DRAFT ENVIRONMENTAL IMPACT STATEMENT
TECHNICAL APPENDICES

Sea Mountain at Punaluʻu

Kaʻū District, Punaluʻu, Hawaiʻi
Tax Map Key: 9-5-19:11, 15, 24, 26, 30, 31, 33, 35; 9-5-27:20;
9-6-01:01, 02, 03, 06, 11, 12, 13; 9-6-02:08, 37, 38, 41, 53

TECHNICAL APPENDICES

Appendix	Title
A	Archaeological Inventory Survey of the Approximately 430-Acre Sea Mountain at Punalu'u Resort (Cultural Surveys Hawai'i, Inc., February 2006)
B	Air Quality Study for the Proposed Sea Mountain at Punalu'u Project (B.D. Neal and Associates, January 2006)
C	Biological Assessment, Sea Mountain at Punalu'u (Patrick Hart, Ph.D., June 2006)
D	Potable Water, Recycled Water and Wastewater Systems, Sea Mountain at Punalu'u (Hunsaker and Associates, June 2006)
E	Preliminary Surface Water Quality Assessment, Sea Mountain at Punalu'u (Hunsaker and Associates, May 2006)
F	Cultural Impact Study/Assessment Punalu'u Development Project (Maria E. Ka'imipono Orr, February 2006)
G	Economic and Fiscal Impacts of the Redevelopment of the Sea Mountain at Punalu'u Project (Knowledge Based Consulting Group, April 2006)
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I	Acoustic Study for Sea Mountain at Punalu'u (Y. Ebisu and Associates, Dec. 2005)
J	Assessment of the Marine and Pond Environments in the Vicinity of the Sea Mountain Village at Punalu'u Project (Marine Research Consultants, Inc., April 2006)
K	Traffic Impact Analysis Report Sea Mountain at Punalu'u (M&E Pacific, Inc. Feb. 2006)
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Appendix A

Archaeological Inventory Survey of the Approximately 430-Acre Sea Mountain at Punalu‘u Resort (Cultural Surveys Hawai‘i, Inc., February 2006)

Archaeological Inventory Survey of the Approximately 430-Acre Sea Mountain at Punalu‘u Resort, Punalu‘u, Wailau, and Nīnole Ahupua‘a, Ka‘ū District, Island of Hawai‘i

TMK: [3] 9-5-019:011, 015, 024, 026, 030-031; 9-6-001:001-003, 006, 011-013; 9-6-002:008, 037-038, 053

Prepared for

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(Job Code: PUNA 10)

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Management Summary

Reference	Archaeological Inventory Survey of the Approximately 430-Acre Sea Mountain at Punalu‘u Resort, Punalu‘u, Wailau, and Nīnole Ahupua‘a, Ka‘ū District, Island of Hawai‘i (TMK: [3] 9-5-019:011, 015, 024, 026, 030-031; 9-6-001:001-003, 006, 011-013; 9-6-002:008, 037-038, 053)(Tulchin et al. 2006)
Date	February 2006
Project Number	PUNA 10
Investigation Permit Number	Cultural Surveys Hawai‘i, Inc. (CSH) completed the fieldwork component of the archaeological inventory survey under Hawai‘i State Historic Preservation Division (SHPD) permit No. 0508, per Hawai‘i Administrative Rules (HAR) Chapter 13-13-282.
Project Location	The Sea Mountain at Punalu‘u Resort project area is located within coastal portions of Nīnole, Wailau, and Punalu‘u Ahupua‘a, with parcels both *mauka* and *makai* of Hawai‘i Belt Highway 11. The project area is bordered on its *mauka* extent by the Old Māmalahoa Government Road, and extends *makai* to the shoreline, from Nīnole Cove in the southwest to Punalu‘u Harbor in the northeast. The project area is depicted on the USGS 1:24,000 Topographic Map Punalu‘u Quadrangle (1995) (Figure 1)
Land Jurisdiction	The subject property is privately owned by SM Investment Partners
Agencies	State Historic Preservation Division
Project Description	Proposed development within the project area included realignment of the existing golf course, and subdivision of much of the undeveloped lands for residential houselot, condominium, and resort development. Minimally, land disturbing construction would include grubbing, major grading, excavations associated with golf course feature construction, dwelling construction, and excavations for the installation of subsurface utilities.
Project Acreage	Approximately 430-Acres

Area of Potential Effect (APE) and Survey Acreage	The project's APE is defined as the entire 430-acre project area. The survey area for the current archaeological inventory survey investigation, totaling approximately 330-acres, consisted of all undeveloped lands within the Sea Mountain Resort property, excluding lands occupied by the existing golf course, resort facilities, and residential condominium complex. The proposed residential house lot, condominium, and resort construction is evaluated as posing no additional auditory or visual impact to any surrounding potential historic properties.
Historic Preservation Regulatory Context	At the request of Group 70 International, Inc., CSH conducted this archaeological inventory survey. In consultation with SHPD, the inventory survey investigation was designed to fulfill the State requirements for an archaeological inventory survey per HAR Chapter 13-13-276 and Chapter 13-13-284.
Fieldwork Effort	Fieldwork was accomplished over a non-consecutive four-week period from September 19, 2005 to December 2, 2005. The alternating CSH field crew consisted of David W. Shideler, M.A., Owen O‘Leary, M.A., Bradley Garrett, M.A., Todd Tulchin, B.S., Jon Tulchin, B.A., Kulani Jones, B.S., Anthony Bush, B.Ed., Constance O‘Hare, B.A., and Jennifer Olson, B.A., under the general supervision of Hallett H. Hammatt, Ph.D., and required 76 person-days to complete. Fieldwork consisted of a 100% coverage pedestrian inspection of undeveloped lands within the project area and limited subsurface testing at select archaeological sites.
Number of Historic Properties Identified	A total of 34 historic properties, comprised of over 125 archaeological features, were identified within the project area. 23 of the historic properties were previously identified and 11 were newly recorded as part of the current inventory survey investigation.
Historic Properties Recommended Eligible to the National/Hawai‘i Register of Historic Places [1]	All 34 historic properties identified within the project area are recommended eligible to the National/Hawai‘i Register: SIHP # 50-10-68-3512, Criteria A, C, D, and E. SIHP # 50-10-68-3513, Criteria D and E. SIHP # 50-10-68-3515, Criterion D. SIHP # 50-10-68-3519, Criterion D. SIHP # 50-10-68-3520, Criterion D. SIHP # 50-10-68-3521, Criterion D. SIHP # 50-10-68-3522, Criteria C and D. SIHP # 50-10-68-3524, Criteria A and D. SIHP # 50-10-68-4309, Criteria D and E. SIHP # 50-10-68-4310, Criterion D. SIHP # 50-10-68-4330, Criterion D. SIHP # 50-10-68-4360, Criterion D.

	SIHP # 50-10-68-4368, Criteria A, C, D, and E. SIHP # 50-10-68-7361, Criteria D and E. SIHP # 50-10-68-7370, Criteria D and E. SIHP # 50-10-68-24897, Criterion D. SIHP # 50-10-68-24898, Criteria D and E. SIHP # 50-10-68-24899, Criteria D and E. SIHP # 50-10-68-24900, Criteria D and E. SIHP # 50-10-68-24901, Criterion D. SIHP # 50-10-68-24902, Criterion D. SIHP # 50-10-68-24903, Criteria D and E. SIHP # 50-10-68-24905, Criterion D. SIHP # 50-10-68-24906, Criterion D. SIHP # 50-10-68-24907, Criterion D. SIHP # 50-10-68-24908, Criterion D. SIHP # 50-10-68-24909, Criteria A and D. SIHP # 50-10-68-24910, Criterion D. SIHP # 50-10-68-24911, Criterion D. SIHP # 50-10-68-24912, Criteria D and E. SIHP # 50-10-68-24913, Criterion D. SIHP # 50-10-68-24914, Criteria D and E. SIHP # 50-10-68-24915, Criteria A, C and D. SIHP # 50-10-68-24916, Criteria D and E.
Historic Properties Recommended Ineligible to the National/Hawai‘i Register of Historic Places	None
Effect Recommendation	Preservation is recommended for 27 sites and no further work is recommended for 5 sites (see Table 5)
Mitigation Recommendation	A preservation plan to address the preservation of 27 sites is indicated. A monitoring program with a monitoring plan (including areas for on-site and on-call monitoring) is indicated A burial treatment plan is indicated to address preservation in place of identified burial sites

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Section 1 Introduction

1.1 Project Background

At the request of the Group 70 International, Inc., Cultural Surveys Hawai‘i Inc. (CSH) conducted an archaeological inventory survey of approximately 430-acres at the Sea Mountain at Punalu‘u Resort, Punalu‘u, Wailau, and Nīnole Ahupua‘a, Ka‘ū District, Island of Hawai‘i (TMK: [3] 9-5-019:011, 015, 024, 026, 030; 9-6-001:001-003, 006, 011-013; 9-6-002:008, 037-038, 053). In consultation with the Hawai‘i State Historic Preservation Division (SHPD), the inventory survey investigation was designed to fulfill State requirements for an archaeological inventory survey per HAR Chapter 13-13-276 and Chapter 13-13-284. CSH completed the fieldwork component of the archaeological inventory survey under SHPD permit No. 0508, per Hawai‘i Administrative Rules (HAR) Chapter 13-13-282.

The Sea Mountain at Punalu‘u Resort project area is located within coastal portions of Nīnole, Wailau, and Punalu‘u Ahupua‘a, with parcels both *mauka* (inland, northwest) and *makai* (seaward, southeast) of Hawai‘i Belt Highway 11 (Figures 1-2). The project area is bordered on its *mauka* extent by the Old Māmalahoa Government Road, and extends *makai* to the shoreline, from Nīnole Cove in the southwest to Punalu‘u Harbor in the northeast. The subject property is privately owned by SM Investment Partners, and consists of a total of approximately 430-acres. Much of the property was undeveloped at the time of the inventory survey, with the exception of an existing 18-hole golf course and associated resort infrastructure, covering approximately 100-acres (Figure 3). A residential condominium complex (TMK: 9-5-19:31,33) within the greater project boundary is owned by other parties and was not included in the project area. Another small exclusion (TMK: 9-6-02:41) of private home parcels lies just northwest of Punalu‘u Cove. Nīnole Pond, previously designated as Site 50-10-68-3514 (Emory 1970:4), is understood as owned by the State. Another significant exclusion is the walled cemetery surrounding the Hōkūloa Congregational Church understood as under the ownership of the Hawaiian Evangelical Association. The survey area for the current archaeological inventory survey investigation consisted of all undeveloped lands within the Sea Mountain Resort property, excluding lands occupied by the existing golf course, resort facilities, and residential condominium complex, totaling approximately 330-acres.

At the time of the archaeological inventory survey, the undeveloped lands within the portion of project area *mauka* of Belt Highway 11 were being actively utilized as pasture for the grazing of cattle. The undeveloped lands within the project area *makai* of Highway 11 were not being actively utilized. Proposed development within the project area includes realignment of the existing golf course, and subdivision of undeveloped lands for residential houselot, condominium, and a resort (Figure 4). Minimally, land-disturbing construction would include grubbing, major grading, excavations associated with golf course feature construction, dwelling construction, and excavations for the installation of subsurface utilities.

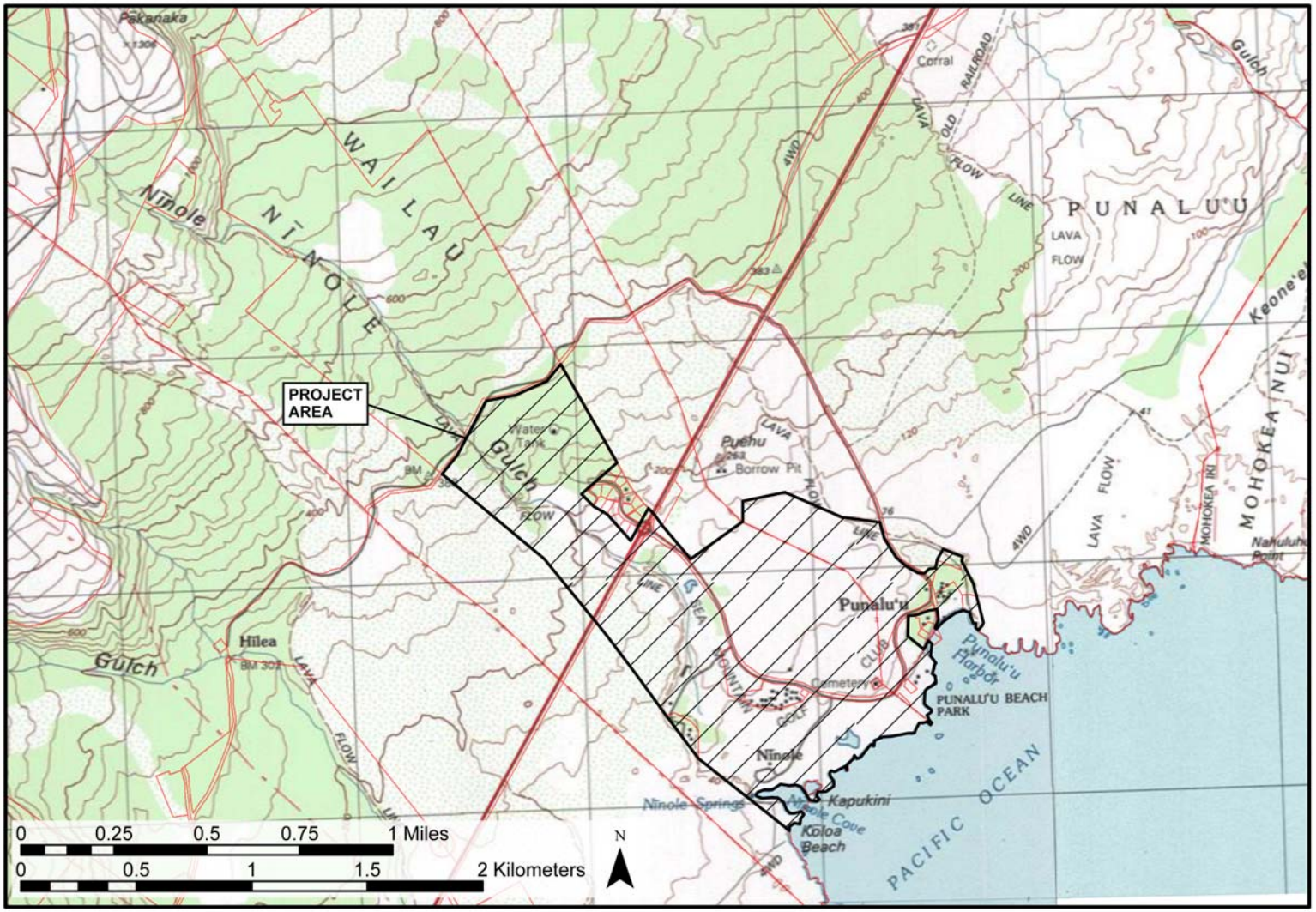

Figure 1. U. S. Geological Survey Topographic Map, Punalu‘u Quadrangle (1995), showing the location of the project area.

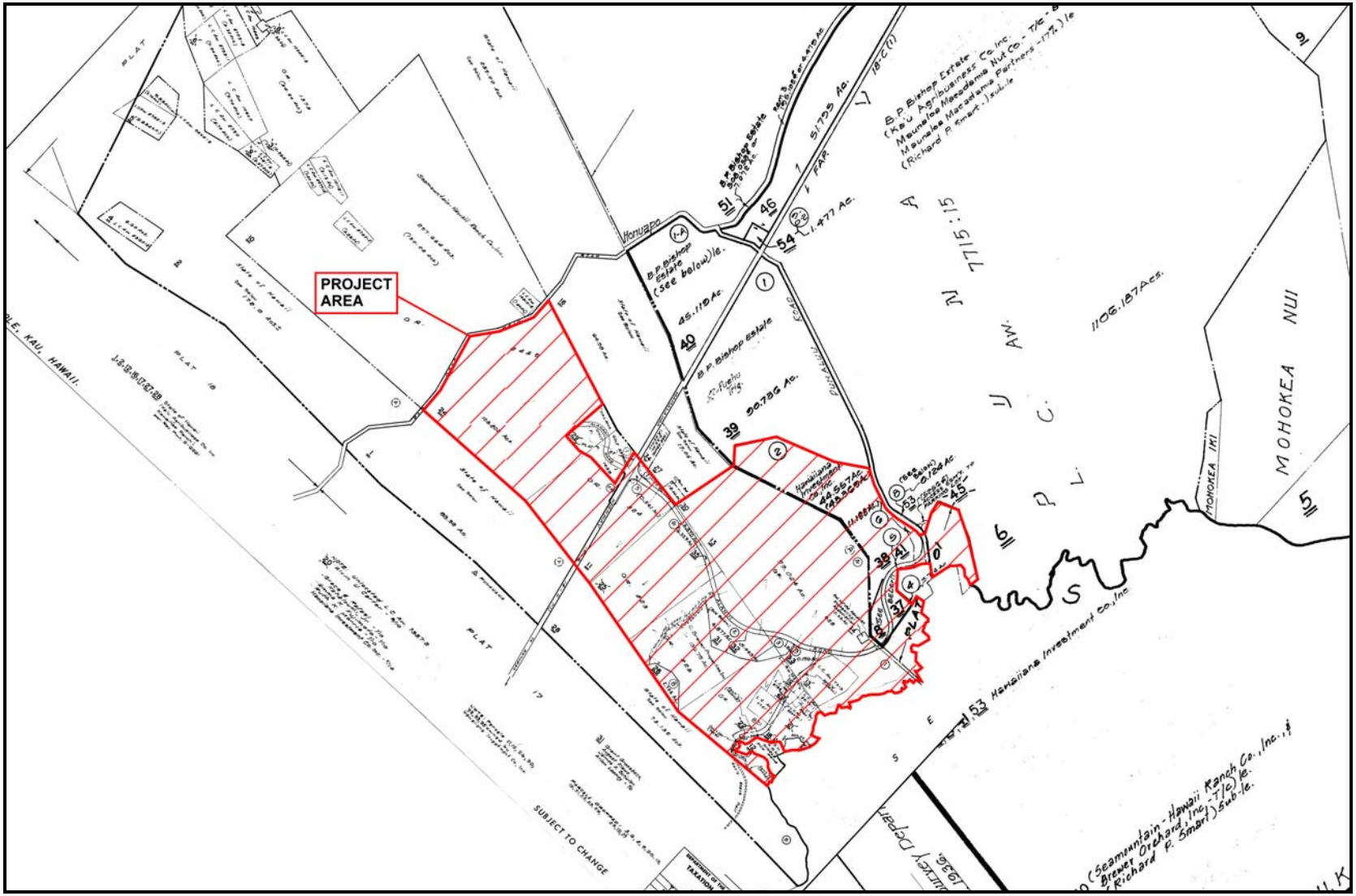

Figure 2. Portions of TMK 9-5-019 and 9-6-002, showing the location of the project area.

Figure 3. Map provided by Group 70 International, showing TMK parcels and the extent of existing golf course construction within the Sea Mountain Resort property.

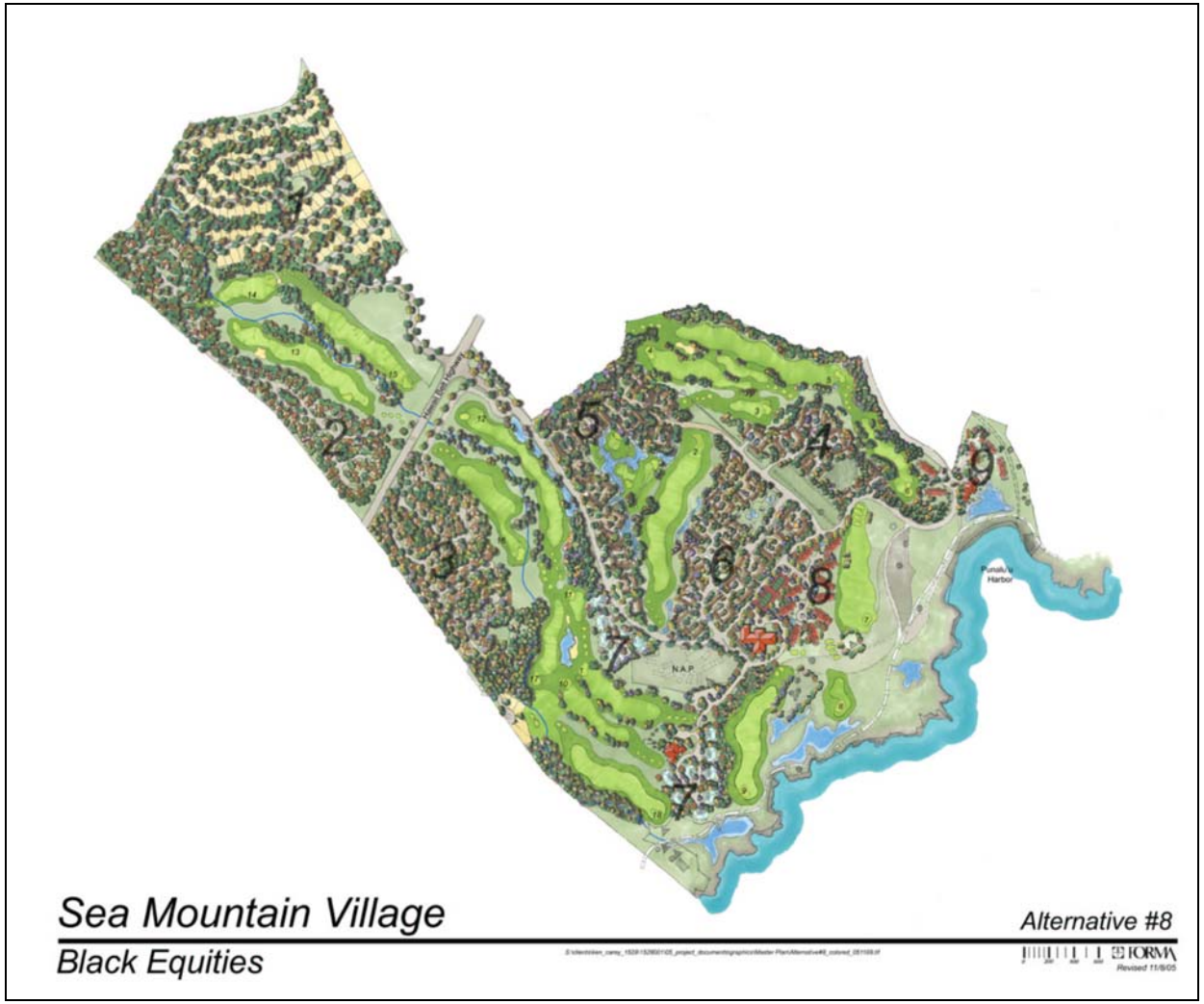

Figure 4. Sea Mountain Village Master Plan, showing conceptual development within the project area.

1.2 Scope of Work

The archaeological inventory survey and its accompanying report documented all historic properties within the subject parcel. The following scope of work satisfies State and County requirements for an archaeological inventory survey [per HAR 13-13-276]:

1. A complete ground survey of the entire project area for the purpose of site inventory. All sites were located, described, and mapped with evaluation of function, interrelationships, and significance. Documentation included photographs and scale drawings of selected sites and complexes. All sites were assigned State Inventory of Historic Properties (SIHP) numbers.
2. Limited subsurface testing was conducted to determine if subsurface deposits were located in archaeological sites of the project area and, if so, to evaluate their significance.
3. Research on historic and archaeological background, including search of historic maps, written records, and Land Commission Award documents. This research focused on the specific area with general background on the Ahupua‘a and district and emphasized settlement patterns.
4. Preparation of this inventory survey report including the following:
    a. A topographic map of the survey area showing all archaeological sites and site areas;
    b. Description of all archaeological sites with selected photographs, scale drawings, and discussions of function;
    c. Historical and archaeological background sections summarizing prehistoric and historic land use as they relate to the archaeological features;
    d. A summary of site categories and their significance in an archaeological and historic context;
    e. Recommendations based on all information generated specifying what steps should be taken to mitigate the impact of development on archaeological resources - such as data recovery (excavation) and preservation of specific areas. These recommendations will be developed in consultation with the client and the State Historic Preservation Division.

This scope of work also includes full coordination with the State Historic Preservation Division (SHPD), and County relating to archaeological matters. This coordination takes place after consent of the owner or representatives.

1.3 Environmental Setting

1.3.1 Natural Environment

Elevations within the project area range from approximately 116 m (380 ft.) a.m.s.l. to sea level. The portion of the project area *mauka* of Belt Highway 11 generally consisted of gently to moderately sloping rocky soil. The land was bisected by Nīnole Gulch, which consisted of steep sloping valley walls and a relatively wide, dry streambed. Lands to the southwest of Nīnole Gulch consisted of *‘a‘ā* lava flows. The portion of the project area *makai* of Belt Highway 11 generally consisted of relatively level to gently sloping lands. Lands southwest of Nīnole Gulch consisted of barren *‘a‘ā* lava flows. The low-lying lands in the coastal portion of the project area consisted of a marsh-type environment, with abundant freshwater springs and brackish water ponds. Lands along the shoreline area consisted of bare *pāhoehoe* or very thin soil.

Soils within the *mauka* portion of the project area are listed as Punalu‘u Extremely Rocky Peat (rPYD) and *‘A‘ā* Lava Flows (rLV) south of Nīnole Gulch. Soils of the Punalu‘u Series are described as “well-drained, thin organic soils over *pāhoehoe* lava bedrock” (Foote et al. 1972). Soils within the *makai* portion of the project area are listed as Very Stony Land (rVS), *‘A‘ā* Lava Flows (rLV) south of Nīnole Gulch and in the northern portion of the project area, and *Pāhoehoe* Lava Flows (rLW) along the shoreline. Very Stony Land is described as “very shallow soil material and a high proportion of *‘A‘ā* lava outcrops” (Foote et al. 1972).

The project area receives approximately 1250 mm (49 in.) of annual rainfall (Giambelluca et al. 1986). Vegetation within the *mauka* portion of the project area consisted primarily of low pasture grasses and *koa haole* (*Leucaena leucocephala*), with scattered Christmas berry (*Schinus terebinthifolius*) and monkey pod (*Pithecellobium saman*) trees. Vegetation within the *makai* portion of the project area consisted primarily of *koa haole* (*Leucaena leucocephala*), Christmas berry (*Schinus terebinthifolius*) lantana (*Lantana camara*), and exotic grasses. Additional species included guava (*Psidium guajava*), sisal (*Agave spp.*), *ti* (*Cordyline fruticosa*), *naupaka* (*Scaevola sericea*), *‘ilima* (*Sida fallax*), *naio* (*Myoporum sandwicense*), *hau* (*Hibiscadelphus giffardianus*), and papaya (*Carica papaya*).

1.3.2 Built Environment

As previously mentioned, an existing 18-hole golf course is located within the Sea Mountain at Punalu‘u Resort. Additional golf course and resort infrastructure includes paved and unpaved roads, a clubhouse, a driving range, a sewage treatment plant, tennis courts, conference rooms, and visitor center. The golf course and associated infrastructure was actively maintained, while many of the resort-related buildings were abandoned and in disrepair at the time of the inventory survey. A water tank and access road were located within the *mauka* portion of the project area. In addition, an independently owned residential condominium complex and county beach park (leased) were located within the greater Sea Mountain Resort project boundary. A residential subdivision was located adjacent to the project area, immediately *mauka* of Belt Highway 11.

Section 2 Methods

2.1 Field Methods

The fieldwork component of the archaeological inventory survey investigation was accomplished over a non-consecutive four-week period from September 19, 2005 to December 2, 2005. The alternating CSH field crew consisted of David W. Shideler, M.A., Owen O‘Leary, M.A., Bradley Garrett, M.A., Todd Tulchin, B.S., Jon Tulchin, B.A., Kulani Jones, B.S., Anthony Bush, B.Ed., Constance O‘Hare, B.A., and Jennifer Olson, B.S., under the general supervision of Hallett H. Hammatt, Ph.D., and required 76 person-days to complete. Fieldwork consisted of a 100% coverage pedestrian inspection of undeveloped lands within the project area and limited subsurface testing at select archaeological sites. The pedestrian inspection of the project area was accomplished through systematic sweeps. The interval between the archaeologists was generally 5-10 m. All historic properties encountered were recorded and documented with a written field description, site maps, photographs, and each site was located using Trimble Pro XR GPS survey technology.

Subsurface testing consisted of the partial excavation, by hand, of selected surface archaeological features located during the pedestrian survey. The purpose of the subsurface testing was to aid in determining the function of located surface sites, as well as to possibly obtain datable materials for later radiocarbon dating. All excavated material was sifted through a 1/8 in. wire mesh screen to separate out the soil matrix, then all cultural material was collected for analysis in the lab. Each test excavation was documented with a scale section profile, photographs, and sediment descriptions. Sediment descriptions included characterizations of Munsell color designations, compactness, texture, structure, inclusions, cultural material present, and boundary distinctness and topography.

2.2 Laboratory Methods

Laboratory analyses of material recovered from limited subsurface testing within the project area included:

1. Preparation and submittal of datable material, such as charcoal, to Beta Analytic for radiocarbon AMS dating.
2. Identification of invertebrate midden. Common marine shells were identified and analyzed at the Cultural Surveys Hawai‘i laboratory in Kailua, Hawai‘i.
3. Identification of vertebrate faunal material. All vertebrate faunal material was identified and analyzed at the Cultural Surveys Hawai‘i laboratory in Kailua, Hawai‘i.
4. Identification and cataloguing of traditional Hawaiian artifacts. Any artifacts collected *in situ* at the project area or contained within sediment samples were measured, weighed and classified by material type and artifact form. The analysis then focused on distinguishing artifact function.

2.3 Document Review

Historic and archival research included information obtained from the UH Hamilton Library, the State Historic Preservation Division Library, the Hawai‘i State Archives, the State Survey Office, and the Archives of the Bishop Museum. Previous archaeological reports for the area were reviewed, as were historic maps and primary and secondary historical sources. Information on Land Commission Awards was accessed through Waihona Aina Corporation's Māhele Data Base (<www.waihona.com>).

2.4 Consultation

A Cultural Impact Assessment is being prepared as a companion study to this work. Thus consultations specifically as a component of this archaeological inventory survey were limited. These consultations focused on identifying concerns regarding archaeological and burial sites and are presented in Section 3.6 of this study.

2.5 A Note on Orthography

Throughout this study the presentation of Hawaiian vocabulary is typically standardized to conform with present orthography and is presented in italics. An exception is made where the rendition of place names is thought to reflect local dialect in which case the standard place name is presented in brackets. However, if the diacritics are uncertain they are left out.

Section 3 Traditional and Historical Background

The project lands are understood to lie within two traditional Hawaiian land divisions or *ahupua‘a*, Punalu‘u on the northeast and Wailau on the southwest (Figure 5). The southeast border of the project area is understood as the boundary between Wailau and neighboring Nīnole Ahupua‘a. Wailau is less than a kilometer wide at the coast and the coastal stretch is sometimes popularly referred to as Punalu‘u/Nīnole. Indeed one of the land commission awards (LCA 7721 to Makaha) within the present project lands is listed as at Nīnole (as are Nīnole Cove and the mouth of Nīnole Stream). Possibly by the time of the *kuleana* claims (1847 - 1850) these land divisions had already become somewhat blurred.

3.1 Mythological and Traditional Accounts Specific to Punalu‘u

3.1.1 Reproducing Stones of Kōloa

Perhaps the most famous story associated with the project area is that of the reproducing stones of Kōloa. William Ellis relates: the following account presumably from his brief visit there in 1824:

> We had not traveled far [from Hīlea] before we reached Nīnole, a Small village on the sea shore, celebrated on account of a short pebbly beach called Koroa [Kōloa], the stones of which were reported to possess very singular properties; amongst others, that of propagating their species. The natives told us it was a *wahi pana* (place famous) for supplying the stones employed in making small adzes and hatchets, before they were aquainted with the use of iron; but particularly for furnishing the stones of which the gods were made, who presided over most of the games of Hawai‘i. Some powers of discrimination, they told us, were necessary to discover the stones which would answer to be deified. When selected they were taken to the *Heiau*, and there several ceremonies were performed over them. Afterwards, when dressed, and taken to the place where the games were practiced, if the parties to whom they belonged were successful, their fame was established; but if unsuccessful for several times together, they were either broken to pieces, or thrown contemptuously away. When any were removed for the purpose of being transformed into gods, one of each sex was generally selected; these were always wrapped very carefully together in a piece of native cloth. After a certain time, they said a small stone would be found with them, which, when grown to the size of its parents, was taken to the *Heiau*, or temple, and afterwards made to preside at the games.
>
> We were really surprised at the tenacity with which this last opinion was adhered to…Koroa [Kōloa] was also a place of importance in times of war, as the best stones used in their slings were procured here….
>
> This place is also celebrated as furnishing the small black and white stones used by the natives in playing *kōnane*… (Ellis 1969:213)

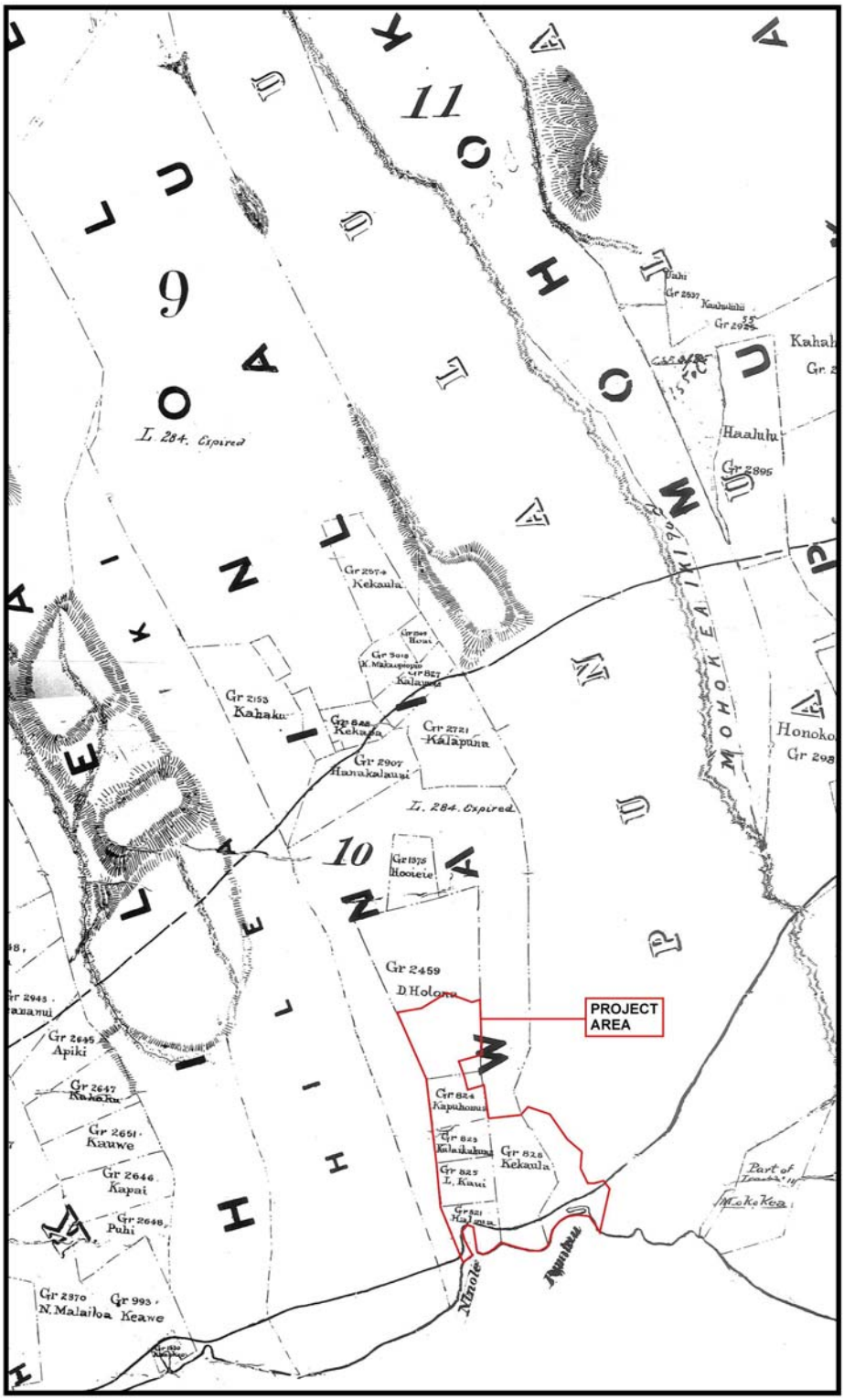

Figure 5. Portion of 1885 Brown map of Ka‘ū District, Hawai‘i showing the location of the project area and land grants within Nīnole, Wailau, and Punalu‘u Ahupua‘a.

Skinner (1900:183-184), in his review of ancient faiths of Hawai‘i, tells a similar story that may be derived from the Ellis account:

> Among these gods none are more curious than the stones of Kaloa [Kōloa] beach, *Nīnole*, Hawai‘i. The natives who believed that they had sex, and propagated, chose male specimens for their household deities. In order to make sure whether or not they were really gods, the stones were blessed in a temple, wrapped in a dress, and taken to see a game of skill or strength. If the owner of the god won he gave to the piece of stone the credit for his victory and established it in his house; but if he lost, the stone was thrown aside. If the believer wanted to make sure of finding a god he would take a beach pebble of each sex, wrap the two in cloth, and put them away for a time. When they were brought back to the light a smaller pebble, the result of their union, was found with them. This grew, like an animal, until it was of a size to be blessed by the priests and formally declared to be a god. The original pebbles are of black trap, compact lava, and white coral.

Kelly (1956:37) relates an account of the abuse of laborers at the time of the construction of a *Heiau* on Makanau Hill involving stones from Kōloa. She relates that:

> All the men in the district were conscripted to transport stones from Kōloa Beach at Nīnole. They formed a human chain and passed the stones up to the site in baskets.
>
> The mana or efficacy associated with the stones of Kōloa may have made them particularly appropriate for inclusion within a *Heiau*.

3.1.2 The Caterpillar Kumuhea

A particularly notable landform in the uplands of Punalu‘u is Pu‘u‘enuhe or “cut-wormhill.” Martha Beckwith gives a succinct account of the story but places Pu‘u‘enuhe in neighboring Hīlea Ahupua‘a:

> Kumu-hea (or *Mo‘o*), son of the god Kū, lives in the hill Pu‘u‘enuhe at Hi‘ilea [Hīlea] in Ka‘ū District and is the god *(‘aumakua*) of the cutworm. He marries a girl but comes to her only at night, for by day he is a worm (or *mo‘o*). He does not support her. With the advice of her parents she ties a hemp string to his back and when he leaves her she follows him to the hill and discovers his true nature. He is angry. Cutworms attack the crop. The parents appeal to Kāne, who cuts up the god; and hence the small *pe‘elua* cutworms (or lizards) of today, which Hawaiians fear to injure.

3.1.3 The Blind Men’s Trials En Route to Punalu‘u

A traditional story of Punalu‘u is the account of “*Nā Makapō o Moa‘ula* (The Blind Men of Moa‘ula)” (Green and Pukui 1936:144-145). In this brief account there once were two men , one of whom was totally blind (“*makapō loa)* and the other of whom had very poor vision but could see a little *(‘ike iki*). They live at Moa‘ula, in the uplands of Ka‘ū and one day they decide to go down to Punalu‘u, with the man who could see a little leading his blind companion. They traverse slowly to the edge of the Punalu‘u Stream where the blind man asks: “How is it? Is there water below?” (*Pehea, he wai anei ko lalo*?”) The near-sighted man replies “Yes there is water

(‘*Ae he wai*),” and is further queried “Is there much water? (*Nui anei ka wai?*)” He replies “Yes there is much water below. (‘*Ae nui ka wai o lalo*).” They both agree to jump into the stream and when they do they both break their legs (*a hakihaki nā wawae*). At a later time the same two companions are again making their way down to Punalu‘u and reach the inland side of the debouch (*kahawai mauka*). The blind man asks his guide “What do you see?, Is the water low (*Pehea kau ‘ike ana? Ua ‘u‘uku anei i ka wai?*)” The near-sighted man replies: “Yes, very low. (‘*Ae ‘u‘uku loa*).” The blind man wants further confirmation asking “Is that true? Is there no water below? (*He mea ‘oiā‘i‘o anei kēnā, ‘a‘ohe wai o lalo*?) As the audience might guess the pair go down to the full stream and are swept away (*ua piha ke kahawai i ka wai a lilo lāua*). They were seen struggling and were fetched up out of the water and then returned to the uplands. Never again did they desire to return to Punalu‘u unless they went with someone who could see.

This may just be a simple tale to amuse the audience with the tribulations of the blind that has little to do with Punalu‘u or Ka‘ū District per se. It is worth noting in passing that Ka‘ū District was associated with the most famous blind person in Hawai‘i’s pre-contact traditions - the blind ruling chief I-mai-ka-lani. Possibly the association of Ka‘ū with the famous blind made Punalu‘u an appropriate setting for the story or possibly Ka‘ū District had a greater prevalence of blindness (as hereditary dispositions toward glaucoma or cataracts).

A common Hawaiian theme that may be reflected in the story is the view held by coastal people that the inhabitants of the uplands were foolish bumpkins (as exemplified in the Maui saying that: “the people of the Kula uplands scale squids”). A theme specific to Punalu‘u, however, is that of the variability of the Punalu‘u watercourse. All of the way along the coast from Hilo to South Point to Kawaihae there may have been no more notable stream than that of Punalu‘u that quickly could go from dry to a raging torrent. Certainly the story emphasizes the stream’s variability and serves to warn those who might try to cross it in spate. Another point not to be lost is the general indication of people who resided in the uplands making periodic trips to Punalu‘u and that there were amenities at coastal Punalu‘u that merited undertaking some risk to get there. One could also read into the story an account of the compassion of the coastal people who must have helped the blind pair when they broke their legs and who later fished them out of the stream.

3.1.4 Punalu‘u and the Bones of Wahieloa, a Ruling Chief of Maui

Punalu‘u is associated with the remains of a ruling chief named Wahieloa whose bones were carried away by his son Laka. One account is found in Thrum’s (1907: 11-112) story of “Laka’s adventure.” Most of the tale involves Laka’s interaction with Menehune presumably in the uplands of Kalaikoi, Kīpahulu, Maui.” Laka is attempting to construct a canoe, a task the Menehune first hinder and then facilitate. Laka needs the canoe to go in search of his father (or his father’s remains) - the ruling chief Wahieloa. We are told:

> One day his father [Wahieloa] went to Hawai‘i in search of the Ala Koiula a Kāne for a toy for his son [Laka], landing at Punalu‘u Ka‘ū, Hawai‘i, where he was killed in a cave called Keana-a-Kaualehu.

There would appear to be more to the story than Thrum relates such as: “Why did Wahieloa go specifically to Punalu‘u?”, “What was the *Ala Koiula a Kāne?”,* and “What associations were there with the cave called Keana-a-Kaualehu?” If nothing else the story supports the idea that the

people of Punalu‘u were fierce and did not take kindly to strangers coming to take their resources. The possible presence of a cave known as Keana-a-Kaualehu and the importance of caves at Punalu‘u is suggested.

Samuel M. Kamakau (1964:41) also makes passing reference to this in his discussion of "Disposal of Corpses" in which he relates that in Kīpahulu Maui:

> …is the burial cave in which the bones of the famous ancient chief Wahieloa were deposited, and the canoe which Laka used to fetch the bones of his father Wahieloa from Punalu‘u in Ka‘ū on Hawai‘i….

3.1.5 Kauila Spring

Punalu‘u is much associated with Kauila Spring that is referred to in the following *‘ōlelo noeau.*

‘Ohu‘ohu Punalu‘u i Ka-wai-hū-o-Kauila

> Punalu‘u is adorned by the rushing water of Kauila.

The only explanation Mary Kawena Pukui (1983:260) offers is that the *‘ōlelo noeau*: "refers to Punalu‘u Ka‘ū." Another *‘ōlelo noeau* lauding the Kauila Spring is as follows:

Kū ka hale i Punalu‘u i Ka-wai-hū-o-Kauila

> The house stands at Punalu‘u, at the gushing water of Kauila

Mary Kawena Pukui (1983:203) explains:

> Said of one who has found peace and comfort at last. Ka-wai-hū-o-Kauila is a spring, the gift of a turtle goddess to the people of Punalu‘u Ka‘ū.

A passing reference to this Punalu‘u spring is made in the somewhat meandering and convoluted account of the adventures of the folk-hero Keaunini (Keaunini‘ulaokalani) and his family. A man, seemingly a resident of Waipi‘o, Hawai‘i and a subject of the chief Olopana, was under sentence of death for his treatment of Keaunini. He:

> went to his house, took his wife and children and ran by way of Hilo to Punalu‘u. It was said this man took his calabash to get water at the spring Kauwila [Kauila], and an owl picked a hole in it and let the water out. For this the owl was injured by a stone which was thrown at him, and he told the other birds. They said he was rightly punished for his fault. (Westervelt 1916: 181-182)

The account is obscure and of the nature of a side story of a side story. It seems likely that Punalu‘u would be a place of refuge for those who fall out of favor with ruling chiefs up in Waipi‘o Hāmākua. The association of the Kauila spring with Punalu‘u brings to mind the reference to an *Ala Koiula a Kāne* in the Thrum account of Laka's adventure related above. The deity Kāne is much associated with springs and may have been associated with the Kauila Spring at Punalu‘u.

3.1.6 Keakealaniwahine at Punalu‘u

John Papa ‘Ī‘ī (1959:160) discusses the high chiefess Keakealaniwahine offering human sacrifices at the six great *luakini heiau* including “Punalu‘u in Ka‘ū” equating the place name with the great temple located there.

3.1.7 Kohāikalani and the Edict of Death for Uncleaness

Mary Kawena Pukui (1983:110) relates a Hawaiian proverb *(‘ōlelo noeau*) as follows:

Ho‘i Hīlea i kalo ‘eka‘eka.

> Go to Hīlea of the dirty taro

She explains:

> Said of a careless person. Once Kohāikalani, a chief of Ka‘ū, was living at Punalu‘u. Poi was brought for him from various parts of the district, and a tiny speck of taro peeling was found in the poi from Hīlea [the next *ahupua‘a* to the south]. The makers of the poi were put to death. To say that someone hails from Hīlea is to say that he is unclean.

The saying associates Punalu‘u with the residence of ruling chiefs and emphasizes the power of their authority. The reference to the residents of Hīlea being unclean brings to mind Pukui’s (Handy and Pukui 1958:222) reference to the “outcasts known as *kauwā* (later doomed to die as human sacrifices), who were kept on a reservation consisting of the west half of the subdistrict of Nīnole.”

3.1.8 Punalu‘u and the Ruling Chief Kalani‘ōpu‘u

Kamakau (1964:108) gives a passing account of the ruling chief Kalani‘ōpu‘u passing through Punalu‘u during his efforts to subdue the rebellion of the chief Imaka Kōloa. Kalani‘ōpu‘u appears to have sailed to Punalu‘u directly from Hilo.

3.1.9 Keouakuahu‘ula and the Moving Cinder Cone

Kamakau (1964:152) offers an unusual account of a moving cinder cone in the time when a column of troops of Keōua Kū‘ahu‘ula was annihilated on the flanks of Kīlauea. According to Kamakau:

> Several cinder cones were heaped up near Kīlauea at this time. One cone moved straight down toward the sea at ‘Āpua and in less than two weeks reached the sand at Punalu‘u, where Keōua Kū‘ahu‘ula was staying at the time under tabu. This cinder heap moved along the sand from ‘Apua to the beach at Punalu‘u where its progress was barred by the highlands at Punalu‘u, Wailau and Nīnole, and there it remains at Punalu‘u to this day.

One can easily conceive of sands from new cinder cones washing from ‘Āpua south to Punalu‘u but Kamakau seems to be suggesting that the entire heap moved as a unit. This is supported by the most likely candidate for the Punalu‘u landform Kamakau is referring to, Pu‘ehu Hill, in that it is well inland. Kamakau relates that the ruling chief Keōua Kū‘ahu‘ula was

resident at Punalu‘u at the time and it would seem likely that Punalu‘u was often the residence of ruling chiefs of Ka‘ū.

3.1.10 Liholiho at Punalu‘u

The Hawaiian historian John Papa ‘Ī‘ī (1959:137) discusses Liholiho’s visit to the paramount *heiau* of each of the districts of Ka‘ū and puts “Punalu‘u in Ka‘ū in the list as if seeing the place name as co-equal with the great state *luakini* temple there.

3.1.11 The Dancing Sea of Punalu‘u

Mary Kawena Pukui (1983:110) relates a Hawaiian proverb *(‘ōlelo noeau*) as follows:

> *Punalu‘u i ke kai kau ha‘a a ka malihini*
>
> Punalu‘u, where the sea dances for the visitors.

She explains (1983:300-301): “Punalu‘u Ka‘ū, Hawai‘i is said to be the place where the sea dances to delight visitors.”

3.1.12 Winds of Punalu‘u

No name specific to the winds of Punalu‘u were discovered. The “Kuehulepo” wind blows at Na‘alehu and the “Uahipele” wind is of Kīlauea (Nakuina 1992:49)

3.2 History of Punalu‘u and Environs from Western Contact to the Māhele

There are no western accounts specific to Punalu‘u in the eighteenth century and few references to Ka‘ū at all. These are briefly summarized below. Lt. James King, sailing off the island of Hawai‘i on the 1779 voyage of Captain James Cook, summarizes Ka‘ū at the first European encounter:

> The coast of Kaoo [Ka‘ū] presents a prospect of the most horrid and dreary kind: the whole country appearing to have undergone a total change from the effects of some dreadful convulsion. The ground is every where covered with cinders and intersected in many places with black streaks, which seem to mark the course of a lava that has flowed, not many ages, back, from the mountain Roa [Mauna Loa] to the shore. The southern promontory looks like the mere dregs of a volcano. The projecting headland is composed of broken and craggy rocks, piled irregularly on one another, and terminating in sharp points. (King 1784: 104)

The only onshore exploration at Ka‘ū involved a search for fresh water:

> When [Mr. Bligh] landed, he found no stream or spring, but only rain-water, deposited in holes upon the rocks; and even that was brackish, from the spray of the sea; and that the surface of the country was entirely composed of flags and ashes, with a few plants here and there interspersed. (King 1784: 545)

The only reference to Punalu‘u in the eighteenth century comes from Archibald Menzies in the course of his rather circuitous ascent of Mauna Loa in 1794. Leaving the uplands of

Wai‘ōhinu and Honu‘apo and 4 to 5 miles from the sea the team stopped “at a plantation belonging to Kamehameha called Punalu‘u” but no details are given (Menzies 1920:187).

Lacking good anchorage and seemingly having little to offer Ka‘ū was very much of a backwater in terms of western contact in the first half of the nineteenth century.

Our first account of coastal Punalu‘u is from the Reverend William Ellis who passed through briefly in 1823. He approached Punalu‘u by way of Wai‘ōhinu upon which he waxed eloquent as:

> open towards the sea, and on both sides adorned with gardens, and interspersed with cottages, even to the summits of the hills.
>
> A fine stream of fresh water, the first we had seen on the island, ran along the centre of the valley, while several smaller ones issued from the rocks on the opposite side, and watered the plantations below.
>
> Our road, for a considerable distance, lay through the cultivated parts of this beautiful valley: the mountain taro, bordered by sugar-cane and bananas, was planted in fields six or eight acres in extent, on the sides of the hills, and seemed to thrive luxuriantly. (Ellis 1963: 133-134)

Ellis’s account confirms the upland luxuriance that had made the *ahupua‘a* of Wai‘ōhinu a center for the *ali‘i* of Ka‘ū. As Ellis continued his journey he moved closer to the coast - along the "foot of the mountains, in a line parallel with the sea, and about a mile and a half from it" (Ellis 1963: 134) - and his journal illumines areas where western eyes had previously descried only a "prospect of the most horrid and dreary kind." Travelling toward Punalu‘u, Ellis found the countryside increasingly: "more thickly inhabited [as his walk continued]...The villages along the sea shore, were near together, and some of them extensive" (Ellis 1963: 136). Specific villages Ellis mentions include Honu‘apo: described as an "extensive and populous village" where more than 200 Hawaiians turned out for a sermon; Hōkūkano [Ka‘ū]: possessing a fresh water spring; and Hīlea: the site of numerous fishponds and where the *konohiki* reported "hogs, fish, taro, potatoes, and bananas in abundance." Ellis also notes the intervening broad stretches of rough *‘a‘ā* between the habitation areas: these flows had been made traversable by waterworn boulder paths. Ellis thus reveals that the desolate coastline described forty-four years earlier by James King was in fact the site of a well-populated, organically developed, active culture and economy where habitation centers, though isolated, were accessible to each other and to the resources of land and sea.

He provides few details of the specific environs of Punalu‘u other than his account of the Kōloa stones quoted above. He mentions a small village on the sea-shore at Nīnole and then asserts “after traveling about two miles, we came to Punaruu [Punalu‘u], where the people of that and the next village, Wailau, collected together in a large house, and were addressed on the nature and attributes of the true God….we now left the road by the seaside, and directed our course towards the mountains.”

During the 1830s, Protestant missionaries based in Kona and Hilo would make occasional tours into Ka‘ū but a permanent missionary presence would not be installed until the early 1840s when Catholic and Protestant missions were established in the district. In 1841 a Catholic priest, Father Marechal, arrived in Ka‘ū and within a few months could boast of 900 converts. The

following year, 1842, the Protestant minister John Paris settled in Wai‘ōhinu where he founded a church and school. Marion Kelly offers a good overview of the early mission work at Punalu‘u:

> In 1843, Rev. Paris reported that a stone meeting house (church) had been built at Punalu‘u and that the school's average attendance there was 140. At that time Paris preached three Sundays each month at Wai‘ōhinu and one Sunday at Punalu‘u. By 1844, he reported the Sabbath school at Punalu‘u averaged 75 to 100 students – men, women and children. The average Sunday congregation at Punalu‘u was reported to be 350 [Station Report, Ms. (1843, 1844)] The Rev. T. D. Hunt, who had first gone to live in Wai‘ōhinu in 1844, moved to Punalu‘u in February 1845. An increase from 70 to 150 and to 180 in the congregation there was reported at that time. (Kelly 1980:33)

Mission station reports and censuses, and accounts by visitors to Ka‘ū document the changes to the district brought about by natural forces and by the pressures of an increasing western presence. A visitor to Wai‘ōhinu and its environs in 1849 published anonymously an account describing the devastating effects of a drought and fire that had occurred three years earlier:

> ...we noticed many a tall, stately trunk, branchless and lifeless standing monument-like, all over the country. On enquiry we ascertained that they were the remains of a noble forest, which, with the whole surrounding country, were burnt in 1846. In that year a severe drought visited the Island, the streams dried up, the grass withered, and fire swept over the whole district... (*Sailor* in Kelly 1980: 89)

An 1831-1832 census of Ka‘ū, the first taken within the district, records a total population of 5,800. This number already reflects the district's de-population - the effect of newly-introduced diseases, cultural unravelling and emigrations to new commercial centers - but the full precipitousness of the population decline within Ka‘ū is revealed in the totals from subsequent censuses. In 1835 the total population is 4,766. The first official government census, taken in 1847, records the population as having dropped to 3,010. Reverend John Paris would write in an 1848 mission station report: "Since the year 1845 the work of depopulation of Ka‘ū has gone on with fearful rapidity." He notes, during the years 1845 and 1846, a "distressing famine" and "fire which overran the country" -the same disasters the anonymous visitor of 1849 mentioned. Another visitor to Wai‘ōhinu during the 1840s, Chester H. Lyman, was informed that: a "like burning over of nearly the whole district, producing great distress among the inhabitants" (c. 1830 or 1831.) By the time of the 1853 government census only 2,210 people are recorded in Ka‘ū.

3.3 Ka‘ū and Punalu‘u Ahupua‘a in the Māhele

In the Māhele or great land division of 1848, the *ahupua‘a* of Wailau was retained by the government and the 5,360 acres of the *ahupua‘a* of Punalu‘u was retained as LCA 7715 to Lot Kapuaiwa Kamehameha (the future Kamehameha V). This may have been understood as an inheritance of the lands claimed by Kamehameha the Great noted by Menzies in 1794 (discussed above).

A total of 91 awardees received lands (total 528.58 acres) in the seven *ahupua‘a* of Ka‘ū with eight awards in Wailau (total 41,16 acres) and nine awards in Punalu‘u (total 39.69 acres). There appear to have been eleven Land Commission Awards within the present project area (7 listed as

at Punalu‘u, 3 listed as at Wailau and 1 listed as at Nīnole). These awards are summarized in Table 1, are given in detail in Appendix A, and those claims that are understood as at least in part in the present project lands are summarized in numeric order below. The land claims for Punalu‘u and vicinity were located in two general areas, in the uplands, particularly near Pu‘u ‘enuhe (Figure 6) and right at Punalu‘u Bay and the coast just to the southwest (Figure 7).

Enos Nakahuna claimed five parcels within his LCA 2564 claim of which at least two parcels were at coastal Punalu‘u and at least one was in the uplands by ‘Enuhe Hill (seemingly called Pu‘u puna). Nakahuna indicates in his testimony that he was the *konohiki* at that time (1847) and that he held the land under a (perhaps previous) *konohiki* named Kinimaka. Nakahuna claimed a house lot at a particularly prominent parcel on the west side of Punalu‘u(nui) Heiau and this prominent land holding may have been a prerogative of the land overseers of Punalu‘u. Nakahuna offers few details regarding his lands but notes that an upland plot of his was in *wauke* and bananas.

Two land claims (LCA 7313 in coastal Wailau and LCA 8760 in the uplands of Punalu‘u) are made by a Kaawa and it appears these are two claims by the same person. The Kaawa of LCA 7313 must have been of some prominence as he claims an entire *ahupua‘a* named Mahakea (bounded by Moaula and another Mahakea) at Waiākea Hilo and lands in other places in addition to Wailau Ka‘ū. He claims two *‘ili* at Wailau named “Aalu” and “Homaikolono.” His one specific claim at Wailau is to an orange tree suggesting that these Ka‘ū oranges were particularly coveted at that time. In the LCA 8760 Kaawa claims a piece of land at Punalu‘u (apparently named Pahoa or Pahaa) as well as fields in Moaula (presumably at Waiākea Hilo). While it is not altogether clear, Kaawa’s LCA 8760 claim appears to refer to a *kihāpai* (cultivated patch) of *olonā (Touchardia latifolia,* a valued fiber plant*)*, a *kihāpai* of *māmaki* (*Pipturus sp*., a *kapa* fiber plant), a *kihāpai ino* (uncertain, seemingly a “bad” patch – perhaps of exhausted soil) and 6 taro *kihāpai* in the uplands of Punalu‘u.

Kalapuna’s LCA 7557 claim is also confusing as he makes reference to six claims by their specific name. One of his claims *(‘āpana* 1) appears to be a houselot at Homaikalono on the *makai* side of a schoolhouse that appears most likely to be the one adjacent to the Punalu‘u church. Another parcel *(‘āpana* 2) is said to have the Punalu‘u *pali* on the Puna-side. This would appear to be a reference to the *pali* just seaward of the church site. No other specifics are given.

Kumaiku’s LCA 7606-C appears to be for his land on the south slope of Pu‘u‘enuhe but no specifics of land use are given nor does there appear to be any reference to his parcel at coastal Punalu‘u.

Makaha’s claim 7721 at Nīnole appears to actually be at Wailau. His testimony makes reference to *māmaki* (*Pipturus sp*.) trees in the uplands and to a shallow squid-spearing sea and two ponds at the coast.

Ahia’s claim 8004 appears to claim 1 house lot, 2 *lo‘i*, 1 taro *kihāpai*, 2 sweet potato *māla* (gardens) and 1 *wauke kihāpai* at Punalu‘u. Again it is not clear which of these claims relates to his coastal Punalu‘u lands and which were located further inland.

Table 1. Land Commission Awards at Wailau and Punalu‘u (underlined claims are within project area)

LCA	Location	Name	Acres
2564	Punalu‘u *uka* & *kai*	Enos Nakahuna	10.25
7313	Wailau *kai*	Kaawa	7.20
7557	Wailau *kai*	Kalapuna	6.63
7606-C	Punalu‘u *uka* & *kai*	Kumaiku	4.97
7721	Nīnole *kai*	Makaha 1	6.12
8004	Punalu‘u *kai*	Ahia	0.25
8758	Wailau *kai*	Kaiolani	2.30
8760	Punalu‘u *uka*	Kaawa	15.20
8760-C	Punalu‘u *kai*	Kekaula	0.80
8973	Punalu‘u *uka*	Kailiponi	0.80
8979	Wailau *uka* & *kai*	Kekapa	8.10
10112	Wailau *uka*	Mauna	3.13
10114	Punalu‘u *kai*	Mahoe	1.46
10510	Wailau *uka*	Nawali	4.30
10836	Punalu‘u *uka*	Poohina	4.48
10848	Punalu‘u *kai*	Pookuia	1.48
10846	Wailau	Palau	3.25
10884	Wailau	Papa	6.25

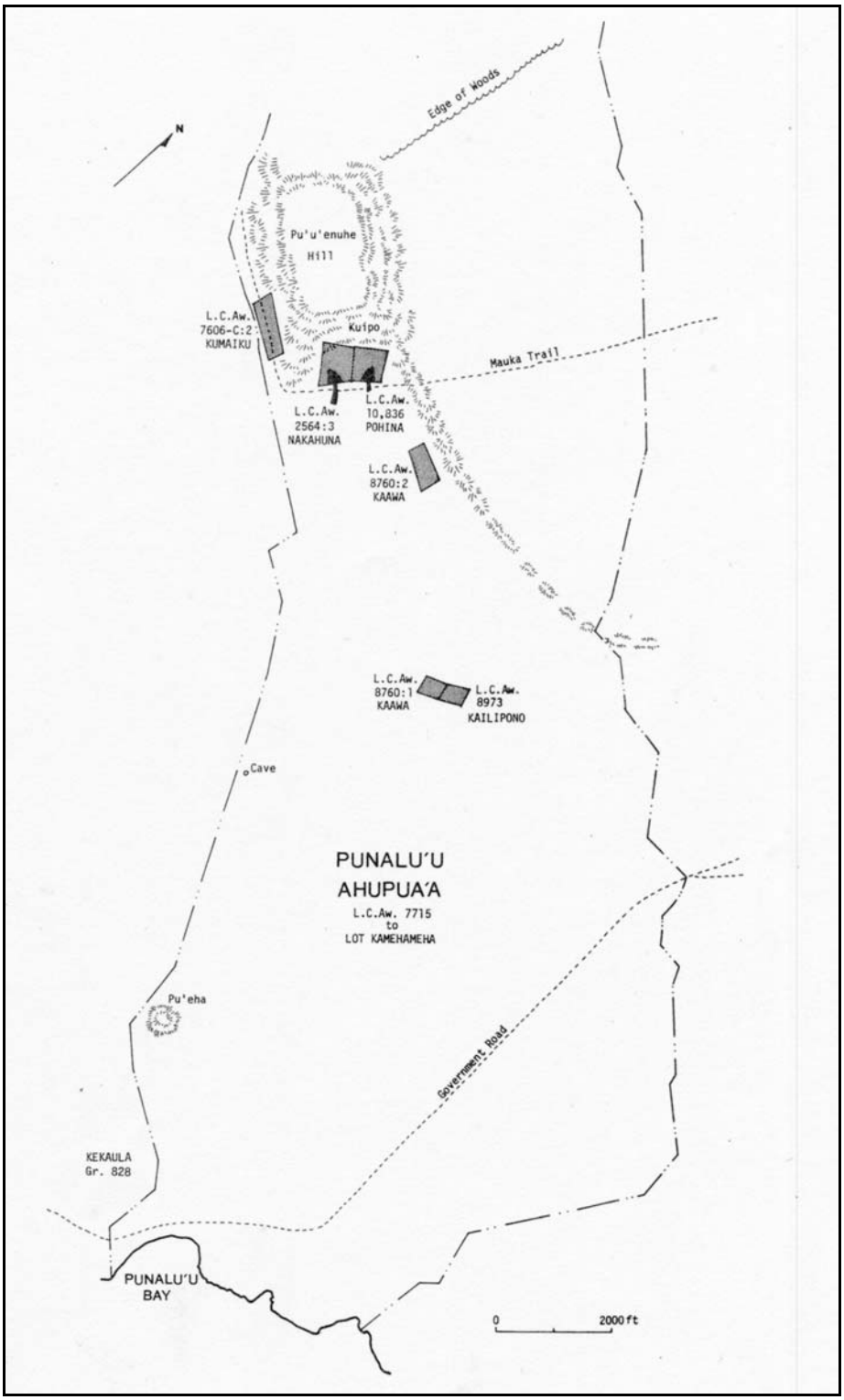

Figure 6. Map showing the location of Land Commission Awards in the uplands of Punalu‘u (adapted from Kelly 1980:65)

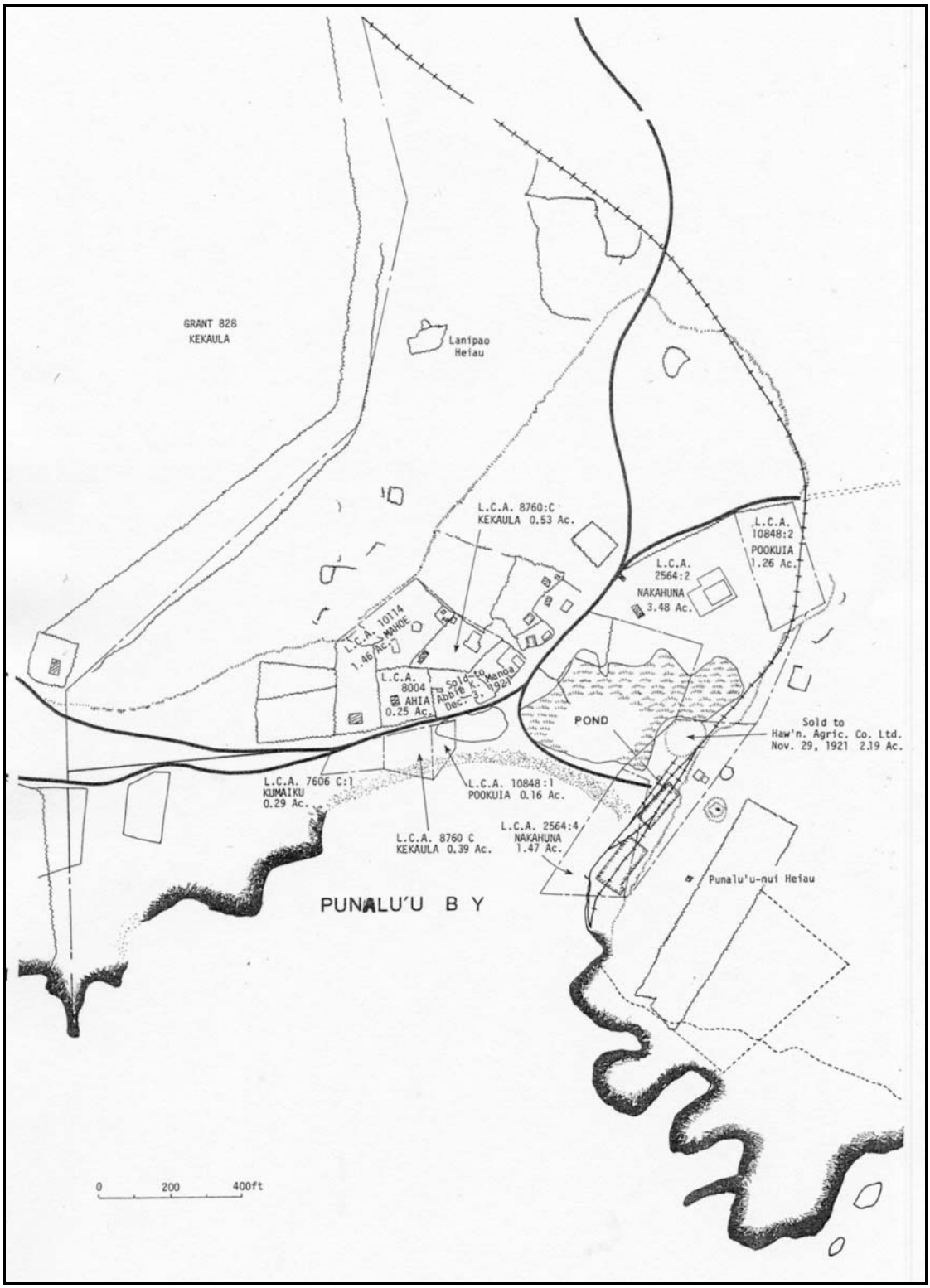

Figure 7. Map showing Land Commission Awards behind Punalu‘u Bay

Kaiolani’s claim 8758 cites no less than nine parcels located at Nīnole, Wailau and Punalu‘u. While the exact location of these claims is less than clear there are some interesting details in his mentions of bamboo, *lauhala,* a goat corral, and an *umu ahau* (a heap of rocks in the sea to shelter and attract young fish).

Kekaula’s claim 8760-C includes two parcels: a house lot at the coast and an inland agricultural parcel. The coastal house lot was said to include *hau* and coconut trees and to lie between the church lot and the Punalu‘u pond.

Mahoe (or Mahae’s) claim 10114 at Punalu‘u Bay mentions *kihāpai* of taro, coconut*, hau,* and *wauke.*

Po‘okuia’s claim 10848 mentions *kihāpai* of taro, *wauke,* and sweet potato.

While these claims are often frustrating because the locations of land holdings are unclear they do flesh out our picture of life at Punalu‘u circa 1850. House sites were typically at the coast where ponds are frequently mentioned along with an octopus-spearing area and a constructed shelter in the sea to attract young fish. The coast apparently was also used for the cultivation of *hau, wauke,* taro, orange, and coconut trees. The uplands were the major agricultural zone with taro, sweet potato, *wauke, māmaki,* and *olonā.* Goats were raised.

3.4 Ka‘ū and Punalu‘u at Mid-Nineteenth Century and Beyond

Already at the middle of the nineteenth century imported livestock roaming freely throughout pasturelands of Ka‘ū were creating new aggravations. Organized ranching of cattle, however, was focused at Kapāpala, Kahuku, and Ka‘alu‘alu at some distance from Punalu‘u. New industry required better paths and a harbor. In the 1850s Rev. Henry Kinney (cited in Kelly 1972) commented on the "hundreds of goats salted and dried" as well as "upland taro, potatoes and onions" which previously had to be hauled "on the backs of men" overland to Hilo and which could now be taken to the harbor at Ka‘alu‘alu and shipped.

While raising cattle and other livestock were significant elements of the new western economic focus imposed upon Ka‘ū during the nineteenth century, it was agriculture that would have the most extensive impact on the land and people. Among new agricultural pursuits attempted in Ka‘ū was wheat growing:

> But it proved difficult to co-ordinate the size of the wheat crop with the requirements of the flour mills; difficult also to coordinate the output of the mills with the demands of the market, domestic and foreign. The business did not become a permanent one. (Kuykendall 1953: 150)

Contributing to the failure of wheat production was the harvesting of *pulu* - tree fern fiber used for stuffing mattresses and pillows – which, during the 1860s, constituted the major export crop from Ka‘ū. A Mission Station Report of 1860 relates the ruinous effect upon the native population of participation in the *pulu* trade:

> The effect - on them - is not good; not that the *pulu* is not a source from which they might secure comfort to themselves and families, but the actual result is the reverse. They are offered goods to almost any amount, to be paid for in *pulu*; this to a native is a strong temptation to go into debt. Consequently many of them are

> deeply in debt and almost all to some extent. The policy of the traders is to get them in debt and to keep them there so long as possible. . .[T]hey are almost entirely under the control of their creditors, and are compelled to live in the *pulu* regions, at the peril of losing their houses and lots, and whatever other property they may possess. Thus their homes are almost in reality deserted, ground uncultivated.

Life in Ka‘ū during the 1860s was further disrupted and devastated by the forces of nature. In March of 1868 began a sequence of major earthquakes and eruptions of Mauna Loa that resulted in many deaths and losses of property and livestock. These disasters were only a prelude to an earthquake in early April that precipitated a tidal wave which destroyed coastal villages, dislodged a cliff side at Kapāpala which blanketed the land below and buried a village, and that opened the Great Crack at Kīlauea, emptying the crater's lava lake into Keauhou. A subsequent lava flow, this time at the west side of Ka‘ū, buried all of Wai‘Ahukini Valley. The Reverend Paris reported: “the earthquake and the tidal wave destroying the villages from Punalu‘u to Ka‘alu‘alu.” (Handy and Pukui 1958:240).

Apparently great natural disasters could not hinder the pace of foreign business interests in Ka‘ū. In 1868, the same year as the great earthquake, Alexander Hutchinson established the Naalehu Sugar Company and built a mill at that town. More enduring commercially than either wheat or *pulu*, sugar cultivation would become the major industry within Ka‘ū, appropriating the focus of life in the district.

During the mid-1870s Waiohinu Plantation was established by John Nott and Company. This operation was bought out in 1877 by Alexander Hutchinson who at the same time founded Hilea Plantation. By the end of the 1870s, sugar mills were operating at Na‘alehu, Hīlea and Honu‘apo. Though Hutchinson died in 1879, his name survived in the Hutchinson Sugar Company which during the remainder of the nineteenth century continued to expand and consolidate existing plantation operations in Ka‘ū.

Another plantation operation, the Hawaiian Agricultural Company, was established in Pāhala in 1876 by a consortium of Honolulu businessmen and used Punalu‘u as its port. A decade later the company would control almost 10,000 acres of cane land and would constitute the largest plantation in the Hawaiian Islands.

The Brown 1885 map of Ka‘ū District (see Figure 5) shows five Land Grants within the present project area: including Gr. 821 to Halona, Gr. 824 to Kapuhonua, Gr 825 to Kalaikahuna, Gr. 828 (portion) to Kekaula and Gr. 2459 (portion) to D. Holona). It is unclear whether there was any development of the project lands by these grant holders.

Change within the Ka‘ū district during the remainder of the nineteenth century and into the twentieth century would center around the activities of the two sugar operations: Hutchinson Sugar Plantation and the Hawaiian Agricultural Company. Wharves for shipping the sugar were constructed at Punalu‘u and Honu‘apo. The railroad from Punalu‘u to the village of Keaiwa was reported in June 1878 to be “the first railroad in these islands” but Conde and Best (1973:29) note that “no locomotive was to appear on the railroad for several years…” The terrible drought of 1876 to 1877 and an invasion of leafhoppers set the sugar cane industry of Ka‘ū back. An interesting system developed for this engine-less track in which: “The Pāhala sugar is sent to

Punalu‘u, its shipping port, on tramway cars propelled from the mill by gravitation, and hauled back the intervening five miles by mules." This system may have lasted until 1895. By the mid 1880s Punalu‘u had storehouses, a restaurant, a store, and numerous homes constructed of lumber (Figure 8 to Figure 10).

Most remarkable upon the physical landscape must have been the systems of flumes and railways for transporting the cut cane from fields to mills. Railway lines ran from Na‘alehu and Hīlea to Honu‘apo and from Punalu‘u to Pāhala. The railroad line from Punalu‘u to Pāhala (dating to 1878) was straightened out and re-aligned a number of times (1896 & 1902) and was changed from a two-foot gauge to a three-foot guage circa 1903. Railroads continued to operate in Ka‘ū until the 1940s but the Pāhala - Punalu‘u railroad was discontinued in 1929. A 1931 coastal chart of Punalu‘u (Figure 11) indicates a vibrant community just back from Punalu‘u Bay. This community that had existed from pre-contact times and had been resurrected by the sugar trade and use of Punalu‘u as a major harbor went into significant decline when use of the railroad was discontinued.

The social landscape of Ka‘ū was also altered by the sugar companies. During the 1870s, Chinese laborers were brought in by Alexander Hutchinson: by the time of the 1884 government census there were 568 Chinese in the district. Japanese laborers were imported beginning in the latter 1880s and Filipinos began arriving during the first decade of the twentieth century.

By the 1960s and 70s, commercial interests in Ka‘ū began to look beyond the mainstay sugar had provided for almost a century. Macadamia nut growing and resort development were conspicuous attempts to move beyond the uncertain future portended for sugar.

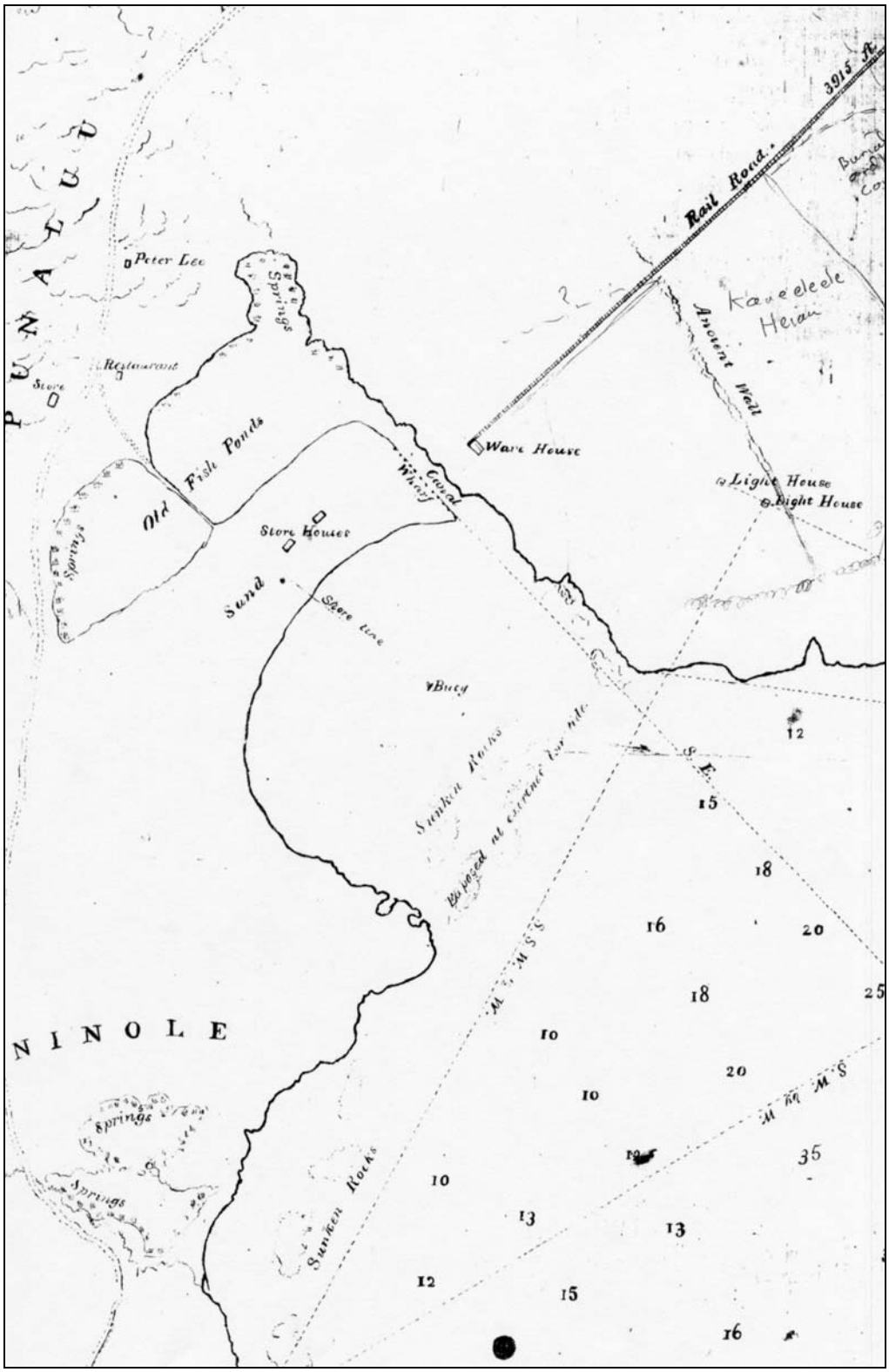

Figure 8. Andrews Chart of Punalu‘u Roadstead c. 1880s showing restaurant, store and store houses.

Figure 9. Punalu‘u Landing c. 1880 showing portion of village including Protestant Church (center background), warehouse (left), cart road (foreground) and interior of Punalu‘u fishpond (center)

Figure 10. View of Punalu‘u Landing from Punalu‘unui Heiau (“sacrificial stone” in foreground, note: rail line left of center)

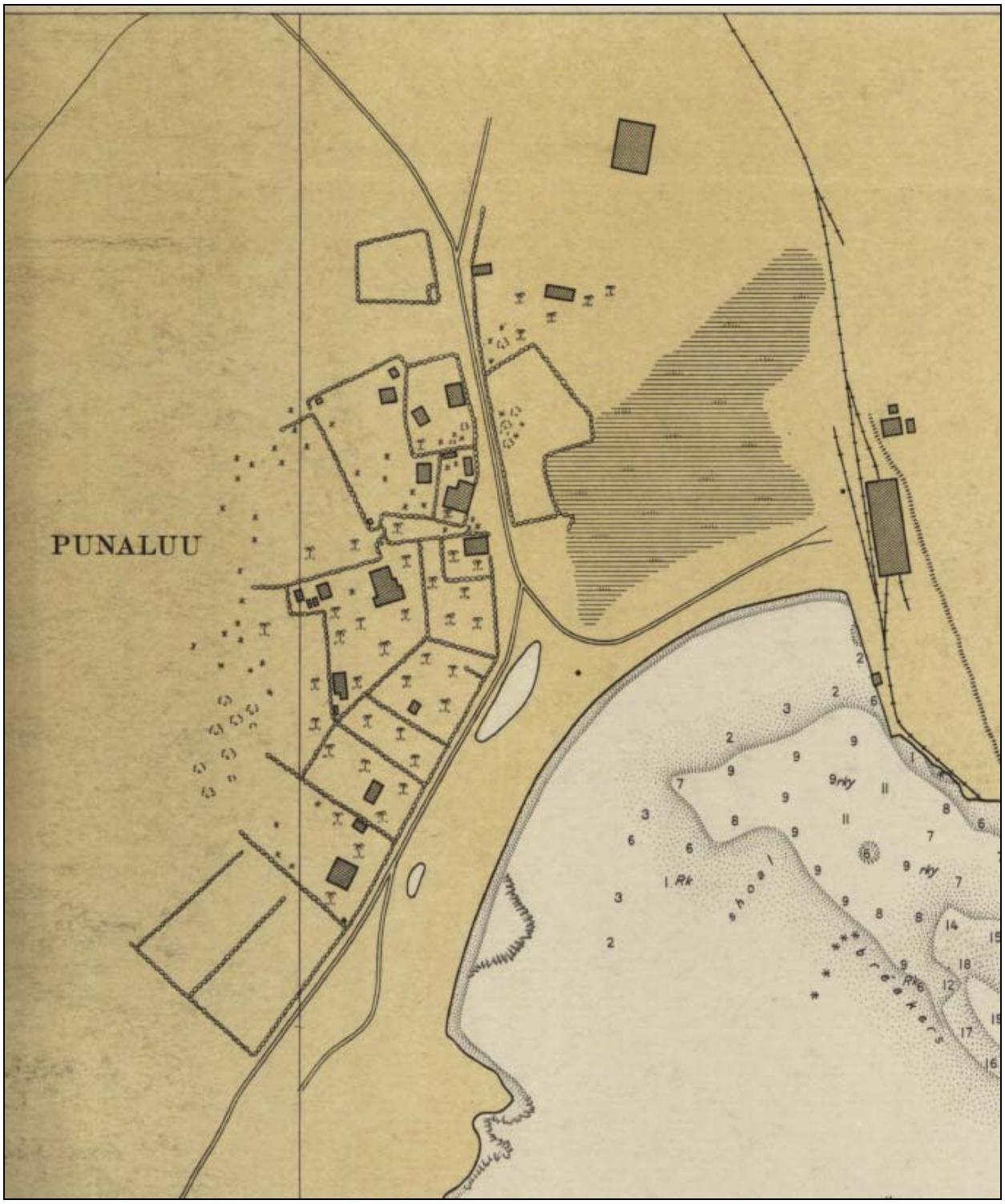

Figure 11. Portion of 1931 Coastal Chart showing closeup of Punalu‘u Town

3.5 Previous Archaeology

3.5.1 A Note on Site Nomenclature

The present project area has a long history of previous archaeological work. Regretably the history of site nomenclature was extraordinarily complicated and confused before Cultural Surveys Hawai‘i undertook work on these lands.

Extensive work conducted by the Bernice Pauahi Bishop Museum identified sites with the Museum’s four-part site nomenclature system. Bishop Museum sites in Ka‘ū were identified with the prefix “50-HA-B“ refering to the 50th state, Hawai‘i Island, Ka‘ū District. Sites within the *ahupua‘a* of Nīnole and Wailau (including the SW approximately 80% of the present project lands) are designated with the prefix “50-HA-B9-“ followed by a site-specific number. Sites within Punalu‘u Ahupua‘a (including the eastern approximately 20% of the present project lands) are designated with the prefix “50-HA-B8-“ followed by a site-specific number. Since the boundary between Nīnole/Wailau Ahupua‘a on the southwest and Punalu‘u Ahupua‘a on the northeast cuts through the present project lands sites with the same final sequence of site-specific numbers (but different prefixes) may lie in close proximity.

When Rosendahl and Rosendahl began their work in 1986 they began using the State of Hawai‘i (previously called the Hawai‘i Register of Historic Places or HRHP and now called the State Inventory of Historic Places or SIHP) four-part site nomenclature system. Within this site nomenclature system all site numbers begin with 50-10-68- (50 = State of Hawai‘i, 10 = Island of Hawai‘i, 68 = USGS 7.5’ series quad map “Punalu‘u Hawai‘i”) followed by a site specific #. Rosendahl and Rosendahl started to make correlations between the Bishop Museum and State site nomenclature systems but this was not completed (some Bishop Museum site designations were never given SIHP #s)

An additional problem is that some sites were regarded as internal parts of designated complexes. Thus sites could have more than one Bishop Museum site # and/or more than one SIHP site number.

Because of the common problem that SIHP #s are only granted after the sites have been described, Rosendahl and Rosendahl introduced a temporary site nomenclature in a T-100 series. Similarly CSH began with a temporary site numbering system in a CSH- series.

In the following discussions, wherever possible, sites are cited by their full SIHP site number followed by a parenthetical presentation of any known other site designations. Because so many of the sites given Bishop Museum site designations were destroyed without ever receiving a state site number it is often appropriate to refer to them by the Bishop Museum designation.

3.5.2 Previous Archaeology

A chronological summary of work is given in Table 2 and is discussed further below.

John F. G. Stokes carried out a survey of Hawai‘i Island *heiau* sites in 1906 documenting three or perhaps four *heiau* in the vicinity of the present project lands. Stokes (1991:131) gives the following accounts of *heiau* in the vicinity:

Table 2. Previous Archaeological Studies at Punalu‘u, Ka‘ū and Vicinity

Source	Nature of Study	Location of Study	Finds
Stokes (and Dye) 1906/1991	Survey of Big Island *Heiau*	Island wide	Documents 3, perhaps 4 *heiau* in vicinity of present project
Stokes 1910	Study of Petroglyphs	Archipelago-wide	Documents a petroglyph site +/- 25 units in coastal Punalu‘u
Hansen, 1974	Letter Re: Walk-through sites survey of the proposed additional 9 hole golf course (21 October).	Punalu‘u	Briefly discusses sites
Hansen, 1974	Letter Re: Reconnaissance survey of road “A.” (26 October)	Punalu‘u	Briefly discusses sites
Hansen, 1978	Letter to Dr. Pila Kikuchi, Kauai, Re: Information on fishponds at Nīnole, (2 November).	Nīnole	Information on fishponds
Hansen, n.d.	Report on Walk-through Reconnaissance and a Recommendation for Further Research at Kuipo, Punalu‘u,	Punalu‘u	Briefly discusses sites
Hansen, n.d.	Unpublished Field Notes for 1968-1974, Site Record File, Department of Anthropology, B.P. Bishop Museum.	Coastal Punalu‘u, Wailau and Nīnole Ahupua‘a	Precursor to Barrera and Hommon (1972) and Crozier and Barrera (1974) reports
Hommon n.d. (1971)	Report on 1971 archaeological survey	Coastal Wailau and Nīnole Ahupua‘a	Precursor to Barrera and Hommon (1972) report
Barrera, and Hommon 1972	Salvage Archaeology at Wailau-Nīnole, Ka‘ū, Island of Hawai‘i,	Coastal Wailau and Nīnole Ahupua‘a	Documented 111 archaeological sites, including 216 features. Pre-contact and historic habitation, agricultural, and burial sites.
Crozier 1972	Archaeological survey and excavations	Coastal Punalu‘u Ahupua‘a	Precursor to Crozier and Barrera (1974) report

Source	Nature of Study	Location of Study	Finds
Kaschko 1973	Salvage excavation of 1 site	Site 50-Ha-B9-21 Wailau Complex	Excavates in a house enclosure
Crozier and Barrera Jr. 1974	Archaeological survey and excavations	Coastal Punalu‘u Ahupua‘a	Documented 25+ archaeological sites. Noted bulldozing in area prior to study
Hansen 1974	Limited reconnaissance surveys	Focused north & west of present project area	Briefly documents archaeological sites
Hansen, 1980	An Historic Sites Survey of a Portion of Punalu‘u, Ka‘u, Hawai‘i, TMK 9-6-02:6, Lot 9-A	Kamehameha Schools lands adjacent to the NE of present study area. Punalu‘u	Documented 76 archaeological sites
Kelly 1980	Historical sketch	Addresses 9 *Ahupua‘a* of Ka‘ū	Documented Lanipau, Ka‘ie‘ie, and Kane‘ele‘ele Heiau in the vicinity of the project area.
Soehren 1980	Summary of archaeological features	Addresses TMK 9-6-02:39 (90 acres)	Documeted 6 archaeological sites. Noted extensive bulldozing
Haun & Rosendahl 1986	Preliminary Archaeological Assessment	Present project lands	One day fieldcheck of 21 previously recorded sites
M. Rosendahl 1986	Archaeological Inspection	S corner of present project area	Documents curb-stone trail only short portion in project area
Rosendahl and Rosendahl 1986a,b	Preliminary & Full Archaeological Reconnaissance Survey Reports	Present project lands at Punalu‘u Wailau	Provides a summary of previous work & reports new sites
Cordy 1988	Settlement pattern overview	Ka‘u District	Little discussion of present project area lands

Ka‘ie‘ie Heiau Heiau of Ka‘ie‘ie, land of Nīnole, Ka‘ū. Situated on the edge of an *‘a‘ā* flow on the west side of Nīnole Bay. Pu‘u Ehu bears 170°50’, 5476 feet. All that was found was a cleared level stretch of *‘a‘ā* paved with beach pebbles. On the east it overhung the sea, the rough *‘a‘ā* forming the other boundaries. On account of these natural limits, it is probable that the place was never enclosed with walls.

Mokini Heiau Heiau of Mokini, land of Nīnole, Ka‘ū. Perhaps identical with Ka‘ie‘ie Heiau. It was a name heard in Wai‘ōhinu and Honu‘apo, but the single resident of Nīnole I met knew only of Ka‘ie‘ie Heiau.

Lanipao Heiau Heiau of Lanipao, land of Punalu‘u, Ka‘ū. Located near the southwest boundary of Punalu‘u 1600 feet from the sea. Pu‘u Ehu benchmark bears 131°56’, 2804 feet. This is a small, L-shaped enclosure with walls 6 feet high and from 6 to 7.5 feet thick. The southern portion is occupied by three terraces, each rising 1 foot. Outside and adjoining the western wall is an enclosure with small walls, 3 feet high and wide. This *heiau* is said to have been built by Laka of Kaua‘i.

Lanipao Heiau [SIHP # 50-10-68-3512 (50-HA-B8-2)] remains within the east corner of the present project lands and is in much the same condition as Stokes observed in 1906. This *heiau* site is discussed further in the Site Description chapter of this study and is recommended for preservation. Stokes provides the following description of the great *luakini heiau* at Punalu‘u:

Kāne‘ele‘ele *Heiau* Heiau of Kāne‘ele‘ele, Mailekini Heiau, Halelau Heiau, or Punalu‘unui land of Punalu‘u, Ka‘ū. Located east of and adjoining Punalu‘u wharf and warehouses, which are probably built on the heiau premises. Pu‘u Ehu benchmark bears 122°37’, 4532 feet.

This *Heiau* probably extended to near the edge of the cliff bordering Punalu‘u Bay, and its western boundary was destroyed when the face of the cliff was graded for the wharf and the first warehouse, built before 1906. Since that date another, larger warehouse has been erected, and the man in charge of the work has informed me that he had dug into a high bank of artificially laid stones and during the work came across a pit about 10 feet deep and “full of bones.” The site of the bone pit is now occupied by the concrete base of the warehouse engine, at the southeast corner of the building, a mark which will no doubt remain for some time.

As seen in 1906, the *heiau* site consisted of a large level area of *‘a‘ā* about 700 by 500 feet, which had been leveled off and partly paved with beach pebbles. The only definite feature remaining was a large wall on the eastern side, 8.5 feet high and 9 feet thick; it ran 341°30’ for 648 feet. From either extreme, broken walls continued at right angles towards the west for about 230 feet. Outside the southern wall was a large flat stone, called locally “the sacrificial stone.” [see Figure 10 of this study] East of and adjoining the large wall was another paved area, measuring about 500 feet each way. It was not enclosed and was better and more evenly paved with beach pebbles than the first portion described.

> The immensity of the place for a *heiau* would denote a temple of great importance, and it was a matter of keen regret that no features of the internal arrangement were definite enough to plot. The name Kāne‘ele‘ele has been selected on Thrum’s authority. It was on the list furnished me by Mr. Thrum but was not known in Punalu‘u. The first name heard locally was Mailekini, and later another native stated that there were two *heiau*, that on the south being known as Halelau and that on the north as Punalu‘unui.

Local informants (Hanoa *‘ohana,* personal communication) know this impressive structure by the name “Punalu‘unui.” While the vast majority of this *heiau* lies on Kamehameha Schools land to the east of the present project area we agree with Stokes that this *heiau* extended into the present project lands prior to the construction of the Punalu‘u wharf and warehouses on the east side of Punalu‘u Bay/Harbor. The project lands in this vicinity were radically altered before Stokes’ visit in 1906. The ruins of the Punalu‘u Harbor Complex have been designated as SIHP site # 50-10-68-7361. This Punalu‘u Harbor complex site is discussed further in the Site Description chapter of this study and is recommended for preservation.

Stokes (1910; also Cox and Stasack 1970:80-81) also recorded a petroglyph cluster “along low lava shore between Nīnole and Punalu‘u village including linear human figures, curved arms and legs, family groups, fish (?), dots, and circles +/- 25 units. These petroglyphs appear to be those located in the modern enclosure immediately north of the Punalu‘u Beach Park parking lot (SIHP # 50-10-68-3513).

Kenneth Emory (1970:4-5) gave SIHP site numbers to 19 sites in Punalu‘u, Wailau and Nīnole in the 3500 number series. His site descriptions are brief and what site is actually being numbered is often unclear. Eight sites discussed in the present study area are identified as sites designated by Emory.

3.5.3 Archaeological Analysis Based on the First Systematic surveys

The first systematic surveying of archaeological sites in the Punalu‘u area was by Violet Hansen between 1968 and 1974. Her early work was followed up on in a report by Robert Hommon (n.d. c. 1971) and particularly in the Salvage Archaeology report by Barrera Jr. and Hommon 1972. This is our best source on the rich archaeology (Figure 12) within the present project lands that was largely destroyed in the course of the resort development in the 1970s. The Barrera and Hommon 1972 study documents a total of 114 sites with 216 component features (summarized in Table 3 and given in Appendix B). Typically the site description is a brief sentence followed by some measurements. Quite a variety of site types were identified (Table 3). Figure 12 is a best-fit overlay of existing infrastructure with the Barrera and Hommon 1972 reported sites. It is immediately apparent that many of these former sites were destroyed in the course of golf course construction. However, fieldwork indicates that bull-dozing was quite extensive in other portions of the project area as well and approximately 80% of these sites are understood to have been destroyed in the 1970s.

It may be noted that in the following table of archaeological sites identified in the Barrera and Hommon 1972 study by the Bishop Museum in coastal Nīnole and Wailau Ahupua‘a (Table 3) that some uncertainty is expressed regarding the possible present existence of certain sites.

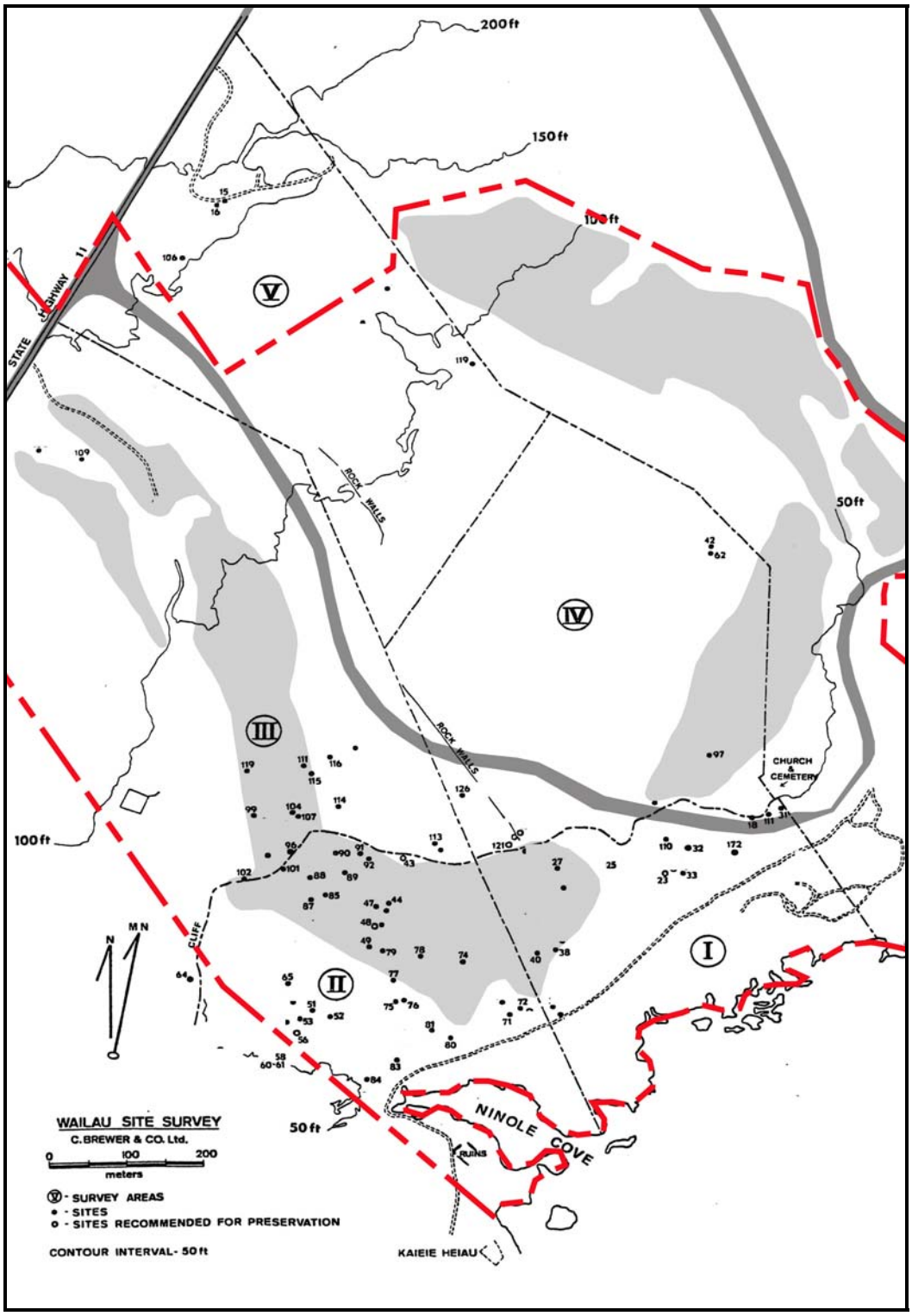

Figure 12. Map of sites identified in initial archaeological surveys of coastal Nīnole and Wailau Ahupua‘a, shaded areas indicate present golf course and road (Sites designated with the Bishop Museum prefix 50-HA-B9-; adapted from Barrera & Hommon 1972:2)

Table 3. Sites Identified in Initial Archaeological Surveys of Coastal Nīnole and Wailau Ahupua‘a (Sites designated with the Bishop Museum prefix 50-HA-B9-; adapted from Barrera & Hommon 1972:2)

BPBM Site # B9-	Wall	Platform	Rock Shelter	Enclosure	Depression	Mound	Terrace	C-shape	Misc.	Present Status
15	1									Outside project
16				1 (M)*			1			Outside project
17				2 (S)*						Site 4309
18	1								1 “cache”	Site 4309
19				1 (H)*						Believed destroyed
20	5		2		1					Believed destroyed
21				1 (H)*						Believed destroyed
22									2 cist graves	Site 4310
23				1 (H)*						Site 4310
24		1								Believed destroyed
25		1								Believed destroyed
26				1 (L)*		4	1		1 alignment	Believed destroyed
27	1									Believed destroyed
28			1							Believed destroyed
29		1								Believed destroyed
30									1 pavement	Believed destroyed
31	1									Site 4309
32	1									Site 4310
33	1	4	1							Site 4310
34	1	1	2			1				Site 4310
35				1 (M)						Believed destroyed
36				1 (H)						Believed destroyed
37				1 (L)						Believed destroyed

BPBM Site # B9-	Wall	Platform	Rock Shelter	Enclosure	Depression	Mound	Terrace	C-shape	Misc.	Present Status
38	1									Believed destroyed
39						2			1 midden	Believed destroyed
40		1								Believed destroyed
41							1			Believed destroyed
42		1								Believed destroyed
43				1 (L)						Site 4330
44	2		2		1					Believed destroyed
45			2							Believed destroyed
46			1		1					Believed destroyed
47				1 (L)						Believed destroyed
48		1	1	1 (M)	1					Believed destroyed
49			2		1					Believed destroyed
50	2				1	2				Believed destroyed
51					2					Believed destroyed
52			2		1					Believed destroyed
53			1							Believed destroyed
54			1							Believed destroyed
55		2	2		1					Site 24898
56		2(B)*	1							Site 24898
57	3									Believed destroyed
58	1									Believed destroyed
59							1 (B)			Site 24898
60	1									Believed destroyed
61	1									Believed destroyed
62	1									Site 4360
63							1			Site 24898
64	1									Believed destroyed

BPBM Site # B9-	Wall	Platform	Rock Shelter	Enclosure	Depression	Mound	Terrace	C-shape	Misc.	Present Status
65	1									Believed destroyed
66	3		3							Believed destroyed
67				1 (S)						Believed destroyed
68				1 (M)						Believed destroyed
69			1							Believed destroyed
70			2							Believed destroyed
71	1									Believed destroyed
72				1 (S)						Believed destroyed
73										Believed destroyed
74	1								1 pavement	Believed destroyed
75	1								1 midden	Believed destroyed
76									1 midden	Believed destroyed
77										Believed destroyed
78	2					1				Believed destroyed
79			1			5				Believed destroyed
80	1									Believed destroyed
81	1									Believed destroyed
82	1	2								Believed destroyed
83	2									Believed destroyed
84	1									Believed destroyed
85			1							Believed destroyed
86					1					Believed destroyed
87		1			1					Believed destroyed
88	1									Believed destroyed
89	1									Believed destroyed
90	1				1					Believed destroyed
91	2									Believed destroyed

BPBM Site # B9-	Wall	Platform	Rock Shelter	Enclosure	Depression	Mound	Terrace	C-shape	Misc.	Present Status
92					1					Believed destroyed
93				1 (H)						Believed destroyed
94								1		Believed destroyed
95				1 (H)						Believed destroyed
96	1									Believed destroyed
97			1							Believed destroyed
98				1 (H)						Believed destroyed
99	1									Believed destroyed
100	2+					2+		2		Believed destroyed
101	1									Believed destroyed
102	1									Believed destroyed
103								1		Believed destroyed
104	1									Believed destroyed
105	2			1 (L)						Believed destroyed
106						3		1		outside project
107	1									Believed destroyed
108	1		1							Believed destroyed
109	1									Site 24902
110	2	1	2		1					Site 4310?
111				2 (H)						Believed destroyed
112				2 (L,H)				1		Believed destroyed
113	1									Believed destroyed
114	1	1							1 “cache”	Believed destroyed
115	1									Believed destroyed
116	1									Believed destroyed
117		1		1 (H)						Believed destroyed
118		1								Believed destroyed

BPBM Site # B9-	Wall	Platform	Rock Shelter	Enclosure	Depression	Mound	Terrace	C-shape	Misc.	Present Status
119	1									Site 4360
120							1			Believed destroyed
121				2 (H)			1			Extant in condo area 24903
122		2								Site 24903
123	1	5								Believed destroyed
124							1			Believed destroyed
125			1							Believed destroyed
126										Believed destroyed
171		1		1 (H,L)					1 midden	Believed destroyed
172				1 (H,S)					1 midden	Believed destroyed

M=Medium Size, S=Small, L=Large H=House B=Terrace Over Burial

Problems arise in attempting to correlate the Barrera and Hommon (1972) site map with the site descriptions. For example there are two sites labeled as (B9-) 119. Site B9-30 is said to be “near Site B9-31” but the map shows them as 350 m apart. The main problem is the brevity of the description and the approximate nature of the location.

Any attempt to reconstruct the archaeological landscape at Nīnole and Wailau is hindered by the brevity of the information reported. It seemed appropriate to at least attempt to glean data on settlement patterns, from this data, above and beyond what was reported. In an attempt to reconstruct gross patterns of the archaeological landscape (Figure 13), the sites reported by Barrera Jr. and Hommon (1972:2, 5-17) were divided into four groupings:

1) Burial Sites	Including indicated burial sites (and possible burials),
2) Permanent habitations	Including “house” sites,
3) Temporary habitations	Including “rock shelters” and other designated “temporary habitation” sites, and
4) Agricultural/ animal husbandry sites	Including designated animal pens or agricultural sites.

A review of the results shows that for many of the sites (walls, enclosures, depressions) no clear determination of function was possible based on the available data. Certain patterns do, however, appear.

Burial sites are indicated in two general areas: 1) the cliff line extending southwest from the church & cemetery, and 2) along the cliff line extending northwest from Nīnole Cove. Permanent habitation sites are widely scattered in a zone extending 500 m back from the coast with a few scattered permanent habitations further inland. Temporary shelters show much the same distribution pattern as permanent house sites but tend to be set slightly further back from the coast. The pens or agricultural sites are similarly dispersed but notably tend not to be in close proximity to either permanent habitation or temporary shelter sites. Site density in general drops quite sharply 500 m back from the coast (assuming the intensity of archaeological survey and previous land disturbance were approximately the same across the project area. Again, these are only suggested to be gross patterns developed within the constraints of the data. Our purpose in presenting the information in Table 3 and Figure 13 is simply to attempt a partial reconstruction of the lost archaeological landscape and to present data in such a way as to be useful to others who may make their own attempts.

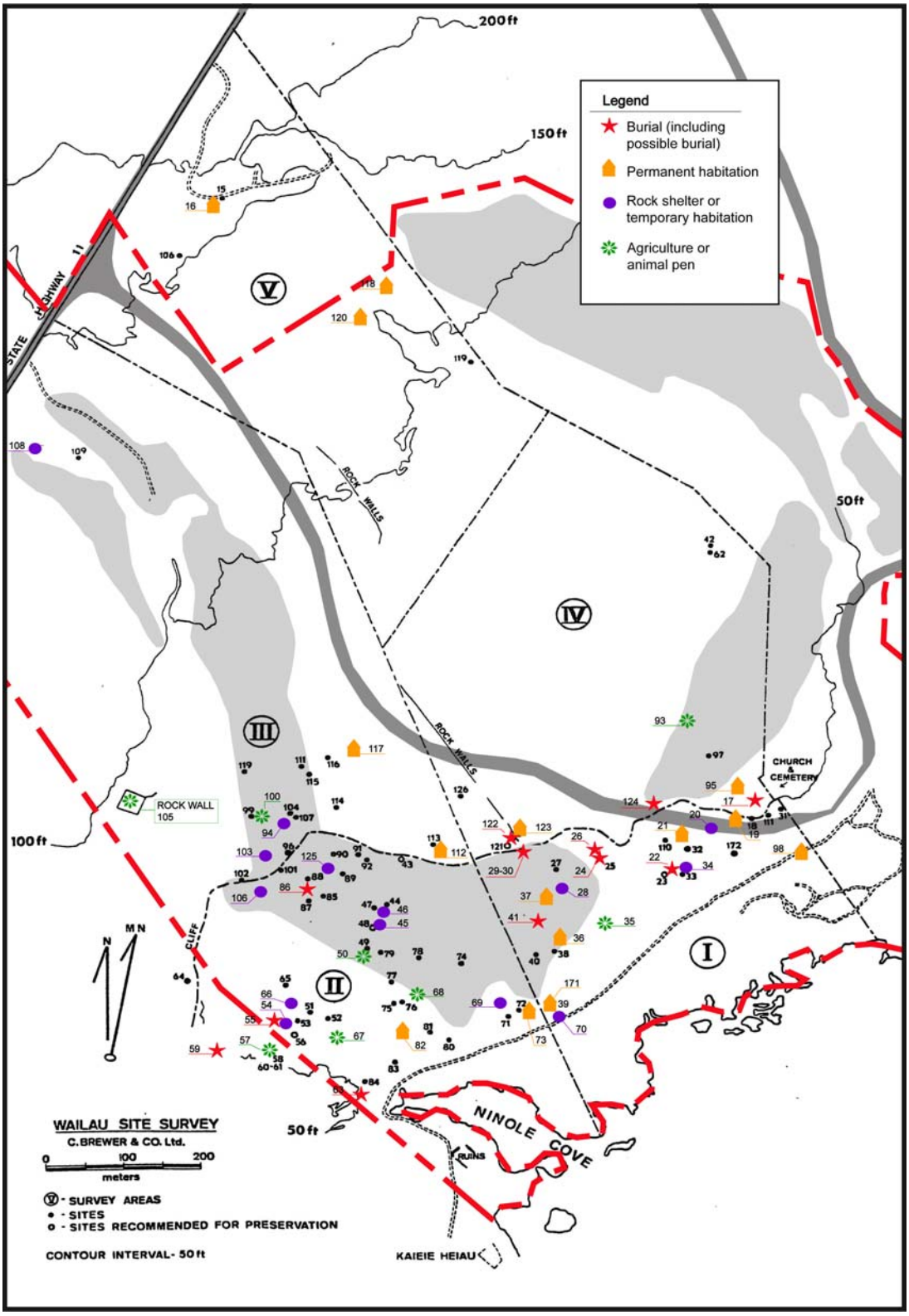

Figure 13. Map showing sites by function identified in initial archaeological surveys (adapted from Barrera & Hommon 1972:2)

3.5.4 Later Archaeological Studies

Crozier (1972) presents data on four separate areas within coastal Punalu‘u Ahupua‘a. He records few sites which probably reflects prior ground disturbance. His designated Area I extends in a northerly curving strip just inland from Punalu‘unui Heiau. Most of the archaeological features he documents lie on the adjacent Kamehameha Schools lands but he does document certain features of the Punalu‘u Harbor Complex within the present project area.

His Survey Area II in the northeast portion of the present project area, in an area proposed for a golf course, documents four sites including Lanipao Heiau (SIHP # 50-10-68-3512;Crozier's site B8-2). Two of his other sites were relocated in the presnt study (50-10-68-3515 = Crozier's B8-5 & 50-10-68-24901 = Croziers B8-5). A formal grave site that Crozier documents (his B8-53) could not be relocated and is presumed to have been destroyed.

In Crozier's Area III, *mauka* of Belt Highway 11 in Nīnole/Wailau, he documents one habitation complex site (Crozier's site B9-73) within the present project lands but this also could not be re-located (despite repeated attempts) and is presumed destroyed.

Crozier's fourth study area was ENE of Punalu‘unui Heiau and outside of the present study area. Crozier (and the subsequent Crozier and Barrera Jr. 1974 study) presents Hydration rind dates on basaltic glass samples to conclude he was encountering archaeological deposits dating back to 1520. These hydration-rind dating results are now regarded as highly dubious but it certainly would not be surprising if archaeological features at Punalu‘u dated to that early or earlier.

The Crozier and Barrera Jr. (1974) study presents all of the Crozier (1972) documentation verbatim but includes discussions of three additional sites (B8-8, B8-36 and B8-52 in the vicinity of Lanipao Heiau. All three are reported as having been bulldozed (Crozier and Barrera Jr. 1974:15-16). Of particular interest is their Site B8-36 reported as a *heiau* located perhaps 100 m southeast of Lanipao Heiau. The size is estimated to have been a considerable 25 x 36 m but virtually the only other information provided is that "Today [1974] all that is left are a few of Violet Hansen's marking flags and a rubble pile." Given that the historic grave (B8-53) was located just 9 m from this *heiau* it seems likely that it too was lost by 1974. More detail is also presented on archaeological sites on the adjacent Kamehameha Schools lands.

Test excavation results are given in the Barrera and Hommon (1972), Crozier (1972) and Crozier and Barrera Jr. (1974) studies. In an attempt to present a full summary of available data these excavation results are presented in detail and are discussed within Section 5 of this study.

In 1973 Mick Kaschko conducted salvage excavation within a probable house enclosure (Bishop Museum site 50-Ha-B9-21 that had been recommended for preservation by Barrera & Hommon (1972:5)

In 1974 Violet Hansen carried out a number of limited reconnaissance surveys but these were focused on lands to the north and west of the present project area.

In 1980 Lloyd Soehren carried out documentation of six archaeological and historical features in an approximately 90-acre parcel (TMK: 9-6-02:39) outside but immediately adjacent to the north of the central portion of the present project lands. He (1980:1) notes that most of the land: "has been bulldozed and chaindragged by way of 'pasture improvements.'" It appears that

extensive inland areas of the present project area were also subject top such ‘pasture improvements.’ Soehren notes that several graves are reported to have been on Puehu Hill prior to its destruction by quarrying and also notes that a lava tube on that parcel was said to have human remains relocated from sites elsewhere in the vicinity.

In 1980 Violet Hansen carried out a historic sites survey of a portion of the Kamehameha Schools lands adjacent to the east of the seaward portion of the present project lands briefly describing some 76 sites.

Also in 1980 Marion Kelly of the Bishop Museum prepared a “historical sketch” of nine Ka‘ū ahupua‘a including Nīnole, Wailau and Punalu‘u. The present study draws upon her work.

In 1984 an attempt at site summary was made by Phillips Brandt Reddick & Associates as part of permitting work. As quoted in Rosendahl & Rosendahl they conclude:

> Since 1972, considerable development has occurred at Punalu‘u…,47 of the 129 sites are still in existence…Twenty-two of the sites recommended for preservation in 1972 have been protected; 4 were evidently inadvertently covered during construction or destroyed in recent tsunamis or flooding….As noted in the Resort Master Plan, the plans are to protect the burials, restore the heiau, and to incorporate the important sites into a pedestrian network with educational and interpretive information. Phillips Brandt Reddick & Associates 1985:Section 4 Chapter XI – 4

In 1986, in connection with a rezoning request and Special Management Area permit application, PHRI carried out a one-day field check of twenty-one previously recorded sites (Haun and Rosendahl 1986)

Margaret and Paul Rosendahl prepared an Archaeological Reconnasissance Survey for an EIS for the Punalu‘u Resort (present project area) in 1986 (Rosendahl & Rosendahl 1986 a, b). This study presents a literature review and the results of a “100% coverage ground reconnaissance survey (variable intensity) of the entire c. 435 acre project area.” This study proved to be quite useful in our efforts to determine the history of prior site documentation. Thy identified a total of 32 sites (83+ component features) of which 25 sites had been previously identified and seven sites were newly discovered.

Ross Cordy prepared an overview of settlement patterns in Ka‘ū in 1988. Little information presented is directly pertinent to the lands of the present study.

In April 1988 a “Final Environmental Impact Statement “ for the Punalu‘u Resort was prepared” addressing archaeological resources and drawing primarily upon the Rosendahl & Rosendahl 1986 studies. It was noted at that time[1988] that: “most of the project area (at least 90%) has already been mechanically cleared, or altered by floods and tsunamis” It was concluded that there were 32 sites and recommended treatment was given for each of these sites. The majority of sites discussed in the Final EIS are addressed with Bishop Museum numbers or temporary site numbers. Although the present study also has a total of 32 sites the accounting is significantly different and the present study discusses a number of archaeological sites not previously documented. The summary recommendations in the Final EIS are discussed in Section 8 “Project Effect and Mitigation Recommendations” of this study.

3.6 Consultation Process

Although a Cultural Impact Assessment is being prepared as a companion study to this work, throughout the course of this survey, an effort was made to contact and consult with Hawaiian cultural organizations, government agencies, and individuals who might have knowledge of and/or concerns about the Sea Mountain at Punalu‘u Resort project area located within coastal portions of Nīnole, Wailau, and Punalu‘u Ahupua‘a, with parcels both *mauka* and *makai* of Hawai‘i Belt Highway 11. This effort was made by telephone and in-person contact.

The individuals, organizations, and agencies we attempted to contact and the results of any consultations are presented in the table below. A more extensive response was provided by Keolalani Hanoa from a “talk-story” session with CSH and is presented following the table.

Table 4. Community Contact Table

Name	Background, Affiliation	Comments
Ayau, Halealoha	Hui Mālama O Nā Kūpuna O Hawai‘i Nei	Contacted.
Hanoa, Keolalani	Recognized descendant of Punalu‘u Ka‘ū	See below.
MacDonald, Ruby	Community Resource Coordinator for the Office of Hawaiian Affairs, Kona Office	Referred me to the new Community Resource Coordinator Office Affairs, Hilo Office.
Ruttles, Lukela	Community Resource Coordinator for the Office of Hawaiian Affiars, Hilo Office	No cultural concerns at this time.

Keolalani Hanoa

Ms. Keolalani Hanoa participated in a “talk-story” session with CSH at her home in Punalu‘u. Keolalani is a recognized lineal descendant of Punalu‘u, Ka‘ū and founder and President of the ‘Aha Hui O Ka‘ū Preservation organization. She has dedicated her time for many years as a past member of the Hawai‘i Island Burial Council. Her home in Punalu‘u is the site of her educational community program every summer - Kūkulu Kumuhana - a program educating Ka‘ū’s youth. The program is dedicated to passing down traditional cultural knowledge and practices to Ka‘ū’s future generations.

When asked about her concerns regarding the cultural sites, practices and burials within the project area, Keolalani mentioned:

> It is my family’s goal and others in the community to advocate the protection and preservation of the entire 80 miles of the Ka‘ū coastline and our sacred *ahupua‘a*

which include the lands behind us here, the present project area. Ka‘ū is home to countless endangered native birds, insects, plants and animals, including the threatened *honu* and *honu‘ea* (Hawaiian Green and critically endangered Hawksbill Turtles) and the Hawaiian Monk Seal.

Ka‘ū includes many estuaries, ancient fishponds, freshwater springs, shorelines, coastal plains and mountain forests. I envision perpetual protection of all historic sites, ancient Hawaiian burials and any that are located within the project area. There must be cultural monitoring as well as archaeological monitoring during this proposed development. It is the utmost importance that these developers meet with us Ka‘ū peoples before they make this change to our lands above. Buffers need to be set between our *kūpuna* resting on the *pu‘u*. Not just 50 feet, I am talking like 100 feet. My true concern is that they should not be building on that ridge above our ancestor’s graves at all. The physical removal of the *‘āina* and all the vibrations of construction disturb their resting places and the resting places of the many which are not seen buried there.

Ka‘ū is a living classroom and educational resource that benefits present and future generations to come. We like to keep Ka‘ū country and that includes Punalu‘u. Much more study has to be conducted in the area so as to document and preserve Ka‘ū’s landscape. Studies such as yours can uncover things of cultural significance. By protecting the natural resources and our practices of Ka‘ū, we can build a stronger community and a sustainable economy.

3.7 General Settlement Patterns

Based on the cultural and historical literature, one can infer some generalities concerning the traditional settlement pattern relevant to our project area. Clearly coastal Punalu‘u and vicinity had a long history as a royal center from the time of Keakealaniwahine including such chiefs as Kohāikalani, Kalani‘ōpu‘u and Liholiho. The great *luakini* temple of Punalu‘unui was an attraction and doubtlessly the fresh water and verdure associated with the Punalu‘u springs and the good sand beach landing there were attractions as well.

Early explorer’s accounts do not mention either coastal villages or upland villages, associated with agricultural pursuits, specific to the *ahupua‘a* encompassed in the present study. Menzies, however reported on a plantation some 4 to 5 miles from the sea at Punalu‘u (Kelly 1980:45). The missionary William Ellis briefly described the coastal village of Punalu‘u but offers few details. By the mid-1800's, population for the district of Ka‘ū had dramatically decreased. Census taken in the 1830's approximate 6,000 individuals in the district, with only roughly 2,000 in the 1850's. Māhele records indicate eleven *kuleana* awards within the project area. House sites were typically at the coast where ponds are frequently mentioned along with an octopus-spearing area and a constructed shelter to attract young fish. The coast apparently was also used for the cultivation of *hau, wauke,* taro, orange and coconut trees. The uplands were the major agricultural zone with taro sweet potato, *wauke, māmaki* and *olonā.* Goats were raised.

The relative demographic importance of Punalu‘u is indicated by the establishment of a stone meeting house at Punalu‘u in 1843, a Sabbath school established in 1844, and with a resident missionary ensconced there in 1845.

The economy, once solely subsistence-based, changed to one based on market-oriented production and/or procurement and Punalu‘u became a significant port on the coast. In Ka‘ū, goats, *pulu*, cattle, and introduced crops (melons, onions, etc.) were some of the first marketable exports. This form of economy further concentrated the shrinking populace to centers of export like Punalu‘u.

One natural event that had a dramatic effect on settlements within Ka‘ū was the 1868 earthquakes and tsunami. Especially hard hit was the coastal zone where villages were swept away. Punalu‘u was reported to have been hit very hard. Based on the historic records it seems likely that much of the traditional Hawaiian landscape of coastal Punalu‘u was swept away in the land convulsions of 1868.

In the late 1800's until the 1940's, sugar cane became the economic mainstay of the entire district. The Hawaiian Agriculture Company initiated the plantation that would eventually become the largest in Hawai‘i. Present day Pāhala town, the main residential area of Ka‘ū, was a "mill town" based on commercial sugar cane cultivation and processing. There is no evidence that sugarcane was actually cultivated within the boundaries of the present study but Punalu‘u became a major port for the export of Hawaiian Agriculture Company sugar. A 1931 coastal chart of Punalu‘u (Figure 11) indicates a vibrant community just back from Punalu‘u Bay but this is understood to have gone into significant decline when use of the railroad was discontinued.in 1929 and use of Punalu‘u as a major harbor ended.

3.8 Predicted Settlement Patterns in the Study Area

As suggested from the survey of available literature, the expected settlement pattern within the present study was anticipated to be concentrated habitation sites along the coast with an overall decrease of habitation activity further inland within the intermediate zone. The present study area does not enter into the upland agricultural zone, but some habitation and agricultural activity is predicted for this zone (Cordy 1988). The background literature suggests that the *ahupua‘a* of the project area would have had their "permanent housing ... focused on the shore," (Cordy 1988:15). The pattern of coastal habitation and archaeology was clearly greatly impacted by the earthquakes and tsunami of 1868 and early resort development in the 1970s.

Historically, the settlement pattern changed as the habitation sites of the coastal zone were abandoned. Specific to the project area *ahupua‘a* was the late 1800's establishment of commercial sugar cane and a railroad link to Pāhala town. Traditional sites associated with permanent habitation, like burials in lava tubes, *pu‘u*(s), and *‘a‘ā* complexes were also abandoned as the Hawaiian population decreased and relocated to Pāhala and other centers of agriculture and commerce. Immigrant labor was brought in to fill a void and Pāhala expanded to become the focus of habitation, including activities such as employment, schooling, housing, and health for the entire Ka‘ū district.

Given the extensive history of prior study it was assumed (correctly) that the vast majority of sites present had been previously identified and also that the vast majority of previously identified sites had been obliterated.

Section 4 Results of Fieldwork

4.1 Survey Findings

The following presentation of survey findings identifies 32 archaeological sites (with 125+ features) by their State Inventory of Historic Places (SIHP) numbers within the project lands. Table 5 presents an overview of these sites that are subsequently described in detail. A substantial effort was made to determine what SIHP site numbers had previously been given to avoid duplication. As SIHP numbers have been assigned at various times between 1970 and 2006 the site numbers are often quite different for sites in close geographic proximity or withion a designated site complex. A substantial effort also was made to present other site designations previously given to these sites but for consistency we have tried to present sites exclusively within the SIHP site numbering system.

4.2 Organization of the Presentation of Sites

In a complex archaeological landscape the determination of site boundaries is a matter of judgment and may be inherently somewhat subjective. The previous conceptualization of sites was typically followed and was privileged over our own considerations. This involved consideration of aggregates of sites as falling into certain previously designated "site complexes." Four major site complexes are designated: the Burial Bluff Complex (site 50-10-68-4309), the Wailau Complex (site 50-10-68-4310), the Kōloa/Nīnole Complex (site 50-10-68-4369) and the Punalu‘u Harbor Complex (site 50-10-68-7361). Within these site complexes several individual sites are often designated.

In our conceptualization of the lands under study we viewed the project lands as falling into two areas: a Mauka Survey Area inland or northwest of Belt Highway 11 (see Figure 14 site location map) and a Makai Survey Area seaward or southeast of Belt Highway 11 (see Figure 15 site location map). Our presentation of sites begins with those in the Mauka Survey Area in which the sites are presented in numeric order by SIHP site numbers.

Subsequently the sites in the Makai Survey Area are presented. These sites are presented in numeric order but sites that are designated as components of the Burial Bluff Complex and the Kōloa/Nīnole Complex are presented in numeric order within those site complexes.

Table 5. Historic Properties Documented within the Current Project Area. (SIHP Site # prefix 50-10-68-)

SIHP #	Temp. Site #	Features	Form	Age	Function	Complex	Signifi-cance	Recommend -ation
3512	B8-02	6	Lanipao Heiau	pre-contact	ceremonial		A, C, D, E	Preserve
3513	B8-03	4	petroglyphs	pre-contact	rock art		D, E	Preserve
3515	B8-05 & B8-37	5	platforms & terraces	pre-contact	habitation complex		D	Preserve
3519	B9-04	3	enclosures	historic	agricultural (animal husbandry)	Kōloa - Nīnole Complex (4368)	D	Preserve
3520	B9-05	3	enclosures	historic	habitation	Kōloa - Nīnole Complex (4368)	D	Preserve
3521	B9-06	1	trail	historic	transportation	Kōloa - Nīnole Complex (4368)	D	Preserve
3522	B9-07	2	"Nīnole School" (platform, enclosure)	historic	School	Kōloa - Nīnole Complex (4368)	C, D	Preserve
3524	B9-09	1	govt. road (Alanui Aupuni)	historic	transportation	Kōloa - Nīnole Complex (4368)	A, D	Preserve
4309 Feats A-J +	B9-31	25+	terraces, WWII gun emplacements	pre-contact w/ historic re-use	possible burials, military	Burial Bluff Complex (4309)	D, E	Preserve
4310 Feat. A	B9-32	1	wall	historic	cattle barrier	Wailau Complex (4310)	D	Preserve **
4310 Feats. B-D	B9-33	3	terraces, overhang shelter	historic	habitation	Wailau Complex (4310)	D	Preserve

SIHP #	Temp. Site #	Features	Form	Age	Function	Complex	Signifi-cance	Mitigation Recommend -ation
4310 Feats. E-H	B9-34	4	overhang shelters, walls	historic	habitation	Wailau Complex (4310)	D	Preserve
4330	B9-43	1	enclosure	historic	agricultural (animal husbandry)		D	Preserve
4360	B9-62 & B9-119	2	walls	historic	property boundary, cattle barrier		D	Preserve **
7361 Feat. A	Wharf	5+	Punalu‘u Harbor Wharf	historic	Harbor Infrastructure	Punalu‘u Harbor Complex (7361)	A, D	Preserve
7361 Feats. B-E	B8-14	5	terraces, well, walls	historic	Harbor Infrastructure	Punalu‘u Harbor Complex (7361)	A, D	Preserve
7361 Feat. F	B8-15	1	terrace	historic	Harbor Infrastructure	Punalu‘u Harbor Complex (7361)	A, D	Preserve
7361 Feat G	B8-16	1	enclosure	historic	Harbor Infrastructure	Punalu‘u Harbor Complex (7361)	A, D	Preserve
7361 Feat. H	B8-33	6	platforms	historic	Harbor Infrastructure	Punalu‘u Harbor Complex (7361)	A, D	Preserve
(7370)*	Church*	3+	historic church and cemetery	historic	ceremonial, burial	Burial Bluff Complex (4309)	D, E	Preserve
24897	T-108	3	enclosures, trail	historic	habitation	Kōloa - Nīnole Complex (4368)	D	Preserve
24898	T-111 & CSH 8	9	platforms & terraces	pre-contact	burial complex	Kōloa - Nīnole Complex (4368)	D, E	Preserve

SIHP #	Temp. Site #	Features	Form	Age	Function	Complex	Signifi-cance	Mitigation Recommend -ation
24899	B9-17	3	crypt, enclosures	historic	burial complex	Burial Bluff Complex (4309)	D, E	Preserve
24900	T-110	4	fishing shrine, platforms	pre-contact	ceremonial, burial	Burial Bluff Complex (4309)	D, E	Preserve
24901	B8-07	4	platforms & enclosures	pre-contact	habitation complex		D	Preserve
24902	B9-109	1	wall	pre-contact	indeterminate		D	No Further Work
24903	B9-121	1	enclosure	pre-contact	habitation, poss. burial		D, E	Preserve
24905	T-104	1	wall	historic	cattle barrier		D	Preserve **
24906	T-109	1	wall	historic	cattle barrier		D	Preserve *
24907	CSH 1	1	wall	historic	property boundary, cattle barrier		D	Preserve
24908	CSH 2	1	enclosure	pre-contact	indeterminate		D	No Further Work
24909	CSH 3	2	govt. road	historic	transportation		A, D	Preserve
24910	CSH 4	1	mound	pre-contact	agricultural		D	No Further Work
24911	CSH 5	1	wall	indeter-minate	indeterminate		D	No Further Work
24912	CSH 6	1	terrace	pre-contact	probable burial		D, E	Preserve
24913	CSH 10	1	well	historic	well		D	No Further Work
24914	CSH 12	1	cave	pre-contact	possible burial		D, E	Preserve
24915	T-107, B8-31, & B8-32	5	railroad berms	historic	transportation		A, C, D	Preserve
24916	T-101	1	petroglyph	pre-contact	rock art		D, E	Preserve

* = The Church site 7370 is an exclusion to the present project area

** = Preservation allowing breaches of wall recommended

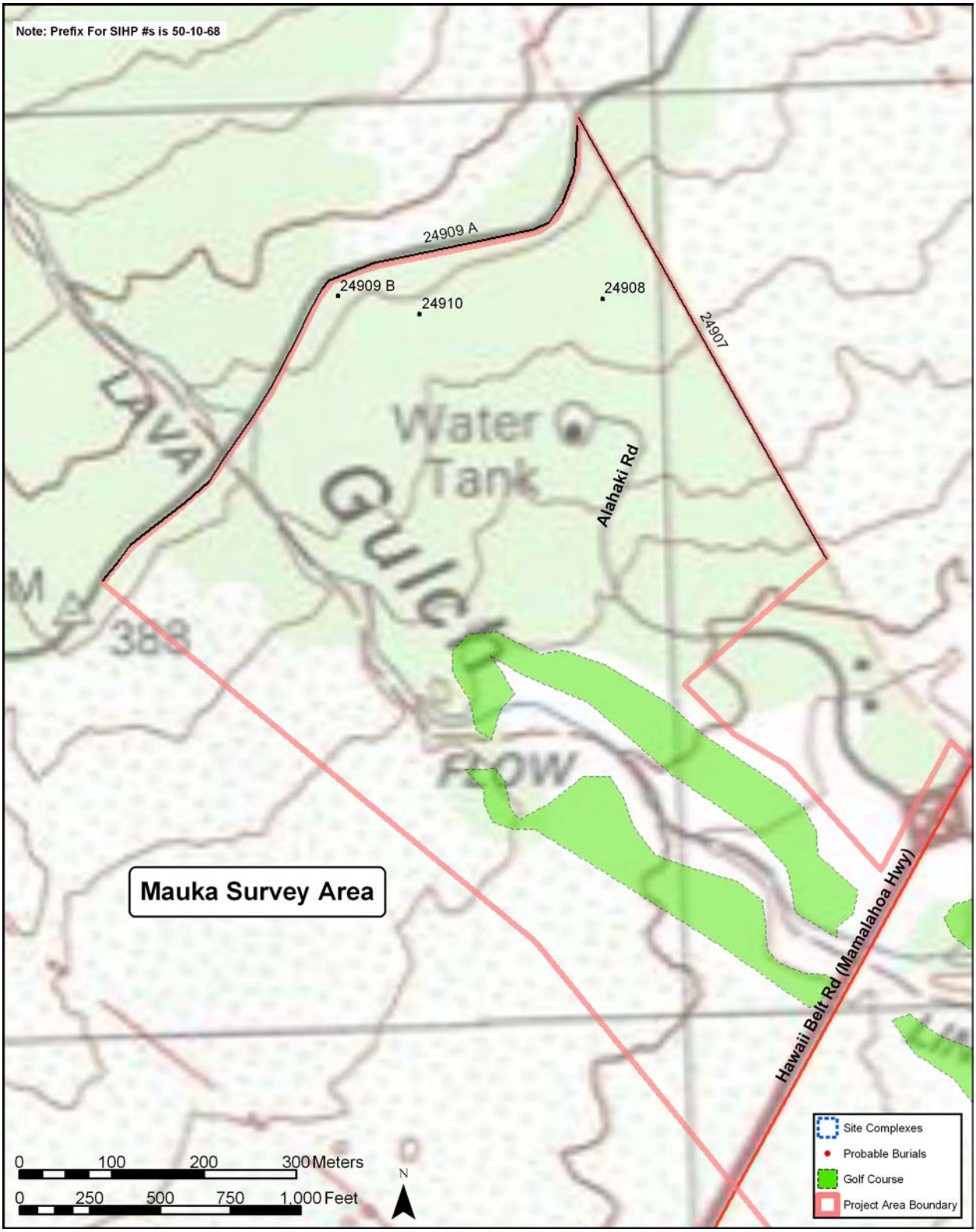

Figure 14. Portion of USGS Topographic Map, Punalu‘u Quad. (1995), showing the locations of historic properties in the *Mauka* Survey Area (inland of Hawai‘i Belt Hwy. 11)

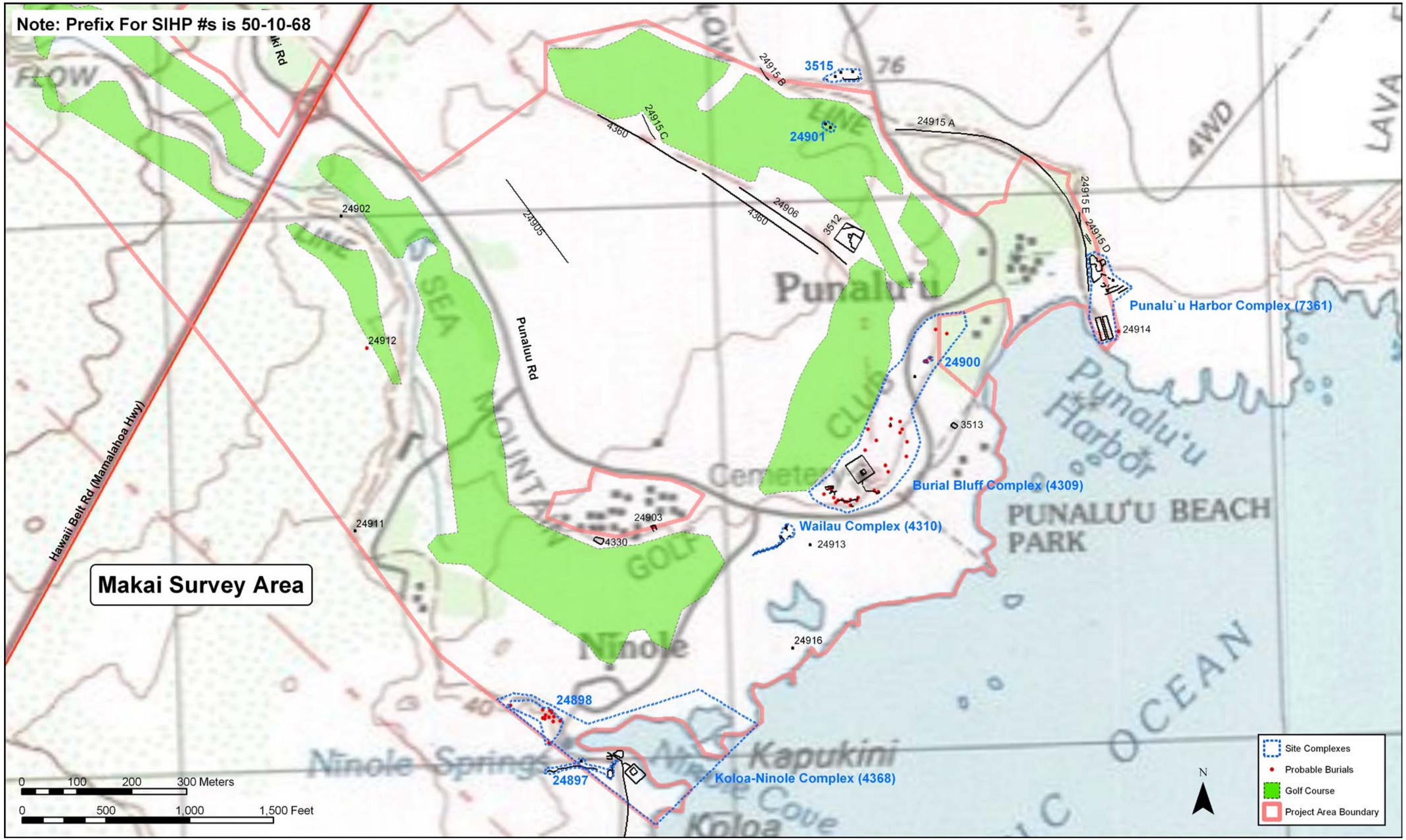

Figure 15. Portion of USGS Topographic Map, Punalu‘u Quad. (1995), showing the locations of historic properties in Makai Survey Area (*makai* of Hawai‘i Belt Rd.)

4.3 Site Descriptions – Mauka Survey Area

4.3.1 SIHP # 50-10-68-24907

SITE TYPE: Stone Wall
FUNCTION: Land Division / Cattle Barrier
FEATURES: 1
DIMENSIONS: Approx. 550 m Long
CONDITION: Good
AGE: Historic
TAX MAP KEY: [3] 9-5-019:024

SIHP # 50-10-68-24907 consists of an approximately 550 m long stone wall located along the northeastern boundary of the Mauka Survey Area (Figure 14). The *mauka-makai* trending wall originates at the northeastern corner of the project area, at the intersection of the project area boundary and an old government road (old Māmalahoa Road; SIHP # 50-10-68-24909), and terminates near a residential subdivision to the southeast.

SIHP # -24907 is constructed of stacked basalt boulders and cobbles, 3-5 courses high (Figure 16). The wall measured a maximum of 0.8 m in height and 1.0 m wide. Metal posts and barbed wire fencing were also incorporated into the wall construction. Several gated breaks in the wall were observed along the wall at intersections with ranch roads.

SIHP # -24907 is interpreted to be a historic ranch-related cattle wall. The wall functions in restricting the movement of cattle, as well as demarcating the property line. The wall has been modified in the modern era with the addition of barbed wire fencing, associated with the continued usage of this portion of the project area as pasture for grazing cattle. SIHP # -24907 is relatively intact and in good condition, with limited areas of collapse. As SIHP # -24907 was constructed during the historic ranching era and the surrounding area continues to be used for ranching purposes, the wall continues to be used for the purpose in which it was originally constructed. SIHP # -24907 maintains integrity of location, design, setting, materials, workmanship, feeling, and association. SIHP # -24907 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

Figure 16. SIHP # 50-10-68-24907 stone wall, view to southeast.

4.3.2 SIHP #: 50-10-68-24908

SITE TYPE: Enclosure
FUNCTION: Habitation
FEATURES: 1
DIMENSIONS: 9 m NE/SW by 11 m NW/SE
CONDITION: Poor
AGE: Pre-contact
TAX MAP KEY: [3] 9-5-019:024

SIHP # 50-10-68-24908 consists of a heavily disturbed enclosure located in the northeastern portion of the Mauka Survey Area (Figure 14). The enclosure is situated in a relatively level soil area, with a gentle slope to the southeast (Figure 17). The surrounding area is heavily disturbed, including grubbing and ranch-road construction associated with pasture improvements.

SIHP # -24908 is composed of low walls constructed of loosely stacked basalt boulders and cobbles, 2-3 courses high (Figure 18). The western and northern walls are oriented at a right angle, indicating the structure was likely a rectangular enclosure, measuring approximately 9 m by 11 m. However, the entire extent of the enclosure cannot be determined due to the heavy disturbance of the site. At present, only the northern and western walls of the enclosure remain. The south and east walls have been totally destroyed by bulldozing associated with the construction of a ranch road (non-paved) that runs along the eastern edge of the enclosure area.

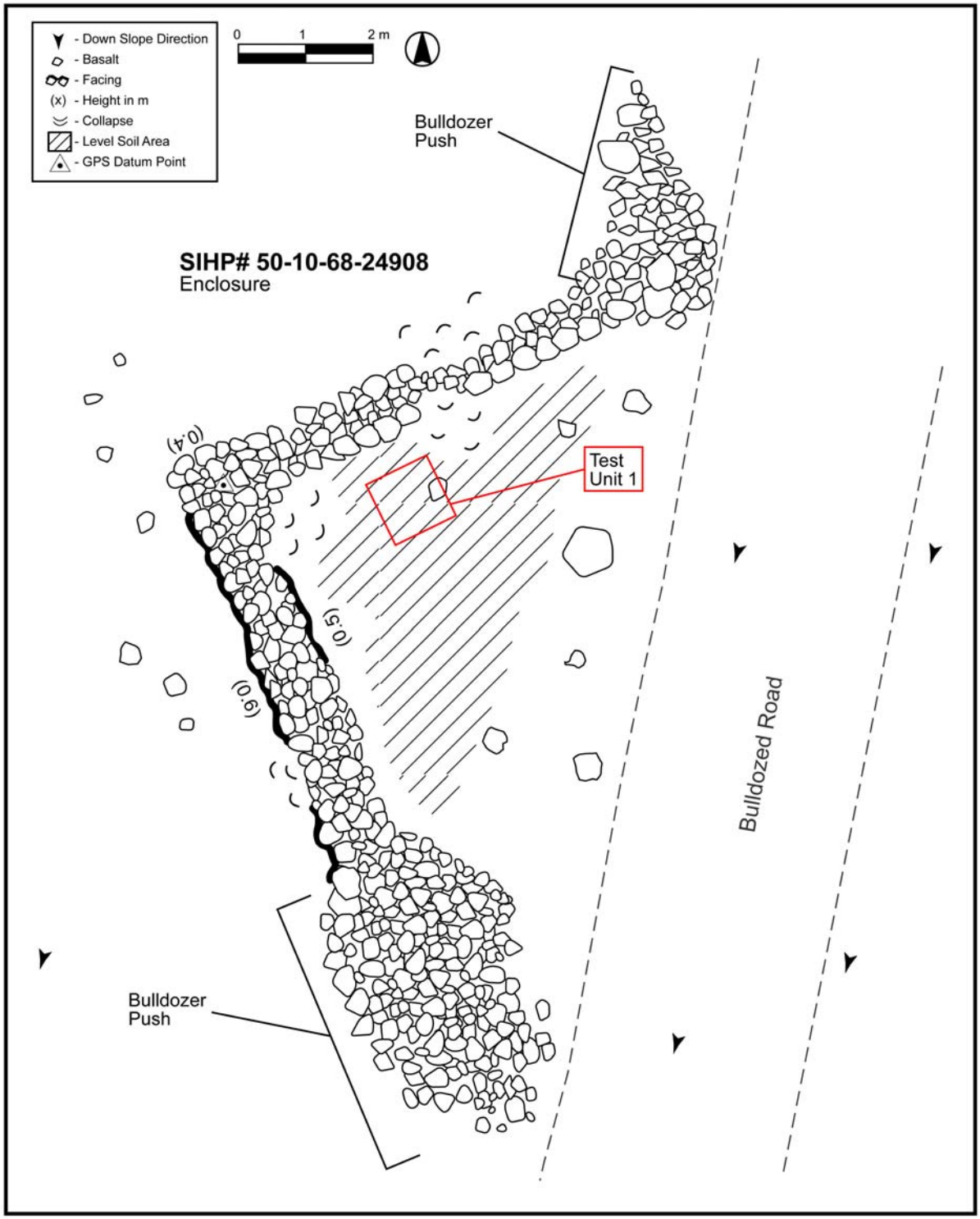

Figure 17. Plan view diagram of SIHP # 50-10-68-24908 enclosure, indicating the location of Test Unit 1.

Figure 18. SIHP # 50-10-68-24908 enclosure, view to north.

The enclosure walls generally measure 80 cm wide and 40-50 cm in height. Portions of the western wall are well-faced. The ends of each of the walls have been truncated by bulldozing. In addition, bulldozer push piles are located at the wall ends, likely composed of the stones of the former eastern and southern walls of the enclosure. The undisturbed interior portion of the enclosure was level and appeared to have been cleared of surface stones. No cultural material was observed within or in the immediate vicinity of the enclosure. A 1x1 meter test excavation was made within the undisturbed interior portion of the enclosure (see Section 5 for detailed results. No cultural material was recovered from the test excavation.

SIHP # -24908 is interpreted to be a pre-contact, traditional Hawaiian habitation site. The enclosure likely functioned as a temporary shelter associated with agricultural pursuits in the area. SIHP # -24908 is in poor condition, with the destruction of half the enclosure and significant collapse observed within the remaining walls. Due to the disturbance of the enclosure and extensive land modification in the surrounding area, SIHP # -24908 does not have integrity of setting, feeling, or association. However, the intact portions of the enclosure maintains integrity of location, materials and workmanship. SIHP # -24908 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

4.3.3 SIHP #: 50-10-68-24909

SITE TYPE: Old Government Road (Old Māmalahoa Road)
FUNCTION: Transportation
FEATURES: 2
DIMENSIONS: 780 m NE/SW x 7.2 m NW/SE
CONDITION: Good
AGE: Historic
TAX MAP KEY: [3] 9-5-019:024

SIHP # 50-10-68-24909 consists of a portion of the Old Government Main Road (Feature A), as well as an associated stone wall (Feature B), located along the *mauka* (northern) boundary of the Mauka Survey Area (Figure 14). The road is located within an adjacent right-of-way owned by the State of Hawai‘i and is therefore not within the boundaries of current project area. However, the associated stone wall is within the project area boundaries.

The portion of SIHP # -24909 Feature A road adjacent to the project area boundary is relatively level, constructed along the contour of the gently to moderately sloping hillside. In general, the upslope portion of the road is nearly level with the ground surface. The down slope portion of the road is raised and is constructed with a stacked basalt boulder foundation (Figure 19). In low areas, such as drainage gullies, the road foundation was raised a maximum height of 3.8 m above the ground surface to keep the roadway level. The road foundation was constructed with a trapezoidal cross-section, with a wide base and narrower top surface and sloping side walls. The top surface of the roadway measured 7.2 m wide, with 3.2 m wide asphalt paving. The road foundation was very well constructed, with well-faced side walls and no collapse observed.

At the intersection of SIHP # -24909 Feature A road and Nīnole Gulch, the former bridge crossing the gulch has been totally destroyed. No evidence of the bridge was observed. The bridge was likely of wood construction and was washed away during a flood event. Concrete bridge foundation remnants still exist along the edges of the gulch (Figure 20). The foundations are relatively intact, though current undercutting by erosion may cause collapse of the foundations in the future.

SIHP # -24909 Feature B consists of a single, stone wall located immediately down slope of a raised portion of the old government road (i.e. Feature A) (Figure 21 & 22). The semi-circular wall is situated within a small drainage gully, with the ends of the wall facing upslope toward the Feature A road, and the apex of the curved wall facing down slope at the base of the drainage gully. The wall is constructed of loosely stacked basalt boulders and cobbles, 3-6 courses high, in a bi-faced, core-filled manner. It measures approximately 18 m long, 0.8-1.0 m wide, with a maximum height of 1.1 m. The ends of the wall appear to have been disturbed by bulldozing associated with the construction of a ranch road that runs along the property line, immediately upslope of Feature B. The Feature B wall stretches across the deepest, most sloping portion of the drainage gully and is interpreted to function in trapping water and sediment at the base of the gully and thereby preventing erosion down slope of, and possible damage to, the Feature A road.

Figure 19. SIHP # 50-10-68-24909 Feature A old government road, view to west.

Figure 20. SIHP # 50-10-68-24909 Feature A old government road bridge foundation at Nīnole Gulch crossing, view to north.

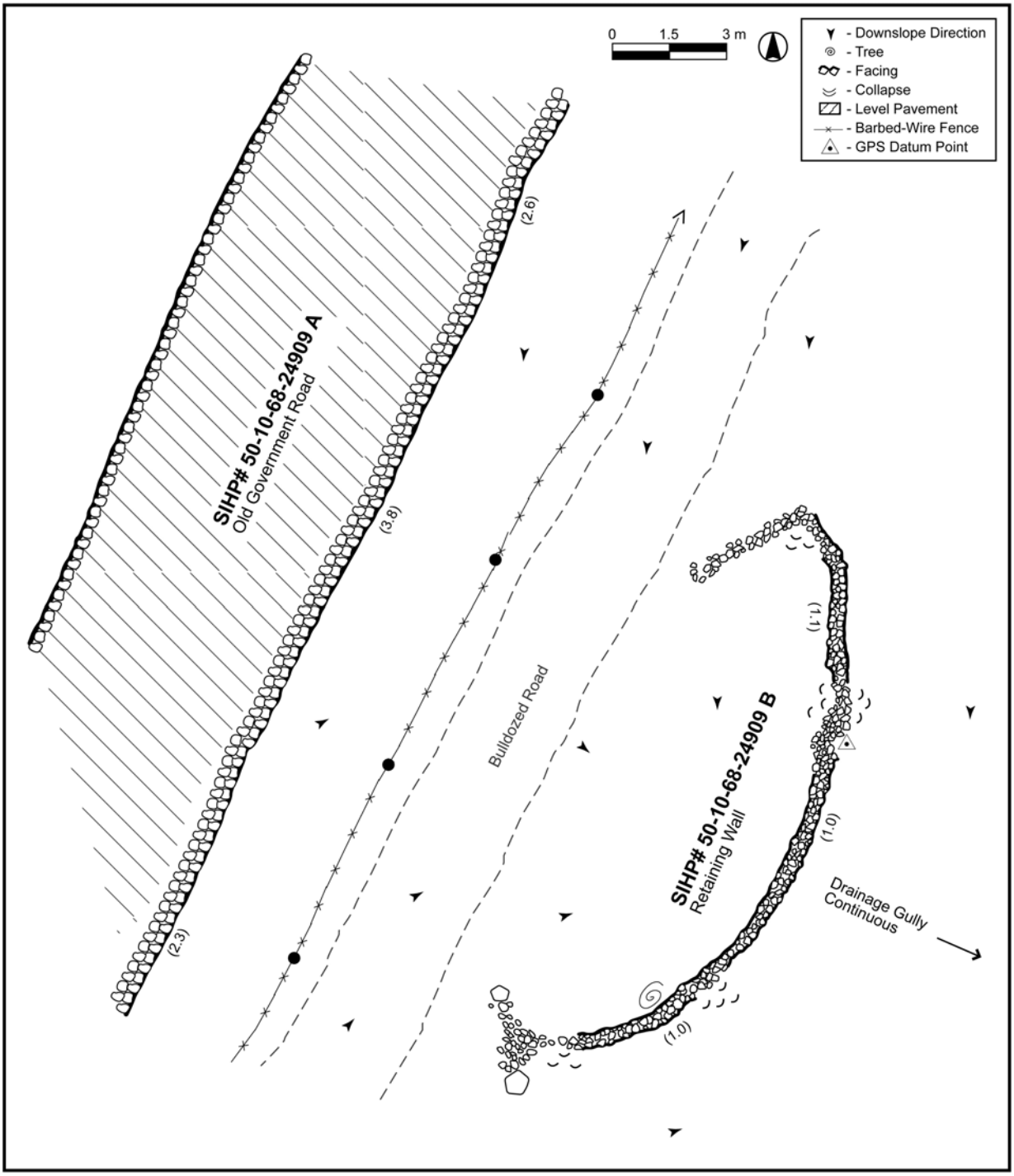

Figure 21. Plan view diagram of SIHP # 50-10-68-24909 Feature A old government road and Feature B wall.

Figure 22. SIHP # 50-10-68-24909 Feature B wall, view to south.

SIHP # -24909 Feature A is a portion of the Old Government Main Road otherwise known as the old Māmalahoa Highway or Ka‘ū Belt Road. Prior to the construction of the modern Hawai‘i Belt Road through Ka‘ū District *circa* the 1960s, the old Māmalahoa Hwy. was the primary transportation corridor for traveling around the southern portion of Hawai‘i Island between Kona and Hilo. The construction of the old Māmalahoa Hwy. was part of a significant historical trend that greatly facilitated intra-island travel and communication and represents a broad historic pattern of travel and communication improvement in the State of Hawai‘i. These improvements also lead to increased development of previously rural areas.

SIHP # -24909 is largely intact and in good to excellent condition, with the exception of the destroyed bridge over Nīnole Gulch. Other than possible maintenance of the road surface (i.e. re-paving), the road does not appear to have been modified from the time of its construction, allowing SIHP # -24909 to maintain integrity of location, design, materials, and workmanship. The surrounding area remains undeveloped and rural, allowing SIHP # -24909 to maintain integrity of setting, feeling, and association. SIHP # -24909 is assessed as significant under Criteria A (associated with events that have made an important contribution to the broad patterns of our history) and D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

4.3.4 SIHP #: 50-10-68-24910

FUNCTION: Mound
SITE TYPE: Agricultural
FEATURES: 1
DIMENSIONS: 2.9 m N/S by 1.0 m E/W
CONDITION: Poor
AGE: Pre-contact
TAX MAP KEY: [3] 9-5-019:024

SIHP # 50-10-68-24910 consists of a single low mound located in the northern portion of the Mauka Survey Area (Figure 14, 23 & 24). The mound is situated on a gently sloping soil area, with the surrounding area heavily disturbed by grubbing associated with pasture improvements. Despite the land modifications, the mound appeared to be undisturbed. SIHP # -24910 is constructed of mounded basalt boulders and cobble, 2-3 courses high, with larger stones around the perimeter and smaller stones filling the interior of the structure. The mound is linear shaped, measuring 2.9 m long and 1.0 m wide, with a maximum height of 25 cm. The western portion of the mound is more formally constructed with stacking and rough facing observed. The stones are loosely piled on the eastern portion of the mound. No cultural material was observed on or in the immediate vicinity of SIHP # -24910.

SIHP # -24910 is interpreted to be a pre-contact agricultural planting mound. The mound likely functioned as a planting bed for crops such as sweet potatoes, gourds, or *kī*. Due to the extensive land modification in the surrounding area, SIHP # -24910 does not have integrity of setting, feeling, or association. However, the mound itself was undisturbed and maintains integrity of location, materials, and workmanship. SIHP # -24910 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

Figure 23. SIHP # 50-10-68-24910 mound (view to southeast)

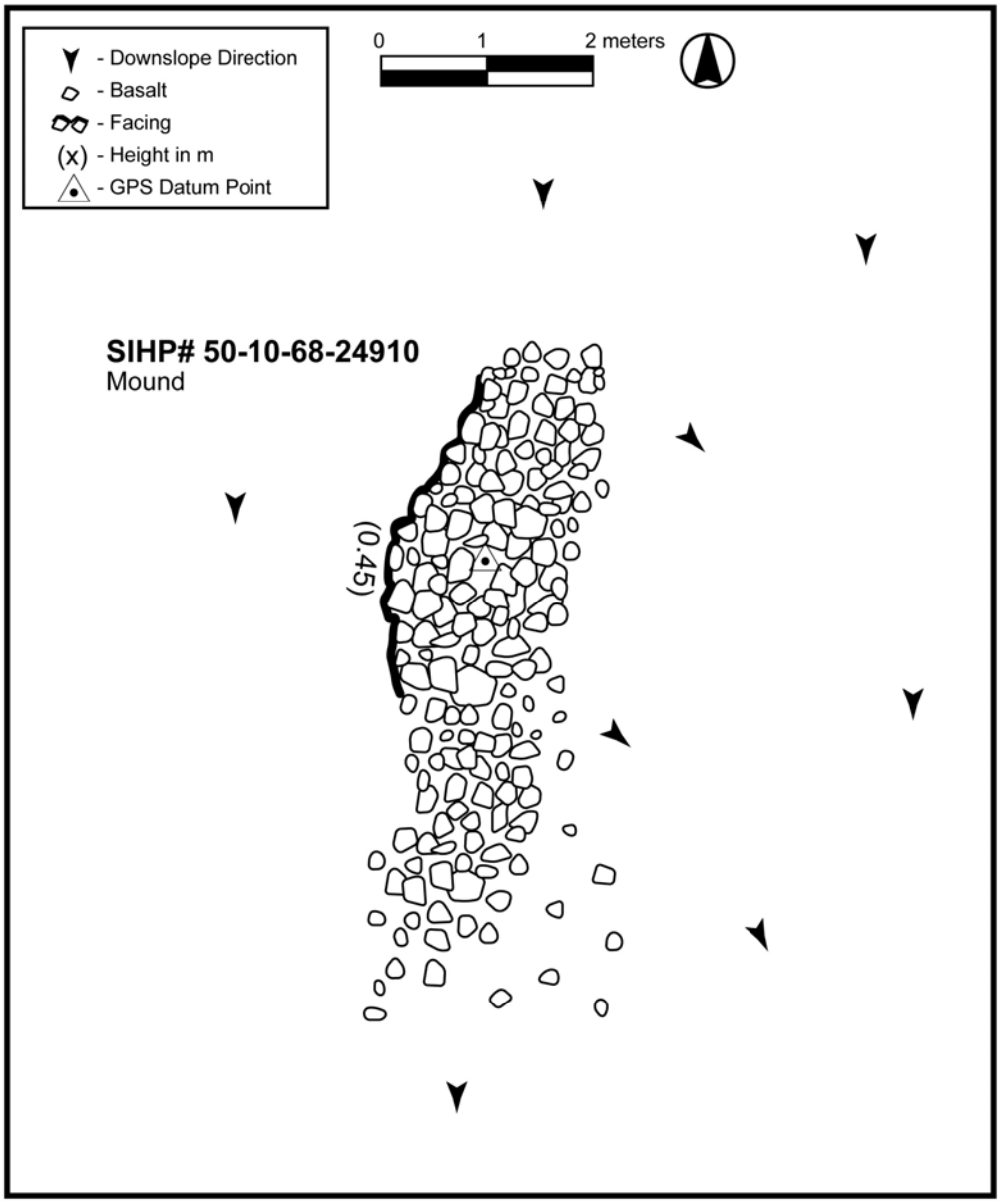

Figure 24. Plan view diagram of SIHP # 50-10-68-24910 mound.

4.4 Site Descriptions – Makai Survey Area

4.4.1 SIHP #: 50-10-68-3512

SITE TYPE: Lanipao Heiau
FUNCTION: Ceremonial
FEATURES: 8+
DIMENSIONS: Approx. 45 m NW/SE by 45 m NE/SW
CONDITION: Good
AGE: Pre-contact
TAX MAP KEY: [3] 9-6-002:038

SIHP # 50-10-68-3512 consists of the Lanipao Heiau complex, located in the eastern portion of the Makai Survey Area (Figure 15 & 25). The complex is bounded on the north, east, and south by the Sea Mountain Golf Course, and on the west by SIHP # -24906 wall. Lanipao Heiau was previously identified by Stokes (1919), given SIHP site number 50-10-68-3512 by Emory (1970:4) and later relocated by Crozier and Barrera (1974), and described as Bishop Museum site 50-HA-B8-02. Crozier and Barrera also produced a detailed map of SIHP # -3512 (Figure 25). The following description of SIHP # -3512 was provided by Crozier and Barrera (1974):

> The largest and best preserved of all the features in Area II is the *heiau* of Lanipao (Stokes, 1919:6). *Lani* means having a heavenly or holy character, and *pao* is arch of a bridge or the bridge itself [one of many definitions] (Andrews, 1922). This *heiau* is said to have been built by Laka of Kaua‘i (Stokes 1919:6). Although we have no definite evidence that the *heiau* was constructed by Laka, we do have a reference by Kamakau (1964:41) that Laka, the son of the famous ancient chief Wahieloa, brought his father’s bones from this area, Punalu‘u, in Ka‘ū on Hawai‘i and buried them along with the bodies of other famous chiefs in a cave at Papaluana, near the village of Kīpahulu, Maui.
>
> The *heiau* was constructed with large *‘a‘ā* stones and, with the exception of *‘‘ili‘ili* paving, no waterworn stones were used. One long wall partially encompasses several smaller enclosures. Many of the walls are still in excellent condition, reaching a height of more than 2 meters with very little batter (slope), and average between 1.5 to 2.5 meters in width. Natural-outcrop boulders on the southern portion were utilized in constructing a portion of one wall, a stepped platform, and a spring or well. It is doubtful that the long wall to the south of the site was associated, but rather was probably added later as a land boundary.
>
> One feature that is unique to Hawaiian archaeology is the triangle-shaped, low platform in the N sector of the site; it is 20 cm high and contains small *‘a‘ā* paving. Although no portable artifacts were found on the surface, numerous pieces of coral were observed which are characteristic to many prehistoric religious structures in Hawai‘i but not generally found at habitation sites. [Their] Figure 8 shows portions of the excellent walls at the *heiau* of Lanipao. (Crozier and Barrera 1974:11)

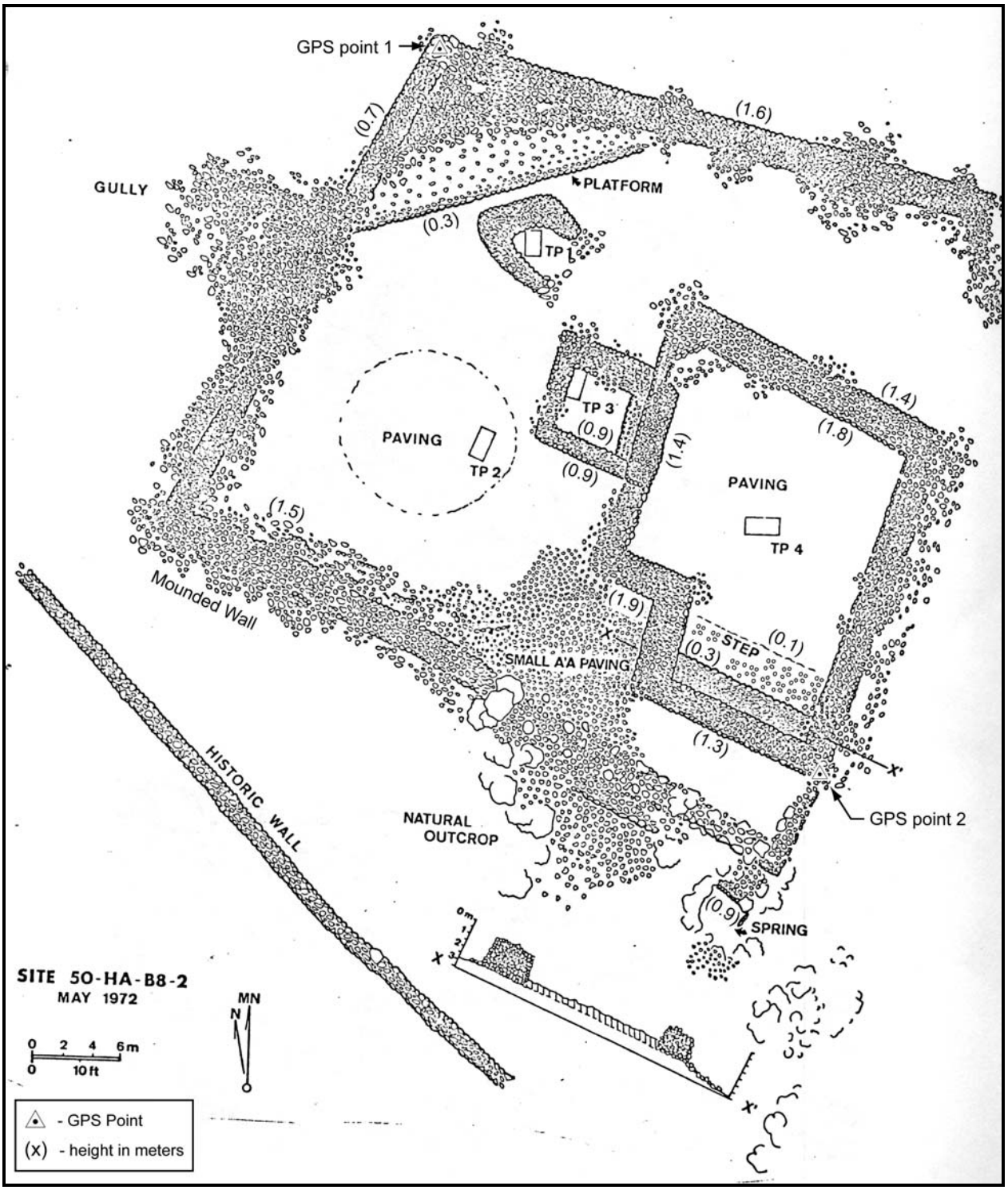

Figure 25. Plan view diagram of SIHP #50-10-68-3512 Lanipao Heiau (adapted from Crozier and Barrera 1974:12).

Additional detailed documentation of SIHP # 3512 Lanipao Heiau was provided by PHRI:

> Lanipao Heiau is comprised of a minimum of six component features. A standing wall encloses the north, west, and south limits of the complex, and measures a maximum of 2.0 m high and 1.5 to 2.5 m in width. In general the interior wells are also quite massive, measuring 1.0 to 2.0 m in width and 0.4 to 1.0 m high. Interior features include an enclosure with overall dimensions of 24.0 by 24.0 m; a smaller enclosure off the west wall of the central enclosure measuring 7.0 m on a side; a triangular platform with a 23.0 m front, located in the north corner of the enclosing wall; a C-shape with a 5.0 m opening; an *‘ili‘ili* and coral paving measuring approximately 12.0 m in diameter; and another paved area of comparable size comprised of small *‘a‘ā*. (Rosendahl and Rosendahl 1986:13)

A total of four test excavations were made within SIHP # -3512 Lanipao Heiau by Crozier and Barrera (1972), shown on Figure 25 above. The results of the subsurface testing are as follows:

> Test Pit 1
>
> A 1x1.5-meter test pit was excavated in the small C-shaped enclosure near the northern section of the site. The walls of the enclosure average 30 to 40 cm in height and 1.5 to 2 meters in width. The center area of the enclosure is paved with *‘ili ‘ili* and a large amount of coral. In the course of excavation it was noted that the *‘ili‘ili* and coral extended to a depth of 15 to 20 cm and fragments of shell were observed. We found between 20 and 27 cm larger chunks of *‘a‘ā*, which had been placed on the Pāhala ash deposit. In the N portion of the excavation a small fire pit had been dug into the Pāhala ash, and charcoal extended to a depth of 35 cm [see present Figure 26]. A charcoal sample was collected from 34 cm. (Crozier and Barrera 1974:11,14)
>
> The larger *‘a‘ā* stones (15 –20-cm diameter) at the 20-cm level may have been a pavement, but the numerous *koa haole* trees in the enclosure have disturbed any flat paving. One worked piece of basaltic glass was uncovered at 10 cm along the W wall of the test pit. The glass had been used as either a scraper or cutting implement [see present Figure 27]
>
> Test Pit 2
>
> A 1x1-meter pit was excavated in an area that was paved with *‘ili‘ili* and coral. A surface alignment of stones, 15 to 20 cm in diameter, transected the walls of the excavation pit. These stones did not extend below the surface, although there was a marked difference in stratigraphy on both sides of the alignment. In the N section the *‘ili‘ili* had been placed directly on bedrock, which was located only 5 cm below the surface. The S section was excavated to a depth of 25 cm before hitting similar bedrock. Approximately 20 pieces of coral were intermixed with the *‘ili‘ili* and small *‘a‘ā* paving. No Pāhala ash was noted in test pit 2.

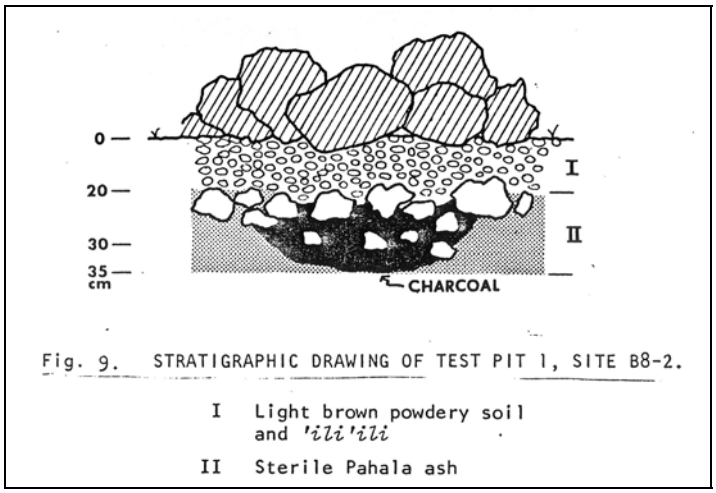

Figure 26. Profile showing Stratigraphy of Test Pit 1 at Lanipao Heiau (from Crozier & Barrera 1974:14, their Figure 9)

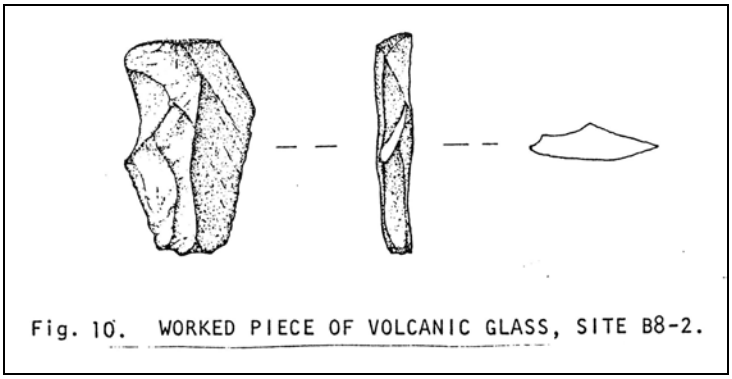

Figure 27. Drawing of volcanic glass recovered from Test Pit 1 at Lanipao Heiau (from Crozier & Barrera 1974:14, their Figure10)

Test Pit 3

Another 1x2-meter test pit was dug at the N corner of a small enclosure near the center of the *heiau*. The walls of the enclosure at this section stand 70 cm high and are 1 to 1.7 meters wide. No *‘ili‘ili* was on the surface, which consisted of dark-brown, powdery, root-filled soil. At 5 cm a scattering of *‘ili‘ili* was observed just above larger (15-20-cm diameter) *‘a‘ā* stones. Only one piece of coral and two pieces of shell were found before the sterile Pāhala ash was reached at a 20-cm depth.

Test Pit 4

In order to examine the varying depths of *‘ili‘ili* paving and Pāhala ash, another 1x2-meter pit was excavated in the center of the high walled enclosure. As in test pit 2, *‘ili‘ili* and coral paved the surface and extended to a depth of 15 cm. Below the *‘ili‘ili*, larger *‘a‘ā* stones were again observed mixed with a fine, dark-brown

> soil and specks of charcoal. Shell and coral were uncovered to a depth of 45 cm and Pāhala ash was not reached until 50 cm of rock and soil had been excavated. One fragment of highly polished basalt, possibly an adze chip, was collected from a depth of 15 cm. (Crozier and Barrera 1974:11-15)

Concluding remarks on the excavations at SIHP # -3512 Lanipao Heiau were as follows:

> *Heiau*, unlike habitation structures, seldom reveal an abundance of artifacts since they were not working or game areas; but stratigraphic information plus comparative construction methods do prove valuable.
>
> The four test areas were carefully selected to obtain the maximum information within the large *Heiau* complex. Test pits 1 and 3 provided us with a clear picture of stratigraphy and wall construction within two of the smaller dwelling enclosures. The similarities between these two features indicate a contemporary temporal sequence. Test pits 2 and 4 were excavated to compare pavement levels and depths of prehistoric cultural material. An *‘ili‘ili* pavement 15 to 20 cm in depth illustrates the importance of the site and the amount of work involved in building such a structure. Naturally, the results of these four test pits cannot reveal the entire story of Lanipao Heiau, but this preliminary research will aid the future investigation that has been recommended. (Crozier and Barrera 1974:15)

SIHP # -3512 Lanipao Heiau, described as “the largest and best preserved of all the features” (Crozier and Barrera 1974:11) in the Punalu‘u portion of the project area was described, mapped, and tested by Crozier and Barrera (1974) and PHRI (Rosendahl and Rosendahl 1986). The previous documentation of SIHP # -3512 Lanipao Heiau was field-checked and found to be thorough and accurate. The location of Lanipao Heiau was accurately plotted by CSH on the project area map (Figure 15) with the use of GPS survey technology. With the exception of the addition of wall heights to the map produced by Crozier and Barrera, and a brief assessment of existing conditions no additional data was generated for SIHP # -3512 by the current study.

SIHP # -3512 Lanipao Heiau was generally observed to be in good condition. The perimeter enclosure wall of the *heiau* was in fair condition, with many partially collapsed areas. Despite the areas of collapse, intact, well-faced portions of the large and impressive walls was observed. The interior features, including the platform, c-shaped enclosure, and interior rectangular enclosures were in good to excellent condition with little collapse observed. SIHP # -3512 is currently under dense vegetation, which is contributing to the gradual degradation of the site.

The area surrounding SIHP # -3512 has undergone extensive land modification, associated with historic ranch-related activities and modern golf course construction, though the *heiau* itself is undisturbed. SIHP # -3512 maintains integrity of location, design, materials, workmanship, feeling, and association. Due to the extensive land modification SIHP # -3512 does not have integrity of setting. SIHP # -3512 Lanipao Heiau is assessed as significant under Criterion A (associated with events that have made an important contribution to the broad patterns of our history), Criterion C (embodies the distinctive characteristics of a type, period, or method of construction, represents the work of a master, or possess high artistic value), and Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places, and Criterion E (have an important value to

the native Hawaiian people due to associations with cultural practices once carried out at the property – these associations being important to the group’s history and cultural identity) of the Hawai‘i Register of Historic Places.

4.4.2 SIHP #: 50-10-68-3513

SITE TYPE: Petroglyph Cluster
FUNCTION: Rock Art
FEATURES: 6
DIMENSIONS: 10 m NW/SE by 7 m NE/SW
CONDITION: Good
AGE: Pre-contact
TAX MAP KEY: [3] 9-6-002:037

SIHP # 50-10-68-3513 consists of a cluster of six petroglyphs, located in the eastern portion of the Makai Survey Area, immediately inland of the Punalu‘u Beach Park parking lot (Figure 15). SIHP # -3513 was previously identified by Stokes (1910) and designated site 50-HA-B8-03. The site was later relocated by PHRI (Rosendahl and Rosendahl 1986). The petroglyph cluster is situated on a gently sloping pahoehoe outcrop, approximately 60 m from the shoreline. The following description was provided by PHRI for SIHP # -3513 (site B8-03):

> This cluster of petroglyphs is located immediately north of the Punalu'u Beach Park parking lot. The figures are located on a relatively flat pahoehoe surface measuring 10.0 by 7.0 m. A minimum of four figures were visible, though additional figures can be seen under optimum viewing conditions. The four figures include three human figures with a triangular body type and another human figure in the "simple, lineal, angular" style (Cox and Stasack 1970:49). Each figure measures approximately 50 to 60 cm in diameter.
>
> This site appears to be the remnant of a petroglyph cluster initially described by Stokes in the early 1900s (Cox and Stasack 1970:81) as a cluster of approximately 25 figures including "linear figures, curved arms and legs, family groups--fish(?)--dots-circles" (1970:81). It appears that a portion of the outcrop likely containing the majority of the petroglyphs was removed during parking lot construction. This site is recommended for preservation and interpretive development.

SIHP # -3513 is currently bounded by a modern low rock wall enclosure, measuring 10 m by 7 m wide, with a height of 0.6 m (Figure 28). The enclosure is bordered on the southeast by the Punalu‘u Beach Park access road (Figure 29). SIHP # -3513 contains six petroglyphs representing human figures. Each petroglyph measures approximately 50 cm in diameter. Five of the figures have roughly triangular body types and one (partially destroyed) has a simple, linear body type (Figure 30). The petroglyphs were pecked into a relatively smooth pahoehoe surface. The petroglyph cluster was observed to have undergone some degree of natural weathering, but remain in good condition. No additional petroglyphs or cultural material was observed in the vicinity of SIHP # -3513. According to Stokes (1910), the petroglyph cluster formerly consisted of 25+ figures including “linear human figures, curved arms and legs, family groups – fish(?) – dots – circles.”

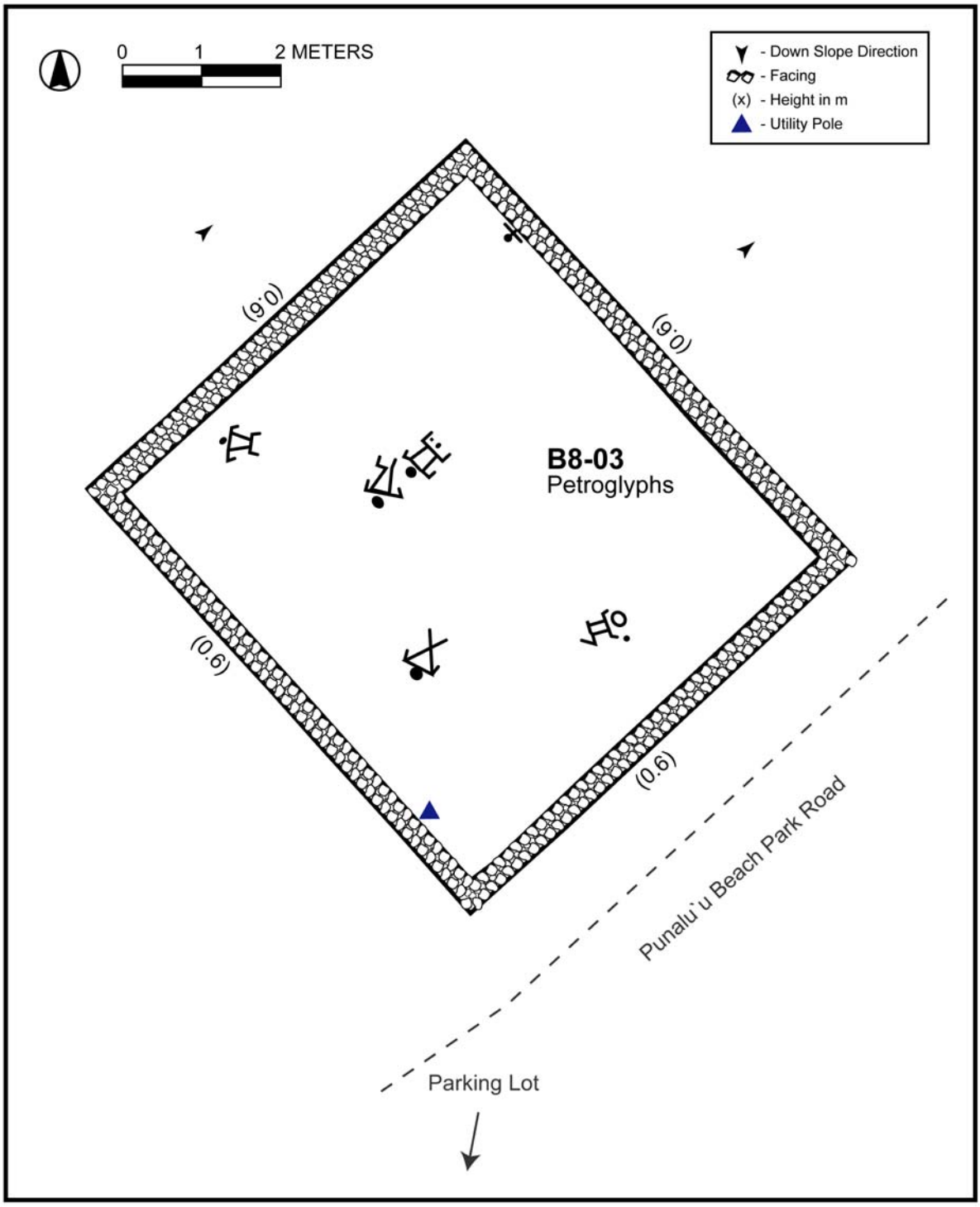

Figure 28. Plan view diagram of SIHP #50-10-68-3513 petroglyph cluster.

Figure 29. SIHP # 50-10-68-3513 petroglyph cluster, view to the southeast)

Apparently, the majority of the petroglyphs were destroyed during the construction of the Punalu‘u Beach Park access road and parking lot. The remaining petroglyphs were preserved with the construction of the low rock wall enclosure.

SIHP # -3513 is interpreted to be an example of pre-contact native Hawaiian rock art. The true function of the petroglyph cluster is unclear. The petroglyph cluster and the surrounding area have undergone extensive disturbance, associated with the construction of the Punalu‘u Beach Park infrastructure. Approximately 75% of the petroglyphs originally identified by Stokes (1910) appear to have been destroyed. Due to the extensive land modification in the surrounding area, SIHP # -3513 does not have integrity of setting, feeling, or association. However, the intact portion of SIHP # -3513 maintains integrity of location, design, materials, and workmanship. SIHP # -3513 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places and Criterion E (have an important value to the native Hawaiian people due to associations with cultural practices once carried out at the property – these associations being important to the group’s history and cultural identity) of the Hawai‘i Register of Historic Places.

Figure 30. SIHP 50-10-68-3513, views of individual petroglyphs.

4.4.3 SIHP #: 50-10-68-3515

SITE TYPE: Complex: incl. a terrace, 2 platforms, an overhang shelter & a wall
FUNCTION: Temporary Habitation, work area
FEATURES: 5
DIMENSIONS: Approx. 16 m N/S by 65 m E/W
CONDITION: Good
AGE Pre-contact
TAX MAP KEY: [3] 9-6-002:039

SIHP # 50-10-68-3515 consists of a complex of five features, located near the northern project boundary of the Makai Survey Area (Figure 15). SIHP # -3515 was previously identified by Hansen (n.d.) and designated site B8-05. The complex was relocated by Crozier and Barrera (1974) and PHRI (Rosendahl and Rosendahl 1986) and designated site B8-37. The complex is situated on a bluff between Punalu‘u Loop Road and the Sea Mountain golf course. The following description was provided by Crozier and Barrera (1974) for SIHP # -3515 (site B8-37):

> Approximately 90 meters N of site B8-7 and 23 meters W of the Punalu‘u access road is an impressive paved platform. The S and E sides of the 17x25-meter platform display a good facing and the paving consists of small *‘a‘ā* stones with some coral, and shell. There is an indication that the S portion had been stepped, but many of the rocks have fallen down the embankment against a possible retaining wall. No postholes were observed on the rock pavement and it is unlikely that such a large site would have been a house platform.
>
> The area to the N and W of site B8-37 is heavily overgrown with *koa haole* and numerous large *‘a‘ā* boulders have been pushed into the area by recent bulldozing. Several rough man-made features were recorded in this area. The few minor features around site B8-37 are small and poorly constructed, indicating a possible temporary dwelling or working area instead of a permanent settlement.

