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APR 23 2013

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506703

March 20, 2013

Mr. Gary Gill, Acting Director
Office of Environmental Quality Control
Department of Health
State of Hawaii
235 South Beretania Street, Suite 702
Honolulu, Hawaii 96813

RECEIVED
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OFC. OF ENVIRONMENTAL QUALITY CONTROL

Dear Mr. Gill:

SUBJECT: Final Environmental Assessment and FONSI
West Loch Golf Course Drainage Improvements
TMK 9-1-017: 060
Ewa, Oahu, Hawaii

The Department of Design and Construction has determined that a Finding of No Significant Impact is warranted for the subject project. No comments were received during the Draft review process. Please publish notice of availability for this project in the next available OEQC Environmental Notice.

We have enclosed a completed OEQC Publication Form and one (1) copy of the document in pdf format on a CD; and one (1) hardcopy of the Draft EA.

Should there be any questions please contact Daniel Takamatsu, project manager at 768-8384, or email Daniel at dtakamatsu@honolulu.gov. You may also contact Taeyong Kim, the environmental consultant, at 528-4661, or email Taeyong at tkim@environcom.com.

Very truly yours,

for M. Yonamine

Chris T. Takashige, P.E., CCM
Director

CTT:jj

Enclosures

West Loch Golf Course Drainage Improvements

Ewa District, Island of Oahu
Job No. 11-P-14

Final Environmental Assessment

Department of Design and Construction

April 2013

West Loch Golf Course
Drainage Improvements
Ewa District, Island of Oahu
Job No. 11-P-14

Final Environmental Assessment

Prepared Pursuant to Chapter 343, Hawaii Revised Statutes (HRS)
for the Department of Design and Construction, Facilities Division

Notice of availability of this document will be made in the April 23, 2013 issue of the Environmental Notice published by the Office of Environmental Quality Control.

For additional information concerning this document please contact:

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Department of Design and Construction, Facilities Division
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Honolulu, Hawaii 96813
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Appendix A

II. PROJECT SUMMARY

APPLICANT:	City and County of Honolulu Department of Design and Construction Facilities Division 650 South King Street, 11th Floor Kapolei, Hawaii 96813 Contact: Dan Takamatsu (808) 768-8483 Project Manager
ENGINEERING: CONSULTANT	Shimabukuro, Endo & Yoshizaki, Inc. 1126 12th Avenue, Suite 309 Honolulu, Hawaii 96816 Contact: Scott Kunioka (808) 737-1875
ENVIRONMENTAL CONSULTANT:	Environmental Communications, Inc. 1188 Bishop Street, Suite 2210 Honolulu, Hawaii 96813 Contact: Taeyong Kim (808) 528-4661
PROJECT NAME:	West Loch Golf Course Drainage Improvements, Phase I Job No. 11-P-14
PROJECT LOCATION:	West Loch Golf Course 91-1126 Okupe Street Ewa Beach, Ewa, Oahu, Hawaii
TAXMAPKEY/ OWNERSHIP:	9-1-017: 060, City and County of Honolulu 9-1-017: 006, City and County of Honolulu
PROJECT AREA:	9-1-017: 060, 101 acres 9-1-017: 006, 80.2 acres
STATE LAND USE:	Urban, Agriculture
DEVELOPMENT PLAN AREA:	Ewa Development Plan
EXISTING ZONING:	AG-1, P-2, R-5
SPECIAL MANAGEMENT AREA:	Area east (makai) of Fort Weaver Road

	Area west (mauka) of Fort Weaver Road is not in SMA
FLOOD ZONE:	Zone AE, AEF, X, XS
CURRENT LAND USE:	The project site is in use as a municipal golf course that was constructed in 1990 to serve both as a recreational facility and as a flood control project.
PROJECT SCOPE:	The proposed action consists of general drainage improvements located throughout the golf course. Improvements proposed consists of: • Installation of a new culvert beneath the 3rd hole to direct runoff from a spring flow into Honouliuli Stream • Restoration of Honouliuli Stream flow capacity throughout the golf course by means of vegetation and sediment removal • Re-establishment of storage capacity and holding volume of ponds located at the 2nd, 10th and 17th holes by removing thick vegetation and deposited sediment • Construction of a new silt basin near the 6th hole • Regrading of fairway areas at the 2nd, 10th and 11th holes • Replacement of cart path culvert crossings at the 3rd, 9th, 13th, 14th and 18th holes • Lining of stream banks and pond edges
PROJECT COST/PHASING	The estimated construction cost for the project is approximately $5,756,000. The scope of work for the project will be constructed as funds are made available for construction.
PERMITS REQUIRED	-Department of the Army, Section 404 Nationwide Permit for new construction -National Pollutant Discharge Elimination System -Department of Health Section 401 -Dept. of Land and Natural Resources Stream Alteration Permit -City and County of Honolulu Grading Permit -City and County of Honolulu Special Management Permit for culverts located east of Fort Weaver Road.

II. PROPOSED ACTION, ALTERNATIVES AND OBJECTIVES

A. Project Location

The proposed project is located within the West Loch municipal golf course located in Ewa, Oahu, Hawaii. Honouliuli Stream bifurcates the site in the west to east direction and exists into the West Loch of Pearl Harbor immediately to the east of the golf course property. Fort Weaver road also splits the site in the north to south direction. Areas within the golf course that are subject of the proposed project are generally located along Honouliuli Stream with the exception of the 3rd hole ground spring and ponds.

Major landmarks to the north of the project site include the former Hawaii Medical Center West and the West Loch Estates subdivision. Extensive subdivision developments lie further to the south along Fort Weaver Road.

B. Need for Project

The West Loch Golf Course was designed as a recreational facility and a flood control project. The Honouliuli Stream runs through the site and exits immediately to the east, into the West Loch of Pearl Harbor. While the site has served its basic functions, the function as a golf course has been severely impacted by the de-silting function during major storm events for the regional drainage system. The stream flowing through the golf course was designed to carry the flow of a ten (10) year storm. During major storm events greater than the ten-year storm event design capacity, the golf course would flood permitting the silt in the storm water to settle out before flowing into Pearl Harbor.

Areas identified for immediate improvement were identified in a report titled *Golf Course Drainage Assessment Report, Golf Course Improvements at West Loch Golf Course, Ewa, Oahu, Hawaii* prepared by Shimabukuro, Endo & Yoshizaki, Inc. in August of 2008.

According to the *Drainage Assessment*, the first significant flooding of the golf course occurred in 1996 when heavy rainfall cause the Honouliuli Stream to exceed its bank flooding the 2nd hole fairway and storage pond, the 11th hole fairway, and the 10th hole fairway and storage pond. Further down stream the 17th hold pond and the 12th hole fairway were flood damaged. These damages caused the golf course to be shut down for several months for repairs. Since 1996, the golf course has been subject of other flooding events resulting in significant loss of revenues.

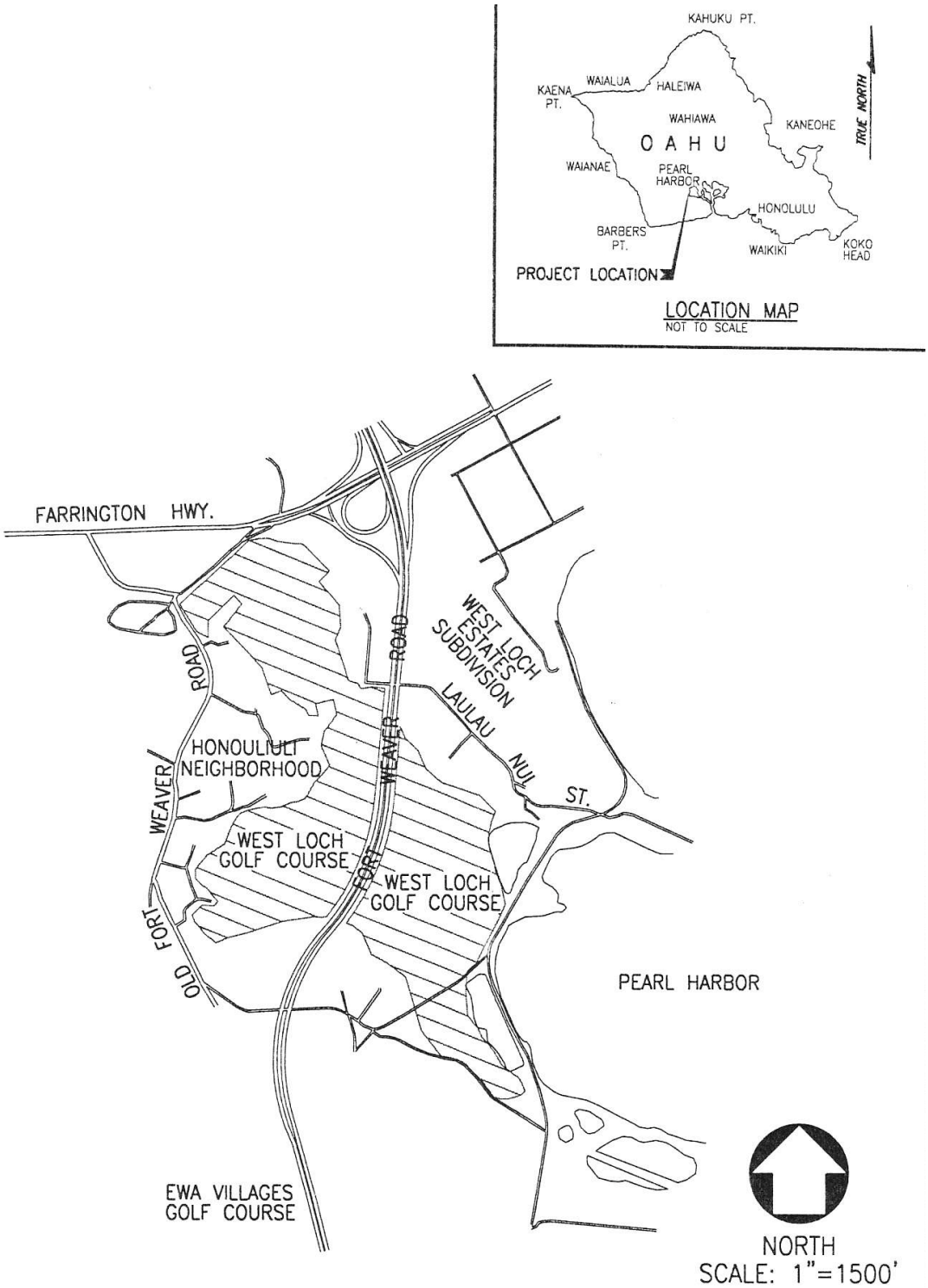

Figure 1: Location Map Source: Shimabukuro, Endo & Yoshizaki, Inc.

Figure 2 General Plan

The proposed improvements will result in better management of water flowing in to the golf course and will reduce maintenance efforts after major storm events and return the golf course to full play in a shorter time.

C. Project Description

The proposed project consists of drainage improvements that will help capture and remove silt from the smaller storm events to maintain the stream capacity for the larger/main storm events, thus reducing the flooding of the golf course fairways and reduce the silt deposition therein. In addition, the replacement of the existing ford crossing type of cart path crossing with freer flowing box culverts will improve the stream flow during the storm events, reducing the deposition of silt within the stream.

The improvements will also accommodate new runoff water emerging from a new ground spring. The specific scope of improvements to be undertaken by this project are described as follows.

C.1. Ground Spring Culvert:

A new 18" pipe drain line is required across the 3rd hole fairway due to a recently emerged ground spring located north of the fairway and flows on the surface across the fairway. An inlet structure, drain pipe, and outlet structure will be constructed to allow the spring water to flow across the fairway and exit into Honouliuli Stream. This system will consist of a concrete invert with wing wall at the inlet, exiting to a concrete outlet structure located at the bank of Honouliuli Stream.

C.2. Restoration and Maintenance of Honouliuli Stream Flow:

Restoration of stream flow will include removal of deposited sediment and thick vegetation from the streambed to its original construction plan profile and cross section. This work will be performed by land based excavator and backhoe and will be a periodic maintenance function.

C.3. Restoration of Ponds:

In addition to the clearing and re-establishment of stream flow in Honouliuli Stream, ponds located at the 2nd hole, 10th hole and 17th hole will be returned to their original design capacity by removal of large vegetation and dredging of sediment removal. Similar to work for clearing Honouliuli Stream, work will be accomplished by land based excavator and backhoe. The interconnecting drain pipes between the stream and ponds will be cleaned of sediment.

C.4. Silt Basin with Inlet and Outlet Structures:

A new silt basin is proposed for the area immediately west of the 6th hole of the golf course. This basin is intended to detain normal and the design storm flow runoff created by areas mauka of Old Fort Weaver Road, and allow the water to be naturally filtered before being released on the golf course and naturally flowing back in to Honouliuli Stream and reduce silting of the stream to improve stream flow during major storm events.

The design stormwater will enter in to the silt basin through a concrete and riprap inlet structure that is located immediately south (makai) of Old Fort Weaver Road. The rectangular shaped basin is able to collect approximately 925 cubic yards of silt that will be periodically removed to allow it to continue its function. At the southern (makai) end of the basin, stormwater will be release by a concrete and riprap lined outlet structure that will feed into Honouliuli Stream. The stream banks immediately around the outlet structure will be lined with riprap for durability and erosion control. The floor of the basin will be lined with concrete to facilitate the removal of accumulated silt while the side slopes will be grassed. The area proposed for the silt basin is presently vacant and covered with natural vegetation.

C.5. Re-grading of Fairways:

The 2nd, 10th and 11th fairways were designed to contain overflow from Honouliuli Stream and the ponds during major storm events. The re-grading planned to contain stream flow and reduce flooding of the fairways and to direct overflow into the pond areas in order to minimize silt and flood damage to the active fairway play areas.

C.6. Culvert Replacement:

An existing ford crossing culvert for the golf cart path crossing over Honouliuli Stream are located at the 3rd hole of the golf course. Presently, the culvert consists of four 72-inch drainpipes that are partially topped by a concrete cart path. This system was designed for storm waters to overflow during major storm flows. It fills with silt and is difficult to clean the pipes resulting in reduced capacity for even the design storm flow.

The proposed replacement structure will be located immediately upstream (north) of the existing culvert but will feature three precast concrete box culverts that will be easier to clear of accumulated silt and better handle normal stream flow and larger storm events. The new culvert will be topped with a concrete golf cart path. Upon completion of the new culvert structure, the old pipe culvert and cart path will be removed.

Construction activities include but are not limited to the demolition and removal of the original pipe culvert, installation of best management practices (BMP), clearing and grubbing, excavation, grading, installation of erosion control measures.

Upon completion, the proposed action will have minimal impact to the existing stream and allows ease of clearing accumulated silt by normal maintenance efforts. Better stream flow will be achieved by the free flowing box culverts, and removal of the existing pipe culverts will allow a greater portion of the stream to remain in a natural state.

Other cart path crossings at the 9th, 13th, 14th and 18th holes presently use 60" CMP pipe culverts. In order to provide clear stream crossings, it is proposed that the existing pipe culverts be replaced with large box culverts of increased capacity.

C.7. Lining of Stream Banks and Pond Edges:

In order to minimize vegetation along the stream banks and along the pond edges, it is proposed that HDPE liners or erosion control fabrics be installed. These liners would provide barriers that would minimize vegetation from growing and still provide erosion protection. Liners will also reduce the amount of maintenance required from golf course staff.

D. Other Alternatives Considered

No alternatives other than the proposed scope of work were considered. Non-action was not considered an alternative as stream clearance maintenance and silt removal is a design requirement of the golf course as a function of the regional drainage system.

E. Project Objective

The proposed project will involve the construction of improvements that will improve maintenance functions and mitigate the flooding conditions at the West Loch Golf Course. It is the objective of the proposing agency to reduce the time and work to restore the golf course for use after a major storm event. It is the project objective to ensure that flood waters are properly treated and released into the downstream section of the drainage system, while reducing the down time after a major storm event to restore the affected portions of the course.

Figure 3: Inlet Structure and Silt Basin Plan

Figure 4: Silt Basin Outlet Structure

Figure 5: Silt Basin Section 1

Figure 6: Silt Basin Section 2

Figure 7: Silt Basin Section 3

Figure 8: Culvert Crossing Plan

Figure 9: Culvert Section

Figure 10: Ground Spring Culvert

III. DECRIPTION OF ANTICIPATED IMPACTS AND MITIGATION

A. Environmental Setting

The project site is located within the West Loch Golf Course and the surrounding West Loch residential subdivision areas. Typical of golf courses, the site consists of maintained grass areas, ponds serving as drainage basins and landscape features, many existing and introduced trees, and other landscape vegetation.

The golf course is bifurcated by Fort Weaver Road that runs in the north/south direction. Honouliuli Stream also traverses the golf course and ultimately exits the golf course directly into the West Loch of Pearl Harbor.

The site is characterized by its open, spacious play areas and undulating grounds found in the northerly direction.

B. Surrounding Uses

Surrounding uses are primarily detached single-family and low-density multifamily dwellings located on similarly sized parcels serviced by county standard streets and infrastructure. The area is commonly referred to as the West Loch subdivision. The former Hawaii Medical Center West and Kahi Mohala Health Center lie to the north while Pearl Harbor lies to the east. Farther to the south lie several new subdivision developments and golf courses.

No adjacent properties will be affected by the proposed action.

C. Environmental Considerations

1. Geological Characteristics

<u>Topography</u>

The West Loch Golf Course consists of various topographies which vary at each hole. The specific topographies of the proposed project improvement areas are generally flat with negligible grade differentials. The proposed culvert improvements are located at shallow portions of the Honouliuli Stream. Surrounding areas are relatively flat and grassed with turf. The stream banks are naturally vegetated. The waterway is unlined and consists of silt and grass. The ground spring improvement area is flat and grassed.

The proposed silt basin area by the 6th hole also consists of flat vacant lands that are covered in field grass with no significant or notable topographic features.

Climate

While Hawaii is generally characterized as being temperate, the geography of the Ewa District is notable for its temperate to dry climate. Rainfall in the project area is slightly lower in comparison with other regions on Oahu. Prevailing trade winds flow from the northeasterly direction.

According to the Atlas of Hawaii, Third Edition, the project typically experiences 40 inches of rainfall annually. Average mean temperatures in district range from mean highs between 75 and 85 degrees to mean lows between 62 and 67 degrees Fahrenheit.

USDA Soil Survey Report

According Sheet Number 44 of the Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii by the US Department of Agriculture Soil Conservation Service, the project site is located on soils classified as Ph Pearl Harbor clay (Figure 11). This series consists of very poorly drained soils located on nearly level coastal plains. Runoff is slow and erosion hazard is considered slight.

Detailed Land Classification

The project site is classified by the University of Hawaii Land Study Bureau as land type Urban on panel 207 of the Detailed Land Classification-Island of Oahu report. This land type is generally characterized by moderately productive, non-stony lands with deep, expanding soils. These lands are not considered agriculturally significant according to this study.

2. Water Resources

The Honouliuli Stream does not does not serve as a water source of any agricultural activity downstream of the project site, however, the stream does serve as a natural drainage source for the area. The stream ultimately flows into West Loch of Pearl Harbor.

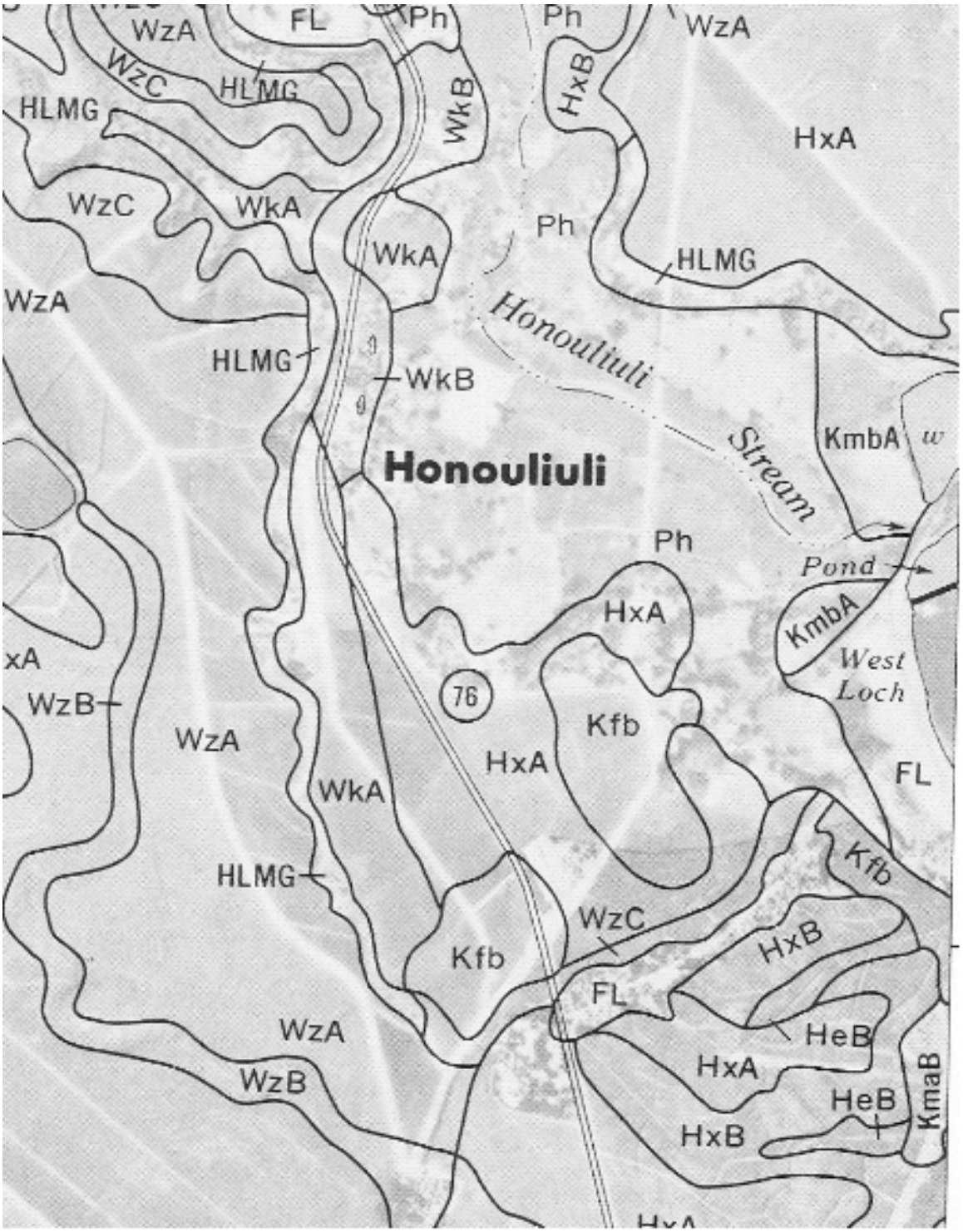

Figure 11: Soils Source: USDA Soil Conservation Service

Hydrologic Hazards and Resources

According to Panel 0310G of the Federal Emergency Management Agency Flood Insurance Rate Map, the project site is located in Zones AE, AEF, X, XS, areas where base elevations have been determined.

The project site is also not identified as an area subject to tsunami evacuation hazard according to the Oahu Civil Defense Agency Maps and the Department of Planning and Permitting.

Special Management Area

The makai portion of the project site is located within the Special Management Area (SMA).

Wetlands

Areas around the stream are not presently designated as wetlands and the surrounding areas remain in active golf course use. Wetlands often serve as a natural habitat for various species of flora and fauna and are regulated by the U.S. Army Corps of Engineers. A determination of wetlands status will be requested from the Corps of Engineers.

The proposed improvements have been designed to protect the surrounding areas and all of the proposed improvements are located beyond tidally influenced waters.

3. Archaeological, Cultural, Botanical and Faunal Resources

Archaeological Resources

A survey of archaeological resources in the project area was conducted by Paul H. Rosendahl, Ph.D., Inc. for the golf course in 1987. The report can be found in its entirety in Appendix A.

The report identified several sites that were considered important for information value and or cultural value. In general, all of these sites were located makai of Fort Weaver Road and will not be impacted by the proposed improvements. Recommendations and remediation measures made in the archaeological report were subsequently implemented.

Cultural Resources

Historic land uses within the West Loch Estates area were researched by Carol L. Silva as part of the Archaeological Assessment included as Appendix A. Research

conducted by Silva indicated that little documentation exists of the Ewa Plain area. While some anecdotal information referencing the Ewa area was found, it did not appear that any references were related to the project site.

Prior to the development of the West Loch Golf Course, the area had been active agricultural production for many years. The golf course has also been in use for over two decades and no cultural sites or practices occur on the golf course property.

Flora

The project site contains a mix of landscaped areas and natural growth. As a golf course, the site is predominantly covered with well-maintained turf that covers all golf holes. . Various trees, such as monkey pod, African tulip, kiawe and coconut are found throughout the site. Areas that are not landscaped near the golf course borders include: California grass, kukui, African tulip, and various weedy species. No rare or endangered species were observed in the area.

Fauna

Based on on-site observation, the only aquatic wildlife noted were guppies and tadpoles. Crayfish, bullfrogs and toads may also inhabit the stream and bank area but none were observed during the field inspections. No rare or endangered species were found in the stream.

4. Infrastructure and Utilities

The proposed improvements are not expected to have a significant negative impact on existing infrastructure. The project is expected to result in the improvement of the existing storm drainage conditions. Public safety will also be improved by providing a large buffer adjacent to the stream, ensuring that no damage will occur to surrounding residential properties.

Vehicular Access and Traffic Conditions

No significant off-site traffic impacts are expected as a result of the proposed improvements. Traffic conditions are not expected to be impacted as a result of the implementation of the proposed improvements.

Noise and Air Quality

Noise and air quality impacts resulting from the development of the proposed project can be assessed in two categories, short-term construction related impacts and long-term operational related impacts.

Construction of the proposed improvements will result in an increase in noise levels and a degradation of air quality. The primary noise impacts occurring during the construction period will from construction vehicles. Typically bulldozers, dump trucks and air hammers will be used in the site preparation process. The operation of these heavy machinery vehicles are subject to State Department of Health Community Noise Standards however it must be acknowledged that during the construction period, noise levels in the project vicinity will increase.

No increase in noise levels is anticipated from the proposed improvements.

Water

The proposed improvements will not affect water service demand.

Wastewater

The proposed improvements will not increase wastewater demand.

Drainage

The primary purpose of the proposed project is to improve drainage within the golf course. This will be accomplished by implementing the improvements explained in the project description.

The proposed silt basin located adjacent to the 6th hole of the golf course will slow and filter waters from Honouliuli Stream immediately after stream waters enter the golf course property. Waters will then be release back in to the stream and will eventually reach the proposed 3rd hole culvert and crossing improvements. These improvements will allow for a better flow of stream waters which will prevent flooding of the area. Lastly, a new ground spring drain line will allow newly emerging spring waters along the 3rd hole to be diverted by an underground pipe.

Solid Waste

Solid waste disposal systems will not be affected by the proposed improvements.

Telephone and Electrical Services

No telephone or electrical services will be affected by proposed project.

5. Public Facilities

The proposed project will not have any impact on public facilities including schools, police, and fire or emergency medical services.

The Waipahu Fire Station serves the project area. This station includes a pumper engine and a quint and provides fire protection and first response emergency to the project area. Additional fire support is available from the Ewa Beach Fire Station which will soon be replaced by a new station located in the Ewa Marina subdivision. Response time to the sites is less than 5 minutes. An engine truck serves this station.

Ambulance service for the project vicinity is co-located at Waipahu Fire Station with back up service provided by the Makakilo Unit located in Kapolei.

Police service is provided by the Honolulu Police Department's District 3, Sector 1, Beat 360. The district main station is located at 1100 Waimano Home Road in Pearl City.

D. Social and Economic Characteristics

The proposed improvements will not have direct impact on the social and economic characteristics of the environment; however, the improvements are critical to the preservation of the golf course as a recreational facility. The West Loch Golf Course is a municipal facility that is available to all residents and visitors of Hawaii. As such, it contributes to the social welfare of the City and County of Honolulu by providing a valued recreation resource at a reasonable cost.

The project itself will generate income to the City and County of Honolulu and State of Hawaii by providing an improved recreational resource, through the purchase of goods and services related to the construction activities, and through secondary and tertiary spending and tax revenues.

E. Relationship to Plans, Codes and Ordinances

1. Federal Plans and Approvals

Work within streams and wetlands generally fall under the jurisdiction of the Department of the Army. Work within Honouliuli Stream may require a Department of the Army (DA) 404-Nationwide Permit. This determination is pending with the Department of the Army Corps of Engineers.

2. State of Hawaii Plans and Approvals

Project site is located with the Urban and Agriculture Districts on the State Land Use Map. The proposed use is consistent with these designations and no approval from the State Land Use Commission will be required.

The project may require a Stream Channel Alteration Permit (SCAP) from the Department of Land and Natural Resources Commission on Water Resource Management. This permit is required whenever work occurs within a perennial stream.

The State Department of Health also will require Section 401 Water Quality Certification which runs in parallel with the DA-Nationwide Permit. In addition, a National Pollutant Discharge Elimination System (NPDES) approval will be required for any disturbances greater than one acre.

3. City and County of Honolulu Plans and Approvals

Zoning for the project area is AG-1, P-2 and R-5 Residential. The proposed action will not require any change in zoning.

The project area is also subject to the Ewa Development Plan. The following section 3.1.4.7 of the plan summarizes the conformance of the proposed action with the general policies pertaining to golf courses.

- Golf courses should be located and designed to optimize their function as drainage retention areas.

- Golf courses should be designed to provide view amenities for adjacent urban areas, including pubic rights-of-way.

- When screening is necessary for safety reasons, landscape treatment, setbacks and modifications to the course layout should be used rather than fencing or solid barriers.

With regard to the general policies of the Ewa Development Plan, the proposed improvements are consistent and further promote these objectives by improving the function of the golf course as a drainage retention area.

Portions of project parcel 9-1-017: 006 are located within the Special Management Area (SMA) boundaries and will be subject to a Special Management Area Permit (SMP). Improvements subject to this permit are the three replacement culverts located makai of Fort Weaver Road.

The proposed improvements will require grading permits from the City and County of Honolulu, Department of Planning and Permitting. Work on the

proposed improvements will not commence until the demolition and grading permits and the environmental assessment process are completed.

F. Probable Impact on the Environment

The proposed action will result in long-term benefit to the environment. The proposed basin improvement is located in an unused portion of the golf course. Topographically, the site will change with the addition of the basin, but this will not be noticeable to area residents or players. This addition will improve water quality down stream by filtering design peak flow waters before they are returned into Honouliuli Stream. The result will be cleaner water flowing through the course during design storm conditions, and ultimately, cleaner waters entering Pearl Harbor.

The culvert replacements will also allow for greater stream flow beneath the crossing and will result in less silting upstream of the crossing structure.

The ground spring diversion pipe will significantly improve play within the 3rd hole area of the golf course by alleviating muddy conditions around the ground spring fissure and fairway.

Restoration and maintenance of the stream and ponds will significantly reduce flood damage to the active play areas of the golf course while additional grading and lining of the streams and ponds will ensure that design storm waters are retained within the stream and pond system.

G. Adverse Impacts Which Cannot be Avoided

Adverse impacts that cannot be avoided are generally related to short-term construction activities. These impacts can be minimized by sound construction practices, adherence to applicable construction regulations as prescribed by the Department of Health, and coordination with applicable State and County agencies.

H. Alternatives to the Proposed Action

No alternatives were considered other than the no action alternative. Non-action was not considered as an alternative as this would allow a hazardous condition to continue.

I. Mitigation Measures

Long-term impacts resulting from the proposed improvements will ensure that normal stormwater drainage conveyed through the Honouliuli Stream will have minimal impact to public safety or property. When the improvements are completed in conjunction with routine maintenance of the downstream portions of the stream, the drainage system for the area will operate optimally for the benefit of the golf course use with reduced impact during major storm events.

Short-term construction related noise and air quality impact mitigation measures include general good housekeeping practices and scheduled maintenance to avoid a prolonged construction period. The contractor will be directed to use best management practices (BMP) wherever applicable.

Examples of BMPs that may be implemented include silt fences, stabilized construction entrances, inlet protection, surface covering, and sediment traps. All waste materials will be securely contained and appropriately disposed.

The project contractor will be directed to comply with the rules relating to the Guidelines and Rules Relating to Storm Drainage Standards. The BMPs that will be specified for the project include: filters that will be monitored for adequate screening of debris into the waterway, silt fencing and dust screening, installation of temporary access points, site inspection and clean up of accumulated debris.

J. Irreversible and Irretrievable Commitment of Resources

Implementation of the proposed project will result in the irreversible and irretrievable commitment of resources in the use of non-recyclable energy expenditure and labor. Materials used for new construction may have salvage value; however, it is unlikely that such efforts will be cost-effective. The expenditure of these resources is offset by gains in construction-related wages, increased tax base and tertiary spending.

IV. DETERMINATION

1. Finding of No Significant Impact (FONSI).

   Pursuant to Hawaii Administrative Rules Title 11 Chapter 200, the City and County of Honolulu Department of Design and Construction has determined that the proposed action will not have a significant impact upon the environment that a Finding of No Significant Impact is warranted and is issued for the project.

2. Evaluation of Significance Criteria.

   The project impacts have been evaluated against the 13 significance criteria contained in Section 11-200-12 of the Hawaii Administrative Rules. The following numbered items cite each of the 13 particular significance criteria then provide the Department of Design and Construction's evaluation for the criteria.

   <u>Involves an irrevocable commitment to loss or destruction of any natural or cultural resources.</u>

   The project does not involve an irrevocable commitment to loss or destruction of any natural or cultural resources.

   Archaeological and cultural assessments were conducted for the golf course project have determined that the project will not significantly affect any cultural practices. A copy of the studies is contained in Appendix A.

   The project will not cause significant negative impact upon botanical resources.

   <u>Curtails the range of beneficial uses of the environment.</u>

   When completed, the drainage improvements not curtail, cart vehicle, and pedestrian safety. The project, will in effect, improve pedestrian and cart vehicular safety by providing a culvert crossing that is safe and not subject to flooding. The drainage improvements will also allow for improved golf play and will minimize repair efforts caused by storm events.

   When completed, the drainage improvements will not cause significant negative impact to adjacent areas and will improve the recreational characteristics of the site.

   <u>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.</u>

The project does not conflict with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS nor with any revisions thereof and amendments thereto, court decisions, or executive orders.

- In brief, the State's environmental policy is to conserve the natural resources and enhance the quality of life. The project is consistent with this environmental policy in that the project: (a) Has examined whether the project causes impacts to natural, cultural, or historic resources; (b) Has determined that the project does not cause any significant negative impact to such natural, cultural, or historic resources, and; (c) Will enhance the quality of life by protecting public property and a valued municipal service through construction of drainage system improvements.

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

The project will affect the economic or social welfare of the community or the State.

- The project will decrease the amount of financial and human resources required to repair flood damage prone areas of the golf course. Decreased repair times will allow for golf play to resume faster after heavy rain events.

- The project is a localized safety improvement project which will create limited temporary construction employment, but generally has insubstantial effect upon economic or social welfare.

- The project has no effect upon potential development, land use policies, and social programs in the existing community.

Substantially affects public health.

The project positively affects public health and safety.

- Public safety will be significantly increased by the proposed drainage improvements. The proposed improvements will decrease the amount of flood damage that may occur on the golf course along the Honouliuli Stream areas. The culvert crossing will be the most directly improved area. By increasing the flow capacity of the culvert, the crossing will be less prone to overtopping allowing pedestrians and cart vehicles to cross safely.

- Homes along Honouliuli Stream will be provided a greater level of safety from flooding and associated damage with the proposed improvements.

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

The project does not involve substantial secondary impacts, such as population changes or effects upon public facilities.

- The project is a localized health and safety improvement project.

- The proposed project does not cause population increases, nor will it negatively affect public facilities, or other substantial secondary impacts.

Involves a substantial degradation of environmental quality.

The project does not involve a substantial degradation of environmental quality.

- The project is in effect, an environmental improvement. Construction of the proposed improvements and restored drainage way will create a natural habitat in addition to providing increased public safety.

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

The project does not have a cumulative considerable effect on the environment and does not involve a commitment for larger actions.

- The temporary noise, dust, and traffic impacts generated by the construction activities are not anticipated to have a considerable effect upon the environment. These temporary impacts will cease when the construction is completed.

- The project is a localized property protection and maintenance project and does not commit larger actions.

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

The project does not substantially affect any rare, threatened, or endangered species, or its habitat.

Detrimentally affects air or water quality or ambient noise levels.

The project positively affect air or water quality or ambient noise levels.

- The project is not anticipated to cause detrimental effects to air quality. The construction activities are not anticipated to cause significant dust or other aerial emissions. Dust control measures will be implemented to minimize dust emissions. Construction machinery will be properly equipped and maintained to minimize exhaust emissions.

- The project will positively affect water quality in the long-term. Proposed project improvements will detain and filter design storm flows of Honouliuli Stream and consequently, result in better water quality with less soil washing into the stream.

- The project is not anticipated to cause detrimental effects to ambient noise levels. The construction activities will increase noise levels but these impacts are short-term. The long-term impact of the project will result in a net decrease in noise levels due to the reduction of restoration activity after major storm events.

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 an environmental improvement that will ensure improved water quality as well as public safety. Use of the site for natural drainage and open space use will increase while simultaneously ensuring that flood damage to the golf course as a recreational resource is minimized.

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

The project does not substantially affect scenic vistas or view planes.

- The project location is not identified within County or State plans or studies for scenic vistas or view planes.

Requires substantial energy consumption.

The project does not require substantial energy consumption.

- The project construction does not require substantial amounts of energy for the construction activities and will have minimal effect upon energy consumption.

V. LIST OF PARTIES CONSULTED DURING THE PREPARATION OF THE DRAFT ENVIRONMENTAL ASSESSMENT

Federal Agencies

- U.S. Army Corps of Engineers

State of Hawaii

- State Historic Preservation Division, DLNR
- Department of Transportation

City and County of Honolulu

- Department of Design and Construction
- Department of Environmental Services
- Department of Facilities Maintenance
- Department of Planning and Permitting
- Honolulu Fire Department
- Honolulu Police Department

V. DISTRIBUTION LIST OF PARTIES CONSULTED DURING THE DRAFT ENVIRONMENTAL ASSESSMENT REVIEW PROCESS

	Date of Comments
Federal Agencies	
• U.S. Army Corps of Engineers	None
State of Hawaii	
3. State Historic Preservation Division, DLNR	None
4. Department of Land and Natural Resources	None
City and County of Honolulu	
5. Department of Design and Construction	Proposing Agency
6. Department of Environmental Services	None
• Department of Facilities Maintenance	None
7. Department of Planning and Permitting	None
• Honolulu Fire Department	None
• Honolulu Police Department	None

Appendix A

PAUL H. ROSENDAHL, Ph.D., Inc.
Consulting Archaeologist

Report 322-102887

ARCHAEOLOGICAL RECONNAISSANCE SURVEY FOR ENVIRONMENTAL IMPACT STATEMENT

WEST LOCH ESTATES - GOLF COURSE AND PARKS

Land of Honouliuli

Ewa District, Island of Oahu

December 1987

305 Mohouli Street • Hilo, Hawaii 96720 • (808) 969-1763 or 966-8038

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WEST LOCH ESTATES - GOLF COURSE AND PARKS

Land of Honouliuli
Ewa District, Island of Oahu

by

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Principal Archaeologist

Prepared for

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Suite 411, 420 Waiakamilo Road
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December 1987

305 Mohouli Street • Hilo, Hawaii 96720 • (808) 969-1763 or 966-8038

SUMMARY

A study of archaeological resources within the approximately 216 ac West Loch Estates - Golf Course and Parks Project area in the Land of Honouliuli, Ewa District, Island of Oahu, was conducted by Paul H. Rosendahl, Ph.D., Inc. (PHRI) during the period October-December 1987. The work was done at the request of the R.M. Towill Corporation (RMTC) for their client, the City and County of Honolulu (CCHONO). The study of the project area included the determination of the presence or absence of archaeological remains within the project boundaries.

On-site field investigation included field survey, shallow subsurface testing by hand tools, and deep subsurface testing by machine auger and backhoe trenching to determine the existence and extent of cultural remains. From the subsurface testing, sample materials were collected for radiocarbon and volcanic glass dating, and for pollen analysis. In addition to field work, historical documentary research was conducted to assist in the identification and interpretation of archaeological remains. Local informants were also interviewed for additional information.

Seven sites were identified during the field studies. These sites include both historic and prehistoric habitation and burial sites situated on Hoaeae Point and on the slopes and uplands surrounding the Honouliuli Stream floodplain. Sites also include the remnants of a once extensive agricultural system which combined aquaculture in fishponds situated on the shores of West Loch, irrigated pondfield cropping of the floodplain, and dryland cultivation of the surrounding slopes and uplands. The historic and prehistoric habitation sites consist of both surface and subsurface deposits containing artifacts and midden. Agricultural use of the Honouliuli Stream floodplain may have begun as early as c. AD 1000, and continuing up to recent times.

Based on the findings of the archaeological study, the significance of cultural remains identified within the project area was assessed. Four of the identified sites (Sites 3318, 3320, 3322, 3324) were determined to be significant for their information content only. Two of the identified sites (Sites 3319, 3321) were determined to be significant both for their information content and for their cultural value because of the presence of one or more human burials. One site (Site 3323) was determined to be significant both for its information content, and as a good example of a site type.

Appropriate mitigation for Sites 3318, 3320, 3322, and 3324 would involve variable degrees of further data collection (intensive survey level detailed recording and test excavations) and possibly subsequent data recovery excavations. For Sites 3319 and 3321, appropriate mitigation would involve either continued in-place protection (preservation "as is"), or disinterment of skeletal remains according to current State Health Department regulations and procedures. Appropriate mitigation for Site 3323 would involve some degree of further data collection (including historical documentary and local informant research) and continued preservation with some level of interpretive development.

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INTRODUCTION

BACKGROUND

At the request of the R.H. Towill Corporation (RMTC), acting for their client, the City and County of Honolulu (CCHONO), the firm of Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted a combined surface and subsurface archaeological reconnaissance survey of the approximately 216 ac West Loch Estates - Golf Course and Parks project area in the Land of Honouliuli, Ewa District, Island of Oahu. The primary objective of this survey was to provide information--concerning the presence or absence of any sites or features of possible archaeological significance within the project area limits--both appropriate to and sufficient for an Environmental Impact Statement (EIS) being prepared in accordance with Chapter 343-Haw. Rev. Stat. and in anticipation of a Land Use Boundary District Amendment petition to be submitted to the State Land Use Commission.

Field work was carried out September 8-October 23, 1987, under the supervision of PHRI Supervisory Archaeologist A. Merrill Dicks (Project Field Director), and the overall direction of PHRI Principal Archaeologist Dr. Paul H. Rosendahl (Principal Investigator). Both surface and subsurface reconnaissance surveys and limited subsurface testing were conducted. On October 21, 1987, Dr. Rosendahl and Mr. Dicks met on-site with Dr. Ross Cordy, chief archaeologist with the State Department of Land and Natural Resources-Historic Sites Section (DLNR-HSS), for a field inspection and discussion of worked completed. On November 13, 1987, Dr. Rosendahl presented an informal summary of field work findings and preliminary conclusions to representatives of RMTC and CCHONO. On December 8, 1987, a more detailed summary was given by Dr. Rosendahl, with the support of RMTC and CCHONO representatives, to DLNR-HSS chief archaeologist Dr. Cordy and Dr. Joyce Bath, DLNR-HSS staff archaeologist for Oahu. In the course of the latter meeting, both Dr. Cordy and Dr. Bath concurred with the general significance assessments made and general mitigation treatments recommended for the archaeological remains identified within the project area. The present report constitutes the final report on the combined surface and subsurface reconnaissance survey of the West Loch Estates - Golf Course and Parks project area.

SCOPE OF WORK

The basic goal of the combined surface and subsurface reconnaissance survey was to identify--to discover and locate on available maps--all sites and features of possible archaeological significance. A reconnaissance survey comprises the initial level of archaeological investigation. It is extensive rather than intensive in scope, and is conducted basically to determine the presence or absence of archaeological resources within a

specified project area. A reconnaissance survey indicates both the general nature and variety of archaeological remains present, and the general distribution and density of such remains. A reconnaissance survey permits a general significance assessment of archaeological resources, and facilitates the formulation of realistic recommendations and estimates for such further archaeological work as might be necessary or appropriate. Such further work could include intensive survey--further data collection involving detailed recording of sites and features, and selected test excavations; and possibly subsequent mitigation--data recovery research excavations, interpretive planning and development, and/or preservation of sites and features with significant scientific research, interpretive, and/or cultural values.

The principal objectives of the combined reconnaissance survey of the West Loch Estates - Golf Course and Parks project area were four-fold: (a) to identify (find and locate) all sites and site complexes present within the project area; (b) to evaluate the potential significance of all identified archaeological remains; (c) to determine the possible impacts of proposed development upon the identified remains; and (d) to define the scope of any subsequent archaeological work that might be necessary or appropriate. Based on a preliminary review of available background literature and records, and on discussions with Mr. Chester Koga of RMTC and with Dr. Cordy and Dr. Bath of DLNR-HSS, the following specific tasks were determined to constitute an adequate scope of work for the combined surface and subsurface reconnaissance survey of the West Loch Estates - Golf Course and Parks project area:

1. Conduct archaeological background and historical documentary research involving (a) review and evaluation of readily available archaeological and historical literature, historic documents and records, and cartographic sources relevant to the immediate project area, and (b) interviews with available knowledgeable local informants;

2. Conduct variable coverage (partial to 100%), variable intensity (30- to 90-ft intervals) ground reconnaissance survey of the project area, with (a) relatively higher-intensity coverage being given to coastal areas, stream drainages, and non-cultivated and otherwise minimally modified lands, and (b) relatively lower-intensity coverage to areas extensively modified by sugar cane cultivation;

3. Conduct sample-coverage subsurface reconnaissance survey of the entire project area by hand and mechanical-powered coring tools, with relative intensity varying as noted in 2.(a,b) above;

4. Conduct limited subsurface reconnaissance testing, by hand tools and/or mechanical backhoe, of selected coastal areas (e.g., suspected fishpond locations), and areas within the inland portion of the project area where coring revealed possible cultural deposits;

5. Analyze background research data and field data (potentially including, but not limited to, sedimentological, palynological, and chronological analyses); and

6. Prepare appropriate reports.

The combined surface and subsurface reconnaissance survey was to be carried out in accordance with the standards for reconnaissance-level survey recommended by the Society for Hawaiian Archaeology (SHA). These standards are currently used by DLNR-HHS/State Historic Preservation Office (SHPO) as guidelines to review and evaluate archaeological reconnaissance survey reports submitted in conjunction with various development permit applications.

