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STUDENT SKILL PROJECT

UNIVERSITY OF HAWAI'I MARINE OPTION PROGRAM

TITLE

COASTAL ZONE RESOURCE INTERPRETATION:
KAWAI NUI MARSH, O'AHU, HAWAI'I

Phase I: Literary research

Phase II: Archaeological field research

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COASTAL ZONE RESOURCE INTERPRETATION:
KAWAI NUI MARSH, O'AHU, HAWAI'I

To Hau-wahine,
the mo'o guardian goddess of
Kawai Nui

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Acknowledgements

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Thanks is also extended to MOP staff members, particularly Henretta and Julie who were always on hand to answer questions, help fill out forms, and rescue me in emergencies. This project was partially funded through the Marine Option Program.

This skill project gave my undergraduate education a unique quality and prompted tremendous personal growth for which I am exceedingly thankful.

ABSTRACT

The purpose of the archaeological and literary research for Kawai Nui Marsh was to determine the geological setting at the time of initial occupation, and the nature of initial occupation. Geoarchaeological work done in 1980 had given evidence that the marsh had once held an open saltwater bay which changed the belief that the first settlements in Kailua were inland. The archaeological excavation in the marsh during the summer of 1981 rendered valuable information on land form changes and land-use through time.

It is a natural ecological process for a bay like the one at Kawai Nui to evolve into a lagoon, and then into a marsh. The process goes on; the marsh eventually will evolve into a meadow. This process generally takes thousands of years. The change at Kawai Nui, however, occurred in a very short geological time. The 1981 excavation provided information as to the time for each stage and the causes for this speeded up process.

As the ecosystem changed, so did human manipulation of the resource. In fact, the impact of human activity greatly influenced the filling in of the marsh.

This paper attempts to show the geological changes and land-use changes through time. A discussion of socio-political, economical, and religious structures of Hawaiian society as it related to the changing basin is attempted. The purpose of this paper is to show people in their environment, and to demonstrate the impact of human occupation through time in lay terms. The graph in Appendix A was the backbone to the organization of this resource interpretation.

Photo by Jeannette A. Simons
Kawai Nui Marsh from Pali Lookout

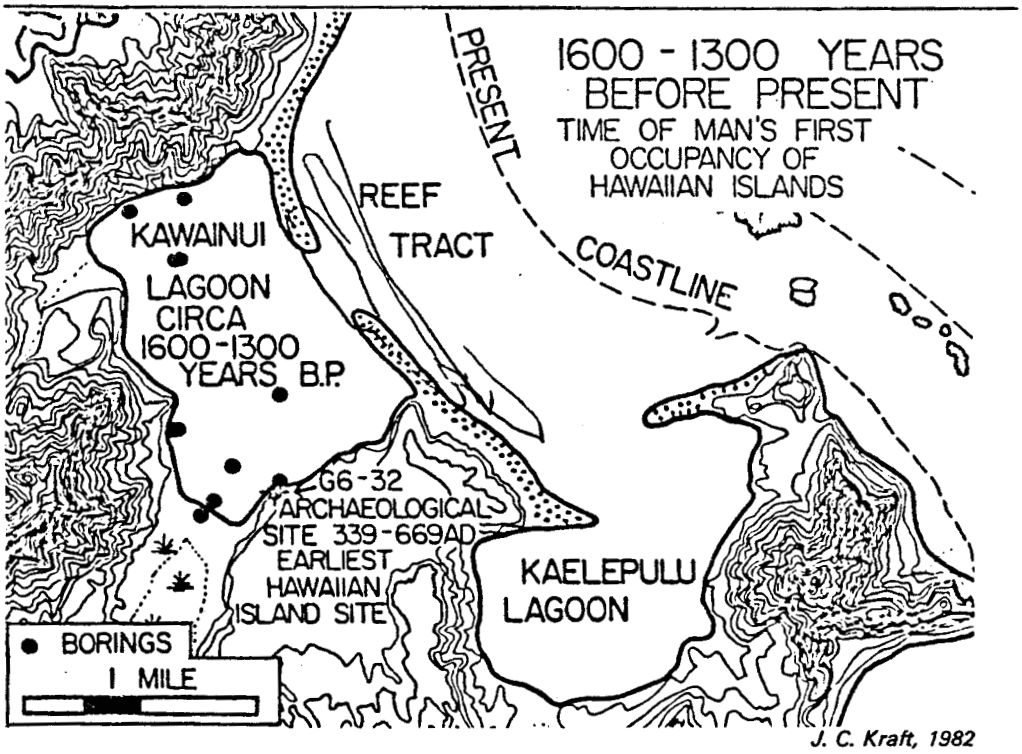
INTRODUCTION

When you are up at the Pali Lookout taking in the panoramic view of Windward O'ahu you can see north as far as Chinaman's Hat, just off the coast from Kualoa Beach Park, and south down to Lanikai Beach. To the left To the left of your view lies Kaneohe Town, and to your right lies Kailua Town. The Pali Golf Course rambles along the base of the Ko'olau mountain range. Down to the right, in front of Kailua, you can see a grassy green spot snuggled between Mount Olomana and the Kapa'a Hills. This triangular spot, which actually spreads out below the hills for a thousand acres, is Kawai Nui Marsh.

It was characteristic of ancient Hawaiians to name a place after its description. Kawai Nui means "the big fresh water"; but it wasn't always Kawai Nui.

Two thousand years ago, around the time of the birth of Christ, Kawai Nui basin held a saltwater marine embayment similar to the present Kaneohe Bay. It is a natural ecological process for a bay like Kawai Nui to evolve first into a lagoon, and then into a marsh. The process goes on, if unimpeded, and the marsh finally evolves into a meadow. But it takes thousands of years.

Archaeological evidence indicates that the first Polynesian voyagers settled on O'ahu around A.D. 300-500. At that time the accretion barrier that would eventually create the lagoon, and later support Kailua Town, had begun to form on the north and



Map of geological changes, and borings by J.C. Kraft, 1982.

south ends of the bay. Coral sands and rubble washed up on the beaches of the peripheral slopes, which supported various forest types. Coconuts for eating and drinking, and noni for medicine, and kukui to light the night would have been able to grow there.

Inland were plots suitable for cultivation of taro, a staple food among the Polynesians. Shellfish were available for gathering, and canoe fishing could have provided aku and opelu, the favorite fish. Basalt rocks from the Ko'olau caldera, in the immediate vicinity of Kawai Nui, could provide materials for stone tools. 'Ohia trees grew that could be used to make their o'o which is a digging stick, the primary cultivation tool. Coral beds in the open water lent themselves to collection. It is possible that this place, rich in resources, was one of the first settled in Hawai'i.

The streams flowing through the valley from the Ko'olaus and the hillslopes nearby deposited sediment and soil on the shores and in the bay. Salt-tolerant vegetation created fringing marshes that could house waterbirds: birds for feathers and food. The streams continued to lay down their sediments and soils, and the ocean brought coral sands. The two increasingly provided support for the fringing marshes, which grew ever larger. The accretion barrier forming from the north and south ends of the bay expanded and extended. A gradual but constant infilling process behind the barrier created a lagoon and later supported lo'i.

The Polynesians that came to O'ahu conceptualized a balanced universe in which the supernatural, natural, and cultural

elements of life made an interrelated whole. They upheld a conservation ethic which created a natural harmony between themselves, the land, and the sea. The complex lanquage that the Hawaiians adapted to describe their islands and ocean demonstrates an intimate awareness of their environment: they had nine different words to describe the ocean waves, for example. But within this harmony the Hawaiians manipulated their resources. It is possible that pressures such as population growth caused an intensified use of the land for taro cultivation which encouraged erosion and the filling-in process of the lagoon.

The land where these O'ahuans had been growing their taro may not have produced enough to feed the growing population. The extra pressure on the fields would have shortened the long fallow period needed for the soil to replenish itself. Some of the fields no doubt became less fertile. At the same time, the fish in the lagoon may not have been easily obtainable in quantities sufficient to feed all the people. They needed new land to plant in taro, and a pond where they could coral and raise fish.

In centuries past, when South Seas residents suffered such pressures, groups had voyaged across the Pacific in search of fresh islands (Finney, 1981). They carried in their double canoes taro shoots, coconut seeds, pigs, and other supplies. Stellar navigation and sensitivity to the ocean swells and atmospheric conditions guided their voyage (Ibid). This was probably how the first Polynesians arrived in Hawai'i: by exploratory voyaging.

But when the ancient O'ahu residents began to feel such pressures on their fields the long distances between the Hawaiian Islands and other island groups presumably made such voyaging infeasible. The Hawaiians looked toward their own island for better subsistence. It is possible that they diverted the streams that flowed from the Ko'olaus so that the sediments and soils would be deposited in a concentrated area. Wetland taro was likely grown on these fresh banks while the process went on. A fishpond was created at the north makai end of the lagoon. Continual maintenance by the Hawaiians preserved this productive ecosystem until the arrival of Europeans in the eighteenth century.

After European contact in 1778 the Hawaiian population decreased, largely due to exotic diseases, and so did taro and fishpond production and maintenance of Kawai Nui. Kawai Nui, however, supported taro and fishpond production into the nineteenth century. Increasing populations of foreigners from Europe, the Orient, and America played a role in converting Kawai Nui into rice fields during the mid-nineteenth century, and later into pasture land for cattle in the twentieth century.

Today Kawai Nui is the larger of two fresh-water marshes remaining in the state. It is a flood control area and sediment trap that protects Kailua Town and Kailua Bay. Kawai Nui, with its associated channels, is one of very few places where you can see an aggregation of Hawaiian waterbirds. It is the home and breeding spot for four endangered endemic waterbirds: the Hawaiian coot, the Hawaiian stilt, the gallinule, and the koloa duck.

Except for a few cattle and horses, the Kawai Nui Marsh no longer provides subsistence for Hawaiian society. Rather, its slopes and floor house sanitary land-fill, basalt quarry, and automobile dump operations. Four secondary sewage plants deposit effluent in the marsh, producing prolific vegetation growth which chokes the streams and ecosystem. In 1975 a three-day fire burned seven hundred acres.

To reverse the previous trend of neglect concerning Kawai Nui, the Department of Planning and Economic Development (DPED) formed the Kawai Nui Marsh Technical and Advisory Committee (KMTAC) in order to develop a resource management plan for the Marsh. Contracts were arranged with research teams to determine the condition of each of several resources (e.g. water, birds, cultural sites) and the best alternatives for resource management. The archaeological research, contracted to Bishop Museum, recovered valuable information on the geological past and Hawaiian cultural impact on the marsh lands through time.

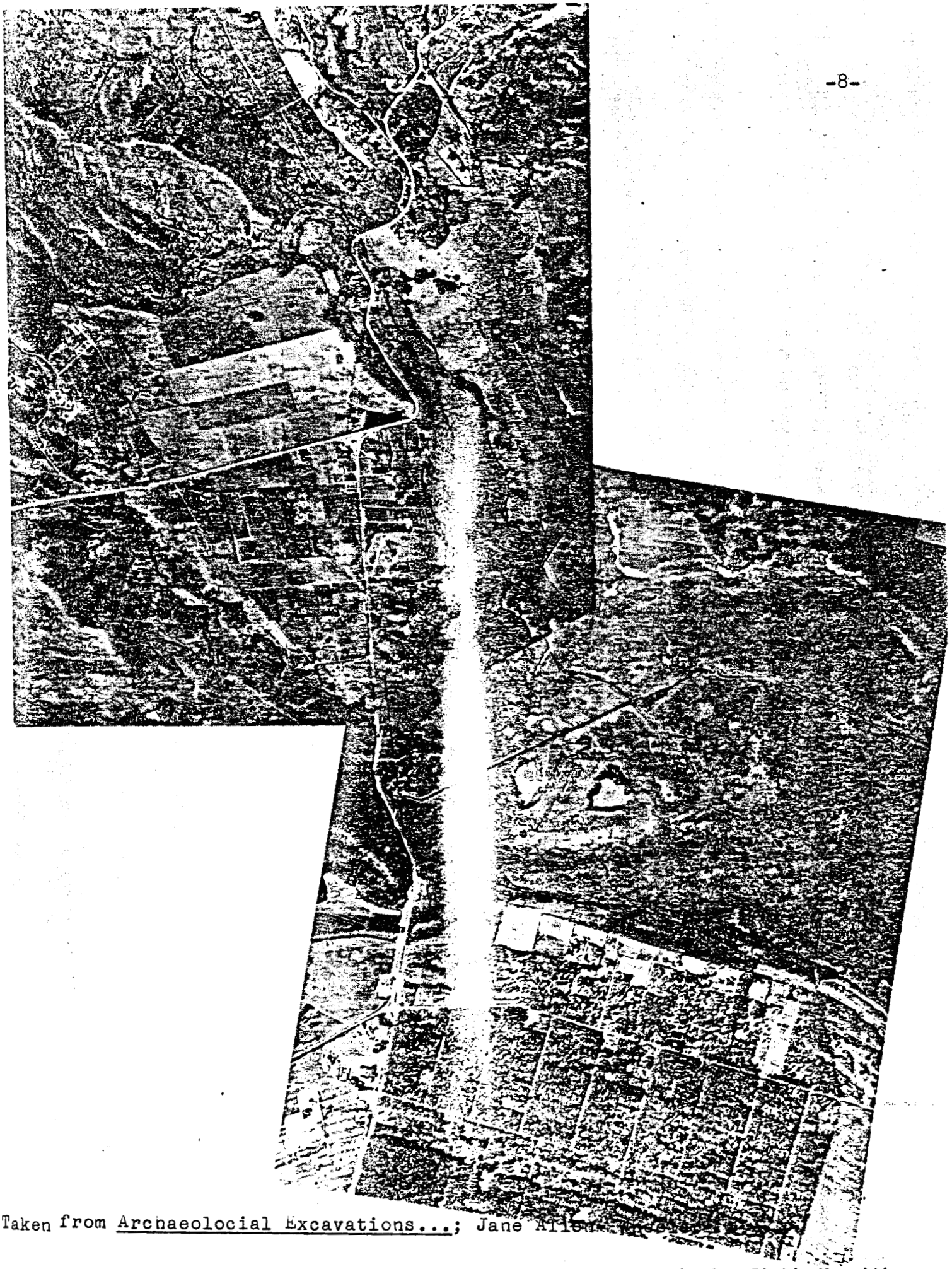
Aerial photographs taken over the Marsh from 1940 through 1981 show linears in a mosaic pattern that suggests agricultural features. These features are rarely recognizable on the ground today. Long after taro walls, 'auwai (canals), and rice bunds (earth embankments) are no longer visible above the surface because of sedimentary accumulation and vegetation growth, aerial photographs expose their subsurface locations, revealing ancient patterns of landuse. The Bishop Museum archaeologists, Jane Allen-Wheeler and Floyd Wheeler, studied photographs and historic maps before a reconnaissance team surveyed the area in order to select trench localities.