The following description was provided by PHRI for SIHP # -3515 (site B8-37):

> Site B8-5 was initially described by Hansen (Ms.) and assigned site number B8-5 during the 1972 survey by Crozier (1972:17). The site was given another site number, B8-37, in the Crozier and Barrera report (1974:19). The site, comprised of a terrace measuring approximately 17.0 by 25.0 m, is intact along the south and east faces. The terrace paving is mostly small *‘a‘ā* pebbles with some ‘ili‘ili, coral, and shell. Much of the feature appears to cover an existing outcrop. Additional minor features were noted in the vicinity. (Rosendahl and Rosendahl 1986:15)

SIHP # -3515 Feature A consisted of a terrace, situated at the crest of the bluff, in the eastern portion of the complex (Figure 31). The terrace measures approximately 38 m by 17 m wide, with a maximum height of 1 m at the southeast corner. The terrace has a retaining wall along the southern down slope side, constructed of stacked basalt boulders and cobbles, 2-3 courses high (Figure 32). The western portion of the terrace becomes lower, to a single course, 30-40 cm

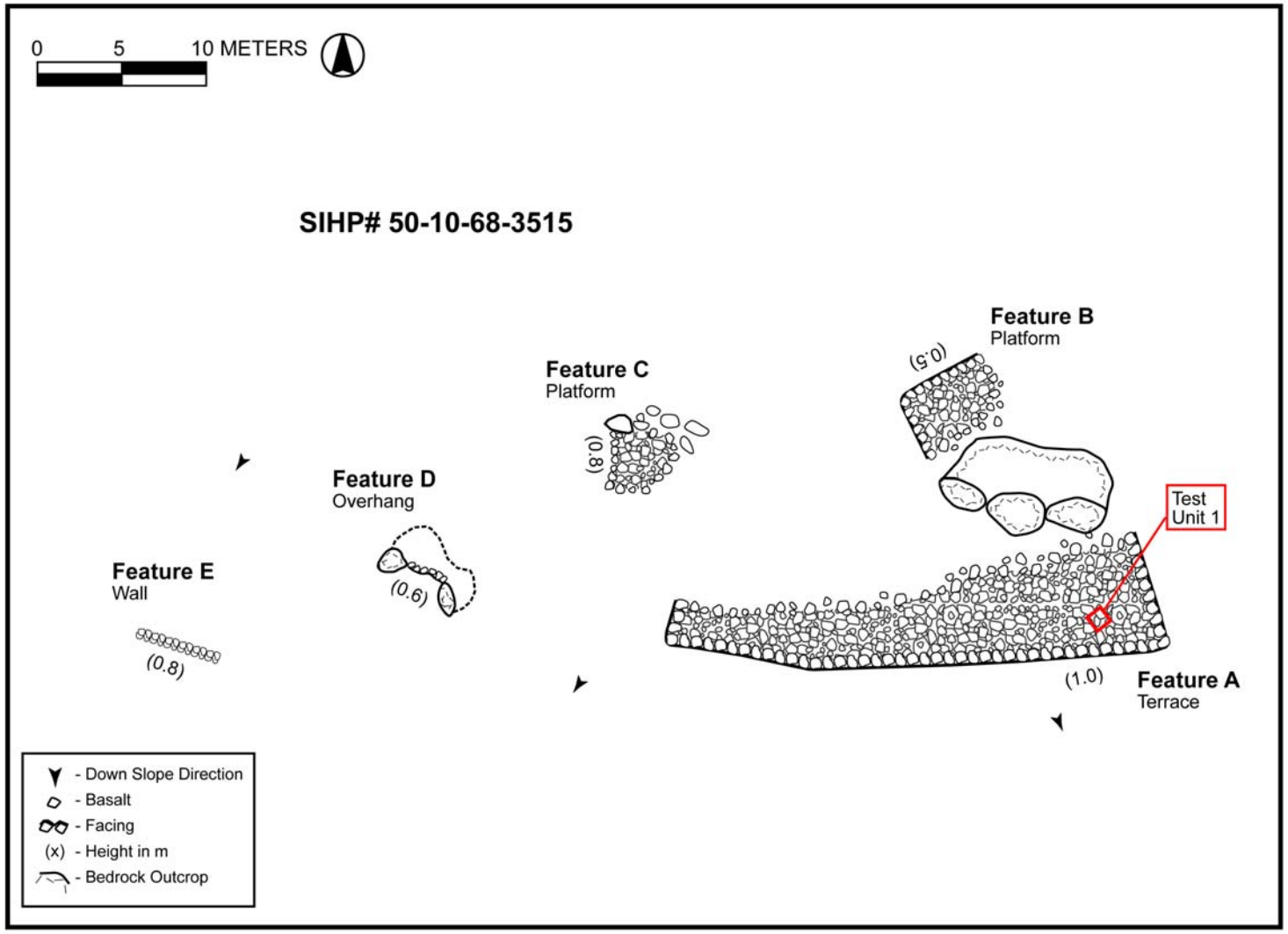

Figure 31. Plan view diagram of SIHP # 50-10-68-3515.

Figure 32. SIHP # 50-10-68-3515 Feature A terrace, view to southwest.

height, and width of 4 m. The surface of Feature A terrace is level and paved with basalt cobbles. Small amounts of *‘ili‘ili*, coral pebbles, and shell were observed in the southeast corner of the terrace. During the present study a 1 m by 1 m test excavation was made near the southeastern corner of the Feature A terrace. Sparse marine shell midden and volcanic glass flakes were recovered. Detailed results of the test excavation can be found in the following section.

SIHP # -3515 Feature B consists of a small platform located approximately 10 m north of the Feature A terrace (Figure 31). The platform measures 5.5 m by 3 m and is situated on an approximately 1 m high bedrock outcrop. The platform is constructed of stacked basalt boulders and cobbles and is naturally faced on south and southeast sides, with a large, 1.5 m diameter boulder in the eastern corner (Figure 33). The surface of the platform is relatively level with cobble fill. No surface cultural material was observed.

SIHP # -3515 Feature C consists of a small platform located approximately 15 m northwest of the Feature A terrace (Figure 31). The platform (Figure 34) measures 2 m by 2 m wide, with a maximum height of 0.75 m. It is constructed of loosely stacked basalt boulders and cobbles, 2-3 courses high. The interior of the platform is level and paved with basalt cobbles. No surface cultural material was observed.

SIHP # -3515 Feature D consists of a small overhang shelter located approximately 13 m west of the Feature A terrace (Figure 31). The overhang measures 0.6 m deep with a ceiling height of 0.6 m. A low terrace across the entrance of the overhang, is constructed of stacked basalt boulders and cobbles, 2 courses high, with a maximum height of 60 cm. No surface cultural material was observed.

Figure 33. SIHP # 50-10-68-3515 Feature B platform, view to south

Figure 34. SIHP # 50-10-68-3515 Feature C platform, view to east.

SIHP # -3515 Feature E consists of a 4.7 m long stone wall segment located approximately 27 m west of the Feature A terrace (Figure 31). The wall is constructed of stacked basalt boulders and cobbles, 2-3 courses high, with a maximum height of 80 cm.

SIHP # -3515 Features A-E are interpreted to be activity areas associated with pre-contact habitation and agricultural activities in the vicinity. In general, the features of SIHP # -3515 are not very well constructed, but are in good condition. The vicinity of SIHP #-3515 has been disturbed by land clearing activities associated with Punalu‘u Rd. and Sea Mountain golf course construction. SIHP # 3515 maintains integrity of location, design, materials, and workmanship. Due to the extensive land modification in the surrounding area, the site does not have integrity of setting, feeling, or association. SIHP # -3515 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

4.4.4 Burial Bluff Complex (SIHP # 50-10-68-4309)

SIHP #:	**50-10-68-4309 Burial Bluff Complex**
SITE TYPE:	Burial Bluff Complex
FUNCTION:	Burial / World War II
FEATURES:	25+
DIMENSIONS:	430 m NE/SW by 110 m NW/SE
CONDITION:	Good
AGE:	Pre-contact with Historic Reuse
TAX MAP KEY:	[3] 9-5-019:015

SIHP # 50-10-68-4309 Burial Bluff Complex consists of many small terraces and paved areas located along a coastal bluff area overlooking the Punalu‘u shoreline, in the central coastal portion of the Makai Survey Area (Figure 15). SIHP # -4309 was previously identified by Barrera and Hommon (1972) as a wall and designated site 50-HA-B9-31. The wall was relocated by PHRI (Rosendahl and Rosendahl 1986), at which time additional features in the bluff area were included in the same site designation. The entire Burial Bluff Complex area measures approximately 430 m by 110 m (Figure 35). The following description of SIHP # -4309 (site B9-31) was provided by PHRI (Rosendahl and Rosendahl 1986):

> In addition to a wall originally identified as Site B9-31, features located on the same bluff are included in this site designation. The bluff area extends northeast from immediately seaward of the eighth green and terminates just inland of the Punalu‘u Beach Park. The complex is primarily comprised of a series of small terraces and leveled areas located along the crest of the bluff. Several of the features have black sand fill which may have been added to existing features during the 1940s. According to a local informant, Pele Hanoa, gun emplacements were located along this bluff during World War II (Hanoa, pers. comm.). In contrast to this recent use, the presence of an adz fragment, volcanic glass flakes, and shell midden on the surface of these features suggests an indigenous use.
>
> A low platform located at the eastern limits of this site appears to be a burial feature. It is similar to the two burial features identified with the *ku‘ula*, Site T-110, and has been designated Feature A. This area is under *koa-haole* while the

> central portion of the bluff is fairly open. The western portion is extremely overgrown with scrub Christmas-berry which may obscure additional features. There appears to be a minimum of 15 features within the site limits. In general, the features located on the bluff appear to have been used for habitation with the exception of Feature A, a suspected burial feature. (Rosendahl and Rosendahl 1986:25)

SIHP # -4309 Feature A consists of the stone wall previously identified by Barrera and Hommon (1972) as site B9-31. The wall begins at the southern, downzone wall of the SIHP # -7370 historic church, and progresses down slope approximately 20 m (Figure 36). This portion of the wall is freestanding and bi-faced, constructed of stacked basalt boulders and cobbles and incorporates bedrock outcrops (Figure 37). The wall measures approximately 70 cm wide, with a maximum height of 1.1 m. An approximately 1.5 m wide constructed break in the wall was observed. The wall then angles to the east, along the contour of the sloping bluff, for approximately 16 m. This portion of the wall serves as a retaining wall, creating a relatively level terrace upslope. The down slope side of the wall measures a maximum of 1.6 m in height. The surface of the terrace was soil, with some historic rubbish including a bottle and what appeared to be an old washbasin.

SIHP # -4309 Feature B consists of a small 2 m by 2 m wide terrace, immediately adjacent to the eastern extent of Feature A (see Figure 36). The terrace is constructed with a crudely stacked basalt cobble retaining wall, 80 cm in height, with a basalt cobble paved interior (Figure 38). The down slope edge of the terrace is an extension of the Feature A wall. An approximately 1.6 m long rusted metal I-beam, along with additional rusted metal fragments, were observed on the surface of the terrace.

SIHP # -4309 Feature C consists of a small 2 m by 3 m circular terrace, adjacent to the eastern portion of Feature B (see Figure 36). The terrace is constructed at the edge of a bedrock outcrop and has a perimeter of crudely stacked basalt cobbles, with a maximum height of 1.0 m. The upslope edge of the terrace is an extension of the Feature A wall. The interior of the terrace is level and filled with black sand, primarily along the down slope edge (Figure 39).

SIHP # -4309 Feature D consists of a small 2m by 2 m terrace (Figure 40) immediately adjacent to the eastern edge of Feature C (see Figure 36). The terrace is constructed with a perimeter of crudely stacked basalt boulders and cobbles, 30 cm in height. The upslope edge of the terrace is an extension of the Feature A wall. The interior of the terrace is filled with black sand which connects with the sand in Feature C.

SIHP # -4309 Feature E consists of a terrace located approximately 48 m northeast of Feature D (Figures 41 & 42). The terrace measures 5 m by 4 m and is constructed with a perimeter of stacked basalt boulders and cobbles to a maximum height of 70 cm. The interior of the terrace is level and has been filled with black sand. The southeastern, down slope wall of the terrace has collapsed, spilling black sand down slope. A remnant metal I-beam, similar to that observed at Feature B, was observed immediately outside the southwestern corner of the Feature E terrace. A mound of stones measuring 2.5 m by 3.0 m was located near the northwestern corner of the terrace. Cowry shells and a cut animal bone were observed on the mound.

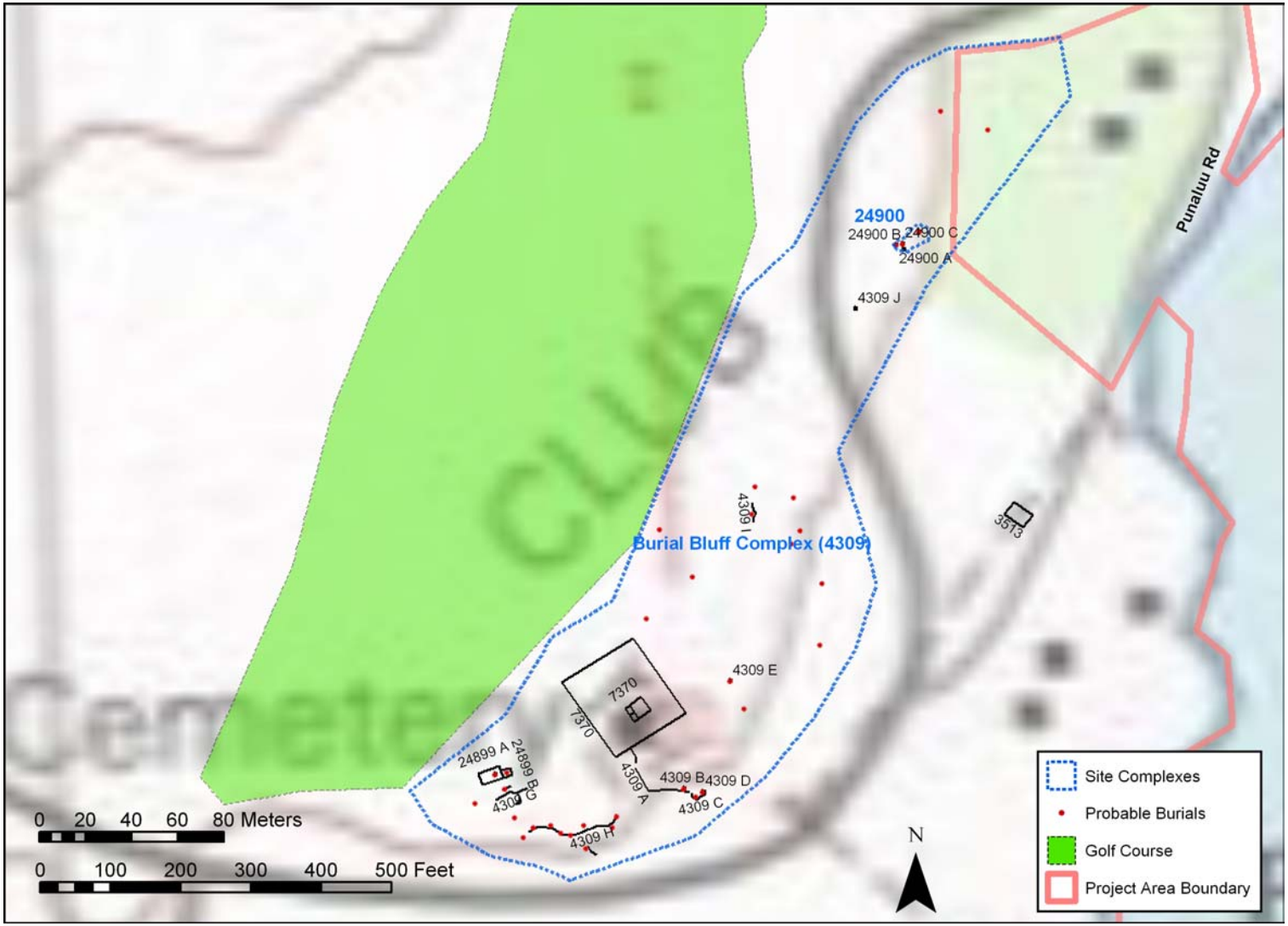

Figure 35. Portion of USGS Topographic Map, Punalu‘u Quad. (1995), showing the locations of historic properties within Burial Bluff Complex (SIHP # 50-10-68-4309)

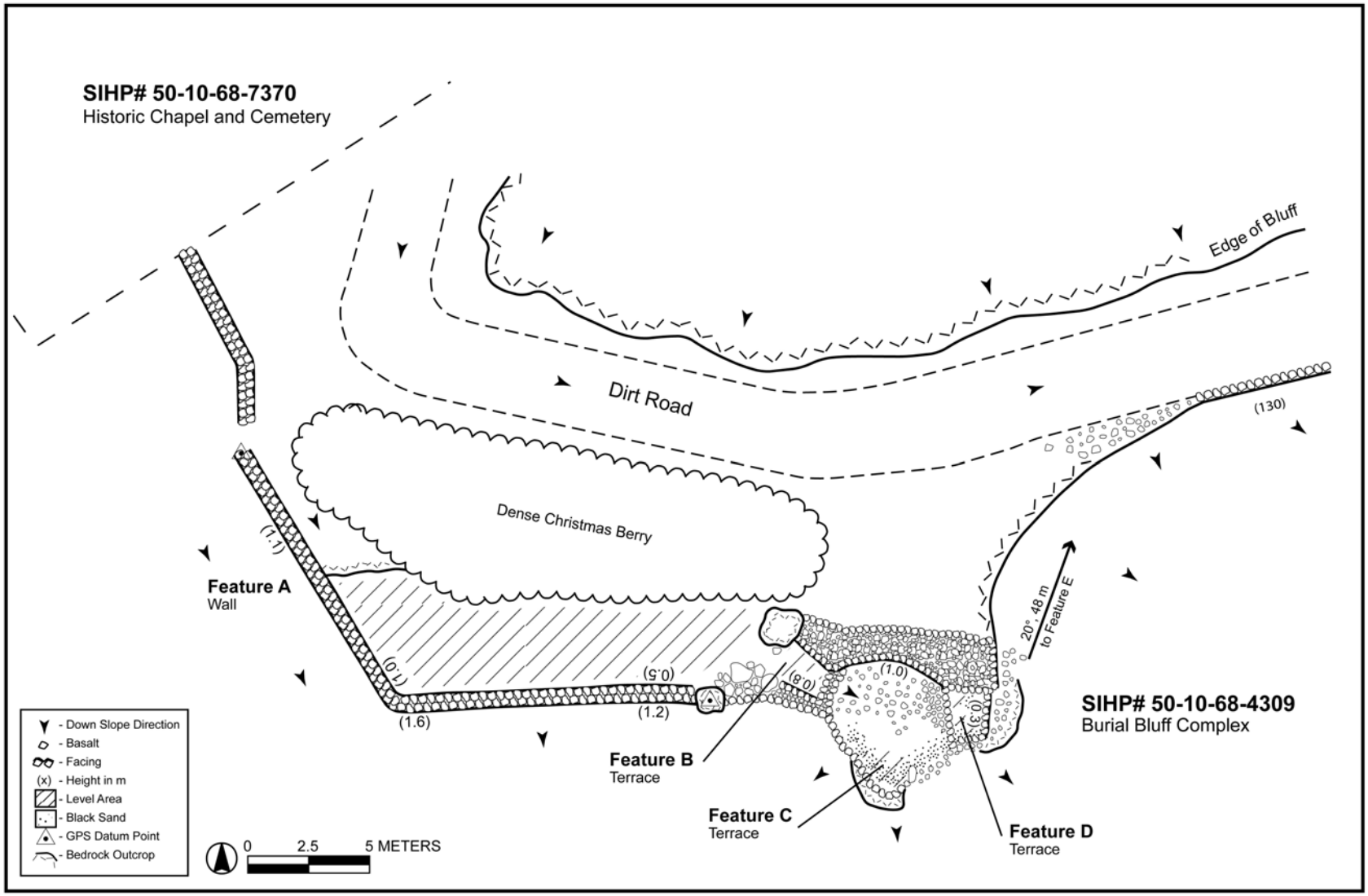

Figure 36. Plan view diagram of SIHP # 50-10-68-4309 Burial Bluff Complex Features A-D.

Figure 37. SIHP # 50-10-68-4309 Feature A wall, view to northwest.

Figure 38. SIHP # 50-10-68-4309 Feature B terrace, view to northeast.

Figure 39. SIHP # 50-10-68-4309 Feature C terrace, view to southeast.

Figure 40. SIHP # 50-10-68-4309 Feature D terrace, view to east.

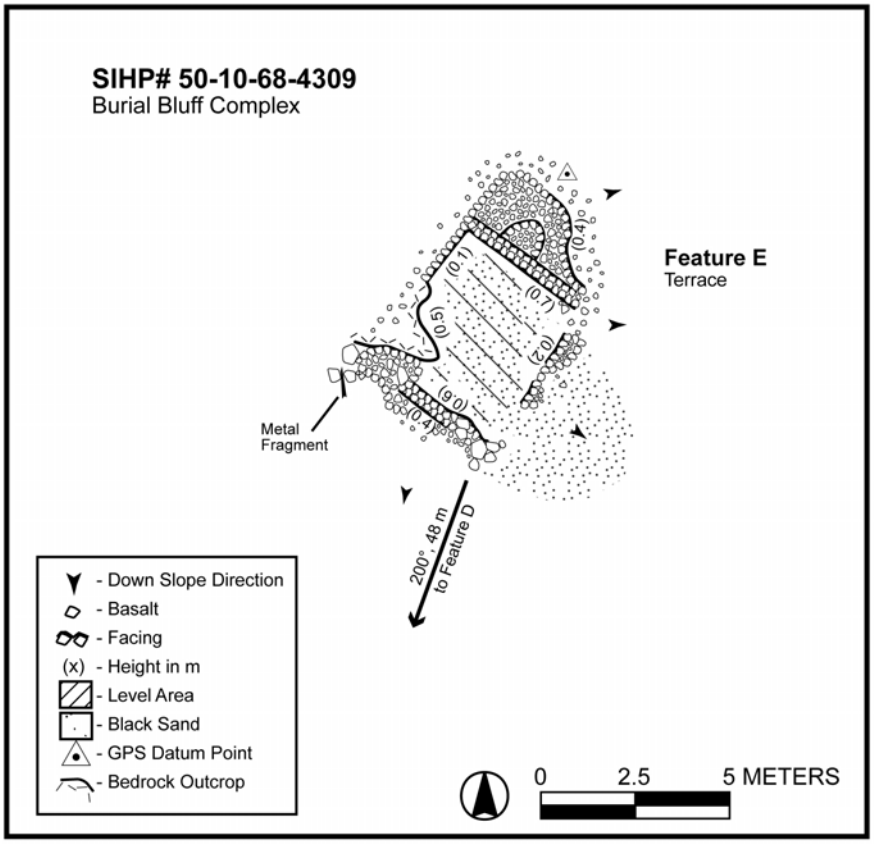

Figure 41. Plan view of SIHP # 50-10-68-4309 Burial Bluff Complex Feature E terrace.

Figure 42. SIHP # 50-10-68-4309 Feature E terrace, view to southwest

SIHP # -4309 Feature F consists of a crude enclosure located approximately 5 m down slope of SIHP # -24899 Feature A historic grave, in the southwestern portion of the Burial Bluff Complex (see Figure 35). The interior of the U-shaped enclosure measures 5.1 by 5.0 m with the open end facing west (Figure 43). The walls of the enclosure are constructed of loosely stacked basalt boulders and cobbles (Figure 44). The most well constructed portion of the enclosure is the down slope wall and southeast corner, which measures approximately 1 m wide and 0.7 m in height. The upslope wall of the enclosure is an extension of the Feature G terrace retaining wall. The interior of the Feature F enclosure is relatively level as is the area immediately down slope of the feature.

SIHP # -4309 Feature G consists of an approximately 15 m long terrace located immediately upslope of the Feature F enclosure (see Figure 43). The terrace is constructed with a loosely stacked basalt boulder and cobble retaining wall, with a maximum height of 0.8 m on the down slope side and 0.6 m on the upslope side (

Figure 45). The wall retains soil upslope, creating a level terrace measuring approximately 1.2 m wide. The surface of the terrace is cobble paved with scattered water rounded cobbles and pebbles.

SIHP # -4309 Feature H consists of a relatively large terrace located approximately 14 m southeast of Features F enclosure (see Figure 43). The terrace is well constructed, with a stacked basalt boulder and cobble retaining wall along the down slope edge (Figure 46). The terrace retaining wall is constructed by filling in gaps and crevices along the natural edge of cliff with stacked stones and incorporating bedrock outcrops to form a wall. The retaining wall is discontinuous, but extends a total of approximately 30 m, with the longest continuous stretch measuring 9 m in length. The terrace is well-faced, stacked 4-5 courses high, with a maximum height of 2 m. The wall retains a level soil terrace approximately 1.5 m in width.

SIHP # -4309 Feature I consists of a terrace located in the central portion of the Burial Bluff Complex (Figure 35). The terrace measures 5 m by 3 m wide and is situated at the crest of the bluff. The terrace is constructed with a stacked basalt boulder retaining wall, 1-2 courses high (Figure 47). The interior of the terrace is level and paved with basalt cobbles and pebbles, with scattered *‘ili‘ili*. A single water worn boulder, measuring 60 cm in diameter, was also located on the surface of the terrace.

SIHP # -4309 Feature J consists of a terrace located in the northern portion of the Burial Bluff Complex, down slope of Punalu‘u Rd. (see Figure 35). The terrace is constructed with a loosely stacked basalt boulder and cobble retaining wall, 3-4 courses high, along the eastern, down slope edge (Figure 48 & 49). The terrace measures 4.5 m by 2.3 m wide, with a maximum height of 1.1 m. The surface of the terrace is leveled with basalt boulder and cobble fill. The northern half of the terrace surface is best preserved with cobble paving. Down slope of the terrace is a larger, less defined terrace area with relatively level surface, with a crudely stacked retaining wall, 2 courses high, with a maximum height of 30 cm. On the surface of lower terrace is a small, faced mound built against upper terrace face, measuring 33 cm in height.

In addition to the 10 described features of SIHP # -4309 Burial Bluff Complex, a minimum of 15 additional small terraces and paved areas were observed along the bluff. The locations of these additional features are indicated on Figure 35. Dense vegetation also undoubtedly obscured other features from view.

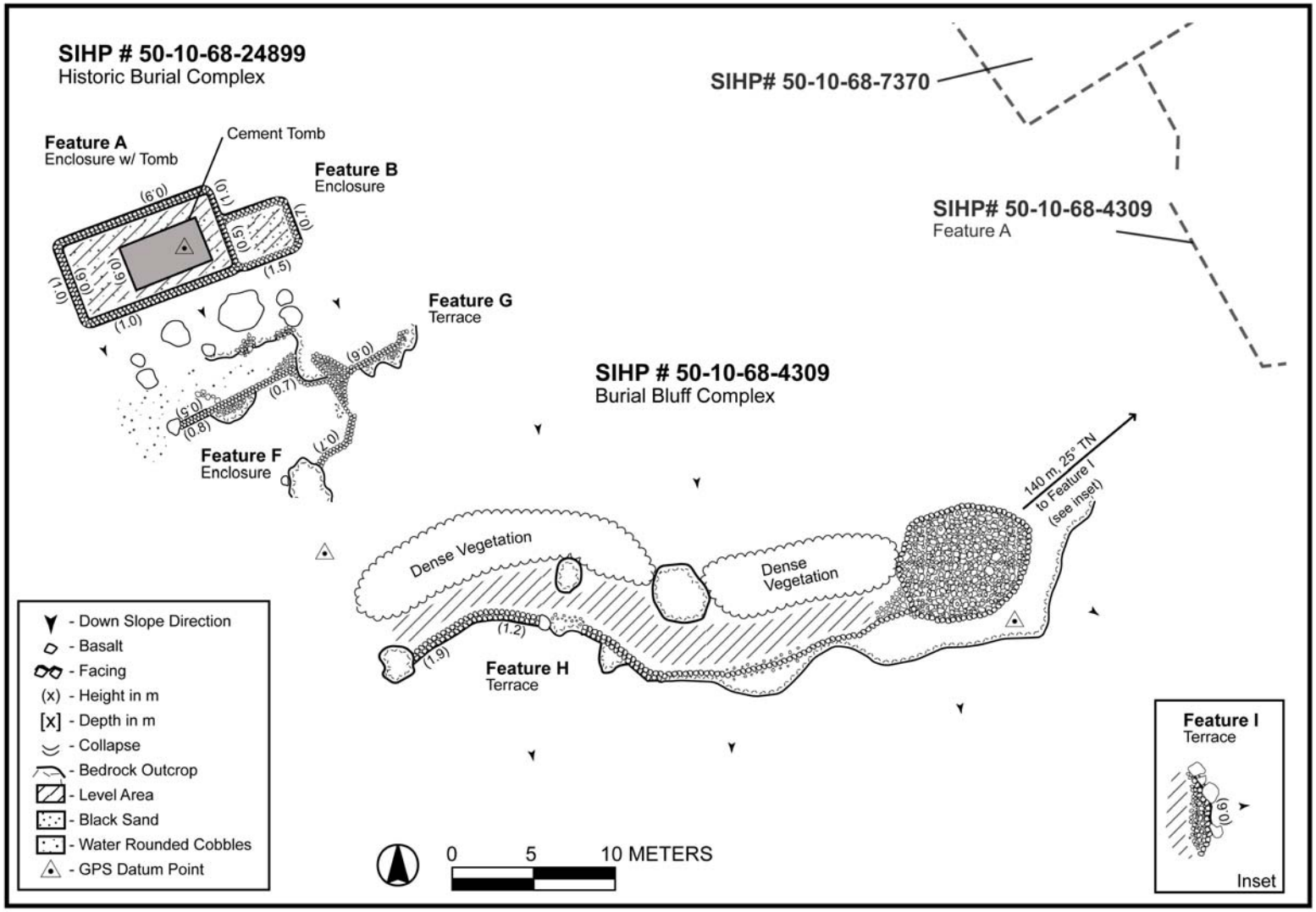

Figure 43. Plan view diagram of SIHP # 50-10-68-4309 Burial Bluff Complex Features F-I and SIHP # 50-10-68-24899 historic burial complex.

Figure 44. SIHP # 50-10-68-4309 Feature F enclosure, view to northeast

Figure 45. SIHP # 50-10-68-4309 Feature G terrace, view to north.

Figure 46. SIHP # 50-10-68-4309 Feature H terrace, view to southeast.

Figure 47. SIHP # 50-10-68-4309 Feature I terrace, view to northwest

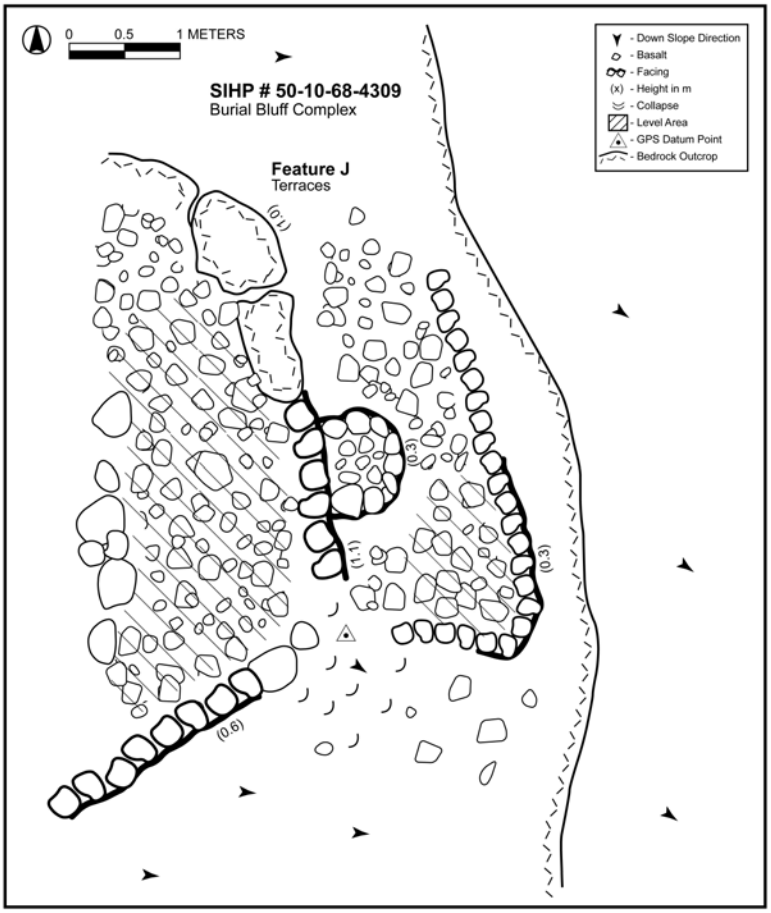

Figure 48. Plan view diagram of SIHP # 50-10-68-4309 Feature J terraces.

Figure 49. SIHP # 50-10-68-4309 Feature J terraces, view to northwest.

SIHP # -4309 is interpreted to be a pre-contact burial ground encompassing the entire coastal bluff area designated on Figure 35. The observed features generally consist of small terraces and paved areas at the crest or along the slope of the bluff, interpreted to be burial features. Local informants (i.e. Hanoa family) also indicated the bluff area was used in the past by their ancestors for human interments. In addition, the informants indicated burials were interred in the vicinity of the present historic church and cemetery (SIHP # -7370) prior to its construction.

Features A-E were atypical compared to the other features identified within the complex in that they were filled with black sand and had historic artifacts on the surface of the features. Local informants indicated during WWII, the U.S. military used the bluff area for gun emplacements for defense of the Punalu‘u harbor and coastline. Features A-E are interpreted to possibly be pre-contact burial features modified in the historic period and used as gun emplacements. The black sand on the features likely originated from degraded sand bags, used in the construction of the gun emplacements.

In general, the bluff are on which SIHP # -4309 is located is undisturbed. The observed features are in good condition. SIHP # -4309 maintains integrity of location, design, setting, materials, workmanship, feeling, and association. SIHP # -4309 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places and Criterion E (have an important value to the native Hawaiian people due to associations with cultural practices once carried out at the property – these associations being important to the group’s history and cultural identity) of the Hawai‘i Register of Historic Places.

4.4.5 SIHP #: 50-10-68-7370 (Component of Site Complex 50-10-68-4309)

SITE TYPE: Church and Cemetery
FUNCTION: Religious / Ceremonial
FEATURES: Many
DIMENSIONS: 40 m NW/SE by 36 m NE/SW
CONDITION: Excellent
AGE Historic
TAX MAP KEY: [3] 9-5-019:015

SIHP # 50-10-68-7370 consists of the Hōkūloa Congregational Church, located at the crest of a bluff in the southern portion of the Burial Bluff Complex (SIHP # -4309) (see Figure 35). The historic church includes the Henry Opukahaia Memorial Chapel and associated cemetery. The Church property is understood to be under the ownership of the Hawaiian Evangelical Association and is therefore not included in the current project area. However, due to its location within a major site complex and association with historic properties that are included in the project area, a brief reconnaissance of the church grounds was made.

The church property is completely bounded by a stacked stone wall enclosure, measuring approximately 40 m by 36 m. The interior of the church property consists of a nearly full cemetery and a small historic chapel (Figure 50 & 51). The Henry Opukahaia Memorial Chapel, is located within the *makai* portion of the church grounds. A plaque on the chapel wall indicated construction was completed April 29, 1957. According to local informants, the present chapel is a reconstructed/relocated structure, following the destruction of the original church by a tidal

Figure 50. SIHP # 50-10-68-7370 Hōkūloa Congregational Church grounds, view to southeast.

Figure 51. SIHP # 50-10-68-7370 showing types of graves observed within the Hōkūloa Congregational Church cemetery.

wave. The chapel is an A-framed structure, constructed of stone and mortar walls, a wooden roof, and concrete floors and pews. A small bell tower is located immediately southwest of the chapel. The concrete slab foundation for the chapel area measures approximately 8.5 m by 7 m.

The remainder of the interior of the church grounds consists of an associated cemetery, with graves completely surrounding the chapel. The earliest dated grave observed was of the Kaniakuas dated to 1904. The same grave is also the largest and most elaborately constructed of all the gravesites, using cut basalt stones and mortar and a 70 cm high cement tomb. Graves within the cemetery have varying construction methods, including informal piles of stones and pavings, low stone platforms and faced mounds, stone and mortar or cement tombs (Figure 51). Many of the graves did not have headstones.

The Hōkūloa Congregational Church is unusual in that the chapel is located within the cemetery, rather than outside and separate from it. This may support informant accounts that the area was used as a burial ground prior to being the site of a church and chapel. Informants also indicated that many burials are located outside the church walls.

4.4.6 SIHP #:50-10-68-24899 (Component of Site Complex 50-10-68-4309)

SITE TYPE:	Enclosure / Platform / Terrace / Wall
FUNCTION:	Burial complex
FEATURES:	2
DIMENSIONS:	14.0 m NE/SW by 6.0 NW/SE
CONDITION:	Good
AGE:	Historic
TAX MAP KEY:	[3] 9-5-019:015

SIHP # 50-10-68-24899 consists of a historic burial complex located in the southwestern portion of the Burial Bluff Complex (SIHP # -4309), approximately 40 m west of the SIHP# 7370 historic church and cemetery (see Figure 35 & 43). SIHP # -24899 was previously identified by Barrera and Hommon (1972) and relocated by PHRI (Rosendahl and Rosendahl 1986), and designated site 50-HA-B9-17. The following description of SIHP # -24899 (site B9-17) was provided by PHRI (Rosendahl and Rosendahl 1986):

> Site B9-17 is comprised of two enclosures and a cement tomb. The larger enclosure measures approximately 11.0 by 5.25 m, with a maximum wall height of 1.3 m and width of 0.8 m. A smaller enclosure, located off the southwest end, measures 2.9 by 2.6 m. A cement tomb measuring 2.54 by 1.76 m and 0.76 m high is situated within the larger enclosure. The site, in good condition, is located on the same bluff and west of a small historic church and cemetery (Site 7370) (Hawaiian Evangelical Association cemetery). The cement tomb is similar to other burial features located within the church's graveyard. The approximately one acre parcel that contains the church and adjacent graveyard is privately owned and not part of the Punalu'u Resort survey. (Rosendahl and Rosendahl 1986:20)

SIHP # -24899 Feature A (Figure 52) consists of an enclosure situated at the crest of a bluff, overlooking the Punalu‘u coastline. The enclosure is rectangular shaped, measuring 10.5 m by 5.7 m wide. The enclosure is constructed of stacked basalt boulders and cobbles, with a

maximum exterior height of 1.0 m. The interior heights of the enclosure wall range from 0.6 on the upslope portion of the enclosure, to 0.2 m on the down slope portion, indicating the interior of the enclosure had been filled and leveled. The interior of the enclosure is nicely leveled with *‘ili‘ili* stones and soil. A cement tomb, measuring 2.5 m by 1.3 m wide and 0.9 m tall, is located in the center of the Feature A enclosure (Figure 52).

SIHP # -24899 Feature B consists of a smaller enclosure adjacent to the eastern wall of the Feature A enclosure. The enclosure measures 2.3 m by 2.5 m wide, with the down slope wall measuring a maximum of 1.5 in height. Feature B is not as well constructed as Feature A, but is defined by 3 poorly faced walls and incorporates the east wall of Feature A. The interior of the enclosure is leveled with black sand (Figure 53). Feature B is also interpreted to be a human burial.

SIHP # -24899 is interpreted to be a historic burial complex with a minimum of two human burials. The burials are likely associated with the nearby Hōkūloa Congregational Church and Cemetery (SIHP # -7370). Local informants indicated human interments were made in the bluff area in the vicinity of the existing cemetery prior to the construction of the church and cemetery enclosure wall. SIHP # -24899 is undisturbed, and in good condition. The surrounding bluff area is also largely undisturbed, with the exception of the area approximately 10 m *mauka* of the bluff, which has been extensively modified by golf course construction. SIHP # -24899 maintains integrity of location, design, setting, materials, workmanship, feeling, and association. SIHP # -24899 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places and Criterion E (have an important value to the native Hawaiian people due to associations with cultural practices once carried out at the property – these associations being important to the group’s history and cultural identity) of the Hawai‘i Register of Historic Places.

Figure 52. SIHP # 50-10-68-24899 Feature A enclosure with cement tomb, view to northeast.

Figure 53. SIHP # 50-10-68-24899 Feature B enclosure, view to northeast.

4.4.7 SIHP #: 50-10-68-24900 (Component of Site Complex 50-10-68-4309)

SITE TYPE: Complex with *Kū‘ula*
FUNCTION: Ceremonial / Burial
FEATURES: 4
DIMENSIONS: 16 m NE/SW by 8 m NW/SE
CONDITION: Excellent
AGE: Pre-contact
TAX MAP KEY: [3] 9-6-002:037

SIHP # 50-10-68-24900 consists of a fishing shrine and three low platforms located within the Burial Bluff Complex (SIHP # -4309) (Figure 35). The SIHP # -24900 complex was previously identified by PHRI (Rosendahl and Rosendahl 1986) and designated site T-110. The complex is situated at the crest of the bluff, upslope of residential house lots and overlooking Punalu‘u Harbor. The four features comprising the SIHP # -24900 complex cover an area approximately 16 m by 8 m wide (Figure 54).

SIHP # -24900 Feature A consists of an *‘a‘ā* bedrock outcrop that protrudes vertically from the crest of the bluff (Figure 55). The outcrop measures 1 m by 2 m wide, and 1.8 m in height, and clearly stands out from the relatively level surface of the bluff. Feature A is clearly visible from the shoreline area, and presumably from coastal waters. Small boulders were loosely piled around the base of the outcrop. Feature A was identified by local informants as a *kū‘ula* or fishing shrine. The following information was provided to PHRI (Rosendahl and Rosendahl 1986):

> Two local informants, Pele Hanoa and Chris Bangay, provided the documentation on this site. Having been raised on the property, they remember their father using the stone as a marker on the shoreline to guide his fishing boat into Punalu‘u Harbor. The stone was said to have glowed at night – being light on very dark nights, and very dark on light evenings (Hanoa and Bangay, pers. comm..). They also recall placing a lantern on the stone to guide boats onshore. (Rosendahl and Rosendahl 1986:A-32)

In addition, Feature A was also referred to as a *ko‘a nui*, or important shrine. At the time of the current inventory survey investigation, the area surrounding Feature A was recently cleared of vegetation, indicating continued use of the *ku‘ula* as a shrine or shoreline landmark by local residents.

SIHP # -24900 Feature B consists of a rectangular platform, located immediately *mauka* of the Feature A *ku‘ula* (Figure 56). The low platform measured 3 m by 2 m wide, and 15-20 cm in height. The platform was constructed of a single course of basalt boulders around the perimeter, with level cobble paving in the interior.

SIHP # -24900 Feature C consists of a rectangular paved area (Figure 57), also located immediately *mauka* of the Feature A *ku‘ula*. The paved area measured 2 m by 2 m wide, and was nearly level with the ground surface. The paving had a perimeter of basalt boulders, with flat portions of the stones facing up, and level cobble paving in the interior.

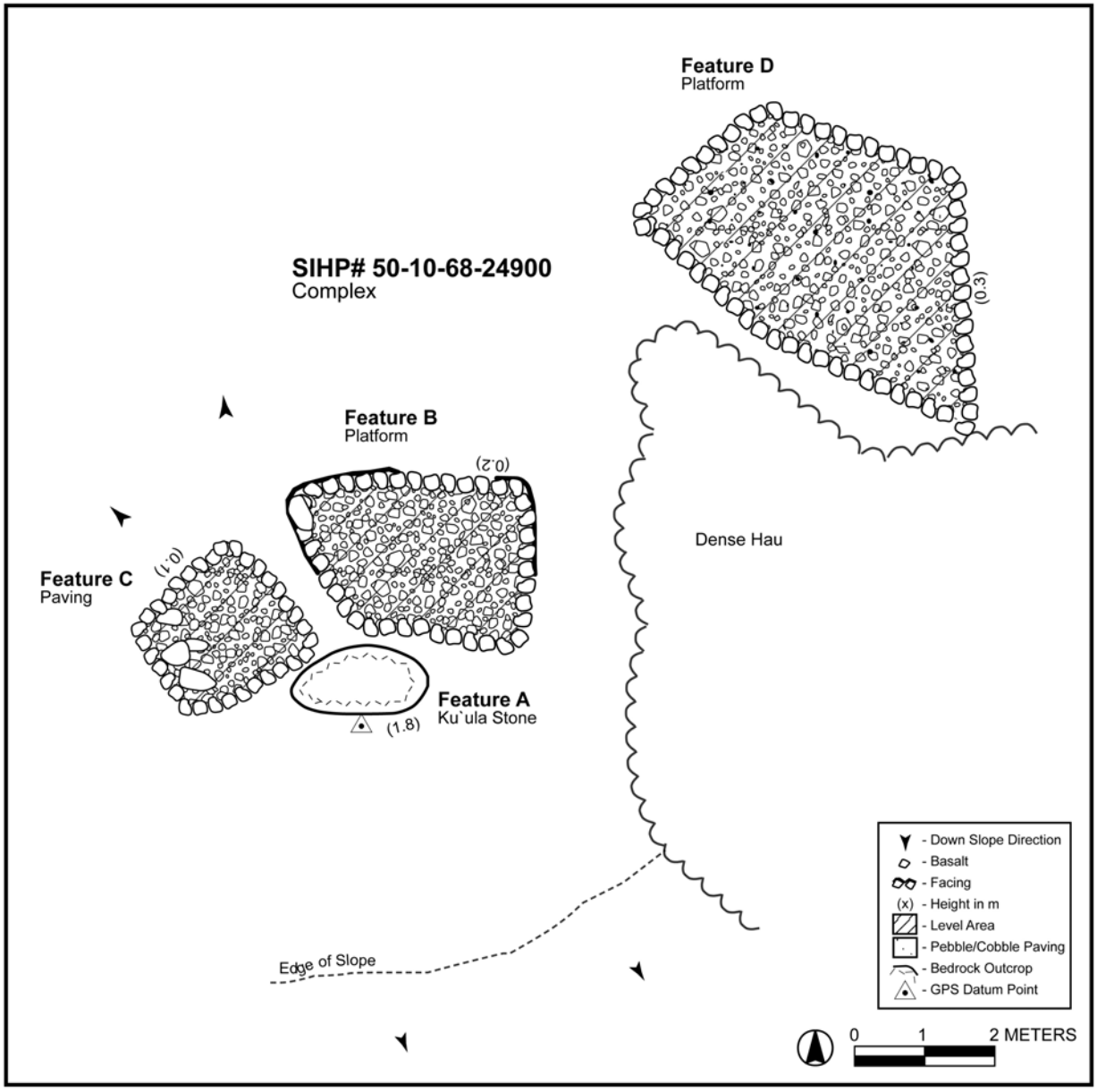

Figure 54. Plan view diagram of SIHP # 50-10-68-24900 complex

Figure 55. SIHP # 50-10-68-24900 Feature A fishing shrine (*ku‘ula*) view to north.

Figure 56. SIHP # 50-10-68-24900 Feature B platform, view to northwest

Figure 57. SIHP # 50-10-68-24900 Feature C paving, view to east.

Figure 58. SIHP # 50-10-68-24900 Feature D platform, view to east.

Feature D consists of a rectangular platform (Figure 58), located approximately 9 m northeast of Feature A. The low platform measured 5 m by 3 m wide, with a maximum height of 30 cm. The platform was constructed of a single course of basalt boulders around the perimeter, with level cobble paving in the interior. Waterworn cobbles and pebbles were scattered throughout the interior of the platform.

SIHP # -24900 is interpreted to be a pre-contact ceremonial complex, comprised of a fishing shrine (*ku‘ula*)(Feature A), and associated burial features (Features B-D). The *ku‘ula* functions as a shoreline landmark, as well as a shrine, associated with fishing activities in the vicinity. SIHP # -24900 is undisturbed and in excellent condition. Local residents appear to upkeep the area and likely continue to use Feature A as a shoreline landmark, as there are no modern aids to navigation in Punalu‘u Harbor. The surrounding bluff area is undisturbed, with limited development in the shoreline area down slope consisting of residential structures and Punalu‘u Beach Park infrastructure. SIHP # -24900 maintains integrity of location, design, setting, materials, workmanship, feeling, and association. SIHP # -24900 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places and Criterion E (have an important value to the native Hawaiian people due to associations with cultural practices once carried out at the property – these associations being important to the group’s history and cultural identity) of the Hawai‘i Register of Historic Places.

4.4.8 Wailau Complex (SIHP # 50-10-68-4310)

SIHP #:	**50-10-68-4310**
SITE TYPE:	Complex
FUNCTION:	Habitation
FEATURES:	8
DIMENSIONS:	Approx. 85 m NE/SW by 23 m NW/SE
CONDITION:	Good
AGE	Historic
TAX MAP KEY:	[3] 9-5-019:011

SIHP # 50-10-68-4310, consists of 8 features including terraces, overhang shelters, walls, and a linear mound, located in central coastal portion of the Makai Survey Area (see Figure 15, 59 & 60). SIHP # -4310 Feature A wall was previously identified by Barrera and Hommon (1972) and designated site 50-HA-B9-32. SIHP # -4310 Features B-D terraces and overhang shelter were previously identified by Barrera and Hommon (1972) and designated site 50-HA-B9-33. SIHP # -4310 Features E-H overhang shelters, wall, and mound were previously identified by Barrera and Hommon (1972) and designated site 50-HA-B9-34. Subsequently, sites B9-32, B9-33, and B9-34 were relocated by PHRI (1986) and described together as the Wailau Complex and given a single SIHP designation (SIHP # -4310).

The following description was provided by PHRI for Feature A (site B9-32):

> Site B9-32 identifies a stacked stone wall that runs in an east-west direction. It follows the crest of a bluff and descends the steep slope to the east. The eastern extensions of the wall no longer exist as it appears that land modification activities have resulted in reduction of the wall. The wall measures a maximum of

> 1.2 m high and 0.8 m wide, and is generally in good condition. (Rosendahl and Rosendahl 1986:20)

SIHP # -4310 Feature A consists of an approximately 60 m long linear stone wall. The wall runs roughly northeast to southwest along the crest of a bedrock bluff (Figure 59-61). The wall is constructed of loosely stacked basalt boulders and cobbles, 3-6 courses high (Figure 61). The wall measures 0.6-1.3 m in height and 0.7-0.9 m wide. Boulders average 20-30 cm diameter with some large boulders measuring 60 cm in diameter at the base of the wall construction. The western end of Feature A was truncated by land clearing activities, which generally included the entire area *mauka* of the wall. Near the eastern extent of the wall, the edge of the bluff curves to the north, crossing the path of the wall alignment. At this point, the wall descends the steep sloping face of the bluff and continues in a northeasterly direction, adjacent to the Feature B terrace located at the base of the bluff (Figure 60). The wall is understood to have continued to the northeast past Feature B, as previously described and mapped by Barrera and Hommon (1972). However, the eastern end of the wall was truncated by land clearing activities immediately east of Feature B. An additional segment of the wall was observed in the vicinity of Feature H (see Figure 66). The wall was constructed over a raised bedrock outcrop and spared from land clearing activities. Feature A is generally in good condition, with little collapse observed.

SIHP # -4310 Features B and C consist of two terraces (Figure 60) located in the eastern portion of the Wailau Complex (SIHP # -4310). The terraces are situated at the base of a bedrock bluff, immediately north of Feature A.

Feature B, the southern terrace, is constructed against the nearly vertical face of the bedrock bluff, adjacent to the northern edge of Feature A wall (Figures 60 & 62). The Feature B terrace (Figure 85) is triangular shaped, measuring 5 m by 2.2 m wide, with a height of 0.7 m. The terrace is constructed with a stacked basalt boulder and cobble retaining wall, 3-5 courses high, and a level, cobble paved interior (Figure 62). Feature B appeared to be constructed in front of a natural overhang area.

Feature C, the northern terrace (Figures 60 & 63), is constructed at the base of an erosion prone area of the bedrock bluff, with loose rockfall on the surface and immediately upslope of the terrace. The terrace is roughly rectangular shaped, measuring 3.2 m by 2.0 m wide, with a height of 65 cm. The terrace is constructed with a stacked basalt boulder and cobble retaining wall, 3-4 courses high, and a level, cobble-paved interior.

The following description of excavations and Stratigraphy was provided by Barrera and Hommon (1972) for SIHP # -4310 Features B and C (their site B9-33):

> This site, …consisted of two platforms against a vertical rock face, and two platforms nearby which had been bulldozed by June of 1971. The N platform [site –4310 Feature C] measured about 2.4 by 3.5 meters and stood to a height of about 65 cm. Excavation revealed that most of the rocks in the platform were the result of the collapse of the roof of a rock shelter. The resultant pile of rockfall had then been modified into a crude platform by leveling off the top with smaller rocks.

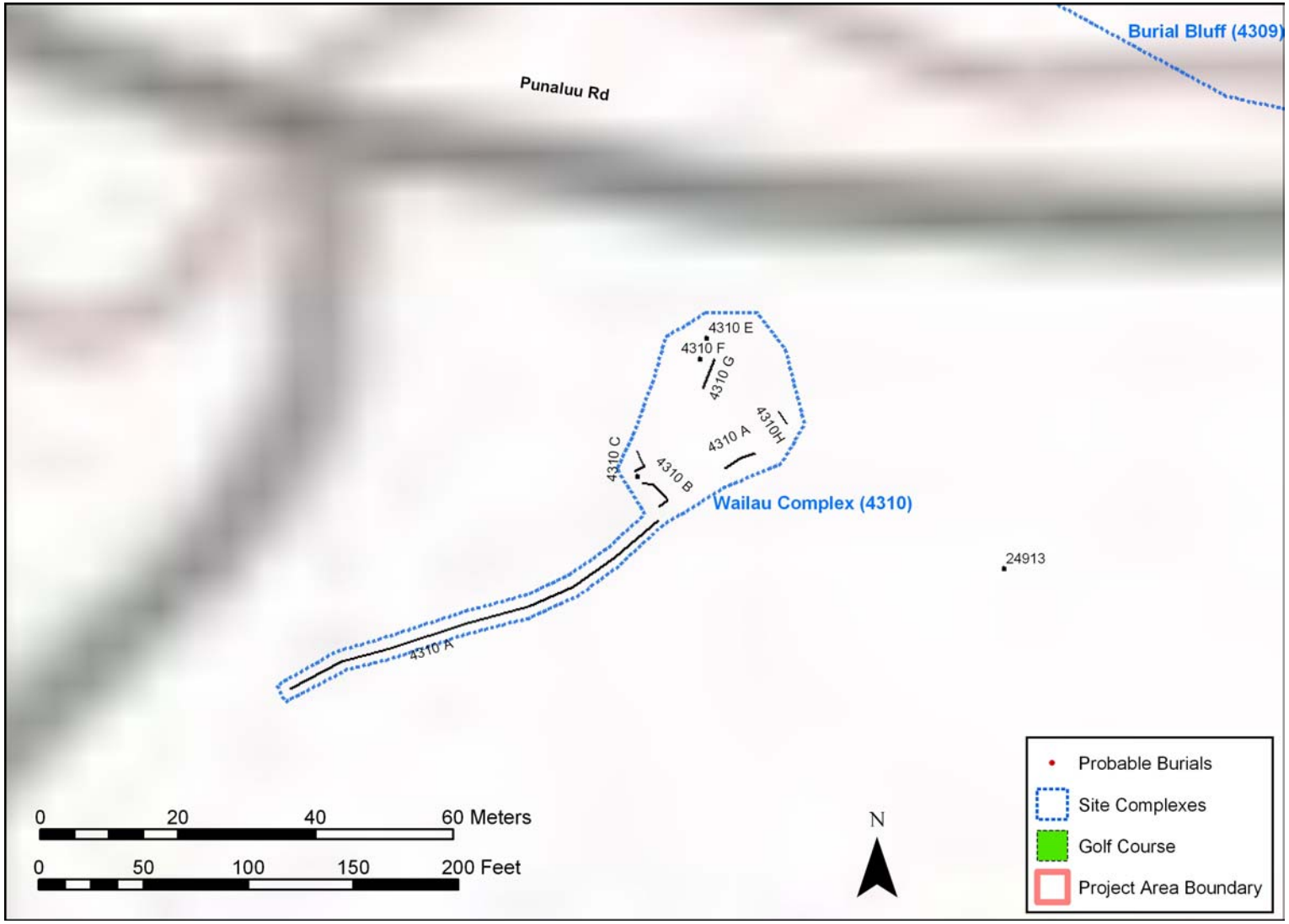

Figure 59. Portion of USGS Topographic Map, Punalu‘u Quad. (1995), showing the locations of historic properties within Wailau Complex (SIHP # 50-10-68-4310).

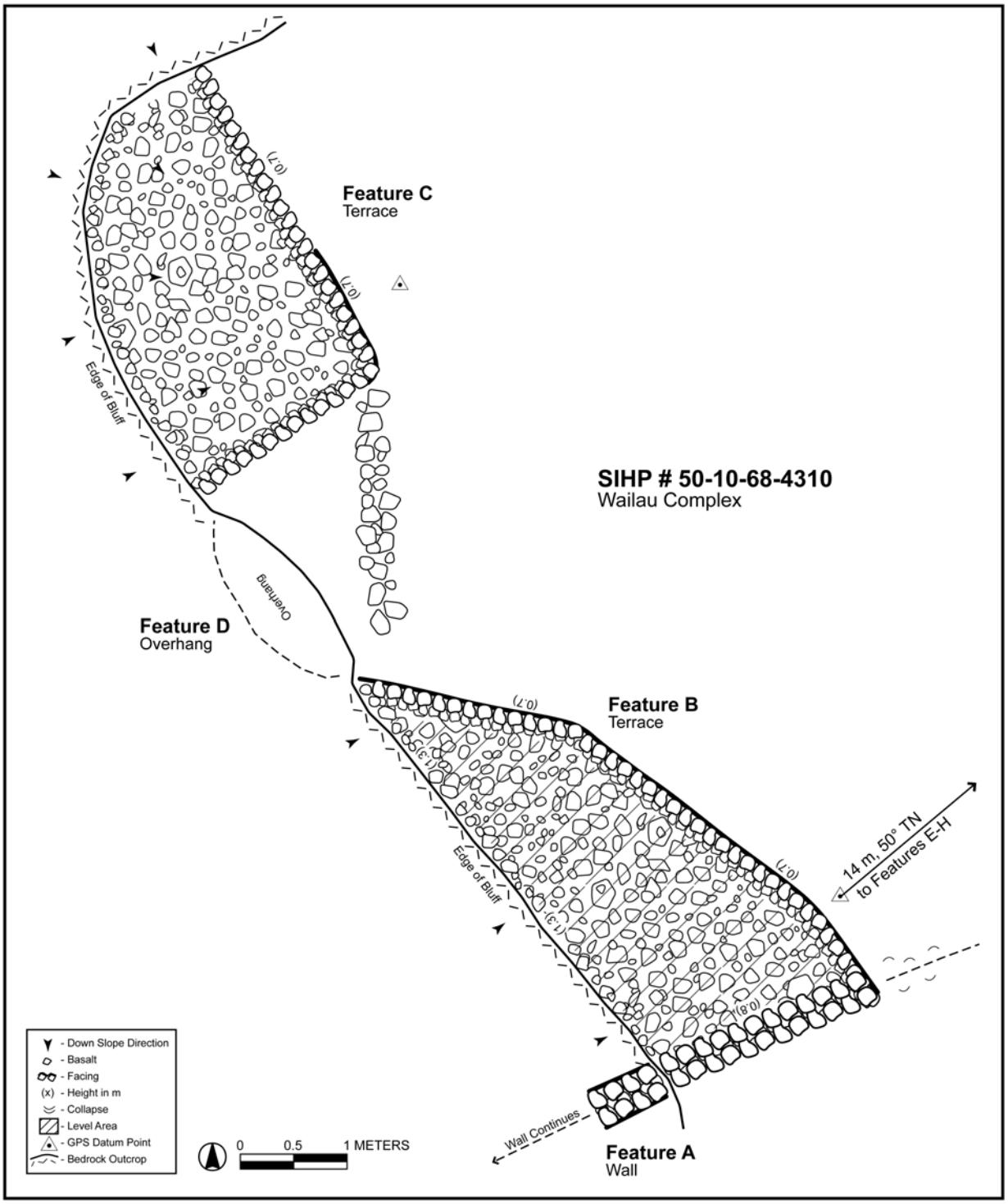

Figure 60. Plan view diagram of the western portion of SIHP # 50-10-68-4310 Wailau Complex, Features A-D.

Figure 61. SIHP # 50-10-68-4310 Feature A wall, view to southeast

Figure 62. SIHP # 50-10-68-4310 Feature B terrace, view to south

Figure 63. SIHP # 50-10-68-4310 Feature C terrace, view to southwest

The S. Platform platform [site –4310 Feature B] measured 2.5 by 5 meters and stood to a height of about 80 cm. Excavation showed that it had been built on a rise in the bedrock. First, a retaining wall of 20- to 30-cm-diameter rocks had been built on the bedrock, behind which had been placed a layer of brown dirt which filled the uneven spaces in the bedrock. This deposit, which reached a maximum thickness of 20 cm, was overlaid by about 15 cm of 10- to 20-cm-diameter rocks, which formed the surface of the platform.

In addition to the excavations within the platforms, two test pits were dug. Square 1 was excavated immediately adjacent to the N platform. The major portion of the fill was composed of large (25- to 40-cm-diameter) rocks, which were a continuation of the rock-fall that formed the foundation for the N platform. Mixed in with these rocks was a deposit of Pāhala Ash. Resting on top of this ash and rock deposit was a 13-cm-thick deposit of brown soil, which abutted against the side of the platform but did not extend beneath it. Square 2 was located adjacent to the long wall that formed the S boundary of the site. Bedrock was found at a depth of about 70 cm. Resting on bedrock was a mixed, 43-cm-thick deposit of Pāhala Ash and large rocks. Resting on top of this was the same surface deposit of brown soil as in Square 1, only in this Square it reached a depth of 27 cm. (Barrera and Hommon 1972:20-22).

Figure 64 indicates the locations of the test excavations made by Barrera and Hommon (1972). Their Square 1 was excavated just southeast of site 50-10-68-4310 Feature C and their Square 2 was excavated just northeast of site 50-10-68-4310 Feature B. The midden material recovered from the excavation is listed in the following Table 6 of the present study.

The recovered material from the two excavation units at site 50-10-68-4310 features B & C revealed sparse shell midden, considerable bone material, and a few historic period artifacts (glass, metal fragments slate (?)) suggesting temporary habitation use. The recovery of forty-eight pieces of volcanic glass from excavation unit 1 and an additional eight pieces from excavation unit 2 indicates pre-contact use of the features which appears to have continued into post-contact times on the basis of the historic artifacts documented.

A crude ramp of piled stones extends south from the edge of Feature C (Figure 60), up the steep sloping face of the outcrop. Feature D consists of a small overhang located at the top of the ramp (see Figures 60 & 66). The overhang measures 2.3 m long, 1m deep, with a maximum ceiling height of 95 cm. Waterworn cobbles were observed on the soil surface within the overhang.

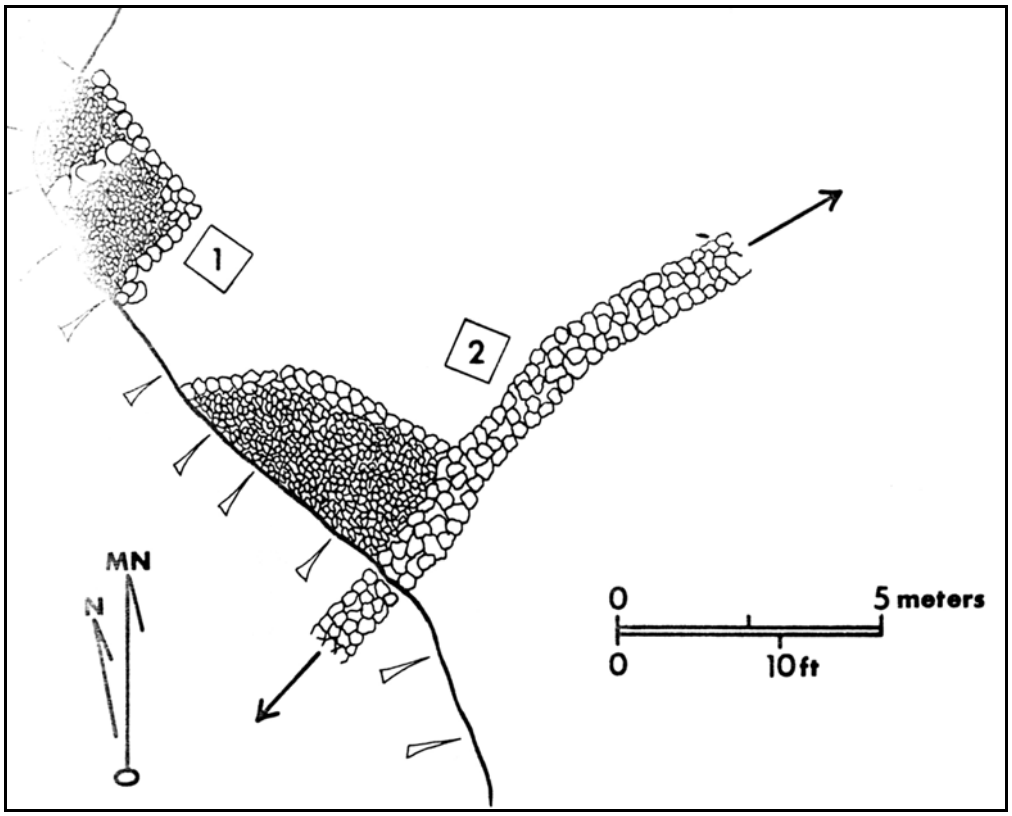

Figure 64. Map of SIHP # 50-10-68-4310 (B9-33), showing the locations of test excavations (from Barrera and Hommon 1972:21).

Table 6. Midden materials recovered from Site 50-10-68-4310 (Bishop Museum Site B9-33) (from Barrera and Hommon 1972:Appendix D)

Material	Sq.	Level (cm)									
		0-10		10-20		20-30		30-40		40-50	
		gm	no.	gm	*no*	gm	*no.*	gm	no.	gm	no.
Barnacle	2			tr*	1						
Cypraea caputserpentis	1			tr	1						
	2			tr	1						
Cypraea reticulata	2			8	1						
Conus sp.	1			tr	1						
Echinoderm	2			tr	*1*						
Helcioniscus exaratus	1	tr	*1*	14	3						
	2										
Isognomon californicum	1			tr	1						
Unidentified shell	1	1	4	7	1	tr	3				
	2	2	2	tr	4						
Basalt chip	2			tr	1						
Bone	1	25		132		35		5		tr	1
	2	1	6	10		4					
Glass	1	tr	1								
	2	1	1								
Kukui-nut shell	2			tr	1						
Metal	1	3	3								
Slate (?)	2	2	1								
Volcanic glass	1	35	27	22	15	4	6				
	2	2	2	1	3	2	2	tr	1		

* tr = trace (less than 1 gm)

Figure 65. SIHP # 50-10-68-4310 Feature D overhang shelter, view to southwest

The following description was provided by Barrera and Hommon (1972) for SIHP # -4310 Features E-H (their site B9-34):

> This site consisted of five features. Feature A [-4310 Feature E] was a rock shelter 8 meters long, 1.8 meters deep, and about 75 cm high. Feature B [-4310 Feature F] was also a rock shelter, 4.3 meters long, 1.4 meters deep, and about 75 cm high. Feature C [4310 Feature G] was a crude platform located in front of Features A and B [-4310 –Features E & F], that measured about 8.7 meters from end to end, between 1.4 and 1.7 meters from front to back (at which point it abutted the steep rock face in which Features A and B [-4310 –Features E & F] were located). Feature D [-4310 Feature H] was a wall consisting of two outer alignments of large (75-to-100-cm-diameter) rocks with a core-fill of smaller ones. Feature E was a 5-by-5.4-meter mound of jumbled rocks, one end of which abutted Feature D [see present Figure 87].
>
> A single square was excavated to a depth of 20 cm in Feature A [site –4310 Feature E]. The fill of this pit was composed of fine brown dirt. Only a very sparse amount of material was recovered [see present Table 7]. The base of a glass bottle dating from between 1840 and 1880 was found on the surface a few meters to the S of the site. (Barrera and Hommon 1972:22)

SIHP # -4310 Features E and F consist of overhang shelters located within the bedrock bluff, approximately 18 m northeast of Feature C (Figure 66). Feature E consisted of an overhang shelter located within the nearly vertical rock face of the bluff, approximately 2 m above the base of the bluff (Figure 67). The overhang measures 8 m wide, 1.8 m deep, with a maximum ceiling height of 75 cm. The interior of the overhang contains a relatively clear and level soil surface area measuring 1.3 by 1.2 m wide. The remainder of the interior is rocky with a thin soil layer. No surface cultural material was observed. The finds from Barrera and Hommon’s (1972) excavation in Feature E are summarized in Table 7.

Table 7. Midden materials recovered from Site 50-10-68-4310 (Bishop Museum Site B9-34) (from Barrera and Hommon 1972:Appendix E)

Material	**Level (cm)**			
	0-10		**10-20**	
	gm	**no.**	**gm**	**no**
Cypraea caputserpentis			2	3
Drupa ricina			tr*	2
Helcioniscus exaratus	1	2		
Neretina cariosa			tr	1
Unidentified shell			4	8
Kukui-nut shell	tr	1	5	8
Volcanic glass	2	1	3	4

tr* = trace (less than 1 gm)

Feature F consists of another overhang shelter, located near the base of the bluff, below and slightly to the west of Feature E (Figure 68). Feature F measured 4.3 m wide, 1.4 m deep, with a ceiling height of 7 cm. The interior of feature F consists of a level, rocky soil surface. No surface cultural material was observed.

Feature G consists of a linear mound constructed across the entrance of Feature F overhang (see Figure 66 & 69). The mound was constructed at the drip line of the overhang, at the base of the bluff. Feature C was constructed of mounded basalt cobbles and small boulders, measuring approx 8.5 m long, 1.2-1.6 m wide, 40-50 cm in height (Figure 69). The mound separates the interior of the Feature F overhang from the rocky soil area at the base of the bluff. Feature G possibly functions in preventing water from entering the Feature F overhang.

Feature H consists of a short wall segment located in the southeaster portion of the Wailau Complex (see Figure 66 & 70). The wall is constructed partially on an exposed bedrock outcrop, then extends northeast off the outcrop on to the rocky soil surface. Feature H is constructed of loosely stacked basalt boulders in a bi-faced core-filled manner, 3-4 courses high (Figure 70). The base course of stones are large boulders averaging 70-90 cm in diameter. The upper courses are 30-50 cm in diameter with small boulder and cobble filling. The intact portion

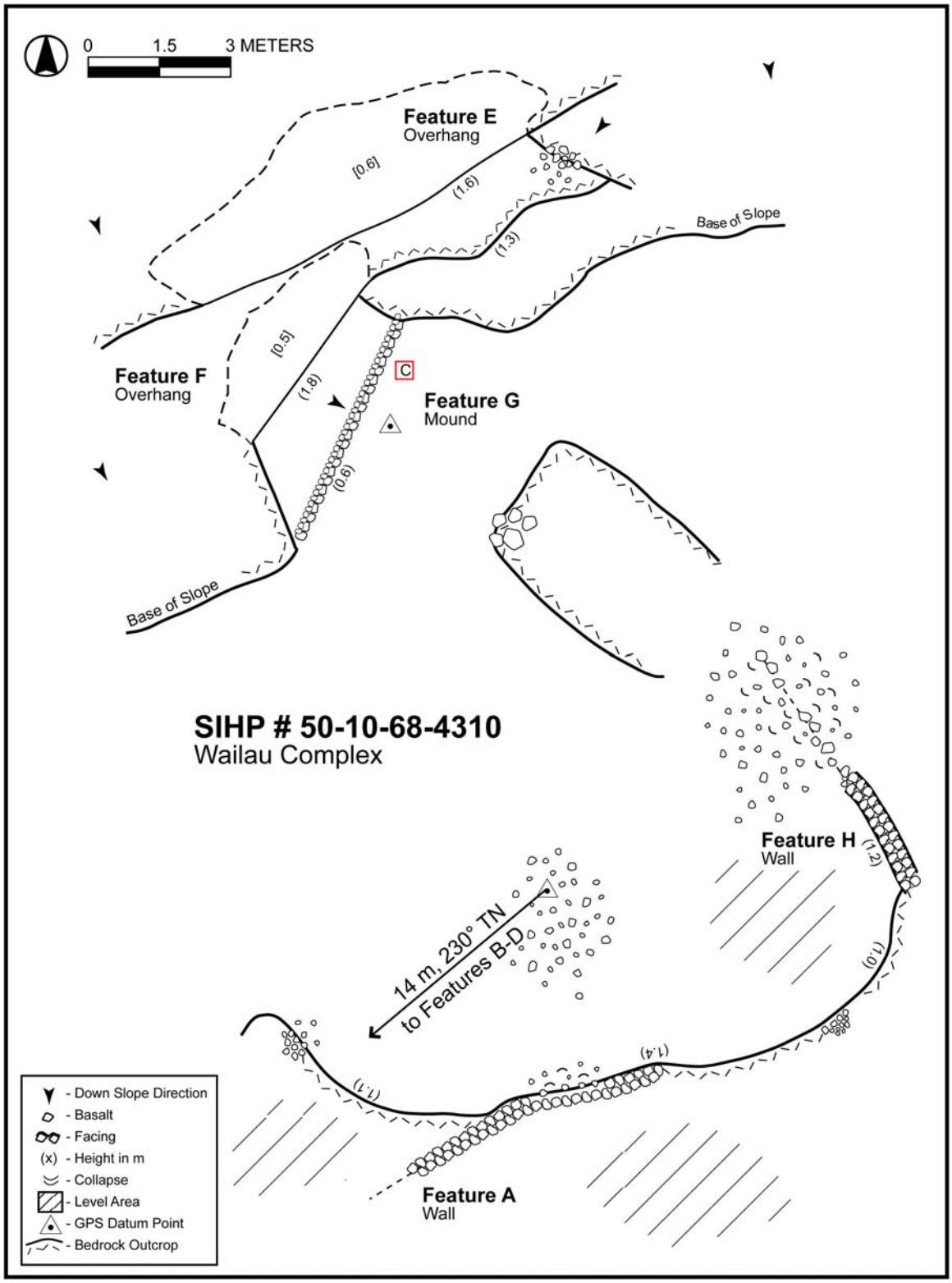

Figure 66. Plan view diagram of the eastern portion of SIHP # 50-10-68-4310 Wailau Complex, Features E-H.

Figure 67. SIHP # 50-10-68-4310 Feature E overhang shelter, view to west.

Figure 68. SIHP # 50-10-68-4310 Feature F overhang shelter, view to north.

Figure 69 SIHP # 50-10-68-4310 Feature G mound, view to north.

Figure 70. SIHP # 50-10-68-4310 Feature H wall, view to southwest.

of the wall measures approx 3 m long, 0.8 m wide, 1.1 m high. The northern extent of the wall appears to be disturbed, and all that remains is the base course of parallel boulders in line with the wall alignment. The wall appears to have extended to the bedrock bluff where Feat A and B are located.

An additional feature was described by Barrera and Hommon (1972:22) as a “mound of jumbled rocks, one end of which abutted Feature D [now designated Feature H].” The CSH field crew was unable to identify a distinct, hand-piled mound of stones adjacent to Feature H wall. However, at the north end of the Feature H wall, where the wall is no longer intact, is a mound of jumbled stones. It is likely that the mound is partially composed of collapse from Feature H, as well as natural stones, which are abundant in the immediate vicinity, and does not appear to be an archaeological feature.

SIHP # 4310 is interpreted to be a historic habitation complex. Feature A is interpreted to be a historic ranch-related cattle wall. The wall functions as a barrier preventing cattle from falling off the steep bluff, as well as possibly demarcating a property boundary. The wall has been truncated, though the intact portion is relatively undisturbed and in good condition. SIHP –4310 Features B and C terraces are interpreted to be foundations for historic habitation structures. Features B and C are undisturbed and in good to excellent condition, with little collapse observed. Features D-F, overhang shelter and Feature G mound are interpreted to function as temporary shelters or storage areas, associated with habitation in the area. Feature H wall is interpreted to be related to historic habitation in the area, possibly demarcating a property boundary. SIHP # 4310 Features A-H are generally intact and undisturbed, with the exception of portions of Feature A wall. However, the surrounding area has been extensively modified by land clearing activities, including the upper bluff area as well as the area immediately *makai* of the complex. SIHP # 4310 maintains integrity of location, design, materials, and workmanship. Due to the disturbance in the area, the complex does not have integrity of setting, feeling, or association. SIHP # -24907 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

4.4.9 SIHP #: 50-10-68-4330

SITE TYPE: Enclosure
FUNCTION: Agricultural (Animal Husbandry)
FEATURES: 1
DIMENSIONS: 18 m NW-SE by 12 m NE-SW
CONDITION: Good
AGE Historic
TAX MAP KEY: [3] 9-5-019:011

SIHP # 50-10-68-4330 consists of a rectangular enclosure located in the central portion of the Makai Survey Area (Figure 15 & 71). The enclosure was previously identified by Barrera and Hommon (1972) and relocated by PHRI (1986), and designated site 50-HA-B9-43. The enclosure is situated near the base of a bedrock bluff, down slope of the Colony One condominiums. SIHP # -4330 is also bordered to the south by the Sea Mountain Golf Course.

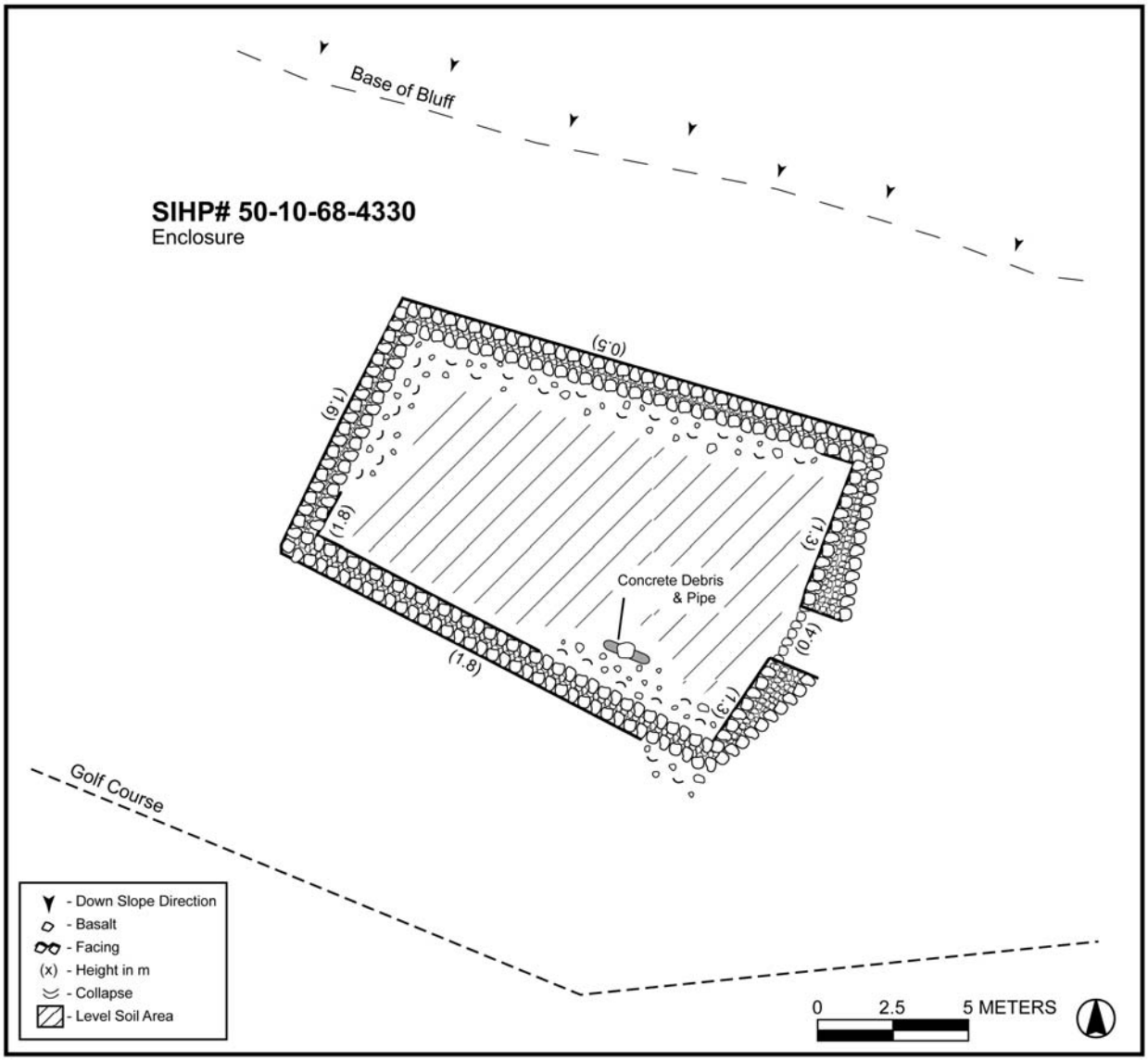

Figure 71. Plan view diagram of SIHP # 50-10-68-4330 enclosure.

Figure 72. SIHP # 50-10-68-4330 enclosure, view to northeast

The following description of SIHP # -4330 (site B9-43) was provided by Barrera and Hommon (1972):

> This rectangular walled enclosure measured 11.8 by 18 meters. The core-filled walls stood as high as 2.2 meters and varied between 1 and 1.4 meters in width. There was a 2.2-meter-wide entryway through the E wall, at which point there was a 50-cm-high step. Four squares were excavated. All revealed deposits of ash up to 40 or 50 cm thick resting on bedrock. (Barrera and Hommon 1972:22)

The following description of SIHP # -4330 (site B9-43) was provided by PHRI (Rosendahl and Rosendahl (1986):

> This site is a rectangular enclosure measuring approximately 11.8 by 18.0 m, with core-filled walls measuring a maximum of 2.2 m in height and 1.4 m in width. The enclosure is in good condition. Barrera and Hommon reported that the four excavation units revealed 40 to 50 cm thick ash deposits on bedrock, and that the recovered materials included sparse midden, moderate quantity of bone, and glass and metal fragments (1972:22). (Rosendahl and Rosendahl 1986:25)

SIHP # -4330 enclosure measures approximately 18 m by 11 m wide, with walls measuring between 0.5-1.8 m in height and 0.5-1.2 m in width (Figure 71). The enclosure is constructed of loosely stacked basalt boulders and cobbles, in a bi-faced, core-filled manner, 7-10 courses high (Figure 72). The southern and western walls of the enclosure are the most substantial, utilizing 30-45 cm diameter boulders in the construction. The intact portions of the enclosure walls are well faced, though considerable areas of collapse were observed. The eastern wall of the

enclosure is faced on the interior side and sloping on the exterior side. The eastern wall also includes a 2 m wide constructed entrance to the enclosure, with a 40 cm high step across the entryway. A cement pipe and other debris was observed within the southeastern portion of the enclosure.

Barrera and Hommon (1972) excavated four test units within SIHP # -4330. Subsurface testing revealed the presence of a 40-50 cm thick ash deposit over bedrock, including sparse midden, unidentified bone material, and historic glass and metal fragments summarized in the following Table 8. The quantities of invertebrate midden reported for these four excavation units are quite small but significant quantities of unidentified bone, glass and metal are reported. It is difficult to draw much in the way of conclusions from this data but it is consistent with the understanding of the site as a historic corral.

SIHP # -4330 enclosure is interpreted to be a historic corral, functioning in confining livestock. The enclosure is in good condition with both intact, as well as partially collapsed portions. SIHP # -4330 maintains integrity of location, design, materials, and workmanship. Due to the extensive land modification in the surrounding area (i.e. golf course and condominium construction) the enclosure does not have integrity of setting, feeling, or association. SIHP # -4330 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

Table 8. Midden materials recovered from Bishop Museum Site B9-43 (from Barrera and Hommon 1972:Appendix F)

Material	**Sq.**	**Level (cm)**									
		0-10		**10-20**		**20-30**		**30-40**		**40-50**	
		gm	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**
Isognomon californicum	3							tr*	1		
Lepas sp.	3			tr	1	9		1	29	tr	9
	4					tr	1				
Nerita picea	3									tr	1
Bone	2			4	2						
	3					150		14		4	8
	4	4	3	22	21	7	22	1	3		
Glass	3					42		1	2	10	1
Metal	3	62									

* tr = trace (less than 1 gm)

4.4.10 SIHP #: 50-10-68-4360

SITE TYPE: Stone Wall
FUNCTION: Land Division / Cattle Barrier
FEATURES: 2
DIMENSIONS: Approximately 475 m Long NW-SE
CONDITION: Good
AGE: Historic
TAX MAP KEY: [3] 9-5-019:015

SIHP # 50-10-68-4360 consists of two linear stone wall segments located in the northern portion of the Makai Survey Area (see Figure 15). The wall segments are portions of a single long wall that had been breached by the construction of an unpaved road. The wall segments were originally described by Barrera and Hommon (1972) and given two site designations, 50-HA-B9-119 for the *mauka* segment and 50-HA-B9-62 for the *makai* segment. The wall segments were relocated by PHRI (Rosendahl and Rosendahl 1986) and determined to be portions of a formerly continuous wall. The following description of SIHP # -4360 (sites B9-62 and B9-119) was provided by PHRI (Rosendahl and Rosendahl (1986):

> Barrera and Hommon initially described this wall as 8.0 m long, 0.8 m wide, and 0.8 m high (1972:11). It appears they located a segment of the wall which actually extends inland toward the abandoned feed lot. At this point, a dirt road truncates this wall. The continuation of this wall on the inland side of the road corridor has a different site designation (B9-119). The wall is in good condition and is actually larger than originally described, with a maximum height of 1.25 m. The wall is constructed of stacked small to large boulders.
>
> The inland extension of Site B9-62 has been designated B9-119. It appears the seaward and inland extents of this wall were located during the Barrera and Hommon survey (1972:11), and the nature of that survey did not afford sufficient time to follow out the extent of the wall. The wall is approximately 0.8 m wide and a maximum of 1.25 m high, and is in good condition. (Rosendahl and Rosendahl 1986:25)

SIHP # -4360 is a *mauka-makai* trending wall, with the combined segments extending approximately 475 m in length. The breach of the wall at the intersection of an unpaved road was approximately 10 m long. Both the *mauka* and *makai* ends of SIHP # -4360 have been truncated by golf course construction. The wall is constructed of stacked basalt boulders and cobbles, 5-6 courses high, in a bi-faced, core-filled manner (Figure 73). The wall measured a maximum of 1.2 m in height and 0.8 m wide. Metal posts and remnant barbed wire fencing were also incorporated into the wall construction. A 3 m long break in the wall was observed along the *mauka* portion of the wall. Wooden posts were observed at the edges of the break indicating a former gate or entryway.

SIHP # -4360 is interpreted to be a historic ranch-related cattle wall. The wall functions in restricting the movement of cattle, as well as demarcating a former property boundary and *ahupua‘a* boundary. SIHP # -4360 was constructed along the northeastern boundary of Grant 828 to Kekaula (see Figure 5), which is also the Punalu‘u-Wailau *ahupua‘a* boundary. The wall

had been modified in the late historic or modern era with the addition of barbed wire fencing, associated with the continued usage of the wall as a cattle barrier. SIHP # -4360 is relatively intact, with the exception of the break at the road intersection and truncated ends. The wall is in good condition, with limited areas of collapse. The surrounding area has been heavily disturbed by golf course construction, as well as grubbing. In some areas, debris and mounded soil and stones have been pushed up against the wall. The intact portion of SIHP # -4360 maintains integrity of location, design, materials, and workmanship. Due to the extensive land modification in the surrounding area, and discontinued use of the area for ranching purposes, the wall does not have integrity of feeling or association. SIHP # -4360 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

Figure 73. SIHP # 50-10-68-4360 wall, view to northwest.

4.4.11 Kōloa-Nīnole Complex (SIHP # 50-10-68-4368)

The Kōloa-Nīnole Complex includes a cluster of historic properties located in the southern, coastal portion of the project area (see Figure 15). The boundaries of the complex include the former Nīnole Fishpond area, the smaller adjacent pond, as well as the *‘a‘ā* bluff that borders the western portion of Nīnole Gulch (Figure 74). The Kōloa-Nīnole Complex was designated SIHP # 50-10-68-4368, with individual sites or site complexes within the overall complex given separate site number designations. SIHP # -3517 (B9-02, Nīnole Fishpond), SIHP # -3519 (B9-04, enclosure), SIHP # -3520 (B9-05, enclosure), SIHP # -3521 (B9-06, trail), SIHP # -3522 (B9-07, “Nīnole School”), and SIHP # -3523 (B9-09, old government road) consisted of the Nīnole coastal sites previously described by Hansen (n.d.). In addition to these sites, Rosendahl identified two additional sites, SIHP # -24897 (T-108, complex) and SIHP # -24898 (T-111, burial complex), located within the boundaries of the Kōloa-Nīnole Complex.

The current project area did not include the former Nīnole Fishpond area, as the parcel is independently owned by the State of Hawai‘i. Therefore, the former fishpond area was not documented in detail by the current study. A brief inspection of the area confirmed previous observations that the former Nīnole Fishpond had been totally filled with sediment and was no longer a pond. The smaller pond, adjacent to the northern edge of Nīnole pond remains intact and filled with water. The following documentation of SHIP # 3517 Nīnole Fishpond was provided by PHRI (Rosendahl and Rosendahl 1986):

> Puhau, a freshwater spring, is located at the inland edge of the pond. The meaning of "Puhau" is given as "icy spring" (Pukui, Elbert, and Mookini 1974:192). Local informant Pele Hanoa stated that "Puhau" also identified the pond, and that this was a male pond (Hanoa. pers. comm.). Pukui, Elbert, and Mookini give another name, "'Ilo‘i", meaning "supreme pond" to the larger pond (1974). According to Hanoa, the smaller pond to the northeast was the female pond, and its name is given as "Kauwale", meaning "useless" (Hanoa. pers. comm.).
>
> These ponds appear to have been utilized as a fishpond during the 1800s. During the Māhele, the fishpond was retained as government land (Kelly 1980:26, 29), and at this time the Alanui Aupuni (Old Government Road) probably was located seaward of the pond. Kelly provides the following information:
>
>> In an interview of January 31, 1972, Mr. William Meinecke, a long-time resident of Ka‘ū, stated that it was traditional knowledge that there had been a road *makai* of Nīnole Pond and that it had disappeared in 1868 at the time of the volcanic and tsunami action in the area. He further stated that, as far as he knew, there had always been a Nīnole spring at the place where the spring is presently located, and that there had always been a pond area just *makai* of the spring. However, he said there was once more land along the shoreline. It was there that the old road came down off the *‘a‘ā* lava flow onto the Nīnole plain and along the coast.... After the 1868

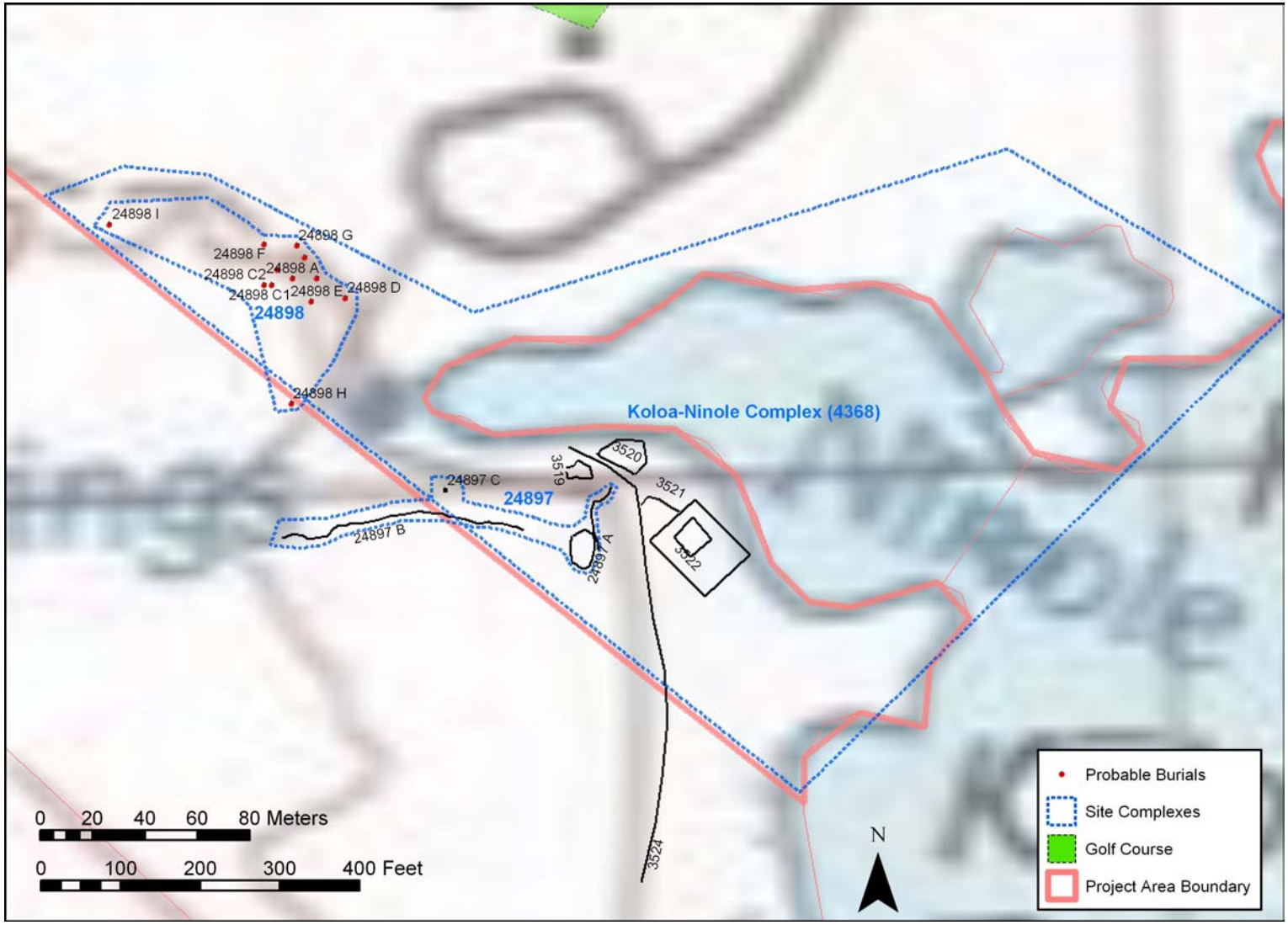

Figure 74. Portion of USGS Topographic Map, Punalu‘u Quad. (1995), showing the locations of historic properties within the Kōloa-Nīnole Complex (SIHP # 50-10-68-4368).

> volcanic and tsunami disaster the road was gone and its disappearance has been laid to subsidence of the land (1980:107).The fishpond was rebuilt after the 1868 disasters and, according to Kikuchi, was a *loko kuapa* (fishpond having no discernable sluice gate) (Hansen 1978). Nothing remains of the fishpond and, as previously stated, the pond is completely filled in with debris washed down during the 1980 floods. This property is owned by the State of Hawai‘i, yet is considered to be within the project area. (Rosendahl and Rosendahl 1986)

Site B9-175, a petroglyph reported to be near the north edge of the pond could not be relocated, and may have also been covered during the event that filled Nīnole Fishpond. Detailed descriptions of the historic properties within the Kōloa-Nīnole Complex follow:

4.4.12 SIHP #: 50-10-68-3519 (Component of Site Complex 50-10-68-4368)

SITE TYPE: Enclosure
FUNCTION: Agricultural (Animal Husbandry)
FEATURES: 3
DIMENSIONS: 10 m E/W by 9 m N/S
CONDITION: Excellent
AGE: Historic
TAX MAP KEY: [3] 9-5-019:011

SIHP # 50-10-68-3519 consists of an enclosure located within the central portion of the Koloa-Nīnole Complex (SIHP # 4368), adjacent to SIHP # -3524 old government road (see Figure 74). The enclosure was previously identified by Hansen (n.d.) and relocated by PHRI (Rosendahl and Rosendahl 1986), and designated site 50-HA-B9-04. The following description was provided by PHRI for SIHP # -3519 (site B9-04):

> Site B9-4 is an enclosure constructed against a cliff face, and measures approximately 25.0 m in length and 10.0 m wide. The walls are a maximum of 2.0 m high and 1.0 m wide. Interior walls divide the enclosure into “two stalls” from the remaining portion of the enclosure (Hansen Ms.). The feature was initially described by Hansen (Ms.) as a corral and pen though the presence of *‘ili‘ili* may suggest habitation use. The feature is presently covered by dense vegetation. (Rosendahl and Rosendahl 1986:18)

SIHP # -3519 is situated against the base of an *‘a‘ā* bluff, on land sloping to the northeast, down toward Nīnole Cove. At the time of the inventory survey, the enclosure was completely covered with dense Christmas berry. SIHP # -3519 consists of a well-constructed enclosure with interior partitions, creating three individual enclosure features (Figure 75). The enclosure walls are generally free-standing, with the exception of a portion of the south wall, which is a retaining wall constructed against an *‘a‘ā* bluff. The walls are constructed of stacked basalt boulders and cobbles, 4-6 courses high, in a bi-faced manner (Figure 76). The enclosure is irregularly shaped, measuring approximately 9.5 m by 8.0 m wide, with a maximum height of 1.4 along the northern (down slope) wall. The northern wall of the enclosure is linear and also serves as the western edge of the SIHP # -3524 old government road corridor. An approximately 1.6 m wide entrance is constructed in northwest portion of the enclosure, facing opposite the old government road.

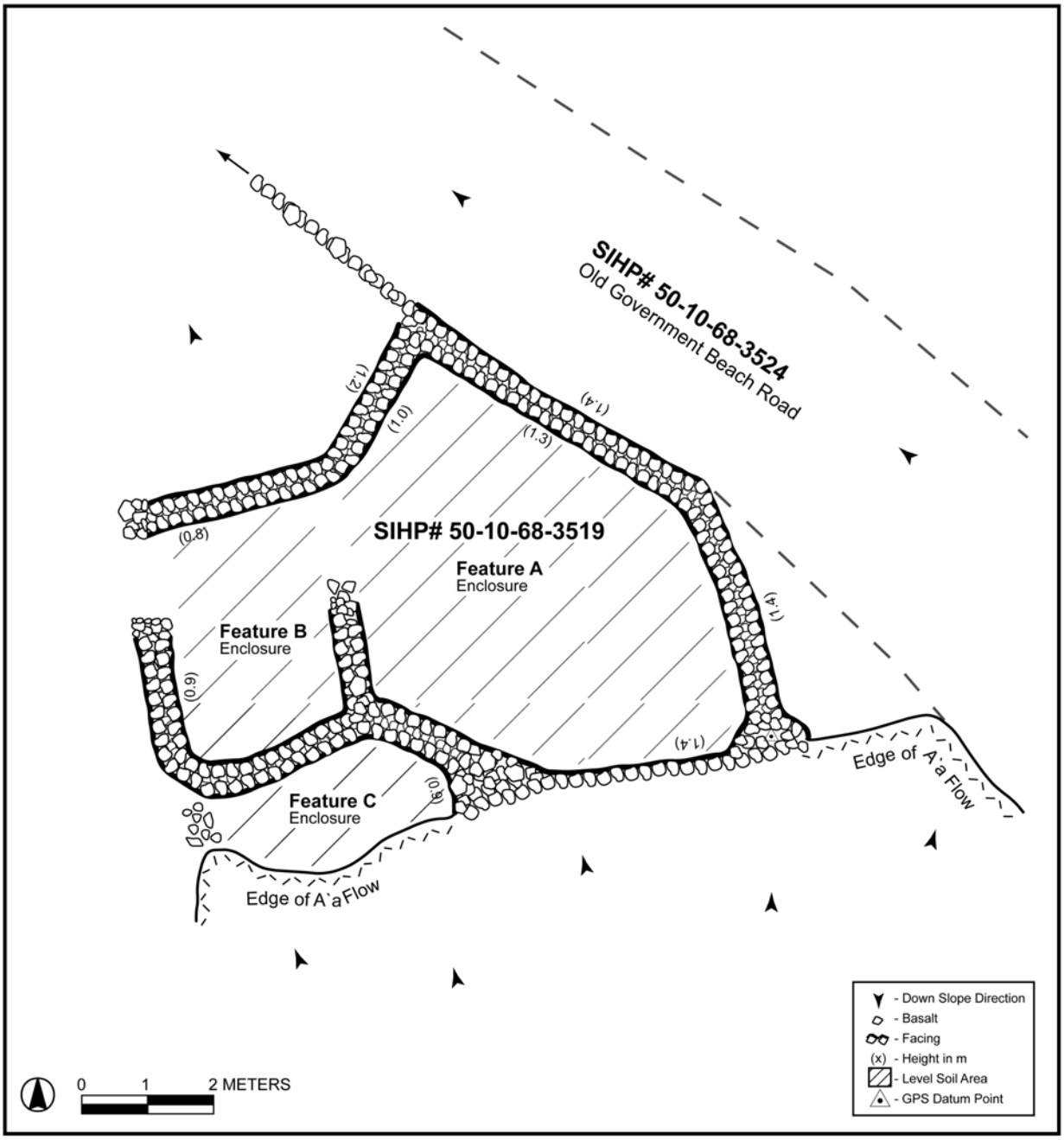

Figure 75. Plan view diagram of SIHP #50-10-68-3519 enclosure.

Figure 76. SIHP #50-10-68-3519 Feature A enclosure, view to northwest.

(SIHP # -3524). No surface cultural material was observed within SIHP # -3519 or in the immediate vicinity.

An interior wall within the main perimeter wall of the enclosure divides the interior of the enclosure into two partitions, designated Features A and B. The interior wall extends from the south wall of the enclosure toward the north wall, leaving an approximately 1.7 m wide entryway between Features A and B. Feature A, the eastern portion of the main enclosure, is the largest of the enclosure partitions, measuring approximately 7 m by 6 m wide. The interior of Feature A is cleared and level soil. Feature B, the western portion of the main enclosure, measures approximately 4 m by 3 m wide. The walls around Feature B are generally 10-20 cm lower than those around Feature A. The interior of Feature B is also cleared and level soil.

Feature C consists of a small enclosure located between the freestanding portion of the south wall of the main enclosure and the bedrock bluff. The enclosure measures 4 m by 2 m wide, with a 0.8 m wide constructed entrance opening to the west. The interior of Feature C is cleared and level soil.

SIHP # 3519 enclosure is interpreted to be a historic animal pen, functioning in confining livestock. The animal pen is associated with the historic habitation and agricultural activities of the Kōloa-Nīnole complex. The surrounding rough *‘a‘ā* lava flow and bluff area is undisturbed and SIHP # -3519 is in excellent condition, with very little collapse observed. SIHP # -3519 maintains integrity of location, design, setting, materials, workmanship, feeling, and association. SIHP # -3519 is assessed as significant under Criterion D (have yielded, or is likely to yield

information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

4.4.13 SIHP #: 50-10-68-3520 (Component of Site Complex 50-10-68-4368)

SITE TYPE: Enclosure
FUNCTION: Habitation
FEATURES: 3
DIMENSIONS: 17 m NW/SE by 13 m SW/NE
CONDITION: Excellent
AGE: Historic
TAX MAP KEY: [3] 9-5-019:011

SIHP # 50-10-68-3520 consists of an enclosure located within the central portion of the Kōloa-Nīnole Complex (SIHP # -4368), adjacent to SIHP # -3524 old government road (see Figure 74). The enclosure was previously identified by Hansen (n.d.) and relocated by PHRI (Rosendahl and Rosendahl 1986), and designated site 50-HA-B9-05. SIHP # -3520 is situated at the edge of an *‘a‘ā* bluff, overlooking Nīnole Cove. At the time of the inventory survey, the enclosure was completely covered with dense Christmas berry.

SIHP # -3520 consists of a well-constructed enclosure with an interior partition creating two individual enclosure features (Figure 77). The main enclosure is irregularly shaped, measuring approximately 17 m by 13 m wide, with a maximum height of 1.5 m along the southwest wall. The walls are generally free-standing and are constructed of stacked basalt boulders and cobbles, in a bi-faced manner. The southwestern perimeter wall of the main enclosure is linear and also serves as the eastern edge of the SIHP # -3524 old government road. The southwestern wall is the most substantial and well-constructed of the enclosure walls, constructed of stones stacked 7-8 courses high and 4-5 courses wide, with a maximum height of 1.5 m width of 1.0m. An approximately 0.8 m wide constructed entrance to the enclosure is located in the western corner, opening to the old government road (SIHP # -3524). The east and north perimeter walls of the enclosure are constructed along the edge of the bedrock bluff and follow the natural curvature of the bluff (Figure 78). These walls are constructed of stones stacked 3-5 courses high and 1-3 courses wide, with an average interior height of 0.8 m. The north wall incorporates natural bedrock outcrops and has a 2 m wide constructed entryway. The entryway faces Nīnole Cove and appears to open to a crude stepped trail down the face of the very steep bluff. A concentration of marine shell midden and historic refuse was observed on the surface of a small natural terrace immediately down slope of the northern enclosure wall. The northwestern perimeter wall of the main enclosure is constructed across land moderately sloping to the northwest, down toward Nīnole Cove. The northwestern wall has an interior height of 20 cm and exterior height of 1.2 m, indicating the interior of this portion of the enclosure has been filled to create a level interior surface.

An interior wall within the main perimeter wall of the enclosure divides the interior of the enclosure into two partitions, designated Features A and B. The interior wall is constructed of stacked boulders and cobbles, 2-3 courses high and 2-3 courses wide. The interior wall height of 1.0 m on the eastern side and 1.5 m on the western side, indicating the eastern portion of the enclosure has been filled to create a level interior surface. The interior wall extends from the

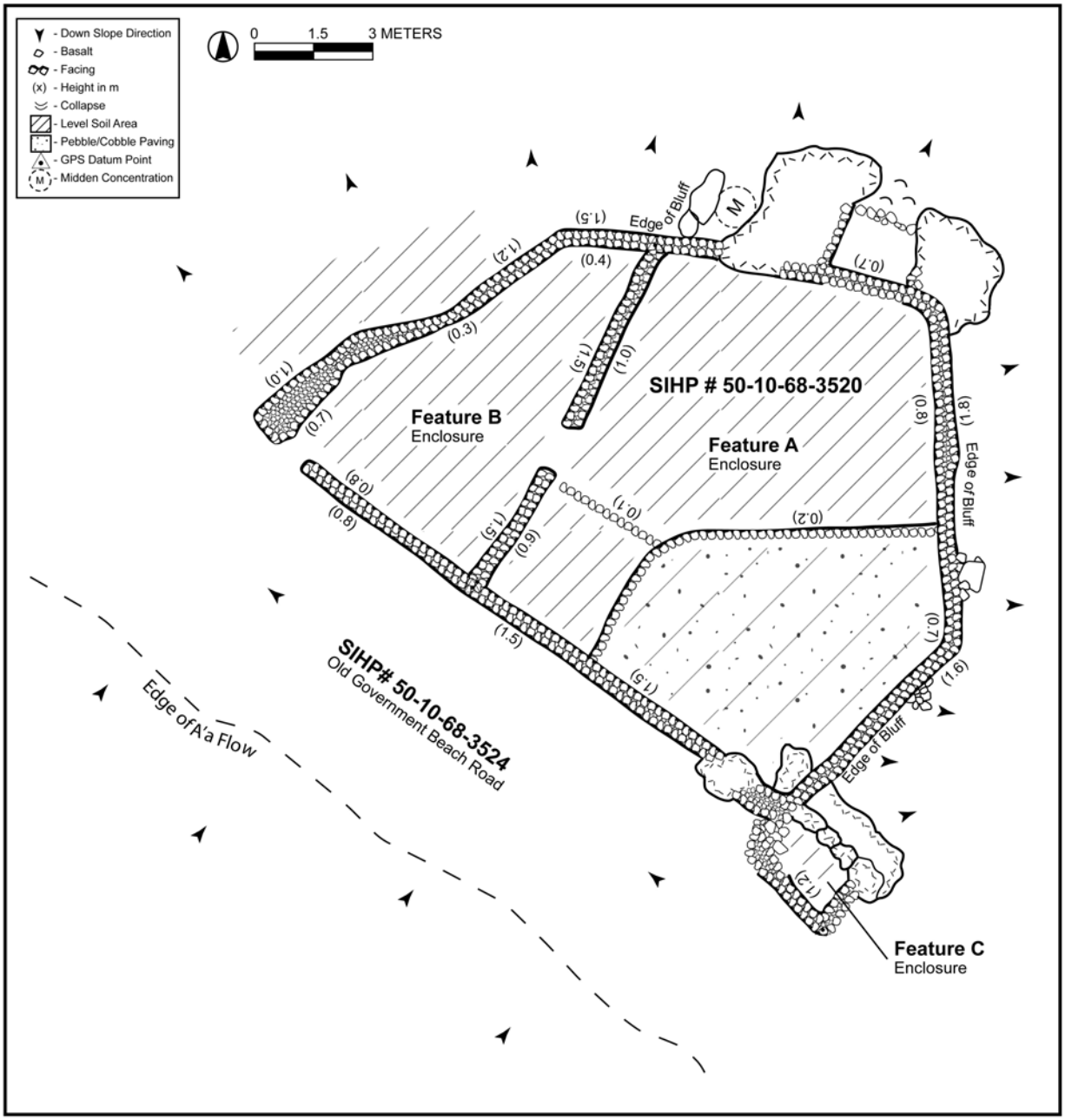

Figure 77. Plan view diagram of SIHP # 50-10-68-3520 enclosure complex.

Figure 78. SIHP # 50-10-68-3520 Feature A enclosure, view to southeast.

northern perimeter wall to the southwestern wall, with a 1.2 m wide constructed entryway between Features A and B. Feature A, the eastern portion of the main enclosure, is roughly rectangular shaped, measuring approximately 12 m by 11 m wide. An interior low terrace is located within the southern portion of Feature A. The terrace is constructed with a low retaining wall of basalt boulders and cobbles, stacked 1-2 courses high, with a maximum height of 0.2 m (Figure 79). The interior of the terrace is level and paved with water rounded cobbles and pebbles. A single course alignment of basalt boulders extends from the entryway between Features A and B to the terrace retaining wall, creating an additional distinct activity area within Feature A. With the exception of the paved terrace, the interior of Feature A is cleared and level soil. Feature B, the western portion of the main enclosure, is roughly triangular shaped, measuring 9.5 m by 6.5 m wide. The interior of Feature B is cleared and level soil.

Feature C consists of a small, crude enclosure located adjacent to the southeastern corner of the main enclosure (Figure 80). The enclosure is constructed with a loosely stacked boulder and cobble wall, 2-4 courses high, with a maximum height of 1.2 m, along the west, south, and eastern sides. The northern edge of the enclosure is bounded by bedrock outcrop. The enclosure measures 1 m by 2 m wide with a level, cobble-paved surface. A single piece of coral was observed on the surface of Feature C.

SIHP # -3520 enclosure is interpreted to be a historic permanent habitation site. The high degree of construction, including the interior paved terrace and partitions delineating activity areas within the main enclosure, as well as the discreet midden concentration are indicative of a permanent habitation site. The constructed entryways to the enclosure facing both the old

Figure 79. SIHP # 50-10-68-3520 Feature A interior terrace, view to southwest.

Figure 80. SIHP # 50-10-68-3520 Feature C enclosure, view to east.

government road and the former Nīnole Fishpond show the relationship of the enclosure with the surrounding sites of the Kōloa-Nīnole Complex (SIHP # -4368). The SIHP # -3520 enclosure represents a habitation component associated with the historic habitation and agricultural activities of the Kōloa-Nīnole complex. The surrounding rough *‘a‘ā* lava flow and bluff area is undisturbed and SIHP # -3520 is in good condition, with little collapse observed. SIHP # -3520 maintains integrity of location, design, setting, materials, workmanship, feeling, and association. SIHP # -3520 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

4.4.14 SIHP #: 50-10-68-3521 (Component of Site Complex 50-10-68-4368)

SITE TYPE: Trail
FUNCTION: Transportation
FEATURES: 1
DIMENSIONS: Approximately 20 m long
CONDITION: Excellent
AGE: Historic
TAX MAP KEY: [3] 9-5-019:011

SIHP # 50-10-68-3521 consists of an approximately 20 m long trail, located in the central portion of the Kōloa-Nīnole Complex (SIHP # -4368) (see Figure 74). The trail was previously identified by Hansen (n.d.) and designated site 50-HA-B9-06. The trail runs roughly east to west from the edge of the old government road (SIHP # -3524) to the northwestern entrance of “Nīnole School” (SIHP # -3522) (Figure 82). SIHP # -3521 is constructed on relatively level terrain and consists of an approximately 1 m wide cleared surface with light waterworn pebble paving (Figure 81). SIHP # -3521 is undisturbed and in excellent condition.

SIHP # -3521 is interpreted to be a historic foot trail providing pedestrian access between the old government road (SIHP # -3524) and “Nīnole School” (SIHP # -3522). The surrounding *‘a‘ā* bluff area is undisturbed and SIHP # -3521 and the surrounding features are in good to excellent condition. SIHP # -3521 maintains integrity of location, design, setting, materials, workmanship, feeling, and association. SIHP # -3521 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

4.4.15 SIHP #: 50-10-68-3522 (Component of Site Complex 50-10-68-4368)

SITE TYPE: Platform / Enclosure Complex
FUNCTION: Historic School Site
FEATURES: 4
DIMENSIONS: 29 m SW/NE by 24 m NW/SE
CONDITION: Good
AGE: Historic
TAX MAP KEY: [3] 9-5-019:011

SIHP #50-10-68-3522 consists of an enclosure surrounding a platform, and paved areas, located in the central portion of the Kōloa-Nīnole Complex (SIHP # -4368) (see Figure 74). The

Figure 81. SIHP # 50-10-68-3521 trail, SIHP # -3522 in background, view to southeast.

complex was previously identified by Hansen (n.d.) and relocated by PHRI (Rosendahl and Rosendahl 1986), and designated site 50-HA-B9-07. SIHP # -3522 is situated near the edge of an *‘a‘ā* bluff, overlooking Nīnole Cove. The following description was provided by Hansen (n.d.):

> School-site. about 66' SE of Site 5. Reported to have been the Nīnole School. Rectangular in shape, stone walls enclosing a platform.
>
> Entrance on the NW side with two steps up from trail (B9-6) onto a *‘ili‘ili* paved walk-way connected with the platform is 6' wide, 16' long and 2'6" high. Another entrance is on the SE side having one step up and down.
>
> The stone wells with the exception of the SE wall show various widths particularly the NE wall and also the heights appear to vary. Condition of walls are relatively good with the exception of the west half of the SW wall and the west half of the NW wall here a greet deal of disturbance has taken place though not beyond restoration.
>
> Platform, average height 2'6". *‘ili‘ili* paving except for about 2' around the outer edges here the paving is of rougher rock. A thick growth of *naupaka* center of platform and which conceals a fire-place. Not venting to expose more than was necessary center of platform was not fully seen. Water-worn stone steps down from platform to yard on the SE side. Overall condition of platform fairly good. Along the NE wall 19' from the north

> inside corner large lava boulders have been utilized in the making of a wall connecting the NE wall to platform.
>
> A low stone wall 2' high, 2' wide from the south corner of platform to about the center of the SW wall. 12' further to the NW is a short section of stone wall 8'6" long, 2' wide and 2' high. Parallel with and between the platform and the SW wall is another wall about 12' long, 2' wide, 2' high and much disturbed. Outside the SE wall. 11' left of the entrance is a fire-place. Faint evidence of the platforms in this area (Hansen n.d.).

SIHP # -3522 is composed of four major features, including an enclosure (Feature A) with an raised walkway (Feature B) and interior platform (Feature C) (Figure 82). In the vicinity of the enclosure are areas paved with waterworn pebbles and cobbles (Feature D). Feature A enclosure is rectangular shaped and measures 29 m by 24 m wide. The enclosure walls are constructed of stacked basalt boulders and cobbles, generally in a bi-faced, core-filled manner, and incorporate large boulders and bedrock outcrops into the construction (Figure 83). The walls average 1.2 m in height and 0.8 m wide, though the northwest and northeast walls are more substantial constructions varying in width and height. The southeastern wall is thinner and of a more uniform height and width. There are two constructed entrances at the *makai* (southeast) and *mauka* (northwest) ends of the enclosure. The *makai* entrance consists of an 80 cm wide break in the enclosure wall with a smooth, flat basalt boulder placed in front, functioning as a crude step (Figure 84). The *mauka* entrance to the enclosure consists of an 80 cm wide break in the enclosure wall, with mounded basalt boulders and cobbles forming crude steps up from a paved trail (SIHP # -3521) to a bedrock outcrop that abuts a raised walkway (Feature B) leading to the interior platform (Feature C) (see Figure 81).

The interior of the enclosure generally consists of land cleared of surface stones, gently sloping to the southeast. Additional low stone walls are located within the Feature A enclosure. A low stone wall, constructed of mounded basalt boulders and cobbles, measuring 60 cm wide and 60 cm high, extends from the center of the southwest wall of the main enclosure to the southwestern corner of the Feature C platform. Approximately 3 m northeast of this wall is another low stone wall, extending 2.5 m in length from the southwest wall of the main enclosure, parallel to the first low wall. A third low wall, measuring 2.3 m in length, is located northeast of the second wall, running parallel to and between the main enclosure wall and the platform. These low walls form crude enclosures, possibly delineating activity areas within the main enclosure.

Feature B consists of a raised walkway measuring 5.2 m long, 1.6 m wide, with a height of 0.7 m. The walkway is an extension of the interior platform (Feature C) and is constructed in the same fashion. The walkway is constructed of stacked basalt boulders and cobbles, 3-4 courses high. The walkway is well-faced on each side, with a level, cobble filled interior surface and paving of waterworn cobbles and pebbles (Figure 85).

Feature C consists of the interior platform within the Feature A enclosure (Figure 86). The rectangular platform measures 12 m by 11 m wide, with an average height of 0.8 m. The platform is constructed with a perimeter of stacked basalt boulders and cobbles, 2-3 courses high, with a level, cobble filled interior. The perimeter walls of the platform are faced on the southeast, southwest and northwest sides and sloping on the northeast side. The surface of the platform is

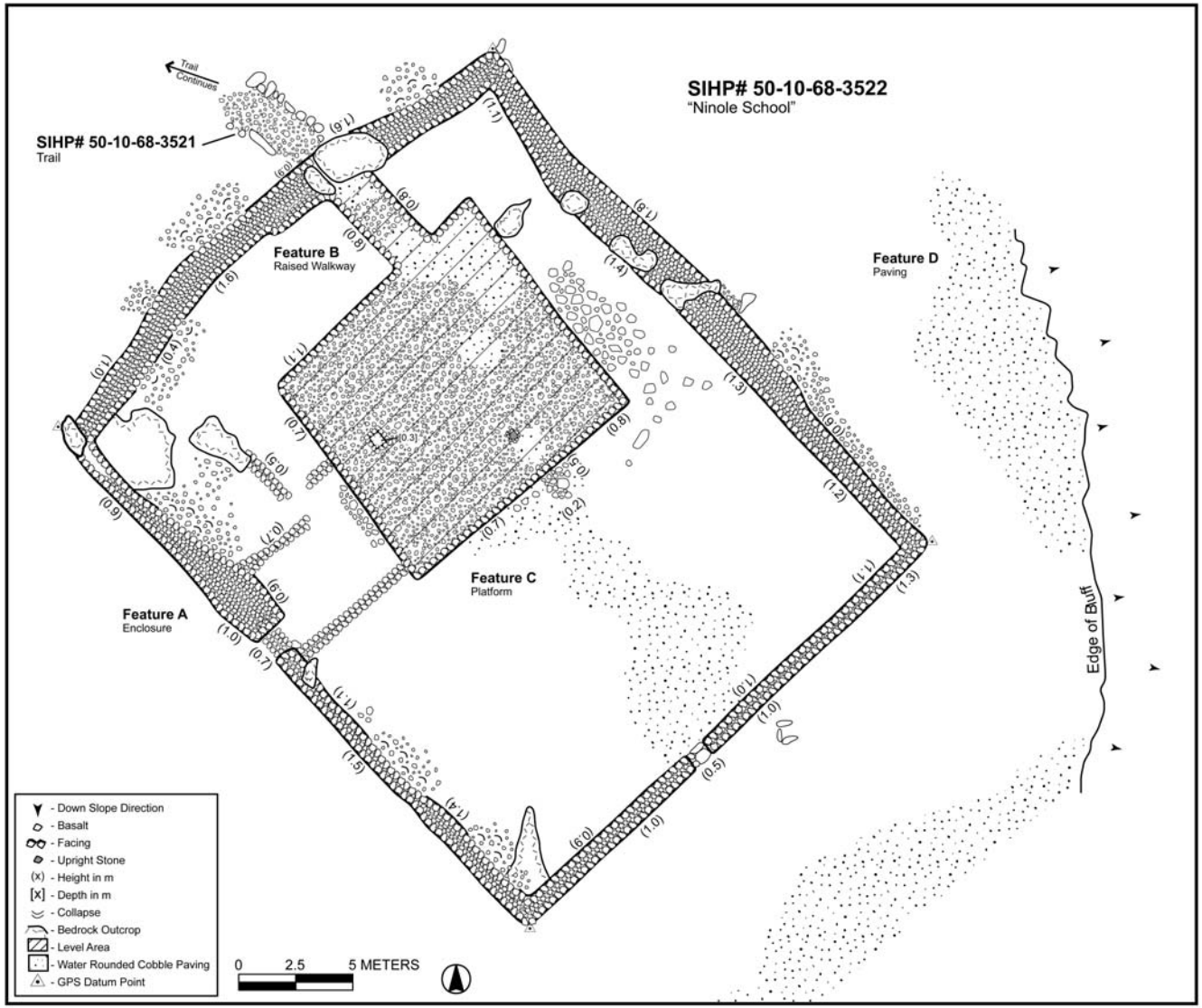

Figure 82. Plan view diagram of SIHP #50-10-68-3522 “Nīnole School”.

Figure 83. SIHP # 50-10-68-3522 Feature A enclosure, view to west.

Figure 84. SIHP # 50-10-68-3522 Feature A enclosure, *makai* wall, view to north.

Figure 85 SIHP # 50-10-68-3522 Feature B raised walkway, view to southeast.

Figure 86. SIHP # 50-10-68-3522 Feature C interior platform, view to northwest.

paved with waterworn cobbles and pebbles with scattered coral fragments observed. Stacked waterworn stones at the base of the southeastern wall of the platform serve as steps down from the platform to the ground level of the Feature A enclosure. An approximately 3 m wide pathway paved with waterworn cobbles and pebbles leads from the steps to the *makai* entrance of the main enclosure.

Dense cover of *naupaka* obscured much of the surface of the platform, though 2 modifications on the platform were observed. A 60 cm tall upright waterworn boulder stone has been placed roughly in the center of the *makai* portion of the platform, approximately 2 m from the *makai* edge. Waterworn cobbles, branch coral, and miscellaneous shells have been arranged around the base of the upright stone (Figure 87). The apparent shrine was not identified by Hansen (n.d.) in the previous description of the site, despite its conspicuous location. The shrine may therefore be a modern addition. A stone lined depression is located on the surface of the western portion of the platform, approximately 5 m west of the upright stone. The depression has a diameter of 60 cm, depth of 30 cm, and is filled with soil. The depression may have functioned as a fire pit.

Feature D consisted of two paved areas, located to the east and southeast of the Feature A enclosure (Figure 82). The paved areas are situated at the edge of the bedrock bluff overlooking Nīnole Cove, and measure approximately 10 m by 4 m wide. The areas are level, have been cleared of surface stones, and paved with water rounded cobbles and pebbles (Figure 88). Abundant marine shell midden was observed on the surface of the paved areas.

Based on the information provided to Hansen (n.d) that the enclosure and platform was the site of “Nīnole School,” SIHP # -3522 is interpreted to be a historic school site. However, consultation with local informants (i.e. Hanoa family), during the present study could not confirm SIHP # -3522 was the site of Nīnole School. The ideal location of the site overlooking the former Nīnole Fishpond and Kōloa Beach, close proximity to Ka‘ie‘ie Heiau (approximately 160 m south), and construction technique may indicate historic reuse of a pre-contact ceremonial site. In addition to the probable historic use of the site, there is an apparently modern addition of a shine on the platform. In general, Features B-D (platform, raised walkway and a pavings) are in excellent condition with very little collapse observed. The Feature A enclosure walls are in good condition, areas of collapse were generally restricted to the northwest portion of the enclosure. The SIHP # -3522 “Nīnole School” site represents an educational component associated with the historic habitation and agricultural activities of the Kōloa-Nīnole complex. The surrounding rough *‘a‘ā* lava flow and bluff area is undisturbed. SIHP # -3522 maintains integrity of location, design, setting, materials, workmanship, feeling, and association. SIHP # -3522 is assessed as significant under Criterion C (embodies the distinctive characteristics of a type, period, or method of construction, represents the work of a master, or possess high artistic value) and Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

Figure 87. SIHP # 50-10-68-3522 Feature C, shrine on platform, view to west.

Figure 88. SIHP # 50-10-68-3522 Feature D paving, view to southeast.

4.4.16 SIHP #: 50-10-68-3524 (Component of Site Complex 50-10-68-4368)

SITE TYPE: Historic Road
FUNCTION: Transportation
FEATURES: 1
DIMENSIONS: Approx. 110 m long segment
CONDITION: Good
AGE Historic
TAX MAP KEY: [3] 9-5-019:011

SIHP #50-10-68-3524 consists of an approximately 110 m long portion of the Old Government Road, also referred to as Alanui Aupuni, located within the southern central portions of the Kōloa-Nīnole Complex (SIHP # -4368) (see Figure 74). The road was previously identified by Hansen (n.d.) and relocated by PHRI (Rosendahl and Rosendahl 1986), and designated site 50-HA-B9-09. The following description was provided by PHRI for SIHP # -3524 (site B9-09):

> The Old Government Road has been designated Site B9-9. It measures approximately 4.0 m in width, and is constructed of large boulders aligned along the outside edge. Much of the road is paved with *‘ili‘ili.* The road ran from Honu‘apo to Punalu‘u, and was said to have been built by Reverend William Cornelius Shipman in the 1850s (Hansen Ms.). Kelly (1980:107-110) has documented the two different routes the road took around Nīnole Pond (Puhau). It appears the initial road passed on the seaward side of the Nīnole Fishpond and continued southwest toward Kōloa Beach, where it ascended the slope (Kelly 1980:107-108). This route roughly corresponds with the existing 4-wheel drive road. The road appears to have been re-routed after 1868 to go around the inland side of the fishpond and then up the incline toward Hīlea and Honu‘apo (Kelly 1980:109-110). The segment on the southwest side of Puhau is all that remains of the Old Government Road within the project area. During a recent survey of the coastal area, no evidence of the Old Government Road could be found northeast of Puhau (Rosendahl 1986) (Rosendahl and Rosendahl 1986:19).

The documentation of the Old Government Road by Marion Kelly (in Barrera and Hommon 1972) is found in Appendix C of this report.

SIHP # -3524 consists of an intact portion of the Old Government Road. The road was observed running immediately *mauka* of Ka‘ie‘ie Heiau (south of the project area) enters the project area from the south. The road heads roughly north to south, inland toward SIHP # -3522 “Nīnole School.” The road was observed to be mechanically graded and is constructed through a rough *‘a‘ā* flow. The road generally measures 3.5-4 m wide, is relatively level, and paved with water rounded pebbles and cobbles (Figure 89). There are low 30-50 cm high boulder berms along the edges of the road.

The road continues north between SIHP # -3522 “Nīnole School” and SIHP # -24897 Feature A enclosure, then curves west and progresses down along the edge of the *‘a‘ā* flow, sloping down into Nīnole Cove. Along the upslope edge of the road, the edge of the *‘a‘ā* flow is faced

Figure 89. SIHP #50-10-68-3524 old government road, view to south.

with a loosely stacked boulder and cobble retaining wall, 5-7 courses high, with a maximum height of 1.5 m. The road continues between SIHP # -3519 enclosure and SIHP # -3520 enclosure down into Nīnole Cove, where it was lost in dense vegetation. No evidence of the road was observed inland of Nīnole Cove.

The observed portion of SIHP # -3524 is intact and in good to excellent condition. The surrounding rough *‘a‘ā* lava flow and bluff area is undisturbed. SIHP # -3524 maintains integrity of location, design, setting, materials, workmanship, feeling, and association. SIHP # -3524 is assessed as significant under Criteria A (associated with events that have made an important contribution to the broad patterns of our history) and D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

4.4.17 SIHP #: 50-10-68-24897 (Component of Site Complex 50-10-68-4368)

SITE TYPE:	Complex
FUNCTION:	Agricultural
FEATURES:	3
DIMENSIONS:	Approx. 30 m N/S by 120 m E/W
CONDITION:	Good
AGE:	Historic
TAX MAP KEY:	[3] 9-5-019:011

SIHP # 50-10-68-24897 consists of an enclosure, stepping stone trail, and U-shaped enclosure, located within the western portion of the Kōloa-Nīnole Complex (SIHP # -4368) (see Figure 74). The complex was previously identified by PHRI (Rosendahl and Rosendahl 1986) and designated site T-108. The complex is situated on a young *‘a‘ā* flow, along the bluff to the west of and overlooking Nīnole Cove and the shoreline to the east. The following description was provided by PHRI for SIHP # -24897 (site T-108):

> Located on the *‘a‘ā* bluff overlooking Puhau, this complex is comprised of three major features. A 1.0 m wide trail crosses the area and appears as a roughly leveled surface oriented across an irregular and very rough surface. Another feature is an enclosure measuring approximately 14.0 by 10.0 m, with crudely stacked *‘a‘ā* boulder walls. The wall incorporates existing bedrock outcrops, and is generally 0.8 m high and 0.9 m wide with a paved level interior. The remaining feature is a U-shaped wall with dimensions of 4.5 by 2.7 m. The wall measures 0.7 m high and is crudely constructed of boulders. There is sparse midden within the feature.
>
> In addition to the three main features, it appears there may be crude terraces on the *‘a‘ā*. The approximate limits of the complex are shown on figure 2, and some of the features included in this site designation may actually be southwest of the project boundary. This site is within the limits of the Nīnole Complex (4368), though it was not identified and included as a component of the complex. (Rosendahl and Rosendahl 1986:32)

SIHP # -24897 Feature A consists of a large enclosure located on a relatively level *‘a‘ā* bedrock surface, approximately about 16 m west of SIHP –3524 old government road (Figure 90). The enclosure is roughly oval shaped, measuring 16 m by 10 m wide. The enclosure walls measured a maximum height of 1.2 m and 0.9 m in width and incorporate natural *‘a‘ā* bedrock outcrops in the construction (Figure 91). The north and west walls of the enclosure are the most substantial and are constructed of stacked basalt boulders and cobbles, in a bi-faced manner, 3-4 courses high and 3-4 courses wide. The south and east walls are less defined and are constructed of stacked basalt boulders and cobbles, 1-2 courses high and 1 course wide. The interior of the enclosure was cleared and level. Feature A is in good condition with very little collapse observed. No cultural material was observed within or in the vicinity of the enclosure.

SIHP # -24897 Feature B consists of a stepping stone trail that runs roughly east/west from Feature A, past Feature C, and continuing to the west outside the project area. The approximately 1 m wide trail is constructed through rough *‘a‘ā* and consists of *‘a‘ā* boulders and cobbles used to fill crevices and arranged with relatively flat surfaces of the stones facing up (Figure 92). An additional portion of the trail runs north from Feature A and intersects with SIHP # -3524 old government road. This portion of the trail is constructed on relatively level terrain and consists of an approximately 1 m wide cleared surface with light waterworn pebble paving. Feature B is undisturbed and in excellent condition.

SIHP # -24897 Feature C consists of a u-shaped enclosure located at the crest of the *‘a‘ā* bluff overlooking Nīnole Cove (Figure 93 & 94). The enclosure measures 3.3 m by 2.5 m wide and is oriented with the open end facing north. The position of the enclosure offers commanding views of the surrounding area. The enclosure walls are poorly constructed of loosely stacked *‘a‘ā*

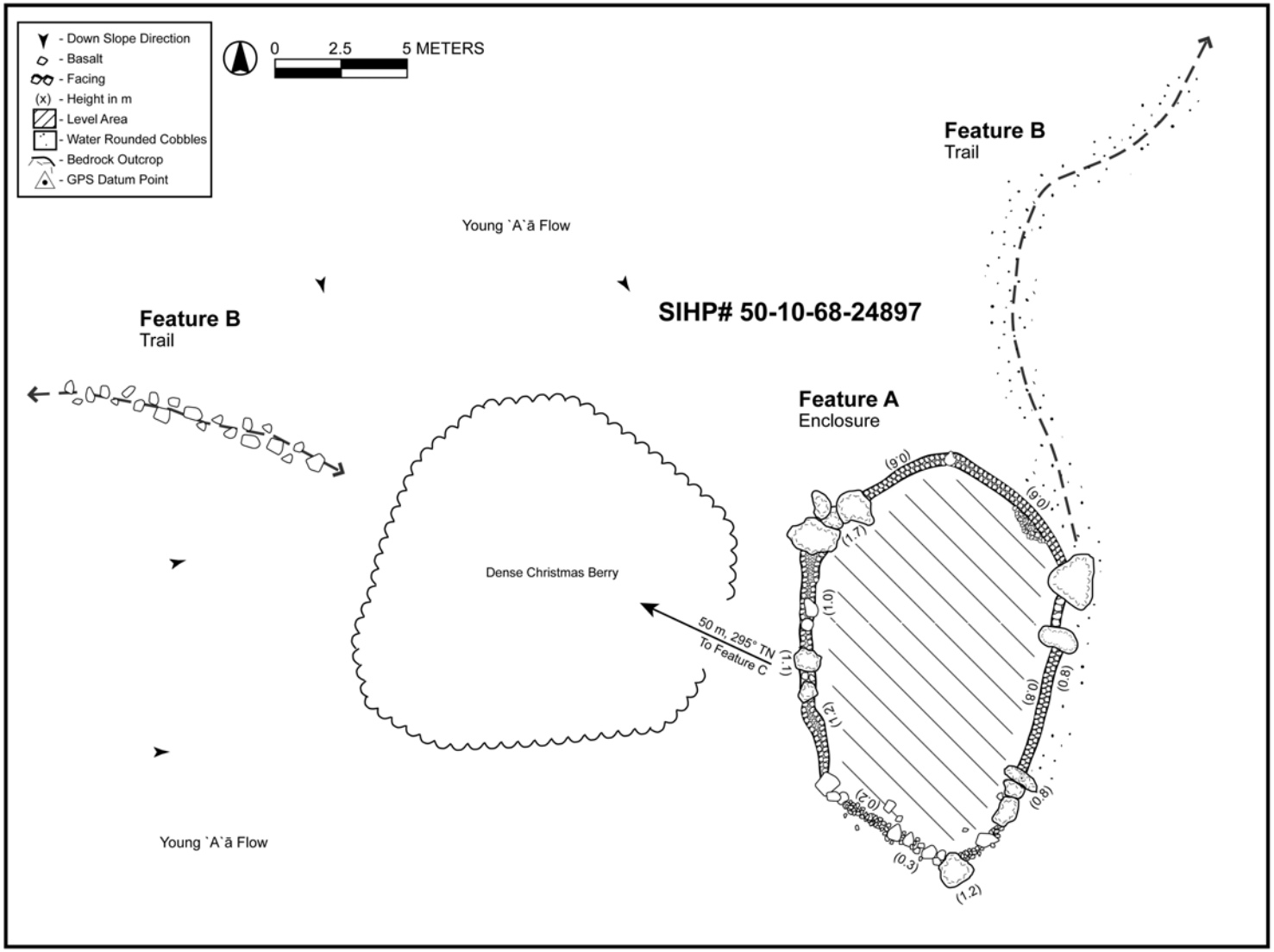

Figure 90. Plan view diagram of SIHP # 50-10-68-24897 Features A enclosure and B trail.

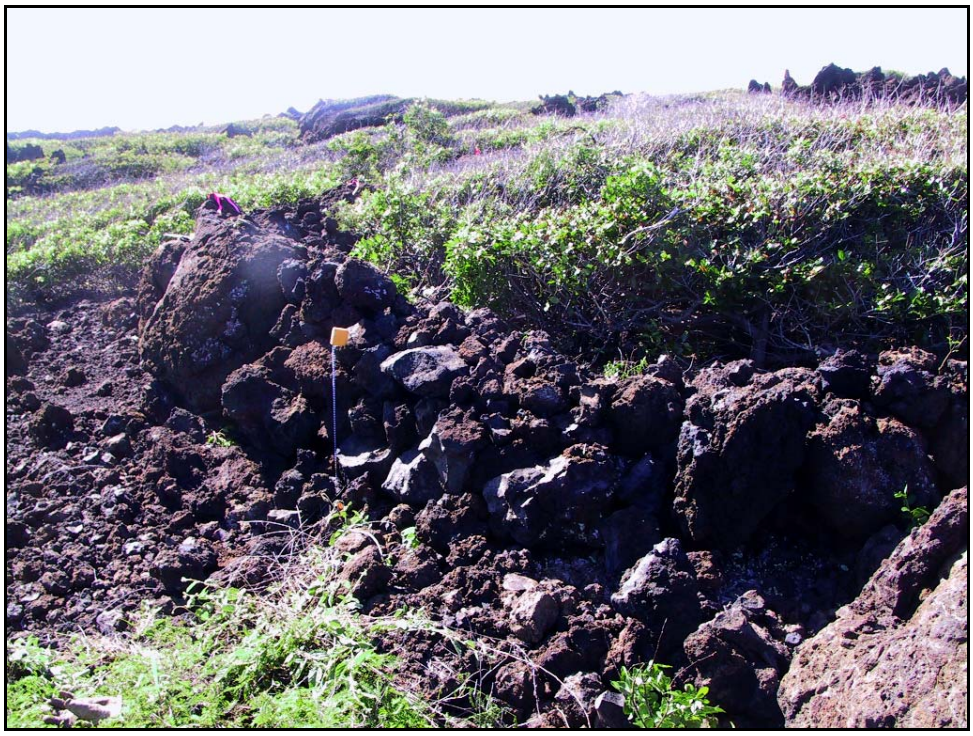

Figure 91. SIHP # 50-10-68-24897 Feature A enclosure, view to south.

Figure 92. SIHP # 50-10-68-24897 Feature B trail, view to north.

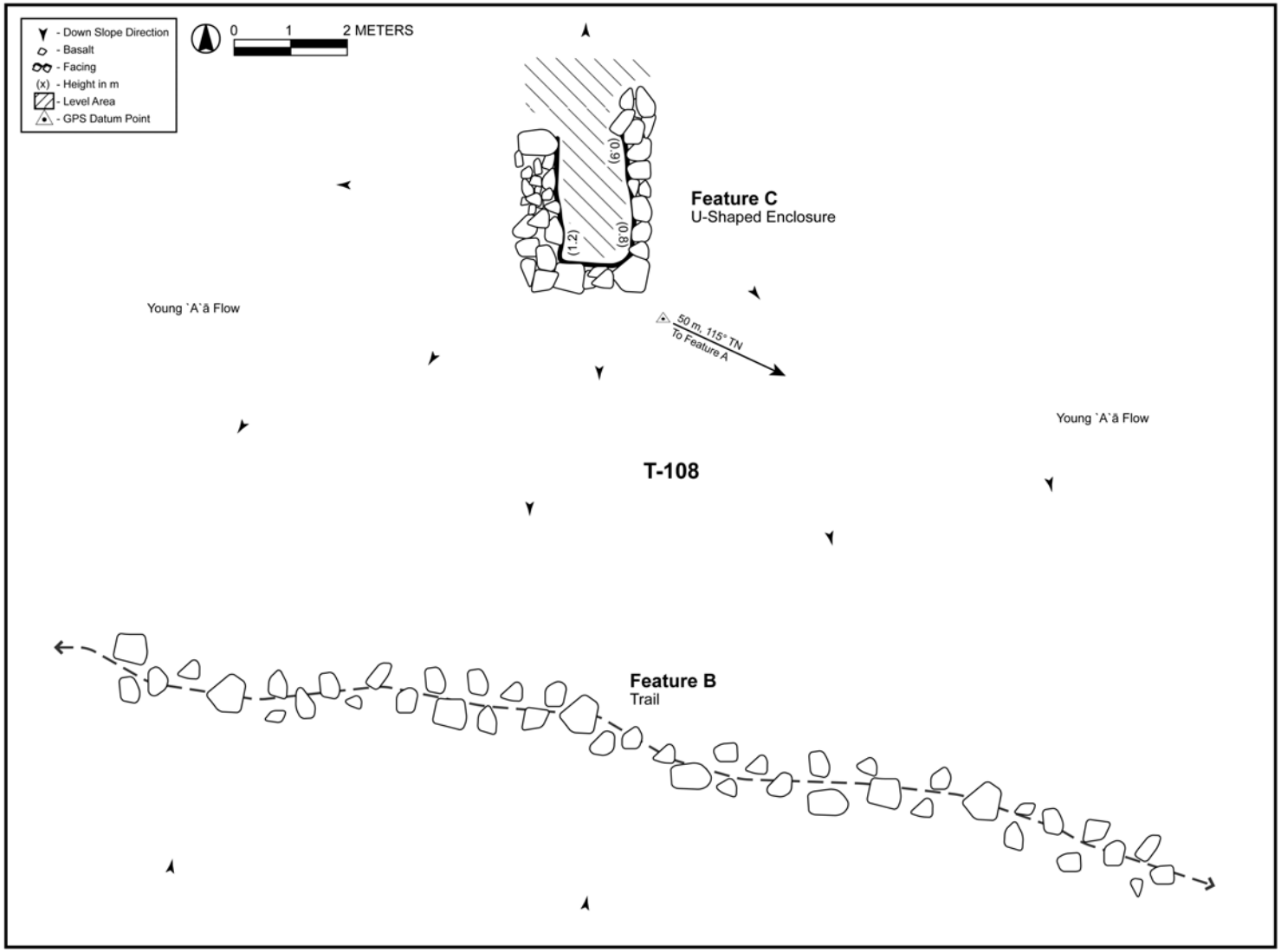

Figure 93. Plan view diagram of SIHP # 50-10-68-24897 Features B trail and C u-shaped enclosure.

Figure 94. SIHP # 50-10-68-24897 Feature C U-shaped enclosure, view to south.

boulders and cobbles, 1-2 courses high and 1-3 courses wide (Figure 94). The walls also incorporate bedrock outcrops. The interior of the enclosure measures approximately 2 m by 2 m wide and is roughly leveled and cleared. Feature C is in good condition with little collapse observed. No cultural material was within or in the vicinity of the enclosure.

SIHP # -24897 Feature A enclosure is interpreted to a historic animal pen, associated with the historic habitation and agricultural activities of the Kōloa-Nīnole complex. Feature B trail is interpreted to be a foot trail providing pedestrian access through the very rough *‘a‘ā* terrain, originating at the old government road (SIHP # -3524) and heading west outside the current project area. Feature C U-shaped enclosure is interpreted to be a temporary shelter, possibly functioning as a vantage point associated with Nīnole fishpond activities down slope. The surrounding rough *‘a‘ā* lava flow area is undisturbed and the features of SIHP # -24897 are in good to excellent condition. SIHP # - 24897 maintains integrity of location, design, setting, materials, workmanship, feeling, and association. SIHP # -24897 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

4.4.18 SIHP #: 50-10-68-24898 (Component of Site Complex 50-10-68-4368)

SITE TYPE: Burial Complex
FUNCTION: Ceremonial
FEATURES: 8
DIMENSIONS: Approx. 100 m NW/SE by 45 m NE/SW
CONDITION: Excellent
AGE: Pre-contact
TAX MAP KEY: [3] 9-5-019:011

SIHP # 50-10-68-24898 consists of a complex of nine terraces and platforms located within the northwest portion of the Kōloa-Nīnole Complex (SIHP # -4368) (see Figure 74). The complex was previously identified by PHRI (Rosendahl and Rosendahl 1986) and designated site T-111. The complex is situated on a young *‘a‘ā* flow, along the top edge of the western slope of Nīnole Gulch, overlooking Nīnole Cove and the shoreline to the east (Figure 95). The following description was provided by PHRI for SIHP # -24898 (site T-111):

> This complex consists of a series of platforms and terraces located on a bluff overlooking the golf course driving range. The features measure 2.5 to 4.2 m on a side and 0.3 to 1.45 m in height, and are situated on an open *‘a‘ā* flow. They appear to be burial features, and are in good condition. A portion of the complex is located within the limits of the Nīnole Complex (4368), and it was not initially included in the complex. (Rosendahl and Rosendahl 1986:35)

SIHP # -24898 Feature A consists of a rectangular platform located on a relatively level *‘a‘ā* bedrock surface (Figure 96). The low platform measured 3.3 m by 2.2 m wide, and 10 cm in height. The platform is constructed with a perimeter of small boulders, 20-30 cm diameter, 1 course high, with a level, cobble-paved interior. An approximately 50 cm by 50 cm wide and 50 cm deep excavated depression was observed in the eastern portion of the platform. The depression has the appearance of an archaeological test excavation, though none was reported in the previous description of the feature by Rosendahl and Rosendahl (1986).

SIHP # -24898 Feature B consists of a rectangular platform located on a relatively level *‘a‘ā* bedrock surface (Figure 97). The platform measured 3.0 m by 2.0 m wide, with a maximum height of 85 cm. The platform is constructed with a perimeter of boulders, stacked 1-3 courses high, with a level, cobble-paved interior.

SIHP # -24898 Feature C consists of a terrace and a platform constructed against opposite ends of an *‘a‘ā* bedrock outcrop. The terrace is located against the eastern edge of the outcrop, within a natural depression (Figure 98). The terrace measured 1.2 m by 2.5 wide, with a maximum height of 90 cm. The terrace is constructed with a loosely stacked basalt boulder and cobble retaining wall along the northern and eastern edges, 2-3 courses high, and a level, cobble-paved interior. The adjacent platform is constructed against the western edge of the bedrock outcrop (Figure 99). The platform measures 4.0 m by 2.5 m wide, with a maximum height of 80 cm. The platform is constructed with a perimeter of loosely stacked boulders and cobbles, 2-3 courses high, with a level, cobble-paved interior. An approximately 20 cm diameter accretionary lava ball was located on the surface of the eastern portion of the platform. An approximately 50 cm by 50 cm wide and 40 cm deep excavated depression was observed in the center portion of

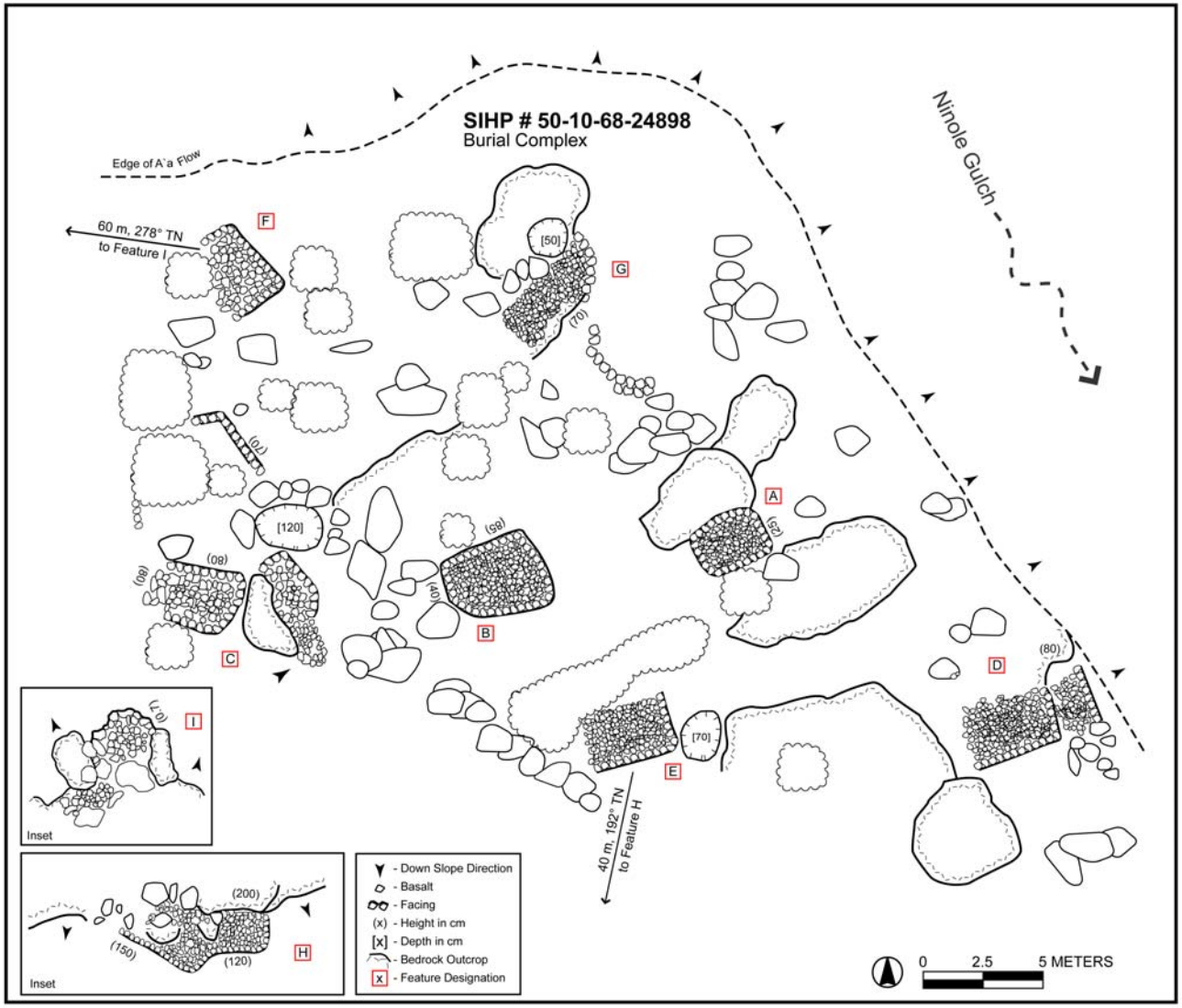

Figure 95. Plan view diagram of SIHP 50-10-68-24898 burial complex (adapted from Rosendahl and Rosendahl 1986:37).

Figure 96. SIHP # 50-10-68-24898 Feature A platform, view to southeast.

Figure 97. SIHP # 50-10-68-24898 Feature B platform, view to west.

Figure 98. SIHP # 50-10-68-24898 Feature C, lower terrace, view to west.

Figure 99. SIHP # 50-10-68-24898 Feature C, upper platform, view to east.

the platform. The depression has the appearance of an archaeological test excavation, though none was reported in the previous description of the feature by Rosendahl and Rosendahl (1986).

SIHP # -24898 Feature D consists of a poorly defined 2-tiered terrace located near the edge of the steep sloping western face of Nīnole Gulch (Figure 100). The upper tier of the terrace measured approximately 3 m by 5 m wide, with a maximum height of 40 cm. The terrace is constructed with a poorly defined retaining wall along the eastern edge, incorporating natural bedrock outcrops, with a relatively level cobble-paved interior. The lower tier of the terrace consists of a cleared and relatively level area with minimal modifications.

SIHP # -24898 Feature E consists of a crude terrace located on a relatively level *‘a‘ā* bedrock surface (Figure 101). The terrace measured approximately 2.3 m by 3.5 m wide, with a maximum height of 60 cm. The terrace may extend to the north, but was obscured by dense cover of Christmas berry. The terrace is constructed with a loosely stacked basalt boulder and cobble retaining wall along the southern and eastern edges, 1-2 courses high, with a level, cobble-paved interior. The eastern edge of the terrace abuts a filled depression, measuring approximately 70 cm deep. The terrace is also adjacent to an area of naturally red colored bedrock.

SIHP # -24898 Feature F consists of a terrace located near the edge of the steep sloping western face of Nīnole Gulch (Figure 102). The terrace measured approximately 4 m by 2.5 m wide, with a maximum height of 70 cm. The terrace is constructed with a loosely stacked basalt boulder and cobble retaining wall along the northern and eastern edges, 1-2 courses high, with a level, cobble-paved interior. The terrace may extend to the west, but was obscured by dense cover of Christmas berry.

SIHP # -24898 Feature G consists of a terrace located within a low area between bedrock outcrops (Figure 103). The terrace measured 4.5 m by 1.5 m wide, with a maximum height of 50 cm. The terrace is constructed with a loosely stacked basalt boulder and cobble retaining wall along the eastern edge, 2-3 courses high, with a level cobble-paved interior. The northern edge of the terrace is adjacent to an approximately 50 cm deep natural depression.

SIHP # -24898 Feature H consists of a terrace located along the southern face of a rough *‘a‘ā* ridge (Figure 104). The terrace measured approximately 6 m by 2 m wide, with a maximum height of 1.5 m. The terrace was constructed well-faced, stacked basalt boulder and cobble retaining wall along the southern and eastern edges, 4-5 courses high, with a level, cobble-paved interior. Two depressions were observed in the surface of the terrace, one approximately 30 cm in diameter, and the other 1 m by 0.4 m wide. The depressions appeared to have been the result of settling within the interior of the terrace.

SIHP # -24898 Feature I consists of a terrace located near the near the edge of the steep sloping western face of Nīnole Gulch (Figure 105). The terrace measured 1.9 m by 1.5 m wide, with a maximum height of 40 cm. The terrace is constructed with a semi-circular, loosely stacked basalt boulder and cobble retaining wall, 1-2 courses high, with a level, cobble-paved interior. An additional small cobble-paved area was observed approximately 2 m southwest of the terrace.

Figure 100. SIHP # 50-10-68-24898 Feature D terrace, view to south.

Figure 101. SIHP # 50-10-68-24898 Feature E terrace, view to southwest.

Figure 102. SIHP # 50-10-68-24898 Feature F terrace, view to north.

Figure 103. SIHP # 50-10-68-24898 Feature G terrace, view to south.

Figure 104. SIHP # 50-10-68-24898 Feature H terrace, view to north.

Figure 105. SIHP # 50-10-68-24898 Feature I terrace, view to southwest.

SIHP # -24898 is interpreted to be a pre-contact native Hawaiian burial complex. The size, construction methods, and locations of the nine component features of the complex in rough terrain and near the edge of a bluff, are typical of traditional Hawaiian burial features. No surface cultural material was observed on any of the features or in the immediate vicinity. Due to the high probability of encountering human remains, no subsurface testing was undertaken within any of the platforms or terraces. The surrounding rough *‘a‘ā* lava flow area is undisturbed and the features of SIHP # -24898 are in excellent condition. SIHP # - 24898 maintains integrity of location, design, setting, materials, workmanship, feeling, and association. SIHP # -24898 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places and Criterion E (have an important value to the native Hawaiian people due to associations with cultural practices once carried out at the property – these associations being important to the group’s history and cultural identity) of the Hawai‘i Register of Historic Places.

4.4.19 Punalu‘u Harbor Complex (SIHP # 50-10-68-7361)

The Punalu‘u Harbor Complex (SIHP # 50-10-68-7361) consists of a cluster of historic properties located in the northeastern corner of the Makai Survey Area (Figure 15). The complex consists of the Punalu‘u Harbor wharf and harbor infrastructure immediately north of the wharf (Figure 106). The associated infrastructure includes the previously identified sites B8-14 (-7361 Features B to E), B8-15 (-7361 Feature F), B8-16 (-7361 Feature G), and B8-33 (-7361 Feature H), which were previously given individual site designations by Hansen (n.d.). However, due to the interconnected nature of the features, the components of the Punalu‘u Harbor Complex were included as features of a single site designation (i.e. SIHP # -7361 Features A-H).

Kelly (1980) relates the following general information about the Punalu‘u Harbor Complex:

> Punalu‘u harbor [see present Figure 9] was called the "port town for the district" in 1880 (Bowser 1880:555). It mainly served the communities of Nīnole, Punalu‘u, and the sugar plantation of Pāhala. It also served for a while as a landing for visitors going to the volcano area. A warehouse at the site stored cargo between steamers, which stopped about every two weeks (Kelly 1980:18).

Detailed descriptions of the component features of the Punalu‘u Harbor Complex are as follows:

SIHP #: 50-10-68-7361

SITE TYPE:	Punalu‘u Harbor Complex
FUNCTION:	Harbor Infrastructure
FEATURES:	8
DIMENSIONS:	Approx. 165 m N/S by 75 m E/W
CONDITION:	Fair
AGE	Historic
TAX MAP KEY:	[3] 9-6-001:002, 013, 9-6-002:006

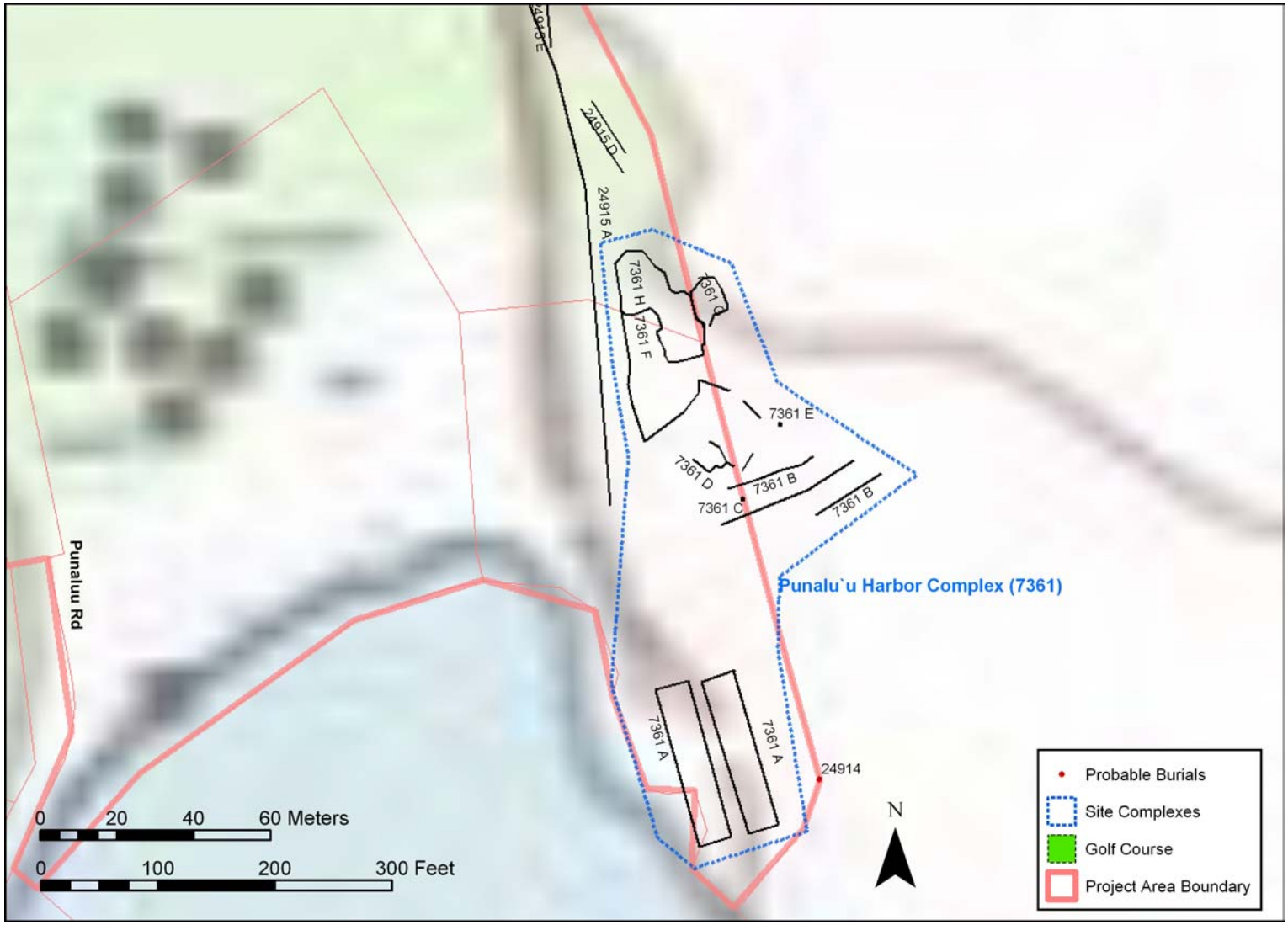

Figure 106. Portion of USGS Topographic Map, Punalu‘u Quad. (1995), showing the locations of historic properties within the Punalu‘u Harbor Complex (SIHP # 50-10-68-7361).

As previously mentioned, SIHP # 50-10-68-7361 consists of the Punalu‘u Harbor wharf and harbor infrastructure, designated Features A-H. SIHP # -7361 Feature A consists of the wharf area at the eastern edge of Punalu‘u Harbor (Figure 106). The following documentation of SHIP # -7361 Feature A wharf was provided by PHRI (Rosendahl and Rosendahl 1986):

> This site identifies remnants of the most recent wharf to occupy the northeast side of Punalu'u Harbor. An existing cement pillar has the inscribed "Built-1916 by KISHII" on it, and according to Ineneo Hanoa the structure was severely damaged during the 1940s when the military forces occupied the area and shot down the walls (I. Hanoa. pers. comm.). The site appears to have undergone further deterioration as a result of high seas.
>
> The site was given a site number during the Statewide Inventory of Historic Sites survey during the 1970s, and no further documenting evidence is present. The existing structural remnants include portions of a large cement platform and cement pilings. (Rosendahl and Rosendahl 1986:35)

The primary sub-features of the Feature A wharf area are two symmetrical concrete platforms (sub-features 1-2) (Figure 107). The platforms measure approximately 42.5 m by 9.5 m wide, 1.0-1.3 m in height, and are spaced 3.4 m apart (Figure 108 & 109). The area between the platforms is concrete paved. Platforms appear to have been constructed by stacking and piling large boulders, with a level surface of smaller boulders and cobbles, and lined with 3-5 cm of mortar cement. A 50 cm wide channel runs lengthwise through the center of each of the platforms. The sub-feature 1 and 2 platforms are understood to be warehouse foundations, with the paved area between the platforms serving as the train docking area. There is significant damage to the southeast corner of the platforms due to erosion and high surf.

Additional information on the construction of SIHP # -7361 is provided by Kelly (1980) in describing Kane‘ele‘ele Heiau, immediately east of the Punalu‘u Harbor wharf:

> East of an adjoining Punalu‘u wharf and warehouses, which are probably built on the heiau premises. Puehu bears 122°37, 4532 ft. This *heiau* probably extended to near the edge of the cliff bordering Punalu‘u Bay, and its western boundary was destroyed when the face of the cliff was graded for the wharf and the first warehouse built before 1906. Since that date another and larger warehouse has been erected, and the man in charge of the work has informed me that he had dug into a high bank of artificially laid stones, and during the work came across a pit about 10 ft. deep and "full of bones". The site of the bone-pit is now occupied by the concrete base of the warehouse engine, at the southeast corner of the building, a mark which will no doubt remain for some time. (Kelly 1980:75)

No evidence of a “bone-pit” was observed in the vicinity of SIHP # -7361. However, local informants pointed out a small cave (SIHP # -24914) near the southeastern corner of the warehouse platform which they indicated to be possible locale for the interment of the remains of human sacrifices offered at Kane‘ele‘ele Heiau.

SIHP # -7361 Feature A Sub-feature 3 consisted of additional remnant wharf appurtenances immediately west of the platforms (Figure 107). A 2 m by 2 m wide, 1.0 m high cement anchor block has an inscription that reads “BUILT-1916 by K.ISHII” (Figure 110). Five remnant

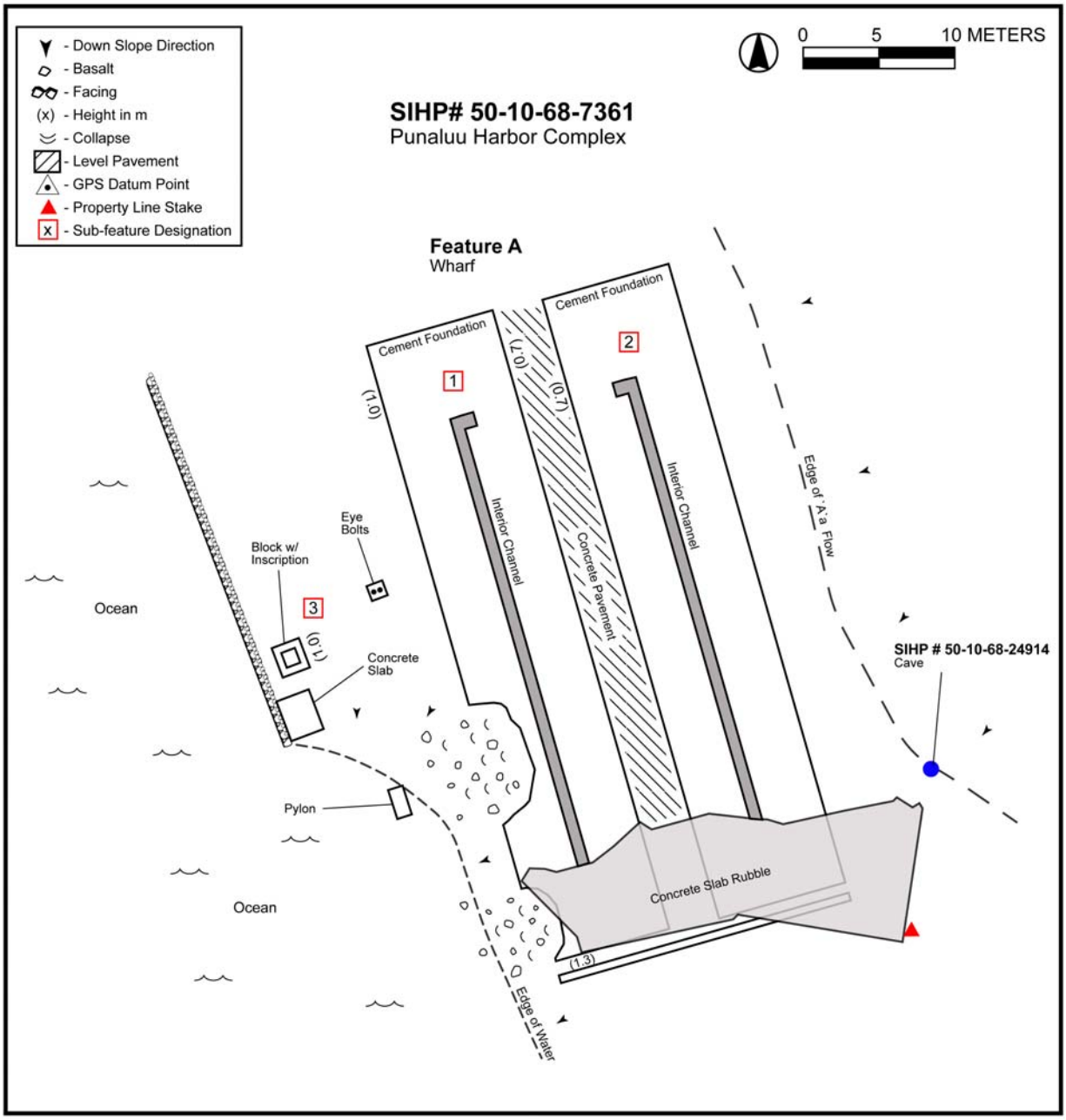

Figure 107. Plan view diagram of SIHP # 50-10-68-7361 Feature A wharf

Figure 108. SIHP # 50-10-68-7361 Feature A wharf, Subfeature 1 cement foundation, view to southeast.

Figure 109. SIHP # 50-10-68-7361 Feature A wharf, Subfeature 1 cement foundation profile, view to northeast.

Figure 110. SIHP # 50-10-68-7361 Feature A wharf, subfeature 3 cement block with inscription, view to south.

Figure 111. SIHP # 50-10-68-7361 Feature A wharf, subfeature 3 cement pillars, view to west.

cement pillars, 1.3 m in diameter, extend from land southeast into Punalu‘u Harbor (Figure 111). An additional 2.8 m by 2.2 m wide concrete slab and a 1.0 m by 1.0 m concrete slab with two eye bolts set in it were located in the area. In addition, a stack stone retaining wall was constructed along the edge of the shoreline in the vicinity of the wharf.

> SHIP # -7361 Features B-E generally consist of an activity area associated with the Punalu‘u harbor shipping activities, located approximately 50 m north of the Feature A wharf (Figure 106). The features are situated within a large natural depression, south of Feature F. The area encompassing SIHP # -7361 Features B-E was previously identified by Crozier and Barrera (1974) and relocated by PHRI (Rosendahl and Rosendahl 1986) designated site 50-HA-B8-14. The following description, primarily of SIHP# -7361 Feature D, was provided by PHRI (Rosendahl and Rosendahl 1986):Site B8-14 is a partially walled terrace located immediately adjacent to and southeast of Site B8-15. The site measures approximately 30.0 by 16.0 m, with a 1.0 m high and 0.7 m wide wall along the north and northwest perimeter of the terrace. The feature is in good condition and has a paving of *‘ili‘ili* with midden and ceramic fragments on the surface. (Rosendahl and Rosendahl 1986:16)

SIHP # -7361 Feature B consists of three large terraces constructed along the southern slope of the depression (Figure 112). The terraces extend along the entire southern slope of the depression, from the base, up to the top surface. The retaining walls of the terraces are constructed of stacked basalt boulders and cobbles, 5-8 courses, and incorporated large bedrock outcrops (Figure 113). The terraces are substantial constructions and are well-faced. The lowest of the terrace retaining walls measures 0.4 to 1.8 m in height and retains an approximately 7 m wide, level soil surface above. The middle terrace retaining wall measures 0.3 to 2.3 m in height and also retains an approximately 7 m wide, level soil surface above. The upper terrace retaining wall measures 1.6 m in height, and is level with the outer edge of the depression. The upper terrace consists of level *‘a‘ā* cobbles and is at the same elevation as Kane‘ele‘ele Heiau to the southeast. The function of the terraces is unclear. However, the substantial construction may indicate usage as a portion of the railroad foundation, or other vehicular access.

SIHP # -7361 Feature C consists of a square stone-lined depression. The depression is located within the southwestern portion of the lower Feature B terrace (Figure 112). The depression measures 2.1 m by 2.4 m with, with a depth of 80 cm. The depression is lined with loosely stacked basalt boulders and cobbles and is well-faced (Figure 114). Ash and crushed limestone cobble at the base of the depression indicates it was likely a fire pit used in the manufacture of lime for mortar.

SIHP # -7361 Feature D consists of a wall and low terraces located in the western portion of the depression (Figure 112). A stone wall constructed of loosely stacked basalt boulders and cobbles, 3-4 courses high, extends up the western slope of the depression. The wall is well-faced and measures 5.2 m long, 0.5 m wide, and 60 cm in height. Also along the western edge of the depression are low terraces (Figure 115). The terraces are generally constructed of loosely stacked basalt boulders and cobble retaining walls, 2-4 courses high, which retail level soil areas above. The upper terrace is at the same elevation as the Feature A wharf, and consists of a retaining wall constructed along the outer rim of the depression. The lower terrace is constructed

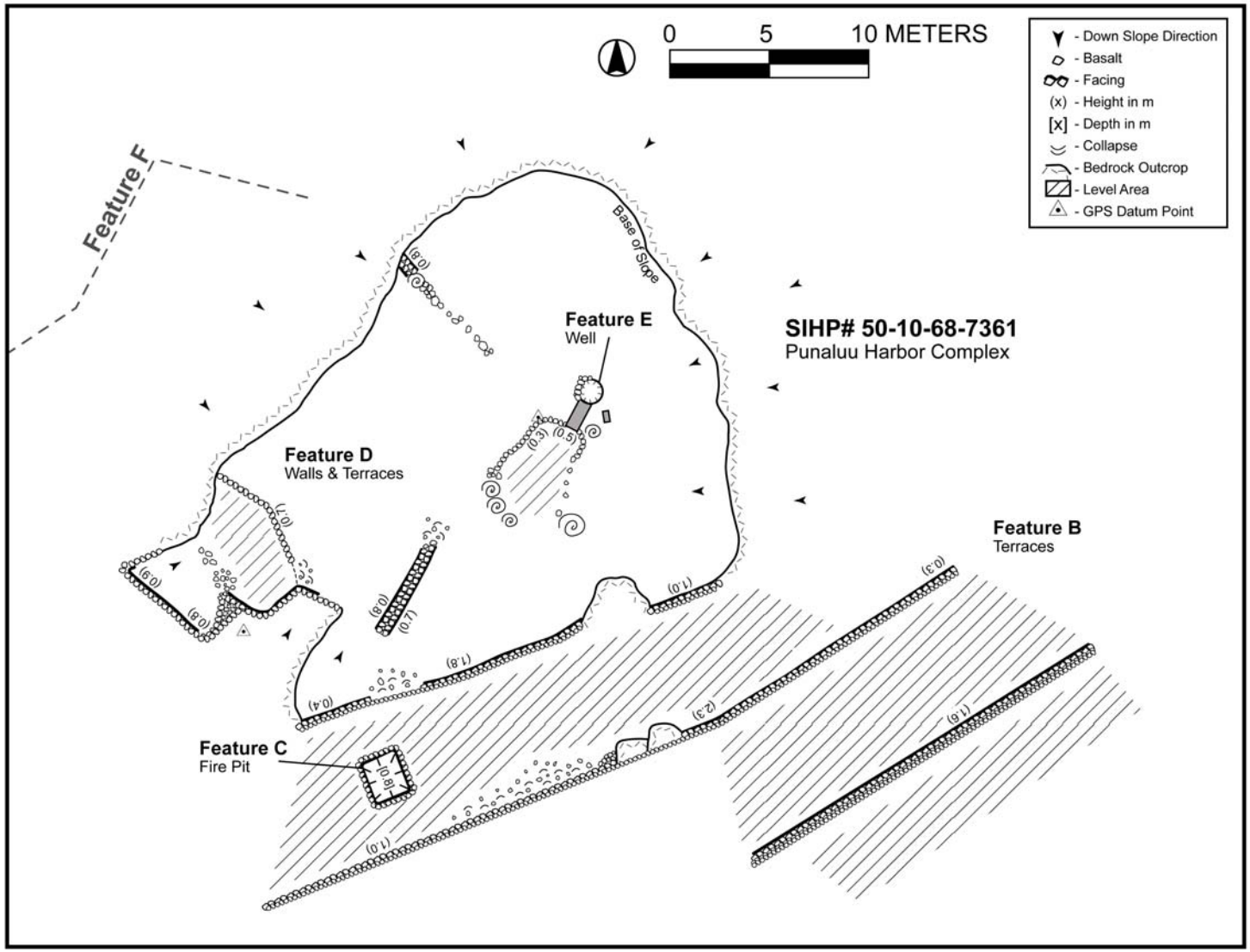

Figure 112. Plan view diagram of SIHP # 50-10-68-7361 Punalu‘u Harbor Complex Features B-E.

Figure 113. SIHP # 50-10-68-7361 Feature B terrace, view to southeast.

Figure 114. SIHP # 50-10-68-7361 Feature C fire pit, view to east.

Figure 115. SIHP # 50-10-68-7361 Feature D terraces, view to west.

Figure 116. SIHP # 50-10-68-7361 Feature E well, view to southeast.

midway down the slope into the depression, and consists of an approximately 5.7 m by 2.8 m level soil area. Scattered historic refuse including midden and ceramic fragments were observed in the vicinity of Feature D. The Feature D terrace area may represent a habitation component of the Punalu‘u Harbor Complex.

SIHP # -7361 Feature E consists of a paved well, located in the eastern portion of the base of the depression (Figure 112). The well has interior diameter of 90 cm and was 80 cm deep at time of survey. However, the well is filled with debris and leaf litter and is likely much deeper. The edges of the well are lined with stone and mortar construction, with mortar along the top surface (Figure 116). A rectangular mortar foundation measuring 50 cm by 60 cm wide is located adjacent to the southern edge of the well. The foundation had 4 metal bolts projecting up, likely for mounting a pump mechanism for extracting water from the well, though no evidence of a pump was observed. A low section was constructed around the rim of the well, 50 cm lower than the top surface, possibly to channel water out of the well. A low stone and mortar wall measuring 1.5 m long, 60 cm wide, and 50 cm tall projects out from the well, at the edge of the low portion of the rim of the well. The wall may also function in channeling water coming out of the well. Immediately southeast of the well is an area partially enclosed by a low wall constructed of loosely stacked basalt boulders and cobbles, 1-2 courses high, measuring 40 cm high and 50 cm wide. The area enclosed by the low wall may have been deeper, but may have been filled by sedimentation. The area enclosed may have served as a detention basin for water pumped out of the well.

A low wall constructed of loosely stacked basalt boulders, 2-3 courses high, extends from the well area northwest to the base of the slope of the depression. The wall is mostly collapsed, measuring 60 cm wide, 80 cm high, and. The wall then proceeds up the steep sloping edge of the depression, out to the top surface and into the vicinity of Features F and H. The wall may have functioned as a support for a pipe going from the well to the Feature H water tanks.

SIHP # -7361 Feature F consists of a large terrace previously designated site 50-HA-B8-15. The following description was provided by PHRI (Rosendahl and Rosendahl 1986):

> Site B8-15 is similar to Site B8-14. though substantially larger. It measures approximately 35.0 by 25.0 m. with a wall partially extending along the north limits of the feature. (Rosendahl and Rosendahl 1986:16)

SIHP # -7361 Feature F (Figure 117) is located in the northern portion of the Punalu‘u Harbor Complex (see Figure 106). The terrace is situated along the edge of a lava flow, north of the Feature D depression area, and immediately east of the SIHP # -24915 railroad berm. The Feature F terrace is constructed with a stacked basalt boulder and cobble retaining wall, 2-6 courses high, along the south and west, down slope edges of the terrace (Figure 118). The terrain down slope of the Feature F terrace retaining wall drops steeply away to the depression to the south and the railroad berm to the west. The retaining wall generally utilizes stones ranging from 10-50 cm in diameter and is well-faced. The top surface of the retaining wall is generally level with soil surface upslope. However, the northern and eastern portions of the retaining wall consist of free-standing, bi-faced and core-filled walls, 40-70 cm high and 20-90 cm wide. The down slope portions of the retaining wall measure from 0.6-1.0 m in height along the southern side, and 0.7-1.1 m along the western side. The Feature F terrace retaining wall retains a level soil area upslope, measuring approximately 35 m by 25 m wide. The Feature H platform

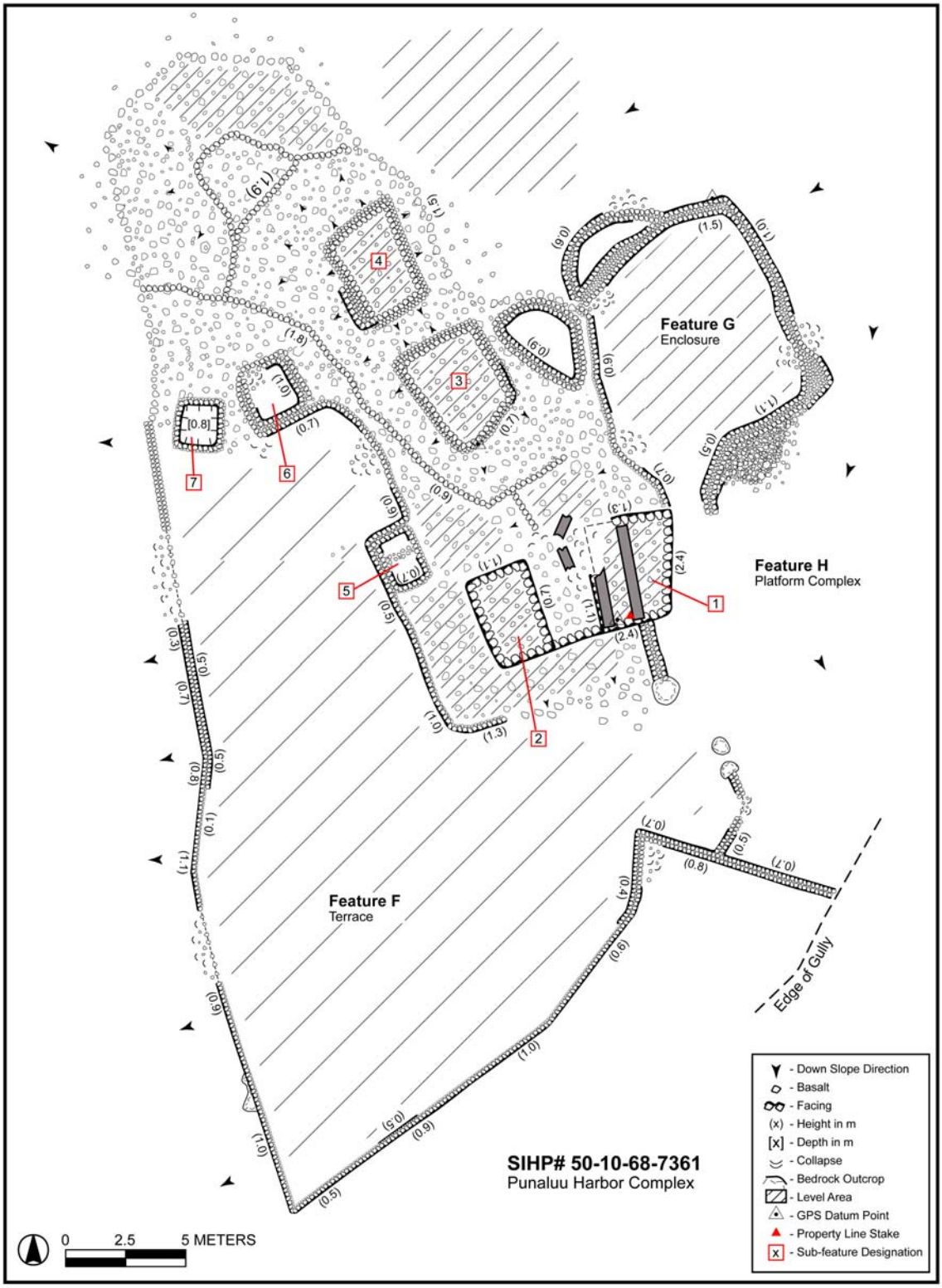

Figure 117. Plan view diagram of SIHP # 50-10-68-7361 Punalu‘u Harbor Complex Features F-H.

Figure 118. SIHP # 50-10-68-7361 Feature F terrace, view to northeast.

Figure 119. SIHP # 50-10-68-7361 Feature G enclosure, view to northeast.

complex is adjacent to the northeastern portion of the Feature F terrace, and was likely constructed on the level terrace area. Portions of the Feature F terrace retaining wall have been modified in modern times with the addition of barbed-wire fencing. Historic bottle fragments were observed on the surface of the northwestern portion of the terrace.

SIHP # -7361 Feature G consists of an enclosure (Figures 117 & 119) located in the northeast portion of the Punalu‘u Harbor Complex, previously designated site 50-HA-B8-16 (see Figure 106). The following description was provided by PHRI (Rosendahl and Rosendahl 1986):

> Site B8-16, situated east of Site B8-33, is an enclosure measuring 10.0 m in diameter. The walls are approximately 1.5 m high and 0.7 m wide. (Rosendahl and Rosendahl 1986:16)

The Feature G enclosure is adjacent to and utilizes the northeastern portion of Feature H platform as the western wall of the enclosure (Figure 117). The Feature G enclosure is roughly rectangular, measuring approximately 10 m by 9 m wide. The enclosure walls are constructed of stacked basalt boulders and cobbles, 4-6 courses high, in a bi-faced, core-filled manner (Figure 119). The enclosure walls generally range from 0.6-1.5 m in height, 0.8 m wide, and are well-faced. The southern wall of the enclosure is more substantial than the other walls, measuring up to 2.5 m wide and is mounded, rather than faced on the down slope side. An approximately x m wide entrance to the enclosure is located between the southern enclosure wall and the eastern edge of the Feature H platform. The interior of the enclosure consists of cleared and level soil. The enclosure is interpreted to function as an animal pen. An additional small enclosure, consisting of a semi-circular wall constructed against the northern wall of the main enclosure, borders an area 3.5 m by 1.1 m wide. The smaller enclosure may function as a storage area.

SIHP # -7361 Feature H (Figures 117, 120 & 121) consists of a large platform located in the northern portion of the Punalu‘u Harbor Complex, previously designated site 50-HA-B8-33 (see Figure 106). The following description was provided by PHRI (Rosendahl and Rosendahl 1986):

> The remaining site in the complex is Site 88-33. This site is comprised of a large platform measuring roughly 12.0 m on a side, and has two water tank foundations on its surface. Water was apparently pumped up from the waterhole (B8-11) into the water tanks, then gravity fed (Hansen Ms.). The waterhole appears on a map to be situated north of the project area, and was not relocated during the reconnaissance survey. Its existence in the general vicinity of Site 88-33 has been described by Hansen (Ms.).
>
> Site B8-33 is fairly open, and the platform surface has been used extensively for smashing recent beer bottles. Additional modifications were noted on the surface of the platform, as well as in the general vicinity. (Rosendahl and Rosendahl 1986:16)

SIHP # -7361 Feature H consists of a large, multi-level platform area. The platform appears to be constructed on an artificially leveled terrace area created by the Feature F terrace. The Feature H platform is generally constructed of loosely stacked basalt boulders and cobbles, measuring 31 m by 19 m wide (Figure 120). The main sub-features of the Feature H platform complex are the two smaller platforms (sub-features 1-2) that are constructed on the southern end of the main Feature H platform. Sub-feature 1 consists of a rectangular platform constructed at the southeast

Figure 120. SIHP # 50-10-68-7361 Feature H platform, general view of northern portion of platform, view to southeast.

Figure 121. SIHP # 50-10-68-7361 Feature H platform, sub-feature 1 water tank foundation, view to southeast.

corner of the main Feature H platform. The sub-feature 1 platform measures 3.5 m by 4.5 m wide, 2.4 m in height above the ground surface, and 1.2 m above the Feature H platform. The sub-feature 1 platform is constructed of stacked basalt boulders, 10-11 courses high, and is well-faced. The top surface of the sub-feature 1 platform is level, cobble-paved, with two parallel stone and mortar walls, measuring 4 m long, 50 cm wide, and 60 cm high (Figure 121). The northeast portion of sub-feature 1 has collapsed. The walls have been previously described as supports for a water tank (Rosendahl and Rosendahl 1986).

Sub-feature 2 is located along the southern edge of the main Feature H platform, to the west of and parallel to sub-feature 1. Sub-feature 2 is constructed at a lower level of the Feature H platform than sub-feature 1. Sub-feature 2 consists of a rectangular platform constructed of stacked boulders 5-6 courses high. Sub-feature 2 measures 3 m by 4 m wide, with a height of 1.3 m above the lower Feature H platform surface, and 65 cm above the platform surface between sub-features 1 and 2. The top surface of the sub-feature 2 platform is level, cobble-paved. Sub-feature 2 does not have stone and mortar foundations on its top surface. However, evidence of metal foundation supports is visible, but all that remains are two parallel rows of rusty debris. Sub-features 1 and 2 are interpreted to be foundations for water tanks as previously described.

Sub-features 3 and 4 are also on raised platform areas constructed on top of the main Feature H platform. Sub-feature 3 measures 3.5 m by 4.5 m wide and is 40 cm in height above the Feature H platform. Sub-feature 4 measures 3.5 m by 4.5 m wide and is 1.5 m in height above the ground surface. Features 3 and 4 are located in the central portion of the Feature H platform. These sub-features have some faced areas, but are generally constructed of sloping mound type walls, with relatively level, cobble paved top surfaces. The function of sub-features 3 and 4 is indeterminate.

Sub-features 5 and 6 are rectangular enclosures constructed along the western edge of the Feature H platform. Sub-feature 5 has interior dimensions of 1.3 m by 2 m wide, with an interior wall height of 70 cm, and exterior height of 50 cm. Sub-feature 6 has interior dimensions of 2 m by 2 m, with an interior height of 95 cm, and exterior height of 70 cm. Sub-features 5 and 6 possibly function as storage areas.

Sub-feature 7 consists of a rectangular pit to the west of sub-feature 6. The pit measures 1.5 m by 1.5 m wide and 30 cm deep (Figure 122). The pit is excavated into the basalt boulder and cobble fill associated with the Feature F terrace. The sub-feature 7 pit is of indeterminate function.

