EXHIBIT B.03C

FINAL REPORT
Archaeological Inventory Survey of the Mauna Kea Access Road Management Corridor, Ka`ohe Ahupua`a, Hāmākua District, Hawai`i Island, Hawaii.

TMK: (3) 4-4-015: 01 (por.)

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February 2010

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Archaeological Inventory Survey of the Mauna Kea Access Road Management Corridor
Ka`ohe Ahupua`a, Hāmākua District, Island of Hawai`i
TMK: (3) 4-4-015: 01 (por.)

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EXECUTIVE SUMMARY

An archaeological inventory survey of a 400-yard wide easement along the Mauna Kea Access Road (TMK: (3) 4-4-015: por. 01) is managed by the University of Hawaii (UH) was undertaken by PCSI for the Office of Mauna Kea Management in 2009. The survey followed on an earlier reconnaissance survey of a 100-ft corridor on both sides of the Mauna Kea Access Road by the Bishop Museum in 1987. No historic properties were found during that survey.

The 2009 survey of the 400-yard wide management corridor identified one previously recorded site (50-10-23-10,314) and three new sites (50-10-23-27,867, 27,868 and 27,869). The previously recorded site is a lithic scatter comprised of the by-products of adze manufacture and octopus lure sinker manufacture. The site, which is interpreted as a workshop, is part of the larger Pu`u Kalepeamoa Site Complex (Site 50-10-23-16,244) that has been interpreted as a logistical support camp occupied on the ascent and descent from the Mauna Kea Adze Quarry Complex (Site 50-10-23-4136). The three new sites are inferred to be possible burials based on their location, architectural characteristics of the structural remains, size and morphological similarity to known and suspected burial features in the higher elevation areas on Mauna Kea.

Continuity in the use of the higher elevation areas on Mauna Kea from pre-contact times to the present is evidenced in modern altars (*lele*) and less formal rock piles without offerings. Remains that are either modern or cannot be classified with any level of confidence as historic sites because of their uncertain age, such as many of the rock piles, were recorded as "find spots," following a practice begun by the State Historic Preservation Division (SHPD) during a reconnaissance survey of selected areas of the Mauna Kea Science Reserve in 1997. A total of 44 find spots were recorded in the project area. About half of these were found on top of a cinder cone just above Hale Pōhaku. Some appear to be what can be loosely called "New Age" features, while others may represent contemporary Hawaiian cultural practices.

Site 10,314 is evaluated as significant under criteria "a" because of its association with the Mauna Kea Adze Quarry Complex and criteria "d" because of the potential it holds to yield more information about activities undertaken outside of the quarry proper, which is defined as areas with the raw material used in adze manufacture. Assuming that Sites 27,867, 27,868 and 27,869 are indeed burials, all three sites are significant under Criterion "d" because of the potential they hold to contribute to an understanding of mortuary practices in the high elevation regions of Mauna Kea, and Criterion "e" because of their probable association with Hawaiian beliefs and cultural practices.

Data collection is recommended for Site 10,314 because of its vulnerability to disturbance and loss of integrity. Preservation in place is recommended for the three possible burial sites. Other relevant management actions are presented, using a list developed for a draft cultural resources management plan (CRMP) for the UH management areas on Mauna Kea.

ACKNOWLEDGMENTS

PCSI is grateful to the Office of Mauna Kea Management (OMKM) for the opportunity to conduct the archaeological survey of the management corridor for the access road and to Stephanie Nagata, Interim Director of OMKM, in particular. Stephanie, and her assistant, Dawn Pamarang, have provided assistance of every imaginable kind for this project and other recently completed projects.

The staff at the Visitor Information Station at the Onizuka Center for International Astronomy, and Dave Byrne in particular, also assisted in various ways. This includes the current group of OMKM rangers: Ahiena Kanahele, Shane Fox , Don Weir and Joel Kelly and former ranger, Matt Church.

Our PCSI colleagues, Keola Nakamura, Valerie Park and Melanie Mintmier, participated in the road easement survey. Their hard work is, as always, greatly appreciated. A good part of the report production fell to Stephan Clark who assisted the authors in assembling the various sections and editing. Andy Tomlinson created the GIS maps.

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1.0 INTRODUCTION

This report presents the results of an archaeological inventory survey of a 400-yard wide management corridor (TMK: (3) 4-4-015: por. 1) located along the Mauna Kea Access Road, between Hale Pōhaku and the lower boundary of the Mauna Kea Science Reserve on the island of Hawai`i. (Figure 1.1). The survey was conducted by Pacific Consulting Services, Inc. (PCSI) for the Office of Mauna Kea Management (OMKM). Often referred to as the "road easement" in this report, the 400-yard wide management corridor is one of three areas on Mauna Kea that are managed by the University of Hawai`i through OMKM. The other two areas are the Science Reserve (TMK: (3) 4-4-015:09) and a 19.3-acre parcel (TMK: (3) 4-4-015:12) at Hale Pōhaku that is the location of the Onizuka Center for International Astronomy (OCIA) and the Visitor Information Station.

The section of the access road managed by UH extends from the OCIA at Hale Pōhaku to the Science Reserve boundary at the approximately 12,000-foot elevation. This includes a non-exclusive easement (Grant of Easement No. S-4697) approximately 400 yards wide on either side of the road, except for sections that fall within the boundaries of the Natural Area Reserve (Figure 1.2). UH's land management responsibilities, including the road easement, were set forth in the Mauna Kea Science Reserve Complex Development Plan (SRCDP), which was prepared in 1983 and subsequently amended in 1987 and again in 1989. The SRCDP defined UH's management areas as follows:

> Boundaries for the UH Management Area include: the Mauna Kea Science Reserve and the roads within, except the portions of the Mauna Kea Ice Age Natural Area Reserve that are situated within the Science Reserve boundaries; the areas at Hale Pōhaku encompassing the astronomy mid elevation facilities, the Information Station, construction camp, and proposed sub-station; and the summit access road from Hale Pōhaku to the Science Reserve Boundary at approximately 12,000 feet elevation, including a corridor approximately 400 yards wide on either side of the improved road (except for portions of this corridor which fall with boundary of the NAR, and all utility rights-of way and easements (Group 70 International, Inc. 1987:141).

Though there was no trigger that would require review and approval of a report by the State Historic Preservation Division (SHPD), the survey of the road easement was nevertheless guided by Hawaii Revised Statutes (HRS), Chapter 6E, and Title 13 of the Hawaii Administrative Rules (HAR), Subtitle 13 (State Historic Preservation Division Rules), Chapter 276 (Rules Governing Standards for Archaeological Inventory Surveys and Reports) to ensure that OMKM is in compliance with these rules and regulations.

1.1 Project Objectives and Scope of Work

The objective of the inventory survey was to determine the number, variety, location and significance of historic properties in the road easement and to record all sites to inventory level standards. Though not included in the SOW, the survey continued the practice, begun by former SHPD staff in a reconnaissance survey of selected areas of the Mauna Kea Science Reserve, in 1997, of recording cultural remains that are either obviously modern or cannot be classified with any level of confidence as historic properties because of their uncertain age and/or function (e.g., one stone or several stones on top of a boulder). The recording of these remains, originally called "locations" and now referred to as "find spots," is part of a resource management strategy aimed at obtaining baseline data with which to evaluate long-term

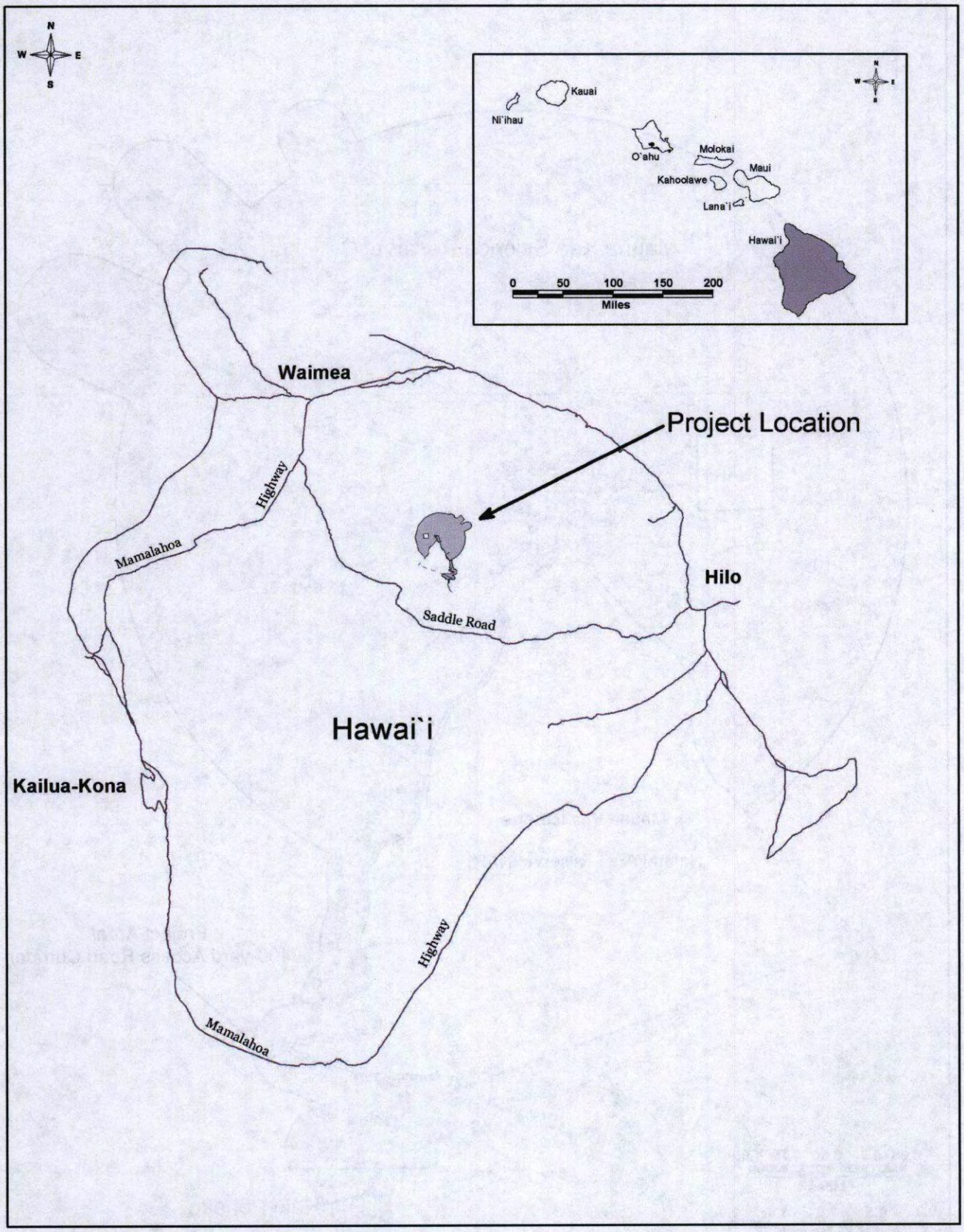

Figure 1.1 Project Location Map.

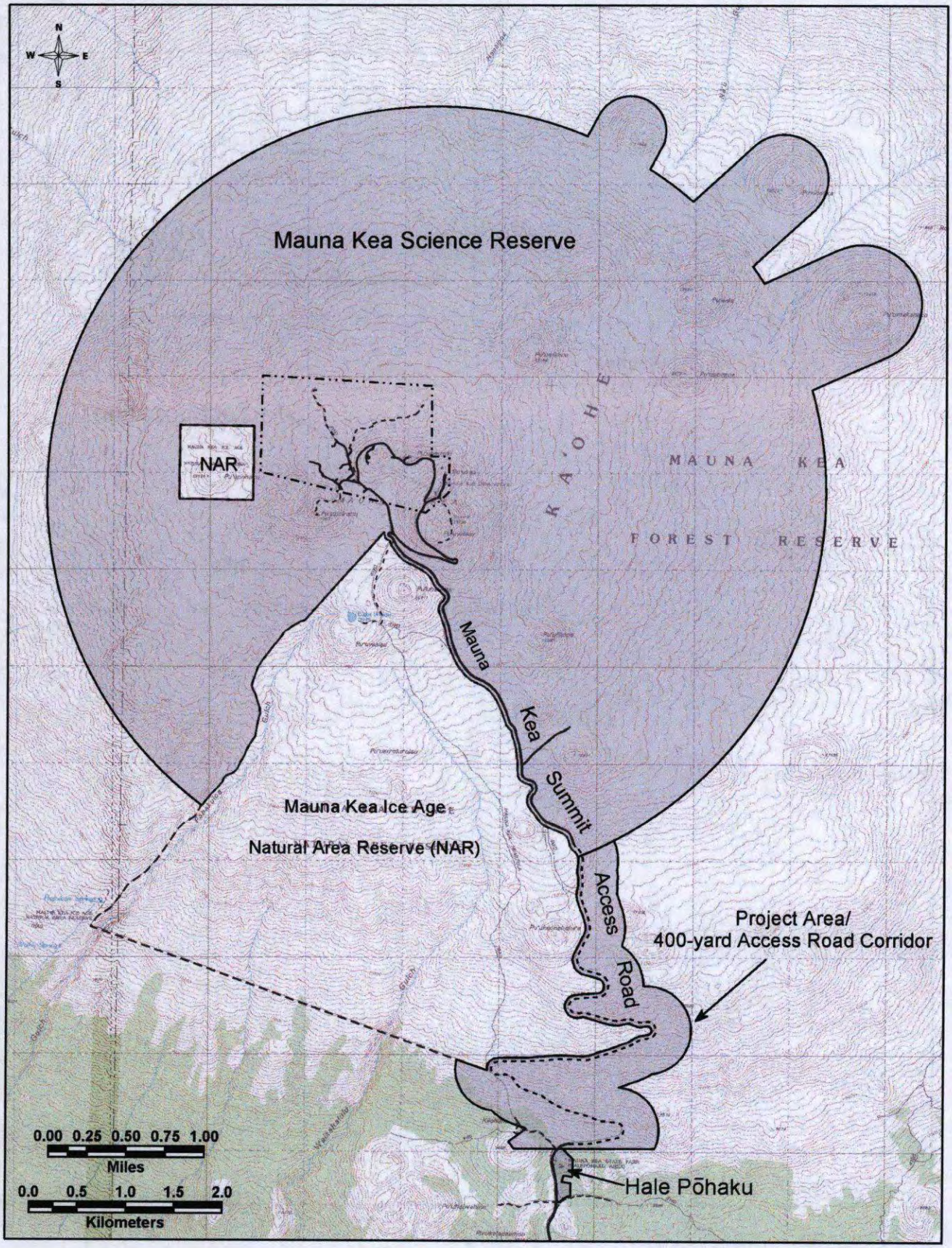

Figure 1.2 University of Hawaii Management Areas on Mauna Kea.

changes to the cultural landscape in both the Science Reserve and the adjacent Mauna Kea Ice Age Natural Area Reserve (TMK: (3) 4-4-015:10 and 11; see Figure 1.1).

1.2 Project Area Location, Fieldwork Schedule and Personnel

The project area encompasses an area of approximately 722-acres between Hale Pōhaku and the lower boundary of the Mauna Kea Science Reserve as shown on Figure 1.2. The project includes the upper portion of a sub-alpine dryland forest and part of a vast alpine desert environment (Figure 1.3). Portions of the project area have been previously disturbed, beginning with the road construction above Hale Pōhaku to the summit in the 1960s and the installation of an underground fiber optic line in the mid-1980s. Both of these projects were done without an archaeological survey or monitoring. As noted in the summary of previous archaeological investigations in the summit region in Section 3, Bishop Museum conducted an archaeological reconnaissance survey of a 100-ft wide corridor on both sides of the summit road between Hale Pōhaku and an old batch plant located in the NAR (Williams 1987). No historic properties were found in that survey.

The archaeological field survey for the management corridor was conducted over a period of five days between July 29 and September 22, 2009. The survey was conducted by the Principal Investigator, Dr. Patrick McCoy, the Field Director, Richard Nees, and PCSI Archaeologists Valerie Park, Keola Nakamura, and Melanie A. Mintmier. The outer boundary of the project area was not marked prior to the survey and was instead estimated based on GPS readings.

1.3 Report Organization

This report is divided into nine sections, excluding the references and one appendix.

Section 1: Introduction--the report begins with a description of the project objectives and scope of work; the organization of the report, and a brief description of the project area location, duration of the project and the personnel that participated in the fieldwork.

Section 2: Environmental, Historical and Cultural Context of the Alpine and Sub-Alpine Zones on Mauna Kea--provides a summary of the environmental, cultural and archaeological context. This includes a discussion of the geoecology of the summit region, the traditional cultural context, and a chronological summary of land use practices and other cultural practices before and after European contact.

Section 3: Previous Archaeological Research and Cultural Resource Management Studies in the Alpine Desert and Sub-alpine Forest Zones of Mauna Kea--summarizes earlier archaeological research, traditional property assessments, cultural impact assessments and mitigation plans for the higher elevation regions of Mauna Kea.

Section 4: Archaeological Theory and Practice--presents an overview of archaeological theory and practice and the authors' theoretical orientation.

Section 5: Summary of Work--includes a discussion of field methods, limitations of the survey, and a presentation of the findings.

Section 6: Summary and Discussion—summarizes the findings of the survey and discusses their relationship to previously recorded historic properties and other cultural resources ("find spots") in the Science Reserve and the Hale Pōhaku area.

Figure 1.3. Photographs of the Upper Project Area Alpine Desert landscape (upper) and Sub-Alpine Dryland Forest at Hale pohaku (below).

Section 7: Significance Evaluations--presents a discussion of the significance of the historic properties found during the survey.

Section 8: Recommendations--are made regarding the mitigation of the historic properties in the project area and more general management issues.

Section 9: References Cited.

Appendix A: Site Number Concordance Table for Historic Properties in the Hale Pōhaku Area.

2.0 ENVIRONMENTAL, CULTURAL AND HISTORICAL CONTEXT OF THE ALPINE AND SUB-ALPINE ZONES ON MAUNA KEA

In a departure from the orthodox practice in Hawaiian archaeology of describing the environmental and culture-historical setting of a project area as "background information," this report employs the term context. This is based on the view that what is commonly called "background" in archaeological reports is more than what the name implies. The overview that follows is taken primarily from other reports and papers (e.g., McCoy 1982a, 1990; McCoy and Nees 2009).

2.1 GEOECOLOGY

The environment on the upper slopes of Mauna Kea evinces similarities to other high mountains, including the marked interdependency of biotic and abiotic processes that has given rise to the term "geoecology" in the recent literature on arctic and alpine environments (Troll 1972; Winterhalder and Thomas 1978; Webber 1979). The complexities that the term geoecology engenders prevent a total environmental analysis in a report of this length. The focus of attention is on what are believed to be the most relevant biogeoclimatic characteristics for understanding the archaeological record of the summit region (McCoy 1985a). The summit region as defined here encompasses the vast alpine desert ecosystem on the top of the mountain.

2.1.1 Geologic History, Landforms, Topography and Soils

Mauna Kea, the highest (13,796 ft asl) and second largest of the five shield volcanoes that form the island of Hawai`i, is estimated to be between 600,000 and 1.5 million years old (Moore and Clague 1992; DePaolo and Stolper 1996; Wolfe et al. 1997; Sharp and Renne 2005). The earliest stage of volcanism consists of a basaltic shield which Stearns and Macdonald (1946) called the Hāmākua Volcanic Series. The latest stage, which caps the mountain, consists of andesitic lavas (Macdonald and Abbott 1970:142; Wolfe and Morris 1996; Wolfe et al. 1997; Sherrod et al. 2007) which were called the Laupāhoehoe Volcanic Series by Stearns and Macdonald (1946). Stephen Porter renamed these lavas the Hāmākua Group and Laupāhoehoe Group (Porter 1979a: Figure 2). The older lavas, which are part of a tholeiitic suite, contain basalts with varying percentages of olivine and feldspars, while the younger lavas, which are grouped in an alkalic suite, consist of primarily hawaiite (Porter 1979a:Figure 5). Even though the last eruption occurred sometime between 4,580 and 8,200 years ago (Sherrod et al. 2007:470), the U.S. Geological Survey (USGS) considers Mauna Kea to be an active post-shield volcano (U.S. Geological Survey 2002).

There are numerous cinder cones and associated lava flows on what is popularly known as the summit plateau (Figures 2.1 and 2.2). One of the earliest known descriptions of the plateau was made by Hitchcock who wrote "There is a sort of plateau upon the higher part of Mauna Kea above the contour of 12,500 feet, with an area of from thirty-five to forty square miles" (Hitchcock 1909:51). A more detailed description was made by Wentworth and Powers:

> Above 11,000 to 12,000 feet is the summit plateau, a rudely circular dome 5 or 6 miles in diameter rising between 500 and 1000 feet per mile to a central area above 13,000 feet (Wentworth and Powers 1941:1197).

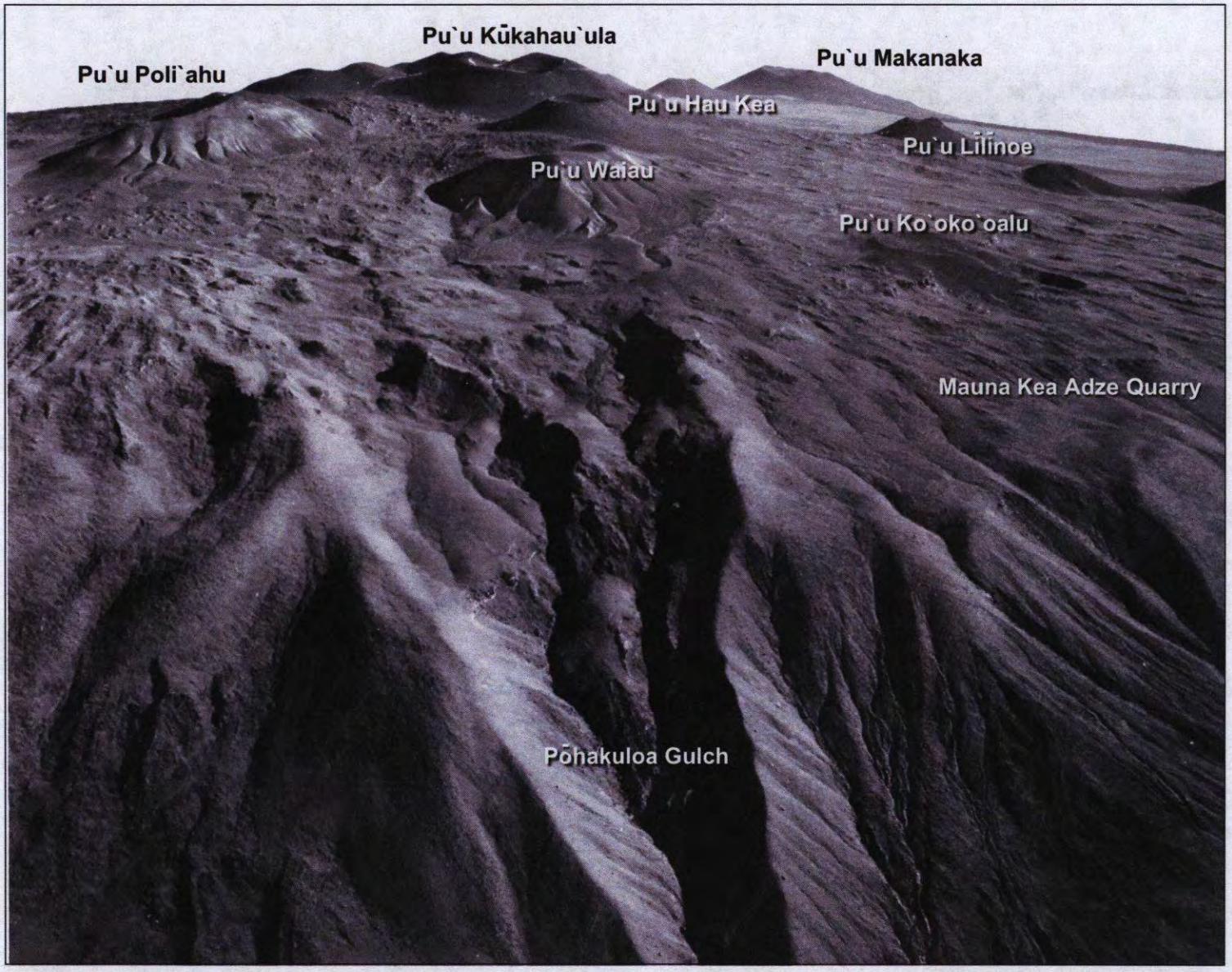

Figure 2.1. Aerial View of the Summit Plateau and Dissected Landscape Below in the Pohakuloa Gulch Area.

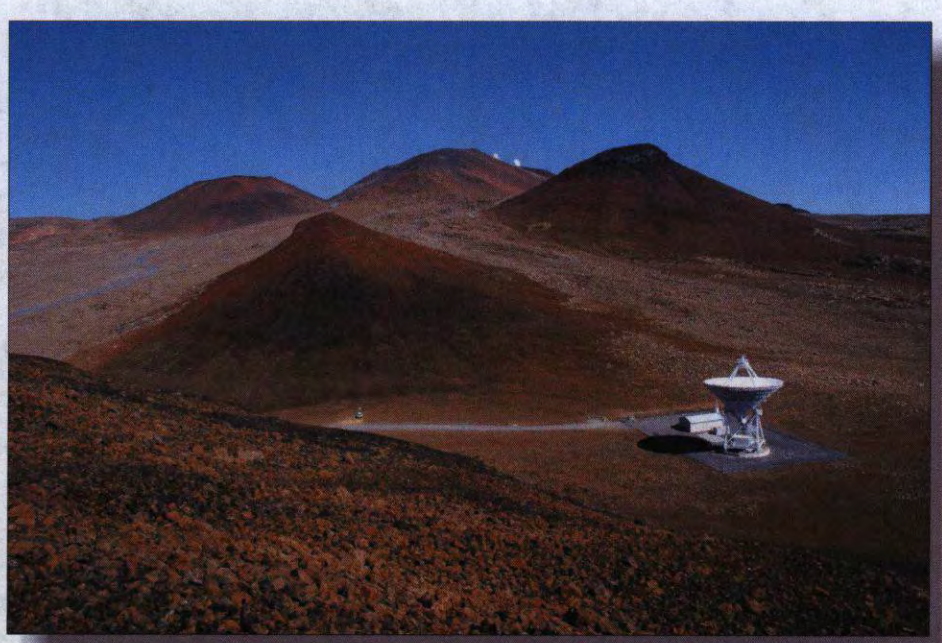

Figure 2.2. Photographs Showing Cinder Cones Located on the Summit Plateau.

Mauna Kea was for many years the only known mountain in the tropical mid-Pacific with evidence of Pleistocene glaciation (Daly 1910; Porter 1972, 1975, 1979b 1979c, 1987). Possible evidence for glaciation has apparently been found recently on Haleakalā (Moore et al. 1993). A number of geologists have studied the glacial deposits on Mauna Kea (e.g., Gregory and Wentworth 1937; Wentworth and Powers 1941; Stearns 1945), but the definitive study was undertaken by Stephen Porter in the 1970s. Porter mapped a succession of four glacial drift sheets, located between the ca. 2,800 m (9,184 ft) and 4,200 m (13,776 ft) elevations, which correspond to four periods of glaciation. From earliest to latest the glacial deposits were named, using local place names, the Pōhakuloa Formation, Waihu Formation, and the Makanaka Formation. The latter includes an older drift and a younger drift (Porter 1979c: Figure 2). More recent investigations suggest that there may have only been three major stages of glaciation, rather than four (Wolfe et al. 1997). Glacial moraines and associated drift deposits cover a large part of the summit region (Figure 2.3).

Porter provides a good description of the effects of glaciation on the topography of the summit plateau:

> Behind the belt of end moraines lies a broad zone of dominantly erosional topography irregularly mantled by thin patches of drift. Within this zone, lava-flow surfaces have been abraded into stoss-and-lee forms and are extensively striated, and the flanks of cinder cones have been oversteepened by glacial erosion so they stand at angles of 30 to 34, instead of the more typical 24 to 26 (Porter 1972; 1975:247).

The stoss and lee forms to which Porter refers are *roches moutonees* (Davies 1972:171), also commonly known as "whaleback ridges" (Porter 1975:247) and "muttonback ridges" (Figure 2.4) A good description of these glacial landforms appears in an early report by Gregory and Wentworth:

> A conspicuous feature of glacial erosion is the “whale-backed” smoothing (roche moutonne). Many of the ledges that extend radially down the slope of the dome (Pl. 1, fig. 2) have been eroded and smoothed on the top sides, with a stoss approach upslope and a plucked cliff or series of steps at the downslope end. In general, the roches moutonnes are long and narrow, with parallel sides and a straight rather than oval or domed longitudinal profile. The form of many, if not all of them, has been determined by the original lava flow. Commonly the irregularities of the lava flow are still in evidence, and in places the deeper pahoehoe wrinkles have not been completely removed. It appears that only a small amount of erosion and smoothing has sufficed to form rather characteristic glacial outlines and surfaces, owing to the similarity in direction of motion of the glacial ice and the lava flows (Gregory and Wentworth 1937:1733).
>
> A thin and discontinuous ground moraine overlies striated bed rock in much of the glaciated area (Pl. 1, fig. 2). It consists of fragments of lava, in many places mingled with cinders from nearby cones or with finer rock detritus washed from the slopes. Nearly all of the fragments are angular or slightly rounded at their edges, though a few are marked by minor grooves and facets and generally granular surfaces. It seems obvious that the “erratics” have not travelled far or been subjected to intense and repeated grinding. Some of them are joint blocks plucked from the underlying ledge; others are slabs broken from low cliffs over which the ice stream passed; still others seem to have been transported within, or on top of, the glaciers, without modification in shape (Gregory and Wentworth 1937:1734).

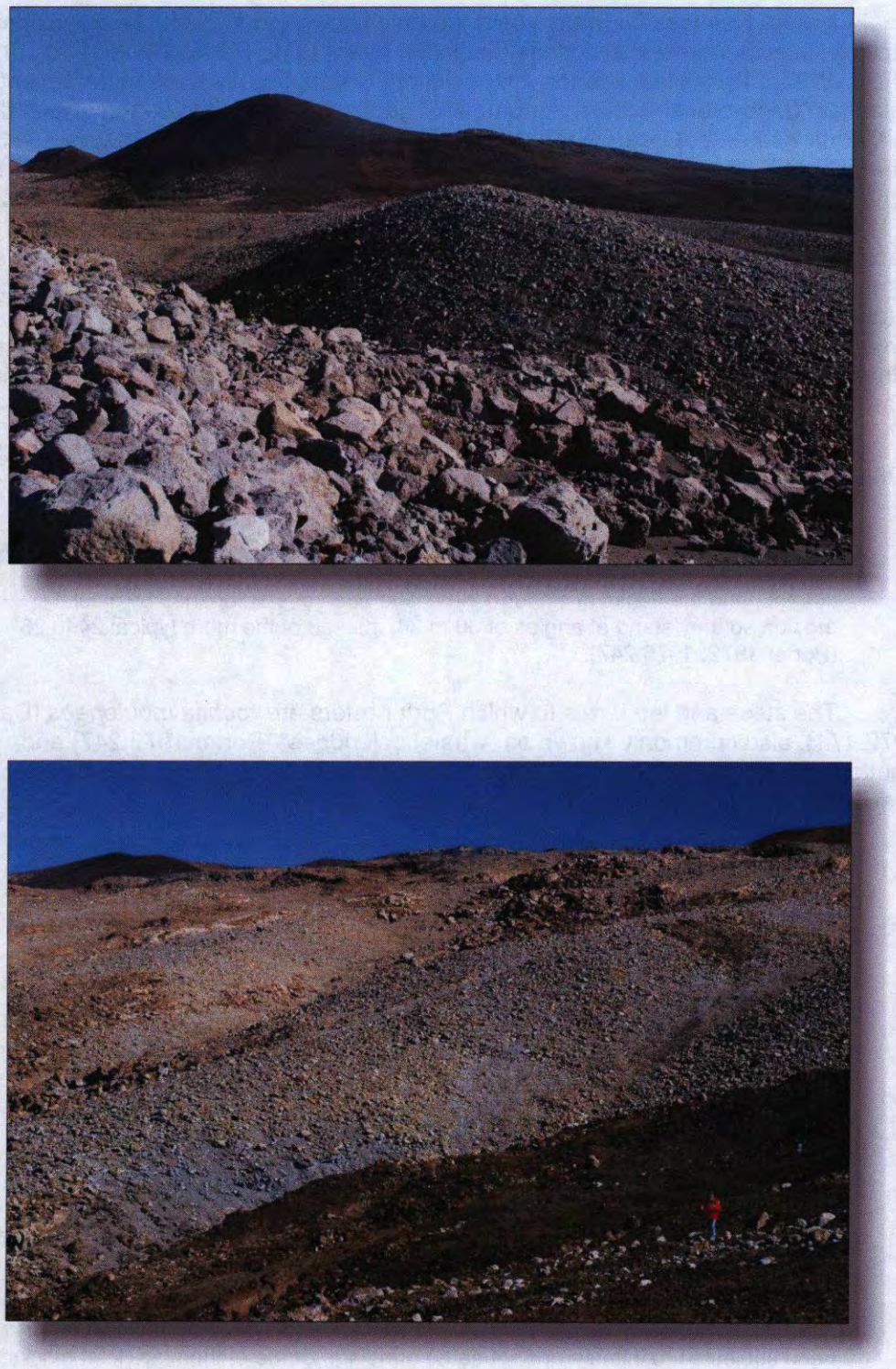

Figure 2.3. Photographs Showing Glacial Moraines.

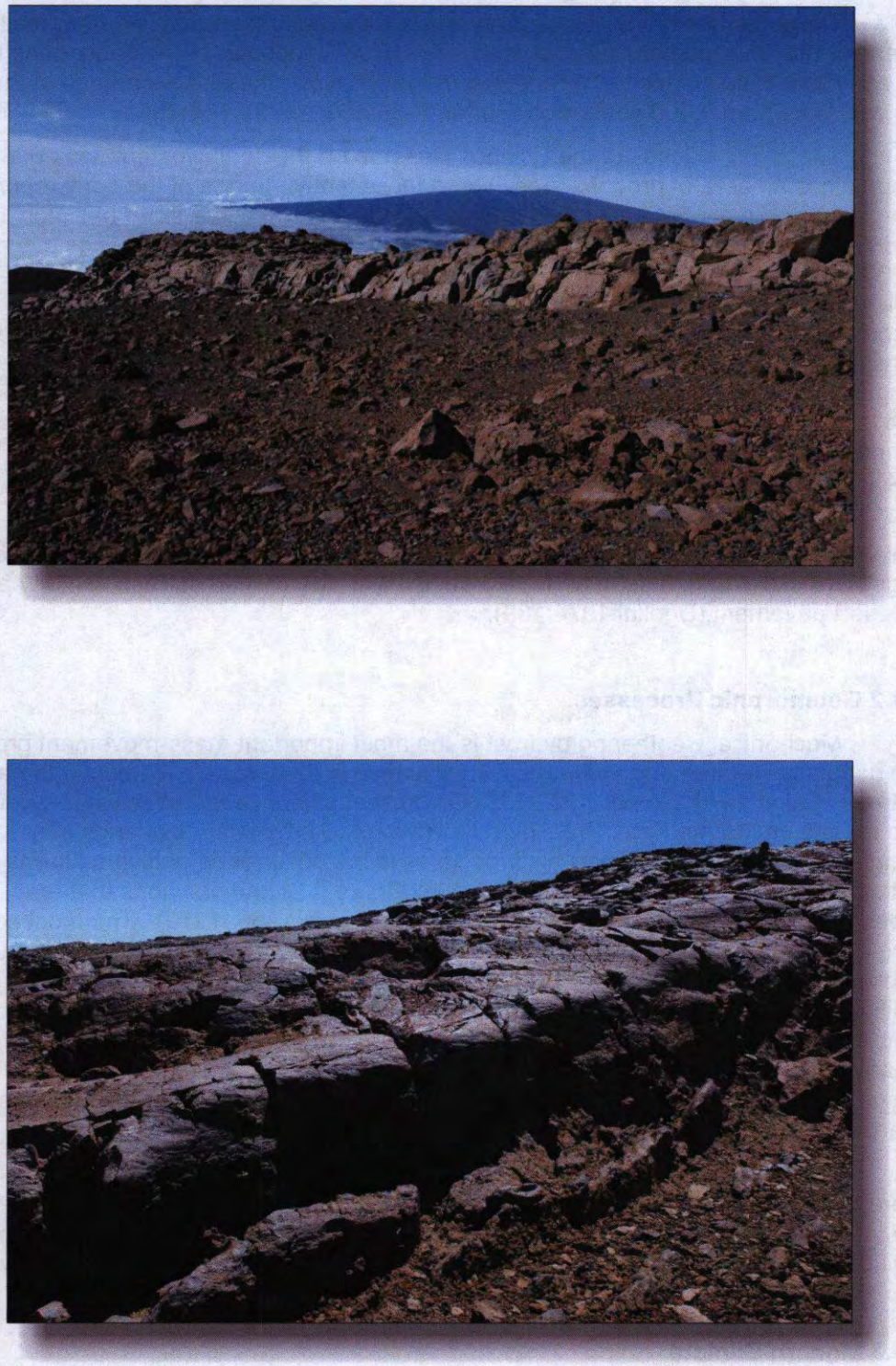

Figure 2.4. Photographs Showing Whaleback Ridges.

The presence of fossil ice [permafrost] in the summit region is further testimony to earlier glacial conditions (Woodcock et al. 1970; Woodcock 1974). According to Porter, there is no evidence for renewed glaciation since the disappearance of the last ice cap more than 9,100 years ago (Porter 1975:250; 1979b 184-185).

The lower reaches of the Science Reserve on the southwestern flank of the mountain is an area of predominantly steep topography. In one of the early reports on the glacial geology of Mauna Kea Gregory and Wentworth wrote that " between 11,000 and 7,000 feet, the general gradient is 1,600 feet, with a few small areas as steep as 2,000 feet, a mile" (Gregory and Wentworth 1937:1724). The general lack of deep radial valleys on slopes that average nearly 40 per cent in many places has been attributed to a combination of low rainfall and porous soils. Pōhakuloa and Waikahalulu, the only substantial gulches on the southwest flank of the mountain, attain a maximum depth of roughly 30 to 90 m between the 2438 and 3353 m elevations (Wentworth and Powers 1941:1198). Water is not totally lacking and in fact there are a number of springs and seeps perched in glacial drift deposits above and below treeline (Wentworth and Powers 1943).

The summit region resembles a stony alpine desert. The soils, like those in alpine environments generally, are poorly developed (Ugolini n.d.). In the absence of a vegetative cover and, thus, a surface organic layer, the ground surface in many places is a desert pavement (Ugolini 1974:189).

2.1.2 Geomorphic Processes

Mechanical weathering by frost is the most important mass-movement process in the periglacial regime and attains real significance in landscape evolution in the absence of trees (Caine 1974; Davies 1972:11). On current evidence the effective lower limit of this regime on Mauna Kea is treeline (Ugolini n.d.). The primary evidence of a periglacial climate and geomorphic processes is the occurrence of diverse forms of patterned ground, such as stone stripes (see Figure 2.2) and polygons that are widespread in the cold regions of the world (Washburn 1956, 1979). The most common type of mass-movement landform in the summit region of Mauna Kea is the stone-banked terrace or lobe (Davies 1972:49-51) which is variably called either solifluction or gelifluction terraces and lobes (Figure 2.5). Here we follow Washburn (1979) and Embleton and King (1975:97) who have noted the advantage of the term gelifluction in clearly denoting a periglacial regime as opposed to other climatic regimes, including low elevation deserts, where similar forms of patterned ground are also found (Cooke and Warren 1973:129).

While there is no evidence of renewed glaciation in the last 9,000 years or so, there is a possibility of a change to a colder and/or wetter climate having occurred during the last 1,000 years. The evidence for this change is based on Porter's interpretation of gelifluction lobe development (Porter 1975:250, 1979b:184-85).

2.1.3 Modern Climate

The climate of the higher elevations on Mauna Kea is like all mountain climates kaleidoscopic, consisting of a great number of individual elements that are continually changing through space and time. It exhibits all of the universal changes that occur in

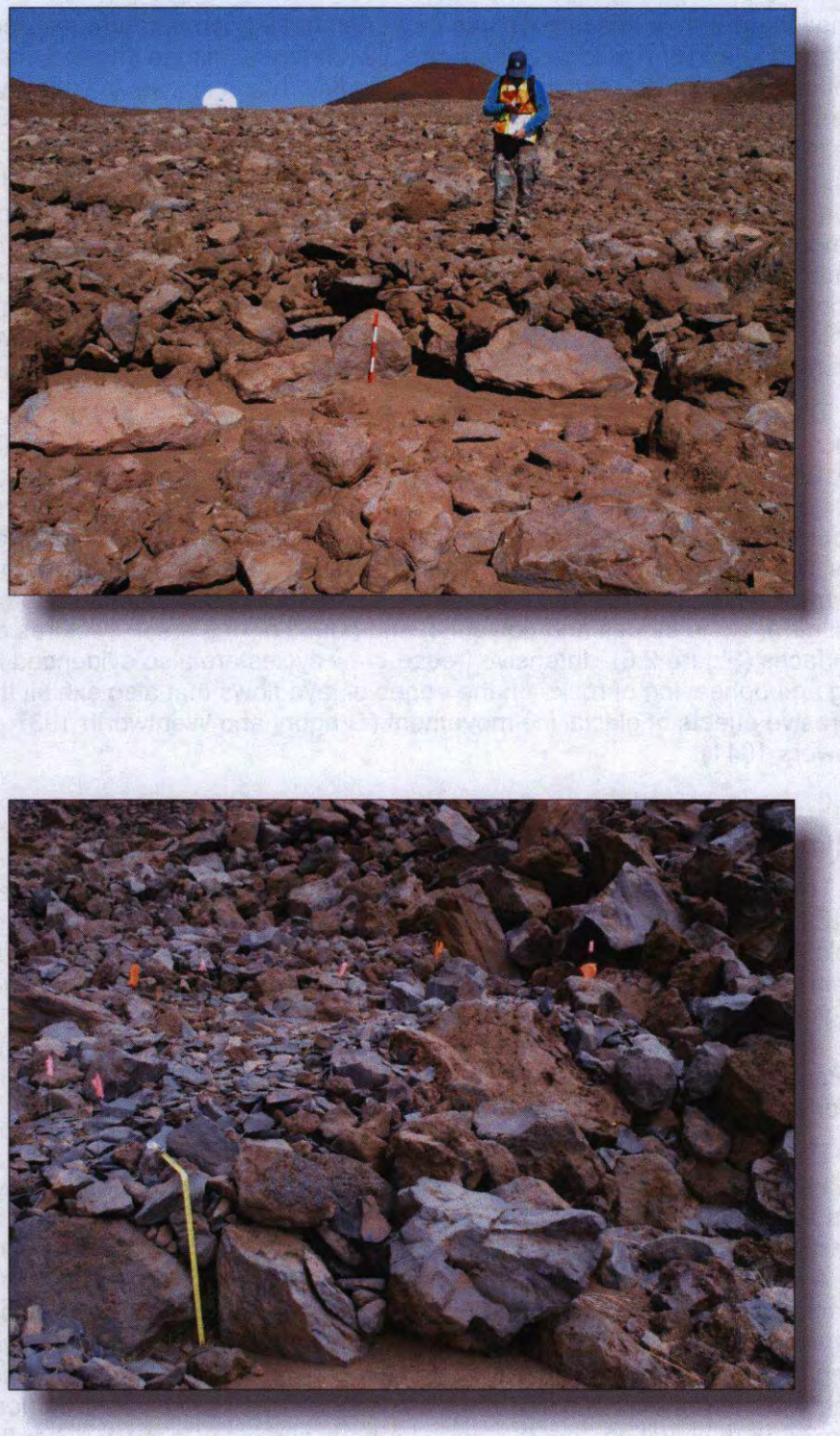

Figure 2.5. Photographs Showing Gelifluction Lobe- Terraces.

the atmosphere with increasing altitude (e.g., decreasing temperature, air density and water vapor) in addition to local effects directly related to latitude and the "mountain mass effect" (Barry 1981; Price 1981). The summit region climate is both dry and cold, but there are few available statistics for evaluating annual and cyclical variability. At this latitude (19-20 degrees N) there is little difference in the mean minimum and mean maximum temperature ranges throughout the year in contrast to pronounced diurnal variation. Precipitation at the higher elevations frequently averages less than one inch in every month of the year, primarily in the form of sleet, hail and snow, which rarely accumulates below the 3,050 m elevation, however. The prevailing winds are from the east-northeast. Fog and other forms of ground condensation are not uncommon and appear to be generally associated with increased cloudiness at midday (Powers and Wentworth 1941).

