sisal of area B may be covering remains of potential significance.

It is recommended that the western lot of area B be partially cleared of sisal for additional surface survey. For the eastern lot of area B, it is recommended that no additional cultural resource inventory needs to be conducted.

Phase I, Area C: Method, Results, and Recommendations

Area C (Figs. 2 and 10) is an open landscaped lot that obviously contains no surface structures of archaeological interest. It was surveyed by sweeps in search of artifacts that might be evident in exposed soil patches, but no evidence of cultural remains was noted. Given the blading of the area, and the shallow soils, it is very unlikely that there are any subsurface remains.

It is recommended that no additional cultural resource inventory be conducted in area C.

V: PHASE II INVENTORY SURVEY

Phase II of the NAS Barbers Point fieldwork is an intensive level archaeological survey of a portion of Phase I, area A, that is scheduled for development as family housing (Project H-208). The phase II project area is a triangular-shaped section, approximately 10.8 acres in size, located on the western side of the Station, near the junction of Midway and Boxer Roads.

Research Problems

The purpose of the Phase II survey is to provide detailed information on the cultural resources of the project area adequate for evaluation and management within the framework of historic preservation regulations. This purpose is achieved through a defined set of research problems.

The research problems of ‘Ewa Plain archaeology that provide the context for the present project involve theoretical issues of human adaptation to this unusual environment, substantive models of occupation history, modern concerns with sites of contemporary cultural significance, and methodological difficulties of site identification and evaluation. An inventory has two primary concerns here: the first is to resolve the methodological problems so that a complete site and feature inventory is generated; the second is to collect the information that will allow site and feature evaluation relevant to establishing a research design (incorporating data collection strategies) that will address the substantive and theoretical issues.

The research problems relating to Hawaiian adaptation are discussed above in the sections on previous research. In sum, the inventory of the project area is concerned with the evaluation of sites in regard to their potential for yielding information about environmental change and human settlement. Contemporary cultural significance focuses on sites and or features that may contain human remains or that have a sacred character.

Regarding methodology, the location and testing of features on the ‘Ewa Plain provide some unusual problems due to the presence of sinkholes in the limestone, and the ways in which the sinkholes were used. In many cases, the amount of surface construction may be relatively limited and sinkholes may constitute the primary cultural feature of the landscape. A review of the archaeological research on the ‘Ewa Plain and of the Phase I survey results suggests that many features are difficult to recognize, difficult to test, or difficult to evaluate with limited testing. Problems of site or feature recognition involve the fact that many sinkholes are capped or filled with rock, disguising their presence or their size.

The problems of sinkhole evaluation involve their morphology and depositional histories. In many cases deposition has filled the bell-shaped chambers of the sinkholes so that the full extent of a deposit may be difficult to estimate without extensive excavation. For rock-filled sinks testing often means removal of most of the fill. Many sinkholes may have no associated stone construction or other surface cultural evidence, but do contain cultural deposits or other remains of human activity, including interment. In these cases, testing is the only means of determining cultural activity.

The other component of site and feature definition in the ‘Ewa Plain is the information on environmental history that is contained in sinkhole deposits. Sinkholes that may contain no direct cultural information nonetheless become a critical part of the inventory because of this information that reflects the pre-human environmental baseline and successive changes following human colonization and settlement.

Research Methods

The problems defined above regarding the history of ‘Ewa settlement constitute the set of research issues behind the inventory survey. With this as background, the framework adopted for site inventory is “landscape archaeology” which approaches the project area as a culturally modified landscape. The problem is to define the specifics of this modification in terms of time period, activity, and significance. This approach is subtractive, in contrast to the additive view of “site archaeology” in that areas and/or features that are found to be not significant are removed from the inventory. This is viewed as the best approach to accomplish the scope of work requirement for an “effort to record features not previously noted”.

The field methods employed for this approach are landscape mapping and testing. The main categories defined for the project landscape mapping are:

(1) structure: used in a broad sense of any stone stacking or piling;

(2) surface modification (non-structural): range from piles of fire-cracked rocks to bulldozer paths;

(3) sinkhole: shafts in the limestone, often expanded at their base into bell-shaped chambers; they usually contain deposits filling much of the chamber;

(4) depression: shallow and slope-sided, and contain shallow soil deposits;

(5) variation in soil cover: mapped in general terms by presence or absence;

(6) variation in vegetation cover: mapped by density and dominant cover; individual trees of *wiliwili*, *opiuma*, and banyan were also noted, standing out among the extensive stands of *kiawe* and *koa haole*.

The scope of work identifies a minimum number of test units, with the recognition that not every feature could be tested. Testing is thus a means to establish the range of feature types and to collect information relevant to significance evaluation. Because not all sinks and depressions could be tested, the field testing was based on a sampling strategy. Sinks and depressions were divided into categories of size, depth, fill, location, modification, and evident cultural materials; examples from all of the categories were tested. In addition, rock-filled sinks were placed in a special category, based on their potential for human remains, and as many of these were tested as time allowed. The recent bulldozer paths (Fig. 11, Bulldozed Areas B and F) were used as a cross-section of surface deposition; the disturbed soils in these paths were examined for cultural evidence and for soil profiles. Shovel tests were placed in locales that had no obvious surface cultural materials, including structures, sinks, and depressions. Test pits were placed in locales that appeared to have cultural material, or in selected sinks or depressions for controlled collections by layer and level. Rock fill was removed from a selection of filled sinks and all capped sinks were examined.

For administrative purposes, the site numbering is produced by a post-field categorization of site and feature designations. One consequence of the survey method based on landscape archaeology is that many more "features" are defined than might otherwise be the case; this is specifically including all sinkholes and major depressions as features. However, this provides a more accurate inventory than that generated by a listing of only "modified" sinkholes, or only "big" sinkholes. This fine-grained approach to survey might be considered unproductive in some archaeological areas, perhaps only producing diminishing returns. However, it is necessary in the peculiar world of the archaeology of the 'Ewa limestone. For example, Site 1723-7 appeared to be an inconsequential depression, but it proved to have the most substantial cultural deposit of all features tested. Site 4701 appeared to be only a few slabs of limestone scattered on the surface, but it turned out to be a hidden chamber. Site 1724-54 first appeared as three rocks stuck in a small, shallow hole, which turned out to be a 3.5 m deep sinkhole completely filled with rock, with human bone in the basal deposit. A less intensive survey would probably not have recorded any one of these as an archaeological feature.

Field Procedures

Mapping

The Barrett Consulting Group topographically surveyed the Phase II project area in 1993 (between the Phase I and Phase II surveys). The map generated by this survey was used as the base map for the Phase II archaeological survey; it includes contours at one foot

intervals, four stations with elevation ASL, a number of the Phase I archaeological features, and a general representation of *kiawe* vegetation density.

For the Phase II survey mapping, two baselines were established: a N-S line near the western edge of the project area and an E-W line through the center of the project area. Secondary lines were then run from the baselines at 10 to 15 m intervals. Detailed landscape mapping was conducted off the primary and secondary lines. Accuracy of the baseline locations and general mapping accuracy were verified by reference to details or features on the Barrett topographic map. An arbitrary grid system was placed over the base map with East 0, North 0 (written as E0/N0) coordinates located in the southwestern corner of the survey area (Fig. 11). During the mapping, all features (including structures and sinkholes) were given a designation identified by coordinates to the meter on the grid system (e.g., E23/N120). These coordinates served as temporary field numbers and each feature was tagged with this number on blue flagging tape. The coordinate system is included in Figure 11, and the temporary feature numbers (coordinates) are included in the site descriptions. The coordinates also provide a means of locating features on the site distribution map.

It should be noted that the listed coordinates are the ones originally established in the field. If a feature location was refined by later mapping, the coordinates were not changed; thus in some cases, the coordinates do not match final map placement, although they will be near.

Characteristics of ground surface and vegetation were also recorded during this landscape mapping. Subsequently, most features or feature complexes were individually described on feature forms, photographed, and mapped in detail. Site 4702, the mound complex, was completely mapped, but individual mounds were not photographed or individually mapped, except for those that were dismantled or excavated.

Prior to the Phase II fieldwork, a botanical survey for the identification of endangered plant species had been carried out (Whistler 1993; Appendix D). Endangered plants were marked with green flagging tape. These plants were avoided during the archaeological work.

Testing

Testing was conducted with five methods: shovel testing, controlled test pitting, structure dismantling, removing of rock fill from sinkholes, and uncapping of sinkholes. Shovel tests were stratigraphically controlled where possible and generally bulk-bagged. In some cases where deposits appeared completely sterile, shovel tests were screen-collected. Controlled test pits were excavated stratigraphically, with 10 cm level maximum sub-units, and material screened through 1/8" screens. Material collection from test pits was by bulk-bagging or total feature collection. Bulk-bagging is the field collection of all material that remains in the screen after sifting, with the exception of pebble-sized rocks. Bulk-bagged material is later sorted in the laboratory. (Bulk-bagging contrasts with the more

common screen-collection, which is the field bagging of cultural material picked from the screen). Total collection is the bagging of the entire contents of a specified unit, without screening, although larger rocks may be removed.

In most of the shovel tests and all of the test pits, quantitative controls were maintained by bucket counts (measured in liters), allowing density measurements for recovered material. During excavation, discarded rock was separated by stratigraphic unit and was roughly measured for composition by size range; this information was later combined with laboratory data and included in the detailed unit descriptions. The presence of basalt fragments in deposits was also noted; these fragments (not flakes) constitute a small part of the fire-cracked rock, which is mostly limestone.

In all of the test pits and in most of the shovel tests, stratigraphic profiles were drawn, basic soil descriptions made, and soil samples collected. In some cases, additional large volume sediment collections were taken from profiles for detailed study.

Six structures (rock piles in Site 4702) were dismantled. A number of rock-filled sinks were tested; rock was removed to allow access to the top of the sedimentary deposit within these sinks, consequently the amount of material removed depended on the depth of the sinkhole. In none of these instances was the removed stone part of any formal construction (such as walls, facings, or platforms), and is best described as fill. In one case, Site 4701, the removal of the fill did expose some stones that had been placed in a structured fashion, but these were not removed.

The last category of testing is the removal of stone capping. In some cases, this was sufficient to allow access to a sinkhole. However, the capping sometimes covered rock fill, which was then removed in selected cases.

Feature testing methods, collection methods, and excavation quantities are shown for each tested feature in the site tables (Appendix A, Tables A-3 and A-4).

At the end of fieldwork, plastic lining was placed in all shovel tests and test pits as an excavation marker, and the pits were then backfilled. However, stone removal tests (i.e., removal of rock fill, uncapping, and dismantling) were not backfilled. The two exceptions are Site 1726-2 where the stone fill was completely replaced, and Site 4701 where the capping was replaced.

Site Tagging

Toward the end of the fieldwork, the distribution of features was evaluated for site designation (as discussed below), and site boundaries were determined. The last step of fieldwork was feature tagging. The site and feature designations were indented into metal tags that were then affixed in the area of the feature, commonly with a large nail placed in a bedrock crack or tree base; for most sinkholes the tag is placed at the bottom of the sink. A

stone with red flagging wrapped around it was placed over or near the site tag and red flagging tape with the site/feature number printed in indelible marking ink was tied to an adjacent tree. The individual features of the mound complex 4702 were not tagged, but the complex was tagged at the corners.

Laboratory Analysis

All excavated material was sorted in the IARII laboratory. After materials were separated by category, shell, artifacts, and organic material were identified in the lab. All animal bone and some Crustacea remains were submitted to Dr. Alan Ziegler for identification. Bone that could be identified in the field as human was left in place; other examples that were not recognized in the field were identified by Alan Ziegler or Rona Ikehara. Final soil descriptions were also made in the laboratory, including Munsell color, verification of texture, and calcium carbonate content (see Appendix C). Gail Murakami evaluated charcoal fragments for plant identification (Appendix B), and two charcoal samples were submitted to Beta Analytic for radiocarbon analysis. A pollen column was submitted to Dr. Jerome Ward for a preliminary assessment of palynological potential (Appendix E). The two pieces of volcanic glass were not submitted for rind measurement because of inappropriate provenience for comparative dating.

Site Numbering

The identification of sites and creation of site boundaries on the basis of spatial-temporal association is not generally possible until complete feature testing or data recovery have been carried out. For the present project, three of the sites (1723, 1724, and 1726) are primarily management units, and two (4701 and 4702) are defined on functional-morphological criteria. Site numbers 1723, 1724, and 1726 had been assigned previously to some of the features in the Phase II survey area (Haun 1991). However, the Phase II survey identified many features outside of the previously defined site areas, as well as among recorded sets, with no distinct breaks among any of the site areas. In an effort to avoid confusion by assigning new numbers, the recorded site numbers were used, with new features added to them. (The designations for features listed in Haun, 1991, have been changed, but can be found in the site number concordance in Appendix A:Table A-7). Areas of lower feature density were used as site boundaries, but because there are no breaks, site boundaries are contiguous. If data recovery or detailed data collection is carried out in the future, the sites should be reorganized into spatial-temporal-functional sets.

Two additional sites were provided new separate numbers because of their unique characteristics. Site 4701 is a modified sinkhole and chamber used during the 20th century. Site 4702 is a cluster of mounds (with no sinkholes or habitation structures) that was a Hawaiian field system.

Site numbers follow the system of the State Historic Preservation Division. All are prefixed by "50-80-12".

Phase II Site Descriptions

The Phase II survey identified five sites in the project area (Table 1), which are described below in general terms. The complete site and feature inventory is listed in Appendix A, Table A-3, with site and feature locations shown in Figures 11 and 12. Feature and test descriptions are presented in detail in Appendix C. (Note: feature totals exceed the numerical listing because some features are assigned alpha-numeric subdivisions; for example, 1723-9a, 1723-9b).

Appendix A, Table A-3 presents a detailed listing by feature of the critical data for the site inventory. Under each feature is a listing of formal classification, function, testing conducted, presence of human bone, and information potential.

Table 2 summarizes each site by number and type of formal features and the type and number of test excavations. Table 3 lists all of the tested features, the type of testing, and the types of data obtained from each test. Table 4 summarizes the testing by feature type and the categorization of deposits. Appendix A, Tables A-4 and A-5 present detailed identifications of data collected from testing, including midden, artifacts, and bone. Appendix A, Table A-4 also includes information on type of test, type of data collection, and volume of excavated material per provenience unit. Table 5 is a listing of artifacts. Tables 6 and 7 provide density calculations (Concentration Indices) for the cultural and faunal data. A site number concordance is found in Appendix A, Table A-7. Radiocarbon dates are presented in Table 8.

Table 1. Phase II site inventory and recommendations.

Site No. 50-80-12-	Description	No. of Features	Significance	National Register Recommendation	Mitigation Recommendation✦	Human Bone
1723	Hawaiian Complex: habitation, agriculture, sinkholes	20	Information content: Hawaiian occupation; Paleoenvironment	Eligible	Data recovery	Not present* but may be found
1724	Hawaiian complex: habitation, agriculture, sinkholes	69	Information content: Hawaiian occupation; Paleoenvironment	Eligible	Data recovery*	Present, consultation recommended
1726	Hawaiian complex: habitation, agriculture, sinkholes	43	Information content: Hawaiian occupation; Paleoenvironment	Eligible	Data recovery*	Present, consultation recommended
4701	20th century storage (for alcohol production?)	1	Information content: Early 20th century use of area	Eligible	Data recovery	Not present, low probability
4702	Agricultural rockpile complex	151	Information content: Hawaiian agriculture	Eligible	Data recovery	Not present, low probability

NOTES: ✦ Data recovery for specified features (Appendix A, Table A-3) is recommended for mitigation of effects of direct impact. Detailed recommendations for actions regarding specific features are included in the feature descriptions in Appendix C.

* Some features recommended for preservation (Table A-3).

Table 2. Phase II site and feature testing summary.

Site 1723	Total	Testpit	Shovel	Dismantle	Surface collection
Wall segment	1	1	-	-	-
Rock Piles	1	-	-	-	-
Fire-cracked rock pile	1	-	-	-	-
Sinkhole, capped	3	-	-	3	-
Sinkhole, rock-filled	5	-	-	3	-
Sinkhole	5	1	-	-	1
Depression/Wall	1	-	1	-	-
Depression	3	-	1	-	-
TOTAL	*20*				

Site 1724	Total	Testpit	Shovel	Dismantle	Surface collection
House enclosure	1	2	-	-	-
C-,U-shape structure	3	2	-	-	-
Rock Piles	3	-	-	-	-
Fire-cracked rock pile	2	-	-	-	-
Sinkhole/Wall	3	1	1	-	-
Sinkhole, capped	1	-	-	1	-
Sinkhole, rock-filled	9	-	1	3	-
Sinkhole	28	2	4	-	2
Sinkhole/Cave	1	-	-	-	1
Depression/Wall	1	1	-	-	-
Depression	13	3	1	-	1
Depression/Sink	4	1	1	-	-
TOTAL	*69*				

Site 1726	Total	Testpit	Shovel	Dismantle	Surface collection
Platform	1	-	-	-	-
C-,U-shape structure	2	1	-	-	-
Rock piles/align	2	-	-	-	-
Fire-cracked rock pile	*	-	-	-	-
Sinkhole/Wall	1	-	2	-	-
Sinkhole, capped	4	-	1	3	1
Sinkhole, rock-filled	5	1	2	3	-
Sinkhole	22	1	4	-	1
Depression	5	-	3	-	-
Pit, recent	1	-	-	-	-
TOTAL	*43*				

*thin scatter around 1726-03,-15, not given feature number

Site 4701	Total	Test pit	Shovel	Dismantle	Surface collection
Sinkhole, capped (20th century chamber)	1	-	-	1	-

Site 4702	Total	Test pit	Shovel	Dismantle	Surface collection
Rock piles/alignment	152	5	11	6	-

Table 3. Testing and surface collection data.

Site/ Feature	Formal Description	Tests			Testing Results									Floor Collection	Human Bone
		test pit	shov. test	rock rem.	mid-den	char -coal	f-c rock	artifact	fish bone	mam. bone	bird bone	egg shell	ag. soil		
1723- *	sinkhole	-	-	-	-	-	-	-	-	-	X	-	-	Pter.ph; Procell	
1723-02	sinkhole	-	-	-	-	-	-	-	-	-	-	-	-	cow, goat/sheep	
1723-04	depression	-	1	-	-	-	-	-	-	-	-	X	-	-	
1723-06	sinkhole, rock-filled	-	-	1	-	-	-	-	-	-	-	-	-	-	
1723-07	sinkhole; fire-crk rock	-	1	-	-	-	X	-	-	-	-	-	-	Conus	
1723-08	sinkhole, rock-filled	-	-	1	-	-	-	-	-	-	-	-	-	-	
1723-10	wall segment	-	1	-	-	-	-	-	-	-	-	-	-	-	
1723-13	sinkhole, rock-filled	-	-	1	-	-	-	-	-	-	-	-	-	-	
1724 02	depression/sink	1	1	-	X	X	X	volcanic glass (1)	-	-	X	X	?	-	
1724 03	sinkhole, low wall	1	-	-	X	X	X	cut bone, limest. fl.	X	sX	X	X	?	-	
1724-04	depression	1	-	-	?	-	-	limestone flake	-	-	-	X	-	-	
1724-05	sinkhole	1	-	-	-	-	X	-	-	-	X	X	X	-	
1724 07	depression	2	-	-	X	X	X	worked limestone	X	sbX	X	-	-	slingstone	
1724 08	sinkhole	-	-	-	-	-	-	-	-	b	-	-	-	adz pre.; cow	
1724 10	sinkhole/cave	-	-	-	-	-	-	-	-	-	-	-	-	volcanic glass (l)	
1724 11	enclosure, small	2	-	-	X	X	X	limestone flakes(5)	-	-	-	X	-	-	
1724-19	sinkhole	-	-	-	-	-	-	-	-	-	-	-	-	human bone	■
1724 34	sinkhole	-	1	-	-	-	-	-	-	-	X	X	-	-	
1724-36	sinkhole	-	1	-	-	-	-	-	-	-	X	X	X	-	
1724-40	sinkhole, alignment?	-	1	-	-	-	-	-	-	-	-	X	X	-	
1724-41	depression, slabs	-	1	-	-	-	-	-	-	-	-	-	-	-	
1724-42	sinkhole	1	1	-	X	X	-	-	X	-	-	X	X	-	
1724 43	C-shaped structure	1	-	-	X	X	X	-	-	-	-	X	-	-	
1724 44	depression	-	1	-	-	-	-	-	-	-	-	-	-	-	
1724-45	sinkhole, rock-filled	-	-	1	-	-	-	-	-	-	-	-	-	-	
1724-46	sinkhole, capped	-	-	1	-	-	-	-	-	-	-	-	-	-	
1724 48	sinkhole	-	1	-	-	-	-	-	-	-	-	-	X	-	
1724-49	sinkhole, rock-filled	-	-	1	-	-	-	-	-	-	-	-	-	-	
1724 54	sinkhole, rock-filled	-	1	1	?	-	-	-	-	-	-	-	-	-	■
1724-55	U-shape structure	1	-	-	X	X	X	-	X	pX	X	X	-	-	
1726-02	sinkhole, rock-filled	1	-	1	?	-	-	-	-	X	-	-	-	-	■

Table 3. Testing and surface collection data (continued).

Site/ Feature	Formal Description	Tests			Testing Results									Floor Collection	Human Bone
		test pit	shov. test	rock rem.	mid-den	char -coal	f-c rock	artifact	fish bone	mam. bone	bird bone	egg shell	ag. soil		
1726-03a	sinkhole, rock-filled	-	1	1	-	-	-	-	-	-	-	-	?		
1726-05	depression	-	1	-	-	-	-	-	-	-	-	-	-		
1726-06	depression	-	2	-	-	-	-	-	-	-	-	-	-		
1726-08	sinkhole	1	-	-	-	-	-	limestone flake?	X	-	X	X	X	bottle glass	
1726-1la	sinkhole	-	1	-	-	-	-	-	-	-	-	-	-		
1726-12	sinkhole, capped	-	-	1	-	-	-	-	-	-	-	-	-		
1726-15	C-shape structure	1	-	-	-	-	X	-	-	-	-	-	-		
1726-17	sinkhole	-	1	-	X	-	-	limestone flake	-	-	-	-	X		
1726 24	sinkhole, capped	-	-	-	-	-	-	-	-	-	-	-	-	50 .cal bullets	
1726-25	sinkhole, pile,	-	2	-	-	-	-	-	-	-	-	-	-		
1726-28	sinkhole	-	1	-	?	-	-	-	-	-	X	-	?		
1726-30	sinkhole	-	1	-	-	X	-	-	X	-	X	-	X		
1726-31	sinkhole, capped	-	1	-	-	-	-	-	-	-	X	X	?		
1726-34	sinkhole rock-filled	-	1	1	-	-	-	-	-	-	X	X	X		
1726-35	sinkhole capped	-	-	1	-	-	-	-	-	-	-	-	-		
4702-01	stone pile	t	-	1	-	-	-	-	-	-	-	-	?		
4702-02	stone pile	-	1	1	-	-	-	-	-	-	-	-	?		
4702-03	stone pile	t	1	1	-	-	-	-	-	-	-	-	?		
4702-04	stone pile	1	-	1	-	-	-	-	-	-	-	-	?		
4702-05	stone pile	-	1	-	-	-	-	-	-	-	-	-	-		
4702-06	stone pile	t	-	1	-	-	-	-	-	-	-	-	?		
4702-07	stone pile	t	-	1	-	-	-	-	-	-	-	-	?		
4702-08	slab scatter	-	1	-	-	-	-	-	-	-	-	-	?		
4702-09	stone pile	-	3	-	-	-	-	-	-	-	-	-	?		
4702-10	stone pile	-	1	-	-	-	-	-	-	-	-	-	?		
4702-11	stone pile	-	1	-	-	-	-	-	-	-	-	-	?		
4702-12	stone pile	-	2	-	-	-	-	-	-	-	-	-	?		

NOTES: 1723-*=E 12/N 159- 3 m west of project area.
Test Pit, 1=50x50 cm. t=trench.
Rock rem.=removal of capping, rock-fill, or dismantling.
Mar. shell= marine shell, cultural only.
F-c rock=fire-cracked limestone.

Mam. bone=mammal bone, non-rodent only.
s=Sus scrofa; b=Bos taurus.
Egg shell=bird egg shell.
Ag.soil=deposit interpreted as modified by cultivation.
■=human bone present

Table 4. Summary of testing by feature type and deposit interpretation.

TYPE	Number Tested	CD	AG	Hs	EV	Note	Features
C-shape	2	2	-	-	2		1724-43; 1726-15
U-shape	1	1	-	-	1		1724-55
House enclosure	1	1	-	-	1		1724-11
Wall segment, ranch	1	-	-	-	-		1723-10
Stonepiles, agriculture	11	-	11?	-	1		4702-1-7,9-12
Slab scatter	1	-	-	-	-		4702-8
Depression/wall	1	-	-	-	-		1724-41
Depression/unmodified	2	2	-	-	2		1724-04,-07
	1	-	-	-	1		1724-04
	3	-	-	-	-		1724-44;1726-05,06
Depression/sink	1	1	?	-	1		1724-02
Sinkholes/wall, alignment	1	1	1	-	1		1724-03
	1	-	1	-	1		1724-40
	1	-	-	-	-		1726-25
Sinkhole, capped	1	-	-	-	1		1726-31
Sinkhole, rock-filled	1	?	-	1	1		1724-54
	1	-	-	-	1	human bone on floor	1726-02
	1	-	1	-	1		1726-34
	1	-	?	-	-		1726-03a
Sinkhole	4	4	4	-	4		1724-05,42; 1726- 08,-30
	1	1	1	-	-		1726-17
	3	-	3	-	3		1724-36,-48; 1726- 28
	1	-	-	-	1		1724-34
	1	-	-	-	-		1726-1la
Sinkhole, outside surface tested	1	1	-	-	-		1723-07

NOTES: The table presents an interpretation of the deposits in features tested with test pits or shovel tests; it does not include rock removal or dismantling.

CD=cultural deposit, indicating some evidence of habitation, primarily in the form of midden or in the case of 1726-08, a sub-surface feature.
AG=agricultural deposit; an inference based on soil characteristics. and content.
HB=human bone; human bone was found in only one deposit test; see text for discussion of other human bone found in the project.
EV=environmental data, indicating the presence of data critical to inferences regarding paleoenvironments; these data are primarily bird bone and land snails.

Table 5. Phase II collected artifacts.

Artifact	Site/Fea.	Test	Layer	Lab No.
Adz Preform, Shell	1724-08	-	Floor of cavity	164.03
Ammo, .50 Cal. (820)	1726-24	-	Floor	-
Basalt Frag(F-C?)	1724-03	TPl	I/l	018.07
Basalt Frag (F-C?)	1724-07	-	Surface	067.02
Basalt Frag (F-C?)	1724-55	TPl	O	013.01
Bone Frag, Cut	1724-03	TPl	I/l	18.02.09
Bottle Glass	1724-09	-	Surface	165.01
Bottle Glass	1726-08	-	Surface	038.00
Limestone Flakes(3)	1724-03	TP1	I/l	018.01
Limestone Flake	1724-03	TP1	II/2	021.03
Limestone Flake	1724-04	TP1	I/l	027.04
Limestone Flake	1724-11	TP1	I	168.01
Limestone Flakes(2)	1724-11	TP1	II	167.03
Limestone Flake	1724-11	TP1	II	166.00
Limestone Flake (?)	1724-11	TP2	I	141.01
Limestone Flakes (8)	1724-55	TP1	I/l	010.06
Limestone Flake?	1726-08	TP1	I	039.02
Limestone Flakes (2)	1726-17	TP1	I	059.02
Limestone, Worked	1724-07	TP1	I/l	068.04
Pellet/Shot, Metal	1726-02	TP1	I	032.03
Slingstone, Basalt	1724-07	-	Floor of cavity	067.01
Volcanic Glass (1)	1724-02	ST1	-	004.04
Volcanic Glass (1)	1724-10	-	Surface	191.00

Table 6. Concentration Indices for Phase II test excavations.

SITE/ Feature	TP	LAYER	MARINE SHELL grams	MARINE SHELL CI g/m^3	BIRD BONE grams	BIRD BONE CI g/m^3	MAMMAL BONE grams	MAMMAL BONE CI g/m^3	FISH BONE grams	FISH BONE CI g/m^3	VOL (Liters) (/1000m^3)
1724-02	TP-l	II	0.52	30.6	-	-	-	-	-	-	17
1724-02	TP-l	IIAB	0.56	43.1	-	-	-	-	-	-	13
1724-03	TP-1	I/1	8.68	333.8	0.13	5.0	1.26	48.5	2.51	96.5	26
1724-03	TP-1	I/2	4.51	225.5	0.04	2.0	-	-	-	-	20
1724-03	TP-1	II/1	1.62	115.7	1.68	120.0	-	-	0.02	1.4	14
1724-03	TP-l	II/2	-	-	3.02	215.7	0.37	26.4	0.01	0.7	14
1724-04	TP-l	I/l	1.04	40.0	-	-	-	-	-	-	26
1724-05	TP-l	II	-	-	0.28	10.8	-	-	-	-	26
1724-05	TP-l	III	-	-	0.12	3.3	0.04	1.0	0.02	0.6	36
1724-07	TP-l	I/l	1.02	29.1	-	-	7.68	219.4	0.70	20.0	35
1724-07	TP-l	I/2	1.35	103.8	-	-	0.55	42.3	0.06	4.6	13
1724-07	TP-2	I	-	-	-	-	0.42	52.5	0.00	0.0	8
1724-07	TP-2	I/l	0.02	0.7	-	-	4.19	149.6	0.01	0.4	28
1724-07	TP-2	II/2	0.02	3.3	-	-	-	-	0.07	11.7	6
1724-07	TP-2	III	0.50	62.5	0.35	43.8	-	-	0.04	5.0	8
1724-11	TP-l	II	1.10	91.7	-	-	-	-	-	-	12
1724-11	TP-l	III	1.28	98.5	-	-	-	-	-	-	13
1724-11	TP-2	A	3.55	394.4	-	-	-	-	-	-	9
1724-11	TP-2	I	0.03	6.0	-	-	-	-	-	-	5
1724-34	ST-l		-	-	1.16	30.5	-	-	-	-	38
1724-36	ST-l	II	-	-	1.69	45.7	-	-	-	-	37
1724-42	TP-l	II/l	0.25	20.8	-	-	-	-	0.02	1.7	12
1724-43	TP-l	I	0.38	47.5	-	-	-	-	-	-	8
1724-43	TP-l	II low	2.04	408.0	-	-	-	-	-	-	5
1724-43	TP-l	II up	6.50	282.6	-	-	-	-	0.07	3.0	23

Table 6. Concentration Indices for Phase II test excavations (continued).

SITE/ Feature	TP	LAYER	MARINE SHELL grams	MARINE SHELL CI g/m^3	BIRD BONE grams	BIRD BONE CI g/m^3	MAMMAL BONE grams	MAMMAL BONE CI g/m^3	FISH BONE grams	FISH BONE CI g/m^3	VOL (Liters) (/1000m^3)
1724-55	TP-l	I/l	2.78	278.0	0.45	45.0	0.94	94.0	22.58	2258	10
1726-08	TP-l	A	-	-	1.77	590.0	-	-	-	-	3
1726-08	TP-l	I	-	-	0.10	5.6	-	-	-	-	18
1726-08	TP-l	II/01	-	-	0.18	25.7	-	-	-	-	7
1726-08	TP-l	II/02	-	-	0.89	44.5	-	-	-	-	20
1726-08	TP-l	II/03	-	-	2.27	108.1	-	-	-	-	21
1726-08	TP-l	II/04	-	-	5.24	218.3	-	-	-	-	24
1726-08	TP-l	II/05	-	-	0.46	30.7	-	-	-	-	15
1726-08	TP-l	II/06	-	-	0.38	27.1	-	-	-	-	14
1726-08	TP-l	II/07	-	-	0.54	30.0	-	-	-	-	18
1726-08	TP-l	II/08	-	-	0.41	29.3	-	-	-	-	14
1726-08	TP-l	II/09	-	-	0.21	9.5	-	-	-	-	22
1726-08	TP-l	II/l0	-	-	0.23	9.2	-	-	-	-	25
1726-08	TP-l	II/11	-	-	0.04	3.1	-	-	0.03	-	13
1726-08	TP-l	II/l2	-	-	1.09	83.8	-	-	-	-	13
1726-17	ST-l		2.45	34.0	-	-	-	-	-	-	72
1726-28	ST-l		-	-	2.15	56.6	-	-	-	-	38
1726-30	ST-l	II	-	-	0.07	4.1	-	-	0.03	1.8	17
1726-31	TP-l		-	-	0.22	20.0	-	-	-	-	11
1726-34	ST-l		-	-	0.21	16.2	-	-	-	-	13
4702-07	TP-l	I	-	-	-	-	-	-	0.01	3.3	3

Note: Marine shell includes only cultural midden. Mammal bone does not include rodents.

Table 7. Concentration Indices for Site 1726-08.

SITE/ Feature	TP LAYER	BIRD BONE		BIRD EGG		RATTUS EXULANS		MUS MUSCULUS		VOLUME
		grams	CI g/m^3	grams	CI g/m^3	grams	CI g/m^3	grams	CI g/m^3	(liters)
1726-08	TP-l A	1.77	590.0	1.46	486.7	0.32	106.7	-	-	3
1726-08	TP-l I	0.10	5.6	-	-	0.21	11.7	0.19	10.6	18
1726-08	TP-l II/01	0.18	25.7	0.18	25.7	0.10	14.3	0.03	4.3	7
1726-08	TP-l II/02	0.89	44.5	1.42	71.0	0.51	25.5	0.03	1.5	20
1726-08	TP-l II/03	2.27	108.1	2.07	98.6	0.25	11.9	-	-	21
1726-08	TP-l II/04	5.24	218.3	3.02	125.8	0.34	14.2	-	-	24
1726-08	TP-l II/05	0.46	30.7	0.24	16.0	0.10	6.7	-	-	15
1726-08	TP-l II/06	0.38	27.1	0.81	57.9	-	-	-	-	14
1726-08	TP-l II/07	0.54	30.0	0.71	39.4	-	-	-	-	18
1726-08	TP-l II/08	0.41	29.3	0.79	56.4	0.04	2.9	-	-	14
1726-08	TP-l II/09	0.21	9.5	-	-	-	-	-	-	22
1726-08	TP-l II/10	0.23	9.2	0.38	15.2	-	-	-	-	25
1726-08	TP-l II/11	0.04	3.1	0.30	23.1	-	-	-	-	13
1726-08	TP-l II/l2	1.09	83.8	1.42	109.2	-	-	-	-	13

Table 8. Radiocarbon dating from Site 1724.

Sample No.	Beta 69557
IARII No.	LN 19.3
Site/Feature	1724-3
Provenience	TP-1, L.I (lower), ca. 5 to 10 cm bs
Coll. unit	scatter
Quantity	0.5 gm carbon
Material	wood charcoal (see Appendix B)
14C	90 ± 80 BP
c13/c12	-25.6 0/00
C13 adjusted	80 ± 80 BP
cal date	A.D. 1660 to 1950 (2 sigma, 95% probability*)

Sample No.	Beta 69558
IARII No.	LN 143.2.0
Site/Feature	1724-11
Provenience	TP-2, F.A
Coll. unit	scatter
Quantity	0.6 gm carbon
Material	wood charcoal (see Appendix B)
14C	130 ± 70 BP
c13/c12	-25.7 0/00
C13 adjusted	120 ± 70 BP
Cal. date	A.D. 1650 to 1950 (2 sigma, 95% probability*)

*Beta Analytic Dendro-calibration Printout

Site 1723

Site 1723 (Figs. 11 and 12) includes 20 features within the project area (Tables 1 and 2, Appendix A, Table A-3). Additional features fall outside the project area, as indicated on Figure 12, and are not listed in the tables.

The northern boundary of Site 1723 is an embankment of fill created when the area was developed for military roads and buildings. The northern half of 1723 is exposed limestone that has been bulldozed, with remnant low piles of debris extending through the middle of it. The features in the northern half have been affected by the bulldozing, primarily through the filling of sinkholes, with some additional ground disturbance.

There is only one standing structure in the site area, a wall segment (1723-10), that is probably a remnant from the ranching period. There are no Hawaiian stone structures, but there is a scatter of fire-cracked rock around 1723-7, and additional fire-cracked rock in two areas of depressions (1723-1 and 1723-9). Feature 1723-1 is adjacent to a series of sinkholes outside the project area (Phase I, 19 series). These areas probably have intact deposits, but with some disturbed areas due to bulldozing. A test in one of the fire-cracked rock scatters (1723-7) failed to isolate any sub-surface features, but did demonstrate that there is cultural material in the surface deposit; one fragment of burned marine shell was found on the surface.

The features of 1723 that are outside the project area to the west include several deep sinks with floor deposits, a C-shape (1723-A), and a small platform (1723-G).

No human bone was found in the features of Site 1723 that fall within the project area, but one feature outside the area (1723-E) has human bone reported by Haun (1991:47). This bone is still observable, lying on the surface of the deep sinkhole.

Site 1723 is interpreted as the remnant of a Hawaiian habitation complex with associated use of sinkholes. No information on chronology is available, but the fire-cracked rock and stone features in the non-project portion of the site suggest that this is an occupation that could date from pre-contact into the early post-contact period. Existing habitation structures lie outside the project area; others have probably been destroyed by bulldozing.

Although some of the features of Site 1723 have been disturbed, at least superficially, this disturbance does not destroy the integrity of the site. Site 1723 contains cultural and paleontological information potentially sufficient for recommendation for eligibility to the National Register of Historic Places.

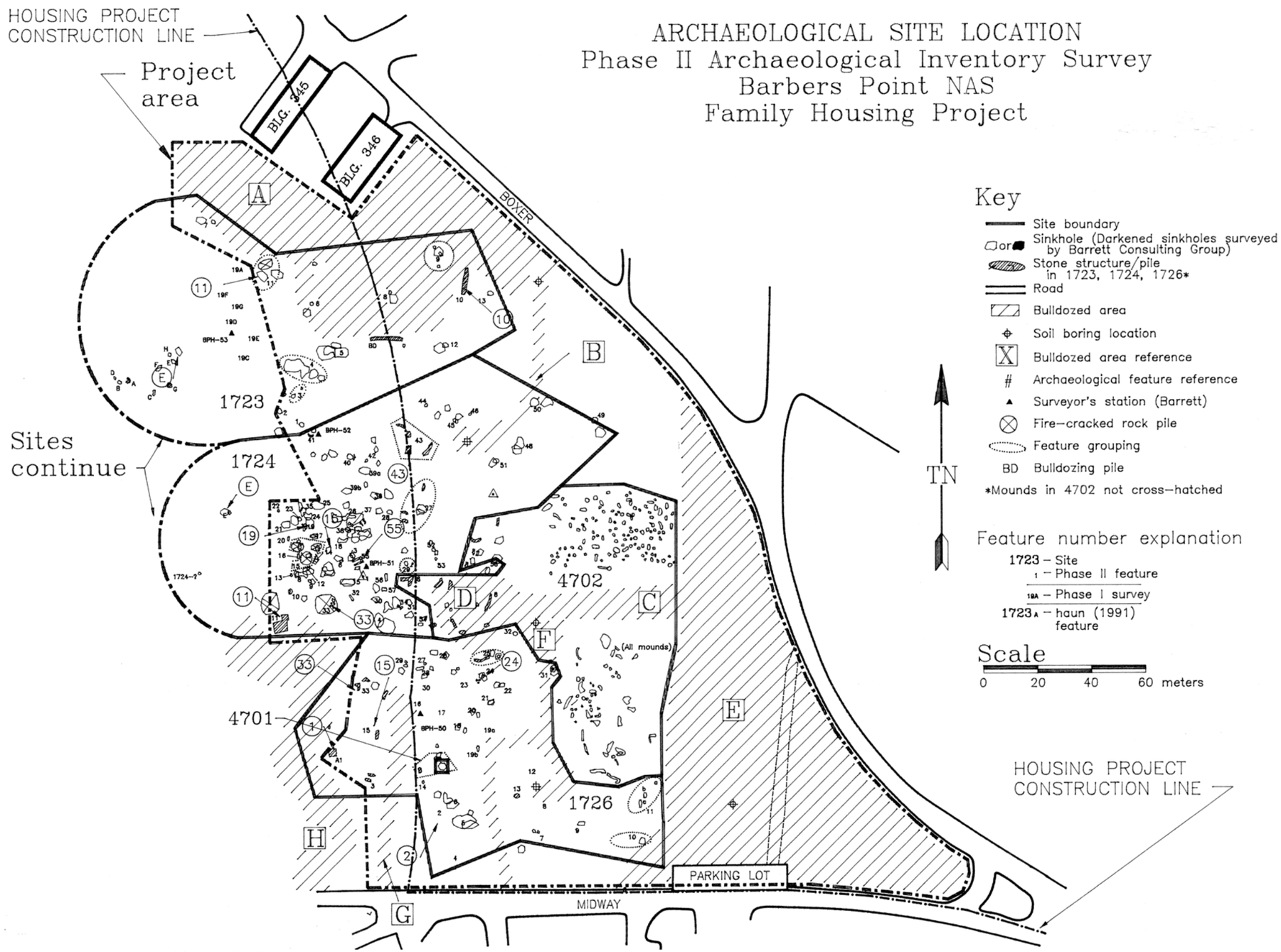


Figure 12. Phase II survey area with site and feature distributions.

Site 1724

Site 1724 contains a total of 69 features within the project area (Figs. 11 and 12; Tables 1 and 2; Appendix A, Table A-3), and an undetermined number of features to the west of the project boundary. The eastern edge of the site is the bulldozed boundary of nearby road construction. The northern and southern edges are the common boundaries with adjacent sites.

Site 1724 has numerous sinkholes of various sizes (Table 2), including several that are capped or rock-filled. Unlike 1723, this site has existing structures. The overall pattern of structure distribution is not immediately identifiable because of lack of survey to the west and bulldozing to the east but the structures may constitute part of a dispersed community settlement. The primary structure is 1724-11, a small, but very well-built house enclosure, with thick, upright-slab, core-filled walls. A U-shape (1724-55) is nearby, and about 35 m to the northeast are the remains of a damaged C-shape (1724-43). In the vicinity of 1724-11 and 1724-55 are numerous piles of fire-cracked limestone. Tests in the structures and in sinkholes and depressions revealed cultural deposits. The density of material in the deposits is low (Table 6), but it is consistent in regard to type of midden and bone. Very few artifacts were found, but these include limestone flakes, a basalt slingstone, and a shell adz preform. The artifactual evidence indicates that this is a Hawaiian settlement dating no later than early post-contact times. The limited radiocarbon data (Table 8) and analysis of faunal remains suggest the possibility that the occupation was late in the pre-contact period with a brief period of continuity into the post-contact time.

Human bone was found in the soil deposit at the base of a deep, rock-filled sinkhole (1724-54), although perhaps as secondary deposition rather than as a burial. The bones of at least one human infant were found on the surface of another sinkhole (1723-19). One infant human cranium is reported from a sinkhole to the west of the project boundary (1724-E, Haun 1991:49). The sinkhole was located during the present project, but it was found to be too deep to enter without a ladder and was not investigated.

Excavations in sinkholes and depressions within 1724 also revealed bones of extinct birds, as well as large quantities of land snails, indicating the potential for paleo-environmental data.

Site 1724 is a site with many important features containing information valuable for understanding Hawaiian occupation of the region and for reconstructing paleoenvironmental change. It is recommended as eligible for the National Register of Historic Places.

Site 1726

Site 1726 contains 43 features within the project area (Figs. 11 and 12; Tables 1 and 2; Appendix A, Table A-3). Not all features recorded in the Haun survey (1991) were

relocated, so these additional features probably lie to the west or northwest of the project's boundary. Most of the area west of the site has been heavily bulldozed and leveled. To the east, Site 1726 shares a boundary with the agricultural mound complex of 4702. To the south, it terminates at bulldozing and fill associated with the construction of the adjacent road.

Although the majority of the features of 1726 are sinkholes, the site does contain one platform (1726-1) that is either a burial, a shrine, or both. This feature was not tested during the present project, as it was specifically excluded in the scope of work. There is also one rough C-shape and some very crudely built (or damaged) alignments. The investigation of features in Site 1726 revealed some limited habitation information in tests, as well as thin scatters of fire-cracked rock along the western side.

This set of features does not have the range that is present at 1724. It may be a functional part of 1724 or may be incomplete due to the destruction of features that would have been present to the west and south.

One human burial was found in this complex (1726-2). The body had been placed deep under the low overhang of a sinkhole, and the sinkhole had been filled with rock. The limited access to the skeletal remains did not allow examination of the bones or a determination of the presence of any artifacts. No other human remains were identified in 1726.

The testing of sinkholes and depressions also yielded bones of extinct avifauna.

The occupation of Site 1726 appears closely related to that of 1724, either as a part of the 1724 settlement or as a similar community with fewer remaining features. It is recommended as eligible to the National Register of Historic Places.

Site 4701

Site 4701 is a sinkhole that was modified to form a unique, capped, hidden, underground chamber (Figs. 11-13, Photo 9) that contains a variety of 20th century artifacts. The artifacts have not yet been evaluated by a specialist in this range of material but appear to date to the 1930s. They include metal jugs, glass jars, and other items that suggest this was a storage room for illegal alcohol production. The site is found in an area of exposed bedrock with a thin vegetation cover.

The deposit of the floor of the chamber was not tested, but there is little possibility of human remains associated with this site.

A complete description of this site is in Appendix C. The site is recommended as eligible for the National Register based on information content related to illegal and hidden alcohol production, probably during Prohibition, or possibly during WWII.

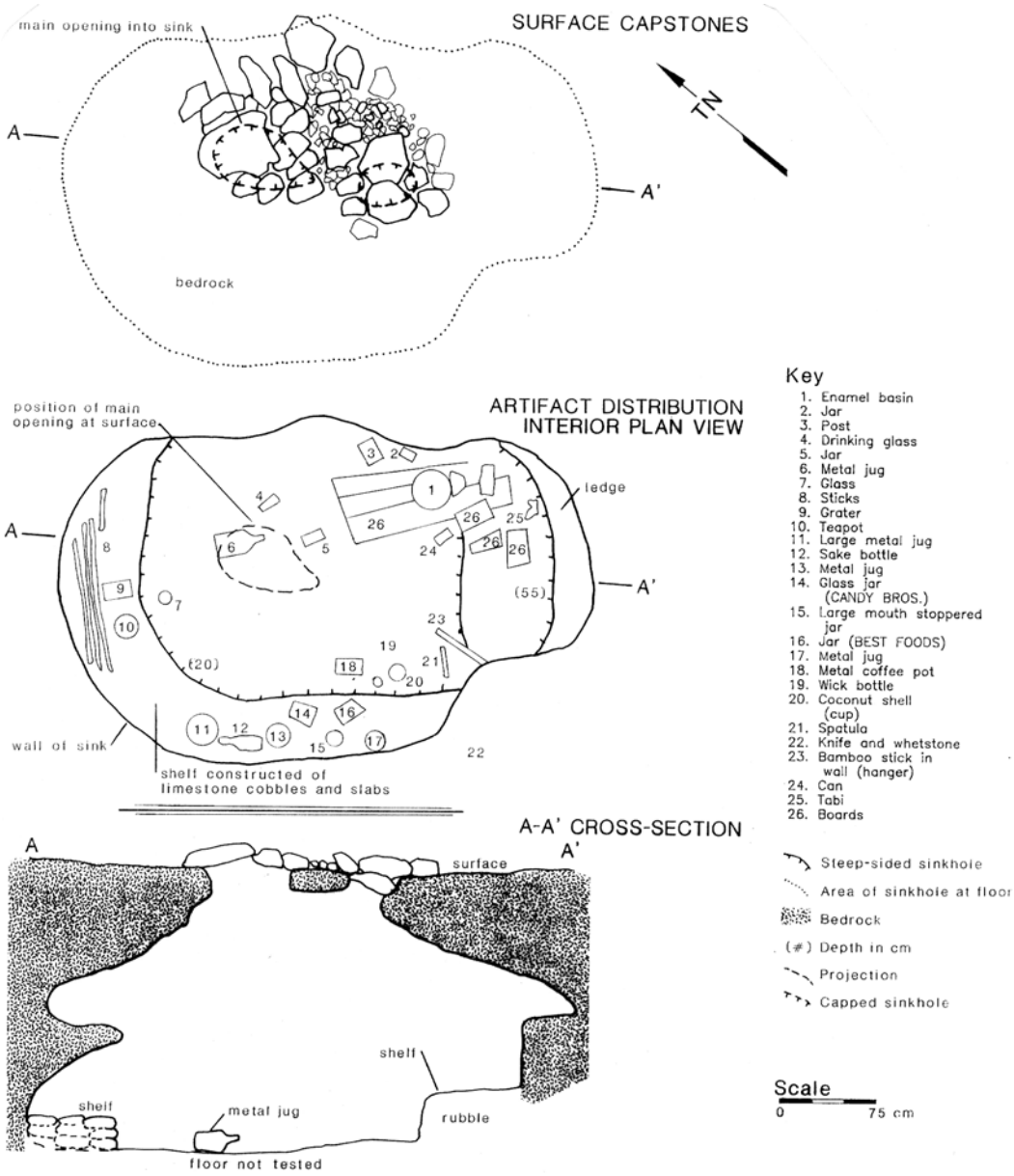


Figure 13. Site 4701.

Photo 9. Artifacts from Site 4701.

Figure 14. Site 4702, eastern section.

Site 4702

Site 4702 is a large area of low stone piles and low elongated mounds (Figs. 11, 12, and 14; Tables 1 and 2) located in a level area with shallow soil cover. There is a thick stand of *koa haole* over the site area, with a few scattered *kiawe* and *wiliwili*. The existing piles number approximately 152, but many more have probably been destroyed. This is particularly the case along the eastern side of the site which has been bladed and leveled. The northern side may also have been bulldozed and there is a damaged path through the central section.

The site has the characteristics of a Hawaiian dryland agricultural field system, primarily devoted to sweet potato cultivation, although testing yielded no definitive cultural information. Such mound complexes are common in the archaeology of the ‘Ewa Plain. The northern half consists of primarily small piles and the southern half is mostly elongated mounds; testing did not show any distinctions in the feature-related soils, suggesting that the features are functionally equivalent. This agricultural complex probably served as a significant part of the settlement system of the area, associated with the habitation complexes of Sites 1723, 1724, and 1726.

No human remains were found in the excavations and, unlike the other three sites associated with Hawaiian occupation, there is very little possibility that any such remains exist in the site area.

This site is recommended as eligible for the National Register of Historic Places, based on its potential to yield information about Hawaiian cultivation.

VI: PHASE II DATA ANALYSES

The information collected during the investigation of the sites of the Phase II project area is examined below in terms of general interpretive categories, including site formation, feature identification, chronological inference, and cultural remains.

Components

In broad terms, the cultural remains of the project area fall into two major components. The majority of the remains can be characterized as a Hawaiian component, or remains from a traditional occupation (although the dating of this component is in question, as discussed under the section on "Chronology"). The other component of the cultural remains relates to 20th century activities.

Other than bulldozing, the evidence of 20th century activities is remarkably limited. At the edges of the adjacent roadways, there is very little modern trash, consisting of only a few soda cans, two scatters of broken glass, and dozens of golf balls. There are two specific 20th century features. One (Site 4701) is a capped, enlarged sinkhole used for the storage of items suggesting illegal liquor production. The second is a capped sinkhole (1724-24) that contained 820 unexpended, linked rounds of WWII 50 caliber bullets (for reasons of safety, these were reported to Navy authorities and they were subsequently removed by EOD personnel). Surprisingly, there are no other features that indicate WWII occupation, although there are some shell casings in a sinkhole to the west of the project area. The importance of the limited artifactual evidence for WWII activities is that this suggests there is little possibility that stone structures or sink modification were created by military training activities.

Site Formation Processes

Several items were found on the floor of a sinkhole just west of the project area; these included the bones of an extinct bird (*Pterodroma phaeodygia cf.*), a golf ball, and the casing of a WWII 50 caliber machine-gun shell. Archaeologists seldom pay attention to surface associations, but if these items became deposit contents as a result of sidewall deterioration and collapse, we could interpret extinction as having taken place during WWII, as a result of birds being struck by golf balls. This is recognized as a ludicrous inference because we know the temporal horizons of the items involved, and because good arguments are difficult to build on single cases. However, if the items were all indigenous Hawaiian in form, a similar sort of argument would not be so readily discarded, even though the

conclusions could be just as erroneous. The point is that arguments of association have to be accompanied by arguments of site formation before they can be accepted.

The present inventory is concerned with site identification and evaluation. While the limited testing cannot clarify all of the site formation processes, it does point up the problem which should be addressed in any future data recovery or other data collection.

The sinkhole deposits appear to be the result of gradual accumulations of sidewall and base decomposition. None of the sinkholes were dug completely, so the three general regimes of sedimentation identified by Davis (1990:182) could not be evaluated. The testing did indicate that there are no multi-strata cultural deposits or cultural deposits interbedded with natural ones. The cultural deposits are consistently a single unit forming the upper layer of deposition (overlain only by a recent duff). On occasion, these deposits may have minor variation, but these not sufficient to be considered as distinct cultural occupations.

The sinkhole deposits exposed to the base of excavation also lack any indication of paleo-surfaces or of stratigraphic units that appear to have resulted from short-term events. This indicates that the filling process was a gradual one. The gradual filling with sedimentary material of mixed size has two implications for cultural and paleoenvironmental research. The first is the problem of movement of material through loose deposits. This could occur with pollen grains and other small fragments of plants or animals (as is possible in the one pollen column analyzed in the present study, as discussed below). The other factor in the process that affects interpretation is erosion of material from the surface limestone bedrock and redeposition in the sink deposit. Basalt cobbles and the shell of marine mollusks occur in bedrock and their redeposition can potentially be confused with cultural deposition.

The problem of how bird bone accumulated in the sinkholes is one of long-standing interest in sinkhole excavation, but remains not totally resolved (see discussions in Olson and James 1982, Davis 1990). It seems to involve several processes including death of trapped birds, death of nesting birds, predator redeposition, and redeposition from the surface as a result of sheetwash.

The presence of bird bone in cultural deposits presents a continuing problem of interpretation because of the possibilities of mixing of naturally deposited bone. Faunal material, like shell, has to be separated between cultural and non-cultural origins. Bone of fish and lizard also occur in deposits with bird bone and may be a result of predator disposal or regurgitation.

The ground surface and the depressions have very shallow, fine-particled soil cover derived primarily from bedrock decomposition. There are also some patches of basaltic silt derived from the cultivation of inland cane fields in the last century.

The cultural contribution to the site formation process appears to have primarily been minor alterations of the existing upper unit of sinkholes and some surface areas, through cultivation and limited trash deposition. There is no evidence in the project area of

widespread fires for cultivation or other purposes. Trash deposition appears to have consisted of a very high percentage of organics and very little non-perishable material in the form of marine shell or bone. The largest quantity of non-structural material left from the cultural occupation is fire-cracked limestone pebbles, presumably rakings from ovens and hearths.

The consequences of the natural and cultural processes may be significant for site interpretation in several important ways. The implication is that time spans of lengthy duration may be compressed into thin, surficial deposits, thus creating problems of association. In addition, the small quantities of non-perishable cultural trash (Table 6) may be misleading measures of occupational intensity or duration.

Types of Features

The characteristics of the Hawaiian component and excavation information are discussed in the following section. The 20th century features are presented in more detail in the site and feature listings.

Structures

The primary structure type in the project area is stone piles and mounds. Most of the numerous stone piles and low, elongated mounds are clustered on the eastern side within Site 4702. These mounds are of a size and pattern that have generally been identified in ‘Ewa Plain archaeology as Hawaiian agricultural features (Davis 1990:240-244).

Other than these features, structures are not common in the survey area. There is one well-constructed small enclosure (1724-11) that is a permanent house site, and three C- or U-shapes (1724-43, 1724-55 , and 1726-33), probably temporary habitation structures. The only other structure is a platform (1726-1) that may be a shrine or a burial.

A feature that is frequently found on the ‘Ewa Plain is the “modified sinkhole”, a sinkhole that has a low wall built along the windward edge, generally considered to be an agricultural feature. However, there are no distinct examples of this type of feature in the survey area, despite all of the other evidence for agriculture. There is a low-walled sink that is part of a small structure set (1724-3 and 1724-55).

The one standing wall (1723-10) in the project area appears to be a remnant of 20th century ranching.

There are also numerous “mounds” or “piles” that are the result of bulldozing. In some cases, the bulldozed mounds are probably only material from loose surface limestone boulders. In other cases, these are damaged structures. As far as can be determined, most of these damaged features were agricultural mounds within the mound complex of Site 4702. Tests yielded no cultural material to indicate that any of the disturbed mounds were habitation

structures. There is one case of a damaged habitation feature (1724-43), but the source of damage is uncertain.

Surface Modifications

The important surface modification constituting cultural resource features is the presence of piles and scatters of fire-cracked rock, primarily limestone pebbles (Photo 10). All of the piles are found clustered on the western side of Site 1724. There is a thin scatter in the vicinity of 1726-3 and 1726-15, and there is a scatter and possible deposit that are part of 1723-11.

Work at other areas of the 'Ewa Plain has reported "cleared areas", perhaps as gardening locales, and surface midden piles. Neither of these was noted in the survey area.

Sinkholes

There are 86 sinkholes in the project area (see Fig. 15 for sinkhole terminology). However, none have the size or shape to be suitable habitation shelters. The term "habitation" as a sinkhole function in the feature descriptions refers to their use or possible use for trash deposition as part of associated habitation activities, and not to actual occupation of the sinks themselves.

Two sinkholes are at the larger end of the size range for the opening and exposed area: Site 1724-47 (2.23 x 1.55 x 2.3 m depth) and Site 1726-17 (3.21 x 2.09 x 1.03 m in depth), but neither has an overhang. Other sinks have small openings with large bell-shaped chambers; however, all are sediment-filled nearly to the chamber ceilings so there is no usable space. For example, Site 1723-8 has a chamber that measures at least 6 x 4 m, but the maximum ceiling (overhang) height is 40 cm.

The evidence from the Phase II testing indicates that the utilized sinkholes without any structural modification or rock fill were used for trash deposition or for agriculture. It is possible that some of these sinks were used for human burial, although no human remains were found in the testing of these open sinks. However, human bone was found on the surface of one of them (1724-19). The open sinkhole that appears to have the highest possibility of human interment is the large 1724-47, but it was not tested due to a massive, active beehive (Fig. 13) present during the field season. After the removal of the beehive following the main field season, the floor of the sink was examined and a shallow probe was placed into the deposit. No bone was observed, but burials could be found in other non-tested portions of the deposit.

Photo 10. Photo of fire-cracked rock pile of Site 1724-38. Pile is about 2 m in diameter. Site 1724-26 in background (facing north).

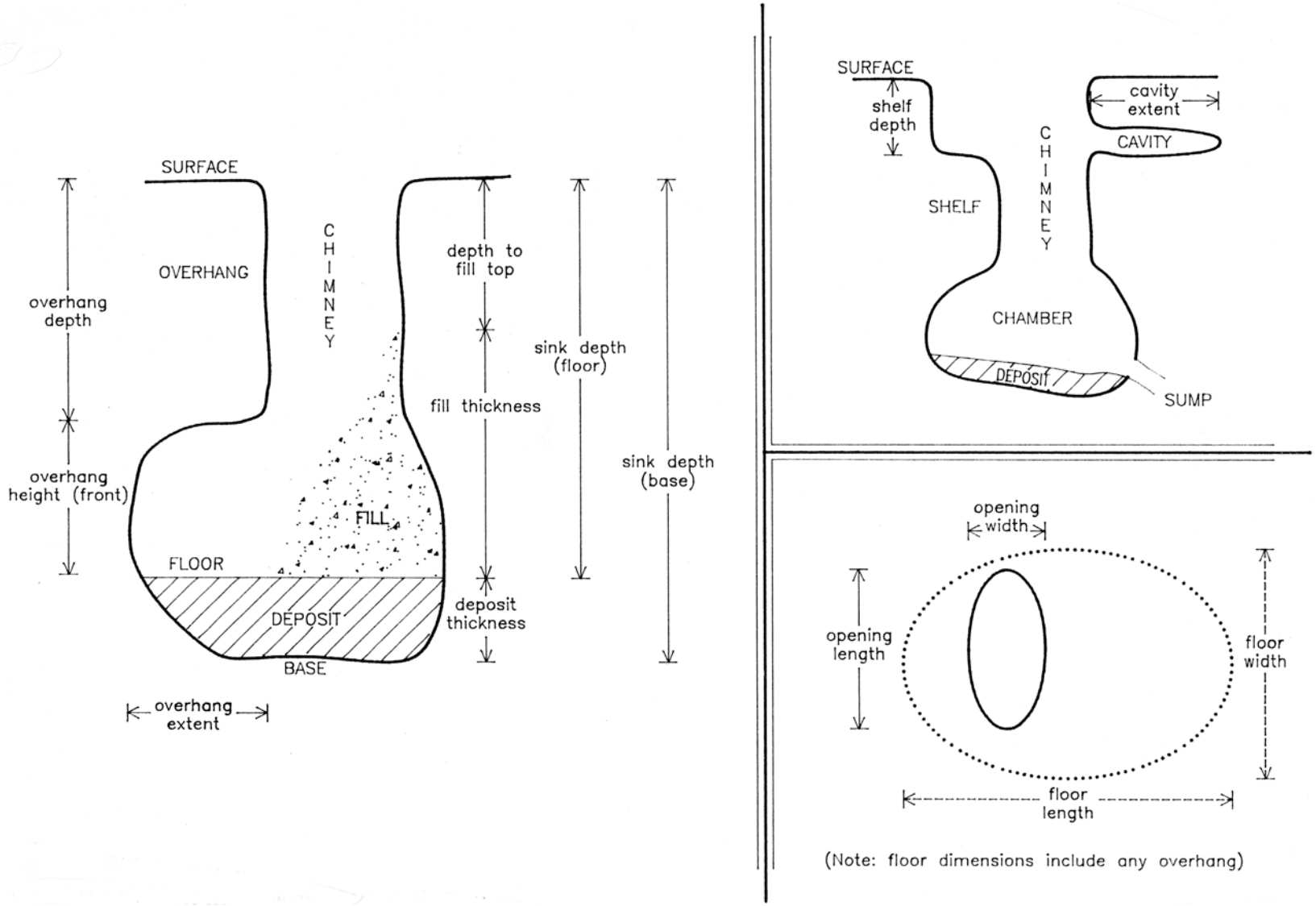


Figure 15. Sinkhole terminology.

The cultural modification of sinkholes in the project area is primarily rock filling, capping, or both, with only one example were a sink is walled (Tables 2 and 4). Two examples of capping (placing limestone slabs over the sinkhole opening) are of 20th century origin (Sites 1724-24 and 4701). Other examples may be Hawaiian, but there are no obvious reasons for the capping. The capped sites without rock fill (e.g., 1726-35) did not contain any cultural material or human remains. One of the capped sinks was tested (1726-31), but it had neither artifacts nor charcoal.

Numerous rock-filled sinks occur in the project area and the rock fill was removed from several of these. One rock-filled sink (1726-3) was found to contain human bone placed as a definite burial in a side cavity, but no cultural material was found in the rock fill or on the portions of the floor that could be seen. None of the other rock-filled sinks that were investigated were found to have human bone or cultural material in the rock fill or on the floor. The deposits of three of these sinks were tested: 1726-3 contains no cultural or paleontological material; 1726-34 contains bone of bird and *Rattus exulans*, but nothing to suggest cultural use; 1724-54 was found to contain human bone.

All varieties of tested sinkholes that contain some form of deposition have paleontological remains, primarily bird bone and land snail shell.

Depressions

Unlike sinkholes, soil-filled depressions (with one exception) proved to have limited cultural information (Table 4). Some may have served as runoff water catchments.