SIHP # -7361 Features A-H represent infrastructure related to shipping activities at Punalu‘u Harbor. SIHP # -7361 is largely undisturbed, with exception of the Feature A wharf, which has suffered damage from military activities, as well as natural erosion by high surf. The eight component features of the SIHP # -7361 Punalu‘u Harbor Complex are generally in good to fair condition. Much of the walls and other stacked stone structures are intact, with partially collapsed portions observed. SIHP # -7361 maintains integrity of location, design, setting, materials, workmanship, feeling, and association. SIHP # -7361 is assessed as significant under Criteria A (associated with events that have made an important contribution to the broad patterns of our history) and D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

Figure 122. SIHP # 50-10-68-7361 Feature H platform, sub-feature 7 stone lined pit, view to east

4.4.20 SIHP #: 50-10-68-24901

SITE TYPE: Complex incl. 2 platforms, 2 C-shape enclosures & a wall
FUNCTION: Habitation
FEATURES: 4
DIMENSIONS: 25 m by 15 m
CONDITION: Good
AGE Pre-contact
TAX MAP KEY: [3] 9-6-002:038

SIHP # 50-10-68-24901 consists of a complex including platforms and enclosures located in the northeastern portion of the Makai Survey Area (see Figure 15). The complex was previously identified by Crozier and Barrera (1974) and relocated by PHRI (Rosendahl and Rosendahl 1986) and designated site 50-HA-B8-07). The complex is situated on a raised bedrock outcrop within the Sea Mountain golf course. The following description was provided by Crozier and Barrera (1974) for SIHP # -24901 (site B8-07):

> Situated on a small bluff 70 meters W of the Punalu‘u access road is a small habitation complex consisting of several platforms and two enclosures (Fig. 14). An area in the center of the site has been bulldozed, as has the entire perimeter, destroying portions of the platforms. Once again no waterworn stones were used in construction and no *‘ili‘ili* or coral was observed on the surface. Wall heights average 70 to 80 cm with varying widths from 1 to 1.5 meters. The size of the site

> indicates that it was probably inhabited by one or two families, but bulldozer destruction prohibits a more accurate hypothesis. (Crozier and Barrera 1972:17)

SIHP # -24901 (site B8-07) was relocated by PHRI and described as follows:

> This site, in the middle of the Sea Mountain at Punalu‘u Golf Course sixth fairway, has been preserved. The site periphery appears to have been bulldozed during golf course construction, although the interior portion remains intact. The features are located on an uplifted pahoehoe outcrop, and include a minimum of two crude platforms and two enclosures. The platforms measure approximately 2.0 to 3.5 m on a side and 0.5 to 0.8 m high. The enclosures incorporate existing large boulders and have overall measurements of 2.5 to 3.0 m on a side. The enclosure walls average 0.7 to 0.8 m high and 1.0 to 1.5 m wide. It appears the dense vegetation cover obscures additional features. Crozier and Barrera briefly described and mapped the site (1974:18). (Rosendahl and Rosendahl 1986:15)

SIHP # -24901 consisted of two crude platforms and two enclosures, covering an area approximately 25 m by 15 m wide. The map of SIHP # -24901 by Crozier and Barrera (1974) (Figure 123) was field checked and found to be accurate, therefore the site was not remapped during the current study. Wall heights and feature designations were added to the previous map. The location of SIHP # -24901 was accurately plotted by CSH on the project area map (Figure 15) with the use of GPS survey technology.

Feature A consists of a crude platform, located in the northern portion of SIHP # -24901, is constructed of stacked basalt boulders and cobbles, utilizing natural bedrock outcrops (Figure 124). The down slope portion of the terrace is stacked 2-4 courses high, with a maximum height of 1.2 m. The surface of the platform is cobble-paved and level with the top of the bluff.

Feature B, a low wall, extends southeast from the platform, measuring approximately 11 m long. The wall is constructed of stacked basalt boulders and cobbles, 1-2 courses high, with an average height of 70-80 cm. The wall also utilizes the bedrock outcrops into the construction.

Feature C, a C-shaped enclosure, was located 7.5 m southeast of the Feature A platform, and incorporates a portion of the Feature B wall. The enclosure is constructed of stacked basalt boulders and cobbles, 2-4 courses high, with a maximum height of 85 cm (Figure 125). The interior of the enclosure is faced, with a height of 80 cm. The interior of the enclosure measured 3.6 m by 1.5 m wide. The interior surface of the enclosure was level soil with limited water rounded cobbles observed.

Feature D, another crude platform, was located in the southern portion of SIHP # -24901. The platform was constructed of piled basalt boulders and cobbles, with little facing observed. The stones were placed against the bedrock outcrop, creating a level soil and stone paved surface, measuring approximately 10.5 by 3.6 m wide. A 1 m by 1 m test excavation was made within the Feature D platform, revealing a relatively shallow soil surface over bedrock. No cultural material was observed.

Feature E consisted of a C-shaped enclosure adjacent to the Feature D platform. The enclosure is constructed of stacked basalt boulders and cobbles, 3-4 courses high, with a maximum height of 80 cm. The interior of the enclosure measured 4.7 m by 2.7 m wide.

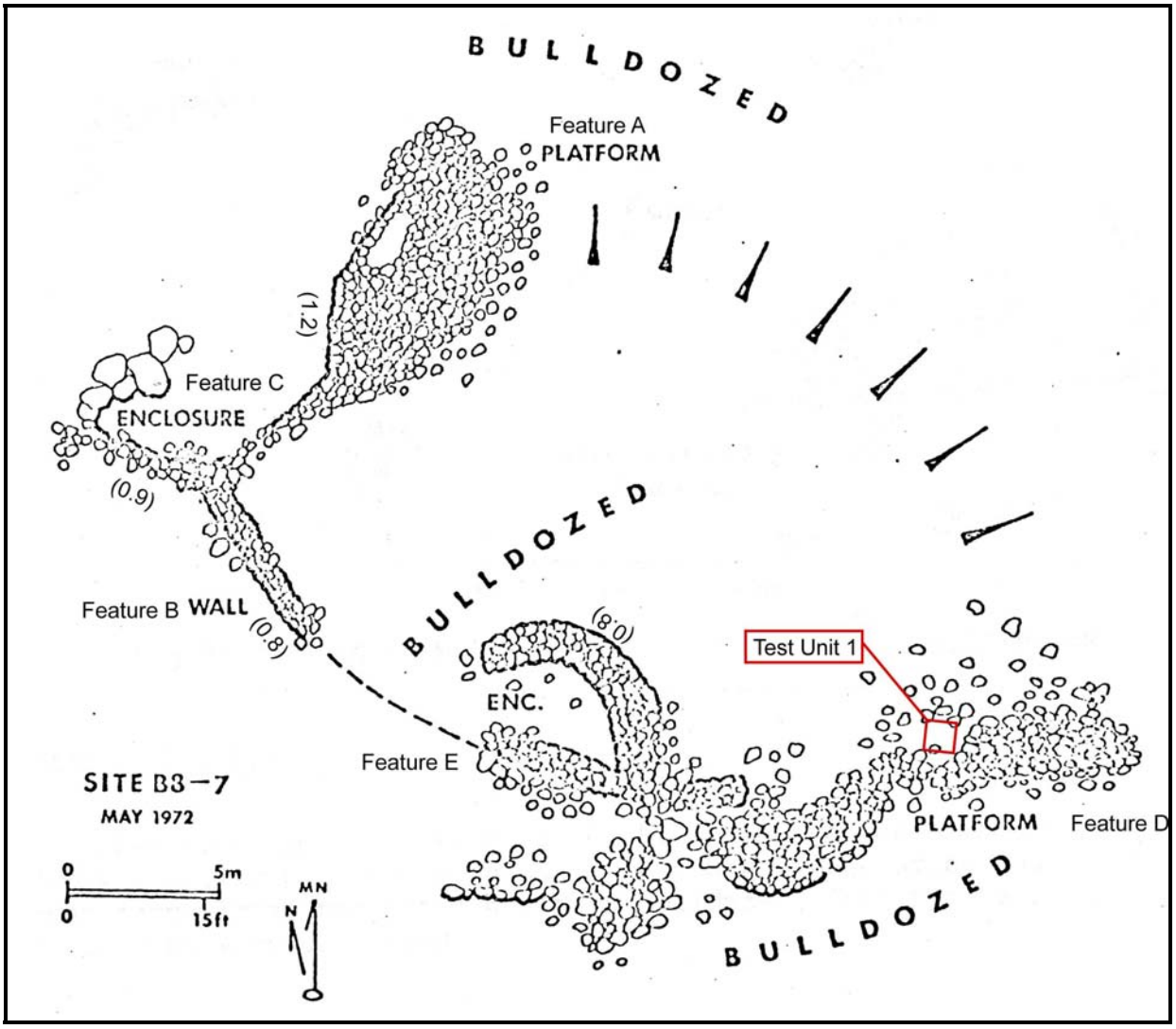

Figure 123. Plan view diagram of SIHP # 50-10-68-24901 (adapted from Crozier and Barrera 1974:18)

Figure 124. SIHP # 50-10-68-24901 Feature A platform, view to southeast.

Figure 125. SIHP # 50-10-68-24901 Feature C C-shaped enclosure, view to east.

SHIP # -24901 is interpreted to be a pre-contact habitation complex. Portions of the complex have been disturbed by land clearing activities associated with golf course construction. However, the identified features of the complex are intact and in good condition with little collapse observed. Additional features were likely located in the immediate area, but have been lost. No cultural material was observed on the surface, or during subsurface testing conducted at SIHP # -24901. SIHP # -24901 maintains integrity of location, materials, and workmanship. Due to the extensive land modification in the surrounding area, as well as within the site complex, SIHP -24901 does not have integrity of design, setting, feeling, or association. SIHP # -24901 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

4.4.21 SIHP #: 50-10-68-24902

SITE TYPE: Wall / Possible Enclosure
FUNCTION: Indeterminate
FEATURES: 1
DIMENSIONS: 5 m NW/SE by 3 m NE/SW
CONDITION: Poor
AGE: Pre-contact
TAX MAP KEY: [3] 9-5-019:011

SIHP # 50-10-68-24902 consists of a single L-shaped wall located in the northwestern portion of the Makai Survey Area (see Figure 15). The wall was previously identified by Barrera and Hommon (1972) and designated site 50-HA-B9-109. The wall is situated within Nīnole Gulch, at the edge of the western stream bank. In this area, Nīnole Gulch is relatively wide and deep, with nearly vertical stream banks and steep sloping side walls. The side walls were very rocky and prone to erosion. Rockfall disturbance from land clearing activities associated with golf course construction outside the gulch was evident.

SIHP # -24902 is constructed of stacked basalt boulders and cobbles, 2-4 courses high. The L-shaped wall was oriented with the long axis along the contour, parallel to the Nīnole Stream channel, and the short axis oriented upslope/down slope (Figure 126). The long axis of the wall measured 5 m long, 1.2 m wide, and 0.6 m in height. The long axis is constructed against the sloping hillside, and is faced on the down slope side (Figure 127). The short axis of the wall measured 3 m long, 2 m wide, and with a maximum height of 1.3 m. It appeared that the wall continued further toward the Nīnole Stream channel, but has been lost due to erosion of the stream bank. The short axis is faced on the southeast side and sloping on the northwest side. The area inside the L is level rocky soil up to the eroding stream bank. Because of the angular orientation of the wall, it is possible that the feature may have been a rectangular enclosure, with the remainder of the enclosure having been lost due to erosion of the stream bank. No cultural material was observed in the vicinity of SIHP # -24902.

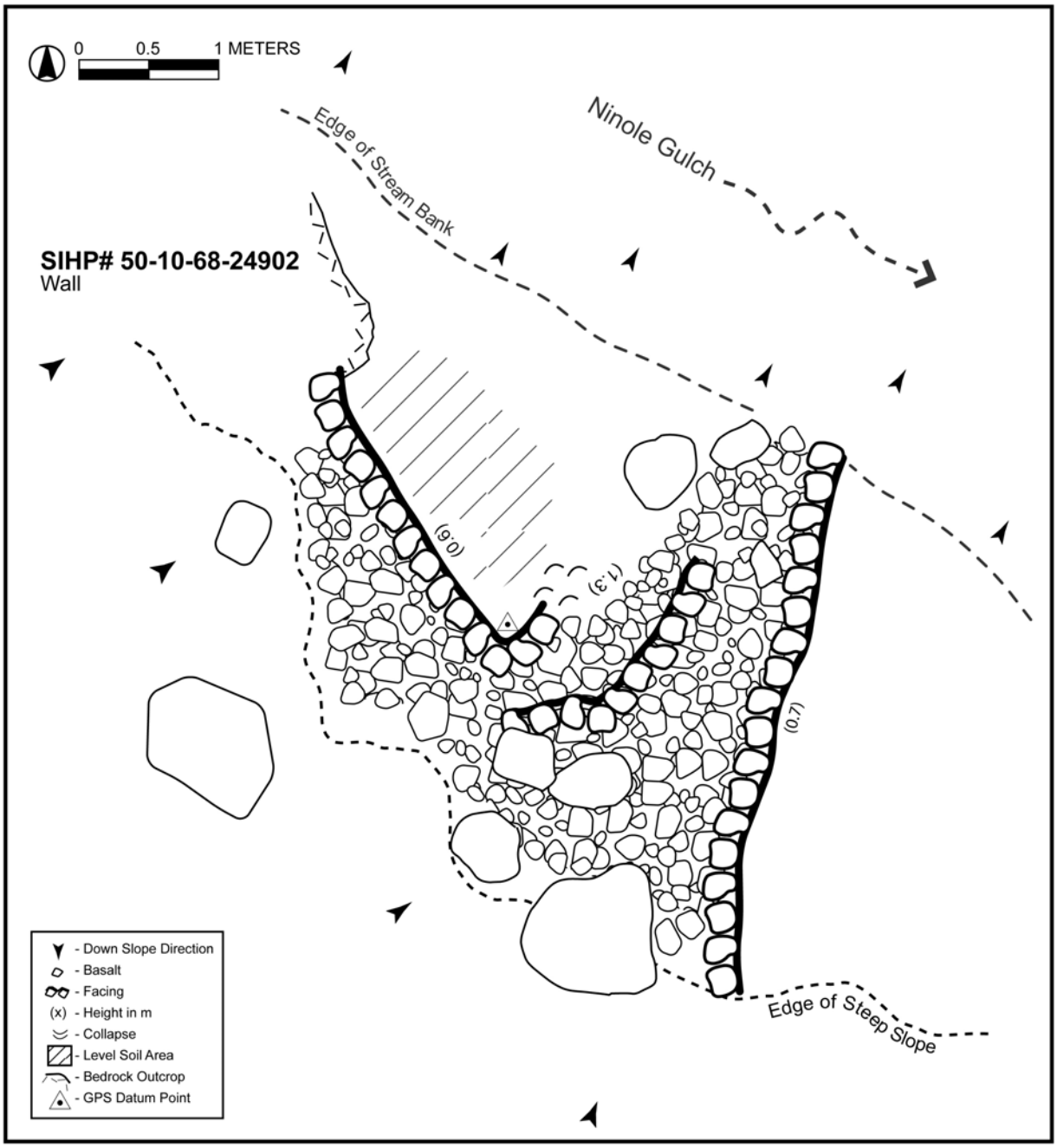

Figure 126. Plan view diagram of SIHP # 50-10-68-24902 wall (possible enclosure).

Figure 127. SIHP # 50-10-68-24902 wall (possible enclosure), view to southeast.

SIHP # -24902 is interpreted to be a pre-contact wall, possibly the remaining portion of an enclosure. Due to the deteriorated state of the feature, the function of SIHP # -24902 is unclear. The wall is generally in poor condition, with areas of collapse, natural erosional disturbance, and rockfall disturbance from land clearing activities upslope. The intact portion of SIHP # -24902 maintains integrity of location, materials, and workmanship. Due to the extensive land modification in the surrounding area (i.e. golf course construction), and deteriorated state of the wall, SIHP # -24902 does not have integrity of design, setting, feeling, or association. SIHP # -24902 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

4.4.22 SIHP #: 50-10-68-24903

FUNCTION: Habitation / Burial
SITE TYPE: Enclosure
FEATURES: 1
DIMENSIONS: 13.5 m NW/SE by 7.5 m NE/SW
CONDITION: Good
AGE: Pre-contact
TAX MAP KEY: [3] 9-5-019:011, 032

SIHP # 50-10-68-24903 consists of an enclosure located in the central portion of the Makai Survey Area (see Figure 15). The enclosure is situated at the top edge of a bedrock bluff, immediately east of the Colony One condominium's pool/hot tub area. SIHP # -24903 was previously identified by Barrera and Hommon (1972) and designated site 50-HA-B9-121. The surrounding area has been completely landscaped and developed, though SIHP # -24903 remains relatively undisturbed.

SIHP # -24903 is enclosed on three sides, with the open end of the enclosure at the edge of the bluff, overlooking the ocean (Figure 128). The enclosure measures 13.5 m by 7.5 m wide, with walls constructed of loosely stacked basalt boulders and cobbles, 2-3 courses high. The walls measure 70 cm wide, 70 cm high and are faced on both the interior and exterior surfaces (Figure 129). The walls are in good to fair condition with only the eastern wall having been disturbed by landscaping activities. The interior of the enclosure has a level terrace on the *mauka* end, with a 30 cm high retaining wall running across the center of the enclosure. The linear retaining is constructed of mounded basalt cobbles and small boulders, and extends from wall to wall, along the contour of the slope. The *mauka* half of the interior of the enclosure is level, rocky soil (possibly paved with basalt cobbles) with many bedrock outcrops. The *makai* half is gently sloping, with a surface of basalt cobbles, pebbles, and bedrock outcrops. 2 coral cobbles, a few water rounded cobbles, and sparse marine shell midden were observed on the surface of the interior of the enclosure.

Two rectangular mounds are located in the center of the *mauka* portion of the enclosure (Figure 130). The mounds were constructed of mounded basalt cobbles and small boulders, 20 cm in height. The mounds were parallel to each other, spaced 45 cm apart, and oriented parallel to the short axis of the enclosure. The *makai* mound measured 2.8 x 1.1 m and the *mauka* mound measured 3.9 x 8 m. The mounds appear to be probable burials.

SIHP # -24903 is interpreted to be a pre-contact habitation enclosure, with an additional burial function. The enclosure and interior terrace and mound features are intact and in good condition. SIHP # -24903 maintains integrity of location, design, materials, workmanship. Due to the extensive land modification in the surrounding area, the enclosure does not have integrity of setting, feeling, or association. SIHP # -24903 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places and Criterion E (have an important value to the native Hawaiian people due to associations with cultural practices once carried out at the property – these associations being important to the group's history and cultural identity) of the Hawai‘i Register of Historic Places.

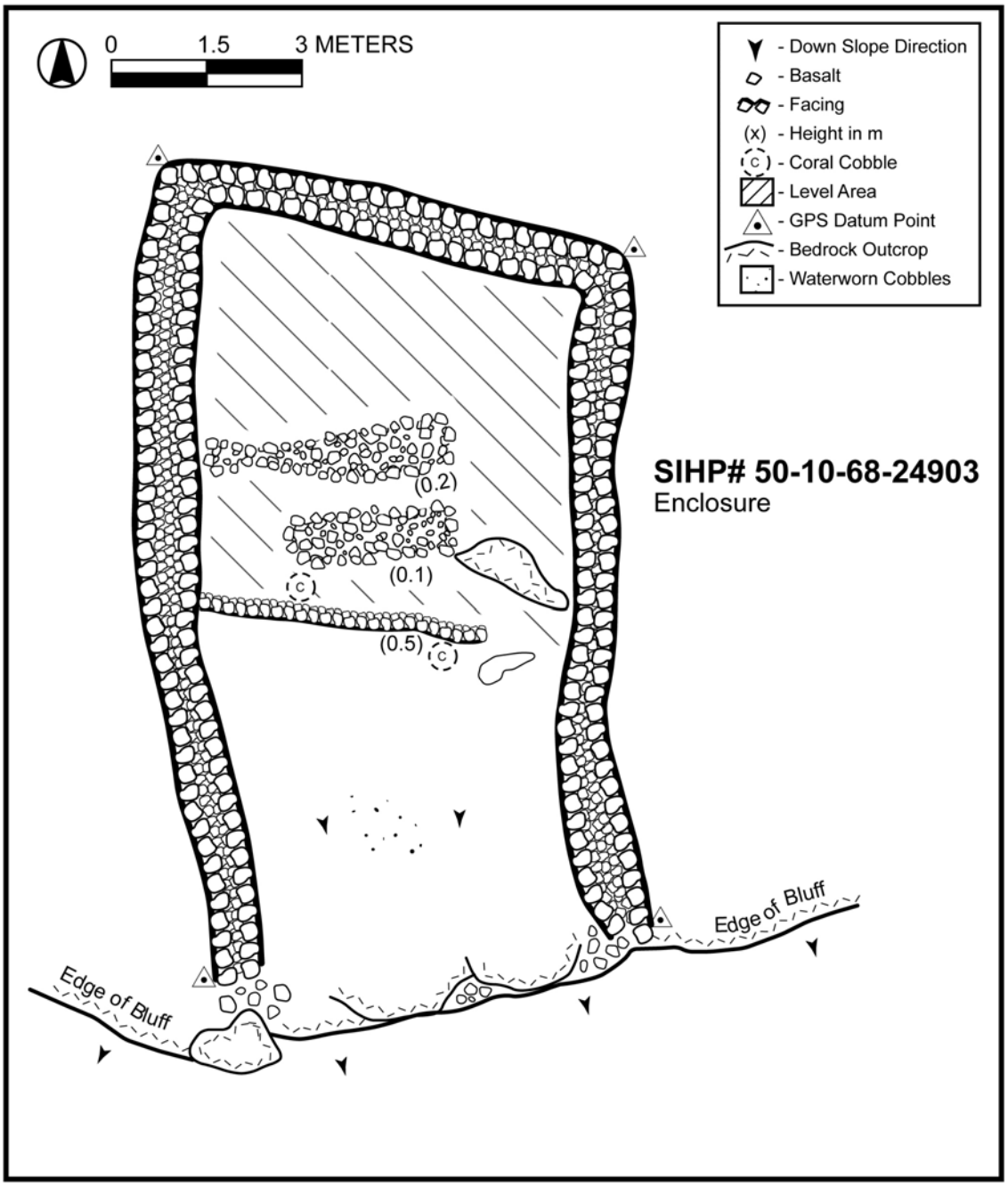

Figure 128. Plan view diagram of SIHP # 50-10-68-24903 enclosure.

Figure 129. SIHP # 50-10-68-24903 enclosure, view to northeast.

Figure 130. SIHP # 50-10-68-24903 enclosure, showing interior mounds, view to northeast.

4.4.23 SIHP #: 50-10-68-24905

SITE TYPE: Stone Wall
FUNCTION: Cattle Barrier
FEATURES: 1
DIMENSIONS: 190 m Long NW-SE
CONDITION: Good
AGE: Historic
TAX MAP KEY: [3] 9-5-091:015

SIHP # 50-10-68-24905 consists of a linear stone wall segment located in the central portion of the Makai Survey Area (see Figure 15). The wall was previously identified by PHRI (Rosendahl & Rosendahl 1986) and designated site T-104. The following description of SIHP # -24905 (site T-104) was provided by PHRI (Rosendahl and Rosendahl (1986):

> This wall measures approximately 1.0 m high end 1.0 m wide, and runs parallel to the entrance road, Punalu'u Road, at a distance 30.0 m to the northeast. The wall is four to six courses high, and constructed primarily of small boulders and large cobbles. Portions of the wall are collapsed. (Rosendahl and Rosendahl 1986:27)

SIHP # -24905 is a *mauka-makai* trending wall, extending approximately 190 m long. Both the *mauka* and *makai* ends of the wall have been truncated by land clearing activities in the area. SIHP # -24905 is constructed of stacked basalt boulders and cobbles, 7-8 courses high, in a bi-faced, core-filled manner (Figure 131). The wall measured a maximum of 1.3 m high and 0.8 m wide. SIHP # -24905 is situated on a relatively rough surface with undulating bedrock outcrops as well as level soil areas. The wall incorporates large bedrock outcrops and was observed to be constructed down into and through natural depressions.

SIHP # -24905 is interpreted to be a historic ranch-related cattle wall, functioning in restricting the movement of cattle. The wall has not been modified with the addition of barbed wire fencing, as observed in other stone walls identified within the project area. SIHP # -24907 has been disturbed with the ends of the wall being truncated, as well as sections of the wall damaged by land clearing activities in the vicinity. However, much of the wall is intact and in good condition, with limited areas of collapse. The surrounding area has been heavily disturbed by land clearing activities. The intact portion of SIHP # -24905 maintains integrity of location, design, materials, and workmanship. Due to the extensive land modification in the surrounding area, and discontinued use of the area for ranching purposes, the wall does not have integrity of feeling or association. SIHP # -24905 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

Figure 131. SIHP # 50-10-68-24905 wall, view to east.

4.4.24 SIHP #: 50-10-68-24906

SITE TYPE: Stone Wall
FUNCTION: Land Division / Cattle Barrier
FEATURES: 1
DIMENSIONS: 240 m Long NW-SE
CONDITION: Poor
AGE: Historic
TAX MAP KEY: [3] 9-5-091:015

SIHP # 50-10-68-24906 consists of a linear stone wall segment located in the northern portion of the Makai Survey Area (see Figure 15). The wall was previously identified by PHRI (Rosendahl & Rosendahl 1986) and designated site T-109. SIHP # 24905 runs parallel to and approximately 19 m northeast of the *makai* portion of SIHP # -4360 wall. The following description of SIHP # -24906 (site T-109) was provided by PHRI (Rosendahl and Rosendahl (1986):

> This wall runs parallel to another wall (Site B9-62) at a distance of 23.0 m to the northeast. Site T-109 is in generally deteriorated condition, with the seaward 10.0 to 15.0 m portion being the most intact. The wall averages 1.0 m wide and 1.0 a high, and is constructed of small to large boulders. Sections of the wall appear to be core-filled. (Rosendahl and Rosendahl 1986:32)

SIHP # -24906 is a *mauka-makai* trending wall, extending approximately 240 m in length. Both the *mauka* and *makai* ends of the wall have been truncated by land clearing activities and

golf course construction in the area. SIHP # -24905 is constructed of stacked basalt boulders, and large cobbles, 4-6 courses high. The wall measured a maximum of 1.0 m high and 0.9 m wide.

SIHP # -24906 is interpreted to be a historic ranch-related cattle wall, functioning in restricting the movement of cattle, as well as demarcating an ahupua‘a boundary. The wall has not been modified with the addition of barbed wire fencing, as observed in other stone walls identified within the project area. The construction methods and generally deteriorated condition of the wall suggest SIHP # -24906 is of greater antiquity than the SIHP # -4360 wall that parallels it to the southwest. SIHP # -24906 may represent an earlier alignment of the Punalu‘u-Wailau ahupua‘a boundary, which was later replaced by the SIHP # -4360 wall. SIHP # -24906 has been disturbed with the ends of the wall being truncated, as well as sections of the wall damaged by land clearing activities in the vicinity. The wall is generally in poor condition, with many areas of collapse. However, portions of the wall area do remain intact, primarily the *makai* portion. The surrounding area has been heavily disturbed by land clearing activities. The intact portion of SIHP # -24906 maintains integrity of location, design, materials, and workmanship. Due to the extensive land modification in the surrounding area, and discontinued use of the area for ranching purposes, the wall does not have integrity of feeling or association. SIHP # -24906 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

4.4.25 SIHP #: 50-10-68-24911

SITE TYPE: Stone Wall
FUNCTION: Cattle Barrier
FEATURES: 1
DIMENSIONS: 4.1 m Long
CONDITION: Good
AGE: Historic
TAX MAP KEY: [3] 9-5-019:011

SIHP # 50-10-68-24911 consists of a linear stone wall located near the western edge of the Makai Survey Area (see Figure 15). The wall is constructed across the base of a gulch, with each end of the wall intersecting with and incorporating large talus boulders against edges of the gulch (Figure 132). The gulch is deep and narrow, with nearly vertical side walls, and is at the edge of a young *‘a‘ā* lava flow. The wall is constructed of loosely stacked basalt boulders and cobbles, 3-4 courses high (Figure 133). The stones used in the wall construction averaged 15-30 cm in diameter, with the base of the wall consisting of larger stones, up to 60 cm in diameter. The wall measured 4.1 m long and 0.8 m wide, with a maximum height of 1.1 m.

SIHP # -24911 is interpreted to be a historic ranch-related cattle wall. The wall functions in restricting cattle from traveling up the narrow gulch. SIHP # -24911 is intact and in good condition, with limited collapse. The wall is undisturbed and maintains integrity of location, design, materials, and workmanship. The area immediately down slope of the wall has been bulldozed, associated with the construction of the nearby wastewater treatment plant. Due to the disturbance of the surrounding area, SIHP # -24911 does not have integrity of setting, feeling, or association. SIHP # -24907 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

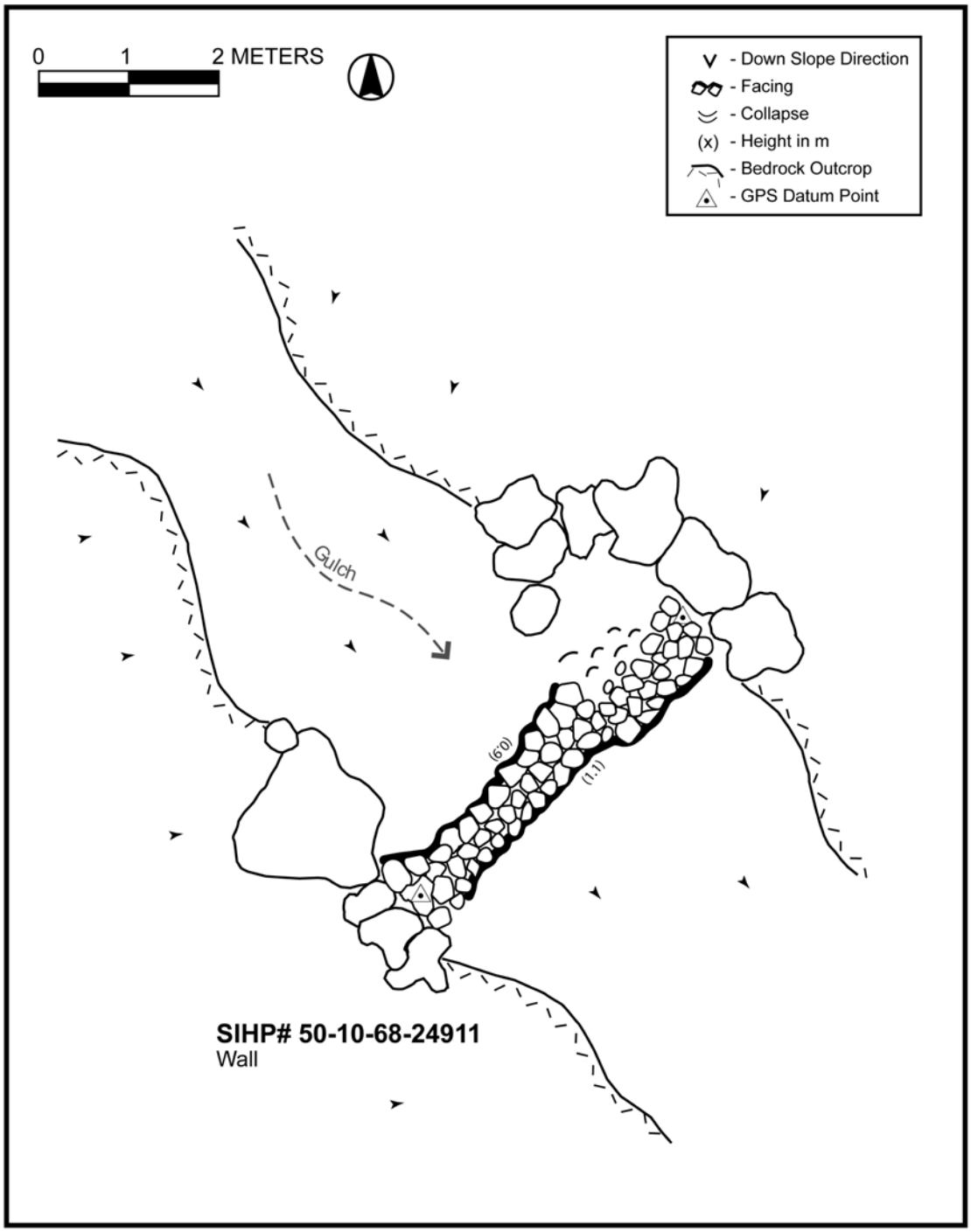

Figure 132. Plan view diagram of SIHP # 50-10-68-24911 wall.

Figure 133. SIHP # 50-10-68-24911 wall, view to northwest.

4.4.26 SIHP #: 50-10-68-24912

SITE TYPE: Terrace
FUNCTION: Probable Burial
FEATURES: 1
DIMENSIONS: 2.0 m E/W by 1.5 m N/S
CONDITION: Excellent
AGE: Pre-contact
TAX MAP KEY: [3] 9-5-019:011

SIHP # 50-10-68-24912 consists of a small terrace located in the northwestern portion of the Makai Survey Area (see Figure 15). The terrace is situated at the base of a natural depression measuring approximately 5 m in diameter and 0.9 m deep. The surrounding area outside of the depression appeared to have been graded. However, the interior of the depression was undisturbed.

SIHP # -24912 is a semi-circular terrace constructed against the northwestern edge of the depression (Figure 135 & 135). The terrace is constructed with a perimeter of loosely stacked *‘a‘ā* basalt cobbles and small boulders, 1-2 courses high. SIHP # -24912 measures 2 m long and 1.5 m wide, with a maximum height of 35 cm. The interior of the terrace is paved with reddish *‘a‘ā* cobbles, with an approximately 40 cm diameter accretionary lava ball in the center. No cultural material was observed on the surface of the terrace or in the immediate vicinity.

SIHP # -24912 is interpreted to be a pre-contact native Hawaiian burial. This interpretation is based on size of the terrace, location within a natural depression, selection for reddish *‘a‘ā*

cobbles for paving, and the positioning of a round lava accretion boulder in the center of the terrace. SIHP # -24912 is undisturbed and maintains integrity of location, design, materials, workmanship, and feeling. Due to the extensive land modification in the surrounding area, the terrace does not have integrity of setting or association. SIHP # -24912 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places and Criterion E (have an important value to the native Hawaiian people due to associations with cultural practices once carried out at the property – these associations being important to the group's history and cultural identity) of the Hawai‘i Register of Historic Places.

Figure 134. SIHP # 50-10-68-24912 probable burial terrace, view to north.

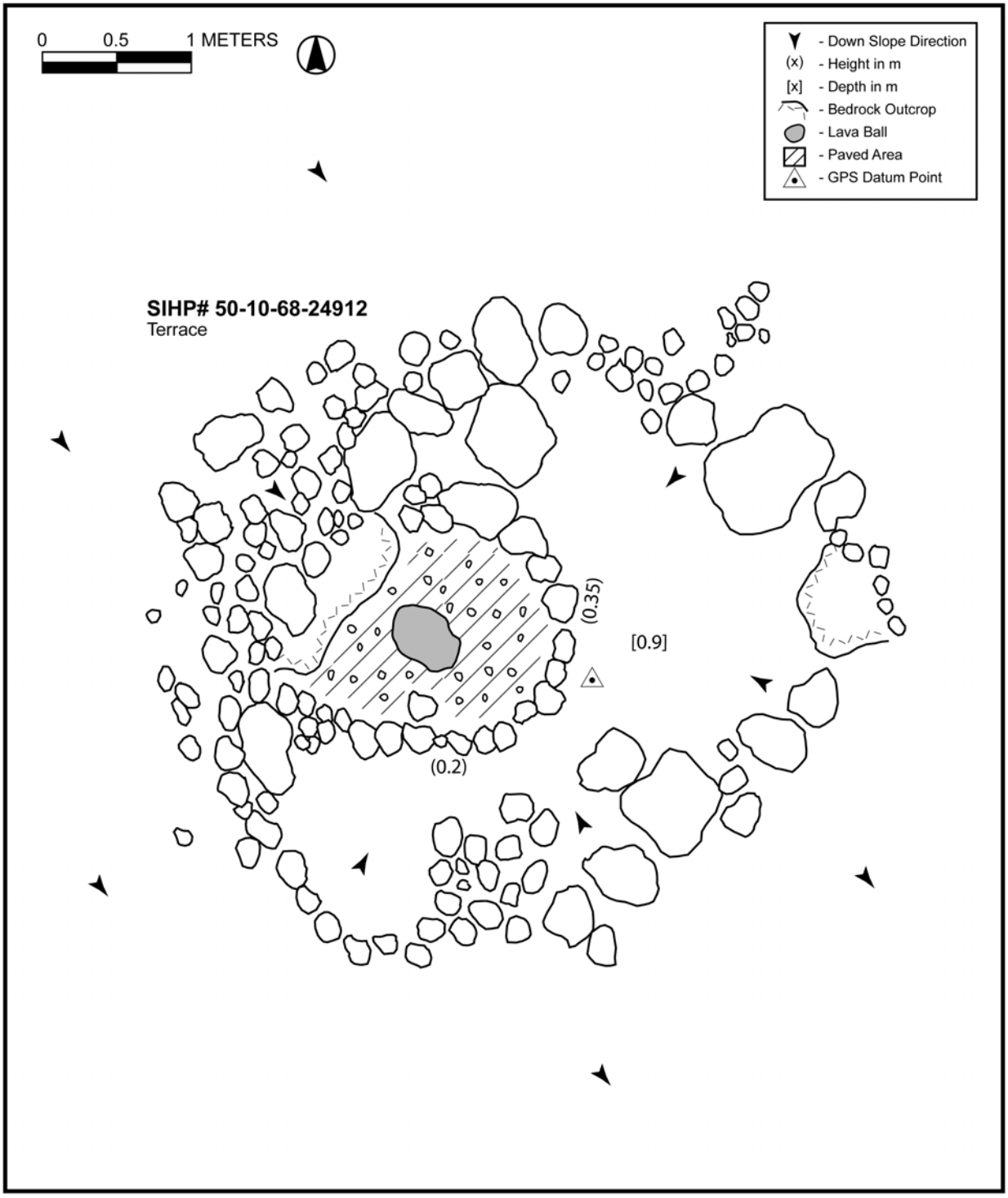

Figure 135. Plan view diagram of SIHP # 50-10-68-24912 probable burial terrace.

4.4.27 SIHP #: 50-10-68-24913

SITE TYPE: Well
FUNCTION: Water Storage
FEATURES: 1
DIMENSIONS: 1.9 m Diameter
CONDITION: Excellent
AGE: Historic
TAX MAP KEY: [3] 9-5-019:011

SIHP # 50-10-68-24913 consists of a paved well located in the southeastern portion of the Makai Survey Area (see Figure 15). The well is situated on the flat coastal plain, approximately 150 m from the shoreline. SIHP # -24913 is a circular construction, excavated in a level soil area with low *pāhoehoe* ridges in the surrounding area. The interior of the well is lined with mortared basalt boulders and cobbles, with 4 courses visible at present. The well measured 85 cm deep at the time of the inventory survey. However, due to heavy sedimentation, the well may be significantly deeper than the present measured depth. The interior of the well measures 1.3 m in diameter, with an exterior diameter of 1.9 m.

SIHP # -24913 is interpreted to be a historic well, associated with historic habitation in the immediate area. The well draws fresh water from the shallow water table in the area, evidenced by the abundant springs and ponds in the vicinity. No cultural material or evidence of historic house sites was observed in the immediate vicinity of the well. However, the well may be associated with historic habitation at the Wailau Complex (SIHP # -4310), which is approximately 45 m northwest of SIHP # -24913. SIHP # -24913 is undisturbed, in excellent condition, and maintains integrity of location, design, materials, and workmanship. Due to the disturbed nature of the surrounding area (i.e. tsunami damage), and lack of continued habitation in the vicinity, SIHP # -24913 does not have integrity of setting, feeling, or association. SIHP # -24913 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

4.4.28 SIHP #: 50-10-68-24914

SITE TYPE: Cave
FUNCTION: Possible Burial
FEATURES: 1
DIMENSIONS: 30 m by 40 m by 100 m
CONDITION: Good
AGE: Pre-contact
TAX MAP KEY: [3] 9-6-001:002

SIHP # 50-10-68-24914 consists of a small cave located eastern portion of the Makai Survey Area (see Figure 15). The cave is situated within the *‘a‘ā* bluff immediately east of the Punalu‘u Harbor wharf ruins (SIHP # -7361). Kane‘ele‘ele Heiau is located on the top of the bluff, to the east of SIHP # -24914. The entrance of SIHP # -24914 measures 0.3 m wide by 0.4 m high. The entrance area to the cave appears to have been built up with mounded basalt stones and soil to within 1 m of the ceiling of the cave entrance (Figure 136). The mounded area allows for easier

access to the cave entrance from the base of the steep bluff. The interior of the cave is relatively small, measuring approximately 2 m deep, with a maximum ceiling height of 1 m. No clear modifications were observed within the interior of the cave. A highly decomposed, 1 mm long bone fragment of unidentifiable origin was observed within the cave. No additional cultural material was observed.

SIHP #-24914 was pointed out to the CSH field crew by local informants and identified as a possible locale for the interment of the remains of human sacrifices offered at the nearby Kane‘ele‘ele Heiau. No clear evidence of the cave functioning as a major interment site was observed. However, due to the possibility of the cave containing human remains and community concern that the cave was associated with sacrifices at Kane‘ele‘ele Heiau, the cave was documented as a significant historic property. SIHP # -24914 was undisturbed and maintains integrity of location, design, materials, workmanship. The cave also has integrity of feeling and association because of the relationship of the cave with Kane‘ele‘ele Heiau. However, due to the construction of the Punalu‘u Harbor wharf (SIHP # -7361), the cave does not have integrity of setting. SIHP # -24914 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places and Criterion E (have an important value to the native Hawaiian people due to associations with cultural practices once carried out at the property – these associations being important to the group’s history and cultural identity) of the Hawai‘i Register of Historic Places.

Figure 136. SHIP # 50-10-68-24914 possible burial cave, view to northeast.

4.4.29 SIHP #: 50-10-68-24915

SITE TYPE: Railroad Berms
FUNCTION: Transportation
FEATURES: 5
CONDITION: Fair
AGE Historic
TAX MAP KEY: [3] 9-6-001:001, 002, 013 9-6-002:006, 038

SIHP # 50-10-68-24915 consists of 4 railroad berm segments and an associated retaining wall, located in the northeastern portion of the Makai Survey Area (see Figure 15). SIHP # -24915 Features A and B were previously identified by PHRI and designated site T-107. The following description was provided by PHRI for site T-107:

> Two segments of this feature are present within the northeast portion of the project area. A 50.0 m segment adjacent to the sixth fairway, measures approximately 7.2 m wide and 2.0 m high, and is a well-faced bed with a level surface. The roadway leading to the east side of Punalu‘u Harbor appears to be the continuation of this railroad bed. It is the same width, though substantially more elevated as it crosses a gulch just before entering the Punalu‘u Harbor area. Hansen (1974b) includes a sketch map of Punalu‘u showing the course of the railroad, which originates at the harbor and continues inland, with a gentle curve to the northeast and another to the southwest (the inland railroad bed segment), and then continues on a straight northerly route toward Pāhala. The railroad bed is in good condition. (Rosendahl and Rosendahl 1986:27)

SIHP # -24915 Feature A consists of an approximately 550 m long segment of railroad berm (see Figure 15). The berm begins at the Punalu‘u Harbor wharf (SIHP # -7361 Feature A) and progresses north along the base of an *‘a‘ā* bluff. In this portion, the edge of the *‘a‘ā* flow has been graded and the railroad bed is constructed with a retaining wall along the western, down slope edge. The berm then curves to the west and traverses a low gully area. In this portion, the railroad berm is freestanding, elevated a maximum height of approximately 3 m. At the intersection with Punalu‘u Rd., the railroad berm has been truncated by road and golf course construction. In general, the Feature A railroad berm is constructed of stacked basalt boulders with well-faced side walls. The berm is trapezoidal shaped, with a wide base and narrower surface, with sloping side walls. The top surface of the berm measures approximately 7 m wide and is level and paved with basalt gravel. The Feature A railroad currently serves as a vehicular access road from Punalu‘u Road to the Punalu‘u Harbor boat ramp.

SIHP # -24915 Feature B consists of a northeastern extension of the Feature A railroad berm. Feature B is located approximately 250 m northwest of Feature A and is bordered to the west and south by the Sea Mountain Golf Course (see Figure 15). Feature B is an approximately 28 m long, roughly linear segment constructed along the base of a bluff. The berm has a retaining wall along the southwestern, down slope side, constructed of stacked basalt boulders and cobbles (Figure 137). The berm is well-faced, measuring approximately 6 m wide, and 1.5-2.4 m in height. The northern end of the Feature B railroad berm has been truncated by land clearing activities, and the southern end truncated by golf course construction.

Figure 137. SIHP # 50-10-68-24915 Feature B railroad berm, view to north.

Figure 138. SIHP # 50-10-68-24915 Feature C railroad berm, view to northeast.

SIHP # -24915 Feature C is also consists of an additional extension of the Feature A railroad berm. Feature C is located approximately 440 m west of Feature A and is bordered to the north and east by the Sea Mountain Golf Course, and to the south by the SIHP # 24904 wall (see Figure 15). Feature C is roughly parallel to Feature B and 230 m to the southwest. The Feature C railroad berm is the most substantial of the observed railroad berm constructions, and consists of an approximately 40 m long, roughly linear segment of railroad berm. The ends of the berm are truncated by golf course construction. The berm segment transverses a low-lying area, where the berm is raised to a maximum of 3.3 m above the ground level. The truncated ends of the berm are level with the ground surface. The berm is constructed of stacked basalt boulders with large boulders, 50-60 cm in diameter, at the base and smaller boulders, 20-30 cm diameter, at the top of the construction (Figure 138). The berm is trapezoidal shaped, with a wide base and narrower surface, with sloping side walls. The top surface of the berm is measures 4.2 m wide and is level and paved with basalt cobbles. Feature C is interpreted to be an alternative, perhaps later, route of the railroad line than that taken from Feature A to B. The route from Feature A to Feature C, by increasing the length of the curve before heading upslope would decrease the grade required for the railroad to progress inland and north toward Pāhala from Punalu‘u Harbor.

SIHP # -24915 Feature D consists of a segment of railroad berm previously identified by Crozier and Barrera (1974) and designated site 50-HA-B8-31. The feature was relocated by PHRI (Rosendahl and Rosendahl 1986) and described as follows:

> Site B8-31 appears to be a section of an old railroad bed that is approximately 5.0 m wide. The railroad bed leads in from the north and continues down a steep slope toward Punalu‘u Harbor. It has been speculated that this could have been one of the first attempts to construct the railroad bed down the steep cliff face (Hansen Ms.). (Rosendahl and Rosendahl 1986:16)

Feature D railroad berm is constructed along the slope of the *‘a‘ā* bluff immediately upslope of Feature A railroad berm (see Figure 15). Feature D is oriented upslope, with the northwestern end of the berm nearly level with the Feature A railroad berm. The berm gains 2.3 m of elevation above Feature A over its 21.5 m length. The berm is constructed with a stacked basalt boulder and cobble retaining wall along the down slope edge, with a level, approximately 4.5 m wide top surface (Figure 139).

SIHP # -24915 Feature E consists of a retaining wall previously identified by Crozier and Barrera (1974) and designated site 50-HA-B8-32. The feature was relocated by PHRI (Rosendahl and Rosendahl 1986) and described as follows:

> A crude wall measuring approximately 15.0 m long. 0.6 m wide, end 0.9 m high has been designated Site B8-32. The wall is oriented upslope. (Rosendahl and Rosendahl 1986:16)

Feature E consists of a retaining wall constructed against the face of the *‘a‘ā* bluff, immediately upslope of the Feature A railroad berm (see Figure 15). The retaining wall extends approximately 27 m, with a maximum height of 3.5+ m. The wall is constructed of stacked basalt boulders and cobbles, and is well faced (Figure 140). There is a large collapsed section in the middle of the wall. Feature E is interpreted to be related to the construction of the Feature A

Figure 139. SIHP # 50-10-68-24915 Feature D railroad berm view to northeast.

Figure 140. SIHP # 50-10-68- SIHP # 50-10-68-24915 Feature E retaining wall, view to northeast.

railroad berm. The retaining wall prevents erosion and rockfall from the unstable slope of the *‘a‘ā* bluff immediately upslope of the railroad berm.

SIHP # 24915 includes segments of a railroad berm and an associated retaining wall. The railroad was constructed by the Hawaiian Agricultural Company (a.k.a. the Pahala Plantation) and extended from the landing at Punalu‘u Harbor to the sugar mill at Pāhala, a distance of approximately five miles (Conde and Best 1973:29). It was the first railroad to be constructed in the Hawaiian Islands, with initial construction *circa* 1878 and a completed track by 1880. The railroad line was realigned *circa* 1897 and again in 1902-03 (Conde and Best 1973:30). The Pāhala to Punalu‘u railroad was abandoned in 1929.

The observed segments of SIHP # -24915 railroad berm are generally intact and in excellent condition. The berms are very well built, with no collapse observed. A section of the Feature E retaining wall has collapsed, but portions remain intact and in good condition. SIHP # -24915 maintains integrity of location, design, materials, workmanship, feeling, and association. Despite the extensive land modification in the vicinity of Features B and C, the Feature A portion of the railroad and the adjacent, and associated Punalu‘u Harbor Complex contribute to the integrity of setting. SIHP # -24915 is assessed as significant under Criterion A (associated with events that have made an important contribution to the broad patterns of our history), Criterion C (embodies the distinctive characteristics of a type, period, or method of construction, represents the work of a master, or possess high artistic value), and Criterion D (have yielded, or is likely to yield information important for research on prehistory or history) of the Hawaii and National Registers of Historic Places.

4.4.30 SIHP #: 50-10-68-24916

SITE TYPE: Petroglyph
FUNCTION: Rock Art
FEATURES: 1
DIMENSIONS: 18 cm Diameter
CONDITION: Good
AGE: Pre-contact
TAX MAP KEY: [3] 9-5-019:011

SIHP # 50-10-68-24916 consists of a single petroglyph located in the southeastern portion of the Makai Survey Area (Figure 15). The site was previously identified by PHRI (Rosendahl and Rosendahl 1986) and designated as site T-101. The petroglyph is situated on a coastal pahoehoe flow, approximately 25 m from the shoreline. SIHP # -24916 includes of three concentric circles pecked into a smooth *pāhoehoe* surface (Figure 141 & 142). The outer circle measures 18 cm diameter, with the middle and center circles measuring 11 cm and 5 cm in diameter respectively. The petroglyph was observed to have undergone considerable natural weathering. No additional petroglyphs or cultural material was observed in the vicinity of SIHP # -24916.

SIHP # -24916 is interpreted to be an example of pre-contact native Hawaiian rock art. The true function of the petroglyph is unclear. The petroglyph and the surrounding area are undisturbed. SIHP # -24916 maintains integrity of location, design, setting, materials, workmanship, feeling, and association. SIHP # -24916 is assessed as significant under Criterion D (have yielded, or is likely to yield information important for research on prehistory or history)

Figure 141. SIHP # 50-10-68-24916 concentric circles petroglyph.

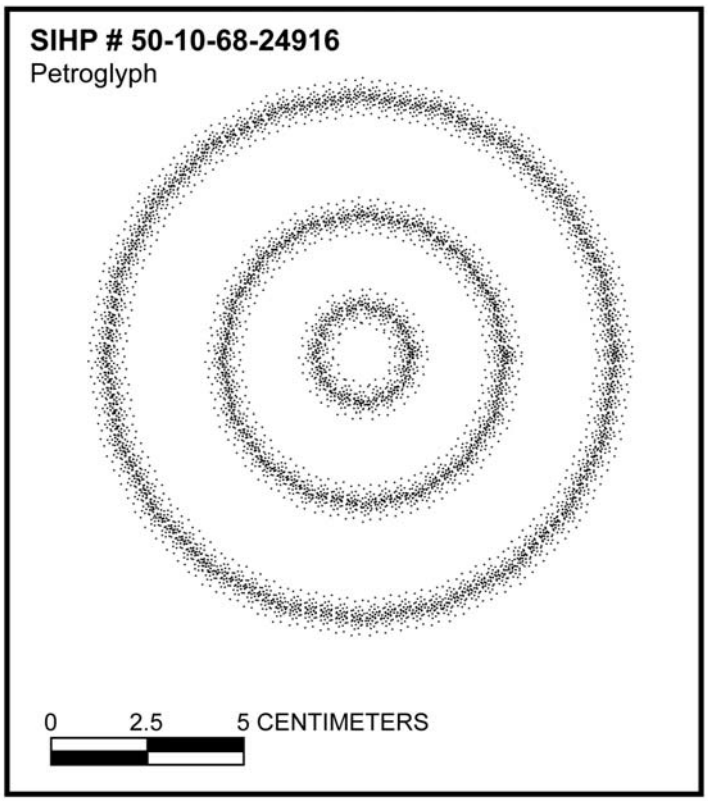

Figure 142. Plan view diagram of SIHP 50-10-68-24916 concentric circles petroglyph

of the Hawaii and National Registers of Historic Places and Criterion E (have an important value to the native Hawaiian people due to associations with cultural practices once carried out at the property – these associations being important to the group’s history and cultural identity) of the Hawai‘i Register of Historic Places.

Section 5 Results of Subsurface Testing

5.1 Archaeological Testing Prior to the Present Study

The following table summarizes the known history of archaeological testing within the present project area at Punalu‘u:

Table 9. Previous Archaeological Excavations within the Current Project Area

SIHP # (50-10-68)	Site # as reported	# Test Units/Area Excavated	Source
-3512, Lanipao *Heiau*	B8-2	TP 1 1.5 m^2, TP 2 1m^2 TP 3 2 m^2 TP 4 2 m^2 Total 4 test pits for 6.5 m^2	Crozier & Barrera 1974: 11, 14 & 15
	B9-18	Bottles collected from wall	Barrera & Hommon 1972:18
	B9-19	Screened debris	Barrera & Hommon 1972:18
	B9-20	TP 1 1 m^2, TP 2 1m^2 Total 2 test pits for 2 m^2	Barrera & Hommon 1972:18, 19
	B9-23	TP 1 1 m^2, TP 2 1m^2 TP 3 1 m^2 TP 4 1 m^2 Total 4 test pits for 4 m^2	Barrera & Hommon 1972:19, 20
-4310	B9-33	N Platform test 1 $m^{2?}$ S Platform test 1 $m^{2?}$ TP 1 1 m^2, TP 2 1m^2 Total 4 test pits for approx. 4 m^2	Barrera & Hommon 1972:20-22
-4310	B9-34	1 test pit for 1 m^2	Barrera & Hommon 1972:22
	B9-43	Total 4 test pits for 4 m^2	Barrera & Hommon 1972:22
	B9-48	Unclear	Barrera & Hommon 1972:22
	B9-56	Apparently 1 test pit for 1 m^2	Barrera & Hommon 1972:23-24
	B9-66	1 test pit for 1 m^2	Barrera & Hommon 1972:24

SIHP # (50-10-68)	Site # as reported	# Test Units/Area Excavated	Source
	B9-69	1 test pit for 1 m^2	Barrera & Hommon 1972:24
	B9-70	3 test pits for 3 m^2	Barrera & Hommon 1972:24-26
	B9-72	1 test pit for 1 m^2	Barrera & Hommon 1972:26
	B9-75	1 test pit for 1 m^2	Barrera & Hommon 1972:26
	B9-76	1 test pit. 1 m^2	Barrera & Hommon 1972:26-27
	B9-110	6 test pits of 1 m^2 each, total 6 m^2	Barrera & Hommon 1972:26-27
	B9-171	1 test pit for 1 m^2	Barrera & Hommon 1972:29
	B9-172	1 test pit for 1 m^2	Barrera & Hommon 1972:30
	B9-21 Wailau Complex	? [report not seen]	Kaschko 1973
	B9-173	TP 1 5 m^2 TP 2 2m^2 TP 3 1 m^2 TP 4 2 m^2 Total 4 test pits for 9 m^2	Crozier & Barrera 1974: 20, 22 & 23

Detailed descriptions of the results of the excavations at sites no longer extant are presented below. Results of excavations at sites that were relocated during the current study are presented along with the description of the site, in the Site Descriptions section.

5.1.1 Site # 50-10-68- -3512, Lanipao *Heiau* (B8-2)

Discussed in Site Descriptions Section 4.3.1.

5.1.2 Site # B9-18

Barrera and Hommon (1972) include their site B9-18 within their “Sites Excavated” descriptions but it appears that work here was limited to the recovery of bottles as explained below:

> This stone wall was 28 meters long, about 80 cm high, and 60 cm wide. At the E end it turned slightly to the N and went up a hillside for 10 meters. Along that upslope wall we found several small natural holes in the hillside that contained bottles; we collected eight specimens, analysis of manufacturing techniques indicates that these were probably in use during the period between about 1880 and 1910. (Barrera and Hommon 1972:18)

5.1.3 Site # B9-19

Barrera and Hommon (1972:18) include Site B9-19 within their “Sites Excavated” descriptions but it appears that work here was limited to screening of disturbed trash deposits recounted as follows:

> This house enclosure measured about 8.5 by 4.4 meters. Only one corner was intact at the time of the survey, as most of the site had been bulldozed. The disturbed trash deposits revealed quantities of historic materials. During the excavation phase of the project an echnoid spine file was found on the surface. In view of the lack of prehistoric sites in the area, we decided to screen the debris to determine the degree of precontact occupation at the site. The screening did not produce a single prehistoric artifact. Only glass, crockery, and metal were found in any quantity; the only artifact that we collected was a glass button. (Barrera and Hommon 1972:18)

5.1.4 Site # B9-20

Barrera and Hommon (1972) excavated 2 test units under an overhang rock shelter adjacent to an enclosure they collectively called site B9-20 (present Figure.143). They described Site B9-20 as follows:

> Two walls had been built across a small depression, forming an enclosed area 8 by 7 meters in extent, with a low-roofed (30 cm high) shelter on the S side that measured 2 by 10 meters. The walls were of simple stacked construction. The N wall stood between 70 and 90 cm in height, was 80 cm wide, and had a 60-cm-wide opening in it. The W wall stood between 35 and 95 cm high on the N end and about 25 cm high on the S end. It was about 75 cm wide and had an 85-cm-wide opening in it.
>
> A third, smaller wall had been built between two large rocks immediately in front of the rock shelter. A fourth wall continued to the S on top of the bedrock slope above the site and joined another wall at about a 90-deg angle. (Barrera and Hommon 1972:18)

Barrera and Hommon (1972) relate the following results of excavations at Site B9-20:

> Two squares were excavated [see present Figure 143], each to a depth of about 40 cm. Midden material was extremely scarce. The fill was composed of fine brown dirt, with no stratification evident. The 14-to20-cm level of Square 1 was a little more consolidated than the rest, and the layer from 28 cm to bedrock contained scattered tiny pieces of charcoal. Square 2 contained fine brown dirt exclusively. (Barrera and Hommon 1972:18)

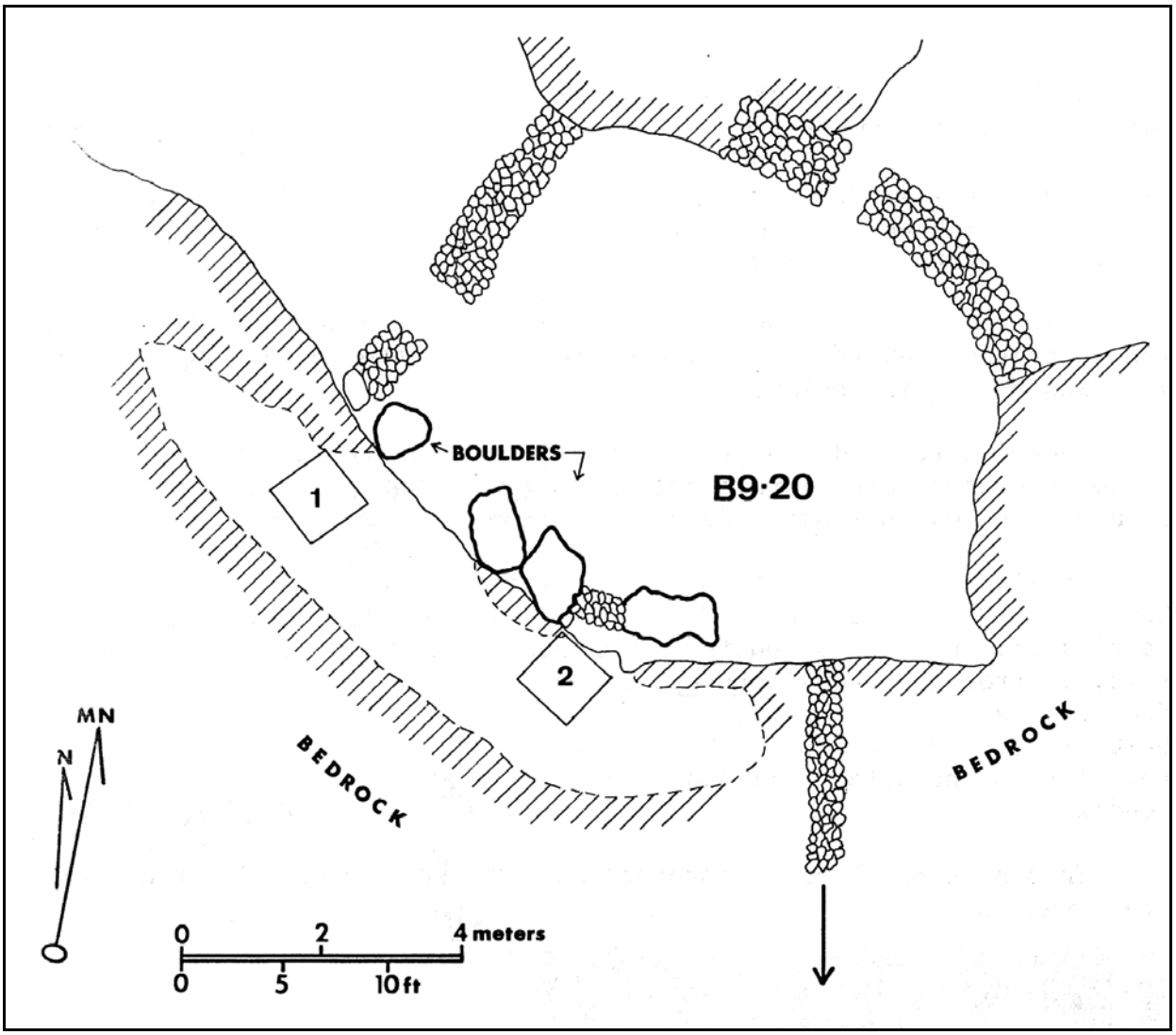

Figure 143. Map of Site B9-20 showing location of excavations (from Barrerra & Hommon 1972:21)

Sparse marine shell midden, unidentified bone, historic artifacts including glass and metal fragments, a single ceramic fragment, and 19 pieces of volcanic glass were recovered. These finds are presented in detail in Table 10. The recovery of such a quantity of volcanic glass and historic trash indicates use in both pre-contact and post-contact times. The modest quantities of midden reported, however, suggest only brief periods of use at this overhang rock shelter.

Table 10 Midden materials recovered from Bishop Museum Site B9-20 (from Barrera and Hommon 1972:Appendix B)

Material	**Sq.**	**Level (cm)**							
		0-10		**10-20**		**20-30**		**30-40**	
		gm	**no.**	**gm**	**no**	**gm**	**no.**	**gm**	**no.**
Cypraea caputserpentis	1	3	1						
	2							tr*	1
Cypraea reticulata	1					20	1		
Isognomon californicum	1					tr	1		
Littorina pintado	1					tr	1		
Unidentified shell	1					3	8		
	2					1	1		
Bone	1							55	
	2	5	2			tr	1		
Crockery	1			1					
Glass	1	6				1			
Kukui-nut shell	1					tr	1		
	2	2	2						
Metal	1	14		2					
	2	20		tr	1				
Volcanic glass	1			3	2	25	11	4	6
	2							tr	3

* tr = trace (less than 1 gm)

5.1.5 Site # B9-23

Barrera and Hommon report 4 excavations from their house enclosure site B9-23. Barrera and Hommon (1972) described Site B9-23 as follows:

> This walled house enclosure measured 10 by 10.8 meters...The enclosing walls of the site, collapsed in places, varied between 25 and 75 cm in height. The floor of the site was paved with moderate amounts of small, water-worn pebbles resting on midden deposits. (Barrera and Hommon 1972:19)

Barrera and Hommon (1972) relate the following results of excavations at Site B9-23:

> Four squares were excavated. The upper 2 cm of Square 1 contained a great many small, water-worn pebbles, below which was a very thin layer of gray ash. Below this ash, all the way to bedrock, was a deposit of fine brown dirt. The pit varied in depth from 10 to 15 cm, depending onn the slope of the bedrock. The NE corner was expanded (this was designated square 1A) in order to determine whether or not the above-mentioned ash layer became any deeper in that direction, but it did not. However, a broken single piece fishhook made of bone was recovered from that place at a depth of 6 cm.
>
> Square 2 reached a depth of 35 cm. The top 2 cm was composed of water-worn pebbles, as in Square 1, but beneath this was a 10 cm-thick deposit of gray ash. Beneath the ash was the same brown dirt as at the bottom of square 1.
>
> Square 3 was quite shallow, only about 5 cm deep, and the fill was similar to that of Square 1 - - a few centimeters of water-worn pebbles on the top and fine brown dirt below.
>
> Square 4 reached a depth of 30 cm. The top few centimeters were again composed of the water-worn pebble paving that was present in the other squares. Below this was a deposit of fine brown dirt.
>
> Artifacts recovered from the excavations are as follows: one bone fishhook [see present Figure 144] from a depth of 6 cm in Square 1A; three glass buttons, one pearl-shell button, one button of unidentified material, and a glass pendant [see present Figure 145] from the 5-cm-deep deposit in Square 3; and a glass button from the 0-10-cm-level of Square 4. (Barrera and Hommon 1972:19-20)

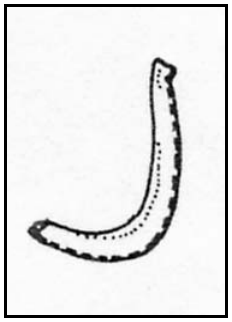

Figure 144. Broken fishhook (approx. full size), made of a single piece of bone. Recovered from NE corner, Square 1, Site B9-23 (from Barrerra & Hommon 1972:20)

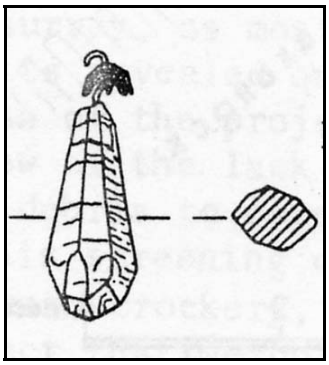

Figure 145. Glass pendant (full size), found in Square 3 of Site B9-23 (from Barrerra & Hommon 1972:20)

In addition to the artifacts described, significant amounts of marine shell midden, unidentified bone, and historic artifacts including glass, ceramic, and metal fragments, nails, and sparse amounts of volcanic glass were recovered. The quantity of midden suggests long-term or recurrent use of the site (consistent with the indications from the artifacts). The quantities of historic artifacts and the relatively modest number of volcanic glass flakes recovered (2 pieces) suggest that almost all of the occupational history at this house enclosure site was post-contact.

5.1.6 Site # 50-10-68-4310 (B9-33)

Discussed in Site Descriptions Section 4.5.1

5.1.7 Site # 50-10-68-4310 (B9-34)

Discussed in Site Descriptions Section 4.5.1.

5.1.8 Site # 50-10-68-4330 (B9-43)

Discussed in Site Descriptions Section 4.3.4

Table 11. Midden materials recovered from Bishop Museum Site B9-23 (from Barrera and Hommon 1972:Appendix C)

Material	**Sq.**	**Level (cm)**																			
		face		**0-5**		**0-10**		**35**		**bed-rock**		**10**		**bed-rock**		**10-20**		**10-bed-rock**		**30**	
			no	**gm**	**no**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no**	**gm**	**no.**	**gm**	**no.**	**gm**	**no**	**gm**	**no.**
Antigona reticulata	1													3	2						
Cypraea caput-serpentis	1	1	1	50										85							
	1A			3	3							25						4	3		
	2							35													
	3									10	7										
	4					72										56				12	
Cypraea reticulata	1	30	1	18	5									45	9						
	1A		22	2								4	2								
	2							20	6												
	3									60	6										
	4					65										18	5			13	7
Conus ebraeus	4					1	1														
Conus sp.	1													2	1						
	2							6	4												
	3									18	1										
	4					tr*	1									1	2				

Material	Sq.	Level (cm)																			
		sur-face		0-5		0-10		0-35		0-bed-rock		5-10		5-bed-rock		10-20		10-bed-rock		20-30	
		gm	no	gm	no	gm	no.	gm	no.	gm	no.	gm	no	gm	no.	gm	no.	gm	no	gm	no.
Drupa ricina	1			9	5									9	9						
	1A			4	1							6	5								
	2							7	6												
	3									8	3										
	4					13	17									6	10			2	3
Echinoderm	1			10										9	36						
	1A			1	4							9						1	3		
	2							1	1												
	3									tr	1										
	4					1	5									4	15			1	10
Helisconiscus exaratus	1	tr	1	25										45							

5.1.9 Site # B9-48

Barrera and Hommon (1972) described enclosure Site B9-48 (see present Figure 146) as follows:

> This was a partially walled enclosure of 8 by 10.5 meters, that utilized the nearly vertical sides of a collapsed lava bubble as part of its perimeter. (Barrera and Hommon 1972:22)

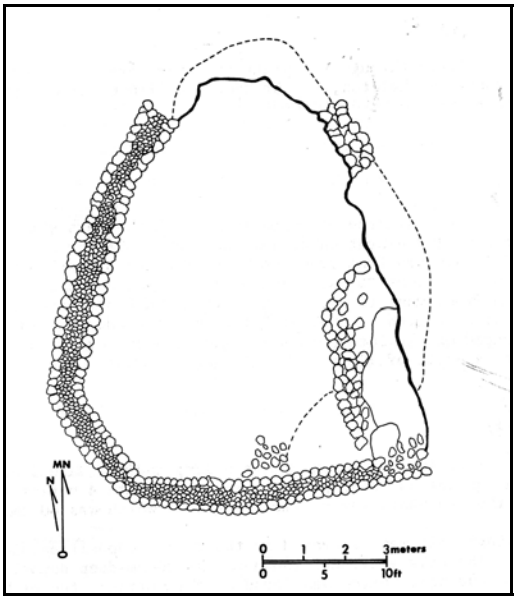

Figure 146. Map of partially walled enclosure, Site B9-48.

Although Barrera and Hommon (1972:22-23) include their site B9-48 within their “Sites Excavated” it is not clear that there was indeed any excavation at this site. No details of any excavations were provided.

5.1.10 Site # B9-56

Barrera and Hommon (1972) described Site B9-56 (2 platforms and a rock shelter) as follows:

> This site consisted of three features. Feature A was a well-constructed platform measuring 1.8 by 3 meters, standing as high as 80 cm on the downslope side. Feature B was a platform, not as well-built as Feature A, that measured 1.8 by 3 meters and stood between 25 and 60 cm high, depending upon the slope of the bedrock beneath. Feature C was a small rock shelter about 1.9 meters wide and 60 cm from front to back. The roof was about 40 cm high. (Barrera and Hommon 1972:23)

Barrera and Hommon (1972) relate the following results of excavations at Site B9-56:

> Excavation of Feature A revealed a burial in a lava bubble underneath. The opening in the roof of the bubble had been covered with a large rock, on top of which smaller ones were placed to construct the platform. No details as to the

> skeleton could be obtained, as all but a single humerus had been covered by the fine dirt that had apparently sifted through the platform after interment, and we could not excavate the skeleton, as our contract with C. Brewer stated that burials were not to be disturbed. (Barrera and Hommon 1972:23-24)

5.1.11 Site # B9-66

Barrera and Hommon (1972) described Site B9-66 (3 rock shelters) as follows:

> This site consisted of three small rock shelters situated along the edge of a low elevation of lava bedrock. Shelter A was 2.3 meters wide and 1.8 meters from front to back; Shelter B was 1.5 meters wide and 90 cm from front to back; and Shelter C was about 1.5 meters wide and 30 cm from front to back. Shelters A and C had crudely piled rubble walls in front. Shelter B also had a crude wall in front, but it was faced on the interior side. (Barrera and Hommon 1972:24)

Barrera and Hommon (1972) relate the following results of excavations at Site B9-66:

> A single pit excavated in Shelter B went to a depth of 10 cm, but only one item was found, a pearl-shell button. (Barrera and Hommon 1972:24)

5.1.12 Site # B9-69

Barrera and Hommon (1972) described rock shelter Site B9-69 as follows:

> This rock shelter was 6.9 meters long and 1.4 meters deep. A rubble alignment had been placed across the mouth 4 meters from the edge of the overhang, the maximum height of which was 60 cm. (Barrera and Hommon 1972:24)

Barrera and Hommon (1972) relate the following results of excavations at Site B9-69:

> A single pit was excavated in the midden deposit outside the shelter. The only artifacts found in the 20-cm-deep deposit were buttons. One bone button was found on the surface; two of bone and one of an unidentifiable material were found in the 5-to10-cm level, and one of an unidentifiable material was found in the 10-to15-cm level.

The midden deposits are listed in the following Table 12. In addition to the artifacts described, significant amounts of marine shell midden, primarily composed of *opihi* and cowry, unidentified bone, and historic artifacts including glass, ceramic, metal fragments, and sparse amounts of volcanic glass were recovered. This would be consistent with temporary habitation at this rock shelter extending into the post-contact period.

Table 12. Midden materials recovered from Bishop Museum Site B9-69 (from Barrera and Hommon 1972:Appendix G)

Material	**Level (cm)**									
	Surface		**0-5**		**5-10**		**10-15**		**15-bedrock**	
	gm	**no.**	**gm**	**no**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**
Cypraea reticulata					20	1	24	2		
Drupa ricina							14	1		
Echinoderm			1	4	4	25	5	3 7	1	8
Helcioniscus exaratus	330		140		117		60		40	
Nerita picea			tr*	1			tr	1		
Thais aperta			44	2	8	1	34	2		
Bone			10	3	32		tr	3		
Crockery	35	2	12	2	18	4	30	5	1	1
Glass	175		193		65		149		3	4
Kukui-nut shell	2	2	5	3	18	5	6	7	1	3
Metal	198		92		175		55		70	

* tr = trace (less than 1 gm)

5.1.13 Site # B9-70

Barrera and Hommon (1972) described Site B9-70 (2 rock shelters) as follows:

> This site was composed of two small rock shelters. The first (70A) was 2.7 meters wide, about 1 meter deep, and 40 cm from floor to ceiling. The second (70B) was 3.6 meters wide, 1.7 meters deep, and 70 cm from floor to ceiling. (Barrera and Hommon 1972:24)

Barrera and Hommon (1972) relate the following results of excavations at Site B9-70:

> Two squares were dug in 70A and one in 70B.
>
> Square 1 was located inside shelter 70A:
>
> > Level 1 (0 to10 cm) – The fill was made up of moderate amounts small rocks, dirt that came out in small (2 to 4 mm) clumps, and many roots.

Level 2 (10 to 20 cm) – The fill from this level was identical to that of Level 1 except that there was a thin layer of small, water-worn pebbles at a depth of 20 cm; this did not appear to have been a paving.

Levels 3 to 5 (20 to50 cm) – These levels were characterized by a deposit of brown dirt.

Square 2 of 70A was located immediately adjacent to Square 1, but was situated in the open in front of the shelter. The deposits were the same as in Square 1, except for the greater amount of historic trash in the uppermost two levels.

The artifacts recovered from site B9-70A are listed below:

Square	Depth	Artifact
1	Surface	Fragment of glass bottle dating from between 1855 and 1913
	0-10 cm	Piece of worked wood [see present Figure 146 below], function unknown
	10-20 cm	Partially worked coral file
2	0-10 cm	Knob portion of basalt pounder [see present Figure 14], Fragment of glass bottle dating from between 1850 and 1913
	10-20 cm	Fragment of lava abrader

No artifacts were recovered from the single 15-cm-deep pit in 70B. Midden remains recovered from the excavations are presented in the following Table 13.

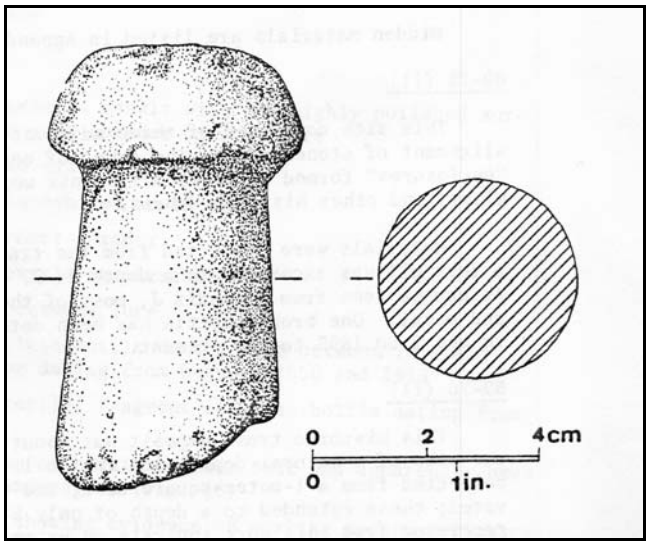

Figure 147. Top of broken basalt pounder found in square 2, Site B9-70A(from Barrera and Hommon 1972:25).

Table 13. Midden materials recovered from Bishop Museum Site B9-70 (from Barrera and Hommon 1972:Appendix H)

Material	**Sq**	**Level (cm)**	**Feature 70A**								**Feature 70B**						
		0-10		**10-20**		**20-30**		**30-40**		**40-50**		**0-5**		**5-10**		**10-15**	
		gm	**no**	**gm**	**no**	**gm**	**no**	**gm**	**no**	**gm**	**no**		**no.**	**gm**	**no**	**gm**	**no.**
Cypraea caputserpentis	1	2	3	5	11	17		27		10							
	2	16		55		27		22		23							
Cypraea reticulata	1	16	5					15	2	3	2						
	2	2	2	14	6	35	2			3	1						
Conus sp.	1	2	1					1	1								
	2			18	5	2	2	tr*	1	6	4						
Drupa ricina	1							tr	2	6	3						
	2	7	5	3	4	4	4	1	1	1	1						
Echinoderm	1	tr	2	2	1			6	1								
	2	2	3	tr	2	3	3										
Helisconiscus exaratus	1	105		20				2	1		4	1					
	2	535		35		8	5	6	6	3	5						
Isognomon californicum	1							tr	2								
	2			tr	1			tr	2	tr	2						
Nerita picea	1							tr	1								
	2	1	3	tr	2												
Thais aperta	1			4	1	4	2			1	1						
	2	8	1	12	7	85	12	5	6	4	1						
Thais harpa	1							2	1								
	2							1	1								
Unidentified	1	tr	1	2	1	1	1			4	5						

Material	Sq	Level (cm)	Feature 70A									Feature 70B						
		0-10		10-20		20-30		30-40		40-50			0-5		5-10		10-15	
		gm	no	gm	no	gm	no	gm	no	gm	no		gm	no.	gm	no	gm	no.
shell																		
	2								5	4								
Bone	1			1	4	3	5	45		1	1							
	2	9		20		35		5		6								
Crockery	1	19	5	4	1													
Glass	1	3	2	22	3								12	3	30		12	
	2	2	1	3	1	1	1	7	2	8	2							
Kukui-nut shell	1	18		20						tr	1	1	1					
	2	14		20		1	2	1	2	1	2							
Leather	2	10																
Metal	1	325		tr	1	8	4	tr	2			180		80		tr	1	
	2	80		10		9				4	2							
Plaster	2			125														
Volcanic glass	2	tr	2			tr	1											

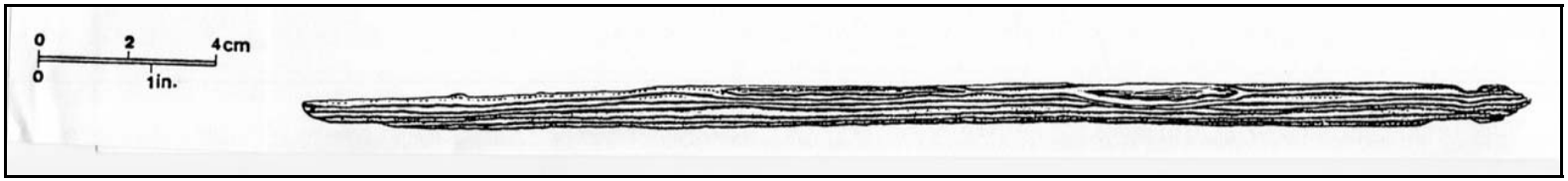

Figure 148. Piece of worked wood, of unknown function, Site B9-70A. (from Barrera and Hommon 1972:25)

The volume of midden recovered at Site B9-70 suggests long-term or re-current use which appears likely to have spanned the pre-contact and post-contact periods.

5.1.14 Site # B9-72

Barrera and Hommon (1972) described Site B9-72 as follows:

> This small, rectangular, walled enclosure measured 2.4 by 2.9 meters, with a 75-cm-wide opening in the SE wall. The wall was about 60 cm wide and 90 cm high. (Barrera and Hommon 1972:26)

Barrera and Hommon (1972) relate the following results of excavations at Site B9-72:

> A single square was excavated against the inside of the W wall. The major portion of the 30-cm-deep deposit was of gray ash and modern trash. On the S side of the pit, at a depth of about 10 cm, was a 2-to-3-cm thick lens of consolidated brown dirt (this lens was designated as Level 3 but the materials were inadvertently included with those of Level 2). The lowest 10 cm of the deposit was a sterile accumulation of fist-sized rocks that were sitting on Pahala Ash, which in turn rested on bedrock.
>
> This excavation showed that the west wall of the enclosure had been built directly on top of the gray-ash deposit – that is, the enclosure was later than the initial use of the site which was, apparently, a place for burning trash. After the enclosure had been built the site continued to function in the same way, as the upper 10 cm or so of the trashy ash deposit was wholly contained by the enclosure walls.
>
> Three buttons—one each of glass, pearl-shell, and bone—were found in the 0-to-5-cm level, and a metal button was found in the 5-to10-cm level.

Midden materials recovered are presented in Table 14 below. In addition to the artifacts described, significant amounts of marine shell midden, primarily composed of *opihi* and cowry, unidentified bone, and historic artifacts including glass, ceramic, and metal fragments, and pottery. Substantial discarding is indicated perhaps entirely within the post-contact period.

Table 14. Midden materials recovered from Bishop Museum Site B9-72 (from Barrera and Hommon 1972:Appendix I)

Material	**Level (cm)**							
	0-5		**5-10**		**10-15**		**15-20**	
	gm	**no.**	**gm**	**no**	**gm**	**no.**	**gm**	**no.**
Cypraea caputserpentis	6	5	1	1				
Cypraea reticulata	125							
Echinoderm	tr*	2	2	10	1	7	tr	2

Material	Level (cm)							
	0-5		5-10		10-15		15-20	
	gm	no.	gm	no	gm	no.	gm	no.
Helcioniscus exaratus	157		45		15		2	4
Nerita picea	8	20	2	4	2	5	1	3
Thais aperta	11	1	8	1	3	4		
Bone	2	2	tr	1			tr	1
Crockery	5	4	4	2				
Glass					14		4	3
Kukui-nut shell	54		10				1	2
Metal	336		265		505		5	
Pottery	12	1						

* tr = trace (less than 1 gm)

5.1.15 Site # B9-75

Barrera and Hommon (1972) described Site B9-75 as follows:

> This site consisted of three adjacent natural rock ledges with an alignment of stones across the front of each. Within the shallow "enclosures" formed by these alignments were found deposits of shells, glass, and other historic debris. (Barrera and Hommon 1972:26)

Barrera and Hommon (1972) relate the following results of excavations at Site B9-75:

> Materials were collected from the trash deposits on the ledges, and a test pit was excavated to a depth of 20 cm in an adjacent trash deposit. As can be seen from Appendix J [Table 15 below], most of the material recovered was glass and metal. One broken bottle has been determined to have been of a type in use from 1895 to the present [1972]. (Barrera and Hommon 1972:26)

In addition to the historic artifacts described, significant amounts of marine shell midden, primarily composed of *opihi* and cowry, were recovered. The occupation indicated may have been entirely within post-contact times.

Table 15. Midden materials recovered from Bishop Museum Site B9-75 (from Barrera and Hommon 1972:Appendix J)

Material	Ledges (cm)		Test Pit Level (cm)			
			0-10		10-20	
	gm	no.	gm	no	gm	no.
Cypraea caputserpentis	tr*	1				
Cypraea reticulata	125	7	5	1		
Echinoderm	1	3	2	8	1	6
Helcioniscus exaratus	65		70		65	
Bone			4	1		
Glass	755		195		110	
Kukui-nut shell			1	1	tr	1
Metal	90		7			

* tr = trace (less than 1 gm)

5.1.16 Site # B9-76

Barrera and Hommon (1972) described Site B9-76 as follows:

> This historic trash deposit was about 8 meters long, situated against the side of a natural depression in the lava bedrock. (Barrera and Hommon 1972:26)

Barrera and Hommon (1972) relate the following results of excavations at Site B9-76:

> Surface trash was collected from a 1-meter-square area, and the deposits beneath were excavated; these extended to a depth of only 5 cm. All of the artifacts recovered from this work indicate an extremely late date of occupation for the site, as the following list demonstrates:
>
> From the trash pile: four bottles of a type used after 1913
>
> From 0 to 5 cm in the test pit:
>
> 12 buttons of unidentified material, possibly rubber
>
> 2 bone buttons
>
> 2 metal buttons
>
> 2 pearl-shell buttons
>
> 1 cowrie-shell octopus lure
>
> 2 bottles of a type used after 1913
>
> 1 U.S. penny dated somewhat illegibly in the 1940s
>
> 1 1942 French 10 centimes coin

Midden materials recovered from the excavations are listed in Table 16 below. In addition to the artifacts described, significant amounts of marine shell midden, primarily composed of *opihi*, *Thais sp.*, and cowry, unidentified bone, and historic artifacts including glass, ceramic, and metal fragments, plastic, and rubber were recovered. The entire deposit may have dated to the twentieth century.

Table 16. Midden materials recovered from Bishop Museum Site B9-76 (from Barrera and Hommon 1972:Appendix K)

Material	**Surface Trash**		**Test Pit 0-5 cm**	
	gm	**no.**	**gm**	**no**
Cypraea caputserpentis	12	3	1	
Cypraea reticulata	130		70	
Conus miliaris abbreviatus	12	1		
Echinoderm	tr*	3	tr	2
Helcioniscus exaratus	500		213	
Nerita picea	9		tr	1
Thais aperta	542		50	
Bone	115		66	
Ceramic	38			
Crockery	1100		426	
Glass	400		320	
Kukui-nut shell	2	1	tr	2
Leather	150		22	
Metal	1570		1005	
Plastic	35		16	
Rubber	20		4	

* tr = trace (less than 1 gm)

5.1.17 Site # B9-110

Barrera and Hommon (1972) described Site B9-110 as follows:

> This collapsed lava bubble measured about 13 by 17 meters, with a rock shelter on the W side. The shelter was about 12 meters wide and 4 meters deep and had a maximum ceiling height of about 1.4 meters. The surface of the shelter contained a few historic artifacts. (Barrera and Hommon 1972:27)

Barrera and Hommon (1972) relate the following results of excavations at Site B9-110:

Six squares were excavated. The upper 30 to 40 cm of the deposits was a relatively sterile brown dirt, almost an ash in consistency. Below this was a dark cultural layer varying between 20 and 70 cm in thickness, depending on the location of depressions or rises in the lava bedrock. A fire pit located at a depth of 55 cm in Square 1 was about 10 cm thick, and its lowest point was about 3 cm above a ledge of bedrock. We did not attempt a radiocarbon determination on the material from this firepit, as the artifacts recovered from the excavations did not indicate any great age for the site, and we believed that any date would overlap too much with those provided by the historic artifacts to be of any value. The artifacts recovered are listed below:

Square	Depth (cm)	Artifact
1	35-40	Fragment of massive basalt with one highly polished surface, probably an abrader of some sort
	45-50	Echinoid-spine file
2	20-30	Fragment of carbonized woven cloth
	40-50	Fragment of coral abrader
3	45-55	Fragment of basalt hammerstone
	55-65	Cowrie-shell octopus lure
4	Surface	Fragment of glass bottle dating from between 1855 and 1913; another dating from between 1850 and 1913
5	0-30	Relatively sterile; fragment of glass bottle dating from after 1913
	5-15	Bottom portion of basalt pounder that had apparently been used as a hammerstone (Fig. 16)
	40-50	Beach cobble showing evidence of working around perimeter, possibly a hammerstone or abrader; another, one end worked in a similar manner
6	10-20	Glass button

The nature of the artifacts and midden material recovered [Table 17 below] from this site would seem to place the initial date of occupation sometime during the early historic period, as only a few of the artifacts could be considered to be completely prehistoric in nature. Those that are not definitely historic (such as the basalt pounder and the abraders, as opposed to the glass and metal) could well have been used during the historic period. (Barrera and Hommon 1972:27-29)

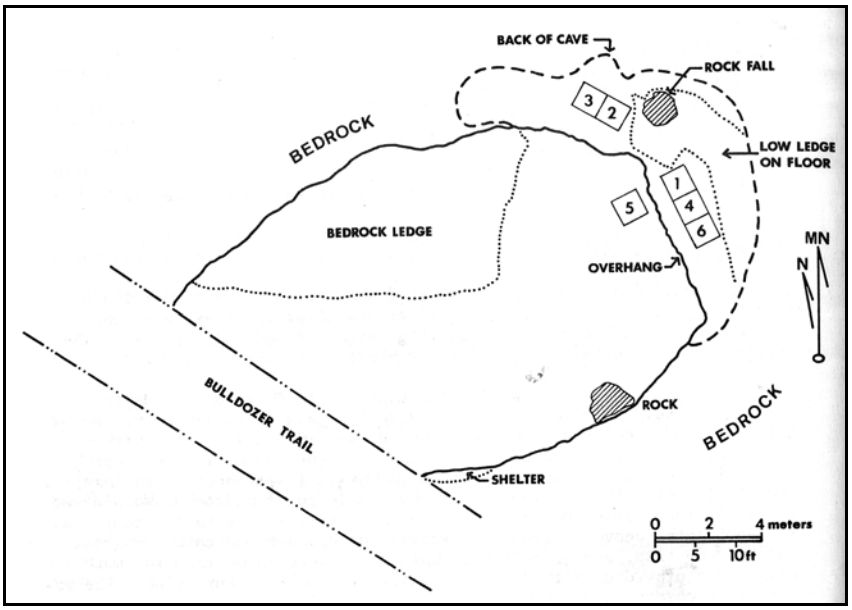

Figure 149. Map of Site B9-110 (from Barrera and Hommon 1972:28)

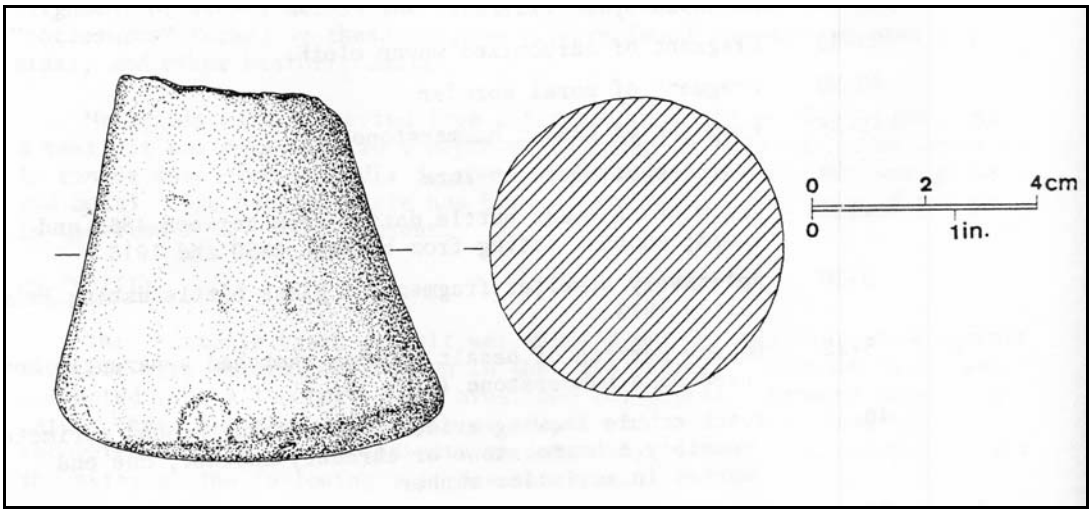

Figure 150. Bottom portion of basalt pounder found in Square 5 of Site B9-110 (from Barrera and Hommon 1972:28)

In addition to the artifacts described, significant amounts of marine shell midden, containing a high diversity of species, fish scales, unidentified bone, and historic artifacts including glass and metal fragments, and sparse volcanic glass were recovered (see following Tables 17-20).

Table 17. Midden materials recovered from Bishop Museum Site B9-110 Square 1 (from Barrera and Hommon 1972:Appendix L-1)

Material	**Level (cm)**																			
	0-10		**10-20**		**20-30**		**30-35**		**35-40**		**40-45**		**45-50**				**55-65**		**65-bedrock**	
	gm	**no.**	**gm**	**no**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**		**gm**	**no.**		**no.**	**gm**	**no.**	**gm**	**no.**
Antigona reticulata															6	1				
Bursa affinis													2	1	10	1				
Conus ceylonensis													1	1						
Conus sp.									2	2	6	5	8	6					1	1
Cypraea caputserpentis	2	2	4	5			1	1	55		75		195		54		33		22	16
Cypraea reticulata			2	2	1	2					17	5	35	6	6	3	20	6		
Drupa ricina			tr	1					1	1	tr	1	4	4	1	1			1	1
Echinoderm	tr	1	tr	1					1	6	4	4	8	12	2	1	1	1	tr	1
Helisconiscus exaratus	12	8	1	8	4	6			14		34		30		20		7	9	7	3
Isognomon californicum			tr	3	tr	2	4	19	33		10		30		2	15	2	11	11	28
Littorina pintado	tr	1							1	3	tr	2	2	9	tr	1	tr	1		
Melampus castaneus													tr	2						
Neretina cariosa									4	6	1	2	3	6	2	4	1	3	2	2
Nerita picea	1	4	3	16	1	4	2	14	18		6	25	24		2	6	1	4	1	4

Material	**Level (cm)**																			
	0-10		**10-20**		**20-30**		**30-35**		**35-40**		**40-45**		**45-50**		**50-55**		**55-65**		**65-bedrock**	
	gm	**no.**	**gm**	**no**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**
Pedalion incisa													3	4					2	2
Thais aperta			3	1					2	1	13	3	6	1						
Thais harpa									tr	1	tr	1	3	3			1	1	tr	1
Unidentified shell			tr	2					3	9			1	5						
Bone			2	10	9	7			1	5	4	10	6	20	8	14	tr	3	tr	1
Fish scales					tr	1			tr	2	tr	1	tr	5	tr	1	tr	1	tr	1
Kukui-nut shell	7	8	8	6	1	2	tr	1	2	8	1	5								
Metal	14	11	12	7	10	4														

Table 18 Midden materials recovered from Bishop Museum Site B9-110, Squares 2, 4 & 6 (from Barrera and Hommon 1972:Appendix L-2)

Material	**Sq.**	**Level (cm)**													
		0-10		**10-20**		**20-30**				**40-50**		**50-60**			
		gm	**no.**	**gm**		**gm**	**no.**	**gm**	**no.**		**no.**	**gm**		**gm**	**no.**
Antigona reticulata	4											5	1		
Barnacle	4													2	2
	6											tr*	1		
Chama iostoma	4											7	2		
Conus miliaris abbreviatus	4									2	1	27	10	13	6
	6									14	5				
Conus sp.	2			16	1	tr	3	8	6	1	1				
	4									1	1				
	6									2	5	1	1		
Cypraea caputserpentis	2	tr	1	10	9	80		147		57					
	4	1	1	tr	1			1	2	280		275		205	
	6			6	5					336	44				
Cypraea reticulata	2					10	3								
	4									5	3	40	10	5	1
	6									34	7	4	1		
Drupa ricina	2					6	5	4	4						
	4									10	10	10	8	5	6
	6														
Echinoderm	2			tr	1	2	5	13		6	12				
	4									11	13	5	14	6	13
	6									5	21	tr	1		
Helisconiscus exaratus	2			1	3	10	15	65		14	9				
	4	2	4	2	2			tr	2	160		26	34	19	41

Material	Sq.	Level (cm)													
		0-10		10-20		20-30		30-40		40-50		50-60		60-bedrock	
		gm	no.	gm	no	gm	no.	gm	no.		no.	gm	no.	gm	no.
	6	1	2	7	10					36		24			
Isognomon californicum	2			tr	2	11		42		15					
	4	tr	1					tr	2	25		30		40	
	6	tr	2	tr	1					80		4	4		
Littorina pintado	2					2	6	3	11						
	4									tr	1	3	7	4	4
	6									3	9				
Melampus castaneus	2							tr	2						
Morula tuberculata	4									1	1	1	3		
	6									tr	1				
Neretina cariosa	2					4	5	6	14	5	6				
	4									9		5	13	11	21
	6	tr	1							20	36	5	8		
Nerita neglecta	4											6	13	tr	1
	6									tr	1				
Nerita picea	2	1	5	tr	1	9		25		8	20				
	4	3	16	3	16			tr	2	45		55		21	
	6	14	72	7	48			tr	2	42		4	11		
Thais aperta	2							12	1						
	4									8	2	2	1		
	6									15	6				
Thais harpa	2	2	1			1	2	1	2	tr	1				
	4									2	3				
	6									2	4				
Trochus	4													tr	1

Material	Sq.	Level (cm)													
		0-10		10-20		20-30		30-40		40-50		50-60		60-bedrock	
		gm	no.	gm	no	gm	no.	gm	no.		no.	gm	no.	gm	no.
intextus															
	6									1	3				
Unidentified shell	2					4	12	4	14	5	1				
	4									20	12			9	9
	6			1	2					13	20				
Bone – cow or horse	2	32	1												
Bone – other	2	2	2	tr	1			12		5	22				
	4	6	3	1	3	21	2	tr	5	35		10	11	tr	3
	6	18	9	14	23	9	6	1	4	30		1	3		
Fish scales	2					tr	2	tr	8	tr	2				
	4			tr	1					tr	9	tr	4		
	6														
Glass	2	10	2												
	4					2	1								
Kukui-nut shell	2	10	14	3	7	7	10	2	5						
	4	1	2	4	7	2	6	tr	1	1	6	tr	2	1	4
	6	3	10	4	5	4	2	tr	2	7					
Metal	2	112		44		22		4	1						
	4	79		42		5	1								
	6	78		10											
Slate (?)	4	2	1												
Volcanic glass	4									3	1	2	2	1	1
	6									1	2	tr	1		

Table 19. Midden materials recovered from Bishop Museum Site B9-110 Square 3 (from Barrera and Hommon 1972:Appendix L-3)

Material	**Level (cm)**													
	0-25		**25-35**		**35-45**		**45-55**				**65-75**		**75-85**	
	gm		**gm**	**no**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**		**no.**		**no.**
Antigona reticulata					23	1	2	1	1	2				
Barnacle									tr*	1				
Cypraea caputserpentis	20	27	105		45		175		133		155		20	19
Cypraea reticulata	7	1	20	5	4	1	18	3	20	2	28	2		
Conus miliarus abbreviatus					4	1	5	2			5	1		
Conus sp.	6	3	5	3			6	5	6	3	1	2		
Cymatium tuberosum							1	1						
Drupa ricina	2	1	2	4	3	2	2	10	5	8	11	6	3	
Echinoderm	tr	1	4	13	1	7	15		43		55		12	26
Helisconiscus exaratus	6	12	44		2	6	43		18	19	50	12	2	2
Isognomon californicum	3	11	45		25		89		213		160		18	
Littorina pintado			tr	1	1	4	tr	3			tr	1		
Morula tuberculata			1	2					13	32	10	18		
Neretina	tr	2	10	11	3	5	20		21		16		5	8

Material	**Level (cm)**													
	0-25		**25-35**		**35-45**		**45-55**		**55-65**		**65-75**		**75-85**	
	gm	**no.**	**gm**	**no**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**
cariosa														
Nerita picea	2	13	13		4	21	18		17		10		4	9
Thais aperta			10	3			2	1						
Thais harpa			1	2			1	1	1	1	tr	1		
Trochus intextus			tr	1										
Unidentified shell							7	1	5	7	1	8		
Basalt chips			6	1	8	1	7	2						
Bone	tr	2	20		5		21		30		30		8	
Fish scales	tr	1	tr	3	tr	4	1		1		1		tr	6
Glass	8	2												

Table 20. Midden materials recovered from Bishop Museum Site B9-110 Square 5 (from Barrera and Hommon 1972:Appendix L-4)

Material	**Level (cm)**																	
	0-40		**40-50**		**50-60**		**60-70**				**80-90**		**90-100**		**100-110**		**110-bedrock**	
	gm	**no.**	**gm**	**no**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**
Barnacle					tr*	1	1	2	1	2	tr	1	tr	1				
Chama iostoma			6	1	10	2	1	1										
Cypraea caputserpentis	14	16	121		147		241		180		105		55		3	3		
Cypraea reticulata			40	7	45	11	30	6	22	4	8	3	5	1				
Cypraea sp.	2	1																
Conus miliarus abbreviatus			20	6	15	7	8	4	6	8	3	4	tr	2				
Drupa ricina	tr	1	8	4	10	8	18	14	6	6	2	4	1	2				
Echinoderm			6	12	10	22	11	36	11	27	6	8	2	16	1	2		
Helisconiscus exaratus	4	8	31		25		30		22		7	9	1	3				
Isognomon californicum			6	25	16		32		40		60		37		1	9	**tr**	**2**
Littorina pintado					2	4	2	4	tr	1	tr	1	1	1				
Melampus castaneus											tr	3						
Morula tuberculata			4	4	tr	1	2	1	tr	1			tr	1				
Neretina cariosa			5	9	6	9	8	17	11	17	10	26	3	8				
Nerita neglecta					tr	1	2	4			1	3						
Nerita picea	tr	2	20		41		48		25		14	46	10	33	tr	2		

Material	**Level (cm)**																	
	0-40		**40-50**		**50-60**		**60-70**		**70-80**		**80-90**		**90-100**		**100-110**		**110-bedrock**	
	gm	**no.**	**gm**	**no**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**	**gm**	**no.**
Thais aperta					15	2	38	3			9	1						
Trochus intextus							2	1										
Unidentified shell	5	11	4	7	9	12	4	8										
Bone (cow or horse)			64	2														
Bone (other)	18		4	8	9	12	2	6	1	4	1	5	tr	4	6		1	
Fish scales			tr	1	tr	1	tr	3	tr	4	tr	3	tr	1				
Fish spines					4						tr	1						
Kukui-nut shell	tr	1					tr	1										
Metal	32																	
Volcanic glass	8	1			24	1	2	1			2	1						

5.1.18 Site # B9-171

Barrera and Hommon (1972) described the walled enclosure with house site Site B9-171 as follows:

> This was the remains of a very large walled enclosure with a house platform that had been extensively disturbed by past bulldozer activity. The enclosure measured about 22 by 23 meters, with walls about 1 meter wide and 70 cm high. The house platform, built against the E wall of the enclosure, probably originally measured about S by 10 meters; it stood about 30 cm above ground level and was well paved with small, water-worn pebbles. (Barrera and Hommon 1972:29)

Barrera and Hommon (1972) relate the following results of excavations at Site B9-171:

> Most of the artifacts were found on the surface of the bulldozed area. These were a coral abrader, three bone buttons, two pearl-shell buttons, one glass button, one basalt abrader, one bone chisel [present Figure 151], one basalt phallic stone [Figure 152], a large grindstone, and two marbles.
>
> The single test pit we excavated in the platform revealed that the stone paving extended to a depth of about 10 cm. Beneath this was a 10-cm deposit of ash and midden. Artifacts recovered from this pit are: a bone button from the 0-to-5-cm level below the paving and two glass buttons from the 5-to-10-cm level below the paving. (Barrera and Hommon 1972:29-30)

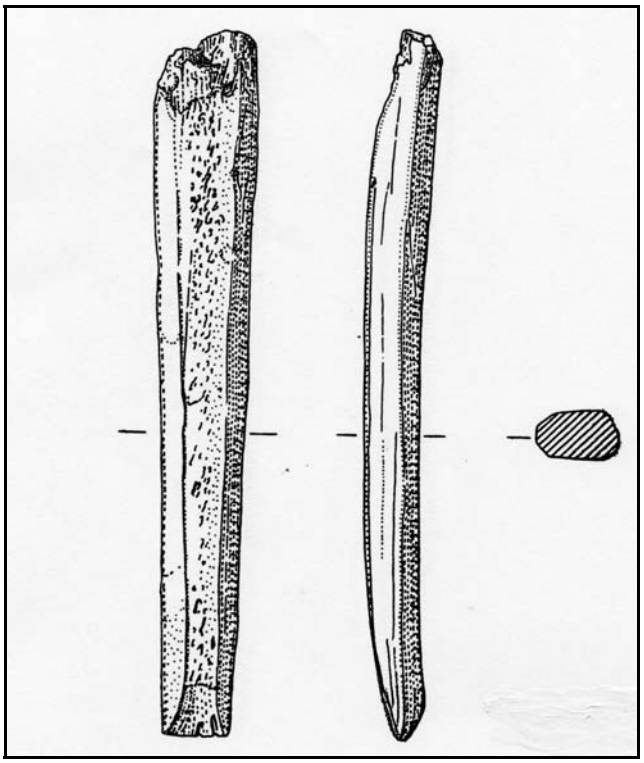

Figure 151 Bone chisel, found on surface of Site B9-171

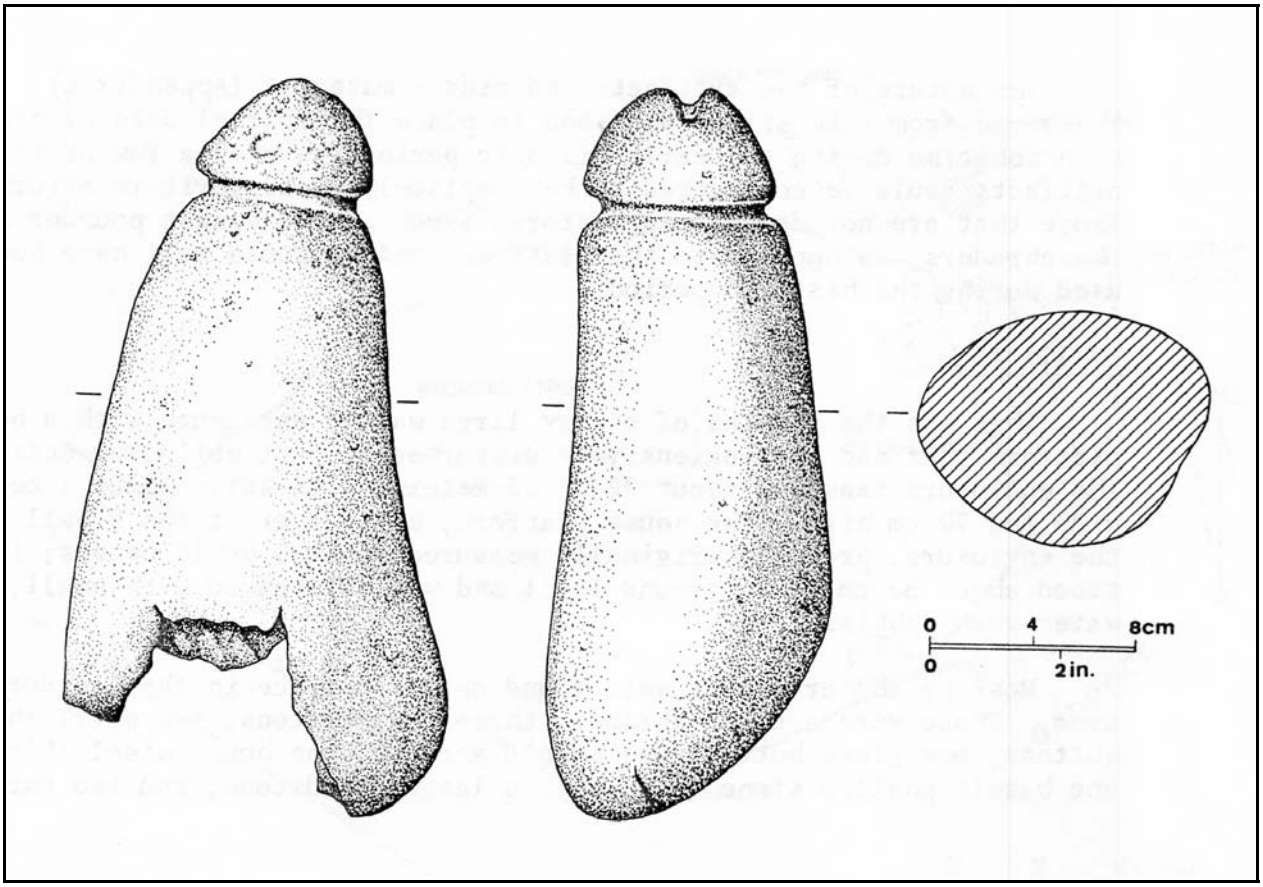

Figure 152. Basalt phallic stone from surface of Site B9-171.

In addition to the artifacts described, sparse amounts of marine shell midden, unidentified bone, and historic artifacts including glass and metal fragments were recovered (Table 21 below). The sparsity of the midden seems at odds with a house site.

Table 21. Midden materials recovered from Bishop Museum Site B9-171 (from Barrera and Hommon 1972:Appendix M)

Material	**Level (cm)**			
	0-5			
	gm	**no.**		**no**
Barnacle			tr*	1
Cypraea caputserpentis	6	4	20	16
Cypraea reticulata	24	4	8	4
Conus ebraeus	2	1		
Conus miliaris abbreviatus	12	2		
Helcioniscus exaratus	9	10		
Isognomon californicum			tr	1
Littorina pintado			tr	1
Morula tuberculata	tr	1	4	4
Nerita picea			tr	1
Thais aperta	1	1	7	3
Tritonalia tritonis	2	1		
Unidentified shell	2	7	10	11
Bone	15	6	1	4
Fish scales	tr	3	tr	1
Glass	20	7		
Kukui-nut shell	10	10	6	
Metal	327		385	

tr *= trace (less than 1 gm)

5.1.19 Site # B9-172

Barrera and Hommon (1972) described Site B9-172 as follows:

> This was a rectangular enclosure with one rounded corner, measuring 5.3 by 10 meters. The walls stood between 45 and 115 cm high and were about 80 cm wide. Remnants of wooden posts were still in place in the wall. (Barrera and Hommon 1972:30)

Barrera and Hommon (1972) relate the following results of excavations at Site B9-172:

> One square was excavated inside the enclosure. The deposits extended to a depth of 50 cm. The only artifacts found were frive buttons—two of glass, one of bone, one of

pearl shell, and one of glass and metal—in the 0-to-10-cm level. Midden deposits recovered from the pit are presented in Appendix N.

In addition to the artifacts described, significant amounts of marine shell midden, primarily composed of cowry, unidentified bone, and historic artifacts including glass, ceramic, and metal fragments were recovered.

Table 22. Midden materials recovered from Bishop Museum Site B9-172 (from Barrera and Hommon 1972:Appendix N)

Material	**Level (cm)**									
	0-10		**10-20**				**30-40**		**40-50**	
		no.	**gm**	**no**	**gm**		**gm**		**gm**	**no.**
Cypraea caputserpentis	10	2								
Cypraea reticulata	4	2			37	3				
Conus sp.					2	1				
Drupa ricina			1	1	6	2	1	2		
Echinoderm			tr*	2						
Helcioniscus exaratus	65		17		42		37		10	
Littorina pintado							tr	2		
Nerita picea	8	20	tr	1	5	16	4	18	tr	2
Thais aperta	7	1			12	1				
Unidentified shell							5	2		
Bone	tr	2	tr	2	2	3	30	12	1	3
Crockery	95		7		55		85		17	4
Fish scales	tr	5	tr	1	tr	5				
Glass	255		14		160		149		45	
Kukui-nut shell	20				14		1	2	1	2
Metal	535		40		140		182		15	2

* tr = trace (less than 1 gm)

5.1.20 Site # B9-173

Crozier and Barrera (1974:20-22) described Site B9-173 (Figure 153) as a disturbed habitiation complex. Crozier and Barrera (1974) relate the following results of excavations at Site B9-173:

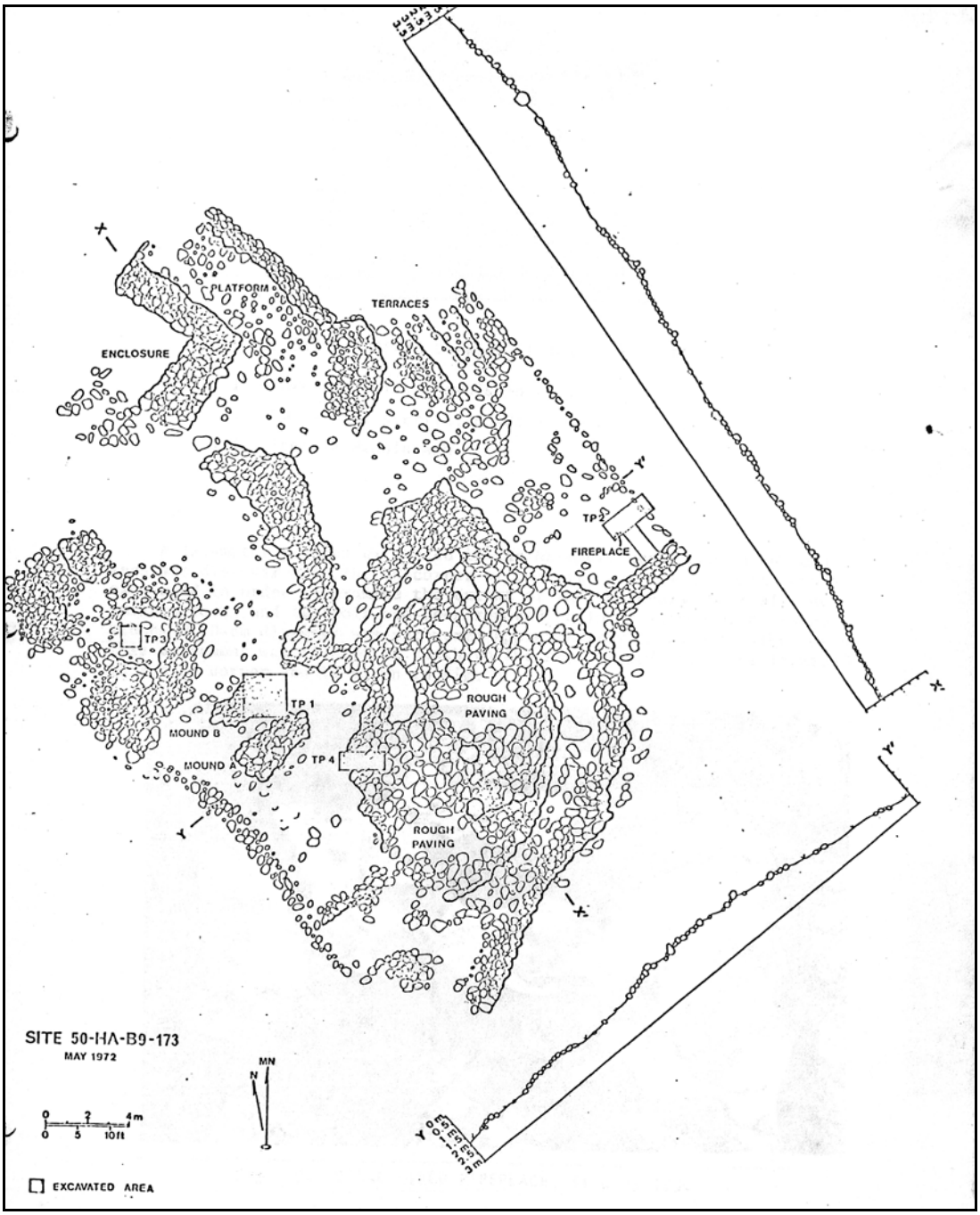

Figure 153. Plan of habitation complex, Site B9-173 (from Crozier and Barrera 1974:21)

Test Pit 1

A 2 x 2.5-meter pit [Figure 154 below] was excavated in the E section of mound B, which was originally thought to be a burial mound. The top 50 cm of rocks was removed until ground surface was reached. We were looking for any outer alignment of large stones that might indicate a crypt but this never materialized, although large rocks did extend to 25 cm below ground surface. There was no evidence of a burial or any cultural material to indicate any occupational function. As shown in the stratigraphic drawing sterile pāhala ash was reached at a depth of 80 cm.

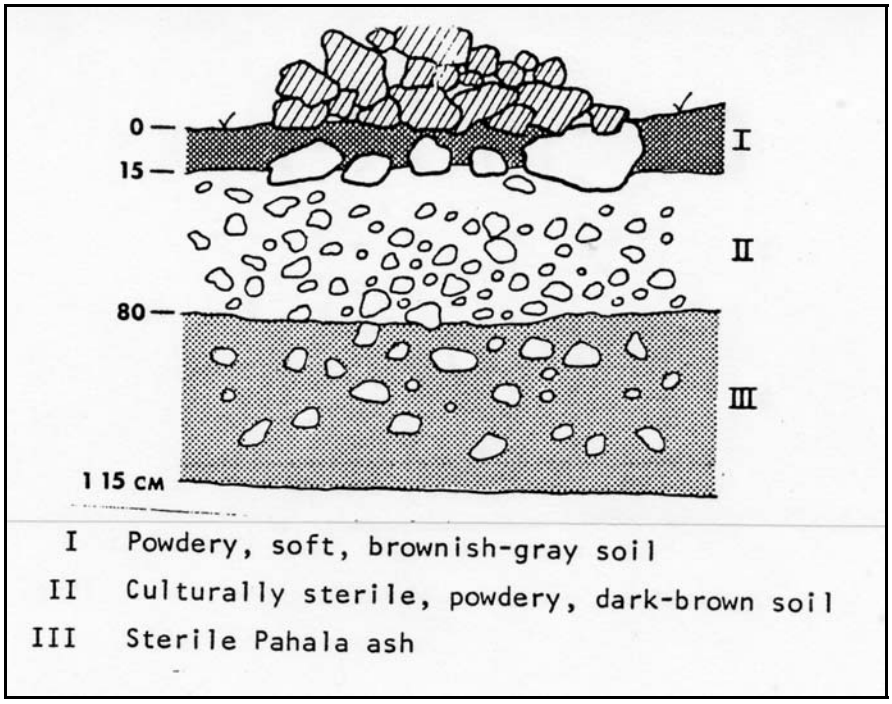

Figure 154. Stratigraphic drawing of Test Pit 1 Site B9-173 (from Crozier and Barrera 1974:22)

Test Pit 2

A 1x2-meter pit was excavated in the NE enclosure. When a charcoal lens was discovered in the SW corner of the pit, a 50-cm extension was excavated in order to examine the extent of the charcoal. Once all the surface rocks and top soil had been removed, a lower alignment of large stones of 20-cm diameter was uncovered approximately 15 cm below the surface. This alignment was related in depth to the stone-lined fireplace located at the SW corner…

The fireplace revealed a 4.5 cm-deep deposit of charcoal from which a sample was collected for future C14 dating. Dirtectly S of the fireplace was an extensive ash deposit that contained crushed shell and had been apparently thrown from the fireplace during repeated usage.

Test pit 2 was then extended SSE for the purpose of examining the depth of the uprights used in the construction of wall A. As the drawing indicates, the uprights extend to a depth of 30 cm below ground surface and were set up on sterile Pahala ash [Figure 155 below]

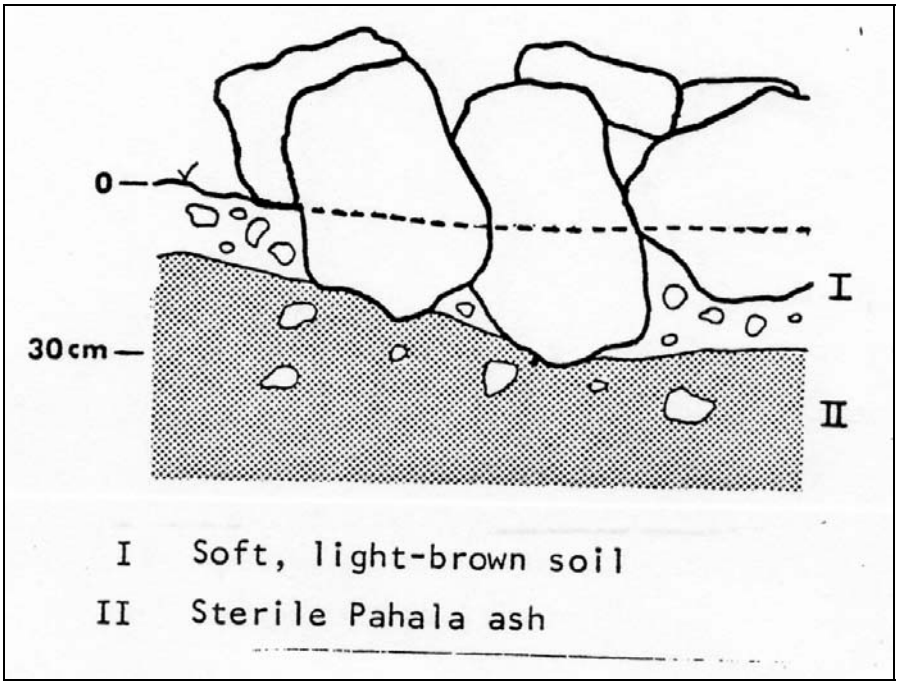

Figure 155. Stratigraphic drawing of uprights in Wall A, Site B9-173

Test Pit 3

Near the W sector of the site a 1-meter square was excavated in the center of a partially disturbed enclosure. No pavement was found, although the numerous *koa haole* trees could have disturbed any such feature. In the course of excavation five pieces of worked basaltic glass were collected, along with small bird bones. No Pahala ash was noted before natural bedrock was reached at a depth of 50 cm.

Test Pit 4

In order to examine the composition of the large stepped platform, a 1 x 2-meter pit was excavated on the W portion. The large rocks were removed and, as expected, a fairly flat, stepped pavement was uncovered below the rubble. Apparently the platform consisted of three steps with a relatively flat paving of aa rocks before the site was disturbed by grazing. Unfortunately, the absence of straight alignments throughout the platform hinder a functional analysis, although the site as a whole was obviously a habitation complex.

5.2 Test Excavations during the Present Study

5.2.1 SIHP # 50-10-68-3515

A 1 m by 1 m archaeological test unit was excavated in the southeastern portion of the SIHP# -3515 Feature A terrace to better determine the age and function of the feature (see Figure 31). The test excavation was located in the most well-constructed and minimally disturbed portion of the terrace, in an area of dense stone floor leveling (Figure 156). This area was thought to have the highest likelihood of containing intact cultural material. The surface of the test excavation was overgrown with exotic grasses. Removal of these grasses revealed a level of basalt boulder and cobble pavement. The test excavation revealed the loosely stacked basalt boulder and cobble platform construction extended approximately 20 cm below the top surface of the platform.

A total of three distinct sediment strata were observed through the excavation of Test Unit 1 (Figure 157). Stratum I consisted of a silty sediment primarily composed of leaf litter and humus accumulated on and within the stacked stone terrace structure. Stratum II consisted of a very dark brown silt sediment, underlying the terrace construction. Stratum II generally represented soils developed from material filtering down through the terrace construction. Sparse cultural material recovered from Stratum II included 1 basalt flake (3.6g), 5 volcanic glass flakes (3.6), marine shell midden (16.9g), and charcoal (0.1g). Stratum III consisted of a dark yellowish brown silt sediment, consisting of saprolite developed from the decomposition of the underlying basalt bedrock. The test excavation terminated at clearly sterile Stratum III sediments.

Following the test excavation, the excavated area was reconstructed as closely as possibly to its original state. Detailed sediment descriptions are as follows:

Strata	Depth (cmbd)	
Stratum I	0-50	10YR 3/3 dark brown silt w/ leaf litter and humus accumulated on and within the stacked stone terrace structure; strong, fine, granular structure; dry, loose consistency; non-plastic; no cementation; terrestrial origin; no cultural material observed; Lower Boundary (LB) is clear, smooth.
Stratum II	50-65	10YR 2/2 very dark brown silt; structureless; dry, loose consistency; non-plastic; no cementation; terrestrial origin; sparse cultural material including charcoal, marine shell, volcanic glass and basalt flake; LB is abrupt, smooth.
Stratum III	65-BOE	10YR 3/4 dark yellowish brown silt w/ 30% decomposing basalt stones; structureless; dry, loose consistency; non-plastic; terrestrial origin; sterile saprolite; no cultural material observed.

Figure 156. SIHP # 50-10-68-3515 Feature A, Test Unit 1, pre-excavation (top) and post-excavation (bottom) photos.

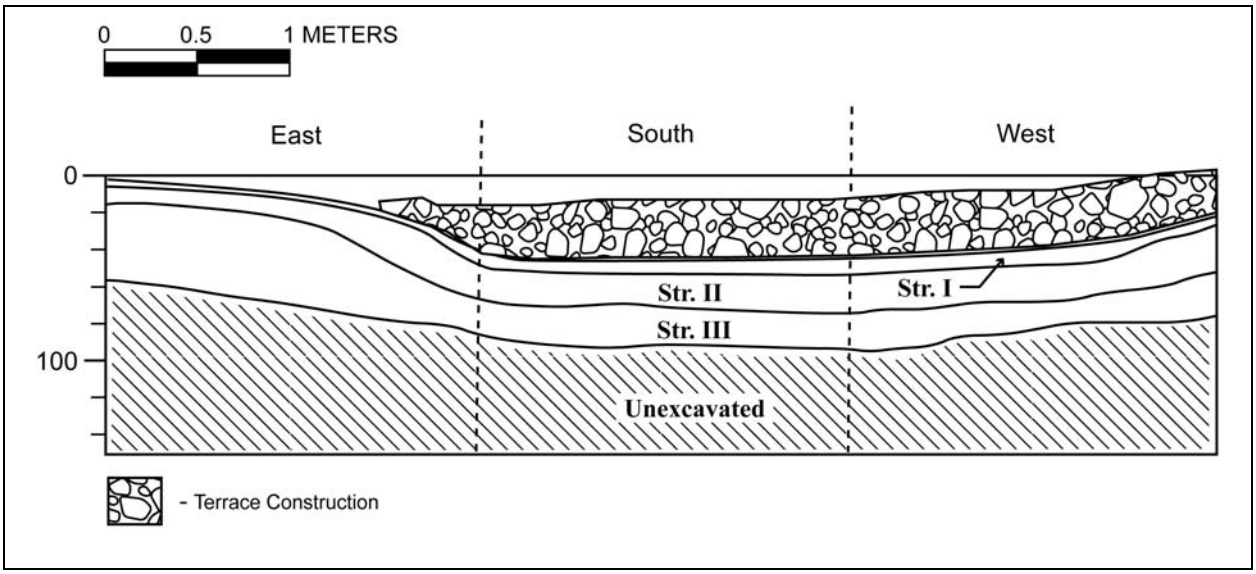

Figure 157. SIHP # 50-10-68-3515 Feature A, Test Unit 1, stratigraphic profile, east, south, and west walls.

5.2.2 SIHP # 50-10-68-24901

A 1 m by 1 m archaeological test unit was excavated on the central portion of the SIHP # -24901 Feature D platform to better determine the age and function of the feature (see Figure 123). The test excavation was located in soil filled terrace area and on a minimally disturbed portion of the platform (Figure 158). This area was thought to have the highest likelihood of containing intact cultural material. The surface of the test excavation was overgrown with exotic grasses. Removal of these grasses revealed soil which became increasing rocky, though most of the rocks seemed to be natural. It is possible that these rocks were brought in as fill for the level area, but it is just as likely that these features were natural.

A single soil strata was observed through the excavation of Test Unit 1 (Figure 159). Stratum I consisted of a dark brown silt loam. The test excavation was made down to bedrock. No cultural material was observed.

Following the test excavation, the excavated area was reconstructed as closely as possibly to its original state. Detailed sediment descriptions are as follows:

Strata	Depth (cmbd)	
Stratum I	0-BOE	7.5YR 3/3 dark brown silt loam; weak, fine, crumb structure; dry, weakly coherent consistency; non-plastic; no cementation; terrestrial origin; abundant roots and rootlets; no cultural material observed.

Figure 158. SIHP # 50-10-68-24901 Feature D, Test Unit 1, pre-excavation (top) and post-excavation (bottom) photos.

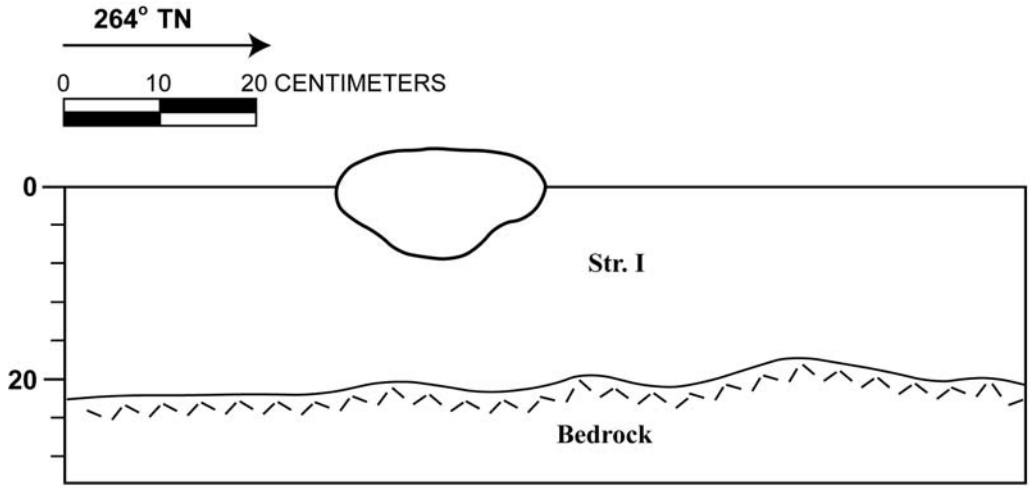

Figure 159. SIHP # 50-10-68-24901 Feature D, Test Unit 1, stratigraphic profile, south wall.

5.2.3 SIHP # 50-10-68-24908

A 1 m by 1 m archaeological test unit was excavated in the level soil area within the interior of the SIHP # -24908 enclosure to better determine the age and function of the feature (see Figure 17). The test excavation was in the area least affected by land clearing activities, thought to have the highest likelihood of containing intact cultural material (Figure 160). The surface of the test excavation was overgrown with exotic grasses. Removal of these grasses revealed soil which became increasing rocky, though most of the rocks seemed to be natural.

A total of three distinct sediment strata were observed through the excavation of Test Unit 1 (Figure 161). Stratum I consisted of a silt loam sediment primarily primarily composed of leaf litter and humus accumulated within the interior of the enclosure. Portions of Stratum I were charcoal stained, likely from modern fires in the area. Strata II and III consisted of a very loose silt loam sediments, dark reddish brown and brown respectively, differing primarily in color. No cultural material was observed.

Following the test excavation, the excavated area was reconstructed as closely as possibly to its original state. Detailed sediment descriptions are as follows:

Figure 160. SIHP # 50-10-68-24908, Test Unit 1, pre-excavation (top) and post-excavation (bottom) photos.

Strata	Depth (cmbd)	
Stratum I	0-9	5YR 2.5/2 dark reddish brown silt loam w/ leaf litter and humus accumulated within the interior of the enclosure; structureless; dry, loose consistency; non-plastic; no cementation; terrestrial origin; no cultural material observed; Lower Boundary (LB) is abrupt, smooth.
Stratum II	9-28	5YR 2.5/2 dark reddish brown silt loam; structureless; dry, loose consistency; non-plastic; no cementation; terrestrial origin; no cultural material observed; Lower Boundary (LB) is abrupt, wavy.
Stratum III	28-BOE	7.5YR 4/4 brown silt loam; structureless; dry, loose consistency; non-plastic; no cementation; terrestrial origin; no cultural material observed.

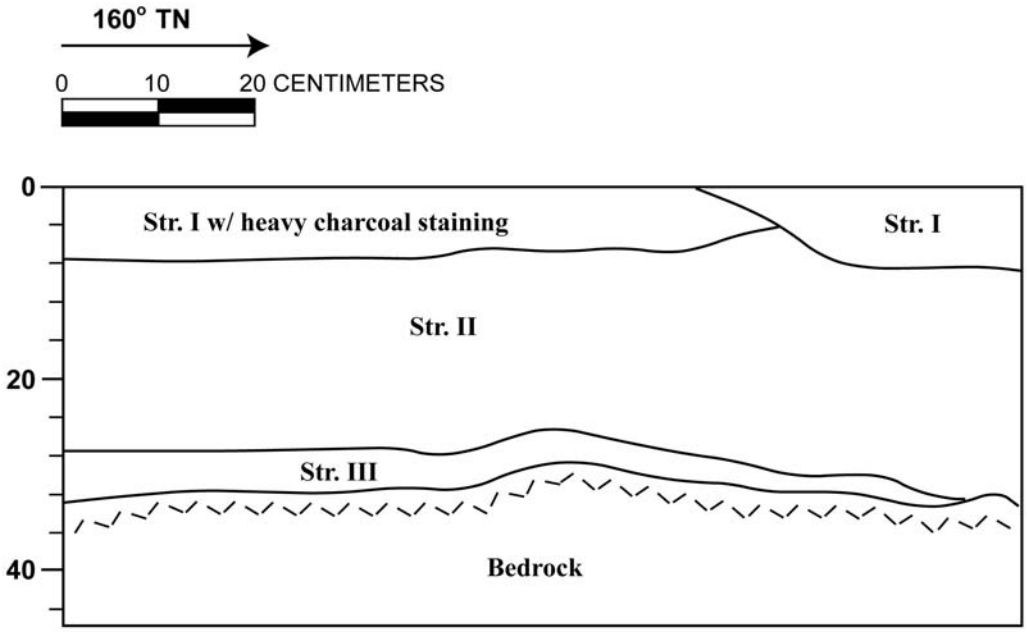

Figure 161. SIHP # 50-10-68-24908, Test Unit 1, stratigraphic profile, east wall.

Section 6 Summary and Interpretation

A total of thirty-two sites were identified as still extant within the 430-acre Punalu‘u Resort project area. Back in April 1988 the “Final Environmental Impact Statement “ for the Punalu‘u Resort noted that: “most of the project area (at least 90%) has already been mechanically cleared, or altered by floods and tsunamis.” Drawing conclusions on the basis of what remains is inherently problematic in that 90% of the pieces of the puzzle are gone. Clearly the present project lands were unusually exposed to transformation by the forces of nature and commerce. Much of the archaeological landscape had undoubtedly changed repeatedly before the major resort development transformations of the 1970s.

Further effort at archaeological analysis based on the first systematic surveys following up on and further developing the information presented in the Section 3.5.3 discussion of this study might be more fruitful than trying to develop insights into patterns on the basis of what remains. Unfortunately the brevity of much of the early documentation limits the prospects for thorough analysis.

Of the thirty-two sites identified in the present study 17 sites (53.1%) were determined to be exclusively or primarily historic sites, 14 sites (43.8%) were determined to be exclusively or primarily pre-contact sites, and one site (3.1%), a wall, was indeterminate. This is suggested to reflect that there was both a long history of extensive and intensive pre-contact use of these lands (hence many pre-contact sites endure) and also the long history of post-contact land use including ranching, port development and military use.

6.1 Pre-contact Sites

The sites that were identified as primarily or entirely pre-contact sites are summarized in Table 23. These 14 pre-contact sites include five sites understood as having a primary burial function (sites 50-10-68-4309, -24898, -24900, -24912, & -2491), three habitation sites (24901, 24903 & 3515) two rock art sites (-24916 & 3513), 1 *heiau* site (3512 Lanipao Heiau), 1 agricultural site (24910) and two sites of indeterminate function (wall site 24902 and enclosure 24908).

6.1.1 Pre-Contact Burial sites

With two exceptions, all of the identified traditional Hawaiian burials occur near areas of *pali* or cliffs: particularly the cliffs in the south corner and the cliffs in the central *makai* portion of the Makai Survey Area. The largest concentration of burials appears to be at Site 4309 which is identified as the “Burial Bluff Complex” (see Figure 35). This includes what appears to be a large number of burials on either side of the Hōkūloa Church and cemetery site. It seems likely that the historic cemetery was located in an area that had been dedicated to interment of the dead from pre-contact times. The cement crypt (Site 50-10-68-24899A) located within the Burial Bluff Complex shows that some historic burials were interred outside of the church cemetery. While most of the burials appear on the upper edge of the *pali* modifications consistent with a burial function were observed at the base of the *pali* as well. The site 24898 burial complex lies at a pali on the south edge of the present project area. Again the pattern appeared to be interment

Table 23. Primarily or exclusively pre-contact sites documented within the project area. (SIHP Site # prefix 50-10-68-)

SIHP #	Temp. Site #	# Feats.	Form		Complex	Significance	Recommendation
3512	B8-02	6	Lanipao Heiau	ceremonial		A, C, D, E	Preserve
3513	B8-03	4	petroglyphs	rock art		D, E	Preserve
3515	B8-05 & B8-37	5	platforms & terraces	habitation complex		D	Preserve
4309 Feats A-J +	B9-31	25+	terraces, (re-use as WWII gun emplacements)	possible burials, military	Burial Bluff Complex (4309)	D, E	Preserve
24898	T-111 & CSH 8	9	platforms & terraces	burial complex	Kōloa -Nīnole Complex (4368)	D, E	Preserve
24900	T-110	4	fishing shrine, platforms	ceremonial, burial	Burial Bluff Complex (4309)	D, E	Preserve
24901	B8-07	4	platforms & enclosures	habitation complex		D	Preserve
24902	B9-109	1	wall	indeterminate		D	No Further Work
24903	B9-121	1	enclosure	habitation, poss. burial		D, E	Preserve
24908	CSH 2	1	enclosure	indeterminate		D	No Further Work
24910	CSH 4	1	mound	agricultural		D	No Further Work
24912	CSH 6	1	terrace	probable burial		D, E	Preserve
24914	CSH 12	1	cave	possible burial		D, E	Preserve
24915	T-107, B8-31, & B8-32	5	railroad berms	transportation		A, C, D	Preserve
24916	T-101	1	petroglyph	rock art		D, E	Preserve

at the top of a *pali* or bluff but it may well be that additional burials lie further down the cliff face utilizing natural declivities.

Site 24903 was also suggested to have a burial (as well as habitation) function. This site appears to lie at least partially (if not completely within the condominium development (an exclusion to the present study). The similarity to the two major interment areas of being at the top of a *pali* strengthens the conclusion that this site has a burial function.

What appeared to be small fragments of human bone were observed in a cave (Site 24914) at the northeast side of Punalu‘u Bay. Human remains have been previously reported from this area. Although the association of these remains with the adjacent and imposing Punalu‘u nui Heiau seems likely this is not certain.

An outlying site that was thought to be a possible burial was site 24912 in the west central portion of the Makai Survey Area. Given the localization of burials at the top of *pali* this site would be quite anomalous if it is indeed a burial site. Possibly some other ritual function is indicated. Clearly there was strong selection for the red clinker *‘a‘ā* cobbles and the accretion boulder that were placed in the interior of the small terrace.

6.1.2 Pre-contact Habitation Sites

The three sites interpreted to have a pre-contact habitation function are widely scattered within the project area. Their survival is probably a function that all three are located near steep slopes. Site 24901 located in the east corner of the project area by the Punalu‘u Harbor Complex appears to be a very intensively utilized habitation area that may have been used by several families. Clearly this site area was used into the historic period and quite likely with unbroken habitation from pre-contact times right up to the early twentieth century. The freshwater source here was later improved as a historic well. Much of this site may in fact lie on Kamehameha School’s lands. Site 24903 on the south side of the condominium complex (by the hot tub) at the top of the ridge appears to have been a walled habitation site that was subsequently used for burial. This location affords a good view to the south and southwest. The 50-10-68-3515 habitation site appears to include a number of different occupation or work areas including a terrace, two platforms and an overhang area. This appears most likely to have been a temporary or recurrent habitation site.

We know little of the pre-contact pattern of the distribution of permanent habitations. It may well be that the pattern reflected in the Land Commission Awards (see Figures 6 & 7) was vastly different reflecting both depopulation and centralization to be close to new western foci of port, schools and church. The pattern developed from the data of Barrera & Hommon (see Figure 13) may well be more correct showing permanent habitations widely scattered in lands back from the coast.

6.1.3 Petroglyph Sites

The two rock art petroglyph sites both lie on low domes of *pāhoehoe* near the coast. Stokes account of 25+ glyphs at what is understood as the site 3513 petroglyph site is somewhat difficult to reconcile with the modest assemblage easily observable there. Given the numbers of Hawaiians who must have lived at Punalu‘u over many centuries it seems odd that there were not more examples of rock art.

6.1.4 Agricultural Site

The indicated annual rainfall of approximately 1250 mm should have been sufficient to grow sweet potatoes, gourds and ti plants within the project lands, especially during wetter than average winters. It is thus somewhat surprising that only one agricultural site (site 24910) was noted. Undoubtedly this is largely the result of the extensive chain-dragging and pasture improvement efforts and the actions of cattle over 150 years. It is clear from the Land Commission Award data that the preferred area for agriculture was far up *mauka* near Pu‘u enuhe. Much of the *mauka* project area may have been in a relatively unutilized intermediate barren zone.

6.1.5 Religious Sites

The enormity of the state *luakini* Punalu‘u nui Heiau on the east edge of the project area must have dominated the religious landscape in pre-contact times. Lanipao Heiau within the project lands may have served some specialized agricultural function for the local people. Lanipao Heiau is certainly the most impressive archaeological site extant within the project area per se. It may be noted in passing that another *heiau* site known by the Bishop Museum designation B8-36 lay only a couple of hundred meters seaward of Lanipao and may well have operated in tandem with Lanipao. Another substantial heiau (Ka‘ie‘ie Heiau) is understood to lie just southwest of the south corner of the project area.

Another notable religious site within the project lands is the *ku‘ula* or *ko‘a nui* designated as site 50-10-68-24900 Feature A. This large bedrock outcrop appears to have been regarded as a shrine/deity associated with fishing and also to have served as a landmark to guide fishing boats. This outcrop is said to have possessed supernatural attributes (see Section 4.4.7 of this study).

6.2 Post Contact Sites

The seventeen historic sites (Table 24) included seven sites associated with ranching or livestock, five sites associated with transportation, a historic habitation (site 3520), a site reported to have been the location of the Nīnole School (site 3522), the wharf infrastructure (site 7361), the Hōkūloa Church site & historic cemetery (Site 7370), outlying historic burial crypt (Site 24899).

6.2.1 Sites Associated with Ranching or Livestock

The sites understood as primarily associated with livestock include two small corrals or pens (Sites 3519 & 4330) and five walls (Sites 4310, 4360, 24905, 24906 & 24907). The project area was a major entrepot for goods brought to the coast on horseback for export by sea. Prior to the beginning of sugar exports goods brought down by cart or livestock probably included provisions (particularly taro, potatoes and onions), probably some wheat, tons of *pulu* and meat on the hoof. It appears that teams of livestock pulled empty railroad cars from Punalu‘u back up to Pāhala for seventeen years from 1878 until 1895. Undoubtedly food stuffs were moved down to the coast and imports were carried *mauka* on livestock as part of the domestic economy. The walls, interpreted as cattle walls, within the project lands suggests a great investment in labor. The long *mauka/makai* trending walls may have served to facilitate the

Table 24. Primarily or exclusively post-contact sites documented within the project area. (SIHP Site # prefix 50-10-68-)

SIHP #	Temp. Site #	Features	Form	Function	Complex	Signifi-cance	Mitigation Recommend -ation
3519	B9-04	3	enclosures	agricultural (animal husbandry)	Kōloa - Nīnole Complex (4368)	D	Preserve
3520	B9-05	3	enclosures	habitation	Kōloa - Nīnole Complex (4368)	D	Preserve
3521	B9-06	1	trail	transportation	Kōloa - Nīnole Complex (4368)	D	Preserve
3522	B9-07	2	"Nīnole School" (platform, enclosure)	School	Kōloa - Nīnole Complex (4368)	C, D	Preserve
3524	B9-09	1	govt. road (Alanui Aupuni)	transportation	Kōloa - Nīnole Complex (4368)	A, D	Preserve
4310 Feat. A	B9-32	1	wall	cattle barrier	Wailau Complex (4310)	D	Preserve *
4310 Feats. B-D	B9-33	3	terraces, overhang shelter	habitation	Wailau Complex (4310)	D	Preserve
4310 Feats. E-H	B9-34	4	overhang shelters, walls	habitation	Wailau Complex (4310)	D	Preserve
4330	B9-43	1	enclosure	agricultural (animal husbandry)		D	Preserve
4360	B9-62 & B9-119	2	walls	property boundary, cattle barrier		D	Preserve *
7361 Feat. A	Wharf	5+	Punalu‘u Harbor Wharf	Harbor Infrastructure	Punalu‘u Harbor Complex (7361)	A, D	Preserve

SIHP #	Temp. Site #	Features	Form	Function	Complex	Signifi-cance	Mitigation Recommend -ation
7361 Feats. B-E	B8-14	5	terraces, well, walls	Harbor Infrastructure	Punalu‘u Harbor Complex (7361)	A, D	Preserve
7361 Feat. F	B8-15	1	terrace	Harbor Infrastructure	Punalu‘u Harbor Complex (7361)	A, D	Preserve
7361 Feat G	B8-16	1	enclosure	Harbor Infrastructure	Punalu‘u Harbor Complex (7361)	A, D	Preserve
7361 Feat. H	B8-33	6	platforms	Harbor Infrastructure	Punalu‘u Harbor Complex (7361)	A, D	Preserve
(7370)+	Church+	3+	historic church and cemetery	ceremonial, burial	Burial Bluff Complex (4309)	D, E	Preserve
24897	T-108	3	enclosures, trail	habitation	Kōloa - Nīnole Complex (4368)	D	Preserve
24899	B9-17	3	crypt, enclosures	burial complex	Burial Bluff Complex (4309)	D, E	Preserve
24905	T-104	1	wall	cattle barrier		D	Preserve *
24906	T-109	1	wall	cattle barrier		D	Preserve *
24907	CSH 1	1	wall	property boundary, cattle barrier		D	Preserve
24909	CSH 3	2	govt. road	transportation		A, D	Preserve
24913	CSH 10	1	well	well		D	No Further Work
24915	T-107, B8-31, & B8-32	5	railroad berms	transportation		A, C, D	Preserve

+ = The Church site 7370 is an exclusion to the present project area

rounding up of livestock driven down from mauka pastures. Substantial cattle ranching endeavor is indicated.

6.2.2 Transportation Sites

Punalu‘u must have been a major pre-contact population center connected by trails to other coastal communities to the southwest and northeast and by *mauka/makai* trails to the uplands. The 1794 account from Archibald Menzies suggests that traffic traversing long distances overland may well have passed well *mauka* of the present project lands to shorten the trip. It seems likely that with the availability of horses that the coastal route may have been more appealing with attendant trail improvements as in the creation of the Alanui Aupuni or government road (Site 3524).

Several alignments of railroad berm were observed within the project area and were collectively given the designation of site 24915. The remaining segments often seem confusing in that they often lie at angles to other segments. Clearly the railroad segments served to unite Punalu‘u with Pāhala to the northwest. Clearly the track alignment was changed a number of times including the initial laying of track in 1878 and the re-alignments of 1896 and 1902.

6.2.3 Village Infrastructure

Post-contact infrastructure documented in the archaeological record includes the Nīnole School (site 3522), the wharf infrastructure (site 7361), and the Hōkūloa Church site (Site 7370).

The Nīnole School site appears to have involved the adaptive re-use of an earlier residential or religious compound. It appears likely that this site out on a point survived the tsunami of 1868 which may have been funneled into the lands back of Punalu‘u Cove by the undersea topography. Although the Nīnole School site lies only a kilometer from Punalu‘u Cove it seems very likely that Punalu‘u had it’s own school house – perhaps close to the original site of the Hōkūloa Church just northeast of Punalu‘u Cove. Any structure down on the flats back from the coast in that area probably would have been swept away in the tsunami of 1868.

The remaining wharf infrastructure is understood to have been developed starting in 1878. The Andrews chart (Figure 8) and a photograph of Punalu‘u (Figure 9) both of c. the mid 1880s show early wharf infrastructure. It is understood that the railroad connecting Punalu‘u with Pāhala reached Punalu‘u Harbor in 1878 (although the date of the first train to run on this track line is understood to have been 1895). It seems likely that much of the concrete infrastructure that remains dates to c. 1916 – the date that is inscribed on Site 50-10-68-7361 Feature A. We understand that much of this harbor infrastructure was deliberately demolished by the military during WWII. Whether this was done for “target practice” or was a deliberate effort to deprive the Japanese of a developed harbor is unclear.

It is understood that an earlier church (or more likely successively more substantial churches) were constructed just to the west of Punalu‘u Cove but that the church extant there in the spring of 1868 was swept away by the widespread geologic convulsions of that year. Logically enough the Hōkūloa Church was re-built on high ground to be above any future tsunami.

6.2.4 Historic Burials

The historic cemetery (Site 7370) surrounding the Hōkūloa Church site, and the outlying historic burial crypt (Site 24899) indicate a continuing pattern of burial on this cliff dating back to pre-contact times. Whether the location of the concrete crypt reflects a choice not to be buried in the churchyard (by either the family of the deceased or the membership of the church) is uncertain. It seems highly probable that several historic burials are located outside the churchyard at the edge of the bluff.

6.2.5 Historic Habitations

Clearly many families lived in residential compounds at Punalu‘u in the nineteenth and twentieth centuries. The maps of coastal Land commission Awards (see Figure 7), early photographs (see Figures 9 & 10) and the 1931 Coastal Chart (Figure 11) give us an indication of what the landscape of historic residence looked like. Very little of this landscape remains. It should be noted that there is a residential exclusion area of privately held parcels within the present project in the area where residences appear to have been particularly dense. Twentieth century tsunamis may be a partial explanation for this seeming obliteration of the remains of habitations. It is assumed for example that there was a historic house site near the mortared well (Site 24913) encountered just back from the coast but all that remains is the relatively impervious well. Perhaps significantly historic house sites back from Punalu‘u Cove are barely noted in the archaeological studies of the early 1970s that should have predated much of the resort development. The only site identified in the present study as a historic house site is 50-10-68-3520 (a component of the Kōloa/ Nīnole Complex Site 50-10-68-4368) situated on the south side of Nīnole Cove. The location of this house site spared it from the forces that removed so many other house sites.

It should be noted that almost all of the sites tested by the Bishop Museum in their salvage work at Punalu‘u include historic trash in their upper levels. Given the intensive occupation at Punalu‘u during the nineteenth and twentieth centuries it would seem that a site without a historic component present would be quite the exception. It is assumed that the adaptive use of traditional pre-contact Hawaiian habitation sites was the norm.

6.3 Midden Analysis

The midden assemblages reported differ in terms of nature of site tested and methodology employed. Only a few generalizations are possible. The midden material reported from earlier salvage work almost all include historic trash (“metal”, “glass”) in their upper levels. These sites with a significant historic component (sites –4310, -4330, Bishop Museum sites B9-20, B9-69, B9-171 & B9-172) typically show quite substantial percentages of bone (unfortunately just reported as “bone”). Midden material from assumed pre-contact sediments (such as Bishop Museum site B9-23 and lower levels of B9-110 show the pattern of shellfish species dominating typically accounting for 90% or so of all midden.

The assemblage of shellfish species reported include large percentages of *Cellana* species (‘*opihi* typically reported as *Helcioniscus exaratus*), Cypraeidae (*C. caputserpentis*, *C. reticulata*) and *pipipi* (*Nerita picea*). The pattern of collection is clearly focused on intertidal rocky environs with substantial wave energy. In other words the shellfish assemblage indicates

collection from precisely the environment that dominates the Punalu‘u coastline. One notable midden component is *Neretina cariosa* that is understood as having a strong preference for brackish environments such as are afforded by the springs of Punalu‘u and Nīnole. There is some evidence (Bishop Museum site B9-110 squares 1,2 & 5) to suggest that the availability of these decreased over time. Given that the preferred environment for the *Neretina* is quite limited, compared to the wave swept rock and cliff environment of greater Ka‘ū, this is a midden species that would be particularly prone to harvesting pressure as the population of Punalu‘u increased.

6.4 Artifact Assemblage

No significant artifacts were encountered in the course of this study. The previously described artifact assemblages seem generally prosaic and typical of what would be expected from a coastal community frequently involved in the manufacturing of fishing gear and consuming taro. The only anomalous artifact reported is the phallic stone (present Figure 152) from Bishop Museum site B9-171 a walled enclosure with house site near the coast just north of Nīnole Cove.

Section 7 Significance Assessments

Each historic property identified within the project area was evaluated for significance according to the broad criteria established for the National and Hawaii Registers of Historic Places. The five criteria are:

A Associated with events that have made an important contribution to the broad patterns of our history;

B Associated with the lives of persons important in our past;

C Embodies the distinctive characteristics of a type, period, or method of construction, represents the work of a master, or possesses high artistic value;

D Have yielded, or is likely to yield information important for research on prehistory or history;

E Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property, or due to associations with traditional beliefs, events or oral history accounts – these associations being important to the group's history and cultural identity.

SIHP # 50-10-68-3512 consists of Lanipao Heiau, a pre-contact ceremonial complex. SIHP # -3512 is evaluated as significant under Criteria A, C, D, and E.

SIHP # 50-10-68-3513 consists of a cluster of four petroglyphs, examples of pre-contact rock art. SIHP # -3513 is evaluated as significant under Criteria D and E.

SIHP # 50-10-68-3515 consists of a complex of five features, interpreted to be activity areas associated with pre-contact habitation and agricultural activities. SIHP # -3515 is evaluated as significant under Criterion D.

SIHP # 50-10-68-3519 consists of an enclosure, interpreted to be a historic animal pen. SIHP # -3519 is included as a component of the Kōloa-Nīnole Complex (SIHP # -4368). SIHP # -3519 is evaluated as significant under Criterion D.

SIHP # 50-10-68-3520 consists of an enclosure, interpreted to be a historic permanent habitation site. SIHP # -3520 is included as a component of the Kōloa-Nīnole Complex (SIHP # -4368). SIHP # -3520 is evaluated as significant under Criterion D.

SIHP # 50-10-68-3521 consists of a paved trail, interpreted to be a historic foot trail. SIHP # -3521 is included as a component of the Kōloa-Nīnole Complex (SIHP # -4368). SIHP # -3521 is evaluated as significant under Criterion D.

SIHP # 50-10-68-3522 consists of an enclosure with an interior platform, interpreted to be a historic school site. SIHP # -3522 is included as a component of the Kōloa-Nīnole Complex (SIHP # -4368). SIHP # -3522 is evaluated as significant under Criteria C and D.

SIHP # 50-10-68-3524 consists of a segment of the historic Old Government Road, *Alanui Aupuni*. SIHP # -3524 is included as a component of the Kōloa-Nīnole Complex (SIHP # -4368). SIHP # -3524 is evaluated as significant under Criteria A and D.

SIHP # 50-10-68-4309 consists of a complex of pre-contact and historic features located along a coastal bluff area, primarily consisting of small terraces and platforms interpreted to be human burials. Additional features in the complex included WWII gun emplacements (SIHP # -4309), a historic church and cemetery (SIHP # -7370), a historic crypt and burial enclosure (SIHP # -24899), and a fishing shrine (SIHP # -24900). SIHP # -4309 is evaluated as significant under Criteria D and E.

SIHP # 50-10-68-4310 consists of 8 features including terraces, overhang shelters, walls, and a linear mound, interpreted to be a historic habitation complex. SIHP # -4310 is evaluated as significant under Criterion D.

SIHP # 50-10-68-4330 consists of a rectangular enclosure, interpreted to be a historic corral. SIHP # -4330 is evaluated as significant under Criterion D.

SIHP # 50-10-68-4360 consists of a stone wall, interpreted to be a historic ranch-related cattle wall, also functioning in demarcating a former property boundary and *ahupua‘a* boundary. SIHP # -4360 is evaluated as significant under Criterion D.

SIHP # 50-10-68-4368 consists of a cluster of historic properties located on a bluff overlooking Kōloa Beach and Nīnole Cove, designated the Kōloa-Nīnole Complex. The complex includes SIHP #s -3519, -3520, -3521, 3522, 3524, -24897, and -24898 within the current project area. Additional components of the Kōloa-Nīnole Complex are located in State of Hawaii property adjacent to the current project area. Significance assessments are provided for each of the individual historic properties. As a whole, SIHP # -4368 is evaluated as significant under Criteria A, C, D, and E.

SIHP # 50-10-68-7361 consists of a complex including the historic Punalu‘u Harbor wharf and harbor infrastructure. Harbor infrastructure included terraces, a well, walls, an enclosure, and platforms. SIHP # -7361 is evaluated as significant under Criteria D and E.

SIHP # 50-10-68-7370 consists of the Hōkūloa Congregational Church, which includes a historic chapel and cemetery. SIHP # -7370 is included as a component of the Burial Bluff Complex (SIHP # -4309). SIHP # -3524 is evaluated as significant under Criteria D and E.

SIHP # 50-10-68-24897 consists of an enclosure, stepping stone trail, and u-shaped enclosure, interpreted to be an animal pen and temporary shelter connected by a foot trail. SIHP # -24897 is included as a component of the Kōloa-Nīnole Complex (SIHP # -4368). SIHP # -24897 is evaluated as significant under Criterion D.

SIHP # 50-10-68-24898 consists of a complex of nine terraces and platforms, interpreted to be human burials. SIHP # -24898 is included as a component of the Kōloa-Nīnole Complex (SIHP # -4368). SIHP # -24898 is evaluated as significant under Criteria D and E.

SIHP # 50-10-68-24899 consists of a historic burial complex, including two enclosures and a cement tomb. SIHP # -24899 is included as a component of the Burial Bluff Complex (SIHP # -4309). SIHP # -24899 is evaluated as significant under Criteria D and E.

SIHP # 50-10-68-24900 consists of a fishing shrine and three low platforms interpreted to be human burials. SIHP # -24900 is included as a component of the Burial Bluff Complex (SIHP # -4309). SIHP # -24900 is evaluated as significant under Criteria D and E.

SIHP # 50-10-68-24901 consists of a complex including platforms and enclosures, interpreted to be a pre-contact habitation complex. SIHP # -24901 is evaluated as significant under Criterion D.

SIHP # 50-10-68-24902 consists of an L-shaped wall, interpreted to be a pre-contact wall, possibly the remaining portion of an enclosure. SIHP # -24902 is evaluated as significant under Criterion D.

SIHP # 50-10-68-24903 consists of an enclosure, interpreted to be a pre-contact habitation enclosure, with an additional burial function. SIHP # -24903 is evaluated as significant under Criteria D and E.

SIHP # 50-10-68-24905 consists of a stone wall, interpreted to be a historic ranch-related cattle wall. SIHP # -24905 is evaluated as significant under Criterion D.

SIHP # 50-10-68-24906 consists of a stone wall, interpreted to be a historic ranch-related cattle wall, also functioning in demarcating an *ahupua‘a* boundary. SIHP # -24906 is evaluated as significant under Criterion D.

SIHP # 50-10-68-24907 consists of a stone wall, interpreted to be a historic ranch-related cattle wall, also functioning in demarcating a property boundary. SIHP # -24907 is evaluated as significant under Criterion D.

SIHP # 50-10-68-24908 consists of a heavily disturbed enclosure, interpreted to be a pre-contact habitation site. SIHP # -24908 is evaluated as significant under Criterion D.

SIHP # 50-10-68-24909 consists of a portion of the Old Government Main Road and an associated stone wall. SIHP # -24900 is evaluated as significant under Criteria A and D.

SIHP # 50-10-68-24910 consists of a low mound, interpreted to be a pre-contact agricultural planting mound. SIHP # -24910 is evaluated as significant under Criterion D.

SIHP # 50-10-68-24911 consists of a stone wall, interpreted to be a historic ranch-related cattle wall. SIHP # -24911 is evaluated as significant under Criterion D.

SIHP # 50-10-68-24912 consists of small terrace, interpreted to be a pre-contact native Hawaiian burial. SIHP # -24912 is evaluated as significant under Criteria D and E.

SIHP # 50-10-68-24913 consists of a paved well, interpreted to be a historic well, associated with historic habitation in the immediate area. SIHP # -24913 is evaluated as significant under Criterion D.

SIHP # 50-10-68-24914 consists of a small cave, identified by local informants as a possible locale for the interment of the remains of human sacrifices offered at the nearby Kane‘ele‘ele Heiau. SIHP # -24914 is evaluated as significant under Criteria D and E.

SIHP # 50-10-68-24915 consists of 4 historic railroad berm segments and an associated retaining wall constructed by the Hawaiian Agricultural Company. SIHP # -24915 is evaluated as significant under Criteria A, C and D.

SIHP # 50-10-68-24916 consists of a single petroglyph, an example of pre-contact rock art. SIHP # -24916 is evaluated as significant under Criteria D and E.

Section 8 Project Effect and Mitigation Recommendations

The Punalu‘u project area that was the subject of this study has undergone massive transformation with perhaps 90% of the land already mechanically cleared, or altered by floods and tsunamis. While much of the context of the sites that remain has been lost the sites that remain may be considered more important as the last vestiges of a vibrant Hawaiian community.

Of the thirty-two designated sites, preservation is recommended for 27 (84.4%). One result of the previous patterns of land clearance is that these remaining sites tend to be in areas that, for the most part, should be easy to accommodate within development plans.

8.1 Project Effect

With the preparation, State Historic Preservation Division review, and implementation of a preservation plan, burial treatment plan and monitoring program the impact of this project on remaining historic resources should be minimal.

Particular attention should be given to development plans in the immediate vicinity of the burial bluff complex site 4309. Particular concern has been expressed for local informants for the preservation of burials along this bluff.

8.2 Mitigation Recommendations

Three plans appear to be indicated to safeguard the cultural resources of the project lands. These are discussed below:

- Preservation Plan

  A Preservation Plan is recommended in accordance with Hawai‘i Administrative Rules (HAR) 13-277-3 to address buffer zones and protective measures for each of the 27 sites recommended for preservation.

- Burial Treatment Plan

  A Burial Treatment Plan is indicated in accordance with Hawai‘i Administrative Rules (HAR) 13-300-33 (b) to address: 1) Site 4309 which is identified as the “Burial Bluff Complex” (see Figure 35). This includes what appears to be a large number of burials on either side of the Hōkūloa Church and cemetery site, 2) The site 24898 burial complex that lies at a *pali* on the south edge of the project area 3) Site 24903 (if it does not lie entirely within the condominium exclusion), that was also suggested to have a burial (as well as habitation) function, 4) the cave (Site 24914) at the northeast side of Punalu‘u Bay and 5) site 24912 in the west central portion of the Makai Survey Area that is thought to be a burial and/or shrine.

- Archaeological Monitoring Program.

  The primary concern prompting an archaeological monitoring program (consisting of an archaeological monitoring plan, a combination of on-site and on-call monitoring, and a monitoring report in accordance with HAR 13-279) are burials associated with the Burial Bluff Complex (Site 4309) and human remains as may remain in the area just back of the

main pond (the focus of prior development efforts) for which there is anecdotal information. Given the history and extent of these lands it would not be surprising if there were additional finds during extensive ground disturbing development.

No data recovery program appears to be indicated at this time with a preference for preservation of sites over data recovery. The five sites that are not recommended for preservation including two walls, a well, a remnant enclosure, and an agricultural mound were judged to be very unlikely to produce significant additional information.

8.3 Disposition of Materials

No significant cultural materials were recovered in the course of this archaeological inventory survey.

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Appendix A Title Land Commission Awards in Coastal Punalu‘u

9.1 No. 2564, Enos Nakahuna

No. 2564, Enos Nakahuna, Kailua, Hawai‘i, December 13, 1847
N.R. 558v3

Greetings to the Land Commissioners: I hereby explain to you my claim for land and house lot which are in the land of Punalu‘u, Ka‘ū. I have a very old right, from my *makuas*. When they died I had been born, and so it has been held until today. Therefore, I explain to you that Kinimaka is the one from whom I hold it and I am under him. The house lot has always been mine, no one else's.
I am, with thanks,
ENOS NAKAHUNA, *konohiki* of Punalu‘u

N.R. 129v8
No. 2564, E. Nakahuna, Kailua, Hawai‘i, December 13, 1847
Greetings to the Land Commissioners: I hereby explain to you that I have a claim for land and a house lot. It is in the land at Punalu‘u in Ka‘ū. It is an ancient claim, from my *makuas*, and they are dead and I hold it until the present. I explain to you that Kinimaka /a *konohiki*/ was the one under whom I hold the land. The house lot claim has been mine continuously. There is no one else, only myself.
I am, respectfully,
E. NAKAHUNA

This claim by Nakahuna was copied in the previous Book, p. 558. W.M.K.
N.T. 372v8
No. 2564, E. Nakahuna, 31 October

Au, sworn, he has seen Nakahuna's 5 sections of land.
Section 1 - House lot and a patch.
Section 2 - 2 patches, Puaniki *mo‘o*.
Section 3 - 1 patch, Mailehahei *mo‘o*.
Section 4 – *Mo‘o* of *Kōloa*hiu.
Section 5 - *Wauke* and banana at Pu‘upuna.

These are old sections of land he had acquired during the days of Kamehameha I and he has lived there without opposition.

The boundaries are:
Section 1:
Mauka by Punalu‘u *Heiau*

Puna by lava rocks
Makai by sand
Kona by Punalu‘u pond.

Section 2:
Mauka and *Puna* by *konohiki* land
Makai by fishpond
Kona by *konohiki* land.

Section 3; This section is surrounded on all sides by Ioba Nakahuna.

Section 4:
Mauka and *Puna* by Government road
Makai by Ioba Nakahuna
Kona by land of the *konohiki*.

Section 5:
Mauka by ‘Enuhe Hill
Puna by land of Kamali
Makai and *Kona* by land of the *konohiki*.

[Award 2564; R.P. 6734; Punalu‘u Ka‘ū; 4 *‘āp*.; 10.25 Acs]

9.2 No. 7313, Kaawa

No. 7313, Kaawa, January 24, 1848
N.R. 137v8

Greetings to the Land Commissioners: I hereby explain my entire land claim to you -- fenced land, house lot, Ahupua`a, *kihapai* and planted trees. The fenced land is 10 chains, 3 fathoms 3 feet, by 8 chains 2 fathoms 0 feet, by 7 chains 8 fathoms 0 feet, by 8 chains 9 fathoms 4 feet. This was received from Kehoakalele. The house lot is 2 chains 5 fathoms 1 foot by 2 chains 2 fathoms 1 foot, by 1 chain 5 fathoms 3 feet, by 1 chain 4 fathoms 1 foot. In the land of Wailau, Ka‘ū, is an orange tree. In the land of Oilikahi is 1 Kona orange tree. In the land of Waiakea, Hilo, is an Ahupua‘anamed Mahakea. The land of Moaula is on the east, on the west is another Mahakea. A mountain is *mauka* and a sea is *makai*. It was received from Kekuni. On the east is the land of Oma. A sea is *makai*, a mountain is *mauka*, and the land of Omea is on the west. There are three *lo‘i kihapais* in the land of Punalu‘u. There is a *kihapai mauka*.
Aloha to you all.
KAAWA

N.T. 373v8
No. 7313, Kaawa, 31 October

Kamali, sworn, he has seen Kaawa's 2 house lots.

Section 1 - In the *‘ili* of Aalu in Wailau from Naihe during Liholiho's days in 1823.
Section 2 - Land lot in the *‘ili* of Homaikolono in Wailau.

Aikanaka had agreed for work on his (*konohiki*) days and granting to Kaawa for himself permanently. There has been much opposition for this land.

[Award 7313; R.P. 7476; Wailau Ka‘ū; 1 *‘āp*.; 7.2 Acs] No. 7557, Kalapuna

9.3 No. 7557, Kalapuna

No. 7557, Kalapuna
N.R. 351v5

Here is my message to you, the Land Commissioners: I am a claimant at Milu in Kau. There is also a *kula* claim named Homaikaloono. Kukukuli is another claim, and Kawili is another claim there. There are *kihapais* in these *‘ilis*. But one, named Kaaipuaa, was lost. Wailauonau is another claim.
I am,
KALAPUNA
January 24, 1848

N.T. 373v8
No. 7557, Kalapuna, 31 October [1849]

Kekapa, sworn, he has seen Kalapuna's 4 sections of land.

Section 1 - House lot at Homaikalono.
Section 2 - Taro field and house ‘ili of Lani.
Section 3 - Farming field in the *‘ili* of Kaawili.
Section 4. ‘Ili field of Aalii.

Section 1 is from Kaaukai in 1848 of January. Sections 2, 3, 4 from Kekapa in 1846. Life has been peaceful. No objections. The boundaries are:

Section 1:
Mauka, Schoolhouse
Puna, Land of Kaawa (lot) maybe
Makai, Kekapa
Kona, Holona.

Section 2:
Mauka, Kekapa

Puna, Punalu‘u pali
Makai, Government road
Kona, Land of Puuhonua.

Section 3:
Mauka, Kekapa
Puna, Land of Kaaumakua
Makai, Kekupa [sic?]
Kona, *Nīnole* ahupuaa.

Section 4:
Mauka, Government land
Puna, Kekapa
Makai, highway
Kona, Land of Kapuuhonua.

[Award 7557; R.P. 8563; Wailau Ka‘u; 3 ap.; 6.63 Acs]

9.4 No. 7606C, Kumaiku

No. 7606C, Kumaiku
N.T. 387v8
[No. 7606C], Kumaiku
[listed as 7606!]

Au, sworn, he has known that Holona has recorded Kumaiku's lands and he has seen Kumaiku's 1 land section. a *mo‘o*, Puehu in Punalu‘u. Nakahuna had given this land in 1830. No objections.

The boundaries are:
Mauka by land of the konohiki
Puna by land of Nihi
Makai by Government road
Kona by land of Kumaiku.

[Award 7606C; Punalu‘u Ka‘ū; 2 *‘āp*.; 4.97 Acs]

9.5 No. 7721, Makaha

No. 7721, Makaha, January 23, 1848
N.R. 153v8

Greetings to the Land Commissioners: I hereby state that I have 3 *ilis* in Nīnole: 1. Keopuka, 2. Paako, 3. Waihi. The land on the east is Keopuka, on the west it adjoins Hīlea, on the north it goes to /the zone where the/ *mamake* /trees grow/, on the south is the shallow squid spearing sea.

In these *ilis* are the two ponds. It is finished.
I am, respectfully,
MAKAHA

N.T. 396v8
No. 7721, Makaha, 2 November

Mano, deposed, he has seen Makaha's land, 2 moo lands at Waihi in *Nīnole*. It is inherited land from the parents in 1819, during the time of Kamehameha I, it was taken away in 1848, without reason by Kahuna, the servant of the wife of Kanihomaule and the land commissioner fee. It should be returned to the rightful owner to the person who has filed a suit. No one should oppose him again from this day forward. It has been settled properly and the boundaries are:

Mauka by the highway
Puna by land of Kapaana
Makai by the sea
Kona by land of Holona.

[Award 7721; R.P. 7879; Nīnole Ka‘ū; 2 *‘āp*.; 6.12 Acs]

9.6 No. 8004, [Ahia]

No. 8004, [Ahia], Ahi, Punalu‘u, Ka`u
N.R. 156v8

Greetings to the Land Commissioners: 1 house lot, 2 *lo‘i,* 1 taro *kihapai*, 2 sweet potato *mala*, 1 *wauke kihapai*. In the Ahupua‘aof Mohokea, 1 taro *mala*.
AHI

N.T. 389-390v8
No. 8004, Ahia 2, 2 November

Naholo, sworn, he has seen Ahia 2's, 3 land sections.
Section 1 – *Mo‘o* of Puehu - house lot.
Section 2 - A patch.
Section 3 - 3 fields in Puhaka, *mo‘o* of Punalu‘u.

Sections 1 and 2 from Nakauna in 1819. Section 3 from Kaaanui in 1819. He lived there continuously, without objections. The boundaries are:
Section 1:
Mauka by konohiki
Puna and *Makai* by Government road

Kona by *konohiki*

Section 2:
Mauka by Kekuapea's taro patch
Puna and *Makai* by land of Kepookuia
Kona by Government land.

Section 3:
Mauka by Kaaanui
Puna and *Makai* by *konohiki*
Kona by land of Malao.

[Award 8004; Punalu‘u Ka‘ū; 1 *‘āp*.; .25 Ac.]

9.7 No. 8758, Kaiolani

No. 8758, Kaiolani, Ka`u, Hawai‘i, January 24, 1848
N.R. 164v8

Hear ye, ye Land Commissioners at Honolulu: Here is my message to you. I am a claimant in Ka‘u, in *Nīnole*. There are some *kihapais* and some *umu ahau**. Also there are some plants - bamboo and *lauhala*.
Those are my claims in Ka‘u.
KAIOLANI

/*A heap of rocks in the sea to shelter and attract young fish./

N.T. 375-376v8
No. 8758, Kaiolani, 31 October

Kepapa, sworn, he has seen Kaiolani's 9 sections.

Section 1 - House lot, Waihi ili, *Nīnole* ahupuaa.
Section 2 - Taro land at Lani, Wailau ahupuaa.
Section 3 - In Aalii ili, Wailau ahupuaa.
Section 4 - At Homaikalono ili.
Section 5 - At Puako ili of *Nīnole*.
Section 6 - At Pue ‘ili.
Section 7 - At Paako ‘ili.
Section 8 - Goat corral in Waihi ‘ili.
Section 9 - Lauhala grove at Punalu‘u.

Section 1 acquired from Kaiolani's parents in 1819. Section 2 acquired from Papa in 1846. Section 3 acquired from Kaaumakua in 1846. Section 4 acquired from Kepapa in 1840. Section 5

acquired from Lai in 1846. Section 6 acquired from Koapapaa. Section 7 acquired from Aa in 1847. Section 8 acquired from Paakiki in 1844. Section 9 acquired from Hoomani in 1844. Kaiolani has lived there always since that time to the present without objections.

The boundaries are:

Section 1:
Mauka by school house
Puna by Kalapuna's lot
Makai by Kanekoa's land
Kona by Nakoko.

Section 2:
Mauka by land of Kalapuna
Puna by Punalu‘u *pali*
Makai by Kepapa
Kona by Kalapuna.

Section 3:
Mauka by Government land
Puna by land of Makuaole
Makai by Kaaumakua
Kona by *Nīnole* ahupu*’a‘ā*.

Section 4:
Mauka by Kepapa
Puna by Punalu‘u
Makai by land lot
Kona by *Nīnole* ahupu*’a‘ā*.

Section 5:
Mauka by Government land
Puna, *Makai*, *Kona* by Kanoena.

Section 6:
Mauka by Government land
Puna by stream
Makai by highway
Kona by Government land
Section 7:
Mauka and *Puna* by land of Makuaole
Makai by stream
Kona by Government land.

Section 8:

Mauka by land of Pahiki
Puna by land of Kapaana
Makai by stream
Kona by Kanekoa's interest.

Section 9: This section is bounded on all sides by the land of the konohiki.

[Award 8758; R.P. 6185; Nīnole Ka‘u; 1 *‘āp*.; 11.22 Acs; Wailau Ka‘u; 1 *‘āp*.; 2.3 Acs]

9.8 No. 8760, Kaawa

No. 8760, Kaawa, Ka‘ū, Hawai‘i
N.R. 165v8

Hear ye, ye Land Commissioners at Honolulu: Here is my message to you. I am a claimant of land in Ka‘ū, in the Ahupua‘aof Punalu‘u. I have a *mo‘o*, Pahaa, also a *kihapai* of *olona*, a *kihapai* of *mamaki**, a *kihapai ino***, and 6 taro *kihapai*. These are my claims in Ka‘ū.
KAAWA

/*Probably a tree whose bark was used for coarse tapa./
/**No data, possibly meaning infertile or ex*hau*sted soil./

N.T. 391v8
No. 8760, Kaawa, 2 November

Au, sworn, he has seen Kaawa's land of 3 sections.
Section 1 - Moo land of Pahoa in Punalu‘u.
Section 2 - Field in Moaula.
Section 3 - Field in Moaula.

Section 1 acquired from Nakahuna in 1819. Sections 2 and 3 from Hoomano in 1826. There has been peace and no objections. Section 4 house lot in Punalu‘u. The boundaries are:
Section 1:
Mauka by konohiki land
Puna by Au
Makai by highway
Kona by *konohiki* land.

Section 2:
Mauka by Government land
Puna by hog's sty
Makai by highway
Kona by Mohekea ahupuaa.

Section 3: Moaula stream surrounds section.

Section 4:
Mauka and *Puna* by Punalu‘u precipice
Makai by Government road
Kona by Waiahulu's lot.

[Award 8760; Punalu‘u Ka‘ū; 2 *‘āp*.; 15.20 Acs]

9.9 No. 8760C, Kekaula

No. 8760C, Kekaula, 12 November
N.T. 392v8

Kamali, sworn she had seen her husband record in Manoa and she has seen 2 sections of land.

Section 1 - Moo land Kuipoi in Punalu‘u.
Section 2 - House lot, *Hau* and coconut trees.

This is old land from Kekaula's parents received during the time of Kamehameha I, where he, Kekaula has always lived without objections. The boundaries are:

Section 1:
Mauka by konohiki land
Puna by land of Malao
Makai by konohiki land
Kona by land of Nihi.

Section 2:
Mauka by land of Kumaiku
Puna by the church lot
Makai by Punalu‘u pond
Kona by Naholo's lot.

[Award 8760C; Punalu‘u Kau; 2 ap.; .8 Ac.]

9.10 No. 10114, Mahae (Mahoe)

No. 10114, Mahae
N.R. 648v8

Hear ye, ye Land Commissioners at Honolulu: I hereby state my claim for land in Punalu‘u,

Ka‘ū. There is a *mo‘o*, Pōhakuhee, *kihapais* of taro, coconut, and *hau*, 4 *kihapai* of taro and 1 of *wauke*. Those are my claims in Ka‘u, Hawai‘i.
MAHAE

N.T. 387v8
No. 10114, Mahoe, 2 November
Au, sworn, he has seen Mahoe's land of 1 section of moo land, Opohakuhee in Punalu‘u. It is an old land received in 1830. He has lived there since that time to the present. No objections.

The boundaries are:
Mauka by land of the *konohiki*
Puna by land of Nihi
Makai by Government road
Kona by land of Kumaiku.

[Award 10114; R.P. 7585; Punalu‘u Ka‘ū; 1 *‘āp*.; 1.46 Acs]

9.11 No. 10848, Po‘okuia

No. 10848, Po‘okuia, January 27, 1848
N.R. 310v7
Hear ye, ye Land Commissioners: I have a claim for land at Punalu‘u in Ka‘ū /Island of Hawai‘i/, consisting of 1 ‘*ili,* 5 *kihapai* of taro, 1 *kihapai* of *wauke* and 1 *kihapai* of sweet potato. Aloha to you all.
POOKUIA

N.R. 121v8
No. 10848, Po‘okuia, Punalu‘u, Ka‘ū, Hawai‘i, January 27, 1848
Hear ye, ye Land Commissioners: I have a claim for land at Punalu‘u in Ka‘ū. It is 1 ili, of 5 taro *kihapai*, 1 *wauke kihapai*, 1 sweet potato *kihapai* and 1 house lot.
POOKUIA

This claim by Po‘okuia was copied in the previous Book on p. 310. W.M.K.
N.T. 377v8
No. 10848, Po‘okuia, 31 October

Kookoo, sworn, he has seen Pookuia's three sections.
Section 1 - House lot and patches.
Section 2 – *‘Ili* land of *Kōloa*kiu.
Section 3 - *Wauke* field at Puehu.

All of these sections have been from Nakahuna in 1819 during the days of Kamehameha I and Po‘okuia has lived there without objections to the present.

The boundaries are:

Section 1:
Mauka by Government road
Puna and *makai* by Punalu‘u *loko*
Kona by Wailau Ahupu*’a‘ā*.

Section 2:
Mauka by *konohiki* land
Puna by stream
Makai by land of the *konohiki*
Kona by Kookoo and Kaka.

Section 3:
Mauka and Puna by Punalu‘u hill
Makai by highway
Kona by Wailau ahupu*’a‘ā*.

Appendix B Site Descriptions from Barrera & Hommon 1972

Descriptions for Sites B9-15 to B-172

The sites are designated according to the Bishop Museum numbering system, which consists of four parts--the first part, the number 50, refers to Hawaii, the 50th state; the second part, HA, refers to the Island of Hawaii; the third part consists of the letter B, which refers to the District of Ka'u, and the number 9, which refers to the *ahupua'a* of Ninole and Wailau. The final part is the number of the individual site. In this report, only the last two parts of the designation are used, as the 50-HA is common to all of them.

Below is a serial listing of the sites located, with brief descriptions: certain of these sites, studied more thoroughly during the 1971 investigation, are described in greater detail in Section III.

B9-15 (V)* Crudely built wall with rubble core, adjacent to B9-16.

L** = 55 meters W = 50 cm H = 80 cm

B9-16 (V) Probable house site; medium-sized enclosure adjacent to B9-15.

L = 12.5 meters W = 9.4 meters H = 30 cm WW = 1.2 meters

A terrace is indicated by traces of a stone alignment and rubble extending across the width of the enclosure.

L = 9.4 meters W = 30 cm H = 20 cm

B9-17 (IV) Two small enclosures; the larger contains a concrete tomb on a small knoll above the cemetery. *'Ili'ili* was found on the surface around the tomb.

Tomb enclosure: L = 10 meters W = 5.2 meters
Other enclosure: L = 4.3 meters W = 2.8 meters

B9-18 (I) Stone wall; discussed in Section III.

B9-19 (I) House enclosure; discussed in Section III.

B9-20 (I) Wall and rock shelters; discussed in Section III.

B9-21 (I) Probable house enclosure, small, with well-built, core-filled walls and *'ili'ili* paving on the floor. An outlined lanai was located on the *makai* side of the structure. One door, on the *makai* side, was 65 cm wide; one on the *mauka* side measured 80 cm.

Enclosure: L = 6.5 meters W = 4.25 meters H = 90 cm WW = 80 cm
Lanai: L = 7.5 meters W = 1.8 meters

This site has been recommended for preservation.

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* Roman numerals in parentheses indicate the survey area in which the site is located.

** L = length W = width H = height WW = wall width

B9-22 (I) Probable burial cists (Figs. 5 and 6). The opened cist was apparently constructed by first digging a pit of the desired size in the ground, and then walling up the sides and roofing over the top. An adjacent low mound with *'ili'ili* paving on top is probably an unopened cist.

Opened cist, exterior: L = 3.1 meters W = 2.5 meters
interior: L = 2.5 meters W = 50 cm H = 60 cm

Unopened cist: L = 3.4 meters W = 2.2 meters

This site is recommended for preservation.

B9-23 (I) Walled enclosure; discussed in Section III.

B9-24 (I) Possible grave; very small platform with rough surface.

L = 1.8 meters W = 1.0 meter H = 30 cm

B9-25 (I) A small, poorly preserved, oval platform.

L = 3.1 meters W = 1.8 meters H = 30 cm

B9-26 (I) Possible graves. A large enclosure built against a cliff, contained four mounds, a medium-sized paved terrace, and an oval stone alignment.

Enclosure: L = 45 meters W = 23 meters
Average mound: L = 1.9 meters W = 1.5 meters
Paved terrace: L = 6.1 meters W = 1.6 meters
Oval alignment: L = 3.9 meters W = 1.8 meters

B9-27 (I) Wall extending from the cliff near site B9-29.

L = 65.9 meters

B9-28 (I) Small rock shelter, with 1.5-meter section of wall in front. No cultural materials were visible in the shallow deposit.

L = 1.5 meters W = 1.7 meters

B9-29 (I) Possible grave. A small, poorly preserved, oval platform was at the base of the cliff near sites B9-27 and B9-30

L = 3.0 meters W = 2.0 meters H = 30 cm

B9-30 (I) Possible grave. A small pavement was at the base of the cliff near site B9-31.

L = 3.3 meters W = 1.6 meters H = 30 cm

B9-31 (I) Wall, extending from the cliff below the church to a wall running along the coast road.

L = 40 meters W = 70 cm H = 1.3 meters

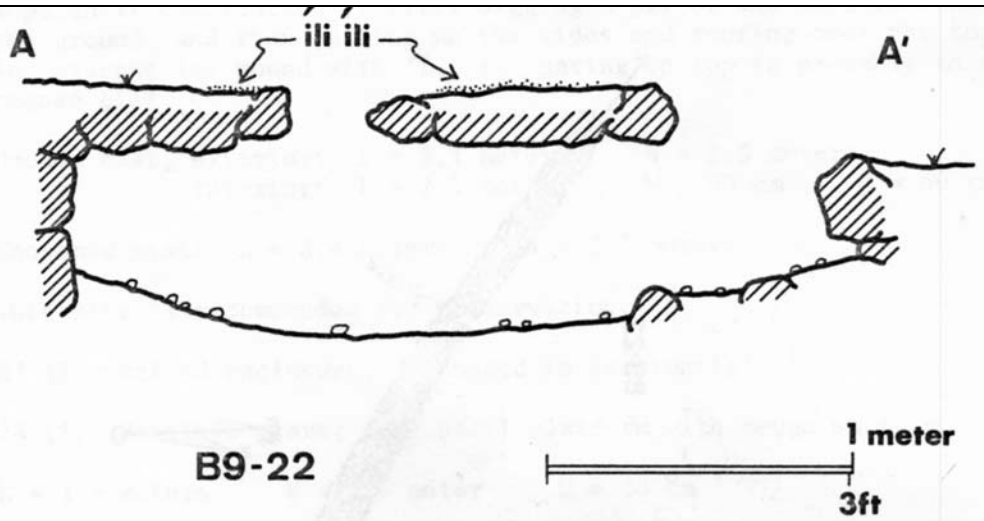

Fig. 6. PROFILE OF OPEN BURIAL CIST IN SITE B9-22.

B9-32 (I) Well preserved wall with numerous corners, trending S and E.

B9-33 (I) Two platforms; discussed in Section III.

B9-34 (I) Complex of rock shelters, platform, wall, and mound; discussed in Section III.

B9-35 (I) Pen, probably modern. Medium-sized enclosure with rotting wooden gate at *makai* end and traces of barbed wire. Modern rubbish was associated with the site.

L = 21.0 meters W = 5.3 meters H = 1.0 meters WW = 1.2 meters

B9-36 (I) Probable house enclosure; small U-shaped structure with some *'ili'ili* paving.