Historic fenceline remnants and a huge banyan tree served as landmarks, so that the surveyors knew where they were on the marsh floor in relation to the linears. Vegetation and moisture differences and the geomorphic character of the land aided the archaeologists in deciding where to begin excavations.

Four trench sites were chosen, based primarily on linear locations and geomorphic characteristics. Two trenches were located near the west (TR D) and east (TR C) limits of what appeared in the photographs to be a complex of agricultural plots oriented approximately north-south. Because of the small fields that showed up in the this area the archaeologists reasoned that they may indicate low-organization farming, in contrast with the larger fields that characterized commercial rice farming in the area. In wetland taro cultivation each lo'i would provide space for several mounds, each mound supporting six to twelve taro plants (Westervelt 1924).

A third trench locality (TR B) off to the southwest from these first two was chosen because of a series of linears that indicated fields oriented roughtly east-west in the area. Trenches were oriented and located so as to cross linears whenever possible. These linears suggested possible rock or earth alignments or 'auwai.

The fourth trench (TR A) was excavated next to a stone wall that protruded ten centimeters above the surface near the base of the Kūkanono-Pōhākupu slopes. Trench A, B, and C were the first excavations in the Marsh proper that went below the water table.



Taken from Archaeolocial Excavations...; Jane Allen, Inc.

PRE-1940 PHOTO MOSAIC. 18th Air Base Photo Laboratory, Wheeler Field, Hawai'i.

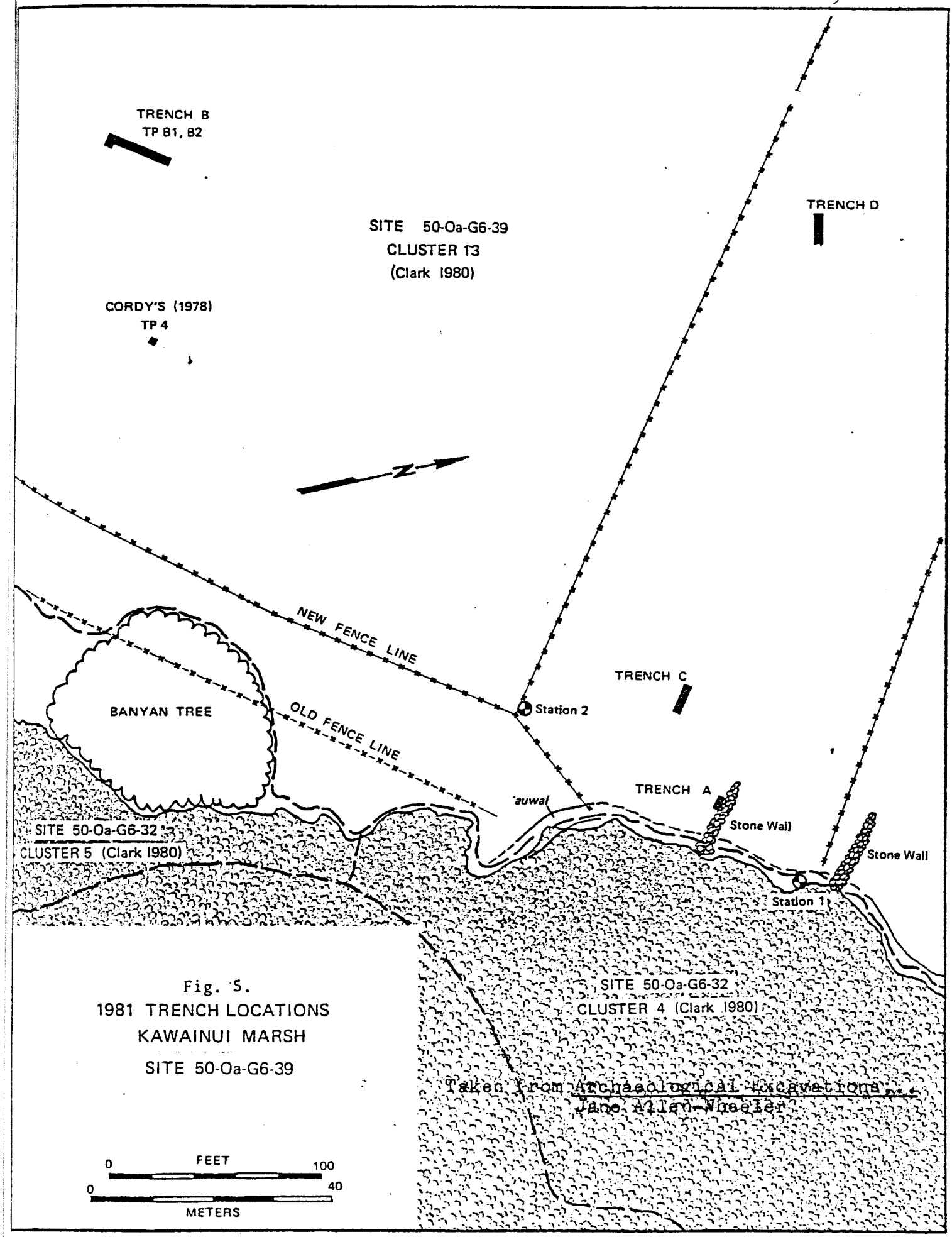


Fig. 5.
1981 TRENCH LOCATIONS
KAWAINUI MARSH
SITE 50-Oa-G6-39

Taken from Archaeological Excavations...
Jane Allen-Wheeler

The purpose of the excavations and accompanying research was to try to determine 1) the nature of the early occupation around Kawai Nui Marsh, 2) the nature of the environment at initial occupation, and 3) what geological changes and human occupation changes occurred through time (B.P. Bishop Museum, 1981). During the excavations, charcoal, volcanic glass, kukui nuts, and artifacts were extracted for analysis and dating. Seeds and leaves which helped in making final conclusions were also found in abundance. Because of the geoarchaeological work done by Dr. John Kraft, University of Deleware, in 1980, it was expected that marine remains would be found. Kraft had extracted core samples which held coral rubble and was the first recent researcher to point out the archaeological implecations of the fact that Kawai Nui was once a saltwater basin.

HISTORY OF LANDUSE-1981-1778

When you are down inside the Marsh you can look in every direction and never guess that you are only ten miles from the largest urban center in the Pacific Ocean or that you are within a short walking distance to Kailua Town. It is so quiet that all you can hear is the birds; you can't hear the garbage trucks rumbling up Quarry Road with a cargo of garbage, or the quarry trucks speeding past leaving with another load of basalt rock, or Kailua Auto Wreckers towing in another wreck.

Post-Rice Era-1981-1900

Today Kawai Nui Marsh is a flood control zone and sediment trap that protects Kailua Town, which is situated on the sand accretion barrier that created the Kawai Nui lagoon. Since 1920 Kailua has suffered twenty minor and major floods (Kelly, 1981). Throughout its history of rice and taro cultivation, and of fish farming, and even during its lagoonal and bay stages, Kawai Nui has also been an estuary and habitat for wildlife. Brackish water and in-shore fish have bred there are used the warm shallow waters for a nursery. Later, exotic fish took refuge there. Tilapia were imported from the mainland in the hope that their hardy breeding and simple eating habits would produce enough to feed the growing population (Kato, 1978).

But the people saw that the tilapia were scavengers and ate any and everything, and they were not inclined to add that

fish to their diet (Ibid). The tilapia are still hardy, however, and they are happily taking over the waters of O'ahu which include Kawai Nui's streams. Their hybrid state when first imported made them meaty; but they have since reverted to their natural bony selves.

Small bass were introduced into the Marsh in order to eliminate the mosquito problem. The bass have been successful in combating the daytime mosquito, but together the tilapia and the bass have overtaken the Marsh waters. These two fish would make it extremely difficult to renovate the fishpond for mullet and milkfish aquaculture (Drigot, 1982).

Waterbirds use the Marsh for breeding, feeding, nesting, and resting grounds. Migratory birds stop by on their annual trips north and south, and some of them stay for the whole season. Other local birds visit the Marsh, and some come to stay. Between one and two hundred night herons live in Hawai'i, and some of them come to nest and feed at the Marsh. The nene Hawai'i's state bird, comes to Kawai Nui, and the golden plover also visits.

Owls live in the big leafy banyan trees on the slopes of the wetland. And the great frigate bird, 'iwa in Hawaiian, comes to swoop down and scoop a drink and fish from the open waters. Hundreds of cattle egrets hang around in the koa haole trees where the cattle are grazing. Four endangered Hawaiian waterbirds make their home at Kawai Nui Marsh: about six ae'o, the Hawaiian stilt; approximately fifty to seventy-five alae ke'oke'o, the Hawaiian coot; about seventy-five 'alae 'ula, the gallinule; about twenty-four koloa, the wild Hawaiian duck, live there.

Efforts have been made to import the endangered koloa duck to Kawai Nui in the hope that it would propagate in the wetlands, but they have not been very successful (Decker, 1981). Besides the mongooses that were brought to Hawai'i in order to eradicate the rat problem, feral dogs and cats are predators on the wildlife in the Marsh. Young people with BB guns and .22 gauge rifles also prey on the birdlife.

A large basalt outcrop near the landfill turnoff on the Quarry Road is an excellent spot for bird-watching. The Audubon Society goes there on their annual Christmas outing to count the bird populations in habitats around O'ahu.

In 1977 the Ad Hoc Committee for Kawai Nui contracted Bob Herlinger, an architect, to design a Directional Park Plan. The idea that water runs downhill guided Herlinger's plan, which includes nature study, wildlife habitat, taro cultivation, fish-pond restoration, botanical gardens, hiking trails, and flood control. The regional park plan is intended to provide protection and preservation for the wildlife and cultural resources in Kawai Nui Marsh and maintain its herbaceous habitat. Lack of a maintenance plan has caused the natural ecological process that over a long period of time causes the evolutionary progression from marsh to meadow to be speeded up by the overabundance of nutrients that flow into the Marsh from present landuses.