The exception to the pattern of non-existent or low density cultural deposition is at Site 1724-7, which testing indicates is filled with fire-cracked rock and cultural trash. This depression is located in a habitation cluster at Site 1724, associated with structures 1724-55 and 1724-11. It can be argued that depressions had little cultural use except for those immediately associated with habitation, or those that naturally trapped water.

Depressions do provide information on depositional history, particularly regarding recent soil transport. And they also contain a surprising bit of environmental data. Three of the seven depressions that were tested contain the shell of bird eggs. Egg shell occurs in these deposits in association with the fossil bird bones. The egg shell in the depressions is consistent with other surficial (non-sinkhole) proveniences, including the soil deposit at 1724-11.

Fire-Cracked Rock

The most common non-structural cultural item identified in the project area is fire-cracked rock, primarily limestone pebbles with a few fragments of basalt. These constitute a major deposit in the 1724-7 depression, are found in piles in the vicinity of the

1724-11 habitation cluster, and occur as scatters and probably remnant piles at 1723-7, 1723-11, and 1724-43, and in the general vicinity from 1726-3 to 1726-33. The piles in the 1724-11 area are 2 to 3 m in diameter and up to 20 cm in height (estimated, none were tested). The burned fragments are highly angular, generally 2 to 3 cm in diameter, and have discolored surfaces and interiors. This material is probably discard (or "rakings") from hearths and ovens where the local limestone has been used as heating stones and slabs. This is common at 'Ewa Plain sites. In the Haun survey of the Station, fire-cracked limestone was noted at many sites. The largest quantity was recorded at Site 1737, which had a pile "nearly 1.0 m high and several meters in diameter..." (Haun 1991:142).

Chronology

There is little definitive information relevant to dating the Hawaiian component sites and features. Two charcoal samples have been submitted for radiocarbon dating, with the results shown in Table 8. One date (Beta 69558) was obtained from charcoal scatter in a small feature associated with the occupation of a rectangular house (1724-11), producing a calibrated age range of A.D. 1650 to 1950 (Table 8). The stratigraphic position of the feature indicates that it was constructed and used in a second phase of occupation, although the first phase may not have been one of long duration (Appendix C).

A second radiocarbon date (Beta 69557) was obtained from a charcoal scatter in the cultural unit of a sinkhole, 1724-55 (Appendix C), with a calibrated age range of A.D. 1660 to 1950 (Table 8).

Neither of these carbon samples was run under ideal circumstances. Both are from scattered charcoal (although one was from a feature) and both are from proveniences that did not have adequate charcoal to run duplicate dates. These dates were run to establish the beginnings of a chronological regime for the project area and cannot be accepted as absolute dates. Comparatively, they are consistent with the late range of radiocarbon dates from excavations at nearby Site 4650 (Fig. 6; Landrum 1993:Appendix 2).

The limited radiocarbon dating available leaves chronological inferences largely dependent on artifacts, midden, and architecture. The only artifacts recovered in situ from excavations are limestone flakes and one piece of volcanic glass; two other indigenous artifacts (a slingstone and shell adz preform) were found on the surface of cavities in two depressions, and were probably in situ. One piece of volcanic glass was recovered from the surface. No non-indigenous artifacts were found in the excavations and the only such surface material appears to be from the mid-20th century (bottle glass and golf balls).

Although the artifacts suggest a pre-contact or early contact period of occupation, the absence of non-indigenous artifacts cannot be taken as a definitive marker of the pre-contact period, particularly in isolated, rural occupations (cf. Carter 1990).

The very small amount of charcoal recovered from testing does not include any identifiable post-contact introductions (see section on "Plant and Animal Remains", below, and Appendix B). The faunal material, however, does provide a hint of post-contact activity in the 1724 habitation complex, in the features clustered around 1724-55. A fragment of cow bone occurs in the upper unit of 1724-7, and there are other fragments of medium-to-large and large mammal in the 1724-7 deposit (Table 4; Appendix A, Tables A-5 and A-6). The 1724-7 deposit is distinctive by the presence of fire-cracked rock and ash (see Appendix C); while the cow bone is possibly intrusive, the medium-to-large and large mammal bone (which could be cow) is almost certainly part of the deposit. In the nearby 1724-8 sinkhole, a shell adz preform and a cow scapula were found placed into a small side cavity. None of this is conclusive evidence that the Hawaiian occupation lasted into the post-contact period, but it is tantalizing, and consistent with the late range of radiocarbon dates.

The architecture provides chronologically ambiguous information. The rough C-shapes could span the range from pre-contact well into the post-contact period. The one permanent house site (1724-11) has architecture that is similar to excavated houses on the 'Ewa Plain and at Makaha Valley; these have been artifactually dated to pre-contact as well as post-contact occupation.

If occupation in the project area did reach into the 19th century, the absence of late 19th century non-indigenous artifacts, which were common in rural areas, and the absence of *kuleana*-style stone fence enclosures are suggestive of an occupation that ended prior to the mid-1800s.

In sum, the present evidence indicates that the occupation of most of the sites appears generally pre-contact in age, but with the possibility remaining open than there was some continuity into the early 19th century.

Duration of occupation is another critical aspect of chronology, but test information provides only limited evidence to address this problem. There are two ranges of data relevant to this, trash or midden deposition and fire-cracked rock piles, and they suggest opposing conclusions. The artifacts and midden occur in very low density, indicating brief occupation. However, the quantities of fire-cracked rock imply more intense occupation, either of longer duration or in multiple episodes.

Laboratory Analysis

Plant and Animal Remains

Although marine shell occurs in many of the sinkhole deposits, an examination of the shell and evaluation of the proveniences indicates that much of this is a result of erosion from the limestone and is not cultural midden. The shell consists primarily of Turbo (frequently the operculum) and occasionally Strombus. The deposits in which this shell is found appear to be natural depositional units, containing no definite artifacts nor other material such as

charcoal that could be cultural in origin. The shell also has a degree of encrustation that is uncommon in cultural deposits (see Carucci 1992). In addition, this shell occurs with what may be the remains of an extinct land crab (possibly, but not certainly, *Geograpsus crinipes* (*Dana*), see Ziegler 1993) and spines of urchin. All of these items are considered non-cultural. They are included in the general excavation listings (Appendix A, Table A-4) but are not considered as midden in the site interpretation and are not included in the midden counts (e.g., density in Table 6) unless they are part of deposits that have distinct cultural evidence and other marine shell taxa present.

Marine shell that is defined as midden occurs in very low density and variety (Table 6; Appendix A, Table A-4). It is primarily Brachidontes, *Nerita picea*, and Tellina, all taxa commonly found in sites on the ‘Ewa Plain and that were collectable from the nearby reefs.

Bone identified as midden also occurs in low density (Table 6; Appendix A, Tables A-4 and A-6). All non-human bone, including fish, was identified by Dr. Alan Ziegler. The only Polynesian domesticate identified is *Sus scrofa*, fragments of which were found in three clustered features (1724-3, 1724-7, and 1724-55). No dog or chicken were found. Bone that is probably *Bos taurus* was found in the upper deposit of 1724-7, the same provenience as one example of *Sus scrofa*. Several other bone fragments of unidentified mammal in the size range of medium, medium-to-large, and large were also found in 1724-7. Much of this bone is probably pig, but could include other species as well, including cow.

The most commonly occurring bone that is probably culturally deposited is fish, found in all of the habitation deposits except those associated with 1724-11 and 1726-17. The fish bone occurs in very low density, except the material in one subsurface feature at 1724-55, where 22 g of bone consisting of at least nine taxa were identified (Appendix A, Table A-5). The fish bone is described as follows (Ziegler 1993):

> Almost all of these fish are of carnivorous types,...but generally of such a small size that I doubt most could have been taken by hook-and-line fishing. I suspect they might have been caught in a meat-baited fishtrap; if they were from a surround-net haul or a poisoning operation, I would expect to also find present a significant number of herbivorous types...

The midden deposits not only contain bone of fish, pig, and other non-rodent mammals, but also bone of *Rattus exulans* and several types of birds. *Rattus exulans* is virtually ubiquitous in the midden units. Bird bone occurs in the midden deposits of three features (1724-3, 1724-55, and 1726-30). In two cases, the bones of extinct or extirpated species of Procellariids occur in the cultural deposits; other extinct taxa may also be present. There is no evidence that the avian bone has been culturally modified (see, e.g., Weisler and Gargett 1993): Ziegler found no indications that they were broken in a manner indicting butchering or that they had been burned.

Bird egg shell also occurs in the deposits, but primarily in non-cultural contexts. It is not known if the small quantity of egg shell in cultural deposits (Appendix A, Table A-4) is midden or of natural deposition.

The quantity of fire-cracked rock around the main habitation complex (see section on "Settlement Pattern", below) suggests much more cooking than is evident from the midden. It is probable that the main food items were vegetal. However, there was only a very small quantity of carbonized wood or plant remains recovered from the excavations. Five plant taxa in the carbonized fragments from habitation deposits have been identified by Gail Murakami (Appendix B). These include *Chamaesyce spp.* (*'akoko*), *Chenopodium oahuense* (*'aheahea*), and *Nototrichium spp.* from 1724-11 (a house enclosure), TP-2, Feature A; *Chamaesyce spp.*, *Chenopodium oahuense*, and a fragment of *kukui* nutshell from the deposit in the sinkhole of 1724-3; and *Chenopodium oahuense* from the deposit in the fire-cracked rock-filled 1724-7. There is a minimum of ten additional plant taxa, not yet identifiable, in the charcoal fragments from these deposits.

These plants are among those that would be expected from the 'Ewa environment and their presence is consistent with these being kitchen midden deposits. *'Akoko* and Nototrichium were common fuels and the *'aheahea* was a food plant that was "wrapped in ti leaves and cooked on hot coals" (Pukui and Elbert 1971:17). *'Aheahea* occurs in seven of the nine proveniences that yielded carbonized plant fragments (see Appendix B). '*Aheahea* could have been a fuel as well as food plant, but its prevalence raises the possibility that Chenopodium was a much more important food plant on the 'Ewa Plain than has been previously suggested. For example, Davis lists *Chenopodium oahuense* as one of the native plants of the region, but does not include it in his list of food plants (1990:Table 7). A more detailed analysis of provenience of this plant is needed.

Only two unburned *kukui* nutshells and one burned fragment were found in the project area. One shell (uncollected) was noted on the ground at the base of the platform (1726-1). The second came from a cavity floor in association with a shell adz preform at 1724-8. The burned fragment is in the midden deposit of 1724-3 (see Appendix B).

The densities of marine shell, bird bone, mammal bone (excluding rodents), and fish bone are shown in Table 6, expressed as a Concentration Index (CI) of grams per cubic meter of excavated material. Material from cultural deposits is all in very low concentrations, with the exception of fish bone from one small, subsurface feature at 1724-55 which has a CI of 2,258. Marine shell midden CI ranges from 0 to 408, and mammal bone CI ranges from 0 to 219.

Compared to material from other sites excavated on the 'Ewa Plain, the marine shell density falls within the low range. For example, the range for one set of sites (with 40 habitation features) in the Deep Draft Harbor area west of the project area is from 20 to 8,256 CI (Davis 1990:269). Of the 40 features, 29 have a higher marine shell CI than the highest in the present project area (408), and nine features have a CI over 1,000.

Artifacts

The artifacts (Table 5; Appendix A, Table A-4; Photo 11) recovered from the Hawaiian occupation include 22 limestone flakes, two pieces of volcanic glass, a small piece of cut bone, one basalt slingstone, and one adz preform made of shell. A few fragments of basalt, all spalls from fire-cracking, were noted on the surface and from excavations. No basalt flakes or debris from knapping were found. All of the artifacts come from the habitation concentration in the vicinity of 1724-11 and 1724-55.

The limestone flakes are all of definite cultural production, having good platforms and scar characteristics (Fig. 23). They range in size from 2 x 3 cm to 7 x 7 cm (Photo 11). No evidence of use has been found on any of them.

The slingstone (Photo 11) is symmetrical and measures 5.6 cm in length, 4.5 cm in width, and weighs 109 g. It is made of dense basalt.

The adz preform is made from the lip of a helmet shell (*Cassis cornuta*). It is 10.8 cm long, 4.3 cm wide, has a maximum thickness of 1.5 cm; it weighs 164 g. It has been cut and partially flaked, with some exfoliation.

Artifacts noted or collected from these sites on a previous survey (Haun 1991:134) include one coral abrader from 1723, and an octopus lure stone sinker, a hammerstone, coral abrader, and flakes of basalt and limestone from 1724. All of the 1724 artifacts, except the sinker, come from a feature west of the project area; the sinker is from 1724-32.

There were no non-indigenous artifacts found in any provenience that is considered a Hawaiian occupation, nor were any non-indigenous artifacts found that date to the 19th century. There are fragments of 20th century glass on the surface near some of the features (Appendix A, Table A-4), a set of 20th century artifacts was found at Site 4701, and WWII ammunition was located at 1726-24.

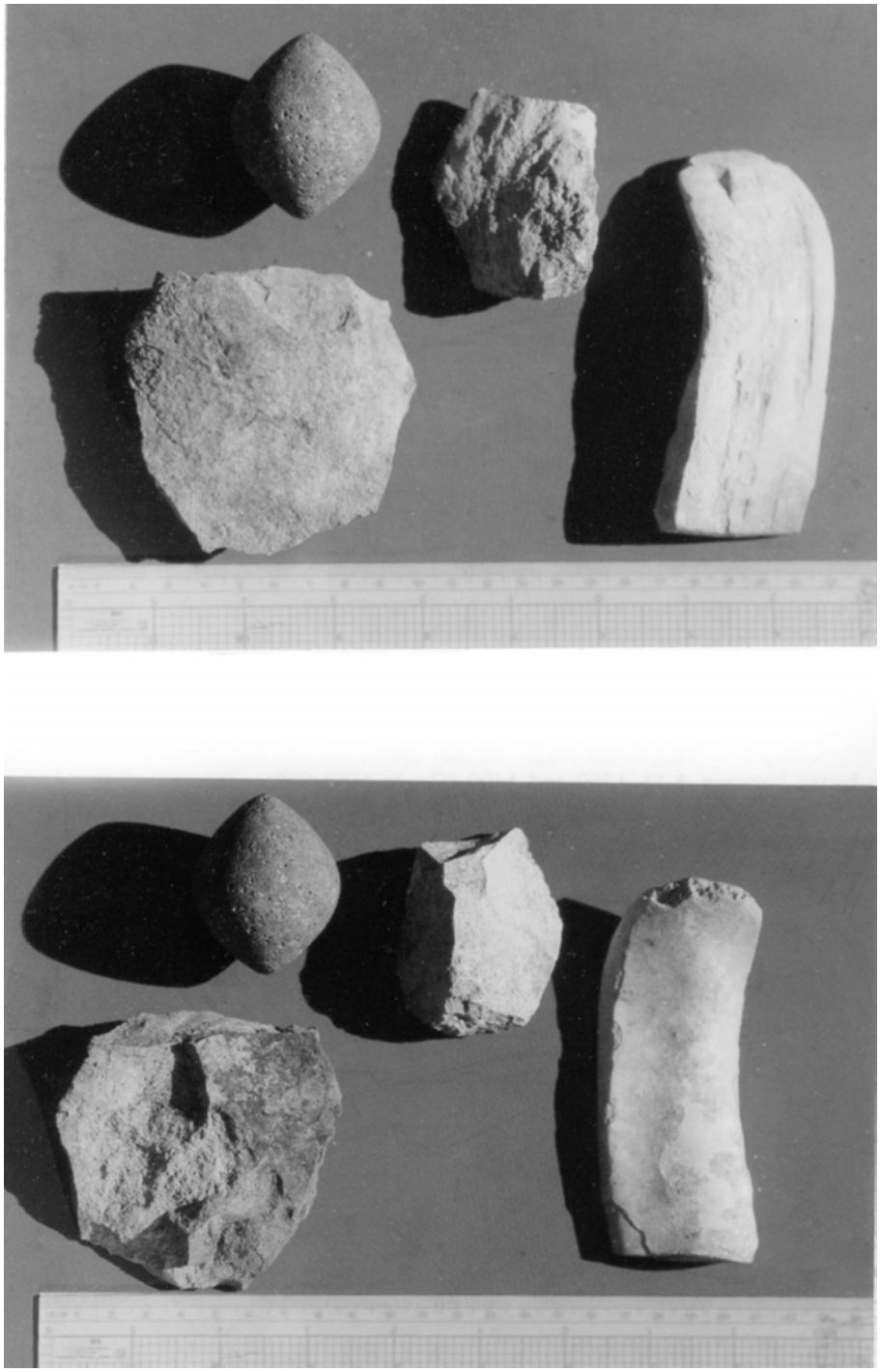


Photo 11. Stone and shell artifacts.

VII: DISCUSSION OF PHASE II SURVEY FINDINGS

Site and Feature Function

The features of the project area can be divided into a number of functional categories. These are discussed below, followed by a general presentation of settlement pattern.

Agriculture

The complex of stone mounds (Site 4702) and many of the sinkholes are probably Hawaiian agricultural features. The mounds have no artifactual evidence directly associated with them, but have the structural characteristics commonly interpreted as dryland agriculture, primarily for sweet potato cultivation. Such mound complexes are found on the ‘Ewa Plain and in a number of other dry environments in Hawai‘i, such as leeward Moloka‘i (Weisler 1989). The soils of the complex, however, show little evidence of disturbance or other cultural modification such as burning. Cultivation is certainly the primary candidate for the construction and use of the mounds, but this needs additional examination and testing.

The sinkholes of the ‘Ewa Plain are also frequently interpreted as cultivation features. Maly (1992:E-120) notes that there is a Hawaiian saying about breadfruit trees planted in pits or fissures, making the fruit available on the adjacent ground: "*‘Ka ‘ulu hua i ka hapapa* (The bread fruit which bears fruit upon the plains)". The sinks in the project area that would fit the morphological characteristics for cultivation are those that are 2 m or greater in diameter, with floors around 1 m below surface. These sinks generally have 10 to 15 cm of an upper deposit that could be culturally modified and some also contain a few midden fragments. However, the degree of disturbance appears minimal and, like the mound soils, these deposits show no substantial evidence of burning.

Natural Water Catchments

Based on the observation that some of the depressions in the limestone hold water following rain, it is probable that these served as local water sources. There is no indication that any were intentionally modified for this purpose, but this is not unlikely. They could have been lined with matting or other materials to decrease their permeability. The other important point is that many of these would have collected not only rainfall, but also runoff. In one observed case of a natural catchment (Feature 1724-9), a water depth of 13 cm was

measured following a six day period of rainfall measured as 1.1 inches (2.8 cm) at the nearby Honolulu International Airport (rainfall figures from the Honolulu Advertiser daily reports).

It should be noted that these water catchments are also a source of fresh-water algae. These algae also form on shallow bedrock "pans" that will hold several square meters of water at a depth of 1 or 2 cm.

Habitation

There is one substantial house site (1724-11) that is defined architecturally as a permanent residence. It is a well-constructed, thick-walled enclosure with an interior paving and a small attached architectural space that may have been for storage. Although substantial in form, it is much smaller in area than the 19 m^2 that is used in the Cordy model to define the low end of the range of permanent houses (Cordy et al. 1993:35). However, it is not a C-shape nor does it show multiple occupations as is characteristic of temporary structures (Cordy et al. 1993:35). Whatever the occupational function and history of the structure proves to be, it should be noted that this is a common house form in the 'Ewa Plain (see, e.g., Haun 1991:Figures 4, 8, and 9).

Only one other well-constructed habitation structure is in the project area, a U-shape (1724-55). A test inside the structure, however, found it to have no associated deposit. Other habitation structures include two roughly constructed C-shapes (1726-15 and 1726-33), and a largely demolished structure that was probably a C-shape (1724-43). Another C-shape (1723-A) is found outside the project area. Habitation is suggested by fire-cracked rock in the vicinity of 1723-7, but the area has been damaged by bulldozing and there are no structures remaining.

Habitation activities, including cooking and trash deposition, are indicated by piles of fire-cracked rock (e.g., 1724-38; Photo 10) and deposits in depressions and sinkholes (Table 4).

Ceremonial Features

No structure definable as a temple or shrine was found in the survey area. A small platform (1726-1) has a form that suggests a shrine, but there is no other supporting evidence such as branch coral or an *'aumakua* stone; Haun (1991:52) suggests that the structure is a burial platform.

One other possible location of a shrine is the small enclosure attached to the 1724-11 house site. There is no information to indicate its use, but the possibility of an *'aumakua* platform should be considered.

Burials

One definite human burial was located within the project area, in Feature 1726-2. The bones were seen in a cavity about 2 m from the sink shaft and could not be examined closely. It is unknown if there are any associated artifacts that might provide an interment date. Other human bones have been noted in and near the project area (discussed below), but none are definitely formal burials.

Site 1726-1 is considered a possible burial platform (Haun 1991:52), but could alternatively be a shrine. This structure was not tested, having been specifically identified by the scope of work as outside the project's testing boundary.

Settlement Pattern

A landscape perspective on the settlement of the project area suggests that this was a cultural landscape during the period of Hawaiian occupation. Analogously, a modern farm is a total cultural landscape and it would be a mistake to view the farmhouse as the "site" and everything else as "non-site". It is clear that Hawaiian cultural activities occurred not only where there are structures and remains, but over an entire area, where depressions and limestone flats would have been used for water collection, trees and other plants used for fuel and tools, loose limestone used for oven stones, and open surfaces used for play. This makes the landscape a "living surface", a background to view the more specific details of human life carried out on this surface that left identifiable remains which are defined as "features".

If features assigned to the Hawaiian component of the project area are considered as a contemporaneous set, they constitute a coherent pattern for a single Hawaiian settlement, or, given the surrounding surface destruction, some portion of such a settlement. This settlement consists of a habitation complex, an agricultural complex, one possible shrine, and at least one burial.

The agricultural mounds (Site 4702) are distinctly clustered on the eastern side of the project area, in association with the primary area of soil cover. Unlike many similar agricultural complexes in dryland areas, no "temporary habitation" features such as C-shapes have been recorded in this area. All of the associated habitation occurs to the west of the mound complex, on the generally exposed bedrock. At the same time, the sinkholes that were used for cultivation are mixed with the habitation features, so there is not a clear distinction between habitation and cultivation, but only between areas of types of cultivation, primarily between sweet potatoes and tree or stalk plants.

Of the features in the project area, 1724-11 clearly stands out as a central residence and probably a permanent habitation within a local community. The sinkholes and C-shapes served for a variety of supporting functions, including cooking, storage, and trash deposition. The overall habitation cluster may thus be seen as an inland version of a *kauhale*, or family community settlement (also see Haun 1991:142).

The probability of "permanent" occupation for structures such as 1724-11 in the NAS Barbers Point area is also one of the conclusions of the Haun survey (1991:141). The nature of the "permanence" of the occupation involves actual occupational episodes and total occupational duration. The suggested permanency could reflect long-term occupation during an annual growing season. The presence of at least one burial in the vicinity, and perhaps several others, is another suggestion of more than short-term occupation. All of this would contrast with simple short-term use of a few days at a time that is usually defined for temporary field shelters. At the same time, it is a variation on coastal permanent settlement models where at least some residents of a family community would be living year round, and the central structures would be larger than that found here (cf. Cordy et al. 1993).

An examination of other sites in the general vicinity (Haun 1991; Burgett and Rosendahl 1992) indicates that the main house structure of 1724-11 is a very common type, defined as a square or rectangular enclosure with thick walls constructed with core-filled uprights, partial interior paving, a doorway, and a small, attached, square architectural unit. There are some sites that have more than one such house (e.g., Haun 1991:Figure 9), and others where the structure is larger than at 1724-11. But the basic pattern is the same. (At 1724-11 the bulldozed areas to the west and south preclude knowledge of whether there were additional structures in the complex.) This cluster of sites in the southwestern area of the Station identified in the Haun survey (1991) provides the impression of substantial habitation, perhaps permanent in nature (Fig. 6).

The suggested model is one of small agricultural communities scattered over a large area of the interior 'Ewa Plain. The contemporaneity, permanence, seasonality, and absolute dating of these communities is poorly known, but the possibility of permanent residence cannot be rejected.

One of the general settlement models proposed for the 'Ewa Plain (Kennedy and Denham 1992:18) suggests that the area of the present project was a "barren zone". The present evidence requires modification of the model. On a large scale, settlement in Honouliuli had a large permanent population on the upper east side, associated with wetland taro and fishponds. Scattered fishing communities were spread along the coastline, with a number of associated local fishing shrines. Other settlements along and near the coast had access to the resources that allowed cultivation. Further scattered across the interior of the plain were small agricultural communities such as that centering on 1724-11. The question of the occupation of these communities in terms of permanence, seasonality, and absolute dating are critical problems for future research.

Human Skeletal Remains

Human bones have been found in the project area in three different sinkholes, and in three sinks immediately adjacent to the project area on the west side.

Feature 1726-2, a rock-filled sinkhole, contains at least one human burial. The bones were seen about 2 m deep in a side cavity after a portion of the rock fill had been removed. No attempt was made to get to the bones and the area where they are located could not be seen clearly from the opening of the cavity. The bones that were visible represent at least one adult individual, possibly in an extended position. The rock fill of the sink was not completely removed, so it is possible that there are other burials within the sinkhole. The rock-fill that was removed was replaced at the end of the field project.

At Feature 1724-19, small bones were noted on the floor of the sink. There were no skull fragments or teeth present. The bones could not be identified in the field and three were taken for identification, which indicated that they were remains of a human infant. There may be two individuals represented by the total set of remains.

At Feature 1724-54, a rock-filled sinkhole, a two liter sediment sample was removed and totally bagged. When the sediment was processed in the lab, it was found to contain fragments of bone that were identified as human. The limited information does not suggest that this is an intact burial because the bone fragments are from several areas of the body, which would not be expected from such a small excavation area. The bone could come from a disturbed burial or from bones that are secondarily deposited.

Just to the west of the project area, human bones were reported in two sinks (Haun 1991): an "infant or juvenile burial" in a sinkhole of 1723-C; "two human long bones" and "a subadult cranium" in a sinkhole of 1723-E. The long bones in 1723-E were seen during the present survey, but the two other sinks were not entered and it is not known if the bones are still present.

Environmental Data

Soils

The soil units of the project area fall into five primary categories. The first is in situ, decomposed limestone, which is calcareous, fine-grained, compact, non-stratified, generally 10YR 8/2 to 10YR 7/3 in color, and lacking in land snails or bone. It is found in depressions and sinks, and occurs in open areas as the weathering surface of the bedrock limestone. Type examples can be found at 1724-2, TP-1 and 1724-11, TP-1.

The second unit is locally deteriorating limestone. This material is calcareous, highly variable in texture, loose to moderately compact, sorted but non-stratified, generally 10YR 4/6 in color, and contains land snails and bone. It is found primarily in sinks as a combination of sink sidewall weathering/collapse and water-transported surface particles. This deposit is the primary source of bird bone. It contains no cultural material, but *Rattus exulans* is present indicating that this unit dates to the period of human settlement. A type example is 1724-42.

The third unit is a weathered, mixed unit associated with human occupation. This material is of mixed calcareous and basaltic origin, medium to fine-grained, unstratified, medium dark-colored in the 10YR 4/3 range, and dense in land snails. It lies above either the first or second units and below the modern duff/humus. This unit contains cultural material in some proveniences and thus is seen as the horizon associated with local human occupation. A type example is 1724-5.

The fourth unit is a modern duff and humus. The fifth unit is a horizon of basaltic silt; this material is predominantly basaltic, fine-grained, unstratified, dark colored 7.5YR 4/4 (orange-hued to the eye), and is variable in land snail density. This unit is interpreted as 20th century deposited silts derived from inland cane field cultivation. It is variably distributed in the project area, but is commonly found in open area deposits. A type example is 1724-4.

As noted above, none of the tested deposits showed any evidence of cultural interbedding with natural deposits, nor is there any evidence of any buried "A-horizons". The only distinctly stabilized surface is the third unit, associated with human occupation.

Bird Bone and Egg Shell

Although bird bone is found in many proveniences, its occurrence is low in quantity and most of the remains are fragmentary, not allowing identification to a high level of specificity (Appendix A, Table A-5). *Porzana ziegleri*, *Chloridops regiskongi*, *Chaetoptila sp.*, Medium Procellariid, and Small Passeriforms have been identified from the excavations, and *Pterodroma phaeopygia* from the floor of a sink. Most of these forms are now extinct in Hawai'i. Numerous bone fragments of unidentified Small and/or Medium Bird also occur. Ziegler (1993) comments "that the 'Medium Bird' material looks mostly like 'Medium Procellariid' ".

Bird egg shell is very widespread in distribution occurring in a larger range of deposits than bird bone, including sinkholes, surface deposits, and depressions.

Regarding egg shell, Ziegler (1993) notes that there are at least two general types of bird egg shell represented. The first type is:

> ...categorized as 'Medium and/or Large Bird', which is noticeably thicker than the egg shell of chicken, and might <u>possibly</u> represent 'Medium Procellariid', judging from its relative abundance, although one or more larger (presumably prehistorically extinct) species could also be represented.

The second type of egg shell is characterized as "Small and/or Medium Bird" which is "almost invariably thinner than that of chicken", but the species represented is (are) unknown.

Although bird bone occurs in most sinkhole deposits, its density is remarkably low compared to other excavation units on the ‘Ewa Plain, where it commonly occurs with CIs of several hundred to several thousand (Davis 1990:209-211). In the present project, the highest density of bird bone in unambiguously natural deposition is 218, and most fall in the 10 to 50 CI range.

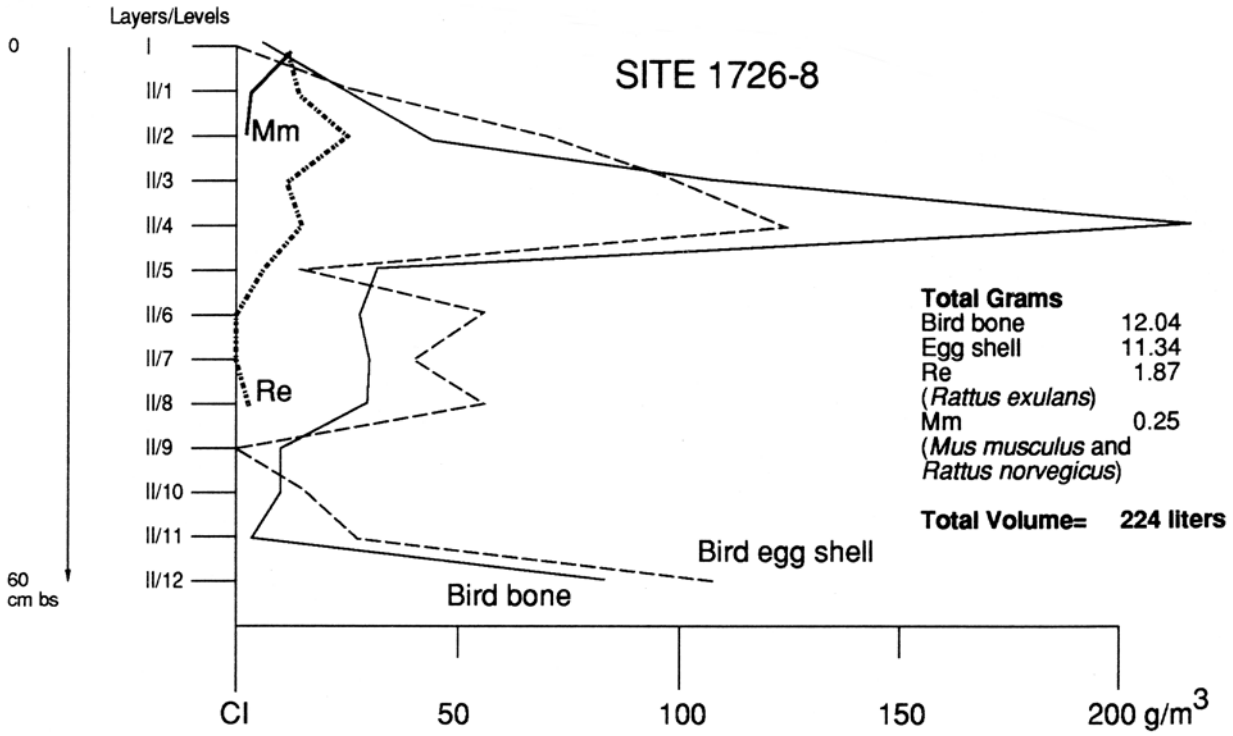
In contrast, egg shell seems to be in higher density in the units of this project than at other areas of the ‘Ewa Plain. At 1726-8, it occurs in density as high as 125 CI, but elsewhere CIs higher than 30 or 40 are uncommon (Davis 1990:210-211).

The deepest test pit excavated in a project sinkhole is TP-1 in 1726-8. This sink was also selected for 5 cm controlled excavation levels for increased control over faunal data. The distribution of bird bone and egg shell in this excavation is shown in Table 6 and Figure 16. For comparison, bird bone density data from Deep Draft Harbor Site 9659-1 are also shown in Figure 16. The relative density profile variation of Site 9659-1 is similar to that of 1726-8, although the actual densities are much greater (as illustrated in the scaled overlay in Figure 16).

Regarding the bird bone and egg shell densities, Ziegler (1993) comments:

> I am most puzzled as to why the skeletal material of prehistorically extinct birds seems exceptionally scarce in all of the present sites (especially the sinkholes, all situated in a coralline-algal reef with an apparent surface elevation of some 40 feet or more) compared to the amount recovered in the past from sinkholes further west (and situated below about 25 feet elevation) [the Deep Draft harbor area]. Bones presumably representing some such birds (medium-sized procellariid, flightless rail, small- and medium-sized passeriforms) do occur in the present sites, but they tend to be scarce, and the assemblage does not obviously contain certain other species (*Branta* sp., Moa-n*alo*, long-legged owl, crow) that tend to be common in the more-westerly sinkholes...[And regarding egg shell] my impression is that egg shell is more abundant here than in the other ‘Ewa Plain sinkholes.

One of the patterns of bird bone and egg shell distribution found elsewhere on the ‘Ewa Plain is a positive correlation of concentration indices (CIs, quantity per excavation volume) in depositional units (Davis 1990:211). This pattern is matched in the present set of data (Fig. 16).



Note variations in scales.

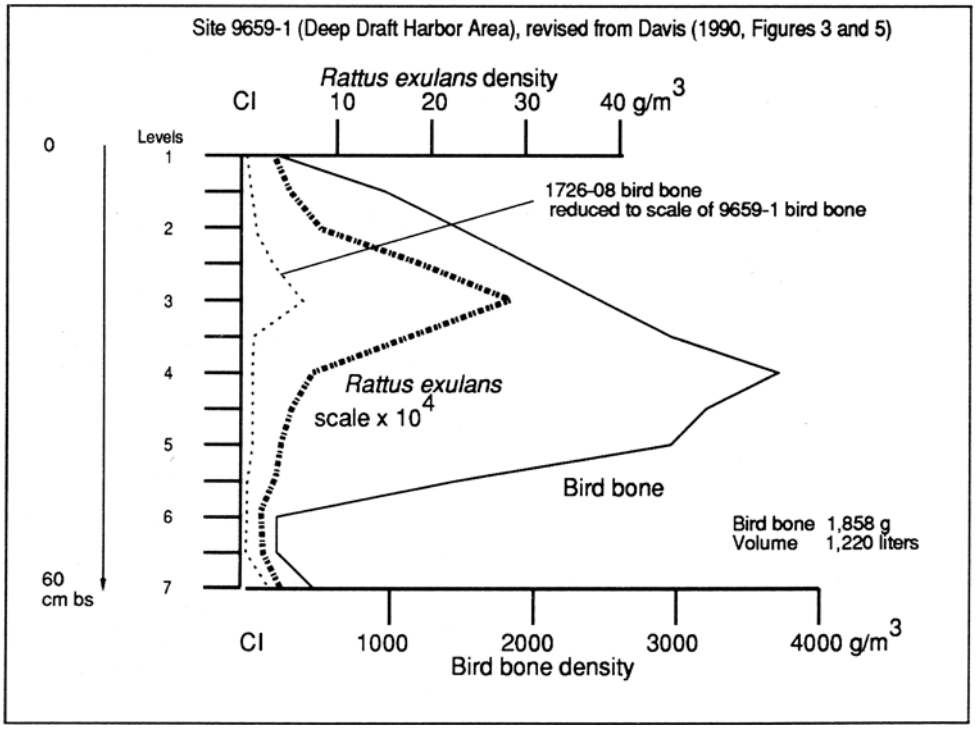


Figure 16. Densities of bird and rat bone at Site 1726-8 and Deep Draft Harbor Site 9659-1.

Rodent Bones and Bird Bones

The bones of *Rattus exulans* (Polynesian rat) are found in virtually every deposit than contains bird bones. This is an association common in ‘Ewa Plain archaeology. Davis (1990:213) notes for the sites he has studied, primarily west of the present project, that *Rattus exulans*:

> ...first appears coincident with, and occasionally slightly earlier...than the peak of avian deposition. Deposition of rodent bone then increases until sometime after the subsequent decline of the avian component.

This pattern has contributed to the argument of associating human presence and bird extinction and to the causal role of rats in the extinction process (Table 7; Fig. 16). Figure 16 shows the bird bone and Polynesian rat densities at site 1726-8 and at the Harbor site of 9659-1. The profile density curves are similar, but the one notable difference is that although the density of bird at 9659-1 is much greater than that at 1726-8 (as discussed above), the density of *Rattus exulans* is almost exactly the same in each case.

The presence of *Rattus exulans* in sinkhole deposits also serves as a time marker for human colonization. However, it is of interest to note that the presence of rat bone and the significant quantities of bird bone stratigraphically precede any direct evidence for human presence in the area.

Crab

Much of the crab material from the deposits has been suggested as possibly representing an extinct species of land crab (*Geograpsus crinipes* (*Dana*), see Ziegler 1993).

Pollen and Land Snails

Studies of land snails and pollen have made substantial contributions to the environmental history of the ‘Ewa Plain (E.G., Davis 1990:250; Cowie 1992; Kirch and Christensen 1981). Samples of land snails have been collected, but have not been identified. They do occur in large quantity and represent a significant potential for environmental reconstruction in the project area.

In order to determine the potential of pollen analysis in the project area, a sample column from a test pit at Site 1724-42 was submitted to Dr. Jerome Ward for palynological study (Appendix E). This unit was selected for study because it was the deepest excavation of the current project. It was planned to compare the environmental data derived from faunal

and pollen analysis. This proved to be a strategic error because no bone was recovered from below the upper layer.

The main conclusions derived from the pollen study are primarily methodological rather than substantive. The samples proved to have low pollen counts and to have small quantities of pollen grains from post-contact introductions in the lowest stratigraphic unit (Appendix E, Table E-1). It is probable that both of these factors result from the comparative looseness and aeration of the sediments.

The implications of these results for future work include the following: 1) pollen samples, and samples for other limited analyses (such as land snail), should be selected only after faunal and cultural analyses are completed; 2) pollen counts will have to be made from larger samples than normal in order to obtain appropriate quantities of pollen; and 3) analyses will have to take into account the probability of downward drift of pollen grains and the resulting contamination of lower sediments.

Substantively, the main pollen types from this small sample are those to be expected from an ‘Ewa Plain sinkhole, primarily Cheno-am and Euphorbia (Appendix E).

Future Research Problems

The research problems concerning the Hawaiian component that should be pursued during any future data recovery or preservation-related excavations are summarized in this section. These problems provide the framework for the information-content significance evaluations for individual features in the detailed site listings.

Selected agricultural features (mounds and sinkholes) need to be studied for more definitive evidence for the nature of the cultivation. A subsequent machine stripping of some of the mound area might be considered in an attempt to locate any sub-surface feature associated with the cultivation. For example, isolated hearths or ovens are often found in dryland agricultural areas, such as upland Kaho‘olawe and the floor of Pololu Valley (Tuggle and Tomonari-Tuggle 1980)

The settlement complex of structures and sinkholes in the project area has high potential for contributing to the problems of the occupation of the ‘Ewa Plain, given the substantial house structure (1724-11), C-shapes, probable cooking features in depressions, trash deposition in sinkholes and depressions, and numerous piles of fire-cracked rock. A detailed study of these features should pay particular attention to problems of chronology and subsistence, and to measures of occupational duration. In both cases, this should involve extensive areal excavations and fine-scale stratigraphic control. It is quite probable that if an early 19th century occupation is present, a few fragments of non-indigenous artifacts might occur and be recoverable from extensive excavations. Careful control and collection of faunal and floral remains will provide information on subsistence, but may also contribute information on chronology. A study of the fire-cracked rock piles should be carried out,

combined with experimental archaeology of breakage production, related to using the rock as a measure of site occupational intensity and duration.

If direct chronological measurements of feature occupation are not available through diagnostic artifacts and radiocarbon dating of charcoal, then several other means of dating should be attempted. Bird bone associated with Polynesian plant and animal introductions (and land snail change) should be dated to at least provide baseline time ranges. In addition, radiocarbon dating of marine shell offers improved possibilities (Dye 1994) and should be part of an integrated dating program. Volcanic glass dating research also needs to be pursued (Tuggle 1994a).

Related to problems of subsistence and environmental reconstruction, the features of the project area that contain bird bone and egg shell in cultural deposits need to be excavated and studied with particular concern for the human alteration of the bone.

The features of the project area have some potential for contributions to the problem of inland settlement pattern and distribution of religious structures. Information potential for settlement analysis is compromised by the amount of destruction around the existing features, precluding complete knowledge of feature distribution and clustering. However, the number of features present allows at least a partial reconstruction of the community.

The problem of the identification of religious structures can also be explored with the features in the present project, primarily by means of a comparative study with feature variation on the ‘Ewa Plain.

The general potential of ‘Ewa Plain sinkhole deposition for environmental reconstruction and for the measure of environmental change is unquestioned. The only issue in any particular locale is one of the type of sinkholes and the degree of disturbance. The tested sinkholes of the Phase II project area clearly contain significant data sets relevant to this problem, including bird bone, egg shell, rat bone, land snails, and probably pollen.

At the same time, the relatively low densities of bird bone (but standard levels of Polynesian rat) in the preliminary data have introduced another element into the recovery pattern. A detailed study of the sinkhole deposit variation in regard to drainage patterns, elevation, chronology, and sinkhole morphology will contribute to resolution of the problem of bird bone deposition.

The features of the project area have been evaluated in terms of their potential contribution to these main issues. This is summarized in the following section and presented in Appendix A, Table A-3 under the category of information contribution (briefly described as potential for data relevant to Hawaiian agriculture and habitation and to problems of environmental reconstruction).

VIII: PHASE II SURVEY SUMMARY AND SIGNIFICANCE RECOMMENDATIONS

The five sites and their features that have been identified and tested in the Phase II intensive survey are listed in Table 1 and Appendix A Table A-3. Sites 1723, 1724, and 1726 are complexes of Hawaiian habitation, with some associated burials. Site 4702 is an agricultural field complex that formed part of the total settlement system of the area. Site 4701 is a site representing a unique occurrence in ‘Ewa Plain archaeology, the 20th century modification and use of a sinkhole as a hidden chamber for storage, probably involved in illegal alcohol production.

The five sites are recommended as significant and eligible to the National Register of Historic Places. All have sufficiently intact features to be considered to have maintained their integrity. Sites 1723, 1724, 1726, and 4702 have high potential for information contribution to Hawaiian history and to paleoenvironmental reconstruction. Site 4701 has information potential regarding early 20th century activities in the area.

The framework for site and feature evaluation is identified in the previous sections on research issues in the history of cultural and environmental history of the ‘Ewa Plain. Appendix A, Table A-3 provides a breakdown of each site with individual features, with recommendations regarding their value in regard to information content and other variables.

NAS Barbers Point and Site Preservation on the ‘Ewa Plain

Little is known of the number and extent of sites that existed on the ‘Ewa Plain before large areas of the Plain were put into sugar cultivation around the turn of the century. But hundreds of sites still remained on the extensive areas of uncultivated limestone. However, with the recent massive development projects at Ko‘olina, the Deep Draft Harbor, and Ewa Marina, most of those sites have been destroyed. The sites at NAS Barbers Point (Fig. 6) represent a large percentage of the ‘Ewa Plain’s Hawaiian past that remains in existence. Under the responsibilities of the Federal antiquities laws, this places special emphasis on appropriate historic preservation treatment of the sites at NAS Barbers Point. This indicates that preservation should be the preferred option. If data recovery is required, it should be based on a well-conceived research design and it should be as intense as practicable.

Suggested Guidelines for Data Recovery and Data Collection for Preservation

In the feature listing of Appendix C, specific recommendations regarding the nature of any required data recovery for most of the tested features are made. However, many sinkholes and depressions remain untested. It is recommended that the data recovery program be initiated with a sampling design that will account for all of the potentially impacted sinkholes and depressions of 1723, 1724, and 1726, followed by intensive data collection from selected features, guided by the research problems identified in the present report.

The stone piles of 4702 should have additional data recovery emphasizing the study of soil characteristics related to Hawaiian agricultural use. In addition, mechanical clearing of portions of the area for the discovery of subsurface features should be conducted.

An historic preservation treatment plan should consider data collection from features that are outside the effective impact zone, but which may be subject to indirect impacts or which could be developed for an interpretive program. This data collection should emphasize 1724-11 and associated features, which have the highest probability of providing definitive information on the dating and intensity of use of the entire complex of features in the project area.

Management Planning

If the sites are found eligible for the National Register, as recommended here, the development of a historic preservation mitigation plan is the next step commonly followed in the preservation process. If the proposed Housing Project is implemented, it would have a major impact on the sites of the project area. The majority of the features are recommended as significant primarily for information content, and data recovery is the standard means of mitigating impacts on such features. At the same time, attention will have to be given to the means to protect and manage any features that fall outside the effective area of project construction impact.

The baseline for a program of historic preservation planning is presented in this report. Recommendations for treatment of individual features are summarized in Table 1 and discussed in Appendix C. The research questions viewed as critical in ‘Ewa Plain archaeology are presented in the section above and are discussed for individual sites and features in Appendix C. Historic preservation planning should also consider expansion of the interpretive program focusing on Site 1719 that is now being developed for the area to the north of Phase II (Traverse Group 1988; Erkelens 1992). Some of the features along the western edge of the family housing project would be very well-suited for such interpretive development.

The impact of the development of family housing will also have to be considered beyond the construction itself. The realization of the project will bring more people into the

area and will make the western area of remaining sites and features susceptible to subsequent damage. Historic preservation planning should propose management actions to protect these sites; interpretive development is one alternative to be considered.

The presence of human skeletal remains is noted above. It is assumed that the inventory survey did not locate all human remains in the area, but that it defined the potential for such remains. The use of the sinkholes for human interment and for disposal of human bones in non-burial contexts is relatively high in the project area and in the area immediately to the west. This indicates that there is a high potential for the presence of additional human remains in the project area.

The management planning for historic preservation should proceed along the following lines:

(1) Identification of the construction project's effective direct impact area and location of sites and features in this area.

(2) Identification of possible secondary impacts and sites and features that may be affected by this.

(3) Determination of site eligibility to the National Register of Historic Places.

(4) Development of a historic preservation mitigation plan, and implementation of the plan.

(5) Consultation with State and Federal agencies needs to be conducted at appropriate intervals in the preservation process.

(6) The features that contain human skeletal remains (Appendix A, Table A-3) are subject to special evaluation and consultation based on historic preservation procedures and the Native American Graves Protection and Repatriation Act (NAGPRA).

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APPENDIX A:
SITE AND DATA TABLES

Table A-1. Archaeological features recorded in the Phase I inventory survey.

Number	Temporary Feature Number	Site	Feature Type	Research Potential
1	25-A(1)	N/A	deflated circular mound	0
2	25-A(2)	N/A	deflated circular mound	0
3	25-A(3)	N/A	deflated circular mound	0
4	25-A(4)	N/A	deflated circular mound	0
5	25-A(5)	N/A	deflated circular mound	0
6	25-A(6)	N/A	linear alignment	2,3
7	24-B(1)	N/A	small enclosure remnant	0
8	24-B(2)	N/A	small enclosure (?)	0
9	23-D	N/A	mound complex	2,3,6
10	24-A	N/A	sinkhole	1
11	23-B	N/A	modified outcrop	2,3
12	23-A(1)	N/A	circular mound	2,3,6
13	23-A(2)	N/A	circular mound	2,3,6
14	23-A(3)	N/A	elongated mound	2,3,6
15	23-A(4)	N/A	circular mound	2,3,6
16	23-A(5)	N/A	circular mound	2,3,6
17	23-A(6)	N/A	circular mounds (5)	2,3,6
18	23-A(7)	N/A	sinkhole	1
19	21-C	N/A	modified outcrop	2,3
20	21-C(2)	N/A	circular mound	2,3,6
21	21-B(1)	N/A	sinkhole	1
22	21-B(2)	N/A	circular mound	2,3,6
23	21-A	N/A	wall segment	2,7
24	22-A	N/A	sinkhole	1
25	22-B	N/A	sinkhole	1
26	22-C	N/A	sinkhole	1
27	21-J	N/A	sinkhole	1
28	21-I	1726	platform	2,5,6
29	21-I(1)	1726	circular mound	2,3,6
30	21-H	N/A	C-shape structure	2,4
31	22-F	N/A	sinkhole	1
32	21-E	N/A	sinkhole/U-shape structure	1,2,4
33	21-F	N/A	cairn	2,6
34	21-G	N/A	modified outcrop	2,3
35	22-G	N/A	elongated mound	2,3,6
36	21-D	N/A	sinkhole	1
37	22-E	N/A	sinkhole	1
38	22-D	N/A	sinkhole	1
39	23-F	N/A	sinkhole	1
40	23-G	N/A	sinkhole	1
41	23-E	N/A	sinkhole	1
42	20-A	1723?	elongated mound	2,3,6
43	19-A	1723	sinkhole	1
44	19-F	1723	sinkhole	1

Table A-1. Archaeological features recorded in the Phase I inventory survey (continued).

Number	Temporary Feature Number	Site	Feature Type	Research Potential
45	19-G	1723	sinkhole	1
46	19-D	1723	sinkhole	1
47	19-E	1723	sinkhole	1
48	19-C	1723	sinkhole	1
49	18-A	N/A	wall/sinkhole	1,2,7
50	17-A	N/A	modified outcrop	2,3
51	16-E	N/A	C-shape structure	2,4
52	16-B	N/A	circular mounds (2)	2,3,6
53	16-F	N/A	platform (?)	2,5,6
54	15-G	N/A	hearth	2,4
55	16-D	N/A	L-shape structure	2,4
56	16-A	N/A	circular mound	2,3,6
57	16-C	N/A	U-shape structure	2,4
58	17-B	N/A	small enclosure	2,4
59	16-H	N/A	concrete cistern	2,7
60	15-D	N/A	irrigation ditch	2,7
61	15-E	1720	C-shape structure	2,4
62	14-J	1720	small enclosure	2,4
63	15-M	1720	collapsed platform	0
64	16-C	N/A	small enclosure	2,4
65	15-L	N/A	circular mounds (3)	2,3,6
66	15-H	N/A	L-shape structure	2,4
67	15-K	N/A	small enclosure/mound	2,3,4,6
68	14-E	N/A	circular mound	2,3,6
69	14-C	N/A	modified outcrop	2,3
70	14-B	N/A	sinkholes (6)	1
71	14-A	N/A	sinkhole	1
72	14-D	N/A	sinkholes (10)	1
73	13-L	N/A	sinkholes (8)	1
74	14-F	N/A	small enclosure/ mound/sinkhole	1,3,4,6
75	14-H/G	N/A	linear stacked rock/ modified outcrop	2,3
76	14-I	N/A	sinkhole	1
77	14-K	N/A	small enclosure	2,4
78	14-N	N/A	elongated mound	2,3,6
79	15-B	1719	elongated mound/ circular mounds (2)	2,3,6
80	15-A	N/A	linear stacked rock	2,3
81	14-L	N/A	elongated mounds (3)/ circular mounds (5)	2,3,6
82	14-M	N/A	modified outcrop	2,3
83	13-A	N/A	L-shape structure	2,4

Table A-1. Archaeological features recorded in the Phase I inventory survey (continued).

Number	Temporary Feature Number	Site	Feature Type	Research Potential
84	13-B/C	N/A	large enclosure	2,5
85	13-D	N/A	military wash room	2,8
86	13-F	N/A	modified sinkhole	1
87	12-D	N/A	indeterminate	?
88	12-F	N/A	enclosure	2,4,5
89	12-G	N/A	mounds (4)	2,3,6
90	13-I	N/A	sinkhole	1
91	13-G(1)	N/A	sinkhole	1
92	13-G(2)	N/A	sinkhole	1
93	13-G(3)	N/A	sinkhole	1
94	13-G(4)	N/A	sinkhole	1
95	13-G(5)	N/A	sinkhole	1
96	13-K	N/A	sinkhole	1
97	13-J	N/A	circular mounds (5)	2,3,6
98	13-L	N/A	sinkholes (5)	1
99	11-B	N/A	elongated mound	2,3,6
100	11-D	N/A	circular mounds (3)	2,3,6
101	11-C	N/A	elongated mounds (2)	2,3,6
102	11-F	N/A	elongated mounds (2)	2,3,6
103	10-U	N/A	modified outcrop	2,3
104	11-E	N/A	modified outcrop	2,3
105	11-G/10-R	N/A	linear stacked rock	2,3
106	11-I	N/A	circular mounds (4)	2,3,6
107	11-J	N/A	indeterminate	?
108	11-H	N/A	sinkhole	1
109	11-L	N/A	elongated mound/circular mounds (3)	2,3,6
110	11-O	N/A	circular mounds (3)	2,3,6
111	11-K	N/A	circular mound	2,3,6
112	11-M	N/A	C-shape structure/wall	2,4,7
113	10-W	N/A	circular mound	2,3,6
114	11-N	N/A	circular mound	2,3,6
115	12-J	N/A	linear stacked rock (?)	2,3
116	12-I	N/A	wall section	2,7
117	12-H	N/A	linear stacked rock (?)	2,3
118	12-E	N/A	elongated mound/circular mounds (2)	2,3,6
119	12-C	N/A	elongated mounds (2)/ circular mounds (3)	2,3,6
120	12-B	N/A	elongated mounds (3)	2,3,6
121	11-P	N/A	elongated mounds (2)	2,3,6
122	12-A	N/A	elongated mound	2,3,6
123	11-Q	N/A	C-shape structure	2,4

Table A-1. Archaeological features recorded in the Phase I inventory survey (continued).

Number	Temporary Feature Number	Site	Feature Type	Research Potential
124	11-M	N/A	linear stacked rock	2,3
125	10-J	N/A	elongated mound	2,3,6
126	10-I	N/A	L-shape structure	2,4
127	10-H	N/A	small enclosure	2,4
128	10-E	N/A	modified outcrop	2,3
129	10-C	N/A	elongated mound/ circular mounds (2)	2,3,6
130	10-A	N/A	circular mound	2,3,6
131	10-D	N/A	circular mound	2,3,6
132	10-F	N/A	wall section	2,7
133	10-G	N/A	modified outcrop	2,3
134	9-BB	N/A	modified outcrop/ L-shape structure	2,3,4
135	10-L	N/A	circular mound	2,3,6
136	10-M	N/A	circular mounds (4)/ linear stacked rock	2,3,6
137	10-O	N/A	modified outcrop	2,3
138	10-N	N/A	modified outcrop	2,3
139	9-N	N/A	linear stacked rock	2,3
140	10-Q	N/A	sinkholes (2)	1
141	9-M	N/A	sinkhole/mound	1,2,3,6
142	10-GG	1718	circular mound	2,3,6
143	9-F	1718	elongated mound	2,3,6
144	9-E	1718	C-shape structure	2,4
145	9-D	N/A	elongated mound	2,3,6
146	9-C	N/A	elongated mound	2,3,6
147	9-B	N/A	circular mound	2,3,6
148	9-A	N/A	cairn/circular mounds (3)	2,3,6
149	9-H	1718	upright slab	2
150	9-I	1718	small enclosure	2,4
151	9-J	N/A	indeterminate	?
152	9-K	N/A	elongated mound	2,3,6
153	10-BB/10-CC	N/A	agricultural features	2,3
154	9-K	N/A	indeterminate	?
155	10-AA	N/A	circular mounds (7)	2,3,6
156	10-Z	N/A	circular mounds (4)	2,3,6
157	9-P	N/A	deflated mounds	0
158	10-Y	N/A	circular mound	2,3,6
159	10-X	N/A	mounds (5)	2,3,6
160	9-V	N/A	circular mound	2,3,6
161	9-U	N/A	sinkhole	1
162	10-T	N/A	circular mound	2,3,6
163	1-A	N/A	linear stacked rock	2,3

Table A-1. Archaeological features recorded in the Phase I inventory survey (continued).

Number	Temporary Feature Number	Site	Feature Type	Research Potential
164	1-C	N/A	circular mound	2,3,6
165	1-B	N/A	mounds (5)	2,3,6
166	1-D	N/A	corner of wall complex	2,7
167	1-G	N/A	wall section	2,7
168	1-H	N/A	modified outcrop	2,3
168	1-I	N/A	small enclosure	2,4
169	1-K	N/A	modified outcrop (?)	2,3
170	1-KK	N/A	circular mound	2,3,6
171	1-M	N/A	modified outcrop	2,3
172	1-N	N/A	modified outcrop	2,3
173	1-O	N/A	modified outcrop	2,3
174	1-Q	N/A	circular mounds (4)	2,3,6
175	1-R	N/A	wall section	2,7
176	1-S	N/A	circular mounds (3)/ elongated mound	2,3,6
177	1-T	N/A	circular mounds (6)	2,3,6
178	1-Y	N/A	historic well/wall	2,7
179	1-Z	N/A	circular mounds (2)	2,3,6
180	1-U	N/A	1930s automobile	7
181	2-D	N/A	circular mounds (5)	2,3,6
182	1-V	N/A	circular mounds (2)/ elongated mound	2,3,6
183	1-W	N/A	elongated mound	2,3,6
184	1-X	N/A	circular mound	2,3,6
185	2-A	N/A	circular mound	2,3,6
186	2-B	N/A	circular mounds (6)	2,3,6
187	2-C	N/A	linear stacked rock	2,3
188	2-F	N/A	elongated mound	2,3,6
189	2-E	N/A	modified outcrop	2,3
190	2-H	N/A	historic trash scatter	2,7
191	2-Q	N/A	modern structure/trash scatter	2,8
192	3-A	N/A	sinkhole	1
193	3-C	N/A	modified outcrop	2,3
194	3-B	N/A	linear stacked rock	2,3
195	3-F	N/A	wall section	2,7
196	3-D	N/A	wall section	2,7
197	3-E	N/A	wall section	2,7
198	2-P	N/A	circular mound	2,3,6
199	2-M	N/A	modified outcrop (?)	2,3
200	2-L	N/A	modified outcrop/wall	2,3,7
201	2-K	N/A	modified outcrop	2,3
202	2-J	N/A	modified outcrop	2,3
203	2-G	N/A	modified outcrop	2,3

Table A-1. Archaeological features recorded in the Phase I inventory survey (continued).

Number	Temporary Feature Number	Site	Feature Type	Research Potential
204	4-I	N/A	sinkhole	1
205	4-G	N/A	modified outcrop	2,3
206	4-H	N/A	linear stacked rock	2,3
207	4-F	N/A	mound	2,3,6
208	4-K	N/A	circular mound (?)	2,3,6
209	4-J	N/A	wall section	2,7
210	6-L	N/A	modified outcrop	2,3
211	5-C	N/A	sinkhole	1
212	5-D	N/A	circular mound	2,3,6
213	5-E	N/A	modified outcrop (?)	2,3
214	5-B	N/A	modified outcrop	2,3
215	6-M	1718	circular mound	2,3,6
216	7-C	N/A	circular mound	2,3,6
217	6-N(1)	1718	linear stacked rock	2,3
218	6-N(2)	1718	circular mound	2,3,6
219	6-N(3)	1718	circular mound	2,3,6
220	6-N(4)	1718	elongated mound	2,3,6
221	7-D	N/A	elongated mound/ circular mound	2,3,6
222	7-G	N/A	wall section	2,7
223	7-F	N/A	small enclosure	2,4
224	7-E	N/A	circular mound	2,3,6
225	8-H	N/A	circular mound	2,3,6
226	8-I	N/A	circular mound	2,3,6
227	8-J	N/A	elongated mound/ modified outcrop	2,3,6
228	8-L	N/A	circular mounds (3)/ elongated mound	2,3,6
229	5-A	N/A	wall section	2,7
230	6-L	1718	sinkhole	1
231	7-H(2)	N/A	small enclosure/ modified outcrop	2,3,4
232	7-H(3)	N/A	modified outcrop	2,3
233	7-H(4)	N/A	modified outcrop	2,3
234	7-H(1)	N/A	wall section	2,7
235	7-H(5)	N/A	linear stacked rock	2,3
236	7-I	N/A	modified outcrop	2,3
237	6-I	N/A	elongated mound	2,3,6
238	6-G	N/A	linear stacked rock	2,3
239	6-H(2)	N/A	wall section	2,7
240	6-H(1)	N/A	circular mound/ modified outcrop	2,3,6
241	6-F	N/A	circular mound	2,3,6

Table A-1. Archaeological features recorded in the Phase I inventory survey (continued).

Number	Temporary Feature Number	Site	Feature Type	Research Potential
242	7-K	N/A	enclosure	2,4
243	7-J	N/A	platform	2,5,6
244	7-L	N/A	small enclosure/mound	2,3,4,6
245	8-E	N/A	elongated mounds (2)	2,3,6
246	8-D	N/A	U-shape structure/ circular mound	2,3,4,6
247	8-F	N/A	circular mound	2,3,6
248	8-G	N/A	modified outcrop	2,3
249	9-0	N/A	circular mound	2,3,6
250	8-A	N/A	circular mound	2,3,6
251	8-C	N/A	circular mound	2,3,6
252	5-F	N/A	elongated mound	2,3,6
253	5-H	N/A	elongated mound	2,3,6
254	5-G	N/A	elongated mound	2,3,6
255	5-I	N/A	wall section	2,7
256	5-L	N/A	circular mound	2,3,6
257	4-C	N/A	historic fence post	2,7
258	5-M	N/A	wall section	2,7
259	6-C	N/A	wall section	2,7
260	10-EE	1718	C-shape structure	2,4
261	9-Q	N/A	circular mounds (4)	2,3,6
262	9-R	N/A	modified outcrop	2,3
263	9-S	N/A	elongated mounds (5)	2,3,6
264	10-V	N/A	circular mounds (3)/ modified outcrop	2,3,6
265	10-S	N/A	circular mound/sinkhole	1,2,3,6
266	9-W	N/A	modified outcrop	2,3
267	9-AA	N/A	elongated mound	2,3,6
268	9-X	N/A	sinkhole	1
269	9-T	N/A	circular mounds (3)/ elongated mounds (3)	2,3,6
270	9-Z	N/A	circular mound/ elongated mound	2,3,6
271	10-K	N/A	elongated mound/modified outcrop	2,3,6
272	9-CC	N/A	mound	2,3,6
273	6-F	N/A	circular mound	2,3,6
274	6-A	N/A	sinkhole	1

Significance Assessment Key: 0 =lack of integrity; **1** =paleontological/paleoenvironmental; **2** =indigenous land use; **3** =indigenous agriculture; **4** =indigenous marine exploitation; **5** =religious/ceremonial; **6** =indigenous burials; **7** =historic land use; **8** =World War II military history.

Table A-2. Phase I inventory features, ordered by temporary feature number.