The significance of all archaeological remains identified within the project area was to be assessed in terms of the National Register criteria contained in the Code of Federal Regulations (36 CFR Part 60.4). The DLNR-HHS uses these criteria to evaluate eligibility for both the Hawaii State and National Register of Historic Places. To further facilitate management decisions regarding the subsequent treatment of resources, the general significance of all archaeological remains identified during the reconnaissance survey was also to be evaluated in terms of potential scientific research, interpretive, and/or cultural values. Scientific research value refers to the potential of archaeological resources for producing information useful in the understanding of culture history, past lifeways, and cultural processes at the local, regional, and interregional levels of organization. Interpretive value refers to the potential of archaeological resources for public education and recreation. Cultural value refers to the potential of archaeological resources for the preservation and promotion of cultural and ethnic identity and values.

PROJECT AREA DESCRIPTION

The West Loch Estates - Golf Course and Parks project area consists of c. 216 acres in the Land of Honouliuli, Ewa District, Island of Oahu (Figure 1). The project area occupies the lower and upper valley segments of Honouliuli Gulch, which extends from the Waianae Range to the West Loch of Pearl Harbor. Bordering most of the project area is the broad Ewa Plain, an emerged Pleistocene reef of level to gently-sloping dissected terrain. North of the project area is the light-industrial urban area of Waipahu; southward and westward of the project area are large tracts of cultivated and fallow sugarcane fields, and eastward of the project area lies the West Loch of Pearl Harbor. The northwestern extent of the project area is where Honouliuli Stream has down-cut through a line of fossil sea-bluffs.

Honouliuli Gulch, which originates northwest of the project area, is approximately 4.5 miles long. Flowing through the gulch is Honouliuli Stream, which extends from the Waianae Range, crosses the southern end of

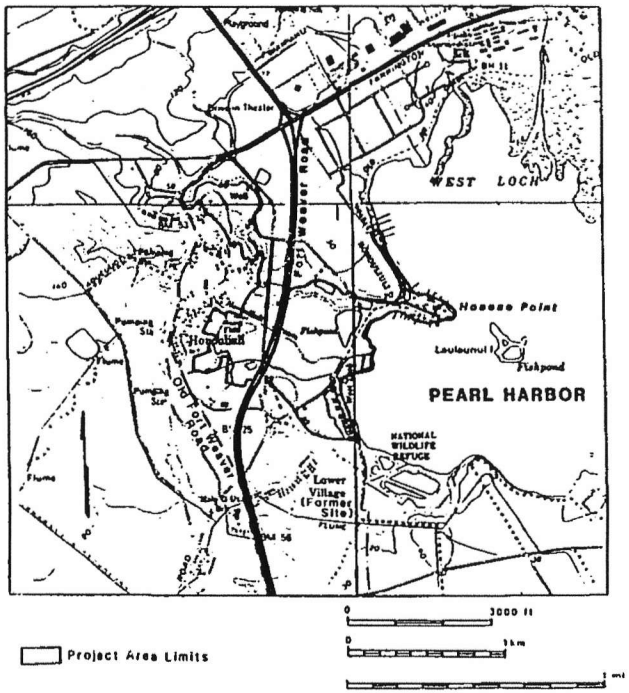

Figure 1.

PROJECT AREA LOCATION MAP

Archaeological Reconnaissance Survey for Environmental Impact Statement
West Loch Estates - Golf Course and Parks
Land of Honouliuli, Ewa District, Island of Oahu

PHRI Project 87-322 October 1987

(Composite map based on current 7.5' series USGS quad maps.)

Schofield Plain and through the Ewa Plain, and finally empties into West Loch. Honouliuli Gulch probably originated during the Pleistocene period, when valley formation by extensive erosional down-cutting coincided with intermittent drops in sea level. In its upper reaches, the gulch is narrow and steep-sided and contains minor expanses of alluvial bottom land. In the Ewa Plain area the gulch widens into a broad valley.

Based on topography and soil pedogenesis, the project area can be divided into three basic sections--an upper valley segment, a lower valley segment, and the upland margins of the Ewa Plain (Figure 2). Except for the Ewa Plain margin segments, terrain in the project area is fairly level. The terrain slopes gradually, from west to east, from one end of the project area to the other. Elevation at the western end, excluding upland margins of the gulch, reaches 35 feet AMSL (above mean sea level). Elevations at upland margins of the gulch range from 15 feet (AMSL) at Hoaeae Peninsula in Survey Area 5, to approximately 75 feet (AMSL) in the western portion of the project area.

The upper and lower valley segments, which can be generally divided along the 10-15 foot (AMSL) contour intervals, undoubtedly reflect environmental trends that occurred in the area--trends which probably remained constant over long periods. The two segments contain major differences in their substrata. The slope gradient of the lower valley segment ranges from 0% to less than 1%--an almost imperceptible gradient. Soils of the lower valley segment are comprised of thick water-saturated muck--a combination of fine alluvial and lacustrine clays, silts, and sands. These soils accumulated gradually, filling in an embayment that once extended from the present margin of West Loch to the line of fossil sea bluffs. The lower valley slope gradient, soil types, and position in the general topography of the area have resulted in very poor drainage, and standing water, the result of a perched water table, is frequently observed in the area.

In contrast, the upper valley segment is well-drained because of its coarse substratum and height above sea level. Narrow and bounded by the gulch walls, this segment is where the gulch intersects the fossil sea bluffs. The substratum in the upper valley is a combination of sands, gravels, cobbles, and boulders--porous Pleistocene deposits which at one time comprised a gravel beach front and talus which the fossil sea bluffs overlooked.

The upland margins of the Ewa Plain are comprised of emerged coral beds which have been overlaid by probable Pleistocene alluvial gravels and clays. Overlying the gravel and clays, and constituting the present soil cover, is a mantle of reddish-brown alluvial and colluvial clays. Where the Ewa Plain meets the margins of Honouliuli Gulch, this clay mantle has eroded away. Although portions of the Ewa Plain outside the project area are somewhat poorly drained, drainage in the plain portion within the project area is generally excellent.

As might be expected, the three designated sections of the project area vary in types of vegetation cover as well as terrain (Figures 3-5).

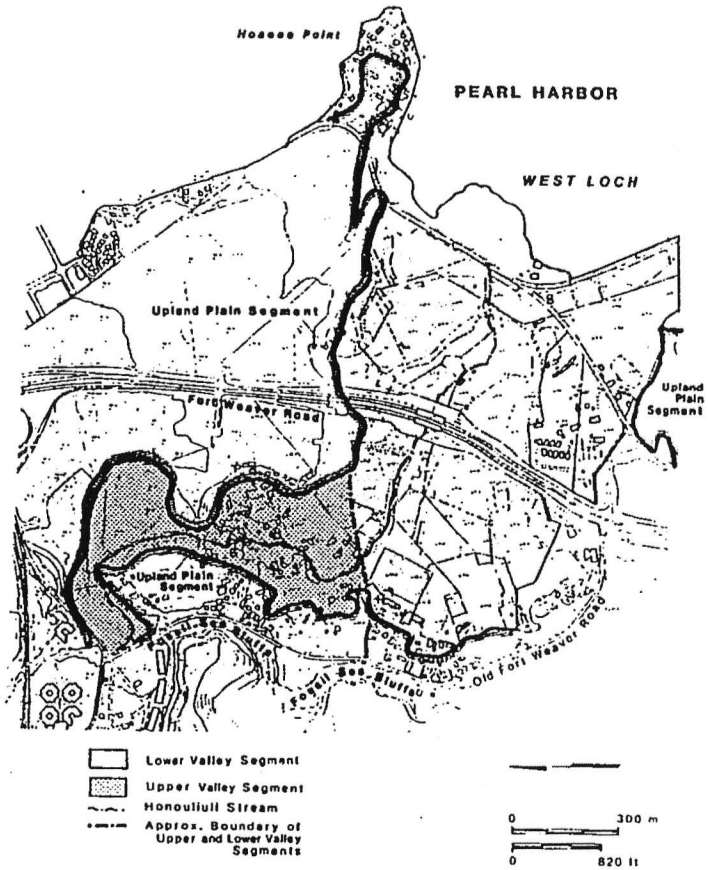

FIGURE 2. SOIL AND TERRAIN DIVISIONS WITHIN THE PROJECT AREA.

Figure 3. GENERAL VIEW OF LOWER VALLEY TERRAIN AND VEGETATION. Honouliuli Stream present along scrub tree line separating Survey Area 1 (foreground) from Survey Area 4 (background). View to ESE. (PHRI Neg.646-22)

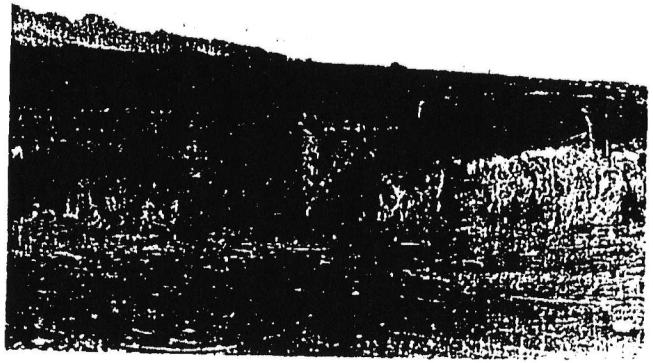

Figure 4. GENERAL VIEW OF UPPER VALLEY TERRAIN AND VEGETATION. View from low bluff overlooking vicinity of Site 3321 in northern portion of Survey Area 2. View to NNW. (PHRI Neg.646-2)

Figure 5. GENERAL VIEW OF UPLAND PLAIN TERRAIN AND VEGETATION. Abandoned sugarcane fields in central portion of Survey Area 2. View to SW. (PHRI Neg.646-4)

In general, vegetation in the lower valley segment is predominantly hydrophytic; as one moves toward the upper valley segment, vegetation becomes increasingly xerophytic. In the upland margins of the Ewa Plain, vegetation is generally xerophytic. Differences in vegetation in the project area is due mainly to drainage differences--drainage largely affects soil development and plant growth. Both individual species and specie associations of vegetation in the project area are generally those of plant husbandry. The landscape of the project area, like much of Oahu since prehistoric times, and especially since Western contact, has been highly modified; present vegetational patterns appear to be wholly unlike prehistoric and early historic period patterns. Over-exploitation and overrazing have drastically affected the landscape.

Small sugarcane (Saccharum sp.) fields are present in the upper valley segment. Within the lower valley segment is a limited amount of pastureland. Along the margins of West Loch, fish ponds have lain fallow for many years. Houses are loosely scattered over the entire project area. Upper elevations of the Ewa Plain are generally dominated by sugarcane; lower elevations are drier and contain kiawe (Prosopis pallida [Humb. and Bonpl. ex Willd.] HBK), koa-haole (Leucaena leucocephala [Lam.] de Wit), and feral sugarcane and other exotic grasses. Shoreline portions of the plain and the lower valley segment are dominated by mangrove (Rhizophora mangle L.) and Californiagrass (Brachiaria mutica [Forsk.] Stapf). (For a more detailed description of the present botanical status of the project area, see Char 1987.)

The extensive land modification in the Land of Honouliuli directly influenced the manner in which archaeological research was conducted in the project area; field work strategies were partly based on the history of land modification in the Land of Honouliuli (Frierson 1972). Extensive historic period modification first took place in 1815-1830, with the harvesting of natural forests on the slopes of the Waianae Mountains; this harvesting initiated wide-scale erosion of the slopes. This erosion was accelerated by the subsequent over-population of the slopes with livestock, and the livestock virtually devastated the natural ground cover. Later in the 1800s, in conjunction with agricultural programs aimed at increasing the fertility of the Ewa Plain, the upland slopes of the Waianae Range were deeply plowed to increase erosion intentionally. As intended, the loosened soil eventually transmigrated to the soil-poor, infertile Ewa Plain. The detrimental effects man-induced erosion had on the environment need not be elaborated on here; what is relevant to the present project is that the translocated soil buried large sections of the pre-historic and early historic landscape of Honouliuli, including the present project area. Buried along with that landscape, of course, were the archaeological remains associated with it.

The translocated soils are particularly extensive in the valley sections of the present project area; constricted by the walls of the valley and by the proximity of the ground surface to sea level, soils appear to have accumulated at a rapid pace. In most valley areas, the overburden is one to three feet thick, and is a hindrance to archaeological survey. Mixed with the overburden are sediments derived from localized slope

erosion and stream activity. In contrast, the upland margins of the Ewa Plain are considerably less affected by soil translocation. The upland plain, due to intensive cultivation (primarily sugarcane) has over the years been in constant transition. The destabilizing effects of this cultivation, coupled with the slope and elevation of the plain, have disrupted translocated soils or removed them at a rate commensurable to the speed at which they accumulate.

PREVIOUS ARCHAEOLOGICAL WORK

Sites previously recorded within and immediately adjacent to the West Loch Estates - Golf Course and Parks project area are listed in Table 1, and their approximate locations are shown on Figure 6. Prior to the present reconnaissance survey, only a single archaeological site had been previously recorded within the project area. During his 1930 survey of Oahu sites for B.P. Bishop Museum, J. Gilbert McAllister described a possible fishing shrine which apparently was situated on the extreme eastern end of Hoaeae Point:

> Site 139. Kalanamaihiki fishing shrine (ko'a) at Kapapuhi, Honouliuli.
>
> Near the end of the small tongue of land that juts out opposite Laulaunui Island in the west loch of Pearl Harbor, are two large rough stones about 2.5 feet in size, with six or seven smooth stones averaging 1 foot in size in a small pile adjoining the larger stones. The entire site is covered with akulikuli (Batis maritima?) and would not be noticed or considered unusual if the Hawaiians did not know of its former sacredness (McAllister 1933:108).

Despite intensive searching of the supposed site location during the present survey, McAllister's fishing shrine site could not be relocated. Several waterworn basalt stones of the general size noted in his description were seen in the vicinity of the apparent site location at the end of Hoaeae Point, but the extensive modern modification of the area (WWII and subsequent) seems to have destroyed whatever McAllister observed in 1930.

McAllister also recorded two other sites in 1930 within the immediate vicinity of the West Loch Estates - Golf Course and Parks project area, a fishpond and a traditional named area:

> Site 140. Fishpond adjoining Laulaunui Island.
>
> The pond is possibly Laulaunui fishpond, and named for the island. It is 4 to 5 acres in extent with a wall approximately 900 feet long, 7 feet wide, and 3.5 feet high. There are no outlet gates (makaha).

Table 1.

LIST OF SITES PREVIOUSLY RECORDED WITHIN AND IMMEDIATELY ADJACENT TO THE WEST LOCH ESTATES - GOLF COURSE AND PARKS PROJECT AREA

HRHP Site 50-80-*	Site Type	Previous Site Designation
13-139	Kalanamaihiki fishing shrine (ko'a)	---
13-140	Fishpond adjoining Laulaunui Island	---
13-141	Kaihuopalaai, Ewa [traditional name for entire West Loch area of Pearl Harbor]	---
13-3314	Midden deposit (?)	T-1[#]
13-3315	Surface artifact collection area	T-2
12-3316	Complex (historic cemetery)	T-3
12-3317	Surface artifact collection area	T-4
12-9714	OR & L (Oahu Railway & Land Co.) Right of Way [National Register Site]	---
13-9992	Pearl Harbor Naval Base [National Register Site]	---

*Hawaii Register of Historic Places (HRHP) site designation system: all site numbers prefixed by 50-80-xx- (50=State of Hawaii, 80=Island of Oahu, xx=12 or 13 [USGS 7.5' series quad map, "Ewa, Oahu" or "Puuloa, Oahu"], three or four digit number=unique Oahu Island site number)

#PHRI Temporary Site Number (Rosendahl 1987)

> Site 141. Kaihuopalaai, Ewa.
>
> This name is said to apply to the whole West Loch of Pearl Harbor. Each year, beginning in October or November, large shoals of mullet are said to go from Pearl Harbor east to Makapuu Point and then north and west to Laie or Malaekahana, from which point they return to Pearl Harbor over the same route in March or April. This is a favorite story which one comes across frequently about the island, and the oral versions are as diverse as those written. Kaihuopalaai is the pond from which the mullet come.
>
> The site is named for Kaihuopalaai, said to be the daughter of Konikonia and his wife Hinaeimalama. Fornander...writes

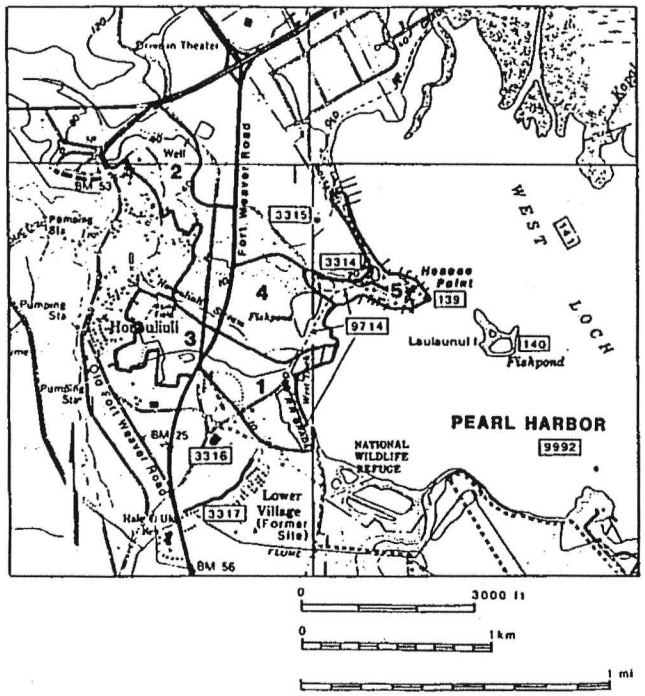

Figure 6.

SURVEY AREAS AND LOCATIONS OF SITES PREVIOUSLY RECORDED WITHIN AND IMMEDIATELY ADJACENT TO THE PROJECT AREA

Archaeological Reconnaissance Survey for Environmental Impact Statement
West Loch Estates - Golf Course and Parks
Land of Honouliuli, Ewa District, Island of Oahu

PHRI Project 87-322 . October 1987

(Composite map based on current 7.5' series USGS quad maps.)

"...on Oahu, Kaihuopalaai saw a goodly man be the name of Kapapapuhi [see Site 139] who was living at Honouliuli, Ewa; she fell in love with him and they were united, so Kaihuopalaai has remained in Ewa to this day. She was changed into that fishpond in which mullet are kept and fattened, and this fish is used for that purpose to this day."

According to old Hawaiians, there never was a fishpond by this name. In another version..., Ihuopalaai is the brother of a woman living in Laie. As the fish were scarce in Laie, this woman sent her husband to Ihuopalaai, who had the mullet follow her husband on his return trip which was made along the shore around Makapuu Point with the mullet following in the water. Makes tells me that Kaihuopalaai's sister was named Malae-kahana. Another story tells of a man who lured the mullet around the island by tossing sweet potatoes into the sea (McAllister 1933:108).

In July-September 1987, four new sites were identified by PHRI immediately adjacent to the present project area during a combined surface and subsurface reconnaissance survey of the West Loch Estates - Residential Increments I and II project area (Rosendahl 1987). The latter project area was found to have been extensively and almost entirely modified by decades of historic period sugarcane cultivation, and only four sites were identified. Three of these sites--Sites 3315 and 3317, surface artifact collection area, and Site 3316, a small cemetery complex--were found to be historic period in age, while the fourth--Site 3316, an exposed midden deposit--was ambiguous as to whether or not it even was a cultural feature. Two of the historic period sites, the cemetery (3316) and the larger surface artifact collection area (3317) appeared to be related to relatively recent sugar plantation occupation, while the third site--the smaller artifact collection area (3315) appeared to date somewhat earlier.

While no sites on the National Register of Historic Places are present within the West Loch Estates - Golf Course and Parks project area, an extension/component of one such site--Site 9714, the OR & L (Oahu Railway & Land Co.) Right of Way--does extend along the entire shoreline portion of the project area. While the portion of the OR & L ROW (railroad grade) which is found within both the present project area and along the seaward side of the previously surveyed Residential Increments I and II project area is not itself a formally identified site, the existing section that extends approximately 13 miles--from the Fort Weaver Road intersection at the southern tip of the Increment II, across the Ewa Plain to the intersection of Farrington Highway and Lualualei Road in Nanakuli, is currently listed on the National Register of Historic Places.

A second National Register site is also situated in the immediate vicinity of the Golf Course and Parks project area. This site, the Pearl Harbor Naval Base (Site 9992), is a large historic district comprised of the three lochs of Pearl Harbor, several islands and islets within the harbor, and various naval facilities along the shoreline.

While very little prior archaeological work has been conducted within or immediately adjacent to the present West Loch Estates - Golf Course and Parks project area, considerable archaeological research has been conducted in recent years in the coral plain portion of the Ewa District extending from Ewa Beach to West Beach, and including the Barbers Point area. This work has been summarized recently in a formal data recovery plan prepared by PHRI in connection with the development of the Ko Olina Resort at West Beach (Davis, Haun, and Rosendahl 1986:10-14).

SUMMARY OF HISTORICAL DOCUMENTARY AND LOCAL INFORMANT RESEARCH

Historical documentary research for the West Loch Estates overall project area was conducted by Historical Researcher Ms. Carol L. Silva, whose report is presented in Appendix A. The intent of Silva's work was to examine readily available mythological, historical, cultural, and early land use data regarding Honouliuli. Included in her report are (a) mythological references to Ewa District, (b) traditional references to the Land of Honouliuli, (c) a historical chronology of the general Honouliuli area, (d) an analysis of early land records specific to the West Loch Estates project area and adjacent portions of Honouliuli Valley, (e) several recommendations for further documentary research, and (f) a bibliography.

There are several mythological and traditional references to the general Honouliuli area. Mythological references to Ewa indicate that Ewa lands were quite visible and that Ewa was a desirable place to live. Gods favored Ewa and thus blessed it with much water and rich soil; crops were plentiful, and with large crops came a sizable population. Ewa was noted as the home of a line of chiefs and also as resort for chiefs. Traditional references to Honouliuli usually connect Honouliuli land forms or places to particular characters or events. For example, Kaihuopalaai, a name assigned to the whole of West Loch, was originally a name for a Honouliuli pond from where mullet would spawn and then swim to Oahu's North Shore. Mentioned in traditional references are Honouliuli heiau, a fishing shrine, and a holua slide.

Silva's historical chronology indicates that Honouliuli was extensively cultivated during its early history. Crops raised in the area included yams, bananas, taro, sweet potato, 'awa, wauke, olona, and mamake. Also in Honouliuli were extensive salt works. The chronology provides a number of capsule descriptions regarding life in Honouliuli--descriptions of the population, agriculture, land use, the development of the Ewa Plantation, James Campbell's Honouliuli Ranch, and various other topics.

Silva's land records for Honouliuli include a comprehensive accounting of land use predating 1850. Records generally indicate that Honouliuli contained numerous houses and many cultivated fields--both irrigated pondfields and dryland areas, and that land in Honouliuli was distributed among a great number of people.

In conclusion, Silva recommends that additional research be conducted. She specifically recommends examining records relating to early churches, cemeteries, schools, and prisons which were situated within Honouliuli at as yet undetermined locations. She also recommends further research on Ewa Plantation and military use of Honouliuli, and the gathering of oral histories from individuals familiar with land use in Honouliuli.

Informal interviews with several knowledgeable local informants were carried out by PHRI Principal Archaeologist Dr. Paul H. Rosendahl, and notes from these sessions are presented in Appendix B. Initial local contacts resulted in a list of numerous potential informants, of whom three were selected on the basis of familiarity with the Honouliuli area and availability. In line with Silva's recommendation concerning the gathering of oral histories, it is apparent that it would probably be productive to consult other individuals from the potential informants list in the future, as well as conducting more formal interviews with the three informants that were visited.

All three informants provided information about 20th century occupation and land use within the project area. Of particular value was the information relating to Hoaeae Point--to the limited pre-WWII habitation, the extensive WWII utilization and modification of the area, and the more recent post-WWII period of occupation--and information relating to the apparent early presence of an old church and associated cemetery on the low ridge just inland of Hoaeae Point, overlooking the OR & L-ROW railroad grade and the fishpond that had been created by the railroad causeway in the early 1890s.

SURVEY METHODS AND PROCEDURES

Field Work

Prior to the reconnaissance survey, the project area was inspected and assessed in order to identify constraints on conducting the survey and to formulate methods and procedures to deal with these constraints. The project area landscape and the potential range of cultural resources that might be encountered in the project area were reviewed and assessed. As indicated by the preliminary findings of the historical documentary research, prehistoric and early historic period habitation sites and agricultural complexes may have once been extensive within Honouliuli Gulch, particularly within a section that includes the present project area. It was expected that these sites and complexes, to a variable extent, along with associated portable cultural materials, had been preserved beneath the overburden of the project area. Field methodology was therefore developed to take into account the buried nature of the remains; e.g., the strategies involved in identifying remains and in retrieving information compatible with the project Scope of Work.

There were several constraints specifically involving terrain in the project area. One constraint concerned access to certain portions covered

by heavy vegetation. Extensive surface and subsurface inspection of these areas would have involved problems concerning access of personnel and machinery--problems beyond the temporal and financial limits of the Scope of Work. For such portions of the project area, limited pedestrian coverage was determined to be adequate. Another problem concerned certain low-lying portions of the project area which had been locally filled; in some portions, the fill was five meters thick. Breaching the fill to reach the original landscape was determined to be similarly outside the bounds of the current Scope of Work. Another major constraint was high subsurface ground water. In some low-lying portions of the project area, ground water was perched only a few inches beneath ground level. This was found to be a major hindrance to subsurface testing, as seeping ground water would rapidly fill test units and cause trench walls to collapse. Other portions of the project area were marshy and often bog-like; such conditions would not constrain pedestrian coverage, but subsurface testing would be limited due to the inability to operate any mechanical powered equipment in such areas.

During the period July 28-September 11, 1987, PHRI conducted--as part of the survey of the West Loch Estates overall project area (including both Residential Increments I and II, and Golf Course and Parks), limited systematic pedestrian coverage and subsurface sampling, and a combination of vehicular coverage and pedestrian point inspections in the present project area. Field work was greatly facilitated by black-and-white aerial photographs of the West Loch Estates overall project area (approx. scale 1"=400'; R.M. Towill, Photos No.8311-3, [5/13/84], and No.8500-4, [7/26/87]) and a blueline topographic map (scale 1"=200', 4-ft contours; R.M. Towill, based on 7/26/87 aerial photograph). Systematic pedestrian coverage concentrated on very limited portions adjacent to several shallow gullies and drainages and portions adjacent to very steep slopes which, on the basis of the aerial photographs and initial field inspection, appeared to have been least modified by sugarcane cultivation and other activities. A combination of vehicular coverage and pedestrian point inspections was used to check accessible locations throughout the project area, primarily to verify the essentially total modification of the project area in recent times by sugarcane cultivation. Subsurface sampling consisted of facing off vertical exposures and digging shovel pits and short trenches into areas suspected to contain cultural deposits. Excavated fill was processed through 0.25-in mesh to facilitate recognition of cultural remains.

All identified sites were assigned sequential temporary field numbers prefixed with "T-." The location of sites were plotted onto a field copy of the 1"=200' scale topographic map. A standard PHRI site survey record form was completed for each site. Where appropriate, sketch maps of sites were drawn. Sites and features were photographed using 35 mm black-and-white film (PHRI Rolls No.639, 640-641, 643-646). Each site, or the primary feature of each site complex, was marked with blue plastic flagging tape and was tagged with an aluminum tag denoting temporary site number, PHRI project number (87-322), the letters "PHRI," and the date.

Between September 8 and October 23, 1987, PHRI conducted surface and subsurface reconnaissance survey and limited site testing within the Golf

Course and Parks portion of the West Loch Estates overall project area. For the reconnaissance survey, the project area was divided into two areas, which were based on topography and probable presence/absence of buried cultural deposits. One area encompassed the upland margins of the Ewa Plain, while the other area encompassed the upper and lower valley segments. At the request of the RMTC, the project area was further subdivided into discrete survey areas; the boundaries of these areas were assigned arbitrarily, as the areas were intended purely for organizational purposes (see Figure 6). Each unit was ascribed a tentative completion date and served as an indicator of field work progress.

Upper and lower valley segments underwent both pedestrian survey and subsurface testing. The pedestrian survey was limited because of the evidence suggesting the original landscape was buried; survey attempted to identify obvious surface features, such as pondfields, fishponds, and historic structures, and included inspection of ravines, erosional banks and gullies, and areas of apparent extensive disturbance. Subsurface testing in the upper and lower valley segments took place in two phases; the objective of the first phase was to gather preliminary data on the presence/absence, nature, and extent of deposits. Using this preliminary data, a second, more intensive subsurface testing program was formulated.

The first phase was accomplished using a mounted power-auger rig. This apparatus consisted of a gasoline-powered auger with detachable four-inch bits mounted on a mobile dolly. The auger could reach to approximately sixteen feet below surface. While ideally it would have been advantageous to conduct the first phase using a horizontal grid system, or designated transects, terrain characteristics rendered such an approach unfeasible. Much of the upper and lower valley terrain is sectioned into small irregular plots by various obstructive natural and cultural features which made systematic sampling essentially impossible. Rather, auger hole tests were placed at a high-density level around obstructions in places accessible by the power rig. Each auger hole test unit was numbered consecutively, with unit numbers prefixed by the number designating the survey area in which it was located (e.g., Auger Hole Unit 2 in Survey Area 3 was designated 3-2). So far as possible, the stratigraphies of individual units were maintained on standardized forms. Bulk soil samples were extracted from appropriate proveniences for further analysis.

The second, more intensive phase of testing involved using a backhoe; the backhoe was used to dig trenches primarily to expose long stratigraphic sections. Backhoe excavation allowed more detailed recording of subsurface stratigraphy and better provenience control when excavating bulk soil samples. The backhoe trench excavations were also intended to delineate in subsurface matrices the boundaries of suspected agricultural fishponds and pondfields. These boundaries were expected to be in the form of earthen and/or stone walls, and dams and terraces.

One primary field task of the second phase was soil sampling in conjunction with detailed recording of soil profiles. Bulk soil samples were recovered for pollen content analysis and radiocarbon age determination analysis. Samples were recovered in vertical columns--ideally, though not

always possible, in 10 cm increments. Vertical provenience was maintained by measurements below ground surface. Samples of subsurface materials from trenches were keyed to the stratigraphic layers from which they came.

Archaeological reconnaissance in the upland margins of the Ewa Plain consisted of a pedestrian survey and subsurface shovel testing. Only a few isolated areas underwent shovel tests; these were mainly areas where vegetation had obscured visibility, thereby necessitating a certain amount of clearing and exposure of the underlying matrix, or where background research had indicated a high probability of buried cultural remains. Shovel testing was deemed unnecessary where sugarcane cultivation had exposed cultural materials at ground surface.

Recording procedures followed a standard format. Recording included photography, scale drawings, site maps, and various standardized forms covering various aspects of the investigations. Identified sites were initially assigned temporary field numbers, and later were assigned permanent Hawaii Register of Historic Places (HRHP) site numbers. Investigations at newly identified sites were limited by the Scope of Work, but surface reconnaissance, shovel unit testing, and backhoe trench testing were intensified in order to produce information sufficient for a preliminary significance assessment of cultural remains. Efforts were made to retrieve basic information on (a) the depth and extent of subsurface deposits, and (b) the nature and integrity of subsurface deposits and cultural remains, and to recover sample materials pertinent to deriving age estimates and cultural affinity.

Post-Field

All materials collected in the field were placed in bags labeled with provenience information and were transported to the PHRI Laboratory at Hilo for appropriate processing and analysis. Artifacts were cleaned and cataloged, and classified according to type and raw material. Scaled drawings and metric and non-metric attributes were recorded onto standard artifact record cards.

The volcanic glass was examined and coded by a trained technician. Absolute age determinations were obtained from volcanic glass hydration-rind measurements and calculations done by MOHLAB of State College, PA.

Analysis of ecofactual samples involved sifting all retained midden through 1/4-inch and 1/8-inch mesh screens. All material retained by the 1/4-inch mesh was completely sorted and identified, while that retained by the 1/8-inch mesh was thoroughly examined for artifacts and faunal remains not present in the 1/4-inch sample.

All shellfish remains were sorted to genera and species, and shellfish weights were recorded by provenience. Vegetal materials were identified to the degree possible, and vertebrate remains when possible were subdivided into class or species. Positive identification of vertebrate remains generally requires an appropriate specialist.

Soil samples were described using standard procedures and terminology set forth in the Soil Survey Manual (Soil Survey Staff 1962). Selected samples were prepared for radiocarbon dating, pollen analysis, and/or qualitative analysis of faunal remains. All samples were preliminarily sorted, weighed, and described in the laboratory prior to submission for analysis. Radiocarbon analysis of charcoal samples was performed by Beta Analytic, Inc. (Coral Gables, FL); pollen identifications was completed by Linda Scott Cummings of PaleoResearch Laboratories (Denver, Colorado); and faunal remains were analyzed in the PHRI laboratory.

FIELD FINDINGS

Archaeological reconnaissance survey and testing in the West Loch Estates - Golf Course and Parks project area was conducted during the period September 8-October 23, 1987 by a crew two to eight persons. The survey and testing included (a) intensive pedestrian survey, (b) test excavation and recording of 176 auger hole units, 81 backhoe trenches, and 98 shovel units, (c) more detailed recording and limited testing of four designated sites, (d) extraction of more than 260 bulk soil samples from backhoe trenches for various analyses, and (e) informal interviews with several local informants.

The basic findings of (a) the surface reconnaissance and shallow subsurface testing and (b) the deep subsurface auger hole and backhoe trench testing are presented immediately following, while individual descriptions for designated site are presented in a subsequent section. Table 2 summarizes the general distribution of subsurface test units according to unit type and Survey Area, while Table 3 presents a more detailed listing of subsurface units which indicates the general nature of findings for each unit.

Table 2.

SUMMARY OF SUBSURFACE TEST UNITS

Test Unit Type	Area 1	Area 2	Area 3	Area 4	Area 5	Total
SHALLOW TESTING						
Shovel Units (SU)	-	-	-	-	98	98
DEEP TESTING						
Auger Holes (AH)	67	13	68	28	-	176
Backhoe Trenches (BT)	18	42	11	10	-	81
TOTAL	85	55	79	38	98	355

SURFACE RECONNAISSANCE AND SHALLOW SUBSURFACE SHOVEL TESTING

As mentioned previously, lower and upper valley portions of the project area underwent only extensive surface reconnaissance. Upland margins of the Ewa Plain, where cultural deposits were determined to most likely occur on or just below ground surface, underwent intensive surface

Table 3.

DETAILED LISTING OF SUBSURFACE TEST UNITS

Test Unit Number	Cultural: Agricultural	Cultural: Habitation	Non-Cultural	Site Designation
AREA 1				
Backhoe Trenches				
1-3	+	-	-	3324
4	-	-	+	-
5-6	+	-	-	3324
7-11	-	-	+	-
12-15	+	-	-	3324
16	-	-	+	-
17-18	+	-	-	3324
Auger Holes				
1	-	-	+	-
2-8	+	-	-	3324
9	-	-	+	-
10-15	+	-	-	3324
16	-	-	+	-
17	+	-	-	3324
18-21	-	-	+	-
22-30	+	-	-	3324
31	-	-	+	-
32	+	-	-	3324
33-37	-	-	+	3324
38-59	+	-	-	3324
60*	-	-	-	-
61	-	-	+	-
62-67	+	-	-	3324
AREA 2				
Backhoe Trenches				
1-3	-	-	+	-
4-5	+(?)	-	-	3324(?)
6	-	-	+	-
7-9	+(?)	-	-	3324(?)
10-15	+	-	-	3324
16	+(?)	-	-	3324(?)
17	-	-	+	-
18	+(?)	-	-	3324(?)
19-21	-	-	+	-
22	-	-	+	-
23-28	+(?)	-	-	3321
29-40	+(?)	-	-	3324(?)
41-42#	-	-	-	-

*Terminated due to impenetrable material.
#Collapsed and filled with water.

Table 3. (Cont.)

Test Unit Number	Cultural: Agricultural	Cultural: Habitation	Non-Cultural	Site Designation
AREA 2 (Cont.)				
Auger Holes				
1	-	-	+	-
2-3	+	-	-	3324
4-8	-	-	+	-
9-11	+	-	-	3324
12	-	-	-	-
13	+	-	-	3324
AREA 3				
Backhoe Trenches				
1-9	+	-	-	3324
10-11	+(?)	-	-	3324(?)
Auger Holes				
1-2	+	-	-	3324
3*	-	-	-	(?)
4	-	-	+	-
5	+	-	-	3324
6	-	-	+	-
7-11	+	-	-	3324
12-13*	-	-	-	-
14-15	+	-	-	3324
16*	-	-	-	-
17-19	+	-	-	-
20*	-	-	-	-
21-41	+	-	-	3324
42*	-	-	-	-
43-65	+	-	-	3324
66*	-	-	-	-
67-68	+	-	-	3324
AREA 4				
Backhoe Trenches				
1	+	-	-	3324
2	-	-	+	-
3-7	+	-	-	3324
8	-	-	+	3322
9-10#	-	-	-	-
Auger Holes				
1-24	+	-	-	3324
23*	-	-	-	-
26-28	+	-	-	3324

*Terminated due to impenetrable material.
#Collapsed and filled with water

Table 3. (Cont.)

Test Unit Number	Cultural: Agricultural	Cultural: Habitation	Non-Cultural	Site Designation
AREA 5 - BOAREAR POINT (SU-1 thru SU-74)				
Shovel Units				
1-4	-	-	+	-
5	-	+	-	-
6	-	+(?)	-	-
7-9	-	+	-	-
10	-	-	+	-
11	-	+	-	-
12	-	-	-	-
13	-	+	-	-
14	-	-	+	-
15-21	-	+	-	-
22	-	+(?)	-	-
23	-	+	-	-
24-25	-	+(?)	-	-
26	-	+	-	-
27	-	-	+	-
28	-	+	-	-
29	-	-	+	-
30	-	+	-	-
31-33	-	-	+	-
34	-	+	-	-
35	-	-	+	-
36-38	-	+	-	-
39	-	+(?)	-	-
40-42	-	+	-	-
43	-	-	+	-
44	-	+	-	-
45-46	-	-	+	-
47	-	+(?)	-	-
48	-	-	+	-
49	-	+(?)	-	-
50-52	-	-	+	-
53-55	-	+	-	-
56-57	-	-	+	-
58	-	+	-	-
59-66	-	+	-	3320
67-68	-	+	-	-
69-73	-	-	+	-
74	-	+		-

Table 3. (Cont.)

Test Unit Number	Cultural: Agricultural	Cultural: Habitation	Non-Cultural	Site Designation
AREA 5 - SITE 3319 AND IMMEDIATE VICINITY (SU-1 thru SU-24)				
Shovel Units				
1-3	-	+	-	3319
4	-	-	+	3319
5-6	-	+	-	3319
7-10	-	-	+	3319
11	-	+(?)	-	3319
12-15	-	-	+	-
16	-	+	-	-
17-18	-	+(?)	-	-
19	-	+	-	-
20	-	+(?)	-	-
21-22	-	-	+	-
23-24	-	+	-	3319

reconnaissance. Surface visibility was excellent in cleared areas of the upland margins. In areas where the ground surface was covered, a combination of shovel testing and pedestrian survey was necessary. Residential areas and wooded overgrown areas in particular required intensive shovel testing.

Because the upland plains sections of the project area were relatively small, survey and testing was conducted in a careful but non-systematic fashion. Locations for shovel unit tests were based primarily on background research and intuition. Background research had indicated certain portions of the upland plains had a high potential for containing cultural material. Of particular interest were early historic sites in upland margins bordering West Loch. Hoaeae Point in Survey Area 5 was designated as a high probability area, as were upland plain segments bordering West Loch.

Survey Areas 2 and 5 had upland plain segments. Survey Area 2, in the northern portion of the project area, consists mostly of cleared sugarcane fields and eroded surfaces which located on the edges of the bluff overlooking Honouliuli Gulch. Since surface visibility in Area 2 was high, only pedestrian survey was conducted. No significant cultural resources were detected; present were only scattered historic artifacts. Erosion and disturbance in Area 2 was extensive; if any sites had been discovered, it is likely they would have been poorly preserved. Survey Area 5 is predominantly residential, but it also contains sections of extensive vegetation; thus, it underwent both pedestrian survey and shovel testing. A total of 96 shovel units were excavated in Survey Area 5; 74 on Hoaeae Point, and 24 at or in the immediate vicinity of Site 3319. The distribution of shovel units in these two areas is shown in Figures 7 and 8.

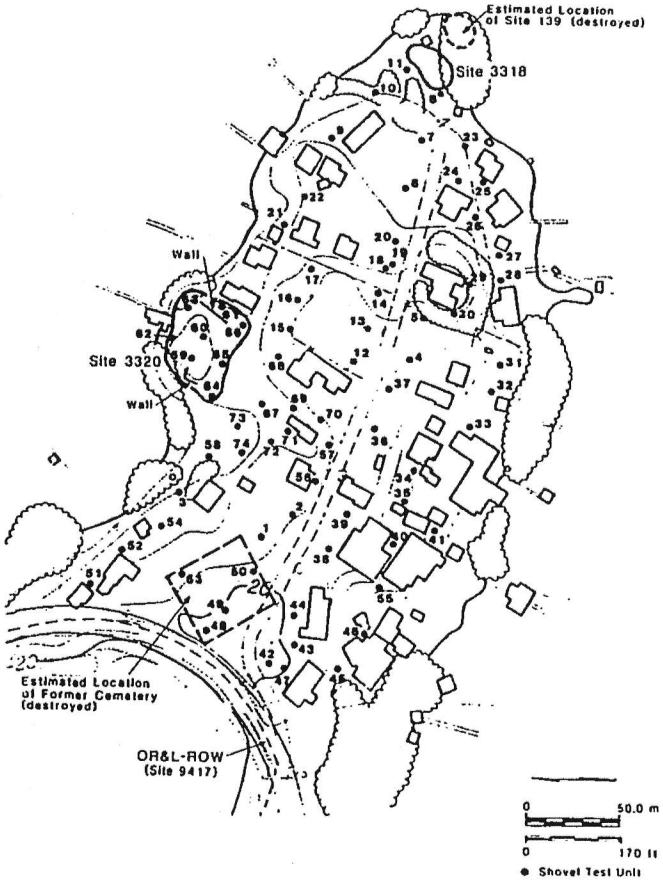

FIGURE 7. DISTRIBUTION OF SHALLOW SHOVEL TEST UNITS ON HOAEAE POINT IN SURVEY AREA 5.

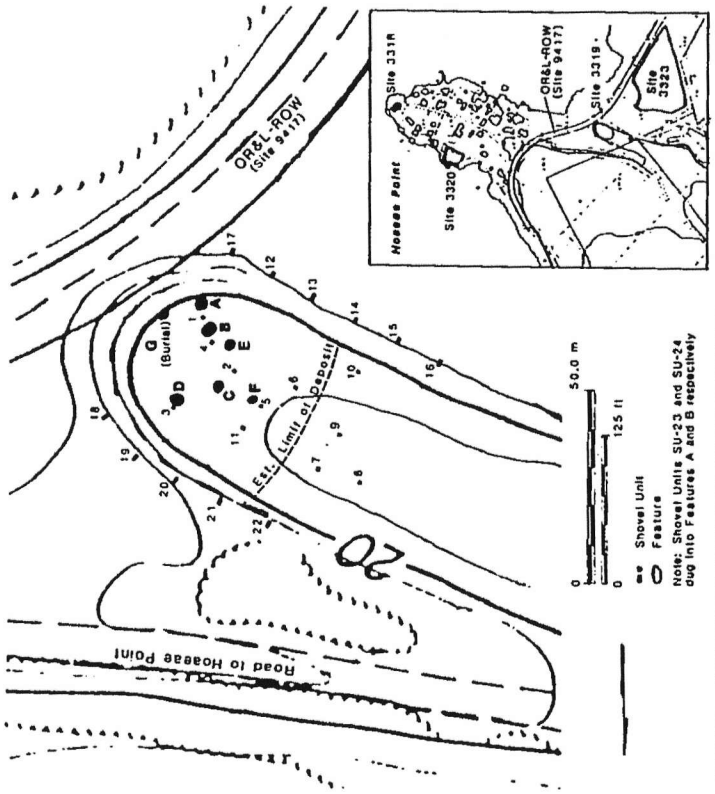

FIGURE 6. DISTRIBUTION OF SHALLOW SHOVEL TEST UNITS AT AND IN THE VICINITY OF SITE 3319 IN SURVEY AREA 6.

Table 2 summarizes the distribution of these tests, and Table 3 summarizes the results of the testing. Appendix D presents detailed stratigraphic descriptions of shovel units.

Inspection of several maps archived in the State Survey Office in Honolulu indicated the presence of fairly dense historic period residential settlement within Survey Area 5. The earliest map, an 1825 map of the south coast of Oahu (Reg. Map No.437), showed good detail of the Pearl Harbor area, and indicated that Hoaeae Point and the immediately adjacent shoreline area to the east were the most densely occupied areas of the entire Pearl Harbor area.

Background documentary research had indicated there were two known sites of potential interest in Survey Area 5, a fishing shrine recorded by McAllister in 1930 (Site 139, Kalanamaihiki Shrine) (1933:108), and a historic period cemetery (Figure 7). In addition, local informants had indicated that perhaps there was a second historic period cemetery and church site present on the low bluff overlooking the OR & L-ROW (Figure 8). Surface reconnaissance failed to relocate the fishing shrine. According to McAllister's description and map, the site should have been situated at the extreme eastern end of Hoaeae Point in Survey Area 5. Careful inspection of the eastern end did reveal several large basalt boulders, but these appeared to have been used as landfill--they were accompanied by fragments of concrete and miscellaneous building material. The purported area of the shrine appeared to have been cleared of vegetation in the recent past. Also present in the area were a small boathouse and a dock. It appears that Site 139 has been destroyed since McAllister observed it over 50 years ago.

A 1928 USGS 7.5 minute series quadrangle map ("Waipahu, Hawaii") indicated there was once a small unnamed cemetery near the neck of the Hoaeae Point. The neck of the point is presently occupied by residential houses and landscaped yards and gardens. Surface reconnaissance was conducted in the area. Again, the results were largely negative. It appeared that formal remnants of the cemetery had been removed. Only a single marble tombstone fragment was discovered; apparently it had been bulldozed into or had been discarded in a small rubbish pile. On the fragment, in Chinese script, was engraved an incomplete inscription. Following the surface inspection, intensive subsurface testing by shovel units and hand-operated bucket auger was conducted. In addition to the four shovel units that were dug, a series of quick bucket auger holes were dug spaced roughly 2.0 m apart over the entire reported location of the cemetery. Again, results were entirely negative. The reconnaissance and subsurface testing indicated the reported area of the cemetery had been substantially altered. Shovel tests indicated that there was no well-developed, old, stable ground surface present in the area. A "berm" or soil bank was discovered in an adjacent area; apparently this berm was part of the original landscape. The berm stood a full meter above the surrounding terrain, suggesting that at least a meter of fill had been removed from the reported cemetery area.

