Archaeological Monitoring of a Communication Line Installation at Hickam Air Force Base, O‘ahu, Hawai‘i

Windy K. McElroy, M. A.

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Contents

1 Introduction 3
  1.1 Nature of the Undertaking ............................. 4
  1.2 The Project ............................................. 4
  1.3 Report Organization .................................... 5

2 Background 5
  2.1 Natural Environment ..................................... 6
    2.1.1 Geologic History of the Hālawa-Moanalua Plain .......... 7
    2.1.2 Discussion ........................................ 11
  2.2 Cultural Environment ................................... 11
    2.2.1 Hawaiian Fishponds ................................ 12
    2.2.2 Early Historic Settlements .......................... 12
    2.2.3 Late Historic Settlements and Industries ............. 13
    2.2.4 Human Burial Areas ................................ 15
    2.2.5 Discussion and Summary ............................ 16
  2.3 Previous Archaeology .................................. 16

3 The Project Area 19

4 Project Design 20
  4.1 Predictive Model ...................................... 20
  4.2 Field Problem .......................................... 23
  4.3 Research Problems ...................................... 23
  4.4 Methods ................................................. 23
  4.5 Field Recording and Sampling ........................... 24
  4.6 Inadvertent Discovery of Human Remains .................. 25
5 Results
5.1 Stratigraphy .................................................. 25
5.2 Artifacts .................................................... 28
  5.2.1 Artifact Concentration .................................. 28
  5.2.2 Artifacts from Elsewhere in the Project Area .......... 30

6 Conclusion .................................................... 32

A Context List .................................................. 34

B Non-Traditional Artifact Descriptions ...................... 35

Glossary .......................................................... 41

Bibliography ..................................................... 42

Illustrations
1 Map of Hickam Air Force Base showing project location .... 3
2 Location of communication line trench ........................ 5
3 Geologic map of the Hālawa-Moanalua plain .................. 10
4 Aerial photograph of Hickam Field, 3 May 1940 .............. 14
5 Hickam Field under construction, January 1937 .............. 15
6 Results of recent archaeological investigations ................ 21
7 Runway construction at Hickam Field .......................... 22
8 West wall profile of trench west of Building 920 .............. 26
9 West wall of the trench west of Building 920 ................. 27
10 Stratigraphic profile at context 15 ............................ 27
11 Medicine or extract bottle .................................... 29
12 Glass fragments from context 15 ............................. 29
13 Light-colored glass fragments from context 15 .............. 30
14 Hand-painted whiteware from context 15 ...................... 30
15 Porcelain ceramics imported from Japan ...................... 31
16 Whole bottle with exterior ribbing ............................ 32
17 Brown beer bottle from 1947 ................................ 35
18 Japanese tableware .......................................... 36
19 Cold cream jar .............................................. 38
20 Buffalo Pottery mark ....................................... 39

Tables
1 Fishponds on the Hālawa-Moanalua plain ...................... 13
2 Stratigraphic profile description, basic four-layer sequence .... 25
3 Stratigraphic profile description at context 15 ............... 26
4 Identified faunal remains .................................... 31
6 Historic artifact identifications ............................... 40
1 Introduction

At the request of the U. S. Air Force, 15th Airlift Wing, T. S. Dye & Colleagues, Archaeologists, Inc. conducted archaeological monitoring at the site of a communication line installation in the western portion of Hickam AFB, between Signer Boulevard and Vickers Avenue (fig. 1). The undertaking is located in areas designated in the Hickam AFB Cultural Resources Management Plan (Hickam Air Force Base 1998) as having high probability for containing archaeological resources (fig. 1). High probability areas are defined as those “where known archaeological or historical resources occur based on previous archaeological studies or archival documentation” (Anderson and Bouthillier 1996). Monitoring was guided by an archaeology monitoring plan (Desilets 2001) and was performed on April 9 through April 24, 2003 by Windy McElroy, Seamus Puette, and Thomas Dye. An archaeological monitor was present during the excavation of all areas of high probability. This excludes areas where previous investigations revealed no subsurface archaeological features (Kennedy and Denham 1991; McGhee and Curtis 2002; Roberts 2002). This report presents the findings of the monitoring.

![Map of Hickam Air Force Base showing project location.](image)

**Figure 1.** Map of Hickam Air Force Base showing project location. Archaeological sensitivity zones are from Hickam Air Force Base (1998).
Throughout this report, the term undertaking will refer specifically to communication line installation and associated ground disturbing work. The term project refers specifically to archaeological monitoring, testing, and data recovery performed by T. S. Dye & Colleagues, Archaeologists, Inc. in response to undertaking activities.

1.1 Nature of the Undertaking

The undertaking consisted of the installation of approximately 5,400 m of PVC pipe which housed fiber optic cables to upgrade the existing communication system (fig. 2). Henkles & McCoy typically used a backhoe to open an 80 cm deep trench in which to place the pipe. Trenching began at the northwest end of the communication line and proceeded east and then south to the two southern termini. Trenches were promptly backfilled after placement of the pipe, upon which the fiber optic cable was pulled through. Whenever possible, boring was performed instead of backhoe trenching. This involved the use of a Ditch Witch boring rig that drilled a horizontal shaft below the surface and pulled the PVC pipe through. Archaeological monitoring was not required during boring, though an archaeologist remained on-call for the duration of the undertaking.

1.2 The Project

T. S. Dye & Colleagues, Archaeologists, Inc. conducted archaeological monitoring of all ground disturbing activities of the undertaking determined in consultation with the State Historic Preservation Division (SHPD) to have the potential for an adverse effect on significant historic sites. These activities were confined to a portion of the communication line trench on either side of Worthington Avenue (fig. 2). Monitoring began at a manhole in a parking lot at the north end of the monitored section of the communication line. It continued south, across Worthington Avenue, to the north end of Building 920, where the communication line split into two branches. One branch followed along the west side of Building 920 and the other along the east side, between Buildings 920 and 922. The primary focus of the project was on the discovery and significant appropriate treatment of historic properties within areas designated as having a high probability for containing historic resources.

Archaeological monitoring was performed under the authority of Section 106 of the National Historic Preservation Act of 1966, as amended. Field procedures were conducted in accordance with an Archaeological Monitoring Plan (AMP) (Desilets 2001) approved by the Hawai‘i State Historic Preservation Office (Coloma-Agaran 2001). This monitoring report is drafted to meet the requirements and standards of both federal and state historic preservation law. These include Sections 106 and 110 of the National Historic Preservation Act of 1966, as amended, Chapter 6e of the Hawai‘i Revised Statutes, and the State Historic Preservation Division’s draft Rules Governing Standards for Archaeological Monitoring Studies and Reports (§13–279). Data and results contained herein may be used in consultation with a variety of interested parties including the State Historic Preservation Officer, the Advisory Council on Historic Preservation, and The Base Historic Preservation Officer, 15th Airlift Wing.
1.3 Report Organization

The report begins with historical overviews of land-use and archaeology in the general vicinity of Hickam AFB and the specific project area. The next section presents the project design, which includes a predictive model for the discovery of archaeological sites in the area, research problems, and field methods. Following this, the results of archaeological monitoring are presented. Project results are summarized in the final section.

2 Background

This section is intended to provide basic information about the natural, cultural, and archaeological history of the land that comprises Hickam AFB. This information will help the reader to understand the context in which the organizational scheme and goals of the research design were developed. The first section describes the natural environ-
ment of Hickam AFB with a special emphasis on surface geology. The second section reviews pre-contact and historic land-use at Hickam AFB. Discrete historic structures such as fishponds, human settlements of various kinds and antiquity, and archaeologically defined regions of special use such as burial grounds are discussed. Much of this information is abstracted from Anderson and Bouthillier (1996) and Tomonari-Tuggle and Dye (1999). Taken together, these two sections present an overview of the evolution of the land from its Hawaiian roots to its modern state. Finally, the history of archaeological investigation at Hickam AFB is reviewed.

2.1 Natural Environment

Hickam AFB is centrally located along the south coast of O‘ahu and encompasses the eastern shoreline of Māmala Bay and the Pearl Harbor entrance on the west and Ke‘ehi lagoon on the east. From east to west, it measures some 6.4 km, and from north to south, 4.8 km. Hickam AFB straddles the southern boundary between Hālawa and Moanalua ahupua‘a of the ‘Ewa and Kona districts respectively. It has consequently been referred to as the Hālawa-Moanalua plain in the archaeological literature (Tomonari-Tuggle and Dye 1999:5), a convention also followed throughout this report. The Hālawa-Moanalua plain includes all of Hickam AFB as well as Honolulu International Airport to the east.

The Hālawa-Moanalua plain is flat and level with few perennial streams. Historic maps show streams draining Lelepaua and Waiaho fishponds, although these have since been channeled and rerouted. Importantly, the streams originate near the southern end of the plain and have no direct relation to inland drainages. With no major drainages, an average annual rainfall ranging between 15 and 30 in. (Juvik and Juvik 1998:56), and an average annual solar radiation intensity of over 250 watts/me (Juvik and Juvik 1998:50), the Hālawa-Moanalua plain is dry and hot.

Currently, vegetation in the landscaped areas of the northern part of the Hālawa-Moanalua plain consists of date palm and a variety of other palms, monkeypod, and banyan. Most of the vegetation in the landscaped areas is maintained by an extensive irrigation system. The southeastern part of Hickam AFB, although containing few native plant species, probably gives a more accurate picture of the types of vegetation that thrive on the plain. This area supports only hardy species such as kiawe, koa haole, ironwood, pickleweed, and pili grass. Historic documents from the late 1800s indicate that much of the plain was once lightly vegetated with only a few trees near the coast, presumably in what is now the Fort Kamehameha area. According to Queen Emma’s April 3, 1883 correspondence,

You will never wish to come here twice if you only saw it once it is precisely like the country between Capt. Makees’ landings and Waikepu 1, and barren but this has a little greener appearance from being over grown with ___bushes. The houses are all on the coast with not a shade tree near them. The only two trees throughout the place are in front and at rear of our house so that nay expectant groves of Cocoanuts, Algerobas, Monkey

---

1Underlines denote illegible text.
2.1 Natural Environment

Pods and etc etc, are just in the shell as it were because they are only just above ground now (Anderson and Bouthillier 1996:A-55).