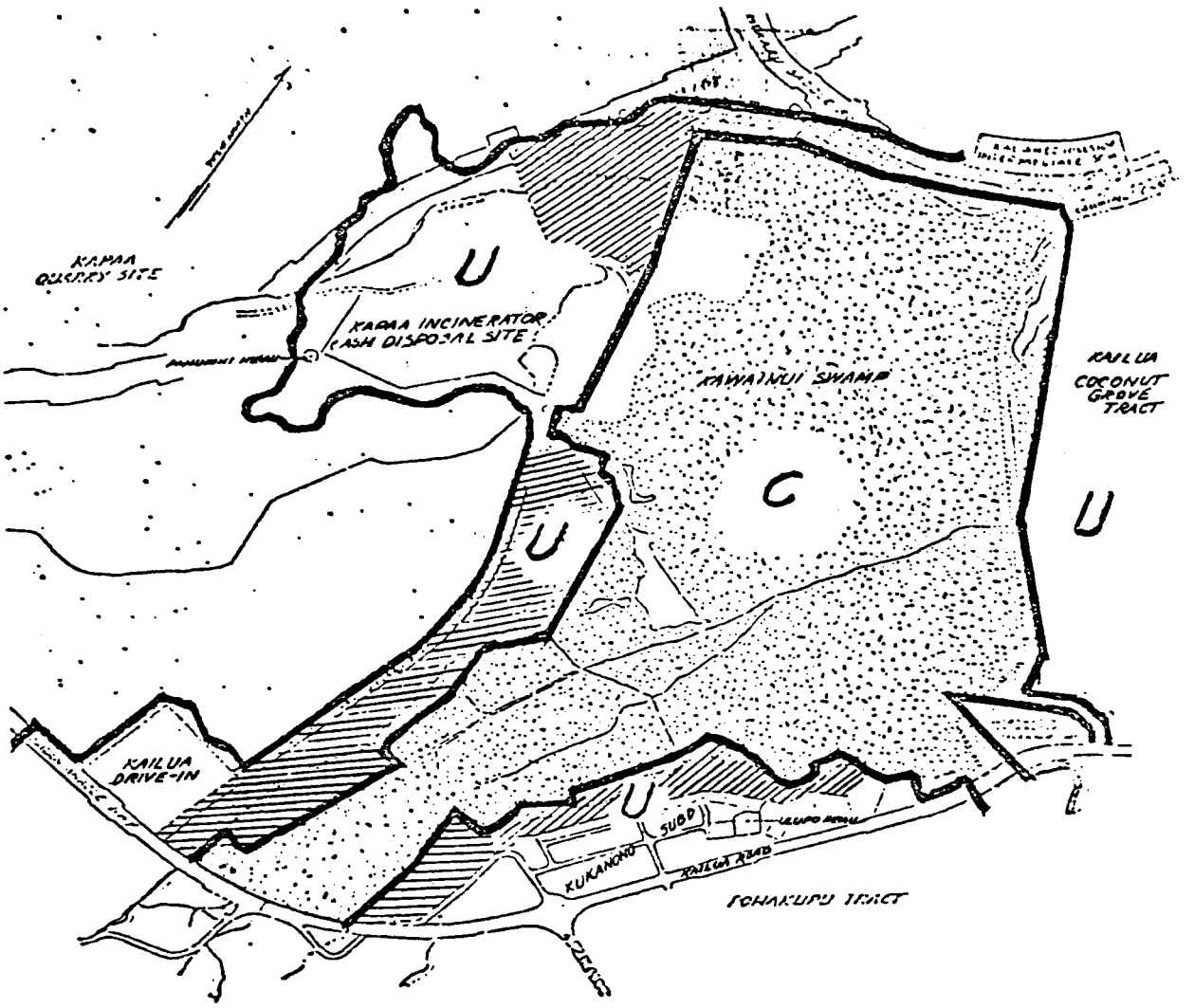
Rain-water run-off from the Kapa'a Sanitary Landfill not only sends soil and toxins into the Marsh but also minerals; all of these convert into vegetation(Zimmerman, 1981). In

1972 the Fasi administration authorized landfill operations o the edge of the Marsh where the model airplane field is now. The City and County of Honolulu, however, had purchased seven hundred and fifty acres of the Marsh proper in 1964 and designated it a conservation area, which is not compatible with rubbish dumping. Therefore, the landfill operations were relocated on the Kapa'a slope. The present location, which receives rubbish from all of Honolulu, will have reached its full capacity for dumping within the next five years (Drigot, 1982).

Pahukini heiau, which is an ancient Hawaiian temple said to have been re-dedicated by King Kamehameha I for secret prayer, was discovered at Kapa'a after rubbish dumping had already begun. In 1980 the Ad Hoc Committee for Kawai Nui was active in having Pahukini placed on the National Register of Historic Places, and a protective chain link fence was built around it.

In the same year that the City and County purchased a large portion of the Marsh and designated it conservation, 1964, the peripheral slopes were zoned for urban development. Kaneohe Ranch, the major land owner on the slopes, revealed plans then for residential development, just one year after Kailua had suffered a severe flood. Seven hundred and sixty-four single-family dwellings were to be built on two hundred and thirty-six acres by Houghtailing Developers. The Dillingham Corporation planned to build a shopping center in the Marsh proper (Drigot, 1981).

Over the years, however, development plans have been modified, and the City and County of Honolulu may purchase two



EXISTING LAND USE BOUNDARIES

LEGEND

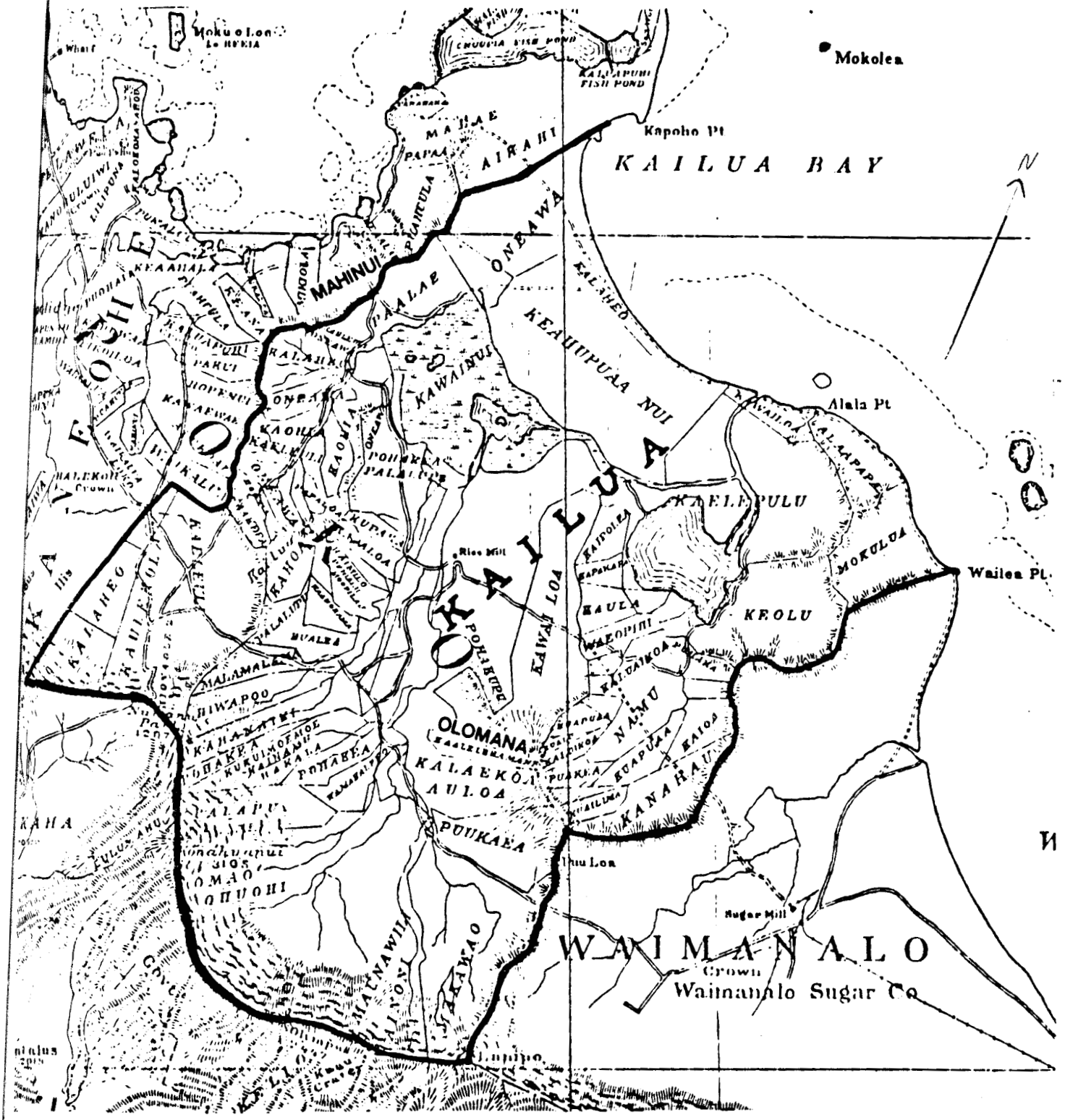
- U — Urban
- C — Conservation
- Marsh Land
- Petition Area Urban to Cons.

DRAFT

ENVIRONMENTAL IMPACT STATEMENT

US DEPARTMENT OF THE ARMY PERMIT APPLICATIO
FOR
OLOMANA-MAUNAWILI SEWER PROJECTS,
KAWAINUI MARSH, OAHU, HAWAII

US Army Engineer District, Honolulu
September 1980



AHUPUA'A OF KAILUA, KO'OLAUPOKO, O'AHU. Portion of map prepared by John M. Donn, 1902, Hawai'i Terr. Survey, from data in the office and from private surveys. Scale: 1" = 5,000'. Named land sections are *'ili*. Note Mahinui mountain (northwestern border) and Olomana peak (near southeastern border), both named for legendary figures.

hundred and fifty acres of peripheral slopes this year, thereby protecting the thousand-acre marsh ecosystem from urban development.

The Health Department, in cooperation with the Army Corps of Engineers, plans to remove the nutrient-rich sewage effluent that make a terrific fertilizer that promotes prolific vegetation growth which chokes the natural ecosystem (Drigot, 1981). The route for the sewer interceptor that the Corps has chosen, however, has caused unrest among the scientific and conservation communities on O'ahu. The Corp's preferred route would run along the base of the Pōhākupu-Kūkanono slopes, on the southern side of the marsh. In this particular spot lie a series of pre-modern basalt rock walls and an 'auwai, both probably associated with taro cultivation. A sample of volcanic glass extracted by Ross Cordy in 1977 during excavation of one of the walls rendered a date of A.D. 1738$\pm$ 34, which is prehistoric (Cordy, 1977).

Construction of the sewer interceptor line would destroy this valuable resource, which can provide information about ancient Hawaiian culture. It is also feared that the construction process would hasten destruction of the already-endangered bird habitat. The intention of the interceptor is to redirect the sewage effluent out of the Marsh into the Mokapu sewer station and out to the deep, turbulent ocean. The routes preferred by scientists and conservationists would run along Quarry Road or Kailua Road going around the Marsh rather than through it (Drigot, 1981).

In 1957, just after the severe flood of 1956, when the first subdivision bordering Kawai Nui was developed, no main connecting sewer lines existed. The developers obtained permission from the City to direct the outflow from the subdivision sewers into the Marsh temporarily. By 1966, after two more severe floods in 1958 and 1961, more housing had been built, and more sewer lines added, se that today four secondary treatment plants dump effluent into the Marsh.

In 1981 Dr. R. Shallenberger of the National Park and Wildlife Service reported two acres of open pond water at Kawai Nui. This is compared to the fifteen open water acres before 1957 and the four hundred and forty-four acre ancient Hawaiian fishpond (Kelly, 1981).

Kaneohe Ranch began outpumping water from the Marsh in 1956, with the intention of reclaiming it for pasture: for for cattle and horses. Urban development was probably anticipated in the distant future. Kaneohe Ranch had cut the Marsh off from the sea with weirs in 1953 in order to create a totally freshwater environment that would support grass for livestock feed. The manipulation of the waters flowing into the Marsh from the Ko'olaus and Maunawili Valley alternated between simple waterstorage and the actual out-pumping of water to the Waimanalo sugar plantation for a price. Today the thousand-acre sugar plantation no longer exists, but the water from Maunawili, which before historic diversion went to Kawai Nui, still serves Waimanalo farmers.

Even though the Oneawa floodway, known as Kawai Nui

Stream, had been constructed in 1950 to prevent the major flooding of the Kailua residential areas situated on the edge of the Marsh, five subsequent severe floods occurred in 1951, 1956, 1958, 1961, and 1963. During the 1951 flood, two hundred and fifty people were forced to evacuate (Kelly, 1981).

During the same year that Oneawa Canal was constructed, 1950, Kaneohe Ranch gave Roy and Helen Weber permission to set up their auto-wrecking establishment on the edge of the Marsh. Today Kailua Auto-Wreckers is spread over twenty acres and has a collection of over ten thousand wrecked cars. The Webers receive approximately five more junk cars every day, and around twenty customers come each day to purchase used auto parts (Weber, 1981). Metals and toxins from the old cars leach into the marsh ecosystem, converting into vegetal growth, and poison the waters. Dr. J. Kraft, University of Delaware, predicted in 1981 that within the next decade the old cars will rust and release increasing amounts of petroleum derivative products into the Marsh (Kraft, 1981).