The modern climate is periglacial, a term that is inconsistently used with reference to a variety of cold climates as well as geomorphological regimes (Davies 1972:9; Embleton and King 1975:2). Mauna Kea is an example of what Tricart (1970) has called the "low latitude mountain variety" of periglacial climate. There are frequent frosts but they are of low magnitude or intensity, penetrating to only shallow depths (Davies 1972:13). As mentioned above, features attesting to a modern periglacial environment include permafrost (Woodcock 1974), gelifluction lobes and terraces (Ugolini n.d.), stone stripes and polygons, and pot-lid or ring crack fractures on smoother rock surfaces (Figure 2.6). Intensive freeze-thaw cycles are also evidenced in the splitting and upheaving of rocks on the edges of lava flows that also exhibit the plucking and abrasive effects of glacial ice movement (Gregory and Wentworth 1937; Wentworth and Powers 1941).

2.1.4 Biota

The biota is predictably impoverished in this oceanic, high mountain ecosystem as the result of extreme isolation which is reflected in a high degree of endemism among a few closely related taxa. The alpine ecosystem on Mauna Kea, as with all high mountain ecosystems, is "at the upper ends of environmental and evolutionary gradients that originate in the surrounding lowlands" (Billings 1979:101). In the summit region there is an "aeolian zone" occupied by a variety of insects (Howarth and Montgomery 1980; Papp 1981) that are believed to have been the only resident fauna in the alpine desert prior to European contact.

The vegetation above the 3,000 m elevation has been classified as a semiarid, barren alpine tundra (Krajina 1963). It consists of lichens, mosses, and a few bunch grasses such as *Trisetum glomeratum* and *Agrostis sandwichensis* (Hartt and Neal 1940; Krajina 1963; Mueller-Dombois and Krajina 1968; Smith, Hoe and O'Connor 1982). A lower xerophytic scrub zone, extending down as far as the 2,100 m elevation, is characterized by the presence of *Styphelia douglasii, Vaccinium peleanum* and *Coprosma* spp. in addition to the higher elevation species. There is some evidence, including the discovery in the course of archaeological investigations of the adze quarry in 1975-76 of the remains of a silversword colony (*Argyroxiphium sandwichensis*) at the 3,475 to 3,658 m elevation, that this zone formerly contained a much richer flora, such as the arborescent Dubautias (Allen 1981:46). Porter (1979b:178-185), in a discussion on the paleoclimatic implications of the latest ice-cap glaciation, suggests that the treeline was depressed to about the 2,000-m (6,560 ft) elevation.

Figure 2.6. Photographs Showing Stone Stripes (top) and Pot-lid Fractures (bottom).

W.D. Alexander's account of his survey trip in 1892 [see below] noted that "The upper limit of the mamane tree is not far from 10,000 feet. The Raillardia, apiipii, extends a thousand feet higher. The beautiful Silver Sword (Argyroximphium), once so abundant is nearly extinct, except in the most rugged and inaccessible localities" (Alexander 1892).

The first systematic study of the flora at Lake Waiau was made by the1935 Hawaiian Academy of Sciences Expedition. Constance Hartt and Marie Neal, the expedition botanists, described their findings in two publications:

> Near the lake a fenced area about forty paces square showed what might result by protection from wild and tame grazing animals. It enclosed approximately 800 plants, most chickweed, grasses, dandelion, and sorrel. Three tiny planted pine trees were merely existing (Neal 1939:7).

> More species of plants were found in Waiau Crater than elsewhere in the summit area, probably because that is the chief destination of pack animals and because of the moisture from melting snow. In addition to the fern and grass just named, the following plants were found near Lake Waiau upon a rocky terrain: *Stellaria media*, *Cirsium vulgatum*, *Erigeron linifolus*, *Taraxacum officinale*, *Poa annua*, and *P. pratensis* (Hartt and Neal 1940:256-257).

> A census was taken of the plants in the area enclosed by a fence (fig. 21), located in the crater of Lake Waiau. The enclosure was 46 by 43 paces. No planted trees labeled *Juniperus* or *Picea* were found alive; three living specimens of *Pinus contorta* were found, all very short (6 to 8 inches in height) (Hartt and Neal 1940: 257-258).

A fossil diatom flora has been found in the bottom sediments (Massey 1978).

2.1.5 Hydrology

Lake Waiau (Figure 2.7; see Figure 1.2), the only permanent body of water on the summit plateau and one of the few lakes in Hawai`i (Maciolek 1982), is located in a glacially scoured cinder cone named Pu`u Waiau. Two intermittent streams, Pōhakuloa Gulch and Waikahalulu Gulch, originate in the environs of the lake. The highly dissected landscape on the south leeward slope of Mauna Kea (see Figure 2.1) is due in large part to the retreat (melting) of the Waihu and ā glaciers rather than modern stream flow. The effects of the hydrological regime on the local topography and reasons for the absence of permanent streams are described by Wentworth and Powers:

> Despite the fact that that the average slope approaches 40 per cent in many places, erosion by running water has been feeble in consequence of the extremely porous character of the cinder and lava surfaces and the relatively light precipitation occurring at the higher levels. Stream channels more than 25 to 50 feet deep, or wider than small ravines, are uncommon. The deepest of these radial valleys are Pohakuloa, Waikahalulu, and Hanipoe gulches on the southwest, south, and north, respectively (Wentworth and Powers 1941:1198).

> Only one flowing stream was observed above 7,000 feet by the writers in July, 1939, namely the west branch of Pohakuloa Gulch for a short distance above the 10,000-foot level. Here a water table, very likely of the perched type, is held up by a bed of early glacial drift and gives rise to a flow of small volume where the channel is cut through overlying lavas...Nevertheless, abundant freshly scoured

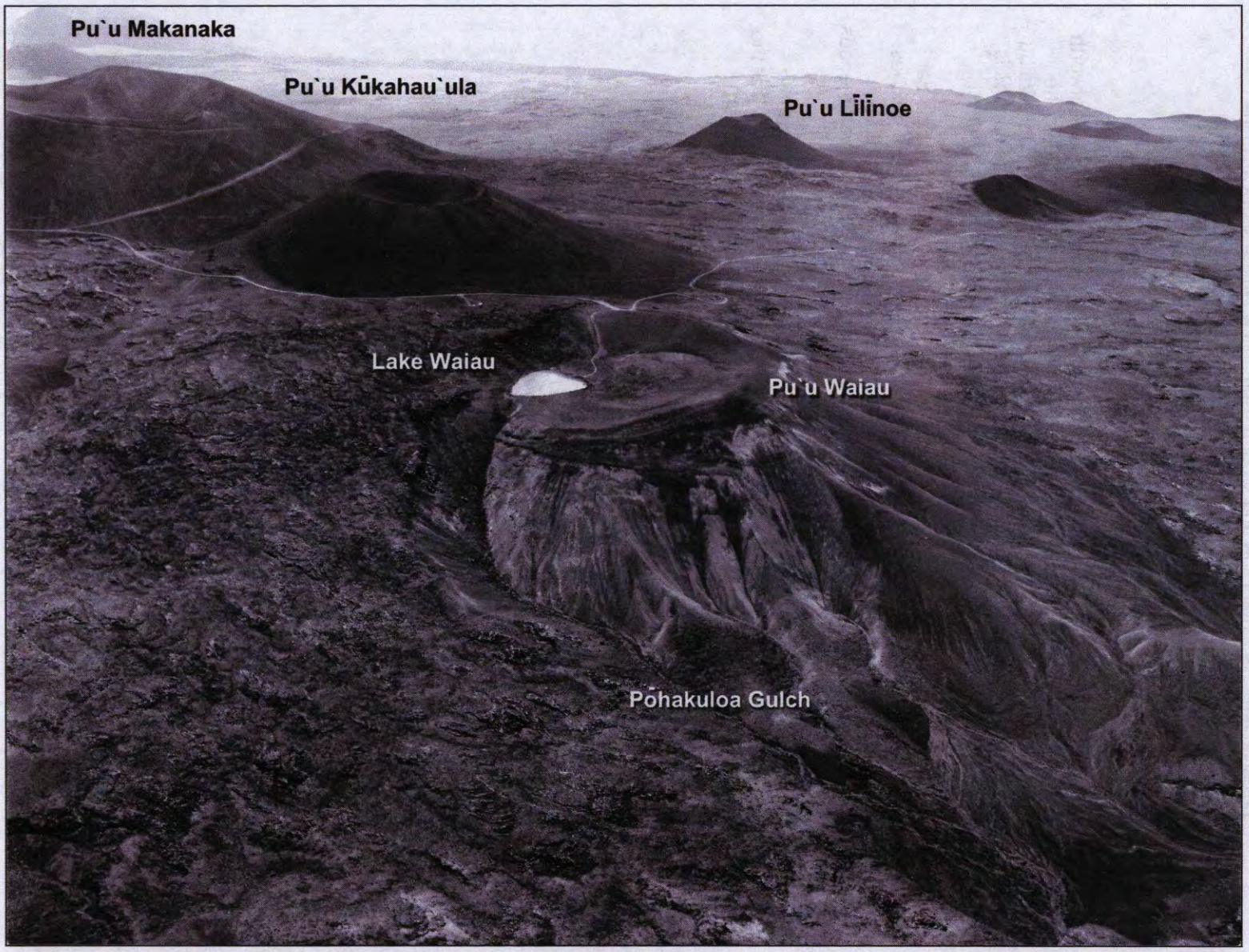

Figure 2.7. Aerial View of Lake Waiau and Surrounding landscape.

potholes and rock channels are found throughout most of the gulches (Pl. 3, Fig. 1), indicating effective stream flow and scour presumably when the snowcap of the summit area melts. The character of these channels throws light on the former glaciation of Mauna Kea. Stream scour, effective even now, must have been much greater during melting of the icecap when stream flow was able to carry boulders up to 6 feet in size far beyond the ice margin (Wentworth and Powers 1941:1198-1199).

The most detailed study of the springs and seeps was undertaken by Wentworth and Powers, in 1937 and 1939. Their research, primarily in the area they called the Waihu branch of Pōhakuloa Valley [this gulch is the one that contains Hopukani, Waihu and Liloe Springs], led them to conclude that the ground water supplying the springs is perched in and on top of permeable glacial drift deposits, some of which are buried under later lava flows (Wentworth and Powers 1943:543). Stearns (1945:274) questioned the glacial origin of the springs based on his reinterpretation of the glacial stratigraphy of Mauna Kea in the type localities in Pōhakuloa and Waikahalulu gulches. The glacial thesis appears to be correct, however, based on evidence collected by Porter regarding the origin of Lake Waiau and, thus, probably all of the freshwater lenses at higher elevations on Mauna Kea.

There are a number of different theories concerning the geologic origin of the lake. One of the first was advanced by Gregory and Wentworth who recognized that the interior of Pu`u Waiau was not an ordinary crater and that the lake may have been created by the retention of glacial ice:

> Lake Waiau lies in the bowl of Puu Waiau—a cone built chiefly of fine-grained and much-weathered cinders and ash. On its north side, the cone is breached and thus forms an outlet for the lake at high water stages. As the average depth of the lake when full of water is about 15 feet and the muck at its bottom as much as 8 feet, the floor of its basin lies 23 feet below the lowest part of its rim. In superficial view, Waiau has the appearance of an ordinary crater, but striae directed toward the basin from the northeast, morainal deposits high up on its southern slope, and scour marks on its outlet bar, show that it was occupied by glacial ice. It seems probable that ice to a depth of 100 feet or more was forced into the basin and after a temporary halt was forced to join the larger ice tongues moving down Pohakuloa Gulch. Scouring by the ice doubtless deepened the original basin, and it may be that some ice remained after the glaciers disappeared. The possibility is suggested that downward seepage of lake water is impeded not only by fine-grained ash and organic material but also by ground ice that probably forms each year (Gregory and Wentworth 1937:1736).

Stephen Porter summarized earlier interpretations and offered his own views regarding the origins of the lake:

> Gregory and Wentworth (1937) suggested that water is retained in the basin because downward percolation is impeded not only be fine-grained ash and organic matter but also by ground ice. The discovery of permafrost in the crater of Summit Cone (Woodcock, 1974) and its probable existence in Douglas Cone and Goodrich Cone (A.J. Woodcock, 1971, personal communication.) has enhanced the hypothesis that impermeable ground ice may be responsible for Lake Waiau. However, lakes are not present in the craters of cones where permafrost has been found. The crater floor of Puu Waiau lies at the top of the hyaloclastite core of the cone and probably has been somewhat deepened by ice scour, as inferred by Gregory and Wentworth (1937), whereas the crater floor of Summit Cone lies above the seismic discontinuity that may represent the upper

> limit of a hyaloclastite core. Consequently, the presence of water in the closed crater basin of Puu Waiau and its absence in the similarly closed crater of Summit Cone suggest that the relatively impermeable hyaloclastite, rather than permafrost, is the primary reason for the lake (Porter 1979c:1039).

Edward Wolfe and his colleagues, who carried out geological investigations at a later date, agree that reduced permeability explains the retention of water in the lake but that the reasons are different from what Porter had suggested:

> The ice-contact flow that originates at the base of Puu Hau Kea buried the north rim of Puu Waiau. A small lobe of this flow extended into the crater, where an isolated remnant now occurs, along with Makanaka drift, on the south side of Lake Waiau (Wolfe et al. 1997:52).

> In both cones, the alteration products weakly cemented the pryoclasts and reduced the permeability of warm water or steam through the cone during or soon after its eruption. Because of reduced permeability, such cones are more susceptible to gullying; water runs of instead of percolating downward. The reduced permeability also apparently accounts for retention of water to form a small permanent lake (Lake Waiau) within the crater of Puu Waiau (Wolfe et al. 1997:51).

Pu`u Waiau is one of the most eroded cones in the summit region (see Figure 2.7) Gregory and Wentworth (1937:1734) noted that:

> Headway cutting by the Pohakuloa stream, which at times of spring melting must carry considerable volumes of water, has reached to within about 100 feet of the margin of Lake Waiau. Blocks of basalt of many tons weight have broken off and tumbled down the steep channel side, probably to be shoved a bit farther by the stream torrent at its occasional maximum.

The depth of the lake sediments was determined in 1966 to be more than 7.5 m based on a probe using a steel rod. Two radiocarbon dates were obtained at this time from the upper 2.0 m of lake sediments from one of two cores collected in 1966 (Fan 1978:219). At 1 meter the deposit dated to 2270 +/- 500 years (Sample W-1834) and at 2.0 m, 7160 +/- 500 years (Sample W-1833) (Woodcock, Rubin and Duce 1966: 647). Radiocarbon dating of organic material from cores indicates that sediments began accumulating in the lake basin between roughly 13,000 and 14,000 years ago (Dorn et al. 1991:460).

The springs in the Pōhakuloa Gulch area are briefly mentioned in two accounts of expeditions to the summit of Mauna Kea. The first was made by W.D. Alexander who wrote "A spring on the southern side of the mountain, called `Wai Hu,' is believed by the natives to be connected to this lake" (Alexander 1892). The second reference is in an amusing story of the experiences of a Sol. N. Sheridan in an article illustrated by the well-known photographer, Alonzo Gartley:

> Afterwards, when we had had the coldest drink in these islands, from a mountain spring at an elevation of 10,500 feet that is probably seepage from the Crater Lake [Lake Waiau], Rawhide Ben [the nickname of Eben Low] and the Secretary went off to shoot wild bullocks, leaving the balance of us hanging in the air on a pinnacle just above the forest line, to which we had descended by a series of long slides (Anonymous 1911:410).

The spring referred to in this account is in all probability Hopukani which is located at the 10,400 ft elevation and is the largest of the springs in the Pōhakuloa Gulch area (see Figure 1.1).

2.1.6 The "Effective Environment" of the Alpine Zone

On current evidence the "effective environment" of the alpine zone, defined as the ecosystem that humans both adapt to and influence (Smith and Winterhalder 1981:8), has been since the end of the last ice age an alpine desert ecosystem. The biogeoclimatic characteristics common to most high-altitude environments (cf. Winterhalder and Thomas 1978:32; Billings 1979:119; Allen 1981:37), including the Mauna Kea summit region, are the following:

(1) reduced partial pressure of oxygen and carbon dioxide, low absolute vapor pressure, and high background radiation;

(2) rugged topography and poorly developed soils;

(3) low temperature with pronounced diurnal variation and frequent frosts, which can occur in any season;

(4) low and irregular monthly distribution of precipitation occurring in various forms (rain, hail, sleet and snow), periodic droughts; and

(5) extreme biotic impoverishment.

What are believed to have been the primary environmental constraints on life and work in this region and the adze quarry in particular are summarized below:

> For humans, it is a particularly difficult environment in which to work and live because of the physiological effects of high altitude (Van Wie 1974), low temperatures and biotic impoverishment (McCoy 1990:91).
>
> The quarry environment is above all else a 'non-subsistence' environment, incapable of supporting a population of any size for any length of time without the introduction of food, clothing, and firewood. The only sources of fuel above treeline are the few arborescent plants and silverswords (Westervelt 1902:15) which would have been hardly adequate or sufficient in terms of the amount of heat they give off and their long-term availability. The biotic environment is an undependable resource and in fact the only subsistence requirement that this environment afforded in any abundance were the margins of lava flows that could be utilised as shelters (McCoy 1990:91-92).

2.1.7 Geology, Climate and Vegetation of the Sub-Alpine Zone

The landscape of the lower part of the project area is entirely of volcanic origin, lying below the lower altitudinal limits of Pleistocene glaciation that is evidenced in the locally unique landforms at higher elevations described above (Porter 1979a, 1979b). The cinder cones, lava flows and airfall deposits in the lower project area, and the Hale Pohaku area in particular, are of uncertain age. On present evidence they are probably less than 40,000 years old, based on petrographic similarities to what Porter (1979a) has termed the Kemolean and Kaulan stages of volcanism. According to Wolfe et al. (1997) the landscape in the immediate environs of Hale Pohaku belongs to the Laupahoehoe Volcanics.

The most interesting of these cones is Pu'u Kalepeamoa, which Wolfe has been mapped as an older hawaiite cone (Wolfe et al. 1997). This cone contains a large number of "cored bombs" (fragments of older rocks, cf. Brady and Webb 1943; Wentworth and Macdonald 1953:83; Macdonald 1967:48; Stearns 1966:47; Macdonald and Abbott 1970:16) many of which are formed of angular mafic blocks with dunite and gabbro inclusions (Porter 1974:244). The minerals (primarily olivine, feldspar and pyroxene) in these rocks have made this a popular collecting locality for local rockhounds (Manhoff and Uyehara 1976:70) as well as geologists (Mike Garcia, personal communication; Jackson, Beeson, and Clague 1982).

There are a number of references in the geological literature to Pu'u Kalepeamoa. Wentworth (1938:63) made mention of Pu'u Kalepeamoa in a general description of the cinder cones on Mauna Kea and in another early paper there is a photo of the southwest slope of the mountain taken from Pu'u Kalepeamoa (Wentworth and Powers 1943:Fig. 1). Some years later the following account appeared: "The cones just west of Hale Pohaku, at 9,500 feet altitude on the south slope of Mauna Kea, and some cones elsewhere on the mountain, contain numerous cored bombs in which the cores are fragments of peridotite and gabbro brought up from depth." (Macdonald and Abbott 1970:302). Pu'u Kalepeamoa is noted in a popular rock collectors book (Manhoff and Uyehara 1976) and in guide books on the geology of Mauna Kea (Porter 1974; Wolfe 1987:25). In none of these publications is there any hint of the presence of archaeological remains.

Of the several other cinder cones located in the immediate environs of Hale Pohaku, perhaps the second most important to the present discussion is Pu'u Haiwahine According to Porter, "Pu'u Haiwahine tephra has been extensively reworked in the vicinity of Hale Pohaku where colluvium thickly mantles the surface and small dunelike bodies of coarse sand have accumulated near timberline" (Porter 1973:1929; Fig. 4). A shallow soil, called "Huikau extremely stony loamy sand" in a U.S.D.A. Soil Conservation Service study, covers much of the project area surface except for the southern and western portions which are classified as "cinder land" (Sato et al., 1973:Sheet 62; l4, 20).

The climate at Hale Pohaku is relatively dry and cool, with an annual mean rainfall of about 25 inches (State of Hawaii, Department of Land and Natural Resources, Division of Water and Land Development 1970:61), and a temperature range of 30° to 70° F. Mist and fog derived from moisture ladened convection clouds frequently cover the area in the afternoon. Snow is a rare occurrence at this elevation. Prevailing winds are from the northeast. There are no permanent streams on the south flank of Mauna Kea, and the nearest sources of permanent water to Hale Pohaku are springs and seeps located along Waikahalulu Gulch (Wentworth and Powers 1943).

Hale Pohaku is situated at treeline in an ecotone (a transitional zone between two overlapping vegetation communities). The two communities are a sub-alpine xerophytic scrub and a *Sophora chrysophylla* (mamane) parkland. The treeless scrub is characterized by a variety of low shrubs: *Styphelia tameiameiae* (*pukiawe*); *Geranium cuneatum* (*noho-anu*); *Vaccinium reticulatum* (*'ohelo)*; *Raillardia ciliolata* (*na'ena'e*), as well as a small fern, *Pellaea ternifolia* (*kalamoho*). In addition to the *mamane* and *noho-anu*, the parkland community contains *Chenopodium oahuense* (*'aheahea*), *Coprosma montana* (*pilo*), and a variety of native and exotic grasses and forbs (Char 1985).

Observable differences in the vegetation patterns in the study area appear to be related to the two soil substrates, with the loamy sand supporting a more dense and varied flora than the cinder land. Kjargaard noted seven species of birds in a 1985 survey, only two of them native (Kjargaard 1985).

Although the project area is situated within the Mauna Kea Forest Reserve, there was a long-standing policy that allowed large populations of feral goats and sheep. One consequence of that policy was the decimation of the native dryland forest (Warner 1960; Scowcroft 1983; Scowcroft and Giffin 1983; Scowcroft and Sakai 1983) which includes the critical habitat for the *palila* (*Loxiodes bailleui*), an endangered species of Hawaiian honeycreeper. The ecosystem of the sub-alpine forest is slowly recovering at the present time following a decision by DLNR to reduce the population of wild ungulates.

2.2 Traditional Culture-Historic Context

Much of what is known concerning the traditional culture history of the summit region of Mauna Kea was summarized by Holly McEldowney in a 1982 report, based on a review of early journal accounts and maps, ethnographic collections, and the Boundary Commission Book for Hawai'i (McEldowney 1982). More recent research by Kepa Maly (1998, 1999) and Charles Langlas (Langlas et al. 1997; Langlas 1999), both of whom have conducted oral interviews in addition to archival research, have provided additional information on the traditions associated with Mauna Kea and its cultural and spiritual significance for Hawaiians today. A major compilation of native traditions, historical accounts and oral history interviews on Mauna Kea and surrounding lands can be found in a study entitled "Mauna Kea—Ka Piko Kaulana o Ka `Aina (Mauna Kea—the Famous Summit of the Land) by Maly and Maly (2005) that was commissioned by OMKM. The overview that follows is based on these studies which should be consulted for more detailed information.

2.2.1 Socio-political Context

The summit of Mauna Kea is located in an *ahupua`a* (a territorial unit generally equated with the community) called Ka`ohe in the Hāmākua District (Figure 2.8). Ka`ohe is perhaps the classic example of the unusually large *ahupua`a* found in what Lyons referred to as the "almost worthless wastes of interior Hawaii" in the following account:

> Then there are the large ahupuaas which are wider in the open country than the others, and on entering the woods expand laterally so as to cut off the smaller ones, and extend toward the mountain till they emerge into the open interior country; not however to converge to a point at the tops of the respective mountains. Only a rare few reach those elevations, sweeping past the upper ends of all the others, and by virtue of some privilege in bird-catching, or some analogous right, taking the whole mountain to themselves...The whole main body of Mauna Kea belongs to one land from Hamakua, viz., Kaohe, to whose owners belonged the sole privilege of capturing the *ua`u*, a mountain-inhabiting but sea-fishing bird.
>
> These same lands generally had the more extended sea privileges. While the smaller ahupuaas had to content themselves with the immediate shore fishery extending out not further than a man could touch bottom with his toes, the larger

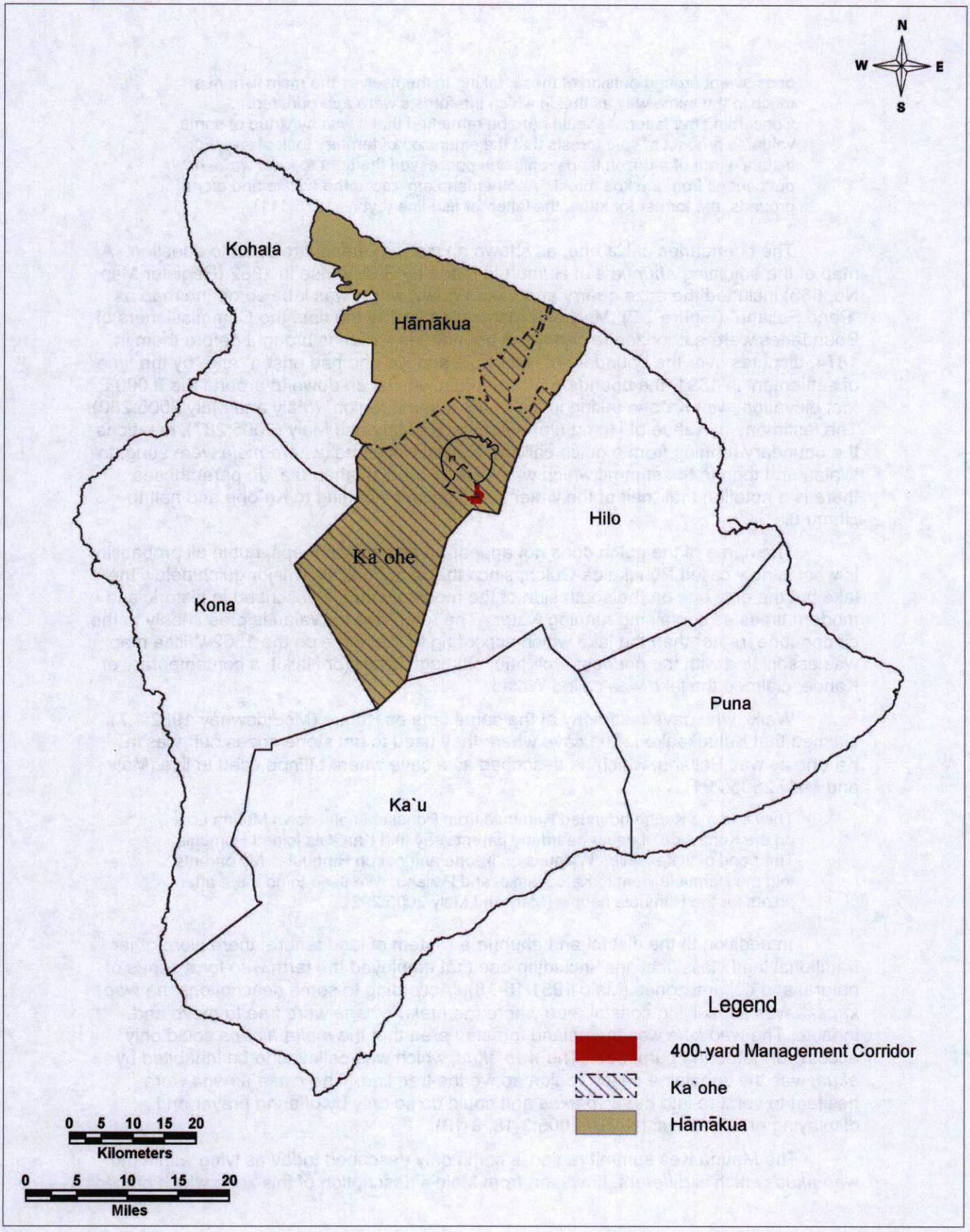

Figure 2.18. Socio-Political Map of the Island of Hawai`i Showing the Location of the Project Area in the Ka`ohe Ahupua`a, Hāmākua District.

> ones swept around outside of these, taking to themselves the main fisheries much in the same way as that in which the forests were appropriated. Concerning the latter, it should here be remarked that it was by virtue of some valuable product of said forests that the extension of territory took place. For instance, out of a dozen lands, only one possessed the right to *kalai wa`a*, hew out canoes from the koa forest. Another land embraced the *wauke* and *olona* grounds, the former for kapa, the latter for fish-line (Lyons 1875:111).

The boundaries of Ka`ohe, as shown on modern maps, are open to question. A map of the adjoining *ahupua'a* of Humu`ula made by S.C. Wiltse in 1862 (Register Map No. 668) included the adze quarry and Lake Waiau, which was labeled on the map as "Pond Poliahu" (Figure 2.9) Maly and Maly note that "By the time the Commissioners of Boundaries were authorized to certify the boundaries for lands brought before them in 1874, disputes over the boundary of Humu`ula and Ka`ohe had arisen" and "by the time of settlement in 1891, the boundary of Humu`ula was taken down to around the 9,000 foot elevation, with Ka`ohe taking in the entire summit region" (Maly and Maly 2005:280). The testimony of Kahue of Humu`ula, presented in Maly and Maly (2005:287), mentions the boundary running from a gulch called Kahawai Koikapue, where *mele* were sung, to Waiau and then to the summit which was called Pu`uokūkahau`ula. In parentheses there is a notation that "half of the water in the gulch belonging to Ka`ohe and half to Humu`ula".

The name of the gulch does not appear on any known maps, but in all probability is what is now called Pōhakuloa Gulch, since this is not only the major gulch below the lake but the only one on the south side of the mountain that is described in historic and modern times as containing running water. The reference to Waiau is presumably to the cinder cone, rather than the lake which according to the name on the 1862 Wiltse map was associated with the goddess Poli`ahu, although Waiki [or Haiki], a contemporary of Kahue, claimed the lake was called Waiau.

Waiki, who gave testimony at the same time as Kahue (McEldowney 1982:1.7), claimed that Kaluakaako`i, "the cave where they used to get stone adzes out" was in Ka`ohe as was Poliahu, which he described as a cave where Līlīnoe used to live (Maly and Maly 2005:291).

> They told me Kaohe bounded Humuula from Pohakuhanalei down Mauna Loa, on the Kona side. I never heard my parents say that Kaalaala joined Humuula. The pond of water called Waiau is on Kaohe and not on Humuula. My parents told me Humuula went to Kaluakaakoi and Poliahu. We used to go there after adzes for the Humuula people (Maly and Maly 2005:292).

In addition to the district and ahupua`a system of land tenure, there were other traditional land classifications, including one that employed the term *wao* for a series of natural and cultural zones (Malo 1951:16-18). According to some descriptions the *wao kanaka* was a low-lying coastal area where the *maka`āinana* were free to move and inhabit. The *wao kele* was the upland forested area that the *maka`āinana* could only access for gathering purposes. The *wao akua*, which was believed to be inhabited by *akua*, was the subalpine desert region above the tree line. The *maka`āinana* were hesitant to venture into the *wao akua* and could do so only by offering prayer and displaying great respect (NASA 2005:3-18, 3-19).

The Mauna Kea summit region is commonly described today as lying within the *wao akua,* which is different, however, from Malo's description of this zone which placed

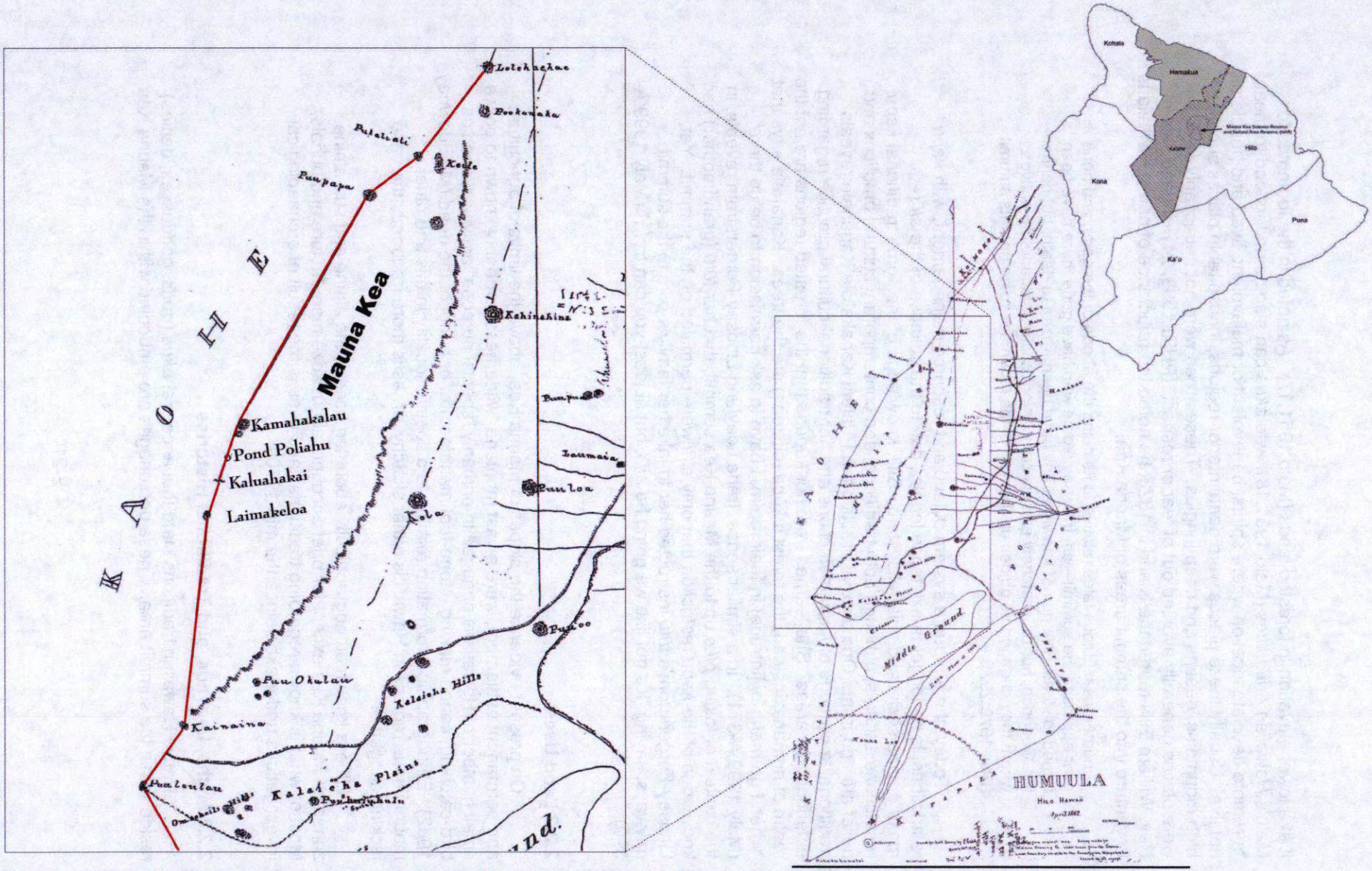

Figure 2.9. 1862 Wiltse Map Showing Boundary of Kaohe. Register Map No. 668, the Land of Humuula (S.C. Wiltse, April 1862). (Modified from Kumu Pono Associates LLC 2005:281).

it at a lower elevation in forested lands (Malo 1951:17). As noted in the footnotes to Malo's *Hawaiian Antiquities* (Malo 1951:18), *wao akua* can also be understood to mean "a remote desolate location where spirits, benevolent or malevolent, lived and people did not live. Usually these places were deep interior regions, inhospitable places such as high mountains, deserts and deep jungles. These areas were not necessarily *kapu* but were places generally avoided out of fear or respect" (PHRI 1999, 24). Indeed, when Rev. William Ellis toured the island in 1823, he noted the reluctance of native Hawaiians to venture into the summit areas of Mauna Kea.

> ...numerous fabulous tales relative to its being the abode of the gods, and none ever approach the summit---as, they say, some who have gone there have been turned to stone. We do not know that any have been frozen to death; but neither Mr. Goodrich, nor Dr. Blatchely and his companion, could persuade the natives, whom they engaged as guides up the side of the mountain, to go near its summit (Ellis 1979:292).

Today, the *ahupua`a* system of land and resource management, with *kapu* restrictions, is no longer in existence legally, due to the collapse of the *ali`i – maka`āinana* social and cultural system. Still, knowledge of the some traditional *kapu* restrictions endures, although both traditional and contemporary cultural practices and belief are apparent. One cultural practitioner, Pualani Kanaka`ole Kanahele reveals traditional knowledge of *kapu* restrictions and her traditional cultural practice regarding entering *kapu* areas. She learned from her *kūpuna* that the forested regions are not the realm of humans; instead, the forest's *kupa* (citizens) are the trees. Kanahele says that "when I go *maha`oi* [intrude] in their realm, I have to ask permission to be up there" (Maly 1999:A-371). In a similar sense, Irene Loeyland Lindsey-Fergerstrom reveals, in the context of taking *piko* up to the Mauna Kea summit, that her *tūtū* (grandmother) had knowledge of the *kapu* restriction that only *ali`i* were permitted on the summit. Yet, Lindsey-Fergerstrom's *tūtū* instructed her to take her family's *piko* to the summit anyways, saying "it's not like we going be *ali`i*, but at least you can try..." (Maly 1999:A-390).

2.2.2 Land Uses

On present evidence the slopes of Mauna Kea, above the limits of agriculture and permanent settlement, were a vast montane "wilderness" probably known to only a small number of Hawaiians engaged in primarily "special purpose" activities, such as bird-catching, canoe making, stone-tool manufacture, or burial of the dead (McEldowney 1982). Ethnographic information relating to a specific locality in this and other mountainous regions in Hawai'i is either sketchy, or, as is more frequently the case, lacking altogether.

Little is known ethnographically about the uses of the alpine and sub-alpine zones on Mauna Kea except for brief accounts about adze manufacture and burials. Most of what is known regarding traditional land uses is the result of archaeological investigations undertaken since the mid-1970s.

2.2.3 Myths, Legends, and Traditional Histories

Native Hawaiian traditions state that ancestral *akua* (gods, goddesses, deities) reside within the summit area. These personages are embodied within the Mauna Kea

landscape – they are believed to be physically manifested in earthly form as various *pu`u* and as the waters of Waiau. Because these *akua* are connected to the Mauna Kea landscape in Hawaiian genealogies, and because elders and *akua* are revered and looked to for spiritual guidance in Hawaiian culture, Mauna Kea is considered a sacred place.

Native Hawaiian genealogical *mele* (poems, chants) explain the centrality of Mauna Kea within Hawaiian genealogy and cultural geography. *Mele* recount that as a result of the union of Papa and Wākea, who are considered the ancestors of Native Hawaiians, the island of Hawai`i was birthed. In the *Mele a Paku`i*, a chant describing the formation of the earth, Mauna Kea is likened as the first-born of the island children of Papa and Wākea, who also gave rise to Hāloa, the first man from whom all Hawaiians are descended (Kamakau 1991:126 in Maly and Maly 2005:7-8). A *mele hānau* (birth chant) for Kamehameha III, who was born in 1814, describes the origins of Mauna Kea:

> *Born of Kea was the mountain,*
> *The mountain of Kea budded forth.*
> *Wākea was the husband, Papa*
> *Walinu`u was the wife,*
> *Born was Ho`ohoku, a daughter,*
> *Born was Hāloa, a chief,*
> *Born was the mountain, a mountain-son of Kea*
> (Pukui and Korn 1973:13-28 in Maly and Maly 2005:9).

Some contemporary Native Hawaiian cultural practitioners continue to view Mauna Kea as a first-born child of Papa and Wākea, and thus, the mountain is revered as "the *hiapo*, the respected older sibling of all Native Hawaiians" (Kanahele and Kanahele 1997 in Langlas 1999:7). Cultural practitioner Kealoha Piscotta explains that this link to Papa and Wākea "is the connection to our ancestral ties of creation" (Orr 2004:61). Pualani Kanaka`ole Kanahele states that "the very fact that it is the 'Mauna a Wākea' tells you that it is the *mauna* that is meeting Wākea" (Maly 1999:A-368).