Temporary Feature No.	Phase I	Temporary Feature No.	Phase I	Temporary Feature No.	Phase I	Temporary Feature No.	Phase I
001A	163	006N4	220	010S	265	016A	056
001B	165	007C	216	010T	162	016B	052
001C	164	007D	221	010U	103	016C	064
001G	167	007E	224	010V	264	016D	055
001H	168	007F	223	010W	113	016E	051
001I	168	007G	222	010X	159	016F	053
001K	169	007H1	234	010Y	158	016H	059
001KK	170	007H2	231	010Z	156	017A	050
001M	171	007H3	232	011B	099	017B	058
001N	172	007H4	233	011C	101	018A	049
001O	173	007H5	235	011D	100	019A	043
001Q	174	007I	236	011E	104	019C	048
001R	175	007J	243	011F	102	019D	046
001S	176	007K	242	011G	105	019E	047
001T	177	007L	244	011H	108	019F	044
001U	180	008A	250	011I	106	019G	045
001V	182	008C	251	011J	107	020A	042
001W	183	008D	246	011K	111	021A	023
001X	184	008E	245	011L	109	021B1	021
001Y	178	008F	247	011M	124	021B2	022
001Z	179	008G	248	011M	112	021C	019
002A	185	008H	225	011O	110	021C2	020
002B	186	008I	226	011P	121	021D	036
002C	187	008J	227	011Q	123	021E	032
002D	181	008L	228	012A	122	021F	033
002E	189	009A	148	012B	120	021G	034
002F	188	009AA	267	012C	119	021H	030
002H	190	009B	147	012D	087	021I	028
002J	202	009BB	134	012E	118	021I1	029
002K	201	009C	146	012F	088	021J	027
002L	200	009CC	272	012G	089	022A	024
002M	199	009D	145	012H	117	022B	025
002P	198	009E	144	012I	116	022C	026
002Q	191	009F	143	012J	115	022D	038
003A	192	009H	149	013A	083	022E	037
003B	194	009I	150	013BC	084	022F	031
003C	193	009J	151	013D	085	022G	035
003D	196	009K	152	013F	086	023A1	012
003E	197	009M	141	013G1	091	023A2	013
003F	195	009N	139	013G2	092	023A3	014
004C	257	009P	157	013G3	093	023A4	015
004F	207	009Q	261	013G4	094	023A5	016
004G	205	009R	262	013G5	095	023A6	017
004H	206	009S	263	013I	090	023A7	018
004I	204	009T	269	013J	097	023B	011
004J	209	009U	161	013K	096	023D	009
004K	208	009V	160	013L	073	023E	041
005A	229	009W	266	014A	071	023F	039
005B	214	009X	268	014B	070	023G	040
005C	211	009Z	270	014C	069	024A	010
005D	212	010A	130	014D	072	024B1	007
005E	213	010AA	155	014E	068	024B2	008
005F	252	010BB/CC	153	014F	074	025A1	001
005G	254	010C	129	014HG	075	025A2	002
005H	253	010D	131	014I	076	025A3	003
005I	255	010E	128	014J	062	025A4	004
005L	256	010EE	260	014K	077	025A5	005
005M	258	010F	132	014L	081	025A6	006
006A	274	010G	133	014M	082		
006C	259	010GG	142	014N	078		
006F	241	010H	127	015A	080		
006G	238	010I	126	015B	079		
006H1	240	010J	125	015D	060		
006H2	239	010K	271	015E	061		
006I	237	010L	135	015G	054		
006L	210	010M	136	015H	066		
006M	215	010N	138	015K	067		
006N1	217	010O	137	015L	065		
006N2	218	010Q	140	015M	063		
006N3	219						

Table A-3. Archaeological Site Inventory for NAS Barbers Point Housing Project, Phase II.

SITE/ FEA NO.	FORMAL TYPE	FUNCTION	TESTING				HB	INFORMATION VALUE					TY	MITIGATION RECOMMEND		
			ST	TP	RX	SC		N	AG	HA	EV	OTHER		C	DR	PR
1723-01	sinkhole	agriculture?							+		+				x	
1723-02	sinkhole	agric? hab?				*			+	+	+				x	
1723-03	sinkhole	hab? agric?							+	+	+	WWII?			x	
1723-04	depression	non-cultura	1								+				x	
1723-05	depression	habitation?								+	+				x	
1723-05	sinkhole, capped, small?									+	+				x	
1723-05	sinkhole, capped, small?										+	?			x	
1723-05	sinkhole, capped, small?										+	?			x	
1723-06	sinkhole, rock-filled	hab? agric?			1				+	+	+	?			x	
1723-07	sinkhole; scattered fire-cracked rock	hab; agric?	1			*			+	+	+				x	
1723-08	sinkhole, rock-filled	hab? agric?			1				+	+	+	?			x	
1723-09	depression	habitation?								+	+				x	
1723-09	sinkhole, rock-filled	BD? agric							+		+	?			x	
1723-09	sinkhole, rock-filled	BD? agric?							+		+	?			x	
1723-10	wall segment	ranch wall	1					+								
1723-11	fire-cracked rock scatter	habitation								+					x	
1723-12	sinkhole	habitation?								+	+				x	

TESTING:
ST = stratigraphic trench
TP = test pit
RX = rock removal
SC = surface collection

INFORMATION VALUE:
AG = agricultural
HA = habitation
EV = environmental
N = no further work
OTHER = other

MITIGATION RECOMMENDATIONS:
DR = data recovery
PR = preservation
C = consultation re: bone

OTHER:
HB = human bone
BD = bulldozing
TY = type site

Table A-3. Archaeological Site Inventory for NAS Barbers Point Housing Project, Phase II (continued).

SITE/ FEA NO.	FORMAL TYPE	FUNCTION	TESTING				HB	INFORMATION VALUE					TY	MITIGATION RECOMMEND		
			ST	TP	RX	SC		N	AG	HA	EV	OTHER		C	DR	PR
1723-13	sinkhole, rock-filled, small	recent fill?			1			+								
1723-14	rock pile, elongated	bulldozing debris						+								
1724-01	sinkhole, small	agric? hab?							+	+	+				x	
1724-02	depression/sink	hab; agric?	1	1					+	+	+				x	
1724-03	sinkhole, low wall	hab; agric?		1					+	+	+				x	
1724-04	depression	hab?		1						+	+				x	
1724-05	sinkhole	hab; agric		1					+	+	+				x	
1724-06	sinkhole	habitation							+	+	+				x	
1724-07	depression	hab/cookin		2		1				+	+				x	
1724-08	sinkhole	habitation				1				+		assoc. w/4701			x	
1724-09	depression	water catchment, natural							+						x	
1724-10	sinkhole/cave	habitation				1				+					x	
1724-11	enclosure, small	perm habit		2						+	+		#			x
1724-12	sinkhole	hab? agric?								+	+				x	
1724-13	sinkhole	hab? agric							+	+	+				x	
1724-14	depression	habitation?								+	+				x	
1724-15	fire-cracked rock, piles	habitation								+					x	
1724-16	sinkhole, rock-filled	habitation?								+	+				x	
1724-17	sinkhole	hab? agric?							+	+	+				x	
1724-18	depression	habitation								+	+				x	
1724-19	sinkhole	burial?hab?				1	●			+	+	internmt				x
1724-20	depression	habitation?								+	+				x	
1724-21a	sinkhole	hab; agric?							+	+	+				x	
1724-21b	sinkhole, small, rock-filled	habitation?								+	+				x	

Table A-3. Archaeological Site Inventory for NAS Barbers Point Housing Project, Phase II (continued).

SITE/ FEA NO.	FORMAL TYPE	FUNCTION	TESTING				HB	INFORMATION VALUE					TY	MITIGATION RECOMMEND		
			ST	TP	RX	SC		N	AG	HA	EV	OTHER		C	DR	PR
1724-21c	sinkhole, small, rock-filled	habitation?								+	+				x	
1724-22	sinkhole, small	habitation?								+	+				x	
1724-23	depression/sinkhole	habitation?								+	+				x	
1724-24	depression	habitation?							+	+	+				x	
1724-25	sinkhole	hab? agric?							+	+	+				x	
1724-26	depression/sink, rock-filled	hab? agric?							+	+	+				x	
1724-27a	sinkhole	habitation?								+	+				x	
1724-27b	pile, stone	agriculture?						+								
1724-27c	pile, stone	agriculture?						+								
1724-27d	pile, stone	agriculture?						+								
1724-28	sinkhole, no deposit	non-cultura						+								
1724-29a	sinkhole	hab? agric?							+	+	+				x	
1724-29b	sinkhole, small, rock filled	?									+	?			x	
1724-29c	sinkhole, small	non-cultura						+								
1724-29d	sinkhole, small	non-cultura						+								
1724-29e	sinkhole, small	non-cultura						+								
1724-30	sinkhole	hab? agric?							+	+	+				x	
1724-31	depression	habitation?								+	+				x	
1724-32	wall segment, C-shaped?	temp habit								+					x	
1724-33	fire-cracked rock, scatter	habitation								+					x	
1724-34	sinkhole	non-									+				x	
1724-35	sinkhole	hab? agric?							+	+	+				x	
1724-36	sinkhole	agriculture							+		+				x	
1724-37a	depression	habitation?								+	+				x	
1724-37b	depression, fire-cracked rock	habitation								+	+				x	
1724-38	depression	habitation?								+	+				x	

Table A-3. Archaeological Site Inventory for NAS Barbers Point Housing Project, Phase II (continued).

SITE/ FEA NO.	FORMAL TYPE	FUNCTION	TESTING				HB	INFORMATION VALUE					TY	MITIGATION RECOMMEND		
			ST	TP	RX	SC		N	AG	HA	EV	OTHER		C	DR	PR
1724-39a	depression	habitation?								+	+				x	
1724-39b	sinkhole, rock-filled	hab? agric?							+	+	+				x	
1724-40	sinkhole, alignment?	agriculture	1						+		+				x	
1724-41	depression, slabs	non-cultura	1					+								
1724-42	sinkhole	hab, agricul	1	1					+	+	+				x	
1724-43	C-shaped structure, remnant	temp hab		1						+	+				x	
1724-44	depression	non-cultura	1					+								
1724-45	sinkhole, rock-filled	agriculture?			1				+		+				x	
1724-46	sinkhole, capped	?			1					+	+				x	
1724-47	sinkhole	hab? agric?							+	+	+				x	
1724-48	sinkhole	agriculture	1						+		+				x	
1724-49	sinkhole, rock-filled	hab; agric			*				+	+	+				x	
1724-50	sinkhole	habitation?								+	+				x	
1724-51	sinkhole, rock-filled (BD)	hab? agric?							+	+	+				x	
1724-52	sinkhole	hab? agric?							+	+	+				x	
1724-53	sinkhole, alignment	hab? agric?							+	+	+				x	
1724-54	sinkhole, rock-filled	burial?	1		1		●				+			x		x
1724-55	U-shaped structure	temp habit		1						+					x	
1724-56	sinkhole	hab? agric?							+	+	+				x	
1724-57	sinkhole	hab? agric?							+	+	+				x	
1724-58	depression/sink?, rock-filled	hab? agric?							+	+	+				x	
1726-01	platform	shrine? burial?								?		religion; burial		x		x
1726-02	sinkhole, rock-filled	burial		1	1		●				+	burial		x		x
1726-03a	sinkhole, rock-filled	agriculture	1		1				+			?			x	
1726-03b	rock alignments	agriculture						+								

Table A-3. Archaeological Site Inventory for NAS Barbers Point Housing Project, Phase II (continued).

SITE/ FEA NO.	FORMAL TYPE	FUNCTION	TESTING				HB	INFORMATION VALUE					TY	MITIGATION RECOMMEND		
			ST	TP	RX	SC		N	AG	HA	EV	OTHER		C	DR	PR
1726-04	sinkhole	agriculture?							+		+				x	
1726-05	depression	non-cultura	1					+								
1726-06	depression	non-cultura	2					+								
1726-07a	sinkhole	habitation?								+	+				x	
1726-07b	sinkhole	habitation?								+	+					
1726-07c	depression	habitation?								+		?			x	
1726-07d	pit and backdirt	recent						+								
1726-08	sinkhole	agriculture?		1		*			+		+				x	
1726-09	sinkhole	hab? agric?							+	+	+				x	
1726-10a	sinkhole	hab? agric?							+	+	+				x	
1726-10b	depression	hab? agric?							+	+	+				x	
1726-11a	sinkhole	non-cultura	1					+								
1726-11b	sinkhole	non-cultura						+								
1726-11c	sinkhole	non-cultura						+								
1726-12	sinkhole, capped	habitation?			*					+	+				x	
1726-13	stone alignments (3)	agriculture?						+								
1726-14	sinkhole	non-cultura						+								
1726-15	C-shaped structure	temp habit		1						+					x	
1726-16	sinkhole, rock-filled	habitation?								+	+				x	
1726-17	sinkhole	hab; agric?	1						+	+	+	assoc.w/ 4701?			x	
1726-18	sinkhole	hab? agric?							+	+	+				x	
1726-19a	sinkhole	agric? hab?							+	+	+				x	
1726-19b	sinkhole	non-cultura									+				x	
1726-20	sinkhole	hab? agric?							+	+	+				x	
1726-21	depression	habitation?								+	+				x	
1726-22	sinkhole	agriculture?							+		+				x	

Table A-3. Archaeological Site Inventory for NAS Barbers Point Housing Project, Phase II (continued).

SITE/ FEA NO.	FORMAL TYPE	FUNCTION	TESTING				HB	INFORMATION VALUE					TY	MITIGATION RECOMMEND		
			ST	TP	RX	SC		N	AG	HA	EV	OTHER		C	DR	PR
1726-23	sinkhole	non-cultura						+								
1726-24	sinkhole, capped	ordn. disp.				*					+				x	
1726-25a	sinkhole, capped				1										x	
1726-25b	sinkhole, pile, elongated	agriculture	2						+		+				x	
1726-26	sinkhole	hab? agric?							+	+	+				x	
1726-27	sinkhole	hab? agric?							+	+	+				x	
1726-28	sinkhole	agriculture?	1						+		+				x	
1726-29	sinkhole	hab? agric?							+	+	+				x	
1726-30	sinkhole	hab; agricul	1						+	+	+				x	
1726-31	sinkhole, capped	agriculture?	1						+		+				x	
1726-32	sinkhole, rock-filled (BD)	hab? agric?							+	+	+				x	
1726-33	C-shaped structure	temp habit							+	+	+					x
1726-34	sinkhole, rock-filled	agriculture?	1		1				+		+				x	
4701	sinkhole	1900s									?	20th C.			x	
4702	stone piles	agriculture							+		?				x	
4702-01	stone pile	agriculture		1	1			+								
4702-02	stone pile	agriculture	1		1			+								
4702-03	stone pile	agriculture	1	1	1			+								
4702-04	stone pile	agriculture		1	1			+								
4702-05	stone pile	agriculture	1					+								
4702-06	stone pile	agriculture	1		1			+								
4702-07	stone pile	agriculture		1	1			+								
4702-08	slab scatter	agriculture	1					+								
4702-09	stone pile	agriculture	3					+								
4702-10	stone pile	agriculture	1					+								
4702-11	stone pile	agriculture	1					+								
4702-12	stone pile	agriculture	2					+								

Table A-4. Phase II Excavation Data.

Site	Fea	Grid	Layer	E	Vol	Contents	Type	Wt.(g)	LN	LNX
1723	004	ST1	I	b	7.	Shell	*Turbo spp.*, operculum	0.78	086	01
1723	004	ST1	II	b	26.	Shell	*Turbo spp.*, operculum	0.61	087	01
1723	004	ST1	II	b	26.	Egg shell frag-2	Bird, medium and/or large	0.09	087	02
1723	004	ST1	III	b	13.	Egg shell frag-1	Bird, medium and/or large	0.13	088	01
1723	007		Surface			Shell	*Conus*	5.01	158	01
1723			Surface	p		Golf ball, cover		3.50	173	02
1723			Surface	p		Casing, rifle shell		14.00	173	03
1724	002	ST1		s	13.	Shell	*Brachidontes*	0.13	004	02
1724	002	ST1		s	13.	Egg shell frag-7	Bird, medium and/or large	0.32	004	03
1724	002	ST1		s	13.	Volcanic glass-1		0.60	004	04
1724	002	ST1		S	23.	Shell	*Brachidontes*	0.33	006	02
1724	002	ST1		S	23.	Egg shell frag-1	Bird, medium and/or large	0.25	006	03
1724	002	ST1		S	23.	Charcoal		0.02	006	04
1724	002	TP1	II	s	17.	Echinoderm		0.46	001	01
1724	002	TP1	II	s	17.	Shell	*Brachidontes*	0.52	001	02
1724	002	TP1	IIA,B	B	13.	Shell	*Brachidontes*	0.40	007	02
1724	002	TP1	IIA,B	B	13.	Echinoderm		0.05	007	03
1724	002	TP1	IIA,B	B	13.	Charcoal		0.01	007	04
1724	003	TP1	I/1	b	26.	Flake, limestone-3		30.30	018	01
1724	003	TP1	I/1	b	26.	Shell	*Tellina*	2.68	018	03.01
1724	003	TP1	I/1	b	26.	Shell	*Brachidontes*	1.98	018	03.02
1724	003	TP1	I/1	b	26.	Shell	*Nerita picea*	4.02	018	03.03
1724	003	TP1	I/1	b	26.	Echinoderm		1.03	018	04
1724	003	TP1	I/1	b	26.	Charcoal		0.80	018	05
1724	003	TP1	I/1	b	26.	Crustacean		0.05	018	06
1724	003	TP1	I/1	b	26.	Frags, basalt-fc?		4.10	018	07
1724	003	TP1	I/1	b	26.	Insect by-product		0.06	018	08
1724	003	TP1	I/1	b	26.	Unknown lithic		0.07	018	09
1724	003	TP1	I/2	b	20.	Shell	*Tellina*	0.29	019	02.01
1724	003	TP1	I/2	b	20.	Shell	*Brachidontes*	1.56	019	02.02
1724	003	TP1	I/2	b	20.	Shell	*Nerita picea*	0.99	019	02.03
1724	003	TP1	I/2	b	20.	Shell	*Cypraea spp.*	0.82	019	02.04
1724	003	TP1	I/2	b	20.	Shell	*Turbo spp.*, operculum	0.85	019	02.05
1724	003	TP1	I/2	b	20.	Charcoal		2.29	019	03

Table A-4. Phase II Excavation Data (continued).

Site	Fea	Grid	Layer	E	Vol	Contents	Type	Wt.(g)	LN	LNX
1724	003	TP1	I/2	b	20.	Echinoderm		0.97	019	04
1724	003	TP1	I/2	b	20.	Crustacean		0.64	019	05
1724	003	TP1	I/2	b	20.	Egg shell frag-5	Bird, medium and/or large	0.16	019	06
1724	003	TP1	I/2	b	20.	Invertebrate		0.04	019	07
1724	003	TP1	II/1	b	14.	Shell	*Turbo spp.*, operculum	1.38	020	02.01
1724	003	TP1	II/1	b	14.	Shell	*Brachidontes*	0.09	020	02.02
1724	003	TP1	II/1	b	14.	Shell	Gastropod, unidentified	0.15	020	02.03
1724	003	TP1	II/1	b	14.	Echinoderm		0.27	020	03
1724	003	TP1	II/1	b	14.	Charcoal		0.45	020	04
1724	003	TP1	II/2	b	14.	Charcoal		0.04	021	02
1724	003	TP1	II/2	b	14.	Flake, limestone		9.20	021	03
1724	004	TP1	I/1	b	26.	Egg shell frag-11	Bird, medium and/or large	46.00	027	01
1724	004	TP1	I/1	b	26.	Shell	*Turbo spp.*, operculum	0.77	027	03.01
1724	004	TP1	I/1	b	26.	Shell	Gastropod, unidentified	0.27	027	03.02
1724	004	TP1	I/1	b	26.	Flake, limestone		71.10	027	04
1724	004	TP1	I/2	b	26.	Egg shell frag-2	Bird, small and/or medium	0.01	028	01.01
1724	004	TP1	I/2	b	26.	Egg shell frag-45	Bird, medium and/or large	1.47	028	01.02
1724	004	TP1	I/2	b	26.	Echinoderm		0.07	028	02
1724	004	TP1	I/3	b	24.	Egg shell frag-4	Bird, small and/or medium	0.07	029	01.01
1724	004	TP1	I/3	b	24.	Egg shell frag-113	Bird, medium and/or large	8.96	029	01.02
1724	004	TP1	I/3	b	24.	Shell	*Turbo spp.*, operculum	1.95	029	02
1724	004	TP1	I/4	b	21.	Egg shell frag-4	Bird, small and/or medium	0.09	030	01.01
1724	004	TP1	I/4	b	21.	Egg shell frag-160	Bird, medium and/or large	10.05	030	01.02
1724	004	TP1	I/4	b	21.	Shell	*Turbo spp.*, operculum	2.65	030	02
1724	005	TP1	II	b	17.	Egg shell frag-8	Bird, medium and/or large	0.48	075	02
1724	005	TP1	III	b	23.	Egg shell frag-1	Bird, medium and/or large	0.14	076	02
1724	007	TP1	Fea.a	t	1.	Charcoal		0.38	069	01
1724	007	TP1	I/1	b	35.	Echinoderm		0.36	068	03
1724	007	TP1	I/1	b	35.	Worked limestone		158.90	068	04
1724	007	TP1	I/1	b	35.	Crustacean		0.01	068	05
1724	007	TP1	I/1	b	35.	Charcoal		0.22	068	06
1724	007	TP1	I/1	b	35.	Shell	*Nerita picea*	0.21	068	07.01
1724	007	TP1	I/1	b	35.	Shell	*Tellina*	0.49	068	07.02
1724	007	TP1	I/1	b	35.	Shell	*Brachidontes*	0.10	068	07.03
1724	007	TP1	I/1	b	35.	Shell	Gastropod, unidentified	0.22	068	07.04

Table A-4. Phase II Excavation Data (continued).

Site	Fea	Grid	Layer	E	Vol	Contents	Type	Wt.(g)	LN	LNX
1724	007	TP1	I/2	t	13.	Charcoal		0.18	070	01
1724	007	TP1	I/2	t	13.	Cf. crustacean		0.14	070	02
1724	007	TP1	I/2	t	13.	Crustacean		0.13	070	02
1724	007	TP1	I/2	t	13.	Echinoderm		0.88	070	04
1724	007	TP1	I/2	t	13.	Shell	*Brachidontes*	0.89	070	05.01
1724	007	TP1	I/2	t	13.	Shell	*Tellina*	0.35	070	05.02
1724	007	TP1	I/2	t	13.	Shell	Gastropod, unidentified	0.11	070	05.03
1724	007	TP1	I/2	t	13.	Unknown substance		0.13	070	06
1724	007	TP1	II/1	b	8.	Shell	*Turbo spp.*, operculum	0.32	071	01
1724	007	TP1	Surface			Sling stone, basalt		108.80	067	01
1724	007	TP1	Surface			Flake?, basalt-fc?		17.10	067	02
1724	007	TP2	II/1	b	28.	Shell	*Brachidontes*	0.02	160	01
1724	007	TP2	II/2	b	6.	Echinoderm		0.73	161	01
1724	007	TP2	II/2	b	6.	Shell	*Brachidontes*	0.05	161	03
1724	007	TP2	III	b	8.	Shell	*Brachidontes*	0.07	162	02.01
1724	007	TP2	III	b	8.	Shell	*Tellina*	0.17	162	02.02
1724	007	TP2	III	b	8.	Shell	Gastropod, unidentified	0.26	162	02.03
1724	007	TP2	III	b	8.	Echinoderm		0.02	162	03
1724	008		Surface Hole			Kukui		2.72	164	01
1724	008		Surface Hole			Adz preform, shell		164.30	164	03
1724	009		Surface			Glass, bottle		140.60	165	01
1724	010	SC				Volcanic glass		0.33	191	00
1724	011	TP1	II	p		Flake, limestone		28.20	166	00
1724	011	TP1	II	b	12.	Echinoderm		0.12	167	01
1724	011	TP1	II	b	12.	Shell	*Nerita picea*	0.79	167	02.01
1724	011	TP1	II	b	12.	Shell	*Strombus*	0.29	167	02.02
1724	011	TP1	II	b	12.	Flake, limestone-2		32.10	167	03
1724	011	TP1	II	b	12.	Crustacean		0.04	167	04
1724	011	TP1	III	t		Egg shell frag-25	Bird, small and/or medium	0.18	147	02.01
1724	011	TP1	III	t		Egg shell frag-1	Bird, medium and/or large	0.04	147	02.02
1724	011	TP1	III	t		Shell	*Turbo spp.*, operculum	0.61	147	03.01
1724	011	TP1	III	t		Shell	*Tellina*	0.64	147	03.02
1724	011	TP1	III	t		Shell	*Brachidontes*	0.03	147	03.03

Table A-4. Phase II Excavation Data (continued).

Site	Fea	Grid	Layer	E	Vol	Contents	Type	Wt.(g)	LN	LNX
1724	011	TP1	I	b	12.	Flake, limestone		210.50	168	01
1724	011	TP2	Fea.a	t	9.	Charcoal		3.36	143	02
1724	011	TP2	Fea.a	t	9.	Shell	*Nerita picea*	1.70	143	03.01
1724	011	TP2	Fea.a	t	9.	Shell	*Brachidontes*	0.27	143	03.02
1724	011	TP2	Fea.a	t	9.	Shell	*Tellina*	1.58	143	03.03
1724	011	TP2	Fea.a	t	9.	Snail		6.98	143	04
1724	011	TP2	I	b	5.	Flake?, limestone		8.20	141	01
1724	011	TP2	I	b	5.	Shell	*Brachidontes*	0.03	141	02
1724	011	TP2	II	b	13.	Egg shell frag-1	Bird, medium and/or large	0.03	142	01
1724	011	TP2	II	b	13.	Crustacean?		0.01	142	02
1724	019	SC	Floor Surface			Plant fiber		7.75	194	00
1724	034			s		Egg shell frag-5	Bird, small and/or medium	0.01	170	02
1724	034			s		Crustacean		0.23	170	03
1724	036	ST1	II	b	37.	Egg shell frag-40	Bird, medium and/or large	2.99	124	01
1724	040		II lower	b	18.	Egg shell frag-2	Bird, small and/or medium	0.05	120	01.01
1724	040		II lower	b	18.	Egg shell frag-66	Bird, medium and/or large	3.29	120	01.02
1724	040		II lower	b	18.	Shell	*Turbo spp.*, operculum	0.21	120	02.01
1724	040		II lower	b	18.	Shell	*Trochus*	0.18	120	02.02
1724	040		II upper	b	13.	Egg shell frag-91	Bird, medium and/or large	2.87	119	01
1724	042	St3		s		Egg shell frag-6	Bird, medium and/or large	0.53	176	01
1724	042	TP1	II/1	b	12.	Crustacean		0.03	082	02
1724	042	TP1	II/1	b	12.	Crustacean		0.04	082	02
1724	042	TP1	II/1	b	12.	Shell	*Turbo spp.*, operculum	0.23	082	03.01
1724	042	TP1	II/1	b	12.	Shell	*Brachidontes*	0.02	082	03.02
1724	042	TP1	II/1	b	12.	Egg shell frag-1	Bird, medium and/or large	0.11	082	04
1724	042	TP1	II/1	b	12.	Charcoal		0.02	082	06
1724	042	TP1	II/2	b	8.	Egg shell frag-1	Bird, small and/or medium	0.04	083	01.01
1724	042	TP1	II/2	b	8.	Egg shell frag-1	Bird, medium and/or large	0.08	083	01.02
1724	042			s		Egg shell frag-10	Bird, medium and/or large	0.62	175	01
1724	042			s		Crustacean		0.13	175	02
1724	042			s		Echinodern		0.13	175	03
1724	043	TP1	I	s	8.	Echinoderm		1.82	096	01
1724	043	TP1	I	s	8.	Shell	*Nerita picea*	0.38	096	02
1724	043	TP1	I	s	8.	Crustacean		0.03	096	03

Table A-4. Phase II Excavation Data (continued).

Site	Fea	Grid	Layer	E	Vol	Contents	Type	Wt.(g)	LN	LNX
1724	043	TP1	II lower	t	5.	Echinoderm		0.06	098	01
1724	043	TP1	II lower	t	5.	Egg shell frag-2	Bird, medium and/or large	0.14	098	02
1724	043	TP1	II lower	t	5.	Shell	*Turbo spp.*, operculum	0.59	098	03.01
1724	043	TP1	II lower	t	5.	Shell	*Nerita picea*	1.56	098	03.02
1724	043	TP1	II lower	t	5.	Shell	*Brachidontes*	0.25	098	03.03
1724	043	TP1	II lower	t	5.	Charcoal		0.12	098	04
1724	043	TP1	II upper	b	23.	Coral reef rubble?		0.03	097	03
1724	043	TP1	II upper	b	23.	Charcoal		0.84	097	04
1724	043	TP1	II upper	b	23.	Echinoderm		1.20	097	05
1724	043	TP1	II upper	b	23.	Crustacean		0.13	097	06
1724	043	TP1	II upper	b	23.	Shell	*Nerita picea*	2.24	097	07.01
1724	043	TP1	II upper	b	23.	Shell	*Conus*	4.26	097	07.02
1724	054	ST1		t	2.2	Shell	*Ctena*	0.41	192	02.02.01
1724	054	ST1		t	2.2	Shell	*Hipponix*	0.09	192	02.02.02
1724	054	ST1		t	2.2	Shell	*Periglypta*	0.24	192	02.02.03
1724	054	ST1		t	2.2	Shell	Gastropod, unidentified	0.53	192	02.02.04
1724	055	TP1	0	s	20.	Frags, basalt-fc?		4.10	013	01
1724	055	TP1	Fea.a	t	1.5	Egg shell frag-1	Bird, medium and/or large	0.07	008	01
1724	055	TP1	I/1	t	10.	Shell	*Turbo spp.*, operculum	0.43	010	04.01
1724	055	TP1	I/1	t	10.	Shell	*Nerita picea*	1.10	010	04.02
1724	055	TP1	I/1	t	10.	Shell	*Brachidontes*	1.25	010	04.03
1724	055	TP1	I/1	t	10.	Flake, limestone-8		65.20	010	06
1724	055	TP1	I/1	t	10.	Echinoderm		0.11	010	07
1724	055	TP1	I/1	t	10.	Charcoal		0.03	010	08
1724	055	TP1	I/1	t	10.	Egg shell-1	Cf. bird, medium or large	0.06	010	09
1724	055	TP1	I/1	t	10.	Crustacean		0.01	010	10
1724	055	TP1	II/1	t	8.	Shell	*Turbo spp.*, operculum	0.26	011	02
1724	055	TP1	II/1	t	8.	Egg shell frag-1	Bird, medium and/or large	0.04	011	03
4702	007	TP1	II	b	18.	Egg shell frag-2	Bird, medium and/or large	0.20	128	01
1726	002	TP1	I	b	26.	Egg shell frag-26	Bird, medium and/or large	1.20	032	01.01
1726	002	TP1	I	b	26.	Egg shell frag-1	Bird, small and/or medium	0.07	032	01.02
1726	002	TP1	I	b	26.	Pellet/shot, metal		0.10	032	03
1726	002	TP1	II	b	9.	Egg shell frag-2	Bird, small and/or medium	0.06	03	02.01
1726	002	TP1	II	b	9.	Egg shell frag-5	Bird, medium and/or large	0.26	033	02.02
1726	008		Surface	p		Glass, bottle		38.70	038	00

Table A-4. Phase II Excavation Data.

Site	Fea	Grid	Layer	E	Vol	Contents	Type	Wt.(g)	LN	LNX
1726	008	Prfle		t	13.	Snail		4.76	182	01
1726	008	Prfle		t	13.	Egg shell frag-25	Bird, small and/or medium	0.15	182	03
1726	008	Prfle		t	13.	Shell	Gastropod, unidentified	0.03	182	04
1726	008	Prfle		t	13.	Crustacean		0.01	182	05
1726	008	Prfle		t		Crustacean		0.05	183	01.01
1726	008	Prfle		t		Crustacean		0.01	183	01.02
1726	008	Prfle		t		Snail		3.94	183	02
1726	008	Prfle		t		Egg shell frag-127	Bird, small and/or medium	0.51	183	03
1726	008	Prfle		t		Shell	Gastropod, unidentified	0.02	183	05
1726	008	Prfle		t		Snail		2.84	184	01
1726	008	Prfle		t		Egg shell frag-22	Bird, small and/or medium	0.11	184	03.01
1726	008	Prfle		t		Egg shell frag-1	Bird, medium and/or large	0.08	184	03.02
1726	008	Prfle		t		Crustacean		0.04	184	04
1726	008	Prfle		t		Mollusk		0.02	184	05
1726	008	Prfle		t		Snail		2.92	185	02
1726	008	Prfle		t		Crustacean		0.83	185	03.01
1726	008	Prfle		t		Crustacean		0.01	185	03.02
1726	008	Prfle		t		Egg shell frag-77	Bird, small and/or medium	0.27	185	04
1726	008	Prfle		t		Shell		0.01	185	05
1726	008	Prfle		t		Snail		2.71	186	01
1726	008	Prfle		t		Egg shell frag-108	Bird, small and/or medium	0.34	186	02
1726	008	Prfle		t		Crustacean		0.02	186	04.01
1726	008	Prfle		t		Crustacean		0.04	186	04.02
1726	008	Prfle		t		Shell?		0.01	186	05.01
1726	008	Prfle		t		Shell		0.01	186	05.02
1726	008	TP1	Fea.a	b	8.	Crustacean		0.18	044	02
1726	008	TP1	Fea.a	t	5.	Egg shell frag-162	Bird, small and/or medium	0.69	045	02.01
1726	008	TP1	Fea.a	t	5.	Egg shell frag-7	Bird, medium and/or large	0.40	045	02.02
1726	008	TP1	Fea.a	t	5.	Egg shell frag-1	Bird, small or medium	0.01	045	02.03
1726	008	TP1	Fea.a	t	5.	Crustacean		0.23	045	03
1726	008	TP1	Fea.a	t	3.	Crustacean		0.11	046	02
1726	008	TP1	Fea.a	t	3.	Egg shell frag-2	Bird, medium and/or large	0.36	046	03
1726	008	TP1	I	b	18.	Flake, limestone		17.20	039	02
1726	008	TP1	II/1	b	7.	Egg shell frag-21	Bird, small and/or medium	0.17	040	02.01
1726	008	TP1	II/1	b	7.	Egg shell frag-1	Bird, medium and/or large	0.10	040	02.02
1726	008	TP1	II/1	b	7.	Crustacean		0.03	040	03.01

Table A-4. Phase II Excavation Data (continued).

Site	Fea	Grid	Layer	E	Vol	Contents	Type	Wt.(g)	LN	LNX
1726	008	TP1	II/1	b	7.	Crustacean		0.02	040	03.02
1726	008	TP1	II/10	b	25.	Crustacean		2.32	052	01
1726	008	TP1	II/10	b	25.	Egg shell frag-4	Bird, medium and/or large	0.38	052	03
1726	008	TP1	II/11	b	13.	Crustacean		0.98	053	02.01
1726	008	TP1	II/11	b	13.	Crustacean(or pos. Coral reef rubble)		0.06	053	02.02
1726	008	TP1	II/11	b	13.	Egg shell frag-5	Bird, small and/or medium	0.04	053	03.01
1726	008	TP1	II/11	b	13.	Egg shell frag-2	Bird, medium and/or large	0.26	053	03.02
1726	008	TP1	II/11	b	13.	Echinoderm		0.03	053	04
1726	008	TP1	II/12	b	13.	Crustacean		5.74	054	01.01
1726	008	TP1	II/12	b	13.	Crustacean		0.13	054	01.02
1726	008	TP1	II/12	b	13.	Egg shell frag-2	Bird, medium and/or large	0.14	054	03
1726	008	TP1	II/2	b	20.	Egg shell frag-17	Bird, small and/or medium	0.14	041	02.01
1726	008	TP1	II/2	b	20.	Egg shell frag-17	Bird, medium and/or large	1.28	041	02.02
1726	008	TP1	II/2	b	20.	Crustacean		0.07	041	03.01
1726	008	TP1	II/2	b	20.	Crustacean?		0.03	041	03.02
1726	008	TP1	II/2	b	20.	Crustacean		0.04	041	03.03
1726	008	TP1	II/3	b	21.	Crustacean		0.88	042	02.01
1726	008	TP1	II/3	b	21.	Crustacean		0.13	042	02.02
1726	008	TP1	II/3	b	21.	Egg shell frag-6	Bird, small and/or medium	0.03	042	03.01
1726	008	TP1	II/3	b	21.	Egg shell frag-15	Bird, medium and/or large	2.04	042	03.02
1726	008	TP1	II/4	b	24.	Crustacean		1.48	043	02
1726	008	TP1	II/4	b	24.	Egg shell frag-15	Bird, small and/or medium	0.15	043	03.01
1726	008	TP1	II/4	b	24.	Egg shell frag-25	Bird, medium and/or large	2.87	043	03.02
1726	008	TP1	II/4	b	24.	Shell	*Strombus*	0.78	043	05
1726	008	TP1	II/4	b	24.	Echinoderm		0.11	043	06
1726	008	TP1	II/5	b	15.	Crustacean		0.63	047	02
1726	008	TP1	II/5	b	15.	Egg shell frag-3	Bird, medium and/or large	0.24	047	03
1726	008	TP1	II/6	b	14.	Egg shell frag-3	Bird, small and/or medium	0.06	048	02.01
1726	008	TP1	II/6	b	14.	Egg shell frag-9	Bird, small and/or medium	0.75	048	02.02
1726	008	TP1	II/6	b	14.	Crustacean		0.30	048	03
1726	008	TP1	II/7	b	18.	Crustacean		1.00	049	02
1726	008	TP1	II/7	b	18.	Egg shell frag-5	Bird, medium and/or large	0.71	049	03
1726	008	TP1	II/8	b	14.	Crustacean		0.90	050	02
1726	008	TP1	II/8	b	14.	Egg shell frag-1	Bird, medium and/or large	0.08	050	03
1726	008	TP1	II/9	b	22.	Crustacean		3.04	051	02

Table A-4. Phase II Excavation Data (continued).

Site	Fea	Grid	Layer	E	Vol	Contents	Type	Wt.(g)	LN	LNX
1726	017	ST1	I & II	s	72.	Shell	*Tellina*	2.45	059	01
1726	017	ST1	I & II	s	72.	Flake, limestone-2		13.40	059	02
1726	028			s	0.	Shell	Gastropod, unidentified	0.01	169	02
1726	028			s	0.	Egg shell frag-2		0.17	169	03
1726	030	ST1	I	b	3.	Egg shell frag-1	Bird, small and/or medium	0.04	102	01.01
1726	030	ST1	I	b	3.	Egg shell frag-2	Bird, medium and/or large	0.23	102	01.02
1726	031	TP1		t	11.	Egg shell frag-30	Bird, small and/or medium	0.17	163	01.01
1726	031	TP1		t	11.	Egg shell frag-40	Bird, medium and/or large	3.33	163	01.02
1726	031	TP1		t	11.	Crustacean		0.18	163	03.01
1726	031	TP1		t	11.	Crustacean		0.04	163	03.02
1726	031	TP1		t	11.	Echinoderm		0.27	163	04
1726	034	ST1	N/A	s	13.	Egg shell frag-1	Bird, medium or large	0.12	172	02
4702	002	ST1	I	s	20.	Echinoderm		0.07	139	01

Table A-4 provides all of the Phase II excavation data (except for bone remains*) in tabular form. The information is ordered by site and provenience.

E=excavation collection method.
b=bulk collection. s=screen collection.
p=surface/floor collection. t=total collection.
Vol=excavation volume per provenience unit in liters.
(Note: volume is repeated for each occurrence from the unit; for unit volume calculations, only one occurrence should be used.)
Contents=general category of collected material from excavation unit.
Type=specific identification of collected material.
Wt=collection weight in grams.
LN.LNX=lab number.

*The bone data are presented in Tables A-5 and A-6.

Table A-5. Phase II Faunal Collections, by Excavation Unit.

Site	Fea	Grid	Layer	Taxon	MNI	Count	Wt.(g)	LN	LNX
1723	002		Surface	*Bos taurus*		1	96.50	171	01.01
1723	002		Surface	Artiodactyl, medium		1	13.05	171	01.02
1723	008			*Rattus norvegicus* or *R. rattus*		1	0.12	181	01.01
1723	008			*Herpestes auropunctatus*		2	1.02	181	01.02
1723			Surface	*Pterodroma phaeodygia*		1	0.09	173	01.01
1723			Surface	Procellariid, medium		1	0.44	173	01.02
1724	002	ST1		Bird, medium		2	0.19	004	01
1724	002	ST1		Bird, medium		3	0.13	006	01
1724	002	TP1	IIA,B	*Rattus exulans*		4	0.08	007	01
1724	003	TP1	I/1	Balistid		1	0.01	018	02.01
1724	003	TP1	I/1	Monacanthid (genus *Pervagor*)		1	0.03	018	02.02
1724	003	TP1	I/1	Fish		15	2.48	018	02.03
1724	003	TP1	I/1	Bird, small or medium		1	0.02	018	02.04
1724	003	TP1	I/1	Bird, medium		2	0.11	018	02.05
1724	003	TP1	I/1	*Rattus exulans*		4	0.06	018	02.06
1724	003	TP1	I/1	Mammal, small to medium or medium		1	0.03	018	02.07
1724	003	TP1	I/1	Vertebrate, small and/or medium		8	0.30	018	02.08
1724	003	TP1	I/1	Mammal, small to medium or medium		1	0.66	018	02.09
1724	003	TP1	I/2	Bird, medium		1	0.04	019	01.01
1724	003	TP1	II/1	Fish		4	0.02	020	01.01
1724	003	TP1	II/1	Procellariid, medium	2	7	0.30	020	01.02
1724	003	TP1	II/1	Bird, small and/or medium		3	0.01	020	01.03
1724	003	TP1	II/1	Bird, medium		46	1.37	020	01.04
1724	003	TP1	II/1	*Rattus exulans*		6	0.05	020	01.05
1724	003	TP1	II/1	Vertebrate, small and/or medium		8	0.02	020	01.06
1724	003	TP1	II/2	Fish		2	0.01	021	01.01
1724	003	TP1	II/2	Procellariid, medium	2	7	0.34	021	01.02
1724	003	TP1	II/2	Bird, small and/or medium		16	0.12	021	01.03
1724	003	TP1	II/2	Bird, medium		97	2.53	021	01.04
1724	003	TP1	II/2	Bird, large		2	0.03	021	01.05
1724	003	TP1	II/2	*Rattus exulans*		2	0.01	021	01.06
1724	003	TP1	II/2	*Sus scrofa*		1	0.37	021	01.07
1724	003	TP1	II/2	Vertebrate, medium		5	0.02	021	01.08
1724	004	TP1	I/1	*Rattus exulans*		2	0.02	027	02

Table A-5. Phase II Faunal Collections, by Excavation Unit (continued).

Site	Fea	Grid	Layer	Taxon	MNI	Count	Wt.(g)	LN	LNX
1724	005	TP1	II	Procellariid, medium		1	0.07	075	01.01
1724	005	TP1	II	Bird, medium		6	0.21	075	01.02
1724	005	TP1	II	Vertebrate, medium		1	0.03	075	01.03
1724	005	TP1	III	Fish		1	0.02	076	01.01
1724	005	TP1	III	Bird, medium		4	0.10	076	01.02
1724	005	TP1	III	Bird, medium		1	0.02	077	01
1724	007	TP1	I/1	Scarid (genus *Calotomus*)		1	0.40	068	01.01
1724	007	TP1	I/1	Fish		10	0.30	068	01.02
1724	007	TP1	I/1	*Rattus exulans*		1	0.02	068	01.03
1724	007	TP1	I/1	*Sus scrofa*		3	1.38	068	01.04
1724	007	TP1	I/1	*Bos taurus*		2	1.29	068	01.05
1724	007	TP1	I/1	Mammal, small to medium and/or medium		11	1.24	068	01.06
1724	007	TP1	I/1	Mammal, medium and/or large		8	3.77	068	01.07
1724	007	TP1	I/1	Vertebrate, medium		3	0.13	068	01.08
1724	007	TP1	I/2	Fish		2	0.06	070	03.01
1724	007	TP1	I/2	*Rattus exulans*		1	0.01	070	03.02
1724	007	TP1	I/2	Mammal, medium or large		1	0.55	070	03.03
1724	007	TP1	I/2	Vertebrate, medium		3	0.43	070	03.04
1724	007	TP2	I	Mammal, medium or large		1	0.42	159	01
1724	007	TP2	II/1	Fish		1	0.01	160	02.01
1724	007	TP2	II/1	*Rattus exulans*		1	0.03	160	02.02
1724	007	TP2	II/1	Mammal, s mall to medium and/or medium		23	2.58	160	02.03
1724	007	TP2	II/1	Mammal, large		1	1.61	160	02.04
1724	007	TP2	II/1	Vertebrate, medium		22	0.93	160	02.05
1724	007	TP2	II/2	Fish		3	0.07	161	02
1724	007	TP2	III	Fish		2	0.04	162	01.01
1724	007	TP2	III	Procellariid, medium		1	0.35	162	01.02
1724	007	TP2	III	*Rattus exulans*		1	0.01	162	01.03
1724	007	TP2	III	Vertebrate, small or medium		1	0.02	162	01.04
1724	008		Surface Hole	*Bos taurus*		1	182.27	164	02
1724	019	SC	Floor Surface	Procellariid, medium		1	0.78	193	00
1724	034			Procellariid, medium		1	0.02	170	01.01
1724	034			*Rattus norvegicus* and/or *R. rattus*		3	0.11	170	01.02

Table A-5. Phase II Faunal Collections, by Excavation Unit (continued).

Site	Fea	Grid	Layer	Taxon	MNI	Count	Wt.(g)	LN	LNX
1724	034			Bird, medium		6	0.83	170	01.03
1724	034			Bird, large		1	0.31	170	01.04
1724	034			*Rattus exulans*		8	0.13	170	01.05
1724	036	ST1	II	Procellariid, small		1	0.07	124	02.01
1724	036	ST1	II	Procellariid, medium		8	0.94	124	02.02
1724	036	ST1	II	Passeriform, small	2	2	0.06	124	02.03
1724	036	ST1	II	Bird, medium		11	0.62	124	02.04
1724	036	ST1	II	*Rattus exulans*	2	5	0.18	124	02.05
1724	042	TP1	II/1	Acanthurid		1	0.02	082	01.01
1724	042	TP1	II/1	*Rattus exulans*		3	0.07	082	01.02
1724	042	TP1	II/1	*Rattus norvegicus* or *R. rattus*		1	0.02	082	01.03
1724	042	TP1	II/1	*Mus musculus*		1	0.01	082	01.04
1724	043	TP1	II upper	Fish		1	0.07	097	01.01
1724	043	TP1	II upper	Vertebrate, medium		2	0.01	097	01.02
1724	044	ST1	I	*Rattus norvegicus* or *R. rattus*		1	0.02	136	01
1724	048	ST1	II	*Rattus exulans*		3	0.05	093	01
1724	055	TP1	I/1	Holocentrid		5	3.00	010	05.01
1724	055	TP1	I/1	Polynemid	2	6	0.10	010	05.02
1724	055	TP1	I/1	Carangid		12	0.16	010	05.03
1724	055	TP1	I/1	Mullid	6	36	0.77	010	05.04
1724	055	TP1	I/1	Labrid	6	30	0.72	010	05.05
1724	055	TP1	I/1	Scarid (genus *Calotomus*)		4	0.11	010	05.06
1724	055	TP1	I/1	Acanthurid		15	0.24	010	05.07
1724	055	TP1	I/1	Balistid		1	0.04	010	05.08
1724	055	TP1	I/1	Diodontid		13	1.64	010	05.09
1724	055	TP1	I/1	Fish			18.80	010	05.10
1724	055	TP1	I/1	Lizard, small	3	3	0.04	010	05.11
1724	055	TP1	I/1	*Porzana ziegleri*		1	0.03	010	05.12
1724	055	TP1	I/1	*Chloridops regiskongi*		1	0.24	010	05.13
1724	055	TP1	I/1	Bird, small		1	0.04	010	05.14
1724	055	TP1	I/1	Bird, small and/or medium		10	0.14	010	05.15
1724	055	TP1	I/1	*Rattus exulans*		16	0.25	010	05.16
1724	055	TP1	I/1	Vertebrate, small and/or medium		32	0.58	010	05.17
1724	055	TP1	I/1	*Mus musculus*		3	0.04	010	05.18
1724	055	TP1	I/1	*Sus scrofa*		1	0.09	010	05.19

Table A-5. Phase II Faunal Collections, by Excavation Unit (continued).

Site	Fea	Grid	Layer	Taxon	MNI	Count	Wt.(g)	LN	LNX
1724	055	TP1	I/1	Mammal, small to medium and/or medium		4	0.85	010	05.20
1724	055	TP1	II/1	*Rattus exulans*		1	0.01	011	01.01
1724	055	TP1	II/1	Vertebrate, small and/or medium		2	0.02	011	01.02
4702	007	TP1	I	Fish		2	0.01	127	01
1726	002	TP1	I	Lizard, small	2	2	0.02	032	02.01
1726	002	TP1	I	*Rattus exulans*		4	0.03	032	02.02
1726	002	TP1	I	*Mus musculus*		1	0.01	032	02.03
1726	002	TP1	I	Vertebrate, small		1	0.01	032	02.04
1726	002	TP1	I	Vertebrate, medium		3	0.10	032	02.05
1726	002	TP1	II	*Rattus exulans*		2	0.04	033	01.01
1726	002	TP1	II	Vertebrate, medium		2	0.02	033	01.02
1726	002	TP1	III	Mammal, small to medium or medium		1	0.01	034	01
1726	008	Prfle		Lizard, small	2	12	0.01	182	02.01
1726	008	Prfle		Bird, small		7	0.04	182	02.02
1726	008	Prfle		Bird, medium		3	0.11	182	02.03
1726	008	Prfle		*Rattus exulans*	2	17	0.11	182	02.04
1726	008	Prfle		*Rattus sp.*		1	0.06	182	02.05
1726	008	Prfle		*Rattus exulans* and/or *Mus musculus*		6	0.03	182	02.06
1726	008	Prfle		Vertebrate, small and/or medium		27	0.04	182	02.07
1726	008	Prfle		Bird, small		1	0.03	184	02.01
1726	008	Prfle		Bird, small or medium		1	0.03	184	02.02
1726	008	Prfle		Vertebrate, small or medium		5	0.07	185	01
1726	008	Prfle		Bird, small or medium		1	0.01	186	03
1726	008	TP1	Fea.a	Procellariid, medium		1	0.13	044	01.01
1726	008	TP1	Fea.a	Bird, small and/or medium		3	0.06	044	01.02
1726	008	TP1	Fea.a	Bird, medium		8	0.31	044	01.03
1726	008	TP1	Fea.a	*Rattus exulans*	2	11	0.21	044	01.04
1726	008	TP1	Fea.a	Vertebrate, small		2	0.03	044	01.05
1726	008	TP1	Fea.a	Lizard, small		1	0.01	045	01.01
1726	008	TP1	Fea.a	*Rattus exulans*		11	0.08	045	01.02
1726	008	TP1	Fea.a	Bird, small or medium		1	0.01	045	01.03
1726	008	TP1	Fea.a	Bird, medium		26	1.02	045	01.04
1726	008	TP1	Fea.a	Vertebrate, small		5	0.01	045	01.05
1726	008	TP1	Fea.a	Bird, medium		3	0.24	046	01.01
1726	008	TP1	Fea.a	*Rattus exulans*		2	0.03	046	01.02

Table A-5. Phase II Faunal Collections, by Excavation Unit (continued).

Site	Fea	Grid	Layer	Taxon	MNI	Count	Wt.(g)	LN	LNX
1726	008	TP1	Fea.a	Vertebrate, small		5	0.01	046	01.03
1726	008	TP1	I	Lizard, small	2	2	0.10	039	01.01
1726	008	TP1	I	Bird, small or medium		1	0.04	039	01.02
1726	008	TP1	I	Bird, medium		1	0.06	039	01.03
1726	008	TP1	I	*Rattus exulans*	2	10	0.21	039	01.04
1726	008	TP1	I	*Rattus norvegicus* and/or *R. rattus*		4	0.13	039	01.05
1726	008	TP1	I	*Mus musculus*		3	0.06	039	01.06
1726	008	TP1	I	Vertebrate, medium		2	0.01	039	01.07
1726	008	TP1	II/1	Lizard, small		2	0.02	040	01.01
1726	008	TP1	II/1	Bird, medium		4	0.18	040	01.02
1726	008	TP1	II/1	*Rattus exulans*		4	0.10	040	01.03
1726	008	TP1	II/1	*Mus musculus*		3	0.03	040	01.04
1726	008	TP1	II/1	Vertebrate, small and/or medium		3	0.04	040	01.05
1726	008	TP1	II/10	Bird, medium		4	0.22	052	02.01
1726	008	TP1	II/10	Bird, medium		1	0.03	052	02.02
1726	008	TP1	II/11	Monacanthid (genus *Pervagor*)		1	0.03	053	01.01
1726	008	TP1	II/11	Bird, medium		1	0.04	053	01.02
1726	008	TP1	II/12	Bird, medium		3	1.05	054	02.01
1726	008	TP1	II/12	Bird, medium		1	0.04	054	02.02
1726	008	TP1	II/2	Lizard, small		1	0.01	041	01.01
1726	008	TP1	II/2	Bird, small and/or medium		4	0.08	041	01.02
1726	008	TP1	II/2	Bird, medium		19	0.81	041	01.03
1726	008	TP1	II/2	*Rattus exulans*	4	24	0.51	041	01.04
1726	008	TP1	II/2	*Rattus norvegicus* or *R. rattus*		1	0.02	041	01.05
1726	008	TP1	II/2	*Mus musculus*		1	0.01	041	01.06
1726	008	TP1	II/2	Vertebrate, small		3	0.06	041	01.07
1726	008	TP1	II/3	Procellariid, medium		1	0.49	042	01.01
1726	008	TP1	II/3	Bird, small		1	0.03	042	01.02
1726	008	TP1	II/3	Bird, medium		27	1.74	042	01.03
1726	008	TP1	II/3	*Rattus exulans*	2	11	0.25	042	01.04
1726	008	TP1	II/3	Vertebrate, small or medium		1	0.04	042	01.05
1726	008	TP1	II/3	Bird, medium		1	0.01	042	01.06
1726	008	TP1	II/4	Procellariid, medium		3	0.37	043	01.01
1726	008	TP1	II/4	Passeriform, small		1	0.07	043	01.02
1726	008	TP1	II/4	Bird, small		3	0.08	043	01.03

Table A-5. Phase II Faunal Collections, by Excavation Unit (continued).

Site	Fea	Grid	Layer	Taxon	MNI	Count	Wt.(g)	LN	LNX
1726	008	TP1	II/4	Bird, medium		73	3.86	043	01.04
1726	008	TP1	II/4	Bird, medium and/or large		3	0.32	043	01.05
1726	008	TP1	II/4	Bird, large		1	0.54	043	01.06
1726	008	TP1	II/4	*Rattus exulans*	3	17	0.34	043	01.07
1726	008	TP1	II/5	Procellariid, medium		1	0.12	047	01.01
1726	008	TP1	II/5	Bird, medium		6	0.34	047	01.02
1726	008	TP1	II/5	*Rattus exulans*		2	0.10	047	01.03
1726	008	TP1	II/6	Bird, small and/or medium		2	0.15	048	01.01
1726	008	TP1	II/6	Bird, medium		4	0.23	048	01.02
1726	008	TP1	II/7	Procellariid, medium		2	0.52	049	01.01
1726	008	TP1	II/7	Bird, medium		2	0.02	049	01.02
1726	008	TP1	II/8	Procellariid, medium		1	0.09	050	01.01
1726	008	TP1	II/8	Bird, medium		8	0.33	050	01.02
1726	008	TP1	II/8	*Rattus exulans*		1	0.04	050	01.03
1726	008	TP1	II/9	Bird, medium		4	0.21	051	01
1726	028			Procellariid, medium	2	4	0.93	169	01.01
1726	028			Bird, medium		30	1.22	169	01.02
1726	028			*Rattus norvegicus* or *R. rattus*		1	0.03	169	01.03
1726	030	ST1	I	*Rattus exulans*		2	0.04	102	02
1726	030	ST1	II	Fish		3	0.03	103	01.01
1726	030	ST1	II	*Chaetoptila sp*		2	0.07	103	01.02
1726	030	ST1	II	*Rattus exulans*	2	3	0.12	103	01.03
1726	030	ST1	II	Vertebrate, medium		2	0.35	103	01.04
1726	030	ST1	III	*Rattus exulans*		2	0.10	104	01.01
1726	030	ST1	III	Vertebrate, small		1	0.02	104	01.02
1726	031	TP1		Lizard, small		1	0.03	163	02.01
1726	031	TP1		Bird, medium		3	0.22	163	02.02
1726	031	TP1		*Rattus exulans*	2	8	0.13	163	02.03
1726	031	TP1		*Rattus norvegicus* and/or *R. rattus*		3	0.05	163	02.04
1726	031	TP1		*Mus musculus*		1	0.01	163	02.05
1726	034	ST1	N/A	Lizard, small		1	0.02	172	01.01
1726	034	ST1	N/A	Bird, medium		3	0.21	172	01.02
1726	034	ST1	N/A	Vertebrate, medium		1	0.06	172	01.03
1726	034	ST1	N/A	*Rattus exulans*		3	0.07	172	01.04

Table A-5. Phase II Faunal Collections, by Excavation Unit (continued).

Site	Fea	Grid	Layer	Taxon	MNI	Count	Wt.(g)	LN	LNX

Key to Table A-5: Phase II faunal (bone) collections, ordered by excavation unit.

The Table A-5 presents bone identifications made by Dr. Alan Ziegler.

MNI=minimum number of individuals.

Count=number of bone fragments.

Wt=collected material in grams.

LN.LNX=lab number.

Table A-6. Phase II Faunal Collections by Taxon.

Taxon	Count	Wt.(g)	MNI	Site	Fea	Grid	Layer	LN	LNX
Acanthurid	1	0.02	-	1724	042	TP1	II/1	082	01.01
Acanthurid	15	0.24	-	1724	055	TP1	I/1	010	05.07
Artiodactyl, medium	1	13.05	-	1723	002		Surface	171	01.02
Balistid	1	0.01	-	1724	003	TP1	I/1	018	02.01
Balistid	1	0.04	-	1724	055	TP1	I/1	010	05.08
Bird, large	2	0.03	-	1724	003	TP1	II/2	021	01.05
Bird, large	1	0.31	-	1724	034			170	01.04
Bird, large	1	0.54	-	1726	008	TP1	II/4	043	01.06
Bird, medium	2	0.19	-	1724	002	ST1		004	01
Bird, medium	3	0.13	-	1724	002	ST1		006	01
Bird, medium	2	0.11	-	1724	003	TP1	I/1	018	02.05
Bird, medium	1	0.04	-	1724	003	TP1	I/2	019	01.01
Bird, medium	46	1.37	-	1724	003	TP1	II/1	020	01.04
Bird, medium	97	2.53	-	1724	003	TP1	II/2	021	01.04
Bird, medium	6	0.21	-	1724	005	TP1	II	075	01.02
Bird, medium	4	0.10	-	1724	005	TP1	III	076	01.02
Bird, medium	1	0.02	-	1724	005	TP1	III	077	01
Bird, medium	6	0.83	-	1724	034			170	01.03
Bird, medium	11	0.62	-	1724	036	ST1	II	124	02.04
Bird, medium	3	0.24	-	1726	008	TP1	Fea.a	046	01.01
Bird, medium	1	0.03	-	1726	008	TP1	II/10	052	02.02
Bird, medium	1	0.04	-	1726	008	TP1	II/11	053	01.02
Bird, medium	1	0.01	-	1726	008	TP1	II/3	042	01.06
Bird, medium	2	0.02	-	1726	008	TP1	II/7	049	01.02
Bird, medium	1	0.04	-	1726	008	TP1	II/12	054	02.02
Bird, medium	3	0.11	-	1726	008	Prfle		182	02.03
Bird, medium	8	0.31	-	1726	008	TP1	Fea.a	044	01.03
Bird, medium	26	1.02	-	1726	008	TP1	Fea.a	045	01.04
Bird, medium	1	0.06	-	1726	008	TP1	I	039	01.03
Bird, medium	4	0.18	-	1726	008	TP1	II/1	040	01.02
Bird, medium	4	0.22	-	1726	008	TP1	II/10	052	02.01
Bird, medium	3	1.05	-	1726	008	TP1	II/12	054	02.01
Bird, medium	19	0.81	-	1726	008	TP1	II/2	041	01.03
Bird, medium	27	1.74	-	1726	008	TP1	II/3	042	01.03
Bird, medium	73	3.86	-	1726	008	TP1	II/4	043	01.04

Table A-6. Phase II Faunal Collections by Taxon (continued).

Taxon	Count	Wt.(g)	MNI	Site	Fea	Grid	Layer	LN	LNX
Bird, medium	6	0.34	-	1726	008	TP1	II/5	047	01.02
Bird, medium	4	0.23	-	1726	008	TP1	II/6	048	01.02
Bird, medium	8	0.33	-	1726	008	TP1	II/8	050	01.02
Bird, medium	4	0.21	-	1726	008	TP1	II/9	051	01
Bird, medium	30	1.22	-	1726	028			169	01.02
Bird, medium	3	0.22	-	1726	031	TP1		163	02.02
Bird, medium	3	0.21	-	1726	034	ST1	N/A	172	01.02
Bird, medium and/or large	3	0.32	-	1726	008	TP1	II/4	043	01.05
Bird, small	1	0.04	-	1724	055	TP1	I/1	010	05.14
Bird, small	1	0.03	-	1726	008	Prfle		184	02.01
Bird, small	1	0.03	-	1726	008	TP1	II/3	042	01.02
Bird, small	3	0.08	-	1726	008	TP1	II/4	043	01.03
Bird, small	7	0.04	-	1726	008	Prfle		182	02.02
Bird, small and/or medium	3	0.01	-	1724	003	TP1	II/1	020	01.03
Bird, small and/or medium	16	0.12	-	1724	003	TP1	II/2	021	01.03
Bird, small and/or medium	10	0.14	-	1724	055	TP1	I/1	010	05.15
Bird, small and/or medium	3	0.06	-	1726	008	TP1	Fea.a	044	01.02
Bird, small and/or medium	4	0.08	-	1726	008	TP1	II/2	041	01.02
Bird, small and/or medium	2	0.15	-	1726	008	TP1	II/6	048	01.01
Bird, small or medium	1	0.02	-	1724	003	TP1	I/1	018	02.04
Bird, small or medium	1	0.03	-	1726	008	Prfle		184	02.02
Bird, small or medium	1	0.01	-	1726	008	Prfle		186	03
Bird, small or medium	1	0.01	-	1726	008	TP1	Fea.a	045	01.03
Bird, small or medium	1	0.04	-	1726	008	TP1	I	039	01.02
Bos taurus	1	96.50	-	1723	002		Surface	171	01.01
Bos taurus	2	1.29	-	1724	007	TP1	I/1	068	01.05
Bos taurus	1	182.27	-	1724	008		Surface hole	164	02
Carangid	12	0.16	-	1724	055	TP1	I/1	010	05.03
Chaetoptila sp.	2	0.07	-	1726	030	ST1	II	103	01.02
Chloridops regiskongi	1	0.24	-	1724	055	TP1	I/1	010	05.13
Diodontid	13	1.64	-	1724	055	TP1	I/1	010	05.09
Fish	15	2.48	-	1724	003	TP1	I/1	018	02.03
Fish	4	0.02	-	1724	003	TP1	II/1	020	01.01
Fish	2	0.01	-	1724	003	TP1	II/2	021	01.01
Fish	1	0.02	-	1724	005	TP1	III	076	01.01
Fish	10	0.30	-	1724	007	TP1	I/1	068	01.02

Table A-6. Phase II Faunal Collections by Taxon (continued).

