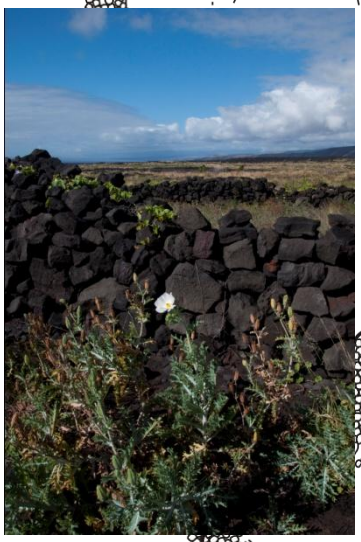
Hawai'i Volcanoes National Park
Island of Hawai'i

Kealakomowaena

Life on a Lava Landscape



Part I

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Pacific Island Cluster
National Park Service
U.S. Department of the Interior

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Kealakomowaena

“The Entrance Path”

Life on a Lava Landscape
Hawai‘i Volcanoes National Park
New Interpretive Area Study

By

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National Park Service
Hawai‘i Volcanoes National Park
2011

EXECUTIVE SUMMARY

At the request of the National Park Service (NPS), staff from the Research Corporation of the University of Hawai'i (RCUH) and Hawai'i Volcanoes National Park (HAVO) carried out inventory surveys of surface cultural remains. The surveys took place within an area of the park known as Kealakomowaena. Once likely a continuous habitation and agricultural site, the protohistoric and historic remains still expressed on the landscape have been dissected by lava which flowed from Mauna Ulu between 1969 and 1974. Located in the District of Puna, on the Island of Hawai'i, Kealakomowaena lies within the *ahupua'a* (traditional land unit) of Kealakomo (TMK #311001007).

This report documents the survey and findings of two inventory projects within Kealakomowaena. The first project, hereafter identified as "Phase I" was an inventory survey of a *kipuka* (a clear place or oasis within a lava bed where there may be vegetation) west of the Chain of Craters road. The field survey began in 1999 and was completed in 2001. Excavation and testing took place between 2006 and 2008. A total of 1343 features and 77 sites were identified during the Phase I inventory and two sites were tested.

The second inventory survey, "Phase II" began and was completed in 2002. This inventory occurred in a *kīpuka* parallel to the Phase I inventory area but east of the Chain of Craters road. Fieldwork for Phase II began on March 11, 2002 and continued over the next nine months, during which time a total of 46 acres were surveyed for archaeological resources. A total of 1981 features and 112 sites were identified during the Phase II inventory. Like Phase I, excavation in Phase II took place in 2006 with the testing of several areas within Road Cut Cave (Site 25940). The goal of the excavation was to obtain charcoal for radiocarbon dating, determine site function, and to identify plant species that existed in the area in the near past.

The Cultural Resources Preservation Program (CRPP) and Recreational Fee Demo program provided the funding for consecutive segments of this project. The objective of the project was to carry out the mandate of Section 110 under the National Historic Preservation Act (NHPA). In doing so, the Park conducted an intensive survey level investigation within these parcels of land, and to identified and recorded features and resources within the designated project boundaries. These surveys were done to document archeological features within the interior portion of the *ahupua'a* of Kealakomo. The goal was to provide baseline data that would assist park management in developing a plan to interpret the area for public visitation.

Combined, both field crews identified 189 sites consisting of 3324 individual structures and features. A total of 11 isolated artifacts were also recorded.

The results of the Phase I and II survey projects suggest that the interior zone of the Kealakomo *ahupua'a* was an important area for agricultural production in this region. The number of house sites identified in the area suggests a small local population likely occupied this area. The caves in the region likely provided a much sought after water source in this parched region. Several trail segments connected the interior inhabitants with the coastal habitation sites. These trail segments were likely used both during the pre-contact and post-contact periods. Major trail system, including the Puna Trail

along the coast to the south, and the Volcano Kalapana Trail to the north connected the interior households and agricultural lots with their neighbors in adjacent *ahupua'a*.

Results of radiocarbon dating of charcoal collected from test units within Road Cut cave suggest initial use of the cave began in the early fifteenth century. This cave, which is one of the earliest dated sites in the park, was initially used for water collection.

ACKNOWLEDGMENTS

Several individuals contributed to the completion of this inventory survey. Phase I field inventory of the western portion of Kealakomowaena was completed by Jennifer Waipa, Taylor Houston, Warren Costa and Christopher Quiseng between 1999 and 2000. Phase II field inventory of the eastern section of Kealakomowaena was done by Mara Durst, Brandee Pang, and Sandra Arnold in 2002. Additional data was collected by Jennifer Waipa, Christopher Quiseng, Summer Roper, Kalena Blakemore, Jahkotta Burrell and Caleb Houck. All of these individuals formally recorded the architectural structures, agricultural features, trails and caves that remain in the two *kīpuka*. Without their dedication to the project, completion of this report would not have been possible.

Sincere thanks to the individuals from HAVO Fire and HAVO Resources Management who participated in the controlled burn of the western *kīpuka*.

Thanks also go to Laura Carter Schuster whose continued support throughout this project has made its successful completion possible. *Mahalo* to the Administration and Staff at Hawai'i Volcanoes National Park for their continued support of the Cultural Resources Management (CRM) program. Taylor Houston was exceptional in his fieldwork and GIS expertise during the field portion of this project. Many thanks to Kalena Blakemore, Jahkotta Burrell, Summer Roper and Dusten Robbins for the final drafted maps from both Phase I and Phase II inventories. They produced a majority of the final site maps for this report. Finally, I'd like to thank those who took the time to review the draft of this report, and Dr. Darcy Hu, who helped me figure out some of the last frustrating formatting issues.

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Chapter 1 . INTRODUCTION

At the request of the National Park Service (NPS) staff from the Research Corporation of the University of Hawai'i (RCUH) and Hawai'i Volcanoes National Park (HAVO) carried out an inventory survey of surface cultural remains. The project took place within Hawai'i Volcanoes National Park, on the Island of Hawai'i (Figure 1.1). The survey took place within the *ahupua'a* (traditional land unit) known as Kealakomo. Kealakomo is located in the district of Puna, on the Island of Hawai'i (TMK #311001007) (Figures 1.2 and 1.3).

The *ahupua'a* of Kealakomo and the project areas are within the 129,665-acre Puna-Ka'ū National Register District (Site 50-10-62-5503, henceforth referred to as Site 5503) (Figure 1.3). This area was determined historically significant and was nominated to the National Register on July 1, 1974 under Criteria "D" of The National Register of Historic Places Criteria for Evaluation. Criteria "D" indicates that lands within the district "have yielded or may be likely to yield, information important in prehistory or history."

The National Park Service is always seeking ways to better the experience of visitors and to expose them to the wonders of the natural and cultural landscape. Few areas within the park are actively interpreted for their archeological resources since the losss of Wahaula and other coastal sites in the Kalapana extension in 1988. One of the goals of the Kealakomowaena project was to explore the possibility of opening the site as a new interpretive area for the public. The project area was selected for inventory survey because of its proximity to roads and existing pullouts, and because it is one of the last remnants that has not been covered by historic lava flows within the *ahupua'a*. The balance between science, interpretation and preservation is considered for the Kealakomo *Ahupua'a* New Interpretive Area Survey Project. In Hawai'i Volcanoes National Park (HAVO), a unique situation exists in that what is on the landscape today may not be there tomorrow due to the fact that the park itself is centered upon an active shield volcano. This survey and final report is designed to furnish baseline data to expand the archeological record of the region, offer assessment of the condition of the resources that remain within the designated study area, and provide information that will assist in the development of a preservation plan for the area.

Scope of Work

The *ahupua'a* of Kealakomo is first mentioned in the historic literature in the writing of the Reverend William Ellis in 1823. Ellis traveled through the area on his trip around the island as he looked for locations to build new Protestant churches. Ellis may not have walked through the specific project area, but he did visit the coastal village at Kealakomo and made reference to the upland (*mauka*) fields at Kealakomowaena.

The first archeology in the project area was carried out by Kenneth Emory 1959 (Emory, Cox et al. 1959). Emory surveyed the most prominent structures in the area as part of the Chain of Craters Road extension project. He was followed in 1964 by Collin Smart, who spent three days doing reconnaissance survey of the largest structures and trails within the *ahupua'a*. While most of their time was spent at the coast, the teams did document many of the largest structures within Kealakomowaena.

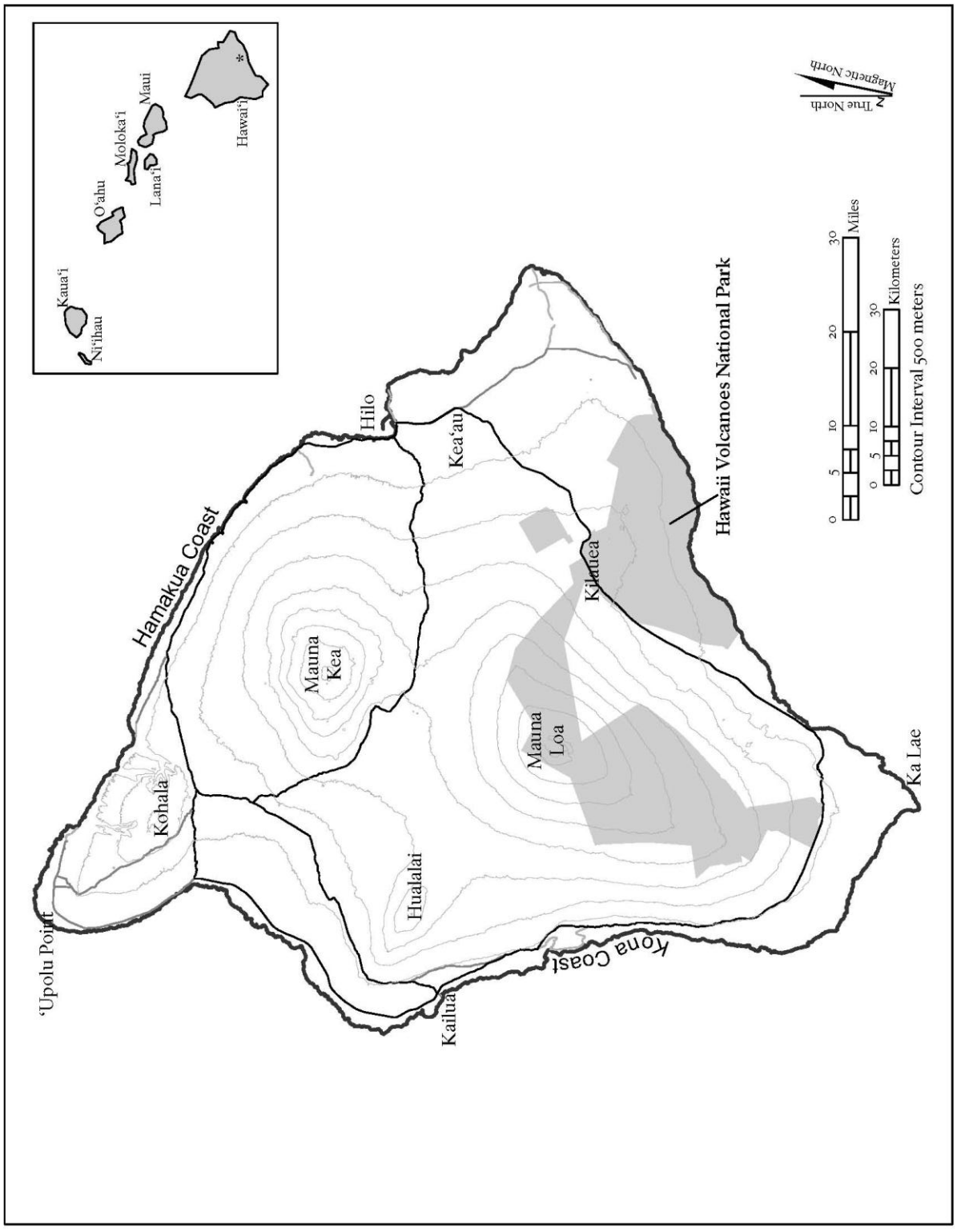

Figure 1.1. Location of Hawai'i Volcanoes National Park.

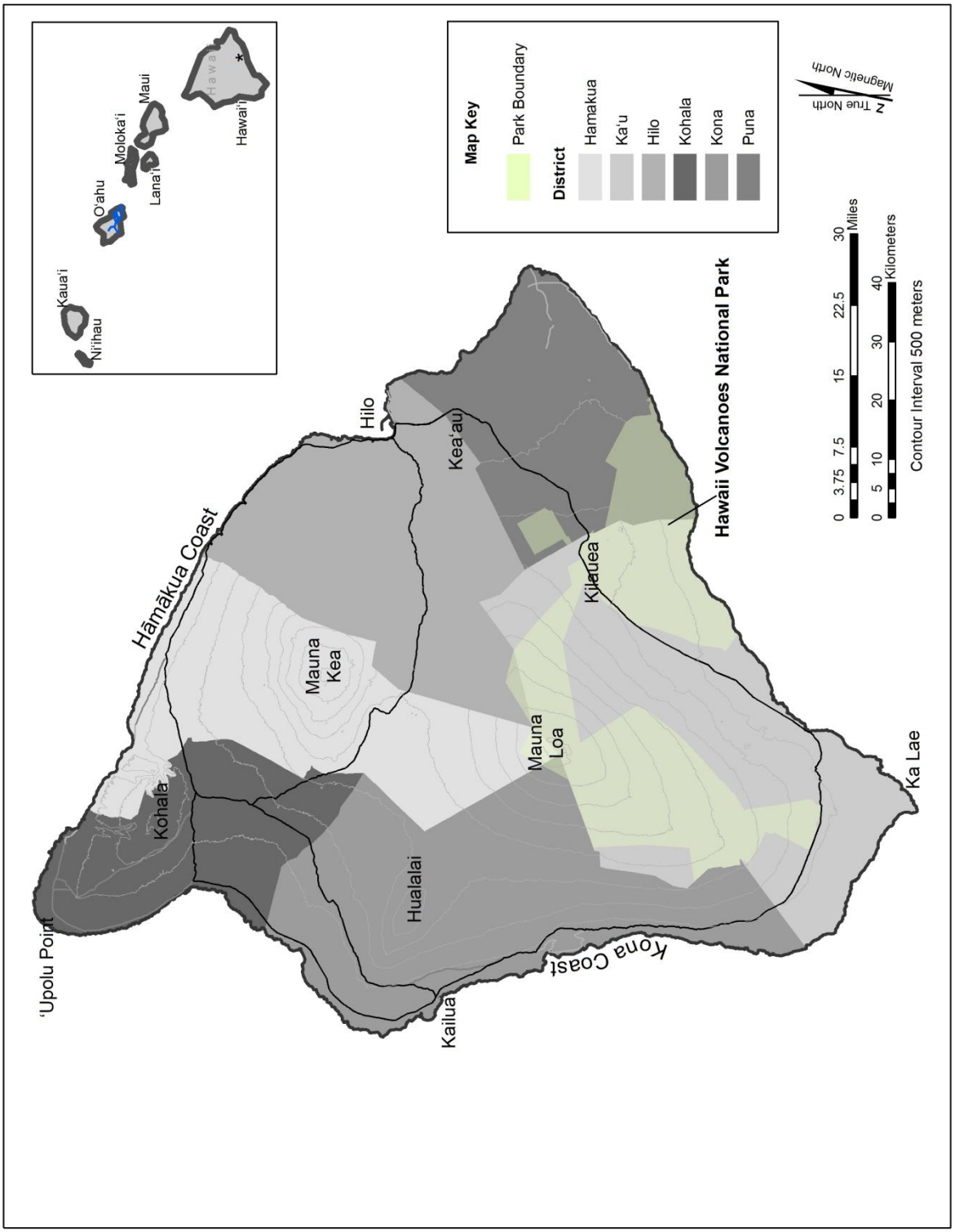

Figure 1.2. Map of Hawai'i Island noting district boundaries.

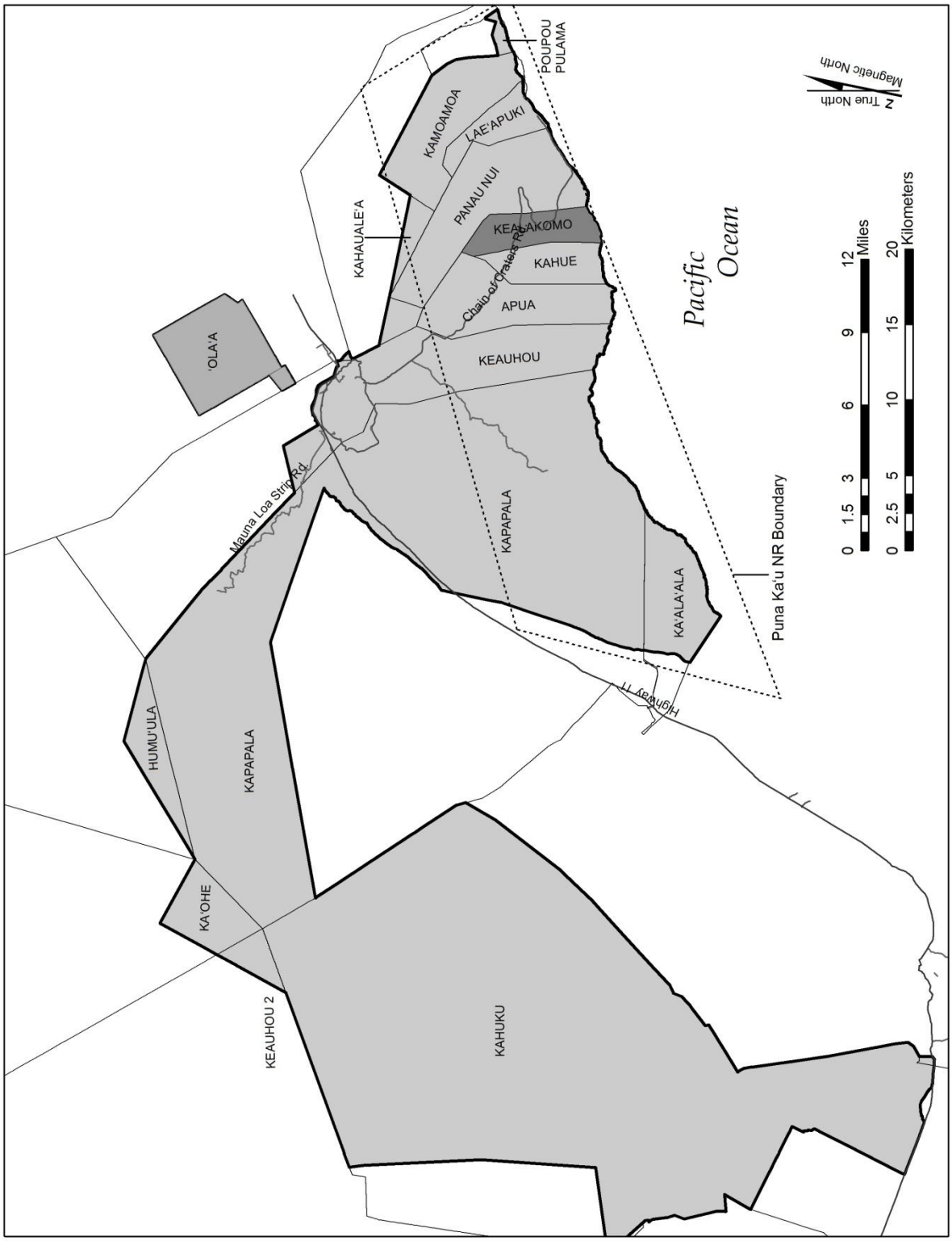

Figure 1.3. *Ahupua'a* boundaries within Hawai'i Volcanoes National Park.

Since Smart's survey, the only additional work done in Kealakomo occurred on its eastern most boundary. Schuster et al. (nd) surveyed a *mauka-makai* (mountain to the sea) transect across the older 400 to 750 year old *ʻaʻā* flow from Kilauea. These projects are discussed in further detail in Chapter 5. The current report documents the most comprehensive and systematic survey of the area to date, and yet large swaths of land and features within the *ahupuaʻa* still remain undocumented.

The Kealakomowaena survey project is broken into two Phases - Phase I and II (Figure 1.4). Phase I began in 1999, when the park decided to do a controlled burn within a *kīpuka* (area of 140 acres) on the west side of the Chain of Craters road within Kealakomo *ahupuaʻa*. The controlled burn was done in response to a request by the vegetation management program to rehabilitate the area and develop experimental plots for native plant taxa.

Several survey transects were established across the *kīpuka* to get a sense of the distribution of sites prior to the burn as well as to document the effects of fire on the archeological features. Following the burn, HAVO archeologists resurveyed the original transects and then expanded the survey area to include a 100% survey of the upper lobes of the *kīpuka*. The lobes were more intensively surveyed in an attempt to identify an area that would be suitable for a new interpretive trail (see Figure 1.5).

In 2002 HAVO CRM expanded the survey of Kealakomo to include a *kīpuka* on the eastern side of the Chain of Craters road (hereafter referred to as the Phase II inventory) (see Figure 1.6). While spatially divided by recent lava flows and the modern Chain of Craters road, the two *kīpuka* are both part of Kealakomowaena.

The goals of the Phase I and II inventories was to expand systematic archeological inventory within Kealakomowaena and to identify suitable areas to develop a new interpretive site primarily for the interpretation of cultural resources.

Photo 1. Photo left Kealakomowaena Phase I kipuka on fire in 1999. Photo right, part of the 1999 fire crew, including Cultural Resource Advisor, Taylor Houston. Photo courtesy of Hawaiʻi Volcanoes National Park.

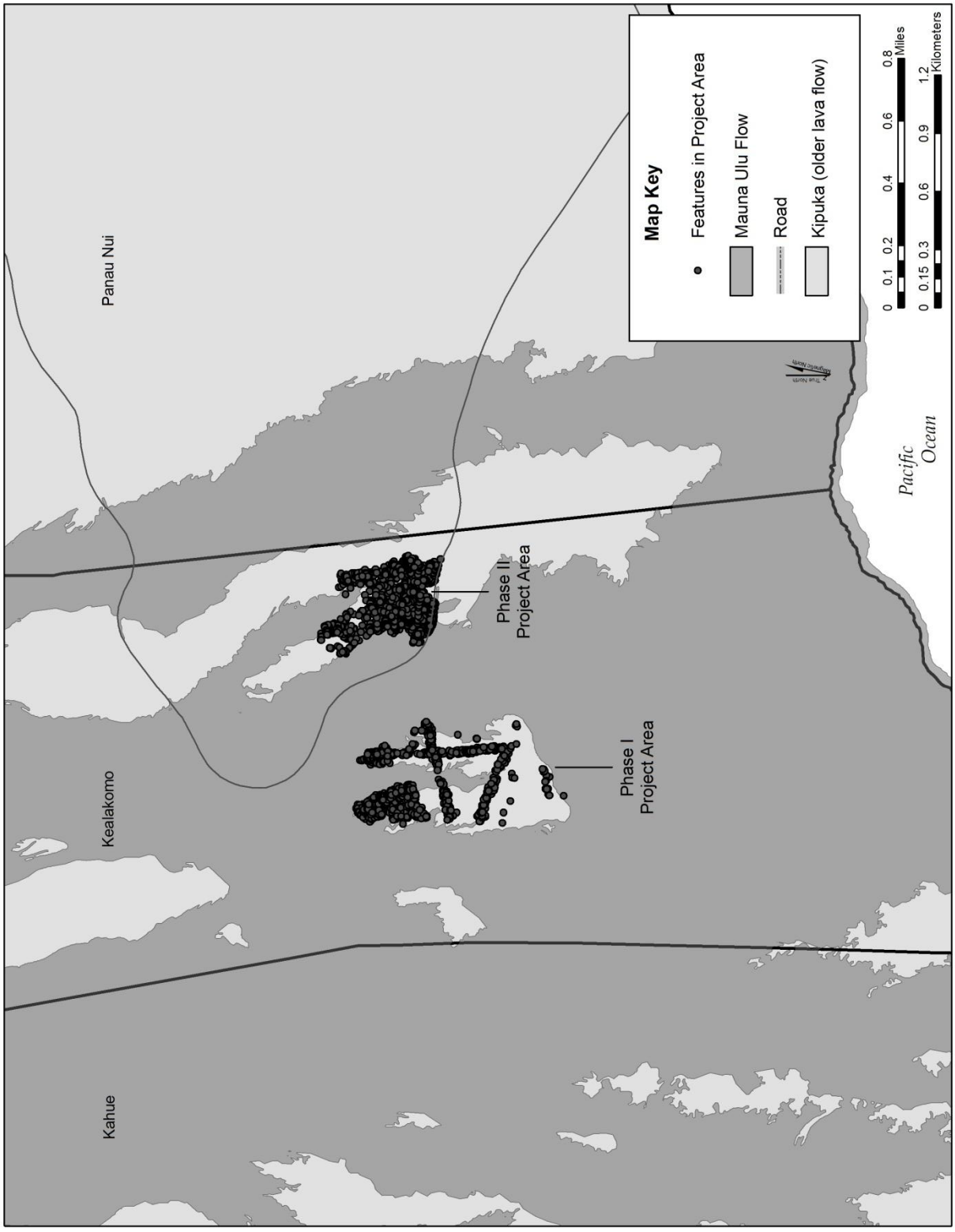

Figure 1.4. Location of Phase I and II survey areas and the historic Mauna Ulu flows.

The location and nature of Kealakomowaena poses a problem for preservation. Located below Holei Pali, this area has been directly impacted by lava flows from rift zones of Kīlauea. The Mauna Ulu flows have covered over 70% of Kealakomo *ahupua'a*. The Mauna Ulu flows undoubtedly covered numerous archeological sites that were never formally documented. Because Kealakomowaena lies on the southern slopes of Kīlauea, there is a continued threat from lava.

The following tasks were determined to satisfy Phase I and II funding requirements by the National Park Service for an adequate inventory of surface and selected subsurface cultural remains in Kealakomowaena:

(1) **review of existing research.** Field notes, maps, published and unpublished manuscripts, ethnographic data and interviews, existing aerial photographs and geologic maps were located and reviewed for relevant data pertaining to the area.

(2) **documentation of all sites in a 140-acre area at an inventory level**. Sites were recorded using a Geographic Positioning System (GPS) unit. Features were documented, plotted on USGS 7.5 minute quadrangle maps, and categorized by formal type. All information was entered into a Geographic Information System (GIS) and linked to a database.

(3) **subsurface testing of structures.** Road Cut Cave (Site 25940), Site 27250 (HV-30) and Site 27258 were examined to determine feature function, age, and to make inferences of feature use and duration of use.

(4) **laboratory analysis of collected materials.** Materials were identified, sorted, and entered onto a computer database. Charcoal samples were submitted for taxa identification and radiocarbon assay.

(5) **report describing procedures and results of the survey, systematic analysis, and test excavations.** This report is an inventory survey level document. Background research covers all existing documentation on the area because no previous work has been done here. The resultant report provides a basic understanding of human use of the area.

Project Summary

The reconnaissance survey for Kealakomowaena occurred sporadically over a nine-year period. Phase I occurred between 1999 and 2001. The second phase of the Kealakomowaena survey project took place between 2002 and 2003. Testing took place in 2006 and 2008. Because of the density of archeological features in Kealakomowaena, the scope of the inventory surveys for both Phase I and II were limited. Intensive survey during Phase I centered on the upper lobes of the western *kīpuka*. The focus of the Phase II survey was to formally record features associated with a well-known cave system known as Road Cut Cave (Site 62-25940). The cave is located within a *kīpuka* on the eastern side of the Chain of Crater road, and it is a prominent

feature very close to the road. Visitors and tours are known to stop at this site. Interpretation of the area may be one means of protecting the site, and provide the public with an opportunity to learn about Hawaiian culture.

An important outcome of the Phase I and II surveys was the discovery and documentation of a nearly continuous spread of archeological structures, trails, and historical artifacts in Kealakomowaena. This project formally recorded a majority of the features within the project area, including agricultural features previously undocumented by Emory and Smart whose survey focused primarily on the largest and most prominent structures.

Survey methods used for both phases were similar. The surviving sites identified by Emory and Smart were first georeferenced using aerial photos and old maps. The sites were then relocated on the ground. Subsequently, north south and east-west transects across the western *kīpuka* were surveyed to identify site distribution. The northern lobes of the western *kīpuka* were then intensively surveyed. Much like the western *kīpuka*, Phase II survey in the eastern *kīpuka* was also limited in scope due to time, funding, and the density of features. Inventory survey was limited to the features closest to Road Cut Cave. Utilizing natural (ʻaʻā lava flows to the east) and artificial (Chain of Craters Road to the west) boundaries, archeologists defined the survey area for the Phase II inventory.

During the archeological surveys, field crews collected Universal Trans Mercator (UTM) coordinate positions of all sites and associated features identified using a Global Positioning System (GPS). Feature forms and descriptive site documentation was done only for the larger structures, they were not done for the smaller and numerous agricultural features although length, width and height of all mounds were recorded. Sketch maps were also done for the larger more prominent sites, but not the mounds, smaller terraces, and rock piles. It was felt that this level of documentation was sufficient for the large project area and allowed for the crews to cover as much ground as possible within a limited time frame; baseline inventory data was obtained and survey methods consistent. Preliminary site function and significance can be assessed using the data collected.

Combined, the Phase I and II field crews identified 189 sites consisting of 3324 individual structures and features. A total of 77 sites (1343 Features) were identified in the western *kīpuka* of Kealakomowaena during the Phase I survey, and 112 sites (1981 Features) were identified in the eastern *kīpuka* during Phase II. A total of 11 isolated artifacts were also recorded. Test excavations were carried out in Road Cut Cave (Site 25940), Site 27205 and Site 27258. The primary purpose of testing was to identify the function of the structures, to collect material for radiocarbon dating, and to reconstruct the past vegetative environment. Archeologists excavated test units in Sites 27205 and 27258 by natural layers, with 5 cm arbitrary levels used. Excavations in Road Cut cave were limited to small probes, controlled by 5 cm arbitrary levels. Natural layers were not utilized as a method of control in Road Cut Cave because the extreme dampness of the site and heavy charcoal concentrations made distinguishing layers nearly impossible. Where natural layers were obvious, such as the discovery of an ash lens, these were noted and excavations proceeded in a traditional manner. All sediments were collected in the field in bulk, and sorted in the lab. Sediment from

Road Cut cave was wet sieved, dried and sorted. Profiles and/or plan views were drawn for all excavated units.

Summary of Field Results

The results of the Phase I and Phase II surveys suggest that numerous clearing and agricultural mounds are spread across the area. Interspersed among these small features are larger structures that were used as habitation sites and possible animal enclosures. Some features were likely multi-functional and were modified throughout the late prehistoric and early historic period. The presence of the cistern at site 27205 and records of an additional cistern mauka of Road Cut Cave at Nā ulu (HV- 176) suggest that the adjacent structures likely contained some kind of roof that functioned as a rainshed to catch water. The water runoff then flowed into the cistern for collection.

The remains of the archeological landscape across Kealakomowaena and what is known about the coastal settlement suggests that a once thriving community was able to survive in what appears to be a barren landscape. At least one major trail system and several smaller trails used during the precontact and post-contact periods cross the region. One long *mauka-makai* wall and shorter segments were recorded during the Phase I survey. Aerial photos taken prior to the Mauna Ulu flows show that additional north/south wall features were also once present in the *ahupua'a*. It is interesting that similar walls were not noted within the western *kīpuka*.

All of the features within the Phase I survey area are constructed on top of a lava flow described by geologists as "p2" (of Kīlauea origin). This Kīlauea flow dates to 1500 to 3000 years ago. Thus, the latest this lava could have flowed through the area was 450 AD - much earlier then when radiocarbon data suggest settlement occurred in this part of Hawai'i Island. The structures identified during the Phase II survey are located on a much younger lava flow. This flow dates to 400 - 750 years old, or 1200 to 1550 AD. Thus, the lava that flowed through the Phase II survey area erupted during a period when people are believed to have moved into this rather remote area of the Puna district. Native vegetation would have been more prevalent within the older western *kīpuka* as were deeper and more widespread ash deposites when Hawaiians first settled in this *ahupua'a*. The ash deposits in the western *kīpuka* may account for the larger, more permanent, structures and more well-defined agricultural features.

The test excavations yielded charcoal sufficient for species identification and radiocarbon dating was obtained for all of the test units and probes excavated in the project area. Dates obtained from these sites suggest that use of Roadcut cave began in the early 15th century (AD 1437-1634). Use of the shelter overhang dates to the mid-seventeenth century (AD 1655-1886) and historic artifacts suggest the use of the hearth at HV-30 dates to the historic period.

Report Organization

In the following chapters the results of the survey and test excavations conducted in Kealakomowaena at Hawai'i Volcanoes National Park are presented. Chapter 2 focuses on the natural history of the project and the Puna-Ka'ū boundary region. In Chapter 3, the rich cultural history of the area is reviewed. In Chapter 4, the impact of changes in

land tenure during the early historic period and early twentieth century National Park Service involvement is discussed. In Chapter 5, previous research carried out in the area is discussed. Chapter 6 summarizes the current project including a discussion of the results from survey and excavation. Chapter 7 includes a discussion of macrobotanical analysis and radiocarbon dating. A review of the various survey and excavation methods and results are included. This report also includes two appendices. Appendix A is a detailed description of all of the sites and features identified in the western *kīpuka*. Appendix B is a detailed description of all of the sites and features identified in the eastern *kīpuka*.

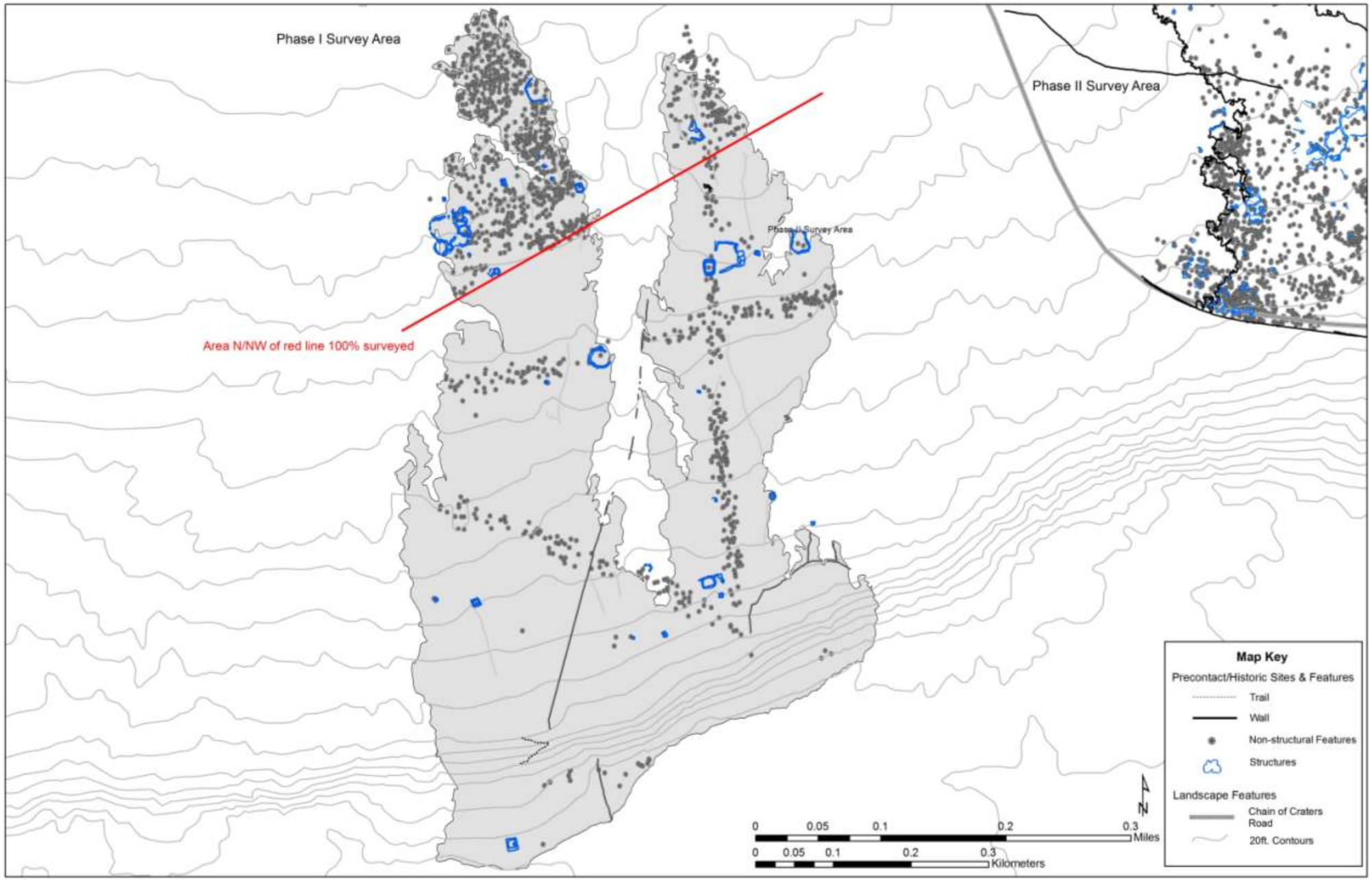

Figure 1.5. Phase I project area and feature distribution.

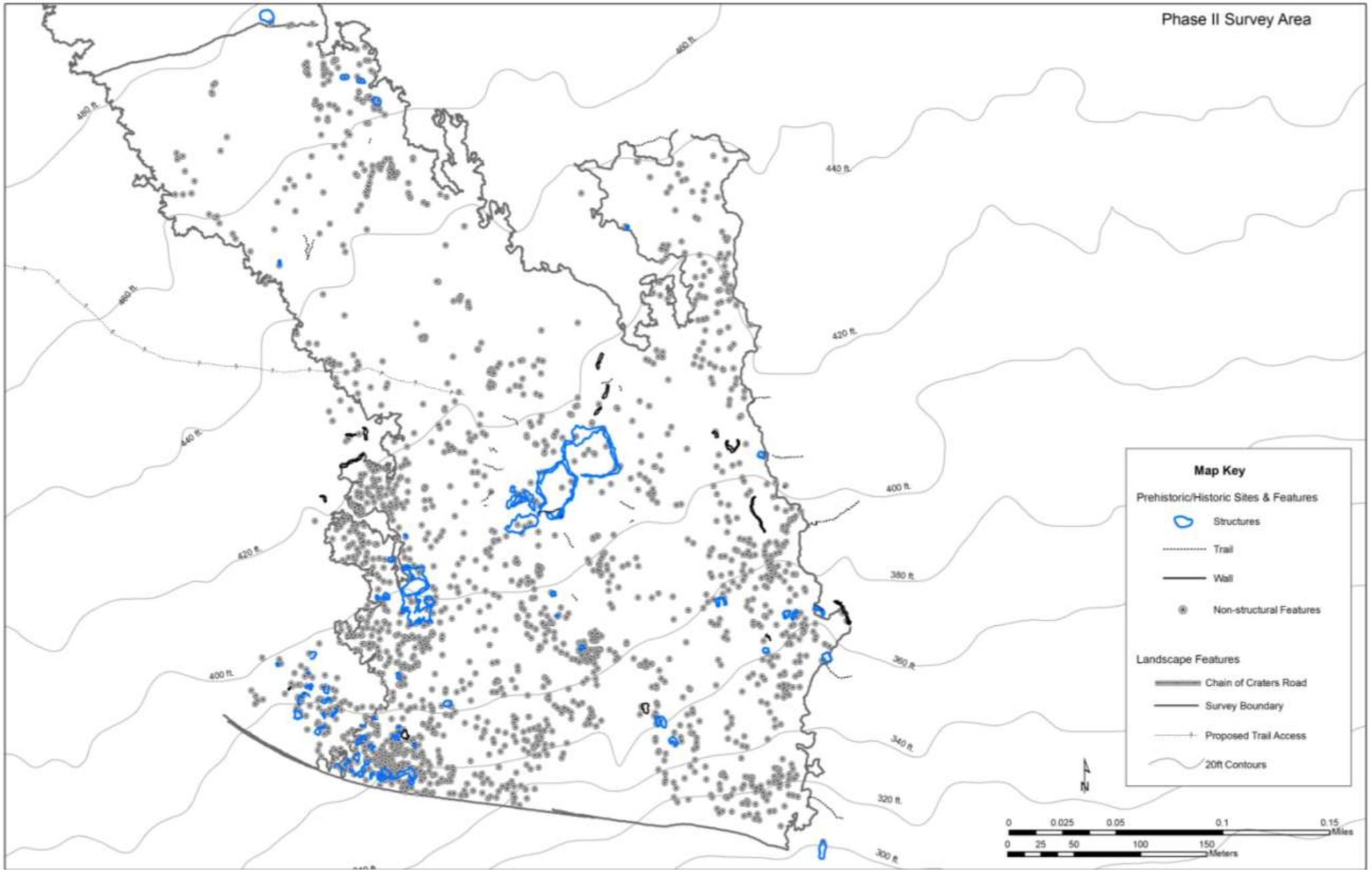

Figure 1.6. Phase II project survey area and feature distribution.

Chapter 2 . NATURAL HISTORY OF THE PROJECT AREA

Lohi'au Puna I ke akua wahine
Puna is retarded by the goddess
(Pukui 1983)

This section of the report focuses on the natural history of the project area and the Puna/Ka'ū boundary region. In this chapter, background information on the landscape in and around Kealakomowaena is presented. The general environment of the Puna/Ka'ū District boundary, including geology, soils, rainfall, and vegetation is presented. This information is important in our understanding of the distribution of sites across the project areas.

Boundaries

Hawai'i Volcanoes National Park spans across 333,086 acres ranging from sea level to the summit of Mauna Loa at 13,677 feet above mean sea level (AMSL) (Figure 1.1). The political boundary of Hawai'i Volcanoes National Park encompass lands of two districts and 13 *ahupua'a* (Figure 1.3). The archaeological survey project which is the focus of this report is situated within the *ahupua'a* of Kealakomo which translates to "the entrance path" in the Hawaiian language. Kealakomo begins along the southeast coast of the island of Hawai'i and extends *mauka* to 2,680 feet along the southern flanks of Kīlauea volcano. Today, Kealakomo is one of the westernmost *ahupua'a* in the Puna District. In the recent past, however, Kealakomo was the Puna *ahupua'a* that bordered the Ka'ū district boundary. At least up until 1856, Āpua was considered to be within the District of Ka'ū, not Puna (Allen 1979). Kahue, now an *ahupua'a*, was once an *'ili kūpono*, or division of Kealakomo (Allen 1979). Thus, Kealakomo could mean the entrance into the District of Ka'ū, or greater Ka'ū. The name Kealakomo could also refer to the entrance into the core realm of Pele, at Kīlauea Caldera. A major trail system may have once tied Kealakomo to the Caldera – Ellis took a route from the rim to the coast at Kealakomo in 1823.

At many locations within the study area, expansive views of the long coastline and the Pacific Ocean to the south are available. The ocean stands only 6890 ft. from the project area and on the first ridge above the coastal flats out of the tsunami zone. Directly north, above the study area, Holei Pali looms large as the backdrop to this setting. This *pali* (cliff) rises above the coastal flats between 340 feet and 485 feet. Holei Pali is a massive fault scarp formed within the Hilina system along the southerly slopes of Kīlauea volcano (Macdonald and Abbot 1970).

The Phase I project area is a 140-acre *kīpuka* completely surrounded by the 1969-1974 flows from Mauna Ulu (see Figures 2.1).The boundaries of the Phase II project area to the west and north are defined by recent *pāhoehoe* flows from the 1972-1974 Mauna Ulu eruption. East of the Phase II project area is an expansive *'a'a* flow (Figure 2.1). While once likely part of the same field and habitation systems, Phase I and II survey areas are now artificially divided by these historic flows and the Chain of Craters road which cuts between them.

Horizontally, the *ahupua'a* is divided into three sections: Kealakomo *makai* -from sea level to approximately 200ft. elevation; Kealakomowaena - from approximately 200ft. elevation to 800ft. elevation; and Kealakomo *uka* - from the 800ft. elevation to 2690ft. elevation. The project area falls within the mid section of the *ahupua'a* at Kealakomowaena**.**

Geology

Pukui's (1983) proverb (*'olelo)* that talks about Puna being "retarded by the goddess" speaks of Pele, the volcano goddess whose lava covers much of the district of Puna. The *'olelo* speaks of the nature of Pele and her active lava flows disrupt the work and progress of the people who live in her wake.

Kīlauea volcano is the youngest and currently the most active of the Hawaiian volcanoes. Over the course of many centuries (between 600 – 1000 years ago), Kīlauea has on occasion erupted explosively, spewing ejecta for miles across the landscape. One such event discharged rocks of up to 1.4 cm in diameter that can be found in the project area (Swanson pers. com. 2001). Such events were similar to the explosive eruption in 1924 at the summit of the volcano and much smaller, but similar explosions in 2008 from Halemaumau. The 1924 eruption provided spectacular viewing as seen in the photo to right.

Photo 2. "No. 267. Same as No. 261, 8:18 a.m. Palmer in foreground. Cloud 11,500 feet high and rising at rate of 15 feet per second." Photo Taken on May 22, 1924. Phtoto from the UH Hilo Library, Stearns Collection, Album 3-1924.

In its current phase, Kīlauea volcano has been in continuous eruption on its east rift at Pu'u O'o from January of 1983 until the present. Many eruptive phases have occurred during the 20th century including summit eruptions, as well as along the southwest and southeast rift zone of Kīlauea. In 2008 another explosive eruptive phase began at the summit. Thus far, it has been mild in comparison to previous events.

Most historic eruptive phases of Kīlauea volcano are more placid than explosive. Typically two types of lava are output - *pāhoehoe* and *'a'ā*. *Pāhoehoe* lava is characterized by smooth, billowy flows while *'a'ā* (also called clinker lava) is stony and sharp.

Photo 3. Fountaining from Mauna Ulu lava flows as seen from the parking lot. Photo courtesy of Hawai'i Volcanoes National Park.

In the Phase I project area, the surface flows which contain archeological features are "p2" Kīlauea *pāhoehoe* flows dating from 1500 to 3000 years ago. This *pāhoehoe* lava flow is gently undulating with ridges, hillocks and tumuli. This is the same flow regime that covers most of Kealakomo (Wolfe and Morris 1996). In the Phase II project area, the surface flows which contain archeological features are Kīlauea flows that date to 400 - 750 years old, or 1200 to 1550 AD.

Historic lava flows from Mauna Ulu that erupted from Kīlauea volcano between 1969 and 1974 (particularly those from the 1972-1974 years) define the northern, eastern and western boundaries of the Phase I and II project areas (see Figure 2.1). These flows erupted from a four kilometer long set of fissures that were centered around a vent between the Alae and Aloi craters. Here, a large parasitic shield called Mauna Ulu was built.

The lava that erupted from these fissures covered an area approximately 50 km^2 (Swanson 1979). A large portion of Kealakomo *ahupua'a* was covered during this eruption including the remains of the ancient coastal village on March 5, 1971. The flow reached the ocean on March 8, 1971 and extended the coast approximately 1312ft. (Swanson 1979). Areas upland from the former coastal village that was left untouched is patchy and discontinuous. These lands that were surrounded but not covered by the Mauna Ulu lava are called *kīpuka* ("an oasis of vegetation surrounded by lava beds"). Within *kīpuka* the older lava flows and associated archeological sites were left mostly untouched. Outside of these kīpuka, the Mauna Ulu flows subsumed numerous archeological features that are now permanently covered (see Chapter 3).

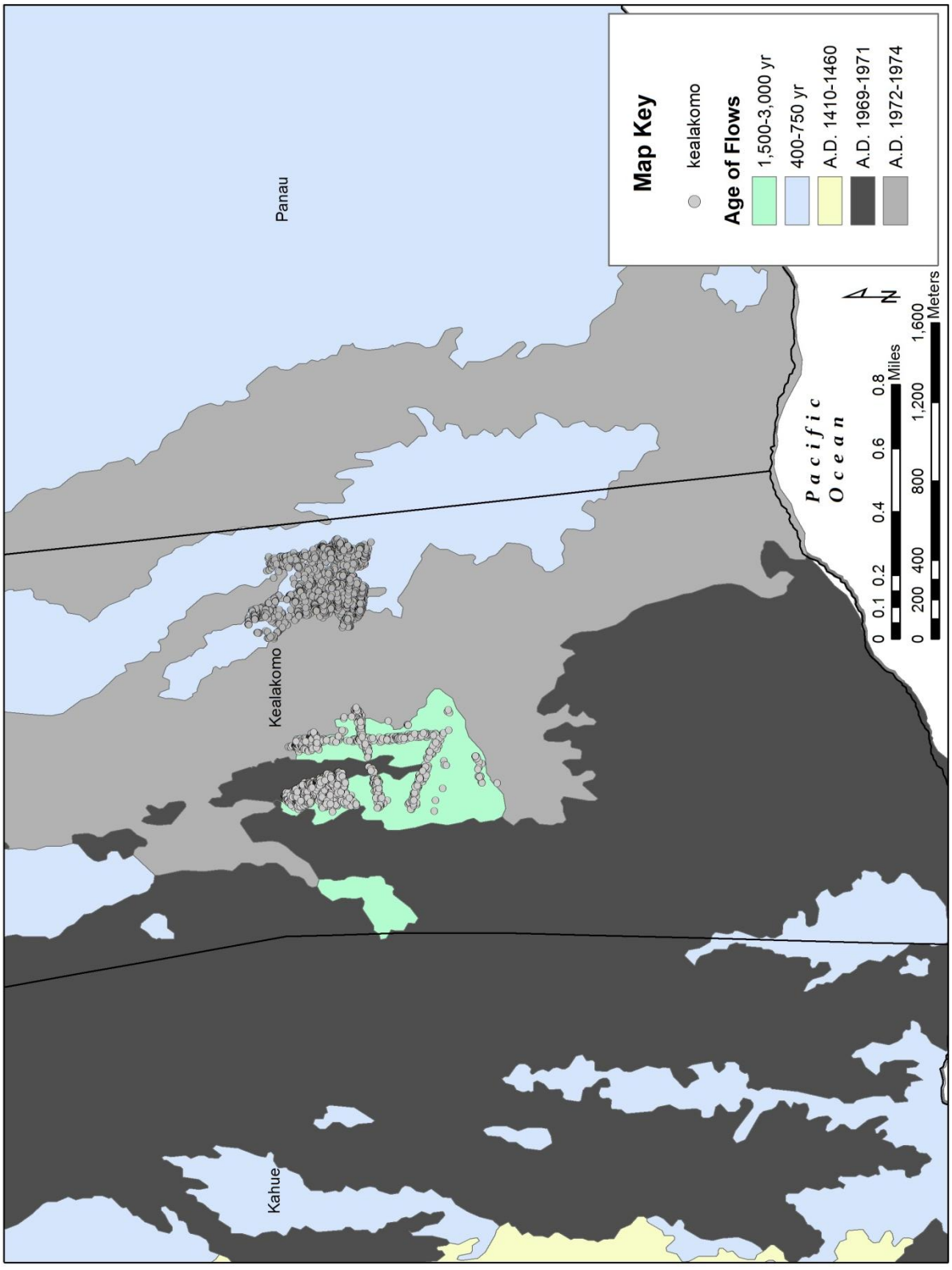

Figure 2.1. Age of surface geology in the project areas.

Soils

Soils are formed through a combination of climate and the actions of living organisms on parent material over time (NRCS 2008). A recent soil survey completed for Hawai'i Volcanoes National Park has resulted in the production of updated maps and descriptions of the soils in the project area (NRCS 2008). The following information has been taken directly from this valuable resource.

The landscape within Hawai'i Volcanoes National Park is very young. The area is dominated by *'a'ā* and *pāheohoe* lava flows. Kīpuka (areas of older lava surrounded by younger flows) also persist, and are generally found in low spots because the younger lava has built up around it. Prior to the younger lava flows encircling it, lands currently within *kīpuka* may have been higher points on the landscape, allowing for the fluid lava to flow around them, filling in what once was the lower spots. Because of the nature of the park's landscape, volcanic ash and cinder deposits from the parent material of soils here, the underlying lava flows contributed very little to soil development. Swanson (pers comm.) has documented the extent of fallout from explosive eruptions from Kilauea. He has developed a map documenting the area covered by tephra from these explosive eruptions that includes the project area (see Figure 2.2). The project area has been impacted by at least three significant explosive events following the circa A.D. 1500 collapse of Kilauea Caldera. Swanson (pers comm.) noted that the Phase I project area ash deposits were much thicker than the Phase II project area. This observation is confirmed by the project director and lead author. These explosive ash-derived deposits would have been the basis for agriculture that was practiced in the area and coincide well with the development of the agricultural fields and the archeological landscape (see chapter 7).

The project area soil type has been classified as *711 – Lava flows – Apuki complex, 2 to 20 percent slopes*. The project area is composed of 50% to 85% *pāheohoe* lava flows, 15% to 55% Apuki soil, and 0% to 10% Kalapana and similar soils. Parent material for the Apuki soil is characterized as "sandy eolian material and basaltic volcanic ash over *pāhoehoe* lava." The Apuki series consists of "very shallow and shallow, somewhat excessively drained soils that formed in basic volcanic ash deposited over basic *pāhoehoe* lava." The depth of the soil ranges from two to 20 inches. The surface layer of the soil is extremely to very strongly acidic, while the subsoil is slightly acidic to neutral. The ability of the soil to hold nutrients is low. The combination of seasonal rainfall, sandy texture and shallow soil depth limits the germination of seedlings to the winter and spring months. A typical profile is as follows:

> C1 – 0 to 0.5 inches; lithochromic black (N 2/0) ashy sand weak or moderate medium platy structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine and fine interstitial pores; extremely acidic (pH 4.3)
>
> C2 – o.5 to 6 inches; lithochromic black (N 2/0) ashy sand; weak fine subangular blocky structure; soft, very friable, non sticky and nonplastic; common very fine and fine roots; many very fine and fine interstitial pores; strongly acidic (pH 5.2);

C3 – 6 to 7 inches; lithrochromic black (10YR 2/1) ashy loamy sand; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; many very fine and fine interstitial pores; neutral (pH 6.6)

2R – 7 inches; hard basaltic *pāhoehoe* bedrock

Climate

On the Island of Hawai'i, the districts of Ka'ū, Kona and Kohala are considered leeward districts while the districts of Puna, Hilo and Hāmākua are thought to be generally windward areas. Windward and leeward areas in Hawai'i are subject to different climatic influences. Typically, windward areas experience greater rainfall as weather systems move in from the northeast following the trade wind pattern. Weather systems are stalled by the high mountains or volcanoes which impede their path, causing precipitation in the windward zone based on the orographic effect. On the other hand, leeward areas are typically dry environments which receive little annual rainfall. The constancy of the trade winds dictates temperature ranges and other environmental factors. When the trade winds die down, the temperature and humidity generally increase.

Kealakomo is located in the windward district of Puna district. However, Kealakomo is very close to the boundary with Ka'ū (a leeward district). The project areas are situated along the southern slopes of Kīlauea volcano. As such, it is situated on the margins of the windward zone of Hawai'i Island. Kealakomo is believed to have a leeward tendency in the lower elevations and a windward tendency in the upper elevations. The Phase I project area is situated between the 140 and 500 ft. elevation. The Phase II project area is situated between the 295 ft. and 492 ft. elevations. Rainfall in these areas range from a median of 40 to 60 inches. On-site rain gauges managed by the HAVO Fire Cache reports 23 to 127 inches a year (see Figure 2.3). Data for the past ten years shows that the area receives its maximum rainfall between the months of October and March (HAVO Fire Cache). The average mean temperature ranges above 72° Fahrenheit in the daylight hours. The rainfall totals and elevation put it within a zone of agricultural potential.

Winds in this area are generally from the north – northeast, with speeds in the 15 to 20 mph. range, with occasional higher gusts. In the winter months winds can be predominantly from the south. Since the beginning of the eruption of Pu'u 'O'o in 1983, the easterly trade winds have periodically inundated the project area with vog. Vog is the result of the emission of sulphur dioxide (SO2) and other gasses from both Pu'u 'O'o vent and the steam plume at the point where the lava is entering the ocean. These emissions react with the atmosphere to produce a blueish, gray haze. This haze has been likened to industrial pollution and is a likely source of both respiratory irritation and acid rain. It affects all plants, animals, and humans that encounter the area. During the winter months when south winds dominate, however, the air in the project area is clear.

Flora

The project areas are situated within plant communities characterized as dry sparse shrubland/grassland. Specifically, the plant communities which dominate the area are Lantana (*Lantana camara*), Natal redtop (*Rhynchelytrum repens*) and Pili (*Heteropogon contortus*). Other plants noted in the project areas during the archeological surveys are identified in Table 2.1.

Not much is known about the pre-Polynesian vegetation within Hawai'i Volcanoes National Park. However, in a 1994 memorandum report by Linda Pratt, then Biological Technician with the National Biological Survey, to Jan Keswick, then HAVO Cultural Resources Specialist, Pratt described what she thought the pre-Hawaiian (hence pre-disturbance) vegetation of Kealakomowaena would likely have been. Pratt writes

> *"this area would likely have been an 'ohi'a or 'ohi'allama (Diospyros sandwicensis) forest with a mixed understory of native trees and shrubs, such as 'alahe'e (Canthium odoratum), naio (Myoporum sandwicensis), sandalwood (Santalum paniculatum), 'akia (Wikstroemia sandwicensis), and 'a'ali'i. Ground cover in such original vegetation would probably have been relatively sparse, but may have included pili grass and native ferns."*

Recently, a slew of carbonized plant materials from archeological excavations were identified from sites within the project area. The most abundant taxa represent the pre- or early-Polynesian plants that were utilized by the local inhabitants that were likely present in the project area or on nearby lands. The plants found in the archeological sites correlate well with historic references to the vegetation communities as well as to botanical surveys done during the historic period. A more detailed discussion of the results including traditional uses of these plants is found in Chapter 6.

The vegetation in a well known Kealakomo site called Nā ulu was described prior to the Mauna Ulu flows which covered most of it. Nā ulu is located north of the current project area. Park naturalists compiled a list of 20 native plants from the Nā ulu Forest in 1966 (Hamilton 1966) (Table 2.2). The village was also known to contain breadfruit and orange trees, halapepe, coconut and kukui (Hamilton and Bright 1963). Nā ulu was the site of a Hawaiian *kauhale* (group of Hawaiian houses) used into the historic period. Many of these taxa were likely planted in the area by the former residents.

Today, the project area is dominated by invasives (see Table 2.1). In the early historic periods this area was quite barren of vegetation, native or otherwise. When Alfred E. Hudson inventoried the area for archeological sites in 1930, he described vegetation as diminishing "progressively from east to west" (Hudson 1932). Westward, he said "there is no vegetation but stunted pili grass and scrub ohia which in turn gradually disappears, leaving nothing but the bare gleaming pahoehoe for ten unbroken miles until the kiawe trees of Keauhou Landing are reached" (Hudson 1932). His description occurred when goats and pigs were roaming largely unchecked throughout the area grazing on whatever could be found giving the area a barren appearance.

Photo 4. Image on topm photo of Kealakomowaena from above. Bottom image of the remnants of Na ulu forest. Photos taken by T. Belfield. Hawai'i Volcanoes National Park.

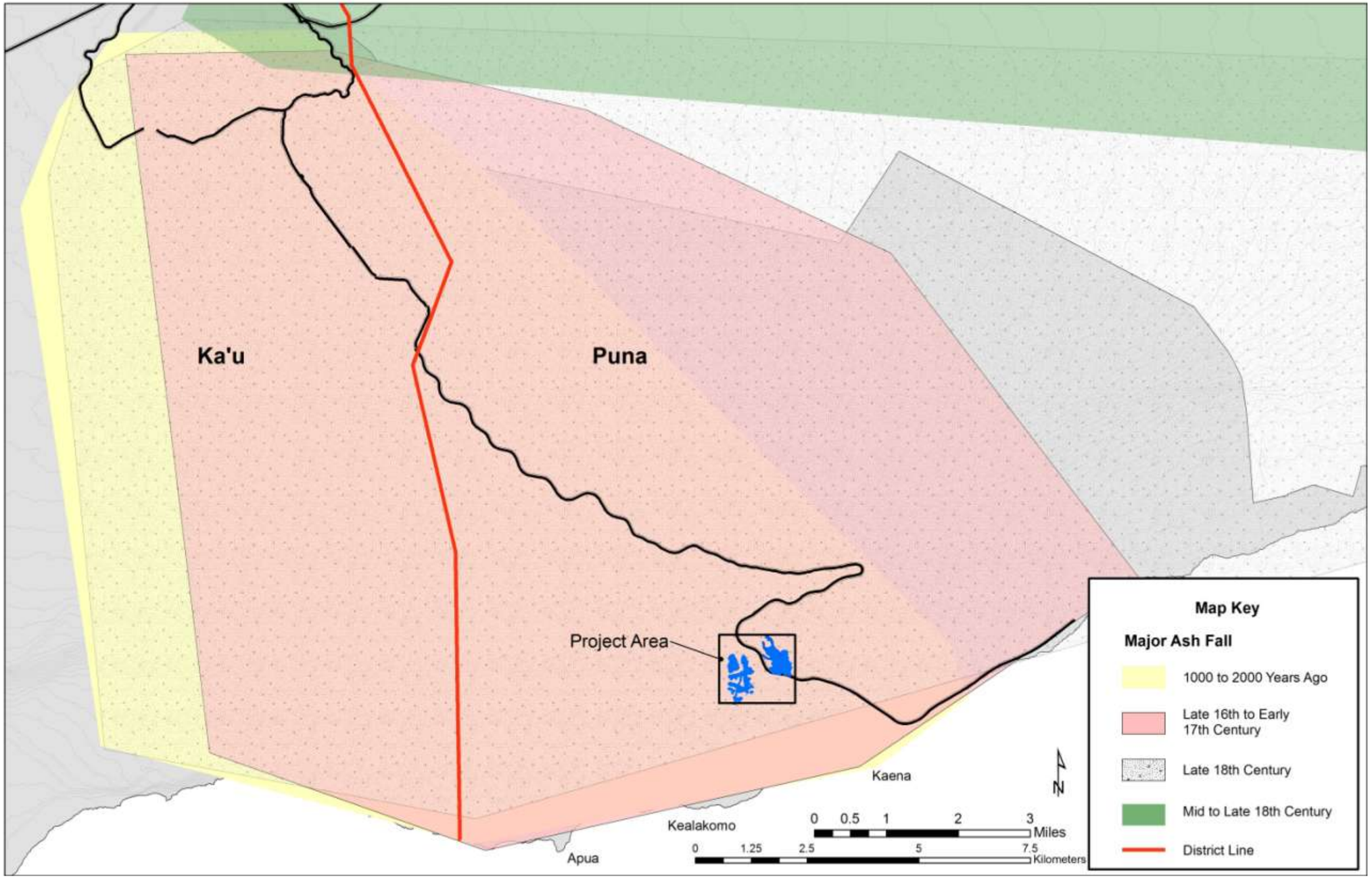

Figure 2.2. Extent of ash fallout as predicted by D. Swanson, HVO.