Interviews with local informants proved more productive. Several older residents of the Honouliuli area remembered the cemetery, and they described it as a "Chinese cemetery" containing "many" graves marked with

"large" tombstones. According to the informants, the cemetery existed until WWII. During the war, the military "removed" the grave markers and leveled the cemetery, along with much of the point. Informants did not know if the graves were disinterred and relocated, but results of shovel unit and bucket auger testing suggested that they had been. Furthermore, the overall results of the shovel testing strongly suggested that the same WWII occupation and modification of the point had largely eradicated evidence of prior prehistoric and early historic period occupation that the early maps of the area had indicated might be expected.

DEEP SUBSURFACE AUGER HOLE AND BACKHOE TRENCH TESTING

As previously discussed in the description of the project area, the valley bottom portions of the project area are characterized by a thick mantle of alluvial and colluvial clay. This distinctive, wide-spread mantle is a recent phenomenon, having been deposited during the late 19th through 20th centuries. The former land surfaces of the lower and upper valley segments of the project area are, of course, buried beneath this mantle. Historical documentary research indicated that nearly the entire valley floodplain was once used for pondfield agriculture. In order to determine the presence or absence of archaeological remains associated with these former land surfaces, deep subsurface testing, using power--driven auger and backhoe, was conducted.

One hundred seventy-six (176) auger holes, and 81 backhoe trenches were excavated. Table 2 summarizes the distribution of these tests, while Table 3 summarizes the results of the testing. Appendix E presents detailed stratigraphic descriptions of backhoe trenches.

In Survey Area 1 (lower valley segment), 67 auger holes and 18 backhoe trenches were excavated. The distribution of these tests is shown in Figure 9. Of the 67 auger tests, 56 revealed gleyed sediments interpreted as possible pondfield deposits. Backhoe trenching revealed gleyed probable pondfield deposits in eleven trenches (Fig. 10). Six trenches in Survey Area 1 did not contain gleyed deposits. These trenches were located along the southeastern edge of the valley floor in areas which apparently were never used for pondfield agriculture.

Thirteen auger (13) holes and 42 backhoe trenches were excavated in Survey Area 2. The distribution of these tests is shown in Figure 11. Relatively few auger cores were placed in Survey Area 2 because impenetrable materials, presumably rocks, were frequently encountered, particularly in the upper valley segment of Survey Area 2. Two backhoe trenches were excavated in the lower valley portion of Survey Area 2; both immediately filled with water and collapsed upon excavation. Of the seven auger tests conducted in the lower valley portion of Survey Area 2, four units revealed gleyed deposits. Backhoe trenching in the upper valley portion of Survey Area 2 revealed probable buried pondfield deposits in seven trenches and possible pondfield deposits in 19 trenches (Figs. 12 and 13). In addition, six backhoe trenches encountered a stratified cultural deposit subsequently designated Site 3321 (see Site Description section).

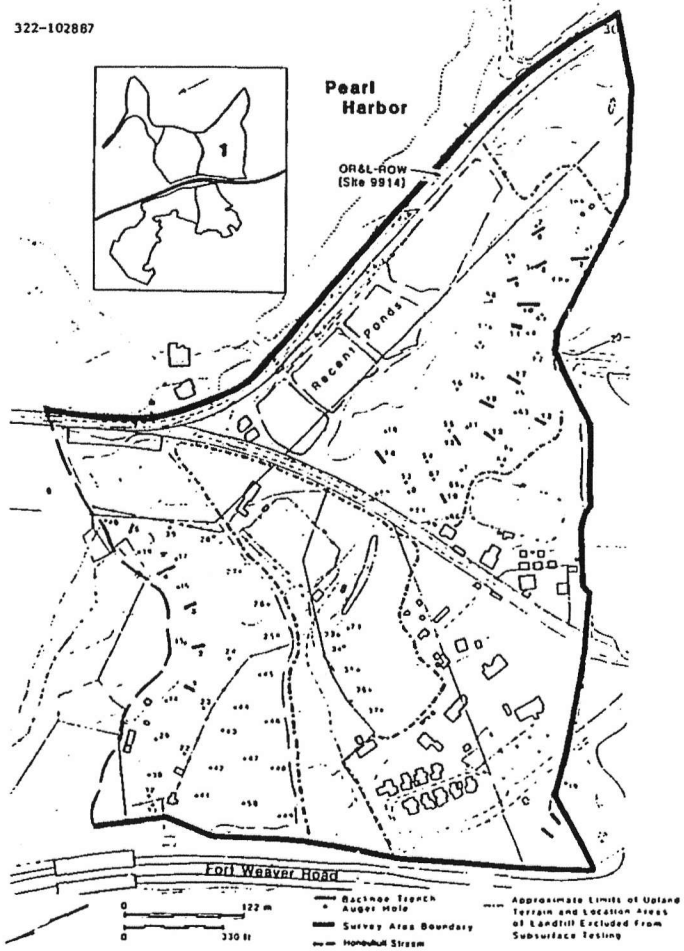

FIGURE 9. DISTRIBUTION OF DEEP AUGER HOLE AND BACKHOE TRENCH TEST UNITS IN SURVEY AREA 1.

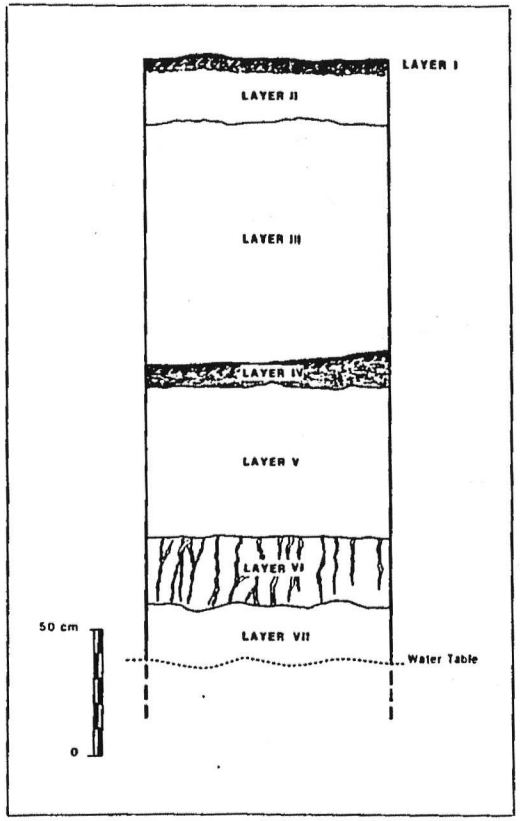

FIGURE 10. PROFILE OF BACKHOE TRENCH 6 IN SURVEY AREA 1. A TYPICAL LOWLAND AGGRADED AND FILLED PONDFIELD. NOTE ROOT-CAST MOTTLING IN LAYER VI.

FIGURE 11. DISTRIBUTION OF DEEP AUGER HOLE AND BACKHOE TRENCH TEST UNITS IN SURVEY AREA 2.

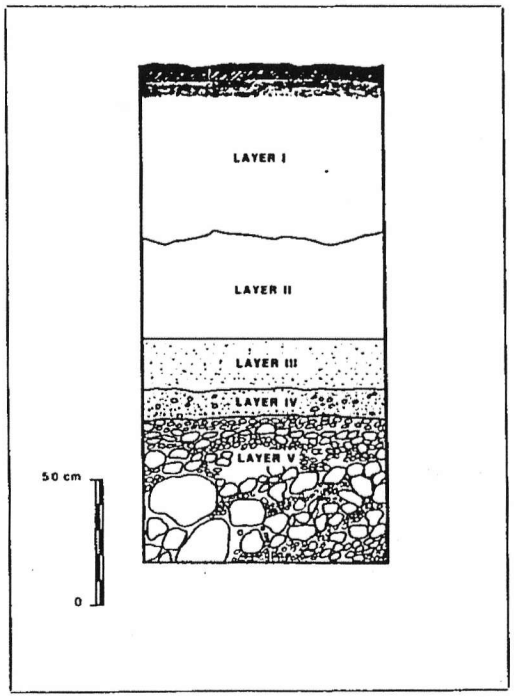

FIGURE 12. PROFILE OF BACKHOE TRENCH 16 IN SURVEY AREA 2.

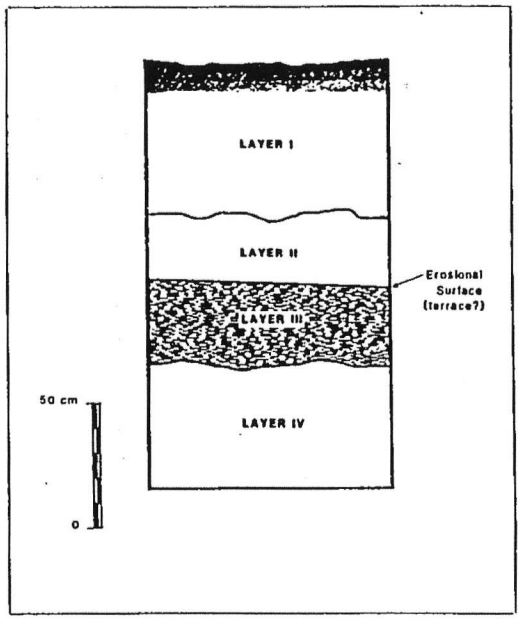

FIGURE 13. PROFILE OF BACKHOE TRENCH 17 IN SURVEY AREA 2, ILLUSTRATING POTENTIAL ALLUVIAL TERRACE. SITE 3321 OCCUPIES A PORTION OF THIS BURIED TOPOGRAPHIC FEATURE.

In Survey Area 3, 68 auger holes and 11 backhoe trenches were dug. Figure 14 shows the distribution of these tests. Except for Backhoe Trenches -10 and -11, which filled with water and collapsed immediately after excavation, nearly all of the test excavations in Survey Area 3 yielded probable evidence of former pondfield cultivation. The two collapsed trenches were excavated in to what appeared to be a buried deposit of recent refuse.

Twenty-eight (28) auger holes and 10 backhoe trenches were excavated in Survey Area 4. The distribution of these tests is shown in Figure 15. Probable pondfield deposits were encountered in 26 auger tests. Seven backhoe trenches contained gleyed deposits. Three backhoe trenches were excavated into a buried fishpond, Site 3322. The results of the latter three excavations are discussed in the Site 3322 site description.

The distribution of deposits interpreted as representing pondfields closely corresponds with the historically documented distribution of pondfields in Honouliuli Valley. These deposits are further discussed in the Site 3324 site description.

DESIGNATED SITES

Based on the findings of the surface reconnaissance and shallow subsurface shovel testing, and the extensive deep subsurface auger hole and backhoe trench testing, seven newly identified sites were formally designated within the project area. These sites are summarized in Table 4 according to HRHP site number, formal type, tentative functional interpretation, significance evaluation mode, appropriate tasks for subsequent field work, and miscellaneous comments. Individual site locations have been shown on previously referenced Figures 7, 8, 9, 11, 14, and 15.

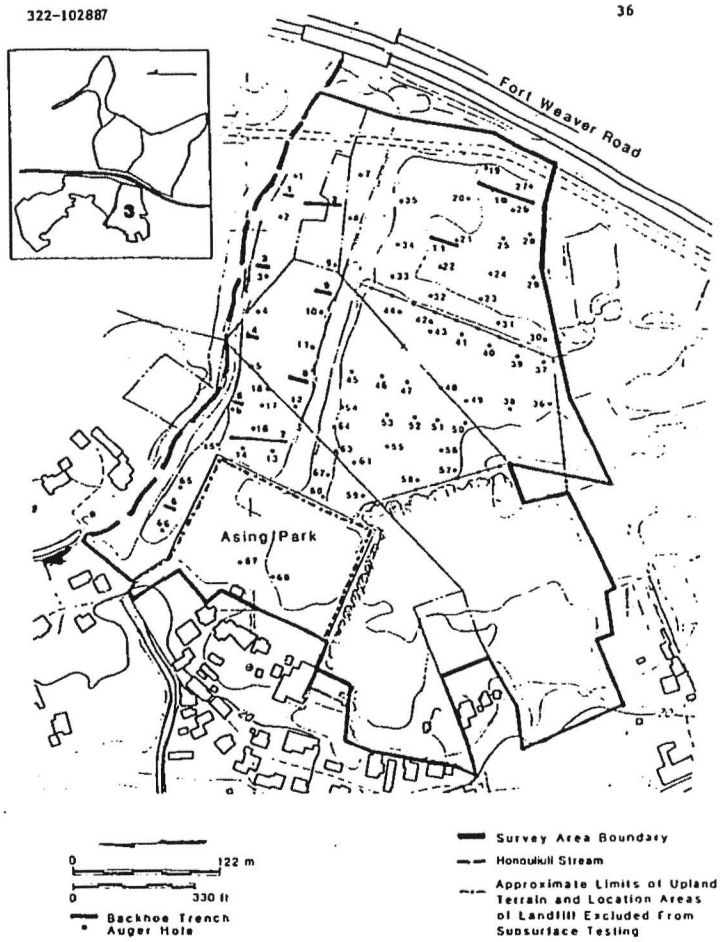

FIGURE 14. DISTRIBUTION OF DEEP AUGER HOLE AND BACKHOE TRENCH TEST UNITS IN SURVEY AREA 3.

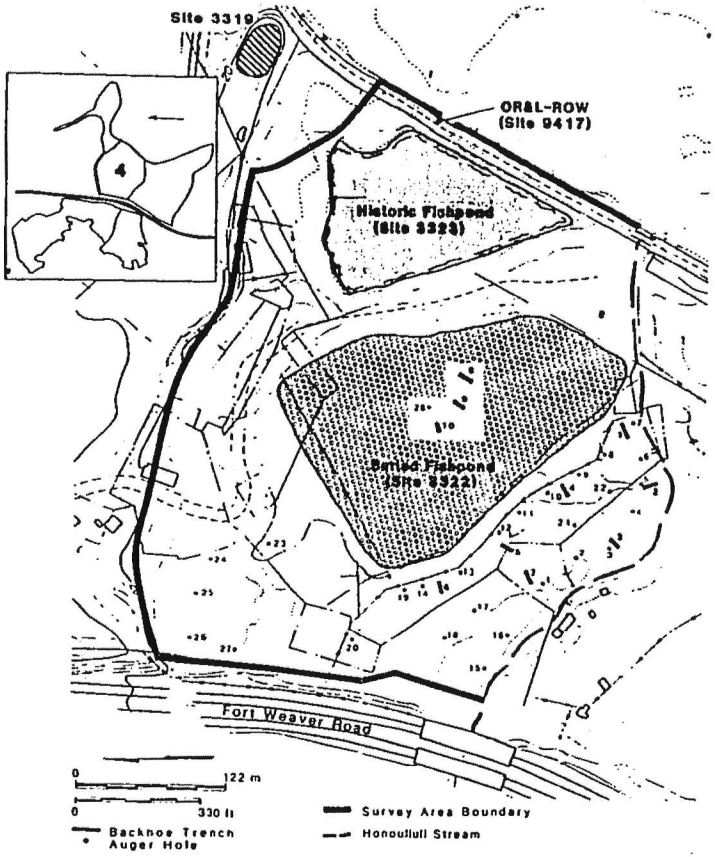

FIGURE 15. DISTRIBUTION OF DEEP AUGER HOLE AND BACKHOE TRENCH TEST UNITS IN SURVEY AREA 4.

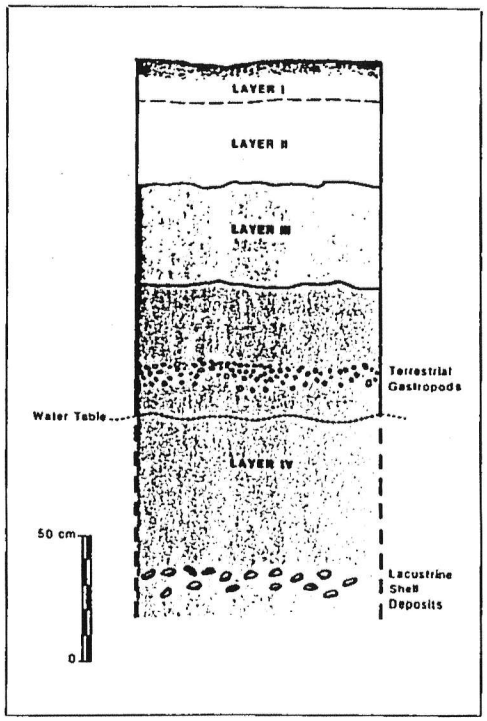

FIGURE 16. PROFILE OF BACKHOE TRENCH 8 IN SURVEY AREA 4. TYPICAL OF AGGRADED FISHPOND DEPOSITS.

Table 4.

SUMMARY OF SITES NEWLY IDENTIFIED WITHIN THE WEST LOCH ESTATES - GOLF COURSE AND PARKS PROJECT AREA

HRHP Site 50-12-xx- & Feature	Formal Site/Feature Type	Tentative Functional Interpretation	*Significance Evaluation R	I	C	#Field Work Tasks DR	SC	EX	Comments
AREA 2									
3321	Cultural deposit	Habitation/ burial	H	L	L	+	-	+	Two cultural layers (min.); human burial
AREA 4									
3322	Buried fishpond	Agricultural	H	L	L	-	-	+	Shown on 1878 and 1897 maps
3323	Historic fishpond	Agricultural	L	M	L	+	-	-	Created in 1890s by OR & L-RR construction
AREAS 1-4									
3324	Buried pond-field system	Agricultural	H	L	L	+	-	+	Limits undetermined; entire system buried
AREA 5									
3318	Surface historic artifact concentration	Habitation	M	L	L	+	-	+	Poss. remnant cult. deposit
3319	Complex (7) A-Rock pile B-Rock pile C-Rock pile D-Rock pile E-Rock pile F-Rock pile G-Burial	Habitation/ burial	H	L	H	+	-	+	Remnant cult. deposit; poss. hist. church and cemetery site; human burial
3320	Cultural deposit	Habitation	H	L	L	+	-	+	Prehist. and hist. deposit

*Significance Evaluation—Nature: R = scientific research, I = interpretive, C = cultural; Degree: H = high, M = moderate, L = low.

#Field Work Tasks: DR = detailed recording (scaled drawings, photographs, and written descriptions), SC = surface collections, EX = test excavations.

SITE DESCRIPTIONS

SITE 3318 - Surface Historic Artifact Concentration

Site 3318 is located in Survey Area 5 near the east end of Hoseae Point (Figure 7); it consists of a surface concentration of 19th century artifacts distributed over an area of approximately 375 sq m. The surface of Site 3318, in contrast to the surrounding area of soil deposits, consists of exposed reef rock with scattered pockets of alluvial sandy loam. Examination of the site suggested that there was only a low probability that the site contained much in the way of intact subsurface deposits. The historic artifacts present were on a deflated surface; this indicated that they were either part of an original landscape that had largely eroded away--leaving only shallow discontinues pockets of soil, or were transported into place--perhaps from the nearby upland margin of the Ewa Plain. In addition, the site was less than 25 cm above sea level, suggesting it would have been unsuitable for habitation.

To define with more certainty the limits of Site 3318, Shovel Units 8, 10, and 11 were excavated in the immediately adjacent area containing soil deposits. Coral-shell reef was encountered at 10 cmbs in SU-10 and at 35 cmbs in SU-11. Shovel Unit 10 consisted of light brown sand and marine and brackish water shell. The soil recovered from SU-8 and -11 was comprised of a loose, brown sandy loam, probably alluvial in origin. Shovel Unit 8 contained shell and flecks of charcoal. Given the conditions at the site, no further subsurface testing was conducted.

Surface artifacts collected at Site 3318 included a variety of historic period ceramics and bottle glass. Although no detailed analysis of the artifacts was undertaken, and thus a more definite time-frame for the site is lacking, preliminary analysis indicated that at least some of the artifacts date to the 19th century and may be associated with early historic settlement in the area.

SITE 3319 - Habitation Deposit and Possible Cemetery

Site 3319 is located in the upland margins of the Ewa Plain, in Survey Area 5, on a narrow ridge-nose which overlooks the shoreline of West Loch (Figure 8). It is bounded to the south by the lower valley section of Honouliuli Gulch and is separated from Hoseae Point, located to the north, by a wide ravine. The crest of the ridge-nose on which Site 3319 is located stands approximately 20 feet above the surrounding lower valley section, and the ridge west of the site merges with the main expanse of Ewa Plain. The margins of the ridge-nose are steep, near-vertical bluffs of exposed, weathered bedrock. A small talus has formed at the base of the bluffs. At the foot of the easternmost extension of the ridge-nose is an elevated occasionally used dirt road. This road, which runs north--south across the eastern boundary of the project area, was originally the

grade-bed of the Oahu Railway & Land Company (OR & L) railroad bed, which was constructed in the early 1890s. Across the neck of Hoseme Point is a grade-cut for the railroad bed which transects the point. These two sections originally formed a continuous railroad corridor. Apparently the ridge-nose on which Site 3319 is located originally extended further eastward, but was removed to accommodate the railroad corridor.

Site 3319 is presently covered with relatively dense vegetation. Large trees indicate that the site has not been cleared for a considerable period of time. At the western end of the site is a series of small livestock pens (pigs) associated with the currently occupied residential structure somewhat further inland.

Site 3319 was first identified during the surface reconnaissance of the upland portion of the project area. A number of small rock piles or cairns comprised of loosely piled waterworn basalt cobbles and boulders were observed on the apex of the ridge-nose (Figure 8). Inspection of the immediate area of the piles revealed a human burial (Feature G) eroding out of the upper face of the cut overlooking the railroad bed at the eastern end of the site (Figure 8). Marine, brackish-water, and terrestrial shell midden was observed scattered across a wide area at the eastern end of the ridge, as well as being exposed to a depth of several centimeters in the eroded face of the cut overlooking the railroad bed.

Limited shovel testing at Site 3319 involved recording surface features and excavating shovel units to assess the depth and extent of the cultural deposits (Figure 8). Six surface features (A-F) and a single human burial (G) were recorded and mapped. All six surface features were relatively small, and appeared to be distributed in no discernible pattern. Feature A, the largest, measured 2.17 m (NW/SE) by 1.21 m (NE/SW) by a maximum 35 cm high (Figure 17). Feature E, the smallest feature, measured approximately 0.85 m in diameter by 30 cm high. Lying on the ground near Feature D was a small wooden cross constructed of two narrow slats of wood. The cross was obviously not of appreciable age, but it suggested that the cairns may have functioned as grave markers. This seemed especially likely in the light of the exposed human burial noted earlier.

Thirteen 0.5 m sq shovel test units (SU-1 thru -11, -23, and -24) were excavated on the ridge-nose. In addition to testing the top of the ridge-nose, a series of eleven 1.0 by 0.5 m shovel test units (SU-12 thru -22) was excavated the talus around the base of the ridge. One early historic period map (1825, State Survey Office Reg.Map No.437) had indicated that several apparent habitation structures were once present within the vicinity of the talus. The precise locations of the structures was not known; however, it seemed likely they could have been buried under the talus. The test findings for all 24 shovel units are summarized in Appendix D, and their locations indicated on Figure 8, which also shows the apparent inland extent of the cultural deposit present on the ridge-nose. As two age determinations are available from one of the shovel units in this deposit, SU-1 is described in some detail below.

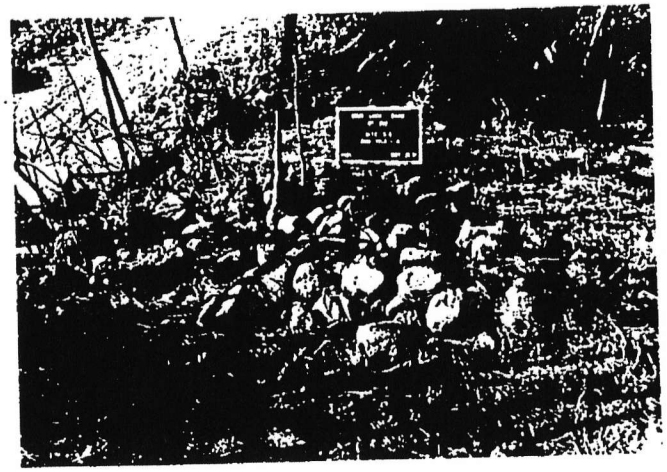

Figure 17. SITE 3319, FEATURE A. Rock pile. View to S. (PHRI Neg.640-30a)

SU-1 was located immediately adjacent to Feature A. The first layer encountered in SU-1 measured five centimeters thick and was comprised of a thin overburden of decomposing forest litter and other unconsolidated organic debris; within this debris were a number of marine shell fragments. The second layer, which extended from five to 50 cmbs, consisted of a compact, dark brown loamy soil which contained large amounts of shell, marine invertebrates, and scattered waterworn basalt pebbles and cobbles. At 30-38 cmbs, a thin ashy deposit and a concentration of fire-cracked rock, the apparent remains of a hearth, was discovered. A sample extracted from the concentration yielded a radiocarbon age determination having two probable ranges, AD 1681-1741 and AD 1800-1940 (PHRI Sample No.RC-357). A single piece of volcanic glass recovered immediately below the hearth, at 40-50 cmbs, yielded a hydration-rind age determination of AD 1788-1828 (PHRI Sample No.VG-720). At 50 cmbs a hard, compact reddish-brown clay loam was encountered; this loam appeared to be sterile. SU-1 was terminated at 55 cmbs.

Two test units (SU-23 and-24) were excavated in the rock piles atop the ridge-nose, one each in Features A and B. As mentioned previously, the piles or cairns were suspected to be possible grave markers, perhaps markers associated with a 19th-century cemetery and church which were said by several local informants to have been located somewhere in the area of Site 3319. Both tests yielded cultural debris from the deposit on the ridge, but neither were found to overlie graves.

The results of the limited testing at Site 3319 were inconclusive in terms of determining the function of the six cairns. Local informants had indicated that in the early 20th century a church had stood slightly to the west of Site 3319. Another church was rumored to have been located near the end of the ridge-nose, within the immediate vicinity of Site 3319. Informants also suggested that a historic cemetery was once located within the site area, although a search and inspection of early maps and records of the area produced no such evidence of this. The exposed human burial (Feature G), the crude wooden cross (grave marker), and the two human teeth recovered from the test units, however, gave credence to the comments of the informants.

The cultural remains encountered at Site 3319 also yielded evidence that it may have functioned as a habitation site, possibly during the prehistoric period. Shovel Units-6, -8, -10, and -11 all yielded marine and brackish-water shellfish remains, fish bone, and charcoal; the hearth-like feature in SU-1 also suggests the site was used for habitation. Although the test units yielded few artifacts, a single volcanic glass flake in SU-1 at least suggests habitation.

The subsurface feature discovered in SU-5, a large coral boulder packed in a tight matrix of waterworn basalt cobbles and pebbles at a depth of c. 18 cmbs, is something of an enigma. Because it was mainly constructed of basalt cobbles and because it lies beneath the ground surface, it may have been some kind of structure foundation, possibly for a structure associated with the possible church. With the limited amount of testing conducted thus far, however, it would be presumptuous to

formulate a definite conclusion concerning the feature configuration, function, and age.

As mentioned previously, the early historic period maps of the project area indicates that there were a number of structures located in the vicinity of Site 3319. In particular, an 1825 map depicts a large number of structures and agricultural fields surrounding and possibly on the ridge-nose. Testing along the base of the upland escarpment, however, failed to produce any evidence of such features, or evidence of any other cultural remains. It appears that Site 3319 is restricted to the top of the ridge-nose, and the restricted inland extent of the cultural deposit further suggests it likely to be the inland remnant of a once larger site atop the ridge that was truncated by the construction of the OR & L grade immediately adjacent to the seaward side.

SITE 3320 - Habitation Deposit

Site 3320, located on the north side of Hosea Point in Survey Area 5, overlooks an inlet located on the west side of West Loch (Figure 7). The general area surrounding the site is primarily residential; the actual site area occupies, for the most part, a small clearing on the north face of a small knoll. East, west, and south of Site 3320 are residential houses; in the immediate vicinity of the site are a number of shacks and outbuildings. Activities associated with the construction of the shacks and outbuildings, and other recent activities, have probably destroyed or disrupted portions of the site. Midden was observed exposed on the ground surface and in eroded areas.

Site 3320 measures approximately 1,800 sq m, although its original extent was probably larger. Features present at the site included surface midden and artifacts, and two segments of stone wall. The stone wall sections are built into the west and east sides of the knoll. The sections do not appear to be structure foundations; they may have functioned as retaining walls.

Shovel testing at Site 3320 revealed several areas of buried intact cultural deposit. Eight shovel units (SU-59 thru -66) provided the basis for defining the approximate limits of Site 3320. The test findings for these shovel units are summarized in Appendix D, and their locations indicated on Figure 7, which also shows the estimated extent of the cultural deposit present.

The shovel testing indicated the subsurface configuration of Site 3320 to be relatively uniform. Shovel tests consistently encountered an A-horizon containing an upper midden deposit comprised of large amounts of shell and smaller amounts of charcoal, ash, fire-cracked rock, bone, and artifacts (both prehistoric and historic types). In every unit, the A-horizon rested on top of a well-defined subsoil characteristically upland plain in type. This subsoil was found to be consistently devoid of cultural remains.

Cultural remains on the surface of Site 3320 were similar to the remains observed in the shovel units--a large amount of shell material was present on open exposed areas, and surface artifacts were generally scarce. Of the surface artifacts collected, a stem and bowl fragment of a clay pipe found near the center of the site is potentially important. The small size of the fragment precludes dating it precisely, but the fragment probably dates to the early half of the 19th century.

Given the information provided by the present investigation, it is not possible to date Site 3320 precisely. The fact that few artifacts were recovered at the site and historic artifacts were generally absent perhaps supports a late prehistoric/early historic period occupation. An adze fragment recovered from SU-59 also supports a prehistoric age, as do the various prehistoric artifacts stated by local informants to have been recovered from the general area of the site. In contrast, the clay pipe fragment is obviously early historic, the wall segments are probably historic, and an 1825 map of Pearl Harbor indicates contemporary occupation on Hoaeae Point. Thus, the evidence indicates two time frames for the site--a late(?) prehistoric frame and an early historic frame. The integrity of and the stratigraphic separation of these two time frames remain to be demonstrated by additional work; however, on the basis of the present evidence, it would seem that perhaps a transitional occupation is indicated.

SITE 3321 - Habitation Deposit

Located in Survey Area 2 (see Figure 11), Site 3321 was discovered during the random backhoe trench testing. The backhoe trench initially exposed a substantial midden deposit. Once the deposit was verified, excavation with the backhoe continued in order to delineate the extent of the deposit. Based on the series of six backhoe trenches dug in the site area (BT-23 thru -28), the subsurface deposits were estimated to comprise an area approximately 450 sq m (Figure 18). In the process of excavation, a possible stone wall section and a human burial were found. Hand and backhoe excavation minimally expanded the area around these features so as to assess better their integrity and nature. Site 3321 was found to be a buried habitation site with at least two stratigraphic components, structural remains, subsurface features, at least one human burial, portable artifacts, and fairly abundant midden remains.

The terrain in the general vicinity of the Site 3321, typical of the upper valley segment, is comprised of abrupt upland margins which bound a level floodplain; through the flood plain runs deeply entrenched Honouliuli Stream (see Figure 11). The terrain specific to the site is a recently worked sugarcane field. The site is bounded on the north by steep bluffs of the upland plain, on the south by a narrow level floodplain which extends several hundred meters to Honouliuli Stream, and on the east and west by the level valley floodplain, which expands along the margins of the valley and gradually slopes eastward towards the lower valley section of the project area.

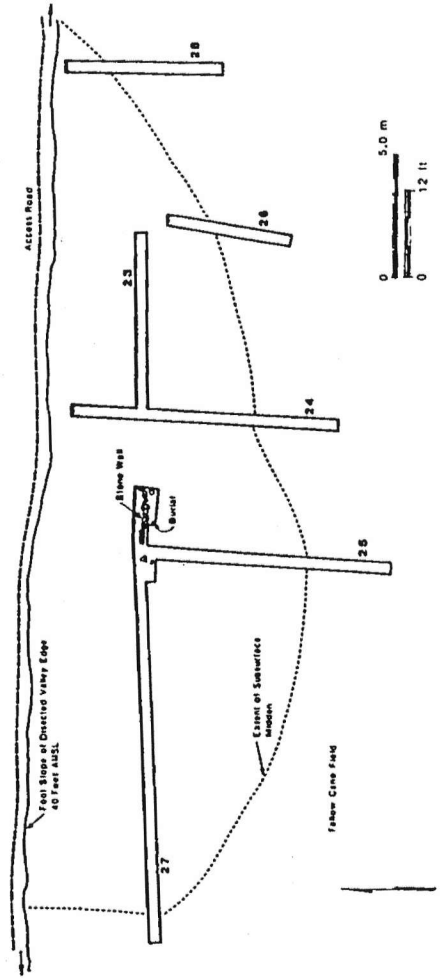

FIGURE 18. PLAN MAP OF BACKHOE TRENCHES AND MAJOR FEATURES OF SITE 3321.

Most of Site 3321 was buried beneath a thick overburden of recently deposited alluvium and colluvium. This overburden varied in thickness across the site, ranging from 1.0 to 1.5 m deep; thus, despite the optimum exposure of the site surface due to recent plowing, no artifacts directly related to the cultural deposits at the site were noted on the surface. However, there was present on the surface a relatively abundant scatter of mostly historic artifacts--probably from small settlements which occupied the immediate area and the peripheries of the adjacent upland margins during the late 19th and early 20th centuries. The few prehistoric artifacts found on the surface of the site area may have derived from the buried cultural deposits; there were indications that plowing had minimally disturbed at least one small area of the deposits.

The soil stratigraphy of Site 3321 is somewhat complex (Figure 19). Layer I, a thick mantle of compact reddish-brown clay, covers the site completely. The upper portion of this mantle has been altered by cultivation and plowing. The lower portion, however, is mostly intact. Layer I is probably mostly derived from the previously mentioned man-induced soil transportation effort which occurred in the Waianae Range during the late 19th century; the soil is therefore of recent colluvial and alluvial origin. Excepting the few predominantly historic artifacts recovered from it, the layer appears to be culturally sterile.

Layer II was a thin cultural deposit of very dark grey clay loam which contained variable amounts of charcoal, ash, bone, shell, fire-cracked rock, and artifacts. Discernible within the layer were features which intruded into the layer from underlying soil layers.

Layer III was a compact sterile reddish-brown clay nearly identical in appearance and composition to the undisturbed portion of Layer I. Layer III probably originated a way similar to Layer I.

Layer IV, a cultural deposit very similar to the Layer II deposit, occurs in restricted areas of the site. Layer IV is comprised of a dark greyish-brown loamy soil with a high organic content. It contains variable amounts of shell, bone, charcoal, ash, fire-cracked rock, and artifacts.

Layer V is a crumbly, sterile, very light grey silt-clay deposit. At the present level of investigation--without detailed chemical and physical analyses, it is difficult to determine the pedogenic origin of the layer. The layer is possibly the result of post-depositional eluviation and leaching, and natural accumulation of calcium carbonate.

Layer VI is comprised of highly consolidated, very old and weathered dark brown clay deposits. Layer VI may represent remnants of stream terraces. Backhoe excavation was terminated within Layer VI at a maximum 3.5 m below surface.

Trench testing revealed within stratigraphic sections a variety of subsurface features--a human burial, trash pits, firepits, possible earth ovens, post holes, ash lenses, charcoal concentrations, a possible living floor, and a number of other pits of indeterminate function. The majority

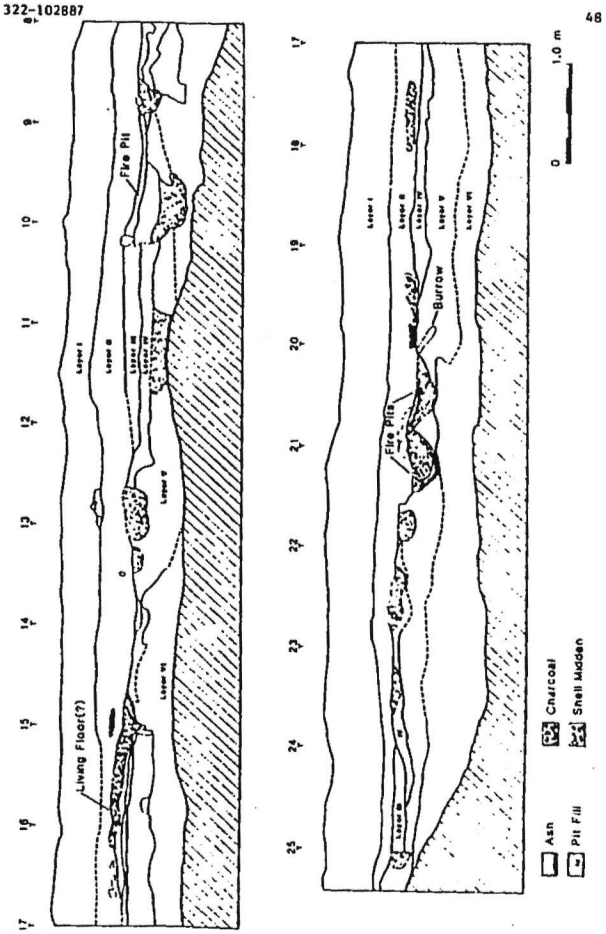

FIGURE 19. PROFILE (WEST FACE) OF BACKHOE TRENCH 27 AT SITE 3321.

of the subsurface features appear to originate in Layer II and intrude into Layers III and/or IV. A crude stone alignment--possibly a wall section--oriented roughly east-west was encountered at the easternmost end of BT-27.

Interpreting the depositional history and development of Site 3321 from available evidence is somewhat conjectural. However, it appears that three major events are represented in the stratigraphic soil profile of the site. These events (series) are described below.

Series I. Layers I and III represent the latest depositional series; they are products of natural and man-induced erosion. This erosion has been discussed in detail in the earlier Project Area Description section. The eroded/transported soils from the upland slopes have adrogate low-lying valley sections of the project area with alluvium and colluvium. The extent to which soils have been aggraded is dependent upon the slope and gradient of the individual areas. In upper valley segments of the project area, where Site 3321 is located, adrogate soils are 1.5 to 2.0 meters in thickness, depending on the extent the landscape has been culturally modified.

Series II. Series II includes Layers II and IV, which represent periods of site occupation. Layers II and IV are cultural deposits. It is commonly assumed that such deposits are primarily composed of organic residue and cultural artifacts which have accumulated on a surface; this is usually true of A-horizon midden deposits, which normally contain mostly organic constituents which only accumulate on a landscape surface. Subsurface cultural horizons, however, such as Layers II and IV at Site 3321, may be comprised of mixtures of materials. For example, there is every reason to believe that Series I processes did not stop during periods of occupation at Site 3321. Thus cultural layers II and IV of Site 3321 are comprised of both cultural deposition and natural/man-induced alluvial and colluvial deposition.

It has been suggested earlier that cultural activities bear directly on the rate of Series I deposition--an increase in activity would lead to an increase in deposition. If such is the case, then there should be measurable changes in the deposition rate throughout the valley landscape through time. Charcoal samples recovered from Layers II and IV have undergone radiocarbon age determination analyses. Layer IV yielded a calibrated range of AD 540-880. Layer II yielded a calibrated range of either AD 1327-1334 or 1390-1640. These dates can serve as chronological brackets, providing indications of the rates at which Layers I and III accumulated. Using mean dates, and assuming that the radiocarbon ages are correct, the Layer III deposits, which are c. 20 cm thick, accumulated within estimated periods of either 620 or 805 years. The time period involved may actually be longer since the contents of Layer II suggest that the radiocarbon dates may be too early. Layer II probably dates to the early 19th century. If Layer II does date to the early 19th century, this means Layer I has been formed in less than 200 years; yet Layer I measures 40-50 cm thick. This suggests a drastic increase in the rate of deposition during formation of Layer I, which in turn reflects a drastic increase in cultural activity. It is somewhat conjectural, but it may be that Series I processes are the direct result of human settlement of the islands, and their ratio of increase is in direct

proportion to expansion of cultural activities such as burning, land clearing, and harvesting.

Series III. Series III includes Layers V and VI; these layers are interesting because Layer V is leached--which makes for a great deal of speculation concerning the origin of the layer, and its relationship to the cultural use and modification of the immediate landscape. Layers V and VI are probably very old. Gradual aggradation in low-lying terrain around Oahu has been occurring for a considerable period of time--accelerated, and at times retarded, by tectonic-caused and eustatic changes in sea level. It is not known precisely when Layers V and VI were deposited; however, in situ weathering and the development of distinct horizons suggest considerable time depth was required for deposition of the layers. In situ weathering also suggests that the burial of these layers by Series I events was comparatively recent.

Investigation of upper valley segments by means of backhoe trenches revealed they contained varied and well-preserved subsurfaces. Within the segments were reflected discrete changes of pre-Series I topography over short distances; i.e., there is much horizontal variation in the pre-Series I landscape. The pre-Series I landscape probably was the original land surface upon which Site 3321 developed. By correlating pre-Series I soil deposits from subsurface tests at Site 3321 with information derived from backhoe trenching in adjacent upper valley segments, it should be possible to broadly reconstruct the original appearance of the Honouliuli Gulch prior to Series I deposition.

South of Site 3321--only slightly less than 100 meters away, backhoe trenching revealed beneath Series I layers meandering deposits associated with a former stream channel (see description of Area 2 BT-7, Appendix E). These deposits probably represent an earlier Honouliuli Stream channel quite different from the present one. The deposits are comprised of sorted stream boulders, cobbles, pebbles, and sand; little in the way of fine-grained alluvium was present. Characteristics of the soil profile of the deposits suggest the flow of the former stream channel was very active and dynamic. The former stream channel was probably broader and shallower than the present one. At times of extended rain fall, it probably overflowed its banks.

With the commencement of Series I erosion and deposition, the former stream channel undoubtedly underwent considerable change; it became silt-laden and its course at times was probably braided. After the massive aggradation ceased in the early 20th century, the silt load in the stream dropped considerably, and the stream began to revert back to its original configuration. Unlike the pre-Series I stream, however, the stream became entrenched--it cut down rapidly into the unresistant Series I clays and silts. Once the more resistant pre-Series I stream deposits of basalt boulders, cobbles and pebbles were encountered, down-cutting ceased or slowed considerably. At present, Honouliuli Stream, where it flows through the lower valley segment, is probably similar to what the upper valley segment course looked like during the Series I stage.

The horizontal variation observed in pre-Series I deposits located between Site 3321 and the backhoe trenches south of Site 3321 can be explained in terms of topographic differences within the buried landscape. As mentioned above, the remains of a former stream course was present in the backhoe trenches. The fact that such remains are absent at Site 3321, coupled with what is known about the Series III deposits, indicates that the area of Site 3321 was probably a prominent stream terrace which paralleled the relic stream course. The stream terrace may have been of Pleistocene origin. Sea-level fluctuations over extended periods of time have probably been accompanied by a continual down-cutting and aggrading of valley surfaces. This suggests that the terrace on which Site 3321 is located, though it may have been formed long before the Series II occupation of the site, may be geologically recent. The terrace also was probably much more extensive, before erosion and stream activity prior to Series I burial and aggradation reduced it somewhat. An attempt to discover the interface between the stream channel and terrace proved too time-consuming; it involved excavating a trench almost 100 meters long by two to three meters deep.

SITE 3322 - Buried Fishpond

Located in the lower valley segment of the project area (see Figure 15), Site 3322 was previously known from historic documentation, and based on vegetational changes and terrain, was easily discernible on aerial photographs. The site consists of the buried remnants of what was once an open fishpond (Figure 20). This pond is now covered by a thin mantle of alluvium and humus; it is presently fenced in and has been used as cattle pasture. The buried pond is clearly discernible as a low spot in the terrain. South and west of the pond are the low-lying fields which characterize the lower valley segment. These fields lie only slightly above the elevation of Site 3322; thus, like the site, the fields are generally wet and susceptible to flooding. North of Site 3322 is the edge of the upland plain, which is separated from the site by a narrow strip of land-fill that constitutes a portion of a large automobile salvage yard. To the east and northeast, the site is bounded by a narrow embankment that separates Site 3322 from Site 3323, an unused but still open historic period fishpond. The embankment stands approximately 1.0 meter above the surrounding landscape and is presently occupied by a narrow private road associated with the automobile salvage yard. Portions of the embankment are constructed of recent land fill.

Site 3322 is depicted on several historic maps; the earliest are several maps in the State Survey Office resulting from a series of 1873 government land surveys. An earlier 1825 map depicts a number of agricultural fields within the project area near the shore of West Loch, but no fishponds. The earliest written references to the site are several LCA claim descriptions. Site 3321 is referred to in several boundary descriptions as Nihola Pond, located in the District of Niukee (see listing at end of Appendix A for information about LCA 760: Kuhemu; and LCA 754: Kaunahi). The pond itself is located in LCA 11216, a huge tract of 43,260 acres awarded to the high-ranking chiefess M. Kekauonohi.

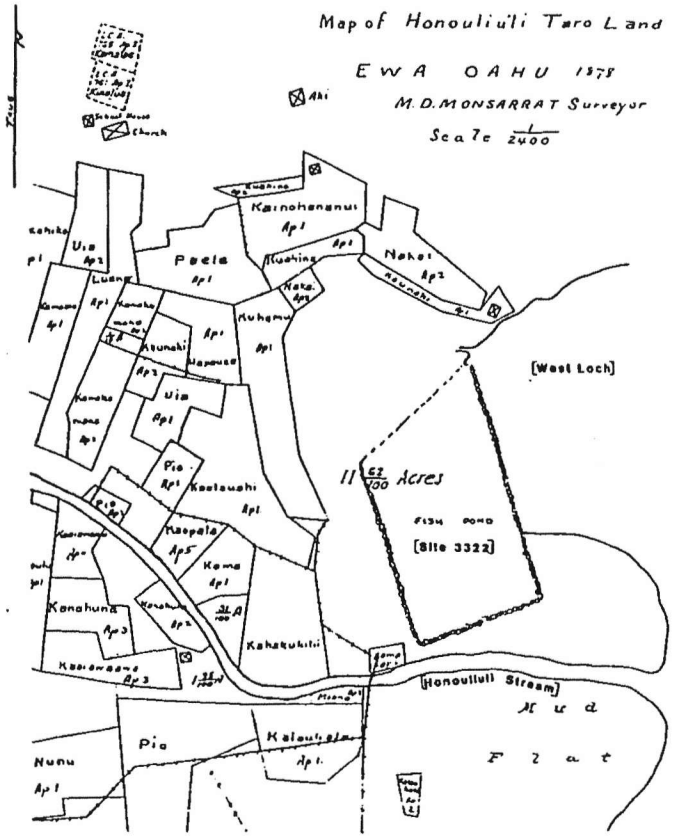

FIGURE 20. PORTION OF MONSARRAT 1878 MAP IN STATE SURVEY OFFICE (REG. MAP NO.360) SHOWING LOCATION OF BURIED FISHPOND (SITE 3322) IN SEAWARD PORTION OF SURVEY AREA 4.