Traditional genealogical *mele* (poems, chants) and *mo`olelo* (stories, traditions) recount associations between Mauna Kea and the following *akua* – Poli`ahu, Līlīnoe, Waiau, and Kahoupakane. In a *mo`olelo* recounting the travels of Pūpū-kani-`oe, it was said that Mauna Kea was a mountain "on which dwell the women who wear the *kapa hau* (snow garments)" (Maly and Maly 2005:31). Yet another *mo`olelo*, which dates to the 1300s, explains that Ka-Miki was sent atop Mauna Kea's summit to the royal compound of Poli`ahu, Līlīnoe, and their ward, Ka-piko-o-Waiau, to fetch water for use in an *`ai-lolo* ceremony (Maly and Maly 2005:42-43).

In the post-Contact period, Native Hawaiian historian S.N. Haleole transcribed *Ka Mo`olelo o Laiekawai* in 1844, which tells that after Poli`ahu broke her engagement to Aiwohikupua, she took up residence on Mauna Kea along with her three maidens Līlīnoe, Waiaie (Waiau), and Kahoupakane (Maly and Maly 2005:20-26). As well, other 19th century ethnographers published on the associations between Mauna Kea and Poli`ahu, Līlīnoe, and Waiau. W.D. Westervelt claimed that Poli`ahu, Līlīnoe, and Waiau were snow goddesses "who embodied the mythical ideas of spirits carrying on eternal warfare between heat and cold, fire and frost, burning lava and stony ice" (Westervelt 1963:55-56). Westervelt also credits Poli`ahu as the rival of the fire-goddess, Pele, said that she battled Pele on numerous occasions, and credits her with having "kept the upper part of the mountain desolate under her mantle of snow and ice" (Westervelt 1963:62).

In 1931, Emma Ahu`ena Taylor, a historian of Hawaiian descent and with genealogical ties to the lands of Waimea and Mauna Kea, reported on Poli`ahu's residence at Mauna Kea, but also described the creation of Lake Wai`au. She wrote:

> Poliahu, the snow-goddess of Mauna-kea, was reared and lived like the daughter of an ancient chief of Hawaii. She was restricted to the mountain Mauna-kea by her godfather Kane. She had a nurse Lihau who never left her for a moment. Kane created a silvery swimming pool for his daughter at the top of Mauna-kea. The pool was named Wai-au. The father placed a supernatural guard [Mo`o-i-nanea] at that swimming pool so that Poliahu could play at leisure without danger of being seen by a man… (Maly and Maly 2005:53).

According to Taylor, on Mauna Kea, Poli`ahu's attendants – Līlīnoe, Lihau, and Kipu`upu`u drove away her suitor, Kūkahau`ula (the pink-tinted snow god). But Mo`o-i-nanea allowed the snow god to embrace Poli`ahu, and to this day, Taylor reports, "Ku-kahau-ula, the pink snow god, and Poli`ahu of the snow white bosom, may be seen embracing on Mauna-kea" (Maly and Maly 2005:53).

In modern-day accounts, Poli`ahu continues to be commonly referred to as "the beautiful snow goddess of Mauna Kea" while Līlīnoe is called "a goddess of the mists and younger sister of the more famous Poliahu" (Pukui and Elbert 1971:392, 396). Langlas reports that Pualani Kanaka`ole Kanahele told him that three *pu`u*—Poli`ahu, Līlīnoe, and Wai`au, were sister goddesses who are female forms of water and that all three of the cinder cones or *pu`u* that bear their names are important religious sites (Langlas 1999). McEldowney (1982:1.3-1.4) recounts that Fornander included Līlīnoe as a person in his genealogies and legends, including a reference to her as the "wife of Nu`u", the "Noah", of the discredited Hawai`i Loa legend involving a great flood. McEldowney (1982:1.4) noted that Kamakau called Līlīnoe "the woman of the mountains" and named her as ancestress of Pae, a *kahuna* of Umi's time (Kamakau 1961:215).

There are several myths concerning Poli'ahu and Līlīnoe. W.D. Westervelt claimed that Poli`ahu was one of four snow goddesses "who embodied the mythical ideas of spirits carrying on eternal warfare between heat and cold, fire and frost, burning lava and stony ice" and who, according to several legends, was the rival of the fire-goddess, Pele (Westervelt 1963:55). Poli`ahu, who battled Pele on numerous occasions, is credited by Westervelt as having "kept the upper part of the mountain desolate under her mantle of snow and ice… (Westervelt 1963:62). Poli`ahu continues to be commonly referred to as the "The beautiful snow goddess of Mauna Kea" (Pukui and Elbert 1971:396). Kealoha Piscotta also retains knowledge that Mo`o Ina`ne`a was the guardian for Poli`ahu and Līlīnoe (Orr 2004:51).

Today, in regards to Lake Waiau, cultural practitioner Pualani Kanaka`ole Kanahele believes that because the waters of Waiau have not "had a chance to come down to the rest of us, then it is sacred water…that water, Waiau, is the most sacred because it isn't the water that has been spilled, it is still up there in the realm of Wākea" and in her estimation, "water is the source of life" (Maly 1999:A-368, A-370). Kealoha Piscotta believes the cultural significance of Lake Waiau rests in several facts - the Kūmulipo creation chant describes a lake that resides in the heavens, the ancient trails meet at the lake, the lake is a navigational gourd, and it is a jumping off point for ancient Hawaiian souls (Orr 2004:44-45).

While there are a number of myths and legends associated with the summit area of Mauna Kea, the higher elevation areas of the mountain do not figure prominently in Hawaiian traditional histories, which McEldowney points out:

> ...revolve mainly around the lives and exploits of prominent chiefs, as passed down through genealogies, chants, and stories, and recorded primarily in works by Fornander an Kamakau (Barrere 1962:62-63). No major events from these histories occur within the summit plateau of Mauna Kea (McEldowney 1982:1.4).

The origins of Mauna Kea and its central place in Hawaiian genealogy and cultural geography are told in myths and chants. Pualani Kanaka`ole Kanahele and her deceased husband, Edward Kanahele, who were interviewed by Dr. Charles Langlas for the Hawaii Defense Access Road and Saddle Road Improvement Project in 1998, referred to two chants, Mele a Paku`i and `O Hānau ka Mauna a Wakea. These chants:

> describe, respectively, the birth of Hawai`i island from the union of Papa and Wakea, the ancestors of Native Hawaiians, and the birth and "budding upward" of Mauna Kea a mountain named for Wakea. As the firstborn of Papa and Wakea, Hawai`i island is the hiapo, the respected older sibling of all Native Hawaiians. The mountain of Mauna Kea is the piko or origin point for the island, more specifically for its northern half, and therefore is a place of great mana. Because of the mana of the mountain and of Lake Wai`au at its summit, Queen Emma went there to bathe in the water in 1874 (Langlas 1999:7).

The second goddess of Mauna Kea is Līlīnoe, who according to Pukui and Elbert (1971:392) was "a goddess of the mists and younger sister of the more famous Poliahu." Westervelt claimed that Līlīnoe was another of the four snow goddesses. McEldowney (1982:1.3-1.4) recounts that Fornander included Līlīnoe as a person in his genealogies and legends, including a reference to her as the "wife of Nu`u, the "Noah", of the discredited Hawai`i Loa legend involving a great flood. McEldowney (1982:1.4) noted that "Kamakau called Lilinoe "the woman of the mountains" and named her as ancestress of Pae, a *kahuna* of Umi's time" (Kamakau 1961:215).

Waiau is also mentioned as a goddess in several legends. Westervelt wrote that she was another of the snow-goddesses or maidens, as he sometimes referred to them (Westervelt 1963:56). Langlas reports that Pua Kanahele told him that three *pu`u*—Poli`ahu, Līlīnoe, and Wai`au, were sister goddesses who are female forms of water and that all three of the cinder cones or *pu`u* that bear their names are important religious sites.

While there are a number of myths and legends associated with the summit area of Mauna Kea, the higher elevation areas of the mountain do not figure prominently in Hawaiian traditional histories, which McEldowney points out:

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2.2.4 Mortuary Practices

There are numerous references to human burials on the high elevation northern and eastern slopes of Mauna Kea (see discussion in McEldowney 1982). The practice of burying the dead in remote, high elevation areas may have been a common practice, based on the information collected by Thomas Thrum for Haleakalā on Maui:

> The use of the craters within Haleakala as burial places, far removed from places of habitation, is quite in keeping with ancient Hawaiian practice. Distances and difficulties were no bar to faithful execution in carrying out the instruction of a dying relative or friend (Thrum 1921:258).

One reason, but undoubtedly not the only one, for taking the dead to remote areas was the fear that the bones might be used to make fishhooks. A person named Nainoa gave such an explanation in testimony before the Boundary Commission:

> In old times, if anyone died, could not wail, but people come and steal shin bones for fishhooks, so used to carry body secretly and bury in mountains (quoted in McEldowney 1982:1.9).

There are a couple of early accounts of burials having been found in the general vicinity of Pu`u Līlīnoe. E.D. Preston's account of his work at Lake Waiau, in 1892, noted that "At an elevation of nearly 13,000 feet, near Līlīnoe, a burying ground was found, where the ancient chiefs were laid to rest in the red volcanic sand" (Preston 1895:601). W.D. Alexander's surveying party saw what they interpreted as graves on the top of Pu`u Līlīnoe, also in 1892:

> The same afternoon [July 25, 1892] the surveyors occupied the summit of Lilinoe, a high rocky crater, a mile southeast of the central hills [the 'summit'] and a little over 13,000 feet in elevation. Here, as at other places on the plateau, ancient graves are to be found. In olden times, it was a common practice of the natives in the surrounding region to carry up the bones of their deceased relatives to the summit plateau for burial (Alexander 1892).

Kamakau indicated that Queen Ka`ahumanu, who like Fornander also considered Līlīnoe a person, made an unsuccessful attempt to recover her bones on Mauna Kea in 1828 (McEldowney 1982:1.4). Kamakau added that the body of Līlīnoe "was said to have lain for more than a thousand years in a well-preserved condition, not even the hair having fallen out" (Kamakau 1961:285). Kamakau's description of Līlīnoe's body is probably the source of modern stories about a mummified body having been found on Mauna Kea and removed to some unknown location.

Of the many locations with confirmed and possible burial sites, Pu`u Mākanaka is perhaps the best known. The 1925-26 USGS survey team found human remains on the summit of Pu`u Mākanaka:

> To set up Camp Four at 12,400 feet near Puu Makanaka, we had difficulty finding a small flat area for the tents. Makanaka is the largest and most perfectly formed cone in the summit area, 1,500 feet in diameter at the rim and 300 feet deep, while the base is more than 600 feet below the rim at one point. On the rim I found a partially uncovered grave, eroded by high winds, with an incomplete human skeleton. This was unknown, as far as I could discover, to anyone familiar with the area. The name Puu Makanaka means "Hill crowded with many people" and the grave must have been ancient (Kilmartin 1974:15).

Ed Stevens maintains that "oral history and traditions tell us that...the bones of very special personages were placed in the *pu`u* at or near the summit for safekeeping... they were the special ones" (Maly 1999:C-10, 13). Daniel Kaniho Sr. suggests that "they were all *ali`i*...they were kind of high-ranking people" (Maly 1999:A-169).

2.2.5 Trails and Trail Markers

Not surprisingly, perhaps, scant information exists about ancient trails in the summit area of Mauna Kea. A *mo`olelo* associated with chief Pili-a-Ka`aiaea, and thus dating from the 1300s, recounts the journey of two brothers, Ka-Miki and Maka-iole, who traveled around the island using ancient *ala hele* (trails). Sent up to the Mauna Kea summit, Ka-Miki was guided by the following traveling *mele:*

The path goes to the uplands
The path goes to the lowlands
It is a lonely path to the mountain
A damp dreary path
A fire will be the wrap
Warming you along the sacred trail…
(Maly and Maly 2005:42)

Kamakau wrote of a battle that ensued between `Umi-a-Liloa and the chief of Hilo in the 1500s, wherein `Umi-a-Liloa and his warriors traveled from Waipi`o to Hilo via Mauna Kea. Kamakau states that "it was shorter to go by way of the mountain to the trail of Poli`ahu and Poli`ahu's spring at the top of Mauna Kea, and then down toward Hilo. It was an ancient trail used by those of Hāmākua, Kohala, and Waimea to go to Hilo" (Kamakau 1961:16 in Maly and Maly 2005:453). Maly and Maly (2005:454) contend that ancient trail systems across all the mountain lands afforded travel to burial sites and facilitated travel for the collection of resources like adze stone, canoe *koa*, and bird feathers.

The ancient trails were essentially footpaths, which, by the 1840s, proved inadequate for travel with the newly-imported horses, wagons, and wagon team animals associated with cattle ranching and bullock-hunting activities; hence, formal wagon road developments, funded by the Hawaiian Kingdom, ensued in the lowland mountain slope regions (Maly and Maly 2005:454). However, the mountain's summit region remained accessible only by trails, on foot or horseback. The difficulty of travel on the terrain by horse and on foot is well documented in historical accounts by European visitors and surveying expedition field notes. Formalized road developments continued in the lowlands into the early 20th century, with the CCC (Civilian Conservation Corps) and the U.S. Army Corps of Engineers improving existing roads, such as the Saddle Road, to accommodate vehicular traffic (Maly and Maly 2005:482).

There are two major named trails in the summit region of Mauna Kea, the Mauna Kea-Humu`ula Trail and the Mauna Kea-Umikoa Trail. The better known of the two, is the Humu`ula Trail which apparently began in the Kalaieha area where the Humu`ula Sheep Station is located. The earliest map showing the upper part of the trail was made by W.D. Alexander's survey party in 1892 (Alexander 1892; Preston 1895). The Alexander map and the 1930 edition of the USGS Mauna Kea Quadrangle map show the trail going around the eastern flank of Pu`u Keonehehee and onward up the mountain to Lake Waiau. This alignment closely follows the modern road (Figure 2.10).

An account of the Alexander survey, published in the *Pacific Commercial Advertiser* on September 14, 1892, indicated that the Humu`ula Trail did not pass through the adze quarry and that the site marked on later maps as Keanakāko`i was in fact some 100 yards west of the trail:

> The trail next turned to the east, winding around an immense sand crater called "Keonehehee," 11,500 feet in elevation, which stands on the edge of the summit plateau. Further to the southeast we were shown a pillar of stones which was

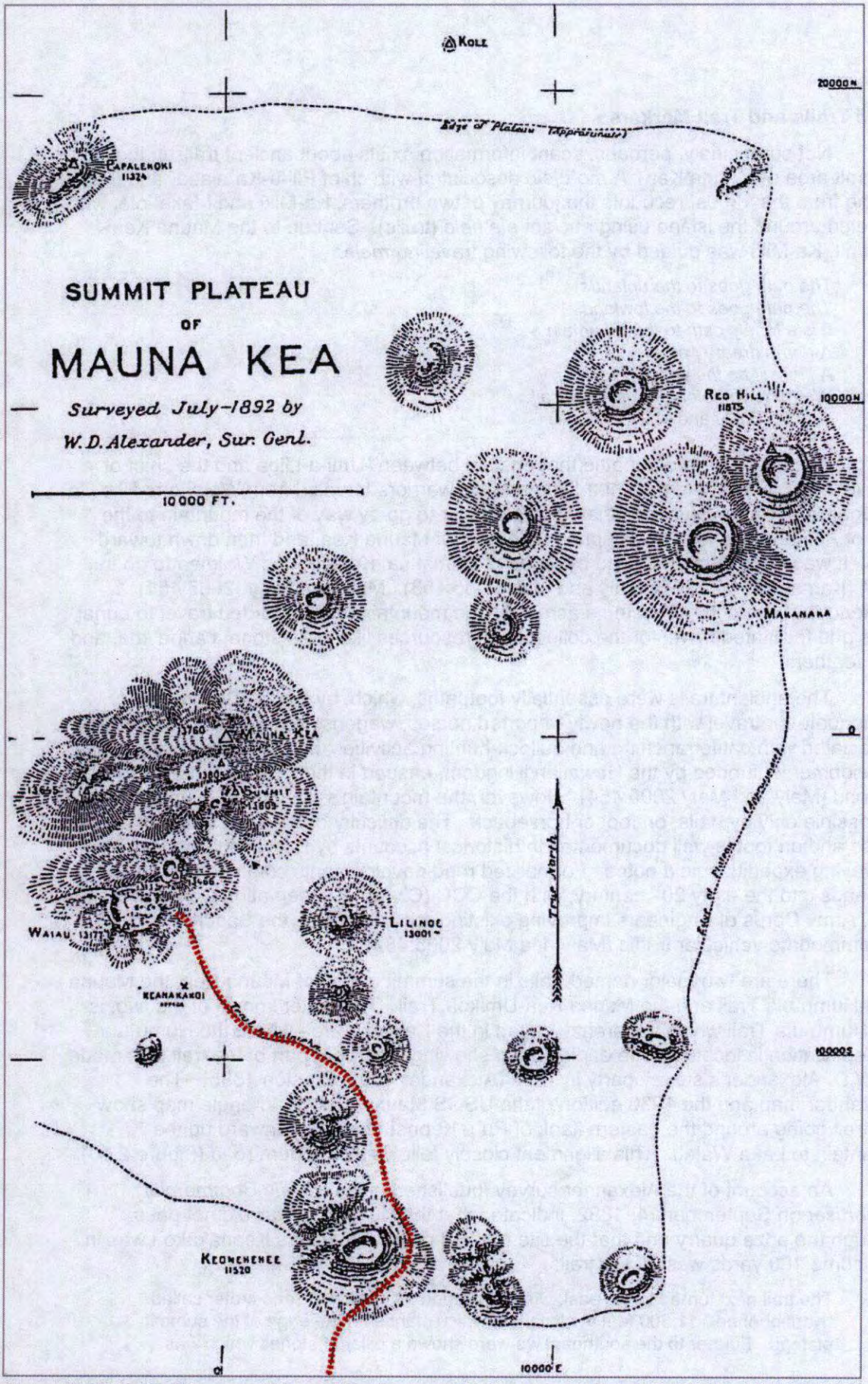


Figure 2.10.1892 Alexander Map of the Summit Plateau and Alignment of the Humu`ula Trail.

raised to commemorate Queen Emma's journey over the mountain to Waimea in 1883 [1882] (Maly and Maly 2005:183).

The Alexander map of the summit plateau published in Preston (1895:602, Illustration 34) also shows the trail, which is labeled Trail to Kalaieha, cutting across the south and eastern slope of Keonehehe`e. This indicates that the Queen Emma memorial was southeast of the trail, contrary to Maly's interpretation (Maly and Maly 2005:Figures 8b and 8c) that it is located on the rim of Pu`u Ko`oko`olau, which is in the adze quarry and the middle, rather than edge of the summit plateau (see Figure 2.10). Preston mentions that there was more than one cairn:

> Some interesting pyramids of stones, built to commemorate Queen Emma's visit, were seen on the edge of the plateau, and at elevation of 12,000 feet was found Keanakakoi, a famous quarry opened by the natives many centuries ago for the manufacture of battle axes (Preston 1895:601).

The 1928 Walter E. Wall map of the Island of Hawai`i shows both the Humu`ula and Umikoa trails, neither of which are labeled as such, however. The map shows two other unnamed trails in the summit area. One leads to Pu`u Poliahu from a junction with the old Waimea Road that passed through the area between Mauna Kea and Mauna Loa that is commonly referred to as the "Saddle." The second trail, which is joined to the Pu`u O`o Trail on the eastern side of the mountain, is a straight line path that crosses over the Umikoa Trail and ending at the summit (Figure 2.11).

The 1930 USGS Mauna Kea quadrangle map (Figure 2.12) shows the Humu`ula Trail joining a second trail just below the lake. This trail, which is not named, is labeled on the later USGS maps as the Umikoa Trail. This trail is not mentioned in any early accounts, however. While it may very well have been an ancient trail, the name would appear to be modern and most likely derived from the Umikoa Ranch, where some of the horseback trips to the summit area in the early part of the 20th century and possibly earlier began. The unpublished manuscript of the 1935 Hawaiian Academy of Sciences Expedition noted that "In recent years a few people have visited the summit in small parties on horseback, with a guide from Umikoa or Humuula" (Wentworth et al. n.d.:1-2).

A new section of the Humu`ula trail was built by the CCC in the 1930s that took a straighter course to the west of Pu`u Keonehehe`e (see Figure 2.12). The new trail was described by L. Bryan in a 1939 article in *Paradise of the Pacific*:

> During the past few years this lake has been visited by increasingly large numbers of visitors. Three years ago the Civilian Conservation Corp reconstructed an old trail from near the Humuula Sheep Station (Kalaieha), past Hookomo and Halepohaku to Lake Waiau and thence to the summit. This trail is well made and carefully marked on the ground with Ahus or piles of stones and the trip to the lake and on to the summit can easily be made by strangers without the assistance of a guide (Maly and Maly 2005:257).

The Umikoa Trail, which is labeled the Mauna Kea-Umikoa Trail on some maps, first appears as a named trail on the advance sheet of the Lake Waiau Quadrangle that was based on the mapping by J.O. Kilmartin in 1925-26. This trail, and the Mauna Kea-Humu`ula Trail are shown as terminating at Lake Waiau on the Kilmartin map. The absence of the Umikoa Trail on the 1892 map may be significant.

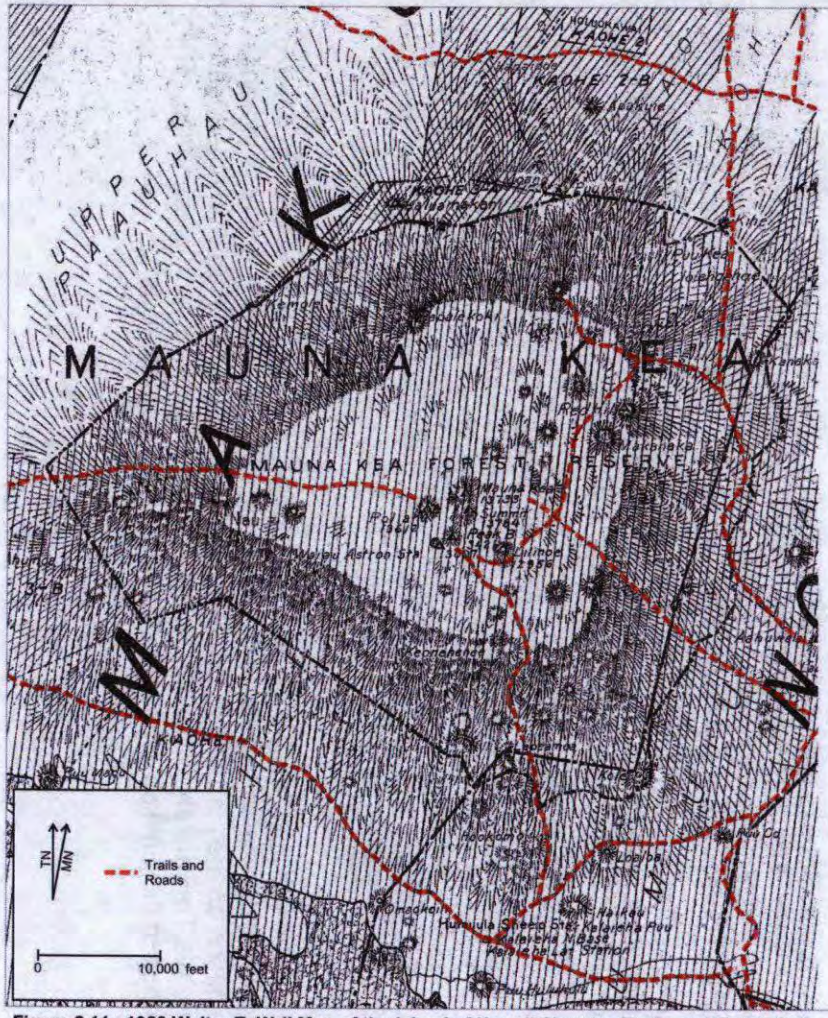


Figure 2.11. 1928 Walter E. Wall Map of the Island of Hawaii Showing Trails and Roads in the Summit Area and Lower Elevations.

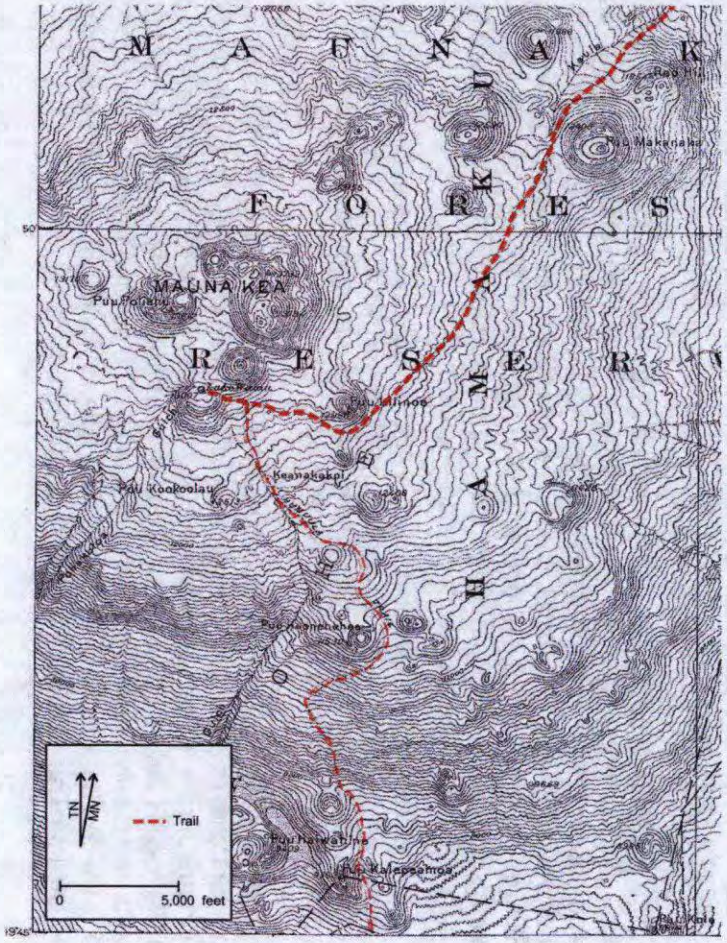


Figure 2.12. 1930 U.S.G.S. Mauna Kea Quadrangle Map Showing Trails in the Summit Area and Lower Elevations.

McEldowney came to the conclusion that the Humu`ula and Umikoa trails are probably more recent:

> After comparing the evidence for trails on historic maps, in descriptions of routes taken throughout the historic period, and in native boundary testimonies, it appears that the major trails or formalized routes as shown on the present U.S.G.S. Quadrangle are of recent origin, and that any specific trails or routes existing in the early historic or possibly prehistoric periods are not discernible in the literature (McEldowney 1982:1.12).

McEldowney (1982:A-9) found references to "commemorative and religious features as well as boundary and trail markers" in the Boundary Commission Book for Humu`ula (Vol. B), as well as mention of "formalized resting places (*o`io`ina*), areas "where *mele* were sung," and localities where propitiation would be made to various gods or spirits to insure safe passage or completion of a task" (McEldowney 1982:A-9). None of the accounts applied specifically to the higher elevation lands on Mauna Kea, however.

2.2.6 Place Names

The place names in the summit region are a mix of traditional names and modern names (see discussion in McEldowney 1982 and Tables 1.1 and 1.2 from her report). The origin and meaning of some names is unknown. The name Mauna Kea itself is open to various interpretations. The commonly accepted, literal translation as "White Mountain" appears in this early account by the Rev. William Ellis who toured the island of Hawai`i in 1823:

> The snow on the summit of the mountain, in all probability, induced the natives to call it Mauna-Kea, (mountain white), or, as we should say, white mountain. They have numerous fabulous tales relative to its being the abode of the gods, and none ever approach the summit---as, they say, some who have gone there have been turned to stone. We do not know that any have been frozen to death; but neither Mr. Goodrich, nor Dr. Blatchely and his companion, could persuade the natives, whom they engaged as guides up the side of the mountain, to go near its summit (Ellis 1979:292).

As already noted, the reference to Mauna Kea as the abode of the gods is emphasized in some native Hawaiian traditions in which the word "Kea" is taken to be an abbreviated form of Wakea, the male god who procreated with Papa to form the mountain. In an account of Queen Emma's trip to the lake in 1881 or 1882 and the *mele* that were written about that trip, Kihei and Mapuana de Silva present some more detail about the names of the mountain and the lake. They note, following Puakea Nogelmeier, that Emma's poets refer to the summit as Piko o Wakea and that:

> Although Maunakea is popularly translated as "white mountain," Kea is also an abbreviated form of Wakea, the sky father who, with Papa, the earth mother, stands at the apex of Hawaiian genealogy. Mauna Wakea is thus viewed traditionally as the sacred meeting point of sky and earth, father and mother, Wakea and Papa. Emma's poets were well-acquainted with the older name and its lasting significance; they refer to Waiau as "ka piko on Wakea"—as the mountain's navel/genital/umbilical/connecting-point/center (de Silva and de Silva 2007: footnote 7).

The name for the summit, which unlike many mountain summits does not consist of a single peak, is now widely accepted as Kūkahau`ula ("Kūkahau`ula of the red-hewed dew or snow") instead of the formerly used name Pu`u Wekiu. On present evidence the name Kūkahau`ula referred to both a legendary figure and to a character in traditional histories and genealogies. The latter includes references to Kūkahau`ula as the husband of Līlīnoe and as an *`aumakua* (family deity) of fishermen (Hibbard 1999). The place name evidence indicates that the "summit" was at the very least a legendary place or *wahi pana* (Pukui and Elbert 1971). Maly and Maly (2005:vi) give the name as Pu`u o Kūkahau`ula, which they say was "named for a form of the god Kū, where the *piko* of new-born children were taken to insure long life and safety. This practice is still participated in at the present time." According to Maly and Maly (2005:vi):

> The name Pu`u of Kukahau`ula is the traditional name of the summit cluster of cones on Mauna Kea, appearing in native accounts and cartographic resources until c. 1932. The recent names, Pu`u Wekiu, Pu`u Hau`oki and Pu`u Haukea, have, unfortunately, been used since the 1960s (since the development of astronomy on Mauna Kea), and have displaced the significant spiritual and cultural values and sense of place associated with the traditional name, Pu`u o Kukahau`ula.

The names Kūkahau`ula and Līlīnoe are both attributed to cinder cones in the summit region: Kūkahau`ula to the summit and Līlīnoe to a cone immediately to the southeast of the summit cluster. These names, along with that of Waiau, appear on the earliest reliable maps in 1884 and are repeated in the next survey of the summit region in 1892 by Alexander in 1892. Kūkahau`ula is given as the name of "the highest peak" even earlier in 1873 land boundary testimonies. Of all the place names in the summit region, these three are applied the earliest and most consistently to specific landmarks on the mountain. In compiling the 1892 map of Mauna Kea, W.D. Alexander refers to these as "genuine native names." The place name Poli`ahu appears in traditions and native testimonies as being applied to a trail, spring, pond, and cave, but it is not consistently applied to a single and identifiable landscape feature until 1892 when W.D. Alexander proposes attaching this name to "a nameless peak" in honor of the demigoddess, Poli`ahu, who appears in the tale of Laieikawai (McEldowney 1982:14; Table 2.1).

Some other place names date to the 1930s (Table 2.2). Gregory and Wentworth made a point of noting that they assigned names to cinder cones that did not have official names at the time (Gregory and Wentworth 1937:1725 footnote 14):

> As an aid in description, names have been adopted for the following cones not recorded on official maps: Puu Mahoe (Twin Cones), Puu Poepoe (Round Cone), Puu Hoaka (Crescent Cone), Puu Ala (Trail Cone), Puu Waiau (incloses Lake Waiau), Puu Kea (White Cone), Goodrich Cone (Joseph Goodrich, Hawaiian missionary, 1823), Macrae Cone (James Macrae, botanist of the *Blonde*, 1825), Douglas Cone (David Douglas, Hawaiian botanist, 1884), Summit Cone (highest point on Mauna Kea).

In a 1973 letter to Libert Landgraph, District Forester, L.W. Bryan wrote that he had obtained the following names from the "old Hawaiians" in the 1920s.

1. The summit cone, 13,796 is called Puu Wekei.
2. Goodrich cone is called Puu Hau Kea
3. Macrae Cone is known as Puu Hau Oki
4. Douglas Cone is called Puu Pohaku

Table 2.1. Earliest Recorded Place Names for the Mauna Kea Summit Plateau Region.

Documentation	Summit	Waiau and Lake	Poli`ahu	Adze Quarry	Within Summit Plateau	
					South Section	North Section
Wiltse Map (1862)		Pond Poli`ahu	Pond Poli`ahu	Kaluahakai	Laimakeloa	Kamahakalau
Boundary Commission Book for Hawaii (1873)	Pu`u o Kūkahau`ula (highest peak)	Waiau (water in gulch)	Poli`ahu (on side of the mountain)	Kaluahaakoi (a cave ... stone adzes)	Lanikepue (a pali)	Makanaka (a large ahu)
		Waiau (pond of water)	Poli`ahu (cave where Lilinoe lived)	Kaluakaakoi (two times)		Kamakahalau (a hill)
		Waiau (three times)	Poli`ahu (five times)			Kamakahalau (one time)

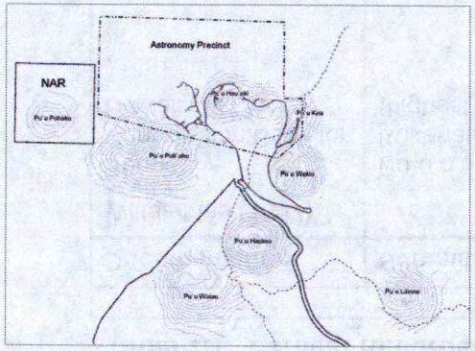
Table 2.2. Correlations Between Named Cinder Cones (and Peaks), Mauna Kea Quadrangle (modified after McEldowney 1982).

Map	Place Names of the Summit Region Cones (between 1884-1956)									Place Names of the Summit Plateau Region (between 1884-1956)									
1884-91 Lyons[1]	Summit Kukahau`ula						Waiau		Lilinoe									Kaupo Red Hill	White Hill Makanaka
1892 Alexander	Summit[2]	Mauna Kea		Poli`ahu[2]			Waiau	Waiau[2]	Lilinoe	Keonehehee[2]		Keanakāko`i						Red Hill Kaupo	Makanaka
1925-26 U.S. Coast and Geodetic Survey	Summit			Pu`u Poli`ahu			Lake Waiau	Waiau Crater	Lilinoe	Keonehehee[2]	Pu`u Ko`oko`olau	Keanakāko`i						Red Hill	Pu`u Makanaka
1928 U.S.G.S.	Summit	Mauna Kea		Poli`ahu		Peak B	Waiau Astrom. Station		Lilinoe	Keonehehee								Red Hill	Makanaka
1937 Gregory and Wentworth		Puu Kea	Macrae Cone	Pu`u Poliahu	Douglas Cone	Goodrich	Lake Waiau	Pu`u Waiau	Pu`u Lilinoe	Keonehehee[2]		Keanakāko`i	Pu`u Mahoe	Pu`u Poepoe	Pu`u Ala	Pu`u Hoaka			Pu`u Makanaka
1956 U.S. Geological Survey	Puu Wekiu[3]	Puu Kea	Puu Hauoki[3]	Pu`u Poli`ahu	Pu`u Pōhaku[3]	Puu Hau Kea[3]	Lake Waiau	Puu Waiau	Pu`u Lilinoe	Keonehehee[2]	Pu`u Ko`oko`olau	Keanakāko`i	Pu`u Mahoe	Pu`u Poepoe	Pu`u Ala	Pu`u Hoaka	Red Hill		Pu`u Makanaka
Currently Used Place Names	Kukahauula	Pu`u Kea	Pu`u Hau`oki	Pu`u Poli`ahu		Pu`u Haukea	Lake Waiau	Pu`u Waiau	Pu`u Lilinoe	Pu`u Keonehehee	Pu`u Ko`oko`olau		Pu`u Mahoe		Pu`u Ala				Pu`u Makanaka

[1] Some place names and accompanying notes on this map appear to have been written at different times and/or by different people. These variations are in keeping with the map's title (i.e., Information Map) and time span given on the label, but they raise the possibility that names from different time periods were added.

[2] Names reported by Alexander to be "genuine native names" with the exception of Poliahu. He attached the name Poliahu to this "nameless peak" in honor of the "demi-goddess" who appears in the "Legend of Laieeikawai." In Alexander's table, the highest peak is listed as Kukakauula, although this name does not appear on his 1892 map (Preston 1895:596).

[3] Names given to L.W. Bryan "by the old Hawaiians in the early 1920"s (Schmitt 1974a).



He added that he had no objection to Pu`u Māhoe, Pu`u Ala and Pu`u Poepoe, but that "I wonder how Lake Waiau and Puu Waiau secured their names? Waiau is not descriptive of the lake. Hau Oki would be more applicable" (Bryan 1973). In a letter dated January 16, 1974 Robert Schmitt, Chairman of the Advisory Committee on Geographic Names, presented recommended changes in some place names, particularly those named after Europeans. He suggested that Puu Wekei be changed to Puu Wekiu because he could not find the word *wekei* in the dictionary whereas wekiu was included and translated as summit. He added that the Pukui and Elbert book on Hawaiian place names wrote Pu`u Hau Oki as Pu`u Hau`oki. Place names currently in use for localities and trails in the summit area are shown on Figure 2.13.

Waiau appears now to be the universally accepted name of the lake, rather than other names, such as Pond Poliahu, that appeared on the 1862 Wiltse map. Waiau, like other place names in the summit region, has been variously translated. In *A Dictionary of the Hawaiian Language*, published by Lorrin Andrews in 1865, Waiau was translated as "A place where water runs continually; water where one can always bathe" (Andrews 2003:513). According to Westervelt (1963:56), "The name Wai-au means water of sufficient depth of bathe." In an article published in *Paradise of the Pacific* in 1939, L. Bryan, a forester, remarked that:

> The name "Waiau" has several meanings, for example, "water to swim in." However, it is questionable whether much use was ever made of this water for swimming or whether this exact meaning was intended by the Hawaiians when they named it. It could mean, "the place of the water" (Maly and Maly 2005:257).

According to Pukui and Elbert (1986:377) Waiau means "swirling water of a current." Maly and Maly (2005:vi) give the following account of Waiau:

> **Waiau**, named for the mountain goddess, Waiau (Ka piko o Waiau), and home of the *mo`o* (water-form) goddess Mo`o-i-nanea. Place where piko of newborn children were taken to ensure long life; and from which "ka wai kapu on Kane" (the sacred water of Kane) was collected. These practices are still participated in at the present time.

Charles Langlas, who conducted a traditional cultural property assessment of Mauna Kea, commented on the cultural significance of the lake:

> Taken together, Lake Wai`au and Pu`u Wai`au which contains it are the best attested specific ritual site at the top of Mauna Kea. Kupuna X was taught that the water of the lake had *mana* and was used traditionally to purify and heal. The newspaper story noted by the Kanahele's about Queen Emma bathing in the lake water to gain spiritual power in her competition with David Kalakaua bears out the Hawaiian belief in the *mana* of the lake. Kupuna X and Kupuna Y both describe it as a place where children's naval cords were placed, with the ritual purpose of giving the children long life. Belief in the spiritual power of the lake and ritual activities connected with it go back in time to the time of their great-grandparents and before. The use of the name Waiau goes back at least to the nineteenth century. The name Waiau [presumably Wai`au] was given by elderly Hawaiians testifying to Boundary Commission in 1873 and was given by Alexander in 1892 as a "genuine native name" (McEldowney 1982: 14, Table 1.2). Protection of the lake's *mana* is still important to Kupuna X, who indicated that individuals who entered the lake carelessly could contaminate its *mana* (Langlas 1999:9-10).

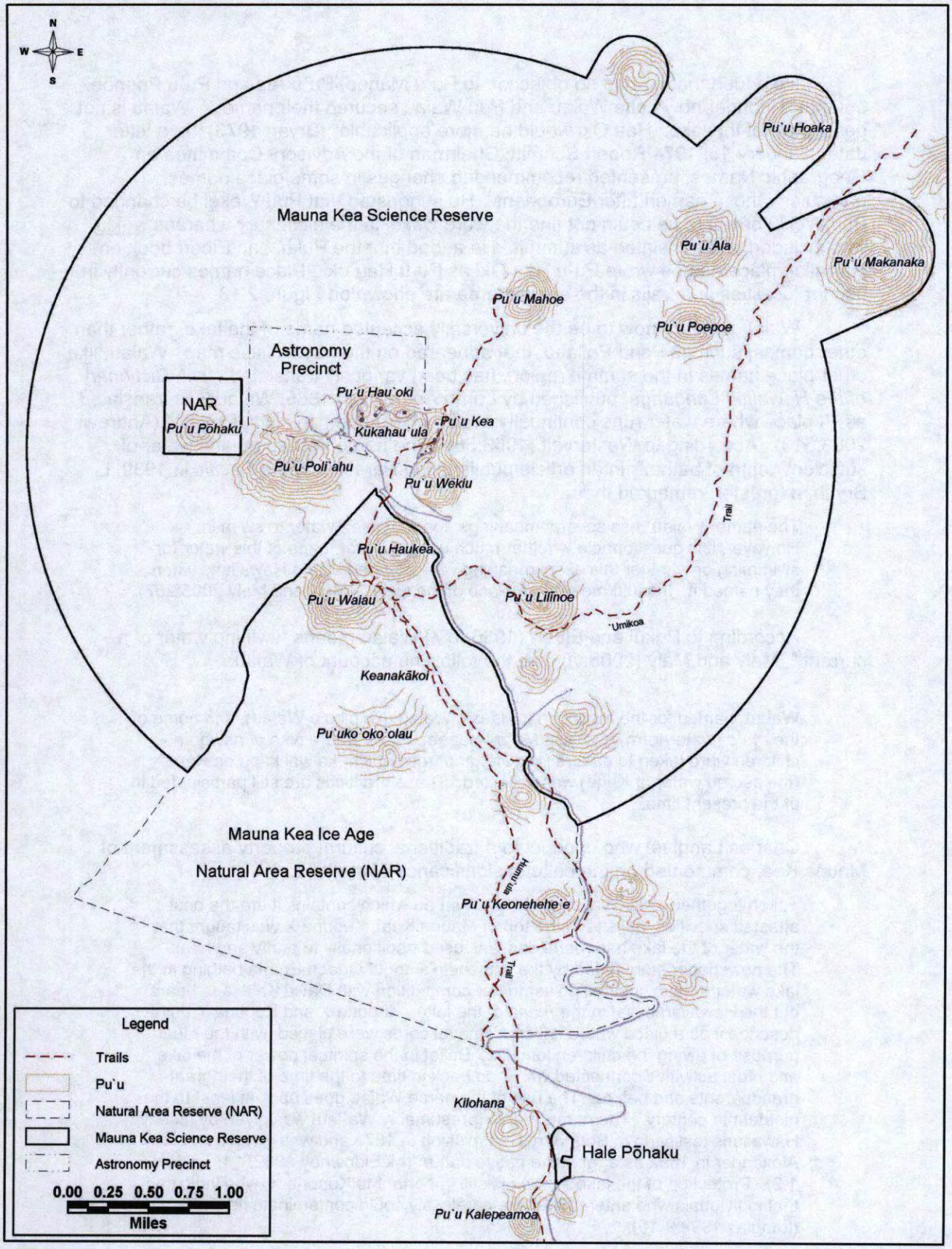


Figure 2.13. Place Names Currently in Use for Localities and Trails in the Summit Region of Mauna Kea.