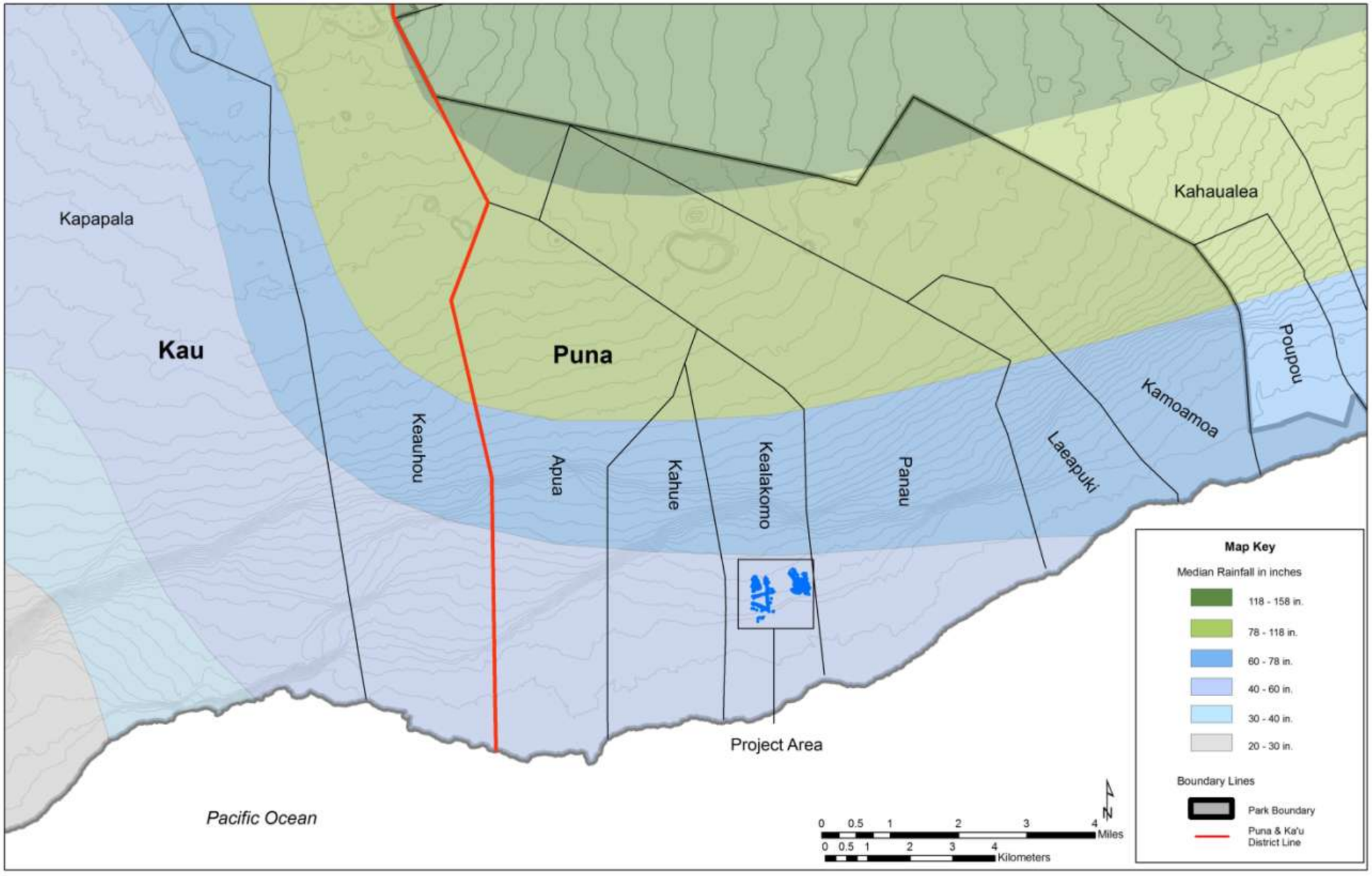

Figure 2.3. Rainfall averages across the Kilauea Section of HAVO.

Table 2.1. Plant taxa noted by archeologists in the project areas in 2000.

	Common Name	Hawaiian Name	Latin Name	Dispersal
Woody Plants				
	Indian mulberry	*Noni*	*Morinda citrifolia*	Polynesian introduction
	Sourbush		*Pluchea odoratum*	Naturalized
	Fleabane		*Pluchea indica*	
	Lantana	*Lankana, la'au kalakala, mikinolia hohono*	*Lantana camara*	Naturalized
	Guava	*Kuawa*	*Psidium guajava*	Naturalized
		'A'a'li'i	*Dodonaea viscose*	Indigenous
		'auhuhu	*Tephrosia purpurea*	
	Christmas Berry	*Wilelaiki*	*Schinus terebinthifolius*	
	Air plant	*'oliwa ku kahakai*	*Kalanchoe pinnata*	
			Crotolaria assamica	Naturalized
			Crotolaria sp.	
	Ohia	*ohi'a lehua*	*Metrosideros polymorpha*	Endemic
	Koa haole		*Leucaena leucocephala*	Naturalized
Ferns, Herbs and Weeds				
	Morning glory	*koali, koani*	*Ipomoea sp.*	Indigenous
	Sword fern	general name Kupukupu	*Nephrolepis (multiflora)*	Naturalized
	Three-flowered beggarweed		*Desmodium triflorum*	
		Laua'e	*Microsporium scolopendria*	Naturalized
	Sword fern	*Kupukupu*	*Nephrolepis exaltata*	
	Passion fruit		*Passiflora sp. (foetida)*	
	Indigo	*iniko, kolu*	*Indigo suffruticosa*	Naturalized
			Peperomia blanda	
		'Ilima	*Sida fallax*	
	Thimble berry	*Ola'a*	*Rubus rosifolius*	Naturalized
	Partridge pea	*laukī*	*Chamaecrista nictitans (L)*	Naturalized
	Waltheria	*'uhaloa*	*Waltheria indica*	
Grasses				
	Molasses grass		*Melinis minutiflora*	Naturalized
	Natal Red Top		*Rhynchelytrum repens*	Naturalized
		Pili	*Heteropogon contortus*	
			Bulbostylis capillaries	

Table 2.2. List of plant taxa identified at Nā'ulu.

Hawaiian Name	Latin Name	Frequency	Dispersal
Kauila	Alphitonia ponderosa	Frequent	Endemic
Kukui	Aleurites moluccana	Frequent on slopes	Indigenous
Ha'a or Mehame	Antidesma pulvinatum [platyphyllum]	Infrequent	Endemic
'Ahakea	Bobea timonioides	Frequent	Endemic
Alahe'e	Canthium [Psydrax] odoratum	Abundant	Indigenous
Lama	Diospyros ferrea var. sandwicensis and var. pubescens	Frequent	Endemic
Hala pepe	Pleomele aurea	Scarce	Endemic
A'ali'i	Dodonaea viscosa var. spathulata	Infrequent to locally frequent	Indigenous
Manono	Gouldia terminalis var. antiqua [Heydotis fosbergii]	Frequent only at upper levels	Endemic
'Ōhi'a Lehua	Metrosideros collina var. polymorpha	Frequent	Endemic
Kōlea lau nui	Myrsine lessertiana	Locally abundant	Endemic
Kōlea	Myrsine lanaiensis	Infrequent	Endemic
Naio	Myoporum sandwicense	Frequent	Indigenous
Kōlea lau li'ī	Myrsine sandwicensis	Frequent	Endemic
Alani	Pelea pickeringii [Melicope adscendens]	Infrequent	Endemic
Hao	Rauvolfia remotiflora [sandwicensis]	Infrequent	Endemic
Kōpiko 'ula	Straussia hawaiiensis [Psychotria sp.]	Frequent	Endemic
'Ohe	Tetraplasandra hawaiiensis	Frequent	Endemic
Maua	Xylosma hawaiiensis var. Hillebrandii	Infrequent to frequent	Endemic
Kulu'ī	Nototrichium sandwicense	Rare	Endemic

Subsistence Zones
Despite the outward appearance of a barren landscape during the early historic period, the archeological landscape suggests that populations found the area habitable. Tuggle and Tomonari-Tuggle (2008) describe four zones of subsistence within the boundaries of Hawai'i Volcanoes National Park. These include a coastal zone where food products could be collected in the littoral zone and near-shore fishing was possible, an agricultural zone, an upland wet forest zone for plant collection, and an alpine zone for collection of nesting seabirds. Within these areas are also resources that can be used for tools, house construction, medicine and ornaments.

The following description of the subsistence zones found within Kealakomo as described by Tuggle and Tomonari-Tuggle (2008)

> *I. Littoral collectables and inshore and near-shore fish. These are predominantly rocky or cliff shorelines, with mollusks, crustaceans, shore-dwelling birds, coastal plants, and fish. There are no significant reefs on the HAVO coastline, which drops off quickly; there are no places suitable for construction of fishponds; there are no large dune formations; there is no surface running water, although there may be submarine springs; locations suitable for easy canoe landings are limited; locations suitable for surfing are limited (primarily 'Āpua and Halapē).*
>
> *II. Lowland dryland resource zone. This is a region of low rainfall (generally under 25 inches annually), unsuitable for most cultivation, but which supports dryland forest when volcanism allows maturation; these forests have usable wood, medicinal plants, and support bird life. However, the active volcanism in the HAVO has limited this form of forest development.*
>
> *III. Zone of agricultural potential. This includes areas with over 25 inches of annual rainfall and below an elevation of about 2000 ft asl. These are the effective limiting conditions for primary Hawaiian cultigens, sweet potato and taro.*
>
> *IV. Wet forest resource zone. The wet forests in the HAVO area are generally above 2000 ft elevation, in areas that receive high rainfall. These are generally dense forests dominated by 'ōhi'a (with some koa and olapa), but with a great range of other trees, as well as ferns and shrubs. Lower areas have the potential for some small areas of cultivation of taro and banana, but in general they provide a great resource zone for wood, medicinal plants, fiber and bark, as well as being the major region for birds with prized feathers* (Tuggle and Tomonari-Tuggle 2008).

Fauna
Native fauna from which subsistence could be depended on was limited for Hawaiian colonizers. The littoral, inshore, and deep sea zones provided an abundance of protein from the sea. On land, however, Hawaiians had only seabirds (albeit abundant early on) to subsist on. Native land mammals are limited to one native species, the Hawaiian

hoary bat (*Lasiurus Cinereus Semotus*). There is no evidence that it was a part of the Native Hawaiian diet. Polynesian colonizers introduced dog (*Canis familiaris*), chicken (*Gallus gallus*) and pig (*Sus scrofa*) to Hawai'i, all of which were part of the traditional Hawaiian culture and diet. Other introduced fauna that was not subsisted on was the rat (*Rattus exulans*) which is believed to have been accidentally introduced by Polynesians as stowaways on their canoes. Other small mammals including the small Indian mongoose (*Herpestes auropunctatus*), two additional rat taxa (*Rattus norvegicus, Rattus rattus*), other rodents, and feral cats (*Felis catus*) were introduced after 1778 in the post-contact period (Tomich 1986). In 1793, Captain Vancouver introduced cattle (*Bos taurus*), from Mission San Carlos in California (on his second voyage to Hawai'i) as a gift to the *ali'i nui* (ruling chief), Kamehameha I. A *kapu* was placed on this species by the king in 1794 and was not lifted until 1830. The intent of the *kapu* (forbidding law) was to allow for time to propagate a herd and establish a livestock population (Henke 1929). During this *kapu* and after it was lifted, wild herds of cattle roamed the island damaging residences, destroying agricultural crops, and heavily impacting the natural vegetation (Tomich 1986).

Like cattle, domestic goats (*Capra hircus*) were also introduced very early to Hawai'i (Tomich 1986). Vancouver delivered two ewes and a ram from California to Kealakekua for Kamehameha and requested a 10-year *kapu* to be placed on this species as well (Henke 1929). Hawaiians took easily to goat ranching, which they adopted and turned into an industry. The sale of goat hides became a source of cash for Hawaiians who were thrust into a western style market economy. Once goats became feral and their herds large and uncontrolled, they began to negatively affect small communities on Hawai'i Island including those within Kealakomo.

Wild goats and cattle began to seriously degrade the native landscape. They also impacted the cultural landscape as well by eating food crops and trampling walls. As a response to conservation and economical issues, goat ranching developed in western Puna at least as early as the 1860s within the *ahupua'a* of Pānauiki, Lae'apuki and Kamoamoa. In a letter to the Kingdom's land agent, Phillip Hafner wrote:

> *"I own the adjoining land of Laeapuki, and had since the beginning more or less trouble with my goats; because the flock of Kamoamoa, owned by half a dozen natives, and not taken care of, trespasses every now and then on my land. On such an opportunity it happens nearly everytime, that some of my stray goats with young ones, are led of [sic], and - generally I do not get them back again… "*
>
> *(Interior Dept. Lands 1862)*

As late as November 1947, the presence of feral ungulates was documented within Kealakomo. As noted by Hawai'i National Park Ranger Clifton J. Davis in a Memorandum to the Superintendent dated November 21, 1947: Enroute seven wild donkeys and seven horses were seen.

> *"At the Kealakomo boundary we left the Puna trail, traveling in a north easterly direction and ascending the first pali on the old Kealakomo trail… Shortly before reaching Naulu an old dwelling site and a water cistern were seen. An ancient trail from here took us to Naulu where we*

saw a large herd of goats. These animals were not particularly alarmed, and although we got close to them our attempted control wasn't very successful, due mostly to the trees in this area….Sixty five goats were destroyed on this trip" (Davis 1947).

Tax records for Kealakomo in 1859 and 1869 listed horses, mules and dogs within the *ahupua'a*. HAVO records suggest that horses and mules roamed free in this area at least up to 1947. Prior to the acquisition of the project area by the Park Service, the Territory of Hawaii had been engaged in efforts to control the wild goat problem. Once the Park Service acquired the land, the Service continued efforts to remove goats utilizing several methods to varying degrees of success. By the early 1980's Hawai'i Volcanoes was declared virtually goat free (Bonsey no date). By this time, however, the damage had been done to the native landscape in many areas, leaving an open road for invasives to enter and dominate.

Photo 5. Photo top left. Herd of goats in Hawai'i Volcanoes National Park before eradication efforts were completed.

Photo bottom left. Degraded park landscape as a result of intensive browsing by ungulates. Photos courtesy of Hawai'i Volcanoes National Park.

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Chapter 3 . CULTURAL HISTORY OF THE PROJECT AREA

He nani wale no o Puna mai ʻo a ʻo
There is only beauty from one end of Puna to the other
(Pukui 1983)

In this chapter myths and legends associated with the district of Puna are discussed. Background information on Hawaiian colonization, social and political structure, and the precontact and early historic use of Kealakomo is presented. This information is key to understanding Kealakomo, its people, and how they lived and how their lives are expressed on the landscape. All of this information will be used in the subsequent analysis of site data and feature patterning in the project area.

Colonization

The first colonizers to arrive in the Hawaiian Islands were no different from the families they left behind in Polynesia. They brought with them the same cultural template of beliefs, and styles for building houses, fields, and temples. They also transported with them key cultigens, pigs, dogs, the knowledge to reproduce their material culture, and a rat or two. Initial settlement of Hawai'i was likely based from Central East Polynesia (Marquesas, Society and Cook Islands) (Kirch 1986). Colonization may have occurred in the centuries around AD 500 although this is still a topic of debate amongst scholars (Kirch 1986; Hunt and Holson 1991; Dye and Komori 1992a; Spriggs and Anderson 1993; Graves and Addison 1995). Having carried with them a cultural template from their Polynesian homeland, they established a religious and sociopolitical system that was soon to evolve into a uniquely Hawaiian culture.

Based on stylistic similarities of fish hooks and linguistic evidence, it is believed that two-way voyaging existed between Hawai'i and other islands in Polynesia, but that this type of contact diminished over time (Kamakau 1991). Archeologists disagree on the frequency of these voyages and when it may have ceased. They do agree, however, that two-way voyaging had long stopped by the time of European contact in 1778 (Abad 2000).

By 1778 Hawaiian canoes had evolved to vessels that were suited only to coastal or in-shore fishing or travel and were not able to complete open-ocean navigation. By the time two-way traveling had ceased, and Hawai'i had been isolated from the rest of Polynesia, Hawaiian society had significantly changed and evolved into what is distinctively known as the Hawaiian culture.

Adaptation/ Social Development

Polynesian colonization of Hawai'i was aided in the availability of certain critical resources such as water, natural vegetation, lithic sources, and marine resources, in addition to suitable habitats. To adapt to the environmental hazards of catastrophic weather and geologic conditions, Polynesian colonizers were able to harmonize traditional and adaptive fishing, agricultural techniques, and the means for supplementing the resource base found in Hawai'i with the plants and animals they introduced.

Adaptation to this new land led to a highly stratified social structure by the time Europeans discovered Hawai'i. This tri-part system consisted of the gods, the *ali'i* (chiefs), and *maka'ainana* (commoners). At the top of the triangle were the gods and religion which was pervasive in every single aspect of society. The *ali'i* managed society on behalf of the gods and the *maka'ainana* were the laborers who produced what society needed (Abad 2000).

The maka'ainana grew staple crops such as taro in the windward areas and parts of the drier leeward districts where the soil and rainfall were sufficient for these crops to survive. In the very driest leeward areas such as Kona, Ka'ū and parts of Puna, sweet potato, yams and breadfruit were the dominant starch crop. The archeological signatures of these crops remain across the landscape in the form of low rock walls, mounds, and pits.

The environment provided Hawaiians with a plethora of resources and they opportunistically altered the natural environment and shaped it into a cultural landscape. Because of the variety of niches and ecosystems, however, not all areas of the islands could produce the food and material items that were needed to subsist. Thus, the *maka'ainana* would pool their resources within extended families to provide for their needs. Engaging in a system of reciprocity, exchange occurred between people who regularly interacted with one another, especially *'ohana* (family) members.

Division of Land – The *Ahupua'a* System

Working together, the *'ohana* (family) were able to provide for the material needs within their own communities as well as the needs of the *ali'i*, especially those of the highest rank. In exchange, the *ali'i* provided organization and management within a land system called the *ahupua'a*. *Ahupua'a* were organized into larger districts, the boundaries of which on Hawai'i Island are believed to date back to circa A.D. 1475 when there were six districts, of which Puna was one (Tomonari-Tuggle and Slocumb 2000).

In theory, the *ahupua'a* was a self-sufficient territory that crosscut the ecological zones of an island (thereby incorporating key resource zones) from the mountain to the shoreline. The open ocean fell under no one's jurisdiction. *Ahupua'a* were chiefly estates often redistributed by the ruling paramount to lesser chiefs or loyal supporters. Redistribution of *ahupua'a* often followed the successful conclusion of a war of conquest. The *ahupua'a* was managed for the chiefs by the *konohiki* (landlords) (Abad 2000).

Ahupua'a followed chiefly designated boundary markers. Landscape features such as ridge tops, caves, or *pu'u* (hill) were common markers on the landscape. Other man-made features such as mounds, or structures like heiau or shrines may have also served as key markers on the landscape (Abad 2000).

Kealakomo, the ahupua'a in which the project area lies, is one of eight *ahupua'a* within the district of Puna (see Figure 1.3). In the June 7, 1848 Act that divided up the Crown and Government lands Kealakomo is listed amongst the other *ahupua'a* in Puna that was assigned to the Government, but it was referred to as "Kealakomo me

Kilauea." This may loosely translate to "Kealakomo with Kilauea," or may have been mis-transcribed and it was meant to be written "ma" meaning "Kealakomo at Kilauea" (Bobby Camara pers. comm. 2010). Whichever translation it may be, Kealakomo is the only *ahupua'a* in either Puna or Ka'ū that is directly tied in name to the Caldera, thus affording it some significance to an area considered to be sacred by many Native Hawaiians.

To the immediate west of Kealakomo is Kahue. In the early boundary commission testimony Kahue is referred to as an *'ili kūpono* (land division that is independent of the ahupua'a in which it is situated) of Kealakomo. Today, for unexplained reasons, it has been classified as an independent *ahupua'a* (Allen 1979). Bordering Kahue on its west is the *ahupua'a* of Apua. In the original division of lands in 1848 Apua was listed as being Crown lands, and it was noted as part of the district of Ka'ū. This would make Kealakomo as the border lands between Puna and Ka'ū. To the east and north of Kealakomo is the *ahupua'a* of Pānau. To the south of Kealakomo is the vast expanse of the Pacific Ocean.

As the example of Kahue illustrates, the *ahupua'a* boundaries in Puna may not have always been so divided. Emory, Cox et al. (1959) write "Ellis in his account of 1823 (see map) gives all the names on present maps except Kahue, as follows: Pulama, Kamoamoa, Laepuki (Lae'a-puki), Punau (Panau), Karakomo, Apua. Since Ellis' time the ahupua'a seem to have undergone some subdivisions. The section Pulama… divided into Pulama and Poupou, and Lae'apuki into Lae'apuki and Panua-iki, or Panau into Panau-nui and Panau-iki. As previously stated, Kealakomo was also subdivided creating Kahue. These subdivisions were in existence in the 1850's as evidenced by the land deeds."

Production/*Ahupua'a* System

The *maka'ainana* across the islands, and within Kealakomo, cultivated their land to produce food necessary to sustain those who lived there. Because Kealakomo is within the active lava zone of Kīlauea, the soil is not well developed, and much of the land is arid. While there was agricultural potential for the *maka'āinana* to engage in, the zone for cultivation was small, and at the low end of productivity (Tuggle and Tomonari-Tuggle 2008). Farming in Kealakomo was limited to dryland agriculture utilizing methods of production that were not dependent on deep soils but relied on mulch.

Those who worked the land lived in *'ohana*, or extended family units. These family units were assigned divisions of the ahupua'a called *'ili 'āina,* smaller units called *mo'o 'āina* or even smaller sections called *pauku'āina*. The *'ohana* remained connected to these lands for generations even if those who ruled over the land changed. In the classic situation, *'ohana* members who lived inland focused on agriculture while those members who lived near the coast acquired fish and other marine resources. Between these *'ohana*, groups members would share their resources, help each other build new houses and canoes and participate in larger community projects such as building new heiau and fishponds (Abad 2000). Ellis' description of activity at Kealakomo suggests that the *'ohana* model was in-tact in 1823. While at the coast, Ellis was promised pigs and sweet potatoes by the village chief who's farm was further inland, suggesting these farms helped support families living at the coast (Ellis 2004).

The *ali'i* tightly controlled the labor pool for large-scale projects, and they also controlled the redistribution of some resources. Certain critical items such as the fine-grained basalt, volcanic glass, large trees used for canoe building, and fiber for cordage plants were not evenly distributed across the ahupua'a. Thus, they were tightly controlled by the *ali'i.* Kealakomo likely had few of these critical resources, except for maybe cordage plants. It did have access to the sea, however, and salt and dried fish became a key trade item for *'ohana* in the late prehistoric and early historic period. The nearest *ahupua'a*, Kapāpala, held many of these key resources including large canoe trees, volcanic glass, and fine-grained basalt used for making adze. It is likely that trade of these key resources occurred between ohana from Kealakomo and Kapāpala. An adze found within Kealakomo at Site 27248, was sourced to a basalt quarry (Site 50-10-52-23647) located on the north rim of Kilauea Caldera in the *ili* of Keauhou, *ahupua'a* of Kapāpala.

Puna A Wahi Pana

Those who lived within the district of Puna lived on sacred land. Kilauea, located in the district of Ka'ū is often cited as a Wahi Pana, (McGregor 2007) argues that the entire district of Puna is also a Wahi Pana - all part of the domain of Pelehonuamea. The district of Puna stretches from Mawae on the northern boundary of Hilo south to Oki'okiaho on the southern boundary of Ka'ū. The district is so large, (311,754 acres) that almost the entire island of Kauai can fit into it (McGregor 2007). The lands of Puna came under the greatest influence of Pele. Ninety percent of the district has been covered by volcanic lava flows from the period of Hawaiian colonization and settlement (see Figure 3.1).

Puna's significance as a Wahi Pana is also enhanced by its geographical location. It is the easternmost district in the Hawaiian Islands. Therefore, it is in Puna, at Cape Kumukahi, that every day in Hawai'i begins. Mary Kawena Pukui (Pukui 1983) writes "*Mai ka hikina a ka la I Kumukahi a ka welona a ka la I Lehua* - from the rising of the sun at Kumukahi to the fading of the sunlight at Lehua" (McGregor 2007). Its geographic position also means that it is the first area to receive the northeast tradewinds, and the rains within them. The "name Puna means wellspring and derives from observations by Native Hawaiian ancestors of how the forests of Puna attract the clouds to drench the district with its many rains" (McGregor 2007). (Pukui 1983) writes "*Ka ua moaniani lehu o Puna* -the rain that brings the fragrance of the lehua of Puna." This proverb speaks to the importance of the lehua flower, and by extension the ohia tree, from which is derives. The ohia tree is a important part of the Hawaiian culture because it is a primary component of the upland forest, the *wao akua*, or the realm of the gods. Ohia is an important tree because it is the primary tree to attract water – water, which is the essence of life for the Hawaiian people (K. Awong, pers. comm. 2009). Water flows from the forests, down to the *wao kanaka*, the realm of man "where it sustained agriculture, aquaculture, and other human activities" (Buck 2003).

Ohia was held to such high esteem by Hawaiians that it was the tree used for carving images of their gods. A proverb written down by Mary Kawena Pukui (Pukui 1983) speaks of the dominance, and hence importance of ohia in Kealakomo. She writes "*Ka 'ohi'a hihipe'a o Kealakomo -the entwining 'ohi'a branches of Kealakomo. Kealakomo*

in Puna, Hawai'i, where 'ohi'a trees grow thickly together." If, as this proverb relates, Kealakomo was once plentiful with ohia, then rain may have also been more abundant, enriching both the native vegetation and plantations that once spread across the landscape.

'Aina I ka houpo o Kane - Land on the bosom of Kane, Puna, Hawai'i." It is said that before Pele migrated to Hawai'i from Kahiki, no place in the islands was more beautiful than Puna (Pukui 1983). McGregor (2007) writes that the waters of Puna originate with the god Kane, the deity of freshwater sources. Kane's domain is in the east, where the sun rises, and where he is the guardian of the Pelehonuamea clan. Kane "protects the subsurface waters, the main source of the volcanic steam that forms the bloodstream of the volcano deity, Pelehonuamea" (McGregor 2007). The subsurface waters also sustained the Hawaiian people who collected it in underground caves. These waters were especially critical to sustain life in Kealakomo, where no surface streams ran.

Photo 6. Photo left, ohia lehua flower. Photo right, adze foud in project area. Source of stone is Kīlauea Volcano. Both photos respresent available resources in the ahupua'a of Kealakomo. Photo courtesy of Hawai'i Volcanoes National Park.

<u>Puna A Place of Destruction As Portrayed in Legends</u>

The frequency and devastation of lava flows through Puna is expressed in Hawaiian legends. In both of the legends related below, Puna is described as a lush, verdant landscape that was destroyed because of battles and boastfulness.

Waka the Mo'o Battles Pelehonuamea

McGregor (2007) relates the story of Waka the Mo'o, who is destroyed by Pelehonuamea. Puna and Ka'ū were once beautiful lands, free of lava. A very long stretch of sandy beach called Keonelauenaakane (Kane's great sand stretch) once existed from Waiakea in Hilo, through Puna all the way to Panau. In the course of the battle between the *mo'o* (lizard) Wakakeakaikawai and Puna'aikoa'e and Pelehonuamea, Pele turned the beach and most of the land in Puna to lava, as it remains today. Only traces of sandy beach can still be found.

Keli'ikuku The Chief Who Boasted

In a second legend about Puna, McGregor (2007) writes that "according to chief Kanuha, up until the 1600s the district of Puna was renowned as magnificent country, with smooth even roads and a sandy soil that was favorable to vegetation." At this time, there was a high chief of Puna named Keli'ikuku (the Puna chief who boasted). This chief was immensely proud of Puna, and on a trip to O'ahu he talked about how no place compared to Puna and its "sweet-scented trees and vines" (Westervelt 1999). On O'ahu he met Kaneakalau, a prophet of Pele. Kaneakalau asked Keliikuku about his homeland, and taking the opportunity to brag, Keliikuku said:

> "*I am Keliikuku of Puna. My country is charming. Abundance is found there. Rich sandy plains are there, where everything grows wonderfully*" (Westervelt 1999).

Kanekalau, ridiculed Keliikuku and stated:

> "*Return to your beautiful country. You will find it desolate. Pele has made it a heap of ruins. The trees have descended from the mountains to the sea. The ohia and puhala are on the shore. The houses of your people are burned. Your land is unproductive. You have no people. You cannot live in your country anymore*" (Westervelt 1999).

Keliikuku, angered and frightened, told the prophet that he would return to his land, and if the prophet was wrong, he would return and kill Kanekalau. When Keliikuku returned to Puna, he climbed to the highest point and looked down on his land. There, "it lay under heavy clouds of smoke." All of the once fertile land was covered in lava, the forest, still burning. Pele had shown the boastful chief that "no land around her pit of fire was secure against her will" (Westervelt 1999).

Photo 7. Lava at ocean entry in Puna in 2009.
Photo courtesy of Hawai'i Volcanoes National Park.

In Puna, new land is created by Pele. On this land, new life sprouts, and then it is ready for human occupation (McGregor 2007). The sacred and special role of Puna may be best reflected by its people who continued to return to the area despite the many lava flows that spread across the landscape.

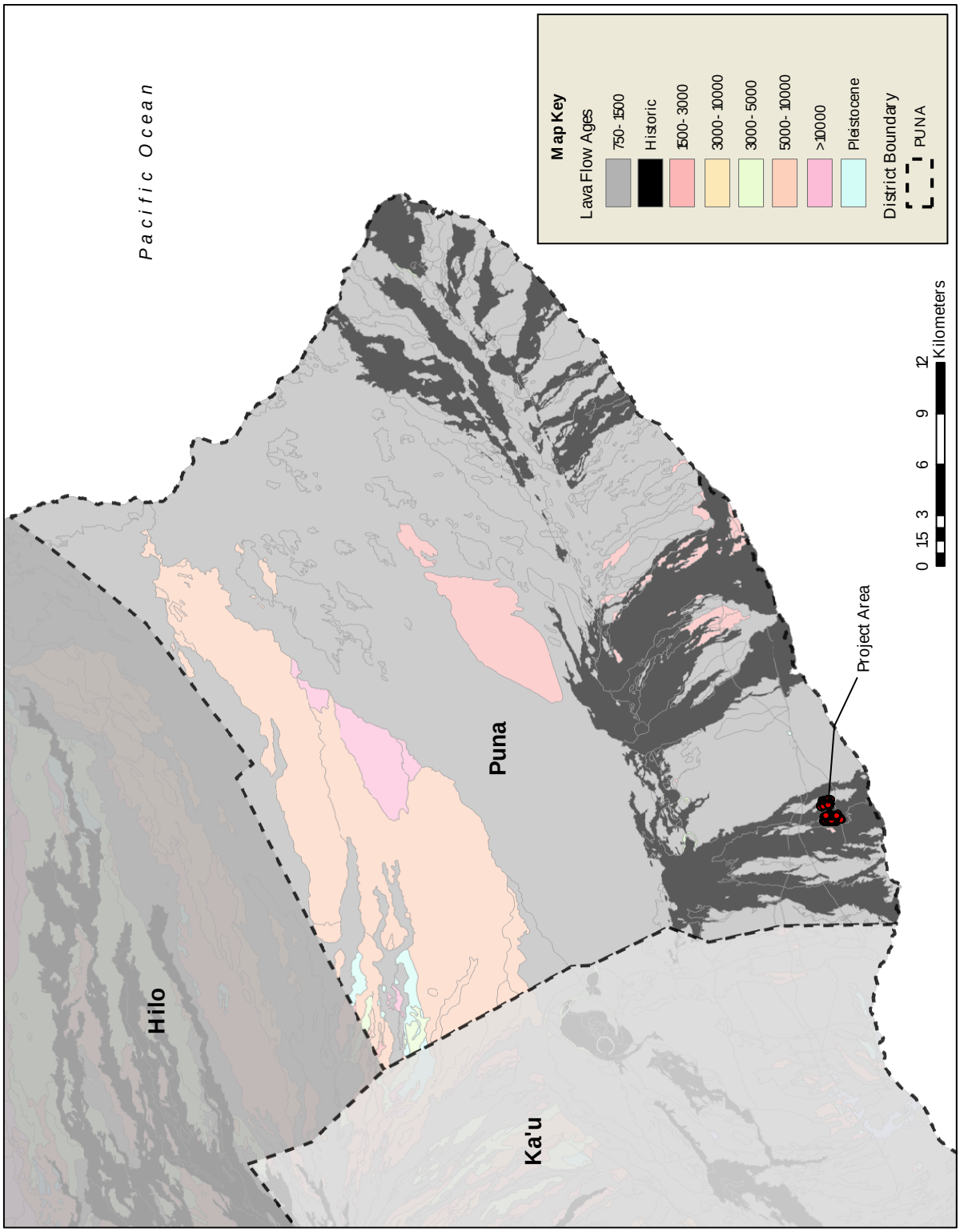

Figure 3.1. Lava flows through the Puna district.

Traditional Political History

Hilina'i Puna, Kalele ia Ka'u
Puna leans and reclines on Ka'u
(Pukui 1983)

Unlike other districts on Hawai'i Island, there were few influential families in Puna that arose from which chiefs could rely on for political support. Although Puna lands were desired, their control was dependent on who controlled Hilo or Ka'ū (Burchard 1994). Puna was especially connected to Ka'ū. As the Hawaiian proverb says: "*Hilina'i Puna kalele ia Ka'u, hilina'i Ka'u kalele ia Puna* - Puna trusts and leans on Ka'u, Ka'u trusts and leans on Puna" (Pukui 1983). This proverb talks about the ancestors of the districts of Ka'ū and Puna, who were once one extended family. In time, the districts decided to have a name of their own, but did not break their link entirely. The people of Ka'ū called themselves *Makaha* and the people of Puna called themselves *Kumakaha* (Pukui 1983).

The tie to Ka'ū may also be reflected in the meaning of "Kealakomo." Western Puna *ahupua'a* up to Poupou was known as Greater Ka'ū (Cordy 1988 cited in Tuggle and Tomonari-Tuggle 2008). Kealakomo means "the entry-path." While (Maly and Maly 2005) suggests that the name refers to the near shore trail running between Puna and Ka'ū, it may also be a reflection of its role as the lands that overlapped between the two districts, or it may refer to the mauka-makai trail system that led through the central portion of the western *kīpuka* and may have once been a primary route to the Caldera.

Chiefly Rule

During the time of Liloa (circa 1475 A.D.), the Puna chiefs were autonomous, though they pledged allegiance to Liloa as their high chief. After his death, his son Umi took over the entire kingdom. Hua'a was the chief of Puna at this time. A battle between Hua'a and Umi's adopted sons Pi'imaiwa'a, 'Oma'okamau and Ko'i led to the death of Hua'a at the hands of Pi'imaiwa'a in Kea'au. As a result of this battle the lands of Puna came under the control of Umi (Burchard 1994).

The first mention of a Ka'ū chief exerting power over Puna occurs when Kau chief Imaikalani enters the scene. Imaikalani is credited with restoring Waha'ula heiau, giving him "supereme authority over the ahupua'a of Pulama in Puna" (McGregor 2007), and likely great sway, if not authority over neighboring ahupua'a such as Kealakomo. History seems to repeat itself, when the sons of Imaikalani and Hua'a were also killed - this time by the son of Umi (Keawenui a 'Umi). Keawenui a 'Umi gained control of the island. From this time on, Puna is linked with Ka'u, which is ruled by members of the Kona chief's family, direct descendents of Keawenuia'umi (Burchard 1994).

Just prior to the time of European contact, "Puna seemed to have enjoyed a brief resurgence of semiauthonomous rule" (McGregor 2007). In the time of Kalaniopuu, Imakakoloa who was the chief of Puna, rose up and resisted the demands of Kalaniopuu for contributions to the ruling chief. McGregor (2007) writes that Imakakoloa was likely a descendant of the chief 'Imaikalani through the 'I family and

therefore may have had some long ties to this part of the Island. These ties may explain his actions and that of his people, after Kalaniopuu overpowered and subdued the Puna chief, Imakakoloa escaped to the country. Tuggle and Tomonari Tuggle (2008) estimate this occurred sometime in the mid 1760's. Imakakoloa was hidden by the people of Puna. Kalaniopuu, having moved to Ka'ū was frustrated by the refuge given to Imakakoloa and thus sent his Kahu Puhili to set the lands of Puna afire. From Apua east, the lands of Puna were burned (Burchard 1994). Kamakau provides this account of the battle and subsequent destruction of Puna:

> *"The fight lasted a long time, but I-maka-koloa fled and for almost a year lay hidden by the people of Puna…Puhili (who was sent by Kalaniopuu to find Imakakoloa) went until he came to the boundary where Puna adjoins Ka-'u to 'Oki'okiaho in 'Apua, and began to fire the villages. Great was the sorrow of the villagers over the loss of their property and their canoes by fires. When one district (ahupua'a) had been burnt out from upland to sea he moved on to the next… Thus it was that found I-maka-koloa where he was being hidden by a woman kahu on a little islet of the sea… I-maka-koloa was taken to Ka-lani-'opu'u in Ka-'u to be placed on the alter as an offering to the god, and Kiwala'o was the one for whom the house of the god had been made ready that he might perform the offering... Before he had ended offering the first sacrifices, Kamehameha grasped the body of I-maka-koloa and offered it up to the god, and the freeing of the tabu for the heiau was completed"* (Kamakau 1991).

With this act, Kamehameha set the stage to usurp Kiwala'o as heir to his father, Kalani'opu'u (McGregor 2007). In the struggle between Kamehameha and Keoua, most of Puna and Ka'u threw their support behind their chief Keouakuahu'ula. However, this support came with some reservations, perhaps because they remembered the way the Ka'ū chiefs had defeated their beloved Imakakoloa and ravaged their lands and homes. This feeling is expressed in the 'olelo which says "'*Apiki Puna I Lele'apiki, ke nana la I Nanawale* - Puna is concerned at Lele'apiki and looks about at Nanawale" (Pukui 1983). This expression implies that the people follow their rulers and are obedient. As Pukui (1983) says "The people of Puna were not anxious to go to war when a battle was declared between Kiwala'o and Kamehameha; it was the will of their chief." The battles between Keoua and Kamehameha were long, and ended in the defeat of Keoua. Kamehameha's attitude towards the people of Puna and Ka'u is expressed in a statement attributed to him: "He moku 'aleuleu" (district of ragamuffins) (McGregor 2007). Kamehameha is believed to have called the people of those districts that, because as hard working farmers, they lived most of the time in old clothes (Pukui 1983). (McGregor 2007) suggests that is also meant that the people of Puna did not prosper under the reign of Kamehameha, who united the island under his rule after the death of Kalaniopuu and the defeat of his successor Keoua (after ten years of war).

Cultural Transformation

During the struggles and battles between ruling chiefs, the *maka'ainana* continued to work the land and make the most of the resources available to them. To manage these

resources, they created artificial boundaries based on landscape attributes. Hawaiians traditionally divided their landscape both vertically and horizontally. The vertical division, which is the most well know, is based on the *ahupua'a* system. For Puna, the mountain resources lay on the slopes of Kīlauea. Though not often recognized as a mountain peak as Mauna Loa and Mauna Kea are, Kīlauea indeed does have its own summit and forests (*wao*), though it lacks an alpine and sub alpine zone. Kealakomo *ahupua'a* does not characterize the "typical" definition of an *ahupua'a* in that it does not cross-cut all ecological zones. Kealakomo is cut off by Panaunui to the east, and Apua to the northwest (see Figure 1.3). Kahaualea ahupua'a cuts off most of the Puna ahupua'a that are within the park boundary, and it in turn is cut off from the alpine and subalpine zones by Keaau**.**

Hawaiians also divided the landscape into less well known horizontal zones. Descriptions of these dimensions are found in (Malo 1951), and are described herein: extending inland from the sea to the highest peaks of the mountains are the *kahakai* (the coastal strand, or narrow strip along the ocean), the *kula* zone (the area clear of forest and where agriculture dominated), *wao* (the forest), and the *kuahiwi* (the unforested mountaintop). The *kula*, is the zone in which the project area lies. The *kula* zone is often divided into two – the kula kai, where the heaviest settlement generally occurs, and the kula uka, the zone used most for agriculture. Much of the kula kai within Kealakomowaena was covered by the historic Mauna Ulu flows. Though severely dissected by these historic flows and the modern Chain of Craters road, portions of the kula uka of Kealakomo remains untouched (see Figure 1.4).

Archeological work within Hawai'i Volcanoes National Park show that the cultural resources on the landscape reflect past use of these traditional geographic zones. Archeologists have documented a string of village settlements within the *kahakai,* as well as dispersed habitation sites associated with agricultural fields further inland in the *kula* zone (see Table 3.1).

Precontact Settlement, Expansion, and Intensification

Despite being a windward district, the western *ahupua'a* like Kealakomo, are considered to have leeward tendencies. Both the threat of devastation by lava flows and the variability of agricultural land contribute to this classification (Sweeney and Burtchard 1995). In such regions where soil is not well developed and rainfall not plentiful, highly intensive agricultural production was the only type possible. Some archeological models suggest settlement is not expected in such marginal areas before A.D. 1100 - 1400 (Kirch 1984; Sweeney and Burtchard 1995). Archeological evidence from sites within Hawai'i Volcanoes support these models. Radiocarbon data from Hawai'i Volcanoes National Park suggests that the most remote areas of Puna and Ka'ū, like Kealakomo, that are within the shadow and under the nearly continuous influence of Kilauea was not colonized until AD 1400.

Table 3.1. List of known settlements in the kula kai and kula uka zones (Langlas 2003a; Langlas 2003b).

Ahupua'a	Coastal Settlements	Inland Settlements
	(kula kai)	***(kula uka)***
District of Puna (Lesser Ka'ū)		
Poupou/Pulama	Poupou-Kauka Ka'ili'ili Pūlama	
Kamoamoa	Kamoamoa kauhale Kamoamoa-Paliuli	Kamoamoa Mauka (200-400 ft. asl)
Laeapuki/ Pānau Iki	Laeapuki kauhale	Moolehua & Paliuli (200-400 ft. asl)
	Kaheka	
Pānau Nui	Ka'ena	Pe'a House Site above Hōlei Pali (900+ ft. asl)
Kealakomo	Kealakomo kauhale	Kealakomowaena (200-700 ft. asl) Nā'ulu (700-900 ft. asl))
Kahue	Kahue kauhale	above Poliokeawe Pali (2000+ ft. asl)
'Āpua	'Āpua kauhale "Tumulus Group"	above Poliokeawe Pali (2000+ ft. asl)
District of Ka'ū (Greater Ka'ū)		
Keauhou	west-side cave sites Keauhou Landing	above Hōlei Pali (400+ ft. asl) below Poliokeawe Pali (1300 ft. asl) Hilinapali (2000 ft. asl)
Kapāpala	Halapē	above Pu'u Kapukapu (1000 ft. asl)) Footprints (3000+ ft. asl)
Ka'ala'ala	Kū'ē'ē	

Constraints on the Population - Water

As previously stated, although Kealakomo is within the windward district of Puna, its close proximity to the leeward district of Ka'u, puts it very much in the margins of the windward zone. The ahupua'a has leeward tendencies with a median rainfall of 40 to 60 inches (Figure 2.1). The project area lies within a narrow zone where agriculture is possible, though challenging. Data for the past ten years shows that the area receives its maximum rainfall between the months of October and March when south (*kona*) winds are predominant.

The substrate in the ahupua'a is young, porous lava. The limited rainfall that does fall in the area seeps quickly through the surface. Flowing water is all but nonexistent. Available water in the ahupua'a can be found underground in caves (collected from natural drips), and in brackish water pools close to the coast. To sustain a population, the available water would have to be enough to provide for potable water for drinking, cooking, and washing. Those living in the villages along the coast could easily access the brackish water pools, while populations living further inland, like Kealakomowaena, would have relied on cave drips and whatever could be caught and captured from downpours. Several sites in the area contain historic cisterns (Site 27205 and HV-176 at Nā ulu), thus suggesting that at least in the historic period collecting rain water was a viable option. Ellis' journal suggests those living near the coast also ventured inland for water from cave drips. As Wilkes walked towards Kilauea, past Ola'a on his journey to Mauna Loa, he mentions "frequently" seeing "pools of water standing in the lava rock." He writes that the Native Hawaiians walking with him would rush into them to cool off (Wilkes 1845). Water could also be collected in steam cracks, closer to the crater. While camped at the summit of Kilauea, Wilkes (Wilkes 1845) and his entourage collected water from the small pools near the earth cracks. The water was the result of condensation of the steam coming out. Wilkes was traveling with a group that may have numbered in the hundreds. Although they used much of the available water in the area, it did not run out. Wilkes described the water as "sweet and soft." Unfortunately for Ellis, the water he was provided at Kealakomo

Photo 8. Cave skylight and entry. Site not located in the project area. Photo courtesy of Hawai'i Volcanoes National Park.

tasted terrible. He described it as "little better than the water of the sea, from which it had percolated through the vesicles of the lava into the hollows from nine to twelve feet distant from the ocean" (Ellis 2004). Though poor in taste, it seems water was available for the travelers who drank "at every hollow to which" they came upon (Wilkes 1845).

Emory, Cox et. al. (1959) writing about the coastal village at Kealakomo said:

> *"The absence of fresh water was not a serious deterrent to the occupation of this coast by the ancient Hawaiians. They did manage with brackish water obtained through fissures in the lava which extended down to the water table. In the uplands… fresh water was caught from drips in caves and stored in calabashes"* (Emory, Cox et al. 1959).

Photo 9. Image top, pool of water in Kīlauea Caldera after a rain.

Image botton, Site HV184c, natural spring located near the coast. Photos courtesy of Hawai'i Volcanoes National Park.

Constraints on the Population - Food

Trade was obviously important to the people of western Puna who relied on ohana living in other parts of the ahupua'a or district to provide them with basics that they lacked in their village. To be able to expand and thrive in these extremely dry and remote environments of western Puna and eastern Ka'ū, it was important that three drought tolerable plants (sweet potato, bottle gourd and breadfruit) be available. All three were introduced during what has been termed the "late voyaging period" between c. A.D. 1200 - 1400 (Hommon 2007 e-mail communication). Hommon (2007) notes that population across Hawai'i Island was widespread but sparse by AD 1100. The Kona Field system, though not yet developed, was experiencing "small scale agricultural activity" by AD 1300. He goes on to say that between AD 1450 – 1550 population, and agricultural expansion and intensification were "exploding," but that by the mid-sixteenth century, "Hawaiian agriculture expansion slowed significantly as it approached effective limits" (Hommon 2007 e-mail communication).

Archeologists working in the Kohala Field System recently gathered evidence that further supports the temporal chronology identified by Hommon for Kona. Ladefoged and Graves (2002:430) state that initial expansion of agriculture into the uplands of Kohala "took place ca. A.D. 1300 to 1500." It wasn't until between A.D. 1450 and 1800 that the fixed field agricultural system developed there (Ladefoged and Graves 2002). By 1800 this system had reached a state of high intensification.

The lands within western Puna would represent some of the most marginal lands on the island. Under Hommon's model, expansion into this part of the island would not have occurred until the mid to late 16th to early 17th century. This model fits well with the radiocarbon data from Hawai'i Volcanoes' Puna and Ka'ū districts. This data suggest that the most western *ahupua'a* in the Puna district and adjacent eastern Ka'ū ahupua'a were first being explored in the early 1400's, but it was not until the 17th century that this area experienced population expansion and came under some form of intensive cultivation (see Chapter 6 for a fuller discussion of radiocarbon data).

Sweet potato was the primary food crop in this region. It was grown on mounds, terraces, and modified outcrops built and heaped on the seemingly bare lava landscape. The dense clusters of agricultural features in Kealakomo, Panau and Laeapuki *ahupua'a* strongly indicate that this area was intensively cultivated during the late prehistoric and into the early historic period (Figure 3.2).

In addition to the cultivated food crops, those moving into the Kealakomo area, would have found some food resources available from the forests and coast. Birds, especially seabirds and some forest birds would have been plentiful and were likely a relatively easy source of food. Marine resources, in the form of shellfish (*'opihi*), fish, and seaweed would have been the most prolific and accessible. The protein available from the sea would have been more than adequate to have supported a population during the pre-contact period. In fact, dried fish was a common trade item and 'opihi was shared with *ohana* and neighbors along the coastline. Salt was also a product traded by Kealakomo residents. In the coastal area of Kāena and Kāheka, just east of Kealakomo, archeologists have documented an abundance of salt drying features. Thus, in the late pre-contact and early historic periods, residents of Kealakomo traded

their salt and dried fish, and engaged in dryland sweet potato cultivation as a primary means of production. Emory, Cox et al. (1959) write:

> *"What supported the amazingly populous village of Kealakomo, situated on such a barren plain of lava and pili grass, was its facility for producing salt and drying fish. These were exchanged for other needs with relatives who could be reached by the trail which led inland and along the coast"* (Emory, Cox et al. 1959).

Environmental Alteration and Transformation

> *He'uala ka au ho'ōla koke i ka wī.*
> The sweet potato is the food that ends famine quickly (Pukui 1983)

Human expansion into the leeward districts, and especially into the marginal areas would not have been possible without the introduction of the sweet potato, the gourd plant, and the breadfruit plant. The sweet potato was critical in remote areas of Puna, where few agricultural products could be grown amongst the lava beds. Sweet potato, however, did grow in these areas, and as the archeological record attests, Hawaiians grew it on almost every piece of available and agrable land.

Sweet potato was grown under dryland conditions, which was not as highly productive as wetland production. A wetland *lo'ī* taro farm could produce five times the amount of taro in one acre than could be produced in an acre of dryland cultivation (Abad 2000). Under dryland conditions, sweet potato is more valuable because 1) it can be grown in more marginal areas where there is less sun and soil; 2) it matures in three to six months, much quicker than the nine to eighteen months for taro; 3) it requires less human labor for both planting and cultivation (Handy and Handy 1991).

The remains of dryland sweet potato field systems in the form of mounds, pits, and rock piles can be seen across the landscape of Kealakomowaena and in Panau and Paliuli (Figure 3.2). In Panau and Paliuli and to a lesser extent in the Phase II project area of Kealakomo, the excavated pits and mounds are located at the base of tumuli. Sweet potato patches grown in these types of stony places were called *makaili.* The plants were grown in "small pockets of semi disintegrated lava… (fertilized) with rubbish… by heaping up fine gravel and stones around the vines" (Handy and Handy 1991). The potatoes grown in these areas are said to be inferior, called *'awa'awa'a*, they are said to be "tasteless, ridged or wrinkled" (Handy and Handy 1991:129). However poor the quality, in marginal areas like Kealakomowaena, the mounds, low walls, pits, and outcrops reflect the remains of the breadbasket of the local region. Ethnobotanist Isabella Aiona Abbott (1992) put it best:

> "*Sweet potato, or uala, ranked second only to kalo in providing carbohydrates and minerals in the Hawaiian diet. Uala were cultivated and eaten throughout the islands but were important especially in settlements on leeward coasts too arid even for "dryland" kalo. The hardiest varieties of uala… will grow successfully in almost any kind of earth except a sticky, clay – like soil*" (Abbott 1992).

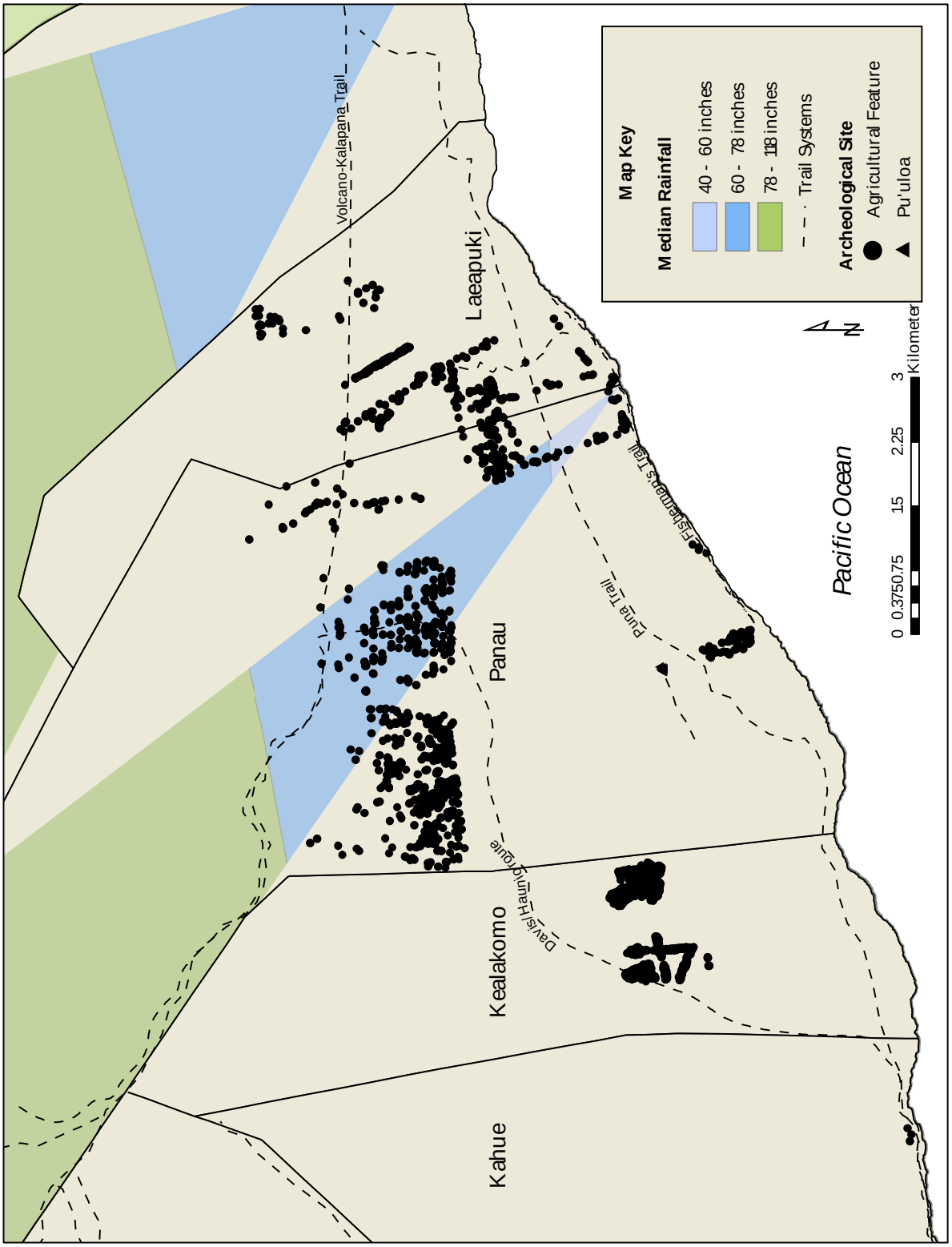

Figure 3.2. Distribution of agricultural features.

Extinction and Environmental Degradation – Puna and Ka'u

As Hawaiians expanded into the marginal regions of Puna and Ka'u, the native dryland forests that they encountered would have offered diverse non-agricultural resources such as native birds (for food as well as highly valued feathers), medicinal plants, fiber, and hardwoods. As the forest regions of the uplands opened up, and the natural landscape was altered to a cultural one, the native resources may have become scarce and the subject of increased competition. While there is no evidence for this pre-contact anthropogenic decline in the Kīlauea region, 'olelo suggests that care for the forests was of primary concern, and that protocol when entering was to be followed. Pukui (1983) writes "*Maka'u ka hana hew I ka uka o Puna* - Wrongdoing is feared in the upland of Puna." In other words, if one does not follow proper protocol, and conserve the forest, then the wrath of Pele will be upon them.

Unfortunately, after the period of Western contact, established protocols were often trumped by the lure of the market economy, and greed. During the historic period sandalwood trees, tree ferns, salt and animal hides were valuable market items in these districts (Maly and Maly 2005). These taxa were greatly impacted, and their numbers in the forest seriously reduced. In addition to human induced change, explosive eruptions from Kīlauea between 1500 and 1790, as well as lava flows from Kīlauea and Mauna Loa, burned and covered valuable forests. The impact of lava flows would have been dramatic. In this region, ninety percent of surface flows are younger than 1,100 years old and seventy percent of the flows are less than 500 years old (Holcomb 1987). Within the time of human occupation, this landscape came under immense change. The lava flows not only would have destroyed potential areas for cultivation, but also forest lands resulting in a young, immature landscape.

Kauhale "Village" Life

Despite the challenging conditions faced by the residents who called western Puna home, those who chose to live in this magnificent area thrived on the resources that were available. Archeological and historical accounts document numerous cluster of house sites, or *kauhale* along the kula kai (coastal) and within the kula uka zones (see Table 3.1, Figure 3.3). *Kauhale* were often dispersed and isolated communities. Topography or close proximity to much needed resources, such as water, led to house sites being grouped together (Handy and Handy 1991). House clusters along the coast of Hawai'i Volcanoes National Park are often referred to as villages. Hawaiians had no term for "village." As (Handy and Handy 1991) write, *kauhale* meant homestead, and when a number of house sites were close together, as they were at the coastal sites of Kealakomo, Kahue, Apua, and in other areas along the Puna and Ka'u coasts, the same term, *kauhale* should be used. Herein are detailed descriptions of some of the *kauhale* neighboring Kealakomowaena.

Kahue

Located just west of Kealakomo is the ahupua'a of Kahue. Located at the coast is a cluster of several structures, petroglyphs, and large mounds of *'opihi* shell midden. Further inland, there are likely more features in areas that have not been surveyed. Park Ranger Gunder Olsen in 1941 remarked about Kahue "why the Hawaiians chose to live in such an infertile, dry and hot place I cannot say" (Olsen 1941b). In the early historic period Kahue was a favorite fishing spot for Kalapana residents. Unlike Apua,

where a nice sandy beach allowed for throw net fishing, the coastal area of Kahue is a deep drop off. Here, Hawaiians were able to fish only with hook and line. Once the fish was caught, it was "immediately cleaned, split in half, treated with coarse natural salt and dried." The fish was then transported by mule back to Kalapana. *'Opihi* was also found in abundance. *'Opihi* were collected and shelled by fishermen on the morning before leaving because of "rapid spoilage in this hot country" (Olsen 1941b). Six years after Olson traveled through this area, Park Ranger Davis noted that the structures at both Apua and Kahue were frequently used. He suggested that the piles of *'opihi* shells outside of the structures at Kahue were evidence that *'opihi* was being collected "for commercial purposes" (Davis and Haunio 1947).

Kealakomo coastal kauhale

The next cluster of house sites east of Kahue is located within Kealakomo. Located on the coast, this *kauhale* was long covered by the Mauna Ulu lava flows between 1971 and 1972. Before it was covered, however, rangers and archeologists had the opportunity to document numerous sites in the area, and aerial photographs taken before the lava flows also show the extent of additional features that were not recorded (Figure 3.4).

The coastal residents at Kealakomo and Kahue had direct access to *ohana* in the uplands via a mauka-makai trail system. Just at the boundary of Kahue and Kealakomo Park Ranger Olsen recorded a single coconut tree growing in 1941. Another tree was recorded further mauka, along what appears to be the same boundary alignment. Just east of the boundary was an "ancient trail" that led mauka (north) to the project area at Kealakomowaena. Olsen stated that the trail "makes a straight almost north-south line over two miles long. This old trail… utilizes the easiest ascent over Poli o Keawe Pali" (Olsen 1941b). Ranger Olsen believed that the trail would be useful for future patrols by park staff. The trail led from the coastal villages to Kealakomowaena and Nā ulu. Beyond Nā ulu it linked up with the Volcano/Kalapana trail (see Figures 3.4 and 3.5a). The trail was key to linking the ohana at the coastal village sites with the interior agricultural fields, house sites, additional upland trails, and the Caldera.

A great description of the area and route was written by Rangers Davis and Haunio in 1947:

> *"At the Kealakomo boundary we left the Puna trail, traveling in a north easterly direction and ascending the first pali on the old Kealakomo trail. Enroute seven wild donkeys and seven horses were seen. Between the pali and Naulu acres of small rock piles were in evidence, including a very old stone wall. Warden Hauanio suggested that those piles may have been used by the early Hawaiians for some of their crops such as sweet potatoes and possibly taro. Shortly before reaching Naulu an old dwelling site and a water cistern were seen. An ancient trail from here took us to Naulu where we saw a large herd of goats. These animals were not particularly alarmed, and although we got close to them our attempted control wasn't very successful, due mostly to the trees in this area…Ascending a small pali to the east of Naulu we traveled into the land of Panau Nui where other stone formations were seen such as goat traps and dwelling sites" (Davis and Haunio 1947).*

It is obvious that Davis and Haunio were traveling directly through the Phase I project area during this trip. As this early written account suggests, the ohana who lived at Kealakomo coast were relatively close to their crops at Kealakomowaena. These crops likely helped sustained the villagers and others in the area.

Nā'ulu

Just north/northeast of the project area, within Kealakomo *ahupua'a*, above Holei Pali was Nāʾulu. Most of the *kauhale* were covered by the 1971 - 1972 lava flows of Mauna Ulu. However, the cistern and house site described by Davis and Haunio before they reached Nāʾulu 1947 still stands. If its name is any indication of its past role within the *ahupua'a*, at one time it may have been an important place for the area residents where breadfruit was grown. In 1959, archaeologist Kenneth Emory made this observation while conducting archaeological surveys in the vicinity:

> "*Naulu (the breadfruit). One mile east of Kealakomowaena on the first ledge of the cliff above the shore plain is the remains of the village of Naulu. The area was mentioned often by our informants at Kalapana and it no doubt was an active village in the early 1800s. No visit was made to this area by a ground party. Photographs were taken from the air which indicated a complex of sites stretching up the rise from the top edge of the cliff and a few sites along the base*" (Emory, Cox et al. 1959).

Puna was the only place where breadfruit (*Artocarpus altilis*) was not secondary to either taro or sweet potato (Handy and Handy 1991). A good year breadfruit was eaten for eight months in Puna. While the archeological landscape and Ellis' account suggests that sweet potato was the dominant crop in Kealakomowaena, breadfruit may have also been an important component of the diet in this area.

Photo 10. Photo left, Ranger on horseback at the coast of Kealakomo. Photo right, house site at the coast of Kealakomo in 1959 examined by John Aubuchon assistant superintendent of Hawaii Nationla Park and J. Halley Cox of the Bishop Museum. Photos courtesy of Hawaii Volcanoes National Park.

In a letter dated October 29, 1964, Dwight Hamilton, Chief Park Naturalist wrote to the Reverend James Keala of Kawaihao Church, asking for information on his mother who he believed had been born at Nāʾulu. Hamilton was interested in obtaining information on Nā ulu because the new extension of the Chain of Craters road to Kalapana was about to be completed and was to pass through this village and others nearby. Although the Reverend Keala did not have any information for Hamilton, Mrs. George E. Goss, who was working with Hamilton to gather information, was able to interview Mrs. Marion Kawena Pukui regarding Nā ulu. In a handwritten note to Hamilton, Goss describes how Nāʾulu got its name. Goss wrote:

> *"Now as to Naulu – the tree (which was cut down for the road) was a great double-twin-tree a shelter from storms – the two trunks were a protection from storms from either the mountain or ocean. It was called Naulu (ka) elua – elua being 2. Also the original name of the village – which is now only the single tree – Naulu. The people wept where the big tree, their friend and protector, was destroyed. Now the lonely breadfruit tree dreams of the departed"* (letter from Goss to Hamilton, Oct. 25, 1964).

Prior to the Mauna Ulu flows and the construction of the Chain of Craters Road extension, park staff visited the village site on several occasions, documenting their observations on the fauna, flora and cultural sites. In August 1947 Cliff Davis, Acting Chief Ranger visited the area. He found the site by going due south from the 2302 benchmark at the Volcano-Kalapana trail. Along the way he documented an "old trail" approximately 300 yards long. Unfortunately this trail does not appear on any of the maps from the early 1920's. It may have been a similar route taken by Davis and Haunio that same year, but from the south at that time. The forest at Nā ulu was "noticeable" and consisted of kukui nut (*Aleurites moluccana*), alahee (*Canthium odoratum*), lama (*Diospyros ferrea*), and ohia (Metrosideros) (Davis 1947). The village itselt was situated at the base of a 700 foot pali within Kealakomo ahupua'a. Unusually large *hao* (*Rauvolfia sandwicensis*), *kopiko* (*Starussia hawaiiensis*), *kolea* (*Myrsine lessertiana*) and *alahee* (*Canthium odoratum*) were noted (Davis 1947).