Government Survey Registered Map No. 630, Territory of Hawaii (State Survey Office), provides a very detailed illustration of Site 3322. On this 1878 map, the fishpond appears as a rectangle. Three sides of the rectangle are bordered by stone embankments, and one side is bordered by the slope of an upland escarpment. The east embankment is shown bordering West Loch and an expanse of Honouliuli Stream delta mud flats. This eastern wall, which now lies buried below the surface, later comprised the western wall of Site 3323, a subsequent historic period fishpond located adjacent to and eastward of Site 3322. The 1878 map also shows precise dimensions for Site 3322. The east wall of the fish pond measures c. 200 meters in length. The west wall, facing inland, measures 150 meters in length, and the south wall, bordering Honouliuli Stream, measures 106 meters in length. The north wall, formed by what was probably the original shoreline of West Loch (the shoreline prior to the construction of the fish pond) measures 122 meters. The original depth of the fish pond is unknown, but based on the several backhoe trenches, it was probably less than 2.0 meters.

By 1928, Site 3322 had apparently been covered with silt and had disappeared. An unregistered 1928 map in the State Survey Office ("Honouliuli Taro Lands Showing Kuleanas Owned by Dowsett & Co., Ltd., Ewa, Oahu") does not show Site 3322; only the later Site 3323 is shown. On the previously referenced 1878 map, the mouth of Honouliuli Stream was shown located only a few meters from the south wall of Site 3322--which places Site 3322 within the active delta of the stream. During the second half of the 19th century, when the fishpond was being used, Honouliuli Stream probably carried a much higher silt load than at present. The high silt load, combined with seasonal flooding of the stream, probably contributed to the very rapid filling of the delta, and thus the fishpond.

Three backhoe trenches were excavated within Site 3322. The area of the trenches was extremely soft and wet and caused severe problems with working the heavy machinery. Ground conditions also hampered the investigations in general; the saturated, fine-grained soils in the trenches often collapsed, and water, resulting from a high water table, filled the trenches. Efforts to mechanically pump the water out failed because the amount of ground water was very high, and because lowering the water table rendered the trench walls even more susceptible to collapse.

Despite conditions, a cursory inspection of two trench profiles was made and a series of soil samples were taken. BT-8 was excavated to a depth of approximately 200 cmbs. Due to collapse of the walls and the high water level in the trench, only the upper 120 cm could be described in detail (see Figure 16). The upper 60 cm of the trench consisted of surface humus and the same reddish-brown clay that is present throughout the lower valley segment of the project area. The surface humus is derived from cattle grazing in the area; the reddish-brown clay has previously been described in detail in the Project Area Description section. Between 60 and 120 cmbs were two deposits clearly associated with the gradual filling-in of the pond field. These deposits were heavily gleyed and muck-like; they were both comprised of very fine, highly saturated, and extremely soft silty clays obviously lacustrine in origin--the clays were comprised of organic residue mixed with fine alluvial and colluvial silts and clays.

Separating the two deposits was a large horizontal concentration of terrestrial gastropods. These gastropods indicate there were intervals when the pond was dried out. The reasons for drying out the pond are uncertain; however, one possibility is that the ponds were intentionally dried to facilitate harvesting. Most fishponds had control gates built into the wall closest to the shore so that fluctuations in tides could be exploited. Water let in at high tide could be retained when the water level dropped, or the pond could be drained, or the water level lowered and adjusted, by opening the gates at low tide. At any rate, the the land snails do indicate that the bottom of the pond was dry long enough for the snails to become established. Certainly, the drying period was not sufficiently long to weather and oxidize the gley deposits--there is no evidence of such effects in the soil stratigraphy.

Three radiocarbon dates were derived from the deposits in BT-8. The uppermost gleyed deposit (Layer II) yielded a date of AD 1510-1955. Based on what is known about the age of the pondfield, the upper end of this age range seems the more correct. The upper boundary of Layer III yielded a date of AD 1160-1410, and the lower boundary of the layer yielded three date ranges--AD 1316-1348, 1390-1520, and 1564-1630. Prior to dating analysis, it had been assumed that Layers II and III were both related to the filling-in of the fishpond; however, Layer III dates seem to suggest a different possibility. It may be that Layer III is not associated with the fishpond at all; the layer may be comprised of fine sediment which accumulated along the submerged portion of the West Loch shoreline prior to construction of the fish pond. This sediment, heavily gleyed, may be the same deposit as described in BT-9, discussed below.

BT-9 collapsed and filled with water before it could be closely examined. However, a cursory inspection revealed a deep, gleyed deposit approximately 2.0 meters below surface (see description in Appendix E). This deposit contained numerous remains, including whole shells of shellfish belonging to the families Venerides and Melampidae, two families which are known to occupy shallow tidal flats similar to the flats at West Loch. The gleyed deposits could well be remnants of a former embayment buried beneath the alluvial and colluvial outwash of the Honouliuli Stream delta. A radiocarbon age determination derived from organic residue in the deposits produced a date of AD 70-610, which would generally support this possibility.

SITE 3323 - Historic Fishpond

Site 3323 is a historic period fishpond located immediately adjacent to Site 3322 (see Figure 15). Unlike Site 3322, this pond is not entirely silted; it includes a large expanse of open water. Site 3323 was formed when the OR & L grade was constructed in the early 1980s across the mouth of a small inlet. The grade isolated the inlet from the open expanse of West Loch and created the pond. East of Site 3323, across the grade, are mud flats of the Honouliuli Stream delta. Most of these flats, the result of alluvial aggradation, have been created since the building of the railroad grade.

Site 3323 is roughly triangular. Its east wall, the railroad grade, measures 275.0 m. Constructed into the railroad grade bed are two control gates. These gates, comprised of sliding slats set in vertical grooves, are built into the mouths of conduits which pass beneath the railroad grade and allows water flow between West Loch and the pond. The water flow is controlled by moving the slats up and down. It is not known whether the gates were originally built into the railroad grade, or if they were added later. The presence of the conduits suggest the gates are recent additions; they may have replaced earlier gates made of less durable material.

The southwest wall of Site 3323 is formed partly by the eastern wall of Site 3322. On early maps, this wall is depicted as extending 230 meters; however, landfilling in the area over recent years has shortened the wall length somewhat. As mentioned in the discussion of Site 3322, the southwest wall is located between Sites 3322 and 3323, and is presently occupied by a private access road associated with an automobile salvage operation.

The north side of the Site 3323 is bounded by the talus of the upland ridge located adjacent to the site. On early 20th-century maps, the north side measures approximately 213.0 meters long. However, the north side, now choked with dense mangrove thickets which extend into the open water of the pond, has been reduced somewhat by gradual natural accumulation of silts and organic residue.

SITE 3324 - Buried Pondfield System

Evidence of pondfield agriculture in the project area comes from several sources. Direct evidence consists of a few isolated, preserved remnants of actual pondfields, still visible within the lower portion of Honouliuli Valley. With one exception, these pondfields all appeared to have been unused, or fallow, for extended periods of time. Only one small field appeared to be currently in use for growing taro and watercress.

Further evidence for the pondfield system comes from cartographic data. Historic maps of the Honouliuli area depict numerous fields within the lower valley segment of the project area. Figure 21 is a composite based mainly on two maps in the State Survey Office dating to 1928 and 1932 which clearly depicts the location of individual pondfields in use at that time the area was surveyed. (These two maps are the previously cited 1928 map of Kuleanas Owned by Dowsett & Co. [unregistered], and Supplement Map Land Court Appl. 1069 [Supplementary Map A]). More than 150 pondfields are illustrated, providing a good indication of the extent and importance of this field type in the Honouliuli area. The entire complex of pondfields is no longer visible on the present landscape, as development and alluvial deposition has destroyed and/or buried almost all of them.

Further detailed information on the pondfield system can be found in the summary listing of Land Commission Awards (LCA), presented at the end of Appendix A, which details the allotment of individual parcels of land in the middle of the 19th century. Not only does this listing provide information

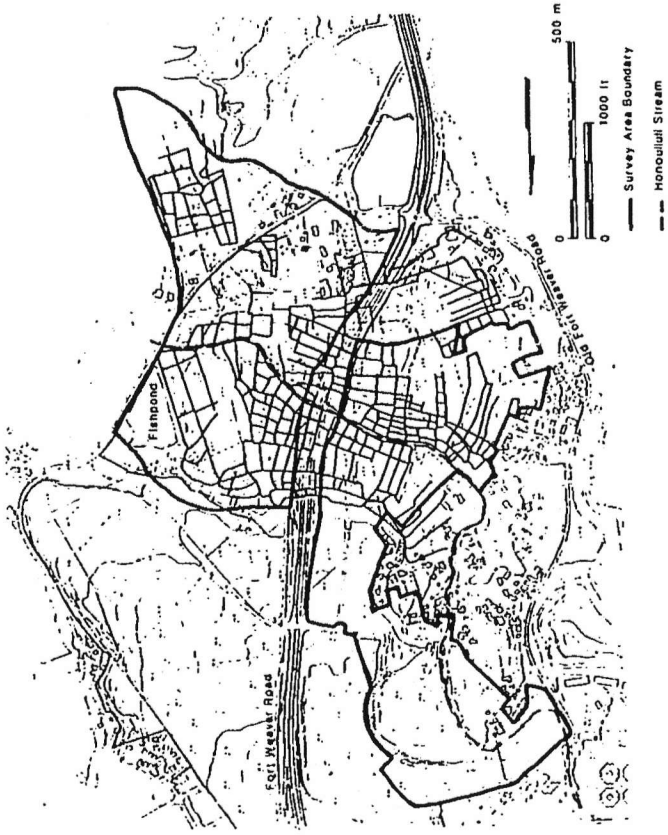

FIGURE 21. COMPOSITE MAP OF HISTORIC PERIOD (c. 1928-1932) HONOULIULI VALLEY PONDFIELD SYSTEM.

on the size and ownership of individual parcels, but it also provides a detailed description of actual land use, including specific references to pondfields and crops. The LCA testimonies indicate irrigated taro was grown in both upper and lower valley segments of the project area.

Deep subsurface auger hole and backhoe trench testing provided much information on the pondfield system. (Previously cited Table 3 summarizes the deep subsurface testing results for each survey area, while Appendix E provides detailed stratigraphic descriptions for backhoe trenches.) Testing included the recovery of stratigraphic data, and radiocarbon dating and pollen samples, all of which underwent subsequent analyses. As mentioned above, little visible evidence of the pondfield system remains on the surface of the project area. A primary focus of subsurface testing within the Honouliuli Valley floodplain was to identify and delineate the extent of buried remnants of pondfield agriculture. In general, the auger and backhoe testing was quite successful in delineating the overall extent of probable pondfield deposits; however, attempts to identify individual pondfield boundaries were not successful.

As expected, probable pondfield deposits were concentrated within the lower valley segment of the project area. The distribution of these deposits closely corresponds to the extents of pondfields depicted on Figure 21. In the lower valley segment, probable pondfield deposits typically occur as a buried A-horizon consisting of a gleyed silt clay loam, clay loam, or clay, which frequently includes charcoal flecks and terrestrial gastropods. This A-horizon overlies a B/C-horizon of homogenous, lighter-colored fine gleyed clay which occasionally contains oxidized root cast mottling (e.g., in BT-6 in Survey Area 1, see Figure 10). The probable pondfield deposits usually are buried beneath a meter or more of recently deposited alluvium, much of which has been mixed by cultivation. In several trenches, the above stratigraphic sequence also includes one or more layers of coarser, stream-deposited sands and gravels.

Extensive subsurface testing of the upper valley segment revealed pondfield deposits both similar to those in the lower valley, and another type of deposit. Deposits similar to lower valley deposits were found in Survey Area 2 (BT-10 thru -15) along the downstream, southeastern third of the broad, semicircular floodplain situated immediately below the New Saint Francis Hospital site. Another type of deposit was found in the remainder of the upper valley floodplain area, buried beneath 1.5 m or more of recent alluvium, much of which mixed by cultivation; this second type of deposit may represent either of two things. The deposits may represent former pondfield cultivation (BT-5, -7 thru -9, -16, -17, and -23 thru -40) (see Figures 12 and 13), as they appeared to be comprised of dried-out or leached pondfield soil consisting of a relatively homogeneous, light grey crumbly silt containing a few gleyed mottles. Another possibility is that the deposits represent a natural stream terrace which has been eroded and subjected to subsequent weathering. The deposits were usually underlain by coarse, stream-borne sand to boulder-sized material. In some profiles, the upper deposit boundary was abruptly and evenly truncated, perhaps reflecting an erosional event in which the top of the deposit was planed off.

Survey Area 2 subsurface testing in the uppermost lobe of the Honouliuli floodplain, situated immediately east of the intersection of Old Fort Weaver Road and Old Farrington Highway, did not identify any intact evidence of pondfield deposits (BT-1 thru -3). In this area, sugarcane cultivation appears to have disturbed all fill overlying a basal deposit of coarse stream-deposited materials.

Radiocarbon age ranges were determined for at least ten probable pondfield deposits. Most of the age ranges post-date c. AD 1100, and fit well within the generally accepted time frame for extensive pondfield agriculture in Hawaii (Kirch 1985:303). Radiocarbon age determination results are discussed in more detail in the Data Analyses section of this report.

Palynological evidence, also summarized below in the Data Analyses section and presented in detail in Appendix C, provides abundant evidence for a variety of cultigens. Plant taxa, notably taro and rice, were identified in fill samples from probable pondfield deposits. While palynological analysis results should be interpreted cautiously because the analysis represents only a preliminary effort, the results do confirm that pondfield crops were cultivated in the valley.

Pondfield deposits encountered within the project area generally are typical of those described by other investigators (Allen 1987, Kirch 1977, Riley 1973). Soils are usually gleyed, very fine textured, and sometimes contain oxidized root casts. Because of the proximity of the lower valley segment to sea level, most of the subsurface soil in the area is permanently saturated by the normally high ground water level; this creates a reducing environment, with little or no oxygen. Consequently, there is little opportunity for such deposits to dry or weather, and the characteristics of pondfield deposits encountered in more elevated settings elsewhere in Hawaii, as cited in the above references, do not appear to apply to most lower valley segment pondfield deposits.

As previously mentioned, subsurface testing failed to reveal any definite evidence of individual fields. Several explanations might be offered to account for this situation. One possibility is that pondfield boundaries were missed by subsurface testing; another possibility is that they simply were not recognized. However, both of these possibilities seem unlikely, given the intensity and nature of subsurface testing, and the expected visibility of such boundaries. Two backhoe trenching patterns that were designed to locate and identify the constructed boundaries of individual pondfields were used during the subsurface testing. Once suspected pondfield deposits were encountered, backhoe trenching proceeded outward, either in long continuous trenches, or in a staggered discontinuous fashion. Neither trenching technique succeeded in finding any subsurface boundary features. The sheer intensity of both backhoe and auger testing would tend to argue that if such boundaries were present, they would have been detected.

A third possibility relates to the nature of the environment, and the available water capacity. It seems unlikely that water supply and water retention were ever much of a problem for agricultural activities within the lower valley segment of the project area. Excessive amounts of water during

periods of heavy precipitation would probably have constituted a more major concern. It may be argued that while some type of field boundaries may have been established, substantial field boundary construction was not necessary to pondfield agriculture within the lower valley segment because there was little need for controlling and retaining water within the fields. Such minimal boundary designations would not be readily apparent or manifested at all in the archaeological record.

A final possibility is that land modification activities which occurred since the early 1900s have largely obliterated field boundaries. This very likely happened in the portion of the lower valley segment situated inland of Fort Weaver Road, an area which has been in sugarcane cultivation for a number of years. The deep plowing associated with cane cultivation could easily have removed former pondfield boundaries.

OTHER MODERN/RECENT SITES

Two areas where fishponds of relatively recent or modern construction are present should be noted. These areas were not recorded in the field, and were not assigned HRHP site numbers. One area is situated on the mud flats on the west side of the mouth of Honouliuli Stream, seaward of the OR & L grade. Several rectangular ponds are shown in this area on the previously cited 1928 map showing Kuleanas Owned by Dowsett & Co. The ponds do not appear on an earlier 1897 map (State Survey Office, Reg.Map No.1919), and are therefore presumed to have been constructed sometime in the period between 1897 and 1928. Except for small openings in the center of the two largest ponds--visible on recent aerial photographs, this mud flat area is now overgrown with dense mangrove vegetation.

The other area is situated immediately adjacent to the OR & L grade (see Figure 9), along the inland side of the shoreline grade beginning at the intersection of the main route and a plantation spur. A series of five rectangular ponds are present, one of which has been recently filled. According to Mr. Chester Koga of RMTC, these ponds are owned by Mr. Richard Towill, and they were part of a recent aquaculture operation, which has since been discontinued. Inspection of the previously cited 1897 map indicates that these ponds were dug in an area that had once been the site of a salt works.

DATA ANALYSES

AGE DETERMINATIONS

Twenty-one (21) samples collected during the field work were packaged in aluminum foil and were submitted to Beta Analytic, Inc. for radiocarbon age determination and C13/C12 isotope ratio determination. Processing of the samples proceeded normally; however, special handling of the samples was necessary because most were bulk samples comprised of organic-rich sediments.

Age determination was not possible for two samples (PHRI No.RC-352 and -354) because they did not contain sufficient amounts of carbon. One sample each was processed from Site 3319 (RC-357), from the upper (RC-356) and lower (RC-355) cultural deposits at Site 3321, and from what was thought to be, in Survey Area 2 BT-30, a buried land surface (RC-359). Also processed were five samples (RC-340 thru -343, and -351) from the Site 3322 fishpond deposits and ten other samples from probable or possible pondfield deposits.

Radiocarbon age determination results are presented in Table 5, and are graphically depicted in Figure 22. Results are reported, according to currently accepted convention, as date ranges based on two sigma statistics. The dates are calibrated using tables contained in Stuiver and Pearson (1986). For eight samples (RC-342, -344, -348, -350, -353, -356, -357, -358), the tables indicate more than one possible age range. Multiple ranges are due to temporal fluctuations in the amount of radioactive carbon (C-14) in the atmosphere. Radiocarbon sample RC-345 from BT-6 in Survey Area 1 produced a modern result.

Three volcanic glass samples were submitted to MOHLAB for hydration-rind age determinations. One sample was from Site 3319, and two were from the lower cultural deposit at Site 3321. The three resulting hydration-rind ranges form an overlapping cluster spanning AD 1769-1828. Complete hydration-rind dating results are presented in Table 6, and are presented graphically in Figure 23. Results are reported as age ranges based on two standard deviations, to make the ranges comparable to the radiocarbon age ranges.

Site 3319, situated on the ridge overlooking the mouth of Honouliuli Stream, yielded two possible radiocarbon age ranges--AD 1681-1741 and 1800-1940. The single volcanic glass sample from Site 3319 yielded a range of AD 1788 to 1828. The fact that this sample came from a lower stratigraphic content than the radiocarbon sample indicates that the later radiocarbon age range is the more likely one. Total dating results for Site 3319 indicate occupation of the site probably occurred during the early historic period shortly after initial Western contact.

The Site 3321 habitation deposits yielded three radiocarbon age ranges--one range (AD 540-860) from the lower cultural stratum and two

Table 5.

SUMMARY OF RADIOCARBON AGE DETERMINATIONS
WEST LOCH, OAHU

PHRI Lab.No. RC-	Lab. No. BETA-	Provenience	C-14 Age Yrs. B.P. (one sigma)	C-13/ C-12 Ratio	C-13 Adjusted C-14 Age Yrs. B.P.	*Calendric Range Yrs. AD
Site 3319 (Area 1)						
357	23735	SU-1, HF-1 25-40 cmbs	70±50	-26.7	50±50	1681-1741 1800-1940# 1955
Site 3321 (Area 2)						
356	23734	BT-27, IAB2 45-65 cmbs Upper Cultural Deposit	360±70	-20.1	440±70	1327-1334 1390-1640
355	23733	BT-27, IIAB1 85-97 cmbs Lower Cultural Deposit	1300±90	-22.0	1350±90	540-880
Site 3322 (Area 4)						
340	23718	BT-8, IIAGNB 80-90 cmbs Fishpond	690±90	-23.6	720±90	1160-1410
341	23719	BT-8, IIAGNB1 110-120 cmbs Lower Valley Fishpond	170±70	-22.0	210±70	1510-1955#
342	23720	BT-8, IIAGNB 130-140 cmbs Fishpond	430±70	-23.5	460±70	1316-1348 1390-1520 1564-1630
343	23721	BT-9 60-70 cmbs Fishpond	530±60	-24.0	550±60	1280-1450
351	23729	BT-9 200+ cmbs Fishpond	1680±120	-24.0	1690±120	70-610
Area 1						
345	23723	BT-6, IIAGNB2 150-160 cmbs	103.3±40.7% Modern	-20.09	102.5±0.7%8 Modern	--

*Calibrated according to Stuiver and Pearson (1986:805-838). Two-sigma range.

#1955 denotes influence of bomb C-14.

Table 5. (Cont.)

PHRI Lab.No. RC-	Lab. No. BETA-	Provenience	C-14 Age Yrs. B.P. (one sigma)	C-13/ C-12 Ratio	C-13 Adjusted C-14 Age Yrs. B.P.	Calendric Range Yrs. AD
Area 1 (Cont.)						
347	23725	BT-12, IIIAGNB 130-140 cmbs Poss. Site 3324 Lower Valley Pondfield	750±70	-18.5	850±70	1020-1280
346	23724	BT-12, IIIAGNB 150-160 cmbs Poss. Site 3324 Lower Valley Pondfield	700±60	-21.0	760±60	1170-1300
350	23728	BT-14 130-140 cmbs Poss. Site 3324 Lower Valley Pondfield	640±70	-19.8	730±70	1170-1320 1339-1392
Area 2						
358	23736	BT-7 130-140 cmbs Poss. Site 3324 Upper Valley Poss. Pondfield	300±70	-22.6	340±70	1430-1670 1949-1952
344	23722	BT-7 140-150 cmbs Poss. Site 3324 Upper Valley Poss. Pondfield	100.7±1.0%	-20.2	30±80	1670-1780 1790-1950 1953-1955*
353	23731	BT-30, III 220-230 cmbs Poss. Site 3324 Upper Valley Poss. Pondfield	700±50	-24.2	720±50	1225-1307 1358-1380
359	23737	BT-30, IV 240-250 cmbs Original Surface Upper Valley	2070±150	-25.2	2070±150	BC 400- AD 240

*1955 denotes influence of bomb C-14.

Table 5. (Cont.)

PHRI Lab.No. RC-	Lab. No. BETA-	Provenience	C-14 Age Yrs. B.P. (one sigma)	C-13/ C-12 Ratio	C-13 Adjusted C-14 Age Yrs. B.P.	Calendric Range Yrs. AD
Area 3						
348	23726	BT-1 160-180 cmbs Poss. Site 3324 Lower Valley Pondfield	930±60	-21.3	990±60	899-906 950-1170
354	23732	BT-2 150-170 cmbs	--	--	--	Insufficient Carbon
360	24116	BT-7 70-90 cmbs Poss. Site 3324 Lower Valley Pondfield	180±70	-23.0	210±70	1510-1955*
352	23730	BT-7 90-110 cmbs Poss. Site 3324 Lower Valley Pondfield	--	--	--	Insufficient Carbon
Area 4						
349	23727	BT-4, IIAGNB3 105-115 cmbs Poss. Site 3324 Lower Valley Pondfield	610±60	-23.6	630±60	1270-1420

*1955 denotes influence of bomb C-14.

possible age ranges (AD 1327-1334 and 1390-1640) from the upper cultural layer. In addition, two volcanic glass samples from the lower stratum also yielded dates (AD 1769-1817 and 1772-1800). While the radiocarbon results are stratigraphically consistent, the volcanic glass results, because they post-date the radiocarbon ones, are problematic. The many pit features and the sugarcane cultivation disturbance present at Site 3321 suggest the possibility that the volcanic glass samples could have intruded into the lower deposit; however, the problem cannot be resolved until additional samples from controlled excavations are collected and dated. A provisional interpretation of the dates indicates three possible time periods for site occupation: AD 540-860, 1327-1640, and 1769-1817.

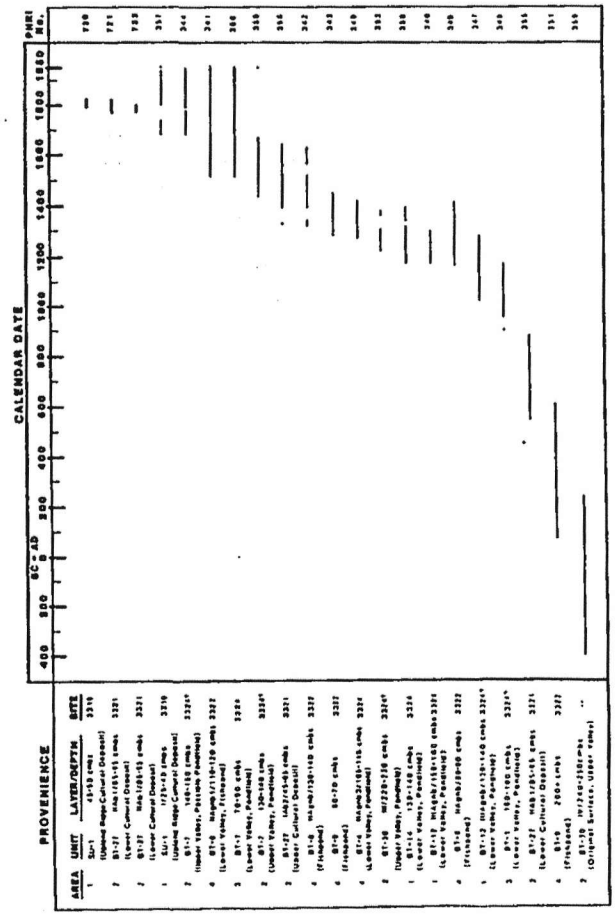

FIGURE 22. RADIOCARBON AND HYDRATION-RIND AGE DETERMINATIONS

Table 6.

SUMMARY OF HYDRATION-RIND AGE DETERMINATIONS

PHRI Lab. No. VG-	MOHLAB Lab. No. (439-)	Source*	Provenience	Hydration Rind (microns)	Calendric Date Yrs. AD	Calendric Range Yrs. AD (2 sigma)
Site 3319 (Area 1)						
720	9	67	SU-1 45-50 cmbs	2.49±0.07	1808±10	1788-1828
Site 3321 (Area 2)						
721	249	67	BT-27, IIAB1 85-95 cmbs	2.59±0.08	1793±12	1769-1817
722	250	67	BT-27, IIAB1 85-95 cmbs	2.64±0.05	1786±7	1772-1800

*Hawaii glass source: 67 = Oahu "B" (Michels 1986).

Five radiocarbon samples from Site 3322, a buried fishpond, were processed. A basal sample from BT-9 yielded an age range of AD 70-610. This sample most likely represents underlying lacustrine sediments which are presumed to have been deposited when the area was still part of the open West Loch embayment. Another sample from Layer III in BT-9, taken from between 60-70 cm below surface, produced an age range of AD 1280-1450. Three radiocarbon samples from BT-8, which is adjacent to BT-9, yielded a number of ranges. RC-342 (Layer IV, 130-140 cm) yielded three age ranges: AD 1316-1348, 1390-1520, and 1564-1630. RC-341 (Layer IV, 110-120 cm) yielded a range of AD 1510-1955; RC-340 (Layer III, 80-90 cm) yielded a range of AD 1160-1410. These radiocarbon results are stratigraphically consistent within each layer; however, the age ranges for the layers are inverted. Layer III has an overall range of AD 1160-1450, while the upper part of Layer VI has an overall potential age range of AD 1316-1955. The inversion may be due to the fact that the dated sediments have eroded from inland locations of varying age; however, without additional evidence it is not possible to resolve the inconsistency.

Age determination age ranges for samples from probable pondfield deposits in the lower valley segment include: AD 899-906 or 950-1170 (RC-348), AD 1120-1280 (RC-347), AD 1170-1300 (RC-346), AD 1170-1320 or 1339-1392 (RC-350), AD 1270-1420 (RC-349), AD 1430-1670 or 1949-1952 (RC-358), and AD 1510-1955 (RC-360). Taken as a whole, these ranges fall between AD 899 and AD 1952. The majority of the ranges cluster between the mid-1100s and the 1600s. This time period corresponds very well with the probable time period for the development of extensive pondfield systems in Hawaii (Kirch 1985:303-306).

Radiocarbon age ranges for samples from possible pondfield deposits in the upper valley segment of the project area include: AD 1225-1307 or 1358-1380 (RC-353), AD 1430-1670 or 1949-1952 (RC-358), and AD 1670-1780 or 1790-1950 (RC-344). If the later possible ranges for RC-344 and RC-358 are omitted--because they are improbably late, then the remaining ranges form a cluster spanning from the 1200s to the late 1700s. While the age ranges for the possible pondfield deposits in the upper valley should be viewed very cautiously because their association with pondfield deposits is not certain, they do fit in well with the expected time frame for the development of extensive pondfields in Hawaii. They also suggest that upper valley segment pondfields were developed somewhat later than those in the lower valley.

A single sample, taken from what is interpreted as a possible natural stream terrace surface in the upper valley segment, yielded a radiocarbon age range of 400 BC to AD 240 (RC-359, Layer III, BT-30). This age range fits well with other later dates from the vicinity--which date subsequent cultural activities, including habitation activities and pondfield agriculture, that occurred on the preexisting stream terrace surface.

PORTABLE ARTIFACTS

One hundred eighty-one (181) artifacts were recovered at the West Loch Estates - Golf Course and Parks project area. Recovered artifacts included 19 (10.5%) indigenous (prehistoric) artifacts and 162 (89.5%) non-indigenous (historic) artifacts. Fourteen (7.7%) artifacts were from Area 1, 91 (50.3%) were from Area 2, and 76 (42.0%) were from Area 5. A summary of the portable artifact collection is presented in Table 7, and a detailed distribution of the artifacts is presented in Table 8.

Area 1 yielded no indigenous artifacts. Area 2 yielded 11 artifacts; of the 11, two (adze fragments) were recovered from the general area and six (three volcanic glass flakes, two basalt flakes, and a basalt ulu maika) were found on the surface of Site 3321. The other three artifacts from Area 2 were two volcanic glass flakes and one polished basalt flake (from BT-27 at Site 3321). Area 5 yielded eight indigenous artifacts--single volcanic glass cores from SU-5, SU-17, and SU-53; volcanic glass flakes from SU-15 and SU-1 (Site 3319); an adze fragment from SU-9; a modified shell from SU-2; and a roughed-out bone tab from the surface of Site 3319.

As a whole, the indigenous artifact assemblage recovered in the project area was somewhat limited, being comprised primarily of flaked stone and tool artifacts. Volcanic glass flakes and cores alone made up 52.6% of the total assemblage. Barrera and Kirch have suggested probable uses for volcanic glass artifacts:

> The possible functions...are many and varied. Basaltic glass holds a fine, sharp edge and the tools make excellent cutting and scraping implements. They may have been used in

Table 7.

SUMMARY OF PORTABLE ARTIFACTS

CATEGORY	AREA 1	AREA 2		AREA 5				TOTAL
	AMs	SURF	SITE 3321	SURF	SUs	SITE 3318	SITE 3319	
INDIGENOUS								
FISHING GEAR	-	-	-	-	-	-	1	1
Roughed-out tab (bone)	-	-	-	-	-	-	1	1
TOOLS	-	1	1	-	1	-	-	3
Adze fragment	-	1	1	-	1	-	-	3
FLAKED STONE	-	-	7	-	4	-	1	12
Volcanic glass	-	-	5	-	4	-	1	10
Basalt flake	-	-	2	-	-	-	-	2
MISCELLANEOUS OTHER	-	-	2	-	-	-	1	3
Ulu Maika	-	-	1	-	-	-	-	1
Modified shell	-	-	-	-	-	-	1	1
Polished basalt	-	-	1	-	-	-	-	1
SUBTOTAL INDIGENOUS	-	1	10	-	5	-	3	19
NON-INDIGENOUS								
Building materials	3	-	-	-	-	-	-	3
Ceramics	-	18	13	1	2	43	-	77
Glassware	5	20	28	-	-	20	-	73
Glass sherd w/ edgewear	-	-	-	-	1	-	-	1
Metal fragments	-	1	-	-	-	1	-	2
Plastic fragments	6	-	-	-	-	-	-	6
SUBTOTAL NON-INDIGENOUS	14	39	41	1	3	64	-	162
TOTAL PORTABLE ARTIFACTS	14	40	51	1	8	64	3	181

food preparation, for cutting and scraping plant materials, or for delicate woodworking.... [T]hese tools are extremely common, being found in virtually every type of [Hawaiian] site. The suggestion, then, is that the ubiquitous basaltic glass flakes functioned as a prehistoric "pocketknife," to use a modern analogy (1973:185-186).

Non-indigenous artifacts recovered in the project area totaled 162 items. The majority (92.6%) of non-indigenous artifacts was comprised of ceramics (77 items, 47.5%) and glassware (73 items, 45.1%). Area 1 yielded 14 non-indigenous artifacts (8.6%)--three building items (nails

Table 8.

DETAILED DISTRIBUTION OF PORTABLE ARTIFACTS

CATEGORY	AREA 1							AREA 2					SUB GRAND TOTAL
	AM-2				AM-3	AM-5	AREA	SITE 3321				AREA	
	II	IV	V	SUB-T	IV	I	TOTAL	SURF	SURF	BT-2/	SUB-T	TOTAL	
INDIGENOUS													
FISHING GEAR													
Roughed-out tab (bone)	-	-	-	-	-	-	-	-	-	-	-	-	-
TOOLS													
Adze fragment	-	-	-	-	-	-	-	1	1	-	1	2	2
FLAKED STONE													
Volcanic Glass													
Core	-	-	-	-	-	-	-	-	-	-	-	-	-
Flake	-	-	-	-	-	-	-	-	3	2	5	5	5
Basalt													
Flake	-	-	-	-	-	-	-	-	2	-	2	2	2
SUBTOTAL FLAKED STONE	-	-	-	-	-	-	-	-	5	2	7	7	7
MISCELLANEOUS/OTHER													
Ulu Maika (basalt)	-	-	-	-	-	-	-	-	1	-	1	1	1
Modified shell	-	-	-	-	-	-	-	-	-	-	-	-	-
Polished basalt	-	-	-	-	-	-	-	-	-	1	1	1	1
SUBTOTAL MISC/OTHER	-	-	-	-	-	-	-	-	1	1	2	2	2
TOTAL INDIGENOUS	-	-	-	-	-	-	-	1	7	3	10	11	11
NON-INDIGENOUS													
BUILDING MATERIALS													
Nails	-	-	1	1	1	-	2	-	-	-	-	-	2
Ceramic tile	1	-	-	1	-	-	1	-	-	-	-	-	1
SUBTOTAL BUILDING MATERIALS	1	-	1	2	1	-	3	-	-	-	-	-	3
CERAMICS													
Bowl	-	-	-	-	-	-	-	6	5	-	5	11	11
Pipe stem	-	-	-	-	-	-	-	-	-	-	-	-	-
Plate	-	-	-	-	-	-	-	3	6	-	6	9	9
Teacup	-	-	-	-	-	-	-	1	-	-	-	1	1
Miscellaneous:													
Vessel sherds	-	-	-	-	-	-	-	8	2	-	2	10	10
Other sherds	-	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL CERAMICS	-	-	-	-	-	-	-	18	13	-	13	31	31

Table 8. (Cont.)

CATEGORY	AREA 1							AREA 2					SUB GRAND TOTAL
	AH-2				AH-3	AH-5	AREA	SITE 3321				AREA	
	II	IV	V	SUB-T	IV	I	TOTAL	SURF	SURF	BT-27	SUB-T	TOTAL	
GLASSWARE													
Beverage	-	-	-	-	-	-	-	9	16	-	18	27	27
Patent/Propriety													
Medicine	-	-	-	-	-	-	-	-	-	-	-	-	-
Miscellaneous Sherds	-	1	3	4	-	1	5	11	10	-	10	21	26
SUBTOTAL GLASSWARE	-	1	3	4	-	1	5	20	28	-	28	48	53
MISCELLANEOUS/OTHER													
Glass sherd w/edgewear	-	-	-	-	-	-	-	-	-	-	-	-	-
Metal													
Fragments	-	-	-	-	-	-	-	1	-	-	-	1	1
Wire	-	-	-	-	-	-	-	-	-	-	-	-	-
Plastic	2	-	4	6	-	-	6	-	-	-	-	-	6
SUBTOTAL MISC/OTHER	2	-	4	6	-	-	6	1	-	-	-	1	7
TOTAL NON-INDIGENOUS	3	1	8	12	1	1	14	39	41	-	41	80	94
TOTAL PORTABLE ARTIFACTS	3	1	8	12	1	1	14	40	48	3	51	91	105

Table 8. (Cont.)

CATEGORY	AREA 5													
	SD-5	SD-15	SD-17	SD-53	SD-54	SD-59	SITE 3310		SITE 3319			AREA	GRAND
	SURF	ALL	ALL	ALL	ALL	ALL	SURF	SURF	SD-1	SD-2	SUB-T	TOTAL	TOTAL
INDIGENOUS													
FISHING GEAR													
Roughed-out tab (bone)	-	-	-	-	-	-	-	-	1	-	-	1	1	1
TOOLS													
Adze fragment	-	-	-	-	-	-	1	-	-	-	-	-	1	3
FLAKED STONE													
Volcanic glass													
Core	-	1	-	1	1	-	-	-	-	-	-	-	3	3
Flake	-	-	1	-	-	-	-	-	-	1	-	1	2	7
Basalt														
Flake	-	-	-	-	-	-	-	-	-	-	-	-	-	2
SUBTOTAL FLAKED STONE	-	1	1	1	1	-	-	-	-	1	-	1	5	12
MISCELLANEOUS/OTHER														
Dia Maika (basalt)	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Modified shell	-	-	-	-	-	-	-	-	-	-	1	1	1	1
Polished basalt	-	-	-	-	-	-	-	-	-	-	-	-	-	1
SUBTOTAL MISC/OTHER	-	-	-	-	-	-	-	-	-	-	1	1	1	2
TOTAL INDIGENOUS	-	1	1	1	1	-	1	-	1	1	1	3	8	19
NON-INDIGENOUS														
BUILDING MATERIALS														
Nails	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Ceramic tile	-	-	-	-	-	-	-	-	-	-	-	-	-	1
SUBTOTAL BUILDING MATERIALS	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CERAMICS														
Bowl	-	-	-	-	-	-	-	23	-	-	-	-	23	34
Pipe stem	1	-	-	-	-	-	-	-	-	-	-	-	1	1
Plate	-	-	-	-	-	2	-	-	-	-	-	-	2	11
Teacup	-	-	-	-	-	-	-	8	-	-	-	-	8	9
Miscellaneous:														
Vessel sherds	-	-	-	-	-	-	-	7	-	-	-	-	7	17
Other sherds	-	-	-	-	-	-	-	5	-	-	-	-	5	5
SUBTOTAL CERAMICS	1	-	-	-	-	2	-	43	-	-	-	-	46	77

Table 8. (Cont.)

CATEGORY	AREA 5														
		SU-5	SU-15	SU-17	SU-53	SU-54	SU-59	SITE 3318		SITE 3319				AREA	GRAND
	SURF	ALL	ALL	ALL	ALL	ALL	ALL	SURF	SURF	SU-1	SU-2	SUB-T	TOTAL	TOTAL
GLASSWARE															
Beverage	-	-	-	-	-	-	-	1	-	-	-	-	1	28
Patent/Proprietary															
Medicine	-	-	-	-	-	-	-	1	-	-	-	-	1	1
Miscellaneous sherds	-	-	-	-	-	-	-	18	-	-	-	-	18	44
SUBTOTAL GLASSWARE	-	-	-	-	-	-	-	20	-	-	-	-	20	73
MISCELLANEOUS/OTHER															
Glass sherd w/edgewear	-	-	-	-	-	1	-	-	-	-	-	-	1	1
Metal															
Fragments	-	-	-	-	-	-	-	1	-	-	-	-	1	2
Wire	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plastic	-	-	-	-	-	-	-	-	-	-	-	-	-	6
SUBTOTAL MISC/OTHER	-	-	-	-	-	1	-	1	-	-	-	-	2	9
TOTAL NON-INDIGENOUS	1	-	-	-	-	3	-	64	-	-	-	-	68	162
TOTAL PORTABLE ARTIFACTS	1	1	1	1	1	3	1	64	1	1	1	3	76	181

and ceramic tile), five glassware sherds, and six plastic fragments. Four of the plastic fragments were recovered from Layer V of Auger Hole 2; this indicates that the auger hole deposit was disturbed.

Area 2 yielded a total of 80 non-indigenous artifacts (49.4%). Of the 80, 39 artifacts--18 ceramic pieces (six bowl fragments, three plate fragments, one tea cup, and eight vessel sherds), 20 glassware pieces (nine beverage fragments and 11 glass sherds), and one metal fragment--were recovered from the general ground surface. The other 41 artifacts were found on the surface of Site 3321; these 41 artifacts were comprised of 13 ceramic fragments (five bowls/fragments, six plates/fragments, and two vessel sherds) and 28 glassware items (18 beverage bottles/fragments and 10 glass sherds)--artifacts which are primarily utilitarian household items.

Area 5 yielded 68 historic artifacts. Of the 68 artifacts, 64 were located on the surface of Site 3318 (Site 3318 was designated a site on the basis of its surface artifact concentration). The Site 3318 surface collection is comprised of 43 ceramic items (23 bowls/fragments, eight teacups/fragments, seven vessel sherds, and five ceramic sherds), 20 glassware items (one beverage bottle, one medicine bottle, and 18 glass sherds), and one metal fragment. Additional Area 5 artifacts include a ceramic pipe stem from the surface of Area 5 and two plate fragments and a glassware sherd with edgewear from SU-54.

ECOFACTUAL REMAINS

Table 9 presents a summary of the variety and distribution of midden remains recovered from the West Loch Estates - Golf Course and Parks project area. Ecofactual remains analysis focused primarily on determining the species present and their relative quantities within excavation units (primarily shovel units). A factor which limited the ecofactual analysis was the disturbed nature of the deposits, especially in Areas 1 and 2.

Marine vertebrates comprised 89.6% of the overall ecofactual remains, with bivalves accounting for 86.9% of the overall total. Brachidontes crebristriatus, Isognomonidae, and Tellinidae made up 94.6% of the bivalves and 82.2% of the overall ecofactual remains. The greatest concentrations of marine vertebrates were present in SU-1 and SU-2 in Area 5 on Hoseae Point. This is probably due to the favorable environment (brackish water, silty sand, and proximate limestone shorelines) in the area.

Since marine vertebrates are natural to coastal areas in Hawaii, it is not possible to determine from an examination of the midden collection which marine invertebrates were exploited, to what extent, or if they were exploited at all in the project area. However, the fact that there are charcoal, Aleurites moluccana (kukui), and bone material present in association with marine invertebrates suggests food preparation and consumption activities took place in the project area.

Table 9.

QUANTITATIVE DISTRIBUTION OF ECOFACTUAL REMAINS
FROM VARIOUS SUBSURFACE TEST UNITS

MATERIAL*	AREA 1 SITE 11111 AU-12 BT-17		AREA 2 SITE 11112 FS-1 ALL				AREA 3 SITE 11113 SU-1 SU-2	SU-3	SU-4	SU-5	SU-10	SU-11	SU-12	AREA TOTAL
MARINE INVERTEBRATES														
CALYPTOTA														
Turbinella flavida	-	-	-	0.22	-	-	-	-	-	-	-	-	-	0.22
Neritina virginea	-	-	-	-	-	-	-	-	-	-	-	0.58	0.58	0.58
Neritina reclivata	-	-	-	0.33	-	-	-	-	-	-	-	-	-	0.33
Littorina flavescens	-	-	-	-	-	-	-	-	-	-	-	-	-	0.33
Nuttallina californica	-	-	-	2.67	-	-	-	-	-	-	-	-	-	2.67
Unidentified gastropods	-	-	-	20.19	0.61	0.17	0.04	-	-	-	0.58	-	0.33	1.67	21.98
SUBTOTAL CALYPTOTA	-	-	-	24.41	0.61	0.17	0.04	-	-	-	0.58	-	0.92	2.25	26.44
ARTHROPODA														
Brachiopoda														
Lingula reeve	-	-	-	11.28	193.81	2.24	10.33	4.04	0.24	0.56	0.28	-	-	0.33	0.33
Crustacea	-	-	-	11.28	193.81	2.24	10.33	4.04	0.24	0.56	0.28	-	-	0.33	0.33
Callinectes sapidus	-	-	-	11.28	193.81	2.24	10.33	4.04	0.24	0.56	0.28	-	-	0.33	0.33
Tellinidae	-	-	-	35.53	187.59	4.76	1.67	1.48	1.01	1.30	0.94	-	-	0.33	0.33
Veneridae	-	-	-	35.41	3.10	7.36	-	9.04	1.37	-	-	0.40	-	0.67	11.08	31.98
Unidentified bivalve	-	-	-	-	-	-	-	-	-	-	-	0.89	-	0.33	1.67	31.98
SUBTOTAL ARTHROPODA	-	-	-	106.28	577.27	20.75	57.23	37.23	5.42	4.71	12.20	0.96	1.29	111.96	206.77	88.74	88.74
OTHER														
Crustacea	-	-	-	-	0.15	-	-	-	-	-	-	-	-	-	0.13	0.13
TOTAL MARINE INVERTEBRATES	-	-	-	206.20	447.81	31.36	57.46	37.31	9.42	4.71	12.78	0.96	1.29	112.76	285.02	911.03	911.03
OTHER INVERTEBRATES														
Nonmarine gastropods	-	-	-	-	-	-	-	0.23	-	-	-	-	-	0.25	0.48	0.48	0.48
VERTEBRATES														
Bird	2.31	12.09	-	2.02	-	-	-	-	3.00	0.28	-	-	0.24	4.92	6.94	81.34	81.34
MENTAL														
Saccharum officinarum	-	-	-	-	2.49	-	-	-	1.01	-	-	-	-	1.03	3.32	3.32	3.32
Cucurbita	-	-	-	0.30	19.84	-	-	-	-	0.78	-	-	-	0.78	21.02	21.02	21.02
TOTAL VEGETAL	-	-	-	0.30	22.32	-	-	-	1.01	-	0.78	-	-	1.81	24.34	24.34	24.34
TOTAL NON-ECOFACTUAL	-	120.43	184.80	900.10	1.20	1.48	13.57	3.43	9.80	1.37	2.03	0.13	11.63	34.58	1,151.46	1,182.04	1,182.04
GRAND TOTAL	2.31	301.71	395.30	1,372.16	32.36	91.88	48.31	13.07	19.44	18.57	4.37	1.42	123.41	324.74	2,094.33	2,396.17	2,396.17

*Weight in grams.