Below Lake Waiau and west of Pōhakuloa Gulch, are three named springs – Hopukani, Waihu, and Liloe. None of the springs are listed in *Place Names of Hawaii* (Pukui, Elbert and Mookini 1974). The names of all three springs first appeared on the 1927 U.S.G.S. Ahumoa Quadrangle (1:31,680) topographic map. On this same map there is a second locality labeled Waihu, a short distance below Liloe Spring. This may be a general place name since there is a similar name (Waiku) in the same area on the 1911 edition of the United States Coast and Geodetic Survey map of the island of Hawai`i. According to the Ka-Miki legends translated by Maly the proper name of Waihu Spring is Ka-wai-hu-a Kane as noted in the following account:

> ...at that time, the guardians [Pohakuakane and Pohakuloa] saw the water rippling, and overflowing from the spring. As they went to investigate, they saw a shadow pass them. Because of the overflowing of the water, the spring came to be called Ka-wai-hu-a-kane (The-overlowing-waters-of-Kane), and so it remains named to this day [Figure 6]. It overflowed because Ka-Miki scooped the water, filling the `awa bowl of the god (Maly and Maly 2005:47).

Maly (1999: D-26) notes variations of Hopukani, including Houpo-o Kane and Ka-houpo-o-kane. Maly (1999:D-26) added, "Interestingly, at Ka-haupo-o-kane are found the waters of Pōhakuloa, Hopukani, and Waihu (also known by the name "Ka-wai-hu-a Kane."

Of the several known place names in the vicinity of Hale Pohaku, Pu'u Kalepeamoa (lit. "the comb [acquired] by [a] chicken"--Pukui, Elbert, and Mookini 1974:77) is the only one to appear on early government survey maps (Lepe o Moa--Alexander 1892) and in the literature on late nineteenth century expeditions to the summit of Mauna Kea (Ka Lepe a Moa--Preston 1895:596, 601, illustration no. 32). Other local place names, including Pu'u Haiwahine and Kilohana, are probably of more recent origin. The uncertain origins and probable recency of many place names in current use on Mauna Kea also applies to the Mauna Kea-Humuula and Mauna Kea-Umikoa trails to the summit (McEldowney 1982:12-15). The Mauna Kea-Humuula Trail, first plotted by Alexander in 1892, is shown as passing through the project area on two later maps (U.S. Coast and Geodetic Survey 1925-26 and U.S. Geological Survey 1956).

2.3 CHRONOLOGICAL SUMMARY OF LAND USE AND OTHER PRACTICES AND BELIEFS

For the purposes of this report the culture history of the Mauna Kea summit region, has been arbitrarily divided into two time periods: (1) the Pre-Contact Period (pre-1778); (2) the Post-Contact Period. Continuing cultural practices and beliefs are summarized in a separate section.

2.3.1 Pre-Contact Period

While there is good reason to believe that the summit region was known to early Hawaiians because of the probable desire to investigate the snow-capped mountain, the only activity that is known with certainty to have occurred in the pre-contact period is the manufacture of stone adzes. Radiocarbon dates on wood charcoal and 230 Thorium dates on branch coral indicate that the adze quarry was in use over a period of possibly as much as 700 years between ca. AD 1100 and 1800 (McCoy 1986:Figure 28; 1990:Figure 4), although a shorter chronology of perhaps just 500 years now seems more likely. When the quarry was abandoned is unknown and may never be known with

any certainty, but there is some evidence that it may have occurred as late as European contact in 1778 or shortly thereafter.

An interesting account of the adze quarry was published by Brigham at the turn of the 20th century:

> Let us climb to the workshop of the adze maker. All these were in high places, and one on Mauna Kea, Hawaii, was nearly 12,900 ft. above the sea. As good clinkstone was not found in many places the known quarries hardly exceeded half-a-dozen. On Hawaii was the most important of all, that on Mauna Kea, where the workmen could only work in favorable seasons for the snow frequently covered the quarry, but from the immense quantity of fragments and chips the work must have extended over many generations; so far as known, this was the earliest quarry exploited, and it is puzzling how the place was discovered when we consider the aversion the Hawaiians had to even visiting those high, bleak and desert regions, the supposed abode of spirits not always friendly. It is possible that the tradition which speaks of the survivor of the deluge of Kahinalii grounding on Mauna Kea and following the receding waters to the lower levels, discovering the koi pohaku on the way, may point to the considerable antiquity of adze-making in this place, but I am inclined to believe that all traditions of the Hawaiian deluge date after the coming of the Spanish discoverers. It has always seemed strange that the axe-makers did not bring the raw material down to their homes and work it up in comfort instead of freezing in their kapa garments at this great altitude. It may be that the mystery of the place and its very solitude kept the trade in few hands and so enhanced the value of a tool that so many must have (Brigham 1902:75-76).

Brigham's account, though lacking documentation of some of the information presented, is nevertheless of great interest for a couple of reasons, including: (1) the reference to a legend connected with the discovery of the source; (2) the general agreement between the legendary evidence and the immense quantity of waste material in pointing to a quarry of great antiquity compared to the few others known at the time; (3) the reference to the aversion of Hawaiians to high desolate places and the discomfort of working under such conditions, and (4) the possible link between environmental conditions and the labor component of the production process and the probable influence this had on the value of a tool that as he so neatly puts it "so many must have."

2.3.2 Post-Contact Period

Changes to the traditional Hawaiian lifestyle began soon after the arrival of Captain James Cook in 1778. One significant change was the rapid adoption in the major trading centers and nearby communities of Western tools, clothing and other items, initially by the chiefs and then the common people. The impact on traditional technologies is known in a general way from historic accounts, such as diaries and newspapers, but for remote centers of traditional crafts, such as the Mauna Kea Adze Quarry, there is little or no information on how long they continued to be utilized before abandonment.

The first recorded ascent of Mauna Kea by a European was made by the Rev. Joseph Goodrich on August 26, 1823 (Goodrich 1833:200). A number of visits followed shortly thereafter, including ones by such prominent figures as the renowned botanist David Douglas (see Maly and Maly 2005 for a comprehensive overview of early visits and expeditions to the top of Mauna Kea). Macrae mentions that Goodrich found a

"heap of stones" on a cinder cone which many have interpreted as located on the summit. Macrae's description suggests a cinder cone at a lower elevation on the edge of the summit plateau:

> Rev. Joseph Goodrich, who, on this occasion, was unfortunately laid up with mountain sickness, had on 26th August, 1823, reached the summit of Mauna Kea. This is the first recorded instance of the ascent of this mountain, although Mr. Goodrich mentions that on reaching the top of one of the terminal cones that encircle the main plateau of Mauna Kea, he discovered a heap of stones, probably erected by some former visitor. Who this former visitor was is unknown, but he was probably one of the white men that in the early years of the nineteenth century got a living by shooting wild bullocks that roved on the side of Maunt Kea. It is very unlikely that any native had reached the top of the terminal cones on the summit, owing to being unprovided with warm clothing to resist the great cold and also to the fact that the natives had a superstitious dread of the mountain spirits or gods. About six months after the date of the first ascent of Mauna Kea by Mr. Goodrich, the peak was scaled by Dr. Abraham Blatchley and Mr. Samuel Ruggle, both connected with the American Mission (Macrae 1922:55).

There are other early references to the building of cairns on the "summit," including one by Jarves in 1844:

> My companions, not having seen the snow, disbelieved the guide's statement the evening previous, and started themselves to seek the summit. Having ascended the hill which the guide had pointed out, they found another arising two hundred or more feet above that, which, after great labor, they scaled. These hills are composed of loose sand, into which one slips knee deep at every step. The second one was frozen hard. This was found to be the highest point; it was covered with slag, lava, and gravel. The snow, or rather ice, lay in chasms, in a few spots, in masses ten feet deep, fourteen wide, and three hundred long...Having piled a cairn, as a memorial of their success, they returned in all haste to the camp (Jarves 1844:228).

Kamehameha, in the company of Kekuhaupi`o, is reported as having made an offering close to Lake Waiau (Desha 2000:94; Maly and Maly 2005:50). Of the many people that made the arduous ascent of the mountain in the 19th century, the trip made by Queen Emma in 1881 or 1882 is one of the best known (de Silva and de Silva 2007). The Queen Emma trip, which was made on horseback, started at Mānā in Waimea. From there the party rode to Kalaieha [the name for the area occupied by the Humu`ula Sheep Station] where the night was spent before riding to the summit the next day. Mary Kalani Ka`puni Phillips, a descendant of W.S. Lindsey, one of the guides that accompanied the Queen, has written that:

> Queen Emma rode on the back of Waiaulima, and he swam around Waiau pond at Mauna Kea. And then he lifted Queen Emma, and carried her to a rocky place. The people were amazed to see Queen Emma's on-the-back swim, and they returned and told the mo`olelo to us (de Silva and de Silva 2007:3).

> The historical record of pilgrimages to Maunakea is not limited to Emma's mele and Phillips's mo`olelo. Steve Desha writes, that as a young man, Kamehameha Pai`ea went to Waiau to pray and leave an offering of `awa. Kamakau tells us that Ka`ahumanu made the same journey in 1828 in an unsuccessful attempt to retrieve the iwi of her ancestress Lilinoe. Kauikeaouli visited Waiau and the summit in 1830, Alexander Liloliho in 1849 and Peter Young Ka`eo in 1854 (de Silva and de Silva 2007:5).

As the summit area of Mauna Kea became better known to the public, it also began drawing the attention of scientists toward the end of the 19th century. The first major scientific study was conducted at Lake Waiau in 1892. W.D. Alexander, Surveyor General of the Kingdom and E.D. Preston, an astronomer with the U.S. Coast and Geodetic Survey, organized an expedition that is sometimes referred to as the "Pendulum Survey Party" because of Preston's objective of making pendulum and meteorological observations. A number of other individuals participated in the Pendulum Party survey which is described in detail in Maly and Maly (2005). The Alexander party found a cairn on the summit, which may have been the one described by Jarves in 1844:

> On Monday, the 25th, the thermometer stood at 20 deg. at sunrise. Messrs. Muir and Alexander ascended the second highest peak on the northwest, overlooking Waimea, 13645 feet height to continue their survey. In the cairn on the summit a tin can was found, which contains brief records of the visits of five different parties from 1870 to the present time, to which we added our own. A party of eight girls from Hilo, "personally conducted" by Dr. Wetmore and D.H. Hitchcock, Esq., in 1976, must have been a merry one. Cpt. Long of H.B.M.'s Ship Fantome had visited this spot in 1876, and Dr. Arning with several Kohala residents in 1885 (Alexander 1892).

The early 20th century for all practical purposes marked the beginning of a new era in the land use history of Mauna Kea. Large numbers of wild sheep were devastating the forests below the summit in the early part of the century. The extent of the devastation was the impetus for a monumental fencing program undertaken by the Civilian Conservation Corp (CCC) in the 1930s. The CCC was also engaged at the same time in improving roads and building facilities for visitors. In 1936 the CCC made improvements to what is believed to have been a section of the old Mauna Kea-Humu`ula Trail, from near the Humu`ula Sheep Station at Kalaieha to the summit (Bryan 1939:11). According to Bryan (1939:11), the first stone cabin, from which Hale Pōhaku takes its name (Hale Pōhaku-"House of Stone'), was built by the CCC about this same time. Prior to the construction of a road above Ho`okomo, the cabin at Hale Pōhaku provided a convenient overnight rest spot for hikers and ski enthusiasts (McCoy 1985b:8).

Beginning with the Alexander survey party in 1892, Lake Waiau was used as a base camp by scientists. The geologist, Herbert Gregory, for example, camped at the lake on August 5-6, 1921 and spent some additional time there on July 23, 1926. The 1925-26 USGS mapping team also camped at the lake (Kilmartin 1974). In addition to research, Mauna Kea continued to attract the curious and even resulted in the formation of an organization called the Mauna Kea Association, Limited as described in the following account:

> At the highest point, an elevation of 13,825 feet, a mound of rocks is built, and in this a can lines that contained lists of the names of those who, in recent years, had climbed the mountain, and deposits of silver money made toward a fund for a monument there, and divers [sic] articles, the leaving of which had suited the taste and fancy of the depositor. One had left a small compass, another a bunch of sulphur matches, another a brass button, another a penny.
>
> We copied the names of those who had been there before us, and left our own and gave each of a bit of silver the Summit Monument. Then we be-though ourselves that as the sum in the can had reached the amount of $4.05, it was time some steps were taken looking to the carrying out of the purposes of the

> contributors. And so we then and there perfected the organization of the Mauna Kea Association, Limited, and elected Joseph G. Pratt, president, Eben P. Low secretary and collector, and A.L.C. Atkinson treasurer. The amount of the collection was turned over to the treasurer, and it was determined that any person who has made the ascent of Mauna Kea, the highest point in the Hawaiian Islands, shall be eligible for membership upon proof that he has been on top of the mountain, and that each member contributing to the monument fund shall receive a certificate stating the date of his ascent and acknowledging the amount of his contribution (Anonymous, Mid-Pacific Magazine 1911:408).

In 1935 the Hawaiian Academy of Science organized the first multi-disciplinary scientific expedition to Mauna Kea. The expedition included specialists in a number of different fields, including the team leader, Chester Wentworth. With the assistance of the U.S. Army, the expedition established three camps. The Humu`ula Sheep Station was the main base camp. Above that was the Ho`okomo Ranger cabin. The uppermost camp was at Lake Waiau which was occupied between July 30 and August 21, 1935. An unpublished account of the expedition, titled *The Mauna Kea Expedition of 1935: Hawaiian Academy of Science*, by Chester Wentworth, John Coulter and Constance Hartt, is on file at Bernice P. Bishop Museum. A popular account of the expedition, *Mauna Kea Here We Come*, was published by one of the members, Ed Bryan, in 1979.

On August 12, 1935 several members of the Hawaiian Academy of Science Expedition took part in the first and perhaps only radio broadcast from the summit. The event is briefly described in Ed Bryan's booklet:

> In the morning Raine and Downing had taken the radio to the top and Downing had set up and operated the first radio station on the top of the Pacific. Six messages were sent and one received. The set was worked for approximately one hour and then carried back to Lake Waiau. The trip took one hour, each of the two carrying about forty pounds of equipment. Thinking that it would be a good time to test the merits of the Pep Caramels, a few of them were taken along but chewing them interfered with breathing so that no comprehensive tests could be made (Bryan 1979:33-34).

The description of this highly momentous event was recorded on film by Raine, who photographed Downing sitting on a stool beside a stone cairn on which was placed the radio equipment. The photographs of this cairn (Bryan 1979:35) indicate that this is Site 21209 (see description in Vol. 2).

Gregory and Wentworth commented on the high probability of unrecorded visits to the summit and a greater knowledge of the upper mountain area in the late 19th century:

> There have doubtless been many unrecorded visits to the summit of Mauna Kea since Goodrich's time. Indeed, it is probable that fifty or more years ago, when ranch operations were of relatively greater importance and the old Makahalau-Keanakolu trail was in general use as a route from Kawaihae and Waimea to Hilo, the upper slopes of the mountain were more generally known to the residents of Hawaii than they are today (Gregory and Wentworth 1937:1722).

Construction of the Saddle Road, begun in 1943 for what would become the Pohakuloa Training Area, was extended after World War II. The completed road, which linked Hilo and Waimea, provided easier access to the south side of Mauna Kea. The first road to the summit of Mauna Kea was completed in 1964. The first astronomy facility, the Lunar and Planetary Station located on the summit of Pu`u Poli`ahu (Group

70 International 2000: Figure IX-1), was opened in July of 1964. Improvements to the original jeep road in the 1970s made access to the mountain top much easier, resulting in more public and commercial activities and as a consequence, conflicts between different public user groups.

2.3.3 Continuing Cultural Practices and Belief

Cultural practices and beliefs involving Mauna Kea have been changing since the arrival of the earliest Polynesian settlers, an evolutionary process that continues today. Absent a written language, Hawaiian practices and beliefs were originally recorded in chants and oral histories that were passed on from generation to generation for over 1,000 years. The earliest written records of native Hawaiian beliefs and practices were created by European explorers and settlers in the late 18th century.

The arrival of European and Asian settlers also marked the beginning of wide-spread changes in cultural practices and beliefs throughout much of Hawai`i. Because of the evolutionary nature of cultures and beliefs, current cultural practices and beliefs involving Mauna Kea are diverse. Over the last 200 years, many practices have been modified or abandoned altogether as non-Hawaiian religious and cultural practices were introduced to the islands.

A variety of cultural and religious beliefs and practices pertain to and are occurring on the mountain today. Whereas some traditional and customary Hawaiian practices and beliefs have survived and have gained wider practice in recent generations, other traditional and customary cultural practices and beliefs appear not be in practice. In addition, recent archaeological and ethnographic studies of Mauna Kea show that contemporary practices and beliefs have developed based on modern beliefs or have evolved from a traditional practice or belief. The difficulty in thoroughly documenting cultural practices is increased by the reluctance of some cultural practitioners to describe their practices and beliefs to researchers.

Traditional and customary cultural practices and beliefs have been defined as "those beliefs, customs, and practices of a living community of people that have been passed down through generations, usually orally or through practice" (Parker and King 1998:1; PHRI 1999:1). Traditional and customary cultural practices and beliefs contribute to the maintenance of a community's cultural identity and demonstrate historical continuity through the present. This is demonstrated through actual practice or through historical documentation of a practice or belief, including both written and oral historical sources (Parker and King 1998:1; PHRI 1999:2).

Contemporary cultural practices and beliefs have been defined as "those current practices and beliefs for which no clear specific basis in traditional culture can be clearly established or demonstrated – for example, the conducting of ritual ceremonies at sites or features for which no such prior traditional use and associated beliefs can be demonstrated. In some cases, however, it may be possible to demonstrate the reasonable evolutionary development of a contemporary practice from an earlier traditional practice" (PHRI 1999:3).

2.3.3.1 Religious Beliefs and Practices

At the time of Contact, Hawaiian cultural and religious practices were inseparably intertwined as were many other activities. When describing the organization, structure

and lifeways of traditional societies, it is important to remember that the terms used today, such as religion, economics and politics, are modern analytical constructs.

Ranging from Euro-American explorers and missionaries journal accounts to early native Hawaiian historians like David Malo, Kepelino, and S.M. Kamakau, and to later 19th and 20th century ethnologists, there is rich documentation of religious ceremonial and ritual life throughout the islands (Valeri 1985:37-44). Indeed, prior to and following significant undertakings, such as battles, dance, voyaging, the cultivation and harvesting of crops and fish, apprenticeship training, and the manufacture of tools or structures, etc., rites marked by offerings or sacrifices occurred. Propitiatory offerings were made to *`aumakua*, or family gods, and *akua* to avert disasters, like famines, volcanic eruptions and disease, or to ensure the coming of rain, success in crop fertility and fish harvest bounties, or victory in battle.

Following European contact, increasing numbers of Hawaiians converted to Christianity, while restrictions were placed upon traditional religious observances. As a result, traditional oral histories and written documentation of historic religious practices and any associated beliefs on Mauna Kea remain virtually non-existent. Because Ka`ahumanu abolished the *kapu* system in 1819 and imposed restrictions on certain traditional Hawaiian religious practices in the post-Contact period (Kamakau 1961:307, 322), in all likelihood, the voices of those practitioners were silenced, or perhaps simply muted, with traditional knowledge being passed on covertly. It is possible that close proximity to missionary settlements and Christian-converted chiefs may have, to a greater degree, influenced decline in traditional religious practice. In areas further removed from Christian centers, where new religious teachings had less appeal, traditional religious practices may have continued (Barreré et al. 1980:34).

Aside from Ka`ahumanu's restrictions, it has also been suggested that it may be culturally inappropriate for practitioners to speak aloud of their ceremonial or ritual practices and beliefs. As Jess Hannah points out when asked about the presence of *heiau* or burials upon Mauna Kea, "those days…if they know about them…they don't talk about `em. Even Alex [Bell], he knew 'em all, they had something here and there, but they would never pin 'em down. You couldn't pin point it. Something about how they were brought up or raised, it was bad luck or hard luck to talk" (Maly & Maly 2005:A-437,438). Likewise, when Johnny Ah San was asked about burial locations on Mauna Kea, he revealed that "you take those Hawaiians, they were superstitious, and they hardly want to talk about that" (Maly 1999:A-75).

Nevertheless, modern-day oral history interviewees explain their knowledge, as well as an unfortunate lack thereof, concerning the presence of and meaning of *ahu* and burials in the summit region. And cultural practitioners also describe their knowledge of and beliefs surrounding the following contemporary religious practices - *kūahu* (family shrine) erection, the scattering of cremation remains, *piko* deposition in Wai`au, pilgrimage, offerings, and prayer.

2.3.3.2 Construction of Ahu and Kūahu

Although the archaeologically-documented presence of *ahu* and *kūahu* within the summit region of Mauna Kea indicates religious observances of various kinds in the Hawaiian past, no knowledge regarding the traditional practices and beliefs associated with these structures exists today. In the early post-Contact period, the existence of *ahu* on Mauna Kea are reported – however, information is unavailable concerning their

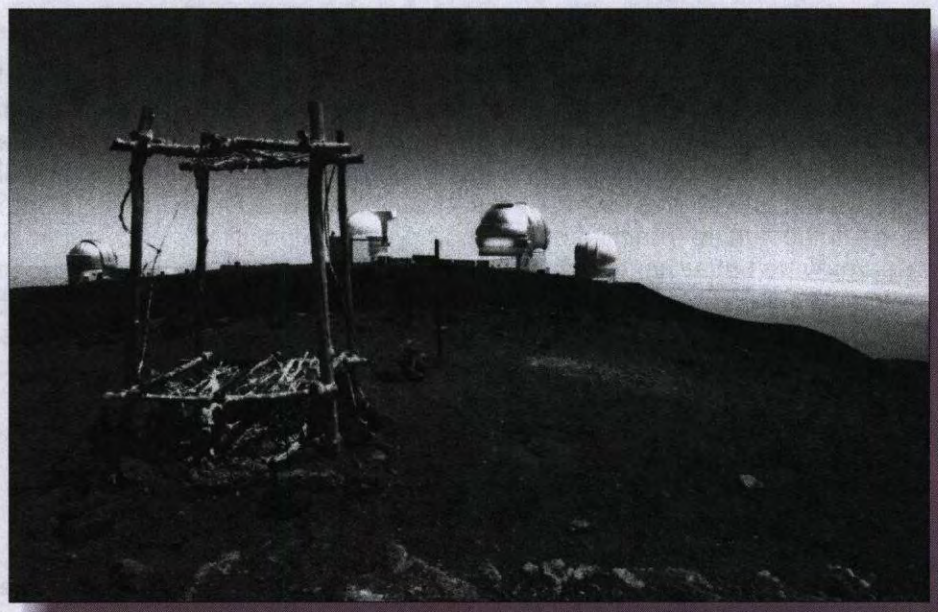
traditional function, be it ritual, ceremonial, or otherwise. In the 1880s – 1890s, two surveyors, J.S. Emerson and E.D. Baldwin, independently denoted various *ahu* located upon *pu`u* in the lowlands surrounding Mauna Kea and the presence of "a pile of stones on the highest point of Mauna Kea" (Maly and Maly 2005:494-502, 505).

It is of interest that the word *kūahu*, a more obscure and presumably older term for one kind of Hawaiian shrine (the *ko`a* or fisherman's shrine is another), does not appear in any of the early accounts. By the post-contact era it appears that *kūahu* was no longer in common use, as opposed to *ahu*, a word with many meanings. Morphologically, *ahu* are a pile or mound of stones, yet in the functional sense, *ahu* may have served historically as altars or shrines, or as markers signifying burial locales, *ahupua`a* boundaries, or trail routes. When Thomas Thrum visited Haleakala on Maui in the 1920s, he reports that *ahu* functioned as trail and way marks, memorials of traveling parties, land boundaries, burial markers, or tributes to deities (Thrum 1921:259). While Emerson and Baldwin certainly confirm the presence of *ahu* as they are defined morphologically, the surveyors do not specifically speak to the functional meanings of the *ahu* on Mauna Kea.

Likewise, oral history interviewees reveal that they have heard of or have seen the presence of *ahu* on the summit plateau and on the Mauna Kea summit (Orr 2004:47; Maly 1999:A-134, -372; Maly and Maly 2005:A-183, -335, -349, -565). Yet, little information is available about the particularities of traditional religious observances practiced in association with the *ahu*. Libert Landgraf states that he had "no idea whether they were trail markers or a grave site or something else" (Orr 2004:47). Pualani Kanaka`ole Kanahele discloses that she does not know if *ahu* "represent these *ahupua`a* markers…or whether they are actually *kūahu* (altar) or *ahu* for different families that lived in that mountainous area…or if it had to do with *konohiki* (land overseers) that were in charge of a particular *ahupua`a* and so this family went there to mark the upper regions…they could also be new ones" (Maly 1999:A-372). On the other hand, Kealoha Piscotta offers up the following explanation of the significance of *ahu* – "some of the shrines mark the birth stars of certain *ali`i*…and also birth and death" (Orr 2004:47).

Piscotta is the only cultural practitioner to describe a contemporary attempt to maintain a *kūahu* (family shrine) on Mauna Kea, which was undermined by repeated destruction and removal of the shrine. It is significant to note that in 1870 Kamakau wrote that "it was not right to trespass on someone else's altar" (Kamakau 1961:96). This statement is the only indication of a traditional cultural practice that regulated people's access to *kūahu* and *ahu*. Piscotta explains that she erected the *ahu*, which consists of a stone from her family, on Mauna Kea because as an employee of one of the observatories, "I thought I would put it where I'm going all the time. And also it was very beautiful and I was always attracted to that place. I prayed at that place all the time" (Orr 2004:52). Piscotta's contemporary cultural practice of erecting *kūahu* represents continuity of a traditional practice, except that she imported her upright stone rather than selecting a local stone.

In 1998 the Royal Order of Kamehameha I erected a *lele* (altar) on the summit. In the last decade the *lele* has been extensively modified. Several years ago it was dismantled and then rebuilt in a new form. Figure 2.14 illustrates how the *lele* looked in 1999 and 2005.



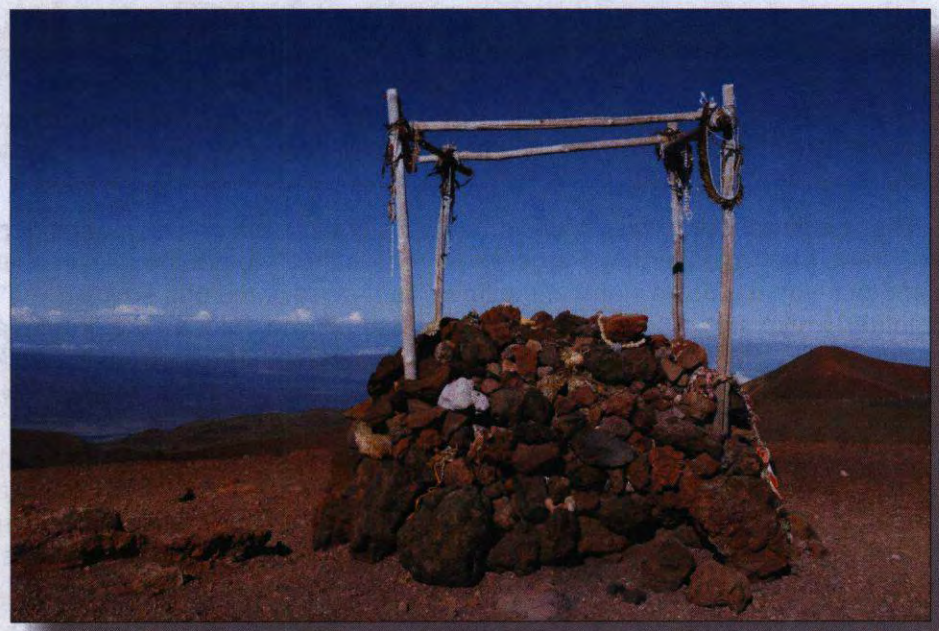


Figure 2.14. Photographs Showing *Lele* (altar) on the Summit Erected by the Royal Order of Kamehameha.

2.3.3.3 *Piko* Beliefs and Practices

The cultural weight that Mauna Kea carries within the Hawaiian community is also evident in the phrase, "*piko kaulana o ka `āina*," which translates as "the famous summit of the land" and is used as a term of endearment (Maly 1999:A-3). However, the phrase also expresses the belief that the mountain is a *piko* (the navel, the umbilical cord) of the island and for this reason it is sacred (Maly 1999:D-20). In this context, the significance of the cultural practice of transporting and depositing a baby's *piko* on Mauna Kea may be better understood. Pualani Kanaka`ole Kanahele explains the symbolic importance of this practice, saying that:

> the *piko* is that part of the child that connected the child back to the past. Connected the child back to the mama. And the mama's *piko* is connected back to her mama and so on. So it takes it back, not only to the *wā kahiko* [ancient times], but all the way back to Kumu Lipo…So it's not only the *piko*, but it is the extension of the whole family that is taken and put up in a particular place, that again connects to the whole family line. And it not only gives *mana* or life to that *piko* and that child, but life again to the whole family (Maly 1999:A-376).

Other Native Hawaiian cultural practitioners illustrate that for some families the practice of *piko* deposition on Mauna Kea is a long-standing traditional cultural practice. In 1956, Kaleohano Kalihi revealed that his grandfather had taken a gourd container "the *piko* of Mauna Kea. The place of the *punawai* [spring]…" which had been filled with 40 *piko* from "all of the people that had been born into this family" (Maly 1999:A-1). Kahili also mentioned that until he took the *piko* to Lake Waiau, his grandfather had "taken care of" those *piko*. Another practitioner, Elizabeth 'Tita' Lindsey Kimura, describes being a *piko* caretaker for her family – "I still have some of her *piko* that she [her mother] collected. Not collected, but when she goes to my sisters that have babies and the *piko hā`ule* [a *piko* that has fallen off], she'd pick it up and bring it home. …yes, I have it in the *`ōmole* [bottle]…And I'm waiting for somebody to go up to Mauna Kea with it" (Maly and Maly 2005:A-217). One of Kimura's relatives, Irene Loeyland Lindsey-Fergerstrom, also confirms that she took her children's *piko* and the *piko* of her one of her relatives up to Mauna Kea (Maly 1999:390).

These cultural practitioners also provide insight into the proper means of placing the *piko*. Irene Loeyland Lindsey-Fergerstrom recalls that "we put the *piko* in a little cotton and put 'em in a bottle. And sometimes it's hard to come out, so *kūkū* [grandmother] Laika said all you do is take the cover off and put it on the ground and it will just deteriorate" (Maly 1999:A-392). Also, when Lindsey-Fergerstrom took *piko* to Mauna Kea, her husband "dug a little hole and put the *piko* in…the summit" (Maly 1999:A-391). Elizabeth 'Tita' Lindsey Kimura relates that her mother "was very particular…you don't just *hana kapulu* [to act carelessly or slovenly]…you got to treat it with respect" (Maly and Maly 2006:A-217). Kimura also says that the reason for taking the *piko* up to Mauna Kea is that the mountains is "neat" and "clean," practitioners "don't want any *kapulu*…in the discarding of the *piko*" (Maly and Maly 2005:A-217). It is clear that maintaining cleanliness and purity is an important component in this cultural practice. Kealoha Piscotta explains that in light of some practitioners belief that Lake Wai`au has become polluted, she fears that "people won't put the *piko* of the baby in there it it's polluted" (Orr 2004:45).

There were many reasons for hiding the *piko* of newborn babies. One was to ensure a long life. Another was to avoid the person from growing up as an irresponsible

adult. There is a well known Hawaiian proverb concerning *piko--He piko pau `iole* which translates as "*an umbilical cord taken by a rat.*" Pukui interpreted the proverb to mean:

> A chronic thief. The umbilical cords of infants were taken to special places where the cords of other family members were kept for many generations. If a rat took a cord before it was hidden away safely, the child became a thief (Pukui 1983:96).

2.3.3.4 Burial

Today, numerous oral history interviewees reveal that they have knowledge of burials located at a number of *pu`u* dotting Mauna Kea's western and eastern slopes, including Ahumoa, Kemole, Papalekoki, Mākanaka, Kihe, Kanakaleonui, Kaupō, and Pu`u O`o (Maly 1999:A-22, -48, -75, -165, -250, -279, -351, -395, -397).

Some cultural practitioners explain practices that relate to ancient family burials atop the mountain. Alexander Kanani`alika Lancaster reveals that he and his family members went up to Mauna Kea "for ceremonial. They go up there bless the whole mountain for all our ancestors who's buried up there…the old folks always said, 'Our family is up there'" (Maly 1999:240). As no documentation exists on traditional cultural practices relating to ancient Mauna Kea burials, it is unknown whether blessing ceremonies would be considered a traditional cultural practice or a contemporary cultural practice.

Other cultural practitioners reveal that they have participated in the practice of scattering the cremated remains of loved ones from atop Mauna Kea. It is noteworthy that cremation was not a common practice in traditional Hawaiian culture, and when it was done it was a punishment and meant to defile the dead person. Writing in the 1830s, native Hawaiian historian David Malo stated that "the punishment inflicted on those who violated the tabu of the chiefs was to be burned with fire until their bodies were reduced to ashes" and that cremation was practiced on "the body of anyone who had made himself an outlaw beyond the protection of the tabu" (Malo 1951:57, 20). In recent years, noted Native Hawaiian historian and ethnologist Mary Kawena Pukui explains why cremation was a defilement – "if the bones were destroyed, the spirit would never be able to join its `*aumakua*" (Pukui et al. 1971:109).

The cultural practitioners who express participation in cremation-related cultural practices on Mauna Kea include Toshi Imoto, Tita Elizabeth Kauikeōlani Ruddle-Spielman, and Kealoha Piscotta. Imoto explained that in 1954, he and six others ascended to Mauna Kea's summit, where *paniolo* Eben Low's ashes were scattered from an *ahu*, which is described as an old survey marker. It is also noteworthy that at the time Low's ashes were scattered, a commemorative cement plaque was placed at Lake Waiau in Low's honor (Maly 1999:25-26). Ruddle-Spielman, who happens to be the granddaughter of Eben Low, explained that in 1969, she and her family members scattered her parents' cremation ashes from the Mauna Kea summit (Maly 1999:273-274). Kealoha Piscotta also revealed that she brought her aunties' ashes to Mauna Kea (Orr 2004:52). Finally, Theodore "Teddy" Bell says that he wants his ashes to be scattered from the mountain (Maly and Maly 2005:A-293).

Undoubtedly, the scattering of cremation ashes today is a contemporary cultural practice that has taken the place of traditional interment practices. But debate ensues over whether this practice has evolved from traditional practices and beliefs or whether it is a new practice based on modern customs and beliefs. Pualani Kanaka`ole Kanahele

explains that while the scattering of cremation remains on Mauna Kea may be viewed by some as non-traditional, she counters that notion saying: "it may not be the *iwi* [bones] itself, but the ashes are the essence of what is left of the *iwi*. It doesn't matter, it's going back" (Maly 1999:A-377). On the contrary, in 1970, a woman identified solely as Kolokea C. testified before the Hawaiian Culture Committee of the Queen Liliuokalani Children's Center that when her brother died, she intended to have his body cremated. However, she was told by her 73-year old great-great-grandaunt that "cremation was *puhi i ka iwi* [bone burning]" and that cremation was an expressly prohibited by Kolokea's great-great-grandfather. This auntie recommended burial in the ground or at sea instead, as with a cremation "the body will be without peace." In the end, Kolokea C. decided to bury her brother (Pukui et al. 1971:106-107). Ms. Kanahele explains that cremation is an evolutionary development of a contemporary practice from an earlier traditional practice, whereas Kolokea C. concluded that cremation was non-traditional in learning of the traditional prohibitions of this practice.

2.3.3.5 The Spiritual Resonance of Mauna Kea: Modern Pilgrimages to Chant, Pray and Make Material Offerings

In public testimony before the Mauna Kea Advisory Committee, Ed Stevens ascribed Mauna Kea's spiritual significance to the fact that it is the highest point in Polynesia. Stevens states the mountain is significant "because it was considered to be the gateway to heaven. When the ancient *kāula* (priests, prophets) made their treks to the summit, it was to be nearest to *akua* where prayers could be offered in the highest reverence" (Maly 1999:C-10).

Instances of the cultural importance of Mauna Kea are related in several pilgrimages made to the mountain by royalty to partake in ceremonial practices in the post-Contact period. During the reign of Kamehameha I, fearing dissension amongst some of his chiefs, in the company of Kekuhaupi`o, the king is reported to have traveled to Mauna Kea to make a ceremonial offering close to Lake Waiau (Desha 2000:94 in Maly and Maly 2005:50). In 1881 or 1882, Queen Emma ascended Mauna Kea and at Lake Waiau, she swam across the lake, riding on the back of Waiaulima (de Silva and de Silva 2007 in McCoy and Nees 2009; Maly and Maly 2005:158; Maly 1999:A-4, -5, -387). Queen Emma's swim across Waiau was a cleansing ceremony initiated in an effort to prove her genealogical connection to Wākea and Papa (Kanahele and Kanahele 1997:9 in Maly 1999:D-21).

In addition, some oral history interviewees reveal seeing offerings left on Mauna Kea in recent times. Libert Landgraf recalls seeing *pu`olo* (offerings) left at Lake Waiau and on the summit of Mauna Kea, which he describes as "a gift or something wrapped in *ti* leaves. My feeling of that is it has cultural, I don't want to go out on a limb and say religious, but it has a significant cultural significance…someone is taking a gift or presentation to a particular area" (Orr 2004:51). Other interviewees, including Rally Greenwell, Hisao Kimura, Coco Vredenburg-Hind, and Daniel Kaniho Sr., testify that they either saw or had heard that *`opihi* shells were present in the Mauna Kea adze quarry (Maly and Maly 2005:A-37, -215; Maly 1999:A-118, -260). Archaeologists theorize that because these *`opihi* shells are too few to be interpreted as the remains of food consumption activities; it is more likely that they were offerings to the *akua* (McCoy 1990:108).

Other oral history interviewees demonstrate the spiritual resonances of Mauna Kea in the following statements:

Libert Landgraf – "I looked at sites, the area, as the church. …In this instance maybe the summit of Mauna Kea represents to us what the church is, and the individual sites or the individual platforms is the altar" (Orr 2004:49).

Kealoha Piscotta – "This is a really hard issue for Hawaiian people, because Hawaiian people have really no temples. [They're] in the state or national parks....So Mauna Kea represents one of the last kind of places where the practice can continue. …But for Mauna Kea, it's not a temple built by man. It's built by Akua…" (Orr 2004:49).

Pualani Kanaka`ole Kanahele – "If you want to reach *mana*, that [the summit] is where you go" (Maly 1999:A:372).

Pualani Kanaka`ole Kanahele – "Mauna Kea was always *kūpuna* [an elder, ancestor] to use. …And there was no wanting to go on top. You know, just to know that they were there…was just satisfying to us. And so it was kind of a hallowed place that you know it is there, and you don't need to go there. You don't need to bother it. …And it was always reassuring because it was the foundation for our island" (Maly 1999:A:366).

Florence La`i-ke-aloha-o-Kamāmalu 'Coco' Vredenburg-Hind oral history – "I don't think I could live anywhere else. I feel like it's right, I belong to the dirt, the soil….It just like they protect all of us. These mountains protect us" (Maly 1999: A-117, 120).

Alexander Kanani`alika Lancaster – "My grandmother…she said, 'When you go up there, you going feel the spirit.' And you do feel the spirit" (Maly 1999:A:234).

Tita Elizabeth Kauikeōlani Ruddle-Speilman – "Yes the *mana* is there. There is no question" (Maly 1999: A-286).

Clearly, these statements demonstrate that Mauna Kea continues to be viewed as a realm of great spiritual and sacred importance, a belief rooted in Hawaiian tradition.

2.3.3.6 Collection of Water for Healing

Little documentation exists that Hawaiians sought to collect water or snow in ancient times, yet Lloyd Case says that "they went there because that mountain has the power to heal and it still does…I've heard of the old ones getting water from Waiau to use for healing…" (Maly 1999:A-353). Presently, cultural practitioners engage water and snow collection for ceremonial/medicinal purposes. Regarding the waters on the mountain, Anita Leilani Kamaka`ala Lancaster and Alexander Kanani`alika Lancaster explain that their family uses the "sacred water" of Waiau for baptisms (Maly 1999:A:246). And Kealoha Piscotta states that "its for medicine…all of these waters" (Orr 2004:45). However, concern surrounding the purity of Lake Waiau is also a factor influencing the contemporary practices of Lake Waiau water collection and snow collection on Mauna Kea. Some cultural practitioners believe that effluent from the observatories enters the aquifer and has caused the green coloration of Lake Waiau's water. Although scientific studies disprove the theory that effluent has in fact leached into the aquifer, Kealoha Piscotta states that "we are not really trusting to take the water for the medicine anymore" (Orr 2004:45). Piscotta states that because she is unsure about the purity of the Waiau waters, she gathers snow instead. In her words, "the snow

along this ridge in here and by the lake, is what I was told is the snow to collect. It's powerful snow..." (Orr 2004:51).

2.3.3.7 Adze Manufacture

The manufacture of stone adzes made from discarded preforms left by ancient Hawaiian adze makers or from unmodified pieces of raw material in the Mauna Kea Adze Quarry is a practice occurring today, about which relatively little is known, however. One reason is that the collection of material from the quarry, a large part of which is located in the NAR, is not a permitted activity under the NAR rules. The collection and use of material from the quarry thus tends to be clandestine.

Cultural practitioners also have different beliefs concerning the appropriateness of using material from the quarry for adze manufacture and whether this activity should be taking place at all. For instance, Lloyd Case does not believe adze collection should take place whatsoever. Case states:

> I think that what ever is there should stay there. Because not only would it be a resource that people can go and see, what the old Hawaiians did and how things were. But if you take everything off of that mountain, and people keep taking things, you have nothing to show for our past (Maly 1999:A-352).