The degree to which the Hālawa-Moanalua plain was vegetated prior to European contact is not known.

2.1.1 Geologic History of the Hālawa-Moanalua Plain

The geologic history of the Hālawa-Moanalua plain is interpreted in the context of the greater Pearl Harbor region (Pollock 1929; Stearns 1935, 1978). Although the geologic history of Pearl Harbor is complex and includes “many events that cannot now be interpreted” (Stearns 1935:51), it does contain some basic formative events which help explain the present stratigraphy of the neighboring Hālawa-Moanalua plain. The geology of the Pearl Harbor area is a product of at least three major sets of Pleistocene epoch events and processes: volcanic eruptions; marine and alluvial erosion and deposition corresponding to sea level fluctuation; and formation of fringing reefs during periods of stable sea level (Denham and Cleghorn 1994).

The initial geologic events relating to the Hālawa-Moanalua plain include a series of Illinoian period eruptions in the East Loch area. These eruptions resulted in the present day Salt Lake, ʻĀliamanu, and Makalapa Craters. They also deposited the Salt Lake and Makalapa tuffs. Where these air-laid tuffs are above sea level and exposed to the elements, they are in a constant state of in-situ decomposition and downslope erosion. They thus contribute to the formation of the Hālawa-Moanalua plain in two ways. First, as the basal substrate for the plain, and secondly in the continued production and alluvial deposition of sediments. Keaau clay and Mamala stony silty clay loam exemplifies the latter case, while Makalapa clay, formed from in-situ weathering of tuff, exemplifies the former (Foote et al. 1972).

Since the deposition of tuffs, there have been a series of sea level changes. The earliest of these, the Waipio stand, occurred several thousand years ago and resulted in seas about 60 ft. below the present level. Eruptions of the Salt Lake, ʻĀliamanu, and Makalapa craters probably occurred during this stand. About 125,000 years ago, the sea rose to 25 ft. above its present level in what is known as the Waimanalo stand. During this long period of stability, reef formation would have taken place, possibly in irregular patches on former stream divides (Stearns 1935:54–55). When the seas receded to their present level, the coral formations were exposed and the alluvial deposition of inland tuffs resumed in the north. At 3485±160 B.P. there was a small high stand of 5 ft. known as the Kapapa high stand (Stearns 1978:50). The effects of this stand on the geologic character of the Hālawa-Moanalua plain are not certain. By the time of the Kapapa high stand, it seems likely that the coastal strip of dunes known from historic records would have formed and served to protect the inland part of the plain from direct marine influence along its southern coast. However, with its eastern end open to the ocean, much of the Hālawa-Moanalua plain’s low-lying central region was probably submerged during the Kapapa high stand.

The dynamic growth of the Hālawa-Moanalua plain is not perfectly understood, but the major features of its evolution are clear. The major processes are deposition of volcanic sediments and growth of an extensive reef platform during periods of higher sea
level. As sea level dropped, wave action against the newly exposed reef would likely have created continuous deposits of calcareous sand and gravel detritus atop the coral bedrock. These can be expected as basal deposits across most of the Hālawa-Moanalua plain, except in its most northerly reaches. Once stabilized, wave and wind acted on the reef margin to produce coastal sand and dune deposits. Low energy terrigenous sedimentation of the northern part of the plain would likely have begun as quickly as the sea receded. This model of the geologic history of the Hālawa-Moanalua plain is consistent with the landscape recorded on pre-military maps of the area (Monsarrat nd) as well as stratigraphic data recorded during archaeological projects.

Modern Surface Deposits A detailed description of modern surface deposits on the Hālawa-Moanalua plain is found in the soil survey of Foote et al. (1972). Fieldwork for this survey was completed in 1965 and the resulting soil designations are therefore considered by the authors as accurate to this date only. Although the addition of the reef runway in the early 1970s marked a major addition to the plain and involved some disturbance of sediments in the southeast, most of the Hālawa-Moanalua plain was not affected. The plain has changed little since 1965.

Soil survey maps show the plain as being primarily composed of a land type called Fill Land, mixed (Foote et al. 1972: sheets 54, 55). This land type is defined as consisting of “areas filled with material dredged from the ocean or hauled from nearby areas, garbage, and general material from other sources” (Foote et al. 1972:31). This is an accurate description of much of Hickam AFB, and issues regarding the sequence and origins of the fill events are discussed below (see pg. 9). Mamala stony silty clay loam is found at Fort Kamehameha, the parade ground, and administrative and residential areas to the northwest. The Mamala Series consists of shallow, well drained soils along the coastal plains on the islands of Oahu and Kauai. These soils formed in alluvium deposited over coral limestone and consolidated calcareous sand. Stones, mostly coral rock fragments, are common in the surface layer and in the profile. In a representative profile the surface layer is dark reddish brown stony silty clay loam about 8 inches thick. The subsoil is dark reddish brown silty clay loam about 11 inches thick. The soil is underlain by coral limestone and consolidated calcareous sand at depths of 8 to 20 inches (Foote et al. 1972:93).

In the northern part of the plain, along the northern border of Hickam AFB, a variety of soil types are present. These include Makalapa Series clays formed in volcanic tuff, Mamala Series stony silty clay loams formed in alluvium, and Keaau Series stony clay also formed in alluvium and deposited over reef limestone or consolidated sand. A small patch of Ewa Series silty clay loam, “formed in alluvium derived from basic igneous rock” (Foote et al. 1972:29), is also present.

In the southwest part of the plain, just north of the Fort Kamehameha residential housing tract, there is an area designated as Jaucas Series, Jaucas Sand Phase. These deposits consist of excessively drained, calcareous soils that occur as narrow strips on coastal plains, adjacent to the ocean. They developed in wind-
2.1 Natural Environment

water-deposited sand from coral and seashells. They are nearly level to strongly sloping . . . In a representative profile [of the Jaucas Sand Phase] the soil is single grain, pale brown to very pale brown, sandy, and more than 60 inches deep. In many places the surface layer is dark brown as a result of accumulation of organic matter and alluvium . . . Permeability is rapid . . . (Foote et al. 1972:48).

Revised Soil Designations The soil survey has long served as background for archaeological work at Hickam AFB (Denham and Cleghorn 1994; Dega 1998; Robins et al. 1999; Drolet 1999a, b; Roberts 2000a, b). The soil survey designations, however, are often generalized and not to be taken as final in all cases. For example, field observations and previous archaeological field and documentary research indicate that soils at Fort Kamehameha and the northwest region of Hickam AFB designated as Mamala Series are, in fact, unlikely to have developed in alluvium. Contrary to the survey, the coastal areas of Fort Kamehameha were, previous to military construction, almost entirely Jaucas Sand. Construction of batteries and military housing at the turn of the century likely included the wholesale movement of deposits in some cases and filling in others. Stratigraphic information indicates that most, if not all, of coastal Fort Kamehameha is currently composed of late historic fill deposits or native calcareous sand (Hammatt and Borthwick 1987c; Hammatt et al. 1988; Drolet 1996). There is no evidence of natural terrigenous clays formed in alluvium, as required for Mamala Series. Although recent construction in the eastern part of Fort Kamehameha might have applied fill materials since the soil survey, the military housing area in the western part has received no appreciable development. A revised soil designation for the eastern part of Fort Kamehameha, based on the stratigraphic evidence collected to date, would replace Mamala Series soils with fill land underlain by Jaucas Sand.

Another large region in the northwest part of Hickam AFB, designated as Mamala Series by Foote et al. (1972), appears to have been misidentified. The area is almost certainly composed of imported terrigenous fill. This area includes most of the Hickam AFB housing area, administrative offices and buildings, and parade ground. Historic maps show this area in the late 1800s and early 1900s as consisting of exposed limestone (Anderson and Bouthillier 1996:A-19, A-23). All available evidence indicates that this part of the Hālawa-Moanalua plain, unlike the fishpond and marsh areas to the east, was not subject to significant alluvial deposition. A revised soil designation for Northwest Hickam would describe the area as composed of fill land underlain by Coral Outcrop.

Fill Sequence and Origins Most of Hickam AFB is covered by fill consisting of “material dredged from the ocean or hauled from nearby areas, garbage, and general material from other sources” (Foote et al. 1972:31). Archaeologists working on the plain generally attribute these calcareous fill deposits to dredge material from the early 1900s widening of Pearl Harbor entrance (e.g. Anderson and Bouthillier 1996:A-4).

The history of fill material application at Hickam AFB is more complex than this, however. The central portion of Hickam AFB was formed by at least three different fill episodes, two of which post-date 1938 and one of which pre-dates 1938 (fig. 3).
The fill materials that pre-date 1938 may well have derived from Pearl Harbor entrance dredging. To the east of this, however, fill materials were laid down after 1938, making them unlikely to be early 1900s Pearl Harbor reef dredge.

Figure 3. Geologic map of the Hālawa-Moanalua plain. Adapted from Ralph M. Parsons Co. (1971:fig. 22). Note that the rough outlines of Lelepaua Pond and the west side of Ka‘ihikapu Pond are identifiable and described in the key as coral fill over swamp or water.

At least a portion of the land filled after 1938 was probably unfilled in 1943. A map drafted in 1943 by the War Department (War Emergency Construction 1943) recorded the origins and depositional locations of fill materials derived from the dredging of a seaplane airstrip complex in Ke‘ehi Lagoon. The map shows the southeastern part of the Hālawa-Moanalua plain with historic Hickam Field on the left and John Rodgers Airport on the right. As of 1943, the central region, which today connects Hickam AFB with Honolulu International Airport, was not filled. The area is labeled as “Future Proposed Fill.” Judging from the presence of railroad track, road alignments, and unchanneled streams, it would appear that fill had not been placed in this area yet. It
also seems likely that the material eventually covering this area derived from dredging of seaplane airstrips or other nearby areas and not early 1900s Pearl Harbor entrance. These sources indicate that fill materials from different places were applied on the plain over a long period in several episodes.