POLLEN SAMPLES

In order to ascertain the crops which may have once been grown in the fishpond/pondfield areas in the present project area, palynological analysis of pollen samples recovered from these areas was conducted. Twenty-four samples recovered from eleven trenches located in Survey Areas 1-4 were submitted to Dr. Linda Scott Cummings of PaleoResearch Laboratories in Denver, Colorado. Her analysis (Appendix C) indicated that a number of crops--including taro (Colocasia esculenta), sugarcane (Saccharum officinarum), sweet potato (Ipomoea batatas), rice (Oryza sativa), corn (Zea mays), and radish (Raphanus)--were probably grown in the fishpond/pondfield areas.

An abundance of taro and sugarcane pollen was present in the pollen record; this indicates these crops were probably once cultivated in several sections of the project area, and were probably cultivated over a long period of time. However, because wind can carry sugarcane pollen a long distance, it is possible that the area the pollen was recovered from was not actually cultivated. The rice pollen was recovered from BT-6 and -12 in Area 1 and from BT-8 in Area 4. Identification of rice pollen is difficult because the pollen closely resembles other types of grass pollen; however, historical research has indicated that rice was grown in the project area. Sweet potato pollen was recovered in Area 1, BT-14, and in Area 2, BT-7. Because sweet potato is insect pollinated and can be transported only by man, insects, or water, there is a strong possibility this crop was cultivated in the project area. Because of the crop requirements, cultivation was probably limited to a few of the drier sections. Further testing is needed to determine the extent of radish pollen in the project area; it is expected that this further testing will indicate that a number of additional vegetable crops were grown in the area. The recovery of corn pollen was somewhat unexpected; again, further testing is needed to determine the crop extent.

As a whole, the palynological analysis indicates that more extensive testing is needed in the project area to define further the nature and extent of crops grown. The present study indicates that palynology is a viable tool in defining and describing historic/prehistoric cultivation in the project area; large quantities of identifiable pollen were recovered and a number of cultivated crops were identified. Based on her initial analysis, Dr. Cummings strongly recommended that the project area undergo further palynological study.

CONCLUSION

DISCUSSION

Soils and Geomorphology

Subsurface and surface investigations within the project area produced a wealth of information concerning the relationship between the depositional history and cultural historical development of Honouliuli Valley. An understanding of this relationship had been deemed essential to interpreting the archaeological remains within the project area--soil pedogeny and specific depositional events are often closely related to the cultural occupation and utilization of an area. Natural and culturally initiated changes in local environments are often reflected in the pedogenic record, making it worthwhile to document and describe such changes. Geomorphological processes can greatly affect the way in which cultural remains become manifested in the archaeological record, and can greatly affect methods of detecting, retrieving, and interpreting archaeological remains.

Riverine settings generally are the most complex, and potentially most significant environments for studying the relationships between geomorphology and culture, and the relationship between geomorphology and the archaeological record. Alluvial processes in riverine settings are complex and variable, and the relationships between such processes and cultural adaptation and change, and archaeological interpretation, are all the more complex. Extensive riverine environments are very few in the Hawaiian Islands. Consequently, very few archaeological studies have been conducted on such environments. Although Honouliuli Valley is a rather minor stream system, the alluvial and geomorphological processes evidenced within it are similar to riverine environments elsewhere in the world; it is hoped that the present study minimally demonstrates the need for further investigation into Hawaiian riverine environments.

A summary of the depositional and topographic products--soil deposits and features of the terrain--of Honouliuli Valley may prove useful in understanding the complex formation of valley substratum. In the following discussion, soil deposits and features of the terrain are grouped into soil units, which in the project area possess definite vertical and horizontal extents, and which relate specifically to features of the terrain.

The significance of these soil units, and their relationship to the archaeology of the project area, has to a large extent, been previously discussed. The following section attempts to refine the definition and interpretation of these depositional units on a broader scale, commensurable with the project area as a whole. Discussed below are four soil units--natural gleyed soils (Soil Unit Gn), gleyed agricultural soils (Soil Unit Ga), leached gleyed soils (Soil Unit K), and historic/prehistoric-induced erosional deposits (Soil Unit K).

Natural gleyed deposits (Gn) are located in the lower valley segment of the project area. They consist of deeply buried, fine-textured sediments which develop within a non-oxidizing, reducing environment to form gley-colored soil compounds. In appearance, these deposits are very similar to those which form in association with pondfield agriculture (Soil Unit Ga described below). The difference between the two is slight. Ga soils form as a consequence of pondfield agricultural activities while Gn soils are purely natural phenomena. The precise extent of the Gn Soil Unit in the project area is unknown, but the unit appears to constitute part of the gradual in-filling and aggrading of the shallow margins of West Loch. As discussed in a previous section, the lower valley portion of Honouliuli Gulch probably represents a filled-in embayment of the adjacent West Loch. Filling of this embayment has been a long-term process that has gradually advanced the shoreline between West Loch and Honouliuli Valley in an eastward direction. Evidence of this advancing shoreline is afforded by a comparison of historic period maps, which clearly depict newly formed lands advancing eastward over a period of little more than 100 years.

The rate at which the lower valley embayment filled to its present configuration has undoubtedly varied considerably through time. Also variable are the kinds of deposits that have served to advance the shoreline. A normal, simplified sequence of filling would entail an initial period in which coarse-grained materials accumulated, followed by a period in which an overburden of very fine-grained sediments accumulated. Deeply buried coarse-grained deposits lying beneath an overburden of predominantly fine-textured materials have been detected by sample boring in the western end of the lower valley section (Geolabs-Hawaii 1987). The textural variation between the coarse and fine-grained layers--which can be expected to also manifest horizontally--in the project area is manifested by the coarse-grain deposits which have accumulated primarily along the original shoreline of the embayment (i.e., adjacent to the fossil sea bluffs near the west end of the project area)--deposits which gradually grade eastward towards West Loch into progressively finer-grained and thicker deposits.

Initial, large-scale deposition of the finer-grained materials probably began with the development of a classic deltaic system at the braided mouth of Honouliuli Stream. Such a deltaic system would account for the predominance of very fine-textured silts and clays present in subsurface deposits in the lower valley section of the project area. It would also account for the fact that the gradual eastward advancement of the shoreline is without a concomitant newly aggraded landscape far above the water level of adjacent West Loch. The Gn deposits, coupled with an absence of an appreciable grade and relief within the lower valley, would ensure that subsurface drainage in the lower valley remains negligible. The present mouth of Honouliuli Stream, where it enters West Loch, is just such a feature--subsurface drainage is negligible, thereby providing the area with an abundance of virtually impounded fresh water. Deposits equivalent to the Gn Soil Unit are presently still forming along the shoreline of West Loch.

The gleyed agricultural soils (Soil Unit Ga) in the project area are believed to have formed in pondfield environments. The horizontal distribution of these soils within the project area is probably quite similar to the horizontal extent of the Gn Soil Unit. Backhoe testing revealed that Ga deposits are present in the lower valley segment and in the lower portion of the upper valley segment of the project area. Ga deposits in the project area appear to be superimposed over the Gn deposits. Ga soils appear to occur on top of, and to some extent within the upper boundary of the Gn Soil Unit. Early historic maps and descriptions of the lower valley indicate it as being excessively marshy or swampy, and being comprised of mud flats. It would appear that farmers took advantage of the wet conditions and developed agricultural fields on this landscape.

Leached, gleyed soils (Soil Unit K) in the project area are confined to the upper valley segment of the project area; these 25-50 cm thick deposits are found buried beneath Soil Unit Eh (described below), and also are found beneath Layers II and IV (cultural layers) at Site 3321. Soil Unit K consists of a single leached layer of crumbly silt, relatively homogenous and containing a few gleyed mottles. The soil unit has been tentatively identified as representing the oxidized remnant of a drained, upper valley pondfield deposit. Radiocarbon and palynological analysis of Unit K layers in Survey Area 2 BT-7 and -30 indicate the layers date to between the 1200s and 1700s, and that pollen in the layers are from both prehistoric and historic cultigens.

Throughout the upper valley segment, Soil Unit K directly overlies stream-deposited coarse material, which becomes increasingly coarse--from sand to horizontally bedded cobbles and boulders--with depth. These underlying, very permeable coarse deposits allow overlying layers much drainage, and thus probably account for the dried-out, leached appearance of Soil Unit K. In some profiles, the upper boundary of Soil Unit K is abruptly and evenly truncated; this truncation clearly reflects an erosional event in which the top of the deposit was planed off. Where this truncation occurs, Soil Unit Eh directly overlies Soil Unit K. This stratigraphic non-conformity implies the removal of a previously established A-horizon from above Soil Unit K. Occasionally, a preserved A-horizon is present, juxtaposed between Soil Unit K and Soil Unit Eh; this may indicate that Soil Unit K is a remnant of a natural stream terrace, the surface of which was subsequently used for pondfield agriculture.

Prehistoric/historic-induced erosional deposits (Soil Unit Eh) are perhaps the most easily identifiable deposits in the project area. They are also the most visible--the deposits are extensively exposed on the ground surface. Soil Unit Eh is comprised of deposits which are believed to be closely, but not exclusively, related to cultural disturbance of the landscape; the unit is comprised of a massive, homogenous clay deposit, which has been transported from the upland interior terrain of the project area to the low-lying coastal plain region. In general, these redeposited upland soils have not been in place long enough to undergo substantial development on the coastal plain; thus the distinctive reddish-brown color of the unit--the result of long-term upland weathering and development.

Two aspects of Soil Unit Eh are particularly relevant to the archaeology of the project area. The first aspect concerns the hypothesized relationship between human impact on the environment and rate of deposition of the soil unit. The second aspect relates to the burial and preservation of archaeological remains within the lowlands of Oahu beneath the soil unit. Erosion of upland terrain, and the transportation and redeposition of weathered, unconsolidated material onto low-lying surfaces are natural phenomena which in any environment may be taken as a given, ongoing process. Changes in the rates at which these processes occur can be related to either specific events, or to natural, gradual changes in the landscape that affect the agents of erosion, transportation and redeposition. Occasionally, the geomorphological record will reveal evidence for events that are, in geomorphological terms, catastrophic in proportion to normally expected rates. Such changes in rates can often be equated with a specific causal event that served to trigger an acceleration of geomorphological processes. Soil Unit Eh appears to represent just such an accelerated event; evidence for this event is manifested within both the archaeological and stratigraphic record of the project area, and to some extent is also documented by historical, written accounts.

Soil Unit Eh, which constitutes the last major depositional event within the project area, forms a mantle over the entire valley portion of the project area. This mantle, which varies in thickness, completely obscures the former landscape, making for a situation that possesses important implications for archaeological study and interpretation of the area. First of all, the buried original landscape necessitates survey methods which include extensive subsurface testing. Secondly, the buried landscape enhances the chances that archaeological remains will be found preserved.

Culture-Historical Summary

Prior to the present project, little archaeological and historical research had been done in the Honouliuli Gulch area. Current project research has significantly added to knowledge of past use of the area. Seven new sites, historic and prehistoric habitation and burial sites situated on Hoaeae Point and on the slopes and uplands surrounding the Honouliuli Stream floodplain, were identified and documented. Perhaps the most significant sites identified are the remnants of a once extensive agricultural system which combined aquaculture (in fishponds situated on the shores of West Loch), irrigated pondfields, and dryland agriculture (on the slopes and uplands surrounding Honouliuli Valley). Agricultural use of the area spans over 1000 years, which surely makes the area the largest such system known on the leeward coast of Oahu.

Initially, the agricultural system in the project area was based on prehistorically introduced cultigens and technology; later the system underwent successive changes--historically introduced rice replaced taro in the pondfield system, and later, modern intensive sugarcane cultivation largely obliterated the earlier pondfields. Agricultural use of the Honouliuli Stream floodplain for pondfield cultivation of taro may have

begun in the lower valley segment as early as AD 1000. Extensive evidence of pondfield cultivation in the lower valley dates from the 1100s to 1600s. As is documented by historic sources, pondfield cultivation continued into the early 1900s, by which time rice had largely replaced taro. Cultivation of upper valley pondfields may have begun as early as the 13th-14th centuries, although historical documentation goes only as far back as the 1800s.

Cultivation of dryland crops on the floodplain and in the upland areas surrounding the floodplain is documented historically. Also documented historically are fishponds along the shore of West Loch. Although no clear evidence of prehistoric fishponds was encountered, it is likely that prehistoric fishponds were constructed in the general area; these ponds were probably located inland of the historic ponds, and over a period of time, as the shoreline aggraded seaward, were converted to pondfields.

Habitation sites in the project area consist of surface and subsurface deposits containing artifacts and midden. Site 3318, located on Hoaeae Point, dates to the historic period. Occupation of Sites 3319 and 3320, situated on ridges overlooking West Loch and Hoaeae Point, respectively, appears to span late-prehistoric to early-historic times. Site 3321, which is located at the edge of the upper valley segment floodplain, may have been occupied as early as the mid-6th to mid-9th centuries, with subsequent occupations occurring between the 1300s and 1600s, and late 1700 to early 1800s. Two habitation sites in the project area (3319 and 3321) contained at least one human burial. While it is difficult to determine the nature and intensity of occupation at these sites, their location next to permanent agricultural fields and the presence of burials at the sites suggests they were permanently occupied.

GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

To facilitate State and County review, general significance assessments and recommended general mitigation treatments for all sites identified during the combined surface and subsurface reconnaissance survey of the West Loch Estates - Golf Course and Parks project area are summarized in Table 10. Significance categories used in the evaluation process are based on the National Register criteria contained in the Code of Federal Regulations (36 CFR Part 60, Section 4). The State Department of Land and Natural Resources-Historic Sites Section (DLNR-HSS) uses these criteria to evaluate eligibility for both the Hawaii State and National Register of Historic Places. Sites determined to be potentially significant for information content (Categories A and X, Table 10) fall under Criterion D, which defines significant resources as ones which "...have yielded, or may be likely to yield, information important in prehistory or history". Sites potentially significant as representative examples of site types (Category B, Table 10) are evaluated under Criterion C, which defines significant resources as those which "...embody the distinctive characteristics of a type, period, or method of construction..., or that represent

Table 10.

SUMMARY OF GENERAL SIGNIFICANCE ASSESSMENTS
AND RECOMMENDED GENERAL TREATMENTS
WEST LOCH ESTATES - GOLF COURSE AND PARKS PROJECT AREA

HRHP Site 50-12-80-	Significance Category				Recommended Treatment			
	A	X	B	C	FDC	NFW	PID	PAI
3318	+	-	-	-	+	-	-	-
3319	+	-	-	+	+	-	-	+
3320	+	-	-	-	+	-	-	-
3321	+	-	-	+	+	-	-	-
3322	+	-	-	-	+	-	-	-
3323	+	-	+	-	+	-	+	-
3324	+	-	-	-	+	-	-	-

General Significance Categories:

A=Important for information content, further data collection necessary (PHRI=research value);
X=Important for information content, no further data collection necessary (PHRI=research value, SHPO=not significant);
B=Excellent example of site type at local, region, island, State, or National level (PHRI=interpretive value); and
C=Culturally significant (PHRI=cultural value).

Recommended General Treatments:

FDC=Further data collection necessary (intensive survey and testing, and possibly subsequent data recovery/mitigation excavations);
NFW=No further work of any kind necessary, sufficient data collected, archaeological clearance recommended, no preservation potential (possible inclusion into landscaping suggested for consideration);
PID=Preservation with some level of interpretive development recommended (including appropriate related data recovery work); and
PAI=Preservation "as is," with no further work (and possible inclusion into landscaping), or minimal further data collection necessary.

a significant and distinguishable entity whose components may lack individual distinction."

Sites with potential cultural significance (Category C, Table 10) are evaluated under guidelines prepared by the Advisory Council on Historic Preservation (ACHP) entitled "Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review" (ACHP 1985). The guidelines define cultural value as "...the contribution made by an historic

property to an ongoing society or cultural system. A traditional cultural value is a cultural value that has historical depth" (1985:1). The guidelines further specify that "[a] property need not have been in consistent use since antiquity by a cultural system in order to have traditional cultural value" (1985:7).

Based on the findings of the combined reconnaissance survey field work, the cultural remains identified within the West Loch Estates - Golf Course and Parks project area appear to range, for the most part, from limited to substantial significance in terms of potential information content. Four of the identified sites (Sites 3318, 3320, 3322, 3324) were determined to be significant for their information content only; appropriate mitigation for these four sites would involve variable degrees of further data collection (intensive survey level detailed recording and test excavations) and possibly subsequent data recovery excavations. The site-specific scope and scale of data collection and recovery work would be developed in consultation with staff archaeologists in DLNR-HSS, and contained within the written cultural resource management plan to be prepared and approved prior to any mitigation field work.

Two of the identified sites (Sites 3319, 3321) were determined to be significant both for their information content and for their cultural value because of the presence of one or more human burials. With regards to their scientific research value (information content), appropriate mitigation for these two sites would involve variable degrees of further data collection (intensive survey level detailed recording and test excavations) and possibly subsequent data recovery excavations. With regards to their cultural value, appropriate mitigation would involve either continued in-place protection (preservation "as is"), or disinterment of skeletal remains according to current State Health Department regulations and procedures.

One site (Site 3323) was determined to be significant both for its information content, and as a good example of a site type. Appropriate mitigation for this site would involve some degree of further data collection (including historical documentary and local informant research) and continued preservation with some level of interpretive development. As with the other six sites for which further work has been recommended, the site-specific scope and scale of data collection work, as well as appropriate plans for interpretation, would be developed in consultation with staff archaeologists in DLNR-HSS, and contained within the written cultural resource management plan to be prepared and approved prior to any mitigation field work.

To evaluate the information content of sites located within the project area, they would be investigated in light of various research topics developed to further understand prehistoric and historic occupation and use of the project area. These topics include four general domains:

1. Period of use;
2. Nature and intensity of habitation site occupation;
3. Delineation of agricultural system development; and
4. Detailed definition of geomorphological processes and environmental change.

Finally, it is recommended that a qualified archaeologist selectively monitor initial grubbing activity and/or vegetation clearing within the project area. The general significance assessments and recommended general treatments presented here are based on the findings of the combined surface and subsurface reconnaissance survey field work, which involved relatively limited subsurface testing. Therefore, these evaluations and recommendations are given with the general qualification that during any development activity involving the modification of the land surface, there is always the possibility--however remote, that previously unknown or unexpected subsurface cultural features, deposits, or burials might be encountered. In such a situation, immediate archaeological consultation should be sought.

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APPENDIX A:

HISTORICAL DOCUMENTARY RESEARCH - WEST LOCH ESTATES PROJECT AREA

Historical Research Relative to the Land of Honouliuli, Ewa District, Island of Oahu

by

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Introduction

The primary intent of this research effort is to examine readily available sources for mythological, historical, cultural and in particular early land use data relative to Honouliuli. It is hoped that the highlights and general commentary which appear here prove serviceable in the development of broad cultural and historical impressions and that they shall provide a documentary context from which the archaeological findings may be better perceived and appreciated.

Native Traditions

Mythological References - Ewa District

Ewa was a land much-favored by the gods, chiefs and the general populace from ancient times. Some of the oldest traditions relate that of the four major gods, two had a particular interest in the area. These two gods of water sources, Kane and Kanaloa, singled-out the Ewa lands and blessed them with an abundance of rivers and springs for the cultivation of crops and constructed and maintained well-stocked fishponds for their use. They are also credited with fixing district boundaries which separate the various Ewa lands. (Handy 1972:472-3)

An ancient line of chiefs sprang from Ewa. According to some genealogies, this class of chiefs dated from ten to fourteen generations

before Kamehameha. (Kamakau 1961:1) It is easily understood how Ewa assumed the position of royal residence and resort; her resources were bountiful - fish and shellfish, starch, fruit and vegetable crops flourished. Ewa was noted for a special variety of taro (kai koi o Ewa) which was quite popular among those of chiefly rank. (Pukui 1983:305) As a natural result of this fertility of land and sea, two royal compounds were located near the shore on the Waipio Peninsula. They were Lepau and Halaulani. (Sterling 1978:22) Puuloa also deserves mention as a royal residence and resort. Bingham recorded visits to this site by the King and his chiefly entourage well into the 1820's. (Bingham 1848:176-8)

The high-productivity of Ewa lands encouraged a sizeable population. By the time the first missionary census was tallied in 1831, Ewa's population was steadily declining. (Schmitt 1973 & 1977) Native historians such as Kamakau insist that "Oahu was then thickly populated. It is sad to see how in so short a time whole villages have vanished leaving not a man...(Kamakau 1961:424) In traditional times, it would seem, a substantial labor force would be necessary to maintain Ewa's taro patch and fishpond systems; however, because no statistics are available, we can only posite approximate size based on the scant literary and physical evidence which remain.

In assembling mythological references relative to Ewa, I became aware of a definite spiritual significance associated with this district. This may result from several factors: long-term connections of chiefs and royalty with the area, battles fought within the district which necessitated the construction of temples of human sacrifice to the war

gods (outcasts were even drowned in Ewa waters prior to their being laid upon these altars), and the presence of agricultural heiau and fishing shrines which were essential in guarantying the continuance of fertility and plenty. (Kamakau 1961:173, Pukui 1983:47, McAllister 1971:108)

Thus, it can be said that Ewa occupied a position of some prestige in traditional times due to its relationship with the gods and chiefs and its reputation for productivity of both land and sea.

Traditional References - Honouliuli

Many of the traditional references relative to Honouliuli connect a particular character or an event with a land form or a site. Puu o Kapolei, which is situated in the center of Honouliuli plain, is preserved in tradition as the home of the grandmother and protectoress of Kamapuaa, Oahu's famed pig-god. (Sterling 1978:33) Kaihuopalaai, a name which eventually became assigned to the whole of West Loch, was the name given to a pond where, in season, mullet would spawn and swim to Oahu's North Shore. Upon arriving there, they turned and retraced their path along the Koolau and Kona coasts, their destination being West Loch. (ibid. p.34)

There is a particular land area located in the project site known as Poohilo. It received its name indirectly from a battle fought between Oahu and Hawaii forces. Although the actual sites of warfare were Waikakalaua and Kipapa Gulches, a retreating warrior Hilo had the misfortune of being slain nearby. His head "was cut off and carried in triumph to Honouliuli, and stuck up at a place still called Poo-Hilo." (ibid. p.31) Literally, this is translated as "Hilo's head."

At least six heiau have been recorded for Honouliuli. Many are poorly located, if at all and they appear to fall outside of the project boundaries. One fishing shrine is mentioned and it falls within these boundaries. It is situated on Kapapapuhi Point and was known as Kalanamaihiki. (ibid. p.32-5) A solitary mention of a holua slide surfaced in a document settling the boundaries of Honouliuli ahupuaa in 1873. It is described as "ancient" and it sat on the boundary between Hoaeae and Pouhala in the vicinity of the Manawaielu gulch. (Hawaii State Archives, Interior Dept. Land File) Holua sliding was a sport for chiefs; its existance in Honouliuli-Hoaeae further verifies occupation of the area by those of rank.

Brief Historical Chronology

Early. Handy cites extensive taro cultivation due to the abundance of springs and rivers; sweet potato cultivation was common to fishermen of the area who tended patches close to their houses. Other crops found here include yams, bananas, awa, wauke, olona, ramake and the popular "kai" taro variety. (Handy 1971:81, 155 and Handy 1972:469-72) Coconut and breadfruit trees were also plentiful in the district. (Handy 1971:190, 193)

The following ponds were found in the vicinity of West Loch: Laulaunui, Kaihuopalaai, Kapamuku, and Okiokilepe. Numerous fish traps and some fishing shrines also existed here. (Sterling 1978:32-42) The waters of Puuloa in particular, abounded with shellfish such as pearl oysters. (Pukui 1983:34)

An extensive and antiquated system of salt works operated on the shore of the Honouliuli lobe of West Loch. Another salt works was situ-

ated further seaward at Puuloa. The Puuloa Salt Works had beginnings that were traceable to the 1820's and possibly even much earlier. By 1861, 100 acres had been devoted to the production of salt. (Pacific Commercial Advertiser 4/18/1861:1)

1823. The Rev. Hiram Bingham accompanied Kamehameha II and the chiefs to Puuloa where they went into temporary residence in native fashion. In his remarks about his visit there, Bingham mentioned seeing the home of a shark god and contributed his observations on taro and fish which he must have found in abundance.

> I one day accompanied the king and others by boat to see the reputed habitation of a Hawaiian deity, on the bank of the lagoon of Ewa. It was a cavern or fissure in a rock, chiefly under water, where, as their traditions teach, and as some then affirmed, a god, once in human form, taking the form of a shark, had his subterraqueous abode. Sharks were regarded by the Hawaiians as gods capable of being influenced by prayers and sacrifices, either to kill those who hate and despise them, or to spare those who respect and worship them....
>
> ... Their usual mode of cooking is to excavate a place in the ground, sufficiently large for a bushel or two of the large bulbous roots of arum or kalo, which are brought fresh from the patch or field, for the occasion; procure and put down at the bottom of the pit, the requisite amount of fuel, wood, or other combustibles, and raise upon it a heap of small stones, which are heated thoroughly, as the fuel burns out. The arum roots, or whatever articles are to be baked there, are placed compactly upon the heated stones, and covered with leaves and grass, to keep them clean, and prevent the heat from escaping into the air. A little water is then thrown upon the mass, and the whole covered quickly with earth, like a little coal-pit, as closely as three or four inches' depth of earth will make it. The water coming gradually in contact with the hot stones and coals, is converted into steam, which, with the radiating heat

> of the stones, in the course of two or three hours, accomplishes the object. Then this hemispherical little mound or ground oven is opened, the covering of earth, leaves and grass, is carefully removed, and the contents taken out. The arum roots are washed and peeled, and usually are pounded on a large thick wooden platter, with a stone pestle, some four or five inches in diameter. When thoroughly beaten, the mass resembles dough....This has long been the principal article of daily food for the mass of the Hawaiian people. The article of food next in importance with them, is fish, raw, dried, roasted or baked. It is eaten in moderate quantity, with the arum paste. Fowls, ducks, turkeys, goats, hogs and dogs, are, like the arum, baked in the ground-oven occasionally.
>
> Such cooking and preparing food being obviously unsuited to the sacredness and duties of the Sabbath, that labor was required to be done previously. The unusually numerous smokes rising from different parts of a village or valley, on a Saturday morning, became at length a pleasing, noiseless signal of the approach of the sacred day, and of preparation for it, as the people came to recognise its authority. (Bingham 1848:177-8)

1825. An early map of this date (with a variation in 1857) by Lieut. Maldan plots a "Watering Place" in the cove inland of Laulaunui Island. This is the same vicinity where the old salt beds were located. A sizeable settlement of dwellings and coconut trees are concentrated on Kapapapuhi Point; other groupings of houses and trees are scattered along the shore and border on a fragment of a road which appears to run mauka-makai (parallel to the cove shore). (Survey Reg. Map 437)

1836-40. The missionary Artemas Bishop found upon his arrival that his predecessor Lowell Smith had constructed an adobe house and church. An adobe school house is also erected; as these structures are mentioned in passing, none of them are given specific locations. However, land records of the late 1840s and early 1850s mention a meeting house upland

of Niukee and Kailikahi. These land records also placed a school house and Kapalani Catholic Church in Polapola. (Archives, Native and Foreign Registers and Testimonies and Bishop 1916:43-4)

1848-50s. The Great Mahele resulted in the ahupuaa of Honouliuli (43,250 acres) being awarded to M. Kekauonohi. 97 other awardees received land parcels ranging from .135 to 9.39 acres in size. (Indices 1929:765-9)

8/15/1848. In a letter of complaint to the Minister of Public Instruction, a school teacher named Naheana told of several "prisoners taro patches" at honouliuli that had been overgrown and long neglected. This teacher and his students reclaimed these patches and made them productive again. Naheana asked that the patches remain under the care of the school as one of the chiefs is attempting to take the patches away from them. (Public Instruction Correspondence file)

5/6/1850. Another teacher at Honouliuli submitted a petition to the Minister of Public Instruction stating that he and the students of his school reclaimed four grassy fishponds and re-stocked them with fish in 1848. As the Tax Assessor of the district had confiscated the ponds, this teacher asked their return. Apparently a circular had gone out some time possibly in 1848, ordering schools to utilize undeveloped or neglected government lands in the vicinity for the upkeep and benefit of the district schools. (ibid.)

4/14/1851. The Privy Council Records indicate that the Minister of Public Instruction reported "disorders existing at Ewa." Nothing more could be located in official record to flesh out the details of the nature of these disorders. However, as a result of these problems, a resolution was passed instructing Gov. Kekuanaoa "to have the prison for women in Ewa enclosed by a secure fence,..." (Privy Council Record 6: 342) Due to the number of taro patches and fishponds set apart in Honouliuli for the prisoners, it appears that this prison for women should be in relatively close proximity to work areas. A district prison was situated at Waiawa; whether it was for males or females is unknown.

11/26/1851. Naheana again wrote the Minister of Public Instruction this time to state his reasons for the rejection of a teacher, Kepilina. He accused Kepilina of dancing and thieving while employed as teacher of Honouliuli school and of general improper conduct while teaching at Puuloa. Naheana also mentioned Catholic priests in the area who have been among the people for a while who do not recommend retaining Kepilina. (Public Instruction Correspondence file)

It is during the 1850s that I believe the Catholics construct another church which was described simply as "located close to Pearl Harbor." By the 1880s this church is abandoned because of its run-down and dilapidated state. It is replaced in the early 1890s by a simple structure situated very close to the mill. A land exchange occurs with Campbell Estate in the late 1920s in which the old land is given for the land close to the mill. As little data existed beyond what is given here in the sources consulted, I am only able to conclude that there is some indication that the old church property may have been on Kapapapuhi Point. A more careful examination of title records will have to be conducted to ascertain if this is so. (Schoofs 1978:110-3)

1/21/1852. Haalelea, the widower of M. Kekauonohi, asserted his privillege as owner of Honouliuli by claiming all mullet as reserved for

his sole use. (Interior Dept. files)

1853. Artemas Bishop commented that the population was in decay by the 1850s. Taro lands had fallen into disuse. The smallpox epidemic of 1853 killed more than half of the Ewa population in a matter of a few weeks. He also noted that the chiefs were rarely seen in Ewa anymore. (Bishop 1916:43-4)

In summarizing land use in 1853, Coulter wrote:

> Nearly all the remaining population of Oahu was scattered around Pearl Harbor, along the east coast of the island, and at Waialua near the center of the north coast.
>
> Pearl Harbor formed an excellent site for fish ponds. An irregular shoreline with a large peninsula jutting out from it and several smaller ones also, formed areas which needed little artificial construction to make them landlocked. There were 27 fish ponds there, one, with an area of 320 acres..." (Coulter 1971:18, 20)

1879. Relative to water sources and the development of Ewa Plantation the following was written:

> The discovery of artesian water on the nearly arid plain of the Ewa District of the Island of Oahu led to the establishment of Ewa Plantation. Located on the southwestern shore of the island, between the entrance to Pearl Harbor and Barber's Point, the plantation was originally promoted by Benjamin F. Dillingham of the Oahu Railway & Land Company fame, to further his railroad interests.
>
> Sugar cane was grown at Ewa long before the 1876 Treaty of Reciprocity or Annexation, as the Reverend S. E. Bishop operated a water-powered sugar mill on the lands in 1840. As a point of interest the cylinder of the good Reverend's mill, which he made himself, was made of hardwood and the machine was capable of grinding more cane than was necessary to produce one ton of sugar a day.
>
> However, sugar as a commercial venture was not considered for the plantation until the first artesian well was drilled at Honouliuli in 1879. In reality it was the eminent James Campbell, of previous Maui Island experience who broke the drought for Ewa in having more artesian wells drilled in the area. (Conde 1973:278)

1880-1. Bowser made the following observations:

> HONOULIULI ESTATE, Honouliuli, District of Ewa; James Campbell, Esq., Proprietor; postoffice address, Government Road, Honouliuli, 15 miles from Honolulu. Acreage, 43,250, all in pasture, but possessing fertile soils suitable for agriculture; affords grazing for much valuable stock. The length of this estate is no less than 18 miles. It extends to within less than a mile of the sea coast, to the westward of the Pearl River inlet. It is on this estate that Mr. Campbell's successful artesian boring has been made, as to which see the author's notes in his Itinerary. There are valuable fisheries attached to this estate. (Bowser 1880:489)
>
> My next halting place after leaving Nanakuli, was at Honouliuli, at Mr. James Campbell's. This gentleman owns, also, the Kahuku ranch, on the extreme north point of the Island, of which I have already spoken. The Honouliuli ranch is an extensive property. The main road runs through it for about twelve miles, and the general breadth is seldom less than four miles. The surveyed area is 43,250 acres. One large tract of this land is perfectly level, with the exception of a few acres near the centre, where there is a knoll of rising ground.
>
> From Mr. Campbell's veranda, looking eastward, you have one of the most splendid sights imaginable. Below the house there are two lochs, or lagoons, covered with water fowl, and celebrated for their plentiful supply of fish, chiefly mullet. In the far distance, some twenty miles away, you can see the range of mountains which form the backbone of the island. It was on the northeastern side of the mountains that the earlier part of my ride was taken. The chain runs from Mr. Campbell's place at Kahuku, away to the easternmost point of the island. The soil at Honouliuli is good, and, with the aid of irrigation, will grow anything. In the mean time, it is wholly pasture land, but the means of irrigation have recently been secured by Mr. Campbell, who has sunk an artisian well to the depth of 273

feet. This well has delivered a continuous stream of water equal to 2,400 gallons per hour, ever since the supply from which the present flow comes, was struck on the 22d of September, 1879. Besides Mr. Campbell's residence, which is pleasantly situated and surrounded with ornamental and shade trees, there are at Honouliuli two churches and a school house, with a little village of native huts. (ibid. p. 495)

1882. From Frank Damon's "Tours Among the Chinese:"

...Towards evening we reached Honouliuli, where the whole valley is leased to rice planters...This was one of the largest rice plantations we visited. Sometimes two or three men only, have a few fields which they cultivate for themselves, and we often too came upon houses where there were eight or ten men working their own land. But the larger plantations are owned by merchants in Honolulu, who have a manager acting for them. The houses are destitute of all but the barest necessities of life, except those of some of the more wealthy planters. The wood-work is unpainted. The beds are arranged around the room like berths in a ship. Sometimes these are quite prettily ornamented with a border above the netting of Chinese silk, on which graceful sprays of flowers are painted and Chinese characters written. In the center of the room is a large table where the meals are taken in common. They never need lack for rice, and of this most excellent article of diet they seem never to weary....But on the rice and sugar plantations I was saddened by the sight of so many men, without women and children. It seemed unnatural inhuman, this herding together in 'quarters,' of scores of laborers, as if they were so many animals. We speak of Chinese Immigration to these Islands. It is properly speaking no immigration, it is simply the transplanting of so many working machines to our fields and valleys. These same men would be better, more desirable laborers, if they had their wives and little ones with them.... (Damon 1882:37)

1885. A description of James Campbell's Honouliuli Ranch appeared in the Pacific Commercial Advertiser. Only cattle and goats were pastured;

little in the way of crops was produced. However, the Chinese were credited with reclaiming the swamplands and former rice lands; for the use of these lands they pay very high rents. Approximately 200 acres were planted in rice and 50 acres were devoted to bananas. This banana plantation belonged to Mark Robinson who during the dry season, flumes water in from Waipahu Stream.

The flat coral plain of which the ranch is primarily comprised was covered with a scant verdure which has proven to be excellent in fattening stock. In fact, this coral pasture became the fattening paddock for both Honouliuli and Kahuku ranches as well.

The writer noted evidence of a considerable native population in former times. The remains of extensive taro and potato cultivation were visible. He attributed the smallpox epidemic of 1853 as the major cause of population decline.

The Honouliuli Ranch was originally the property of M. Kekauonohi; upon her death it passed to her husband Haalelea. Upon his death, his second wife sold it to J. H. Coney. J. Campbell purchased it from Coney in 1877. (Pacific Commercial Advertiser 8/15/1885)

1889. An article appeared in the Hawaiian Gazette in which it was stated that Honouliuli ranch was used exclusively for cattle up until 1889. After this date, ideas of a sugar plantation there begin to materialize. (Hawaiian Gazette 8/18/1891)

1891. The above article reported that in August of 1891 the mill was under construction. It was scheduled to open in November; grinding began that December. (ibid.)

1895. Whitney observed the following in his tourists' guide:

A SUGAR PLANTATION.-as an instance of a large enterprise rendered possible and profitable by the opening of the railway, the Ewa sugar plantation, eighteen miles from Honolulu, may be referred to. Where this plantation now is, was formerly a dry and barren plain, destitute of water or cultivation, the home of wild cattle. With the introduction of steam, and the aid of the artesian water, a splendid sugar plantation has been developed, capable of turning out annually from eight to ten thousand tons of the richest sugar, the cane crops being raised solely by artesian water. It is now really one of the largest and most profitable estates on these islands. All the produce and travel created by it are conveyed over the railway, which alone has rendered profitable such a vast undertaking as the Ewa plantation, with its dependent population of one thousand persons. And it is not improbable that other similar industrial enterprises will spring up along the route. When the road is completed to Kahuku, it well serve the travel and freighting of several sugar and rice plantations, not to refer to other minor industries.

COAL TRAFFIC.-Another outcome of the Oahu railway enterprise is the erection of a coal depot, on the west side of the harbor, where cargoes of coal are rapidly discharged by an apparatus known as the Boston coal elevator, which has been doing good work in unloading and loading ships during the past two or three years. The coal is stored in sheds erected for it, and can be put on board vessels in the same way, whenever required for coaling steamships or for shipment to other ports. For this improvement, the public are indebted to Mr. Dillingham, the general manager of the Oahu Railway Company. (Whitney 1895:39-40)

1898-1902. The following article on the Hawaiian Fiber Company appeared in the Paradise of the Pacific:

...The venture was made and a tract of land containing a large percentage of disintegrated coral, in the neighborhood of Ewa Plantation, where nothing else would grow, was chosen for the planting. A few years before several hundred plants had been set out by the government on a part of this land for experimental purposes, but

no sisal industry was developed by the trial. They stand in the ground now waiting for the harvester. An expert in sisal culture would say at once that the soil is an ideal one for this hardy plant. The Hawaiian Fiber Co., which Mr. Turner organized, and of which he is now manager, has 755 acres under fence, two and a half miles of which is stone wall with good gates at convenient places. Five hundred acres are cleared and planted. Most of this has been weeded, only 50 acres remaining to complete all that is necessary to weed this year. There are also four miles of road ready. Three hundred thousand growing plants in the various fields testify to the activity of the manager and his helpers. The whole plantation is as level as a prairie. In a large field containing 130 acres, mauka of the Oahu Railway & Land Co.'s track, the first harvest is to be gathered in a few months. The plants were set out in December 1898, the old Ewa Plantation nursery furnishing the suckers. It was a remarkably dry winter and, though young plants require rain, they thrived well and are today past the harvest time, only awaiting the arrival of a decorticator to render returns in fiber. Out of this section of 130 acres the company has figured on securing 50 tons of clean fiber, for which it is offered eight cents per pound in Honolulu or nine cents per pound in San Francisco... (Paradise of the Pacific March 1902:17)

1904. The Hawaiian Fiber Company increased its area of sisal cultivation from 750 to 1,000 acres. (Thrum 1905:173)

1939. An Ewa Plantation Co. map of this date plotted the locations of the following landmarks: field railroad lines, OR&L line and station, ditches, a park adjacent to 31.2, reservoirs, villages, Naval Reserve area, sisal and sandy inland areas. (Conde 1973:285)

1941-5. Relative to military activity in the area, the following extracts will serve as a summary of highlights:

The Marine Corps Air Station at Ewa - a great modern airfield -

was developed from what had been for 15 years merely a dirigible mooring mast. As the headquarters base of Marine aviation in the Pacific, it served as the springboard into forward areas. Every Leatherneck air unit going to or returning from Pacific action went through Ewa. (Allen 1950:225)

Re: the Pearl Harbor attack:

At about 7:57 a score of fighters swooped down from the clouds to within 20 feet of the ground at the Marine Corps Air Station at Ewa, riddling the 49 planes closely lined up on the field. Thirty-three aircraft went up in smoke, and the remaining 16 were too badly damaged to fly. The marines, in desperation, emptied their pistols at the departing Japanese. (ibid. p. 2)

At Ewa, after bombing the near-by Marine airfield, enemy planes machine-gunned the plantation's main street, the mill and power plant and some 30 houses, and started two cane fires. (ibid. p.7)

...On a Thursday less than two weeks after the bombing, farmers adjacent to West Loch at Pearl Harbor were ordered to leave their farms by sundown. The order was modified to allow two days to prepare, and the men were permitted to return to their farms during daylight until livestock could be moved and crops harvested. The displaced farmers, who had only recently been established at West Loch by the Farm Security Administration, were forced to seek temporary housing with friends and relatives or at Ewa plantation. Since they had invested in their enterprises practically all of their life's savings and considerable money borrowed from the FSA as well, several suffered heavy losses. (ibid. p.109)

Analysis of early land records specific to the project site

Appended to this report is a comprehensive accounting of land occupation and use pre-dating 1850. The data has been gathered from primary documents of all registered claims and from testimony rendered in behalf of these claims before the Land Commissioners during the Great Mahele. This effort thus takes advantage of the earliest and most complete body of land record available for study.

It is immediately apparent that although many of the claimants formally received their lands from the various konohiki in the 1830s and 1840s, a good number of them inherited use of these lands from their parents or ancestors who occupied the land since the time of Kamehameha I. As Kamehameha I died in 1819, some of these lands being claimed had generational occupation and use within a family.

The entire ahupuaa of Honouliuli was claimed by M. Kekauonohi who received 43,250 acres. Within her land, 97 claimants presented their letters of registration before the Land Commission for lands which they either had under actual residence or cultivation. Parcels being claimed and awarded ranged in size from .135 to 9.39 acres. Claims and testimony reflected extensive taro culture, upland potato cultivation and pasturage. House sites and clusters of houses were numerous and scattered. Also encountered in these records are references to taro patches reserved for paahao or prisoners. Regarding these, little else could be found in official record except that fishponds were also designated for them in the area. It is supposed that the maintenance of these patches and ponds were the responsibility of the prisoners as part of their "hard labor." The fruits of their travail probably went to the chief or toward their own upkeep.

Also worthy of note are the various physical features and landmarks mentioned as boundaries by residents of Honouliuli. Following is a listing by district of some of the more interesting points used by residents in describing parcels:

Kapapapuhi	houselots among which are listed a farmhouse, a vineyard, pastureland, a pond, trails, hog pens, salt beds. There appears to be a church and a cemetery on the rise which may date post-Mahele, as none of the testimony given refer to it.

Niukee	Kaakau cliff, Kaakau community, Nihola pond, Kihewamakawalu cliff, Kehewanakawalu pond, Kalokoiki pond, meeting house, prison plot, huluhulu (prickly pear?), cattle fences.
Kaaumakua	Panahaha fish pond, bulrushes, a high road from the sea inland, Waholowaa pond, salt beds, Kalahu pond.
Mokuneha	2 fishponds, salt beds of which the most westerly situated is called Kohuakahou.
Kamilomilo	extensive taro patches
Loloulu	taro patches, fishpond, a hala grove, a road toward Kaopala's house, pig pens, breadfruit, bulrushes.
Polapola	school house, prison plot, Kapalani Catholic church.
Hiwalalo	kou
Kaulaula	Kaulaula cliff on which is set a wall
Poohilo	Makaakua cliff, Puehuehu stream, Aimea pond, Waianu pond, Kahui pond, taro lake, taro patch guard house, pupulu cave (wet cave?), prison plot, prickly pear, Kalokoloa taro pond, Kaaimano fishpond, Puehuehu road.
Kamookahi	bulrushes
Kailikahi	Highway/roadway, Kauhipuna cliff, lapalapa (panax) thickets, meeting house, prickly pear.
Kamoku	Kauhipuna cliff, kou and aila trees, prickly pear

Note: So far as possible, the approximate locations of the above local land units or areas have been plotted relative to each other on the appended copy of Monsarrat's 1878 map of Honouliuli Valley (State Survey Office, Reg.Map No.630).

Recommendations

It is recommended that additional research effort be expended toward the examination of records relative to early historic period sites such as cemeteries, churches, schools, and prisons within the district. As the information presented in the present report is intended more as an overview based oin readily available sources and often specific information regarding site locations were not found, it is hoped that a more concentrated effort will determine whether any of the above sites are situated within the project area.

Specific research relative to Ewa Plantation and military use of Honouliuli would also be valuable in assessing historical and archaeological sites.

It is also recommended that oral histories be gathered from various individuals associated with the area who are familiar with the details of historic period land use and site locations. As this kind of primary data is too recent to be encountered in the historical literature, it is of definite importance.