L = 5.0 meters W = 4.7 meters

B9-37 (I) Possible house enclosure, small.

L = 26.5 meters W = 23.0 meters H = 85 cm WW = 65 cm

B9-38 (I) Three poorly preserved features.

Wall: L = 6.1 meters W = 10 cm
Mound: L = 1.5 meters W = 40 cm
Mound: L = 2.8 meters W = 1.2 meters

B9-39 (I) Midden diposit with modern rubbish on the surface; discussed in Section III.

B9-40 (I) Very small, square platform; well-constructed but deteriorated.

L and W = 1.6 meters H = 1.0 meter

B9-41 (I) Possible grave; small, roughly-paved terrace.

L = 2.2 meters W = 2.1 meters H = 80 cm

B9-42 (IV) Large platform. A natural knoll had been converted to the platform structure with artificially built-up sides on the N and S. A narrow "step" was located on the N side.

Platform: L = 7.3 meters W = 7.0 meters H = 1.6 meters
Step: W = 60 cm H = 1.4 meters

B9-43 (II) Walled enclosure; discussed in Section III.

B9-44 (II) Medium-sized depression with two rock shelters. One shelter was fronted by a rough wall; another wall was built into a break in the side of the depression.

First wall: L = 2.5 meters W = 60 cm
Second wall: L = 2.5 meters W = 1.0 meter H = 70 cm

A low, circular mound or rough pavement (D* = 2.0 meters) was located near a natural earthen "ramp" leading into the depression.

B9-45 (II) One small and one medium-sized rock shelter. The latter had a rough arc-shaped wall in front.

Small-shelter: L = 1.3 meters W = 80 cm
Medium-sized shelter: L = 3.3 meters W = 1.1 meters
Wall: L = 3.3 meters

The distance from the back of the shelter to the wall was 2.3 meters

B9-46 (II) Small depression with small rock shelter.

Depression: L = 4.5 meters W = 4.3 meters
Rock-shelter: L = 2.5 meters W = 1.0 meter

B9-47 (II) Large enclosure with 14 sides.

C** = 191.8 meters WW = 50 cm H = 80 cm

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* D = diameter.

** C = circumference.

B9-48 (II) Walled enclosure; discussed in Section III.

B9-49 (II) Small depression with one large and one small shelter.

Depression: L = 7.3 meters W = 3.0 meters
Large shelter: L = 9.0 meters W = 1.3 meters
Small shelter: L = 3.0 meters W = 60 cm

B9-50 (II) Possible animal pen; large depression with two walls and two mounds. Between the walls is an "entrance" to the depression 80 cm wide.

Depression: L = 13.0 meters W = 7.5 meters

B9-51 (II) Two depressions--one small, and one very small. The latter had a 70-cm overhang around most of its perimeter; the former was open at one end and was roughly paved at the other.

Very small depression: D = 1.5 meters
Small depression: L = 6.5 meters W = 2.8 meters
Pavement: L = 2.8 meters W = 1.7 meters

B9-52 (II) Very small depression with two small overhang shelters.

Depression: L = 3.8 meters W = 3.4 meters
Shelters: L = 1.8 meters W = 80 cm
L = 1.8 meters W = 60 cm

B9-53 (II) Very small depression with a small entrance located near sites B9-54 through B9-56. No cultural debris was visible.

Depression: L = 5.0 meters W = 50 cm
Entrance: L = 0.9 meter W = 30 cm

B9-54 (II) Small rock shelter with a poorly preserved, arc-shaped wall in front. The distance from the back of the shelter to the walls was 1.85 meters.

Shelter: L = 1.6 meters W = 1.2 meters
Wall: L = 2.4 meters

B9-55 (II) Possible graves; small depression containing two platforms.

Depression: L = 5.3 meters W = 4.6 meters
Platforms: L = 2.8 meters W = 1.5 meters
L = 2.3 meters W = 1.3 meters

This site has been recommended for preservation.

B9-56 (II) Two platforms and a rock shelter; discussed in Section III.

B9-57 (II) Three walls; possible agricultural complex utilizing flood-water irrigation along with features of sites B9-58, B9-60, and B9-61. The longest wall extended along the bank of a stream gulch; at each end of this wall was a wall that extended across the stream bed.

Long wall: L = 120 meters W = 60 cm H = 80 cm
N cross-wall: L = 15 meters W = 60 cm H = 80 cm
S cross-wall: L = 11.5 meters W = 60 cm H = 80 cm

B9-58 Wall extending across a stream bed, located 26 meters upstream of site B9-57. A section in the stream channel itself has been washed away (see B9-57).

L = 12.5 meters W = 65 cm H = 60 cm

B9-59 (II) Possible burial; small paved terrace built against a natural slope in a small tributary gully. This site has been recommended for preservation.

L = 2.9 meters W = 2.6 meters

B9-60 (II) Wall extending across the stream bed (see B9-57).

L = 10.5 meters W = 90 cm H = 50 cm

B9-61 (II) Wall paralleling the upstream end of the long wall of site B9-57 along the opposite bank of the stream bed (see B9-57).

L = 10 meters W = 70 cm H = 70 cm

B9-62 (IV) Wall near site B9-42.

L = 8.0 meters W = 80 cm H = 80 cm

B9-63 (II) Possible grave; medium-sized, roughly-paved terrace abutting a lava flow.

L = 4.2 meters W = 3.8 meters H = 1.65 meters

B9-64 (III) Wall extending across the stream floodplain.

L = 40.0 meters W = 50 cm H = 50 cm

B9-65 (II) Wall oriented roughly NE-SW.

L = 91 meters W = 55 cm H = 80 cm

B9-66 (II) Small rock shelters; discussed in Section III.

B9-67 (II) Possible animal pen; small enclosure adjacent to a ledge, with an "entrance" 1.10 meters wide.

L = 4.2 meters W = 3.95 meters H = 55 cm WW = 80 cm

B9-68 (II) Possible animal pen; medium-sized enclosure formed on three sides by a natural ledge and on the fourth by a wall.

L = 15.6 meters W = 7.3 meters

B9-69 (II) Rock shelter; discussed in Section III.

-11-

B9-70 (II) Rock shelters; discussed in Section III.

B9-71 (II) Wall trending roughly SE to SW.

L = 82 meters W = 75 cm H = 75 cm

B9-72 (II) Small walled enclosure; discussed in Section III.

B9-73 (II) Probable house site. This was a well-preserved *'ili'ili* pavement delimited by a rectangular outline of medium-sized stones. At a distance of 3.1 meters from the pavement was a 3.2-meter-long alignment of stones. The area between the pavement and the alignment was littered with *'ili'ili*. This site has been recommended for preservation.

Pavement: L = 4.3 meters W = 2.5 meters H = 10 cm

B9-74 (II) Wall extending from site B9-76 to B9-28.

L = 350 meters

B9-75 (II) Trash deposits; discussed in Section III.

B9-76 (II) Trash deposit; discussed in Section III.

B9-77 (II) Roughly conical mound of stones.

L = 1.9 meters W = 1.7 meters

B9-78 (II) Two walls and five mounds. The walls and three of the mounds were probably remnants of a single wall at least 63 meters long extending SE along the road that parallels the *ahupua'a* boundary wall. The other two mounds may have been part of a branch wall. These walls appeared to have been used as sources for stones for building the modern boundary wall of the *ahupua'a* (see B9-119).

Longer wall: L = 15 meters W = 1.4 meters H = 70 cm
Three mounds (probably portions of long wall): D = 2.4, 2.7, and 2.3 meters

B9-79 (II) Medium-sized rock shelter; no midden deposit visible.

L = 3.1 meters W = 1.6 meters

B9-80 (II) Wall.

L = 13.0 meters W = 1.0 meter H = 40 cm

B9-81 (II) Wall extending *makai-mauka* near B9-82.

L = c. 50 meters W = 1.10 meters H = 65 cm

B9-82 (II) Historic house complex; two very large platforms with abundant remains of recent wooden structures and extensive areas of *'ili'ili* and large (0.2- to 0.3-meter-diameter) stone paving. The platforms shared one border. A corner of a wall was located NW of one of the platforms. This site has been recommended for preservation.

Platforms: L = 11.2 meters W = 9.9 meters H = 50 cm
L = 12.6 meters W = 10.2 meters H = 60 cm
Wall corner: L = 5.2 meters L = 3.3 meters

B9-83 (II) Two walls located near and possibly associated with site B9-82. The longer wall, oriented NW-SE, is core-filled, with a good facing on both sides, and is the better preserved. The shorter wall is oriented NE-SW.

Long wall: L = 82 meters W = 80 cm H = 80 cm
Short wall: L = 46 meters

B9-84 (II) Short wall on the lava flow near Ninole Cove.

L = 4.9 meters W = 85 cm H = 1.3 meters

B9-85 (II) Medium-sized rock shelter with no midden.

L = 3.6 meters W = 1.1 meters

B9-86 (II) Possible burial; very small depression with possible very rough stone pavement covering half of the floor.

L = 4.0 meters W = 2.2 meters

B9-87 (II) Small depression containing a small, well-preserved platform. An overhang extending around 3/4 of the circumference of the depression formed a rock shelter. Recent cultural materials, including a broken shovel and the remnants of a ladder were found in the depression.

Depression: L = 4.0 meters W = 2.4 meters
Platform: L = 5.0 meters W = 1.5 meters
Shelter: L = c. 6.0 meters W = 1.5 meters

B9-88 (II) Wall extending from the cliff toward the ocean for a distance of 58 meters and then turning to the NE for a distance of 41 meters.

W = 65 cm H = 80 cm

B9-89 (II) Poorly preserved wall near the cemetery.

L = 17.1 meters

B9-90 (II) Medium-sized depression with a gentle slope along one side. A 3-meter-long wall extended along one side of the depression.

Depression: L = 8.5 meters W = 8.5 meters

B9-91 (II) Two walls near and possibly associated with site B9-88. The longer wall had eight corners; the other wall branched from the first at nearly a right angle.

Long wall: L = 96 meters W = 50 cm H = 60 cm
Short wall: L = 19.0 meters W = 50 cm H = 60 cm

B9-92 (II) Small depression.

L = 2.7 meters W = 2.3 meters

B9-93 (II) Possible animal pen. A small enclosure was formed by a natura outcrop and a short, arc-shaped wall.

Enclosure: L = 5.3 meters W = 1.6 meters
Wall: W = 40 cm H = 70 cm

B9-94 (III) Possible temporary shelter; poorly-preserved, C-shaped structure.

L = 4.1 meters W = 3.0 meters

B9-95 (IV) Possible house enclosure. This small well-constructed enclosure was built into a natural U-shaped depression.

L = 7.9 meters W = 6.8 meters H = 1.3 meters WW = 1.0 meter

B9-96 (III) Wall with four corners.

L = 93.9 meters W = 90 cm H = 90 cm

B9-97 (IV) Large rock-shelter. No cultural evidence was found on the surface of the deposit.

L = 6.7 meters W = 2.2 meters H = 1.0 meter

B9-98 (I) Possible house enclosure. Small enclosure abutted, and was later than, a long wall running parallel to the beach road. A small shallow pit abutted the wall in one corner.

Enclosure: L = 7.2 meters W = 5.4 meters

B9-99 (III) Poorly-preserved wall.

L = 12.5 meters W = 70 cm H = 1.0 meter

B9-100 (III) Possible dry-agriculture complex. The several poorly preserved structures included short walls, two possible C-shaped structures attached to one another, and mounds.

B9-101 (II) Wall.

L = 13.7 meters H = 90 cm

B9-102 (III) Wall extending along the bank of a dry stream bed.

L = 30 meters W = 60 cm H = 80 cm

B9-103 (III) Possible temporary shelter. The poorly-constructed C-shaped structure was of unfaced dry masonry.

L = 4.8 meters W = 2.7 meters H = 40 cm WW = 80 cm

B9-104 (III) Wall, extending more than 100 meters SE from site B9-15.

B9-105 (III) Probable modern corral. The large, well-constructed enclosure was near a stream bed; two walls abutted and formed obtuse angles with the *mauka* wall of the enclosure.

Enclosure: L = 30 meters W = 32 meters H = 2.2 meters
WW = 1.4 meters
Walls: L = 21.0 and 18.4 meters

B9-106 (V) Probable temporary shelter. The C-shaped structure with several mounds in the vicinity was possibly associated with dry agriculture. A stone lamp was found at the site.

C-shape: L = 2.7 meters W = 2.8 meters H = 50 cm WW = 60 cm

B9-107 (III) Poorly constructed wall.

L = 25 meters

B9-108 (III) Small rock shelter with a short wall at the opening.

Shelter: L = 1.4 meters W = 1.0 meter
Wall: L = 3.0 meters W = 1.3 meters H = 1.3 meters

B9-109 (III) L-shaped wall, possibly the remnant of an enclosure, near the bank of a gulch.

L = 7.5 and 15 meters W = 1.8 meters H = 70 cm

B9-110 (I) Collapsed lava bubble and rock shelter; discussed in Section III.

B9-111 (I) Two poorly preserved enclosures sharing a common wall.

L = 7.4 meters W = 5.2 to 9.0 meters
L = 7.4 meters W = 5.7 meters

B9-112 (III) Probable residential complex. A large, well-preserved enclosure contained three small enclosures.

Large enclosure: L = 40.8 meters W = 38.5 meters H = 90 cm
WW = 60 cm
Small enclosures: L = 5.0, 4.7, 3.9 meters W = 4.5, 3.4, 3.6 meters

B9-113 (III) Wall extending NW from the large enclosure wall of site B9-112.

L = 13.0 meters W = 75 cm H = 1.0 meter

B9-114 (III) Poorly-constructed platform, short wall, and small bedrock hollow used to store glass bottles and other objects.

Platform: L = 4.7 meters W = 3.2 meters H = 60 cm
Wall: L = 4.0 meters H = 1.1 meters

B9-115 (III) Short wall.

L = 2.2 meters W = 1.2 meters H = 40 cm

B9-116 (III) Short wall.

L = 4.5 meters W = 1.4 meters H = 40 cm

B9-117 (III) Medium-sized, poorly-defined possible house platform with earthen surface.

L = 5.0 meters W = 3.5 meters H = 85 cm

B9-118 (V) Medium-sized platform, probable house-site, with remains of enclosure on top.

L = 4.6 meters W = 3.65 meters H = 75 cm WW = 80 cm

B9-119 (V) Poorly-preserved wall, possible old boundary wall (see site B9-78, p. 12), running parallel to the modern *ahupua'a* boundary walls in the upper section of the surveyed area.

L = 200+ meters

B9-120 (V) Possible house terrace. This is a large terrace consisting of a low knoll with a wall of large bordering stones and smaller paving stones along one side.

L = 5.5 meters W = 4.4 meters H = 1.0 meter

B9-121 (IV) Medium-sized open-ended enclosure in poor to fair condition. This probable house site contains a low terrace at the closed end. The open end of the enclosure is at the cliff edge, facing the ocean. This site has been recommended for preservation.

Enclosure: L = 11.5 meters W = 7.8 meters H = 70 cm WW = 80 cm
Terrace: L = 7.8 meters W = 6.9 meters H = 30 cm

B9-122 (IV) Two small adjacent platforms. These possible graves are on the opposite side of a long *mauka-makai* wall from site B9-123. This site has been recommended for preservation.

L = 2.9 meters W = 1.9 and 1.7 meters H = 20 cm

B9-123 (IV) Three large platforms, two small platforms, and a wall corner; probable residential complex. This site has been recommended for preservation.

Platform A:	L = 8.7 meters	W = 7.4 meters
B:	L = 12.6 meters	W = c. 3.0 meters
C:	L = 3.4 meters	W = 2.3 meters
D:	L = 2.7 meters	W = 1.8 meters
E:	L = 6.2 meters	W = 5.0 meters

Platform A is paved with *'ili'ili*, the others have rough surfaces. The wall corner might be the remnant of a large enclosure that contained Platforms A, B, and C.

L = 27.5 and 15.6 meters W = 1.0 meter H = 1.1 meters

B9-124 (IV) Small, poorly preserved terrace paved with small stones; possible grave.

L = 3.5 meters W = 2.1 meters H = 60 cm

B9-125 (II) Medium-sized rock shelter.

L = 4.0 meters W = 1.6 meters

B9-126 (IV) Small, roughly paved terrace.

L = 6.5 meters W = 2.0 meters H = 65 cm

B9-171 (I) Walled enclosure with house platform; discussed in Section III.

B9-172 (I) Rectangular enclosure; discussed in Section III.

Appendix C Documentation of Old Government Road

Alanui Aupuni at Ninole

by

Marion Kelly

A comparison of the 1852 map (Fig. 19) with the 1907 map (Fig. 20) of the coastline at Ninole indicates that the old Alanui Aupuni probably followed a route seaward of Ninole Pond after it left the high aa lava that is S of Ninole Pond. After coming off the aa lava, the old road took a northeasterly direction across a small river* at the southern edge of Ninole Pond, along sand dunes on the pahoehoe flats at the eastern end *(makai)* of the pond, then a northern turn around the back *(mauka)* of a smaller pond (see Fig. 19), and finally off in a northeasterly direction toward Koloa beach, which is the home of the famous legendary multiplying stones ('Ili'ili-o- Koloa) that can still be seen today (Fig. 21).**

In an interview on January 31, 1972, Mr. William Meinecke, a long-time resident of Ka'u, stated that it was traditional knowledge that there had been a road *makai* of Ninole Pond and that it had disappeared in 1868 at the time of the volcanic and tsunami action in the area. He further stated that, as far as he knew, there had always been a Ninole spring (Fig. 22) at the place where the spring is presently located, and that there had always been a pond area just *makai* of the spring. However, he said there was once more land along the shoreline (Fig. 23). It was there that the old road came down off the as lava flow onto the Ninole plain and along the coast. After the 1868 volcanic and tsunami disaster the road was gone and its disappearance has been laid to subsidence of the land.

If it can be presumed that the present Koloa beach is the same as that reported by Ellis in 1824, any subsidence would have been restricted only to the portion of the road *makai* of Ninole Pond. Dr. Gordon Macdonald confirmed (in a telephone interview) that he knows of no literature that describes any subsidence at Ninole; however, he also said that it is entirely possible that such action took place and would now be known only through traditional knowledge carried on by people living in the area.

From the evidence available at this late date, it would seem that there would be no need for subsidence to account for a change in the shoreline at this point, although it is still possible that subsidence occurred. The change described as having taken place in 1868 could have been entirely effected by tsunami action alone. If subsidence occurred, it would have been extremely restricted to the one area *makai* of Ninole Pond, and while such restriction would not be impossible, it would seem highly unlikely. It is more reasonable to assume that sand dunes did cover the pahoehoe flats *makai* of the pond and that tsunami wave action into and back out of Ninole Pond scoured the sand off the pahoehoe, taking with it the original road *makai* of the pond.

Brigham (1909:103-104) quotes a report by a passenger on board the schooner *Oddfellow,* which was cruising along the coast of Ka'u shortly after the disaster. Arriving at Punalu‘u on Monday, April 6, 1868, the passenger wrote:

> Too rough to attempt a landing. The stone church and all other buildings near the sea gone. At Ninole but three houses were left. Smoke or steam is issuing from the hills back of Hilea. Came to anchor at Kaalualu at noon. The houses, wharf, etc., all gone here, and the rocks inland strewed with the wreck for a distance of six or eight hundred feet.

While the volcanic and landslide action was severe from Kahuku to Waiohinu (Fig. 24), Hilea, and beyond, the tsunami action that followed was even lore disasterous in terms of destruction of houses and loss of life. Brigham's scoreboard for losses in Ka'u reads as follows (1909:118):

Houses destroyed by land-slide	10	Deaths	31
Houses destroyed by sea-wave	108	Deaths	46
Houses destroyed by earthquake	46	Deaths	0
Houses destroyed by lava-stream	37	Deaths	0
Totals	201		77

He also reported that only one life was lost in Puna by the tsunami and one in Hilo "...by a falling cliff" (1909:118).

Summary:

Evidence indicates that the old government road around the island (Alanui Aupuni) did traverse the area makai of the present Ninole Pond (refered to on C. Brewer map as Ninole cove). In addition, it appears that "this road was destroyed in the 1868 disaster, and that it was probably the tsunami that washed it away, although some subsidence may have occurred.*

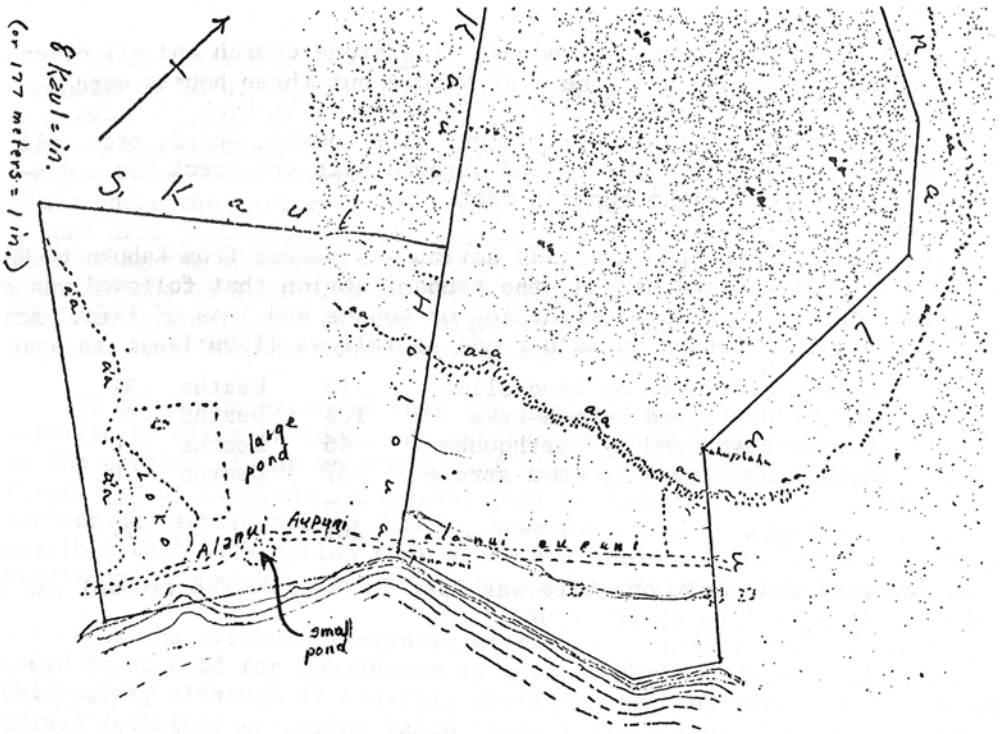


Fig. 19. MAP OF ROYAL PATENT GRANTS NO. 821 TO HOLOUA AND 828 TO KEKAULA, SHOWING COASTLINE AND ALANUI AUPUNI AS SURVEYED JULY 19, 1852.

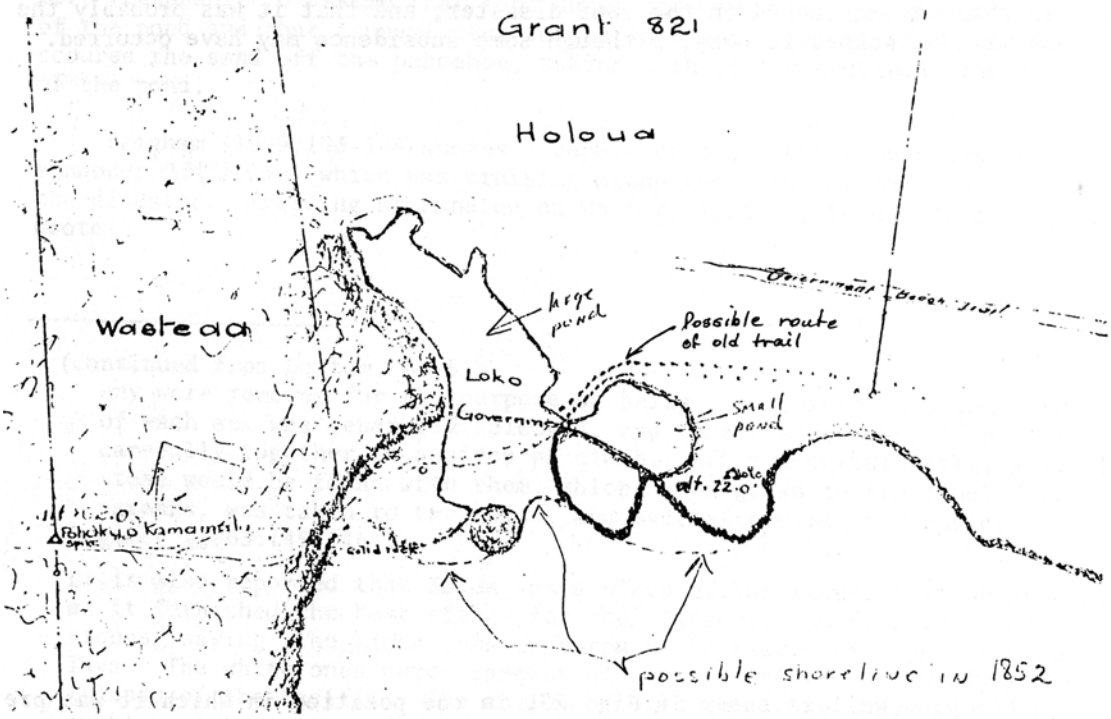


Fig. 20. MAP OF NINOLE AND WAILAU REMNANTS, KA'U, HAWAII (REG. NO. 2395) AS SURVEYED BY GEO. F. WRIGHT, MARCH, 1907.

Fig. 21. WILLIAM MEINECKE AND FRIENDS EXAMINING 'ILI'ILI-O-KOLOA, MULTIPLYING STONES OF KOLOA, AUGUST 21, 1954.

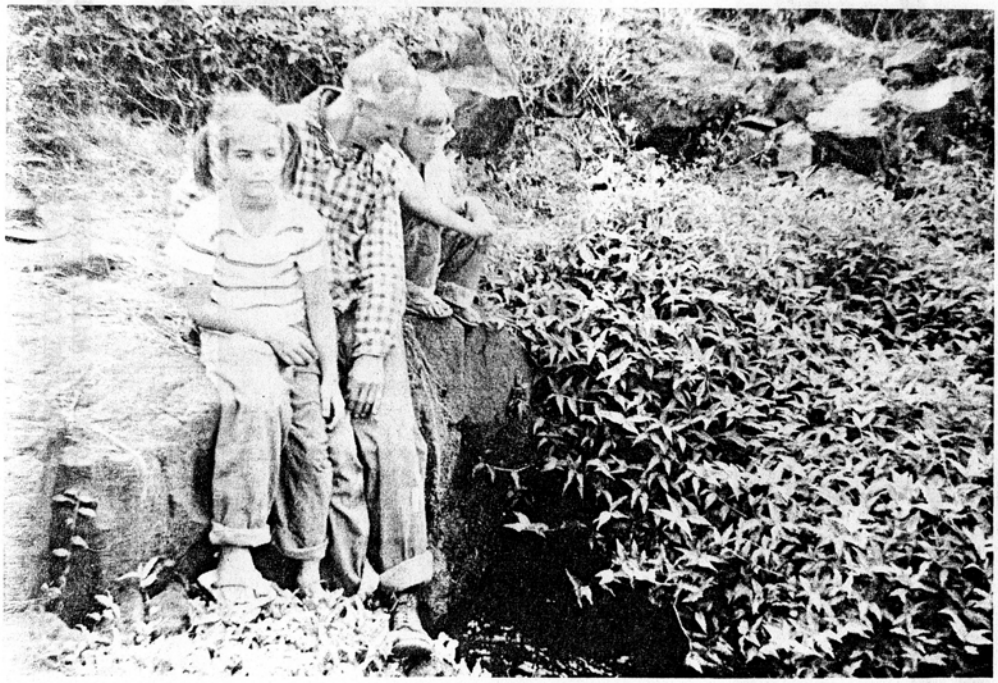
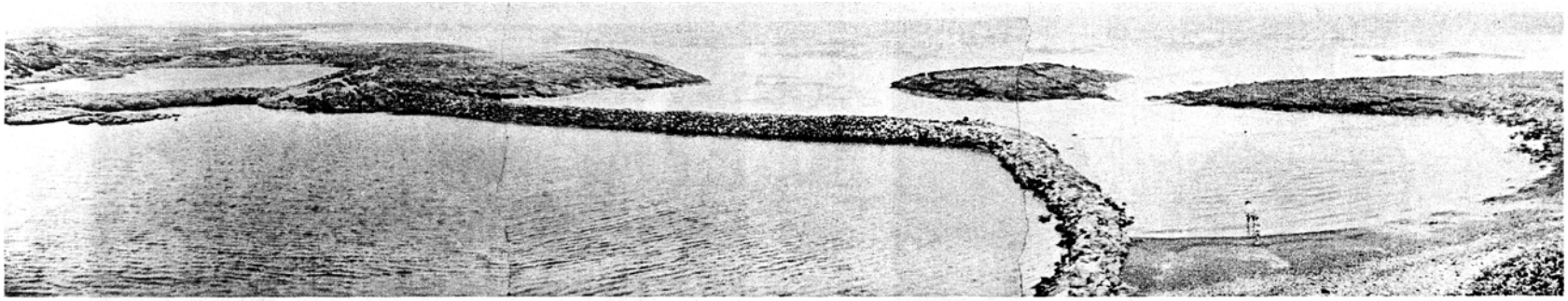
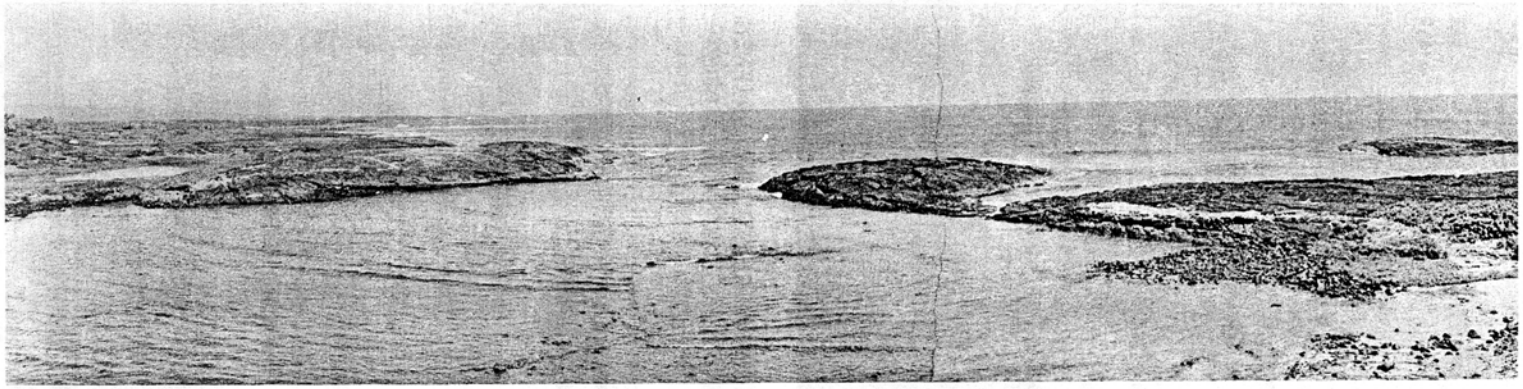


Fig. 22. WILLIAM MEINECKE AND VISITORS BY NINOLE FRESH-WATER SPRING WITH *HONOHONO* GRASS, AUGUST 21, 1954.

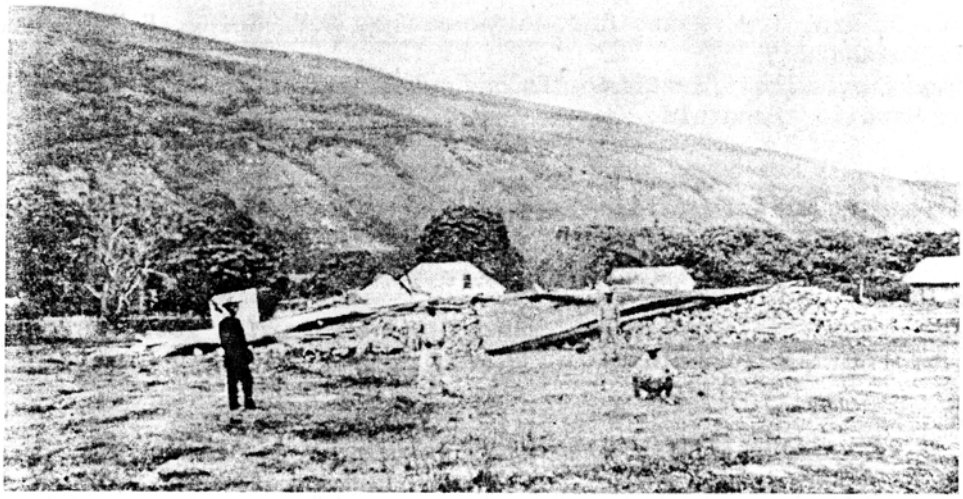


a. August 21, 1954



b. March 14, 1972

Fig. 23. LOOKING *MAKAI* FROM TOP OF A'A FLOW TOWARD EASTERN WALL OF NINOLE POND AND SMALL POND NE OF NINOLE POND (at left in photo).



(From Brigham, 1907)

Fig. 24. CHURCH AT WAIOHINU WRECKED BY EARTHQUAKE, APRIL 2, 1868.

Appendix B

Air Quality Study for the Proposed Sea Mountain at Punalu‘u Project
(B.D. Neal and Associates, January 2006)

DRAFT

AIR QUALITY STUDY

FOR THE PROPOSED

SEA MOUNTAIN AT PUNALU'U PROJECT

PUNALU'U, KAU, HAWAII

Prepared for:

Group 70 International, Inc.

January 2006

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Table

1.0 SUMMARY

The proposed Sea Mountain at Punalu'u Project is a resort/residential community located along Mamalahoa Highway in the Kau District on the island of Hawaii. In addition to 1823 single- and multi-family dwelling units, it includes an 18-hole championship golf course, a 15,000 square-foot cultural/marine center and a 50,000 square-foot village commercial area. Full development and occupancy of the project is planned for 2015. This study examines the potential short- and long-term air quality impacts that could occur as a result of construction and use of the proposed facilities and suggests mitigative measures to reduce any potential air quality impacts where possible and appropriate.

Both federal and state standards have been established to maintain ambient air quality. At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii air quality standards are comparable to the national standards except those for nitrogen dioxide and carbon monoxide which are more stringent than the national standards.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the project area is very much affected by its near coastal situation and by nearby mountains. Winds are predominantly trade winds from the northeast, but kona storms generate occasional strong winds from the south or southwest during winter. Temperatures in the project area are generally very consistent and moderate with average daily temperatures

ranging from about 62°F to 81°F. The extreme minimum temperature recorded at nearby Pahala is 48°F, while the extreme maximum temperature is 91°F. Average annual rainfall in the area amounts to about 48 inches with much of the precipitation occurring during the winter months.

Except for periodic impacts from volcanic emissions (vog), the present air quality of the project area is believed to be relatively good. The limited air quality data that are available for the area from the Department of Health suggest that (despite the vog) concentrations are likely well within state and national air quality standards.

If the proposed project is given the necessary approvals to proceed, it is inevitable that some short- and long-term impacts on air quality will occur either directly or indirectly as a consequence of project construction and use. Short-term impacts from fugitive dust will likely occur during the project construction phase. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the disruption of traffic, and from workers' vehicles may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, using wind screens, keeping adjacent paved roads clean, and by covering of open-bodied trucks. Other dust control measures could include limiting the area that can be disturbed at any given time and/or mulching or chemically

stabilizing inactive areas that have been worked. Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Monitoring dust at the project boundary during the period of construction could be considered as a means to evaluate the effectiveness of the project dust control program. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

After construction, motor vehicles coming to and from the proposed development will result in a long-term increase in air pollution emissions in the project area. To assess the impact of emissions from these vehicles, an air quality modeling study was undertaken to estimate current ambient concentrations of carbon monoxide at intersections in the project vicinity and to predict future levels both with and without the proposed project. During worst-case conditions, model results indicated that present 1-hour and 8-hour carbon monoxide concentrations are probably well within both the state and the national ambient air quality standards. In the year 2015 without the project, carbon monoxide concentrations were predicted to decrease or remain about the same despite an expected slight increase in ambient traffic volumes. This is because older vehicles that emit more air pollution will be retired during the intervening years. With the project in the year 2015, carbon monoxide concentrations were estimated to increase, but concentrations should still remain well within the standards. Due to the small impact the project is expected to have, implementing mitigation measures for traffic-related air quality impacts is probably unnecessary and unwarranted.

Depending on the demand levels, long-term impacts on air quality are also possible due to indirect emissions associated with a development's electrical power and solid waste disposal requirements. Quantitative estimates of these potential impacts were not made, but based on the estimated demand levels and emission rates involved, any significant impacts are unlikely. Nevertheless, incorporating energy conservation design features and promoting conservation and recycling programs within the proposed development could serve to further reduce any associated impacts and conserve the island's resources.

2.0 INTRODUCTION

The proposed Sea Mountain at Punalu'u Project is a resort/residential community that includes a championship golf course, a cultural/marine center and a village commercial area. The site of the proposed development is along Mamalahoa Highway in the Kau District on the island of Hawaii midway between Naalehu and Pahala. Sea Mountain at Punalu'u presently includes an 18-hole golf course and condominium units. The resort/residential component of the proposed project will consist of a total of 1823 new single- and multiple-family units, and the existing 18-hole golf course will be expanded and refurbished to become a championship course. The 15,000 square-foot cultural/marine center is expected to include a gift shop and possibly a restaurant, while the Village Center will consist of 50,000 square feet of commercial space for shopping and services. Full development and occupancy of the project is planned for 2015.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short- and long-term

direct and indirect air quality impacts that could result from construction and use of the proposed facilities as planned. Measures to mitigate impacts on air quality from the project are suggested where possible and appropriate.

3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, national and state AAQS have been established for particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The state has also set a standard for hydrogen sulfide. National AAQS are stated in terms of both primary and secondary standards for most of the regulated air pollutants. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow a specified number of exceedances each year.

The Hawaii AAQS are in some cases considerably more stringent than the comparable national AAQS. In particular, the Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit. The U.S. Environmental Protection Agency (EPA) is currently working on a plan to phase out the national 1-hour ozone standard in favor of the new (and more stringent) 8-hour standard.

The Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make the state standards essentially the same as the national limits. In 1993, the state also revised its particulate standards to follow those set by the federal government. During 1997, the federal government again revised its standards for particulate, but the new standards were challenged in federal court. A Supreme Court ruling was issued during February 2001, and as a result, the new standards for particulate were implemented during 2005. To date, the Hawaii Department of Health has not updated the state particulate standards. In September 2001, the state

vacated the 1-hour standard for ozone and an 8-hour standard was adopted.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affect the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state, significant differences in these parameters may occur from one location to another. Most differences in regional and local climates within the state are caused by the mountainous topography.

The site of the proposed project is located along the southeastern coast of the island of Hawaii. The topography of Hawaii Island is dominated by the great volcanic masses of Mauna Loa (13,653 feet), Mauna Kea (13,796 feet), and of Hualalai, the Kohala Mountains and Kilauea. The island consists entirely of the slopes of these mountains and of the broad saddles between them. Mauna Loa and Kilauea, located on the southern half of the island, are still active volcanoes.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. Areas along the eastern coasts of the islands are particularly affected by the trade winds and are usually well-ventilated nearly year round. Although the project site is situated along the southeastern coast of Hawaii Island, the nearby high mountains of Mauna Loa and to a lesser extent Kilauea

modify the trade wind influence. The nearest long-term wind data available for the project area are collected at the Hilo Airport located about 50 miles to the northeast. These data are probably only semi-representative of the project area. Mean annual wind speed at the Hilo Airport is about 8 mph, which is lower than many windward locations in the state, and wind directions are bimodal showing either a northeast or southwest preference [1]. Northeast trade winds typically occur during the daytime, while winds from the southwest typically occur during the nighttime due to cold air drainage from the mountains. Winds from the south or southwest also occur occasionally in association with winter storms. Winds at the project site can be expected to be mostly northeast trade winds during the day. During the night, mountain drainage winds from the northwest probably often occur.

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower concentrations of photochemical smog and ground-level concentrations of air pollution from stack sources. In Hawaii, the annual and daily variation of temperature depends to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the most. At nearby Pahala, average annual daily minimum and maximum temperatures are 62°F and 81°F, respectively. The extreme minimum temperature on record is 48°F, and the extreme maximum is 91°F [2]. Temperatures in the project area are similar to these.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is often measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 the least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails. In the project area, stability classes 5 or 6 probably often occur, developing during clear, calm nighttime or early morning hours when temperature inversions form due to radiational cooling or to drainage flow from the mountainous interior of the island. Stability classes 1 through 4 occur during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the onset and extent the sea breeze conditions.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas also may experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Mixing heights in Hawaii typically are above 3000 feet (1000 meters).

Rainfall can have a beneficial affect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it also may "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. Annual rainfall in the project area is usually moderate. At nearby Pahala, normal annual rainfall is about 48 inches [2]. Winter months generally are the wettest.

5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from vehicular, industrial, natural and/or agricultural sources. Table 2 presents an air pollutant emission summary for the island of Hawaii for calendar year 1993. While these emission estimates have become somewhat dated and current emission levels are probably somewhat higher, the proportional relationships are likely still about the same. The emission rates shown in the table pertain to manmade emissions only, i.e., emissions from natural sources are not included. As suggested in the table, much of the manmade particulate emissions on Hawaii originate from area sources, such as the mineral products industry and agriculture. Manmade sulfur oxides are emitted almost exclusively by point sources, such as power plants and other fuel-burning industries. Nitrogen oxides emissions emanate predominantly from area sources (mostly motor vehicle traffic), although industrial point sources contribute a significant share. The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic), while hydrocarbons are emitted mainly from point sources.

It should be noted that Hawaii Island is unique from the other islands in the state in terms of the natural volcanic air pollution emissions that occur. Volcanic emissions periodically plague the project area. This is especially so since the latest eruption phase of the Kilauea Volcano began in 1983. Air pollution emissions from the Hawaiian volcanoes consist primarily of sulfur dioxide. After entering the atmosphere, these sulfur dioxide emissions are carried away by the wind and either washed out as acid rain or gradually transformed into particulate sulfates or acid aerosols. Emissions from Kilauea are vented to the atmosphere relatively close by (about 25 miles east of the project site), and the prevailing wind patterns tend to carry the emissions toward the project area much of the time. Because of this, relatively high concentrations of sulfur dioxide may occur at the project site and volcanic haze (vog) can impact the area.

Since the closure of the sugar mill at nearby Pahala, the nearest major industrial sources of air pollution in the project vicinity are Hawaii Electric Light Company power plants located in Keaau and Hilo, but these sources are very distant. Air pollution emissions from these sources consist mostly of sulfur dioxide and oxides of nitrogen. Hydrogen sulfide emissions are also emitted from Puna Geothermal Venture’s geothermal power plant located about 50 miles to the northeast.

Mamalahoa Highway, which passes through the project area, is the region's only major arterial roadway. Emissions of carbon monoxide, nitrogen oxides, hydrocarbons and other contaminants will occur from motor vehicles traversing this roadway, but the

volume of traffic is relatively light. Any impacts are probably very small.

The State Department of Health (DOH) operates a network of air quality monitoring stations at various locations around the state. Unfortunately, very limited data are available for Hawaii Island, and none are available for the project area specifically. Specialized monitoring stations are located about 20 miles to the east at Volcanoes National Park, but these stations are not operated by DOH and the data are not readily available. Sulfur dioxide and particulate are monitored at a station located in Hilo, which is the nearest location. Table 3 summarizes the data from the Hilo monitoring station for the four-year period from 2001 to 2004. Measurements of sulfur dioxide concentrations at Hilo during the 2001-2004 monitoring period were consistently low in terms of the annual average concentrations which ranged from 6 to 8 $\mu g/m^3$. This represents about 10 percent of the state and national standard. The highest annual second-highest 3-hour and 24-hour concentrations (which are most relevant to the standards) for these four years were 520 and 104 $\mu g/m^3$, respectively; these are about 30 to 40 percent of the applicable standards. The higher short-term concentrations reflect periodic episodes of vog in the Hilo area. While these concentrations are relatively high compared to most other locations in the state, no exceedances of the state/national 3-hour and 24-hour AAQS for sulfur dioxide were recorded.

The annual average particulate concentrations in Hilo for the 2001-2004 period ranged from 10 to 13 $\mu g/m^3$, which equates to about 25 percent of the state/national standard. The highest

annual second-highest 24-hour concentration of particulate matter for this period, 25 $\mu g/m^3$, is about 17 percent of the state/national standard, and there were no violations of the state/national AAQS.

At this time, there are no reported measurements of lead, ozone, nitrogen dioxide or carbon monoxide in the project vicinity. These are primarily motor vehicle related air pollutants. Lead, ozone and nitrogen dioxide typically are regional scale problems. Concentrations of lead and nitrogen dioxide generally have not been found to exceed AAQS elsewhere in the state. Ozone concentrations, on the other hand, have been found to exceed the state standard at times at Sand Island on Oahu. Carbon monoxide air pollution typically is a microscale problem caused by congested motor vehicular traffic. In traffic congested areas such as urban Honolulu, carbon monoxide concentrations have been found to occasionally exceed the state AAQS. Concentrations of carbon monoxide in the project area are estimated later in this study based on computer modeling of motor vehicle emissions.

6.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions that could directly result in short-term air quality impacts during project construction: (1) fugitive dust from vehicle movement and soil excavation; and (2) exhaust emissions from on-site construction equipment. Indirectly, there also could be short-term impacts from slow-moving construction equipment traveling to and from the project sites, from a

temporary increase in local traffic caused by commuting construction workers, and from the disruption of normal traffic flow caused by lane closures of adjacent roadways.

Fugitive dust emissions may arise from the grading and dirt-moving activities associated with site clearing and preparation work. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately. This is because of its elusive nature of emission and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [3] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions at the project site would likely be somewhere near that level, depending on the amount of rainfall that occurs. In any case, State of Hawaii Air Pollution Control Regulations [4] prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further

stipulate that open-bodied trucks be covered at all times when in motion if they are transporting materials that could be blown away. Haul trucks tracking dirt onto paved streets from unpaved areas is often a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving of parking areas and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions. Monitoring dust at the project property line could be considered to quantify and document the effectiveness of dust control measures.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Project construction activities will also likely obstruct the normal flow of traffic at times to such an extent that overall vehicular emissions in the project area will temporarily increase. The only means to alleviate this problem will be to attempt to keep roadways open during peak traffic hours and to move heavy construction equipment and workers to and from construction areas during periods of low traffic volume. Thus, most potential short-

term air quality impacts from project construction can be mitigated.

7.0 LONG-TERM IMPACTS OF PROJECT

7.1 Roadway Traffic

After construction is completed, use of the proposed facilities will result in increased motor vehicle traffic in the project area, potentially causing long-term impacts on ambient air quality. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and other contaminates.

Federal air pollution control regulations require that new motor vehicles be equipped with emission control devices that reduce emissions significantly compared to a few years ago. In 1990, the President signed into law the Clean Air Act Amendments. This legislation requires further emission reductions, which have been phased in since 1994. More recently, additional restrictions were signed into law during the Clinton administration, which will begin to take effect during the next decade. The added restrictions on emissions from new motor vehicles will lower average emissions each year as more and more older vehicles leave the state's roadways. It is estimated that carbon monoxide emissions, for example, will go down by an average of about 30 to 40 percent per vehicle during the next 10 years due to the replacement of older vehicles with newer models.

To evaluate the potential long-term indirect ambient air quality impact of increased roadway traffic associated with a project such as this, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem that can be addressed locally to some extent, whereas nitrogen oxides air pollution most often is a regional issue that cannot be addressed by a single new development.

For this project, three scenarios were selected for the carbon monoxide modeling study: (1) year 2005 with present conditions, (2) year 2015 without the project, and (3) year 2015 with the project. To begin the modeling study of the three scenarios, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic queuing. For this study, the two key intersections identified in the traffic study were also selected for air quality analysis. These included Mamalahoa Highway at Ninole Loop West and Mamalahoa Highway at Ninole Loop East. The traffic impact assessment report for the project [5] describes the existing and projected traffic conditions and the laneage configurations of these intersections in detail.

The main objective of the modeling study was to estimate maximum 1-hour average carbon monoxide concentrations for each of the

three scenarios studied. To evaluate the significance of the estimated concentrations, a comparison of the predicted values for each scenario can be made. Comparison of the estimated values to the national and state AAQS was also used to provide another measure of significance.

Maximum carbon monoxide concentrations typically coincide with peak traffic periods. The traffic impact assessment report evaluated morning and afternoon peak traffic periods. These same periods were evaluated in the air quality impact assessment.

The EPA computer model MOBILE6 [6] was used to calculate vehicular carbon monoxide emissions for each year studied. One of the key inputs to MOBILE6 is vehicle mix. Unless very detailed information is available, national average values are typically assumed, which is what was used for the present study. Based on national average vehicle mix figures, the present vehicle mix in the project area was estimated to be 42.3% light-duty gasoline-powered automobiles, 44.9% light-duty gasoline-powered trucks and vans, 3.6% heavy-duty gasoline-powered vehicles, 0.2% light-duty diesel-powered vehicles, 8.4% heavy-duty diesel-powered trucks and buses, and 0.6% motorcycles. For the future scenarios studied, the vehicle mix was estimated to change slightly with fewer light-duty gasoline-powered automobiles and more light-duty gasoline-powered trucks and vans.

Ambient temperatures of 59 and 68 degrees F were used for morning and afternoon peak-hour emission computations, respectively. These are conservative assumptions since morning/afternoon ambient temperatures will generally be warmer than this, and emission

estimates given by MOBILE6 generally have an inverse relationship to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE6, these data were then input to an atmospheric dispersion model. EPA air quality modeling guidelines [7] currently recommend that the computer model CAL3QHC [8] be used to assess carbon monoxide concentrations at roadway intersections, or in areas where its use has previously been established, CALINE4 [9] may be used. Until a few years ago, CALINE4 was used extensively in Hawaii to assess air quality impacts at roadway intersections. In December 1997, the California Department of Transportation recommended that the intersection mode of CALINE4 no longer be used because it was thought the model has become outdated. Studies have shown that CALINE4 may tend to over-predict maximum concentrations in some situations. Therefore, CAL3QHC was used for the subject analysis.

CAL3QHC was developed for the U.S. EPA to simulate vehicular movement, vehicle queuing and atmospheric dispersion of vehicular emissions near roadway intersections. It is designed to predict 1-hour average pollutant concentrations near roadway intersections based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Although CAL3QHC is intended primarily for use in assessing atmospheric dispersion near signalized roadway intersections, it can also be used to evaluate unsignalized intersections. This is accomplished by manually estimating queue lengths and then

applying the same techniques used by the model for signalized intersections. Currently, both of the study intersections are unsignalized. In the future, in accordance with the traffic report, both intersections were assumed to remain unsignalized.

Input peak-hour traffic data were obtained from the traffic study cited previously. This included vehicle approach volumes, saturation capacity estimates, intersection laneage and queue lengths. All emission factors that were input to CAL3QHC for free-flow traffic on roadways were obtained from MOBILE6 based on assumed free-flow vehicle speeds corresponding to the posted speed limits.

Model roadways were set up to reflect roadway geometry, physical dimensions and operating characteristics. Concentrations predicted by air quality models generally are not considered valid within the roadway-mixing zone. The roadway-mixing zone is usually taken to include 3 meters on either side of the traveled portion of the roadway and the turbulent area within 10 meters of a cross street. Model receptor sites were thus located at the edges of the mixing zones near all intersections that were studied for all three scenarios. This implies that pedestrian sidewalks either already exist or are assumed to exist in the future. All receptor heights were placed at 1.8 meters above ground to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 6 was assumed for the morning

cases, while atmospheric stability category 4 was assumed for the afternoon cases. These are the most conservative stability categories that are generally used for estimating worst-case pollutant dispersion within rural areas for these periods. A surface roughness length of 100 cm and a mixing height of 1000 meters were used in all cases. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration. Concentration estimates were calculated at wind directions of every 5 degrees.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be at low levels. Thus, background contributions of carbon monoxide from sources or roadways not directly considered in the analysis were accounted for by adding a background concentration of 0.5 ppm to the predicted concentrations for 2005. Although increased traffic is expected to occur in the project area within the next several years with or without the project, background carbon monoxide concentrations may not change significantly since individual emissions from motor vehicles are forecast to decrease with time. Hence, a background value of 0.5 ppm was assumed to persist for the future scenarios studied.

Predicted Worst-Case 1-Hour Concentrations

Table 4 summarizes the results of the modeling study in the form of the estimated worst-case 1-hour morning and afternoon ambient carbon monoxide concentrations. These results can be compared directly to the state and the national standards. Estimated worst-case carbon monoxide concentrations are presented in the

table for three scenarios: year 2005 with existing traffic, year 2015 without the project and year 2015 with the project. The locations of these estimated worst-case 1-hour concentrations all occurred at or very near the indicated intersections.

As indicated in the table, the highest estimated 1-hour concentration within the project vicinity for the present (2005) case was 1.3 mg/m^3. This was projected to occur during the morning peak traffic hour near both of the Ninole Loop intersections with Mamalahoa Highway. Predicted worst-case 1-hour concentrations for the 2005 scenario were well within both the national AAQS of 40 mg/m^3 and the state standard of 10 mg/m^3.

In the year 2015 without the proposed project, the predicted worst-case concentrations remained about the same or decreased slightly compared to the existing case. This was due to the decrease in emissions that is expected to occur over the next several years, which is the result of older motor vehicles being retired. For the 2015 without project scenario, the highest worst-case 1-hour concentration was predicted to occur during the morning at the intersection of Mamalahoa Highway and Ninole Loop West. A value of 1.3 mg/m^3 was predicted to occur at this location. The peak-hour worst-case value at the Ninole Loop East intersection was 1.0 mg/m^3. All projected worst-case concentrations for this scenario remained well within the state and national standards.

Predicted 1-hour worst-case concentrations for the 2015 with project scenario increased substantially on a percentage basis but still remained low compared to the standards. The highest worst-

case concentration, 2.2 mg/m^3, was predicted to occur during the morning at the intersection of Mamalahoa Highway and Ninole Loop West. At the Ninole Loop East intersection, the highest concentration was 1.8 mg/m^3 and also occurred during the morning. Predicted worst-case 1-hour concentrations for the 2015 with project scenario were well within both the national and the state AAQS.

Predicted Worst-Case 8-Hour Concentrations

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a persistence factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological conditions are more variable (and hence more favorable for dispersion) over an 8-hour period than they are for a single hour. Based on monitoring data, 1-hour to 8-hour persistence factors for most locations generally vary from 0.4 to 0.8 with 0.6 being the most typical. One study based on modeling [10] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [11] recommend using a value of 0.7 unless a locally derived persistence factor is available. Recent monitoring data for locations on Oahu reported by the Department of Health [12] suggest that this factor may range between about 0.2 and 0.6 depending on location and traffic variability. Considering the location of the project and the traffic pattern for the area, a 1-hour to 8-hour persistence factor of 0.5 will likely yield reasonable estimates of worst-case 8-hour concentrations.

The resulting estimated worst-case 8-hour concentrations are indicated in Table 5. For the 2005 scenario, the estimated worst-case 8-hour carbon monoxide concentrations were 0.6 mg/m^3 at both intersections of Ninole Loop with Mamalahoa Highway. The estimated worst-case concentrations for the existing case were well within both the state standard of 5 mg/m^3 and the national limit of 10 mg/m^3.

Compared to the existing case, the estimated worst-case concentrations for the year 2015 without project scenario remained the same at Ninole Loop West and decreased slightly to 0.5 mg/m^3 at Ninoloe Loop East. The predicted worst-case 8-hour concentrations for the 2015 without project case were well within the standards.

In 2015 with project case, the predicted worst-case concentrations increased to 1.1 mg/m^3 at Ninole Loop West and 0.9 mg/m^3 at Ninole Loop East, but the concentrations still remained low compared to the standards. Predicted 8-hour concentrations for the 2015 with project scenario remained well within both the national and the state AAQS.

Conservativeness of Estimates

The results of this study reflect several assumptions that were made concerning both traffic movement and worst-case meteorological conditions. One such assumption concerning worst-case meteorological conditions is that a wind speed of 1 meter per second with a steady direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction for an

hour is extremely unlikely and may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above. The 8-hour estimates are also conservative in that it is unlikely that anyone would occupy the assumed receptor sites (within 3 m of the roadways) for a period of 8 hours.

7.2 Electrical Demand

The proposed project also will cause indirect air pollution emissions from power generating facilities as a consequence of electrical power usage. The average electrical demand of the residential components of the project when fully developed is expected to reach about 22 million kilowatt-hours per year [13]. Electrical loads for the non-residential uses will be calculated at a future phase when plans or uses are more clearly defined.

Electrical power for the project will most probably be provided mainly by oil-fired generating facilities, but some of the project power may also be derived from geothermal energy, wind power or other sources. In order to meet the electrical power needs of the proposed project, power generating facilities will likely be required to burn more fuel and hence more air pollution will be emitted at these facilities. Given in Table 6 are estimates of the indirect air pollution emissions that would result from the project residential electrical demand assuming all power is provided by burning more fuel oil at local power plants. These values can be compared to the island-wide emission estimates for 1993 given in Table 2. The estimated indirect emissions from project electrical demand amount to less than 1 percent of the present air pollution emissions occurring on

Hawaii Island even if all power is assumed to be derived from oil. Due to the small scale of the operations, it is anticpated that the additional emissions from the electrical demand of non-residential components of the project are likely to be minimal.

7.3 Solid Waste Disposal

Solid waste generated by the resort/residential units of the proposed development when fully completed and occupied is not expected to exceed about 3,700 tons per year [13]. This does not include any solid waste that may be generated the commercial or other components of the project. Currently, all solid waste on the island is buried at solid waste landfills. Thus, assuming this continues to be the method for solid waste disposal, the only associated air pollution emissions that will occur will be from trucking the waste to the landfill and burying it. These emissions should be relatively minor.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The major potential short-term air quality impact of the project will occur from the emission of fugitive dust during construction. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month, depending on rainfall. To control dust, active work areas and any temporary unpaved work roads should be watered at least twice daily on days without rainfall. Use of wind screens and/or limiting the area that is disturbed at any given time will also help to contain fugitive dust emissions. Wind erosion of inactive areas of the site that have been disturbed could be controlled by mulching or by the use of chemical soil stabilizers. Dirt-hauling

trucks should be covered when traveling on roadways to prevent windage. A routine road cleaning and/or tire washing program will also help to reduce fugitive dust emissions that may occur as a result of trucks tracking dirt onto paved roadways in the project area. Paving of parking areas and establishment of landscaping early in the construction schedule will also help to control dust. Monitoring dust at the project boundary during the period of construction could be considered as a means to evaluate the effectiveness of the project dust control program and to adjust the program if necessary.

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

After the proposed project is completed, any long-term impacts on air quality in the project area due to emissions from project-related motor vehicle traffic should be small. Worst-case concentrations of carbon monoxide should remain well within both the state and the national ambient air quality standards. Implementing any air quality mitigation measures for long-term traffic-related impacts is probably unnecessary and unwarranted.

Any long-term impacts on air quality due to indirect emissions from supplying the project with electricity and from the disposal

of waste materials generated by the project will likely be small based on the relatively small magnitudes of these emissions. Nevertheless, indirect emissions from project electrical demand could likely be reduced somewhat by incorporating energy-saving features into project design requirements. This might include the use of solar water heaters; designing building space so that window positions maximize indoor light without unduly increasing indoor heat; using landscaping where feasible to provide afternoon shade to cut down on the use of air conditioning; installation of insulation and double-glazed doors to reduce the effects of the sun and heat; providing movable, controlled openings for ventilation at opportune times; and possibly installing automated room occupancy sensors. Solid waste related air pollution could likely be reduced somewhat by the promotion of conservation and recycling programs within the proposed development. This could reduce solid waste volumes, which would in turn reduce any related air pollution emissions proportionately.

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Figure 1 - Project Location Map

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	National Secondary	State of Hawaii
Particulate Matter (<10 microns)	$\mu g/m^3$	Annual 24 Hours	50[a] 150[b]	50[a] 150[b]	50 150[c]
Particulate Matter (<2.5 microns)	$\mu g/m^3$	Annual 24 Hours	15[a] 65[d]	15[a] 65[d]	- -
Sulfur Dioxide	$\mu g/m^3$	Annual 24 Hours 3 Hours	80 365[c] -	- - 1300[c]	80 365[c] 1300[c]
Nitrogen Dioxide	$\mu g/m^3$	Annual	100	100	70
Carbon Monoxide	mg/m^3	8 Hours 1 Hour	10[c] 40[c]	- -	5[c] 10[c]
Ozone	$\mu g/m^3$	8 Hours 1 Hour	157[e] 235[f]	157[e] 235[f]	157[e] -
Lead	$\mu g/m^3$	Calendar Quarter	1.5	1.5	1.5
Hydrogen Sulfide	$\mu g/m^3$	1 Hour	-	-	35[c]

[a] Three-year average of annual arithmetic mean.
[b] 99th percentile value averaged over three years.
[c] Not to be exceeded more than once per year.
[d] 98th percentile value averaged over three years.
[e] Three-year average of fourth-highest daily 8-hour maximum.
[f] Standard is attained when the expected number of exceedances is less than or equal to 1.

Table 2

AIR POLLUTION EMISSIONS INVENTORY FOR ISLAND OF HAWAII, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	30,311	9,157	39,468
Sulfur Oxides	9,345	nil	9,345
Nitrogen Oxides	4,054	8,858	12,912
Carbon Monoxide	3,357	23,934	27,291
Hydrocarbons	1,477	203	1,680

Source: Final Report, "Review, Revise and Update of the Hawaii Emissions Inventory Systems for the State of Hawaii", prepared for Hawaii Department of Health by J.L. Shoemaker & Associates, Inc., 1996

Table 3

ANNUAL SUMMARIES OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST SEA MOUNTAIN AT PUNALU'U PROJECT

Parameter / Location	2001	2002	2003	2004
Sulfur Dioxide / Hilo				
Period of Sampling (months)	12	12	12	12
3-Hour Averaging Period:				
No. of Samples	2876	2816	2870	2716
Highest Concentration ($\mu g/m^3$)	461	430	574	427
2nd Highest Concentration ($\mu g/m^3$)	348	376	520	333
No. of State AAQS Exceedances	0	0	0	0
24-Hour Averaging Period:				
No. of Samples	363	355	361	340
Highest Concentration ($\mu g/m^3$)	101	95	112	107
2nd Highest Concentration ($\mu g/m^3$)	89	92	104	98
No. of State AAQS Exceedances	0	0	0	0
Annual Average Concentration ($\mu g/m^3$)	6	8	8	7
Particulate (PM-10) / Hilo				
Period of Sampling (months)	12	12	12	12
24-Hour Averaging Period:				
No. of Samples	61	59	61	49
Highest Concentration ($\mu g/m^3$)	20	23	20	29
2nd Highest Concentration ($\mu g/m^3$)	19	18	20	25
No. of State AAQS Exceedances	0	0	0	0
Annual Average Concentration ($\mu g/m^3$)	12	10	12	13

Source: State of Hawaii Department of Health, "Annual Summary, Hawaii Air Quality Data, 2001, 2002, 2003 and 2004

Table 4

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR SEA MOUNTAIN AT PUNALU'U PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario					
	2005/Present		2015/Without Project		2015/With Project	
	AM	PM	AM	PM	AM	PM
Mamalahoa Highway at Ninole Loop West	1.3	0.9	1.3	0.8	2.2	1.8
Mamalahoa Highway at Ninole Loop East	1.3	0.9	1.0	0.8	1.8	1.2

Hawaii State AAQS: 10
National AAQS: 40

Table 5

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR SEA MOUNTAIN AT PUNALU'U PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario		
	2005/Present	2015/Without Project	2015/With Project
Mamalahoa Highway at Ninole Loop West	0.6	0.6	1.1
Mamalahoa Highway at Ninole Loop East	0.6	0.5	0.9

Hawaii State AAQS: 5
National AAQS: 10

Table 6

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM SEA MOUNTAIN AT PUNALU'U PROJECT ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	6
Sulfur Dioxide	55
Carbon Monoxide	5
Volatile Organics	<1
Nitrogen Oxides	24

[a]Based on U.S. EPA emission factors for utility boilers [3]. Assumes electrical demand 22 million kw-hrs per year of electrical power use. Estimated emission rates assume low-sulfur oil used to generate power.

Appendix C

Biological Assessment, Sea Mountain at Punalu‘u
(Patrick Hart, Ph.D., June 2006)

Biological Assessment
Sea Mountain at Punalu‘u,
District of Kau
Hawai‘i

Patrick Hart, Ph.D
Marcos Gorresen, M.S.
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February 2006

INTRODUCTION

This report describes the results of a biological survey of an approximately 175 hectare (437 acre) section of the proposed Sea Mountain at Punalu‘u project site. The project site is within the district of Kau, at elevations ranging from sea-level to approximately 110m (Figure 1). Much of the project lands are comprised of 5,000 – 10,000 year old pahoehoe and ‘a‘a lava flows from Mauna Loa (Wolfe and Morris 1996). Mean yearly rainfall ranges from approximately 20-30 inches at the coast to approximately 40 inches at the upper boundary of the property. The survey was undertaken at the request of Group 70 International to supply information for an Environmental Impact Statement and applications for various potential land use approvals.

The overall objectives of the survey were to 1) identify all threatened and endangered plant and bird species found on the project site; 2) provide a comprehensive list of all plant and bird species; 3) describe the different plant communities and general vegetation patterns; and 4) provide estimates of the relative abundance of endangered Hawaiian Hoary bats throughout the project site. The survey paid special attention to identifying and assessing the value of any relict native forest or shrub lands. The survey did not attempt to locate the numerous species of introduced mammals that are highly likely to be present on the project site. These mammals include feral dogs (*Canis familiaris*) and cats (*Felis sylvestris catus*), pigs (*Sus scrofa*), goats (*Capra aegagrus hircus*), rats (*Rattus rattus*), mice (*Mus musculus*), and mongooses (*Herpestes auropunctatus*), all of which are detrimental to the native Hawaiian biota. The survey also did not include field sampling for candidate, threatened, or endangered invertebrate species. The degraded habitat and lack of native plants on the project site makes it extremely unlikely that any federally listed invertebrates, including *Megalagrion* damselflies, *Manduca* moths, or *Drosophila* Pomace flies inhabit the area.

Plants

Methods

Fieldwork was conducted in September and October of 2005, and January 2006. Vegetation transects were walked throughout the entire project site with the exception of the residential areas. In the few areas where the forest was relatively dense, these transects were separated by 30-50 meters. In the more open areas where there was little vegetation, especially along the golf course, they were separated by up to 200 meters. Special attention was given to the dry gulch that spans the project area from its mauka to makai boundary and to the coastal areas (Figure 1) as these had the most potential as habitat for rare species. Plant species were identified in the field and, as necessary, collected and keyed out in the laboratory. The approximate boundaries of different vegetation

communities were also determined primarily in the field, with the aid of aerial photographs. The geographic coordinates (UTM 5N– Hawaii NAD 83) for mapping the precise boundaries of plant zone "A" were determined on the ground with a Garmin 12 Global Positioning System (GPS) receiver. Nomenclature of flowering plants generally follows Wagner et al. (1990) and Wagner and Herbst (2003). Nomenclature of ferns and fern allies follows Palmer (2003). Many of the plants growing within the residential areas or the golf course are listed in Appendix 1, however no attempt was made to provide a comprehensive list of ornamental plants in those areas.

Results

Current Vegetation and Flora of the Area

With the exception of a narrow strip of predominantly native vegetation along the coast, the natural vegetation of the entire project site has been severely degraded and modified by centuries of human use. One federally listed endangered plant species was detected (Loulu; *Pritchardia affinis*) in patches along the coast. Otherwise, no other threatened or endangered plant species were found, nor are any likely to be present outside of the coastal zone due to the long history of human disturbance in the area. The project site does not comprise Critical Habitat for any federally listed threatened or endangered plant species (US Federal Register, July 2003). A total of 28 native (including three endemic and 25 indigenous) and 112 introduced plant taxa were detected (Appendix 1). Aside from the residential area, abandoned commercial area, and golf course, three general plant communities exist on the project site and are discussed below.

Coastal strand

The coastal strand zone consists of plant species that are primarily dispersed by ocean currents and waves, and are tolerant of salt in the soil or atmosphere (Wagner et al. 1990). This zone (Zone A, Figures 1 and 2) comprises a very small proportion of the total project acreage but had more native species than all other areas combined. The endangered Loulu palm (*Pritchardia affinis*) was found in a few small patches in this zone. These trees do not appear to be regenerating in the area, and most, if not all of them were likely planted by humans. Naupaka (*Scaevola taccada*), an indigenous shrub, was the dominant plant in this zone. Other common natives included 'Ilima (*Sida fallax*), herbs such as 'Akulikuli (*Sesuvium portulacastrum*), 'Ohelo kai (*Lycium sandwicense*), and *Bacopa monnieri,* and vines including Nanea (*Vigna marina*), Pa'u o Hi'iaka (*Jacquemontia ovalifolia*), and Pohuehue (*Ipomoea pes-caprae*). The indigenous *Fimbristylis* sedge was also abundant. A few Naio (*Myoporum sandwicense*) individuals were encountered in this area. These plants had the shrubby growth form common to this species in other coastal areas of Kau but relatively rare elsewhere. Two dominant non-native species that occurred throughout many

sections of the coastal strand zone were Guinea grass (*Panicum maximum*), and *Wedelia trilobata*.
One additional native tree species was present - the indigenous Hala (*Pandanus tectorius*). The potentially indigenous Milo (*Thespesia populnea*) was also commonly encountered. Both these tree species have great cultural value. However, most of the trees in the coastal strand zone are human introductions, including Kou (*Cordia subcordata*; a Polynesian introduction), Tree heliotrope (*Tournefourtia argentea*), Coconut (*Cocos nucifera*), Ironwood (*Casuarina equisetifolia*) and Christmas berry (*Schinus terebinthifolius*).
The Coastal strand zone contained numerous fresh water and/or anchialine pools. In addition to the native plants described above, two indigenous sedges, Makaloa (*Cyperus laevigatus*) and *Schoenoplectus lacustris validus*, were present along the margins of these pools. The invasive Water Hyacinth (*Eichhornia crassipes*) was growing in some of the larger pools.

Coastal Dry Shrubland
Directly mauka of the coastal strand zone and extending up to at least the highway at an elevation of approximately 60m lies the highly modified coastal dry shrubland community (Zones B and D, Figure 1). Prior to human disturbance, this community was likely dominated by shrubs such as *Wikstroemia sp., Chamaesyce sp.*, and a low lying variety of *Myoporum sandwicense*. ‘Alahee trees (*Psydrax odoratum*) were also probably found in this area, with Pili grass (*Heteropogon contortus*) dominating much of the understory, along with various herbs such as *Peperomia leptostachya* and *Plectranthus parviflorus*. Centuries of human disturbance, primarily ranching and fire, has resulted in a community that is almost completely devoid of native species and that can best be described as a Haole koa (*Leucaena leucocephala*) dry shrubland. Guinea grass (*Panicum maximum*) dominates the understory, with introduced vines such as *Passiflora suberosa* often forming dense mats in the *Leucaena* canopy. The few native species that were found in this area included scattered individuals of ‘Alahee trees, two shrubs: ‘A‘alii (*Dodonea viscosa*), and ‘Ilima (*Sida fallax*), and the herb *Peperomia leptostachya.* The most abundant native plant was the ubiquitous herb ‘Uhaloa (*Waltheria indica*). All native trees and shrubs encountered in this zone appeared to be newly re-colonizing the area, as opposed to remnant individuals that had survived past human disturbance. Zone B had a much denser growth of Haole koa than Zone D, and was the only area below the highway that contained regenerating ‘Alahee trees. Zone D appeared to have undergone more recent disturbance (probably fire and some cattle grazing) and had far greater coverage of Guinea grass than Zone B.

Coastal Dry Forest
Above the highway, at an elevation of approximately 60m, the Coastal Dry Scrub community likely began to intergrade with the Coastal Dry Forest community. This community was probably dominated by Wiliwili (*Erythrina sandwicensis*),

‘Iliahi (Sandalwood: *Santalum ellipticum*), ‘Alahee, and Naio trees (*Myoporum sandwicense*), along with many others. However, the native Coastal Dry Forest community has almost completely disappeared from the project area. Other than a few ‘Alahee individuals, this botanical survey failed to locate any remnant dry forest trees. The area (Zone C, Figure 1) is now primarily a continuation of the Haole koa/Guinea grass shrubland, with both species attaining much larger size than at the lower elevations, probably as a result of higher rainfall. Other common introduced plants in this area include Monkeypod (*Samanea saman*), Java Plum (*Syzigium cumini*), and African Tulip (*Spathodea campanulata*). Cattle ranching still occurs in the southern portion of Zone C above the highway (Fig. 1). The native Pua kala (*Argemone glauca*) is common in this otherwise highly disturbed area. The mauka portion of the Sea Mountain Golf Course also comprises a large portion of the land above the highway, and is dominated exclusively by non-native, primarily ornamental trees, grasses, and shrubs.

The entire length of the dry gulch that bisects the property from the mauka to makai boundary and extends from the former Dry Forest through the Dry Shrubland to the coast was walked to detect any remnant native trees or shrubs. There were no native plants found in the gulch that did not occur elsewhere on the property, with the exception of *Doryopteris decora,* a relatively common species of dryland fern.

Discussion and recommended mitigation measures for plant resources

Humans have substantially altered the vegetation of the entire property, either directly (e.g. clearing for farming, ranching, housing developments, and golf courses) or indirectly (e.g. introduction of cattle and goats, introduction of alien plants, and fire). Native plant species are a negligible component of the current vegetation, which is almost completely comprised of a large diversity of introduced species. Even the gulch that extends from the mauka to makai boundaries of the property contains very few native plants, and none that are uncommon in other areas. The only area on the project site that should be treated with caution, in terms of the preservation of native plants, is the coastal strand community and the associated anchialine or tidal pools. In particular, the native Loulu palms should be left intact. In order to minimize direct and/or indirect impact to the coastal strand plant community and to improve native plant habitats, the following measures are recommended:

- No construction should occur within the Coastal Zone (Zone A) as depicted in Figure 1. The GPS coordinates used to produce this boundary are listed in Appendix 2. The golf course could potentially encroach on small portions of the least sensitive areas of the zone. In that event, the precise locations of the encroachment

should be determined during a site visit by a Botanist and Course Designer at a later date.

- Minimal, if any, development should occur within a 10-20 meter buffer zone on the mauka side of the Coastal Zone boundary.

- Land-owners should commit to establishing the Coastal Zone (Zone "A") as some form of legally recognized coastal preserve. This will also ensure protection of all endangered Loulu trees on the project site.

- Land-owners should work with biologists and interested members of the local community to produce a Coastal Zone Management Plan that would guide restoration of the coastal strand habitat while simultaneously preserving and improving public shoreline access. Restoration of the plant community would include both the removal of alien plant species such as Christmas-berry, and the out-planting of native plants that exist or formerly existed in the area.

- Land-owners should commit to providing a source of funding for carrying out the Coastal Zone Management Plan.

- Even though the mauka-makai gulch does not currently contain many native plant species, this gulch should be preserved as potential habitat for any future native plant restoration efforts on the project site.

- Landscaping should include native Hawaiian plants wherever possible. Land-owners should consult with biologists to determine an appropriate list of native plants that a) currently exist or historically existed in the area, and b) show potential as landscaping elements. Many of the native plants listed in Appendix 1 of this report would do well as landscaping plants.

- Land-owners should ensure that care is taken to minimize run-off or dust from the construction site that could adversely affect native plants and aquatic biota in this area.

Birds

Purpose and Methodology

The objective of the bird survey was to document all bird species, including landbirds, shorebirds, waterbirds, and seabirds, found within the boundaries of the project site. The primary portion of the survey was conducted from 06:00 to 11:00 hrs, and from 15:00 to 18:30 hrs on October 15-16, 2005. In addition, surveys were conducted for night-flying seabirds for the first 45 minutes after sunset for each of six nights during September and October 2005. Because the survey occurred over a relatively limited period of time, we also report birds that are likely to make occasional use of the project area but that were not detected during the study.

Surveys were conducted along transects that sampled all areas and habitat types on the property, including: the coastal areas and anchialine pools, the golf course fairways and ponds, the gulch, and the haole koa shrubland. Transects were established approximately every 200 meters, and birds were surveyed using the line-transect method, whereby the observer walks along the transect and notes each bird detected. Birds were identified by calls, songs, and visual observations.

Results

Fourteen species of birds were detected during the surveys, all alien introductions except one indigenous heron species and one indigenous shorebird species (Table 1). No native landbirds were observed on the project site.

Landbirds

The most common birds overall were Japanese white eyes (*Zosterops japonicus*). These birds were found in all areas of the project site, and were by far the most abundant in the Haole koa shrubland. Other birds in this shrubland included the Nutmeg mannikin (*Lonchura punctulata*) and Northern cardinal (*Cardinalis cardinalis*). On the golf course and in the residential areas, the most common birds were the Saffron finch (*Sicalis flaveola*), the Zebra dove (*Geopelia striata*), and the Yellow-fronted canary (*Serinus mozambicus*).

Barn owls (*Tyto alba*) were observed in the evening on four occasions over two weeks of observation in the upper portion of the property. These introduced owls were the only Birds of Prey detected during the survey. Although the federally endangered Hawaiian Hawk ('Io) and federally threatened Hawaiian short-eared owl (Pueo) were not detected during the surveys, both are likely to occasionally be found on the project site. However, because the area represents

poor habitat for both species, it is possible but unlikely that either species nests in the area.

Shorebirds and Waterbirds

Flocks of indigenous Pacific golden-plovers (Kolea; *Pluvialis fulva*) were found foraging in the grass on both the upper and lower golf courses. This common migratory shorebird is usually present in Hawaii from August through April, and spends its summers foraging and breeding in Alaska. Other shorebirds that likely make use of the project site but were not seen during the surveys include the Wandering Tattler (*Heteroscelus incanus*), Ruddy Turnstone (*Arenaria interpres*), Bristle-thighed Curlew (*Numenius tahitiensis*), Sanderling (*Calidris alba*), and various other Sandpipers.

The Black-crowned night-heron (‘Auku‘u; *Nycticorax nycticorax hoactli*), an indigenous wetland bird, was found foraging near the pond adjacent to Punalu‘u beach, as were several domesticated, introduced geese. Other native water birds that may make use of the various ponds along the shoreline include the federally endangered Black-necked stilt (Ae‘o; *Himantopus mexicanus knudseni*) the federally endangered Hawaiian coot (‘Alae ke‘oke‘o; *Fulica alae*), and the federally endangered Nene (*Branta sandvicensis*).

Seabirds

No seabirds were detected through the two months of sporadic surveying. Seabirds such as Black noddies (Noio; *Anous minutus melanogenys*), White-tailed tropic birds (Koa‘e kea; *Phaethon lepturus dorotheae*), Frigate birds (‘Iwa; *Fregata minor palmerstoni*), Shearwaters (*Puffinus sp.*), Bulwer’s Petrels (‘Ou; *Bulweria bulwerii*), and Boobies (*Sula sp.*) are all likely to make use of the airspace over the makai portion of the project site. In addition, three species of rare seabirds have the potential to use the property: the federally endangered Dark-rumped petrel (‘Ua‘u; *Pterodroma phaeopygia sandwichensis*), the federally threatened Newell’s shearwater (‘A‘o; *Puffinus auricularis newelli*), and the Band-rumped storm-petrel (*Oceanodroma castro*). The Petrels and Shearwater hunt over the ocean during the day and fly to higher elevations at night to roost and nest. Dark-rumped petrels presently nest on the southwest rift zone of Mauna Loa (Banko 1991, Hu 2001), in an area far mauka and to the north of Punalu`u. However, because the project site is highly disturbed and likely contains a high density of mammalian predators such as cats, rats, and mongooses, it represents very poor nesting habitat for any seabird.

Table 1**.** List of bird species found within Sea Mountain Property boundaries on October 15- 16 2005.

Scientific Name	**Common Name**	**Status**
Nycticorax nycticorax hoactli	Black-Crowned Night-Heron	Indigenous Resident
Tyto alba	Common Barn Owl	Alien Resident
Pluvialis fulva	Pacific Golden-Plover	Indigenous Visitor
Cardinalis cardinalis	Northern Cardinal	Alien Resident
Paroaria capitata	Yellow-Billed Cardinal	Alien Resident
Streptopelia chinensis	Spotted Dove	Alien Resident
Geopelia striata	Zebra Dove	Alien Resident
Acridotheres tristis	Common Myna	Alien Resident
Carpodacus mexicanus	House Finch	Alien Resident
Passer domesticus	House Sparrow	Alien Resident
Serinus mozambicus	Yellow-Fronted Canary	Alien Resident
Zosterops japonicus	Japanese White-Eye	Alien Resident
Sicalis flaveola	Saffron Finch	Alien Resident
Lonchura punctulata	Nutmeg Mannikin	Alien Resident

Discussion and recommended mitigation measures for bird resources

The Sea Mountain project site is comprised of large tracts of human-altered and disturbed landscape, none of which can be considered good habitat for native land birds. Given the current vegetation and low elevation of the project site, there is little chance for re-establishment of significant populations of native landbirds. The project, therefore, will have little effect on native landbirds. Nevertheless, there are numerous large, ornamental trees that have the potential to serve as nest sites for the endangered Hawaiian Hawk (‘Io). In order to eliminate the chance that bulldozing or land-clearing could destroy an ‘Io nest and nestlings, we recommend that a trained biologist survey all lands for the presence of nesting ‘Io within two weeks before the land is cleared. If an active ‘Io nest is discovered, then no bulldozing should occur within a 200 meter radius of the nest. Bulldozing could then resume when the chicks have fledged.

The shoreline habitat within Zone “A” does contain good resources for native shorebirds and waterbirds. In particular, the federally endangered Black-necked stilt (Ae‘o), the federally endangered Hawaiian coot (‘Alae ke‘oke‘o), and the federally endangered Nene goose have the potential to make use of the wetland areas within Zone A, especially if habitat restoration measures recommended in this study are implemented. Unfortunately, these birds (with the exception of nene) are generally quite wary of people, so as the human population in this

area increases and shoreline access is improved, there will be less chance that the wetlands and ponds can support these birds. If preserving or creating habitat for native shorebirds and waterbirds is a desirable goal for the landowners, then any management plan for the coastal zone will have to balance the shoreline access needs for the people of the community with the habitat requirements of the birds.

The Sea Mountain project has the potential to negatively impact over-flying Dark-rumped Petrels (‘Ua‘u) and Newell’s Shearwaters (‘A‘o). Both these federally listed sea-birds are known to be attracted to exterior (and sometime interior) lighting in populated areas. There is currently no information as to whether the lands mauka of the project site within Kau Forest reserve and the Kahuku Unit of Hawaii Volcanoes National Park contain nesting populations of either seabird. If seabird colonies are present on these lands, then the project lighting may attract birds moving to and from their nesting grounds. In this event, there will inherently be seabird mortalities. In order to minimize this potential problem, it is recommended that shields be placed on all exterior lighting in accordance with Hawaii County regulations. Also, Low Pressure Sodium lighting should be used in all street lights, also in accordance with county regulations. This will have the added benefit of reducing light disturbance on nesting sea-turtles.

In addition to habitat restoration within Zone “A”, when choosing landscaping plants, consider using native plants such as ‘Ohi‘a (*Metrosideros polymorpha*) or Wiliwili that could attract native birds.

The Pacific golden-plover (Kolea) is the only abundant native bird on the project site and was most common on the golf course fairways and greens. Because the golf course represents winter feeding grounds for these birds, it is recommended that care be used when applying chemical fertilizers, herbicides, or insecticides. To avoid poisoning these birds on golf courses, Johnson (2004) recommends limiting chemical application to May-August, when the birds are in Alaska.

Bats

Purpose and Methodology

The objectives of the Hawaiian hoary bat survey were to 1) record all detections in the study area; 2) estimate bat detectability; 3) adjust measures of occurrence by detectability; 4) identify areas with active feeding activity; and 5) map and record coordinates at all locations at which the species was detected.

Fieldwork was conducted during six separate visits to the study area from September 4 to October 21, 2005. Eight survey sites spaced an average of 475 meters apart were established roughly equidistantly throughout the property. Survey site locations (Appendix 4) were recorded in a Universal Transverse Mercator projection (UTM 5N– Hawaii NAD 83) with a Garmin 12 Global Positioning System receiver.

The duration of sampling was 15 minutes per visit per site. Sampling began at sundown (time available at http://www.sunrisesunset.com/usa/Hawaii.asp) and focused on the first several hours of the night during which insect and bat activity is highest (Menard 2001). Bat occurrence was determined by echolocation detection and occasionally by sight. Data recorded included call type (i.e., search/commuting flight calls versus active target-approach ["feeding buzz"] calls), start/end time of detections and survey, and weather conditions. Bat echolocation calls were sampled with a heterodyne Pettersson D-100 Bat Detector set at a frequency of 30 KHz.

Bat detectability and occurrence were estimated with the program PRESENCE. PRESENCE enables the estimation of the occurrence (i.e., proportion of area of occupied), or similarly, the probability a site is occupied, by a species of interest according to the model presented by MacKenzie et al. (2002). Typically, a species is not guaranteed to be detected even when present at a site. Therefore, the "naïve" estimate of occurrence (calculated simply as the proportion of sites where the species was detected) will underestimate the true occurrence when detectability is less than perfect. MacKenzie et al. proposed that the probability of detecting the species can by estimated by repeated survey of a series of sites. The detection probability may then be applied to a set of observations to derive an unbiased estimate of occurrence. PRESENCE was developed by Darryl MacKenzie of Proteus Research & Consulting Ltd. (http://www.proteus.co.nz) under contract to U.S. Geological Survey as part of their Amphibian Research and Monitoring Initiative (http://www.mp2-pwrc.usgs.gov/armi).

Results and Discussion

General bat movements

The Hawaiian hoary bat was detected commuting through or searching for prey at 7 of 8 sites in the study area (Table 2 and Figure 3). The number of sites with detections per night of survey ranged from a low of 2 sites on 9/4/2005 to a high of 6 sites on 9/28/2005 and 10/15/2005. Consequently, naïve estimates of occurrence based on the results of a single night of survey could have ranged from 0.25 (i.e., 2 of 8 sites with bat detections) to 0.75 (i.e., 6 of 8 sites with bat detections).

However, given the moderate probability of detecting bats observed during the study (mean = 0.67; 95% confidence interval = 0.51 – 0.80), true occurrence is expected to be higher. Adjusting for detection probability yielded an estimate of mean occurrence equal to 0.88 and a 95% confidence interval between 0.65 and 1.0. In general, the results indicate that the Hawaiian hoary bat occurs throughout most, if not all, of the study area.

Table 2. Detections of Hawaiian hoary bat search and commuting flight calls by site and date (1 = detected; 0 = not detected).

	survey site							
date	1	2	3	4	5	6	7	8
9/4/2005	0	1	1	0	0	0	0	0
9/28/2005	0	0	1	1	1	1	1	1
10/6/2005	0	1	1	0	0	1	1	0
10/14/2005	0	0	1	1	0	1	1	1
10/15/2005	0	1	1	1	1	1	0	1
10/21/2005	0	1	1	0	1	0	1	1
total visits with detections by survey site								
	0	4	6	3	3	4	4	4

Survey site 1 is notable for the consistent absence of bats. Conversely, survey site 3 is notable for the regular presence of bats. As with many aerial insectivores, the hoary bat forages preferentially in openings and over forest and riparian habitats because these areas support higher densities of flying insects (Menzel et al. 2005, Wunder and Carey 1996). Although the two sites are within 800 meters of each other, the site with no detections is located within an extensive and homogenous stand of 3-4 meter tall haole koa shrubs. The absence of bats in the area may indicate that the vegetation does not support much bat prey. The site with a consistent bat presence lies along a drainage with large *Ficus* trees and openings (golf lawns). The heterogeneous structure of the vegetation appears to provide high quality foraging habitat.

Bat feeding activity

Areas at which bats were recorded actively approaching target prey (and presumably feeding) ranged from 1 to 2 sites per survey night, and were limited to a total of 4 sites for all survey nights combined (Table 3 and Figure 3). Naïve estimates of the occurrence of feeding activity based on the results of a single night of survey would have ranged from 0.13 (i.e., 1 of 8 sites with bat detections) to 0.25 (i.e., 2 of 8 sites with bat detections). However, given the low probability of detecting feeding bats (mean = 0.35; 95% confidence interval = 0.15 – 0.56), the actual occurrence of feeding activity is expected to be higher. Adjusting for detection probability yielded an estimate of mean occurrence equal to 0.56 and a 95% confidence interval between 0.16 and 0.94.

That is, feeding activity appears to concentrate in specific areas comprising about one-half of the property.

Table 3. Detections of Hawaiian hoary bat target-approach calls ("feeding buzzes") by site and date (1 = detected; 0 = not detected).

	survey site							
date	1	2	3	4	5	6	7	8
9/4/2005	0	0	1	0	0	0	0	0
9/28/2005	0	0	1	0	0	0	0	0
10/6/2005	0	0	1	0	0	1	0	0
10/14/2005	0	0	0	0	0	0	1	1
10/15/2005	0	0	1	0	0	0	0	1
10/21/2005	0	0	0	0	0	0	0	1
total visits with detections by survey site								
	0	0	4	0	0	1	1	3

Two sites (3 and 8) are notable for the high incidence of feeding activity by bats. Both sites are adjacent to stands of tall trees next to open areas (golf lawns at site 3 and beach strand and open water at site 8). The physical structure of the vegetation at these sites may promote relatively high prey densities and bat feeding activity. Although bats were detected feeding only once at two additional sites (6 and 7), the sites are also located in proximity to tall tree stands and open areas.

Discussion and recommended mitigation measures for bats

On two occasions (10/14/2005 and 10/15/2005), as many as 5 bats were seen actively swooping near one another over the bay at survey site 8. This "rutting" behavior is typical of some species following the birth and "fledging" of young bats in the summer, and indicates that hoary bats find the study area hospitable during the critical period of breeding.

The Hawaiian hoary bat is an obligate tree foliage roosting species (Wunder and Carey 1996, Menard 2001). Early observations of bat emergence (for example, 9 minutes before sunset and 32 minutes before twilight ended on 10/15/2005 at site 8) indicate that the species is using as roosting habitat the stands of trees within or in the immediate vicinity of the study area. Likely roost sites include the trees along the golf lawns, residences and within the dry gulch.

The original native lowland dry forest ecosystem has been completely altered throughout the region. Little is known about the potential impact that historical

and current changes to the landcover may have had on the prey base of the Hawaiian hoary bat. However, roosting habitat is likely a limiting factor for the species, particularly in the dry low-elevation habitats of Hawai'i Island.

The following measures are recommended to minimize adverse impacts to the Hawaiian hoary bat:

- Preserve as many existing stands of tall trees and riparian trees as possible. Although all large trees on the project site are introduced species, these trees appear to serve both as roosting and foraging habitat for bats. In particular, the large, mixed, stand of introduced trees growing on the grounds of the abandoned restaurant and visitor center (Zone E, Figure 1) appears to be an important roosting area.

- Plant native Hawaiian dry forest trees, especially within the gulch area, to enhance bat habitat.

- Cutting of tall trees should only be done from September through May to avoid potential take of Hawaiian hoary bats during the breeding season.

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Appendix 1. Alien (A), indigenous (I), and endemic (E) plant species found on the Sea Mountain project site.

Scientific Name	**Family**	**Common Name**	**Life Form**	**Status***
Abutilon grandifolium	Malvaceae	Hairy abutilon	Shrub	A
Acacia confusa	Fabaceae	Formosan koa	Tree	A
Adiantum hispidulum	Pteridaceae	Rough Maidenhair	Herb	A
Agave sisalana	Agavaceae	Sisal	Shrub	A
Albizzia lebbeck	Fabaceae	Siris tree	Tree	A
Aleurites moluccana	Euhporbiaceae	Kukui	Tree	A
Amaranthus spinosus	Amaranthaceae	Spiny Amaranth	Shrub	A
Antigonon leptopus	Polygonaceae	Mexican creeper	Vine	A
Argemone glauca	Papaveraceae	Pua kala	Herb	E
Bacopa monnieri	Scrophulariaceae	Bacopa	Herb	I
Barleria cristata	Acanthaceae	Philippine violet	Shrub	A
Bidens pilosa	Asteraceae	Beggar's tick	Herb	A
Boerhavia coccinea	Nyctaginaceae	Boerhavia	Herb	A
Bothriochloa pertusa	Poaceae	Pitted beardgrass	Grass	A
Bougainvillea sp.	Nyctaginaceae	Bougainvillea	Shrub	A
Brachiaria mutica	Poaceae	California grass	Grass	A
Bryophyllum pinnata	Crassulaceae	Air plant	Shrub	A
Bryophyllum tubiflorum	Crassulaceae	Chandelier plant	Shrub	A
Caesalpinia pulcherrima	Fabaceae	Poinciana	Tree	A
Calophyllum inophyllum	Clusiaceae	Kamani	Tree	A
Canavalia cathartica	Fabaceae	Mauna Loa	Vine	A
Carica papaya	Caricaceae	Papaya	Tree	A
Carissa macrocarpa	Apocynaceae	Natal plum	Shrub	A
Cassia fistula	Fabaceae	Golden Shower Tree	Tree	A
Casuarina equisetifolia	Casuarinaceae	Ironwood	Tree	A
Catharanthus roseus	Apocynaceae	Madagascar periwinkle	Shrub	A
Chamaecrista nictitans	Fabaceae	Partridge Pea	Herb	A
Chamaesyce hirta	Euphorbiaceae	Garden Spruge	Herb	A
Chloris barbata	Poaceae	Swollen finger grass	Grass	A
Cenchrus echinatus	Poaceae	Common sandbur	Grass	A
Clusia rosea	Clusiaceae	Autograph tree	Tree	A
Coccoloba uvifera	Polygonaceae	Sea grape	Tree	A
Cocculus trilobus	Menispermaceae	Huehue	Vine	I
Cocos nucifera	Arecaceae	Niu	Tree	A
Cordia subcordata	Boraginaceae	Kou	Tree	A
Cordyline fruticosa	Agavaceae	Ki	Shrub	A

Crassocephalum crepidiodes	Asteraceae	Crassocephalum	Herb	A
Crotalaria sp.	Fabaceae	Rattlepod	Herb	A
Cynodon dactylon	Poaceae	Bermuda grass	Grass	A
Cyperus laevigatus	Cyperaceae	Makaloa	Sedge	I
Cyperus polystachyos	Cyperaceae	Cyperus	Sedge	I
Dactyloctenium aegyptium	Poaceae	Beach wiregrass	Grass	A
Delonix regia	Fabaceae	Royal poinciana	Tree	A
Desmodium incanum	Fabaceae	Desmodium	Herb	A
Desmodium intortum	Fabaceae	Desmodium	Vine	A
Digitaria insularis	Poaceae	Sourgrass	Grass	A
Dioscorea pentaphylla	Dioscoreaceae	Dioscoreae	Vine	A
Dodonea viscosa	Sapindaceae	‘A‘ali‘i	Shrub	I
Doryopteris decora	Pteridaceae	Doryopteris	Fern	E
Dracaena marginata	Agavaceae	Money tree	Tree	A
Eichhornia crassipes	Pontederiaceae	Water hyacinth	Herb	A
Eleusine indica	Poaceae	Wire grass	Grass	A
Emilia fosbergii	Astraceae	Pualele	Herb	A
Eragrostis pectinata	Poaceae	Carolina lovegrass	Grass	A
Erythrina variegata	Fabaceae	Wiliwili	Tree	A
Euphorbia heterophylla	Euphorbiaceae	Kaliko	Shrub	A
Ficus benghalensis	Moraceae	Indian banyan	Tree	A
Ficus elastica	Moraceae	Rubber tree	Tree	A
Ficus microcarpa	Moraceae	Banyan	Tree	A
Fimbristylis cymosa	Cyperaceae	Mau`u `aki`aki	Sedge	I
Grevillea robusta	Proteaceae	Silk oak	Tree	A
Heliotropium curassavicum	Boraginaceae	Seaside Heliotrope	Vine	I
Hibiscus sp.	Malvaceae	Hibiscus	Shrub	A
Hylocereus undatus	Cactaceae	Night blooming cereus	Shrub	A
Hyptis pectinata	Lamiaceae	Comb hyptis	Shrub	A
Indigofera suffruticosa	Fabaceae	Indigo	Shrub	A
Ipomoea indica	Convolvulaceae	Koali ‘awa	Vine	I
Ipomoea pes-caprae	Convolvulaceae	Pohuehue	Vine	I
Ipomoea triloba	Convolvulaceae	Little bell	Vine	A
Jacquemontia ovalifolia	Convolvulaceae	Pa‘u o Hi‘iaka	Vine	I
Justicia betonica	Acanthaceae	White shrimp plant	Shrub	A
Lantana camara	Verbenaceae	Lantana	Shrub	A
Leucaena leucocephala	Fabaceae	Haole koa	Tree	A
Livistona chinensis	Arecaceae	Chinese fan palm	Tree	A
Lycium sandwicense	Solanaceae	‘Ohelo kai	Herb	I
Macroptilium	Fabaceae	Cow pea	Vine	A

lathyroides				
Malvastrum coromandelianum	Malvaceae	Malvastrum	Herb	A
Mangifera indica	Anacardiaceae	Mango	Tree	A
Melaleuca quinquenervia	Myrtaceae	Paperbark	Tree	A
Melia azedarach	Meliaceae	Chinaberry	Tree	A
Melinus minutiflora	Poaceae	Molasses grass	Grass	A
Mimosa pudica	Fabaceae	Sensitive plant	Herb	A
Momordica charantia	Cucurbitaceae	Balsam Pear	Vine	A
Monstera deliciosa	Araceae	Splitleaf philodendron	Vine	A
Morinda citrifolia	Rubiaceae	Noni	Shrub	A
Nasturtium microphyllum	Brassicaceae	Leko	Herb	A
Neonotonia wightii	Fabaceae	Neonotonia	Vine	A
Nephrolepis multiflora	Nephrolepidaceae	Sword Fern	Herb	A
Nerium oleander	Apocynaceae	Oleander	Shrub	A
Ochna thomasiana	Ochnaceae	Mickey Mouse plant	Shrub	A
Oxalis corniculata	Oxalidaceae	Wood Sorrel	Herb	I
Pandanus tectorius	Pandanaceae	Hala	Tree	I
Panicum maximum	Poaceae	Panicum	Herb	A
Paspalum vaginatum	Poaceae	Seashore paspalum	Grass	A
Passiflora edulis	Passifloraceae	Lilikoi	Vine	A
Passiflora suberosa	Passifloraceae	Huehue haole	Vine	A
Peperomia leptostachya	Peperomiaceae	Ala ala wai nui	Herb	I
Phlebodium aureum	Polypodiaceae	Phlebodium	Herb	A
Phymatosorus grossus	Polypodiaceae	Maile-scented Fern	Herb	A
Pithecellobium dulce	Fabaceae	Opiuma	Tree	A
Pityrogramma calomelanos	Pteridaceae	Silver fern	Fern	A
Plantago major	Plantaginaceae	Broad-leaved plantain	Herb	A
Pluchea symphytifolia	Asteraceae	Sourbush	Shrub	A
Plumeria sp.	Apocynaceae	Plumeria	Tree	A
Portulaca lutea	Portulacaceae	‘Ihi	Herb	I
Portulaca oleracea	Portulacaceae	Pig weed	Herb	A
Portulaca pilosa	Portulacaceae	Portulaca	Herb	A
Pritchardia affinis	Arecaceae	Loulu	Tree	E
Pritchardia pacifica	Arecaceae	Fiji Fan Palm	Tree	A
Pritchardia thurstonii	Arecaceae	Long inflorescence Fiji Fan Palm	Tree	A
Prosopis pallida	Fabaceae	Kiawe	Tree	A
Psidium guajava	Myrtaceae	Guava	Tree	A
Psilotum nudum	Psilotaceae	Moa	Herb	I
Psydrax odoratum	Rubiaceae	Alahe’e	Tree	I

Rhynchelytrum repens	Poaceae	Natal red-top	Grass	A
Ricinus communis	Euphorbiaceae	Castor Bean	Shrub	A
Rivina humilis	Phytolaccaceae	Coral Berry	Shrub	A
Rumex crispus	Polygonaceae	Curly dock	Herb	A
Samanea saman	Fabaceae	Monkeypod	Tree	A
Scaevola taccada	Goodeniaceae	Naupaka	Shrub	I
Schinus terebinthifolius	Anacardiaceae	Christmas Berry	Shrub	A
Senna occidentalis	Fabaceae	Coffee Senna	Shrub	A
Sesuvium portulacastrum	Aizoaceae	‘Akulikuli	Herb	I
Schoenoplectus lacustris validus	Cyperaceae	‘Aka ‘akai	Sedge	I
Sida fallax	Malvaceae	‘Ilima	Shrub	I
Sida rhombifolia	Malvaceae	Cuba Jute	Herb	A
Solanum linnaeanum	Solanaceae	Sodom’s apple	Herb	A
Spathodea campanulata	Bignoniaceae	African Tulip tree	Tree	A
Spermacoce assurgens	Rubiaceae	Buttonweed	Herb	A
Stachytarpheta jamaicensis	Verbenaceae	Jamaica vervain	Shrub	A
Syzygium cumini	Myrtaceae	Java plum	Tree	A
Syzygium jambos	Myrtaceae	Rose-apple	Tree	A
Terminalia catappa	Combretaceae	False kamani	Tree	A
Thespesia populnea	Malvaceae	Milo	Tree	I
Thevetia peruviana	Apocynaceae	Tree poppy	Tree	A
Tournefourtia argentea	Boraginaceae	Tree heliotrope	Tree	A
Tridax procumbens	Asteraceae	Coat buttons	Herb	A
Triumfetta rhomboidea	Tiliaceae	Bur bush	Shrub	A
Vigna marina	Fabaceae	Nanea	Vine	I
Waltheria indica	Sterculiaceae	Uhaloa	Herb	I
Wedelia trilobata	Asteraceae	Wedelia	Herb	A

Appendix 2. GPS Coordinates (UTM Hawaii NAD 83) that were used to determine the boundary for Zone A.

Coordinate number	Easting	Northing
1	235806	2117027
2	235920	2117145
3	235950	2117169
4	235985	2117186
5	236030	2117233

6	236019	2117250
7	236024	2117283
8	236019	2117330
9	236037	2117326
10	236069	2117332
11	236103	2117348
12	236126	2117355
13	236169	2117349
14	236190	2117319
15	236275	2117353
16	236338	2117447
17	236369	2117498
18	235806	2117027

Appendix 3. GPS coordinates (UTM Hawaii NAD 83) for the three patches of *Pritchardia affinis* located on the Sea Mountain project site.

Patch ID	Easting	Northing	Number of plants	Plant height
1	235833	2117094	1	13-15m
2	235856	2117084	2	10-11m
3	235861	2117082	5	4-7m

Appendix 4. GPS Coordinates (UTM Hawaii NAD 83) for the eight survey sites established to sample Hawaiian hoary bat echolocation calls.

Survey Site	Easting	Northing
1	234915	2118635
2	234988	2118122
3	235404	2118014
4	235380	2117405
5	235824	2117152
6	235870	2117667
7	236275	2118105
8	236588	2117791

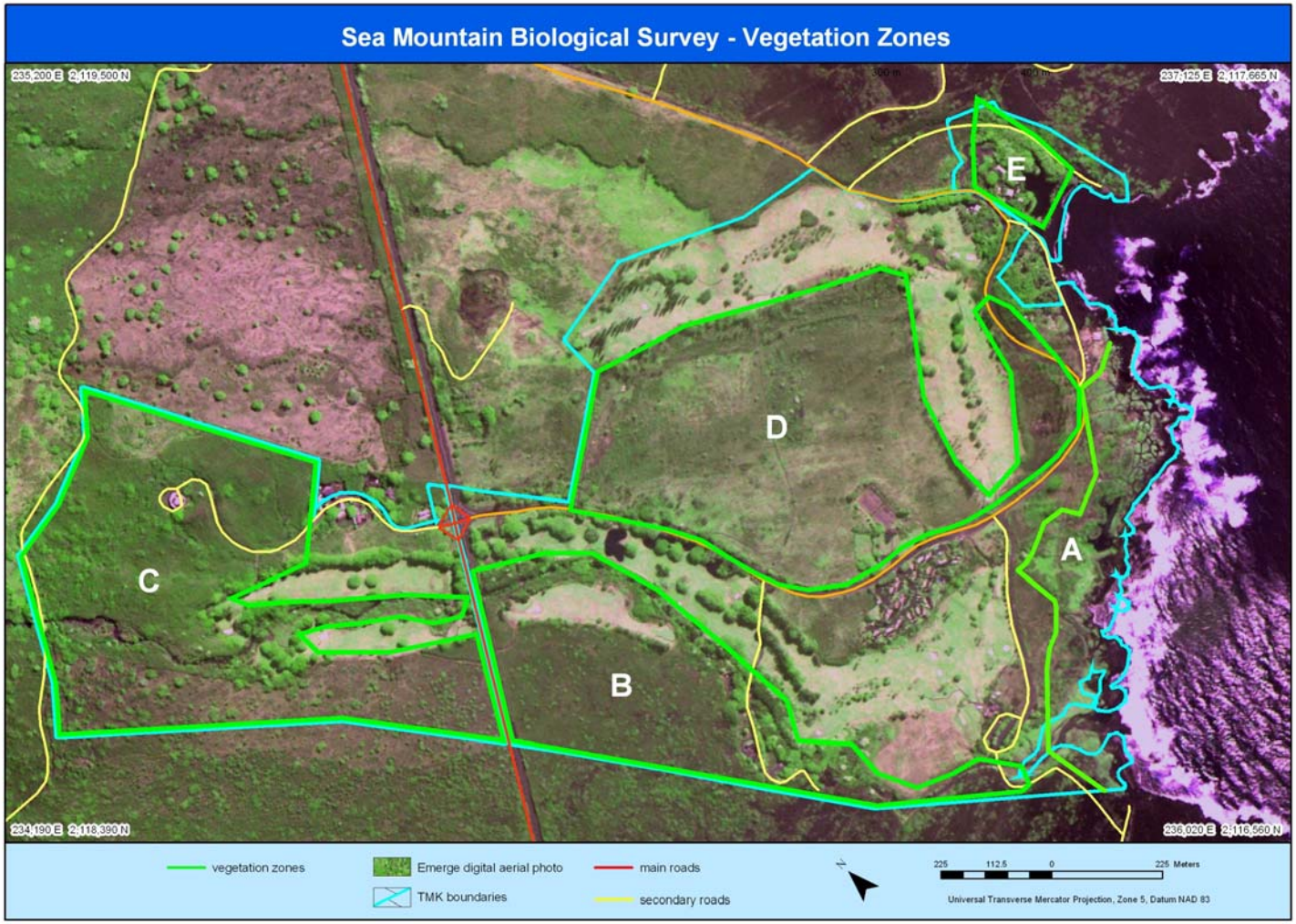

Figure 1. Approximate (Zones B-E) and precise Coastal Zone (Zone A) boundaries (outlined in green) of vegetation zones in the Sea Mountain at Punalu‘u project site.

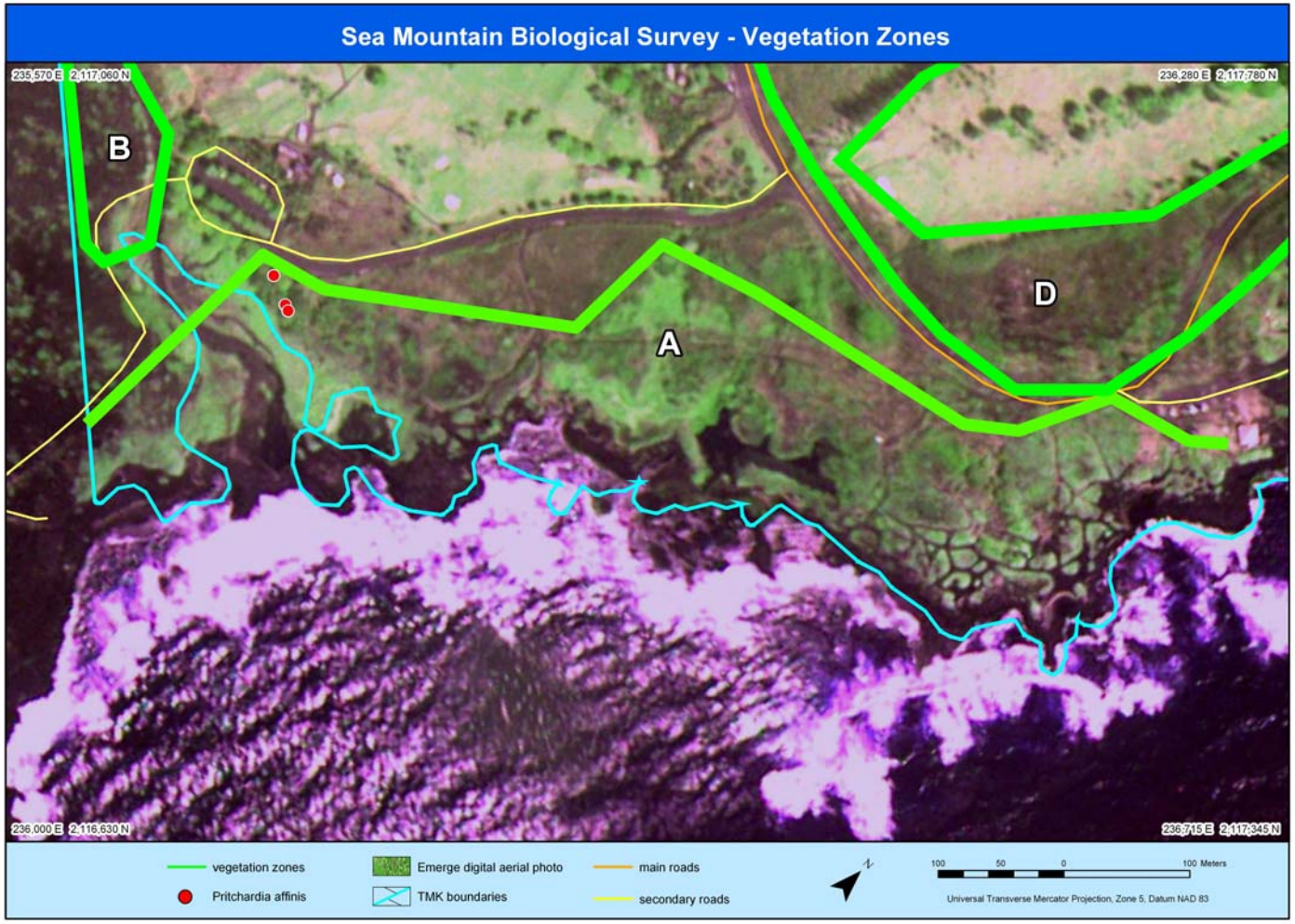

Figure 2. Coastal Zone "A" of the Sea Mountain at Punalu'u project site. Locations of three groups of eight Endangered *Pritchardia affinis* trees highlighted with red dots.

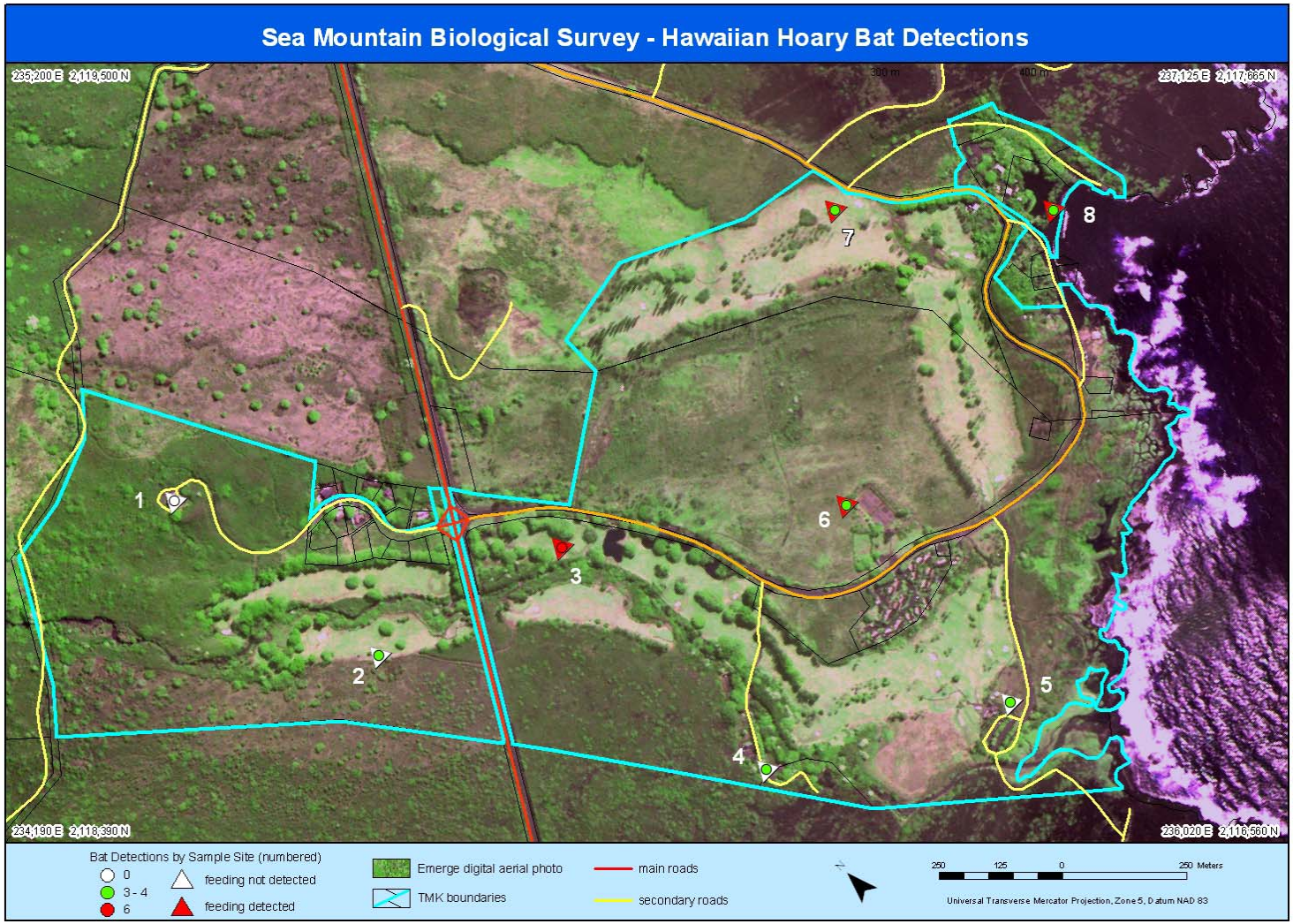

Figure 3. Hawaiian hoary bat survey sites (numbered) and number of visits with detections (circles), including feeding activity (triangles).

Appendix D

Potable Water, Recycled Water and Wastewater Systems, Sea Mountain at Punalu‘u (Hunsaker and Associates, June 2006)

Preliminary Master Plan
Potable Water, Recycled Water and Wastewater Systems

June 19, 2006

Sea Mountain Village
Punalu'u, Hawaii

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Filename: 3442-1 Punaluu-SeaMountainCVR.psd

GENERAL

Purpose

The purpose of this report is to provide a preliminary estimate of the potable water, wastewater and recycled water requirements for the proposed Sea Mountain Village, Punalu'u, Hawaii, and to develop a basis for the related infrastructure required to serve the project. The design of potable water systems will be based upon the requirements of the 'County of Hawaii, Department of Water Supply, (DWS) as well as the Department of Health, State of Hawaii (DOH). Wastewater systems will be based upon the "Design Standards of the Department of Wastewater Management, City and County of Honolulu, State of Hawaii." Recycled water will be based upon "Guidelines for the Treatment and Reuse of Recycled Water, Hawaii State Department of Health." Because potable water will be used on a regular basis to supplement the recycled wastewater for golf course irrigation, potable water and recycled water (irrigation) will be estimated and described under "estimated water demand" section of this report.

Project Description

Sea Mountain Five, LLC (SMF) is planning the expansion and enhancement of an existing golf course resort community, known as Sea Mountain at Punalu'lu, to be called Sea Mountain Village. The project is located on the Ka'u coastline of the island of Hawaii, approximately 60 miles southwest of Hilo and 70 miles southeast of Kailua-Kona. The project site is shown on the Regional Location Map, Exhibit 1 and is sited mauka of the Punalu'u Beach Park (Black Sand Beach) as shown on Exhibit 2, Project Site. The site includes approximately 432 acres of land. The current Sea Mountain community was developed by C. Brewer Properties around 1969 to 1972. The community includes two residential enclaves; Colony I, a 76-unit condominium community; Kalana I, a 19 lot single family residential subdivision; and facilities for other related cultural activities.

The proposed Sea Mountain Village will include the re-construction of the golf course as well as a new community that will be constructed through 9 development areas. The Concept Plan is shown on Exhibit 3 and described in terms of proposed land use in Table 1.

Table 1 - Planning Area Description

Plan Area	Land Use	# of Bdrms	DU's	Sq. Ft.
1	SFD	3	142	
2	Duplex	3	185	
3	Triplex	3	248	
4	Cluster TH	3	180	
5	Cluster TH	3	282	
6	Cluster TH	3	220	
7	Lanai *	3	114	
	CH/Retail **			8,000
8	Lanai *	2	332	
	Retail Service**			50,000
9	Lanai	2	120	
	Retail Service**			15,000
	Project total		**1,823**	**73,000**

* Potential hotel operation but analyzed as primary housing
** Restaurants, spa, galleries, sundries, salons, etc.

Phasing/Absorption

The development areas shown in Table 1 are proposed for development over a 10 year period as follows:

Table 2 - Phasing/Absorption

Phase	Planning Areas	DU's	Area (SF)
1	6,7,8,9	786	
	Retail		73,000
	Existing	95	
	Subtotal Phase 1*	**881**	**73,000**
2	3,4,5	**710**	
3	1,2	**327**	
	Total Phase 1,2,3	**1,823**	**73,000**

*Golf course will also be developed during phase 1.

Occupancy

Occupancy will affect the estimated flows for both water and wastewater. The following Table 3 shows the effect of an occupancy factor of 25% on the apparent dwelling unit count.

Table 3 - Phasing/Occupancy

Phase	Planning Areas	DU's	Area (SF)
1	6,7,8,9	196	
	Retail		18,000
	Existing	95	
	Subtotal Phase 1*	**291**	**18,000**
2	3,4,5	**178**	
3	1,2	**82**	
	Total Phase 1,2,3	**551**	**18,000**

WATER SYSTEM

Existing Water System

There are currently, two wells, a booster pump station and related appurtenances sited makai of the State Highway near the site entrance. The wells are located approximately 200 feet apart and are used as a potable water supply for existing residential development as well as water supply for the irrigation of the golf course. These wells appear to be in very poor repair and should be further inspected by video equipment and water quality testing prior to integration into any portion of the water system for the proposed community. The wells have a chlorination system, which is understood by this writer, is still working. The well piping and equipment is in very poor repair and will require replacement if the wells are used with the proposed project. The golf course superintendent indicated that each well was operated separately since it appears that simultaneous operation of the wells reduces the production capacity of each well. Each well, as told by the Sea Mountain onsite management, provides backup support for the other well. The developer plans to have each well inspected and production tested by a certified hydro-geologist. Water quality samples will also be required to determine how best to utilize this water supply for the proposed Sea Mountain project.

A concrete reservoir, of approximately 1 million gallon capacity, is located mauka of the Kalana I residences. This reservoir, reported to have a High Water Level (HWL) of approximately 305 feet elevation. The reservoir defines the hydraulic gradient, thus provides water pressure throughout the existing community. The reservoir has been leaking for some time as indicated by previous engineering studies. This reservoir will require structural inspection and repairs as required in order to integrate this facility into the proposed Sea Mountain Village water supply system. The plans

used for the construction of the underground piping system are not available, therefore no assessment of the piping can be made at this time. Future pressure testing and inspection of the community piping system will reveal how much of the piping system can be safely redeemed and used in the Sea Mountain Village water system.

The potable water system also serves as the main water supply for the existing golf course, since only a small quantity of treated wastewater is available for irrigation use.

Estimated Water Demands

Summary The following is a summary of the estimated water demands at ultimate development and 100% occupancy for the Sea Mountain Village in million gallons per day (mgd), including potable and golf course irrigation.

	Table 4 - DWS Basis		**Table - 5 Mod. DWS**	
	ADD*	**MDD***	**ADD**	**MDD**
Potable	0.777	1.166	0.807	1.268
Golf/Landscape	0.431***	0.992****	0.431	0.992
Total Estimated Demands	**1.208**	**2.158**	**1.238**	**2.260**

Potable - The potable water demands for the Sea Mountain Village are based upon the standards of the County of Hawaii, DWS as previously indicated. The estimated water demands are based upon a "duty" factor and are as shown in Table 4 at full build out and 100% occupancy.

**ADD = Average Day Demand*

***MDD = Maximum Day Demand*

****Based upon Harvey Mills Design (HMD) total season water demand of 482.62 acre feet, including historical rainfall.*

*****Based upon the ratio of no rainfall water supply requirement of 919 gpm (0.992 mgd) to ADD (0.431 mgd) = 2.3.*

Table 4 - Estimated Water Demands

County of Hawaii, Department of Water Supply Duty Factors

Potable Water

Area	Land Use	DU/SF	Duty (gpd)/DU	ADD (gpd)	MDD *(gpd)
1	SFD	142	400	56,800	85,200
2	Duplex	185	400	74,000	111,000
Exist. Kalana 1	SFD	19	400	7,600	11,400
Subtotal 500		**346**		**138,400**	**207,600**
3	Triplex	248	400	99,200	148,800
4	Cluster TH	180	400	72,000	108,000
5	CTH	282	400	112,800	169,200
6	CTH	220	400	88,000	132,000
7	Lanai	114	400	45,600	68,400
8	Stacked	332	400	132,800	199,200
9	Flat	120	400	48,000	72,000
	Comm.	73,000	0.14	10,200	15,300
Exist. Colony I		76	400	30,400	45,600
Subtotal 305		**1,572**		**639,000**	**958,500**
Total Project		**1,918**		**777,400**	**1,166,100**

In the alternative, Table 5 was prepared to estimate water demands based upon separately identified interior and exterior water use. The interior use is based upon the water consumption as determined by the City and County of Honolulu Standards, said standards are used by the County of Hawaii. Exterior use is determined based upon landscape area as determined by FORMA and by water consumption duties developed by the project golf course irrigation consultant, HMD.

Table 5 - Estimated Water Demands

Modified DWS Method Using Area Landscape Irrigation

Potable Water

Area	Land Use	DU/Ac	Duty (gpd)/	ADD (gpd)	MDD *(gpd)
1 & 2	Table 4	327	320	104,600	104,600
1 & 2	Landscape	37.45	3,100	116,100	267,000
Exist. Kalana 1	SFD	19	400	7,600	11,400
Subtotal 500		**346**		**228,300**	**383,000**
3	Triplex	248	320	79,400	79,400
3	Landscape	9.57	3,100	29,700	68,300
4, 5 & 6	CTH	682	320	218,200	218,200
4, 5, & 6	Landscape	29.20	3,100	90,500	208,200
7, 8 & 9	Table 4	566	320	181,100	181,100
7, 8, & 9	Landscape	9.62	3,100	29,800	68,500
	Comm.	73,000	0.14	10,200	15,300
Exist. Colony I		76	400	30,400	45,600
Subtotal 305		**1,572**		**669,300**	**884,600**
Total Project		**1,918**		**807,100**	**1,267,600**

Note 1 – Residential landscaping duty derived from HMD landscape duty estimates with historical rain.

Note 2 – Landscape peaking factor equals 2.3 times average based as shown in notes for Estimated Water Demand Summary on Page 4.

Note 3 – Maximum day domestic water supply for interior remains constant.

Note 4 – Water requirements estimates for the existing Kalana 1 and Colony 1 development are based upon DWS standards.

Table 6- Estimated Water Demands

Modified DWS Method Using Area Landscape Irrigation

Potable Water - 25% New Occupancy

Area	Land Use	DU/Ac	Duty (gpd)/	ADD (gpd)	MDD *(gpd)
1 & 2	Table 4	82	320	26,200	26,200
1 & 2	Landscape	37.45	3,100	116,100	267,000
Exist. Kalana 1	SFD	19	400	7,600	11,400
Subtotal 500		**101**		**149,900**	**304,600**
3	Triplex	62	320	19,800	19,800
3	Landscape	9.57	3,100	29,700	68,300
4, 5 & 6	CTH	170	320	54,400	54,400
4, 5, & 6	Landscape	29.20	3,100	90,500	208,200
7, 8 & 9	Table 4	142	320	45,400	45,400
7, 8, & 9	Landscape	9.62	3,100	29,800	68,500
	Comm.	18,000	0.14	2,500	2,500
Exist. Colony I		76	400	30,400	45,600
Subtotal 305		**450**		**302,500**	**512,700**
Total Project		**551**		**452,400**	**817,300**

Note 1 – Same reference notes as table 5.

Estimated Water Demands

Summary The following is a summary of the estimated water demands for the Sea Mountain Village in mgd, including potable and golf course irrigation.

	Table 5 - Mod. DWS		**Table 6 – 25% Basis**	
	ADD	**MDD**	**ADD**	**MDD**
Potable	0.807	1.268	0.452	0.817
Golf Course Irrigation	0.431	0.992	0.431	0.992
Total Estimated Demands	**1.238**	**2.260**	**0.883**	**1.809**

Golf Course Irrigation – The maximum irrigation requirements for the golf course are based upon calculations dated February 23, 2006, prepared by Brent Harvey, ASLA of Harvey Mills Design. Mr. Harvey's calculations assume no rainfall and an average irrigation rate of 887.41 acre-feet per year over 156 acres, including 106 acres of turf, greens and tees, 47 acres of landscaping and 3 acres of lakes. The Ninole Stream was assumed to be left natural. The average 24-hour flow rate for the high season average of 887.41 acre-feet is 792,229 gallons per day. Mr. Harvey estimated the peak daily flow to be 919 gpm for 18 hours or **992,520** gallons per day. The irrigation water demands calculations are included in the appendix of this report.

Fire flows - Fire flows estimated in this report are based upon Table 100-19, Fire Flow Requirements of the DWS standards. All residential development proposed for Sea Mountain will require a fire flow of 1,500 gpm for one hour for the new 500 pressure zone. Neighborhood business, small shopping centers and hotels require a fire flow of 2,000 gpm. for 2-hours. The highest fire flow requirement for the Sea Mountain project is therefore 2,000 gpm for 2-hours for the 305 pressure zone.

WATER SUPPLY

Upon full development of the Sea Mountain Village, a water supply equal to the maximum day demand will be required. Generally, the water supply must also be available assuming one of the key sources is out of service. There will be two sources of water supply available to the project; namely, water wells and R-1 quality recycled water from the wastewater reclamation plant.

Recycled Water - Based upon service to 1,823 homes plus related commercial development H&A, using the City and County of Honolulu Standards, has estimated the wastewater treatment requirements to be about 80% of the average day potable water requirements for the community, including commercial development. H&A has estimated the maximum wastewater treatment capacity required to be approximately 622,000 gpd. A 600,000 gpd treatment plant is recommended later in this report, phasing of the treatment plant would be in accordance with development needs.

Treated R-1 recycled water can usually be recaptured at a rate of 90% or greater of the treated wastewater flows. H&A therefore estimates that approximately 540,000 gpd will be available for irrigation of the golf course during maximum occupancy while only 160,000 gpd would be available during 25% occupancy.

Wells – Simply as a matter of public health and safety, H&A recommends the use of the existing wells to be limited to meeting irrigation water demands only due to the lower quality of water available from the wells. In addition, H&A recommends the construction of three or four new wells all of which would be designed to meet the project potable water requirements. Each well, H&A believes could be designed with a capacity of approximately 700 gpm. There will be at least one well that will not be required for service at any given time but will be dedicated as "standby duty" for any well that is out of service for any reason.

H&A further recommends the construction of the new wells at or above the elevation of the existing 305-foot reservoir, each well to be utilized in the potable water system, while the existing wells could be dedicated to irrigation service only. Upon additional well testing it is assumed that this well development concept will be refined.

Water Supply Summary - The following is a summary of the estimated water demands in mgd for the project based upon the modified DWS technique employed in the development of Table Nos. 5 and 6 and the corresponding water supply source available to meet the demands.

	100 % Occupancy		25% Occupancy	
	ADD	**MDD**	**ADD**	**MDD**
Irrigation Demand	0.431	0.992	0.431	0.992
Available R-1 Recycled	0.540	0.540	0.160	0.160
Net Irrigation Well Supply*	0.000	0.452	0.271	0.832
Potable Well Supply**	0.807	1.268	0.452	0.817
Total Required Well Supply	0.807	1.720	0.723	1.649

*Existing wells can provide the water required to meet the golf irrigation water demands as they do now.

**New wells will be constructed in order to meet the potable water demands

Water System Facilities

Exhibit 4, shows the water system facilities recommended for the Sea Mountain Village, including pipelines and reservoirs based upon the preliminary development information available and our understanding of the existing water system. The reader will note that wherever possible, H&A supports the use of existing pipelines and the concrete tank.

Distribution System - The existing Sea Mountain water distribution system is supplied from two wells sited makai of the State Highway. These wells together with a booster pump station deliver water to a existing concrete reservoir located at an elevation that provides a HWL of 305 feet. All existing development is served from the existing reservoir. H&A recommends dedication of the existing wells to irrigation service only, based upon isolation of the potable water supply from the irrigation water supply.

Future development will require that an offsite reservoir be sited at an elevation that can serve the highest developed lot with at least 40 psi of water pressure. H&A estimates that a reservoir located offsite at an elevation that will permit a HWL of approximately 500 feet.

The future water system should be divided into two pressure systems or service pressure zones. H&A recommends that the existing pressure system serve only the development located makai of the State Highway, including Development Area Nos. 3 through 9 and the Colony I condominiums. A new pressure system should be created at the 500 foot elevation that will serve only the development mauka of the State Highway (Planning Areas Nos. 1 and 2).

Reservoirs - Reservoir storage requirements are based upon the requirements of the County DWS Standards, Generally, one maximum day water demand plus fire flow describe the water storage criteria. The maximum day water demands are dependent upon the water storage available for golf course irrigation. If golf course irrigation is removed from the equation, through independent storage, then only potable water demands need be considered.

System	MDD	Fire Flow	Required	Storage
500	207,600	90,000	297,600	*500,000
305	958,500	240,000	1,198,000	1,000,000
Total			1,495,600	1,500,000

*H&A has assumed that the existing 305 foot elevation reservoir can be repaired and used to serve the 305 water system, there fore a new 500,000 gallon reservoir can be constructed to serve the 500 zone as well as supplement water storage for the 305 zone. The recommended water system is shown in Exhibit 3.

WASTEWATER SYSTEM

Existing Wastewater System

Collection System - The existing wastewater system is based upon a gravity collection system with two sewage lift stations provided to collected the wastes that drain to areas too low to be served by the gravity system. The sewer lift station located near the beach is currently inoperative. Little is known about the condition of the existing collection system and therefore should be inspected by video camera and repairs made or pipe replaced as required.

Wastewater Treatment Plant – The treatment plant was viewed by this writer during a preliminary reconnaissance visit and was not inspected in detail. The treatment plant, however appears to be in very poor repair and treatment system technology is over 35 years old. The treatment plant apparently was designed for a flow of 50,000 gpd but has seldom operated beyond a 10,000 gpd flow rate. Based upon the treatment requirements of the time, the plant should be able to process the collected wastewater to a disinfected secondary treatment level known as "R-2" treatment level. The treated wastewater is disposed of to the golf course when there is an irrigation requirement. R-2 level treatment is approved for disposal to golf courses according to State Guidelines with a 500 foot setback to dwellings. When there is no need for a irrigation water supply and the R-2 water should disposed into the ground through an DOH approved injection well system. The DOH administers a program for wastewater disposal control in order to protect the States groundwater resources. The system is known as the Underground Injection Control program or "UIC". Treated effluent may be injected into the underground maiki of the UIC line. The correspondence from the DOH pertaining to the UIC line is in the appendix of this report. Currently R-2 treatment no longer meets the DOH requirements for reuse or disposal and R-1 treatment level is required. H&A has assumed that the treatment plant will be replaced when the new development begins. Current planning calls for the use of the existing treatment plant site while H&A recommends that 3 acres be set aside for the plant site.

Estimated Wastewater flow Requirements

The project wastewater flow requirements are based upon the Design Standards of the Department of Wastewater Management, City and County of Honolulu as required by the County of Hawaii. The estimated wastewater flows contained in this report are based upon proposed development phasing as shown herein over a ten year development period. Table 7 shows the estimated wastewater flows based upon 100% occupancy while Table 8 reflects a uniform 25% occupancy of the Sea Mountain Village. One alternative wastewater collection system is shown schematically in Exhibit 5.

It is apparent from the inspection of Tables 7 and 8 that the estimated wastewater flows can vary significantly based upon the occupancy of the Sea Mountain Village. While projected occupancy figures have not been developed at this time, actual operating treatment capacity could vary from a maximum of approximately 600,000 gallons per day to less than 180,000 gallons per day based upon 25% occupancy of the project.

Table 7 - Estimated Wastewater Flows

Department of Wastewater Management

City and County of Honolulu Standards @ 100% Occupancy

Phase	PA's	DU's	Duty (gpd)	Est. Flow (gpd)
1	6,7,8,9	786	320	251,500
	Retail	73,000	0.11	8,000
	Existing	95	320	30,400
	Subtotal Phase 1	**881**		**289,900**
2	3,4,5	710	320	227,200
	Subtotal Phase 2	**606**		**227,200**
3	1,2	327	320	104,600
	Subtotal Phase 3	**327**		**104,600**
	Total Phase 1,2,3	**1,918**		**621,700**

Table 8 - Estimated Wastewater Flows

Department of Wastewater Management

City and County of Honolulu Standards @ 25% Occupancy

Phase	PA's	DU's	Duty (gpd)	Est. Flow (gpd)
1	6,7,8,9	196	320	62,700
	Retail	18,000	0.11	2,000
	Existing	95	320	30,400
	Subtotal Phase 1	**291**		**95,100**
2	3,4,5	178	320	57,000
	Subtotal Phase 2	**178**		**57,000**
3	1,2	82	320	26,200
	Subtotal Phase 3	**82**		**26,200**
	Total Phase 1,2,3	**551**		**178,300**

Wastewater Treatment, Reuse and Disposal

Based upon the preceding wastewater flow estimates a new treatment plant will be required to meet the generated flows as development occurs. If the Sea Mountain Village develops seasonal occupancy differentials, the treatment system will be required to operate at reduced capacity. While the main use of the R-1 treated wastewater will be irrigation of the proposed golf course, a secondary system of disposal of the treated effluent below the UIC line will be required by the DOH for operation of the wastewater treatment and reuse system. Biological nutrient removal will be included with the treatment process to mitigate impacts to down gradient receptors.

A properly design treatment plant can be expected to produce approximately 90% of the plant influent to usable recycled water. For the full capacity plant, a usable water supply of approximately 540,000 gallons per day. Alternatively, should occupancy occur for example, to the 25% level, only 178,000 gallons of wastewater would be generated and only 160,000 gpd of treated effluent would be available for golf course irrigation.

LIST OF EXHIBITS

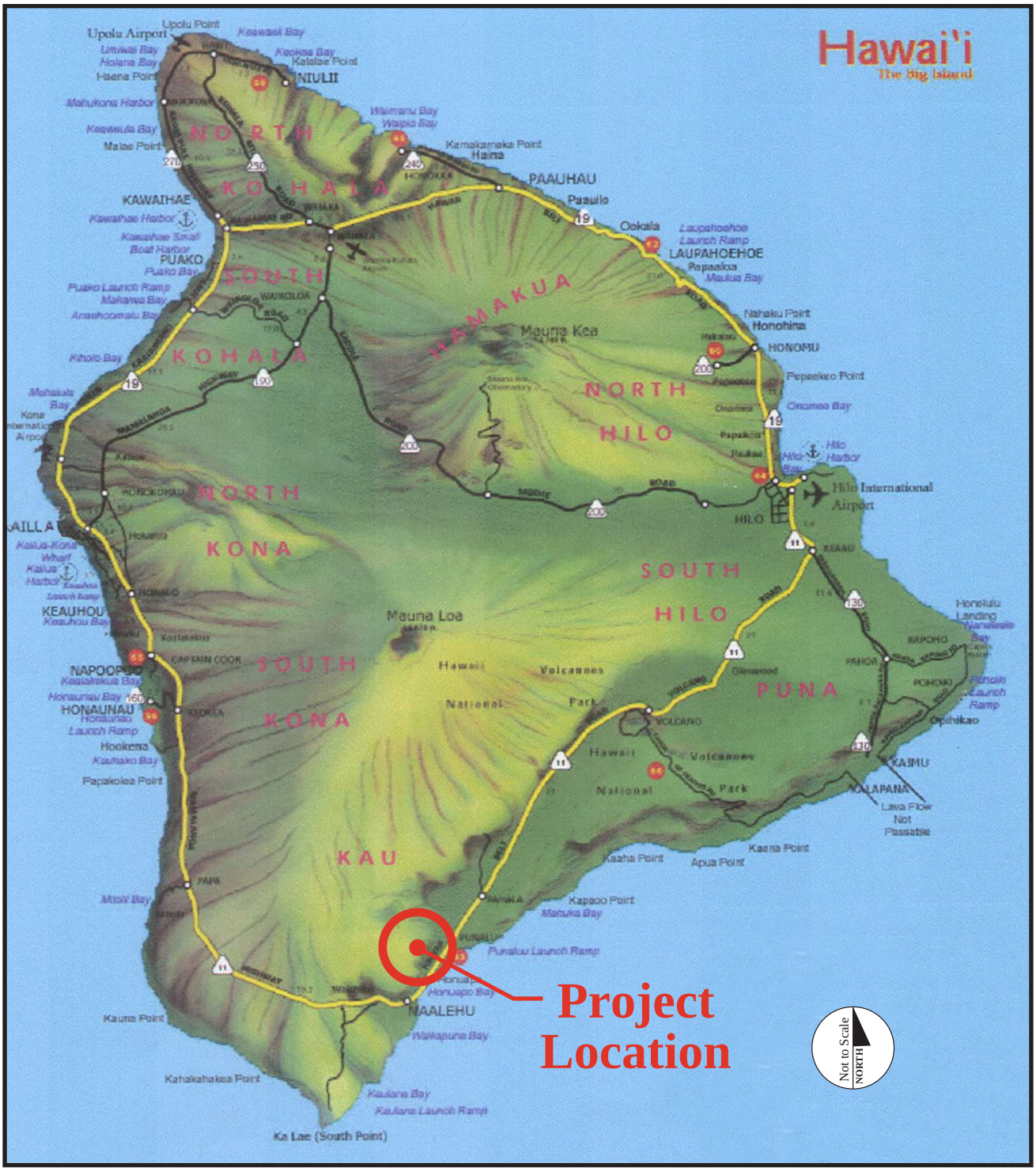
Exhibit No.	Title
1	Project location map
2	Vicinity Map
3	The Sea Mountain Village Concept Plan
4	Proposed Water System
5	Proposed Wastewater System

Appendix

Appendix No. 1	Harvey Mills Design Calculations, dated 2/23/06
Appendix No. 2	State DOH UIC Line transmitted 1/25/06

Prepared For: Sea Mountain Five, LLC

Prepared By: HUNSAKER & ASSOCIATES IRVINE, INC.



Sea Mountain Village

Punalu'u, Hawaii

Sea Mountain Village
Punalu'u, Hawaii

Regional Location Map

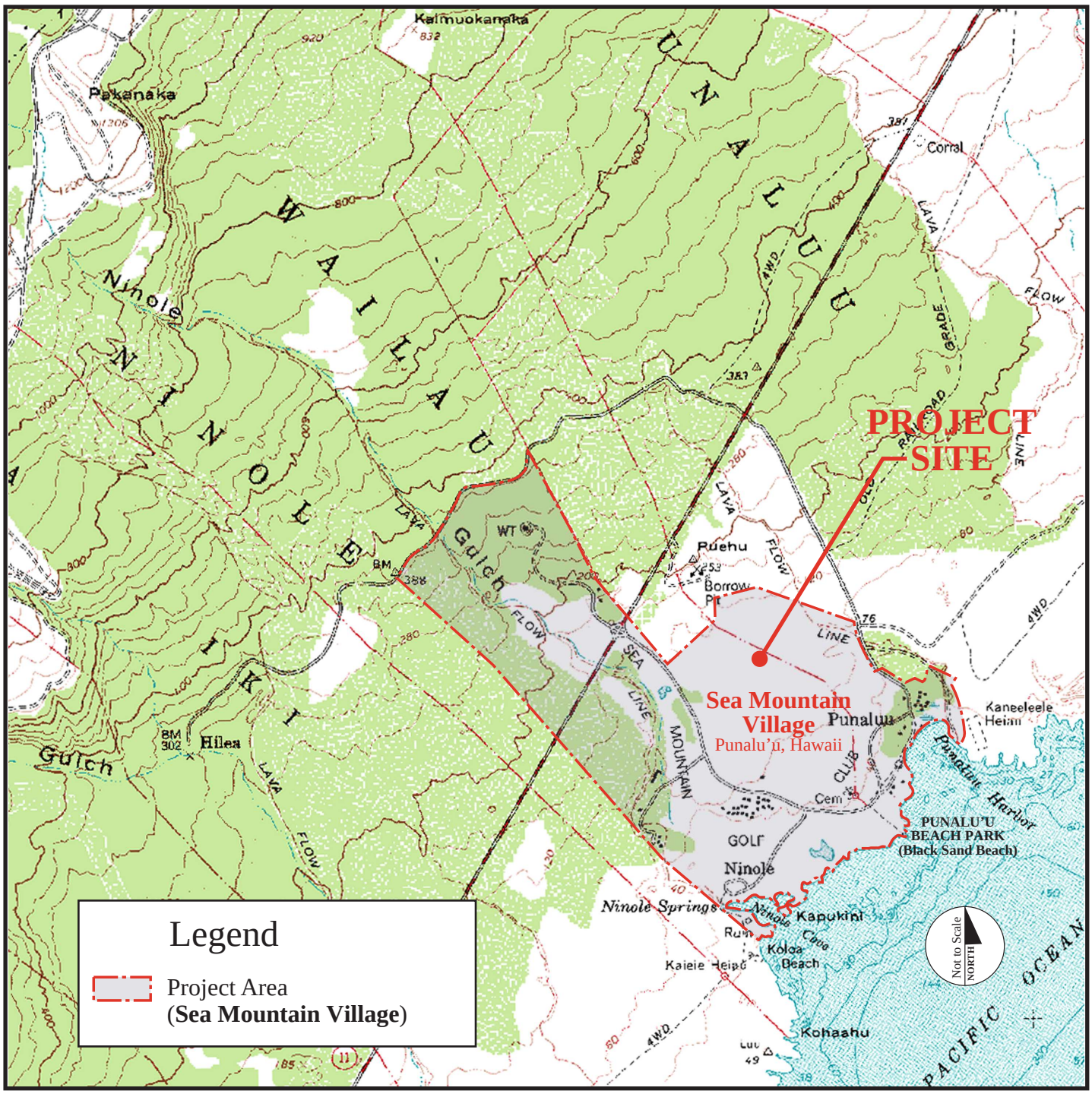
Date: 6-19-06

Exhibit 1

File name: 3442-1 Punaluu-Hawaii-Exh1-RMap

Prepared For: Sea Mountain Five, LLC

Prepared By: HUNSAKER & ASSOCIATES IRVINE, INC.



Sea Mountain Village

Punalu'u, Hawaii

Sea Mountain Village
Punalu'u, Hawaii

Date: 6-19-06

Project Site

Exhibit 2

File name: 3442-1 Punaluu-Hawaii-Exh2-ProjectSite

Prepared For: Sea Mountain Five, LLC

Prepared By: HUNSAKER & ASSOCIATES IRVINE, INC.

Sea Mountain Village

Punalu'u, Hawaii

Sea Mountain Village
Punalu'u, Hawaii

Date: 6-19-06

File name: 3442-1 Punaluu-Hawaii-Exh3-CSP

Concept Site Plan

Exhibit 3

Prepared For: Sea Mountain Five, LLC

Prepared By: HUNSAKER & ASSOCIATES IRVINE, INC.

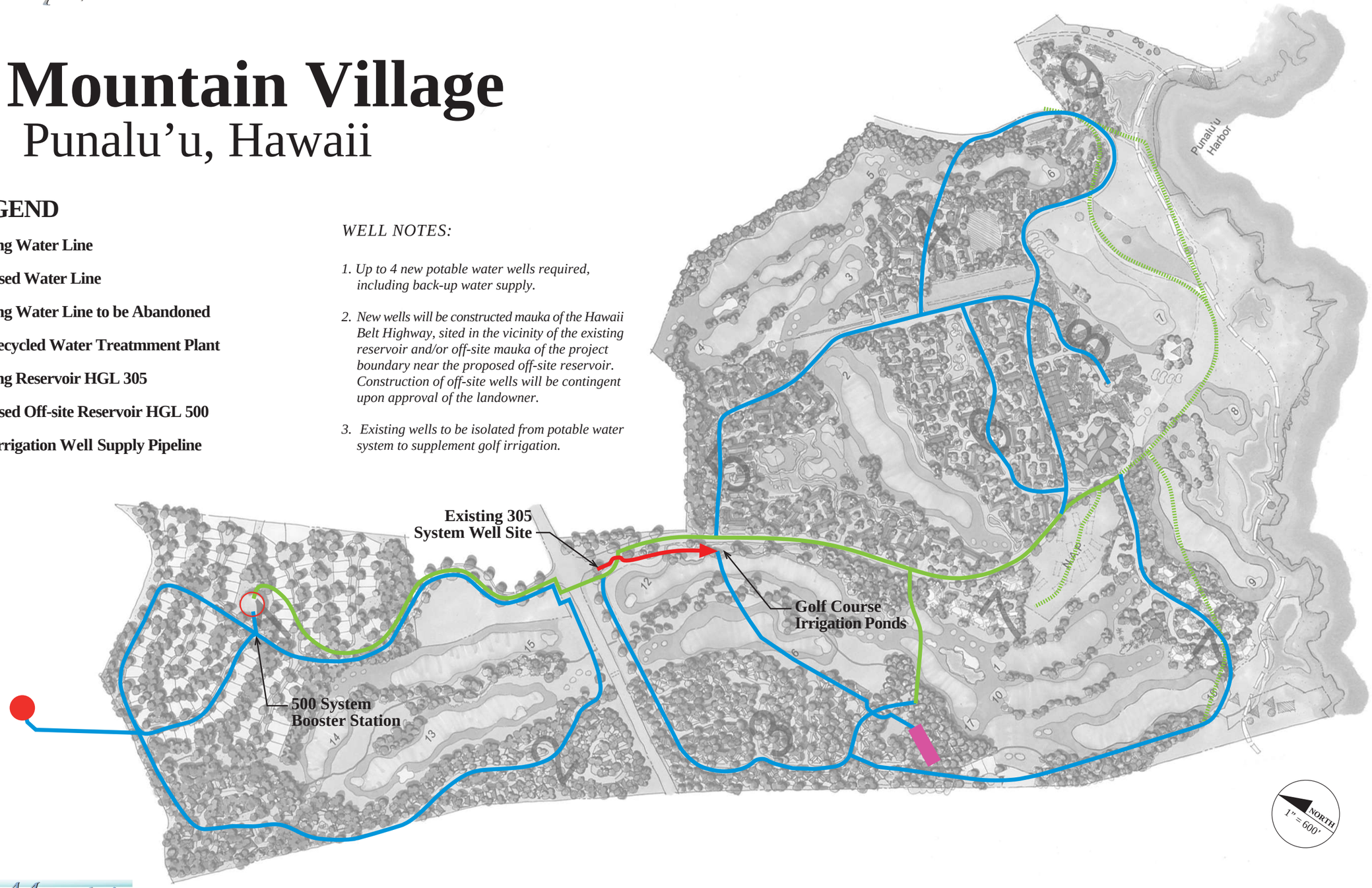
Sea Mountain Village
Punalu'u, Hawaii

LEGEND

- Existing Water Line
- Proposed Water Line
- Existing Water Line to be Abandoned
- R-1 Recycled Water Treatmment Plant
- Existing Reservoir HGL 305
- Proposed Off-site Reservoir HGL 500
- Golf Irrigation Well Supply Pipeline

WELL NOTES:

1. *Up to 4 new potable water wells required, including back-up water supply.*
2. *New wells will be constructed mauka of the Hawaii Belt Highway, sited in the vicinity of the existing reservoir and/or off-site mauka of the project boundary near the proposed off-site reservoir. Construction of off-site wells will be contingent upon approval of the landowner.*
3. *Existing wells to be isolated from potable water system to supplement golf irrigation.*



Sea Mountain Village
Punalu'u, Hawaii

Date: 6-19-06

File name: 3442-1 Punaluu-Hawaii-Exh4-Water

Proposed Water System

Exhibit 4

Prepared For: Sea Mountain Five, LLC

Prepared By: HUNSAKER & ASSOCIATES IRVINE, INC.

Sea Mountain Village

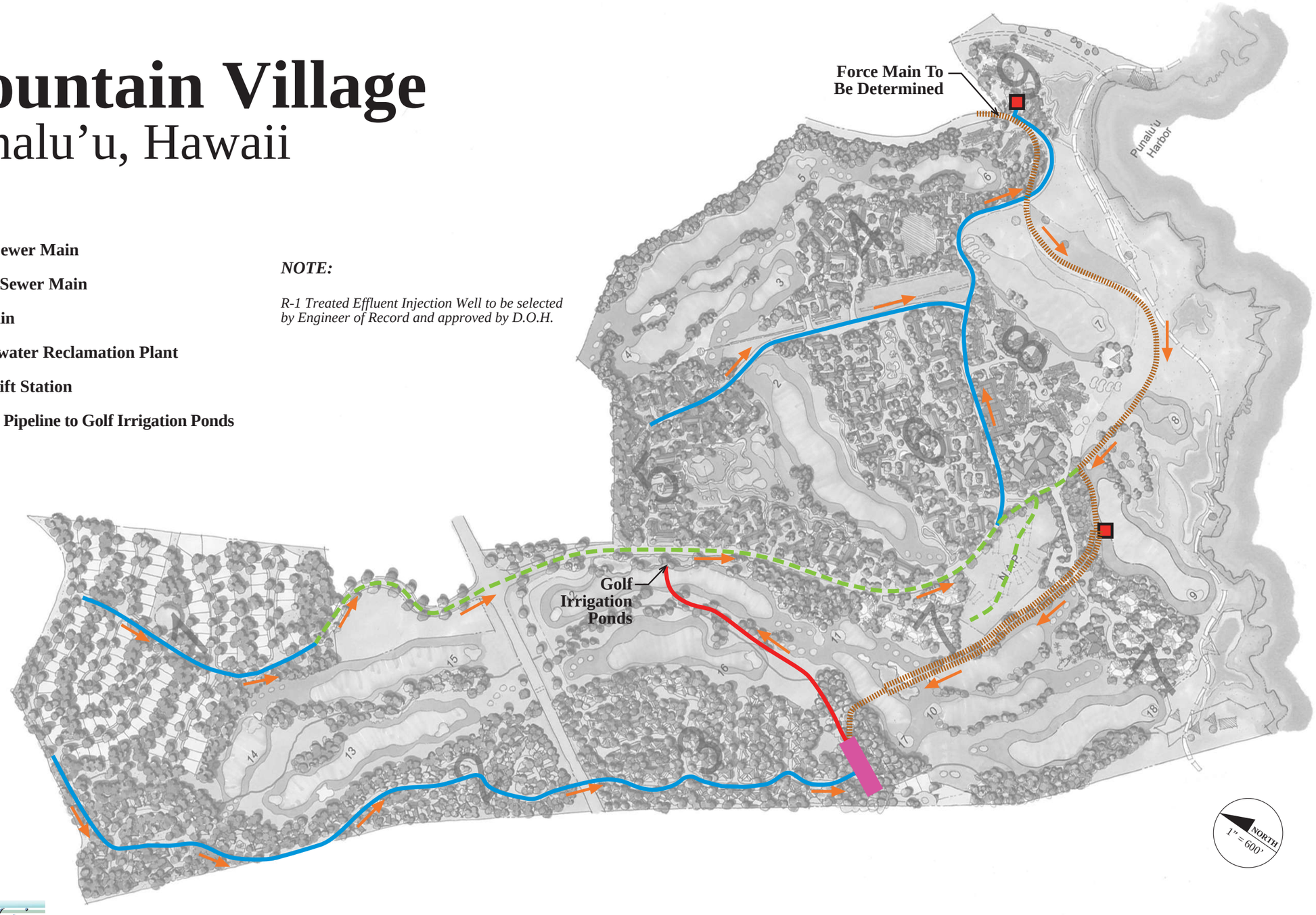
Punalu'u, Hawaii

LEGEND

- Existing Gravity Sewer Main
- Proposed Gravity Sewer Main
- Existing Force Main
- Future R-1 Wastewater Reclamation Plant
- Existing Sewage Lift Station
- R-1 Effluent Reuse Pipeline to Golf Irrigation Ponds
- Direction of Flow

NOTE:

R-1 Treated Effluent Injection Well to be selected by Engineer of Record and approved by D.O.H.



Sea Mountain Village
Punalu'u, Hawaii

Date: 6-19-06

File name: 3442-1 Punaluu-Hawaii-Exh5-WWtr

Proposed Wastewater System

Exhibit 5

APPENDIX 1

Harvey Mills Design Calculations
2/23/06

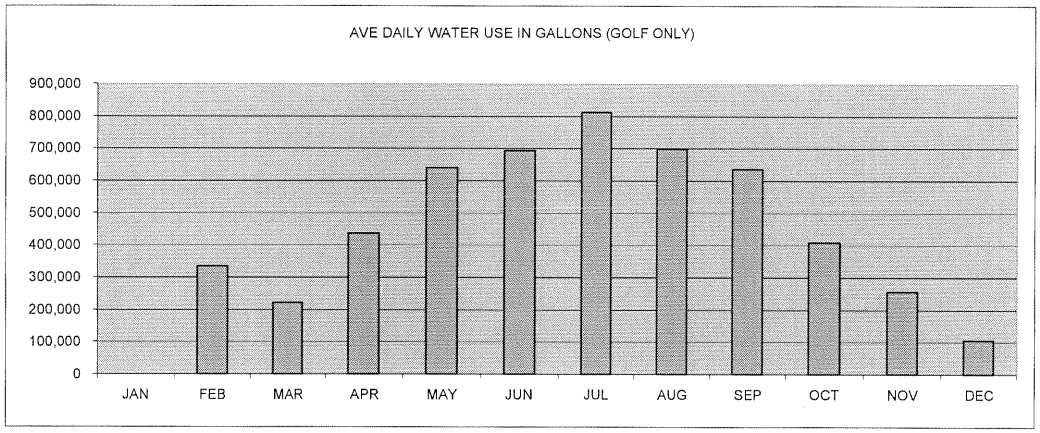
SEA MOUNTAIN HAWAII

IRRIGATION WATER PROJECTIONS
TOTAL SEASON REQUIREMENTS AND PEAK FLOW
SEASONAL WATER USE

February 23, 2006

Includes Historical Rainfall

Area Description	Total Area (Sq. Ft.)	Total Area (Acre)	Total Season Req.(Ac.Ft.)	Peak Season Flow(GPM)
TOTAL ALL AREAS				
Fairways/Roughs	4,356,000	100.00	286.26	1,325
Greens	130,680	3.00	12.08	112
Tees	130,680	3.00	9.81	45
Reveg/Landscaping	2,047,320	47.00	165.59	767
Other 1	0	0.00	0.00	0
Other 2	0	0.00	0.00	0
Lakes	130,680	3.00	8.88	N/A
TOTAL	6,795,360	156.00	482.62	2,249
Irrigation Pump Station Min. Flow Rate	2,249			
Water Supply Flow Rate (18 hour delivery)	742			



SEA MOUNTAIN HAWAII
WATER PROJECTION ASSUMPTIONS

Crop Coefficient	Kc	
	Ave	Overseeded
Fairways/Roughs	0.65	NO
Greens	0.80	NO
Tees	0.65	NO
Reveg/Landscaping	0.70	
Other 1	0.00	
Other 2	0.00	
Lakes	0.84	

Irrigation Window	Hrs
Fairways/Roughs	6.0
Greens	3.0
Tees	6.0
Reveg/Landscaping	6.0
Other 1	6.0
Other 2	6.0
Lakes	16.0

Distribution Uniformity	DU
Fairways/Roughs	0.80
Greens	0.70
Tees	0.70
Reveg/Landscaping	0.70
Other 1	1.00
Other 2	1.00
Lakes	1.00

ETo	Inches
JAN	6.55
FEB	7.24
MAR	7.07
APR	6.86
MAY	7.24
JUN	6.70
JUL	7.71
AUG	8.12
SEP	7.45
OCT	6.79
NOV	6.60
DEC	5.96
TOTAL	84.29

Rain*	Inches
JAN	6.62
FEB	4.55
MAR	5.28
APR	3.34
MAY	2.08
JUN	1.12
JUL	1.16
AUG	2.48
SEP	2.32
OCT	3.50
NOV	4.53
DEC	5.10
TOTAL	42.08

* Nance

Net	Inches
JAN	0.00
FEB	2.69
MAR	1.79
APR	3.52
MAY	5.16
JUN	5.58
JUL	6.55
AUG	5.64
SEP	5.13
OCT	3.29
NOV	2.07
DEC	0.86
TOTAL	42.28

Leaching Factor	
JAN	1.00
FEB	1.00
MAR	1.00
APR	1.00
MAY	1.00
JUN	1.00
JUL	1.00
AUG	1.00
SEP	1.00
OCT	1.00
NOV	1.00
DEC	1.00

Pan Evaporation*	Inches
JAN	5.50
FEB	6.08
MAR	5.94
APR	5.76
MAY	6.08
JUN	5.63
JUL	6.48
AUG	6.82
SEP	6.26
OCT	5.70
NOV	5.54
DEC	5.01
TOTAL	70.80

*Nance

Estimated Evapotranspiratioin	Inches
JAN	6.55
FEB	7.24
MAR	7.07
APR	6.86
MAY	7.24
JUN	6.70
JUL	7.71
AUG	8.12
SEP	7.45
OCT	6.79
NOV	6.60
DEC	5.96
TOTAL	84.29

PE = 84% of ET

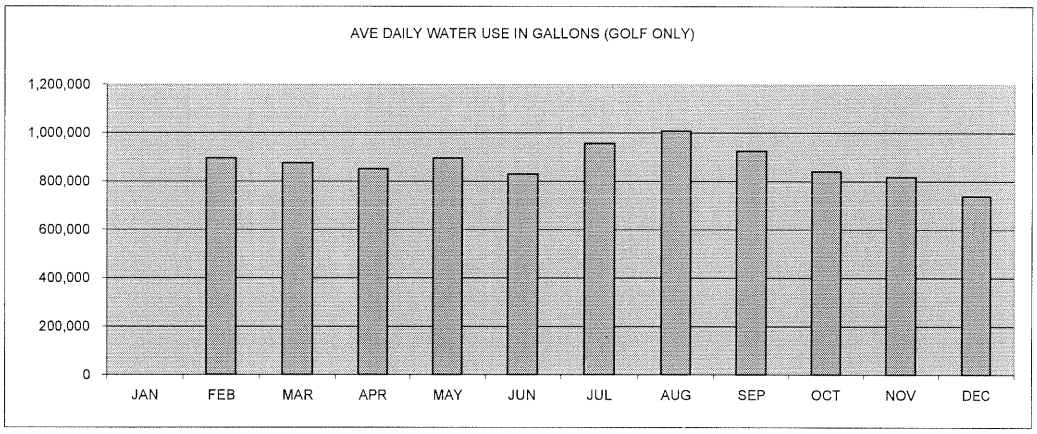
SEA MOUNTAIN HAWAII

IRRIGATION WATER PROJECTIONS
TOTAL SEASON REQUIREMENTS AND PEAK FLOW
SEASONAL WATER USE

February 23, 2006

No Rainfall

Area Description	Total Area (Sq. Ft.)	Total Area (Acre)	Total Season Req.(Ac.Ft.)	Peak Season Flow(GPM)
TOTAL ALL AREAS				
Fairways/Roughs	4,356,000	100.00	526.35	1,642
Greens	130,680	3.00	22.21	139
Tees	130,680	3.00	18.05	56
Reveg/Landscaping	2,047,320	47.00	304.47	950
Other 1	0	0.00	0.00	0
Other 2	0	0.00	0.00	0
Lakes	130,680	3.00	16.33	N/A
TOTAL	6,795,360	156.00	887.41	2,786
Irrigation Pump Station Min. Flow Rate	2,786			
Water Supply Flow Rate (18 hour delivery)	919			



SEA MOUNTAIN HAWAII
WATER PROJECTION ASSUMPTIONS

Crop Coefficient	Kc	
	Ave	Overseeded
Fairways/Roughs	0.65	NO
Greens	0.80	NO
Tees	0.65	NO
Reveg/Landscaping	0.70	
Other 1	0.00	
Other 2	0.00	
Lakes	0.84	

Irrigation Window	Hrs
Fairways/Roughs	6.0
Greens	3.0
Tees	6.0
Reveg/Landscaping	6.0
Other 1	6.0
Other 2	6.0
Lakes	16.0

Distribution Uniformity	DU
Fairways/Roughs	0.80
Greens	0.70
Tees	0.70
Reveg/Landscaping	0.70
Other 1	1.00
Other 2	1.00
Lakes	1.00

ETo	Inches
JAN	6.55
FEB	7.24
MAR	7.07
APR	6.86
MAY	7.24
JUN	6.70
JUL	7.71
AUG	8.12
SEP	7.45
OCT	6.79
NOV	6.60
DEC	5.96
TOTAL	84.29

Rain*	Inches
JAN	0.00
FEB	0.00
MAR	0.00
APR	0.00
MAY	0.00
JUN	0.00
JUL	0.00
AUG	0.00
SEP	0.00
OCT	0.00
NOV	0.00
DEC	0.00
TOTAL	0.00

* Nance

Net	Inches
JAN	0.00
FEB	7.24
MAR	7.07
APR	6.86
MAY	7.24
JUN	6.70
JUL	7.71
AUG	8.12
SEP	7.45
OCT	6.79
NOV	6.60
DEC	5.96
TOTAL	77.74

Leaching Factor	
JAN	1.00
FEB	1.00
MAR	1.00
APR	1.00
MAY	1.00
JUN	1.00
JUL	1.00
AUG	1.00
SEP	1.00
OCT	1.00
NOV	1.00
DEC	1.00

Pan Evaporation*	Inches
JAN	5.50
FEB	6.08
MAR	5.94
APR	5.76
MAY	6.08
JUN	5.63
JUL	6.48
AUG	6.82
SEP	6.26
OCT	5.70
NOV	5.54
DEC	5.01
TOTAL	70.80

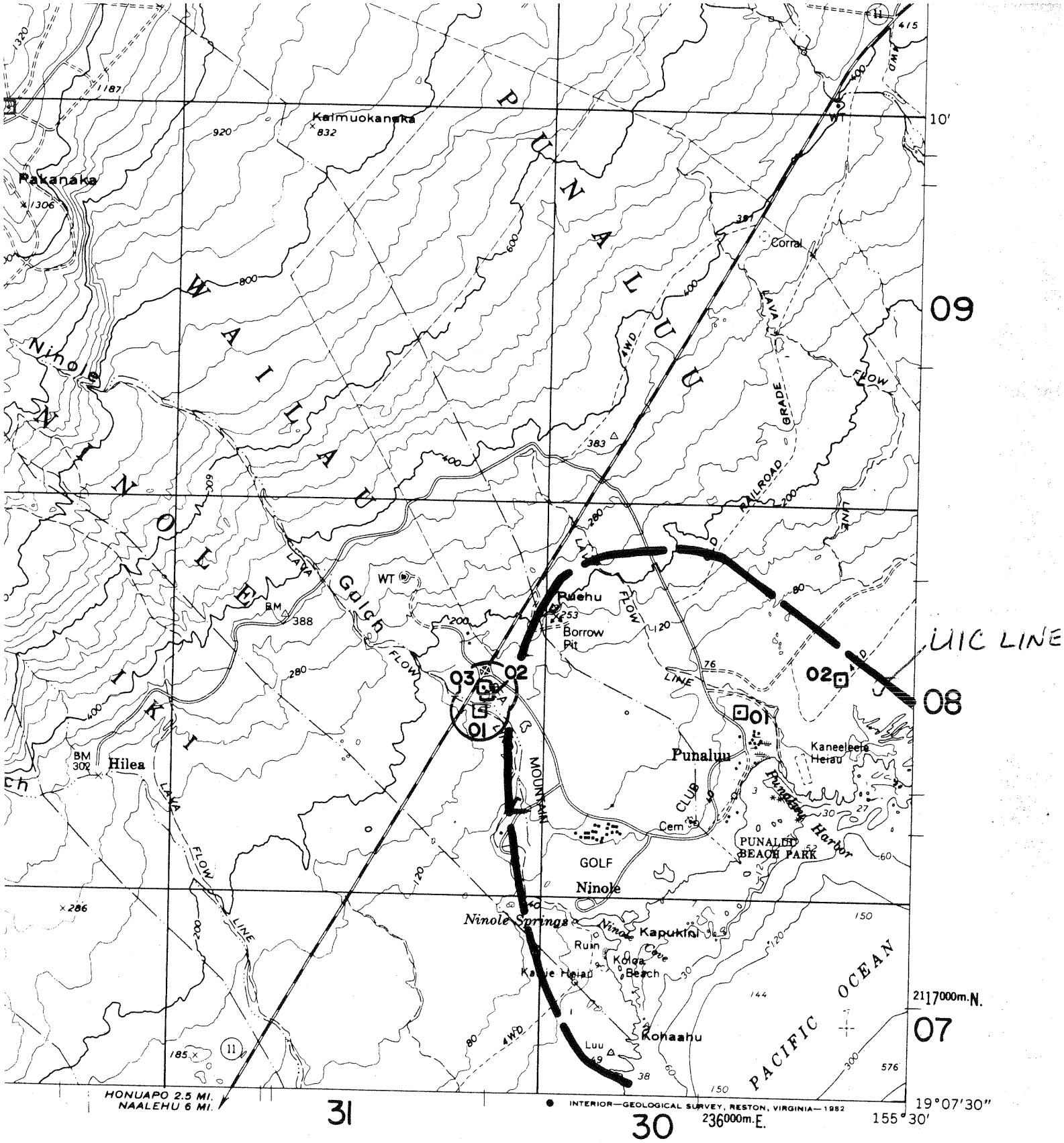
*Nance

Estimated Evapotranspiratioin	Inches
JAN	6.55
FEB	7.24
MAR	7.07
APR	6.86
MAY	7.24
JUN	6.70
JUL	7.71
AUG	8.12
SEP	7.45
OCT	6.79
NOV	6.60
DEC	5.96
TOTAL	84.29

PE = 84% of ET

APPENDIX 2

State DOH UIC Line Transmittal
1/25/06

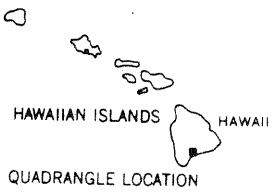


ROAD CLASSIFICATION

Medium-duty ——— Light-duty ═══

Unimproved dirt = = = = = = = = =

State Route



QUADRANGLE LOCATION

I (UIC) line

PUNALUU, HAWAII

N1907.5—W15530/7.5

1982

Appendix E

Preliminary Surface Water Quality Assessment, Sea Mountain at Punalu‘u
(Hunsaker and Associates, May 2006)

SEA MOUNTAIN AT PUNALU'U

KA'U DISTRICT, ISLAND OF HAWAI'I

TAX MAP KEYS: 9-5-19:11, 15, 24, 26, 30, 31, 33, 35; 9-6-01:01, 02, 03, 06, 11, 12, 13;
9-6-02:08, 37, 38, 41, 53

PRELIMINARY SURFACE WATER QUALITY ASSESSMENT

Prepared by:

Tommy Hsu, CPESC, CPSWQ
Water Quality Division
Hunsaker and Associates Irvine, Inc.
3 Hughes
Irvine, CA 92612
(949) 583-1010

MAY 20, 2006

W.O. #3442-1

Table of Contents

1.0 Introduction

1.1 PURPOSE AND NEED

The objectives of this Preliminary Surface Water Quality Assessment are to describe the existing surface water resources, to determine if the potential impacts of the project on the surface water resources would be significant based on preliminary project information, and to identify potential Best Management Practices (BMPs) to address any potentially significant impacts. This report will discuss how the project would increase the amount of impervious surface area and potentially increase runoff flows and volumes to receiving water bodies. It will also discuss how the proposed development may generate pollutants commonly related to golf course use, as well as common household pollutants related to residential developments, such trash and debris, which could be carried by surface flows into local surface drainages.

1.2 SITE DESCRIPTION

The Sea Mountain at Punalu'u project site consists of 433 acres of partially developed land on the Island of Hawai'i. Existing development at Sea Mountain includes an operational 18-hole golf course, pro-shop, wastewater treatment facility, County beach park and Colony I condominium complex. Other existing development consists of a restaurant, gift shop, cultural center, Aspen Institute conference facility, and golf club house. However, these facilities have been abandoned due to deterioration. The site is located between Na'alehu and Pahala along the Hawai'i Belt Highway. The property is privately owned by SM Investment Partners, and site development is proposed by Sea Mountain Five, LLC.

1.3 PROJECT DESCRIPTION

Sea Mountain Five, LLC, proposes to develop the Sea Mountain project on a 433-acre partially developed site in Punalu'u. Additional site improvements would involve construction of residential units, a world class destination resort/hotel, a championship 18-hole golf course, cultural/marine center, light commercial, upgraded wastewater treatment facility, water reservoir and other supporting infrastructure.

The Sea Mountain conceptual land use plan seeks to provide a mix of residential unit types which will include single-family residential lots and multi-family units for sale or lease. The development concept for a hotel/resort complex includes a village center which would serve as a gathering place for the resort with shopping and services for guests and local residents. Affordable housing options will be provided in accordance with County standards.

Sea Mountain Five, LLC would construct roadway improvements servicing the site, major electrical improvements (including transmission lines and necessary switching and transformer substations), sewage treatment plant renovation and golf course improvements (including irrigation wells). Sea Mountain Five, LLC would also provide internal connector roads and other infrastructure to service the residential, retail and commercial lots that it will create.

2.0 Affected Environment

2.1 EXISTING WATER RESOURCES

The proposed site is located within Ka'u District and the Ninole Stream watershed, a tributary to the Ninole Cove and the Pacific Ocean. Ninole Stream resides in the western portion of the site.

2.1.1 Regional and Local Climate and Precipitation

Hawai'i's climate is classified as tropical, and includes mild temperatures throughout the year, moderate humidity, significant differences in rainfall within adjacent areas and a persistent northeasterly trade wind. Severe storms are infrequent in Hawai'i. Rainfall on the Big Island of Hawai'i ranges significantly from one area to another. Rainfall between various portions of the island differ drastically, from as much as fifteen times the amount of one area to less than one-third the amount in another. Average rainfall varies from 25 to 30 inches per year.

Hawai'i's heaviest rainfall occurs between October and April, during the winter season. However, orographic rainfall (mountainous rains) contributes to the majority of the island's rainfall. These rains form as the trade winds force moist air from the sea up the steep mountainous areas. As the air cools, moisture within the air condense, leading to rainfall. Maximum rainfall elevation lies between 2,000 to 3,000 feet, with drastically decreasing rainfall above these elevations. High cumulus clouds located over the mountains and interiors of the island also contribute to the island's rainfall. These localized showers are usually brief in duration, but often intense in nature. Over the lower parts of the island, rainfall amounts decrease with decreasing elevation.[1]

Rainfall within Ka'u and the project area occurs year-round. Mean annual rainfall in the project area ranges from approximately 20-30 inches at the coast to 40 inches at the northwestern project limits.

2.1.2 Surface Water Features (Onsite)

Runoff from the site drains generall drains towards the southeast via Ninole Gulch, which resides at the western portion of the site. Surface runoff from this area is eventually discharged to the Ninole Cove and the Pacific Ocean. Flows from the eastern portion of the site drain southeasterly via two unnamed intermittent streams. The confluence of these two streams is located near the northern portion of the eastern project limits, with the final discharge point located at Punalu'u Harbor. Total drainage for the site consists of three sub-areas (totaling 463.8 acres) and produces a 10-year 1-hour flow rate of 205.2 cfs (Exhibit 1 refers).

Storm runoff from the area northwest of the State Highway and west of Punalu'u Road is directed to catch basins and conveyed under the Highway via a reinforced concrete storm drain line to a natural drainage between Ninole Cove and Punalu'u Beach Park prior to discharging to

[1] Price, Saul. 1983. *Atlas of Hawai'i, Second Edition.* University of Hawai'i Press.

the Pacific Ocean. Runoff from the existing golf course area is conveyed to two drainage culverts, located within Punalu'u Beach County Park and near the former Punalu'u Black Sand Restaurant, prior to discharging to the Pacific Ocean.

Due to the highly permeable characteristic of the underlying project soils, which consist predominantly of lava, it is uncommon for runoff to reach the sea coast. Runoff is usually infiltrated into the highly permeable soil and rock formations beneath to the underlying aquifers. However, flows do reach the ocean during periods of extensive rainfall, as was experienced in 1978 and 1982.

2.1.3 Groundwater Features

In general, groundwater level within the site is expected to fluctuate seasonally and annually due to changes in rainfall. The depth of groundwater is expected to be relatively shallow and decrease with proximity to the shoreline. Current estimates of groundwater flux to the ocean range from approximately 5-6 million gallons per day (MGD) per mile of shoreline[2] to 10 MGD per mile of shoreline.[3]

2.1.4 Offsite Surface Water Features

2.1.4.1 Ninole Stream

The project receives the majority of offsite flows from Ninole Stream (HI-8-2-21_00; HUC: 20010000[4]), which originates in the Ka'u Forest Reserve, flowing approximately 5.6 miles in a southeasterly direction to the Pacific Ocean. Ninole Stream is ephemeral, and flows only during and immediately after periods of heavy rainfall.

The stream receives the majority of its flow from the mountainous areas to north and northeast of the Ka'u Forest Reserve. Heaviest flows for the stream usually occur during the winter season from winter storms. However, similar to the vast majority of Hawai'i's rivers and streams, the majority of the Ninole Stream's water supply stems from orographic rainfall.

The drainage area for Ninole Stream is shown in Exhibit 2 as Drainage A1. The amount of run-on to the proposed property from Ninole Stream in a 100-year storm event is approximately 10,452 cubic feet per second (cfs).

2.1.4.2 Unnamed Tributary Drainages

The project also receives offsite run-on from four other tributary drainage areas, shown as A2, A3, A4 and A5 in Exhibit 3. Respectively, these areas contribute 634.9 cfs, 764.8 cfs, 390.6 cfs and 532.4 cfs of flow to the site in a 100-year storm event.

[2] As estimated for west Hawaii.
[3] Depth of existing groundwater has not been determined. Soil borings will be required to provide accurate estimates of groundwater depth.
[4] Assessment Unit ID; Location ID

These streams are intermittent and flow only during periods of intense rain, with the majority of its flows stemming from orographic rainfall and heavy winter storms.

2.1.4.3 Punalu'u Shoreline

The southeastern portion of the project site includes approximately one mile of the Punalu'u shoreline, which extends south from the northern edge of Punalu'u Bay. The adjacent shoreline includes a black sand beach, basaltic-cliff shorelines and basaltic shoreline platforms. Flows from the site only reach the shoreline during intense rain events.

2.1.4.4 Coastal Ponds

The southeastern portion of the site currently contains four coastal ponds, as shown in Figure 1.

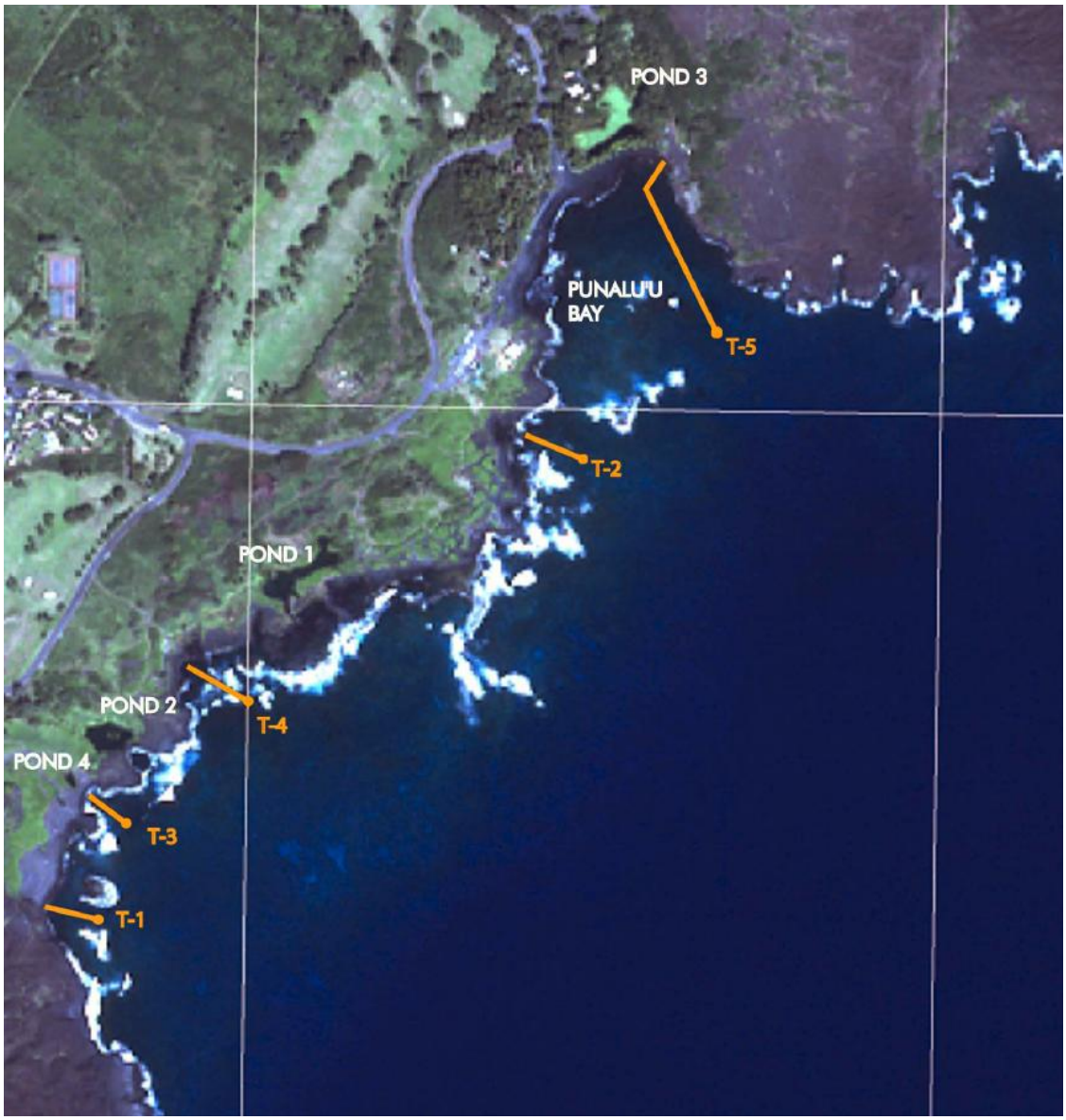


Figure 1. Sea Mountain Project – Coastal Ponds (Prepared by Marine Research Consultants, Inc.)

Based on the marine study prepared by Marine Research Consultants, Inc.[5], all of the existing ponds are brackish, with salinity ranging from one to six percent. The ponds are not considered anchialine and are supported by basal groundwater.

2.2 EXISTING WATER QUALITY

2.2.1 Surface Waters

Existing beneficial uses Ninole Stream, as designated by the State of Hawai'i, include Overall Use Support, Aquatic Life Support, Fish Consumption, Shellfishing, Primary and Secondary Contact for Recreational Use, Drinking Water Supply, Aesthetics, Agriculture, Cultural/Ceremonial and Non-degradation.

Ninole Stream is currently not listed on the State's 303(d) list[6]. The stream fully supports nine of the eleven State designated uses, with Overall Use Support partially supported and Non-degradation not supported.[7] The source of the partial and non-attainment status of the uses include nutrients from agriculture and livestock. Based on a field survey of the project site, the portion of the stream within the proposed project site is intermittent, with impacted vegetation and minimal aquatic species and habitat.[8]

A discussion of shoreline water quality as well as the existing pond water quality is provided in *Assessment of the Marine and Pond Environments in the Vicinity of the Sea Mountain Village at Punalu'u Project* (See Footnote 3).

2.2.2 Groundwater

Existing groundwater quality within the project site is assumed to be consistent with groundwater located within the vicinity of the project site. Based on samples collected from Ninole Spring, Ninole Well #2, Pahala DWS Well and Palima Well (all located within the vicinity of Sea Mountain Village) by Dr. Steve Dollar on December 16, 2005, existing groundwater within the project site is assumed to be of good quality.

2.2.3 Erosion and Siltation

Erosion and siltation is a natural process for all rivers and streams. In general, the majority of the accelerated erosion and siltation for the project's streams occur as the result of heavy storms. In particular, the 1981 to 1982 winter storms caused flooding in various portions of Ninole Stream as the volume of runoff over-capacitated the existing gulch. The effects of erosion and siltation from this period are most evident at the mouth of the stream, in which Ninole Cove was filled in

[5] Marine Research Consultants, Inc. April 2006. *Assessment of the Marine and Pond Environments in the Vicinity of the Sea Mountain Village at Punalu'u Project.* Draft.
[6] Koch, Linda; Harrigan-Lum, June; and Henderson, Katina. June 16, 2004. *Final 2004 List of Impaired Waters in Hawaii, Prepared Under Clean Water Act §303(d)*. Hawaii State Department of Health (DOH), Environmental Planning Office.
[7] Based on information obtained from the Environmental Protection Agency (EPA).
[8] The beneficial uses for the stream likely refer to the off-site mauka reaches of the stream.

with rocks and sediment. Since then, measures have been incorporated to prevent future occurrences.

2.2.4 Flooding

The Hawai'i County Floodway Boundary and Floodway Maps have designated a floodway through a portion of the site. Flood Insurance Rate Map (FIRM) flood zone designations for the site include zones AE, VE, and X. Zone AE corresponds to areas within the one-percent annual chance floodplains (within the flood hazard area) that are determined by base flood elevations. Zone VE corresponds to areas within the one-percent annual chance floodplains that have additional hazards associated with storm waves. Zone X corresponds to areas outside of the floodplain. Mandatory flood insurance are required for Zones AE and VE, but not for Zone X.

The most recent flooding for the area occurred in late 1981 and early 1982. Winter storms producing unusually high and intense rainfall within the upper reaches of the stream caused flooding of Ninole Stream, as well as increased runoff from various cultivated lands (sugar fields). The resulting volume of runoff exceeded the drainage capacity of the existing gulch.

As a result of the storms, the streambed of Ninole Stream was widened and deepened. In addition, earthen berms, consisting of large boulders, retaining walls and a debris basin were installed along portions of the channel. Periodic maintenance is performed to ensure that these measures function adequately to prevent future flooding.

2.3 APPLICABLE REGULATIONS, PLANS, AND POLICIES

2.3.1 Federal

U.S. Environmental Protection Agency (USEPA)

The primary federal law governing water quality is the Clean Water Act (CWA) of 1972. This act established the National Pollutant Discharge Elimination System (NPDES) program and currently provides for the restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters. The CWA emphasizes technology-based (end-of-pipe) control strategies and requires discharge permits to use public resources for waste discharge. The Act also limits the amount of pollutants that may be discharged and requires wastewater to be treated with the best treatment technology economically achievable regardless of receiving water conditions.

Under the CWA, the National Pollutant Discharge Elimination System (NPDES) permits require effluent limits necessary to meet water quality standards for pollutants that may cause or contribute to an exceedance of a State Water Quality Standard (40 C.F.R. 122.44). NPDES permits may establish enforceable effluent limitations on discharges, require monitoring of discharges, designate reporting requirements, or require the permittee to perform best management practices (BMP's). BMPs are procedures designed to minimize the release of pollutants. BMPs may be used in addition to numeric effluent limitations, or, in some cases, in lieu of numeric effluent limitations (40 C.F.R. §122.44(k)). When application of numeric

effluent limitations is technically infeasible, such as in permits governing storm water discharges, effluent limitations are expressed as BMPs.

The 1987 amendments to the Clean Water Act included Section 402(p), which established a framework for regulating municipal and industrial storm water discharges. The amendments also required individual states to develop and implement nonpoint pollution management programs and provided a framework to assist states in regulating storm water runoff from construction sites. On November 16, 1990, the USEPA published final regulations that established requirements for storm water permits.

In 1998, Section 303(d) was amended to the CWA, requiring the state to identify and maintain a list of waterbodies that do not meet water quality standards and also implement a Total Maximum Daily Load (TMDL) program for impaired waterbodies.

In March of 2003, Phase II of the NPDES program (40CFR 122.34) was implemented, requiring NPDES permittees to develop, implement, and enforce a stormwater program to reduce the discharge of pollutants from Municipal Separate Storm Sewers System (MS4s) to the maximum extent practicable. At minimum, the stormwater management program must include the following control measures:

1. Public education and outreach on stormwater impacts

2. Public involvement/participation

3. Illicit discharge detection and elimination

4. Construction site stormwater runoff control

5. Post-construction stormwater management in new development and redevelopment

6. Pollution prevention/good housekeeping for municipal operations

<u>Ocean and Coastal Resource Management (OCRM)</u>

The Coastal Zone Management Act (Title 16 U.S.C. 1451-1464) was enacted in 1972 to "preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations." The purpose of the CZMA was to encourage and assist States in developing and implementing coastal land use and water resources management programs. The CZMA is administered at the federal level by the Coastal Programs Division (CPD) within the National Oceanic and Atmospheric Administration's Office of Ocean and Coastal Resource Management (OCRM). However, regulatory authority over permits, licenses and funding approvals for projects that affect coastal zone resources are delegated to the State.