2.1.2 Discussion

The geology of the Hālawa-Moanalua plain is regionally variable within a framework of nearly universal calcareous bedrock and both terrigenous and calcareous fill deposits. At its base, the Hālawa-Moanalua plain consists of an emerged limestone shelf. This has been apparent to observers as early as the 1800s, who describe the plain as being coral covered with occasional grasses (Tomonari-Tuggle and Dye 1999:5). According to historic maps, this description applies only to the northwest part of the plain (Anderson and Bouthillier 1996:A-19, A-21).

Prior to modern landfill applications, various deposits have formed on the basal coral shelf, two of which are especially important to the archaeologist. These include the terrigenous silty clays found in the northern portion of the plain, and the calcareous coastal dunes in the Fort Kamehameha area. The terrigenous clay deposits, which accumulated via low-energy stream transport from Makalapa, ʻAliamanu, and ʻAliapaʻakai craters, comprise the northern part of the plain and were historically used for sugar cane cultivation. These sediments may also have found their way onto the lowland marshes and ponds recorded on historic maps (Monsarrat nd). Also important is the complex of coastal dunes which comprise much of the southern coastal margin. These sandy deposits likely developed as a result of wave action against the fringing reef once present to the south. Today, most of the coastal dunes and inland terrigenous deposits are covered with several layers of fill material. Much of this material is calcareous, derived from either the dredging of Pearl Harbor entrance or the seaplane airstrip in Keʻehi Lagoon (War Emergency Construction 1943). Other fill materials, such as terrigenous silts and clays, are also common and were used to landscape residential and administrative areas of Hickam AFB. The terrigenous fills are easily distinguishable from naturally deposited clays by their typical stratigraphic position overlaying coral fill. In sum, sediment profiles on the Hālawa-Moanalua plain typically exhibit, from top to bottom:

- Modern or late historic fill materials;
- Naturally deposited terrigenous silts in the north, sandy dune deposits along the southern coast, and coral detritus in the northwest; and
- Calcareous sand, gravel, and cobbles associated with the basal limestone shelf.

2.2 Cultural Environment

A number of similar organizational schemes for describing elements of the cultural environment of the Hālawa-Moanalua plain have been used by archaeologists (Anderson and Bouthillier 1996; Drolet 1999b). Such schemes typically distinguish several related categories of phenomena important to understanding the history of land-use and
its effects on the plain. These often include discrete historic structures such as fishponds, human settlements of various kinds and antiquity, and archaeologically defined regions of special use such as burial grounds. Most of these categories were derived from historic documentation and maps of the area. They are useful for helping to predict the location and nature of archaeological resources as well as to interpret geologic changes which have occurred since western contact.

This section retains these general categories for the historical review and discussion which follow. The categories include: Hawaiian fishponds; early historic settlements; late historic settlements and industries; and human burial areas.

### 2.2.1 Hawaiian Fishponds

The early cultural histories of Hālawa and Moanalua ahupua‘a are richly documented by Anderson and Bouthillier (1996). Legends dating to at least the late pre-contact period are presented in detail, as are the observations of travelers and explorers of the eighteenth and early nineteenth centuries. These accounts testify to the ecological and cultural importance of these ahupua‘a, and especially of Pearl Harbor and its fertile system of streams and uplands. Very rarely in these accounts, however, is specific reference made to locations on the Hālawa-Moanalua plain. The bulk of the traditional Hawaiian population apparently resided in and around the drainages feeding into Pearl Harbor and on the terraced lowlands nearby. It does not appear that the Hālawa-Moanalua plain was considered suitable for large-scale habitation or agricultural use by traditional Hawaiians. The fishponds and small coastal settlements that appear on early historic maps give the best clues to traditional Hawaiian use of this area (Monsarrat nd). Marine resources, principally the fishponds and the fringing reef, were a primary focus of traditional Hawaiian land-use on the plain.

Four ponds were once located on the Hālawa-Moanalua plain. From east to west, the ponds include Ka‘ihikapu, Lelepaua, Waiaho, and Keoki (table 1). The largest two, Ka‘ihikapu and Lelepaua, are known to have been used traditionally as fishponds. It is not known whether the smaller ponds to the west were ever used in this manner. By 1930, the small western ponds had been completely filled. Following construction of Hickam AFB, Honolulu International Airport, and residential housing in the northern cane fields, Lelepaua and Ka‘ihikapu were also filled. The initial phase of filling appears to have been the result of natural alluvial sedimentation, likely caused by construction activities in the north. The second phase of filling was performed by the military and constitutes the present surface of the central region of the Hālawa-Moanalua plain.

### 2.2.2 Early Historic Settlements

Although the Moanalua side of the plain was composed predominantly of fishponds and marshlands, the Hālawa side contained a number of small settlements which were either abandoned as land passed to federal ownership, or evolved into small workmen’s towns such as Watertown. These early settlements include Halekahi, Holokahiki, and an unnamed settlement between them (Anderson and Bouthillier 1996:21, fig. 4). No accounts that describe these settlements have been located, although it can be assumed
2.2 Cultural Environment

Table 1. Fishponds on the Hālawa-Moanalua Plain

<table>
<thead>
<tr>
<th>Name</th>
<th>Site Number</th>
<th>Area (ha)</th>
<th>Construction Elements*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaʻihikapu</td>
<td>50–80–13–00081</td>
<td>104</td>
<td>1372 m seaward wall with 3 outlets</td>
</tr>
<tr>
<td>Lelepaua</td>
<td>50–80–13–00082</td>
<td>134**</td>
<td>Earthen and coral embankments, seaward wall</td>
</tr>
<tr>
<td>Waiaho</td>
<td>50–80–13–00094</td>
<td>13</td>
<td>Coral and sand walls and 5 outlets</td>
</tr>
<tr>
<td>Keoki</td>
<td>50–80–13–00095</td>
<td>—</td>
<td>Narrow wall of coral, rock and sand</td>
</tr>
</tbody>
</table>

* As reported by McAllister (1933:93, 101), unless otherwise noted.
** As reported by Cobb (1903).

that residents harvested marine resources as part of their subsistence. They may also have tended a fishpond once located off Bishop Point (Stokes 1909). There were also historically recorded settlements on the Moanalua side of the plain. These include Poi Village and Kumumau. Residents of these settlements probably tended nearby Lelepaua and Kaʻihikapu fishponds (Dorrance nd:4).

2.2.3 Late Historic Settlements and Industries

In addition to the traditional Hawaiian component of the Hālawa-Moanalua plain are several poorly documented late historic settlements associated with various agricultural, industrial, and military operations. Chief among these was Watertown, established in 1908. Watertown functioned predominantly as a housing settlement for workers dredging Pearl Harbor. Workers on the project were of varied ethnicity including Russian, Hawaiian, and Japanese. By the 1930s, with the patronage of nearby Fort Kamehameha military personnel, Watertown became notorious for its gambling and nightlife. This lasted until 1935 when construction of airfields began for Hickam AFB. No definite archaeological remains of Watertown have been previously recovered. Demolition and filling associated with base construction appeared to have obliterated most physical remains. Historic maps indicate that a complex infrastructure including numerous roads, houses, and buildings once existed.

Although no surface remains relating to Watertown are present today, residential structures were present as late as 1940. An historic aerial photograph taken on 3 May 1940 shows a group of structures along the coast just north of Bishop Point (fig. 4). Judging from their locations and orientations, these structures pre-date Hickam Field construction. They also correspond to a Watertown era neighborhood located on the site of former Halekahi settlement. These structures appear to be the last remnants of historic Watertown. It is also conceivable that they bear some relation to Halekahi, although more documentary evidence is needed to support this speculation. In addition to the structures, vestigial Watertown roads can be discerned on the 1940 aerial photograph. As construction of Hickam Field, and later Hickam AFB, proceeded over the next two decades, all traces disappeared.

Another settlement on the Hālawa-Moanalua plain was Pu‘u‘ūloa Camp. This was also a workers’ housing area and supported the sugar cane plantations adjacent and
Figure 4. Aerial photograph of Hickam Field, 3 May 1940. Note the location of the project area in relation to the remaining structures of Watertown.

to the north. No evidence of Pu’uloa Camp has been found to date, although this might be due to the fact that little archaeological work has been done in its vicinity. Historic aerial photographs show that the remains of Pu’uloa Camp’s infrastructure were still visible in January of 1937 (fig. 5). Vestiges of cane field roads are visible in several locations, as is the former road to Fort Kamehameha. By 1937, almost all of the structures and infrastructure associated with Pu’uloa Camp had been destroyed and the new Hickam Field road system laid out.

Another settlement complex, Fort Kamehameha, was established on the western coast of the plain in the early 1900s. This involved construction of a series of coastal defense batteries and military housing to protect the entrance to the new Pearl Harbor naval facility. The residential and defensive structures are still largely intact today. This military complex was constructed on the sites of the former Holokahiki settlement and Queen Emma’s residence.

Prior to construction of the Fort Kamehameha housing and batteries, a country retreat for Queen Emma was located on this coastal strip. It is thought to have been somewhere in the southwest corner of the present Fort Kamehameha (Anderson and Bouthillier 1996:A-56). As discussed in more detail below, the Fort Kamehameha area
2.2 Cultural Environment

Salt works were located on the peripheries of two of the former fishponds. One salt works was located at the northwest end of Ka‘ihikapu fishpond in its surrounding wetlands. The other, in operation as late as 1888, was located about 800 ft. from Lelepaua fishpond. The nature of the salt industry and dates of operation of the salt works have not been reported by previous investigators. These operations and their remains were either buried or obliterated during military and civilian airstrip construction in the middle part of the twentieth century.