Taxon	Count	Wt.(g)	MNI	Site	Fea	Grid	Layer	LN	LNX
Fish	2	0.06	-	1724	007	TP1	I/2	070	03.01
Fish	1	0.01	-	1724	007	TP2	II/1	160	02.01
Fish	3	0.07	-	1724	007	TP2	II/2	161	02
Fish	2	0.04	-	1724	007	TP2	III	162	01.01
Fish	1	0.07	-	1724	043	TP1	II upper	097	01.01
Fish		18.80	-	1724	055	TP1	I/1	010	05.10
Fish	2	0.01	-	1724	060	TP1	I	127	01
Fish	3	0.03	-	1726	030	ST1	II	103	01.01
Herpestes auropunctatus	2	1.02	-	1723	008			181	01.02
Holocentrid	5	3.00	-	1724	055	TP1	I/1	010	05.01
Labrid	30	0.72	6	1724	055	TP1	I/1	010	05.05
Lizard, small	3	0.04	3	1724	055	TP1	I/1	010	05.11
Lizard, small	2	0.02	2	1726	002	TP1	I	032	02.01
Lizard, small	12	0.01	2	1726	008	Prfle		182	02.01
Lizard, small	1	0.01	-	1726	008	TP1	Fea.a	045	01.01
Lizard, small	2	0.10	2	1726	008	TP1	I	039	01.01
Lizard, small	2	0.02	-	1726	008	TP1	II/1	040	01.01
Lizard, small	1	0.01	-	1726	008	TP1	II/2	041	01.01
Lizard, small	1	0.03	-	1726	031	TP1		163	02.01
Lizard, small	1	0.02	-	1726	034	ST1	N/A	172	01.01
Mammal, large	1	1.61	-	1724	007	TP2	II/1	160	02.04
Mammal, medium and/or large	8	3.77	-	1724	007	TP1	I/1	068	01.07
Mammal, medium or large	1	0.55	-	1724	007	TP1	I/2	070	03.03
Mammal, medium or large	1	0.42	-	1724	007	TP2	I	159	01
Mammal, small to medium and/or medium	23	2.58	-	1724	007	TP2	II/1	160	02.03
Mammal, small to medium and/or medium	11	1.24	-	1724	007	TP1	I/1	068	01.06
Mammal, small to medium and/or medium	4	0.85	-	1724	055	TP1	I/1	010	05.20
Mammal, small to medium or medium	1	0.03	-	1724	003	TP1	I/1	018	02.07
Mammal, small to medium or medium	1	0.66	-	1724	003	TP1	I/1	018	02.09
Mammal, small to medium or medium	1	0.01	-	1726	002	TP1	III	034	01
Monacanthid (genus *Pervagor*)	1	0.03	-	1724	003	TP1	I/1	018	02.02
Monacanthid (genus *Pervagor*)	1	0.03	-	1726	008	TP1	II/11	053	01.01
Mullid	36	0.77	6	1724	055	TP1	I/1	010	05.04
Mus musculus	1	0.01	-	1724	042	TP1	II/1	082	01.04
Mus musculus	3	0.04	-	1724	055	TP1	I/1	010	05.18
Mus musculus	1	0.01	-	1726	002	TP1	I	032	02.03

Table A-6. Phase II Faunal Collections by Taxon (continued).

Taxon	Count	Wt.(g)	MNI	Site	Fea	Grid	Layer	LN	LNX
Mus musculus	3	0.06	-	1726	008	TP1	I	039	01.06
Mus musculus	3	0.03	-	1726	008	TP1	II/1	040	01.04
Mus musculus	1	0.01	-	1726	008	TP1	II/2	041	01.06
Mus musculus	1	0.01	-	1726	031	TP1		163	02.05
Passeriform, small	2	0.06	2	1724	036	ST1	II	124	02.03
Passeriform, small	1	0.07	-	1726	008	TP1	II/4	043	01.02
Polynemid	6	0.10	2	1724	055	TP1	I/1	010	05.02
Porzana ziegleri	1	0.03	-	1724	055	TP1	I/1	010	05.12
Procellariid, medium	1	0.44	-	1723			Surface	173	01.02
Procellariid, medium	7	0.30	2	1724	003	TP1	II/1	020	01.02
Procellariid, medium	7	0.34	2	1724	003	TP1	II/2	021	01.02
Procellariid, medium	1	0.07	-	1724	005	TP1	II	075	01.01
Procellariid, medium	1	0.35	-	1724	007	TP2	III	162	01.02
Procellariid, medium	1	0.78	-	1724	019	SC	Floor surface	193	00
Procellariid, medium	1	0.02	-	1724	034			170	01.01
Procellariid, medium	1	0.09	-	1726	008	TP1	II/8	050	01.01
Procellariid, medium	1	0.13	-	1726	008	TP1	Fea.a	044	01.01
Procellariid, medium	1	0.49	-	1726	008	TP1	II/3	042	01.01
Procellariid, medium	3	0.37	-	1726	008	TP1	II/4	043	01.01
Procellariid, medium	1	0.12	-	1726	008	TP1	II/5	047	01.01
Procellariid, medium	2	0.52	-	1726	008	TP1	II/7	049	01.01
Procellariid, medium	4	0.93	2	1726	028			169	01.01
Procellariid, medium	8	0.94	-	1724	036	ST1	II	124	02.02
Procellariid, small	1	0.07	-	1724	036	ST1	II	124	02.01
Pterodroma phaeodygia	1	0.09	-	1723			Surface	173	01.01
Rattus exulans	4	0.08	-	1724	002	TP1	IIA,B	007	01
Rattus exulans	4	0.06	-	1724	003	TP1	I/1	018	02.06
Rattus exulans	6	0.05	-	1724	003	TP1	II/1	020	01.05
Rattus exulans	2	0.01	-	1724	003	TP1	II/2	021	01.06
Rattus exulans	2	0.02	-	1724	004	TP1	I/1	027	02
Rattus exulans	1	0.02	-	1724	007	TP1	I/1	068	01.03
Rattus exulans	1	0.01	-	1724	007	TP1	I/2	070	03.02
Rattus exulans	1	0.03	-	1724	007	TP2	II/1	160	02.02
Rattus exulans	1	0.01	-	1724	007	TP2	III	162	01.03
Rattus exulans	8	0.13	-	1724	034			170	01.05
Rattus exulans	5	0.18	2	1724	036	ST1	II	124	02.05

Table A-6. Phase II Faunal Collections by Taxon (continued).

Taxon	Count	Wt.(g)	MNI	Site	Fea	Grid	Layer	LN	LNX
Rattus exulans	3	0.07	-	1724	042	TP1	II/1	082	01.02
Rattus exulans	3	0.05	-	1724	048	ST1	II	093	01
Rattus exulans	16	0.25	-	1724	055	TP1	I/1	010	05.16
Rattus exulans	1	0.01	-	1724	055	TP1	II/1	011	01.01
Rattus exulans	4	0.03	-	1726	002	TP1	I	032	02.02
Rattus exulans	2	0.04	-	1726	002	TP1	II	033	01.01
Rattus exulans	17	0.11	2	1726	008	Prfle		182	02.04
Rattus exulans	11	0.21	2	1726	008	TP1	Fea.a	044	01.04
Rattus exulans	2	0.03	-	1726	008	TP1	Fea.a	046	01.02
Rattus exulans	11	0.08	-	1726	008	TP1	Fea.a	045	01.02
Rattus exulans	10	0.21	2	1726	008	TP1	I	039	01.04
Rattus exulans	4	0.10	-	1726	008	TP1	II/1	040	01.03
Rattus exulans	24	0.51	4	1726	008	TP1	II/2	041	01.04
Rattus exulans	11	0.25	2	1726	008	TP1	II/3	042	01.04
Rattus exulans	17	0.34	3	1726	008	TP1	II/4	043	01.07
Rattus exulans	2	0.10	-	1726	008	TP1	II/5	047	01.03
Rattus exulans	1	0.04	-	1726	008	TP1	II/8	050	01.03
Rattus exulans	2	0.04	-	1726	030	ST1	I	102	02
Rattus exulans	3	0.12	2	1726	030	ST1	II	103	01.03
Rattus exulans	2	0.10	-	1726	030	ST1	III	104	01.01
Rattus exulans	8	0.13	2	1726	031	TP1		163	02.03
Rattus exulans	3	0.07	-	1726	034	ST1	N/A	172	01.04
Rattus exulans and/or *Mus musculus*	6	0.03	-	1726	008	Prfle		182	02.06
Rattus norvegicus and/or *R. rattus*	3	0.11	-	1724	034			170	01.02
Rattus norvegicus and/or *R. rattus*	4	0.13	-	1726	008	TP1	I	039	01.05
Rattus norvegicus and/or *R. rattus*	3	0.05	-	1726	031	TP1		163	02.04
Rattus norvegicus or *R. rattus*	1	0.12	-	1723	008			181	01.01
Rattus norvegicus or *R. rattus*	1	0.02	-	1724	042	TP1	II/1	082	01.03
Rattus norvegicus or *R. rattus*	1	0.02	-	1724	044	ST1	I	136	01
Rattus norvegicus or *R. rattus*	1	0.02	-	1726	008	TP1	II/2	041	01.05
Rattus norvegicus or *R. rattus*	1	0.03	-	1726	028			169	01.03
Rattus sp.	1	0.06	-	1726	008	Prfle		182	02.05
Scarid (genus *Calotomus*)	1	0.40	-	1724	007	TP1	I/1	068	01.01
Scarid (genus *Calotomus*)	4	0.11	-	1724	055	TP1	I/1	010	05.06
Sus scrofa	1	0.37	-	1724	003	TP1	II/2	021	01.07
Sus scrofa	3	1.38	-	1724	007	TP1	I/1	068	01.04

Table A-6. Phase II Faunal Collections by Taxon (continued).

Taxon	Count	Wt.(g)	MNI	Site	Fea	Grid	Layer	LN	LNX
Sus scrofa	1	0.09	-	1724	055	TP1	I/1	010	05.19
Vertebrate, medium	5	0.02	-	1724	003	TP1	II/2	021	01.08
Vertebrate, medium	1	0.03	-	1724	005	TP1	II	075	01.03
Vertebrate, medium	3	0.13	-	1724	007	TP1	I/1	068	01.08
Vertebrate, medium	3	0.43	-	1724	007	TP1	I/2	070	03.04
Vertebrate, medium	22	0.93	-	1724	007	TP2	II/1	160	02.05
Vertebrate, medium	2	0.01	-	1724	043	TP1	II upper	097	01.02
Vertebrate, medium	3	0.10	-	1726	002	TP1	I	032	02.05
Vertebrate, medium	2	0.02	-	1726	002	TP1	II	033	01.02
Vertebrate, medium	2	0.01	-	1726	008	TP1	I	039	01.07
Vertebrate, medium	2	0.35	-	1726	030	ST1	II	103	01.04
Vertebrate, medium	1	0.06	-	1726	034	ST1	N/A	172	01.03
Vertebrate, small	1	0.01	-	1726	002	TP1	I	032	02.04
Vertebrate, small	2	0.03	-	1726	008	TP1	Fea.a	044	01.05
Vertebrate, small	5	0.01	-	1726	008	TP1	Fea.a	046	01.03
Vertebrate, small	5	0.01	-	1726	008	TP1	Fea.a	045	01.05
Vertebrate, small	3	0.06	-	1726	008	TP1	II/2	041	01.07
Vertebrate, small	1	0.02	-	1726	030	ST1	III	104	01.02
Vertebrate, small and/or medium	8	0.30	-	1724	003	TP1	I/1	018	02.08
Vertebrate, small and/or medium	8	0.02	-	1724	003	TP1	II/1	020	01.06
Vertebrate, small and/or medium	32	0.58	-	1724	055	TP1	I/1	010	05.17
Vertebrate, small and/or medium	2	0.02	-	1724	055	TP1	II/1	011	01.02
Vertebrate, small and/or medium	27	0.04	-	1726	008	Prfle		182	02.07
Vertebrate, small and/or medium	3	0.04	-	1726	008	TP1	II/1	040	01.05
Vertebrate, small or medium	5	0.07	-	1726	008	Prfle		185	01
Vertebrate, small or medium	1	0.04	-	1726	008	TP1	II/3	042	01.05
Vertebrate, small or medium	1	0.02	-	1724	007	TP2	III	162	01.04

Table A-6. Phase II Faunal Collections by Taxon (continued).

Taxon	Count	Wt.(g)	MNI	Site	Fea	Grid	Layer	LN	LNX

Table A-6: Phase II Faunal Collections, by Excavation Unit.by Dr. Alan Ziegler.

The Table A-6 presents bone identifications made by Dr. Alan Ziegler.

MNI=minimum number of individuals.

Count=number of bone fragments.

Wt=collected material in grams.

LN.LNX=lab number.

Table A-7. Site number concordance.

Site/Feature	Coordnant	Phase I	Haun (1991)	Other
1723				
1723-	012/ 159			
1723-01	028/ 168			
1723-02	021/ 172			
1723-03	020/ 180			
1723-04	040/ 186			
1723-05a	040/ 196			
1723-05b	040/ 196			
1723-05c	040/ 196			
1723-05d	040/ 196			
1723-06	036/ 215			
1723-07	-06/ 246	18-A		
1723-08	066/ 220			
1723-09a	083/ 232			
1723-09b	083/ 232			
1723-09c	083/ 232			
1723-10	096/ 222	21-A		
1723-11	014/ 225			
1723-12	086/ 198			
1723-13	110/ 222			
1723-14	042 228	20-A		
1724				
1724-01	052/ 115			
1724-02	057/ 130			
1724-03	050/ 120			
1724-04	061/ 100			
1724-05	044/ 111			
1724-06	046/ 119			
1724-07	046/ 120			
1724-08	031/ 114			
1724-09	033/ 111			
1724-10	018/ 103			
1724-11	024/ 096			
1724-12	031/ 116			
1724-13	028/ 114			
1724-14	033/ 121			
1724-15	031/ 120			
1724-16	030/ 120			
1724-17	035/ 129			
1724-18	048/ 127			
1724-19	031/ 133			
1724-20	026/ 127			
1724-21a	025/ 134			
1724-21b	025/ 134			
1724-21c	025/ 134			
1724-22	022/ 140			
1724-23	030/ 138			
1724-24	022/ 142			
1724-25	044/ 140	21-D		
1724-26	049/ 139			
1724-27a	076/ 138			
1724-27b	076/ 138			
1724-27c	076/ 138			
1724-27d	076/ 138			
1724-28	068/ 138			
1724-29a	065/ 119			
1724-29b	065/ 119			
1724-29c	065/ 119			
1724-29d	065/ 119			
1724-29e	065/ 119			
1724-30	063/ 104			
1724-31	074/ 100			
1724-32	050/ 106		H	
1724-33	044/ 104			
1724-34	067/ 108			
1724-35	030/ 141			
1724-36	066/ 144			
1724-37a	076/ 138			
1724-37b	076/ 138			
1724-38	050/ 133			
1724-39a	054/ 155			
1724-39b	054/ 155			
1724-40	042/ 159			
1724-41	041/ 167			
1724-42	061/ 156			
1724-43	068/ 163	21-F		
1724-44	076/ 170	21-B1		
1724-45	090/ 170			
1724-46	094/ 171			
1724-47	090/ 153	23-A(7)		
1724-48	110/ 164			
1724-49	140/ 170			
1724-50	114/ 180			
1724-51	100/ 153			
1724-52	079/ 126			
1724-53	085/ 112			
1724-54	076/ 096			
1724-55	051/ 120	21-E	F	
1724-56	059/ 114			
1724-57	058/ 109			
1724-58	099/ 114			
1726				
1726-01	042 048		A	
1726-02	078/ 022	22-B		
1726-03a	056/ 040	21-J		
1726-03b	056/ 040	21-J		
1726-04	084/ 010	22-A		
1726-05	084/ 020			
1726-06	078/ 032	22-C		
1726-07a	118/ 017	23-G		
1726-07b	118/ 017	23-G		
1726-07c	118/ 017	23-G		
1726-07d	118/ 017	23-G		
1726-08	117/ 023	23-E		
1726-09	134/ 023			
1726-10a	149/ 015	23-F		
1726-10b	149/ 015	23-F		
1726-11a	162/ 032	24-A		
1726-11b	162/ 032	24-A		
1726-11c	162/ 032	24-A		
1726-12	118/ 039	22-D		
1726-13	112/ 034			
1726-14	075/ 039			
1726-15	060/ 057		B	
1726-16	068/ 065			
1726-17	078/ 064			
1726-18	088/ 060			
1726-19a	102/ 058	22-E		
1726-19b	102/ 058	22-E		
1726-20	095/ 064			
1726-21	101/ 068			
1726-22	110/ 078			
1726-23	092/ 078	22-F		
1726-24	098/ 078			
1726-25	096/ 083			
1726-26	079/ 090			
1726-27	078/ 092			
1726-28	075/ 080			
1726-29	070/ 086			
1726-30	084/ 076			
1726-31	125/ 079			
1726-32	114/ 090			
1726-33	052/ 073	21-H	C	
1726-34	054/ 078			
1726-35	098/ 083			
4701	081/ 047			
4702		*		
4702-01	140/ 062			
4702-02	140/ 072			
4702-03	146/ 050			
4702-04	158/ 125			
4702-05	162/ 052			
4702-06	124/ 124			1724-59**
4702-07	093/ 114			1724-60**
4702-08	071 114			1724-61**
4702-09	130/ 110			
4702-10	128/ 114			
4702-11	132/ 114			
4702-12	125/ 125			

*21-F,G, 21-B(2), 21-C, 21-C(2), 23-A(1)-(6), 23-B, 23-D, 24-B(1)-(2), 25-A(1)-(6).
**changed after field tagging.

APPENDIX B:
MACROSCOPIC SCREENING RESULTS OF CHARCOAL SAMPLES FROM BARBERS POINT, O‘AHU

by

Gail M. Murakami
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Fourteen charcoal samples from Barbers Point, O‘ahu, were screened under a dissecting microscope at magnifications up to 40X for the presence of alien and easily identifiable native taxa. While no alien taxa were recognized, five native taxa were tentatively identified in the screening (Table B-1). Short descriptions of these taxa, arranged alphabetically by family, are presented in the following review. The results are summarized in Table B-2 and the distribution of the identified taxa among the samples is given in Table B-3. The percentages used in Tables B-2 and B-3 are based on the sorted sample weight.

Review of Taxa

Amaranthaceae

Nototrichium spp. (*kulu‘i*)

The two species of this endemic genus, found on O‘ahu, are shrubs to small trees with stems up to 7 m long. They are generally found in open dry forests (Wagner et al. 1990: 193-194).

Chenopodiaceae

Chenopodium oahuense (Meyen) Aellen (*‘aheahea*, *‘āweoweo*)

This endemic species is usually a shrub in the coastal lowlands but may become arborescent at higher elevations (Hillebrand 1888: 380). Its known distribution in the main Hawaiian Islands includes coastal, dry forest, and subalpine shrubland at 0-2,520 meters elevation (Wagner et al. 1990: 538). The soft wood was probably not used by the ancient Hawaiians but the leaves were cooked and eaten as greens (Hillebrand 1888: 380; Malo 1951: 23).

Euphorbiaceae

Aleurites moluccana (L.) Willd. (*kukui*)

Once cultivated, this Polynesian introduction has escaped into the native forest, where the pale foliage of the 10 to 20 meter trees (Wagner et al. 1990: 598) can be seen in abundance in moist gulches and valleys. Dyes were once extracted from the bark and roots (Buck 1957: 187), the oily kernel was burned for light (Buck 1957: 107) or eaten as a relish after baking (Buck 1957: 48), and net floats and dugout canoes were made from the soft wood (Buck 1957: 297).

Chamaecyse spp. (*‘akoko*)

The endemic members of this genus consists of 15 species which may be found in coastal to wet forests as shrubs to small trees (Wagner et al. 1990:602-617). Hillebrand (1888: 396) believed the Hawaiians valued *‘akoko* for firewood. The milky sap was once considered a possible source for rubber (Rock 1913: 261).

Malvaceae

Sida fallax Walp. (*'ilima*)

This indigenous shrub was planted in the past as it is today near houses to provide flowers for *lei* making (Neal 1965: 553). It has been found along coasts, on open lava fields, in dry to mesic forests on all of the main Hawaiian islands (Wagner et al. 1990: 898). The entire plant had many uses for the native Hawaiians. The erect stems were tied to the frame of the sleeping house upon which *pili* grass (*Heteropogon contortus*) was lashed. Whole *'ilima* bushes tied together were also used to secure mounds of taro plantings in swampy areas. The prostrate coastal *'ilima* was used as floor coverings under mats (Handy & Handy 1972: 228). The roots and flowers were used medicinally (Neal 1965: 553).

* * * * *

Table B-1. Taxa Identified from Macroscopic Screening of Charcoal Samples from Barbers Point, O'ahu.

Scientific Name	Common Name	Origin	Habit	Part
Aleurites moluccana	*Kukui*	Polynesian Introduction	Tree	Nutshell
Chamaesyce spp.	*'Akoko*	Endemic	Shrub	Wood
Chenopodium oahuense	*'Āheahea, 'Āweoweo*	Endemic	Shrub-tree	Wood
Nototrichium sp.	*Kalu'i*	Endemic	Shrub-tree	Wood
Sida fallax	*'Ilima*	Indigenous	Shrub	Wood

Table B-2. Summary of Macroscopic Screening of Charcoal Samples from Site 1724, Barbers Point, O‘ahu.

Cat. No.	Feature	Grid	Layer/Level	Taxa	Count	Wt., g	% Wt.
LN 6.4	2	ST-1	II	*Chamaesyce* spp.	1	0.02	100.0
LN 7.4	2	TP-1	II	1 taxa	1	0.03	100.0
LN 18.5	3	TP-1	I/1	*Chamaesyce* spp.	4	0.06	7.6
				Chenopodium oahuense	5	0.08	10.0
				cf. *Sida fallax*	1	0.02	2.5
				ca. 8 taxa	32	0.63	79.9
LN 19.3	3	TP-1	I/2	*Chamaesyce* spp.	--	1.20	53.4
				Chenopodium oahuense	--	0.48	21.3
				ca. 10 taxa	--	0.57	25.3
LN 20.4	3	TP-1	II/1	*Chenopodium oahuense*	3	0.05	10.9
				ca. 9 taxa	21	0.40	87.0
				Aleurites moluccana nutshell	1	0.01	2.1
LN 21.2	3	TP-1	II/2	ca. 4 taxa	6	0.02	100.0
LN 68.6	7	TP-1	I/1	ca. 4 taxa	9	0.20	100.0
LN 69.1	7	TP-1	Fe. A	*Chenopodium oahuense*	3	0.24	100.0
LN 70.1	7	TP-1	I/2	2 taxa	2	0.16	100.0
LN 82.6	42	TP-1	II/1	1 taxa	1	0.03	100.0
LN 97.4	43	TP-1	II, upper	cf. *Chamaesyce* spp.	2	0.41	51.3
				Chenopodium oahuense	6	0.39	48.7
LN 98.4	43	TP-1	II, lower	1 taxa	1	0.04	100.0
LN 10.8	55	TP-1	I/1	*Chenopodium oahuense*	1	<0.01	<50.0
				1 taxa	1	0.01	>50.0
LN 143.2.0	11	TP-2	Fe. A	*Chamaesyce* spp.	--	1.20	53.4
				Chenopodium oahuense	--	0.31	10.2
				Nototrichium sp.	--	0.16	5.2
				ca. 10 taxa	--	1.26	41.3

Table B-3. Distribution of Taxa in Charcoal Samples from Site 1724, Barbers Point, O‘ahu.

Taxa Catalog Number:	6.4	7.4	10.8	18.5	19.3	20.4	21.2	68.6	69.1	70.1	82.6	97.4	98.4	143.2.0
Aleurites moluccana						2.1								
Chamaesyce spp.	100			7.6	53.4							51.3		53.4
Chenopodium oahuense			50.0	10.0	21.3	10.9			100			48.7		10.2
Nototrichium sp.														5.2
cf. *Sida fallax*				2.5										
Other taxa		100	50.0	79.9	25.3	87.0	100	100		100	100		100	41.3

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APPENDIX C:
TECHNICAL DESCRIPTIONS; SITES/FEATURES AND TEST EXCAVATIONS

Features and text excavations are presented below in summarized form. The terminology used for sinkhole and depressions is shown in Figure 15. In particular note that "surface" is used only for ground surface, and that "floor" is used for the top of the sediment in a sinkhole or depression. A distinction is made between "sediment" and "fill". "Sediment" refers to the natural and cultural deposition in a sinkhole or depression, usually a fine-grained matrix (sand-sized and smaller) with pebble and cobble inclusions, creating a level floor. "Fill" refers to material, usually pebbles to boulders, deposited on top of the floor; in most cases this fill is cultural, sometimes from Hawaiian placement, sometimes from bulldozing. The term "sump" refers to the area opening into a drainage channel in a sink chamber; deposits, including bird bone, often accumulate at this point. This term was provided by Alan Ziegler, who indicated that it has become the conventional usage for this part of a sinkhole.

The measurements of a sinkhole give dimensions of the opening and the floor, plus the depth to the floor (unless otherwise noted). The floor dimensions are the total floor area, including that extending under overhangs.

With a few exceptions made for unique occurrences, common names only are used for plants in the feature descriptions. These plants were not specifically identified in the field by botanists, but based upon the botanical survey of the area (Appendix D) are assumed to be the following taxa: *kiawe* (*Prosopis pallida*), *wiliwili* (*Erythrina sandwicensis* Deg.), banyan (*Ficus microcarpa*), *opiuma* (*Pithecellobium dulce*), Philippine violet (*Barleria cristata* L.), octopus tree (*Schleffera actinophylla* [Endl.] Harms), and wild basil (*Ocimum gratissimum* L.).

Identifications of site/feature function and age are generally preliminary evaluations, based on information from comparable features studied elsewhere on the 'Ewa Plain.

The soil descriptions are a combination of field observations and laboratory study. Soil color was identified dry, in the lab. Calcareous content was identified in the lab by visual evaluation of acid-produced effervescence.

Land snail quantity is a rough assessment based on laboratory evaluation of soil samples, augmented by field observations. Marine shell is categorized as either cultural midden or natural deposition from limestone erosion, based on criteria discussed in the main text.

ABBREVIATIONS

Testing:
ST=shovel test.
TP=test pit.

Measurements:
bs=below surface.
cm=centimeter.
m=meter.

Other:
LN=Lab number (see Appendix A, Table 4).
NA=not available.
NT=not tested.

Note: all stone is limestone unless otherwise noted.

Site/Feature No: 1723-1
Other No: E28/N68.
Figure(s): 11, Photo 3.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.22 x 1.15 m opening; 2.1 x 1.2 m floor; 160 cm depth.
Description: oval-shaped sinkhole, with 50 cm high, shallow overhang; ti (*Cordyline fruticosa*) plant growing in sink.
Surface: rough limestone bedrock; thin vegetation cover, primarily scattered brush and *kiawe*.
Floor: soil deposit with a few loose rocks.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: agriculture?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1723-2
Other No: E21/N172.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.19 x 1.15 m opening; 2.20 x 1.20 m floor; 180 cm depth.
Description: oval-shaped sinkhole, with overhang extending to west; small (.25 m wide) sink opening to NE.
Surface: rough limestone; fallen *kiawe* on north side; thin vegetation cover, primarily scattered brush and *kiawe*.
Floor: soil deposit; animal bones found on the surface were identified as *Bos taurus cf.*, and medium Artiodactyl, probably cow and sheep/goat; these were probably naturally deposited during the ranching period.
Deposit: NT.
Fill: several large boulders lie in the SE corner of the sink.
Cultural material: none.
Function: agriculture?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendation: data recovery if necessary.

Site/feature No. 1723-3
Other No: E20/N80.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.55 x .90 m opening; 2.60 x 1.4 m floor; 115 cm depth.
Description: oval-shaped sinkhole opening, bell-shaped chamber 45 cm bs; narrow shelf on east side.
Surface: rough limestone bedrock; thin vegetation cover, primarily scattered brush and *kiawe*.
Floor: soil deposit with a layer of cobbles.
Deposit: NT.
Fill: none.
Cultural material: metal cylinder (military? not collected) lying on shelf.
Function: agriculture?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendation: data recovery if necessary.

Site/Feature No: 1723-4
Other No: E40/N186.
Figure(s): 11, C-1.
Testing: one ST.
Natural feature: depression.
Structure: none.
Dimensions: 4.75 x 3.02 m; 5 to 25 cm depth.
Description: irregular-shaped depression; smaller depression to S.
Surface: smooth limestone bedrock, with dense ground cover of basil and grasses; scattered *kiawe* and banyan.
Floor: soil deposit.
Deposit: humus and weathering, redeposited silt.
Fill: none.
Cultural material: none.
Function: non-cultural.
Age: NA.
Natural history: bird egg shell.
Research potential: limited to problem of origin of egg shell.
Recommendations: no further work.

Test Excavations: One shovel test was placed in the unit (Fig. C-1). Bedrock was encountered at 40 cm bs. No cultural material was located.

1723-4, ST-1 Descriptions:

Layer I **Dimensions:** surface; 3 cm thick. **Matrix:** very dark brown (10YR 2/2. mottled with some sand-size grains of limestone) silt loam (non-calcareous); weak, crumb, medium; slightly sticky, non-plastic, loose; abrupt, smooth boundary. **Composition:** not determined. **Inclusions:** land snails in low density; insect fragments, plant fragments. **Intrusions:** roots and rootlets. **Cultural material:** none. **Interpretation:** duff in process of forming soil.

Layer II **Dimensions:** 3 cm bs; 21 cm thick. **Matrix:** dark yellowish brown (10YR 3/6) silt (non-calcareous); moderate, crumb, medium; slightly sticky, non-plastic, soft; abrupt, smooth boundary. **Composition:** not determined; limestone pebbles and cobbles present. **Inclusions:** no land snails; marine shell, bird egg shell. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** weathering upper unit of a natural silt deposit; no evidence of cultural modification.

Layer III **Dimensions:** 24 cm bs; 16 cm thick. **Matrix:** dark yellowish brown (10YR 4/6) silt (non-calcareous); moderate, crumb, medium; slightly sticky, slightly plastic, fine; abrupt boundary with limestone bedrock. **Composition:** not determined; limestone pebbles and cobbles present. **Inclusions:** no land snails; bird egg shell. **Intrusions:** roots and rootlets. **Cultural material:** none. **Interpretation:** natural silt deposition.

Site/Feature No: 1723-5a-d
Other No: E40/N196.
Figure(s): 11.
Testing: none.
Natural feature: depression and three sinkholes.
Structure: one or two stone slabs over each of the sinkholes.
Dimensions: (a) depression 5.4 x 3.4 m, 15 to 25 cm depth; (b),(c), and (d) sinkholes .3 m diameter opening, 20 to 30 cm to top of fill, possibly as deep as 200 cm.
Description: oval-shaped depression; 3 small-apertured, deep sinkholes adjacent; bulldozing debris at edge of depression.
Surface: shallow soil cover around depression, with heavy vegetation of basil, grasses, vines, and *kiawe*; sinks are on open limestone bedrock.
Floor: depression has soil deposition; sink floors not determinable due to small size and fill.
Deposit: NT.
Fill: no fill in depression; some rock fill in three sinkholes.
Cultural material: none.
Function: unknown.
Age: NA.
Natural history: NA.
Condition: Good
Research potential: by comparison with other similar features, these features should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

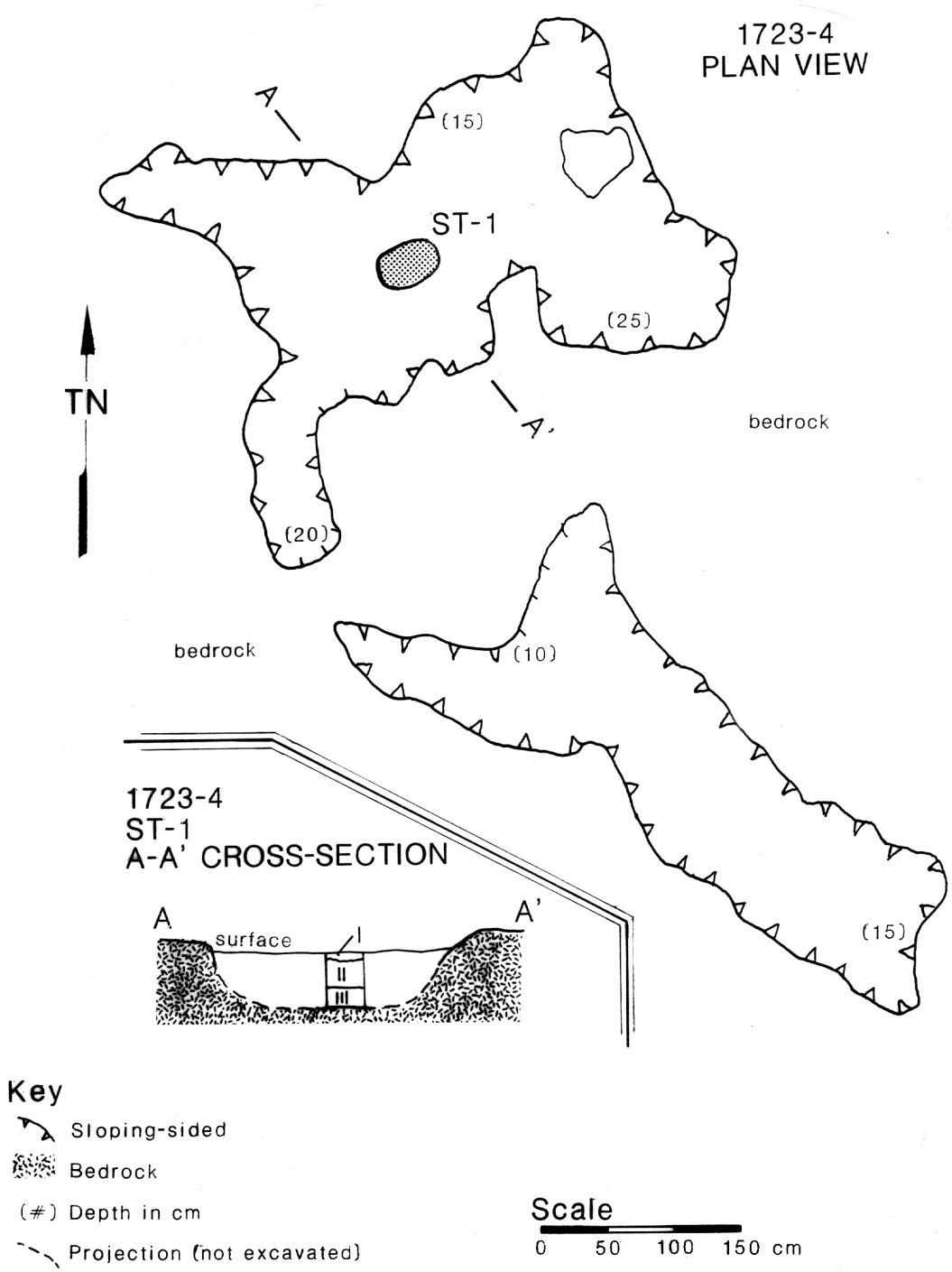

Figure C-1. Site 1723-4.

Site/Feature No: 1723-6
Other No: E36/N215.
Figure(s): 11, C-2.
Testing: rock fill removed.
Natural feature: sinkhole.
Structure: rock fill to surface; slab scatter (placed?) around opening.
Dimensions: .55 x .53 m opening; 1.15 x .55 m floor; 83 cm depth.
Description: circular sinkhole, rock-filled, vertical walls; overhang at 75 cm bs, probable bell-shaped chamber.
Surface: open limestone bedrock, with scatter of limestone slabs.
Floor: soil deposit.
Deposit: NT.
Fill: cobbles and boulders to surface.
Cultural material: none.
Function: agriculture and other?
Age: pre-contact to mid-1800s.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendation: data recovery, if necessary.

Test Excavation: The rock fill was completely removed. No human bone or cultural material were found. The deposit was not tested.

Site/Feature No: 1723-7
Other No: E-6/N246; Phase I 18-A.
Figure(s): 11, C-3.
Testing: one ST outside sinkhole.
Natural feature: sinkhole.
Structure: none.
Dimensions: estimated 1.0 x .75 m opening; floor area and depth undetermined.
Description: sinkhole covered with stone rubble; sinkhole is adjacent to developed and filled warehouse area; rubble over sinkhole is probably from bulldozing during construction.
Surface: shallow, rocky soil; light brush cover and scattered *kiawe* and *koa haole*.
Floor: NA.
Deposit: deposit within sink unknown; test outside sink shows some fire-cracked limestone pebbles.
Fill: NA.
Cultural material: on the surface, some fire-cracked limestone pebbles and one fragment of burned Conus shell; fire-cracked rock in deposit outside sink.
Function: possible agriculture, but fire-cracked rock suggests some habitation activity.
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: Probably good; sinkhole is under bulldozed rock, but probably intact; condition of surface deposit is uncertain.
Research potential: there is the possibility of intact habitation deposits around the sink, and by comparison with other similar features, the sink should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery if necessary; data recovery would require (1) trenching of the surface deposit to locate intact deposits associated with fire-cracked rock, and (2) removing of boulders and debris from the sinkhole prior to sink excavation.

Test Excavation: One shovel test was placed on SW side of sink and rock debris. The test showed that there is fire-cracked rock not only on the surface but in the shallow soil deposit. Bedrock is 12 cm bs.

1723-7, ST-1 Description:

Layer I **Dimensions:** surface; 3 cm thick. **Matrix:** black (10YR 2/1. mottled with small fragments of limestone) loam (non-calcareous); structureless; non-sticky, non-plastic, loose; abrupt, smooth boundary. **Composition:** not determined. **Inclusions:** numerous land snails; plant and insect fragments. **Intrusions:** rootlets. **Cultural material:** a few fire-cracked limestone pebbles. **Interpretation:** recent organic duff, forming soil.

Layer II **Dimensions:** 3 cm bs; 9 cm thick. **Matrix:** dark yellowish brown (10YR 4/4) clay loam (non-calcareous); weak, crumb, medium; slightly sticky, slightly plastic, soft; abrupt smooth boundary on bedrock. **Composition:** not determined. **Inclusions:** land snails in high density. **Intrusions:** roots. **Cultural material:** fire-cracked pebbles. **Interpretation:** this is a deposit with cultural material, possibly a secondary deposit resulting from surface disturbance (bulldozing).

Site/Feature No: 1723-8
Other No: E66/N220.
Figure(s): 11, C-4.
Testing: rock fill removed.
Natural feature: sinkhole.
Structure: rock fill.
Dimensions: 1.66 x .82 m opening; 6.4 x 4.40 m floor; 190 cm depth.
Description: oval-shaped sinkhole with a shelf on N side; at bottom of shaft extensive chamber opens to the S, with very low overhang over deposit.
Surface: smooth limestone bedrock; no vegetation except a few *koa haole*.
Floor: soil deposit.
Deposit: NT
Fill: shaft filled to surface with cobbles and boulders, which do not extend into chamber; bone fragments on ledge (ca. 50 cm bs), are of mongoose and European rat.
Cultural material: none.
Function: agriculture possible, but unlikely due to shape of sink hole.
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Test Excavations: A portion of rock fill was removed, sufficient to allow access to the floor and to determine whether or not there was any cultural material in or below the fill. Rock fill consisted of cobbles and boulders, some as large as 50 to 60 cm long. Large slab and boulder fill was left on and around shelf on N.

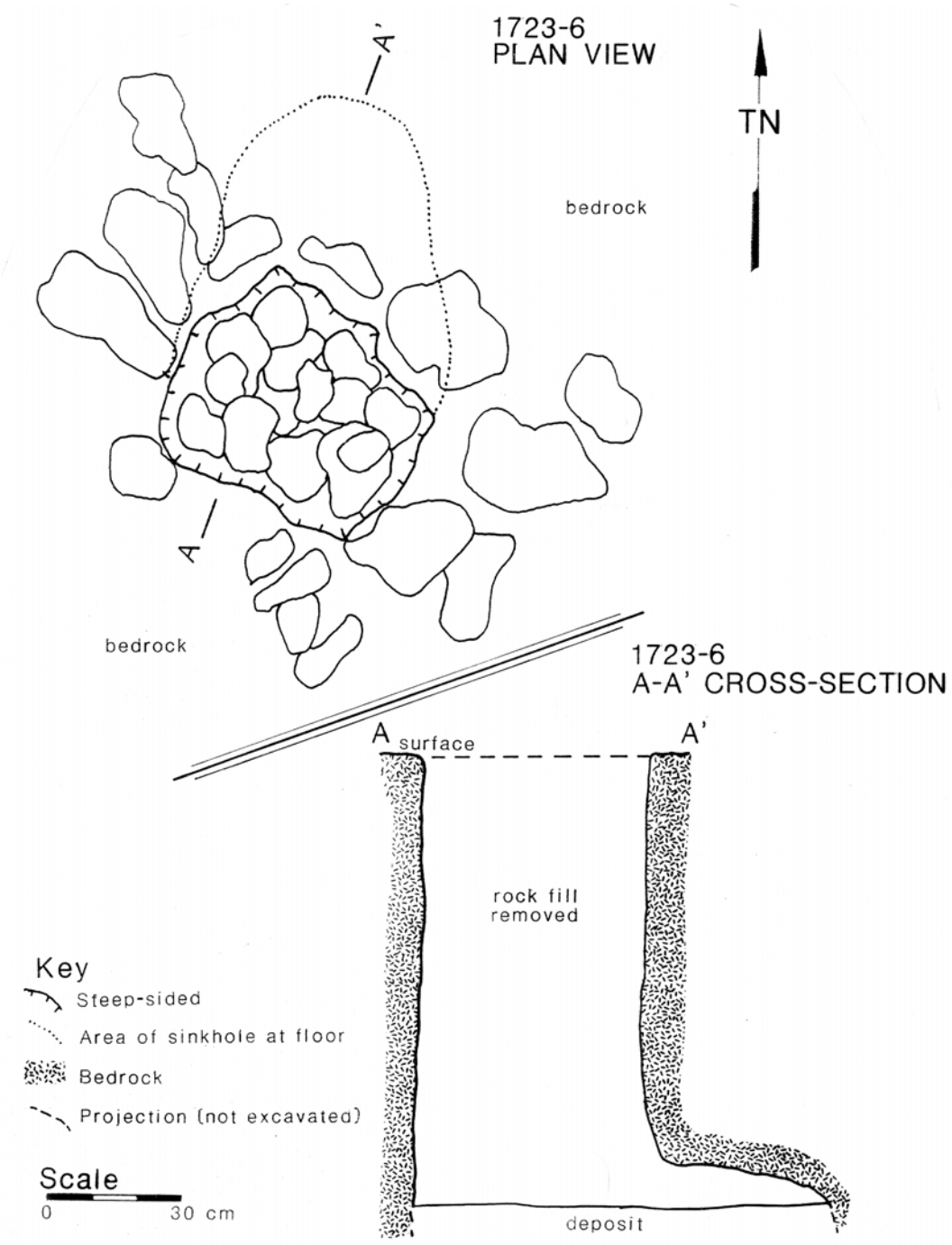

Figure C-2. Site 1723-6.

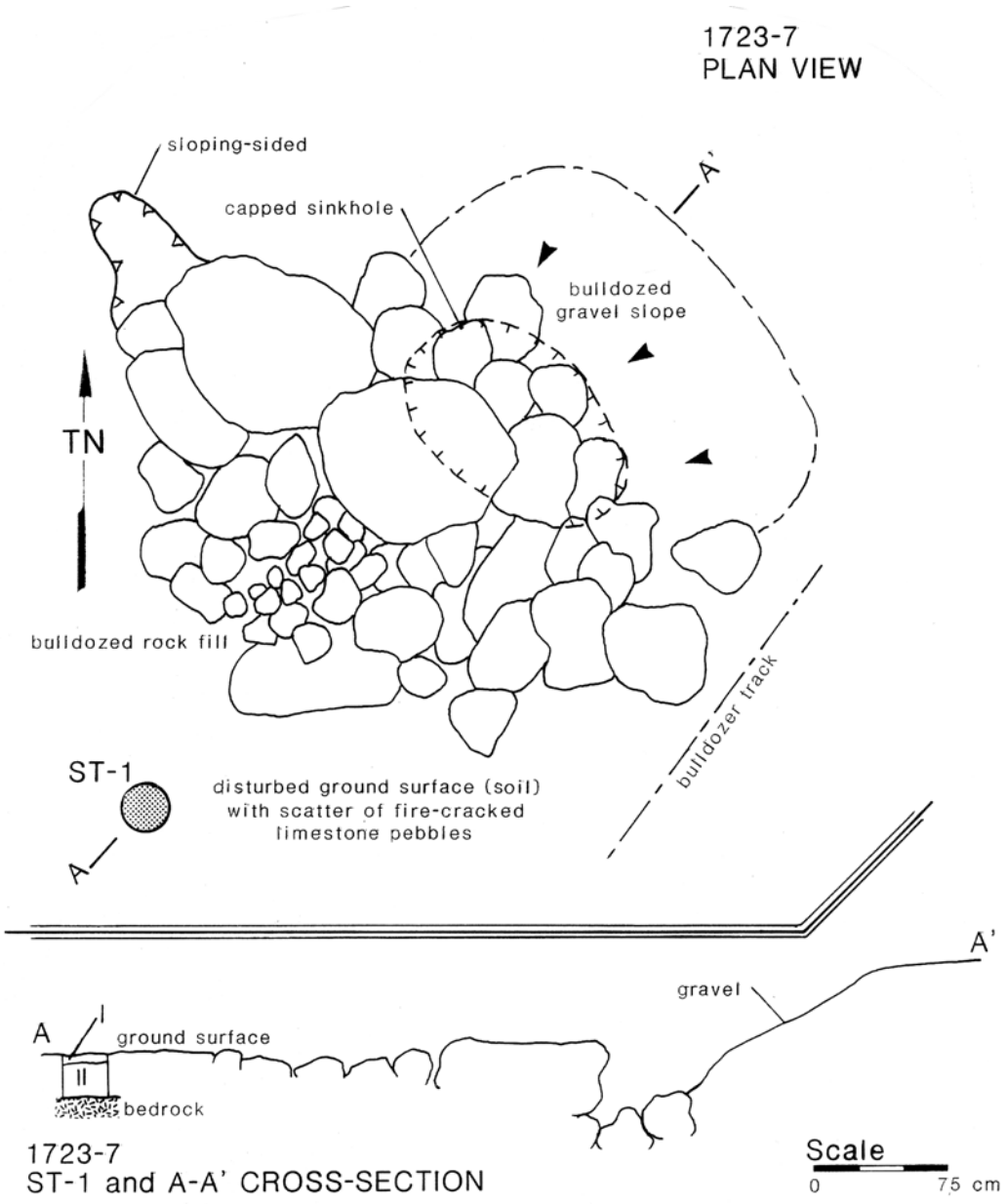

Figure C-3. Site 1723-7.

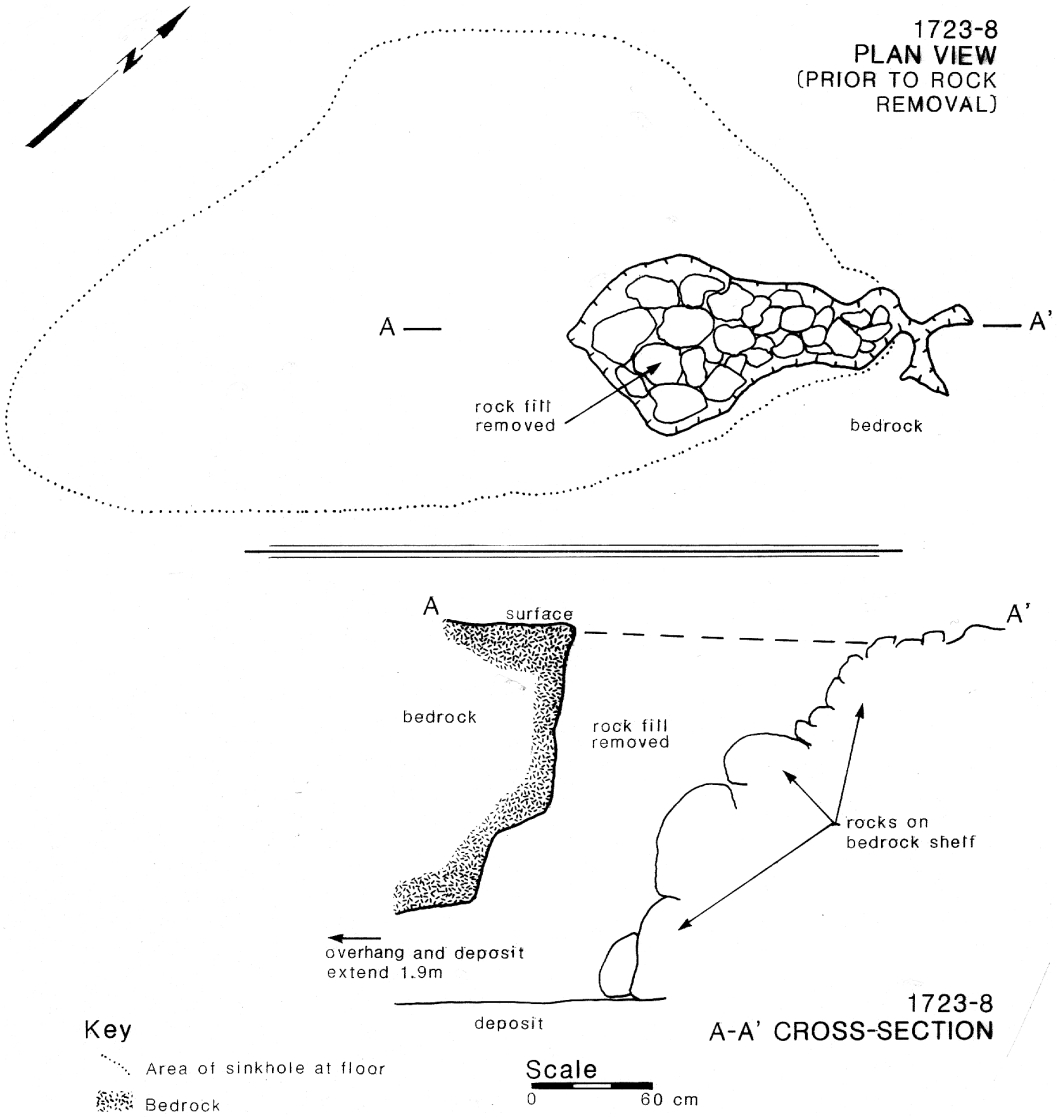

Figure C-4. Site 1723-8.

Site/Feature No: 1723-9 a,b,c
Other No: E83/N232.
Figure(s): 11.
Testing: none.
Natural features: (a) depression; and two sinkholes (b,c).
Structure: none.
Dimensions: depression, 2.0 x 2.0 m (approx.); sinks each 2.0 x 1.0 m (approx.).
Description: depression and sinks are in an area of extensive bulldozer damage.
Surface: depression is in a area of shallow soil, with sinkholes lying just to N on a 40 cm high limestone shelf; dense vegetation of grasses, *koa haole*, and *kiawe*; extensive surface disturbance.
Floor: NA.
Deposit: NA.
Fill: sinks are covered and possible filled with bulldozer rock debris.
Cultural material: none.
Function: unknown.
Age: unknown.
Natural history: NA.
Condition: uncertain; bulldozer debris probably does not affect sink deposit.
Research potential: by comparison with other similar features, these feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1723-10
Other No: Phase I: 21-A; E96/N222.
Figure(s): 11, C-5.
Testing: one ST.
Natural feature: none.
Structure: stacked stone wall segment.
Dimensions: 7.55 x 1.20 m; 55 cm high.
Description: stacked cobble and boulder wall, constructed of local limestone; approximately seven courses high, three wide (not core-filled); metal can in top of wall; area around wall has been bulldozed, the ends of the wall have been damaged; original extent of wall is unknown; highly deteriorated condition; testing indicates that wall is not of recent construction.
Surface: limestone bedrock with areas of shallow soil.
Cultural material: recent metal can (not collected).
Function: wall for agriculture or ranching?
Age: late 19th to early 20th century?
Condition: poor.
Research potential: none.
Recommendations: no further work.

Test Excavations: One shovel test was placed adjacent to the west face of the wall. It demonstrated that the wall was not recent, with the humic layer built up around the base rock; however, a thin dark stain is beneath the stone, probably representing an A-horizon existing at the time of wall construction.

Layer Descriptions: No formal descriptions made; Layer I is a recent humus 5 cm thick; base of Layer I may be an older A-horizon that extends beneath wall; Layer II is a silt similar to the matrix of 1723-7, Layer II; Layer II is 10 cm thick, on bedrock.

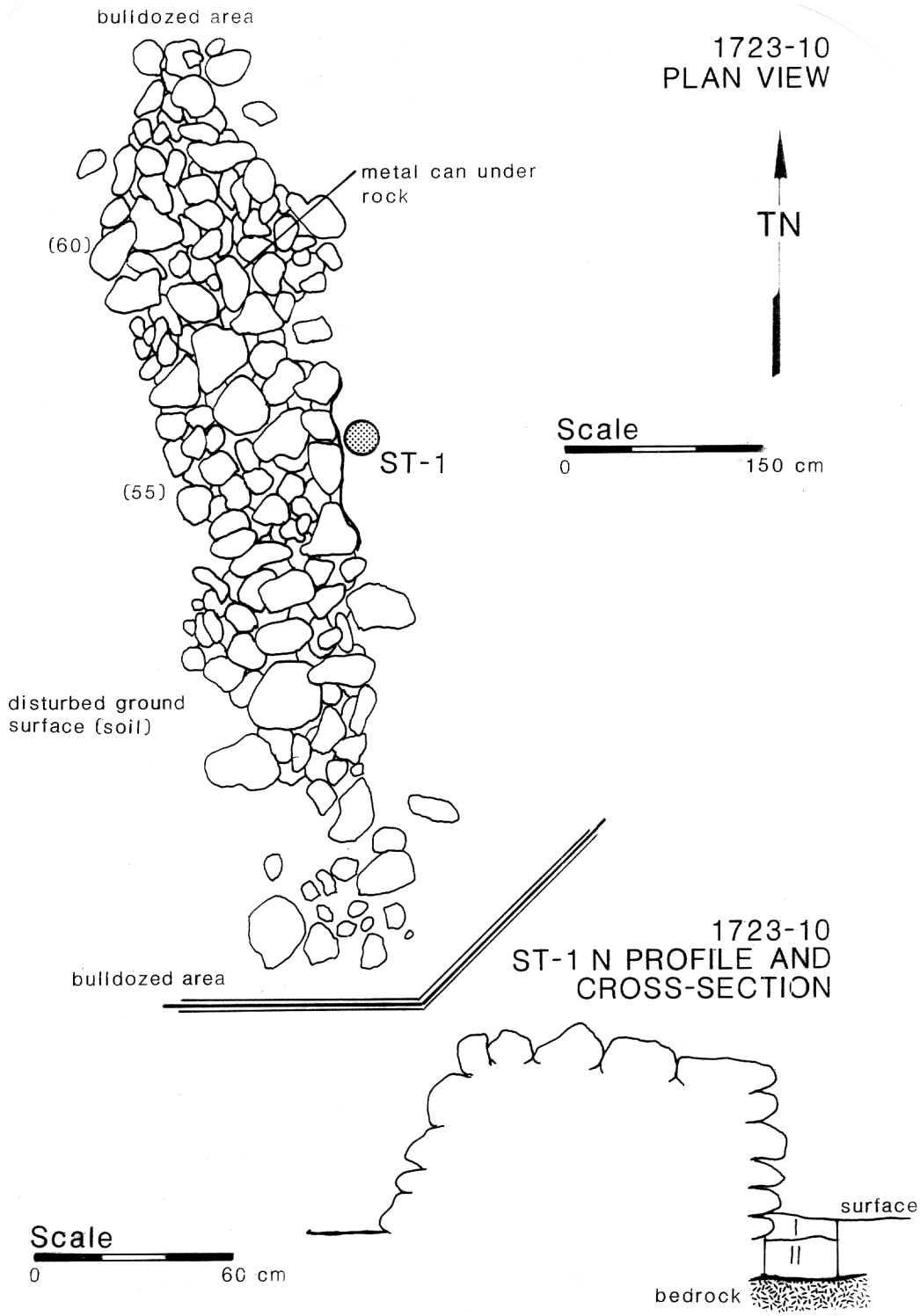

Figure C-5. Site 1723-10.

Site/Feature No: 1723-11
Other No: E14/N225.
Figure(s): 11.
Testing: none.
Description: scatter of fire-cracked limestone pebbles on surface, in a general area of depressions and sinks; sinks are outside project area, but include Phase II features 19-A, D, F, and G; estimated 10 m diameter surface distribution.
Surface: soil with dense grass and brush cover, several *kiawe*; several adjacent depressions.
Cultural material: fire-cracked rock on surface.
Function: fire-cracked rock indicates that a habitation deposit is present.
Age: pre-contact to mid-1800s.
Condition: uncertain.
Research potential: based on the fire-cracked rock, the area has potential of providing evidence related to traditional Hawaiian habitation.
Recommendations: data recovery, if necessary.

Site/Feature No: 1723-12
Other No: E86/N198 (Note: incorrectly tagged in field as 1724-58).
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.24 x .53 m opening; 1.30 x 1.15 floor; 140 cm depth.
Description: oval-shaped sinkhole, with slight expansion near floor.
Surface: bedrock limestone with thick banyan adjacent.
Floor: soil deposit.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: unknown, seems too small for agriculture.
Age: uncertain.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information primarily relevant to the pre-human environment, post-colonization environmental change.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-13
Other No: E110/N228.
Figure(s): 11.
Testing: rock fill removed.
Natural feature: sinkhole.
Structure: rock fill.
Dimensions: .85 x .45 m opening; .75 x .35 m floor; 65 cm depth.
Description: oval-shaped sinkhole with rock fill; constricted toward base.
Surface: rough limestone bedrock and patches of soil, with grasses and scattered *kiawe*.
Floor: soil deposit, but small area.
Deposit: NT.
Fill: cobble fill.
Cultural material: none.
Function: unknown; too small for agricultural use; purpose of fill unknown, but perhaps recent.
Age: unknown.
Natural history: NA.
Condition: good.
Research potential: none.
Recommendation: no further work.

Site/Feature No: 1723-14
Other No: E42/N228; Phase I 20-A.
Figure(s): 11.
Testing: none.
Natural feature: none.
Structure: elongated rock pile, bulldozed.
Description: jumbled pile of stone of varying sizes, with some intermixed soil; feature is recent bulldozed pile.
Research potential: none.
Recommendation: no further work.

Site/Feature No: 1724-1
Other No: E52/N115.
Figure(s): 11, C-6.
Testing: none.
Natural feature: sinkhole.
Structure: none, but adjacent to stone structure of 1724-55.
Dimensions: double opening: .92 x.65 m, 83 cm deep; 1.08 x .70 m, 54 cm deep.
Description: small double sinkhole; shallow overhang on NE side; sinks too small for access.
Surface: limestone bedrock; *kiawe*, thin ground cover.
Floor: soil deposit.
Deposit: NT.
Fill: cobbles and boulders fill a portion of the west hole.
Cultural material: none.
Function: probably used for midden dumping; part of habitation complex.
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with tested features in Habitation Cluster 1, this feature should prove to contain midden and trash from the habitation occupation.
Recommendation: data recovery if necessary, excavation may be difficult, due to small size of openings.

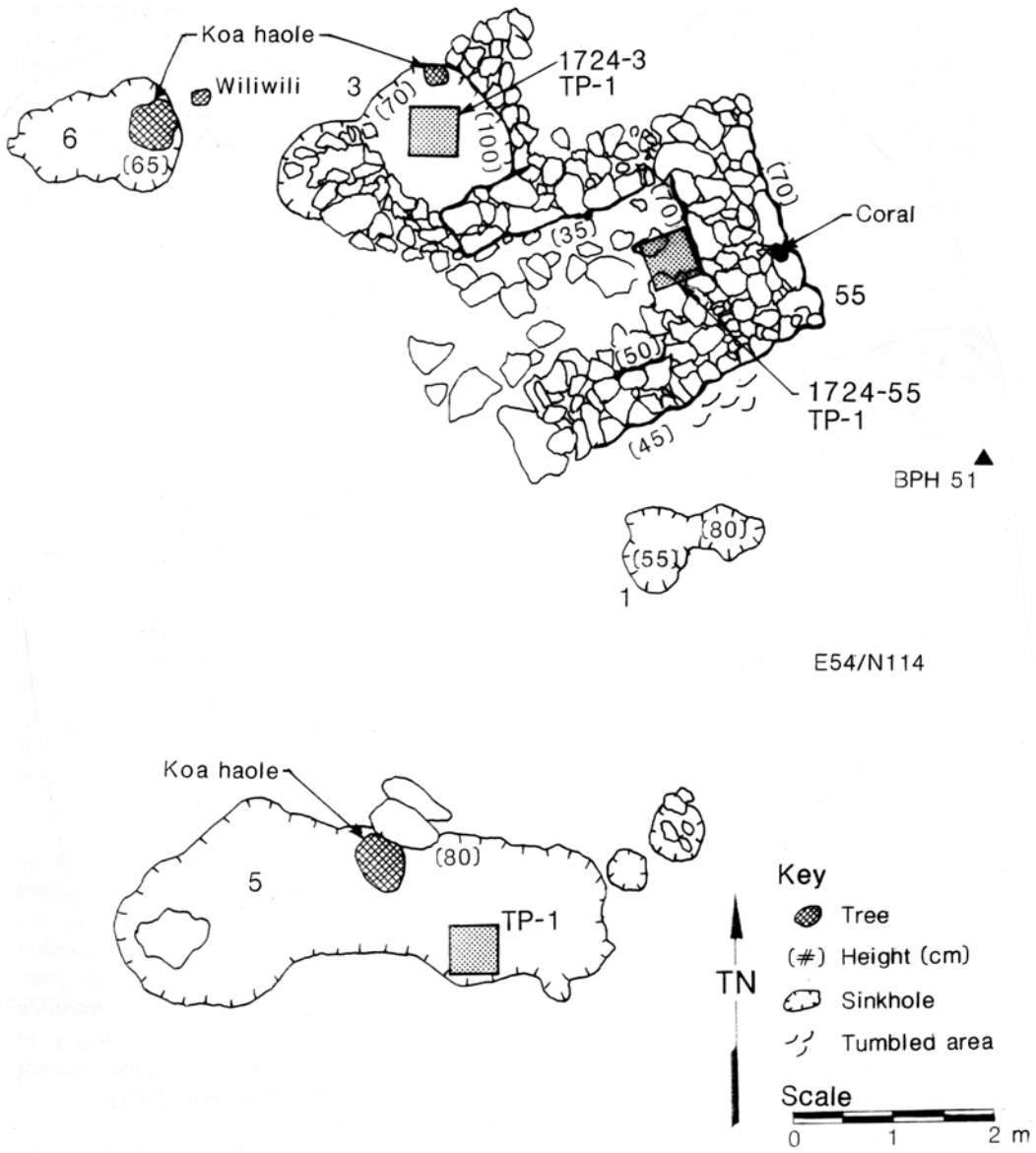

Figure C-6. Site 1724-1,3-6, and 55.

Site/Feature No: 1724-2
Other No: E57/N130.
Figure(s): 11, C-7.
Testing: one ST, one TP.
Natural feature: depression/sinkhole.
Structure: none.
Dimensions: 7.35 x 4.12 m opening; 25 to 110 cm depth.
Description: depression/sinkhole is irregularly shaped, with one shallow arm to the southeast and a deeper section to the northeast; the south section of the northeast arm is 80 cm to the top of the deposit (which is 5 to 20 cm above bedrock) and drops off on the north end (110 cm to top of deposit, with depth of bedrock uncertain).
Surface: exposed limestone bedrock, scattered *kiawe* and thin brush cover.
Floor: the sinkhole contains a soil deposit, with several boulder slabs on the northern end.
Deposit: testing indicates that the upper five to 15 cm contains some cultural material in low density, probably over the extent of the sink floor. No habitational features were found in the testing, but could be present.
Fill: none.
Cultural material: adjacent to the sink are scatters and low piles of fire-cracked limestone; in the deposit are shell midden, one piece of volcanic glass (LN 4.04), and charcoal (including *`akoko*, see Appendix B).
Function: trash deposition, agriculture?
Age: pre-contact to mid-1800s?
Natural history: bird bone and egg shell; land snails.
Condition: good.
Research potential: feature has information related to the occupation of the habitation complex.
Recommendations: data recovery, if necessary: additional excavations should be conducted in this feature, including controlled units in the deeper portion, and areal excavation over the shallow sections of the sink.