On the other hand, Hannah Springer believes that if it can be demonstrated that the quarries lack potential for archaeological analysis, adze quarrying could be permitted. She expresses that she does not know how access could or should be regulated, but expects that if it were stipulated that practice be done in a traditional manner, not many individuals would engage in quarrying. Springer says:

> Should there be fresh mining? I don't know if there's information that can still be extracted from the fragments that remain from past work done there. If already there has been tremendous removal of material, how valid is the data that remains? What sort of picture would we get from analysis of it? I cannot answer that. If it has relatively low value maybe we would want people to continue to mine an already tapped source. Hundred and eighty degrees away from that, I can't imagine how many people would make the effort if they had to go *kālai* [carve or cut] the *pōhaku* [stone]. So that might be self regulation, right there. To identify and designate an area where people could go. And again I don't know how you determine who's authentic to go up there (Maly 1999:A-310).

Pualani Kanaka`ole Kanahele believes that adze quarrying should be permitted, but only if those quarrying can demonstrate a genealogical tradition of adze quarrying. She says:

> I have two *mana`o* [opinion, thought] for that. One is, an old site should be approached...it depends on what you are taking it for. I can only say, 'Yes, take it if I see that you bring down the *ko`i* [adze] and you use it for something.' It has to be functional for you, and not just a show piece or something that you want to use commercially. ...So I am thinking that if you would go to an old place to mine the *ko`i*, then you need to show some kind of genealogy where your *kūpuna* also had that kind of function. So if your *kūpuna* were some kind of *kālai ki`i* [carvers of images] or *kālai wa`a* [canoe makers] or had some kind of function with the *ko`i*, if you have that...Because then it would make us stronger to know that you still have that and that you still continue this in some form. ...So it's not like saying, 'Oh you cannot, first you have to show us your genealogy.' No. 'Show us what your genealogy is because that makes you stronger, that makes us

> stronger, that brings *mana* to the place.' That it is still being continued by the *mo`opuna kuakāhi*, *kualua*, *kuakolu* [the great; great great great; and great great great grandchildren] of this *kūpuna* (Maly 1999:A-373-374).

Modern-day adze collection and quarrying can be considered a traditional cultural practice that has been modified to include the use of contemporary methods and tools (such as steel rock hammers).

2.3.3.8 Navigation/Orienteering

Kepā Maly notes in his collection of archival documentation on traditional practices that no specific references to *kilo hōkū* (observing and discerning the nature of the stars) upon Mauna Kea are present (Maly and Maly 2005:95). Maly speculates it is likely that *kilo hōkū* was practiced upon the mountain, as the gods and deities associated with the mountain are also embodied in the heavens, but such accounts are absent from the historical literature (Maly and Maly 2005:95). Libert Landgraf also says that he has "no personal knowledge of it," but he suspects "that it probably was a very good observation [point]" (Orr 2004:55). Lloyd Case says that he believes a platform, which he believes to have been a "navigational *heiau*" was present on the Mauna Kea summit. He states that "before the observatories were there, they had one when all the stones were piled up, kind of similar to some of the *heiau* at Mahukona" (Maly 1999:A-349).

In contrast to Maly's statement that there is an absence of evidence of traditional Hawaiian astronomical observations, cultural practitioner Kealoha Piscotta believes that "the lake [Wai`au] is like the navigation gourd," a concept which she learned from her auntie (Orr 2004:45). According to Piscotta, her auntie also instructed her to go to the lake and when she did, Kealoha says "I could see clearly why she wanted to look into the lake. Because when you look into the lake, the whole heavens are reflected in it and it's just like the gourd that they carry on the canoe with the water and the *ane ane*" (Orr 2004:45).

Piscotta states that *mo`olelo* passed down from her auntie describe solstice alignments with Mauna Kea, thus she believes that the solstices were marked from the Mauna Kea summit. Piscotta emphasizes that she does not doubt the validity of *mo`olelo*, but she is interested in understanding how the solstice alignments work. Thus, she has concerns that the view plane from Mauna Kea has been diminished and obstructed by the leveling of *pu`u* and the erection of observatory domes (Orr 2004:54-55). Piscotta reveals the importance of the solstice alignments by stating that "if you do not measure the solstice and the equinox, you cannot keep track of the sacred time. And if you don't know what year you're at, you don't know part of the *wā* or the epic period you're in, so you don't know where you are in the prophesy either" (Orr 2004:58-59). It is noteworthy that not only is Piscotta interested in validating traditional Hawaiian astronomy techniques, she also holds a degree in physics and has worked as a telescope systems specialist at a Mauna Kea observatory.

On a similar note, Tita Elizabeth Kauikeōlani Ruddle-Spielman conveys the significance of the Mauna Kea view plane, but as a landscape viewed from the sea. She says:

> It was so important when we used to go fishing with uncle Francis, I used to go with him. From Keawaiki. When we started out, he'd say 'Now watch the *pu`u* on the mountain.' And we'd go out, and that was my job to watch the *pu`u* as we went along. And as soon as a cloud came down to that certain *pu`u* we'd turn

around and go right home again, because he knew that the ocean would change. It was anywhere that we went, whether we were going towards Kona or coming this side towards Kohala. He said 'You watch that *pu`u* and as soon as you see the clouds hug it, or heading towards it, let me know, because we are turning around and going home.' And he never failed. ....No, it was on the side, the slopes [not the *pu`u* near the summit, but on the slopes]. But he knew, and sure enough, by the time we got home, that wind would change, but we had gotten home safely. ...that is very important, this whole idea of line of sight, cultural landscape. So not only is it important close up on top, but as viewed from afar (Maly 1999:A-282).

2.3.3.9 Hunting

There is no evidence that hunting in the summit region was a traditional cultural practice. Available information indicates that it was not until the late 19th century and throughout the 20th century, following the introduction of numerous non-native ungulate species such as bullock (cattle), goats, and sheep, that hunting for subsistence and for sport began on Mauna Kea. Following the Māhele, livestock was deemed the property of the King and the government, although private parties could apply for license to own and brand livestock (Maly and Maly 2005:270). Interestingly, government correspondence dating from 1850-1856 shows that illegal hunting activity by individuals was becoming problematic (Maly and Maly 2005:270-273).

In 1861, a legal dispute over hunting rights led to the decision that no hunting activities could take place on Mauna Kea, except for individuals who acquired leasehold interests in the mountain lands or who gained special permission to hunt (Maly and Maly 2005:274-277). In the years that the forested slopes of Mauna Kea were controlled by cattle ranching operations, Jess Hannah contends that one benefit of being employed as a ranch hand lay in one's ability to practice subsistence hunting. He says, "If you go hunting that was the main benefit because guys could go hunt pig, sheep, and all that. You could always eat" (Maly and Maly 2005:A-428). Dave Woodside, a former government naturalist, concurs and explains that it was only after the World War II era that public hunting on Mauna Kea lands was permitted. This managed hunting policy was developed in part because non-native goats and sheep were adversely impacting the forests and in part because individuals interested in sport and subsistence hunting organized to gain the right to hunt (Maly and Maly 2005:A-323-326). Indeed, Lloyd Case explains the importance of subsistence hunting to many ranch families, "a lot of my brothers and the old timers like David Hogan Kauwē, when they went out hunting, it was basically a hunt where each family took home so much of the meat so that everybody had meat" (Maly 1999:A-345).

Based on all available evidence, subsistence hunting, within the UH management areas on Mauna Kea is a contemporary cultural practice that has evolved from non-Hawaiian traditions.

3.0 PREVIOUS ARCHAEOLOGICAL RESEARCH AND CULTURAL RESOURCE MANAGEMENT STUDIES IN ALPINE AND SUB-ALPINE ZONES ON MAUNA KEA

A number of research and cultural resource management (CRM) studies have been undertaken in the alpine and sub-alpine zones of Mauna Kea. The two zones essentially correspond to the ecosystems above and below tree line, which varies between roughly 9,200 and 9,500 ft amsl. The majority of the studies have been CRM projects conducted in areas managed by the University of Hawaii (UH) for astronomical research. The CRM studies that have been conducted for the UH management areas include:

1) archaeological surveys and mitigation projects;

2) traditional cultural property assessments;

3) cultural impact assessments;

4) preparation of a burial treatment plan; and

5) preservation and cultural resource management plans.

CRM studies have also been undertaken west of Pōhakuloa Gulch at Hopukani, Waihu, and Liloe Springs.

In contrast to the long history of geological research on Mauna Kea the only area that has been the subject of problem-oriented archaeological research is the Mauna Kea Adze Quarry Complex which encompasses parts of the NAR, the Science Reserve, and the Mauna Kea Forest Reserve in the vicinity of Hopukani, Waihu and Liloe Springs and elsewhere on the south flank of the mountain. The overview of CRM and problem-oriented research that follows is organized primarily by modern administrative units. In some cases there is an overlap between two or more administrative units. There are also a couple of studies that covered a larger area of the mountain, including one traditional cultural property assessment and two preservation/management plans covering all three UH management areas. These are discussed separately.

The history of archaeological investigations in each of the primary administrative units and management areas are described below. Figure 3.1 is an index map showing the series of maps for each of the administrative units that follow (Figures 3.2-3.5).

3.1 Mauna Kea Science Reserve

The first systematic archaeological investigations in the Mauna Kea Science Reserve were carried out in 1975-76 in the context of a National Science Foundation funded research project on the Mauna Kea Adze Quarry (McCoy 1977, 1990; Cleghorn 1982; Allen 1981; Williams 1989) (see Figure 3.2). The primary research objectives of the 1975-76 Mauna Kea Adze Quarry Project as originally conceived were to:

1) develop a technological model of adze manufacture based on a characterization of techniques, stages, and activity pattern variability within and between sites in the quarry complex;

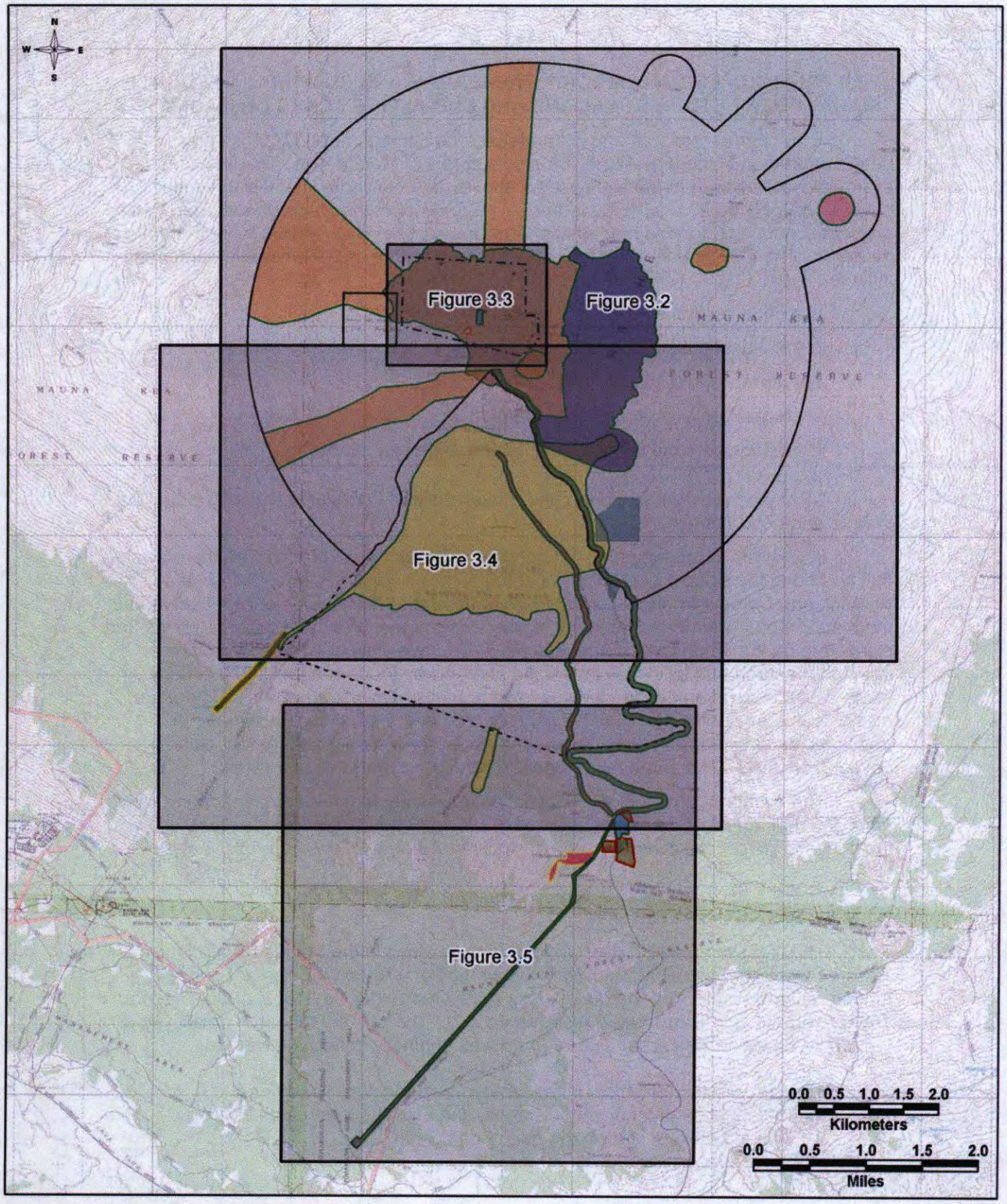


Figure 3.1 Index of Maps Showing the Location of Previous Archaeological Investigations in the Alpine and Sub-Apline Zones on the South Flank of Mauna Kea.

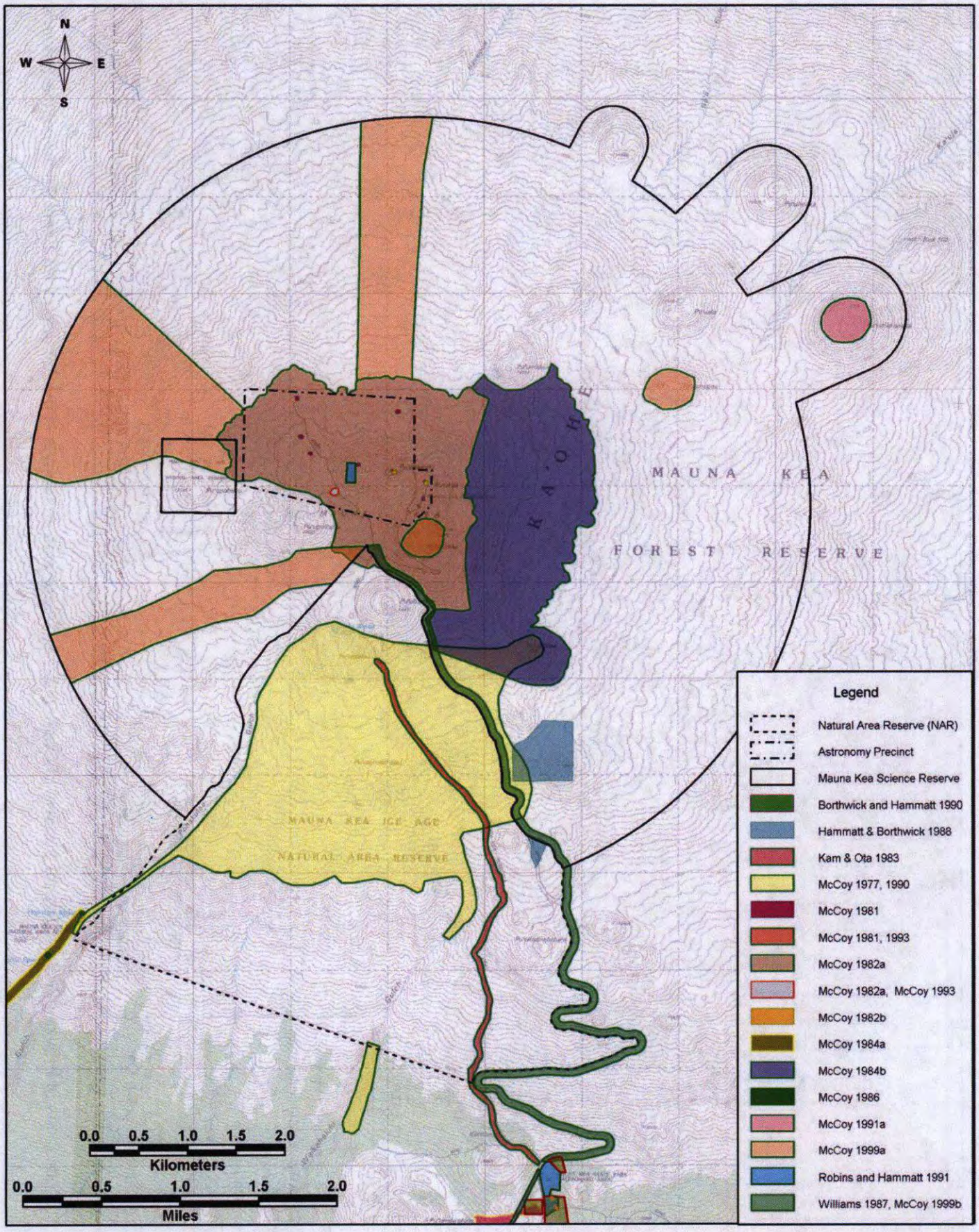


Figure 3.2 Locations of Previous Archaeological Surveys in the Mauna Kea Science Reserve.

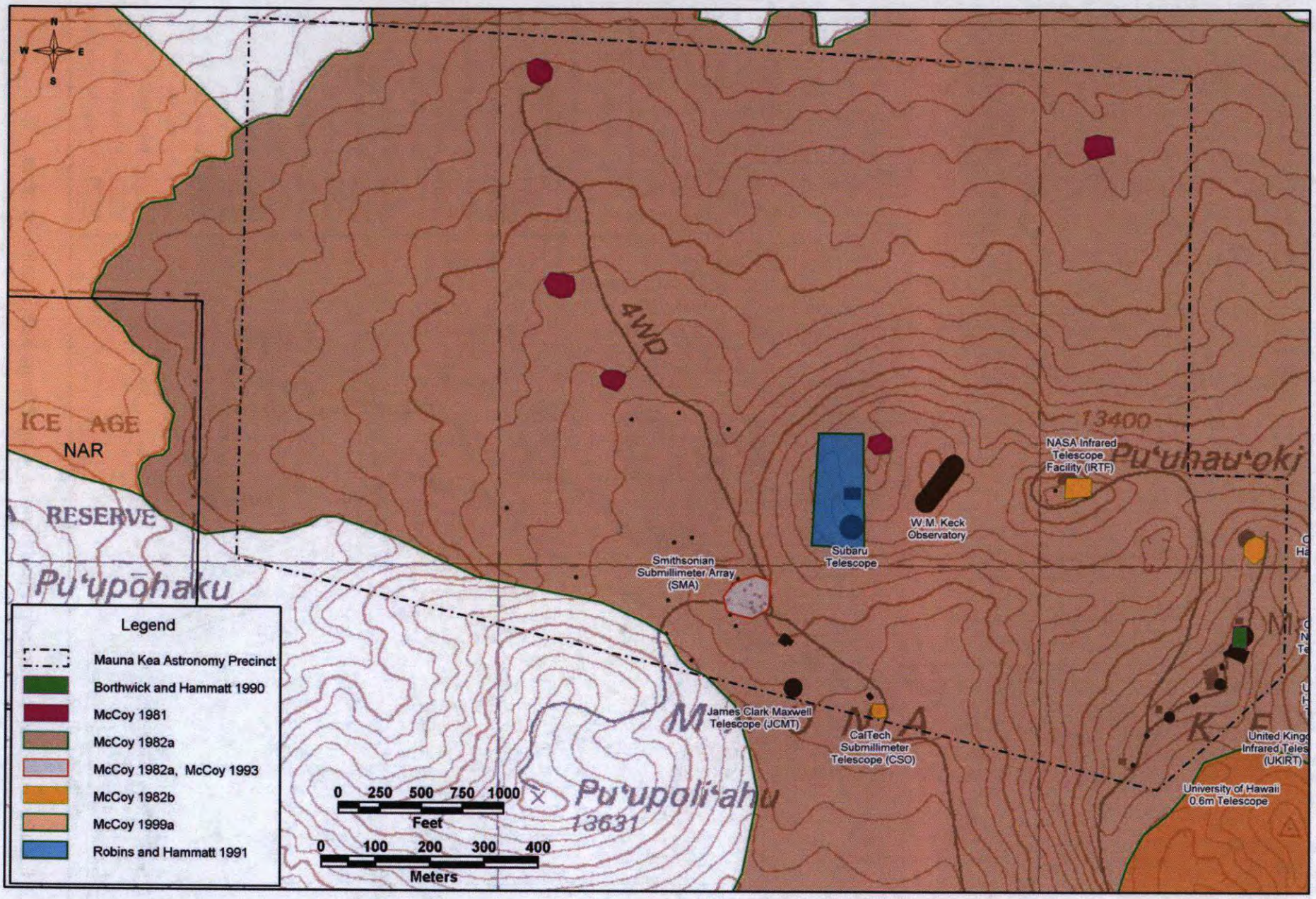


Figure 3.3 Locations of Previous Archaeological Surveys of Observatories, Telescopes and Arrays in the Astronomy Precenct Portion of the Science Reserve.

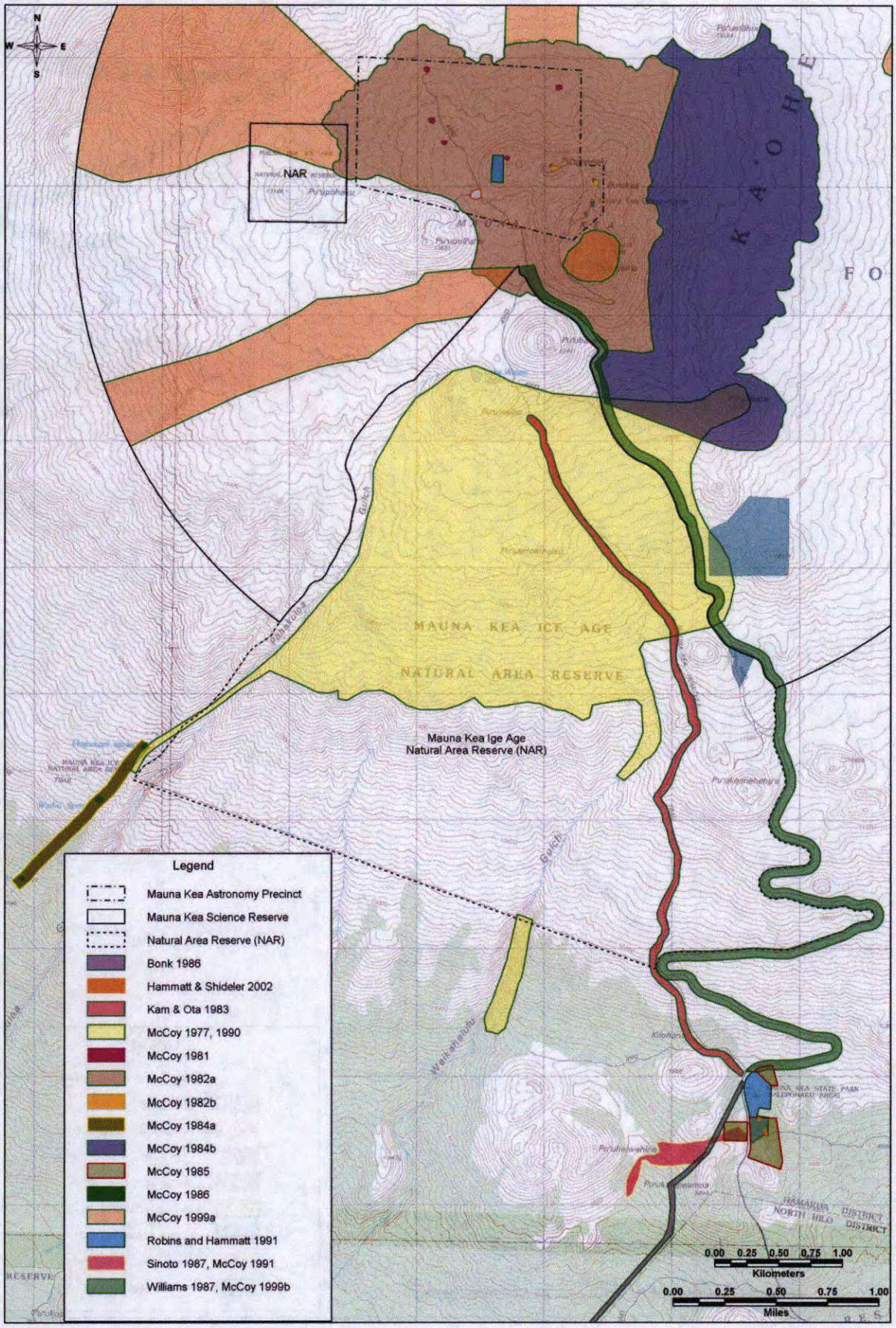


Figure 3.4 Locations of Previous Archaeological Research and Data Recovery Projects in the Natural Area Reserve, alont the Mauna Kea Access Observatories Access Road and in the Hopukani, Waihu and Liloe Springs Area.

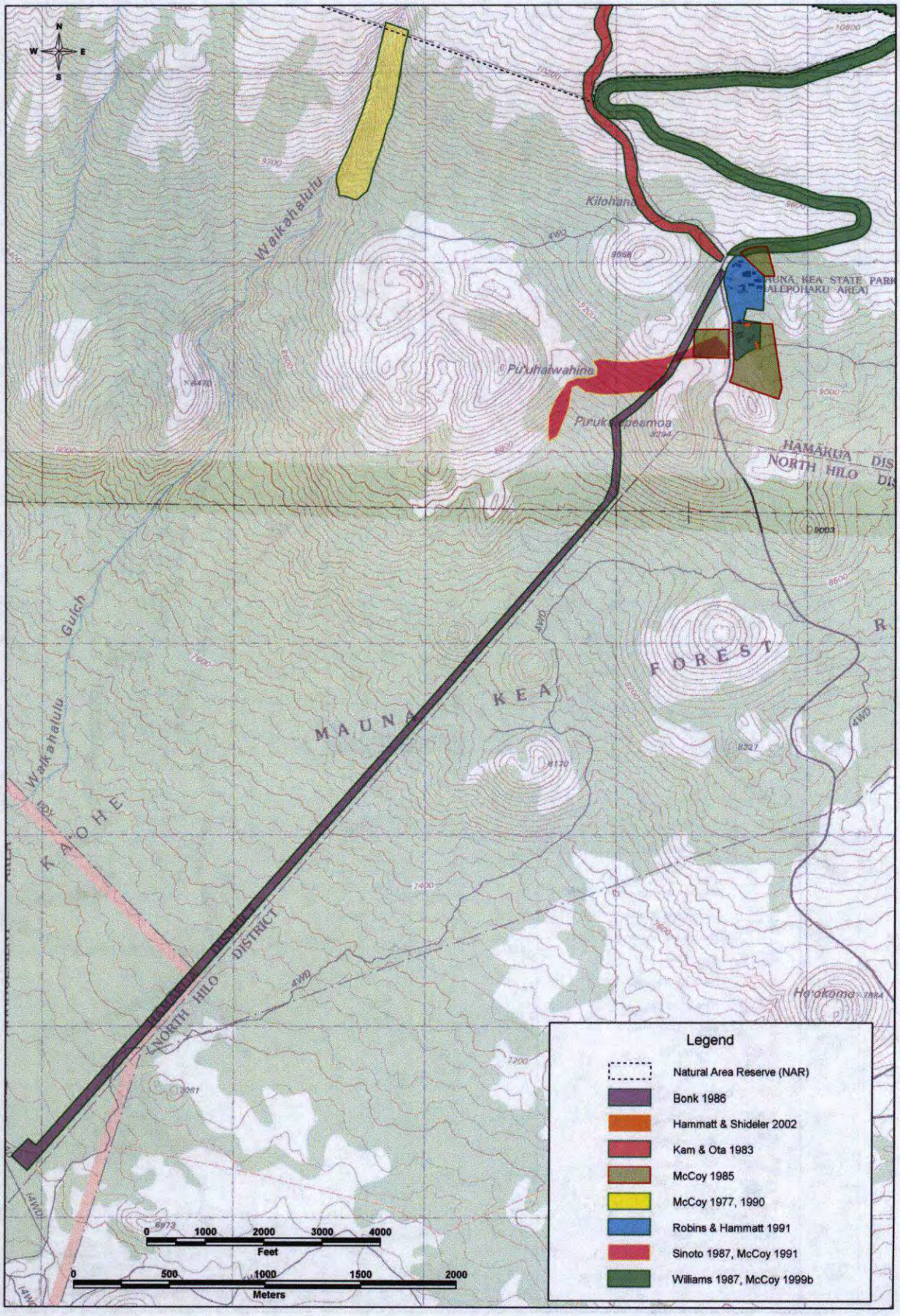


Figure 3.5 Locations of Previous Archaeologicial Surveys and Data Recovery Projects in the Hale Pohaku Area.

2) provide new data on chronological changes in Hawaiian adze types, and

3) determine the relationship of this particular quarry industry to other forms of economic specialization and the development of socio-political complexity (McCoy 1976, 1986:7).

A reconnaissance survey undertaken in 1975 to determine the boundaries of the quarry, a National Historic Landmark, found one site just inside the Science Reserve boundaries on the eastern side of the summit road, between the ca. 12,250 and 12,300 ft elevations (see Figure 3.2). The site (BPBM Site No. 50-Ha-G28-1; State Site No. 50-10-23-16204) as defined at the time, using the site definition criteria employed in the quarry project, consists of five shrines, 25 open-air enclosures (shelters) and a diffuse lithic scatter of adze manufacturing by-products (McCoy 1977, 1999b). Two other sites were found in the Science Reserve in the 1976 field season, which involved more intensive survey and site recording. One site (BPBM Site No. 50-Ha-G28-38; State Site No. 50-10-23-16163) is a shrine with a diffuse scatter of flakes located on a ridgetop at the ca. 12,880 ft elevation. The second site (BPBM Site No. 50-Ha-G28-76; State Site No. 50-10-23-16195) are the remains of two stone mounds on the rim of Pu`u Līlīnoe. These would appear to be the remnants of the burial interment features noted by W.D. Alexander's survey party in 1892.

Table 3.1--Summary of Previous Archaeological Surveys in the Mauna Kea Science Reserve and Number of New Sites Recorded

Year	Project	Survey Type	New Sites	Reference
1975-76	NSF Research Project on the Mauna Kea Adze Quarry	Reconnaissance and inventory	3	McCoy 1976, 1977; Cleghorn 1982
1981	Kitt Peak National Observatory	Reconnaissance	0	McCoy 1981
1982	Hawaii Institute for Astronomy	Reconnaissance	21	McCoy 1982a and McEldowney 1982
1982	Caltech Telescope	Reconnaissance	0	McCoy 1982b
1983	Mauna Kea Observatory Power Line	Reconnaissance	0	Kam and Ota 1983
1984	NSF Grant-in-Aid Survey	Reconnaissance	19	McCoy 1984b
1987	Summit Road Improvement	Reconnaissance	0	Williams 1987; McCoy 1999a
1988	VLBA Telescope	Reconnaissance	2**	Hammatt and Borthwick 1988
1990	Subaru Telescope	Reconnaissance	0	Robins and Hammatt 1990
1990	Gemini Telescope	Reconnaissance	0	Borthwick and Hammatt 1990
1991	Pu`u Mākanaka	Reconnaissance	1	McCoy 1999a
1995	SHPD site relocation and GPS recording	Reconnaissance	17	McCoy 1999a
1997	SHPD transect survey	Reconnaissance	31	McCoy 1999a
1999	SHPD survey of Pu'u Wekiu	Reconnaissance	1	McCoy 1999a

Note: Three previously identified sites (16183, 11076 and 11078) were deleted from the inventory during the work undertaken by the State Historic Preservation Division in 1995. A reassessment of Site 16183, recorded in 1982 as an open-air shelter with modern rubbish on the floor (McCoy 1982a, McCoy 1982b), convinced us that the walls are also modern. Site 11076 had been previously recorded in 1975 and 11078, a rockshelter, showed no evidence of modification or use. The number of sites found in the 1997 survey includes two that are just outside the Science Reserve boundaries. These were left out of the count used in McCoy (1999a), which referred to a total of 93 sites.

On June 2, 1981 the Bishop Museum conducted an archaeological reconnaissance survey of five locations on the north slope of the mountain that were under consideration as sites for the proposed Kitt Peak National Observatory data-collecting stations. Each of the alternative facility sites (see Figure 3.3) which were only generally located on a map, was inspected and found to be devoid of historic sites (McCoy 1981).

The first major survey in the Science Reserve was conducted by the Bishop Museum over 5 1/2 days between July 12 and 17, 1982 for the Hawaii Institute for Astronomy (IfA) and encompassed roughly 1,000 acres of land on the summit and northern slope of the mountain, down to the ca. 13,000-ft elevation (see Figure 3.1). Few, if any, archaeological sites were predicted to occur within the boundaries of the project area, given the high altitude location and presumed absence of exploitable resources, including adze-quality stone, which was believed to be restricted to the south slope of the mountain. A total of 22 sites were recorded in this survey (McCoy 1982a). For field purposes, all but one site, an open-air shelter, were classified as "shrines," earlier defined by Buck (1957:527) as "a convenient term to designate a simple altar without a prepared court." The open-air shelter, which contained modern debris, was later deleted from the historic places inventory because of the belief that it is a modern feature. The number of historic properties found in the 1982 survey has thus been changed to 21.

The 1982 project also included ethnographically-oriented archival research on a variety of topics, such as land use patterns, place names, and practices in the summit region of Mauna Kea (McEldowney 1982). A survey of the Caltech Telescope site was conducted at the same time as the larger survey. No sites were found within the proposed project area, but two sites were found in close proximity (McCoy 1982b).

In 1983 SHPD conducted a reconnaissance survey of a proposed underground power line from Hale Pōhaku to the summit (see Figure 3.5). The survey, which did not identified any historic properties, was undertaken before the final alignment had been determined, however.

Archaeological survey of the Science Reserve was resumed in 1984 by the Bishop Museum with the support of a National Historic Preservation Grant-in-Aid. The 1984 survey (see Figure 3.2), which was carried out over a period of 6 days between July 23 and 28, was aimed at completing an inventory of archaeological remains on the east-southeast flank of the mountain adjoining the proposed northern boundary of the Mauna Kea Adze Quarry (McCoy 1978). The survey strategy and methodology were the same as those employed in the 1982 fieldwork. A total of 20 new, dispersed and aggregated sites was recorded in the survey (McCoy 1984b), which covered ca. 1,000 acres on the eastern slope of the mountain. Time did not permit survey of the upper slopes and summit of Pu`u Māhoe as originally planned.

In 1988 Cultural Surveys Hawaii, Inc. conducted a reconnaissance survey of two areas that were being considered as alternative sites for the National Radio Astronomy Observatory (now called the Very Long Base Array). No archaeological sites were found in the survey of the first area, an area of some 15 acres located between the 11,560 and 11,840 ft elevations near the junction of the summit road and a utility road (Hammatt and Borthwick 1988:1). Four archaeological sites were recorded in the survey of the second alternative site, an area of some 100 acres located on the east side of the summit road at the 12,100 to 12,225 ft elevations. Three of the sites (11076, 11077, and 11079) were interpreted as possible shrines; the fourth site (11078) is a small rockshelter (Hammatt

and Borthwick 1988:21). Sites 11076 and 11078 were subsequently deleted from the inventory. Site 11076 had been previously recorded as part of Site 16204 (McCoy 1999a) and Site 11078 showed no evidence of human modification or use.

Two archaeological surveys were undertaken in the Science Reserve in 1990, both by Cultural Surveys Hawaii, Inc. The first involved a resurvey of a portion of Pu`u Hau Oki for the proposed Japan National Large Telescope (JNLT-- later renamed the Subaru Telescope) (see Figure 3.3). No sites were found in this survey, which covered an area of 5.1 acres (Robins and Hammatt 1990). The second survey was done for the proposed Galileo Telescope (later renamed the Gemini Telescope) (see Figure 3.3). Two alternative sites were inspected, both of them located on what the authors called the "summit ridge" (Borthwick and Hammatt 1990). No sites were found in either area.

In 1991 an unofficial one-day reconnaissance of the top of Pu`u Mākanaka was undertaken by Holly McEldowney and Marc Smith (SHPD) and Patrick McCoy (Mountain Archaeology Research Corp.) to relocate previously reported burials (see Figure 3.2). The survey, which was interrupted by bad weather, found a number of burials, none of which were mapped, however (McCoy 1991 field notes) a single state site number (50-10-23-16248) was assigned to the burials on the *pu`u* at that time.

As part of their Section 106 compliance, the Smithsonian Institution Astrophysical Observatory (SMA) contracted Mountain Archaeology Research Corp. in December 1992 to relocate two previously recorded sites in the general vicinity of one of the pads (see Figure 3.3). The two sites (50-10-23-16164 and 16165), which were found in the 1982 survey and described as shrines (see discussion of site types below) were found to be located well outside of the observatory footprint. Flagging of the two sites was recommended as a precautionary measure (McCoy 1993).

In 1995 SHPD with financial support from IfA, initiated a project designed to result in a historic preservation management plan for the Science Reserve. The first task, which was begun in 1995, involved the relocation and GPS locational mapping of the sites recorded in the 1982 and 1984 surveys (see Figure 3.2). In the course of the fieldwork 17 new sites were found and recorded (McCoy 1999a).

In 1997 SHPD undertook a reconnaissance survey of five previously unsurveyed areas aimed at obtaining a better idea of site distribution patterns for both management and research purposes. The 1997 survey area included three transects on the north, northwest and southwest slopes of the mountain from the summit area to the lower boundary of the Science Reserve at the ca. 12,000 ft elevation and two other areas—Pu`u Poepoe and a small piece of land located near the Science Reserve boundary downslope of the CalTech observatory (see Figure 3.2). A total of 31 new sites, including two located just below the Science Reserve boundary (21436 and 21437), were found in the 1997 project, which was conducted over a period of 6 days (McCoy 1999a).

The 1997 survey also began the process of recording what were initially referred to as "locations" but are now being termed "find spots"--a general term referring to man-made remains that are either obviously modern features (e.g., camp sites with tin cans, pieces of glass and other modern material culture items), or features that cannot be classified with any level of confidence as historic sites because of their uncertain age and function (e.g., a pile of stones on a boulder).

In summary, archaeological surveys undertaken between 1975 and 1999, the last year archaeological surveys were conducted in the Science Reserve prior to the

current project, identified a total of 95 sites (McCoy 1976, 1977, 1982a, 1982b, 1984b, 1990, 1999a; Hammatt and Borthwick 1988, Borthwick and Hammatt 1990) in an area encompassing some 3,711 acres, which represents roughly 33% of the 11,288 acre Science Reserve (Table 3.2 ; see Figure 3-2). With the exception of a survey undertaken as part of a research project on the Mauna Kea Adze Quarry Complex, all of these surveys were reconnaissance level studies, which by definition are limited in terms of coverage and completeness. The list of previously identified sites is presented in Appendix A.

Five of the 95 sites are of unknown function. The other 90 sites include: (1) 77 shrines; (2) 1 isolated adze quarry-workshop; (3) 1 adze manufacturing workshops; (3) 1 positively identified burial site and 4 possible burial sites with an unknown number of interments at each site, and (4) 5 cairns that appear to be markers built either by surveyors or visitors to commemorate a visit (Appendix 1).

Of the original 95 sites identified in the Science Reserve, 77 or 81% were classified as shrines. An additional 8 shrines are associated with adze manufacturing by-products, one each on Sites 11079, 16203, and 21211 and five on Site 16204. These four sites have been previously interpreted as a different kind of workshop, but the functions are not readily clear. The total number of shrines recorded in the Science Reserve through 1999 is thus 85. The locations of the 95 sites are shown on Figure 3.6.

Table 3.2. Historic Property Types Recorded in the Science Reserve between 1975-1999

Site Type	Number	Percent Total
Shrines	77	81.05
Isolated Adze Quarry-Workshop	1	1.05
Workshop	1	1.05
Adze Quarry Ritual Complex	1	1.05
Burials and Possible Burials	5	5.26
Stone Markers/Memorials	5	5.26
Unknown Function	5	5.26
TOTAL	**95**	**100%**

Note: The number of sites recorded between 1975 and 1999 was previously reported as 93 (McCoy 1999a). Two sites (21436 and 21437) located just below the Science Reserve boundary that were recorded in 1997 were omitted. They are included as part of the inventory because of their proximity to the boundary.

3.2 HALE PŌHAKU AREA

The second area that is managed by UH is a 19.3-acre site at Hale Pōhaku (CDUP No. HA-1819, Tax Map Key 4-4-15:12) encompassing the Onizuka Center for International Astronomy (OCIA), the Visitor Information Station, and an old construction laborer camp. Some of the cabins in the old camp are now used by the OMKM rangers; others are available for rent by the public for short-term use.