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EARLY HISTORIC PERIOD OCCUPATION AND LAND USE - HONOULIULI VALLEY

LCA Awardee	Term of Residence	Land Uses	Comments/Description
748 Kalauhala	since 1837	unfenced houselot and 2 taro patches in Panahaha	bound N. Makali (Kea) stream, E. Panahaha fish pond, S. & W. kulruahee
749 Nahina	since c. 1838	taro land (a long strip) & houselot in Kaulaula	bound N. Naea's irrigated terraces, E. Puahu's land, S. houses of Opala/Opoepu, W. fenced land of Kaulaula & Kaulaula cliff. 2nd bound N. Keli's land, E. Pahu's land, S. Naea's irrigated terraces, W. Kauhikaula's land (A wall sits atop Kaulaula cliff)
751 Kalauli	since 1837 or 8 however, considered an old resident	1) taro land at Kaaoku 2) kula land at Kaaoku 3) houselot at Kailikahi 4) houselot at Kailikahi; Kalauli lives makai	1) bound E. Kauhipuna cliff, E. Punisua's land, S. Makali stream, W. Nahua's land. 2) bound N. Kauhipuna cliff, E. Nanuwa's land, S. Kaaoku's land, W. Naea's land. 3) bound N. Kahua's and Kaiheapalani's houses, E. Kealani's house, W. Faruka. 4) bound N. highway & Kalapilau kula land, S. Punisua's house, E. & W. Kailikahi fence
752 Naea	since 1842	houselot and 16 taro patches situated next to those of Kekauoohi (possibly her potlatch) all in Kailikahi.	bound N. Puhipaka, E. Kauhipuna cliff & Kaaoku, S. Makali stream, W. Puhipaka
753 Nanuwa	since 1843	6 taro patches and pasture land in Kaaoku; a taro patch site in the middle of the land. Kaaohiki also has 1 patch here	bound N. Kauhipuna cliff, E. Nahua, S. Makali stream, W. Kaaoku & Kahalowai
754 Kaunahi	since 1838	1) houselot 2) taro patches 3) houselot, pasture, 4 taro patches 4) 2 patches 5) 1 patch 6) 1 patch 7) 1 patch 8) upland parcel cultivated with potatoes, also a house where clt. & kaaohiki live. all parcels appear to be situated in Hikeo.	1) bound N. Kaakau cliff, E. Kapoo ppu, S. Nihola pond, W. Aaron Nakai & Kauwahine auwai. 2) bound N. Aaron Nakai & Kauwahine auwai, S. Nihola pond, W. Aaron Nakai. 3) bound N. Kinolua, W. river, S. Kaahanana, E. Naauwa 4) bound N. Napauna, E. Kapio, S. Hia, W. Kaahanana 5) bound N. Kalawai, E. Kalauwai, S. Waahuia, W. Pio 6) bound N. Nakai, E. Hia, S. Kaahanana, W. Napauna 7) bound N. Nakai, E. Hia, S. Nakai, W. Kauhing, 8) ---
755 Kainnhanauui	since 1820's, 1838	1) taro/pasture/house - Hikeo 2) houselot in Kailikahi	1) bound N. pali & Kuahine's taro patch, E. Kuheau's kula & A. Makali's land, S. by Kuahine's land, W. Kalauaau & Paula. 2) bound N. by fence, E. fence, S. Kuahine's house, W. lapalapa thicket.
756 Kaunua	since 1846 as a gift from Kanpa the kaaohiki	taro land without a house or a fence except the general one belonging to the district, situated in Kaaoku	bound N. Pio's land, E. Kapahi's land, S. district fence, W. Hilei's land.

LCA Awardee	Term of Residence	Land Uses	Comments/Description
758 Nihua	before 1839	4 taro patches, pasture and a house in Hikeo	bound N. pali (house sits near this boundary), E. Kinolua's & Kaaoku's lands, S. Kinolua's land, W. Kuhunuhu's land.
760 Kuheau	since 1839	5 taro patches in Hikeo; an upland parcel and a house was not awarded to him as it was claimed by the kaaohiki Naauwa. It was in Kailikahi.	1) bound N. Kaahanana's land and Nihola pond, E. Kalakaeli, S. & W. Kaalauahi's land 2) bound N. Paula's and A. Makai's lands, E. Kamahi's land, S. & W. Napauna's land 3) bound N. Kaalauahi, E. also, S. Kaahuia's fence, W. Kaunahi's land
761 Kinolua	since Kamehameha I, officially since 1839	taro lands, pasture lands & house sites; lands at Hikeo & house at Kailikahi.	1) 6 taro patches bound N. by Nihua's land, E. Kaaoku's land, S. Makali stream, W. a poalima and Kealani's land 2) bound N. Kukahiko's land, E. Kaaoku's land, S. poalima taro patch, W. Kaaoku's land 3) kula land bound N. Kalinaua pali, E. Kaaoku, S. Kapunua, W. Kalauaau 4) kula land bound N. pali, E. Kaaoku, S. Nihua, W. Nihua 5) kula land bound N. pali, E. Kuhunuhu's kula, S. Kuhunuhu, W. Kauhi - this is a house lot in Kailikahi 5) houssite bound N. district fence, E. Kaaoku's and Makai's lands, S. pali and Paula's house, W. meeting house with rough lumber and a prickly pear fence/lapalapa thicket. Clt. lived on this parcel.
762 Kalana	from his parents during the time of Kamehameha I	houselot and taro lands in Kaumakua	1) unfenced house site bound N. Kaholowaa's lot, E. Paukane's houselot, S. lots, W. Laulii 2) taro land bound N. gov't. patches of Alae, Waa and Lolowiu, E. Kuaihae poalima and Paukane's land, S. Kaumakua district fence, W. Kaholowaa's and Laulii's lands.
763 Kelisa	from his father before Kamehameha I	4 houses on a lot at Niua and another houselot and 13 taro patches there. 2 taro patches at Poohilo and cultivated land at Moakapuna.	1) bound N. Oni, E. Puahu, S. Kuhiana and Koi, W. pali; Niua 2) 2 taro patches in Poohilo bound N. Opuwai, E. Opiopio, S. Kaeua, W. Kaainui. 3) 13 taro patches and a house lot occupied by Clt. in Niua bound N. Napahi, E. Kaaui, S. Kaleoa, W. pali 4) Moakapuna parcel bound N. Kamapoho, E. Laulii, S. Kupopo, W. pali
765 Kaaoka	from his father	a houselot, 5 taro patches and 1 pasture in Hikeo. Houselot is in Kailikahi.	1) houselot bound N. & E. by Honouliuli district fence, S. road, W. Lapalapa thicket.

LCA Awardee	Term of Residence	Land Uses	Comments/Description
			2) 5 taro patches & 1 pasture bound E. pali, W. Kekuhaiha & Kanaale, S. Makali stream, W. Kinolua
766 Paala	since 1837	2 houses & 6 taro patches in Hinkas; a houselot in Kailikahi.	1) taro land bound N. Kaluamano, W. Kainohanauli, S. Waepaua, W. Kanaale 2) houselot bound W. Kinolua's house, E. & Kalai's house & pali of Kihewaahanaale, W. by "the meeting house for worshipping Jehovah."
767. Kepouea	before Kinau's death	2 taro patches & a houselot in Hinkas	1) taro land bound N. Paele, E. Kaunahi, S. Waikala 2) unenclosed houselot on a separate parcel of land; description not given.
768 Pia	from father in 1836	1) 4 patches at Kaumakua - no or fence; from wife 2) 2 house, hog sty, some growing trees & 2 taro patches at Hikas 3) fenced houselot at Waiohe	1) bound N. Kalaihopu, E. Kalauhala, S. Kaunoa & gov't. fence, W. Puna & Kaumauna 2) bound N. Kaunahi, Uia & Nakai, E. Kalauahi, S. Kaunahi & Wakula, W. Konohiki stream 3) bound N. Kaumauna, E. Konohiki stream, S. & W. master land of Ope
827 Kauakahilau	since 1834	1) taro land in Pookilo 2) houselot	1) bound N. a stream and above Kepaui's land, E. Ninau & Oni, S. Oni, W. the stream and across Kaku's land. 2) bound N. by "a land fence erected for Cattle" W. Kepaui, S. stream then Kepaui's land then Kaumakua
828 Kanahoa	from Kainaina, the first konohiki, before 1834; Kahakai become the next konohiki in 134	1) kula land consisting of "one large Kalo lake" of which the taro belongs to the chiefess and the fish belongs to Kekauonohi 2) houselot Both are situated in Pookilo	1) bound N. Oni, E. Kapule, S. Kaku, W. Oni 2) bound N. Kauakahilau's house, W. Kaiziuui, S. Oni's house, W. Makaku pali
831 Kaekua	from Kapule in 1834	1) 2 taro patches and kula land 2) 2 new taro patches & 2 houses, one of which is on an enclosed lot Both situated at Pookilo	1) bound N. Ninau pond, E. a pasture, S. Kaniauo, W. Kamuhau 2) bound N. common cattle fence, E. Manaole, S. Kepauui, W. Kaku
832 Opiopio	from his father Oni in 1839	1) taro land (3 patches) 2) taro land (separate patches) 3) cultivated plot All are situated in Pookilo	1) bound N. Kauakahilau, Kaekua, Oni, W. Oni, S. Kaeya, W. Solomon Kelilua 2) bound N. Oni, E. Kaniauaua, S. Konohiki, W. Naui 3) bound N. Oni, E. Kaniauaua, S. Kuailau & Pehu, W. Kei
834 Oni	from ancestors during Kamehameha I's time	Makaakua pali, Waiau & Kahui ponds and Puahuhu stream is mentioned by Oni as boundaries of one of his parcels; this was not verified by other testimony.	1) Pookilo houselot bound N. Kaniauaua, E. goat's fence, S. Kekauonohi W. Kuailo & Kaekua

LCA Awardee	Term of Residence	Land Uses	Comments/Description
		1) houselot in Pookilo - 2 houses for Oni and 2 houses for his father Kuailau 2) 17 taro patches and some upland area 3) 4 taro patches and some upland area 4) a taro patch 5) 2 taro patches & upland 6) upland parcel without a house or fence 7) a taro patch All claims appear to be situated in Pookilo	2) bound N. Kauakahilau, Manaola, Kaeya, E. Ninau, S. Kekuahilo & Kaalaua, W. Kapule 3) bound N. gov't. fence, E. Kuaupopo, S. Nika, Kaniauaua, Opiopio, W. Oni & Nika 4) bound N. Ninau, E. Manaoole, S. Kuahilo, W. Ninau 5) bound N. Manaoole, E. gov't. fence, S. Puniawa 6) bound N. Kauakahilau, E. Manaoole & Kapule, S. Ninau, W. Manoole & Kapule 7) bound N. Kaaahana, W. stream, S. Opiopio, W. Kauakahilau
839 Kaalauawa	parents lived here during the reign of Kamehameha I	1) houselot contains 2 houses which are unenclosed 2) a taro patch 3) patches 4) patches 5) patches 6) pasture All parcels appear to be situated in Kailimoilo; testimony claims that the konohiki Kalaihopu has a right to all of Kaniauaua's taro patches.	1) bound N. lot, E. Oni & Kuailau, S. Kekuahilo, W. Puniwai 2) bound N. river, E. Kalaihopu, S. Kanaauna, W. Kaula 3) bound N. Kaula, E. Kanaauna, S. Kaaaikai, W. Kahikuula 4) bound N. Oni, E. Nika, S. Kailau, W. Opiopio 5) bound N. Kekuahilo, E. Kahakai, S. Pula, W. Kahanana & Kahakai 6) pasture bound N. Oni, E. kula land, S. Puniwai, W. Oni
845 Kalukahiko	from parents during Kaki's time; Kekuahiko lived there as a child	1) houselot containing a farmhouse, a pasture, winayard (?) at Kapapepuhi. It has been fenced but is falling apart. 2) taro lands	1) bound N. Kaalani's houselot, E. pali, S. ocean, W. Kaaala's house (Kaalani's pond is also listed as a eastern boundary) 2) bound N. pali & church, E. Nita/Uniaf, S. irrigation ditch & Kinolua, W. Kaaalaa & Kanauau
847 Ninau	from the time of Gov. Adams	1) 14 taro patches, a kula land and a guard house; land is enclosed and situated in Pookilo	1) bound N. Manaole, Oni, Kauahilau and Kauhailapa, W. Oni & Kekuahilo, S. Kauakahilau, a river and Oni, W. fence and Ninau's guard house for his patches
848 Kapule	acquired parcels at various times from the 1790's to 1845	1) houselot with 4 houses where Kapule and his children live; partially enclosed by a fence 2) 6 taro patches 3) 3 taro patches 4) a taro patch 5) 5 taro patches & a pasture. All appear to be situated in Pookilo	1) bound N. Oni & Kahanana, E. Kaku & Kuaupopo, S. Kuaupopo, W. kula & pali, 2) bound N. Kaekuna, E. Nika, S. Nika & river, W. Kauakahilau, Kahanana, Kaniauaua & Kahakai 3) bound N. Oni, E. Kelesana & Moana, S. Manolo & Kelijahonui, W. Kaku 4) bound N. Kauakahilau, E. Oni, S. & W. Ninau 5) bound N. "pupulu cave", E. Manaole, S. Oni, W. Kauakahilau
669 Pua	since 1842	1) houselot with 2 houses - one for Pua and one for his father-in-law Puali 2) kula land, pasture 3) 2 taro patches All appear to be in Naui	1) bound N. Koe, E. Koe, S. Kuhiana, W. Koi 2) bound N. Puali, E. Kua, S. fence, W. Pua's houselot 3) bound N. Koe, E. Koe, S. Kuhiana, W. Koe

LCA Awardee	Term of Residence	Land Uses	Comments/Description
872 Kahahulio-111	from Kaope in c. 1814	1) 1 taro patch in 2 halves, one-third of a fishpond and an unfenced houselot; situated in Laloulu	1) bound N. Kaiaulani, E. Kalokoili & Kekauonohi, S. Naakiki stream and hala grove, W. Nakaii stream, Puaonui & Kaea
874 Lazzaikahiki	since 1836	1) houselot with 2 houses - 1 for Lazzaikahiki, 1 house and the lot itself for Kaneapla. Situated at Polapola. 2) 5 taro patches	1) bound N. school house, E. Kaapola's house, S. Kapiioho's house, W. land fence. 2) bound N. Laulii & Kaapola E. Kekauonohi, S. Lazzaikahiki Ahilinae, W. Laulii & Kapiioho
876 Nahuanui I	since the time of Kamehameha I	1) houselot unenclosed, taro patches (2) and pasture which is unfenced; situated at Niuhea	1) bound N. auwai, pali and Nahuanui's house, E. Nihua, auwai and "hulubulu", S. auwai & Maalani, W. Anao & Kinolua
881 Kikala	since mid-1830s	1) houselot unfenced with 1 house in Polapola 2) 10 taro patches and some pasturage (1 testimony: 7) 3) 5 taro patches	1) bound N. Nika, E. Kalaaa, S. Kaope, W. fence (gov't.) 2) bound N. Kaope, E. Nika & Kaumapapa, S. gov't. land, W. Waio 3) bound N. Hilinae, E. Ohai, S. Kukae, W. Kalaaa
886 Kahalezai	since 1843	1) houselot, taro lands & pasturage (4 taro patches) In the vicinity of his house stood two 4 ulia trees and auwai. Another houselot is bound by the sea on the east and on the north, Keolani's house sits in the south.	1) bound N. gov't. land, E. Aoao, S. small stream then Kaape's land, W. Puniawa
887 Kaihikapu	since 1825	1) houselot, 5 taro patches and pasturage Clt. also mentioned other houses of his in Honua and a vineyard at Pakai in Honua.	1) bound N. gov't. land, E. Aoao, S. a river, W. Puniawa other testimony gives: 1) bound E. Keihonau, S. Kaaehuaiola, W. Kaumalei & Kukahoe.
892 Manuela Aoao	since Kamehameha I	1) houselot fenced with a single house 2) 5 taro patches Both appear to be in Niuhea	1) bound N. road & sea, E. Kaapala, S. sea, W. trail 2) bound N. gov't. fence, E. Keolani & Nahuanui, S. Kinolua, W. Kahalewai
898 Kaapala	since 1834	1) houselot with 3 taro patches and 2 houses - 1 for Clt., 1 for Lazzaikahiki who lives under him. 2) kula land with 2 taro patches 3) a taro patch 4) 2 patches and some upland area	1) bound N. Laulii, E. Kapiioho & Kaope, S. gov't. fence, W. Kekauonohi 2) bound N. Kapiioho & Laulii, E. Upai, S. Nika, W. Laulii 3) bound N. Kaope, E. Lazzaikahiki, S. Laulii, W. Kahina & Kaheaanui 4) bound N. Konouliuli stream, E. "high road from the Sea inland, S. Puahu, W. Koa
901 Kuahine		1) houselot 2) cultivated land 3) cultivated land	1) bound N. Keinohanamui's house & fence, E. Kaakau community, S. pali, W. Kuheau's house & gully 2) bound N. Keinohanamui, E. Nakai, S. Kuheau, W. Paele 3) bound N. Konaunau kula & the pali, E. Keinohanamui, W. Konaunau

LCA Awardee	Term of Residence	Land Uses	Comments/Description
905 Kaiauana	from Kaope in 1835	1) houselot unfenced with 2 houses 2) unfenced taro land Both appear to be in Kaanaakua	1) bound N. Kaholoua, E. S. A W. Kekauonohi 2) bound N. Kupe, E. & W. Kekauonohi, S. Kalaa
906 Kaaoho for Abraham	since 1844	1) 7 taro patches and some kula land in one lot situated in Kaaoho	1) bound N. Kaae, E. Nanaua, S. Kekauonohi, W. Kaae
907 Luana	from father-in-law Kaaaala in 1842	1) 3 taro patches and a strip of kula land which is unfenced and situated in Niuhea 2) small kula in Niuhea	1) bound N. auwai & Kaaaala's patch E. Kaahaanaa, S. "paahao" prison & stream, W. Kaaaala 2) bound N. pali & meeting house, E. Kinolua's kula, S. Kaaaala's patch, W. kulae of Kaaaala & Owia
910 Kuaa	from the konohiki Kaaae in 1835	1) houselot fenced with 2 houses upon it 2) 4 taro patches and some kula Both appear to be in Kaanaakua	1) bound N. gov't. fence, E. Kekauonohi, S. Kaahaana, W. Auaihai 2) bound N., E. & W. Kekauonohi, S. Kaiauana
911 Kaihaiiapa	from Kinau before 1835	1) 4 taro patches & a strip of kula on which a house sits in Paohiia 2) a taro patch	1) bound N. gov't. fence & prison patch & Hinaa, E. stream & across Hinaa, S. Kaaahaiiau, W. Kaahaiiau & Kaaaala 2) bound N. Kaaaala, E. Kaaahaiiau, S. Kapaaui & Kauka, W. Kaahaana
914 Kaaaala	from the time of Kamehameha I & Kaahumanu	1) fenced houselot with 4 houses nakai of Kapaamahi 2) 2 taro patches & some kula 3) 3 taro patches & some kula All appear to be at Niuhea	1) bound N. Keolani, E. Kekuahiko, S. hoe pen & shore, W. Aoao's house 2) bound N. Kinolua, E. Luana, S. Konaunau, W. Kinolua 3) bound N. Ohia, E. Nokuaakuaole, S. Luana, W. Ohia
916 Kaaa	from Kaope in 1842	1) unfenced houselot with 2 houses 2) 2 taro patches	1) bound N. Nika, E. Nika, S. Kalauhala & stream, W. Kuaanai 2) bound N. Kalauahi & auwai, Kuheau, E. Kalauahi & Kekahuliiili, S. Kuaanai, W. Nakaii stream & Naakuia
917 Kaulu for Kaniiko	from his father in 1848	1) 6 taro patches 2) a taro patch 3) 2 taro patches 4) a taro patch The above lands appear to be in Kaaiiwaila & Kaauakua	1) bound N. stream, E. Kalaihopu, S. Kalaikuila, W. Kaope 2) bound N. Kalaihopu, E. Kaiguaaua, S. Kaaiwaaua, W. Kaaikeula 3) bound N. Kaaeula & Niau E. Kalaihopu, S. Kapio, W. Aaaaikai 4) bound N. "winding branch of the sea", E. hill & Nahoiooaa pond, S. "salt bed kula" W. Pia's house
947 Kaapala	His grand-father rented it during the time of Kamehameha I	1) houselot 2) 14 taro patches	1) bound N. Puahu, E. Nika, S. Kalaaa, W. Nika

LCA Awardee	Term of Residence	Land Uses	Comments/Description
	Kaopala got it from his father in 1841	3) 3 taro patches 4) 2 taro patches 5) 3 taro patches	2) bound N. Nika, S. Kauhi, E. Kanaaala, W. Poepua 3) bound N. Kaope, E. Keakua, S. gov't land, W. Kauhi 4) bound N. stream separating Kanaaala's land, E. Nika, S. & W. Nika 5) bound N. Lauhala, E. Nika, S. gov't. fence, W. Kaeoe
960 Poepua	resided here a long time, land acquired from ancestors	1) houselot unenclosed with one house, situated at Loloulu 2) 3 taro patches also at Loloulu	1) bound N. road to Kaopala's house, E. pig pen & Kaopala's land, S. kula & Naulu's house, W. breadfruit 2) bound N. Kiheapua koele, E. Kaopala, S. Kanaaala, W. Kaopala
1565 Kaalauahi	since 1841	1) 6 taro patches & a houselot in Wiukaauliuli	1) bound N. Kekauanahi, Kuheua, Kayahanana, E. Kahakuliliti, Kana, Naakua, S. Pio, Nakai, Nia, W. Kamana
1570 Kalua I	from the time of Kaahumanu	1) a taro patch & kula land called Aihonu in Waiamu, Poohilo 2) a taro patch called Kaalolemui in Waiamu, Poohilo 3) a cultivated field falls ed Kaluanonaaoku in Aihonu, Poohilo 4) 2 taro patches called Kaiopelu & Kalokulua in Waiamu, Poohilo	1) bound N. Kopaami koele, E. Nooiki patche belonging to Kauhailepa, S. Kuauulu patch belonging to Nanaole, W. land fence 2) bound N. by Kauhailepa's patches Kaualuo & Kaluiiki, E. konohiki's kuala, W. Kanaole patch & kula, S. Nooiki patch 3) bound N. Kauhailepa's pasture land, E. Nanaole's patch called Poepoe, S. Kaakuna's pasture land, W. land fence 4) bound N. Oani's parcel of land called Poepoe, E. Kuhlana's patch called Kalakaloa, S. Kumupopo's parcel of land called Kapoe, W. Kekiaha's pasture called Kalaokana
1570B Paakana	from the time of Kaahumanu	1) 3 sections of land in a single piece called Maniauli within this is Nooiki & Kuaihea which are 10 taro patches and a houseite. 2) 2 fishponds in Wokuaaha. Both are situated in Kaauakua	1) bound N. Kumulu land, E. land fence, S. Kalaua's land called Kanaoopa, W. Hilua's land called Kaaokahi 2) bound N. sea shore, E. field of salt beds, S. konohiki lands called Wokuaaha, W. Kohuaaha hoe salt beds
1570C Kaholoua	from the time of Kaahumanu	1) 1 taro patch, 2 fish ponds & cultivated kula in Kpauwai, Kauuakua 2) a houselot in Wokuaaha	1) bound N. konohiki's land called Kaisulpule, E. land fence, S. konohiki's pond called Kalahu, W. konohiki's land called Polapola 2) bound N. seashore, E. Kaimuana's group of houses, S. Wokuaaha kula, W. Wokuaaha kula
1573 Kaaaha-nana	from the time of Kaahaaaha II	1) houselot at Kapapauhi 2) 5 taro patches in Wiukaa	1) bound N. sea, E. Kaalauahi's house, S. sea, W. salt bed 2) bound N. Paele, E. Kaunahi, Kaapauea, Honauau, S. Nika, W. Luana & Kanaala

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1580 Kaaahuna	from his father in the time of Kaahaaaha I	1) 3 taro patches in Kaailoaila named Kalayaha, Poina & Palakai 2) houselot	1) bound N. Nakali stream, E. Kauuakua land, S. Kuauulu koele, W. Auana koele 2) bound N. Kuauulu koele, E. Kauuakua land, S. Kaalauaana's land called Palakai, W. Kalauahaiki's koele
1580B Kapiioho	from Kalaoa in the time of Kinau	1) 2 land sections named Naaaalua in Kaahupalaai. 2) 1 taro patch in Hivalale Kaahupalaai	1) bound N. Alaa & Kikaia patches/rice koele, E. Palakai land, S. Kumupali kula of Nikala, W. Lopanui land 2) bound N. Alaa auwai, E. Kapalakai land of Nalo, S. konohiki's poalina, W. Lopanui land of Kalaoa
1598 Kekua	houselot very old; either lands received during Kuakini's time	1) houselot enclosed at Kapapauhi 2) 5 taro patches in Loloulu 3) 1 taro patch in Loloulu	1) bound N. sea, E. Kahalauai's house & the esp. S. & W. houselots 2) bound N. poalina & Noano's patch, E. Noano, S. bulrushes, W. Kumupopo 3) bound N. Kaope & poalina, E. Kumupopo & bulrush patch, S. bulrushes & gov't patches, W. poalina & Kaopala
1605B Nakai	from Kuakahia in the time of Keki	1) 5 taro patches named Nakala, Nahuna, 2 small one called Kaahupu, Kapaihi 2) a taro patch named Kalaii, and a kula land 3) houselot All are in Wiukea	1) bound N. konohiki kula & Kiheyaakayalu pond, E. Kaunahi's houselot, S. Nihola pond, W. Kaunahi's patch called Kapaihi and a part of Kiheyaakayalu pond 2) bound N. taro pond of Nihola, E. Lokoela pond, S. Pio's pond, W. Wiukea auwai 3) bound N. land fence, E. Kauahi & Nanua house complexes, S. Kiheyaakayalu pali, W. Kanalaa's houselot
1666 Maiuala	from Kuakahilan in 1841	1) 4 taro patches called Kaluaeo in Poohilo	1) bound N. Kapule's land called Palaau, E. Kaope's land called Puehuehu, S. Kahui land, W. Waiamu koele (Kahui & Waiamu ponds)
1666B Kushila	from Kahakai in the time of Kaahumanu	1) 3 patches & a kula land called Kalaiwaea in Poohile	1) bound N. Kahakai's kula & the prickly pear, E. Aiwa koele, S. Kalaipuaea koele, W. Kalokolea taro pond
1670 Moano	from Kaope during Kinau's reign	1) 1 large taro patch & a houseite at Loloulu 2) cultivated land in Puehuehu 3) houseite in Kalauhala	1) bound N. Kaope & the estuary, E. Kaope's land, S. Pio's land and the bulrushes, W. Keku's land 2) bound N. Kapule, E. Kaope, S. Kalauana & the estuary, W. Kalauana & the estuary 3) bound N. Aikakane's house & the estuary, E. Pond, S. Kalauhala land, W. Kalauhala taro pond

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1672 Mahua	from Kahalewai during the time of Kalaimoku	1) 6 taro patches, 1 pasture and a houselot at Kaaoku 2) cultivated land 3) houselot at Kapapapuhi	1) bound N. prickly pear & auwai, E. Kalauli's land, S. Puaiwa pond, W. Kanuna's land 2) bound N. Puaiana land, E. Kalauli, S. koele, W. Kanuna 3) bound N. sea, E. Kalokolo, S. kula land, W. Keelani & Keakua
1699 Lalaiaupo		1) parcel situated at Maui 2) parcel situated at Maui	1) bound N. Koi, E. Kanaaola, S. Mahina, W. Koi 2) bound N. Kuhiana, E. Koi, S. Kua, W. Kai & Puali
3701 Alauka	from Kauakahilau in 1843	1) 4 taro patches at Pochile	1) bound N. Oni, E. stream, S. Kakaunoohi, W. Kauakahilau
3703 Aaaaikai	from his father-in-law Kauiki/ Kuhulu in Kiman's time	1) fenced houselot 2) a taro patch Both situated in Kaailomile	1) bound N. Nuu, E. Kekauonohi's waste land, S. Kekauonohi, W. gov't. fence 2) bound N. Nuu & Kaapauaa, E. Kaapauaa, S. & W. Kaope
1713 Kaalani	from Nohumoku in the time of Kaahumanu	1) 3 taro patches called Kahui in Hiukea 2) a pond assward of Kapapapuhi (small sea pond) 3) houselot at Kapapapuhi	1) bound N. konohiki koele, E. Wakaii stream, S. Aoao's land called Kaloiloa, W. auwai & pond called Kaloiiki 2) bound N. salt bed, E. sea shore, S. sea shore, W. Kapapapuhi hula 3) bound N. Kaaekuaiola's houselot, E. Kekukahiko's houselot, S. Kekapa's houselot, W. Kekua's houselot
1719 Kiilua	from Kauaa in the time of Kaahumanu	1) 5 patches, a pasture/kula and a houselot in Kaaumakua 2) a patch called Kaaookaki in Kaaumakua	1) bound N. Maui patch, E. land fence, S. konohiki koele, W. Kaimuena's land in Kumulu 2) bound N. bulrushes of Kaaumakua, E. Kaaumakua auwai, S. bulrushes of Kaaookaki, W. Kaailomilo land section
1720 Kilinao	from his father Kaio during the time of Kamehameha I	1) 4 taro patches 2) houselot Both situated in Polapola	1) bound N. prison & Kikala's land, E. Kikala, S. Kaaaokala, W. Kapilcho -- bound N. Kakai, E. Laaaikahiki, S. Kaaaokala, W. Ohai pond 2) bound N. Upai, E. houses of Kaaaapla & Laaaikahiki, S. land fence, W. Kapalaai Church
5204 Kalaoa 2		1) a taro patch & a "dry kula" in Polapola	1) bound N. Nika's & Kalaoa's patches, E. Kakala's patch, S. 2 houses belonging to Kalaoa & Laaaikahiki, W. Kaope's boundary fence
5653 Kua	occupancy from ancient times; received land as an inheritance from parents	1) 2 patches & a kula land called Kahui at Maui 2) 1 patch called Kamalua at Polapola	1) bound N. Koi's patch called Kahukuaka, E. land fence, S. konohiki's patch called Puomaikala, W. Kalaiau's patch called Iao

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			2) bound N. Kikala's patch called Kaoooao, E. Ohai's patch called Lopanui, S. Kikala's patch called Kaaalua, W. Laaaikahiki's patch called Kaaoolekia
5653B Kaaahiki-ii	from his father Haraupa in the time of Kamehameha I & Kaahumanu	1) 3 patches & 1 pasture in Kaaookahi, Pochile	1) bound N. land fence, E. Kalikahi land, S. Kaalmano fish pond for the konohiki, W. Kaakuna's land called Kuauhau
5654 Kuhiana	from Koi in the time of Kamehameha I	1) Paaohiha taro land in Haui 2) 2 taro patches in Kalohiea, Pochile 3) a house site in Maui	1) bound N. river, E. konohiki's patch called Kapahuwa, S. Koi's land called Ohikeili, W. Pua's land called Kuapuali 2) bound N. Puohuchu & a patch, E. Kekiiha's patch called Puiaaa, S. Kalochana's patch, W. banks of Puohuchu road 3) bound N. Puohu's house & the stream, E. Pua's land called Kuaupali, S. Koi's house, W. wall
5670B Kaohai	from his parent in the time of Kaahumanu	1) 3 patches in Lepanui, Kaimupalaai which was later claimed and awarded to the konohiki 2) taro land called Kuaana in Wakaala 3) house site in Pulapola, adjoining the Catholic chapel yard.	1) bound N. Laaaikahiki's taro patch called Puohuchu, E. Kapilcho's land called Kaaaikiili, S. 2 patches - Kuaupali, W. Makaala 2) bound N. Kuaana, W. Kuaipuu, S. Pulehu, W. Panaiaui 3) bound N. land fence, E. Catholic chapel, S. road/land fence, W. houselot & kula
5670C Kuaupopo	from Kaope in the time of Kinau	1) 7 patches & 1 pasture & house site in Kapui, Pochile 2) 1 patch called Kaaociki in Lolualu 3) 2 patches & other small patches in Puualuu	1) bound N. Waianu pond, E. Kahui pond, S. Opingin's land called Kaluakanaka, W. land fence 2) bound N. Kekua's patch called Kapalaho, E. Ahakai plants (bulrushes) in Moolki, S. Kaalaa's & Kekua's patch, W. konohiki's plot 3) bound N. Moolki ahakai plants, E. Kanaunui's land called Kaakaruaa, S. land fence, W. Kikala's patch
5950 Pihana	from Puniawa in the time of Kaahumanu	1) 3 patches and a kula in Kahui 2) 2 patches named Kalua in Kekaa, Kaaoku 3) house site in plains of Kailikahi	1) bound N. Kahui ditch & Kailikahi plain, E. Kahalepai's land in Kahui, S. Makaii river, W. Kalauli's land called Kaaoauka 2) bound N. Kakua's patch Kekaa, E. Kalauli's patch, S. Kalauli's land, W. Kahui patch 3) bound N. & E. Kailikahi pasture, S. land fence, W. prickly pear & Kailikahi kula
10933 Nia	from the time of Kinau; Cit. moved to Honolulu & gave land to Kaikaina	1) cultivated land in Kuahinaloa, Hiukea 2) 3 patches in Kaaoomuku, Hiukea	1) bound N. Kaaaala, E. Kaaaala & watercourse, S Kaloaloa watercourse, W. kula & meeting house

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LCA Awardee	Term of Residence	Land Uses	Comments/Description
		3) houselot in Kapapapuhi	2) bound E. Kaunahi & Kapaeb, K. Kaelauahi & pio, S. Kuaiko koole, W. konohiki & Kaunahi lands
			3) bound N. konohiki kula, E. Apan's house site, S. beach, W. Kapaeas's house
11216 Kekauonohi	owns entirely	43,260 acre ahupuaa	

LOCAL LAND UNITS AND AREAS IN HONOULIULI VALLEY

Copy of 1878 Monsarrat Map of Honouliuli Valley (State Survey Office, Reg.Map No.630), with approximate locations of local land units or areas plotted relative to each other. Based on analysis of LCA documents and testimonies.

between 1913-1917. It was not there after the war. There was also an associated cemetery; the graves did not have headstones, but were just earth mounds.

Fishpond by the railroad was run by the Japanese. The fish were sold at Honouliuli Railroad Station Depot. Some of the Japanese possibly had fishing rights offshore.

There were two houses on Hoaeae Point--Japanese were on the end of the point; they had fishing rights from Campbell Estate. Both houses were on the SSE side of point, located by the brackish well and old windmill.

A Chinese cemetery was mostly located on the present Yoshida lot and also on Mizumoto and Mau lots. There were numerous graves with headstones or monuments.

1942 - During WWII, the army came to Hoaeae Point to put an underground communication cable from the main Waianae Road to the army camp on the point. The army had already modified the area, with antiaircraft gun emplacements. There was a fairly large camp with many wooden buildings. Army bulldozed much of the point area, and apparently leveled the cemetery areas.

1955 - Moved to Hoaeae Point.

1957 - Built a small boat ramp into West Loch. Several artifacts were found during this work, and included a small basalt ulu maika, blade of medium-sized rectangular cross-section basalt adze (tanged), and a small coral knobbed pounder which was found in a small cavity (mortar) in boulder at shore.

INFORMANT "C"

Male, c.80 years old.

1917 - Born at Honouliuli, in home near the old railroad station depot. Attended Ewa School for elementary school, and later St. Louis High School in Honolulu. At approximately 20 years of age, he moved to the inland portion of Honouliuli.

1940 - Enlisted in the Army at the age of 23 years old, served on mainland and many overseas posts, and returned in 1945.

For the next two years, he worked for his brother in Honolulu. He took off for approximately one year.

1950 - Started working at the Ewa Plantation Store, and remained there for the next 32 years, retiring in 1982.

While he had not returned to Hoaeae Point since before WWII, he remembered such things as the Chinese cemetery on the point, and that the ridge above the historic fishpond (Site 3323) was a "spooky place" for children. He also was able to name many of the families that had resided in the seaward part of Honouliuli Valley, and to point out the approximate former locations of their residences on a recent aerial photograph.

APPENDIX B:

NOTES ON LOCAL INFORMANT INTERVIEWS WEST LOCH ESTATES PROJECT AREA

by

Paul H. Rosendahl, Ph.D.
PHRI
Hilo, Hawaii

Informal interviews with several knowledgeable local informants were carried out as part of the overall West Loch Estates reconnaissance survey project. Initial local contacts resulted in a list of numerous potential informants, of whom three were selected on the basis of both familiarity with the Honouliuli area and practical availability. In line with the concluding recommendation made by Silva in her historical documentary research report concerning the gathering of oral histories, it is apparent that it would most likely be productive to consult other individuals from the initial list of potential informants, as well as conduct more formal interviews with the three informants that were visited.

All three informants provided information about 20th century occupation and land use within the project area. Of particular value was the information relating to Hoaeae Point--to the limited pre-WWII habitation, the extensive WWII utilization and modification of the area, and the more recent post-WWII period of occupation--and information relating to the apparent early presence of an old church and associated cemetery on the low ridge just inland of Hoaeae Point, overlooking the OR&L-ROW railroad grade (Site 9417) and the adjacent fishpond (Site 3323) that had been created by the railroad causeway in the early 1890s.

The following information was obtained in a series of informal interviews with three older residents of the Honouliuli area. Individual informants have not been identified by name here in because the interviews were not formal ones, and the information obtained has not been confirmed or checked by means of repeat visits.

INFORMANT "A"

Male, c. 84 years old; married.

1903 - Born 6/6/1903 in Kula, Maui; both parents Chinese.

1912 - At the age of ten, his family moved to the Kahua Ranch area in Honouliuli. A horse stable was located where there is now a large mango tree (between the two lanes of Fort Weaver Road). His father had a store and was also a tailor. He attended Ewa School through the eighth grade.

c. 1918-1919 - Recalled that when he was 15 or 16 years old, he used to go down to Hoaeae Point, along the shoreline as there was no road. There was only the railroad bed. There was a foot trail located along the south side of the point, along the shoreline. Also present at Hoaeae Point were two houses; one at the end of the point, and the other was more inland and seaward of the well. Japanese fishermen had fishing rights to the area. No oysters were in the area; only plenty of clams and crabs. Near the railroad bed was a fishpond [Site 3323] operated by Japanese named Masuda or Matsuda, who lived near the pond.

1920 - Started work at Ewa Plantation. After one year, he went to work in the plantation laboratory, where he stayed for about 20 years.

1941-1945 - During WWII, he worked nights in Office of Civil/Civilian Defense (OCD) for five years.

1945-1967 - After WWII, worked as warehouse supervisor for Ewa Plantation, and retired in 1967.

1947 - Got lease on lot on Hoaeae Point from Campbell Estate. The area was covered with kiawe trees, no army structures remained--only holes [including gun emplacements] from army activities.

c. 1947-1948 - Hardly any mangroves present, mostly along shore.

c. 1950 - Acquired a house and had it moved to Hoaeae Point. Well on Spillner lot was used as a water source (brackish).

c. 1953 - Connection to County waterline extended to Hoaeae Point by residents.

Informant "A" lived in the Kahua Ranch area from 1912-1972. In 1972, he moved to Hoaeae Point, onto the leased lot he had acquired in 1947, and on which he had planted several fruit trees.

Concerning the cemetery previously located on the inland portion of Hoaeae Point, he stated that numerous good-sized tombstones had been present. During the war, soldiers removed tombstones and threw them into the water on the south side of Hoaeae Point. He remembered visiting a cemetery on the ridge overlooking the historic fishpond [Site 3319 vicinity], and that there were tombstones but no church structure present.

He remembered that all land seaward of new road [Fort Weaver Road] had rice fields, and that the fields stretched all the way up the valley to Asing Park. Also, that salt works were operated by Chinese where the National Wildlife Refuge is now located.

INFORMANT "B"

Male, c. 80 years old; married.

1907 - Born in Waikiki in November of 1907; is half Hawaiian (mother), and one-quarter Scotch and one-quarter Irish (father).

1913 - Moved to Pipeline Camp, also referred to as Spanish Camp [on bluffs above old Fort Weaver Road]. Went to Ewa School through 6th grade; and then to Aiea for seventh and eighth grades.

Informant's father became a policeman in 1898, and worked in the Ewa, Waipahu, and Pearl City areas. In 1913, he moved to Ewa, when Mr. Renton was the plantation manager.

1913-1917 - Lived at Pipeline Camp from 1913 to 1917; in 1917, moved to Pearl City, near the court house, until his father retired in 1927.

1913-1917 - At six to ten years of age, went fishing with his father in the shallow waters beyond Honouliuli Stream. There was a wooden house and pier at Johnson's Bar, on the flats to the south of the stream mouth.

Old fishpond area (up to present Fort Weaver Road) was in rice. Old rice mill (Hip Sang Wai Co.) was located between Honouliuli Stream and new polo field. Chinese operated the mill.

Salt works in area of five small ponds [recent ponds].

1922 - Worked on the Farrington Highway road construction as an employee of McCandless Construction.

1926-1940 - Worked for federal government, US Army-Corp of Engineers; initially lived in Waikiki.

1928 - Moved to Kalihi.

1940 - Transferred employment to FCC (Federal Communications Commission). Retired in 1966.

1955 - Moved to Hoaeae Point in 1955, after selling residential lot in Waikiki. As of 1955, there were only a few mangrove trees in Hoaeae Point vicinity of West Loch; dense groves grown up since then.

When young, he remembers Chinese were living in the seaward part of Honouliuli Valley, and raised rice. Hawaiians lived in the inland part; they were mostly fishermen and plantation workers. There was still some taro raised. Chinese grew lotus root in the spring-fed area in back of Johnson's parcel (presently area of Harry Akana's auto parts yard).

Remembers there was a Hawaiian church on the ridge above the historic fishpond [Site 3319 vicinity], a small building that was still in use

between 1913-1917. It was not there after the war. There was also an associated cemetery; the graves did not have headstones, but were just earth mounds.

Fishpond by the railroad was run by the Japanese. The fish were sold at Honouliuli Railroad Station Depot. Some of the Japanese possibly had fishing rights offshore.

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APPENDIX C:

POLLEN ANALYSIS OF AGRICULTURAL DEPOSITS NEAR WEST LOCH, OAHU

by

Linda Scott Cummings
PaleoResearch Laboratories
Denver, Colorado

INTRODUCTION

Pollen samples were collected in conjunction with the archaeological survey of an historic settlement on the edge of West Loch in the flood plain of the Honouliuli Stream. Pollen samples were collected from trenches through areas that displayed probable fishpond or pondfield sediments. These locations have been identified with the assistance of both historic information and examination of the sediments. Pollen analysis was oriented toward the recovery of pollen types that would indicate what, if any, crops were grown in these areas.

METHODS

Pollen was extracted from samples submitted by Paul H. Rosendahl, Ph.D., Inc. from the West Loch area of Pearl Harbor. Hydrochloric acid (10%) was used to remove any calcium carbonates present in the pond deposits, and Lycopodium tablets were added to the samples at this stage, after which the samples were screened through 150 micron mesh. All samples received a short (10 minute) treatment in hot hydrofluoric acid to remove inorganic particles. The samples were then acetolated for 5 minutes to remove organic matter. The samples were examined microscopically at this time, and a single reference slide was made. The samples were then acetolated for an additional 30 minutes to remove more of the voluminous organic matter present. The samples were processed at an elevation of 5,400 feet above sea level, where the acetolysis reaction is considerably slower than at sea level. The samples were rinsed until neutral, at which time two to three drops of 5% KOH were added to the distilled water rinse, to put remaining humic acids into solution. Basic fuschin stain was added to the samples at this time. When the samples rinsed clear with distilled water, microscope slides were made with glycerol to facilitate counting.

A light microscope was used to count the pollen to a total of 100 to 200 pollen grains at a magnification of 500x. Pollen preservation in

these samples varied from good to fair. Comparative reference material collected at the Bishop Museum Herbarium was used to identify the pollen to the family, genus, and species level, where possible.

Pollen aggregates were recorded during identification of the pollen. Aggregates are clumps of a single type of pollen, and may be interpreted to represent pollen dispersal over short distances, or the actual introduction of portions of the plant represented into an archaeological setting. Aggregates were included in the pollen counts as single grains, as is customary. The presence of aggregates is noted by an "A" next to the pollen frequency on the pollen diagram.

DISCUSSION

The project area was divided into four survey areas. Areas 1 and 4 lie closest to the West Loch of Pearl Harbor, while Areas 2 and 3 represent upland areas. The pollen diagram has been organized to reflect these divisions. The majority of the pollen samples analyzed were collected in Areas 1 and 4 (Table 1). Three trenches are represented in each of these areas.

Pollen analysis for this project has identified six pollen types which may represent agricultural activities in this area. These include cf. Oryza (rice), Saccharum (sugar cane), Colocasia (taro), Ipomea (sweet potato), Zea (corn) and Cruciferae (cf. Raphanus - radish).

Probable Oryza (rice) pollen was distinguished from other grass pollens by size and surface texture. The pollen are relatively small, ranging from approximately 20 to 30 microns in size. The pore and annulus combine to measure approximately 6 - 8 microns in diameter. The exine is approximately 1 micron thick and the surface is smooth. Frequently these pollen stained a uniformly dark brown within the trench samples. These grains were separated from small grasses with scabrate surface textures and medium and large grasses during identification It is probable that other grasses occurring naturally in this area overlap the size range of Oryza pollen and have been included in this pollen type.

Saccharum (sugar cane) is a large grass pollen that varies in size from 40 - 65 microns in diameter. The pore plus annulus varies from 10 - 12 microns in diameter. The exine is 2 microns thick and is finely reticulate. Although some grasses overlap sugar cane in size, few if any also have a finely reticulate surface.

The Zea (corn) pollen recovered measured 95 microns in diameter and exhibited a pore plus annulus of 18 microns in diameter. This pollen grain was clearly outside the size range of all other grasses and well within that expected for cultivated corn.

Table 1.

PROVENIENCE OF POLLEN SAMPLES

Sample No.	Depth in cm below pgs	Deposit	Layer	Pollen Counted
Area 1 - Trench 6				
195	140-150	Pondfield deposit	V	100
207	150-160	Pondfield deposit	V	100
189	160-170	Pondfield deposit	V	200
Area 1 - Trench 12				
186	110-130	Pondfield deposit	V	100
187	130-140	Pondfield deposit	VI	100
184	140-150	Pondfield deposit	VI	100
188	150-160	Pondfield deposit	VI	100
Area 1 - Trench 14				
174	130-140	Pondfield deposit	VI	100
Area 2 - Trench 7				
223	130-140	Pondfield?	III	200
232	140-150	Pondfield?	III	200
Area 2 - Trench 30				
303	240-250	Buried old land surface	IV	100
Area 3 - Trench 1				
225	160-180	Pondfield deposit	III	200
Area 3 - Trench 2				
154	150-170	Pondfield deposit	II	Insuff
Area 3 - Trench 7				
163	90-110	Pondfield deposit	III	50
Area 4 - Trench 4				
200	105-115	Pondfield deposit	V	200
Area 4 - Trench 8				
245	60-70	Fishpond deposit	II	200
243	70-80	Fishpond deposit	II	100
234	89-90	Fishpond deposit	II	200
264	90-100	Fishpond deposit	III	100
255	100-110	Fishpond deposit	III	200
252	110-120	Fishpond deposit	III	100
262	120-130	Fishpond deposit	III	100
254	130-140	Fishpond deposit	III	100
Area 4 - Trench 9				
246	60-70	Fishpond deposit	II	200

Pandanus (hala) and Colocasia (taro) pollen are very similar to one another. Both pollens are spherical, echinate, and approximately the same size. Identifiable differences include a single pore in Pandanus, which is occasionally indistinct, and a single culpi (furrow), which is frequently indistinct in taro. All pollen identified as taro were scrutinized for the presence of pores or furrows. No pores were noted in any of these pollen grains included in this category. While furrows were observed in several of the pollen grains, they were not always visible. There were some grains that exhibited no apparent sign of apertures. These grains were included in the taro-type pollen.

Both spiny and smooth Urtica/Moracese pollen were recovered and were combined into a single category. Breadfruit belongs to the Moracese family and is a small reticulate pollen grain with two pores. Breadfruit pollen was not recognized specifically as the pollen was counted.