Test Excavations: One shovel test (50 cm deep) and one test pit (50 x 50 x 20 cm) were excavated (Fig. C-7). The test pit produced a small quantity of midden in a thin deposit (Layer IIa) overlying sterile decomposing bedrock (Layer IIb), and bedrock at the base. The shovel test encountered a heavy concentration of rock and roots, and was not excavated to bedrock. The nature of the deposit is unclear, but is a fill in the deepest area of the depression/sink. One piece of volcanic glass was found in this unit.

There is a thin layer of cultural material in the upper portion of the deposition. The deeper portion of the sink contains a mixed deposit that may be a cultural fill.

Cultural material from the two excavations includes the one piece of volcanic glass, a few fragments of charcoal, some fire-cracked pebbles, as well as urchin parts, Brachidontes shell, and bone, all in low density (Appendix A, Table A-5).

1724-2, TP-1 Descriptions:

Layer I **Dimensions:** surface; 5 cm thick. **Matrix:** dark brown (10YR 3/3, mottled with sand-size fragments of limestone) loam (non-calcareous); weak, crumb, very fine; loose; non-sticky, non-plastic; abrupt, smooth boundary. **Composition:** 90% non-calcareous sub-gravel; 10 % calcareous gravel. **Inclusions:** land snails. **Intrusions:** roots and rootlets. **Cultural material:** none. **Interpretation:** relatively recent surface accumulation of organic debris, aeolian basaltic soils transported from upland fields, and fragments of local limestone bedrock.

Layer IIa **Dimensions:** from 2 to 5 cm bs; 5 cm thick. **Matrix:** pale brown (10YR 6/3) silt loam (calcareous); weak, crumb, very fine; soft, slightly sticky, non-plastic; clear, smooth boundary. **Composition:** 90% sub-gravel, 5% gravel, 5% pebbles (calcareous). **Inclusions:** land snails; *Rattus exulans*. **Intrusions:** rootlets. **Cultural material:** 1 fire-cracked pebble; charcoal; marine shell. **Interpretation:** soil derived from limestone bedrock; slightly modified by organic staining and limited cultural activity; cultural material probably deposited primarily on top of this layer.

Layer IIb **Dimensions:** from 5 to 10 cm bs; 5 cm thick. **Matrix:** very pale brown (10YR 7/3) silt loam (calcareous); weak, crumb, very fine; soft, slightly sticky, non-plastic; very abrupt boundary on bedrock. **Composition:** 90% sub-gravel, 5% gravel, 5% pebbles, (calcareous). **Inclusions:** none. **Intrusions:** none. **Cultural material:** (material mixed with IIa in part of excavation). **Interpretation:** decomposing limestone bedrock.

1724-2, ST-1 Descriptions:

Layer Ia **Dimensions:** surface; 10 cm thick. **Matrix:** dark brown (10YR 3/3, mottled with sand-size fragments of limestone) loam (non-calcareous); weak, crumb, very fine; loose; non-sticky, non-plastic; abrupt, smooth boundary. **Composition:** 90% sub-gravel (non-calcareous); 10% gravel (calcareous). **Inclusions:** land snails. **Intrusions:** roots and rootlets. **Cultural material:** none. **Interpretation:** see IIb.

Layer Ib **Dimensions:** 10 cm bs; 8 cm thick. **Matrix:** very dark grayish brown (10YR 3/2, mottled with sand-size fragments of limestone) loam (non-calcareous); weak, crumb, very fine; loose; non-sticky, non-plastic; abrupt, smooth boundary. **Composition:** 90% non-calcareous sub-gravel; 10% calcareous gravel. **Inclusions:** land snails. **Intrusions:** roots and rootlets. **Cultural material:** none. **Interpretation:** Layers Ia and Ib are relatively recent surface accumulation of organic debris, aeolian basaltic soils transported from upland fields, and fragments of local limestone bedrock; appear partially disturbed and probably moved by sheet wash into the lower portion of the sink.

Layer II **Dimensions:** 8 cm bs; 25+ cm thick (bottom undetermined). **Matrix:** dark yellow brown (10 YR 4/4, mottled with sand-size fragments of limestone) loam; weak, crumb, fine; slightly sticky, slightly plastic, soft. **Composition:** 50% sub-gravel, 10% gravel, 10% pebbles, 30% cobbles; all calcareous. **Inclusions:** land snails; bird bone and egg shell. **Intrusions:** roots. **Cultural material:** volcanic glass (LN 4.04); marine shell; fire-cracked rock. **Interpretation:** This is a deposit with cultural material but numerous cobbles and large roots did not allow a clear evaluation by means of a shovel test.

Bedrock was not reached.

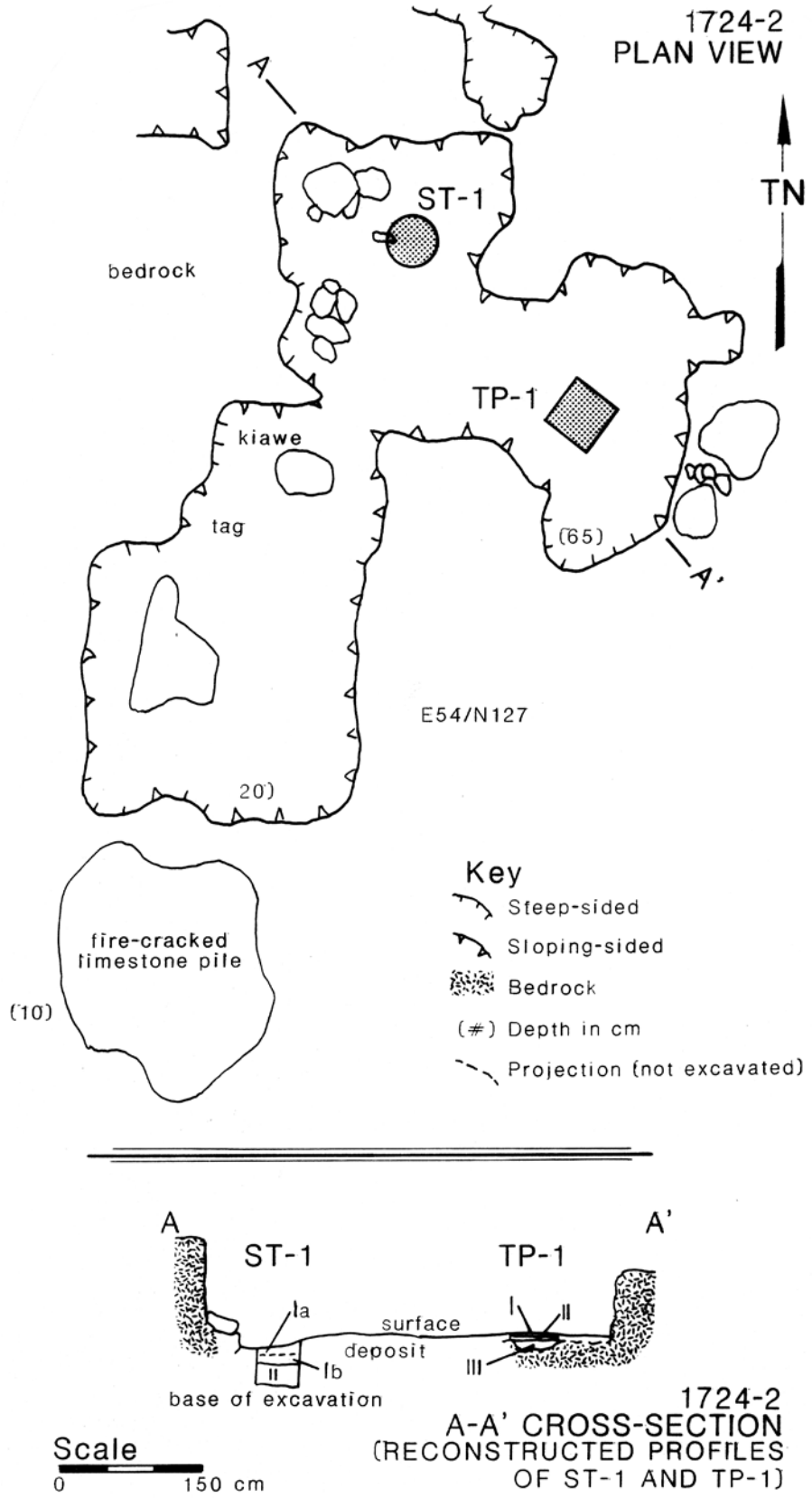

Figure C-7. Site 1724-2.

Site/Feature No: 1724-3
Other No: E50/N120.
Figure(s): 11, C-6, C-8, Photo C-1.
Testing: one TP.
Natural feature: sinkhole.
Structure: low stone wall along eastern edge of sink, adjoining wall of the 1724-55 (U-shaped structure) that stands on the southern edge of the sink.
Dimensions: 1.52 x1.20 m opening; 2.85 x 1.35 m floor; 70 cm deep; east wall is 1.22 m long, .45 m wide, and .35 m high.
Description: oval-shaped sinkhole; one wall of the U-shaped structure 1724-55 is built along the southern edge, with a wing wall on the eastern edge.
Surface: limestone bedrock; sparse vegetation cover of grasses and basil.
Floor: soil deposit.
Deposit: testing revealed a 20 cm cultural layer (Layer I) overlying a natural deposit of calcareous accumulation more than 30 cm thick; the cultural layer contains midden and a few limestone flakes.
Fill: cobbles and boulders filled western half of the sinkhole, probably collapse of the adjoining wall.
Cultural material: marine shell; fish bone; pig and other mammal bone; cut bone fragment; limestone flakes; and charcoal (including *`akoko*, *`ilima*, and Chenopodium, see Appendix B).
Function: trash deposition, and agriculture?
Age: pre-contact to mid-1800s?
Natural history: bird bone and egg shell; land snails.
Condition: good.
Research potential: feature contains information relevant to the pre-human environment, post-colonization environmental change, and Hawaiian habitation. There may also be data related to Hawaiian agricultural practices; this feature is a part of a habitation complex; of special note is the presence of bird bone mixed with the cultural material.
Recommendations: data recovery, if necessary; given the quantity of material recovered, this feature should be completely excavated.

Test Excavations: A test pit (50 x 50 cm) was excavated in the deposit of the sinkhole (Fig. C-6 and C-8). A 20 cm thick cultural deposit was identified just below the duff. The deposit contains fragments of charcoal, a few fire-cracked limestone pebbles, marine shell, bone, and three limestone flakes. There is no evidence of internal stratification within the cultural layer. Although the midden density is low considered within the range of Hawaiian sites in general, nonetheless this is the two densest deposit encountered in the project testing (the other being in nearby 1724-7).

1724-3, TP-1 Descriptions:

Layer I **Dimensions:** surface; 15 cm thick. **Matrix:** dark brown (10YR 4/3, mottled with sand-size limestone fragments) silt loam (non-calcareous); weak, crumb, fine; soft, slightly sticky, non-plastic; abrupt, smooth boundary. **Composition:** 60% non-calcareous sub-gravel; 10% gravel; 19% pebbles, 1% cobbles, calcareous. **Inclusions:** land snails; bird bone and egg shell; *Rattus exulans*. **Intrusions:** rootlets. **Cultural material:** charcoal flecks; five fire-cracked rock pebbles; marine shell; 3 limestone flakes; one piece of cut bone (LN 18.02.09); fish bone; mammal bone. **Interpretation:** cultural deposit; low density of cultural material indicates trash deposition along with extra-cultural source for matrix; matrix is primarily a non-calcareous, highly organic, probably partially aeolian and derived from inland basaltic soils; radiocarbon sample from scattered charcoal in bottom portion of deposit (B-69557) produced a calibrated date of A.D. 1660 to 1950 (Table 8).

Layer II **Dimensions:** 15 cm bs; 35+ cm thick (not excavated to bottom). **Matrix:** grayish brown (10YR 5/2) clay loam (calcareous); weak, crumb, very fine; slightly sticky, slightly plastic; boundary not reached in excavation. **Composition:** 65% subgravel, predominantly calcareous; 10% gravel, 10% pebbles, 15% cobbles, calcareous. **Inclusions:** numerous land snails; marine shell; bird bone; *Rattus exulans*. **Intrusions:** rootlets. **Cultural material:** charcoal flecking; fish bone; *Sus scrofa* cf. and mammal bone; marine shell; one limestone flake. **Interpretation:** during excavation this appeared to be natural sink sediment with some cultural material in the upper portion; however, charcoal and cultural bone (pig) were found in the lowest level, indicating some cultural deposition.

Note: bedrock not reached, but based on probe, the total deposit is at least 20 cm deeper than base of pit (or minimally 70 cm thick).

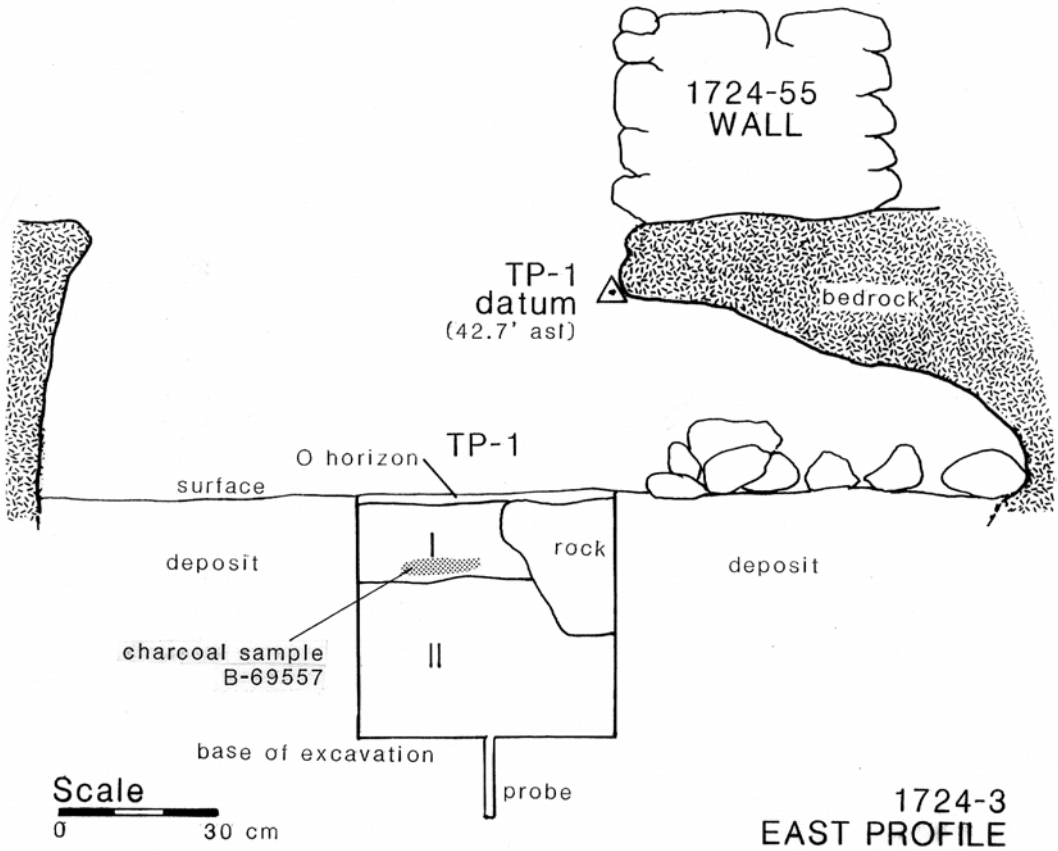

Figure C-8. Site 1724-3.

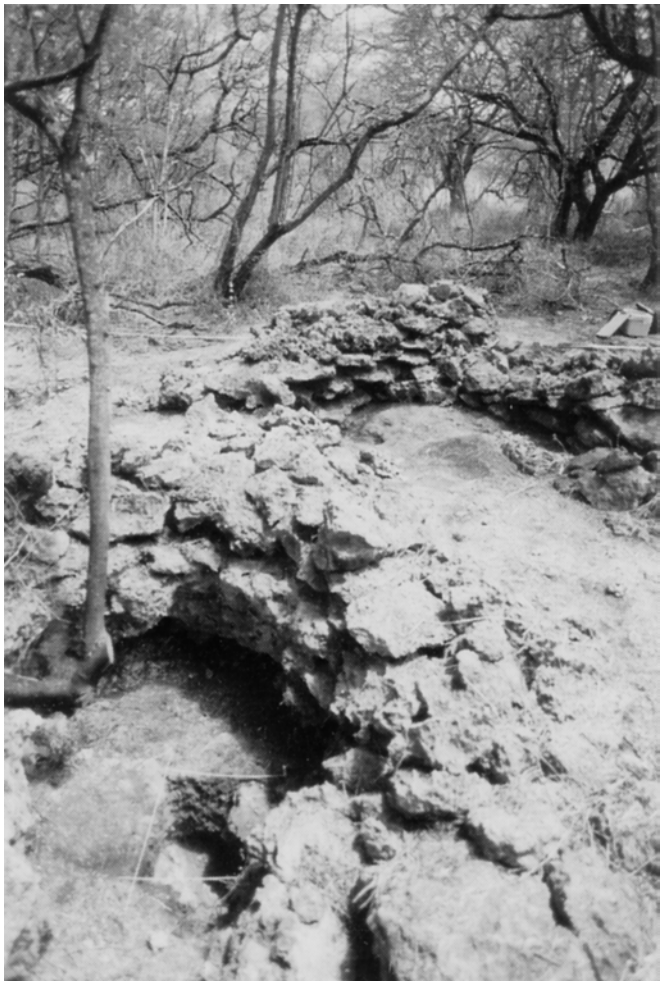

Photo C-1. Site 1724-3 (sinkhole) and Site 1724-55 (U-shape). (facing east)

Site/Feature No: 1724-4
Other No: E61/N100.
Figure(s): 11, C-9.
Testing: one TP.
Natural feature: depression.
Structure: none.
Dimensions: 4.85 x 3.48 m opening; 5 to 30 cm depth.
Description: large, oval-shaped depression.
Surface: limestone bedrock; medium ground cover of grasses and basil, with several large *kiawe* trees adjacent.
Floor: soil deposit with scattered boulders; large *kiawe* growing at southern end.
Deposit: some cultural material in the upper section, but the deposit is amorphous and unstratified; cultural material may be secondary.
Fill: none.
Cultural material: charcoal flecking; one limestone flake.
Function: uncertain, deposition may be secondary.
Age: cultural materials are pre-contact to mid-1800s.
Natural history: the exposed portion of the deposit is transported silt with few land snails; *Rattus exulans*.
Condition: good.
Research potential: research potential of feature lies in the information related to the history of soil change in the area; if this is transported silt containing pre-contact cultural material, then questions of history of land-clearing are raised.
Recommendations: data recovery, if necessary; additional sample excavations to reach base of sink to determine complete stratigraphic development.

Test Excavations: One test pit (50 x 50 cm) was excavated on the western side of the depression. Below a shallow humus layer, only a single unstratified layer was identified; excavation, however, did not reach bedrock. There is a small quantity of cultural material in the upper 10 cm of the layer, including a few charcoal flecks and one limestone flake. However, there is no indication that this is a primary cultural deposit; there is no charcoal, lensing, or features, nor is there any stratigraphic break with the underlying sterile portion of the layer. The cultural material is probably redeposition. The depression is in the vicinity of the habitation complex. The deposit appears to be transported basaltic silt, raising the problem of the time and nature of its deposition.

1724-4, TP-1 Descriptions:

Layer I **Dimensions:** surface; 40+ cm thick (base of deposit was not reached). **Matrix:** dark brown (7.5YR 4/4) silt (non-calcareous); weak, granular, medium; slightly sticky, non-plastic, slightly hard; lower boundary not reached in excavation. **Composition:** 85% non-calcareous sub-gravel; 10% gravel, 5% pebbles, calcareous. **Inclusions:** land snails in low density; *Rattus exulans*. **Intrusions:** numerous large roots. **Cultural material:** charcoal flecking; one limestone flake. **Interpretation:** a transported basaltic soil; the presence of cultural material in the upper portion may be the result of redeposition.

Note: bedrock not reached, but probing indicated that the deposit is at least 10 cm deeper; if like other tested depressions unhampered by roots, this fill will prove to be on decomposing bedrock.

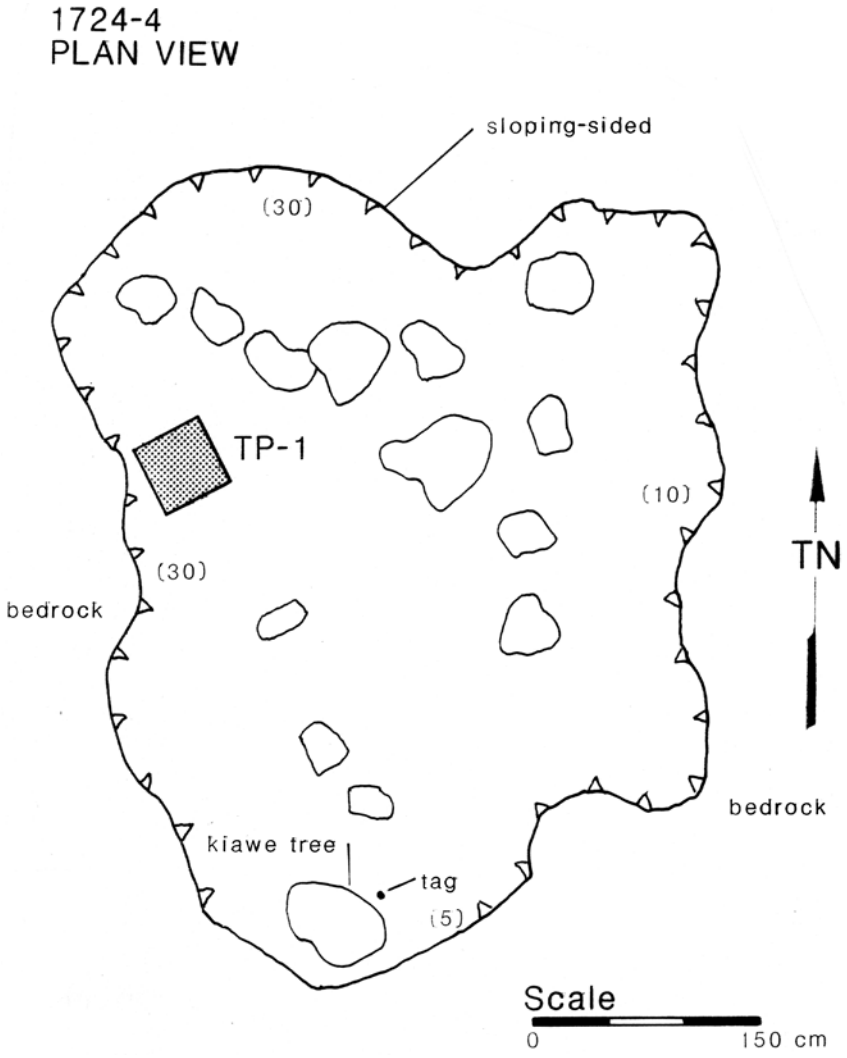

Figure C-9. Site 1724-4.

Site/Feature No: 1724-5
Other No: E44/N11.
Figure(s): 12, C-6.
Testing: one TP.
Natural feature: sinkhole.
Structure: none.
Dimensions: 4.05 x 1.10 m opening; 4.11 x 1.46 floor; 80 cm depth.
Description: a long, narrow sinkhole with straight sides; one cavity with no cultural material; there is no indication from the exposed portion of the sink that it has a bell shape.
Surface: limestone bedrock; thick ground cover of basil and grasses to south.
Floor: soil deposit with one large cobble; large *kiawe* growing on the northern side.
Deposit: testing showed a stratified deposit, a probable cultural unit (Layer II) overlying decomposing limestone; the small quantity of midden in Layer II along with the mixed nature of the soil matrix suggests primarily an agricultural use.
Fill: none.
Cultural material: a few scattered fragments of fire-cracked pebbles on the surface; charcoal flecking, marine shell, and fire-cracked rock in deposit.
Function: agricultural? limited use for trash deposition.
Age: pre-contact to mid-1800s.
Natural history: sink is primarily filled with decomposing limestone, contains land snails. bird bone, egg shell.
Condition: good.
Research potential: feature contains information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities. It is part of the habitation complex.
Recommendations: Data recovery, if necessary; data recovery should consist of an additional sample from the sinkhole.

Test Excavations: One test pit (50 x 50 cm) was excavated in the sink on the southern side. There is a cultural deposit or culturally modified soil of about 10 cm thickness lying beneath the modern humus. This deposit contains a few fire-cracked pebbles, a piece of Nerita; the matrix is a mixed basaltic and calcareous silt. This features is near the structure of 1724-55, but unlike nearby sink 1724-3, it contains very little midden. It was probably used primarily for cultivation.

1724-5, TP-1 Descriptions:

Layer I **Dimensions:** surface; 3 cm thick. **Matrix:** black (10YR 2/1, mottled with small fragments of limestone) loam (non-calcareous); structureless; non-sticky, non-plastic, loose; abrupt, smooth boundary. **Composition:** 95% non-calcareous sub-gravel; 5% gravel and pebbles, calcareous. **Inclusions:** numerous land snails, plant and insect fragments. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** recent organic duff, forming soil.

Layer II **Dimensions:** 3 cm bs; 10 cm thick. **Matrix:** dark brown (10YR 4/3) silt loam (partially calcareous); weak, crumb, fine; slightly sticky, slightly plastic, soft; abrupt, smooth boundary. **Composition:** 90% sub-gravel (partially calcareous); 5% gravel, 5% pebbles, calcareous. **Inclusions:** land snails in low density; bird bone and egg shell. **Intrusions:** roots and rootlets. **Cultural material:** a few fragments of fire-cracked limestone, charcoal flecking, one piece of Nerita. **Interpretation:** a cultural deposit, or deposit with cultural modifications.

Layer III **Dimensions:** 13 cm bs; 17+ cm (bottom not reached). **Matrix:** yellowish brown (10YR 5/6) silt (calcareous); weak, granular, medium to coarse; slightly sticky, slightly plastic, slightly hard; boundary not reached. **Composition:** 85% sub-gravel, 5% gravel, 5% pebbles, 5% cobbles, calcareous. **Inclusions:** land snails in low density; bird bone and egg shell; fish bone (probably natural). **Intrusions:** roots. **Cultural material:** none. **Interpretation:** natural decomposing limestone.

Note: bedrock was not reached, but probe indicates that it lies at least another 15 cm below base of excavation.

Site/Feature No: 1724-6
Other No: E46/N119.
Figure(s): 11, C-6.
Testing: none
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.73 x 1.01 m opening; 2.60 x 1.53 m floor; 65 cm depth.
Description: oval sinkhole, with overhang.
Surface: limestone bedrock; vegetation of grasses and basil; scattered *kiawe* and *wiliwili*.
Floor: soil deposit; large *kiawe* growing on east side.
Deposit: NT.
Fill: none.
Cultural material: a few fire-cracked pebbles on surface.
Function: probably midden or fire-cracked rock deposition.
Age: pre-contact to mid-1800s.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: Data recovery, if necessary; sample of cultural deposit should be obtained.

Site/Feature No: 1724-7
Other No: E46/N120.
Figure(s): 11, C-10, Photo C-2.
Testing: 2 TPs.
Natural feature: depression.
Structure: none.
Dimensions: 2.77 x 1.44 m opening; 70 cm depth.
Description: large, irregular-shaped depression; small cavity on south side.
Surface: one piece of fire-cracked basalt and several pieces of fire-cracked limestone on the bedrock surface around the sinkhole; ground cover of grass and basil, with several large *kiawe*.
Floor: soil deposit, with a few limestone slabs and one large *kiawe* growing in the eastern half.
Deposit: a 10 to 20 cm thick deposit of fire-cracked limestone pebbles, charcoal, and marine shell; the deposit lies on decomposing limestone.
Fill: none.
Cultural material: some fire-cracked limestone pebbles and two fragments of basalt lie on the surface at the base of the tree; inside the small cavity is an exposed deposit of fire-cracked rock; a slingstone (LN 67.01) and basalt fragment (LN 67.02) were recovered from the surface inside the cavity; the deposit includes marine shell, cow bone, pig bone, fish bone, and charcoal (including Chenopodium, see Appendix B).
Function: locale of cooking debris deposition; probably also a cooking area, but cooking features (hearths and ovens) were not encountered in the testing.
Age: pre-contact to mid-1800s.
Natural history: natural substrate of limestone decomposition.
Condition: good.
Research potential: this feature contains a major occupational deposit, and is a critical part of the habitation complex; there is the possibility of intact hearths or ovens with datable contents.
Recommendations: data recovery, if necessary; if data recovery takes place, this feature should be excavated in its entirety; if the feature is not in an area proposed for data recovery, additional test sampling should be carried out to provide datable materials related to the understanding of the entire habitation complex.

Test Excavations: Two test pits (50 x 50 cm each) were placed in the depression. Each yielded a solid cultural deposit of fire-cracked limestone rock in an ashy matrix with charcoal fragments and midden. This material does not appear burned in place but represents debris removed from hearths and ovens. No definite occupational features were exposed in the testing, but TP-2 has a lower horizon (Feature A) that may be part of a feature or an earlier deposit. The limited profile suggests that it is a feature dug into the substrate.

The cultural deposit contains shell midden, fragments of urchin and crab, animal bone, and one piece of worked limestone. The food remains are in low density, suggesting that there is a additional deposit elsewhere or that the primary item being cooked was vegetal. The lack of a substantial midden in other sinkhole tests suggests that the latter is the more probable.

The presence of the slingstone on the floor of the adjacent cavity should also be noted.

1724-7, TP-1 Descriptions:

Layer I **Dimensions:** surface; 20 cm thick. **Matrix:** very dark gray (7.5YR 3/0) loam (moderately calcareous; high ash content); weak, crumb, very fine; slightly sticky, slightly plastic, soft; abrupt, wavy boundary. **Composition:** 45% sub-gravel, moderately calcareous; 5% gravel, 50% pebbles (fire-cracked limestone). **Inclusions:** land snails in low quantity; *Rattus exulans*. **Intrusions:** rootlets. **Cultural material:** charcoal; marine shell; *Sus scrofa cf.*; *Bos taurus cf.*; other mammal bone, fish bone; worked limestone fragment (LN 68.04). **Interpretation:** cultural deposit of fire-cracked rock, ash, charcoal fragments; no evidence of in situ burning; probably redeposited from an oven elsewhere in the sink.

Layer II **Dimensions:** 20 cm bs; 10+ cm thick (not excavated to bottom). **Matrix:** white (10YR 8/2) silt (calcareous); weak, crumb, medium; slightly sticky, slightly plastic, soft; boundary unexposed. **Composition:** 50% sub-gravel, 5% gravel, 5% pebbles, 10% cobbles, calcareous. **Inclusions:** land snails in very low density; marine shell. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** non-cultural, decomposing limestone substrate.

Note: not excavated to bedrock, but based on TP-2 bedrock is located 10 to 20 cm below base of excavation.

1724-7, TP-2 Descriptions:

Layer I (0): duff, one piece of large mammal.

Layer II **(II/1; also=TP-1, I) Dimensions:** surface; 15-20 cm thick. **Matrix:** very dark gray (7.5YR 3/0) loam (moderately calcareous; high ash content); weak, crumb, very fine; slightly sticky, slightly plastic, soft; abrupt, wavy boundary. **Composition:** 50% sub-gravel, moderately calcareous; 5% gravel, 45% pebbles (fire-cracked limestone). **Inclusions:** charcoal; land snails in low quantity; *Rattus exulans*. **Intrusions:** rootlets. **Cultural material:** charcoal; fire-cracked rock; fish bone; mammal bone. **Interpretation:** a cultural deposit of fire-cracked rock, ash, and charcoal fragments; no evidence of in situ burning; probably redeposited from an oven elsewhere in the sink; underlain by a deposit (IIa) or feature with the same matrix, but with few fragments of fire-cracked limestone.

Layer IIa **(=II/2) Dimensions:** 15 cm bs; 10 cm thick. **Matrix:** very dark gray (7.5YR 3/0) loam (moderately calcareous; high ash content); weak, crumb, very fine; slightly sticky, slightly plastic, soft; abrupt, wavy boundary. **Composition:** 85% sub -gravel, non-calcareous; 5% gravel, 10% pebbles, calcareous. **Inclusions:** charcoal; land snails in low density. **Intrusions:** rootlets. **Cultural material:** charcoal flecking; marine shell; fish bone. **Interpretation:** a cultural deposit or feature underlying redeposited fire-cracked limestone layer (II).

Layer III **(=TP-1, II) Dimensions:** 20 cm bs; 15 cm thickness. **Matrix:** white (10YR 8/2) silt (calcareous); weak, crumb, medium; slightly sticky, slightly plastic, soft; very abrupt, wavy boundary. **Composition:** 50% sub-gravel, 5% gravel, 5% pebbles, 10% cobbles, calcareous. **Inclusions:** no land snails; *Rattus exulans*; bird bone; marine shell. **Intrusions:** roots. **Cultural material:** none? **Interpretation:** non-cultural, decomposing limestone substrate lying atop bedrock; contains small quantity of bone and marine shell that may be natural, but this needs additional excavation for detailed analysis. Notably this deposit contains bird bone, but the definitive cultural deposit above it does not contain any bird bone.

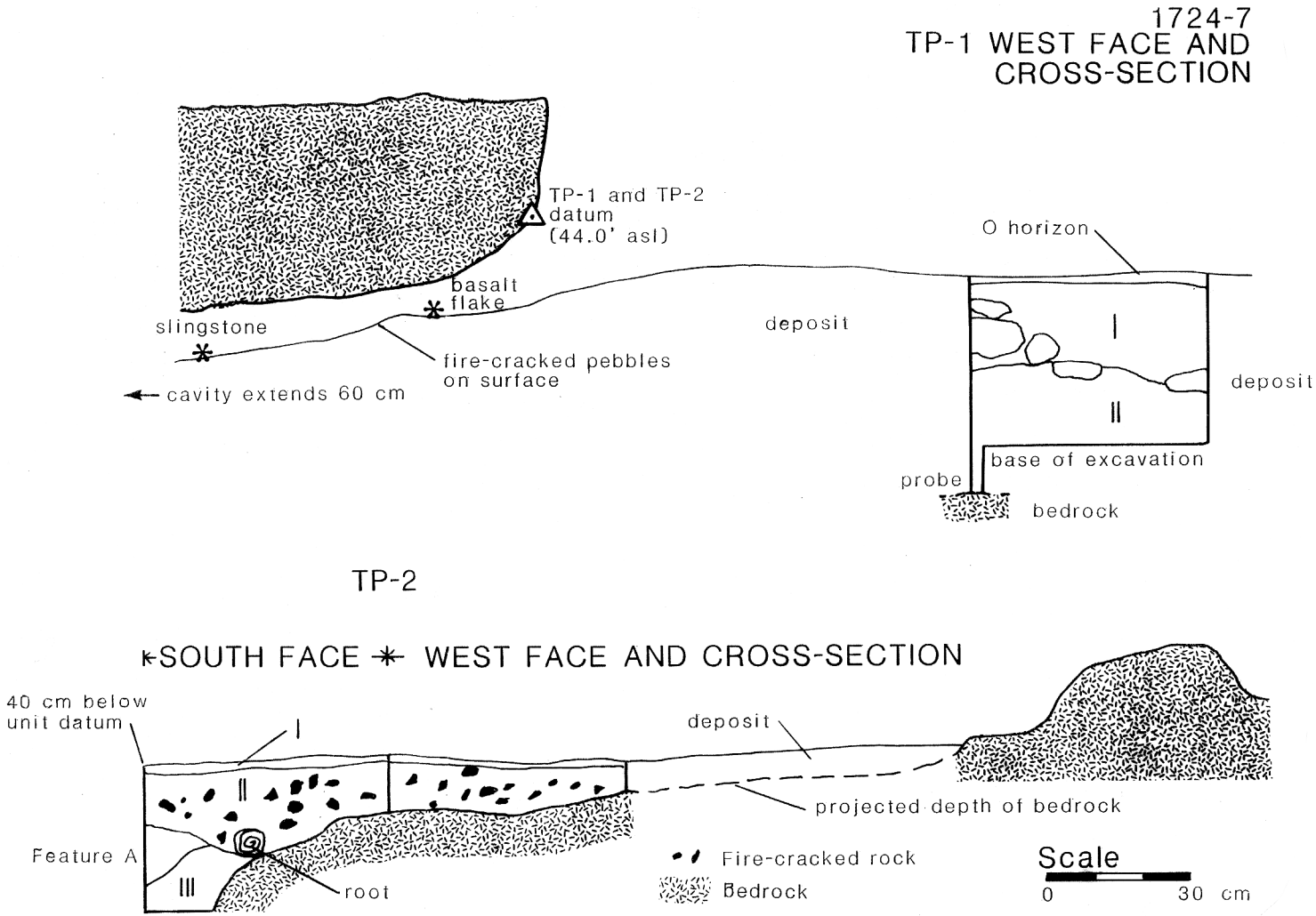

Figure C-10. Site 1724-7.

Photo C-2. Site 1724-7, TP-1. Pebbles in deposit are fire-cracked limestone; base of excavation is bedrock. (facing north)

Site/Feature No: 1724-8
Other No: E31/N114.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 3.55 x 2.23 m opening; floor (under fill) not exposed; depth to fill is 20 to 70 cm.
Description: irregularly-shaped sinkhole with fill of cobbles and fire-cracked rock; cavity on south side.
Surface: limestone bedrock, with several nearby sinks; vegetation is primarily basil and grasses;
Floor: floor is beneath fill and was not exposed.
Deposit: NT.
Fill: piles of fire-cracked limestone evident on the east and west sides; cobbles and boulders fill much of the horizontal area of the sink, but not piled to the level of the surface.
Cultural material: broken bottle glass (20th century) nearby; scatter of fire-cracked rock on surface; a "Best Foods" glass jar (not collected) is in the upper part of the rock fill; a shell adz preform (LN 164.03) was collected from the floor of the cavity, along with a piece of bone identified as a scapula of *Bos taurus cf.*
Function: trash deposition and activity area associated with habitation complex.
Age: pre-contact to mid 1800s? plus 20th century use.
Natural history: NA.
Condition: good.
Research potential: because of the exposed midden, shell adz preform, and location within habitation complex, this feature probably contains substantial occupational deposits; the fire-cracked rock suggests that ovens may be present which would provide datable material.
Recommendation: data recovery, if necessary; data recovery should involve excavation of a substantial sample of the deposit.

Site/Feature No: 1724-9
Other No: E33/N111.
Figure(s): 11.
Testing: probed.
Natural feature: depression.
Structure: none.
Dimensions: 1.10 x1.14 m opening; 35 cm depth.
Description: small circular depression, traps run-off water.
Surface: limestone bedrock; grass and *kiawe*.
Floor: sediment with cobble scatter.
Deposit: NT (but see probe information below).
Fill: none.
Cultural material: 20th century glass bottle fragments on surface (LN 165.01).
Function: unknown.
Age: unknown.
Natural history: NA.
Condition: good.
Research potential: none.
Recommendations: no further work.

Probe Description: Following a period of rain, it was noticed that this sink had trapped a substantial amount of water.

Site/Feature No: 1724-10
Other No: E18/N103.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole/cave.
Structure: none.
Dimensions: 1.22 x.60 m opening; 1.56 x 1.20 floor; 120 cm depth.
Description: sinkhole what opens into a small cave just below the surface (not a bell-shape chamber); the cave (1.20 x 1.10 m; 98 cm height) is only large enough for one person to take shelter in.
Surface: limestone bedrock; grasses, *kiawe* and *wiliwili*.
Floor: soil deposit.
Deposit: NT, but appears to be a shallow (ca. 10 cm) cultural deposit on the floor of the small cave; *koa haole* growing in sink.
Fill: none.
Cultural material: fire-cracked rock scatter on surface; metal can on surface; piece of volcanic glass (LN 191) on surface.
Function: trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: this feature should prove to contain information relevant to traditional Hawaiian occupation; it is part of the habitation complex.
Recommendation: data recovery, if necessary.

Site/Feature No: 1724-11
Other No: E24/N96.
Figure(s): 11, C-11, C-12, Photo C-3.
Testing: two TPs.
Natural feature: none.
Structure: small, square, stone-walled enclosure, with attached unit.
Dimensions: 5.11 x 4.85 m outside dimensions of main unit, with 2.25 x 2.30 m outside dimensions of attached unit; 40 to 55 cm wall height.
Description: main structure: small enclosure formed by bi-faced core-filled walls. all limestone; three of the walls are constructed with large slab uprights (most about one m long, 50 to 65 cm wide [standing height], and 10 cm thick); the fourth wall (west side) is constructed with wall-high uprights on the interior face, but has an exterior facing formed by a line of low uprights with a course of stacked stones above them (this "wall" gives the impression that it may have been a lanai rather than a wall); all of the walls are wide, from 75 to 110 cm; core-fill of all the walls ranges in size from pebble to boulder, but generally medium-sized cobble; some portions of the walls are slightly collapsed, with the central section of the north wall the most deteriorated, possibly the remnant of a doorway; some of the walls appear to partially stone-robbed of fill; a rough paving exists inside the enclosure adjacent to the western wall; the construction pattern suggested upright placement is that elongated "boxes" or "troughs" of upright slabs were made, then these boxes were filled with the core material; testing indicates that the structure was built on subsoil.
Description: attached structure: the small stone structure attached to the enclosure is formed by a single row of upright slabs, with a low rock interior fill or paving.
Surface: soil deposits and exposures of limestone bedrock; dense ground cover of grasses and brush, particularly basil, numerous *kiawe* around, and several *wiliwili*; areas to the S, SE, and SW appear bulldozed (Disturbance Area H).
Deposit: testing indicates that there is a cultural deposit about 10 cm thick inside and outside the walls of the enclosure; the interior deposit indicates two phases of occupation; one occupational feature, a shallow pit, was located in TP-2.

Cultural material: fire-cracked pebbles; marine shell; three limestone flakes (LNs 168.1, 168.2, and 166), and charcoal (including *`akoko*, *kulu`i*, and Chenopodium, see Appendix B).
Function: permanent habitation structure.
Age: pre-contact to mid-1800s.
Natural history: land snails; bird egg shell.
Condition: good.
Research potential: this feature is the primary structure in habitation complex, and as such has information relevant to the primary Hawaiian occupation of the project area.
Characteristics of Type: the feature is an outstanding example of a Hawaiian square house type that is found in the Barbers Point area and 'Ewa plain generally.
Recommendations: preservation; specifically preservation with interpretation if possible; additional test excavations should also be conducted for more information on history and function of this structure; these excavations should be limited in scope to prohibit extensive damage to the structure, but they should also be adequate to provide enough understanding to interpret the place of the structure within the settlement of the region in general and within the habitation complex in particular.

Test Excavations: Two test pits (each 50 x 50 cm) were excavated at this feature (Fig. C-11, and C-12); TP-1 was placed outside the N wall at the NE corner; TP-2 was placed inside the SE corner. The two stratigraphic profiles are very similar, each have a 10 to 12 cm cultural layer (Layer II) underling humus and overlying a sterile decomposing limestone horizon, some 10 to 15 cm thick, on bedrock. The primary difference between the two profiles is that the cultural layer in TP-2 is subdivided into deposits of somewhat different color. In addition TP-2 has a feature (Fea. A) that intrudes into the lower cultural unit (IIb) from its surface, the occupational floor for the accumulation of IIa. The feature has the same basic matrix as the cultural deposits, but has thin limestone slabs placed around its sides, perhaps intended as support for some item. The feature was not completely excavated, but there is no evidence that it is a hearth, although it does contain a small quantity of charcoal.

The cultural deposits contain a low density shell midden, urchin and crab fragments, charcoal fragments, and some fire-cracked pebbles. The only artifacts are limestone flakes. The cultural deposit at 1724-11 is quite similar to found in other midden-bearing deposits in the habitation complex. The one notable difference is the absence of animal bone at 1724-11.

The limited tests at 1724-11 suggest that the walls were built on a sterile deposit, with no indication of pre-existing occupation; further, the cultural deposit appears to have accumulated after wall construction. There is no suggestion that this deposit was pre-wall and trenched for wall construction. In the three cases where the deposit was sectioned against wall facing (Fig. C-12), two of the stones sit on sterile without evidence of trenching; the third facing stone (TP-2, north face) was placed in a shallow trench excavated into subsoil, and supported by two chocking stones.

The construction process suggested by the tests is that stones which would stand upright were not entrenched, but those requiring support were entrenched. In either case, it appears that the wall could not have been built higher than the top of the single row of uprights without bulging and collapse.

There are two depositional units (IIa and IIb), both associated with house occupation. A single radiocarbon date obtained from Feature A (associated with IIa, intrusive into IIb) produced a calibrated age range of A.D. 1650 to 1950 (Table 8).

1724-11, TP-1 Descriptions:

Layer I **Dimensions:** surface; 3 cm thick. **Matrix:** black (10YR 2/1, mottled with small fragments of limestone) loam (non-calcareous); structureless; non-sticky, non-plastic, loose; abrupt, smooth boundary. **Composition:** 90% non-calcareous sub-gravel; 10% gravel and pebbles, calcareous. **Inclusions:** numerous land snails; plant and insect fragments. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** recent organic duff, forming soil.

Layer II **Dimensions:** 3 cm bs; 7 to 12 cm thick. **Matrix:** dark brown (10YR 4/3) silt loam (partially calcareous); weak, crumb, fine; slightly sticky, slightly plastic, soft; abrupt, smooth boundary. **Composition:** 90% sub-gravel (partially calcareous); 5% gravel, 5% pebbles, calcareous. **Inclusions:** land snails in high density. **Intrusions:** rootlets. **Cultural material:** charcoal; a few pieces of fire-cracked limestone; marine shell; 2 limestone flakes, one lying on top of deposit, one lying at base of deposit (on Layer III). **Interpretation:** cultural deposit associated with occupation of house.

Layer III **Dimensions:** 12 cm bs; 20 to 25 cm thick. **Matrix:** white (10YR 8/2) silt (calcareous); weak, crumb, medium; slightly sticky, slightly plastic, soft; very abrupt, wavy boundary (on bedrock). **Composition:** 50% sub-gravel, 10% gravel, 30% pebbles, 10% cobbles, calcareous. **Inclusions:** land snails in low density, near top; bird egg shell, marine shell. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** non-cultural, decomposing limestone substrate lying atop bedrock.

1724-11, TP-2 Descriptions:

Layer I

Same characteristics of TP-1, Layer I, with some marine shell.

Layer IIa **Dimensions:** 3 cm bs; 5 cm thick. **Matrix:** dark brown (10YR 4/3) silt loam (partially calcareous); weak, crumb, fine; slightly sticky, slightly plastic, soft; abrupt, smooth boundary. **Composition:** 85% sub-gravel (partially calcareous); 10% gravel, 5% pebbles, calcareous. **Inclusions:** land snails in high density; bird egg shell. **Intrusions:** rootlets. **Cultural material:** charcoal flecking; fire-cracked rock; limestone flake (LN 141.01). **Interpretation:** cultural deposit associated with second period of house occupation (deposition on floor suggested by IIa, IIb boundary and Fea. A).

Layer IIb **Dimensions:** 8 cm bs; 8 cm thick. **Matrix:** grayish brown (10YR 5/2) silt loam (partially calcareous); weak, crumb, fine; slightly sticky, slightly plastic, soft; abrupt, smooth boundary. **Composition:** 75% sub-gravel (partially calcareous); 10% gravel, 5% pebbles, 10% cobbles, calcareous. **Features:** Fea. A intruded from surface of layer IIb. **Inclusions:** land snails in high density. **Intrusions:** rootlets. **Cultural material:** charcoal flecking; (not distinguished from IIa during excavation). **Interpretation:** cultural deposit associated with earliest occupation of house.

Feature A

Excavation: estimated one half of feature excavated. **Dimension:** 5 cm bs; 6 cm at thickest; 25 cm wide by an estimated 30 cm long. **Description:** portion excavated suggests feature is shallow, oval shaped; underlying Layer IIa, intruded into IIb; two small, thin limestone slabs lie on the sloping side of the feature (Fig. C-12), perhaps intended as base for something placed in or over feature; no evidence of in situ burning. **Matrix:** dark brown (10YR 3/3) silt loam (partially calcareous); weak, crumb, fine; slightly sticky, slightly plastic, soft; very abrupt, smooth boundary. **Composition:** 95% sub-gravel (partially calcareous); 5% gravel, calcareous. **Inclusions:** land snails in high density. **Intrusions:** rootlets. **Cultural material:** charcoal flecking; fire-cracked rock; marine shell. **Interpretation:** feature with fill similar to material in Layer IIa, but darker, and higher percentage of sub-gravel; use during existence of occupational floor at top of Layer II b; a radiocarbon sample (B-69558) produced a calibrated age range of A.D. 1650 to 1950 (Table 8).

Layer III

Same characteristics as TP-1, Layer III: shows evidence of intrusion for the construction of house wall (Fig. C-12).

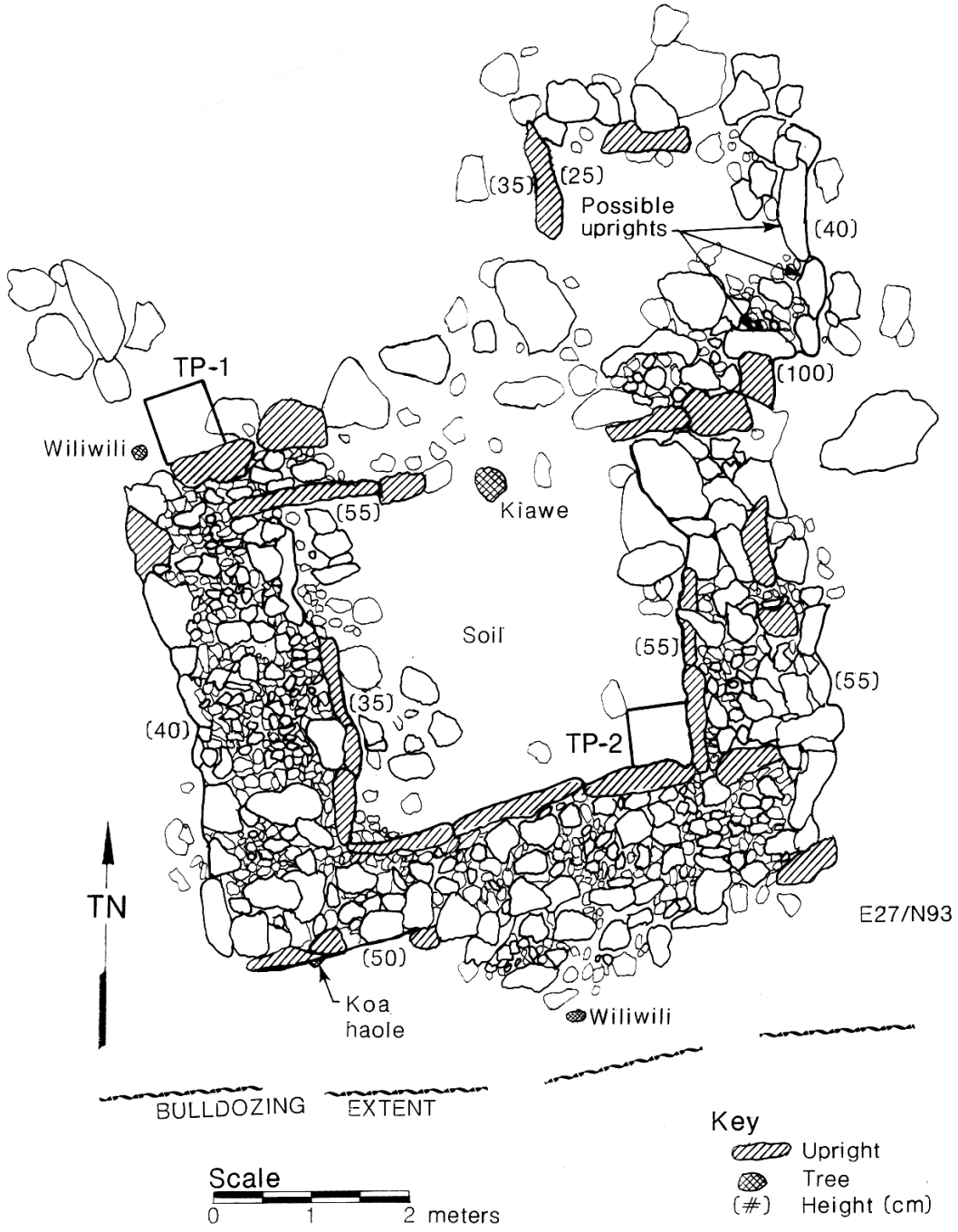

Figure C-11. Site 1724-11.

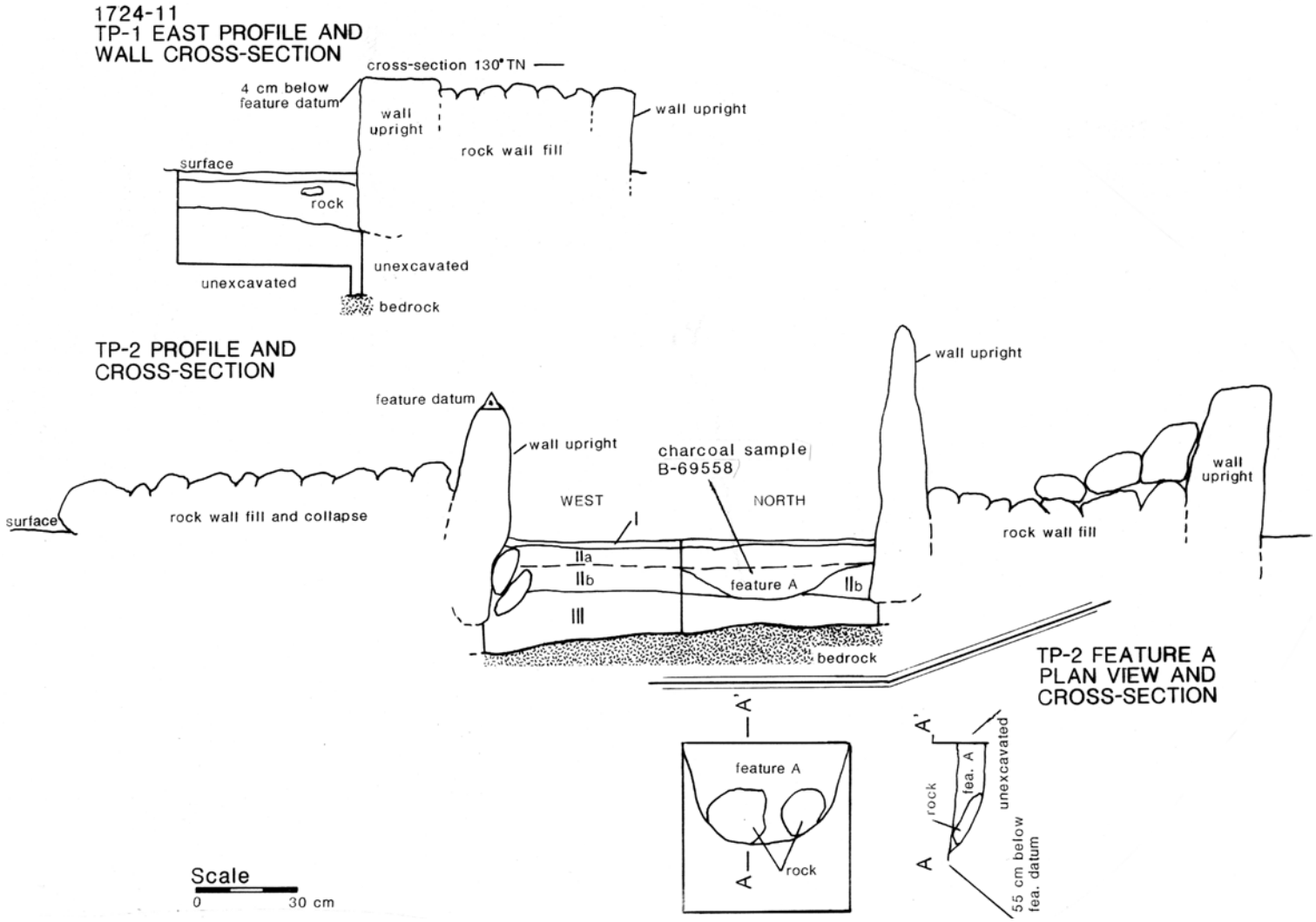

Figure C-12. Site 1724-11, TP-1 and TP-2.

Photo C-3. Site 1724-11. Note wide west wall in foreground and uprights on inside of south wall (right). (facing east)

Site/Feature No: 1724-12
Other No: E31/N116.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 2.10 x .55 m opening; 2.15 x .65 floor; 90 cm depth.
Description: straight-sided, irregularly-shaped sinkhole.
Surface: limestone bedrock; ground cover of grasses and brush; numerous *kiawe*.
Floor: soil deposit.
Deposit: NT.
Fill: none.
Cultural material: a few fire-cracked rock on the surface.
Function: trash deposition?
Age: pre-contact to 1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; a sample of the deposit should be obtained.

Site/Feature No: 1724-13
Other No: E28/N114.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.25 x .80 m opening; 1.02 x .60 m floor; 85 cm depth.
Description: oval-shaped sinkhole, slightly slope sided, possible depression.
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe* and *wiliwili*.
Floor: soil deposit with two large cobbles.
Deposit: NT.
Fill: none.
Cultural material: scattered fire-cracked rock on surface.
Function: trash deposition?
Age: pre-contact to mid-1800s.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-14
Other No: E33/N121.
Figure(s): 11.
Testing: none.
Natural feature: depression.
Structure: none.
Dimensions: 2.56 x .98 m opening, 30 cm depth.
Description: oval-shaped depression.
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe* and *wiliwili*.
Floor: soil deposit.
Deposit: NT.
Fill: none.
Cultural material: scattered fire-cracked rock on surface.
Function: trash deposition?
Age: pre-contact to mid-1800s.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-15
Other No: E31/N120.
Figure(s): 11.
Testing: none.
Natural feature: none.
Structure/other: piles of fire-cracked limestone pebbles.
Dimensions: see description.
Description: 3 large piles of fire-cracked limestone pebbles; several small piles and scatters; large piles are approximately 5 x 3 m in length and width, 20 cm in height; a small number of pieces of cracked basalt are found among the limestone, estimated in a ratio of 1:250.
Surface: these piles are on limestone bedrock, clustered NE of 1724-7 (the depression with a deposit of fire-cracked rock); grasses and brush dominated by basil; scattered *kiawe*.
Deposit: NT.
Cultural material: none noted other than the fire-cracked rock of the feature.
Function: rake-out from ovens and hearths.
Age: pre-contact to mid-1800s.
Natural history: NA.
Condition: good.
Research potential: these rock piles are deposited from ovens and hearths, and contain potential information on site occupational use and history; in addition, these and other deposits of fire-cracked rock provide one source of information on the intensity and duration of occupation.
Recommendations: data recovery, if necessary; a sample of the piles should be excavated.

Site/Feature No: 1724-16
Other No: E30/N120.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: rock fill.
Dimensions: .88 x .45 m opening; floor and depth undetermined.
Description: small-opening sinkhole with rock fill to surface.
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe* and *wiliwili*.
Floor: NA.
Deposit: NT.
Fill: cobble fill to surface.
Cultural material: none.
Function: trash deposition?
Age: pre-contact to mid-1800s.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-17
Other No: E35/N129.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 2.15 x .75 m opening; 2.20 x .95 m floor; approx. 80 cm depth.
Description: irregularly-shaped sinkhole.
Surface: limestone bedrock; grasses and brush; *kiawe* and *wiliwili*.
Floor: soil deposit with scattered cobbles.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities; part of habitation complex.
Recommendations: data recovery, if necessary; excavation of sample of deposit.

Site/Feature No: 1724-18
Other No: E48/N127.
Figure(s): 11.
Testing: none.
Natural feature: depression.
Structure: none.
Dimensions: 3.05 x 1.12 m opening; 15 cm depth.
Description: irregularly-shaped depression.
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe* and *wiliwili*.
Floor: soil deposit with cobble scatter.
Deposit: NT.
Fill: none.
Cultural material: scatter of fire-cracked rock.
Function: trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities; part of habitation complex.
Recommendations: data recovery, if necessary; excavation of sample of feature deposit.

Site/Feature No: 1724-19
Other No: E31/N133.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.14 x .75 m opening; 2.5 x 1.5 m (estimated) floor; 140 cm depth.
Description: sinkhole and small cave; large boulder partially covers opening; human bone on surface; small rock-filled arm of sink on N side.
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe* and *wiliwili*.
Floor: soil deposit with several cobbles; scattered human bone.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: burial placement?; other occupation?
Age: pre-contact to mid-1800s.
Natural history: bird bone (Procellariid, medium) on surface.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Human skeletal remains: fragments of bone from at least one human infant were found on the floor of the sinkhole. The bone was not identifiable in the field and a few fragments were collected for identification. Additional bone remains on the sink floor.
Recommendations: the feature needs additional investigation to determine the archaeological context of the bone and the nature of deposition; also recommended is consultation with appropriate agencies and cultural groups concerning such investigation, disposition of the collected bone, and long-term treatment of human bone.

Site/Feature No: 1724-20
Other No: E26/N127.
Figure(s): 11.
Testing: none.
Natural feature: depression.
Structure: none.
Dimensions: 1.78 x .84 m opening; 20 cm depth.
Description: small depression.
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe* and *wiliwili*.
Floor: soil deposit, large *kiawe*.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: habitation, trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-21 (a,b,c)
Other No: E25/N134.
Figure(s): 11.
Testing: none.
Natural feature: sink.
Structure: none.
Dimensions: (a) .72 x .30 m shelf opening; 80 cm depth; floor area undetermined.
Description: sinkhole that has a large upper area (3.1 x2.4 m) with sloping shelf that drops into actual sink opening; (b,c) two small associated rock-filled sinkholes.
Surface: limestone bedrock; grasses and basil; *kiawe* and *wiliwili*
Floor: soil deposit, but sink too small to enter to determine size of cavern and floor area.
Deposit: NT.
Fill: none.
Cultural Material: none.
Function: trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-22
Other No: E22/N140.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole, small.
Structure: none.
Dimensions: .65 x .60 m opening; 155 cm depth; floor area not determined.
Description: small, deep sinkhole with no modifications
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe* and *wiliwili*.
Floor: soil deposit.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-23
Other No: E30/N138.
Figure(s): 11.
Testing: none.
Natural feature: depression/sink.
Structure: none.
Dimensions: 2.13 x 1.85 x .20 m depression, with .50 m diameter sink, 210 cm depth.
Description: shallow depression and small, deep sink.
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe* and *wiliwili*.
Floor: soil deposit.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: unknown.
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-24
Other No: E22/N142.
Figure(s): 11.
Testing: none.
Natural feature: depressions.
Structure: none.
Dimensions: 3.55 x 3.35 m opening; 15 cm depth.
Description:
Surface: limestone bedrock and patches of soil; grasses and brush dominated by basil; *kiawe* and *wiliwili*.
Floor: soil deposit; large *kiawe*.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-25
Other No: Phase I, 21-D; E44/N140.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 2.35 x 1.13 m opening; 2.45 x 1.56 m floor; 130 cm depth.
Description: oval-shaped sinkhole, with shallow overhang, possible bell-shape.
Surface: irregular limestone bedrock; grasses and brush dominated by basil; *kiawe* and *wiliwili*.
Floor: soil deposit, cobble pile in SE corner, several *koa haole* trees.
Deposit: NT.
Fill: none.
Cultural material: none in sink, but fire-cracked piles adjacent (see 1724-26).
Function: trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; excavation of sample of deposit.