2.2.4 Human Burial Areas

Human remains have been found in a fairly localized coastal segment of the Hālawa-Moanalua plain. The area known today as Fort Kamehameha is the focal point for traditional Hawaiian burials at Hickam AFB. Inadvertent discoveries have been made there since 1975 (Watanabe 1991; Shun and Schilz 1991; Drolet 1992, 1999a, b, 2001). The most extensive and well documented set of remains was recovered during four field projects near the Waste Water Treatment Plant at the northern end of Fort Kamehameha (Drolet 1992, 1999a, b, 2001). Eighty-seven individuals were recorded during the four
phases of work. Associated grave goods, when present, ranged from traditional pre-contact materials to historic era glass beads and buttons. $^{14}$C dates indicate that this area was used for human interment from at least A.D. 1450 to A.D. 1900. Isolated remains from the southern portion of Fort Kamehameha (Streck 1988) have also been reported.

2.2.5 Discussion and Summary

The Hālawa-Moanalua plain has undergone major changes in land-use over the past two hundred years. Early documentary records of traditional Hawaiian use of the area are virtually silent. The bulk of the populations of Hālawa and Moanalua ahupua`a resided in areas surrounding the rich drainages feeding Pearl Harbor. The presence of a complex of fishponds, coastal burials, and cultural deposition attest to the exploitation of marine resources and small-scale habitation. Apart from marine resources, the plain seems to be a marginal environment for subsistence activities. The calcareous soils of the northwest are too well drained to support a fertile A-horizon development, and low precipitation combined with an exceptionally high solar radiation intensity make agriculture a difficult enterprise, at best. It is therefore likely that pre-contact use of the plain did not deviate greatly from the pattern observed at contact. That is to say, the plain supported only small settlements along its coastal fringe. Inhabitants of the settlements exploited a variety of local marine resources and maintained fishponds. The unconsolidated sands of the southwestern shoreline dunes were used for burial.

The decades immediately following contact probably saw little change to traditional land-use. By the mid-1800s, however, cattle were grazing north of the Hālawa-Moanalua plain and may have encroached on its northern periphery. Also in the mid to late 1800s, salt works were put into operation to supply the whaling industry. Two were constructed; one on the west side of Lelepaua fishpond and one on the northwest side of Ka`ihikapu fishpond.

It may be significant that Queen Emma maintained a residence here expressly for the “freedom and quiet” the place offered (Anderson and Bouthillier 1996:A-47). She describes the area in 1883 as barren and virtually treeless with a population concentrated on the coast (Anderson and Bouthillier 1996:A-47). By this time, Pu`uloa Camp had been established to support the growing sugar cane operations on the northern part of the plain. Soon after, Watertown and Fort Kamehameha were established. From the early 1900s on, military use increasingly dominated the Hālawa-Moanalua plain and culminated in the construction of present day Hickam AFB.

2.3 Previous Archaeology

Archaeological work on the Hālawa-Moanalua plain before 1993 is presented in detail by Anderson and Bouthillier (1996:A-83–A-15). Archaeological investigations between 1994 and 1998 are summarized by Tomonari-Tuggle and Dye (1999). The following account draws on these authors but also includes reviews of many of the original works. Despite the number of different and often destructive historic land-uses occurring on the Hālawa-Moanalua plain, there are still areas which retain integrity and that have high potential for significant cultural deposits.
The history of concerted archaeological investigation on the plain dates back only to the mid 1980s. Before this, a number of investigators including Cobb (1903), Stokes (1909), and McAllister (1933) had recorded sites on the Hālawa-Moanalua plain as part of broader survey projects focused primarily on large-scale architectural features such as heiau, stone walls, and fishponds. Cobb (1903) noted that Lelepaaua fishpond had been mostly filled and another unnamed fishpond was partially filled. Ka‘ihikapu and Waiaho fishponds were as yet unfilled. Stokes (1909) learned from local informants that a walled fish trap was once in operation at Bishop Point on the east bank of Pearl Harbor entrance. It had been abandoned before the memory of the native informants and the stones were reportedly used to construct a pier near Bishop Point. McAllister (1933) describes Ka‘ihikapu fishpond, Lelepaaua fishpond, Waiaho fishpond, Ke‘oki fishpond, and Papiolua fishpond located opposite Waipi‘o peninsula.

**Site 82** Lelepaaua, a large inland fishpond, in Moanalua. It is “332 acres, mostly filled,” according to Cobb. The walls are coral and earth embankment, 10 feet or more wide. The pond was built by Ka‘ihikapu-a-Manuia and according to Dibble was the place at which Captain Brown obtained salt.

**Site 94** Loko Waiaho, known as Queen Emma’s pond, was located near Watertown. The walls were of coral and sand, 6.5 feet wide, 2 feet high, with five outlets (mākahā). It covered an area of 32 acres.

**Site 95** Loko Ke‘oki was a pond near the present site of Watertown in Halawa. It had a narrow wall of coral rock and sand. It has been filled in.

**Site 96** Papiolua fishpond was located in Halawa opposite the tip of Waipio Peninsula. It was a small pond, about 1 acre in area with a wall 150 feet long, 4 feet wide and high. There were no outlet gates (mākahā) (McAllister 1933).

No further archaeological work was done on the Hālawa-Moanalua plain until 1986 when archaeological testing projects began at Fort Kamehameha (Hammatt et al. 1986; Hammatt and Borthwick 1987b, c, d, a; Hammatt et al. 1988). Initial work on a proposed water main replacement in the northwestern part of the fort recovered gley. The gley was interpreted as a fishpond sediment, possibly Waiaho fishpond, and returned a 14C date of cal A.D. 1340–1650 (Hammatt et al. 1986). A few traditional Hawaiian artifacts were also recovered, including a possible shell fishhook and polished basalt beads or sinkers. Historic-era material, including metal, nails, ceramics, glass, shell buttons, and bottles was also unearthed. These materials came from only a few of the 67 0.25 m² test trenches, a fact that was interpreted as indicating an absence of extensive prehistoric or historic occupation of the Fort Kamehameha area (Hammatt et al. 1986). Four subsequent projects in the eastern part of Fort Kamehameha (Hammatt and Borthwick 1987b, c, d, a), during which 60 test trenches and auger holes were excavated, seemed to support this conclusion. No pre-contact deposits were recorded except for gley interpreted as evidence of historic fishponds (Hammatt and Borthwick 1987a). Work on a proposed apron addition (Hammatt and Borthwick 1987d) produced only metal, glass and ceramic artifacts dating to the 1920s and 1930s. The other two projects produced no traditional Hawaiian or historic period deposits (Hammatt and Borthwick 1987b, c).
In 1988, work on the water main project recommenced with monitoring of an 875 m trench through the northwestern part of Fort Kamehameha (Hammatt et al. 1988). Again, no traditional Hawaiian or early historic remains were found. Gley corresponding to the gley observed in 1986 was discovered. Another sample of the deposit was dated and returned a date range of cal A.D. 1385–1655. The deposit was again interpreted as evidence of Waiaho fishpond. However, historic maps (Donn 1906; Monsarrat nd) place Waiaho fishpond well to the northeast of the gley. Interpretation of the gley as fishpond sediments has been contradicted by the results of subsequent archaeological investigations (Drolet 1996; Kennedy and Denham 1991).

Also in 1986, Watanabe conducted survey and testing in the eastern inland part of Fort Kamehameha (Watanabe 1986). The work produced a number of historic military structures as well as sediments indicative of a ponded marsh environment. Fishpond sediments were not found. In 1988, human remains were inadvertently discovered under Quarters #14 in the Fort Kamehameha housing area (Streck 1988). Four individuals were eventually unearthed. In 1991, investigations in the northwestern part of Fort Kamehameha produced another burial, an adze preform, and a polished adze (Shun and Schilz 1991). Also that year, survey and testing were conducted for the MIDPAC T-1 Network project (Watanabe 1991). Eight auger samples returned no evidence of cultural deposition, including fishpond sediments. Later monitoring of trenches for the fiber-optic cable running from the inland northeastern part of Fort Kamehameha to the northwestern part of Hickam AFB produced no cultural materials or fishpond sediments (Kennedy and Denham 1991).

Testing and monitoring at the waste water treatment plant located in the northwest corner of Fort Kamehameha (Drolet 1992, 1999a, b, 2001) between 1992 and 1994 yielded 87 individual sets of human remains, numerous pit features, and traditional Hawaiian cultural materials including charcoal, animal bone, and thermally altered rock. Material associated with the thermally altered rock returned an age range of cal A.D. 1200–1550. Historic material was also abundant and included bottles, metal, and ceramics dating to the late nineteenth and early twentieth centuries. Early historic artifacts dating to the 1800s were also recovered. These findings confirm that the northwest part of Fort Kamehameha contains buried cultural deposits from the traditional Hawaiian and historic periods. Human remains in the former dune sands are numerous and indicate the importance of the area for traditional Hawaiian burial.

Archaeological work in the late 1990s included monitoring projects (Carlson 1997; Erkelens 2000; Magnuson 2001; Desilets and Magnuson 2001), as well as several paleoenvironmental coring projects (Athens et al. 1997; Athens and Ward 1999a, b). These projects expanded the areal coverage of archaeological investigations at Hickam AFB, and provide a more general picture of the distribution of historic remains than can be discerned from the previous investigations which were focused on the Fort Kamehameha area.

Recent monitoring projects have discovered few traditional Hawaiian cultural deposits in areas outside Fort Kamehameha. Monitoring of Manuwai Canal dredging produced no cultural remains or deposits (Carlson 1997) in excavations that were largely confined to recent deposits within the canal. Removal of four underground storage tanks yielded no cultural deposits (Erkelens 2000). More extensive monitoring projects by Magnuson (2001) and Desilets and Magnuson (2001) likewise turned up little evi-
ence of cultural deposition, except for possible Lelepaua fishpond sediments at UST Site 1818B.

The only significant finding has been in the western part of Hickam AFB, in the motor pool and aircraft parking apron areas (Dega and Farrell 1999). Although these areas are in the vicinity of historic Watertown, historic remains were not found. Instead, excavation produced intact traditional Hawaiian deposits containing earth oven features, post molds, shellfish, fish bone, fire cracked rock, volcanic glass flakes, and one shell adze fragment. One dated feature returned a $^{14}$C date range of A.D. 1720 to A.D. 1820.