All pollen samples were scanned following the original 100 or 200 grain count, in an effort to recover additional large pollen grains which may provide clues to the cultivation of plants in these areas. It was in this man**** that pollen from sweet potato and corn were recovered in multiple samples. Only a single fragment of sweet potato pollen was recorded within the standard pollen count.

Taro was the most prized cultivated plant among the native Hawaiians. Taro requires 9 - 18 months to mature, and requires complicated and arduous labor to produce a good crop. Areas with finer soils and adequate fresh water are required, and are frequently terraced for cultivation. Drought adversely affects this crop. In contrast, sweet potato provided a common food, that matured quickly in a few months, was easy to tend, and flourished in less favorable locations. Potatoes were not as highly prized as food, however. Sweet potato was frequently planted in areas around houses or dwellings, while taro required prepared, terraced fields for growth. The varieties of taro being grown in Hawaii took advantage of both wet lowlands and drier upland habitats. Taro prospers under a great variety of conditions of soil and soil moisture. Numerous ways of preparing taro existed including steaming, mashing, and pressing into cakes which when dried kept almost indefinitely (Handy and Handy 1978:75).

Taro (Colocasia) is a semiaquatic plant that requires a fresh supply of flowing water. Where sufficient water is not available "dry taro" may be cultivated under mulch. In preparing the soil for taro planting, grasses and weeds were pulled and stamped into the mud. Old taro leaves and weeds were also stamped into the mud at each weeding. These activities may well have introduced an abundance of weed pollen into the soils of taro fields. Large volumes of "green manure" were commonly used to enrich taro soil, whereas animal or human manure, seaweed, and fish were not used as fertilizer. When the soil was exhausted large quantities of hau and kukui branches were pressed into the mud and allowed to rot prior to preparation for the next planting. The important subsidiary crops such as banana, sugar cane, arrowroot, and ti plants were frequently planted on the banks of wet-taro fields. The lo'i or flooded, terraced taro fields also functioned occasionally as fishponds to raise and breed fish. The taro fields remain

flooded throughout most of the growing season, and are drained only when harvest is imminent. The old Hawaiians normally harvested only a portion of the taro from the fields, leaving mature taro corms flooded in the fields where they were preserved for future harvest. Taro corms may be left flooded in the fields for several months before they begin to rot. Taro blooms shortly before the corms have matured (Handy and Handy 1978:81, 89, 94, 101).

Taro, sugar cane, and bamboo are associated with one another through mythology and are thought to have been introduced to the Hawaiian Islands early in the Polynesian occupation. Sugar cane (Saccharum) is noted to grow on the banks separating taro fields, as well as the drier upland areas. Sugar cane requires 12 - 15 months to mature in the lowlands and must have irrigation if rainfall is not sufficient. Just prior to harvesting the cane field is burned to remove the leaves, after which the cane is cut (Handy and Handy 1978:186-187; Neal 1965:78).

Sweet potato (Ipomea) was second only to taro as a dietary item for the Hawaiians. Numerous varieties exist in Hawaii with varying times for maturity. Sweet potato ('uala) requires between 3 and 6 months to mature, whereas taro requires 6 - 12 months in the lowlands. Little labor is required for the planting or cultivation of sweet potato. Sweet potatoes may be grown in any soil except clay and were frequently planted in mounds. The ground is frequently cleared by burning, then mixing the soil thoroughly. The soil is ready for planting when it is thoroughly moist. Sweet potatoes may be planted in terraces which have been levelled for taro, particularly if the season was dry. Like taro, sweet potatoes were never dug completely from an existing bed (Handy and Handy 1978:127-149).

Rice (Oryza) was introduced to Hawaii, probably from China, in 1856. Additional seed was introduced from South Carolina in 1860 and proved to be more suitable. Rice became an important agricultural crop in Hawaii, surpassing coffee in 1862 and becoming second only to sugar in importance (Neal 1965:70-71). Rice is a swamp grass that is usually grown in terraced, irrigated fields. These fields remain flooded until the grains begin to ripen, at which point the water is drained from the fields to hasten the harvest.

Corn (Zea) has been grown in Hawaii for more than a century, placing its introduction at or prior to the same time as the introduction of rice. Corn was attacked by both insect pests and diseases until the introduction of a more resistant form (Neal 1965:82).

Myrtaceae pollen was not identified to genus, and may represent any number of trees, including guava. This pollen was widely scattered through Areas 1 and 4.

Loulu palms are noted to grow in the vicinity of this project area, as their pollen was recorded in small quantities throughout these samples.

All spores were held outside of the pollen count so that pollen frequencies would be directly comparable between samples. The relative frequencies of fern spores are presented at the right side of the pollen diagram, and are calculated on the same base as the pollen frequencies. Fern spores are most abundant in the areas of Trenches 8 and 9 in Area 4, probably indicating wet ground. Sample 303 representing a buried old land surface from Trench 30 in Area 2 is the only other area to exhibit large quantities of spores. This area may also have been rather wet, as both rice-type and taro pollen are noted.

The Honouliuli Stream runs through the project area and provides a constant source of fresh water to these lands. The stream was used as the division between Survey Areas 2 and 3 in the upland and Survey Areas 4 and 1 at the edge of West Loch. The location of this stream is probably very important in the upland section with regard to potential irrigation of farmlands. The entire project lies within the floodplain of this stream, therefore the entire area may be subject to periodic flooding. Trenches in all four survey areas were sampled for pollen to identify crops grown in the various fields. Pondfield deposits were sampled in all four areas, while fishpond sediments were sampled only in Area 4.

Survey Area 2 is farthest upstream, and was sampled in Trenches 7 and 30. Trench 7 is located just east of the banks of Honouliuli Stream and yielded rice-size grass, sugar cane, taro, radish, and sweet potato pollen (Figure 1, Table 2). Because the fields in this area were located so close to the stream they may have been easily irrigated and both rice and taro cultivation, which require considerable amounts of water, may have been possible. It is unlikely that sugar cane, radishes, and sweet potato were grown in the same fields at the same time as rice and taro due to differing water requirements. It should be noted that both rice and sugar cane pollen is wind transported and may, therefore, occur in areas adjacent to fields where these crops were grown. The presence of sweet potato (Ipomea) pollen in both of these samples from Trench 7 suggests that sweet potatoes were cultivated in this portion of Area 2. Taro, radishes, and sweet potato are all insect pollinated. Additional sampling in this area should assist in clarifying which portions of Area 2 were used for cultivating specific crops. Trench 30, represented by a single pollen sample, yielded rice-size grass, sugar cane, and taro pollen. The sugar cane frequency was very small and in all probability represents wind transport of the pollen, not growth of sugar cane in this vicinity. The rice-size grass and taro pollen suggest that this area may have been flooded to allow the growth of these two water-dependent crops, or that the pollen was transported by wind and water to this location. This sample represents a buried old land surface and appears to have been in or near a cultivated field.

Downstream Survey Area 3 is represented by single pollen samples from Trenches 7 and 1. Sample 154 representing Trench 2 did not contain a sufficient concentration of pollen for analysis. The remaining two samples were dominated by Cheno-am pollen, possibly representing weedy annuals. Trench 7 yielded only sugar cane-type grass pollen, suggesting that sugar cane was grown locally in this area. Trench 1, however, yielded a larger frequency of sugar cane pollen, as well as small quantities of rice-size

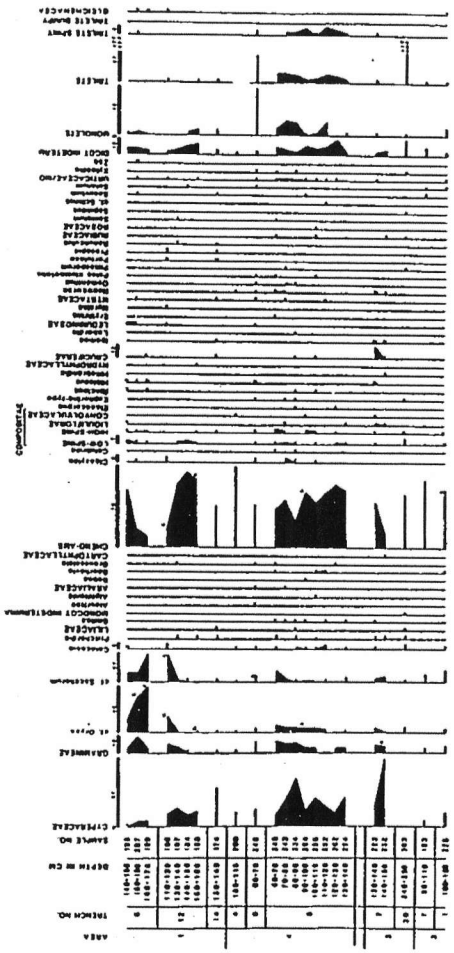

FIGURE 1. POLLEN DIAGRAM FROM AGRICULTURAL DEPOSITS NEAR WEST LOCH, OAHU

Table 2.

POLLEN TYPES RECOVERED FROM THE WEST LOCH AREA

Scientific Name	Common Name
MONOCOTS:	
Cyperaceae	Sedge family
Graminese	Grass family
Oryza	Rice, laiki
Saccharum	Sugar cane, ko
Colocasia	Taro, kalo
Pritchardia	Loulu palm
Liliacese	Lily family
Smilax	Hoi-kuahui, smilax
Monocot Indeterminate	
DICOTS:	
Aleurites	Kukui nut
Alphitonia	Toi, kauila tree
Araliaceae	Panax family
Bobea	'Ahakea
Boerhavia	Alena
Broussaisia	Kanawao
Caryophyllaceae	Pink family
Cheno-ams	Pigweed family and amaranth
Claoxylon	Po'ola
Colubrina	Anapanapa kukuku
Low-spine Compositae	Sunflower family, includes ragweed, and cocklebur, kikania
High-spine Compositae	Sunflower family
Liguliflorae	Sunflower family, includes cichorium tribe
Convolvulaceae	Morning glory family
Elaeocarpus	Blue marble tree, blue fig
Euphorbia-type	Spurge
Rincinus	Castor bean
Hibiscus	Hau, hibiscus
Hillebrandia	Pau-maka-nui, aka'aka'awa
Hydrophyllaceae	Water leaf family
Cruciferae	Mustard family
Ipomea	Sweet potato, 'uala
Labordia	Kamakahala
Leguminosae	Legume or pea family
Erythrina	Wiliwili
Myrsine	Myrsine
Myrtaceae	Myrtle family
Neowawrae	Mehamehame
Osmanthus	Kwai-fah
Pelea clusiaefolia	Mokihana
Pittosporum	Pittosporum

Table 2. (Cont.)

Scientific Name	Common Name
Portulaca	Purselane, 'akulikuli-kula
Prosopis	Mesquite, kiawe
Ranunculus	Buttercup
Rubiaceae	Coffee family
Rosaceae	Rose family
Santalum	Sandalwood, 'ili-ahi
Sapindus	Soapberry, Manele, a'e
Schinus	Christmasberry
Sesuvium	'Akulikuli, ice-plant
Solanum	Kikania-lei, nightshade, etc.
Urticaceae/Moraceae	Nettle or fig family
Xylosma	Maua
Zea	Corn, maize, kulina
Dicot Indeterminate	
Spores:	
Monolete	
Trilete	
Trilete Spiny	
Trilete Bumpy	
Gleicheniaceae	Vine fern family

The common Hawaiian and English names are given, when known.

grass and taro pollen. It is probable that sugar cane is also a dominant crop in this area, although it is also possible that this area immediately adjacent to the Honouliuli Stream was flooded to allow the growth of rice and taro. Additional pollen samples should be collected from trenches both immediately adjacent to the stream and far removed from the stream in an effort to identify both the actual field components and crops in this area, and to identify a potential diversity in land use or cropping occurring farther from the stream banks. The lack of variety in pollen types representing cultivated crops in Area 3 may be due in part to the few samples representing this area. Additional sampling should clarify which crops were indeed grown in this area, and may substantiate the use of this area for a few specific crops.

Areas 2 and 3 represent the upland sections of this study. Considerably less variety was noted in the pollen record from these two areas than were recovered in Areas 1 and 4. This suggests less diversity in the vegetation. Cheno-ams continue to be the dominant pollen type in most of the samples, with the exception of Trench 7, where Cyperaceae was dominant in the lower sample, indicating wet conditions. Trench 7 is the only portion of this area that exhibits pollen frequencies similar to those recorded in the pondfields from Areas 1 and 4.

Survey Area 4 to the north of Honouliuli Stream and west of the West Loch of Pearl Harbor is represented by samples from Trenches 4, 9, and 8. Trench 4 was closest to the stream and exhibits very small quantities of rice-size grass, sugar cane, and taro pollen. The sample is dominated by Cheno-am pollen, probably representing the growth of weeds in this area. The pollen record provides very weak evidence that this level represents a cultivated field. Sample 246 representing Trench 9, several hundred feet north of the Honouliuli Stream, yielded rice-size grass, sugar cane, and taro pollen. This trench is fairly close to Trench 8, and this large area appears to represent fishpond deposits. Kukui nut (Aleurites) and hau (Hibiscus) pollen were also recovered suggesting the growth of Kukui nut trees and hau in the vicinity or the use of kukui and hau branches to rejuvenate the soil. Mention of this technique is made in Handy and Handy (1978:89) as a common use of "green manure."

The stratigraphic samples collected from Trench 8 exhibit their largest frequency of sugar cane pollen towards the top of the column. Rice-size grass pollen is observed fairly consistently throughout the sediments suggesting the possibility that rice was grown in this flooded area. Taro pollen was associated with the recovery of rice-size grass pollen in all samples except 243, which contained no taro pollen, suggesting that these fields were used at least sporadically to grow taro. Both taro and rice, which require inundation, may be grown in fishponds where fish are being raised or bred. Sugar cane pollen distribution mirrors that of rice, occurring sporadically in the lower portion of the trench, and more regularly in increasing frequencies in the upper portion of the trench. This suggests that sugar cane cultivation may have been more important in this area in more recent times. Small quantities of Cruciferae pollen were also observed in samples from this trench, suggesting that a member of this family was cultivated or grew as a weed in this area. Sugar cane and taro represent crops that were introduced to the Hawaiian Islands early during the Polynesian occupation, whereas rice was a relative latecomer.

Area 1 to the south of Honouliuli Stream and to the west of the West Loch of Pearl Harbor is represented by three trenches in the pollen record. Trench 14 is removed from Honouliuli Stream by approximately 1,000 m., but is within a few hundred meters of West Loch. Fishponds are noted between this pondfield area and West Loch. A single pollen sample was collected from Trench 14 and yielded a very small quantity of rice-size grass pollen, a relatively small frequency of sugar cane pollen, as well as small quantities of both Cruciferae and sweet potato pollen. The Cruciferae pollen is consistent with radish pollen, and may represent the growth of radishes in this area. It is doubtful that the rice-size grass pollen represents the cultivation of rice in this area, as the frequency is very low and rice pollen is wind transported. The presence of sugar cane, sweet potato, and possibly radish pollen is interpreted to be more representative of local crops.

Trench 12, a few hundred feet to the south of Trench 14, is represented by a series of four pollen samples from pondfield sediments. The uppermost pollen sample from this column displays relatively large

frequencies of both rice-size grass and sugar cane pollen, as well as taro pollen. It appears that this level (110 - 130 cm) represents the possible growth of rice and taro in an inundated field, and possibly sugar cane either along the pond margins or during drier years in the same field area. The lower samples contain very small frequencies of rice-size grasses and sugar cane pollen suggesting that these may have been worked down into the lower sediments during the process of working "green manure," which consists of leaves and weeds, into the soil to enrich it. This would provide mixing of pollen from the upper cultivated levels with lower levels. These lower levels also exhibited large Cheno-am frequencies, similar to those observed in Trench 4. It is possible that these very high frequencies of Cheno-am pollen and low quantities of agricultural crop pollen represent fallow periods for these fields. Many members of the Cheno-am group which are noted to be edible include pigweed or lambs quarters, which was used for its greens; Mexican tea, used for greens, tea, and medicine; garden beet; swiss chard; and spinach. Several amaranths were grown as ornamentals although the greens may also be eaten (Neal 1965:331).

Several pollen samples were very black and dominated by small black fragments under the microscope. These samples emitted a foul odor similar to burning rubber when the microscope slides were made using an infra-red lamp. Pollen samples 184, 187, and 188 from Trench 12 in Area 1 were noted to display these characteristics. This may have resulted from burning vegetation in the fields, such as sugar cane. A few other samples scattered throughout the trenches also were noted to have similar characteristics, although not to as great a degree.

Trench 6 is the closest to the fishponds and West Loch of Pearl Harbor. All three samples examined from the pondfield sediments in this trench yielded large frequencies of rice-size grass pollen suggesting that rice was, in fact, grown in this area. A small quantity of taro pollen was recovered from the upper level (140 - 150 cm, sample 195). Moderate to large frequencies of sugar cane pollen were also recovered from these samples, suggesting that sugar cane was grown in this general vicinity. A small quantity of Cruciferae pollen was recovered from the lowest sample examined from this trench, suggesting that a member of this family may have been grown at the edge of this field. The only corn (Zea) pollen recovered in this project was observed in sample 207 from a depth of 150 - 160 cm in this trench. This indicates that corn was also grown in this general vicinity. Corn pollen is relatively heavy and does not travel farther than a few hundred feet on the wind. Most corn pollen, in fact, travels only a few tens of feet beyond the edge of the field. Corn pollen may have been transported by water from the edge of the pondfield represented by sediments in these trench. Small quantities of hau (Hibiscus pollen) were recovered from all of the samples from this trench, indicating that either hau grew along the field boundary or that hau branches were used as "green manure" to enrich the soil.

SUMMARY AND CONCLUSIONS

The pollen record from this examination of sediments from several trenches in the project area indicates that pollen analysis is a valuable tool for identifying crops grown in these fields, as well as identifying probable field locations. Much more extensive and intensive sampling is recommended, based on the recovery large quantities of identifiable pollen from these sediments, and the presence of pollen representing several cultivated crops including sugar cane, sweet potato, corn, taro, and possibly rice and radishes.

The pollen record suggests that rice cultivation was most probable in the areas of Trenches 6 and 12 in Area 1. Rice cultivation is also possible in Trench 8 in Area 4. Due to the problematic identification of rice pollen, in that its size overlaps with other types of grass and the fact that there are no distinguishing characteristics on the surface of this pollen, identification of actual rice fields based on pollen data is tenuous. Sugar cane, on the other hand, has a relatively large pollen which does not overlap in size with many other grass types and the surface is reticulate, a characteristic that is uncommon in this family. Identification of this grass pollen is far more certain in the record. It should be noted, however, that sugar cane pollen is transported by the wind and may be recovered from sediments outside the areas where sugar cane is grown. Sugar cane pollen is ubiquitous in this pollen record, indicating that sugar cane was probably planted in several areas within the study area, and was planted over a long time period. Sweet potato pollen is insect transported and its presence is interpreted as representing sweet potato cultivation or transportation of this pollen by water to its present location.

Sugar cane-type pollen was recovered from Trench 6 in Area 1 in its largest frequency in sample 189 (160 - 170 cm). The frequencies declined slightly in the upper two samples. This suggests sugar cane cultivation in the general vicinity. It should be noted that all grasses are wind pollinated and the identification of actual fields of rice and sugar cane, as well as corn, would require considerable additional sampling in this area to provide a mosaic of samples capable of addressing fluctuating frequencies of pollen types.

Area 1 Trench 12 exhibited a large frequency of sugar cane pollen in the uppermost sample, suggesting sugar cane cultivation in this area. Much smaller quantities of sugar cane size pollen were recovered in samples 187 and 184 from this trench. Both sugar cane and rice cultivation, as well as taro cultivation, appear to have been more widespread at 110 - 130 cm (186) than previously in this area. The low quantities of rice and sugar cane pollen observed in the lower portions of this trench may represent either cultivation of these crops in the immediate vicinity, or wind or water transport of this pollen from other nearby areas. They may also be the result of working "green manure" into the soil to prepare the ground for taro cultivation, thus introducing the pollen into lower levels. The recovery of kukui and hau pollen in Area 4

Trench 9 suggests that these branches may have been used as "green manure" to enrich the soil. In addition, hau pollen was recovered in Area 1 Trench 6, again suggesting either the presence of hau at the field boundaries or use of hau branches as "green manure."

The pollen record suggests that rice-size pollen recovered from most locations (which did not exceed c. eight percent) is wind transported grass pollen. The only rice-size pollen to exceed eight percent was recovered from Layer V of Trenches 6 and 12 in Area 1--an area in which rice may have been cultivated. None of the other areas trenched display large frequencies of rice-size grass pollen. Identification of a "threshold" frequency for rice-size grass pollen that would serve to indicate probable rice cultivation is necessary to further work in this area. This would be best accomplished by sampling modern cultivated fields as controls for interpreting the historic and prehistoric field sediments. This type of control is particularly important in the interpretation of evidence for rice cultivation.

Sweet potato pollen was recovered from two locations: Area 1 Trench 14 and Area 2 Trench 7. The presence of sweet potato pollen is a strong indication of cultivation of this crop, since the plant is insect pollinated and the pollen does not travel unless carried by man or insect, or possibly water. Due to the relatively wet nature of most of the study area, sweet potato cultivation is expected to be confined to only a few areas.

The recovery of corn pollen was unexpected in this area. Its presence raises questions concerning the abundance of this crop and locations of fields in which it was grown. Cruciferae pollen that most closely resembles radish was abundant in one location (Area 2 Trench 7). Additional pollen representing garden vegetables may be recovered during future sampling.

The successful recovery of pollen from a variety of plants in these 24 samples examined from four survey areas indicate that palynology is a valuable tool in describing and defining historic and prehistoric cultivated areas. Based on analysis of the material, additional study and analysis of these fields is strongly recommended. Definition of agricultural fields is possible through the identification of pollen representing cultivated plants. Analysis of additional samples within these areas would provide better definition of agricultural fields used by the historic and prehistoric occupants of this area. It would assist in defining areas that had been used for the cultivation of sweet potatoes as opposed to rice or taro. The growth of corn in this area would also be further identified. A mosaic of pollen samples across all areas that may have been cultivated would assist in a definition of areas used in the cultivation of corn, as well as other crops.

Additional sampling should be structured to sample identified stratigraphic layers in each survey area, as well as provide a representative horizontal distribution of samples across each area.

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APPENDIX D:

DETAILED SUMMARY OF SHALLOW SUBSURFACE TESTING RESULTS - SHOVEL TEST UNITS IN SURVEY AREA 5

HOAEAE POINT - (SU-1 thru SU-74)

Shovel Unit 1

0-30 cmbs	Compact, brown clay loam containing large amounts of marine and brackish-water shell. No cultural material present.
30-50 cmbs	Very durable, compact, brown sandy clay loam. No cultural material present.

Shovel Unit 2

0-10 cmbs	Compact, brown clay loam with basalt gravel fill. No cultural material present.
10-30 cmbs	Very hard, durable, brown clay loam. No cultural material present.

Shovel Unit 3

0-30 cmbs	Very loose dark brown loam with decomposing organic materials; probably an O/A-horizon. Large amounts of *Pinctada* spp. shell present. No cultural material present.
30 cmbs	Coral-shell reef.

Shovel Unit 4

0-65 cmbs	Brown clay loam with sparse amounts of shell.
65 cmbs	Coral-shell reef.

Shovel Unit 5

0-50 cmbs	Brown clay loam matrix containing large amounts of marine and brackish-water shell and one volcanic glass fragment.
50-65 cmbs	Compact brown clay loam with no cultural material.

Shovel Unit 6

0-38 cmbs	Brown sandy clay loam with sparse amounts of shell.
38-50 cmbs	Compact brown clay loam with no cultural material.

Shovel Unit 7

0-5 cmbs	Brown sandy clay loam with one piece each of ceramic and bottle glass, not retained.
5-50 cmbs	Brown sandy clay loam with no cultural material.

Shovel Unit 8

0-40 cmbs	Soft brown sandy loam which contained about 12 pieces of shell, and modern trash and glass.
40-60 cmbs	Hard compact clay.

Shovel Unit 9

0-45 cmbs	Very loose dark brown loam with decomposing organic material and large amounts of marine and brackish-water shell; probably an O/A-horizon. One to two pieces of charcoal and fish bone were present between 0-30 cmbs.
45 cmbs	Coral-shell reef.

Shovel Unit 10

0-10 cmbs	Light brown alluvial sand containing a few pieces of shell.
10 cmbs	Coral-shell reef.

Shovel Unit 11

0-35 cmbs	Brown sandy loam with shell and charcoal.
35cmbs	Coral-shell reef.

Shovel Unit 12

0-40 cmbs	Compact brown sandy clay loam.
40-55 cmbs	Sterile very compact brown clay loam.

Shovel Unit 13

0-35 cmbs	Compact brown sandy clay loam with one *Cypraea* sp. and one fire-cracked basalt fragment.
35-50 cmbs	Sterile very compact brown clay loam.

Shovel Unit 14

0-35	Brown sandy clay loam with no cultural material.
35-55 cmbs	Sterile compact brown clay loam.

Shovel Unit 15

0-30 cmbs	Dark brown sandy clay loam containing large amounts of marine and brackish-water mollusc shell, one flake of volcanic glass, and two machine-made nails.
30-50 cmbs	Very compact, reddish-brown clay loam. No cultural material present.

Shovel Unit 16

0-30 cmbs	Dark brown sandy loam containing large amounts of marine and brackish-water mollusc shell, and scattered charcoal.
30-50 cmbs	Compact, reddish-brown clay loam. No cultural material present.

Shovel Unit 17

0-40 cmbs	Soft brown sandy loam containing large amounts of marine and brackish-water mollusc shell and one flake of volcanic glass.
40-60 cmbs	Very compact, brown clay loam. No cultural material present.

Shovel Unit 18

0-60 cmbs	Disturbed brown sandy clay loam with shell material, basalt fill, charcoal, and automobile glass and metal.
60 cmbs	PVC pipe. Unit discontinued.

Shovel Unit 19

0-50 cmbs	Same as SU-18. Unit discontinued.

Shovel Unit 20

0-50 cmbs	Road fill. Unit discontinued.

Shovel Unit 21

0-30 cmbs	Dark brown clay loam containing small amounts of marine mollusc shell, basalt rocks, and one bird bone.
30-35 cmbs	Compact brown clay with no cultural materials.

Shovel Unit 22

0-10 cmbs	Brown sandy clay loam with marine and brackish-water mollusc shell.
10-35 cmbs	Brown clay loam with no cultural material.
35 cmbs	Coral-shell reef.

Shovel Unit 23

0-20 cmbs	Dark brown, compact clay loam containing minor amounts of shell, one fragment of green bottle glass, and miscellaneous recent garbage.
20-50 cmbs	Very compact, brown clay loam. No cultural material present.

Shovel Unit 24

0-10 cmbs	Dark grayish-brown clay loam containing only three fragments of marine shell.
10-50 cmbs	Very compact, brown clay loam. No cultural material present.

Shovel Unit 25

0-35 cmbs	Reddish-brown sandy loam containing small scattered amounts of shell, recent historic garbage, and brick fragments. Local informant indicates that this is recently placed land fill.
35-55 cmbs	Very dark brown silt containing small scattered amounts of shell. According to local informant this area was a mud flat prior to land filling. This lower deposit is probably comprised of the former mudflat.

Shovel Unit 26

0-30 cmbs	Compact, dark brown clay loam containing large amounts of *Brachidontes*, other shellfish remains, and scattered charcoal.
30-46 cmbs	Very compact brown clay loam. No cultural material present.

Shovel Unit 27

0-10 cmbs	Dark brown clay loam containing small, scattered amounts of marine and brackish-water shell.
10-25 cmbs	Light gray decomposing coral.
25-50 cmbs	Very dark gray water-saturated silt loam scattered with a small amount of shell.

Shovel Unit 28

0-15 cmbs	Dark brown clay loam containing recent miscellaneous garbage and a single flake of volcanic glass. Also present were small amounts of scattered marine shell.
15-21 cmbs	Decomposing coral bedrock.

Shovel Unit 29

0-12 cmbs	Compact dark brown clay loam, containing small amounts of scattered marine and brackish-water shell.
12-55 cmbs	Loosely compacted, light brown to brown sandy loam, containing moderate amounts of shell and waterworn basalt and coral.

Shovel Unit 30

0-30 cmbs	Loosely compacted light brown clay loam, containing moderate amounts of shell, charcoal, and modern garbage.
30-50 cmbs	Loosely compacted light brown clay loam containing a small number of waterworn basalt cobbles and pebbles.

Shovel Test 31

0-22 cmbs	Brown sandy clay with no cultural materials.
22-47 cmbs	Waterworn basalt pebbles and cobbles; either alluvial or river/beach bed. No cultural material present.

Shovel Unit 32

0-20 cmbs	Brown silty clay loam, mostly basalt fill, with no cultural material present.
20 cmbs	Extremely compact sandy clay with decomposing shell and coral reef.

Shovel Unit 33

0-10 cmbs	Sterile sandy clay loam.
10 cmbs	Coral-shell reef.

Shovel Unit 34

0-15 cmbs	Dark brown silty clay loam with shell, charcoal, crustacea, kukui, and fire-cracked waterworn basalt.
15-35 cmbs	Very dark brown silty clay loam with charcoal and fire-cracked basalt.
35-40 cmbs	Very compact sandy clay with decomposing shell and coral rock. No cultural material present.

Shovel Unit 35

0-30 cmbs	Dark brown sandy clay loam with marine and brackish-water mollusc shell. No cultural material present.
30-50 cmbs	Brown sandy clay loam with no shell and no cultural material.

Shovel Unit 36

0-10 cmbs	Brown sandy loam, loose with moderate amounts of shell and recent trash.
10-35 cmbs	Brown sandy loam with shell, charcoal fragments, and no trash.
35-50 cmbs	Very compact clay loam with a decrease in shell material. No cultural material present.

Shovel Unit 37

0-7 cmbs	Brown clay loam, compact, with rusty metal fragments.
7-35 cmbs	Brown clay loam, compact, with moderate shell and no metal.
35-40 cmbs	Very compact brown clay with a decrease in shell material. Unit discontinued.

Shovel Unit 38

0-30 cmbs	Dark brown loam with organic material and some marine and brackish-water mollusc shell (including Nerita picea).
30-50 cmbs	Slightly compact brown clay loam. No cultural material present.

Shovel Unit 39

0-25 cmbs	Compact yellowish-brown clay loam with 20 pig vertebrae.
25-40 cmbs	Basalt rock in a clay loam matrix. No cultural material present.

Shovel Unit 40

0-20 cmbs	Dark brown loam with modern trash.
20-50 cmbs	Compact dark brown loam with moderate amounts of marine and brackish-water shell, sparse fish bone, and charcoal.
50 cmbs	Brown, very hard stony loam with shell material decreasing. Unit discontinued.

Shovel Unit 41

0-22 cmbs	Brown sandy clay loam with moderate amounts of marine and brackish-water shell, and sparse charcoal.
22-26 cmbs	Yellowish-brown silt loam with no cultural material.
26-35 cmbs	Brown stony sandy loam with no cultural material. Unit discontinued.

Shovel Unit 42

0-15 cmbs	Brown sandy clay loam with modern glass.
15-25 cmbs	Very hard clay loam with no modern glass.
25-35 cmbs	Sterile compact brown clay loam.

Shovel Unit 43

0-10 cmbs	Brown loam with decomposing organic material. No cultural material present.
10-25 cmbs	Compact brown clay loam with some marine and brackish-water shell.
25-40 cmbs	Very hard sterile clay loam.

Shovel Unit 44

0-20 cmbs	Very hard brown clay loam with modern trash and sparse amounts of shell.
20-45 cmbs	Extremely hard clay loam.

Shovel Unit 45

0-50 cmbs	Dark brown sandy clay loam with alluvial waterworn basalt. Shovel unit bisects most likely post-1950 terrace with retaining wall. No cultural material present. Unit discontinued.

Shovel Unit 46

0-45 cmbs	Dark brown clay loam with no cultural material present.
45 cmbs	Coral-shell reef.

Shovel Unit 47

0-45 cmbs	Disturbed brown clay loam with sparse shell and PVC water pipes. Unit discontinued.

Shovel Unit 48

0-20 cmbs	Brown silty clay with marine and brackish-water mollusc shell. No cultural material present.
20-50 cmbs	Compact silty clay with less shell material. No cultural material present.

Shovel Unit 49

0-60 cmbs	Brown sandy clay loam with marine and brackish-water mollusc shell and one pig tooth.
60-85 cmbs	Brown sandy clay loam with sparse mollusc shell. Unit discontinued.

Shovel Unit 50

0-20 cmbs	Slightly compact sandy clay loam with no cultural material present.
20-35 cmbs	Very hard brown clay loam with no cultural material present.

Shovel Unit 51

0-30 cmbs	Soft brown sandy clay loam with sparse marine and brackish-water mollusc shell. No cultural material present.
30-50 cmbs	Compact brown clay loam with a decrease in shell. No cultural material present.

Shovel Unit 52

0-37 cmbs	Brown sandy clay with no cultural material present.
37 cmbs	Coral-shell reef.

Shovel Unit 53

0-35 cmbs	Brown silty clay loam with large amounts of marine and brackish-water mollusc shell, sparse charcoal, kukui, and one piece of fire-cracked waterworn basalt.
35-50 cmbs	Very hard sterile brown clay.

Shovel Unit 54

0-32 cmbs	Brown sandy clay loam containing metal fragments, burnt shell, and worked bottle glass.
32-40 cmbs	Compact sterile clay.

Shovel Unit 55

0-47 cmbs	Dark brown sandy to gravelly clay loam with bottle glass, and ceramic sherd. Tar uncovered at 35 cmbs.
47-60 cmbs	Dark brown gravelly clay loam with no cultural material present. Unit discontinued.

Shovel Unit 56

0-60 cmbs	Brown sandy clay loam with no cultural material present.
60 cmbs	Coral-shell reef.

Shovel Unit 57

0-25 cmbs	Brown clay loam containing a small amount of, scattered shell. No cultural material present.
25-50 cmbs	Compact reddish-brown clay loam. No cultural material present.

Shovel Unit 58

0-10 cmbs	Grayish-brown sandy loam with modern trash.
10 cmbs	Coral-shell reef.

Shovel Unit 59

0-40 cmbs	Dark grayish-brown silt loam containing large amounts of Brachidontes sp. shell, as well as minor quantities of other shell types. Scattered charcoal, ash, and waterworn basalt pebbles also present. A single basalt adze fragment was recovered 0 and 12 cmbs.
40-50 cmbs	Very compact brown clay loam. No cultural material present.

Shovel Unit 60

0-35 cmbs	Semi-compact grayish-brown sandy silt loam containing large amounts of marine and brackish-water shell, predominantly Brachidontes sp. Scattered ash and charcoal and several small waterworn basalt cobbles and pebbles also present. A small amount of recent-historic rusted metal fragments were present within the upper portion of this layer.
35 cmbs	Light gray decomposing coral-shell reef.

Shovel Unit 61

0-30 cmbs	Loosely compact, reddish-brown silty clay loam containing large amounts of marine and brackish-water shell fish remains.
30-40 cmbs	Very compact reddish-brown clay. No cultural material present.

Shovel Unit 62

0-31 cmbs	Loosely compact grayish-brown silty sand containing large amounts of fragmented shell, a few pieces of burned shell, two unburnt fish bones, ash, charcoal, and fire-cracked rock.
31-37 cmbs	Concentrated layer of ash and charcoal; probably the remains of a buried hearth.
37-40 cmbs	Very hard brown clay. No cultural material present.

Shovel Unit 63

0-30 cmbs	Dark brown silty clay loam containing small amounts of marine and brackish-water shellfish remains.
30-40 cmbs	Very compact, brown clay loam. No cultural remains present.

Shovel Unit 64

0-25 cmbs	Grayish-brown silty loam containing large amounts of shell fragments, sparsely scattered charcoal, and waterworn basalt cobbles and pebbles.
25-40 cmbs	Very compact yellow-brown clay loam. No cultural remains present.

Shovel Unit 65

0-45 cmbs	Moderately compact, grayish-brown sandy silt loam containing large amounts of shell, coral, and basalt cobbles and pebbles.
45-50 cmbs	Very compact reddish-brown clay. No cultural material present.

Shovel Unit 66

0-50 cmbs	Loosely compact, light brown sandy silt loam containing large amounts of fragmented shell, vesicular and waterworn basalt cobbles and pebbles, and recent historic tar paper, plastic, and charcoal.
50-60 cmbs	Very compact reddish-brown clay. No cultural material present.

Shovel Unit 67

0-35 cmbs	Loosely compact grayish-brown sandy silt loam containing recent garbage, charcoal, and ash.
35-50 cmbs	Very compact yellow-brown clay loam. No cultural material present.

Shovel Unit 68

0-23 cmbs	Dark grayish-brown sandy silt loam containing small, scattered amounts of charcoal, and rusted fragments of metal.
23-45 cmbs	Very compact brown sandy clay loam. A small amount of shell present.

Shovel Unit 69

0-15 cmbs	Loosely compacted brown clay loam. No cultural material present.
15-50 cmbs	Very compact reddish-brown clay. No cultural material present.

Shovel Unit 70

0-20 cmbs	Dark brown clay loam containing a small, scattered amount of shell.
20-50 cmbs	Very compact reddish-brown clay. Small amount of shell present near the upper boundary of this otherwise culturally sterile deposit.

Shovel Unit 71

0-40 cmbs	Compact brown clay loam. No cultural material present.
40-50 cmbs	Very compact reddish-brown clay. No cultural material present.

Shovel Unit 72

0-15 cmbs	Very compact brown clay loam. No cultural material present.
15-50 cmbs	Very compact reddish-brown clay. No cultural material present.

Shovel Unit 73

0-30 cmbs	Very compact brown clay loam containing a small number of scattered marine and brackish-water shells.
30-50 cmbs	Very compact reddish-brown clay. No cultural material present.

Shovel Unit 74

0-20 cmbs	Dark brown sandy loam with historic glass and metal.
20 cmbs	Coral-shell reef.

SITE 3319 AND IMMEDIATE VICINITY (SU-1 thru SU-24)

Shovel Unit 1

0-5 cmbs	Decomposing forest litter and unconsolidated organic debris plus scattered marine shell fragments.
5-50 cmbs	Compact, dark brown loamy soil containing large amounts of marine invertebrates, and scattered waterworn basalt pebbles and cobbles. A thin ash deposit containing fire-cracked rock (a possible hearth) encountered at c. 30-38 cmbs. A single piece of volcanic glass encountered at 40-50 cmbs.
0-55 cmbs	Hard, compact reddish-brown clay loam. No cultural material present.

Shovel Unit 2

0-30 cmbs	Decomposing forest litter and unconsolidated organic debris. Under the surface litter/debris was an A-horizon which extended to 30 cmbs. Within this horizon was a moderate amount of marine/brackish-water shell, including a single fragment of worked or modified marine shell.
30-50 cmbs	Comprised of a consolidated reddish-brown clay. No cultural material present.

Shovel Unit 3

0-30 cmbs	A-horizon contained a moderate amount of marine/brackish-water shellfish remains, a small number of terrestrial gastropods, and small waterworn basalt pebbles and cobbles.
30 cmbs	Comprised of compact, sterile reddish-brown clay. No cultural materials.

Shovel Unit 4

0-10 cmbs	A thin A-horizon containing small amounts of marine/brackish-water bivalve shells.
10 cmbs	Compact, sterile reddish-brown clay. No cultural remains.

Shovel Unit 5

0-18 cmbs	Contained a small amount of marine and brackish-water shell.
18-28 cmbs	A large coral boulder packed in a tight matrix of waterworn basalt cobbles and pebbles.
28-30 cmbs	Waterworn basalt cobbles and pebbles containing two (probably adult) human teeth, a lower incisor and a premolar fragment. Also present were fragments of possible human bone, including a short mid-section of a long bone.

Shovel Unit 6

0-10 cmbs	A-horizon contained small amounts of unidentified mammal bone and small amounts of brackish-water and marine shell.
10 cmbs	Reddish-brown clay subsoil. No cultural materials.

Shovel Unit 7

0-5 cmbs	Comprised of unconsolidated decomposing humus and forest litter.
5-25 cmbs	Sterile reddish-brown clay. No cultural materials were recovered.

Shovel Unit 8

0-5 cmbs	Comprised of humus, unconsolidated forest litter, and very small amounts of shell and charcoal.
5-35 cmbs	Sterile subsoil; no cultural material.

Shovel Unit 9

0-5 cmbs	Comprised of unconsolidated humus and organic debris.
5-35 cmbs	Sterile subsoil; no cultural remains.

Shovel Unit 10

0-10 cmbs	Thin A-horizon of forest litter and humus which contained a small amount of shell.
10-40 cmbs	Sterile reddish-brown clay. No cultural remains present.

Shovel Unit 11

0-40 cmbs	A-horizon containing large amounts of brackish- and fresh-water shells, a number of terrestrial gastropod shells, and a fish vertebra.
40-55 cmbs	Sterile reddish-brown clay.

Shovel Unit 12

0-30 cmbs	Comprised of water-saturated, reddish-brown clay loam which probably eroded off the top of the ridge nose. No cultural material present in the loam.
30-50 cmbs	Coarse sand; this sand may have once been part of a beach that bordered West Loch. A small amount of marine and brackish-water shell was recovered from the sand.

Shovel Unit 13

0-60 cmbs	Homogenous deposit of reddish-brown loamy clay; this clay probably eroded off the top of the ridge nose. No cultural material was recovered.

Shovel Unit 14

0-50 cmbs	Comprised of loosely compact, water-saturated dark brown clay loam.
50-65 cmbs	Compact reddish-brown clay. No cultural material was recovered.

Shovel Unit 15

0-55 cmbs	Comprised of loosely compacted, dark brown clay loam. This loam became increasingly saturated with water as the depth of the unit increased. Two marine shell fragments were recovered from the loam.

Shovel Unit 16

0-10 cmbs	Comprised of loosely compacted, dark brown clay loam.
10-65 cmbs	Comprised of a thick layer of historic garbage--plastic, glass bottles, aluminum cans, and pull-top rings.

Shovel Unit 17

0-30 cmbs	Loosely consolidated, dark brown loamy clay.
30-33 cmbs	A dark grey lens of clay.
33-35 cmbs	Consolidated reddish-brown loam containing numerous waterworn basalt cobbles and pebbles.
35-50 cmbs	Reddish-brown loam; no cultural remains.

Shovel Unit 18

0-40 cmbs	Comprised solely of loosely compacted, dark brown to reddish-brown loam. Within the loam eight fragments of marine and brackish-water shell were recovered. Excavation terminated on coral bedrock.

Shovel Unit 19

0-35 cmbs	Comprised of loosely consolidated dark brown to dark reddish-brown clay loam. Within this loam were several fragments of marine shell, a modern glass bottle neck, a probable canine mandible fragment, and numerous waterworn basalt and coral cobbles and pebbles.
35-45 cmbs	Compact clay loam.

Shovel Unit 20

0-50 cmbs	Loosely consolidated, dark brown clay loam. Present throughout this loam were basalt stream cobbles and pebbles—which are indicative of alluvial conditions. The sizes and numbers of the cobbles and pebbles increased with the depth of the unit. Three shell fragments were recovered from the unit.

Shovel Unit 21

0-25 cmbs	Loosely consolidated, dark brown clay loam and scattered basalt gravel.
25-50 cmbs	The quantity and size of the gravel increased in this layer and severely impaired the excavation. The material was obviously alluvial, and yielded no cultural remains.

Shovel Unit 22

0-25 cmbs	Dense alluvial gravel; no cultural remains.

Shovel Unit 23

0-30 cmbs	Piled basalt boulders; a single unidentified bone fragment was recovered at 20 cmbs.
30-75 cmbs	Dark brown, somewhat compact clay loam. Within this loam were large amounts of Brachidontes sp. shell and charcoal.
75-95 cmbs	Sterile brown to reddish-brown compact clay loam.

Shovel Unit 24

0-30 cmbs	A loosely constructed basalt cobble and boulder cairn raised 30 cm above ground surface.
30-50 cmbs	Dark brown silty loam which contained large amounts of marine and brackish-water shellfish remains and small amounts of charcoal and ash.
50 cmbs	Sterile brown to dark brown compact clay subsoil.

APPENDIX E:

DETAILED SUMMARY OF DEEP SUBSURFACE BACKHOE TRENCH TESTING RESULTS - SURVEY AREAS 1, 2, 3, AND 4

SURVEY AREA 1

Backhoe Trench 1-1

LAYER	DESCRIPTION
I	0-80 cmbs; Ap-horizon. Plow zone of 5YR-3/3 dark reddish-brown clay loam probably derived from recent historic alluvial and colluvial overburden (Soil Unit Eh).
II	80-110 cmbs; C-horizon. 5YR-3/1 very dark gray clay.
III	110-180 cmbs; Agb-horizon. Gleyed pondfield deposit of 5b-4/1 dark blue-gray very fine clay loam (Soil Unit Ga).

Backhoe Trench 1-2

LAYER	DESCRIPTION
I	0-70 cmbs; Ap-horizon. Plow zone of 5YR-3/3 dark reddish-brown clay loam probably derived from recent historic alluvial and colluvial overburden (Soil Unit Eh).
II	70-100 cmbs; B/C-horizon. 2.5YR-3/4 dark reddish-brown clay overburden of recently deposited historic period alluvium and colluvium (Soil Unit Eh).
III	100-120 cmbs; IIAgb1-horizon. Gleyed pondfield deposit predominantly comprised of 5G-4/1 dark greenish-gray fine clay loam (Soil Unit Ga).
IV	120-160 cmbs; IIAgb2-horizon. Gleyed pondfield deposit of N-4/0 dark gray fine clay loam (Soil Unit Ga). Water table encountered at approximately 160 cmbs.

Backhoe Trench 1-3

Stratigraphic soil profile of this trench was not described in detail due to imminent danger of side-wall collapse.

LAYER	DESCRIPTION
I	Ap-horizon. Historic plow zone.
II	B/C-horizon. Recently deposited overburden of historic period colluvium and alluvium (Soil Unit Eh).
III	110+ cmbs; IIAgb-horizon. Gleyed deposit of fine clay possibly associated with buried pondfield agricultural system (Soil Unit Ga).

Backhoe Trench 1-4

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. Historic plow zone of 5YR-3/3 to 5YR-3/4 dark reddish-brown clay loam.
II	60-105 cmbs; Apb2-horizon. Buried historic period plow zone of 5YR-3/2 dark reddish-brown clay. Contains numerous cane burn lenses and fragments of carbonized cane.
III	105-160 cmbs; B-horizon. 10YR-4/2 dark grayish-brown clay.
IV	160-190 cmbs; C-horizon. 10YR-4/1 dark gray fine clay.