Site/Feature No: 1724-26
Other No: E49/N139.
Figure(s): 11.
Testing: none.
Natural feature: depression/sink.
Structure/other: rock fill and fire-cracked rock pile.
Dimensions: 4.55 x 2.23 m opening of sink/depression, 20 cm depth of depression; depth of sink undetermined; 3 m diameter fire-cracked rock pile, 20 cm height.
Description: depression and rock-filled sinkhole, with associated large pile of fire-cracked limestone pebbles.
Surface: limestone bedrock; thin cover of grasses and brush; *kiawe*, *koa haole*, and *wiliwili*.
Floor: soil deposit in depression with some fire-cracked rock; floor of sink unknown; large *kiawe* in depression.
Deposit: NT.
Fill: pebble, cobble, and boulder fill in sink.
Cultural material: none.
Function: trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-27 (a-d)
Other No: E76/N138.
Figure(s): 11.
Testing: none.
Natural feature: (a) sinkhole.
Structure: (b-d) 3 stone mounds.
Dimensions: (a) 3.20 x 1.3 m opening; shelf 23 cm deep; two secondary sinkholes within larger depression; each sink is about 40 cm in diameter and 120 cm deep; areas of floor not determinable; (b-d) 3 stone mounds, each about 1.5 m long, 50 cm wide, and 50 cm high.
Description: irregularly shaped sinkhole with shelf in center and two small individual sinkholes; 3 nearby stone mounds.
Surface: thin soil patches and limestone bedrock; grasses and brush; *kiawe* and *wiliwili*.
Floor: soil deposits within sinks; banyan on shelf.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; sinkholes are too small for standard excavation, but samples should be obtained for possible trash and bird bone. For the stone mounds, no further work recommended.

Site/Feature No: 1724-28
Other No: E68/N138.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none
Dimensions: 1.23 x 1.14 m opening; 55 cm depth.
Description: sinkhole with shelf and cavities, exposed base.
Surface: limestone bedrock; grasses; scattered *kiawe*.
Floor: none; shelf and cavities.
Deposit: NA.
Fill: none.
Cultural material: none.
Function: non-cultural.
Research potential: none.
Recommendations: no further work.

Site/Feature No: 1724-29 (a-e)
Other No: E65/N119.
Figure(s): 11.
Testing: none.
Natural feature: sinkholes.
Structure: one sinkhole rock-filled.
Dimensions: (a) 1.56 x 1.05 m opening; 120 cm depth; (b-e) each about .6 m diameter, 70 to 130 cm depths.
Description: sinkhole complex,
Surface: limestone bedrock; grasses; *kiawe* and banyan.
Floor: soil deposit in (a), with one boulder.
Deposit: NT.
Fill: rock fill in one of the small sinks (b)
Cultural material: none.
Function: trash deposition?
Age: pre-contact to mid-1800s.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery if necessary, limited sample of deposit.

Site/Feature No: 1724-30
Other No: E63/N104.
Figure(s): 11.
Testing: none.
Natural feature: sink.
Structure: none.
Dimensions: 3.45 x 1.23 m opening; 50 cm depth.
Description: irregularly-shaped sinkhole.
Surface: limestone bedrock; grasses, vines, and brush; *kiawe*.
Floor: soil deposit.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-31
Other No: E74/N100.
Figure(s): 11.
Testing: none.
Natural feature: depression.
Structure: none.
Dimensions: 3.65 x2.34 m opening; 10 cm depth.
Description: oval-shaped depression.
Surface: limestone bedrock; grasses, thick vines; *kiawe*.
Floor: soil deposit.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-32
Other No: Haun (1991) 1724-H; E50/N106.
Figure(s): 11.
Testing: none.
Natural feature: none.
Structure: wall segment.
Dimensions: 1.41 x .59 m; 40 cm height.
Description: wall segment with one upright slab and other stacked boulders; possible remnant of C-shape; possible surface deposit.
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe*.
Deposit: NT.
Cultural material: some scattered fire-cracked rock in vicinity.
Function: temporary habitation.
Age: pre-contact to mid-1800s?
Condition: poor.
Research potential: habitation information, related to larger habitation complex.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-33
Other No: E44/N104.
Figure(s): 11.
Testing: none.
Natural feature: none.
Structure/other: fire-cracked rock scatter.
Dimensions: 8 x 6 m (approximate) scatter.
Description: area of fire-cracked rock, and scattered boulders, possibly disturbed structure.
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe*.
Deposit: NT.
Cultural material: a few fragments of marine shell and fire-cracked rock on surface.
Function: habitation debris, possible structure.
Age: pre-contact to mid-1800s?
Condition: poor.
Research potential: habitation information, related to main habitation complex.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-34
Other No: none
Figure(s): 11 and C-13, Photo C-4.
Testing: one ST.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.11 x .85 m opening; 2.12 x 1.22 m floor; 275 cm depth.
Description: oval-shaped, deep sinkhole.
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe* and *wiliwili*.
Floor: soil deposit.
Deposit: natural deposition, with bird bone and egg shell, and Rattus exulans.
Fill: none.
Cultural material: none.
Function: non-cultural.
Age: pre-contact to mid-1800s.
Natural history: NA.
Condition: good.
Research potential: feature contains information relevant to the pre-human environment and post-colonization environmental change,
Recommendations: data recovery, if necessary.

Test Excavations: A shovel test was carried out by Dr. Alan Ziegler, with the removal of 23 liters of deposit. The deposit was screen collected. No cultural material of any kind was noted in the sample, but some fragments of bird bone are present.

1724-34, ST-1 Descriptions: Formal soil descriptions were not made; sediment is comparatively loose, with matrix as yellowish brown (10YR 5/4) sandy clay loam (calcareous). Deposit contains bird egg shell, plus bone of Procellariid, medium and large bird, *Rattus exulans*, and European rat.

Site/Feature No: 1724-35
Other No: E30/N141.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 2.04 x 1.05 m opening, 1.99 x .99 m floor, 70 cm depth.
Description: irregularly shaped sinkhole.
Surface: limestone bedrock; grasses and basil; *kiawe* and *wiliwili*.
Floor: soil deposit, and two cobbles.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: agriculture and trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

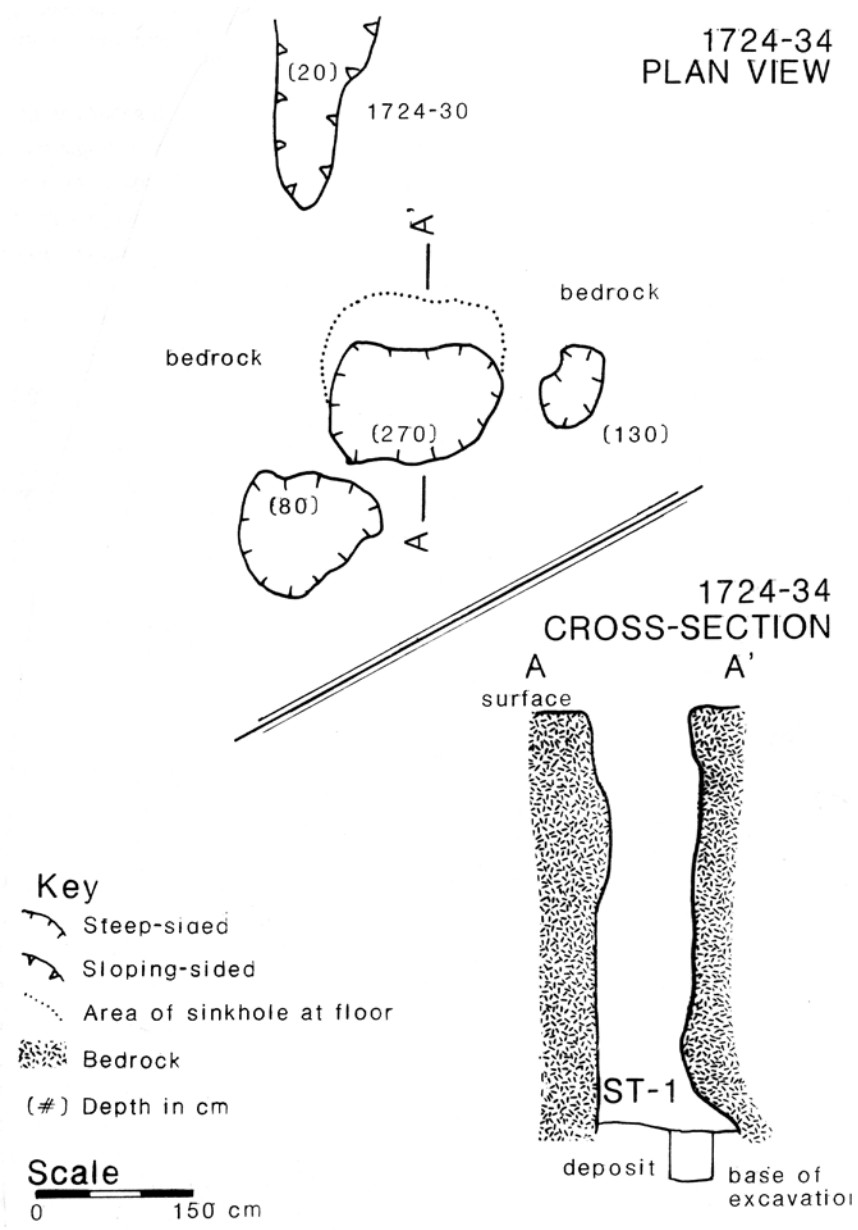

Figure C-13. Site 1724-34.

Photo C-4. Excavation of Site 1724-34, with Dr. Alan Ziegler. Sinkhole is 2.75 m deep. (facing north)

Site/Feature No: 1724-36
Other No: E66/N144.
Figure(s): 11 and C-14.
Testing: one ST.
Natural feature: sinkhole.
Structure: none.
Dimensions: 4.40 x 4.20 m opening, 3.65 x 3.50 floor, 70 cm depth.
Description: circular sinkhole, with large shelf on south and low, deep overhang on north.
Surface: limestone bedrock; grasses, brush, and vines; *kiawe* and *koa haole*.
Floor: soil deposit, numerous *koa haole*; four boulders on shelf.
Deposit: 20 cm culturally modified deposit, probably agricultural, overlying decomposing limestone.
Fill: none.
Cultural material: charcoal fleck.
Function: agricultural.
Age: pre-contact to mid-1800s.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Test Excavations: A shovel test was excavated on the northern side of the exposed portion of the floor. It was excavated to 70 cm bs, where rock and pit depth prevented further excavation.

1724-36: ST-1 Descriptions:

Layer I **Dimensions:** surface; 10 cm thick. **Matrix:** black (10YR 2/1, mottled with small fragments of limestone) loam (non-calcareous); structureless; non-sticky, non-plastic, loose; abrupt, smooth boundary. **Composition:** 85% non-calcareous sub-gravel; 5% gravel, 10% pebbles, calcareous. **Inclusions:** numerous land snails; plant and insect fragments. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** recent organic duff, forming soil.

Layer II **Dimensions:** 10 cm bs; 20 cm thick. **Matrix:** dark yellowish brown (10YR 4/4) clay loam (non-calcareous); weak, crumb, medium; slightly sticky, slightly plastic, soft; abrupt smooth boundary. **Composition:** 90% sub-gravel, non-calcareous; 5% gravel, 5% pebbles. **Inclusions:** snails in high density; Procellariid and Passeriform bone; bone of *Rattus exulans*. **Intrusions:** roots. **Cultural material:** charcoal fleck. **Interpretation:** culturally modified soil; comparatively thick, possibly an agricultural soil.

Layer IIIa **Dimensions:** 30 cm bs; 14 cm thick. **Matrix:** yellowish brown (10YR 5/6) silt (calcareous); weak, granular, medium to coarse; slightly sticky, slightly plastic, slightly hard; boundary not reached. **Composition:** 80% sub-gravel, 10% gravel, 5% pebbles, 5% cobbles, calcareous. **Inclusions:** land snails in medium density. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** natural decomposing limestone.

Layer IIIb **Dimensions:** 44 cm bs; 15+ cm thick (not excavated to bottom). **Matrix:** Graded continuation of IIIa, with higher percentage of coarse fraction.

Note: Bedrock not reached.

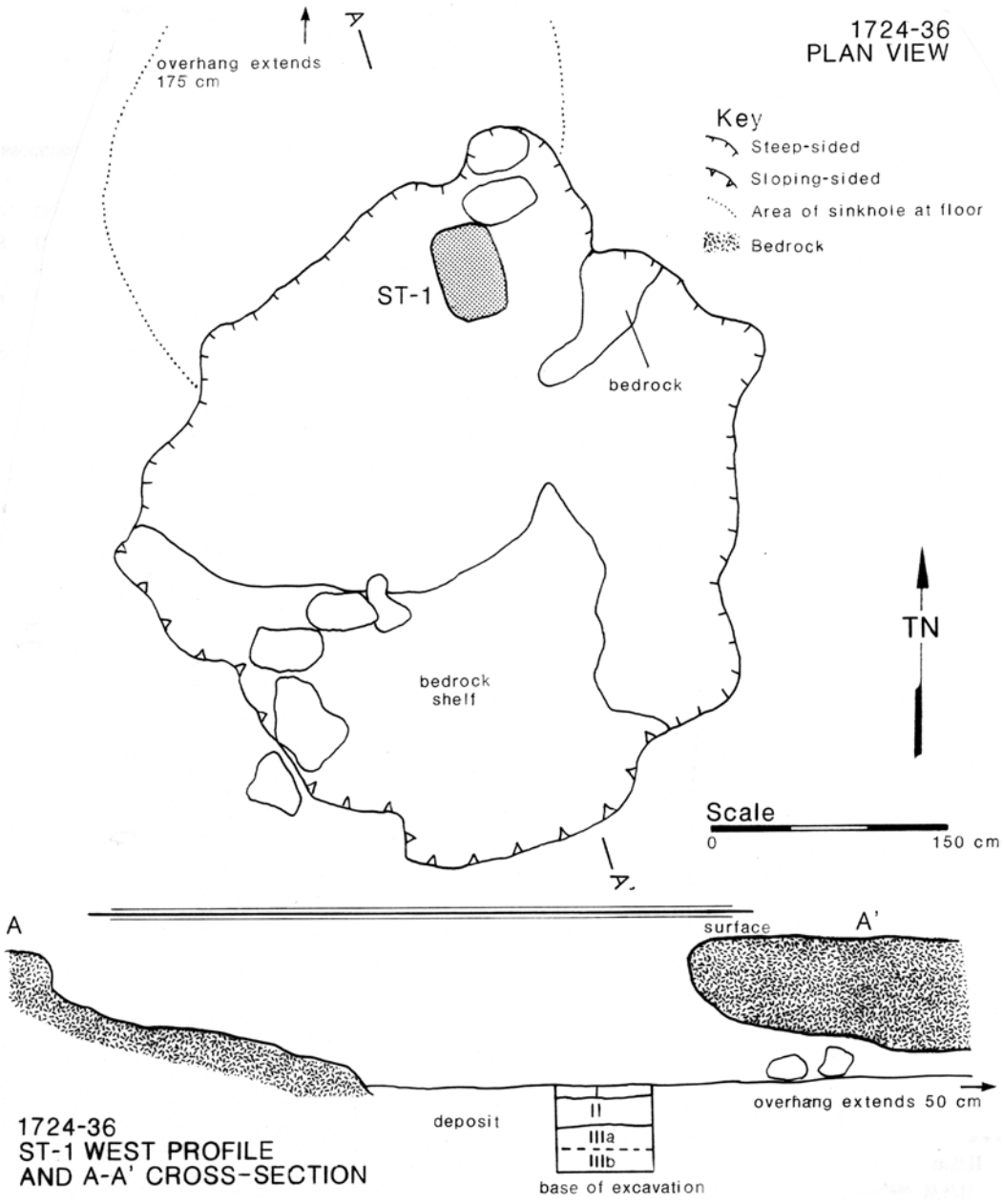

Figure C-14. Site 1724-36.

Site/Feature No: 1724-37 (a,b)
Other No: E50/N135.
Figure(s): 11.
Testing: none.
Natural feature: depressions.
Structure: no
Dimensions: (a) 1.53 x.76 m opening, 30 cm depth; (b) ,85 x.50 m, 30 cm depth?
Description: two small depressions, one (b) filled with fire-cracked rock.
Surface: limestone bedrock; grasses; *kiawe*.
Floor: soil deposits.
Deposit: NT.
Fill: fire-cracked rock in (b).
Cultural material: fire-cracked rock.
Function: oven debris and trash deposition?
Age: pre-contact to mid-1800s.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-38
Other No: E50/N133.
Figure(s): 11 and Photo 10.
Testing: none.
Natural feature: depression.
Structure/other: fire-cracked rock.
Dimensions: 2.23 x 1.11 m opening; 15 cm deep depression; (b) 3.13 x 2.20 m, 10 cm high rock pile.
Description: oval depression and adjacent pile of fire-cracked rock.
Surface: limestone bedrock; brush dominated by basil; *kiawe* and *koa haole*.
Floor: soil deposit.
Deposit: NT.
Fill: none.
Cultural material: fire-cracked rock.
Function: fire-cracked rock and trash deposition?
Age: pre-contact to mid-1800s.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-39 (a,b)
Other No: E54/N155.
Figure(s): 11.
Testing: none.
Natural feature: (a) depression, (b) sinkhole.
Structure/other: rock fill.
Dimensions: (a) 4.67 x 2.34 m opening, 15 cm depth; (b) 1.03 x 1.04 m, depth unknown.
Description: large oval sinkhole, with adjacent rock-filled sink, 3 m to the S.
Surface: limestone bedrock; grasses; *kiawe*.
Floor: (a) soil deposit; (b) unknown.
Deposit: NT.
Fill: cobble fill in (b).
Cultural material: none.
Function: trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; limited sample collection from (a), rock removal from (b).

Site/Feature No: 1724-40
Other No: E42/N159.
Figure(s): 11 and C-15.
Testing: one ST.
Natural feature: sinkhole/depression?
Structure: rock alignment?
Dimensions: 6.24 x 4.85 m opening, 30 cm depth.
Description: oval-shaped depression, with pebble concentration on west side; pebbles not fire-cracked, origin unknown; large slabs and cobbles on east side of depression may be placed, but are not a definite cultural feature.
Surface: limestone bedrock; basil; *kiawe* and *koa haole*.
Floor: soil deposit.
Deposit: 18 cm culturally modified deposit, agricultural?
Fill: none.
Cultural material: scatter of fire-cracked rock on surface nearby.
Function: agriculture.
Age: pre-contact to mid-1800s?
Natural history: land snails; bird egg shell.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; selected sampling.

Test Excavations: One shovel test was placed in the northern half of the deposit; the test is 70 cm in diameter, 30 cm depth; excavation terminated with dense rock; deposit shows some evidence of mixing, possible agricultural modification.

1724-40, ST-1 Descriptions:

Layer I **Dimensions:** surface; 3 cm thick. **Matrix:** black (10YR 2/1, mottled with small fragments of limestone) loam (non-calcareous); structureless; non-sticky, non-plastic, loose; abrupt, smooth boundary. **Composition:** 90% non-calcareous sub-gravel; 5% gravel, 5% pebbles, calcareous. **Inclusions:** numerous land snails; plant and insect fragments. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** recent organic duff, forming soil.

Layer II **Dimensions:** 3 cm bs; 18 cm thick. **Matrix:** dark yellowish brown (10YR 4/4) silt loam (non-calcareous); weak, crumb, medium; slightly sticky, non-plastic, slightly hard; increasingly compact toward bottom; abrupt, wavy boundary. **Composition:** 75% sub, gravel, non-calcareous; 15% gravel, 5% pebbles, 5% cobbles, calcareous. **Inclusions:** land snails in medium density; bird egg shell. **Intrusions:** roots and rootlets. **Cultural material:** two fragments of fire-cracked rock. **Interpretation:** natural soil with some cultural modification; agricultural?

Layer III **Dimensions:** 21 cm bs; 10+ cm thick (not excavated to bottom). **Matrix:** yellowish brown (10YR 5/6) silt (calcareous); weak, granular, medium to coarse; slightly sticky, slightly plastic, slightly hard; boundary not reached. **Composition:** 70% sub-gravel, 10% gravel, 5% pebbles, 15% cobbles, calcareous. **Inclusions:** land snails in low density. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** natural deposition of decomposing limestone.

Note: Bedrock not reached.

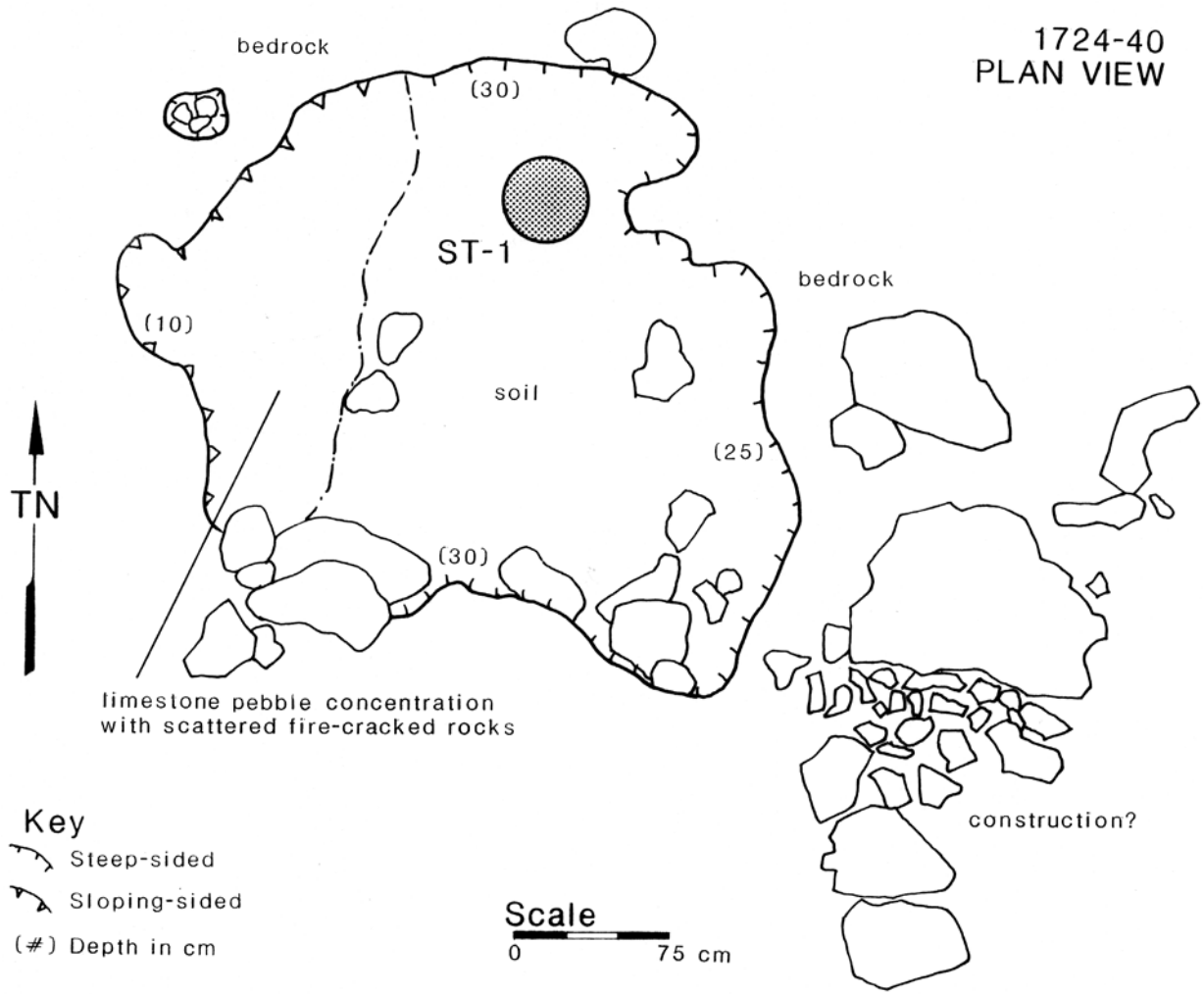

Figure C-15. Site 1724-40.

Site/Feature No: 1724-41
Other No: E41/N157.
Figure(s): 11.
Testing: one ST.
Natural feature: depression.
Structure/other: slab scatter (natural?)
Dimensions: 1.10 x 1.05 m; 15 cm depth, depression; 1.25 m long scatter.
Description: small oval depression and adjacent scatter of 7 limestone slabs, probably natural; location of transit survey point BPH 52.
Surface: limestone bedrock; grasses, vines; *koa haole*.
Floor: soil deposit.
Deposit: NT in depression; decomposing limestone ground surface.
Fill: none.
Cultural material: none.
Natural history: NA.
Research potential: none.
Recommendations: no further work.

Test Excavations: One shovel test (30 cm in diameter, 11 cm depth) was placed in ground surface adjacent to rock scatter. Beneath the loose duff is a 9 cm unit of decomposing limestone lying on top of bedrock. There is no cultural material in the deposit or on the ground. No formal descriptions.

Site/Feature No: 1724-42
Other No: E61/N156.
Figure(s): 11 and C-16.
Testing: one TP.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.60 x 1.45 m opening; 1.90 x 1.04 m floor; 107 cm depth.
Description: oval sinkhole, two small shelves, low overhang.
Surface: limestone bedrock; grasses; *kiawe* and *koa haole*.
Floor: soil deposit.
Deposit: below a shallow layer of duff, approximately 12 cm of a culturally modified soil, probably representing an agricultural deposit.
Fill: none.
Cultural material: charcoal flecking; marine shell; fish bone.
Function: agriculture and trash deposition?
Age: pre-contact to mid-1800s?
Natural history: long-term history of natural accumulation, with bird egg shell, land snails.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; intensive sample.

Test Excavations: A controlled test pit (50 x 50 cm, 30 cm depth) was excavated on the southern end of the floor, slightly below the overhang. Subsequently, the pit was slightly expanded and deepened to 75 cm bs by shovel testing (with screening) to attempt to determine if there may be buried horizons with dense bird bone (see text discussion). No such bone was found.

Pollen analysis was conducted on samples from this unit (Appendix E). The results showed relatively poor pollen preservation, with some mixing of post-contact introductions in lower levels, probably due to relative coarseness of sediments.

1724-42, TP-1 Descriptions:

Layer I **Dimensions:** surface; 13 cm thick. **Matrix:** very dark brown (10YR 2/2, mottled with limestone grains) loam (non-calcareous); structureless; non-sticky, non-plastic, loose; abrupt, smooth boundary. **Composition:** 95% sub-gravel, non-calcareous; 5% gravel, calcareous. **Inclusions:** land snails in high density; bird egg shell; marine shell(?); insect parts; plant fragments; *Rattus exulans*; *Mus musculus*; European rat. **Intrusions:** rootlets. **Cultural material:** charcoal; marine shell; fish bone. **Interpretation:** upper portion (Ia) is modern duff, increasingly compact lower portion (Ib) may be older developing soil with cultural modification.

Note: during the excavation, the boundary between Layers I and II was misread; thus excavation unit II/1 contains the bottom 3-4 cm of Layer I; the cultural material in II/1 is attributed to Layer I.

Layer II **Dimensions:** 13 cm bs; 49 cm thick. **Matrix:** dark yellowish brown (10YR 4/6) sandy clay loam (calcareous); weak, granular, medium; slightly sticky, slightly plastic, soft; clear, smooth boundary. **Composition:** 40% sub-gravel, 10% gravel, 20% pebbles, 30% cobbles, calcareous. **Inclusions:** land snails in medium density; bird egg shell. **Intrusions:** roots. **Cultural material:** none. (see note, above). **Interpretation:** natural deposition of decomposing limestone.

Layer III **Dimensions:** 60 cm bs; 15+ cm (not excavated to bottom). Not studied in detail, but has characteristics similar to Layer II, but darker yellow, and higher percentage of cobbles.

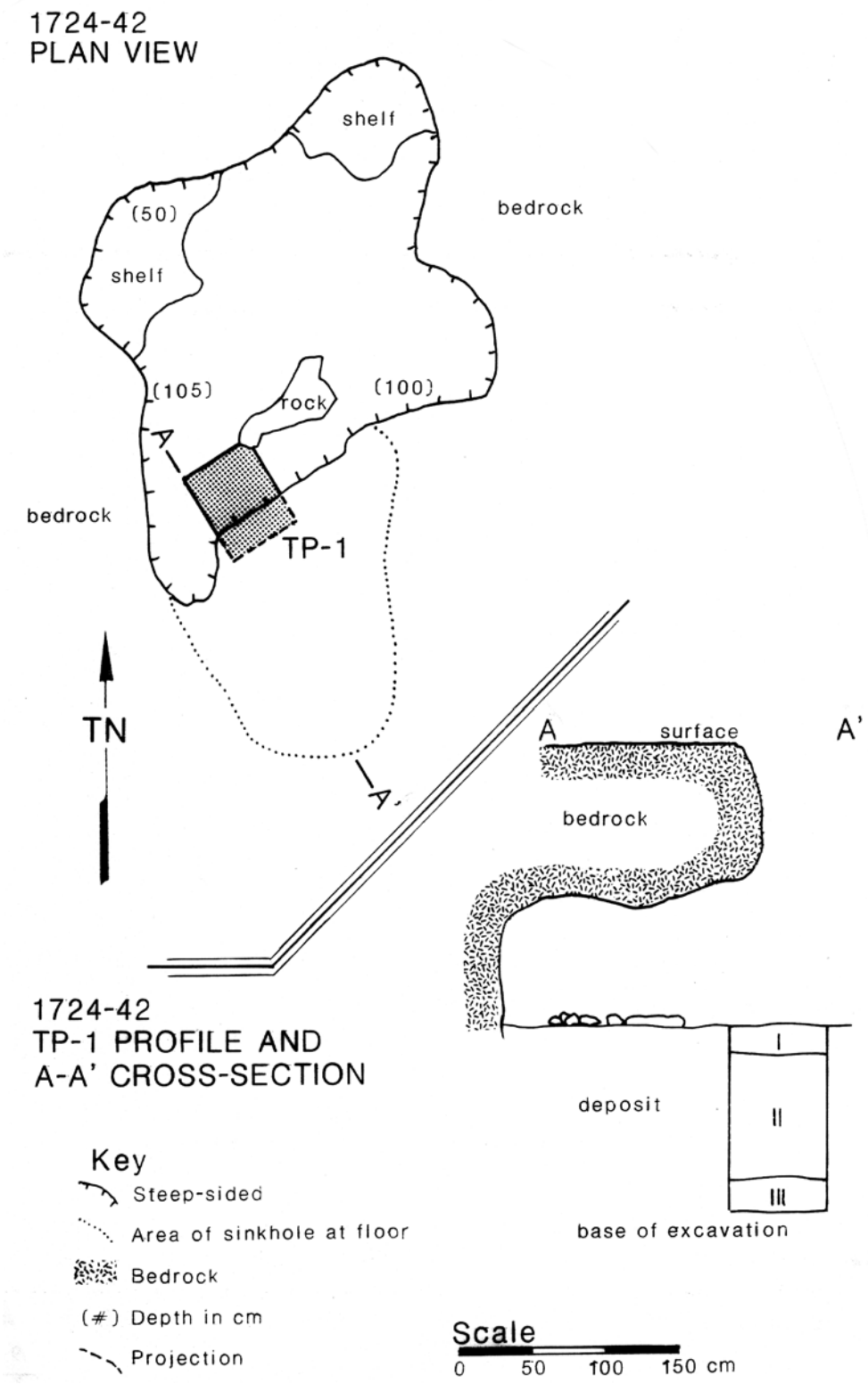

Figure C-16. Site 1724-42.

Site/Feature No: 1724-43
Other No: E68/N163.
Figure(s): 11 and C-17.
Testing: one TP.
Natural feature: none.
Structure: remnant C-shape, alignment.
Dimensions: approximately 10 x 12 m total area.
Description: two stone piles, 1 m apart, including two upright slabs (probable C-shape remnant) with thin midden scatter; the north pile (3.2 x 1.5 m; 40 cm high) has two upright slabs, several boulders, and about 90% small cobbles; the south pile (1.6 x 1.2 m; 35 cm high) has small boulders and cobbles, but has no uprights; 1 isolated upright to the east; also to east is a cobble scatter with thin midden; to the north is a rough cobble alignment (7.9 m long)(this may be a damaged structure whose original form is not determinable; it probably had core-filled uprights); destruction may be from stone-robbing of uprights.
Surface: thin soil and brush cover around structures; limestone bedrock nearby; scattered *kiawe* and *koa haole*.
Deposit: 10 cm thick cultural deposit overlying bedrock and thin decomposition horizon.
Cultural material: marine shell, crab, urchin, fire-cracked rock, and charcoal (including Chenopodium and probably *`akoko*, see Appendix B).
Function: temporary habitation.
Age: pre-contact to mid-1800s?
Condition: surface structures damaged, deposit intact.
Research potential: structure has potential for information related to occupational history of area, either as temporary habitation, or as specialized structure related to larger settlement pattern and use of agricultural complex.
Recommendations: data recovery, if necessary; structure and deposit should be intensively excavated, including trenching to determine original form of structure and presence of sub-surface features.

Test Excavations: One test pit (50 x 50 cm) was placed in area near remnant structure wall, revealing a shallow occupational deposit (Fig. C-17).

1724-43, TP-1 Descriptions:

Layer I **Dimensions:** surface; 3 cm thick. **Matrix:** very dark brown (10YR 2/2, mottled with limestone grains) loam (non-calcareous); structureless; non-sticky, non-plastic, loose; abrupt, smooth boundary. **Composition:** 90% sub-gravel, non-calcareous; 5% gravel, 5% pebbles, calcareous. **Inclusions:** land snails in high density; insect parts; plant fragments. **Intrusions:** rootlets. **Cultural material:** marine shell. **Interpretation:** recent duff, forming soil.

Layer II **Dimensions:** 3 cm bs; 5 to 11 cm thick. **Matrix:** dark brown (10YR 4/3) silt (moderately calcareous); weak, crumb, fine; slightly sticky, non-plastic, soft; abrupt, smooth. **Composition:** 80% sub-gravel (moderately calcareous); 15% gravel, 5% pebbles, calcareous. **Inclusions:** land snails in low quantity; bird egg shell. **Intrusions:** rootlets. **Cultural material:** marine shell; fish bone; fire-cracked rock; a few small fragments of charcoal. **Interpretation:** a cultural deposit associated with the occupation of the structure.

Layer III **Dimensions:** 6 cm bs; 1 to 4 cm thick. **Matrix:** white (10YR 8/2) silt (calcareous); weak, crumb, medium; slightly sticky, slightly plastic, soft; very abrupt, smooth boundary (on bedrock). **Composition:** 90% sub-gravel, 5% gravel, 5% pebbles, calcareous. **Inclusions:** land snails in low density, near top. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** non-cultural, decomposing limestone substrate lying atop bedrock.

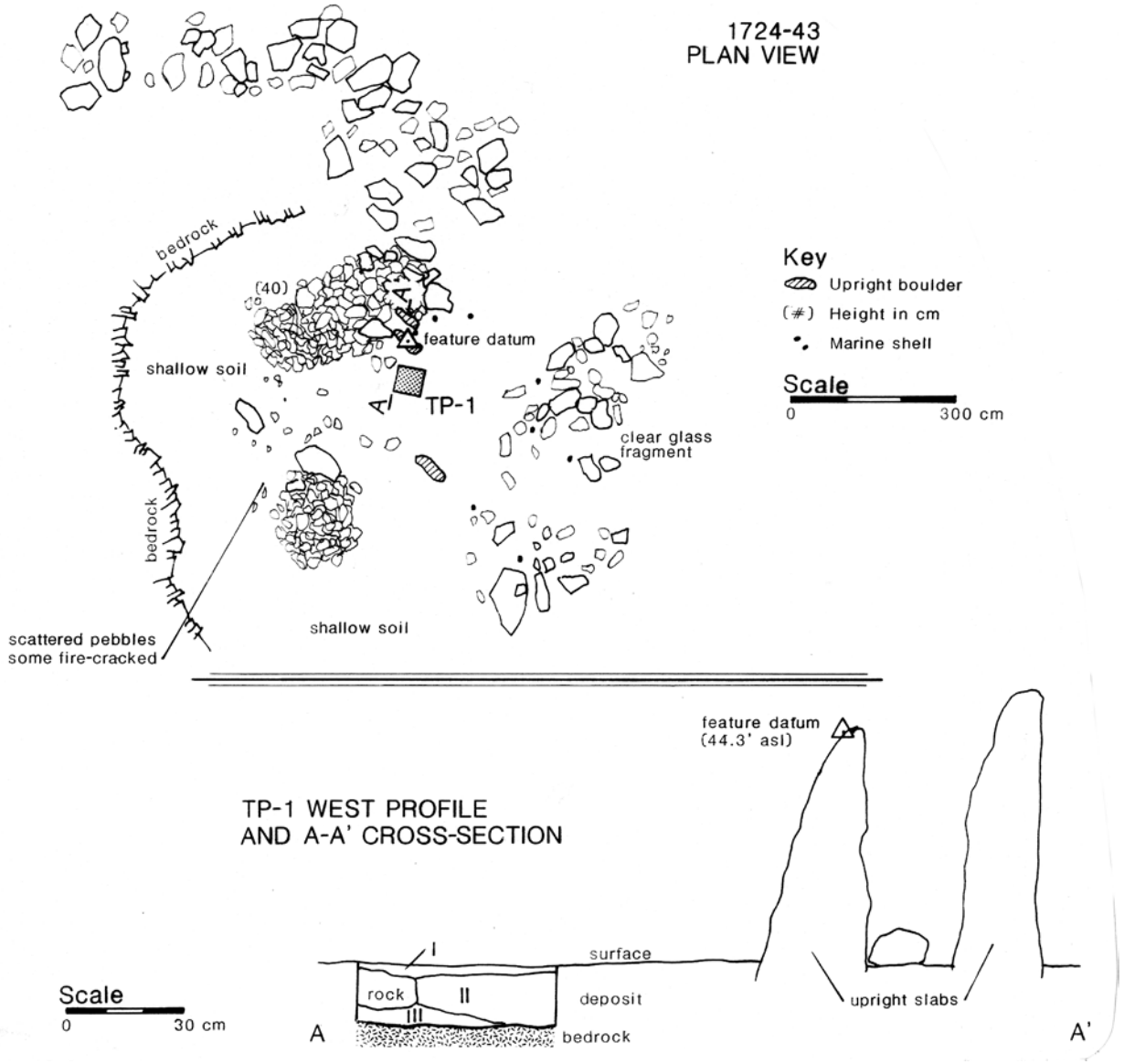

Figure C-17. Site 1724-43.

Site/Feature No: 1724-44
Other No: E76/N170.
Figure(s): 11 and C-18.
Testing: one ST.
Natural feature: depression.
Structure: none.
Dimensions: 6.13 x 4.10 m opening; 10 to 55 cm depth.
Description: large oval depression
Surface: limestone bedrock, some shallow soil; grasses and brush dominated by basil; *kiawe* and *wiliwili*.
Floor: soil deposit, a few scattered cobbles; several *koa haole*, *kiawe*.
Deposit: test shows natural soil formation, with no cultural material.
Fill: none.
Cultural material: none.
Function: non-cultural.
Natural history: natural bedrock decomposition; European rat in upper portion,.
Research potential: none.
Recommendations: no further work.

Test Excavations: One shovel test (40 cm diameter, 35 cm depth) was placed at the N end of the depression. No cultural material was encountered. Excavation ceased at heavy root mass.

1724-44, ST-1 Descriptions:

Layer I **Dimensions:** surface; 6 cm thick. **Matrix:** black (10YR 2/1, mottled with limestone grains) loam (non-calcareous); structureless; non-sticky, non-plastic, loose; abrupt, smooth boundary. **Composition:** 95% sub-gravel, non-calcareous; 5% gravel, calcareous. **Inclusions:** land snails in high density; European rat bone; insect parts; plant fragments. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** recent duff, soil forming.

Layer II **Dimensions:** 6 cm bs; 29+ cm thick (bottom not reached). **Matrix:** dark yellowish brown (10YR 4/6) sandy clay loam (calcareous); weak, granular, medium; slightly sticky, slightly plastic, soft; lower boundary not reached. **Composition:** 60% sub-gravel, 10% gravel, 20% pebbles, 10% cobbles, calcareous. **Inclusions:** land snails in medium density. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** natural deposition of decomposing limestone.

Bedrock not reached in excavation.

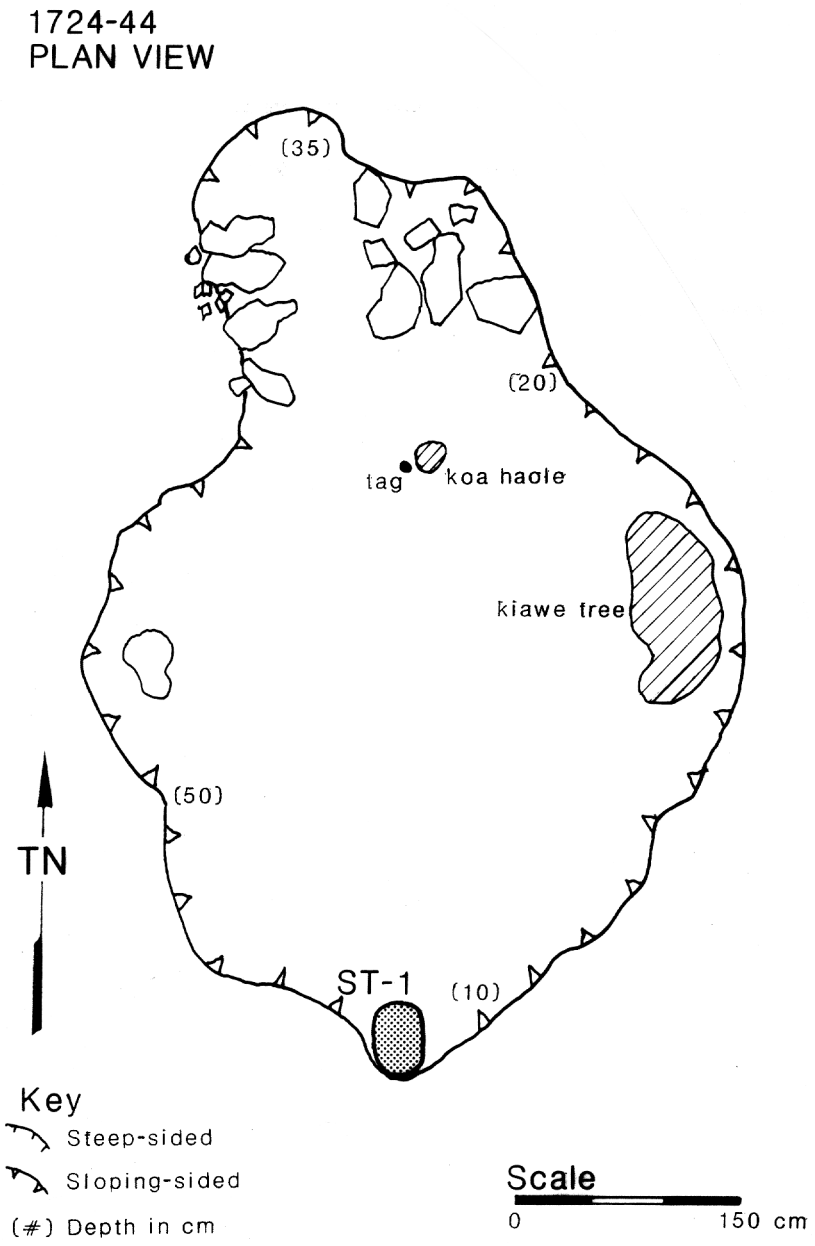

Figure C-18. Site 1724-44.

Site/Feature No: 1724-45
Other No: E90/N170.
Figure(s): 11.
Testing: rocks removed.
Natural feature: sinkhole.
Structure: rock fill and "paving" to sinkhole.
Dimensions: 1.03 x .73 m opening; 150 cm deep; narrow floor unreachable to measure; rock feature 165 x 86 cm.
Description: small rock-filled sinkhole, and adjoining small area of single layer cobble paving.
Surface: limestone bedrock and soil patches; grasses; *kiawe*.
Floor: soil deposit.
Deposit: NT.
Fill: cobble and boulder fill in sinkhole; banyan in sinkhole.
Cultural material: none.
Function: unknown.
Age: NA.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; selective sampling.

Test Excavations: The cobble and boulder rock fill was removed from the upper 45 cm of the sinkhole, but was not continued sinkhole, but sinkhole was not entered because entry narrows and opening is blocked, below rock, by roots of a banyan. A 30 x 40 cm area of the adjoining paved area was removed, indicating that this is a surface layer, with no cultural material.

Site/Feature No: 1724-46
Other No: E94/N171.
Figure(s): 11.
Testing: rock capping partially removal.
Natural feature: sinkhole.
Structure/other: capping of sinkhole.
Dimensions: .71 x .28 m opening, floor area unmeasured, 230 cm deep; capping in area of about 140 x 40 cm.
Description: sinkhole with very small opening covered by layer of limestone capping; overhang and probably bell-shaped chamber at base, but deposition reaches within 15 cm of ceiling; small size of sink prevents measurement of floor area.
Surface: limestone bedrock; *kiawe*.
Floor: soil deposit.
Deposit: NT.
Fill: none.
Cultural material: one wooden 2 x 4 and piece of concrete block near sink; no suggestion that this is associated with sink capping; no recent artifacts noted within the sinkhole.
Function: unknown.
Age: NA.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; the access to this sink is so narrow that any work in sink will be very difficult.

Test Excavations: The rock capping was removed. Capping consisted of four 30 to 40 cm diameter slabs and several smaller cobbles places around edge and over sink opening.

Site/Feature No: 1724-47
Other No: E90/N153.
Figure(s): 11; Photo 3.
Testing: one shallow probe.
Natural feature: sinkhole.
Structure: none.
Dimensions: 2.23 x 1.55 m opening, floor approximately same size (unmeasured), 230 cm depth.
Description: large, oval sinkhole; straight-sided by suggestion of top of bell-shaped chamber at top of floor; large beehive prevented close study or testing during field period. Subsequently the sinkhole was briefly examined.
Surface: open limestone bedrock; scattered grass patches; adjacent to recent area of bulldozing, and mechanical soil testing.
Floor: covered with cobble layer.
Deposit: NT.
Fill: one layer of cobbles overlies a deposit.
Cultural material: none noted.
Function: unknown, but floor covering is definitely a cultural placement (based on comparison with deposition in other sinks).
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; the size and unusual rock covering of floor suggests presence of important cultural materials and/or a substantial deposit of bird bone, necessitating intensive excavation.

Test Excavation: following the main field period, the beehive was removed by Navy personnel, and a shallow probe of about 15 cm was placed into the deposit, then backfilled without screening. No cultural material was noted in the probe, and no human bone was seen on the surface or in the soil that was removed. A deep paleontological deposit is probably present, but the existence of cultural material (or evidence of cultural use, such as agriculture) has not been established.

Site/Feature No: 1724-48
Other No: E110/N164.
Figure(s): 11 and C-19.
Testing: one ST.
Natural feature: sinkhole.
Structure: none.
Dimensions: 4.42 x 4.12 m opening, 4.23 x 2.06 m floor, 150 cm depth.
Description: irregularly shaped sinkhole, with large shelf on S side, overhang to N 35 cm high; scattered boulders at overhang opening.
Surface: limestone bedrock with soil patches; heavy grasses, vines, and brush; *kiawe*; bulldozer path on W side.
Floor: soil deposit; banyan, *koa haole*.
Deposit: test shows no definite cultural material, but possible 12 cm thick agricultural deposit.
Fill: none.
Cultural material: none.
Function: ?
Age: pre-contact to ?
Natural history: land snails; *Rattus exulans*.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; limited sample for additional bone and evidence for cultivation.

Test Excavations: One shovel test (40 x 50 cm, 40 cm depth) was placed on the N side of the sink, in front of the low overhang. No cultural material noted. Excavation ceased at heavy rock layer.

1724-48, ST-1 Descriptions:

Layer I **Dimensions:** surface; 6 cm thick. **Matrix:** black (10YR 2/1, mottled with limestone grains) loam (non-calcareous); structureless; non-sticky, non-plastic, loose; abrupt, smooth boundary. **Composition:** 85% sub-gravel, non-calcareous; 5% gravel, 10% pebbles, calcareous. **Inclusions:** land snails in high density; insect parts; plant fragments. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** recent duff, soil forming.

Layer II **Dimensions:** 6 cm bs; 12 cm thick. **Matrix:** dark yellowish brown (10YR 3/4, mottled with limestone gravel) sandy loam (non-calcareous); weak, crumb, medium; slightly sticky, non-plastic, soft; very abrupt, smooth boundary. **Composition:** 85% sub-gravel (non-calcareous); 5% gravel, 5% pebbles, 5% cobbles, calcareous. **Inclusions:** land snails low in density; *Rattus exulans*. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** a natural deposit; possible modification for agriculture.

Layer III **Dimensions:** 18 cm bs; 20+ cm thick (bottom not reached). **Matrix:** dark yellowish brown (10YR 4/6) loam (calcareous); weak, granular, medium; slightly sticky, slightly plastic, soft; lower boundary not reached. **Composition:** 65% sub-gravel, 15% gravel, 20% pebbles, 10% cobbles, calcareous. **Inclusions:** snails in medium density. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** natural deposition of decomposing limestone.

Bedrock not reached in excavation.

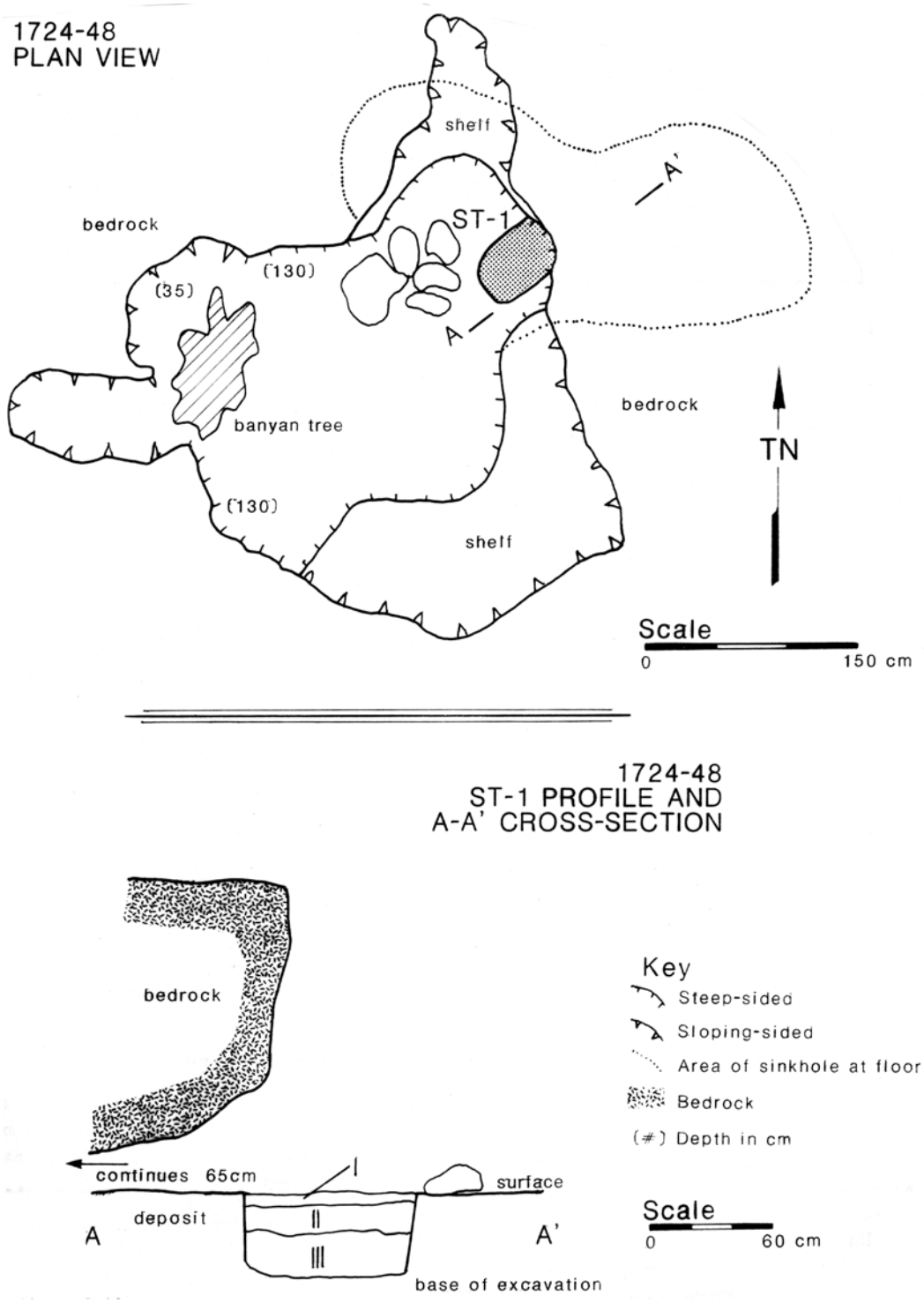

Figure C-19. Site 1724-48.

Site/Feature No: 1724-49
Other No: E140/N170.
Figure(s): 11.
Testing: rock removal.
Natural feature: sinkhole.
Structure/other: rock fill.
Dimensions: 1.22 x 1.24 m opening, .83 x .65 m floor; 80 cm depth.
Description: small oval sinkhole, filled with cobbles; deep part of sinkhole.
Surface: limestone bedrock; grasses, brush, and vines; *kiawe* and *koa haole*.
Floor: soil deposit.
Deposit: NT.
Fill: cobble fill.
Cultural material: none.
Function: unknown.
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; small sink, limited sampling.

Test Excavations: Rock fill removed, all cobbles, to floor of small sink to examine possibility of cultural material or human remains at base; none was identified.

Site/Feature No: 1724-50
Other No: E114/N180.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.62 x .75 m opening; 1.45 x .85 cm floor, 85 cm depth.
Description: oval sinkhole. (Incorrectly field tagged 1724-58.)
Surface: limestone bedrock; grasses; sink on east side of recently bulldozed road.
Floor: soil deposit with some cobbles; slight overhang, so sink may expand to chamber; banyan, with piece of wire fencing trapped in roots.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: agricultural?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; small opening and banyan would make this difficult, making it low priority for data collection.

Site/Feature No: 1724-51
Other No: E100/N153.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure/other: rock fill (bulldozing?).
Dimensions: 2.21 x 1.22 m opening (estimated), 130 m (minimum) depth.
Description: rock-filled sinkhole, with rock obscuring actual size of opening.
Surface: limestone bedrock, some soil; grasses and brush. thick *kiawe*; area appears disturbed, probably from bulldozing.
Floor: unknown.
Deposit: NT.
Fill: rock fill, possibly from bulldozing.
Cultural material: none.
Function: unknown, probably agricultural.
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-52
Other No: E79/N126.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.62 x 1.52 m opening, 2.13 x 1.23 m floor, 60 cm depth.
Description: oval sinkhole, straight-sided, with 20 cm high overhang to east.
Surface: limestone bedrock; grasses.
Floor: soil deposit, with low rock pile on eastern end extending into overhang.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: agriculture and trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1724-53
Other No: E78/N116.
Figure(s): 11.
Testing: none.
Natural feature:
Structure: rock alignment.
Dimensions: 3 x 1.5 m upper opening, .6 x .6 m lower opening, 150 cm depth (all measurements estimated).
Description: double leveled sinkhole, main opening has a shelf at 75 cm depth, with rocks on shelf; lower opening is small oval sinkhole dropping to at least 150 cm bs, with possible overhang; single line of cobbles and small boulders extends for 1.75 m along east edge of sinkhole; sink not examined closely due to large bee colony.
Surface: limestone bedrock; thin grasses; *kiawe*.
Floor: not examined, due to bees.
Deposit: NT.
Fill: rock layer on upper shelf.
Cultural material: none.
Function: agriculture?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; deeper sinkhole is small and would be difficult to enter; however, alignment on eastern side indicates cultural activity, and there appears to be an overhang.

Site/Feature No: 1724-54
Other No: E76/N96.
Figure(s): 11 and C-20.
Testing: removal of rock fill, and one ST.
Natural feature: sinkhole.
Structure/other: rock fill.
Dimensions: .50 x.30 m opening, 3 x 7 m floor (estimated), 350 cm depth.
Description: rock-filled sinkhole; small opening, deep shaft, large chamber with overhang 30 cm high.
Surface: open limestone bedrock; scattered grasses; *kiawe*.
Floor: soil deposit.
Deposit: test produced fragments of human bone; nature of deposit uncertain.
Fill: rock fill of boulders and cobbles completely filling shaft to surface level; some post-fill sediment accumulated at base of rock fill.
Cultural material: none.
Function: burial?
Age: pre-contact to mid-1800s.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, human bone disposition, and potentially other Hawaiian activities.
Human skeletal remains: fragments of human bone were found in the upper portion of the deposit; additional bone probably exists.
Recommendations: this is a very unusual depositional situation and the feature needs additional investigation to determine the archaeological context of the bone and the nature of deposition. Also recommended is

consultation with appropriate agencies and cultural groups concerning such investigation, disposition of the collected bone, and long-term treatment of human skeletal material remaining in the feature.

Test Excavations: Small opening of sink was filled with four cobbles; cobbles were removed indicating the presence of a deeper shaft; all of the shaft fill was removed except for the bottom 60 cm. No cultural material was collected from the fill.

A two liter sediment sample was collected from the deposit beneath the overhang. Because of lack of room for excavation and lack of light, a total sample was taken non-stratigraphically, for cultural materials, bird bone, and land snails. When this process was sampled in the lab, it proved to have fragments of human bone. The unburned bone is from an adult individual, with sex and ethnic identity indeterminable; bone fragments are from several areas of the skeleton, including cranium, pelvis, and foot. The bone does not appear to come from a burial, either extended, flexed, or bundle, because of the variety of bone present in such a small area. The bone could be from a previously disturbed burial or from secondary deposition. No artifacts were recovered from the sediment sample and none were noted on the floor.

1724-54, ST-1 Descriptions:

Dimension: 15 cm of surface deposit, not stratigraphically studied. **Matrix:** yellowish brown (10YR 5/4) sandy clay loam (calcareous). **Inclusions:** land snails in high density; marine shell. **Intrusions:** roots. **Cultural material:** none. **Other:** fragments of human bone. **Interpretation:** matrix appears to be natural deposition of decomposing limestone; origin of human bone is undetermined.

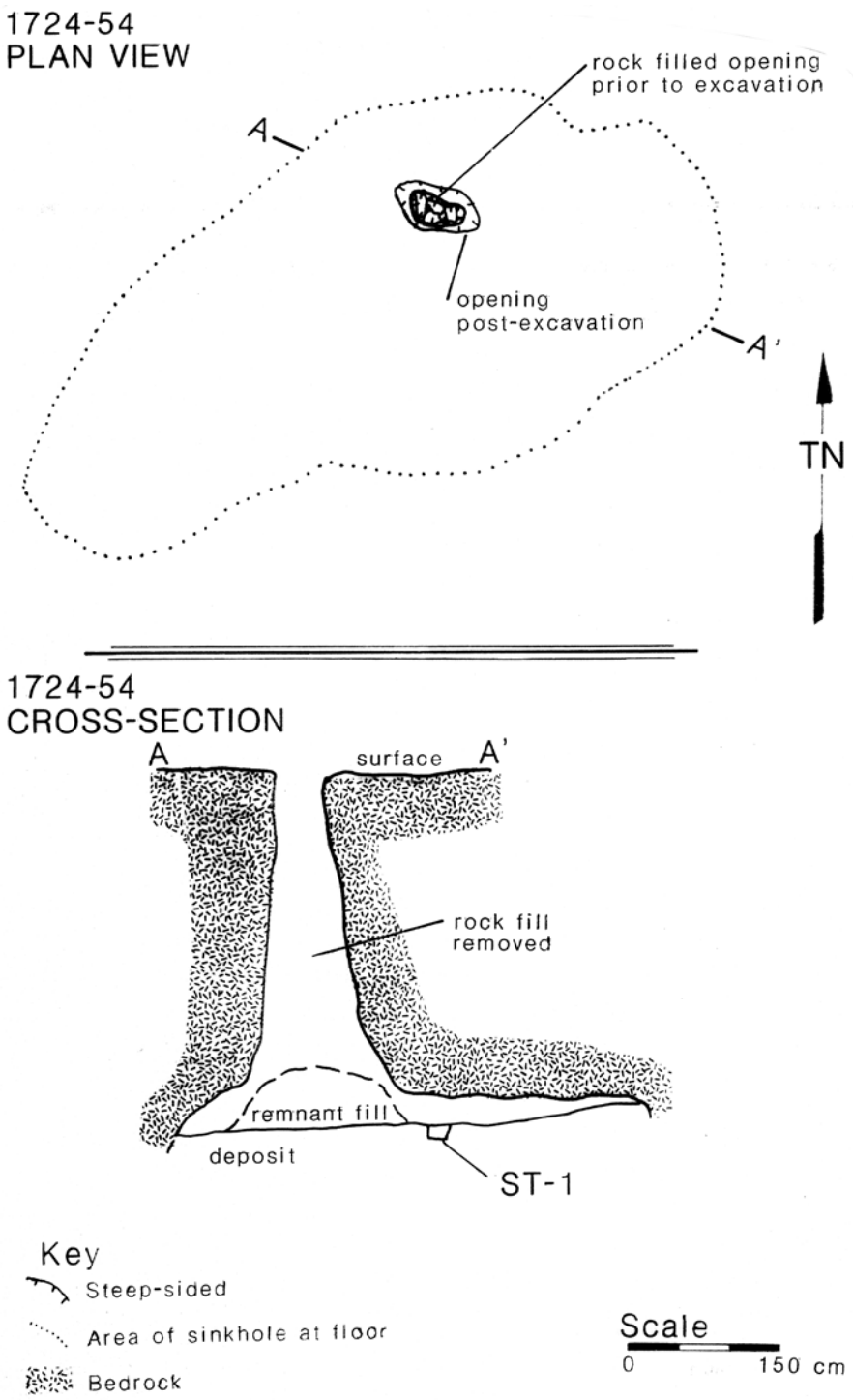

Figure C-20. Site 1724-54.

Site/Feature No: 1724-55
Other No: E51/N120.
Figure(s): 11 and C-21; Photo C-1 and C-5.
Testing: one TP.
Natural feature: none.
Structure: U-shaped stone structure.
Dimensions: 3.12 x 2.43 m outside dimensions, 2.01 x 1.43 m inside dimensions, 70 cm height, back wall 75 cm wide, side walls 60 cm wide.
Description: U-shaped stacked stone structure, open side toward SW; walls constructed of horizontally placed slabs, most in range of 40 to 50 cm long, 30 cm wide, 10 cm thick; some smaller filler stones; two courses wide, seven courses high; some collapse into interior of structure; one piece of fossil coral on top of NW wall; structure has no upright slabs; adjacent sinkhole with low wall (1724-3) attached to 1724-55 wall.
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe*.
Deposit: test in floor of structure shows no surface deposit, but a deposit-filled depression in bedrock (Feature A), which partially underlies wall.
Cultural material: Feature A, fish bone, marine shell, urchin, 8 limestone flakes, 2 pieces of fire-cracked rock, and charcoal (including Chenopodium, see Appendix B).
Function: trash deposition prior to construction; temporary habitation.
Age: pre-contact to mid-1800s.
Condition: good.
Research potential: information on construction of feature and habitation information in remnant of Feature A.
Recommendations: data recovery, if necessary; dismantling of wall for information on construction, recovery of any artifacts that may be within or beneath walls.

Test Excavations: Loose cobbles on floor of structure were completely removed; test pit was initiated adjacent to wall; as duff was clear, it became apparent that there was no floor deposit. Subsequently all duff was cleared out, exposing a small, deposit-filled depression or "pit" (Feature A) in the bedrock. The depression extends beneath the NE wall. The open area of the depression was excavated, revealing a stratified deposit containing marine shell, bird bone, fish bone, pig bone, rodent bone, other mammal bone, and eight limestone flakes. The depression may be artificially chipped from the bedrock. The depression is oval in shape, but the exposed, excavated portion is 41 x 40 cm and 28 cm deep.

The bedrock "pit" extends beneath the NW wall and contents were clearly deposited before construction of the structure.