Recent paleoenvironmental investigations at Hickam AFB (Athens et al. 1997; Athens and Ward 1999b, a) extracted sediment cores from areas suspected to be on or near fishponds. The TRACON and Vault-X cores were suspected to be near the southwestern boundary of Ka‘ihikapu fishpond (Athens et al. 1997; Athens and Ward 1999a). No evidence of fishpond sediments was recovered, however. Marsh sediments consistent with the natural landscape shown on 1930s maps, however, are present. Cores from the vicinity of Lelepaua fishpond also returned no evidence of fishpond sediments (Athens and Ward 1999b).

3 The Project Area

The project area is located in the western portion of Hickam AFB, on either side of Worthington Avenue, east of Signer Boulevard, TMK:9–9–01:13 (see fig. 2). The project area is level with no significant elevation change. The area north of Worthington Avenue consists of an open, grassy field and a covered parking area. South of Worthington Avenue are buildings 920, 922, and 925. Numerous large trees and exotic ornamental vegetation surround the buildings. The project area is within the Hickam Historic District, as defined in the Hickam AFB CRMP (Hickam Air Force Base 1998:31), and within the region designated as having a high probability for containing archaeological resources (Hickam Air Force Base 1998:33). This area contains the former Watertown settlement (fig. 4 on page 14).

Watertown was a 2,000 acre settlement containing numerous large structures, roads, rail lines, port facilities, and an ethnically diverse population of laborers responsible for the dredging of Pearl Harbor ( Hollingsworth 1935). The town got its name because of the frequent leaks in its water main, which was installed so hastily that much of it lay above ground. In 1935 the population of Watertown numbered 1,000 laborers and their families, including 300 school-aged children (Hollingsworth 1935). The town included a schoolhouse and adjacent Catholic Church, a theater, post office, at least one hotel, and a number of stores and offices.

Laborers working on the Pearl Harbor dredging project are known to have lived in ethnically distinct neighborhoods including populations of Russians, Hawaiians, and Japanese. A 1935 newspaper article mentions at least one Japanese family housed on “the wharf” living in traditional Japanese style, with the women dressed in kimonos and obis (Hollingsworth 1935). Material remains indicative of ethnicity may help in delimiting these neighborhoods archaeologically. Such deposits also have the potential to address questions about the degree of segregation of these neighborhoods, to assist
in drawing lifestyle comparisons between sub-communities, and to assess the retention of native ethnic characteristics.

In addition to housing its resident population, Watertown was noted as a recreation hub for the entire region, complete with gambling, drink, and prostitution. These aspects of the late historic era are rarely documented by archaeologists and may provide important data regarding everyday life in a “temporary” laboring community such as Watertown. By the early 1930s Watertown was falling into disrepair and businesses were declining. Demolition began in 1935, when Hickam AFB airfields replaced the town.

Despite intense historic activity in this area, remains associated with Watertown proved elusive prior to this project. Two hypotheses have been proposed to explain the lack of Watertown remains in previous projects (Desilets 2002). The absence of remains were explained as a sampling problem due to the limited nature of previous undertakings or were thought to indicate a very low level of preservation due to Hickam AFB construction.

## 4 Project Design

This section sets out the design of the project. It reviews a predictive model for archaeological and historical resources, specifies the field problem that the monitoring is designed to address, and sets out the research problems to which field data were applied. Following this, the methods used for recording and sampling in the field are described and attention is drawn to the existence of procedures to deal with inadvertent discovery of human remains.

### 4.1 Predictive Model

A predictive model for archaeological and historical resources (Anderson and Bouthillier 1996:A-116) guides historic preservation review of undertakings at Hickam AFB. Based on the results of archaeological projects and documentary research, the model defines three levels of probability for finding archaeological or historic remains: high, moderate, and low. These probability levels are organized into regional zones (fig. 1). This regional breakdown, in conjunction with the estimated locations of historic settlements, landscape features, and previous archaeological projects (Anderson and Bouthillier 1996:17, 21, 23), has proven especially useful for investigators working at Hickam AFB.

Since the development of the predictive model, a great deal of new archaeological work has been done in areas designated as high and moderate probability. The results of this work can be used to evaluate the success of the predictive model.

The bulk of modern archaeological research on the Hālawa-Moanalua plain has focused on the Fort Kamehameha area. Testing and monitoring there have produced abundant pre-contact human remains, traditional Hawaiian cultural deposits, early historic remains and deposits from late historic military occupation. By comparison, other areas have produced almost no cultural deposition other than Hickam AFB construction fill.
Findings from eight recent projects (Athens et al. 1997; Athens and Magnuson 1998; Athens and Ward 1999b, a; Dega and Farrell 1999; Carlson 1997; Erkelens 2000; Magnuson 2001), give some indication of the success of the predictive model for archaeological resources outside the Fort Kamehameha Area (fig. 6). No historic sites were found in the low probability zone, as would be expected from the model. The high probability zone, however, with some 17 excavation sites spread throughout the zone, shows only one possible historic site, identified as possible fishpond sediments from Lelepaaua pond, and one site containing traditional Hawaiian deposits. From these results, it is clear that the model might over-predict historic sites in the regions once occupied by Watertown and the traditional Hawaiian fishponds. Although the Fort Kamehameha area has proven to be archaeologically rich in its northwestern region, very little has been recovered from the rest of the high probability zone.

Figure 6. Results of recent archaeological investigations at Hickam AFB. Adapted from Tomonari-Tuggle and Dye (2000, fig. 5). Sources: Magnuson (2001); Athens et al. (1997); Athens and Magnuson (1998); Athens and Ward (1999a, b); Carlson (1997); Erkelens (2000); Dega and Farrell (1999).
There are several possible reasons for the negative results of the archaeological monitoring projects. First, the few positive results might be a function of sampling; there have been relatively few, small-scale excavations over the large area classified as high probability. Second, the predictive model might underestimate the degree to which cultural deposits were destroyed during base and air field construction, especially in the northwestern part of Hickam AFB where many excavations have produced negative findings. The central and eastern parts of Hickam AFB have not received nearly this intensity of investigation and consequently the degree of preservation of the former fishponds is not known.

Some idea of the degree of disturbance involved in constructing Hickam Field can be obtained from historic photographs. Runway construction in 1937, for example, set foundations that extend well into the coralline substrate (fig. 7). The destruction of historic or traditional Hawaiian features in such an area would appear total. Since runways encompass a major part of the central and eastern parts of Hickam AFB, it may be inferred that substantial portions of the former fishponds have been destroyed.

![Runway construction at Hickam Field in 1937.](image)

The predictive model might have overestimated the probability of finding archaeological resources in northwestern Hickam AFB. Archaeological results indicate that the model accurately predicts a high probability of cultural deposits in the southwest
4.2 Field Problem

The field problem is defined as a phase of sub-surface inventory survey for traditional Hawaiian and historic-era archaeological sites. Given the extensive modern disturbance to Hickam AFB, traditional Hawaiian and historic-era deposits are likely to exist as discontinuous remnants. The primary field problem of the monitoring is identification of paleosols and cultural remains appropriate or suitable for data collection through a program of limited test excavation and sampling. The field problem is explicitly constrained to the undertaking’s area of potential effect.

4.3 Research Problems

The problems of archaeological monitoring can be separated into two general categories: site or deposit identification and site or deposit characterization. Site or deposit identification refers to the location of intact cultural deposits, and the estimation of their extent and depth. Site or deposit characterization problems refer to the determination of the nature and significance of the deposits, and their potential to address questions of Hawaiian cultural history and settlement. This set of research problems concerns elements of stratigraphic interpretation, the historical sequence, and the larger problems of Hawaiian archaeology. Archaeological remains in the project area are important for their potential contribution to the knowledge of life in ethnically diverse late historic-era labor communities.

4.4 Methods

The backhoe operator, Gary Greenwood, and the construction crew were briefed on the goals and methods of the archaeological project. They were instructed that the archaeological monitor had the authority to halt excavation in the immediate area of a find. They cooperated fully throughout the entire project.

An archaeological monitor was present at all times the backhoe was excavating within the project area. Monitoring took place from April 9 through April 24, 2003. It was carried out by Windy McElroy on April 14–18 and 21–24, Seamus Puette on April 10 and 24, and Thomas Dye on April 9, 10 and 14. Monitors kept a daily log of activity and took digital photographs as appropriate. Stratigraphic profiles were drawn in the area of greatest artifact concentration and in an area that lacked artifacts.

Artifacts were collected from the backdirt and from the side walls of the trench. They were assigned to one of eighteen contexts identified in the field recorded according to vertical and horizontal position. The identified contexts are listed in appendix A.

All collected artifacts were taken to the archaeology laboratory at the University of Hawai‘i Anthropology Department, where they were washed, sorted, and cataloged. Historic artifacts were identified and described by Susan Lebo at B. P. Bishop Museum. Faunal remains were identified by Alan C. Ziegler.
4.5 Field Recording and Sampling

Field recording and sampling were directed toward the research problems enumerated in the AMP (Desilets 2001). They are intended to mitigate any potentially adverse effects to historic properties. Standards of documentation, recording, and analysis of features, soil and sediment profiles, and artifacts accord with the Secretary of the Interior’s *Standards and Guidelines for Archaeological Documentation*. Accurate map locations of stratigraphic profiles and archaeological features, deposits, and artifacts were recorded.

The first three items in the following list are intended to provide basic stratigraphic data relevant to the reconstruction of land surfaces in the project area in sufficient detail to make possible correlation of land surfaces with information from early topographic maps and with information from past or future archaeological projects. Items four through seven are intended to address the problem of long term use of a stable surface and the associated difficulties of inferring use and occupational history.