Davis (1947a) wrote that the forest ended "abruptly at the base of the pali." He knew he was in the Village of Nā ulu because of the presence of eight breadfruit trees along with orange trees, a cistern, and stone terraces. He went on to write that "there isn't much left at Naulu." Today, after the Mauna Ulu flows covered much of the area, there is even less.

In 1963 Dwight Hamilton and Raymond Bright photo documented the vegetation and cultural sites at Nā ulu (Hamilton and Bright 1963). Their efforts highlight the oasis of native vegetation in this unique area.

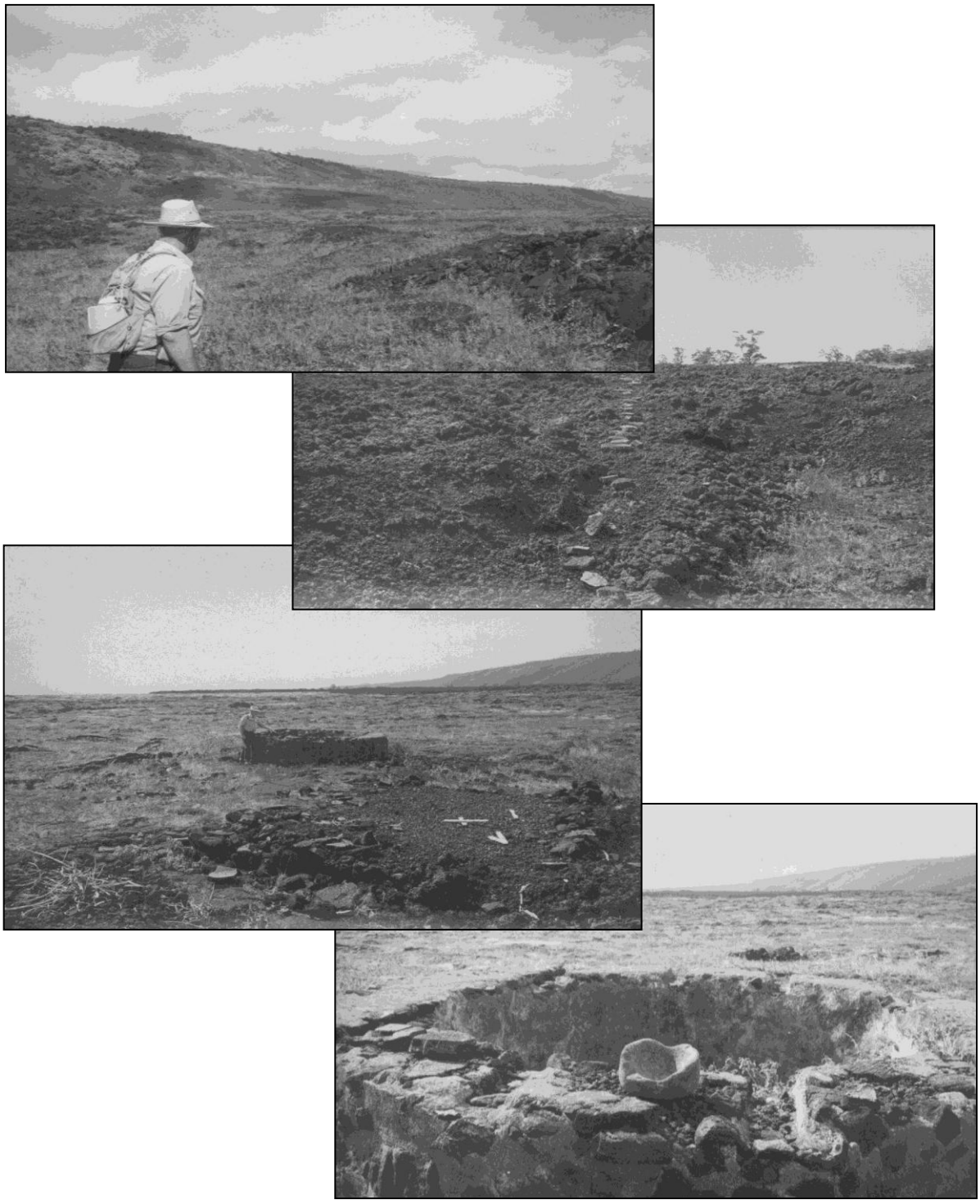

Photo 11. Various views of lower Nāʻulu Village. Photos courtesy of Hawaiʻi Volcanoes National Park.

Kaena
Just east of the coastal village of Kealakomo is Kaena Point. Though never identified as a "village" Kaena located in the neighboring ahupua'a of Panau does contain evidence of temporary habitation sites, a few pits, and numerous salt drying features, both large and small. This area is currently being documented, but preliminary results suggest a rich salt processing area along the park coastline that supported a small population in the precontact period.

Kaheka
East of Kaena is Kaheka. Kaheka is situated along the coast, in the *ahupua'a* of Panau Iki, which is just south of the east rift of Kīlauea. Survey of Kaheka in the 1990's (Waipa 2005) resulted in the identification of three new sites, consisting of 198 features. The features represent traditional Hawaiian, historical, and recent use of the area. Kaheka was a site of salt drying and fishing. Salt production was common and a well-known product from this part of the island, and it is a practice that continued into the early historic period. The salt trade was an important means by which the local residents were able to supplement their subsistence economy. In addition to salt, the area was an important site for Kalapana fishermen and their families well into the historic period. Unfortunately recent lava flows from Pu'u O'o covered most of this area.

Holei Pali
"Holei is on top of the bluff on the face of which cling groves of kukui trees. This name extended to the bottom of the grove. Samuel Konanui claimed many people lived at Holei. Hale-o-Lono, which, according to Konanui was "the place where the rain was cooked" is directly on top of the Holei bluff. Hau-a-neneia, Strike-till-groaning, is the name of some land between Holei and Pu'uloa. It refers to the act of a robber who held forth here. Pu'u-loa, Hill-(of)-long-(life), is the name of the *pāhoehoe* mound covered with petroglyphs. Tradition has this name derived from the mother of the shark Ka-ehu-iki-mano-o-Pu'uloa. Going upland towards Maka-o-Puhi crater, following closely the Kalapana trail, the names of the lands are Ki'i-Ki'i-lei, then Ka-lehua. To the west of Holei on an old route to Na'ulu is Ha'iana, the location of a water-drip cave. Between Ha'iana and Ki'i-ki'i-lei is Ka-lani-hale. Between Ha'iana and Wili Pe'a is Paio" (Emory, Cox et al. 1959).

Trails

The ability to travel to and from kauhale across the coastline and into the uplands was imperative to acquire a range of resources for subsistence. Historically, the project area was connected by a series of short trails which linked to major inter- and intra-*ahupua'a* trails. Many of these trails continued to be used well into the historic period, and today some have been incorporated into the park trail system. Utilizing a series of maps from 1921 to present, this section documents our state of knowledge regarding the trails that were either directly or indirectly associated with the project area. Some trails have been documented archeologically. Many, however, have not (Figure 3.5).

<u>Kalapana Trail</u>
Leading from the Nāpau Trail south at Makaopuhi Crater the Kalapana Trail proceeds southward through Pulama, Poupou and Kahaualea. The Kalapana Trail has also been

called the Volcano-Kalapana Trail on 1920s maps, and the Panau Trail by Emory et al. (1959). Emory (1959) describes the trail as traversing east of the village of Kapa'ahu and westward of the village for approximately six miles until the terminus of the Chain of Craters Road (as it was in 1959 prior to the extension). "The roadbed (trail) is six to eight feet wide and is bordered on each side with curbstones" (Emory, Cox et al. 1959).

Nā ulu Trail

At the 2600-foot elevation, a spur trail of the Kalapana Trail proceeds for two miles due south to Nā ulu Forest. This, the Nā ulu Trail, terminates at the juncture of the Chain of Craters Road (2000-foot elevation) at the top of Holei Pali. It is unclear how ancient the Nā ulu trail is, or how much it was once used, as it does not show up on early 20th century maps like the Kalapana trail does.

Puna Trail

A major thoroughfare is situated only 1100m south of the study area. The Puna trail served and still serves to connect the coastal villages within *ahupua'a* along the southern coast of the island. This trail is considered an ancient trail used in the pre-contact period up through the present day. The Puna Trail is listed as a component feature or a zone of secondary significance of the Puna-Ka'ū Historic District, a district listed in the National Register of Historic Places under Category "D" as of July 1, 1974.

Puna Coast Trail

Just inland of the Puna Trail is the Puna Coast Trail. This trail segment links up with the Hilina Pali trail on the west. Its eastern boundary links up with Pu'uloa.

Old Kealakomo Trail

A trail connecting the coastal settlement at Kealakomo and the inland settlements at Kealakomowaena and Nā'ulu crosses the middle of the project area (Site 27265). A switchback portion of the trail up the unnamed lower pali was recorded during this survey. Davis and Haunio document this trail on a map they produced in 1947. Their trip started from the Ka'ū Desert trail took them along the Puna Trail, through Kealakomowaena and Nā'ulu, along the what is now the Hairpin Turn, and then east to the Kalapana Trail (see Figure 3.4). A photo of the trail taken in 1947 (see right) clearly shows the trail alignment. Though only a segment of the trail can still be found, aerial photos taken before the Mauna Ulu eruption clearly show the trail segment south of Nā ulu (see Figure 3.4).

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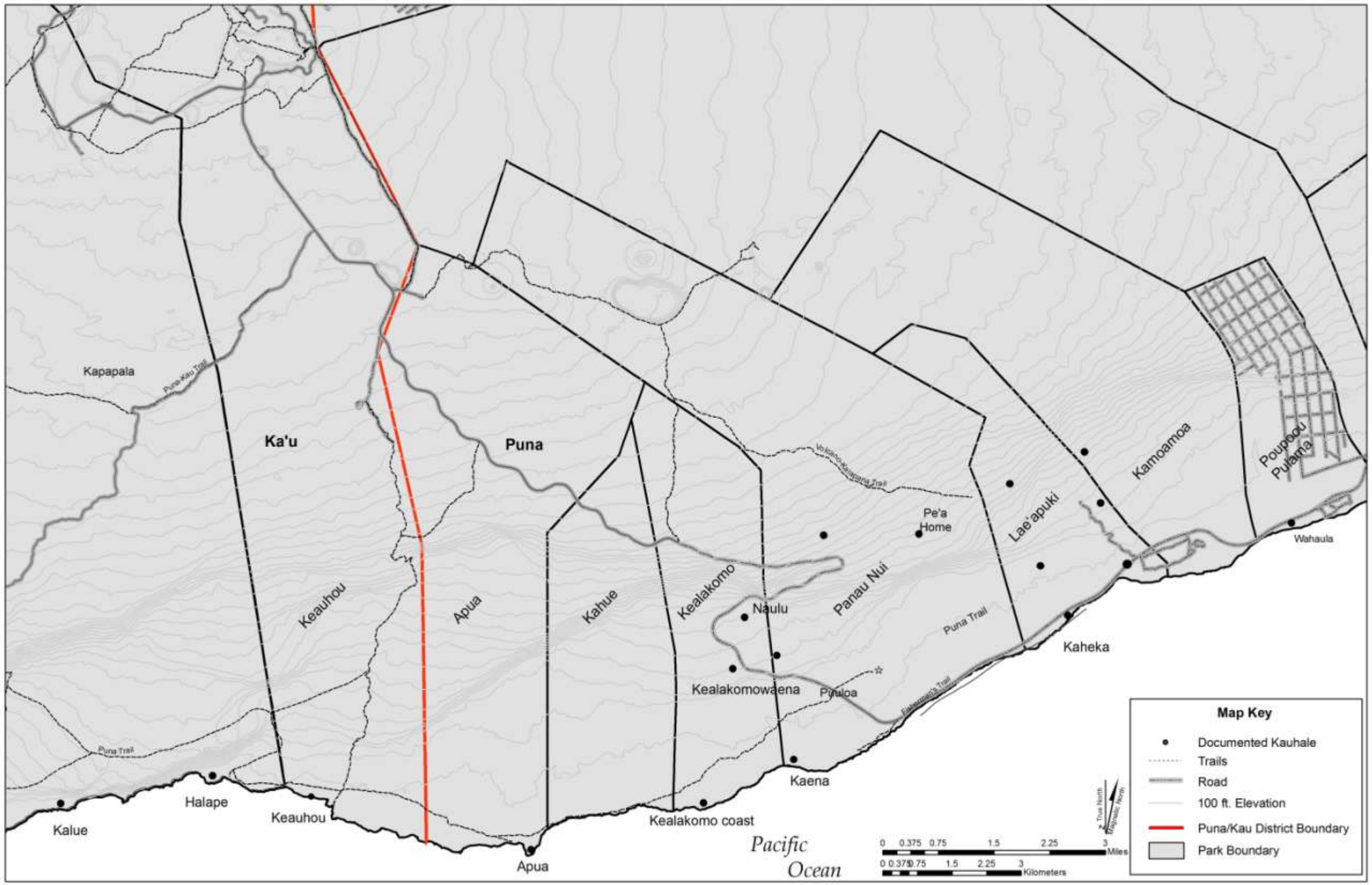

Figure 3.3. Location of *kauhale* across Puna and parts of Kaʻū within HAVO.

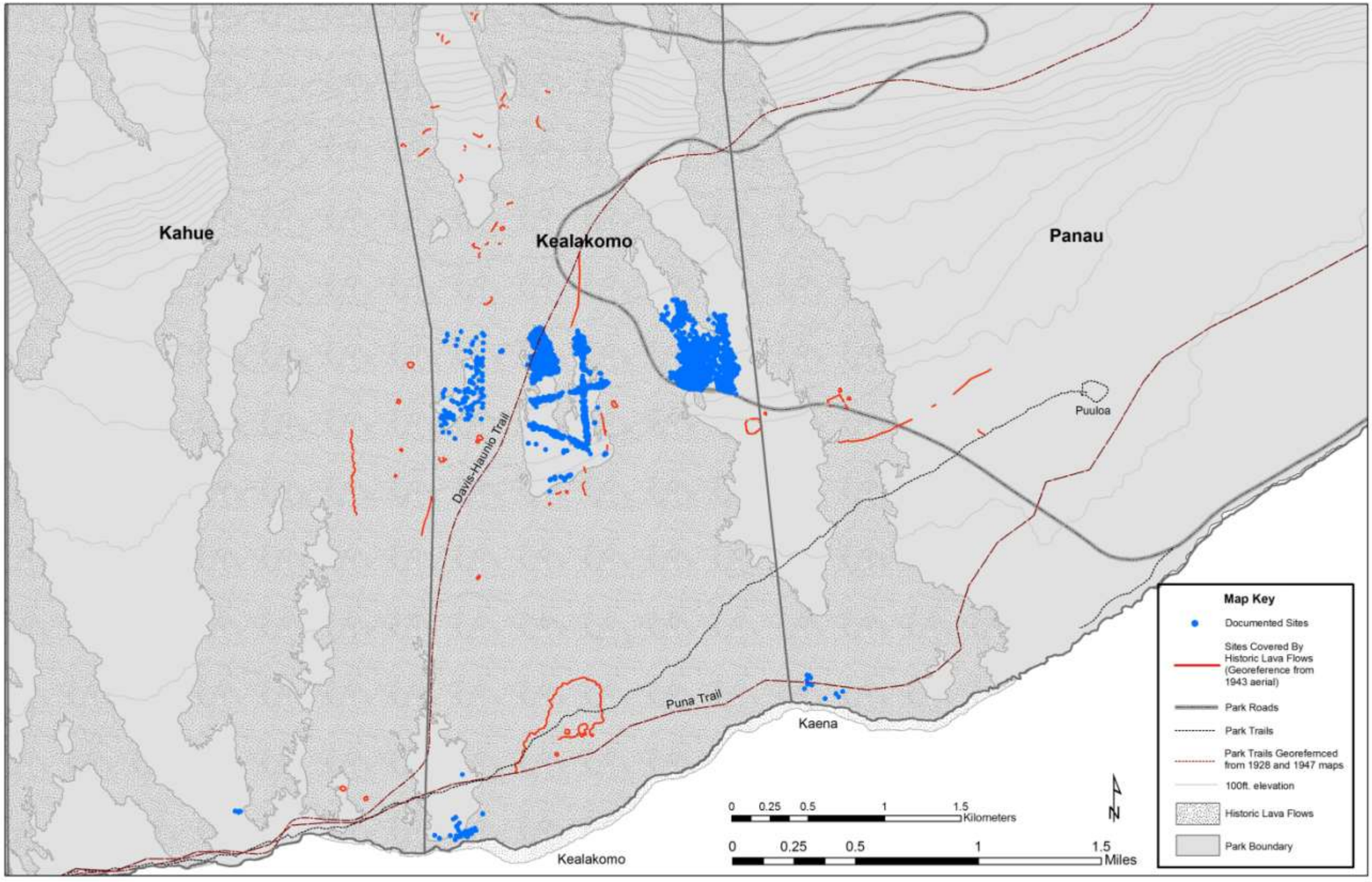

Figure 3.4. Cultural sites identified from 1943 aerial photos.

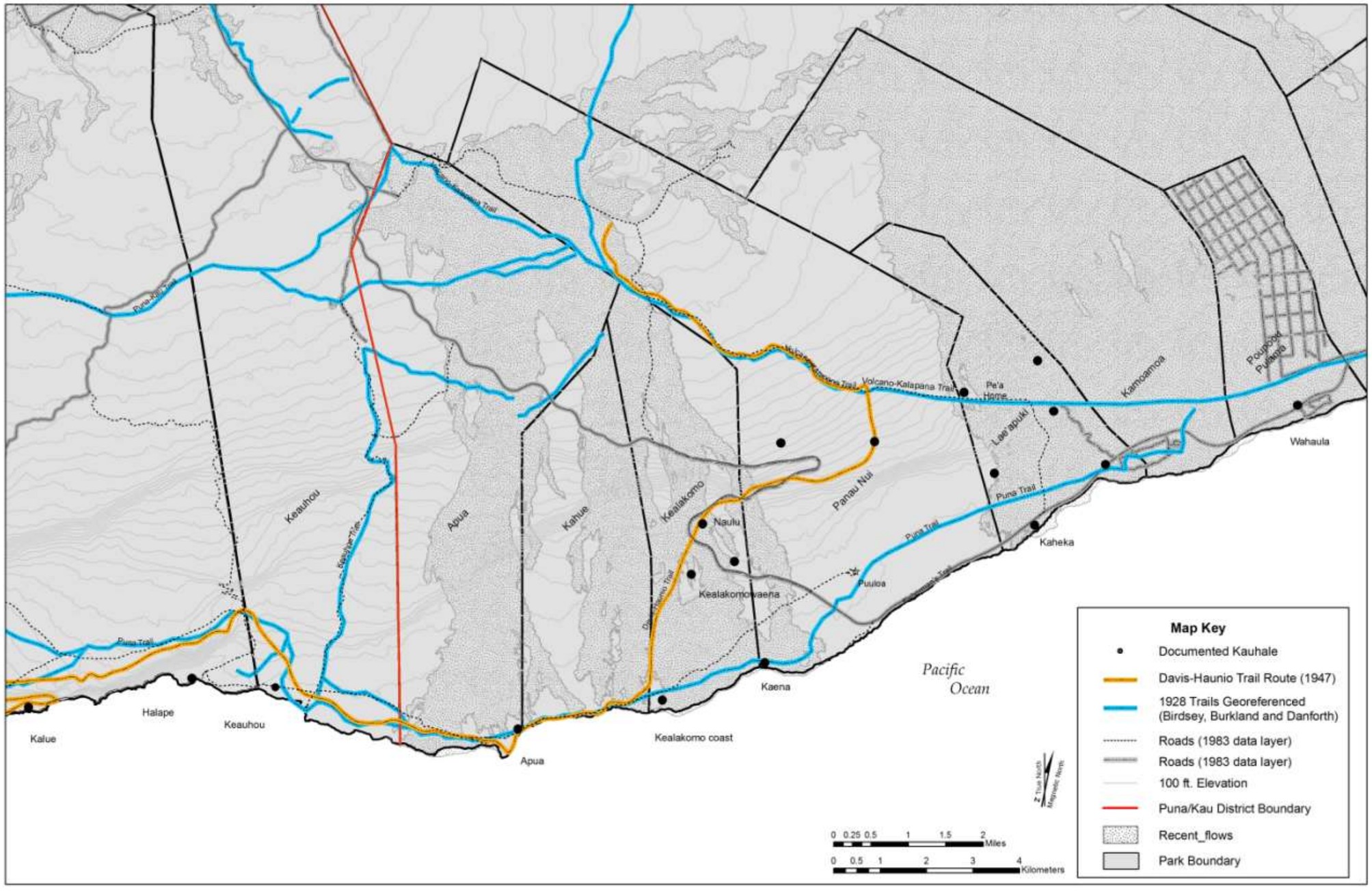

Figure 3.5. Location of known trails georeferenced from 1921 maps.

Chapter 4 . WESTERN IMPACTS AT KEALAKOMO

Oia no. Poereere makou. E ake makou I hoomaramarama ia.
So it is. We are dark. We desire to be enlightened
(Kealakomo resident, 1823 [(Ellis 2004)])

This chapter documents and discusses the impact historic period changes in land tenure brought to the environment and the people that were connected to the land. Journal entries from the first missionaries and explorers who traveled through the district of Puna area are used to paint a picture of the historic period at Kealakomo. Legal documents including *mahele* and tax records are used to reconstruct population change.

The First Historical Accounts of Western Puna

Captain James Cook - 1778

Captain Cook was the first to write about the Puna-Kaʻū region of Hawaiʻi Island. His account is brief, and we only get a glimpse of the area and its people in the late 18th century. Although he did not anchor along this coastline, he did engage in some limited trade with its residents. Those natives who ventured in their canoes out to the European ships in this region brought very little with them to trade. The sailors surmised that either the locals were afraid that they would lose their goods at sea, or were uncertain if they would have anything to trade with. Sahlins (1995) suggests an alternate reason for the Hawaiians reluctance to contact Cook and his crew. He theorizes that Cook and his crew likely arrived off the coast of Hawaiʻi in December – during the *Makahiki*, an important time on the Hawaiian calendar. During the 23 day procession of the god Lono around the island, the sea is kapu and no canoes are allowed out to sea, even for fishing. On two occasions, Hawaiians on-shore were seen waving white flags – not as a sign of truce (as some on Cook's ship believed), but as a sign that a kapu was in effect (Sahlins 1995). So, going out to sea would mean bending ritual. In some areas, including off the south coast of Hawaiʻi, Hawaiians did venture out, to trade with Cook and his crew. Sahlins (1995) suggests that because they believed Cook was Lono, and because Lono arrived from the sea, those who did go out rationalized that it was okay because Cook's ship was seen as his temple (*heiau*). They did not go out eagerly, however. In fact, on several occasions the Hawaiians who approached are described as "shy" and needed to be enticed out to the ship. Though not many people ventured out to meet Cook off the coast of Puna and Kaʻū, he was able to obtain "fruit and roots; and at last some hogs were brought off" (Cook 1846). Along the southeast side of the island Cook describes exchanges with very few Hawaiians who would come on-board when they were "five leagues from the shore." Cook felt that either they were afraid of losing items at sea, or were not sure there would be anything to trade, because those who did venture over brought very little. The "principal article secured was salt which was extremely good" (Cook 1846). It was not until Cook rounded the southern tip of the island that he described a "pretty large village" whose inhabitants "thronged off to the ship with hogs and women" (Cook 1846).

After Captain Cook's contact with Hawai'i in 1778, traditional Hawaiian culture underwent dramatic changes. Cooks voyage opened the islands up to a larger world, and the world, in turn, was introduced to Hawai'i. Soon, exploration parties, missionaries, traders, and whaling ships called upon the shores, and over time began to explore the inland zones. Many of them, especially the explorers and missionaries, documented their travels, the natural landscape, and the culture of the Hawaiian people. Native Hawaiian scholars also wrote prolifically about their culture and the changes being brought upon them. Hawaiian newspapers which were numerous and widely circulated are a good source for researchers to access and better understand changes to the culture. Much of what we know about the early historical period in Hawai'i is gleaned from the written accounts from the 18th and 19th centuries, a few of which are directly related to the project area. Many of these are cited below.

Archibald Menzies

The first westerner to mention the Kīlauea area in some detail was Archibald Menzies, Naturalist aboard Captain Vancouver's ship *Discovery*. In 1794 Menzies journeyed up to Hualālai and Mauna Loa, visiting Mokuoweoweo crater. While he did not travel to Kīlauea or the project area, he was the first to mention the volcano there and described the *ahupua'a* of Kapāpala.

William Ellis

The Reverend William Ellis was the first westerner to describe in detail the Puna and Ka'ū Districts, and specifically Kealakomo as he travelled through the area. In 1823 Ellis walked on foot around Hawai'i Island looking for appropriate sites to set up missionary stations for the London Mission Society. He ventured to Kilauea Volcano, and became the first Caucasian to witness an active eruption there. Leaving Kilauea on a "south-east-by-east" path, Ellis and his group walked to the coast and reached "Kearakomo" (Kealakomo) in the early evening (Ellis 2004) (Figure 4.1). Because Ellis does not mention either 'Āpua or Kahue, it is likely that he did not pass through 'Āpua, or Kahue may still have been part of Kealakomo *ahupua'a*. In either case, he took a trail system down the pali that led him from the caldera to the coast at Kealakomo, bypassing both villages (see Figure 4.1).

The first thing Ellis and his group did when they reached Kealakomo was to stop at the first house they came to and ask for water. The taste of the water was not very good, but the group was thirsty, and appreciated the availability as they drank "at every hollow" they came to (Ellis 2004). The Village of Kealakomo was populous, and many of the houses crowded. Mauae, their guide, showed them a hut that Ellis and his group were to stay at. Ellis claimed the *hale* was "miserable" but there was nothing else available. A majority of the locals, he stated, were "in a state of intoxication" likely from a common intoxicating drink made of either *ti* root, sugarcane, or sweet potatoes, all of which would have been available in the area (Ellis 2004).

The inebriated state of the villagers unfortunately left Ellis and his group only able to get a "few cold potatoes, and two or three pieces of raw salt fish" that evening (Ellis 2004). Though drunk, Ellis stated that the villagers thronged around their hut and they discussed Pele, and her abode, of which Ellis and his group had just passed through. The villagers of Kealakomo expressed shock and surprise that Ellis had walked through Pele's domain.

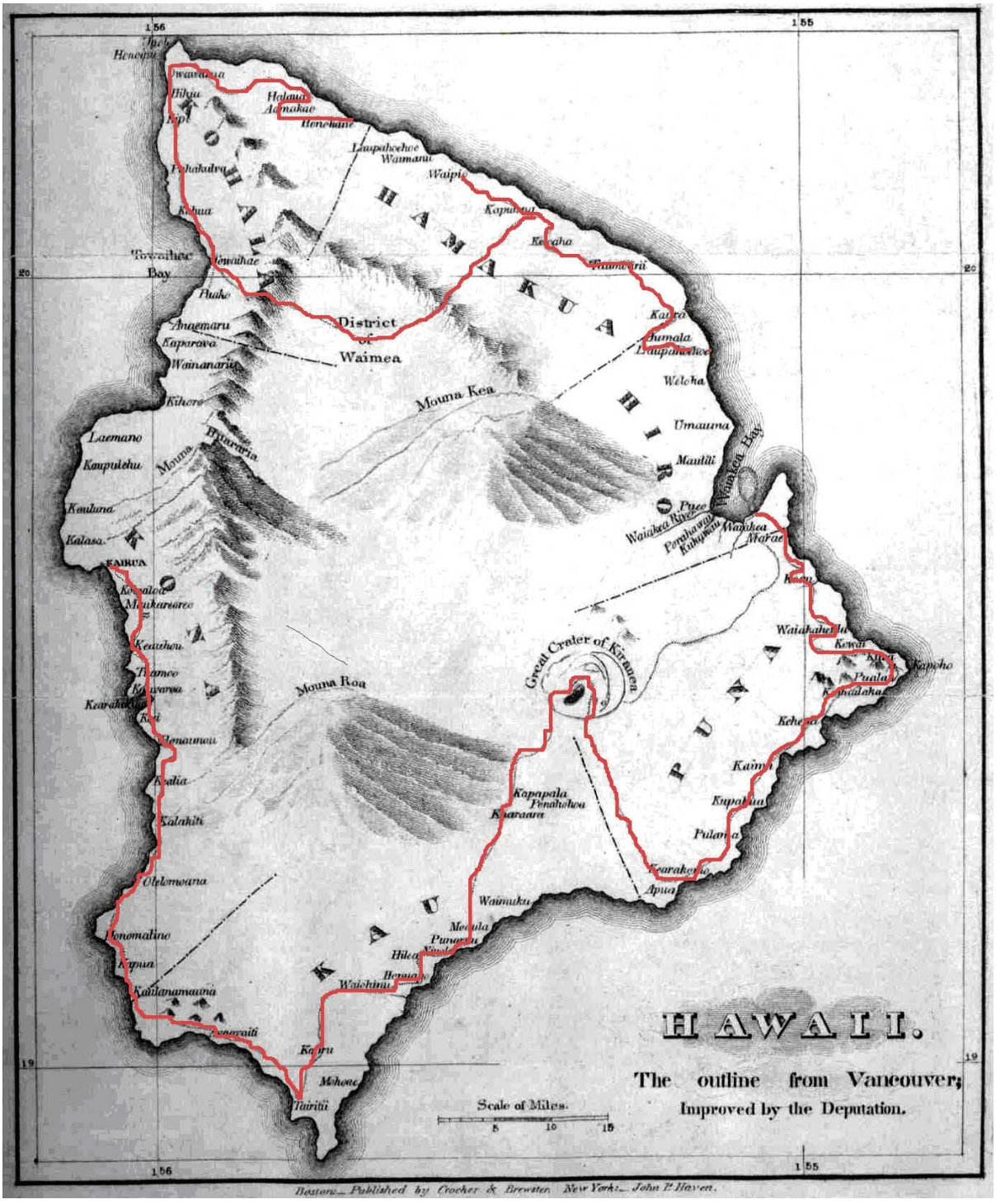

Figure 4.1. Map noting estimated route (in red) of the Rev. W. Ellis.

The following morning Ellis and his group were given two bundles of sweet potato and a chicken for breakfast. Their native guides cooked the meal in an *imu,* and with more brackish water from the area, they enjoyed their first breakfast at Kealakomo (Ellis 2004). The group then participated in a second Sunday service with "three hundred of the people" at noon. The head of Kealakomo village joined the service at noon and later said he would bring them provisions the next day from his inland farm, which likely was in the vicinity of the project area. Ellis informed him that they were going to leave in the morning, so he brought them some fish and baked sweet potatoes then and there (Ellis 2004). Water from nearby mountain caves was also given to Ellis' group. Although the water was bitter from sitting in the calabash placed in the cave to collect it, Ellis state that it was "a luxury, for (their) thirst was great" (Ellis 2004).

As he left Kealakomo, Ellis leaves us with an informative description of the western portion of the Puna coast. He described the coast as "desolate" and was surprised that so many people chose to live at the coast over the inland which he described as consisting of "fertile tracts." Ellis surmises that the locals preferred the coast because of the proximity to fishing grounds. Ellis notes that they saw "several fowls and a few hogs… but tolerable number of dogs, and quantities of dried salt fish… This latter article, with their poe and sweet potatoes, constitutes nearly the entire support of the inhabitants" (Ellis 2004). Dried fish was apparently abundant. The Kealakomo residents traded it in "large quantities" with Hilo and Hamākua *'ohana* for vegetables, *mamake* and "other tapas" that came from these "more fertile districts of Hawaii" (Ellis 2004).

Beyond Kealakomo, Ellis and his group traveled east through the *ahupua'a* of Pānau, Lae'apuki and Kamoamoa. It was not until they had passed Kamoamoa that Ellis stated the landscape started to "wear a more agreeable aspect." Beyond Kamoamoa "groves of cocoa-nuts ornamented the projecting points of land, (along with) clumps of kou-trees" And habitation sites along the coastline were "thickly scattered" (Ellis 2004).

Titus Coan – 1835

Titus Coan was a Congregational minister who applied with the American Board of Commissioners of Foreign Missions (ABCFM) to come to Hawai'i to convert the Hawaiians to Christianity. Coan served in the Hilo Church (now Haili Congregational) from 1835 to his death in 1882. Coan was responsible for evangelizing in the districts of Hilo and Puna and during his years as a preacher came to know the people and the land. His records provide invaluable insight into the past, and he was able to introduce others to these areas as well. He worked closely with the Reverend Lyman of Hilo. Together they split their duties, with Rev. Lyman focusing on teaching at his boarding school for boys, and Coan pastoring and preaching across the two districts (Coan 1882). At the time Coan visited western Puna there were apparently still large numbers of people who lived in this area. Coan describes his experience as follows:

> *"…they rallied in masses, and were eager to hear the Word. Many listened with tears, and after the preaching, when I supposed they would return to their homes and give me rest, they remained and*

> *crowded around me so earnestly, that I had no time to eat, and in places where I spent my nights they filled the house to its entire capacity, leaving scores outside who could not enter… Every village begged for a sermon and for personal conversation. Commencing at daylight I preached in three of them (villages) before breakfast, at 10 a.m. When the meeting closed at one village, most of the people ran on to the next, and thus my congregation increased rapidly from hour to hour"* (Coan 1882).

The large population that still thrived in the districts of Ka'ū and Puna become even more apparent as Coan describes his experiences at his primary station in Hilo:

> *"Soon scores and hundreds who had heard the Gospel in Kau, Puna, and Hilo, came into town to hear more. During the years of 1837-38, Hilo was crowded with strangers; whole families and whole villages in the country were left, with the exception of a few of the old people, and in some instances even the aged and the feeble were brought in on litters from a distance of thirty or fifty miles. Little cabins studded the place like the camps of an army, and we estimated that our population was increased to 10,000 souls"* (Coan 1882).

Some of the newcomers took up what may have been a new, perhaps not so temporary residence, planting sweet potatoes and tar, and fishing. The newcomers also took it upon themselves to build a second house of worship. The larger church was used by the people of Hilo, to hear the gospel preached in the morning of the Sabbath. In the meantime, the people of Puna and Ka'ū would meet in the smaller church. In the afternoon, they would change places and the people of Puna and Ka'ū would then hear the Word of the Lord. Coan estimated that the second structure was built in three weeks, and that nearly 2,000 people filled it. Men and women sat separately on the ground, only a freshly laid layer of grass between them and the compacted earth (Coan 1882).

Despite the large numbers of people from Ka'ū and Puna that thronged to Hilo, Coan continued to visit these areas, preaching to "nearly every person left in the villages (who) came to the preaching stations." Even those who lived a half mile or more inland came down to hear him (Coan 1882).

Chester A. Lyman – 1846

Ten years after Coan began to visit and preach to the people of Puna, Chester A. Lyman, a professor of astronomy, physics, and theology, came to the islands. He visited Puna with Coan in 1846. Lyman's description of the area suggests the population had changed dramatically from the time Coan first started working in the area. Lyman described Kealakomo as the last stopping place for the Reverend Coan, who evangelized throughout the Puna district. Kealakomo was the only place west of Kamoamoa where people could still be found living. There were few people left and Lyman described them as "miserably poor" and "almost in a state of famine" (Lyman 1924). They made their living by "fishing, making salt and getting fern roots and a few potatoes in the mountains" (Lyman 1924). He wrote that the residents at Kealakomo made a living in part by trading their salt for what

he considered a low price. He compares the population at Kealakomo village with Ellis' observations in 1823 and stated that it "must have greatly diminished." Perhaps, as (Coan 1882) seems to have suggested, those who had moved to Hilo stayed, and did not return to their land. Perhaps, as Burchard (1994), suggests, Lyman traveled through the area at the wrong time of day. Burchard (1994) suggests that Lyman visited this village in the middle of the day, when many people would have been out working. Thus, he suggests that depopulation may not have been as drastic as suggested, at least not yet. The epidemics of 1848 and 1849 had yet to strike and the *pulu* trade which drew many people away from their traditional practices was over a decade away. It would seem unusual that a visit from Coan, no matter what time of day, or what day of the week, would not have attracted many to him as they had in the past. Perhaps after ten years of his visits, those that were left were not interested in what either man had to say.

Catholic Priests in the 1840's

The Protestant missionaries were not the only ones preaching in this region and making converts. Catholic priests were also starting to make their mark on the souls of those living in Puna and Ka'ū. In 1840 a Catholic priest named Father Walsh was assigned to Hawai'i island and within a year (1841) he was baptizing Hawaiians in Puna and Ka'ū (McGregor 2007). After the initial visits by Father Walsh, a Catholic priest was soon assigned to Ka'ū and he made periodic visits to Puna. It was not until the arrival of Father Damien De Veuster at Puna in 1864, however, that more baptisms and conversions to Catholicism were made (100 in one year).

Charles Wilkes - 1841

In 1841 Captain Charles Wilkes of the U.S. Exploring Expedition traveled throughout the Puna area and through lands now within Hawai'i Volcanoes National Park. Anchored in Hilo, Wilkes' part made its way to Ola'a, and from there on to Kilauea where they camped on the north rim overnight before departing for the summit of Mauna Loa on a long and eventful journey. The descriptions of the volcano at Kilauea and the ascent up the slopes of Mauna Loa give the reader a good sense of the landscape in the 1840's, but no description of habitation sites outside of the village of Hilo. As it had been for many who came before him, water was a scarce commodity along this trip. At one point the natives who were employed as couriers were trading items of clothing and other goods with each other for a drink (Wilkes 1845). For three weeks Wilkes and his crew remained on the summit, taking measurements and observations. Once Wilkes completed his work at the summit of Mauna Loa, the group returned to Kilauea Caldera where they conducted more studies. They left Kilauea on a route which took them along the row of pit craters to the former village of Nanawale, which had recently been covered by an eruption in May 1840 (Wilkes 1845).

Reverend John D. Paris – mid to late 1840's

The Reverend John D. Paris, who ran the Ka'ū mission station during the mid- to late-1840s, comments on several disasters befalling the district; "Since the year 1845 the work of depopulation of Ka'ū has gone on with fearful repidity…the distressing famine which prevailed in 1845-46" and a bad fire in 1846-47 (Paris 1926). Recent fires that have spread in the region through Hawai'i Volcanoes National Park suggests that fires started by lava flows could have been devastating to the local

residents. The invasive vegetation dominating the area today encourages fierce wildland fires. In the recent past fire started by lava flows, would have been inevitable.

Chester H. Lyman's diary provides testament to the devastation that even a lush landscape can succumb to. Lyman (n.d.) writes of the country below Kapāpala and into Wai'ōhinu as "recently burned over." He goes on to write that "…the black roots of the tufts of grass, the wilted and blackened shrubs, and the smoked stones [presenting] a most dismal prospect for many miles." The fire, he writes, "….consumed houses, taro & potato patches & produced a famine." Area residents reported that there had been a similar fire in 1830 or 1831, starting in the drought-stricken dry grass and the moving into the upland stag-horn fern and "burning over…nearly the whole district" (Handy and Pukui 1958).

Western Ways Imposed on the Native People

The mid-nineteenth century was a crucial time in the history of the Hawaiian people. At this time broad land tenure changes were beginning. The Hawaiian government, at the urging and pressing of foreign nationals, was to forever alter the traditional land system, and in the process disenfranchising many *maka'ainana* from the land. In addition, the Hawaiian people were also under increasing pressure from government taxes, much different than the system of "taxation" traditionally imposed by the *ali'i*. The advent of foreign trade a market economy and the overextension of the monarchy all contributed to the *maka'ainana* abandoning their crops and fields to work outside of their land for foreign interests that served to benefit the king and others.

The Mahele

When Europeans first encountered the Hawaiian Islands in the late 18th century, they found an already well-established system of land division and land use. At the time of Kamehameha I (c. 1753-1819), there were six districts (*moku*) on the Island of Hawai'i, each containing anywhere from 70-to-100 *ahupua'a*. Traditional land tenure was one in which the konohiki managed the land for the *ali'i* by the *maka'āinana*. Lands were ancestral - *maka'āinana* cared for the land given to them to use and they were responsible for the proper use of it (Abad 2000). Land was not owned, in fact, land would often change hands between *ali'i* after conquest, death, or marriage.

By the 1840s, foreigners were seeking western style rights to Hawaiian lands. They desired to clarify commoners' rights to their rural house and farm lots (*kuleana*). In 1846 legislation was passed authorizing a land division or "*mahele,*" (Chinen 1958). On December 10, 1845, the Hawaiian legislature created the Board of Commissioners To Quiet Land Titles, better known as the Land Commission, who were charged with the duty to oversee and process title claims to Hawaiian lands. The Land Commission established a set of guidelines, which became law on October 26, 1846 (Chinen 1958).

In 1847 legislators authorized a quit claim division of lands between the king, on the one hand, and the chiefs and *konohiki* on the other. Some lands were set aside for the support of the kingdom. These series of land divisions became collectively known as the "*Mahele*." The *Mahele* of 1848 divided the land on all of the Hawaiian Islands between Kamehameha III and 245 of his Hawaiian chiefs (Kuykendall 1938; Chinen 1958). On March 8, 1848, Kamehameha III further divided his lands (ca. two-thirds of the lands in the Hawaiian Islands) into crown lands and government lands converting the kingdom's land system into a private land holding system. Crown lands became the personal property of the king, while the government lands were set aside for the chiefs and commoners.

Legislation passed in 1850 provided a procedure for native tenants living on these royal, chiefly, and governmental lands to claim their individual *kuleana*. Testimony from both Hawaiians and foreign residents were taken under oath to clarify landmarks and traditional or known boundaries of the land divisions.

Some native tenants were given the opportunity to acquire title to the lands that they lived on and cultivated. The titles for these lands, known as *kuleana* lands, were given fee simple to the people. However, there are several factors that worked against the *maka'ainana* which subsequently led to many losing their lands. First, claims for these lands had to be made before the Land Commission on or before February 14, 1848. In remote areas of the Islands, the people were often unaware of what was happening or could not make the trip to appear before the Land Commission. Second, there were fees for surveying the lands and a "general cost fee." Many Hawaiians, especially those living in areas where trade or barter were the primary basis of the economy, were not able to afford these fees. Third, one of the provisions for acquiring a *kuleana* award was that it had to be under cultivation. By this time, many people had been drawn away from the land. Some were involved in the sandalwood trade, while others moved to commercial centers and were engaged in money making activities away from home leaving them unable to adequately care for their farms. Fourth, much of the lands of Puna were continually under volcanic activity and this, combined with the belief that the lands of Puna were under the domain of Pelehonuamea may have discouraged residents from making claims (McGregor 2007). Finally, some individuals files late and did not meet the deadline. An 1851 petition by residents of Puna to the legislature asks that their land grants be issued, without penalty, despite missing the deadline (McGregor 2007).

As a result of many of these factors, very few Land Commission Awards (LCA) were granted in the District of Puna. In fact, Puna had the smallest amount of private lands awarded (McGregor 2007). A total of nineteen LCAs were recorded for Puna. Sixteen of these LCA's were awarded to high ranking chiefs - ten of whom were from outside of Puna. These awards included "50,876 acres, four ahupua'a, and two portions of a third 'ili" (McGregor 2007). Only three parcels totaling 32.33 acres were granted to commoners, thereby excluding most of the population of Puna from land ownership. A bulk of the land in Puna was given either to the monarchy, or assigned as government lands to the Kingdom of Hawaii. In McGregor's words this means that "the interests of the majority of the Native Hawaiians in Puna were

never separated out from the lands of Puna and remained vested in the lands held by the Crown and the government" (McGregor 2007).

The Mahele and Kealakomo

Like a majority of the land in Puna, the *ahupua'a* of Kealakomo initially fell under the control of a Chief. Kealakomo was bequeathed to Lota Kapuaiwa, Kamehameha V, by Hoapilikane, Governor of Maui, on May 18, 1842 at Lahaina. The *ahupua'a*, was under Kapuaiwa's control up until just prior to the 1848 Mahele (Kame'eleihiwa 1992). It was designated as government land in 1848 as a result of the *Mahele*.

The survey of Kealakomo as part of the Mahele reveals a wealth of useful information regarding the *ahupua'a* and adjacent lands. Of particular interest is the mention of the "road from Puna to Kilauea" which fits with archeological and ethnohistoric evidence that a trail to the Caldera did indeed pass nearby or through Kealakomo. Below is the boundary description provided for Kealakomo *ahupua'a*:

> *FS Lyman. Sworn*
> *I have been surveying lands in Puna, and know the land of Panau, having surveyed some of the adjoining lands. Panauiki and Laeapuki for foreigners, also a piece of Poo on the pali. I surveyed the whole of the land of Kealakomo, on the South West side, and these pieces have all been patented. I also went with my brother Henry when he surveyed Panau Nui. It was during the time of the small pox in 1853. The konohiki of Panau Nui and his kamaaina went with us, and he and the kamaaina pointed out the boundaries of the land and my brother surveyed as they pointed it out. I surveyed the land of Kealakomo a long time afterwards and surveyed in the same line that Panau Nui was formerly surveyed. I cannot give the names of the place where Kealakomo, Kahue and Apua end. Kealakomo bounds Panau Nui from shore, then Kahue and Apua. The corners are on the road from Puna to Kilauea. We went up to the top of Puuhuluhuu and slept. The konohiki and kamaaina said that was the West corner of the land. I do not remember what land they said bounded it on the mauka side, as I have not been to that place to survey since then. I have only worked towards the shore since that time. One of the points on the boundary adjoining Kealakomo is Kuihupi. We surveyed from this point to the mauka corner of Kealakomo 101.00 chains. From Puuhuluhulu we calculated distance by triangulation to a large ohia tree at the north corner of the land. The North side being the only remaining side was calculated. I think they may have said Kahualea is the land on the north side of Panau Nui. I made out the map of land and notes of the survey, now before the Commissioners from my brothers field book: and Patents of adjoining lands.*
> *CX*

No *kuleana* awards were given for the *ahupua'a* of Kealakomo. In 1850, two years after government lands were made available for sale, an individual named Hewahewa of Ponahawai, Hilo applied for Kealakomo. His name, however, does

not show up in the land tax records (Int. Dept. Letters, October 21, 1850, cited in Allen 1979:32-34). So, it is unlikely that his claim was ever awarded.

There were a total of three land awards in Kealakomo. The first included Grant 2893 which included 4,298.4 acres granted to Kenaaulani and 16 others in 1862. The second was Grant 2166 which included 3.75 acres within Kealakomo Village granted to Palapala in 1856. And the third was a single school grant recorded for Kealakomo as Grant No. 4, Apana No. 9 for 3.42 acres in Kealakomo Village in 1882 (Figure 4.2).

In 1856 a survey of Kealakomo by D.B. Lyman was done for Grant 2166. This grant involved 3.75 acres applied for by Palapala (Int. Dept. Letters, July 24, 1856). A 1954 Territory of Hawaii survey department map (Tax Map Key 1-1-01) notes that "parcel 3" to Palapala is located within the Village of Kealakomo, bounding the ocean. The entire village less this school lot is 10 acres. Rent for Grant 2166 of $8.75 was received by Kaina in 1860.

In 1860, Lyman again surveyed portions of Kealakomo. This second survey was for Grant 2893 to a hui including Kenaaulani and sixteen others who were applying for 4,289.4 acres (see Figure 4.2). Grant 2893 to the 17 individual was awarded in 1862 (see Table 4.1). In 1869 Kaina applied for a five year lease for the ʻili of Kahue, west of Kealakomo for $20.00 a year. Kaina proposed to use the land for pasturage (Allen 1979:49). He was awarded the lease in 1870. In 1874, the land was leased to Jones for $20.00 as well. The next year, 1875, the same hui who had received grant 2893 in Kealakomo tried to purchase the *ʻili* of Kahue. They offered $200.00 at that time for the land in Kahue (Allen 1979:49 citing Interior Department letter dated for Feb. 16, 1875 and December 1875, BK 13 p, 135). The hui does not appear to have been successful in gaining the ʻili that year, and applied again later in 1877 offering to lease the land this time for $70.00 a year (Allen 1979). Another Hawaiian, E.P. Hoaai also requests to lease Kahue in 1876 (Allen 1979 citing Interior Department letter dated Feb. 16, 1876. Subsequent documents show that the ʻili was government land, and that Hoaaiʻs request was deferred (Allen 1979 citing Interior Department letters dated March 6, 1876 and March 20 1876, Bk. 13, pg. 279). Interest in Kahue continued. In 1982 Herman Elderts requested to lease the land, and finally in 1893, O.T. Shipman paid $30.00 in rent for Kahue (Allen 1979).

In 1850, the legislature adopted an act that set aside 5% of all government lands for the general purposes of education (school grants). In 1882 the first school grant was awarded in Kealakomo - 3.42 acres (Grant #4) in Kealakomo was designated as a "school grant". Numerous land actions in Kealakomo occurred from the time of the Mahele up until the ahupuaʻa came under the control of the federal government (see Table 4.1).

Late 19th Century Commercial Activities

With the coming of westerners to Hawaiʻi and the changes in land tenure, also came changes in the economic system. Hawaiʻi went from a subsistence based system to a capitalist based one. And those who owned land in Kealakomo were likely engaged in some form of economic activity that was available to the locals of

the area. The primary industries involved the coastal resources of fish, salt and to a lesser extent *'opihi*, and the interior resources of pulu, ohia wood, sandalwood, and cattle and goat ranching.

Taxes were not a foreign concept to Native Hawaiians, but the form in which taxes were paid, and the amount changed dramatically over time. The maka'ainana were accustomed to paying taxes to the chiefs in the form of food and other goods. However, during the historic period, the maka'ainana found themselves increasingly burdened by more demands for taxes, and many were forced to leave their lands to work in the sandalwood trade, ranching, sugar (introduced in 1802, the first mill built in 1835), rice (1838), coffee (1817), salt (1819), pulu, and other markets to make cash (Kemper and Kamins 1993). In Kealakomo, the traditional trade in salt continued, and from the archeological evidence which remains along the coastline at Kealakomo, Kaena, and Kaheka, it appears that a good deal of the coastline was devoted to this venture.

Salt Trade

Possessing a dry climate and easy access to the ocean, Kealakomo was noted for its production of dried fish and salt. As previously discussed, Ellis (1979) mentions an abundance of dried fish and salt, both of which were used as articles of trade in 1823. Several other early travelers also noted salt being manufactured in the area, and its high quality. In addition to a product for export, Hawaiian salt was also being used to cure the hides and meat of island cattle. Two journal entries, both written in the latter half of the 19th century, provide good descriptions of the methodology used by the residents of Kealakomo to make salt.

Photo 12. Salt drying feature located at the coast in Kaena, east of Kealakomo Village. Note coastal trail to the left of the feature. Photo courtesy of Hawai'i Volcanoes National Park.

The reference to salt production in the project area is from the journal of Chester E. Lyman written in 1846 and is excerpted as follows:

> *"There are but few people in this region, scattered thro' the few poor villages that lie beyond. They are miserably poor, and for some time past have been almost in a state of famine. They get their living by fishing, making salt, and getting fern roots and a few potatoes in the mountains. Their salt works are on the naked lava near the sea, the water of which is evaporated in little cups or vessels made of the Ki leaf, and holding of course but a minute quantity of water. These are laid in parallel rows over several acres, and the water poured into them a little at a time from calabashes. The process is an extremely slow one, though the salt is said to be excellent for the table. It is sold at the exceedingly low price of 25 cents a bag, which will contain I should judge ½ bushel or more…."(Lyman 1924)*

Nearly fifty years later, the missionary Charles Wetmore describes the manufacture of salt in Kealakomo:

> *"At Kealakomo, almost the extreme southern point of Puna, we spent three days. The salt works which I saw there, were a novel site… (vats, shall I call them?) where the saline product was crystallized; most of those (vats?) were constantly growing and decaying in their immediate neighborhood. They were made from the "Ki" leaf, (Cordyline terminalus), which belongs to the Lily family of plants. The people arranged those leaves in the following manner just at the outskirts of their village, where they could readily watch and replenish them. They arranged pebbles in two narrow rows about a foot long between which they inserted these narrow leaves, presenting the forms of little narrow boughs, about an inch and a half wide; into these they poured the Pacific "sea water" for evaporation; they dished it up and bought it to their works from the ocean in calabashes, cocoa-nut shells and; every day they added a little to the salt fluid until there was enough to more than half fill the containers with salt when finished.*
>
> *We had a shower or two while I was there and it was very amusing to see the natives run and cover their vats with other leaves constantly in readiness for such purposes and also for night—coverings as needed; on these covers they placed other pebbles to keep them from being blown away, the people also evaporated some of the sea water in small (natural) hollow basins found here and there in basaltic rocks scattered around them in former years by earthquakes and volcanic activity.*
>
> *In this way they made their salt; then wrapped it up in bags made of the same "Ki" leaves in quantities generally weighing about fifty pounds. Such a bag a man would occasionally bring in on his 'mamaka' to Hilo and sell it for half a dollar. The "mamaka' is a stick,*

(as seen in the daguerreotype) which Hawaiians formerly carried burdens resting it across the shoulders.

Their salt was of course tempered with small quantities of magnesia… lime and minute particles of other mineral substances. Many persons considered their product more delicious than any brought to the island from foreign sources (Wetmore 1894)."

Salt was one of Hawai'i's first exports. It was "carried by some of the early ships in the fur trade back to the Pacific Northwest for curing furs. Another early market was provided by the Russian settlements in Alaska; records show a cargo of salt going to Kamchatka in 1819" (Kemper and Kamins 1993). In addition to the method for producing salt as described above, salt was also "made by natural evaporation of seawater in tidal pools" and "later commercial salt was mined from the bottom of Moanaula Lake" (Kemper and Kamins 1993:45-46). The salt export was significant. In the 1830's exports averaged 2,000 to 3,000 barrels a year. By 1847 it had reached 15,000 barrels and "thereafter declined gradually until exports ceased in the 1880s" (Kemper and Kamins 1993).

Lyman's description of salt production took place before export of the product began, while Wetmore's took place after. Yet both are very similar, suggesting even the heavy demand for the product did not alter the methodology used to make it. From their descriptions, it is obvious that the process for making salt was time consuming and labor intensive. Despite this, it was one of the few products available to the residents of this part of the island, and they took advantage of a demand for their product just as they were being thrust into a market economy.

Photo 13. View of the coastal area and ocean near the salt drying features at Hawai'i Volcanoes. Photo courtesy of Hawai'i Volcanoes National Park.

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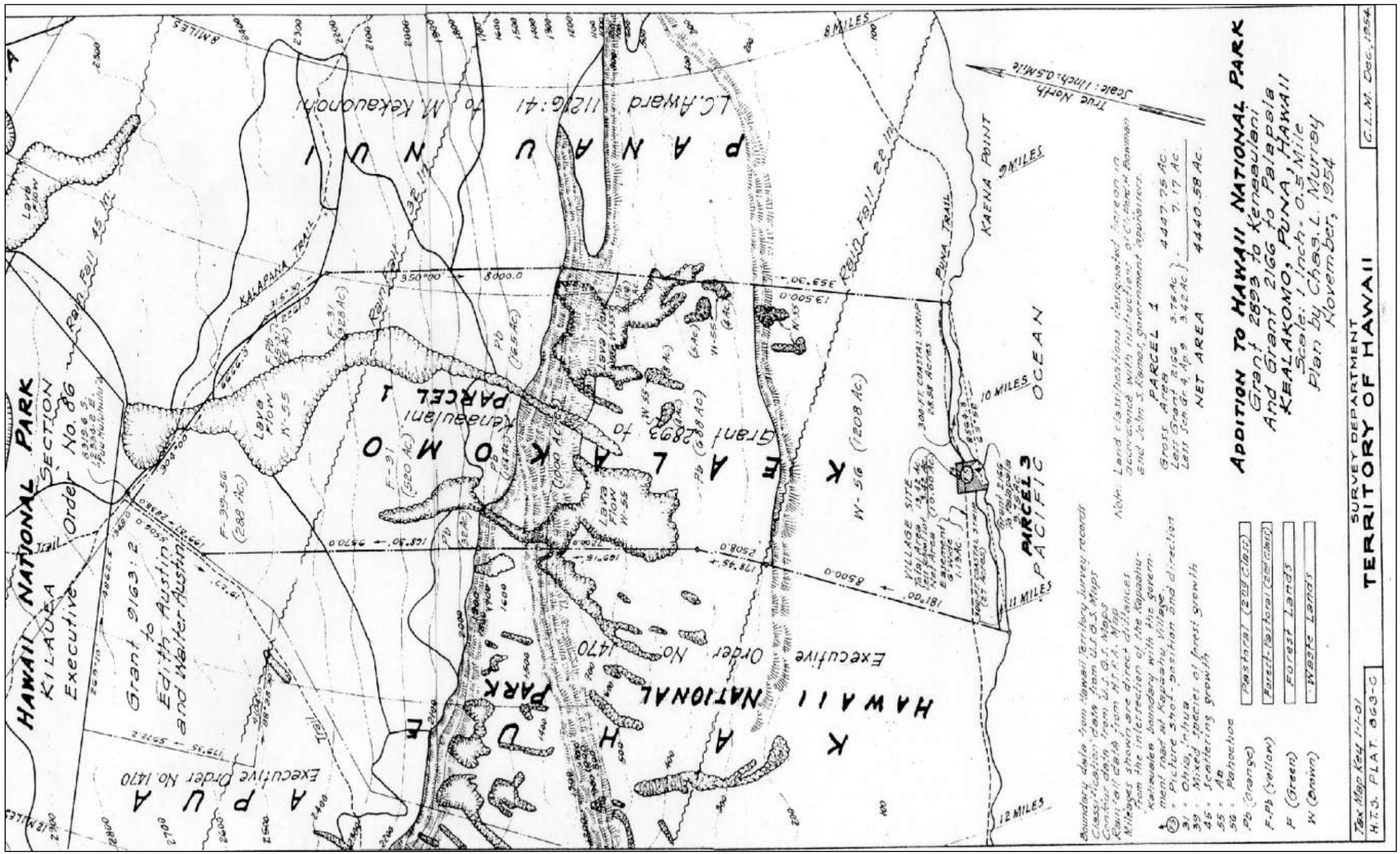

Figure 4.2. Survey Department, Territory of Hawaii Map, TMK 1-1-01, December 1954.

Table 4.1. Land ownership chronology for Kealakomo ahupua'a (from Allen 1979:32-34).

Year	From	To	Acerage	Reference
Ahupua'a				
1842	Hoapilikane (Governor of Maui)	Lota Kapuaiwa, Kamehameha V	Ahupua'a	Kameeleihiwa 1992
1848	-	Government Lands	Ahupua'a	Kameeleihiwa 1992
Grant 2983				
1861		Kenaaulani, Kama, Kauhili, Keaka, Ioane, Kaulunahele, Holokai, Inoa, Naloha, Kahai, Mahu, Palapala, Kaiana, Kekimoo, Kahaka, Kaau, and Kaanaana		Index to Land Grants
1874	Kanaaulani of Honolulu	Jones and Richardson (lease)	A portion	B.C. book 40, pg. 198.
1887	Lukela	Naeole (deed)	84 acres	B.C. book 109, pg. 139.
1888	Mahu	William C. Achie and wife (deed)	3.75 acres	B.C. Book 115, page 88)
1888	Wailehua and his wife, Kaialua	William Achi and wife (deed)	126 acres	B.C. Book 113, page 281
1889	W.S. Kalama, and wife	Kamohoalii, S.W. and wife (deed)	UNK	B.C. Book 189, page 82
1889	Achi	S. Roth (mortgage)	UNK	B.C. Book 115, page 282
1890	S. Roth	Achi (released from mortgage)	UNK	B.C. Book 123, page 217
1890	Achi	Alexander Cartwright Jr. (foreclosure affidavit)	3.78 acres 126 acres	B.C. Book 123, page 201
1891	Achi	Portuguese Mutual Benefit Society of Hawaii and John Cluney	3.78 acres 126 acres	B.C. Book 131, page 302
1892	Joe Mahu	Achi (deed)	126 acres	B.C. Book 188, page 393
1892	Achi	Charles Bishop and Samuel M. Damon of Bishop and Co. (mortgage)	80 shares of stock of the Reciprocity Sugar Co. 126 acres 3.75 acres	B.C. Book 139, pg 266
1892	A.J. Cartwright Estate	Robert R. Hinds (mortgage)	Two pieces of land of Achi	B.C. Book 123, pg 201
1892	Achi	Charles Gulick (Trustee) conveyed by trust deed	All lands mortgaged by him to Bishop Co.	B.C. Book 139, pg 266.
1893	Achi	Charles Hustace Jr. (deeds by mortgage)		B.C. Book 141, pg 298
1893	Charles Hustace Jr.	Charles Bishop and Samuel Damon (deeds to the land acquired by mortgage deed from Achi)	126 acres from Wailehua and 3.75 acres from Mahu	B.C. Book 141, pg 300
1893	Achi	Bishop Co. (Foreclosure affidavit)	portions of Grant 2893	B.C. Book 145, pg 24

Table 4.1 Continued.

Year	From	To	Acerage	Reference
1896	John Cluney	Robert Hind (Assignment of Mortgage of Achi)		B.C. Book 131, pg 304
1899	Achi	deeds to Bishop and Co.	portions of Grant 2893	B.C. Book 198, pg 440
1898	Malimali and husband	N.G. Peterson (deeds to)	504 and 10/17ths of the interior of Grant 2983	B.C. Book1 86, pg 148
1898	Rahela Kupono and husband	Fred Meyer (deeds to)	3 shares in Grant 2893	B.C. Book 189, pg 124
1899	Maikai (w)	Fanny Strauch (deeds to)	2 and 2/10ths acres of Grant 2893	B.C. Book 201, pg 37
1940	W. Tin Yan(1/17), Alice K. Lane (12/17), Solomon Lalakea (1/17) and George T. Poteet (3/17).		Grant 2893	
1951		condemned by Executive Order 1416	Gant 2893	Executive Order 1416
Grant 2166				
1882	School Grant 4:9 issued	owned by John C. Lane (Territorial Senator and husband of Alice Lane	Grant 2166	Index to Land Grants (Apple 1954:28).
		condemned by Executive Order 1416	Grant 2166	(Executive Order 1416).

B.C. = Bureau of Conveyances

---(No date available) Owners of Grant 2893	Share 9: Share of Holokai – 13 owners
Share 1: W. Tin Yan – full owner	Share 10: Share of Inoa – 3 owners
Share 2: Share of Kama - 41 owners	Share 11: Share of Naloha – 3 owners
Share 3: Solomon Lalakea – full interest	Share 12: Share of Kahai – Solomon Lalakea full interest
Share 4: Solomon Lalakea – full interest	Share 13: Share of Mahu – Solomon Lalakea full interest
Share 5: Share of Keaka – 10 owners	Share 14: Share of Palapala – 16 owners
Share 6: Share of Kaau – Solomon Lalakea full interest	Share 15: Share of Kaiana – Solomon Lalakea full interest
Share 7: Share of Ioane – Solomon Lalakea full interest	Share 16: Share of Kekimoo – Solomon Lalakea full interest
Share 8: Share of Kaulunahele – 2 owners	Share 17: Share of Kahaka – 46 owners

Pulu Processing

A second industry that was available to the residents of west Puna was the pulu trade. The pulu trade began in 1851. The practice involved the harvesting the silky fiber (pulu) from young fronds of the *Hapu'u* tree fern (*Cibotium* spp.). The pulu is found where the leave or stem shoots out of the stalk. Only a small amount, about two to three ounces, can be gathered from each plant, and it takes approximately four years to reproduce this amount. It is possible that sale of this material preceded 1851, but records from the Customs house in Hawai'i show records of sales and shipments from 1851 (see Table 4.2). The industry lasted from 1851 to 1885. Locals supplied the material to merchants who sold the material to California factories as pillow and mattress stuffing (Degener 1930).