The Coastal Zone Act Reauthorization Amendments of 1990 was enacted to regulate the use of land (including development activities) and water resources within the coastal zone. The

amendments required Hawai'i to administer the Federal coastal management program, which is primarily achieved through the development and implementation of a statewide coastal nonpoint pollution control program. Once the statewide program is reviewed and certified by the CPD (within the NOAA), the state government is delegated regulatory authority. Hawai'i's coastal program is developed jointly by the coastal zone management agency, which is part of the Hawai'i Department of Business, Economic Development and Tourism, and the Water Quality Branch of the Hawai'i Department of Health (DOH). Permitting authority is the responsibility of Hawaii County Planning Department, in the form of Special Management Area (SMA) permits.

2.3.2 State

Hawai'i Department of Health (DOH)

In 1974, the U.S. EPA delegated administration of the NPDES Permit program to the Hawai'i DOH. The establishment of additional NPDES regulations in 1987, under Section 402(p) of the Clean Water Act, required that the USEPA also delegate to the State the responsibility of the NPDES Program, as it pertains to municipal, industrial and construction storm water discharges.

Hawai'i's first attempt to address the State's nonpoint source pollution began with the passage of Act 249 in 1974. The act instructed each of Hawai'i's counties to develop an ordinance requiring grading permits for erosion control in urban areas. Later legislations, including Act 298 in 1990, established the Hawai'i Administrative Rule (HAR), Chapter 11-54, "Water Quality Standards," and HAR Chapter 11-55, "Water Pollution Control," which require compliance with the NPDES Permit, regulate storm water and non-storm water discharges, development and other activities that may impact the integrity of the State's receiving water bodies. In particular, the DOH is required to regulate storm water discharges related to construction activities to ensure that the land owners:

1. Eliminate or reduce non-storm water discharges to storm drains and receiving waters of the U.S.;

2. Submit a Notice of Intent to be covered by an NPDES general permit at least 30 days prior to the commencement of any applicable soil disturbing activities[9];

3. Develop and implement a Storm Water Pollution Prevention Plan (SWPPP);

4. Inspect the Water Pollution Controls (WPC) specified in the SWPPP; and

5. Monitor storm water runoff from construction sites to ensure that the BMPs specified in the SWPPP are effective.

[9] Projects subjected to an NPDES individual permit must submit permit application at least 180 days prior to commencement of proposed activities.

2.3.3 County

County of Hawai'i

The County of Hawai'i is the authority at the county level for the development, implementation and enforcement of various State and Federal water quality regulations. Chapter 10, Erosion and Sedimentation Control, of the Hawai'i County Code establishes the grading conditions, limitations and other requirements for project proponents to ensure that the State's water quality objectives are not violated.

2.3.4 Applicable Permits

The proposed project will be required to apply for and adhere to the provisions of the General NPDES Permit for Construction Activities, Hawai'i Administrative Rules, Chapter 11-55. The Permit requires that a Storm Water Pollution Prevention Plan (SWPPP) be prepared for all projects greater than 1 acre (0.4 hectares) of soil disturbance and a Notice of Intent (NOI) be filed with the Department of Health at least 30 days prior to any soil-disturbing activities. In addition, the construction of the proposed project shall be subject to all applicable Best Management Practices (BMPs) specified by the State and the County of Hawai'i. The provisions and requirements of the Permit are enforced by the Clean Water Branch of the Department of Health.

At the county level, the project will be subjected to a Special Management Area (SMA) permit from the Hawaii County Planning Department for development within a coastal zone; and any applicable Hawai'i County ordinances and codes in effect at the time of construction, including but not limited to the County of Hawai'i grading permit, which requires all applicants comply with Chapter 10, Erosion and Sedimentation Control, of the Hawai'i County Code.

In addition to the permits previously discussed, the project may require a Stream Channel Alteration Permit from the Hawaii State Water Commission and a Section 404 Permit from the United States Army Corp of Engineers (USACOE).

3.0 Environmental Evaluation

3.1 IMPACT ANALYSIS

The proposed project would be considered to have a significant impact on water resources if it substantially affected the overall amount of runoff, the amount of discharge into natural surface drainages, or the existing pattern of natural surface drainage in the project vicinity. The proposed project would be considered to have a significant impact on water quality if it substantially contributed to the exceedance of any adopted water quality standard or conflicted with the objectives, plans, goals, policies, or implementation of the Hawai'i Department of Health, and any other applicable plans and policies. Recommended mitigation measures are provided in Section 4 of this document.

3.2 POTENTIAL PROJECT IMPACTS

3.2.1 Runoff and Drainage

The proposed project would involve some changes to the existing site. Currently, the site has approximately 10% impervious area. Construction of the planned development would increase impervious area to approximately 30% of the site.

Drainage from the site is not expected to be significantly different from the existing conditions nor is it expected to significantly alter stream flow. Current project plans propose to retain the existing drainage patterns.

In the existing condition, site drainage is divided into three (3) sub-areas, producing a 10-year 1-hour flow rate of 205.2 cfs. In the proposed condition, the site would be divided into 39 sub-areas and produce a 10-year 1-hour flow rate of 501.5 cfs (increase of 296.3 cfs). Runoff from the developed portions of the site will be directed to the golf course area, which will also serve as infiltration basins. Various landscape areas within the golf course, such as the "rough" and "fairway" areas, will serve as vegetative swales and/or buffer strips, to decrease flow velocity and to provide runoff filtration.

The project proposes to retain all runoff volumes up to the 10-year storm level onsite for filtration and infiltration. Based on preliminary calculations, the total capacity required to retain the 10-year storm volume for the site is 249.69 acre-feet.[10]

3.2.2 Water Quality Degradation (Surface Water)

Runoff from the site is expected to be characteristic of residential areas and golf courses, which may include bacteria and viruses, metals, nutrients, pesticides, organic compounds, sediments, trash and debris, oxygen-demanding substances, and oil and grease. These potential pollutants

[10] Based on preliminary calculations, capacity of existing golf course is 10.13 acre-feet. Required volume for proposed condition is subject to change based on actual percolation rate and more detail sight design.

will be addressed via filtration and infiltration. As previously stated, the project will retain all flows up to the 10-year storm level onsite.

The proposed structural BMPs incorporated into project plans are expected to adequately address any potential pollutants in the project's runoff and ensure that all discharge is in compliance with the discharge requirements of the National Pollutant Discharge Elimination System and the State and County of Hawai'i. With incorporation of proposed non-structural BMPs, structural BMPs and the proposed retention of all flows up to the 10-year storm volume, the proposed project is not anticipated to result in a significant impact to surface water quality for areas within the site. For areas located downstream of the site, please refer to the following section.

3.2.3 Water Quality Degradation (Groundwater)

Groundwater quality is of concern as surface runoff from the site will percolate into the underlying soils. This implies that pollutants of concern commonly associated with residential and golf course developments would have the potential to enter the groundwater basin, which supports the existing costal ponds and is eventually discharged to the ocean.

Although the vast majority of the anticipated pollutants of concern will be removed within the topsoil and the vadose zone[11], there still remains a potential for the leaching of nitrates to the groundwater. However, based on the findings of the marine study prepare for Sea Mountain Village (as referenced in Footnote 3 of this document), which assumes that approximately 10% of the applied nitrogen reaches the groundwater and corresponding coastal ponds and ocean habitats, the excess amount of nitrogen would not post a significant impact to the receiving water bodies.

3.2.4 Erosion and Siltation

Erosion and siltation in the drainage area could be increased during construction of the proposed project. The potential for erosion and siltation would be greatest during the grading phase of construction. Detailed construction plans, rough grading plans and precise grading plans have not been prepared. Therefore, the exact amounts of increased erosion and siltation can not be determined in this report.

The amount of sediments entering the streams within the project site during construction is expected to be minimal with stringent implementation of the Storm Water Pollution Prevention Plan (SWPPP). This would include the development of a site-specific SWPPP and implementation of various combinations of construction site Best Management Practices.

Post-construction, the increase in impervious surface and the employment of various structural and non-structural BMPs designed into the project plans, erosion and siltation is expected to be minimal.

[11] Vadose zone is the non-saturated portion of the earth between the land surface and the groundwater table.

3.2.5 Flooding

The project does not propose construction of housing units within the flood hazard zones. Construction of the proposed development is not expected to cause flooding downstream. All site runoff as well as offsite run-on will be directed to the golf course area, which will be designed to retain all flows up to the 10-year storm level. Portions of the golf course will be designed as infiltration basins, and contain various vegetative swales and buffer strips throughout the fairway and rough portions of the course, which will serve to decrease flow velocity and provide some infiltration. Proposed development areas as well as flow rates are shown in Exhibit 4 of this report.

4.0 Recommended Mitigation

4.1 CONSTRUCTION PERIOD (Short-Term)

The amount of sediments entering streams located within the proposed site during construction is expected to be minimal with implementation of the project's site-specific Storm Water Pollution Prevention Plan (SWPPP). This would include the development of a SWPPP and implementation of construction site Best Management Practices. The following is a list of requirements to be incorporated during construction of the proposed project:

- The Contractor shall conform to the requirements of the NPDES General Permit for Construction Activities, and any subsequent permit, local plans and policies in effect at the time of project construction.

- A Storm Water Pollution Prevent Plan (SWPPP) shall be prepared by the Contractor prior to the commencement of any soil-disturbing activities. The SWPPP shall address all state and federal stormwater control requirements and regulations. The SWPPP shall address all construction-related activities, equipment, and materials that have the potential to impact water quality. The SWPPP shall include BMPs to control pollutants, sediment from erosion, storm water runoff, and other construction related impacts. In addition, the SWPPP shall include all elements as required by HAR 11-54 and 11-55 to ensure that the implemented BMPs are effective in preventing exceedance of any water quality standards.

- A Notice of Intent (NOI) shall be filed with the Hawai'i Department of Health at least 30 days prior to any soil-disturbing activities[12].

- Construction of the proposed improvements shall be conducted in phases to limit the amount of exposed soil disturbed at any given point. Phasing of the golf course improvements will be completed in 20 acre non-contiguous parcels. A parcel is considered non-contiguous if it is separated by 200" or more of stabilized property. Stabilized areas can consist of natural upgraded areas, streets or home site pads that have been graded, or soil import areas that have been stabilized with landscaping or other erosion control BMP's. During the development of the golf course areas, all of the detention capacity of the individual areas will be maintained.

[12] See footnote 9.

- All work shall conform to the State of Hawai'i's construction site BMPs standards and requirements to control and minimize the impacts of construction and construction-related activities, materials, and pollutants on the watershed. These include, but are not limited to, temporary sediment control, temporary soil stabilization, scheduling, waste management, materials delivery, storage and handling, and other non-stormwater BMPs.

- Construction activities will give special attention to storm water pollution control during the winter season. Water Pollution Control BMPs will be used to ensure all project runoff is contained onsite and to prevent impact to receiving waters. Measures will be incorporated to contain all vehicle loads and avoid any tracking of materials, which may fall for blow onto adjacent roadways.

- A variety of sediment and erosion control BMP's will be utilized on the Sea Mountain project site. These BMP's consist of detention basins, rock berms, rock berms with an integral impermeable barrier, silt fences, gravel bags, check dams, sediment traps and other BMPs as applicable. Source control BMP measures will also be implemented throughout the site.

- All non-storm water discharges shall be prohibited from discharging to any State waters.

- All project related grading, grubbing, and stockpiling permits and operations shall conform to the erosion and sedimentation control standards and guidelines established by the Hawaii County Department of Public Works in conformity with chapter 180C, Hawai'i Revised Statutes (1975, Ord. No. 168, sec. 3.4.).

4.2 POST-CONSTRUCTION PERIOD (Long-Term)

To satisfy the requirements of various Federal, State and County regulations regarding new developments, the proposed project shall be required to develop and implement a comprehensive water quality management plan, which addresses the employment of various non-structural, structural and treatment control BMPs, as well as to ensure that pollutants from the site's runoff has been addressed to the maximum extent practicable (MEP). In addition to the water quality management plan, the project shall also implement an Integrated Golf Course Management Plan, as discussed in Section 4.2.4.

4.2.1 Non-structural BMPs

Non-structural BMPs are procedures, rules and methods, that when implemented and followed, should reduce and/or eliminate the specific source of pollution targeted. These BMPs include:

1. Education for Property Owners, Tenants, Occupants and Facility Users – The Developer will insure that all property owners, tenants, occupants and facility users be notified of the impacts of their actions on water quality. Prior to first sale of units, the Developer will establish requirements for the implementation of an awareness program that informs homeowners, tenants and facility users of the impacts of dumping oil, paints, solvents or other potentially harmful chemicals into the storm drain; the proper use and management of fertilizers, pesticides and herbicides in home landscaping and gardening practices; the

impacts of littering and improper watering. The Developer will also be responsible for providing environmental awareness education materials to all homeowners at first sale of units.

2. Landscape Management – Management programs will be designed and established by the developer, which will own and maintain all common areas within the project site. These programs will include how to mitigate the potential dangers of fertilizer and pesticide usage. Fertilizer and Pesticide usage shall be consistent with State recommendations.[13]

3. BMP Inspection and Maintenance – The Developer shall be responsible for implementation of each applicable non-structural BMP as well as scheduling inspection and maintenance cleaning of all applicable structural BMP facilities within the common project areas. Individual owners shall be responsible for all areas within their private lots.

4. Litter Control – The Developer, through the site maintenance contractor, will be required to maintain weekly sweeping and trash pick-up within the common private areas of the site. Daily inspection will be made of trash enclosures at the apartment sites and any other site with trash enclosures to ensure trash lids are closed and pick-up of any excess trash on the ground has occurred. Homeowners will be responsible for maintaining all areas within their lots.

5. Employee Training – An annual employee training/education program will be established by the Developer and would apply to future employees, contractors and volunteers of the developer to inform and train employees and contractors engaged in maintenance activities regarding the impact of dumping oil, paints, solvents or other potentially harmful chemicals into storm drain; the proper use of fertilizers and pesticides in landscaping maintenance practices; and the impacts of littering and improper water disposal.

6. Street Sweeping – The Developer shall have all private common parking areas and streets vacuum swept on a weekly basis to prevent the build up of pollutants that may be washed downstream during storm events.

4.2.2 Structural BMPs

Structural BMPs are structural devices which are designed into a site's infrastructure to meet storm water quality objectives. These BMPs include various devices designed to control and/or detain runoff and prevent contact with rain and storm water run-on. Applicable structural BMPs include:

1. Site Design and Landscape Planning – As a part of the design of all common area landscape areas, similar planting material with similar water requirements will be used in order to reduce excess irrigation runoff and promote surface filtration. Such common areas will be owned and maintained by the Developer and private homeowners.

[13] State of Hawaii. Office of Planning. 1992. *Golf Course Development in Hawaii – Impacts and Policy Recommendations*.

2. Roof Runoff Controls – Runoff from the roofs of private residences, apartments, golf course related buildings, etc. will be directed to landscape areas to promote plant filtration and soil infiltration.

3. Efficient Irrigation – As a part of the design of all common area landscape irrigation, such provisions as water sensors, programmable irrigation times (for short cycles), etc., will be used. Such areas will be maintained by the appropriate parties (homeowners, golf course, etc.).

4. Catch Basin Stenciling - During construction, the Developer shall have all catch basins stenciled with the message "No Dumping - Drains to Ocean". This will be done in a location that can be clearly seen by all and will be routinely inspected and re-stenciled, as required.

5. Pervious Pavements – The use of porous concrete, turf block, unit pavers, open-jointed paving materials, vegetated/natural parking areas and other site designs, which allow for filtration and infiltration of runoff, will be considered during the project's design phase and employed where feasible.

6. Alternative Building Materials – Materials that minimize leaching of pollutants (metals), such as in special roofing materials, will be considered and employed where feasible to minimize contamination of storm water runoff.

7. Trash Enclosures – Trash enclosures will be provided for the golf course area as well the residential high density areas. The enclosures will be covered and protected from rain and storm water run-on. Any drains located within the trash enclosure area will be connected to the sanitary sewer and prohibited from discharging to the storm drain system.

8. Designated Work and Material Storage Areas – Special work and storage areas will be required within the golf course area. These areas will be kept clean at all times. Additionally, these areas will be covered to prevent contact with rain and storm water run-on.

4.2.3 Treatment Control BMPs

Treatment BMPs include natural and mechanical devices that are specifically designed to target storm and non-storm water pollutants of concern from various development types. Applicable treatment BMPs for the Sea Mountain Project include a combination of vegetated buffer strips, vegetated swales, and infiltration basins.

All onsite runoff will be directed to the proposed golf course areas, which will be designed with a depression and also utilized as infiltration basins. The golf course perimeter areas will be designed to include vegetated buffers strips designed with a minimum length in the direction of flow of 15 feet. The strips will be employed to pre-treat storm water runoff from the developed areas of the project site via filtration and sedimentation. Storm water will then be conveyed to various fairway areas of the golf course, which will be used as vegetated swales during rain events. The runoff will receive further treatment from the vegetated swales via filtration,

sedimentation, as well as adsorption and plant uptake. The swales will convey runoff to the lowest points of the golf course area and allowed to infiltrate to the ground water basin.

The proposed infiltration basins are anticipated to remove project pollutants via precipitation, sorption, physical filtration and bacterial degradation. The project soil is anticipated to provide high removal efficiencies for particulate pollutants and moderate removal of soluble pollutants. Based on the preliminary soils investigation prepared for this project, the site is suitable for infiltration basins, with the assumption that existing groundwater depth will be greater than ten feet from the proposed basin invert, and the infiltration rate is greater than 0.5 inches per hour and less than 2.5 inches per hour.

Figures 2 and 3 provide the schematics for the infiltration basin and buffer strip designs. Please note that the basin design will be modified to the specific requirements of the site as it pertains to golf course designs.

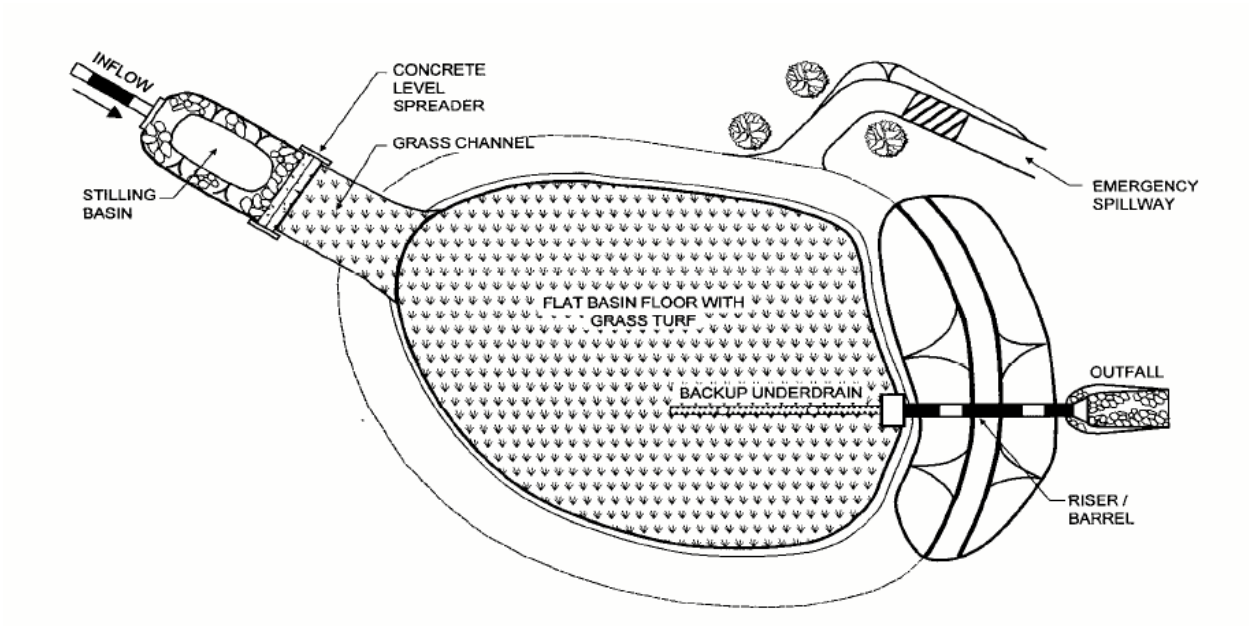


Figure 2. Infiltration and Detention Basin Schematics (CASQA 2003)[14]

[14] California Stormwater Quality Association (CASQA). January 2003. *Stormwater Best Management Practice Handbook. New Development and Redevelopment.*

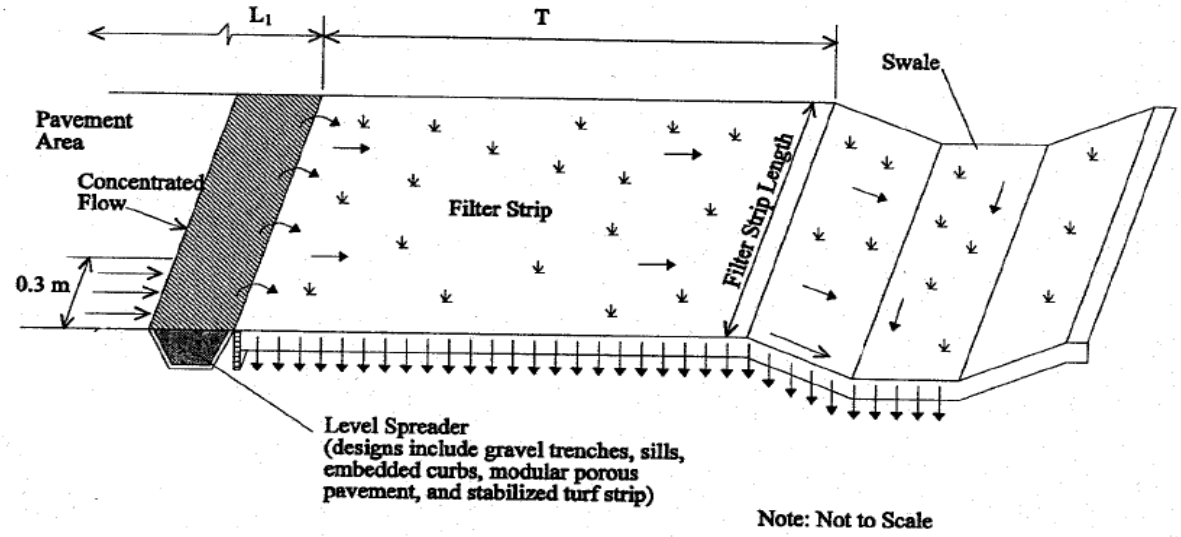


Figure 3. Vegetated Buffer Strip Schematic (CASQA 2003)

In the event that infiltration basins are not feasible for various portions of Sea Mountain Village due to site constraints, a combination of treatment Best Management Practices (BMPs) will be designed to ensure storm runoff from the site is properly treated prior to discharge. These alternative BMPs include the use of vegetated filter strips, vegetated drainage swales and detention basins (Figure 2 refers), which will treat project runoff via filtration and sedimentation.

Specifically, the golf course areas located adjacent to the coastal ponds is of concern. Due to the proximity to the shoreline, groundwater in this portion of the site may be relatively shallow. In this scenario, infiltration basins would not be recommended nor proposed. These areas will likely receive the combination of treatment practices previously described, or be equipped with a dry weather diversion drainage system capable of diverting first flush and dry weather flows to the sanitary sewer system for treatment.

4.2.4 Integrated Golf Course Management Plan

An Integrated Golf Course Management Plan (IGCMP) has been prepared that discusses the following: appropriate irrigation techniques, including an assessment of evapotranspiration needs and nutrient and pest management as described below. For details regarding the IGCMP, please refer to the study prepared by Blankinship & Associates, Inc.[15]

A. Nutrient Management Plan

The goal of nutrient management is to limit raw water and fertilizer nutrient applications to levels equal to or less than turfgrass and vegetation nutrient uptake in order to minimize nutrient transportation via runoff, interflow, or deep percolation.

[15] Blankinship & Associates, Inc. May 7, 2006. *Integrated Golf Course Management Plan for Sea Mountain Project*.

1. The following nutrient management components are included in the Plan:

    a. Nutrient budget shall account for nutrient constituents in fertilizers, raw water, and rainfall.

    b. Application of fertilizers shall be done to maximize plant uptake and minimize nitrogen loss below the root zone. Quick release fertilizers may be used as part of a 'spoon feeding' program.

    c. Fertilizer applications shall be made at times and amounts commensurate with turfgrass growth requirements based on species and cultivar, climate and soil conditions.

    d. The IGCMP shall require plant tissue and soil testing. For soil testing only, all species of nitrogen will be analyzed along with total phosphorus and plant available phosphorus, in order to help ensure that excesses of these nutrients are not applied.

2. The following specific requirements shall be included in the IGCMP:

    a. Nutrient applications shall be made not to exceed turf and plant uptake requirements during any season.

    b. Chemical applications on bare soils shall be prohibited.

    c. Increased care and handling of pesticides and fertilizers shall be used in areas with shallow soil depth.

    d. Nutrient uptake efficacy shall be maximized through selection of realistic turfgrass goals, selection of application rates to meet goals and use of soil and tissue tests to direct application rates.

B. Integrated Pest Management

Design and implement an integrated pest management ("IPM") component of the IGCMP in order to accomplish effective pest management that is protective of sensitive species and natural resources on the golf course.

1. The following pesticide management components shall be included in the IGCMP:

    a. The IGCMP shall be integrated with irrigation, fertilization, and cultural management plans.

    b. Action thresholds shall be developed and implemented for insect, weed, and disease pests, below which no applications are used, to reduce the use of pesticides. Pest infestation thresholds shall also be developed for mechanical and cultural control measures.

c. Pesticides shall be selected using pest specific products that are less toxic, less mobile, and less persistent or using alternate control strategies to reduce hazards to beneficial organisms.

d. Pesticide applications shall be minimized to reduce hazards to beneficial organisms using information from label, chemical characteristics, and application site characteristics.

2. The following specific requirements are required to be included in the IGCMP:

a. Spot treatments shall be used wherever possible, rather than broadcast treatments.

b. Pesticides shall be incorporated into soil/turf to reduce exposure to runoff and enhance adsorption.

c. Proper equipment maintenance and calibration shall be performed for all volumes of application.

d. Proper disposal of all unused chemicals and containers shall be maintained.

e. Use of chemigation equipment shall be prohibited.

f. Pesticide formulations shall be selected to reduce pesticide leaching losses (wettable powders, dusts, and microgranules are preferred).

g. Pesticide applications shall be controlled and timed in relation to local environmental conditions.

C. Maintenance Facility Management Plan

The IGCMP shall also provide guidance on proper design and management of the maintenance facility. Specifically, guidance shall be provided on chemical storage and handling, and use and disposal of equipment washdown and fertilizer and pesticide dilution solutions.

D. Irrigation Management

The IGCMP shall provide guidance on irrigation water application that sustains healthy turf while minimizing runoff and subsurface losses of nutrients and pesticides. Irrigation management is required based on a water budget, weather conditions, and soil moisture data obtained by an on-site weather station.

A. The following irrigation management components shall be included in the IGCMP:

1. A water budget will be developed that shall incorporate all water inputs, such as raw surface water, collected storm water, well water, and rainfall for a reliable irrigation plan.

2. Total storage capacity, including design freeboard, shall be based on seasonal supply and plant needs.

3. An on-site weather station shall be maintained to measure rainfall, temperature, wind conditions and soil moisture sufficient to determine evapotranspiration. This information will be used to assess turf and other plant evapotranspiration rates in order to govern irrigation amounts and frequencies.

4. The irrigation practices will account for differences in turf types and drainage characteristics in different areas of the golf course. In addition, the irrigation practices shall account for the plant growing season and dormant season on all irrigated areas.

B. The following specific requirements are to be included in the Plan.

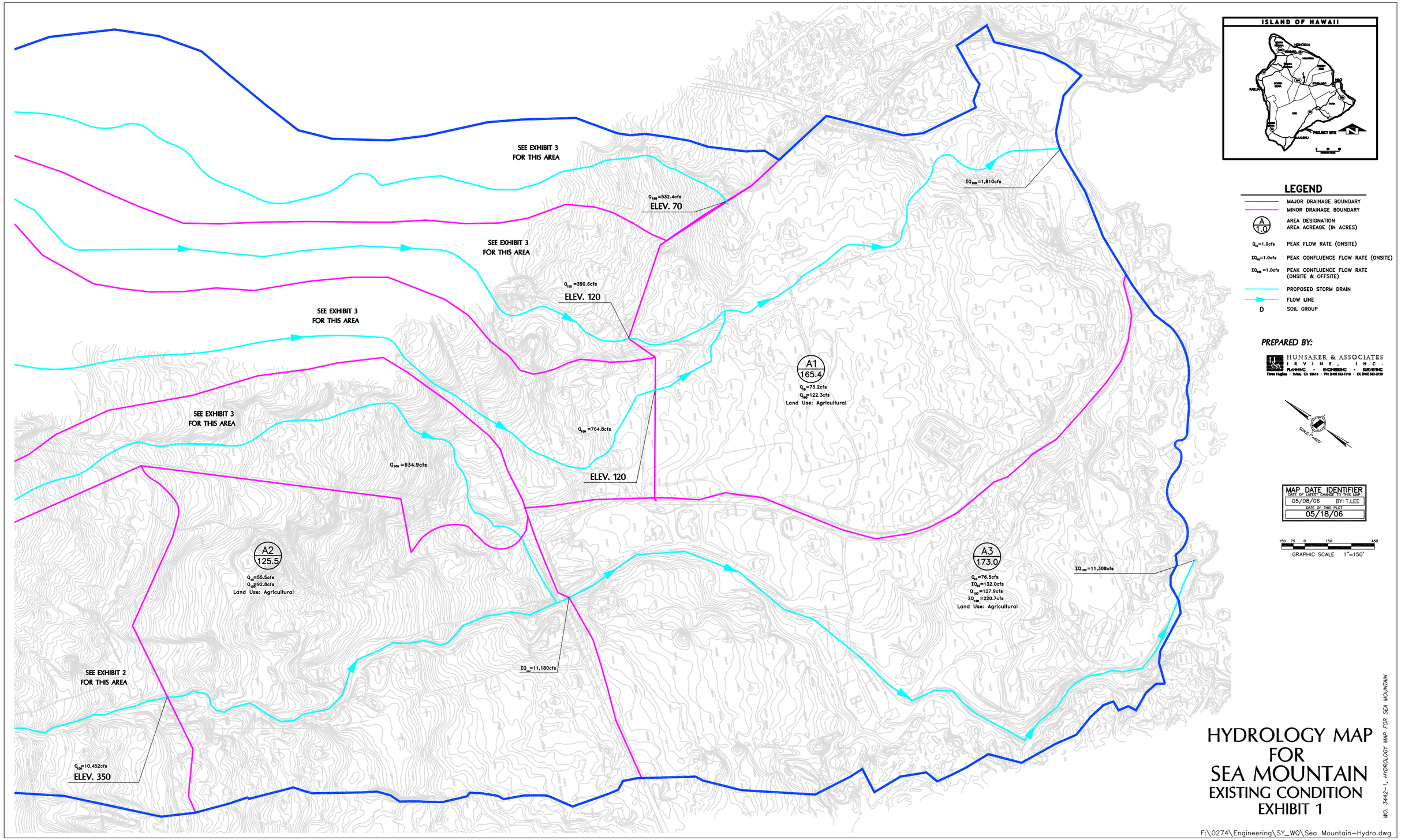
1. Irrigation rate shall be the minimum necessary to establish and maintain healthy and vigorous turfgrass growth without allowing transport of applied fertilizer or pesticides below the root zone as calculated from the daily water balance.

2. Irrigation shall be prohibited during rain, and prudent judgment shall be used before irrigating when rain is pending.

3. Irrigation facilities shall be properly maintained, including maintenance to ensure the structural integrity of drainage features and application equipment.

4. Watering efficiency shall be maximized by frequent mowing at moderate height, consistent with industry standards.

5. Irrigation equipment shall be operated to encourage deep root development and to avoid wilting and other stress conditions.


SEE EXHIBIT 3
FOR THIS AREA
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SEE EXHIBIT 2
FOR THIS AREA
Q_{100}=532.4cfs
ELEV. 70
Q_{100}=390.6cfs
ELEV. 120
Q_{100}=764.8cfs
ELEV. 120
Q_{100}=634.9cfs
ΣQ_{100}=1,810cfs
A1
165.4
Q_{10}=73.2cfs
Q_{100}=122.3cfs
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A2
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Q_{10}=76.5cfs
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Land Use: Agricultural
ΣQ_{100}=11,308cfs
ΣQ_{100}=11,180cfs
Q_{100}=10,452cfs
ELEV. 350
ISLAND OF HAWAII
HONOKAA
HAMAKUA
KOHALA
HILO
KAU
PUNA
KONA
KAILUA
KA'U
MAKAHA
PROJECT SITE
LEGEND
MAJOR DRAINAGE BOUNDARY
MINOR DRAINAGE BOUNDARY
AREA DESIGNATION
AREA ACREAGE (IN ACRES)
Q_{10}=1.0cfs PEAK FLOW RATE (ONSITE)
ΣQ_{10}=1.0cfs PEAK CONFLUENCE FLOW RATE (ONSITE)
ΣQ_{100}=1.0cfs PEAK CONFLUENCE FLOW RATE (ONSITE & OFFSITE)
PROPOSED STORM DRAIN
FLOW LINE
D SOIL GROUP
PREPARED BY:
HUNSAKER & ASSOCIATES
IRVINE, INC.
PLANNING • ENGINEERING • SURVEYING
Three Hughes • Irvine, CA 92618 • PH: (949) 583-1010 • FX: (949) 583-0759
SCALE: 1"=600'
MAP DATE IDENTIFIER
DATE OF LATEST CHANGE TO THIS MAP
05/08/06 BY: T.LEE
DATE OF THIS PLOT
05/18/06
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GRAPHIC SCALE 1"=150'
HYDROLOGY MAP
FOR
SEA MOUNTAIN
EXISTING CONDITION
EXHIBIT 1
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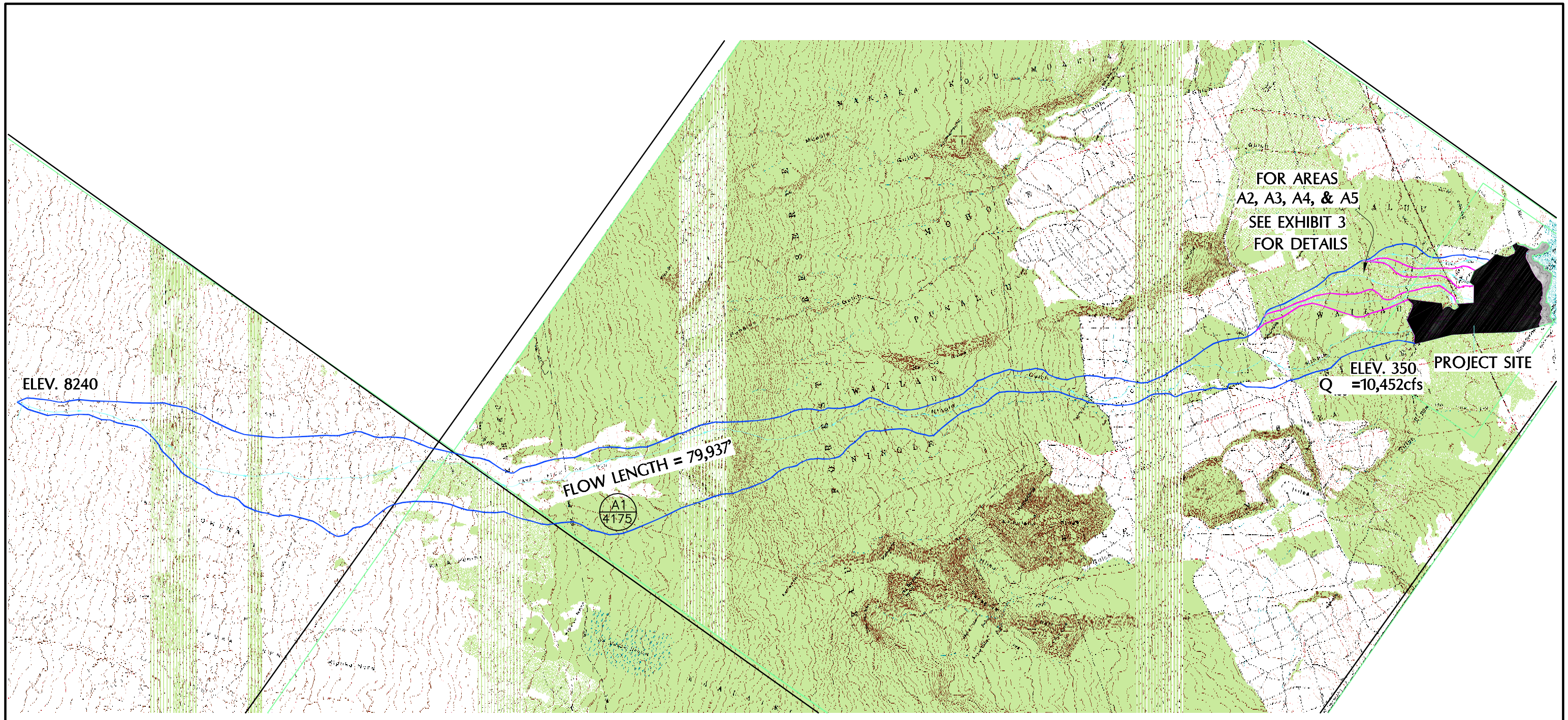

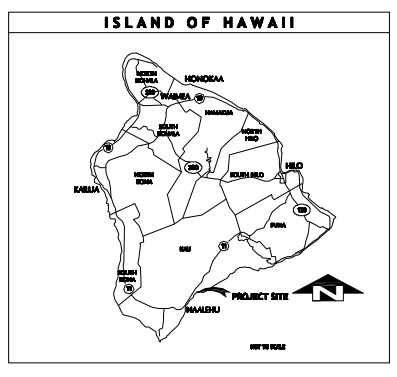

LEGEND

- MAJOR DRAINAGE BOUNDARY
- MINOR DRAINAGE BOUNDARY
- A / 1.0 — AREA DESIGNATION / AREA ACREAGE (IN ACRES)
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- ΣQ_{os}=1.0cfs — PEAK CONFLUENCE FLOW RATE (ONSITE)
- ΣQ_{oo}=1.0cfs — PEAK CONFLUENCE FLOW RATE (ONSITE & OFFSITE)
- FLOW LINE
- D — SOIL GROUP

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MAP DATE IDENTIFIER
DATE OF LATEST CHANGE TO THIS MAP
01/24/06 BY: A.L.
DATE OF THIS PLOT
02/02/06

SCALE: 1" = 5250'

HYDROLOGY MAP FOR SEA MOUNTAIN

OFFSITE AREA

EXHIBIT 2

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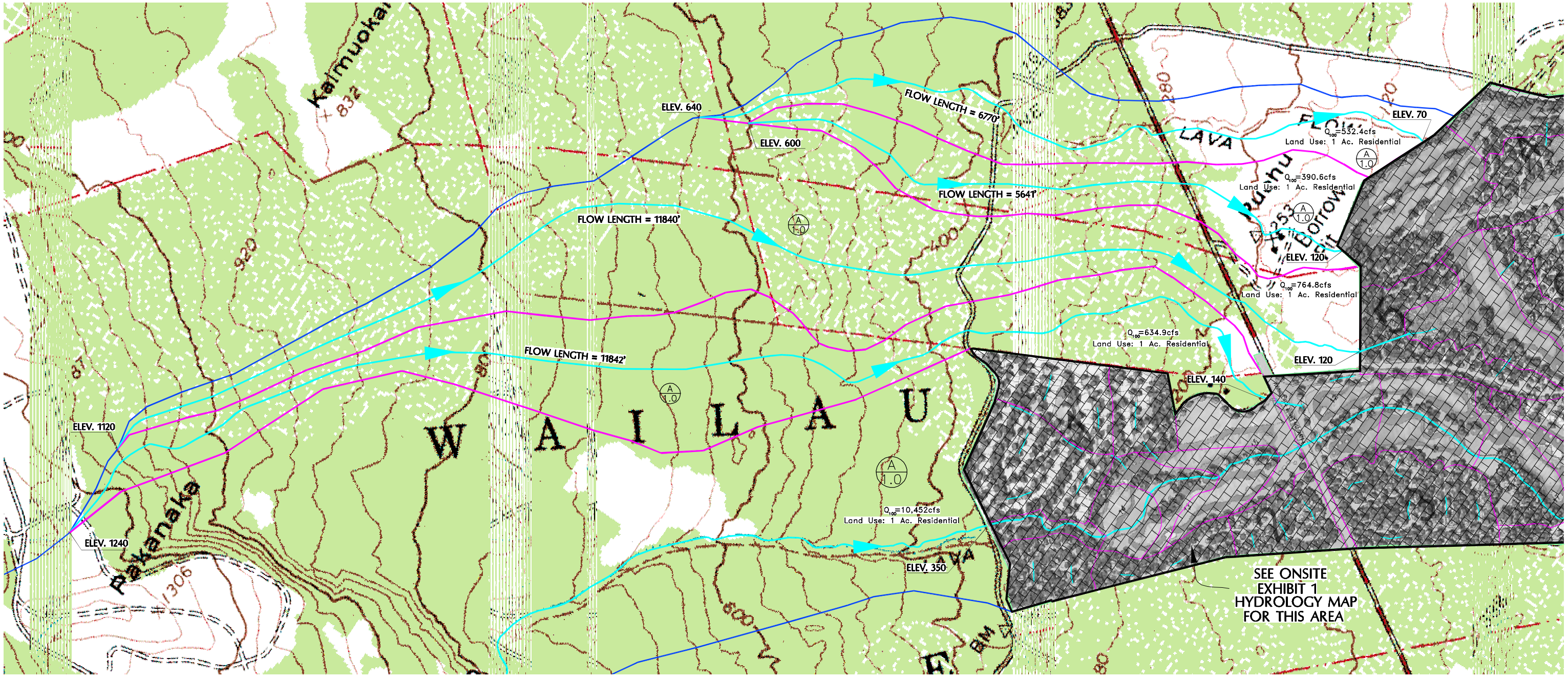

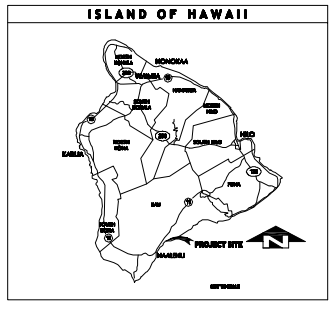

LEGEND

	MAJOR DRAINAGE BOUNDARY
	MINOR DRAINAGE BOUNDARY
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ΣQ_{10}=1.0cfs	PEAK CONFLUENCE FLOW RATE (ONSITE)
ΣQ_{100}=1.0cfs	PEAK CONFLUENCE FLOW RATE (ONSITE & OFFSITE)
	FLOW LINE
D	SOIL GROUP

PREPARED BY:

HUNSAKER & ASSOCIATES
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SCALE: 1"=800'

HYDROLOGY MAP FOR SEA MOUNTAIN

PROPOSED CONDITION

EXHIBIT 3

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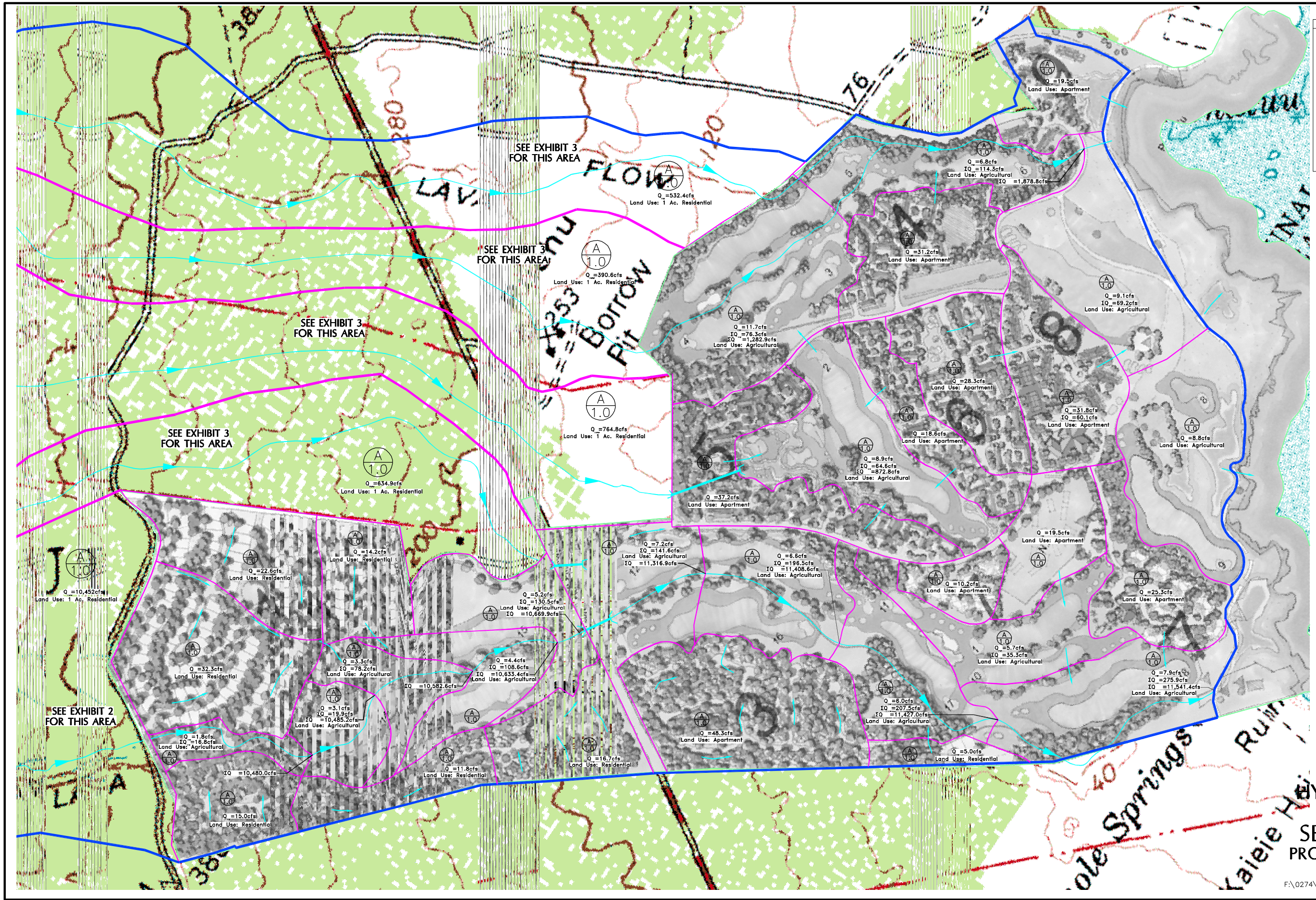
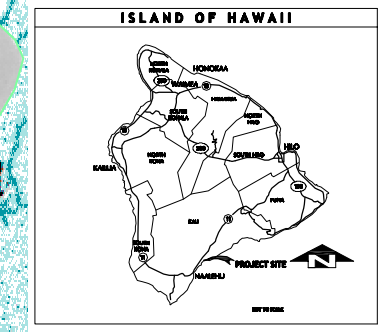


ISLAND OF HAWAII



LEGEND

	MAJOR DRAINAGE BOUNDARY
	MINOR DRAINAGE BOUNDARY
A / 1.0	AREA DESIGNATION AREA ACREAGE (IN ACRES)
Q_{os}=1.0cfs	PEAK FLOW RATE (ONSITE)
ΣQ_{os}=1.0cfs	PEAK CONFLUENCE FLOW RATE (ONSITE)
ΣQ_{os}=1.0cfs	PEAK CONFLUENCE FLOW RATE (ONSITE & OFFSITE)
	FLOW LINE
D	SOIL GROUP

PREPARED BY:

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Three Hughes • Irvine, CA 92618 • Ph: (949) 583-1010 • Fx: (949) 583-0759

SCALE: 1" = 400'

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HYDROLOGY MAP FOR SEA MOUNTAIN

PROPOSED CONDITION

EXHIBIT 4

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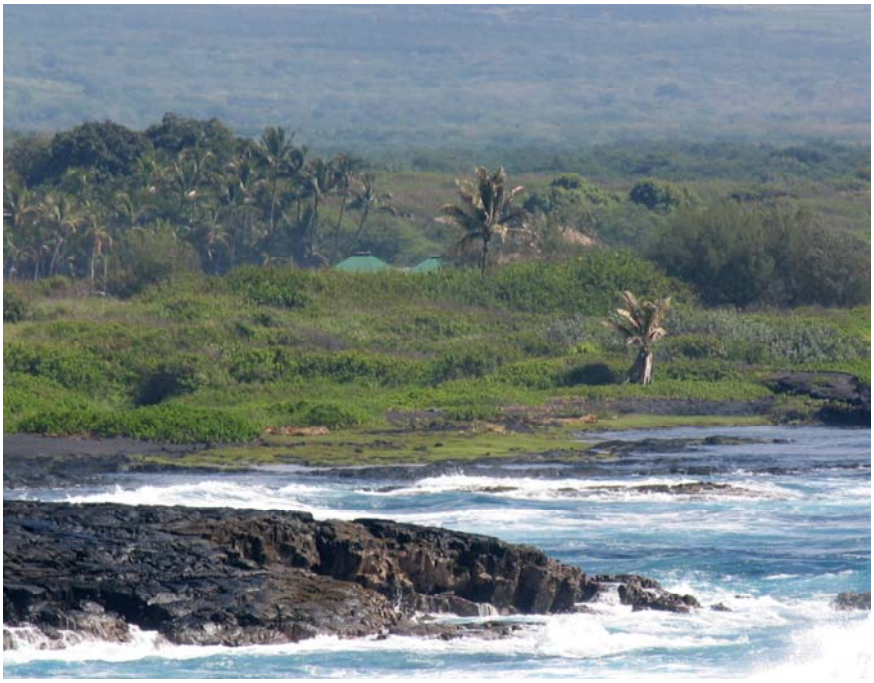
WO: 3442-1, HYDROLOGY MAP FOR SEA MOUNTAIN

Appendix F

Cultural Impact Study/Assessment Punalu‘u Development Project
(Maria E. Ka‘imipono Orr, February 2006)

Cultural Impact Study/Assessment
Punalu`u Development Project
Ahupua`a of Punalu`u, Wailau and Nīnole
District of Ka`ū, Hawai`i Island, Hawai`i



Prepared for
Group 70
Sea Mountain Five LLC

By Maria E. Ka`imipono Orr
February 7, 2006
Revised
May 10, 2006

Cover Page: Looking Mauka: Land of Punalu`u, Wailau & Nīnole

All photos unless otherwise cited are by the author.

EXECUTIVE SUMMARY

At the request of Group 70 International, Inc. [Group 70], a Cultural Impact Study/Assessment [CIS] of the *ahupua`a* of Punalu`u, Wailau and Nīnole, District of Ka`ū, Hawaii Island, was conducted intermittently between September 2005 to January 2006 with a site visit/field trip and meeting in September 2005 and another site visit in December 2005. This study was part of a larger study prepared by Group 70 for the Sea Mountain Five LLC project located on the lands of Punalu`u, Wailau and Nīnole.

This Cultural Impact Study was in accordance with the State of Hawaii Office of Environmental Quality Control [OEQC] Guidelines for Assessing Cultural Impacts [1997] and in compliance with Act 50 SLH 2000 (HB 28 H.D.1) [Appendix A] as it amends the State of Hawai`i Environmental Impact Statement law [Chapter 343, HRS]. To this end, the targeted "audience" of this report is the people who will be reviewing it. Therefore, it was written with this in mind and includes an overview of the history of the area. The literature review included *mo`olelo* or Hawaiian stories and legends of the vicinity, ethno-historic works from the 19th and early 20th centuries, other pertinent archival material, and an Inter Net search.

The *level of effort* included a limited background review of the literature and an ethnographic survey of six cultural consultants. Some of the lands that will be included in this undertaking have been previously modified by traditional Hawaiians of the past, by *kuleana* awardees of the mid-1800s and by their descendants and/or subsequent land owners. There are people currently living in the vicinity of the project lands who are descendants of some of the *kuleana* awardees and there are also people currently living who worked on these lands in various capacities. Some of these people were selected as cultural consultants for the ethnographic survey of this Cultural Impact Study/Assessment.

From the literature and when one walks the land, it is evident that there is an abundance of cultural resources that dot the landscape, in the form of ancient temples, fishponds, trails, springs, burial areas and a range of other cultural features. The sea waters of Punalu`u, Wailau and Nīnole also have an abundance of marine resources that were enjoyed by people of the ancient past as well as people of today.

Six people, all of them of *kupuna* status, shared their *mana`o* for this study. Their combined stories and information cannot begin to bring to light the knowledge and experiences they still collectively have about the lands of Punalu`u, Wailau and Nīnole; and as long as they live, they are still valuable resources in their own right.

Based on their *mana`o,* and that of the archival records and what is on the landscape, it would be almost impossible for this undertaking not to impact a cultural resource or practice of Punalu`u, Wailau and Nīnole or access to them, in some regard. Suggestions, other than avoidance, are represented in the summary section of this report.

ACKNOWLEDGEMENTS

This project could not have been completed without the assistance, support and *mana`o* of my ethnographic consultants: Kupuna Pele Hanoa, Kupuna Maile (Spencer) Napoleon, Tutu Jeanette Howard, Tutu Pauline Enriques, Tutu Arnold Howard, and Tutu Rayner Kinney.

Special mahalo to Kupuna Maile for her company and for typing her own "interview."

Additional mahalo also goes out to Mr. Analu Josephides for his *mana'o* about his Punalu`u *ohana*-past and present (Mahoe).

Mahalo to Mr. George Atta and Ms. Rachel Shaak of *Group 70, International, Inc.*

MAHALO!

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INTRODUCTION

At the request of Mr. George Atta and Ms Rachel Shaak representing *Group 70 International, Inc*. a Cultural Impact Study/Assessment [CIS] for the Sea Mountain Five LLC project lands was conducted from September 2005 to January 2006. This Cultural Impact Study was in accordance with the State of Hawaii Office of Environmental Quality Control [OEQC] Guidelines for Assessing Cultural Impacts [1997] and in compliance with Act 50 SLH 2000 (HB 28 H.D.1) [Appendix A] as it amends the State of Hawai`i Environmental Impact Statement law [Chapter 343, HRS] to include:

> *effects on the cultural practices of the community and State. Also amends the definition of "significant effect" to include adverse effects on cultural practices.*

The purpose of this CIS was to gather information about traditional cultural practices, ethnic cultural practices and pre-historic and historic cultural remains that may be affected by the implementation of the development project. The *level of effort* of this study includes a broad but limited cultural and historical background review and six oral histories. A cursory site inspection of the project area confirmed a number of prehistoric and historic sites in a range of conditions.

This report is organized into five parts. Part I describes the project area in terms of location, in the context of *ahupua`a*, district and island, as well as a generalized description of the natural environment [geology, flora and fauna]. Part II explains the methods and constraints of this study. Part III summarizes the review of the traditional and historical literature in the context of the general history of Hawai`i, the island of Hawai`i, the district of Ka`ū, and the local history of Nīnole, Wailau and Punalu`u as it pertains to cultural resources, land, water and marine resources and use in the project area and vicinity. Part IV presents the analysis of the ethnographic survey based on the supporting data (oral history transcripts). Part V summarizes the findings of this cultural impact study/assessment.

SCOPE OF WORK

The scope-of-work (SOW) [Appendix B] was based on the OEQC *Guidelines for Assessing Cultural Impacts* (1997) [Appendix C] and focuses on three cultural resource areas (traditional, historical and archaeological), conducted on two levels: archival research (literature review) and ethnographic survey (oral histories). Since independent contractors have already conducted the archaeological inventory survey of the *Sea Mountain Resort-Punalu`u* project area, this study will only include an annotated list of studies in the project area and vicinity, focusing on information regarding cultural/historical significance.

Scope of Work: **Cultural Impact Assessment** [in accordance with OEQC Guidelines]

1. identify and consult with individuals with expertise concerning the types of cultural resources, practices and beliefs found within the broad geographical area, e.g., district or *ahupua`a*; or with knowledge of the area potentially affected by the proposed action;

2. receive information from or conduct ethnographic interviews and oral histories with person(s) having knowledge of the potentially affected area;

3. conduct ethnographic, historical, anthropological, and other culturally related documentary research;

4. identify and describe the cultural resources, practices and beliefs located within the potentially affected area; and

5. assess the impact of the proposed action on the cultural resources, practices and beliefs identified.

Research on traditional resources entailed a review of the literature of Hawaiian *mo`olelo* (stories, legends or oral histories) of late nineteenth and early twentieth century ethnographic works, and interviews with knowledgeable consultants who met the following consultant criteria:

- Had/has Ties to Project Location
- Known Hawaiian Cultural Resource Person
- Known Hawaiian Traditional Practitioner
- Referred By Other Cultural Resource People
- Referred By Group 70 staff

Historic research focused on the history of the area. Literature from the following places were reviewed: University of Hawai`i-Manoa Hamilton Library-Hawaiian Collections; Bishop Museum Archives; State Historic Preservation Division Library; Waihona `Aina Corp.; Group 70 International, Inc. reports; personal library and the Inter-Net.

Archaeological research entailed a limited review of archaeological reports; and two site visits.

PART I: PROJECT AREA

Project Location

The project site is located in the *ahupua`a* (traditional land division) of, Nīnole, Wailau, and Punalu`u in the *moku* (district) of Ka`ū, on the island of Hawai`i (Figures 1 and 2).

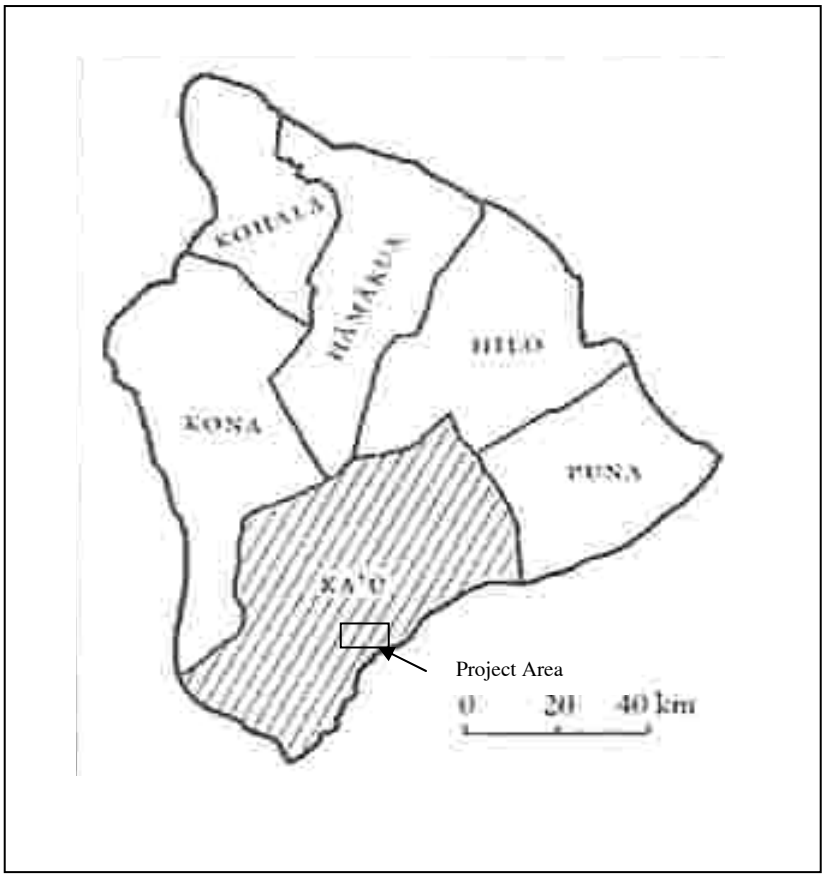

Figure 1. Project Location Map

Figure 2. Project Area TMK Map (Group 70: 2005)

Geology.

The project lands are located on the south eastern coastal flanges of the Mauna Loa volcano from *makai* to *mauka* of Highway 11, primarily in the *ahupua`a* of Nīnole, Wailau and Punalu`u, in the district or *moku* of Ka`ū, on the island of Hawai`i.

Hawaii Island. The Island of Hawai`i is built from five separate shield volcanoes that erupted somewhat sequentially, one overlapping the other. These are (from oldest to youngest): Kohala (extinct), Mauna Kea (dormant), Hualālai (dormant), Mauna Loa (active, partly within Hawai`i Volcanoes National Park), and Kīlauea (very active; part of Hawai`i Volcanoes National Park). Interpretation of geological evidence from exposures of old surfaces on the south and west flanks of Mauna Loa led to the proposal that two ancient volcanic shields (named Ninole and Kulani) were all but buried by the younger Mauna Loa (MacDonald and Abbott, 1970). Geologists now consider these "outcrops" to be part of the earlier building of Mauna Loa….

The Island is 93 miles (150 km) across and has a land area of 4,038 mi² (10,458 km²), representing more than half (~62% actually) of the total land area of the Hawaiian Islands. Measured from its base at the sea floor, to its highest peak, Hawai'i is the tallest mountain in the world, even taller than Mount Everest, according to the Guiness Book of Records. Traditionally, Hawai`i is known as the *Big Island* because it is the largest of the Hawaiian Islands and some confusion between Hawai`i Island and Hawai`i State can be avoided.

Because Mauna Loa and Kīlauea are active volcanoes, the island of Hawai`i is still growing. Between January 1983 and September 2002, 2.2 km² (543 ac) of land were added to the island by lava flows from Kīlauea volcano extending the coastline seaward. Several towns have been destroyed by Kīlauea lava flows in modern times: Kapoho (1960), Kalapana (1990), and Kaimū (1990). Hawai`i is the southernmost island in the Hawaiian archipelago. The nearest landfall to the south would be in the Line Islands. To the north is the island of Maui, where East Maui Volcano (Haleakalā) is visible across the `Alenuihāhā Channel.

[Eighteen] 18 miles (29 kilometers) off Hawai`i Island's southeast coast is the undersea volcano known as Lo`ihi. Lo`ihi is an actively erupting seamount that lies 3,200 feet (975 meters) below the surface of the ocean. It is thought that continued volcanic activity from Lo`ihi will cause the volcano to eventually breach sea level and later attach at the surface onto Kīlauea, adding even more land to Hawai`i's surface area. This "event" is presently predicted for a date several tens of thousands of years in the future (MacDonald & Abbott (1970) in Wikipedia 2006).

Punaluu Series. The Punaluu series consists of well-drained, thin organic soils over pahoehoe lava bedrock. These soils are gently sloping to moderately steep. They are on uplands at an elevation ranging from near sea level to 1,000 feet and receive from 60 to 90 inches of rainfall annually. The mean annual soil temperature is between 72° and 74° F. The natural vegetation consists of *koa haole*, Christmas berry, guinea grass, natal redtop, and sand bur. These soils and Kaalualu, Kaimu, Kainaliu, Malama, Pakini, and Waiaha soils are in the same general area. Punaluu soils are used for pasture.

Punaluu extremely rocky peat, 6 to 20 percent slopes (rPYD). This soil is low on the leeward side of Mauna Loa. Rock outcrops occupy 40 to 50 percent of the surface. In a representative profile the surface layer is black peat about 4 inches thick. It is underlain by pahoehoe lava bedrock. This soil is medium acid. The peat is rapidly permeable. The pahoehoe lava is very slowly permeable, although water moves rapidly through the cracks. Runoff is slow, and the erosion hazard is slight. Roots are matted over the pahoehoe lava. This soil is used for pasture. (Capability subclass VIIs, nonirrigated; pasture group 3)

Representative profile, Punaluu Quadrangle, lat. 19°08’56” N. and long. 155°30’58” W.:

O2-4 inches to 0, black (10YR 2/1) peat; weak, very fine, granular structure; very friable, nonsticky, nonplastic, and nonsmeary; many roots; many very fine pores; few pebbles on surface; medium acid; abrupt, wavy boundary. (3 to 8 inches thick). IIR-0 to 10 inches, hard pahoehoe

lava. The O2 horizon ranges from 3 to 8 inches in thickness and from 5YR to 10YR in hue (CTAHR 2006).

Punalu'u Black Sand Beach is located in Punalu`u. The dark-colored or black sand is does not consist of coral, but volcanic glass particles that are produced when the hot lava explodes on contact with sea-water (Stearns and MacDonald 1946:97 In Kelly 1980:7). Signs are posted on the beach prohibiting people from taking the black sand. However, packets are sold in the beach shops.

> Located between Naalehu and Pahala, on the Big Island of Hawaii, is the only remaining Black Sand Beach on this island…. The sand is formed by crushed lava. The village of Punaluu was destroyed by the continuous earthquakes and tsunamis (tidal waves) of 1868. It was recorded that during three weeks the earth seemed to vibrate all the time. Mud and lava flows accompanied these events…. There are freshwater vents in the ocean off the beach. Years ago, the Hawaiians living on the beach, would secure drinking water from these vents (Yorck 1999)

Photo 2. Punalu`u Black Sand Beach, resting/feeding place for island turtles.

Photo 3. Sea Green Turtle on Punalu`u Beach.

Flora.

For the last several decades the project area has been primarily a mixture of alien or exotic, native and Polynesian-introduced flora. These lands have gone through several modifications over time. In *Hawaii a Natural History*, Carlquist divides each island into six regions: Coast, Dry Forest, Wet Forest, Epiphytic Vegetation, Bog and Alpine. The coastal vegetation are plants that grow near the shore. Most of the native coastal plants consisted of shrubs and herbaceous vegetation such as *naupaka kai* (*Scaevola taccada*), *'ilima* (*Sida fallax*) and *Ipomoea* sp. (Carlquist 1980:269, 300). Within the 0-500' elevation the only native tree is the *hala* (*Pandanus spp*). Both pre-contact and post-contact humans have introduced other coastal vegetation in this zone (Carlquist 1980:267).

The Dry Forest Region [lower and upper] has suffered the most impact by man. This is the area the early Polynesians modified extensively in slash and burn cultivation to expand their subsistence level, intensifying food production with complex irrigated agricultural systems of various crops in some areas (Kirch 1985:217). Some of the Dry Forest vegetation that may have been affected by early Hawaiian cultivation practices are the *naio* (*Myoporum sandwincense*), *wiliwili* (*Erythrina sandwincensis*), *`ohe* (*Reynoldsia sandwincensis*), *'iliahi* (*Santalum sp*), *`ohi`a* (*Metrosideros sp*), *koa* (*Acacia koa*), as well as several species of shrubs [i.e., (*Sida cordifolia*), *`ulei* (*Osteomeles anthyllidifolia*)], vines and ground cover (Carlquist 1980: 275-300).

The distinction of a Hawaiian Wet Forest is that it gets more than 70 inches of rain per year, and its most predominant native plant is the multi-range '*ohi`a*. Other native species of this region are the *loulu* palm (*Pritchardia macdanielsii*), *uluhe* (*Dicranopteris*), *hapu* (*Cibotium*), *maile* (*Alyxia oliviformis*) and an abundant variety of fern, mosses, liverworts, fungi and lichens. The significance of the *'ohi`a* or wet forest is that it is the most bio-diverse region of the Islands. It is here that the greatest evolution and diversification of plants and animals take place, and it was a region relatively unoccupied at first [by early Hawaiians] on the Islands (Carlquist 1980:301, 306).

Epiphytes of the Hawaiian wet forests are limited to the many species of mosses, liverworts, lichens, ferns, about 50 species of Peperomia, and *'ie'ie* (*Freycinetia arborea*), a plant of early Hawaiian ethno-botanical significance that displays qualities of an epiphyte and a climber (Carlquist 1980: 333-5).

Bogs are usually found at higher elevations where rainfall exceeds the porosity level of the soil, and on old volcanic domes with steep slopes and natural damming. They usually consist of mud, very small pockets of standing water and tussocks of sedge (*Oreobolus sp*) or grass (*Panicum sp*). Plants that grow in the bog are usually dwarfed (Carlquist 1980: 351-355).

Pratt and Gon (In Juvik and Juvik 1998: 121-129) define five ecological zones in the Hawaiian terrestrial ecosystems, based on elevation, moisture (Dry, Mesic, Wet), dominant life forms and vegetation structures (Forest and woodlands, Shrublands, Dwarf shrublands, Grasslands, herblands and desserts): Alpine (>9,000 feet); Subalpine (6,000 – 9,000 feet); Montaine (3,000 – 6,000 feet); Lowland (0 – 3,000 feet); and Coastal (0 -100 feet) and Multizonal (with tidepools and anchialine ponds) now classified as *land transformed by human activity.* The project area is primarily Coastal and Lowland.

Coastal Communities (0-100 feet).

Biota:	Greatly influenced by proximity to the ocean with many salt-tolerant species. Dwarf shrublands of *naupaka-kahakai* (*Scaevola sericea*), *`ilima* (*Sida fallax*), *naio, hinahina* (*Heliotropium anomalum*), *`akulikuli* (*Sesuvium portulavastrum*), *`aki`aki* grass (*Sporobolus virginicus*) or sedge (*Fimbristylis cymosa*). Coastal forests of *hala* (*Pandanus* sp) in a few windward sites; wetlands of native sedges now rare.

Threats	Most coastal areas, particularly where beaches occur, have been and continue to be, used and altered by humans; many wetlands have been drained or modified; cattle grazing, development, and urbanization ongoing. Alien species: *kiawe* (*Prosopsis pallida*); rats, cats, mongoose, and dogs, all of which harass nesting turtles, waterbirds, and seabirds.
Significance:	Most populated zone in ancient times and continues to be important in traditional Hawaiian culture, providing medicines, *lei* materials, and other resources.

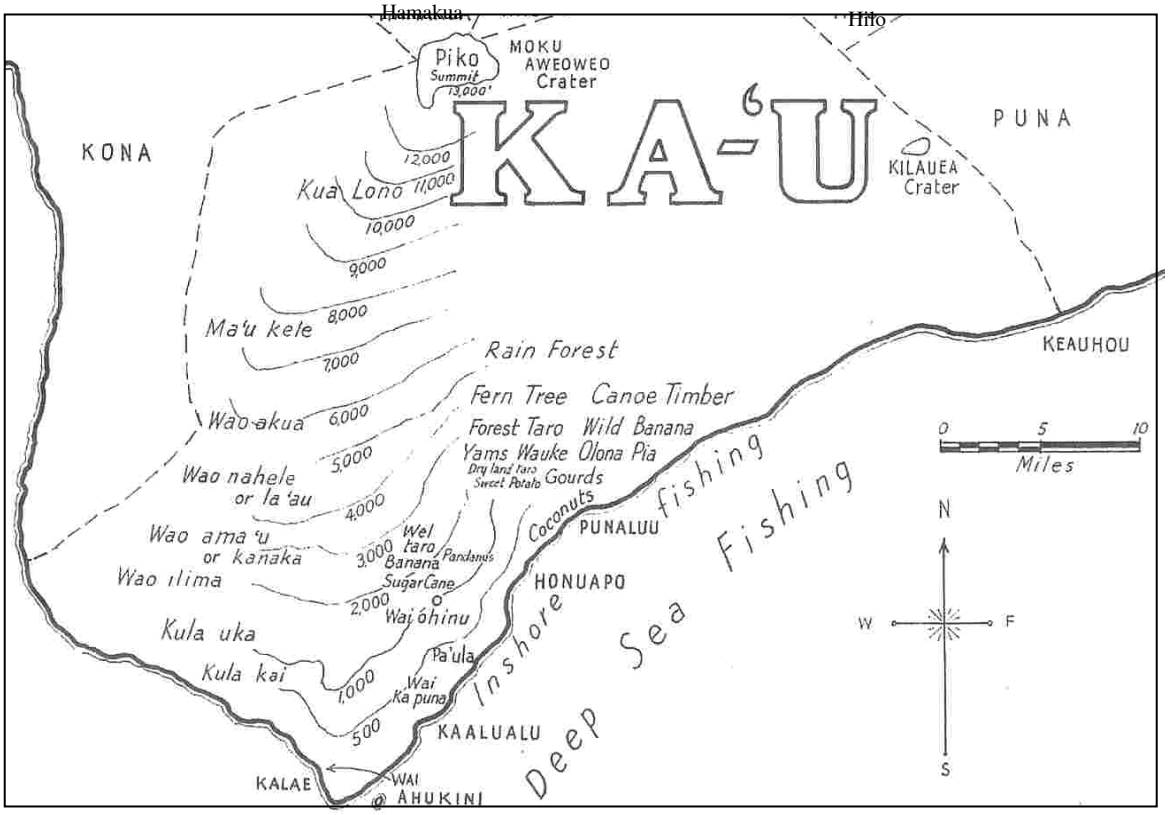

Figure 3. Environmental Map of Ka`ū (from Handy & Pukui 1972:19).

Several photos were taken during a recent field trip (December 10-12, 2005) of vegetation in the project area and coastal vicinity. Photo 4. (L) Punalu`u Black San Beach. Photo 5. (R) Punalu`u Fishpond.

Photo 6. Sea Mountain Resort Golf Course.

Photo. 7. Wailau Ponds native and alien flora.

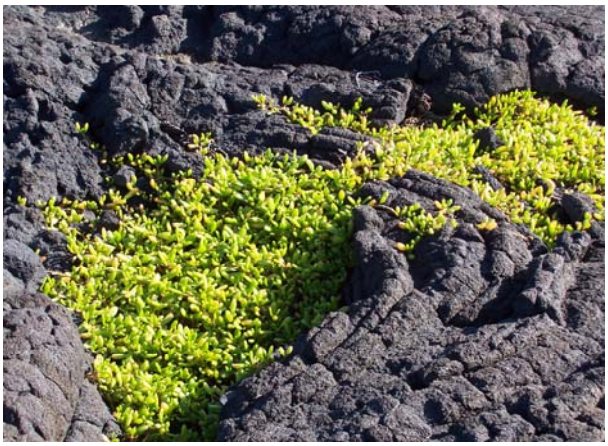

Photo 8 and 9. Native flora on Wailau pahoehoe.

Lowland Dry Shrubland & Dry Shrubland.

Distribution:	leeward lowlands of Hawai`i Island in mountain rain shadows;
Climate:	very hot and dry, annual rainfall less than 20 inches, seasonal
Biota:	natural vegetation now rare, but *pili* grasslands (*Heteropogon contortus*) and *`a`ali`i* (*Dodonaea viscosa*) shrublands, dry cliff vegetation, small patches of Hawaiian cotton or *ma`o* (*Gossypium tomentosum*), and dwarf shrublands of *`ākoko* (*Chanaesyce* sp) may exist. Open, dry woodlands of native trees once may have covered parts of this zone.
Threats:	Wildfire fueled by widespread alien grasses; alien shrubs also common. Feral goats, mongoose and cats may be present. Much of this zone was altered in ancient Hawaiian times; cattle grazing, irrigated agriculture, and development, particularly resort construction and expanding urbanization are ongoing.
Significance:	Except where springs allowed for habitation, this zone was ideal for burial and storage caves…(Pratt & Gon In Juvik & Juvik 1998:127-128). Sandalwood exploitation of the early 1800s occurred in lowland mesic forests. *Pili* grasslands, a source of thatch material; medicinal plants and hardwoods were gathered. Some mesic lands were converted to dryland *kalo* or taro (*Colocasia esculenta*) and *`uala* (*Ipomoea batatas*) agriculture. (Pratt & Gon In Juvik & Juvik 1998: 127).

Several photos were taken of vegetation in the project area during the September 23, 2005 field trip.

Photo 10. Flora near the old Punalu`u restaurant.

Photo 11. Flora near the old Aspen Center.

Photo 12. Mauka area of the golf course.

Photo 13. Mauka just off golf course area.

Fauna.

Terrestrial fauna in pre-colonized Hawaii consisted of one endemic mammal, the hoary bat (*Lasiurus cinereus*) which still exists and an extinct bat (Birney 2005), thousands of endemic insects [i.e., damselflies (*Ischnura ramburii* and *Ischnura posita*) found around ponds and streams], and about 100 species of endemic birds (Berger, 1972:7, Kirch, 1985:28). The project area lies within the Coastal and Lowland Shrubland zones. Founa in the Coastal area includes the "threatened" green sea turtle (*Chelonia mydast*); shorebirds such as wandering tattler or *`ūlili* (*Heteroscelus incannus*) and ruddy turnstone or *`akekeke* (*Arenaria interpres*)

Native birds once found there in ancient times were *`elepaio* (*Chasiempis sandwichensis*), *`apapane* (*Himatione sanguinea*) and *`amakihi* (*Hemignathus virens*). The *nēnē* (*Branta sandvicensis*) is slowly making a comeback. The Hawaiian hoary bat (*`ōpe`āpe`a, asiurus cinereus semotus*) favored this zone.

Early Polynesian-introduced animals included the Southeast Asian pig (*Sus scrofa*), jungle fowl (*Gallus gallus*), dog (*Canidae*), and the Polynesian rat (*Rattus exulans*). Rats, alien birds and mongoose have replaced native species in this zone (Pratt & Gon In Juvik & Juvik 1998:121-129), as has some feral animals such as goats, pigs and donkeys in the case of the project area.

The project area is located a short distance away from the Coastal zone. However, as once part of the self-sustainable *ahupua`a* system, the Coastal zone was very significant. This is where densely populated fishing villages thrived on the marine resources in the tidepools, near-shore and off shore areas.

> **Punalu`u Black Sand Beach.** This beach is the home of many Hawaiian Green Sea Turtles. The turtles eat limu (seaweed) off the rocks and enjoy basking in the sun on the beach. Swimmers and spectators can have a closeup view of the turtles in and out of the ocean (Yorck 1999).
>
> At Punalu'u [sea turtles] can be seen in great numbers, as it is a favored nesting area. They will be up on the beach basking in the sun, on the rocks with waves splashing over them while eating algae, and popping their heads up for breath in the bay.

Photo14. Limu at low tide.

Photo15. Honu resting on beach.

Photo 16. Turtle rests in background as visitors play in the surf.

Near the pavilion at the southern end of the black sand beach is a bronze plaque that explains the legend of a mystical turtle named Kauila who could take a human form and play with the children at the beach. The plaque reads:

> *"The mystical turtle, Kauila, makes her home in the Kau District at Punalu'u Bay. According to Hawaiian mythology, Kauila was empowered with the ability to turn herself from a turtle into human form and would play with the children along the shoreline and keep watch over them. The people of Kau loved Kauila as the guardian of their children and also for her spring, that gave them pure drinking water.*
>
> *The presence of Kauila can still be felt today by the sea turtles that inhabit this special place. The Hawaiian Honu (Green Sea Turtle) can be regularly seen in the bay feeding on lime growing in the shallows. In addition the Honu`ea (Hawksbill Turtle) sometimes enters the bay at night to crael ashore and deposit eggs in the black sand. Both species of sea turtles are fully protected under the U.S. Endangered Species Act and wildlife laws of the State of Hawaii. Enjoy watching these marvelous creatures but do not disturb them in any way.*
>
> *SAVING KA`U'S COAST* is a 15 minute film expressing the views of people intimately related to the shoreline. It explores the value of three endangered places: Honu`apo Bay & Fish Ponds, Kawa surfing beach and Punalu`u Black Sand Beach. All three have estuaries, important Hawaiian sites and seaside recreational areas (kaucoast.org 2006) http://www.kaucoast.org/pages/1/

Punalu`u Fishpond. The fishpond is continually being overcome by alien plants to the detriment of locals who try to clean the fishpond periodically. There are several alien fishes and water fowls that now make it their home. It is not known by the author if the dragonfly/damsel flies are native or alien as well.

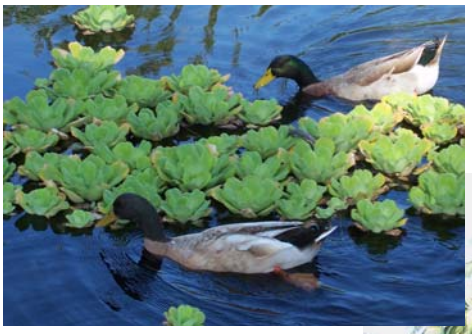

Photo 17. Fishpond now habitat for ducks and water flora.

Photo 18. Picturesque pond, but not up to traditional fishpond standards.

PART II: METHODS

The Cultural Impact Assessment/Study for the *Punalu`u Sea Mountain* project was conducted between the months of October 2005 through January 2006, with one site field trip in September 2005, and one in December 2005. The study consisted of three phases: (1) cultural and historical archival research (literature review); (2) ethnographic survey (oral history interviews), transcribing interviews, analysis of ethnographic data; and (3) report writing.

Personnel. The personnel consisted of the researcher who has a masters degree in Anthropology, with a graduate curriculum background in the archaeology track as well as anthropology theory, cultural resource management, ethnographic research methods, and public archaeology; an undergraduate curriculum background that included a core archaeology track as well as Hawaiian History, Hawaiian Language, Hawaiian Archaeology, Pacific Islands Religion, Pacific Islands Archaeology, Cultural Anthropology, Geology and Tropical Plant Botany; and ethnographic field experience that includes over 215 interviews to date.

Level of Effort. The *level of effort* of this study includes six oral histories; and broad but limited background review of Punalu`u within the context of Ka`ū and the greater Hawaii history. A cursory site visit with two staff members of *Group 70* indicated that while project area has been heavily modified it still has remnants of traditional Hawaiian ceremonial and habitation sites in a range of conditions.

Theoretical Approach. This study is loosely based on *Grounded Theory,* a qualitative research approach in which "raw data" [transcripts and literature] are analyzed for concepts, categories and propositions. Conceptual labels or codes are generated by topic indicators [i.e., fishing, agriculture, flora, ranching]. Categories are generated in a similar manner by forming groupings such as "Land Resource & Use," or "Water Resource & Use," or "Traditional History." Since this was a semi-focused study, categories were pre-selected as part of the overall research design. However, it is not always the case that these research categories are supported in the data. In the *Grounded Theory* approach, theories about the social process are developed from the data analysis and interpretation process (Haig 1995; Pandit 1996). This step was not part of this cultural impact study and assessment as the research sample was too small.

Archival Research. Archival research included a broad but limited background literature review as previous studies connected to this project area have already been conducted. Compiling data took several weeks of intermittent archival research. The majority of the archival research [primary and secondary sources] took place in the University of Hawaii Hamilton Library-Hawaiian Collections, Bishop Museum Archives and Library, State Historic Preservation Division library, the researcher's private library, material from *Group 70* and a focused InterNet search. Primary source material included land records, maps, genealogies, oral histories and other studies. Secondary source material included translations of 19th century ethnographic works, historical texts, indexes, archaeological reports, and Hawaiian language resources [i.e., proverbs, place names and dictionary].

Consultant Selection. The selection of the consultants was based on the following criteria:

- Had/has Ties to Project Location
- Known Hawaiian Cultural Resource Person
- Known Hawaiian Traditional Practitioner
- Referred By Other Cultural Resource People
- Referred By Group 70 staff

Interview Process. The interview process included a brief verbal overview of the study. Then the consultant was provided with a consent or agreement to participate form to review, which was drafted for the edification and protection of each consultant (Appendix D). An ethnographic research instrument

(Appendix E) was designed to facilitate the interview; a semi-structured and open-ended method of questioning based on the person's response ('talk-story' style). Each interview was conducted at the convenience (date, place and time) of each cultural consultant. A *makana* or gift was given to each consultant in keeping with a traditional reciprocal protocol.

Ethnographic Interview Procedures. Each interview was conducted using a cassette tape recorder. Three interviews were conducted at Punalu`u Black Sand Beach--one on family property and two at their stands/shops. One was conducted at a restaurant in Ocean View at the suggestion of the consultant. One interview was conducted at the home of the consultant. And one consultant decided to type their "interview" due to lack of time because of a previous engagement.

Transcribing Process. The taped interviews were transcribed by two hired transcribers. After the interviews were transcribed, each cultural consultant was sent a *mahalo* letter that explained the transcript review process, along with two hard copies of the interview transcripts, two *Release of Information* forms, and a self-addressed, stamped envelope for return of one signed release form and one copy of the edited transcripts. This process allows for corrections (i.e., spelling of names, places), as well as a chance to delete any part of the information if so desired or to make any stipulations if desired.

Analysis Process. The analysis process followed a more traditional method, as a qualitative analysis software program was not necessary. The interview was manually coded for research thematic indicators or categories (i.e., personal information; land and water resources and uses; site information-traditional and/or historical; and anecdotal stories). For the purpose of this study, it was also not necessary to go beyond the first level of content and thematic analysis, as this was a more focused study. However, sub-themes or sub-categories were developed from the content or threads of each interview [i.e., irrigation system, ranching, and agriculture].

Research Problems. A typical constraint for most studies is not enough time for archival research as there is a lot of material to review. However, several unforeseen circumstances prevented some interviews from taking place.

- Not all of the potential consultants were reachable by telephone.
- One potential consultant made a commitment to a time for the interview, then did not show up.
- The daughter [contact person] of one potential consultant changed jobs and left no forwarding phone number and did not have a listed phone number.

PART III: CULTURAL & HISTORICAL BACKGROUND REVIEW

The Cultural and Historical Background Review entailed a search of primary and secondary source literature. The majority of this research took place in the University of Hawaii (Manoa Campus) Hamilton Library Hawaiian Collections, Bishop Museum Archives and Library, State Historic Preservation Division library, the researcher's private library, and the InterNet. Primary source material included Land Court records, maps, visitor journals, genealogies, oral histories and other studies. Secondary source material included translations of 19th century ethnographic works, historical texts, indexes, archaeological reports, and Hawaiian language resources (i.e., proverbs, place names and Hawaiian language dictionary). A review of the archival material is presented in this section as an overview of the chronology of the *moku* (district) of Ka`ū, within the context of the broader history of the *moku `āina* (island) of Hawai`i and Greater Hawaii, along with specific review of traditional and historic literature as they pertain to Punalu`u and vicinity.

A. Models of Hawaiian Chronology.

Models of Hawaiian Chronology such as Cordy (1974/1996), Hommon (1976/1986) or Kirch (1985) provide a temporal view of settlement patterns as well as cultural changes through time, from initial settlement through first contact with the western world. Cordy's (1974) first model of a cultural development sequence looked at Initial Settlement Period, New Adaptation Period and a Complex Chiefdom Period. He has since modified this model (1996). Hommon's (1976) model of sociopolitical development sequence included four phases: Phase I AD 500-1400; Phase II AD 1400-1550; Phase III AD 1550-1650; and Phase IV AD 1650-1778. This model was later modified (1986) to three phases: Phase I AD 400-1400 Exploration and Settlement; Phase II AD 1400-1600 Expansion; and Phase III AD 1600-1778 Consolidation. Kirch (1985) believed that initial settlement occurred much earlier than AD 600. His culture-historical sequence model has four phases: Phase I Colonization Period (AD 300-600); Phase II Developmental Period (AD 600-1100); Phase III Expansion Period (AD 1100-1650); and Phase IV Proto-Historic Period (AD 1650-1795) (Kirch, 1985:296-308; Kolb, 1991:205).

It should be noted that another study (Tuggle & Spriggs 2001) refutes the 'early colonization' dates supposition. For decades, the consensus among Hawaiian archaeologists was that evidence from Bellows and Ka`ū supported early Polynesian colonization dates of AD 300 to AD 600 (Tuggle 1997; Kirch 1985). However, Tuggle and Spriggs (2001) have since studied new data and re-evaluated past dates and dating methods and have concluded that acceptable early dates fall within AD 700-1100. These dates appear to coincide with data that indicates that eastern Polynesia was settled much later than previously thought (Rolett 1989).

While Kirch's chronology model may need to be revised, his basic period system is still a working model. Therefore for this cultural impact study, Kirch's (1985) model will be used with the following modifications and additions: the dates for the Colonization and Development periods will not be used; Early Historic Period (AD 1795-1899), Territorial History (AD 1900-1949), and Modern Historic Period (post AD 1950) will be added. The reasoning behind using Kirch's model is the belief of many native Hawaiian people that based on oral histories or legends, the migrations of their Polynesian ancestors to Hawai`i took place prior to AD 700. According to Fornander (1917:IV: II: 406), there are seventy-five generations from Wakea to Kamehameha I who was born around AD 1753. If just eighteen years were allotted to each generation (typically a generation is twenty years) that would make the time of Hawaiian progenitors Wakea and Papa Haumea (who settled in Nu`uanu, Oahu) approximately AD 403. [McKenzie (1983:12) gives thirty years per generation, which would make first migration even earlier.]

The following overview highlights significant events and people and encapsulates cultural changes over time. More corroborating details follow this overview section with traditional *mo`olelo* and *mele,* and a review of historical works and various studies.

An Overview of Human Impact, Settlement and Socio-economic Development in Ka`ū in the context of Greater Hawaii

B-1. Colonization Period. First voyager dating is scanty at best, however, based on early site dates from Bellows, Oahu and South Point, Hawaii, Kirch (1985) estimated that the Colonization Period of the Hawaiian Islands was somewhere between AD 300-600. A couple of *mo`ōlelo* [Appendix F and Appendix G] about Hawai`i Loa the navigator, have the islands being settled much earlier than this. It is believed that the first Polynesian voyagers to Hawaii "followed the tracks of migratory birds. Mainly they traveled by the stars…. On a voyage of migration, from sixty to a hundred persons could exist for weeks on a large canoe, which might be a hundred feet in length" (Day 1992:3). This feat was "remarkable in that it was done in canoes carved with tools of stone, bone, and coral; lashed with handmade fiber; and navigated without instruments" (Teruia 1995:vii).

Reconstructing the cultural sequence for the Ka`ū district and other places in Hawai'i during the colonization period would involve the 'founder effect' and time necessary to adjust and adapt to a new environment. The colonizers were not able to bring all of the gene pool or cultigens from their homeland, so their new culture consisted of what survived the journey, what was remembered and what could be applied to the new environment (Kirch 1985:285-6). Although early Hawaiians were farmers and felt spiritually tied to the *`āina* (land) in many ways (Waters, n.d.), when they first arrived they had to modify both their subsistence practices and the land. Faunal remains analyses indicate that early Hawaiian subsistence depended on fishing, gathering, bird hunting (extinct fossil remains, see Olson and James, 1982), as it took time to clear the dryland forests, plant their crops, breed their animals, and construct suitable living quarters. Creation chants such as the *Kumulipo* depict a very deep philosophical bond with the land and nature and "the respectable person was bound affectionately to the land by which he was sustained" (Charlot 1983: 45,55). Ancient sites of various *ko'a* (fishing and bird shrines) also imply a spiritual respect for their sustenance.

As the founding groups grew, they fissioned into subgroups anthropologists refer to as *ramages*, with the senior male of the original ramage as chief of the conical clan, although hierarchical ranking was not just relegated through the patrilineal line of descent (Kirch 1985:31). Bellwood refers to these groups as tribal and related by blood (Bellwood 1978:31). Chiefly ranking probably did not occur until late in the Developmental Period.

B-2. Developmental Period. According to Fornander (1969) certain practices were universal Polynesian customs which the Hawaiians brought from their homeland; such as the major gods *Kane, Ku* and *Lono*; the *kapu* system of law and order; *pu`uhonua* (place of refuge); *'aumakua* (ancestral guardian) concept; and the concept of *mana* (supernatural or divine power) (Fornander 1969:61, 113,118,127-8). The early culture evolved as the population grew, and many of the changes were related to significant socio-economic changes. The evidence indicates that the "ancestral pattern of corporate descent groups" were still in place (Kirch 1985:302-3). However, this was changing as well.

During the Developmental Period, changes occurred bringing about a uniquely Hawaiian culture, documented by the material culture found in archaeological sites. The adze (*ko'i*) evolved from the typical Polynesian variations of plano-convex, trapezoidal and reverse-triangular cross section to a very standard Hawaiian quadrangular-tanged adze. A few areas in Hawaii produced quality basalt for adze production. Mauna Kea on the island of Hawaii was a well-known adze quarry. The two-piece fish hook and the octopus lure breadloaf sinker are Hawaiian inventions of this period, as are the *'ulu maika* stones and the *lei niho palaoa*. The later was a status item worn by those of high rank, indicating a trend toward greater stratification (Kirch 1985:184,204,306). In *Ka Po'e Kahiko* Kamakau refers to Hawaiian ranking in the following passage:

> For 28 generations from Hulihonua to Wakea, no man was made chief over another, and during the 25 generations from Wakea to Kapawa, various noted deeds are mentioned in the traditions and well-known stories. Kapawa was the first chief to be set up as a ruling chief. This was a Waialua, Oahu [Kukaniloko]; and from then on, the group of Hawaiian Islands became established as chief-ruled kingdoms - Maui from the time of Heleipawa, son of Kapawa and Kauai from the time of Luanu`u. In the time of Heleipawa, records (oral) began to be kept of the chiefs; of the day of birth, the land where each was born…the famous deeds of each, and the burial place where each was laid (Kamakau 1964:3)

B-3. Expansion Period. The Expansion Period, AD1100-1650, is significant in that most of the "ecologically favorable zones," the windward and coastal areas of all major islands, were now settled, and the more marginal leeward areas were being developed. This was also the period of high population growth, the development of large irrigation field system projects, and dryland farming (Bellwood 1978:98; Kirch 1985:298,303-4).

It was during the early part of this period that a second major migration settled in Hawaii, this time from Samoa and/or Tahiti in the Society Islands (Fornander 1969:33-35). It was also during this leeward expansion movement that voyaging canoes from the Southern islands brought Mo`ikeha (Oahu), La`maikahiki (Kauai), Pilika`aiea or Pili (Hawai`i) and *kahuna* Pa`ao who settled in the islands during the 13th century (Kamakau 1976:125). Pa`ao was the keeper of the god Ku`ka`ilimoku and had fought bitterly with his older brother, the high priest Lonopele. After much tragedy on both sides, Pa`ao escaped Lonopele's wrath by fleeing in a canoe from Kahiki. Kamakau (1991) told the following story in 1866:

> Puna on Hawai`i Island was the first land reached by Pa`ao, and here in Puna he built his first *heiau* for his god Aha`ula and named it Aha`ula [Waha`ula]. It was a *luakini*. From Puna, Pa`ao went on to land in Kohala, at Pu`uepa. He built a *heiau* there called Mo`okini, a *luakin*i. It is thought that Pa`ao came to Hawaii in the time of the *ali`i* La`au because Pili ruled as *mo`i* after La`au. You will see Pili there in the line of succession, the *mo`o kū`auhau*, of Hanala`anui. It was said that Hawaii Island was without a chief, and so a chief was brought from Kahiki; this is according to chiefly genealogies. Hawai`i Island had been without a chief for a long time, and the chiefs of Hawai`i were *ali`i maka`āinana* or just commoners (Kamakau 1991:100). There were seventeen generations during which Hawai`i Island was without chiefs--some eight hundred years (Kamakau 1991:101, 102).

There are several versions of this story which are discussed by Beckwith (1976), including the version where Mo`okini and Kaluawilinau, two of Moikeha's men decide to stay on at Kohala (Beckwith 1976:352, 353, 370-373). Pa'ao brought with him the Kū practice of human sacrifice, used in monumental *luakini heiau* or war temples. Pili started a line of *ali'inui* that would continue to the Kamehameha "dynasty." The evolution of the *luakini heiau* is difficult to place archaeologically, and although the arrival of Pa'ao may have been a real event, the uniqueness and complexity of *heiau* were most likely a local (Hawaiian) development (Kolb 1989:3). The bones of *kahuna* Pa`ao are said to be deposited in a burial cave in Kohala in Pu`uwepa [possibly Puuepa] (Kamakau 1987:41).

The uniquely Hawaiian invention, the *loko* or fishpond aquaculture, was developed in the fifteenth century or the later half of this period (Kirch 1985: 303). A fairly large fishpond is still evident today in Punalu`u. There are also several *mo`olelo* about significant personalities from this expansion time period; from Pa`ao to Liloa and Umi. During the last 200 years of the Expansion Period, the concept of *ahupua'a* was established, as well as class stratification, territorial groupings, powerful chiefs and *"mo'i"* or king (Kirch 1985:303-6). This land unit became the equivalent of a local community, with its own social, economic and political significance. Ahupua'a were ruled by *ali`i 'ai ahupua'a* or lesser chiefs, who for the most part, had complete autonomy over this generally economically self-supporting piece of land, which was managed by a *konohiki*. Ahupua`a were usually wedge or pie-shaped, incorporating all of the eco-zones from mountain to the sea and for several hundred yards beyond the shore, assuring a diverse subsistence resource base (Hommon 1976:15,16).

The *ali'i* and the *maka'ainana* (commoners) were not confined to the boundaries of the ahupua`a. Not only did the *makai* (ocean direction) and *mauka* (mountain direction) people share seafood and produce by lighting a fire when there was a need, they also shared with their neighbor *ahupua'a ohana* (Hono-ko-hou 1974:14,15). The ahupua'a was further divided into smaller sections such as the *'ili, mo'o'aina, pauku'aina, kihapai, koele, hakuone* and *kuakua* (Hommon 1976:15; Pogue 1978:10). The chiefs of these land units gave their allegiance to a territorial chief or *mo'i* (king). *Heiau* building flourished during this period as religion became more complex and embedded in a socio-political climate of territorial competition. Monumental architecture such as heiau, "played a key role as visual markers of chiefly dominance" (Kirch 1990:206).

It was during this time, during the reign of `Umi-a-Līloa that the island of Hawaii was divided into six *moku* or districts (Fornander 1973 v II: 100-102). The district of Ka`ū was subdivided into at least 26 ahupua`a--most of them located on the southeastern end of Hawai`i Island.

Mo`olelo* about events that took place in the early to mid 1600s were revealing in that they illustrate that many of the battles of this period were relatively quickly contained by the opposing *ali`i [see *History of Kualii* (Kualii ca. 1555-1730) in Fornander 1917:IV: II: 364-434]. These stories also illustrate the on-going inter-relationships between the people of the various islands. In the *History of Kualii*, the exploits of Kualii (great-great grandson of Kahuihewa, *ali`inui* of Oahu) take him to every island and he eventually unites all the islands "from Hawaii to Niihau" (Fornander 1917:IV: II: 406).

B-4. Proto-Historic Period. The Proto-Historic Period, A. D. 1650-1795, appears to be marked with both intensification and stress. Many wars took place during this time between intra-island chiefdoms and inter-island kingdoms. Some of these wars were associated with significant chiefs such as Kalani`opu`u who became a ruling chief of Ka`ū and Puna after the battle of Mahinaakaka with Alapa`inui. Kalaniopu`u was a native of Ka`ū as were some of his ancestors (Kamakau 1992:77).

> In the year 1754 Ka-lani-`opu`u became ruler over the island of Hawai`i. H e was the son of Ka-lani-nui-`I-a-mamao, the ruling chief of Ka`ū and the first-born of the ruling chief over all Hawaii, Keawe-i-kekahi ali`i-o-ka-moku, by Lono-ma`a-i-kanaka, the daughter of Ahua-I. The mother of Kalani-`opu`u was Ka-maka`i-moku, the daughter of Ku-a-nu`uanu and `Umi-`ula-i-ka-`ahu-manu (Kamakau 1992:78-79).

During the early part of this period Maui *ali`inui* Kama-lala-walu ignored the advice of his counsel and sent his half-brother Ka-uhi-o-ka-lani (both sons of Kiha-a-Pi`ilani) to spy on Hawai`i island, to see how large the population was. They landed in Kawaihae.

> Ka-uhi-o-ka-lani ran about that same evening and returned before the canoes were dismantled and placed in the house. The keepers of the gods at Mailekini were servants of Kama, and so they concealed the canoes of the spies. When Ka-uhi-o-ka-lani returned his fellow spies and hosts asked, where did you go?" "I went visiting from here to the lava bed and Kiholo, the pond. Then did you turn back?" "No, I went on to the long stretch of sand, to the small bay with a point on that side and one on this side. There are large inland ponds." "The sandy stretch is `Ohiki, and this walled-in ponds are Kaloko and Honokohau. Then you came back?" No, I went on…" (Kamakau 1992:56).

The next morning the spies began a circuit of Hawaii, then they returned to Maui and reported to Kama-lala-walu the following:

> 'We went all around Hawaii. There were many houses, but few men. We went to Kohala and found the men only on the shores….' The spies had seen the land of Kohala but had failed to see the people for on all of the fields where sports were held from inner Kohala to outer Kohala, from Kohala of the coastal cliffs to Kohala of the inland, a crowd of people gathered every day from morning to night to play. Kohala was known as a thickly-populated land. The spies thought that if

> Kohala was conquered, Kona, Ka`ū and Puna would be easily taken, and they felt that Hilo and Hamakua would lend no assistance. This was true, for the chiefs of these districts were cousins of the chiefs of Maui (Kamakau 1992:56-57).

While most of the prophets and seers supported Kama-lala-walu's war on his cousins of Hawaii Island, children of his father's sister Pi`ikea and `Umi-a-Liloa, some warned that if he did go, he would die and not return to Maui alive. They landed at Kohala and began the destruction of the people of Kohala. Kanaloa-kua`ana, son of Keawe-nui-a`Umi was captured and treated cruelly. "His whole skin was tattooed, his eyelids turned inside out and tattooed." He was renamed Ka-maka-hiwa.

> From Kohala, Kama-lala-walu set forth for Kawaihae, and found no one there. The people had gone up to Waimea, for all observed the services at the heiau of Mailekini. Only those of lower Kawaihae and Puako remained. The battlefield was at Waimea. Kama-lala-walu's counselors said, "Waimea is not a battle site for strangers because the plain is long, and there is no water…. It is better to go to Kona..." (Kamakau 1992:58).

Kama-lala-walu did not take heed and listened instead to two old men of Kawaihae who gave him false information and suggested that he cut up his canoes before heading up to Waimea so that Maui warriors would not be tempted to retreat to Maui. Then they headed for the plains of Waimea. When they got there they looked back towards the sea and saw the men of Kona advancing toward them.

> The lava bed of Kaniku and all the land up to Hu`ehu`e was covered with men from Kona. Those of Ka`ū and Puna were coming down from Mauna Kea, and those of Waimea and Kohala were on the level plain of Waimea. The men covered the whole of the grassy plain of Waimea like locusts (Kamakau 1992:58).

The battle of Pu`u`oa`oaka commenced just outside these plains. The light-weighted lava rocks here contributed to the defeat of the Maui warriors who were used to heavier water-worn rocks. The Maui warriors retreated; some to Kawaihae, others to Kohala. And because of the lack of canoes, very few escaped alive. Ka-uhi-a-Kama, son of Kama-lala-walu who was killed on the plain of Puako, escaped to Kekaha, found a canoe and fled to Maui. He was saved by Hinau, the foster son of Lono-i-ka-makahiki. Many of the chiefs of Kona were relatives of Ka-uhi-a-Kama through his mother Kapu-kini-akua (Kamakau 1992:59-60

After the death of Hawai`i Island *ali`inui* Lono-i-ka-makahiki, his children did not succeed him. Instead Hawai`i Island was divided into smaller divisions. The descendants of Kanaloa-kua`ana [Keawe, Ke`eaumoku, Kalani`opu`u and Keoua] later ruled Kohala, Kona and Ka`ū. The descendants of Keawe-nui-a-`Umi ruled Hilo and Hamakua. This was not a peaceful period. The chiefs of Kona and Hilo fought each other for the various resources each area had [Hilo's bird feathers, war canoes, fine tapa; Kona's food, drinking water and fish]. These wars lasted for several decades with the Hilo chiefs usually defeating the Kona-Kohala chiefs, especially during the reigns of Kua`ana, Kuahu`ia, Ka-lani-ku-kau-la`ala`a and Moku. Ke-aka-mahana (w) was the ruler of Kona during the wars with Hilo. "The rulers of Kona who succeeded Ke-aka-mahana were her daughter Keakea-lani and her son, Keawe [Ke-awe-i-kekahi-ali`i-o-ka-moku]." "Keakea-lani was the ruler of Kona and Kohala. The Mahi clanwere the war leaders, that is they were in charge." "But the chiefs of Hilo were always victorious over those of Kona…after they won the battle of Hu`ehu`e the secret places and burial caves in Kona were broken open…" In the battle of Mahiki, Ka-lani-ku-kau-la`ala`a and Moku were the chief war leaders of Hilo. After Moku the Hilo chiefs ceased to reign (Kamakau 1992:61-63).

It was during the later part of the Proto-Historic period that the *Royal Kolowalu Statute* or Kualii's Law was enforced. Kualii Kuniaakea Kuikealaikauaokalani lived for an extremely long time, was said to sometimes have supernatural powers, and was the first to "unite" all the islands. This *ali`inui* of Oahu died at Kailua in Ko`olaupoko in AD 1730, supposedly at the age of one hundred and seventy five.

> It (Kualii's Law) was strict, unvarying and always just. It was for the care and preservation of life; it was for the aged men and women to lie down in the road with safety; it was to help the husbandmen and the fishermen; to entertain (morally) strangers, and feed the hungry with food. If a man says, "I am hungry for food," feed (him) with food, lest he hungers and claims his rights by swearing the *kolowalu* law by his mouth, whereby that food becomes free, so that the owner thereof cannot withhold it; it is forfeited by law. It is better to compensate…. A transgressor, or one who is about to die, is, under the application of this law exonerated of his death or other penalty…(Fornander 1917:IV: II: 432).

However, this law did not prevent the continuing battles between families, factions and district chiefs. Kohala's Ka-lani-kau-lele-ia-iwi was the mother of Alapa`i-nui-a-Ka-uaua, who went to live on Maui with his half sister, Ke-ku`i-apo-iwa-nui (wife of Ke-kau-like, Maui *ali`inui*) after his father's (Ka-uaua-nui-a-Mahi) death at the hands of the Hilo chiefs in the battle of Mahiki. When Alapa`i heard of (his uncle) Keawe's death and the unrest between the district chiefs, he went back to Hawai`i Island with plans to make war on all the chiefs. "Moku was the ruling chief of Hilo, Hamakua, and a part of Puna; Ke`e-au-moku of Kona and Kohala (Kamakau 1992:66). He was victorious and united the island under his rule. At the time Kalani-`opu`u and Keoua, sons of two of Keawe's sons where children and Alapa`i brought them up to be commanders of his troops (Kamakau 1992:66).

However, when his brother-in-law Ke-kau-like heard about Alapa`i's victory, Ke-kau-like made war on Alapa`i ravaging the lands of Kawaihae and Kona and slaughtering the people of Kohala. In retribution, Alapa`i [who was connected to both Maui and O`ahu] decided to carry the war to Maui (Kamakau 1992:66). While Alapa`i and his warriors were encamped in Kohala, Kamehameha I was born to Ke-ku`i-apo-iwa (II) in Kapakai (`I`i, John Papa 1983:3), in the *ahupua`a* of Kokoiki, in the *moku* of North Kohala [Kamakau (1992:67) says it was AD 1736; however others say it was between AD 1753 and 1758 with more leaning towards AD 1753 [Cahill 1999:56-57)] near the Mo`okini *heiau*. He was quickly taken by Kohala chief Nae-`ole and hidden in Halawa (Kamakau 1992:67-69), his ancestral homeland (Williams 1919:121). Ke-ku`i-apo-iwa (II) was the daughter of Kekela and Ha`ae. Kamehameha's father was Keoua, younger brother of Ka-lani-`opu`u. Because of her weakened condition, Ke-ku`i-apo-iwa did not accompany the Alapa`i expedition to Maui. The infant Kamehameha was placed in the charge of Nae-`ole and his younger sister Ke-ku-nui-a-lei-moku until he was five. He was then returned to Alapa`i who placed the child in the care of his wife, Ke-aka (Kamakau 1992:68-69).

However, before Alapa`i reached Maui, a dying Ke-kau-like [Ka-lani-ku`i-hono-i-ka-moku] made his son Kamehameha-nui his successor. Ke-kau-like died enroute to Kula (Kamakau 1992:69). When Alapa`i heard of his death, he decided not to make war on his sister's son. While visiting them on Maui, Alapa`i heard that the O`ahu chiefs attacked his relatives on Molokai, so he went there to help (Kamakau 1992:70).

Alapa`i was said to have been a good ruler and loved by the common people, but his rule had come about by slaying *ali`inui* Ka-lani-nui-`i-a-mamao [father of Kalani`opu`u and Keoua] and his brother Ka-lani-ke`e-au-moku, rightful *ali`inui* of Hawaii island, and taking control. This would be the cause of several battles between Alapa`i and his nephew, Kalani`opu`u (Kamakau 1992:75-78).

In 1754 Alapa`i became ill and moved to Kikiako`i in Kawaihae. As his illness progressed "at Kikiako`i in the *heiau* of Mailekini, Kawaihae, he appointed his son Keawe-`opala to be ruler over the island" (Kamakau 1992:77). However, this was short-lived due in part to shifting allegiances of Keawe-`opala's chiefs (e.g. his relative Ke`eaumoku) and *kahuna,* to go with Kalani`opu`u. "A canoe arrived from Kekaha and brought word to Ke`eaumoku that Ka-lani-`opu`u was at Kapalilua (in south Kona) and was coming to make war against Keawe-`opala. Ke`eaumoku therefore made up his mind to join forces with Ka-lani-`opu`u" (Kamakau 1992:78). It was that same year that Kalani`opu`u, a lover of war, became *ali`inui* of Hawaii Island (Kamakau 1992: 78-79).

Kalani‘opu‘u was the son of Ka-lani-nui-I-a-mamao (ruling chief of Ka`ū --whom the *Kumulipo* was composed for-- first-born of Hawai`i ruling chief Keawe-i-kekahi ali`i-o-ka-moku) however, his biological father was said to be Pele-io-holani, *ali`i nui* of Oahu (Kamakau 1992:78-79; 110; see also `I`i 1983). Kalani`opu`u's mother was Ka-maka`i-moku, the daughter of Ku`aunu`uanu and `Umi-`ula-i-ka`ahu-manu.

About 1759 Kalani'opu'u conquered East Maui from Maui *ali`i nui* Kamehameha-nui (son of Kekaulike and brother of Kalani`opu`u's wife Kalola) by using Hana's prominent Pu'u Kau'iki as his fortress. He appointed one of his own Hawaii chiefs, Puna, as governor of Hana and Kipahulu. "Many chiefs from Hawaii at this time settled on Maui, some of them grandchildren of Keawe" (Kamakau 1992:79-80).

Conflict between Hawai`i chiefs continued. Ke`eaumoku, son of Keawe-poe-poe rebelled against Kalani`opu`u and set up a fort at Pololū and Honokane. He was attacked by Kalaniopu`u so he moved to Maui with his mother to live with her relatives there. A few years later in 1766, Maui *ali`inui* Kamehameha-nui became ill in Hana and ceded his lands to his younger brother Ka-hekili-nui-‘Ahu-manu (Kahekili), a fierce warrior and "manipulator." Following the death of Kamehameha-nui, Ke`eaumoku "married" Kameheameha-nui's widow Namahana, a cousin of Ku-nui-akea Kamehameha (Kamehameha I), to the chagrin of Kahekili who planned to marry his half-sister himself. Their daughter Ka'ahumanu, would later become a favorite wife of Kamehameha I (Kamakau 1992:79-84, 309).

Between 1775 and 1779 fighting continued between Kalani`opu`u and Kahekili. In 1775 Kalani'opu'u and his Hana forces raided and severely destroyed the neighboring Kaupo district, before continuing several more raids on Molokai, Lanai, Kaho'olawe and parts of West Maui. It was at the battle of Kalaeoka`ilio that Kamehameha, nephew and favorite warrior of Kalaniopu`u, was first recognized as a great warrior and given the name of Pai`ea (hard-shelled crab) by the Maui chiefs and warriors (Kamakau 1992:84). Kalani‘opu‘u returned again to Maui in 1776, but was severely defeated by Kahekili's warriors.

> Ka-lani-`opu`u returned to Hawaii embittered against Kahekili…and spent a year in preparing an army made up of a body of men from each of the six districts…he gave to each division a name: I, Ahu, Mahi, Palena, Luahine, and Paia. The war chief was called a Keawe. His own attendants, selected chiefs who excelled as soldiers, Kalani`opu`u called the Alapa and the Pi`ipi`i. He built houses for his war god Ka`ili, `Ohia-mukumuku at Kahalu`u, and Keiki-pu`ipu`I at Kailua as heaiu against sedition and for vengeance upon the chief of Maui. Holo`ae was his leading kahuna, whose grandchildren were Pu`ou and Hewahewa, and he belonged to the order of Pa`ao (Kamakau 1992:84-85).

In 1776 Kalani`opu`u and his chiefs returned to wage war on Maui again, but were again defeated. Kalani`opu`u was forced to sue for peace and sent his young son Ka-lani-kau-i-ke-aouli Kiwala`o and with his twin brother's-in-law Ka-me1e-ia-moku and Ka-manawa, who were also half-brothers of Kahekili. Kahekili called for a cease and sent fish and vegetables to his sister Kalola and her husband Kalani`opu`u. This too was short-lived as a few years later Kalani`opu`u waged war o Maui again, then ravaged Lanai slaughtering the chiefs and soldiers there leaving only one survivor to tell the tale. Kalani`opu`u then went back to Maui to wage many battles from 1778 to 1779. It was during these Maui battles that Kamehameha I distinguished himself as a fierce warrior (Kamakau 1992:88-91).

In January 1778 Cook landed in Waimea, Kauai and the culture of old Hawaii began its spiraling change (see Day 1992). Captain Cook left an English saw and boar on Ni`ihau and observed chickens on Kauai. (Takeguchi et al.,1999:1). Cook left Hawaii for several months, but returned later in the year. Kalani‘opu‘u was fighting Kahekili's forces in Wailua, Maui on November 19, 1778 when Cook's ship was sighted on his return trip to the islands. Kalaniopu‘u visited Cook on the *Resolution,* while Kahekili visited Clerke on the *Discovery* (Kuykendall and Day 1976:16).

When Cook sailed into Kealakekua Bay on January 17, 1779, Kalani‘opu‘u was still fighting Kahekili on Maui. At this time Kahekili's brother Ka`eo-kulani was ruling chief of Kauai; Ka-hahana was ruling

chief of Oahu and Molokai; Kahekili`ahumanu of western Maui, Lanai and Kaho`olawe; and Kalaniopu‘u was ruling chief of Hawaii and Hana (Kamakau, 1992:84-86, 92, 97-98). On January 25th Kalaniopu‘u visited Cook again at Kealakekua Bay, presenting him with several feather cloaks. By February Cook's scheme to kidnap Kalaniopu‘u as a hostage were thwarted and Cook was killed following a skirmish over a stolen cutter (Kuykendall and Day 1976:18).

After the death of Captain Cook the aging Kalani`opu`u moved to various parts of the island to enjoy surfing at Kahulu`u, Holualoa and Kailua; and the hula dance, *kilu, maika,* and sliding sticks in Kapa`au, North Kohala. However, trouble brewed in the form of famine and rebellion of some chiefs and kahuna such as I-maka-koloa of Puna and Nu`u-anu-pa`ahu of Ka`ū. Kalola and Kiwala`o were on Maui with Kahekili and sent him a double canoe filled with small-meshed nets and fish line. But Kalanio`opu`u feared a coup and plotted with his *kahuna* to be rid of Nu`u-anu-pa`ahu, the surfer chief of Ka`wa, Ka`ū, while he was out surfing at Maliu and Ka-pae-lauhala. He was to be devoured by a shark. While surfing two sharks did attack him--he out-surfed one, then pulled its gills out; he punched the other, then out-surfed it to shore, but not before being gashed on his buttock. He died a little latter at Pololu (Kamakau 1992:105-107).

After the death of Nu`u-anu-pa`ahu, Kalani`opu`u had two *heiau* constructed--one at Waipio and the other at Pu`ueo, Hilo. He stayed at Waiakea while his army went to Puna. The fighting lasted for a while, but I-maka-koloa fled and was hidden by the Puna people for almost a year. Kalani`opu`u awaited his capture, but left Hilo and stayed at Punalu`u, then Waiohino and Kama`oa in southern Ka`ū. His *kahu* Puhili in the meantime began setting entire *ahupua`a* in Puna on fire to flush out I-maka-koloa who was finally found on an islet (Kamakau 1992:106-108).

Kalanio`opu`u had already declared his young son Ka-lani-kaui-ke-a-ouli Kiwala`ō to be his heir; to his nephew Kamehameha he gave the war god, Ku-ka`ili-moku (Kamakau 1992:107). But even before the death of Kalani`opu`u in 1780, chiefs and *kahuna* were already taking sides between Kiwala`ō and Kamehameha. Kamehameha and a few other chiefs were concerned about their land claims which Kiwala`ō did not seem to honor, so Kamehameha usurped Kiwala`ō in a sacrificial ritual at the *heiau* Pakini with the body of I-maka-koloa at the suggestion of the other chiefs. Kalani`opu`u heard that other chiefs were plotting to kill Kamehameha for this and told him to flee to Kohala (Kamakau 1992:109).

Kamehameha retreated to his district of Kohala. While in Kohala, Kamehameha farmed the land growing taro and sweet potatoes (Handy and Handy 1978:531). After Kalani'opu'u died civil war broke out and the wars between Maui and Hawaii also continued (Kuykendall and Day 1976:23, 24; Handy and Handy 1978:528; King 1990). In 1781 after Kahekili heard about the death of Kalani‘opu‘u, Kahekili, split his forces and sent them through Maui's south-eastern Kaupo Gap and the north-eastern Ko‘olau Gap into Hana. After damming and diverting the supply of spring water to Pu`u Kau‘iki, the Hawaii chiefs were finally defeated, and the Maui *ali‘inui* regained control of Hana in1782 (Kamakau, 1992:84-86; 115-116; Fornander 1900: Vol II 146-7, 150, 216). Following his Hana victory, Kahekili went on to gain control of all the islands except Hawaii, by trickery and warfare (Kamakau 1992:116, 128-141).

Kiwala`ō was killed in 1782 by Ke`eaumoku (Kamakau 1992: 121; Cahill 1999:62), but the warring between the forces of Hawai`i Island districts continued. Demographic trends during the Proto-Historic Period indicate a population reduction in some areas, yet show increases in others, with relatively little change in material culture. There was a continuum of craft and status material, intensification of agriculture, *ali'i* (chief) controlled aquaculture, upland residential sites, and oral records which were rich in information. The Kū cult, along with its *luakini heiau,* and the *kapu* (restriction or regulation) system were at their peak, although western influence was already altering the cultural fabric of the islands (Kirch 1985:308, Kent 1983:13).

In 1790 when Captain George Vancouver made his first stop in the Hawaiian Islands he was told that Kalaniopu`u was dead; Hawai`i was ruled by Keoua Kuahu`ula (half-brother of Kiwala`ō), his uncle

Keawe-mau-hili, and Keoua's cousin, Kamehameha (Day 1984:77). Vancouver went on to trade with Kalanikūpule in Waikiki. He then found that the ruling chief of Kauai, Ka-umu-ali`i, was a mere child; his father Ka`eo was on Maui with his brother, Kahekili. Vancouver also noted a decrease in the population and the number of chiefs since the arrival of Cook (Kamakau 1992: 162-163).

In early 1790 the *Eleanora,* lay off the village of Ka`ūpūlehu. Before heading to Kealakekua Bay there was an altercation between Capt Metcalfe and high chief Kame`eiamoku. For revenge the next ship, the *Fair American*, was attacked and all on board were killed except for crewmember, Isaac Davis. As the attack was going on, *Eleanora*'s boatswain John Young was on shore trading for supplies. Fearing retaliation by the crew of the *Eleanora*, Kamehameha detained Young and allowed his ship to sail without him. Kamehameha took both Davis and Young under his care (Cahill 1999:11-12).

By 1790 Kamehameha I had gained enough control of the island of Hawai`i that he could leave to join the war parties on Maui. Kamehameha also had at his disposal western weapons, and an armed schooner (n.a. 1967:5). Kamehameha brought a cannon from the *Eleanora* along with the expertise of Isaac Davis and John Young, who were now advisors and *aikane punahele* (favorites) of Kamehameha I (Kamakau 1992:147-148). "At Kawaihae and Kealakekua, Young and Davis built up an army and navy for Kamehameha along European lines, introduced firearms to Hawaiian warfare, and directed their use in Kamehameha's conquest of Maui, Lanai and Molokai" (n.a. 1967:5). His canoe fleet "beached at Hana and extended from Hamoa to Kawaipapa" to battle Kalanikūpule, son of Kahekili (who now ruled Oahu). After several battles along the East Maui coast, Kamehameha's forces reached Wailuku where the "great battle" took place. This would be the beginning of the end of independent ruling chiefs because of the inequity of battle strategy and weaponry I (Kamakau 1992:147-148).

Back on Hawai`i island in 1790, Keoua Kuahu`ula [twin brother of Keoua Pe`e`ale, sons of Kalaniopu`u and Kane-kapo-lei (Kamakau 1992:120)] ravaged Kamehameha's birth lands of Kohala. At the advice of Ka-pou-kahi, a *kahuna* from Kauai (Kelly 1974:6), Kamehameha personally helped to construct the heiau Pu`u Koholā in the summer of 1791, to assure his victory over his cousin, Keoua Kuahu`ula, who was to be sacrificed at the *heiau* (Day 1984:77; Kamakau 1992:154-157).

> After the death of his older brother [Kiwala-ō] Keoua lived in Ka`ū successfully fighting off Kamehameha's generals. Following the new strategy, Kamehameha sent Keoua's uncles, Keaweaheulu and Kamanawa, to convince Keoua that Kamehameha was offering him a truly respectful peace. Apparently trustful at first, Keoua consented to go with them, but at some point on the trip to Kawaihae he evidently suspected he was being led into a trap. His canoes landed briefly at the sacred place of Luahinewai near Kiholo. There, in the beautiful fresh-water pool, he bathed…. After bathing he cut off the end of his..*`omu`o,* an act which believers in sorcery call 'the death of Uli' and which was a certain sign that he knew he was about to die…. 'The death of Uli' refers to death caused by the vengeance of the sorcerer, since Uli is the goddess worshipped by sorcerers. The part cut off is used for the purpose of sorcery so that those who do a man to death may themselves be discovered and punished…. Just as Keoua was stepping from the canoe onto the beach at Kawaihae, Keeaumoku and the other chiefs of Kamehameha's forces attached him and the occupants of his canoe (Kamakau 1961:156-157).

John Young reportedly noted that "Kamehameha offered 11 human sacrifices at the dedication of the *heiau.* The principal offering was the body of Keoua Ku-ahu`ula" his cousin (Llopis & Sharp 1994:1).

On his second voyage to Hawaii in 1793, Vancouver counseled the chiefs to stop making war on each other. He gave Kamehameha some cows and sheep (at Vancouver's advice Kamehameha put a ten-year *kapu* on them). Vancouver went on to visit Kahekili in Lahaina and made the same request; then on to Waikiki to Kalanikūpule. When Vancouver returned in January 1794 on his third and last visit, he gave Kamehameha three bulls and more cows and sheep [horses came later in1803 from Captain Richard J. Cleveland]. Kahekili had recently died (late 1793) in Waikiki at the age of eighty-seven and his brother Ka`eo was now ruling Maui (Kamakau 1992:162-166; Brennan 1995:15-23, 31-34).

By 1794 at least eleven foreigners were living on the island of Hawaii; these included American, English, Irish, Portuguese, Genoese, and Chinese (Day 1992:23-25) most likely holdovers of the sandalwood trade. In November and December 1794 a great battle was fought in `Aiea, Oahu between Ka`eo and his nephew Kalanikūpule. Ka`eo was killed and his young son Ka-umu-ali`i (great-grandson of both Kekaulike of Maui and Pele-io-holani of O`ahu; and cousin to both Keōpūolani and Ka`ahumanu] became ruling chief of Kauai (Kamakau 1992:168-169).

B-5. Early Historic Period. The Early Historic Period (AD 1795-1900) is marked by very significant events. In February 1795 Kamehameha's war fleet landed in Lahaina and covered the coast from Launiupoko to Mala. All the food patches and cane fields were overrun by Hawaii warriors; and on Molokai the coast from Kawela to Kalama`ula was also covered by warrior-laden canoes (Kamakau 1992:171). Kamehameha also invaded O`ahu in 1795, covering the beaches from Wai`alae to Waikiki. Several foreigners were living with Kalanikūpule on O`ahu at that time (Kamakau 1992:172, 174). Kamehameha brought the daughter of Kalola, Ke-ku`i-apo-iwa Liliha and her daughter, Kalanikauiaka`alaneo to O`ahu to witness the Battle of Nu`uanu Pali and the defeat of Oahu. It was during this trip that the name Keōpūolani (who was later to be the royal wife of Kamehameha I) was given to Kalanikauiaka`alaneo (Kleiger 1998:21). Kamehameha's forces defeated Kalanikūpule's forces. After several months of hiding, Kalanikūpule was found and sacrificed to Kamehameha's war god (Kamakau 1992:174).

By 1796 Kamehameha had conquered all the island kingdoms (with the help of western advice and technology) except Kauai; it wasn't until 1810 that Kaumuali`i ceded his kingdom of Kauai, Ni`ihau, Lehua and Ka`ula. Ka`umuali`i gave his allegiance to Kamehameha and the Hawaiian Islands were unified under one rule (Kuykendall and Day 1976:26-29, 32). This marked the end of the Proto-Historic Period. Hawaii's culture and economy continued to change radically as capitalism and industry established a firm foothold.

At this time the sandalwood (*Santalum sp*) trade in Hawaii was flourishing; the Fijian and Marquesan supply of sandalwood was exhausted, so Hawaii became known as the "sandalwood mountains" to entrepreneurs of Southern China. Sandalwood came under the personal control of Kamehameha I, who had become "a fervent consumer of high-priced western goods" (Kent 1983:17-20). The sandalwood industry, founded by Euro-Americans in 1790 and turned into commerce by 1805 (Oliver 1961:261), was flourishing in Hawai`i by 1810 to the point where the subsistence level fell apart, as farmers and fishermen were ordered to spend most of their time logging, causing famine to set in, and resulting in a population decline. However, Kamehameha did manage to keep some control on the trade (Kuykendall and Day 1976:43; Kent 1983: 23, 29; Bushnell 1993:212). In 1813, Don Francisco de Paula y Marin, Spanish advisor to King Kamehameha I introduced coffee and pineapple to Hawaii, but it wasn't until later that John Wilkinson brought 30 coffee plants from Brazil, the type that would become known as "Hawaiian coffee" (Takeguchi et al., 1999).

By the mid-1800s ranching became a flourishing economic factor in the Kohala and North Kona areas with cattle being shipped out of Kawaihae (Rosendahl 1995:11). In 1815 John Palmer Parker, an ex-seaman, made his home at Kawaihae where he began hunting cattle that roamed the slopes of Mauna Kea. By this time the Vancouver's cattle of 1793 had increased to destructive numbers and Parker was hired to thin the wild herds. Since people had not yet developed a taste for beef, Parker salted the meat with Kawaihae salt and tanned the hides to trade with ships that stopped at Kawaihae. He later built pens to confine the cattle and horses (n.a. 1967:14-15).

Kamehameha I died on May 8, 1819 in Kailua-Kona "and at the close of the purification the *kahuna* Hewahewa said, 'Where shall the ruling chief stay?" The chiefs responded in unison, "Where indeed? Are not you the one to choose the place?" "Since Kona is unclean, there are but two places for him to stay,

Ka`ū and Kohala." The chiefs chose Kohala because they believed the people there to be more loyal to Kamehameha (Kamakau 1992:213). "When the people of Kona and of neighboring places heard of the death of the chief, the voice of weeping and wailing arose and the sound of lamentation and general mourning, recalling their regret and reciting their love for their chief" (Kamakau 1992:213-214).

Once again the culture of Hawaii was to change radically; six months after the death of Kamehameha, his son and successor Liholiho, met with his mother Keōpūolani, *kuhina nui* Ka'ahumanu, and a council of chiefs and chiefesses at Kawaihae. His advisors, which included his father's *kahuna* Hewahewa, convinced the new king Kamehameha II to abolish the *kapu* system. After some contemplation, he signified his agreement by sitting down and eating with his mother Keōpūolani, breaking the *`ai kapu*. (Oliver 1961:260; Kuykendall and Day 1976:41; Kamakau 1992:222-228).

Liholiho's cousin Kekuaokalani, caretaker of the war god Ku-Kailimoku, disagreed and rebelled. By December of 1819 the revolution was quelled. Kamehameha II sent edicts throughout the kingdom renouncing the ancient state religion, ordering the destruction of the *heiau* images and the *heiau* structures to be destroyed or abandoned and left to deteriorate, allowing the personal family religion, the *'aumakua* worship, to continue (Oliver 1961:260; King 1990; Kamakau 1992:222-228). Regarding this subject Fornander wrote the following:

> When the tabus were abrogated, when the Heiaus were doomed, when Christian zealots proved the genuineness of their new faith by burning the objects of faith of their fathers, and when the ancient gods were striped of their kapas and feathers and their altars overturned, then many a devotee, a Kahu or servant of special Heiaus or individual gods, hid the object of his adoration in caves, in streams, in mountain recesses, in the mud of swamps or other unfrequented places, in hopes of the better days which never came. Thus many a Kahu died and made no sign, and the idol he cherished has only been discovered by accident (Fornander: 1879-80:37-38 vII).

Ironically, in October of 1819, seventeen Protestant missionaries had set sail from Boston to Hawaii. They arrived in Kailua-Kona on March 30, 1820 to a markedly changed culture; one with a "religious" void, and a growing appetite for western products. Many of the *ali'i* who were already exposed to western material culture welcomed the opportunity to become educated in a western style and adopt their dress and religion. Soon they were rewarding their teachers with land and positions in the Hawaiian government (King 1990). During this period, the sandalwood trade was wreaking havoc on the commoners who were weakening with the heavy production, exposure, and famine just to fill the coffers of the *ali`i* who were no longer under any control constraints (Oliver 1961:261; Kuykendall and Day 1976:42; Bushnell 1993:212). On a stopover in the Kohala district in the early 1800s Ellis wrote the following:

> About eleven at night we reached Towaihae [Kawaihae], where we were kindly received by Mr. Young...Before daylight on the 22nd, we were roused by vast multitudes of people passing through the district from Waimea with sandal-wood, which had been cut in the adjacent mountains for Karaimoku, by the people of Waimea, and which the people of Kohala, as far as the north point, had been ordered to bring down to his storehouse on the beach, for the purpose of its being shipped to Oahu. There were between two and three thousand men, carrying each from one to six pieces of sandalwood, according to their size and weight. It was generally tied on their backs by bands of ti leaves, passed over the shoulders and under the arms, and fastened across their breasts.... (Kuykendall and Day 1976:42, 43, Ellis 1984:397)

The lack of control of the sandalwood trade was to soon create the first Hawaiian national debt as promissory notes and levies were initiated by American traders and enforced by American warships (Oliver 1961:261, 262). In 1825, Kuhina-nui Ka`ahumanu [King Kamehameha III was just a child] placed a *kapu* on cutting sandalwood trees. She saw what it was doing to the people; neglecting their crops and fishing and getting into debt (Brennan 1995:48). During this period the free-ranging cattle were also taking its toll; any chances of re-growth of the forests were squelched by the wild cattle. They even ate the grass-thatched roofs of native houses (Handy and Handy 1972:18).

As a result of the sandalwood trade, followed by the whaling industry, the mercantile business did very well in Hawaii. In 1926 a mercantile business was founded by Captain James Hunnewell; that establishment later became C. Brewer & Co., Ltd. Captain Charles Brewer established the company on a permanent foundation so the company bears his name. It was the oldest business west of the Rocky Mountains and included hides, skins and the whaling industry (Wisecarver 1983:19) [more in section **D. Historical References**] then later (1856) got into the sugar industry (Dorrance 2000:19).

However, beef soon became a barter item (Brennan 1995:48); and in 1832, Kamehameha III sent a high chief to California to bring some *vaqueros* back to Hawaii to help with the training of horse and cattle handling. Although the cattle were being slaughtered by the thousands for their hides and tallow, their numbers were increasing beyond belief. Over 100,000 wild cattle were roaming the mountains of Waimea alone. Many crops were ruined by the hordes of cattle (Brennan 1995:51-54). The solution was for the *vaqueros* or *paniolo* as Hawaiians called them, to first train Hawaiian and *haole* men to be good horsemen or wrangler or cowboy (*paniolo*). This was the beginning of Hawai`i's cattle kingdom (Brannen 1995:70). Paniolo Jack Purdy and John Parker, Kamehameha III's chief cattle killer, partnered to furnish the king with badly needed beef for bartering with foreign ships (Brennan 1995:74).

The Hawaiian culture was well on its way towards Western assimilation as industry in Hawaii went from the sandalwood trade, to a short-lived whaling industry, to cattle ranching, and the more lucrative, but insidious sugar industry. "For the first time Hawaiian masses were drawn to a cash economy as workers and producers." In 1836 the first sugar plantation was established on Kauai (Kent 1983:22, 23, 29). However, sugar cane (*Saccharum officinarum* L.) was originally Polynesian introduced and served a variety of uses. The *ko kea* or white cane was the most common, usually planted near Hawaiian homes for medicinal purposes, and to counteract bad taste (Handy and Handy 1978:185). Sugar cane was a snack, a condiment, a famine food, fed to nursing babies, and helped to strengthen children's teeth by chewing on it (Handy and Handy 1978:187). It was used to thatch houses when *pili* grass (*Heteropogon contortus*) or *lau hala* (*Pandanus odortissimus*) were not abundant (Malo 1987:121, 124). Sugar cane was also used in relation to taro and sweet potato. Handy and Handy (1978) explain:

> In wet-taro farming, cane was planted along the embankments separating the flooded terraces and flats. In dry-taro and sweet potato fields on the sloping *kula* or in the lower forest zone, cane was planted as hedges along the lines of stone and rubbish thrown up between the fields. Thus it helped the planter to utilize to the maximum his soil and water, and acted as a windbreak against the gusty breezes which blow in most valley bottoms, along the coasts, and on the uplands where taro is grown (Handy and Handy 1978:186).

Sugar cane was grown on all islands and when Cook arrived, he wrote of seeing sugar cane plantations. The Chinese on Lanai are credited with first producing sugar as early as 1802. However, it was not until 1835 that sugar became established commercially, primarily to replace a waning sandalwood industry (Oliver 1961:263; Kuykendall and Day 1976:92). Many of the Hawaiian chiefs became involved in the early days of the sugar industry. Hawai`i's Governor (John Adams) Kuakini, son of Ke`eaumoku and Namahana (Kamakau 1992:149) and sister of Ka`ahumanu, grew sugar cane and had a mill in South Kohala; he also had a sugar plantation in North Kohala in the 1830s-1840s (Dorrance 2000:17). In 1840 King Kamehameha III ventured into the sugar industry in Wailuku. His mill stood on the site where the first Wailuku Sugar Company mill (west of Market Street and south of the `Īao Stream, near Iron Bridge) would later be constructed (WSC 1962:10). In the mid-1870s partners James Cambell and Henry Turnton bought out the plantation formed by Lot Kamehameha and others (Conde 1973:252).

In the 1840s a political act of the Hawaiian Kingdom government would change forever, the land tenure system in Hawai`i and have far-reaching effects. The historic land transformation process was an evolution of concepts brought about by fear, growing concerns of takeovers, and western influence regarding land possession. King Kamehameha III, in his mid-thirties, was persuaded by his *kuhina nui* and other advisors to take a course that would assure personal rights to land. One-third of all lands in the

kingdom would be retained by the king; another one-third would go to *ali`i* as designated by the king; and the last one-third would be set aside for the *maka`ainana* or the people who looked after the land. In 1846 he appointed a Board of Commissioners, commonly known as the Land Commissioners, to "confirm or reject all claims to land arising previously to the 10th day of December, AD 1845." Notices were frequently posted in *The Polynesian* (Moffat and Kirkpatrick, 1995). However, the legislature did not acknowledge this act until June 7, 1848 (Chinen 1958:16; Moffat and Kirkpatrick 1995:48-49), known today as *The Great Mahele*. In 1850, the Kingdom government passed laws allowing foreigners to purchase fee simple lands (Speakman 2001:91).

The 1840s also heralded other changes as well. King Kamehameha III passed a law making all forests, government property in 1946 (Takeguchi et al. 1999). The Hawaiian government, with the aid of the missionaries, encouraged the sugar industry as well as other enterprises such coffee, cotton, rice, potatoes, and silk worms (Speakman 2001: 93). Subsistence crops were ruined by displaced dirt and dust, natives were being asked to grow sugar cane on their lands in exchange for money, only to find themselves indebted, and forced to surrender homelands; land-use disputes between natives and other cultures ensued; and restrictions on government lands prevented subsistence hunting and gathering. Subsistence-based culture was eventually lost with the escalating dependence on purchased goods and the growing development related to sugar production (Tomonari-Tuggle 1988:50, 51).

Disease also had a devastating affect on the population and the landscape, killing *ali'i* and *maka'ainana* alike; measles epidemics in 1848 and 1849, was followed by the horrendous smallpox epidemic in 1853. Ten thousand people are said to have died of this disease in Hawaii (Kamakau, 1992:411, 418). John Papa `I`i in *Fragments of Hawaiian* History (1984) talks about the impact of this disease and as *kahu* or guardian of several young *ali`i*; he had to take several of them off of Oahu island. They just kept sailing from island to island and usually were not allowed to land as Oahu was thought to be the source of the smallpox (`I`i 1984:171).

While other places were getting established with growing sugar cane in the 1850s, cattle ranching was becoming an industry for the island of Hawaii, as was livestock such as goats. A law had been passed "requiring livestock owners to register their brands or the animals would be considered government property."

By 1858 at least 2,119 foreigners lived in Hawaii. Many were merchants who traded and provided provisions, ranchers and missionaries who lived in various locations throughout the islands. "Foreigners engaged in agricultural pursuits with the idea of reaping a profit from the land, in contrast with the Hawaiians, who carried on…subsistence agriculture" (Coulter 1971:11). In the 1860s the U. S. Civil War brought about a boost for the sugar industry in Hawai`i as sugar plantations in the South were boycotted or destroyed. The industry brought in tens of thousands of laborers from Asia, Europe, the Americas, Oceania, and Africa to work on the many plantations and mills that were being established on all major islands, which had a profound effect on life in Hawaii (Oliver 1961:123). This influx not only radically changed the culture, but also drastically altered ethnobotanical agricultural lands, destroying traditional architectural features in the process as lands were cleared for mono-crops, domestic settlements and large-scale ranching.

> In 1872 Hawaiians and part-Hawaiians constituted 82.8 percent of the total plantation work force of 3,846, while the Chinese represented only 11.5 percent (446 laborers). Within ten years, however, the Chinese had replaced the Hawaiians as the primary source of labor…. During the 1880s Japanese laborers quickly outnumbered the Chinese…from 0.1 percent...in 1882 to 63.3 percent in 1892 to 73.4 percent in 1902 (Takaki 1983:28).

The following are sugar ventures in the Ka`ū District in the 1800s; some ended very quickly (Dorrance 2000:84):

Hawaiian Agricultural Company	*1876 – 1972*
Hīlea Sugar Company	*1878 – 1891*
Naalehu Plantation	*1878 – 1884*
Honu`apo Plantation	*1879 – 1884*
Charles Wall	*1882 – 1883*
H. M. Whitney	*1882 – 1884*
L. Chong	*1895 – 1899*

The history of sugar in the remote Ka`ū District was based on a continual combining of plantations as mill and harvest transportation improvements made possible the realization of the economies of scale. In the end, in 1996, all Ka`ū lands were farmed by one corporation, Kau Agribusiness Company, Inc….

Divided up by ancient lava flows and subject to droughts, the [Ka`ū] lands seemed uninviting for cultivation. Nevertheless, sugar farming came to Ka`ū before the catastrophic Mauna Loa eruption of 1868, survived that event, and lived on to include the last sugar farm on the Big Island. The Ka`ū District was relatively inaccessible in the nineteenth century, but drew some of the shrewdest entrepreneurs in the Kingdom.

Following the eruption, lava flow and mud slide of 1868, Alexander Hutchinson moved to Nā`ālehu in the Ka`ū District. He had been an engineer at the Honolulu Iron Works, and entered the sugar business with John Costa. In 1870 they established the *Nā`ālehu Sugar Company* on leased land and Costa erected a mill. However, the men soon had a falling out. In 1872 Costa sold his partnership to Charles R. Bishop…. In 1877 Hutchinson added to Nā`ālehu Sugar Company's lands by acquiring neighboring Waiohino Plantation, organized in 1875 by John Nott & Company…. [Hutchinson met an untimely death in 1879 when he hit his head on coral outcropping at Honu`apo landing when his rowboat capsized--he was picking up two deserters from the inter-island steamer] (Dorrance & Morgan 2000:108-109).

In 1880 Claus Spreckles and William Irwin purchased *Nā`ālehu Sugar Company* from the estate of Alexander Hutchinson. Four years later they incorporated as *Hutchinson Sugar Company*. In 1889 they increased its land holdings by acquiring nearby *Hilea Sugar Company* (est. 1870 by investors Charles Spencer, Alexander Hutchinson and William Irwin)…. Production grew…harvests were brought to the mill's railroad by a system of flumes that reached as far as six miles uo Mauna Loa's slopes…. The fields were situated above the mill on a series of ledges hundreds of square acres in size. The last of several mills was located at Honu`apo, less thasn a mile from where sugar was shipped until the onset of World War II (Dorrance and Morgan 2000:109).

Hutchinson Sugar Company operated Honu`apo landing until it was closed in 1942…. From 1930 until 1942 the landing also served *Hawaiian Agricultural Company's* mill in Pāhala via a narrow gauge railroad. In 1971 owners *C. Brewer & Company* merged *Hutchinson Sugar Company* into *Hawaiian Agricultural Company* to form *Ka`u Sugar Company, Inc*…. The short-lived *Honu`apo Plantation* was started in 1879 by Dr. Richard Oliver on 3,600 acres of cultivated land. In 1880 the distinguishing feature of this venture was the presence of 10,000 to 20,000 goats (Dorrance and Morgan 2000:109-110).

In 1876 a high-powered group of investors met to organize the *Hawaiian Agricultural Company.* They included the wealthy banker Charles Bishop, John Dominis and Peter Jones, Jr…. Jones was a partner and later president of *C. Brewer & Company, Ltd.* They controlled over 50,000 acres of leased and purchased land in and around Pāhala, Ka`ū. By 1880 the plantation's steam-driven mill was the most modern and largest in the islands…. Under economic pressure, sugar farming operations were shut down in 1996. Much of the former cane fields have been cleared and planted in macadamia trees, which require seven years to mature, and great patience in a region where droughts are frequent (Dorrance and Morgan 2000:110-111).

Additional industry for Hawai`i Island included coffee, macadamia nuts, introduced in 1881 by William H. Purvis; and John Ackerman; and Waldemar Muller began canning pineapple commercially in Kona in 1882 (Takeguchi et al., 1999).

B-6. Territorial History (AD 1900-1949). Several events, which took place in the early 1900's eventually, created a downward spiral effect on the sugar industry. Mainland labor union leaders went into the fields organizing membership drives, the military began a major drive to install airfields and encampments, and the Federal government imposed quota restrictions on sugar exports (Oliver 1961:147, 148). This period saw Native Hawaiians running for Congress (Daws 1974 297); and much of the lands being sold in fee simple. In 1920 Hawaii delegate to Congress, Prince Joanah Kuhio Kalanaianaole authored the Hawaiian Homes Act. Lands were set aside on all islands for homesteading by Hawaiians with 50% or more native blood (Takeguchi et. al., 1999). In 1920 corporations dominated the sugar industry.

> Five corporations dominated sugar production in Hawaii: of the total tonnage of sugar produced in 1920, American Factors controlled 29 percent, C. Brewer 26 percent, Alexander and Baldwin 23 percent, Castle and Cooke 10 percent and Theo H. Davis 6 percent. These corporations, known as the "Big Five," also developed extensive control in all other acres of the Hawaiian economy, including pineapple production, the retail merchandise business, electric power, telephone communication, railroad transportation, steamship lines, banking, and later the tourist industry (Takaki 1983:20).

B-7. Modern History (AD 1950-). Post World War II brought about an influx of people and industries to Hawai`i, allowing the tourism industry and offshoot enterprises to flourish. 1950 also marked the introduction of radiocarbon analysis which shifted the focus of study in archaeology from relative dating excavated material cultural remains to carbon dating; this was followed by a research focus on settlement and subsistence patterns, and land and marine use.

Along with the rise of the tourism industry, and competing sugar markets abroad, the sugar companies saw a sharpening decline in business (the Sugar Acts of 1934 and 1937, and ILWU Strike of 1946 didn't help). The 1950s and 1960s were the bleakest years for the sugar industry and it was becoming apparent that the sugar industry was beyond salvage (Kent 1983:107-108). More changes were soon to take place on the landscapes of Hawaii.

In the 1960s, various federal and state environmental and historic preservation laws and regulations were passed, mandating surveys and impact studies of the landscape, prior to development. Technology and mechanization initiated in the 1950s to 1970s helped to bring about the decline of plantation camps and lifestyles, yet in 1959 "one out of twelve people employed in Hawaii was in the sugar industry" (Vorfeld 2002:1). However, technology could not save the sugar industry, which could not compete with unfavorable sugar markets and higher costs. By the 1990s most of the sugar plantations reluctantly closed down operations. The vacant lands soon gave way to various development projects and the need for more Environmental Impact Studies (EIS).

However, the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) and its implementing regulations (43 CFR Part 10) shifted the focus of studies to include a greater interaction with indigenous peoples, and a lesser focus on invasive methods of study. In 2000 Hawai`i Legislature passed an EIS amendment resolution which the governor signed as Act 50. This legislation has broadened the scope of environmental impact studies to include cultural impact studies in order to assure that traditional Hawaiian and other ethnic cultural practices are not adversely impacted by proposed projects, as vacant sugar fields give way to the ever-growing population, expanding tourist and real-estate industries, and other development projects.

C. Traditional Literature

The ethnographic works of the late 19th and early 20th century contribute a wealth of information that comprise the traditional literature--the *mo'olelo, oli,* and *mele*--as well as glimpses into snippets of time, and a part of the Hawaiian culture relatively forgotten. The genealogies handed down by oral tradition and later recorded for posterity, not only give a glimpse into the depth of the Hawaiian culture of old, they provide a permanent record of the links of notable Hawaiian family lines. The *mo'olelo* or legends allow *ka po'e kahiko*, the people of old, the *kupuna* or ancestor, to come alive, as their personalities, loves, and struggles are revealed. The *oli* (chants) and the *mele* (songs) not only give clues about the past, special people and *wahi pana* or legendary places, they substantiate the magnitude of the language skills of *na kupuna kahiko* (the people of old).

C-1. Genealogies. *Po'e ku'auhau* or genealogy *kahuna* (masters) were very important people in the days of old. They not only kept the genealogical histories of chiefs "but of *kahunas*, seers, land experts, diviners, and the ancestry of commoners and slaves…. An expert genealogists was a favorite with a chief." During the time of 'Umi-a-Liloa, genealogies became *kapu* (restricted) to commoners, which is why there "were few who understood the art; but some genealogists survived to the time of Kamehameha and even down to the arrival of the missionaries" (Kamakau 1992:242).

There are several chants from Hawaii and other Polynesian islands referred to as migration chants that expand on the travels of ancient Polynesians and not only explain why they traveled from place to place, and where the traveled, they also give their genealogy illustrating how families are connected from one Polynesian island-nation to another. An example are the chants and stories about Hawaii-loa and famous ancient navigator and discoverer of the islands named after him by Kamakau and Kepelino (PVS 1999; Daniel 2003) [see Appendix F and G].

Surviving genealogies illustrate that the ruling families of each island were interrelated quite extensively. The chiefs of O`ahu, Kauai, Hawaii, Maui and Molokai had one common ancestry. Families branched out, but conjoined several times in succeeding generations (Kamakau in McKenzie, 1983:xxv). Not only were the chiefs or *ali'i* related to each other, they were also related to the commoners. In *Ruling Chiefs,* Kamakau states that "there is no country person who did not have a chiefly ancestor" Kamakau (1992:4). "It is said that the chiefs of Hawai'i island were from Maui and from O`ahu and Molokai between the times of 'Aikanaka and Hanala'anui" (Kamakau, 1991:101).[See Appendix H for *mo`ōlelo* that connects Kipahulu, Maui with Punalu`u/Wailau, Ka`ū, Hawaii Island].

Malo (1987) also wrote about the connection between the *maka'ainana* and the chiefs. "Commoners and *alii* were all descended from the same ancestor, Wakea and Papa" (Malo, 1987:52). This is evident in the genealogies. Genealogies were very important to the chiefs, because ranking was very important. The genealogies not only indicated rank, they ascertained a link to the gods. The following excerpt explains the idea and importance of rank and the role of genealogies:

> Position in old Hawaii, both social and political, depended in the first instance upon rank, and rank upon blood descent—hence the importance of genealogy as proof of high ancestry. Grades of rank were distinguished and divine honors paid to those chiefs alone who could show such an accumulation of inherited sacredness as to class with the gods among men…a child inherited from both parents…. (Beckwith:1990:11).

Ruling chiefs of the various islands came from combinations of genealogies or branches. In this list of Hawai`i Island chiefs most of the people are in a loose chronological order, however, the multiple unions of a particular person is not necessarily in a chronological order, as much of that information was not provided in most cases. Table 1. lists various ruling chiefs of Hawai`i Island. This list is not by any means inclusive as many lesser unions (mates and offspring) were not listed or recorded in official genealogies.

Table 1. Hawaii Line extracted from McKenzie (1983, 1986) and Kamakau (1992).

Kane	Wahine	Keiki
*Hanala`anui	Mahuia	Lanakawai [14 generations before the following]
[*twin of Hanala`aiki progenitor of the Maui Pi`ilani Lines]		
Kauholanuimahu	Neula	**Kiha**nuilulumoku [Kiha 1]
Kiha 1	Waoilea [Ewa, Oahu Chfs]	**Liloa**-a-Kiha
Liloa	Pinea 1 [younger sib of Waoilea]	Hakau [later killed by Umi]
"	Haua [Maui Chfs]	Kapukini
"	Akahiakuleana [←Hana]	Umi-a-Liloa I
Hakau	KukukalaniPae	Pinea 2
Umi	Ohenahena/Hehena	Kamolanuiaumi
"	"	Kahekilinuialokapu
"	Kulamea	Kapunahahuanuiaumi
"	Makaalua	Nohowaaumi
"	**Kapukini/**Kapulani	Kealiiokaloa→Kalaniopu`u/Kamehameha I
"	"	Kapulani
"	"	**Keawe**nuiaumi
"	Piikea-a-Pi`ilani	Aihakoko
"	"	Kumalae→ Aikanaka/Lili`u
"	Kuihewamakawalu	Papaikaneau
"	"	Kuimeheua (k)
"	"	Uluehu
"	Mokuahualeiakea	Akahiilikapu→ Liholiho/Kamamalu
Keawenuiaumi	Koihalawai [Kauai Chfs]	Kanaloakua`ana
"	Hoopiliahae	Umiokalani
"	"	Keawepaikana
Keawe	Hoopilihae	Lililoa 2
Keawenuiaumi	"	Hoolaaikaiwi
Kaulahea [Maui king]	Kalanikauleleaiwi	**Kekuiapoiwa Nui**
Keawe [Hawaii king]	"	Kalani**Keeaumoku**
"	"	**Kekela**kekeaokalani
Kauaunuimahioloii "		Alapainui [Hawaii king]
Lonoikahaupu [Kauai king]	"	Keawepoepoe [Chief-Hawaii/Maui/Oahu/Kauai]
Kaulaheanuiokamoku	Papaikaniau	Kalaninuikuihonoikamoku **Kekaulike**
Kekaulike [sibs]	**Kekuiapoiwa Nui**	**Kamehameha Nui** [Ruling Chf Maui]
"	"	**Kalola**
"	"	**Kahekili**nuihumanu 2 [Iron king of Maui]
"	"	Kuhooheiheipahu (w)
"	"	Naaiakalani
"	"	Manuailehua
"	?	**Namahana**ikaleleokalani [→ Ka`ahumau]
Kalaninuimamao [Ka`ū]	Kamakaimoku	**Kalaniopu`u** *[Hawaii king]
"	"	**Keoua**kalanikupuapaikalaninui→K-I
*[Two fathers: also Begotten by Pele-io-holani, ruling chief of Oahu and Kamakaimoku of Waikele]		
Kalaniopu`u	Kalola [Maui High Chfs]	**Kiwalao**
"	"	Liliha Kakuiapoiwa
"	Kaneikapolei [Maui line]	**Keoua** Kuahu`ula [Ka`ū]
"	"	Keoua Peeale
"	Mu`olehu	Manoua→ Peter Kaeo of Kauai
"	Halau	Kawelaokalani
"	Kamakolunuikalani	Pualinui [→a Lahaina line]
"	Manoua [Ka`ū]	Manono [Died in battle/placed on Mookini altar]
"	"	Kukanaloa [mo`opuna of 3 kings]
Haae	**Kekela**okalani	**Kekuiapoiwa** 2 [Oahu/Maui Chiefess]
Keaoua Kalanikupu	**Kalola** [→Keopuolani]	Kekuiapoiwa 3 Liliha
Keoua KupuapaiKalani	Kekuiapoiwa 2	**Kamehameha I**
"	"	Keliimaikai [Kalanimalokuloku-Kepookalani]
"	?	Kalaimamahu
Keawe Ka`iana	"	KaluaiKonahale Kuakini/John Adams

Table 1. Continued. Hawaii Line extracted from McKenzie (1983, 1986) and Kamakau (1992).

Kane	Wahine	Keiki
Kiwalao [Hawaii Chf] [Sibs]	**Kekuiapoiwa** Liliha 2	Kalanikauika`alaneo **Keopuolani** [Wailuku]
"	Manoua	Kaaimalolo→ Kaeo of Kauai
Kamehameha Nui [sibs]	**Kalola** [Maui]	Kalaniakuaiokikilo/Kalaniwaiakua [Kapu]
" [Cousins]	**Namahana**ikaleleonalani	Pele-io-holani
"	"	**Kuakini**okalani
Kamehameha I	**Kalola**-a-Kumuko`a	?
"	Kanekapolei	Pauli Kaoleioku
"	Peleuli	Kapulikoliko
"	"	Kahoanoku Kina`u
"	**Keopuolani** [Kapu chiefess]	Liholiho [b Hilo]
"	"	Kalanikauikeaouli Kiwala`o [b Keauhou]
"	"	Harriet Nahienaena
"	Kanekapolei	Kaoleioku
Kalaimamahu [K1 sib]	Kaheiheimalie	Kahahaika`ao`aokapuoka/Kekauluohi
Kamehameha 1	"	Kamehameha Kapuaiwa
"	"	Kamehamehamalu Kekuiwaokalani
"	"	Kaho`anoku Kina`u
"	Kauhilanimaka	Kahiwa Kanekapolei [mother of Kepelino]
"	Peleuli	Kinau
"	Kaheiheimalie	Kekuaiwa [Lunalilo Kamehameha]

One could defend and/or prove their rank by knowing or having one's genealogist recite one's genealogy. "To the Hawaiians, genealogies were the indispensable proof of personal status. Chiefs traced their genealogies through the main lines of 'Ulu, Nana'ulu, and Pili, which all converged at Wakea and Papa (Barrère, 1969:24). Two well-known genealogy chants are the *Kumuhonua* and the *Kumulipo.*

C-1-a. Kumuhonua. The *Kumuhonua*, first published by Fornander in 1878, in *The Polynesian Race* Vol. I, was based on information from Kamakau and Kepelino. Kumuhonua, the man, was of the Nanaulu line, and the older brother of Olopana and Moikeha (McKenzie 1986:14-15). However, the birth chant *Kumuhonua* has been a subject of controversy as noted in following *Preface* by Kenneth P. Emory:

> We have become painfully aware that the Kumuhonua 'legends' are not ancient Hawaiian legends, nor is the genealogy which accompanies them a totally authentic genealogy…in his second volume (1880) when he relates events from the period of the arrival in Hawaii of migrant chiefs from Tahiti to the time of Kamehameha, in these writings he is dealing with relatively untampered, authentic Hawaiian traditions and genealogies…we must ever be on guard against the effects of this impact in what was recorded subsequently about the pre-contact period….. The world of the Polynesian began to be transformed overnight by Western influence." (In Barrère, 1969:i)

Barrère (1969) explains that some of the *Kumuhonua* legends were recorded by Kamakau and Kepelino between the years 1865 and 1869, however, the 'genealogy' of the *Kumuhonua*, published by Fornander, was given to him "to provide credibility to the legends…this 'genealogy' (was) constructed from previously existing genealogies--the *Ololo* (*Kumuhonua*) and the *Paliku* (*Hulihonua*) which are found in the *Kumulipo* chant (see Beckwith 1951:230-234) and interpolations of their own invention" (Barrère, 1969:1).

C-1-b. Kumulipo. A better example is the famous Creation Chant *The Kumulipo.* Feher (1969) asks several notable Hawaiian scholars to write passages in his *Kumulipo: Hawaiian Hymn of Creation-Visual Perspectives by Joseph Feher.* In the *Introduction* Momi Naughton states "The Kumulipo belongs to a category of sacred chants known as *pule ho'ola'a ali'i,* 'prayer to sanctify the chief,' which was recited to honor a new-born chief (Feher, 1969:1).

In her passage, Edith McKenzie states:

> The *Kumulipo* is a historical genealogical chant that was composed by the court historians of King Keaweikekahiali'iokamoku of the island of Hawai'i about 1700 AD in honor of his first born son Ka-lani-nui-'I-a-mamao. This important chant honors his birth and shows the genealogical descent of both the *ali'i* (chiefs) and the *maka'ainana* (commoners) from the gods, in particular Wakea…. (Feher, 1969:1).

In a passage by Roger T. Ames, he corroborates this idea and states that "what is of particular humanistic interest is the way in which the *Kumulipo* as a repository of cultural authority served Hawaiian society in transmitting its cultural legacy and organizing its community. In doing so, it combines both a linear sense of temporal development, and the richness of one particular moment in time" (Feher, 1969:3).

C-1-c. Hawaiian Genealogies. Edith McKenzie completed the first volume of *Hawaiian Genealogies* in 1983, based on genealogy articles translated from 19th Century Hawaiian newspapers such as *Ka Nonanona* and *Ka Nupepe Kuokoa* in the late 19th century and early 20th century. These articles were in response to a call to preserve the Hawaiian heritage. Some of the information came from Malo's (1838) *Hawaiian History*, and in Fornander's (1880), *The Polynesian Race* (Book I) (McKenzie, 1983:1).

Youngblood (1992) found that he could draw on both Fornander and Beckwith's translations of *The Kumulipo* to sketch a socio-political history of Hawaii (Youngblood, 1992:34). In his re-creation he found that stemming from Wakea and Papa are two major Hawaiian genealogies: the *Nana'ulu* and the *'Ulu*. The *Nana'ulu* was the wellspring for the *ali'i* of O`ahu and Kauai, while the *'Ulu* line supplied the chiefs of Maui and the Big Island.

Using thirty years to account for one generation, McKenzie determined that Wakea was born in AD 190; Umi-a-Liloa in 1450; Keawekehahialiiokamoku in 1650, Kalanihuiikupuapaikalanui Keoua in 1710; and Kamehameha I in 1740" (McKenzie, 1983:12). Volume Two of *Hawaiian Genealogies* was published in 1986 and consists of information extracted from genealogical lists published in thirteen newspapers from 1858 to 1920. It compliments genealogies found in other works, such as Fornander's (1880) *An Account of the Polynesian Race…* and David Malo's *Hawaiian Antiquities* (McKenzie, 1986:v).

The following excerpt is from Kamakau's article in *Ka Nupepa Kuokoa* October 7, 1865, and was translated by McKenzie (1986). It illustrates some of the mid-19th century sentiment regarding genealogies:

> *I na makaainana, he mea waiwai ole, no ka mea ua papa ko lakou mau makua o hoohalikelike, a hoohanau keiki o ke kuaaina a pii aku i na li`i. Nolaila ia ao ole ia ai na keili a na makaainana, ma kahi makuakane a makuahine, a kupuna aku no…. Ia kakou i ka poe o keia wa, aole waiwai o keia mea he mooalii aole a kakou mau kuleana nui iloko. Aka, ma ko kakou noonoo iho he waiwai nui. Ua komo kakaou iloko, ua waiwai na'lii i na kupuna; a ua waiwai pu kakou i koo kakou ike ana. No ka mea, ua kapu i ka makaainana aole e ike i keai mea. Aka, no ka pii ana i ka naauao a me ke akamai o na keiki a na makaainana; nolali, ua noa na wahi kapu, ua pii waleia. O ke koeana mai o na kupuna oia kahi waiwai.*
>
> To the commoners, a genealogy was of no value because their parents forbad (sic) it lest comparisons should occur and country children be born and rise up as chiefs. Therefore, the children of the commoners were not taught beyond father, mother, and perhaps grandparents…. To us, the people of this time, there is no value of this thing of a chiefly lineage; we have no great interest in it. But in our thoughts it is of great value. We have entered into discussion of it; the chiefs valued the chiefs and ancestors; and we also value our knowledge of it. Because it was forbidden to the commoners, they were not to know this. However, due to the rise of wisdom and skill of the children of the commoners, therefore, all of the ranking privileges were no longer restricted; it was only lifted. What remains of the ancestors is something of value (McKenzie 1986:18-19).

C-2. Mo‘olelo. Legends, stories or *mo‘olelo* are a great cultural resource as well as entertaining. Leib and Day (1979) state in their annotated bibliography of Hawaiian legends, that legends “are a kind of rough history.” They noted Luomala’s idea of the value of legend and myth in the serious study of a culture and her following quote. “To a specialist in mythology, a myth incident or episode is as objective a unit as an axe, and the differences and similarities of these units can be observed equally clearly and scientifically.” Leib and Day also expressed concern about authenticity, and sometimes found it difficult to determine if a legend was a primary or secondary source. The following definitions of terminology, including the Hawaiian classification of prose tales--*mo‘olelo* or *ka‘ao,* come from their work (Leib and Day 1979:xii, 1):

Tradition	used to refer to that which is handed down orally in the way of folklore
Folklore	a rather inclusive term, covering the beliefs, proverbs, customs, and literature (both prose and poetry) of a people
Myth	a story of the doings of godlike beings
Legend	deals with human beings and used interchangeably with ‘myth’… because the collectors and translators of the tales often failed to make the strict distinction
Ka‘ao	“pure fiction”
Mo‘olelo	deals with historical matters and somewhat didactic in purpose… included tales of the gods, as well as tales of historical personages… many have recurring patterns, plots, and types of characters

C-2-a. History of Mo‘olelo Collecting. According to Leib and Day (1979) a substantial number of legends were collected and written in Hawaiian, during the century following Cook’s arrival in Hawaii. A few accounts of the mythology were printed in the journals of missionaries and travelers, and a few of the Hawaiian lore were printed in languages other than English. The following synopses are excerpts from the works of Leib and Day’s (1979), and gives an overview of the first collectors and compilers of Hawaiian myths and legends.

> The missionaries did a more thorough job of writing down the legends than did the explorers and voyagers (Leib and Day 1979:5). William Ellis, who toured Hawaii in 1823, is credited as “chronologically the first important source of Hawaiian mythology. Although (Ellis) deplored the content of the legends, they showed that the Hawaiians had mental powers which might later be ‘employed on subjects more consistent with truth’ (Leib and Day 1979:6).
>
> About 1836 a movement was started under the influence of Reverend Sheldon Dibble, to write down in Hawaiian some of the material dealing with the native legendary history, customs, and other lore. Results of the research were published at the Lahainaluna press in 1838. A partial translation made by Rev. Reuben Tinker was issued serially in 1839 and 1840---the first four installments appearing in ***The Hawaiian Spectator*** and the last four in ***The Polynesian***. In 1841 the Royal Hawaiian Historical Society was formed at Lahainaluna. Some of their research and the earlier *Ka Moolelo Hawaii* were incorporated into Dibble’s *History of the Sandwich Islands* (1843). After his death in 1843 his work was carried on principally by two of his outstanding native pupils, David Malo and Samuel M. Kamakau. Malo wrote his own *Moolelo Hawaii* about 1840 at the request of Rev. Lorrin Andrews, which was later translated by Emerson as *Hawaiian Antiquities.* In 1858 the Rev. John F. Pogue of Lahainaluna printed a third *Moolelo Hawaii,* based on the 1838 history, but included additional material. Kamakau did not print any of his material for thirty years (Leib and Day 1979:7, 8, 9).
>
> The increase in the amount of Hawaiian lore appearing in the native press in the 1860’s and thereafter was at least in part the result of an organized effort to collect and preserve such material. At Kamakau’s instigation a Hawaiian society was formed in 1863 to collect material for

publication in the native press at the time, and also to aid Fornander's research. Fornander was the greatest collector of Hawaiian lore. He credits as sources, several natives whom he sent on tours of the Hawaiian Islands to collect all available Hawaiian lore, as well as Kalākaua, Lorrin Andrews, Malo, Dibble, Dr. John Rae, Kamakau, Naihe, S.N. Hakuole, Kepelino, and Remy. The culmination of this effort was Fornander's (1880) *An Account of the Polynesian Race: Its Origin and Migrations and the Ancient History of the Hawaiian People to the Times of Kamehameha I.* Fornander's collection remains the most important single source of Hawaiian legends (Leib and Day 1979:9, 12, 13).

In June 1865 Kamakau began publishing in *Ka Nupepa Kuokoa,* articles on traditions and legends. His series of articles dealing with Hawaiian history, particularly from the late eighteenth century on, and especially of Kamehameha, appeared weekly in the same publication in October 1866. When the newspaper ceased in 1869, this series continued in *Ke Au Okoa* for nine months. Kamakau then wrote a series on ancient Hawaiian religion, customs, and legendary history in *Ke Au Okoa* until February 1871. All of his writings were in Hawaiian (Leib and Day 1979:8, 9).

Very little work was done in translating Hawaiian mythology into English until late in the nineteenth century. It wasn't until 1888, over a hundred years after the discovery of the Hawaiian Islands, that the first book in English dealing exclusively with Hawaiian mythology was printed; *The Legends and Myths of Hawaii* by King Kalākaua. However, it was more likely authored by former United States Minister to the Hawaiian Islands, R.M. Daggett (Leib and Day 1979:5, 7).

Thrum is one of the most frequently cited authorities on Hawaiian lore. He was born in Australia in 1842 and arrived in Honolulu in 1853. In 1875 he began publication of the *Hawaiian Almanac and Annual*, later known as *The Hawaiian Annual* or *Thrum's Annual*, which appeared yearly under his editorship until his death in 1932. Thrum's contribution is as editor, compiler, and publisher of translations, not translator. By providing in his *Annual* a place for the publication of such material, and perhaps by persuading authors to provide him with translations, he was instrumental in much legendary matter appearing in printed form. Thrum wrote or rewrote a large portion of his own material (Leib and Day 1979: 17).

Thrum's first book *Hawaiian Folk Tales* was published in 1907 and consisted largely of tales that had previously been published in *Thrum's Annual*. Only 35 of the 260 pages were translated by Thrum, the rest were credited to Rev. A.O. Forbes, Rev. C.M. Hyde, William Ellis, J.S. Emerson, Mrs. E.N. Haley, N.B. Emerson, Mrs. E.M. Nakuina, Walter M. Gibson, Joseph M. Poepoe, and M.K. Nakuina. His second book *More Hawaiian Folk Tales,* published in 1923 was similar. A number were translations from Hawaiian language newspapers of half a century earlier, often with no translator cited. Translators credited were A. F. Knudsen, Henry M. Lyman, W. D. Westervelt, J. H. Boyd, and Lahilahi Webb. Some of the chapters were reprinted or abridged from the Bishop Museum translations of the *Fornander Collection*, of which Thrum was editor. His greatest work, *Fornander's Collection of Hawaiian Antiquities and Folklore,* was published by Bishop Museum in 1916 and 1920 in three volumes. The original editor was W. D. Alexander and most of the work completed under his supervision. However, he died in 1913 and Thrum was appointed to complete the production. Beckwith credits John Wise with the original translation of that work. In 1920 or 1921 Thrum completed another work "Ancient Hawaiian Mythology" which was never published (Leib and Day 1979: 18-19).

The most important twentieth-century translators of Hawaiian legends have been N. B. Emerson, Thomas G. Thrum, William D. Westervelt, William Hyde Rice, Laura C. S. Green, Martha Warren Beckwith, and Mary Wiggins Kawena Pukui. Emerson's extensive notes were a major contribution to Hawaiian scholarship. Most of them explain the meanings of Hawaiian words. In many, Emerson alludes to legends, giving a number of them briefly and relating a few in some detail. Some of these probably do not exist anywhere else in print (Leib and Day 1979:14).

**C-2-b. List of Moeolelo associated with Punalu`u and vicinity.** A cursory review of *mo`olelo* sources was done. Marion Kelly compiled *mo`ōlelo* of Ka`ū in 1980 and will be excerpt in this section if they pertain to the Punalu`u area. The following is a list of *mo`olelo* about the lands of Punalu`u and Ninole from *Hawaii Legends Index* vol III (1989) and other sources:

Punalu`u

Green, Laura & Pukui, Mary 1936	"The Blind Men of Maoula" In *Legend of Kawelo*
Thrum, Thos G. 1907 [Appendix H]	"Stories of the Menehune-Laka's Adventures" In *Hawaiian Folk Tales*
Beckwith, Martha 1940 [Appendix I]	"Wahieloa-Laka Cycle" In *Hawaiian Mythology*
Westervelt, W.D. 1916	"Keaunini" In *Hawaiian Legends of Ghosts and Ghost-Gods*

Nīnole

Green, Laura 1928	"The Shark–gods of Kau" In *Folk-tales from Hawaii*
Skinner, Charles 1900	"Ancient Faiths of Hawaii" In *Myths & Legends of our New Possessions & Protectorates*

Wailau [NOTE: This is most likely about Wailau on Molokai Island]

Fornander	"Story of Lonoikamakahiki" In *Fornander Collection of Hawaiian Antiquities and Folklore* (v1)

Legend of Makanau-Nīnole. This legend compiled by Kelly (1980)is about the construction of a *heiau* on top of Pu`u Maka-nau, which can be seen directly inland from Nīnole, and the oppressive chief named Kohā-i-ka-lani who it is said abused his people by working them too hard building it (Kelly 1980:4). One version is excerpted below. The *heiau* was destroyed during the plantation era and only one section remains according Kupuna Pele Hanoa of Punalu`u (2005).

Photo 19. Hill where *heiau* is said to have been built near grove of trees on top.

A chief living in the district of Ka`u directed that a large temple be built and dedicated to the gods to increase his mana. It was built on the top of a high promontory, Makanau, about three miles from the shore. All men in the district were conscripted to transport stones from Kōloa beach at Nīnole. They formed a human chain and passed the stones up to the site in baskets. The Taboo for building such a structure was strict. Not a word could be spoken. If a stone dropped, it could not be picked up. This work took several weeks. When the structure was completed, without giving the men time to tend to their food crops, the chief insisted on erecting a wooden image to be carved from the biggest tree in the forest several miles away. The men became angry but they cut down the tree and dragged it from the forest to the temple site. Instead of allowing it to be brought up the low sloping side of the hill, the chief insisted it be brought up the steepest side.

Photo 20. Pu`u Makanau from Ninole……...

Photo 21. Kōloa Beach next to Nīnole Beach

This last demand was too unreasonable. Together with the priest in charge of construction, the people planned a course of action. Placing the great log heading up the steep incline and securing ropes on it so that the people at the top of the hill might pull it up, the priest then asked the chief to stand under the bottom end of the log and place his hands on it so his great mana as a powerful chief would flow into the log and make it easy for the tired people to pull it to the top. Blinded by his own ego, the chief took the fatal position. The log was hauled up a few feet. The priest giving the signal, the ropes were cut. The thoughtless chief came to his end (Kelly 1956:37).

Photo 22. Kōloa and Nīnole beaches looking southwest.

The legend of Black Sand Beach. According to Kamakau (1961:152-153) the black sands of Punalu`u, Ninole and Koloa were created from the explosive eruption of Kīlauea November 1790. This was the same eruption that annihilated part of Keōua Kuahu`ula's army as they marched past the crater (Kelly 1980:7).

A cinder heap moved from Apua to Punalu`u, Wailau and Ninole (Kamakau 1961:152). In this way, according to Kamakau, the black sand was laid down from Punalu`u to Ninole. The explosive volcanic action of Kilauea in 1790, Kamakau wrote, was caused by Hi`iaka, Pele's sister, who was angry with Keoua for having left Hilo where she was enjoying the fat mullet of Wai-akea (Kamakau 1961:152-153).

Photo 23. Black sand now covers old road way too.

* * * * * * * * * *

**C-3. `Ōlelo No'eau.** *`Ōlelo no'eau* or proverbial/traditional sayings usually had several layers of meanings. They reflected the wisdom, observations, poetry and humor of old Hawai'i. Some of them referenced people, events or places. The following *`Ōlelo no'eau* were compiled by Pukui between 1910 and 1960 with both translations and an explanation of their meaning (Williamson, et al. in Pukui, 1983:vii), which are often more *kaona* (hidden or double meaning) than obvious. The following are references to the place names associated with Punalu`u on Hawaii Island.

'Ōlelo no'eau:	*Hele aku nei `imi i ka `ili`ili hānau o Kōloa.*
Translation:	Went to seek the pebbles that give birth at Kōloa.
Meaning:	Said of one who goes and forgets to come home. These pebbles were found at a small beach called Kōloa, in Punalu`u, Ka`ū (#731, p 81).
'Ōlelo no'eau:	*Ho`i`iI Hīlea i kalo `eka`eka.*
Translation:	Go to Hīlea of the dirty taro.
Meaning:	Said of a careless person. Once, Kohāikalani, a chief of Ka`ū, was living at Punalu`u. Poi was brought for him from various parts of the district, and a tiny speck of taro peeling was found in the poi from Hīlea. The makers of the poi were put to death. To say that someone hails from Hīlea is to say that he is unclean (#1030, p 110).
'Ōlelo no'eau:	*Ka `ili`ili hānau o Kōloa; ka nalu ha`i o Kāwā.*
Translation:	The reproducing pebbles of Kōloa; the breaking surf of Kāwā.
Meaning:	In Punalu`u, Ka`ū, is a small beach called Kōloa. The pebbles found here were believed to reproduce--smooth ones being males and the porous ones, females. These were considered the best on the island of Hawai`i for hula *`ili`ili*. Kāwā is just beyond Kōloa toward Honu`apo (#1404, p 152).
'Ōlelo no'eau:	*Ku ka hale I Punalu`u I Ka-wai-hū-Kauila.*
Translation:	The house stands at Punalu`u, at the gushing water of Kauila.
Meaning:	Said of one who found peace and comfort at last. Ka-wai-hū-Kauila is a spring, the gift of a turtle goddess to the people of Punalu`u, Ka`ū (#1887, p 203).

'Ōlelo no'eau:	*`Ohu`ohu Punalu`u I Ka-wai-hū-Kauila.*
Translation:	Punalu`u is adorned by the rushing water of Kauila.
Meaning:	Refers to Punalu`u, Ka` ū (#2380, p 260).
'Ōlelo no'eau:	*Punalu`u, I ke kai kau ha`a a ka malihini.*
Translation:	Punalu`u, where the sea dances for the visitors.
Meaning:	Punalu`u, Ka` ū, Hawai`I is said to be the place where the sea dances to delight the visitors (#2746, p 300-301).

* * * * * * * * * *

C-4. Place Names. Hawaiians of old generally named everything; from winds and mountains, to rocks, springs, canoes, taro patches, fishing stations, and "the tiniest spots where miraculous or interesting events are believed to have taken place" (Elbert in Pukui et al., 1974:x). They all represented a story, some known only locally, while others became legendary.

Table 2. Annotated place names of Punalu`u and vicinity.

Hīlea	Village, gulch, and land division, Honu`apo qd., Ka`ū, Hawai`i (see PE) Lit., *careless* (Pukui et al., 1976: 45). Freshwater springs in this area (Kelly 1980:10).
Kō-loa	Beach at Punalu`u, Ka` ū, Hawai`i, where birthstones (*`ili`ili hānau*) were said to reproduce (Pukui et al., 1976:116).
Moa`ula	Land sections and gulches, Honu`apo, Mauna Loa, and Pahala qds., Hawai`i; originally called Mo`a`ula (Lit., *cooked red* [by Pele's fires]) (Pukui et al, 1976:153).
Nīnole	land section, homesteads, village, cove, and gulch, Honu`apo qd., Hawai`i. There are freshwater springs at Nīnole…. A cannibalistic *mo`o*, Kaikapū (hag), lived at Honu`apo Nīnole; her pretty granddaughter led travelers to her cave, where she ate them raw (HM 264). Lit. *bending* (Pukui et al., 1976:165).
Punalu`u	Land sections and gulches, Honu`apo and Pāhala qds.; harbor, landing, black sand beach and beach park, and ancient surfing area (Finney and Houston 26), Honu`apo qd.; village and *heiau*, Puna qd., south Hawai`i. A cannibalistic *mo`o*, Kaikapū (hag), lived here; she was killed by Laka and his helpers (HM 263). Stream, Mauna Loa qd., Hawai`i (Pukui et al., 1976:194). Famous for fresh-water springs-land and ocean (Kelly 1980:10).
Wai-lau	Land section, Honu`apo and Pāhala qds, Hawai`i (Pukui et al., 1976:224).Lit., *many waters* (Kelly 1980:10).

D. Historic References.

By and large "Historic References" pertain to notable historic events, overviews of important place names and land tenure within the project area and districts. One of the most significant practices in the history of the Hawaiian people was their concept of the stewardship of the land. However, over time, these practices were replaced by more western methods of land use, as the lands of Punalu`u went from the domain of the *ali`inui* to the monarchy, to various individuals and corporate entities.

D-1. History of Land Divisions. It was during the time of Kahaukapu of Hawaii and Kaka'alaneo of Maui [also said to be the time the Spanish first came with Ku-kanaloa (Kamakau 1991:324] that the division of lands is said to have taken place under a *kahuna* named Kalaihaohi'a. He portioned out the lands into districts, sub-districts, and smaller divisions, each ruled over by an agent appointed by the landlord of the next larger division, and the whole under control of the ruling chief over the whole island or whatever part of it was his to govern (Beckwith 1970:383). Each island was divided into *moku* or districts that were controlled by an *ali'i 'ai moku.* Within each of the *moku* on each island, the land was

further divided into *ahupua'a* and controlled by land managers or *konohiki*. The boundaries of the *ahupua'a* were delineated by natural features such as shoreline, ridges, streams and peaks, usually from the mountain to the sea, and ranged in size from less than ten acres to 180,000 acres (Moffat and Kirkpatrick 1995:24-29, see also Chinen 1958:3).

Each *ahupua'a* was often divided and sub-divided several times over (i.e., *`ili, kuleana, mo'o, pauka, koele, kiha pai*), answerable to *ali'i* where the lesser division was located. However the *`ili kupono* or the *`ili ku* was "completely independent of the *ahupua'a* in which it was situated…tributes were paid directly to the king himself" (Chinen 1958:4). Rights to lands were mutable or revocable; a ruling chief or any "distributor" of lands could change these rights if displeased, or as favors--usually after a victorious battle, and after the death of the *ali'i nui* (Chinen 1958:5).

During the period between 1839 to 1855, several legislative acts transformed the centuries-old Hawaiian traditions of *ali'i nui* land stewardship to the western practice of private land ownership. In the first stage, King Kamehameha III (Kauikeaouli) divided up his lands among the highest-ranking *ali'i* (chiefs), *konohiki* (land managers), and favored *haole* (foreigners) (Chinen 1958:7-14; Moffat and Fitzpatrick, 1995:11, 17). This historic land transformation process was an evolution of concepts brought about by fear, growing concerns of takeovers, and western influence regarding land possession. Kamehameha III, in his mid-thirties, was persuaded by his *kuhina nui* and other advisors to take a course that would assure individual personal rights to land.

One-third of all lands in the kingdom would be retained by the king; another one-third would go to *ali`i* or chiefs as designated by the king. In 1846 he appointed a Board of Commissioners, commonly known as the Land Commissioners, to "confirm or reject all claims to land arising previously to the 10th day of December, AD 1845." Notices were frequently posted in *The Polynesian* (Moffat and Kirkpatrick, 1995). However, the legislature did not acknowledge this act until June 7, 1848 (Chinen 1958:16; Moffat and Kirkpatrick, 1995:48-49), known today as *The Great Mahele*. "The *mahele* did not actually convey title to the various *ali'i* and *konohiki*; it essentially gave them the right to claim the lands assigned to them--these lands became known as the *konohiki* lands. The *konohiki* chiefs were required to present formal claims to the Land Commission and pay a commutation fee, which could be accomplished by surrendering a portion of their land to the government." The government could later sell these lands to the public in the form of Grants. Upon payment of the commutation fee, the Minister of Interior issued a Royal Patent to the chief or *konohiki*. The last one-third was originally designated to the *maka'ainana*, but not acted on--instead it was set aside to the government, "subject always to the rights of the tenants" (Moffat and Kirkpatrick, 1995:41-43; see also Chinen 1958:15-21).

`Ili kupono* were the only *`ili (parcel) recognized in this process, all the *`ili* and lesser divisions were absorbed into the *ahupua'a* claim (Chinen 1958:20). In 1892 the legislature authorized the Minister of Interior to issue Royal Patents to all *konohiki* or to their heirs or assignees where the *konohiki* had failed to receive awards for their lands from the Land Commission. The Act further stipulated "that these Royal Patents were to be issued on surveys approved by the Surveyor General of the kingdom" (Chinen 1958:24; Moffat and Fitzpatrick 1995:41-43). Kamehameha III formalized the division of lands among himself (one-third) and 245 of the highest-ranking *ali'i* and *konohiki* (one-third) between January 27 to March 7, 1948. He acknowledged the rights of these individuals to various land divisions in what came to be known as the *Buke Mahele* or 'sharing book.'

**D-2a. Nīnole, Wailau and Punalu`u Land Commission Awards (LCA).** Maps illustrating locations of Land Commission Awards (LCA), Mahele Awards or *kuleana* lands in the *ahupua`a* of Nīnole, Wailau and Punalu`u. were excerpted from Kelly's (1980:64-66) report. Data for the three Tables (3-5) following the maps came from the Waihona Mahele and Boundary Commission Databases (*Waihona `Āina, Inc.*) (see Appendix J for additional information).

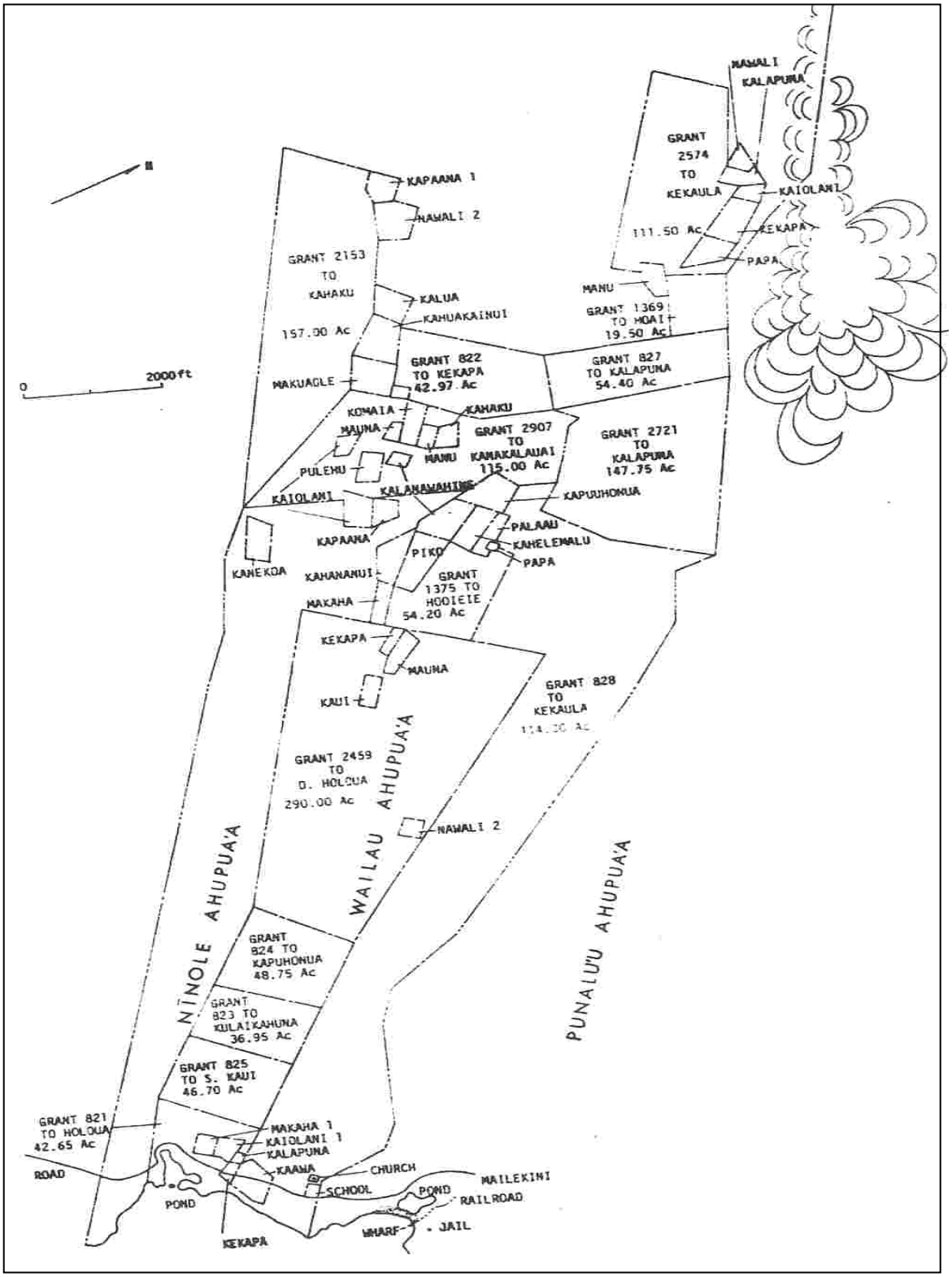

Figure 4. Mahele Awards in the *ahupua`a* of Nīnole and Wailau (Kelly 1980:64).