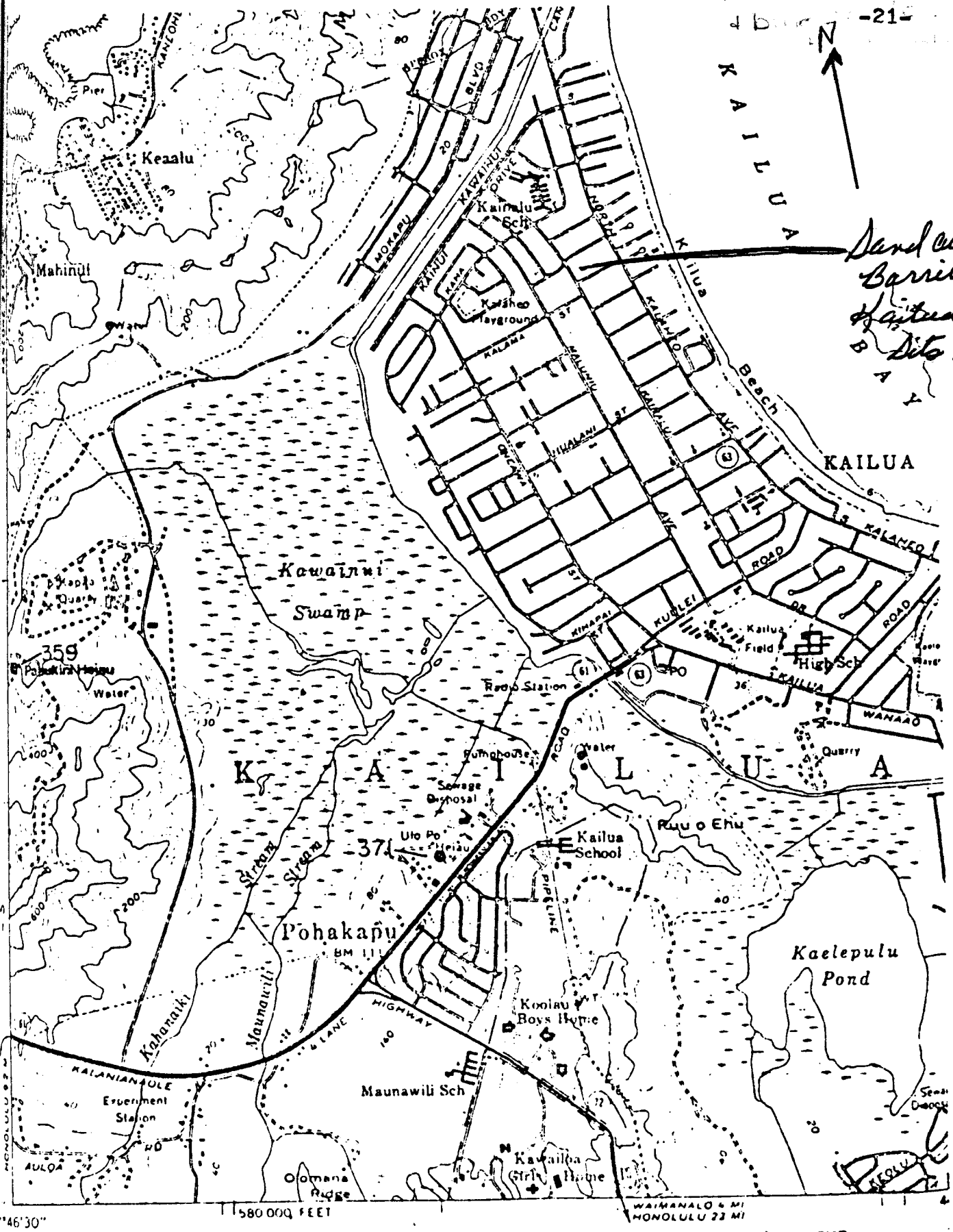
Quarry operations began late in 1949, when Honolulu Construction and Draying Company, Ltd. leased land in the Kapa'a Hills from Kaneohe Ranch (Kelly, 1981). Kapa'a Quarry has extracted large amount of basalt rock from the mountain for gravel and cement since that time. The results of this enterprise can be seen from Mokapu Road, which runs along the north side of Kawai Nui: a sheer grey cliff void of vegetation. Soils and sediments are carried from the quarry into the Marsh by rainwater.

With minerals, metals, toxins, soils, sediments, and nutrients entering Kawai Nui from the landfill, autodump, quarry, and sewage treatment plants, the Marsh is not able to convert them all into vegetation. What does not become vegetation or settle down as sediment on the Marsh floor flows on to Kailua Bay, via the Oneawa Canal (Kawai Nui Stream).

In 1909 two brothers, the Waterhouses, leased 200 acres on the sand accretion barrier that today underlies Kailua, with the intention of growing coconuts for the copra market. That was a fashionable thing for foreign entrepreneurs to do on Pacific Islands at the time and was generally successful. These brothers, however, planted the wrong kind of coconut trees, and so their venture failed.

Residential subdivision began in 1916 when A.H. Rice acquired the property from the Waterhouses. Later, in 1924, Earl H. Williams, associated with Liberty Investment Company, continued the development plan. Today this area is the Coconut Grove residential section in northeast Kailua, and is still characterized by its abundant coconut palm trees.

Between 1927 and 1940 Kailua suffered five floods. The Marsh itself had already been envisioned by enthusiastic entrepreneurs as reclaimed dry land, even though ten floods had occurred between 1902 and 1924 (Kelly, 1981). In 1945 Kailua Town began to grow with post-war impetus. In about one-and-one-half years the number of homes in Kailua rose from 400 to 750 (Ibid). Until then Kaneohe Ranch had been the largest enterprise in the Kailua ahupua'a; rice cultivators who had leased land



PORTION OF U.S. GEOLOGICAL SURVEY MAP (revised 1959), SHOWING KAWAINUI SWAMP AND PRESENT (1980) HIGHWAY LEADING INTO KAILUA TOWN. Note location of Ulupo *heiau*. Location of Pahukini *heiau*, left, marked on map after publication. Scale 1:24,000; contour interval, 40'.

from the Ranch dominated the Marsh earlier in the century, but the shift to livestock grazing had already begun.

Other developments during the first quarter of the twentieth century on the slopes surrounding the Marsh include a radio station, located on the southeast side of Kawai Nui, and a jailhouse somewhere in that same vicinity. A rice mill that operated from 1902 through 1913 was built where the Castle Hospital is now. A store eventually became a gas station at what is now known as the Knott farmhouse, located near the hospital. During this development process life was largely subsistence-oriented for most windward O'ahu residents: they grew taro, truck gardens, and rice in and around the Marsh on small plots leased or granted to them or their familes during the Great Mahele land division. And they went to the ocean and ponds for fish protein. There was little electricity and upper-grade school children had to go to Honolulu (Simons, 1981).

Because of its location near the road into Kailua, Ulupō heiau was known to exist early on. It was placed on the National Register of Historic Places and is the best preserved of the five known heiaus in the Kailua ahupua'a. People still bring fruit and animal offerings to Ulupō, and recently an 'aumakua stone was anonymously left there: in order for a heiau to "live," it must have a god stone. The date of the heiau has been estimated at about A.D. 700-800 (Seto, 1981), but it may have a more ancient core. Ulupō heiau and that series of walls in the Marsh that probably date to the eighteenth century, which makes them more than two hundred years old, stand as permanent structures that have survived urbanization, cattle, horses, and buffalo: a

testimony to excellent Hawaiian engineering.

Kawai Nui Marsh contains one of the few preserved cultural complexes of its kind. There are religious, habitational, agricultural, and aquacultural archaeological remains which are significant to our understanding of geological changes and pre-contact Hawaiian landuse and culture. There are also historical archaeological landmarks that are vital to interpreting the role of Chinese, Japanese, European, and American history in Hawai'i. Historical and contemporary landuse has resulted in a significant build-up of soil and sediment deposition as well as vegetal over-growth.

During the archaeological excavation inside the Marsh proper in July-August 1981 a glass sherd was extracted from the southwest trench, TR B, at thirty-five centimeters below the surface. The director, Jane Allen-Wheeler, estimated an earliest possible date of 1910, based on the probable manufacture date for the mass-produced, clear glass sherd. That means that within the last seventy-one years thirty-five centimeters of soil, sediment, and vegetal decomposition have accumulated in that portion of the Marsh floor. Allen-Wheeler projected a rate of fifty centimeters of deposition per century, compared to an estimated rate of thirty centimeters over a one hundred-year period in the time prior to 1910.

The layer of soil above the glass sherd was silty clay, with decomposed roots, and was characterized by mottling caused by the oxidation of roots. Within the region of the glass sherd and down to sixty-five centimeters below the surface the soil appeared homo-

genized, which suggests a plow zone: farm machines had worked the soil and mixed it up. The plow zone is indicative of rice agriculture, since water buffalo were used to pull plows in Kawai Nui for commercial rice farming.

Rice Era 1900-1860

By the turn of the century rice production in Kawai Nui had already begun to wane. It was labor-intensive, and the wages paid to Chinese and Japanese farm laborers made it unprofitable (Decker, 1981). Rice cultivation in California was successful and the trade routes to the mainland were operating at a steady pace: it became more profitable to import the rice from California than to grow it here. By this time Kawai Nui fishpond had fallen out of use. Nevertheless, there were fish in the rice fields and Kawai Nui was primarily a wetland system with dry fields on the slopes.

Portions of the Marsh, however, in the southwestern side had already been made suitable for cattle grazing by 1890. It has been said that King Kalākaua owned a piece of the land and grazed cattle there, and that he lost the grazing land in a gambling game while carousing in Waikiki. Kanehoe Ranch was established in 1890. The amount of dry land in that southwest part of the Marsh was likely increased by the diversion of Maunawili Stream over to the Waimanalo Sugar Plantation in 1878. Water storage and the actual out-pumping of water from the Marsh to the sugar plantation also occurred at this time.

The ever-decreasing Hawaiian population continued their taro cultivation and fished the wetlands in a marginal way on the surrounding areas of the rice fields. Earth bunds, which showed up in the archaeologists' photogrammetric analysis, provided paths and access through and across Kawa Nui. Rice production had only begun in 1860, in order to fill a demand for rice by Japanese and Chinese sugar-cane field laborers. Taro fields were converted into rice fields, and earth bunds were constructed in areas where lo'i walls did not exist. Increasingly, the Hawaiians were pushed off their lands and torn from their culture.

When they saw their beautiful and rich Kawai Nui converted into rice fields, which they considered rubbish food compared to taro, the Hawaiians felt a sadness. An anonymous Kailua resident composed a chant to the mo'o guardian goddess, Hauwahine, that expressed the feeling of the people toward the changes in their land brought by foreigners. The chant was recorded by Fornander, who was a missionary hisorian, and the deSilvas who are teachers of the Halau Mohala 'Ilima have translated and interpreted the chant, which the Halau frequently performs.

> Perhaps you are she, the leaf of love
> Perhaps this stirs my memory
> Remembering her presence
> She might still come
> But when she does, who will cry out
> Your day is gone, your understanding of her.
>
> The feeling is intense, desire gnaws from within
> I've been swallowed in the great ocean
> Great is my turmoil, my soul is in strife
> No man is unhurt in love
> You are the absent woman, I the estranged subject
> Our parting was difficult to bear; we are mere husks
> of our former selves.

Look at Kawai Nui, the fish container
It is filled with 'ōpala food at Mokulana
Limu clogs Makau-wahine
You are the woman, he the man; Haw-wahine the goddess, Kane the god.
If she comes, who will wail
If she returns, who will acknowledge?

It was said in Hawaiian tradition that the yellowing of vegetation in Kawai Nui indicated the presence of Hau-wahine. She was the protector of the resources at Kawai Nui, and it was believed that if they were misused the mo'o Hau-whaine would leave and take away all the fish and taro at Kawai Nui. The Hawaiian chanter apparently believed, or feared, that this had happened with the coming of the 'ōpala rice agriculture for foreign appetites.

Pre-rice Era (initial European contact) 1860-1778

Up until the rice cultivation era Hawaiians had used the soil for taro production; a fishpond at the northern makai side of the Marsh had provided mullet and milkfish. The richness and beauty of Kawai Nui had long attacted the elite class of Hawai'i, the ali'i, who after contact had become known as the royalty. In earlier times the fishpond had been cleaned of algae and vegetation and sediments by the maka'ainana (commoner) work force. But the population had dropped to such an extent from exotic diseases that maintenance efforts had declined. It had taken Hawaiians from Kaneohe, Kailua, and Waimanalo to clean the pond when their population flourished (Kelly, 1981).

In 1852 the sugar growers in Hawai'i brought labor workers from the Orient to fill the labor gap created by the shrinking

Hawaiian population. Actually, the Hawaiians were never much inclined to work as day-time farm laborers in the rice fields: traditional farming and working hours were in the early morning, evening, and night. Their culture had bred people more inclined to gambling and cowboy roles than farm wage-labor workers in any case. Gambling was consistent with their social and leisure activities and style, and riding horses and working with cattle had specific appeals to their male role model (Finney, 1981).

The Great Mahele in 1848 caused a dramatic change in land-use throughout Hawai'i. Prior to 1848 private land ownership did not exist. But European and American entrepreneurs saw a promise in Hawai'i for a sugar cane empire. It would take capital investment to make it succeed, and the businessmen were perplexed by Hawaiian land division. The paramount chiefs held the land but allotted parcels to konohiki, the lesser chiefs, and the maka'ainana were granted use of the land. Thus there was no private land ownership, but the Hawaiians had freedom of movement over the whole ahupua'a to exploit from the mountains into the sea. Their conservation ethic and system of kapu prohibited over-exploitation of the resources.

Big business was leary of investing capital on land they did not own. So they coaxed King Kamehameha III, who was interested in expanding the cash economy of the Islands, into a new division of land that would permit private foreign ownership. The Great Mahele saw the land divided to the businessmen's liking (Finney, 1981). Paramount chiefs and the konohiki claimed the best and largest parcels (Ibid): Queen Kalama, the wife of

King Kamehameha III, claimed the whole ahupua'a of Kailua, which included Kawai Nui. The maka'ainana could claim small kuleana plots for their taro cultivation and home sites (Kelly, 1981).