Table 4.2. Sales and Shipments of Pulu between 1851 and 1854.

Year	Amount (lbs)	Year	Amount (lbs)
1851	2,479	1855	82,558
1852	27,088	1856	247,740
1853	12,739	1857	260,560
1854	34,031	1858	313,220

Though the Hapu'u tree could be found on most of the main Hawaiian Island, the trade was primarily limited to the Hilo, Hamākua and Puna areas of Hawai'i Island (Hooker 1861). Mr. Harris was the principal dealer for pulu and leader in the trade. He apparently came upon the business by accident. In an 1854 lawsuit he brought upon a storekeeper, he was awarded 800 pounds of pulu as the judgment. Worth ve3ry little at that time, he shipped it to San Francisco where they got 28 cents per pound. Realizing they could make money from this, Harris started to trade in the product and soon two thirds of the market was supplied by him (Hooker 1861).

Western Puna played an important role in the *pulu* industry. In 1860 Abel and C.C. Harris and Frank Swain leased the ahupua'a of Panau so that they could harvest the *hapu'u* there. Judge George Anson Kaina of Hilo and Heleluhe requested to least government land in Lae'apuki and Panauiki for harvesting and processing of pulu (McGregor 2007). The center of the pulu trade in Puna, and the location in which the material was processed was located a mile and a half to the north of the project area at the Pulu Processing Center (aka Pulu Factory). Kaina owned the Pulu Factory which processed the soft, golden fiber covering of fronds. The Pulu Processing Center situated within the *ahupua'a* of Panau Nui (in Nāpau) at the 2800-foot elevation was reliable supplier of the material. Entire families (men, women and children) from Puna and Ka'ū were employed at the center where the *pulu* was processed and baled, then shipped to Keauhou Landing for storage in Honolulu (Glidden 1998).

Those who worked for Judge Kaina earned approximately $1.50 - $3.00 per month. With this money they were allowed to buy various goods, including western products, on loan at a cost beyond their means. This resulted in the worker being indebted to his/her employer forcing them to continue to live in the pulu regions and ultimately losing their land and homes (Rivoli 2000).

Two to three thousand people were engaged in the trade. Those who picked the pulu would get five to six cents per pound when delivered. Dealers preferred the pulu be dry when it was weighed because the water added to the weight (Hooker 1861). Because pulu was often collected in the wet rainforest areas, it often took several weeks to dry (Hooker 1861). The method for collecting, drying, packing and shipping improved each year, however, and they were shipped out in "closely packed wool bales" (Hooker 1861). The export of pulu between the 1860s and 1870s averaged between 400,000 pounds a year (Kemper and Kamins 1993).
Unfortunately, the pulu trade had a down side, especially for those maka'ainana who were employed in the trade. Thrum (1929, cited in McGregor 2007) wrote:

> *"The sad part of the story lies in the fact that the industry caused homes in various sections to be broken up, the people moving up into the forests to collect pulu. In many cases whole families were employed, who provided themselves with rude shelter huts meanwhile, to live long periods at a time in damp, if not actually rainy quarters, without regular and proper food, that resulted in colds and illness."*

Wild Goat Trade & Goat Ranching

Of all the ventures that took place in the area, goat ranching has left the most enduring legacy. Goats, (*Capra hircus*), were first introduced to the Hawaiian Islands on February 2, 1778, by Captain James Cook (Tomich 1986). Cook first brought goats to the island of Ni'ihau. Within a year they had increased to six, but all were killed in a dispute between rival Kaua'i and Ni'ihau chiefs. Cook likely introduced goats to Hawai'i Island before his death because by 1792 when he arrived at Kealakekua, chief Tianna [Kaiana] "already had several goats" (Tomich 1986). A second introduction to Hawai'i Island was made by Captain George Vancouver circa 1793.

Both of these initial introductions were primarily to provide a supply of meat for subsequent explorations. The goats reproduced enthusiastically and soon they were abundant and widespread on Hawai'i Island (Marques 1905 cited in Tomich 1986). They soon became a trade item. Goats were systematically trapped even in remote places (Tomich 1986). From 1836 export of cattle hides and goat skins had reached 6,000 and 20,000 respectively. By 1850 there was a thriving trade in goat hides in the Hawaiian Islands, with 26,514 hides being exported to the United States of America in the first year alone. By the 1860's and 1870's that figure had risen to 20,000 hides and 50,000 skins annually (Kemper and Kamins 1993).

Hawaiians would also salt and dry the meat, all being exported each month. Initially, vessels would harbor at Ka'u but soon the harbor there was not safe and the locals had to look elsewhere to ship their goods.

> *"We see nothing but a bad report of the safety of our harbours, to prevent them from coming and doing a fair business. Now all the produce must be carried to Hilo on the backs of men or animals…for a few months past, the people have been unusually active in planting taro, potatoes and onions, having been encouraged that vessels will come bye and bye for their produce" (Station Reports 1851).*

The importance of wild goats to those who lived in the Puna and Ka'ū region is highlighted by the Boundary Commission records, where the hunting of them are noted, and their ownership described by the ahupua'a they were in. Tuggle and Tomonari Tuggle (2008) write "hunting of feral goats is mentioned by numerous witnesses before the Boundary Commission in the 1870s." They go on to say that "although the traditional *ahupua'a* system had long since been abandoned, witnesses still described "ownership" of the wild goats by *ahupua'a*."

Goat ranching began in Puna and Ka'ū in the latter part of the nineteenth century. Phillip Hafner, a local rancher ran a flock of goats in the neighboring *ahupua'a* of Pānauiki and Lae'apuki as early as 1862 and tax records for the area indicate that area rancher, C. J. Pea was taxed for 1000 goats in Pānau (Allen 1979). Presumably, Kealakomo was also used as pasturage as there are no physical boundaries that would prevent the movement of goats. The progeny from these early flocks soon became a management nightmare.

By the early twentieth century, feral goats were a source of both frustration and sustenance. While feral goats provided a source of meat for Native Hawaiians in the area, they were also destroying crops. One writer remarked, "Soon after their release, they began to encroach on the cultivable lands, while to their depredations was also attributed in part the destruction of forests" (Marques 1906). Another writer called goats "a voracious pest" that "constitute a real and serious menace of which only a few are aware" (Judd 1922).

Emma K. Kauhi, a resident of nearby Kapa'ahu relates that, in 1925, the men from Kapa'ahu would go into the mountains in Paliuli in Pānau to hunt goats, donkeys, and wild cattle. A preferred method of capture was to chase the goats either on foot or by horseback till they could be lassoed or driven into a corral. Ms. Kauhi states that "A whole lot of men would go and build a corral and drive the goats inside. And they would be shared out to all the people" (Kauhi 1996). Undoubtedly, at least one of the larger features in the project area is of this origin, see feature C – 25. These methods were adopted by land managers in their early goat suppression efforts and were mutually beneficial to both the Native Hawaiians in the area and land managers as illustrated in the following;

Another well – planned drive was held in Ka'ū and Puna in cooperation with neighboring ranches and the NPS on May 19, 1931 and 70 mounted persons were successful in driving 3048 wild goats into the Apua Point corral by noon. From this place the goats were driven to Kalapana for slaughter and use by the 25 native Hawaiians who had been hired to assist in the drive (Agriculturalist 1933).

Tuggle and Tomonari Tuggle (2008) go on to write that "by the early 20th century, wild goats had become a major problem on Mauna Loa. Periodic goat drives were held with the cooperation of the territorial government, ranchers, and plantation owners in Ka'ū and Puna. Within park lands there are goat corrals noted across the landscape including at Laeapuki (HV-328), Apua and Kealakomo. Tuggle and Tomonari Tuggle (2008) citing a 1929 report to the territorial Board of Commissioners of Agriculture and Forestry (Honolulu Star-Bulletin 1929:37, brackets added) reports that:

"Five goat drives were held on Hawai'i during the biennium [1926 to 1928] in cooperation with land owners and with plantation managers who have loaned their men for a day, the pay for their hire being goat meat. In this manner, 1,669 goats were driven from the lands below Kilauea Volcano, 2,949 goats from the land of Kahuku and 100 from Kapapala, a total of 4,718 goats."

The 1929 Territorial Board of Commissioners of Forestry and Agriculture likened the control of goats to "warfare" which "must be continued on Hawai'i where the inaccessible lava flows provide retreats and breeding places" (Tomich 1986). In 1931 the goat population on Hawai'i Island had exploded to 75,000 (Tomich 1986). In Ka'ū a fence was erected along the southeast flank of Mauna Loa to keep the upland goats from invading the forests in the lower elevations.

Hawai'i Volcanoes National Park was also heavily engaged in controlling goats on park land. But, despite their best efforts, the NPS was not able to get control of the "goat problem" until the 1970's. Early goat drives were too sporadic and the Park Service lacked the funds and personnel to be effective. At one point the NPS adopted a program that enlisted the help of private hunters, but the project failed amid rumors of favoritism in the permitting process and inadequate kill numbers. From 1938 – 1941, personnel from the Civilian Conservation Corps (CCC), were enlisted and were highly effective in their suppression efforts which included organized drives and strategically placed fences around the Park. The onset of World War II ended this program. From 1944 – 1955 contracts were given to private individuals who were forming goat control companies. This program was discontinued because not enough goats were being removed. Apparently, goats were a source of income for the hunters and they had no intention of eradicating their source of livelihood. From 1955 – 1970 NPS employees were the sole means of goat control. During this time the NPS was relatively successful in their suppression efforts, but goat control is still a management issue today.

Photo 14. Prodginy of ancestral goat populations in the park on Mauna Loa in the 1970's. Photo courtesy of Hawai'i Volcanoes National Park.

At present the coastal and mid – elevation areas of the Park are devoid of goats, but there have been occasional sightings of individual animals and small groups from time to time. Also, there are elusive vestigial flocks that roam the rocky, upper slopes of Mauna Loa.

Population Changes in Puna

When Ellis, Coan, and Lyman traveled through the western portions of the district of Puna, they noted maka'ainana living primarily along the coast. They made very little mention of Hawaiians living in the uplands. This would leave one with the impression that the uplands were devoid of house sites and habitation. However, we know from the archeological record that maka'ainana also lived and sustained themselves in the uplands, not only at Nā ulu, but in Kealakomowaena, Holei, and Panau (Figure 3.3). As local residents both on the coast and in the uplands moved away from traditional means of sustaining themselves through farming and fishing, they engaged in commercial activities that were available in the local areas such as the salt, pulu, and goat trades as discussed above. Eventually, however, these markets also dried up, and more and more local residents were forced to venture further and further beyond their home villages to gain employment.

Many local residents were forced to work outside of their land – often walking miles to reach their jobs. Such was the case of Samuel Oulu Konanui's father. Samuel was an informant to archeologist Kenneth Emory in 1959 and related this story about his father:

> *Here is a little something about Kealakomo. There was a schoolteacher who lived there whose name was Kaho'owaiwai. He taught school at Kahauale'a. He taught his school in Hawaiian. When school was over, he went back to Kealakomo. The distance is about twenty miles, more or less. He did this five days a week. Before going to school he would take sweet potatoes from three to five mounds, then he would take a bath and eat. At 7:30 he would leave, at nine be at school. If a horse tried to match his speed in walking the horse couldn't catch up to him. The school where Kaho'owaiwai taught stood at Kahauale'a, but the sea came up and washed it away. The school was then moved up to a place now called Ka – pa – kula"* (Emory, Cox et al. 1959).

Overall, despite the industries available to the residents of western Puna and eastern Ka'ū, the populations there had little money. Chester Smith Lyman traveled through the vicinity of Kealakomo circa 1845 and commented on the general economic condition of the people of Puna. He states that "Probably there are not ten dollars in money in all Puna and it is tho't that not over 1 in 500 has a single cent" (Lyman 1924).

As the maka'ainana was being pushed further and further into a market economy, and as local options dwindled, some families moved out of the area. The census information collected by the early missionaries and then later the government provide information regarding the overall trends in the population. The information contained in Table 4.3 on the census of Puna was taken from McGregor (2007) (citing Robert C.

Schmitt, *The Missionary Census of Hawaii*, Pacific Anthropological Records 20, Honolulu, Bernice P. Bishop Museum Press, 1973 and Charles Baldwin's *Geography of the Hawaiian Islands* published in 1908). The table shows a 96% decrease in population between 1823 and 1960. This dramatic decrease even takes into account the influx of plantation labor in 1900 with the development the Puna Sugar Company in Kapoho, the first sugar plantation in the district of Puna. If we look at the population estimate just four year prior to the plantation, in 1896, the population decrease, which likely measures primarily Hawaiians is 98% - almost a complete collapse.

Table 4.3. Puna Census from 1823 to 1960.

Year	Population Estimate	Source
1823	142,050	Ellis, 1823, in Journal of William Ellis
1832	12,755	Jarves, History of the Hawn Islands (1872), p.202 (North Hilo and South Hilo included)
1834	4,000	American Board of Commissioners for Foreign Missions
1835	4,807	Ke Kumu, April 13, 1836
1854	2,702	Lyman, letter to Armstrong, Jan. 14, 1854
1860	2,158	Anderson, Hawaiian Islands, p. 278
1866	1,932	Jarves, History of the Hawn Islands (1872), p. 202
1872	1,228	Thrum's, 1876
1878	1,043	Gen'l Supp. Of the Census (G.S.P.), Dec. 27, 1878
1884	944	G.S.P., Dec. 27, 1884
1890	834	Bureau of Public Instruction, G.S.P., Census, 1890
1896	1,748	Department of Public Instruction, G.S.P., 1896
1900	5,128	Twelfth U.S. Census: 1900
1910	6,834	Thirteenth U.S. Census: 1910
1920	7,282	Bureau of Health Statistics, Board of Health, pop. Est.
1930	8,284	Fifteenth U.S. Census:1930
1940	7,733	Sixteenth U.S. Census: 1940
1950	6,747	Seventeenth U.S. Census: 1950
1960	5,030	Eighteenth U.S. Census: 1960

This reduction in population from a high in over 100,000 individuals in 1823 when the first missionary traveled through the area, to a low in 1890 of 834 is consistent with the trend that was happening throughout the Hawaiian Islands since the arrival of Captain Cook. Decimation from foreign introduced disease is one of several causes for this decline. The Hawaiians had no immunity to diseases such as syphilis, smallpox, and measles, and large numbers of the native population perished as a result. One writer remarked that "The mortality among the native children is very great, and it is computed that full one – sixth of the population die annually, the foreign residents, however, appear to enjoy excellent health…" (Jenkins 1853). When Ellis reached Kealakomo he described Kealakomo as a "populous, though desolate looking village" (Ellis 2004). However, as western influences expanded across the islands, populations in outlying areas such as Kealakomo were further reduced as people began moving away to commerce centers in the pursuit of money to pay for foreign introduced goods.

Tax Records

Both land records and census counts provide valuable information on population, but both can be skewed. Census are prone to errors such as who the census taker got their information from, whether those giving the information were being truthful or trying to withhold information, and whether the census taker accurately recorded the information given. Land records can also be skewed, as they only provide information on those who were participants in western style land ownership. While the land and census records suggest that people were still present in Puna and Kealakomo well into the twentieth century, what about maka'ainana who did not own land, or who did not happen to be around when someone was passing through the neighboring village taking a count? Tax records can provide additional information on these individuals as well as an insight into some of the animal property owned by these individuals and present in the *ahupua'a*.

During the historic period in Hawai'i, there were several types of taxes levied against Native Hawaiians. An animal tax was levied on all unlicensed horses two years or older at a cost of $10 per horse. All licensed horses and mares over two years of age were taxed at $0.50 each. All mules over the age of two were taxed at $0.25 each and all dogs were taxed at $1.00. Exceptions were made for animals belonging to the King, Foreign Representatives, or representatives of the Government.

A school tax of $2.00 per person was applied to all males in the kingdom fifteen years or older. The exceptions to the school tax were given to the King, all non-naturalized foreigners, all foreigners resident in Honolulu that were subject to the Honolulu Foreign School Tax, school masters who were employed as such, all soldiers in service, and all elderly parties (age not defined).

A road tax of $2.00 was applied to every male, whether foreign or naturalized between the ages of 16 and 50. If the individual was unable to pay the cash, he had to perform six eight hour days of labor annually. Exceptions for this tax was made for the King, diplomatic and consular agents of foreign governments, employed school teachers, firemen, the insane, invalids, and those unable to work because of long-term illness.

A poll tax of $1.00 was levied against all males over the age of twenty. For those males between the age of 15 and 20, a tax of $0.50 was applied to each. These poll taxes were applied to males whether they were native or naturalized. The first tax records for Puna date from 1858 and over a period of forty years, they provide a rough estimate of population size and distribution. Data specific to Kealakomo were extracted from the records and organized into a table for this report (see Table 4.4).

Natural Disasters

Located in the shadow of Kilauea volcano, the residents of Kealakomo and other adjacent ahupua'a in both Puna and Ka'ū were continually under the influence of Pele – their land, homes, crops, and lifestyles under constant threat from earthquakes, lava flows, chocking gases and tidal waves. The *ahupua'a* of Kealakomo and Panau are particularly vulnerable to earthquakes and is known for many tremblers (Don Swanson pers comm). Over 400 years of eruptive events have been documented in Hawaiian oral traditions through chants and legends (Swanson 2008). The period A.D. 1400 – 1800 is an especially rich time period for scientists who are correlating the geological

records with the cultural record. It is also the timeframe in which initial colonization, expansion and settlement would have taken place in the Kealakomo area and therefore fits well with our attempts to understanding the pattern of human history in this part of the park.

Initial colonization of the project area and perhaps this part of the island correlates closely with the end of the 'Aila'au flow, which geologists have dated to AD 1470. The earliest date from the project area comes from Roadcut cave (Site 25940) and dates to the early 15th century (AD 1437-1634). Soon after the end of the 'Aila'au flows (not more than 100 – 150 years), the caldera collapsed (some time at the start of the 16th century), and explosive eruptions were more common (Swanson 2008:429). Though people living in Kealakomo were likely impacted by these explosive eruptions, the threat posed by the 'Aila'au lava flows had ended.

Earthquakes often accompany eruptions, though they may occur without any eruptive event as well. At times, as a result of large earthquakes, locally generated tidal waves (also known as tsunami) can occur. There have been several large earthquakes and subsequent tidal waves recorded in the historic period, the most destructive events that have impacted the project area and larger Puna and Ka'ū districts occurred in 1868 and again in 1975. The 1868 earthquakes and subsequent tidal wave was, up to that time, the largest, longest sustained, and most devastating set of events. For the people on Hawai'i Island, the event started on the morning of March 27, 1868 and continued on through April 2, 1868, when the largest earthquake ever to occur in the Hawaiian Islands during the historic period struck. The magnitude of the earthquake on April 2 is estimated to have been 7.9 with an epicenter located approximately five miles north or northeast of Pahala (http://hvo.wr.usgs.gov/volcanowatch/1994/). The event triggered eruptions at Kīlauea Iki and on the Southwest Rift Zone, and caused a large mud slide in Wood Valley, Ka'u. The tidal wave was especially destructive, especially to archeological sites along the coastline from Hilo to South Point. An account of the event taken from an undated source in the park archives follows:

> *"The great earthquakes of 1868 caused a tidal wave (Kai'e'e) to sweep the coast from Kahuku to Kapoho. The schooner "Oldfellow" was cruising along the coast of Hilo, Puna, and Kau about the time of the sea-wave and the eruption (of Mauna Loa), and from the report of a passenger the following notes are extracted:*
>
> *"…Sunday April 15, 1868. Made Kealakomo, Puna, at daylight. The houses nearest the beach are gone; the same at Kahue. All swept clean at Apua.*
>
> *Reaching Keauhou, Kau at seven a.m., and anchored. Found the anchorage and boat landing all right. Every building, eleven in all, washed away…Men who were at work near the beach at the time of the shock (April 2), say that the wall of stone buildings were thrown outward by the shock, which was so severe that they were themselves thrown off their feet; then the sea came pouring over the rocks which lined the shore, and they escaped being overtaken, by the hardest kind of running. No one was hurt." (HAVO Archives, n.d.:16)*

An account by Frederick Lyman gives a good sense of the frequency of the quakes over this period of days. Lyman writes:

> *On March 27, 1868 "between 9 and 10 o'clock, a slight tremble, soon another, and another, at short intervals. Bella tried to keep a record of them, but soon gave it up, when they went into the hundreds during the day – some of them… continued thro the night…with more earthquakes increasing in violence. On Saturday, just after lunch, there was a hard one, peculiar, it seemed as if we moved backwards and forwards, 2 or 3 feet each time, for several seconds – it made the small children seasick – and it threw down some of our stone walls…but the earthquakes kept on too – every few minutes, often we could hear it coming from the south, then give us a good smart shake and pass on towards Kilauea, North East from us – at night it made the house rock and creak like a ship in a heavy sea, and we could not sleep… about 4'oclock (on the final day) it shook as usual, but did not stop – shook East and West, North and South, round and round, and up and down – lessen, then increase in violence. It was impossible to stand; we had to sit on the ground, bracing with hands and feet to keep from rolling over (Lyman 1924)."*

Titus Coan pastor to the people of Puna from 1835-1870, wrote in 1871 article for Scribner's Weekly in which he said:

> *"For four days this state of things continued, until at 4 p.m. on the 2nd of April, 1868, an event occurred which defies description. Such a convulsion has no parallel in the memory, the history, or the traditions of the Hawaiian Islands. The shock was awful. The crust of the earth rose and sunk like the sea in a storm. The rending of rocks, the shattering of buildings, the crash of furniture, glass and earthenware, te falling of walls and chimneys, the swaying of trees, the trembling of shrubs, the fright of men and animals, made throughout the southern half of Hawai'i such sense of terror as had never been witnessed before…. In the district of Kau more than three hundred shocks were counted upon this terrible day; people were made seasick by their frequency. By the culminating shock, nearly every stone wall and house in Ka'u was demolished in an instant… At* Kealakomo the salt-works are destroyed and the foundation on the shore sunk. …" [i]

The following account was taken from the native Hawaiian newspaper Ke Alaula a portion of which is excerpted here:

> *"The most terrible quake. At four o'clock in the afternoon on Thursday, April 2nd , there was a strong and terrifying quake that shook Hawaii, Maui, Molokai and Oahu. On the south side of Hawaii, it was the strongest. Houses were cast down, stones rolled down the cliff, the stone church in Kau was destroyed. The ground cracked open in Kau, and gaping fissures opened in the government road at Kilakaa, Kau. The quake was so fearfully strong in Puna, Hilo, Kona, Hamakua, and Kohala, that the people there fled outside of their houses"* (Maly and Maly 2005).

Brigham describes the quakes in the following passage:

> *About ten o'clock a.m. on the 28th (Saturday), a series of earthquakes began, which has continued at intervals for nearly eight months... From this time until the 10th of April the earth was in an almost constant tremor... The culminating shock occurred on Thursday, April 2nd, at twenty minutes before four in the afternoon. Every stone wall, almost every house, in Kau was overturned, and the whole was done in an instant (Brigham 1909).*

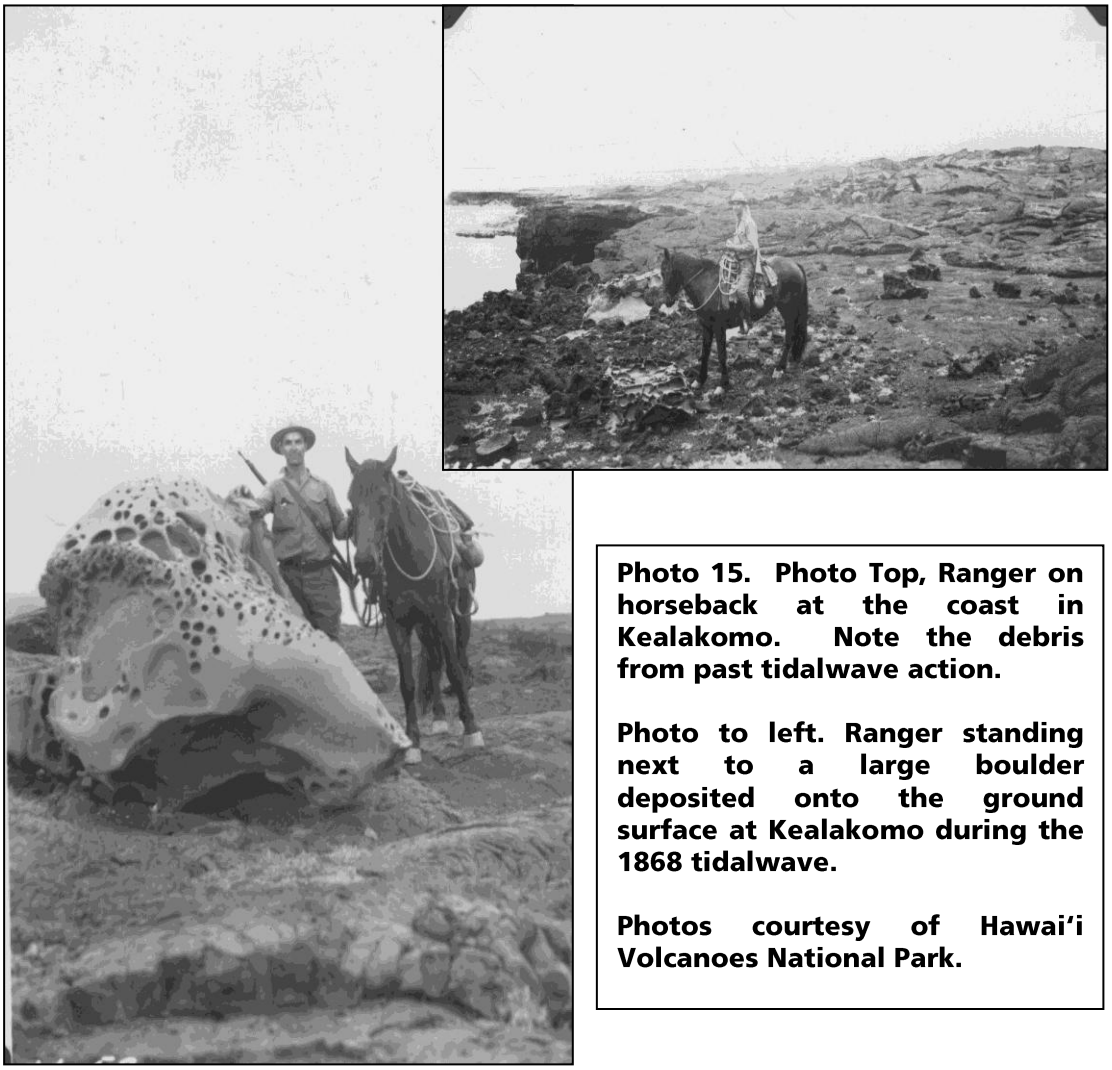

Photo 15. Photo Top, Ranger on horseback at the coast in Kealakomo. Note the debris from past tidalwave action.

Photo to left. Ranger standing next to a large boulder deposited onto the ground surface at Kealakomo during the 1868 tidalwave.

Photos courtesy of Hawai'i Volcanoes National Park.

Earthquakes, tidal waves, lava flows and mud flows were not the only natural disasters to impact the people of Ka'u and Puna. Drought was also a big concern in this region that was already on the ecological margin. Just five years prior to the devastating 1868 seismic events, the area faced a terrible drought and subsequent famine that was compounded by wild cattle and horses ranging over lands once used for cultivation, as well as the pulu trade, which drew away an important labor component. In 1863 the Reverend Gulick wrote:

> *"For two years famine has raged in Kau—that is to say, taro & poi have been scarce… The effect of the famine has been to send many of our people to Hilo, Puna, Kona and Oahu to sojourn. Still there is but little suffering from the famine as the mountains contain a bountiful supply of pala fern and ti-root which afford a tolerable substitute for the taro"* (Gulick 1863).

While the population across Puna declined because of death, disease, and out-migration to commerce centers, there were families who continued to live in the district and utilized the lands within Kealakomo and neighboring *ahupua'a* for its vital resources. These *maka'ainana* continued to base their primary livelihood on fishing, hunting, and gathering. Crops were likely limited to small family gardens consisting of sweet potato, some dry upland taro, banana, and breadfruit.

Kalapana Extension

In 1932, the Superintendent Leavitt tried to use the availability of federal funds to extend the Chain of Craters Road to Kalapana as a bargaining chip for expanding the park boundary. Leavitt proposed that if the Territory of Hawaii acquired the land for the park, he would gain federal funds to build the road. When Superintendent Leavitt lobbied the Director of the Park Service for the extension, he suggested that there was "no opposition" to the proposal. This, in fact, was incorrect.

The Congressional Act of June 20, 1938 authorized the inclusion of the Kalapana Extension and the Footprints area to Hawaii National Park (Figure 4.3). The original lands proposed for inclusion into the park included Kalapana Village and Kaimu black sands beach (Apple 1954). The Congressional act of June 20, 1938 (Public Law 680, 75th Congress, 52 Statute, 781), which authorized the extension, however, did not include these areas, but it did authorize the inclusion of 49,340 acres. The Kalapana Extension consists of lands extending from lower Keauhou east to Poupou. It took over 20 years of discussions and negotiations, however, for the entire addition to happen. The name Kalapana Extension, however, stuck, perhaps because the intent of extending the Chain of Craters Road to Kalapana remained a primary goal.

Superintendent Wingate listed the following individuals as having been involved in drafting Public Law 680: Lawrence M. Judd, Victor Huston, Samuel Wilder King, Joseph R. Farrington, Alfred Carter, Princess Kawananakoa, the Mamalahoa Chapter of the Order of Kamehameha, Herbert Ahuna, the Hawaii County Board of Supervisors and the Hilo Chamber of Commerce. The biggest and active opponents to the bill were Territorial Senator Thomas Pedro and the Hawaiians living at Kalapana (Apple 1954; Apple 1955).

Wingate was very supportive of the extension and argued that the bill which created the extension was a good one, because it protected what he saw as the only "right" Hawaiians had in the area – fishing, and in his eyes added others such as homesteading and employment (Apple 1954; Apple 1955). Wingate also stated that only two individuals, Gabriel Pea and W.J. Stone owned land in the proposed extension, and both agreed to sell (Apple 1954; Apple 1955). Though Wingate was the one who insisted on adding the provisions described above, he did not seem to fully understand the extent to which the maka'ainana were connected to the land.

Negotiations For Kealakomo Stalls

Despite the disagreement between the government and the Kalapana people, the Territorial Legislature authorized the condemnation of 4,289.4 acres of Kealakomo ahupua'a in 1941. Land Commissioner Whitehouse suggested Kealakomo be purchased for $3,700.00 – the money coming from the Territories general fund upon the issuance of a warrant voucher. Kealakomo was owned as follows:

W. Tin Yan – 1/17
Alice K. Lane – 12/17
Solomon Lalakea – 1/17
George T. Poteet – 3/17
John C. Lane – 3.75 acres (Grant 2166)

The resolution passed by the Territory interestingly did not include the 12/17 portion of the lands held by Alice K. Lane. She was the wife of Territorial Senator John C. Lane (Apple 1954; Apple 1955).

Apparently, by this time, George Poteet had passed away, and his portion of Kealakomo was inherited by Archie E. Poteet and C.E. Poteet from Washington state. Both not being in the islands to represent themselves, they wrote to Wingate regarding the acquisition. Wingate referred them to the Territorial Land Commissioner Whitehouse because at this point the acquisition was a Territorial, not Federal Government matter. Whitehouse suggested that Senator Lane represent them, despite the fact that Lane's land was not included in the condemnation resolution (Apple 1954; Apple 1955).

No further action on the Kealakomo lands took place until 1944, when a new land commissioner, A. Lester Marks, wrote to all of the land owners in March 1944 indicating land ownership, acreage owned, and appraised values (Apple 1954; Apple 1955).

The Lane's took matters into their own hands, and asked former Territorial delegate Samuel Wilder King, now a real estate broker to represent them. They offered their 12/17 interest plus 3.75 acres of grant 2166 (Apple 1954; Apple 1955). The Lane's, through King, claimed the land was worth $7,153.00 but they offered to sell it for $6,000.00. The government, however, claimed the land was appraised at $1,400.00 and that is what the Lanes were offered. King and the Lanes rejected the Territories offer. The government then offered to purchase all of Kealakomo plus the 3.75 acres of grant 2166 for $1,403.40. Mr. King rejected that offer as well, because he only represented 12/17 of the total area, and because he claimed the price was too little. King then

stated it would be easier to sell the land on the open market, at market price (Apple 1954; Apple 1955). The matter ended with no agreement. Perhaps it was because then Territorial Governor Stainback was not in favor of exchanging lands in the extension for private lands, except for a strip of land for the road (which the federal government should pay for). The Territory especially wanted to keep the land along the coast (Apple 1954; Apple 1955).

Although the negotiations for Kealakomo ended without any agreement, Superintendent Wingate continued to push for acquisition of the extension lands and stressed that the Chain of Craters road to Kalapana would not be completed until *all* of the lands were acquired. The Territory appointed a new appraisal board to re-appraise the land. The men were unable to inspect all of the lands and asked the Army to take aerial photos of the area in 1943. Though later classified because of the war, the appraisers were able to use it under special circumstances, and valued all of the lands within the extension at $21,189.50. They used the following figures to calculate value:

Poor pasture - $0.60/acre
'Āinahou and Keauhou ranch land - $0.75/acre
Forest land - $0.40/acre
Waste land - $0.20/acre

The first lands added to the park were 12,190 acres of government lands of Apua and Kahue (Apple 1954; Apple 1955). Kamoamoa (10,492 acres) was exchanged with Senator William H. Hill of Hilo on February 1, 1947. The exchange of Kamoamoa involved a complicated set of negotiations on both Hill and the government's part. Hill appears to have been quite the businessman and used his former position of power to get what he wanted (Apple 1954; Apple 1955).

A new superintendent, and disagreement over the intent of Congress and appraisals led to the Territory completing yet another appraisal of the lands in 1948 (Apple 1955:34). Total value for the 1948 appraisal was $15,011.92 – less than the 1943 appraisal.

In 1949 the Territories Deputy Attorney Blatt stated that he would soon write letters to start condemnation of the extension lands, but there are no records to that effect (Apple 1954; Apple 1955). On November 4, 1949, 2,458.5 acres of Laeapuki and Panau Iki were also exchanged with Senator Hill, who had previously traded Kamoamoa (Apple 1954; Apple 1955). Nothing more happened on the extension issue for the next three years, except for an Executive Order (1416) passed by then Governor Oren E. Long which set aside the 18 parcels of private lands in the extension for addition to the park – simply a good will gesture to show the federal government that if and when the lands were acquired by the Territory, they would be turned over to the park (Apple 1954; Apple 1955).

The first land exchange took place on February 1, 1947 in acquiring the 10,492 acre *ahupua'a* of Kamoamoa. Laeapuki and Panau Iki followed in 1949.[ii] Yet, it wasn't until 1951 that Kealakomo was officially condemned and then transferred into the possession of the National Park Service.

On January 26, 1951 Territory of Hawaii Governor Oren E. Long issued Executive Order 1416 condemning 18 parcels of land within the Kalapana Extension included the *ahupua'a* of Kealakomo. Condemnation was deemed appropriate due to the complications of land ownership, multiple estates and beneficiaries. The Territory and federal government determined that a deed in this case was required, whereas most other land acquisitions involving the National Park Service were based on land exchange (Figure 4.2).

Chain of Craters Road Construction

With the acquisition of the lands within the Kalapana Extension taken care of, the idea of completing the Chain of Craters road to Kalapana began in earnest in 1954. After over twenty years of waiting, the cost to build the road extension had ballooned to two million dollars. The Territory was in dire financial straits, and was in need of a large public works project such as this one (Apple 1954; Apple 1955).

The Chain of Craters Road was constructed in two phases. The earliest segment of the road was developed in 1928 and extended from Crater Rim Drive southeast for seven miles to Makaopuhi Crater. Development of a road from Kalapana up to the then Park boundary completing the Chain of Craters Road was promised by the County of Hawai'i but funding was not available (Jackson 1972:133). Attempts at raising funds were made over the years but it wasn't until the acquisition of all of the lands in the Kalapana Extension was completed that money became available to extend the Chain of Craters Road through Kalapana (Jackson 1972:136). In June of 1961, the firm of Harland Bartholomew was hired to survey the proposed road alignment and by February of 1963 the centerline for the road corridor had been staked and the first 8.82 miles of road construction was contracted. In November of 1963, the remaining nine miles of the Kalapana Road was contracted out for construction.

The lower portion of the road in its original configuration extended down to the coast and headed eastward as State Highway 130 until it proceeded outside of the park's boundary. The connecting segment of road was completed and the final paving of the entire stretch of new road by 1965. The new road dedicated at Waha'ula *heiau* on June 19, 1965 (Jackson 1972).

During the 1965 archaeological study by Colin Smart, he noted that: "The new road from Kalapana to the Chain of Craters passes directly through the area [Kealakomowaena] (claiming only two sites in the process) and will allow easy access to this rich array of ruins when opened to visitors" (Smart, Emory et al. 1965).

The Chain of Craters Road was cut through lava beds as it crosses into the project area. The use of explosives to build the road is evident in the profile of the road cut at the southern boundary of the study area. This activity likely caused post-construction impacts to the cultural features on site by falling rock debris.

After the 1969-1974 flows from Mauna Ulu covered over sections of the roadbed, the Chain of Craters Road was again re-cut and made passable to motorized vehicles. The re-cut followed the same general alignment at the north end of the project area, though it was moved in several areas. At the south end of the current survey project the road followed the same alignment. During the course of the Phase II survey, it was

observed that the landscape had been disturbed beyond the immediate edge of road alignment. Disturbance was noted approximately two to three meters from the road edge. In addition, there is a rather significant area of disturbance to the southeast corner of the Phase II project area. Here, a 10 x 6 m area at the base of an *ʻaʻā* flow has been leveled likely to support a staging area for construction crews.

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Table 4.4. Tax records for Kealakomo.

	Tax Year																						
	1858	1859	1863	1864	1865	1866	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1885
Hauhili	1	1	1	1	1	1	1	1							1									
Holokai	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
Ioane	1	1	1		1																			
Kama	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1									
Keikimoo	1	1	1	1	1		1	1																
Mahu	1	1	1	1	1	1																		
Nalohelua	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
Palapala	1	1	1	1																				
Hoopii	1	1																						
Keaka	1	1			1									1	1	1	1	1			1			
Kenaaulani	1		1	1	1	1	1	1	1	1	1	1	1	1										
Imaikalani	1																							
Kahananui	1																							
Kalanui	1																							
Kaluahi	1										1													
Kamealoha	1																							
Kanahili	1																							
Kanounou	1			1																				
Kekaula	1																							
Koieono	1																							
Konanui	1			1																				
Makaino	1																							
Mauhili	1																							
Naaleewalu	1																							
Ohue	1																							
Opunui	1																							
Kaanaana		1	1		1	1	1	1	1	1	1	1	1	1	1									
Kanahele		1	1	1	1										1			1			1	1	1	
Koieamo		1	1	1	1	1	1	1	1	1	1				1	1	1							
Hao		1																						
Kahaku		1																						
Kinaulani		1																						
Pualinui		1																						
Haau			1		1		1	1	1	1	1			1										
Inoa			1	1	1		1	1																
Kauwe			1	1	1																			
Kawai			1	1	1										1			1						
Keakaailama			1	1																				
Nakahilielua			1																					
Kaau				1																				
Naimi					1	1																		
Kanuikeanu					1																			
Lulea					1										1	1	1	1						
Kaulunahele						1	1	1	1	1	1	1	1	1		1			1	1				1
Ohialau 1							1	1	1				1	1	1	1	1	1	1	1	1	1	1	
Kanealii							1	1		1	1	1	1											

Table 4.4. Tax records for Kealakomo cont.

	Tax Year																						
	1858	1859	1863	1864	1865	1866	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1885
Kanoa							1			1		1	1											
Kaaekai										1	1	1	1								1			
Kaainoa										1														
Ekekiela											1	1												
Keoni											1	1	1	1										
Ehu													1	1	1									
Josepa													1	1	1									
Lukela													1	1	1									
Kini														1	1	1	1	1	1	1				
Malimali														1	1									
Naale														1										
Ohialau 2														1										
E.P. Hoaai															1									
Kalaniku															1									
Mahoahoa															1									
Puuomoeawa															1									
Keo Mahu																1	1							
Halaniku																1								
Kahainamoku																		1						
Kealoha																								
Keana																								
Pualinui																								
Males ($2 school tax + $2 road tax + $1 poll tax for those over 20 [0.50 for 15-20yr olds])	26	17	18	17	19	10	14	13	9	12	13	11	14	17	20	10	8	9	5	5	4	2	2	1
Dog ($1.00)	6	3	1	2	3	0	2	3	2	0	3	7	5	9	11	4	6	3	0	0	0	0	0	na
Horse ($0.50 licensed; $10 unlicensed)	5	19	22	28	42	27	31	22	14	18	17	12	14	10	25	14	16	14	5	5	4	3	2	na
Mules and asses ($0.25)	4	0	2	7	13	7	8	5	4	6	4	5	4	14	19	13	na	na	na	na	na	na	na	na
Minimum Taxes ($) Collected for the YR (assuming all horses were licensed and all males were over 20yrs of age)	139.5	97.5	102.5	102.75	122.25	65.25	89.5	80.25	55	70.5	77.5	69.25	83	102.5	128.25	64.25	54	55	27.5	27.5	22	11.5	11	5

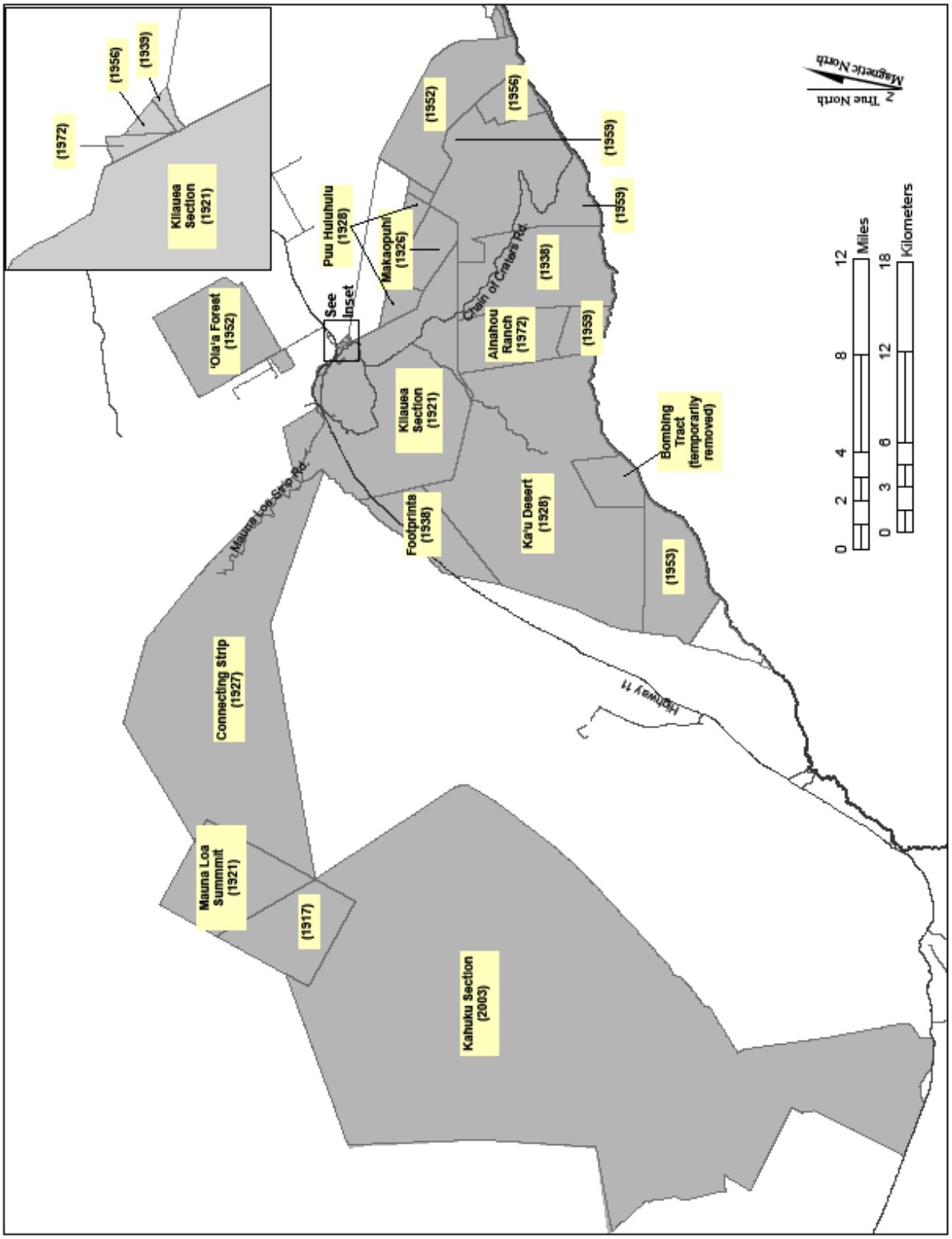

Figure 4.1. Land acquisition within Hawai'i Volcanoes National Park.

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Chapter 5 . PREVIOUS RESEARCH

In this chapter a brief overview of past research within the ahupua'a of Kealakomo is outlined. Though short, each project is highlighted to give the reader a sense of the breadth of work done, the types of features noted, and the kinds of research programs directed by the Park Service to record and document its resources.

Island-wide Surveys

In the beginning of the 20th century broad surveys took place around the island. Though archeological sites were often not mapped and documented in the manner in which they are today, excellent descriptive records were often left behind which are still of value today.

A. Baker 1931

In his fourth installment of discussions of petroglyphs on the Island of Hawai'i, Albert Baker briefly describes his trip in search of Puna petroglyphs. Baker discusses the numerous petroglyphs at Pu'uloa and few other sites along the coastal region of Puna within the now National Park boundary (Baker 1931).

A. Hudson 1932

Between 1930 and 1932 Hudson conducted a broad survey of sites in east Hawai'i. Specifically, he documented structural remains in the districts of Hamākua, North and South Hilo, Puna and the northern coast of Ka'ū. Though he makes no direct mention of resources in Kealakomo he did state that "..piled in hillocks are found potato patches, consisting of loose bits of lava along the coast from Pulama to Kamoamoa…and a mile or more inland" (Hudson 1932).

Backcountry Reports

From the earliest days of Hawaii National Park, park staff have documented their travels, observations, and projects carried out within the park boundary. These records are invaluable sources of information on the natural and cultural history of this magnificent landscape that has been preserved in perpetuity for future generations. The Superintendents reports to the Director of the Park Service are invaluable sources of information on park history as are the backcountry trip reports often written by the Chief Ranger to the Superintendent. Park rangers working in the backcountry of the park – often on horseback – recorded their observations and noted their encounters with both native and cultivated plants, animals, and ruins within the park boundary. For some areas of the park, these early reports are the only documentation recorded for these resources before lava flows covered them over or tidal waves washed them away. In conjunction with early maps, we get some of our first glimpses of the cultural landscape.

G.E. Olson, February 27, 1941 & March 14, 1941

Between February 4th and 7th, 1941 Ranger Olson took a horseback trip through Āpua, Kahue and Kealakomo. The primary purpose of the trip was to do a reconnaissance survey of the coastal village site at Kahue, visit the interior of Kealakomo, and find a

route up Poli o Keawe Pali. Starting from Hilina Pali shelter, they stopped at Puu Kaone, crossed through Keauhou at ʻAinahou Ranch, and then followed the "old Puna trail past Āpua" to Kahue. His subsequent report and photographs document his travels through these areas. Āpua and Kahue had recently been added to the park boundary, and Kealakomo, which was described as "of archaeological and botanical interest" by the then Superintendent, was authorized for addition to the park under the Kalapana Extension, but was still under private ownership and therefore not officially within the park boundary. The purpose of the trip was to document the village sites along the sea coast and to report on the archeological features. The purpose of traveling through Kealakomo was to document points of interest for use in publicity campaigns for upcoming legislative actions.

The route taken by Olson and Junior Park Warden Medeiros took them north along the Kahue-Kealakomo boundary, up to the first pali, and then northeast through Kealakomowaena. They made their way to Panau Nui and climbed Poli o Keawe Pali before returning to Kealakomo village. Olson commented that "the chief items of interest found in this country, which is rich in history and features of Hawaiian life… is probably unknown." Olson writes that a Mr. Charles Kauhi and Peter Pakele of Hilo were both familiar with this area and they should be consulted regarding the site.

Olson notes that Kalapana residents would easily travel 15 miles to fish in Āpua, Kahue, and Kealakomo because "fishing near the modern settlements have depleted the waters along the nearby shores." He says that Āpua was the favorite fishing spots for Kalapana fishermen because of its shallow beach and the ability to throw net there. But in places like Kahue where there is cliff, only hook and line fishing is done. Fish are immediately cleaned and salted, but *ʻopihi* is only picked on the last day because of spoilage.

At the Kahue-Kealakomo boundary Olson comments that vegetation is "sparse." He noted a coconut tree growing near the boundary. The forest he notes is thick above Poli o Keawe Pali, but ended at the base. He noted a second coconut tree and small *kukui* grove higher up on the plateau.

They continued to travel east until they came to an old trail which they called an "Ancient Trail." They do not describe the trail except to say they followed it about 1/3 of the way up the cliff on horseback and then explored it on foot. The trail is aligned almost straight north-south for almost two miles. While the trail runs through the easiest ascent of Poli o Keawe pali, it was unstable in areas due to lack of use and erosion. Olson goes on the describe a cairn, associated house sites and cave which from his photos appear to be HV-176 at the lower boundary of Nā ulu village. He photographed several *papamū*, petroglyphs, walled structures and the trail at Kealakomo and commented on the numerous letters that "show what appears to be Biblical influence as the first teachings that the Hawaiians received from the missionaries were from the New Testament." The letters were often upside down, backwards, and had capital and lower case mixed together. Finally, Olson photographed what he called the "hermits" shelter near Nā ulu. Aku Haunio (pers. comm. 2010) stated that his father, the Warden John Haunio, said the hermit was a Korean man.

C. Davis, August 18, 1947
Ranger Davis does not travel through Kealakomowaena on this trip, but he does visit Nā ulu Village, which is located in the ahupua'a of Kealakomo. On this trip to Nā ulu, his route takes him south to the village from the Kalapana trail. His purpose on this trip was to "observe wildlife conditions and other interesting natural phenomena" but he does comment on the presence of anthropogenic plants such as breadfruit, orange trees, and the cistern and terraces located there. Davis comments that other than these features, "there isn't much left of Naulu" (Davis and Haunio 1947).

C. Davis and Warden Haunio, November 21, 1947
Ranger Davis and Warden Haunio's report documents their trip traveling from west to east across the Puna trail. At the boundary of Kealakomo they leave the Puna trail to travel north along the "old Kealakomo trail," eventually passing through Kealakomowaena and the Phase I project area. The report offers the reader a sense of the use of the coastal area, especially at Kahue, the location of specific cultural plants such as *ahuhu*, and the expanse and location of agricultural features through Kealakomowaena (see Figure 5.1).

D. Hamilton and R. Bright, December 3 & 6, 1963
Surveying an area on Holei Pali adjacent to Nā ulu Forest, Hamilton and Chief Ranger Bright photographed numerous cultivars, unique to the park including breadfruit, coconut trees, a reference to orange trees formerly growing at this site notes that they are "now dead" (Hamilton and Bright 1963). Unique endemics photographed by Hamilton and Bright include 'Ahakea and Halapepe. The *kukui* grove that once grew above Nā ulu Village was also noted in several photographs. Of particular interest to this report is the documentation of a stepping stone path that led from the village southwest to a water cave and cistern site. The water cave contained several petroglyphs, the cistern, associated house sites and hearth are the few features that remain of this village today. Unfortunately, recent documentation of the cistern indicates a larger portion of the cistern wall on the eastern side has since collapsed. A map provided by the rangers show the locations of a long rock wall (Site 27200) that runs north/south through the project area, an old curbstone trail just northeast of the rock wall, the cistern site (Site 27205), drip cave, and the locus of Nā ulu Village (see Figure 5.2). Hamilton also traveled through Kealakomowaena, noting and photographing several enclosures, house sites, and the salt pan and cistern from site HV-30. Kealakomowaena also once had *keawe* trees growing there.

Cultural Research – Chain of Craters Road
In 1959 the National Park Service began its first formal archeological surveys as a result of the acquisition of the Kalapana Extension lands, and the impending extension of the Chain of Craters Road through the new areas. A series of surveys took place between 1959 and 1965, primarily by staff from the Bishop Museum.

Cox, J.H. and W.J. Bonk 1959
A preliminary archaeological report of the southern portion of the District of Puna, Hawai'i was prepared in 1959 that represented the in-progress survey of the Chain of Craters Road corridor. This report is a broad-based review of the archaeological

resources identified and recommendations regarding those resources. References to Kealakomo include:

> *"Kealakomo is an extensive village site on the shore about one mile west of Kaena point and about two and one-half miles southwest of Pu'uloa. An old trail connects Kealakomo with Pu'uloa and can be used by those wishing to make this rather strenuous but historically rewarding trip. The village consists of an extensive series of house platforms and walled structures, some in an excellent state of preservation, and numerous petroglyphs scattered throughout the [sic] area. A significant feature of the area is the large number (about 70) of papamu cut into the flat pahoehoe lava and quite often located adjacent to the house sites. The area was (and to some extent still is today) important as a Hawaiian salt producing center. Dried fish were exported to Olaa and other mauka areas in exchange for taro, tapa, and other necessary items"*(Cox and Bonk 1959).

Emory, Cox et al. 1959

In the planning stages of the extension of the Chain of Craters Road through the District of Puna within Hawai'i Volcanoes National Park, the Bernice P. Bishop Museum was contracted to conduct a cultural and natural resources survey of the proposed road corridor and alternatives. Over the course of a five-week period, from June 19, 1959 until July 27th of that same year, Kenneth Emory led a 5-to-9 person crew across the landscape of Puna via jeep, horseback, air and the more frequent mode of transport walking. Reconnaissance, transit mapping and surveying were conducted in areas within the proposed road project location as well as outside of the project area.

A complete survey of Kealakomowaena was not conducted but aerial photographs were taken and depict "…scattered walls and enclosures, some of which were viewed from the helicopter at a later date." Nā ulu village was not visited during this survey but aerial photographs "…indicated a complex of sites stretching up the rise from the top edge of the cliff and a few sites along the base."

The survey area of Kealakomo by Emory et al. in 1959 was reached by helicopter due to the distance to be traveled and gear to carry (field headquarters was at the Kalapana School Teachers' cottage). A party of four and equipment for a four day stay was transported to Kealakomo (Cox and Bonk 1959). Aerial photos and aerial reconnaissance were used and was especially useful for locating structures "along the top of the cliffs" (Cox and Bonk 1959). Kealakomo "because of transportation problems and time limitations was surveyed by the plane table method" (Emory, Cox et al. 1959).

Emory notes that the Panauiki area was in "thick lantana… the sites themselves were covered" (Emory, Cox et al. 1959). It is reasonable to assume that invasives had also spread to Kealakomo although Emory does not specifically say so in his report.

Much of Emory's work focused on the coastal area, where he noted an "extensive settlement" lay, surrounded by "a meandering wall about 4300 feet long, enclosing approximately seven and a half acres" (Emory, Cox et al. 1959) (see Figure 5.3 and 5.4).

Emory described a "variety" of sites within this coastal village including a church that was pointed out to him by his informant, Sam Konanui of Kapa'ahu. The village was reached by both the coastal trail from Lae'apuki and Kaena as well as the more inland trail from Pu'uloa. Emory describes an "important" inland trail that at one time "led from Kealakomo to meet the Volcano-'Ōla'a trail. A section of this trail (Site 27265) has been identified on the ground along the face of the lower un-named pali, further inland, an additional section has been identified from aerial photos, and it has been documented, photographed and described by park rangers in the 1940's (see Chapter 6 and Appendix A for further details).

'Emory et al. (1959) do provide some preliminary description of the project area at Kealakomowaena. Their reconnaissance was brief, but the descriptions of the features are familiar having completed intensive inventory of all of the largest structures for this report. It is interesting to note that Emory's group was drawn to the same structures that currently exist in the *kīpuka* – suggesting that these were the most prominent sites on the landscape, and that the largest area of cultural activity was spared (see Chapter 7, Figure 7.1). Emory's (1959) description of the project area follows:

> *"A mile north of Kealakomo Village two ledges, marking the beginnings of the cliffs, rise to about 250 feet elevation . Where the old inland trail crosses these ledges are a few scattered sites and walls which at one time were the outskirts of Kealakomo Village. The first ledge is cut by a wall running north and south across its entire width (about 100 yards). A similar wall continues on the upper ledge. There is one house site on the lower level near the trail which is now merely a rectangular pile of jumbled rock. On the upper ledge about even with the upper end of the long wall and 300 yards south is another complex of ruins, walled enclosures, platforms and a water cistern. Two large timbers about twenty feet long, notched at the ends are laying across the ruins. They were very likely ridge poles or rafters of a house. Also at this site is a large stone bowl made from a roughly circular boulder about thirty inches in diameter.*
>
> *This is the extent of these sites that were viewed at close range on a very brief reconnaissance trip made by Bonk, Cox and Hansen on June 30. The aerial photographs of the area show other scattered walls and enclosures, some of which were viewed from the helicopter at a later date. A complete survey should be made in this area."*

Smart 1965

The work conducted in 1965 by Colin Smart of the Bishop Museum was focused on expanding the knowledge gained in the 1959 expedition in the vicinity of the proposed Chain of Craters Road extension through the district of Puna. Smart's work was the first in a two phased study that included Kaena Village, Kealakomowaena, and Kū'ē'ē. Various coastal sites were investigated and few upland sites were recorded. At Kealakomowaena, Smart investigated sites HV18-44, HV174-183, HV208, and HV211. Smart's description of the sites at Kealakomowaena are much more informative and detailed than the previous surveys.

A complete citation follows with reference to sites and site numbers discussed later in this report added in parenthesis and underlined to distinguish it from the original text:

> *"At Kealakomo Waena occurs a great profusion of surface remains scattered over a large area of grassland. The area is a short distance inland from the coast and elevated somewhat above the coastal plain. The rockland soil on a pāhoehoe base is covered in places by narrow flows of 'a'ā lava, supporting no vegetation at all, which have run down the face of the Poliokeawe and Holei Pali and spread across the land below. The new road from Kalapana to the Chain of Craters passes directly through the area (claiming only two sites in the process) and will allow easy access to this rich array of ruins when opened to visitors. In some places the grass, supplemented by stunted shrubs, all but conceals the sites when viewed at ground level. But from the crest of the Pali above, the black stone structures stand out clearly against the light background of grass, and they are also visible on the aerial photographs – a factor which greatly facilitated their locations and subsequent field examination.*
>
> *The majority of the structures are low and roughly heaped walls (likely the mounded ridges identified as part of Site 27195 see Appendix A). Many are walled enclosures, but long straight stretches of wall are present. A number of enclosures make use of natural barriers like outcrops and cliffs thereby reducing the length of wall required.*
>
> *The sites tend to group themselves into separate clusters. Most prominent is the cluster in the very middle of the Kealakomo Waena area. The central site is a large and well-preserved enclosure complex with walls standing over a meter high in most places (No. 30) (this would be Site 27205). Beside the enclosure complex is a house platform and cemented-stone cistern, with a few additional platform structures nearby. The cistern, as well as boards, metal, porcelain and iron objects lying scattered about, clearly date the sites. In the surrounding area occur several rectangular enclosures (Sites 27210, 27214, 27211) as well as an array of irregular enclosures and a number of stone heaps. These heaps lie mainly over a shallow depression, just to the east of the central enclosure complex, on a sloping ground where the soil supports richer vegetation. This group of sites probably represent the structures of a single family engaged in goat herding (perhaps with other stock as well), growing a few crops in the better soils from which stone has been cleared and dumped in heaps (the mounds identified as part of Site 27195 see Appendix A).*
>
> *A similar cluster of enclosure sites, but lacking the enclosure complex and house site, is located to the northwest on the western side of a large and prominent 'a'ā lava flow. A number of others are apparent over a wide area to the west of the enclosure complex and house platform, and yet another group occurs to the east. None of these three groups include*

sites other than walled enclosures of more or less irregular plan and they may well have been subsidiary to the central group.

To the north of the central group, and close by the new road, stands another house site with cemented stone cistern (HV-176). This house site is not associated with an enclosure complex and indeed the only distinct enclosure nearby (No. 174) is a single example constructed in a steep-sided depression. A number of others are apparent over a wide area to the west of the enclosure complex and house platform, and yet another group occurs to the east. None of these three groups include sites other than walled enclosures of more or less irregular plan and they may well have been subsidiary to the central group.

To the north of the central group, and close by the new road, stands another house site with cemented stone cistern. This house site is not associated with an enclosure complex and indeed the only distinct enclosure nearby (No. 174) is a single example constructed in a steep-sided depression. A number of trails radiate from the house site. Within a channel in the aa lava flow, against the side of which this site was built, is a cave and another enclosure. Again a single residence is apparent, but this one is not a central feature for an array of enclosures (this cluster likely has been covered by the Mauna Ulu lava flow).

To the east of Kealakomo Waena stand a few additional sites, but none appear of special significance. Two platform remains, some coconut palms growing in a depression in the lava, and a pair of caves in which some vague structural features are present, are all that was recorded here.

A short distance up the Holei Pali and overlooking the new road stands another house site with a cistern, and growing nearby are some breadfruit trees. These sites were not examined in detail but there are certainly no enclosures of any note in the immediate area.

Running through Kealakomo Waena and passing just to the east of the central complex of sites is a well-defined trail (Site 27265). The trail is visible on the top of the Holei Pali, across the Kealakomo area, and continues to run toward Kealakomo itself. It is probably the trail from Kealakomo to the upland regions where it might connect with the Kalapana trail."

"To the east of Kealakomowaena stand a few additional sites, but none appear of special significance. Two platforms remain, some coconut palms growing in a depression in the lava, and a pair of caves in which some vague structural features are present, are all that was recorded here" (Smart, Emory et al. 1965).

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Figure 5.1. Map from Davis and Haunio's 1947 survey scanned and reproduced.