A number of archaeological investigations have been conducted at Hale Pōhaku, both in and outside of the 19.3-acre parcel (Table 3.3; see Figure 3.5), beginning with a one-day reconnaissance survey by the Bishop Museum in 1979 for the Hale Pohaku Mid-Level Complex Development Plan. No sites were found at that time (McCoy 1979). Three more surveys were conducted by the Bishop Museum between July 1984 and June 1985 as part of the preparation of a supplemental Environmental Impact Statement

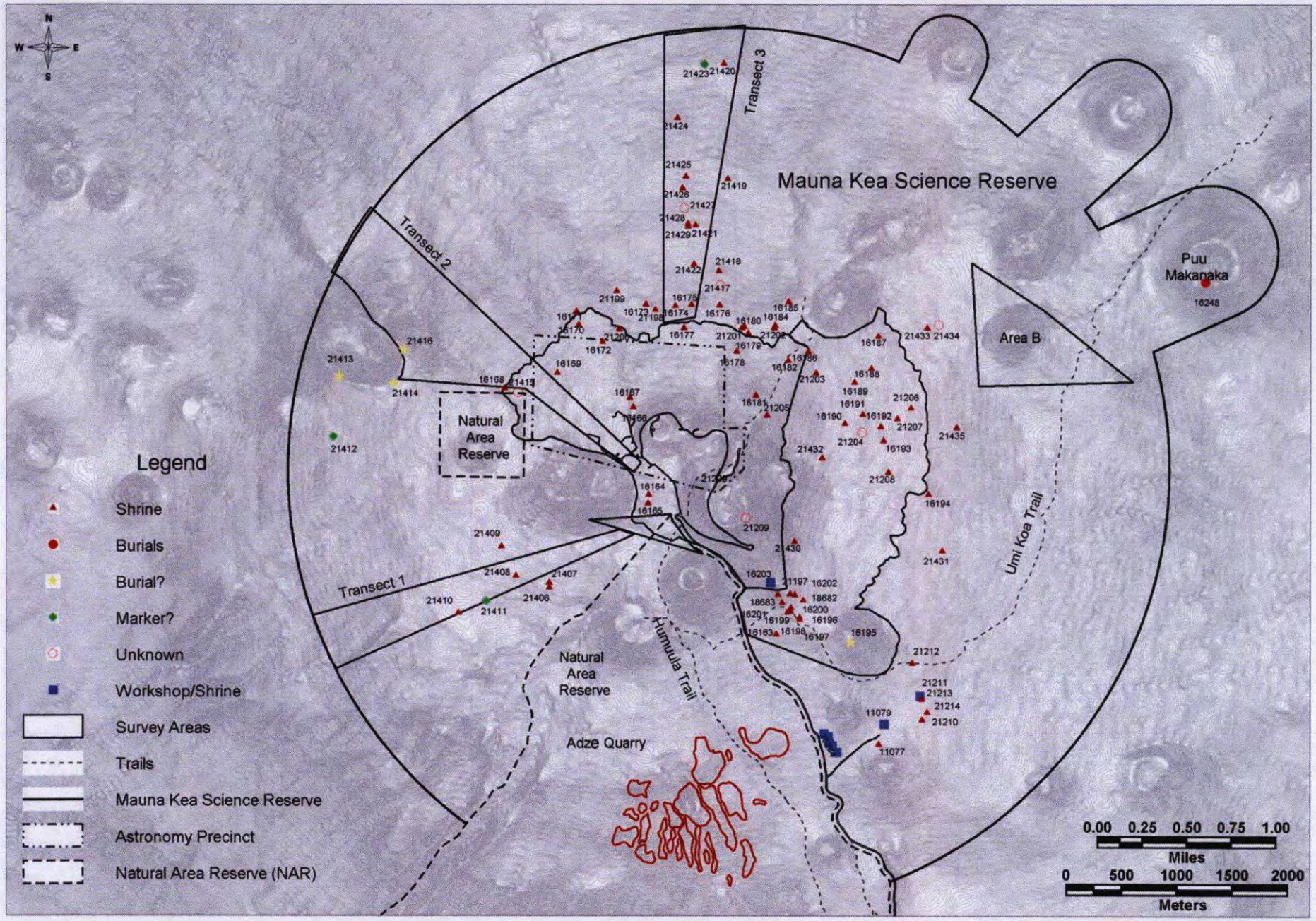


Figure 3.6 Location of Historic Properties and Other Cultural Resources Identified in the Science Reserve Between 1975 and 1999.

(EIS) for a permit to build a new construction laborer camp (McCoy 1985b). Two shrines and five lithic scatters comprised of adze manufacturing by-products and octopus sinker manufacturing by-products were recorded in the surveys, which encompassed roughly 40 acres on the west and east sides of the Mauna Kea Observatory Access Road between the ca. 9,080 and 9,200 ft elevations. The lithic scatters and shrines, one of which has octopus manufacturing by-products on it that have been interpreted as offerings, were designated the Pu`u Kalepeamoa Site (Bishop Museum site number 50-Ha-G28-87) after the name of one of the large cinder cones at Hale Pōhaku (McCoy 1985a, 1985b). This cone, through which the summit access road passes, is the source of the stone (primarily dunite and gabbro) used in the manufacture of the sinkers. The two shrines and some of the lithic scatters found in the 1984-85 work are located outside of the Mid-Level facility parcel, as are some other 9 recorded lithic scatters found in later work (see Figure 3.5). SHPD arbitrarily assigned SIHP numbers to the two shrines and 12 lithic scatters (Cordy 1994) and to the site complex as a whole (16244) which corresponds to the BPBM site number. The Bishop Museum designations and corresponding SIHP numbers are presented in Appendix C of the draft Cultural Resource Management Plan for the UH management areas on Mauna Kea (McCoy et al. 2009; Appendix C).

Table 3.3. Previous Archaeological Investigations at Hale Pōhaku.

Year	Project	Investigation	Reference
1979	Hale Pōhaku Mid-Level Facilities Complex Development Plan	Reconnaissance survey	McCoy 1979
1984-85	Supplemental EIS for Construction Laborer Camp	Reconnaissance survey	McCoy 1985b
1986	HELCO transmission line and substation	Reconnaissance survey	Bonk 1986
1987	HELCO transmission line and substation	Reconnaissance survey	Sinoto 1987
1987	HELCO substation and surrounding area	Data recovery	McCoy 1991
1990	Japan National Large Telescope Dormitories	Reconnaissance Survey	Robins and Hammatt 1990
1993	Japan National Large Telescope Dormitories	Data Recovery	Hammatt and Shideler 2002
2005	Septic Tank Excavations	Monitoring	McCoy 2005

In early 1986 the late William Bonk of the University of Hawaii at Hilo conducted a reconnaissance survey of a proposed new HELCO transmission line and substation located at Hale Pōhaku. No historic sites were found in the survey which extended from an existing 69 KV powerline north of the Saddle Road and west of the Mauna Kea Access Road, (Bonk 1986) to the substation location at Hale Pōhaku. The alignment that Bonk surveyed, however, was different from the final alignment (see Figure 3.5).

The subsequent discovery of lithic artifacts in the vicinity of the HELCO substation led to a data recovery project that involved additional survey and surface collections at 11 different lithic scatters and limited test excavations of two of the scatters (Sinoto 1987; McCoy 1991; Figure 3.7). A total of 2,364 artifacts and 129 faunal remains were collected. In addition to the debris related to adze and octopus sinker manufacture some 20 special purpose bird cooking stones called *pohaku `eho* were found. Three radiocarbon dates from charcoal recovered in fire pits indicate that the site, which has been interpreted as a temporary camp occupied on the ascent to and descent from the Mauna Kea Adze Quarry, is of late pre-contact age (ca. AD 1600-1700).

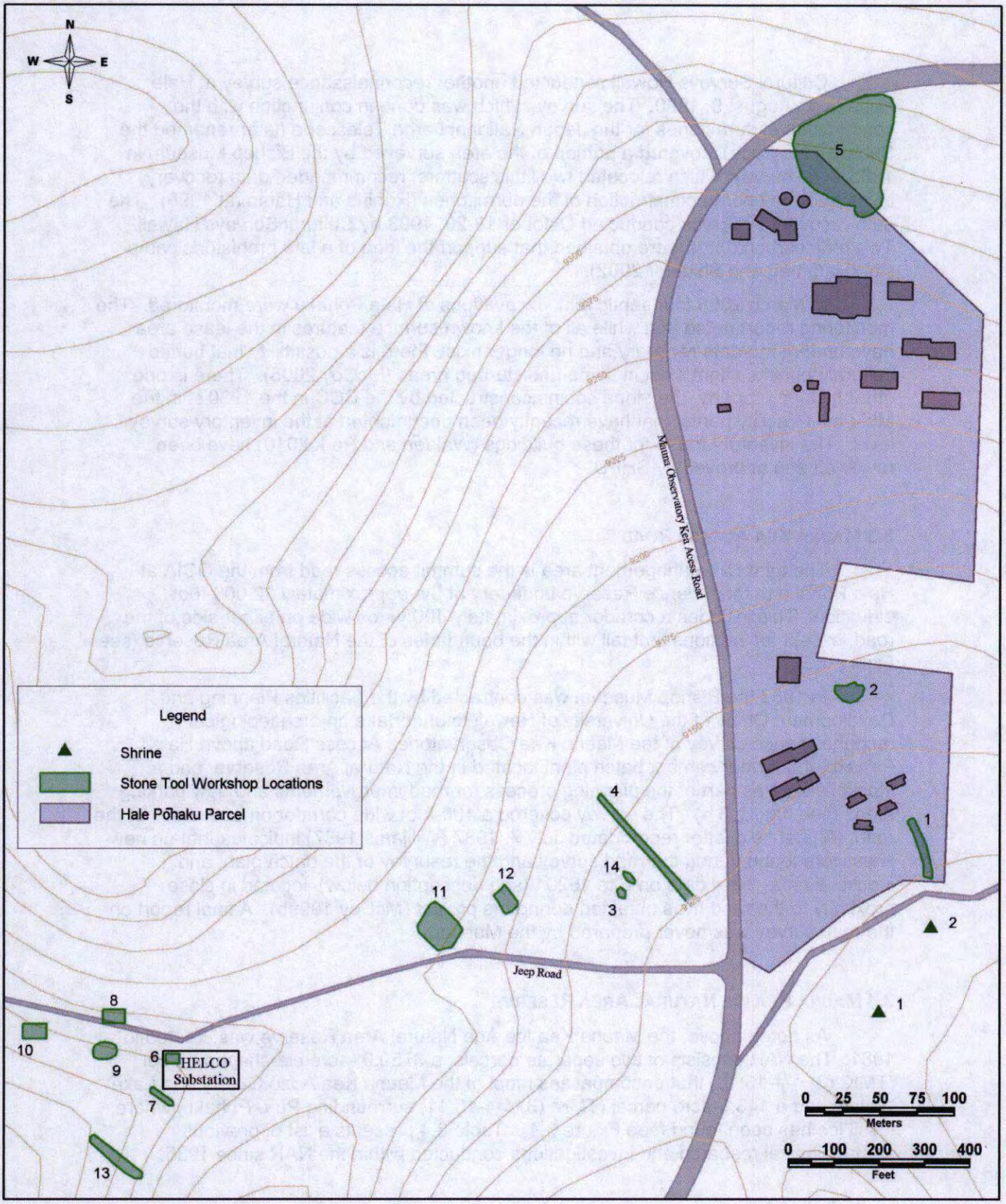


Figure 3-7 Locations of Historic Properties in the Hale Pōhaku Area

Cultural Surveys Hawaii conducted another reconnaissance survey at Hale Pohaku on August 9, 1990. The survey, which was done in conjunction with the construction of dormitories for the Japan National Large Telescope (later renamed the Subaru Telescope), covered a portion of the area surveyed by the Bishop Museum in 1985. The survey, which relocated two lithic scatters, recommended data recovery investigations prior to construction of the dormitories (Robins and Hammatt 1990). The data recovery work was conducted October 19-20, 1993 by Cultural Surveys Hawaii. Two radiocarbon dates were obtained that support the idea of a late prehistoric camp site (Hammatt and Shideler 2002).

In March 2005 four septic tank excavations at Hale Pōhaku were monitored. The monitoring report noted that while all of the known surface features in the lease area have undergone data recovery and no longer exist, there is a possibility that buried cultural deposits might exist in some undisturbed areas (McCoy 2005). There is one other historic property, the stone cabins constructed by the CCC in the 1930's, in the Mid-Level Facility parcel that have recently been documented at the inventory survey level. The inventory forms for these buildings (Walden and Park 2010) have been reviewed and approved by SHPD.

3.3 Mauna Kea Access Road

The third UH management area is the summit access road from the OCIA at Hale Pōhaku to the Science Reserve boundary at the approximately 12,000-foot elevation. This includes a corridor approximately 400 yards wide on either side of the road, except for sections that fall within the boundaries of the Natural Area Reserve (see Figure 1.2).

In 1987 the Bishop Museum was contracted by the Facilities Planning and Development Office of the University of Hawaii to undertake an archaeological reconnaissance survey of the Mauna Kea Observatories Access Road above Hale Pōhaku, the former cement batch plant located in the Natural Area Reserve, and a stockpile area as part of the planning process for road improvements and new parking areas (see Figure 3.4). The survey covered a 100-foot wide corridor on both sides of the road. A post-field letter report dated July 7, 1987 (Williams 1987) indicates that no new sites were found during the road survey and the resurvey of the batch plant and stockpile area. New data on Site 16204 (see description below), located in close proximity to the road, was obtained during the project (McCoy 1999b). A final report on the road survey was never prepared by the Museum.

3.4 Mauna Kea Ice Natural Area Reserve

As noted above, the Mauna Kea Ice Age Natural Area Reserve was created in 1981. The NAR consists of two separate parcels, a 3750.0 -acre pie-shaped parcel (TMK: (3) 4-4-15:10) that encompasses most of the Mauna Kea Adze Quarry and Lake Waiau, and a 143.5-acre parcel (TMK: (3) 4-4-15:11) surrounding Pu`u Pōhaku, where fossil ice has been found (see Figure 3.4). Table 3.4 presents a list of previous archaeological research and investigations conducted within the NAR since 1935.

Table 3.4. Previous Archaeological Research and Cultural Resource Management Studies in the Natural Area Reserve

Year	Project	Study	Reference
1935	Hawaiian Academy of Science Expedition	Reconnaissance	Wentworth et al. nd
1937	Independent Research on Mauna Kea Adze Quarry	Reconnaissance	Emory 1938
1956	Independent Research on Mauna Kea Adze Quarry	Mapping and Description of a rockshelter	Y. Sinoto field notes
1971	Geo-Archaeological Research on Mauna Kea Adze Quarry	Test Excavation of Site 50-Ha-G28-6	Barrera field notes
1975-76	NSF Research Project on the Mauna Kea Adze Quarry	Reconnaissance and inventory survey	McCoy 1977, 1978, 1990; Cleghorn 1982; Allen 1981; Williams 1989)
1984	Bishop Museum Survey	Reconnaissance of Lake Waiau and Pu`u Hau Kea	Carter and Peterson field notes
1997	SHPD Survey	Reconnaissance of Lake Waiau	SHPD field notes
2007	PCSI Survey	Inventory Survey of Lake Waiau Area	McCoy and Nees 2009

Several 19th century expeditions to the summit region spent some time passing through what is now the Mauna Kea Ice Age Natural Area Reserve and occasionally stopping at one well known locality named Keanakako`i, or Keanakāko`i, which translates literally as "cave of the adze," appeared for many years on USGS quadrangle maps and according to some is the traditional name for what has become to be called the Mauna Kea Adze Quarry Complex, although another similar name, Kaluakako`i also appears in the literature (Maly and Maly 2005:279). The existence of the adze quarry was reported in the first recorded European ascent of Mauna Kea by Joseph Goodrich in 1823. Short accounts of the quarry complex appear in the records of other late 19th century and early 20th century expeditions to the mountain. One of the most informative is the account of W.D. Alexander's party, in 1892. About half an hour after leaving Lake Waiau, on the descent back to base camp, the party came to what they called the "axe-makers" cave called Keanakāko`i:

> This is situated about a mile south of Waiau, and a hundred yards west of the trail, in a ledge of that hard, fine-grained kind of rock, which ancient Hawaiians preferred for their stone implements. Here we saw the small cave in which the axe-makers lodged, their fire place, and remains of the shell fish they ate. In front of it is an immense heap of stone flakes and chips some 60 feet across and 20 or 30 feet high. Near by several hundred unfinished axes are piled up just as they were left by the manufacturers, when the arrival of foreign ships and the introduction of iron tools had ruined their trade…It was here that the late Dr. Hillebrand found a curious idol, which is still in the possession of his family (Maly and Maly 2005:189).

One of the earliest and most interesting descriptions of the adze quarries on Mauna Kea was made by William Brigham in his treatise *Stone Implements and Stone Work of the Ancient Hawaiians*.

His description, which contains several factual errors, was nonetheless the first to acknowledge the quarry as the most important of all those known at the time:

> Let us climb to the workshop of the adze maker. All these were in high places, and one on Mauna Kea, Hawaii, was nearly 12,900 ft. above the sea. As good clinkstone was not found in many places the known quarries hardly exceeded half-a-dozen. On Hawaii was the most important of all, that on Mauna Kea, where the workmen could only work in favorable seasons for the snow frequently covered the quarry, but from the immense quantity of fragments and chips the work must have extended over many generations; so far as known, this was the earliest quarry exploited, and it is puzzling how the place was discovered when we consider the aversion the Hawaiians had to even visiting those high, bleak and desert regions, the supposed abode of spirits not always friendly. It is possible that the tradition which speaks of the survivor of the deluge of Kahinalii grounding on Mauna Kea and following the receding waters to the lower levels, discovering the koi pohaku on the way, may point to the considerable antiquity of adze-making in this place, but I am inclined to believe that all traditions of the Hawaiian deluge date after the coming of the Spanish discoverers. It has always seemed strange that the axe-makers did not bring the raw material down to their homes and work it up in comfort instead of freezing in their kapa garments at this great altitude. It may be that the mystery of the place and its very solitude kept the trade in few hands and so enhanced the value of a tool that so many must have (Brigham 1902:75-76).

Of particular interest is Brigham's reference to the aversion of Hawaiians to high desolate places and the discomfort of working under less than favorable conditions; the possible link between environmental conditions and the labor component of the production process, and the probable influence this had on the value of a tool that as he so neatly put it *"so many must have*."

Robert Aitken, a member of the 1935 Hawaiian Academy of Science Expedition, made some general observations about the quarry which are summarized in the unpublished manuscript of the expedition (Wentworth et al. n.d.). In 1937 Bishop Museum archaeologist Kenneth Emory visited the quarry over a three day period. He photographed and briefly described some of the shrines and rockshelters. A popular account of Emory's visit appeared in *Paradise of the Pacific* (Emory 1938:21-22).

Dr. Yosihiko Sinoto sketched and described one rockshelter in 1956. In 1971, the late William Barrera partially excavated a 50 cm square test pit in the floor of a rockshelter that was subsequently recorded as Bishop Museum Site 50-Ha-G28-6-R1 (SIHP Site 50-10-23-16209). The excavation was undertaken in conjunction with geological and soil studies by Drs. Stephan Porter and Fiorenzo Ugolini of the University of Washington. No report was ever prepared on the excavations (McCoy 1977:223-224).

The first major archaeological investigations of the adze quarry were conducted over a 7-month period in the summers of 1975-76. The 1975-76 project, which did not cover the whole of the quarry, identified 37 sites, two of which are located in the Science Reserve. The sites included 263 workshops comprised of 1566 "chipping stations" with 182 open-air enclosures; 39 rockshelters (this includes what were originally called overhang shelters); 40 shrines; 2 rock art localities and 1 basaltic glass source and workshop.

The Mauna Kea Adze Quarry Complex, one of the most significant historic sites in the Hawaiian Islands, was placed on the National register of Historic Places in 1962 as a National Historic Landmark (NHL). The boundaries of NHL have yet to be officially established by the National Park Service. Boundary recommendations were made in 1978 following the research in the best known and most accessible part of the quarry in 1975-76 (McCoy 1978:Figure 2). On present evidence the quarry covers not only more area but also contains a larger volume of manufacturing by-products and related archaeological remains than all of the other known adze quarries in the Hawaiian Islands combined (McCoy 1977; McCoy and Gould 1977). Fieldwork west of Pōhakuloa Gulch, in 1984-85 and again in 2007, indicates that the quarry encompasses a larger area than what was reported earlier, at the conclusion of the first phase of research in 1975-76 (McCoy 1977; McCoy and Gould 1977). Most of the quarry complex is located in the NAR, but some sites are located in the Science Reserve. Quarry and workshop sites have also been found on Mauna Kea Forest Reserve lands.

A reconnaissance survey of the Lake Waiau area was conducted in 1976 during the second field season of the Mauna Kea Adze Quarry research project (McCoy 1977, 1978). Little time was devoted to the survey of the lake area after finding that there was no tool-quality basalt in the immediate environs. No artifacts linking the lake to the adze quarry were found in the survey, but the lake was included in the proposed boundaries of the Mauna Kea Adze Quarry National Historic Landmark based on the assumption that not only was the lake a part of the "effective environment" used and possibly modified by Hawaiian adze makers, but because of the potential of the lake to aid in the interpretation of paleoenvironmental changes through the study of fossil pollens contained in the lake sediments (McCoy 1978:17-18). In addition, it was assumed that the location of the lake, just below the summit of the mountain, held special cultural significance for the adze makers and other Hawaiians. One site, a cluster of cairns located above the northwestern side of the lake, was recorded and assigned a site number in 1976 (BPBM Site No. 50-Ha-G28-36). The site marks the northwest corner of the proposed NHL boundary (McCoy 1978:Figure 2).

A sketch map showing cultural features at the lake and on the rim of Pu`u Hau Kea was made on July 28, 1984 at the end of the reconnaissance survey of ca. 1,000 acres of land on the east slope (McCoy 1984b). A number of features were noted on the rim of the Pu`u Waiau and below, along the margins of the lake. Two possible cairns were noted in a quick reconnaissance around the rim of Pu`u Haukea (Carter and Peterson, unpublished field notes).

Prior to an archaeological inventory survey conducted in 2007 (see below) only one site at Lake Waiau had been given a Statewide Inventory of Historic Places (SIHP) number. A cluster of five cairns and two uprights was assigned Bishop Museum site number (50-Ha-G28-36) in 1976 for the purpose of marking one corner of the recommended boundaries for the Mauna Kea Adze Quarry National Historic Landmark (McCoy 1978: Figure 2). The site was later given a SIHP number (50-10-23-16232) by Cordy during the writing of his *Regional Synthesis of the Hamakua District* (Cordy 1994).

While a number of other features were observed in 1976, 1984 and at other times, it was not until 1997 that a conscientious effort was made to begin recording all of the sites and features at the lake. The survey initiated by SHPD in 1997 was constrained by time, with the result that many sites and features were left unrecorded. The quality of much of the data that were collected was, moreover, not up to inventory survey standards. In view of the obvious need for a more comprehensive survey no SIHP numbers were assigned to the remains recorded in 1997.

Material support for the theory that the lake was frequented by the adze makers was found in the 1997 survey. A flake, presumed to be a waste flake from the adze quarry based on its texture and color, was found near the outlet to lake. While there is no way of knowing when the flake was introduced, it is not part of any modern construction and was in fact found in close proximity to a petroglyph, the first recorded at the lake.

PCSI conducted an archaeological inventory survey of Lake Waiau, located at the 13,020 ft elevation in the Mauna Kea Ice Age Natural Area Reserve, over a 6-day period in July 2007. The survey followed on earlier archaeological reconnaissance surveys in 1976, 1984, and 1997 that had identified a number of features in the immediate environs of the lake. A total of 21 sites comprised of 99 features were found in the survey area which covered approximately 43 acres (McCoy and Nees 2009).

The features recorded during the 2007 survey include possible burials; cairns that may have functioned as survey markers, boundary markers or trail markers; shrines and possible shrines; one trail segment; petroglyphs; lithic scatters related to adze manufacture; a cemented stone pedestal for survey equipment from an 1892 expedition; an historic dump and stone markers or memorials, including the remnants of a memorial plaque to a local cowboy. A number of features that had never been seen before because they are normally covered by water were found in the lakebed which was at a low stand in 2007. Most of these features, which are morphologically similar to previously identified structural remains on the rims of a number of cinder cones in the Mauna Kea summit region, are interpreted as possible burials.

If the remains are in fact burials, it indicates a much more diverse set of mortuary practices than what was previously known at the lake. It mirrors the on-going cultural practice of placing umbilical cords (*piko)* in the lake and on the land. The lithic scatters, which consist of primarily flakes but in one area also include an adze preform and a hammerstone, confirm a long suspected use of the lake by Hawaiian adze makers working in the Mauna Kea Adze Quarry Complex as not only as a probable source of freshwater but for other activities as well.

While none of the 21 sites have been dated, the presence of adze manufacturing by-products suggests that the cultural chronology of Lake Waiau began sometime in the pre-contact era. Continuity in the use of the lake from pre-contact times to the present is evidenced in the remains left by early scientific expeditions, modern altars (*lele*) and less formal rock piles. Remains that are either modern or cannot be classified with any level of confidence as historic sites because of their uncertain age, such as many of the rock piles, were recorded as "find spots," following a practice begun by the State Historic Preservation Division (SHPD) during a reconnaissance survey of selected areas of the Mauna Kea Science Reserve in 1997. A total of 63 find spots were recorded in the project area (McCoy and Nees 2009).

3.5 Hopukani, Waihu, and Liloe Springs

The first published reference to the existence of archaeological sites in the Pōhakuloa Gulch area is contained in a report by Wentworth and Powers (1943) who made the following observations during the course of their geological investigations in 1939:

> One section of the valley is isolated by the steep walls of thick lava flows, above and below which are stone walls built many years ago as a trap in which to

> impound wild cattle that frequented the spring area. The last of the wild cattle have been killed, but a few skulls were to be seen in 1939.
>
> In the area to the east and up the slope from the springs are numerous small heaps of pre-European stone adz workings. Certain lava caves contain evidence of habitation, suggesting that the springs were frequented by adz workers. The latter not only secured adz material from lava flows in places but carried on a surprising amount of casual prospecting on dense basalt boulders included in the moraines and outwash strewn several thousand feet down the mountain (Wentworth and Powers 1943:544).

In a later report on this area, Richardson and Woodside (1954:326-7) noted the presence of dark-rumped petrel (*Pterodroma phaeopygia)* bones and artifacts in a site they named Hopukane Shelter Cave, located at the ca. 10,000 ft elevation. This must be one of the habitation caves seen by Wentworth and Powers in 1939. It appears, more precisely, to be site 50-Ha-G28-34 (renamed Hopukani Rockshelter) based on information obtained from Woodside (personal communication).

The first systematic archaeological investigations in the Pōhakuloa Gulch area were undertaken in 1976, during the second field season of the Mauna Kea Adze Quarry Project (Table 3.5; see Figure 3.4). A reconnaissance survey of the Pōhakuloa Gulch area, between Lake Waiau and Mauna Kea State Park, was conducted over a two-day period (August 14-15, 1976). Five sites were recorded in this survey (unpublished field notes). Two of these sites (50-Ha-G28-34 and 35) are located along or in close proximity to the Pohakuloa Training Area (PTA) waterline. The proposed western boundary of the National Historic Landmark (McCoy 1978: Fig. 2) was established on the basis of the findings made during this survey.

In 1984 six archaeological sites and a number of find spots were identified in a reconnaissance survey of the PTA waterline catchments and pipeline at Hopukani, Waihu, and Liloe springs, located between the ca. 10,400 and 8,640 ft elevations in the western sector of the Mauna Kea Adze Quarry Complex (McCoy 1984a). The 1984 reconnaissance survey consisted of an intensive survey within a 100 meter radius of each spring and a walk-through survey of the intervening areas, covering roughly 50 meters on either side of the pipeline. The survey area encompassed approximately 16 hectares (McCoy 1984a:3). Five adze manufacturing sites and one historic corral were identified in the survey, which confirmed expectations of a significantly larger number and variety of sites in this part of the quarry complex, which includes sites located above and below modern treeline at the ca. 9,500 ft elevation. Indications of even more sites to the west of the major Pōhakuloa Gulch drainage area suggest the probability of a future boundary amendment and need to reassess what has been implicitly regarded as a fringe or marginal area of the larger quarry complex.

A data recovery project was undertaken in 1985 to mitigate the possible adverse effects of proposed repairs to the pipeline on the sites identified in 1984 (Table 3.4). Test excavations of a small overhang shelter at Hopukani Spring (10,400 ft) revealed a small assemblage of waste flakes, hearths and faunal remains suggestive of a temporary, short-term occupation. A much larger and more diversified collection of lithic artifacts and organic materials was recovered in the survey and test excavations of Hopukani Rockshelter (10,160 ft), the only previously known base camp in this region of the quarry. Investigations of the isolated site in the subalpine forest at Liloe Spring (8,921 ft) resulted in the definition of site boundaries and acquisition of data pointing to the existence of an open camp site at this lower elevation locality.

The chronology for this area of the quarry, based on a total of eight radiocarbon dates for the three excavated sites, spans a period of some 700-800 years beginning ca. AD 1000 and terminating some time prior to 1800. Some preliminary ideas regarding the significance of adze manufacturing sites and other sites located in the two major drainages on the south slope of the mountain were presented in a 1984 report:

> The sites located in the mid-elevation reaches of the Pohakuloa and Waikahalulu Gulch drainage systems are of particular importance with regard to questions relating to ascent routes, resource ownership, and general relationships to the main quarry area at the 12,200 to 12,400 ft. elevations. Material recovered in the excavations of Waikahalulu Rockshelter (Site 50-Ha-G28-11-R1) at the c. 10,000 ft. elevation on the gulch of the same name, suggest a strategically located mid-elevation base camp on a southerly ascent route to the primary sources of raw material further up the mountain. Both this site and Hopukani Rockshelter (50-Ha-G28-34) are located just above present treeline in close proximity to freshwater springs, thus providing ready access to water, firewood, and other forest products, including birds, of which there are a number of species in the Waikahalulu camp site (McCoy 1983). The final provisioning of some task groups of adze makers residing in the rockshelters at higher elevations probably took place at these two intermediate camp sites and possibly much of the cooking of foods such as taro and yams as well, although there is as yet no direct archaeological evidence for these activities. There is the added implication, again admittedly speculative, that these upper montane forest base camps were occupied by family groups, including women, engaged in a variety of activities directly related to adze production and, perhaps, other unrelated economic pursuits as well (e.g. feather, fiber and wood crafts).
>
> Equally significant from an historical perspective on later land-use and socio-economic patterns are the walls and corral that functioned as a wild cattle trap. This site reflects a socially, and environmentally critical period in the early post-contact era of Hawaiian-European relations in Hawaii and the Mauna Kea-Waimea-Kawaihae areas in particular (McCoy 1984a:26-27).

Table 3.5. Previous Cultural Resource Management Studies at Hopukani, Waihu, and Liloe Springs.

Year	Project	Study	Location	Reference
1984	PTA Waterline Improvement	Reconnaissance	Hopukani, Waihu, and Liloe Springs	McCoy 1984a
1985	PTA Waterline Improvement	Data Recovery	Hopukani and Liloe Springs	McCoy 1986

3.6 Radiocarbon Chronology for Previously Excavated Sites in the Alpine and Sub-alpine Zones

A suite of 23 radiocarbon dates from eight excavated sites (Figure 3.8; Table 3.6 indicate that the adze quarry industry spanned a period of some 700 years between ca. AD 1100 and 1800. A lower limiting date of perhaps AD 800-1000 seems likely based on the interpretation of stratigraphic evidence from several of the excavated rockshelters. The basal layer of Ko`oko`olau Rockshelter No. 1, for example, is undated and where test excavations have been undertaken exterior of the dripline there is an indication of earlier activity. With regard to an upper limiting or terminal date, there is archaeological as well as ethnohistoric evidence (McEldowney 1982:7) suggesting that

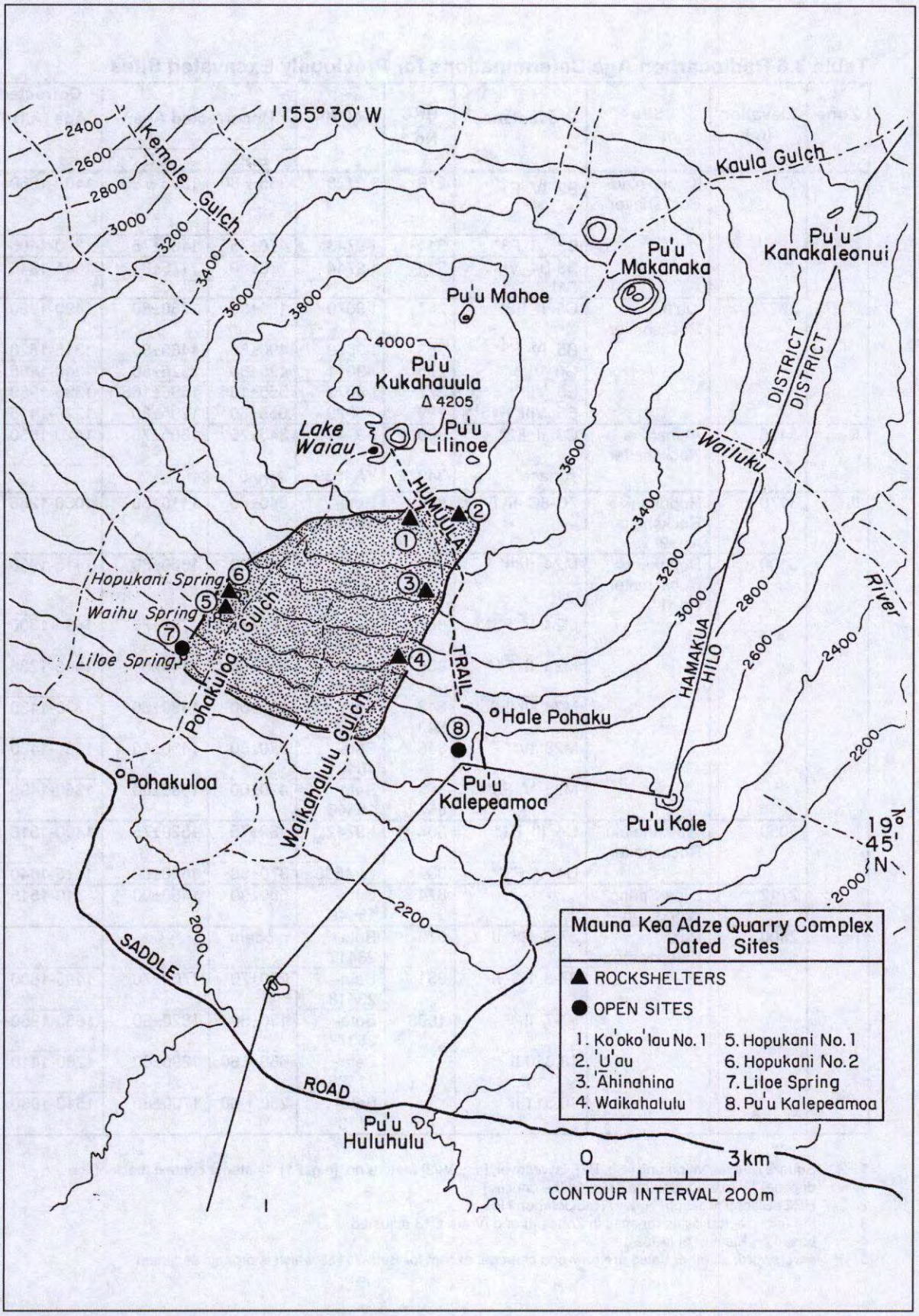


Figure 3.8. Location of Radiocarbon Dated Sites from Previously Excavated Sites.

Table 3.6 Radiocarbon Age Determinations for Previously Excavated Sites

Zone	Elevation (m)	Site	Provenience[1]	HRC No.[2]	Lab NO.	Uncorrected Age[3]		Corrected Age (A.D.)[4]
						B.P.	A.D.	
I	3780	Ko'oko'olau Rockshelter No. 1	B2 IV F1*	279	I-9128	355 ± 80	1595 ± 80	1400-1660
			B3 VI F3*	311	I-9743	470±75	1480±75	1350-1495
			B3-B4 VIII F4*	312	I-9744	775±80	1175±80	1045-1340
	3727	'Ua'u Rockshelter	C5 II F2*	267	I-9070	190±80	1760±80	1490-1950
			B5 IV F3*	263	I-9069	490±80	1460±80	1315-1520
			G5 VI/3 **	275	I-9071	425±80	1525±80	1340-1465
			E5 VIII**	277	I-9072	355±165	1595±165	1335-1950
			E5 VIII F15**	299	I-9929	655±80	1295±80	1225-1415
II	3475	Ahinahina Rockshelter	C3 II F2*	300	I-9741	345±75	1605±75	1420-1650
			surface*	340	W-4539	<200[5]		
III	3170	Hopukani Rockshelter No. 2	7C-8C II F1*	828	Beta-15644	840±60	1110±60	1050-1265
	3100	Hopukani Rockshelter No. 1	M24 II/III*	862	Beta-15647	290±80	1660±80	1415-1950
			M24 V F5*	869	Beta-15648	250±70	1700±70	1495-1800
			M28 II F1**	836	Beta-15645	810±60	1140±60	1065-1285
			M28 III F2b**	842-843	Beta-16400	520±60	1430±60	1330-1430
			M28 IV**	845	Beta-16401	520±60	1430±60	1330-1430
			M28 V F3**	853-857	Beta-15646	470±60	1480±60	1350-1495
	3050	Waikahalulu Rockshelter	C4 III F1*	304	I-9742	430±75	1520±75	1400-1515
			D4 V F3**	307	W-4538	370±60	1580±60	1415-1640
	2712	Liloe Spring Workshop		874	Beta-15649	500±90	1450±90	1310-1515
IV	2800	Pu'u Kalepeamoa	87-8 H8 II	979	Beta-23417	modern		
			87-8 H8 II	981	Beta-23418	250±70	1700±70	1495-1800
			87-7 II	1008	Beta-26377	130±50	1820±50	1650-1950
			10,310 II		Beta-71138	660 ± 60	1290±60	1260-1410
			10,311 II		Beta-71139	250 ± 60	1700±60	1510-1950

1 Square or excavation unit [e.g. B2], layer/level, [e.g. VI/3] feature no. [e.g. F1]; *=interior context [back of the dripline] **=exterior context [beyond the dripline]
2 HRC=Bishop Museum Hawaii Radiocarbon No.
3 the uncorrected dates for sites in Zones III and IV are C13 adjusted
4 based on Klein et al (1982)
5 silversword; all other dates are on wood charcoal except for Beta-71138 which is organic sediment

the quarry may have been abandoned prior to or just following first known European contact in 1778 (see Section 7 for further discussion of the chronology of adze.

The 840 ± 60 B.P. date (Beta-15644) for the occupation of the Hopukani Spring Overhang Shelter is somewhat older than expected, but not out of line with the early dates for `Ua`u Rockshelter and Ko`oko`olau Rockshelter No. 1 in the main quarry (see Figure 3.8; see Table 3.6). The date is associated with a temporary occupation and, thus, should not be interpreted as marking the beginning of intensified adze manufacture at this locality, or even this region of the quarry. On present evidence the chronology of long-term, repeated exploitation of the drift deposits on and below the Makanaka and Waihu glacial moraines is believed to have begun ca. AD 1300. Terminal dates are not available for Hopukani Rockshelter, but the cultural sequence almost certainly ends prior to 1800. The 500 ± 90 B.P. date (Beta-15649) for the Liloe Spring Site is consistent with the Hopukani Rockshelter dates, thus suggesting broad contemporaneity of adze manufacturing locales in the subalpine forest and the larger, more visible ones above treeline. This interpretation is consistent with the chronological relationships of lower and higher elevation sites elsewhere in the quarry.

On present evidence, which is limited to five dates from very limited testing, the Pu'u Kalepeamoa site is a late prehistoric and possibly even protohistoric age site (see Figure 3.8; see Table 3.6). It appears to be one of the latest sites in the quarry sequence which spans a period of approximately 700 years between ca. AD 1100 and 1800. Given that all but one of the dates are consistently late, there does not appear to an "old wood problem" (Schiffer 1987:309-312; cf. also Gould 1990:19-21). The one anomalous date (Beta-71138) is organic sediment (Hammatt and Shideler 2002).

A comparison of the available dates (see Table 3.6) indicates that the sites with the earliest and longest sequences are located along the escarpment in what I have elsewhere referred to as Zone 1 (McCoy 1990) and at Hopukani Spring in Zone 3. In sharp contrast to this pattern are the lowest elevation sites, the Pu`u Kalepeamoa site and the Saddle Road lava tube shelter, which appear to have been occupied for a brief period of time after ca. AD 1600-1700.

3.7 Assessments and Mitigation Plans

Cultural assessment studies have been undertaken for two of the more recent projects. One is a traditional cultural property assessment and the other a cultural impact assessment, which is now required under Chapter 343 for Environmental Impact Statements. A draft Historic Preservation Plan (HPP) was developed for the UH Management Areas on Mauna Kea in 1999 and PCSI is in the process of developing a cultural resource management plan for the same areas.

3.7.1 Traditional Cultural Property Assessments

Traditional cultural properties are a type of historic property that was formally defined for the first time in 1998 by Patricia Parker and Thomas King, in National Register Bulletin 38 (*Guidelines for Evaluating and Documenting Traditional Cultural*

Properties). TCP's, to use the commonly used acronym, were defined by Parker and King defined as follows:

> A traditional cultural property, then, can be defined generally as one that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community (Parker and King:1998:1).

Parker (1993) notes that an important difference between traditional cultural properties and other kinds of historic properties is that the significance of tcp's "cannot be determined solely by historians, ethnographers, ethnohistorians, ethnobotanists, and other professionals. The significance of traditional cultural properties must be determined by the community that values them" (Parker 1993:5). The Hawaiian oral traditions summarized in Section 2 testify to the importance of Mauna Kea and the summit in particular.

At the request of SHPD, Dr. Charles Langlas of the University of Hawaii at Hilo conducted a TCP assessment of Mauna Kea in 1997 as part of the cultural resource management studies for the Hawaii Defense Access Road and Saddle Road Project. Langlas' work was undertaken in conjunction with a social impact assessment of the proposed road improvements on the *mamane-naio* forest (Kanahele and Kanahele 1997). The studies had two objectives: "(1) to evaluate the two areas as to their potential eligibility for the National Register of Historic Places, and (2) if eligible, determine the effect of the project and how to mitigate any adverse effect" (Langlas 1999:1). A letter written in March 1999 that accompanied the submittal of a supplement to the main study (Langlas et al. 1997), indicated that "the author intended to conclude that although the whole upper zone of Mauna Kea should be considered eligible as a traditional cultural property for the National Register of Historic Sites (as a historic district), he cannot recommend that the summit peak be considered eligible as a specific site, because he cannot make public the information he collected by Kupuna X" (Langlas 1999).

During the preparation of the Master Plan, in 1999-2000, SHPD designated three areas as TCP's because of their association with legendary figures and on-going cultural practices. Two of the TCPs, which are described in Section 5, are located in the Science Reserve. These include the summit (Kūkahau`ula) and Pu`u Līlīnoe. The third is Lake Waiau, which is located just outside of the Science Reserve in the Mauna Kea Ice Age Natural Area Reserve.

Tom King, in the declaration he submitted as part of the contested case hearing for the Keck Outrigger project (King 2003), stated his opinion that the landscape on the upper slopes of Mauna Kea meets the eligibility criteria for inclusion in the National Register as a TCP (King 2003:6-7). There are other individuals who believe that all of the lands above the 6,000 ft elevation should be recognized as a TCP (NASA 2005:xv).