Most of the maka'ainana, however, ended up with no kuleana claims. It was difficult, if not impossible, for them to perceive the concept of private land ownership, and they did not respond to the urgings to register their claims. The sugar growers happily purchased land that was suitable for sugar, and began diverting water away from the taro for their sugar, thereby usurping control over the waters (Finney, 1981), the most valuable resource. Missionaries and their families who had arrived in Honolulu in 1838 became involved in sugar plantations and land-purchasing, which eventually came to include Kawai Nui (Kelly, 1981).

The missionaries came bearing exotic diseases such as measles, mumps and influenza, which had the effect of decimating the already declining Hawaiian population. That is why, in a large part, Kawai Nui fishpond had fallen into neglect. The impact of foreign contact had significantly lowered the population in a very short time. While the Hawaiians waned in numbers their traditional culture dissolved in the cash economy brought by foreigners.

King Kamehameha I had been eager to participate in the cash economy when he saw the trade items available; an iron nail for one pig was a good trade because of the strength of the iron and lack of the technology required to make it. He compelled his people to harvest sandalwood trees for trade to the extent that a near-famine occurred. The maka'ainana were

obliged to neglect their fields and go to the mountains for the sought-after tree, which quickly became extinct in many areas (Finney, 1981). It was with European technology that Kamehameha had conquered and united the islands in 1795. When he came to O'ahu he chose Kawai Nui for his favorite residence and increased the production of the fishpond and taro fields in order to feed his court. It is said that the King removed the kapu that surrounds the ali'i, so that he could work side by side with his people.

In 1778, when he came upon the Hawaiian Islands, Captain James Cook was on his third voyage to the Pacific, commissioned by the Admiralty and the Royal Society of England in order to seek a northern passage from the Pacific to the Atlantic and to continue his excellent mapping of the Pacific. The Islands were quickly added to the trade routes of whalers and merchants. These traders brought with them veneral diseases that the Hawaiians were not able to fight. Within a very short time the population dropped from approximately 300,00 or 250,000 to only 50,000.

PRE-HISTORY A.D. 1778-2000 B.C.

Archaeological Work

Kawai Nui Marsh is situated at the base of an eroded ampni-theater valley, and volcanic basalt mountain slopes surround it on the north, west, and south sides. On the east is the sand accretion barrier on which Kailua Town is now located. The floor of the Marsh declines gradually makai from about twenty feet above sea level to just below sea level on the east side. During the Pleistocene era, before Kawai Nui had filled in with soils and sediments, the fluctuating sea levels alternatingly filled and exposed the open basin (Allen-Wheeler, 1981). Archaeological excavations directed by Jane Allen-Wheeler, Bishop Museum, in the summer of 1981, confirmed Dr. John Kraft's hypothesis that Kawai Nui Marsh once held an open water bay (Ibid).

During the summer's excavation the marine layer was reached in three of the trenches, (A.B. and C) the fourth having been abandoned because of flooding. Below the plowed zone, which characterized the foreign occupation and rice cultivation era, the gleyed and mottled layer of ponded soil that is characteristic of wet taro cultivation generally began with an abrupt, wavy boundary at about fifty-five to sixty-five centimeters below the surface. Because of the high water table, which started at about twenty-five to forty-five centimeters below the surface, a pump was required in order to keep the trenches dry enough for excavation. Charcoal flecking, which suggest cultural activities, began to appear in the ponded soil and continued through the peat layer. Charcoal flecking may be associated with extensive,

Photo by Tyrone Rienhardt
Rock wall, TR B. Front, Jane Allen-Wheeler;
Back, Jeannette Simons

swidden agriculture, often characteristic of low population densities.

Since it is believed that farming in the Marsh floor was lo'i which is comparatively intensive and associated with higher population, it is possible that the flecking was stream-borne, coming from swidden farming in Maunawili Valley. Some areas of the Marsh floor, however, may have been used for swidden agriculture; there was enough charcoal flecking that it may have been in-situ. Kukui nut also recovered from ponded soils, may have rolled downslope. Kukui nut was used by the Hawaiians for lighting fuel and oil. Samples of charcoal and kukui were extracted for analysis and dating: measurments were taken to assure close provenience, and they were packaged carefully for storage. For dating purposes the kukui and charcoal were wrapped, untouched by any organic substance in order that they not become contaminated, in aluminum foil.

Two kukui nuts from the ponded soil rendered radiocarbon dates between A.D. 1374± and 1630±. The charcoal samples were found to be too small for dating. The kukui nuts were found near basalt rock alignments that were interpreted by the archaeologist as lo'i-associated; taro cultivation was therefore probably underway during the twelfth century on the Marsh floor. Mottling due to the oxidation of roots was also observed in sizes and forms that could include taro corms (Allen-Wheeler, 1981).

It is believed that taro farming began in the Maunawili Valley plains as a kula activity (Ibid). Later, taro was planted on the stream banks. More intensive agriculture included

use of marginal dry areas; streams were diverted into 'auwai for irrigation purposes, causing increased stream-carried deposition of soil and sediments into the basin, where they were caught by the floating and fringing vegetation mat. Soils, sediments, and sands had accumulated to a thickness between one hundred and one hundred and forty centimeters on the Marsh floor by seventeenth century.

Several basalt flakes were also recovered from the ponded soil for analysis. Basalt flakes are stone tools that may be related to agricultural, as well as other cultural, activity; they could have been used in Kawai Nui for harvesting taro leaves or cutting taro corms, the edible root. A basalt flake stone tool is distinguished from a naturally-occurring flake in two ways: 1) Where the core is struck with another rock, a hammerstone, a positive bulb forms on the flake; this is sometimes used as a handle. A core is a larger stone that is chipped away for the purpose of making flake tools, or for one of several other purposes including the manufacture of a tool , generally hafted to a wood stem with fibers for us. 2) Context; where the flake is found is important. If it is discovered near a lo'i wall in association with agricultural activity, and appears cultural, it is safe to determine that it is a stone tool.

Beneath the ponded soil lies the peat layer. Peat is an accumulation of decomposed organic matter and sediment that has not yet become soil. It will, however, support some vegetation, in the case of Kawai Nui, probably salt-tolerant species. This peat layer varied in thickness from twenty to thirty centimeters over the three trenches. Generally, the mauka trench, TR B,

showed thicker layers than the other two trenches. This would be expected due to closer proximity to the streams.

Seasonal streams had continuously laid down basalt-derived soil and sediments along the shoreline of the bay, and, together with coral sands, had provided a soil base for fringing marshes that might possibly have housed waterbirds. Agricultural activity upland increased soil deposition, which promoted the organic growth that formed the peat. One whole log crossed Trench C within the peat layer; a portion was submitted for dating, along with two pieces of wood and one peat sample from Trench B. These samples rendered dates between A.D. 668±80 and 1309±60 for the peat layer. Peat is not capable of supporting taro, and so with these dates the archaeologist can determine that lo'i farming did not characterize the areas tested before the twelfth century.

Also extracted from the peat layer were seeds, leaves, and gourd chips. Some of the leaves have been identified by Suzy Allen as sugar cane. But since no comparative collection of vegetal speciments exists in Hawai'i as yet, many of the taxa cannot yet be specified. Nevertheless, Allen-Wheeler was able to make certain conclusions concerning floral growth on the slopes of Kawai Nui, based on the ground conditions indicated by soil sample analysis and knowledge of what plants grow in certain environments.

By the time the marine layer was reached the trenches had become very narrow and dangerous due to the extremely wet working conditions. Because of the great inflow of water only one

person could work below two hundred centimeters in Trench C, two hundred and eighty-five centimeters in Trench B. Even with the continuous out-pumping of water from the trenches they could not be kept dry, and it was difficult to extract marine specimens. Nevertheless, samples for dating were collected with a small army-type shovel and were placed directly into aluminum foil, thereby avoiding contamination by organic matter which could alter the dates. Shell samples that were not worn or weathered, and were therefore likely living in the locality, were submitted for radiocarbon dating and rendered a date of 2434 B.C.±90.

Shell samples were also analyzed at the Bishop Museum laboratory to determine their habitat range. Small shells that live in sandy and/or silty shallow waters like a lagoon were in abundance. There were also occasional brackish-water species that indicate an inflow of fresh water into the bay/lagoon. Other types of shellfish that attach themselves to coral reefs were also discovered. Coral deposited as rubble with the sand and shells was somewhat worn, which indicated that it had been swapt ashore from farther out in the bay. One shark's tooth that had undoubtedly washed ashore from some distance out was also found among the sand and shell collection (Allen-Wheeler, 1981).

Dr. John Kraft hypothesized that ships could have come into this open water bay. Archaeologist Jane Allen-Wheeler speculated that that early inhabitants participated in fishing by canoe.

By the time people occupied the area in about A.D. 300-500 the accretion barrier had probably partially formed on the

north and south ends of the bay. Fish and shellfish would have been available for food, and coral for tool making. The fringing mats along the shoreline would have provided waterbirds for eating and feathers for decoration. Fruits and nuts and wood could have been collected up through the Maunawili Valley to the Ko'olau mountains. Volcanic glass and basalt were available for tool making in these upland regions (Allen-Wheeler, 1981).

The accretion barrier could have supported coconuts planted from seed. And upland terraces in the valley would have provided garden plots for the occupants' taro shoots. Forage for pigs would also have been available up the valley. The small population that first arrived in Hawai'i, and Kawai Nui, would not have been stratified to the extent observed when Captain Cook came upon the islands in 1778 (Finney, 1981).

Lo'i and Fishpond Era (ponded soil layer) 1300-1860

When Captain Cook first came upon the Hawaiian Islands in 1778 there were an estimated 300,000 people, who had evolved a highly stratified society divided into three classes: the ali'i, who were chiefs; the maka'ainana, who were roughly the equivalent of European commoners; and the kauwa, who were slaves and outcastes. Influenced by his own British kingship society, Cook interpreted Hawai'i's socio-political system as a kingdom also. This was not actually the case, however. When King Kamehameha I conquered and united the islands in 1795 with the aid of European technology he established the first monarchy, and Hawai'i then became a kingdom (Finney, 1981).

Hawai'i's ali'i were divided into roughly three levels: the paramount chiefs, the lesser konohiki chiefs, and the kahuna, who were priests. The ali'i kept careful track of their genealogies, and those who could trace their lineage back to the gods Ku, Kane, Lono, and Kanaloa were the paramount chiefs. These genealogies were committed to memory in myths, chants, and legends, some of which were performed in the hula dances. Mana--supernatural power--flowed through these lineages. Special care was taken to see that the first-born, male or female, who would inherit the chiefdom, possessed the strongest possible force of mana, which was sometimes assured by ritual brother-sister mating (Malo, 1898:135-136; Finney, 1981).

The Hawaiians came to divide their islands into districts and subdistricts. Each district had a paramount chief, and each subdistrict had a lesser chief who was subordinate to the ruling prarmount chief. The subdistrict was called an ahupua'a and ideally was a triangular-shaped piece of land that extended from the mountain to the sea. The Ko'olaupoko district on O'ahu had eleven ahupua'a subdistricts of which Kailua was one. It has been said that the paramount chief of Ko'olaupoko, who possessed strong mana, resided at the Kailua ahupua'a (Kelly, 1981: 5-6;10-13; Seto, 1981).

The chiefs were overseers of the land and imposed kapus in order to influence social behavior and enforce conservation: for instance, the aku and opelu were protected by alternate six-month kapu periods, which prevented over-fishing of the ocean fish (Beckwith, 1970:35). Although the maka'ainana owned no land, they had rights to farming plots and were free to wander

over the whole ahupua'a in order to gain sustenence: strict kapu prohibited over-exploitation. The ali'i had the authority to call on the maka'ainana to construct large stone structures such as heiau or fishpond walls. Kawai Nui fishpond was likely one of these cooperative projects. Kikuchi (1976) has estimated that it would have required 10,000 men to construct walls for the four hundred and forty-four acre pond.

The maka'ainana were then obliged to clean the pond periodically, to prevent its filling-up as it has today. It took approximately thirty-three days for workers from Waimanalo, Kailua, and Kaneohe to rid the pond of vegetation, algae, and accumulated sediments. Mullet and milkfish were raised in Kawai Nui Fishpond. There are legends about the awa, the milkfish, that came to people without strong-smelling bodies, as they stood in the water: thus, the awa was known as the suicide fish. Legends also tell about the Mākālei tree that lived at Kawai Nui, where the radio station was later located, said to attract fish and so make them easy to catch. To Hawaiians the presence of the Mākālei tree was a sign of abundance (Coleman, 1981).

Another legend tells of the edible mud lepo 'ai 'ia at Kawai Nui. It was allegedly brought from Kahiki, the distant place, by a Kailua chief Kaulu-a-Kalana and the mud was surrounded by kapu and saved for a famine food. Kamehameha was said to have fed his court with the edible mud at Kawai Nui when they suffered a food shortage (Kelly, 1981: 5).