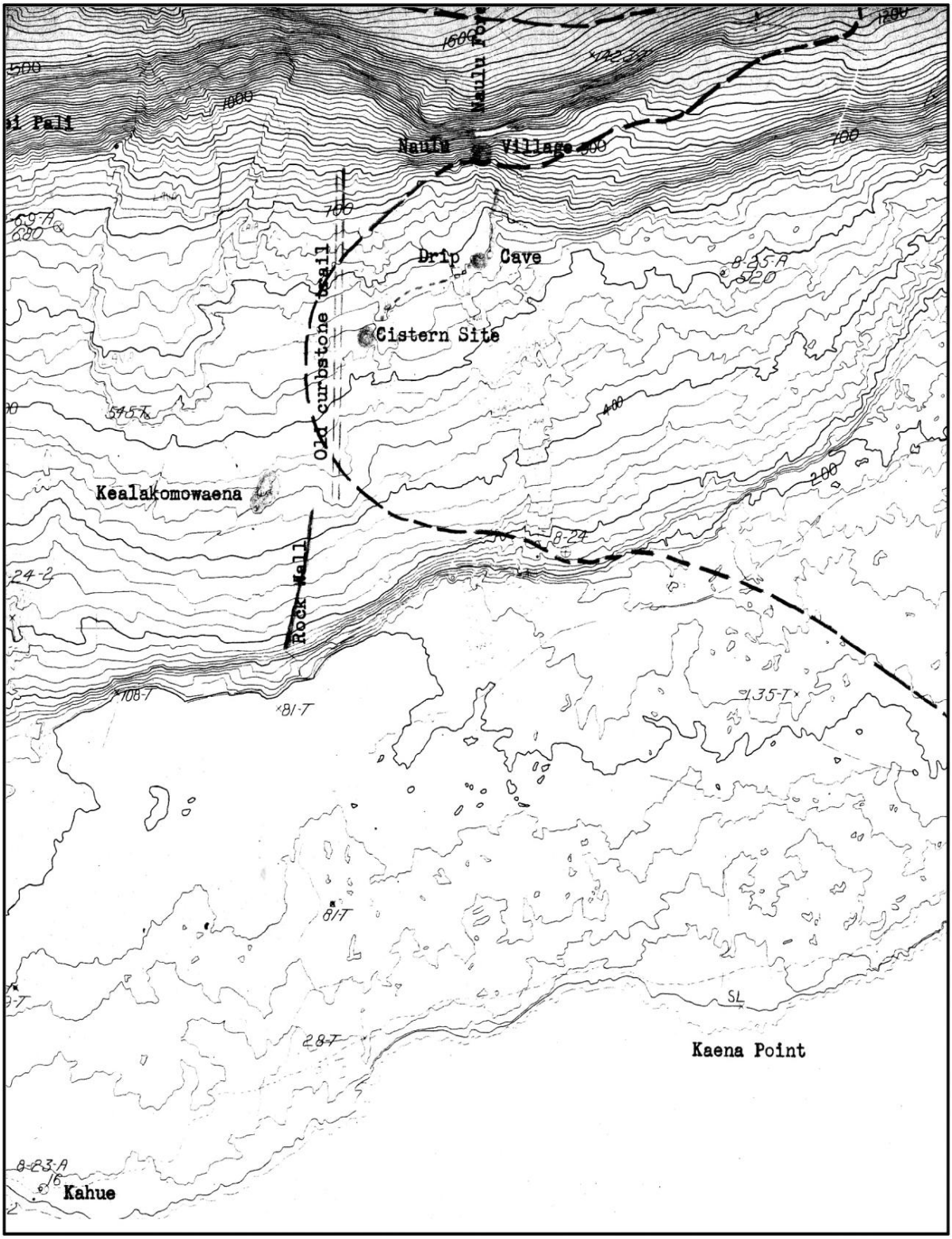

Figure 5.2. Map from Hamilton and Bright, 1963.

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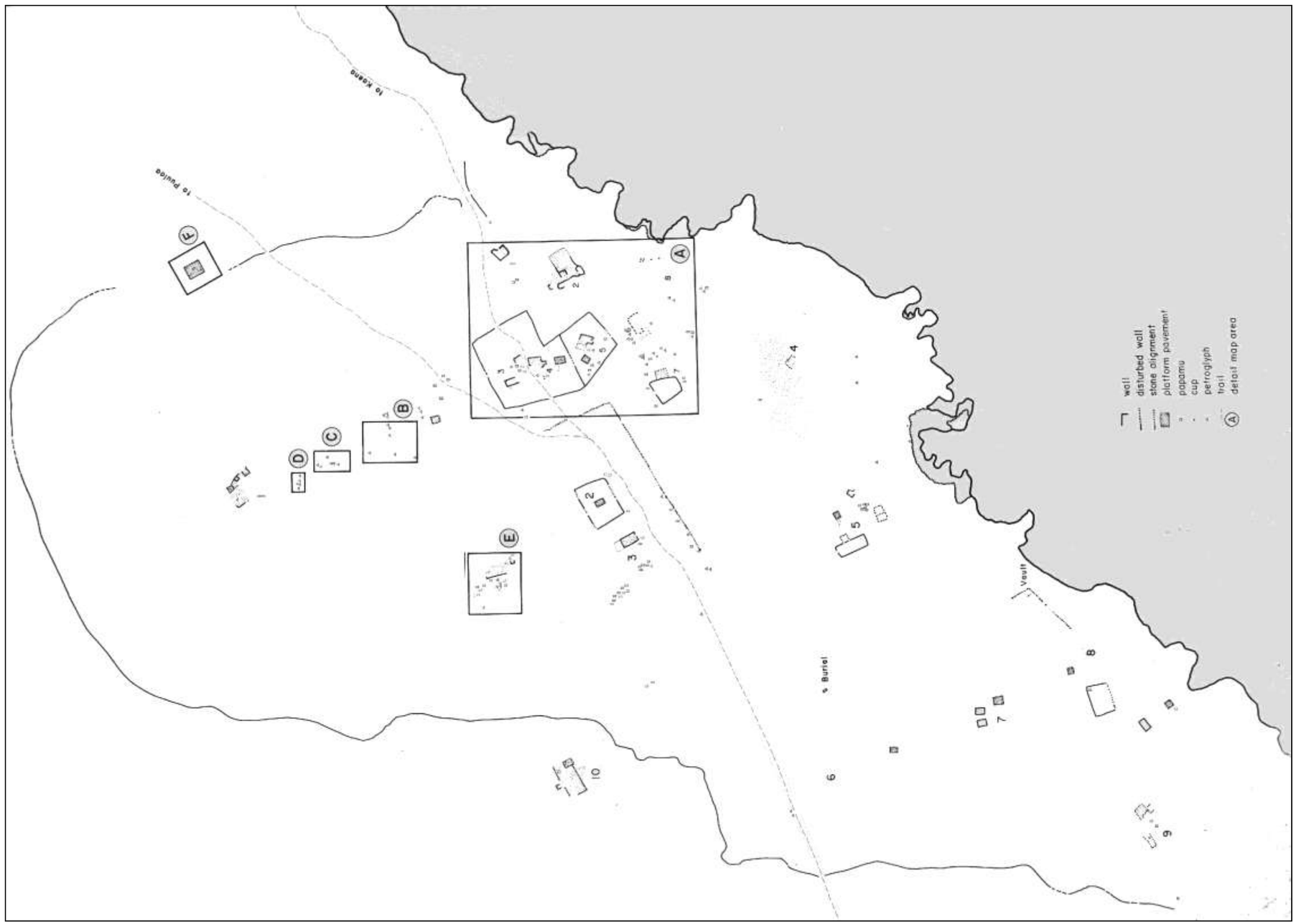

Figure 5.3. Map VI of the Kealakomo Coastal Area from Emory, Cox et. al. 1959.

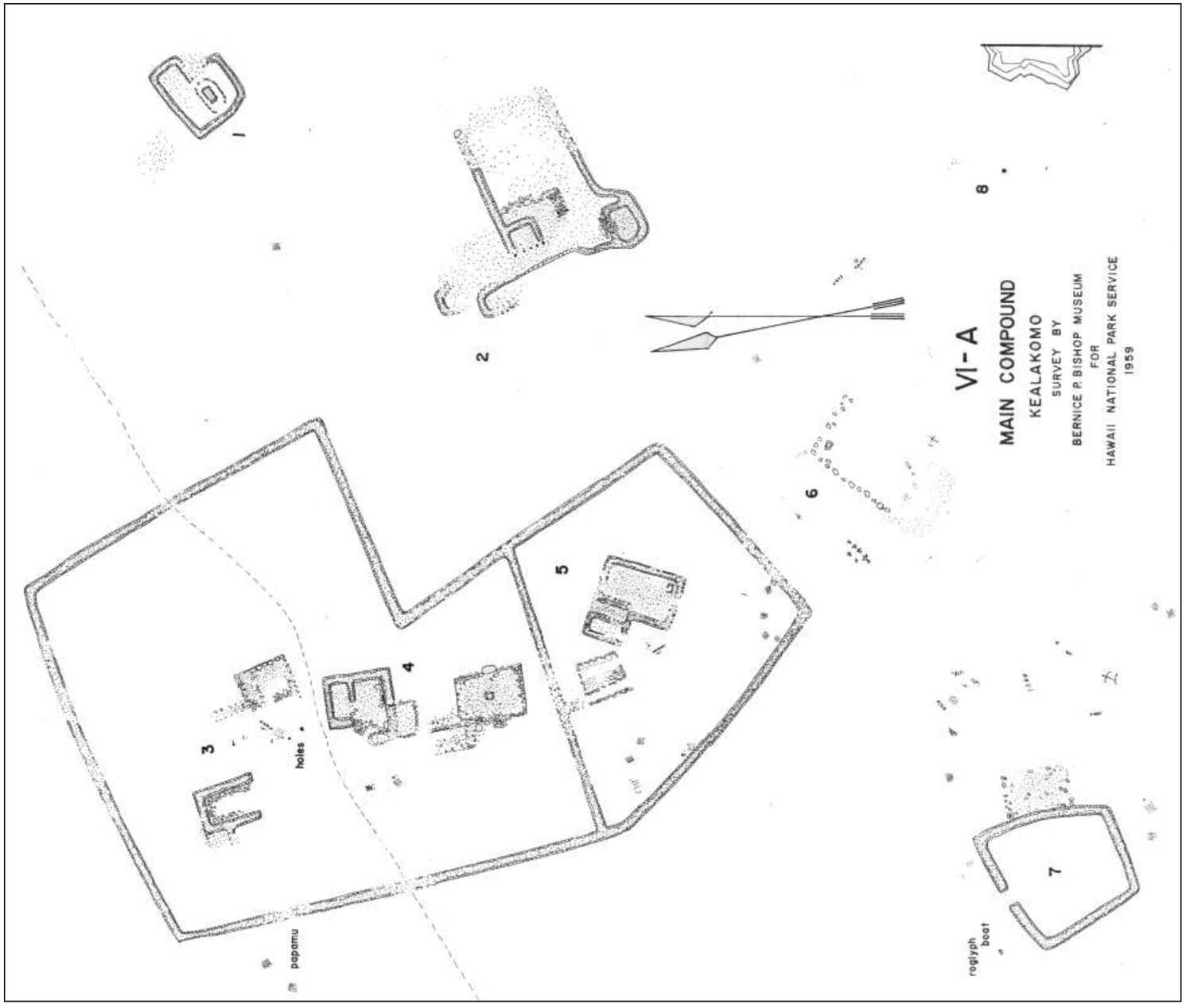

Figure 5.4. Map VIA, Close-up of the Kealakomo Coastal Area from Emory, Cox et. al. 1959

Emory, Soehren and Ladd, 1965
The second phase of the project consisted of site excavations at Keauhou and Kamoamoa and recording of the Pu'uloa petroglyph field and other sites in Panau Nui. Together, the 1965 projects provide a good baseline of the larger structures and petroglyphs in this area of the park, though they generally ignored agricultural features.

Dwight Hamilton 1966
Prepared as a guide for use by "tour drivers and other professional guide personnel" a descriptive guide to sites along the Chain of Craters Road was compiled by Dwight Hamilton in April of 1966. Included in the guide is a short description of Kealakomo:

> *"Beyond the Puu Loa Parking Area the road climbs the first small pali where it crosses the boundary between Panau Nui and Kealakomo near a pullout. Close by is a good example of a lava tube dissected by the road. The area above the road shows many signs of ancient use—stone walls, house platforms, petroglyphs, and stepping-stone trails. This is probably part of the general area known as Naulu (the breadfruit trees).*
>
> *…Reaching the top of this first pali the road begins a long, sweeping curve toward Holei and Poliokeawe Palis. The curve of the road crosses the old Kealakomo curbstone trail which is also visible running laterally to the left up Poliokeawe Pali. …As the road begins ascending the large pali, an old water cistern is visible to the right. Here are two house platforms paved with small stones. All were reportedly built by Jack Kaulunahele, who later moved to Ka'u. Iron and glass artifacts indicate it was probably inhabited until close to 1900, perhaps even later.*
>
> *The road passes close to several breadfruit trees and a single coconut tree. Naulu may have received its name from this specific location. Holei is the only other place in the park where we know breadfruit is growing. Above is Naulu Forest; the visible part is composed chiefly of kukui trees. Near here is another water cistern, plastered on the inside with coral cement to make it waterproof. Within a 7-mile radius, there are five such cisterns—the two just mentioned, and one each at Paliuli, Pea's Place on the old Kalapana Trail, and Kealakomowaena"*(Hamilton 1966).

Modern Surveys
From 1974 through the 1990's much of the survey work in the park have focused on Kalapana - land on the park's far eastern boundary. These surveys were in part stimulated by applications from Native Hawaiians for homestead sites as well as a result of emergency work ahead of lava flows from Pu'u O'o. Some of the work was done by inexperienced Youth Conservation Corps (YCC) and Young Adult Conservation Corps crews. While their surveys were intensive in nature, later review by professional archeologists deemed many of the maps to be inaccurate and field notes and records not well kept (Ladefoged, Somers et al. 1987).

Work in the 1980's was much better organized and systematic under the direction of archaeologist Gary Somers who worked out of the Pacific Area Office of the National

Park Service in 1982. Somers' focus was to systematically document sites threatened by the lava flows, again on the far east side of the Park, though one transect survey by L. Carter Schuster between 1989 and 1990 was adjacent to the Phase II project area in Kealakomo.

Much of the remainder of the work that involved a focus on archeology in Kealakomo centered on studies of Roadcut Cave (Site 25940). Many of these studies involved recording of the petroglyphs associated with the cave as well as studies of the cave system by amateur "cavers." Some of these studies are described below:

Zabrok 1986

An amateur caver published an article in both the Toronto Caver and the Canadian Caver magazines in 1986 mentioning his caving experience at Hawai'i Volcanoes National Park. The cave "…beneath Holei Pali, where we spotted a large collapse entrance above a roadside tube" was entered and explored for "…nearly a kilometer…" (Zabrok 1986). The cave resource referred to is commonly known as Roadcut Cave which was visited in August of 1985 by the author of the article and another amateur caver.

In addition, the Road Cut Cave resource is on file with the Hawai'i Speleological Survey, and has been publicized in the December 1990/January 1991 issue of the Volcano Gazette, Vol. 1, No.6, the article written by Joyce Jacobson.

L. Carter Schuster et. al. 1989 - 1990

Between 1989 and 1990 archeologists with the National Park Service surveyed 17 transects in the lowlands between Kalapana and Kealakomo. A single transect (Transect 9) was located in Kealakomowaena on the far eastern boundary of the Phase II project area. The results of the survey have yet to be compiled into a report. However, in 2003 Kelly Luscomb, under the direction of L.C. Schuster interpreted and transcribed the feature descriptions for the project from the original field notes. Luscomb also developed a matrix of feature types, their length, width and height. A total of 573 features were identified along Transect 9 during the survey project (Appendix C). Like the Phase I and II surveys, the most frequently documented feature during 1989-90 survey were likely related to agriculture. These included mounds, rock concentrations/alignments, excavated pits, and excavated filled pits. A number of trails (17) or trail segments were identified. Petroglyphs and presumably habitation related features such as platforms, enclosures and caves were also documented – numbering three each along Transect 9.

Doug and Hazel Medville (October 1996)

On October 8, 1996, this team of cavers mapped the interior of RoadCut Cave from the entry at Chain of Crater Roads northward for approximately 1,098 feet in length. The resulting map includes the plotting of eight formal entrances into the cave system, geomorphological features as well as simplistic representations of the archaeological resources within the lava tube.

Stasack and Stasack 1998 and 1999

In 1998, the Stasacks completed a rock art recording project at Nā ulu, *ahupua'a* of Kealakomo. The Nā ulu village site is situated to the immediate north of the Phase II project area at Kealakomo. A single cave resource was examined at Nā ulu, one of only a few features that remain after the lava flows from the 1972 period of the Mauna Ulu eruption flowed through the area. Two loci of petroglyphs at the site were found to contain 226 cupules, 28 anthropomorphs, 12 indeterminate images, and tow images of material culture (a canoe paddle and an adze motif). Several of the cupules are associated with *kōnane* boards, yet many are not. In fact, an alignment of 87 cupules was identified, the extent of which is a not commonly found.

A rock art recording project for areas within Roadcut Cave (Site 25940) as well as associated open air petroglyph sites in the corridor of the cave system was undertaken in 1999. One hundred and ninety-two petroglyphs were identified: anthropomorphic, geometric and indeterminate images each representing one-third of the total number of images identified (Stasack and Stasack 1997; Stasack and Stasack 1998; Stasack and Stasack 1999).

J. Lippert, June 1993

General baseline data for the monitoring of the Roadcut Cave was collected initially on April 16, 1993. Lippert established photographic monitoring points of eight cave entrances for Roadcut Cave as well as for selected petroglyph panels. Data collected included conditions of the resource, flora present, and brief descriptions of both cultural and natural features identified within the lava tube itself.

Lippert's work in 1993 at the Roadcut Cave suggests that visitation to the cave itself is relatively high for a site within the Park that is not formally interpreted for nor officially open to the public. Lippert indicates that "There have been 30 visitors since 1/25/93 to 8/25/93, often with the same visitor returning with new people. I have seen buses (KMC) stop on the road for a couple of minutes to view the cave as part of their tour."

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Chapter 6 . SUMMARY OF PHASE I, AND II SURVEYS AND TESTING

O Kamapua'a-kane and Kamapua'a-wahine, O Ku and Hina,
O Kamapua'a-kane and Kamapua'a-wahine,
Here is our patch,
Dig only in our patch, excrete only in our patch,
Do not excrete in the patch of others,
Lest you be stoned and hurt.
Dig and excrete only in our patch, you will not be stoned,
All the boundaries of this patch are ours.

(prayer recited by kahuna as he planted *uala*)
(Handy and Handy 1991)

Project Summary

While many archeologists have focused on the social and political organization of chiefs – writing about their roles, actions, and strategies (e.g. (Abad 2000); (Kirch 1984); (Kirch and Sahlins 1992; Kolb 1994), this project focuses on the farmers and fishermen, the *maka'āinana* who were less recorded but upon whose support the chiefs relied on for food, labor, and loyalty. Without the *maka'āinana*, the political, social and religious systems would not have existed. Specifically, we look at how the landscape was molded and modified by the Hawaiian farmer and how the land influenced where people settled and grew their crops. In doing so, we are attempting to understand the relationship of the Hawaiian farmer with his/her environment as well as with *'ohana* who lived and fished on the coast. Most importantly, this project looks at how people adapted to life on a lava landscape in the late prehistoric and early historic period. To that end, this chapter focuses on the results of two surveys (Phase I and II) within Kealakomowaena *ahupua'a*.

Phase I

Phase I includes the inventory of a large kīpuka immediately west of the Chain of Craters road between 120ft. and 500 ft. elevation. This *kīpuka*, within Kealakomo *ahupua'a,* encompasses 140 acres. Field survey of the Phase I area began in 1999 and was completed in 2001. Inventory was initially done along four established transects. One transect ran north/south through the eastern lobe of the kīpuka, nearly across the entire elevational gradient of the kīpuka. The other three transects crossed the kīpuka in a generally east/west direction (Figure 6.1). The transects were surveyed prior to a controlled burn which occurred in 1999. The transects were again surveyed after the 1999 burn to determine the extent of damage, if any, to the sites from the fire, and to document any features that were missed because of the thick vegetation coverage. The results of the post burn survey were telling. Prior to the burn, 212 features were identified by the field crew. After the burn, an additional 278 features were noted (see Table 6.1). The sites missed before the burn were primarily low lying mounds and modified outcrops, thus documenting what many archeologists already were aware of – that invasive vegetation greatly skews results of inventories, especially against the smaller, less visible cultural elements. The widespread nature of invasives in the park adversely affects the ability of park staff to adequately survey and document archeological resources. The maintenance and control of vegetation through such methods as fire and limited hand clearing is beneficial to the inventory of cultural sites.

Table 6.1. Results of Transect Survey pre and post-burn in 1999.

Transect	Pre-burn	Post-burn	% Increase
A	48	165	344%
B	59	112	190%
C	96	202	210%
D	9	11	122%
Total	212	490	231%

After the post burn transect survey, 100% of the upper lobes of the kīpuka were surveyed. Because project funding was limited, and the kīpuka large, the upper lobes were chosen for more intensive survey because they contained several large structures, and the area was close to the Chain of Craters Road and an existing pullout. Thus, this section of the kīpuka would be the most convenient location should the park decide to open the sites to visitors for interpretation. In addition to the intensive survey, aerial photos were used to identify existing large structures such as enclosures and walls. Once identified, these large structures and walls were located on the ground and documented with GPS, photographs, written descriptions and plan view maps.

Excavation and testing in the Phase I survey area took place between 2006 and 2008. Two sites were tested. They include a cave (Site 27258) and a habitation complex (Site 27205 [HV-30]). These sites were selected because they contained in-tact deposits. Excavation of surface features were limited to hearths because of the lack of sediment in most structures and the desire to maintain as much of the site's integrity as possible for interpretation. The goal of the excavation was to obtain charcoal for radiocarbon dating, and to identify plant species that existed in the area in the near past.

In 2009 the Phase I kīpuka was again burned. The grasses and other invasive shrubs had all re-grown since the 1999 burn and the sites were once again inundated. The goal of the burn was to re-establish the ten year old vegetation monitoring transects, encourage *pili* growth, and maintain the fire-adapted cultural landscape. The original goal for resources management was to burn the kīpuka every five years, but it had been ten years between the two burns. The current intent is to burn the kīpuka in cycles, perhaps again in two or three years. More frequent burns may help maintain the cultural landscape and control invasive vegetation while encouraging the regrowth of natives.

Phase II

Phase II inventory survey began and was completed in 2002. This inventory occurred in a kīpuka parallel to the Phase I inventory area but east of the Chain of Craters road. Transects were conducted in parallel east-west declinations, with the survey crew spaced at intervals of 10 meters. The east-west transects were terminated at the base of the slope of the surface expression of Road Cut Cave. The Road Cut Cave complex was inventoried at the end of the field project so that the inexperienced field crew could build their skills by first recording features of less complexity.

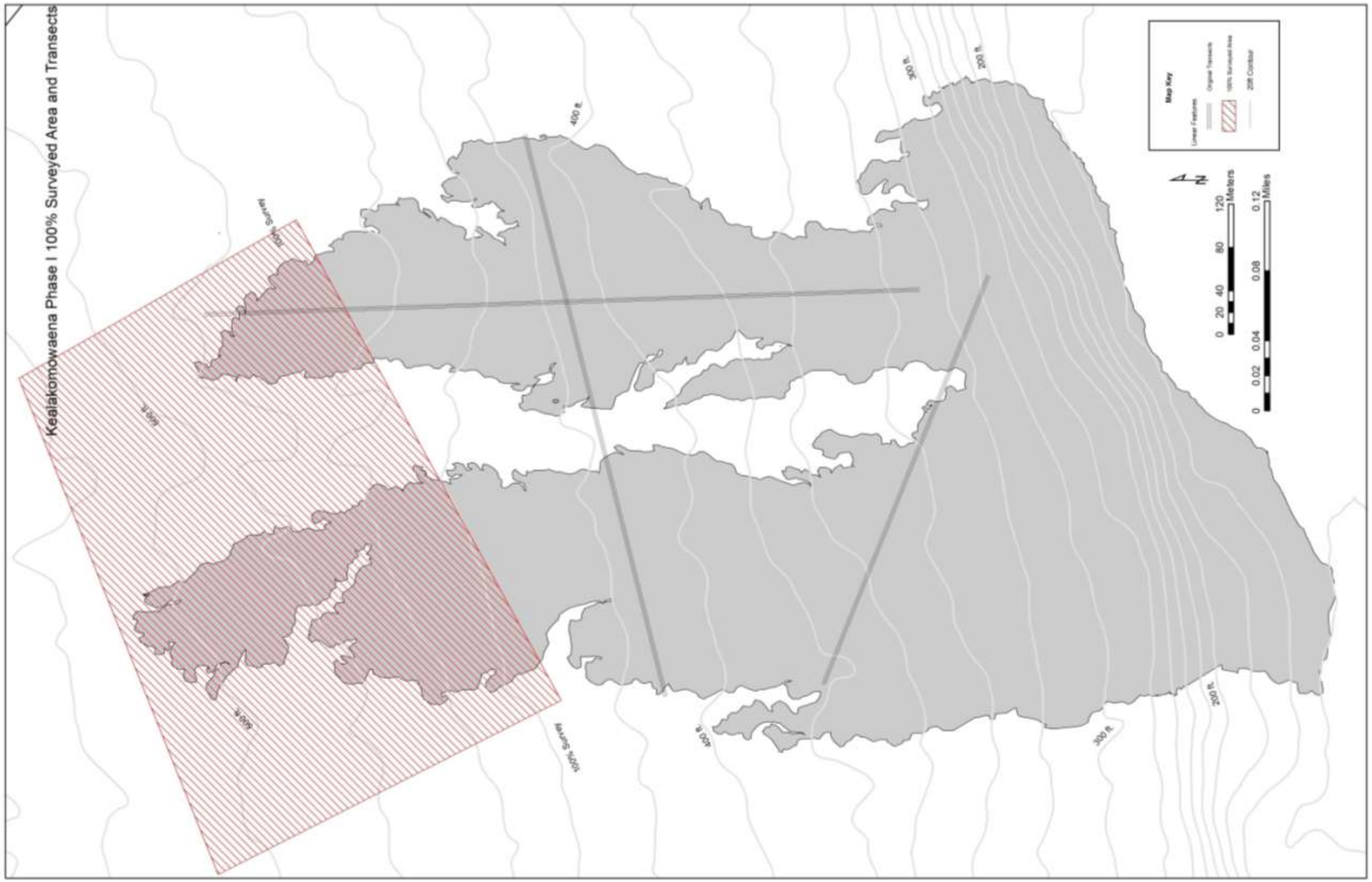

Figure 6.1. Phase I Area and Transects Surveyed.

Fieldwork for Phase II began on March 11, 2002 and continued off and on over the next nine months. Poor air quality from volcanic gases (vog) blown in from Puu O'o, a nearby lava flow, and subsequent forest fires closed Chain of Craters Road to all visitors and non-essential staff during the 2002 Mother's Day Flow. Because the Chain of Craters Road is the only vehicular access route to the project area, the field crew was redirected at times to another project during portions of the months of July and August 2002. Once the work in the Phase II area was completed, however, a total of 46 acres were surveyed for archaeological resources. Like Phase I, excavation in Phase II took place in 2006, with the testing of several areas within Road Cut Cave (Site 28144). The goal of the excavation was to obtain charcoal for radiocarbon dating, and to identify plant species that existed in the area in the near past.

Morphological Feature Types – Phase I and II

Feature descriptions and assessments for the Phase I and II surveys were recorded using the HAVO feature inventory forms. Feature locations were recorded with submeter accuracy with the Trimble TSC1 Global Positioning System (GPS) unit using the North American Datum of 1983 in Universal Transverse Mercator Zone 5 . Digital photographs, and planview tape and compass maps were produced for certain features.

Sites and features are categorized by formal characteristics based on definitions refined from several sources see (Ladefoged, Somers et al. 1987; Tomonari-Tuggle 1994; Moniz Nakamura 2003). In defining these morphological types, we are attempting to separate typology from inferred function. While the functional determinations are made for many of these features, in the absence of subsurface testing they are not conclusive.

In developing the functional determinations for features and sites, several criteria are considered. These criteria are: configuration and construction of surface features, location and density of features, the presence or absence of elements that may contribute to the interpretation (e.g. coral, waterworn stones, hearths, midden, upright stones), and comparability with similar structures in similar environments. Structures that functioned as **habitation** sites are either single features or complexes used for residential purposes including shelter and food processing. **Resource procurement** refers to features related to the collection of material used for making tools such as volcanic glass or basalt quarry areas, or other basalt quarry sites where rock was extracted for purposes of constructing another feature such as a wall or mound. Resource procurement can also refer to features used to enhance and collect ground-nesting seabirds such as the excavated pits related to petrel nesting. **Markers** are features constructed and used to identify areas of importance such as trails, resource areas, or habitation complexes. Markers include some rock piles and mounds (generally singular, or along a linear trail route), commonly referred to as *ahu*. **Transportation** refers to features used for transit or movement across the landscape. These features usually include roads and trails. **Agriculture** refers to features related to the enhancement of food production systems such as terraces, modified outcrops, alignments, mounds, rock piles and excavated pits with associated mounds. **Animal husbandry** refers to those features that functioned as pens to enclose hoofed animals such as cattle and goats as well as pigs. **Boundary/barrier** are those features that

functioned to spatially delineate activity areas, or social or political divisions on the landscape. Finally, **art/gaming/communication** refers to those features that are the manifestations of human creative ideas and whose meaning is symbolically expressed.

Alignment - a single course and row of cobbles or boulders placed end to end with no stacking involved; may be part of, or flush with, the surrounding ground surface; stones may be laid flat or upright. Functionally, alignments may be related to habitation as the parallel alignments that may be associated with or without paving may have supported a wood frame superstructure, or it may have been an open air work space. Alignments can also function as part of a transportation network as trail markers or trail edges.

Battering – pecked, ground or depressed areas on natural *pāhoehoe* surfaces. These features are distinct from petroglyphs in that no clear image or patterning is present. The function of some of these features is unknown, but some may be related to fishing – battering of bait etc.

Cave, Lava Blister – naturally formed within active *pāhoehoe* flows, where a river of *pāhoehoe* crusts over forming the roof of the tube and the stream of magma then empties out with the ceasing of the flow and a tube is created; may have structural modifications to the entrance or interior area. These features generally functioned as temporary habitation sites, water collection, and burial.

C-shape, L-shape or U-shape – these features are defined by a constructed wall that is not fully enclosed. Natural features such as *pāhoehoe* outcrop, pressure ridges, or collapsed lava bubbles/tubes may be incorporated into the construction; variable in size and plan. These features function as temporary habitation, and to a lesser extent as agricultural features if the enclosing wall intended to define garden plot and/or keep animals away from crops

Enclosure – an area defined by constructed fully enclosed wall (or wall remnant); natural features such as *pāhoehoe* outcrop, pressure ridges, or collapsed lava bubbles/tubes may be incorporated into the enclosing construction; variable in size and plan. This type of feature may have function as a habitation site, the remnants of which are the foundation for a wood frame superstructure. Related to that, the feature may be a house lot, the area of which includes a house, accessory structures, and sometimes a burial. It may also have functioned as an animal pen, the enclosing walls being used for animal control. In the 1940's and 1950's ranching era the feature could have been used as a cattle trap for ranching. On a broader scale, a large enclosure could have had an agricultural function, its enclosing wall intended to define garden plot and/or keep animals away from crops.

Excavated Pit - typically areas of *pāhoehoe* bedrock in which stones have been removed to create a pit (a pit is typically as deep or deeper as it is wide). In the lowlands, these features had an agricultural function. They were the results of the creation of planting areas; may be from clearance of stone from surrounding surfaces. In the uplands these types of features were used for resource procurement, areas where ground nesting birds were gathered from.

Excavated pit shelter – areas where the natural substrate has been excavated to create a pit feature which exhibits an overhang or roof component which would provide shelter.

Filled Crack, depression, or pit - this feature type consists of a concentration or piling of stones deliberately deposited within a geomorphological feature to create a lens of rock material which basically fills in the natural geomorphological feature. Its function is not known, though they may be related to nearby agricultural features or habitation/living areas.

Historic Road – this feature is a modern road, over 50 years old, that is paved with asphalt and has been dissected or cut off by a historic lava flow.

Modified Outcrop - aggregation of cobbles and boulders on top of, along the slope of, or at the base of a bedrock exposure; stones may be clustered as loose mounds or fill small crevices in the bedrock; variable size and often irregular plan dictated by dimensions of outcrop exposure. These features were agricultural in nature as they were related to the creation of planting areas; may be from clearance of stone from surrounding surfaces.

Mounds and Mounded Ridges - rough construction of piled cobbles and boulders; convex upper surface; variable size, plan, method of construction, and construction materials typically wider than it is high. Mounded ridges are similar to *kuaiwi*, but not as well defined. Mounded ridges are elongated, linear stacked mounds. Mounds, depending on the context in which they are identified may have a number of functions. They may have functioned as part of a habitation complex, where they were used as open-air work space or activity area (e.g., for drying *kapa* or fishnets). They may have had an agricultural function (as in this project area) as a planting feature or the remains of clearing an area. They may have been burial markers, or boundary markers. The later would be indicated by the presence of mounds or line of mounds at a known location or along a known boundary.

Pavement – a pavement is defined as a discrete area in which lithic materials (usually graded pebble-sized, sometimes cobble-sized stones) have been placed to create a compact, uniform, level surface. Pavements may have multiple functions. In some instances they may have a habitation function, where they were the foundation for a wood frame superstructure, or they may also be an open-air work space. They may also have been burial markers, or functioned as part of a transportation system in the form of a paved trail.

Petroglyph - engraved, incised, pecked, carved, or scratched image on natural *pāhoehoe* surface oftentimes expressed as a geometric, or anthropomorphic motif, in addition to historic writing images. Petroglyphs may have functioned as art, gaming or a form of communication.

Platform - free-standing structure with all sides raised and oftentimes faced with the interior filled with sediment or stone; level surface; may be built on outcrops or larger structures. Platforms may have a habitation related function where it served as a

foundation for a wood frame superstructure. It may have functioned as an open air work space, or may have a ceremonial or burial function.

Quarry – also noted as a quarried edges, or excavated edges, this type of feature represents an area of the natural lava flow surface that has been removed through anthropogenic actions. The removal of the surface stone, and/or lower lying layers is not due to natural processes such as erosion, but rather a purposeful action. This type of feature likely served as a source rock for building other features such as mounds, rock piles, walls, or check dams.

Rock Concentration/Pile - grouping of stones which exhibit no piling, nor stacking, but clearly express cultural manipulation. This feature represents a loosely heaped stones that is not well defined and is not regular in shape both in profile and plan view. This type of feature may have an agricultural related function as a planting feature, or they may be the result of field clearing.

Slab-lined hearth – upright tabular stones forming typically a rectangular border to accommodate a hearth feature within. Hearths generally functioned as cooking areas or were used for heating the interior of a structure.

Terrace - structure elevated on at least one side with remaining sides abutting or adjoining the surrounding grade or bedrock exposures; the interior area is filled with sediment or stone. Terraces may have had a habitation function, serving as the foundation for a wood frame, or they may have been open-air work spaces. Terraces may also have a religious function a ceremonial site, or they may be burial markers, or finally they may have had an agricultural function as a planting feature.

Trail – there are usually two kinds of trails. The first are stepping stone trails which are typically constructed across the jagged surface of an *ʻaʻā* flow. This trail type consists of the placement of *pāhoehoe* stones (typically tabular or waterworn stones) in an alignment to create a pathway of a relatively smooth surface upon which a pedestrian might pass. The second type of trails are cleared or level trials, noted within the ropey *pāhoehoe*/*ʻaʻā* transitional lava flows. A level bed of pebble-size stones set within the surrounding jagged lava substrate typically distinguishes the trail bed. Both types of trails functioned as transportation systems.

Quarry – area of bedrock (both pahoehoe and ʻaʻā) where stones have been removed; may exhibit battering damage along the edges of the exposure. These features functioned as procurement resource sites for construction material to build habitation, transportation, burial or ceremonial sites, and agricultural features. They are also features used for the procurement of volcanic glass and basalt to make tools.

Wall - linear alignment of stone that is minimally two courses high. The feature length is greater than feature width. Walls may have functioned as boundary markers, barriers, ceremonial sites, or agricultural features where planting areas are defined or they may have been the base for planting such as *kuaiwi*.

Artifact isolate - a single artifact located on the surface with no associated features, artifacts, or midden. Various functions.

Midden - an isolated find of or concentration of organic materials *(i.e*. shell, charcoal, animal bone) which is the waste product of human activity.

Results of Phase I Inventory

A total of 77 new sites comprised of 1343 individual features were identified during the Phase I survey efforts (Figure 6.2 – 6.7 and Tables 6.2 - 6.3 and Appendix A). These sites include 15 caves/lava blisters; 22 c-shapes; 22 enclosures; two (2) l-shapes; four (4) platforms; seven (7)petroglyphs; one historic road segment; one (1) trail segment; five (5) walls; five (5) complexes; and one agricultural site consisting of 12 alignments, five (5) excavated pits, 48 filled cracks, depressions or pits, 446 modified outcrops, 633 mounds, 26 mounded ridges, 68 terraces and 17 rock concentrations.

The largest site in terms of the number of features and distribution across the landscape is site 50-10-62-27195 which is comprised of 1255 agricultural features. Thse features were combined into this single site for several reasons. It provides for ease of discussion, and because of the widespread distribution of the features, and commonality of feature types, it is apparent that the entire area has been modified. The primary activity of the area is centered on agricultural production. Finally, not all of the kīpuka has been surveyed. While it is believed that most of the largest structures have been identified and surveyed, it is expected that many hundreds more agricultural features and numerous temporary shelters will be identified as survey of the area continues. In the future as features are added only this single number wil need to be edited.

Table 6.2. Features Identified During the Phase I survey.

Feature Type	Total No. of Features
Cave	15
C-shape	22
Enclosure	22
L-shape	2
Platform	4
Petroglyph	7
Historic Road	1
Trail	5
Wall	5
Complex	5
Alignment	12
Excavated Pit	5
Filled Crack, Depression or Pit	48
Modified Outcrop	446
Mound	633
Mounded Ridge	26
Terrace	68
Rock Concentration	17
Total	**1343**

Table 6.3. Site Numbers, Feature Type and Function for the Phase I Survey Area.

SIHP Site No.	Formal Site Type	Function
50-10-62-27195	Various	Agricultural
50-10-62-27196	Petroglyph	Art/Communication
50-10-62-27197	Road	Transportation
50-10-62-27198	Petroglyph	Art/Communication
50-10-62-27199	Wall Segment	Boundary Marker
50-10-62-27200	Wall Segment	Boundary Marker
50-10-62-27201	Wall Segment	Boundary Marker
50-10-62-27202	Complex	Habitation
50-10-62-27203	Complex	Habitation
50-10-62-27204	Complex	Habitation
50-10-62-27205	Complex	Habitation
50-10-62-27206	Enclosure	Animal Pen
50-10-62-27207	Enclosure	Habitation
50-10-62-27208	Enclosure	Habitation
50-10-62-27209	Hearth	Fire/Cooking
50-10-62-27210	Enclosure	Habitation
50-10-62-27211	Enclosure	Habitation
50-10-62-27212	Enclosure	Habitation
50-10-62-27213	Enclosure	Habitation
50-10-62-27214	Enclosure	Habitation
50-10-62-27215	Enclosure	Habitation
50-10-62-27216	Hearth	Fire/Cooking
50-10-62-27217	Enclosure	Animal Pen
50-10-62-27218	Platform	Habitation
50-10-62-27219	Petroglyph	Art/Communication
50-10-62-27220	Cave	Complex
50-10-62-27221	Cave	Habitation, temporary
50-10-62-27222	Cave	Habitation, temporary
50-10-62-27223	Cave	Habitation, temporary
50-10-62-27224	Cave	Habitation, temporary
50-10-62-27225	Cave	Habitation, temporary
50-10-62-27226	Cave	Habitation, temporary
50-10-62-27227	Cave	Habitation, temporary
50-10-62-27228	Enclosure	Animal Pen
50-10-62-27229	Cave	Habitation, temporary
50-10-62-27230	Cave	Habitation, temporary
50-10-62-27231	Cave	Habitation, temporary
50-10-62-27232	Cave	Habitation, temporary
50-10-62-27234	Complex	Habitation, temporary

Table. 6.3. Site Number, Site Type and Function for the Phase I Survey Area cont.

SIHP Site No.	Formal Site Type	Function
50-10-62-27235	C-shape	Habitation, temporary
50-10-62-27236	C-shape	Habitation, temporary
50-10-62-27237	C-shape	Habitation, temporary
50-10-62-27238	C-shape	Habitation, temporary
50-10-62-27240	C-shape	Habitation, temporary
50-10-62-27241	C-shape	Habitation, temporary
50-10-62-27242	C-Shape	Habitation, temporary
50-10-62-27243	C-Shape	Habitation, temporary
50-10-62-27244	C-Shape	Habitation, temporary
50-10-62-27245	C-Shape	Habitation, temporary
50-10-62-27246	C-Shape	Habitation, temporary
50-10-62-27247	C-shape	Habitation, temporary
50-10-62-27248	C-shape	Habitation, temporary
50-10-62-27249	C-shape	Habitation, temporary
50-10-62-27250	Enclosure	Animal Pen
50-10-62-27251	C-Shape	Habitation, temporary
50-10-62-27252	C-Shape	Habitation, temporary
50-10-62-27253	C-shape	Habitation, temporary
50-10-62-27254	C-shape	Habitation, temporary
50-10-62-27255	C-Shape	Habitation, temporary
50-10-62-27256	C-shape	Habitation, temporary
50-10-62-27257	C-Shape	Habitation, temporary
50-10-62-27258	Cave	Animal Pen
50-10-62-27259	Petroglyph	Art/Communication
50-10-62-27260	Lava Blister	Habitation, temporary
50-10-62-27261	Lava Blister	Habitation, temporary
50-10-62-27262	L-shape	Habitation, temporary
50-10-62-27263	L-Shape	Habitation, temporary
50-10-62-27264	Wall Segment	TBD
50-10-62-27265	Trail	Transportation
50-10-62-27266	Alignment	Undetermined
50-10-62-27267	Enclosure	Undetermined
50-10-62-27268	Enclosure	Undetermined
50-10-62-27269	Wall	Undetermined
50-10-62-27270	Petroglyph	Art/Communication
50-10-62-27271	Petroglyph	Art/Communication

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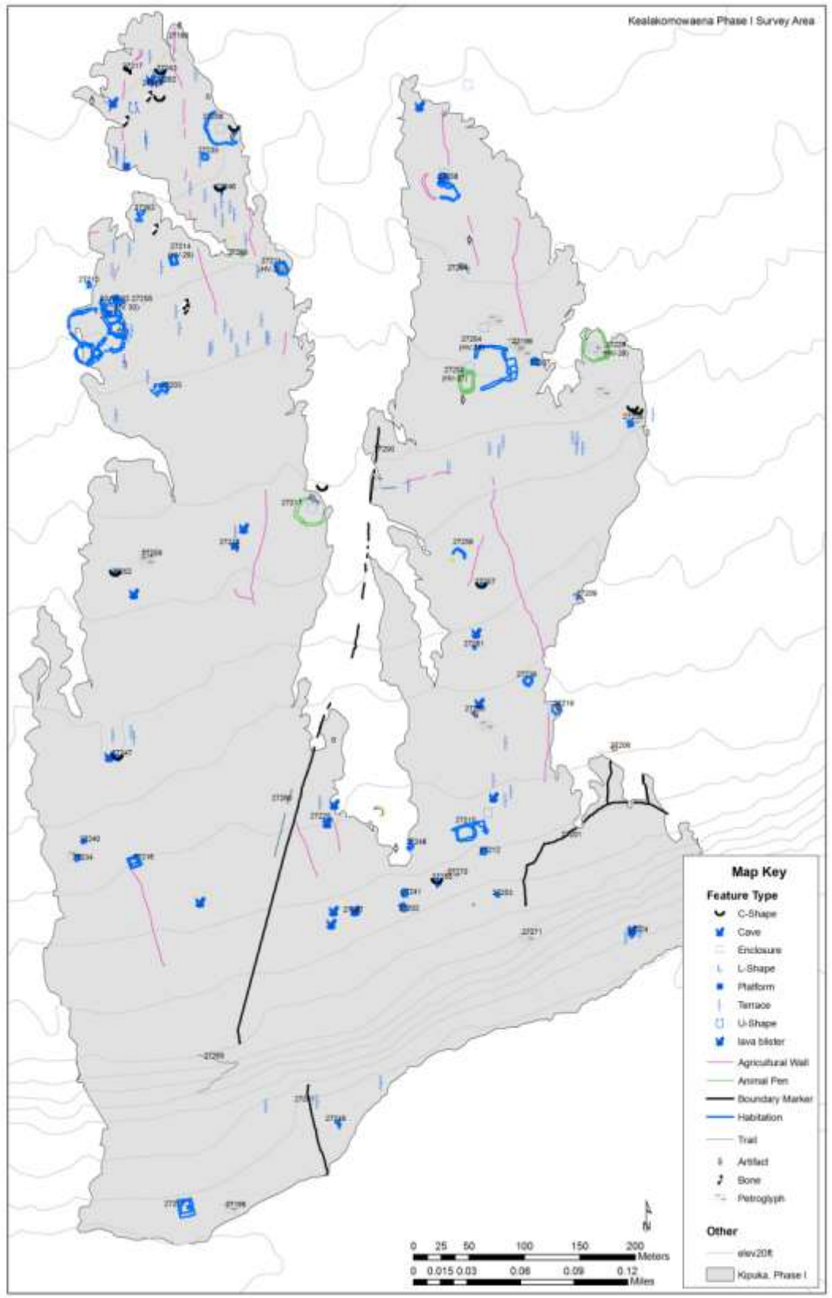


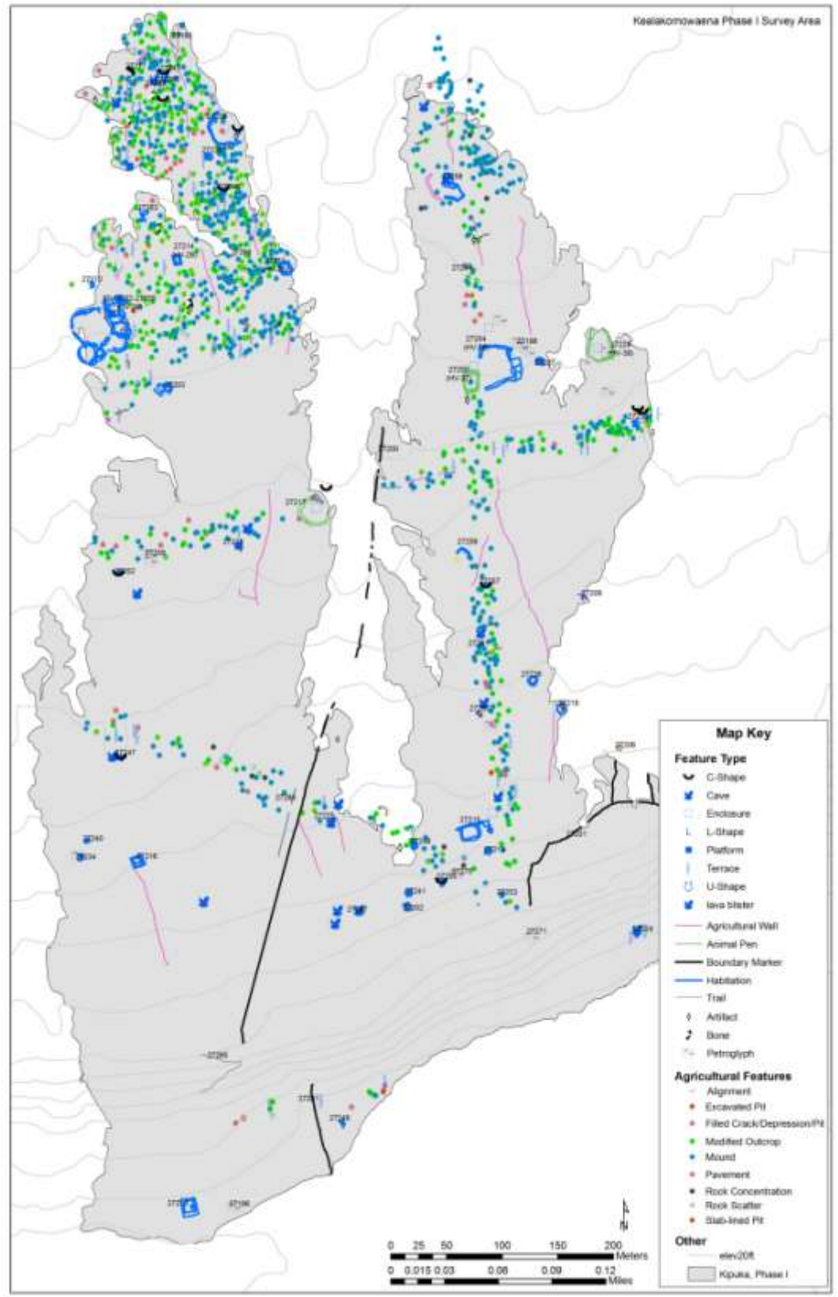


Figure 6.2. Sites identified during the Phase I survey. Figure to the left without agricultural Site 27195. Figure to the right with features from Site 27195 included.

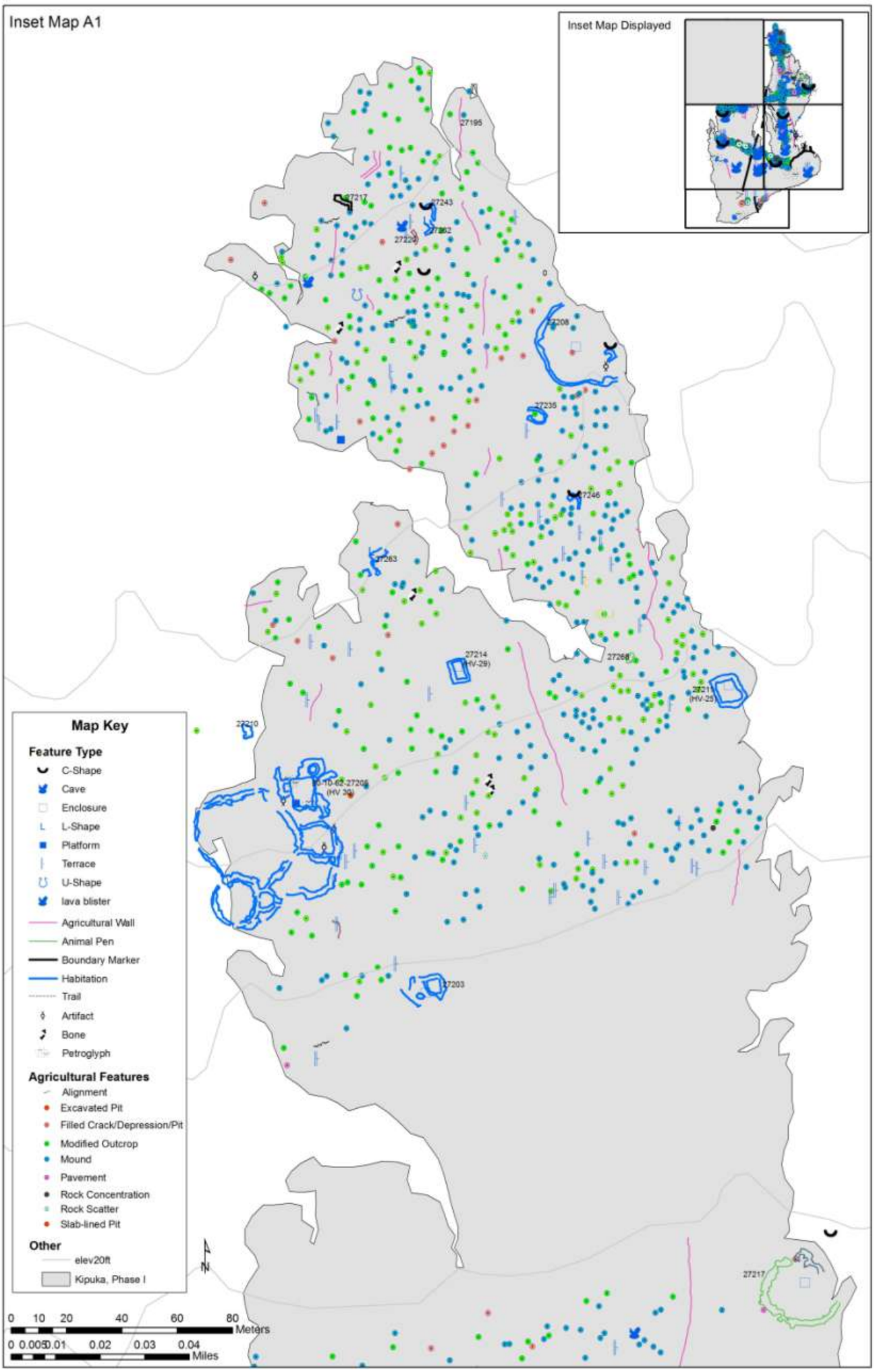


Figure 6.3. Sites identified during Phase I Survey, Inset Map A1.

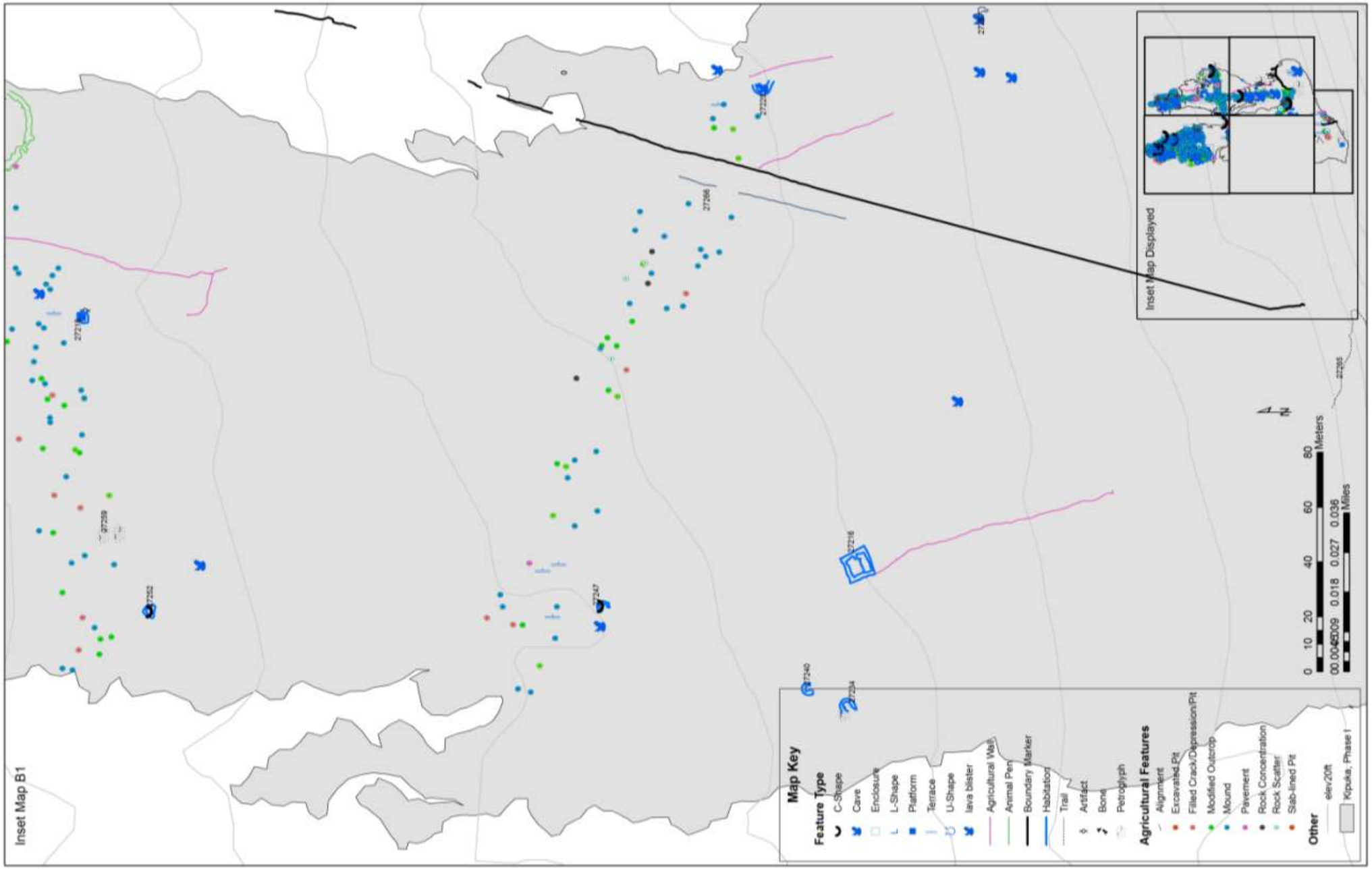


Figure 6.4. Sites identified during Phase I Survey, Inset Map B1.

Figure 6.5. Sites identified during Phase I Survey, Inset Map C1.

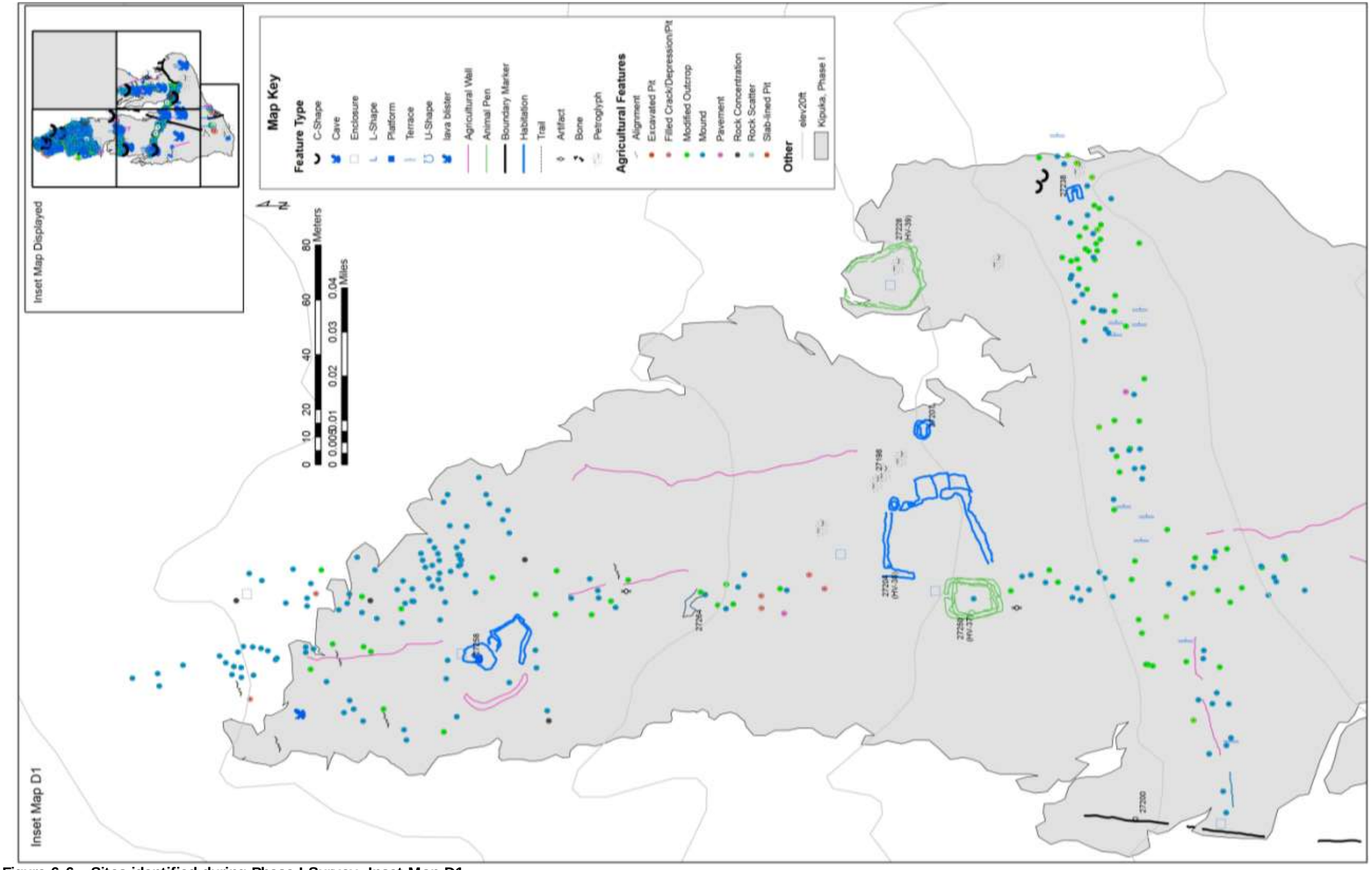


Figure 6.6. Sites identified during Phase I Survey, Inset Map D1.

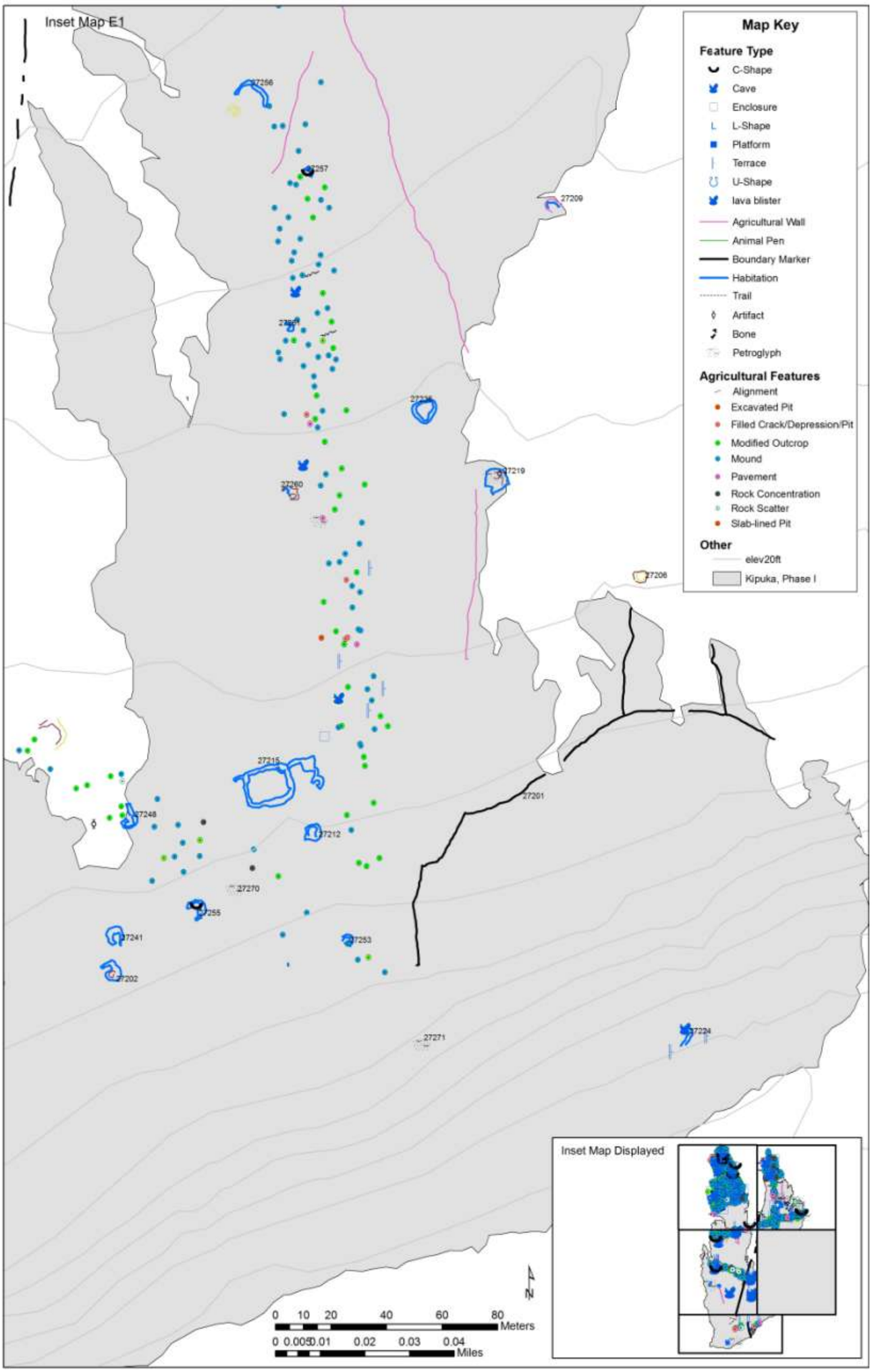


Figure 6.7. Sites identified during Phase I Survey, Inset Map E1.