1. The archaeological monitor recorded all stratigraphic profiles with cultural remains or features; stratigraphic profiles where samples have been taken; and profiles where there is a sedimentary change or nonconformity that, in the professional judgment of the archaeological monitor, contains information important for the research problems enumerated in the AMP;

2. The archaeological monitor maintained detailed notes on exposures whose stratigraphic profiles were not drawn;

3. The locations of stratigraphic profile drawings and photographs were recorded;

4. All cultural deposits were examined in the field for:
   
   (a) Evidence of micro-stratification and other data relevant to the evaluation of depositional history; and
   
   (b) Evidence of disturbance, irregularity, or boundary conditions that might indicate cultural activities.

   Such evidence was recorded in the profile description.

5. All deposits were examined for cultural items and the stratigraphic positions of these items noted. Notation includes reference to the estimated age of the artifact and how this age might indicate either disturbance to a deposit of different age, or the age of the deposit itself. In particular, evidence for nineteenth century traditional Hawaiian occupation was noted, as well as evidence for early twentieth century military, commercial sugarcane, or other uses of the land;

6. Profile descriptions include appropriate technical information (in conformance to standards established by the U.S. Soil Conservation Service), as well as field-based interpretation of depositional history; and

7. The stratigraphic positions of samples collected from profiles, including artifacts, feature contents, sediments, and dating materials were recorded.
4.6 Inadvertent Discovery of Human Remains

Special procedures applicable in the event that human remains were inadvertently discovered can be found in the AMP (Desilets 2001). No human remains were discovered during archaeological monitoring.

5 Results

This section presents the results of archaeological monitoring in the project area. Cultural materials uncovered during the trenching were confined primarily to the portions of the trench south of Worthington Avenue. North of Worthington Avenue only a single bottle was recovered as an isolated find, unassociated with a cultural layer or features.

Abundant early twentieth century artifacts recovered south of Worthington Avenue are likely remains of the settlement at Watertown (see pg. 19). Cultural material was found in a concentration east of building 920, at context 15 (appendix A), and as isolated finds in the vicinity of buildings 920 and 922. Glass and ceramics were the dominant materials recovered in both the artifact concentration and as isolated finds. The glass collection consists of two intact bottles, an intact jar, and more than 200 bottle and jar fragments. The ceramic collection consists of 54 vessel fragments. Small amounts of metal, linoleum tile, shell, bone, and charcoal were found as well. Historic artifacts identified by Bishop Museum historic archaeologist Susan Lebo are described in appendix B.

5.1 Stratigraphy

Stratigraphy consisted of four layers throughout most of the project area (figs. 8 and 9, table 2). Layer I, a modern topsoil, overlay layer II, a pale brown fill material, which had been laid down over layer III, an in situ brown sandy clay. Layer IV is the coral bedrock found throughout Hickam AFB. The only exception to this four-layer sequence was the area containing the artifact concentration (fig. 10, table 3). In this section, the modern topsoil, layer I, overlay a single layer of dark yellowish brown fill containing a lens of cultural material that had been laid down directly on the coral bedrock. No intact cultural deposits or cultural features were identified in the trench or in any of the trench walls.

Table 2. Stratigraphic profile description, basic four-layer sequence

<table>
<thead>
<tr>
<th>Layer</th>
<th>Depth*</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0–16</td>
<td>Dark reddish brown (2.5YR 3/4, dry); silty clay loam; fine and medium roots throughout; abrupt, smooth boundary.</td>
</tr>
<tr>
<td>II</td>
<td>16–50</td>
<td>Pale brown (10YR 6/3, dry); medium sand (1/4–1/2 mm); 5% coral; abrupt, smooth boundary.</td>
</tr>
<tr>
<td>III</td>
<td>50–65</td>
<td>Strong brown (7.5YR 4/6, dry); sandy clay; few fine and medium roots; abrupt, smooth boundary.</td>
</tr>
<tr>
<td>IV</td>
<td>65+</td>
<td>Solid coral bedrock.</td>
</tr>
</tbody>
</table>

* Centimeters below surface.
Figure 8. West wall profile *makai* of pebble walkway west of Building 920. *a*, metal; *b*, very dark brown (10YR 2/2) lens; *c*, glass and shell. See table 2 for layer descriptions and figure 9 for a photograph of the section.

Table 3. Stratigraphic profile description at context 15

<table>
<thead>
<tr>
<th>Layer</th>
<th>Depth*</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0–20</td>
<td>Dark reddish brown (2.5YR 3/4, dry); silty clay loam; fine and medium roots throughout; abrupt, smooth boundary.</td>
</tr>
<tr>
<td>II</td>
<td>20–65</td>
<td>Dark yellowish brown (10YR 4/4, dry); clay loam, 2% coral; abrupt, smooth boundary.</td>
</tr>
<tr>
<td>III</td>
<td>65+</td>
<td>Solid coral bedrock.</td>
</tr>
</tbody>
</table>

* Centimeters below surface.
5.1 Stratigraphy

Figure 9. A portion of the west wall of the trench west of Building 920 showing the bottom three layers. See figure 8 for a profile of this section. Layers are described in table 2. The scale is marked in 10 cm increments.

Figure 10. Stratigraphic profile at context 15, the concentration of cultural material. See table 3 for layer descriptions. Note that the trench was partially filled before the stratigraphic section was drawn.
5.2 Artifacts

This section summarizes the artifacts recovered from the artifact concentration at context 15, along with the isolated finds found elsewhere in the trench. A detailed description of the artifacts, ordered by context, is presented in appendix B.

5.2.1 Artifact Concentration

A concentration of cultural material was encountered in the eastern portion of the project area, directly east of building 920, which is part of the lodging complex on Worthington Avenue (fig. 2). The concentration stretched across a 10-meter section of the trench 32–42 centimeters below the surface in a layer of fill. Because cultural material was found in secondary context and no features were present, excavation was not halted. Artifacts were collected from the excavation backdirt and walls of the trench without the aid of screens, with the intention of collecting diagnostic materials that could be identified and dated. Glass, ceramic, linoleum, metal, and bone were recovered. These are believed to be the remains of the historic Watertown settlement.

Glass

One intact bottle, one intact jar, 152 bottle and jar fragments, and one window glass fragment were recovered from the artifact concentration. Bottle and jar fragments came from milk, soda, beer, gin, oil, food, medicine, cosmetic, and household cleaner containers dating from 1880 to after 1924. All of the bottles and jars were manufactured in the United States.

The intact bottle is a clear-colored, mold-blown medicine or extract container that dates from 1880–1910 (fig. 11). The intact jar is a machine-made cold cream container manufactured between 1924 and 1964 by the Hazel-Atlas Company in Wheeling, West Virginia.

Glass fragments were light blue, clear, cobalt blue, light green, amber, brown, dark olive, and aqua (figs. 12 and 13). These fragments represent at least 20 different containers. Clear glass was the most abundant, numbering 77 fragments from at least 11 bottles and jars. The 41 fragments of cobalt blue glass represent at least four “Phillips Milk of Magnesia” bottles manufactured in Connecticut in 1928. At least four amber colored bottles were household cleaner containers, two of which were manufactured by Purex and Clorox in San Francisco, California in 1932.

Ceramics

Ceramics from the artifact concentration included 53 tableware fragments and one fragment of an industrial porcelain insulator. Most of the tableware dated from the late nineteenth century to the early twentieth century and included fragments of plates, cups, a saucer, a rice bowl, and a shallow dish. These consisted of plain and decorated whiteware (fig. 14), plain ironstone tableware, and plain and decorated porcelain (fig. 15). One of the ironstone plates was manufactured in Buffalo, New York, and the porcelain tableware was imported from Japan. The whiteware was manufactured in either England or the United States.
5.2 Artifacts

Figure 11. Medicine or extract bottle from context 15.

![Figure 11](image1.png)

Figure 12. Glass fragments from context 15. 
- a. Clorox bleach bottle base; 
- b. Purex bleach bottle base; 
- c and d. Phillips Milk of Magnesia bottle fragments; 
- e and f. Clear rim sherds.

![Figure 12](image2.png)

Metal Six wire nails, a threaded nut and bolt, and three fragments of a pocket knife were among the metal items recovered. The wire nails post-date the 1890s; the age of the other metal items is uncertain.
30 RESULTS

Figure 13. Light-colored glass fragments from context 15. a and d, food oil bottle embossed “Meat Company”; b, light green sherd with prominent bubble; d, embossed aqua bottle base; e, Waialua Soda Works bottle fragment.

Figure 14. Hand-painted whiteware from context 15. Note the gold gilt along the rim of both sherds.

Bone Four small fragments of bone were among the materials collected from the artifact concentration (table 4). Three of these were identified as small to medium or medium mammal, while one fragment was of a medium vertebrate. None of the bones are thought to be human (Ziegler 2003).

5.2.2 Artifacts from Elsewhere in the Project Area

A number of artifacts were found in other parts of the project area. These were isolated finds unassociated with the main concentration of cultural material. They included an intact bottle and fragments of glass, ceramic, metal, bone, shell, and charcoal. The intact bottle was found 4 m north of Worthington Avenue, north of building 920 in disturbed soil (fig. 16). This clear, faceted bottle was manufactured in San Francisco,
5.2 Artifacts

Figure 15. Porcelain ceramics imported from Japan recovered from context 15. a-c, blue transfer print; d and e, plain base sherds from different vessels; f, gold gilt handle.

Table 4. Identified faunal remains

<table>
<thead>
<tr>
<th>Context</th>
<th>Taxon</th>
<th>Count</th>
<th>Wt. g</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Small-to-Medium and/or Medium Mammal</td>
<td>2</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Medium Mammal</td>
<td>1</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Medium Vertebrate</td>
<td>1</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Medium or Large Mammal</td>
<td>2</td>
<td>6.2</td>
<td>One metal sawed.</td>
</tr>
<tr>
<td>18</td>
<td><em>Bos taurus</em> (domestic cattle)</td>
<td>1</td>
<td>86.0</td>
<td>At least 2–2½ yrs old.</td>
</tr>
</tbody>
</table>

* Weight in grams.