This is a very unusual sub-surface feature and deposit. It is the only "pit" found in bedrock during the project and no similar ones have been found in the archaeological literature. It contains the highest midden density (primarily fish bone) of any project deposit (Table 5). Within the 10-12 cm thickness of this small deposit there is not only fish bone, but pig, other mammal, two species of extinct bird, *Rattus exulans*, and *Mus musculus*.

1724-55, TP-1 Descriptions:

Layer 0: duff, 0 to 3 cm.

Feature A (includes all deposit within small depression in bedrock)

Layer I **Dimensions:** 3 cm bs; 10 cm thick. **Matrix:** dark grayish brown (10YR 4/2) silt (non-calcareous); weak, crumb, fine; slightly sticky, non-plastic, soft; abrupt, smooth boundary. **Composition:** 60% sub-gravel (non-calcareous); 5% gravel, 5% pebbles, 30% cobbles, calcareous. **Inclusions:** land snails in high density; bird bone (including extinct taxa) and egg shell; *Rattus exulans*; *Mus musculus*. **Intrusions:** none. **Cultural material:** charcoal, 2 fire-cracked limestone pebbles; fish bone; *Sus scrofa cf.*; other mammal bone. **Interpretation:** cultural deposit.

Layer II **Dimensions:** 13 cm bs; 15 cm thick. **Matrix:** dark brown (10YR 4/3) silt (moderately calcareous); weak, crumb, fine; slightly sticky, non-plastic, soft; abrupt boundary with bedrock. **Composition:** 60% sub-gravel (moderately calcareous); 10% gravel, 20% pebbles, calcareous. **Inclusions:** land snails in high density; *Rattus exulans*; bird egg shell. **Intrusions:** none. **Sub-Feature:** Feature A-1 intrusion into Layer II. **Cultural material:** 3 fire-cracked limestone pebbles; marine shell. **Interpretation:** cultural deposit.

Feature A-1 **Dimensions:** (partially excavated) 13 cm bs; excavated area of basin-shaped pit: 30 x 20 x 10 cm. **Matrix:** brown (10YR 5/3) silt (calcareous); weak, crumb, coarse; slightly sticky, non-plastic, soft; abrupt boundary intrusion into Layer II and with bedrock. **Composition:** 85% sub-gravel, 15% gravel and pebbles, calcareous. **Inclusions:** land snails in low density; bird egg shell. **Intrusions:** none. **Cultural material:** charcoal flecking; one fragment of fire-cracked rock. **Interpretation:** cultural feature of unknown function; no definite evidence that this served as a hearth or a trash pit.

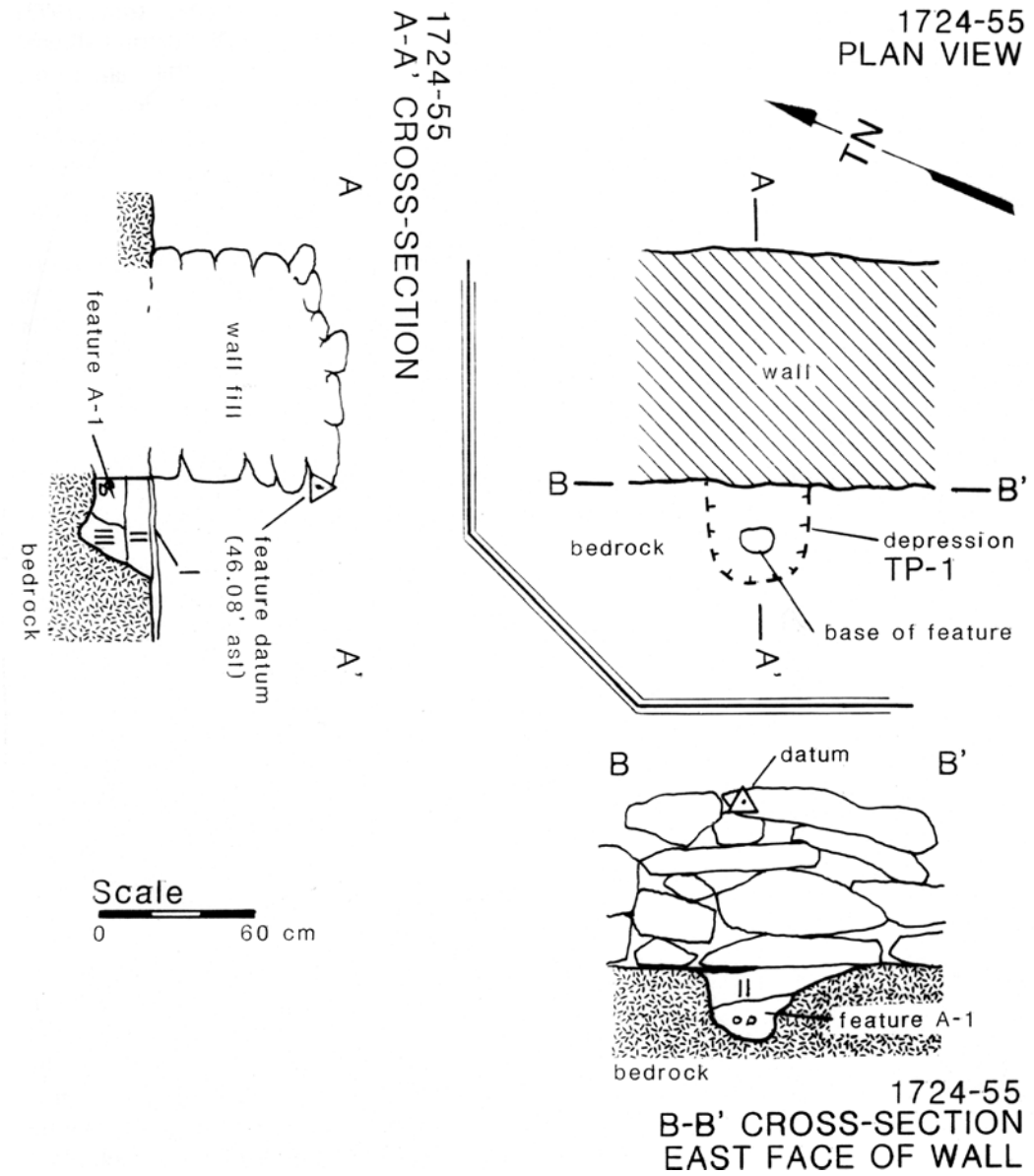

Figure C-21. Site 1724-55.

Photo C-5. Site 1724-55, TP-1, Feature A. Feature A is pit in the bedrock. The unexcavated portion of the deposit in Feature A extends under the wall of 1724-55. (facing northeast)

Site/Feature No: 1724-56
Other No: E59/N114.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.65 x .67 m opening, 1.71 x .83 m floor, 30 cm depth.
Description: oval sinkhole, straight-sided; usually smooth side walls.
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe*.
Floor: soil deposit, large *kiawe* in NW corner.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: agriculture and trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, habitation, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; proximity to habitation features suggests intensive sampling.

Site/Feature No: 1724-57
Other No: E58/N109.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 2.51 x 1.01 m opening, 2.68 x .98 m floor, 80 cm depth.
Description: oval sinkhole, straight sided, slight overhang on east side.
Surface: limestone bedrock; grasses, basil, other brush; *kiawe*.
Floor: soil deposit, two small boulders.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: agriculture and trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, habitation, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; feature is near habitation features and should have intensive sampling.

Site/Feature No: 1724-58
Other No: E99/N114.
Figure(s): 11.
Testing: none.
Natural feature: depression/sinkhole?
Structure/other: rock fill.
Dimensions: 3.2 x 1.3 m opening (estimated), floor and depth unknown (one exposed area has depth of 60 cm).
Description: rock-filled area, probable depress, possible sinkhole; pebbles and cobbles obscure nature of depression
Surface: soil covered area; dense grass cover; *kiawe*, including one downed *kiawe*; rock has some appearance of disturbance, some may be result of bulldozing.
Floor: unknown.
Deposit: NT.
Fill: rock fill, possibly some resulting from bulldozing.
Cultural material: none.
Function: unknown.
Age: unknown.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1726-1
Other No: Haun (1991) 1726-A; E42/N48.
Figure(s): 11.
Testing: none.
Natural feature: none.
Structure: stone platform.
Dimensions: 3.10 x 2.55 m, 109 cm in height.
Description: rectangular platform constructed of horizontally placed limestone slabs; slabs generally in the range of 30 to 40 cm in length, 10 to 15 cm in thickness; well-constructed, slight depression in top; no independent uprights and no slab uprights used in construction; appears constructed directly on bedrock.
Surface: limestone bedrock; grasses, basil; *kiawe* and *koa haole*.
Deposit: very little soil adjacent to platform; no evidence of deposit within platform, based on observations around base.
Cultural material: one unburned *kukui* shell fragment on surface.
Function: burial or shrine.
Age: pre-contact to 1800s?
Condition: excellent.
Research potential: information on Hawaiian religious structures or interment in regional settlement pattern.
Cultural significance: importance of the structure lies in its potential as either a burial or shrine.
Recommendations: preservation; protective management.

Site/Feature No: 1726-2
Other No: Phase I, 22-B.
Figure(s): 11 and C-22.
Testing: rock fill removal, one TP.
Natural feature: sinkhole.
Structure/other: rock fill, slabs around edge of sink.
Dimensions: 2.20 x .84 m opening, floor area undetermined, 105 cm depth.
Description: irregularly shaped, cobble and boulder filled sinkhole; scatter of large slabs around edge of sink; low overhang, 35 cm high, extending over 2 m, with human bones of at least one adult individual at rear of overhang; probably additional burials present.
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe* and *wiliwili*.
Floor: soil deposit.
Deposit: very limited test found deposit at least 18 cm thick; not definitely cultural.
Fill: fill of cobbles and boulder.
Cultural material: no definite artifactual material, but human skeletal remains on floor; also see excavation comments.
Function: burial.
Age: pre-contact to mid-1800s?
Natural history: bird egg shell; *Rattus exulans*; *Mus musculus*.
Condition: good.
Research potential: information on burial practices; deposit also contains information related to environmental reconstruction and may contain cultural material.
Human skeletal remains: the skeleton of at least one individual are located on the floor, beneath overhang.
Recommendations: Additional investigation is needed to determine the archaeological context of the bone and the nature of deposition. Appropriate agencies and cultural groups should be consulted concerning such investigation and any actions regarding treatment of the human skeletal material in the feature.

Test Excavations: A portion of the rock fill was removed adequate to allow access to the floor deposit; one small test pit (20 x 30 cm, 18 cm in depth) was excavated, but working room within sink was inadequate to allow testing to base. No definite cultural material was obtained from the floor deposit. However, one fragment of mammal bone, "small to medium or medium" was found in Layer III, suggesting dog or pig.

The rock removal and the test did provide room to examine the extent of the overhang on the S side of the sink. One human bone (adult fibula) was noted lying near the front of the overhang. At the rear of the overhang are other human bones. Because of the distance, lighting, and intervening stones, these could not be seen for complete identification, but appear to represent the complete extended skeleton of an adult. No artifacts were seen in the rock fill or under the overhang. All of the bones were left in place and the rock fill was replaced.

The lower portion of the rock fill in the unexcavated area of the sink and the area fronting the overhang have stones that are placed on end; the remainder of the fill in not placed in any organized manner. There is high potential for more than one burial in the sink, including under the remaining fill or in additional overhangs.

1726-2, TP-1 Descriptions:

Layer I **Dimensions:** surface; 3 cm thick. **Matrix:** dark brown (10YR 3/3) silt loam (moderately calcareous); structureless; slightly sticky, non-plastic, loose; abrupt, smooth boundary. **Composition:** not calculated. **Inclusions:** land snails in high density; bird egg shell; *Rattus exulans*; *Mus musculus*. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** recent highly organic, soil formation.

Layer II **Dimensions:** 3 cm bs; 7 cm thick. **Matrix:** dark yellowish brown (10YR 4/4) silt loam (moderately calcareous); weak, granular, fine; slightly sticky, non-plastic, soft; abrupt smooth boundary. **Composition:** not calculated. **Inclusions:** land snails in medium quantity; bird egg shell; *Rattus exulans*.

Intrusions: rootlets. **Cultural material:** none. **Interpretation:** probably natural soil horizon, but excavation too limited for definitive conclusion.

Layer III **Dimensions:** 10 cm bs; 8+ cm thick (not excavated to bottom). **Matrix:** dark yellowish brown (10 YR 4/6, lighter than Layer II) silt loam (slightly calcareous); weak, crumb, fine; slightly sticky, non-plastic, soft; boundary not exposed. **Composition:** not calculated. **Inclusions:** land snails in high density. **Intrusions:** roots. **Cultural material:** none, although fragment of mammal bone may be of cultural origin. **Interpretation:** natural deposition of decomposing limestone.

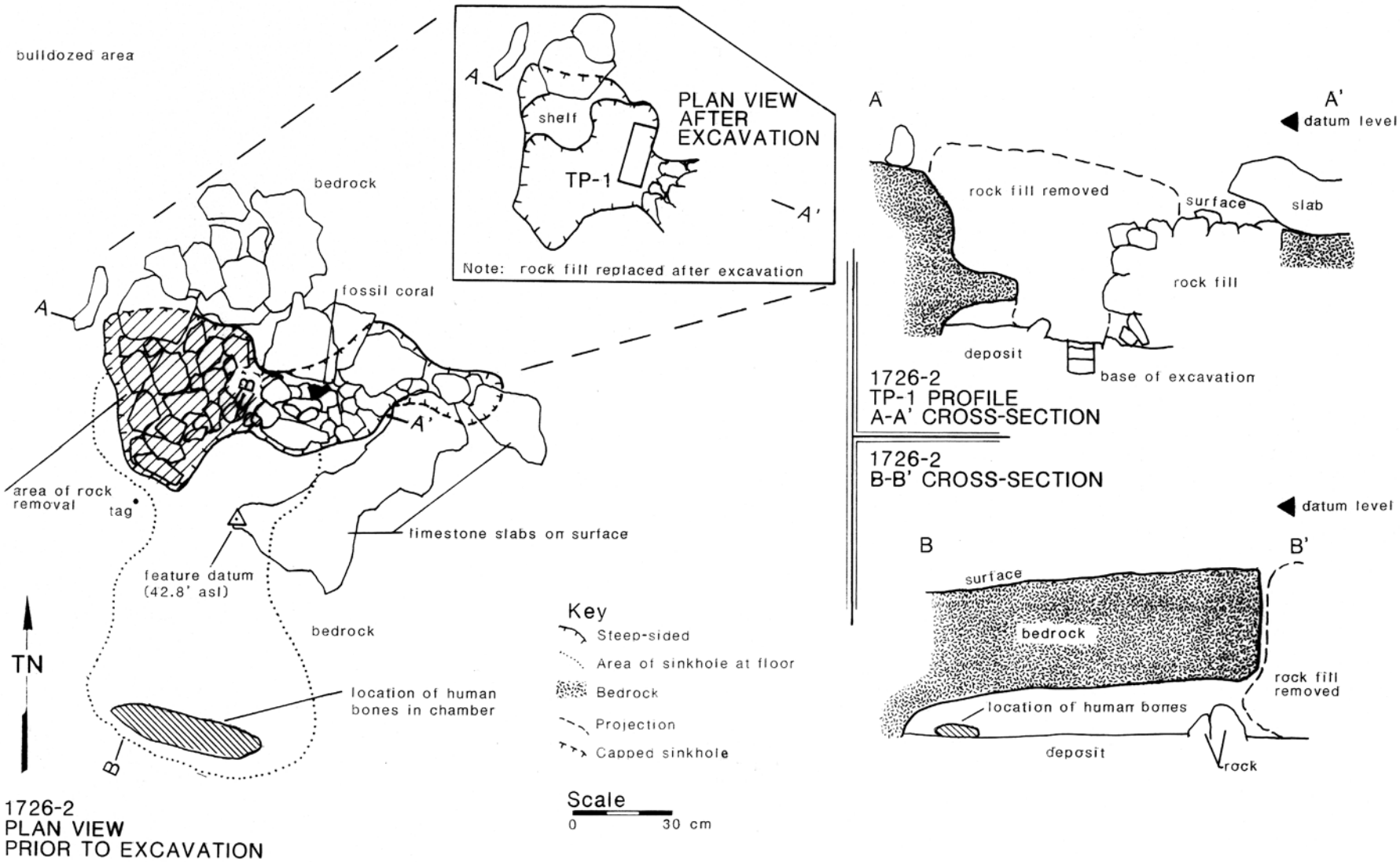

Figure C-22. Site 1726-2.

Site/Feature No: 1726-3 (a,b)
Other No: Phase I, 21-J; E56/N40.
Figure(s): 11 and C-23.
Testing: rocks removed and one ST.
Natural feature: sinkhole.
Structure/other: (a) rock fill and (b) two stone alignment.
Dimensions: (a) 4.55 x 1.20 m, opening, floor area undetermined, 60 cm depth; (b) 6.7 m long alignment, 50 to 70 cm wide and up to 55 cm in height; 3.3o m long alignment, 35 cm high; total feature area approximately 15 x 10 m.
Description: a long, irregularly-shaped sink, rock filled, with very roughly formed alignment of boulders and cobbles; rocks piled on adjoining boulder.
Surface: thin soil cover with some limestone bedrock exposure; grasses, basil; *kiawe* and *koa haole*.
Floor: soil deposit.
Deposit: test shows shallow deposit with possible cultural modification.
Fill: cobble and boulder fill.
Cultural material: a few fragments of fire-cracked rock on surface near northern end of feature.
Function: agriculture.
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; additional rock fill should be removed.

Test Excavations: Area of rock fill removed (approximately 1 m. in diameter) to floor of sink. One shovel test (30 cm diameter, 20 cm deep) dug to bedrock. No cultural material was identified in the rock removal. The soil deposit may have agricultural modification.

1726-3, ST-1 Descriptions:

Layer I

Loose organic material; not described.

Layer II **Dimensions:** 4 cm bs; 16 cm thick. **Matrix:** dark yellowish brown (10YR 3/4, mottled with limestone gravel) sandy loam (non-calcareous); weak, crumb, medium; slightly sticky, non-plastic, soft; very abrupt, smooth boundary on bedrock. **Composition:** 80% sub-gravel (non-calcareous); 10% gravel, 5% pebbles, 5% cobbles, calcareous. **Inclusions:** land snails low in density. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** a natural deposit, but color and slight disturbance indicates possibly modified for agriculture.

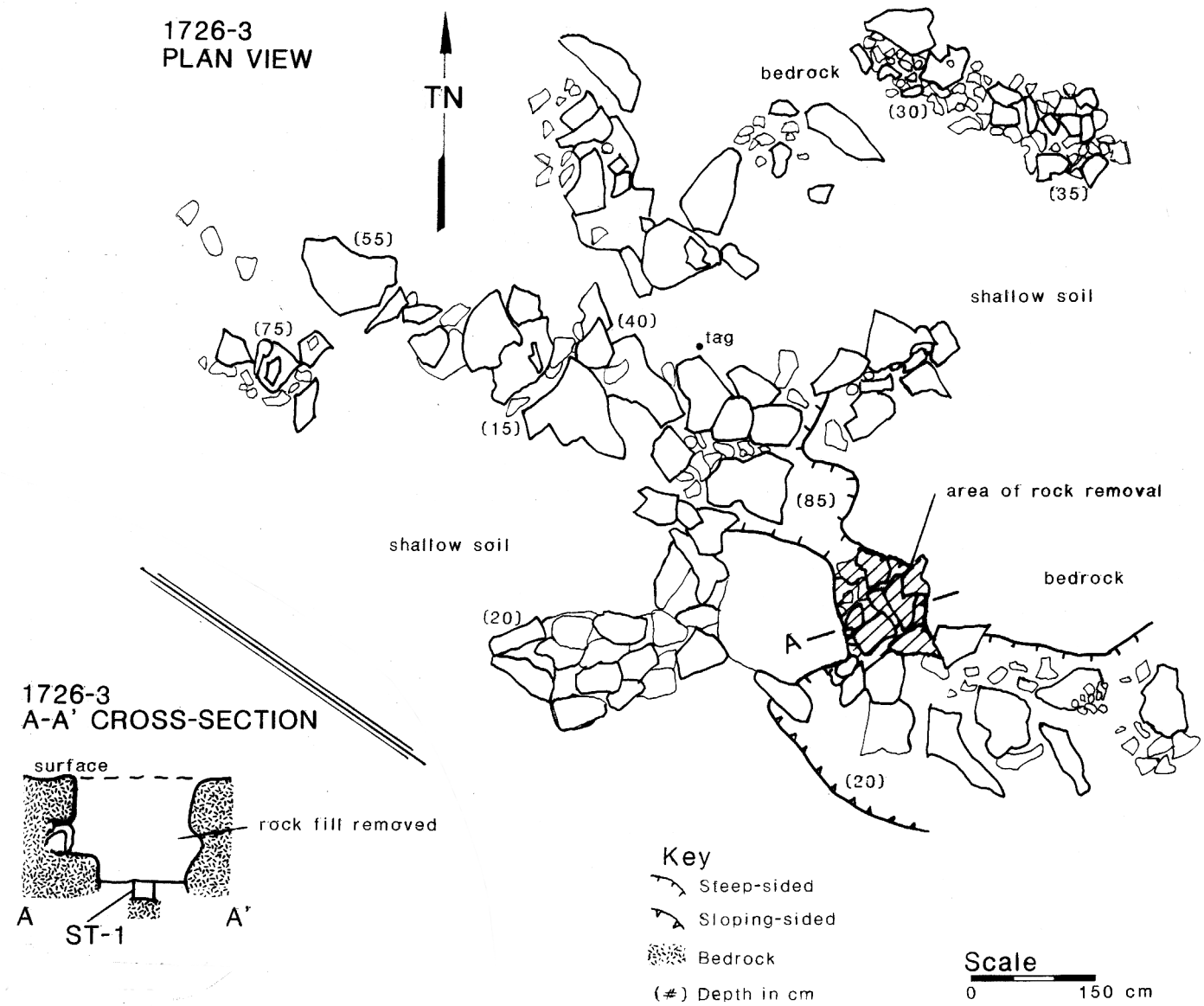

Figure C-23. Site 1726-3.

Site/Feature No: 1726-4
Other No: Phase I, 22-A; E84/N10.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.73 x 1.55 m opening, 1.88 x 1.67 m floor, 90 cm depth.
Description: irregularly shaped sinkhole, with slight overhang around each side.
Surface: limestone bedrock, limited soil; grasses and brush dominated by basil; *kiawe*.
Floor: soil deposit, with one small boulder.
Deposit: NT.
Fill: none.
Cultural material: broken Coca-Cola bottle on floor.
Function: agriculture?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1726-5
Other No: E84/N20.
Figure(s): 11.
Testing: one ST.
Natural feature: depression.
Structure: none.
Dimensions: 7.35 x 5.12 m opening; 7.30 x 5.05 floor, 60 cm depth.
Description: large oval depression.
Surface: limestone bedrock, some thin soil patches; grasses and brush dominated by basil; scattered *kiawe*, banyan, *wiliwili* and *opiuma*.
Floor: soil deposit, with three cobble concentrations around edge; two *kiawe*.
Deposit: test shows a deposit of basaltic silt, probably relatively recently deposit.
Fill: none.
Cultural material: two fragments of basalt (not collected), probably fire-cracked, on the surface.
Function: non-cultural.
Natural history: NA.
Research potential: none.
Recommendations: no further work.

Test Excavations: One shovel test (50 cm diameter, 60 cm deep) was placed on the northern side of the floor revealing a thick homogeneous deposit that appears to be relatively recent basaltic silt.

1726-5, ST-1 Descriptions:
Layer 0: duff; 2 cm thick.

Layer I **Dimensions:** 2 cm bs; 62+ cm thick. **Matrix:** dark yellowish brown (10YR 4/6) silt loam (non-calcareous); moderate, granular, very coarse; slightly sticky, slightly plastic; boundary not exposed. **Composition:** 85% sub-gravel (non-calcareous); 5% gravel, 10% pebbles, calcareous. **Inclusions:** none. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** natural deposit, silty, but non-calcareous; probably a transported from upland basaltic soils.

Note: Bedrock not reached.

Site/Feature No: 1726-6
Other No: Phase I, 22-C; E78/N32.
Figure(s): 11.
Testing: two STs.
Natural feature: depression.
Structure: none.
Dimensions: 6.03 x 4.70 m opening; 5.45 x 4.65 floor, 32 cm depth.
Description: irregularly shaped depression.
Surface: limestone bedrock; grasses; *kiawe*, *koa haole*, and banyan.
Floor: soil deposit, two *kiawe* trees.
Deposit: tests in two sections of the depression show very different deposits, one local decomposition, the other transported basaltic soils; no evidence of cultural modification.
Fill: none.
Cultural material: none.
Function: non-cultural.
Natural history: NA.
Research potential: none.
Recommendations: no further work.

Test Excavations: Two shovel tests were placed in depression, one (50 cm diameter, 21 cm deep) on NW side and one on the E side (50 cm diameter, 40 cm deep). The first test produced natural decomposing limestone horizon on bedrock. The second produced transported basaltic soils. No cultural material or evidence of cultural modification was found in either.

1726-6, ST-1 Descriptions:
Layer 0: duff, 2 cm thick.

Layer I **Dimension:** 2 cm bs; 21 cm thick. **Matrix:** brown (10YR 5/3) loam (calcareous); weak, crumb, medium; slightly sticky, slightly plastic, soft; very abrupt, smooth boundary (on bedrock). **Composition:** 55% sub-gravel, 5% gravel, 15% pebbles, 25% cobbles, calcareous. **Inclusions:** land snails in low density, near top. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** non-cultural, decomposing limestone substrate lying atop bedrock.

1726-6, ST-2 Descriptions:
Layer 0: duff, 2 cm thick.

Layer I **Dimensions:** 2 cm bs; 45 cm thick. **Matrix:** dark yellowish brown (10YR 4/6) silt loam (non-calcareous); moderate, granular, very coarse; slightly sticky, non-plastic, slightly hard; lower boundary not exposed. **Composition:** 80% sub-gravel (non-calcareous); 5% gravel; 15% pebbles, calcareous. **Inclusions:** land snails in medium density. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** natural deposition of transported basaltic soils, mixed with local limestone decomposition.

Note: bedrock not reached.

Site/Feature No: 1726-7 (a-d)
Other No: Phase I, 23-G; E118/N17.
Figure(s): 11.
Testing: none.
Natural feature: (a,b) sinkholes; (c) depression; (d) recent pit.
Structure: none.
Dimensions: (a and b) approximately 1 m diameter, 75 cm depth; (c) 4.55 x 1.85 m, 20 cm depth; (d) 2 m diameter, depth not measured.
Description: two small sinkholes (not investigated closely due to beehives), large depression, and a pit; the pit is recently dug (or exploded?), circular with dirt piled around sides, giving the general appearance of resulting from an explosive device.
Surface: soil cover; limestone bedrock; dense grasses and brush; thick *kiawe*.
Floor: soil deposit in depression and probably in sinks.
Deposit: NT.
Fill: none.
Cultural material: recent trash of bottles and paper scattered in vicinity (features are near Midway Road).
Function: unknown.
Age: (a,b,c) unknown; (d) modern.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, Features (a) and (b) should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery from (a) and (b), if necessary.

Site/Feature No: 1726-8
Other No: Phase I, 23-E; E117/N23.
Figure(s): 11, 16, and C-24; Photo C-6.
Testing: one TP.
Natural feature: sinkhole.
Structure: none.
Dimensions: two openings (1.55 x 1.24 m, 2.06 x 1.05 m), 3.12 x 2.05 m floor, 240 cm depth.
Description: deep sinkhole with two openings, but single floor area separated by overhang; low, shallow overhang on SE side.
Surface: rough limestone bedrock; dense grasses and brush; thick *kiawe*; eastern side of area is adjacent to recent bulldozing for soil test boring.
Floor: soil deposit; octopus tree growing on wall.
Deposit: test shows a possibly modified upper deposit and a subsurface pit feature (Feature A).
Fill: none.
Cultural material: no definitive material; all marine shell appears to be natural.
Function: agricultural?
Age: pre-contact to 1800s?
Natural history: land snails; marine shell; bird bone and egg shell; *Rattus exulans; Mus musculus*; lizard bone.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; intensive sampling.

Test Excavations: One test pit (50 x 50 cm., 60 cm depth) was excavated in the sink deposit. This test pit was excavated in 5 cm levels for fine-control because the sink was considered an excellent candidate for information

on cultural use of sinkholes and on natural depositional processes, including bird bone deposition. It contains an upper deposit (Layer II) that is may be agricultural; at the bottom of Layer II is a pit intruded into the sterile deposition beneath it.

During excavation, the pit (Feature A) appeared to be cultural, based on its form and the presence of "midden". However, nothing distinctly cultural was found in the laboratory analysis. The "midden" all appears to be natural, including egg shell, crustacea fragments, and bird bone. There is no non-rodent mammal bone, such as pig or dog, and none of the bone is notably modified by burning or cutting. If this is a natural pit of some kind (although it is definitely not a recent rodent burrow), it may be related to bird activity. Curiously, the pit contains the highest density of bird bone found in the project tests. Bone and egg shell densities are shown are in Figure 16.

1726-8, ST-1 Descriptions:

Layer I **Dimensions:** surface; 3 cm thick. **Matrix:** dark brown (10YR 3/2) silt loam (non-calcareous); moderate, crumb, coarse; slightly sticky, non-plastic, soft; abrupt, smooth boundary. **Composition:** 75% sub-gravel (non-calcareous); 10% gravel, 15% pebbles, calcareous. **Inclusions:** land snails in high density; plant fragments; insect parts. **Intrusions:** roots and rootlets. **Cultural material:** one limestone flake, not definitely cultural. **Interpretation:** recent humic layer forming soil.

Layer II **(=II/1, II/2) Dimensions:** 3 cm bs; 8 cm thick. **Matrix:** dark brown (10YR 4/4) silt loam (moderately calcareous); weak, crumb, fine; slightly sticky, slightly plastic, soft; abrupt wavy boundary. **Composition:** 70% subgravel (moderately calcareous); 10% gravel, 20% pebbles (calcareous). **Inclusions:** land snails in medium density; crustacea fragments; bird egg shell and bone; *Rattus exulans*; *Mus musculus*. **Intrusions:** roots and rootlets. **Feature:** Feature A, associated with beginning of deposition of II (top of III). **Cultural material:** none. **Interpretation:** modified natural deposit; possibly agricultural; Feature A may be an agricultural feature.

Feature A **Dimensions:** 11 cm bs; deep pit partially excavated (excavation area: 15 x 20 x 33 cm). **Matrix:** dark brown (10YR 4/3) silt loam (moderately calcareous); weak, crumb, medium; slightly sticky, slightly plastic, soft; abrupt, smooth boundary intrusive in L. III. **Composition:** 80% sub-gravel (moderately calcareous); 10% gravel, 10% pebbles (calcareous). **Inclusions:** land snails in high density; crustacea fragments; bird bone and egg shell; *Rattus exulans*. **Intrusions:** roots and rootlets. **Cultural material:** none. **Interpretation:** cultural feature, with soil characteristics similar to L. II; probably agricultural.

Layer III **(=II/3 and following) Dimensions:** 11 cm bs; 50+ cm thick (bottom not reached). **Matrix:** pale brown (10YR 6/3) silt (calcareous); weak, crumb, medium; slightly sticky, non-plastic; soft; boundary not excavated. **Composition:** 50% sub-gravel, 10% gravel, 15% pebbles, 25% cobbles (calcareous). **Inclusions:** land snails in low quantity; crustacea fragments; bird egg shell and bone (including Procellariid and Passeriform); *Rattus exulans*; fish bone. **Intrusions:** roots. **Feature:** Feature A is intrusive into III. **Cultural material:** none. **Interpretation:** natural decomposing limestone.

Note: bedrock not reached in excavation; large rocks in base of excavation unit.

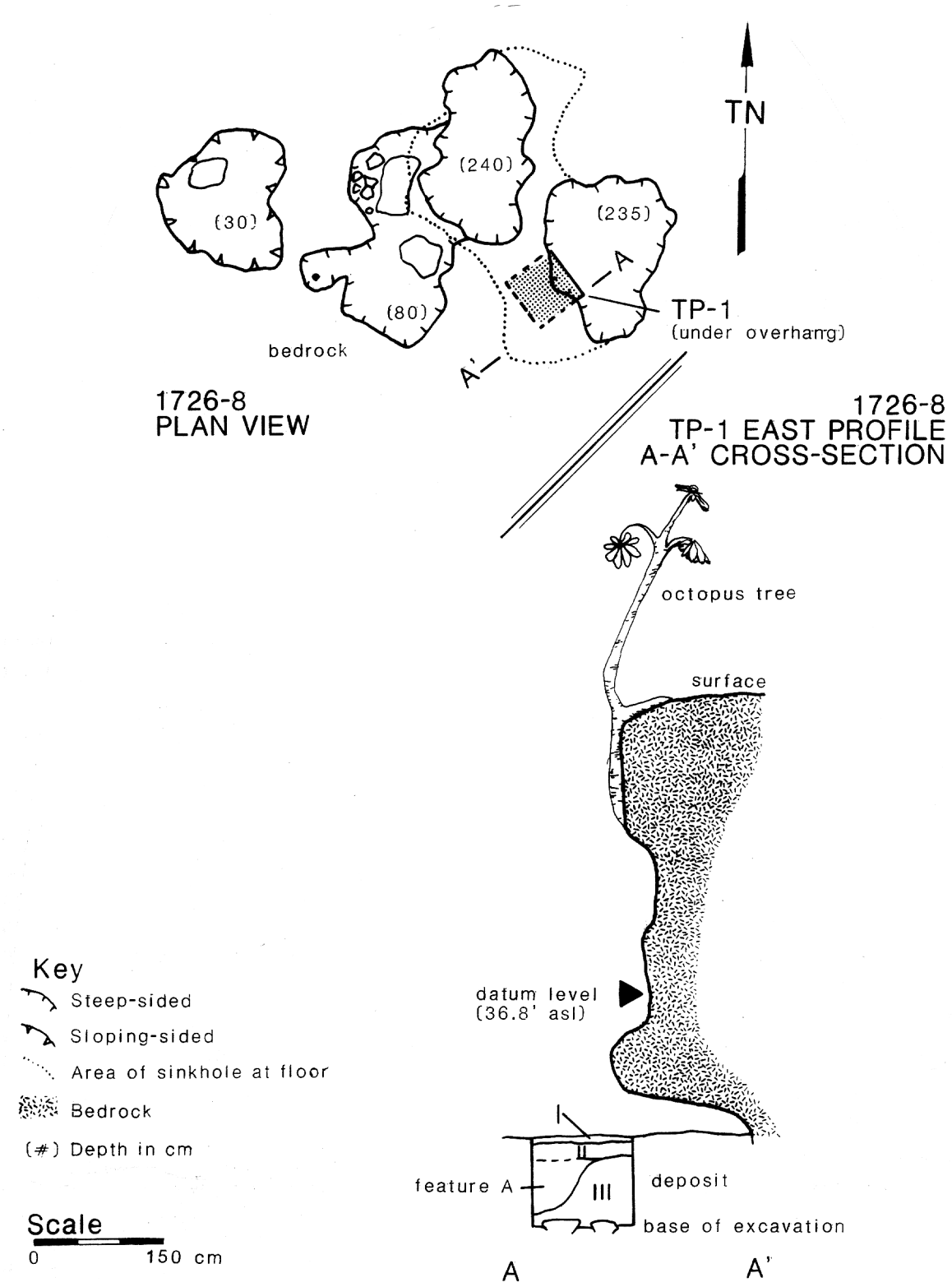

Figure C-24. Site 1726-8.

Photo C-6. Site 1726-8, TP-1. TP is 60 cm deep (facing south)

Site/Feature No: 1726-9
Other No: E134/N23
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 2.01 x 1.55 m opening, floor approximately the same, depth 70 cm.
Description: straight-sided sinkhole.
Surface: limestone bedrock; grasses and brush; *kiawe*.
Floor: soil deposit.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: agriculture?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1726-10 (a,b)
Other No: Phase I, 32-F; E149/N15.
Figure(s): 11.
Testing: none.
Natural feature: (a) sinkhole and (b) depression.
Structure: none.
Dimensions: (a) 1.55 x 1.25 m opening, 2.65 x 1.35 m floor, 150 cm deep; (b) 4.55 x 1.67 opening, 50 cm deep.
Description: (a) oval sinkhole with 90 cm high overhang to west; 5 m east of (a) is (b) oval depression with recent rocks (from bulldozing?) in N end.
Surface: limestone bedrock; thin grass cover; scattered *kiawe*; (b) is adjacent to very large pile of bulldozed rock and debris, probably from construction of parking lot for nearby building.
Floor: (a) rocks, one large boulder, modern trash (feature near Midway Road); (b) soil deposit.
Deposit: NT.
Fill: none.
Cultural material: (a) recent trash including broken bottles, soda cans; 5 m to SE of (a) is scatter of 5 waterworn basalt cobbles, appear to be recently deposited.
Function: agriculture, (a) temporary habitation?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, these features should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, habitation, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; intensive sample from sinkhole (a) because it has form for possible temporary habitation; limited sample from (b).

Site/Feature No: 1726-11 (a,b,c)
Other No: (a) Phase I, 24-A; E162/N32.
Figure(s): 11; Photo 7.
Testing: one ST in (a).
Natural features: sinkholes.
Structure: none.
Dimensions: (a) 1.01 x .3 m opening, 1.70 x 1.30 m floor, 220 cm depth; (b) 1 x 1 m (approximate) opening, floor and depth not measured; (c) 2.23 x 1.25 m opening, 80 cm depth.
Description: (a) deep, small, bell-shaped sinkhole; (b) oval sinkhole (not examined due to bee colony); (c) oval sinkhole.
Surface: limestone bedrock; scattered grass patches; thin *kiawe* and *koa haole*.
Floor: soil deposit in (a) and (c); (b) uninvestigated.
Deposit: (a) tested, natural deposit in sink with no suggestion of cultural material and no bird bone.
Fill: none.
Cultural material: none.
Function: non-cultural.
Natural history: none
Research potential: none.
Recommendations: no further work.

Test Excavations: A single sediment sample was collected from the floor of the sink; this was removed from beneath detritus and limestone rock; total area collected beneath rock is 20 cm wide x 25 cm deep.

1726-11, ST-1 Descriptions: No formal descriptions; stratification consisted of 3 cm of loose organic detritus; limestone fragment lying flat (20 x 30 x3 cm); dark granular layer 10 cm thick; light-colored layer more than 15 cm thick (not excavated to base); no cultural material and no bird bone.

Site/Feature No: 1726-12
Other No: Phase I, 22-B; E118/N39.
Figure(s): 11.
Testing: rocks removed.
Natural feature: sinkhole.
Structure/other: capping.
Dimensions: 2.43 x 2.23 m opening, floor undetermined, 230 cm depth.
Description: sinkhole, with capping, partially collapsed; overhang (not investigated because of danger); capping appears to have been constructed by filling bedrock shelves at the top of the sink, then placing large slabs (up to 1 m long) over the opening; possibly vaulted, but several of the slabs had fallen into the upper section of the sinkhole, hanging precariously; on the last visit to the feature, some of the slabs had fallen further into the sink (see testing discussion).
Surface: limestone bedrock; grasses, brush, *Chamaesyce skottsbergii*; *kiawe*; adjacent to bulldozed track for soil core drilling.
Floor: soil deposit.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: unknown.
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: capping damaged.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, habitation, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; this will require moving some of the larger capping collapse and testing of deposit under overhang.

Test Excavations: Some of the collapsed capping stones were removed in an attempt to enter the sinkhole. However, this exposed two large capping slabs that had fallen into the upper portion of the sink and were hanging precariously on the sidewalls, and blocking access. The sinkhole was not entered at this time. A final visit to the sink found that one of the slabs had slipped further into the sinkhole, allowing a brief look into the overhang. The floor of the sink was examined quickly for the presence of human bone; when none was found, investigation was not carried further, due to the continuing danger of capping collapse.

Site/Feature No: 1726-13
Other No: E112/N34.
Figure(s): 11.
Testing: none.
Natural feature: none.
Structure: 3 stone alignments.
Dimensions: 3 x 4 m area.
Description: 3 stone alignments; 1.3 m long; 1.9 m long, and 2.3 m long; each formed by limestone cobbles and small boulders; these are same type of features as found in nearby 4702 agricultural mound area.
Surface: limestone bedrock; grasses and brush; *koa haole* and a few *kiawe*.
Deposit: NT, but features similar to those of the agricultural mound complex 4702, where tests have not produced any cultural materials.
Cultural material: none.
Function: agriculture.
Age: pre-contact to mid-1800s.
Natural history: NA.
Condition: good.
Research potential: none.
Recommendations: no further work.

Site/Feature No: 1726-14
Other No: E75/N39.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.55 x 1.23 m opening, .45 x .35 floor, 45 cm depth.
Description: small sinkhole with constricted base.
Surface: limestone bedrock; grasses; *kiawe*.
Floor: soil deposit.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: non-cultural.
Natural history: NA.
Research potential: none.
Recommendations: no further work.

Site/Feature No: 1726-15
Other No: Haun (1991) 1726-B; E60/N57.
Figure(s): 11.
Testing: one TP.
Natural feature: none.
Structure: C-shape.
Dimensions: 3.12 m x .72 m, 35 cm high.
Description: roughly stacked low wall of cobbles and small boulders, poorly faced, two upright slabs in facing; built on bedrock.
Surface: limestone bedrock, limited soil patches; dense grasses and basil; numerous *kiawe*, a few *koa haole*.
Deposit: a small area of deposit in slight depression in bedrock; tested
Cultural material: fire-cracked pebbles in deposit; a few fire-crack rock scattered throughout area.
Function: temporary habitation.
Age: pre-contact to mid-1800s.
Condition: good.
Research potential: feature contains information related to Hawaiian habitation.
Recommendations: data recovery, if necessary; thin area of habitation debris, additional sampling of broad area.

Test Excavations: One test pit (50 x 40 cm, 25 cm deep), excavated to bedrock. Deposit is cultural, but only a few fire-cracked rock present.

1726-15, TP-1 Descriptions:

Layer I: duff; 3 cm thick; no formal description.

Layer II **Dimensions:** 3 cm bs; 15 cm thick. **Matrix:** dark brown (10YR 4/3) silt (moderately calcareous); weak, crumb, medium; slightly sticky, non-plastic, soft; abrupt boundary with bedrock and Layer III. **Composition:** 80% sub-gravel (moderately calcareous); 5% gravel, 15% pebbles, calcareous. **Inclusions:** land snails in medium density. **Intrusions:** none. **Feature:** possible small pit, but area of excavation too limited to evaluate; fill collected with Layer II. **Cultural material:** 4 fire-cracked limestone pebbles. **Interpretation:** cultural deposit.

Layer III

Matrix: brown (10YR 5/3) loam (calcareous); weak, crumb, medium; slightly sticky, slightly plastic, soft; very abrupt, smooth boundary (on bedrock). **Composition:** 65% sub-gravel, 15% gravel, 20% pebbles, calcareous. **Inclusions:** none. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** non-cultural, decomposing limestone substrate lying atop bedrock.

Site/Feature No: 1726-16
Other No: E68/N65.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure/other: rock fill.
Dimensions: 1.60 x 1.23 m opening (approximated), floor unknown, depth uncertain, at least 60 cm.
Description: rock-filled sinkhole with fallen *kiawe* overlying it.
Surface: limestone bedrock; grasses and basil; *kiawe*.
Floor: unknown.
Deposit: NT.
Fill: rock fill of boulders and cobbles.
Cultural material: none.
Function: unknown.
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, habitation, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1726-17
Other No: E78/N64.
Figure(s): 11 and C-25.
Testing: one ST.
Natural feature: sinkhole.
Structure: none.
Dimensions: 3.22 x 2.02 m opening, 3.20 x2.20 floor, 90 cm depth.
Description: oval, straight-sided sinkhole.
Surface: limestone bedrock; grasses and brush dominated by basil; *kiawe* and *koa haole*; transit survey station BPH-50 3 m to W.
Floor: soil deposit; *koa haole*.
Deposit: test shows a 30 cm thick cultural deposit, with low density cultural materials, probably agricultural.
Fill: none.
Cultural material: marine shell, fire-cracked rock, two limestone flakes, all in low density; metal pipe on surface.
Function: agriculture and trash deposition; second recent use possibly associated with 4701.
Age: pre-contact to mid-1800s; also modern use.
Natural history: land snails.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, habitation, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; presence of cultural material indicates feature should have intensive sampling.

Test Excavations: One shovel test (30 cm diameter, 55 cm depth) was placed in the sinkhole deposit (Fig. C-25). A 29 cm thick cultural deposit containing low density midden was encountered. The deposit is interpreted as primarily agricultural.

1726-17, ST-1 Descriptions:

Layer 0: duff; 1 cm.

Layer I **Dimensions:** 1 cm bs; 29 cm thick. **Matrix:** dark brown (10YR 4/3) silt loam (moderately calcareous); weak, granular, medium; slightly sticky, slightly plastic, soft; abrupt, smooth boundary. **Composition:** 85% sub-gravel (moderately calcareous); 1-% gravel, 5% pebbles (calcareous). **Inclusions:** land snails in high density. **Intrusions:** roots. **Cultural material:** 1 fleck of charcoal; 1 piece of Tellina; 2 limestone flakes (LN. 59.02); 3 fire-cracked limestone pebbles. **Interpretation:** an unusually thick modified deposit, probably agricultural with low density of cultural material.

Layer II **Dimensions:** 30 cm bs; 25+ cm thick (bottom not excavated). **Matrix:** light yellowish brown (10YR 6/4) loam (calcareous); weak, crumb, medium; slightly sticky, slightly plastic, soft; boundary not excavated. **Composition:** 85% sub-gravel, 5% gravel, 10% pebbles, calcareous. **Inclusions:** land snails in low density, near top. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** non-cultural, decomposing limestone substrate lying atop bedrock.

Note: bedrock not reached in excavation.

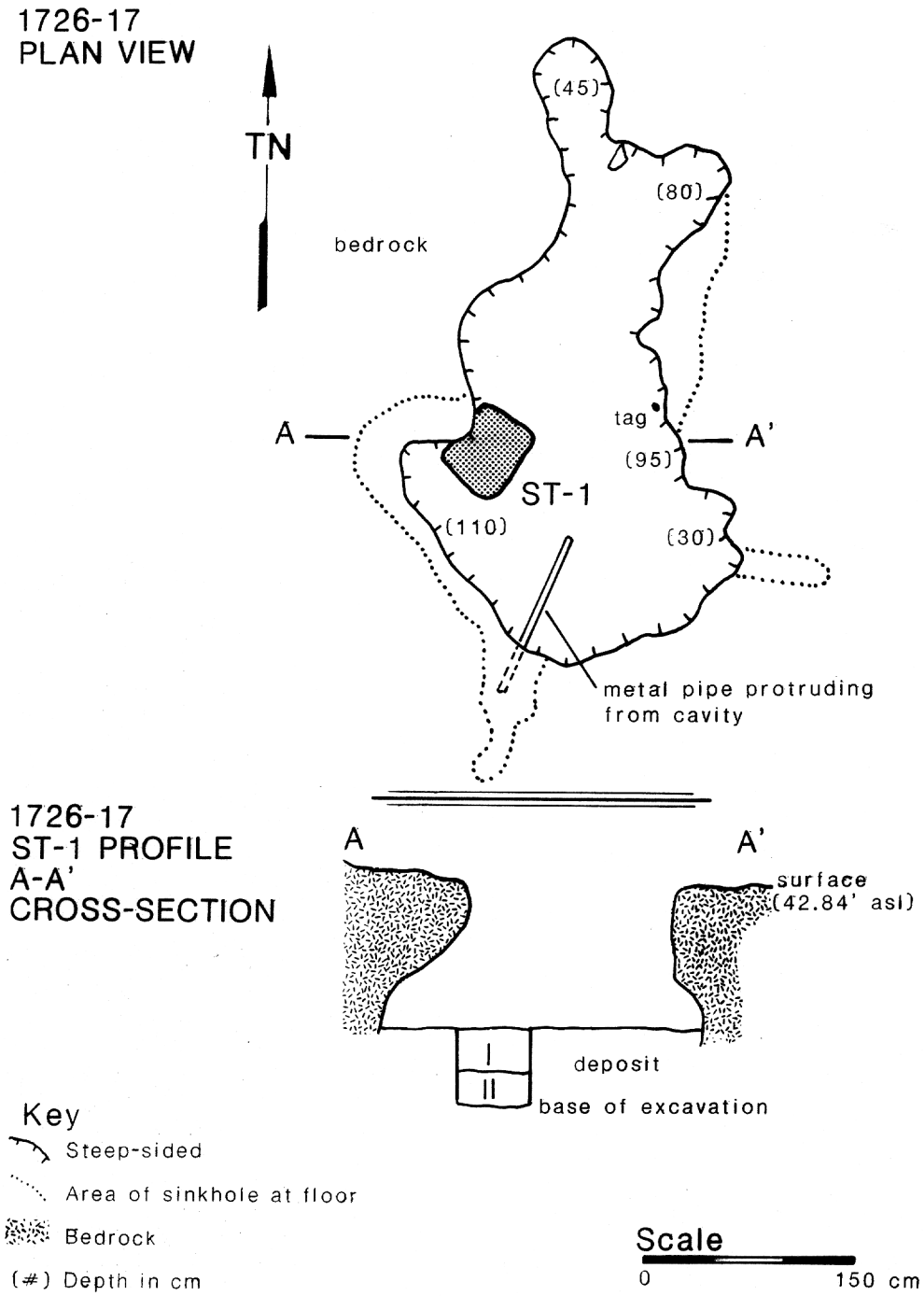

Figure C-25. Site 1726-17.

Site/Feature No: 1726-18
Other No: E88/N60.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.90 x 1.45 m opening, 1.95 x 1.50 m floor, 65 cm depth.
Description: oval sinkhole with slight overhang.
Surface: limestone bedrock; grasses; *kiawe* and *koa haole*.
Floor: soil deposit, with two boulders; *koa haole*.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: agriculture?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1726-19 (a,b)
Other No: Phase I, 22-E; E102/N58.
Figure(s): 11.
Testing: none.
Natural feature: two sinkholes.
Structure: none.
Dimensions: (a) 2.09 x 1.08 m, floor approximately the same size, 80 cm depth; (b) 1.05 x .22 m, floor undetermined, 110 cm depth.
Description: (a) oval sinkhole, straight-sided, beehive; 6 m to SE (b) very small opening sinkhole.
Surface: limestone bedrock; grasses; *kiawe*; adjacent to recent bulldozed track for soil coring; (a) is in *kiawe*; (b) is on open bedrock.
Floor: soil deposit in both sinkholes.
Deposit: NT.
Fill: none
Cultural material: metal can in sink.
Function: (a) agriculture? (b) non-cultural.
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: (a) by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities; (b) may contain other environmental information.
Recommendations: data recovery, if necessary; (a) suitable for selected sampling; (b) too small for easy excavation; sink opening would have to be enlarged for access to deposit.

Site/Feature No: 1726-20
Other No: E95/N64.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.85 x .95 m opening, 2.03 x 1.10 m floor, 70 cm depth.
Description: oval sinkhole, with slight overhang.
Surface: limestone bedrock; grasses; *kiawe* and *koa haole*.
Floor: soil deposit, with small boulders on floor, *koa haole*.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: agriculture?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1726-21
Other No: E101/N68.
Figure(s): 11.
Testing: none.
Natural feature: depression.
Structure: none.
Dimensions: 2.45 x 2.30 m opening, 25 cm depth.
Description: oval depression.
Surface: limestone bedrock; grasses and brush; *kiawe* and banyan.
Floor: soil deposit, *kiawe*, banyan.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: agriculture, trash deposition?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, habitation, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; limited sample.

Site/Feature No: 1726-22
Other No: E110/N78.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole
Structure: none
Dimensions: 2.45 x .86 m opening, floor same dimensions, 40 cm depth.
Description: long oval sinkhole, straight-sided.
Surface: limestone bedrock; grasses; *kiawe* and *wiliwili*.
Floor: soil deposit, boulder.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: agriculture?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, habitation, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1726-23
Other No: Phase I, 22-F; E92/N78.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 2.12 x 1.33 m opening, floor estimated at 1.5 x 1.5 m, 340 cm depth.
Description: very deep sinkhole, with small shelf at 150 cm; probable drainage at base.
Surface: limestone bedrock; grasses; *kiawe* and *koa haole*.
Floor: soil deposit.
Deposit: NT, appears shallow.
Fill: none.
Cultural material: none.
Function: non-cultural.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change.
Recommendations: data recovery, if necessary; small deposit to sample.

Site/Feature No: 1726-24
Other No: E98/N78.
Figure(s): 11.
Testing: capping removed.
Natural feature: sinkhole.
Structure: capping of sinkhole.
Dimensions: .50 x.30 m opening, floor not measured, but estimated 1.5 m diameter, 190 cm depth.
Description: sinkhole is bell-shaped with small, capped opening; contains machine-gun shells; 3 very small sinks to the SW.
Surface: limestone bedrock; thin grasses cover, numerous Philippine violet; scattered *kiawe*.
Floor: soil deposit, cobbles, large number of machine-gun shells.
Deposit: NT.
Fill: none.
Cultural material: 820 machine-gun shells, linked, 50 cal., dated 1942-1943, on floor.
Function: WWII dump; also Hawaiian use?
Age: WWII; plus pre-contact?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; any data collection should be conducted under military supervision because of possible additional ordnance.

Test Excavations: This sink was capped with one slab which covered three small boulders jammed into the small opening. All of the capping stone was removed, exposing a deposit of machine-gun shells on the floor of sink. By all appearances, these extremely corroded shells (dated 1942-1943) were deposited during or shortly after the war. A Navy representative was notified and the shells were removed by an ordnance team on October 20.

Site/Feature No: 1726-25
Other No: E96/N83.
Figure(s): 11; Photo C-7.
Testing: two STs.
Natural feature: sinkhole.
Structure: capped sinkhole and associated boulder alignment.
Dimensions: sinkhole, .62 x .26 cm opening, 1.30 x 1.30 m floor (estimated), 202 cm depth; alignment, 9 m long, 50 cm wide, 50 cm high.
Description: capped sinkhole, small opening, bell-shaped; adjacent to curving, roughly constructed boulder/cobble alignment, single course high (alignment does not serve as a windbreak for the sink).
Surface: soil deposit and exposed limestone bedrock; grasses, basil; *koa haole* and thin *kiawe*.
Floor: soil deposit in sinkhole.
Deposit: test of soil around alignment shows very shallow deposit on bedrock, no definite cultural modification; sinkhole deposit not tested.
Fill: none.
Cultural material: none.
Function: sinkhole function unknown; alignment possibly agricultural.
Age: pre-contact to mid-1800s.
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary, of deposit in sinkhole; no further work in surface deposit.

Test Excavations: The first layer of capping of the sinkhole was removed, composed of eight cobbles and boulders. This exposed three small boulders jammed into the opening of the sinkhole. One side of sink is a shallow shelf; this lower area has been filled with cobbles prior to capping, to make it level with the ground surface. The sinkhole was entered but not tested, due to very small access area. Two shovel tests were placed in the surface soil deposit associated with the alignment. No evidence of cultural modification was found.

1726-25, ST-1 Descriptions:

Layer I **Dimensions:** surface; 2 cm thick. **Matrix:** very dark brown (10YR 2/2, mottled with limestone grains) loam (non-calcareous); structureless; non-sticky, non-plastic, loose; abrupt, smooth boundary. **Composition:** 50% sub-gravel, (moderately calcareous); 20% gravel, 15% pebbles, 15% cobbles, calcareous. **Inclusions:** land snails in low density; plant fragments. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** recent duff, forming soil.

Note: lower rocks of feature are partially buried in Layer I.

Layer II **Dimensions:** 2 cm bs; 13 cm thick. **Matrix:** dark yellowish brown (10YR 4/6) loam (slightly calcareous); moderate, granular, medium; slightly sticky, slightly plastic, soft; abrupt boundary with bedrock. **Composition:** 45% sub-gravel, 15% gravel, 20% pebbles, 20% cobbles, calcareous. **Inclusions:** snails in low density. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** natural deposition of transported basaltic silts and decomposing limestone, overlying limestone bedrock, no evidence of modification.

1726-25, ST-2 Descriptions:

Same stratigraphic characteristics as ST-1.

Photo C-7. Site 1726-25, a capped sinkhole. Photos are before removal of capping, after removal of capping, and during recording (Joan Clarke). (facing east)

Site/Feature No: 1726-26
Other No: E79/90.
Figure(s): 11.
Testing: none.
Natural feature: sink.
Structure: none.
Dimensions: 2.80 x .75 m opening, floor approximately the same, 30 cm depth.
Description: oval sinkhole, with loose pebbles and cobbles filling east end.
Surface: limestone bedrock; thick grasses; thick *kiawe*.
Floor: soil deposit.
Deposit: NT.
Fill: pile of loose pebbles and cobbles on east end, not fire-cracked; mot definitely cultural.
Cultural material: none.
Function: agriculture?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1726-27
Other No: E78/N92.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none.
Dimensions: 1.45 x .98 m opening, 1.65 x .95 m floor, 80 cm depth.
Description: oval sinkhole, with slight overhang.
Surface: limestone bedrock; grasses, vines; *kiawe* and *koa haole*.
Floor: soil deposit.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: agriculture?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1726-28
Other No: E75/N80.
Figure(s): 11.
Testing: one ST.
Natural feature: sinkhole.
Structure: none.
Dimensions: 2.65 x .82 m, 2.80 x .87 m, 82 cm depth.
Description: double opening sinkhole, straight sided, with slight overhang on east side.
Surface: limestone bedrock; grasses, vines, and brush dominated by basil; scattered *kiawe*.
Floor: soil deposit.
Deposit: tested deposit produced no cultural material, but possibly culturally modified soil.
Fill: none.
Cultural material: none.
Function: agriculture?
Age: pre-contact to mid-1800s?
Natural history: land snails; bird egg shell and bone; European rat.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Test Excavations: Shovel test (70 x 40 cm, 25 cm deep) by Dr. Alan Ziegler for first-hand examination of sink deposits and bird bone deposition.

1726-28, ST-1 Descriptions:
No formal description, but deposit is similar to that from 1724-48. Deposit contains bird egg shell, bird bone (including Procellariid), and bone of European rat.

Site/Feature No: 1726-29
Other No: E70/N86.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure: none
Dimensions: 2.10 x 1.05m opening, floor approximately the same size, 75 cm depth.
Description: double opening sinkhole, straight-sided, not investigated due to beehive.
Surface: limestone bedrock; grasses, vines, basil; *kiawe* and *wiliwili*.
Floor: soil deposit.
Deposit: NT.
Fill: none.
Cultural material: none.
Function: agriculture?
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary.

Site/Feature No: 1726-30
Other No: E84/N76.
Figure(s): 11 and C-26; Photo 6 and C-8.
Testing: one ST.
Natural feature: sinkhole.
Structure: none.
Dimensions: 3.14 x 2.24 m opening, 3.46 x 1.84 floor, 84 cm depth.
Description: large, irregularly shaped sinkhole, straight-sided, with overhang 20 cm high, extending about 1 m.
Surface: limestone bedrock; grasses, basil; *kiawe*, *wiliwili*, *koa haole*, and banyan.
Floor: soil deposit, with cobble pile on S end.
Deposit: test shows a 17 cm thick cultural deposit (Layer II), possibly an agricultural soil with low density trash.
Fill: none.
Cultural material: charcoal flecking; a few fire-cracked rock; fish bone.
Function: agriculture and trash deposition.
Age: pre-contact to mid-1800s?
Natural history: land snails; bird bone and egg shell; Rattus exulans.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, habitation, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; nature of deposit suggests data recovery should be intensive.

Test Excavations: One shovel test (40 cm diameter, 35 cm deep) was placed in the N section of the depression. This revealed a cultural deposit, probably agricultural, overlying a sterile base of decomposing limestone.

1726-30, ST-1 Descriptions:

Layer I **Dimensions:** surface; 3 cm. **Matrix:** very dark brown (10YR 2/2, mottled with flecks of limestone) silt loam (non-calcareous); moderate, crumb, coarse; slightly sticky, non-plastic, soft; abrupt, smooth boundary. **Composition:** 75% sub-gravel (non-calcareous); 10% gravel, 15% pebbles, calcareous. **Inclusions:** land snails in high density; bird egg shell; *Rattus exulans*; plant fragments; insect parts. **Intrusions:** roots and rootlets. **Cultural material:** none. **Interpretation:** recent humic layer.

Layer II **Dimensions:** 3 cm bs; 17 cm thick. **Matrix:** dark brown (10YR 4/3) silt loam (non-calcareous); weak, crumb, medium; slightly sticky, slightly plastic, soft; abrupt wavy boundary. **Composition:** 80% sub-gravel (non-calcareous); 5% gravel, 5% pebbles, 10% cobbles (calcareous; cobbles appear to be more coraline than limestone). **Inclusions:** land snails in high density; bone of *Chaetoptila sp. cf.*; *Rattus exulans*. **Intrusions:** rootlets. **Cultural material:** flecks of charcoal; fire-cracked rock; fish bone. **Interpretation:** culturally modified soil, with some midden present; probably an agricultural soil rather than a cultural deposit.

Layer III **Dimensions:** 20 cm bs; 20+ cm thick (not excavated to bottom). **Matrix:** yellowish brown (10YR 5/6) silty clay loam (calcareous); moderate, crumb, medium; slightly sticky, slightly plastic, slightly hard; boundary not exposed. **Composition:** 90% sub-gravel, 5% gravel, 5% pebbles (calcareous). **Inclusions:** *Rattus exulans*. **Intrusions:** roots and rootlets. **Cultural material:** none. **Interpretation:** natural decomposing limestone.

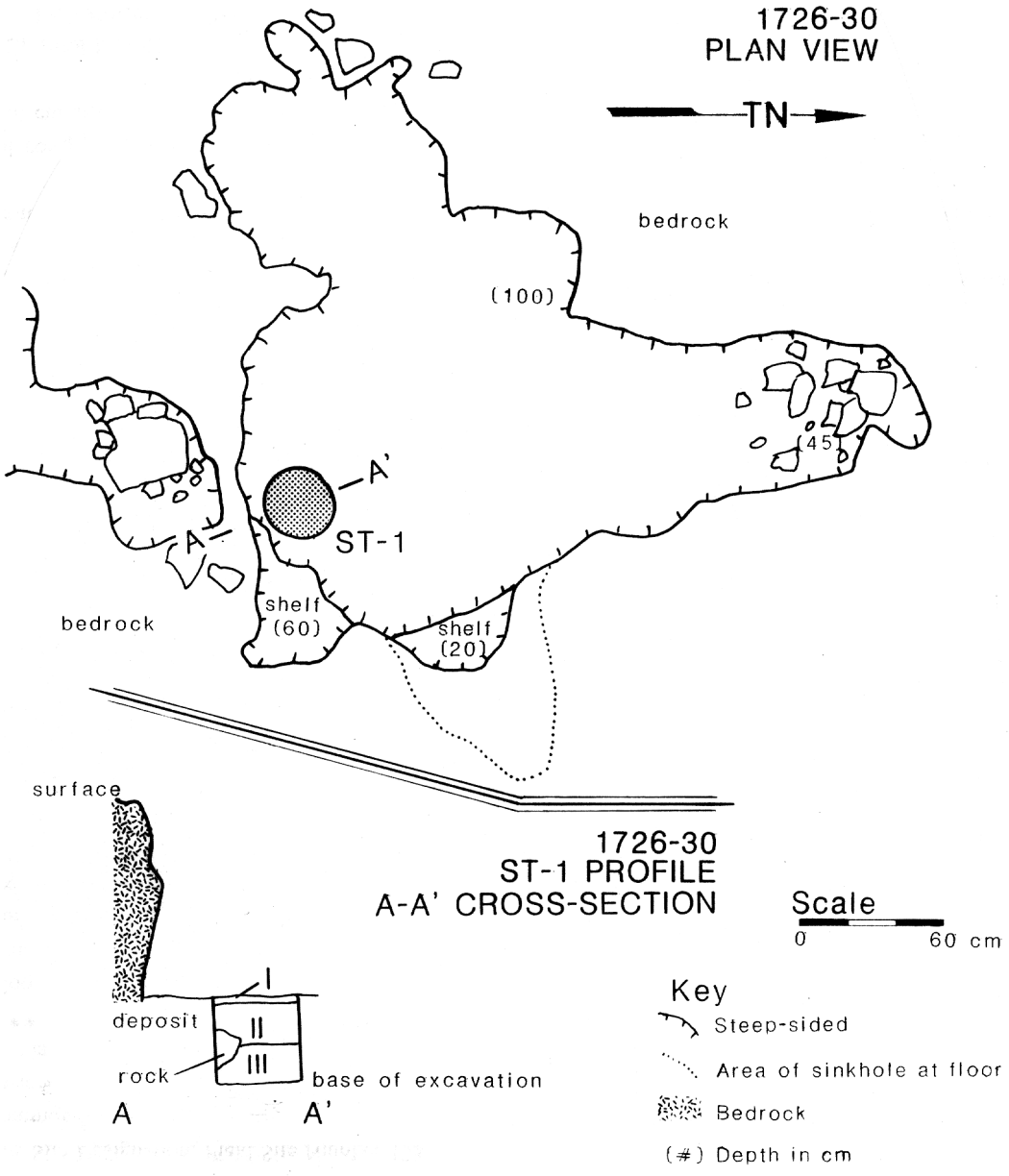

Figure C-26. Site 1726-30.