Results of Phase II Inventory

A total of 112 new sites comprised of 1,998 individual features were identified during the Phase II survey efforts (see Table 6.4 and Figures 6.8 – 6.15). These sites include one battered area, 21 complexes, four c-shapes, one cupboard, six enclosures, one cave, seven paved areas, 20 petroglyphs, three rock piles, two terraces, 21 trails or trail segments, four u-shapes, one large agricultural site, and 20 walls or wall segments (see Table 6.5 and Appendix B).

Like the Phase I survey area, the largest site in terms of the number of features and distribution across the Phase II survey area is the agricultural site (SIHP Site 28252) which is comprised of 1,683 features. All of the features that are believed to be agricultural in nature were combined into this single site in part because it provides for ease of discussion. In addition, because of the widespread distribution of the features, and the commonality of the feature types, it is apparent that the entire area has been modified and is in fact a cultural landscape with the primary activity centered on agricultural production. Not all of the kīpuka has been surveyed. It is expected that many hundreds more agricultural features will be identified as the surveys continue. Thus, it will be easier to add individual features to a single site number thus requiring only this site number to be edited.

Table 6.4. Feature types identified during the Phase II Survey.

Feature Type	Total No. of Features
Alignment	6
Artifact	4
Battered Use Area	1
Cave (entrances and skylights)	11
Clearing	1
C-shape	5
Cupboard	2
Enclosure	9
Excavated Pit	117
Filled Area	41
Hearth	3
L-shape	1
Midden	2
Modified Tumulus	1
Mound	493
Paving	30
Petroglyph	110
Quarry	49
Rock Pile	929
Terrace	112
Trail	28
U-shape	5
Wall	38
Total	1988

Table 6.5. Site Number, Site Type and Function for the Phase II Survey Area .

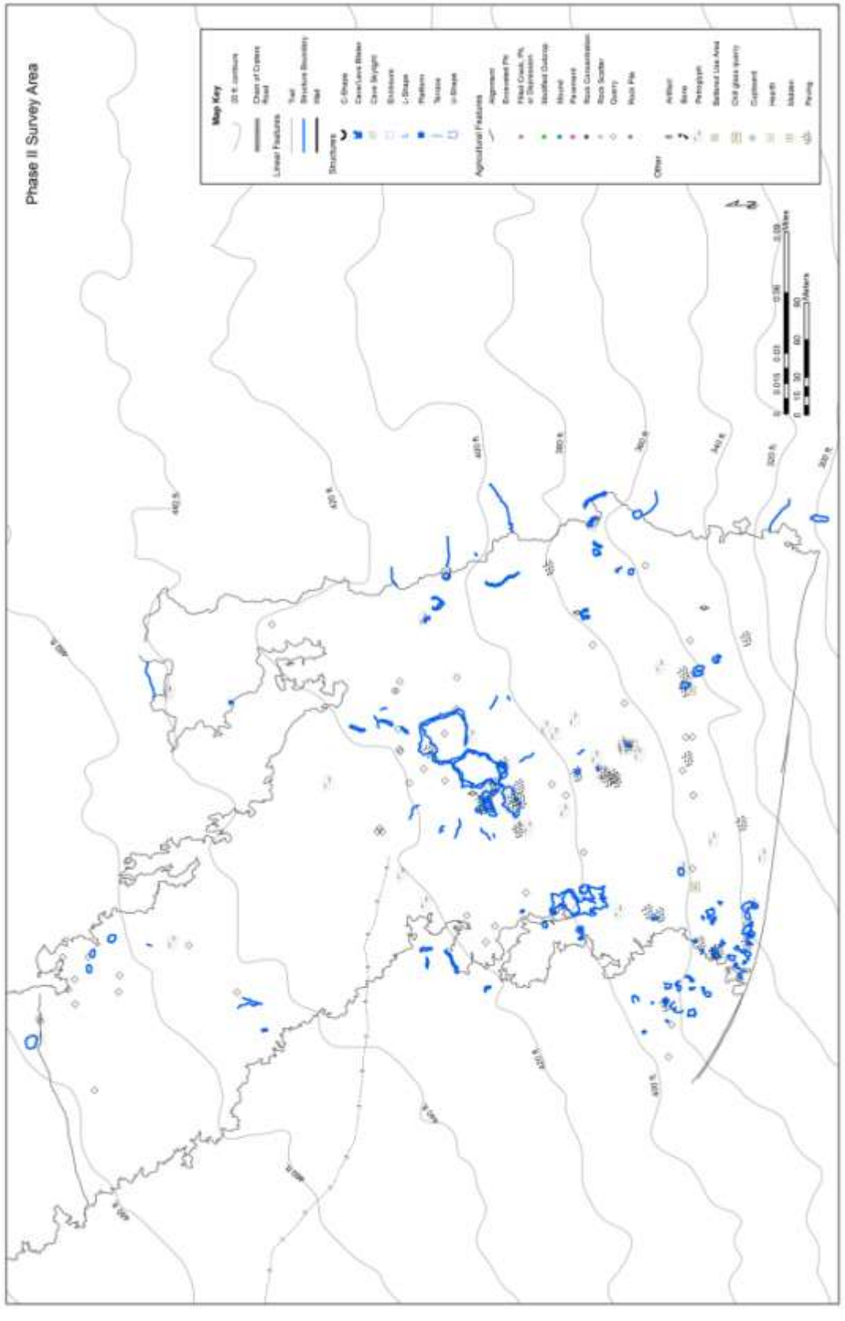
SIHP Site No.	Formal Site Type	Site Function
50-10-62-28143	Trail	Transportation
50-10-62-28144	Trail	Transportation
50-10-62-28145	Petroglyph	Art/Communication
50-10-62-28146	Complex	Habitation
50-10-62-28147	Complex	Habitation
50-10-62-28148	U-shape	Habitation, Temporary
50-10-62-28149	Wall	Boundary Marker
50-10-62-28150	Wall	Boundary Marker
50-10-62-28151	Complex	Habitation
50-10-62-28152	Complex	Undetermined
50-10-62-28153	Complex	Habitation
50-10-62-28154	Terrace	Habitation, temporary
50-10-62-28155	U-shape	Habitation, Temporary
50-10-62-28156	Complex	Habitation
50-10-62-28157	Enclosure	Habitation
50-10-62-28158	Complex	Habitation
50-10-62-28159	Complex	Habitation
50-10-62-28160	Complex	Habitation
50-10-62-28161	Enclosure	Animal Pen
50-10-62-28162	C-shape	Habitation, temporary
50-10-62-28163	Wall	Boundary
50-10-62-28164	Terrace	Habitation, temporary
50-10-62-28165	Complex	Habitation
50-10-62-28166	Complex	Habitation
50-10-62-28167	Complex	Habitation
50-10-62-28168	Petroglyph	Art/Communication
50-10-62-28169	Complex	Habitation
50-10-62-28170	Petroglyph	Art/Communication
50-10-62-28171	C-shape	Habitation, temporary
50-10-62-28172	Complex	Habitation
50-10-62-28173	Petroglyph	Art/Communication
50-10-62-28174	Complex	Habitation
50-10-62-28175	Complex	Undetermined
50-10-62-28176	Petroglyph	Art/Communication
50-10-62-28177	Complex	Agricultural Enclosure
50-10-62-28178	Complex	Undetermined
50-10-62-28179	Trail	Transportation
50-10-62-28180	Complex	Art/Communication
50-10-62-28181	Complex	Art/Communication
50-10-62-28182	Trail	Transportation
50-10-62-28183	Trail	Transportation
50-10-62-28184	Trail	Transportation
50-10-62-28185	Complex	Habitation

Table. 6.5. Site Number, Site Type and Function for the Phase II Survey Area cont.

SIHP Site No.	Formal Site Type	Site Function
50-10-62-28186	Paving	Habitation
50-10-62-28187	Petroglyph	Art/Communication
50-10-62-28188	Trail	Transportation
50-10-62-28189	Wall	Boundary Marker
50-10-62-28190	Petroglyph	Art/Communication
50-10-62-28191	C-shape	Habitation, temporary
50-10-62-28192	Enclosure	Animal Pen
50-10-62-28193	Petroglyph	Art/Communication
50-10-62-28194	Petroglyph	Art/Communication
50-10-62-28195	Wall	Boundary Marker
50-10-62-28196	Trail	Transportation
50-10-62-28197	Trail	Transportation
50-10-62-28198	Petroglyph	Art/Communication
50-10-62-28199	Trail	Transportation
50-10-62-28200	Paving	Art/Communication
50-10-62-28201	Petroglyph	Art/Communication
50-10-62-28202	Petroglyph	Art/Communication
50-10-62-28203	Petroglyph	Art/Communication
50-10-62-28204	U-shape	Habitation, Temporary
50-10-62-28205	Trail	Transportation
50-10-62-28206	Petroglyph	Art/Communication
50-10-62-28207	Wall	Habitation, temporary
50-10-62-28208	Cupboard	Habitation
50-10-62-28209	Trail	Transportation
50-10-62-28210	Trail	Transportation
50-10-62-28211	Wall	Boundary Marker
50-10-62-28212	Wall	Boundary Marker
50-10-62-28213	Wall	Boundary Marker
50-10-62-28214	Petroglyph	Art/Communication
50-10-62-28215	Wall	Boundary Marker
50-10-62-28216	Petroglyph	Art/Communication
50-10-62-28217	Trail	Transportation
50-10-62-28218	Wall	Boundary Marker
50-10-62-28219	Trail	Transportation
50-10-62-28220	C-shape	Habitation, temporary
50-10-62-28221	Wall	Boundary Marker
50-10-62-28222	Complex	Habitation
50-10-62-28223	Trail	Transportation
50-10-62-28224	Petroglyph	Art/Communication
50-10-62-28225	Wall	Shelter
50-10-62-28226	Trail	Transportation
50-10-62-28227	Wall	Boundary Marker

Table. 6.5. Site Number, Site Type and Function for the Phase II Survey Area cont.

SIHP Site No.	Formal Site Type	Site Function
50-10-62-28228	Wall	Boundary Marker
50-10-62-28229	Wall	Boundary Marker
50-10-62-28230	Trail	Transportation
50-10-62-28231	Wall	Boundary Marker
50-10-62-28232	Enclosure	Habitation
50-10-62-28233	U-shape	Habitation, Temporary
50-10-62-28234	Enclosure	Animal Pen
50-10-62-28235	Wall	Boundary Marker
50-10-62-28236	Trail	Transportation
50-10-62-28237	Complex	Habitation
50-10-62-28238	Wall	Boundary Marker
50-10-62-28239	Enclosure	Animal Pen
50-10-62-28240	Trail	Transportation
50-10-62-28241	Cave	Habitation, temporary
50-10-62-28242	Paving	Habitation
50-10-62-28243	Pavement	Habitation
50-10-62-28244	Wall	Boundary
50-10-62-28245	Paving	Habitation
50-10-62-28246	Trail	Transportation
50-10-62-28247	Battered Use Area	Activity Area
50-10-62-28248	Paving	Undetermined
50-10-62-28249	Paving	Activity Area
50-10-62-28250	Rock Pile	Activity Area
50-10-62-28251	Rock Pile	Activity Area
50-10-62-28252	various	Agriculture
50-10-62-28253	Petroglyph	Art/Communication
50-10-62-28254	Petroglyph	Art/Communication



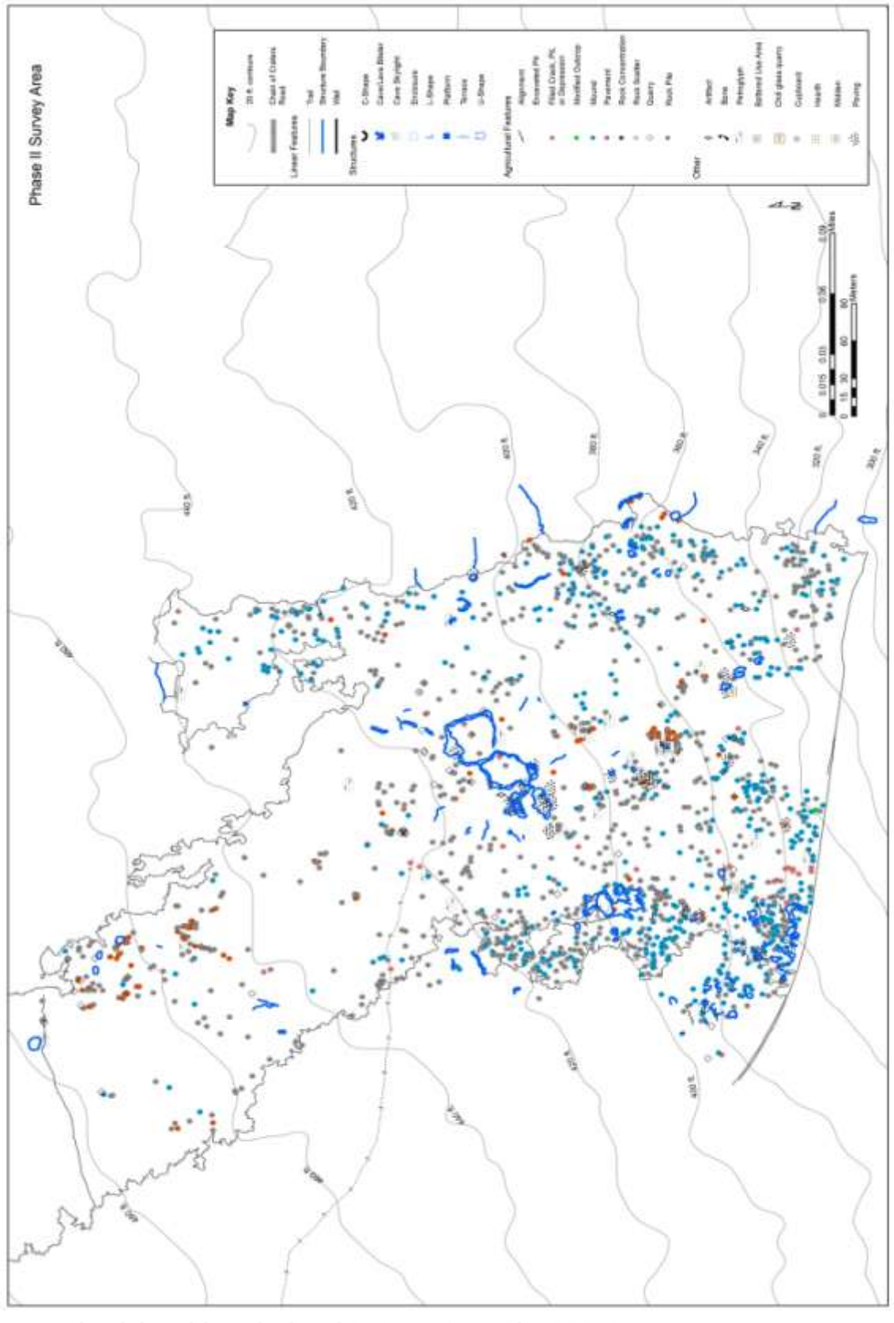


Figure 6.8. All Sites Identified during the Phase II Survey. Figure to the left, without agricultural Site 28252. Figure to the right with agricultural features from Site 28252.

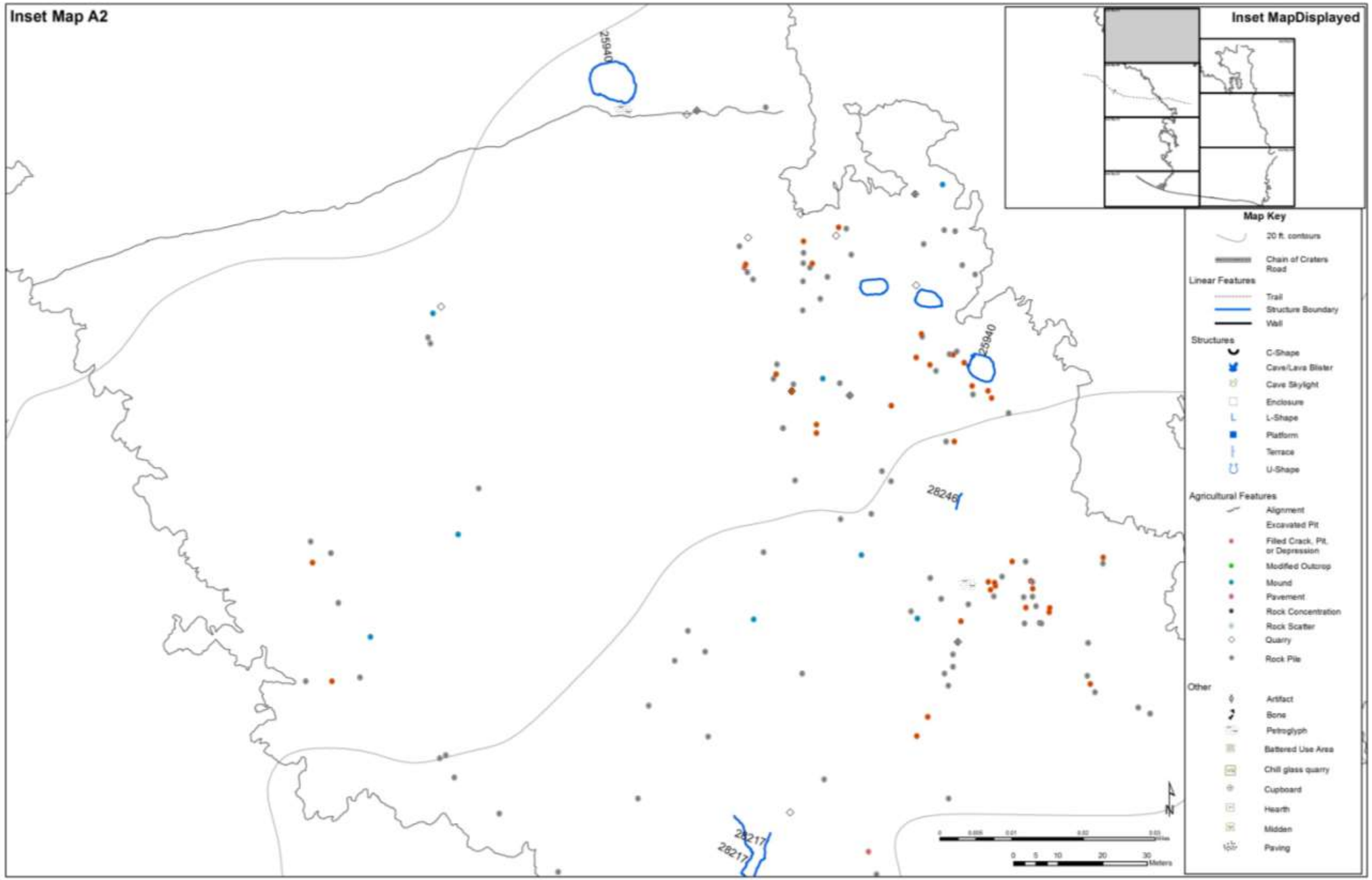


Figure 6.9. Sites identified during Phase II Survey, Inset Map A2.

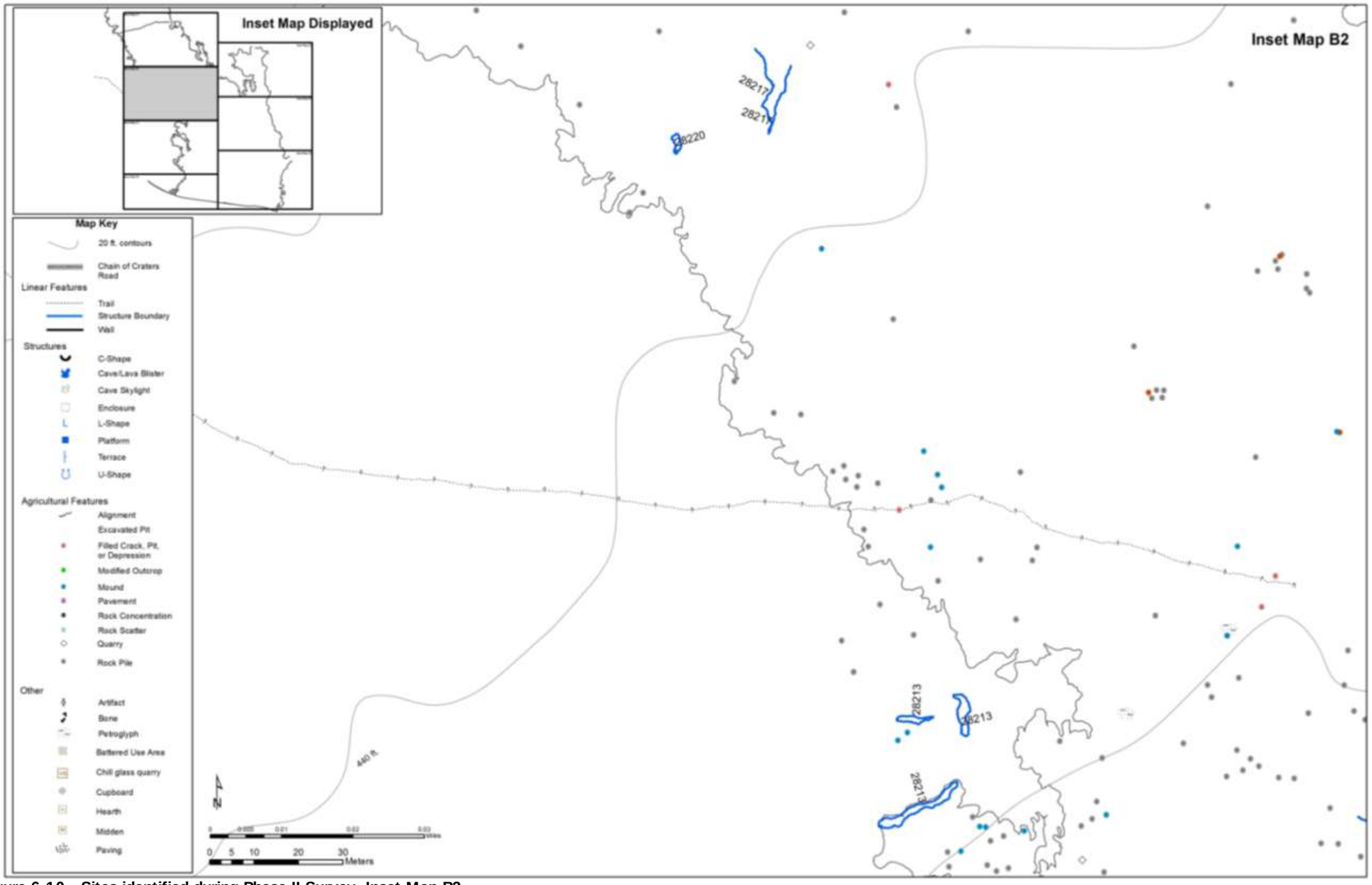


Figure 6.10. Sites identified during Phase II Survey, Inset Map B2.

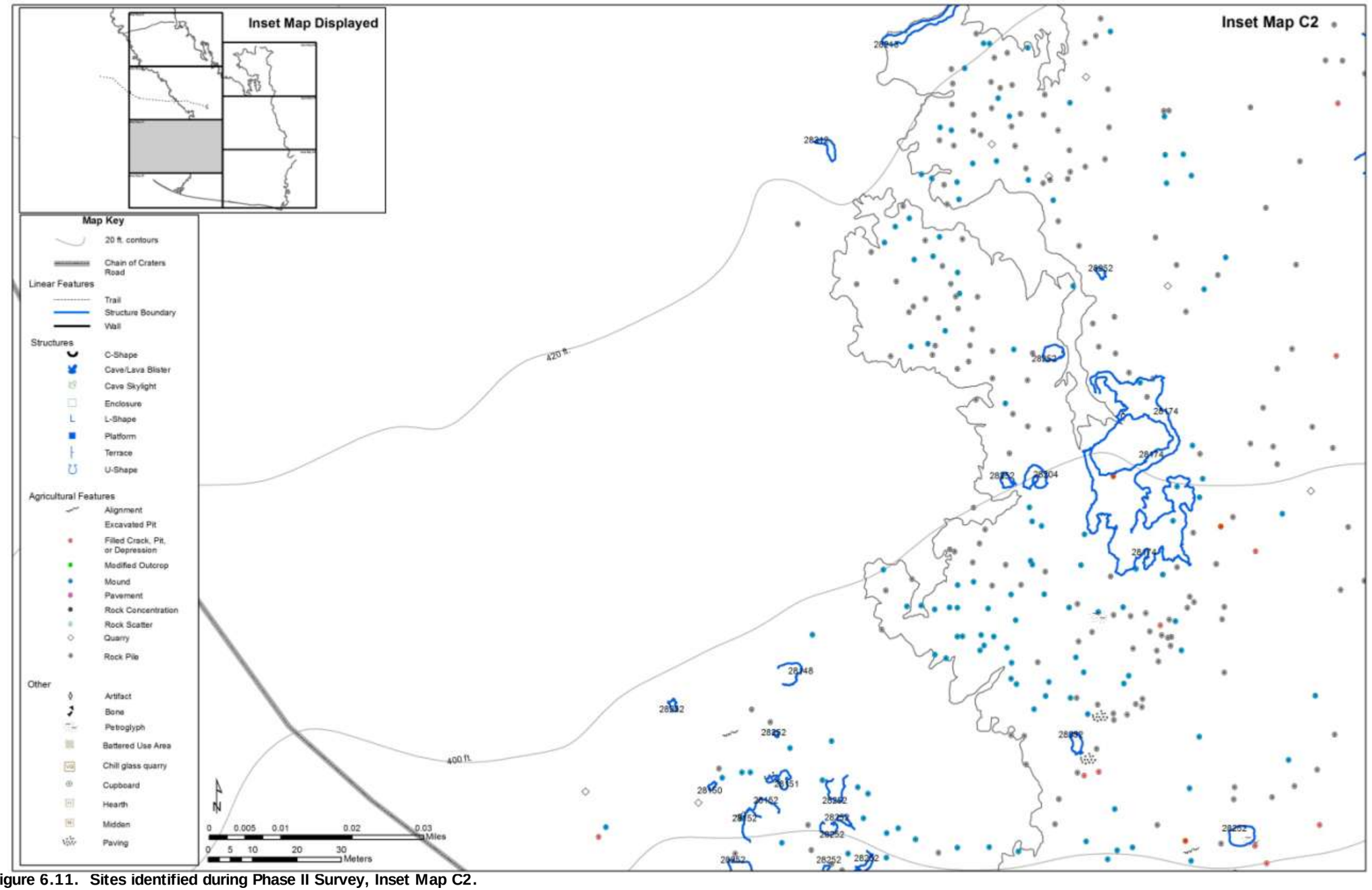


Figure 6.11. Sites identified during Phase II Survey, Inset Map C2.

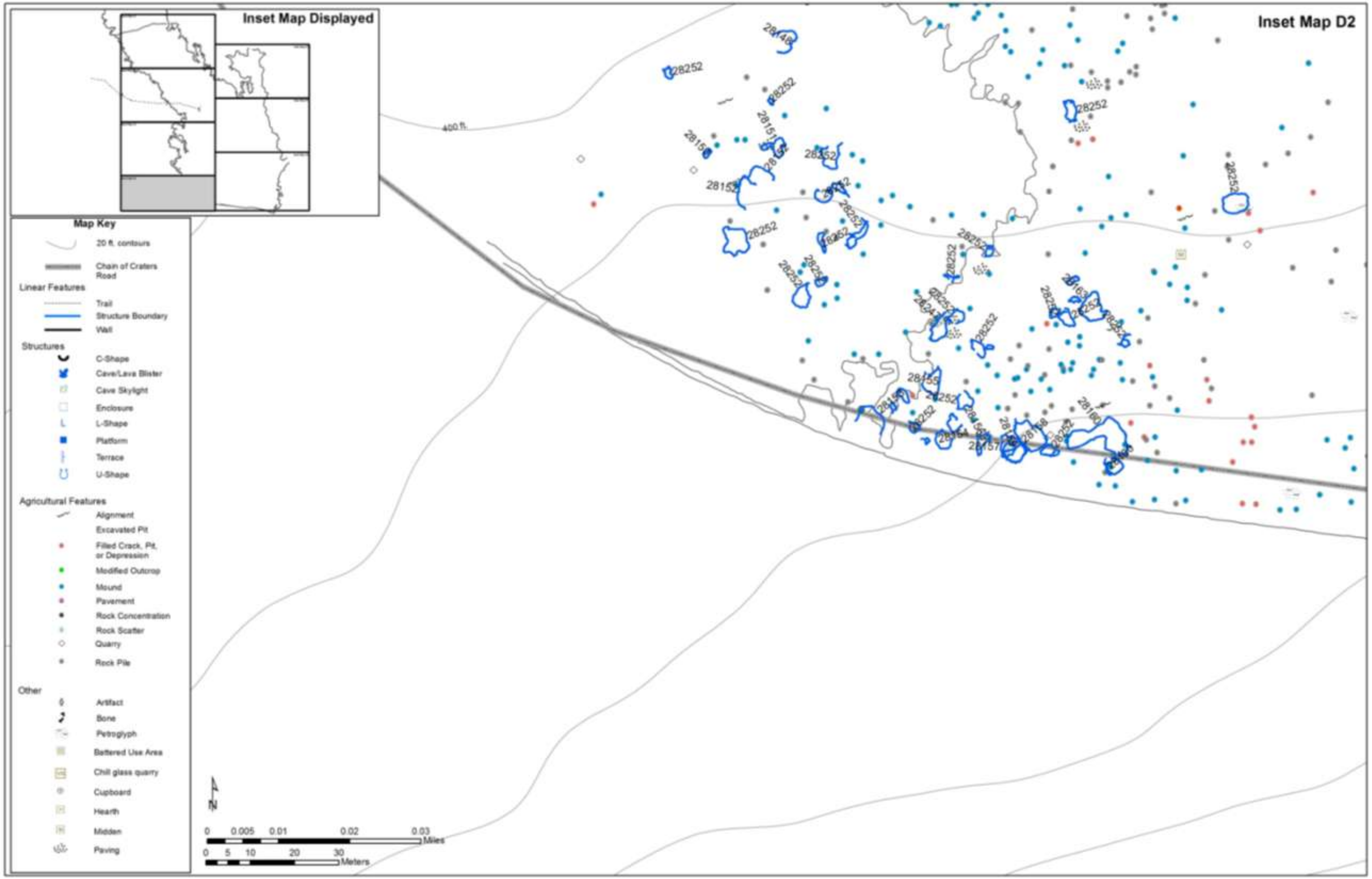


Figure 6.12. Sites identified during Phase II Survey, Inset Map D2.

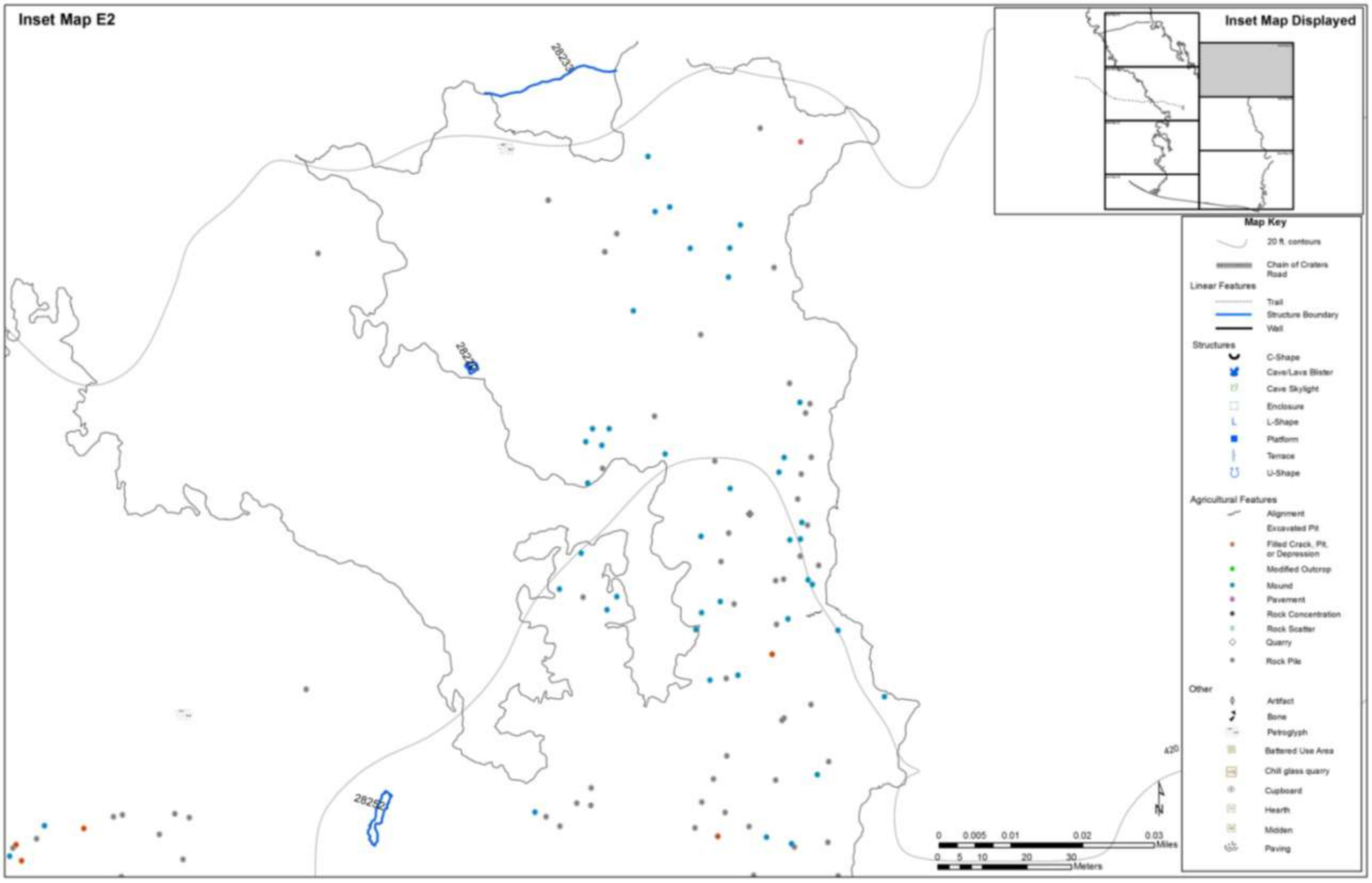


Figure 6.13. Sites identified during Phase II Survey, Inset Map E2.

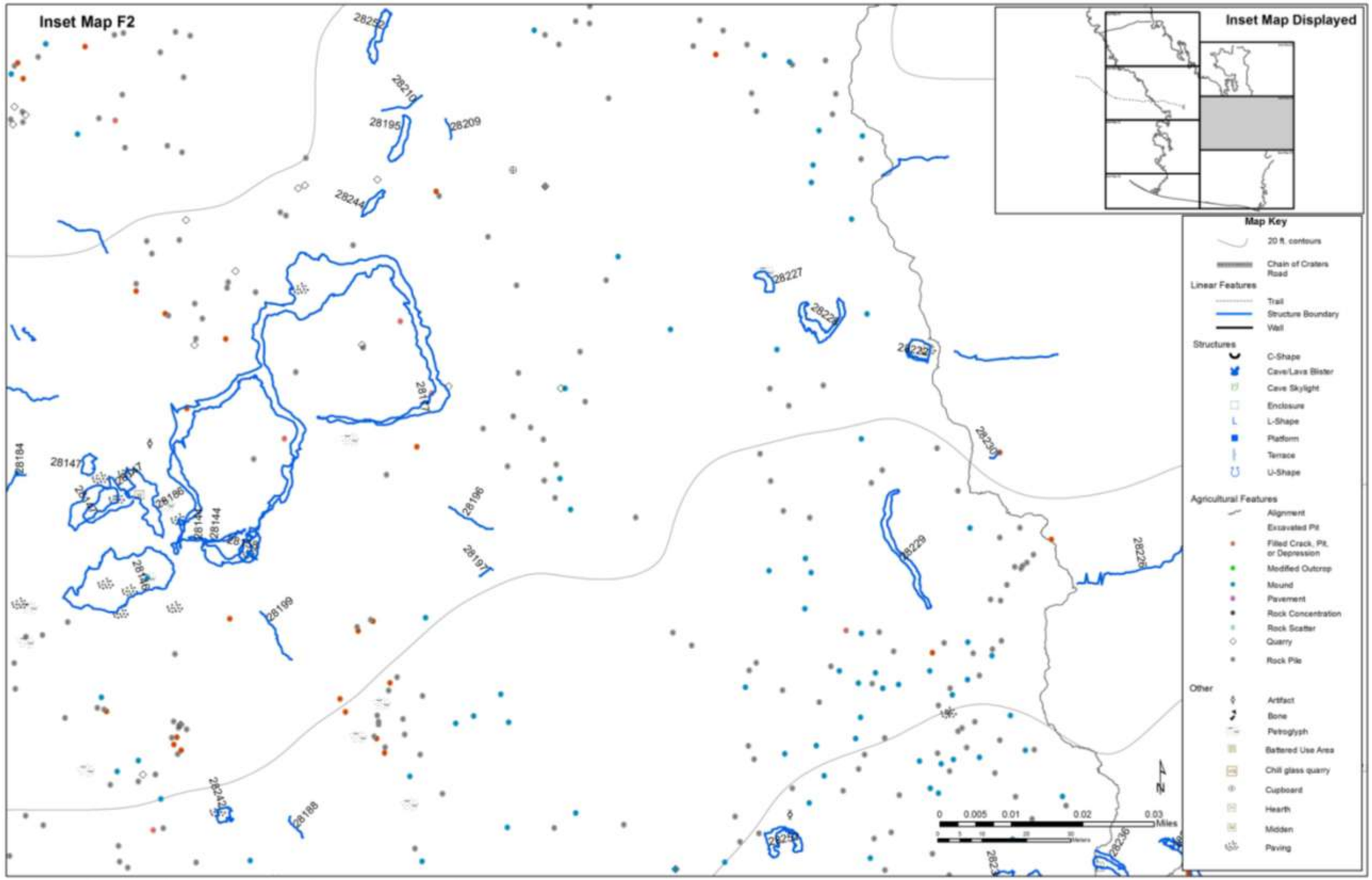


Figure 6.14. Sites identified during Phase II Survey, Inset Map F2.

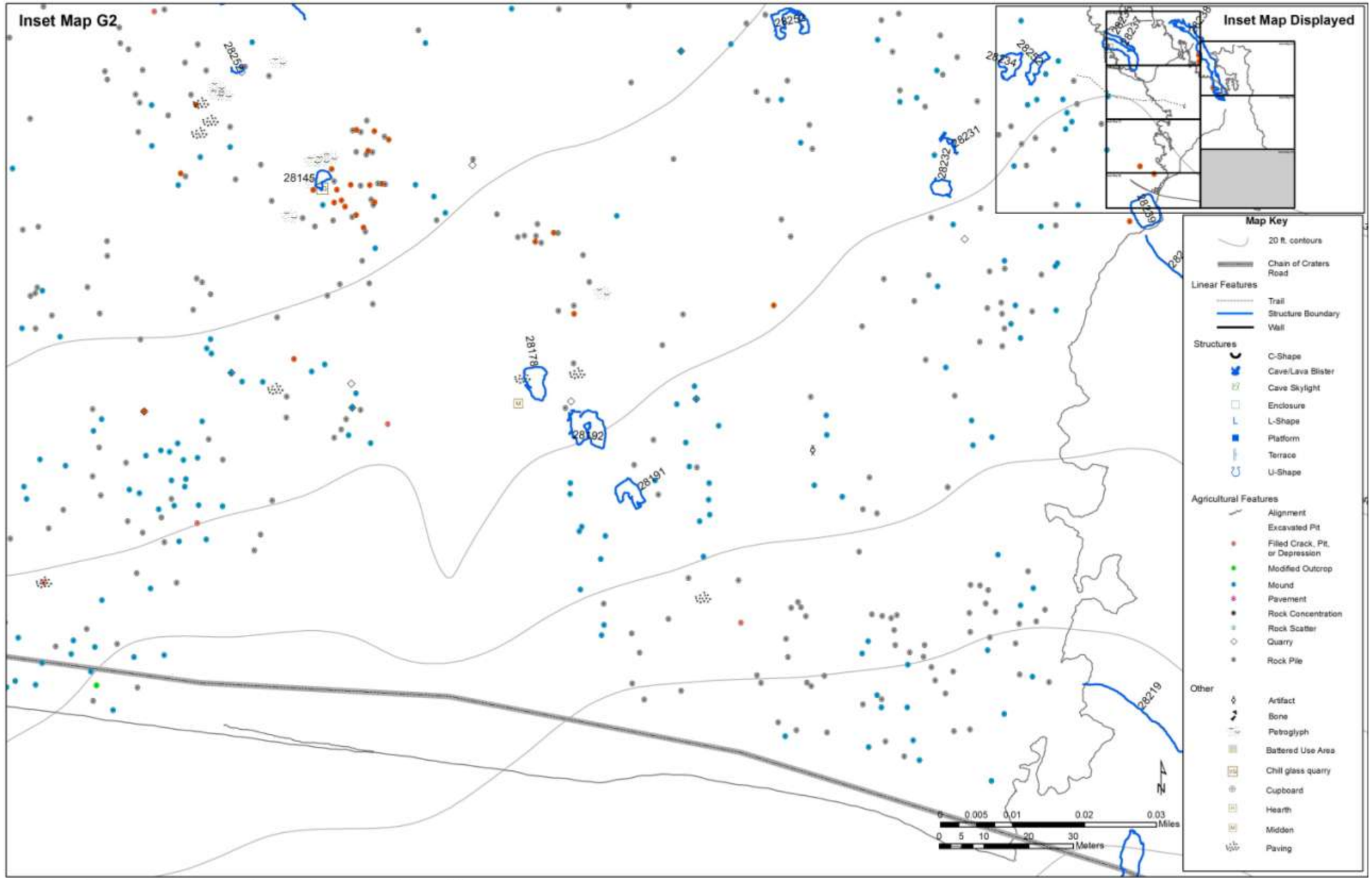


Figure 6.15. Sites identified during Phase II Survey, Inset Map G2.

A prominent resource embodying both cultural and natural significance within the study area is a cave system. The recent name of the resource is "Roadcut Cave," named during the second phase of Chain of Craters Road construction when the road corridor cut into the *pāhoehoe* bedrock at about the 320 foot elevation and created another opening to this ancient cave system. Roadcut Cave is an unusual volcanic phenomenon in Hawai'i in that the formation of the lava tube system is expressed as a *pāhoehoe* ridge and exhibits overflow vents. A number of structures and petroglyphs are associated with the cave, and likely part of a larger complex. However, because caves are managed as individual units, and because Roadcut Cave had been documented absent of the adjacent structures, it had previously been given its own site number. To avoid causing additional confusion, the original site number was maintained, and additional numbers were given to the associated features.

Results of Test Excavations – Phase A

Test excavations were conducted at 10 sites over two periods. So as not to confuse the discussion with the overall project, the excavation periods will be called Phase A and Phase B. Phase A testing occurred between December 2005 and November 2007. Phase B testing occurred between November 16, 2010 and January 4, 2011. Testing was done in-between project work in other areas of the park. All testing was done under the direct supervision of the project's lead author, who is also served as the Project Director.

Three Sites were excavated during the Phase A testing period: Site 27205 (HV-30), Site 27258, and Site 25940 (Roadcut Cave). Six sites were tested during the Phase B testing period: Site 27219, Site 28186, Site 28222, Site 28237, Site 27216, and two mound features in agricultural Site 27195. The primary purpose of the testing was to obtain charcoal suitable for radiocarbon dating. A secondary purpose was to better understand the function of these features, and to describe the paleoenvironment of the project area. To that end, samples from selected sites were sent in for pollen, phytolith and starch analysis.

Site25940 - (Roadcut Cave)

Five test probes were conducted within Roadcut cave – two in Entrance 5 and three in the *mauka* end of Entrance 9 (Table 6.6). The first test probe (TU1) was a 10cm x 10cm excavation within Hearth 1 in the *mauka* end of Entrance 9. The probe was excavated in 5cm arbitrary levels to maintain strict control. This test probe was very shallow – only 10cmbs because base rocks pinched off any more removal of sediment. The sediment that was removed was very wet, dark charcoal. All of the material was bulk bagged and taken back to the office for drying and sorting.

The second test probe in the *mauka* end of Entrance 9 was located just outside of a gourd cradle, the remains of which are several fragments of very fragile, wet, gourd pieces. The excavation is located approximately 50cm south of mapping station #22 (Figures B-1 – B-9). This test probe (TU2) was also 10cm x 10cm, and was just as shallow as TU1 (10cmbs). Excavation in this test unit stopped because solid *'a'ā* floor was encountered. All of the sediment removed was wet ash and charcoal, and was bulk bagged to dry in the office and sort. No natural layers were evident due to the dark, wet sediment.

Test probe number three (TU3) was excavated in the *mauka* entrance of Roadcut Cave Entrance 9. Like TU2, TU3 is also associated with a gourd cradle. A 10cm x 10cm test probe, this excavation was very short (only 4cm deep) and ended when the *ʻaʻā* floor was encountered. Very dark wet, ash and charcoal was removed, bulk bagged and taken back to the office to dry and sort.

Test probe four (TU4) was a 10cm x 10cm excavation done in Feature 13 of Entrance 5. The excavation was done within a hearth that appears to be modern. The unit is located south of a well constructed wall that bisects the cave just *makai* of the Entrance 5 sink. The unit was excavated in 5cm arbitrary levels to maintain strict control. Like the other units, all sediment was bulk bagged and sorted in the office. This test probe was also very shallow, only 5cm deep.

Test Unit 5 (TU5) was the final 10cm x 10cm probe excavated in Entrance 5. This unit was located 50cm southeast from Feature 13 because it was suspected that Feature 13 is modern and we wanted to maintain some control. The probe was excavated in 5cm arbitrary levels and went down to 12cmbs. At 6cmbs an ash lens was encountered in the south half of the unit and at 10cmbs at the north half. The ash layer was removed and bagged separately. The ash was a very shallow, thin layer. Below the ash layer the unit only went down another two centimeters to 12cmbs when it ended at the bottom of the cave floor.

Site27205 - (HV-30)

A single test unit (TU1) was excavated within a hearth (SF2) in Site 27205 (HV-30) (Table 6.7). The hearth is a slab-lined feature located within a paved platform. The hearth was bisected and excavated in 5cm arbitrary levels to maintain tight control. The top layer of sediment within the hearth was 10cmbs below the top of the slab. A single coral fragment and a complete cowry shell were located on the surface of the hearth. Within the first five centimeters small *ʻaʻā* paving stones were mixed in with the sediment. This material likely came from the adjacent platform paving. Numerous roots were removed from the first 5cm. The second level (I/2) was 15-20cmbs. It contained very loose sediment with lots of angular *ʻaʻā* stones, again much like the stones used for pavement on the surface of the platform. Two rusted metal pieces were noted and removed from this layer. Lot of fish bone and shell were noted during excavation of this level. All material was bulk bagged and taken back to the office for sorting. When a new layer was noted at the northern end of the hearth at 19cmbs excavation within this section was halted until the entire first layer was removed. Layer II/1 extended from 19cmbs to 25cmbs. This layer consisted of ash, with less stone. Small pieces of rusted metal and rust colored fragments were removed. Layer II/2 continued to 30cmbs and consisted of less bone and shell fragments than Layer II/1. Some charcoal pieces were evident, and rusted metal nails were removed and bagged with the larger bulk sample. Layer II/3 consisted of the same ash and charcoal material. This layer ended at 32cmbs when bedrock of course basalt was hit at the base of excavation. No charcoal was sent for radiocarbon dating from this excavation because historic metal was recovered from each layer, and clearly dates this site to the historic period.

Site 27258
A single 25cm x 25cm test unit (TU-1) was excavated within the cave overhang of Site 27258 (Table 6.8). The test unit is near the entrance, about half-way beyond, or under, the drip line. The test unit was placed between three large surface cobbles. A few scattered marine shells and shell fragments were noted on the surface of the cave floor. No marine shells, or other manuports were located on the surface of the test unit. The unit was excavated in five centimeter arbitrary levels. The test unit was rather deep compared to other sites excavated in the project areas. Although no discernable natural layers were noted, eight arbitrary levels were excavated and ended at bedrock at 48cmbs. Marine shell midden and some corral was removed from levels three and four (10 – 15cmbs and 15-20cmbs respectively) and level seven (40 – 45cmbs).

Results of Test Excavations – Phase B
Site 27219 (TU-2)
Site 27219 consists of one rock platform measuring 6.5 x 8.5 x 0.6 meters with a slab lined hearth in the center. The hearth was bisected and one half of the hearth was excavated down to bedrock.

TU-2 consisted of three layers and seven levels. The surface of the hearth was covered with vegetation growing out of and around it. The vegetation was removed, exposing the natural ground surface and excavation commenced. Layer II (17-22 cmbd) was a lighter colored ash layer in the center and the edges were part of the darker colored layer I. Layer II also contained numerous paving stones that were removed during this excavation. Layer III extended from 27-45 cmbd and contained the biggest concentration of cultural deposits with an abundance of charcoal pieces, shell and bone fragments as well as some seeds. The base of excavation was reached at 47 cmbd. The test unit narrowed as we got deeper due to the shape of the upright slabs that were used to construct the hearth.

Site 28186 (TU-3)
Site 28186 consists of a pavement feature measuring 15.1 x 6.5 x 0.4 meters high with a slab lined hearth. The hearth was bisected and half of it was excavated. The hearth was labeled test unit 3 (TU-3).

Test unit 3 was a shallow hearth and only consisted of one layer and two levels. The depth ranged from 23 to 31 cmbd. Ash smears were present in layer I level 1 between 23-28 cmbd. Small basalt pebbles were removed in this layer as well. It was determined that due to the shallowness of this hearth it was not used as frequently as some of the others in the area. Bone, seed, charcoal and shell was found consistently throughout the excavation.

Table 6.6. Bag list from Site 29940, Roadcut Cave excavation*.

Field Bag #	Test Unit #	Provenience	CMBS	Weight	Material Type	Genus/Species	Item Count	Date Collected	Description
1	TU-1	I/1	0-5 cmbs	0.865 g	charcoal	Unid	1 bag	12/13/2005	Ent. 9, Hearth #1
4	TU-2	I/1	0-5 cmbs	16.310 g	charcoal	Unid	1 bag	12/13/2005	Ent. 9
5	TU-2	I/2	5-7 cmbs	8.725 g	charcoal	Unid	1 bag	12/13/2005	Ent. 9
6	TU-3	I/1	0-5 cmbs	38.267 g	charcoal	Unid	2 bags	12/13/2005	Ent. 9
8	TU-4	I/1	0-5 cmbs	0.04 g	shell	Unid	1 bag	12/13/2005	Ent. 5, Feat. 13
8	TU-4	I/1	0-5 cmbs	5.8 g	charcoal	Unid	1 bag	12/13/2005	Ent. 5, Feat. 13, Hearth
10	TU-4	I/2	5-10 cmbs	1.318 g	charcoal	Unid	1 bag	12/13/2005	Ent. 5, Feat. 13, Hearth
12	TU-5	I/1	0-5 cmbs	0.579 g	shell	Unid	1 bag	12/13/2005	Ent. 5
12	TU-5	I/1	0-5 cmbs	3.505 g	charcoal	Unid	1 bag	12/13/2005	Ent. 5
14	TU-5	I/2	5-10 cmbs	3.03 g	shell	Unid	1 bag	12/13/2005	Ent. 5
14	TU-5	I/2	5-10 cmbs	3.272 g	charcoal	Unid	1 bag	12/13/2005	Ent. 5
	NA	Surface	surface		wood	Unid	1 bag	12/13/2005	Cache - west wall of Ent. 9

*Project Number HAVO 2006B, Accession Number HAVO-394.

Table 6.7. Bag list from Site 27258 excavation*.

Field Bag #	Catalog Number	Test Unit #	Artifact Type	Provenience	CMBS	Weight	Material Type	Item Count	Date Collected
1	HAVO 15447	TU-1	bulk soil	I/1	0-5		bulk soil	1	11/20/2007
1	HAVO 15448	TU-1	shell	I/1	0-5		shell	6-8	11/20/2007
1	HAVO 15449	TU-1	charcoal	I/1	0-5	0.454 g	charcoal	N/A	11/20/2007
2	HAVO 15450	TU-1	bulk soil	I/2	5-10		bulk soil	N/A	11/20/2007
2	HAVO 15451	TU-1	charcoal	I/2	5-10	11.181 g	charcoal	N/A	11/20/2007
2	HAVO 15452	TU-1	shell	I/2	5-10		shell	20+	11/20/2007
2	HAVO 15453	TU-1	teeth	I/2	5-10		teeth	2	11/20/2007
3	HAVO 15454	TU-1	bulk soil	I/3	10-15		bulk soil	N/A	11/20/2007
3	HAVO 15455	TU-1	charcoal	I/3	10-15	11.907 g	charcoal	N/A	11/20/2007
3	HAVO 15456	TU-1	shell	I/3	10-15		shell	20+	11/20/2007
3	HAVO 15457	TU-1	fish bones/scales	I/3	10-15		fish bones/scales	20+	11/20/2007
3	HAVO 15458	TU-1	coral	I/3	10-15		coral	3	11/20/2007
5	HAVO 15459	TU-1	bulk soil	I/4	15-20		bulk soil	N/A	11/20/2007
5	HAVO 15460	TU-1	shell	I/4	15-20		shell	20+	11/20/2007
5	HAVO 15461	TU-1	charcoal	I/4	15-20	6.893 g	charcoal	N/A	11/20/2007
6	HAVO 15480	TU-1	bulk soil	I/5	20-35		bulk soil	N/A	11/20/2007
6	HAVO 15462	TU-1	charcoal	I/5	20-35	1.27 g	charcoal	N/A	11/20/2007
6	HAVO 15463	TU-1	shell	I/5	20-35		shell	3	11/20/2007
6	HAVO 15464	TU-1	fish bone	I/5	20-35		fish bone	1	11/20/2007
6	HAVO 15465	TU-1	waterworn	I/5	20-35		stone	1	11/20/2007
7	HAVO 15466	TU-1	shell	I/4	15-20	10.029 g	shell	1	11/20/2007
9	HAVO 15467	TU-1	bulk soil	I/6	35-40		bulk soil	N/A	11/20/2007
9	HAVO 15468	TU-1	charcoal	I/6	35-40	8.183 g	charcoal	N/A	11/20/2007
9	HAVO 15469	TU-1	shell	I/6	35-40		shell	20+	11/20/2007
9	HAVO 15470	TU-1	tooth	I/6	35-40		tooth	1	11/20/2007
9	HAVO 15471	TU-1	fish bones/scales	I/6	35-40		fish bones/scales	10	11/20/2007
10	HAVO 15472	TU-1	bulk soil	I/7	40-45		bulk soil	N/A	11/20/2007

Table 6.7. Bag list from Site 27258 excavation continued*.

Field Bag #	Catalog Number	Test Unit #	Artifact Type	Provenience	CMBS	Weight	Material Type	Item Count	Date Collected
10	HAVO 15473	TU-1	charcoal	I/7	40-45	15.421 g	charcoal	N/A	11/20/2007
10	HAVO 15474	TU-1	fish bones/scales	I/7	40-45		fish bones/scales	20+	11/20/2007
10	HAVO 15475	TU-1	shell	I/7	40-45		shell	20+	11/20/2007
12	HAVO 15476	TU-1	bulk soil	I/8	45-48		bulk soil	N/A	11/20/2007
12	HAVO 15477	TU-1	charcoal	I/8	45-48	2.555 g	charcoal	N/A	11/20/2007
12	HAVO 15478	TU-1	shell	I/8	45-48		shell	20+	11/20/2007
12	HAVO 15479	TU-1	fish bones/scales	I/8	45-48		fish bones/scales	10+	11/20/2007

*Project Number HAVO 2006B, Accession Number HAVO-394.

Table 6.8. Bag list from SF-2, Hearth feature in HV-30, Site 27205 excavation*.

Field Bag #	Catalog Number	Test Unit #	Artifact Type	Provenience	CMBS	Weight	Material Type	Item Count	Date Collected
1	HAVO 15552	TU-1	charcoal	I/1	10-15	4.896g	charcoal		12/4/2007
1	HAVO 15553	TU-1	shell	I/1	10-15	0.121g	shell	20	12/4/2007
1	HAVO 15554	TU-1	bone	I/1	10-15	1.258g	bone frags	20-25	12/4/2007
1	HAVO 15555	TU-1	metal	I/1	10-15	4.354g	metal	3	12/4/2007
1	HAVO 15556	TU-1	cowry shell	I/1	10-15	126.634g	shell	1	12/4/2007
1	HAVO 15557	TU-1	soil	I/1	10-15	343g	soil	1	12/4/2007
2	HAVO 15558	TU-1	metal	I/2	15-20	7.056g	metal	1	12/4/2007
3a/b	HAVO 15559	TU-1	shell	I/2	15-20	2.847	shell	>46	12/4/2007
3a/b	HAVO 15560	TU-1	charcoal	I/2	15-20	5.47	charcoal		12/4/2007
3a/b	HAVO 15561	TU-1	coral	I/2	15-20	4.264	coral	13	12/4/2007
3a/b	HAVO 15562	TU-1	shell	I/2	15-20	9.284g	shell	>20	12/4/2007
3a/b	HAVO 15563	TU-1	nails	I/2	15-20	23.059	metal	11	12/4/2007
3a/b	HAVO 15564	TU-1	bone	I/2	15-20	17.776	bone	>100	12/4/2007
3a/b	HAVO 15565	TU-1	soil	I/2	15-20	453g	soil		12/4/2007
3a/b	HAVO 15566	TU-1	plant fibers	I/2	15-20	0.222g	plant	2	12/4/2007
3a/b	HAVO 15567	TU-1	soil	I/2	15-20	304g	soil		12/4/2007
4ab	HAVO 15568	TU-1	shell	II/1	19-25	34.673g	bones	>300	12/4/2007
4ab	HAVO 15569	TU-1	charcoal	II/1	19-25	3.723g	charcoal		12/4/2007
4ab	HAVO 15570	TU-1	metal	II/1	19-25	22.981g	metal	6	12/4/2007
4ab	HAVO 15571	TU-1	shell	II/1	19-25	0.026g	shell	5	12/4/2007
4ab	HAVO 15572	TU-1	shell	II/1	19-25	3.22g	shell	>35	12/4/207
4ab	HAVO 15573	TU-1	shell	II/1	19-25	3.222g	shell	>45	12/4/2007
4ab	HAVO 15574	TU-1	soil	II/1	19-25	382g	soil		12/4/2007
5	HAVO 15575	TU-1	charcoal	II/2	25-30	1.932g	charcoal		12/4/2007
5	HAVO 15576	TU-1	shell	II/2	25-30	3.243	shell	>25	12/4/2007
5	HAVO 15577	TU-1	metal	II/2	25-30	45.519	metal	10	12/4/2007

Table 6.8. Bag list from SF-2, Hearth feature in HV-30, Site 27205 excavation continued*.

Field Bag #	Catalog Number	Test Unit #	Artifact Type	Provenience	CMBS	Weight	Material Type	Item Count	Date Collected
5	HAVO 15578	TU-1	bones	II/2	25-30	12.777g	bones	>400	12/4/2007
5	HAVO 15579	TU-1	metal	II/2	25-30	3.060g	metal	2	12/4/2007
5	HAVO 15580	TU-1	soil	II/2	25-30	507	soil		
6	HAVO 15581	TU-1	charcoal	II/3	clean up 30	2.179	charcoal		12/4/2007
6	HAVO 15582	TU-1	shell	II/3	clean up 30	0.336	shell	3	12/4/2007
6	HAVO 15583	TU-1	bone	II/3	clean up 30	0.776	bone	20	12/4/2007
6	HAVO 15584	TU-1	soil	II/3	clean up 30	317g	soil		12/4/2007
7	HAVO 15585	TU-1	bone	II/3	30-32	1.74	bone	15-20	12/4/2007
7	HAVO 15586	TU-1	metal	II/3	30-32	5.428	metal	>10	12/4/2007
7	HAVO 15587	TU-1	button	II/3	30-32	0.34	button	1	12/4/2007
7	HAVO 15588	TU-1	shell	II/3	30-32	2.499	shell	10	12/4/2007
7	HAVO 15589	TU-1	charcoal	II/3	30-32	1.951	charcoal		12/4/2007
7	HAVO 15590	TU-1	soil	II/3	30-32	347g	soil		12/4/2007

*Project Number HAVO 2006B, Accession Number HAVO-394.

Site 28222 (TU-4)
Site 28222 consists of a residential complex containing a walled enclosure, pavement and a slab-lined hearth feature. The hearth was bisected and half of it was excavated. This hearth was labeled test unit 4 (TU-4).

TU-4 revealed three layers and four levels ranging from 20-36 cmbd. Findings include shell, charcoal, bones and seeds. The surface layer contained mostly organic sediment and roots along with small pebbles. An ash deposit was deposited in layer II at approximately between 22-27 cmbd. Layer III starts at 29cmbd and consisted of a darker more organic layer. Pockets of ash are still present in Layer II before it reaches the base of the excavation at 36 cmbd.

Site 28237 (TU-5)
Site 28237 consists of residential complex, a main terrace feature with internal components of a rock wall, a terrace and a slab-lined hearth. The hearth was bisected and half of it was excavated and labeled test unit 5 (TU-5). This site is located approximately 167 meters north of chain of craters road.

TU-5 contained three layers and four levels that range from 18-33cmbd. Cultural remains in TU-5 consist of bone, shell, metal, charcoal fragments and seeds. The remains were distributed evenly throughout the hearth. The first layer was mostly organic material, very dark in color. As we dug down to expose layer II we encountered charcoal smears and a clay like ash layer. Opihi shell fragments began surfacing at layer III, level 4 and were bagged. Layer III, level 4 also showed a mixture of ash and darker sediment. This gave way to small rocks before it terminated at 33 cmbd.

Site 27216 (TU-6)
Site 27216 consists of two – tiered platform (labeled structures A and B). The hearth is located in structure A, the uppermost tier of the feature and was labeled test unit 6 (TU-6). This site is located approximately 930 meters from chain of craters road.

TU-6 revealed three layers spanning eight levels. Cultural remains include charcoal, bone, shell and metal fragments. These remains were found predominantly in layer III between levels three and eight. Layer I was made up of organic material and deposits from the surrounding vegetation. Once removed, layer II showed a fine ash layer with less organics. Charcoal smears appeared at approximately 19.5 cmbd. Layer III appears at 18.5 cmbd and continues to the base of the excavation at 52cmbd. The hearth narrows the deeper we went due to the upright slabs shape on the north side. This layer (III) is where most of the cultural remains were found. It is apparent that this hearth was utilized much more than the other six we excavated due to the depth of the hearth.

Site 27195, Rock Mound MTU-1
Rock mound MTU-1, located in the Kealakomowaena project area was the first of two rock mounds excavated. Our methodology changed for the two rock mounds. Due to

the size and potential depth of the mound, 10 cm intervals between levels were used. This excavation consisted of a 1 square meter test unit and contained two layers and six levels. Quart size bag samples for pollen and phytolith where taken on every level.