Kikuchi believes that fishpond production was for the benefit of ali'i only; others say it was for everyone. It may have

been the case close to the contact date 1778 that the fish from Kawai Nui were exclusively for the ali'i. But the legends that abound about the fishpond and its fish seem to indicate that it was for everyone. The mo'o Hau-wahine, who was the legendary guardian goddess of Kawai Nui, protected the people from oppressive leaders. She would take away all that Kawai Nui had to give from everyone--ali'i and maka'ainana-- if a leader were greedy (Beckwith, 1970:126).

Hau-wahine was a benevolent water goddess, who warded off illness and assured that fish were plentiful. Legend says that the first mo'o that came to Hawai'i were sent to live at Kawai Nui. That the pond production was dependent on the happiness of Hau-wahine tended to instill an ethic of conservation among Hawaiians.

Although archaeologists have not yet located the boundaries of the fishpond, it is believed that it was situated at the northern makai side of the marsh. Kawai Nui fishpond likely evolved from the lo'i fields mauka of the pond. Lo'i demand that cool water must flow in order to prohibit stagnation, which causes root rot in the taro corm. The waters that flowed from the mountains through the valley lo'i and on down into the marsh floor lo'i maintained water movement to the pond.

Thus, it appears that as the population grew, extensive kula farming shifted to intensified kula and then lo'i farming. As native vegetation was removed from the peripheral slopes and stream banks, and was replaced with taro cultivation, erosion increased. Stream waters were diverted into 'auwai to supply water to the lo'i that were located in previously dry areas.

Irrigation and drainage agriculture encouraged the in-filling of the March floor. Lo'i fields moved into the Marsh, and waters flowed through these into the makai pond.

Soils and sediments were continuously transported from the mountains by rain water, which washed down through the valley by way of the streams and 'auwai into the Marsh floor on top of the peat. Maintenance was therefore necessary in order to preserve the wetland system of lo'i fields and the fishpond. While the population grew, the social system probably became more and more stratified, facilitating the organization of maka'ainana from three ahupua'a to clean the pond and keep it productive. Jane Allen-Wheeler believes that the freshwater fishpond was a late occurrence in Hawaiian pre-history (Allen-Wheeler, 1981:8 -83).

Pre-Lo'i and Fishpond Era (peat layer) A.D. 650-1300

Salt-tolerant vegetation was forming a layer of peat that supported floating and fringing marshes capable of housing water-birds. The sand accretion barrier continued to develop: the lagoon was increasingly closed off from the sea, and the filling-in of Kawai Nui had begun. Corals were no longer growing in the basin, and shore shellfish and reef fish were no longer available. Subsistence activities were concentrated upland in the valley, and the accretion barrier provided access to the open sea. The barrier supported coconut trees.

Swidden, kula, agriculture dominated farming efforts on the valley terraces early in this era. Gradually, as the population increased, kula farming took hold and moved down to the peripheral slopes around A.D. 700-800. The natural forest that held the soil

on the slopes was removed and replaced with taro and other crops. This move to the slopes caused a significant increase in erosion, which would have deposited sediments on top of the peat in the Marsh floor. Lo'i farming likely began on the stream banks at this time.

The construction of 'auwai and moving of earth for lo'i would have further increased the amounts of soil and sediments flowing into the basin. Terrace walls were probably not built until a significant amount of soil from the slopes had eroded into the basin. Both terrace walls and lo'i characterize intensive farming, which is indicative of a higher population. Soils did not actually cover the peat until around A.D. 650 or later. The Marsh floor was not covered with soil capable of supporting taro until 1300 (Allen-Wheeler, 1981:62).

Canoe fishing probably still provided fish protein, and the accretion barrier gave access for line fishing. Coconuts were planted, as well as other trees that produced fiber and wood. Medicinal plants were available: noni, among others. The Hawaiians lived in a closed system in which all subsistence depended directly on their efforts. There was nobody outside the Islands to trade with as there is today. As their population grew, the Hawaiians found new ways to exploit their land. When kula farming became inadequate to support the growing population, agriculture activities moved away from dry hillslopes and toward the valley floor in the basin.

Although they were surrounded by ocean, the Hawaiians now depended much more on their farming abilities than on fishing. Actually, Hawaiian oceans are considered a desert for fish life

compared to other Polynesian waters (Finney, 1981). More of the population were farmers than were fishermen. The Hawaiians had an ethic of sharing, and extended family units called 'ohana shared subsistence gain: whoever exploited the valleys and mountains shared and traded with those who exploited the shores and the sea.

The Islanders developed a lunar calender that guided their planting and fishing efforts. Eash night of the moon was assigned to certain activities. Fishing and planting were done on certain nights, and other times were set aside for the cultivation of soil and tool making. Since the Hawaiians held each element of their environment to be an expression of the supernatural forces, prayer accompanied each activity. Some nights and days were set aside exclusively for prayer (Taylor, 1957:42-45).

The best time for planting was at night, and particularly the full moon night. It was believed by Hawaiians that nighttime was the time of the gods, and that is when they did most of their work.

Ulupo heiau was constructed possibly around A.D. 700-800, and perhaps earlier, and was probably for the purpose of agriculture (Reinhardt, 1981). It is said to have been built at night by the menehune, small mythical people who worked carrying stones hand over hand at night. People lately, however, have come to think that the menehune were actually the maka-'ainana, and, since they worked at night, it was not peculiar that the heiau would have been built during the night. Heiau served as temples for worship and ritual and were designed to

Taken from Hawaiian Almanac, Taylor.

SAMPLE MONTH OF HAWAIIAN CALENDAR

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1	2	3	4	5
The symbol used for Sacred Nights represents a heiau, *Hawaiian temple of worship.*					HILO	HOAKA Fishing & Planting
6	7	8	9	10	11	12
KUKAHI Pray	KULUA NIGHTS SACRED TO KU Pray	KUKOLU Pray	KU'PAU Planting & Fishing	OLEKUKAHI	OLEKULUA Cultivate Soil Mend Gear	OLEKUKOLU Cultivate Soil Mend Gear
13	14	15	16	17	18	19
OLEKUPAU Cultivate Soil Mend Gear	HUNA Fishing & Planting	MOHALU Sacred to Kane Planting	HUA Fishing	AKUA Fishing & Planting	HOKU Fishing & Planting	MAHEALANI Fishing & Planting
20	21	22	23	24	25	26
KULU Fishing Planting Taro	LA'AUKUKAHI Fishing & Planting	LA'AUKULUA Fishing & Planting	LA'AUPAU Fishing & Planting	OLEKUKAHI Cultivate Soil Mend Gear	OLEKULUA Cultivate Soil Mend Gear	OLEPAU Cultivate Soil Mend Gear
27	28	29	30	31	1	2
KALOAKUKAHI SACRED TO KANALOA Pray Planting	KALOAKULUA Pray Planting & Fishing	KALOAPAU Pray Fishing	KANE Sacred to Kane Pray Fishing	LONO Sacred to Lono Pray Harvest & Fishing	MAULI Fishing & Planting	MUKU Dark Night

The Hawaiians reckoned time by the phases of the moon, from one new moon to the next. Theirs was a lunar calendar. On these pages a lunar month as it was observed in old Hawaii is superimposed on a present-day calendar.

The Hawaiian calendar can thus be reckoned today by starting with the night before the new moon of any given month and marking that on a modern calendar as the first day of the month.

serve the need of the society at the time.

When the purpose was no longer prevalent, or the heiau had ceased to be effective, it was abandoned; but it could be rededicated for another purpose or by another chief for his purpuse. Each heiau reflects the purpose of the paramount chief at the time of its construction. Ulupo was likely built in an effort to increase and assure agricultural production in the Kailua ahupua'a. It was dedicated to Ku, the god of production.

Heiau were customarily placed so as to provide a panoramic view; it was desireable that the priests could communicate from heiau to heiau by fire. Before modern land-form changes in the Kapa'a Hills by the landfill operations, such a communication would have been possible between Ulupo and Pahukini heiau.

As the natural ecological process that would change the lagoon to a marsh took place, the people encouraged the change with their farming activities. A growing population became more and more organized, and intensive landuse altered the environment considerably. The lagoon was lost, but more land became available to grow the staple food that kept the people alive and multiplying. Manipulation of the resources by the Hawaiians replaced one productive ecosystem with another.

Initial Occupation, Bay and Lagoon Era (marine layer) A.D.650-2000 B.C.

When the people came to Kailua ahupua'a they were likely still voyagers. The bay that existed at initial occupation would have provided excellent access to the deep ocean from the

shore by canoe. Fishing in the bay would have provided fish protein for less adventuresome fishing expeditions. The sand accretion barrier had probably already begun to form, and coral heads grew; the bay was on its way to becoming a lagoon. Dr. John Kraft has suggested that the basin held a lagoon during A.D. 400-500 (Kraft, 1980). The population was small, and no ali'i existed.

During the era of initial occupation settlements in Kailua were likely not of a permanent nature (Clark, 1980:65; Allen-Wheeler, 1981:84). The slopes would have provided fruits and nuts and wood for cloth-making; more fruits and nuts were available upland in the valley. Fresh water and basalt rocks and volcanic glass for tool-making were available in the mountains. 'Ohia trees provided wood for the o'o cultivation tool and for canoes. 'Ohia was also used in temple construction and icon carving. The lagoon and reef would have provided shellfish and reef fish for gathering; visiting waterbirds were there for eating and feather collection. Taro was likely grown in garden plots up the valley. Coconuts could have grown on the accretion barrier. There was forage available for the pigs. Fishing and farming efforts were probably more balanced at early occupation than later, when farming-dominated.

When the first settlers voyaged toward Hawai'i from the south in search of new land they brought seeds, shoots, and pigs with them in their double canoes. They also brought Polynesian and a pantheon of gods. There were four main gods; Ku, Kane, Lono, and Kaneloa. Ku was the god of productivity; Kane was

was the god of creation; Lono was the god of fertility; and Kaneloa was the god of the sea. These four gods are prevalent in all Polynesian religion (Beckwith, 1970:3).

It is probable that these gods were ancestors who had been deified over the centuries for their exceptionally good works. The Hawaiians were collectors of mana, and this collection was part of the deification. Mana is the power and ability a person derives from the supernatural realm. When a person died who was believed by the people to have strong mana, rituals took place so that the mana of the person was cared for after death and his or her mana used. Mana could be collected and used for powers of manipulation. Ali'i evolved out of those who had collected the mana of Ku, Kane, Lono, and Kaneloa.

Other gods were personifications of natural objects and forces of nature. Some of these became 'aumakua, family gods. A family god could be represented by a god of the elements like the mo'o water goddess (Beckwith, 1970:2). Not all of the mo'o goddesses were 'aumakua, and it is not known whether Kawai Nui's Hau-wahine was 'aumakua to any family.

Favorite relatives who died could be deified and dedicated to the mo'o, and thereby the mana of that person was collected through the mo'o. To do this the body was wrapped in yellow tapa and taken to a stream. Chants were said until lizards, which represent the mo'o, approached the banks. Then the body was put into the stream and became a mo'o goddess. The goddess Kihawahine who, according to David Malo, was worshipped by women had such a beginning. She was a child of an ali'i family and

was in line to become the chiefess. But she died in her childhood and was deified into a mo'o goddess (Kamakau, 1964:82-91; Handy and Pukui, 1972: 151-153).

The mo'o represents the water element in nature, just as Pele represents the fire element. The chiefessess are represented in mo'o legends, just as Mount Olomana represents an ancient chief. The mo'o serves to keep a relationship with dead relatives for those people who have 'aumakua who are mo'o. the mana from the mo'o remained in the family. Her role was to care for the needs of the family; she therefore was a guardian goddess. Legends of the mo'o abound throught Polynesian folklore (Beckwith, 1970).

The deification of dead relatives not only kept the mana flowing through the family, giving it strength; it also served to keep genealogies alive with memorable ancestors. In societies with only oral tradition to carry on heritage exciting legends dotted with important ancestors are a widespread method of memorizing genealogies.

Living there by the bay the people memorized and composed traditional chants and legends that carried their culture and genealogies. They sailed their canoes and fished for aku and opelu while the change was taking place. The people grew and multiplied. Their subsistence needs and efforts speeded up the natural ecological process. But each stage remained a system that help to fill the people'e needs.

Appendix A

Stratigraphy:

cm = centimeter ; BS. = below surface

Trench A

Sediment trap - 0 - 33 cm B.S.
Upper plow zone - To 77 cm B.S.
Gleyed layer, taro - To 200 cm B.S.
Peat layer - to 213 cm B.S.
Marine layer - To 220 + cm B.S.

Trench B

Sediment trap - 0 - 27 cm B.S.
Upper plow zone - To. 65 cm B.S.
Gleyed layer, taro - to 207 cm B.S.
Peat layer - To 285 cm B.S.
Marine layer - To 312 + cm B.S.

Trench C

Sediment trap - 0 -
Upper plow zone - To 55 cm B.S.
Gleyed layer, taro - To 150 cm B.S.
Peat layer, - To 180 cm B.S.
Marine layer - To 275 + cm B.S.

Trench D

Water table - 25 cm B.S.
Gleyed plow zone - To 75 cm B.S.
Excavation site flooded to a pond state; abandoned.

Flood control and sediment trap.