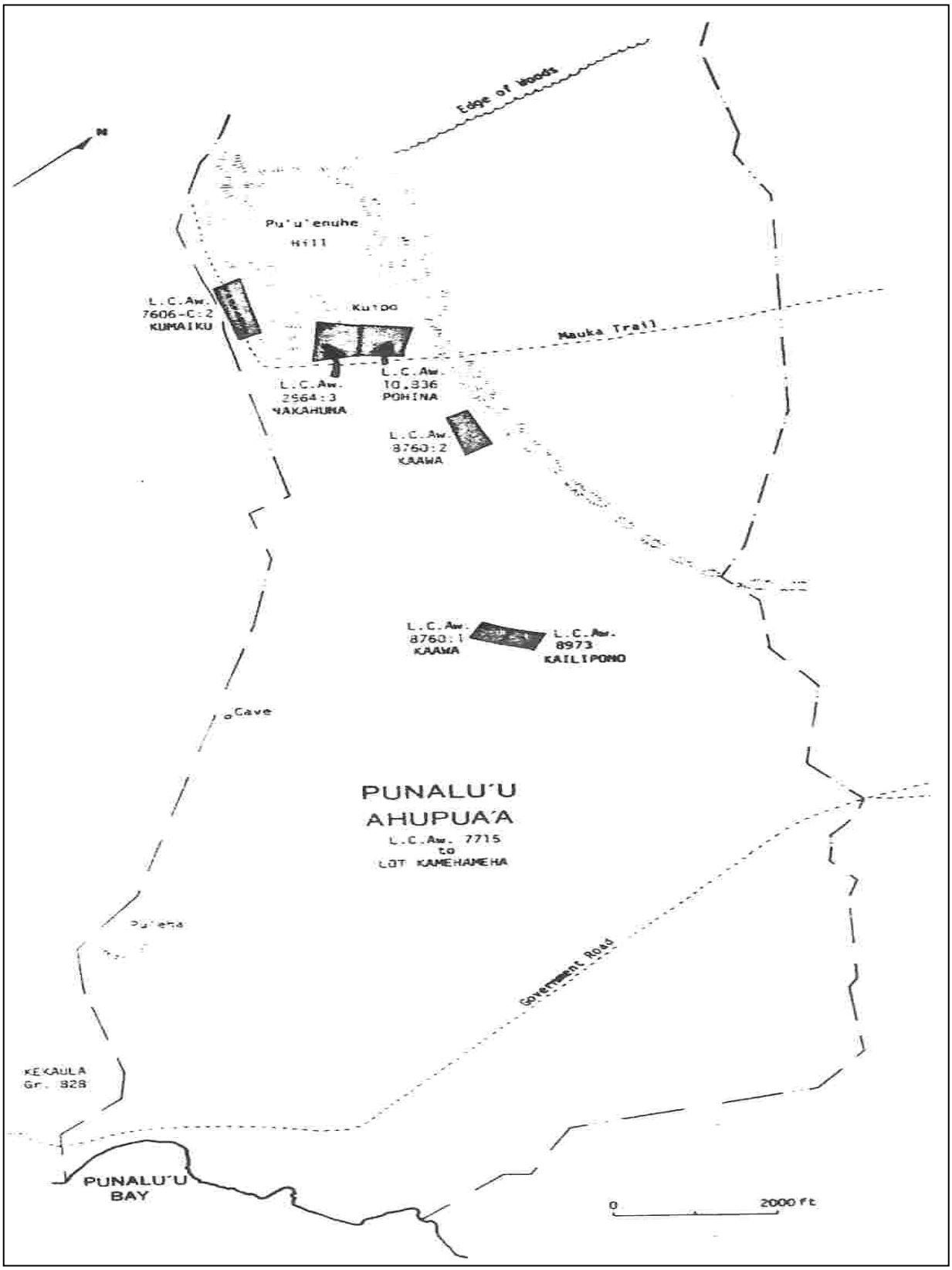

Figure 5. Mahele Awards in the *ahupua`a* of Punalu`u-mauka (Kelly 1980:65).

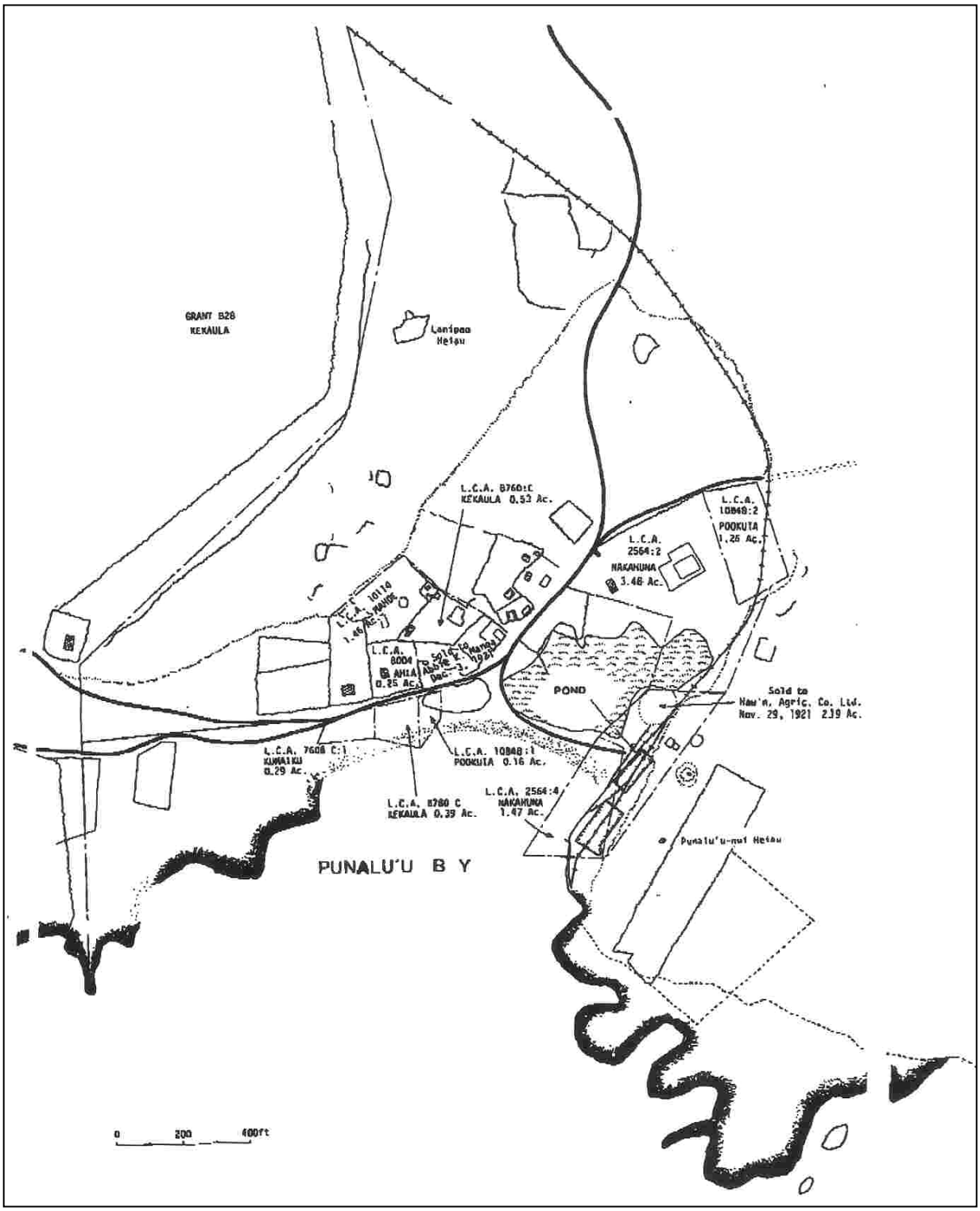

Figure 6. Mahele Awards in the *ahupua`a* of Punalu`u-makai (Kelly 1980:66).

D-2b. Tables 3-5 include Mahele Awards for the ahupua`a of Nīnole, Wailau and Punalu`u. An additional "*ahupua`a*" of Moaula appears to be located between Punalu`u Wailau and Nīnole is located next to Wailau. Several *`ili* and *mo`o* names taken from Native Testimonies are also listed in the following tables, as are crops, natural features such as streams and man-made features such as *heiau*.

Table 3. Nīnole Ahupua`a Mahele Awards (LCA)

LCA #	Claimant	Place Names (*mo`o/`ili*)	Crops/Features	Other
7721	Makaha	Keopuka, Paako, Waihi	mamake, 2 ponds	squid-spearing
8360 8853	Kanekoa	Waihi, Keopuka, Haukoi	10 mala of taro, 4 mala `uala, stream	house lot
8758	Kaiolani	Waihi, Puako, Pue, Paako	bamboo, lauhala, various kihapai, streams, umu ahua	house lot, goat corral
8760DD	Kahuakainui	Paako, Makenala	mo`o, olona & wauke fields	stream
8782	Kalua	Makenala, Paako, Pia	taro lo`i, wauke, stream	house lot
8790	Kahananui	Pue, Paako, Haukoi, Keopuka	taro lo`i n all 4 mo`o, stream	pig enclosure
8792	Kapuuhonua	Kapio, Ninole Hill	wauke field	
8793	Kalanawahine	Makalena, Pakanaka, Haukoi	wauke, cane, banana fields, lo`i	stream
8794	Kahaku	Pakanaka, Makenala	wauke, `uala, spring, stream	house lot
8853	Kanekoa	See above 8360		
8853B	Nawali	Pue, Paako	taro lo`i in both mo`o	
8979	Kekapa		farming fields- 2 taro, wauke	
9167	Komaia*	Haukoi, Makenala, Pue, Kupoho Heiau	13 various kihapai, lauhala, mo`o, farming fields, stream	house lot, stream
9204	Kapaana	Kakuoi, Makenala, Pue, Pia	various crop fields, taro, mo`o	
10093	Manu	Kamaoa	3 kihapai-taro, 1 mala `uala	
10112	Mauna	Pueo, Makenala	2 taro lo`i, 3 kihapai-wauke, 1 kihapai-sugar cane	
10115	Makuaole	Paako, Keopuka	3 mo`o, field wauke	house lot
10510	Nawali	Makenala, Pue, Paako	3 kihapai-taro, kihapi-pumpkin, kahapai-`uala, 6 kihapai-olona	house lot, umu ahua
10844	Papa			
10847	Pulehu	Haukoi, Pue-Pakanaka	mo`o, fields, kihapai	

* Konohiki

Table 4. Wailau Ahupua`a Mahele Awards (LCA).

LCA #	Claimant	Place Names (*mo`o/`ili*)	Crops/Features	Other
7313	Kaawa	Aalu, Homaikolono	Orange tree, other trees	fenced, 2 house lots
7557	Kalapuna	Homaikalono, Lani, Aalii	taro field, farm fields, `ili, kula lands	2 house lots one by school
8360	Kanekoa		3 mala of taro	
8758	Kaiolani	Lani, Aalii, Homaikalono	taro lands	
8792	Kapuuhonua	Aalu, Aalii	mo`o, large koa tree	extends to sea
8794	Kahaku	Kalanokio	7 kihapai-wauke, coconut grove, `uala, spring	house lot
8979	Kekapa	Homaikalono, Lani, Kukui	4 farm fields-taro, wauke	house lot
10112	Mauna		wauke	
10115	Makuaole	Aalii	mo`o	
10510	Nawali	Manowai	kihapai-taro, `uala, wauke	
10844	Papa	Laui/Lani, Aalii, Kapio	kihapai-taro, mo`o, wauke field	house lot
10846	Palau	Kaohia, Laui, Aalii	`ohia mo`o, 5 olona kihapai	

Table 5. Punalu`u Ahupua`a Mahele Awards (LCA).

LCA #	Claimant	Place Names (*mo`o/`ili*)	Crops/Features	Other
2564	Enos Nakahuna*	Puaniki, Mailehahei, Puupuna, Koloahiu, Punalu`u Heiau	4 taro lo`i, 3 mo`o, wauke, banana, Enube Hill, Punaluu	house lot, fishponds
7312	Moses Keawe		2 taro kihapai by Punaluu pond	
7557	Kalapuna	Kaawili, Kaaipua`a	kihapai	
7606C	Kumaiku	Puehu,	mo`o	
7715	Lot K.	Puehu	mo`o	
8004	Ahi/Ahia	Mohokea, Puehu, Puhaka	2 lo`i, 1 kihapai-taro, 2 mala of `uala, 1 kihapai-wauke, 1 mala of taro	house lot
8758	Kaiolani		Lauhala grove	
8760	Kaawa	Pahaa, Pahoa, Moaula	mo`o, kihapai-olona, māmaki, 6 taro, stream	4 house lots
8760C	Kekaula	Kuipoi	mo`o, hau, coconut trees; by church lot and Punaluu pond	house lot
8760D	Waiahulu	Moaula-Kaimukule	mo`o	house lot by Punaluu stream
8785	Kookoo**	Puaniki, Kaholoakiu	3 kihapai-taro, 1`uala, stream	house lot
8973	Kaliponi	Moaula, Huokekahi,	mo`o, kihapai-taro, `uala, streams, from sea to olona	house lot
8981	Iaea	Keauakapuaa, Haekapala, Moae	5 kihapai-taro, 1 of wauke, 2 mo`o, Moaula stream, Molokea or Mohokea stream	house lot
10118	Mulehu**	Moaula:Palahalaha, Nahaekapala, Kamuku	4 kihapai-taro, 5 fallow kihapai, firewood section, stream	house lot, hog enclosure
10118	Mulehu**		1 kihapai-wauke, 1 lo`i, stream	
10119	Mahoe	Moaula: Kalawa, Haekapala, Kaumukiele, Puukilei, Mohokea, Keopu	5 farm plots, 3 kihapai-taro, 1 kihapai-`uala, bananas, by Moaula stream 3 farm plots, 2 mo`o	house lot by sea
10450	Namakaelua		2 lo`i, by Punalu`u pond	
10522	I. Nakahuna**	Pohakukee to Kaohia	5 mo`o, 12 koele	
10836	Pohina	Moaula, Puhaku, Naono	mo`o, kihapai-taro, bananas, 3 `uala, wauke	house lot
10848	Pookuia	Koloakiu, Puehu	1 `ili, 5 kihapai of taro, 1 of wauke, 1 of `uala, Punalu`u hill, Punalu`u loko, stream	house lot
10875	Puana	Kalawa/Moaula, Mohokea, Kaumuokiele	1 kihapai-taro, mo`o, kihapai, Moaula stream	house lot, by school house
11005	Waiwaiole**	Moaula	1 `ili, wauke, 3 farm plots	

*Konohiki **Not Awarded

D-2b. Summary of LCA/Kuleana Land-Use Patterns of the mid-1800s. Most LCA claims were for multiple sections (e.g., *mo`o, mala, `ili, kihapai*) within one *`ahupua`a* or multiple *ahupua`a.* Both awarded land claims and land claims not awarded were fully utilized and had at least one house lot and a wide range of land use--mostly farming with a few indications of animal husbandry (e.g., goat and pig enclosures). The high level of farming included wet/dry taro farming, *wauke, `uala* or sweet potato, banana, sugar-cane and pumpkin cultivation. Coconut and lauhala groves and *hau* were also mentioned; as were fields of *mamake, olona* and bamboo, and individually planted orange and *koa* trees. Several *kuleana* were located alongside streams (e.g., Nīnole, Mo`a`ula, Mohokea and Punalu`u streams), a few shared boundaries with Punalu`u fishpond and other ponds in Nīnole and a few included natural springs. Interestingly, a two mentioned fish houses (e.g., *umu āhua*) as part of their claim and one included a squid-spearing area. At least two schools and one church were in this area in the mid-1800s.

D-3. Traditional Land History of Project Area. The traditional history would have included various land uses and settlement patterns. As the early Polynesians first settled in the Ka`u District they would have looked for areas with fresh water, easy access to the ocean, good soils for planting their crops, and areas that supplied material for constructing their homes and other structures. These settlers most likely were families that were run by the head of the family and later as the population grew, by a council.

Sometime around the AD 1100s each district had a ruling chief. However, there appeared to be times that a ruling chief emerged who controlled whole islands. Centuries later, the lands were organized as land divisions (*ahupua`a*) with ruling chiefs assigning land managers or *konohiki*.

In the 1700s, Kalani`opu`u was a ruling chief who had suzerainty over the island of Hawaii. His father, Kalani-nui`i-a-mamao (son of Keawe, ruling chief of Kohala, Kona and Ka`u, who also fathered chiefly children in Molokai and Kauai--before he died he decreed that his son Kalani-nui`i-a-mamao rule Ka`u and another son Ke`eaumoku, rule Kona and Kohala ), was a ruling chief of Ka`u (Kamakau 1992: 65, 122; Day 1984:65) whose birth or family lands were located in Honomalino, Kahuku, Ka`u (area of the green sands beach); he also spent time in Punalu`u (Josephides 2006). Kalani`opu`u's son Kiwala`o became the ruling chief of Hawai`i Island in 1782 when his father died. However, Kiawala`o's younger brother Keoua Kuahu`ula and he decided to join forces against their cousin, Kamehameha who was conspiring against Kiwala`o as ruling chief of Hawai`i Island. This developed into a civil war in which Kiwala`o was killed at Ke`ei by his uncle Ke`eaumoku (husband of Namahana-sister of Kiwala`o's mother, Kalola) after being felled by a sling-stone during the battle. After Kiawala`o's death the island was divided up between Keawe-ma`u-hili, brother of Kalani`opu`u (Hilo and southern Hamakua), Kamehameha (Kona, Kohala, northern Hamakua) and Keoua Kuahu`ula (Ka`u and Puna) (Kamakau 1992:119-122; Day 1984:65, 77, 79), who went back to Ka`u (Kamakau 1992:120-121). His seat of government in Ka`u was said to be Punalu`u where the *kuleana* lands of Mahoe (#10119) is located (Josephides 2006).

It was a time after Isaac Davis and John Young were made *aikane punahele* of Kamehameha, that Kamehameha asked Keawe-ma`u-hili for canoes, men and feather capes to supply a war expedition to Maui to fight ruling chief of Maui, Kalani-ku-pule, son of Kahekili. Keawe-ma`u-hili consented causing an irreparable rift between he and Keoua Kuahu`ula (Kamakau 1992:147). Keoua heard about it and promptly waged war on Keawe-ma`u-hili and killed him; he then went on to plunder Hamakua, Waimea and Kohala, taking advantage that Kamehameha was still on Molokai waiting for Kalola (wife of Kalani`opu`u, sister of Kahekili and aunt of Kalanikupule) to die, so he could bring her daughters and granddaughter to Hawai`i Island as his spoils of war (Kamakau 1992:151).

Kamehameha returned and pursued Keoua to Hamakua where a battle took place with heavy loses on both sides and none a victor. Kamehameha went back to Waip`io and Kohala, while Keoua went on to Hilo where he divided the land among his warrior and chiefs. With this accomplished he went on to Ka`u via Ola`a and on past the crater to Kapapala where his rear division was annihilated by the volcanic ash fall (November 1790). One cinder cone "moved straight down toward the sea at Apua and in les than two weeks reached the sand at Punalu`u, where Keoua Kuahu`ula was staying at the time under tabu." The cinder heap was said to have moved along the sand to Punalu`u beach where it was prevented from moving any further by th highlands of Punalu`u, Wailau and Nīnole. A *kahuna* told Keoua that this event happened because Hi`iaka was upset with him for leaving Hilo (Kamakau 1992:152).

Several more skirmishes and battles took place especially after Ka`iana and his brothers from Kauai joined Kamehameha's army. After Kamehameha constructed the *heiau* Pu`u Kohola at Kawaihae (AD 1791), he sent his counselors Keawe-a-heulu and Ka-manawa to Ka`u to get Keoua, who was now living in *mauka* Kahuku wit his warrior and guards. Keoua ordered that they not be killed because they were younger brothers of his father, who said they came to get him so peace could be made between him and his cousin Kamehameha and they could co-rule. However, Keoua must have felt otherwise because he

mutilated his genitals at Kekaha just before going on to Pu`u Kohola and his eventual death (Kamakau 1992:156-157). The district of Ka`u then came under the rule of Kamehameha. A footnote states that the "people of Ka`u retain their love of Keoua and their hatred for Kamehameha" (Kamakau 1992:158).

By the mi1800's Native Testimonies to the Land Commission indicated that *konohiki* still lived in the *ahupua`a* they were responsible for; Punalu`u (Nakahuna) and Nīnole (Komaia). However, in many ways the Mahele brought about great changes as lands were re-assigned by King Kamehameha III. The *ahupua`a* of Nīnole, Wailau and Mo`a`ula were first set aside as Crown lands or personal lands of Kamehameha III. Punalu`u (RP 6885) was assigned to Lot Kamehameha Kapuaiwa (King Kamehameha V) as was Hīlea-iki (RP 7621). Lot died intestate on December 11, 1872 and Princess Ruth was declared his heir (Barrere 1994:273-274). Nīnole later went to William Lunalilo, who died February 3, 1874; his personal property went to his father, Charles Kanaina and his lands were sold to establish and maintain Lunalilo Home for the elderly. Later the *ahupua`a* of Wailau and Moaula became Kingdom or Government Lands and Hīlea-nui went to William P. Leleiohoku (Baker & Baker 1989:14, 16, 31, 60, 100, 103, 155) the younger brother of Kalakaua and Lili`uokalani; he was adopted at birth by Princess Ruth (Day 1984:84). However, he was also said to be the natural son of Kalanimoku and Kiliwehi (Barrere 1994:410). Nīnole also later became government lands in lieu of commutation fees (Kelly 1980:ix).

Punalu`u was known as a fishing village with a large bay that teemed with fish and turtles. And according to Kelly (1980:10), Punalu`u, Nīnole, Hīlea and Honu`apo had several brackish ponds used to cultivate mullet and wet taro. In spite of this abundance, these lands are located in a district known for its aridness and historic fires (1830, 1831, 1845 and 1846) that burned homes, crops and other vegetation causing large-scale famine. Along with drought, free-ranging cattle and horses also damaged crops and local vegetation (Kelly 1980:14). But as illustrated above, by the mid-1800s, residents of the area appeared to be re-bounding according to their native testimonies.

However, once land came into the possession of individuals, it was much easier for outsiders, such as sugar planters to later acquire these lands. By 1880 there were three mills in the Ka`u District; the largest one located in near-by Pāhala, a fourth being constructed in neighboring Hīlea, as well as five plantations without mills – all importing foreign laborers (Kelly 1980:15). The landscape of traditional crops and lifestyle was seemingly changing over night into fields and fields of sugar cane, from the low elevations to the mountain areas where the abundance of mountain spring water allowed fluming the cane to the mills (Kelly 1980:17).

**D-4. Punalu`u Harbor and Landing.** Boat landings such as Punalu`u Landing were retained by the Government (Kelly 1980:ix). The harbor and landing served the communities of Punalu`u and Nīnole and the sugar plantation at Pāhala and was considered the "port town for the district in 1880" (Bowser 1880:555 In Kelly 1980:18). For a while it also served as a landing for visitors going to the volcano area and a warehouse located there was used as cargo storage for the steamers that stopped by every two weeks (Kelly 1980:18). The following is from Stokes (1991:132) who conducted archaeological field studies in Ka`u in October and November 1906 (Dye 1991:12) [see also Kelly's (1980:75) report, Appendix A by John F.G. Stokes (manuscript)] [more in Section E of this report]:

> H*eiau* of Kāne`ele`ele, Mailekini, Halelau, or Punalu`u-nui, land of Punalu`u, Ka`ū. Located east of and adjoining Punalu`u wharf and warehouses, which are probably built on the *heiau* premises. Pu`u Ehu benchmark bears 122°37, 4532 ft. This *heiau* probably extended to near the edge of the cliff bordering Punalu`u Bay, and its western boundary was destroyed when the face of the cliff was graded for the wharf and the first warehouse built before 1906. Since that date another, larger warehouse had been erected, and the man in charge of the work informed me that he had dug into a high bank of artificially laid stones, and during the work came across a pit about 10 ft. deep and "full of bones." The site of the bone-pit is now occupied by the concrete base of the warehouse engine, at the south-east corner of the building, a mark which will no doubt remain for some time.

Photos 24 & 25 . Remnants of Punalu`u Landing.

**D-5. Punalu`u and Nīnole Fishponds.** Fishpond aquaculture in Hawai`i was considered to be the most sophisticated and complex method of fish farming in all of Oceania. Fishponds included natural enclosures inland from the shoreline utilizing local spring(s) (e.g., *loko wai, loko i`a kalo, kaheka* and *hapuna-puna*) and seeping sea water (e.g., *loko pu`uone*to completely man-made structures in the ocean connected to the shore (*loko kuapā*). In the *mo`ōlelo*, the first fishponds were created to have been built by the gods Kāne and Kanaloa on O`ahu, however, the majority of the fishponds throughout the islands were said to have been built by *Menehune* who some say are mythical, while others say they were the masons or architects of the first inhabitants to the islands (Farber 1997:6-10). A few are attributed to various chiefs. Traditionally fishponds were considered an asset belonging to the ruling chief where certain favorite fish could be cultivated.

However, when the lands where divided by Kamehameha III in the Great Mahele, these resources were included. In 1850 the Kingdom government began selling "government" lands, but specifically excluded landings and fishponds. However, they did lease some of them in auctions for periods of one to five years. The Punalu`u and Nīnole fishponds were noted in the legend of the cruel chief Koihala who was killed after his over-worked people turned on him. It appears that they have lost their original splendor and usefulness--Nīnole as early as 1852 when a surveyor reported that the pond had no fish, just slime and hogs that lived in it (Kelly 1980:25-26). Today the fishponds of both Punalu`u and Nīnole are being over-taken by alien vegetation, which the local community tries valiantly to keep at bay.

A map of 1875 [Figure 7.] indicates a canal that was dug from Punalu`u Bay to the Punalu`u fishponds with a wharf located alongside the canal; “this canal was dug to provide a safe, quiet place where cargo discharged from a ship in the harbor could be handled safely and smoothly by barge (*Hawaiian Gazette* Nov 13, 1878 In Kelly 1980:30).

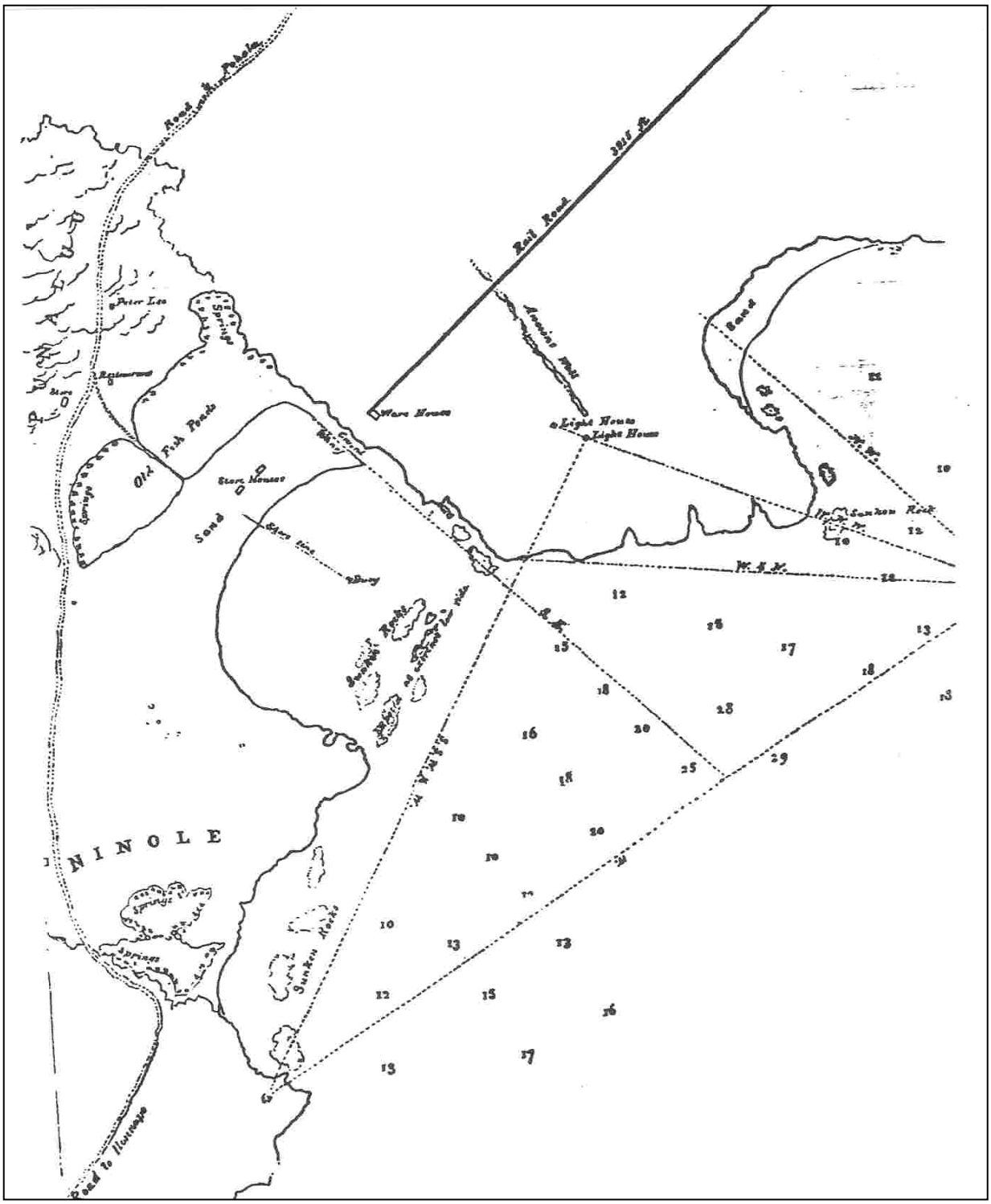

Figure 7. Punalu`u Bay, Fishponds and Canal (by Willfong & Andrews 1875 In Kelly 1980:32).

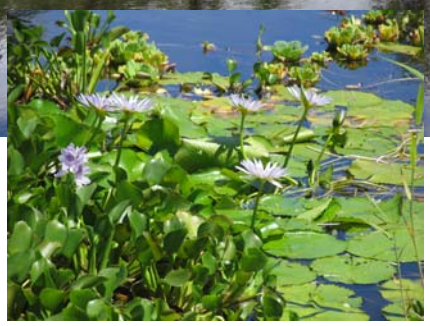

Photo 26. Picturesque Punalu`u Fishpond.

Photo 27. Pretty, but alien vegetation in fishpond.

Photo 28. Alien ducks in a Nīnole pond with alien vegetation.

Close-up of the ducks

Photos 29 -32. Various ponds now at Nīnole

D-6. Kōloa Beach, Nīnole. An area very significant to cultural practitioners is Kōloa Beach in Nīnole Ahupua`a because of a phenomenon that occurs there. Porous basalt is said to give birth (*hānau*) to little (*`ili`ili*) black pebbles which are sometimes used for healing purposes.

> ***`Ili`ili Hānau O Kōloa*.** These stones appear today on what Rev. William Ellis [1823] described as a "short pebbly beach, called Koroa, the stones of which were reported to posses very singular properties, among other that of propagating their species" (Ellis 1963:145). He described the stones, saying "the black ones appeared to be pieces of trap, or compact lava. The white ones were branches of white coral common to all islands of the Pacific. The angles of both were worn away, and a considerable polish gaven (sic), by the attrition occasioned by the continual rolling of the surf on the beach" (Ellis 1963:146). Residents told Ellis that Koroa was:
>
> > "a *wahi pana* (place famous) for supplying the black and white *konane* stone; and also the stones for making small adzes and hatchets, before they were acquainted with the use of iron, but particularly for supplying the stones of which the gods were made, that presided over most of the games of Hawaii. Some powers of discrimination, they told us, were necessary to discover the stones, which would answer to be deified. When selected, they were taken to the *heiau,* and there several ceremonies were performed over them.
> >
> > Afterwards, when dressed and taken to the place where the games were practiced, if the party to whom they belonged were successful, their fame was established; but, if unsuccessful for several times together, they were removed for the purpose of being transformed into gods, one of each sex was generally selected, and were always wrapped up very carefully together in a piece of cloth. After a certain time, a small stone would be found with them, which, when grown to the size of its parents, was taken to the *heiau,* and made afterwards to preside at the games (Ellis 1963:145-146 In Kelly 1980:33-34).

Photos 33 - 35. Various size/type rocks and pebbles at Nīnole.

According to Kelly (1980:34) the birthstones or *`ili`ili hānau* were collected by Emerson at Kōloa and he wrote the following in his catalogue:

> *Iliili* Koloa or breeding stones which abound on the beach of Koloa, Kau, Hawaii. These are simply beach worn pebbles. The interest attaching to them from the curious belief still held by many natives with whom I have conversed that they are of different sexes and beget off-spring which increase in size and in turn beget others of their kind. The males are of a smooth surface without noticeable indentations or pits. The females have these little pits in which their young are developed and in due time separate from their mothers to begin independent existence (Summers ms:200).

For those who doubt the veracity of this report, the following article which appeared in the *Hawaiian Gazette* in1922, is offered:

Na`ili`ili Hānau o Kōloa (Breeding Pebbles of Koloa)

> Very famous are the breeding pebbles of Koloa, Ka`u, because of their breeding. It is declared to be true by many Hawaiians rhat the pebbles breed, but it is puzzling and hard for the *haole* to believe, unless they see them with their own eyes--like Thomas. A few days ago Paul Ke`a came into this office with some of the breeding pebbles of Koloa, perhaps not the very pebbles that gained fame for their peculiarities, but certainly their descendants, the fifth or sixth generation, perhaps, or even many generations since these pebbles began to multiply…. He left them in a tub with sand for two years and they overflowed the tub…. The breeding pebbles of Koloa are on exhibition in the window of the newspaper company, *The Hawaiian Gazette* and they are objects of amazement to the *haole*…. The appearance of these pebbles is that some aere smooth and some full of holes. The little pebbles come from those with holes and it is believed that these are the females and the smooth ones, males (Kelly 1980:35-36).

The following from Kelly (1980:36) was in the Hawaiian newspaper *Ka Napepa Kuokoa* on February 10, 1911; the translation here was by Mary Kawena Pukui for HEN.

> One small pebble was seen almost ready to give birth to its young and it is being constantly watched these days for the time of birth. Perhaps it will put an end to the mistaken idea and skepticism of some people who declare that pebbles do not breed. Paul Ke`a first went with his pebbles to see Mayor Fern, and the Mayor assured him that it was so. He has some pebbles at hom and he knew that they bred. Because he was urged to, Ke`a came to the office of *Kuokoa* to show the whole public, not only in the newspaper, but by putting the pebbles on display for the public to go and see for themselves.

Kelly (1980:36-37) also noted two other observations about Kōloa Beach recorded by Rev. Ellis in 1823.

> **Kōnane Stones.** Kōloa Beach is renown not only for the presence of the *`ili`ili hānau,* it is also known as a source of the small black stones used in playing the Hawaiian checker game called *kōnane*. Ellis described a *kōnane* board as being "generally two feet long, and containing upwards of two hundred squares, usually fourteen in a row" (Ellis 1963:146).
>
> **Kōloa Sling Stones.** Ellis also reported that Kōloa was a place of importance in time of war, as it furnished the best sling stones (Ellis 1963:146).

**D-7. Punalu`u Mission Churches & Schools.** By 1843 there was a stone meeting house (church) and school with an average attendance of 140 as reported by Reverend Paris, who preached at Punalu`u one Sunday a month. He also reported that Sabbath school had an average attendance of 75 men, women and children, while Sunday congregation was about 350 people. In 1845 Rev. T. D. Hunt moved to Punalu`u after living in Wai`ōhinu for a year (Kelly 1980:33). Currently there is only a tiny chapel surrounded by gravestones; a bronze plaque says that it is dedicated to the memory of Henry Obookiah/Opukahaia who was born there and who was the first to inspire the American missionaries to come to Hawai`i.

Photo 36. Opukahaia Chapel on a bluff above Punalu`u Park and Nīnole ponds.
Photo 37. Close-up of cross cut-out design of chapel wall.
Photo 38. Opukahaia memorial plaque.

D-8. Henry Obookiah. Henry Opukahaia was born around 1792 in the area between Punalu`u and Nīnole, almost ten years after the death of Kalani`opu`u [whose father was a ruling chief of Ka`u] and his heir Kiwala`o -- the designated ruling chief -- and one year after the death of Keoua Kuahuula, heir, and half-brother of Kiwala`o. Keoua, chief of Ka`u was killed by Ke`eaumoku and sacrificed at Kawaihae's Pu`u Kōhola Heiau (1791) by Kamehameha I as a first offering to his war god Kū-ka`ili-moku. This action helped assure his position as ruling chief of Hawai`i Island. However, it did not stop the skirmishes and battles, which continued and often at the expense of women and children. Such was the case of young Henry whose parents and sibling were killed right in front of him when he was about 11 years old. Even after he ran with his infant brother on his back, he was pursued and his little brother slain by a spear thrown into his back. Young Henry was taken prisoner to live in the home of the man who slaughtered his family for several years until found by his uncle who was a high ranking priest (Wolfe 1984:1-2).

Figure 8. Henry Opukahaia (Wolfe 1984).

Henry later explained in his memoirs that "two parties were contending for the domination of the island. The warriors met and a dreadful slaughter ensued. The party to which the father of Obookiah belonged was overpowered. The conquerors, having driven their antagonists from the field, next turned their rage upon the villages and families of the vanquished" (Wolfe 1984:1).

His uncle lived in Napo`opo`o and trained young Opukahaia to be a *kahuna* at Hiki'au Heiau (Fullard-Leo 1998). It was from near-by Kealakekua Bay that he went on board a ship from New York. Through an interpreter, Captain Brintnall asked him if he wanted to go to America and he agreed. The captain asked him to go ashore and get permission from his uncle, who of course did not want to see him go. Henry snuck out of their *hale* and went back on board. The next day his uncle came looking for him; eventually his uncle settled on a hog as a price to release him to the captain. They set sail for America via China where he had an adventurous, but short life. While in America, Henry came under the tutelage of Yale student E. W. Dwight and stayed at the residences of several missionaries who saw to his continuing Christian education and training. Opukahaia not only learned to speak English, he became proficient enough in his Christian studies to translate the Bible into Hawaiian and to say prayers in Hawaiian (Wolfe 1984:43, 50) and when asked why he would wish to return to Hawai`i he answered "To preach the Gospel to my countrymen" (Wolfe 1984:34).

Henry wrote his memoirs at the request of his instructor at Canaan as part of a daily exercise, and started a diary and wrote for a year (1815-1816); this discontinued when he moved to Amherst. He did however, continue with his letter writing to various friends he made (Wolfe 1984:47). Henry came down with typhus fever in 1818; only 26 years old. While he laying sick and dying his many friends came to him and he always gave words of spiritual encouragement. To his Hawaiian friends, he spoke at length in Hawaiian, thanking them for their friendship and reminding them to make their peace with God. Just before he died he said "*Alloah o`e*." – *My love be with you.* And his doctor asked him how he felt and he said "*Very well—I am not sick—I have no pain—I feel well*." In a few minutes he was dead, with a smile on his face (Wolfe 1984:88-96). He was buried at Cornwall, Connecticut (Wolfe 1984:107). He would have to wait 185 years before going home; in 1993 his remains were brought back to Hawaii by members of his family and re-interred at the Kahikolu Cemetery in Napo`opo`o (Fullard-Leo 1998).

The following excerpt is from the website of the *Henry 'Opukaha'ia Center for Pacific Theological Studies* (HOCPTS), Hawaii Conference of the United Church of Christ in Honolulu.

HENRY OBOOKIAH'S STORY (his name is written `Opukaha`ia in Hawaiian) is one of the most remarkable in Christian history. The young Hawaiian lad of 17 arrived in New England in 1809, having sailed from the islands on the ship Triumph with a Yankee sea captain who took him to New Haven. There Edwin Dwight, a Yale student, discovered Obookiah sitting on the college steps, weeping because, as he said, "No one gives me learning." "Do you wish to learn?" Dwight asked him, to which Obookiah replied, "I do."

E. Dwight and other Yale students began to tutor him, and Yale President Dr. Timothy Dwight took him into his own home. Students from Andover Seminary and people of the New England churches befriended the orphan boy. Under their tutelage, in a single decade, Obookiah went from illiteracy to eloquence and excellence in speech and writing. More important, "by the prayers and instructions of pious friends, he became a Christian." He was the first Hawaiian convert to Christianity.

Determined to go back to Hawai`i to carry the Gospel to his own people, Obookiah was preparing himself at the Foreign Mission School in Cornwall, Connecticut, when on February 17, 1818, at the age of 26, he died, a victim of typhus fever.

After Obookiah's death, his early friend, Edwin Dwight, published the young islander's "Memoirs" in the form of a brief biography. The little book so aroused the interest of New Englanders in Hawai`i as a field for missionary work that the American Board chartered a ship and engaged a pioneer company to go to the islands. Two ministers, two teachers, a doctor, a printer, a farmer and their wives, plus five children and four Hawaiian youths were on the *Thaddeus* when it left Boston, October 23, 1819. Obookiah's was the face -- and the faith -- that launched that ship! (HOCPT 2004)

D-9. C. Brewer & Company. *C. Brewer & Company* was involved with sugar industry in the Pāhala to Nīnole-Punalu`u area in the late 1800s and later went into other ventures.

In 1826 a company was founded by James Hunnewell, who was a second mate on the *Thaddeus,* the ship that brought the original missionaries to Hawaii in 1820. Hunnewell had 50 barrels of merchandise and rum and set up a trading business on Fort Street on an acre-lot with four thatched-roofed houses. Hunnewell felt that Hawai`i was the crossroad of the Pacific and brought in goods such as coffee, tea, sugar, chocolates, spices, beef, pork, candles and other hardware. He also sold sandalwood and furs from the West Coast to China. He eventually amassed a fortune, was a founding trustee of Punahou School [there is a street named after him near the University of Hawai`i], but returned to Charleston, Massachusetts and left the business to Henry Pierce, his second in command. Hunnewell oversaw his shipping business that had spread half-way around the world until he died in 1869. Pierce then brought in sea captain Charles Brewer, who supplied whaling ships with oil until the whaling business died, and who the company was eventually named after--*C. Brewer*-- today it is the oldest American corporation west of the Rocky Mountains. After the demise of the whaling industry, sugar then became the predominant industry in Hawai`i. “While over 150 companies rushed into the sugar business, eventual control went to the Big Five (C. Brewer, Castle & Cooke, Amfac, Alexander & Baldwin and Theo. H. Davis), which dominated the industry for almost 100 years.” With the gradual demise of the sugar industry, “C. Brewer moved into diversified agriculture with macadamia nuts, coffee, and guava taking the lead.” The company recently moved to Hilo and transformed the publicly owned company into a private one. “The new company, called *C. Brewer Enterprises*, focuses on the wellness industry. They envision long-term care facilities for older people, growing healthy crops, and developing a wellness school (Sigall 2004:42, 108).

D-10. Sea Mountain Resort & Golf Course. The *Sea Mountain Resort* [*Colony One*] is the only resort property in Ka`u and was started by *C. Brewer & Co.* in 1974. It is currently a 75-unit condo operation that boosts of an 18-hole, par-72 golf course (Dayton 2005). Since *C. Brewer* sold the property in 1994, some of it is in disrepair such as the only resort restaurant in Punalu`u--severely damaged in the last tidal wave-- and the Golf Club House.

Photos 39. Condo unit of Sea Mountain Resort. Photo 40. Part of old restaurant.

Sea Mountain Resort. A peaceful, relaxing spot next to one of our famous black sand beaches, Sea Mountain at Punaluu is a central location to see both sides of the Big Island. From your 1-bedroom condo you can take a quick stroll to the Punaluu Black Sand Beach, famous for its hawksbill sea turtles *(honu)* population, play a round of golf at Sea Mountain's par-72 golf course, or swim in the pool on a bluff overlooking the ocean (BIVR 2006).

Sea Mountain at Punaluu Golf Course. Hwy 11 & Nino Ole Hawaii - Pahala, HI 96777 (95-789 Ninole Loop Road). The Sea Mountain Golf Course at Punalu'u offers a distinctly Hawaiian golf experience. The 18-hole, par-72 golf course measures 6,106 from the regular tees. Starting at sea level, it moves up to 600 feet in elevation offering ocean views from every hole. The fairways at Sea Mountain are planted with common Bermuda grass, while the greens make for fast putting. C. Brewer Corporation developed the 435-acre resort, which includes the golf course, the Aspen Conference Center, four tennis courts and a swimming pool (free to golfers), and the Punalu'u Black Sand Restaurant.

The golf course, designed by Arthur Jack Snyder, was opened for play in 1974. The golf course's natural beauty can make it appear easy, but even the short holes can be deceiving. Sea Mountain offers complete facilities including a clubhouse with a restaurant, cocktail lounge, snack bar and locker room. There is also a driving range and a fully-stocked pro shop with golf club and golf car rentals. Golf cars are required on the course. Open daily all year, reservations for tee times are required. About an hour's scenic drive from Hilo, this golf course and resort are certainly worth visiting (TravelHero.com 2005).

Photo 41. Makai section of Golf Course. Photo 42. Mauka section of Golf Course.

E. Limited Review of Previous Studies in Project Area.

The following is a review or listing of studies that have been conducted in Punalu`u and vicinity in the district of Ka`ū. Most of the reports of the studies listed here were reviewed and basic information was highlighted below in a synopsis format.

Stokes (1906/1907 – pub 1991). *Heiau of the Island of Hawai`i: A Historic Survey of Native Hawaiian Temple Sites.* In August 1906 John F. G. Stokes was sent by Bishop Museum director William T. Brigham to survey (1906-1907)sites of Hawai`i Island. However, ongoing internal problems at Bishop Museum as well as other tasks/assignments, philosophical and technical differences of opinions of directors and trustees put the publishing of Stokes' findings on-hold indefinitely…until 1991.

> Stokes arrived in Kona with a full camping outfit, surveying equipment, a list of the island's *heiau* drawn up by Thrum, and a directive from Brigham to spend three weeks locating and mapping all of the *heiau* on the list. A far as possible, Stokes planned to follow the route traveled by Ellis in 1823, making his way south from Kona through Ka`ū, and from there to Puna, Hilo, Hāmākua and Kohala, ending his trek at the great temple of Pu`ukoholā. Once in the field however, Stokes discovered that local Hawaiians could identify many more *heiau* than appeared on Thrum's list, and after two weeks of work in the Kona District alone, with many *heiau* foundations located but still unrecorded, he wrote to Brigham asking for more time…. Stokes spent the second week of October to the first week of November in Ka` ū, a district where traditional life had changed very little, and there, first encountered native Hawaiians who still practiced the native religion (Stokes 1991:11).
>
> ***Heiau* of Project Area**.
>
> **Ka`ie`ie Heiau.** (BMC 50-Ha-B9-I) (SHPD #3516). *Heiau* of Ka`ie`ie, land of Nīnole, Ka`ū. Situated at the edge of the `a`ā flow on the west side of Nīnole Bay. Pu`u Ehu bears 170˚50', 5476 feet. All that was found was a cleared level stretch of `a`ā paved with breach pebbles. On the east it overhung the sea, the rough `a`ā forming the other boundaries. On account of these natural limits, it is probable that the place was never enclosed with walls (Stokes 1991: 131).
>
> **Mokini Heiau**. *Heiau* of Mokini, land of Nīnole, Ka`ū. Perhaps identical with Ka`ie`ie Heiau. It was a name heard in Wai`ōhinu and Honu`apo, but the single resident of Nīnole I met with knew only of Ka`ie`ie Heiau (Stokes 1991:131)..



Photos 43-45. Sections of Ka`ie`ie/Mokini Heiau and possible pre-contact house sites.

> **Lanipao Heiau.** (BMC 50-Ha-B8-2) (SHPD# 3512). *Heiau* of Lanipao, land of Punalu`u, Ka`ū. Located near the southwest boundary of Punalu`u, 1600 feet from the sea. Pu`u Ehu benchmark bears 131˚56', 2804 feet. This is a small, L-shaped enclosure with walls 6 feet high and from 6 to 7.5 feet thick. The southern portion is occupied by three terraces, each rising 1 foot. Outside and adjoining the western wall is an enclosure with small walls, 3 feet high and wide. This *heiau* is said to have been built by Laka, of Kauai (Stokes 1991:132). [see *mo`ōlelo* above about Laka who

was born in Kipahulu, Maui and whose father Wahieloa was killed in a cave in near-by Nīnole by a cannibal *mo`o*] [NOTE: Located today on Golf Course and not part of field visit.]

**Kāne`ele`ele Heiau, Mailekini Heiau, Halelau Heiau or Punalu`u nui Heiau**. (BMC 50-Ha-B8-1) (SHPD # 3511). *Heiau* of Kāne`ele`ele Heiau, Mailekini Heiau, Halelau Heiau or Punalu`u nui Heiau, land of Punalu`u, Ka`ū. Located east of and adjoining Punalu`u wharf and warehouses, which are probably built on the *heiau* premises. Pu`u Ehu benchmark bears 122˚37', 4532 feet.

This *heiau* probably extended to near the edge of the cliff bordering Punalu`u Bay, and its western boundary was destroyed when the face of the cliff was graded for the wharf and the first warehouse, built before 1906. Since that date another, larger warehouse has been erected, and the man in charge of the work has informed me that he had dug into a high bank of artificially laid stones and during the work came across a pit about 10 feet deep and "full of bones." The site of the bone pit is now occupied by the concrete base of the warehouse engine, at the southeasr corner of the building, a mark which will no doubt remain for some time.

As seen in 1906, the *heiau* site consisted of a large area of a`ā about 700 by 500 feet, which had been leveled off and partly paved with beach pebbles. The only definite feature remaining was a large wall on the eastern side, 8.5 feet high and 9 feet thick; it ran 341˚30' for 648 feet. From either extreme, broken walls continued at right angles towards the west for about 230 feet. Outside the southern walls was a large flat stone, called locally "the sacrificial stone." East of and adjoining the large wall was another paved area, measuring about 500 feet each way. It was not enclosed and was better and more evenly paved with beach pebbles than the first portion described.

The immensity of the place for a *heiau* would denote a temple of great importance, and it was a matter of keen regret that no features of the internal arrangement were definite enough to plot. The name Kāne`ele`ele has been selected on Thrum's authority. It was on the list furnished me by Mr. Thrum but was not known in Punalu`u. The first name heard locally was Mailekini, and later another native stated that there were two *heiau*, that on the south being known as Halelau and that on the northas Punalu`u nui (Stokes 1991:132-133).

Ching (1967). Memo to J. M. Souza, Jr. [Hawaii Register of Historic Places-State Parks/DLNR] reporting on sites in Kona and Ka`u and where to place National Historic landmark plaques:

Ninole--situated on the lava tube just seaward and to the south of Ninole Springs is Ka Heiau O Kaieie. This temple is still in good condition despite the fact that part of its seaward walls have fallen into the sea. Directly behind Kaieie is another unnamed heiau situated on a little rise. Looking mauka and to the right of the unnamed heiau is an interesting site. This site is unique in that a raised stone pathway connect the outer wall with the inner platform.

**Punalu`u**--Ka Heiau O Kaneeleele, on the north side of Punalu`u Bay, is perhaps the largest heiau on the Ka`u Coast. It is in fair condition.

Emory (1970). See PHRI (1992).

Lamoureux, Macdonald & Doty (1970). "Evaluation of Punalu`u Black Sand Beach, Kau District, Island of Hawaii, Hawaii" for recognition as a Registered national Natural History Landmark, was prepared by the UHM Botany Dept. On January 22, May 19 and November 10, 1969 for the specific purpose of making this evaluation study; geological descriptions are primarily Macdonald's and botany by Lamoureux. The main beach is about 700 feet long and averages about 75 feet in width; southwest of the beach is a rocky headland on which is a pavilion with other County park facilities. The low rolling rocky coast continues southwestward to an inlet that contains Ninole Fishpond (which was once a mullet pond); beyond the pond the coastline is much higher and more rugged. The toal are recommended for designation as a National Natural History Landmark include approximately 65 acres.

Ownership. For 700 feet southwest of the beach, the area of the rocky land seaward from the road is, with the exception of two small parcels close to the road, under lease to the County of Hawaii by the B.P. Bishop Estate (6.57 acres). Further northwest, the land close to the shoreline is owned by Helen E. Dahlberg, Matsuhei Okana, the Bishop Estate and C. Brewer & Co. The land west of the road is owned by Elizabeth Bangay, Cecil Carmichael and Helen Dahlberg. The land extending southwest (toward Ninole Pons) is owned by C. Brewer & Co. The Ninole Fish Pond, and the land south and west of it, is owned by the State of Hawaii and under lease to C. Brewer & Co., with small parcels in this area owned by C. Brewer & Co.

**Description of Natural Values: Punalu`u Beach and Ninole Fish Pond.** Punalu`u beach was formed in a cove by the side of the sea front of [an] apron. Beaches of the type of Punalu`u can form only where basaltic a`a lava enters the ocean or lake…. Particles in such deposits vary in size from several inches across to fine dust. The action of waves further reduces the size, and waves and currents tend to sort the material according to size, with some of the finer particles being carried into deep water and lost, others being carried along the shore…. Punalu`u beach was formed in this way. Although the date of formation of this beach is unknown, it is considered to have been within the last few hundred years…. Black sand beaches such as Punalu`u beach differ from most beaches in that their formation depends on a single episode, rarely repeated in the same area…. There is no continuing source of the black-glass sand forming this beach, and some of the sand is constantly being lost into deep water. The beach will become narrower and eventually disappear…at the present rate of loss…the sand will continue to exist in reasonable volume for two of three centuries, provided only natural processes are operable….

A half mile southwest of Punalu`u Beach lies the Ninole Fish Pond; this is the site of a group of basal springs, where water is escaping from the edge of the Ghybent-Herzberg lens of fresh and brackish water that underlies the island. It has been estimated that the discharge of these springs is 20 to 30 million gallons a day. The water is beautifully clear, and at several places the outflow of the spring water is plainly visible.

Between Ninole Fish Pond and Punalu`u beach the lava which forms the shoreline is pahoehoe, with a relatively smooth but undulating surface. Hollows in the surface of this lava flow arw occupied by small ponds. Beyond the pond is the steep side of a younger flow of a`a lava.

An additional danger to the region is the proposed development of the region from Punalu`u to South Point into a tourist and resort area.

Hansen (1968/1971). See Crozier & Barrera (1974) and PHRI (1992).

Barrera and Hommon (1972). See PHRI (1992).

Crozier & Barrera (1974). "Archaeological Survey and Excavations at Punalu`u, Island of Hawaii." This report was prepared for the *Ka`u Historical Society* by S. Neal Crozier and William Barrera, Jr. of Bernice Pauahi Bishop Museum-Department of Anthropology (BPBM-DA) and funded by *C. Brewer & Com., Ltd.* The survey areas were designated by sections I, II and III (Figures 9 & 10).

Area I. Survey Area I was previously studied by Violet Hansen in 1971. Crozier and Barrera mapped sites recorded by Hansen as well as other previously unmapped sites found. Several precontact sites were re-located and mapped (e.g., terraced and walled house sites, campsites, *ahu,* and gravesite--sites #14-26); they noted that two abandoned railroad beds were still visible and may have disturbed sites in the area. Site #17 was dated between AD 1520-1658, abandoned for 100 years; ten utilized again in early historic period. Other historical sites were also found in Area I. However, the most significant features of Area I are the *heiau* Kane`ele`ele complex (e.g., trails, platforms, *ahu*, walls). Many of the sites in this area were pre-contact, but still functioning in historic times. [Note: much of this area (e.g., the large heiau complex) is located on Bishop Estate lands.]

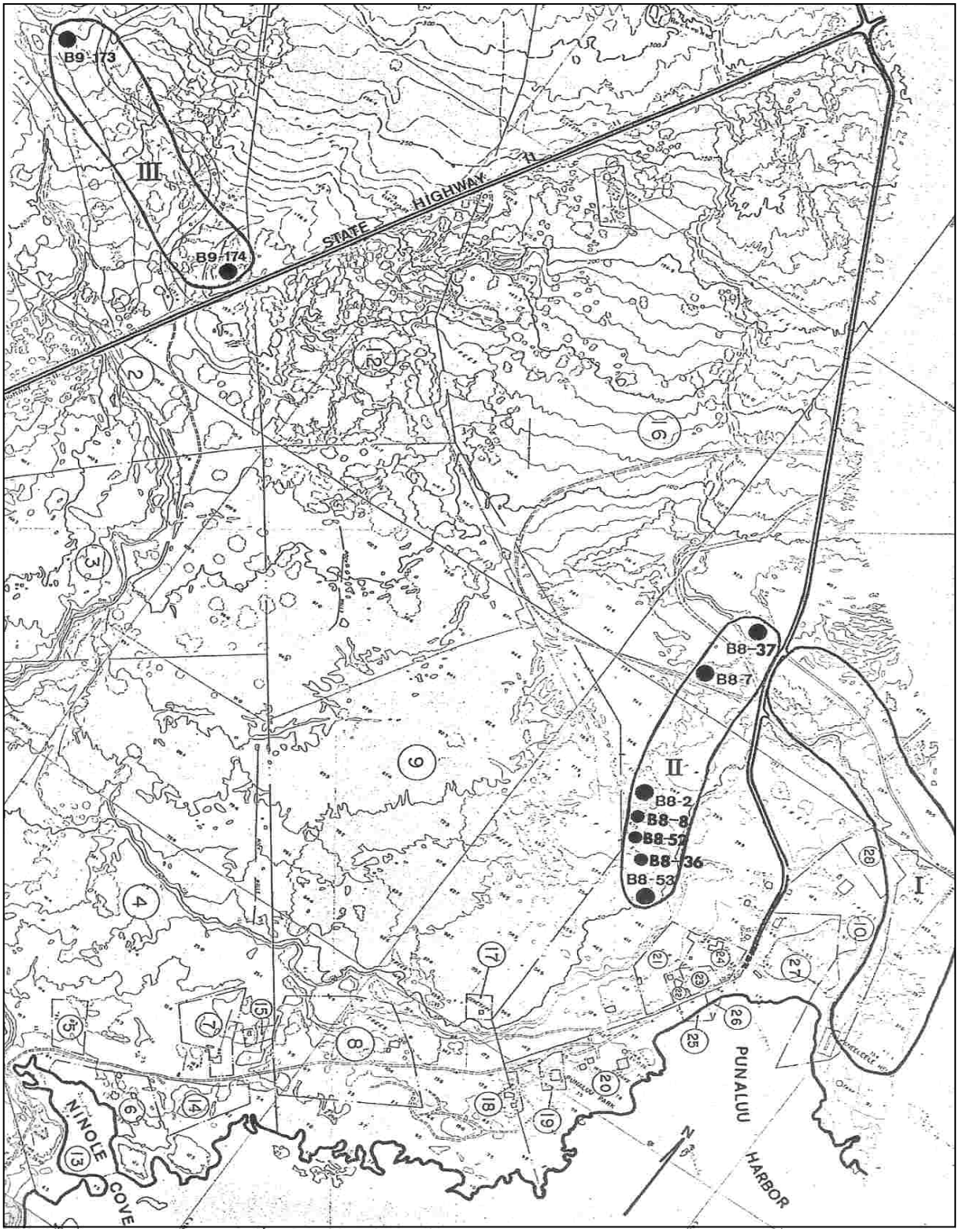

Figure 9. Locations of Study Areas I, II & III in Punalu`u (Crozier & Barrera 1974:3).

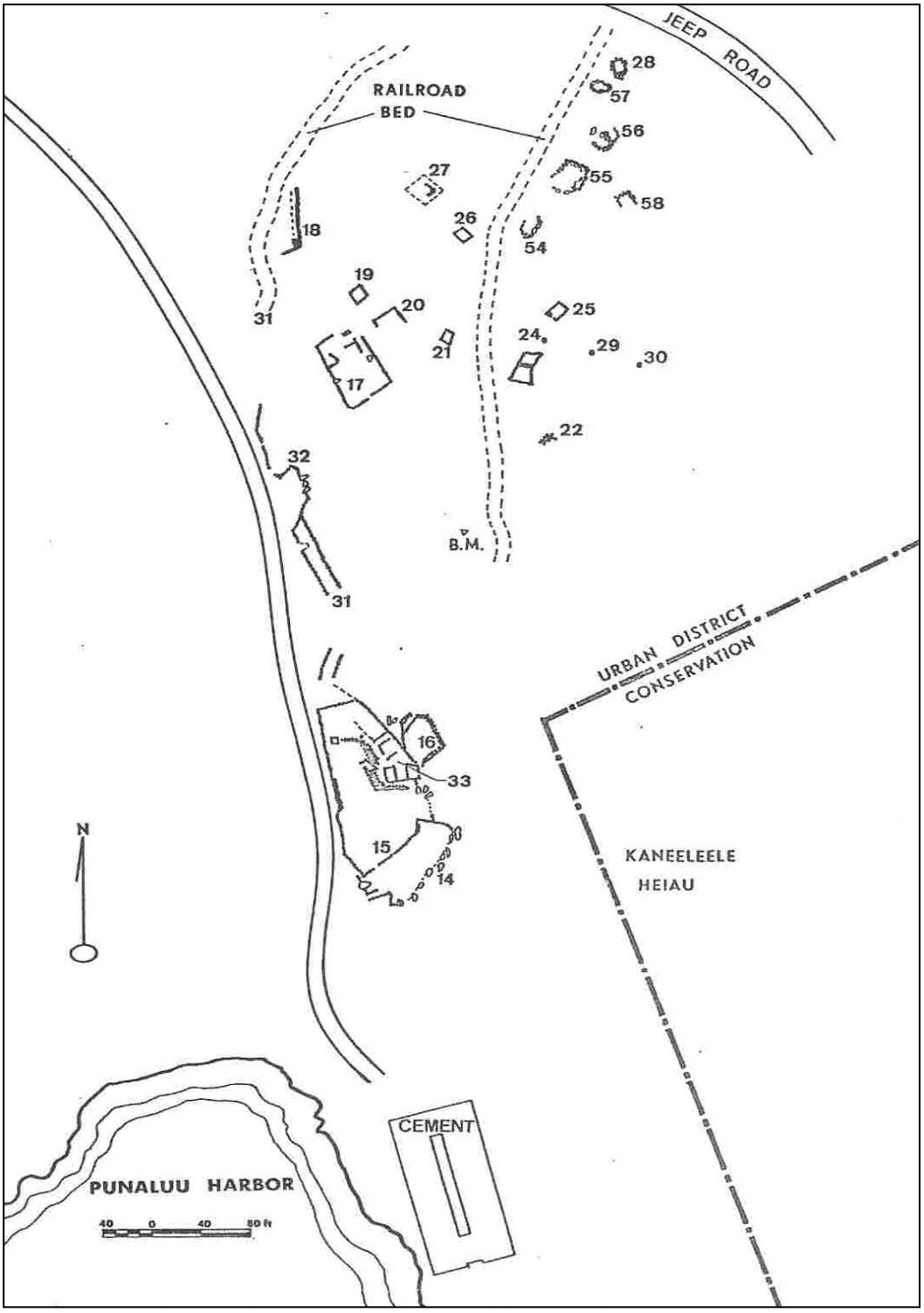

Figure 10. Locations of sites/features in Area I (Crozier & Barrera 1974:5).

Area II. The *heiau* Lanipao (Site #2; Figure 11), said to have built by Laka, was the largest and best preserved feature found in Area II. Numerous pieces of coral were found at the site, along with *`ili`ili* and shell fragments. Kamakau (1964:41) noted that Laka took the bones of his father, the famous ancient chief Wahieloa, and other famous chiefs to a cave in Papaluana near the village of Kipahulu, Maui. Many of the *heiau* walls are still in excellent condition. One feature of this *heiau* is unique--a triangle-shaped, low platform in the north section of the site.

Site # 52 is a stepped platform; only a portion remains. Site #36 is another unnamed *heiau* recorded by Hansen in 1971 as well as Dr. Sinoto, Chair of BPBM-DA who recommended further study and preservation. Sadly, all that is left is rubble and Hansen's flags--the *heiau* was bulldozed sometime between December 1971 and August 1974. Site #53 is a historic grave platform. Site #7 is a habitation Complex (several platforms and two enclosures) situated on a small bluff 70 meters west of Punalu`u access road--also partially destroyed by bulldozer.

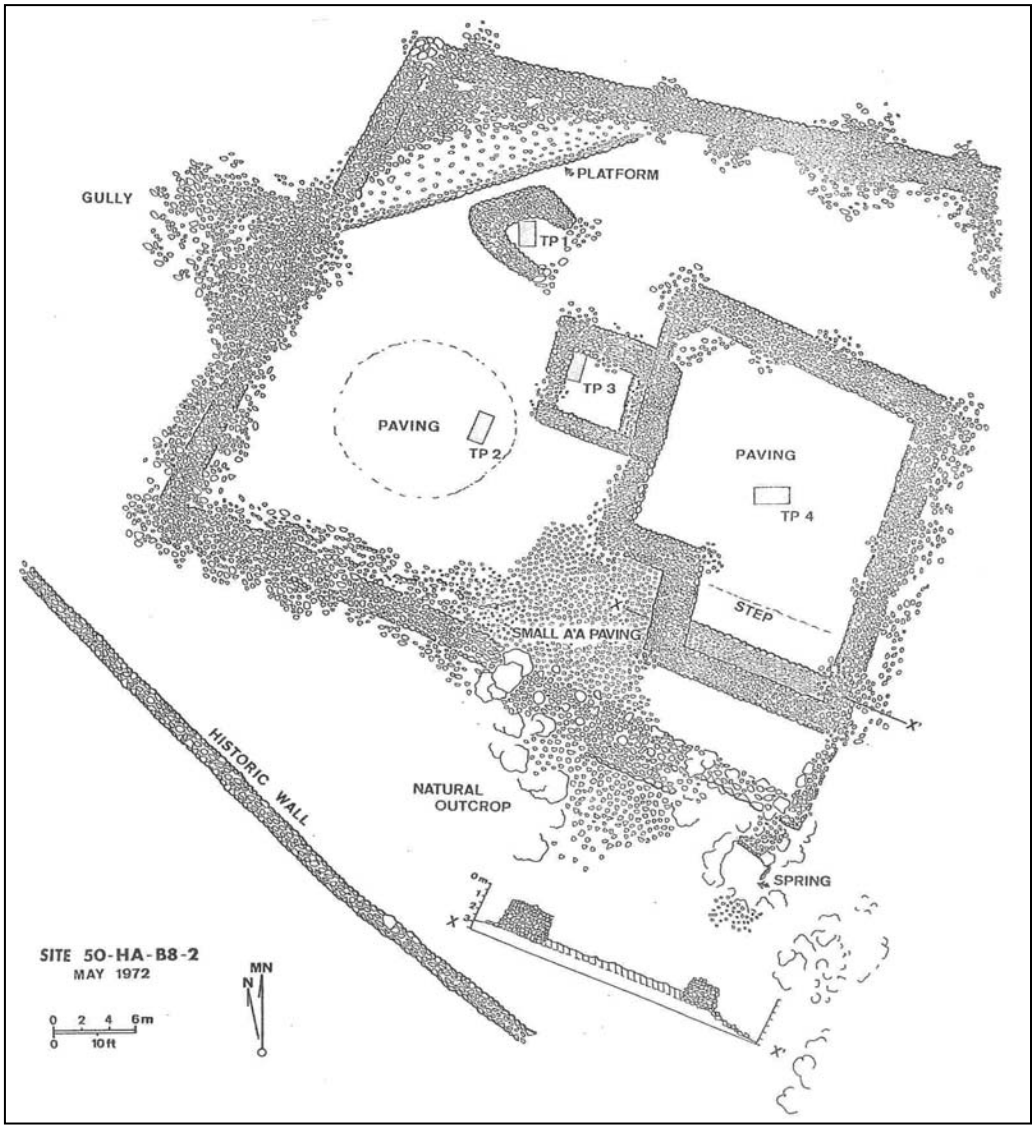

Figure 11. Mapping of Lanipao Heiau Complex (Cozier & Barrea 1974:12).

Area III. This area consisted of complexes # 173 (ca. AD 1656) and 174 determined to be pre-contact sites [see Figure 9 for located within the Punalu`u project area].

Walk-Through Survey of Coastal Sites. This walk-through started at east-north-east of Kāne`ele`ele Heiau to south-west of Nīnole Cove where numerous sites were noted with a heavy concentration located along the coast to 600 meters inland. The types of sites include trails, house sites, fireplaces, circular features, *ahu*, platforms, possible fish-drying areas, three large burial platforms, *konane* board and an abandoned village along an old carriage trail south west of Ninole Cove that included eight enclosures all in good preservation, with *`ili`ili* pavement over *pahoehoe* bedrock inside the enclosures. A heavy concentration of sites were noted as far south as Kuhua Bay, including a sealed, undisturbed cave.

1868 Tidal Wave. Crozier & Barrera noted that the tidal wave of 1868 did not appear to damage the *ahupua`a* of Punalu`u, but devastated the low-lying areas of Nīnole to the south.

Site Preservation/Recommendation. Crozier & Barrera recommended the preservation of several sites within their study area. Their table of recommendations for sites is reproduced below (Figure 12).

Survey Area	Site No.	Type of Structure	Present Condition	Recommendation
II	B8-2	*Heiau*	Fair to excellent	Preserve, excavate, stabilize, restore
	B8-53	Grave	Good	Preserve
	B8-7	Habitation complex	Poor	Not recommended for preservation
	B8-37	Platform	Good	Preserve
III	B9-173	Habitation complex	Poor	Not recommended for preservation
	B9-174	Habitation complex	Poor to good	Excavate
Coastal Walk-Through	--	Various	Various	Further survey

Figure 12. Recommendations for Surveyed Sites in Punalu`u (Crozier & Barerra 1974:34)

Recommendations. Crozier & Barrera (1974:34-35) recommended the following:

> **Survey Area II: Site #2**. Lanipao Heiau is certainly one of the more impressive structures found in the Ka`u district. It is strongly recommended that additional study be undertaken at this sites. First, the dense vegetation should be carefully and completely cleared. Next, extensive excavation should be conducted, with particular emphasis placed on studying the relationship and function of the various features within the perimeter wall. Finally, it is recommended that the *heiau* be restored. Once completed, this majestic structure would not only enhance the surrounding gold course and resort complex, but would offer all people interested in Hawaiiana an exciting view of one of the few restored religious structures in the islands.

Survey Area II: Site 37. This platform is recommended for preservation for two reasons--it is the only remaining large, paved platform in Survey Area II, and its position on the low *pali* would not interfere with the proposed golf-course development.

Survey Area III: Site 174. Although bulldozing has taken place in the vicinity, most of this habitation complex has been spared. It is our recommendation that extensive excavation be undertaken at this site. Since this area is not presently zoned for residential development, our recommendation should not interfere with the existing plans, and the recent study of the site shows that more archaeological work could certainly benefit the understanding of dwelling complexes in the Ka`u district.

Coastal Survey. The extensive archaeological sites along the coast have already been discussed. Should the present resort plans change and a major development project be initiated beyond the existing stage, then a more complete site survey should take place before any bulldozing is allowed.

Kelly (1980). "Majestic Ka`u: Mo`ōlelo of Nine Ahupua`a." This study entailed an extensive review of the literature that included traditional and historic information. The study was limited primarily to nine *ahupua`a* that were considered to be within the sphere of influence of *C. Brewer & Co.* and included the following: Honu`apo, Hi`ona`ā, Hōkūkano, Ka`alāiki, Hīlea-Nui, Hīlea-Iki, Nīnole, Wailau and Punalu`u. [Note: Fortunately, three of the *ahupua`a* in Kelly's study are in this CIS/A project area and her information is used and cited throughout this report.]

Hansen (1980). "An Historic Sites Survey of a portion of Punalu`u, Ka`u, Hawaii" prepared for *ADM International.* The survey area included the makai portion of the ahupua`a of Punalu`u (TMK: 9-6-02:6 Lot 9-A); over 6 acres, part of a larger area of 31.667 acres. Hansen's site list (#1-292) includes the following types identified: Ahu (36), Composite enclosures (6), `Ili`ili Scatter (3), Habitation Sites and/or Complexes (77), Kuleana Habitation Sites (2), Mounds (2), Platforms (11), Storage Pit (1), Railroad Bed (1) Trails (12), Wagon Road (1), and Walls (15).

Soehren (1980). Reconnaissance survey of a 90-acre parcel extending inland of the 5th and 6th fairways to Highway 11 (TMK: 9-6-02:39), in the *ahupua`a* of Punalu`u, which was awarded to Lot Kamehameha, but subsequently becoming part of the Bernice Pauahi Bishop Estate. The parcel contains 90 acres bounded on the northwest by Highway 11, on the northeast by the County road to Punalu`u village, and on the south by the existing golf course--from 80 feet to 320 feet elevation--a cinder pit is near the west corner, formerly the site of a small hill "Puehu." In recent years the land was used for grazing-- most of it bulldozed or chain-dragged for pasture improvement. Sites may have been destroyed by these activities and no traces were found. Several graves were reported to have been on Puehu, but were destroyed during quarrying activity. Sites included:

- Site #34-lava tube exposed by a large collapsed section; under a natural bridge are several terraces and areas cleared for habitation; possible entrance to lava tube running mauka; the natural shelter cave has a very good potential for yielding information/material; at south end of the collapsed area is the entrance to the lava tube running makai, with two terraces inside the entrance. Human remains removed from sites elsewhere in the vicinity are said to have been re-interred somewhere in this feature.

- Site #293-a large well made and well preserved house platform and attached pen--view of shoreline; several fragments of china were found near the site but nothing else seen.

- Site #31-a well preserved section of railroad bed (construction began in 1878 by Hawaiian Agricultural Co. and used to 1929--grade realigned about 1896 and 1902), now used as jeep road.

- Site #294-a low, rough platform about three fathoms square, built at the base of the a`a lava flow, is typical of prehistoric grave monuments--some damage from cattle or earthquakes.

- Site #6--another burial platform, four feet high on the south and about two fathoms square--at base of a`a lava flow.

- Site #37--this feature, a large terrace with several smaller features clustered around a very rocky hummock--bulldozing has disturbed some of the minor features to the north and west of the main entrance. The terrace may well be a grave monument, vut can only be determined by excavation. Preferable to leave intact along with preceding two.

Phillips, Brandt, Reddick & Asso (1984, 1985). Summaries of previous archaeological work and listsings of existing sites within the Punalu`u Resort project area in conjunction with permit applications. A list produced indicated 47 sites in the project area. See PHRI (1992:9).

Haun & Rosendahl (1986). A preliminary archaeological assessment of archaeological resources conducted in connection with a zoning request and Special Management Area (SMA) permit application. See PHRI (1992:9).

Hanoa, P. (1988). Letter to Mr. Albert Lyman, director of Count of Hawaii Planning Department (Jan 19)--comment to EIS:

> **Recreational**. Punalu`u to Ninole shoreline is also heavily used by the community, for family gathering, children wading in the ponds, overnight camping and picnicking. Shoreline fishermen use the area every day as part of their lifestyle, for diving, throwing net, pole fishing, gathering of limu and opihi to provide their family home with food, a basic resource in their lifestyle.
>
> **Government Road and Trail.** Old Government Road and Trail Issues: partial destruction; no convenient access; relocation not allowed; County Road/Bangay Estate.
>
> **Historic Sites.** Information and access to the Punalu`u/Ninole area should be mentioned in the EIS:
>
> 1. Hokuloa Church-now chapel of Henry Opukahaia
> 2. The active cemetery must be kept open at all times for burials.
> 3. Punahaha Point (gathering of Limu)
> 4. Laupapaohua (gathering of lime and ohuas during season
> 5. `Ili`ili hanau o Koloa
> 6. Paliki Flat
> 7. Spring ponds of Puhau and Kauwale, Puhau should be restored to its original pond, so the ocean water could get into Kauwale Pond. These ponds should be providing natual spawning of aholehole and mullet.
> 8. La`e loa Flat. Puhau Pond and La`e Flat were formerly the habitat for a number of Hawaiian waterbirds that are rarely seen today. The Koa`a kea, the Hawaiian duck (koloa), kolea, auku`u and a`eo (stilt). Those waterbirds were there prior to the development of the present golf course. Perhaps it should be pointed out at this time that the flash flood which occurred in the `80s creating a fill in the Puhau Pond, most probably occurred as a result of ther tremendous runoff created by the changes in riparian environement introduced by the applicant when it built the golf course and made other changes upstream and dumping of gravel by the truck load.
> 9. Ninole Beach is a sandy area for swimming.
> 10. Pa`ala
> 11. Ka`ie`ie Heiau
> 12. House sites
> 13. Canoe shed with platform
> 14. Ko`a
> 15. Burial Cave in Ninole
> 16. Fishing ground of Kuhua

17. Ke`eku Heiau
18. Kawa Bay

The County should and State should encourage the establishment of the Ninole Springs Region as a recreation area.

Bare Coastline. The coastline from Punalu`u, Nīnole, Kuhua, and Kawa are having some kind of chemical contamination that is causing the *limu* and *ha`uke`uke* to disappear. The endangered species, the green turtle and hawksbill turtle depends on the *limu* for survival.

Hanoa, JK (1988). Letter to Mr. Albert Lyman, director of Count of Hawaii Planning Department (Jan 20)--comment to EIS regarding several issues:

1. Kuleana Lands/Bangay vs C. Brewer.
2. Environmental Concerns: green sea turtle, hawksbill turtle due to pollution, overuse by tourists, depletion of food resources (limu) due to heavy use of pesticides adnherbicides by the resort; disruption to the fragile ecosystem by changes to its natural environment.
3. Historical Sites Concerns: destruction of famous `ili`ili hanau of Koloa; the ko`a still in use by local fishermen are threatened by destruction; petroglyph face destruction….
4. Native Rights Concerns: infringement of religious practices; loss of gathering rights due to limited access; lack of convenient access to coastline; denial of freely using old ahupua`a mauka/makai trails
5. Recommendations: marine and wildlife conservation areas to be used as a research area; donate or purchase by State or County for recreational park.

Ka Wai Ola O Oha v8 #9 (1991). "Court Voids Sale of Punalu`u Road" in the September issue. Judge Acoba ruled that BLNR has no power to sell the coastal segment of the government beachroad fronting the hotel resort at Punalu`u, Ka`u to a private hotel landowner. The court voided a purported 1986 BLNR transfer of the road…as it attempted to do in a quitclaim deed. During the course of the lawsuit it became evident that the stretch of road that was part of the county inventory of highways it maintained since 1940.

***Environmental Hawaii* v2 #15 (1991).** "Shoreline Disputes Stall Punalu`u Development Plan," an article in the November issue. Several years ago the State sold three-quarters of a mile of the old government road leading to Ninole Cove and the County Park at Black Sand Beach to C. Brewer & Co.; a court challenge resulted I a finding that the road was not the State's to sell because it belongs to the County. Since then C. Brewer sold its holdings in Punalu`u to the Japanese-owned *Punalu`u Development, Inc*. and affiliated *Sazale (Hawaii) Corp*.

Tachibana (1992a). Letter (Jan 30) to Mrs. Pele Hanoa from *Haseko, Inc.* regarding their first meeting of her role as community resource person; their opposition of the sale of the Old Government Trail, their adversarial relationship during the SMA process, and appreciation of her cultural knowledge.

Tachibana (1992b). Letter (Jan 30) to Mrs. Pele Hanoa from *Haseko, Inc.* regarding their second meeting informing Mrs. Hanoa of the Rosendahl (1992) study affected the design/orientation of the resort/golf course into its present Master Plan and the resultant follow-up archaeological activity, surveying, and buffer zone guidelines; the Cultural Committee review of the 32 archaeological sites to determine proper treatment; and two non-resort concerns of Mrs. Hanoa (1) correct location of Koloa Beach which is in Wailanu and not Nīnole, and (2) the correct name for Kane`ele`ele Heiau, which she field was misnamed.

Witty (1992). "Punalu`u mega-resort rides the approval roller coaster" In *Building Industry* (September issue). The *SazaleGroup* won a victory when the Planning Commission approved the SMA after denying that opposition had "no standing;" this was challenged by individuals and groups who claim they meet the necessary standing requirements; the suit also contends that an incomplete application was filed without a valid certified shoreline survey or proper documentation under the Hawaii Environmental Protection Act and that the Commission ignored the policies of the Coastal Zone Management Act.

PHRI (1992). This "Cultural Resources Management Plan (CRMP)-Sazale Black Sands Resort at Punalu`u" [Draft] was produced by *Paul H. Rosendahl, Inc.* (TMK: 3-99-5-19:VAR; 3-9-6-01, 02:VAR).

> "The basic premise of Cultural Resource Management is that cultural resources (like natural resources) are nonrenewable and are becoming increasingly endangered by activities which modify the landscape (McGimsey and Davis 1977:22). Federal, state, and local laws require the mitigation of adverse impacts on cultural resources. Cultural Resources Management involves a delicate balance between the immediate needs of today and the long-term benefits of caring for one's history and cultural past [4].

This draft CRMP included (1) an Implementation Program for a Cultural Resources Management Plan (IN-CRMP); archaeological sites flagging; (2) additional archaeological inventory survey field work; (3) community participation in the development of the Punalu`u Bay CRMP; and (4) encourage community input on the formation of interpretive themes, programs and long range stewardship.

The project area in the lands of Nīnole, Wailau and Punalu`u consists of approximately 435 acres and extends along the coast from Nīnole Cove to Punalu`u Harbor and inland across Highway 11 to the Old Government Road; the area ranges from sea level to 400 feet above sea level. The project area includes the *Sea Mountain* complex and Golf Course. Most of the undeveloped lands in this area were grubbed in 1974; excluding the coastal area, lands in the northeast and southwest parts of the project area, and in the vicinity of known archaeological sites [6].

Previous Archaeological Work.

- In 1906, Stokes recorded a petroglyph cluster on the coastal flats between Nīnole and Punalu`u village (In Cox and Stassack 1970:80-81).

- In 1968 surveying and recording of sites was started by Violet Hansen (1971).

- Emory (1970) "Inventory of Archaeological and Historical Sites in the District of Kona and Ka`u and in Anaeho`omalu, South Kohala, Island of Hawai`i. State site numbers were given to several sites in the project area.

- Barrera and Hommon (1972). Report of results of survey conducted in 1970 and subsequent excavations undertaken in 1971. The survey was limited to Nīnole and Wailau between the coast and the Highway. Barrera and Hommon concluded that most of the sites were from the historic period occupation and any prehistoric sites may have been destroyed by the 1868 earthquake and tidal wave [8].

- Kaschko (1973). One site within the Wailau Complex (Site #21) was excavated by Bishop Museum. The salvage excavations were conducted for *Hawaiiana Investment Co., Inc* (prior name of *C. Brewer Properties, Inc.*) [9].

- Crozier and Barrera (1974). [8] See above.

- Hansen (1980). Survey of lands adjacent to project area (east) and inland from Punalu`u-Nui Heiau.

- Soehren (1980). Reconnaissance survey of a 90-acre parcel extending inland of the 5th and 6th fairways to Highway 11. See PHRI (1992:9).

- Phillips, Brandt, Reddick & Asso (1984, 1985). Summaries of previous archaeological work and listings of existing sites within the Punalu`u Resort project area in conjunction with permit applications. A list produced indicated 47 sites in the project area. See PHRI (1992:9).

- Haun & Rosendahl (1986). A preliminary archaeological assessment of archaeological resources conducted in connection with a zoning request and Special Management Area (SMA) permit application. See PHRI (1992:9-10). Ten sites inland of Nīnole, Wailau and coastal Punalu`u were relocated (Sites 2, 7, 14, 15, 16, 31, 32, 33, and 53.). Sites (32 out of 37) of coastal Nīnole and Wailau were identified within the project area and five sites (5, 6, 121, 122, and 123) were identified as being outside the project area; of the 32 sites only ten were relocated. The following six sites appeared to have been covered and/or destroyed by flooding in the lower portion of Nīnole Stream (57, 58, 60, 61, 64, and 84). Three sites (22, 23, and 48) previously recommended for preservation have been partially or completely destroyed by subsequent construction. Nine sites (18, 19, 21, 95, 98, 110, 119, 120, and 172) were determined to have been destroyed or improperly located on the 1984 map…final determination of their current status must await a more intensive attempt to relocate them, using original field records from the earlier studies (1986:7).

- Rosendahl (1986). This was a field inspection by Margaret Rosendahl of the area south of Nīnole Cove and north of Kōloa Beach [10].

- Rosendahl & Rosendahl (1986). An archaeological reconnaissance survey for the *Sea Mountain at Punalu`u* project area was completed as part of an Environmental Impact Study (EIS); 32 sites (83+ features) were identified--of these, 25 sites (66+ features) were previously recorded and seven sites (17+ features) were newly identified. Preservation is recommended for all 32 sites [10-1].

Inventory of Cultural Sites/Burials. The range of formal feature types encountered includes platforms, enclosures, terraces, rock shelters, walls and petroglyphs--all apparently prehistoric in origin. The historic period is documented by the presence of railroad beds, a wharf, a cement tomb, wallsm enclosures, and a section of the "*ala nui aupuni"* [King's Trail]. Site #2, Lanipao Heiau is located inland of the second green and to the southwest of the third fairway. Another Site #174 has been functionally identified as a probable *heiau* (`Imakakoloa). This site is partially located within a privately owned lot in *Kalana Subdivision.* A petroglyph cluster (Site #3) and a single figure (Site T-101) are located along the coast. A *ku`ula* or fishing shrine (Site #T-110) is located south of Punalu`u Bay, and has two known burials immediately inland of it. A burial cave was describged as being located beneath the *ku`ula* and concealed by rockfall (Hanoa); this cave was not located but the existence of the cave has been previously recorded. Other burials include: Site #T-111, Site # 17-historic tomb, Site #53-burial platform, Site #22-burial crypt, and two sites #31 and T-108 may also contain burials [14-15].

Nīnole Pond. Community members and participants in the "Punalu`u Cultural Resources Advisory Committee" and the "Shoreline and Pond Management Committee" will be involved with planning any work in the general vicinity of the ponds. Plans will also be approved by SHPD-DLNR, Hawaii County Planning Department, and the U. S. Army Corp of Engineers. This work will undergo separate compliance with the U.S. National Historic Preservation Act of 1966 (as amended) [16].

***Building Industry* (1994)**. "Plans Dashed for Black Sands Resort Project." *Sazale Corp.* announced it will sell the partially developed Black Sands Resort located at Punalu`u. The Tokyo-based corporation purchased the developemtn from C. Brewer in 1989. The sale was instigated by Japanese banks asking Sazale Corp's debts to be paid. *Punaluu Preservation Inc.,* an opponent of the resort project indicated that they hoped 160 acres of land will be placed on the *National Register of Historic Places,* however most of the land has developemtn rights approved by Hawaii County. The sale is being handled by BDL Investments Banking & Commercial Real Estate.

Roelofs (1994). "Investigating the South Coast: Punalu`u to Manukā."

> **Nīnole Cove and Punalu`u**. Walk on a jeep road through the grass to Nīnole Cove, cross the streambed that is often dry on top but wet underneath because a spring-fed stream flows through the rocks into brackish Nīnole Pond. The spring, Pūhau, was once a major source of fresh water in this area. The pond was much larger when it was used as a fishpond in the 1800s. Hawaiians raised *`o`opu, aholehole,* and shrimp (*`ōpae*) in the brackish water (Titcomb 1972:7). When the area flooded in 1980, gravel covered Pūhau spring and partly filled Nīnole Pond.
>
> **Stones that Give Birth.** Kōloa Beach adjacent to the pond is famous for its *`ili`ili*. Hawaiians believe that the larger *`ili`ili* give birth to the smaller ones that are always collecting in the cracks and crevices of this rocky headland. They believed that the smooth, close-grained rocks were male and the porous ones were female…. These small, water-worn, rounded stones, black from basalt and white from coral, were collected for playing Hawaiian checkers or *kōnane.* Some of the stones were selected to as gods to preside over games. The special ones were taken to a *heiau* for ceremonies, then taken to the place where the games were played. If they brought luck to their owner, the stones became famous. If not, they were broken or thrown away.
>
> **Ala Loa, Long Road Encircling the Island.** The earthquake, lava flows and tsunami of 1868 wioed out much of the path and some of it eas rerouted *ma uka* including a section that once went *ma kai* of Nīnole Pond. In 1890, with the public right-of-way act, it became known as as Old Government Road.
>
> **Food and Medicine from the Shore.** Hawaiians relied on plants growing near the shore for food, fiber and medicine.
>
> - *Naupaka kahakai* (*Scaevola sericea*): shrubs provided bark to aid digestion and treat skin diseases; the white waxy fruit in times of famine
> - *`Ilima papa* (*Sida fallax*): flowers used for lei and collected the flower buds for laxative and punded the root bark with other plants to treat asthma
> - *`Akulikuli kai* (*Sesuvium portulacastrum*): all parts of it are edible raw or cooked
> - *Nehe* (*Lipochaeta integrifolia*): 20 or more species that grow from shore to mountaintops; daisy-like flowers resembles wedelia; used for landscaping
>
> **Nīnole School.** In 1840 the Kingdom passed an act requiring every community with 15 or more children to have a school. Nīnole built its own school on this cool point overlooking the sea. Walk west on the Old Government Road about 100 yards to where it forks. Turn sharply right and head northeast to reach the stone work of the old school

Abrigo et al (1998). Community Planning in the Ahupua`a of Kamā`oa-Pu`u`eo and Punalu`u, Ka`ū: Hō`ili`ili Ka `ike O Ka Ikaika "Gathering the Strength of Knowledge" prepared for Queen Lili`uokalani Children's Center, prepared by the Department of Urban and Regional Planning (Spring 1998 Practicum). This Practicum involved a range of activity such as interaction with kūpuna and other knowledgeable residents of Ka`ū to facilitate a hands-on mapping process of cultural sites and resources; a survey to assess public perspectives on various issues; a series of informal and semi-structured interviews, primarily with kūpuna and other key people in Ka`ū; and team members wrote detailed field notes, drew maps and sketches, and took photographs and live video to document everyday life and environmental features.

Residents at Punalu`u revealed a strong connection to the land and sea and to Native Hawaiian cultural practices and customs. The beach at Punalu`u and surrounding cultural sites seemed to be the focal point for much of the cultural activity. For instance a section of the beach is preferred for *hi`wai* or ritual cleansing. There is a general sense of the deep history of the Native Hawaiian tenure on the land and a profound respect for and interest in traditional customs and values. Residents "talk-story" about the old days when traditions were strong, such as feeding the *`opelu ko`a,* the various legends of Ka`ū or names of

various *pu`u* and *heiau. Hana Laulima* and *Punalu`u Preservation Society* are two very active community groups whose members include long-time Punalu`u residents.

Mauka Punalu`u is home to native and introduced plants used for medicinal, ornamental and subsistence purposes. Native or Polynesian-introduced plants include: *`ulei, maile, `a`ali`i, hō`i`o, hapu`u, māmaki, la`ī* (ti), *palapalai, naupaka kuahiwi, `ōhi`a, `ōhi`a `ai* (mountain apples), *`ōhi`a lehua, kukui, kiawe, milo, `ōlapa, olonā, hau, niu*, and *`alani.* The following sea-vegetation were noted in the *makai* side of Punalu`u *ahupua`a:* reddish-brown *limu kohu,* long brown *limu kala,* golden-brown *limu `aki`aki,* reddish *lipe`epe`e,* brownish *lipoa,* dark red *huluhulu waena,* and mossy *wāwae `iole.* On land included: *naupaka kai, nānuka* (Bulrush), *maunaloa* (sea bean), *kaunā`oa kahakai* and *`uhaloa* thrive on the shore.

Coastline and ocean fauna include: *wana* (sea urchin), *`opihi* (limpets), *`a`ama* (crab), *hā`uke`uke* (cliff-perching sea urchin), and *pipipi* (small mollusks). Locals fish the shoreline throwing net to catch *manini, aholehole* (Hawaiian flagtail), *nenue* (chub fish), *kala* (unicorn fish), *puwalu* (surgeon fish), *Palani* (variety of surgeon fish), and mullet. Pole fishing for *po`opa`a* (hawkfish), *`ala`ihi* (squirrelfish), and *hīnālea* (wrasse). Other fauna of Punalu`u include: *koloa* (Hawaiian duck), *kolea* (Golden Pacific Plover), *`ōpe`ape`a* (Hawaiian bat), *`alae kea* (Hawaiian coot), *ae`o* (Hawaiian black-necked stilt), and the *pueo* (Hawaiian short-eared owl).

The culturally significant sites in Punalu`u are concentrated along the *ala loa* or King's Trail at Punalu`u Bay, Nīnole Bay and Kawa`a Bay. North of Punalu`u Bay and its famous black sand beach, the trail travels past the famous sacrificial stone and a human sacrificial *heiau* called Punalu`u Nui Heiau, and eventually leads to another black sand beach called Keone`ele`ele. The west side of King's Trail begins with Kōloa Bay where *`ili`ili hānau* can be found, then travels past a fishing *heiau* named Ka`ie`ie Heiau, a resting platform, and leads ultimately to a gathering *heiau* called Ke`ekū Heiau adjacent to Kawa`a Bay.

Mauka Access. A major problem facing residents in the area is access to important cultural sites and natural resources locations. Native Hawaiians are guaranteed access to areas for cultural and religious purposes, but many of the old access routes in the *ahupua`a* have either been gated-up by private landowners or neglected, making access difficult, and in some cases dangerous. Proposed access routes include an existing jeep trail that leads to Ka`ū Forest Reserve--this lies on the western boundary near the foot of Makanau and follow the existing trail to the foot of Kaiholena; the other route is on the eastern section of the *ahupua`a* along the base of Pu`u `Enuhe, then northwest in to the Ka`ū Forest Reserve--there is an existing paved road along a portion of the route, eliminating potential tight-of-way problems.

The conservation areas in Punalu`u are located along the coastline, affording protection of the many cultural sites; these include burial sites, *heiau*, historic fishponds, and other culturally-sensitive sites. Maintaining the ocean access areas is important to local residents, as they don't want the beaches and coastline closed off as many of the mountain access points have been in recent years.

Chambers (2001). "Henry Opukaha`ia Hawai`i's Ongoing Legacy," in *The Waimea Gazette,* August issue. "There are those who impact the world in ways that defy explanation. Opukaha`ia, born near the Black Sand Beach at Punalu`u, Ka`u…was such a person. This orphaned but brilliant man once fled Hawai`i…and returned a favorite son." His original gravesite was in Cornwall, Connecticut recording his birth as 1792. However, Kealakekua Bay area Hawaiian elders are convinced he was born five years earlier in 1787. Many young men and women who read his memoirs and diary, published after his death in 1818, were so moved that they applied for membership in the newly formed Sandwich Islands Mission. When the first missionaries arrived they found a kingdom that had overthrown the established traditional religion in a bloody battle only months before; temples and religious artifacts had been destroyed (Opukaha`ia's *kahuna* uncle served with *kahuna nui* Hewahewa who had been one of the first to set fire to a *heiau*.)

The first-person account of a civil war on the Big Island {in which his family were slaughtered] is believed by Hawaiian elders to have been a revolt by Namakeha against Kamehameha I that took place in 1796; the rebel leader was defeated by Kamehameha who sacrificed him January 1797 at the *heiau* of Kaipalaoa in Pi`ihonua, Hilo. In Opukaha`ia's words "a war [was] made after the old king died, to see who should be the greatest among them." The "old king" may have been Kalani`opu`u, ruler of Hawaii, whose death triggered about 15 years of on-and-off tribal warfare. Opukaha`ia's mother who was a relative of the king and his father who was a commoner aligned themselves with the opposition [probably Keoua Kauhuula] and a brutal retaliation began.

Opukaha`ia who was about ten years old fled with his parents to Mauna Loa where they hid in a cave. Overcome with thirst they ventured out and were overcome by their enemies while drinking water at a spring. His parents were brutally "cut into pieces" in front of him. He tried to save his infant brother who was also killed. Opukaha`ia was taken to live with the warrior who killed his parents. After a couple of years he was rescued by his uncle Pahua who was a *kahuna* who served at the *heiau* Hikiau ay Kealakekua Bay, and became an apprentice priest.

After years of observing foreign ship that went in and out of Kealakekua Bay he wondered about the world outside of Hawai`i. He resolved to leave and one day went on board the brig *Triumph* from New York. His uncle did not want him to go, but eventually exacted the price of a hog in exchange for his departure. Henry was twenty-one when he left on his journey to America, which took him to China, New York and eventually Connecticut where he resided with numerous families for the next nine years. He became a Christian and in 1814 was formally accepted as a candidate for ministry.

His dream to return to Hawai`i was shattered when he contracted "typhus fever." He died February 17, 1818. Opukaha`ia left a spiritual legacy and academic treasure: a Hawaiian dictionary, grammar and spelling book, and a section of the Bible translated into Hawaiian. His remains were finally returned, after 175 years, to Hawai`i in 1993 and interred on the grounds of Kahikolu Church in Napo`opo`o which overlooks Kealakekua Bay.

Photo 46. Rocky beach of Kealakekua Bay.

F. Previous Oral Histories (1987). "Ka`ū oral Histories: Interviews with residents of Ka`ū, island of Hawai`i" by *Ka`Ohana o Ka Lae* (www.namaka.com). Two mini-samples of the interviews are below.

Pele Hanoa/Adeline Andrade. Pele is talking with Adeline.

I come from a family of 14 of us in the family. And we're all born at home. My father was a doctor. And then 7 of us died and left 7. In 1954, my third oldest brother Lani died. And I'm the fourth oldest of the Bangays. And I have brother Joe Koa Bangay and I have a sister Ho`ola, Helen Ho`ola Galban. And I have another brother, that is Christopher Bangay. The I have another brother Peter Bangay and a sister Kalanikauleleiwi Bell. But they all lived away from Punalu`u. I'm the only one now living in Ka`ū. I do now live in Wai`ōhinu, although we still have our property down here in Punalu`u….

We'd like to say something about Nīnole…. And she drowned in that pond up Kawale. And that's where they have their well…like we do in Punalu`u. The family in Punalu`u have their own well in each property owners. But Nīnole, they have their two wells to go to their spring, which is in Pūhau and one in Kawale. So they carry their bucket down to the spring and get their drinking water, which is brackish water, and take it back to their home. And that's how they live. And they go down to Pūhau to do their laundry….

I came from Punalu`u. And of course, we had Kawila, where I used to do our laundry for the family, being the oldest…girl in the family. And down Pu`umoa, when it's low tide, I wash right by the spring where the water comes up, before high tide…. We dry our clothes on the rocks…we don't have clothes line…we also bleach our clothes in the sun….

I'd like to talk about the family that was in Punalu`u at our time. It was the Kunabui family, the Puanhoa family, and a woman called Mrs. Ahia--we called her "Mama Nui"--were all up here. And Jeanette Akiu, the Akiu family was my neighbor. And the old lady Mi`i. And we had Mrs. Sarah AhSing, which is Mrs. Ford. And she used to live where the restaurant is now….

Adeline Andrade. I was born in Punalu`u and raised in Nīnole. Well during my time, my childhood, I was raised because we had *mahi`ai* up *mauka* in Wailau. We had property up in Wailau ad we had the property down here at the beach. So in the morning during the weekend, after school and all summer, we ride on the horse. Get on the horse and the donkey and we go up to Wailau to do our *mahi`ai*, our taro patch, work in our taro patch during that time.

And during the school season, we down here at the beach. And weekends we go…I go over to Hokukano or to Kāwā, up mauka to Ka`alāiki, to gather papaya, *mīkana,* for our pigs….we raise pigs down here at Punalu`u…. The story of Ka`ie`ie was a *heiau* known down there. But then, we weren't told much of the *heiau.* I guess my mother didn't feel that…it was our business to know about the *heiau*. There's also a burial cave down there just above Nīnole…they have about a dozen more bodies or ore bodies in there, that is buried in that cave, up in Nīnole.

Thenwe came up to Punalu`u. Of course we have our won *heiau, which is Punalu`u Nui Heiau.* And *Kahiholo,* which is the sacrificial rock…. And Kawila was that little pond, which is now the big pond also. And there was a spring there coming out right by the road. It's already covered by sand. That;s where we washed the laundry. All the Punalu`u people go to that one particular pond, called Kawila, is branch out from the big pond, Kawila, that existing now….

Pele Hanoa. And Kawila is known to be a kupua pond. But now they are dirty, the pond. They're not keeping the pond clean. And Pūhau is all polluted and –I mean Kawale, and Pūhau is all covered with gravel…. I'm hoping that C. Brewer will restore that Nīnole cove and that pond at Pūhau back to its original pond. And that's all our recreational swimming area was that two ponds for the Punalu`u and Nīnole people.

PART IV. ETHNOGRAPHIC SURVEY

The Ethnographic Survey (oral history interviews) is an essential part of the Cultural Impact Study and Assessment (CIS) because they help in the process of determining if an undertaking or development project will have an adverse impact on the cultural practices or access to cultural practices. The following are initial consultant selection criteria:

- Had/has Ties to Project Location(s)
- Referred By Office of Hawaiian Affairs (OHA)
- Known Hawaiian Cultural Resource Person
- Known Hawaiian Traditional Practitioner
- Referred By Other Cultural Resource People

The consultants for this CIS/A were selected because they met the following criteria: (1) consultant grew up, lives or lived in Punalu`u, Wailau or Nīnole; (2) consultant is familiar with the history and *mo`olelo* of Punalu`u, Wailau or Nīnole; (3) consultant referred by Hawaiian Cultural Practitioner(s); and/or (4) consultant referred by staff of *Group 70 International, Inc.* or other cultural resource people. Copies of signed "Consent" and "Release" forms are provided in (Appendix L and Appendix M).

Research Themes or Categories

In order to comply with the scope of work for this cultural impact study (CIS), the ethnographic survey was designed so that information from cultural consultants interviewed would facilitate in determining if any cultural sites or practices or access to them would be impacted by the implementation of the *Sea Mountain Five LLC* development project. To this end the following basic research categories or themes were incorporated into the ethnographic instrument: Consultant Background, Land Resources & Use, Water Resources & Use, Marine Resources & Use, Cultural Resources & Use and Project Concerns. Except for the 'Consultant Background' category, all the other research categories have sub-categories or sub-themes that were developed based on the ethnographic data or responses of the consultants. These responses or clusters of information then become supporting evidence for any determinations made regarding cultural impacts.

A. Consultant Background and Demographics

Each consultant was asked to talk about their background; where they were born and raised, where they went to school and worked, and a little about their parents and grandparents. This category helps to establish the consultant's connection to the project area, their area and extent of expertise, and how they acquired their proficiency. In other words, how the consultant met the research consultant criteria. Nine individuals were identified as potential consultants. However, due to scheduling circumstances only five were interviewed and one wrote their own responses to basic questions. Three consultants were born in Punalu`u; one was born in Kohala; two consultants were born on O`ahu--one now lives in Punalu`u and the other lives elsewhere in Ka`ū. Table 6 provides visual demographics of the cultural consultants.

Table 6. Cultural Consultant Demographics in relation to Project Lands.

Consultant	Hawaiian	Born/Raised	Work	Live*	Project Area**	Ka`ū Ties
Pauline Enriques	X	X	X	X	X	X
Pele Hanoa	X	X		X	X	X
Arnold Howard	X		X	X	X	X
Jeanette Howard	X	X	X	X	X	X
Rayner Kinney	X		X		X	X
Maile Napoleon	X				X	

*or Lived; **Ties to Project Area

There is always a danger of not allowing the consultant's "voice" to be heard; of making interpretations that are not theirs; and of asking leading questions. To remedy this, the "talk story" method is used and allows for a dialogue to take place, thereby allowing the consultant to talk about a general topic in their own specific way, with their own specific words. All of the excerpts used are in the exact words of each consultant or paraphrased to insert words that are "understood" or to link sentences that were brought up as connected afterthoughts or related additions spoken elsewhere in the interview. The following excerpts in "Consultant Background" provide a summary of each consultant, as well as information about their parents and grandparents. First names of each cultural consultant are used to identify quotes used as two have the same last name. They are presented below alphabetically according to their last names.

A-1. Pauline Enriques. My name is Pauline Enriques, and I was born here in Ka'u, raised around here, went to the mainland for college, returned to Pahala, I reside in Pahala, and I've been here down at Punaluu for quite some time maybe about 40 or almost 50 years on the beach where the shops are. My father is an immigrant from the Philippines and his name is Feliciano Damazo, and he passed away when I was only 17 years old and my mother just passed away this year in April and her name is Lillian Kaukini Damazo Pajo and she was born in the island in fact up at Wood Valley somewhere around there. She has a Hawaiian name but I really don't know, it's quite long. The Kaukini's were from Ka'u, in fact they used to own quite a bit of land in Wood Valley. My father used to work on the sugar plantation in Ka`u…when I was little. In fact, I can't remember, I think because he came to the islands in 1920 somewhat around there, so he worked for Hutchison which is at Na`alehu up Honu`apo--they had the mill there, and then he was transferred over to Pahala [C. Brewer] that was in 1941 I think. He worked there until he passed away. My mother was a housewife, she worked a little while on the plantation [C. Brewer] but that's about it, not too long. We were all grown, there were four of us in the family. My mother worked in the fields, what they used to call those -- *hoe-hana* or what, for a little while because she was tired staying at home and we were all grown and needed the extra cash. I graduated from Pahala High, that time it was Pahala High, now it's Ka`u, and I went to Armstrong in Berkeley. I stayed about three years, came back and got stuck in the islands. About 50 something [years], yea…1956…started the shop with my husband (Joseph Enriques) and then gradually he pulled out and I became the sole one who really stood by him right through until now. He still yet around but he's taking things easier…in a care home in Hilo [Mr. Enriques passed away January 2006].

A-2. W. Pele Hanoa. My name is Pele Hanoa. I was Bangay, actually, maiden name. I married Hanoa. I was born and raised right here in Punalu`u, right in this area here, this kuleana that we have since 1852. And we have never given up this kuleana until today. So I still come down here. After the tsunami (tidal wave) in 1946 that destroyed our home. Then we built a home in 1954 and 1975 a tidal wave took it again. So this is how we live today because I didn't want to keep building and [tidal wave] keep taking it away. So this is like our beach picnic area and property that we always come down and spend the weekend and the time have. Christmas we come down here away from everybody. Because we spend our life down here too. So my parents left this kuleana, now it's still in our hands, my children, my great-grand children now will enjoy the place. I was born August 8, 1923. I'm 82 years old now. I went to school in Na`alehu. I graduated in 9th grade in 1939. And then the war broke out so I couldn't continue my education. Then I worked as a nurse aid at Ka`u Hospital when the military came down… I was nursing all my life. I went to Honolulu, I worked for the Navy first. Then I went to St. Francis Hospital. From there I went to Leahi Hospital. I worked Leahi until I moved to Hilo '71 and then I retired from there…. I was nursing all my life. I went to Honolulu, I worked for the Navy first. Then I went to St. Francis Hospital. From there I went to Leahi Hospital. I worked Leahi until I moved to Hilo '71 and then I retired

from there…. I think I was 56 years old--maybe I wasn't that old--to about '76 or '77 when I retired. Pau. I never go back to work again because my husband was working all over. And he was the one who built the Hyatt. My husband had good job. He built the Hyatt, that train at the Hyatt. Oh, he'd leave home early. He built the University of Hawaii at Hilo Library, put up that building in the front. When he came home first in 1974, build up the French Canadian telescope on Mauna Kea. He built that up there. So he know how sacred it is up there…..

My parents had about 12 of us children. And I was the oldest girl. And we never go to the hospital, we all gave birth at home. My dad was doctor, he was a fisherman, and he was a *mahi`ai* man (farmer)…. My tutu J. W. Kuaimoku. Actually he's also from Kona. I had two tutu, two brothers. One is Keoki Kamakakane and J. W. Kuaimoku. And they were two brothers. But you know the Hawaiians before, somehow the ali`is, you know they want to hide from being taken away so they split their names. And my tutu, that's the way both of them were split, and yet they were two brothers. And my tutu Keoki is one, all up here, Kuaimoku, all are buried up here. But this land was got to my tutu J. W. Kuaimoku. So all the Kuaimoku, the maka, all them from Kona is all my ohana. [Mahoe connection] My tutu was a nephew, Jed Kuaimoku. And then this went to my tutu J. W. Kuaimoku. You see J. W. Kuaimoku and Kainoakupuna. Kainoakupuna is a big landowner too, up all in the mauka side. Kainoakupuna Kahenenui. He's originally from Maui. So the Nakoa's is related to my husband, that's my husband's side. My husband's great grandfather is Kahenenui. But he go under the name of Kainoakupuna Kahenenui. But originally his ohana from Maui, Hana side…. You see the Hawaiians travel. That's why no matter where you stay, you still have ohana, even Kona. I say I have ohana in Kona. And how I came to be lineal descendant to Pu`ohau is because of Mahoe….

My mother, born and raised down here, her name was Kalanikauleleaiwi. She was [named after] one of the ladies that brought up all the chiefs, way back. If you look back you find it in the history. She was the lady that make all the chiefs. And then when I was born, she had a dream during her high period, that if she had a child, to name 'em Pele. So she had miscarriage of two boys. And then she had a third boy. And then she came to me the fourth. And she didn't know whether she was going to have a boy or what, but in her dream…with a fire. That's how when I was born, she named me Pele….

I'm on the Burial Council. I was one of the first kupuna teachers, the program Kupuna for the DOE. Started '76. We started with Nalani Sing and Loko Ma`ika`i Snakenberg. I belong to Native Hawaiian Legal Corporation, long time I was with them. Ka Lahui Hawai`i. And I'm on the advisory board for the kupuna committee for the National Park. Hawaiian Civic Club, President. I was all over place. So I'm just like an advisor for a school in Keokaha, and advisory for that Kukulu Kumuhana, a class my daughter has down here, kupuna for them. I used to get all Kamehameha School kids come down here every year. And I give the story about this area, the history of this place [PELE].

Photo 49. Hanoa *kuleana* lands in Punalu`u.

A-3. Arnold P. Howard. My English name, Arnold LeRoy Palekaluhi Howard, born He`eia Oahu, schooled Kapalama and Farrington. I was born June 29, 1924. I am 81 years old. WWII took my education. I went in the Navy and when I came out didn't want to go back to school, I only went to the 10th grade. I was a machinist on warships…I loved it. I was 17 years old. It was fun. All my family was in the Navy -- father, brother, and myself…. I was supposed to go from Kalakaua to Roosevelt – they were English standard schools. I wanted to be a farmer so my dad said you go down there, you're that dumb enough and wanna be a farmer. So that saved his car fares sending me there. [I learned to farm at] Kalakaua and Farrington--I took four periods of agriculture. I told the teachers I come here to learn to be a farmer and I want to take four periods, I don't care about Social Studies and crap like that. And I was a farmer. We had 25 acres in Kona. I come to Kona in 1964 and started to farm in 1965—my wife had family in Kona. But they stole everything I raised…and then it got so doggone bad when they would break in and steal the dishes and everything so we decided to get rid of it and live here and go fishing. Must have been about two years later, but we were off and on I mean we were fixing the place and all that. Started out here with canoes to go fishing and then they built the ramp over there, the plantation boss so I can build a boat. So this boat was built by me I had three of them, all built the same, and I built the canoe. Canoe you can only go so long because you don't have enough room to keep your catch, with these boats you have big tanks and lots of ice and all that. So you can stay out there longer and take more.

My father, Guy Howard, but before all that it was Guy Howard Harvey. When he went in the Navy it was Howard, he left out the Harvey. So when he applied for communication license, he couldn't use that, he had to go with Howard, so we had to change all the birth certificates back to Howard. There was two people with radio license in the Hawaiian Islands, Worley was one who was a chief, and my father. My father worked for KGMB and Worley worked for KGU, them two radio stations. Your father won't know of them. They got KGMB now. Before used to be the Advertiser business with KGU. My father [was] transmitter man--he put all the radios in the police cars when they started having radios, and then Hawaiian Airlines hired him. He worked till he died for that company--he was a radio man when Hawaiian Airlines went in business. They looked for a man with license, and my father had a license and my father worked there till he died. I don't know when he died, 1964 or 1965. But he wasn't that old but bad kind of things, cancer, that's what it was, cancer in the bladder. I live longer than my dad so far, my mama was 96 when she died.

My mother's name was Victoria Rose Valpoon. My grandfather was Charley Valpoon…see he came here -- a haole -- married my grandmother – Hawaiian lady, Emma I don't know what her maiden name was. I have all the pictures of all our Hawaiian relatives, I got it all piled up in that damn room. They dress real nice, oh, it's unbelievable! The people today don't dress like that. Oh, it was beautiful. I don't know why they got away from dressing like that….. My grandfather worked for the fire department, and for the poling line, and Pearl Harbor on the big dry-dock that fell down…. My Hawaiian name is Palekaluhi. You know what that means? It means 'give away all my hard work.' And you wanna hear a good story about that? When I was born this old gentleman, my mama's relative come in half intoxicated, and said 'you give the boy my name!' My mama didn't like that name, but Hawaiian style, you gotta accept it. The first Hawaiian that give the name you gotta accept it or something happens to you, you understand? That's the belief my mama had. My mama buy me this wallet years ago. My mama every so many years, she buy me a new one and she put my name on it. My grandfather ride a horse to the power lines the telephone lines, the power lines. He had a helper and him they ride a horse to check the power lines in Kauai now. My mother lives way up in the mountains where the power line is and they have to go to school, so they have to cross these little rivers all the time. When plenty rain they take off all their clothes, cross the river, then put their clothes back on to get to school. My mama tell me all them stories. She say it was really tough. The house they live in was grass. The cookhouse was made out of tin, galvanized iron, 'cause of the fire. But where they sleep was made outa grass in Kauai. That's how long ago that was. They go to school, they just have to swim across the river. My

grandmother was a gatherer, see, so the food is all caught in the rivers, opae, o`opu, and that's what they eat. They shoot all the animals and they salt em. And everything they salt. And anything they sell. My mother say, that's all we eat is salt. And then they talk about salt not good for you, and tobacco. My mama don't smoke but my mama know my grandmother smoke and nurse the baby the same time, My Uncle Macky. And she says, 'tobacco don't bother me' it don't bother my grandmother, my grandmother died in the big flu epidemic, you heard of that -- what year was that now? My mama got the flu and my grandmother got the flu, my mother made it, my grandmother died. Way back, in fact my mother was a little girl when she got the flu all her hair came off, that's how bad it was, she's bald, she tell me the story. And she kept all her hair for years in the couch. We had a couch that you could lift up like that, and she keep all the Hawaiian stuff in there and her hair. I don't know what happened, maybe my daughter still got the hair, but she kept all the hair that fell off.

I work for the plantation summer time. I was tall so they hire me. I was a case packer and the label machine, put cans of pineapple. I work for Libby and I work shine shoes, sell newspaper. I sold newspapers in front of Waikiki Theater after they built it. I remember Saturday night I sell the Sunday morning paper there, big money, 5 cents every one I sell. I made money just to buy fishing stuff. Five hooks for a nickel, you get three shrimps for a nickel, I spend my vacations in Haleiwa maybe more than 10 years as a little boy all the way up every summer. My cousins live all down there. Real Hawaiian. But they half, just like me, not half but less than half. They live down there and I like fishing so I go down there. I fish so long my aunty send the girl down call me and I wouldn't come home and then I see oh my aunty coming with a stick and I take a beeline home to take a bath and eat. Oh boy, I was so scared of my aunty. That's the one took me to school my first day. I wouldn't go, I wouldn't go. My aunty says "let me get my clothes on, I take that boy to school." Finally went to school, Kapalama, only about oh my God, 300 yards up the road, Houghtailing Road. I remember Carter was the principal for the school at the time, she's a big gorilla, big lady, whew! But she get the job done boy. She didn't believe we gonna have a hoolaulea thing, May Day. I being a white-looking boy with blue eyes, I told her I wanted to carry one of them spears. Oh, no, no. You haole boy. I went home I told my mom, my mom give me some damn Hawaiian pictures on tin now, not on paper, made on iron, so the next day I went there and slap it down in front of that gorilla and said, "I am Hawaiian, there's the proof that's my grandmother right there." I carried the spear. But I look like hell on the movies. They had movies then, and here's this white looking guy with white legs, 'cause you wearing a malo, walking by, I says 'oh boy, I shouldn't have opened my mouth, I look terrible!' But it rained that day, I lucked out, it rained so we stayed on the porch instead. Oh my God. You can see I can remember, can't I?

I remember everything, three years old I start fishing, my dad use to carry me, put me on a stone and he would go to work. The radio station was out in the water at Wailupe, it extend out in the water and he would be working and keeping an eye on me, and when come lunch time he would roll up and take off his shoes, walk out there and get me off of that thick cement pillars that hold the area wires. And then I gotta go home and sleep -- eat lunch and go to bed. That's how young I was--I was three, four years old. I wasn't allowed to have a hook so I tie with this wire that they tie around a milk bottle. They put the cover in the milk bottle those days and they put a cap over it and they tie it with this lead wire. So I would use bacon rind. you buy a bacon that big in the Navy and the hard part my mama would keep for me for crab bait, and I tie a piece with that wire on and then I have a little slit in the string and I throw it in the water and when the crab start pulling, I pull the crab slowly, then I would scoop him up. Sometimes I would get five or six for my mama. My mama likes to eat em. Yea, when I was a kid, I started early, fishing [ARNOLD].

A-4. Jeanette Howard. My name is Jeanette Kaualani Akiu Howard. I was born here in Punalu`u, Kau, Hawaii August 19,1928. I went to school in Naalehu and Pahala and during my 11th ad 12th year, on Oahu. I moved to Oahu in August of 1940 and attended the Wallace Rider Farrington High School. I graduated in June of 1942. During that year, two months before graduation, the Federal government needed workers to work at Pearl Harbor, as we were at war with the Japanese. The school was used as a hospital then. There were other buildings at the back where half of the students attended classes in the mornings, the rest in the afternoon. I applied for work and was hired ad a file clerk typist to work at the Naval Supply Depot. Summer of 1945 I left my job and went to the Mainland. December of 1950 I returned home to Punalu`u until today. My real mom died when I was three months old of T.B. She was about 17 or 18. As for my Dad I really don't know who he is. After my Mom died, my grandparents adopted and raised me and they are the only ones I know, as my parents. Their names are Adelaid Kanihokula Akiu and Henry Akiu. Adelaide was born in Waiohinu, Ka`u 1873 and died late 1946. She was the last *kahu* or minister for the Hokuloa (original) Protestant Church that sat on the hill. Henry was born in Keaiwa, Ka`u 1875 and died 1952. We lived in a home by the beach road on land owned by Ohana, the Whittingtons. The April Fool's Day tidal wave in 1946 washed the house away as well as the neighbors. I was not present at that time. Luckily my grandma saw and knew the changes of the ocean, got my grandpa who was permanently blind, out to safe ground. They lost everything. The sugar plantation manager at that time, Mr. William Campsey gave my parents permission to build a home on this land where I am living on now for one dollar a year for as long as they lived. The Red Cross had furnished all the materials for a four room home but they had to hire a contractor to build it for them, which they did. I cared for my grandpa until he died and I'm still on this place since. The beach land was later given to Whittingtons daughter, Margaret Carnichael who is now 90 and lives in Hilo. At her age, her daughter, Sidney Strange is now in charge of the Estate. Margaret also has a son, Curtis who lives in Hilo [JEANETTE]. [NOTE: I apologize as her photo did not come out. Will be #52.]

Photo 53. Shops at Punalu`u Black Sand Beach.

A-5. Rayner Kinney. I was born in Honolulu…in 1929 in Waikiki--Kaniloa Road, right in the heart of Waikiki. The family was there. Do you know where Lalani Village was? That was where my family's home was right on the beach of Waikiki. That's where Paoakalani and Kalakaua, that's where the family home was until they moved in 1929 to Kaimuki. So when they were building the home in Kaimuki the lots were $25 a lot. My father was Raymond Kinney. My mother was Hanaka'ulani Holt Kinney, and there were five of us. I was raised in Waikiki and went to Kamehameha Schools. I'll start out with Dad. He was an entertainer; he came home from New York and had an opportunity to buy a 41-room hotel in Waimea on the big island. I spent a lot of years in Waimea when we had the hotel, the Waimea Ranch Hotel. And then my Dad lived in Mana, and his mother was from Honomu and her mother was from Ka'u. Her mother was a Kauahi from Ka'u, so I had ohana here and Ka'u, and in Kohala too…. My father was from Hilo side, Kaumana. He came home and wanted to…. I worked for the territory in the retirement system in bookkeeping – that

dates me! I worked there for a little while and had a little place called Dusty's Market down at Ward Street selling wholesale aku because my uncle was a lawyer-judge and owned a tuna boat and he owned part of another tuna boat, and I started a business there at Kaakako with my Dad and my uncle Oliver, and was working for the state, and every afternoon I would go there. So then I decided to get the Waimea Ranch Hotel and started that. My dad and I went into a partnership and we purchased Waimea Ranch Hotel, and we operated that for seven years. Then we went back to Honolulu, and Dad became an entertainment director for Sheraton at the Monarch Room of Royal Hawaiian Hotel. So we went back to Honolulu and I went to work for Henry J. Kaiser at the Hawaiian Village. Stayed there, and it was taken over by Hilton in 1961, and at that point I went through various stages where I was lucky, Hilton was expanding from 19 hotels to 64 hotels, and so they used us to train us. I worked at various hotels, 15 different hotels from all over. I worked my way from executive assistant manager to food and beverage director, then in Maui I had my first management job, I managed the Maui Hilton. And then from there, there was an outfit that was bringing in a lot of tourists, and they purchased a number of properties and one of them was the Regent in Waikiki, and I became the project director for that hotel and became the first general manager in Waikiki. At that point, C. Brewer wanted to sell their lands here in Punaluu, and they decided the only way to do that was to make a window through Hilo, coming in to this area. So the purchases from the Brothers--they purchased the Hilo Hotel, the Volcano House; and then they built the restaurant down in Punaluu and there was also a small museum. They built a golf course there, and also purchased the Volcano House golf course there. I became the general manager then the vice president of all of those properties when they were developing them.

My grandparents -- my grandmother married a Holt. She was a Lemon. Her father came from Canada. Her mother was from the Ewa plains. That family line goes to Kalani, who was the alii of that area. My grandfather's mother was Hanaka'ulani. She had an interesting start. Her father was Lord George Paulet, and he arrived here when there were two British counsels here. They also sold liquor to the king. The king sometimes was a little late in payment, and because he was behind in payment they said he had to wait [to get more]. Then the king told them they had to wait [for payment], and there were a few words, and so they said they were gonna remove him and he told them they cannot. One went to Valparaiso where the British there was helping Maximillẽn in his quest for the crown of Mexico at the time. And the other went back to England to report. The admiral over in Chile sent the *Carysfort*, a British battleship, and the captain was Lord George Paulet. He came over and aimed guns on the palace and said cease and desist and as you know in history he took the islands for the crown. This was in February 1843. Well, while he was here, he met the young princess Kamaluoleleohoku, and her father was the grandson of Kamehameha….. Lord George Paulet left without knowing that Kamalu was with child. So when he found that out, he came back and he was very honorable in that he was married in England. He had family in England, but I guess in those days they had em in every port, I don't know. But he came back to find the child. But the Hawaiians took the baby up into Nuuanu Valley and hid her in a cave. He searched for the baby, and then he left. Later in the early 1900s someone in my family went to England to look it up….

So my grandmother's side on the maternal side, her mother was Lihu'enuiahanakalani who was from the Ewa plains, and Lihu'e was the name of a district down at Kokio and that whole area wrapped around all the way through Waialua down to Ka'ena. Yes, it came all this way back this way and around to Ewa right around to Ka'ena. That was the breadbasket of Oahu at that time. So her father was Kalani, and he I think it was either his brother or his uncle was the king of Oahu, and the other was Kaumualii who was the brother of the king of Oahu, and he [Kaumualii] was the king of Kauai or the alii of Kauai. So we have a branch that goes back. I married a Kama'iaululu whose second name starts with Kama'i and my wife's name was Leinani Kama'i but her line goes to Liloa, to Umi-a-Liloa in a direct line. My brother-in-law was Heinz Kama'i who was the alii'aimoku for the Kamehameha Society who passed away last year. On her [wife] line, she goes straight up. And then Liloa's mother and grandmother came from the Ewa plains. So what goes on from Oahu there, connects. So my children have a very, very strong line. Their line goes straight up from this side of their mother and their grandmother. My heritage goes a couple of ways that lead to Kamehameha; but Kamehameha kind of strays to this side too. I have that genealogy, so we're actually cousins [RAYNER].

A-6. Maile Spencer Napoleon. My name is Maile (Spencer) Napoleon, born in North Kohala. My mother was Lahapa Ah Yuen from Kohala and my Dad was John Kahanu Spencer, Sr. I was raised by my Dad's mother, who was Alapa`i.--her name was Abigail Kaomea Alapa`i Spencer. She raised me and my younger brother Daniel, because my Mom had to raise 7 nieces and nephews and had four other children when I came along. Tutu Abigail spoke only Hawaiian, *ōlelo kanaka* to us. No English. She was a very good person and we learned a lot of things Hawaiian from her--about plants--medicinal and otherwise. And from her I learned to do *lomilomi,* Hawaiian massage. Because the Christian missionaries came, she used the *Babala* (Bible) before she did her *lomilomi* work and always prayed before and after each person she worked on. She shared with me that you need to use unconditional love to do the work. And breathe (*ha*) with your patient so you could energize each other as I do the "work." *Ha* is very important, but so is "aloha" or love.

I left Kohala at age 18 and went to Kapiolani Nursing School. My Dad decided that I should be a nurse, since he had a stroke when I was 17 in 1957. I cared for him and did *lomilomi* on him to help bring him back to walking. Six and a half months later, March 1958, he spoke his first word; "okay" was what he said. I was so happy! By the time I graduated from High School he was walking. A doctor from Kohala said that he would never walk or talk again. In those days, people just gave up when someone had a stroke. He was able to come to my graduation from High School. So off to Kapiolani Technical School I went to for nursing.

Afterwards I was too young to be an airline attendant so I went to Kapiolani School for Hotel & Restaurant training. It was the best school I think at the time, that I could have gone because I learned how to talk to people and how to be with people in the social part of life. One thing remains in my mind about learning all of that is "When you think that you are too good for the job, the job is too good for you!" and many other things…. Mrs. Schuler was the head of the school at the times it was held at the Old Club, next to the Ala Wai Canal. Then it eventually moved to Ft. DeRussey. The campus for nursing was adjacent to McKinley High School and I trained at Queens, at Kuakini, and the State Hospital. My object was to return home to Kohala, but I never did….

My wild desire was always to become a minister the way that grandma became one by going to a Hawaiian school where they teach you Hawaiian philosophy and healing and what we call Huna, "the secrets of the old." That was one of my high desires. I lived on Oahu for many years and went to stay in Colorado and Kentucky to be with my children and *mo'opuna* there for a little while. But my feeling was to move back to Big Island where the magic for me has always been. So after making a powerful prayer asking Ke Akua to find me a way to live on the Big Island, in Waimea, my prayers were answered. I was able to get a job here on the Big Island in Waimea, working for my church on Oahu. Once I got here I made another prayer to be able to learn how to do *la'au kahea* from a certain kahuna--Kahuna of healing in *la'au kahea*. My niece had been asked by the Kahuna to find three people that would like to come and learn in Kona all about the use of La'au Kahea work. So I did go to the classes and learned that…. I attended the Huna classes that were taught by Serge Kahili King. Who learned his mana'o (knowledge) from his Hawaiian hanai (adopted) family from Kauai. I was able to learn from him about Huna and as I sat in his classes at age 50 I kept saying that is what my own Grandma or Tutu Abigail said, or taught me when I was growing up with her at her home in Hawi. I was ordained by Serge Kahili King in Kauai. To be able to have a license to marry people, bless places, homes and do funerals and baptisms [MAILE].

Malama okou ka aina, ka aina e malama iao okou.
If you take care of the land, the land will take care of you
Ancient proverb--Pele Hanoa (2005)

B. Land Resources & Uses.

Land resources and use changes over time. Evidence of these changes is often documented in archival records. Cultural remains are also often evident on the landscape and/or beneath the surface and provide information regarding land resources and use. However, oral histories can give personal glimpses of how the land was utilized over time and where the resources are or may have been. Oral histories can also provide confirmation of cultural practices.

Much of the project lands have been continuously utilized for a range of uses; from traditional farm lands in the mid-1800s, to sugar cultivation and cattle grazing in the early twentieth century, to resort development in the later twentieth century to its current uses of resort and private dwellings. Some of the cultural consultants still remember traditional agricultural, gathering and recreational practices of the old days--many still being practiced in varying degrees today.

B-1. Punalu`u and Vicinity.

> The weather here is pretty good; it's nice most of the time--it's the windward side of the island so it's windy a lot of the time, but we do have beautiful days down here, beautiful, so peaceful, very nice place for people to enjoy and relax. I've spent nights up there [at *Colony One/Sea Mountain* resort], it's so quiet--sometimes you can hear the ocean. I like it [PAULINE].

> Punaluu is in a recess right now. It's just not going ahead. We had a nice restaurant we could go over there Saturday night, people come from town and have a decent dinner down there, the environment was good, and they had a tennis court over there and the place was clean, you look at it now, you look at that roads and you look at all the bushes, terrible, used to be nice garden in there, just walking in there would give you inspiration. But now it's just a damn bunch of junk. You ever went in there? You see how it's all broken? That's all our kids did that; they stole that painting. We wasn't home, if we was home they wouldn't have done it. Somebody knew we went on vacation [ARNOLD].

> The area is growing so quickly, homes are coming up as we speak. Every time, we go out there and golf--I was out in Punaluu last week golfing with my son, and we generally go out to Discovery Harbor which is closed but they have one caretaker and he rents that out for five dollars with cart, and we just do the fairways; you hit the green and take an automatic 2; but we have a lot of fun with that. Since Hawaiian Homes has picked up 80 lots I think at Discovery Harbor, that's coming up. Every day you go down there are five or six places coming up. This place is growing so quickly, and what's really gonna develop in Punaluu is now beginning to show. Last week I saw six houses there that I never seen before, right on the 15th fairway [mauka]. It's growing in leaps and bounds…. So I think eventually they gotta be viable, it's something that should work, this area has grown if you count up here in Ocean View and you go all the way down to Waiohinu, Na`alehu and to Pahala, it's better. It's so crowded in Kailua that people are coming this way. It's still affordable if you wanna call it that. It's terribly expensive [RAYNER].

> [Punalu`u in the `70s] was just like it is right now. There was nothing here but sugar cane at the time, but on the makai side where they didn't grow sugar cane this is where they wanted to develop. It was too rocky for sugar cane and they wanted to put lots to build homes there--mostly around the bay. And also make another smaller community up above. So they had the museum and the restaurant, they operated that [RAYNER].

B-2. Punalu`u Village Lifestyle.

We hardly had meat, if we did was from the ranches that bring down. And we had to salt our fish or our pork. That's because we didn't have refrigerator. We had ice box, we had to go buy the ice, in a whole block, wrap it in burlap bag, and put it in the ice box so it lasts long. And certain things like butter then mama puts it in the ice box. We didn't have electricity. That was fine, that's how our life was down here [PELE].

I built these two boats. I tried buying a boat; I bought two boats but I didn't like them. I like the ones I built better. The motors don't have to be real large to push it, and they all 24-foot boats. Unbelievable. I got the plans from a popular mechanics book at a dentist's office and tore the pages out. When I start to read that, oh, this is what I need! I had only a canoe, and that was in 1968 or 1969 when I start building the damn boat. [I bought my lumber from] Lewers & Cooke--they not in business no more. But I bought all my lumber for my houses, I built two in Kona and one up here in Pahala. This [Punalu`u] house was half-built. I just put in a bathroom and this other room over here. It was half-built and there used to be an out-house over here, and I put in a bath and shower, and I pumped water from the well down there. Now I got this company water. But we had a hole in the ground down there and I tied plenty water and the pump would run and bring it up to the house. It was about a hundred yards down there. I put the pump half way down. It did good. I come here and took a bath on the back steps. You go down there and get two buckets of water. I put it on the kerosene stove. No electricity, no nothing. We own the house, we don't own the land. We pay for the lease of the land. Every month we pay…this company--Roberts of Hawaii or SMA Partners. I have another home uptown [Pahala]. Because when the big wave came in 1975, I says oh, oh, and only my house was left. Only this one was left, so I decided hey it's time to buy me a piece of ground up there. So since that tidal wave, I live up there. This house was built in 1946 because it was down there [on the beach] and the grandfather [Akiu] was blind so the Red Cross made the house up here because he couldn't see. So this was my wife's grandfather's house. We paid the plantation a lease 'cause they had a ranch, then when Brewer bought all this, we paid Brewer [ARNOLD].

In the Early Years. We didn't have electricity at that time [1930-1940s] down here, we had kerosene lamps. And we didn't have running water. Our drinking well we had in our property, we lived on brackish water, and we had outdoor lua. So we had to walk out there to the lua and then we walked out here to sleep at our house. Our house was right here by the punawai, so easy for us to carry, our punawai there [PELE].

Farm Lands. So we go up to Wailau to do our planting of our taro and our pumpkin. We have fruits up there, banana. We come down and then we pound our own poi, we do our own poi. I help daddy pound [PELE].

You know what good about here, we have all this coconut tree. I make my own kulolo, I make my own haupia. So when I go to school and teach children, I take the coconut leaf, I make pluminiau, that's what we use the broom for sweep. That's the only kind broom I use…the ribs of the coconut. You gather all that and you make nice big bunch. And that's what we sweep our lauhala map down here. And then every weekend my mama take 'em out, and we gotta wipe 'em all and take 'em inside… Lauhala mats, all our lauhala mats--we make that [PELE].

B-3. Punalu`u Black Sand Beach.

I share with them [Kamehameha School students] about Punalu`u Beach, why it's called Punalu`u. Because Puna is a spring-- spring water. And lu`u means to dive. Dive in the ocean. So those days, the way I was told, the reason why it's called Punalu`u, diving spring, it's because our Hawaiian boys used to challenge one another, dive into the ocean of bay, and find how many cold spring spots they can feel in the water. But if you read in one of the book, the haole put down that the Hawaiians used to go with their *ipuwai,* to go and fill up with water. Now, nobody could ever think of going into the ocean, diving down, and try to fill up a gallon when the wave is throwing back and forth. How you going fill that water coming from down there, when the ipu is up. We're

not stupid, the spring is coming up, you have to put your ipu underneath so the water can go in. Not like this, you cannot fill the ipu this way when the water is coming from down, and your ipu on top. How you gonna fill up? You try go do that if you can. I challenge anybody who can do that. But you know how they write 'em, backwards. They said we don't need to dive to fill up ipuwai, because the whole coastline get ipuwai. We get punawai over here. But that's how the haole translate it. Make it so impossible kind of story. So I tell them, that's not the reason why they call it Punalu`u. They said because they go with the water to fill up the gallon in the ocean. How you can do that in the bay. When the water is way down from the *punawai* [PELE].

B-4. Beach Business/Road and Traffic.

Once in a while they [busses/vehicles] would get kind of close, but we do have a sign--oh, what happened to the sign? It's not there. It was last week. They would drive in from the beach. Or we would remind them don't drive too close up, so they would just back up. So far we used to have nice people, they would back up. But now that road closed, so they just park all kinds of places. They use to just go through, the cars used to go right through back and forth either way and that was convenient and then when we have buses you know there are drivers that really know us so they reverse and sometimes it's so dangerous but they keep reversing [PAULINE].

Photo 55. Black Sand Beach and turtle-watching visitor.

[Tour busses bring business] I always tell them thank you. But sometimes there are tours that first circles the whole island, and it's a rush, rush thing they have to meet deadlines and get into Kona earlier, so they come in to use the restrooms, and on the go, and I understand. [Some tour drivers drop them off at restroom and circle back to beach shop area] But not all of them would do that! A lot would just you know rush them on the bus and off they would go. So if this was open they would drive right through. Drop their people and tell the people meet them right up here too. It has happened, they drop the people and tell them meet them up here--they'll go straight up there from the beach. So both ways, we can see it both ways. But I wish this beach could be kept like this you know [PAULINE].

This black sand beach is one of our island's most popular visitor's stops. All the tour companies buses brings their groups here daily as well as the U-drives to see this black sand beach and the *honu* (sea turtle) rest on the beach--the only black sand beach available and accessible to everyone who visits our island. For whatever reasons given by the Hanoa's to the Mayor, Harry Kim about keeping the beach road closed since August 2005, he is on their side and not for all the many people who signed a petition to keep it open as this is the original old government road which hasn't been closed since I can remember living here in Punalu`1u. The back road was made by C. Brewer and allowed the public to use it until now with other new owners. They could close it anytime they see fit or if ever anything should happen on that road which so far only one accident which a car ran into the electrical light pole (street) [JEANETTE].

Photo 56. One of many tour buses.

When Sazale bought this place we had the council people and we had DLNR, they sold this ala nui, this old road, they wanted to sell it to Sazale. But we went to court in Honolulu where Judge Acoba stated--it was in the paper, I have a copy of all that--that they have no right to sell the road, this old government road. So now it's still remain that they have no right to sell it, it's just ours yet. So that's how this road remains this way [PELE].

Just like those vendors over there. Because there's the vendors over there, that's why I fought for them. Now those ladies, they know damn well, we are not to sell our minerals, our sand, they selling `ili `ili, the sand, and the green sand, put 'em on the postcard, and they sell 'em. When I'm on the National Park now, advisor board for the National Park, these people experience all this kind of haoles, tourist come out here. They pick up the sand, they put 'em in a bag, because they sell the sand, so they feel can take and put in the Ziploc bag. So they walk down here, they think why should they go buy if they can get 'em free. They put 'em all in the Ziploc bag and you know what happen, when they go to the mainland, they experience bad luck, broken arm, broken leg, everything, they ship 'em all back to the National Park…. When Sam Limu, DLNR came to have one meeting with us, and told us that we can take the sand for personal use, like us we live down here, but not for profit. Never teach them lesson, they still selling sand [PELE].

B-5. Kuleana and Konohiki Lands.

Kekaula is the one that owned this whole piece up here, the whole kuleana, 114 acres. And then down the other side was Holua--owned that whole Ninole mauka. If you look in the map, you find all these people's names. But down the kahakai area, nobody owned the kahakai area…. Mahoe was here--on this property--my tutu. My tutu was a nephew, Jed Kuaimoku. And then this went to my tutu J. W. Kuaimoku. You see J. W--Kainoakupuna Kahenenui. He's originally from Maui. So the Nakoa's is related to my husband, that's my husband's side. My husband's great grandfather is Kahenenui. But he go under the name of Kainoakupuna Kahenenui. But originally his ohana from Maui, Hana side [PELE].

When C. Brewer came down here, they tried to grab this piece of property that we have. And so I had Native Hawaiian [Legal Corporation] come but then I went kick the surveyor out of here. Because I feel this is the konohiki that was awarded to my tutu. And those days we had konohiki. Konohiki land is where they give to the chief or to the high ranking, you can have that 'cause you take care of the area. So my tutu had that as a konohiki right. But I have a picture where it shows our house was right here and up there was all stone wall. The wall I think is still there, right at the end of this before you go up to the pali. Not way up that cliff now, right by my little goat house there, right above there. That's where the kuleana go, all the way and goes in the back. We have a bigger piece of property down here. And then Carmichael is next, and then Delbert is next. So only three of us left now with kuleana in this Punalu`u area. And you see why the telephone poles is in the middle of the road when you folks come down? That's because the road was on that other side and the telephone poles was to be ours, we paid for that poles to be in this property. My dad had to pay when we get electricity down here in the 1960s. I think the electricity came when they built the pavilion [PELE].

Photo 57. Pole marks part of Hanoa property.

And all over here when the sand was way out, and down there at Wailau kai people used to live there, all black sand. You know all down this home was all sand, black sand. Not today, today get all punawai, all open up, the sand all disappeared. And the tidal wave, because of that too, all destroyed everything. But anyway, that where all people living on that area. And was all

open, all open. And in the front here, has kuleana. In the front of this road towards the ocean, has kuleana. But now, the waves came in, the ocean came in, so it disappeared. Now I don't know how anybody, I'm telling you, could own this whole beach here, from Ninole all the way to Punalu`u here [PELE].

I'm at the DLNR, Peter Young--why you folks allow that house to build on conservation? It's all conservation. Over there went urban, we didn't, we stayed conservation. And you know what? They came down on me for building this house down here--the county--for building this house down here, like this, a shed. It's open, it's not a building, but you can tear it down. I can tear this down any time. They came up to me, they wanted me to pay $5,000 a day, or something like that, for building this. And we get Native Hawaiian Legal Corporation, 'cause I was on the board for 10 years with them. And then he came and the lawyer, we fought for this--because this is kauhale style. The Hawaiians had kauhale style, it's because you can sleep one area, you go *lua* one area, you go *au`au* one area, because you never had any running water. It's how we sleep. *Punawai* is where we cook and eat close to it. Our shower was over here, our *au`au* house. I went to see Harry Kim. This is not right, what you folks are doing to me? I said. I been on this property since 1852 and I say, if you look at Pahoa, down at Kapoho. All those big shot people down there build a punawai right into the ocean. They're all cement, all cement freshwater pond. I say if you can do that, you folks violating the law. And I am on my own *kuleana*. I'm not in the water. And he goes after me, and you know, he told me, because he had property down there. I said what is wrong with that? Then he said well we had that since 1960. I said Mr. Mayor, I had mine 1852. From that day, they never come to bother until today. They never did, because they know it's wrong for them to do that to me. This is my *kuleana* style, that's how we stayed. Our *auau* house all separate, that's *kauhale* style. We call it kauhale style, the Hawaiians, because we never had one whole single dwelling where we could put everything in one, kitchen and all, we cannot. Because we never have running water. So we had to stay separate, near the punawai, you have your kitchen so you can carry the water. We used to use bucket water and leave on our counter. When high tide, we go get our water. When *kai make*, you cannot because the pond is too low [PELE]. .

B-6 Old Government Road/Ala Hele Nui.

C. Brewer destroyed part of that land that goes all the way down to Honu`apo. This road go all the way. And when you go down to Ninole side, is a big open road in that section, all the way down to Kawa. And all the way to Honu`apo there's a road and still remains. So I told Eric Arakaki, with the *ala kahakai* trail, I told him to check all of this *ala nui*, 'cause this is an old government road. And when Marion Kelly did historical society research for this ahupua`a…in Ka`u. On the map shows all this trail, all this road going all the way up to Honu`apo. And beyond the trail is all open [PELE].

B-7. Nīnole Churches and Schools.

All up here, over here, this side, was the school too. 1886 when they had that big mudflow and Ninole was all covered. And then they took the church and put it up there on the bluff up there. And that's called Hokuloa Church. And down Ninole they took the school and put it down. And Ninole by the cliff, if you go there, there's a nice little space there, was for the school. And across Ka`ie`ie Heiau--the Ka`ie`ie Heiau is in the front overlooking Ninole Bay. And mauka, across there, overlooking the punawai there's a school, Ninole School. And up here was the church and cemetery. So all my ohana is up here buried on the chapel up there. They took the church down I think in 1957 because was all termites. And then they built Henry Opukaha`ia's chapel. Henry Opukaha`ia was born at Ninole and then when he went to the mainland, Connecticut, he died up there. They buried him up there, but the ohana went and get him and brought him back to Kahikolu Church--I think he's down at Kahikolu Church in Kona [Napo`opo`o near Kealakekua Bay]. We used to go up here and every time when *kaipi`i* (tidal wave)--when my mother see big wave and give us warning, we all run up to the church, 'cause that's the safest place for us. All the people run up there. And you can see the water. When you're up there, you can see a lot, nice you know, looking down here, all clear, when you go up there [PELE].

B-8. C. Brewer.

C. Brewer wanted to sell their lands here in Punaluu, and they decided the only way to do that was to make a window through Hilo, coming in to this area. So the purchases from the Brothers they purchased the Hilo Hotel, the Volcano House; and then they built the restaurant down in Punalu`u and there was also a small museum. They built a golf course there, and also purchased the Volcano House golf course there. I became the general manager then the vice president of all of those properties when they were developing them. They decided that they would go first class in putting this hotel together because they wanted to sell the land and subdivide all of the property into these lots. In order to do that, they had to build the infrastructure. They wanted a golf course, they wanted a shopping center, a small school. They were gonna fit everything together with that bringing them in to Hilo--they built the Waiakea Village. The Waiakea Village at that time was one of the most expensive hotels ever, ever built. They put in waterways, they brought in 200 exotic birds, tropical fish and koi. The Waiakea spring was putting out over 2 million gallons a day. So they built a beautiful waterfall and from that they sped the waterways that went through the entire property. It was really gorgeous. I opened that, we had quite an opening with a queen and princess from Tonga to come and they had yards of tapa. It was quite an event. So from there, I also ran all of the operations. What they did was their marketing strategy was to approach all of the better country clubs from the United States -- going to the upper 4% in order to bring them out and buy this property and individual homes around the golf course throughout that area. So at that time IU (International Utilities) purchased C. Brewer. I think the better of it, midway through, they thought better of putting $30 million into that hotel, and they backed off. They got a hold of Sheraton, and got Sheraton to operate the Volcano House and the Waiakea Village. At that time, I was offered a very nice job with Continental Airlines, and I went with them and I operated their 5 hotels as vice president of Continental Airlines hotel division. But I think I was more interested in the Punaluu property…. [I started] in 1970 – 1971 right in that area, and then I stayed with them until 1973 until they decided to stop the project, and all the land development stopped but they finished the golf course and the museum. And we were still operating the Volcano House and the Hilo Hotel, and we were in full operation at the Waiakea Village. Waiakea Village was a very hard-sell at the time. This wasn't the tourist path – through Hilo – it was through Kailua-Kona. But what little we did, they didn't care, they wanted to make it first class just to be sure they could bring the people in to a very beautiful hotel and bring them up to the Volcano and then over to this area so they can see the lodge…. In Punaluu it wasn't that bad, but in Hilo and Volcano it was--I mean it not only rained but there was a lot of fog up there. Waiakea, we didn't have a golf course there…we have a beautiful weather in Punaluu [RAYNER].

Everybody used asbestos in those days--they did, even the restaurant. I mean they used it everywhere. I used to spray it on. After a while they stopped [RAYNER].

What they [C. Brewer] did to Punalu`u somewhat benefited the residents of Ka`u as well as for the visitors and the *kama`ainas*. They built a place to eat, a museum or cultural center contained with history of Punalu`u and Ka`u, a golf course, pro-shop, condo's where visitors and kama`aina can have a place to stay, an Aspen Institute or (think tank) where people from all over the world come to meet, discuss and plan world issues. They had jobs for people who wanted to work. Most were either lazy or didn't want because they were getting free money by being on welfare. We use to be able to hold the Aloha Week festivities here in Punalu`u as well as other programs, activities and parties at the restaurant or at Aspen. It was really nice and I was able to work at the restaurant as a hostess too [JEANETTE].

When C. Brewer was to develop this area, they did not have much trouble with people protesting their plans. Most including my husband and I thought it was good to have something nice done for Punalu`u and Ninole. Pele Hanoa and her daughter Keola for example, were not living here at the time. They came back to Ka`u when C. Brewer was all done. They do have property in Punalu`u but there are others in the family who has a share in it. Pele's residence is in Waiohinu. Her daughter Keola and companion lives on the property. The land next to theirs, they claim it as adverse possession, which I thought it to belong to whom ever buys this whole place just like

where I am. Sad to say, Pele's daughter, Keola Hanoa just passed away on March 13, 2006 [JEANETTE].

To tell you the truth, I think C. Brewer did a fraud with all this land, kuleana down here. They had cheat a lot of our Hawaiian people. And it's so sad, our people don't have the money to get lawyer to fight for it. And now it's all being sold. I hope we can still fight for the land because a lot of the land around here was cheated by C. Brewer, they changed the decimal point of the land, the aina, because this was all Kekaula's aina. Kekaula owned from up mauka, not down the beach area. Kekaula owned this whole section up there, down Ninole holoa, going down, that section. The old ahupua`a go up, and 828 belonged to Kekaula. But what C. Brewer did was changed it from 114 acres, and Kekaula gives about ½an acre of that to build the church and the chapel of Henry Opukaha`ia, Pohokulua Church and Cemetery. So it left about 113 acres. What C. Brewer did, it changed the decimal point to make it 11.3 and all that land now they changed, and not only that, when the land went to Kainoakupuna, what C. Brewer did, went and get my brother-in-law, his name was Kainoakupuna also, named after his grandfather, and made him sign some paper, and the paper was not signed by him, was signed by his wife. How can you have a notary to have things like that done, one signature for Mr. and one signature Mrs., the same signature, Mrs. Sumiko Hanoa and Mr. Kainoa Hanoa, one signature. Don't you supposed to have a husband sign, and the wife sign? No. And both of these papers that we found out, signed by one person, signing the two names, Sumiko Hanoa and Kainoa Hanoa. And you know this was fraud done by C. Brewer. And I don't know how Bishop Estate also came in and occupied this whole 114 acres. So according to what we found, some lawyer said that there's no limitation on fraud, so maybe a day when. . .Like now, Warrick is fighting for the land up mauka there, and he's successful with that, then maybe these things can all be turned around in some way. And how we can see what we could do with that fraud business C. Brewer did. Lot of crooked things were done. And that's the reason why even by that restaurant, how can they own the beach? That's what I don't know. How can they own the pond in it? [PELE].

B-9. Sazale and Punalu`u.

Sazale came down and blocked that pond one time, and they want us to go that side, 'cause he had his advertisement for that kind of car that they had, and they put 'em right on the sand on that side. They blocked the beach over there, and put the car on the side and take video, advertisement. What kind of car? Lexus. They advertised over there. So when they did that, I called in to the mayor, how can they block us off on the beach. He said, oh, that's Robert's. Robert them do not own the beach, nobody owns the beach. 'Cause if you look into the map, there's no kuleana down the beach area. It's all open. The kuleana is all mauka. That's the reason why I don't understand. . .Now the people come in and want to develop all the beach area. That's open for us. This was always open [PELE]

B-10. Sea Mountain Resort.

General Deterioration. During the years that Roberts of Hawaii or Sea Mountain Partners owned this area, they have let everything go down the drain. Nothing was done to improve this place at all, even when people were vandalizing the area. It was like that they didn't care at all. The boss that they have isn't the best. My husband and I are the ones who always have to notify him whenever something is wrong going on in the restaurant area. Only when the mural was stolen they offered a $5,000 reward. This would not have happened if we were at home. We were on vacation on the Mainland for three weeks June, July 2005. The boss didn't even know that it was gone until we came home and he, as well as the workers was surprised [JEANETTE].

Punalu`u Restaurant, Bar and Museum. I used to go there--Herb [Kane] and myself and Van, Don the Beachcombers worked very long and hard in the project--we built the Waiakea Village and the marketplace--and I got a lot of help from Don the Beachcombers. Herb did a lot of research and the paintings for us and of course Punaluu, and he just stood there and painted it [the mural] while we were building it. I worked with him for many years, we're good friends. He's sick now and going blind too. Somebody stole [the mural]. They cut it out and took it, and I have

no idea who took it. I went in there--it was about five years ago--I went in there with my son-in-law, Mana's husband, he was the manager of Punaluu [restaurant] and we went in and walked through, and the painting was still there. It was still in good shape. Then I heard or read in the paper that someone came in and took it out and stole it. Just a couple of years, maybe last year I'm not sure, very recent [RAYNER].

Punalu`u Restaurant/Fishpond. They wanted a small museum and a restaurant and a wonderful little stop to show the cultural background [fish pond] and that is why the walk-through where the painting was, and the little taro patch and all of that so that the tourists coming in and people coming in could get a feel for the area and possibly buy land, the golf course was where they wanted the recreational, and the tennis ranch right there, all that for the marketing of the lots. They didn't mind spending 33 million for Waiakea because they thought they would make over 300 million selling the lots. That was the approach in those days [when building up Sea Mountain Resort]. And then somebody got cold feet [RAYNER].

New Development. I think…it would sell itself. It's gonna build no matter what. There's a big demand now for lot and land and everything in this area I think it's a go. They were trying to go for the upper 4%, with the 2% they wanted the affluent, they wanted a gated community, they wanted a community that was like the Greenbreyer. They wanted that type of approach. The only advertising they did was in the magazines that the lawyers put out, the doctors, they were aiming for that upper crust. So that's why they went after the country clubs. They had big bulletin boards. This was their marketing plan and after that they just stopped halfway through [RAYNER].

Affordable Development & Cultural Center. To me anyone who owns a property should be able to do on it as they see fit as long as they have acquired all the necessary permits and whatever else is needed that is legal and approved by the State, County or other officials to proceed with their plans. At least Sea Mountain Five LLC is good enough to let the public know about their plans and get some ideas of what the people of Ka`u would like to see and would not like to see done in Punalu`u and Ninole. For me I'd like something built nice and simple, not too fancy, affordable and that it will benefit the people of Ka`u as well as others who come and want to live here. To down size their plans a little and not build anything close to the shore, because of high surfs or when Tsunami occurs. Build a nice restaurant a little further up from the existing one that can hold about 250 to 300 people especially at lunch time, with a large parking lot so that busses, U-drives and others could park there and walk to the restaurant or to the beach. A cultural center and whatever kinds of building above the parking lot, which could use the same parking area [JEANETTE].

Relationship with Kuleana Landowners. I think it might have been a little strained. They didn't think like you think now. Everybody was getting a job then, sugar was going down and people were getting laid off, but here comes this other industry to pick it up, so there was mixed feelings. A lot of people living in those areas, Pahala, like that they saw areas where they could go to work. Save the whole community. This is the end of the island and for others this is the end of the world, you know we are all the way out [RAYNER].

B-11. Public Lands/Features.

In one of her [Kelly 1980] research she did, she found out that the Department of Interior had stated that all the beaches, open space, landing area, and fishponds are not to be sold. So that pond over there Kauila, and we get two down Ninole side. See this is the ahupua`a of Punalu`u. And then you get ahupua`a of Wailau. And then you go the far end down where the golf course is, across, there's two punawai down there. One is called Kawale, a mo`o wahine, and Pūhau, mo`o kane. And that was all covered in 1981 when we had the storm and C. Brewer had covered up [PELE].

No overnight camping by the landing area as there are no bathroom facilities there. Overnight camping can be done at the County Park area where there are facilities and lights [JEANETTE].

B-12. Punalu`u in the War Era.

We had this whole area covered with the 299 National Guard. The boys, I think they were Battalion 299 at that time. So they covered this whole coastline, it's because the Japanese ships were coming in. So we had to cover our windows [PELE].

B-13. Hunting: Birds, Goats & Pigs.

Bird Hunting. I go hunting. I hunt up at Kapapala Ranch for birds. I don't take no more goats and pigs. I don't need to. I used to take them because I had brothers and family that ate em, but I won't eat em. And since I don't have no brother no more, no people, I don't take animals no more. Oh, we got a lot of birds; there are franklins, pheasants, chuckers, quails. We got a lot of birds up there. We got the most birds in the United States, thanks to a good white man that came over here and brought 'um all over here…that guy, what's his name, Dick Woodworth, he brought on all that stuff, all the turkeys and chuckers--he was my friend…. They got the Nepal pheasant --black pheasant; they got that, I shoot a lot of that, up there's a lot of that. That was introduced here. So was the chuckers, so is the erkles, I get a lot of erkles up there. They look like a damn chicken. They're not as beautiful as the Nepal pheasant or our regular ring-neck pheasant. They not that pretty. They fly good. I don't eat em, I give them to people who eat them. That land up there is game management and they let Kapapala Ranch use it for ranching, but technically, it's the people's land that they lease to Kapapala Ranch. Every year during bird season they open it up for us to go and hunt--the first Saturday of November and the last weekend--Martin Luther King Day. That's the end for the year but they have other special days for turkey and stuff like that, but the main weekend days goes from first Saturday in November to Martin Luther King Day. [They use] shotguns--you only can use shotguns for birds. It's against the law to use other than shotguns [ARNOLD].

Goat and Pig Hunting. I used to guide for goats and pigs before. In Kona once I had a friend--he get some of those haole tourists that wanna goat hunt or something, and we make arrangements and I guide em but that's only once in a while. I didn't make it a business. Just to help that poor tourist go get one, they paid. Sometimes they say oh, I paid this guy and I didn't get nothing. Well you don't have to pay me if you don't get nothing. I always get um game. We used to go right up here, now you call it Ocean View Ranch, it used to be all rubbish land down there, no roads no nothing, now people live there and no more goats. Just park on the highway, walk in, plenty goats. Manuka, that's another good place [ARNOLD].

B-14. Tidal Wave Damage.

The tidal wave took the other houses--all [gone] only mine left--seven. Let's see now, 1975. 1975, big wave, came all the way up the road, came all the way up to this doorstep, came under that house there but didn't take it away. Ours was the only one left – wrecked that restaurant across the street and then they put it back up. Dahlberg had a house down there. He put that back in afterwards. And then there's some Hawaiian people down over there, Filipinos and Hawaiians. They got Hawaiian name because the father is Hawaiian--Hanoa. They got shacks down there now--they built without permit and all that stuff. Their house wasn't destroyed; it just floated up on this road here. It was a couple of houses, and I don't know why Pele, the oldest sister, wanted to wreck the houses…. But the house just floated up 'cause I went over there soon after the waves went down, I went down to see if the old folks got out and they just got out before I got there, and it was on the road here. No [warning] it was just a big earthquake and I sat down on my easy chair and lighted up a cigarette and it crashed, that was it. I went out the back door and went up the road and then I walked down. My wife went down the store where she saw stuff in there and was right up in the intersection. And then we were talking down there and another one came, after one came all the way up to here--took the A-frame house. The first one hit and everybody was in their [homes]. I was in there, so was Carmichael, he had a big A-frame house down there and then the old folks down there and then this Beamer house over here that Dahlberg owns now, nobody was in that.

And a security guy was in the restaurant and he drove up when I yelled at him and the wave went down already, he drove all the way to the pavilion to help some people that was over there and then the next one came, took his automobile--well it was C. Brewer's truck. He was in there [restaurant] probably sleeping and he didn't know but the second wave he'd a known, because that second wave did all the damage. We was down at the corner down there just before the beach and then it turned all black all of a sudden. This is 5:30 in the morning, I had a hunch another one was coming, so we run up the road you can hear all the houses crack, breaking. And people running and stopping. Hard to run. Old Carmichael just got out of that area, walked through just two yards and got out and we were talking down there and I said run, run, run. They were kinda old and then we ran and ran until we got up in front of my place and then we still hear stuff crash, oh, oh, there went your house. True. It just wrecked everything--had pavilions there--wrecked the two small ones down there, and had Mizuno's house and had that Hawaiian lady Cachola, two more houses down there, took em all, all but this old house here [ARNOLD].

[Pu`umoa tidal area] it's all covered now since the tidal wave came in 1946, and 1975 did the worst damage because the land went down so many inches. And so the waves are more in, we get more ocean now than we do land. But the land was way out where I had canoe [PELE].

But for tidal wave is *kaiopeli, kaipii, kaihohonu*, all that. *Hohonu* means high tide. *Kaipii* means climbing, or *kaiopeli*. Because in order to get tidal wave, you have to have earthquake. But when they come out here, the scientist put tsunami. Hey, we have our own name for tsunami over here. We don't need to have Japanese name. I don't like that when they put tsunami [PELE].

B-15. Punalu`u "Ghosts."

Well, I do know that they had when you come out of Punaluu Road coming up from the park down below and take a right going to Pahala there's a stretch in there called "Kukuipilau" and that's where most of the accidents happened; and many sightings at night, early in the morning had ghosts on that road. And one person told me that when coming down, he looked around and saw nothing but all of a sudden this terrible scream in the car with him – a woman screaming – that scared him half to death. He just went straight, came back down to Punaluu Restaurant where we were and he was telling us about it and he was physically shaken. Told us where it came from, how it happened…there's plenty people that can give you stories like that in Pahala and in Punaluu about that area [RAYNER].

B-16. Flora.

These coconut trees were planted by my husband right in the back here…in the 1950s or 1960s [Pauline].

Photo 58. Coconut trees planted by Joseph Enriques.

C. Water Resources & Uses

The Hawaiian word for fresh water is *wai;* the Hawaiian word for wealth is *wai wai.* This is because of the value the ancient Hawaiians placed on fresh water, which was crucial for growing taro, the staple of the Hawaiian people. Water was also critical for all peoples in these islands and very much appreciated by the residents, past and present, of Punalu`u, Wailau and Nīnole. Many of the comments regarding the categories below, were used elsewhere in this report or in combination with other categories or issues.

C-1. Well-water.

Photo 59. Punawai or well of Hanoa Ohana.

C-2. Mountain Spring Water.

And all our water, down here, from Ninole to Honu`apo, comes from the mountain, our rain god, Kumauna. Kumauna is our rain god way up by Ka`iholeno--had water nutrients all down here. So this is why you call this Punalu`u. In that whole bay, if you go auau inside that bay, you can feel the spring. Until today, you go in there. And you know down by the *lihikai*, all that waterfront here, you walk down there, all the spring coming out, all over, every day. So when C. Brewer built this place up, they stated in their book, in their record, that from 25 to 50 millions of gallons of water, that's gushing out every day, 24 hours. And it's still doing it until today [PELE].

There was also a nice fresh water spring and pond by the electrical pole across from the shops called "*Ka wai hū o Kauila*" the rising waters of Kauila, which there is a legend about this spring. It was first covered by the 1946 tidal wave until today. The monument that you see by the beach pavilion is not correct and people are getting the wrong ideas. If you read the legend, then you'll know why [JEANETTE].

C-3. Streams.

Photo 60. Part of Nīnole Stream.

C-4. Ponds.

Photo 61. One of several ponds in project area.

As for the pond, someone decided to put some water hyacinth or water lilies in the pond and it took over. My son Guy and his team of boys as well as other tried twice to clean them out as much as they could but to no avail. It grows back faster and more [JEANETTE].

D. Marine Resources & Use.

The sea can be a great resource to people with access to its bounty. The consultants benefited from the resources of the nearby coastal environs of Punalu`u, Wailau and Nīnole; went fishing there or had family members who went fishing, diving or gathering. It is also a place of recreation to go swimming, picnic and enjoy the unique black sand beaches. Just as importantly, it is the resting place of endangered green sea turtle and the hawksbill turtle

D-1. Fishponds.

> Well, he [Ishida] leased the pond, then he built a breakwater. After he built the breakwater to keep all his mullet in and he put a *makahā* so the fish could come in. When they get big they cannot go out because the *makahā* going drop it. And that area, that Pūhao plenty *āholehole*. So every time it rained the *kahawai* goes right to that pond. See that pond is right in the *kahawai* of Nīnole. So when it starts raining and the *kahawai kai* running, then the *āholehole* get stuck all between that *makahā*, that iron grill. And that's how we go and pick all the *āholehole* and put 'em in the *pakini* and we bring 'em home. And we cleaned that all up and we fried crispy, and that's how we eat, so *ono*. Because that's our life, fish [PELE].

D-2. Springs.

> A lot of them [shore springs], the brackish ones, the freshwater spring, bubble up -- you should go get some pictures. There's a lot of them, when the tide is low you can see them right along the edge. In fact that's the reason why the fish along here is so good eating--like the *manini*, it's so good. Other places I won't eat the *manini* because it's so smelly--this one is good [PAULINE].

D-3. Honu.

> That's where the *honu`ea*. See this whole area from Kamehame to Puhue, that's a nesting ground for the hawksbill, the *honu`ea*. So this is the endangered species area, this whole area we're trying to protect. Now there's an endangered species act now, to protect those turtles [PELE].

> .So, you see, when over here the lights are on, that's why they changed the light bulb, had bright lights for the park. They used to hatch right in front here on that sand in front this area. That year when they hatch, they found all the baby turtles all up there in the pavilion, all underneath the pavilion, on the road, no can see the car, smash some. We had Larry Katahira, that National Park that protects these turtles, came over and they found that. It's because of those lights, attract the honu to go up. Normally, the honu *hanau*, and they see the glare of the moonlight on the ocean, the reflection, they go swim to the ocean. But instead of doing that, they saw the light up here on the land, so the come up to the land, and that's how they get killed, *pau, make* [PELE].

Photo 62. Visitor or resident of Punalu`u Beach.

> They [honu] have been here a long time. We use to catch then for food. It wasn't easy like it is now, since they have been protected. Long ago when the turtle sees you, they high tail it out to the deep. The only way you could catch them is by snagging them with a three prong hook ad line tied up to the end of a strong bamboo pole looking down a cliff or using lay or cross nets. They somehow can't see you from up high. You have to try and snag them at a soft area like the

flippers or by the neck area, then drag it to shore by an opening nearby. Honu do have very good meat or steaks and in various colors. Some look like beef, some kike pork or chicken. It also could be prepared in many different ways, teriyaki, breaded, BBQ, dried or soup, which is not for me. In the early 60s my husband and I use to catch them with cross or lay nets at night and pick them up early the next morning. There would be around 4 to 6 that are caught. We did this because they were in demand by the restaurants, Volcano House, Hukilau and others. It was also a source of income for us and we did not do this every day. We have photos of some of the catch [JEANETTE].

As long as I lived and growing up in Punalu`u, I have never seen or heard of turtles nesting here until one morning in the late 60s my husband and I discovered the first nesting for us. It was close to the electrical pole across from the shops. We roped it off with stakes and contacted the C. Brewer Management at the time--Mr. Crook and Mr. Garrett who came and helped us protect the nest with wire fence around it. After discovering another nest, we contacted a marine biologist on Oahu whom we knew (George Balaz) flew over to check out the type and saw that they were the Hawkbills. He also knew we were catching turtles with nets and of course later put a stop on us by purchasing all of our nets for them to use. Then made the law to protect all the honu. There were several ore nesting after the first two and the restaurant lights at that time as well as the street lights did not bother them from coming to shore to nest. Now if they did want to try and nest by the pond area, they would have to a hard time doing so for the coconut tree roots. When I was a kupuna at the Na`alehu and Pahala Elementary Schools, I would have Mr. Balaz come and talk to my class students about the honu. My son Guy made and put all the signs along the beach explaining the things that one shouldn't do while a turtle is resting on the beach. He also gives talks about the honu to any school classes who ask him to [JEANETTE].

D-4. Fishing, Crabbing and Squidding: Methods & Resources.

You get kumu in the net or you get kumu by spearing. Kumu comes out mostly at night time. But if you spear, you can go in where he lives and kill him but at my age swimming is almost out. When I stand back up after swimming for a couple of hours to get back out, I really struggle. I used to dance around this place like a crazy man, now I'm barely moving. But I'm in good shape for 81 years old [ARNOLD].

I have grandsons, this one about ten years old throwing net you know, learning how to throw net, he has caught little manini like that, and say "Grandma you want it?" So I say, 'okay I'll take it.' There's lots of fish in the bay, lots…. Pole fishing, throw net, and sometimes when the *akule* comes in they would surround it with the net--in fact Jeanette's husband does it a whole lot. Certain times of the year it does come in…and squid [PAULINE]. Photo 63. Enriques grandchildren catching fish.

My dad and I'd go out opelu fishing, and we had the canoe shed all on two sides of the sand bank. Was all canoe shed. And we did go out fishing opelu. This [Punalu`u] was a fishing village. We get our fish and we live on that, mostly fish. Maybe that's what makes us healthy today, my family, because we live on fish. And fish is really good, it's better than [meat] [PELE].

And over here I go *po`opa`a* down here, I go *lamalama* all the way down, that's how we catch our crab at night. And during the day we go by the cliff side to catch crab. We make the bamboo like this, the *niau*, we tie to ends with black thread. Then we go down, then the crab eye open. And you put that black thread there, they shut eye, then you hook 'em, come up. All kinds of way I do fishing, all kinds. My father build the *imu* out there for me, I go throw a net, throw it over…. Just before the shoreline, little ways out, he built *imu*, just roughly built, so it leaves space. So when the water is coming up, so we throw rocks in the water and all the fish running to the *imu*. So he told me, instead of me throwing like how the men throw far and I'm a girl, so I throw right over the imu, and I go shake the pohaku and all the fish come out, the manini. They all run out and get caught in the net. That's how I catch my fish…. And the other way that I do, I go *naunau*, in the

crack. You go with the hand with your bag. I have two bags in both hands. So there's a little crack in there, cave-like, small cave. Swim in the water, you dive, you can see 'em. So what I do, exactly the same way. You throw the *pohaku* and they all run into this little cave. Then you put one hand this side, one hand this side, and they're all in there. So I grab, one, I bring it out, I bite the head, put it in my bag, I go back again, grab, bite. It's our way of life--was so nice because we used that as our food…. So this place is so much aloha for this *aina* [PELE].

**Opelu Ko`a.** I grate the taro and the pumpkin, and then that's our bait for our *opelu*. So we go out to the *ko`a*, we have about seven *ko`a*, and he go down and feed *ko`a opelu* for about couple of weeks. After they *ma`a*, then he goes with the net, then we throw the net down, we put the *palu* in the net, and all them go into the net, then we hook it and net up. That's how we catch our *opel*u. And we catch 'em by the *ka`au*. Then you go by the *lau*. See we count by the *ka`au* first. Then you go to *lau*. The *lau* is 800. We do all that. Well that's the life I had down here, my experiences in Punalu`u [PELE].

Ono-Opelu Fishing. I do all kinds of fishing -- I go bottom fishing a lot. I got bigger boat and can catch tuna and so I go for the tuna and ono. Ono is my specialty--trolling and then lines that we call bubble--a floater and a flag; and you throw the floater in the water and let it float down the coastline and if there's any fish that see the bait going by, they'll take 'em. We put 5 or 6 of them floaters out and they go with the current. They disappear and the flags would come up and we go get the fish. It's not a continuous line, it's just individual bubbles, it's legal. But long line ain't legal here. When the floater disappears, that means there is a fish on the line—when the flag shows up again, go get it. [For bait we use] opelu or mackrals. I used to go out nights on a canoe and catch the opelu and then we freeze them. Now I use mostly akule (horse-eye mackerel) which I catch them with nets. So being 80 something years old, I just don't go out in the ocean at night anymore…. [I catch opelu] with a hook and fly, what do they call it, we call it fly – *kakele* – in Hawaiian it's *kakele*. You got your own formula and you think it's the best, but the fish gotta be willing to take any bait, the fish is the one that's gotta be willing, not you. You can have the best but if he's not willing you ain't going get him. You didn't hear that before? Everything's gotta be willing. You got five or six hooks on this line, you let the line go down and you take the fish off and put 'um in the cooler, and then you let the line back down, sometimes you miss count, you get the number one in your finger. So you gotta be able to remember how many hooks are on the line; if you miscount, you get it in your hand. I used to go out by myself, come in and walk up this road here. Back in those days we didn't have electricity. We used all lanterns and lamps. We have a lantern on the beach that I can see to come in through that channel out there. It was bad. Then I bought spot lights and that was good. You shine until you see the white water splashing on the rocks and you follow the rocks to come in to the harbor. You see that harbor over there, eh? But there were older fishermen than me here when I started. But they all died or they're disabled or they can't go no more. I fished ever since I was a kid but when I came here, I learned a lot from the old-timers from here--not Hawaiian, two Japanese – Teramoto and Ito – those guys did teach me about this area of fishing. I fished on Oahu with net. I was the biggest net fisherman in Kaneohe Bay at one time, probably the biggest here now [ARNOLD].

Fish Catch. We keep some for bait, give some away and sell the rest to who ever wants to buy them. People would come down from up town; all you need is one to know, and they spread the news and there would be cars like there is a big chicken fight here. They come with tubs and buckets, because my price is not outrageous. You see how we live, we're not rich…. Last week I went ehu fishing. Ehu is red snapper. But I stayed little more than half a day but then the wind came up and I never went since--and it's gonna stay, maybe to next week. But we usually get good weather before Christmas and New Year's. That's when you gotta give all your friends fish. My fish is mostly giveaway. Except the big ones I sell--the tuna and ono, to pay for the gas, oil and other fishing equipment [ARNOLD].

Fishing Regs: Introduced Fish & Gill Net Fishing. These biologists we got now, they don't wanna bring nothing here. They blame a fish, taape, you heard of taape? They blame that fish for destroying the rest of the native fish. But who's eating the taape out there? Who's eating the baby ones out there? Gotta be the native fish, so they bark up the wrong tree. Sure you bring something

that might eat some of your native fish but at least you can throw a line and catch something where you couldn't before…oh, here's something you should know. They almost wanted to put me out of business. New Fishing Regulations – to deprive. Did you ever read that? These white boys, you see these white boys here--they go to school the rest of their lives and when it came down to net fishing, you see where it says, prohibited gill nets etc. 125 feet, that's from here to the road over there. One piece of net now, that's all they're gonna allow you. And on this boat here, there's ten, and in my room there's another ten. Yeh, those guys really tried to put the hurt on me but I talked to the game warden and he says only goes up to south point. This way, I can use this net too [ARNOLD].

Selective Fishing. I fish for akule, I'm selective, and I'm not leaving the net in the water for hours. I surround them and I take what get hung up in the net. It's not like leaving the net in the water and kill all kinds of fish. I used to do that for years and take everything. You leave the net overnight and pick em up the next morning. I checked my net twice every night because it's valuable, the fish, so if you leave it there the shark will bite some of them and crabs will climb up on the net and drag them down and eat them, so it's best to check. But these people, they don't know that. I ain't gonna put a net out there and let something else eat them, eel is the worst one. So being selective, I don't lose too many fish. They drop off the net or throw them away, but not through predators. I use all three inch [eye nets]. The law is three inch now. Twelve two and three quarter but I think the law is three inch now. I always use three inch. If mullet, I use three and a quarter. But there's not much mullet here. In Kaneohe Bay where I was born and raised, I go for the mullet there and what we call papio but actually they are jack -- what's that French word, anyway. Yeah, Cravelle--we always say papio. Blue line Cravelle or blue fin Cravelle or the jack, the regular big ulua is all jack fish. They are giant Cravelle [ARNOLD].

Fishing Triangulation/Landmarks. Landmark use to tell me how far out I am, and where I'm at for fishing--I don't have no depth recorder. All my marks is from the old-timers, this place. And now the plantation that sold this land, then plant Eucalyptus on the sugar cane fields where they used to leave the rut, what would you they call them, gullies. And the trees grow in there, and I use all that and you go so far and see how they disappear from certain stone or bank, and then you in the right depth of water so far out. You go this much – it look like this much -- but it's miles and miles from shore, you go straight out from the bank, and I can tell those other fishermen just how deep all over the place, honestly. I tell them and they can't believe it, I can tell them how deep every place is 'cause I pull line how many years all by hand, and if you throw too deep that's a lot of work for nothing--the fish only stay a certain depth, 120 fathoms, 140 fathoms that's the farthest I go out. Guys with machines come, I ask em, I know. Yup, I'm lucky I got that experience from the old timers. Terramoto was my best in teaching; I don't know what his first name--lived up Pahala. He died fishing; had a heart attack and his boat went to shore and turned over killed him. Maybe that's going happen to me. I already paid for my funeral, Do-Do Mortuary. The boys will take me out, Do-Do will cremate me [ARNOLD].

Hukilau Fishing. I saw the recent Hukilau they did, was wrong. We get all the ti leaves. Let me explain to you. You know that big rope that they have for horse, the big one, bigger than this kind rope. We get all the ti leaf we can go get, you rip 'em all up, every leaf you make about seven inches apart. We open, unwind that cord, little bit, enough to cut, you stick the ti leaf lau inside, and then we keep on going like that so every one have lau every so many feet. We put all this rope, I don't know how many hundred feet was that, we put 'em all on top the canoe. So one person go by the wharf there and grab that end, and one person right over here on Pu`umoa, the other person hold. So the canoe drop that off from all the way and drop the end. With that ti leaf in the water, shaken, the fish all scared of that leaf so they all come in. When you get as close as you can to the sand, then you put your net, you surround it with the net. And then everybody jump in the water. That's what you call pa`ipa`i. Pa`ipa`i the water like this. You pa`ipa`i. And when you put your all net, and then you keep coming in, and you coming in, to the sand by the bay, and then you pull up. You caught all kinds of fish, all kinds of fish come out. You even catch a turtle. That's what you call hukilau. So we get all that, the people all over there get fish to go home. So one year this ____ _____, they think they know. So they went and just go put openaku`u. They just put the net. Never even think of putting lau to scare the fish in. They came up, only catch one fish. 'Cause

nothing there already for them. They don't know how to do it. So we do that once or twice a year, we go hukilau. All the people in the village here get together. Beautiful, nice fish. Now no more, not this kind people now--they all too greedy [PELE].

D-5. Gathering Limu , Opihi and Wana.

Limu and Wana. Limu, not too many people like it, in fact there's not that much edible ones right here, it's further on down I think. We used to pick some limu out there but it was years and years ago, not any more. I don't even walk out here. But further on, on the side, there are [some] down that way, down the coastline [PAULINE].

Photo 64. Type of Limu

Yes, we have *limu kohu* down here, they have *lipoa*, they have *limu `ele `ele*, and we have *lipepe`e*, and we have *lipalu. Lipalu* is the soft one, you have to go scrape from the stone. And we have *huluhuluwaina* that grows by the sand. And that's the kind of *limu* that you use when you make *liwa*, the *ake*. And that's good with the *ake*--they make with *ake*, 'cause it's long and small. But *limu kohu* is my favorite up here. And then, even with the *limu `ele `ele*, I like that, and *lipalu, lipepe`e*, I mix that with the *opihi*. I used to go here make all *opihi* on my ground, go outside, I go down all the way down, *make opihi*. I go myself. No over here, all good. If I fall down in the water, you can come right back up [PELE].

Wawaioli, get. That's another *limu*. But I no eat too of that. Mama only make, she like certain kind. People mix that with the *hoio*. They sell that plenty *wawaioli* in Honolulu. And you know the *limu akeaki*? They call that *ogo*. We call it *limu akeaki* over here, it's because they grow on the *pohaku* in the sun. Honolulu they grow in the water, Ewa Beach they all in the water, so they grow long and thin and soft--more tender. But over here it's crunchy, but if you put 'em in the hot water, they come alright, they come soft. And you cut 'em up and mix with your [*mea `ai*] And *lipoa* are very few, but in certain areas [PELE]

We have wana over here, we have haukeoke. My dad make the wana with da kine wire, and then we go dive and grab 'em with the wire, the long kind [PELE].

Opihi. They have only two kind, the dark and the yellow. But I only go for the yellow one. The yellow one is more dangerous because they grow more down in the water. The dark one, they way up in the crack, but I no like that. I don't care for that. I go for the nice yellow one, more crunchy [PELE].

Hardly any. But we do have not here, but further down we have a whole lot and we have sea urchins, we used to have a lot of them clinging to the rocks. But I don't see any now. We used to call them *ha`uke`uke--wana*, is in the water. People, outsiders, used to come and get bagsful but I haven't seen them about a year or so now [PAULINE].

When we get, we learn to eat, to share, that's how we do. We learn to share things. But today, you have all kinds of people now coming to ku your opihi, taking all the size of opihi and selling it. Twenty dollars a Ziploc bag of opihi. They go down. The haoles do that, the Samoans do that, the Micronesians do that, the Filipinos do that. So you have every race. So when you go Filipino party you have opihi. You have a`ama. Everybody eat that now. But hard to get 'em now you know, they're not like before. We only go for our food resource. We used to get that for eat [PELE].

Photo 65. Opihi picker .

D-6. Development and Marine Resources.

I don't think they [C. Brewer] thought about fishing that sort of thing. No one even thought of that, we were still fishing, everybody was, it was just the locals that were doing like we are doing now. The tourists all they were looking for is a good beach that they could lie on. I don't think any of them were thinking about fishing, the fishermen were doing that [RAYNER].

That's why I'm saying they can develop, go mauka, leave the shoreline because that's our breadthe reason why I don't like the cruise ship. The cruise ship come one year, this whole bay was al and butter, our food resource, is from the ocean. And everything in the ocean for us Hawaiians is edible. We eat from *wana* to *haukeoke* to *pipipi*--those are all our food resources. It's just like a refrigerator for the Hawaiian people. So why are they coming and destroying? That's l full with *kukai*, human feces all around. I went down there, I look, a smell. Then I went on the *paahoe*, was low tide, dry feces on the *pohaku*. They dumped their waste and up inside the shoreline. And we eat *opihi* and the crab. Don't you think that's going up on there and going to our food? I went call the Board of Health and I told them to come down and look. You know what they tell me? Oh, that feces is from the turtle. So I said, you telling me that it's from a turtle? And I told that Board of Health man, you know I born and raised in Punalu`u, I swim with the turtle, I eat turtle, we never had this much covering the whole coast line, the whole bay. And they no come check. That's the kind of department we have [PELE].

The beach not supposed to be sold, not supposed to be. I don't know why our State don't stress that, that the ocean is always open for the people over here. I don't know why the State allow that. That's why our government sometime you put people in there, they don't think of the land, they don't think of our people. They think of money. But you know, that kind of people don't live long to enjoy, lot of them. That's what I always say. They anunu like that, they don't take care of the aina. That's what my tutu always remind us, malama okou ka aina, ka aina e malama iao okou. If you take care of the land, the land will take care of you. It was given to us, our ancestors left us the land. But why is it our government is not looking at that that way. Our ancestors left for us. Now they buying the land, double the price. I hope you can protect our aina, that's what I like [PELE].

D-7. Pu`umoa Tidal Areas.

We'd also do our laundry down here by the ocean, during low tide. And the place is called Pu`umoa, right below the pavilion. Where the pavilion is, it's called Pu`umoa. And then we'd do our laundry down there [PELE].

D-8. Recreation: Swimming.

After growing up we go do a lot of swimming [PELE].

Photo 66. Pu`umoa Tidal Pond.

Photo 67. Punalu`u Bay Skin-diver.

Photo 68. Getting ready to launch boat.

Photo 69. Young pole fisherman at Punalu`u.

E. Cultural Resources & Practices.

This category represents traditional Hawaiian cultural resources and practices and other ethnic resources and practices. The traditional Hawaiian cultural resources and practices, includes the pre-contact era, as well as cultural practices after contact. Cultural Resources can be the traditional *wahi pana* or sacred places, any cultural gathering place, or the tangible remains of the ancient past. One of the most significant traditional Hawaiian cultural resources is the *heiau* or places of worship. Other places of great significance for all cultures are the burial places of loved ones. Unfortunately with the massive transformation of the landscape as a result of the many western industries [i.e., provisioning, sandalwood, sugar, tourism, urban development] coupled with the secretive nature of ancient burial practices, most of the ancient burial places are unknown or forgotten and are easily disrupted and disturbed by subsurface activity. Both the literature and the oral histories attest to the plethora of cultural resources and practices in the project area and vicinity.

E-1. Heiau, Ku`ula/Ko`a, Ahu and Petroglyphs.

Lanipao Heiau is right up in this valley, in the middle of the golf course…Ka`ie`ie was a fishing heiau. This [Punalu`u Nui] was human sacrificing heiau. And then, up here one [Lanipao] I think was just a heiau, but I don't know--agriculture kind. And then you get the one down there, was a fishing heiau, down by Ka`ie`ie Heiau [PELE].

Now we have Punalu`u nui heiau, is right on top here, that whole platform up there is Punalu`u and it's the largest heiau up here. And in the front, just below that, you have a *pohaku mohai*, sacrificial rock. And on the side of that pali, where they built the warehouse for the sugar cane, has a big cave, and in that cave have all the *iwi*, the bones that people were sacrificed. That heiau and Wahaula Heiau in Puna, they affiliated together--the human sacrifice *heiau*. So that is what that heiau over there is about, down over there. So when they built that wall for there, they had to seal that cave because there's all human bones in it. But all the way going up to Keone `ele `ele. . .See C. Brewer mixed up the names. Keone `ele `ele, you have a nice stepping stone, I have a picture of that, today still there. You go out, then you get to another black sand bay, that's why they call that Keone `ele `ele, Black Sand Beach. And that's where on top they have all these sites also, where they buried, and people used to live all the way going to Puna. It's a trail to Puna. So Puna's people come to Ka`u. And that's how when we had the ranch up here (Ka`u people), you had Puna people like the Nu`uanu all come here, Kanakaoles from Puna, they all moved to Ka`u. And you have the Kona people, like us, Kuaimoku from Kona, came to migrate all in Ka`u. So in Ka`u, you have people from other areas came to live in here. But in this area, that's when the ali`i was in this whole Punalu`u. 'Cause this is the only place in Punalu`u that have punawai behind and have a big, high wall, like a platform [PELE].

No, [C. Brewer didn't know about it]. If they did no one said a thing about it. They weren't paying attention to that [RAYNER].

There's some petroglyphs right across from the pavilion, and then up above, you know over the hill, there's a heiau, I don't know what they call it. I have books on them and study about it, but I can't remember the names of it. This is a nice one, in fact [PAULINE].

Photo 70. One of several petroglyphs in protected area.

Photos 71-74. Views of Punalu`u Nui Heiau (E), (ESE)

Photo 75. Western end of Punalu`u Nui Heiau-towards Punalu`u Village.

E-2. Burial Places.

There were lots of burials around here in the golf course--at one time but I guess the bones were taken away and placed somewhere. My husband used to work with Swenton Hawaii I think, they were the ones that used to work here for Brewer. That was who did all the development for C. Brewer and that was in the 1970s, late 1960s, early 1970s around there [PAULINE].

And they had a cave behind here, but we never go in, my daddy said get something in that cave, but we never bothered to go in, he didn't want to go in. But this is the only place had fresh water [PELE].

But when C. Brewer came down here and started developing down here, oh my goodness, the heiaus and our burials were all destroyed by C. Brewer. And I think that is the reason why they weren't successful with this developing down here, this Sea Mountain Resort--because the hewa that they did. And you know those days we never had cemetery until the missionaries came. But even with the missionaries in 1820, we still didn't have cemeteries. Where people were living, that's where they were buried. So on this kuleana that I had, I had buried all people in the back there, people right up here by this ku`ula, and below that, right by the ku`ula, that's where you have some burials too. Up here, on that level there, we have burials covered by the grass, all in that area…. And my tutu Keoki is one, all up here, Kuaimoku, all are buried up here [PELE].

Somebody did a research, you know, and he's in Honolulu. But somebody came and do this research. One haole. Well, they did it before C. Brewer. But still they destroyed that. You see Ka`u is known for Kamakanipuhiolepo. So we had the pu`u called Pu`ehu. And they destroyed the pu`u--that's the cinder cone. And they found all the burials in there. But I don't know what they did with it [PELE].

But mauka side get. That's a whole burial ground, where C. Brewer have the golf course. Was all burials behind there and they cover all that… by Ninole, up mauka. Not above the road, below the road--this side of the Aspen…mauka of this side of the Kahawai. You see the Aspen you gotta go across, go down to the Aspen and the river, you pass by the river mauka of this side of the Kahawai. You see the Aspen you gotta go across, go down to the Aspen and the river, you pass by the river mauka of this side of the Kahawai. You see the Aspen you gotta go across, go down to the Aspen and the river, you pass by the river …. Ka`u side. 'Cause when you go down, you got the Aspen on that side. On this side of the Kahawai, they have their office down there. In that section there, was Ninole people buried all in there. People from Ninole. And that's where they when cover that up, and then make golf course over there. That was destroyed by the restaurant. Had plenty grave that was destroyed. They built the restaurant on top. And then Pu`ehu, that cinder cone that was destroyed, was burials [PELE].

E-3. Legendary Entities and Sites.

Kauila. And, well, you heard about the turtle maiden, Kauila? She used to come up and play with the little kids you know. She was half turtle and half human, yeah. There is a plaque I think up there [near the pavilion] that mentioned something about it, check it out. I think it says she used to play with the kids out here [at Punalu`u Black Sand Beach]…. Way before our time--the olden days [PAULINE].