3.7.2 Cultural Impact Assessments

A cultural impact assessment study was undertaken by Paul H. Rosendahl, Ph.D. Inc. (PHRI) for the EIS for the Master Plan under "Chapter 343-Environmental Impact Statements" (HRS) and "Title 11, Chapter 200-Environmental Impact Statement Rules" (HAR, Department of Health). Office of Environmental Quality Control (OEQC)

guidelines were employed in the study, which was focused on determining what effects implementation of the Master Plan would have on Native Hawaiian cultural practices, features and beliefs. The primary sources of information used in the assessment were oral histories and consultations undertaken by Kepa Maly, who at the time was employed by PHRI. Another of Maly's reports was included in the Master Plan as Appendix I (Maly 1999).

The cultural impact assessment identified a number of traditional and customary practices, several potential traditional cultural properties and several kinds of contemporary cultural practices, some of which may represent continuity of older practices, but also including practices where "no clear specific basis in traditional culture can be clearly established or demonstrated" (PHRI 1999:Table 2, 40). The PHRI report summarized Native Hawaiian perspectives on the Master Plan, from which Maly presented six recommendations, and a concluding discussion of potential mitigation measures.

3.7.3 Preservation and Burial Treatment Plans

In 1999-2000 the State Historic Preservation Division of the Department of Land and Natural Resources began preparing a Historic Preservation Plan (HPP) for the UH management areas on Mauna Kea. A final HPP was never completed before the authors of the plan left SHPD, but parts of the HPP were included in the Mauna Kea Science Reserve Master Plan as appendices. These included "Mauna Kea Historic Preservation Plan Management Components" (Appendix F, SHPD 2000) and "Mauna Kea Science Reserve Archaeological Site Inventory: Formal, Functional, and Spatial Attributes" (Appendix K, McCoy 1999a).

The SHPD Plan identified all of the major activities and actions that could have a potential adverse effect on historic properties located in the state lands managed by UH and the means by which such effects could be mitigated to ensure the long-term protection of individual historic properties and the Mauna Kea Summit Region Historic District as a whole. It also summarized existing management policies, which included the NAR, and made a number of additional policy recommendations.

In 1999 NASA proposed the addition of four and possibly as many as six outrigger telescopes to the W.M. Keck Observatory. After consultation with SHPD, NASA determined that the proposed project, which was classified as an undertaking under Section 106 of the National Historic Preservation Act would have an adverse effect on the summit, which had been recognized as a significant historic property. The finding of adverse effect prompted the development of a Memorandum of Agreement (MOA). One of the stipulations in the MOA was the need to develop, prior to construction, an Inadvertent Discovery of Human Remains and Archaeological Properties Monitoring Plan.

While NASA later withdrew the funding for the Outrigger Project, following legal challenges, the MOA (Appendix B) and the Burial Treatment Plan (Appendix C) included in the Final Environmental Impact Statement (FEIS) are important documents that could be used as models in the development of future construction monitoring plans and burial treatment plans.

PCSI began preparing a CRMP for all three of the UH management areas on Mauna Kea in 2007. A draft of the CRMP (McCoy et. al. 2009) has been reviewed by OMKM and its cultural advisory group, the Kahu Kū Mauna Council. A series of public consultation meetings were held on the island of Hawai`i in 2008. The results of these meetings have been summarized in the draft plan. The CRMP was approved by the UH Board of Regents on November 19, 2009.

4.0 ARCHAEOLOGICAL THEORY AND PRACTICE

Many archaeologists, including the authors of this report, have ambivalent feelings toward "archaeological theory," especially toward some of the grand theories with a capital "T" that derive from philosophy, such as the covering law model. For us, theory is not synonymous with the hypothetico-deductive system.

One of the problems with modern archaeological theory is that it has become increasingly "rarified and removed" (Hodder 2001:4). Another problem is the existence of competing and often conflicting theoretical paradigms which tend, moreover, to be abstract. Without any obvious or immediate relevance "Abstract theory for theory's sake becomes engaged in battles over opposing abstract assertions" (Hodder 2001:4). Some archaeologists even question the existence of archaeological theory. Johnson argues that *we are all theorists* (his emphasis), whether we admit to it or not, because anyone involved in the production of archaeological knowledge uses "theories, concepts, ideas, assumptions in their work" (Johnson 1999:6). Shanks and Tilley go even farther in concluding that "The facts of the case become facts only in relation to convictions, ideas and values" (Shanks and Tilley 1987:104).

Hodder, who is clearly opposed to abstract theory, has noted that "archaeological theory is always "of something" and the recognition of this "undermines claims for a universality and unity of archaeological theory" (Hodder 2001:5). Lacking a universal theoretical underpinning, there are many archaeologists who argue that we should forget about theory and just "get on the business with doing archaeology." For other archaeologists, including the senior author, this is unacceptable:

> Ignoring philosophical and theoretical concerns is no way out. Such an approach, urging us to simply press on with the study of data without worrying about the niceties of theory, presumably inviting us to respond directly to that data, assumes that the lack of any systematic approach or procedure is somehow a miraculous guarantee of objectivity. Such a common-sense approach systematically evades any confrontation with its own premises, safeguards any methodology which is currently available and, in this manner, produces the very opposite of objective problem-free research. Empirical research presented as the obvious stuff of common sense is never called upon to guarantee its consistency, silences, and contradictions and hence is entirely unsatisfactory (Shanks and Tilley 1987:33).

4.1 THE THEORY-DATA DIALECTIC

While there is certainly a place for theory, it is, of course, also possible to go into the field without any theoretical presuppositions and make useful observations that can contribute to new ideas and new theories. Indeed, many archaeological projects are "*data-led*" (Hodder 1999:51). One reason is that the kinds of sites under investigation constrain the types of questions that can be asked (Hodder 1999:51). In the case of archaeological surveys there are, moreover, several potential problems with a strict problem-oriented approach and rigid adherence to the deductive method:

> It may be recognized (Charles Redman, in discussion) that strict problem orientation may miss a great deal, and that simply being open to what may happen to turn up in an excavation is a quite legitimate research strategy. There is nothing wrong with sensitive exploration, being open to finding out (Shanks and Hodder 1995:16).

> The usual contemporary attempt to provide research with rigor, to conquer the difficulties inherent in the natural process of observation and conceptualization, is framed deductively. Studies, we are instructed, should begin and move forward with explicitly stated hypotheses that are continuously tested and refined. Such studies are always methodologically admirable, but they may easily become trivial if the initial hypothesis was incorrectly formed with relation to the objects selected for study. An equally important trouble with the general demand for deductive research is that the scholar might like to approach a new problem, and yet find himself without enough information to form a useful first hypothesis (Glassie 1975:14).

Without hypotheses to test it is necessary to use an inductive approach based on the search for meaningful patterns in the data that have been collected. More important is the need for a rigorous method of recording data (Glassie 1975:116). As Glassie has written, "It is no test of the scholar or his craft to invent a theory and pop bits of information into it" (Glassie 1975:13).

Whether a researcher starts with a theory or collection of raw data, to make any significant contribution to archaeological knowledge requires going back and forth between the two (Jones 2002:37). Shanks and Tilley (1987) and Hodder (1999) describe the tacking between data and theory as a dialectical process:

> Archaeological interpretations of the past are not secondary to the physical reality of the past, the objects in the archaeological record. Understanding the past is a dialectical process occasioned by continual adjustments of ideas, concepts and representations and is not something that could be fixed by a single method such as the hypothetico-deductive method (Shanks and Tilley 1987:108).

4.2 THEORETICAL ORIENTATION

Philosophically, the senior author is a realist in the way it was defined by Hirst (1967) and summarized by Bunge: "Realism is the view that material objects exist externally to us and independently of our sense experience" (Hirst 1967). It is the epistemology that all of us adopt tacitly when not under the influence of narcotics or anti-scientific philosophies" (Bunge 1996:326). Trigger provided a short but useful contrast with an idealist and a positivist:

> An idealist epistemology generalizes the everyday processes by which human beings deal with each other; a positivist one generalizes the way in which humans cope with the natural world; and a realist one takes account of the selective processes acting on all forms of human behavior (Trigger 1998:9).

In contrast to idealism and positivism, realism is "anti-reductionist and embraces a view of science that takes account of the need for employing different modes of inquiry to study different kinds of phenomena" (Trigger 1998:6). The realist, in Trigger's view, "believes that some imperceptible entities, either processes or phenomena that are presently unobservable, are appropriate objects for scientific investigation even if they can be known only conceptually" (Trigger 1998:6).

For a realist the "archaeological record is a product of human behavior that was shaped with varying degrees of directness by material constraints, as these were comprehended in terms of culturally conditioned understandings of reality" (Trigger 1998:12). Aronson et al. (1995:43) summarize a point of view that to them and many

other people is obvious, that "nature is intransigent and unforgiving" and that "There are causal structures that exist independently of the theories and projects and beliefs of human kind, that are totally unaffected by the way we classify things" (Boyd 1990:183). We agree. As discussed in an earlier report on Mauna Kea (McCoy 1990:86), there is a need to recognize that there are different kinds of material realities, including some like climate, which "remains outside the direct or indirect sway of humankind, but never ceases to affect it" (Godelier 1986:4).

Rather than claiming that the environment is limiting we think it is preferable to follow Glassie in saying that "The physical environment constrains, but it does not direct. It provides the stage upon which cultural options are sorted out, rejected, accepted, and ordered into a particular cultural logic" (Glassie 1975:189; cf. Sahlins 1976 for a similar but even stronger statement, albeit a controversial one, regarding the autonomy of cultural logic). Hodder elaborates on the implications for archaeology:

> The causes of variability in the archaeological record are not cultural or natural. They are both. Many archaeologists would now accept that while the environment and material forces constrain human endeavour, the specific character of human behaviour is equally informed by cultural choice and human intention. This dialectical view has been arrived at from many directions (Hodder 1999:199).

The senior author also favors the interpretive as opposed to the evolutionary perspective as summarized by James Peacock in the following passage:

> The evolutionary perspective tends to an "objective" positivist stance. This is partly due to the large scale of the evolutionary perspective, so that life is viewed from afar in order to see the whole panorama. Accordingly, life is viewed, not engaged...If humans are seen as aspects of a process, they are seen as worked over by such massive mechanisms as natural selection, the process through which the survival of traits is determined by the environment. The subjective viewpoints are of little interest and, in fact, raise the spectre of what evolutionists term the "teleological fallacy" (the fallacy that subjective purposes affect the evolutionary process, which, instead, should be seen as governed by the law of natural selection regardless of any petty motives and purposes...). Given the irrelevance of the actor's viewpoint, humans are treated as part of nature and analyzed according to natural laws (Peacock 1986:98-99).

It is not that the evolutionary perspective is wrong, but that like all paradigms, including the ecological paradigm with which it is commonly linked in the New Archaeology, it is limited (Peacock 1986:96; Pauketat 2004). Trigger summarizes the major shortcomings of the evolutionist perspective in the context of the debate between the older "processual" and the newer "post-processual" archaeology:

> Yet, contrary to the predictions of processual archaeology, during the last fifteen years there has been a growing realization among archaeologists that there is more variation in the archaeological record, and hence in human behavior, than can be accounted for in terms of neo-evolutionism and ecological determinism. This calls into question the distinction that processual archaeologists drew between evolutionism and history, as well as their assertion that, because evolutionism is more generalizing, its study is superior to that of history, in the sense that all or most specific historical situations can be explained in terms of small number of evolutionary generalizations. Post-processualism denies that neo-evolutionary generalizations adequately account for specific situations (Trigger 1991:66-67).

In favoring the historical approach, the senior author differs from many Hawaiian archaeologists who interpret the archaeological record in primarily evolutionary terms as a series of unilinear transformations or stages of development from simple to complex. This approach, which is focused on the development of so-called "complex societies," is typically presented in terms of periods or phases, such as the Colonization Period, Expansion Period, etc. (Kirch 1984, 1985; Hommon 1976,1986; Carson and Mintmier 2006). The senior author agrees with Barrett who has argued that archaeologists should view material culture as a medium of social practice rather than "an external trace or record of a type of society" (Barrett 1994:35), such as a tribe or chiefdom (see also Pauketat 2007).

The senior author holds to the view that archaeology is an interpretive social science and that the "archaeological record" must be understood in both materialist (ecosystem) and idealist terms (the conviction that ideas, beliefs, values, motives, intentions, etc. are of paramount importance in human life). As remarked on elsewhere (McCoy 1991:25), humans, unlike other animals, do not simply adapt to the constraints of the external world (see also Johnson 1999:100); they also make their world--physically, by changing or altering it, and symbolically, by imposing a structure based on beliefs and values. This point of view is today becoming better known as "practice theory." Pauketat, citing Bordieu (1977) and Giddens (1979), has defined practice theory as "...a theory of the continuous and historically contingent enactments or embodiments of people's ethos, attitudes, agendas, and dispositions" (Pauketat 2000:115). Sahlins' writings on how the ideology of a people is changed in practice has been summarized by Hodder:

> In Hawaii, Sahlins recognises sets of preconceptions and ideas which are part of action. For example, *mana* is a creative force that renders visible the invisible, that gives meaning to goodness and godliness. The divine *mana* of chiefs is manifest in their brilliance, their shining, like the sun. On the daily level, such notions orientate actions, as habitus, but they are changed in practice, in `structures of the conjuncture'. No-one can ever know exactly how a particular event or meeting will be played out in practice. The intended and unintended consequences of action lead to reformulation of the habitus and of the social structure (Hodder 1986:85).

Like other brands of archaeology, including what have been called "processual" and "post-processual" archaeologies, there is no consensus on what constitutes a proper field of study in the field of practice theory because of differences in definitions of key terms, such as agency and action (Dobres and Robb 2000; Clark 2000:97; Dornan 2002; Pauketat 2004). Pauketat has said that what he earlier called "historical processualism" (Pauketat 2001) "is not a rigidly structured or even internally coherent research program with a unified agenda" (Pauketat 2004:199). Johnson (2007) summarizes what is a core concept in views of agency and practice theory: "Practice, then insists that people's actions are bound up with a "real world" but that this world is created by them; its elements are constituted through their subjective experience, their view of the world, not an explicit or implicit economic model imposed by a modern writer" (Johnson 2007:145).

Practice theory, which recognizes the centrality of human intentionality in social life (Ortner 2001:272), has been used previously in arguing that the Mauna Kea Adze Quarry represents something more important and meaningful than the adaptation to raw material scarcity (McCoy 1990:87). Rather, the quarry represents in the senior author's view a pre-eminent form of social action in the production of goods and reproduction of

the social order, so that even though the primary activity was technological and economic, the underlying motives and intentions were in large part social and political, and encompassed societal as well as individual motives--the pursuit of personal careers (see Goldschmidt 1990) governed by the motivation to achieve a status, to seek prestige and honor (McCoy 1990:110; 1991:25).

In a paper written a number of years ago, the senior author concluded that work in the Mauna Kea Adze Complex was an integral part of the social construction of reality (McCoy 1990:114). The term "social construction" has become a common phrase in the writings of many social scientists. Some believe that everything, including nature, is socially constructed (see discussion in Johnson 1999:102). Ian Hacking (1999) has warned against the "strong view" of social construction (see also Weiner 2001). Hacking has written "Social construction has in many contexts been a truly liberating idea, but that which on first hearing has liberated some had made all too many others smug, comfortable, and trendy in ways that have become merely orthodox. The phrase has become a code" (Hacking 1999:vii). The senior author, taking heed of Hacking's critique, has adopted the "weak view" of "social construction."

5.0 SUMMARY OF WORK

The project summary that follows includes a discussion of field methods and findings. The findings include a description of all of the historic properties that were identified in the survey of the 400-yard wide management a summary of other cultural resources that were found and recorded. The latter encompasses parts of the built environment that are suspected of being less than 50 years old and thus do not qualify as historic properties under Chapter 6E and the National Historic Preservation Act of 1966.

5.1 FIELD METHODS

This survey employed the use of systematic transects, following the road easement and taking into consideration topographic features to ensure that the coverage was as complete as possible. The spacing of individuals within transects varied and was determined by the kinds of landforms present in a given area. In open areas with no rock outcrops, individual crew members were more widely spaced. It is important to note in this regard that "archaeological visibility" in the summit region, indeed on the whole top of the mountain above tree line, is exceptionally good.

The locations of sites and "find spots" were established using GPS technology. Sites were mapped with compass and tape and described on a site recording form developed for other projects on Mauna Kea. Digital photographs were taken of all sites.

5.2 SITE AND FEATURE DEFINITIONS

No universally accepted definitions of site and feature exist in Hawaiian archaeology and it is unlikely that any ever will because of the architectural complexities of the archaeological landscape in many areas of the Hawaiian Islands, and the different perspectives that archaeologists hold on how the archaeological landscape should be observed and recorded. It is in fact rather uncommon to see a definition of site and feature in Hawaiian archaeological reports, especially those written in the last decade or so. Our impression is that there was more concern with definitions in the 1970s and 1980s. Rob Hommon is one of the few Hawaiian archaeologists to have offered a definition of site and feature:

> An *archaeological site* is a location with evidence of human activity in the past and consists of either a single feature or a complex of features. An *archaeological feature* is a spatially limited cluster of evidence of past human activities whose boundaries are determined by the extent of the evidence and/or by the boundaries of the artificial structure or natural land-form that contains it. An *archaeological complex* is a site composed of two or more features that appear to be related in some archaeologically significant way (Hommon 1980b 7:37).

Though Hommon's definitions were never widely employed, perhaps because the distinguishing criteria are somewhat vague, he at least realized the importance of site and feature definitions. It is of interest in this regard that HAR 13-276 does not contain definitions of site and feature and does not even require them.

In our view site and feature definitions for project areas like the Mauna Kea Science Reserve need to be developed in the field and modified as seen fit, instead of trying to pigeonhole every find into a single, predetermined set of definitions. The site definitions and recording procedures employed in this report derive in part from decisions made in earlier surveys, which recognized a simple distinction between "simple" sites, such as shrines, and "complex sites" which refers specifically to the Mauna Kea Adze Quarry Complex where there

are a number of different kinds of activity remains.

5.3 Historic Property Types: Formal and Functional Categories

The convention in Hawaiian archaeology today, due largely to the requirements set forth in Chapter 13-276 of the Hawaii Administrative Rules on archaeological inventory surveys, is to distinguish between formal and functional "types." While sites and features can be easily described in terms of formal attributes, there is in reality no dichotomy between form and function, since function is inferred from form, as argued below for artifacts, but which applies to sites and features as well:

> It must at the same time be recognized that function is an inferential variable... that is, it is an inference made by the archaeologist himself, mostly on the basis of the observable form of the artifact. Consequently, there is no real dichotomy between functional and formal classification ...functional classification merely involves the consideration of certain specific attributes of form and not others (Adams and Adams 1991:285).

Functional inferences in this report are based on the environmental and culture-historical context of the project area, formal attributes, locational context, and comparative ethnographic and archaeological data from Hawai`i and other areas of East Polynesia.

Because archaeology is fundamentally an interpretive practice, as argued in Section 4, and because the traces of past practices that archaeologists interpret are often fragmentary and incomplete, there is always an element of ambiguity or uncertainty in the inferences that are made, especially inferences of site function and age. This is especially true of piled and stacked rock features. The problem of determining the age and function of rock features, such as mounds and cairns, is common in Hawaiian archaeology (cf. Reinman and Pantaleo (1998) for a discussion of the problem in the Pohakuloa Training Area).

5.3.1 Formal Site and Feature Types in the Project Area

The following terms are those used in the site descriptions that follow:

Lithic Scatter. Lithic scatter is a generic term for all of the stone tool residues found at a given locality; these may include tools or implements, unfinished tools, manufacturing waste and hammerstones or some combination of all of these. Lithic scatters represent activity areas where one or more of the following activities may have taken place: tool manufacture, tool use, tool discard.

Mound. A pile or heap of stones that is more irregular in construction and form than a cairn; the linear variety has sloping sides and a generally irregular upper surface.

5.3.2 Functional Site and Feature Types in the Project Area

Definitions of the functional site and feature types found in the project area are presented below. Functional inferences are based on a number of factors, including morphology, construction style and materials, locational context and comparison with similar remains of known function. The confidence level in assigning functions to many of the sites and component features varies.

Burial. A deliberate or intentional interment of human remains.

Workshop. In sites, such as adze quarries the term workshop is the functional equivalent of a lithic scatter that contains material evidence of tool manufacture and/or use; though rarely defined in the literature, this term normally implies in the case of reduction technologies, such as stone tool manufacture, a coherent structure amongst the various by-products of work [cores, waste flakes, rejected tools, etc.] that constitute this category of archaeological remains. Like quarry, this term or one with the same meaning, such as "working areas," is rarely defined in the literature. Torrence, for example, noted that in her work on the island of Melos, "Well-delimited regions on the density maps can be translated into 'working areas' in behavioral terms, with the density of the surface obsidian as a rough quantitative measure of the amount of use of each location..." (Torrence 1984:51-52).

5.4 Survey Limitations

In contrast to the archaeological inventory survey of the Science Reserve (McCoy and Nees 2010), there were no serious limitations on the completion of the road easement survey. The vegetation in the sub-alpine forest at the bottom of the road easement, for example, was not thick enough to pose a problem.

The authors agree with George Cowgill, however, that it is a mistake to think that an archaeological survey, surface collection or excavation is ever "total" or complete in terms of, for example, identifying or recovering every single artifact (Cowgill 1986;1989). In the case of the current project area it is possible that human remains might be buried on some of the cinder cones, but not marked by a stone mound like those inferred to be possible burials.

5.5 Survey Findings

Four archaeological sites were found within the boundaries of the Road Easement survey area (Figure 5.1; Table 5.1). These include one previously recorded site (State Site 50-10-23-10314) and three new sites. No Traditional Cultural Properties were identified in the road easement. Forty-four (44) "find spots" were also recorded during the current survey (see Table 5.2; see Figure 5.8).

Table 5.1. Historic Properties Recorded in the Mauna Kea Access Road Easement Survey Area.

Site No.	Site Type	Number of Features	Site Function
50-10-23-10314	Lithic scatter	1	Adze and octopus lure sinker workshop
50-10-23-27867	Mounds	4	Possible burial
50-10-23-27868	Mound	1	Possible burial
50-10-23-27869	Mounds	2	Possible burial

5.5.1 Site Descriptions

Each site description includes a summary table of general site characteristics, such as topographic location and elevation, type and function, number of features, the date when the site was first recorded and subsequent updates. This is followed by a narrative description of each site.

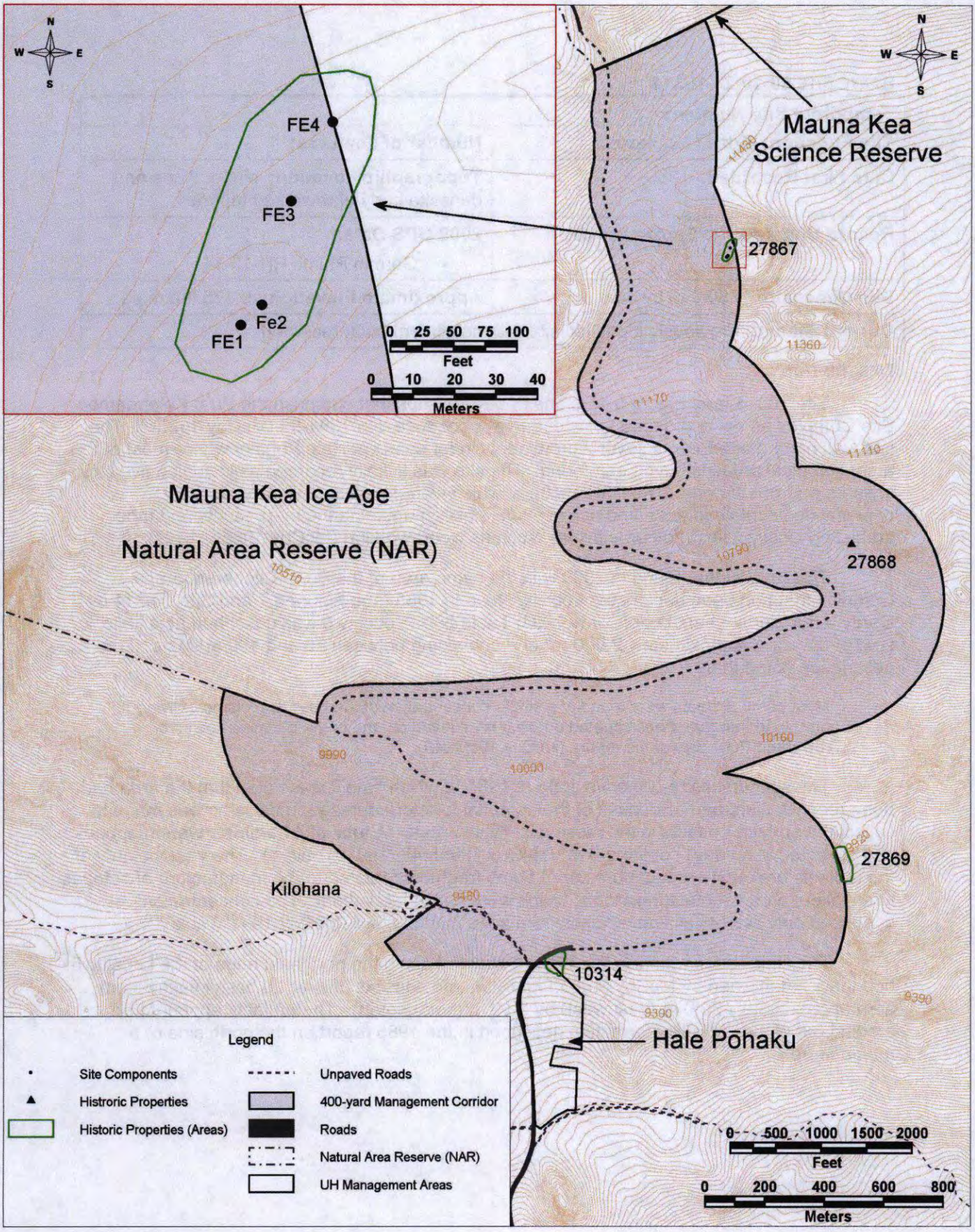


Figure 5.1 Location of Historic Properties in the Mauna Kea Access Road Management Corridor.

STATE SITE 50-10-23-10314

Temporary Site Number:	
Site Function: Adze Manufacture	**Number of Features:** 1
Date First Recorded: 1985	**Topographic Location:** cinder slope and dunelike body of reworked tephra
Record Updated: 21 September 2009	**2009 GPS Data:** • Garmin Points RN-13-14
Site Dimensions: 50.0 m by 40.0 m	**Approximate Elevation:** 9,325 ft a.m.s.l.
Current Status: Previously identified site with new information recorded	

DESCRIPTION

Site 10314 (see Figure 5.1) is one of several sites that comprise the Pu`u Kalepeamoa Site Complex as defined on the basis of surveys conducted in 1984-85 (McCoy 1985a). The site was named after one of several prominent cinder cones at Hale Pohaku where most of the archaeological remains have been found. The site was initially recorded as including five lithic scatters and two shrines. The lithic scatters, which were subsequently given locality designations contained adze and octopus lure sinker manufacturing by-products and other artifacts possibly used in other activities, such as wood-working (McCoy 1985b, 1991).

The lithic scatter found in 2009 is in the same area of the Pu`u Kalepeamoa Site Complex that had been designated Locality No. 5 in 1985 (see Figure 3.7 and Site 10,314 by Cordy a number of years later [Cordy 1994: Table 28]). Locality 5 was described as a lithic scatter covering approximately 2,000 m^2 and containing between 75 and 100 artifacts. The description noted that:

> Most of the artifacts were found in a single concentration at the base of a clump of living and dead *mamane* trees situated on what is believed on one of the dunelike bodies of reworked Pu`u Haiwahine tephra (McCoy 1985b:49).

The scatter was re-visited in June of 1985 at which time it was noted that the area had been recently disturbed. Because of the potential for more damage, a decision was made to collect the surface artifacts in the most vulnerable areas. A total of 44 artifacts were mapped and collected in an area covering 9 m^2 (McCoy 1985b:49, 1991: Table 1). The vast majority of the artifacts are dunite and gabbro cored bomb fragments related to the manufacture of octopus lure sinkers and manufacturing tools, which were called fabricators. The concentration contained only two basalt waste flakes from adze manufacture (McCoy 1991: Table 1).

The lithic scatter observed in 2009 is situated along the northeast edge of the Locality 5 boundary established by McCoy (1985:Figure 5), and consists of over 20 basalt flakes in an area approximately 20.0 m (east/west) by 10.0 m (north/south). The artifacts appear to be eroding out of the dune-like formation described in the 1985 report on the north side of a *mamane* tree.

STATE SITE 50-10-23-27867

Temporary Site Number: VP-2009.01	
Site Function: Possible Burial	**Number of Features:** 4
Date Recorded: 30 July 2009	**Topographic Location:** Pu`u crater rim
2009 GPS Data: • Feature 1: Garmin Point KN-100 • Feature 2: Garmin Point KN-101	 • Feature 3: Garmin Point KN-99 • Feature 4: Garmin Point KN-102
Site Dimensions: 80.0 by 30.0m	**Approximate Elevation:** 11,659 to 11,667 ft a.m.s.l.
Current Status: New Site	

DESCRIPTION

Site 27867 consists of four mound features designated Features 1 to 4. The site is located on the crater rim of an unnamed cinder cone (pu`u) in the northern portion of the Road Easement survey area at the c. 11,659 to 11,667 ft elevation (see Figure 5.1). The site is in good condition with evidence of only limited disturbance, most likely from natural elements.

Feature 1 is a well defined stone mound, approximately 1.5 by 1.25 m in area and 0.31 m in height (Figure 5.2). It consists of a`a cobbles and several small boulders, stacked in two to three courses. It is located on the southeast crater rim of an unnamed pu`u. No artifacts or other remains were observed in association with this feature.

Feature 2 is a well defined stone mound, approximately 1.5 by 1.3 m in area and 0.25 m in height (see Figure 5.2). It consists of a`a cobbles and several small boulders, stacked in two courses. It is located on the southeast crater rim of an unnamed pu`u. No artifacts or other remains were observed in association with this feature.

Feature 3 is a well defined stone mound, approximately 1.38 by 0.9 m in size and 0.46 m in height (Figure 5.3). It consists of 14 a`a cobbles and a small fractured a`a boulder, stacked in two to three courses. It is located on the east crater rim of an unnamed pu`u. No artifacts or other remains were observed in association with this feature.

Feature 4 is a well defined stone mound, approximately 2.1 by 1.3 m in size and 0.24 m in height (Figure 5.4). It consists of a`a cobbles, small boulders, and one fractured volcanic bomb, stacked in two courses. It is located on the east crater rim of an unnamed pu`u. No artifacts or other remains were observed in association with this feature.

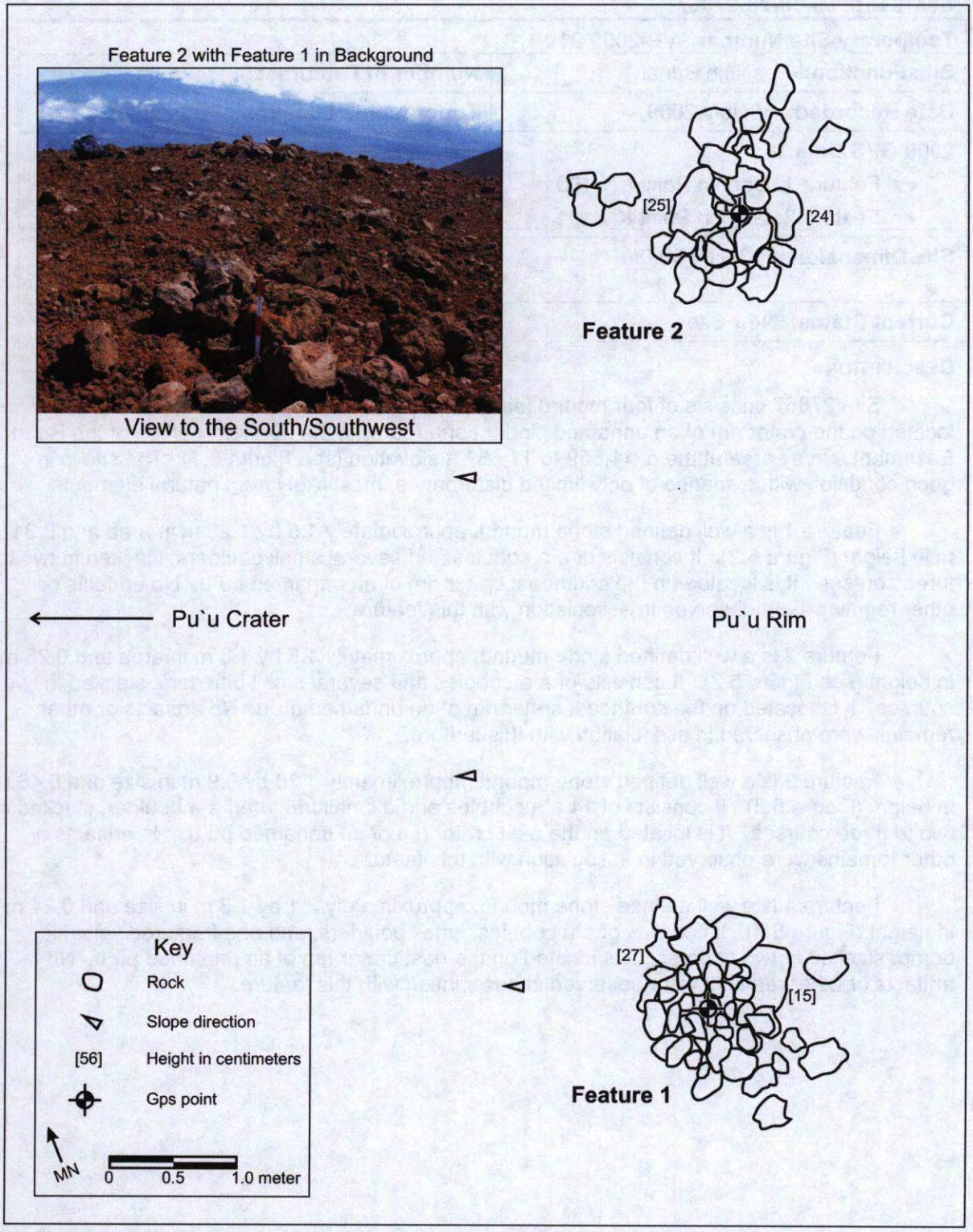


Figure 5.2. Site 50-10-23-27867, Features 1 and 2, Plan View and Photograph.

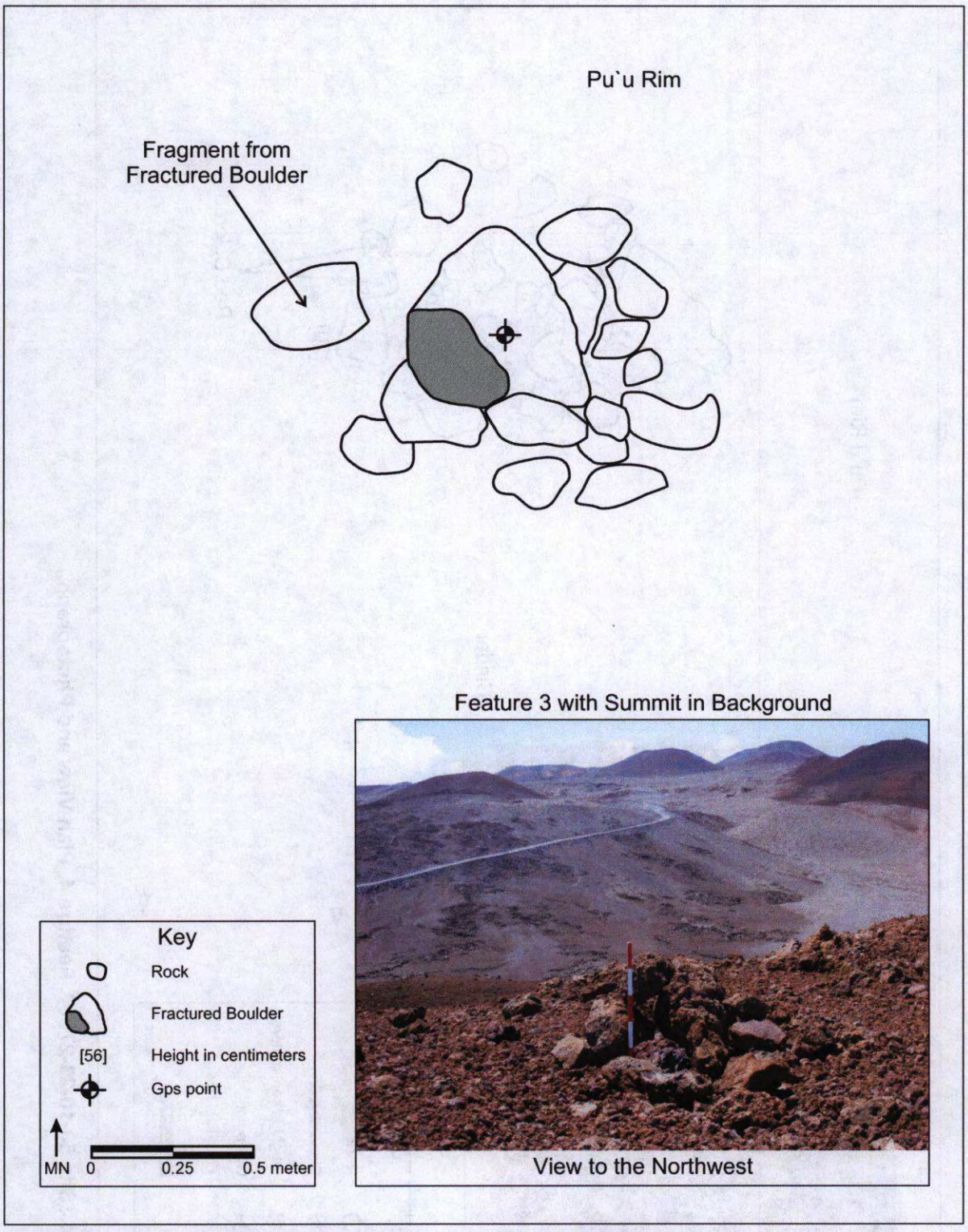
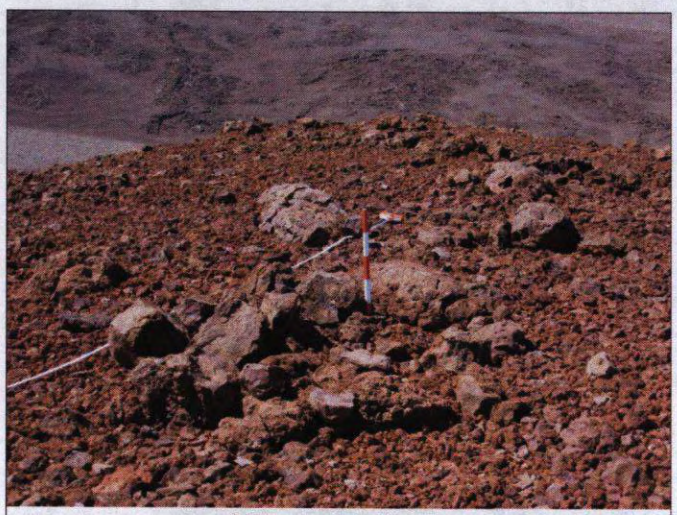


Figure 5.3. Site 50-10-23-27867, Feature 3, Plan View and Photograph.



View to the North

Pu`u Rim

Cinder

Key

Rock

Slope direction

[56] Height in centimeters

Gps point

MN

0 0.25 0.5 meter

Figure 5.4. Site 50-10-23-27867, Feature 4, Plan View and Photograph.

STATE SITE 50-10-23-27868

Temporary Site Number: VP-2009.02	
Site Function: Possible Burial	**Number of Features:** 1
Date Recorded: 21 September 2009	**Topographic Location:** Ridge crest (summit)
2009 GPS Data (UTM): • Feature 1: Garmin Point KN-04	
Site Dimensions: 2.0 by 2.0m	**Approximate Elevation:** 10,044 ft a.m.s.l.
Current Status: New Site	

DESCRIPTION

Site 27868 consists of one stone mound designated Feature 1. The site is located on a flat cinder surface on a summit ridge crest in the central portion of the Road Easement survey area at the c. 10,044 ft elevation (see Figure 5.1). The site is in good condition with evidence of only limited disturbance, most likely from natural elements.

Feature 1 is a well-constructed stone mound, approximately 1.55 by 1.15 m in area and 0.56 m in height (Figure 5.5). It consists of small to medium a`a boulders and large cobbles, stacked in three to four courses. No artifacts or other remains were observed in association with this feature.

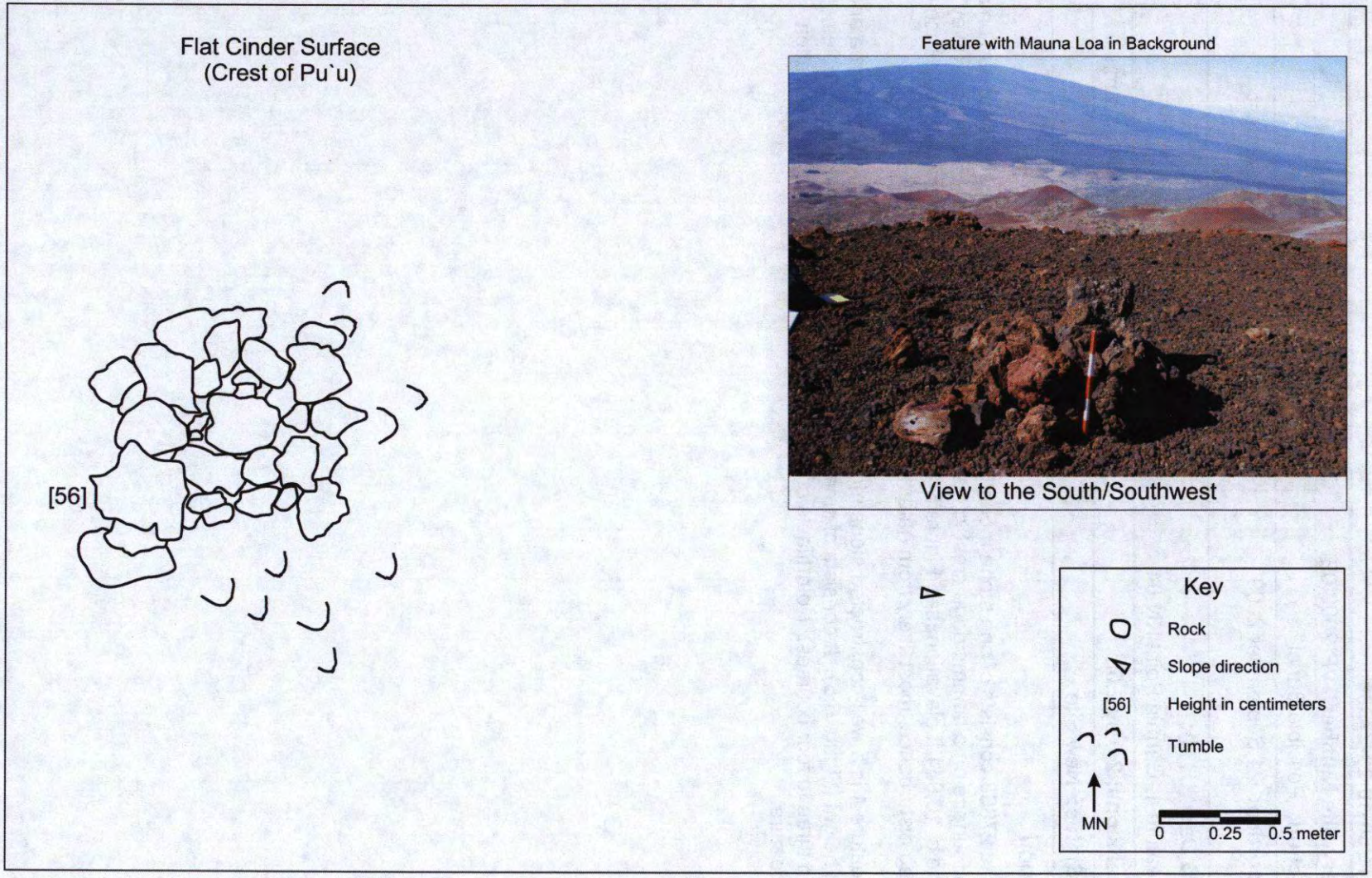


Figure 5.5. Site 50-10-23-27868, Feature 1, Plan View and Photograph.