* Glass shard

Taro and ridge cultivation. (Upper-plow zone)

* Hubine net, Bezant flake

Irrigation and drainage agriculture, taro, maintained fishpond. (Gleyed layer; pre-plowed zone)

+ Log piece; seeds and leaves.

Salt-tolerant vegetation forming a fringing and floating mat. Usually water-birds; no coral growing (Peat layer)

* Coral rubble shallow water shell fish

Lagoon with coral heads (Marine Layer)

* Coral rubble; deepwater shell fish

Saltwater bay (Marine Layer)

Marine layer depths from summer 1981 archaeological excavation:
TR A - 213 centimeters
TR B - 285 centimeters
TR C - 180 centimeters

1000 B.C. 650 A.D. 1300 1860 1981

Fig. I

* Samples extracted for analysis

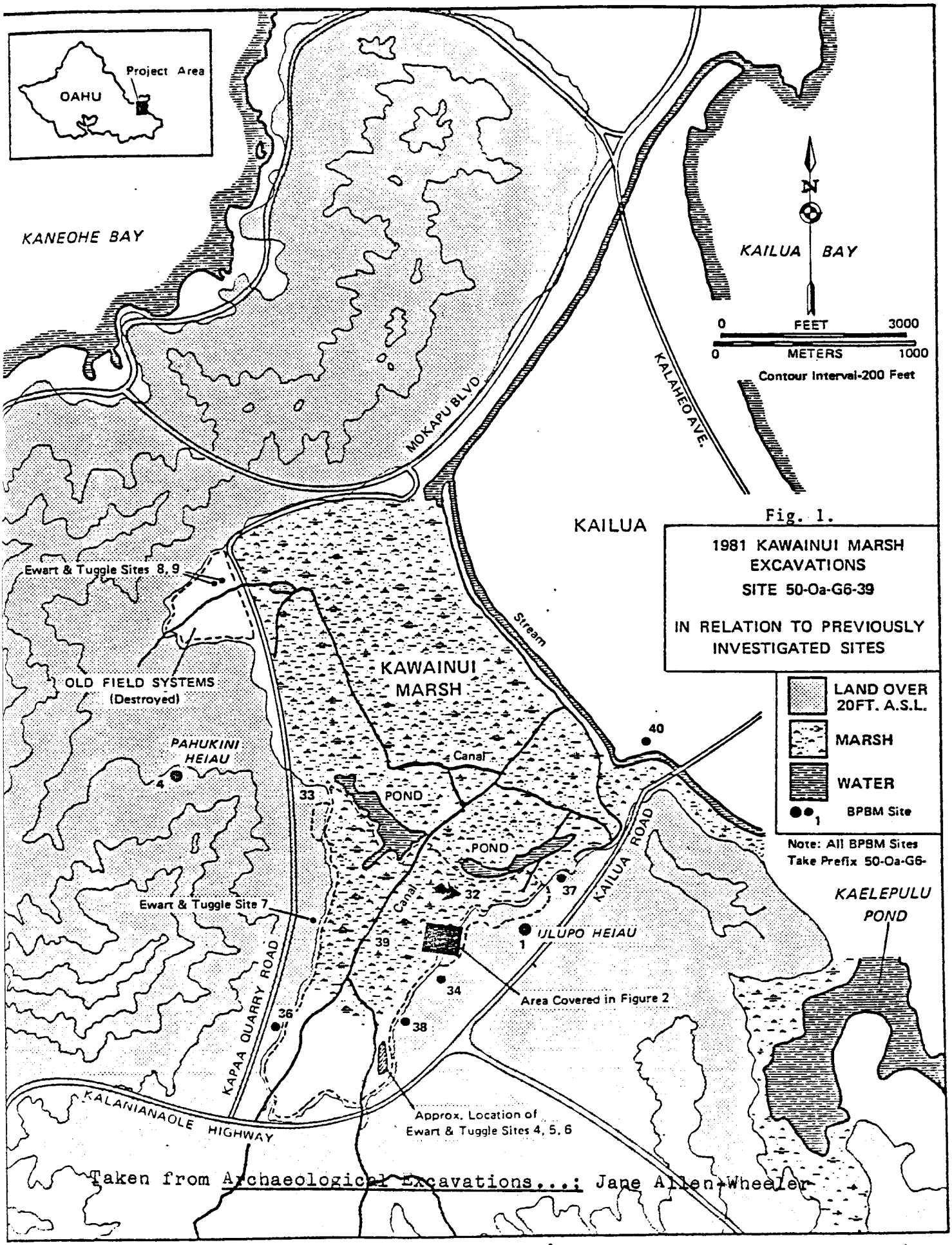


Fig. 1.

Taken from Archaeological Excavations...; Jane Allen-Wheeler

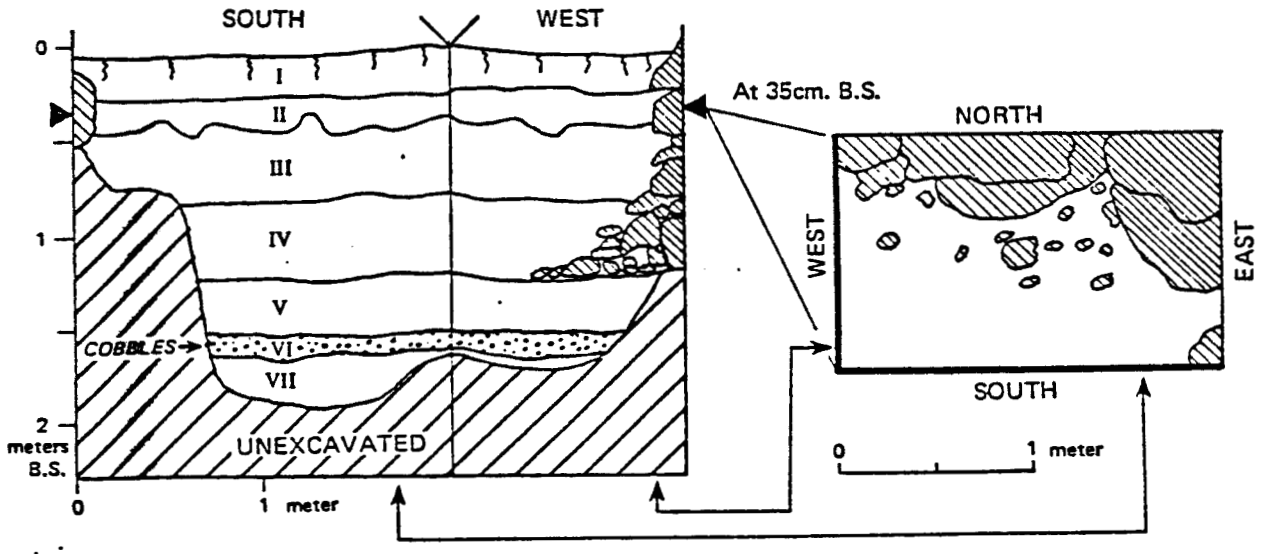


Fig. 7. PLAN VIEW OF TRENCH A AT 35 cm BELOW SURFACE, WITH PROFILES OF SOUTH AND WEST FACES. Note stacked wall boulders.

Taken from Archaeological Excavations...; Jane Allen-Wheeler.

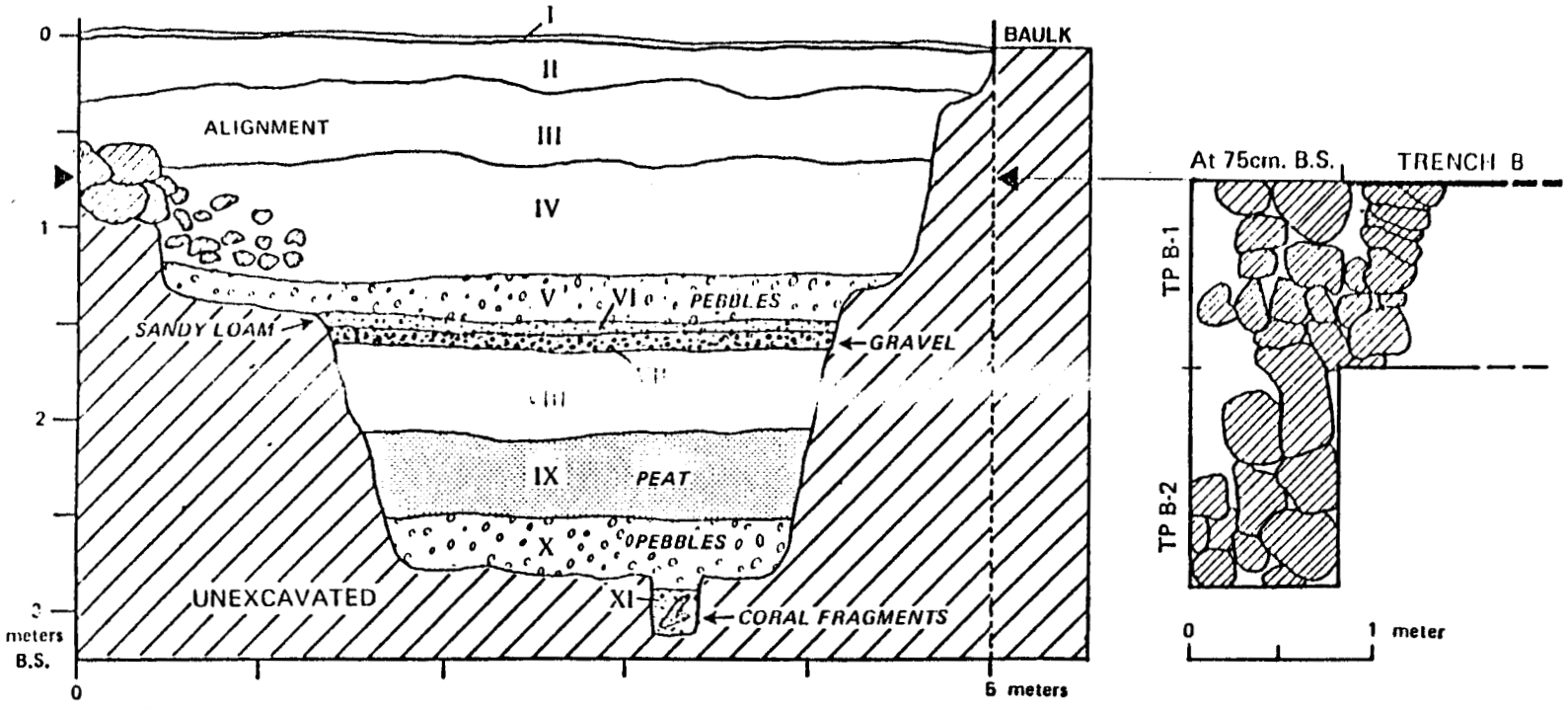


Fig. 11. PLAN VIEW OF TRENCH B AT 75 cm BELOW SURFACE, INCLUDING TEST PITS B-1 AND B-2. PROFILE OF WEST FACE OF TRENCH B, SOUTH END. Note rock alignment.

Taken from Archaeological Excavations...; Jane Allen-Wheeler.

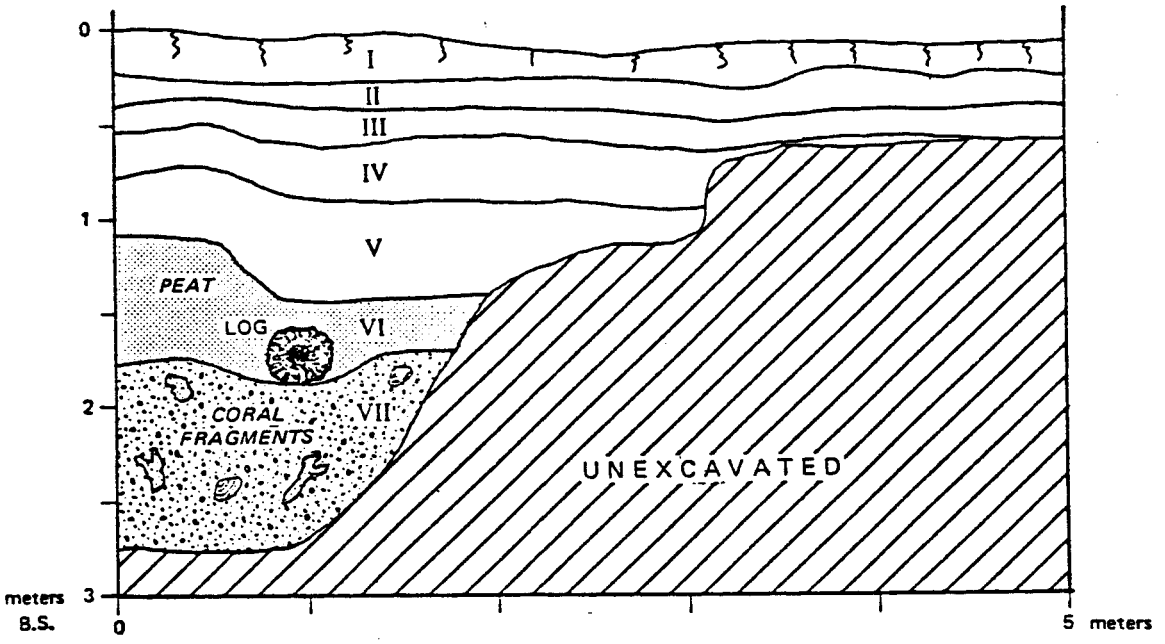


Fig. 13. PROFILE OF SOUTH FACE OF TRENCH C.