The majority of the potential cultural remains included charcoal, seeds and shell. Layer I, level 1 exclusively contained rocks and boulders. This level ranged from 10-45 cmbd. Once all the rocks were removed and the soil was exposed we began excavating the soil matrix. The majority of the findings came from layer II, level 4, between 62-72 cmbd and included some shell fragments and one water worn stone. Charcoal was the most common material found throughout the entire excavation. There is potential this could possibly be from the 2008 controlled burn but we will know more when the samples return from the lab. This excavation terminated at 92cmbd.

Site 27195, Rock Mound MTU-2
MTU-2 was the second rock mound excavated in the Kealakomowaena project area. This excavation followed the same methodology as MTU-1. It was located at the base of a small hill were more soil/sediment was found opposed to MTU-1 which was located on top of the same hill.

MTU-2 consisted of two layers and five levels ranging from 7.5-61 cmbd. The first level consisted entirely of small to large pahoehoe boulders that were removed to expose the soil layer. We screened the soil on site with a 1/16" screen and found only charcoal and seeds. These findings ranged from 40-61 cmbd. No other cultural remains were found in this excavation.

Site 27195, MTU-2 control
This excavation is a control site approximately two meters from the site of MTU-2 and was used as a comparison to the excavation of MTU-2. We used a ½ square meter test unit opposed to the larger 1 meter test units used on the rock mounds. We expected the soil matrix to be roughly the same as the rock mound but without the potential for cultural remains. This excavation consisted of 4 layers and 6 levels and terminated at 41 cmbd. No cultural remains were found at the control site.

Table 6.9. Bag list from feature MTU-1, Site 27195 excavation.

Bag. No.	State Site #	Test Unit #	Layer/Level	CMBD	Item Count	Object	Status
2	50-10-62-27195	MTU-1	II/2	43-53 cmbd		BONE FRAGMENTS	
3	***50-10-62-27195***	***MTU-1***	***II/2***	***43-53 cmbd***	***72.171g***	***CHARCOAL***	***Sent for Analysis***
4	50-10-62-27195	MTU-1	II/2	43-53 cmbd		SEED	
1	50-10-62-27195	MTU-1	II/2	43-53 cmbd		SOIL SAMPLE	
5	50-10-62-27195	MTU-1	II/3	53-63 cmbd		STONE, WATERWORN	
6	***50-10-62-27195***	***MTU-1***	***II/3***	***53-63 cmbd***	***66.638g***	***CHARCOAL***	***Sent for Analysis***
7	50-10-62-27195	MTU-1	II/3	53-63 cmbd		UNIDENTIFIED	
8	50-10-62-27195	MTU-1	II/3	53-63 cmbd		SEED	
9	50-10-62-27195	MTU-1	II/3	53-63 cmbd		SHELL FRAGMENT	
10	***50-10-62-27195***	***MTU-1***	***II/3***	***53-63 cmbd***		***SOIL SAMPLE***	***Sent for Analysis***
11	50-10-62-27195	MTU-1	II/4	62-72 cmbd		STONE, WATERWORN	
12	50-10-62-27195	MTU-1	II/4	62-72 cmbd		BONE FRAGMENTS	
13	50-10-62-27195	MTU-1	II/4	62-72 cmbd		CHARCOAL	
14	50-10-62-27195	MTU-1	II/4	62-72 cmbd		SEED	
15	50-10-62-27195	MTU-1	II/4	62-72 cmbd		SHELL FRAGMENT	
17	50-10-62-27195	MTU-1	II/4	62-72 cmbd		SOIL SAMPLE	
16	50-10-62-27195	MTU-1	II/4	62-72 cmbd		VOLCANIC GLASS	
18	***50-10-62-27195***	***MTU-1***	***II/5***	***72-82 cmbd***	***7.557g***	***CHARCOAL***	***Sent for Analysis***
	50-10-62-27195	MTU-1	II/5	72-82 cmbd		SEED	
	50-10-62-27195	MTU-1	II/5	72-82 cmbd		SEED	
19	50-10-62-27195	MTU-1	II/5	72-82 cmbd		SHELL FRAGMENT	
	50-10-62-27195	MTU-1	II/5	72-82 cmbd		SHELL FRAGMENT	
20	***50-10-62-27195***	***MTU-1***	***II/5***	***72-82 cmbd***		***SOIL SAMPLE***	***Sent for Analysis***
	50-10-62-27195	MTU-1	II/5	72-82 cmbd		VOLCANIC GLASS	
22	50-10-62-27195	MTU-1	II/6	82-92 cmbd		CHARCOAL	
21	***50-10-62-27195***	***MTU-1***	***II/6***	***82-92 cmbd***		***SOIL SAMPLE***	***Sent for Analysis***

Table 6.10. Bag list from MTU-2 and MTU-2 Control, Site 27195 excavation.

Bag. No.	State Site #	Test Unit #	Layer/Level	CMBD	Item Count	Object	Status
1	***50-10-62-27195***	***MTU-2***	***II/3***	***40-50 CMBD***	***3.279g***	***CHARCOAL***	***Sent for Analysis***
3	50-10-62-27195	MTU-2	II/3	40-50 CMBD		SEEDS	
2	50-10-62-27195	MTU-2	II/3	40-50 CMBD		SOIL SAMPLE	
4	50-10-62-27195	MTU-2	II/4	50-60 CMBD		CHARCOAL FRAGMENTS	
5	50-10-62-27195	MTU-2	II/4	50-60 CMBD		SEEDS	
6	50-10-62-27195	MTU-2	II/4	50-60 CMBD		SHELL FRAGMENTS	
7	50-10-62-27195	MTU-2	II/5	60-70 CMBD		CHARCOAL FRAGMENTS	
9	50-10-62-27195	MTU-2	II/5	60-70 CMBD		SEEDS	
8	50-10-62-27195	MTU-2	II/5	60-70 CMBD		SOIL SAMPLE	
1	50-10-62-27195	MTU-2 Control	I/1	2-11 CMBD		CHARCOAL FRAGMENTS	
2	50-10-62-27195	MTU-2 Control	I/1	2-11 CMBD		SOIL SAMPLE	
4	50-10-62-27195	MTU-2 Control	II/2	8-10 CMBD		SOIL SAMPLE	
5	50-10-62-27195	MTU-2 Control	III/3	9-15 CMBD		SOIL SAMPLE	
6	***50-10-62-27195***	***MTU-2 Control***	***IV/4***	***13-23 CMBD***		***SOIL SAMPLE***	***Sent for Analysis***
7	50-10-62-27195	MTU-2 Control	IV/5	23-33 CMBD		SOIL SAMPLE	
8	***50-10-62-27195***	***MTU-2 Control***	***IV/6***	***33-41 CMBD***		***SOIL SAMPLE***	***Sent for Analysis***
3	50-10-62-27195	MTU-2 Control	LENS 1	9.5-10 CMBD		SOIL SAMPLE	

Table 6.11. Bag list from TU-6, Site 27216 excavation.

Bag. No.	State Site #	Test Unit #	Layer/Level	CMBD	Item Count	Object	Status
1	50-10-62-27216	TU-6	I/1	11.5-16.5 CMBD		BONE FRAGMENTS	
2	50-10-62-27216	TU-6	I/1	11.5-16.5 CMBD		CHARCOAL FRAGMENTS	
3	50-10-62-27216	TU-6	I/1	11.5-16.5 CMBD		METAL FRAGMENTS	
4	50-10-62-27216	TU-6	I/1	11.5-16.5 CMBD		SEED	
5	50-10-62-27216	TU-6	I/1	11.5-16.5 CMBD		SHELL FRAGMENTS	
6	50-10-62-27216	TU-6	II/2	16.5-21 CMBD		BONE FRAGMENTS	
8	***50-10-62-27216***	***TU-6***	***II/2***	***16.5-21 CMBD***	***0.881g***	***CHARCOAL***	***Sent for Analysis***
7	50-10-62-27216	TU-6	II/2	16.5-21 CMBD		SEED	
9	50-10-62-27216	TU-6	II/2	16.5-21 CMBD		SHELL FRAGMENTS	
10	50-10-62-27216	TU-6	III/3	18.5-23.5 CMBD		BONE FRAGMENTS	
11	50-10-62-27216	TU-6	III/3	18.5-23.5 CMBD		CHARCOAL FRAGMENTS	
12	50-10-62-27216	TU-6	III/3	18.5-23.5 CMBD		SHELL FRAGMENTS	
13	50-10-62-27216	TU-6	III/4	23.5-28.5 CMBD		BONE FRAGMENTS	
14	50-10-62-27216	TU-6	III/4	23.5-28.5 CMBD		CHARCOAL FRAGMENTS	
15	50-10-62-27216	TU-6	III/4	23.5-28.5 CMBD		METAL FRAGMENTS	
16	50-10-62-27216	TU-6	III/4	23.5-28.5 CMBD		SEED	

Table 6.11. Bag list from TU-6, Site 27216 excavation continued.

Bag. No.	State Site #	Test Unit #	Layer/Level	CMBD	Item Count	Object	Status
17	50-10-62-27216	TU-6	III/4	23.5-28.5 CMBD		SHELL FRAGMENTS	
18	50-10-62-27216	TU-6	III/5	28.5-33.5 CMBD		BONE FRAGMENTS	
19	50-10-62-27216	TU-6	III/5	28.5-33.5 CMBD		CHARCOAL FRAGMENTS	
20	50-10-62-27216	TU-6	III/5	28.5-33.5 CMBD		METAL FRAGMENTS	
21	50-10-62-27216	TU-6	III/5	28.5-33.5 CMBD		SHELL FRAGMENTS	
22	50-10-62-27216	TU-6	III/6	33.5-38.5 CMBD		BONE FRAGMENTS	
23	50-10-62-27216	TU-6	III/6	33.5-38.5 CMBD		CHARCOAL FRAGMENTS	
24	50-10-62-27216	TU-6	III/6	33.5-38.5 CMBD		SHELL FRAGMENTS	
25	50-10-62-27216	TU-6	III/7	38.5-43.5 cmbd		BONE FRAGMENTS	
26	***50-10-62-27216***	***TU-6***	***III/7***	***38.5-43.5 cmbd***	***3.481g***	***CHARCOAL***	***Sent for Analysis***
27	50-10-62-27216	TU-6	III/7	38.5-43.5 cmbd		SHELL FRAGMENTS	
28	50-10-62-27216	TU-6	III/8	43.5-48.5 CMBD		BONE FRAGMENTS	
29	50-10-62-27216	TU-6	III/8	43.5-48.5 CMBD		CHARCOAL FRAGMENTS	
30	50-10-62-27216	TU-6	III/8	43.5-48.5 CMBD		SHELL FRAGMENTS	

Table 6.12. Bag list from TU-2, Site 27219 excavation.

Bag. No.	State Site #	Test Unit #	Layer/Level	CMBD	Item Count	Object	Status
1	50-10-62-27219	TU-2	I/1	13-18 cmbd		BONE FRAGMENTS	
2	50-10-62-27219	TU-2	I/1	13-18 cmbd		CHARCOAL	
3	50-10-62-27219	TU-2	I/1	13-18 cmbd		SEED	
4	50-10-62-27219	TU-2	I/1	13-18 cmbd		SHELL	
5	50-10-62-27219	TU-2	I/2	18-22 cmbd		CHARCOAL	
6	50-10-62-27219	TU-2	II/3	17-22 cmbd		BONE FRAGMENTS	
7	***50-10-62-27219***	***TU-2***	***II/3***	***17-22 cmbd***	***5.748g***	***CHARCOAL***	***Sent for Analysis***
8	***50-10-62-27219***	***TU-2***	***II/4***	***22-27 cmbd***	***2.677g***	***CHARCOAL***	***Sent for Analysis***
9	50-10-62-27219	TU-2	II/4	22-27 cmbd		SHELL	
10	50-10-62-27219	TU-2	II/5	27-30 cmbd		BONE FRAGMENTS	
11	50-10-62-27219	TU-2	II/5	27-30 cmbd		CHARCOAL	
12	50-10-62-27219	TU-2	II/5	27-30 cmbd		SHELL	
13	50-10-62-27219	TU-2	III/6	27-32 cmbd		BONE FRAGMENTS	
14	50-10-62-27219	TU-2	III/6	27-32 cmbd		CHARCOAL	
15	50-10-62-27219	TU-2	III/6	27-32 cmbd		SHELL	
16	50-10-62-27219	TU-2	III/7	32-45 cmbd		BONE FRAGMENTS	
17	***50-10-62-27219***	***TU-2***	***III/7***	***32-45 cmbd***	***0.508g***	***CHARCOAL***	***Sent for Analysis***
18	50-10-62-27219	TU-2	III/7	32-45 cmbd		METAL FRAGMENTS	
19	50-10-62-27219	TU-2	III/7	32-45 cmbd		SEED	
20	50-10-62-27219	TU-2	III/7	32-45 cmbd		SHELL	

Table 6.13. Bag list from TU-3, Site 28186 excavation.

Bag. No.	State Site #	Test Unit #	Layer/Level	CMBD	Item Count	Object	Status
1	50-10-62-28186	TU-3	I/1	23-28 cmbd		BONE FRAGMENTS	
2	50-10-62-28186	TU-3	I/1	23-28 cmbd		CHARCOAL FRAGMENTS	
3	50-10-62-28186	TU-3	I/1	23-28 cmbd		METAL FRAGMENTS	
4	50-10-62-28186	TU-3	I/1	23-28 cmbd		SEED	
5	50-10-62-28186	TU-3	I/1	23-28 cmbd		SHELL FRAGMENTS	
1	50-10-62-28186	TU-3	I/2	23-28 cmbd		BONE FRAGMENTS	
2	***50-10-62-28186***	***TU-3***	***I/2***	***23-28 cmbd***	***0.312g***	***CHARCOAL***	***Sent for Analysis***
3	50-10-62-28186	TU-3	I/2	23-28 cmbd		SEED	
4	50-10-62-28186	TU-3	I/2	23-28 cmbd		SHELL FRAGMENTS	

Table 6.14. Bag list from TU-4, Site 28222 excavation.

Bag. No.	State Site #	Test Unit #	Layer/Level	CMBD	Item Count	Object	Status
1	50-10-62-28222	TU-4	I/1	17-22 cmbd		BONE FRAGMENTS	
2	50-10-62-28222	TU-4	I/1	17-22 cmbd		CHARCOAL FRAGMENTS	
3	50-10-62-28222	TU-4	I/1	17-22 cmbd		SEED	
4	50-10-62-28222	TU-4	I/1	17-22 cmbd		SHELL FRAGMENTS	
5	50-10-62-28222	TU-4	I/2	22-27 cmbd		BONE FRAGMENTS	
6	50-10-62-28222	TU-4	I/2	22-27 cmbd		CHARCOAL FRAGMENTS	
7	50-10-62-28222	TU-4	I/2	22-27 cmbd		SHELL FRAGMENTS	
8	50-10-62-28222	TU-4	II/3	24-29 cmbd		BONE FRAGMENTS	
9	***50-10-62-28222***	***TU-4***	***II/3***	***24-29 cmbd***	***0.849g***	***CHARCOAL***	***Sent for Analysis***
10	50-10-62-28222	TU-4	II/3	24-29 cmbd		SHELL FRAGMENTS	
11	50-10-62-28222	TU-4	III/4	29-36 cmbd		BONE FRAGMENTS	
14	***50-10-62-28222***	***TU-4***	***III/4***	***29-36 cmbd***	***0.155g***	***CHARCOAL***	***Sent for Analysis***
13	50-10-62-28222	TU-4	III/4	29-36 cmbd		SEED	
12	50-10-62-28222	TU-4	III/4	29-36 cmbd		SHELL FRAGMENTS	

Table 6.15. Bag list from TU-5, Site 28237 excavation.

Bag. No.	State Site #	Test Unit #	Layer/Level	CMBD	Item Count	Object	Status
1	50-10-62-28237	TU-5	I/1	18-20.5 cmbd		BONE FRAGMENTS	
4	50-10-62-28237	TU-5	I/1	18-20.5 cmbd		METAL FRAGMENTS	
3	50-10-62-28237	TU-5	I/1	18-20.5 cmbd		SEEDS	
2	50-10-62-28237	TU-5	I/1	18-20.5 cmbd		SHELL FRAGMENTS	
5	50-10-62-28237	TU-5	II/2	19.5-24.5 cmbd		BONE FRAGMENTS	
5	50-10-62-28237	TU-5	II/2	19.5-24.5 cmbd		BONE FRAGMENTS	
9	50-10-62-28237	TU-5	II/2	19.5-24.5 cmbd			
6	50-10-62-28237	TU-5	II/2	19.5-24.5 cmbd		METAL FRAGMENTS	
8	50-10-62-28237	TU-5	II/2	19.5-24.5 cmbd		METAL FRAGMENTS	
7	50-10-62-28237	TU-5	II/2	19.5-24.5 cmbd		SHELL FRAGMENTS	
11	50-10-62-28237	TU-5	II/3	24.9-29.5 cmbd		BONE FRAGMENTS	
10	50-10-62-28237	TU-5	II/3	24.9-29.5 cmbd		SHELL FRAGMENTS	
13	50-10-62-28237	TU-5	III/4	29.5-33 cmbd		BONE FRAGMENTS	
14	***50-10-62-28237***	***TU-5***	***III/4***	***29.5-33 cmbd***	***0.269g***	***CHARCOAL***	***Sent for Analysis***
15	50-10-62-28237	TU-5	III/4	29.5-33 cmbd		METAL FRAGMENTS	
16	50-10-62-28237	TU-5	III/4	29.5-33 cmbd		SEEDS	
12	50-10-62-28237	TU-5	III/4	29.5-33 cmbd		SHELL FRAGMENTS	

Chapter 7 . Results of Radiocarbon dating

Prior to 2009 Hawai'i Volcanoes National Park had analyzed approximately 27 charcoal samples for radiocarbon dating. These samples were collected primarily by HAVO archeologists. The sites from which the charcoal samples were collected are located throughout the Puna and Ka'ū districts including the Kahuku Unit, the Puna/Ka'ū Historic District (Site 50-10-62-5553) and the Kilauea Historic District (Site 50-10-52-5502). Although these dates have been relied on for years, many were obtained without the benefit of charcoal wood species identification of the taxa before the material was sent for radiocarbon dating. It is important to do wood charcoal taxa identification prior to radiocarbon dating. Wood charcoal identification provides information on the types of woods that were burned at the site. It also identifies appropriate samples of known taxon for radiocarbon dating. The identification of taxa for radiocarbon dating is used to avoid dating of known historically introduced plants and to select for short-lived species such as shrubs or short-lived plants parts such as seeds to minimize age-related effects on the radiocarbon date. The radiocarbon dates provide a temporal relationship to the activities at the sites. By not analyzing short-lived wood species prior to radiocarbon dating, the results may be skewed suggesting the site is older than it is.

In 2009 the park provided funding that made it possible to re-analyze many of its radiocarbon dates, as well as submit a number of new samples from recently excavated sites. The park submitted 53 charcoal samples for wood species identification and 38 of these samples for radiocarbon dating. Of those 38 samples, ten were from the project area. In 2010 under a separate project, the park provided funding to gather additional data on sites. This data would be useul in developing a more comprehensive understanding of sites within the park, their function, age and condition. An additional 15 samples were submitted for charcoal identification. Tweleve of these were submitted for radiocarbon dating. Of the twelve, ten samples were from sites within the project area.

International Archaeological Research Institute (IARII) carried out the analysis for HAVO. The 20 wood charcoal samples were submitted by IARII to Beta Analytic, Inc. for radiocarbon dating using the accelerated mass spectrometry (AMS) technique. The results were recalibrated using Oxcal v.4.0.5 (Bronk Ramsey in press) using the northern hemisphere atmospheric curve (Intcal04; Reimer et al. 2004). Table 6.9 lists the calibrated radiocarbon ages (95.4% probability) obtained from the OxCal analyses along with the Beta Analytic laboratory results and sample numbers for sites within the project area. Figure 6.16 - 6.19 graphically depicts this information.

Results suggest that the earliest dated sites in the project area are from a Platform (Site 27216) in the Phase I project area, and from Entrance 9 in Roadcut cave. Roadcut cave and likely represents the earliest dated occupation and incursion into the region in the early to mid 15th century. Entrance 9 of Roadcut cave that dated to 1437 -1634 AD and Site 27216 dated to 1487 – 1649 AD and 1497 – 1795 AD (Table 6.16). A cluster of additional sites, date to the early 16th century, suggesting additional populations moving into the area. The largest cluster, however, date to the mid to late 17th century, suggesting that the Puna district and eastern Ka'ū ahupua`a were widely occupied at least a century before the arrival of westerners. The pattern for the lands

within HAVO parallel that of the more western areas of Ka'ū like Manuka to the west which was settled after A.D. 1600, "when there was an archipelago-wide expansion into arid and marginal lands" (Allen and McCanany 1994). The marginal lands of Hawaii Volcanoes fit well into the larger chronological sequence of the island. The area saw initial forays into the area in the early 15th century, but settlement and expansion likely did not occur until the 17th century (the late pre-Contact period). This coincides with the explosive eruptions that deposited the ash across the landscape and was the basis for the agricultural potential in the area (Figure 2.2). Likely soon after the eruptive events people moved into the area to take advantage of the rich deposit which made it possible to grow their crops in this marginal part of the island.

Like Kahikinui, a marginal area on the island of Maui, the chronology for human activity in the western lands in the Puna district begins in the fifteenth century (1400 AD) though there is some evidence of activity centered around the construction of Waha'ula prior to AD 1400 (Kirch and Rallu 2007). Much like the marginal region of Kahikinui and Manuka, people began to settle and utilize the Kealakomowaena lands and adjacent marginal ahupua'a "at the same time that the archipelago-wide growth curve reached its peak" (Kirch and Rallu 2007).

The cluster of dates for HAVO correlate with Kirch and Rallu's (2007) summary of population density. They state that by AD 1600:

> *" there was widespread human use and occupation virtually all of the lowland zones (ie. areas below about 800 m elevation excepting where there are steep slopes), even into regions considered fairly marginal from an ecological and agricultural viewpoint. Although population density clearly varied over this lowland landscape, there were no significant "empty zones" into which new settlements could have expanded"*(Kirch and Rallu 2007).

Photo 16. Excavation of Hearth at HV-30 (Site 27205). Photo courtesy of Hawai'i Volcanoes National Park.

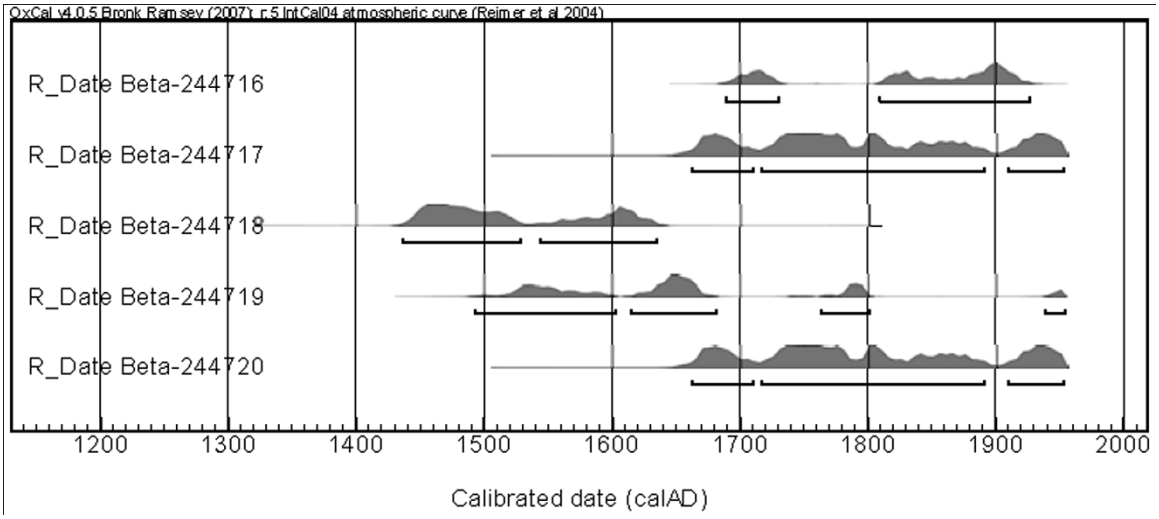


Figure 7.1. OxCal graph of Roadcut Cave Site.

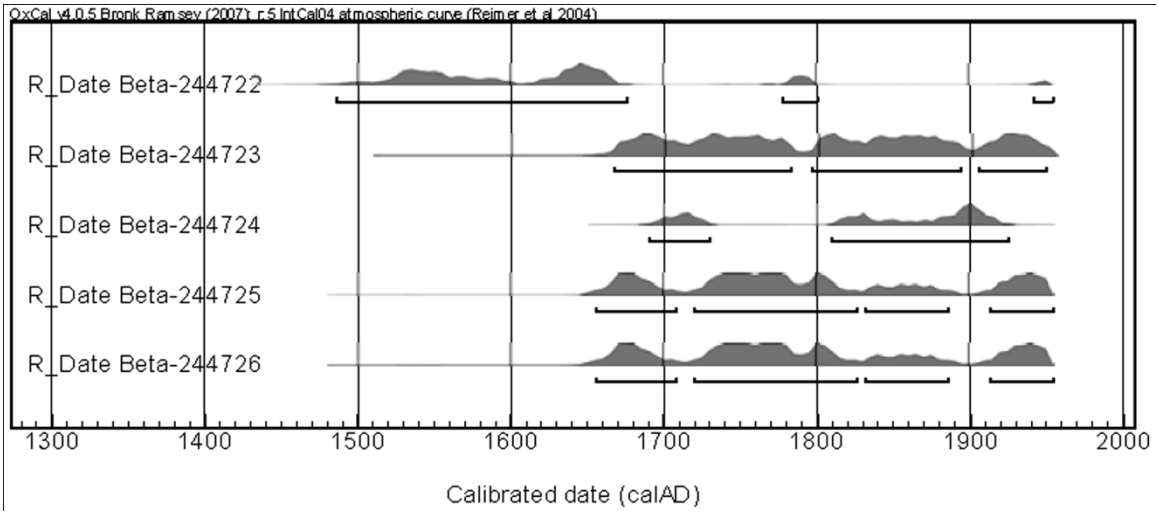


Figure 7.2. OxCal graph of Kealakomo Waena Cave Site.

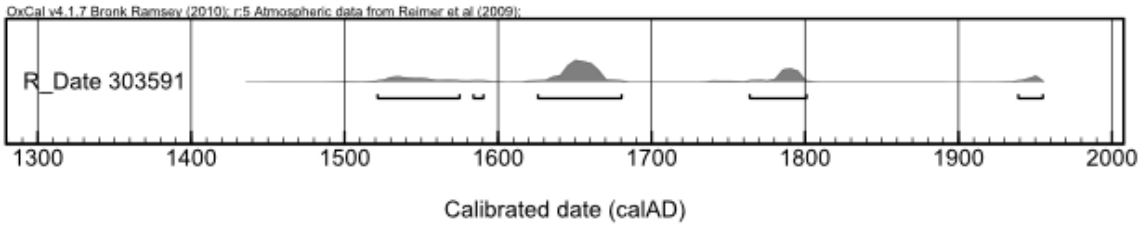


Figure 7.3. Site 28237, Residential Complex.

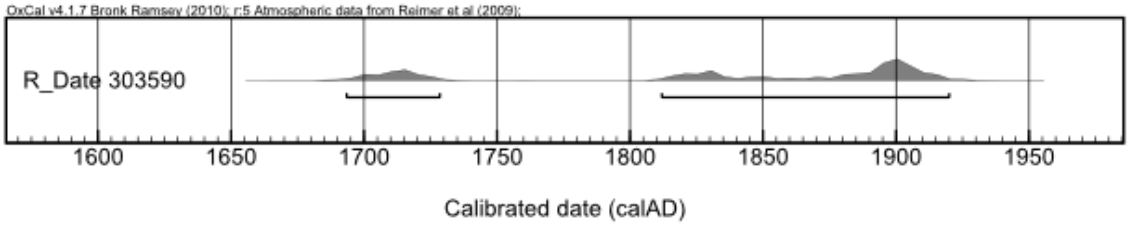


Figure 7.4. Site 28222, Residential Complex.

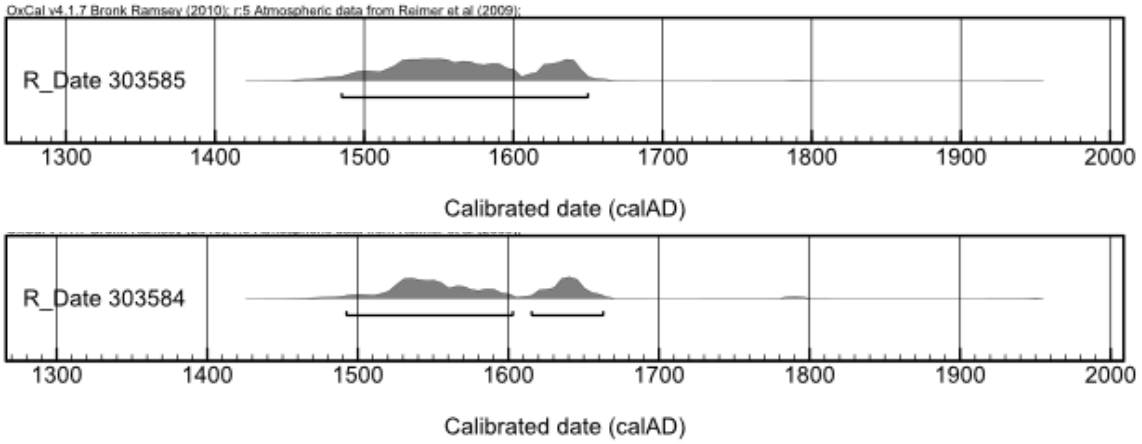


Figure 7.5. Site 27216, Platform.

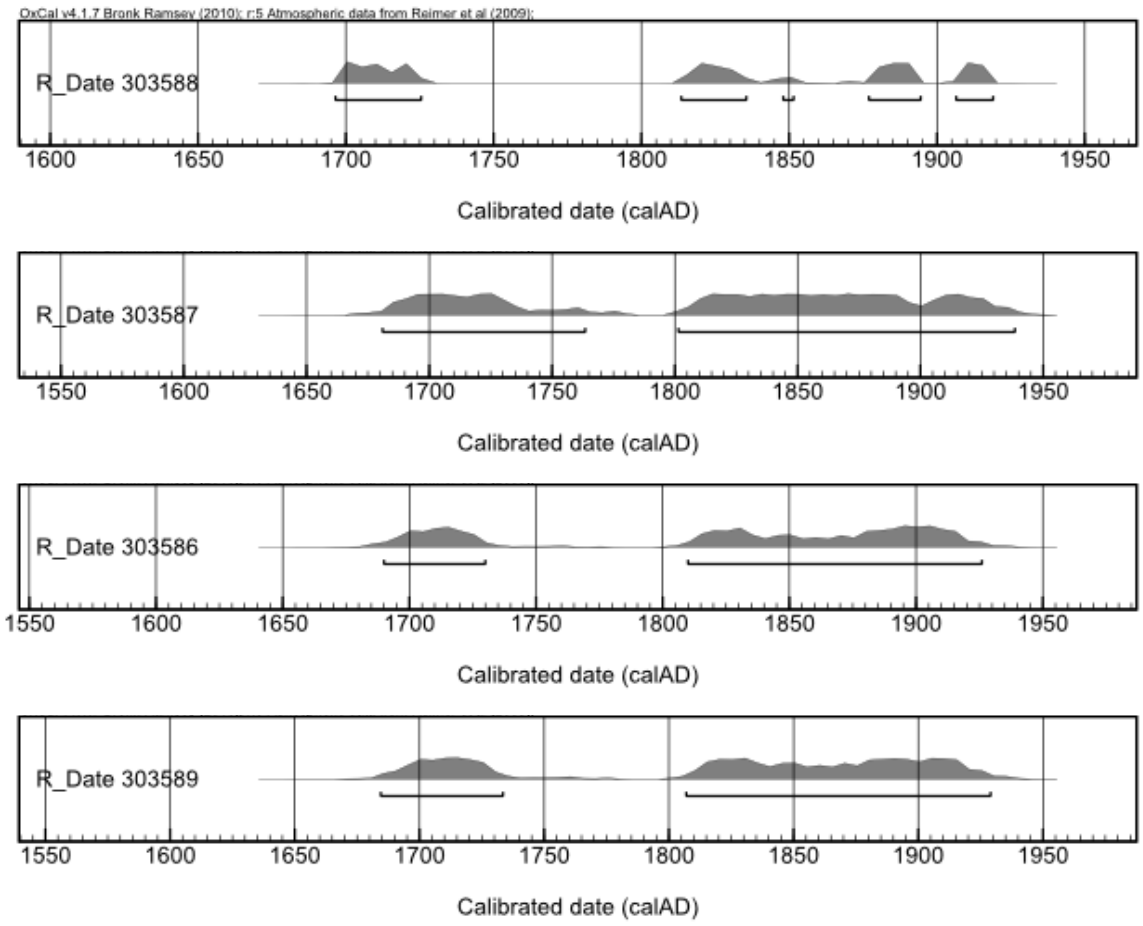


Figure 7.6. Site 27219, Platform.

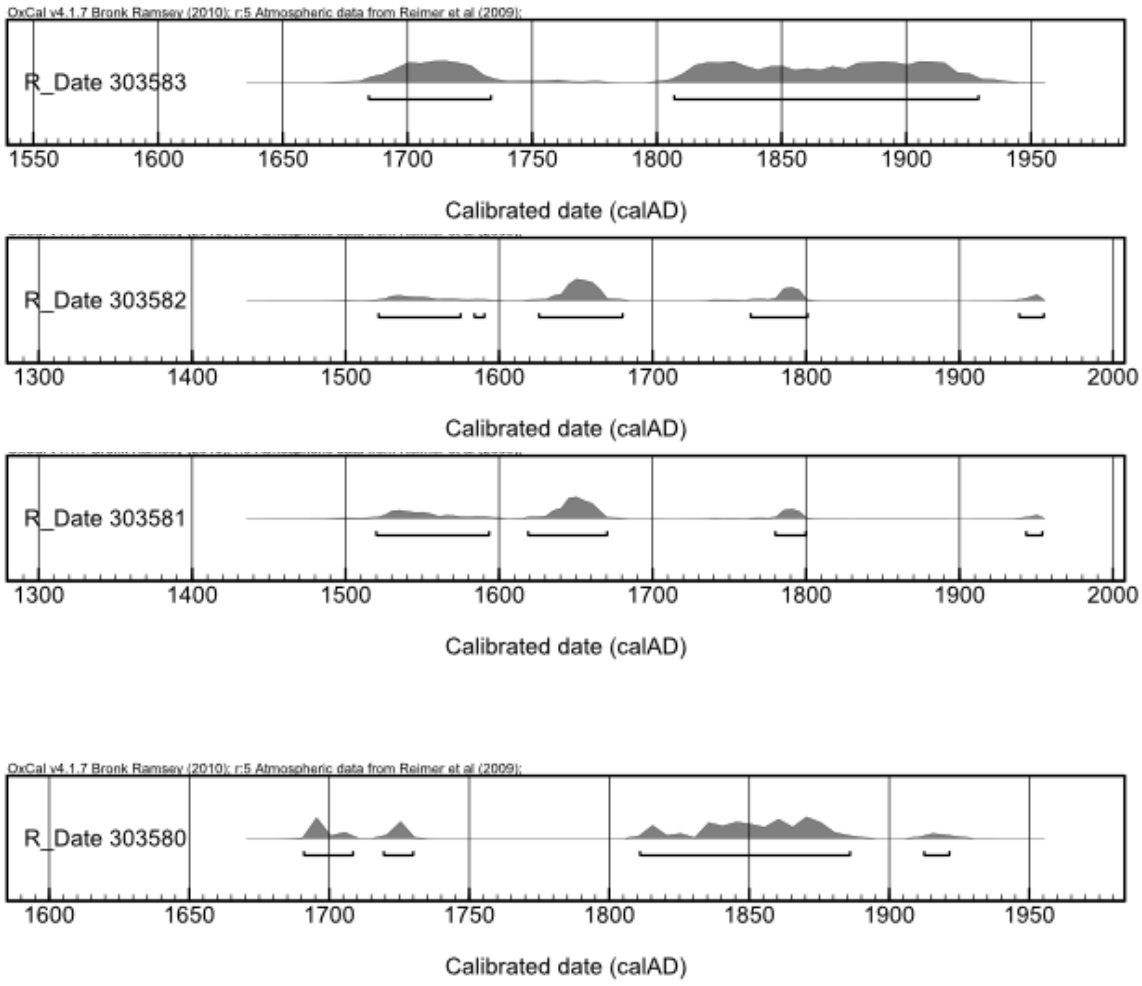


Figure 7.7. Site 27195, Mound Features (MTU-1 and MTU-2).

Table 7.1. Radiocarbon data for Kealakomowaena, Hawai` i Volcanoes National Park.

Site Name/Place Name	Site Number	Temp. Feat. No. or Bag No.	Lab Sample No.	Test Unit #	Provenience	Depth (cmbs)	Measured Radiocarbon Age	Conventional Radiocarbon Age (BP)	Calibrated Range: 2 sigma	Relative Probability
Roadcut Cave	29940	Entrance 9	Beta 244716	TU-1	Layer 1/Level I	0-5 cmbs	50 ± 40 BP	50 ± 40 BP	AD 1688-1926	0.967733
Roadcut Cave	29940	Entrance 9	Beta 244718	TU-2	Layer 1/Level II	5-7 cmbs	360 ± 40 BP	390 ± 40 BP	AD 1437-1634	0.999999
Roadcut Cave	29940	Entrance 9	Beta 244717	TU-2	Layer 1/Level I	0-5 cmbs	170 ± 40 BP	160 ± 40 BP	AD 1663-1890	0.817989
Roadcut Cave	29940	Entrance 5	Beta 244720	TU-5	Layer 1/Level II	5-10 cmbs	80 ± 40 BP	160 ± 40 BP	AD 1663-1890	0.817989
Roadcut Cave	29940	Entrance 5	Beta 244719	TU-5	Layer 1/Level I	0-5 cmbs	260 ± 40 BP	260 ± 40 BP	AD 1491-1802	0.970535
Kealakomowaena Cave	27258	T2007-1	Beta 244726	TU-1	Layer I/Level 8	45-48	180 ± 40 BP	170 ± 40 BP	AD 1655-1886	0.818091
Kealakomowaena Cave	27258	T2007-1	Beta 244725	TU-1	Layer I/Level 7	40-45	170 ± 40 BP	140 ± 40 BP	AD 1655-1886	0.818091
Kealakomowaena Cave	27258	T2007-1	Beta 244724	TU-1	Layer I/Level 6	35-40	30 ± 40 BP	40 ± 40 BP	AD 1691-1923	0.95933
Kealakomowaena Cave	27258	T2007-1	Beta 244723	TU-1	Layer I/Level 4	15-20	150 ± 40 BP	140 ± 40 BP	AD 1668-1893	0.826677
Kealakomowaena Cave	27258	T2007-1	Beta 244722	TU-1	Layer I/Level 2	5-10	250 ± 40 BP	270 ± 40 BP	AD 1486-1799	0.98535
Phase II/Residential Complex	28237	14	Beta 303591	TU-5	III/5	29.5-33	250 +/- 30 BP	250 +/- 30 BP	AD 1522 - 1800	0.967332
Phase II/Residential Complex	28222	9	Beta 303590	TU-4	II/3	24-29	40 +/- 30 BP	50 +/- 30 BP	AD 1694 - 1918	0.978069
Phase I/Platform	27216	26	Beta 303585	TU-6	III/7	38.5-43.5	310 +/- 30 BP	310 +/- 30 BP	AD 1487 - 1649	1
Phase I/Platform	27216	8	Beta 303584	TU-6	II/2	16.5-21	290 +/- 30 BP	280 +/- 30 BP	AD 1497 - 1795	1
Phase I/Platform	27219	17	Beta 303588	TU-2	III/7	32-45	0 +/- 20 BP	100.1 +/- 0.3 pMC	AD 1697 - 1893	0.868366
Phase I/Platform	27219	8	Beta 303587	TU-2	II/4	22-27	110 +/- 30 BP	110 +/- 30 BP	AD 1681 - 1938	0.992377
Phase I/Platform	27219	7	Beta 303586	TU-2	II/2	17-22	60 +/- 30 BP	80 +/- 30 BP	AD 1690 - 1925	0.986139
Phase I/Platform	27219	2	Beta 303589	TU-3	I/2	28-31	90 +/- 30 BP	90 +/- 30 BP	AD 1685 - 1928	0.98702
Phase I/Agricultural Mound	27195	18	Beta 303583	MTU-1	II/5	72-82	90 +/- 30 BP	90 +/- 30 BP	AD 1685 - 1928	0.98702
Phase I/Agricultural Mound	27195	13	Beta 303582	MTU-1	II/4	62-72	250 +/- 30 BP	250 +/- 30 BP	AD 1522 - 1800	0.967332
Phase I/Agricultural Mound	27195	6	Beta 303581	MTU-1	II/3	53-63	270 +/- 30 BP	260 +/- 30 BP	AD 1519 - 1799	0.986102
Phase I/Agricultural Mound	27195	1	Beta 303580	MTU-2	II/3	40-50	115.2 +/- 0.4 pMC	115.7 +/- 0.4 pMC	AD 1692 - 1885	0.94068

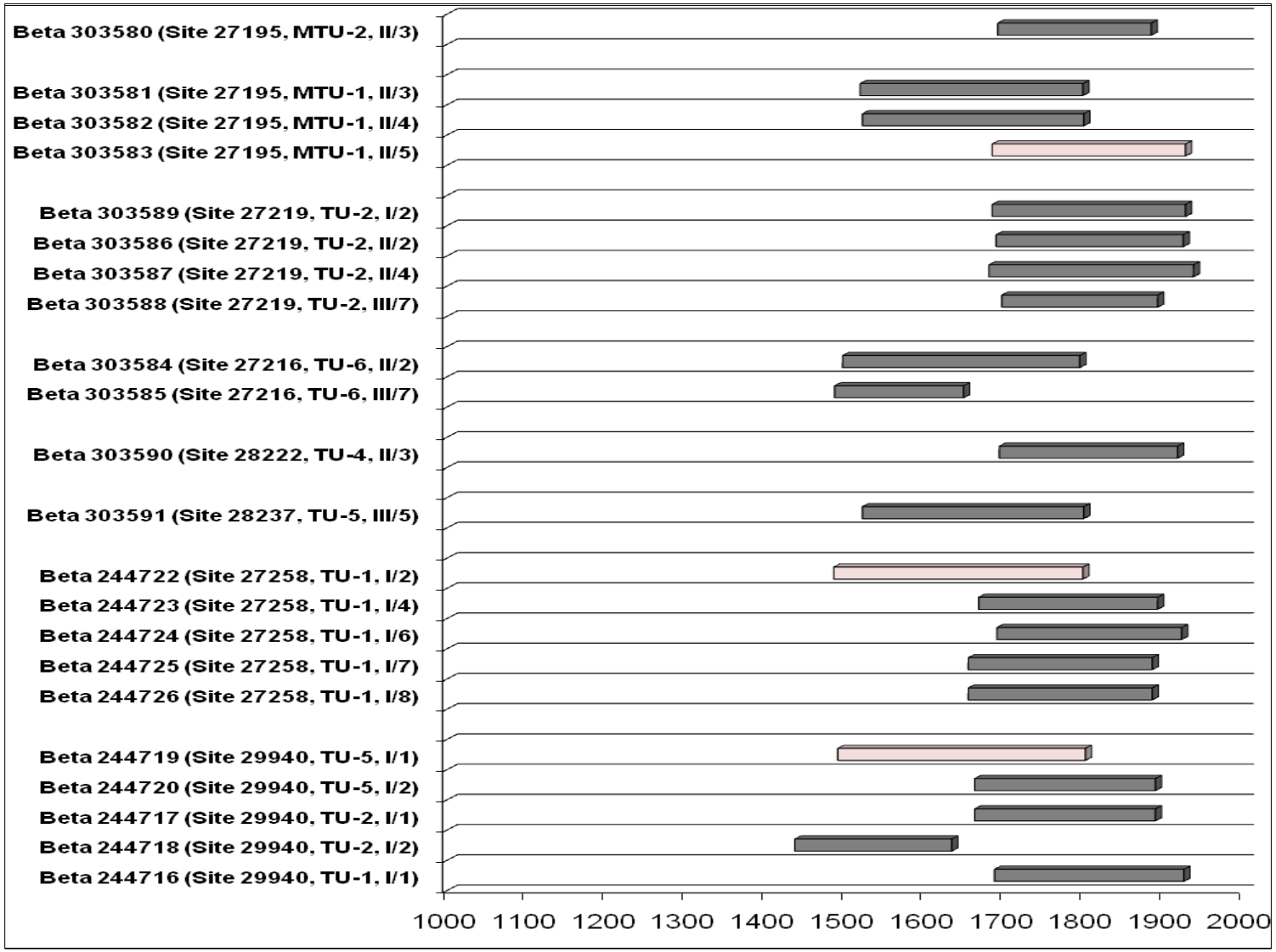


Figure 7.8. Radiocarbon graphic of Kealakomowaena data. Pink bars are skewed dates.

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Chapter 8 . Results of Macro and Microbotanical Analysis

Recovery of macrobotanical remains from Kealakomowaena inventory was of three types: wet cave sediments collected for flotation, dry cave sediments collected by bulk in situ and sorted, and open air site excavation within hearths and agricultural mounds. Only the agricultural mound samples were screened. The rest of the bulk sample materials were sorted through by hand. The wet cave sediments were dried and then floated. Charcoal and seed material was recovered and allowed to dry. The wet cave sediments were processed in this manner as a necessity for the ease of processing and to avoid damaging the structure of the wood charcoal.

Wood Charcoal Identification

Five sediment samples were recovered for flotation from Roadcut Cave (Site 25940) entrances five and nine. The materials came from Layer 1, Level 1 deposits of TU-1 and Layer I, Levels 1 and 2 deposits of TU-2 and -5. This allowed archeobotanical remains associated with the various entrances of Roadcut cave to be assessed. Both entrances five and nine had associated cultural remains. All of these samples came from very wet environments and they were not able to be screened in the field. They were collected by bulk and dried in the lab. Because they dried as a mass, manually separating the sample would likely have destroyed much of the charcoal pieces that were intact. Thus, the decision was made to float the sample to separate the individual pieces and then to dry it again. The dried sample maintained the integrity of the charcoal which facilitated species identification and radiocarbon dating.

The plant materials encountered in the samples consisted of charred materials. The charred materials consisted of wood charcoal, a single stem of a monocotyledon, an ipu rind, and unknown tubers or corms (Table 6.17-6.24). Based on corresponding radiocarbon dates, the charred materials were most likely in situ, resulting from the occupation of the sites by humans. Radiocarbon dates from both cave entrances suggest that the deposit in Entrance 9 is stable and has not been subject to disturbance. The radiocarbon dates from Entrance 5, however, suggests that there is mixing in this entrance. While unfortunate, the results are not surprising, as Entrance 5 is closer to the road and many park visitors are drawn to it. Despite park rules against it, visitors often enter caves thus increasing the chance for disturbance. One other date, from Site 27195, MUT-1 was also skewed and is likely a result of mixing from erosion and previous natural fires.

The recovered wood charcoal was identified to the species level. A total of 22 taxa were identified to the species level. The features sampled were shallow in nature, and the amount of material excavated limited to bisecting of hearths, 5 cm probes in Roadcut Cave, and 1.0 m x 1.0 m units in MTU-1 and MTU-2. The objective of the sampling was to preserve the integrity of the feature while obtaining enough materials for radiocarbon dating, and to gain a sense of the paleoenvironmental landscape. While the sample results may not reflect the entire native vegetation at the time of site use, its nevertheless a sample of the species collected by those who used the caves, structure, and other nearby associated features.

The Roadcut cave entrance nine samples clearly came from cultural features (hearths), while the entrance five sample came from an area outside of a hearth. The Kealakomo samples were obtained from a sediment area within the cultural feature - under the pahoehoe overhang. However, the sample was not taken from any visible sub-feature such as a hearth. Thus, the dense cultural material from Roadcut cave entrance nine is easier to explain then those from entrance five or the Kealakomo overhang feature. The density of charred plant material appears to be related to surface architecture but independent of other cultural markers such as subsurface features and artifacts. The charred materials in Roadcut cave entrance 5 and the Kealakomo overhang may be associated with field clearance and possibly cooking. Entrance nine is likely associated with water collection activities as the features were located at the far rear of the cave.

The charcoal samples from sites 27219, 27216, 28186, 28222, and 28237 clearly came from cultural features (hearths). The samples from MTU-1 and MTU-2 were presumably from agricultural planting mounds. The taxa identified from the residential complex's and platforms were not nearly as diverse as that identified from the mound features. The charcoal collected from the hearths likely represented a select sample of vegetation found in the area that was specifically collected fore firewood. The taxa represented by the agricultural features more likely represent the much more diverse vegetative landscape of Kealakomowaena. The tuber/corm found in site 28222 is likely a remnant of sweet potato that was cooked in the hearth, while the tuber/corms found in sites 27219 is possibly a remnant of a cooked sweet potato (G. Murakami email correspondence July 8, 2011). The tuber/corm and ipu rind found in site 27195 are possibly remnants of cultivars grown in the mound feature.

Taxa recovered as wood charcoal

Kukui, Candlenut
Aleurites moluccana, Family Euphoribiaceae
A Polynesian introduction t Hawai'i, the *Kukui* grows in the wet and moist forests of the eastern lowlands within Hawai'i Volcanoes National Park. Within the park boundaries it is found in "mixed strands within 'ōhi'a, lama or hala" (Stone and Pratt 1994:91). Kukui was once a prominent tree in the coastal forest of Waha'ula, and it currently can be found in the parks eastern boundary up to an elevation of 2,000 ft. Along Hōlei Pali, it grows in scattered groves, and can be found near Lae'apuki and along the lower part of Chain of Craters Road (Stone and Pratt 1994:91). The tree grows best along steep slopes and cliffs because of the ability of the rocks to break up the hard seed covering as it rolls or washes downslope.

Hawaiians found the nut to be the most useful part of the plant. Roasted, the meat was eaten as a relish called *'inamona* or as a salve for external ulcers and sores. Strung together, the nuts produced an oil that was used in lamps and to light torches. Burned and mashed the charcoal was used for sore throat. Historically, the nuts were shined, polished, and strung together to form lei. The soft wood was used for fishnet floats, as fire starters, and in canoes, and the bark, roots, fruit and ash of the burned nuts were used for dye, and all parts of the tree were useful in medicine as a form of laxative, or in high doses as a "carthartic or purge" (Abbot 1992:100). The fresh leaves were used as a compress for swelling and deep bruises.

Ulu
cf. *Artocarpus altilis*
The breadfruit is a commonly eaten fruit by Hawaiians of old. It was of such importance to their diet, that they traced its origins to the god Ku. It was not used in sacrifice and it was not *kapu* to women. The plant grows to a tall tree. Once found in Naulu in the park, this taxa is not longer found here. All varieties found in Hawaii prior to Westerners were seedless, and therefore had to be propagated vegetatively. It was only found in one level of Kealakomowaena cave.

Ko`oko`olau
cf. *Bidens/Dubautia*
A herb or shrub, there are 19 species endemic to Hawai`i which represent an adaptive radiation from a single ancestor. Some species were used as medicine by Hawaiians in the past and some are still harvested as an herbal tea (Wagner, Herbst, & Sohmer, 1990). Abbott (1992) calls the teas that are made from this plant "very tasty, naturally sweet." Besides tea, the plant was used for stomach and throat problems and bad cases of asthma (Abbott, 1992). Ko`oko`olau can be found in the dry mid-elevation woodlands of the park. One species is native to Hawai`i Volcanoes, and it is very rare today in the park (it is not endangered island wide) (Stone & Pratt, 1994). It can be found at ʻĀinahou Ranch and Hilina Pali Road – two areas north of the project area. It is one of the least common taxa identified from Kealakomowaena Cave. Its presence suggests that it may have not been growing in the area in abundance, but it may have been brought into the site for some medicinal use.

Dubautia, known in Hawaiian as Na`ena`e is also a shrub. Commonly found in the dry open *ʻohia* woodlands of Kilauea Caldera and along the Chain of Craters Road, *Dubautia ciliolate* is endemic to Hawaii Island (Stone & Pratt, 1994).

Alaheʻe
cf. *Canthium odoratum*
An important understory tree of the lowland forests, *alaheʻe* is found on all of the main Hawaiian Islands. This taxa was once abundant in the lama forests of Kamoamoa, it is also scattered in the dry ʻōhiʻa woodlands on and above the pali's of the lowlands (Stone and Pratt 1994:95). The hard wood of the *alaheʻe* was used to make digging sticks, or *ʻōʻō*.

Ki, ti
cf. *Cordyline fruticosa*
This plant was widely spread by humans and was introduced to Hawaii by Polynesians. It was harvested extensively and cultivated and occurs on all islands except Kahoolawe. Its leaves were used for thatch for houses, food wrappers, skirts, capes, and sandals. The roots of the plant were baked for food and used to make an alcoholic beverage (Wagner, Herbst, & Sohmer, 1990). The alcoholic beverage known as *`okolehao* was probably invented after the arrival of Captain Portlock in 1789. Portlock boiled the roots to make a beer which he stated was excellent for "curing" scurvy. The word *`okolehao* means "iron bottom" and prior to the arrival of westerners there were no iron pots which were necessary for brewing the beer (Abbott, 1992). Ti plants brought to Hawaii by Polynesians were "male sterile" (i.e.

with defective pollen) and therefore Hawaiians would have had to propagate it by vegetative means. Today, *ti* plants are found in relative abundance in a spot north of the project area and in spot areas near archeological sites throughout the park. Its presence is often a marker for areas where humans once inhabited. It is found only in Kealakomowaena Cave in small numbers and therefore was likely either not growing in abundance in the area, or not used widely.

ʻAʻaliʻi

cf. *Dodonaea viscose*

This endemic taxa is one of the most abundant shrubs in Hawaiʻi Volcanoes National Park. It is found across every ecological zone except in rain forests and in the alpine desert on the summit of Mauna Loa. In the montane *koa* groves and mid-elevation ʻōhiʻa forests this taxa is an understory tree. ʻAʻaliʻi responds favorably to fire, therefore the fires that naturally burned through the project areas as a result of nearby eruptions likely stimulated its growth (Stone and Pratt 1994:15). ʻAʻaliʻi is a hard wood that was used in framing traditional Hawaiian *hale*. Although ʻōhiʻa, *lama* and *naio* were more commonly used for ridgepoles, posts, rafters and thatching, *ʻaʻaliʻi* would sometimes be substituted as well.

ʻŌhiʻa Lehua

cf. *Metrosideros polymorpha*

Like the *ʻaʻaliʻi*, *ʻōhiʻa* is the most abundant tree in Hawaiʻi Volcanoes National Park. It is found from the coastal lowlands to the tree line on Mauna Loa. It is among the first flowering plants to colonize new lava flows. Within 20 years ʻōhiʻa can be well established, and within 400 years a "mature multilayered rain forest" can develop (Stone and Pratt 1994:12). The hard wood of the tree is used for framing materials in Hawaiian *hale*, in canoes, and it was the wood of choice to make the image of the hula god Kūkāʻōhiʻa Laka and most of the other large images noted at the time of European carved from wood were made from this taxa. *ʻOhiʻa* was the *kinolau* of the gods Kāne and Kū. The reddish color of the freshly cut wood may have been seen as appropriate for images associated with sacrifice (Abbot 1992:114).

Naio

cf. *Myoporum sandwicense*

A shrub or tree, this taxa while drying or burning had an odor that was similar to sandalwood. It was shipped to China as a substitute after the sandalwood supply was exhausted, but it was not accepted there. Hawaiians preferred this wood to make house frames (Wagner, Herbst, & Sohmer, 1990).

Kolea, Kolea Lau Nui, Kolea Lau Liʻi

cf. *Myrsine sp.*

There are three species of Myrsine that occur in the park: M. sandwicensis (Kōlea lau liʻi), M. Lanaiensis (Kōlea), and M. lessertiana (Kōlea lau nui). The latter (Kolea Lau Nui) is the most abundant in the park and it is a common understory tree in the HAVO rainforests. M. lanaiensis is the rarest and unlike the other two taxa it is found in the dry-forest. The wood from the Kōlea tree was used for timbers in Hawaiian *hale*, and the bark and sap was used for dyeing *kapa* (Stone and Pratt 1994:181).

ʻŪlei

cf. *Osteomeles anthyllidifolia*, Family Rosaceae
A relatively common woody vine or shrub, this taxa is seen sprawling across the moist to dry lowlands in the park. Outside of the park it can be found in the subalpine shrublands above 6,000 ft. This taxa is indigenous to the Hawaiian Islands where the flowers and foliage were used in lei. The wood of the plant was used for implements and the viney branches used for weaving fish traps and baskets, and for the handles and closures of scoop nets. The branches of this taxa can be easily bent into loops, and they were often lashed together with cord to form the handle of the net (Abbot 1992:84). ʻŪlei can commonly be found near Lae ʻĀpuki, at ʻĀinahou Ranch, Hilina Pali Road, the Chain of Craters Road, between the Hawaiian Volcanoes Observatory and Kīpuka Puaulu, and on the Keʻāmoku lava flow in the Kaʻū Desert. Like the *aʻaliʻi*, *ʻūlei* responds well to fire which is a benefit growing in an area that is frequently burned by fires started from Kīlauea's east rift eruptions (Stone and Pratt 1994:101).

Olomea
cf. *Perrottetia sandwicensis*
A small rainforest understory tree, this plant species can still be found in the park in the forest. This endemic species was used in ancient times as a fire stick. Fire was made by rapidly "rotating a piece of this wood against the softer wood of the *hau* tree (Wagner, Herbst, & Sohmer, 1990). Its presences in entrance 9 of Roadcut cave suggests it was used for the purposes of starting fires because of the high abundance of charcoal likely from torches that burned as water was being collected in the back of the cave.

cf. *Poaceae*
Several grasses, both native and invasive are found in the park and in the project area. One native plant is the pili (*Heteropogon contortus*) is a common lowland grass that is found widely throughout the park, but is only abundant at a few sites (Kaʻaha, Halapē, and a few sites below Hōlei Pali). Pili is well adapted to fire, and Hawaiians would purposefully burn large areas to stimulate its growth. This taxa was extremely useful to Hawaiian culture for thatching. It was a fragrant plant that was uprooted by clumps, or bunches in which it grows.

Kopiko `ula
cf. *Psychotria sp.*
A single taxa, known as kōpiko ʻula (*Psychotria hawaiiensis*) grows in the lower-elevation forests (rain forest) of Kīlauea's East Rift. It is a common understory plant. The rain forest are characterized by high rainfall (greater than 75-100 in. annually) (Stone and Pratt 1994:173-174). The wood is hard and was used for beating bark into *kapa* and also used for fuel (Wagner, Herbst, & Sohmer, 1990).

cf. *Senna sp.*
This taxa can occur as a tree, shrub, or herb.

ʻĀkia
cf. *Wikstroemia sp.* Family Thymelaeaceae
Two endemic species (*W. phillyreifolia and W. sandwicensis*) are commonly found in Hawaiʻi Volcanoes National Park. The former is found in the open ʻōhiʻa woodlands

along the Chain of Craters Road to the forests and shrublands of Kīlauea Caldera. It is also found in the woodlands and shrublands near the Ka'ū Desert and in the "western section of the Park up to Kīpuka Puaulu" (Stone and Pratt 1994:135). The latter species is more dominant in the eastern coastal lowlands of the park. It is a large shrub or small tree and a component of the understory in rain forests below 3,500 ft. This later taxa was found near Kamoamoa and Lae 'Āpuki (Stone and Pratt 1994:135).

This taxa was used by Hawaiians for cordage, the stem and bark were crushed and used as a fish poison. The crushed pieces were spread in tide pools and in a few minutes the small fish would float to the surface and would be gathered. The bright orange and golden berries of the 'ākia were used in making seed lei (Abbott 1992).

`Akoko
Chamaesyce sp.
These taxa can be found as an herb, sub shrub, large shrub or small tree. It is the most abundant taxa found in Roadcut cave, and is also relatively abundant in Kealakomowaena.

Lama
Diospyros sandwicensis
A tree, this taxa was used for medicine, and was placed in hula alters because its name suggests enlightenment. It was also used to fence sacred areas (Wagner, Herbst, & Sohmer, 1990). It is found in lowland forests, woodlands and shrublands and scattered on several pali cliffs (Stone & Pratt, 1994). A significant lama forest was once near Kamoamoa Campground, but it's now covered by lava. It is the dominant tree found in the Naulu forest just north of the project area. It was found in every level of Kealakomowaena Cave which may indicate its dominance in the past vegetation. Its decrease in abundance over time may be reflective of its decrease in abundance in the local area as well.

Only native species were identified in the samples for Kealakomowaena. No invasive historic introductions such as lantana or myrica faya were seen in the charcoal samples. The taxa assemblage identified in this study represents many of the woody species that are currently found or previously found at or near the sites. These taxa include shrubs from the lowland dry shrub land vegetation communities such as the *'A'ali'i* (*Dodonaea*) The lowland dry shrub land vegetation occurs on the lower leeward slopes of all the main islands, except Ni'ihau and Kaho'olawe, at 100-600 m elevation. On Hawai'i Island the lowland shrub land type of vegetation occurs on the Ka'ū and South Kona districts in areas with rugged terrain and very rocky substrates (Gagne and Cuddihy 1990:71). Many of the taxa identified by this study are associated with this vegetation community.

Kā'e'e
cf. Mucuna gigantean
Commonly known as the sea bean, this taxa is large and wood, with stems that are "high-climbing or sprawling." Likely indigenous to Hawai'i, this species is usually found near the ocean or streams. The seeds, known as *pēka'a* were used medicinally as a "violent carthartic" and were strung into *lei* (Wagner, Herbst, & Sohmer, 1990).

Pūkiawe
cf. Styphelia tameiameiae
Commonly a shrub, but sometimes a tree-like, this species is a common plant found in Hawai'i Volcanoes National Park. It is a principal component plant in mesic forests, open areas of low elevation and mountain wet forests and areas in the albine shrubland where fog is a common component. This plant was burned and used when a high ranking chief wanted to be in the presence of commoners. The chief would be smudged with the smoke from the *pūkiawe* wood as a priest chanted. The plant is also used in *lei* (Wagner, Herbst, & Sohmer, 1990).

Neleau, nenelaeau
cf. Rhus sandwicensis
This taxa is a small tree, approximately 3 to 8 meters high. Found along roadsides, in disturbed areas, in wet and dry places on Oahu, Molokai, Maui and Hawai'i island. Found most commonly in Hilo and Waimea. The wood is lightweight and tough and was once used for saddle trees, yokes and plows (Wagner, Herbst, & Sohmer, 1990).

Ipu
Lagenaria siceraria
This species is part of the Cucurbitaceae, or gourd family. A Polynesian introduction, ipu or bottle gourd was widely grown and used for utensils and instruments and was an important component of the Hawaiian culture.

Table 8.1. Summary of Charcoal Taxa Identifications for Roadcut Cave.