Photo C-8. Site 1726-30, ST-1 (facing north)

Site/Feature No: 1726-31
Other No: E125/N79.
Figure(s): 11 and C-27.
Testing: removal of capping; one ST.
Natural feature: sinkhole.
Structure/other: capping of sinkhole
Dimensions: .70 x .46 cm opening, 2.80 x 1.40 m floor, 280 cm depth.
Description: capped, small opening sinkhole, with 2 m deep shaft opening into chamber w/ 60 cm high overhang.
Surface: limestone bedrock; grasses; *kiawe*; 3 m east of bulldozed track for soil test borings.
Floor: soil deposit.
Deposit: test shows no definite cultural material.
Fill: none.
Cultural material: none.
Function: trash deposition?
Age: pre-contact to mid-1800s.
Natural history: land snails; bird bone; *Rattus exulans*; European rat; crustacea and echinoderm fragments (probably naturally deposited).
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; limited sampling recommended for additional information related to purposes for capping.

Test Excavations: The sinkhole was covered with four, loosely placed boulders. The boulders were removed for access to the sinkhole. One shovel test (20 cm diameter, 35 cm deep) was placed in the deposit with no stratigraphic control; the sediment sample collected for content analysis for bird bone and cultural material. The deposit contains crab and urchin, but these are probably naturally deposited. The opening of sinkhole and depth are not appropriate for cultivation use. The purpose of the capping is unknown.

1726-31, ST-1 Descriptions:

No formal stratigraphic description or analysis; sediment is comparatively loose, with matrix as yellowish brown (10YR 5/4) sandy clay loam (calcareous); contains land snails in medium density; urchin and crab remains; bird bone; *Rattus exulans*; *Mus musculus*; and European rat.

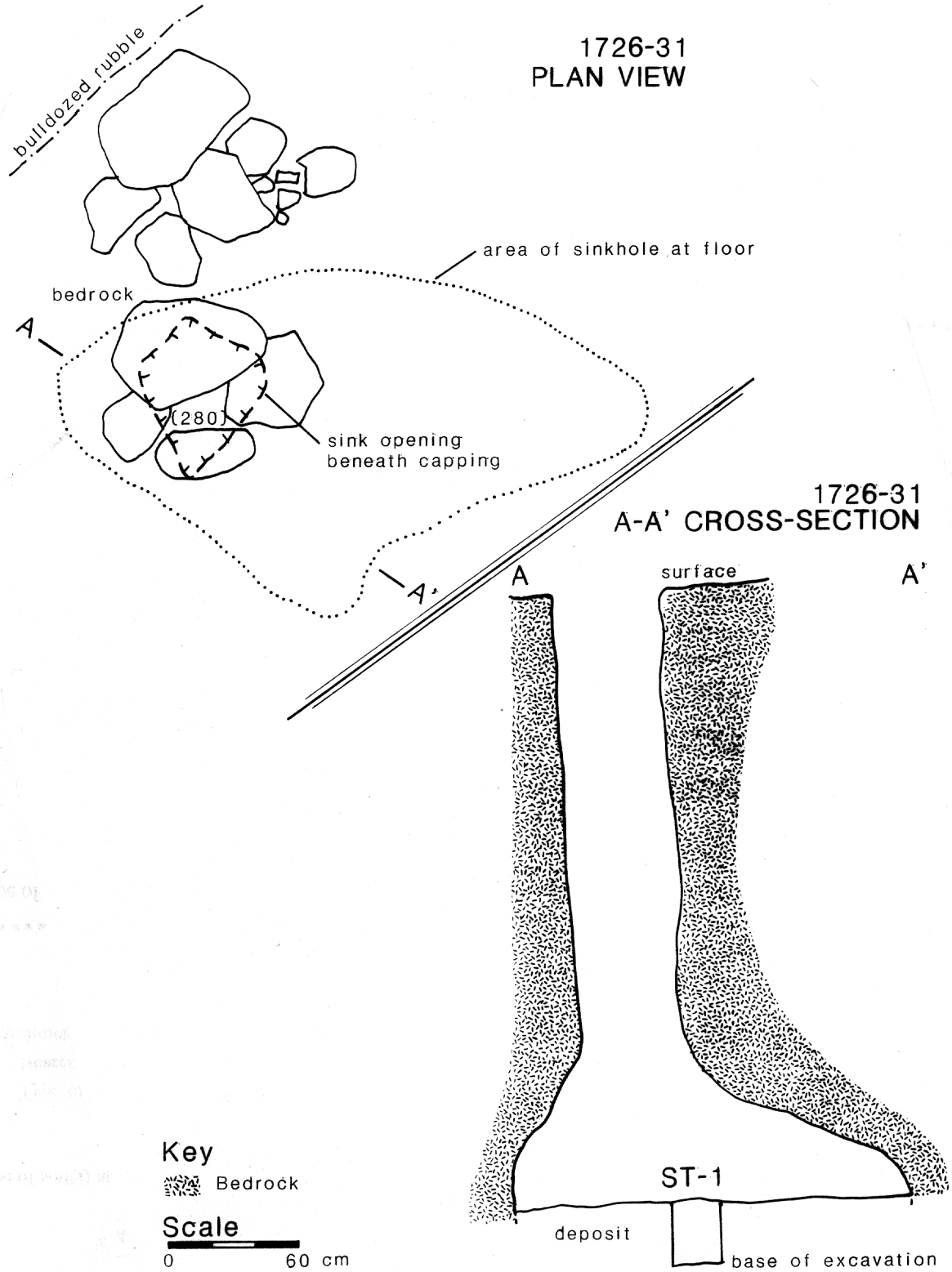

Figure C-27. Site 1726-31.

Site/Feature No: 1726-32
Other No: E114/N90.
Figure(s): 11.
Testing: none.
Natural feature: sinkhole.
Structure/other: rock fill (bulldozing).
Dimensions: 2.5 x 1.0 m (approximate), floor and depth unknown.
Description: sinkhole filled with cobbles and boulders, probably from bulldozing.
Surface: soil exposure and limestone bedrock; thick grasses and *kiawe*; disturbed area.
Floor: unknown.
Deposit: NT.
Fill: rock fill, probably from bulldozing.
Cultural material: none.
Function: agriculture?
Age: pre-contact to ?
Natural history: NA.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, habitation, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; will require clearing of cobble debris.

Site/Feature No: 1726-33
Other No: Haun (1991) 1726-C; Phase I, 21-H; E52/N73.
Figure(s): 11.
Testing: none.
Natural feature: none.
Structure: C-shape.
Dimensions: 5.1 x .55 m wide, 45 cm in height.
Description: poorly constructed C-shape, built of limestone slabs and cobbles, at least 3 upright slabs used in construction; structure is deteriorated, with one damaged section; built on bedrock.
Surface: limestone bedrock; grasses; *kiawe*.
Deposit: NT, but there appears to be some deposit
Cultural material: no midden noted, but thin scatter of fire-cracked rock in vicinity.
Function: temporary habitation.
Age: pre-contact to mid-1800s?
Natural history: NA.
Condition: slightly deteriorated.
Research potential: information on Hawaiian habitation.
Recommendations: data recovery, if necessary; this feature lies just outside the project limits for feature testing. As such it should be in a non-impact area.

Site/Feature No: 1726-34
Other No: E54/N78.
Figure(s): 11; Photo C-9.
Testing: removal of rock fill and one ST.
Natural feature: sinkhole.
Structure: rock fill.
Dimensions: 6.10 x .95 m opening, floor approximately the same, 75 cm depth.
Description: elongated, irregularly shaped sinkhole, straight-sided, with small overhang; cobble/boulder filled.
Surface: rough limestone bedrock; grasses, basil, Philippine violet, one prickly pear; *kiawe* and *wiliwili*.
Floor: soil deposit.
Deposit: test shows possibly modified soil.
Fill: rough rock fill.
Cultural material: none.
Function: agriculture and trash deposition?
Age: pre-contact to ?
Natural history: land snails; bird bone and egg shell; *Rattus exulans*.
Condition: good.
Research potential: by comparison with other similar features, this feature should prove to contain information relevant to the pre-human environment, post-colonization environmental change, Hawaiian agricultural practices, and potentially other Hawaiian activities.
Recommendations: data recovery, if necessary; additional areas of rock fill should be cleared.

Test Excavations: An area of rock fill (90 x 75 cm) was removed from the sink for access to the floor. The rock fill consists of cobbles and small boulders, and contains no cultural material. No cultural material was seen on the floor. A shovel test (25 cm in diameter, 36 cm deep) was placed in the floor deposit, providing limited evidence of cultural modification by color and possible disturbance, but no definite cultural material.

1725-34, ST-1 Descriptions:

Layer 0: duff, 2 cm.

Layer I **Dimensions:** 2 cm bs; 14 cm thick. **Matrix:** dark yellowish brown (10YR 3/4, mottled with limestone gravel) sandy loam (non-calcareous); weak, crumb, medium; slightly sticky, non-plastic, soft; very abrupt, smooth boundary. **Composition:** not calculated. **Inclusions:** land snails low in density; bird bone and egg shell. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** a natural deposit with possible modification for agriculture.

Layer II **Dimensions:** 16 cm bs; 20+ cm thick (bottom not reached). **Matrix:** dark yellowish brown (10YR 4/6) loam (calcareous); weak, granular, medium; slightly sticky, slightly plastic, soft; lower boundary not reached. **Composition:** not calculated. **Inclusions:** snails in low density. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** natural deposition of decomposing limestone.

Bedrock not reached in excavation.

Photo C-9. Site 1726-34. (facing east)

Site/Feature No: 4701
Other No: E81/N47.
Figure(s): 11 and 13; Photo 9.
Testing: stone capping removed; no excavations.
Natural feature: sinkhole.
Structure/other: sinkhole has been capped and its interior modified to form a storage room for artifacts associated with activities of the 1930s.
Dimensions: .91 x.53 m opening, 4.20 x 2.60 floor, 225 cm depth.
Description: sinkhole with two small openings, both capped; large chamber modified to form a room for 20th century activities; room includes a stone slab shelf, and numerous artifacts from the 1930s(?).
Surface: rough limestone bedrock; dense basil; scattered *kiawe*.
Floor: modified sinkhole floor.
Deposit: NT.
Fill: none.
Cultural material: numerous 20th century artifacts (see site description in text).
Function: storage room for liquor production items.
Age: 1930s(?).
Natural history: NA.
Condition: good.
Research potential: information on local cultural activities during Prohibition.
Recommendations: Site should be mapped in more complete detail, all artifacts collected. Limited excavations of the sink floor should be conducted.

Test Excavations: Capping slabs were removed, but no tests were made in floor deposit.

Site/Feature No: 4702-1
Other No: E140/N62.
Figure(s): 11, 14, and C-28; Photo 5.
Testing: one TP (extended to trench).
Description: L-shaped stone pile, arms of pile are 2.23 m and .73m in length, 40 cm in width and about 50 cm high; roughly constructed of cobbles and small boulders; has appearance of crude structure, but tests produced no cultural material.
Surface: soil cover with bedrock exposures; grasses and brush; dense *koa haole*, scattered *kiawe* and *wiliwili*.
Deposit: test shows possible soil modification (Layer II), but this layer predates mound construction.
Cultural material: none.
Function: agricultural mound.
Age: pre-contact to mid-1800s?
Natural history: land snails.
Condition: good.
Research potential: no additional potential.

Test Excavations: One test pit (50 x 50 cm) was placed inside the "L", and then extended for 1 m (30 cm wide) through the S wall (Fig. C-28). Test shows this portion of wall constructed with cobbles and boulders, unfaced, lying on Layer II. One portion of wall was built by first placing a large thin slab horizontally (Fig. C-28), then placing rocks on top of it. If Layer II is an agricultural soil, it was developed prior to mound construction.

4702-1, TP-1 Descriptions:

Layer I **Dimensions:** surface; 2 cm thick. **Matrix:** black (10YR 2/1) silt loam (mottled with grains of limestone); weak, crumb, medium; non-sticky, non-plastic, loose; abrupt, smooth. **Composition:** 40% sub-gravel (non-calcareous); 15% gravel, 25% pebbles, 20 % cobbles (calcareous). **Inclusions:** land snails in high density; plant fragments; insect parts. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** recent humic layer, soil formation.

Layer II **Dimensions:** 2 cm bs; 11 cm thick. **Matrix:** dark brown (10YR 4/3) silty clay loam (moderately calcareous); moderate, crumb, medium; slightly sticky, slightly plastic, soft; abrupt wavy boundary. **Composition:** 65% sub-gravel (moderately calcareous); 5% gravel, 5% pebbles, 25% cobbles (calcareous). **Inclusions:** land snails in moderate quantity. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** deposit containing some calcareous material and some basaltic-derived silt; no charcoal or other direct evidence to suggest agricultural use, but thickness suggests possible cultural modification.

Layer III **Dimensions:** 12 cm bs; 0 to 13 cm thick (on bedrock). **Matrix:** light yellowish brown (10YR 6/4) silt (calcareous); weak, crumb, medium; slightly sticky, non-plastic, soft; abrupt boundary with limestone bedrock. **Composition:** 85% sub-gravel, 10% gravel, 5% pebbles (calcareous). **Inclusions:** none. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** decomposing limestone.

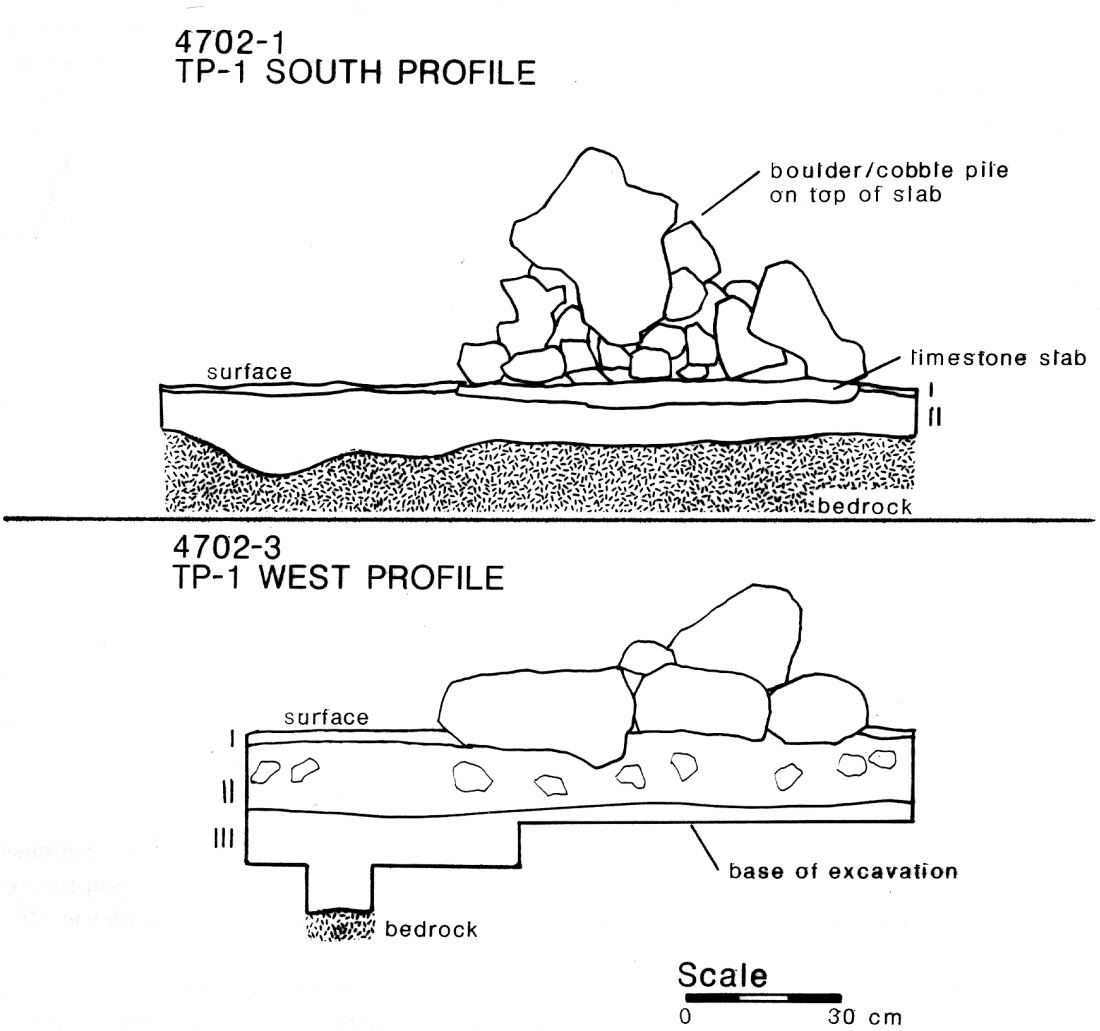

Figure C-28. Site 4702-1 and 4702-3.

Site/Feature No: 4702-2
Other No: E140/N72.
Figure(s): 11 and 14.
Testing: one ST; dismantling of stone pile.
Description: stone pile, 3.4 x 1.6 m, 23 cm in height.
Surface: soil cover with bedrock exposures; grasses and brush; dense *koa haole*, scattered *kiawe* and *wiliwili*.
Deposit: shallow soil, possibly modified.
Cultural material: none (one sea urchin spine, probably natural).
Function: agricultural mound.
Age: pre-contact to mid-1800s?
Natural history: land snails.
Condition: good.
Recommendation: no further work.

Test Excavations: Stone pile was dismantled; it was found to have been constructed by using a large slab as the base, then piling cobbles on it. One shovel test was placed in adjoining soil. No definite cultural material was recovered from the mound or the shovel test, although one urchin fragment was found.

4702-2, ST-1 Descriptions:

Layer 0: duff; 1 cm thick.

Layer I **Dimensions:** 1 cm bs; 17 cm thick. **Matrix:** dark brown (10YR 3/3, heavily mottled with limestone granules) sandy loam, sandiness primarily due to high percentage of granular limestone inclusions; structureless; slightly sticky, non plastic; abrupt boundary with limestone bedrock. **Composition:** 15% sub-gravel; 85% gravel, pebbles, and cobbles (calcareous). **Inclusions:** land snails in very high density. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** uncertain; probably an area of decaying limestone bedrock, with loose soil deposited among stones.

Site/Feature No: 4702-3
Other No: E146/N50.
Figure(s): 11, 14, and C-28.
Testing: one TP (extended to trench); one ST.
Description: stone pile, 5.10 m long, .95 m wide, 25 cm in height; slightly C-shaped in form, but pile unfaced, and tests produced no cultural material.
Surface: soil cover with bedrock exposures; grasses and brush; dense *koa haole*, scattered *kiawe* and *wiliwili*.
Deposit: shallow deposit, possibly modified.
Cultural material: none.
Function: agricultural.
Age: pre-contact to mid-1800s?
Natural history: land snails.
Condition: good.
Recommendation: no further work.

Test Excavations: A test pit (50 x 50) cm was excavated inside the curve of the pile, then extended (75 x 40 cm) through the N wall. There is a possibly modified soil lying atop decomposing limestone and bedrock. The stone pile, like the others of the area, is built on this older soil. A shovel test was placed at the E end of the pile, with the same results. No cultural material was recovered in the test pit or in the shovel test.

4702-3, TP-1 Descriptions:

Layer I **Dimensions:** surface; 3 cm thick. **Matrix:** black (10YR 2/1, mottled with grains of limestone) silt loam; weak, crumb, medium; non-sticky, non-plastic, loose; abrupt, smooth. **Composition:** 45% sub-gravel (non-calcareous); 10% gravel, 25% pebbles, 20 % cobbles (calcareous). **Inclusions:** land snails in high density; plant fragments; insect parts. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** recent humic layer, soil formation.

Layer II **Dimension:** 3 cm bs; 11 cm thick. **Matrix:** dark brown (10YR 4/3) silty clay loam (moderately calcareous); moderate, crumb, medium; slightly sticky, slightly plastic, soft; abrupt wavy boundary. **Composition:** 65% sub-gravel (moderately calcareous); 5% gravel, 5% pebbles, 25% cobbles (calcareous). **Inclusions:** land snails in moderate quantity. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** deposit contains some calcareous material and basaltic-derived silt; no charcoal or other direct evidence to suggest agricultural use, but thickness suggests possible cultural modification.

Layer III **Dimension:** 13 cm bs; 15 cm thick (on bedrock). **Matrix:** light yellowish brown (10YR 6/4) silt (calcareous); weak, crumb, medium; slightly sticky, non-plastic, soft; abrupt boundary with limestone bedrock. **Composition:** 90% sub-gravel, 5% gravel, 5% pebbles (calcareous). **Inclusions:** none. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** decomposing limestone.

4702-3, ST-1 Descriptions:

Same stratigraphic profile as 4702-3: TP-1.

Site/Feature No: 4702-4
Other No: E158/N125.
Figure(s): 12, 14, and C-29.
Testing: one TP and dismantling of rock pile.
Description: a carefully laid, but unfaced stone pile (Fig. C-29), about 1 m across, 30 cm high.
Surface: soil cover with bedrock exposures; grasses and brush; dense *koa haole*, scattered *kiawe* and *wiliwili*.
Deposit: possibly modified, very shallow soil.
Cultural material: none.
Function: agricultural mound.
Age: pre-contact to mid-1800s?
Natural history: land snails.
Condition: good.
Recommendation: no further work.

Test Excavations: A 60 x 40 cm section of the mound was dismantled and the deposit below was then excavated. The dismantling and excavation indicate that the soil development and pile construction have the same history as those of 4702-3; Layer II is a weathered or modified soil, with the stone feature constructed on top of it. The stone pile and Layer II may both be agricultural, but if so, they were developed sequentially.

4702-4, TP-1 Descriptions:

Same stratification and soil characteristics as 4702-3.

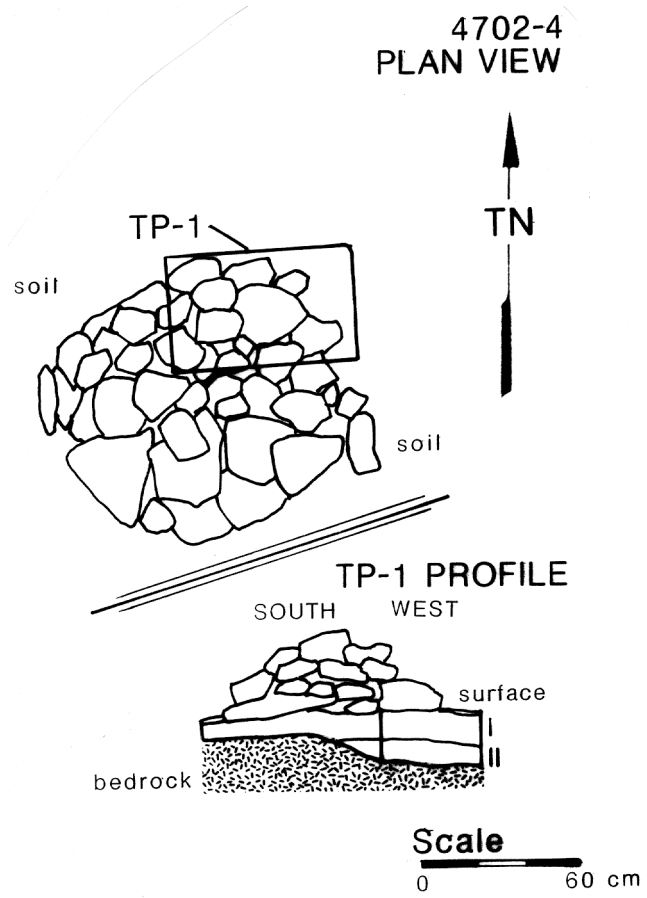

Figure C-29. Site 4702-4.

Site/Feature No: 4702-5
Other No: E162/N52.
Figure(s): 11 and 14.
Testing: one ST.
Description: stone pile roughly C-shaped, about 2.8 m long, .7 m wide, 20 cm in height; appears very recent, with rocks loosely places with mixed soil, probably bulldozed.
Surface: soil cover with bedrock exposures; grasses and brush; dense *koa haole*, scattered *kiawe* and *wiliwili*; nearby treehouse in *kiawe*; adjacent disturbed area.
Deposit: shallow soil.
Cultural material: none.
Function: bulldozing pile
Age: recent.
Natural history: land snails.
Condition: good.
Recommendation: no further work.

Test Excavations: One shovel test was placed adjacent to the pile. No cultural materials were obtained. Examination of the elongated stone pile indicates that it was formed by bulldozing; the rocks are jumbled, many on their edges, and the ground surface in the vicinity is disturbed; the stones may derive from agricultural piles, but none survive intact in this area; the deposition associated with this feature is different from that of the main area of mounds of 4702, further supporting the recent origin of the piles of 4702-5.

Layer II of 4702-5 is quite different from Layer II of other 4702 features; it is an orange silt, contrasting with the more yellowish and darker silt-loam of the other features; unlike Layer II at other 4702 features, Layer II of 4702-5 has very few land snails. In general 4702-5 shows no evidence of soil modification, in contrast to the Layer II soil of other 4702 areas of stone piles; this provides some support for the agricultural origin of most of 4702 soils and stone piles.

4702-5, ST-1 Descriptions:

Layer I **Dimensions:** surface; 3 cm thick. **Matrix:** black (10YR 2/1) silt loam (mottled with grains of limestone); weak, crumb, medium; non-sticky, non-plastic, loose; abrupt, smooth. **Composition:** 50% sub-gravel (non-calcareous); 10% gravel, 20% pebbles, 20 % cobbles (calcareous). **Inclusions:** land snails in high density; plant fragments; insect parts. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** recent humic layer, soil formation.

Layer II **Dimensions:** 3 cm bs; 8 cm thick. **Matrix:** dark yellowish brown (10YR 4/6) silt loam (non-calcareous); moderate, crumb, medium; slightly sticky, slightly plastic, soft; abrupt, smooth boundary. **Composition:** 65% sub-gravel, 5% gravel, 10% pebbles, 20% cobbles (calcareous). **Inclusions:** land snails in very low density. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** deposit is natural silt deposition derived from basaltic soils.

Layer III **Dimensions:** 11 cm; 4 cm thick (on top of bedrock). **Matrix:** yellowish brown (10YR 5/8) silt (calcareous); weak, crumb, fine; slightly sticky, non-plastic, soft; abrupt boundary on limestone bedrock. **Composition:** not calculated. **Inclusions:** none. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** natural decomposing bedrock.

Site/Feature No: 4702-6.
Other No: E101/N104 (photographed as 1724-59).
Figure(s): 11 and 14.
Testing: one TP (extended to trench).
Description: low stone pile, 8.5 x .85 m, 20 cm high, no more than two courses, not faced, appears to be damaged, perhaps bulldozed remnant of agricultural mound.
Surface: soil cover with bedrock exposures; grasses and brush; dense *koa haole*, scattered *kiawe* and *wiliwili*.
Deposit: test shows shallow soil deposit with no evidence of cultural activity.
Cultural material: none.
Function: probably agricultural mound remnant.
Age: pre-contact to mid-1800s?
Natural history: land snails.
Condition: poor.
Recommendation: no further work.

Test Excavations: A trench (140 x 30 cm) was placed through the mound. It shows no evidence of cultural materials, and the stone is disturbed.

4702-6, TP-1 Descriptions:

Layer I **Dimensions:** surface; 3 cm thick. **Matrix:** very dark brown (10YR 2/2, mottled with limestone grains) loam (non-calcareous); structureless; non-sticky, non-plastic, loose; abrupt, smooth boundary. **Composition:** 70% sub-gravel, (moderately calcareous); 10% gravel, 20% pebbles, 1 calcareous. **Inclusions:** land snails in medium density; plant fragments. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** recent duff, forming soil.

Layer II **Dimensions:** 3 cm bs; 22 cm thick. **Matrix:** dark yellowish brown (10YR 4/6) loam (calcareous); moderate, granular, medium; slightly sticky, slightly plastic, soft; abrupt, irregular boundary with bedrock. **Composition:** 60% sub-gravel, 15% gravel, 20% pebbles, 15% cobbles, calcareous. **Inclusions:** snails in low density. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** natural deposition of decomposing limestone, overlying limestone bedrock.

Site/Feature No: 4702-7.
Other No: E93/N114 (photographed as 1724-60).
Figure(s): 11, 14, and C-30.
Testing: one TP (extended into trench)
Description: a rough, elongated stone pile, 4.16 m long, .50 m wide, 20 cm in height, somewhat dispersed, no more than two stones high, unfaced; slightly curving suggestion of a C-shape, but excavation shows that it is recent or recently disturbed, possibly by bulldozing.
Surface: soil cover with bedrock exposures; grasses and brush; dense *koa haole*, scattered *kiawe* and *wiliwili*.
Deposit: shallow non-cultural soil.
Cultural material: fish bone (questionably cultural).
Function: remnant of agricultural mound.
Age: pre-contact to mid-1800s?
Natural history: bird egg shell; fish bone (?).
Condition: poor.
Recommendation: no further work.

Test Excavations: A test pit (50 x 50 cm) was excavated on the inner side of the pile's curve, then extended (1.2 x .30 m) through the pile. A very shallow non-cultural soil was encountered, and the pile appears recent or disturbed. One fragment of fish bone was found, but this is probably a non-cultural deposition, given that bird egg shell is also present, and no definitive cultural material is in evidence.

4702-7, TP-1 Descriptions:

Layer I **Dimensions:** surface; 2 cm thick. **Matrix:** very dark brown (10YR 2/2, mottled with limestone grains) loam (non-calcareous); structureless; non-sticky, non-plastic, loose; abrupt, smooth boundary. **Composition:** 60% sub-gravel, (moderately calcareous); 15% gravel, 25% pebbles, 1 calcareous. **Inclusions:** land snails in low density; plant fragments. **Intrusions:** rootlets. **Cultural material:** none. **Interpretation:** recent duff, forming soil. Note: lower rocks of feature are only partially buried in the humus of Layer I, and appear displaced.

Layer II **Dimensions:** 2 cm bs; 9 cm thick. **Matrix:** dark yellowish brown (10YR 4/6) loam (slightly calcareous); moderate, granular, medium; slightly sticky, slightly plastic, soft; abrupt, wavy boundary with bedrock. **Composition:** 60% sub-gravel, 15% gravel, 20% pebbles, 15% cobbles, calcareous. **Inclusions:** snails in low density; bird egg shell; fish bone. **Intrusions:** roots. **Cultural material:** none. **Interpretation:** natural deposition of transported basaltic silts and decomposing limestone, overlying limestone bedrock.

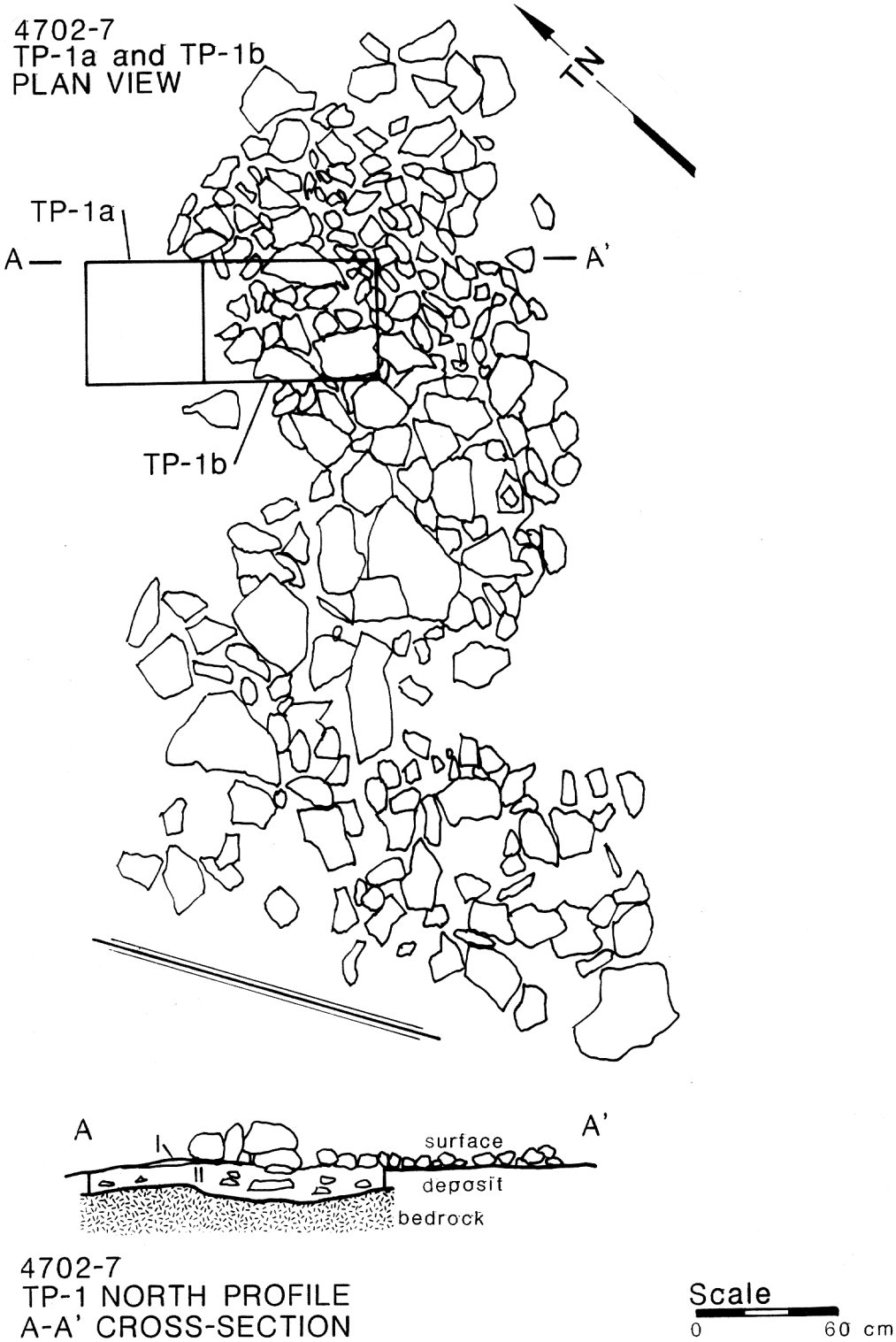

Figure C-30. Site 4702-7.

Site/Feature No: 4702-8
Other No: E71/N114 (photographed as 1724-61)
Figure(s): 11.
Testing: one ST.
Structure: limestone slab scatter.
Description: roughly L-shaped slab scatter, 4.3 x 2.3 m, 30 cm in height, primarily composed of slabs from 75 to 100 cm long and 50 cm wide; no facing and little piling; test produced no cultural material; feature may be agricultural or natural, resulting from root disturbance.
Surface: limestone bedrock, little soil cover; grasses and brush; *kiawe*, *opiuma*, and *wiliwili*.
Deposit: shallow soil, with no cultural material.
Cultural material: none.
Function: agricultural mound or natural.
Age: pre-contact to mid-1800s?
Natural history: land snails.
Condition: good.
Recommendation: no further work.

Test Excavations: One shovel test (25 cm wide, 23 cm deep) was placed in the adjacent soil deposit, producing and cultural evidence and bedrock at 23 cm.

4702-8, ST-1 Descriptions:

No formal description: humus and orange-colored soil; like 4702-7; bedrock at 23 cm; no evidence of cultural material.

Additional shovel tests were conducted in the vicinity of four stone piles (Fig. 14) in the 4702 complex, all with equivalent results. The features (4702-9, 10, 11, 12) are all roughly piled, low mounds of limestone cobbles and boulders. None are faced and tests indicate that all are built on Layer II. Seven shovel tests were placed in the soil deposits around these structures, all with equivalent profiles, profiles that duplicate 4702-1 through 3. No further work in these features is recommended..

Recommendations for 4702: Additional testing for better information on agricultural soils needs to be carried out; in addition testing for sub-surface features with machinery is recommended.

APPENDIX D:
CHECKLIST OF PLANTS FOUND IN THE PROPOSED HOUSING AREA

(Modified from Whistler 1993:Table 1)

Checklist of plants found during the 100 percent survey of the proposed housing area at Barbers Point Naval Air Station.

Species	Family	Common name
	MONOCOTS	
	AGAVACEAE (Century Plant Family)	
Cordyline fruticosa (L.) Chev.		*lauki*, ti plant
	POACEAE (Grass Family)	
Cenchrus ciliaris L.		Buffelgrass
Chloris barbata (L.) Sw.		swollen fingergrass
Digitaria insularis (L.) Mez ex Ekman		sourgrass
Rhynchelytrum repens (Willd.) C.E. Hubb.		Natal redtop
Setaria verticillata (L.) P. Beauv.		bristly foxtail
	DICOTS	
	ACANTHACEAE (Acanthus Family)	
Asystasia gangetica (L.) T. Anderson		Chinese violet
Barleria cristata L.		Phillipine violet
	AMARANTHACEAE (Amaranth Family)	
Achyranthes aspera L.		------
	ANACARDIACEAE (Mango Family)	
Schinus terebinthifolius Raddi		Christmas berry
	ARALIACEAE (Ginseng Family)	
Schleffera actinophylla (Endl.) Harms		octopus tree
	ASCLEPIADACEAE (Milkweed Family)	
Cryptostegia grandiflora (Roxb.) R. Br.		Indian rubber vine
	ASTERACEAE (Sunflower Family)	
Bidens pilosa L.		beggar's-tick
Pluchea symphytifolia (Mill.) Gillis		pluchea, sourbush
Sonchus oleraceus L.		sow thistle
Tridax procumbens L.		coat buttons
Verbesina encelioides (Cav.) B. & H.		golden crownbeard
Vernonia cinerea (L.) Less.		little ironweed
	BIGNONIACEAE (Bignonia Family)	
Spathodea campanulata P, Beauv.		African tulip tree
	CACTACEAE (Cactus Family)	
Opuntia ficus-indica (L.) Mill.		opuntia, *panini*
Hylocereus undatus (Haw.) Britt & Rose		night-blooming cereus
	CAPPARACEAE (Caper Family)	
Capparis sandwichiana DC.		*pua pilo*
	CONVOLVULACEAE (Morining Glory Family)	
Ipomoea cairica (L.) Sweet.		*koali*
Ipomoea indica (J. Burm.) Merr.		*koali'awa*
Merremia aegyptia (L.) Urb.		hairy merremia

Species	Common name
EUPHORBIACEAE (Spurge Family)	
Chamaesyce hirta (L.) Millsp.	grarden spurge
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge
Chamaesyce skottsbergii (Sherff) Croiz. & Def.	*'akoko*
Pedilanthus tithymaloides (L.) Poit.	slippery flower
FABACEAE (Pea Family)	
Acacia farnesiana (L.) Willd.	klu
Caesalpinia bonduc (L.) Roxb.	*kakalaioa*, gray nickers
Desmanthus virgatus (L.) Willd.	virgate mimosa
Erythrina sandwicensis Deg.	*wiliwili*
Indigofera suffruticosa Mill.	indigo, *'iniko*
Indigofera spicata Forssk.	creeping indigo
Leucaena leucocephala (Lam.) de Wit	*koa haole*, *ekoa*
Pithecellobium dulce (Roxb.) Benth.	*'opiuma*
Prosopis pallida (H.B. ex Willd.) Kunth	*kiawe*, mesquite
LAMIACEAE (Mint Family)	
Leonotis nepetifolia (L.) R. Br.	orange lion's ear
Ocimum gratissimum L.	wild basil
LAURACEAE (Laurel Family)	
Cassytha filiformis L.	*kauna'oa*
MALVACEAE (Mallow Family)	
Abutilon grandifolium (Willd.) Sweet	hairy abutilon
Sida fallax Walp.	'ilima
Sida spinosa L.	prickly sida
MORACEAE (Mulberry Family)	
Ficus microcarpa L. f.	Chinese banyan
PASSIFLORACEAE (Passion flower Family)	
Passiflora foetida L.	love-in-a-mist
PLUMBAGINACEAE (Leadwort Family)	
Plumbago zeylanica L.	*'ilie'e*
PORTULACACEAE (Purslane Family)	
Portulaca oleracea L.	common purslane, pigweed
Portulaca pilosa L.	*'ihi*
RUBIACEAE (Coffee Family)	
Morinda citrifolia L.	Indian mulberry, *noni*
SOLANACEAE (Nightshade Family)	
Solanum americanum Mill.	black nightshade, *popolo*
Solanum seaforthianum Andr.	blue potato-vine
STERCULIACEAE (Cocoa Family)	
Waltheria indica L.	*'uhaloa*
VERBENACEAE (Verbena Family)	
Lantana camara L.	lantana
Stachytarpheta jamaicensis (L.) Vahl	jamaica vervain, *oi*, *owi*

APPENDIX E:
POLLEN ANALYSIS OF SAMPLES FROM SITE 1724-42

by Jerome V. Ward, Ph.D.

Pollen samples were obtained from Site 1724-42, a sinkhole at NAS Barbers Point (see Appendix C for description). One sample was analyzed from each of four stratigraphic units, Ia (humus, Lab Number 177), Ib (a cultural layer, LN 178) II (decomposing limestone with some sediment, LN 179), and III (a lower decomposing limestone unit, LN 180). The samples were initially treated with HCL to dissolve carbonates, followed by KOH to solubilize organics, and HF to dissolve the silica fraction. Acetolysis solution, advocated by Herngreen (n.d.), was used to break down the abundant cellulose, and dilute HNO_3 was used to oxidize the remaining microscopic plant debris, including lignin. After final rinsing the pollen residue was mounted in glycerine jelly following Erdtman's (1960) technique.

Palynomorphs, which include pollen, pteridophyte spores, and other organic-walled microfossils are usually less than the 200 μm size fraction (Tschudy and Scott 1969). These were identified using published pollen floras that include Pacific types, chiefly Selling (1946, 1947) for Hawai'i, Cranwell (1953) for New Zealand, Huang (1972) for Taiwan, along with a personal reference collection of pollen and spores from the Pacific. Three slides were counted per sample, each with a 22 x 40 mm cover glass area to arrive at a minimum pollen sum including pollen and spores.

The count data are presented in Table E-1. The pollen is separated into ecological groups, Herbs, and Trees and Shrubs, while the Pteridophytes are divided on the basis of morphology, whether monolete or trilete.

The samples contained amorphous organic debris, cuticle, fungal palynomorphs, and spores of unknown affinity. Pollen and spores were poorly preserved and in very low concentrations. The four samples clustered into two groups in terms of palynomorph concentration, the 177 and 178 samples contained 2665 and 1792 palynomorphs/cc while the 179 and 180 samples contained only 128 and 181 palynomorphs/cc, respectively. The poor preservation may derive from mixing and aeration of sediments after deposition.

Three slides per sample were counted to arrive at the minimal pollen sums indicated in Table 1: 177, 123; 178, 145; 179, 75; and 180, 53 pollen grains. The higher sums recorded in samples 177 and 178 may be attributable to the much higher pollen concentration. Usually, a sum of at least 200 pollen grains is preferred for Hawaiian work in order to adequately record shifts in forest types but also to detect the presence of ethnobotanically important species.

Lowland paleoenvironment

In general, the samples contained a mixture of pollen types that may have been derived from lowland dry forests and the coastal zone. Only a few pollen grains were recovered that suggest the presence of a pristine lowland forest, with a single grain of *Pritchardia* in sample 179, 3 grains of *Kanaloa* in sample 177, and 2 grains of *Gouania* in sample 178. The samples are dominated by pollen of cheno-ams which are favored under disturbed conditions and by an undetermined type that is suggestive of a diminutive

Euphorbia grain. Monolete, psilate fern spores, typical of disturbed horizons in the tropics are abundant. *Lycopodium cernuum* spores, representing a fern ally and favored under open conditions, is also very common along with a trilete, echinate type, in the trilete category.

The samples suggest mixing due to the presence of pollen types of the post-contact introductions *Astragalus* type, lophate *Asteraceae*, *Casuarina*, *Leucaena*, and *Prosopis* along with natives such as *Kanaloa* and *Pritchardia*. Therefore, the samples are either of historic age or represent a mixture of historic and prehistoric sediments.

Record of charcoal particles

The charcoal particle concentrations, like the pollen concentrations, cluster into two groups, samples 177 and 178, and samples 179 and 180. In addition, there is a positive correlation between the pollen and charcoal concentrations, a result which may be expected (Edlund and Byrne, n.d.). The first group contained relatively high values at 29.6 and 5.4 mm^2/cc, respectively, while the second group held to much lower levels at 0.5 and 0.8 mm^2/cc, respectively. The second group is from "non-cultural" deposits, but it is not known if these are pre-Polynesian deposits. Natural fires are not presently known on O‘ahu for the pre-Polynesian period (Athens and Ward 1993).

Table E-1. Palynomorphs from Site 1724-42.

Species or type	Layer (with sample number) !a (177)	Ib(178)	II(179)	III (180)
HERBS:				
Boerhavia diffusa type	1			
Cyperaceae (sedge)	4	8	3	2
Poaceae (grass)	11	5		2
Plantago		2		
TREES AND SHRUBS:				
Abutilon	4	2		4
Antidesma	4	7	3	4
Artemisia				1
Asteraceae (high-spined)	3	3	2	2
Asteraceae (lophate)	4	14		2
Astragalus type	1			
Casuarina	4	1		
Cheno-am	22	54	40	12
Chamaesyce	3	8	4	7
Colubrina	4			
Cordyline fruticosa	11	2	1	3
Dodonaea viscosa	1			
Euphorbia (small type)	5	23	16	10
Gouania		2		
“Kanaloa kahoolawensis”	3			
Leucaena leucocephala	1			
Myrtaceae	1			
Pandanus	3			
Pritchardia			1	
Prosopis pallida	3			3
Sida	1			
Solanaceae	2			
UNKNOWN POLLEN:				
Tricolporate, reticulate	4	14	5	1
Tricolporate, thin-walled, reticulate	8			
Tricolporate, short colpi, 42 um	5			
Tricolporate, prolate, thick-walled, Apiaceae?	8			
Triporate, psilate	2			
TOTAL POLLEN:	123	145	75	53
PTERIDOPHYTES:				

Table E-1. Palynomorphs from Site 1724-42 (continued).

Species or type	Layer (with sample number) Ia (177)	Ib(178)	II(179)	III (180)
MONOLETE SPORES:				
Polypodium pellicidum type	1	1		
Psilate	23	57	23	14
Granulate	4	7	2	5
Echinate	1	3	3	
Verrucate	3			
Foveo-reticulate, large	1	8	6	3
Perinate				1
TRILETE SPORES:				
Cibotium	4	16	9	2
Gleichenia linearis	7	8	1	
Lycopodium cernuum	1	17	4	
L. phlegmaria		1	1	
Pteris	1			
Psilate	2	8	8	5
Echinate	12	37	17	5
Echinate, fine			1	
Granulate		1		
Reticulate, fine		9	1	3
TOTAL SPORES:	60	173	76	38
TOTAL POLLEN AND SPORES:	183	318	151	91
Markers	388	401	2671	1135
Starting volume (ml)	4	10	10	10
Markers/cc	5650	2260	2260	2260
Palynomorph concentration	2665	1792	128	181
OTHER PALYNOMORPHS:				
Arcella	1	1		1
Large reticulate sac			21	12
Acritarch, echinate				5
Macrobiotus egg (tardigrade)	1			
Horn-shaped structure		2		3
CHARCOAL:				
Markers	223	145	976	39
Starting volume	4	10	10	10
Markers/cc	5650	2260	2260	2260
Charcoal particles	906	147	88	7
No. grid squares	1970	584	344	24
Total area (mm^2)	1.17	0.35	0.20	0.14
Charcoal concentration (mm^2/cc)	29.6	5.4	0.5	0.83

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APPENDIX C

BOTANICAL SURVEY REPORT

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Kalaeloa Solar One
Botanical Survey of TMK (1) 9-1-13:28 (portion)
Land Parcel at Kalaeloa (the former Naval Air Station, Barbers Point)
with Special Focus on ***'Akoko*** (*Chamaesyce skottsbergii* var. *kalaeloana*)

INTRODUCTION

The study site comprises an 80-acre parcel of land belonging to the Department of Hawaiian Home Lands located near the northwest corner of Kalaeloa (the former Naval Air Station, Barbers Point). The parcel is bounded on the west side by a fence and road marking the western side of the former base, on the north side by Boxer Road, and on the south by a line extending east-west across the property. The land is being developed as a solar farm and an Environmental Assessment (EA) is being prepared by TEC Inc. Several botanical surveys have been done in the area over the years, and the presence a federally listed Endangered Species, *Chamaesyce skottsbergii* var. *kalaeloana* (***'akoko***), was documented in the project area. This additional survey was conducted at greater field coverage to determine if this species is found in the area planned for development, and if present, where and in what numbers it occurs.

Kalaeloa is one of the few remaining places where this ***'akoko*** has been identified, and has been reported in or near the parcel during two previous studies by the author (one specifically in the area and one just outside of it). However, it is noted that the last survey conducted on the parcel in the wet season (Whistler 2008) did not find any individuals of this endangered plant.

METHODOLOGY

The area was visited during October 18th and 19th 2010 by the Consultant, along with Tec Inc. representative Glenn Metzler. Mr. Metzler also visited the site on the 21st and 23rd October without the consultant. A normal 100% survey conducted in searches for rare plants involves transects 30 feet apart. However, because this survey was done in the dry season (of a drought year) when the ***'akoko*** plants are often leafless, the methodology was modified somewhat to do closer transects, particularly in areas of suitable habitat. Determination of suitable habitat was based on observations during the author's numerous previous surveys in the area. ***'Akoko*** does not occur uniformly on the site, instead being virtually restricted to a certain type of microhabitat in the *Prosopis pallida* (***kiawe***) forest present on the property. The plant is rarely found under forest shade or in grassy areas. Instead it prefers open areas of flat limestone rock devoid of the dominant grass in the area, *Cenchrus ciliaris* (Buffelgrass), which are

scattered throughout, but not commonly in, the area (This habitat is more common elsewhere at Kalaeloa). Additional field effort was focused in these areas of suitable habitat.

The transect lines run by the Consultant and Glenn Metzler were marked by color flagging tape, with alternating colors in different rows. This was done to facilitate straight lines so that no part of the study area would be missed. It was supplemented by the use of a handheld GPS unit that indicated where the boundaries were and how the transect lines had been walked. The lines were run south from Boxer Road, with return runs in the opposite direction. As mentioned, places with suitable habitat (open places on rocky ground) were given extra attention. A checklist was completed for all plant species found (see Table 1) to document the flora and to make sure that no other critical plant species occur on the site.

RESULTS

Flora

Fifty-two species were recorded at the study site (see Table 1) during the present study. Only eight of the 52 species are native, six of them indigenous (***nena***, ***ʻuhaloa***, ***ʻilima***, ***huehue***, ***ilieʻe***, and ***kaunaʻoa pehu***), and two of them endemic (***wiliwili***, ***maiapilo***). Indigenous plants are species native to a region or place, but which are also found elsewhere. Endemic plants are species restricted to a single region or area, i.e., in the case of Hawaiʻi, they are found only in Hawaiʻi. In biodiversity terms, the endemic status is the more important of the two categories, because if a species belonging to it is endangered or threatened in Hawaiʻi, it would likewise be classified globally. Indigenous species, however, can be rare in Hawaiʻi, but may be common elsewhere in the Pacific. Over 90% of the native plants in Hawaiʻi are endemic, one of the highest rates in the world. The vast majority of the 52 species encountered during the survey are naturalized or weedy "alien" plants that were accidentally or intentionally introduced to Hawaiʻi, but which have now become established in the islands and can spread on their own. Most of these native species are common in Hawaiʻi, and none are Threatened or Endangered.

Vegetation

The vegetation at the site is mostly a ***kiawe***/***koa haole*** forest (= *Prosopis*/*Leucaena* forest) described by Char and Balakrishnan (1979), dominated by large trees of *Prosopis pallida* (***kiawe***, mesquite) up to 10 m or more in height, with smaller amounts of shorter and thinner *Leucaena leucocephala* (***koa haole***). The Chinese banyan (*Ficus microcarpa*) is scattered throughout the site, and during this drought period, was virtually the only tree with conspicuous leaves. The canopy of the ***kiawe*** trees produces a variable shade beneath it, which results in a ground cover dominated by more shade-tolerant plants, such as Guinea grass (*Panicum maximum*), Chinese violet (*Asystasia gangetica*), but these were severely affected by the drought and mostly dead or leafless. In the more open areas, the ground cover is typically dominated by the less shade tolerant Buffelgrass (*Cenchrus ciliaris*). The shrubs ***ʻilima*** (*Sida fallax*) and ***klu*** (*Acacia farnesiana*) are occasional in these sunnier areas. Areas with the combination of ***koa haole*** and ***ʻilima*** comprise the prime habitat for ***ʻakoko*** plants, which are, however, uncommon in the area (especially live ones). In areas with few or no trees, the vegetation is typically a grassland dominated by Buffelgrass, often with scattered ***koa haole*** and ***ʻilima*** shrubs. The distinction between the ***kiawe/koa haole*** forest and Buffelgrass grassland is blurred because they blend into each other.

DISCUSSION

During the survey, a population of what appeared to be *Chamaesyce skottsbergii* var. *kalaeloana* was found on the eastern portion of the property within the development area. (Note: the location was collected with a Garmin GPS76 by Glenn Metzler and is shown on Figure 3.6 of the draft EA). The site is ideal ***ʻakoko*** habitat with a flat rock surface having cover and no shade. About a dozen individuals of a species of *Chamaesyce* were found, all but about three of them dead. The largest of the dead individuals appeared to be the Endangered ***ʻakoko***, but upon closer examination, the withered flowers, in clusters

rather than solitary, indicated that this dead individual was probably *Chamaesyce hypericifolia* instead. This latter species is an alien weed reported to be an annual rather than a woody perennial plant, but the large dead individual in question seemed clearly to be a woody perennial. Since most of the other individuals do not appear to be woody, and on the live ones the flowers are in clusters, it is likely that the large individual is just an aberrant *Chamaesyce hypericifolia*. It may be a moot point, because the only specimen in question was dead. The difficulty in identifying the plant is exacerbated by the fact that the "key" to determining the difference between the two species (Wagner et al. 1990) separates the Hawaiian species first into native and non-native species, so if one does not know the answer to that question, then the step in the key is useless.

Perhaps the best way to remove any uncertainty about the identification of the plants is to have an expert from the Hawaii DLNR, USFWS, or Bishop Museum examine them and give a determination.

Other than these specimens, the only interesting botanical resources are the presence of two endemic species, *Erythrina sandwicensis* (***wiliwili***) and *Capparis sandwichiana* (***maiapilo*** or ***pua pilo***). (Note: the locations were collected with a Garmin GPS76 by Glenn Metzler and are shown on Figure 3.6 of the draft EA). These were found on the eastern side of the survey area. It would be desirable if the individuals of these species can be preserved, since they are uncommon on O‘ahu. About 10 live individuals of ***wiliwili*** were recorded, and about five of the ***pua pilo***. These were marked with flagging and should be avoided, if possible, when the site is developed.

RELEVANT REFERENCES

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Table 1. Plant Species Checklist

The following is a checklist of the vascular plants inventoried during the field study on the ca. 80 acre study site at Kalaeloa. The plants are divided into two groups: monocots, and dicots. Within these groups, the species are presented taxonomically by family, with each family and each species in the family in alphabetical order. The taxonomy and nomenclature of the ferns follow Palmer 2003 and the flowering plants (monocots and dicots) follow Wagner *et al*. (1990). In most cases, common English and/or Hawaiian names listed here have been taken from St. John (1973) or Porter (1972).

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name, when known.
3. Biogeographic status. The following symbols are used.
   E = endemic (found only in Hawai‘i).
   I = indigenous (native to Hawai‘i as well as other geographic areas).
   P = Polynesian introduction (introduced to Hawai‘i by Polynesians before the advent of the Europeans).
   X = Introduced or alien (not native, introduced to Hawai‘i, either accidentally or intentionally, after the advent of the Europeans).

Species	Common Names	Status[1]
MONOCOTS		
AGAVACEAE (Agave Family)		
Cordyline fruticosa (L.) A. Chev.	ti, ki	P
COMMELINACEAE (Spiderwort Family)		
Commelina benghalensis L.	hairy honohono	X
POACEAE (Grass Family)		
Cenchrus ciliaris L.	Buffelgrass	X
Chloris barbata (L.) Sw.	swollen fingergrass	X
Cynodon dactylon (L.) Pers.	Bermuda grass	X
Eragrostis cilianensis (All.) Link	stink grass	X
Panicum maximum Jacq.	Guinea grass	X
Sporobolus diander (Retz.) P.Beauv.	Indian dropseed	X
	DICOTS	
ACANTHACEAE (Acanthus Family)		
Asystasia gangetica (L.) T. Anderson	Chinese violet	X
Barleria cristata L.	Philippine violet	X
AMARANTHACEAE (Amaranth Family)		
Achyranthes aspera L.	----------	X
ARALIACEAE		
Schefflera actinophylla (Endl.) Harms	octopus tree	X
ASCLEPIADACEAE (Milkweed Family)		
Cryptostegia grandiflora Roxb. ex Br.	panay rubber vine	X
Stapelia gigantea N.E. Brown	carrion flower	X

Species	Common Names	Status[1]
ASTERACEAE (Sunflower Family)		
Pluchea indica (L.) Less.	Indian pluchea	X
Verbesina encelioides (Cav.) Benth. & Hook.	golden crownbeard	X
BIGNONIACEAE (Bignonia Family)		
Spathodea campanulata P. Beauv.	African tulip tree	X
BORAGINACEAE (Heliotrope Family)		
Heliotropium curassavicum L.	nena	I
CACTACEAE (Cactus Family)		
Opuntia ficus-indica (L.) Mill.	prickly pear, panini	X
CAPPARACEAE (Caper Family)		
Capparis sandwichiana DC	pua pilo	E
CASSYTHACEAE (Cassytha Family)		
Cassytha filiformis L.	kauna‘oa pehu	I
CLUSIACEAE (Mangosteen Family)		
Clusia rosea Jacq.	autograph tree	X
CONVOLVULACEAE (Morning-Glory Family)		
Ipomoea cairica (L.) Sweet	koali	X
CUCURBITACEAE (Gourd Family)		
Coccinea grandis (L.) Voigt	ivy gourd	X
EUPHORBIACEAE (Spurge Family)		
Chamaesyce hirta (L.) Millsp.	garden spurge	X
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	X
Chamaesyce prostrata (Aiton) Small	prostrate spurge	X
Euphorbia lactea Haw.	milk-stripe spurge	X
Pedilanthus tithymaloides (L.) Poit.	slipper plant	X
FABACEAE (Pea Family)		
Acacia farnesiana (L.) Willd.	klu	X
Erythrina sandwicensis Deg.	wiliwili	E
Glycine wightii (Wight & Arn.) Verdc.	----------	X
Leucaena leucocephala (Lam.) de Wit	koa haole	X
Pithecellobium dulce (Roxb.) Benth.	‘opiuma, Manila tamarind	X
Prosopis pallida (Humb. & Bonpl.ex Willd.) Kunth	kiawe, mesquite	X
LAMIACEAE (Mint Family)		
Ocimum gratissimum L.	wild basil	X
MALVACEAE (Mallow Family)		
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	X
Malvastrum coromandelianum (L.) Garcke	false mallow	X
Sida ciliaris L.	----------	X
Sida fallax Walp.	‘ilima	I
Sida rhombifolia L.	Cuba jute	X

Species	Common Names	Status[1]
MENISPERMACEAE (Moonseed Family)		
Cocculus trilobus (Thunb.) DC.	huehue	I
MORACEAE (Mulberry Family)		
Ficus microcarpa L. f.	Chinese banyan	X
PASSIFLORACEAE (Passionflower Family)		
Passiflora foetida L.	love-in-a-mist	X
PLUMBAGINACEAE (Leadwort Family)		
Plumbago zeylanica L.	‘ilie‘e	I
PORTULACACEAE (Purslane Family)		
Portulaca oleracea L.	common purslane	X
Portulaca pilosa L.	‘ihi	X
RUBIACEAE (Coffee Family)		
Morinda citrifolia L.	Indian mulberry, noni	P
SOLANACEAE (Nightshade Family)		
Solanum seaforthianum Andr.	blue potato-vine	X
STERCULIACEAE (Cacao Family)		
Waltheria indica L.	‘uhaloa	I
VERBENACEAE (Verbena Family)		
Lantana camara L.	lantana	X
Stachytarpheta jamaicensis (L.) Vahl	Jamaica vervain, oi, owi	X

[1]E = endemic; I= Indigenous; X = alien; P = Polynesian introduction.

SUPPLEMENT FOR THE SEPARATE SOUTHWEST PROJECT AREA PARCEL OF THE PROPOSED SOLAR SITE

PREPARED BY TEC INC.

Glenn Metzler, senior biologist with TEC Inc. conducted the endangered plant survey of the noncontiguous southernmost portion of the study area on October 21 using the same methodology as described above for the other proposed project areas. The only exception to the survey methodology was that only a cursory inspection was conducted for the southwestern corner of the parcel (over ½ of the entire parcel) because it has been bulldozed relatively recently and the vegetation there consists entirely of sparse ***koa haole*** and thick Buffelgrass. The area not bulldozed was very similar to the ***kiawe***/***koa haole*** forest vegetation observed on the other project areas that were described above. The species observed on this parcel were all also recorded in the project areas described previously and listed in Table 1 (not all of the species in Table 1 were present) with the exception of one additional plant observed at one location, *Ricinus communis* (castor bean). The only indigenous species observed were *Sida fallax* (***‘ilima***) and *Cassythia filiformis* (**kauna‘oa pehu**). There was minimal area with the combination of ***koa haole*** and ***‘ilima*** and bare rock areas with full sun which comprise the prime habitat for ***‘akoko*** plants in the area. No native ***‘akoko*** plants have ever been reported in this area in the previous surveys that have been conducted or as reported by the Hawaii Biodiversity and Mapping Program, Hawaii DLNR, or USFWS.

PHOTO LOG

Typical somewhat open, primarily koa haole forest with bufflegrass understory vegetation on the western side of the northern project area.

Typical kiawe/koa haole forest with denser overstory on the western side of the northern project area.

Open area where *Chamaesyce* sp. was found; the dead clump of questionable identification is the reddish upright dead plant to the left of the backpack.

Typical sinkhole on the eastern side of the northern project area.

Trees often grow from shallow sinkhole features.

Part of the wiliwili (*Erythrina sandwicensis*) grove with a moderate-sized wiliwili on the left (orange-green bark); non-native trees are intermixed.

Maiapilo (*Capparis sandwichiana*) shrub near a sinkhole entrance.

The bulldozed southwestern part of the southern project area, completely dominated by koa haole and bufflegrass.