But you know what, when they built this on here, they call 'em Kauila. Kauila is that pond. In that pond, it's a kupua pond. Not of a turtle, but of a kupua pond. Now, there's a there's a chief in Tahiti, Keola know that, he was in that pond. And that's where that pond was, it was named after them from Tahiti, they came in that pond over there. But we call it Kauila [PELE].

E-4. Other Wahi Pana.

> **Wahi pana Coast.** I don't to want to see any building on this whole coast line, because it's so historical. This whole beach area, the archaeologist came. We have a place, just like a big opening cave, right below Honu`apo--it's called Puhi`ula. In there has a spring right in the middle of that, just like Waikiki Shell, open all in the front and go in deep, go in deep right down there. This kind of thing we should protect, 'cause if we don't we lose everything that Hawai`i's all about [PELE]
>
> Anna Cariaga, a couple other ladies and men, myself together with Violet Hansen who was an archaeologist went through the area of sites, which was recorded at that time. Now at my age and with all the overgrown trees and etc., I forget where they are [JEANETTE].

`Ili`ili Hānau o Kōloa. This unique feature located at the beach area of Kōloa Cove where male and female rocks purportedly give birth (*hānau)* to *`ili`ili* or little black basalt pebbles has added to the fame of the area from ancient to modern times.

> When I was a girl of eight I went to do some work at my mom's place in Honomaka'u, from where I lived in Hawi with my tutu Abigail. I was looking in a koa glass showcase at the time and noticed that there were these little pebbles on the shelf that I had been counting every time I went to help my mom with cleaning our three acre yard. I was a very curious child, so as my mom was passing thru the living room, I asked her why here were more stones on the shelf then I counted before. She said "You know from all the six children that I have you are the only one that asked me about those stones." See my mom never opened the show-cases, they were all kept locked tight with a key, and forbade everyone from opening these old koa showcases. They had all of the family heirlooms from China. Jade jewelry--five hundred years old from her Dad's family and gold pieces, gold bracelets--Hawaiian kind, all placed in there by my mom's maternal and paternal parents and great grandparents. Anyways, my mom said that she wanted to share with me the story of what and where these stones came from that had multiplied in this showcase. She said that she had been named after her grandmother, her mom's mother, Lahapa (Nawa'a) Ne. She said that, that tutu nui, was a very powerful La'au Kahea Kahuna in her days and was also able to preach at Kalahiki'ola Church. In the place the Hawaiians called I'ole (rat), where out Protestant Church was built,. Tutu Lahapa nui practiced La'au Kahea work on people in Kohala. They would come to her for healing of whatever they had. As they laid down on a table she would speak in Hawaiian over them, special healing prayers as well as chants. I feel the chants were like prayers. She had to do them three times and after each time she would have to blow into her lima cupped hands her breath and then move her hands over the person's body, saying "E'ola piha, E'ola mau". Over and over several times, then do the chants again. Repeat the part about using her breath in cupped hands, which needed to be done three times. Hawaiians medicate people 3, 5, or 7 days depending on what they felt was needed as healers. Anyways, after doing this, Tutu Nui Lahapa would snap her fingers and "boom" the person she had worked over, was well. Then she would get the *'ili 'ili hanau* from a little pouch she made. Take one out blow on that *'ili'ili* and say from now on when you get sick you no need come back to me. She would cup her hands and blow her breath on the stone. Present it to her patient and say "all you have to do is take this one stone cup your hands and blow your breath on it and ask the stone to take your illness and "boom" you will be healed. You no need to come back to see me. She empowered each stone with healing power and my mom said they never had to come back to see Tutu nui. (Great grandma) So my next questions was, "Where did she get the stones from?" Then my mom said "Well, grandma had one short leg and one long leg when she was born. And as she grew up she would hobble everywhere she went. Her desire was to become a minister and also a kahuna of la'au kahea. She had learned from her ancestors that in the Ka`u side of the island she could get the *'ili'ili hanau* she could use for empowering it with healing "ha" or breath. So she was taken over the mountain trails from Kohala and over more mountains to the other side of the island to get the very stones. It took Tutu Nui over a week to go and come back all by herself. Fill her little pouch that she made for the stones and return thru the mountain trails back to Kohala. So before she died, way back when, she placed those special stones in the showcase that was made special for all their valuables. And she placed them in the forefront of the showcase so I could see them and count them and then ask my mom about them…. So these stones are very special to my heart that I was able to learn about the use of them for healing…I shall always treasure the place of

Punalu'u where my Tutu ventured to pick those very special stones, called '*ili'ili hanau*, used for healing by my Tutu nui Lahapa…. The place name of Kōloa is where the stones are [Maile].

Photo 76. Kōloa Cove Beach home of the *`ili`ili hānau*.

And so the pebble, *`ili `ili hanau*, is on the Shark Beach, it's a very short little bay, and it's called Kōloa. So the pebbles that you talking about, *`ili `ili hanau o koloa*, is in Kōloa Beach, that little short pebble beach. What C. Brewer did, and this is why I'm so angry with our Department of Land and Natural Resources. Why did they allow on conservation land, district, zone, whatever, allow C. Brewer to take a truckload of all those pebbles to build the restaurant. So if you go up to that restaurant now, you look on the flooring, all that concrete, it's mixed with the pebbles. They used that to mix with the pebbles to make the flooring so you don't *pakika*, you don't slide. That's *hana`ina*. That's why I said they did all the destroying, this whole Punalu`u. I'm so sad about that 'cause I know this place so well, this is my birth *aina, aina hanau* for me. So I see this – they took that but I was in Honolulu at that time, because I was married and was in Honolulu. When I moved back in 1971 they already built and destroyed this aina over here. But then they opened a restaurant in 1973. But prior to that when they were building, that's when they took all the pebbles from that beach – Kōloa – and then they put into the restaurant, they built a hot house with all pebbles, they paste them all with pebbles. The hot house was all *`ili `ili* on top. Was really nice. And then Herb Kane did the mural on the wall in that place. And then they make a stone wall around it, a little short stone wall maybe about 12 inches or more wider. Just strip right around with all the pebbles. They put all pebbles. And they destroyed the Pebble Beach of Kōloa.

Then when they did the mapping they put Kōloa way down the end in the ahupua`a of Ninole. They when change and put it way down the far end of the *pali*. If you look at C. Brewer's map now, when they did the development, it says Kōloa, and they have Kōloa way down the far end. Kōloa is in the ahupua`a of Ninole and has black sand in that area. Then you have Pūhao, the fresh water pond. So they changed it because that end before was white sand in that beach. So C. Brewer wanted to put white sand beach down there. I think Kawaihae's great, all that coral make white sand now. And we stopped it, we fought for it. And so they would stop that. And they wanted to build right around that *punawai*. And that's state land, that's a state pond, Pūhao. And until today, I still don't agree with what they did, changing Kōloa Beach, it's a short pebble beach, and they put it down in the other end of the land. That was wrong. And I think if we go back to see some old maps you can't find Kōloa, it's a little short beach, before you get to the Punawai of Kauali, and then you get to Pūhao. There's two ponds down there. Pūhao was open, where the water comes in and go out. When the plantation, the state allowed this Japanese man Ishida to build

a pond down there for his mullet, then he built a breakwater to close that pond. But before, the shark used to come into that *punawai* into Pūhao and goes back out. It's all open [PELE].

Photo 77. View (S) of Kōloa Cove/Beach & Shark Beach.

Well we have a legend here where we have this maternity rock it gives birth to tiny pebbles and their called *`ili`ili*. We all find a lot of rocks along the coastline especially below or on the other side of the pavilion or on the fence… this is what they call the maternity rock and it disperses pebbles; yeah, all those holes in it. And they claim that if you take it out from the water you take it home and put it in a dish half submerged in water later on you go check on it you see it has a lot of tiny pebbles. And that's why there are a whole lot of pebbles around. That's the legend I know about here. [PAULINE].

My Tutu Nui pick up that because she used 'em for empowerment. So when she get her La`au kahea, she would go over body and do her chants, and she had to do it three times, and then pau. Eola piha, eola mau, always blowing in her and then when finished, snap her finger and whatever is wrong with the people, no more, pau. Very powerful. And she would come here to pick up the stones, and she would empower each stone whenever her patients finish being healed, she would take one little `ili `ili, put in her hand, her breath go, and then she would say, from now on, when you get sick, any kind of sick, no need come to me, you take this stone, I empowered it with healing, you just put in your hand like this, your breath, and you ask the stone to take your sickness, snap your finger, you'll be OK. So the people never had to come back to her [MAILE].

Up here on Pu`u Makanau, you get Kohaikalani Heiau. Kohaikalani – "as we sound to the sky." Then you get below that, on Ka`alaiki, you get Imakakoloa Heiau…. Imakakoloa – "the eye of the koloa bird." That's a hula heiau in the ahupua`a of Ka`alaiki…. That's the first hula heiau built. In there have all the pebbles. That's the reason why the pebbles were important to the Hawaiian people. It's because they get all this *`ili `ili*, they put it into the center of the heiau. Like Kohaikalani, had all pebbles inside there. And on the side of Pu`u Makanau going to Kohaikalani Heiau, there's a stepping stone going all the way up… Those are the heiau, and plenty more was in Honuapo, all destroyed by the plantation…. Just like out here, has the stepping stone going out to Keone `ele `ele, that's all the nice stepping stone, all the way up there. And up there had one. But the plantation destroyed Kohaikalani and left just one section, mauka side. If you driving up, you see that pu`u and that tree on the top, when you drive out you going see that Pu`u Makanau is flat, kind of green, and has a tree. When you see that trees on the top, that's a part left by C. Brewer of

the heiau. The inner part, the interior part all dug out for plant sugar cane. Was destroyed. And the same thing they did with Koloa. They destroyed Koloa to take all the pebbles out, to put up there. So that's the reason why, to the Hawaiian people, *`ili `ili* pebbles was important. We used that for hula, you know that *`ili `ili* dancing hula. You use that also for put it in the interior of the heiau, 'cause it's easier to step on, we're all bare-footed Hawaiian. And you also used that for stepping stone for walking. So those were important, the `ili `ili for the Hawaiian people. Pohaku was our mana anyway, for the Hawaiian people. The pohaku was the mana. And they have special kind of rock that was made. Just imagine, how could nature do that, make all this `ili `ili. And that's the only place you going see so fine, this `ili `ili, just so nice [PELE].

`Ili`ili and Cancer Education. I came up with this size of our `ili `ili pebbles, they put 'em on the TV, come on news sometimes, 30 minutes, me talking about it. I told `em the Hawaiians too had this, because we know the Hawaiians had that but never know what it is. But we have different size of *`ili `ili*, from the tiniest one -- they like sand, go all the way up. That's why they call it *`ili `ili hanau*, because they multiply. People don't believe that. A lot of these haoles not going to believe that. But us Hawaiians we believe that. So that's why I put it all in a postcard, from the smallest to the biggest, I sent to Dr. Chong, Dr. Ka`anoe, 'cause they were doing the cancer research for Native Hawaiian breast cancer. I put 'em in that, I sent 'em to them. I said this is *`ili `ili hanau o Koloa*, and this is the size of the pebble that multiply from small up to big, so they can show that to the cancer people, from small how they stretch big. So I tried to do that and you know, the good thing about-- I love this ka`akai. When I came home with cancer I felt bad, I walk every morning to this end, to that end, I walk down. I walk every day, and I do my aumakua, every day I walk, ask them until today [PELE].

Old Trails and Ala Hele Nui. Because you have the trail and you have just opposite that you have a site right there. Just like a resting area, you come, you rest there. They built a place like that right across that heiau, is where Ninole School used to be--overlooking the fishpond--on the mauka side. And then you have that road, go all the way down to Kawa. Then when you go to Kawa, you got Ka`eku Heiau [PELE].

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F. Project Concerns.

Change often meets with resistance, especially change of lifestyle brought about by outside entities. People who grew up on the lands often don't want to see it changed, especially if it provided resources, recreation and respite. They also understand that things don't stay the same, and change could occur with cultural sensitivity. The consultants shared their *mana`o* about the future of this area; some of their mana`o are stated below.

F-1. Punalu`u Black Sand Beach.

We've been having more and more people that have come around to be on the black sand beach because this is the only one they could come to and relax, especially on weekends; we do have a whole lot of them around. It doesn't bother us at all. So I just wish they'll just make it easier for everyone and let the local people come in and enjoy it [PAULINE].

This is the only black sand beach to visit--it should be made nice [JEANETTE].

I don't mind, I mean you can't stop progress. It has to go on, but I just hope they don't spoil this area, especially for the local people because that's the only place they have to go to. Sometimes you give them too much and they're the ones that spoil it. But as long as we fight for the beach and keep it open. That's all I can say [PAULINE].

But this whole beach area, I don't want to see any building. And I think I'm going to try to protect our endangered species. 'Cause if they come right by the ocean, then they're gonna ruin all our

hawksbill nesting ground. Few of them living, hardly any, we're going to lose them if we're not going to protect them. I can see the green sea turtles, but not the hawksbill. The hawksbill don't come up and bask on the sand like the green sea turtle. The green sea turtle come up and bask, but I was walking my daily walk and I saw the four wheel drive (I took the picture of it). From that vendor shop, they when drive right across and the honu used to lay on the sand up there. Six, seven, all lie on the sand. But there was a big one, and I have a picture of that big honu. They lie on the sand. That morning I walked down there, I saw the four wheel drive vehicle, from the lei stand, drove up, went down by the ocean, by the beach, right at the end, and drove back up. So I think they went down there and pick up all these turtles and pau, we don't see the turtles any more. No more, they took 'em. Somebody found the head once, they herd cattle over there, found the head of the turtle. But we cannot catch 'em. But this is what's going to happen if we're not going to protect our turtles, we're gonna lose it [PELE].

A lot of them--the developers--they can do and stay above, but not close to the ocean side. And as long as we get to stay here that's the only thing I ask. And if they want anymore or help, you know we can help [Pauline].

F-2. Public vs Private Roads.

But now, let's get back to this place. All this area is private area. The county road down here that's blocked by sand and they won't clean it off because some people think that road should be closed. That's the only public road we got and they block it with sand and sign. You saw the road you traveled on here, that's private road see. So I don't know what's gonna come of it and so is that road back there. That road -- half of it, right about this half belongs to Bishop Estate, the other half belong to this Sea Mountain. It's an old railroad track road, and we use it. When I come here we couldn't use it, only the plantation bosses and plantation workers but then now we can use it [ARNOLD].

F-3. Development with Restrictions.

Well, I like to see something that would benefit the people of Ka'u, the people who, like some of these children who graduated and somehow don't wanna continue their education and probably need to look for work, so at least got something for them to do while they're building up or something…. If this company [*Sea Mountain Five LLC*] build up, they have work and then they could go. That's what I'm trying to say. I don't like to see high rise. And I'm not quite sure where they want to build whatever, whereabouts, how far they gonna own. And then people are building up here and I think they wanna build around here yea. And I don't know what they're gonna do to like the old restaurants or places like that, I don't know. They should have because people come and they looking for places to eat and we have to tell them don't have, used to have, and some people that came here long time ago when they had restaurant, they look for it and no more. So we need something, don't have to be big like that one, gee. And a long time ago when I used to like I belong to the Hawaiian Civic Club and it was a nice place to have meetings, or little parties or something like that, we miss that, it's been so long. We cannot have meetings anywhere. [We have to go] Na`alehu, but they always charge or something. They charge to use it or they charge for electricity. But we just do the best we can, but we miss all that, it used to be so nice. At Christmas it look so nice and we have entertainment and things like that. [looking at project map] looks okay to me, whatever they do that would benefit everybody it's okay with me, yeah…. I like to see some nice thing going for this area, but there are some who don't want nothing…. And I like to see simple houses, low-rise condo/duplex [JEANETTE].

But they going to build house where, Group 70? Mauka of the highway? I don't care if they do that. That's fine [PELE].

They're gonna build more house. I don't know where everything going. That's the only way we can try protect. Before they can do anything, I think the Group 70 have to go check. Do a lot of checking, what C. Brewer didn't do right. It's so bad. C. Brewer did a lot of destroying. What get me, is our iwi kupuna. You know, we're there to malama our iwi kupuna, our ancestors. They died

for us. They lived the land for us. We should try to respect their wishes and try to do it. We can have developments, we're not stopping it, but there's a place for it. And not take everything away from us Hawaiians. That's what I don't like [PELE].

F-4. Punalu`u Landing/Camping Restrictions.

I don't want to see camping allowed by the landing area--if fishermen want to go out, keep the gate closed and have a key to get in [JEANETTE].

F-5. Public Safety.

And the building, the old restaurant building should be torn down because it's full of rats and what not, oh, terrible. Have you ever been in there? It was nice when it worked, and I really liked it then. But now it's uhg. People nowadays they don't care, some people they don't care, it's not theirs. Like it's been closed, they let the place go down here, so they figure they can go in and take anything they want because nobody been taking care of it [JEANETTE].

They have to tear that whole thing down [restaurant]. So that's just all in that area. We took the test in that building, and that asbestos is going into that pond water. It's all polluted that pond …. That's the reason why we're waiting now to see, 'cause Ron is the lawyer. And Robert Kim in fact wanted to come and fight with C. Brewer on this because they should have known better. And you know what? When they built the golf course, on the road there's a big culvert they put underneath the road. So the waste of the golf course go right into the pond. And that pond and that septic tank they have in the restaurant, it's leaking out. That's the reason why they couldn't open that again. And there's another one up here, the old treatment, where they had the treatment center right up here by the golf course. And they have a treatment there for where you gather all the sewage water, go into there, the treatment plant. That's old, need to be repaired. You know all the lua from the golf course and the condos, goes up into this treatment thing, and then they spread 'em all on the golf course. So with all that going into the golf course and with all this underground channel coming into the ocean, and so all that *pilau* is going sea. So we cannot drink my well. I cannot drink water anymore. That's what is destroying us up here. The golf course, with all that they have to re-do or do something, and because it's so much money, that's how C. Brewer gave up and then Sazalie gave up. And now Roberts no can do that, it cost million dollars to build that treatment plant, to make that sewage work good [PELE].

Photo 78. Inside of Damaged Restaurant

Just like the restaurant over here. This restaurant no can use--they have to tear the whole thing down and build a new one. So...Group 70 should do it. Make that a nice cultural center. You know, we give and take. You know, share some with us, they get money. Build a cultural center for us down here. So we have place to come there. And they can put all these vendors up there by the cultural center. And save the beach. These vendors not supposed to be on the beach in the first place [PELE].

F-6. Rain God Kūmauna

Now just like our rain god up here, we call him Kumauna. That's the rain god of Ka`u. And this guy Shirl was the manager for the plantation. He went up there, because he was given water, and sometime drought. So when Ka`u get drought they always ask for water. They need rain for the sugar cane, Hutchinson's sugar plantation, these haoles. They know the Hawaiian people, and they

said, "Oh we need water, we need rain." So they go up there, they try to get water. So they ask the Hawaiian people to go and pule for water, see if you can get water. So this guy went up there pule, they get plenty water. And the rain was sometime too often, too much, so they want to stop it. So this Hawaiian guy said, how can we please these haoles. Because they either want rain or not rain. So anyway, when they wanted rain, they gave rain. So when he had rain, it came so heavy, so this guy Shirl mahaoi went up there, they said, with a gun. This is the story I heard. With a gun and shoot the okole of Kumauna. Shoot the okole of the moon. You see haole how they make up story. How can you reach up to the okole of the moon? But anyway, he went up there and shoot the pohaku, a boulder-like image of Kumauna. But was of the side of Kaiholena, big mountain. But that's where we get our water. So we call it Kumauna, it's the rain god of Ka`u. He blew that pohaku and then it fall apart. And that's how that rain when flood Hilea and cover Hilea. Hilea was a nice plantation camp. We had everything over there, store, bakery. And over there has nice wall, long stone wall, and you drive between the stone wall and the camp mauka, the boss houses. And we used to go there, pass through there, go school Naalehu. This in the '30s now. So this haole went up there and blow that pohaku up, and that pohaku went flood up Hilea until today. No can go in there, all covered up. The boulders, everything came down. And you know where they find that man afterwards? *Make* in the cane field, in the fill and the pua was eating him up, the pig. The hewa. But the water still nurtured us down here, still kahe down here. That's our god Kumauna. And only in Ka`u we have that. I think Kohala get their. Every area get their own [PELE].

F-7. Koloa Beach.

Kōloa or Kawale Beach? There's three ahupua`a. You come to Punalu`u here, and this is Wailau, and this is Ninole. There's three ahupua`a going up. So Wailau mauka, Wailau kai, Ninole mauka, Ninole kai. And Punalu`u up here up to that height and put it as Punalu`u. So they went change. That's what C. Brewer did, that's why I'm telling you, Kōloa is not this far end. And now, this side here is lava, supposed to be a`a. And you know who own this now? Ed Olsen. He just told me now, he own this place. And has the big cave, Hawaiian caves up in this area. Ed Olsen own over there. He just told me at the meeting. I said, well, what son? And this supposed to be all a`a. I don't know how they get that [PELE].

Photo 79. Ninole-Punalu`u Coast from Ka`ieie Heiau.

PART V: SUMMARRIES & CULTURAL IMPACT ASSESSMENT

The following summaries are based on the information presented in the previous sections: the traditional and historical literature review and the ethnographic data and analyses. References are not cited unless it is new information and not already cited in the text above. These summaries condense the information above, but also serve to focus on a few significant individuals and events in the history of the project area and vicinity in relation to Ka`ū and the *ahupua`a* of Punalu`u, Wailau and Nīnole, as well as give a broad overview of land, water and marine resources and uses in the general area, as they reflect cultural practices. The cultural impact study is based on two guiding documents, Act 50 and OEQC Guidelines [see Appendices A & B], as well as the *Criteria for Historic Preservation* cited below.

State Historic Preservation Division Draft Rules (1989)

Criteria for Historic Preservation. The "significance" of a site is determined by a set of criteria. The following is the State of Hawaii criteria for historic preservation:

Criterion A:	Be associated with events that have made an important contribution to the broad patterns of our history.
Criterion B:	Be associated with the lives of persons important in our past.
Criterion C:	Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value.
Criterion D:	Have yielded, or be likely to yield, information important for research on prehistory or history.
Criterion E:	Have an important historical cultural value to an ethnic group of the state.

Summary of Significant People and Events.

According to traditional and historical material, the project lands of Punalu`u, Wailau and Nīnole has gone through a number of significant changes, and witnessed the comings and goings of many significant people over time. Some of these people contributed substantially not only to the history of this area, and the district of Ka`ū, but of Hawai`i Island and the rest of the Hawaiian Islands. There were several people and events noted in the oral histories and later recorded by explorers, missionaries, native Hawaiian scholars and ethno-historians, from the time of the gods and goddesses to Kamehameha I who caused the various island kingdoms to come under one realm. Some of these significant people lived in area and were responsible for land modifications, shifts in polity and commerce, and the gene pool of Hawaii's *ali`i* and monarchs. A few of these people and events are noted below.

Mythical Entities.

The most significant mythical entity to impact the district of Ka`ū, the lands of Punalu`u, Wailau and Nīnole, as well as greater Hawai`i Island, was the volcano or fire goddess Pele, who left evidence of her visits in the form of *pu`u* which dot the landscape, but especially the residuals of her monumental lava flows. In her wake she annihilated villages, shelters, trails, temples, shrines, water sources, fishponds, pools, holua slides, countless other structures and features, and people, forever changing those lives

affected by the destruction. Even those outside of the direct flows of lava were affected as resources on the land, in the fishponds and pools, and in the marine environment were forever extirpated. Through time the people have had to alter their lifestyle, look for other resources and start all over again. Often, though time has passed, archaeologists with the help of oral histories are able to reconstruct the life of the ancient Kohaiones through the clues left by their abandoned shelters, house sites, sacred places and remains of the food they ate. This cannot be done in the places visited by Pele; the few stories left will have to suffice. However, the flows of Pele created more land mass, more possible lava tube shelters should they be needed someday, a kind of contrasting beauty unique to the islands, and always a sense of awe.

Other legendary entities of this area is the rain god Kūmauna; the mo`o creatures (Kawale and Pūhau) who inhabited the ponds and caves of Nīnole; Kaikapu, the female cannibal guardian of the bones of Wahieloa, whom she killed and who lived in Kaualehu Cave in Kōloa, Nīnole; Nīnole, the beautiful granddaughter of Kaikapu who enticed people to the cave; Wahieloa, who was born in Wailau-Nīnole and became father of Laka; Laka who came to Punalu`u in search of his father's bone and who built the *Lanipao Heiau;* and Kauila, the legendary *kupua* turtle-woman who is said to guard and play with the children at the shore of Punalu`u Bay.

Ali`i nui and Kahuna.

The lands of Punalu`u, Wailau and Nīnole attest to the many *ali`i nui* and *kahuna* who lived and worked in the area by the *heiau* (Punalu`u Nui, Lanipao, Ka`ie`ie, Mokini and nearby Kohaikalani and Imakakoloa), and the vast number of shrines, complex habitation sites and petroglyphs. A few infamous *ali`i nui* of the area included Koihala, Kohaikalani and Halaea. Other *ali`i nui* from the area included Kalani-nui-i-a-mamao, father of Kalani`opu`u; and Kiwala`o and Keoua Kuahuula, sons of Kalani`opu`u who where affiliated with the project lands; and other Hawai`i ruling chiefs, Liloa, Umi-a-Liloa, Keawe, Lonoikamakahiki, Alapa`i nui and Kamehameha I. A *kahuna* known to be from the project area and said to be a relative of Keoua, was Kahoapuahi. Unfortunately, the names of other *kahuna* who must have officiated at the various *heiau* in the project area have been lost through time.

Historic People

Significant people of the project lands in historic times would have been the *konohiki* Komaia (Nīnole), Nakahuna (Punalu`u) and Mahoe (Punalu`u); and Henry Opukaha`ia who was born in Nīnole.

Significant Events.

Most of the significant traditional events would have been associated with the legendary entities and chiefs and *kahuna* of the project lands; such as the construction of the *heiau* and their high ceremonies, the birth and deaths of the *ali`i nui,* the construction of the fishponds and the *konohiki* entertaining visiting chiefs. Significant modern events would include the construction of the Punalu`u Landing and Wharf and perhaps in some circles, the construction of the Sea Mountain Resort and its facilities. However, there are some who would say the significant events for them would be the births of their children, grandchildren and great-grandchildren and their victories in court to save their lands and resources.

Summary of Land Resources and Use

Various land use patterns are physically evident as well as recounted in the literature. The physical evidence is in the form of stone ruins that are fortunate to have been preserved relatively intact. Clues regarding function and use can sometimes be extrapolated from the stories, songs, chants and ethno-historical observations that were also fortunately recorded, as well as from the cultural remains identified during surface and sub-surface studies (artifacts, midden, and charcoal for dating). Several of these stone cultural remains were recorded during various studies of Punalu`u, Wailau and Nīnole lands and also mentioned by the cultural consultants (i.e., *heiau*, burials, ahu, caves, platforms, mounds, walls, and enclosures). These are all evidence of both permanent and temporary use of the land and its diverse natural resources.

Ancient Land Resources & Use

While the traditional literature is somewhat silent on the subject of Punalu`u, Wailau and Nīnole lands, the cultural resources found on the landscape speak volumes. The permanent and temporary shelters, the midden clues at those sites, and in the caves, the extended use of the lava tube systems, the habitation and agricultural complexes, and especially the burials and the heiau tell a story of ancient use of the land. People lived and died here. People worked and worshipped here. People cultivated the diverse natural resources (endemic/indigenous plants; bountiful marine resources; bountiful aquaculture resources), as well as cultivated their own Polynesian-introduced cultigens; their staples and their medicine and ritual plants. The lands of Punalu`u, Wailau and Nīnole were not barren, as presented in the native testimonies to the Land Commission regarding the Mahele Awards. It is very conceivable that these people of the mid-1800s were following in the practices of predecessors of the land.

Historic Land Resources and Use (post 1801)

During the 1700s there were many battles across the landscape of Hawai`i i Island. Many fishing villages and farmlands were ravaged by warriors passing through or exacting harsh revenge on opposing chiefs and their families. This was the case for the lands of Punalu`u, Wailau and Nīnole, even up to the late 1700s. However, the native testimonies mentioned above indicate that they must have made a great comeback during the mid-1800s. At least 20 people were awarded *kuleana* lands in Nīnole; twelve in Wailau; and at least sixteen in Punalu`u; several people did not get awarded their lands even though they testified that they were living and farming on it. There was a wide range of what was being cultivated and/or gathered on these lands: crops or patches of taro, wauke, sweet potato, banana, sugar cane, pumpkin, olona, mamake, bamboo, hala, coconut, hau and `ohia. A couple of the cultural consultants recalled the resources of the area (e.g., coconut) and one talked about going to their taro patch in Wailau when they were young.

Summary of Water Resources and Use.

In modern times, the streams of Punalu`u, Wailau and Nīnole are not running, however, several LCA claimants mentioned streams on or bordering their lands: Punalu`u, Nīnole, Moa`ula and Mohokea. Many also mentioned ponds and/or springs on their lands; several noted lo`i, which by definition, needed running or fresh supply of water. Wauke and olona also need to grow in moist areas. Several cultural consultants mentioned the ponds and springs and their domestic use such as drinking water, water to wash clothes, raising fish, and swimming.

Summary of Marine Resources and Use.

This category probably mentions the most resources and use. Many of the consultants shared the types of fish they caught and methods; the types of limu or sea weed, opihi, and wana (see table below). There would most likely be more fish listed if other fishermen would have been able to share the types of fish they catch diving or pole fishing or net fishing. The consultants also noted the endangered turtles (green sea turtle and hawksbill turtle) and the migratory and native sea birds and ducks of the area. There is grave concern for the turtles that nest in the area and their young who have been known to get crushed by vehicles in the beach area.

Table 7. Lists of Marine Resources in Punalu`u, Wailau and Nīnole.

FISH	OTHER	LIMU	SHELL	ACTIVITY
ahi-aku	*honu*	*akeaki*	*a`ama*	*auau*
āholehole	*honu`ea*	*`ele`ele*	crab-white	*hukilau*
akule	*he`e*-squid	*huluhuluwaina*	*ha`uke`uke*	*imu-umu*
ehu		*koku*	dark *opihi*	*kakele*
kumu		*lipalu*	yellow *opihi*	*ko`a*
manini		*lipepe`e*	*pipipi*	*lamalama*
mullet		*lipoa*	*wana*	line-hooks
ono		*wawaiole*		*na`una`u*
opelu				*pa`ipa`i*
papio				*palu*
ulua				pole
				po`opa`a
				spearing
				throw net

Summary of Cultural Resources and Use.

Fortunately some of the *heiau,* shrines, house sites, caves, lava tubes and burials survived the battles of opposing chiefs, the destruction of the temples by the Liholiho-Ka`ahumanu regime, the missionaries, the sandalwood industry, free-roaming cattle and horses, and the sugar industry. For some of the cultural constants the question is will they survive the onslaught of urban sprawl. While that may be slow in coming to the district of Ka`ū, the lands of Punalu`u, Wailau and Nīnole have already been modified by activity associated with development. Some of the cultural consultants lament the loss of traditional lands and resources; the destruction of sites and features of their forefathers and foremothers; and especially the disturbance and/or obliteration of the burials of their ancient ohana.

Summary of Consultants Concerns.

There were many concerns expressed by the consultants, some are listed below:

Concern/Issue	Comments
Punalu`u Black Sand Beach Issues:	More and more visitors are coming; but make it easier for the local people to come and enjoy. This is the only black sand beach; it should be make nicer. You can't stop progress; I just hope they don't spoil this area, especially for the local people because this is the only place they have to go--keep it open. I don't want to see any building on this beach; we need to protect the endangered species--no driving on beach. No one should be selling the black sand or `*ili`ili*; it's for personal use, not for profit.
Road Issues:	The road is now covered with sand from high waves; this is the only public access--the road in back is private, if the owners want to close it there will be no [park] access. The road is a County road, but it's blocked by sand and they won't clean it up; it's the only public road and it's blocked…. They have no right to sell this road--this *ala nui*
Kuleana Land Issues:	We have *kuleana* and *konohiki* rights here--we should have the right to build or have the property that is ours. C. Brewer tried to grab out property; they also changed the decimal is one the *kuleana* lands and took away 100 acres of land from Kekaula. When the sand was way out, people used to live there [Wailau], now no sand and, but it was all open before.
Punalu`u Landing-Camping Issue:	I don't want to see camping allowed by the landing area; if fishermen want to go out, keep the gate closed and have a key to get it.
Public Safety:	The old restaurant buildings should be torn down because it's full of rats and it's dilapidated They have to tear that place [restaurant] down; it has asbestos that is going into the pond--polluting the pond. The waste of the golf course is going into the pond. The pond and the septic tank in the restaurant is leaking out. The [waste] treatment center needs repair. All that is going underground channel into the sea--all that *pilau* is going into the sea. I cannot drink my well water anymore--that's destroying us here. They should tear the old restaurant down and build a nice, new cultural center so we have a place to go; the vendors can go to the cultural center --save the beach.

Landscaping and Upkeep:	I'd like to see nice things, not bushes and overgrown things; and not buildings sitting around with nothing but rats in it. They need to fix and take care of things; salt water/air corrodes.
Development with Restrictions:	Development should benefit the people of Ka`ū; jobs, places to eat, place to have community meetings, or parties, entertainment and simple houses, low-rise condo/duplexes--I don't want to se any high-rises. Why DLNR allow some people to build on conservation lands and I can't build on *kuleana* lands. Open spaces, beaches, landings, and fishponds are not supposed to be sold, no one should build there. They going to build house mauka of the highway; I don't care if they do that. That's fine
Spring/Pond Resources:	Resources should be protected, especially the fresh water like the springs (25-50 million gallons per day), the ponds. The springs in the water make the fish taste better. The ponds used to have fish and native ducks; now they're overgrown with alien vegetation.
Marine Resources:	This is area is nesting grounds for the honu; they should be protected from vehicles, people and lights
Cultural Resources-Sites and Burials:	There were lots of burials around the golf course—I guess the bones were taken elsewhere. There are caves in this area that need to be protected When C. Brewer came down here they heiau and burials were all destroyed; I think that's the reason they weren't successful. Where people were living that's where they were buried--on this *kuleana* I have people all buried in back, covered by grass. The cinder cone had burials--all destroyed. On mauka side that's a whole burial ground where have the gold course; this side of Aspen, mauka of the kahawai--was Ninole people buried there. They built the restaurant over burials.
`Ili`ili o Kōloa	Why did DLNR allow C. Brewer to get truck-loads of those pebbles from Kōloa Beach? This is why I'm so angry with them.
Kōloa or Kawale Beach:	The map is wrong; it's not at the far end.

Summary of Survey Findings (Cultural Resources and Practices)

It is evident that at one time the lands of Punalu`u, Wailau and Nīnole were part of an ancient Hawaiian life system. Archaeological surveys indicate a multi-use of the land because of the *heiau,* burials, enclosures, house platforms, petroglyphs, walls and mounds, cave and lava tube systems. Perhaps the biggest cultural resources and practices still evident are the diverse marine resources, and the inexhaustible fresh water springs. However, access to these resources is not easy to get to, dependant on open roads and vegetation growth. While many ethno-botanical plants are still accessible and used today, such as coconuts and hala on the coastal zone, the *mauka* areas do not appear to have easy or any access for ethno-botanical plants for medicine (*la`au*), *lei*, hula, other crafts or religious purposes. Cultural resources such as the Laka *heiau* (Lanipao) are not accessible at all for practitioners or *ohana* to visit. Many of the burials have been desecrated, removed to unknown places with no means to care for them; and many other burials located within the project area may potentially be disturbed as most of them are unmarked.

Cultural Resources Potentially Impacted by Development:

➢ Lanipao Heiau (Hula)	Practice	Access (none)
➢ Burials on Golf Course	Practice	Access (none)
➢ `Ili`ili Hānau o Kōloa	Practice	Access (hindered)
➢ Punalu`u Fishpond	Practice	Access (limited/hindered)
➢ Nīnole-Wailau Ponds	Practice	Access (limited/hindered)
➢ Punalu`u Bay Mea `Ai (Limu, Fish, Wana, Opihi, etc.)	Practice	Access (hindered)
➢ Punalu`u Nui Heiau	Practice	Access (hindered)
➢ Ka`ie`ie Heiau (Fishing)	Practice	Access (hindered)
➢ Other Burials	Threatened	
➢ Mauka Gathering	Practice	Access (none)
➢ Punalu`u Beach	Practice	Access (limited/hindered)
➢ Kōloa Beach	Practice	Access (limited/hindered)
➢ Kawale/Shark Beach	Practice	Access (limited/hindered)
➢ Pu`umoa	Practice	Access (limited/hindered)

Cultural Impact Study (CIS) Assessment/Recommendations.

According to the OEQC Guidelines, the types of cultural practices and beliefs subject to assessment may include subsistence, commercial, residential, agricultural, access-related, recreational, religious and spiritual customs.

Several of these particular cultural practices may potentially be affected by this project. And there is a range of traditional sites that were used in antiquity and some up to historic periods and it would be irresponsible to say that any future development of the property could not have any adverse effects or impacts. Cultural consultants, native Hawaiian *kupuna* from this region, expressed concern that certain sites be protected and preserved; any action/activity contrary to this would constitute an adverse affect.

The *ahupua`a* of Punalu`u, Wailau and Nīnole are a part of the arid Ka`ū District.. Adaptation to life on these lands would have included lava tube habitation/use, water-collection practices, cave habitation, petroglyphs, and agricultural complexes that exist in a place that does not appears to have much water, yet was not barren at all. How did the plants continue to thrive? What methods of adaptation did the people use to survive? There are still people alive who may be able to answer these questions. There still are visible signs and tangible evidence of ancient habitation that can give answers as well.

An interpretive program for Punalu`u, Wailau and Nīnole should tell the story of these lands and the people who lived, adapted and thrived in this environment--many still continue--the connection to the past history of the lands has never been broken. However, their Punalu`u-Wailau-Nīnole lifestyle is being threatened by urban sprawl and resort development plans. Instead these people should be a part of any planning for this area and consulted regarding place names, landscaping plants, and discussion regarding the future of this area.

It should also be noted that for over a hundred years, native Hawaiians have lived in a culturally repressed state. It has only been within the last thirty years, due to evolved awareness, that native Hawaiians have been aggressively trying to reclaim their *wahi pana* (sacred and/or legendary places). The passage of Act 50 in 2000 legally recognizes and supports this effort. It is in this spirit that the recommendations above and below have been made.

Qualifier. When considering any future action(s) in regard to the project area based on the results of this study, one should be mindful that although much effort was made to locate people who are knowledgeable about Punalu`u, Wailau and Nīnole in general, there may be others who have even more pertinent knowledge. Consideration should be given to them should they come forth as information about the land and development project is made public.

In the traditional Hawaiian culture burial practices included secrecy; the concept of "*make pau*" – to "bury" where you die, such as in home or on travels in caves, lava tubes, under mounds of rock, in a sand dune, and under platforms of *hale* or *heiau*; as well as in a hole to replace a tree that was cut for a *heiau.* Predicting exactly where burials are could be difficult. Therefore developers and crews should always be mindful of the possibility of burials.

Conclusion. There are known sites and burials in the project area, any "inadvertent" discovery made during the various preparation and construction phases of the proposed project, should follow proper protocols as required by the Hawai`i State Historic Preservation Division (SHPD) Burial Sites Program.

It is also recommended that an Integrated Natural Cultural Resources Management Plan (INCRMP) be implemented as it would address cultural consultant issues and concerns regarding *heiau*, *ku`ula*, documented burial areas, fishponds, springs, trails, ethno-botanical, indigenous and endemic plants, lava tubes, caves, and cultural pebbles and rocks.

Follow-up Recommendations.

- **Special Punalu`u-Ma Burial Task Force**

  - Develop procedural protocol
  - Recommend protocol regarding burials found during development activity
  - Determine if/where relocation will take place
  - Recommend proper protocol for handling

- **Accessible Roads/Paths to Cultural Resources**
  (with ongoing maintenance of road/path/resources)

  - Lanipao Heiau
  - Ka`ie`ie Heiau
  - Punalu`u Nui Heiau
  - `Ili`ili Hānau o Kōloa
  - Punalu`u Beach & resources
  - Punalu`u Fishpond
  - Kōloa Beach & resources
  - Kawale Beach & resources
  - Pu`umoa Tidal Pools & resources
  - Nīnole-Wailau Ponds

- **Monument Acknowledging the Punalu`u Nui Heiau Iwi**

- **Proper Signage for Cultural Resources** (Name, require respect/protocol)

  - Lanipao Heiau
  - Ka`ie`ie Heiau
  - Punalu`u Nui Heiau
  - `Ili`ili Hānau o Kōloa
  - Punalu`u Fishpond
  - Nīnole-Wailau Ponds
  - Pu`umoa Tidal Pools
  - Punalu`u Ahupua`a
  - Nīnole Ahupua`a
  - Wailau Ahupua`a
  - Punalu`u Beach
  - Kōloa Beach
  - Kawale Beach
  - Nīnole Stream

- **Construct A Punalu`u Cultural Center**

  - Education
  - Meetings
  - Other Gatherings

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Figure 13. Herb Kane (1973) mural of life in Punalu`u – stolen in July, 2005.
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APPENDIX A

A BILL FOR AN ACT RELATING TO
ENVIRONMENTAL IMPACT STATEMENTS
[UNOFFICIAL VERSION]

HOUSE OF REPRESENTATIVES H.B. NO, 2895 H.D.1
TWENTIETH LEGISLATURE, 2000
STATE OF HAWAII

A BILL FOR AN ACT
RELATING TO ENVIRONMENTAL IMPACT STATEMENTS.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF HAWAII:

SECTION 1. The legislature finds that there is a need to clarify that the preparation of environmental assessments or environmental impact statements should identify and address effects on Hawai`i's culture, and traditional and customary rights.

The legislature also finds that native Hawaiian culture plays a vital role in preserving and advancing the unique quality of life and the "aloha spirit' in Hawaii. Articles IX and XII of the state constitution, other state laws, and the courts of the State impose on government agencies a duty to promote and protect cultural beliefs, practices, and resources of native Hawaiians as well as other ethnic groups.

Moreover, the past failure to require native Hawaiian cultural impact assessments has resulted in the loss and destruction of many important cultural resources and has interfered with the exercise of native Hawaiian culture. The legislature further finds that due consideration of the effects of human activities on native Hawaiian culture and the exercise thereof is necessary to ensure the continued existence, development, and exercise of native Hawaiian culture.

The purpose of this Act is to: (1) Require that environmental impact statements include the disclosure of the effects of a proposed action on the cultural practices of the community and State; and (2) Amend the definition of "significant effect" to include adverse effects on cultural practices.

SECTION 2. Section 343-2, Hawai`i Revised Statutes, is amended by amending the definitions of "environmental impact statement' or "statement" and "significant effect", to read as follows:

"'Environmental impact statement" or "statement" means an informational document prepared in compliance with the rules adopted under section 343-6 and which discloses the environmental effects of a proposed action, effects of a proposed action on the economic [and] welfare, social welfare, and cultural practices of the community and State, effects of the economic activities arising out of the proposed action, measures proposed to minimize adverse effects, and alternatives to the action and their environmental effects.

The initial statement filed for public review shall be referred to as the draft statement and shall be distinguished from the final statement which is the document that has incorporated the public's comments and the responses to those comments. The final statement is the document that shall be evaluated for acceptability by the respective accepting authority.

"Significant effect" means the sum of effects on the quality of the environment, including actions that irrevocably commit a natural resource, curtail the range of beneficial uses of the environment, are contrary to the State's environmental policies or long-term environmental goals as established by law, or adversely affect the economic [or] welfare, social welfare[.], or cultural practices of the community and State."

SECTION 3. Statutory material to be repealed is bracketed. New statutory material is underscored.

SECTION 4. This Act shall take effect upon its approval.

Approved by the Governor as Act 50 on April 26, 2000

APPENDIX B

Scope of Work (SOW)

Cultural Impact Assessment [in accordance with OEQC Guidelines]

1. identify and consult with individuals and organizations with expertise concerning the types of cultural resources, practices and beliefs found within the broad geographical area, e. g., district or ahupua`a;

2. identify and consult with individuals and organizations with knowledge of the area potentially affected by the proposed action;

3. receive information from or conduct ethnographic interviews and oral histories with persons having knowledge of the potentially affected area;

4. conduct ethnographic, historical, and other culturally related documentary research;

5. identify and describe the cultural resources, practices and beliefs located within the potentially affected area; and

6. assess the impact of the proposed action, alternatives to the proposed action, and mitigation measures, on the cultural resources, practices and beliefs identified.

Methods

The specific tasks listed below expand on the above scope of work:

- Conduct historical and cultural background research (i.e., business records, land records; archival documents, literature, reports, letters, photographs, journals, or newspaper files) to locate material that will provide broad patterns of the history of the project area such as subsistence, religious, recreational, and commercial uses of the land; as well as settlement and residential patterns of the area and region; major family groups that inhabited, used or controlled lands within the project area and region; documented legends, myths, or traditional histories associated with the area; and descriptions of traditional practices, customs and beliefs associated with identified traditional cultural practices;

- Prepare a semi-structured ethnographic research instrument that will include questions that will generate general biographical information, association with and knowledge of the project area, its history and use

- Prepare a consent form to be used as written agreement with any individual interviewed concerning the review of content and use of information recorded during the interview

- Identify individuals knowledgeable with the project area e.g., Punalu`u, Wailau and Nīnole

- Conduct and record ethnographic interviews with knowledgeable individuals. If feasible individuals shall participate in field inspections (Makana to be given)

- Transcribe recorded interviews (Approximate time, 3-4 hrs/per hr of recording)

- Prepare a report that will include an overview of the archival material, and an analysis of the ethnographic data;

APPENDIX C

Guidelines for Assessing Cultural Impacts
Adopted by the Environmental Council, State of Hawaii
November 19, 1997

I. INTRODUCTION

It is the policy of the State of Hawaii under Chapter 343, HRS, to alert decision makers, through the environmental assessment process, about significant environmental effects which may result from the implementation of certain actions. An environmental assessment of cultural impacts gathers information about cultural practices and cultural features that may be affected by actions subject to Chapter 343, and promotes responsible decision making.

Articles IX and XII of the State Constitution, other state laws, and the courts of the state require government agencies to promote and preserve cultural beliefs, practices, and resources of native Hawaiians and other ethnic groups. Chapter 343 also requires environmental assessment of cultural resources, in determining the significance of a proposed project.

The Environmental Council encourages preparers of environmental assessments and environmental impact statements to analyze the impact of a proposed action on cultural practices and features associated with the project area. The Council provides the following methodology and content protocol as guidance for any assessment of a project that may significantly affect cultural resources.

II. CULTURAL IMPACT ASSESSMENT METHODOLOGY

Cultural impacts differ from other types of impacts assessed in environmental assessments or environmental impact statements. A cultural impact assessment includes information relating to the practices and beliefs of a particular cultural or ethnic group or groups.

Such information may be obtained through scoping, community meetings, ethnographic interviews and oral histories. Information provided by knowledgeable informants, including traditional cultural practitioners, can be applied to the analysis of cultural impacts in conjunction with information concerning cultural practices and features obtained through consultation and from documentary research.

In scoping the cultural portion of an environmental assessment, the geographical extent of the inquiry should, in most instances, be greater than the area over which the proposed action will take place. This is to ensure that cultural practices which may not occur within the boundaries of the project area, but which may nonetheless be affected, are included in the assessment. Thus, for example, a proposed action that may not physically alter gathering practices, but may affect access to gathering areas would be included in the assessment. An ahupua'a is usually the appropriate geographical unit to begin an assessment of cultural impacts of a proposed action, particularly if it includes all of the types of cultural practices associated with the project area. In some cases, cultural practices are likely to extend beyond the ahupua'a and the geographical extent of the study area should take into account those cultural practices.

The types of cultural resources the historical period studied in a cultural impact assessment should commence with the initial presence in the area of the particular group whose cultural practices and features are being assessed. The types of cultural practices and beliefs subject to assessment may include subsistence, commercial, residential, agricultural, access-related, recreational, and religious and spiritual customs.

The types of cultural resources subject to assessment may include traditional cultural properties or other types of historic sites, both man made and natural, including submerged cultural resources, which support such cultural practices and beliefs.

The Environmental Council recommends that preparers of assessments analyzing cultural impacts adopt the following protocol:

1.identify and consult with individuals and organizations with expertise concerning the types of cultural resources, practices and beliefs found within the broad geographical area, e.g., district or ahupua`a;

2.identify and consult with individuals and organizations with knowledge of the area potentially affected by the proposed action;

3.receive information from or conduct ethnographic interviews and oral histories with persons having knowledge of the potentially affected area;

4.conduct ethnographic, historical, anthropological, sociological, and other culturally related documentary research;

5.identify and describe the cultural resources, practices and beliefs located within the potentially affected area; and

6.assess the impact of the proposed action, alternatives to the proposed action, and mitigation measures, on the cultural resources, practices and beliefs identified.

Interviews and oral histories with knowledgeable individuals may be recorded, if consent is given, and field visits by preparers accompanied by informants are encouraged. Persons interviewed should be afforded an opportunity to review the record of the interview, and consent to publish the record should be obtained whenever possible. For example, the precise location of human burials are likely to be withheld from a cultural impact assessment, but it is important that the document identify the impact a project would have on the burials. At times an informant may provide information only on the condition that it remain in confidence. The wishes of the informant should be respected.

Primary source materials reviewed and analyzed may include, as appropriate: Mahele, land court, census and tax records, including testimonies; vital statistics records; family histories and genealogies; previously published or recorded ethnographic interviews and oral histories; community studies, old maps and photographs; and other archival documents, including correspondence, newspaper or almanac articles, and visitor journals. Secondary source materials such as historical, sociological, and anthropological texts, manuscripts, and similar materials, published and unpublished, should also be consulted. Other materials which should be examined include prior land use proposals, decisions, and rulings which pertain to the study area.

III. CULTURAL IMPACT ASSESSMENT CONTENTS

In addition to the content requirements for environmental assessments and environmental impact statements, which are set out in HAR §§ 11-200-10 and 16 through 18, the portion of the assessment concerning cultural impacts should address, but not necessarily be limited to, the following matters:

1.A discussion of the methods applied and results of consultation with individuals and organizations identified by the preparer as being familiar with cultural practices and features associated with the project area, including any constraints or limitations which might have affected the quality of the information obtained.

2.A description of methods adopted by the preparer to identify, locate, and select the persons interviewed, including a discussion of the level of effort undertaken.

3.Ethnographic and oral history interview procedures, including the circumstances under which the interviews were conducted, and any constraints or limitations which might have affected the quality of the information obtained.

4.Biographical information concerning the individuals and organizations consulted, their particular expertise, and their historical and genealogical relationship to the project area, as well

as information concerning the persons submitting information or interviewed, their particular knowledge and cultural expertise, if any, and their historical and genealogical relationship to the project area.

5.A discussion concerning historical and cultural source materials consulted, the institutions and repositories searched, and the level of effort undertaken. This discussion should include, if appropriate, the particular perspective of the authors, any opposing views, and any other relevant constraints, limitations or biases.

6.A discussion concerning the cultural resources, practices and beliefs identified, and, for resources and practices, their location within the broad geographical area in which the proposed action is located, as well as their direct or indirect significance or connection to the project site.

7.A discussion concerning the nature of the cultural practices and beliefs, and the significance of the cultural resources within the project area, affected directly or indirectly by the proposed project.

8.An explanation of confidential information that has been withheld from public disclosure in the assessment.

9.A discussion concerning any conflicting information in regard to identified cultural resources, practices and beliefs.

10.An analysis of the potential effect of any proposed physical alteration on cultural resources, practices or beliefs; the potential of the proposed action to isolate cultural resources, practices or beliefs from their setting; and the potential of the proposed action to introduce elements which may alter the setting in which cultural practices take place.

11.A bibliography of references, and attached records of interviews which were allowed to be disclosed.

The inclusion of this information will help make environmental assessments and environmental impact statements complete and meet the requirements of Chapter 343, HRS. If you have any questions, please call 586-4185.

APPENDIX D

Agreement to Participate in this Cultural Impact Study/Assessment

Project Title: **Sea Mountain Resort**
Ahupua`a of Punalu`u, Wailau and Nīnole, District of Ka`ū

Investigator: Maria E. Ka`imipono Orr, M.A.

You are being asked to participate in a cultural impact study/assessment [CIS/A] conducted by an independent investigator contracted by *Group 70* as part of a larger study of the proposed *Sea Mountain Resort development*, primarily a renovation and upgrading of this already established country resort. This CIS/A will be included in a larger Environmental Impact Study by *Group 70*. The investigator will explain the purpose of the study, the procedures to be used, the potential benefits and possible risks of participating. You may ask the investigator any question(s) in order to help you to understand the study or procedures. A basic explanation of the study is written below. If you then decide to participate in the study, please sign on the second page of this form. You will be given a copy of this form to keep.

I. Nature and Purpose of the Study

The purpose of this cultural impact study/assessment is to gather information about the project lands and vicinity in the Punalu`u Ahupua`a, District of Ka`u, through interviews with individuals who are knowledgeable about this area, and/or about traditional and historic information such as cultural practices, legends, songs, chants or other information. The objective of this study is to facilitate in the identification and location of any possible pre-historic and/or historic cultural resources, or traditional cultural practices in the area mentioned above, in accordance with applicable historic preservation laws, regulations, and guidelines, including:

Office of Environmental Quality Control [OEQC] *Guidelines and Act 50 HB2895* [A.D.2000], *HRS Chapter 343*

II. Explanation of Procedures

After you have voluntarily agreed to participate and have signed the consent page, the investigator will tape record your interview and have it transcribed later. Data from the interview [ethnographic research] will be used as part of the background historical summary for this project. The investigator may also need to take notes and/or ask you to spell or clarify terms or names that are unclear.

III. Discomforts and Risks

Foreseeable discomforts and/or risks may include, but are not limited to the following: having to talk loudly for the recorder; being recorded and/or interviewed; providing information that may be used in reports which may be used in the future as a public reference; knowing that the information you give may conflict with information from others; your uncompensated dedication of time; possible miscommunication or misunderstanding in the transcribing of information; loss of privacy; and worry that your comment(s) may not be understood in the same way you understand them. It is not possible to identify all potential risks, however reasonable safeguards have been taken to minimize risks.

IV. Benefits

This study will give you the opportunity to express your thoughts (*mana`o*), and your opinions will be listened to and shared; your knowledge may be instrumental in the preservation of significant cultural resources, practices and information.

V. Confidentiality

Your rights of privacy, confidentiality and/or anonymity will be protected **if you so desire**. You may request, for example, that your name and/or sex not be mentioned in write-ups, such as field notes, on tape, on files (disk or folders), drafts, reports, and future works; or you may request that some of the information you provide remain "off-the-record" **and not be recorded in any way**. In order to ensure protection of your privacy, confidentiality and/or anonymity, you should immediately advise the investigator of your desires. The investigator will ask you to specify the method of protection, and note it on this form below.

VI. Refusal/Withdrawal

You may, at any time during the interview process, chose to not participate any further and ask the investigator for the tape and/or notes. Please note that you will be given an opportunity to review your transcript, and to revise or delete any part of the interview.

VII. Waiver

Part I: Agreement to Participate

I, _____, understand that Maria E. Ka'imipono Orr, an independent investigator contracted by Group 70 will be conducting oral history interviews with individuals knowledgeable about the project lands and vicinity, in the ahupua`a of Punalu`u, District of Ka`u, Hawaii. The oral history interviews are being conducted in order to collect information on possible pre-historic and/or historic cultural resources associated with these lands, as well as traditional cultural practices.

I understand I will be provided the opportunity to review my interview to ensure that it accurately depicts what I meant to say. **I also understand that if I don't return the revised transcripts after two weeks from date of receipt, my signature below will indicate my release of information for the draft report. I also understand that I will still have the opportunity to make revisions during the draft review process.**

_____ I am willing to participate.
_____ I am willing to participate, under the following conditions:

_____

Consultant Signature **Date**

_____

Print Name **Phone**

_____

Address

MAHALO NUI LOA

Part II: Personal Release of Interview Records

I, _____, have been interviewed by Maria E. Ka'imipono Orr, an independent investigator contracted by Group 70. I have reviewed the written transcripts of tape recordings of the interview, and agree that said documentation is complete and accurate except for those matters specifically set forth below the heading "CLARIFICATION OR CORRECTIONS."

I further agree that Ms. Orr, Group 70 and/or Sea Mountain Resort developers. may use and release my identity and other interview information, both oral and written, for the purpose of using such information in a report to be made public, subject to my specific objections, to release as set forth below under the heading "SPECIFIC OBJECTIONS TO RELEASE OF INTERVIEW MATERIALS."

CLARIFICATION OR CORRECTIONS:

SPECIFIC OBJECTIONS TO RELEASE OF INTERVIEW MATERIALS:

_____

Consultant Signature **Date**

_____

Print Name **Phone**

MAHALO NUI LOA

APPENDIX E

Ethnographic Survey

Basic Research Instrument for Oral History Interviews

Sea Mountain-Punalu`u CIS/A

This research instrument includes basic information as well as research categories which will be asked in the form of open primary questions which allow the individual interviewed (Consultant) to answer in the manner he/she is most comfortable. Secondary or follow-up questions are asked based on what the Consultant has said and/or to clarify what was said. The idea is to have an interview based on a "talk-story" form of sharing information. Questions will NOT be asked in an interrogation style/method, NOR will they necessarily be asked in the order presented below. This research instrument is merely a *guide* for the investigator and simply reflects general categories of information sought in a semi-structured format. Questions will be asked more directly when necessary.

The Consultants were selected because they met one or more of the following criteria:

- Had/has Ties to Project Location
- Known Hawaiian Cultural Resource Person
- Known Hawaiian Traditional Practitioner
- Referred By Other Cultural Resource People
- Referred By Group 70 staff

[NOTE: This part of the interview, #1-4 is mutual sharing and rapport building. Most of the information for research categories "Consultant Background" and "Consultant Demographics" come from this section, but not exclusively.]

1. *Name?* *Birth Year?*
   Address? *Phone #?* *Email address?*

   [This information can be addressed in a couple of ways. After the investigator first turns on the tape recorder, the following information will be recorded: Day/Date/Time/Place of Interview/Name of Consultant (if authorized by Consultant)/Name of Investigator/Questions: Have you read the Agreement To Participate?/Do you have any questions before we begin?/Will you please sign the Consent page. The investigator will explain again the purpose of the interview.

   The investigator will then ask the Consultant to "Please tell me about yourself--when/where were you born? where did you grow up? where did you go to school?" This general compound question allows the Consultant to share as much or as little as he/she wants without any pressure. Most of the information for #1 may already be known to the investigator.]

2. *Family Background: History? Hawaiian connection (if any)?*

   [Much of the information for questions #2, 3, and 4 usually comes from the "monologue" answer to Question #1. If it does not, then these questions will be asked. The answers in this section usually establishes how the Consultant meets the criteria; how the Consultant developed his/her information base, etc.]

3. *Youth? Where lived?*

4. *Schooling*?

[NOTE: This part of the interview, #5-7 reflects information sought for the following research categories: "Significant Properties," "Significant People," "Significant Events," "Traditional Cultural Practices," 'Traditional Arts/Crafts," and Oral History/Folklore/Place Names." The questions are open-ended so as NOT to "put words in the mouths" of the Consultants.]

5. *Can you tell me what you know about the lands of Punalu`u and vicinity?*

[NOTE: Generally when people share information about a specific topic/place, they usually state where their information came from. If it isn't volunteered, it is asked as a follow-up question(s). A map of the project area should be available to confirm that investigator and consultant are talking about the same place. Photos would also help if a field trip is not possible. The best scenario would be to be "on-site" at some part of the interview…although this is not always practical.]

6. What are your recollections and/or personal experiences of this area?

[NOTE: If Consultant is related to any Land Commission Awardee [LCA] or subsequent land-owner in the project zone, or former resident or employee of C. Brewer, the follow-up question(s) is asked.]

7. How are you related to the Awardee? Or subsequent land owner?

8. Do you know any stories/legends/songs/chants associated with these areas?

[NOTE: Possible follow-up questions for Punalu`u and vicinity:

- How are you or your family connected to the lands of Punalu`u?
- What year(s) were you and/or your family associated with these lands?
- What was this place/area called when you were growing up?
- Can you describe what the area looked like--what kinds of natural and/or man made things?
- To your knowledge what kind of activities took place in this location?
- Do you know of any traditional gathering of plants, etc in the area?
- To your knowledge please describe any gathering practices nearby?
- Any other land/water use?
- What was the historic land use? Ranching Agriculture? Habitation? Dwellings?
- Where were these "features" located? [Have map ready for marking.]
- Can you describe any stream/fresh water use?
- Do you know about any burials in the project area?

9. Is there anyone you know who can also tell me about the project area?

[NOTE: Usually in the course of the interview, Consultants suggest other people to interview.]

10. *As soon as I have transcribed this interview I will send you two copies. Please review the transcript, make any corrections and/or additions. If you're satisfied, please sign the attached third page of the Consent Form thereby releasing the information. Then mail one set back to me in the enclosed stamped addressed envelope.*

MAHALO NUI LOA

APPENDIX F
Hawai'iloa and the Discovery of Hawai'i

(Samuel M. Kamakau and Z. Kepelino)

By *Polynesian Voyaging Society*

The Discovery and Settlement of Hawai'i

Hawai'i Loa, or Ke Kowa i Hawai'i, was one of the four children of Aniani Ka Lani.1 The other three were Ki, who settled in Tahiti, Kana Loa, who settled the Marquesas, and Laa-Kapu. The ocean was called Kai Holo-o-ka-I'a (Ocean where the fish run). Only two islands existed and both were discovered and settled by Hawai'i Loa. The first he named Hawai'i after himself; the second Maui, after his eldest son. (The other islands were created by volcanoes during and after the time of Hawai'i Loa. [See note 5.])

Hawai'i Loa and his brothers were born on the east coast of a land called Ka 'Aina kai melemele a Kane (the land of the yellow or handsome sea of Kane).2 Hawai'i Loa was a distinguished man and noted for his fishing excursions which would occupy months, sometimes the whole year, during which time he would roam about the ocean in his big canoe (wa'a), called also an "island" (moku), with his crew and his officers and navigators (poe ho'okele and kilo-hoku).

One time when they had been at sea for a long time, Makali'i, the principal navigator said to Hawai'i Loa, "Let's steer the canoe in the direction of Iao, the Eastern Star, the discoverer of land [Hoku hikina kiu o na 'aina]. There is land to the eastward and here is a red star, hoku 'ula (Aldebaran), to guide us, and the land is there in the direction of those big stars which resemble a bird." And the red star, situated in the lap of the goats [a constellation], was called Makali'i after the navigator. Some other red stars in the circle of the Pleiades were called the Huhui-a-Makali'i ("Cluster of Makali'i").

So they steered straight onward and arrived at the easternmost island of the Hawaiian chain.3 They went ashore and found the land fertile and pleasant, filled with 'awa, coconut trees, and so on, and Hawai'i Loa, the chief, gave that land his name. Here they dwelt a long time and when their canoe was filled with vegetable food and fish, they returned to their native country with the intention of returning to Hawai'i-nei, which they preferred to their own country. They had left their wives and children at home; therefore, they returned to get them. When Hawai'i Loa and his men arrived at their own country and among their relatives, they were detained a long time before they set out again for Hawai'i.

At last Hawai'i Loa sailed again, accompanied by his wife and his children. He settled in Hawai'i and gave up all thought of ever returning to his native land. He was accompanied on this voyage by a great crowd of men, steersmen, navigators, shipbuilders, and others.4 Hawai'i Loa was chief of all these men. He alone brought his wife and children; all the others came singly, without women, so he was the progenitor of this nation. On their voyage here, the Morning Star (ka Hoku Loa) was the special star they steered by. And Hawai'i Loa called the islands after the names of his children and the stars after his navigators and steersmen. [The island of Maui was called after Hawai'i Loa's first born son. The island of O'ahu was called after Hawai'i Loa's daughter, and her foster parent was Lua, and hence the name O'ahu-a-Lua. Kaua'i was called after Hawai'i Loa's younger son; his wife's name was Waialeale, and they lived on Kaua'i, and the mountain was called after her because there she was buried. And thus other islands and districts were called after the first settlers.]5

After Hawai'i Loa had been some time in Hawai'i-nei, he made another voyage to find his brothers to see if they had any children who might become husbands or wives to his own. They left from Lae o Kalae, in Ka'u, and followed the stars Ke Ali'i-o-Kona-i-k a-Lewa [Canopus] and the stars of Hoku-kea o ka Mole Honua ["Star-cross of the bottom of the earth," or Southern Cross] to Tahiti and other islands to the south. On Tahiti, he found his brother Ki who had settled there and called the island after one of his own names. They sailed together southward (i ka mole o ka honua), and found an uninhabited island, which Hawai'i Loa gave his name, and another smaller island, which he named for his daughter O'ahu.

When they had finished their business here, they returned to Hawai'i, to Lae o Kalae, steering by the Hoku-'Iwa stars and the Hoku Poho ka 'Aina. On this return voyage, Hawai'i Loa brought Tu-nui-ai-a-te-Atua, the first born son of

his brother Ki, who became the husband of Hawai'i Loa's favorite daughter O'ahu. The couple had a child called Kunuiakea, who was born at Keauhou in Puna, Hawai'i. Puna was a fertile and fine land and it was called Puna by Kunuiaiakeakua [Tu-nui-ai-a-te-Atua] after his own birthplace, Puna-Auia, in Tahiti.

Kunuiakea, on both father's and mother's side, became a chief of the very highest rank (kapu loa). From him sprang the race of chiefs here in Hawai'i (welo ali'i) and from Makali'i sprang the race of common people (welo kanaka). The first has been kept separate from the most ancient times, and the second has been kept separate from the time of chaos (mai ka Po mai). But the priestly race (welo kahuna) was one and the same with the race of chiefs from the beginning.6

Hawai'i Loa's Descendants

Kunuiakea's son Ke Lii Alia, and his grandson Kemilia, were born at Tahiti along with the Aoa, the royal tree; but his great grandson, Ke Lii Ku (Eleeleualani), was born on Hawai'i.

Eleeleualani was the grandfather of Papa-Nui-Hanau-Moku (w). His wife was called Ka Oupe Ali'i and was a daughter of Kupukupunuu from Ololoimehani (supposed to be either a name for the island of Nu'uhiwa, or of a place on that island). They had a son called Kukalani'ehu, whose wife was Ka Haka-ua-Koko, the sixth descendant from Makali'i, and they two were the parents of Papa-Nui (w).

Papa-Nui-Hanau-Moku (w) first married Wakea, who was the son of Kahiko (k) and Tupu-rana-i-te-hau (w), who was a Tahitian woman. Papa's first child with Wakea was a daughter called Hoohokukalani.

Papa, having quarreled with Wakea on account of their daughter [i.e., Wakea slept with their daughter], went to Tahiti and there she took to Te Rii Fanau for husband and had a son called Te Rii i te Haupoipoi. She afterwards returned to Hawai'i under the name of Huhune and had a son with Waia and called him Hinanalo. Domestic troubles now made her crazy and she returned to Tahiti where she had another son with Te Ari'i Aumai, who was said to be the fourth generation of the Tahiti chiefs, and she called his name Te Ari'i Taria, and he became chief over that part of Tahiti called Taharu'u.

Because she was the mother of chiefs, both here and in Tahiti, she is called Papa Nui Hanau Moku ["Great Papa, the Mother of Islands"]. She is said to have been a comely, handsome woman, very fair and almost white.7

Papa is said to have traveled eight times between Tahiti and Hawai'i, and died in a place called Waieri, in Tahiti, during the time of Nanakelihi the fifth descendant from her and Wakea.

Wakea was a wicked and bad man. He instituted the bad and oppressive kapu, such as that men and women could not eat together; that women could not eat red fish, hogs, fowl or other birds, and some kinds of bananas. These kapu were put on to spite and worry Papa, on account of her growling at and reproaching him for his wickedness. Wakea also departed from the ancient worship and introduced idol worship, and many people followed him, because they were afraid of him.

Other Travels of Hawai'i Loa

Hawai'i Loa was born on the eastern shore of the land of Kapakapaua-a-Kane. One of Hawai'i Loa's grandchildren was called Keaka-i-Lalo (w) whom he married to Te Ari'i Aria, one of his brother Ki's grandchildren, and he placed them at Sawai'i [Samoa?], where they became the ancestors of that people, Sawai'i being then called Hawai'i-ku-lalo [Hawai'i rising downwind].

Afterwards Hawai'i Loa revisited Tahiti and found that his brother Ki had forsaken the religion in which they were brought up, that of Kane, Ku and Lono, and adopted Ku-waha-ilo [maggot-mouthed Ku], the man-eating God (ke akua 'ai kanaka), as his God. After quarreling with his brother on this account, Hawai'i Loa left Tahiti and brought with him Te Ari'i Apa as a husband for Eleeleualani, his mo'opuna (grandchild) From these two was born Kohala (w), a girl, from whom the Kohala people sprang.

Afterwards Hawai'i Loa went again to Tahiti and Hawai'i-ku-lalo (Sawai'i) and held a meeting with those peoples at Tarawao, but finding that they persisted in following after the God Ku-waha-ilo and that they had become addicted

to man-eating, he reproved and repudiated them, and passed a law called "he Papa Enaena," forbidding anyone from Hawai'i-Luna (upwind Hawai'i) from ever going to the southern islands, lest they should go astray in their religion and become man-eaters.

When Hawai'i Loa returned from this trip he brought with him Te Ari'i Tino Rua (w) to be a wife to Kunuiakea, and they begat Ke Ali'i Maewa Lani, a son, who was born at Holio in North Kona, Hawai'i, and became the Kona progenitor.

After this Hawai'i Loa made a voyage to the westward, and Mulehu (Hoku Loa) was his guiding star. He landed on the eastern shore of the land of the Lahui-makalilio (the people with the turned up, oblique eyes, i.e., Asians). He traveled over it to the nor thward and to the westward to the land of Kuahewahewa-a-Kane, one of the continents that God created, and thence he returned, by the way he had come, to Hawai'i nei, bringing with him some white men (po'e keokeo kane) and married them to native women (a ho'omoe i ko'onei po'e wahine). On this return voyage the star Iao was his guiding star to Hawai'i.

After this Hawai'i Loa made another voyage to the southern and eastern shore of Kapakapaua-a-Kane and took with him his grandchild Kunuiakea in order to teach him navigation, etc. When they had stayed there long enough they returned and Kunuiakea brought with him "he mau ha'a elua" (two stewards), one called Lehua and the other Nihoa, and they were settled on the two islands which bear their names, as konohiki (land stewards) and put under the charge of Kaua'i, the youngest son of Hawai'i Loa.

When Hawai'i Loa returned from the conference with his brother Ki and his descendants, his wife Hualalai bore him a son who was called Hamakua, and who probably was a bad boy (keiki 'ino'ino), for so his name would indicate. Ten years later, Hualalai died and was buried on the mountain of Hawai'i that has been called after her name ever since.

After Hawai'i Loa was dead and gone, in the time of Kunuiakea, came Tahitinui from Tahiti and landed at Ka-lae-i-Kahiki (the southwest point of Kaho'olawe, a cape often made by people coming from or going to Tahiti.) Tahiti-nui was a mo'opuna of Ki, Hawai 'i Loa's brother, and he settled on East Maui and died there.

The descendants of Hawai'i Loa and also of Ki (which are one, for they were brothers) peopled nearly all the Polynesian islands. From Ki came the people of Tahiti, Borabora, Huahine, Taha'a, Ra'iatea and Mo'orea [the Society Islands].

From Kanaloa [brother of Hawai'i Loa] were peopled Nukuhiwa, Uapou, Tahuata, Hiwaoa and those other islands [the Marquesas Islands]. Kanaloa married a woman from the man-eating people, Taeohae [Taiohae, on Nukuhiwa], from whom spring those cannibals who live on Nukuhiwa, Fiji, Tarapara, Paumotu [the Tuamotus], and the islands in western Polynesia so is it reported in the Hawaiian legends and prayers but the people of Hawai'i and the Tahiti (properly speaking) did never addict themselves to cannibalism.

Notes

This English version of the Hawai'i Loa story is from Fornander, Vol. VI, 278-281. Another version entitled "Hawaii-nui," in Hawaiian and English, appears in Kepelino's Traditions of Hawaii (Honolulu: Bishop Museum, 1932, 74-77). The authenticity of the Hawai'i Loa tradition has been questioned:

"The legend seems to be a summary of statements contained in many other Hawaiian legends and genealogies. At the time it was recorded in writing, many Hawaiian had become Christianized and were familiar with Biblical history. The temptation to interpret certain incidents similar to those in Biblical history as being in fact the Hawaiian rendering of Biblical events seems to have influenced the translators. This unfortunate condition has more or less discredited the ancient legends on which the legend of H awaii-loa is based, branding them, in the opinion of many modern students as "doctored accounts, influenced by Christianity" (Cartwright 105)

Both Kamakau and Kepelino, the authors of the tradition of Hawai'i Loa, were Christian converts The tradition includes the notion that Hawaiians worshipped one God formed by a trinity of gods (Kane, Ku, and Lono). It also contains an account of the creation of the first man (Kumuhonua) out of clay and the first woman (Lalo Honua) out of the rib of the first man. Kanaloa, angry that he was denied 'awa, rebelled against God and later seduced the first woman, after which the first man and woman broke the la w of Kane and fell from grace. The Hawaiian Noah in this

tradition is called Nu'u; he survived a flood in a large vessel with a house on it; after the flood subsided, he landed on top of Mauna Kea, etc.

Cartwright points out, however, that "many of the persons mentioned [in the genealogy] are and have been accepted by Hawaiians of chieftain rank as their ancestors." He concludes that the tradition is authentic, though the Hawai'i in the story is actually Ra'iatea (formerly called Hawa`iki) rather than the Big Island of Hawai'i. He offers no evidence for this conclusion.

Randie Fong notes "the Hawai'ii Loa portion [of the tradition of Hawai'i Loa] bears no resemblance to any Biblical account. The names, places, settings, and plots give us no reason to question their age and authenticity. Further, Patience Bacon of the Bishop Museum remembers kupuna being interviewed by Tutu Puku'i. The kupuna spoke of Hawai'i Loa as their 'reality,' and this was somewhere in the 1920's and 30's. Mrs. Bacon feels that the tradition is sound" (Unpublished commentary on Hawai'iloa; the name has been used for a Hawaiian voyaging canoe that will retrace in 1995 an early settlement route to Hawai'i from the Marquesas Islands.)

1. The story begins with the genealogy of Hawai'i Loa for many generations, from the first man, Kumu Honua, and his wife Lalo Honua, who lived in a land called Kalana i Hauola, down to Aniani Ka Lani, Hawai'i Loa's father and Ka Mee Nui Hikina, his mother .

2. Kepelino's version: Hawai'i-nui sailed from a land called Kahiki-Honua-Kele.

3. Kepelino's version states that the canoe made landfall at the western end of the archipelago: "First he saw the island of Kaua'i, but he kept on sailing and found O'ahu and then the islands of the Maui group, then, seeing the mountains of Hawai'i, he kept on until he reached that island. There he lived and named the island after himself. The other islands from Maui to Kaua'i were named for his children and for some who sailed with him. Here are the names of this children: Maui was the eldest, O'ahu younger, and Kaua'i the youngest. These names he gave to the three large islands, but the smaller islands were perhaps named for those who accompanied him."

4. Kepelino's version: Hawai'i-nui sailed to Hawai'i with his eight steersmen: Here are their names: Makali'i, a famous steersman and great farmer; Iao; Kahiki-Nui; Hoku 'Ula [perhaps the star Aldebaran]; Maiao; Kiopa'a ["fixed," one name for Polaris, the north star; also called Hokupa'a]; Unulau; Polohilani [perhaps the star Schedir in Cassiopeia]. And because of their skill in observing the stars, each one called the star he observed after his own name. One steersman, Kahiki-Nui, has a land district on Maui named after him.

5. Another passage in Fornander says "When Hawai'i Loa arrived here, there were only the two islands of Hawai'i-Loa and Maui-au-Ali'i; but during his time and close afterwards the volcanoes on Hawai'i and on Maui began their eruptions; and earthquakes and convulsions produced or brought to light the other islands" (279).

6. Earlier in the story we are told that only Hawai'i Loa came with a wife and children so he was "the special progenitor of this nation" (278). Kepelino concludes, "Hawai'i-nui was perhaps a chief or perhaps not; he was a man of high standing (ke kanaka ko'iko'i), as I see it. He had a granddaughter Ku-ka-lani-ehu, who lived in ancient times." A note at the end of the Fornander version states, "In the first age, from Hawai'i Loa to Wakea, the royal authority and prerogative were not very well defined. T he chiefs were regarded more in the light of parents and patrons (haku), than as moi and ali'i-kapu, although they enjoyed all the honor and precedence due to their rank. This state of things was considerably altered by Wakea, his priest and successors, y et even so late as the time of Kanipahu, who refused the government, it is evident that the royal authority was not well settled in the olden times ('aole he ano nui o na ali'i i ka wa kahiko loa 'ku) (281).

7. See Kamakau, Tales and Traditions (133-135) for one version of the story of Papa and Wakea. Papa and Wakea are considered by many as the first female and male ancestors of the Hawaiian people: "Wakea, from whom all Hawaiian genealogies stem as the anc estors of the Hawaiian people, 'both chiefs and commoners,' is regarded as a man in Hawaiian tradition, not as a god as in southern groups [of Polynesia]." (Beckwith 294)

http://leahi.kcc.hawaii.edu/org/pvs/traditionsloa.html

APPENDIX G
The First Wave: Ancient Times
By Frank Daniel

Hawaii-loa and the First Hawaiians

The South Pacific island of Ra'iatea was home to Chief Hawaii-Loa, (ca. 88 B.C.). A navigator and explorer, he had just returned from exploring the north Pacific to find his family and friends near starvation.

Chief Hawaii-Loa commissioned Hagoth, a Maori *kahuna kalai wa`a*, to build three double hull canoes, each 100 feet long, large enough to carry three hundred people. The largest was named Uruao. Uru was the name of the Maori homeland known to the Hawaiians as Ulu-nui.

Chief Hawaii-Loa was going to settle the uninhabited islands he discovered in the center of the Pacific Ocean that he named the Hawaiian Islands. There he believed they could live in peace and harmony with sufficient food, where they would no longer be threatened in any way. It was about 53 B.C.

He asked Matariki, also known as Makalii, an old friend and navigator, to be his head steersman. Matariki would decide when the tides, winds and moon phase were favorable to begin the voyage.

Matariki and Hawaii-Loa asked eight other steersmen to bring their families. Kii, Maui-Loa and Kana-loa, the brothers of Hawaii-Loa, and their families and friends began the months of preparation. Matariki was also a farmer and it was he who decided what plants to bring.

After consulting with the gods, studying the tides and moon phase, Matariki decided it was time to begin their voyage. Using the stars A'a and Hokule'a, ancient chants and their knowledge of the currents and winds they pointed their canoes north. The voyage took several weeks.

Early one morning, as the edge of dawn was separating from the darkness of the sea, a very large white cloud appeared floating on the ocean seemingly held in place by a sky full of stars. As dawn lit up the sky they could see the cloud was the snow on top of a mountain. They named the mountain Mauna Kea. It was on the island of Hawai'i. The star Hokule'a rested in the sky above. Their destination had been reached.

Their first homes were in caves. Crops of fast growing taro and other crops from the 27 species of plants brought with them were planted. At first their food was dried fruits, vegetables and livestock they brought with them, fresh fish and limu. There were no animals except the honu that walked on all fours on the islands.

Chants tell of a peace that reigned for more than 600 years during which time great works were accomplished by the *ka po'e kahiko*. Large waterways were engineered, great walls of stone for *heiau* and *loko i'a kuapa*. Many stand today as testament to their skills and ability to live in peace and harmony with the '*aina* and *kai*.

Those who came with Hawaii-Loa ultimately settled the other islands, building villages, farms and fishponds. The population of the islands in 400 A.D. had grown considerably.

From Hawai'i, across the channel Hawaii-Loa could see Kauiki Head on the island Ihikapapalaumaewa, and the mountain Aleheaakala. Ever the explorer, Hawaii-Loa, and his wife Hualalai moved to Maui where he died as a very old man. His bones are buried on Kauiki Head, near Hana.

Hawaii-Loa discovered the Hawaiian Islands and was the leader of the First Wave. More would follow in the centuries to come!

http://www.formaui.org/3wave2-1.htm

Frank Daniel.

APPENDIX H
"Stories of the Menehunes-Laka's Adventures"
Thrum (1907)

Wahieloa, a chief, lived at Kalaikoi, Kipahulu, Maui. He took to him a wife named Hinahawea. In due time a boy was born to them, whom Hinahowana, the mother of Hinahawea, brought up under her care at Alaenui. She called him Laka-a-wahieloa. He was greatly petted by his parents. One day his father went to Hawaii in search of the *Ala-Koiula a Kane* a toy for his son, landing at Punalu`u, Kau, Hawaii, where he was killed in a cave called Keana-a-Kauelehu.

After a long absence Laka asked for his father, and his mother refered him to his grandmother, who, on being questioned, told him that his father went to Hawaii, and was supposed to be dead. Laka then asked for means by which he could search for his father.

His grandmother replied: "Go to the mountains and look for the tree that has leaves shaped like the moon on the night of Hilo, or Hoaka; such is the tree for a canoe."

Laka followed this advice, and went to the mountains to find the tree for his canoe. Finding a suitable one, he commenced to cut in the morning, and by sundown he felled it to the ground. This accomplished he went home. Returning the next day, to his surprise he could not find his fallen tree, so he cut down another, with the same results. Laka was thus tricked for several days, and in his perplexity consulted again with his grandmother, who sent him off with the same advice as before, to look for the crescent-shaped leaf.

He went to the mountains again and found the desired tree, but before cutting it he dug a big hole on the side where the Kalala-Kamahele would fall. Upon cutting the tree it fell into the hole or trench, as designed; then he jumped into it and lay in waiting for the person or persons who were re-erecting the trees he had cut down for his canoe.

While thus waiting, he heard some one talking about raising the tree and returning it to its former position, followed by some one chanting as follows:

E ka mano o ke Akua,	O the four thousand gods,
Ke kini o ke Akua,	The forty thousand gods,
Ka lehu o ke Akua,	The four hundred thousand gods,
Ka lalani Akua,	The file of gods,
Ka Pukui Akua!	The assembly of gods!
E na Akua o ke kuahiwi nei,	O gods of these woods,
I ka mauna,	Of the mountains,
I ke kualono,	And the knoll,
I ka manowai la-e,	At the water-dam,
E-iho!	Oh, come!

When this appeal ended there was a hum and noise, and in a short time (*manawa ole*) the place was filled with a band of people, who endeavored to lift the tree; but it would not move. Laka then jumped out from his hiding place and caught hold of two of the men, Mokuhalii and Kapaaikee, and threatened to kill them for raising the trees he had cut for his canoe. Mokuhalii then told Laka that if they were killed, nobody would be able to make a canoe for him, nor would anybody pull it to the beach, but if they were spared they would willingly do it for him, provided Laka would first build a big and long shed (*halau*) of sufficient size to hold the canoe, and prepare sufficient food for the men. Laka gladly consented, released them and returned to his home and built a shed on the level ground of Puhikau. Then he went up to the woods and saw the canoe, ready and complete. The Menehunes told Laka that it would be brought to the halau that night. At the dead of night the hum of the voices of the Menehunes was heard; this was the commencement of the lifting of the canoe. It was not dragged, but held up by hand. The second hum of voices brought the canoe to Haloamekiei, at Pueo. And at the third hum the canoe was carefully laid down in the *halau*. Food and fish were there spread out for the workers, the *ha* of taro for food, and the *`opae* and *`o`opu* for fish. At dawn the Menehunes returned to their home. Kuahalau was the name of the *halau*, the remains of the foundation of which were to be seen a few years ago, but now it is ploughed over. The hole dug by Laka still exists.

APPENDIX I
Hawaiian Mythology
Martha Beckwith
1940

WAHIELOA-LAKA CYCLE

THE story of Wahieloa (Wahieroa), son of Kaha‘i (Tawhaki) duplicates that of Hema, and the story of his famous son Laka (Rata) corresponds with the journey made by Kaha‘i to restore his father or his father's bones to his native land. In the Pele legend Wahieloa (Wahialoa, Wahioloa) is named as one of the husbands of Pele while she is living with her parents at Hapakuela, "a place unknown." Laka and Menehune are their children. The husband is "snatched away" by Pele-kumu-lani and Pele migrates to Hawaii in search of him. 1 Wahieloa's wife Hina-hawea may be the Hina-kawea drawn out of the sea by Wakea. Her other name, Koolau (north Kahiki), corresponds with South Sea versions, where she is a chiefess of North Tahiti.

LEGEND OF WAHIELOA

Wahieloa is son of Kaha‘i and Hina-ulu-ohia, born at Wailau, Ninole, in Ka-u district on the island of Hawaii. He lives as chief in Kipahulu at Kalaikoi and has by his wife Hina-hawea, daughter of Hina-howana, a son Laka. Wahieloa sails to the home of the child's grandmother on Hawaii after the birth gift (Alakoi-ula-a-Kane), lands at Punalu‘u, Ka-u, and is seized and sacrificed. His bones are guarded in the cave of Kaualehu (at Koloa 2) by Old-woman-Kaikapu. His son brings back his bones to Maui and deposits them in Papa-ulu-ana at Alae, Kaumakani, Kipahulu. 3

Maori. Wahie-roa (Long piece of firewood) is so named from a great log of wood which his father Tawhaki has brought into (p. 260) camp where his wife is living with her people. His mother is called Hine-nui-a-to-kawa 4 or Maikuku-makaha 5 or Hapai-nui-a-maunga. 6 His wife is Matoka-rau-tawhiri, 7 Kura, 8 Hawea, 9 or Hine-tu-a-haka. 10 He is killed by alien people across the sea led by Matuku. The story varies. Matoka-rau-tawhiri has a pregnancy craving for parson birds (tui) and Wahieroa traps them in the preserves of Matuku and is caught and killed. Or he goes to war with Pou-a-hao-kai and Matuku and is killed. 11 Or he is attacked and murdered by Matuku and Whiti, and his wife taken prisoner. 12 Or a party of travelers led by Whakarau arrive at Whiti-a-naunau, home of Wahieroa, wearing bird plumes which they say come from Pariroa on the seacoast belonging to Pou-haa-kai, Matuku-tangotango, and Hina-komahi, daughter of Tu-rongo-nui. These people go naked and are wild and roving in habit. The chief Manu-korihi leads an expedition of a thousand men to Pari-roa after feathers, a four months' journey from Whiti-kau in Whiti-roa. The expedition is successful, but Wahieroa is slain. 13

Tahiti. Vahieroa is son of Tafa‘i and his wife Hina and is born at his father's home in the Ta-pahi hills of Mahina in North Tahiti. He weds Maemae-a-rohi, sister of the ruling chief Tumu-nui. King Tu-i-hiti of Hiti-au-revareva [said to be Pitcairn island] takes to wife Hau-vana‘a, daughter of Tumu-nui, the ruling chief of North Tahiti. She at first has rejected him, but when he prepares to leave her, love awakens and she insists upon accompanying him. They sail in the boat Are-mata-ro-roa. He invokes monsters who guard the way to let him pass but to attack Tumu-nui should he attempt to follow. When therefore that chief sails in the boat Matie-roa and the canoe Matie-poto in an attempt to recover his daughter, the entire party are swallowed up by the great clam. His younger brother Iore-roa (Big rat) and his brother-in-law Vahie-roa go to seek him and (p. 261) are swallowed in their turn. The younger rat brothers are also lost. Vahieroa's wife Maemae-a-rohi, sister to Tumu-nui, who has been left as regent, rears her son Rata and herself sails with Tumu-nui's wife, leaving her son as regent in her place, and on her return is drawn in by the clam just as her son arrives to rescue her and restore the bones of the other voyagers. 14

Tuamotus. (*a*) Vahieroa weds Matamata-taua or Tahiti To‘erau (North Tahiti) and on the night of their son Rata's birth the parents go fishing and are snatched away by the demon bird of Puna king of Hiti-marama, "an island north of Pitcairn and Elizabeth but long since swallowed in the sea." The bird Matatata‘ota‘o bites off the chief's head and swallows it whole. The wife is placed head downward as a food holder in the house of Puna's wife Te-vahine-hua-rei. 15 (*b*) Vahi-vero is the son of Kui, a demigod of Hawaiki, and a goblin woman named Rima-roa. Kui plants food trees and vegetables and is also a great fisherman. The goblin woman Rima-roa robs his garden; he lies in wait and seizes her and she bears him the son Vahi-vero. Vahi-vero visits a pool from which the beautiful Tahiti-tokerau

daily emerges. Kui teaches him how to lie in wait and seize her and never let her go until she pronounces his name. Having mastered her, he finds that Puna, king of Vavau, is his rival. He goes by way of the pool to the place where Puna guards the girl in a house with round ends, and brings her back with him, leaving her sister Huarehu in her place. Tahiti-tokerau bears to him the boy Rata. Puna comes in shark form to avenge himself, kills Vahi-vero and takes his wife back and makes of her eyes lights for her sister to do sennit work by and of her feet supports for the sister's work basket 16

Compare the legend of Mamo and Rigorigo from the same locality, where eyes are plucked out and used as lamps and the body as a post to support the house. 17

Rarotonga. Vaieroa is the son of Taaki and Ina-uru-o-runga and they live in Avaiki. Vaieroa's wife Tairiiri-tokerau has a (p. 262) pregnancy longing for eels and the eels Pupu and Kavei are, in spite of their sister's warning, caught, cooked, and eaten, hence a rash comes on the child and as the parents seek a kind of sea-weed to cure it they are swept out to sea and Vaieroa is swallowed by the sons of Puna (octopus, clam, etc.) and the mother's eyes are scooped out and given to Te-vaine-uarei on Motu-ta‘ota‘o. 18

Aitutaki. Vaiaroa and Tairi-tokerau, parents of Nganaoa, are lost in the land of moonlight, Iti-te-marama, and Nganaoa joins Rata's sailing expedition to that land under promise to slay all the monsters that endanger them on the way. The parents are found braiding sennit inside a monster whale that has swallowed them whole. 19

Marquesas. Vehie-oa has by his first wife four sons and two daughters. He lives with Tahi‘i-tokoau (North Tahiti). His plants are stolen and he is spirited away by Tui-vae-mona. Tahi‘i-tokoau goes down to Hawaiki to live with Teiki-o-te-po whose wife is Vehie-oa's sister. At the advice of the two old wives, each day of her journey to Hawaiki she gives a pig, until on the tenth day she reaches the place. She has left tokens along the way, a broken leaf, spittle, and tears, and her husband follows her with birds, a cock, and a drum with which to summon the day to the realm of night. He sends the birds ahead, the cock crows five times, the drum sounds, and it is day. 20

Samoa. Fafieloa is the son of Tafa‘i and his second wife Hine-piripiri. Tula is his wife and Lata their son. 21

The story of Laka, son of Wahieloa, is told today in Hana district and the sites are pointed out of his canoe shed, Ku-ohalau, his tree-cutting in the forest, with the rock table where he "greased the mouths" of the forest deities who helped him build the canoe, and the place where he launched his canoe, (p. 263) together with the rocks into which his two sisters were transformed who swam after him.

LEGEND OF LAKA

(*a*) Laka is the son of Wahieloa and Hina-hawea (Koolau-kahili or -kahiki) and is brought up by his grandmother Hina-howana in Kipahulu district on the island of Maui. As the time of his birth approaches, his father sails after a birth gift for his son and, landing at Punalu‘u in Ka-u district on Hawaii, is killed and his bones are thrown into the cave of Kaualehu guarded by old woman Kaikapu (or at the cave Makili and Makula at the cliff of Kupinai). When the boys jeer at Laka because he is fatherless he determines to seek his father's bones.

The tree cut down one day for the canoe, he finds restored to its place the next morning. Instructed by his grandmother, he first hides and seizes the leaders of the little gods of the forest who are doing the mischief, Moku-hali‘i and Kupaaike‘e who are his relatives, then "greases the mouths of the gods" with offerings, and the gods complete the two canoes for him in a single night. In the morning after the night of Kane he finds them standing outside his door ready to be lashed together and launched.

Four skilful men accompany him, father Prop (makua Poupou) to hold open the mouth of the cave, father Stretch (makua Kiko‘o) to reach inside, father Torch (makua Kalama) to light the cave, and father Seeker (makua Imi) to hunt for the bones. Arrived at Punalu‘u they bribe the old woman to open the door by offering her a dish of soup. She tastes it and slams shut the cave door, declaring it is not salt enough. Father Reach now puts out his hand and tries the salt of various seas until the old woman is suited with that of Puna. No sooner is the door opened to take in the bowl of soup than father Prop holds it open, father Torch lights it up, father Seeker finds where the bones are lying, and father Reach stretches in an arm and brings them outside. They kill old Kaikapu and return to Maui, landing at Kaumakani. The bones, together with the canoes and the bodies of his companions, Laka deposits in the

cave at Papauluana, whose entrance no man has found to this day. 22 (p. 264) (*b*) Laka was born in Hilo, at Haili, on Hawaii. His mother was Koolau-kahili(kahiki?). He rules over Koolaupoko on Oahu, dies at Kualoa, and his body is brought back to Maui by his son Luanu‘u, child of Hikawailena from Waimea (the shark aumakua Haiwahine) and laid in Iao valley. 23 Kamakau quotes his chant, elaborating upon the searching party:

> Searched for by father Searcher,
> Lighted by father Torch,
> Dug for by father Digger,
> Uprooted by father Striker,
> Propped up by father Post,
> Reached after by father Reach,
> Danced for by father Dancer,
> Laka found them. . . . 24

Old woman Kaikapu (Tapu sea) appears in several other Hawaiian stories. In the story of Kaumailiula her role is similar to that in this story. She lives in the land of Olopana and burns Kaumailiula and his brothers with fire because they arrive during a tapu period of whose rules they are ignorant. In the story of Aukelenuiaiku she is the old blind relative whose sight is restored by Aukele and who guides him to the water of life, and is represented as sister of his mo‘o ancestress Ka-mo‘oinanea and of his god Lono-i-kouali‘i (-ikuali‘i?). Her local legend resembles the Tahitian story of the cannibal grandmother of Pu‘a (Puna) and Hema.

Old Woman Kaikapu lives in a cave in Ninole, Kau district, on Hawaii. She is a cannibal and uses her pretty granddaughter Ninole to decoy travelers to her cave, whereupon she will take them out one by one and kill and devour them raw. She eats her own grandson, Ninole's brother, before she discovers who he is. 25

The Laka legend is widespread in the south Pacific. (p. 265)

Maori. (*a*) Rata is the son (or grandson) of Wahieroa by Kura (or Matoka-rau-tawhiri or some other). He teaches the art of cutting and polishing greenstone with the whetstone. His wife is Tonga-rau-tawhiri and their son is Tu-whaka-raro. Rata asks after his father and learns that he has been killed by Natuku-Takotako and his bones (or eyeballs) carried away "where the sun comes up." His mother sends him out to find a tree suit-able for a canoe and gives him stone axes which he must "sharpen on the back of his ancestress" who is the daughter of Whetstone. The tree he fells returns to its place. He hides and catches the little people of Roro-tini, Pona-ua, and Haku-turi, who take the forms of the birds and insects of the forest. These spirits teach him to place an asplenium fern over the cut stump. The next day a canoe appears outside his door.

Ceremonies are performed for its successful launching. It is named Pu-niu (or nui), Aniu-wara, Ni- (or Ri-)waru, Tiurangi, Aniwaniwa, or Pakawai. Rata first slays some monster like the leader of the rat people, Kiore-roa, 26 or the swallowing monster Pouahaokai, 27 or he first slays Matuku, then Whiti. 28 Rata goes overseas to Matuku's (or Whiti's) land, persuades a friendly guard to give a false call, and when Matuku comes up out of his cave before the season to bless the crops he nooses or snares him (as Maui snares the sun). 29 (*b*) *Best version*. Rata is son of Wahieroa and Hine-tuahoanga. He learns from his mother that his father died at Pariroa south of Tawhiti-roa, slain by Pou-haokai and Matuku-tangotango while accompanying a party after bird plumes. The tree he cuts down for his canoe is found erect in the morning and he is told to cover the stump with a special kind of fern and then convey the ferns so used to the priest Whakaiho-rangi, his ancestor, who utters building incantations. It is his "elders," the supernatural folk of whom the forest is full, who have done the mischief. The same priest teaches charms to insure the canoe Ani-waru against sharks, points out his route, and predicts success (p. 266) from the signs given him by the gods. He is accompanied by Apakura as "controlling expert of the various supernatural beings despatched by him as a protection." The party first slay the people of Pouhaokai while they are scattered about looking for food. Baskets full of the slain are brought to Matuku as food, Apakura impersonating Pouhaokai. The house is then set on fire and when Matuku tries to escape his neck is caught in snares. His bones are made into spear points for spearing birds. 30

Tahiti. Rata is son of Vahieroa and Maemae-a-rohi, sister of the ruling chief of North Tahiti, Tumu-nui. He is born after Tumu-nui and his four rat brothers Iore-roa, Iore-poto, Iore-mumu, Iore-vava, and his brother-in-law Vahieroa, father of Rata, have all been swallowed by a giant clam while voyaging to Tu-i-hiti, whose chief had made Tumu-

nui's daughter his wife. Rata grows into a giant and at a boar hunt loses self-control and knocks men about fatally. His mother upbraids him and when she sets forth to seek her lost husband, refuses to let Rata accompany her.

Rata must have a canoe in order to follow her. He fells a sacred tree in the grove of Ihu-ata. The little people of Tuoi replace it until Rata hides and seizes Tuoi and the artisan Fefera, releasing them only when they promise him the canoe. He brings them a great offering of food and the next day it is completed and brought down to the beach, where a baptism ceremony has to be performed before the canoe is successfully floated. It is named Va‘a-i-ama (-i-a, or -i-ura).

Strong warriors, Matua-fa‘auu, Matua-a-aro, Te-iri-poto, Te-iri-roa, accompany him, and slay all the monsters enumerated in the voyages of Tumu-nui and the others lost in seeking him. First they slay the great clam, recover the bones of the dead, and also Rata's living mother, just fallen into the monster's mouth on her return voyage from Hiti-au-revareva, the home of Tumu-nui's son-in-law. Afterward they slay the demon bird Matutu-taotao and extract the skull of a relative from its maw who speaks "in an audible voice" calling upon them to rescue his wife from king Puna in Hiti-marama. Rata escapes a fire (p. 267) trap at king Puna's place and slays Puna (as in the Tuamotuan version) and recovers the woman. 31

The four Tuamotuan versions of the Laka story are so similar that they must have come from a single source and probably by way of Tahiti, since the locale of Laka's home is laid in North Tahiti. The land of Hiti-marama, sometimes spoken of as a land swallowed up in the sea, is in one version called Aihi and identified with Makatea or Saunders island, seventy miles east of Tahiti. The story of the competition for Puna's wife is in the Tuamotus worked into the Matutu story with a consequent inconsistency in the causation. In Seurat's version the canoe builders are crabs and insects and a crab is the guardian on the way. From each of the monsters Rata recovers a part of his father's body and eventually restores him to life. His mother is in the power of an eel, as in the Tuna story.

Tuamotus. Rata is the son of Vahieroa (Vahivero in Seurat) and his wife Tahiti-to‘erau (or Matamata-taua, or Tairiri-tokerau) in North Tahiti. He is brought up by his maternal grandmother Ui-ura (Kuhi, [K]ui, Ine-uru-o-runga, Tiau-tara-iti). When the boys taunt him because his clay boat is left behind in the race (or because he outdistances them with his toy boat), he learns from her that his parents have been seized by Matutu, demon bird of Puna, and his father's head bitten off and swallowed and his mother used as a food holder for Puna's wife (or daughter) Te-vahine-huarei (or father killed and mother taken to sacrifice on the altar). He sharpens an axe "on the back of his grandmother" and fells a tree for a canoe. The tree returns to its place. He hides and surprises To-a-hiti (Too-hiti-mataroa) and Ta-va‘a, the leading artisans among the canoe-building spirits of the forest, makes them a handsome present of food, and the next morning a complete war canoe stands at his door. Puna has a number of sea gods whom he sends to keep back the voyagers. Guided by Ta-va‘a, Rata spears them one by one (with his spear Taipu-ari‘i): a giant bivalve, a shoal of monsters, a great billfish, a cavalla fish, and (p. 268) a ghost-possessed rock (or branching coral which forms Fakarava today). He slays the demon bird Matutu-ta‘ota‘o (Matu‘u). At Puna's home he is received with pretended friendship, escapes an attempt to kill him in his sleep, and plays tricks on Puna's men by betting his empty crab baskets for their full ones, then filling his own from theirs. He slays Puna by first slaying the warriors of Matutu who guard Puna, hooking the rooster who wakens him in the morning, and tying Puna in his sleep to the rock Papa-‘ari‘ari. He frees his mother (in Kororo-po) and secures the daughter of Puna (Tie-maofe or Te-vahine-huarei). 32

Rarotonga. Rata lives in the island of Avaiki. Vaieroa is his father, son of Taaki, son of Ema; Tairiri-tokerau is his mother. He is brought up by his grandmother Ine-uru-o-runga (or Tiau-tara-iti) until the gods reveal to him that soon after his birth his parents were swept out to sea and destroyed by the sons of Puna (octopus, clam, etc.). He sharpens his axe by burying it overnight in the sand and when the little gods re-place the tree felled for a canoe, he makes an offering to the gods Atonga and Tonga-iti-matarau and they complete for him the canoe O-tutai and tell him of his parents' fate. A crew of ten men is selected for the voyage, each an expert in some art essential to managing the canoe. When Nganaoa the kite flyer asks to join the party, he is refused. Twice taken in as a floating gourd and thrown out again he is finally accepted upon the promise to kill all the monsters on the way. This he achieves by entering their bodies in gourd form and stabbing their vitals; but for him all in the canoe would have been lost. At Great Fiji where Tukai-ta-manu is chief and Ina-ara-maunga his wife, he outriddles the riddling priest and hence the saying,

> "It was said by the young priest Kairu-mauanoke
> 'Do not tempt voyagers lest you be outwitted.'"

He voyages to Motu-ta‘ota‘o and kills Te-vaine-uarei who has his mother's eyeballs. (p. 269) Thence he voyages to many lands, remaining for a time at Vai-a-kura in the west of Tumu-te-varovaro. Returning to Avaiki, he attacks Kuporo and there his canoe is lifted and lodged in the treetops and he himself is slain by a great warrior named Vaea, but some say he escaped. 33

Marquesas. Ata is the son of Vehie-oa and Tahi‘i-tokoau. He is brought up by Tua-hoana and her sister, who find him sleeping in the cave where his parents left him when they went after crabs in Vae-tea and were carried away in the boat of Puna-iino which had come seeking victims for sacrifice. Ata plays with the Hana-ui children and although they give him green fire sticks to use and green breadfruit, his sticks alone strike fire and his breadfruit has the best meat; although he fishes in the sand with a thorn and the other children have fine hooks to cast into the sea, yet he catches all the fish and they catch none. The boys abuse him but the old women teach him how to wield a stick and throw stones. The boys taunt him about his parents and he learns the truth from his grandmothers. The temanu tree he fells for a canoe is erect the next morning. He thinks it may be a god and hides to see. Hope-ou-toi and Motuhaiki are discovered. He brings food offerings and they make the boat for him. He goes to the land of Puna-iino, takes seven men as a sacrifice, and bakes them in the oven in a feast of vengeance at Hana-ui. Kau-tia, daughter of Puna, he takes for a wife. Koomahu carries her away. He returns weeping to Hana-ui and his companions go to the home of Koomahu and bring back the wife while Koomahu is away seeking his sister; when Koomahu returns he finds all gone. 34

Aitutaki. Rata lives in a far land called Kupolu (Ukupolu). In search of adventure he finds a heron attacked by a serpent. The tree he is cutting for a canoe for a voyage to the "land of moonlight" returns to its place until he rescues the bird by killing the snake [a foreign interpolation], then grateful seabirds deposit the completed canoe at his door. Nganaoa, refused passage, follows in an empty gourd and is taken into the canoe on (p. 270) condition that he kill all the monsters they meet on the way. These are a giant clam, an octopus, and a whale. Inside this last, Nganaoa finds his lost parents Tairi-tokerau and Vaiaroa sitting plaiting sennit. He builds a fire inside the whale [foreign interpolation] and leaves it to die. 35

Mangaia. Una the moon is invoked in a canoe-making song to use the wonderful axe with which Lata felled forests:

> "Slash away, Una,
> With the wonderful axe from another land,
> That which enabled Lata to fell the forest." 36

Vaitupu (*Ellice islands*). Rata is the child of Mafieloa and Tavini-tokelau, born when she eats an eel to satisfy a pregnancy craving. A tidal wave carries everyone away, but the child is saved. He finds a house, clothing, and adz, and adapts each to his use. A Sinota monster repeatedly erects the puka tree Rata has cut down for a canoe, until he has defeated it in wrestling. The monster Ulu-poko-fatu begs to come aboard, and accompanies and protects him from danger. 37

Pukapuka. Lata of Samoa goes to pick out a log for a canoe and selects the favorite tree of a rival magician named Hinata. The two wrestle but find they are of equal strength. Hinata's chant restores his tree as before, but Lata has put another trunk into its body and has the log he wants. He selects for a crew "Head of stone," "Flat head," "Hole digger," etc., and voyages to see the world. As dangers approach, each man uses his special power and gets rid of the danger. Finally Lata dives into a giant clam, digs at the roots, the shell opens, and out he swims and divides the flesh among the islands, but forgets Pukapuka, which gets the unedible root. The voyagers come to the Witi people and win in competition with them, due to the special powers of Lata's companions. One of the tricks is that of a crab-digging competition, which Lata's man wins by putting the Witi man to sleep with stories and taking the crabs from the (p. 271) other's full basket into his own, then making holes in the other's basket and pretending that the crabs have escaped. 38

Samoa. Lata is a canoe builder who comes from Fiji, "visited Upolo and built two large canoes at Fangaloa," but dies before the deckhouse is completed. He builds a double canoe at Tafagafaga on the island of Tau off Manu‘a and sails to Savai‘i, where a southwestern district is called Lata after his name. Two hills on this island are called "the double canoe of Lata." From Savai‘i he sails to Tonga and dies there and from him the Tongans learn to make the one-sided deckhouse after the Manu‘a pattern, called fale fa‘amanu‘a. "Steersmen in the canoe of Lata" (Seu i le va‘a o Lata) is a title still heard in Samoa in Turner's day. 39

Tonga. Lasa (Laka) prepares to make a trip to Fiji. Haelefeke replaces the tree he has felled for a canoe, until on the fourth day Lasa hides and catches Haele, who then helps to build the canoe and advises his taking on board anyone whom he sees beckoning to him. Three helpful beings are taken on board in this way, a great eater, a thief, and finally Haelefeke himself. With their Help the tests set by the demon of Fiji are successfully met, namely, an eating test, a catching test when fruit is shaken from a tree, a test as to which will first fill a basket of crabs. The thief waits until the contestant of Fiji has filled his basket, then puts him to sleep with a charm and empties it into his own. 40

Santa Cruz. Santa Cruz people say that Lata made men and animals. They equate him with Qat.

The Laka story follows a fairly uniform type pattern, most consistently developed in the Tuamotu versions. Maori versions are without the trickster elements of the eastern islands.

(A) Discovery of his father's fate (A1) through taunts of (p. 272) jealous companions, (A2) through discovery of superior strength which has disastrous consequences upon his companions.

(B) Canoe building halted by spirits who replace the tree he has felled.

(C) Dangers encountered on the voyage overcome through (C1) a companion voyager, (C2) companions with special skills.

(D) Swallowing monster slain, (D1) parent rescued from the monster or (D2) from a cave.

(E) Competitive tasks won: (E1) filling baskets, (E2) riddling, (E3) escaping a fire trap.

(F) Monster in a distant land tricked and slain: (F1) by noosing, (F2) after a false call, (F3) after setting fire to the house, (F4) by freezing.

(G) Woman sought: (G1) stolen mother rescued, (G2) wife or daughter of enemy taken, (G3) both woman and mother recovered, (G4) woman slain.

The motive of the tree that resists felling occurs regularly in the Laka story. In the form of the reērected tree it appears in the Kana story in Hawaii; 41 in New Zealand, in a folktale of the Rata type in which two children who seek to build a canoe to rescue their father from an ogress find the tree restored at the command of Tane; 42 in the Marquesas, in the story of Taheta and his son Vaka-uhi, who, neglected by his father because of the death of his mother in childbirth, attempts to build a canoe in which to leave the land, and finds it each morning reset by the grandmothers, because they fear the death of their grandchild on the expedition, but upon his making offerings they build the canoe in a single night; 43 in Samoa, in a fable of Toa in the form of a handsome tree replaced by his friend Pale, who has concealed himself from woodcutters in the shape of a bent stick, 44 and in the story of two chiefs of Upolo who cut down a tree in Raka's forest, which Raka restores with an incantation; 45 in Dobu, of a (p. 273) mango tree which, when felled, returns to its place each night; 46 in Mota of the Banks islands, in a trickster tale of Qat, who fells a tree for a canoe, which Marawa the spider re-sets until Qat hides a chip; 47 among the Dyak in the story of Pulang-gana in which a clearing is restored as before until the proper offerings are made and incantations repeated. 48

In other instances the tree resists felling except with a special instrument. In Hawaii, the legend of the Kalaipahoa tree which can be cut with a stone adz alone belongs to this type, 49 and the story of Maui told on Kauai, where a spear of lehua wood and a special ritual are required. 50 In the Ono-kura legend of Mangaia a demon living at the taproot of an ironwood tree destroys those who cut it down and restores the tree to position. Ono-kura kills the demon with his ironwood spade Rua-i-para, removes the roots, and forms weapons out of the hard wood. 51 In the Marquesas, the great tree Anianiteani cannot be felled by the avenger of Apekura's son until a special axe is secured. 52 In Tahiti, Tafa‘i can cut the sinews of the great fish with a special axe alone. 53 In a Maori story, Te-Peri's brother is buried at the foot of a tree which resists felling until cut with the axe Tia. 54

Among Hawaiians, the felling of a hardwood tree for a canoe is an occasion of great spiritual excitement as the feller feels himself drawn into close relationship with spirits of the forest whose anger he fears and whom he placates with

propitiatory offerings and prayers. Special rituals attend the cutting and shaping of a canoe and its bringing down from the forest, or the cutting of the tree for the building of a new heiau. In Tahiti, "When canoes were hewed out in the mountain, Tifai (Mender) was invoked and there would come a wind, the men would lie inside the canoe with the ropes hanging (p. 274) outside, and the canoe would go down the mountainside of its own accord. When they came to low ground, the men got out of the canoes, picked up the ropes and sang, and the canoe was light to draw and was taken to the builders' marae to be completed." 55 Even today in Hawaii the canoe makers assure us that the difficult course of the canoe to the sea is achieved with such ease as could not be possible by human hands alone.

The Aikanaka-Laka legend emphasizes throughout this dependence of man upon the cooperation of spirit forces which control the material world whose resources he would utilize for his own needs. The cycle revolves about two major themes in Polynesian story, the winning or losing of a supernatural wife, and the voyage of adventure or revenge. These are developed by means of a multitude of details in which the supernatural forces of the mother's family are assembled in behalf of her child, either through direct endowment, instruction in magic incantations, or cooperation in the quest. The gods of a family, its aumakua, are thought of as restricted within a limited locality. A wife from a foreign land may control, through family descent, supernatural forces superior in power to her husband's but unable to exercise control within his territory. Competition against alien and inimical forces is necessarily set up by contestants who venture outside the area protected by their own gods. Death on an expedition to a foreign land or on a fishing trip into unknown waters is no natural occurrence but due to the malignity of evil powers. It must be avenged upon these powers in order to uphold the family honor. Even the preservation of an ancestor's bones from ignoble uses becomes a sacred obligation. Who is able to carry out such a revenge but one whom the ancestral gods have endowed beyond his fellows; specifically, one descended from divine parentage beyond the limits of the household into which he is born? The superiority of divine aid over brute force--the necessity therefore of propitiating the gods--is hence emphasized throughout the cycle. The characteristic Polynesian turn to this world-wide (p. 275) theme is that of the necessity imposed upon the gods to acknowledge the family claim and to succor and support their offspring. It is through the idea of the kumu-pa‘a, the "fixed foundation," that such an obligation becomes inherent. In the course of popular development and in groups where the idea of family inheritance has been perhaps less firmly established than in Hawaii, the religious background gives way to interest in trickery and native wit over dullard achievement or to a realistic scene of human revenge, and the devices for achieving a supernatural wife multiply down the line; but on the whole the legend throughout the whole area unfolds a family history of divine parentage through marriage with a goddess, and the rise of an avenger equipped against the mysterious forces of a supernatural world.

APPENDIX J
Waihona `Aina, Corp.
NINOLE AHUPUA`A AWARDS

LCA No. 7721/ R.P. 7879**, Makaha** (6.12 acres)
N.R. 153v8, January 23, 1848

Greetings to the Land Commissioners: I hereby state that I have 3 ilis in Ninole: 1. Keopuka, 2. Paako, 3. Waihi. The land on the east is Keopuka, on the west it adjoins Hilea, on the north it goes to /the zone where the/ mamake /trees grow/, on the south is the shallow squid spearing sea. In these ilis are the two ponds. It is finished. I am, respectfully, MAKAHA

N.T. 396v8
No. 7721, Makaha, 2 November

Mano, deposed, he has seen Makaha's land, 2 moo lands at Waihi in Ninole. It is inherited land from the parents in 1819, during the time of Kamehameha I, it was taken away in 1848, without reason by Kahuna, the servant of the wife of Kanihomaule and the land commissioner fee. It should be returned to the rightful owner to the person who has filed a suit. No one should oppose him again from this day forward. It has been settled properly and the boundaries are:

* * * * * * * * * *

LCA No. 8758/ R.P. 6185**, Kaiolani,** Ka`u, Hawaii, January 24, 1848
N.R. 164v8 (Ninole 11.22 acres; Wailau 2.3 acres)

Hear ye, ye Land Commissioners at Honolulu: Here is my message to you. I am a claimant in Kau, in Ninole. There are some kihapais and some umu ahua*. Also there are some plants - bamboo and lauhala. Those are my claims in Kau. KAIOLANI

/*A heap of rocks in the sea to shelter and attract young fish./

N.T. 375-376v8
No. 8758, Kaiolani, 31 October

Kepapa, sworn, he has seen Kaiolani's 9 sections.

Section 1 - House lot, Waihi ili, Ninole ahupuaa. [mauka by school house]
Section 2 - Taro land at Lani, Wailau ahupuaa. [Puna by Punalu`u pali]
Section 3 - In Aalii ili, Wailau ahupuaa. [mauka by government land; Kona by Ninole ahupua`a]
Section 4 - At Homaikalono ili. [Puna by Punalu`u ahupua`a; Kona by Ninole ahupua`a]
Section 5 - At Puako ili of Ninole. [mauka by government land]
Section 6 - At Pue ili. [mauka by government land; Puna by stream; makai by highway; Kona by government land]
Section 7 - At Paako ili. [makai by stream; Kona by government land]
Section 8 - Goat corral in Waihi ili. [makai by stream]
Section 9 - Lauhala grove at Punaluu. [bounded on all sides by konohiki lands]

Section 1 acquired from Kaiolani's parents in 1819. Section 2 acquired from Papa in 1846. Section 3 acquired from Kaaumakua in 1846. Section 4 acquired from Kepapa in 1840. Section 5 acquired from Lai in 1846. Section 6 acquired from Koapapaa. Section 7 acquired from Aa in 1847. Section 8 acquired from Paakiki in 1844. Section 9 acquired from Hoomani in 1844. Kaiolani has lived there always since that time to the present without objections.

* * * * * * * * * *

LCA No. 8760DD/ R.P. 6317 & 6895**, Kahuakainui,** (9.25 acres)
N.T. 399v8, 2 November [listed as 8760!]

Kahaku, sworn, he has seen Kahuakainui's land of 3 sections.

Section 1 - Moo, Paako in Ninole. [mauka, makai and Kona by government lands; Puna by Ninole stream;
Section 2 - Olona field. [surrounded by government lands]
Section 3 - Wauke field at Makenala. [surrounded by government lands]

* * * * * * * * * *

LCA No. 8782 R.P. 6663**, Kalua** (5.75 acres)
N.R. 611v8

Hear ye, ye Land Commissioners at Honolulu: Here is my thought to you. I am a claimant of land in Ninole, Kau. There is a kihapai of taro, a kihapai of wauke, (5) kihapai of sweet potatoes. That is my claim. KALUA

N.T. 400v8
No. 8782, Kalua, 2 November

Kahuakainui, deposed, he has seen Kalua's 4 sections.

Section 1 - Taro patches at Ninole. [stream on Puna side; highway makai]
Section 2 - Moo of Pia at Makenala in Ninole. [highway mauka; Puna by Ninole pali; makai by stream; Kona by street
Section 3 - Wauke field at Pia. [mauka/Puna by Ninole stream; makai by highway; Kona by Ninole pali]
Section 4 - House lot at Paako. [similar to mauka/Puna by Ninole stream; makai by highway; Kona by Ninole pali]

* * * * * * * * * *

LCA No. 8790, Kahananui (5.7 acres)
N.R. 612v8

Hear ye, ye Land Commissioners at Honolulu: Here is my claim. It is in Ninole, Kau, and is for a lot, an enclosure for pigs. That is my claim in Kau, Hawaii. KAHANANUI

N.T. 395v8
No. 8790, Kahananui, 2 November

Kahaku, sworn he has seen Kahananui's 4 sections.

Section 1 - Taro field 6 in Pue moo. [Puna Ninole stream; Kona by Ninole stream]
Section 2 - Taro field in Paako moo. [Kona by cliff]
Section 3 - Taro field in Haukoi in Ninole.
Section 4 - Taro field in Keopuka. [Puna, Makai, Kona by Ninole cliff]

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LCA No. 8792/ R.P. 7677**, Kapuuhonua** (11.3 acres)
N.R. 613v8

Hear ye, ye Land Commissioners at Honolulu: Here is my thought to you. I am a claimant of land in Kau at Wailau, a mo`o /named/ Aalii. It extends from inland to the ocean. There is also a very

large koa tree on my land. Those are my claims in Kau on Hawaii. KAPUUHONUA

N.T. 374v8
No. 8792, Kapuuhonua, 31 October 1848

Kekapa, sworn, he has seen Kapuuhonua's 2 sections of land.

Section 1 - a moo, Aalu Aalii in Wailau. [surrounded by government land]
Section 2 - Wauke field at Kapio in Ninole. [mauka by highway; Kona by Ninole hill]

* * * * * * * * * *

LCA No. 8793/ R.P. 6486**, Kalanawahine, Halehemalu** (9.1 acres)
N.R. 613v8

Hear ye, ye Land Commissioners: I, Kalanawahine am a claimant of land. I have 2 kihapai of taro, 2 of bananas, 1 of wauke, and 1 of sugar cane. Those are my claims. KALANAWAHINE

I, Kahelemalu, am a claimant for my taro kihapai, that is my claim. These claims are in the land of Ninole. KALANAWAHINE, KAHELEMALU

N.T. 388v8
No. 8793, Kalanawahine

Kalakahuna, sworn, he has seen Kalawahine's 4 sections of land.

Section 1 - Wauke field, moo of Makenala in Ninole.
Section 2 - Cane field, moo of Pakanaka. [Puna by Ninole cliff; Kona by Ninole cliff]
Section 3 - Banana field at Haukoi. [Mauka by Ninole stream]
Section 4 - Taro patches at Haukoi. [Kona by Ninole stream]

* * * * * * * * * *

LCA No. 8794, Kahaku (2.9 acres)
N.R. 613v8

Hear ye, ye Land Commissioners at Honolulu: Here is my thought to you. I am a claimant of land in Ninole in Kau. I have a mo`o, Pakanaka, also a kihapai and wauke kihapai. At Wailau are 7 kihapai, a house lot, a sweet potato kihapai, a house lot, a coconut kihapai, and a spring. Those are my claims in Kau, Hawaii. KAHAKA/KAHAKU

N.T. 399-400v8
No. 8794, Kahaku, 2 November

Kahuakainui, sworn he has seen 4 sections of Kahaku's land.

Section 1 - Moo of Pakanaka in Ninole. [surrounded by government land]
Section 2 - Field at Makenala. [surrounded by government land]
Section 3 - Field at Wailau. [surrounded by government land]
Section 4 - Coconut grove at Kalanokio in Kahanalea. [mauka by Punalu`u stream; Puna, makai, Kona by flat lava land]

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LCA No. 8853, Kanekoa, Wailau, Ninole, Kau, Hawaii
[see also LCA#8360/RP 6201] (6.8 acres)
N.R. 614v8

Greetings to the Land Commissioners: Here are my claims for 1 house lot, 10 mala of taro and 4 of sweet potatoes. At Wailau are 3 mala of taro. Those are my claims. KANEKOA

N.T. 394v8
No. 8853, Kanekoa, 2 November

Kalaikahuna, sworn, he has seen Kanekoa's 3 sections.

Section 1 - Moo land, Waihi in Ninole. [mauka by government road]
Section 2 - Moo land, Keopuka in Ninole. [mauka by highway; makai by government land; Kona by Hilea ahupua`a]
Section 3 - Taro patches in the moo of Haukoi in Ninole. [Puna by Hilea streram; Kona by Ninole stream]

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LCA No. 8853B/LP 8133**, Nawali** (8 acres)
N.T. 395v8, 2 November

It has been written, but there has been no ship. [refers to loss of NR documents]

Kahaku, deposed, he has seen Nawali's land of 3 sections.

Section 1 - Taro patches, Pue moo in Ninole.
Section 2 - Taro patches, Paako moo in Ninole. [Puna and Kona by government lands]
Section 3 - Taro patches, Kalihi moo in Hilea. [Puna by Hilea cliff; makai and Kona by government lands]

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LCA No. 8979/ R.P. 2785**, Kekapa** (Ninole 2.8 acres; Wailau 8.1 acres)
N.R. 275v7

I, Kekapa, am at Wailau /Ahupua`a/. My claim is at Ninole, for three kihapai
- two of taro and one of wauke. Those are my claims. KEKAPA

N.T. 374v8
No. 8979, Kekapa, 31 October

Kalapuna, sworn, he has seen Kekapa's 5 sections.

Section 1 - House lot at Homaikalono ili. [makai by government land]
Section 2 - Farming field at Homaikalono ili. [makai by road leading to Ninole]
Section 3 - Farming field at Kukui Wailau ahu. [Kona by Ninole ahupua`a]
Section 4 - Farming field at Lani ili. [Puna by Punalu`u cliff]
Section 5 - Farming field at Ninole ahupuaa.

Kalapuna received sections 1, 2, 3, 4 from his parents in 1819 during the time of Kamehameha I. Section 5 from Manu in 1846.

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LCA No. 9167/ R.P. 7379**, Komaia,** Ninole, Kau, Hawaii (4.75 acres)
N.R. 623v8

Hear ye, ye Land Commissioners in Honolulu, Island of Oahu: Here is my thought to you about quiet title to my land in Kau, Island of Hawaii. There are 13 kihapai at Ninole. KOMAIA, konohiki of Ninole

N.T. 397-398v8
No. 9167, Komaia, 2 November

Kahaku, deposed, he has seen Komaia's land of 4 sections.

Section 1 - Lauhala field at Haukoi in Ninole. [surrounded by government lands]
Section 2 - Field at Makanala in Ninole. [mauka by government land; puna, makai and Kona by Ninole stream]
Section 3 - House lot in Moo of Pue. [mauka by highway; Puna and makai by government lands; Kona by Ninole stream]
Section 4 - Farming field. [mauka by Ninole pali; makai by heiau of Kupoho; Kona by pali]

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LCA No. 9204/ R.P. 7442**, Kapaana** (7.86 acres)
N.R. 625v8

Hear ye, ye Land Commissioners at Honolulu, Island of Oahu: Here is my thought to you about quiet title to my land in Kau, Island of Hawaii. There is a mo`o. 2 kihapai are in Ninole and one is in Hilea. KAPAANA

N.T. 405-406v8
No. 9204, Kapaana, 2 November

Ouli, sworn, he has seen Kapaana's land of 4 sections.

Section 1 - Moo land of Kakuoi in Ninole. [mauka and makai by government lands]
Section 2 - Taro land (Kihapai) at Makenala in Ninole. [surrounded by Piko's lands]
Section 3 - Field at Pia. [surrounded by Mano's lands]
Section 4 - field at Pue. [surrounded by Koapapaa's lands]

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LCA No. 10093/ R.P. 5547**, Manu,** Kamaoa, Kau, Hawaii (6.66 acres)
N.R. 647v8

To the Land Commissioners: I have a claim for kihapais: 3 of taro and 1 mala of sweet potatoes. MANU

* * * * * * * * * *

LCA No. 10112, Mauna (1.3 acres)
N.R. 648v8

Hear ye, ye Land Commissioners at Honolulu: Here is my thought to you - I am a claimant of land in Ninole, Kau, for 3 kihapai of wauke, 1 of sugar cane and 2 of taro. At Punaluu is a wauke kihapai. Those are my claims in Kau, Hawaii. MAUNA

N.T. 430-431v8
No. 10112, Mauna

Piko and Kapaana, deposed, they have seen his land.

Section 1 - Taro patches at Pueo ili of Ninole
Section 2 - Field at Makenala.
Section 3 - Wauke field at Punaluu.

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LCA No. 10115/ R.P. 7698**, Makuaole** (9 acres)
N.R. 649v8

Hear ye, ye Land Commissioners at Honolulu: Here is my thought to you. I am a claimant of mo`o, Small Aalii, in Wailau, Kau. There is also a kihapai of wauke in Ninole. Those are my claims here in Kau. KAAUMOKU /sic/

N.T. 398v8
No. 9167B!, Makuaole, 2 November

Kahaku, sworn, he has seen Makuaole's 4 sections.

Section 1 - Moo field, Puehu at Punaluu. [mauka and Puna by government lands]
Section 2 - Moo field, Aalii at Wailau. [surrounded by government lands]
Section 3 - Moo field, Paako at Ninole. [surrounded by government lands]
Section 4 - House lot, moo Paako and Keopuka. [surrounded by government lands]

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LCA No. 10847/ R.P. 7571**, Pulehu,** Hilea, Kau (3.7 acres)
N.R. 665v8, January 26, 1848

Hear ye, ye Land Commissioners at Honolulu, Island of Oahu: Here is my message to you. I have a claim for quiet title to land in Kau, Island of Hawaii. I have 1 mo`o in Ninole and 2 kihapai in Pue. PULEHU

N.T. 398-399v8
No. 10847, Pulehu, 2 November

Kahaku, deposed, he has seen Pulehu's 2 sections.

Section 1 - Moo of Haukoi in Ninole. [mauka by highway; Puna by Ninole pali; makai by government land]
Section 2 - Field at Pue in Pakanaka. [surrounded by government lands]

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WAILAU AHUPUA`A AWARDS

LCA No. 7313/ R.P. 7476**, Kaawa** (7.2 acres)
N.R. 137v8**,** January 24, 1848

Greetings to the Land Commissioners: I hereby explain my entire land claim to you -- fenced land, house lot, Ahupua`a, kihapai and planted trees. The fenced land is 10 chains, 3 fathoms 3 feet, by 8 chains 2 fathoms 0 feet, by 7 chains 8 fathoms 0 feet, by 8 chains 9 fathoms 4 feet. This was received from Kehoakalele. The house lot is 2 chains 5 fathoms 1 foot by 2 chains 2 fathoms 1 foot, by 1 chain 5 fathoms 3 feet, by 1 chain 4 fathoms 1 foot. In the land of Wailau, Ka`u, is an orange tree. In the land of Oilikahi is 1 Kona orange tree. In the land of Waiakea, Hilo, is an Ahupua`a named Mahakea. The land of Moaula is on the east, on the west is another Mahakea. A mountain is mauka and a sea is makai. It was received from Kekuni. On the east is the land of Oma. A sea is makai, a mountain is mauka, and the land of Omea is on the west. There are three lo`i kihapais in the land of Punaluu. There is a kihapai mauka. Aloha to you all. KAAWA

N.T. 373v8
No. 7313, Kaawa, 31 October

Kamali, sworn, he has seen Kaawa's 2 house lots.

Section 1 - In the ili of Aalu in Wailau from Naihe during Liholiho's days in 1823.
Section 2 - Land lot in the ili of Homaikolono in Wailau.

Aikanaka had agreed for work on his (konohiki) days and granting to Kaawa for himself permanently. There has been much opposition for this land.

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LCA No. 7557/ R.P. 8563**, Kalapuna** (6.63 acres)
N.R. 351v5

Here is my message to you, the Land Commissioners: I am a claimant at Milu in Kau. There is also a kula claim named Homaikaloono. Kukukuli is another claim, and Kawili is another claim there. There are kihapais in these `ilis. But one, named Kaaipuaa, was lost. Wailauonau is another claim. I am, KALAPUNA January 24, 1848

N.T. 373v8
No. 7557, Kalapuna, 31 October [1849]

Kekapa, sworn, he has seen Kalapuna's 4 sections of land.

Section 1 - House lot at Homaikalono. [mauka by school house]
Section 2 - Taro field and house ili of Lani. [Puna by Punalu`u pali; makai by government road]
Section 3 - Farming field in the ili of Kaawili. [Kona by Ninole ahupua`a]
Section 4.- Ili field of Aalii. [mauka by government land; makai by highway]

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LCA No. 8758/ R.P. 6185**, Kaiolani**, Ka`u, Hawaii (2.3 acres)
N.R. 164v8, January 24, 1848

Hear ye, ye Land Commissioners at Honolulu: Here is my message to you. I am a claimant in Kau, in Ninole. There are some kihapais and some umu ahua*. Also there are some plants - bamboo and lauhala. Those are my claims in Kau. KAIOLANI

/*A heap of rocks in the sea to shelter and attract young fish./

N.T. 375-376v8
No. 8758, Kaiolani, 31 October

Kepapa, sworn, he has seen Kaiolani's 9 sections.

Section 1 - House lot, Waihi ili, Ninole ahupuaa. [mauka by school house]
Section 2 - Taro land at Lani, Wailau ahupuaa. [Puna by Punalu`u pali]
Section 3 - In Aalii ili, Wailau ahupuaa. [maika by government land; Kona by Ninole ahupua`a]
Section 4 - At Homaikalono ili. [Puna by Punalu`u ahupua`a; Kona by Ninole ahupua`a]
Section 5 - At Puako ili of Ninole. [mauka by government land]
Section 6 - At Pue ili. [mauka and Kona by government land; Puna by stream; makai by highway]
Section 7 - At Paako ili. [makai by stream; Kona by government land]
Section 8 - Goat corral in Waihi ili. [makai by stream]
Section 9 - Lauhala grove at Punaluu. [surrounded on all sides by Konohiki lands]

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LCA No. 8979/ R.P. 2785**, Kekapa** (8.1 acres)
N.R. 275v7

I, Kekapa, am at Wailau /Ahupua`a/. My claim is at Ninole, for three kihapai
- two of taro and one of wauke. Those are my claims. KEKAPA

N.T. 374v8
No. 8979, Kekapa, 31 October

Kalapuna, sworn, he has seen Kekapa's 5 sections.

Section 1 - House lot at Homaikalono ili. [makai by government road]
Section 2 - Farming field at Homaikalono ili. [makai by road leading to Ninole]
Section 3 - Farming field at Kukui Wailau ahu. [Kona by Ninole ahupua`a]
Section 4 - Farming field at Lani ili. [Puna by Punalu`u cliff]
Section 5 - Farming field at Ninole ahupuaa.

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LCA No. 10112, Mauna
N.R. 648v8

Hear ye, ye Land Commissioners at Honolulu: Here is my thought to you - I am a claimant of land in Ninole, Kau, for 3 kihapai of wauke, 1 of sugar cane and 2 of taro. At Punaluu is a wauke kihapai. Those are my claims in Kau, Hawaii. MAUNA

N.T. 430-431v8
No. 10112, Mauna
Wailau Kau; 1 ap.; 3.32 Acs; & Ninole Kau; 1 ap.; 1.38 Acs]

Piko and Kapaana, deposed, they have seen his land.

Section 1 - Taro patches at Pueo ili of Ninole. [mauka and Puna by konohiki lands]
Section 2 - Field at Makenala. [surrounded by Konohiki lands]
Section 3 - Wauke field at Punaluu. [makai and Kona by Konohiki lands]

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LCA No. 10510, Nawali
N.R. 656v8 (4.3 acres)

Hear ye, ye Land Commissioners at Honolulu: I am a claimant of land in Wailau in Kau. There are kihapais of taro, sweet potato and wauke. In Ninole are 3 kihapai of taro, 1 of pumpkin, 1 of sweet potatoes, a lot, a house lot, 6 kihapai of olona, and an umu ohua /a pile of rocks placed in the sea to attract young fish./ NAWALI

N.T. 404v8
No. 10510, Nawali, 2 November

Kekapa, sworn, he has seen Nawali's 5 sections of land.

Section 1 - Moo of Manowai at Wailau.
Section 2 - Field in Moo of Pue. [mauka by Ninole stream]
Section 3 - Field in Makenala moo in Ninole. [surrounded by Konohiki Komaia lands]
Section 4 - Field in Paako. [surrounded by Makuaole lands]
Section 5 - Field in Makenala moo in Ninole. [surrounded by Konohiki Komaia lands]

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LCA No. 10844, Papa
N.R. 664v8 (6.25 acres)

Hear ye, ye Land Commissioners at Honolulu: Here is my message to you. I am a claimant of land in Wailau ahupua`a in Kau. A mo`o, Laui, a kihapai of taro, a kihapai of lauhala, and one of sweet potatoes, and a house lot. Those are my claims here in Kau on Hawaii.PAPA

N.T. 384-385v8
No. 10844, Papa, 31 October

Kaleikahuna, sworn, he has seen four sections.

Section 1 - Kihapai, moo land of Lani [Laui] in Wailau. [Puna by Punalu`u pali]
Section 2 - House lot at Aalii. [mauka and Puna by highway; makai by government land; Kona by Ninole pali]
Section 3 - Kihapai, moo land. [Puna by Punalu`u ahupua`a; makai by government land]
Section 4 - Wauke field in the moo of Kapio. [Kona by Ninole pali; Puna by `ili of Kehau; makai by `ili of Ho`o`ie`ie]

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LCA No. 10846/ R.P. 2784**, Palau** (3.25 acres) [Not found on ahupua`a map]
N.R. 664v8

Hear ye, ye Land Commissioners at Honolulu: Here is my message to you. I am a claimant of land in Wailau ahupua`a in Kau; there are 5 kihapai. At Kaohia are 5 kihapai. At Laui are 5 kihapai of olona. Those are my land claims in Kau, Hawaii. PALAU

N.T. 401-402v8
No. 10846, Palau, 2 November

Papa, sworn, he has seen Palau's 2 sections.
Section 1 - Ohia moo land in Wailau. [mauka by government land; Kona by Ninole ahupua`a]
Section 2 - Olona field in Aalii moo in Wailau. [Kona by Hilea pali]

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PUNALU`U AHUPUA`A AWARDS

LCA No. 2564/ R.P. 6734**, Enos Nakahuna, Kailua, Hawaii** (10.25 acres)
N.R. 558v3, December 13, 1847

Greetings to the Land Commissioners: I hereby explain to you my claim for land and house lot which are in the land of Punaluu, Ka`u. I have a very old right, from my makuas. When they died I had been born, and so it has been held until today. Therefore, I explain to you that Kinimaka is the one from whom I hold it and I am under him. The house lot has always been mine, no one else's. I am, with thanks, ENOS NAKAHUNA, konohiki of Punaluu

N.R. 129v8
No. 2564, E. Nakahuna, Kailua, Hawaii, December 13, 1847

Greetings to the Land Commissioners: I hereby explain to you that I have a claim for land and a house lot. It is in the land at Punaluu in Ka`u. It is an ancient claim, from my makuas, and they are dead and I hold it until the present. I explain to you that Kinimaka /a konohiki/ was the one under whom I hold the land. The house lot claim has been mine continuously. There is no one else, only myself. I am, respectfully, E. NAKAHUNA

This claim by Nakahuna was copied in the previous Book, p. 558. W.M.K.

N.T. 372v8
No. 2564, E. Nakahuna, 31 October

Au, sworn, he has seen Nakahuna's 5 sections of land.

Section 1 - House lot and a patch. [mauka by Punalu`u Heiau; Puna by lava rocks; makai by sand; Kona by Punalu`u pond]
Section 2 - 2 patches, Puaniki moo. [mauka and Puna by Konohiki lands; makai by fishpond; Kona by Konohiki land]
Section 3 - 1 patch, Mailehahei moo. [surrounded on all sides by Ioba Nakahuna lands]
Section 4 - Moo of Koloahiu. [mauka and Puna by Government road; makai by Ioba Nakahuna lands; Kona by Konohiki land]
Section 5 - Wauke and banana at Puupuna. [mauka by Enuhe Hill; makai and Kona by Konohiki land]

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LCA No. 7312/ R.P. 6844 **, Mose Keawe**
N.R. 134-135v8, January 19, 1848

Greetings to the Land Commissioners of this Government: I hereby tell you of my lands. My occupancy over these lands was received from Laanui. I will describe the boundaries: on the east it is adjoined by the land of Makue, on the west by another Makue, on the north by the mountain, on the south by the sea. Also, my house lot is at Paauau in Ka`u, which I acquired as follows: it was an unpeopled land and I occupied it and cultivated it in 1843, that is the basis of my claim to my house lot and I have planted some things in it. Its boundaries are: on the east, 35, on the west, 35, on the north, 45, on the south, 45. Furthermore, I have a taro kihapai at Punaluu - there is one taro lo`i adjacent to the Pond of Punaluu on the east side. I have a planted orange tree at Waiohinu. MOSES KEAWE

N.T. 370-371v8
No. 7312, Keawe

Haaleleaina, sworn, He has seen Keawe's 5 sections of land.

Section 1 - House lot at Paanau.
Section 2 - House lot.
Section 3 - Taro patch at Punaluu. [mauka by church road; makai by Punalu`u pond]
Section 4 - Taro fields at Hianamoa 2.
Section 5 - Taro fields at Paanau 1.

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LCA No. 7606C, Kumaiku (4.97 acres)
N.T. 387v8 [No. 7606C], Kumaiku [listed as 7606!]

Au, sworn, he has known that Holona has recorded Kumaiku's lands and he has seen Kumaiku's 1 land section. a moo, Puehu in Punaluu. Nakahuna had given this land in 1830. No objections.

The boundaries are:
Mauka by land of the konohiki
Puna by land of Nihi
Makai by Government road
Kona by land of Kumaiku.

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LCA No. [7715*H, Lot Kapuaiwa], Honolulu, 17 June 1848 [Lot Kamehameha]
N.R. 434v3

Esteemed William l. Lee, Greetings to you and your fellow workers: I hereby tell you of the house lot and stone house at Wainee in Lahaina, Maui, which was thought to be for Wm. Lunalilo. It was decided by the nobles of the Legislature that this house lot and stone house should go to Lot Kapuaiwa and I agreed to this decision by the Legislature, that this lot should be for Lot Kapuaiwa and that M. Kekuanaoa should be his administrator.

I presented a document for the quieting of title of Wm. Lunalilo to this place. I hereby state that Wm. Lunalilo's claim to this place is ended and that document which I entered to quiet title be applied to Lot Kapuaiwa's interest, and he shall be responsible for the costs of your work on the claim. That is what I have to say to you. With thanks,

N.R. 444-445v5
No. 7715*H, Lota Kapuaiwa [Lot Kamehameha]

N.T. 244v10
No. 7715, Lot Kamehameha
Lot Kapuaiwa Kamehameha's land as registered in the Mahele Book, [not all listed here]
Keauhou, the King's birth place, Kona, Hawaii
Hilea, ahupuaa, Kona, Hawaii
Punaluu, ahupuaa, Kau, Hawaii.

TRUE COPY
A.G. Thruston, Clerk
Interior Department
21 July 1853

Resolved, That in consideration of the relinquishment of Kahikinui [p. 363] on East Maui by Lot Kamehameha to the government in the former division of lands, the Minister of the Interior is hereby authorized to grant Royal Patents to Lot for his lands (said to be eighteen in number) without further commutation or divisions.

By order of the King and Council
29 August 1850
(sign) R.C. Wyllie
Acting for W. Andrews

[Award 7715; (Hawaii) no R.P. Hihiu & Kamano Kohala; Kahua 1 Kohala; Kauapalaoa Kohala; R.P. 4395 Hikiaupea & Hawi Kohala, R.P. 8214; Kaloko 4230 Acs., 1 ap.; R.P. 6885 Punaluu Kau; 1 ap.; 5369 Acs; R.P. 7621 Hilea-iki Kau; 1 ap.; 2015 Acs; R.P. 7843 Kaupulehu N. Kona; R.P. 7844 Keauhou 2 N. Kona; R.P. 7845 Puaa 1 Kona; Land Patent 8335; Paukaa Hilo; 1 ap.; 6700 Acs;(Maui) R.P. 2567; Hanakaoo Lahaina; R.P. 7860; Waiokama Lahaina; (Oahu) R.P. 7858; Moanalua Kona; See also 7713 Foreign Testimony v3]

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LCA No. 8004, [Ahia], Ahi, Punaluu, Ka`u (25 acres)
N.R. 156v8

Greetings to the Land Commissioners: 1 house lot, 2 lo`i, 1 taro kihapai, 2 sweet potato mala, 1 wauke kihapai. In the Ahupua`a of Mohokea, 1 taro mala. AHI

N.T. 389-390v8
No. 8004, Ahia 2, 2 November

Naholo, sworn, he has seen Ahia 2's, 3 land sections.

Section 1 - Moo of Puehu - house lot. [Puna and makai by government road]
Section 2 - A patch. [Kona by government land]
Section 3 - 3 fields in Puhaka, moo of Punaluu.

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LCA No. 8760, Kaawa, Ka`u, Hawaii (15.20 Acres)
N.R. 165v8

Hear ye, ye Land Commissioners at Honolulu: Here is my message to you. I am a claimant of land in Ka`u, in the Ahupua`a of Punaluu. I have a mo`o, Pahaa, also a kihapai of olona, a kihapai of mamaki*, a kihapai ino**, and 6 taro kihapai. These are my claims in Ka`u. KAAWA

/*Probably a tree whose bark was used for coarse tapa./
/**No data, possibly meaning infertile or exhausted soil./

N.T. 391v8
No. 8760, Kaawa, 2 November

Au, sworn, he has seen Kaawa's land of 3 sections.

Section 1 - Moo land of Pahoa in Punaluu. [mauka /Kona by Konohiki lands; makai by highway
Section 2 - Field in Moaula. [mauka by government land; Puna by hog sty; makai by highway]
Section 3 - Field in Moaula. [Moaula stream surrounds this section]
Section 4 house lot in Punaluu. [mauka and Puna by Punalu`u precipice; makai by government rd]

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LCA No. 8760C, Kekaula (8 acres)
N.T. 392v8, 12 November

Kamali, sworn she had seen her husband record in Manoa and she has seen 2 sections of land.

Section 1 - Moo land Kuipoi in Punaluu.
Section 2 - House lot, Hau and coconut trees. [Puna by church lot; makai by Punaluu pond]

This is old land from Kekaula's parents received during the time of Kamehameha I, where he, Kekaula has always lived without objections. The boundaries are:

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LCA No. 8760D/ R.P. 6476 & 6903**, Waiahulu**
N.T. 393v8, 2 November

Kalakua, sworn, he has seen Waiahulu's 2 sections of land.

Section 1 - Moo land, Kaimukule in Moaula.
Section 2 - House lot in Punaluu. [mauka by Punaluu stream; Puna by Mohokea stream]

He had seen Kalaaukamahele record Waiahulu's claim. Section 1 was acquired from Kalakua in 1840. Section 2 from Kaanui in 1845 and there has been no objections since then. The boundaries are:

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LCA No. 8785, Kookoo
N.R. 614v8

Hear ye, ye Land Commissioners: I have a claim at Punaluu in Kau, for 1 ili of land. There are 3 kihapai of taro, 1 of sweet potatoes and 1 house lot. KOOKOO

N.T. 377v8
No. 8785, Kookoo, 31 October

Kekuapea, sworn, he has seen Kookoo's 2 sections

Section 1 - Puaniki moo of Punaluu. [some sand dune patches for the konohiki]
Section 2 - At Kaholoakiu ili land. [Puna by stream]

[No. 8785 not awarded]

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LCA No. 8973, Kailiponi, Moaula, Kau, Hawaii (8 acres)
N.R. 615v8

Hear ye, ye Land Commissioners at Halekauwila in Honolulu; the Commissioners to administer the land: I hereby tell you my thought about my land claim. I have one mo`o, from the seashore to where the olona grows, and back. 2 kihapai which are only cultivated are at Moaula. Here is my basic claim - 2 farm plots at Punaluu, 1 kihapai of taro, 1 of sweet potatoes, and 1 house lot. These three things combined are my land claim.
KAILIPONI

N.T. 381v8
No. 8973, Kailiponi, 31 October

Samesona Halulu, sworn, he has seen three sections.

Section 1 - House lot at Punaluu. [mauka by highway; Puna by Punalu`u stream; makai by government road; Kona by Punalu`u pali]

Section 2 - Huokekahi moo at Moaula. [mauka and Puna by Moaula pali; makai by government road; Kona by Punalu`u pali]
Section 3 - Potato field at Punaluu. [mauka by Punalu`u stream; Puna and Kona by Konohiki land; makai by Punalu`u pali]

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LCA o. 8981/ R.P. 6917**, Iaea,** See K**,** Moaula, Kau, Hawaii (8.83 acres)
N.R. 616v8

Hear ye, ye Land Commissioners at Halekauila, Honolulu: I am a claimant of land on Hawaii: 5 kihapai of taro are at Punaluu and 1 of wauke. At Makaka is 1 taro planting. IAEA

N.T. 384v8
No. 8981, Iaea, 31 October

Puana, sworn, I have seen Iaea's 5 land sections.

Section 1 - House lot and Kihapai. [mauka by government land; Puna by Moaula stream; makai by pali; Kona by Moaula stream]
Section 2 - Moo land at Keauakapuaa. [mauka by pali; Puna by Moaula stream; makai by government road; Kona by Molokea stream]
Section 3 - Moo land at Haekapala. [mauka by government land; Puna by Moaula stream; makai by government road; Kona by Molokea stream]
Section 4 - Not known. [mauka by Moaula pali; Puna by stream; makai by highway; Kona by stream]
Section 5 - Kihapai in Moae moo. [mauka by Moaula pali; Puna by stream; makai by government road; Kona by Mohokea stream]

* * * * * * * * * *

LCA No. 10118, Mulehu [Not awarded]
N.R. 649v8

Hear ye, ye Land Commissioners at Halekauila, in Honolulu: Here is my explanation to you: I have 4 kihapai of taro, 5 fallow kihapai, 1 house lot, 1 animal enclosure, and 1 section for firewood. Also, at Punaluu, I have another claim for 1 kihapai of wauke and 1 loi. That is my claim for land here on Hawaii. MULEHU Moaula, Kau, Hawaii

N.T. 379v8
No. 10118, Mulehu, 31 October

Kaniokamoku, sworn, he has seen 5 sections.

Section 1 - House lot and hog corral. [mauka by government land; Puna by Moaula pali; makai by government road; Kona by Moaula stream]
Section 2 - Taro kihapai in the ili of Palahalaha. [mauka by government land; Puna by Moaula pali; makai by government road; Kona by Moaula stream]
Section 3 - Taro kihapai and banana at Nahaekapala. [mauka by government land; Puna by Moaula pali; Kona by Moaula stream]
Section 4 - Moo land kihapai of Kamuku. . [mauka by government land; Puna by Moaula pali; Kona by Moaula stream]
Section 5 - Wauke kihapai in Punaluu. [mauka by Punaluu point; Puna by Punaluu stream]

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LCA No. 10119/ R.P. 6845**, Mahoe,** Moaula, Kau, Hawaii (17. acres)
N.R. 649-650v8

Hear ye, ye Land Commissioners at Honolulu, the persons who administer the lands: I hereby state my claim here on Hawaii. There are 5 farm plots at Moaula - it is not a mo`o - they are only cultivated. My claim consists of these farm plots, the five of them are each 50 by 12, 3 kihapai of taro, 1 of sweet potatoes and 1 of bananas. That is my land claim. 3 farm plots are in Keopu. 2 mo`o are in Keopu. I live in Moaula - these lands are only chosen by me. Here is another explanation - I live under the authority of the official document in the occupation of school luna /superintendent/. Also, there are two house lots - one at Moaula and one at Mohokea. My statement to you is ended. MAHOE

N.T. 386-387v8
No. 10119, Mahoe, 2 November

Puana, sworn, he has seen Mahoe's 7 sections.

Section 1 - House lot, moo of Kalawa in Moaula. [Puna by Moaula strea; makai by government land; Kona by Moaula stream]
Section 2 - Taro kihapai at Kalawa in Moaula. [Puna/makai by Moaula stream]
Section 3 - Kihapai at Haekapala. [mauka/Puna by Moaula stream; makai by government; Kona by Moaula pali]
Section 4 - Kihapai at Kaumukiele. [mauka by Moaula pali; makai by government road; Kona by Moaula stream]
Section 5 - Taro kihapai at Puukilei. [mauka by Moaula pali; Puna/makai by government land; Kona by Moaula]
Section 6 - Kihapai at Haekapala. [Puna by Moaula stream; makai/Kona by Punaluu ahupuaa]
Section 7 - House lot at Mohokea. [mauka/Puna by government land; makai by land/sea; Kona by Punaluu ahupuaa]

* * * * * * * * * *

LCA No. 10450/ R.P. 7096**, Namakaelua**
N.R. 656v8

Hear ye, ye Land Commissioners at Honolulu: I am a claimant of land here on the Island of Hawaii. There are 2 ili extending from the end of the zone where olona grows to the seashore of the kuuna wahanui* and back. There is a house lot, 3 kihapai are in a portion of it. There are also 2 loi at Punaluu. NAMAKELUA, School Trustee A.2. *No Data

N.T. 427v8
No. 10450, Namakelua
Laanui and Kalaikoa Haupu and Kaolelopono, deposed, they have seen Namakelua's land.

Section 1 - Two patches in Punaluu. [mauka by government road; Puna, makai & Kona by Punaluu pond
Section 2 - To ili lands, Kaokanuku and Kahona in the ahupuaa of Waiohinu.

* * * * * * * * * *

LCA No. 10522, I. Nakahuna, Punaluu, Kau, Hawaii [No. 10522 not awarded]
N.R. 657v8

Hear ye, ye Land Commissioners: Here is my second message to you. I have a mauka claim for land. There are 5 mo`o, from the pali of Pohakukee to the pali of Kaohia, from the hill to the sea. Furthermore, the koeles in all these mo`o - there are 12 of them - pertain to me.I. NAKAHUNA

* * * * * * * * * *

LCA No. 10836/ R.P. 6930**, Pohina, Punaluu, Kau, Hawaii, AKA Poohina** (4.48 acres)
N.R. 663v8

Hear ye, ye Land Commissioners in Honolulu: I hereby state my claim for land. I have one mo`o in Punaluu, also some separate kihapais of taro and bananas. In Moaula I also have a farm plot with 3 kihapai of sweet potatoes and 2 of taro. Also, a house lot is in Moaula. That is my claim for land. POHINA AKA POOHINA

N.T. 442v8
No. 10836, Poohina (deceased), Puukiki heir.
Ku and Kawainui, deposed, we have seen Poohina's land of 2 sections.

Section 1 - 2 taro kihapai, 1 patch of wauke in the `ili of Puhaku, Punaluu. [mauka by Konohiki land]
Section 2 - House lot in the ili of Naono, Punaluu. [mauka and makai by Konohiki land]

* * * * * * * * * *

LCA No. 10848/ R.P. 6928**, Pookuia** (1.48 acres)
N.R. 310v7, January 27, 1848

Hear ye, ye Land Commissioners: I have a claim for land at Punaluu in Ka`u /Island of Hawaii/, consisting of 1 `ili, 5 kihapai of taro, 1 kihapai of wauke and 1 kihapai of sweet potato.
Aloha to you all. POOKUIA

N.R. 121v8
No. 10848, Pookuia, Punaluu, Ka`u, Hawaii, January 27, 1848
Hear ye, ye Land Commissioners: I have a claim for land at Punaluu in Kau. It is 1 ili, of 5 taro kihapai, 1 wauke kihapai, 1 sweet potato kihapai and 1 house lot. POOKUIA

N.T. 377v8
No. 10848, Pookuia, 31 October
Kookoo, sworn, he has seen Pookuia's three sections.

Section 1 - House lot and patches. [mauka by government road; Puna/makai by Punaluu loko; Kona by Wailau ahupuaa]
Section 2 - Ili land of Koloakiu. [Puna by stream]
Section 3 - Wauke field at Puehu. [mauka/Puna by Punaluu hill; makai by highway; Kona by Wailau ahupuaa]

* * * * * * * * * *

LCA No. 11005, Waiwaiole, Moaula, Kau, Hawaii
N.R. 667v8

Hear ye, ye Land Commissioners at Honolulu. Here is my petition for my land claim. I have 1 ili in Punaluu, a planting of wauke. 3 farm plots are in Moaula ahupua`a. Those are my claims. WAIWAIOLE

[No. 11005 not awarded]

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APPENDIX K
SIGNED CONSENT FORMS
(copies)

APPENDIX L
SIGNED RELEASE FORMS
(copies)

Appendix G

Economic and Fiscal Impacts of the Redevelopment of the Sea Mountain at Punalu‘u Project (Knowledge Based Consulting Group, April 2006)

KNOWLEDGE BASED CONSULTING GROUP

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ECONOMIC AND FISCAL IMPACTS OF THE REDEVELOPMENT OF THE SEA MOUNTAIN AT PUNALU'U PROJECT

Prepared for

Sea Mountain Five, LLC

Prepared by

Knowledge Based Consulting Group

April 2006

ECONOMIC AND FISCAL IMPACTS OF THE REDEVELOPMENT OF THE SEA MOUNTAIN PROJECT

EXECUTIVE SUMMARY

Knowledge Based Consulting Group (KBCG) prepared the following economic and fiscal impact analysis for the redevelopment of the Sea Mountain at Punalu'u project.

PROJECT DESCRIPTION

The Sea Mountain project site consists of 433 acres of partially developed land near the southern tip of the Island of Hawai'i. Existing development at Sea Mountain includes an operational 18-hole golf course, pro-shop, wastewater treatment facility, County beach park and Colony I condominium complex. The site is located between Na'alehu and Pahala along the Hawai'i Belt Highway. The property is privately owned by SM Investment Partners, and site development is proposed by Sea Mountain Five, LLC.

Sea Mountain Five, LLC proposes to redevelop the Sea Mountain project through additional site improvements that would involve renovation of the 18-hole golf course and construction of new residential units, the Sea Mountain Inn, a cultural/marine center, light commercial, upgraded wastewater treatment facility, water reservoir and other supporting infrastructure. They anticipate that the Sea Mountain property will be developed over a 10-year timeframe and should commence development in the beginning of 2008 and be fully built out in 2017.

The Sea Mountain concept plan seeks to provide a mix of residential unit types, which will include single-family residential lots and multi-family units for sale. The prices for new single-family and townhome/ condominium units range from an average golf view lot at $264,000 to $770,000 for a spacious ocean view duplex. In addition, 55 affordable housing options may be provided.

ECONOMIC AND FISCAL IMPACTS

At build-out, approximately 1,277 permanent residents will live in the Sea Mountain community. In addition there will be a non-resident population of about 2,382 owners and renters that will occupy residences during peak periods. Over 600 permanent jobs will be generated at the Sea Mountain Inn, golf course, village commercial areas, and for community maintenance services.

The County of Hawaii could receive surplus revenues of approximately $33.4 million over the development period (2008 to 2017), after receiving all revenues from property taxes and other sources (includes revenues from fuel taxes, utility taxes, license fees, permits, and state and federal grants) and incurring all expenses to serve the community.

The State of Hawaii could receive surplus revenues of $26.5 million over the development period from a combination of excise taxes, accommodations tax, transfer taxes, utility taxes, and income taxes on individuals and businesses.

In addition to on going revenues, there will be taxes on construction materials and services. Total development and construction costs are approximately $598 million, creating some 3,800 person-years of employment. State revenues from excise taxes and income taxes on construction workers and businesses should amount to an additional $24.8 million over the buildout period.

ECONOMIC AND FISCAL IMPACTS OF THE REDEVELOPMENT OF THE SEA MOUNTAIN PROJECT

INTRODUCTION

This assessment has been prepared by Knowledge Based Consulting Group (KBCG) in response to the need to evaluate the impact on community services and facilities to the County of Hawaii and other service providers that would result from the redevelopment and revitalization of the Sea Mountain at Punalu'u project.

PROJECT SITE

The Sea Mountain at Punalu'u project site consists of 433 acres of partially developed land on the Island of Hawai'i. Existing development at Sea Mountain includes an operational 18-hole golf course, pro-shop, wastewater treatment facility, County beach park and Colony I condominium complex. At one time, the development also included a restaurant, gift shop, cultural center, Aspen Institute conference facility, and golf club house. However, these facilities have been abandoned due to deterioration. The site is located between Na'alehu and Pahala along the Hawai'i Belt Highway. The property is privately owned by SM Investment Partners, and site development is proposed by Sea Mountain Five, LLC.

PROPOSED ACTION

Sea Mountain Five, LLC, proposes to redevelop the Sea Mountain project on a 433-acre partially developed site in Punalu'u. Additional site improvements would involve construction of residential units, the Sea Mountain Inn, a renovated 18-hole golf course, cultural/marine center, light commercial, upgraded wastewater treatment facility, water reservoir and other supporting infrastructure.

The Sea Mountain conceptual land use plan seeks to provide a mix of residential unit types that will include single-family residential lots and multi-family units for sale. The development concept includes an inn and village center that would serve as a gathering place with shopping and services for guests and local residents. Work force housing will be provided in accordance with existing zoning conditions based on project job generation. In addition, 55 affordable housing options may be provided.

Sea Mountain Five, LLC would construct roadway improvements servicing the site, major electrical improvements (including transmission lines and necessary switching and transformer substations), sewage treatment plant renovation, and golf course improvements (including irrigation wells). Sea Mountain Five, LLC would also provide internal connector roads and other infrastructure to service the residential, retail and commercial lots that it will create.

It is anticipated that the Sea Mountain property will be developed over a 10-year timeframe and should commence development in the beginning of 2008. An illustrative development plan is shown on the following page

Phasing – over ten years:

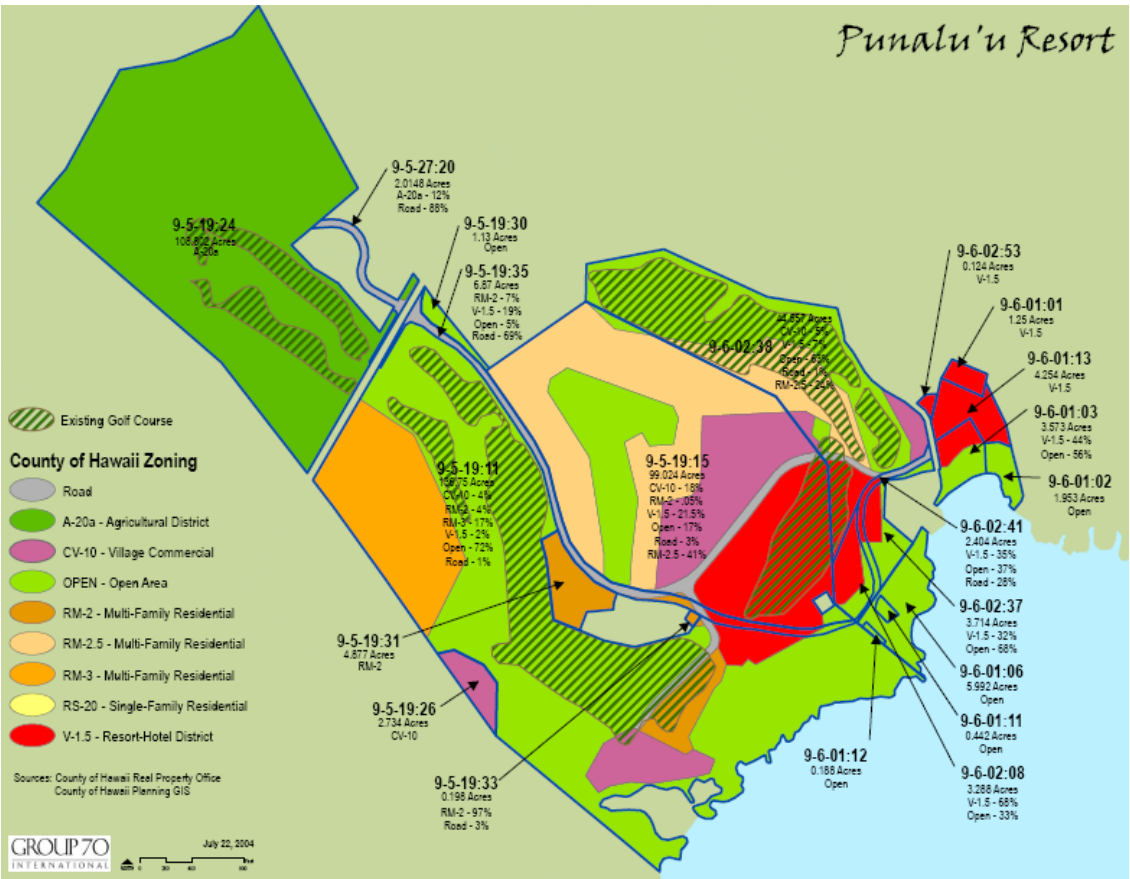
1. Areas 6,7,8,9
2. Areas 3,4,5
3. Areas 1,2

A project description, along with development assumptions is provided below and in more detail in Table 1.

The Sea Mountain development project is proposed for

Area	Type	Dwelling Units	SF
1.	Single Family Lots	142	
2.	Duplex	130	
3.	Triplex	248	
4.	Cluster Townhomes	180	
5.	Cluster Townhomes	282	
6.	Cluster Townhomes	220	
7.	Lanai stacked flat	114	
8.	Stacked flats	32	
9.	Stacked flats	120	
2	Affordable Housing	55	
Total Residential Units		1,523	
8.	Sea Mountain Inn	300	
8.	Village Commercial		50,000
9.	Community Commercial		15,000
7.	Golf Clubhouse and Retail		8,000
Project Total		**1,823**	**73,000**

The site slopes from sea level to an elevation of 380 feet, providing good to excellent ocean and golf course views from nearly all development parcels. The 433 acres is zoned for a variety of resort and community related uses as shown below:



By applying the appropriate tax rates, the ensuing analysis develops estimates of real estate and excise tax revenues to be received over time by the County of Hawai'i and State of Hawai'i. Comparing these revenues to service costs then determines net impact.

Positive impacts to the County of Hawaii and other providers of service could result from the redevelopment of the Sea Mountain resort community and golf course. Although some impacts are difficult to measure, positive impacts to the entire community would include:

- The redevelopment of a deteriorated resort to provide a broader level of service at more acceptable standards
- A range of housing types (plus work force and possible affordable housing) that will allow local entities such as schools, police and fire departments, etc. to attract employees.

At build-out, approximately 1,300 permanent residents will live in the Sea Mountain community. In addition there will be a non-resident population of about 2,400 owners and renters that will occupy residences during peak periods. Over 600 permanent jobs will be generated at the Sea Mountain Inn, golf course, village commercial areas, and for community maintenance services.

FISCAL ANALYSIS

Development Program

The program for real estate development at Sea Mountain at Punalu'u is based on a three-phased land use and infrastructure development plan as prepared by Group 70. The expected production schedule is illustrated in Table 2, which shows the mix of product and absorption schedule by year. The developer estimates that the project will be built out over a 10-year period starting in 2008. Phase 1 encompasses 2008 through 2011, while Phase 2 is from 2012 through 2015 and Phase 3 is 2016 and 2017.

Residential

The residential development program for Sea Mountain includes a mix of multifamily units as well as a selection of single family lots. Based on market data from comparable subdivisions, anticipate annual demand for residential units at Sea Mountain could range from a combined 100 to 200 units a year for single-family lots and multi family units. Phase 1 consists of 486 townhome and stacked flat residences absorbed over four years in Land Areas 6,7,8, and 9. Phase 2 is also absorbed over four years and includes 360 cluster townhomes in Land Areas 4 and 5 plus 248 residences on Land Area 3 in a unique triplex format. Phase 3 completes the project and includes 130 residences in duplex configuration on Land Area 3, 142 single family lots on Land Area 1, and 55 affordable housing units on Land Area 2.

We expect that the Sea Mountain residential community will be primarily used for seasonal residences and include a rental program. In other Hawaii resort communities, we see that the average occupancy by owners is relatively low. As shown below, less than 20% of the units are occupied full time by owners and the average overall occupancy by owners is less than 30%.

Resort Community Occupancy Patterns

Days Occupied			Weighted Days	
Category	Average Days	% of Households	Total	Seasonal
Less than 60	40.2	35%	14.2	14.2
60 to 90	67.1	17%	11.5	11.5
90 to 120	93.3	11%	10.2	10.2
120 to 150	124.2	7%	9.1	9.1
150 to 180	157.6	12%	19.2	19.2
180 and over	250.9	17%	42.8	
Average Owner Occupied Days			107.1	64.2
Owner Occupancy Rate			29%	18%
Plus rentals			15%	25%
Total Occupancy Rate			52%	43%

Similar occupancy patterns should be observed at Sea Mountain. At build out, we anticipate that permanent residents (persons staying 180 or more days per year) will occupy about 440 homes (30%) and seasonal residents and renters would occasionally occupy the remainder.

Commercial

The commercial development at Sea Mountain will begin with the construction of the first element of the Village Commercial area and the Sea Mountain Inn in 2008 on Land Area 8. The initial Village Commercial consists of 15,000 square feet of visitor and community serving retail, while the Sea Mountain Inn includes 300 visitor accommodations as well as associated amenities. The second component of Village Commercial is another 15,000 square feet that will be developed at the start of Phase 2 in 2012 on Land Area 8. Full development of the village commercial program will include another 20,000 square feet be completed in 2015. A Community Commercial zone of 15,000 square feet will be developed on Land Area 9 in 2012. This area will include community serving retail and professional office space. Another commercial component will be included as part of the new golf course clubhouse to be developed in 2008. This will include 8,000 square feet and be comprised of a clubhouse restaurant and golf/ visitor serving retail. In total, the commercial retail, restaurant and professional office development at Sea Mountain will encompass 73,000 square feet.

MARKET AND ASSESSED VALUE

The proposed Sea Mountain development project is planned for a variety of residential unit types (single-family detached, duplex, triplex, townhomes, and stacked flat units). The prices for single-family lots in Land Area 1 range from $264,000 for golf view lots to $600,000 for ½ acre ocean view sites. Prices for the multifamily units range from $372,000 for stacked flat condominiums in Land Areas 8 and 9 to $770,000 for spacious ocean view duplexes in Area 2. This analysis has not applied an inflation rate to real estate prices, and, for lot sales, assumes that homes are built an average of one to two years after lot purchase. The potential 55 affordable housing units in Land Area 2 are priced at an average of $245,000.

Residential Values

As shown in Table 3, residential market values for the project will be $49.6 million in the first year of occupancy (2008), including units sold to both seasonal and permanent residents. As the residential product is built-out, the residential market value will increase to $222.2 million at the end of Phase 1, $602.5 million at the end of Phase 2, and $768.6 million at final buildout in 2017.

Commercial Values

The market value for the commercial areas of Sea Mountain will reach an estimated $76.3 million in 2008, reflecting the opening of the Sea Mountain Inn, the new golf course clubhouse, and the initial phase of Village Commercial. As the commercial area is built-out by 2015, the market value of commercial real estate will increase to $82.3 million.

Total Market Value

The total real estate value of the Sea Mountain project reaches $298.5 million at the end of Phase 1, $684.9 million at the end of Phase 2 and $850.9 million at buildout (2017), before inflation and real estate appreciation.

IMPACT ON THE COUNTY OF HAWAI'I

Table 4 provides estimates of the projected population for the Sea Mountain development as well of tax revenues and expenses through 2017.

Population

Based upon the demographic patterns of Hawaii County as well as surveys of resident and seasonal home owners in Kona and Waikoloa Village, we expect that most seasonal residents will be empty nesters and in pre retirement or retirement. The average number of persons per seasonal/ renter household at Sea Mountain is expected to be 2.75 as shown below:

Household Size Distribution for Sea Mountain

Family Size	%
2	66%
3	10%
4	16%
5	7%
6	1%
Average family members per household	2.65
% with caretaker/ caregiver	10%
Average persons per household	2.75

The family size for permanent residents will also be a majority of empty nesters along with some families in the work force housing units. For permanent residents, the average household size will therefore be somewhat larger at 2.9 persons per unit. At the end of Phase 1 (2011), there should be 235 new permanent residents at the redeveloped Sea Mountain community who reside there at least 180 days per year. In addition, there will be a non-resident population that will occupy their residences on a seasonal basis. They may also rent them as vacation rentals. We anticipate that up to 80% of the seasonal residences may be occupied during peak periods resulting in a maximum seasonal population of 2,382 part time residents and renters. This leads to a peak population of permanent and seasonal residents plus renters of just under 3,700 persons and an average population of around 2,430 persons

County Tax Revenues

Below is a listing of property tax rates that effect residents and commercial entities in Hawaii County. Property tax rates for residents are broken down to differentiate between seasonal and permanent residents.

TAX CATEGORY	TAX RATE
Permanent Residents	$5.55 per $1,000
Seasonal Residents	$9.10 per $1,000
Commercial Properties	$9.85 per $1,000

KBCG estimates that, the County of Hawaii can expect to receive approximately $2.6 million in annual real estate tax revenues at the end of Phase 1. These taxes are broken out by residential

taxes ($1.7 million from seasonal residents and $205,000 from permanent residents) and $750,000 from commercial land uses. These tax revenues increase to $7.0 million upon residential build-out in 2017. In addition to real estate taxes, other revenues are received. These other revenues include fuel taxes, utility taxes, license fees, permits, and state and federal grants. Other revenues historically have represented 35% of total county revenues, with property taxes at 65% of total. This ratio has been assumed to be constant in this model. It is estimated that total annual revenue after residential and commercial build-out will be $10.4 million.

County Expenses

The County of Hawaii provides essential services to residents and businesses throughout the county. The overall budget for the County of Hawaii was $246.6 million for fiscal 2005:

Hawaii County Expenditures by Function ($000)

Function	Expenditures	% of total	Increase (Decrease)	% Increase (% Decrease)
General Government	$ 27,638	11.2%	$ 896	3.4%
Public Safety	$ 79,274	32.1%	$ 8,640	12.2%
Highways & Streets	$ 12,966	5.3%	$ 2,940	29.3%
Health, Education, & Welfare	$ 20,675	8.4%	$ 2,464	13.5%
Culture and Recreation	$ 14,264	5.8%	$ 155	1.1%
Sanitation & Waste Removal	$ 23,970	9.7%	$ 5,481	29.6%
Debt Service	$ 23,921	9.7%	$ 331	1.4%
Pension & Retirement	$ 15,065	6.1%	$ 3,193	26.9%
Health Fund	$ 16,650	6.8%	$ 1,710	11.4%
Miscellaneous	$ 12,174	4.9%	$ (299)	-2.4%
Total	**$246,597**	**100.0%**	**$25,511**	**11.5%**
Less: Debt Service	$222,676			
Population	163,000			
Current Expenditures per Resident	$1,366			

The current county expenses per person to provide all services including law enforcement are approximately $1,366/person. Applying this full cost allocation to projected peak population, the potential cost to the County of Hawai'i to serve the Sea Mountain development project will be $341,000 in 2008, rising to $5.0 million by 2017. These expenses are projected on a conservative basis of peak occupancy whereas in actuality most residents will be seasonal occupants.

It should be noted that the redevelopment of the Sea Mountain project will provide significant infrastructure improvements that will serve the entire community, and many of these improvements will not require county maintenance.

These lower costs are due to the following:

- Sea Mountain Five, LLC will fund most or all of the building costs for infrastructure improvements (roads, water systems, wastewater systems, etc.), and recreational facilities.
- The Sea Mountain community association dues will cover the cost of:
  - Maintaining local roads
  - Operating and maintaining wastewater systems
  - Operating and maintaining recreational facilities; and
  - Providing on-site security.

- The comparatively low occupancy rates for seasonal homes at Sea Mountain will result in a lower demand for County services.
- Most residents are expected to be comparatively wealthy, so they will require little government assistance.
- Most occupants will be retirees and visitors who are less likely to travel offsite during heavy traffic periods, and so are less likely to add to the demand for additional road capacity.

Therefore, actual county costs could be substantially less than the amounts illustrated in this model.

Comparison of Revenues and Expenses

Combining revenues and costs, Table 4 illustrates that there is an annual surplus ranging from $1.4 million in 2008 at the first year of occupancy, increasing to $2.4 million at the completion of Phase 1 and to $5.4 million annually by 2017. Moreover, the County of Hawai'i will have a cumulative surplus of $33.4 million by project buildout in 2017.

IMPACT ON THE STATE OF HAWAI'I

The State of Hawai'i provides a wide range of services to meet the transportation, education, social services, and other vital needs of its population.

State Tax Revenues

Revenues to the State of Hawai'i from the Sea Mountain project will be generated from excise taxes, accommodations tax, transfer taxes, utility taxes, and income taxes on individuals and businesses. These revenues go directly to the State General Fund.

Excise taxes are assessed at a rate of 4% on expenditures made by both permanent and seasonal residents/ renters. Additional excise taxes from non residents who patronize the commercial areas are based on non resident sales of $100 per square foot in the Sea Mountain commercial areas. Other state taxes include individual income taxes on permanent residents up to a rate of 8.25%, a graduated scale of 0.15% to 0.35% conveyance tax on the transfer of fee interest, including leases of five years or greater, state utility taxes, and liquor taxes. Hotel taxes on the Sea Mountain Inn revenues should add another $547,000 annually in State general fund revenue as well as $953,000 to the hotel fund. Accommodations taxes on rental condominiums increase from $506,000 annually at the end of Phase 1 to $1.35 million at buildout. This revenue is allocated to a variety of expenditure categories, with a portion (18.6% of hotel fund) returned to the County of Hawai'i.

As shown in Table 5, annual state revenues from residents is expected to reach $4.9 million in 2017, while revenues from commercial operations should reach $3.2 million at buildout. State variable expenditures for permanent residents are estimated at $4,071 per person. Comparing state revenues to costs over the life of the project, state revenues should exceed expenditures by $26.5 million.

JOB CREATION

Resident and Visitor Spending

Spending by permanent and seasonal residents as well as hotel guests and condominium renters will create substantial permanent job support within the local community. Spending by new residents and renters should approach $13.0 million at the end of Phase 1, $35.3 million at the end of Phase 2, and reach $45.5 million at buildout. This represents nearly $30,000 in local spending per residence. Approximately 60% of these expenditures are expected to be on site, with the remainder spent elsewhere in the local community and Hawaii County. Guests at the hotel are expected to spend about $120 per day outside the hotel for food and beverage, retail, and recreation, entertainment and tourist services. These expenditures should amount to around $12.6 million per year of which 40% is expected to be spent on site, with the other 60 % spent elsewhere in the local community and Hawaii County. Total on site spending from Sea Mountain residents, renters, and hotel guests should therefore start at about $6.7 million when the hotel opens and increase to $12.8 million by the end of Phase 1, to $26.2 million by the end of Phase 2, and $32.4 million at buildout.

Supportable Commercial Space

The on site resident and hotel guest expenditures will support about 25,000 square feet of retail and restaurant space in Phase 1, which is consistent with the proposed development program. In addition, another 15% of commercial space is allowed to accommodate resident serving professional offices. At buildout, the total supportable commercial space is just less than 80,000 square feet. The Sea Mountain space program is slightly less than this potential so that some additional demand may spill over into the local area.

Other Local Spending

Additional local spending outside the Sea Mountain project area should also be quite substantial. Off site expenditures in the local area and elsewhere in Hawai'i County are expected to be $8.6 million in 2008 with the opening of the Sea Mountain Inn and increase to $25.8 million at buildout. These expenditures will support additional local jobs, existing businesses and new small business opportunities.

Permanent Jobs

As shown in Table 6, ongoing on site employment in the commercial, business, and service activities at Sea Mountain is expected to jump by about 321 jobs with the opening of the Sea Mountain Inn, Village Commercial area, and renovated golf course/ clubhouse. This employment level should increase to 372 jobs by the end of Phase 1 and 471 jobs at the end of Phase 2. Total ongoing employment should reach 517 jobs at full buildout in 2017.

Construction Impacts at Sea Mountain

Construction Spending and Employment

As shown in Table 7, the total development and construction investment at Sea Mountain is expected to be about $598 million. This estimate is considered comparable to costs observed at other development projects in Hawaii, but should be considered preliminary and could be subject to substantial variation as more detailed engineering and site evaluations are conducted. As shown in Table 8, this investment supports nearly 3,800 person years of construction and service related employment over the life of the project.

Construction Excise and Other Taxes

In addition to the creation of construction jobs, the State of Hawaii will receive excise tax revenue on finished development and building materials and income taxes on construction wages. As shown in Table 9, these will amount to an additional $24.8 million in State of Hawaii revenue over the life of the project.

Indirect Impact

In 2000, DBED developed a model of the impact of construction on the Hawaii economy. On the basis of the factors developed in that model, the construction expenditures of $598 million on the Sea Mountain project will result in an increase in total output of $735 million, an additional 7,232 person years of employment, and an additional $342 million in household income (See Table 10)

Appendix H

Integrated Golf Course Management Plan (IGCMP), Sea Mountain Golf Course
(Blankinship & Associates, Inc., April 2006)

DRAFT

Sea Mountain Golf Course
Punalu'u, Hawaii

Integrated Golf Course Management Plan (IGCMP)

April 14, 2006

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Sea Mountain Golf Course
Integrated Golf Course Management Plan

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1.0 PURPOSE AND SCOPE

The primary purpose of this Integrated Golf Course Management Plan (IGCMP) is to provide overall structure and guidance for turf grass management that creates desirable playing conditions while adequately managing pests and protecting natural resources and the environmental quality of Sea Mountain Golf Course (herein referred to as the "Course").

The scope of this document includes a description of how Integrated Pest Management (IPM) is implemented on the Course. IPM is a decision-making process of pest identification, monitoring, damage threshold assessment, and pest control. This document also includes descriptions of Best Management Practices (BMPs) that control and mitigate the impact of Course operations on natural resources within and adjacent to the Course.

This is a dynamic document that is designed to adapt to and accommodate inevitable changes in ecological and environmental conditions on the Course and take advantage of advances in turf grass management science and technology.

The IGCMP accomplishes the following:

1. Describes cultural and chemical strategies to achieve and maintain maximum turf health and vigor;

2. Lists anticipated pests, methods used for their monitoring, area-specific allowable damage thresholds, and recommended control strategies for each pest;

3. If pest control strategies include the need for pesticides, it provides information on the type and class of pesticide, considerations necessary for selection, methods and restrictions for application, and potential environmental considerations, and

4. Describes Best Management Practices (BMPs) for preventing introduction of fertilizers and pesticides into surface, storm, and groundwater. It further describes methods for monitoring of these chemicals, and if detected, mitigation, and corrective action measures.

2.0 PROJECT DESCRIPTION

The Sea Mountain Golf Course (herein referred to as the "Course") at the Punalu'u project site is located within the district of Kau, on the Island of Hawaii. Ninole Creek meanders along the southwestern boundary of the Course, and flows in a north to south direction into the ocean. Two anchialine ponds are present along the southern tip of the project site. Refer to **Figure 1**.

The project site ranges from sea-level to approximately 110 m in elevation. Much of the project lands are comprised of 5,000 – 10,000 year old pahoehoe and ´a´a lava flows from Mauna Loa (Wolfe and Morris, 1996). Topography is dominated by the Ninole Creek streambed with rolling hills throughout the 433 acres of partially developed land. The Course is currently being redesigned as part of an overall development plan for the site.

2.1 Course Design

The 19-hole Course playing approximately blank yards with grassed areas occupying up to blank acres. Approximately blank acres will remain natural or undisturbed. The Course will have a driving range, and a practice green. Average tee complex size is blank square feet (sq. ft.) and average green size is blank sq. ft. Seven? lakes will occupy the Course.

Todd: Fill in the blanks here

Paspalum is the type of grass that will be used throughout the Course. It withstands reduced light from prolonged rainy seasons or tree-dominated fairways, and endures periodic inundation from heavy rains or high tides (Duncan and Carrow, 2002). Paspalum is tolerant to moderate to high salt content in irrigation water and so can be irrigated with the recycled water generated on site.

3.0 PHYSICAL SETTING

3.1 Biological Resources

Hart et al (2006) prepared a biological assessment report. The report lists numerous species present within the project area. **Table 1** summarizes the listed species mentioned in the biological report, along with threatened and endangered status and habitat characteristics. Footnotes at the bottom of the table indicate reason(s) why the species was not considered at risk as a result of Course activity. If a species was considered as potentially at risk, the discussion below presents mitigation to that risk.

Hawaiian short-eared owl (Pueo) occupies broad expanses of open land and uses low vegetation for nesting and foraging. Suitable areas include marshes, prairies, meadows, savannah. Its prey consists of rodents, but also small mammals, birds, and insects. Although no rodents or small mammals are expected to be on the Course, if they are found and require control, they will be trapped. No rodenticides will be used in order to prevent secondary poisoning of the owl.

Hawaiian Hawk ('Io) inhabits various forest, pastureland, and savannah areas. Most successful nesting occurs in higher elevation native forest of 'ohi'a trees. It has a varied diet including; small birds, rodents, insects. Although no rodents or small mammals are expected to be on the Course, if they are found and require control, they will be trapped. No rodenticides will be used in order to prevent secondary poisoning of the owl.

Hawaiian Coot ('Alae ke'oke'o) inhabits a variety of aquatic habitats including fresh and brackish-water marshes, estuaries and ponds. Its breeding sites typically have suitable emergent plant growth interspersed with open water (usually < 1m deep). Its diet consists of seeds and leaves of aquatic plants, various invertebrates including snails, crustaceans, and aquatic or terrestrial insects, tadpoles, and small fish. Manicured turf will not have seeds, flowers or fruit and will unlikely attract feeding. Native vegetation that it may feed on will not be fertilized or treated with pesticides. In addition, its' prey base includes marine species and Course BMPs prevent pesticides from entering the marine environment. However, because the coot may have be present in the shoreline habitat near the course, the use of insecticides in EMAs for greens 8, 9, and 18 must be done with caution. If coot is present, the use of insecticides must be suspended until they leave the green. If coot can not be kept from the green, the use of insecticides can not occur. If pesticides are used in the EMAs for greens 8, 9, and 18, only use liquid formulations and water in thoroughly to prevent incidental exposure or ingestion.

Pacific Golden-Plover (Kolea) has a winter range (August through April) habitat that includes areas with short grass, open fields, lawns, and some wetlands. It has a varied diet including

terrestrial and aquatic invertebrates, berries, leaves and seeds. Manicured turf will not have seeds, flowers or fruit and will unlikely attract feeding. Native vegetation that it may feed on will not be fertilized or treated with pesticides. In addition, its' prey base includes marine species and Course BMPs prevent pesticides from entering the marine environment. However, because the plover may have be present in the shoreline habitat near the course, the use of insecticides in EMAs for greens 8, 9, and 18 must be done with caution. If plover is present, the use of insecticides must be suspended until they leave the green. If plover can not be kept from the green, the use of insecticides can not occur. If pesticides are used in the EMAs for greens 8, 9, and 18, only use liquid formulations and water in thoroughly to prevent incidental exposure or ingestion.

3.2 Hydrogeology

The hydrogeology, surface and groundwater hydrology of the site has been characterized (Huntsaker, 2006 and 2006a).

Jim and Tommy: Need some information here on depth to water, percolation rates, etc

Based on recent heavy rains, soils on site appear to be well-drained and appear to have moderate to high hydraulic conductivities, and as such provide reasonable opportunity for infiltration of surfacewater to groundwater.

3.3 Groundwater Quality

Two groundwater wells exist on the Course, one of which was sampled on March 15, 2006. Refer to **Table 2**. This water appears to be of marginal quality for turf irrigation, but may be suitable for use on paspalum.

3.4 Surfacewater Quality

Surfacewater sampling was done on Ninole Creek and one of the ponds near the existing 17th hole on March 15, 2006. Refer to **Table 2.** Creek water is of excellent quality for turf irrigation use; pond water is generated from the Course groundwater wells and is of similar quality.

3.5 Surface Water Management

An assessment of golf Course surfacewater flow has been developed (Huntsaker 2006c) Jim: What is the name of the document that addresses this? The purpose of this document is to assure that potential indirect impacts from golf Course irrigation and stormwater runoff into the coastal zone area of the Course minimized. The proposed design of the Course addresses the control of irrigation and storm water runoff through:

1. Drainage facilities which collect, direct, store and/or treat irrigation and stormwater runoff; and
2. Operational procedures, which minimize the potential harmful interaction of fertilizer and pesticides with the environment.

Best Management Practices (BMPs) have been developed for the proposed project that will integrate golf Course drainage systems and operational procedures such that non-stormwater and stormwater runoff up to a 10-year storm event are not discharged off of the Course. Jim: Please check this language. Refer to Chapter 4.

3.5.1 Golf Course Drainage

The Course drains by a combination of surface flow and groundwater percolation. Currently, no fairway drains are present. The proposed design calls for the construction

of United States Golf Association (USGA) specification greens that will have drains. These drains will collect water percolated through the green and will discharge this water on grass surfaces adjacent to the green. A combination of biological, chemical and physical processes will degrade fertilizers and pesticides that may be present in the drain water. This water would subsequently percolate to groundwater. Drainage from greens located adjacent to the shoreline habitat (8, 9, and 18), Ninole Creek (13, 16, and 17), and the unnamed drainage on the northern edge of the Course (5) will be directed away from these water features.

3.5.2 Maintenance Facility and Parking Lot

All flows from the equipment rinsing and loading pad at the maintenance facility will be treated via filtration and re-applied to the Course. Parking lot runoff will be pre-treated through an oil/grease separator, fossil filter or similar filter/absorbent prior to discharge to the Course Jim: Has this been decided?