HAVO #	Test Unit	Layer/ Level	Depth, cmbs	Taxa	Common/ Hawaiian Name	Origin/Habit	Part	Count	Weight (g)
15432	1	I/1	0-5	*Chamaesyce* sp.	*'Akoko*	Native/Shrub	Wood	11	0.32
Ent. 9				Unknown 1			Wood	4	0.08
				cf. *Perrottetia sandwicensis*	*Olomea*	Native/Tree	Wood	6	0.10
				cf. Wikstroemia *sp.*	*'Akia*	Native/Shrub	Wood	2	0.04
				Unknown 5			Wood	5	0.18
15433	2	I/1	0-5	Unknown 6			Wood	4	0.65
Ent. 9				cf. *Metrosideros polymorpha*	*'Ohi'a lehua*	Native/Tree	Wood	3	0.04
				cf. *Osteomeles anthyllidifolia*	*'Ulei*	Native/Shrub	Wood	61	1.75
				Chamaesyce sp.	*'Akoko*	Native/Shrub	Wood	41	1.76
				cf. *Dodonaea viscosa*	*'A'ali'I*	Native/Shrub	Wood	31	1.12
				cf. *Aleurites moluccana*	*Kukui*	Polynesian Introduction/ Tree	Wood	11	0.15
				cf. *Psychotria* sp.	*Kopiko*	Native/Shrub	Wood	1	0.02
15434	2	I/2	5-7	cf. *Myoporum sandwicense*	*Naio*	Native/Tree	Wood	7	0.29
Ent. 9				cf. *Dodonaea viscosa*	*'A'ali'I*	Native/Shrub	Wood	33	1.89
				cf. *Osteomeles anthyllidifolia*	*'Ulei*	Native/Shrub	Wood	14	0.38
				Chamaesyce sp.	*'Akoko*	Native/Shrub	Wood	15	0.49
				Diospyros sandwicensis	*Lama*	Native/Tree	Wood	5	0.09
				cf. *Myrsine* sp.	*Kolea*	Native/Tree	Wood	2	0.03
				cf. *Perrottetia sandwicensis*	*Olomea*	Native/Tree	Wood	2	0.03
				cf. *Psychotria* sp.	*Kopiko*	Native/Shrub	Wood	5	0.08
				Unknown 2			Wood	16	0.42
				Unknown 5			Wood	7	0.28
15440	5	I/1	0-5	Monocotyledonae			Stem	1	0.03
Ent. 5				cf. *Osteomeles anthyllidifolia*	*'Ulei*	Native/Shrub	Wood	10	0.58
				Chamaesyce sp.	'Akoko	Native/Shrub	Wood	19	0.45
				cf. *Dodonaea viscosa*	*'A'ali'i*	Native/Shrub	Wood	12	0.42

Table 6.17 Summary of Charcoal Identifications for Roadcut Cave continued.

HAVO #	Test Unit	Layer/ Level	Depth, cmbs	Taxa	Common/ Hawaiian Name	Origin/Habit	Part	Count	Weight (g)
15440				cf. *Metrosideros polymorpha*	*'Ohi'a lehua*	Native/Tree	Wood	10	0.29
				cf. *Myrsine* sp.	*Kolea*	Native/Tree	Wood	3	0.06
15442		I/2	5-10	*Chamaesyce* sp.	*'Akoko*	Native/Shrub	Wood	12	0.54
Ent. 5				cf. *Dodonaea viscosa*	*'A'ali'I*	Native/Shrub	Wood	6	0.35
				Unknown 8			Wood	1	0.03
				Diospyros sandwicensis	*Lama*	Native/Tree	Wood	1	0.04
				cf. *Metrosideros polymorpha*	*'Ohi'a lehua*	Native/Tree	Wood	5	0.39
				Unknown 9			Wood	5	0.51
15443 Ent. 9				cf. *Senna* sp.	*Kolomona*	Native+Historic introduction/Tree	Wood	1	—

Table 8.2. Summary of Charcoal Identifications for Kealakomowaena Cave.

HAVO #	Test Unit	Layer / Level	Depth, cmbs	Taxa	Common/ Hawaiian Name	Origin/Habit	Part	Count	Weight (g)
15451	1	I/2	5-10	cf. *Dodonaea viscosa*	*'A'ali'i*	Native/Shrub	Wood	14	0.62
				Chamaesyce sp.	'Akoko	Native/Shrub	Wood	20	0.82
				cf. *Metrosideros polymorpha*	*'Ohi'a lehua*	Native/Tree	Wood	9	0.33
				cf. *Myrsine* sp.	*Kolea*	Native/Tree	Wood	2	0.03
				Unknown 2			Wood	3	0.11
				Unknown 10			Wood	5	0.22
				cf. *Psychotria* sp.	*Kopiko*	Native/Shrub	Wood	3	0.10
				Diospyros sandwicensis	*Lama*	Native/Tree	Wood	1	0.02
				Not identified			cf.tuber/ embryo	1	0.01
				Unknown 1			Wood	1	0.02
				Unknown 5			Wood	12	0.34
15461	1	I/4	15-20	*cf. Cordyline fruticosa*	Ki, ti leaf	Polynesian introduction/ Shrub	Wood	1	0.19
				Unknown 5	Hau	Native/Shrub-Tree	Wood	10	0.61
				Chamaesyce sp.	*'Akoko*	Native/Shrub	Wood	10	0.31
				Diospyros sandwicensis	*Lama*	Native/Tree	Wood	3	0.07
				cf. *Dodonaea viscosa*	*'A'ali'i*	Native/Shrub	Wood	11	0.36
				cf. *Artocarpus altilis*	*'Ulu*	Polynesian introduction/ Tree	Wood	1	0.07
				cf. *Myrsine* sp.	*Kolea*	Native/Tree	Wood	2	0.11
				Aleurites moluccana	*Kukui*	Polynesian Introduction/ Tree	Nutshell	1	0.03
15468	1	I/6	35-40	Unknown 5			Wood	21	0.84
				Chamaesyce sp.	*'Akoko*	Native/Shrub	Wood	11	0.50

Table 6.18. Summary of Charcoal Identifications for Kealakomowaena Cave continued.

HAVO #	Test Unit	Layer / Level	Depth, cmbs	Taxa	Common/ Hawaiian Name	Origin/Habit	Part	Count	Weight (g)
15468				*Diospyros sandwicensis*	*Lama*	Native/Tree	Wood	2	0.35
				cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood	14	0.72
				Unknown 10			Wood	4	0.12
				cf. *Metrosideros polymorpha*	*ʻOhiʻa lehua*	Native/Tree	Wood	6	0.11
				Aleurites moluccana	*Kukui*	Polynesian Introduction/ Tree	Nutshell	3	0.06
				Unknown 11			Wood	3	0.13
15473	1	I/7	40-45	*Chamaesyce* sp.	*ʻAkoko*	Native/Shrub	Wood	11	2.32
				Diospyros sandwicensis	*Lama*	Native/Tree	Wood	13	0.63
				cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood	33	1.45
				cf. *Metrosideros polymorpha*	*ʻOhiʻa lehua*	Native/Tree	Wood	7	0.32
				cf. *Osteomeles anthyllidifolia*	*ʻUlei*	Native/Shrub	Wood	3	0.13
				Unknown 8			Wood	1	0.17
				Unknown 5			Wood	10	0.37
				Aleurites moluccana	*Kukui*	Polynesian Introduction/ Tree	Nutshell	7	0.30
				Unknown 11			Wood	2	0.05
				cf. Poaceae	Grass			1	0.03
				cf. *Canthium odoratum*	*Alahe'e*	Native/Tree	Wood	2	0.05
				cf. *Bidens/Dubautia*		Native/Shrub	Wood	4	0.07
				cf. *Psychotria* sp.	*Kopiko*	Native/Shrub	Wood	2	0.04
15477	1	I/8	45-48	cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood	12	0.56
				Diospyros sandwicensis	*Lama*	Native/Tree	Wood	3	0.11
				cf. *Psychotria* sp.	*Kopiko*	Native/Shrub	Wood	5	0.05

Table 6.18. Summary of Charcoal Identifications for Kealakomowaena Cave continued.

HAVO #	Test Unit	Layer / Level	Depth cmbs	Taxa	Common/ Hawaiian Name	Origin/Habit	Part	Count	Weight (g)
15477				*Chamaesyce* sp.	ʻAkoko	Native/Shrub	Wood	10	0.36
				cf. *Myrsine* sp.	*Kolea*	Native/Tree	Wood	5	0.14
				cf. *Metrosideros polymorpha*	*ʻOhiʻa lehua*	Native/Tree	Wood	7	0.14

Table 8.3. Summary of Charcoal Identifications for HV-30.

HAVO #	Test Unit	Layer / Level	Depth cmbs	Taxa	Common/ Hawaiian Name	Origin/Habit	Part	Count	Weight (g)
15552	1	I/1	10-15	cf. *Perrottetia sandwicensis*	*Olomea*	Native/Tree	Wood		4.89
15560	1	I/2	15-20	cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood		0.05
				cf. *Chenopodium oahuense*	*ʻAheahea, ʻāweoweo*	Native/Shrub	Wood		0.01
				cf. *Sophora chrysophylla*	*Mamane*	Native/Tree	Wood		0.11
15569	1	II/1	19-25	cf. *Osteomeles anthyllidifolia*	*ʻUlei*	Native/Shrub	Wood		0.02
				Chenopodium oahuense	*ʻAheahea, ʻāweoweo*	Native/Shrub	Wood		0.07
				cf. *Metrosideros polymorpha*	*ʻOhiʻa lehua*	Native/Tree	Wood		0.07
				cf. *Sophora chrysophylla*	*Mamane*	Native/Tree	Wood		0.51
				cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood		0.03
15575	1	II/2	25-30	cf. *Osteomeles anthyllidifolia*	*ʻUlei*	Native/Shrub	Wood		0.23
				Unknown 12			Wood		0.15
15589	1	II/3	30-32	cf. *Osteomeles anthyllidifolia*	*ʻUlei*	Native/Shrub	Wood		1.95

Table 8.4. Summary of Charcoal Identifications for Sites 27195, 27219, 28186, 28222, 28237, 27216, 27195.

Bag No.	Site No.	Unit, Layer, Depth, cmbd	Taxa	Common/Hawaiian Name	Origin/Habit	Part	Count	Weight (g)
1	27195	MTU-2, II/3, 40-50	cf. *Rhus sandwicensis*	*Neleau, neneleau*	Native/Tree	Wood	27	1.85
			Chamaesyce sp.	*ʻAkoko*	Native/Shrub	Wood	11	0.29
			cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood	5	0.13
			Unknown 1[1]			Wood	24	0.20
			cf. *Mucuna gigantea*	*Kāeaʻeʻe,* sea bean	Native/Vine	Stem	7	0.04
7	27219	TU-2, II/2, 17-22	cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood	51	4.98
8	27219	TU-2, II/4, 22-27	cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood	13	1.54
			Chamaesyce sp.	*ʻAkoko*	Native/Shrub	Wood	6	0.12
			Unknown 2			Wood	1	0.01
17	27219	TU-2, III/7, 32-45	cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood	3	0.10
			Not identified			cf. Tuber/ Corm	1	0.10
			Chamaesyce sp.	*ʻAkoko*	Native/Shrub	Wood	1	0.03
			Unknown 2			Wood	5	0.11
2	28186	TU-3, I/2, 28-31	cf. *Osteomeles anthyllidifolia*	*ʻUlei*	Native/Shrub	Wood	1	0.01
			Aleurites moluccana	*Kukuiu*	Polynesian Introduction/Tree	Nutshell	4	0.07
			cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood	7	0.12
			cf. *Styphelia tameiameiae*	*Pukiawe*	Native/Shrub	Wood	2	0.02
			Chamaesyce sp.	*ʻAkoko*	Native/Shrub	Wood	5	0.04
9	28222	TU-4, II/3, 24-29	cf. *Metrosideros polymorpha*	*ʻOhiʻa lehua*	Native/Tree	Wood	4	0.33
			cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood	3	0.06
			Not identified			cf. Tuber/ Corm	1	0.02
			cf. *Osteomeles anthyllidifolia*	*ʻUlei*	Native/Shrub	Wood	1	0.07
			cf. *Chamaesyce* sp.	*ʻAkoko*	Native/Shrub	Wood	1	0.02
			cf. *Styphelia tameiameiae*	*Pukiawe*	Native/Shrub	Wood	1	0.01
			Aleurites moluccana	*Kukuiu*	Polynesian Introduction/Tree	Nutshell	1	<0.01
14	28222	TU-4, III/4, 29-36	cf. *Metrosideros polymorpha*	*ʻOhiʻa lehua*	Native/Tree	Wood	6	0.10
14	28237	TU-5, III/5, 29.5-33	cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood	8	0.08
			Chamaesyce sp.	*ʻAkoko*	Native/Shrub	Wood	1	0.01

Table 6.20. Summary of Charcoal Identifications for Sites 27195, 27219, 28186, 28222, 28237, 27216, 27195 cont.

Bag No.	Site No.	Unit, Layer, Depth, cmbd	Taxa	Common/Hawaiian Name	Origin/Habit	Part	Count	Weight (g)
			Unknown 3			Wood	2	0.01
8	27216	TU-6, II/2, 16.5-21	cf. *Mucuna gigantea*	*Kāʻeʻe,* sea bean	Native/Vine	Stem	4	0.12
			cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood	9	0.21
			Chamaesyce sp.	*ʻAkoko*	Native/Shrub	Wood	3	0.01
26	27216	TU-6, III/7, 38.5-43.5	cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood	10	0.33
			Unknown 2			Wood	8	0.22
			Chamaesyce sp.	*ʻAkoko*	Native/Shrub	Wood	7	0.16
			cf. *Styphelia tameiameiae*	*Pukiawe*	Native/Shrub	Wood	1	0.03
6		MTU-1, II/3, 53-63	cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood	196	18.48
			Chamaesyce sp.	*ʻAkoko*	Native/Shrub	Wood	69	3.97
			Diospyros sandwicensis	*Lama*	Native/Tree	Wood	33	2.15
			cf. *Metrosideros polymorpha*	*ʻOhiʻa lehua*	Native/Tree	Wood	15	1.21
			cf. *Rhus sandwicensis*	*Neleau, neneleau*	Native/Tree	Wood	18	0.73
			cf. Peridophyta	Fern		Root	1	0.01
			cf. *Osteomeles anthyllidifolia*	*ʻUlei*	Native/Shrub	Wood	3	0.08
			Unknown 4				1	0.31
			cf. *Styphelia tameiameiae*	*Pukiawe*	Native/Shrub	Wood	6	0.24
			Unknown 5				6	0.16
			Not identified			cf. Tuber/ Corm	1	0.04
			Unknown 1				8	0.18
13	27195	MTU-1, II/4, 62-72	cf. *Dodonaea viscosa*	*ʻAʻaliʻi*	Native/Shrub	Wood	231	23.53
			Unknown 2			Wood	18	0.74
			Chamaesyce sp.	*ʻAkoko*	Native/Shrub	Wood	65	5.04
			cf. *Myoporum sandwicense*	*Naio*	Native/Tree	Wood	2	0.34
			Canthium odoratum	*Alaheʻe,*	Native/Tree	Wood	3	0.48
			cf. *Osteomeles anthyllidifolia*	*ʻŪlei*	Native/Shrub	Wood	23	1.64
			Diospyros sandwicensis	*Lama*	Native/Tree	Wood	27	1.46
			Unknown 6			Wood	1	0.02
			cf. *Metrosideros polymorpha*	*ʻOhiʻa lehua*	Native/Tree	Wood	5	0.21
			Lagenaria siceraria	*Ipu*	Polynesian Introduction/Vine	Fruit rind	1	0.05
			Unknown 4			Wood	7	0.42

Table 6.20. Summary of Charcoal Identifications for Sites 27195, 27219, 28186, 28222, 28237, 27216, 27195 cont.

Bag No.	Site No.	Unit, Layer, Depth, cmbd	WIDL #	Taxa	Common/Hawaiian Name	Origin/Habit	Part	Count	Weight, g
			1108-77	cf. *Styphelia tameiameiae*	*Pukiawe*	Native/Shrub	Wood	8	0.37
18	27195	MTU-1, II/5, 72-82	1108-1	Chamaesyce sp.	*ʻAkoko*	Native/Shrub	Wood	8	0.62
			1108-2	cf. Diospyros sandwicensis	*Lama*	Native/Tree	Wood	5	0.22
			1108-3	cf. Dodonaea viscosa	*ʻAʻaliʻi*	Native/Shrub	Wood	12	0.61
			1108-4	cf. Osteomeles anthyllidifolia	*ʻŪlei*	Native/Shrub	Wood	5	0.17
			1108-5	cf. Rhus sandwicensis	*Neleau, neneleau*	Native/Tree	Wood	1	0.02

1 mostly twigs, may be immature *pūkiawe*

Table 8.5. Rank order species abundance by weight for Roadcut Cave.

	Roadcut Cave Ent. 9			Roadcut Cave Ent. 5	
	TU-1	TU-2		TU-5	
	Layer 1/Level 1 0-5 cmbs	Layer 1/Level I 0-5 cmbs	Layer 1/Level II 5-7 cmbs	Layer 1/Level I 0-5 cmbs	Layer 1/Level II 5-10 cmbs
cf. *Aleurites moluccana*		5			
cf. *Dodonaea viscosa*		3	1	3	4
cf. *Metrosideros polymorpha*		6		4	3
cf. *Myoporum sandwicense*			5		
cf. *Myrsine* sp.			9.5	5	
cf. *Osteomeles anthyllidifolia*		2	4	1	
cf. *Perrottetia sandwicensis*	5		9.5		
cf. *Psychotria* sp.		7	8		
cf. *Wikstroemia* sp.	4				
Chamaesyce sp.	1	1	2	2	1
Diospyros sandwicensis			7		5
Monocotyledonae				6	
Unknown 1	3				
Unknown 2			3		
Unknown 5	2		6		
Unknown 6		4			
Unknown 8					6
Unknown 9					2

Table 8.6. Rank order species abundance by weight for Kealakomowaena cave.

	Kealakomowaena cave				
	TU-1				
	Layer I/Level 2 5-10 cmbs	Layer I/Level 4 15-20 cmbs	Layer I/Level 6 35-40 cmbs	Layer I/Level 7 40-45 cmbs	Layer I/Level 8 45-48 cmbs
Aleurites moluccana		7	7	7	
cf. *Artocarpus altilis*		6.5			
cf. *Bidens/Dubautia*				9	
cf. *Canthium odoratum*				10.5	
cf. *Cordyline fruticosa*		4			
cf. *Dodonaea viscosa*	2	2	2	2	1
cf. *Metrosideros polymorpha*	4		6	5	3.5
cf. *Myrsine* sp.	8	5			3.5
cf. *Osteomeles anthyllidifolia*				8	
cf. Poaceae				12	
cf. *Psychotria* sp.	7			11	5
Chamaesyce sp.	1	3	8	1	2
Diospyros sandwicensis	9.5	6.5	3	3	4
Unidentified	10				
Unknown 1	9.5				
Unknown 2	6				
Unknown 5	3	1	1	4	
Unknown 8				6	
Unknown 10	5		5		
Unknown 11			4	10.5	

Table 8.7. Rank order species abundance by weight for Site 27195, agricultural mounds.

	Site 27195, Agricultural Mounds			
	MTU-2 II/3 40-50 cmbd	MTU-1 II/3 53-63 cmbd	MTU-1 II/4 62-72 cmbd	MTU-1 II/5 72-82 cmbd
Canthium odoratum			6	
Chamaesyce sp.	2	2	2	1
Diospyros sandwicensis		3	4	3
cf. *Dodonaea viscosa*	4	1	1	2
Lagenaria siceraria			11	
cf. *Metrosideros polymorpha*		4	10	
cf. *Mucuna gigantea*	5			
cf. *Myoporum sandwicense*			9	
cf. *Osteomeles anthyllidifolia*		10	3	4
cf. Peridophyta		12		
cf. *Rhus sandwicensis*	1	5		5
cf. *Styphelia tameiameiae*		7	8	
Unknown 1[1]	3	8		
Unknown 2			5	
Unknown 4		6	7	
Unknown 5		9		
Unknown 6			12	
Not identified (cf. tuber, corm)		11		

Table 8.8. Rank order abundance by weight for Platform sites 27219 and 27216.

	Site 27219, Platform			Site 27216, Platform	
	TU-2 II/2 17-22 cmbd	**TU-2 II/4 22-27 cmbd**	**TU-2 III/7 32-45 cmbd**	**TU-6 II/2 16.5-21 cmbd**	**TU-6 III/7 38.5-43.5 cmbd**
Chamaesyce sp.		2	3	3	3
cf. *Dodonaea viscosa*	1	1	2.5	1	1
cf. *Mucuna gigantea*				2	
cf. *Styphelia tameiameiae*					4
Unknown 2		3	1		2
Not identified (cf. tuber, corm)			2.5		

Table 8.9. Rank order abundance by weight for Pavement and Residential Complex's, sites 28186, 28222, and 28237.

	Site 28186, Pavement	Site 28222, Residential Complex		Site 28237, Residential Complex
	TU-3 I/2 28-31 cmbd	**TU-4 II/3 24-29 cmbd**	**III/4 29-36 cmbd**	**TU-5 III/5 29.5-33 cmbd**
Aleurites moluccana	2	6		
Chamaesyce sp.	3	4.5		2.5
cf. *Dodonaea viscosa*	1	3		1
cf. *Metrosideros polymorpha*		1	1	
cf. *Osteomeles anthyllidifolia*	5	2		
cf. *Styphelia tameiameiae*	4	5		
Not identified (cf. tuber, corm)		4.5		
Unknown 3				2.5

Results of Microfossil Analysis

In addition to the wood charcoal identification, microfossil analysis on pollen, phytolith and starch was also conducted on five samples – three from MTU-1 (samples 10, 20, and 21), and two from an adjacent control sample (samples 6 and 8). The microfossil analysis provided evidence of local landscape disturbance as well as cultivation of two Polynesian introduced crops – giant taro (*Alocasia macrorrhiza*) and ti (*Cordyline fruticosa*). Landscape disturbance is evident by pllen samples of grasses, gerns and fern allies, and Cheno-Am. Pollen from both taro and ti were found in sample 10 of MTU-1 (Layer II/1, 53-63 cmbd). Because neither taxa has abundant pollen production or long distant transport, they were most likely cultivated close to if not in the mound.

The phytolith assemblage was dominated by grasses, much like the pollen assemblage, reflecting a disturbed landscape. No cultigens phytoliths were identified in the samples, however, phytolith analsysis is relatively new and many taxa are not yet known.

No starch remains were found in the samples, despite the identification of giant taro in the pollen. Abundant microscopic fragments of charcoal was found in all of the samples, suggesting burning of vegetation at the site. The age of the mound dates to the early sixteenth century to just after contact, suggesting a late prehistoric, early historic use of the feature.

Chapter 9 . SUMMARY AND CONCLUSION

Distribution of Upland Archeological Remains

Kealakomowaena is a well-developed upland complex of habitation sites and features associated with agriculture and animal husbandry – all located within the *ko kula uka* zone. The habitation complexes are spread across the landscape, interspersed by a large number of agricultural features, a trail system that connected the *'ohana* living in *kauhale* (group of houses) at the coast with those living amongst the upland agricultural plots, shorter trail segments within the main complex living area, and boundary walls that demarcated political and social units.

The fields and associated structures found in Kealakomowaena are very similar to the dry land field systems that Kirch (1994) described for Hawaii Island. Writing that these field systems "share common features he says they include:

> *"closely spaced grid of stone field borders defining permanent plot boundaries… Integrated with the stone borders are a wide range of agronomic modifications , such as stone mounds and heaps, windbreaks, planting circles, clearings, simple terraces, and various animal enclosures (for pigs or dogs, presumably), as well as both temporary and permanent residential sites"*(Kirch 1994).

The grid-like layout of the field borders is the least represented and developed feature in Kealakomowaena. At Kealakomowaena stone mounds seemingly randomly placed are the most dominant feature and will be discussed in greater detail below.

Residential Sites - Kauhale

One of the primary site types found in the upland field systems is the house site – or *kauhale*. Work conducted in the project areas over the last decade has resulted in the documentation of numerous stone structures, the majority of which are likely components of residential complexes. These clusters of habitation sites or complexes are commonly called *kauhale* (group of houses). There were several key functional types of structures that were found in the *kauhale*. They included the following:

> *"(1) the common dwelling and sleeping house, hale noa; (2) men's eating house, mua; (3) an oven or cookhouse, hale kāhumu; (4) various storage structures; and (5) a women's menstrual house, hale pe'a." Kauhale were occupied by "single nucleated households, which might count from one to three generations among its members" (Kirch and Rallu 2007).*

The landscape and subsistence economy in the islands "naturally created the dispersed community of scattered homesteads" (Handy and Handy 1991). Grouping of kauhale thus was more "fortuitous" than anything else. What was of more importance was "the ties of relationship of each household (who) reached out to relatives living in other parts of the same or neighboring *ahupua'a*" (Handy and Handy 1991).

The ties between *'ohana* that lived at the coast and in the uplands at Kealakomowaena were of great importance as the upland *kauhale* residents tended the gardens that fed the families. Handy and Handy described a true community as consisting of residents:

> *"located on upland slopes (ko kula uka), some on the plains toward the sea (ko kula kai), and some along the shores (ko kaha kai). Neighborly interdependence, the sharing of goods and services, naturally resulted in the settling of contiguous lands by a given 'ohana rather than a scattering over an entire district. In this way there came to be an association of particular 'ohana with the land units later designated as ahupua'a"* (Handy and Handy 1991).

This type of settlement pattern is documented within Kealakomo *ahupua'a* in the *ko kula uka* and *ko kaha kai*. Though the focus of this report is on the *ko kula uka* lands, a brief discussion of the *ko kula kai* and *ko kaha kai* are also important. The style of habitation sites found in Kealakomowaena located in the *ko kula uka*, consists primarily of enclosures, but also some terraces, platforms, and pavements.. In the Phase I survey area, 13 sites were identified as having a habitation function and 37 as temporary habitation. Most of these in the latter category were c-shapes. The Phase II project area had 17 sites identified as part of a complex of habitation features, three paved areas, one single standing enclosure, and 12 temporary habitation sites which are primarily c- and u- shapes.

Several criteria identified by Ladefoged et al. 1987 and Handy and Handy (1991) led to these functional determinations. The criteria are outlined in Table 7.1. For those features that functioned as residential enclosures, the structure walls are often core filled, and have interior components that may consist of a hearth for cooking and heat, and a terrace or paving used for sleeping areas. Residential enclosures could have an opening in the wall which would have functioned as an entry way. Some house sites however, may not have an opening, and entry would have been gained over the low wall using a wooden stile. The walls would have been low, and the structure itself small (less than 15m in length) to accommodate a roof that would have sat right on top of the structure. The rafters would have rested directly on top of the walls and were described by Handy and Handy (1991) as a "small thatched pent roof set on the rock walls." These types of structures would have been well suited in treeless areas and areas where thatching was limited because they could be made with a minimum of wood and grass materials. Kealakomowaena was such an area. Less thatching on the walls would have discouraged animals from eating off of the sides, thus protecting and preserving the structure. Habitation sites would have neatly faced exterior walls to keep animals from climbing in. *Pili* grass, *lau hala*, sugar cane, *ti* and *uki* could all have been used for thatching and the choice of materials would have depended on what was most plentiful in the area (Handy and Handy 1991). Household artifacts may also been found within these types of sites.

Photo 17. Imge Top, typical structure found in the coastal lowlands of western Puna in Kealakomo. Structure modified in historic period by fishermen to accommodate tin roofing material.

Image Bottom, typcial Hawaiian hale in the early twentieth century found in the coastal lowlands of eastern Puna in Kalapana. Photos courtesy of Hawai'i Volcanoes National Park.

Two habitation sites show clear use and occupation during the historic period. These are HV-30 (Site 27205) and HV-38 (Site 27204). Historic sites are often complexes that have multiple components and are relatively larger than other structures. Others have suggested that sites used during the historic period exceed 300m^2 (Allen and McCanany 1994). The presences of historic artifacts as well as ethnohistoric documentation are also obvious signs.

Smart, Emory et al. (1965) identified HV 30 as a house site utilized during the historic period. They describe HV-30 as the most prominent of all of the clusters of structures located "in the very middle of the Kealakomo Waena area." They noted artifacts lying on the surface that included boards, metal, porcelain and iron which he stated "clearly date the sites." Their description follows:

> "*The enclosure complex comprises a large central enclosure, with well-fitted walls about 1.5 m high for the most part, of somewhat circular plan. Against the southern end of this is a smaller, circular enclosure, while three other enclosures of more rectangular plan are attached to the eastern side. All have similar wall constructions. Entrances are present in some places.*
>
> *Against the northern side of the enclosure complex stands a large paved platform and a cemented-stone cistern. The platform has several subsidiary structures and levels, but a growth of thick bushes conceals details. Iron, glass and porcelain objects, as well as several large timbers, are scattered over or near the platform*" (Smart, Emory et al. 1965).

Aerial photos and early records produced by archeologists show that *kauhale* also existed in the *ko kaha kai*, or along the shore of Kealakomo. Unfortunately, most of the plains toward the sea (*ko kula kai*) has been covered by lava flows, and we will never know what this area contained. Aerial photos and early archeological research suggests that few kauhale existed in this area.

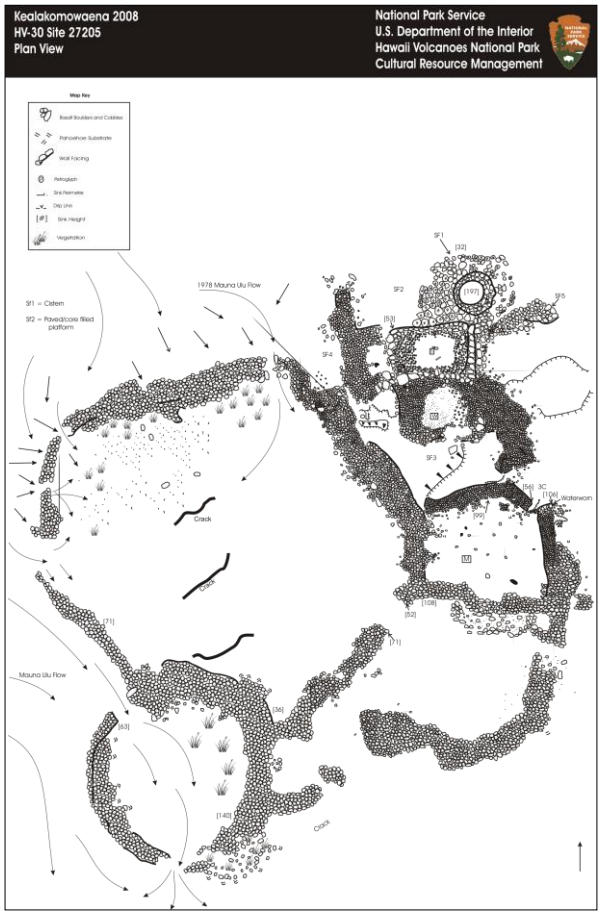

Image 1. Plan view map of HV-30 (Site 27205).

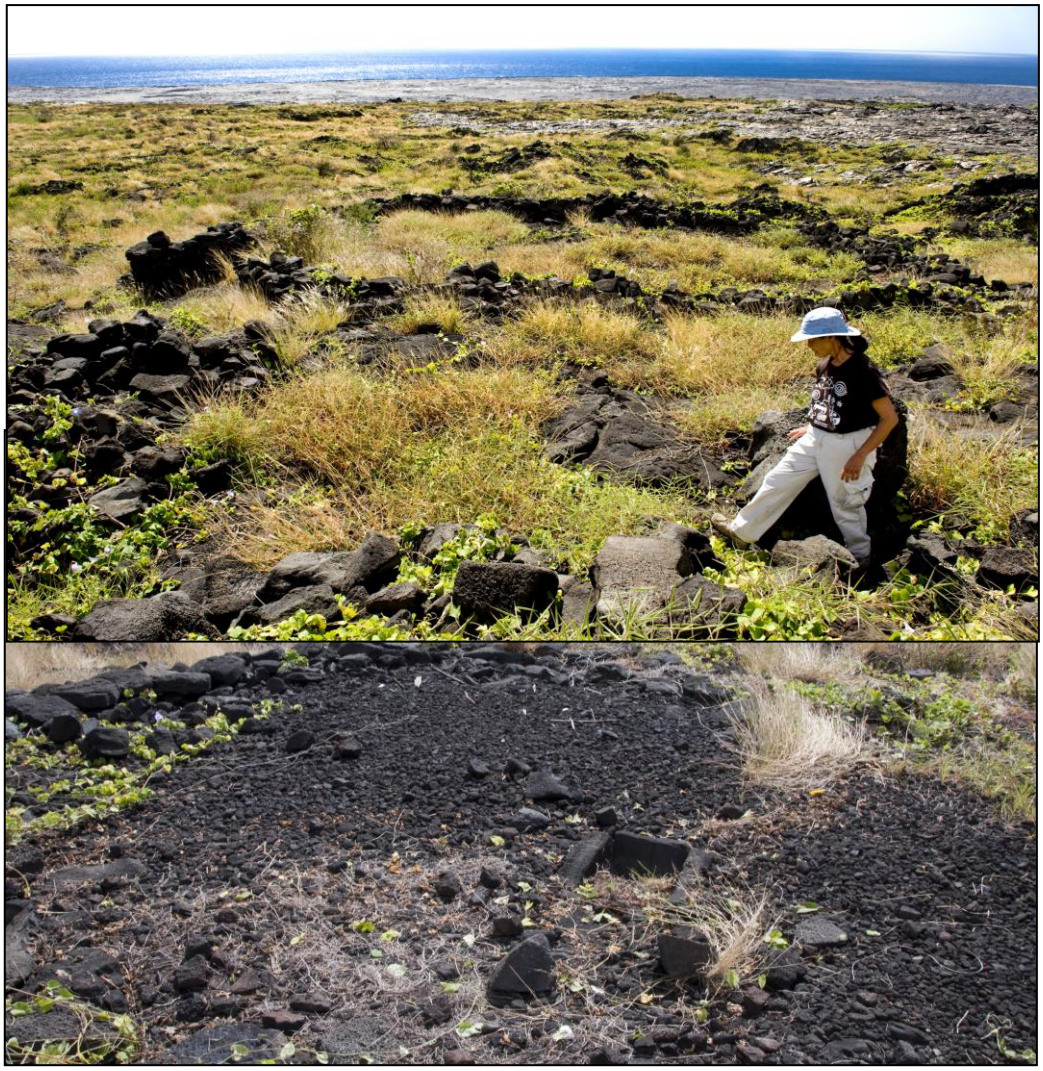

Photo 18. Site 27205 (HV-30). Stuructre B is in the photo below and Structure C is above. Photo courtesy of Hawai'i Volcanoes National Park.

Photo 19. Top image of Site 27250, likely an animal pen. Photo taken in 2010. Image at bottom, structure used for a horse corral at the coast in Hawai'i Volcanoes National Park. Photo circa 1920. Photos courtesy of Hawai'i Volcanoes National Park.

Table 9.1. Typology for Enclosures.

Function	Stylistic Attribute	Discussion
Habitation		
	Small, under 15m in length	Structure large enough for a roof.
	Core filled wall	Low walls to accommodate a roof. Type of structure used in treeless areas because it requires less wood and thatch.
	Interior paved surface	
	Opening in one side or stile type entrance	Interior division suggests separate internal living functions.
	Low, rock side walls accommodate roof	
	Interior components include paving, terraces, hearths	Exterior wall facing keeps animals out.
	Neatly faced exterior walls	
Animal Pen		
	Large, over 15m in length	Structures larger than 15m would require too big of a roof
	No interior components	
	Core filled wall	Interior facing keeps animals in and prevent them from escaping.
	Neatly faced interior walls for animal	
	3ft. (0.9m) high walls	Used to contain donkeys
	4.5 ft. (1.4m) high walls	Used to contain cattle
	6 – 8ft. (1.8 to 2.4m) high walls	Used to contain goats and wild pigs
Agricultural Enclosure		
	Large, over 49.2ft (15m) in length	Size negates use of roof.
	Core filled or stacked wall	
	Interior components	Consists of planting features (mounds).
	Neatly faced exterior walls	Exterior walls keep animals out

Animal Pens

In addition to structures used for living, eating and cooking, Kealakomowaena also contains structures that were used in animal husbandry, and functioned primarily as animal pens. Existing features are primarily free standing enclosures. However, aerial photos of the *ahupua'a* prior to the Mauna Ulu flows suggest there also once were enclosure built up against the base of lava flows – therefore utilizing the natural flow to encompass one side of the structure. Smart (1965:45) describes several features in Kealakomowaena that are constructed in this manner and they also show up on the aerial photos (Figure 3.4).

A total of five sites in the Phase I area and four sites in the Phase II project area were determined to be animal pens. These features would have functioned to enclose mules, horses, cattle, goats, pigs, and possibly dogs. When Ellis was in Kealakomo and while he was traveling northeast along the coast of Puna, he described seeing "several fowl, and a few hogs" as well as "a tolerable number of dogs" (Ellis 1979:263). Nineteenth century tax records also note the presence of horses and mules and we know from other records that goats were plentiful in the area during the post-contact period as well. Ladefoged et al. (1987:69) provide an example from Kona of the height of enclosure walls necessary to contain certain taxa. Despite the fact that the data was collected in Kona, it is applicable to Puna if we assume that the ability of an animal to escape a pen is generally equal across landscapes. Thus, we can assume that a pen for donkeys must have wall heights of at least 3 feet 90.9 m). For cattle, the walls must be at least 4.5 ft., for goats and pigs at least 6 to 8 feet. Ethnographic and archeological evidence such as the cistern feature at HV-30 show that this area was utilized during the historic period. Many of the animal pens were also likely used, if not constructed, during the historic period.

Political Boundaries and Trails

The Phase I kīpuka above the unnamed pali is nearly bisected by a long linear rock wall (Site 27200) that runs in a north/south direction. This site may be an *ili* boundary wall. Just above the un-named pali, the wall ends near a switchback trail (Site 27265) that cuts across the face of the pali. Below the trail, another north/south wall segment which is likely the continuation of this possible boundary wall, was recorded just east of the remaining trail segment. Its true extent will never be known, but aerial photos suggest that its northern terminus is close to where it ends today (see Figure 7.1).

Photo 20. Site 27200, linear wall that bisects the kipuka. Photo courtesy of Hawai'i Volcanoes National Park.

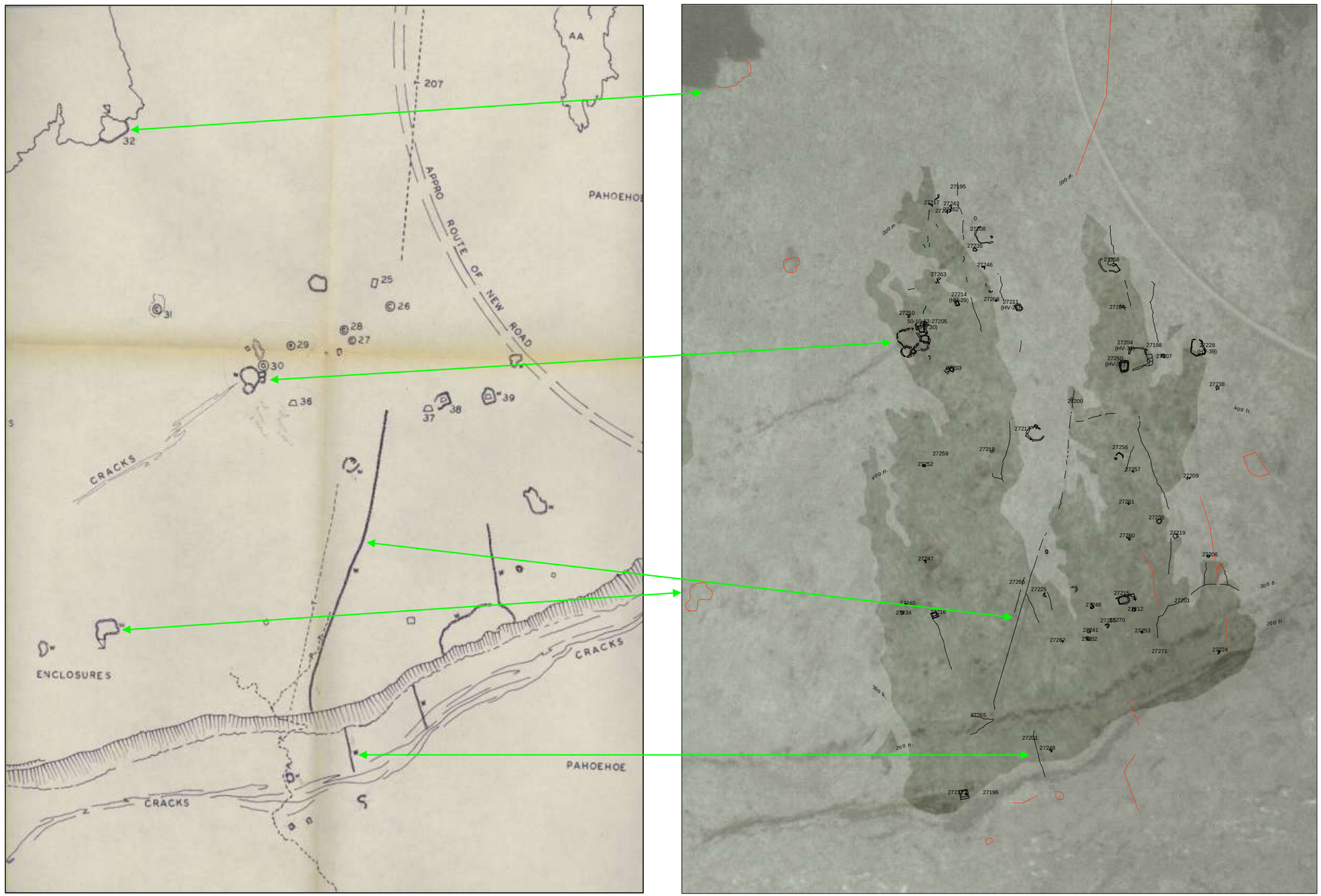

Figure 8.1. Map (left) from Emory et. al. 1959 showing various wall segments, trails, and structures identified during their survey. A similar snapshot of the area after the Phase I survey (right). Red lines indicate predicted site locations based on aerial photo analysis. Green arrows show a small representation of matching sites.

The segment of the boundary wall below the pali is cut off to the south by the Mauna Ulu flow. Aerial photos before the lava flow, however suggested that this segment was not very long, is mostly preserved.

Aerial photos also show two parallel wall segments below the unnamed pali – one to the east of Sites 27256 and 27200 and one to the west. The eastern wall was noted by Emory, but not numbered (Figures 3.4 and 7.2).

The trail that once connected the coast to Kealakomowaena was first recorded by archeologists a half century ago. At that time, it was already in poor shape, however, Emory et. al. (1959) were able to document a segment that ran parallel and to the west of the boundary wall (Site 27200). Today, the only visible remnant of the *mauka-makai* trail that connected the coast with the uplands is a switchback segment found on the lower un-named pali. This section is fairly collapsed and jumbled which may be due to earthquakes and erosion over the years.

A photo taken from horseback in 1941 shows the trail crossing through Kealakomowaena. This north/south trail segment was utilized by park rangers to access the uplands and coastal sites within the park. It is unclear from the photo how the trail was constructed. But, in 1941 park ranger Gunder E. Olson describes the trail in a backcountry report to the Superintendent. An excerpt and photo from his report is highly informative. Olson writes:

> *"An ancient trail… now partially overgrown, is so straight and well made that one is led to believe that it was laid out with a surveyor's instrument. It is 4 feet wide and easily followed from the top of the first pali to the top of Poli o Keawe Pali, a distance of about 3 miles. It is said that the natives used this trail in commuting between the inland where crops were grown and the seashore where fish, shellfish and seaweeds were obtained" (Olson 1941).*

To the north of the kīpuka the trail linked Kealakomowaena with Nā ulu Village. The segment of trail that once paralleled the wall is no longer visible, and much of the trail segment north of the kīpuka lies under the historic Mauna Ulu lava flow. However, aerial photos from the 1960's taken prior to Mauna Ulu clearly shows the segment of trail closest to the base of Nā ulu Village (see figure ?).

Agricultural Features

The Hawaiian Islands express both wetland and dryland field systems. The kind of system that is present on each island and in parts of the island is reflective of the archipelago's "environmental heterogeneity" (Kirch et al. 2004:1666). The islands of Maui and Hawaii, are comprised of young volcanoes. There are few surface streams on these islands, unlike the older islands in the chain such as Oahu and Molokai which "support well-developed drainage networks" (Vitousik, T.N. Ladefoged et al. 2004). As a result, the younger islands (Maui and Hawaii) support dryland agricultural systems. These dryland systems are "confined to discrete areas of the younger volcanoes" (Vitousik, T.N. Ladefoged et al. 2004). Both Kirch (et al. 2004) and Newman (1971) provide maps noting locations of known field systems on Hawai'i Island. Kirch's maps are based on archeological and ethnographic evidence. Newman's maps were based

on an analysis of Ellis' journal (Newman 1971). Both maps are similar and both miss the presence of agricultural field systems in western Puna.

Research in Puna by the National Park in the last 20 years have filled in many of the gaps in these maps. These kinds of features are not only found within Kealakomo ahupua'a. They have also been documented in the more eastern ahupua'a of Poupou, Pulama, Kamoamoa, Lae'apuki, Panau and Paliuli (Ladefoged, Somers et al. 1987; Glidden 2006).

Interspersed amongst the clusters of habitation sites, boundary wall and trail are a large number of agricultural features. Sweet potato (*uala*) was likely the primary crop grown in these fields because of the types of features (mounds, modified outcrops and *kuaiwi*) that are commonly associated with *uala*, and the area is located within a zone of marginal, yet adequate rainfall. Other taxa that may have been cultivated include sugar cane, ti, dryland taro and breadfruit.

Mounded Ridges - *Kuaiwi*

The agricultural field system, most particularly in the Phase I project area is incompletely partitioned into a series of individual fields by loosely mounded ridges, or low stacked walls. The ridges are aligned in a generally north/south direction – perpendicular to the northeasterly trade winds and contour of the land. Their placement on the landscape would have allowed these walls to have possibly functioned as field boundaries and as a means to decrease surface wind flow, and reduce erosion and evapotranspiration. These features are called mounded ridges for this discussion and are believed to have functioned in a similar manner to *kuaiwi.* The Kealakomowaena mounded ridges are similar to those described in the Ka'ū *ahupua'a* of Manuka (Allen and McCanany 1994)at the Amy Greenwell Gardens in Kealakekua (Allen 2001), Captain Cook (Tomonari-Tuggle 2006), and described by Menzies (1909) while at Kealakekua. The mounded ridges, known as *kuaiwi*, were created by the clearance of the ground of loose rock. By mounding them, they served both as planters, wind breaks, and moisture retainers. Menzies described these features:

> *"In clearing the ground, the stones are heaped up in ridges between the little fields and planted on each side, either with a row of sugar cane or the sweet root of these islands (Dracena ferra) [syn. Cordyline fruticosa (L.) A. Chev.] where they afterwards continue to grow in a wild state, so that even these stony uncultivated banks are by this means made useful to the proprietors, as well as ornamental to the fields they intersect"(Menzies 1907).*

Kuaiwi are also found in Kona, Lapakahi, and Waimea-Kawaihae. The Kealakomowaena features are most similar in construction to the "alignments" recorded by Ladefoged et al. (1987) in the Kalapana Extension area of Kamoamoa and Waha'ula. The mounded ridges in the project area run parallel to the slope like those in Kona, but in contrast to the perpendicular walls in Lapakahi and Waimea-Kawaihae. Ladefoged et al. (1987) postulated that the informal nature of the features in Kalapana may be due to less severe environmental conditions than those in Lapakahi. Archeologists believe that these features functioned in part to protect plants from wind damage and evapo-transpiration. If these factors were not as great in Kalapana

or Kealakomowaena, then it would not be necessary for the Puna features to be as big or formal.

The original linear extent of many of these ridge systems is unknown in part because the Mauna Ulu flow has cut them off, and frequent earthquakes and trampling by goats in the recent past likely impacted their integrity. The more intact features are found primarily in the upper lobes of the kīpuka. However, the current distribution may be an artifact of time and natural elements (lava flows, earthquakes, goats), and construction techniques.

Although only the upper portion of the Phase I area was surveyed in detail, transects across the kīpuka suggest that rock mounds and modified outcrops are spread throughout in great density.

One feature that is not abundant in the Phase I area of Kealakomowaena is excavated pits. These pits have been documented in far greater numbers in the Phase II area. They were described and documented in the Puna district during the historic period by Lyman (1924) in 1846 and Hildebrand (1981) in the 1880s (as cited in Ladefoged et al. 1987). The lack of pits in the Phase I area may be due to the available sediement in this kīpuka. An older kīpuka, the Phase I area has relatively well developed sediment for this part of Puna that was a result of explosive ash eruptions from Kīlauea (see chapter 2 for more detail).

Photo 21. Typical ridge feature located in Kealakomowaena. Photo courtesy of Hawai'i Volcanoes National Park.

The most abundant agricultural feature identified in the Phase I area are *pu'e* (mounds) used primarily to grow sweet potatoes. These features were first described by Wilkes in 1845 when he passed through the Puna district on his way to the summits of Kīlauea and Mauna Loa. He described how sweet potatoes were grown in Puna:

> *"growing literally among heaps of stones and pieces of lava, with scarcely soil enough to cover them; yet they are, I am informed, the finest on the island"* (Wilkes 1845).

Wilkes' description of these features and the sweet potato growing within them indicates that over half a century after the islands were "discovered" by Captain Cook, Hawaiians still maintained their traditional subsistence practice for growing sweet potato. This crop was only second in importance to taro for Hawaiians across the archipelago, but in the marginal environments of western Puna sweet potato was a very important crop.

Nearly a century after Wilkes described the Puna crops, Bishop Museum archeologist Alfred Hudson carried out a survey of east Hawaii in 1932. He too described the sweet potato planting mounds as:

> *"potato patches, consisting of loose bits of lava piled in hillocks, are found along the coast from Pulama to Kamoamoa and a mile or more inland over the whole region"* (Hudson 1932).

Pu'e are the most abundant features documented in the Phase I area. Hawaiians of old had specific methods and traditions for planting sweet potato. These traditions depended on the type of land in which the sweet potatoes were planted. Kamakau describes how sweet potato was planted on *palawai* lands – "bottom lands" which "might be pitted, or stony, or uneven." Kealakomowaena fits this classification. On these lands, planting of sweet potato occurred on:

> "*about a hundred or more acres"* (which was) *"set on fire, and after a week had gone by, the land was softened by digging, and all stubbles of grass and brush were removed. Thus it lay for a month, until the moisture in the ground rose to about half an inch from the surface*" (Kamakau 1976).

When the potato slips, *lau*, were ready, they were planted in mounds "spaced three or four meters apart. It was not well to have them too close together, lest the vines become entangled with each other" (Kamakau 1976). Together, men and women would plant these *makaili* patches (sweet potato patches in stony places like Kahikinui on Maui and Kona, Hawaii, and Kealakomo, Puna Hawaii) (Handy and Handy 1991). The men would use an *'o'o* to work the soil, while the women came up behind them planting the slips (Kamakau 1976).

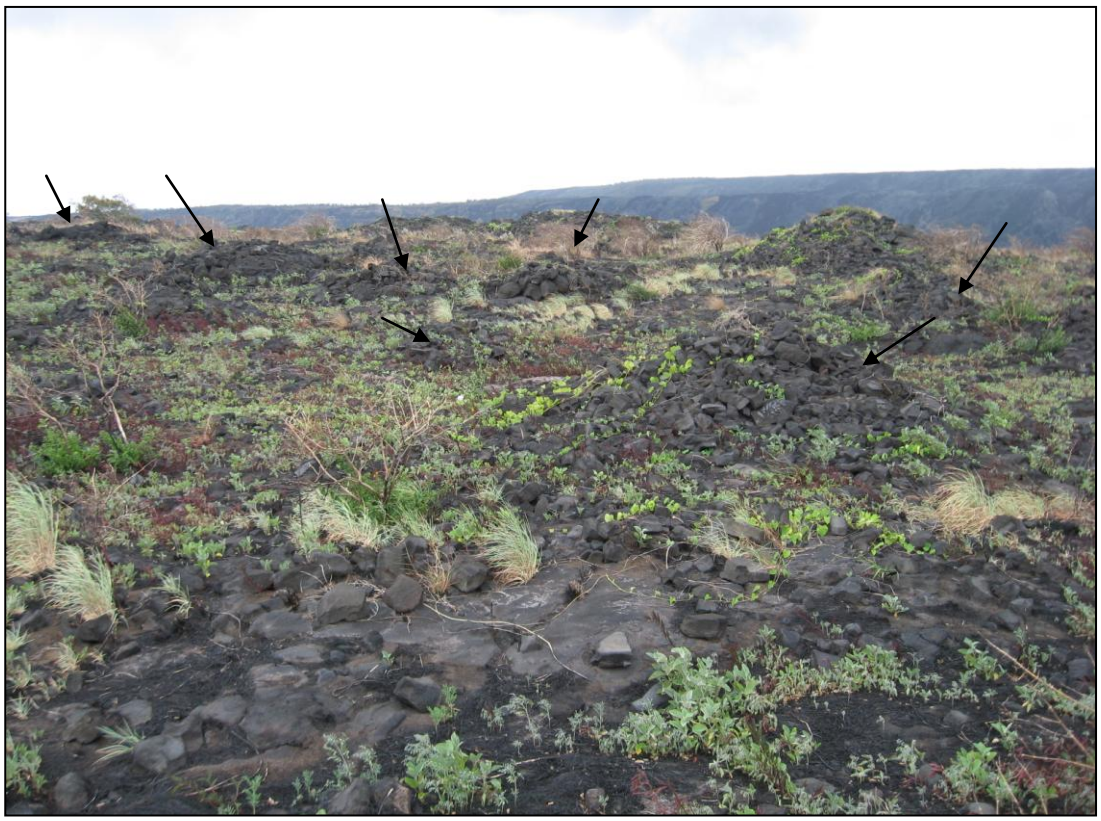

Photo 22. Distribution of mounds revealed after 2009 prescribed burn. Photos courtesy of Hawai'i Volcanoes National Park.

At least two or three sweet potato slips would be planted in each mound, placed "vertically in holes made with the digging stick (*ʻoʻo*)" (Handy and Handy 1991). In places like Kealakomo,

> *"Where potatoes are planted in crumbling lava combined with humus, as on eastern Maui and in Kona, Hawaii, the soil is softened and heaped carelessly in little pockets and patches, utilizing favorable spots on slopes. The crumbling porous lava gives ample aeration without much mounding"* (Handy and Handy 1991).

The sweet potato was secondary in overall subsistence importance to taro. However, in areas like western Puna it can be argued that the sweet potato was the primary crop. Unlike taro, the sweet potato was a completely dryland crop – in some parts of the island, such as Kealakomowaena, it was the primary starch crop grown where rainfall was scarce. In Kealakomowaena, the average rainfall is 1000 – 1500 mm/yr (40 – 60 in/yr). Sweet potato grows best where rainfall is above 500 mm/yr (19.6 in/yr) (Vitousik, T.N. Ladefoged et al. 2004).

In parts of the island where sweet potato is grown, Handy and Handy (1991) describe a "much greater body of lore (that) has grown up around its cultivation than around taro or other food plants." Prayers focusing on rain-making and rituals focusing around the god Lono and "Kamapuaʻa… who was a form (*kino lau*) assumed by Lono in this rain-making function. Ku and Kane also were appealed to… as gods of growing things and living waters" (Handy and Handy 1991). In the volcanically active area of Kilauea, where the presence of Pele is all around, it fits that the cultivators worshiped Lono-makua, who is also identified with Pele in her migration from Kahiki.

The rituals associated with sweet potato extended to every aspect of its cultivation. As such, the kahuna played a large part in the whole planting process. It was the kahuna who planted the first two sweet potato slips, and it was he who weeded the first two mounds, and when the potatoes were ready for harvest, the kahuna dug out the first mature potatoes (Handy and Handy 1991).

As he planted the kahuna prayed:

> *O Kamapuaʻa-kane and Kamapuaʻa-wahine, O Ku and Hina,*
> *O Kamapuaʻa-kane and Kamapuaʻa-wahine, here is our patch,*
> *Dig only in our patch, excrete only in our patch,*
>
> *Lest you be stoned and hurt.*
> *Dig and excrete only in our patch, you will not be stoned,*
> *All the boundaries of this patch are ours.*

The gods may once have smiled upon the people of Puna, because Hawaiian traditions imply that this district "was once Hawaii's richest agricultural regions and that it is only in relatively recent time that volcanic eruption has destroyed much of its best land"(Handy and Handy 1991). As geologic records have shown, both in the precontact and historic times, lava flows have covered more of the lands suitable for gardening than in any other district on the island. The final blow to agriculture in the area may

have come during the historic period when "the gradual abandonment of their country by Hawaiians after sugar and ranching came in"(Handy and Handy 1991).

Kilauea was sacred ground and those who were the administrators, or *kahu*, of Pele "supplied offerings for ceremonies to Pele and maintained the grounds at Kī-lau-ea" (Nimmo 1990). One duty of the kahu was to provide the material used for the offerings to Pele. Such offerings included taro, sweet potato, sugar cane, pigs, chicken, and the cloth plant used to make kapa (Nimmo 1990). Stewart (1831:109 as cited in Nimmo 1990) wrote that there were specific plantations that were sacred to this use and located close to the Caldera. One was at the seashore, and the other "within the precincts of the crater – in the broken ground." The kahu would live part of his time at the coast, and part nearby the crater. Could Kealakomowaena have grown the food crops that were a major source of *hookupu* to Pele? It is highly likely, given that the farm land at Kealakomowaena is very close in proximity. Could the name Kealakomo (the entrance path) be a hint of an important link between these lands and the Caldera?

Ko Kaha Kai and Ko Kula Kai Zones

The residents and planters at Kealakomowaena did not live in a vacuum. They were most intimately connected with their family and neighbors within their ahupua'a. Aerial photos and early archeological records show that kauhale also existed in the *ko kaha kai*, along the shore at Kealakomo. These sites were recorded in the mid 20th century. Unfortunately, much of the coastal area has since been covered in lava by the Mauna Ulu flows. Most of the area immediately inland, and above the coast, the ko kula kai has also been covered over in historic lava flows from Mauna Ulu. This area, which likely lay below the lowest unnamed *pali* does not appear to have had many large structures. Very few features were identified in the *ko kula kai* during the early archeological surveys, and aerial photos have not revealed many additional structures. Trails obviously crossed this zone, but perhaps the land was not as fertile or elevated and therefore not as attractive. Whatever the reason, the distribution of sites across the wider landscape at Kealakomo is strikingly similar to Manuka where:

> *"…the archeological remains of Manuka are concentrated in two localities, along the immediate coast and in the uplands adjacent to or within fertile kīpuka. Between the coast and the uplands, a distance of 8 to 9 km, is a barren zone where only a few archaeological features are found, and those are often in association with coastal-inland trails"* (Allen and McCanany 1994).

Because the ko kula kai zone of Kealakomo is now mostly covered by lava flows, it will be difficult to know the actual distribution of features. However, additional study immediately south of the Phase II project area may give us some clues and parallels to the kinds of activities that went on in the *ko kula kai* zone of Kealakomo.

Expansion and Life in an Economically Marginal Area

Expansion into the leeward areas of the island and especially into areas that are economically "on the margin" required ohana to pool their resources including labor. In the western islands of Hawai'i work in the agricultural fields was primarily a male activity (Kirch 1994). In the eastern islands of Hawai'i and Maui, however, both men and women worked in the fields (Kamakau 1992; Kirch 1994). Kamakau (1992) writes "…it was not uncommon to see the women of Hawaii packing food on their backs, cooking it in the *imu*, and cultivating the land or even going fishing with the men." Kirch (1994) believes this difference in male and female roles between the islands has to do with the greater amount of labor that is required to plant and cultivate dryland field systems.

Why then, would people choose to settle in areas that were as challenging as Kealakomo in western Puna; a landscape that was, as some archeologists have labeled, "economically marginal" (Kirch and Rallu 2007). The "reasons" are likely many. One factor that can be examined archeologically is the growth of the human population across the island. As Hommon (1976, 1986 as cited by Kirch 2007:56) states, the need for additional food by a growing population may be the "simplest explanation for inland expansion" into areas that are literally at the margin of productivity. Hommon (1976, 1986 as cited by Kirch 2007:56) provides an argument that population increase peaked in AD 1400. His work is supported by Dye and Komori's model which shows "a phase of rapid population increase between ca. AD 1120 and 1440, and indicates a late pre-Contact decline in overall population from a peak of ca. AD 1441" (Dye and Komori 1992a; Dye and Komori 1992b). After the period of rapid growth the population stabilized after about AD 1450 – 1500 (Kirch and Rallu 2007).

Summary of the Distribution of Cultural Sites

Much of the landscape between and around Kealakomowaena has been altered by the modern lava flows from Mauna Ulu. This has resulted in a fragmented picture of the archeological landscape. However, we do have a window into the past through the early surveys done by Emory et al. (1959), Smart (1965) and maps produced by Ladd (1971). Of added value has been the use of aerial photos taken in the 1960's just after the Chain of Craters road was built, but prior to the Mauna Ulu lava flows. GIS technology has allowed us to digitize these aerials and estimate the location of sites now covered by historic lava flows. This data suggests that the main habitation site, and its associated agricultural features are still preserved, and are represented in the kīpuka that was surveyed for this project located in the *ko kula uka*. Although several associated features have been covered we can glean enough information from the records to get a sense of their functional relationship to the main project area. The only features that are not be well represented by previous records are the smaller agricultural features because they were not recorded by Emory and Smart, and they do not show up on the aerial photos. However, we can make some assumptions regarding their distribution. It is likely that the main agricultural complex located in the *ko kula uka* still exists, though some periphery features are covered. It appears that there were few sites across the *ko kula kai*, or in the plains between the uplands (below the un-named pali) and the coastal kauhale at the *ko kaha kai.* However, the *ko kula kai* was probably a largely barren zone with few structures.

Why was the main complex spared while other areas along the boundary or border covered? The answer may lie in the elevational gradient before the Mauna Ulu flows. One aspect that is obvious at the site complex is the fantastic views of the coastline and surrounding landscape. It appears that many habitation sites were built to take advantage of these grand views which may have allowed them to see both friend and foe approaching.

Another, perhaps more important characteristic of the preserved landscape is the good soils available here. As previously discussed, the older lava flow in the Phase I project area is overlaid by several important, large eruptive ash deposits that provided a rich and substantial substrate. The agricultural features were built to take advantage of the available and deep ash. The explosive eruptions, as postulated by geologist Don Swanson (pers comm..), fit well both temporally and spatially with the expansion of Hawaiians into this part of the island, and in particular this area of the landscape. Without these ash deposits, the extendt of agriculture practiced here may not have been possible and therefore it may have been more difficult to support *ohana* living in the area.

The very nature of the landscape is also what may have contributed to its continued preservation. The project area was likely once a high point between the pali above and below it. Because we know that lava flows like water, and finds the lowest topographic plane to flow, we can surmise that the landscape around the kīpuka was lower than lands within the kīpuka itself. Therefore, the selection by Hawaiians for this site may have been based in part on its elevation and good soils. The preservation of the site was also due to these same factors. Because it may have been raised, the modern Mauna Ulu lava flowed around the main site complex, thus preserving it for future generations. This hypothesis is supported by a brief comment made by Colin Smart in his 1965 report on the area. Smart writes that Kealakomowaena is a "short distance inland from the coast and *elevated somewhat above the coastal plain*" (emphasis added) (Smart, Emory et al. 1965).

Although the landscape today is a fragment of what it once was - bisected and surrounded by modern lava flows - what remains is a testament to what was once a thriving community. The archeological landscape is a reflection of how Hawaiians lived life on a lava landscape – took advantage of resources that were available, and completely modified their environment to suit their needs.

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