California in 1930. Glass fragments consisted of 37 green, brown, aqua, and clear pieces of alcohol, food, and Clorox bottles. The earliest piece may be a fragment of a mold-blown bottle predating 1910. The most recent are a number of beer bottle fragments manufactured in 1947. These were found on the west side of building 920 in a tangle of roots; they clearly postdate the other historic artifacts collected during the monitoring.

Japanese porcelain fragments were found on the east and west sides of building 920 and south of building 922. Two of these were hand-painted rice bowl fragments and two were transfer-printed shallow dish fragments. The pattern on one of the shallow dish fragments was identical to several of the pieces recovered from the artifact concentration. All postdate 1880. Metal consisted of an iron wire fragment and a wire nail. The piece of wire was found on the west side of building 920 and may be part
6 Conclusion

Archaeological monitoring of all undertaking activities with a potential for adverse effect on historic sites yielded secondary deposits of cultural materials. Much of the cultural material recovered from the project area dates to the late 1800s and early 1900s, supporting the hypothesis that these are the remains of Watertown, a 2,000 acre settlement that was home to Russian, Hawaiian, and Japanese laborers between 1908 and 1935.
Artifacts later than 1935 were relatively rare, limited to the isolated find of beer bottle fragments that date to 1947. These fragments are unassociated with the artifact concentration that represents the primary location of Watertown remains, and were clearly deposited later. No traditional Hawaiian artifacts or cultural materials were found. No human remains were uncovered during the trench excavation.

The Watertown cultural materials provide a glimpse into the way of life of an ethnically-diverse community of the late historic era. Watertown glass came from a wide range of products used in every-day life. Food and beverage containers included beer, soda, and milk bottles and catsup and relish jars. Household cleaners, cosmetics, and medicines were represented as well. All of the glass was manufactured in the United States, indicating close economic ties to the U.S. at a time when there were multiple foreign interests in Hawai‘i. The majority of ceramics may have been imported from the U.S., as well. Japanese porcelain was also utilized at Watertown, but was less common than English/American tableware. Japanese tableware included rice bowls, shallow dishes, and a cup, perhaps items of every-day use in one of Watertown’s traditional Japanese households.

The remains of Watertown have eluded archaeologists for more than a decade (Kennedy and Denham 1991; Carlson 1999; Dega and Farrell 1999; Magnuson 2001; Grant 2002). The absence of remains has been explained as a sampling problem due to the limited nature of previous undertakings or as an indication that the settlement was thoroughly demolished during construction of Hickam AFB (see pg. 4.1). Their discovery in a secondary context indicates that both explanations are correct. The artifact concentration at context 15 appears to represent a small lens containing debris from the demolition of Watertown that was incorporated into fill material laid down during construction of the Air Force base. Cultural features, such as the remains of houses or other types of infrastructure present in Watertown, were not found. Thus, the original location of the artifacts, prior to their incorporation into the fill material, is not known. Given that the project area was within the area of Watertown, it is likely that the artifacts were not moved far from their original location. Future work makai of Worthington Avenue stands the best chance of recovering additional remains of Watertown. Therefore it is recommended that the area makai of Worthington Avenue remain at a high level of probability for encountering historic properties.

Although the artifact deposit at context 15 represents something of a breakthrough in the archaeological search for the remains of Watertown, the deposit itself is not a significant historic site. This is because, as a secondary deposit, it lacks integrity of location and association required by the criteria for significance evaluation set out in 36 CFR §60.4. Thus, the activities of the undertaking had no effect on significant historic properties, because significant historic properties were absent in the communication line trench.
A Context List

<table>
<thead>
<tr>
<th>Context</th>
<th>Material</th>
<th>Provenience</th>
<th>Depth*</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Glass</td>
<td>4 m north of Worthington Ave., north of Bldg. 920</td>
<td>Unknown</td>
<td>Came up in backhoe</td>
</tr>
<tr>
<td>2</td>
<td>Glass, Shell</td>
<td>West of Bldg. 920, 60 cm south of pebble walkway</td>
<td>50</td>
<td>In west wall face</td>
</tr>
<tr>
<td>3</td>
<td>Shell, Metal</td>
<td>West of Bldg. 920, 2.5 m south of pebble walkway</td>
<td>45</td>
<td>In east wall face</td>
</tr>
<tr>
<td>4</td>
<td>Glass</td>
<td>West of Bldg. 920, 3 m from south end of parking lot</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Metal</td>
<td>West of Bldg. 920, south end of trench</td>
<td>N/A</td>
<td>Building debris discarded in field</td>
</tr>
<tr>
<td>6</td>
<td>Glass</td>
<td>West of Bldg. 920, south end of trench</td>
<td>N/A</td>
<td>From backdirt</td>
</tr>
<tr>
<td>7</td>
<td>Metal</td>
<td>West of Bldg. 920, south end of trench</td>
<td>N/A</td>
<td>Building debris discarded in field</td>
</tr>
<tr>
<td>8</td>
<td>Ceramic</td>
<td>West of Bldg. 920, south end of trench</td>
<td>N/A</td>
<td>From backdirt</td>
</tr>
<tr>
<td>9</td>
<td>Metal</td>
<td>North of Bldg. 920</td>
<td>40</td>
<td>Came up in backhoe</td>
</tr>
<tr>
<td>10</td>
<td>Ceramic</td>
<td>East of Bldg. 920, 4 m south of Worthington Ave.</td>
<td>Unknown</td>
<td>Came up in backhoe</td>
</tr>
<tr>
<td>11</td>
<td>Ceramic</td>
<td>East of Bldg. 920, north of Bldg. 918</td>
<td>10</td>
<td>Came up in backhoe</td>
</tr>
<tr>
<td>12</td>
<td>Glass</td>
<td>East of Bldg. 920, 4–5 m south of Worthington Ave.</td>
<td>18</td>
<td>In south wall face</td>
</tr>
<tr>
<td>13</td>
<td>Glass</td>
<td>East of Bldg. 920, 5 m south of Worthington Ave.</td>
<td>Unknown</td>
<td>Came up in backhoe</td>
</tr>
<tr>
<td>14</td>
<td>Charcoal</td>
<td>East of Bldg. 920, 20 m north of Worthington Ave.</td>
<td>32</td>
<td>In west wall face</td>
</tr>
<tr>
<td>15</td>
<td>Ceramic, Glass, Linoleum, Metal, Bone</td>
<td>East of Bldg. 920, 25–35 m south of Worthington Ave.</td>
<td>32–42</td>
<td>Came up in backhoe, in backdirt, and in east and west wall faces</td>
</tr>
<tr>
<td>16</td>
<td>Glass</td>
<td>South of Bldg. 922</td>
<td>68</td>
<td>Came up in backhoe</td>
</tr>
<tr>
<td>17</td>
<td>Ceramic</td>
<td>South of Bldg. 922</td>
<td>12</td>
<td>Came up in backhoe</td>
</tr>
<tr>
<td>18</td>
<td>Bone</td>
<td>Southwest corner of Bldg. 922</td>
<td>34</td>
<td>Found by workers digging with shovel</td>
</tr>
</tbody>
</table>

\* Centimeters below surface.
B Non-Traditional Artifact Descriptions

By Susan A. Lebo

Context 1  This whole, machine-made bottle has a slight yellow tint, suggesting the use of selenium as a decolorizing agent, a practice common in the period 1916–1930. It has exterior ribbing, a lug finish, and an embossed manufacturing mark on the base (see fig. 16 on page 32). It was manufactured by the Illinois Pacific Coast Company, San Francisco (1930–1932).

Context 2  Two small pieces of shell and fragments of two bottles were found. These two bottles likely are machine-made beverage containers. Five fragments, several with embossing or texturing, were recovered from the emerald green bottle. The manufacturing mark indicates manufacture by the Glenshaw Glass Company. This Pennsylvania company primarily made alcohol bottles. The single non-diagnostic brown fragment may be from a beer bottle, or possibly a Clorox bottle. This latter possibility is suggested by the recovery of Clorox bottles elsewhere within the project area.

Context 3  A thin, non-diagnostic, highly corroded, iron wire fragment was found along with a small piece of shell. The wire fragment could be from a variety of objects ranging from fencing wire, a container handle, or even a clothes hanger.

Context 4  This brown, machine-made beer bottle is embossed on the side “4/5 QUART.” Manufacturing embossing on the base indicates it was manufactured in 1947 by the Owens-Illinois Glass Co., which had plants in many states (fig. 17).

Figure 17.  Brown beer bottle base from 1947.

Context 5  Building debris discarded in the field.
Context 6  These two aqua bottle sherds belong to two different machine-made (post-1910) wide-mouth bottles. One is a rim-shoulder fragment, while the other is a base fragment. Both likely are from food jars, which were not commonly used in this area.

Context 8  This small rim fragment is to a shallow dish identical to several vessels found in context 15 (fig. 18, a). This Japanese tableware has a blue transfer-printed motif. Such vessels have been widely available since the 1880s.

![Figure 18. Japanese tableware. a, shallow dish, context 8; b, porcelain rice bowl, context 10; c, porcelain rice bowl, context 11; d, cup or shallow dish, context 17. See appendix A for a list of collection contexts.](image)

Context 9  This is a whole wire nail, 6 in. long. Wire nails were first imported to Hawai‘i in the mid-1890s. This style of nail is still commonly available.

Context 10  This is a single rim-body fragment of a Japanese porcelain rice bowl (fig. 18, b). It has a hand-painted blue geometric and floral motif. Such vessels have been widely available since the 1880s.

Context 11  This large porcelain fragment is part of a Japanese rice bowl (fig. 18, c). The bowl has a hand-painted geometric motif. Such vessels have been widely available since the 1880s.

Context 12  This small non-diagnostic fragment of aqua bottle glass has a flat surface, which may be part of the base. Although too small to be definite, this fragment appears to be from a mold-blown bottle (pre-1910).
The two bottle glass fragments found at this location are non-diagnostic to manufacturing technology and contents. Both appear to be parts of beverage bottles. One piece is clear and the other is aqua.