STATE SITE 50-10-23-27869

Temporary Site Number: VP-2009.03	
Site Function: Possible Burial, Stone Marker/Memorial	**Number of Features:** 2
Date Recorded: 21 September 2009	**Topographic Location:** Ridge crest (summit)
2009 GPS Data (UTM): • Feature 1: Garmin Point KN-12 • Feature 2: Garmin Point KN-13	
Site Dimensions: 75 by 30m	**Approximate Elevation:** 10,016 to 10,044 ft a.m.s.l.
Current Status: New Site	

DESCRIPTION

Site 27869 consists of two mounds designated Features 1 and 2. The site is located on a flat cinder surface on a summit ridge crest in the southern portion of the survey area at the c. 10,016 to 10.044 ft elevation (see Figure 5.1). The site is in good condition and appears to be undisturbed.

Feature 1 is a well defined stone mound, approximately 2.3 by 2.2 m in area and 1.2 m in height (Figure 5.6). It consists of small to large a`a cobbles and boulders, stacked in three courses. No artifacts or other remains were observed in association with this feature.

Feature 2 is a well defined stone mound, approximately 1.8 by 1.6 m in area and 1.0 m in height (Figure 5.7). It consists of small to large a`a cobbles and boulders, stacked in two courses with two loose boulders stacked on top. No artifacts or other remains were observed in association with this feature.

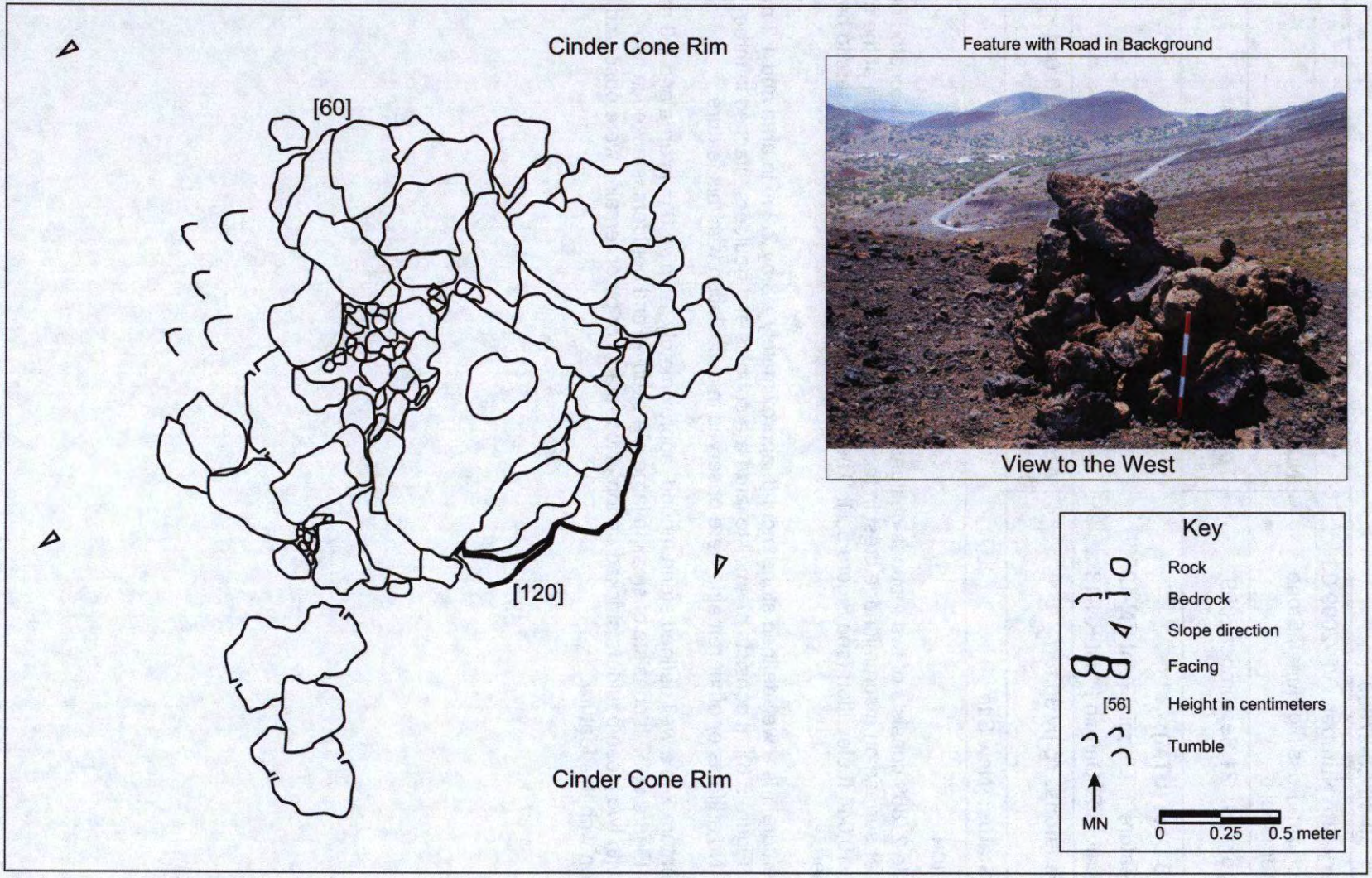


Figure 5.6. Site 50-10-23-27869, Feature 1, Plan View and Photograph.

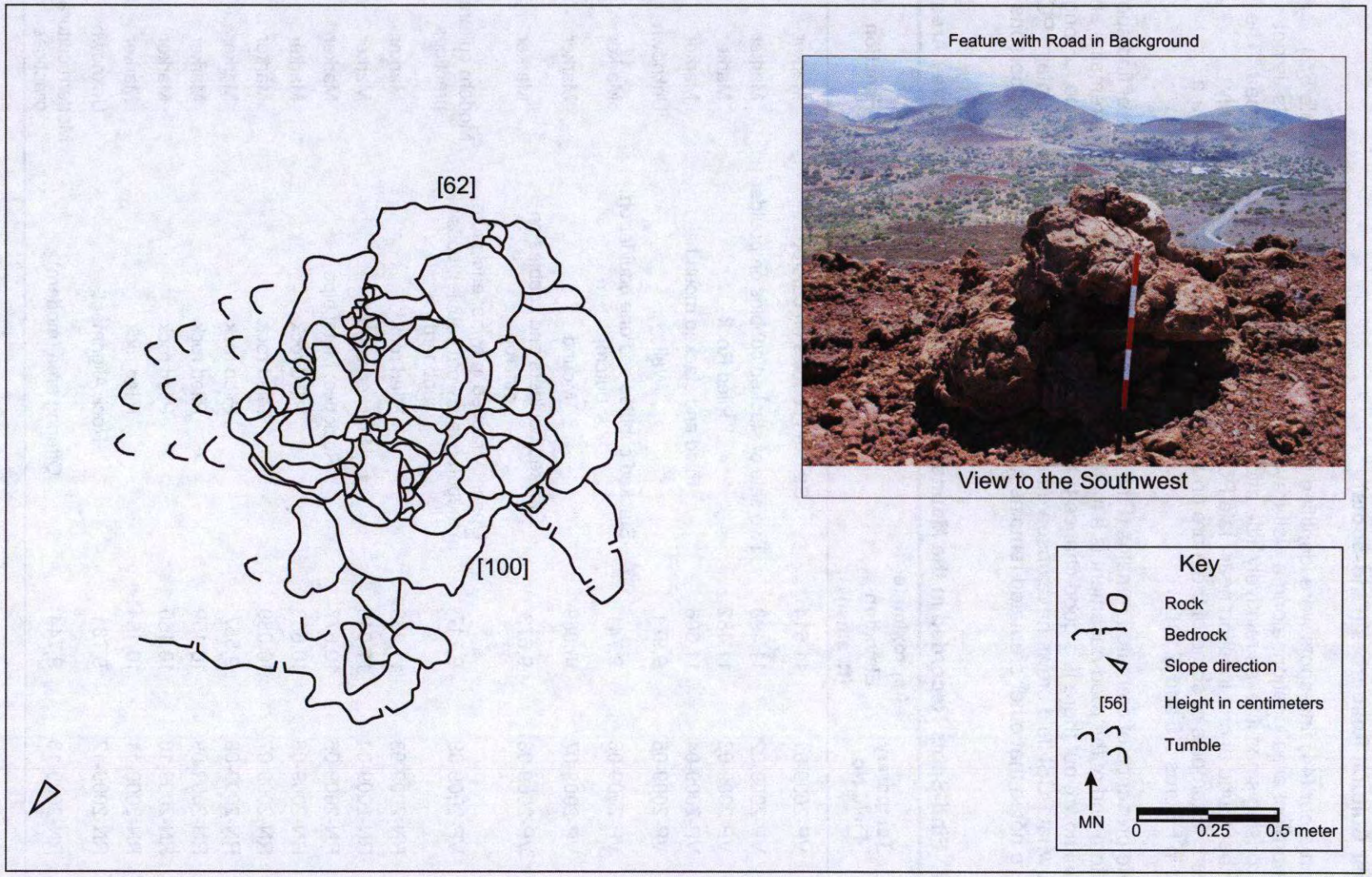


Figure 5.7. Site 50-10-23-27869, Feature 2, Plan View and Photograph.

5.5.2 Other Cultural Resources (Find-Spots)

Forty-four (44) find-spots were identified in the project area (Figure 5.8; Table 5.2). Given the project area location, along a well-travelled road, the number of "find spots" is not wholly surprising since it takes relatively little effort to walk a short distance off the road. The large number found at one location near Hale Pōhaku is unusual, but again not totally unexpected. Examples of some of the more unusual and interesting constructions are illustrated in Figures 5.9 and 5.10).

The presence of cremated remains (Find Spot 2009.31) amongst the group of find spots at the bottom end of the road easement is a matter of some concern. Who left the remains and when is unknown, but there is a good chance that the remains will not remain in place for long based on what PCSI field crews have observed at cremation sites higher on the mountain. PCSI crews have noted that other cremated remains have been disturbed and removed by persons unknown.

Table 5.2. Find-Spots Recorded in the Mauna Kea Access Road Easement Survey Area.

Year. No.	Temporary Field No.	Approximate Elevation (ft. amsl)	Description	Function
2009.01	VP-2009-01	11,514	Stacked cobbles on outcrop	Marker
2009.02	VP-2009-02	11,498	Two sets of stacked cobbles on boulder	Marker
2009.03	VP-2009-03	11,482	Piled Rock	Marker
2009.04	VP-2009-04	11,606	Piled and stacked mound	Marker
2009.05	VP-2009-05	9,971	Wall	Unknown
2009.06	VP-2009-06	9,741	Stacked cobbles and one boulder on outcrop	Marker
2009.07	VP-2009-07	10,069	Mound	Marker
2009.08	VP-2009-08	9,673	Stacked boulders and cobbles on outcrop	Marker
2009.09	VP-2009-09	9,717	Upright wrapped in twine; enclosure; manuport (waterworn cobble); possible cupboard	Modern cultural practices
2009.10	RN-2009-03	11,289	Piled rock	Marker
2009.11	RN-2009-04	11,045	Stacked cobbles	Marker
2009.12	RN-2009-05	10,677	Rock pile; Metal pipe	Marker
2009.13	RN-2009-06	10,633	Piled rock	Marker
2009.14	RN-2009-07	10,089	Piled rock	Marker
2009.15	RN-2009-08	9,557	Piled rock	Marker
2009.16	RN-2009-09	10,159	Piled rock	Marker
2009.17	RN-2009-10	10,160	Piled rock	Marker
2009.18	RN-2009-11	10,164	Piled rock	Marker
2009.19	RN-2009-12	9,731	Rock Alignment	Unknown
2009.20	RN-2009-13	9,744	Offering area (modern)	Modern cultural practices

Year. No.	Temporary Field No.	Approximate Elevation (ft. amsl)	Description	Function
2009.21	This number was not assigned to a find spot.			
2009.22	RN-2009-01	11,530	Piled Rock	Marker
2009.23	RN-2009-02	11,495	Piled Rock	Marker
2009.24	RN-2009-027	9,600	Piled Rock (Scattered)	Marker
2009.25	RN-2009-028	9,600	Piled Rock (Scattered)	Marker
2009.26	RN-2009-029	9,600	Rock Alignment (Circular)	Unknown
2009.27	RN-2009-030	9,600	Piled Rock	Marker
2009.28	RN-2009-031	9,600	Piled Rock on a Boulder	Marker
2009.29	RN-2009-032	9,600	Rock Enclosure (with rock-alignment writing)	Marker
2009.30	RN-2009-033	9,600	Rock Alignment ("Y" shaped)	Marker
2009.31	RN-2009-034	9,600	Cremation inside Rock Alignment (Circular)	Burial; Burial Marker
2009.32	RN-2009-035	9,600	C-Shape with Rock Alignment across entrance	Unknown
2009.33	RN-2009-036	9,600	Piled Rock (Scattered)	Marker
2009.34	RN-2009-037	9,600	Scattered Cobbles	Unknown
2009.35	RN-2009-038	9,600	Piled Rock (Scattered, Rectangular)	Marker
2009.36	RN-2009-039	9,600	Piled Rock (Scattered)	Unknown
2009.37	RN-2009-040	9,600	Piled Rock (x2) Connected by an Alignment	Unknown
2009.38	RN-2009-041	9,600	Piled Cobbles	Unknown
2009.39	RN-2009-042	9,600	Piled Rock (Circular)	Marker
2009.40	RN-2009-043	9,600	Piled Rock (Scattered)	Marker
2009.41	RN-2009-044	9,600	Broken Cobbles	Unknown
2009.42	RN-2009-045	9,600	Cobble Alignment	Unknown
2009.43	RN-2009-046	9,600	Piled Rock (Scattered, Roughly Circular)	Unknown
2009.44	RN-2009-047	9,600	Possible Burial Mound	Burial; Burial Marker
2009.45	RN-2009-048	9,600	Piled Rock (Roughly Triangular)	Marker

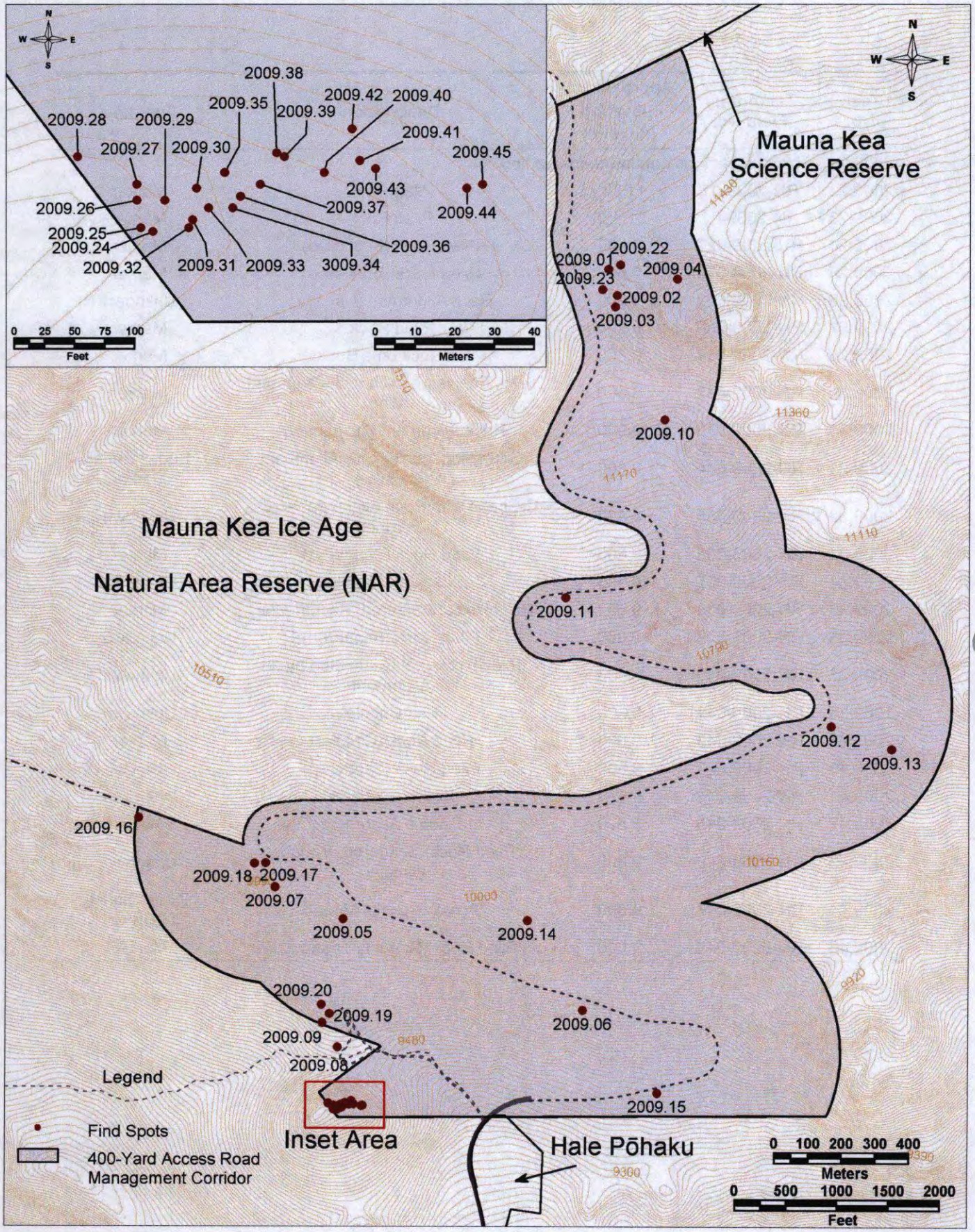


Figure 5.8 Location of Find Spots in the Mauna Kea Summit Access Road Management Corridor.

Figure 5.9. Photographs of Find Spot 2009.17 Rock Pile Adjacent to Access Road (upper) and Find Spot 2009.30 "Y" Shaped Rock Alignment (below).

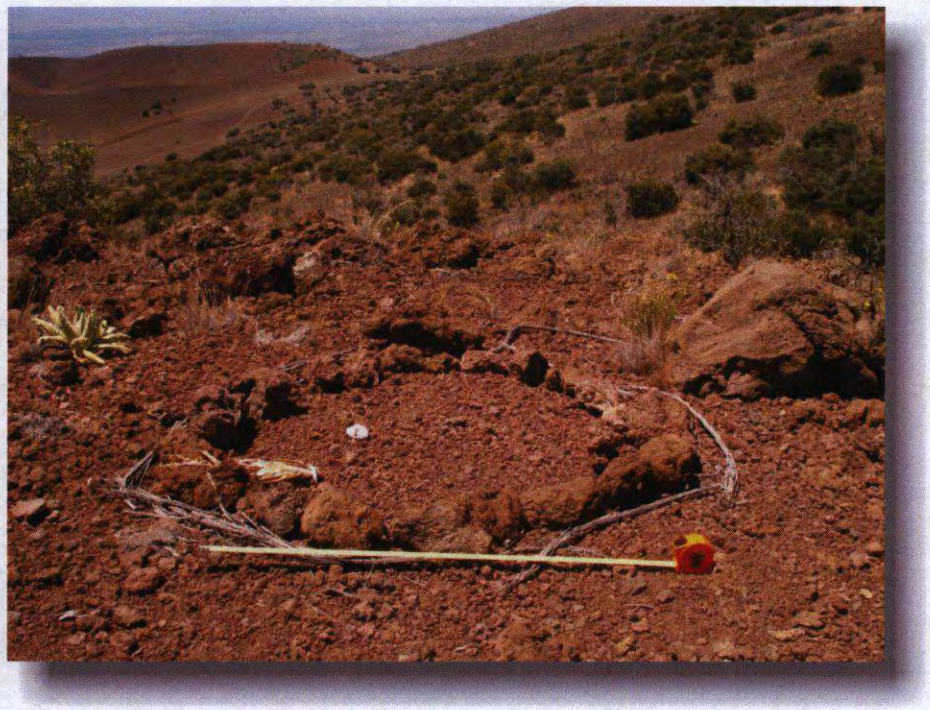


Figure 5.10. Photographs of Find Spot 2009.20 Circular Alignment (upper) and Find Spot 2009.29 Rectangular Enclosure with Rock Alignment (initials- FSM).

On January 13, 2010, well after fieldwork was completed, one of the OMKM rangers reported what turns out to be a new "find spot" within the 400-yard wide road management corridor. This "find spot" is located on a small knoll immediately below the NARS sign, at the second bend of the Mauna Kea summit access road from Hale Pōhaku. The "find spot" consists of a recently constructed mound (*ahu*) for the placement of cremated ashes. Within the mound were memorial items, including ti leaves, a *lei*, two gallon sized bags of ashes, (both torn open,) two beer cans, one small glass bottle, and two small ceramic angel figurines, approximately 5 inches in height. This find has not been given a find spot designation yet. The Kahu Kū Mauna Council will be meeting soon with OMKM staff to discuss this find and another cremation found during the 2009 survey (see Section 5 for details on its location).

6.0 SUMMARY AND DISCUSSION

In 1987 the Bishop Museum conducted an archaeological reconnaissance survey within the road easement survey area. The 1987 survey was limited, however, to a 100-foot (30-meter) wide corridor on both sides of the road (see Figure 3.4). No sites were found in that survey (Williams 1987). The current survey, which covered roughly 722-acres, identified one previously recorded site (50-10-23-10314) and three new historic properties (50-10-23-27867, 27868 and 27869).

The previously recorded site is a lithic scatter comprised of manufacturing by-products related to basalt adze production and the manufacture of octopus lure sinkers. The basalt flakes found at Site 10314 add to the inventory of previously identified artifacts at this locality, which is interpreted as a workshop and part of the larger Pu`u Kalepeamoa Site Complex (McCoy 1985b, 1991). Further analysis would be required to determine if all of the flakes are adze waste flakes, or if some may have been utilized as flake tools.

The three new sites are stone mounds located on the summit of three unnamed cinder cones. The mounds are fairly uniform in terms of construction technique, materials, and size. The mounds were built using locally available a'a that was stacked two to four "courses" high to form roughly rectangular structures. The number of mounds varies from one at Site 27868 to four at Site 27867. There are two mounds at Site 27869. No artifacts or other cultural materials were observed at any of the three sites. The mounds are inferred to be possible burials based on their location on the rims of cinder cones, their construction and size, and comparison to confirmed burials in the Mauna Kea Science Reserve. The practice in all previous archaeological surveys in the Science Reserve area has been to **not** test possible burial features to determine the presence/absence of human remains. This same practice was adhered to in this project. The result is that all of the structures without observable human remains in the current project area and in the Science Reserve have been classified as "possible burials."

The three possible burial sites are tentative evidence, albeit unconfirmed, of the interment of individuals on the tops of cinder cones located just below the summit plateau (McCoy 1999a). These lower elevation burial sites are difficult to interpret, but it is possible that they are the remains of individuals of either lower rank or status than the presumed higher status burials higher on the mountain and closer to the mountaintop, which oral traditions speak of as having been the *piko*. Another possibility is that the lower elevation burials are from a different time period. Whatever their age, their location on the easterly and southerly sides of cinder cones conforms to a widespread pattern in the Science Reserve (McCoy and Nees, in prep) where all of the confirmed and possible burials are inferred to be Hawaiian.

7.0 SIGNIFICANCE EVALUATIONS

Evaluating the significance of sites or historic properties is a requirement for state projects under Chapter 6E-8 and its implementing regulation (Chapter §13-275-6). Site significance in American archaeology tends to be evaluated using standard criteria, such as those set out in the National Park Service's National Register regulations at 36CFR 60.4. There are four National Register Criteria:

(a) That are associated with events that have made a significant contribution to the broad patterns of our history; or
(b) That are associated with the lives of persons significant in our past; or
(c) That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or possess high artistic values, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
(d) That have yielded, or may be likely to yield, information important in prehistory or history.

One other criteria (e) has been added to the list in Hawai`i. Historic properties evaluated as significant under Criterion "e":

> Have an important value to the native Hawaiian people or other another ethnic group with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity (Chapter §13-275-6).

Site significance tends to be viewed as fixed and unchanging, but in reality it is "both dynamic and relative" (Moratto and Kelly 1978:2). Bowdler (1984:2) and others have noted how archaeological significance is anything but static. Charles McGimsey and Hester Davis emphasize the importance of having a frame of reference in making significance evaluations and why they are always at the minimum relative:

> The fact that archaeological sites and the information they contain are our only clues to much of human life in the past makes every site potentially significant. It is generally recognized, however, that defining significance implies some frame of reference, problem orientation, geographic, temporal or other context, against which an archaeological phenomenon is to be evaluated. A site is therefore more or less significant relative to some criterion or criteria (McGimsey and Davis 1977:31).

In 1999, during the preparation of the Master Plan, SHPD proposed that the cultural landscape on the top of Mauna Kea be recognized as the Mauna Kea Summit Region Historic District. The historic district proposal was summarized in the cultural impact assessment for the Master Plan (PHRI 1999:30-32) and discussed in more depth in the early planning process for the proposed Keck Outrigger project (Hibbard 1999; NASA 2005). The IfA, NASA, and other parties agreed that the proposed district, which on current thinking would include all of the Science Reserve, the Natural Area Reserve, and additional areas at selected locations lower on the mountain, meets the eligibility criteria for inclusion on the National Register of Historic Places. The preliminary district boundaries are shown in Figures 3.6 and 3.7. The district is listed in the Statewide Inventory of Historic Places as Site 50-10-23-26869 and has been evaluated as follows.

The historic district is significant under all four National Register criteria and criterion "e" of the Hawaii Administrative Rules, Chapter §13-275-6. The district is significant under criterion

"a" because of the presence of the Mauna Kea Adze Quarry Complex (a National Historic Landmark), which was used over a period of 500 years or more and the hundreds of shrines in and outside of the quarry. Both the quarry and the shrines are associated with broad patterns and events in Hawaiian prehistory. The district is significant under criterion "b" because of the association with several gods who may have been deified ancestors. These include Kūkahau`ula, Līlīnoe, and Waiau. The sites in the adze quarry and many of the shrines embody distinctive characteristics of traditional Hawaiian stone tool manufacture by craft specialists and a distinctive type of shrine construction found in only a few other places in the Hawaiian Islands. These make the district significant under criterion "c." Studies of the Mauna Kea Adze Quarry Complex and the on-going archaeological survey of the Mauna Kea Science Reserve have already made a significant contribution to our understanding of Hawaiian prehistory and history, and hold the potential to make even more contributions. The district is thus significant under criterion "d." Finally, the district is significant under criterion "e" because of the presence of numerous burials and the hundreds of shrines which have been interpreted as evidence of a previously unknown land use practice in the form of pilgrimages to the summit of Mauna Kea to worship the gods and goddesses. As noted earlier, Pu`u Kūkahalu`ula, Pu`u Waiau and Pu`u Līlīnoe were deemed Traditional Cultural Properties (TCPs) by SHPD in 1999 based on legendary information and continuity of cultural practices (Hibbard 1999; SHPD 2000). There are people, both Hawaiian and non-Hawaiian, who believe that more of the mountain, if not the entire mountain, is sacred and should be recognized as one large TCP.

The four sites located in the current project area fall outside of the currently proposed boundaries of the historic district and cannot therefore be evaluated as potential contributing properties to the historic district. However, because the historic district boundaries are not final, it is possible that they could be extended, with some justification, to encompass the three possible burial sites.

The significance of the four historic properties found in the current project is summarized in Table 7.1. Site 10,314 is evaluated as significant under Criterion "a" because of its link to the Mauna Kea Adze Quarry Complex, and Criterion "d" because of the potential information that could be obtained from a study of the flakes found at this site. On the assumption that Sites 27867, 27868 and 27869 are indeed burials, all three sites are significant under Criterion "d" because of the potential they hold to contribute to an understanding of mortuary practices in the high elevation regions of Mauna Kea, and Criterion "e" because of their probable association with Hawaiian beliefs and cultural practices.

Table 7.1. Significance of Historic Properties Recorded in the Road Easement Survey Area.

Site No.	Site Type	Site Function	Significance Evaluation Criteria
50-10-23-10314	Lithic Scatter	Adze and Octopus lure sinker Workshop	a and d
50-10-23-27867	Mounds	Possible Burial	d and e
50-10-23-27868	Mound	Possible Burial	d and e
50-10-23-27869	Mounds	Possible Burial	d and e

8.0 RECOMMENDATIONS

The presence of three possible burial sites in the 400-yd road easement will require the preparation of a burial treatment plan. OMKM has already committed itself to developing a burial treatment plan for sites located in the Science Reserve, as noted below in the list of management actions that were developed for a cultural resources management plan (McCoy et al. 2009). Since all of the burials are located on lands currently leased by the University of Hawai`i and managed by OMKM it may be feasible to prepare a single burial treatment plan covering all of UH's management areas. While OMKM needs to consult with its Hawaiian advisory group, the Kahu Kū Mauna Council, and SHPD, OMKM is committed to preserving in place all of the confirmed and possible burial sites in the Science Reserve and road easement.

The lithic scatter at Site 10,314 is threatened by erosion. Though a collection of artifacts from one small area of this site was made in 1985, the basalt flakes found in the current project have provided a somewhat different perspective on the activities that took place at this locale. The 1985 collection, for example, included only two flakes, while all of the artifacts observed in the current survey were basalt flakes. Before the integrity of this site is diminished even further, it is recommended that the flakes be collected and a couple of test probes excavated to determine the presence/absence of subsurface cultural deposits.

As already mentioned above, a number of mitigation measures aimed at preserving, protecting and enhancing the importance of the historic properties in the UH management areas on Mauna Kea, including the road easement, have been outlined in a draft Cultural Resources Management Plan (McCoy et al. 2009) that will be submitted to DLNR for review and approval, Brief summaries of the proposed management actions in the CRMP are presented below.

1) ***Develop a policy to assure that Kahu Kū Mauna council is consulted on individual development projects.*** As the primary Native Hawaiian advisory group associated with Mauna Kea, the Kahu Kū Mauna Council will be consulted on individual development projects, in a timely and appropriate manner. The consultation policy will include mechanisms for addressing any recommendations or concerns raised by the Council.

2) ***Continue to prohibit the use of vehicles off of established roads.*** Unauthorized off-road vehicle use has caused serious damage to the fragile alpine environment of the summit and is therefore prohibited. Direct and indirect damage to historic properties, as well as to the cultural landscape of Mauna Kea, can also occur through unauthorized off-road vehicle use. OMKM's policy will continue this ban and strengthen measures to deter off-road use.

3) ***Prepare a Burial Treatment Plan.*** Once the final AIS report reviewed and approved, a BTP will be prepared for all of the confirmed and possible burial sites documented for the three UH Management Areas using guidelines set forth in the CRMP. The BTP will detail how the burials will be preserved and protected (including any site stabilization measures), suggest the enforcement responsibilities OMKM Rangers will have, and describe any provisions for visitation by recognized descendants.

4) ***Develop an archaeological monitoring program.*** Once the final AIS report is completed and submitted, the archaeological monitoring program can begin. The CRMP

contains a conceptual AMP and program on which this program can be built. The program will be guided by a final AMP, to be prepared and submitted to OMKM and DLNR. The AMP will include guidelines for monitoring the condition of historic properties in order to identify patterns in the alteration of historic properties. In addition, the plan will include steps for maintaining and updating the catalogue of historic properties, as documented in the AIS, and record their current condition for comparative impact assessments.

5) ***Develop guidelines regarding the use of ancient shrines and protocols for offerings.*** The AIS fieldwork has documented alterations made to shrines and other historic sites in the UH Management Areas; some of the alterations appear to be related to modern cultural and religious practices. Guidelines will be developed in consultation with the Kahu Kū Mauna Council to prevent alterations that affect the integrity of historic properties, such as the removal or addition of new upright stones.

6) ***Develop a list of individuals, families or organizations who will be consulted when individual development projects are proposed or when other issues arise that may be a concern.*** A list of parties to be consulted will be developed and expanded from those who participated in consultations over the CRMP, Natural Resource Management Plan (NRMP), and CMP. Development of the list will include procedures for updating it, and for ensuring prompt and accurate communications between OMKM and all parties.

7) ***Develop a policy for the construction of new Hawaiian cultural features and the long-term management of these features.*** The AIS has documented many small stone features of presumably recent origin that may or may not be ceremonial or religious in nature. The policy will address the construction of additional new features, and include protocols (developed by the Kahu Kū Mauna in consultation with other Native Hawaiian organizations) for how, where, and when such construction may occur.

8) ***Retain commercial permitting process.*** Currently, the OMKM reviews and approves commercial permit applications made by such businesses as tour operators or film companies; permit approvals may include conditions on uses or activities. These procedures will continue and be supplemented by requiring cultural orientation training for all tour operators and key personnel, on-going monitoring of commercial activities, and controlling visits.

9) ***Prepare a debris control and removal plan that incorporates protective measures for historic properties.*** This plan will include provisions for monitoring the distribution of debris and minimizing its escape from the observatories and during maintenance and construction work. The plan will also include measures for debris collection in publicly accessed areas and safe removal practices that will not cause damage to historic properties. Public education and positive reinforcement of public behavior (e.g., strategic placement of rubbish containers) will form a part of the plan.

10) ***Develop a staff training program.*** A staff training program will include basic information from the AIS on site locations and descriptions, including site and artifact recognition. Primary elements of other plans or policies – prevention of off-road vehicle use, debris control and removal, public access management – will form the basis of staff training. The program will also integrate all regulations, restrictions, and polices in a single document to aid management staff.

11) ***Implement archaeological monitoring program.*** Once the AMP is approved by OMKM and DLNR, the monitoring program can be implemented. The primary purpose of the monitoring program is to determine what uses, if any, are affecting historic properties, the degree and frequency of these effects, and ways to prevent or minimize their occurrence. Implementation of the monitoring plan will require the presence of trained OMKM staff, or a qualified archaeological consultant, who will conduct site visits to all relevant locations within the UH Management Areas in order to monitor uses and conditions of historic properties, as well as document and describe any impacts to these properties.

12) ***Coordinate hunting policies with DLNR to ensure that historic properties are protected.*** The policies will include measures for advising the public of sensitive areas, the enforcement of prohibitions on off-road vehicle driving or parking, and controlling debris. Coordination with DLNR may include a Cooperative Agreement with DOFAW.

13) ***Develop research guidelines that incorporate protective measures for historic properties.*** Research on Mauna Kea, for example, geological, botanical, and zoological research activities, can range from relatively low-impact efforts, such as those in which researchers hike to specific areas to record information, to more intrusive efforts such as setting up instruments to record data over time or collecting samples. Research guidelines will specify which kinds of research require permits, which agency reviews are necessary, and how permit conditions will be enforced. Information on historic properties and the need to avoid any alteration of them will also be provided to research permit applicants.

14) ***Implement debris control and removal plan.*** Take steps to ensure that appropriate OMKM personnel, including Rangers, are aware of the plan's measures for protecting historic properties.

15) ***Implement staff training program.*** Take steps to ensure that the training program includes a comprehensive review of the relevant documents pertaining to the archaeological and other cultural resources in the UH Management Areas as well as field trips to various site types present. Rangers will receive training in recording damage to historic properties.

16) ***Develop an educational and interpretive program that minimizes the impact of visitation to historic properties.*** As part of the development of this program, an educational and interpretive plan will be prepared in coordination with DLNR. The educational and interpretive plan will include educational themes, signage (if deemed appropriate), content of the sign text, guidelines for implementation of the program, and measures that will ensure protection and preservation of any historic sites involved in the program, as well as protection and preservation of Mauna Kea's cultural landscape. The program will designate historic properties suitable for public visitation through guided or self-guided tours. The program can also include development of educational brochures, displays, and materials for supporting staff presentations to the public. The development of such programs will be coordinated with OMKM, the Kahu Kū Mauna Council, and DLNR.

17) ***Implement the educational and interpretive programs.*** Implementation of these programs will follow steps and guidelines in the educational and interpretive plan, and will be coordinated with DLNR, and the Kahu Kū Mauna Council.

18) ***Develop a plan to mitigate off-road vehicle tracks.*** The plan will recommend additional barriers, provide language for signage and public information, and contain recommendations for restoring areas damaged previously by off-road vehicular activity. OMKM Rangers will be involved in the development and implementation of this plan.

19) ***Implement the mitigation plan for off-road vehicle tracks.*** Initially, a survey to document the location of existing off-road vehicle tracks will be conducted to ensure that mitigation efforts will not impact any historic properties.

20) ***Develop and maintain an integrated GIS database for cultural resources to include guidelines for access and use.*** The existing database from the AIS of the three UH Management Areas will be the foundation on which the integrated GIS database will be developed. Using data from the AIS and the results of periodic monitoring of the condition of historic properties, the GIS database should prove to be an effective and efficient cultural resources management tool. Guidelines regarding public access to the database and use of historic and cultural resources information will be developed.

21) ***Prepare a curation plan for archaeological collections.*** The curation plan will detail temporary and long-term measures for the storage of archaeological collections and associated records, in accordance with Hawaii State and Federal standards. It is anticipated that OMKM staff will need to consult with a qualified archaeological consultant or collections management specialist to develop the curation plan. The plan will specify the location(s) for curation facility, materials to be used (acid-free paper, files, and storage bags), and provisions for access and use.

22) ***Prepare an emergency plan that includes measures to avoid and protect historic properties.*** The plan will include anticipated situations and recommend contingency measures for each one, such as maps showing appropriate access routes and measures to avoid impact to historic sites or surrounding landscape. The plan will be prepared in coordination and consultation with OMKM Rangers and local safety officials (Fire Department, Police Department).

23) ***Implement the curation plan.*** Initially, steps need to be taken to locate an adequate curation facility for the archaeological collections and hard copies of the archaeological records (notes, forms, drawings and maps, etc.). Implementation of the curation plan will follow the guidelines that were developed and approved.

24) ***Implement the emergency plan.*** Steps need to be taken to ensure that the OMKM Rangers as well as local safety officials are aware of implementation of the emergency plan and the protective measures that need to be taken for historic properties.

25) ***Review the CRMP periodically to ensure all historic preservation regulations, restrictions, and policies are updated and revised as appropriate and to evaluate existing management policies and the implementation of management actions.*** Periodic review will rely partly on the results of the monitoring program to be carried out as well as any changes in applicable statutes, regulations or policies. Review of the CRMP will be conducted by the OMKM, the Mauna Kea Management Board and other interested parties and stakeholders (for example, the Kahu Kū Mauna Council). Should it be decided that amendments to the CRMP are desired, the CRMP will be amended in consultation with DLNR.

26) ***Develop a management policy for the scattering of cremated human remains.*** A management policy on the scattering of cremated human remains could be patterned after the policy recently instituted at Hawai'i Volcanoes National Park. This type of policy will be developed and implemented for the Science Reserve.

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APPENDIX A

Site Number Concordance Table for Historic Properties in the Hale Pōhaku Area

LIST OF HISTORIC PROPERTIES LOCATED IN THE HALE POHAKU AREA (SITE 50-10-23-16244)**

State Site No.	BPBM Site No. 50-Ha-G28-87-	Description	Functional Interpretation
10310	Locality 1	Lithic scatter	Adze and octopus sinker manufacturing workshop
10311	Locality 2	Lithic scatter	Adze and octopus sinker manufacturing workshop
10312	Localities 3 and 4	Lithic scatter	adze and octopus sinker manufacturing workshop
10313	Shrine 1	3-5 uprights and octopus sinker manufacture offerings	Octopus sinker manufacturing ritual
10314	Locality 5	Lithic scatter	Adze and octopus sinker manufacturing workshop
10315	Shrine 2	1 upright	ritual
10316	Locality 6	Lithic scatter	Adze and octopus sinker manufacturing workshop
10317	Locality 7	Lithic scatter and firepit	Possible temporary camp and adze and octopus sinker manufacturing workshop
10318	Locality 9	Lithic scatter	Adze and octopus sinker manufacturing workshop
10319	Locality 10	Lithic scatter	Octopus sinker manufacturing workshop
10320	Locality 8	Lithic scatter and firepit	Temporary camp and adze and octopus sinker manufacturing workshop
10321	Locality 11	Lithic scatter	Adze and octopus sinker manufacturing workshop
10322	Locality 12	Lithic scatter	Octopus sinker manufacturing workshop
10323	Locality 4	Lithic scatter	Adze and sinker manufacturing workshop
16245	Locality 13	Lithic scatter	Adze and octopus sinker manufacturing workshop
16246	Locality 14	Lithic scatter	Adze and octopus sinker manufacturing workshop

**The State site numbers were arbitrarily assigned by Cordy (1994:Table 28) before the 1991 site report was submitted to SHPD. Cordy assigned numbers to each of the 14 remains identified in the survey and also gave a number (50-10-23-16244) to the whole site complex (BPBM Site No. 50-Ha-G28-87), which was called the Pu`u Kalepeamoa Site by McCoy (1985, 1991)