Backhoe Trench 1-5

LAYER	DESCRIPTION
I	0-65 cmbs; Ap-horizon. Historic period plow zone, 5 YR-3/4 dark reddish-brown clay loam.
II	65-115 cmbs; B-horizon. 5YR-3/2 dark reddish-brown clay (Soil Unit Eh).
III	115-145 cmbs; Agnb/C-horizon. Gleyed deposits of N-4/0 dark gray fine clay loam possibly associated with buried pondfield agricultural system (Soil Unit Ga). Water table encountered at 145 cmbs.

Backhoe Trench 1-6

LAYER	DESCRIPTION
I	0-3 cmbs; C-horizon. Recent sheet wash deposit of silty alluvium and evaporated salts.
II	3-25 cmbs; IIApb1-horizon. Historic period plow zone, 7.5YR-3/2 dark brown silt clay loam (incorporates Soil Unit Eh).
III	25-115 cmbs; IIAanb 2-horizon. Recent historic land fill and garbage dump (probably post-World War II).
IV	115-130 cmbs; III Ab?-horizon. Probably represents original land surface prior to land filling. Predominantly 10YR-4/2 dark grayish-brown silt clay loam. Contains scattered historic artifacts, probably of early 20th-century origin.
V	130-190 cmbs; IIIAgb-horizon. Gleyed deposit of 5Y-4/1 dark gray and 5B-4/1 dark bluish-gray fine clay loam. This deposit is probably associated with the buried pondfield agricultural complex (Soil Unit Ga).
VI	190-215 cmbs; IIIB/C-horizon. 10YR-4/4 dark yellowish-brown clay with numerous oxidized root cast mottling of 7.5YR-4/4 brown to dark brown.
VII	215-235 cmbs; IIIC-horizon. Fine sticky clay, 2.5Y-4/4 to 7.5Y-4/2 dark grayish-brown to olive brown. Water table encountered at 235 cmbs (Soil lens + Gn).

Backhoe Trench 1-7

LAYER	DESCRIPTION
I	0-30 cmbs; Ap-horizon. Historic period plow zone, 7.5 YR-4/2 brown to dark brown clay with mottling of 5 YR-4/4 reddish-brown. Contains fragments of carbonized cane and *Brachidontes* shells (incorporates Soil Unit Eh).
II	30-220 cmbs; B/C-horizon. 10YR-4/3 brown to dark brown, and 10YR-4/4 dark yellowish-brown clay with clay skins of 10YR-4/6 dark gray. Deposit represents eroded edge of upland terrace (Soil Unit Eh parent material).

Backhoe Trench 1-8

LAYER	DESCRIPTION
I	0-25 cmbs; Ap-horizon. Historic period plow zone of 10 YR-3/2 very dark grayish-brown clay loam.
II	25-30 cmbs; IIAanb1-horizon. Recent historic period land fill and rubbish (post-World War II).
III	30-35 cmbs; IIAanb2-horizon. Recent historic period land fill and rubbish (post-World War II).
IV	35-45 cmbs; IIB/C-horizon. 10YR-4/3 brown to dark brown clay.
V	45-85 cmbs; IIC1-horizon. 10YR-4/2 dark grayish-brown clay.
VI	85-155 cmbs; IIC2-horizon. 10YR-4/4 dark yellowish-brown clay.
VI	155-170 cmbs; IIC3-horizon. Coarse-grained alluvial sands and gravels; lightly gleyed. Water table encountered at 170 cmbs.

Backhoe Trench 1-9

LAYER	DESCRIPTION
I	0-25 cmbs; Ap-horizon. Recent historic plow zone, 10 YR-3/2 very dark grayish-brown clay.
II	25-60 cmbs; Aanb-horizon. Recent historic land fill and rubbish (post-World War II).
III	60-110 cmbs; IIApb-horizon. Probably represents original ground surface prior to burial by land filling. 10YR-4/2 dark grayish-brown clay loam with scattered fragments of carbonized organic materials.
IV	110-170 cmbs; II B/C-horizon. 2.5Y-4/2 to 2.5Y-4/4 dark grayish-brown to olive-brown clay.
V	170-230 cmbs; IIC1-horizon. 2.5Y-5/2 very dark grayish-brown with 2.5Y-N3/0 very dark gray sandy clay alluvium and scattered fragments of Brachidontes shell.
VI	230-240 cmbs; IIC2-horizon. 2.5Y-N3/0 very dark gray sandy clay alluvium with scattered fragments of Brachidontes shell.

LAYER	DESCRIPTION
VII	240-255+ cmbs; IIC3-horizon. 5Y-4/1 dark gray sandy clay alluvium containing scattered fragments of Brachidontes shell.

Backhoe Trench 1-10

LAYER	DESCRIPTION
I	0-50 cmbs; Ap-horizon. Recent historic period plow zone of 5YR-3/2 dark reddish-brown clay loam (incorporates upper boundary of Soil Unit Eh).
II	50-66 cmbs; B-horizon. 10YR-4/6 dark yellowish-brown silty clay.
III	66-96 cmbs; C1-horizon. 10YR-3/3 dark brown silty clay.
IV	96-126 cmbs; C2-horizon. 10YR-4/2 dark grayish-brown clay with scattered fragments of shell and charcoal.
V	126-176 cmbs; C3-horizon. 10YR-4/3 brown to dark brown coarse alluvial sands with numerous fragments of Brachidontes shell.

Backhoe Trench 1-11

LAYER	DESCRIPTION
I	0-25 cmbs; Ap-horizon. Recent historic period plow zone of 7.5YR-3/4 dark brown silt clay loam.
II	25-55 cmbs; C-horizon. Thin deposit of cross-bedded angular shell and sand. Appears to be a localized alluvial deposit.
III	55-75 cmbs; IIAb7-horizon. Deposit of silt clay loam containing angular fragments of Brachidontes shell and charcoal. Matrix is 10YR-3/3 dark brown.
IV	75-90 cmbs; B-horizon. 10YR-3/6 dark yellowish-brown clay.
V	90-110 cmbs; C1-horizon. 10YR-3/3 to 10YR-3/4 dark brown to very dark brown coarse alluvial sand containing pulverized shell and charcoal.
VI	110-200 cmbs; C2-horizon. 10YR-3/6 dark yellowish-brown very compact clay.

Backhoe Trench 1-12

LAYER	DESCRIPTION
I	0-25 cmbs; Ap-horizon. Recent historic plow zone of 10 YR-3/6 dark yellowish-brown clay loam.
II	25-60 cmbs; Aan-horizon. Recent historic land fill and rubbish (post-World War II).
III	60-90 cmbs; B/C-horizon. 10YR-3/4 dark yellowish-brown clay with fragments of marine shell and charcoal.
IV	90-110 cmbs; C1-horizon. 10YR-5/1 gray mottled clay with 10YR-4/6 dark yellowish-brown clay.
V	110-130 cmbs; IIAgb1-horizon. Gleyed deposit of N-4/0 dark gray and 5b-4/1 dark bluish-gray fine clay loam, possibly associated with buried pondfield agricultural system (Soil Unit Ga).
VI	130-160 cmbs; IIAgb2-horizon. Gleyed deposit of 5b-4/1 dark bluish-gray to 5bg-4/1 dark greenish-gray fine clay loam, possibly associated with buried pondfield agricultural system (Soil Unit Ga).
VII	160-165 cmbs; R-horizon. Weathered bedrock of decomposing coral. Water table encountered at approximately 165 cmbs.

Backhoe Trench 1-13

LAYER	DESCRIPTION
I	0-30 cmbs; B/C-horizon. 10YR-4/4 dark yellow to 10 YR-4/3 dark brown silty clay. Deposit comprised of recent alluvium derived from adjacent upland slope wash.
II	30-70 cmbs; C/IIB-horizon. 5Y-4/1 dark gray clay with numerous oxidized root cast and mottling of 2.5YR-3/6 dark red.
III	70-130 cmbs; C-horizon. 10Y-4/8 dark gray to 10YR-3/3 dark brown clay.
IV	130-210 cmbs; IIAgb-horizon. Gleyed soil deposit of N-4/0 dark gray fine clay, possibly associated with buried pondfield system (Soil Unit Ga).

Backhoe Trench 1-14

LAYER	DESCRIPTION
I	0-35 cmbs; C-horizon. Deposit comprised of recent alluvium and colluvium from adjacent upland slopes. 10 YR-4/6 dark yellowish-brown silty clay.
II	35-55 cmbs; B-horizon. 5Y-4/1 dark gray clay with numerous root cast of 2.5Y-4/4 olive-brown.
III	55-80 cmbs; C-horizon. 5Y-3/1 very dark gray fine sticky clay.
IV	80-95 cmbs; IIC-horizon. 5Y-4/2 to 5/2 olive-gray sand.
V	95-115 cmbs; IIIC-horizon. 5Y-4/2 olive-gray fine clay.
VI	115-160 cmbs; IVAgb-horizon. Gleyed soil deposit possibly associated with buried pondfield agricultural system (Soil Unit Ga).

Backhoe Trench 1-15

This backhoe trench collapsed immediately after excavation. Gleyed soil deposits were observed in the spoil pile suggesting the presence of buried pond fields. No detailed description of the soil profile in this trench was made.

Backhoe Trench 1-16

LAYER	DESCRIPTION
I	0-90 cmbs; C-horizon. Deposit comprised of colluvial and alluvial slope wash derived from the adjacent uplands. 7.5YR-4/2 brown to dark brown silt clay mottled with 10YR-5/3 brown silt clay.
II	90-105 cmbs; IIAb-horizon. Probably represents recently buried ground surface. 2.5YR-4/2 dark grayish-brown silt clay loam containing scattered fragments of carbonized sugar cane.
III	105-145 cmbs; IIAb2-horizon. Appears to be a second buried surface. 10YR-3/1 very dark gray silt clay loam containing scattered fragments of charcoal and small lumps of burnt clay.
VI	160+ cmbs; IIB-horizon. Weathered clay 10YR-4/3 brown to dark brown.

Backhoe Trench 1-17

LAYER	DESCRIPTION
I	0-90 cmbs; C-horizon. 2.5YR-4/2 dark grayish-brown clay mottled with 2.5Y-4/4 olive-brown. Contains small quantities of terrestrial gastropods. This deposit is probably the result of colluvial slope washing of the adjacent upland slopes.
II	90-105 cmbs; C/Ab-horizon. 5Y-4/1 dark gray clay loam.
III	105-120 cmbs; IIAgb1-horizon. Gleyed soil deposit possibly associated with buried pondfield agricultural system (Soil Unit Ga). 5Y-4/1 dark gray to 5GY-4/1 dark bluish-gray fine clay loam.
IV	120-145 cmbs; IIAgb2-horizon. Gleyed soil deposit possibly associated with buried pondfield agricultural system (Soil Unit Ga). 5Y-5/1 gray clay loam.
V	145-175 cmbs; IIAgb3-horizon. Gleyed soil deposit possibly associated with buried pondfield agricultural system (Soil Unit Ga). N 4/0 dark gray clay loam containing numerous small terrestrial gastropods.

Backhoe Trench 1-18

LAYER	DESCRIPTION
I	0-80 cmbs; C-horizon. Recent deposit of alluvium and colluvium derived from the adjacent upland slopes. 10 YR-4/1 dark gray to 10YR-4/4 dark yellowish-gray clay.
II	80-105 cmbs; B-horizon. 10YR-4/1 dark gray clay.
III	105-135 cmbs; C-horizon. 10YR-3/2 very dark grayish-brown clay.
IV	135-155 cmbs; IIAgb1-horizon. Gleyed soil deposit possibly associated with buried pondfield agricultural system (Soil Unit Ga). N-4/0 dark gray clay containing numerous terrestrial gastropod shells.
V	155-180 cmbs; IIAgb2-horizon. Gleyed soil deposit possibly associated with buried pondfield agricultural system (Soil Unit Ga). 5G-4/1 dark greenish-gray fine clay containing numerous terrestrial gastropod shells.

Backhoe Trench 1-19

The stratigraphic soil profile of this trench was not described in detail because the side walls collapsed immediately after excavation. An inspection of the spoil pile, however, revealed that gleyed soils were present and that these contained numerous shell fragments, some of which appeared to be terrestrial gastropods and others that were marine or brackish-water species. It is possible that these gleyed soils were associated with buried fishpond/pondfield agricultural systems.

Backhoe Trench 1-20

LAYER	DESCRIPTION
I	0-25 cmbs; Ap-horizon. Recent historic period plow zone of 10YR-5/4 yellowish-brown clay loam.
II	25-60 cmbs; B/C-horizon. 10YR-4/2 dark grayish-brown clay.
III	60-130 cmbs; C-horizon. 10YR-3/3 dark brown to 2.5Y-4/2 dark grayish-brown clay.
IV	130-150 cmbs; IIAgb1-horizon. This is a gleyed soil deposit possibly associated with buried pondfield agricultural systems (Soil Unit Ga). 5 G-4/1 dark greenish-gray clay.
Layer V	150-175 cmbs; IIAgb2-horizon. This is a gleyed soil deposit possibly associated with buried pondfield agricultural systems (Soil Unit Ga). N-4/0 dark gray clay. Water table encountered at approximately 175 cmbs.

Backhoe Trench 1-21

A detailed description of the stratigraphic soil profile in this trench was not made because the side walls collapsed immediately after excavation. An inspection of the spoil pile revealed that no gleyed soil deposits were present.

Backhoe Trench 1-22

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. Recent historic period plow zone, 7.5YR-4/4 dark brown clay loam
II	60-125 cmbs; B/C-horizon. 7.5YR-4/2 brown to dark brown mottled with 7.5YR-5/6 strong brown clay.

LAYER	DESCRIPTION
III	125-155 cmbs; C-horizon. 10YR-4/1 dark gray clay.
IV	155-185 cmbs; IIAgb-horizon. Gleyed soil deposit possibly associated with buried pondfield agricultural system (Soil Unit Ga). 5 B-4/1 dark greenish-gray clay. Water table encountered at approximately 185 cmbs.

Backhoe Trench 1-23

No detailed description of the stratigraphic soil profile of this trench was made because the side walls collapsed immediately following excavation. An inspection of the spoil pile indicated that gleyed soil deposits, possibly indicative of buried pondfield agricultural systems, were present.

SURVEY AREA 2

Backhoe Trench 2-1

LAYER	DESCRIPTION
I	0-58 cmbs; Ap-horizon. Recent historic period plow zone of coarse alluvial clay mixed with basalt boulders, cobbles, and pebbles. 7.5YR-4/2 brown to dark brown.
II	58-72 cmbs; B-horizon. 7.5YR-4/2 brown to dark brown hard compact clay (Soil Unit Eh).
III	72-127 cmbs; B/C-horizon. 7.5YR-3/2 to 3/4 dark brown sandy clay which grades vertically into cross-bedded and vertically sorted alluvial stream deposits of sands and rounded to angular basalt pebbles.

Backhoe Trench 2-2

LAYER	DESCRIPTION
I	0-53 cmbs; Ap-horizon. 7.5YR-4/2 brown to dark brown coarse alluvial clay with small rounded to angular pebbles and cobbles of basalt. This deposit is a recently formed plow zone.
II	53-78 cmbs; B1-horizon. 10YR-4/3 brown to dark brown hard compacted clay containing small oxidized (weathered) concretions.

LAYER	DESCRIPTION
III	78-86 cmbs; B2-horizon. 10YR-3/3 dark brown hard, compact sandy clay.
IV	86-146 cmbs; C-horizon. 7.5YR-4/2 brown to dark brown coarse angular sand and pebbles.
V	146-200 cmbs; IIB/C-horizon. 10YR-3/3 dark brown silt clay .

Backhoe Trench 2-3

LAYER	DESCRIPTION
I	0-33 cmbs; Ap-horizon. Recent historic period plow zone of 10YR-3/1 very dark gray clay.
II	33-58 cmbs; B1-horizon. 5YR-3/2 dark reddish-brown silt clay loam.
III	58-78 cmbs; B2-horizon. 5YR-3/2 dark reddish-brown sandy clay.
IV	78-110 cmbs; B3-horizon. 10YR-4/3 brown to dark brown silt clay.
V	110-120 cmbs; B4-horizon. 10YR-3/3 dark brown sandy clay.
VI	120-130 cmbs; B4-horizon. 10YR-4/4 dark yellowish-brown silt clay.
VII	130-143 cmbs; B5-horizon. 10YR-3/3 and 10YR-4/2 dark brown and dark grayish-brown sandy clay.

Backhoe Trench 2-4

LAYER	DESCRIPTION
I	0-48 cmbs; Ap-horizon. Recently formed historic period plow zone. 5YR-3/2 dark reddish-brown clay loam.
II	48-60 cmbs; B1-horizon. 5YR-3/3 dark reddish-brown hard compact clay (Soil Unit Eh).
III	60-79 cmbs; IIApb-horizon. Possible buried surface beneath recent deposits of colluvium and alluvium. 5YR-3/2 dark reddish-brown clay loam with scattered charcoal and unconsolidated organic staining.

LAYER	DESCRIPTION
IV	79-101 cmbs; IIB-horizon. 5YR-3/2 dark reddish-brown silt clay.
V	101-108 cmbs; IIC-horizon. 10YR-3/3 dark brown sandy clay lens of alluvium.
VI	108-230 cmbs; II/IIIB-horizon. 10YR-4/3 brown to dark brown silt clay.

Backhoe Trench 2-5

LAYER	DESCRIPTION
I	0-40 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam. Represents recently formed historic period plow zone.
II	40-120 cmbs; B-horizon. Massive clay bed of 7.5YR-4/2 dark brown to brown clay (Soil Unit Eh).
III	120-150 cmbs; K?-horizon. 10YR-5/2 grayish-brown compact silt calcium carbonate layer (Soil Unit K). Possible bleached or dried out and oxidized gleyed soil possibly associated with buried pondfield deposits.
IV	150-195 cmbs; IIB-horizon. 10YR-5/3 brown compact clay.

Backhoe Trench 2-6

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. Recently formed historic plow zone; 7.5YR-3/2 dark brown clay loam.
II	60-100 cmbs; B-horizon. 7.5YR-4/2 dark brown to brown clay (Soil Unit Eh).
III	100-130 cmbs; IIApb-horizon. Probably a recently buried plow zone containing large amounts of carbonized cane fragments and unconsolidated organic matter. 10YR-4/1 dark gray clay loam.
IV	130-190 cmbs; IIB-horizon. 7.5YR-4/6 yellowish-brown clay.
V	190-260 cmbs; IIC-horizon. Unconsolidated coarse-grained stream deposits of cross-bedded sands and silts, basalt boulders, cobbles, and pebbles.

Backhoe Trench 2-7

LAYER	DESCRIPTION
I	0-55 cmbs; Ap-horizon. Recently developed historic plow zone, 7.5YR-4/2 brown to dark brown clay loam.
II	55-130 cmbs; B-horizon.7.5YR-4/6 strong brown, hard, compact clay (Soil Unit Eh).
III	130-190 cmbs; K?-horizon. Possilby bleached or dried out calcium carbonate layer of gleyed silty clay. 10YR-4/2 dark brown to brown clay (Soil Unit K).
IV	190-240 cmbs; IIB-horizon. 10YR-5/3 yellowish-brown clay.
V	240-280 cmbs; IIC-horizon. Unconsolidated, massive bed of alluvial stream deposits of large basalt boulders, cobbles, and rounded pebbles intermixed with cross-bedded sands and silts.

Backhoe Trench 2-8

Refer to Backhoe Trench 2-7 for a detailed description of soil stratigraphy characteristic of Backhoe Trench 2-8.

Backhoe Trench 2-9

Refer to Backhoe Trench 2-7 for a detailed description of soil stratigraphy characteristic of Backhoe Trench 2-9.

Backhoe Trench 2-10

LAYER	DESCRIPTION
I	0-35 cmbs; Ap-horizon. Plow zone of 10YR-3/1 very dark brown clay loam.
II	35-70 cmbs; C-horizon. 5Y-3/1 very dark gray clay.
III	70-90 cmbs; IIAgb1-horizon. Gleyed soil deposit of 5G-6/2 to 5G-4/2 pale green to grayish-green sandy clay. Water table encountered at approximately 70 cmbs (Soil Unit Ga).
IV	90-110 cmbs; IIAgb2-horizon. Gleyed soil deposit of 5BG-4/1 dark greenish-gray sandy clay (Soil Unit Ga).
V	110-145 cmbs; IIAgb3-horizon. Gleyed soil deposit of 5GY-5/1 greenish-gray clay (Soil Unit Ga).

Backhoe Trench 2-11

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. Plow zone of 7.5YR-4/0 dark gray clay mottled with 7.5YR-3/2 dark brown.
II	60-115 cmbs; B/C-horizon. 5Y-4/1 dark gray clay.
III	115-155 cmbs; Cg-horizon. Gleyed deposit of 5Y-5/1 gray fine sandy clay. Water table encountered at 115 cmbs (Soil Unit Ga?).

Backhoe Trench 2-12

LAYER	DESCRIPTION
I	0-70 cmbs; Ap-horizon. 2.5YR-3/4 dark gray brown clay loam
II	70-85 cmbs; Apb-horizon. Buried plow zone of 10YR-3/1 very dark gray silt clay loam containing large amounts of cane charcoal and ash. May represent a filled-in drainage ditch.
III	85-115 cmbs; C1-horizon. Vertically sorted alluvial bed of basalt cobbles and pebbles.
IV	115-140 cmbs; Cg2-horizon. Gleyed deposit of N4/0 dark gray sandy clay. Water table encountered at approximately 115 cmbs (Soil Unit Ga).
V	140-185 cmbs; IIAgb-horizon. Gleyed deposit of 5Y-6/1 gray clay.

Backhoe Trench 2-13

LAYER	DESCRIPTION
I	0-70 cmbs; Ap-horizon. Plow zone of 7.5YR-4/2 brown to dark brown coarse silt clay.
II	70-100 cmbs; B1-horizon. 7.5YR-3/4 dark brown silt clay.
III	100-140 cmbs; B2-horizon. 10YR-4/2 dark grayish-brown mottled with 10YR-3/6 dark yellowish-brown and 10YR-3/2 very dark grayish brown fine sandy clay loam.

LAYER	DESCRIPTION
IV	140-197 cmbs; C-horizon. 5Y-4/1 dark gray mottled with 5Y-5/6 olive sandy clay.
V	197-250 cmbs; IIAgb-horizon. Gleyed soil deposit of 5 Y-4/1 dark gray clay (Soil Unit Ga).

Backhoe Trench 2-14

LAYER	DESCRIPTION
I	0-80 cmbs; Ap-horizon. Plow zone of 10YR-4/2 dark grayish-brown silt clay loam.
II	80-108 cmbs; B1-horizon. 10YR-4/3 brown to dark brown silt clay.
III	108-153 cmbs; B2-horizon. 10YR-4/2 to 10YR-5/2 dark grayish-brown to dark brown fine sandy clay.
IV	153-203 cmbs; IIAgb-horizon. Gleyed soil deposit of 5Y-5/1 gray fine sticky clay with oxidized root cast and mottled peds of 10YR-6/6 brownish-yellow.

Backhoe Trench 2-15

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. Plow zone of 10YR-4/1 dark gray clay.
II	60-90 cmbs; B-horizon. 10YR-5/4 yellowish-brown mottled with 10YR-5/2 grayish brown clay.
III	90-140 cmbs; B/C-horizon 10YR-5/2 grayish-brown coarse clay.
IV	140-170 cmbs; IIAgb-horizon. Gleyed soil deposit of 5 Y-5/1 gray clay (Soil Unit Ga).
V	170-195 cmbs; IIC-horizon. 5YR-4/1 dark gray silty clay.

Backhoe Trench 2-16

LAYER	DESCRIPTION
I	0-70 cmbs; Ap-horizon. Plow zone of 7.5YR-3/2 dark brown clay.
II	70-110 cmbs; B-horizon. 10YR-4/2 dark grayish-brown mottled with 7.5YR-5/8 strong brown silty clay.
III	110-130 cmbs; C1-horizon (Soil Unit K7). 10YR-5/2 grayish-brown silty clay.
IV	130-143 cmbs; C2-horizon. Predominantly 7.5YR-5/2 brown coarse-grained alluvial sand.
V	143-200 cmbs; C3-horizon. Vertically sorted alluvial deposit of basalt pebbles, cobbles and boulders.

Backhoe Trench 2-17

LAYER	DESCRIPTION
I	0-55 cmbs; Ap-horizon. Plow zone of 7.5YR-3/2 dark brown clay.
II	55-85 cmbs; B1-horizon. 7.5YR-4/2 brown to dark brown clay.
III	85-155 cmbs; B2-horizon. 10YR-5/8 to 10YR-5/4 yellowish-brown silt clay.
IV	155-200 cmbs; C-horizon. Vertically sorted alluvial stream deposit of basalt pebbles, cobbles, and boulders.

Backhoe Trench 2-18

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. Plow zone of 5YR-3/2 dark reddish-brown clay loam.
II	60-90 cmbs; B1-horizon. 5YR-3/3 dark reddish-brown mottled with 7.5YR-6/8 reddish-yellow clay.
III	90-120 cmbs; B2-horizon. 10YR-5/2 grayish-brown clay (Soil Unit K7).
IV	120-170 cmbs; B3-horizon. 10YR-5/3 brown mottled with 10YR-5/8 yellowish-brown coarse silty clay.

Backhoe Trench 2-19

LAYER	DESCRIPTION
I	0-30 cmbs; Ap-horizon. Plow zone of 10YR-4/3 brown to dark brown clay loam.
II	30-110 cmbs; B-horizon. 10YR-6/4 light yellowish-brown silt clay.
III	110-260 cmbs; C-horizon. Vertically sorted deposit of alluvial sands gravels, cobbles and boulders.

Backhoe Trench 2-20

LAYER	DESCRIPTION
I	0-50 cmbs; Ap-horizon. Plow zone of 7.5YR-4/2 brown to dark brown clay loam.
II	50-90 cmbs; B-horizon. 10YR-5/4 yellowish-brown silty clay.
III	90-210 cmbs; vertically sorted deposit of alluvial sands, gravels, cobbles, and boulders.

Backhoe Trench 2-21

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon Plow zone of 7.5YR-3/2 dark brown clay loam.
II	60-200 cmbs; B/C-horizon. 7.5YR-5/6 strong brown to 5 Y-5/6 olive silty clay.

Backhoe Trench 2-22

LAYER	DESCRIPTION
I	0-80 cmbs; Ap-horizon. Recently formed historic period plow zone. 7.5YR-4/4 dark brown to brown, mottled with 7.5YR-3/2 dark brown sandy clay loam.
II	80-150 cmbs; B/C-horizon. 7.5YR-4/2 brown to dark brown, mottled with 7.5YR-5/6 strong brown clay.

LAYER	DESCRIPTION
III	150-190 cmbs; C-horizon. 10YR-4/1 dark gray mottled with 5YR-5/8 yellowish-red clay.
IV	190-240 cmbs; IIC-horizon. Massive alluvial stream deposit of vertically and horizontally sorted boulders, cobbles, gravels, sands, and silts.

Backhoe Trench 2-23

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. Recently formed historic period plow zone, 7.5YR-3/2 dark brown clay loam.
II	60-75 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown to 10YR-4/3 dark brown hard, compact clay (Soil Unit Eh).
III	75-90 cmbs; IIAan-horizon. Cultural midden deposit, 10 YR-4/3 dark brown to brown and 10YR-3/3 brown loamy clay.
IV	90-130 cmbs; IIB-horizon. 5YR-3/2 dark reddish-brown to 10YR-4/2 dark reddish-gray compact silt clay.
V	30-150 cmbs; K-horizon. Bleached or dried-out homogenous silt, 10YR-6/3 pale brown to 10YR-7/1 light gray (Soil Unit K).
VI	150-195 cmbs; IIIB-horizon. 10YR-5/3 brown silt clay.

Backhoe Trench 2-24

LAYER	DESCRIPTION
I	0-50 cmbs; Ap-horizon. Recently formed historic period plow zone (incorporates Soil Unit Eh). 7.5YR-3/2 dark brown clay loam.
II	50-75 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown compact clay (Soil Unit Eh).
III	75-90 cmbs; IIAan-horizon. 10YR-4/3 dark brown to brown clay loam cultural midden deposit.
IV	90-130 cmbs; IIB-horizon. 5YR-3/2 dark reddish-brown and 10YR-4/4 dark yellowish-brown silt clay.

LAYER	DESCRIPTION
V	130-160 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
VI	160-205 cmbs; IIIB-horizon. 10YR-5/3 brown silt clay.

Backhoe Trench 2-25

LAYER	DESCRIPTION
I	0-65 cmbs; Ap-horizon. Recently formed historic plow zone (incorporates Soil Unit Eh). 7.5YR-3/2 dark brown clay loam containing small, scattered amounts of artifactual material (historic) and midden.
II	65-80 cmbs; IIAan-horizon. Cultural midden deposit, the upper boundary of which has been truncated by the plow zone throughout most of the extent of Backhoe Trench 2-25. Layer II is a loamy clay, 10YR-4/3 dark brown to brown and 10YR-3/3 brown. Contains scattered charcoal (wood?), marine and brackish-water shell, volcanic glass, mammal bone and historic period glass (early 19th century ?).
III	80-110 cmbs; IIB-horizon. 5YR-3/2 dark reddish-brown to 10YR-4/2 dark reddish-gray very compact silty clay. Contains minor quantities of midden and artifacts that are probably the result of intrusion from overlying Layer II, or erosional transport (Soil Unit Eh).
IV	110-130 cmbs; IIIAn-horizon. Cultural midden deposit and buried landscape. 10YR-6/3 pale brown to 5YR-4/4 reddish-brown silty clay loam.Contains small amounts of worn basalt gravel and cobbles as well as scattered marine and brackish-water shells, charcoal (wood?), and mammal bone (including a single human interment). Subsurface pits and postholes were observed originating in the midden deposit and intruding into the underlying sterile matrix of Layer V.
V	130-160 cmbs;K-horizon. Bleached or dried-out layer of homogenous silt. 10YR-7/1 light gray silt loam (Soil Unit K).
VI	160-200 cmbs; IIIB-horizon. 10YR-5/3 brown silt clay.

Backhoe Trench 2-26

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam.
II	60-125 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown and 7.5YR-3/2 dark brown compact clay (Soil Unit Eh).
III	125-150 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
IV	150-200 cmbs; IIB-horizon. 10YR-4/6 dark yellowish-brown silt clay.

Backhoe Trench 2-27

LAYER	DESCRIPTION
I	0-55 cmbs; Ap-horizon. Recently formed historic plow zone (incorporates Soil Unit Eh). 7.5YR-3/2 dark brown clay loam.
II	55-75 cmbs; IIAb1-horizon. Cultural midden deposit, discontinuous and truncated by the overlying plow zone. 10YR-4/3 brown to dark brown clay loam.
III	75-95 cmbs; IIB-horizon. 5YR-3/2 dark reddish-brown to 10YR-4/2 dark reddish-gray compact silt clay (Soil Unit Eh)
IV	95-110 cmbs; IIAb2-horizon. Discontinuous cultural midden deposit. 10YR- 4/3 dark brown to brown clay loam.
V	110-135 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
VI	135-250 cmbs; IIIB-horizon. 10YR-5/4 to 10YR-4/4 yellowish-brown to dark yellowish-brown silt clay.

Backhoe Trench 2-28

Refer to Backhoe Trench 2-27 for a detailed description of soil stratigraphy characteristic of Backhoe Trench 2-28.

Backhoe Trench 2-29

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam.
II	60-125 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown and 7.5YR-3/2 dark brown compact clay (Soil Unit Eh).
III	125-150 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
IV	150-200 cmbs; IIB-horizon. 10YR-4/6 dark yellowish-brown silt clay.

Backhoe Trench 2-30

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam.
II	60-125 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown and 7.5YR-3/2 dark brown compact clay (Soil Unit Eh).
III	125-150 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
IV	150-200 cmbs; IIB-horizon. 10YR-4/6 dark yellowish-brown silt clay.

Backhoe Trench 2-31

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam.
II	60-125 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown and 7.5YR-3/2 dark brown compact clay (Soil Unit Eh).
III	125-150 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
IV	150-200 cmbs; IIB-horizon. 10YR-4/6 dark yellowish-brown silt clay.

Backhoe Trench 2-32

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam.
II	60-125 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown and 7.5YR-3/2 dark brown compact clay (Soil Unit Eh).
III	125-150 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
IV	150-200 cmbs; IIB-horizon. 10YR-4/6 dark yellowish-brown silt clay.

Backhoe Trench 2-33

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam.
II	60-125 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown and 7.5YR-3/2 dark brown compact clay (Soil Unit Eh).
III	125-150 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
IV	150-200 cmbs; IIB-horizon. 10YR-4/6 dark yellowish-brown silt clay.

Backhoe Trench 2-34

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam.
II	60-125 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown and 7.5YR-3/2 dark brown compact clay (Soil Unit Eh).
III	125-150 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
IV	150-200 cmbs; IIB-horizon. 10YR-4/6 dark yellowish-brown silt clay.

Backhoe Trench 2-35

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam.
II	60-125 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown and 7.5YR-3/2 dark brown compact clay (Soil Unit Eh).
III	125-150 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
IV	150-200 cmbs; IIB-horizon. 10YR-4/6 dark yellowish-brown silt clay.

Backhoe Trench 2-36

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam.
II	60-125 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown and 7.5YR-3/2 dark brown compact clay (Soil Unit Eh).
III	125-150 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
IV	150-200 cmbs; IIB-horizon. 10YR-4/6 dark yellowish-brown silt clay.

Backhoe Trench 2-37

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam.
II	60-125 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown and 7.5YR-3/2 dark brown compact clay (Soil Unit Eh).
III	125-150 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
IV	150-200 cmbs; IIB-horizon. 10YR-4/6 dark yellowish-brown silt clay.

Backhoe Trench 2-38

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam.
II	60-125 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown and 7.5YR-3/2 dark brown compact clay (Soil Unit Eh).
III	125-150 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
IV	150-200 cmbs; IIB-horizon. 10YR-4/6 dark yellowish-brown silt clay.

Backhoe Trench 2-39

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam.
II	60-125 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown and 7.5YR-3/2 dark brown compact clay (Soil Unit Eh).
III	125-150 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
IV	150-200 cmbs; IIB-horizon. 10YR-4/6 dark yellowish-brown silt clay.

Backhoe Trench 2-40

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam.
II	60-125 cmbs; B-horizon. 10YR-3/2 very dark grayish-brown and 7.5YR-3/2 dark brown compact clay (Soil Unit Eh).
III	125-150 cmbs; K-horizon. Bleached or dried-out layer of homogenous silt, 10YR-7/1 light gray (Soil Unit K).
IV	150-200 cmbs; IIB-horizon. 10YR-4/6 dark yellowish-brown silt clay.

Backhoe Trenches 2-41 and 2-42

Below water table—collapsed.

SURVEY AREA 3

Backhoe Trench 3-1

LAYER	DESCRIPTION
I	0-70 cmbs; Ap-horizon. Recently formed historic period plow zone (incorporates Soil Unit Eh). 5YR-4/1 dark gray clay loam with mottling of 2.5YR-4/4 reddish-brown. Fragmented cane charcoal scattered throughout this layer.
II	70-140 cmbs; C-horizon. 5YR-4/1 dark gray fine sticky clay (Soil Unit Gn).
III	140-200 cmbs; IIAgb-horizon. Gleyed soil deposit of fine, sticky clay, 5Y-4/1 dark gray. Water table encountered at approximately 200 cmbs (Soil Unit Ga).

Backhoe Trench 3-2

LAYER	DESCRIPTION
I	0-65 cmbs; Ap-horizon. Recently formed historic period plow zone (incorporates Soil Unit Eh). 5YR-4/1 dark gray mottled with 2.5YR-4/4 reddish-brown. Fragmented cane charcoal and small waterworn pebbles of basalt are scattered throughout this layer.
II	65-160 cmbs; IIAgb-horizon. Gleyed soil deposit of fine clay, grading vertically into coarser grained materials. Possibly vertically stratified pondfield and alluvial stream deposits 5 BG-5/1 greenish-gray to 5G-4/1 greenish-gray. Water table encountered at approximately 60 cmbs (Soil Unit Ga).

Backhoe Trench 3-3

LAYER	DESCRIPTION
I	0-50 cmbs; Ap-horizon. 7.5YR-3/2 dark brown clay loam; historic plow zone (incorporates Soil Unit Eh).
II	50-130 cmbs; B/C-horizon. 10YR-4/1 dark gray clay lightly mottled with 10YR-5/8 yellowish-brown.

LAYER	DESCRIPTION
III	130-170 cmbs; IIAgb-horizon. Gleyed soil deposit of fine sticky clay, N-5/0 gray. Water table encountered at approximately 120 cmbs (Soil Unit Ga).

Backhoe Trench 3-4

LAYER	DESCRIPTION
I	0-60 cmbs; Ap-horizon. Recently formed historic plow zone of 7.5YR-3/2 dark brown clay (incorporates Soil Unit Eh).
II	60-120 cmbs; B/C-horizon. 10YR-4/1 dark gray clay with mottling of 2.5YR-4/4 olive-brown.
III	120-150 cmbs; IIAgb1-horizon. 5Y-4/1 dark gray coarse sandy clay gleyed soil deposit. Water table encountered at approximately 120 cmbs (Soil Unit Ga).
IV	150-170 cmbs; IIAgb2-horizon. 5Y-5/1 gray fine clay gleyed soil deposit (Soil Unit Gn?).

Backhoe Trench 3-5

LAYER	DESCRIPTION
I	0-80 cmbs; Ap-horizon. Recently formed historic plow zone, 7.5YR-4/2 dark brown clay (incorporates Soil Unit Eh).
II	80-100 cmbs; B-horizon. 10YR-4/2 dark grayish-brown clay with mottling of 7.5YR-4/4 dark brown.
III	100-116 cmbs; Cg-horizon. Gleyed alluvial deposit of coarse sand, 5G-5/2 grayish-green. Water table encountered at approximately 10 cmbs (Soil Unit Gn?).
IV	116-175 cmbs; IIAgb-horizon. N-4/0 dark gray fine sticky clay gleyed deposit (Soil Unit Ga).

Backhoe Trench 3-6

LAYER	DESCRIPTION
I	0-55 cmbs; Ap-horizon. Recently formed historic plow zone, 7.5YR-4/4 dark brown clay loam (incorporates Soil Unit Eh).

LAYER	DESCRIPTION
II	55-145 cmbs; C-horizon. 10YR-4/1 dark gray clay.
III	145-185 cmbs; IIAgb-horizon. Gleyed soil deposit of fine sticky clay, 5Y-5/1 gray clay. Water table encountered at approximately 145 cmbs (Soil Unit Ga).

Backhoe Trench 3-7

LAYER	DESCRIPTION
I	0-70 cmbs; Ap-horizon. Recently formed historic plow zone, 7.5YR-3/2 dark brown clay loam (incorporates Soil Unit Eh).
II	70-100 cmbs; B-horizon. 7.5YR-4/2 dark brown clay mottled with 7.5YR-4/6 strong brown (Soil Unit Ga?).
III	100-107cmbs; C1-horizon. 7.5YR-5/2 brown silty clay.
IV	107-147cmbs; C2-horizon. 10YR-4/1 dark gray clay (Soil Unit Gn?).
V	147-185 cmbs; C3g-horizon. Mixed 5BG-4/1 dark greenish-gray clay and 10YR-5/2 grayish-brown sandy clay. Water table encountered at approximately 147 cmbs (Soil Unit Gn).

Backhoe Trench 3-8

LAYER	DESCRIPTION
I	0-40 cmbs; Ap-horizon. Plow zone of 7.5YR-4/2 brown to dark brown clay.
II	40-70 cmbs; C1-horizon. Cross-bedded deposit of coarse alluvial sand and gravel.
III	70-110 cmbs; C2-horizon. 5YR-4/1 dark brown clay.
IV	110-170 cmbs; IIAgb-horizon. Gleyed soil deposit of fine sticky clay; 5G-4/1 greenish-gray. Water table encountered at approximately 110 cmbs.

Backhoe Trench 3-9

LAYER	DESCRIPTION
I	0-40 cmbs; Ap-horizon. Plow zone of 7.5YR-4/2 brown to dark brown clay.
II	40-70 cmbs; C1-horizon. Cross-bedded deposit of coarse alluvial sand and gravel.
III	70-110 cmbs; C2-horizon. 5YR-4/1 dark brown clay.
IV	110-170 cmbs; IIAgb-horizon. Gleyed soil deposit of fine sticky clay, 5G-4/1 greenish-gray. Water table encountered at approximately 110 cmbs.

Backhoe Trench 3-10 and 11

Below water table; trenches collapsed. Area appears to be former landfill.

SURVEY AREA 4

Backhoe Trench 4-1

LAYER	DESCRIPTION
I	0-55 cmbs; Ap-horizon. Plow zone of 5YR-3/2 dark reddish-brown clay (incorporates Soil Unit Eh).
II	55-70 cmbs; C1-horizon. Coarse alluvial sand deposit of variable color.
III	70-80 cmbs; C2-horizon. 5YR-3/1 dark gray clay.
IV	80-115 cmbs; C3-horizon. 10YR-3/2 very dark gray sandy clay.
V	115-145 cmbs; IIAgb-horizon. Gleyed soil deposit of 5 G-4/1 dark greenish-gray clay (Soil Unit Ga/Gn).

Backhoe Trench 4-2

LAYER	DESCRIPTION
I	0-50 cmbs; Ap-horizon. 2.5YR-4/8 red clay with 5 YR-3/2 dark reddish-brown clay.
II	50-65 cmbs; Apb-horizon. Buried plow zone of 5YR-3/1 very dark gray clay with scattered fragments of carbonized cane.

LAYER	DESCRIPTION
III	65-80 cmbs; B-horizon. 5YR-3/2 dark reddish-brown clay.
IV	80-120 cmbs; C-horizon. 10YR-3/2 very dark grayish-brown clay (Soil Unit Gn).
V	120-145 cmbs; IIAgb-horizon. Gleyed soil deposit of fine sticky clay, N-4/0 dark gray (Soil Unit Ga).

Backhoe Trench 4-3

LAYER	DESCRIPTION
I	0-45 cmbs; Ap-horizon. 7.5YR-4/2 brown to dark brown clay loam plow zone.
II	45-55 cmbs; Apb-horizon. Buried plow zone of 7.5YR-3/2 dark brown clay with scattered fragments of carbonized cane.
III	55-95 cmbs; B-horizon. 5YR-4/2 dark reddish-gray clay with 10YR-4/3 brown to dark brown. Also observed were numerous oxidized root casts (Soil Unit Eh/Ga?).
IV	95-125 cmbs; C-horizon. 10YR-3/2 very dark grayish-brown silty clay.
V	125-150 cmbs; IIAgb-horizon. Gleyed soil deposit of fine sticky clay containing numerous carbonized organics. 5Y-4/1 dark gray (Soil Unit Ga?).

Backhoe Trench 4-4

LAYER	DESCRIPTION
I	0-40 cmbs; Ap-horizon. Plow zone of 5YR-3/4 dark reddish-brown clay loam.
II	40-70 cmbs; B1-horizon. 5YR-3/2 dark reddish-brown to 5YR-3/1 very dark gray clay (Soil Unit Eh?).
III	70-90 cmbs; IIAb-horizon. 10YR-4/1 dark gray clay with mottling of 2.5YR-3/6 dark red. Fragments of charcoal are scattered throughout this layer. Water table encountered at approximately 90 cmbs (Soil Unit Ga?).
IV	90-105 cmbs; IIAgnb1-horizon. Gleyed soil deposit of 5Y-4/1 dark gray to N-4/0 dark gray fine sandy clay (Soil Unit Ga).

LAYER	DESCRIPTION
V	105-115 cmbs; IIAgb2-horizon. Gleyed soil deposit of 5BG-4/1 dark greenish-gray fine sandy clay. Small shell fragments (terrestrial gastropods [?]) and fragments of charcoal are present in this deposit (Soil Unit Ga).
VI	115-122 cmbs; IIAgb3-horizon. Gleyed soil deposit of 5 GY-4/1 dark greenish-gray medium fine sandy clay (Soil Unit Ga/N?).
VII	122-150 cmbs; IIC-horizon. 10YR-3/1 very dark gray fine clay (Soil Unit Gn).

Backhoe Trench 4-5

LAYER	DESCRIPTION
I	0-40 cmbs; Ap-horizon. Plow zone of 5YR-3/2 dark reddish-brown clay.
II	40-80 cmbs; B1-horizon. 5YR-3/4 dark reddish-brown clay (Soil Unit Eh).
III	80-105 cmbs; IIAgb1-horizon. Gleyed soil deposit of 5 BG-4/1 dark greenish-gray clay (Soil Unit Ga).
IV	105-125 cmbs; IIAgnb2-horizon. Gleyed soil deposit of N-4/0 dark gray clay (Soil Unit Ga/Gn?).

Backhoe Trench 4-6

LAYER	DESCRIPTION
I	0-55 cmbs; Ap-horizon. Plow zone of 7.5YR-4/2 dark brown clay mottled with 2.5YR-4/6 red.
II	55-70 cmbs; B1-horizon. 7.5YR-4/2 dark brown silty clay.
III	70-95 cmbs; B2-horizon. 5YR-4/1 dark gray to 5YR-3/1 very dark gray clay mottled with 5YR-4/6 yellowish-red (Soil Unit Eh/Ga).
IV	95-115 cmbs; IIAgb-horizon. Gleyed soil deposit of N-4/0 dark gray fine sticky clay (Soil Unit Ga).

Backhoe Trench 4-7

LAYER	DESCRIPTION
I	0-30 cmbs; Ap-horizon. Plow zone of 5YR-3/2 dark reddish-brown silt clay loam.
II	30-90 cmbs; B-horizon. 10YR-4/1 dark gray mottled with 2.5YR-4/6 red clay (Soil Unit Ga).
III	90-120 cmbs; C-horizon. 5YR-5/1 gray clay.
IV	120-130 cmbs; IIAgb-horizon. Gleyed soil deposit of 5b-4/1 dark blue-gray sandy clay. Water table encountered at approximately 120 cmbs (Soil Unit Gn?).

Backhoe Trench 4-8

LAYER	DESCRIPTION
I	0-17; O/A-horizon. Recently deposited and decaying plant material.
II	17-60 cmbs; B/C-horizon. 2.5YR-2.5/4 to 2.5YR-3/4 very dusky red to dark reddish-brown fine sticky clay (Soil Unit Eh).
III	60-90 cmbs; IIAgb1-horizon. Gleyed soil deposit of 5 Y-4/1 dark gray fine clay loam. Water table encountered at approximately 60 cmbs (Soil Unit Gn?).
IV	90-120+ cmbs; IIAgb2-horizon. 5 B-4/1 dark bluish-gray fine clay with numerous small terrestrial gastropod shells (Soil Unit Ga/Gn?).

Backhoe Trenches 4-9 and 4-10

Refer to Backhoe Trench 4-8 and Site 3322, Discussion. Trenches 4-9 and 4-10 became filled with water and collapsed.