One piece of light green window glass (2.1 mm thick) and 152 fragments of bottle glass were found. Also collected are two whole bottles, 53 ceramic tableware fragments, a white porcelain insulator fragment, and two pieces of floor linoleum.

At least 20 bottles are represented, some by a single fragment and others by more than 20 pieces. One bottle fragment has a slight aqua tint, but is otherwise non-diagnostic. The two light blue fragments are also non-diagnostic. Two manganese-decolorized fragments are from bottles manufactured between 1880 and 1910. One is possibly from a case gin, the other is too small to identify to bottle type. Two fragments appear to have a slight yellow tint, suggesting the use of selenium as a decolorizing agent. Selenium was commonly used for this purpose between 1916 and 1930.

Seventy-seven clear fragments represent at least eleven machine-made bottles. Two are wide-mouth food jars with continuous-threaded lips (post-1924). One is identifiable as a relish jar and another as “Heinz” catsup. The catsup bottle was manufactured by the Illinois Pacific Glass Corporation, San Francisco (1925–1930). A milk bottle is also represented, which was manufactured by the Northwestern Ohio Bottle Company (1911–1929). At least four of the clear machine-made bottles are sodas. One is diagnostic to both manufacturing and bottling companies, and another is identifiable to manufacture only. Both bottles date between 1925–1930 and were produced in San Francisco. One was made by the Pacific Coast Glass Company and contained soda from Waialua Soda Works (fig. 13, e). The other bottle was made by the Illinois Pacific Glass Company. A machine-made clear medicine/extract bottle fragment (post 1910) was found, along with a mold-blown whole example (1880–1910).

At least four “Phillips Milk of Magnesia” bottles are represented by 41 pieces of cobalt blue glass (fig. 12, c and d). These machine-made bottles are oval in shape, have continuous-threaded finishes (post-1924), and company embossing, which indicates the company was located in Glenbrook, Conn. One fragment has a patent number on the base indicating 1928.

The eleven light green fragments are from three machine-made bottles. One is a beverage bottle, probably a soda or beer. One is unidentifiable, while the third is a panel bottle (fig. 13, a). The panels are embossed, indicating the bottle contained some type of food oil produced by an unidentified “Meat Company.”

The 18 amber and brown fragments are from at least five machine-made bottles, one of which may have been a beer. Four are household cleaners. Two are identifiable to company: Purex and Clorox. The Clorox bottle has a manufacturing mark associated with either Illinois Pacific Glass Company or the Pacific Coast Glass Company, both of San Francisco (1932).

The seven dark olive green fragments are from a single alcohol bottle, while the 16 aqua pieces are from several bottles. The thicker fragments are from a large machine-made container, possibly wide-mouth jar or a jug. The other pieces are from a beer bottle manufactured by the Adolphus Busch Glass Manufacturing Company, St. Louis. This mold-blown beer bottle dates 1904–1907.
Two white milk glass cold cream jars are present; one whole and one partial jar. Both are machine made, date to the 1924–1964 period. The whole jar was made by the Hazel-Atlas Glass Company, Wheeling, West Virginia (fig. 19). The other also has embossing, but was not identifiable to company.

![Cold cream jar from context 15.](image)

**Figure 19.** Cold cream jar from context 15.

Eleven fragments are plain English/American blue-tinted whitewares, all of which appear to be parts of plates. None crossmend and all but two are from thicker vessels. These likely date between 1850 and 1910.

Other plain English/American whitewares are one unburned and four badly burned fragments. Three are plate rims, while the fourth is a cup rim. A discolored, partially burned plate rim with a light repoussé motif is also present. These vessels likely date from the 1900 to 1920 period.

Four pieces of English/American white whiteware have polychrome, floral, overglaze, decalcomania decorations. Each appears to be from a separate vessel. Three are portions of plates, while the fourth is probably part of a cup. Two pieces of fluted cup have both gold gilding and floral decalcomania decoration on the exterior and a thin hand-painted blue rim band on the interior. These polychrome tablewares were likely popular between 1900 and 1930.

The three white ironstone tablewares consist of two plates and a saucer, all of which are plain (n=18 sherds). Fourteen fragments are from a single plate with a partial makers’ mark on the base (fig. 20). This stenciled mark belongs to Buffalo Pottery (Buffalo, New York). The “Q.M.C.” portion of the mark indicates “Quality Stamo Company” wares, which were produced in the 1920s and 1930s. The other two vessels are similar in style and may have been made by the same company.

Three of the seven English/American dark ivory-tinted whiteware fragments are plain and too small to identify to vessel form. Two are parts of cups with polychrome, floral, decalcomania decorations. One is from a cup with a silver gilded rim band, while the last is a scalloped, and relief-molded plate rim fragment. These wares were most popular between 1930 and 1960.

Also present are six pieces of porcelain, including two undecorated base fragments. One is a cup handle with gold gilding. The others are two pieces of a rice bowl and a rim to a shallow dish. All appear to be Japanese in origin. They likely date after the arrival of Japanese immigrants and several reflect styles still available. All are styles
Figure 20. Buffalo Pottery mark on ironstone plate.

widely available during the first half of the twentieth century.

Miscellaneous items from this context include five wire nails, one wire nail/spike, three pieces of a small pocket knife, one threaded bolt and nut, one partial threaded bolt, two unidentified fragments of iron, and a small battery core fragment.

**Context 16** This non-diagnostic piece of clear bottle glass is not identifiable to technology or contents. Its diameter suggests it may be part of a wide-mouth jar.

**Context 17** This is a small rim fragment of a cup or shallow dish. It is Japanese in manufacture and is decorated with a blue-transfer print “dashed line” motif (fig. 18, d). This motif has been found in many late nineteenth or early twentieth century assemblages.
### Table 6. Historic artifact identifications

<table>
<thead>
<tr>
<th>Context</th>
<th>Count</th>
<th>Material</th>
<th>Description</th>
<th>Date Range</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Glass</td>
<td>selenium-decolorized bottle</td>
<td>1930</td>
<td>Jones and Sullivan (1988); Munsey (1970); Toulouse (1971)</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>Glass, Shell</td>
<td>1 med. green beverage bottle, 1 unid. brown bottle</td>
<td>1910–1940</td>
<td>Jones and Sullivan (1988); Munsey (1970)</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>Shell, Metal</td>
<td>1 shell fragment, 1 wire fragment</td>
<td>20th c</td>
<td>Toulouse (1971)</td>
</tr>
<tr>
<td>4</td>
<td>27</td>
<td>Glass</td>
<td>brown alcohol bottle</td>
<td>1947</td>
<td>Toulouse (1971)</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Metal</td>
<td>rebar discarded in field</td>
<td>1910–1940</td>
<td>Toulouse (1977)</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>Glass</td>
<td>aqua wide-mouth bottles</td>
<td>1910–1940</td>
<td>Toulouse (1977)</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Metal</td>
<td>1 porcelain shallow dish</td>
<td>1880–1910</td>
<td>Costello and Maniery (1988)</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Ceramic</td>
<td>wire nail</td>
<td>20th c</td>
<td>Costello and Maniery (1988)</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Metal</td>
<td>porcelain rice bowl</td>
<td>1880–1910</td>
<td>Costello and Maniery (1988)</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>Ceramic</td>
<td>porcelain rice bowl</td>
<td>1880–1910</td>
<td>Costello and Maniery (1988)</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>Ceramic</td>
<td>porcelain rice bowl</td>
<td>1880–1910</td>
<td>Costello and Maniery (1988)</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>Glass</td>
<td>aqua bottle fragment</td>
<td>1880–1910</td>
<td>Jones and Sullivan (1988); Munsey (1970)</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>Charcoal</td>
<td>charcoal fragment (in several pieces)</td>
<td>1880–1910</td>
<td>Berge (1980); Elliott and Gould (1988); Jones and Sullivan (1988); Lehner (1988); Moir (1987); Munsey (1970); Toulouse (1971)</td>
</tr>
<tr>
<td>15</td>
<td>221</td>
<td>Ceramic, Glass, Linoleum, Metal, Bone</td>
<td>30 ceramic tablewares, 1 ceramic insulator, 1 window pane, 20 beverage, condiment, medicine/extract bottles, 1 linoleum tile, 3 pocket knife fragments, 6 wire nails, 2 bolts, 1 nut, 1 battery carbon core</td>
<td>1880–1964; most 1910–1930</td>
<td>Berge (1980); Elliott and Gould (1988); Jones and Sullivan (1988); Lehner (1988); Moir (1987); Munsey (1970); Toulouse (1971)</td>
</tr>
<tr>
<td>16</td>
<td>1</td>
<td>Glass</td>
<td>clear bottle fragment</td>
<td>1880–1940</td>
<td>Jones and Sullivan (1988); Munsey (1970)</td>
</tr>
<tr>
<td>17</td>
<td>1</td>
<td>Ceramic</td>
<td>porcelain shallow dish/cup</td>
<td>1880–1940</td>
<td>Costello and Maniery (1988)</td>
</tr>
</tbody>
</table>
Glossary


ahupua'a  Traditional Hawaiian land division usually extending from the uplands to the sea.

banyan  A large tree in the Ficus family, several species of which have been introduced to Hawai‘i.

date palm  The introduced palm, Phoenix dactylifera.

gley  A soil horizon in which the material is bluish gray or blue-gray, more or less sticky, compact, and often structureless. It is developed under the influence of excessive moisture.

ironwood  A large tree, Casuarina equisetifolia, introduced to Hawai‘i before 1895.

kiawe  The algaroba tree, Prosopis sp., a legume from tropical America, first planted in 1828 in Hawaii.

koa haole  A common shrub or small tree, Leucaena glauca introduced to Hawai‘i after 1864.

mākahā  A fish pond sluice gate.

makai  Seaward.

monkeypod  A large tree, Samanea saman, introduced to Hawai‘i from tropical America.

paleosol  A soil of the past, often buried.

pickleweed  A low shrub, Batis maritima, introduced to Hawai‘i before 1859.

pili  A native grass, Heteropogon contortus.
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BIBLIOGRAPHY


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