Taken from Archaeological Excavations...; Jane Allen-Wheeler.

Table 7. RADIOCARBON DATES, ARRANGED CHRONOLOGICALLY

HRC No.	Beta No.	Context/Material/Matrix	Depth b.s. (cm.)	B.P. Date	B.C./A.D. Date	Corrected* B.C./A.D. Date	Corrected B.C./A.D. Range
420	3345	B IV-V/*kukui*/silty clay	127	230±80	A.D. 1720±80	A.D. 1630±80	A.D. 1550-1710
419	3344	B IV/*kukui*/silty clay	120	560±90	A.D. 1390±90	A.D. 1374±90	A.D. 1284-1464
398	3341	C VI/wood/peat	175	640±60	A.D. 1310±60	A.D. 1309±60	A.D. 1249-1369
399	3342	B IX/wood/peat	233	830±60	A.D. 1120±60	A.D. 1136±60	A.D. 1076-1196
400	3343	B IX-X/wood/peat	257	1060±50	A.D. 890±50	A.D. 919±50	A.D. 869-969
397	3340	B IX/peat/peat	210-250	1310±80	A.D. 640±80	A.D. 668±80	A.D. 588-748
396	3339	C VII/shell/sand	250	3910±90	1960 B.C.±90	2434 B.C.±90	2524-2344 B.C.

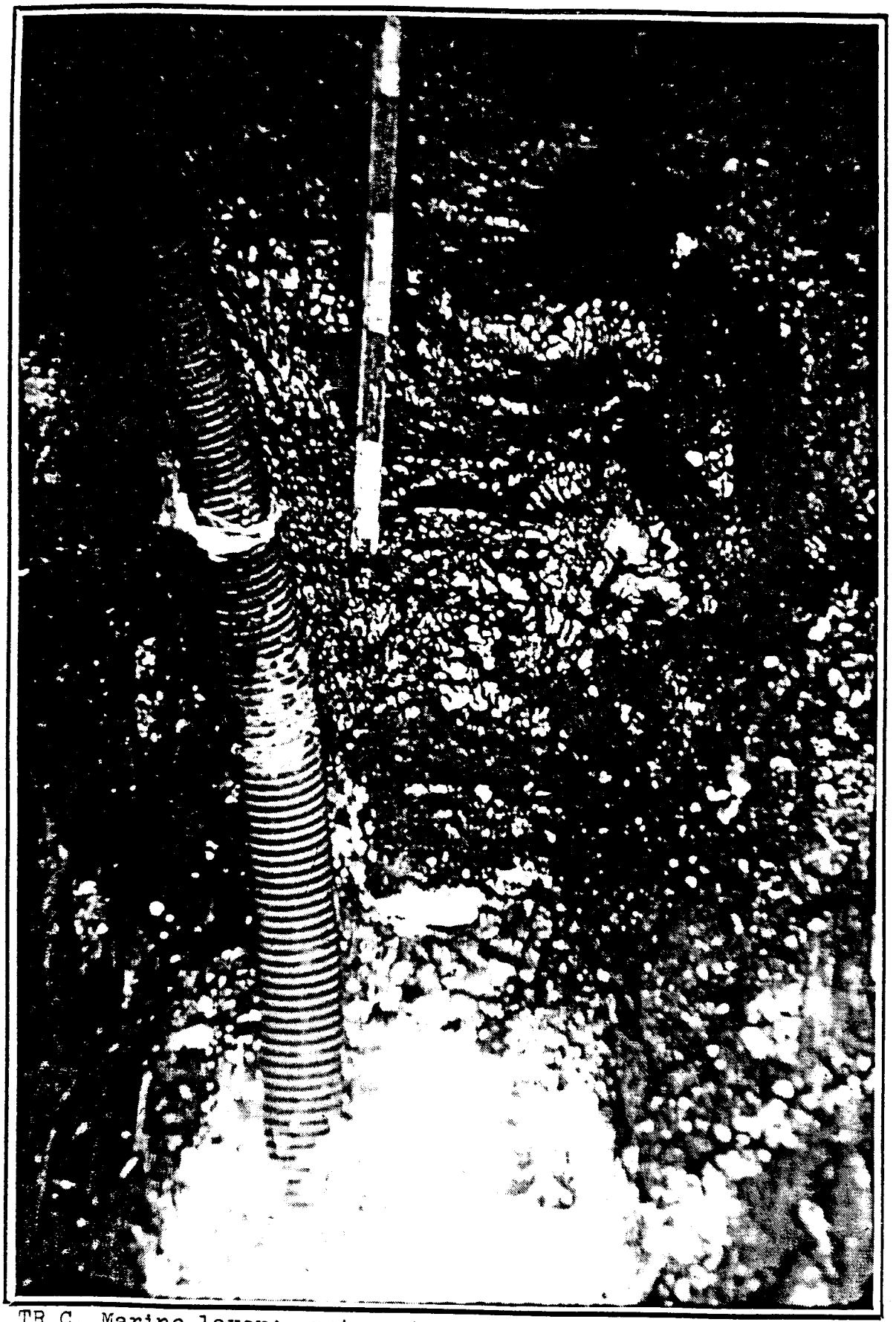
*Michael and Ralph (1972) correction.

Taken from Archaeological Excavations...; Jane Allen-Wheeler.

Table 6. BASALT ARTIFACTS, SIZING SUMMARY, CONTEXTS COMBINED (all ponded soil layers).

CATEGORY	NUMBER IN EACH SIZE CLASS (lengths in cm)					
	<2.0	2.0-2.5	2.51-5.0	5.1-7.5	7.6-10.0	TOTAL
Flake						
Diagnostic		1	2	3	1	7
Non-Diagnostic		1				1
Poss. Biface Fragment			1			1
Core				1		1
Fragment			1			1
TOTALS	0	2	4	4	1	11

From Archaeological Excavations...; Jane Allen-Wheeler.



TR C, Marine layer: note water flow.

Appendix B

Skills learned and tools used for excavation and laboratory analysis.

On-ground survey
Photogrammetric analysis
Preparation for soils analysis
Midden laboratory separation
Soil stratification
Auger use for boring
Mapping
Mapping tools; 1) Four inch transit for elevation; 2) Stadia rod; 3) Brunton pocket transit.
Lithics analysis
Artifact extraction
Samples extraction
Samples and artifact storage and recording

GLOSSARY OF TERMS

Ahupua'a-Subdistrict land division that characteristically extended from the mountain into the ocean and which Hawaiians exploited for subsistence.

Ali'i-Ruling class.

'Aumakua-Family god, usually of a nature deity.

'Ili-Land division within ahupua'a subdistrict granted to lesser konohiki chiefs.

Kahuna-Hawaiian priest, member of ali'i class.

Kapu-Forbidden, taboo.

Konohiki-Lesser chief, in the ali'i ruling class.

Kukui-Candlenut.

Kula-Dry field taro agriculture.

Kuleana-Smallest land division within the ahupua'a; granted to the maka'ainana.

Limu-Seaweed, algae.

Lo'i-Wet taro field.

Maka'ainana-Roughly the equivalent of European commoners.

Makai-Toward the ocean.

Marsh-Wetland characterized by herbaceous vegetation.

Mauka-Toward the mountain.

'Ohana-Extended family sharing unit.

'Ōpala-Rubbish.

Poi-Pudding type food made from pounding taro, the staple food of Hawaiian.

Swidden-Agricultural practice that cuts and burns vegetation which create nutrients; plot is used usually for one or two croppings and then set to fallow.

BIBLIOGRAPHY

Allen-Wheeler, Jane. Archaeological Excavation in Kawainui Marsh, Island of O'ahu. Bishop Museum. Nov., 1981.

Beckwith, Martha. Hawaiian Mythology. Honolulu: University of Hawai'i Press, 1970.

Beggerly, Pat. Personal communication. July 15, 1980.

B.P. Bishop Museum. "Proposal for Archaeological and Historical Investigation of Land Utilization in Kawainui Marsh, O'ahu." Prepared by Department of Anthropology. Feb., 1981.

Native Plants of Old Hawaii. Bulletin 233. Honolulu: Bishop Museum Press, 1972.

Brown, William L. Jr.. Islands of Hope. Washington D.D.: National Recreation and Park Association, 1974.

Cordy, Ross. "A Cultural Resources Study for the City and County of Honolulu's Permit Request: Kawainui Marsh Sewerline (Oahu). Archaeological Reconnaissance and Pre-1850 Literature Search." U.S. Army Engineer District, Honolulu: Mimeo, 1977.

Cordy, Ross. "Test Excavations, Site 7, Kawainui Marsh, Kailua Ahupua'a, Oahu." U.S. Army Engineer District, Honolulu: Mimeo, 1978.

Crane, J. and M. Angrosine. Field Projects in Anthropology: a Student handbook. Glenview: Scott, Foresman and Company,

Decker, Bryce. Class Lecture, Geog.412. University of Hawai'i, 1981.

Drigot, Diane. Class Lecture, EDED 686. University of Hawai'i, 1981.

Drigot, Diane. Class Lecture, IS 489. University of Hawai'i, 1982.

Emerson, N.B. Unwritten Literature of Hawaii: The Sacred Songs of the Hula. Washington Government Printing Office. 1909.

Finney, Ben. Class Lecture, Anth. 350. University of Hawai'i. 1981.

Finney, Ben. Personal communication. March, 1982.

Fornander, A. Collection of Hawaiian Antiquities and Folklore. V. 4,5,6. Honolulu: B.P. Bishop Museum, 1916-1920.

Fornander, A. An Account of the Polynesian Race, It's Origins and Migrations. Tokyo: Charles E. Tuttle Company, 1969.

Handy, C. and M.K. Pukui. The Polynesian Family Systems in K'au, Hawai'i. Tokyo: Charles E. Tuttle Co., 1972.

Kamakau, S.M. Ruling Chiefs of Hawaii. Honolulu: Kamehameha Schools Press, 1961

The People of Old. Mary Kawaina Pukini trans. D. Barrere, ed. Honolulu: B.P. Bishop Museum Spec. Publ. 51, 1964.

The Works of the People of Old. Honolulu: B.P. Bishop Museum Press, 1976.

Kato, H. Personal communication, 1978.

Kelly, Marion. "Kawainui Fishpond." Historic Hawaii News, 1979.

Kelly, M. and J. Clark. Kawainui Marsh, O'ahu: Historical and Archaeological Studies. Honolulu: B.P. Museum, Sept. 1980.

Kikuchi, W. "Prehistoric Hawaiian Fishponds." Science 193:295-29. 1976

Kraft, John C. Letter to Mr. Ed Marcus re corings in Kawai Nui Marsh. December 18, 1980.

Malo, David. Hawaiian Antiquities. Honolulu: B.P. Bishop Museum Press, 1898.

Marcus, Ed. Personal conversation, (CZM), July 23, 1981.

Morgenstein, Maury. "Geoarcheological Analysis of Field Remnants, Kawainui Marsh, Kailua, Oahu." U.S. Army Engineer District, Honolulu. Mimeo. n.d.

Oliver, D. The Pacific Islands. Honolulu: University of Hawai'i Press, 1979.

Reinhardt, Rev. Personal communication through out 6/1/81-5/1/82.

Seto, Muriel. Life History: Kalaukoa Sisters. Typescript. 1980.

Seto, Muriel. Personal communication 6/1/81-5/1/82.

Simons, Jeannette. Life History in Brief: Henry H. Wong, 1981.

Smith, L.L. Development of Emergent Vegetation in a Tropical Marsh. Masters Thesis. University of Hawaii, May, 1978

Stearns, H. Geology of the State of Hawaii. Palo Alto: Pacific Books, 1966.

Taylor, Clarion B. Hawaiian Almanac. Honolulu: Tongg Pub. Co., L.T.D., 1957.

Thrum, T. "Heiaus of Hawaii Nei." Hawaiian Annual. Honolulu: Paradise of the Pacific Press, 1924.

Tilden, F. Interpreting Our Heritage. N.C.: University of Northern Carolina Press, 1967.

Weber, Helen. Personal communication. Nov. 12, 1981.

Westervelt, W. "Ancient Hawaiian Farming." Hawaiian Annual. Honolulu: Paradise of the Pacific Press, .

Zimmerman, D. Personal Communication. AECO Rep. Sept. 18, 1981.

_____ Department of Land and Natural Resources. Division of Water and Land Development. "Flood Control and Flood Water Conservation in Hawaii." V. II. Jan., 1963. PP.15-16.

_____ Department of Planning and Economic Development. Proposed Use of $80,000 grant funds from Office of Coastal Zone Management. "Proposed Contracts to Carry Out First Year Study Items for Kawainui Marsh Baseline Study."

_____ Memoirs of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History. V.5. Honolulu: B.P. Bishop Museum Press, 1918-1919.

Slide Index

1-Marsh from Pali Lookout.
2-Marsh from farther down the Pali Highway.
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9-Cattle grazing.
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15-Pahukini heiau and land-fill.
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