4.0 BEST MANAGEMENT PRACTICES

Best Management Practices (BMPs) involve several techniques that minimize the impact that golf Course activities have on the surrounding environment. These BMPs are discussed below. Numerous BMPs will be implemented to prevent the introduction of fertilizers and pesticides into surface or groundwater. These BMPs include:

4.1 Maintenance of Rough Buffer Zones

Approximately blank acres of rough separate the fairways, greens, and tees from the native vegetation and the various water features on the Course. This rough will be maintained at a height of cut higher than the other portions of Course used for golfing and as such will act as a buffer zone between the native vegetation and the higher use areas such as fairways, greens, and tees. For example, a typical rough height of cut ranges from 1 to 2 inches, where fairways are 0.5 to 0.75 in and greens and tees range from 0.125 to 0.25 inch.

The width of these rough buffer zones varies from between blank and blank feet. The effectiveness of buffer strips within this range has been demonstrated and advocated (USDA 2000, MacKay 1999, Smart 1999). The rough buffer zone disperses surfacewater energy during rain events and allows for water to percolate downward instead of running along the ground surface. This dispersion and percolation also aids in the prevention of erosion and sedimentation as the buffer area physically stops sediment transported by stormwater and allows it to settle out prior to movement (GCSAA 1999, Audubon International 1996, ASGCA 1998).

Turf provides infiltration, retention, and subsequent metabolism of pesticides and fertilizers (GCSAA 1999, Horst 1996). The uppermost layer of turf, referred to as the biomat, reduces the ability of pesticides and nutrients to move from target areas and aids in their biological degradation.

4.2 Specific Areas for Restricted Pesticide/Fertilizer Use

Because several State and Federally listed species and their habitat may be found on or adjacent to the Course, and several grassed areas of the Course are adjacent to water features, specific restrictions on the use of fertilizers and pesticides exist as described below and illustrated in **Figure 1**.

4.2.1 Greens and Tees

1. No more than 7 lbs per 1,000 sq. ft. per year (lbs/ 1,000 ft^2yr) of nitrogen (N) and potash (K), and 2 lbs/1,000 ft^2yr of phosphorus (P) will applied.

4.2.2 Fairways

1. No more than 5 lbs/ 1,000 ft^2yr of N and K.

4.2.3 Roughs

1. No more than 2 lbs/ 1,000 ft^2yr of N and 4 lbs/ 1,000 ft^2yr of K.
2. Do not apply fertilizer/pesticide within 10 ft. of the border with native vegetation.

4.2.4 Areas Designated as Management Practice Areas

1. Do not use rotary spreaders.
2. Do not apply fertilizer or pesticide if rain is forecast within 12 hours.
3. Do not apply fertilizer or pesticide within 25 feet of water.
4. Use a windfoil when making liquid fertilizer or pesticide applications within 25 feet of native vegetation
5. Do not apply pesticides with high or very high aquatic toxicity. Refer to **Table 3** for pesticide toxicity information.

4.3 Eto–based Irrigation Water Application

The Superintendent will strictly control irrigation water application from a central location. The rate and amount of irrigation water will be gauged primarily by evapotranspiration (Eto) measurements made from the weather station located on-site. Knowledge of irrigation water requirements and precise control of application prevents over-application of water on the Course, thus minimizing erosion and fertilizer runoff caused by surfacewater flow. Further, precise application of irrigation water maximizes benefit to the turf in terms of maximizing turf health. For example, deep, infrequent irrigation promotes high root shoot densities, and keep thatch and disease incidence low. Daily inspection of sprinkler heads and lines will occur to identify and correct leaks in the irrigation system.

Irrigation water application timing and volume are evaluated in relation to fertilizer application in order to select and apply a fertilizer type that maximizes plant uptake and minimizes the likelihood of migration of soluble fertilizer to surface or groundwater. For example, adequate watering of turf is required when granular fertilizer is applied in order to allow for movement of the fertilizer into the soil profile for subsequent plant uptake. Conversely, foliar applications of fertilizer are not followed by application of irrigation water as irrigation water would remove this fertilizer, minimizing its effectiveness and creating a potential for off-site movement.

4.4 Fertilizer Application Based on Agronomic Need

Fertilizing materials and rates will be determined by the Superintendent depending on growing conditions and the results of soil nutrient level testing. Turf will be fertilized as frequently as required to maintain a healthy turf and a high standard playing surface. Healthy turf and soil is more capable of providing erosion control, disease resistance, and drought tolerance, thereby minimizing fertilizer, pesticide, and irrigation water inputs. Application of fertilizer based upon agronomic need minimizes the over-use of fertilizer, and thereby minimizes the likelihood for surfacewater runoff and potential subsequent introduction of fertilizer to Ninole Creek.

Details on the amounts and types of fertilizer that are anticipated on specific areas of the Course are presented in Chapter 5.

4.5 Monitoring of Soil Quality

Regular soil testing and monitoring is planned to evaluate soil fertility in order to maintain healthy turf and provide for adequate drainage of water. Healthy turf and adequate drainage are

critical to controlling erosion. Soil testing involves quantitation of the following parameters: total exchange capacity, pH, organic matter, estimated nitrogen release, soluble sulfur as sulfate, Phosphorus, Calcium, Magnesium, Potassium, Sodium, Boron, Iron, Manganese, Copper, Zinc, Aluminum, Chloride, Nitrate, and Ammonia. Based on results of testing, soil amendments are added to the soil to correct deficiencies or imbalances. This topic is further discussed in Chapter 5.

4.6 Use of Soil Amendments for Adequate Soil Percolation

Depending on the results of soil quality monitoring (see preceding discussion in section 4.9), amendments may be added to the soil to increase the rate of water percolation. Amendments needed to modify soil chemistry may include the addition of gypsum (calcium sulfate) or sulfurous acid.

The benefits that these amendments provide include increases in soil percolation, and increased grass plant root health. Increases in soil percolation decrease the likelihood of surfacewater runoff during storm and irrigation events and provides better root absorption of fertilizer. This in turn increases plant health and vigor resulting in increased disease resistance and drought tolerance. Decreases in surfacewater runoff and increases in fertilizer uptake protects surface and groundwater from impacts from fertilizers contained and transported by this runoff.

4.7 Storage, Loading, and Handling Requirements

Fertilizers will be stored on pallets in the maintenance facility. Pesticides will be stored in a locked facility. Materials will be purchased on an as needed basis and used as soon as feasible to reduce the need for storage and will be handled, mixed, and loaded at the washpad located at the maintenance facility. Spills will be contained and cleaned up promptly. In order to minimize waste, all material, including tank rinsate, will be used on the Course to the extent practicable. Prior to spray rig filling and departure from the maintenance facility, hoses, fittings, valves and controls will be checked to insure that they are operating properly and are not leaking.

4.8 Spill Clean-up and Response

A spill clean-up kit including brooms, dust pans, spill absorbent pads, and absorbent materials (e.g., kitty litter) will be stored at the maintenance facility in an accessible location known to the agronomy staff. These materials will be used to clean-up and control the spill of fertilizer to prevent off-target movement. The Superintendent will instruct staff in the proper use of these supplies. Refer to Chapter 10 for details of procedures for spill control.

4.9 Use of Adjuvants

Adjuvants are useful in controlling the physical placement of chemicals on turf and subsequently reducing or eliminating runoff and drift. Another benefit of using adjuvants is that they maximize a chemical's effectiveness, therefore allowing for the lowest possible label rate that is efficacious.

Adjuvants are used in spray tank mixes and are compounds that modify a spray solution. These include wetting agents and surfactants, deposition and retention agents, and emulsifiers and solvents. Adjuvants enhance pesticide efficacy by providing more uniform spray deposits, increased foliar penetration, coverage, and chemical retention. The use of adjuvants will be done in a manner consistent with the label and the manufacturer's recommendations.

General adjuvant groups include wetting agents/surfactants, depositing/sticking agents, and emulsifiers/solvents.

4.10 Use of Windfoils

No application of liquid fertilizer or pesticide will occur when there is a likelihood of wind drift. Drift is the unintentional escape or release of a material away from its target and can occur at wind speeds as low as 5 mph (Dexter 1993). Application can proceed when the use of a windfoil or similar device has demonstrated that fertilizer drift is not occurring. Elimination of drift has been demonstrated and can be successfully accomplished (Rogers 1999). The shroud and curtain of the windfoil contain and limit the movement of spray as it leaves the nozzle of the equipment. If at any time drift is anticipated, the application will cease until conditions improve such that drift is adequately controlled.

4.11 Application Techniques

All pesticides will be applied according to label directions. All label directions regarding worker health and safety, environmental protection, storage, handling, mixing, application, and container disposal will be followed. A person holding a current Ornamental and Turf Pest Control Commercial Applicator certification from the Hawaii Department of Agriculture will apply or supervise the application of pesticides on the Course.

Application techniques include, but are not limited to the use of booms, rotary or drop spreaders, or backpack sprayers or spreaders. As necessary, drift will be controlled by the use of windfoils and/or the use of adjuvants.

If necessary, applications will be suspended until weather conditions are acceptable. For example, applications will not occur if wind speed and direction pose any threat of drift and will not be made when the label forbids application at a specified windspeed speed.

5.0 TURF GRASS MANAGEMENT

5.1 Philosophy

The overriding philosophy for the golf Course is healthy, vigorous turf growing in properly drained and adequately balanced soil meets playability needs, tolerates traffic, is disease resistant, and requires the least long-term input. This philosophy dictates the quantities and frequencies of irrigation water and fertilizer use and the regular implementation of cultural, mechanical, and biological pest control techniques. Proactive use of these tools minimizes the need for the use of chemical pest controls (Ali 1989; Beard 1982; Couch 2000).

5.2 Physical Characteristics: Greens and Tees

Paspalum is the proposed grass variety for the greens and tees. The height of cut for greens and tees ranges from 0.12 to 0.25 inches. All greens will be reconstructed according to United States Golf Association (USGA) specifications. USGA greens have a layered soil profile which allows for water to be retained and held near the root zone. Retention of water in the root zone conserves moisture and nutrients for the purposes of maintaining and promoting root growth and vigor. The top 10 to 14 inches of USGA greens consist primarily of a mixture of sand and root material that have a hydraulic conductivity of approximately 2 to 4 inches/hour. Hydraulic conductivity is a measure of the rate at which water travels through a soil profile. The lower the hydraulic conductivity, the slower that particular soil permits the passage of water.

USGA greens are designed and constructed to adequately drain water into the root zone and maintain it there. Excess water, if present as a result of heavy rains for example, is drained away from the root zone. Proper drainage is critical to root growth and vigor, which in turn is critical to turf health. Once excess water is drained away from the root zone, a tile drainage system

consisting of gravel and piping beneath the surface of the green directs percolated water to a willow subsurface collection box. In general, greens are constructed with one or more main drain lines with laterals spaced approximately 10 to 15 feet apart. The number and location of the main drain lines varies with green geometry. Once water reaches these boxes, it will be directed to grassed areas adjacent to the green.

5.3 Physical Characteristics: Fairways and Roughs

Paspalum is the proposed grass variety for fairways and roughs. Typical height of cut for fairways is 0.5 to 0.75 inches and roughs will range from 1 to 2 inches.

5.4 Fertilizers and Soil Amendments

Fertilizers are necessary to grow healthy, vigorous turf grass that resists and tolerates disease pressure. Fertilizers are applied to maximize turf health in order to minimize disease susceptibility. Irrigation water application timing and volume are considered before fertilizer application in order to select and apply a fertilizer type that maximizes plant uptake and minimizes the likelihood of migration of soluble fertilizer to groundwater. For example, foliar application of fertilizer does not require the application of water where granular fertilizer needs to be watered in.

The Superintendent determines the need for fertilizer application and will consider the soil fertility testing, visual inspections, and the application quantity and frequency guidelines presented later in this chapter. If a deficiency is noted, the Superintendent will either make an independent determination of the appropriate remedy or will consult with an appropriate agronomist.

Several fertilizers may be used on the Course. Some fertilizers are commercially available as "off the shelf" and have specified amounts of the macronutrients nitrogen (N), phosphorus (P), and potassium (K). Other fertilizers are specially formulated to meet the specific fertility or soil chemistry deficiencies identified through lab analysis. The following materials are anticipated for use on the Course:

<u>Quick Release Inorganic Nitrogen (N).</u> High water solubility, rapid initial plant response, high foliar burn potential, limited residual response, subject to leaching, lower cost per unit on N. Types include:

Ammonium Sulfate	Ammonium Nitrate
Urea	Calcium Nitrate

<u>Slow Release Inorganic Nitrogen Carriers</u>. Intermediate initial release rate, lower foliar burn potential, medium to low water solubility, reduced loss by leaching, higher cost per unit of N, longer residual response. Types include:

Ureaformaldehydes	Sulfur-coated Urea
Isobutylidene Diurea	Poly-coated Urea

<u>Phosphorous (P)</u>. This is essential when growth is being done by cell division and development of meristem tissue. It is very important in early stages of plant growth. Types include:

Monoammonium Phosphate	Diammonium Phosphate
Super Phosphate	Triple Super Phosphate
Rock Phosphate	

Potassium (K). Essential for the formation of plant proteins and transfer of plant foods from leaves to roots. Can counteract the effects of excess nitrogen and increase winter hardiness. Types include:

Potassium Sulfate	Potassium Nitrate
Muriate of Potash (Potassium Chloride)	Potassium Hydroxide

Sulfur. Constituent of plant proteins. Plays a major role in soil acidity. Types include:

Sulfate of Potash	Sunflower Ash
Sul-Po-Mag	

MicroNutrients. Types include:

Iron	Copper	Molybdenum
Manganese	Zinc	Boron

Chelating Agents. Typically used with micronutrients to help provide a slow release and less reactive nutrient. Types include:

EDTA	Citric Acid
Glucoheptonates	

Organic Fertilizers. Slow release form of nitrogen that can build carbohydrate reserves for microorganisms in soil. Low burn potential, reduced leaching, builds C:N ratio in soil, low salt index, often can provide a host of micro and macronutrients. Typically, organic fertilizer relies on microbial degradation to release nitrogen in sufficient quantity and type to aid fertility. Types include:

Poultry Manure
Slaughter House Wastes (blood, bone, and feather meal)
Human waste sludge

Biostimulant-type Soil Conditioners. These are important for establishing and maintaining organic content in the soil and supporting microbial growth. Types include:

Humic Acid	Fish Emulsion
Kelp Extract	Fulvic Acid

Calcium. This is important for soil conditioning and imparting permeability for water infiltration, particularly where soils are high in magnesium or sodium. Types include:

Hi-Calcium Lime	Gypsum
Dolimitic Lime	

5.5 Fertilizer Use

The anticipated guidelines for application of fertilizers and soil amendments to tees and greens, fairways, surrounds, and rough are described below.

5.5.1 Greens and Tees

The greens will be fertilized in increments of not more than 0.5 pounds of soluble nitrogen per 1,000 sq. ft. (lbs./sq. ft.) per application. Any fraction up to 1 lb./1,000 sq. ft. of natural or synthetic slow release nitrogen may be added to or substituted for the soluble nitrogen fraction per application. The greens will be fertilized frequently enough to support constant

growth consistent with the particular season of the year. After establishment and grow-in, no more than approximately 4 lbs./ 1,000 sq. ft. of nitrogen will be used in one year.

Based on soil tests and the judgment of the Superintendent, phosphorus, potash, and trace elements will be added in greens fertilization on a periodic basis through the growing season. The maximum amount of potash applied will not exceed approximately 12 lbs./1,000 sq. ft. per year and the maximum amount of phosphorus will not exceed 8 lbs./1,000 sq. ft. per year.

5.5.2 Fairways

Fairways will be fertilized in maximum increments of 0.5 lbs./1,000 sq. ft. of soluble nitrogen per application with phosphorous, potash, and minor element ratios determined by soil analysis and the Superintendent's judgment. Any fraction up to 1 lb./1,000 sq. ft. of natural or synthetic slow release nitrogen may be added to or substituted for the soluble nitrogen fraction per application. After establishment and grow-in, no more than approximately 4 lbs./1,000 sq. ft. of nitrogen will be used in one year.

5.5.3 Roughs

Roughs will be fertilized in maximum increments of 0.5 lbs./1,000 sq. ft. of soluble nitrogen per application with phosphorous, potash, and minor element ratios determined by soil analysis and the Superintendent's judgment. Any fraction up to 1.5 lbs./ 1,000 sq. ft. of natural or synthetic slow release nitrogen may be added to or substituted for the soluble nitrogen fraction per application. The maximum annual nitrogen total will not exceed approximately 4 lbs./1,000 sq. ft.

5.6 Irrigation

The objectives of irrigation on the Course are maximizing turf health by applying irrigation water in such a way as to maximize root length and minimize irrigation water runoff. A vigorous, strong root system allows the plant to grow in a healthy, vigorous manner. A healthy and well-rooted plant provides desirable playing conditions and has increased disease resistance when compared to a poorly rooted one (Ali 1989; Beard 1982; Couch 2000). Minimization of irrigation water runoff is beneficial because it decreases erosion and increases water conservation.

In general, the Course will be irrigated as infrequently as possible and with as long a cycle period as possible to achieve deep infiltration without creating runoff. This approach results in turf with a vigorous, strong rooting system.

Once the irrigation system is installed, application of irrigation water on the Course is centrally controlled. This system controls the application of irrigation water from a desktop computer in the Superintendent's office with an accuracy of within 0.05 inches of water applied. The weather station accompanying the irrigation system will be located on the Course and will continually measure a variety of meteorlogic parameters including wind speed and direction, temperature, relative humidity, and dew point.

With data from the weather station located on the Course, the irrigation control system calculates Evapotranspiration (Eto), which is used to assist in determining the timing, rate and amount of irrigation water needed. Daily downloading and review of Eto data allows for the application of irrigation water so that the required amount of water to replenish the previous day's Eto loss is applied. Application of irrigation water in this fashion minimizes the amount of water that percolates through and out of the root zone or runs off. Eto measurements are made on the Course daily and form the basis for irrigation water application decisions. The Superintendent, however, will exercise his judgment and discretion in adjusting the amount and rate of irrigation water applied depending on turf appearance, wear, compaction, etc. For example, the presence of

localized dry spot (LDS) requires immediate hand-watering, which is outside of the scheduled irrigation program.

Surfacewater and groundwater are discussed in Chapter 3. Several sources for irrigation water exist for the Course, and also from reclaimed water. Analysis of samples from a variety of these sources has been completed and is summarized in **Table 2**. As **Table 2** indicates, some sources have constituents that adverse impact to turf when used for irrigation. As details of irrigation water source chemistry are made available, the irrigation water quality criteria in **Table 2** will be used to evaluate suitability.

Fresh, non-recycled water that is low in dissolved solids, including salts, will be used as needed to irrigate the greens in order to maintain suitable soils capable of sustaining healthy turf.

5.7 Soil Fertility

Soil amendments are necessary to correct, increase, and maintain soil fertility in order to provide a medium for growing healthy vigorous turf grass that resists and tolerates disease pressure. Soil amendments are also applied to balance soil chemistry in order to make nutrients and water readily available to the turf and to correct and maintain proper drainage.

For example, areas less able to drain may do so as a result of an imbalance of the exchangeable cations calcium and magnesium. For turfgrass, the desired percentages of calcium and magnesium are approximately 68% and 12%, respectively.

The turf will be inspected regularly for signs of nutrient deficiency and periodic sampling and analysis of soil will be accomplished. If a deficiency is noted, the Superintendent will either make an independent determination of the appropriate remedy or consult with an appropriate agronomy consultant.

6.0 INTEGRATED PEST MANAGEMENT

Integrated pest management (IPM) is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural and mechanical practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, which may include damage threshold exceedance. Treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment. The steps of the IPM program for the Course are briefly described below, including damage thresholds.

6.1 Pest Identification

Pest identification is done using the experience of the Superintendent, his staff, and hired agronomy and plant pathology consultants. Use of industry standard references (Beard 1982; Couch 2000; University of California 1999) will be used as needed. **Table 4** summarizes some of the pests anticipated on the Course.

6.2 Pest Monitoring and Record Keeping

Three primary tools are used to monitor and record data on pest presence at the Course. These are: scouting, use of indicator greens, and weather monitoring and forecasting software. Each of these is discussed below.

6.2.1 Scouting

At a minimum of once per week, the Course will be scouted and data recorded on the presence, location and severity of pests. For the green, tee, and fairway of each hole, between 2 and 6 quadrants will be established. The following information will be recorded: Number and type of pest, quadrant, and location within quadrant of pest(s).

The Superintendent will review the data and make regular spot checks to verify the accuracy of the scouting reports. A summary of the results of that particular week's scouting report will be placed on a dry erase marker board in the maintenance office. This allows the Superintendent and his assistant to quickly identify location(s) on the Course that have indications of pest pressure. Scouting books are kept on file in the Superintendent's office.

In the event of anticipated or identified pest pressure, the Superintendent will make determinations on changes in cultural practices or implementation of pest control techniques as described in the following sections.

6.2.2 Indicator Greens

The Superintendent also uses several "indicator greens" on the Course to monitor for pests. The initial selection of these green(s) will be done after construction is completed. These greens may be particularly susceptible to different pests at different times of the year and under different environmental conditions. If pest pressure is noted on an indicator green, the Superintendent is alerted to the possibility that this pest may be present or pending at other locations. This allows him to take corrective action in a preventative manner so that more invasive curative measures may not be necessary. The advantage of this approach is that typically less total amount of pesticide is needed if applied in a preventative manner.

6.2.3 Weather Monitoring and Forecasting

The Course anticipates the use of a weather monitoring and forecasting service. This service is capable of collecting weather data and preparing forecasts specific to the Course. Data include trends in air and soil temperature, humidity, wind speed and direction, evaporation, and rainfall events.

Several degree-day disease models are commercially available and are used to produce information on which weather conditions are associated with a particular disease development (Skybit 2006). For example, predictive tools are available for fungal diseases found primarily on greens and tees such as Anthracnose, Brown Patch, Pythium, etc. These services provide probability of disease incidence based on site-specific data such as soil and air temperature and humidity. Reviewing these status reports is a useful tool for knowing when to implement fungal disease control.

6.3 Damage Thresholds

Damage thresholds are the points at which disease pressure has equaled or exceeded a defined limit that cannot be tolerated for economic, aesthetic, or other reasons.

Prior to threshold exceedance, chemical/cultural/mechanical/biological pest control techniques will be regularly used in a preventative manner to maximize turf health and disease resistance. Conditions such as weather or heavy golfer traffic stress the turf resulting in conditions that favor pest population increases and may result in damage thresholds being reached. Prior to a damage threshold being reached, additions or modifications to the existing suite of cultural, mechanical, and biological practices will be considered and may be implemented. The decision to use a particular control will be made by the Superintendent.

Different damage thresholds exist for different areas of the Course and are described below and summarized on **Table 4**.

6.3.1 Greens and Tees

Greens, tees and their respective surrounds are the most actively traveled, highly used, and highest value portions of the Course. They are carefully managed in order to meet playability requirements while tolerating heavy traffic.

For the purposes of scouting and record keeping, each green surface is divided into up to 6 quadrants of approximately 1,000 sq. ft. each. Tees are not divided up. The damage threshold for pest on the greens and tees is reached if at any location on any of the quadrants grass exhibits pest presence equal to or greater than that shown in **Table 4**.

6.3.2 Fairways and Roughs

The height of cut on fairways is greater than that of greens and tees, and as such the disease resistance and tolerance of fairway turf is generally greater than that of greens and tees turf. The rough forms the perimeter barrier buffer between the cultivated portion of the Course and the native vegetation.

Thresholds are assessed by first combining the fairway and rough for one hole and dividing it into three roughly equal size sections. A 1,000 sq. ft. area for each section is evaluated. If thresholds presented in **Table 4** are exceeded in a 1,000 sq. ft. area, than that section has exceeded its threshold. If pest presence exceeds established thresholds in two areas, than the entire fairway/rough has reached its threshold for that pest.

The damage threshold for roughs is the same as for fairways. However, significant differences exist between the rough and the fairway. For example, the height of cut on roughs is greater than that of fairways. Due to a higher height of cut and subsequently a larger leaf surface and a less frequent mowing schedule, rough turf health and disease resistance is typically greater than that of greens and fairways. In addition, the higher cut of the rough can camouflage the presence of pests and pest damage. Although the damage threshold is the same for the rough as it is for the fairway, better disease tolerance and camouflaging allows the Superintendent to use discretion in tolerating higher damage in the rough than on the fairway.

6.4 Pests, Symptoms and Cultural Controls

Five different types of pests are anticipated on the Course. These are fungus, , weeds, insects, nematodes, and algae. Symptoms and cultural controls for each pest are briefly described below. Chemical controls are discussed in Chapter 7.

6.4.1 Fungus

Fungus lacks chlorophyll, does not produce seeds, and do not have true roots, stems, or leaves. They do not produce their own food and therefore live off of living plant or animal matter. Many fungi produce seed-like bodies called spores that are resistant to adverse environmental conditions.

Fungal disease may be present at a variety of locations on the Course at any one time. However, the presence of this class of pest is most prominent on turf with short heights of cut such as greens and tees.

The cultural control techniques for some common fungal diseases are presented in **Table 5**. In addition to these cultural techniques, good agronomic practices to maintain healthy turf and soil are critical to prevention of fungal diseases. Examples of good agronomic practices for fungal pathogen control include:

1. Soil chemistry will be monitored, with particular emphasis on nitrogen, calcium, magnesium, potassium and phosphorus.
2. Turf health will be monitored to maintain vigor with minimum fertilizer input.
3. No fertilization occurs during periods of high temperatures.
4. Irrigation will be applied according to Eto requirements.
5. Thatch will be kept to a minimum.
6. Soil will be kept aerated to improve water percolation.
7. Implements will be thoroughly cleaned between greens.
8. Changes in mowing frequency, height of cut, and/or the use of a roller to reduce mowing frequency will be made dependent on golfer traffic and weather.
9. Ball marks and divots will be repaired as soon as possible.
10. The use of metal-spiked golf shoes will be prohibited. Spikes cut and abrade the leaves of turf grasses, creating wounds that increase susceptibility to further injury.
11. Mowers will be ground and back-lapped on a regular basis to keep the mowers sharp and provide a high quality of cut so that tearing of the turf leaf tips is avoided. High cut quality reduces the susceptibility of the cut and exposed plant leaf to disease.

The following is a description of some of the common fungus found on other Courses on the Big Island and anticipated on the Course.

Brown Patch (Pathogen: Rhizoctonia solani) cause circular patches of dead and dying grass ranging from a few inches to several feet in diameter. Turf blades initially appear dark and water-soaked. Further progression of the disease results in weathering, drying and a distinctive brown color. In some cases, the center of the infected area may recover and the infected perimeter remains brown, producing a brown ring in the turf.

Pythium Blight (Pathogen: *Pythium aphanidermatum*) Pythium Blight, also known as grease spot, kills turf in small, roughly circular spots (2 to 6 inches) that tend to run together. Blackened leaf blades rapidly wither and turn reddish brown. Leaf blades tend to lie flat, stick together, and appear greasy. The fungus forms thick-walled sexual spores, which enable it to survive in the soil for long periods. Pythium blight usually appears in low spots that remain wet; the disease depends on excessive moisture and may be very destructive at high temperatures. Under humid conditions, masses of fungal mycelium may appear.

Dollar Spot (Pathogen: *Sclerotinia homeocarpa, Lanzia sp. and Moellerodiscus sp.*) affects small, circular areas of turf, about 1 to 5 inches in diameter. The spots may merge to form large, irregular areas. Leaves appear water-soaked at first, then later turn brown; they often have a reddish band extending across the leaf. Fine, white, cobwebby hyphae (fungal threads) may be seen in early morning. The fungus survives in soil as sclerotia, which are tiny, hard, often dark, resting bodies. Moderate temperatures (60 to 80 F), excess moisture or water stress, fog, and excess mat and thatch favor dollar spot. Turf deficient in nitrogen tends to develop more dollar spot than turf adequately fertilized.

Summer blight (Pathogen: *Rhizoctonia solani*) Ash green and water-soaked lesions appears at first then the infected leaves fall on each other and a hyphae like spider' web appears. Later, light brown to brown sclerotia of about 5 mm in diameter are produced on the infected part. At this point, the infected grass withers.

Anthracnose (Pathogen: Colletotrichum graminicola) appears as irregular patches of diseased turf that can be up to 12 inches in diameter but usually is much smaller, about the size of a dime. Leaf blotches are brown, fading to light tan. The fungus forms minute, black fruiting structures on dead grass blades. The disease is most severe under high temperatures (80 to 90 F), when foliage remains wet, and soil fertility is low.

6.4.2 Weeds

Weeds are "plants out of place" and they can generally be classified as aquatic, annual, perennial, grass, or broadleaf. Good agronomic practices to maintain healthy turf and soil are critical to preventing the establishment and proliferation of weed. Examples of good agronomic practices for weed prevention include:

1. Mowers and cultivation equipment are thoroughly cleaned before moving from infested to weed-free areas.
2. Ball marks and divots are repaired quickly.
3. Turf is maintained properly to assure maximum vigor, which helps these plantings become as competitive as possible and slows invasion of the weed. Dense turf shades the soil surface, making the establishment of weed seedlings difficult. Because of this, open spots such as divots will be overseeded as soon as possible.
4. Deep and infrequent irrigation will be used to the extent practicable to discourage the development of the willow-rooted weeds. Irrigation will be set and monitored so that shady areas are not over-watered.
5. Over fertilization will be avoided.
6. Turf will not be aerated during peak(s) of weed germination.
7. Weeds will be hand removed as feasible. Spot treat with heat as feasible.
8. Grass clippings will be collected as feasible to help to reduce the number of seed that reach the soil.

The following is a description of some of the common weeds anticipated on the Course.

Kikuyugrass is an aggressive perennial weed that is sometimes mistaken for St. Augustinegrass and has pointed leaves with hairy stems. It is a non-native invasive species that spreads by laterally growing stolens and seed. It is easily spread by movement of cut stolens and establishes readily in bare turf that has moderate to full sun. Its growth peaks in the mid spring and mid fall.

Dandelion is a perennial with a heavy, deep taproot. Removal of the leaves and 1 to 2 inches of taproot will not control it because it will regenerate from the remaining portion of the taproot. Poorly maintained open turf areas allow the establishment of dandelion. Frequent mowing to remove the flowers will reduce the spread of viable seeds.

Smooth and Large crabgrass. Both species are annuals that spread primarily by seed, and to a lesser extent, by rooting at swollen nodes of stems. Crabgrass is frequently a problem in over irrigated turf. Frequent, willow irrigation encourages the establishment of crabgrass.

Crabgrass typically germinates during the summer. In June and July, the plants produce tillers, shoots, and it flowers in late July and August.

Yarrow. Yarrow is a perennial with hairy, spreading rootstocks. Its leaves are feathery, similar to carrot leaves and although not typically seen in the turf, flowers are white or yellow in dense, flat clusters at stem ends. Frequent irrigation and cooler, shaded areas favor this species.

Spurge. Spurge or spotted spurge is a widely spreading, many-branched, low-growing, mat-forming summer annual. The oval seed leaves are bluish green, powdery or mealy on the upper surface and have a reddish tinge underneath. Leaves on mature plants grow oppositely on short stalks. Spotted spurge has milky, sticky sap and small, inconspicuous flowers. The plant is named for the dark, reddish spots often found in the middle of the leaves.

6.4.3 Algae and Aquatic Weeds

The lakes on the Course consist of ecosystems comprised of a variety of flora and fauna, including two general categories of algae: planktonic (suspended) and filamentous (mat-forming). Examples of aquatic weeds that may pose a problem in the lakes of the Course include water hyacinth, hydrilla, and pondweed.

When temperatures rise in the spring and early summer, a buildup of organic debris during the winter combined with a lack of oxygen can cause algae blooms, a proliferation of aquatic weeds, and odors (Ennis et al 2000).

Management of the lakes, while maintaining an esthetically acceptable water feature, requires regular visual monitoring of conditions, the implementation of BMPs, and the use cultural controls of algae and aquatic vegetation as described in Chapters 4 and 7. The use of chemical controls may also be warranted, but will not be undertaken without first consulting with knowledgeable personnel.

Details on a specific algaecide and aquatic herbicide are presented in **Table 3**. Several cultural controls can be used to address aquatic weed and algae issues:

1. Prevent debris such as grass clippings, tree leaves, with particular emphasis during the spring, from entering the lakes.
2. Follow BMPs for fertilizer and pesticide applications to minimize introduction into the lakes.
3. Periodically, remove undesirable aquatic vegetation from the lakes.
4. Maintain water circulation to distribute oxygen throughout each lake.

To prevent the creation of submersed organic material and its subsequent decay and oxygen consumption, the Superintendent will not treat aquatic weeds with herbicides during the summer months without first considering initially treating just a portion of the lake. Subsequent hand removal of treated vegetation with rakes or nets may be required.

In addition to the cultural controls discussed above, several chemical controls can be used to address algae and aquatic weed problems:

1. Adjust pH to maximize microbial digestion of organic materials.
2. Apply algaecides and aquatic weed herbicides as needed.
3. Use light-absorbing colorant dyes to reduce the amount of sunlight able to reach submerged aquatic vegetation.

6.4.4 Insects

Several insects are anticipated on the Course. In general, there are several cultural techniques that can be used to control them. These include:

1. Maintain dense, healthy turf with adequately drained soil.
2. Minimize or eliminate damp areas with rank growth where armyworms tend to lay their eggs.

The following insects are anticipated on the Course.

Grass Webworm (*Herpetogramma licarsisalis*) larvae (caterpillar) damage turf by feeding at night on grass blades and crowns. They create ragged grass blades and leave webbing on the grass leading to holes into the thatch. Larvae can be located at the base of grass and when disturbed may become active. After significant infestation, large bare and/or brown patches of turf result. Grass Webworm has 5 larval instars that develop over approximately 2 weeks. After the larvae stage, adult pupae (moths) develop and live for up to 7 days. Pesticides are largely ineffective against this stage of development. However, bird and bat predation of the moth is high.

Lawn Armyworm **(***Spodoptera mauritia (Boisduval)* larvae (caterpillar) feeds on grass blades, crowns and stems and may result in a silvering of the grass blade at the tips. Like the soil webworm, larvae feed at night and hide in the grass during the day. Caterpillars have 7 or 8 instars that develop over approximately 28 days. Pupation occurs over a 10-14 day period. Moths are nocturnal and commonly attracted to lights. Natural bird and bat predation of the moth is high.

6.4.5 Nematodes

Plant parasitic nematodes are microscopic roundworms that feed principally on plant roots. They survive in soil and plant tissues, and several different species may occur simultaneously. They have a wide host range, and vary in their environmental requirements and in the symptoms they cause. Speciation of nematodes is a service that the Superintendent contracts to appropriate experts.

Presence of nematodes may not in itself cause turf damage. In fact, many beneficial nematodes exist. However, populations of damaging nematodes can reach a point where either the nematode itself damages the turf, or the nematode's presence reduces the health and vigor of the turf making it susceptible other nematodes, fungal pathogens, or the establishment of competing weeds.

The symptoms caused by nematode presence maybe indicative of a nematode problem, but are not diagnostic because they could result from other causes. Infestations may occur and maintain presence without causing any aboveground symptoms. As such, damage thresholds for nematodes are not associated with the number and type of nematode(s), but is evaluated based upon aboveground visual damage to the turf.

Sting nematode is an example of a nematode that may be found on the Course that feeds on the tips and along the sides of grass roots. Activity of these pests is highest in light, sandy, moist soils when air temperature is above 68 F. It damages turf and causes drought and malnutritional symptoms that do not respond to watering or feeding. Badly affected plants collapse and die in patches that can measure up to several feet in diameter.

6.4.5 Vertebrate Pests

No Vertebrate pests are anticipated on the Course.

7.0 CHEMICAL CONTROLS IN IPM

As discussed in the previous chapter, cultural pest control techniques will be regularly used in a preventative manner to maximize turf health and disease resistance. Because conditions such as weather or heavy golfer traffic stress the turf, conditions that favor pest population increases may result in damage thresholds being reached. Prior to a damage threshold being reached, additions or modifications to the suite of cultural practices will be considered and may be implemented.

If a threshold is reached and cultural techniques do not provide adequate pest control, chemical controls will be considered and may be used. This chapter describes the factors considered when evaluating and selecting chemical controls.

7.1 Efficacy

The Superintendent will compare data gathered from pest monitoring and record keeping, and evaluate potential pesticides with characteristics that control the identified pest. A list of chemicals for the control of fungal pathogens is presented in **Table 5**. An overall list, including chemicals for the control of weeds, insects, nematodes, vertebrates, and pathogens is presented in **Table 3.**

The selection of the chemical will include a careful review of the product label to evaluate the effectiveness of that chemical against the pest(s) that is (are) present. Various resources (Couch 2000; Beard 1982; University of California 1999; Lesco 1998), independent consultants, manufacturer's field representatives, trade journals (Golf Course Management, Golfdom, etc) and professional organizations (Golf Course Superintendent's Association of America) will be used as necessary by the Superintendent to evaluate efficacy.

Once efficacy has been considered, one or more chemicals are identified for potential use. In order to finalize the selection, the potential risk posed by the use of the chemical must then be considered. Of the chemicals meeting the efficacy criteria, selection preference is given to the chemical that will not pose a risk to natural resources.

7.2 Risk

The risk posed to natural resources by the use of a chemical is due to two factors: toxicity and exposure. Changes in either toxicity or exposure change the overall risk. Neither factor independently dictates the level of risk that is present. For example, without exposure to a toxic chemical, no risk is present. Conversely, frequent exposure to a moderately toxic chemical may present a risk. Several sources of information are available to the Superintendent that address risks posed to natural resources by the use of pesticides (Bigger 1987; Forster 1996; GCSAA 1999). The best tools available for the Superintendent to minimize risk are ones that allow for selection of the least toxic pesticide and the control of exposure to non-target organisms.

7.3 Toxicity

Prior to application, the toxicity and exposure to receptors will be evaluated and considered. The toxicity and components of exposure (characteristics of the chemical, the site's soil, ground, and surfacewater, the adjuvant, location of receptors, and the method of application) all play a part in how that chemical behaves and what risk it imparts once applied. **Table 3** lists toxicity classifications for the chemicals that are proposed for use on the Course. These classifications (i.e., slight, moderate, high, etc.) are based upon LD_{50} values. The Lethal Dose for 50% of the population, or LD_{50}, is expressed in terms of the milligrams (mg) of chemical per kilogram of body weight (Kg) dose that kills 50 % of an exposed test population.

The Superintendent will consider both toxicity classifications when selecting a chemical and will select the least toxic alternative.

7.4 Exposure

Understanding the pathways of exposure (i.e., runoff, drift, percolation to groundwater, etc.) and routes of intake (i.e., ingestion, inhalation, dermal exposure, etc.) are critical in estimating risk. Other factors influencing exposure are the type and location of sensitive species (i.e., fish, birds, mammals) and the time(s) they are present in or near the area of treatment. Pathways and intake must be considered to estimate exposure.

Chapter 4 presents numerous BMPs that are used by the Superintendent to minimize exposure and therefore reduce risk. Many of these BMPS specifically address and minimize potential exposure pathways. For example, BMPs such as buffer strips and restrictions on locations and timing of chemical application specifically reduce the potential for the pesticide runoff pathway of exposure to exist. Another example is the use of windfoils to eliminate the drift exposure pathway. The use of BMPs to reduce or eliminate exposure results directly in a reduction or elimination of risk.

The Superintendent will consider exposure scenarios and select and implement applicable BMPs as described in Chapter 4 to reduce or eliminate exposures.

7.5 Factors Influencing Chemical Fate and Exposure

Solubility. The solubility of a chemical is critical in understanding the extent to which a chemical may move with surface and/or groundwater. Higher solubility chemicals dissolve more readily than lower solubility chemicals and therefore have the potential to move into and travel with surface and groundwater. Refer to **Table 3** for pesticide solubility data.

Soil Affinity. The desire a chemical has to stay in water or be absorbed by organic matter within soil particles is Koc. Typically, the more organic carbon a soil has, the greater the affinity an organic chemical has for that soil. The higher the Koc, the greater the chemical's affinity is for soil. Refer to **Table 3** for pesticide Koc data.

Soil Type. The percent sand, silt, and clay a soil has, the degree to which it is compacted, the amount of organic material in the soil are all important characteristics when evaluating the fate of a chemical. Highly compacted, high clay content soil may not permit water infiltration and may be prone to surfacewater runoff if not sufficiently vegetated. Compacted, high clay content soils do not allow water infiltration and may result in surfacewater runoff if insufficient vegetation or poor or non-existent energy dispersion is present.

Evaporation Loss. Vapor pressure must also be considered to evaluate the relative likelihood that a chemical has to evaporate after application. The lower the vapor pressure, the less chance a chemical has to evaporate and potentially drift to non-target locations. Evaporation is strongly influenced by atmospheric pressure and air temperature. Low temperature and high atmospheric pressure conditions minimize evaporative loss.

Groundwater. If a compound's label or other data suggest that the compound has a water solubility in excess of 500 mg/L, or otherwise is considered a potential threat to ground or surface water, or is listed on the label as a potential groundwater contaminant, then the Superintendent and the applicator will estimate potential threats to groundwater. This can be done by taking into account the depth to groundwater, distance and drainage direction to surfacewater, soil type, % organic carbon in the soil, soil hydraulic conductivity, soil/water partition coefficient, irrigation water scheduling, and other relevant data.

Depth to Groundwater and Distance to Surfacewater. Once dissolved or adhered to sediment or soil particles, the distance and path a chemical has to travel influences whether or not it reaches a sensitive receptor. The longer the distance a chemical has to travel, or the more circuitous the path, the more chance it has to degrade or adsorb to soil particles.

Degradation. As a result of biological of chemical reactions in soil, air, or water, a chemical's half-life, or the time it takes for the initial concentration to be reduced by half, is important in evaluating its fate. The lower the half-life, the faster the chemical degrades. Half-lives are often given for soil and water.

7.6 Exposure Mitigation for Sensitive Species

As previously discussed, reduction or elimination in exposure results in a reduction or elimination of risk. Several sensitive species have been observed or may have the chance of occurrence in or near the Course. (Hart 2006). Refer to **Table 1**. As a result of a recent site-specific survey (Hart 2006), environmental management areas (EMAs) with use restrictions have been adapted for the Course as presented in **Figure 1**.

Results of water quality monitoring discussed in Chapter 9 will be used by the Superintendent to demonstrate that State of Hawaii Water Quality Standards (WQSs) for fertilizers and pesticides are not exceeded. If data from monitoring show that WQSs are exceeded, then action is taken as indicated on **Figure 2.**

Hawaiian Fan Palm (Loulu) is present at undetermined locations in the Shoreline Habitat area. Refer to **Figure 1**. Restrictions on the use of fertilizers and pesticides in EMAs within 25 feet of native vegetation will protect the palm.

7.7 Fungal Pathogen Prevention

Threshold exceedance and the failure of cultural controls are not the sole criteria used to initiate chemical controls. The most common example of this scenario is the preventative control of fungal pathogens.

The potential presence of turf grass pathogens can be predicted by the use of several models that consider degree-days, soil and air temperature, humidity, and time of year to predict an outbreak of a particular pathogen. An example of this model is the Skybit System (Skybit 2006). If a fungal pathogen outbreak is predicted, the Superintendent may elect to treat it preventatively.

Preventative treatment and control is significantly more protective of turfgrass and can achieve control with fewer inputs compared to a curative control done after a fungal pathogen outbreak has occurred.

7.8 Fungicide Resistance

The prevention of resistance to fungicides requires attention. According to several sources (University of California 1999; Couch 2000), the following general recommendations should be used to control, delay, or prevent development of resistance to fungal disease control agents:

1. Maintain a healthy, vigorously growing turf. Properly maintained turf generally sustains less severe damage from disease and is able to recover quickly.
2. In general, since fungus cannot develop without moisture, proper irrigation is important. For example, water early in the morning rather than late at night and use deep infrequent waterings rather than frequent willow waterings. Reduce leaf

wetness from irrigation, dew or guttation water to less than 12 hours by dragging a hose or like device across the grass surface.

3. Use cultural practices such as sanitation to reduce disease pressure. Thoroughly clean and rinse implements prior to moving from one area to the next.
4. Use fungicides with different modes of action. This has the advantage of affecting the pest in two different ways. It is much harder to develop resistance to two different materials than it is to develop resistance to one.
5. Use the resistance-prone or single site mode of action compound only 1 to 3 times per season. When possible, use preventative, not curative fungicides. It is easier to prevent a disease from getting started than it is to stop it from spreading.
6. Do not use single site mode of action fungicides as curative control on established disease. Applying materials late to control a disease which is already present increases the opportunity for resistance dramatically because of the increased amount of inoculums in plantings and the variability present in that population. Use fungicides in a protective rather than a curative manner when ever possible.
7. Reduce spray intervals whenever appropriate.
8. Alternate fungicides with different modes of action, i.e., a multisite mode of action and a single site mode of action. Refer to **Table 3 and 5**.

7.9 Restricted Pesticide and Fertilizer Use Areas

Several locations on the Course have EMAs where there are restrictions on the use of pesticides and fertilizers. Refer to Chapter 4 and **Figure 1**.

7.10 Use of Windfoils

No application of liquid fertilizer or pesticide will occur when there is a likelihood of wind drift. Drift is the unintentional escape or release of a material away from its target and can occur at wind speeds as low as 5 mph (Dexter 1993). Application can proceed when the use of a windfoil or like device has demonstrated that fertilizer drift is not occurring. Elimination of drift has been demonstrated and can be accomplished (Rogers 1999). The shroud and curtain of the windfoil contain and limit the movement of spray as it leaves the nozzle of the equipment.

7.11 Special Consideration: Algae Control in Lakes

The presence of algae in lakes on the Course may exceed thresholds presented in **Table 4**. If cultural and mechanical means are unable to control the algae, algaecides may be required. The use of algaecides will not be undertaken without consulting with knowledgeable personnel.

8.0 CHEMICAL PEST CONTROL: GENERAL REQUIREMENTS

As described in Chapter 6, IPM is used to prevent pests or their damage through a combination of techniques such as chemical, biological control, habitat manipulation, modification of cultural and mechanical practices, and use of resistant varieties. Cultural pest control techniques will be regularly used in a preventative manner to maximize turf health and disease resistance. Prior to a damage threshold being reached, additions or modifications to the suite of cultural practices will be considered and may be implemented.

Chapter 7 described the factors considered when evaluating and selecting chemical controls, with an emphasis on the management of risk through either toxicity and exposure reduction or elimination. Eventual selection of a pesticide is done only after risk is reduced to an acceptable level. This chapter describes general requirements that will be considered after a chemical is

selected for use on the Course.

8.1 Pesticide Label

The pesticide label contains information such as signal word (Danger, Warning, Caution), personal protection, mixing requirements, efficacy, and other important information. **ALWAYS CAREFULLY READ AND UNDERSTAND THE LABEL BEFORE MAKING OR DIRECTING OTHERS TO MAKE AN APPLICATION. Table 3** lists signal words for the pesticides considered for use on the Course.

8.2 Notification and Posting

Notification and posting will be done consistent with the pesticide's label directions. Further, the Superintendent will display the following information in prominent locations at the Maintenance Office at least 2 hours before, during, and up until the reentry interval has expired:

Identification of treated area(s);
Time and date of application;
Reentry interval; and
Product name, EPA registration number and active ingredient(s).

8.3 Pesticide Information and Personal Protective Equipment

Before employees are allowed to handle pesticides, the Superintendent requires them to read a copy of the pesticides' Material Safety Data Sheet (MSDS). A copy of each pesticide's MSDS will be kept in the maintenance office. In addition, the Superintendent will make a copy of the pesticide label.

As required by the label, persons applying chemicals will wear appropriate personal protective equipment (PPE). Prior to wearing such equipment, the Superintendent or the certified applicator will provide sufficient instruction on the proper use of the equipment. The Superintendent is responsible for supplying PPE equipment to the staff.

8.4 Reentry

In general, and unless otherwise stated on the label, no reentry into a treated area can occur until the pesticide is dry.

8.5 Pesticide Use Reporting and Record Keeping

Pesticide application use records are kept on site for a minimum of two (2) years. An application use record for an application event consists of a written recommendation, and packaging slips and invoices from dealers and applicators. Monthly Use Summaries will be prepared and retained. The Monthly Use Summary consists of the following:

1. Name of product;
2. Registration number;
3. Amount used/acreage covered; and
4. Number of applications (frequency per day).

8.6 Pesticide and Fertilizer Applications

Once loaded, all equipment used for the application of fertilizers and pesticides will completely emptied to the extend feasible at the location of application so as to minimize or eliminate unused or excess material.

8.7 Restricted Pesticide/Fertilizer Use Areas

Because of the proximity of grassed areas of the Course to Ninole Creek, and the presence of three listed species and their habitat, several locations on the Course have restrictions on the use of fertilizers and pesticides. Refer to **Figure 1**.

9.0 ENVIRONMENTAL MONITORING, REPORTING, AND MITIGATION

9.1 Purpose and Rationale

The primary purpose of the monitoring is to evaluate compliance with WQSs established for the course. Based upon results of the water quality monitoring, the Superintendent and management staff will make any required changes in agronomic and maintenance practices on the Course.

The Hawaii State Department of Health has established WQSs for constituents that may be present in surface or groundwater at the Course. Of these constituents, a specific subset is of interest: pH, electrical conductivity (EC), total dissolved solids (TDS), nitrates, total Kjeldahl nitrogen (TKN), ammonia, sulfate, phosphate and pesticides. The presence of these specific constituents will be determined by analytical laboratory techniques. If no WQS exists for a specific pesticide, allowable concentrations for that pesticide will be derived by evaluating the average 96-hour LC50 published in the USEPA Ecotox database (USEPA 2006).

All sampling and analysis will be done using appropriately sized and cleaned sampling apparatus, chain-of-custody and storage protocols, and analytical techniques appropriate for the analytes listed above. Monitoring will include the collection of samples from the locations described below.

9.2 Greens

As presented earlier, USGA greens are designed and constructed to adequately drain water into the root zone and maintain it there. Excess water, if present as a result of heavy rains, is drained away from the root zone through a drainage system and out onto the Course. Specific greens to be sampled will be determined at a later date.

9.3 Fairway and Bunkers

Samples of stormwater will be collected during or shortly after the first major rain event of the storm year. Rainfall history and weather forecasts (Intellicast 2006) are available to assist in predicting first of the year storm events. Locations of stormwater sampling points are to be determined.

9.4 Groundwater

One of the production wells will be sampled. The wells will be adequately developed and purged prior to sampling.

9.5 Ninole Creek

Surfacewater samples will be collected and analyzed at three locations in Ninole Creek: one upstream of the Course, one at midpoint of the Course and one down stream of the Course.

9.6 Coastal Ponds

Surfacewater samples will be collected and analyzed at the three ponds in the shoreline habitat area.

9.7 Data Reporting

The results of physical and chemical analysis of will be prepared by the Superintendent and presented in a brief annual summary report to the golf Course general manager. As data are gathered, plots of concentration vs. time will be produced to assist in identification of trends.

9.8 Corrective Action

If during monitoring, information is obtained that suggests that environmental impact has occurred, appropriate actions will be taken. Refer to **Figure 2**. Modifications on use beyond those described in this document or on the product label may include alterations to the rate and timing of application, adjuvants used, formulation(s) used, technique, and/or irrigation scheduling.

10.0 CHEMICAL HANDLING, STORAGE, AND SPILL CONTROL

10.1 Wash Pad

All pesticide and fertilizer tank spray preparation, including mixing and loading, will take place on the recycled water wash pad located adjacent to the maintenance facility. The recycled water wash pad is a concrete pad that tapers from all directions to the center of the pad. If spillage occurs, material reaches the drain at the center of the pad and is pumped to the treatment and recycling unit.

The treatment and recycling unit will pump the water collected from the center drain through a settling basin to remove sand and grit, an oil filter to remove oils and greases, an aerobic treatment holding tank, and then to a filtration system. Once filtered, the water is stored in a holding tank for reuse in future tank mix preparation.

10.2 Storage

Pesticide and adjuvant storage occurs in a pre-fabricated and self-contained storage unit located adjacent to the maintenance facility. The unit is locked and the Superintendent and his assistant keep keys. The locker is specifically designed for compliance with Occupational Safety and Health Administration (OSHA) and applicable State of Hawaii safety standards. Fertilizers will be stored on pallets in the maintenance facility. Materials are currently purchased on an as needed basis and used as soon as feasible to reduce the need for storage.

10.3 Spill Control

The Superintendent and/or his designee are responsible for the direction and supervision of response to spills of chemicals. As appropriate, the Superintendent will utilize outside contracted expertise to assist in spill cleanup, depending on the size and severity.

<u>Spill Response of 10 gallons, 100 pounds, or less</u>

> If the spilled material is less than 10 gallons or 100 pounds in size, the Superintendent or personnel designated by him will take immediate action by using materials available from the spill clean-up kit.

These spills are handled by absorbing, neutralizing, and controlling spread of the spill with absorbent booms or spreading of absorbent material on the spill, or both. A spill control kit is located at the maintenance facility and consists of the following:

Ten 4 ft. long absorbent booms
Five 2 ft. by 2 ft. absorbent pillows
1 5 lb. container of absorbent material (Pestizorb® or like absorbent material)
Rubber Gloves
Goggles
Tyvex Coveralls

The same personal protective equipment (i.e., gloves, coveralls, eye protection, etc.) specified on the label for application of the material will be used during control and clean up of the spill. Once contained and absorbed, the spilled material will be placed into appropriate containers for disposal. Disposal of the spilled material will be done in a manner consistent with local, state and federal law.

Spill Response of Greater than 10 gallons or 100 pounds

If the spilled material is greater than 10 gallons or 100 pounds in size, the Superintendent or his designee will take immediate action to mitigate the threat. This may include but not limited to: all steps previously mentioned for smaller spills, partial or complete Course closure, extensive booming or diking around areas of surface drainage, and/or removal of the material mixed with soil and/or water.

If the Superintendent deems that the spill is of such a size and nature that a contracted service is necessary to adequately clean up the spill, then that contractor will be called. The Course will establish and maintain a 24-hour on-call contract with a hazardous waste contractor.

11.0 PERSONNEL QUALIFICATIONS, LICENSING, AND TRAINING

11.1 Personnel Qualifications

Each applicator will be under the direct supervision of, or will be have a current Ornamental and Turf Pest Control Commercial Applicator certification from the Hawaii Department of Agriculture.

11.2 Licensing Requirements

The individuals holding the Commercial Applicator certification are required to meet all continuing education requirements as specified by the Hawaii Department of Agriculture.

11.3 Training

In addition to the training required to maintain licensure as described above, agronomy staff will also attend quarterly lunch-time presentations made by the Superintendent or others that cover topics described in the IGCMP.

12.0 CHANGES IN THE IGCMP

The IGCMP is a dynamic document that will change to reflect improvements in pest management tools and techniques. As is indicted on the footer of each page, the date of last revision is listed. Pages or sections of the IGCMP should be modified as deemed appropriate by the Superintendent and golf Course general manager, but not without concurrence and approval from both.

The State of Hawaii regularly approves use of new pesticides for use on turf. New fertilizers are also continuously being made available. As appropriate, these new compounds be evaluated by the Superintendent and if deemed appropriate, included in the IPM program for the Course.

13.0 REFERENCES

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Table 1. Species and Habitat Summary

Common Name	Scientific Name	Status	Habitat	Diet	Habitat is not Present in Project Area; Species Eliminated from Further Consideration	Habitat is Present in Project Area; Species Eliminated from Further Consideration for Reasons Given (see numbered notes)	Potential Risk is Present from Project Activities
BIRD							
Hawaiian short-eared owl (Pueo)	*Asio flammeus*	FT	Broad expanses of open land with low vegetation for nesting and foraging are required. Suitable areas include marshes, prairies, meadows, savannah.	Mainly rodents, but also small mammals birds and insects			**X(1)**
Hawaiian Goose (Nene)	*Branta sandvicensis*	FE	Wide variety of habitat including; coastal dune vegetation, non-native grasslands (i.e. golf courses, pastures) low/high elevation vegetated lava flows, shrubland, cinderfall, alpine grasslands.	Leaves, seeds, flowers, and fruits of native and non-native grasses, sedges, composites, and shrubs.		**X(2)**	
Hawaiian Hawk ('Io)	*Buteo solitarius*	FE	Various; forest, pastureland, savannah. Most successful nesting occurs in higher elevation native forest of 'ohi'a trees.	Varied diet including; small birds, rodents, insects			**X(1)**
Hawaiian Coot ('Alae ke'oke'o)	*Fulica Alae*	FE	Variety of aquatic habitats including fresh and brackish-water marshes, estuaries and ponds. Breeding sites typically have suitable emergent plant growth interspersed with open water (usually < 1m deep).	Seeds and leaves of aquatic plants, various invertebrates including snails, crustaceans, and aquatic or terrestrial insects, tadpoles, and small fish.		**X(2,3)**	**X(5)**
Black-necked stilt (Ae'o)	*Himantopus mexicanus knudseni*	FE	Feeding typically occurs in shallow flooded wetlands (~13 cm depth) including; open mudflats, pickleweed mats, and open pasture lands. Preferred nesting areas are freshly exposed mudflats interspersed with low growing vegetation or islands within fresh or brackish ponds.	Variety of invertebrates and other aquatic organisms in shallow water and mudflats such as insects, worms, small crabs and fish.		**X(3, 7)**	
Band-rumped storm-petrel	*Oceanodroma castro*	Candidate Species	Feeding habitat: over open ocean. Breeding Habitat: nests on island in burrow or rocky crevice, or in barren lava flows at tops of volcanoes.	Small fish, squid, crustaceans		**X(3)**	
Pacific Golden-Plover (Kolea)	*Pluvialis fulva*	NL	Winter range habitat in HI (August through April) includes areas with short grass, open fields, lawns, and some wetlands.	Varied diet including; terrestrial and aquatic invertebrates, berries, leaves and seeds		**X(2,3)**	**X(5)**
Dark-rumped petrel	*Pterodroma phaeopygia sandwichensis*	FE	Feeding habitat: over open ocean. Breeding Habitat: nest in burrows along large rock outcrops, under cinder cones at elevations above 7,200 feet (March - October).	Squid, crustaceans, and fish		**X(3)**	
Newell's shearwater	*Puffinus auricularis newelli*	FT	Feeding habitat: over open ocean, offshore waters near breeding grounds. Breeding habitat: burrows under ferns in forested mountain terrain, 500 - 2,300 feet.	primarily feeds on squid		**X (3)**	

Table 1. Species and Habitat Summary

Common Name	Scientific Name	Status	Habitat	Diet	Habitat is not Present in Project Area; Species Eliminated from Further Consideration	Habitat is Present in Project Area; Species Eliminated from Further Consideration for Reasons Given (see numbered notes)	Potential Risk is Present from Project Activities
MAMMAL							
Hawaiian Hoary Bat ('ope'ape'a)	*Lasirus cinereus semotus*	FE, SE	Feeding Habitat: open areas adjacent to forest and riparian habitats, Roosting Habitat: stands of tall trees	Flying insects, especially moths		**X(4)**	
Reptile							
Hawksbill Sea Turtle	*Eretmochelys imbricata*	FE, SE	Shallow water around reefs, bays, and inlets. Nesting Habitats: Beaches on the main islands of Hawaii with woody cover from May through October.	marine sponges and benthic invertebrates		**X(3)**	
PLANT							
Hawaiian fan palm (Loulu)	*Pritchardia affinis*	FE	Coastal mesic forest on the leeward side of the island. Grows near or in brackish water, 0 - 2000 feet elevation.	N/A		**X(6)**	

Notes:

(1) If rodent species present, control will be with traps. No rodenticides will be used.

(2) Manicured turf will not have seeds, flowers or fruit and will unlikely attract feeding. Native vegetation will not be fertilized or treated with pesticides.

(3) Species not likely to have pesticide exposure as its' target prey base consists of marine species. Course BMPs prevent pesticides from entering the marine environment.

(4) Species not likely to have pesticide exposure. Its' target prey only exists only if larval stage (caterpillar) is not controlled by pesticide treatment and therefore survives, pupates, and becomes an adult moth. Surviving caterpillars and resulting flying moths are not expected to carry residual pesticide.

(5) When treating insect pests in the EMAs for Greens 8, 9, and 18, use caution and suspect or cancel use if coot or plover is present. Only apply liquid formulation of pesticides and water in sufficiently in EMAs for Greens 8, 9 and 18.

(6) Species not likely to have pesticide exposure as a result of Environmental Management Areas (EMAs) adjacent to potential habitat.

(7) Ponds on the course are too deep to provide a suitable forage area, therefore exposure to pesticides used near ponds is not likely.

(NL) This species is Not Listed (NL) on any state or federal species lists, however it is the only abundant native bird observed in the course of the biological assessment.

FE - Species listed as federally endangered
FT - Species listed as federally threatened
SE - Species listed as state endangered

Table 2.
Quality of Potential Irrigation Water Sources

Parameter	Unit	No Impact[1]	Slight to Moderate Impact[1]	Sources				
				P1	SW	W2	WWTP	RES
EC	umhos/cm	< 700	700 to 3000	490.00	20.00	650.00	**760.00**	670.00
Hardness	mg/L			73.88	7.04	104.57	111.16	113.28
Bicarbonate	mg/L	< 90	90 to 500	36.80	14.15	55.91	82.80	62.28
pH	Std Units	Normal Range	6.5 to 8.4	8.56	**7.08**	**7.87**	**7.19**	**7.73**
Hardness	grains/gal			4.32	0.41	6.11	6.50	6.62
Sodium Adsorption Ratio	N/A			3.47	0.57	3.87	4.53	4.07
Sodium	ppm	< 70	> 70	68.28	3.36	**90.79**	**109.65**	**99.39**
Chloride Root Absorption	ppm	< 70	70 to 355	**117.27**	< 2.00	**163.57**	**165.27**	**173.61**
Chloride Foliar Absorption	ppm	< 100	> 100	**117.27**	< 2.00	**163.57**	**165.27**	**173.61**
TDS-Salt Concentration	ppm	< 450	450 to 2000	311.68	13.44	414.08	**483.84**	430.08
EC (given SAR < 3)	umhos/cm	> 700	700 to 200	490.00	20.00	650.00	760.00	670.00
Residual Sodium Carbonate	meq/L	< 1.25	> 1.25	-0.49	0.10	-1.16	-0.85	-1.23

Notes:

Date sampled: March 15, 2006

Values in Bold are above values that may cause slight to moderate impact to turf.

1-UC Cooperative Extension, California Turgrass Culture, Volume 49,#1-4, 1999. Interpreting Turfgrass Irrigation Water Results.

P1 = Pond near 12th fairway

SW = Surface water in Ninole Stream

W2 = Wellwater from Pump #2. Well purged 10 minutes at approximately 2 gpm prior to sampling.

WWTP = Wastewater Treatement Plant effluent

Table 3.
List of Proposed Chemicals

Trade Name	Pesticide Type	Pest(s) Active Against	Common Name	Topical Mode of Action	Biochemical Mode of Action	Signal Word	Resistance Potential	Fish Toxicity[a]	Avian Toxicity[b]	Mammalian Toxicity[b]	Water Solubility (mg/L)	Koc	% Active Ingredient	MAC[c] (ug/L)
Banner Maxx	Fungicide	Take All Patch (Gaeumannomyces); Microdochium Novale (Pink Snow Mold); Dollar Spot; Fusarium Patch; Brown Patch; Anthracnose; Summer Patch; Yellow Patch	Propiconazole	Acropetal Penetrant	Single site; Inhibit sterol synthesis in sensitive fungi.	Warning	High	High	Slight	Slight	100	648	14.3%	335
Bayleton 50 T&O	Fungicide	Dollar Spot (Sclerotinia); Anthracnose; Fusarium; Brown Patch; Summer Patch; Take All Patch	Triadimefon	Acropetal Penetrant	Single site; Inhibit sterol synthesis in sensitive fungi.	Caution	High	Moderate	Slight	Moderate	260	319	50.0%	1650
Chipco 26019	Fungicide	Dollar Spot (Sclerotinia); Microdochium Novale (Pink Snow Mold); Fusarium Blight and Patch; Brown Patch; Red Patch	Iprodione	Contact (Foliar Applied)	Single site; respiration interference by blocking the activity of certain respiratory enzymes	Caution	Moderate	Moderate	Slight	Practically Non-Toxic	13	666	50.0%	1300
Cleary's 3336 F	Fungicide	Take All Patch (Gaeumannomyces); Microdochium Novale (Pink Snow Mold); Summer Patch ; Anthracnose; Dollar Spot; Fusarium Patch; Large Brown Patch; Summer Patch	Thiophanate methyl	Systemic	Single site; inhibition of DNA synthesis and interference with nuclear division	Caution	Very High	Moderate	Practically Non-Toxic	Practically Non-Toxic	3.5	1830	46.0%	3450
OHP 6672 50W	**Fungicide**	**Leaf Spot (Bipolaris sorokiniana); Diplodia Blight (Sphaeropsis sapinea); Twig Blight (Kabatina spp.)**	**Thiophanate methyl**	**Systemic**		Caution		Very High	Practically Non-Toxic	Practically Non-Toxic	insoluble		50.0%	
Terramaster 35 WP	**Fungicide**	**Grease Spot (Pythium)**	**Etridiazole**	**Systemic**				Moderate	Practically Non-Toxic	Slight				
Daconil 2787/Weather Stik	Fungicide	Brown/Yellow Patch (Rhizoctonia); Dollar Spot; Anthracnose; Fusarium Patch; Brown Blight; Algae	Chlorothalonil	Systemic, multi-site	Multisite; disrupts cell enzyme activity	Warning	Unknown	Very High	Practically Non-Toxic	Practically Non-Toxic	1	5000	54.0%	6.5
Fore WSP	Fungicide	Algae (Oscillatoria); Microdochium Novale (Pink Snow Mold); Dollar Spot; Brown Patch; Pythium	Mancozeb	Systemic (foliar applied)	Multisite; disrupts enzyme activity	Caution	Unknown	High	Practically Non-Toxic	High	0.5	2000	80.0%	425
Heritage	Fungicide	Take All Patch (Gaeumannomyes); Microdochium Novale (Pink Snow Mold); Dollar Spot; Fusarium Patch; Brown Patch; Antrhacnose; Summer Patch;Yellow Patch	Azoxystrobin (Pyroxystrobin)	Systemic	Single site; blocks mitocondrial respiration	Caution	Unknown	Slight	Practically Non-Toxic	Practically Non-Toxic	6	15	50.0%	75000

Table 3.
List of Proposed Chemicals

Trade Name	Pesticide Type	Pest(s) Active Against	Common Name	Topical Mode of Action	Biochemical Mode of Action	Signal Word	Resistance Potential	Fish Toxicity[a]	Avian Toxicity[b]	Mammalian Toxicity[b]	Water Solubility (mg/L)	Koc	% Active Ingredient	MAC[c] (ug/L)
Subdue Maxx	Fungicide	Pythium Root Rot and Blight; Yellow Tuft	Mefenoxam (Apron; Metalaxyl)	Systemic	Single site, inhibits RNA synthesis	Caution	Unknown	Moderate	Slight	Practically Non-Toxic	26000	171	22.0%	6800

Table 3.
List of Proposed Chemicals

Trade Name	Pesticide Type	Pest(s) Active Against	Common Name	Topical Mode of Action	Biochemical Mode of Action	Signal Word	Resistance Potential	Fish Toxicity[a]	Avian Toxicity[b]	Mammalian Toxicity[b]	Water Solubility (mg/L)	Koc	% Active Ingredient	MAC[c] (ug/L)
Primo WSB	Growth Regulator	Poa Annua (Annual Bluegrass); Bentgrass	Trinexapac-ethyl	Acropetal Penetrant	Growth regulator	Caution	Unknown	Slight	Practically Non-Toxic	Practically Non-Toxic	1100	n.a.	25.0%	15500
Betasan 4-E Turf	Herbicide	Poa Annua (Annual Bluegrass); Annual Weeds	Bensulide	Preemergent	Shoot/Root Inhibitor	Caution	Unknown	High	Slight	Moderate	25	3900	46.0%	400
Chipco Ronstar 50WSP	Herbicide	Crabgrass (Digitaria sspp. & Sanguinalis); Annual Grasses; Broadleaf Weeds	Oxadiazon	Preemergent	Inhibits photosynthesis	Warning	Unknown	High	Slight	Practically Non-Toxic	0.7	3345	50.0%	350
Confront	Herbicide	English Daisy (Bellis Perrenis); Dandelion; Broadleaf Weeds	Chlopyralid, triethylamine salt; Triclopyr, triethylamine salt	Postemergent	Growth regulator	Danger	Unknown	High	Slight	Slight	435/23	68	45.1%	235
Dimension Turf	Herbicide	Poa Annua (Annual Bluegrass); Annual Weeds; Kikuyu Grass	Dithiopyr	Preemergent	Inhibits mitosis	Warning	Unknown	High	Practically Non-Toxic	Practically Non-Toxic	1.3	n.a.	12.7%	230
Riverdale MCPP-4 Amine (Mecoprop)	Herbicide	Broadleaf Weeds; Yarrow	MCPP (methyl-chlorophenoxy proprionic acid)	Postemergent	Growth regulator	Caution	Unknown	Slight	Moderate	Moderate	734	20	n.a.	50000
Round-Up Pro	Herbicide	Grasses; Weeds	Glyphosate	Postemergent, Broad-Spectrum	Amino acid synthesis inhibitor	Caution	Unknown	Slight	Slight	Practically Non-Toxic	12,000	2100	41.0%	16000
Rodeo	Aquatic Herbicide	Grasses; Weeds	Glyphosate	Postemergent, Broad-Spectrum	Amino acid synthesis inhibitor	Caution	Unknown	Slight	Slight	Practically Non-Toxic	12,000	2100	53.80%	16000
Surflan A.S.	Herbicide	Poa Annua (Annual Bluegrass); Annual Weeds; Broadleaf Weeds	Oryzalin	Preemergent	Inhibits microtubule formation	Caution	Unknown	High	Slight	Slight	2.5	600	40.4%	1115
Turflon Ester	Herbicide	English Daisy (Bellis Perrenis); Yarrow; Kikuyu Grass	Triclopyr, butoxyethyl ester	Postemergent	Growth regulator	Caution	Unknown	Slight	Slight	Slight	435	68	61.6%	180
DeltaGuard GC 5SC	Insecticide	Cutworms; Ants; Black Turfgrass Ataenius	Deltamethrin	Systemic Pyrethroid	CNS poison	Caution	Unknown	Very High	Practically Non-Toxic	Practically Non-Toxic	0.002	n.a.	4.75%	1.45
Dursban 50W	**Insecticide**	**Grass Webworm; Rhodesgrass Mealybug**	**Chlorpyrifos, Carbaryl**			Warning								
Sevin	**Insecticide**	**Grass Webworm; Rhodesgrass Mealybug**	**Chlorpyrifos, Carbaryl**											

Table 3.
List of Proposed Chemicals

Trade Name	Pesticide Type	Pest(s) Active Against	Common Name	Topical Mode of Action	Biochemical Mode of Action	Signal Word	Resistance Potential	Fish Toxicity[a]	Avian Toxicity[b]	Mammalian Toxicity[b]	Water Solubility (mg/L)	Koc	% Active Ingredient	MAC[c] (ug/L)
Merit 0.5 G	Insecticide	Grubs (chagers and ataenius); Black Turfgrass Ataenius; Cutworms	Imidacloprid	Systemic	CNS poison	Caution	Unknown	Very High	High	Moderate	0.01	n.a.	0.5%	41.5
Basamid Granular	Nematicide	Various Nematode Species; Various Weed Species; Various Fungal Diseases	Dazomet	Contact Soil Fumigant	CNS poison	Warning	Unknown	Very High	Moderate	Moderate	3000	10	99.0%	70
Nemacur	Nematicide	Various Nematode Species	Fenamiphos	Contact	Nerve poison	Danger	Low	Very High	High	High	400	100	10.0%	1.9
Eaton's Answer	Rodenticide	Various Vertebrate Pests	Diphacinone	Ingestion	Anti-coagulant	Caution	Low	Moderate	High	High	17	n.a.	0.005%	1155

Notes:
a: Qualitative Designation (Meister, R.T. (ed.). 1999. Farm Chemicals Handbook '99. Meister Publishing Company, Willoughbby, OH
Very Highly Toxic: LC50 < 100 µg/L
Highly Toxic: 100 µg/L < LC50 < 1000 µg/L
Moderately Toxic: 1000 µg/L < LC50 < 10,000 µg/L
Slightly Toxic: 10,000 µg/L < LC50 < 100,000 µg/L
Practically Non-Toxic: LC50 > 100,000 µg/L
b: Qualitative Designation (Meister, R.T. (ed.). 1999. Farm Chemicals Handbook '99. Meister Publishing Company, Willoughbby, OH
Very Highly Toxic: LD50 < 10 mg/kg
Highly Toxic: 10 mg/kg < LD50 < 50 mg/kg
Moderately Toxic: 50 mg/kg < LD50 < 500 mg/kg
Slightly Toxic: 500 mg/kg < LD50 < 2,000 mg/kg
Practically Non-Toxic: LD50 > 2,000 mg/kg
N/A- Not Applicable, **n.a.**- Not Available

CNS- Central Nervous System

c: MAC-Maximum Allowable Concentration. Value represents 50 % of the lowest published 96 hr LC50 for freshwater aquatic organisms available in EPA AQUIRE ECOTOX Database as of December 2002.

Table 4.
Summary of Potential Pests, Threshold Ranges, and Controls

Pest Type	Course Location	Threshold Range (Noticable Damage or Presence/1,000 Sq. Ft.)	Cultural Controls[1]	Chemical Controls [2]
Fungal Pathogens	Greens, Tees	1-2	Variable. Refer to Table 5.	
	Fairway	4-10		
	Rough	6-12		
Grass Weeds, Annual	Greens, Tees	1-2	HP, OS, RBM, RD	ST, B
	Fairway	10-20	HP, OS, RD	ST, B
	Rough	20-50	HP, OS, RD	ST, B
Grass Weeds, Perennial	Greens, Tees	1-2	HP, OS, RBM, RD	ST, B
	Fairway	10-20	HP, OS, RD	ST, B
	Rough	20-50	HP, OS, RD	ST, B
Broad Leaf Weeds, Perennial	Greens, Tees	1-2	HP, OS, RBM, RD	ST, B
	Fairway	4-10	HP, OS, RD	ST, B
	Rough	6-12	HP, OS, RD	ST, B
Algae	Lakes	Nuisance Levels	Aerify, adjust pH, RD/ExVg	ST, B
Aquatic Weeds	Lakes	Nuisance Levels	HP	ST, B
Nematodes	Greens, Tees	1	IHOC, IRG	B
	Fairway	4-10	IHOC, IRG	ST, B
	Rough	6-12	Leave	ST, B
Insects	Greens, Tees	1-2	HP	ST, B
	Fairway	4-10	IHOC	ST, B
	Rough	6-12	IHOC	ST, B

Pest Types may include, but are not limited to:
Fungal Pathogens: Fusarium Patch and Blight, Pythium Blight, Dollar Spot, Rhizoctonia
Grass Weeds, Annual: Kikuyu, Crabgrass, Goosegrass
Grass Weeds, Perennial: Rattail (Smut grass)
Broad Leaf Weeds, Perennial: Clover, Dandelion, Plaintain
Aquatic Weeds: Hyacinth, Hydrilla, and Pondweed
Nematodes: Various
Insects: Soil Web worm, Army worm, Fiery Skipper
Algae: Planktonic and Filamentous

Cultural Practices include, but are not limited to:
HP: Hand Pick
HP-Net: Hand Pick with Net
OS: Overseed
RBM: Repair Ball Marks
RD: Repair Divots
IHOC: Increase Height of Cut
IRG: Increase Root Growth
RD/ExVg: Remove Debris & Excess Vegetation

Chemical Control includes:
ST: Spot Treat, Refer to Tables 3 & 5.
B: Broadcast, Refer to Tables 3 & 5.

Notes:
1. Assumes that good agronomic practices to establish/promote healthy turf and soil are maintained.
2. Chemical Controls are variable and depend on the pest. Always follow label directions. Refer to Table 3.

Table 5.
Summary of Fungal Disease Controls

Fungal Pathogen	Conditions Favoring Development	Cultural Practices for Control[1]	Chemical Control Options[2]						
			Daconil	Heritage	Subdue Maxx	Banner Maxx	Cleary's 3336	Chipco 26019	Fore
		Trade Name: Chemical Name:	Chlorothalonil	Azoxystrobin	Metlaxyl	Propiconazole	Thiophanate Methyl	Iprodione	Mancozeb
Fusarium Patch	Temps between 32-65 F, extended leaf wetness, soil pH >6.5, Excess Fall N Fertilization	Decrease Soil pH, Inc. Hgt. of Cut, reduce shade, improve aeration				X	X	X	
Fusarium Blight	South facing slopes; High N, high moisture, heavy thatch, Heavy gutation water	Core, amend to decrease compaction, remove thatch, moderate N					X	X	X
Pythium Blight	Poor sanitation of implements, extended leaf wetness, high N	Pole or drag in AM, Reduce shade		X	X				X
Sclerotina Dollar Spot	High Humidity, Heavy thatch, Low soil moisture, Low N	Pole or drag in AM, remove excess thatch	X			X	X	X	
Summer Patch	Hot, Humid Weather, poorly rooted turf, compacted soil, High Soil Moisture	Core, amend to decrease compaction		X		X	X		
Brown Patch	Moist Soil, Temperatures 50-65 F, Soil pH>6.5, High rates of Urea application	Remove dead sod, rake or reseed, maintain adequate P, K, soil pH <6.5, fertilize with ammonium salts	X	X		X	X	X	X
Anthracnose	Susceptible/weakened turf, high temperatures, soil compaction	Core, amend to decrease compaction, syringe during hottest part of day, reduce thatch, avoid heavy late summer fertilization	X	X		X	X		

Notes:

X Indicates that partial or complete control of this pathogen is achieved with this fungicide. Always refer to the product label.

1. Assumes the following:
   - Use of metal spikes are prohibited
   - Good agronomic practices to establish and promote healthy turf and soil are maintained
   - Proper cleaning of implements (verticutters, cup cutters, aerators, mowers, etc.) between surfaces occurs
2. Adequate fungicide rotation for prevention resistance development is critical. Always read the product label.

Sea Mountain Golf Course Sampling Locations

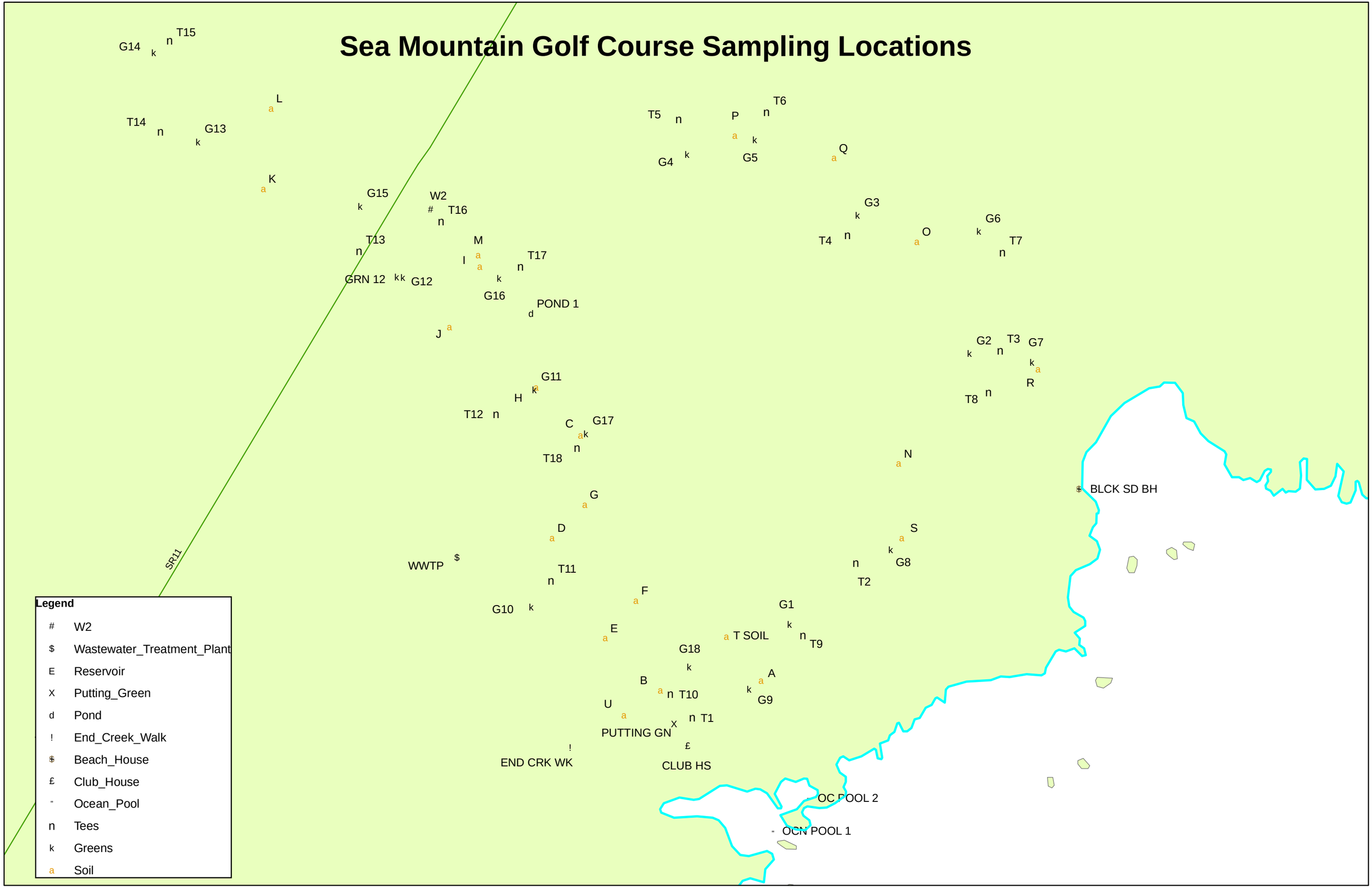
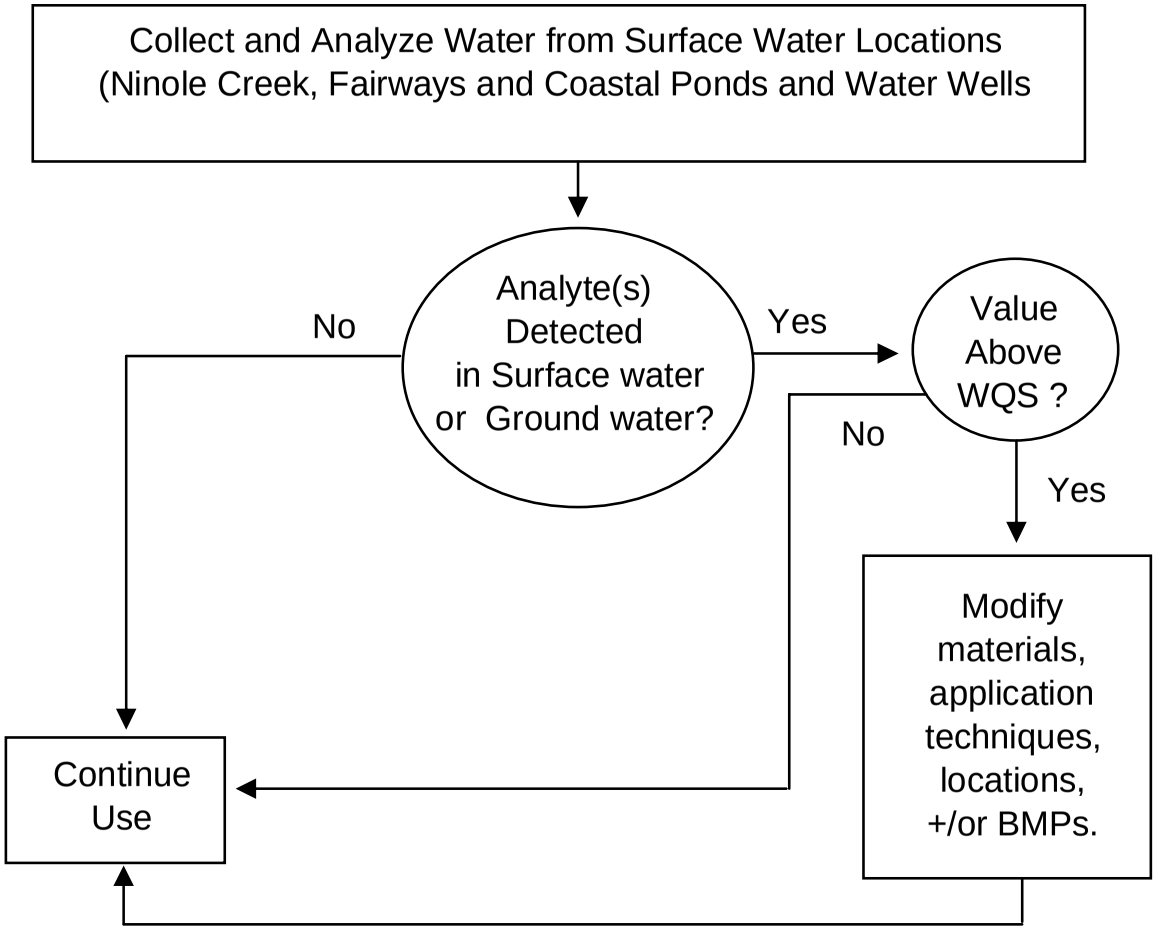


Figure 2.
Water Quality Monitoring Decision Tree



Legend
WQS: Water Quality Objective
BMP: Best Management Practice

Action

Decision

SMGC IGCMP Tables.xls, Fig 2. Decision Tree
4/20/2006

Appendix I

Acoustic Study for Sea Mountain at Punalu‘u
(Y. Ebisu and Associates, Dec. 2005)

ACOUSTIC STUDY FOR SEA MOUNTAIN AT PUNALU'U HAWAII, HAWAII

Prepared for:

GROUP 70 INTERNATIONAL

Prepared by:

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DECEMBER 2005

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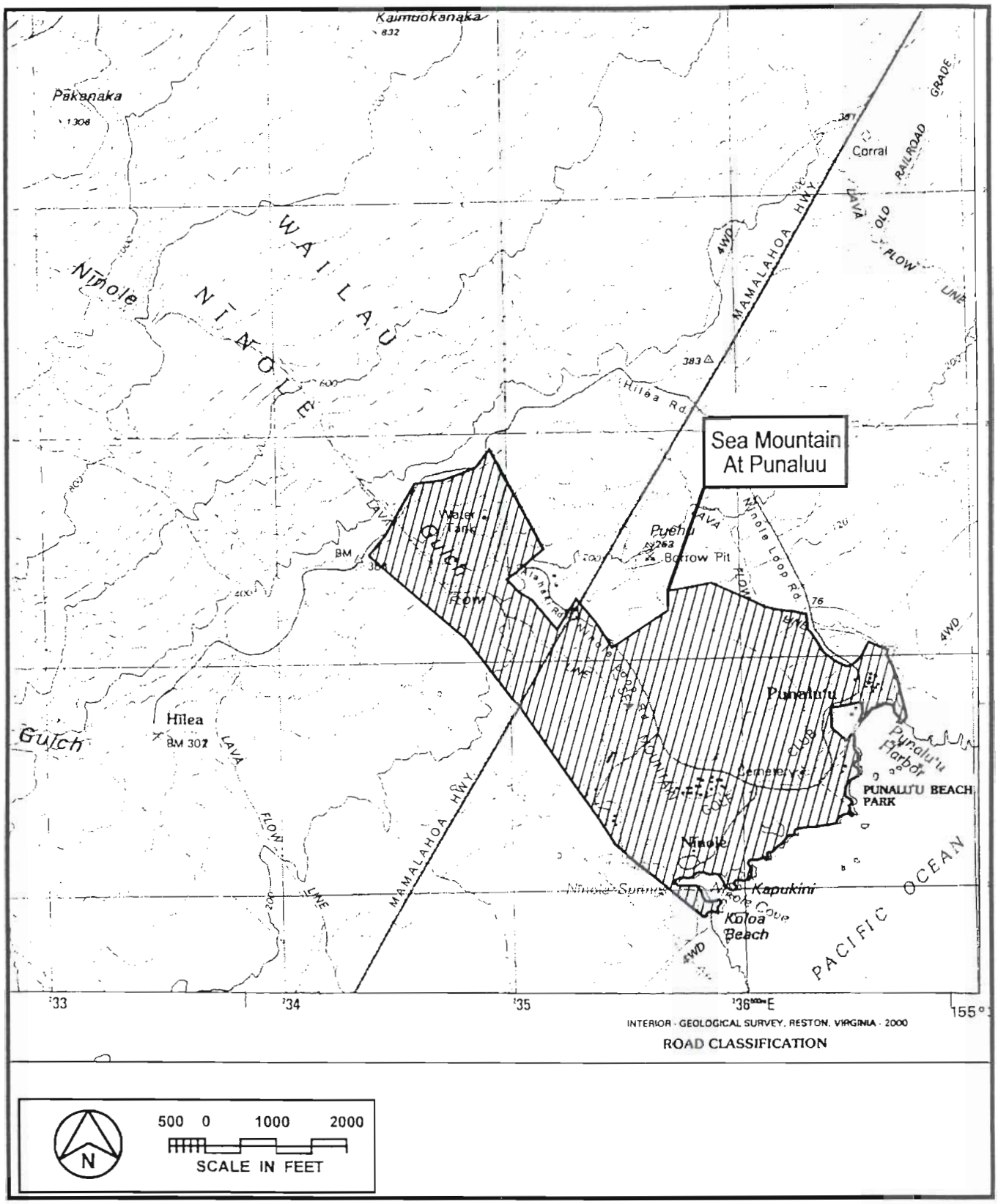
CHAPTER I. SUMMARY

The existing and future traffic noise levels in the vicinity of the proposed Sea Mountain At Punaluu Project on the Island of Hawaii were evaluated for their potential impact on present and future noise sensitive areas. Figure 1 depicts the location of the project site. The future traffic noise levels along the primary access roadways to the project were calculated for the year 2015.

Along the existing Mamalahoa Highway, traffic noise levels are expected to increase by 4.5 to 5.2 DNL between CY 2005 and CY 2015 as a result of both project and non-project traffic. Along the section of Alahaki Road north of Mamalahoa Highway through the existing subdivision, traffic noise levels are predicted to increase from essentially zero to 54 DNL at 50 FT setback distance from the roadway centerline. South of the highway along Ninole Loop Road, traffic noise levels are predicted to increase by 12.2 DNL above existing levels. Traffic noise increases due to project traffic are predicted to range from 4.2 to 5.0 DNL along Mamalahoa Highway, and increases caused by non-project traffic are predicted to range from 0.2 to 0.4 DNL along the highway. The future increases in traffic noise levels are expected to be controlled by project traffic along Mamalahoa Highway as well as along Alahaki Road and Ninole Loop Road.

Future traffic noise levels at existing residences along Mamalahoa Highway, Alahaki Road, and Ninole Loop Road should not exceed the FHA/HUD standard of 65 DNL at project build-out by CY 2015. For this reason traffic noise mitigation measures should not be required at these existing residences in conjunction with this project. Two of the planned project residences fronting Mamalahoa Highway will require traffic noise mitigation measures since they appear to be located within the 65 DNL traffic noise contour. Traffic noise mitigation in the form of a 6 foot high sound attenuating wall should be possible for single story construction at these two residences. If two-story construction is used, closure and air conditioning will probably be required at the second floor rooms. In order to reduce risks of occupant dissatisfaction in the new project residences fronting Mamalahoa Highway, construction of sound attenuation walls and/or the use of air conditioning should be considered.

Unavoidable, but temporary, noise impacts may occur during the construction of the proposed project. Because construction activities are predicted to be audible at adjoining properties, the quality of the acoustic environment may be degraded to unacceptable levels during periods of construction. Mitigation measures to reduce construction noise to inaudible levels will not be practical in all cases. For this reason, the use of quiet equipment and construction curfew periods as required under the State Department of Health noise regulations are recommended to minimize construction noise impacts.



PROJECT LOCATION MAP

FIGURE 1

CHAPTER II. PURPOSE

The objectives of this study were to describe the existing and future noise environment in the environs of the proposed Sea Mountain At Punaluu on the island of Hawaii. Traffic noise level increases and impacts associated with the proposed development were to be determined within the project site as well as along the public roadways expected to service the project traffic. A specific objective was to determine the future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases. Assessments of possible impacts from short term construction noise at the project site were also included in the noise study objectives. Recommendations for minimizing these noise impacts were also to be provided as required.

CHAPTER III. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies to assess environmental noise is the Day-Night Average Sound Level (DNL or Ldn). This descriptor incorporates a 24-hour average of instantaneous A-Weighted sound levels as read on a standard Sound Level Meter. The maximum A-Weighted sound level occurring while a noise source such as a heavy truck or aircraft is moving past a listener (i.e., the maximum sound level from a "single event") is referred to as the "Lmax value". The mathematical product (or integral) of the instantaneous sound level times the duration of the event is known as the "Sound Exposure Level", or Lse, which is analogous to the energy of the time-varying sound levels associated with a single event.

The DNL values represent the average noise during a typical day of the year. DNL exposure levels of 55 or less are typical of quiet rural or suburban areas. DNL exposure levels of 55 to 65 are typical of urbanized areas with medium to high levels of activity and street traffic. DNL exposure levels above 65 are representative of densely developed urban areas and areas fronting high volume roadways.

By definition, the minimum averaging period for the DNL descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the DNL descriptor. Because of the averaging used, DNL values in urbanized areas typically range between 50 and 75 DNL. In comparison, the typical range of intermittent noise events may have maximum Sound Level Meter readings between 75 and 105 dBA. A more complete list of noise descriptors is provided in Appendix B to this report. In Appendix B, the Ldn descriptor symbol is used in place of the DNL descriptor symbol.

Table 1, extracted from Reference 1, categorizes the various DNL levels of outdoor noise exposure with severity classifications. Table 2, also extracted from Reference 1, presents the general effects of noise on people in residential use situations. Figure 2, extracted from Reference 2, presents suggested land use compatibility guidelines for residential and nonresidential land uses. A general consensus among federal agencies has developed whereby residential housing development is considered acceptable in areas where exterior noise does not exceed 65 DNL. This value of 65 DNL is used as a federal regulatory threshold for determining the necessity for special noise abatement measures when applications for federal funding assistance are made.

As a general rule, noise levels of 55 DNL or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, DNL levels generally range from 55 to 65 DNL, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 DNL, and as high as 75 DNL when the

TABLE 1

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

NOISE EXPOSURE CLASS	DAY–NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL (1) STANDARD
Minimal Exposure	Not Exceeding 55 DNL	Not Exceeding 55 Leq	Unconditionally Acceptable
Moderate Exposure	Above 55 DNL But Not Above 65 DNL	Above 55 Leq But Not Above 65 Leq	Acceptable(2)
Significant Exposure	Above 65 DNL But Not Above 75 DNL	Above 65 Leq But Not Above 75 Leq	Normally Unacceptable
Severe Exposure	Above 75 DNL	Above 75 Leq	Unacceptable

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) FHWA uses the Leq instead of the Ldn descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 Leq.

TABLE 2

EFFECTS OF NOISE ON PEOPLE
(Residential Land Uses Only)

EFFECTS[1] / DAY-NIGHT AVERAGE SOUND LEVEL IN DECIBELS	Hearing Loss	Speech Interference		Annoyance[2]	Average Community Reaction[4]	General Community Attitude Towards Area
		Indoor	Outdoor			
	Qualitative Description	%Sentence Intelligibility	Distance in Meters for 95% Sentence Intelligibility	% of Population Highly Annoyed[3]		
75 and above	May Begin to Occur	98%	0.5	37%	Very Severe	Noise is likely to be the most important of all adverse aspects of the community environment.
70	Will Not Likely Occur	99%	0.9	25%	Severe	Noise is one of the most important adverse aspects of the community environment.
65	Will Not Occur	100%	1.5	15%	Significant	Noise is one of the important adverse aspects of the community environment.
60	Will Not Occur	100%	2.0	9%	Moderate to Slight	Noise may be considered an adverse aspect of the community environment.
55 and below	Will Not Occur	100%	3.5	4%		Noise considered no more important than various other environmental factors.

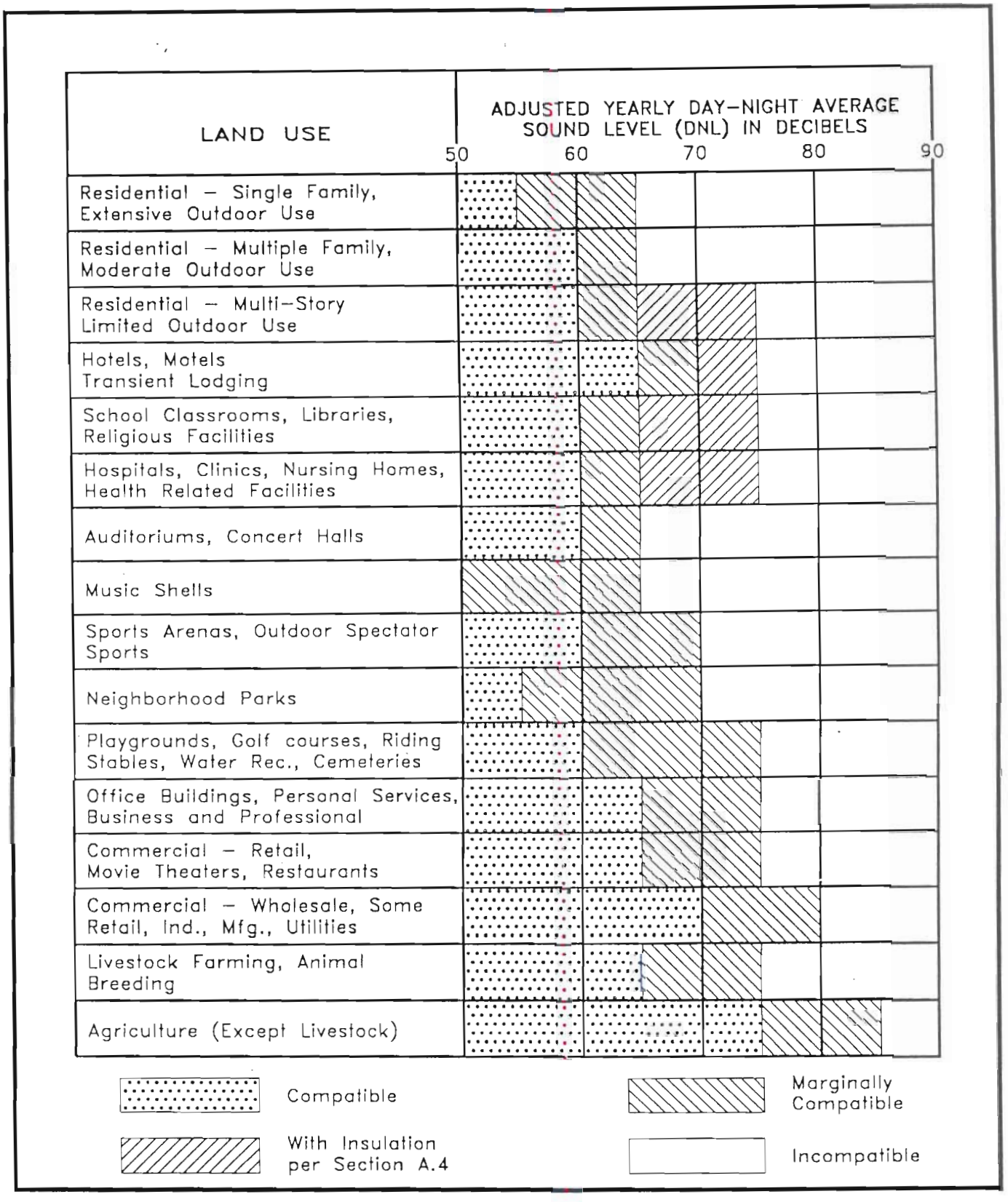
1. "Speech Interference" data are drawn from the following tables in EPA's "Levels Document": Table 3, Fig. D-1, Fig. D-2, Fig. D-3. All other data from National Academy of Science 1977 report "Guidelines for Preparing Environmental Impact Statements on Noise, Report of Working Group 69 on Evaluation of Environmental Impact of Noise."

2. Depends on attitudes and other factors.

3. The percentages of people reporting annoyance to lesser extents are higher in each case. An unknown small percentage of people will report being "highly annoyed" even in the quietest surroundings. One reason is the difficulty all people have in integrating annoyance over a very long time.

4. Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.

NOTE: Research implicates noise as a factor producing stress-related health effects such as heart disease, high-blood pressure and stroke, ulcers and other digestive disorders. The relationships between noise and these effects, however, have not as yet been quantified.



LAND USE COMPATIBILITY WITH YEARLY AVERAGE DAY-NIGHT AVERAGE SOUND LEVEL (DNL) AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED.
(Source: American National Standards Institute S12.9-1998/Part 5)

FIGURE 2

roadway is a high speed freeway. Due to noise shielding effects from intervening structures, interior lots are usually exposed to 3 to 10 DNL lower noise levels than the front lots which are not shielded from the traffic noise.

For the purposes of determining noise acceptability for funding assistance from federal agencies, an exterior noise level of 65 DNL or lower is considered acceptable. These federal agencies include the Federal Aviation Administration (FAA), Department of Defense (DOD); Federal Housing Administration, Housing and Urban Development (FHA/HUD), and Veterans Administration (VA). This standard is applied nationally (see Reference 3), including Hawaii.

Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 DNL does not eliminate all risks of noise impacts. Because of these factors, a lower level of 55 DNL is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise (see Reference 4). For typical, naturally ventilated structures in Hawaii, an exterior noise level of 55 DNL results in an interior level of approximately 45 DNL, which is considered to be the "Unconditionally Acceptable" (or "Near-Zero Risk") level of interior noise. However, after considering the cost and feasibility of applying the lower level of 55 DNL, government agencies such as FHA/HUD and VA have selected 65 DNL as a more appropriate regulatory standard.

For commercial, industrial, and other non-noise sensitive land uses, exterior noise levels as high as 75 DNL are generally considered acceptable. Exceptions to this occur when naturally ventilated office and other commercial establishments are exposed to exterior levels which exceed 65 DNL.

In the State of Hawaii, the State Department of Health (DOH) regulates noise from on-site activities. State DOH noise regulations are expressed in maximum allowable property line noise limits rather than DNL (see Reference 5). The noise limits apply on all islands of the State, including the island of Hawaii. Although they are not directly comparable to noise criteria expressed in DNL, State DOH noise limits for preservation/residential, apartment/commercial, and agricultural/industrial lands equate to approximately 55, 60, and 76 DNL, respectively.

Because the proposed project site is located on lands designated for single family and multifamily residential, and resort uses, various DOH noise limits would be applicable along the lot boundary lines or receptor locations for any stationary machinery, or equipment related to commercial or construction activities. These property line limits are 60 dBA and 50 dBA during the daytime and nighttime periods, respectively, for resort lots. For multifamily or apartment use, the State DOH limits are also 60 dBA and 50 dBA during the daytime and nighttime periods, respectively. For single family residential and public facility uses, the State DOH limits are 55 dBA and 45 dBA during the daytime and nighttime periods, respectively. These noise limits

cannot be exceeded for more than 2 minutes in any 20-minute time period under the State DOH noise regulations. The State DOH noise regulations do not apply to aircraft or motor vehicles.

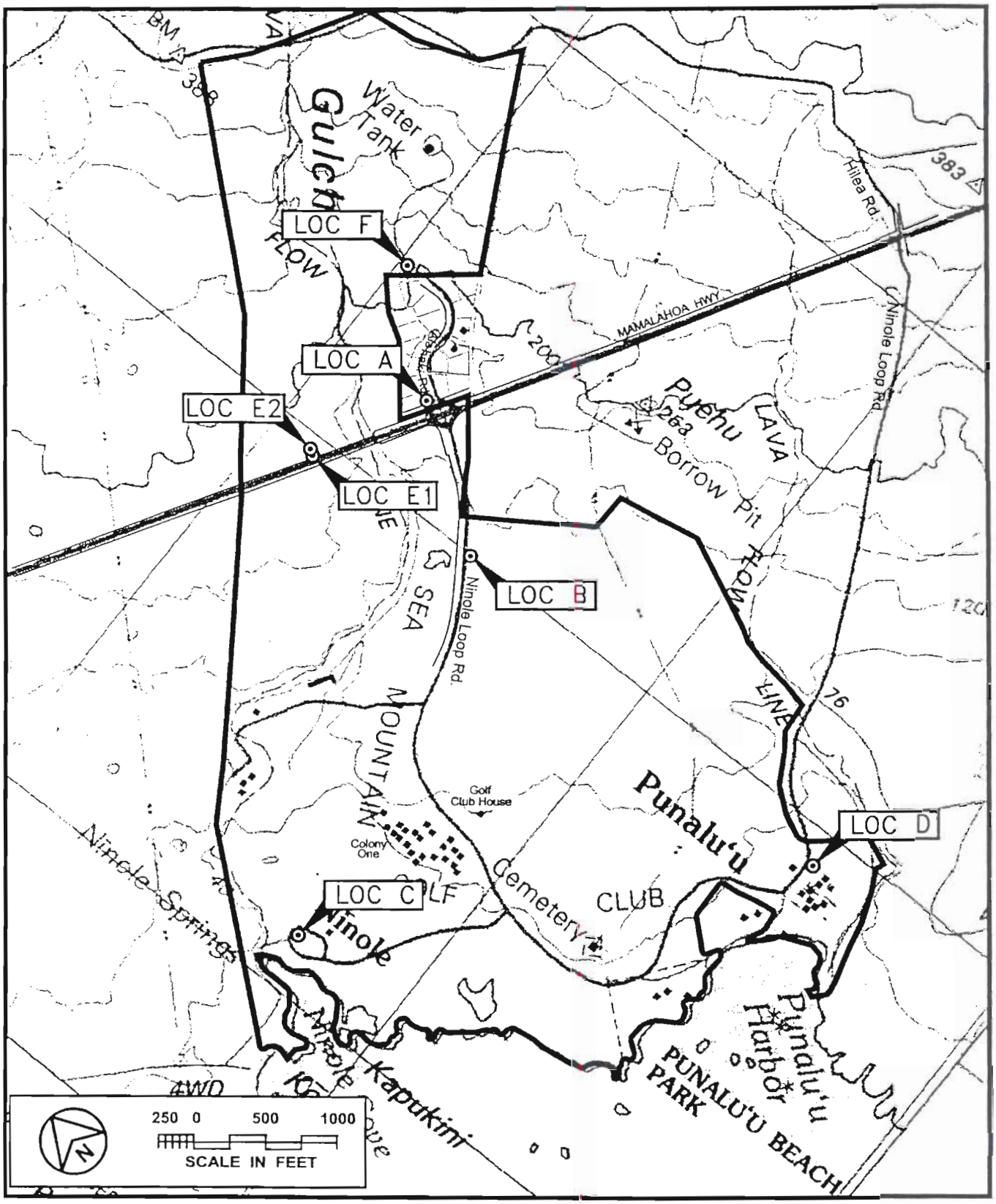
CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing traffic and background ambient noise levels were measured at seven locations in the project environs to provide a basis for developing the traffic noise contours along the roadways which will service the proposed development: Mamalahoa Highway, Alahaki Road, and Ninole Loop Road; and for determining the existing background ambient noise levels in the project area.

The locations of the measurement sites are shown in Figure 3. Noise measurements were performed during December 2005. The traffic noise measurement results, and their comparisons with computer model predictions of existing traffic noise levels are summarized in Table 3. The results of the traffic noise measurements were compared with calculations of existing traffic noise levels to validate the computer model used.

Traffic noise calculations for the existing conditions as well as noise predictions for the future conditions with and without the project were performed using the Federal Highway Administration (FHWA) Noise Prediction Model, Version 2.5 (Reference 6). Traffic data entered into the noise prediction model were: hourly traffic volumes, average vehicle speeds, estimates of traffic mix, and hard soil propagation loss factor. The traffic assignments for the project (Reference 7) and Hawaii State Department of Transportation counts on Mamalahoa Highway (References 8 and 9) were the primary sources of data inputs to the model. For existing and future traffic, it was assumed that the average noise levels, or Leq(h), during the PM peak hour were 0.4 dB higher than the 24-hour DNL along each roadway segment. This assumption was based on computations of both the hourly Leq and the 24-hour DNL of traffic noise along Mamalahoa Highway (see Figures 4 and 5).

Traffic noise calculations for both the existing and future conditions in the project environs along Mamalahoa Highway and along the project access roads were developed for ground level receptors without the benefit of shielding effects. Traffic assignments with and without the project were obtained from the project's traffic turning movements (Reference 7). The forecasted increases in traffic noise levels over existing levels were calculated for scenarios with and without the project. Areas with potential adverse noise impacts resulting from the project were identified. The relative contributions of non-project and project related traffic to the total noise levels were also calculated, and an evaluation was made of possible traffic noise impacts resulting from the project.



LOCATIONS OF NOISE MEASUREMENT SITES

FIGURE 3

TABLE 3
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	------ Hourly Traffic Volume ------ AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
A. 126 FT from centerline of Mamalahoa Highway (12/20/05)	0942 TO 1042	52	166	1	7	58.0	58.5
B. 50 FT from centerline of Ninole Loop Road (12/20/05)	1228 TO 1328	37	84	0	0	52.8	52.9
C. At West End of Parking Lot Near Golf Cart Barn (12/20/05)	1334 TO 1404	N/A	N/A	N/A	N/A	55.8	N/A
D. 50 FT from centerline of Ninole Loop Road (12/20/05)	1412 TO 1512	36	34	0	1	49.9	50
E1. 50 FT from centerline of Mamalahoa Highway (12/20/05)	1522 TO 1622	52	237	2	9	63.3	63.6
E2. 100 FT from centerline of Mamalahoa Highway (12/20/05)	1522 TO 1622	52	237	2	9	54.6	56.4

TABLE 3 (CONTINUED)
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	Hourly Traffic Volume AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
F. At North End of Alahaki Road (12/20/05)	1628 TO 1658	N/A	N/A	N/A	N/A	52.0	N/A

FIGURE 4

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF MAMALAHOA HIGHWAY S.W. OF NINOLE ROAD (WEST) (MAY 4, 2004)

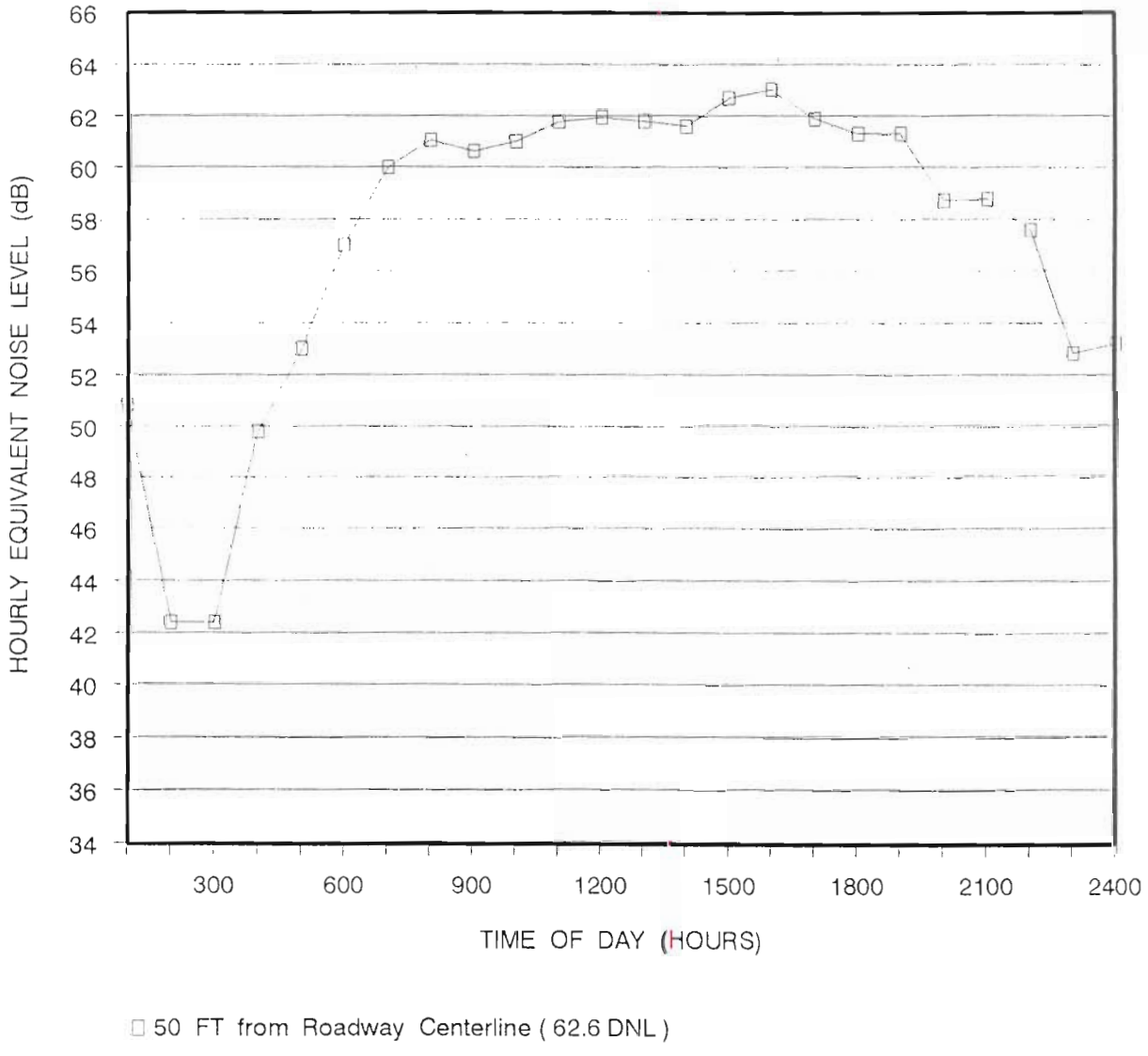
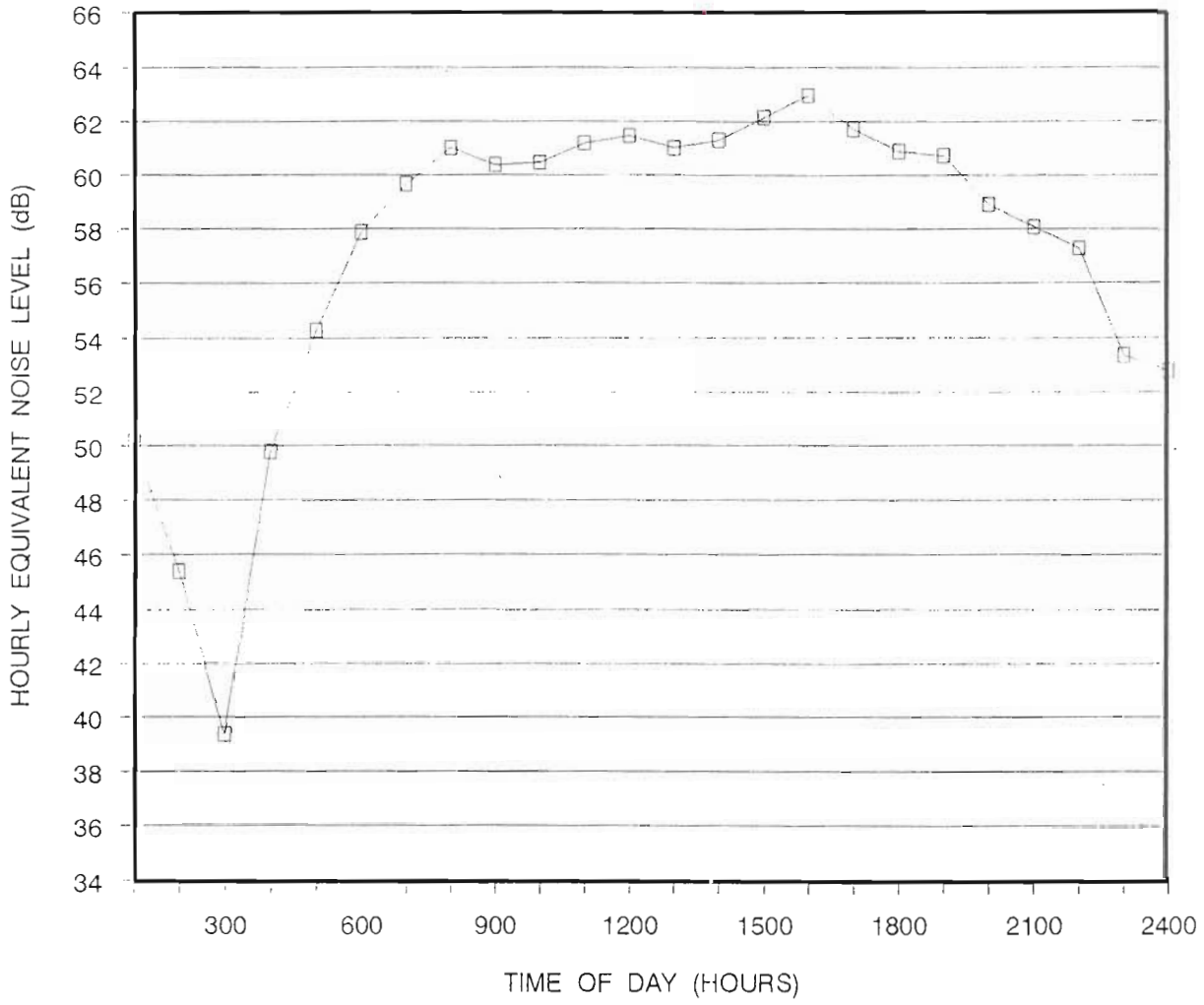


FIGURE 5

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF MAMALAHOA HIGHWAY N.E. OF NINOLE ROAD (WEST) (MAY 4, 2004)



□ 50 FT from Roadway Centerline (62.5 DNL)

CHAPTER V. EXISTING NOISE ENVIRONMENT

The existing traffic noise levels in the project environs vary from levels of approximately 65 DNL along the Mamalahoa Highway Rights-of-Way, to less than 45 DNL at the mauka (north) property boundary and interior locations of the project site. Traffic noise levels along Mamalahoa Highway are less than 65 DNL at 31 FT or greater setback distances from the highway centerline. Along Ninole Loop Road, existing traffic noise levels are approximately 50 DNL at 50 FT setback distance from the roadway centerline.

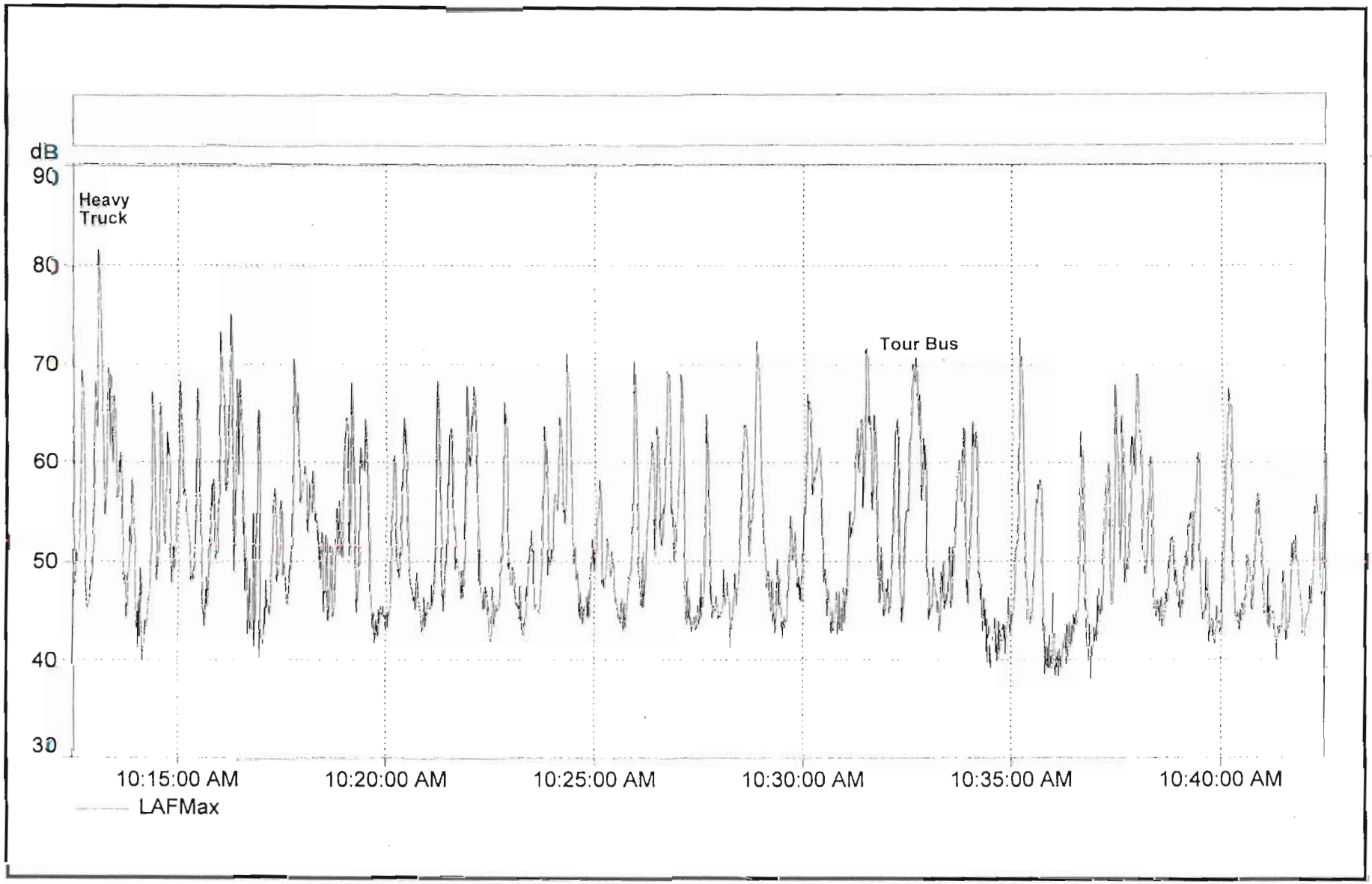
Measured traffic and background noise levels which were recorded at Locations "A" through "F" on December 20, 2005 are shown in Figures 6 through 11. At Locations "A" and "E1", which were along Mamalahoa Highway, the regular excursions of sound levels from 40 dB to 70 dB were caused by motor vehicles passing the noise measurement locations. Because of the relatively low traffic volume along the highway, each passing motor vehicle produced a discrete noise event (or "spike"). With increasing traffic volumes on the highway, the discrete noise events become more frequent, and the periods of quite (or low noise levels) become less frequent.

At Locations "B" and "D", which were along Ninole Loop Road, the discrete noise events (or "spikes") were less frequent and not as intrusive due to the lower traffic volumes and lower vehicle speeds.

At locations removed from the highway and along Ninole Loop Road, measured background noise levels were controlled by the sounds of birds, passing golf carts, and barking dogs. During periods of quiet, background noise levels dropped to values between 30 to 35 dB. With the sounds of birds present, background noise levels were typically between 50 and 55 dB.

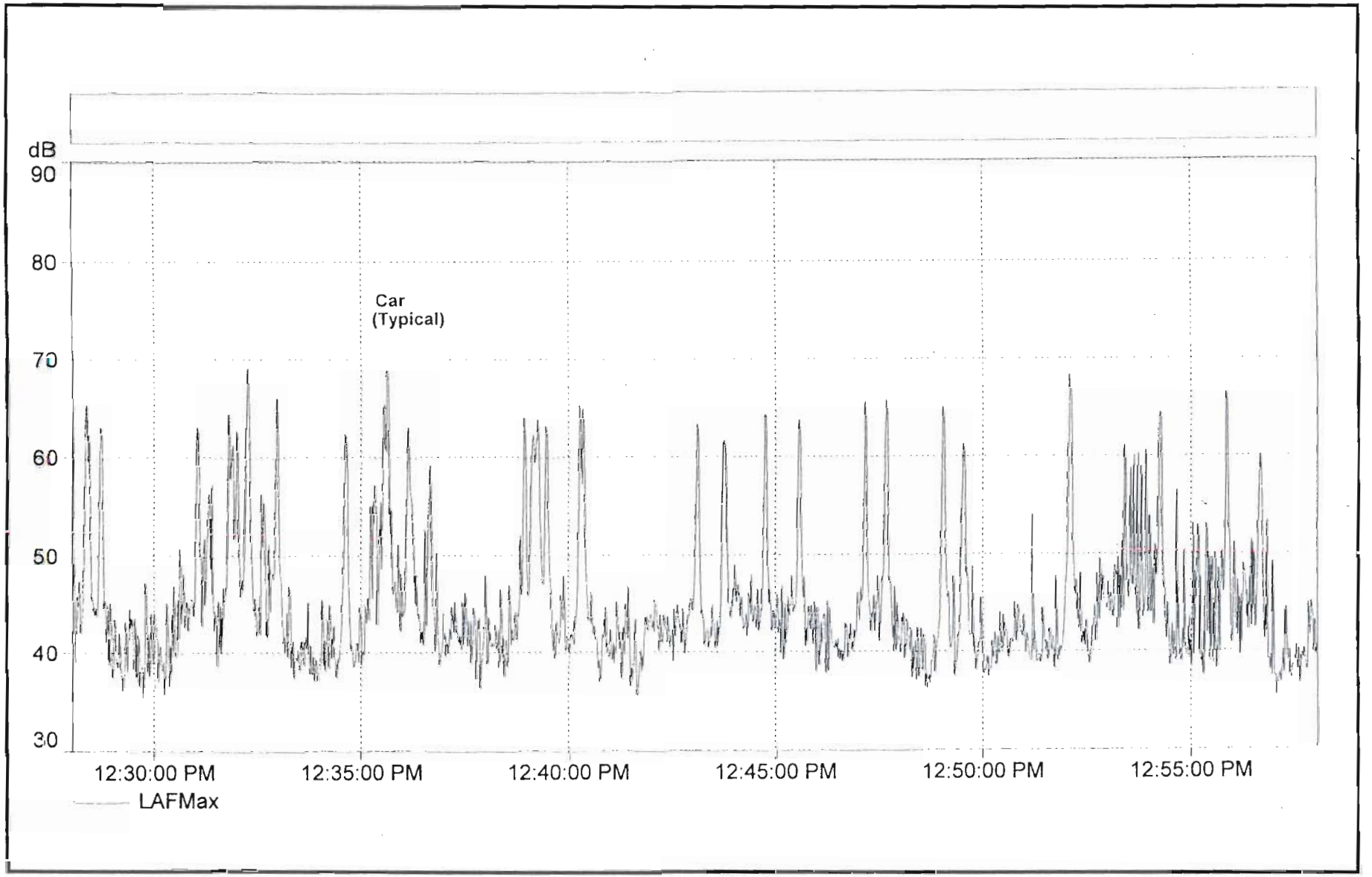
Calculations of existing traffic noise levels during the PM peak traffic hour are presented in Table 4. The hourly Leq (or Equivalent Sound Level) contribution from each roadway section in the project environs was calculated for comparison with forecasted traffic noise levels with and without the project. The existing setback distances from the roadways' centerlines to their associated 65 and 70 DNL contours were also calculated as shown in Table 5. The contour line setback distances do not take into account noise shielding effects or the additive contributions of traffic noise from intersecting street sections. Based on the results of Table 5, it was concluded that the existing 65 DNL traffic noise contour is located approximately 31 FT from the centerline of Mamalahoa Highway.

At setback distances of 200 FT from the Mamalahoa Highway centerline, existing traffic noise levels are less than 55 DNL, and present minimal risk of adverse noise impacts. At these locations on the project site which are removed from Mamalahoa Highway, local traffic noise, dog barking, golf course maintenance equipment, and the



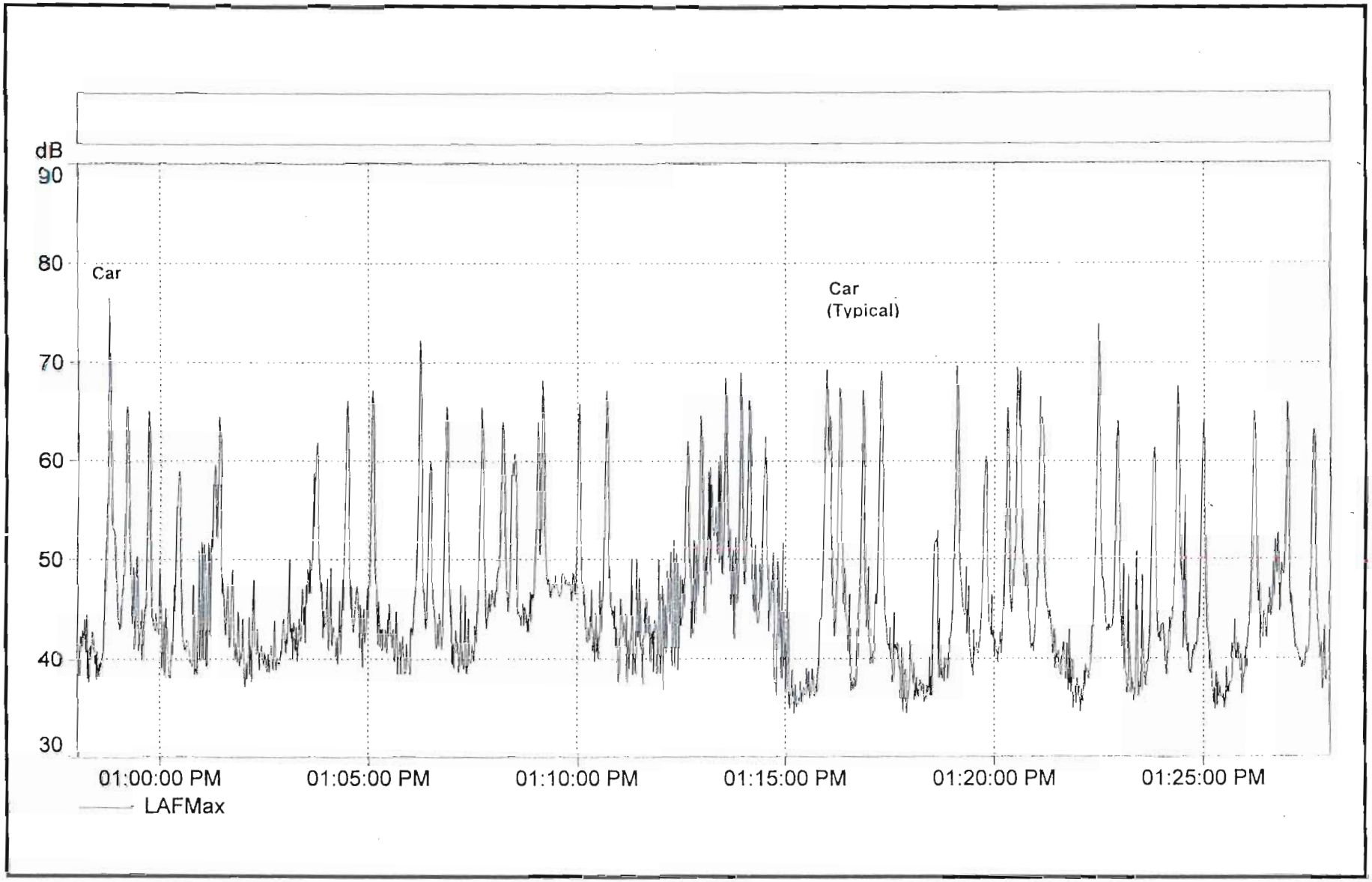
MAXIMUM SOUND LEVEL VS. TIME MEASURED AT LOCATION "A" (12/20/05; 0942 TO 1042 HOURS)

FIGURE 6(CONT.)



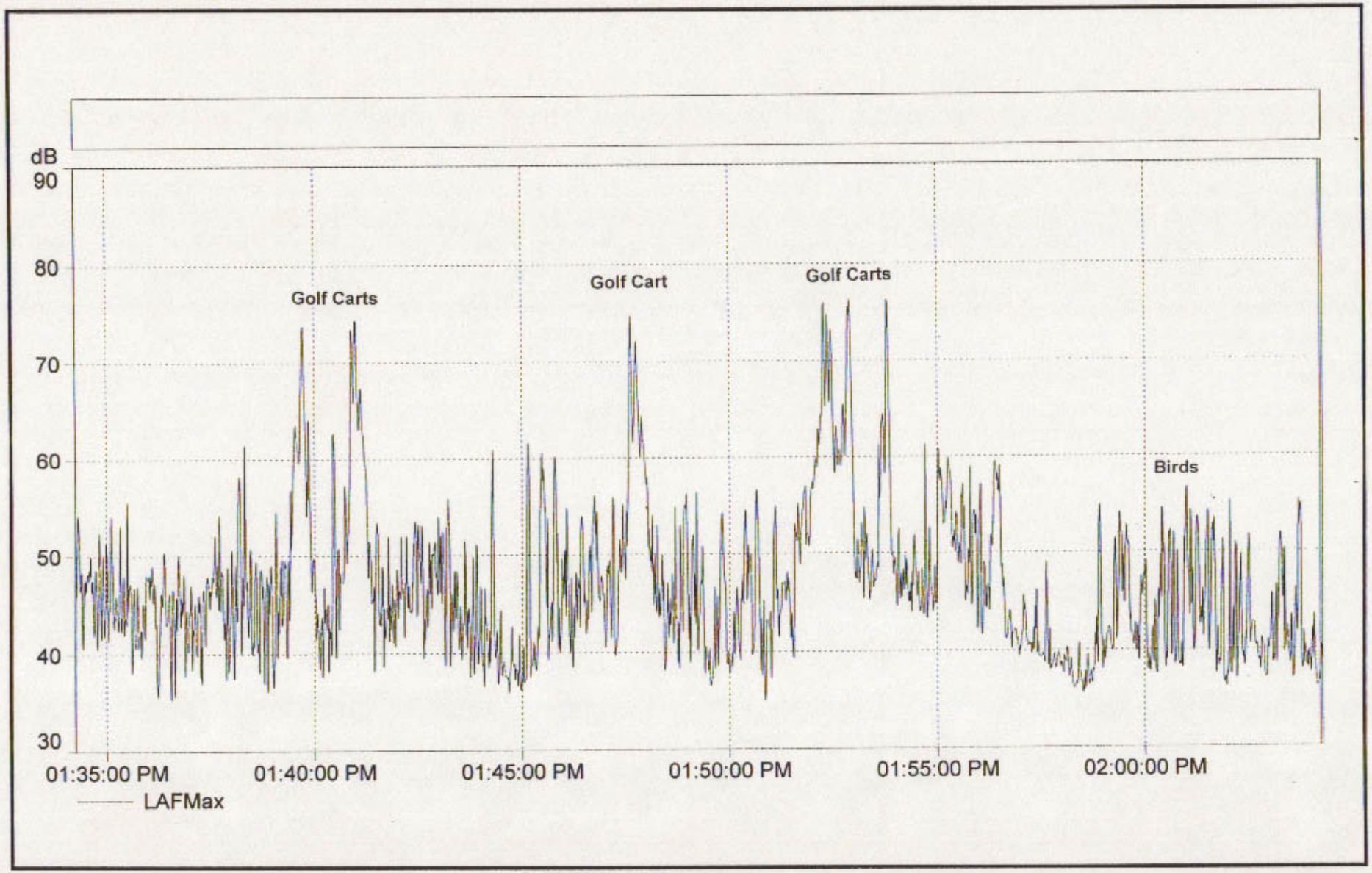
MAXIMUM SOUND LEVEL VS. TIME MEASURED AT LOCATION "B" (12/20/05; 1228 TO 1328 HOURS)

FIGURE 7



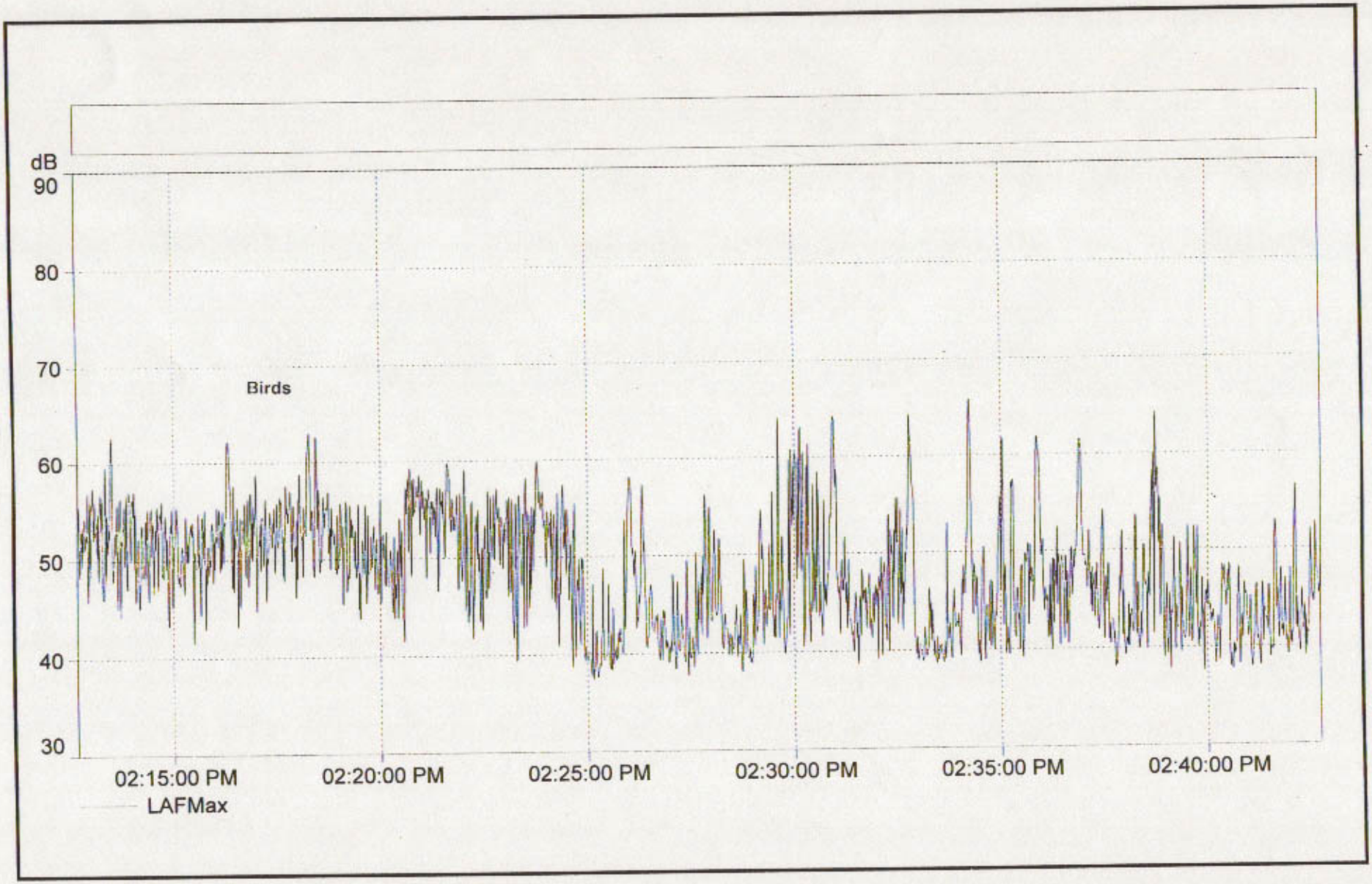
MAXIMUM SOUND LEVEL VS. TIME MEASURED AT LOCATION "B" (12/20/05; 1228 TO 1328 HOURS)

FIGURE 7(CONT.)



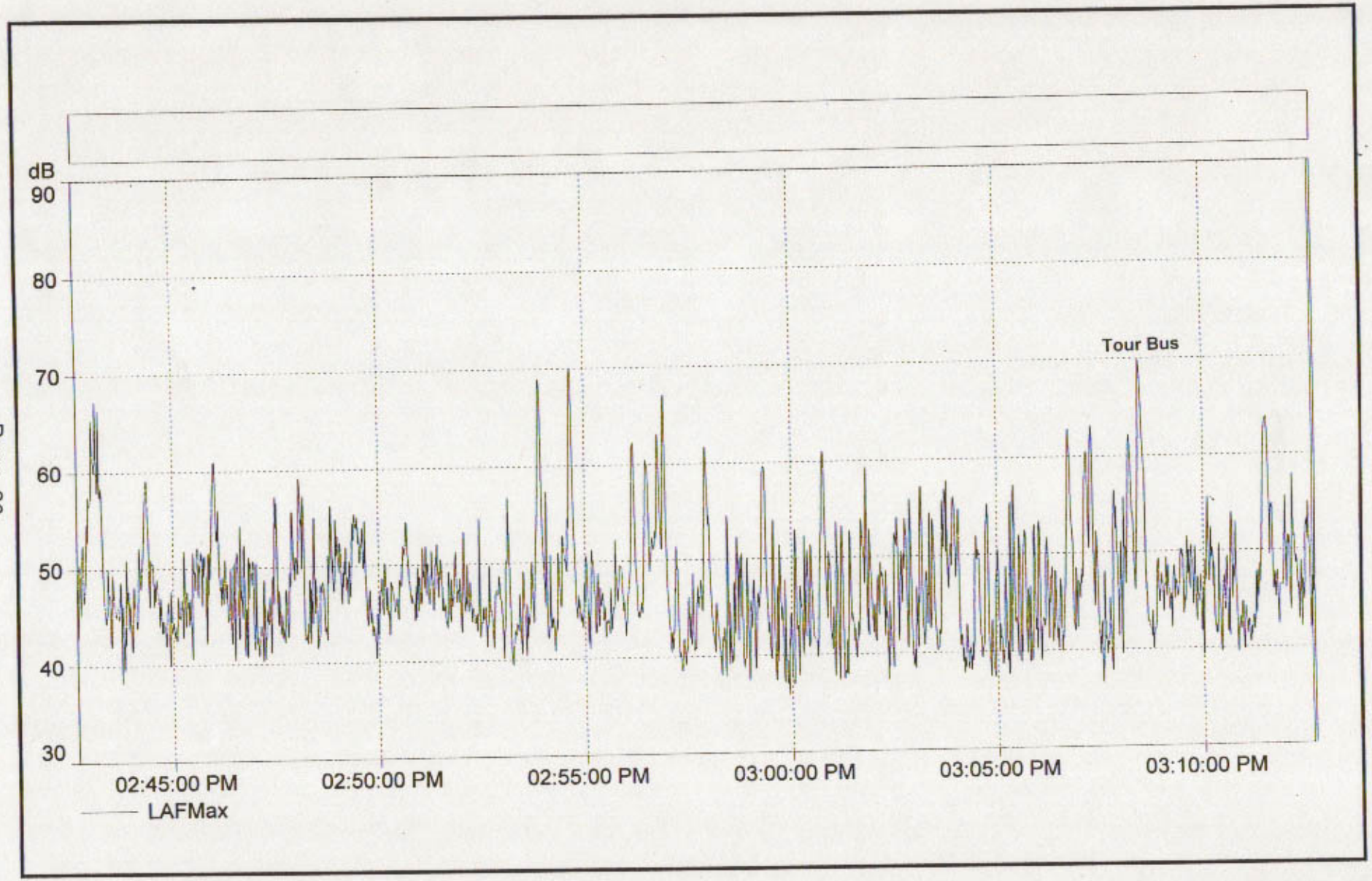
MAXIMUM SOUND LEVEL VS. TIME MEASURED AT LOCATION "C" (12/20/05; 1334 TO 1404 HOURS)

FIGURE 8



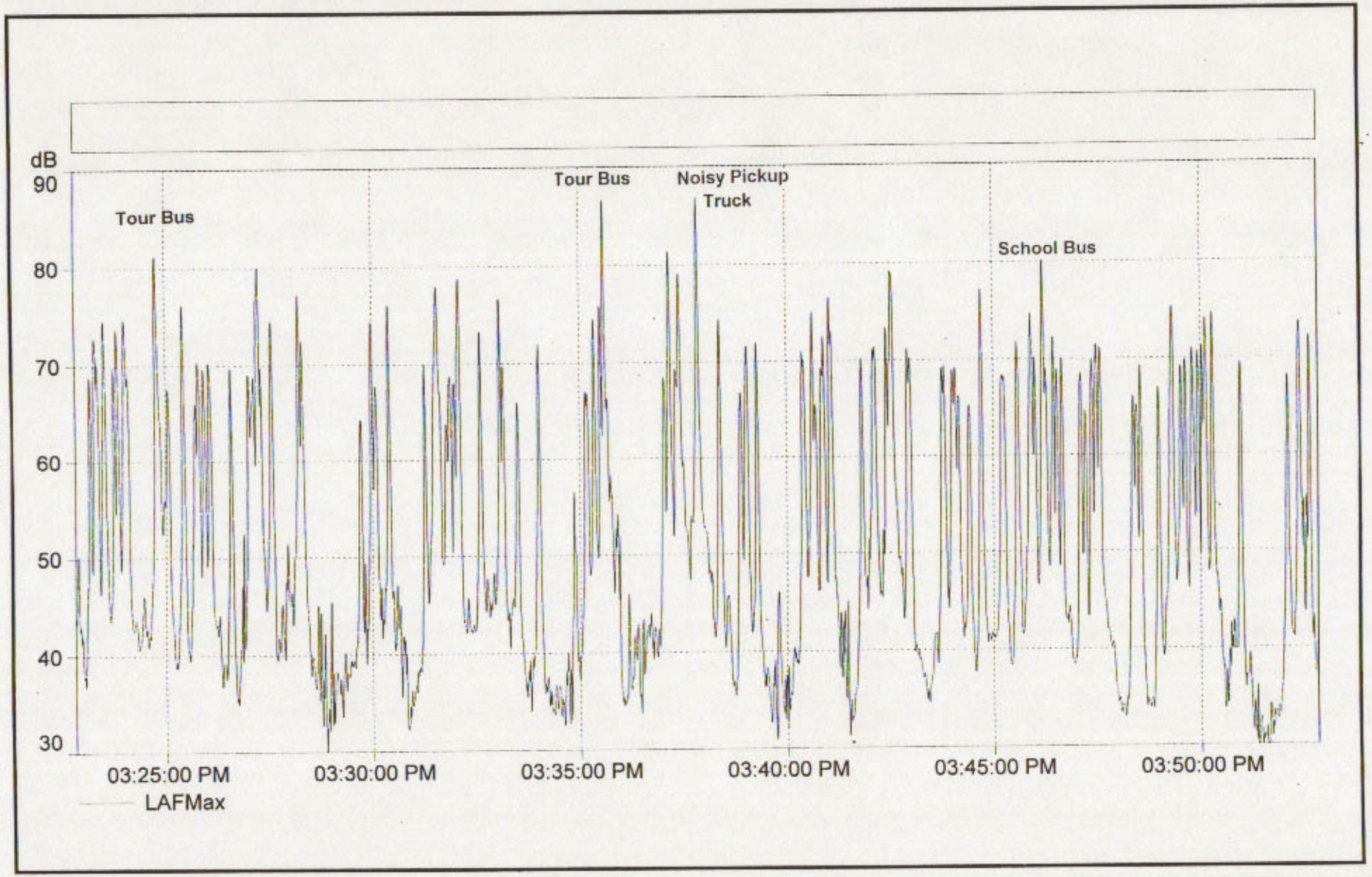
MAXIMUM SOUND LEVEL VS. TIME MEASURED AT LOCATION "D" (12/20/05; 1412 TO 1512 HOURS)

FIGURE 9



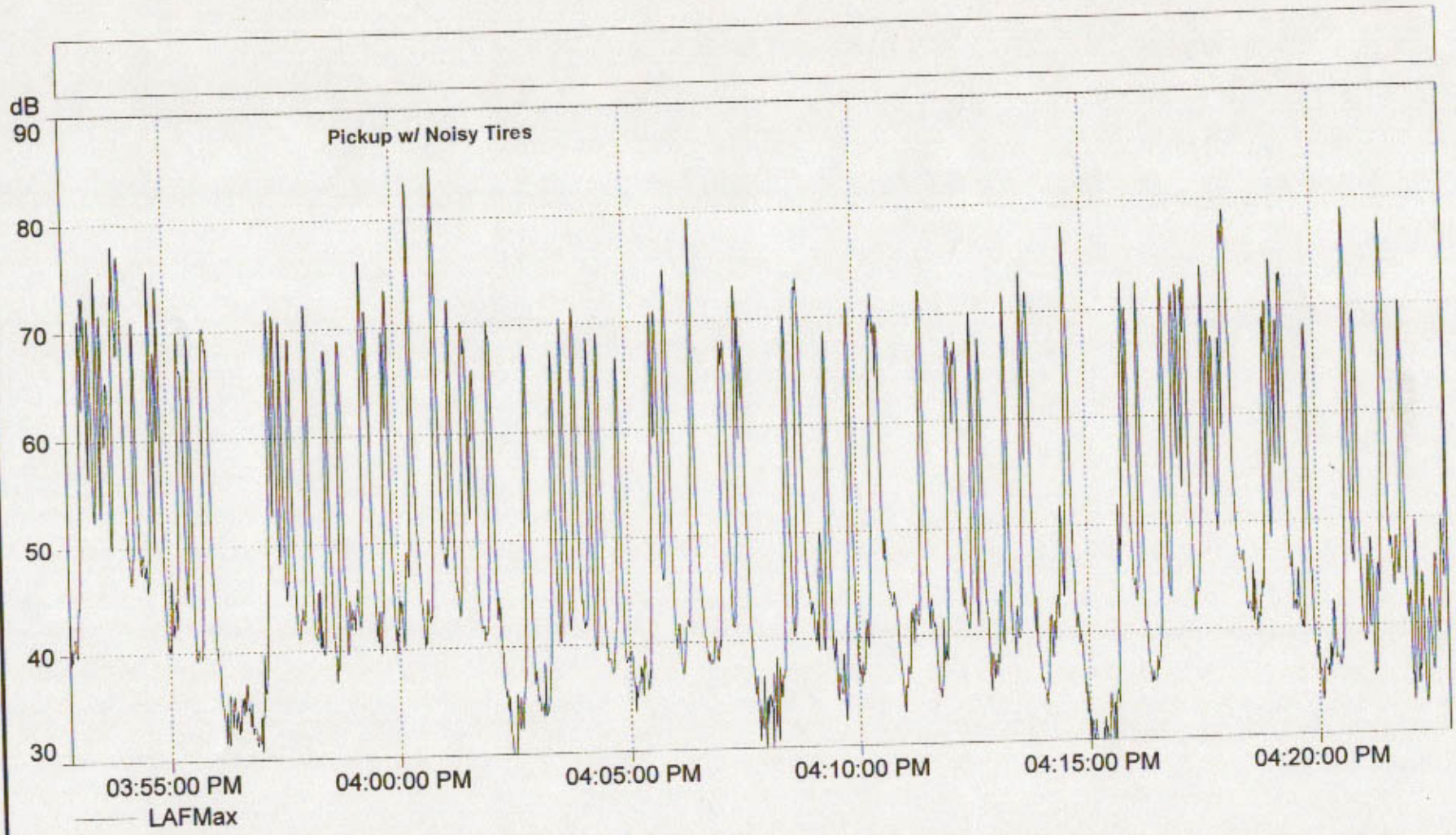
MAXIMUM SOUND LEVEL VS. TIME MEASURED AT LOCATION "D" (12/20/05; 1412 TO 1512 HOURS)

FIGURE 9(CONT.)



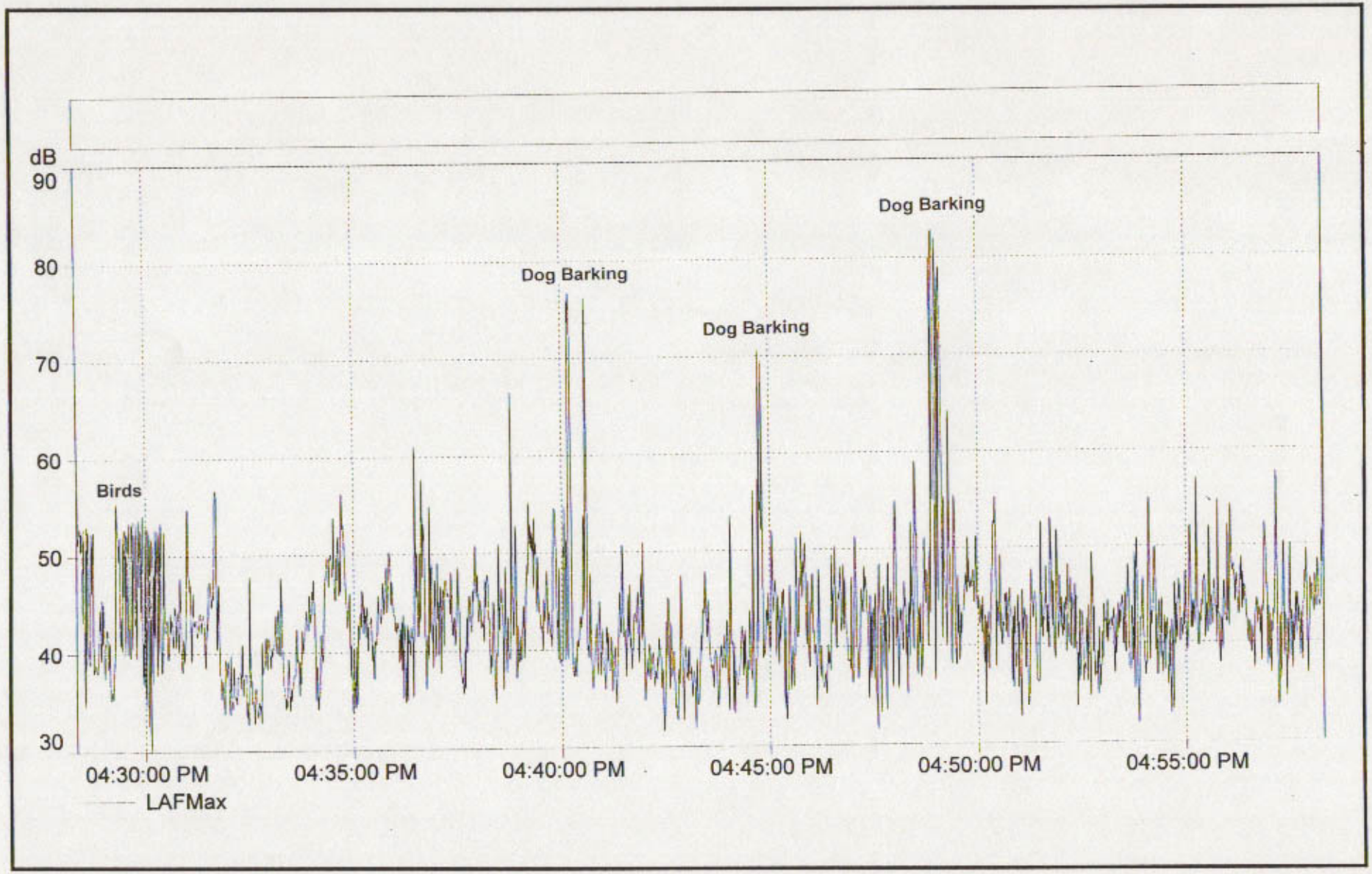
MAXIMUM SOUND LEVEL VS. TIME MEASURED AT LOCATION "E1" (12/20/05; 1522 TO 1622 HOURS)

FIGURE 10



MAXIMUM SOUND LEVEL VS. TIME MEASURED AT LOCATION "E1" (12/20/05; 1522 TO 1622 HOURS)

FIGURE 10(CONT.)



MAXIMUM SOUND LEVEL VS. TIME MEASURED AT LOCATION "F" (12/20/05; 1628 TO 1658 HOURS)

FIGURE 11

TABLE 4

EXISTING (CY 2005) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (PM PEAK HOUR)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) ********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	150' Leq
Mamalahoa Hwy. East of Linole Lp. Rd. (East)	52	185	177	1	7	62.9	59.2	56.9
Mamalahoa Hwy. Between Linole Lp. Rd.	52	180	173	1	6	62.7	58.9	56.7
Mamalahoa Hwy. West of Linole Lp. Rd. (West)	52	200	191	2	7	63.2	59.5	57.2
Alahaki Rd. North of Mamalahoa Hwy.	30	0	0	0	0	N/A	N/A	N/A
Ninole Loop Rd. South of Mamalahoa Hwy.	37	44	44	0	0	50.8	47.1	44.9

Notes:

1. Traffic mix along Mamalahoa Highway was assumed to consist of 95.6% automobiles, 0.8% medium trucks, and 3.6% heavy trucks and buses.
2. Traffic mix along Ninole Loop Road was assumed to consist of 99.0% automobiles, 0.0% medium trucks, and 1.0% heavy trucks and buses.
3. Traffic mix along Alahaki Road was assumed to consist of 100.0% automobiles.
4. Hard Soil ground attenuation factor was assumed.

TABLE 5

YEAR 2005 AND 2015 DISTANCES TO 65 AND 70 DNL CONTOURS

STREET SECTION	65 DNL SETBACK (FT)		70 DNL SETBACK (FT)	
	CY 2005	CY 2015	CY 2005	CY 2015
Mamalahoa Hwy. East of Linole Lp. Rd. (East)	31	83	12	32
Mamalahoa Hwy. Between Linole Lp. Rd.	31	70	12	27
Mamalahoa Hwy. West of Linole Lp. Rd. (West)	33	78	13	31
Alahaki Rd. North of Mamalahoa Hwy.	< 12	< 12	< 12	< 12
Ninole Loop Rd. South of Mamalahoa Hwy.	< 12	31	< 12	12

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See Tables 4 and 6 for traffic volume, speed, and mix assumptions.
(3) Setback distances are for unobstructed line-of-sight conditions.
(4) DNL assumed to be 0.4 dB less than PM peak hour Leq(h) along all roadways.

natural sounds of birds and winds in foliage are the dominant noise sources. Between motor vehicle or maintenance equipment noise events, background ambient noise levels can drop to a range of 30 to 35 dB. The minimum background ambient noise levels at these interior locations are controlled by distant traffic, the sounds of birds, and wind noise.

Existing traffic noise levels at the existing residential subdivision north of the Mamalahoa Highway and Ninole Loop Road intersection are in the "Minimal Exposure, Unconditionally Acceptable" noise exposure category. The sounds of traffic along Mamalahoa Highway, barking dogs, and the sounds of birds are the dominant noise sources for those existing homes within 300 feet of the highway centerline. Existing traffic volumes along the subdivision's access roadway (Alahaki Road) are very low, and the noise level contributions from local traffic on Alahaki Road are near zero DNL.

CHAPTER VI. FUTURE NOISE ENVIRONMENT

Traffic Noise. Predictions of future traffic noise levels were made using the traffic volume assignments of Reference 7 for CY 2015 with and without the proposed project. Appendix C presents the future traffic assignments from Reference 7 for CY 2015 with and without the proposed project. The future assignments of project plus non-project traffic on the roadway sections which would service the project are shown in Table 6 for the PM peak hour of traffic. Also shown in Table 6 are the predicted future traffic noise levels at 50, 100, and 150 FT setback distances from the centerlines of the roadways servicing the project.

Table 7 presents the predicted increases in traffic noise levels by CY 2015 with and without the proposed project, and as measured by the Leq or DNL descriptor systems. As indicated in Table 7, by CY 2015 and following complete project build-out, traffic noise levels on Mamalahoa Highway in the areas fronting the project are predicted to increase by 4.5 to 4.6 Leq (or DNL). Along the mauka (north) access roadway (Alahaki Road) through the existing residential subdivision, traffic noise levels are predicted to increase from essentially near zero levels to 54.1 DNL at 50 FT setback distance from the centerline. Makai (south) of the highway, and along Ninole Loop Road, traffic noise levels are predicted to increase by 12.2 DNL. This range of increases in traffic noise levels from 4.5 to 54.1 DNL is considered to be large, and reflects the growth in forecasted project related traffic in the project environs by CY 2015, from relatively low Base Year levels in CY 2005. Without the project, increases in traffic noise levels by CY 2015 are expected to be relatively small at 0 to 0.4 DNL, with traffic noise levels essentially similar to present levels.

Table 5 summarizes the predicted increases in the future setback distances to the 65 and 70 DNL traffic noise contour lines along the roadways in the project environs and attributable to both project plus non-project traffic in CY 2015. The setback distances in Table 5 do not include the beneficial effects of noise shielding from terrain features and highway cuts, or the detrimental effects of additive contributions of noise from intersecting streets. As indicated in Table 5, the setback distances to the 65 DNL contour are predicted to range from 70 to 83 FT from the centerline of Mamalahoa Highway following project build-out in CY 2015. Along Alahaki Road, setback distances to the 65 DNL contour are predicted to be less than 12 FT from the centerline of the mauka access roadway. Along the existing Ninole Loop Road, setback distances to the 65 DNL contour are expected to not exceed 31 FT.

TABLE 6

FUTURE (CY 2015) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS ROADWAY SECTIONS (PM PEAK HOUR, WITH PROJECT)

LOCATION	SPEED (MPH)	TOTAL VPH	********* VOLUMES (VPH) ********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	150' Leq
Mamalahoa Hwy. East of Linole Lp. Rd. (East)	52	620	593	5	22	68.1	64.4	62.1
Mamalahoa Hwy. Between Linole Lp. Rd.	52	498	476	4	18	67.2	63.5	61.2
Mamalahoa Hwy. West of Linole Lp. Rd. (West)	52	575	549	5	21	67.8	64.1	61.8
Alahaki Rd. North of Mamalahoa Hwy.	30	175	175	0	0	54.1	50.5	48.3
Ninole Loop Rd. South of Mamalahoa Hwy.	37	645	639	0	6	63.0	59.4	57.1

Notes:

1. Traffic mix along Mamalahoa Highway was assumed to consist of 95.6% automobiles, 0.8% medium trucks, and 3.6% heavy trucks and buses.
2. Traffic mix along Ninole Loop Road was assumed to consist of 99.0% automobiles, 0.0% medium trucks, and 1.0% heavy trucks and buses.
3. Traffic mix along Alahaki Road was assumed to consist of 100.0% automobiles.
4. Hard Soil ground attenuation factor was assumed.

TABLE 7

CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2015) (PM PEAK HOUR)

STREET SECTION	NOISE LEVEL (DB) INCREASE DUE TO: NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Mamalahoa Hwy. East of Linole Lp. Rd. (East)	0.2	5.0
Mamalahoa Hwy. Between Linole Lp. Rd.	0.4	4.1
Mamalahoa Hwy. West of Linole Lp. Rd. (West)	0.4	4.2
Alahaki Rd. North of Mamalahoa Hwy.	0.0	54.1
Ninole Loop Rd. South of Mamalahoa Hwy.	0.0	12.2

VII. DISCUSSION OF PROJECT RELATED NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES

Traffic Noise At Existing Residences. The increases in traffic noise levels attributable to the project from the present to CY 2015 are predicted to range from 4.1 to 5.0 DNL along Mamalahoa Highway, where traffic noise levels are expected to be above 65 DNL along the highway Rights-of-Way. These increases in traffic noise levels along Mamalahoa Highway which are attributable to the project are considered to be in the moderate category, and are higher than the traffic noise increases expected as a result of non-project traffic.

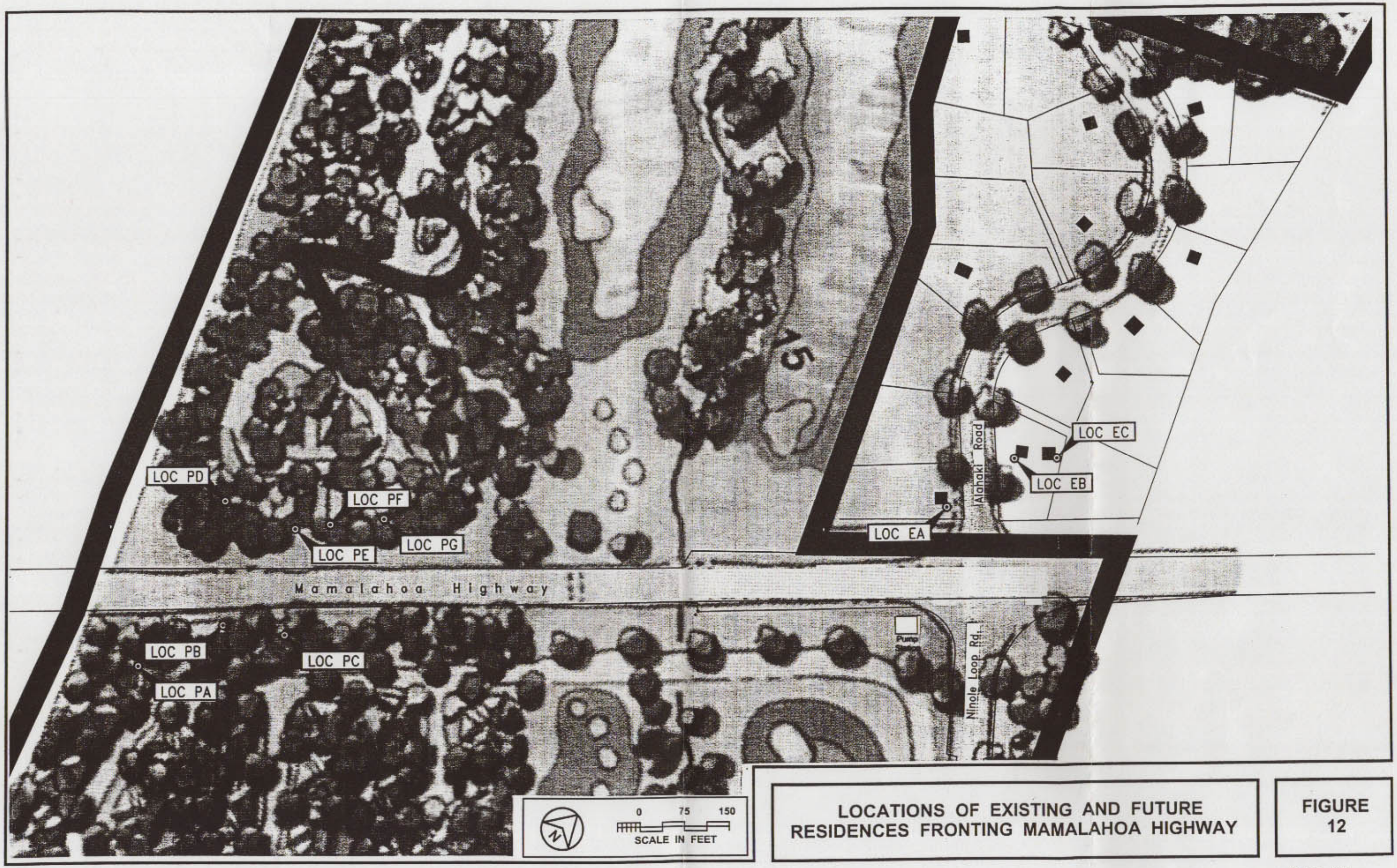
The lands along the highway Rights-of-Way are generally vacant in the project environs, except for homes which are present along Alahaki Road. The newly constructed residence on the northwest corner of the Alahaki Road and Mamaloahoa Highway intersection is the closest existing residence to the highway (see Location EA, Figure 12) . Traffic noise levels at this closest residence are expected to increase from 58 DNL in CY 2005 to 63 DNL in CY 2015 with the project.

Two existing residences are located northeast of the Alahaki Road and Mamaloahoa Highway intersection (see Locations EB and EC, Figure 12), and at relatively large setback distance of approximately 207 FT. Due to their larger setback distances from the highway and the presence of a natural terrain berm, existing traffic noise levels at these two residences are lower at 53 to 55 DNL. With the project, future traffic noise levels are expected to increase to a range of 58 to 60 DNL at these two residences.

Along Alahaki Road are located approximately 10 existing residences, plus an additional residence presently under construction. Future traffic noise levels with the project are expected to be approximately 54 DNL at 50 FT from the centerline of Alahaki Road. All of the existing homes plus the one under construction are located at least 57 FT from the roadway centerline, so future traffic noise levels at the residences of this subdivision should not exceed 54 DNL. This noise exposure level is considered to be low and in the "Minimal Exposure, Unconditionally Acceptable" noise exposure category.

Along Ninole Loop Road, three of the existing Colony One condominium and vacation rental units are located as close as approximately 50 FT from the centerline of Ninole Loop Road. Traffic noise levels at these closest units are predicted to increase from approximately 51 DNL to less than 63 DNL by CY 2015 with the project. Future traffic volumes along Ninole Loop Road were not available in front of the Colony One units, so a worst case estimate based on future traffic volumes at the Mamalahoa Highway intersection was used.

In summary, the traffic forecasts for CY 2015 conditions indicate that future traffic noise levels with the project should not exceed the FHA/HUD acceptability



LOCATIONS OF EXISTING AND FUTURE RESIDENCES FRONTING MAMALAHOA HIGHWAY

FIGURE 12

threshold of 65 DNL at existing residences in the project environs. For this reason, traffic noise mitigation measures should not be required at these existing residences.

Traffic Noise At Future Project Residences. Future Sea Mountain residences are planned along Mamalahoa Highway on both the mauka (north) and makai (south) sides of the highway. The locations of the residences closest to the highway are marked as Locations PA through PG in Figure 12. At two of the planned residences (Locations PB and PC), forecasted traffic noise levels are expected to exceed the FHA/HUD standard of 65 DNL, and be in the "Significant Exposure, Normally Unacceptable" noise exposure category by CY 2015. The remaining project residences fronting the highway are expected to be in the "Moderate Exposure, Acceptable" noise exposure category.

Along the section of Mamalahoa Highway west of the Ninole Loop Road intersection, potential noise impacts from project and non-project traffic are possible by CY 2015 at two planned residences which are located within 78 FT from the centerline of the highway. As long as these future residences are single story, attenuation of traffic noise to levels below the 65 DNL FHA/HUD threshold should be possible with 6 Ft high sound walls located along the highway Right-of-Way. If two-story residences are constructed near the highway and inside the 78 FT setback distance to the 65 DNL noise contour, closure and air conditioning of the upper floors would also be required, because 6 FT high walls would not provide sufficient sound attenuation for the second floor rooms.

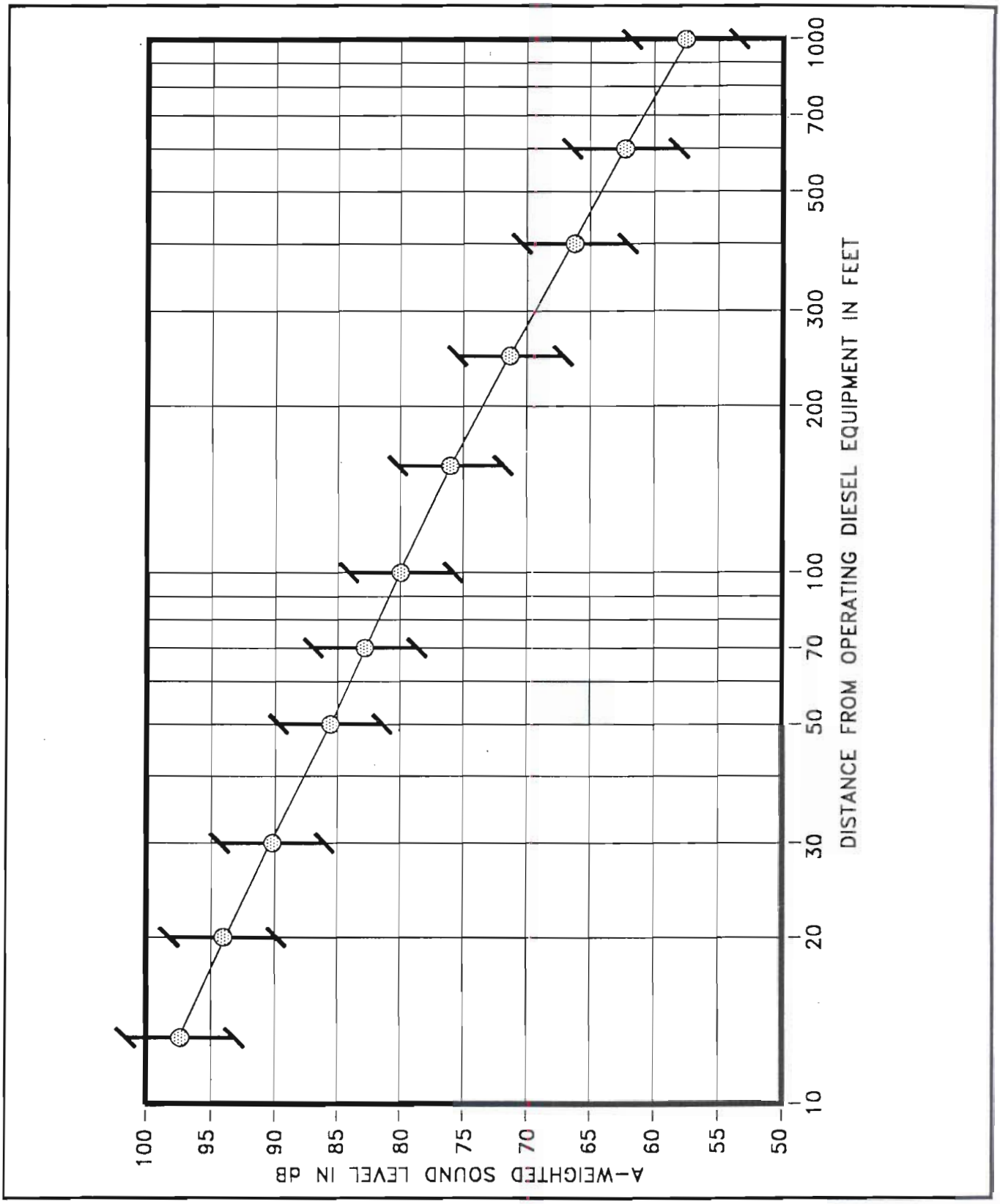
The construction of minimum 6 Ft high sound attenuation walls for the planned residences at Locations PB and PC in Figure 12 is recommended. The exact height and length of the sound attenuation wall will need to be determined after the lot, house pad, and grading plans become available.

It should be noted that the "Minimal Exposure, Unconditionally Acceptable" noise exposure level is 55 DNL. Essentially all of the future residences fronting Mamalahoa Highway in Figure 12 are predicted to be exposed to traffic noise levels greater than 55 DNL, so there is some risk of occupant dissatisfaction due to future traffic noise levels at these future residences. In order to reduce future traffic noise levels at these frontage lots to 55 DNL or less, sound attenuation wall heights in the order of 10 FT will be required for single story homes. The exact height and length of the sound attenuation walls will need to be determined after the lot, house pad, and grading plans become available. The construction of sound attenuating walls and/or the use of air conditioning should be considered to minimize risks of occupant dissatisfaction along the first row of homes fronting Mamalahoa Highway.

Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for construction is unknown, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction

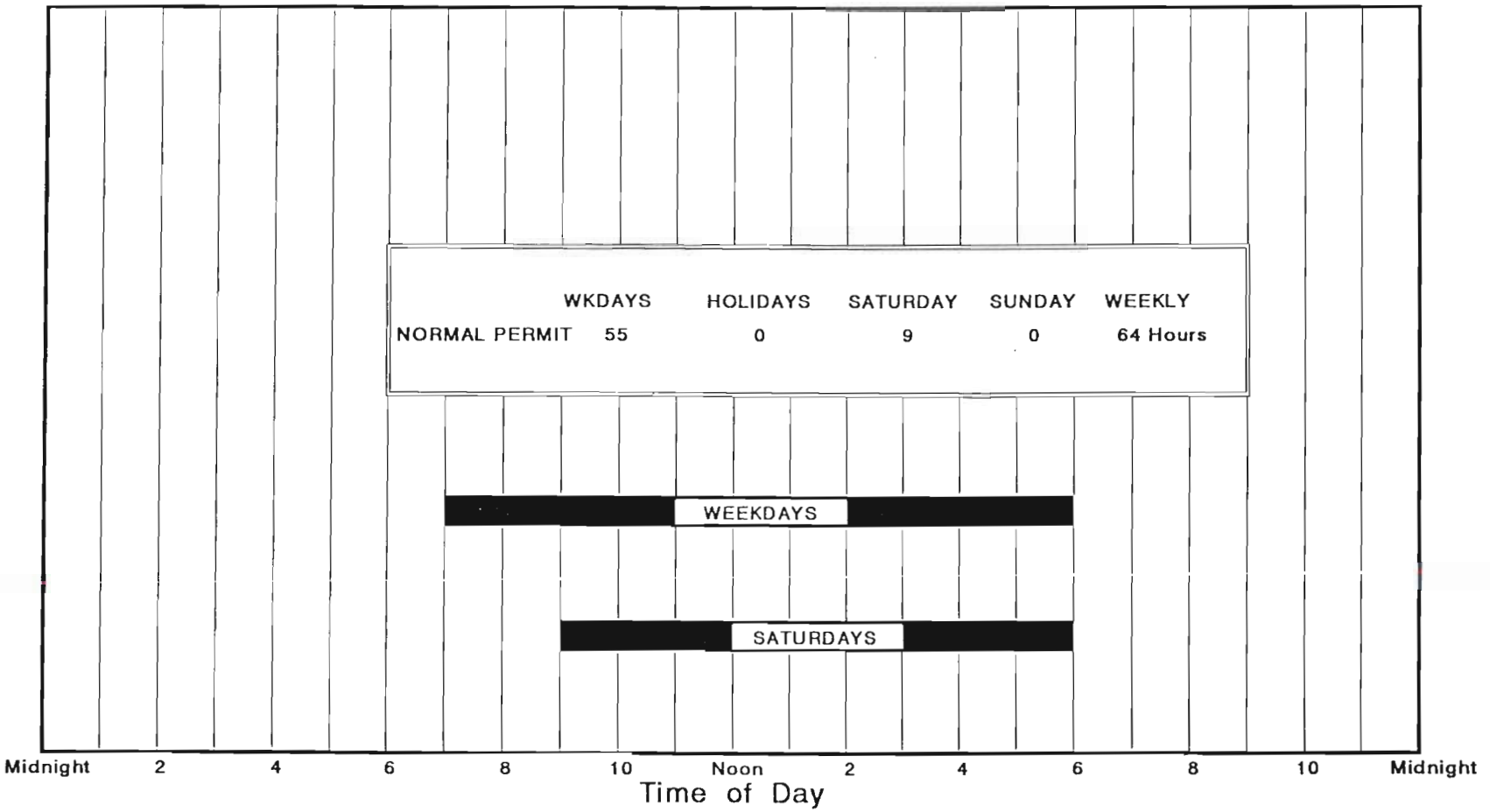
noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of noise from construction activity (excluding pile driving activity) are shown in Figure 13. The noise sensitive properties which are predicted to experience the highest noise levels during construction activities on the project site are the existing residences at the north end and west of Alahaki Road and those residents and guests at Colony One. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 FT distance), and due to the exterior nature of the work (grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. The incorporation of State Department of Health construction noise limits and curfew times, which are applicable on the island of Hawaii (Reference 5), is another noise mitigation measure which can be applied to this project. Figure 14 depicts the normally permitted hours of construction for normal construction noise as well as the curfew periods for construction noise. Noisy construction activities are not allowed on Sundays and holidays under the DOH permit procedures.



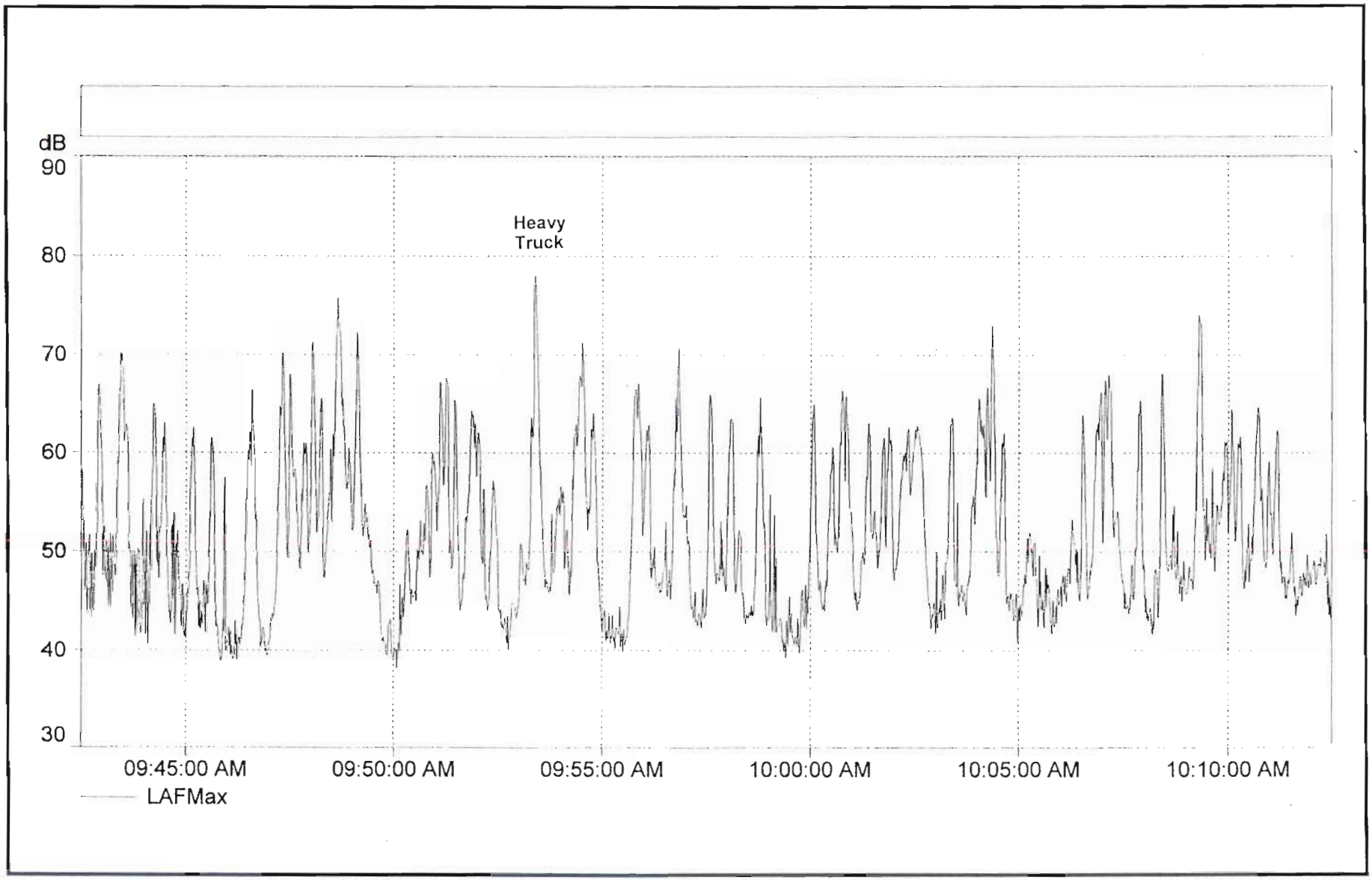
ANTICIPATED RANGE OF CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 13



AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

FIGURE 14



MAXIMUM SOUND LEVEL VS. TIME MEASURED AT LOCATION "A" (12/20/05; 0942 TO 1042 HOURS)

FIGURE 6

APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control;" Federal Interagency Committee on Urban Noise; June 1980.

(2) American National Standard, "Sound Level Descriptors for Determination of Compatible Land Use," ANSI S12.9-1998/ Part 5; Acoustical Society of America.

(3) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; July 12, 1979.

(4) "Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety;" U.S. Environmental Protection Agency; EPA 550/9-74- 004; March 1974.

(5) "Title 11, Administrative Rules, Chapter 46, Community Noise Control;" Hawaii State Department of Health; September 23, 1996.

(6) "FHWA Highway Traffic Noise Model User's Guide;" FHWA-PD-96-009, Federal Highway Administration; Washington, D.C.; January 1998 and Version 2.5 Upgrade (April 14, 2004).

(7) Existing and Future Traffic Turning Movements at Mamalahoa Highway for the Sea Mountain At Punaluu Project; via email from M&E Pacific, Inc.; December 21, 2005.

(8) 24-Hour Traffic Counts, Station 4-A, Mamalahoa Highway at Ninole Road (West Entrance to Punaluu Black Sand Beach); State Department of Transportation; May 4-5, 2004.

(9) 24-Hour Vehicle Type Classification Counts, Station 5, Mamalahoa Highway at Honuapo Wharf Road; State Department of Transportation; May 3-4, 2004.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "LepN" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

TERM	SYMBOL
1. A-Weighted Sound Level	L_A
2. A-Weighted Sound Power Level	L_{WA}
3. Maximum A-Weighted Sound Level	L_{max}
4. Peak A-Weighted Sound Level	L_{Apk}
5. Level Exceeded x% of the Time	L_x
6. Equivalent Sound Level	L_{eq}
7. Equivalent Sound Level over Time (T) (1)	$L_{eq(T)}$
8. Day Sound Level	L_d
9. Night Sound Level	L_n
10. Day-Night Sound Level	L_{dn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$
12. Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78,

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

TERM	A-WEIGHTING	ALTERNATIVE[1] A-WEIGHTING	OTHER[2] WEIGHTING	UNWEIGHTED
1. Sound (Pressure)[3] Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% of the Time	L_x	L_{Ax}	L_{Bx}	L_{px}
6. Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7. Equivalent Sound Level[4] Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8. Day Sound Level	L_d	L_{Ad}	L_{Bd}	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average Value Over (Non-Time Domain) Set of Observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level Exceeded x% of the Total Set of (Non-Time Domain) Observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x Value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

APPENDIX C

SUMMARY OF BASE YEAR AND FUTURE YEAR TRAFFIC VOLUMES

ROADWAY LANES	**** CY 2005 *****		CY 2015 (NO BUILD)		CY 2015 (BUILD)	
	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH
Mamalahoa Hwy. - East of Ninole Lp. Rd. (EB)	95	80	100	85	375	270
Mamalahoa Hwy. - East of Ninole Lp. Rd. (WB)	68	105	73	110	135	350
Two-Way	163	185	173	195	510	620
Mamalahoa Hwy. - Between Ninole Lp. Rd. (EB)	100	78	106	83	333	213
Mamalahoa Hwy. - Between Ninole Lp. Rd. (WB)	64	102	69	109	115	285
Two-Way	164	180	174	192	448	498
Mamalahoa Hwy. - West of Ninole Lp. Rd. (EB)	120	90	130	95	295	285
Mamalahoa Hwy. - West of Ninole Lp. Rd. (WB)	62	110	67	120	130	290
Two-Way	182	200	197	215	425	575
Alahaki Rd. North of Highway (NB)	0	0	4	0	55	100
Alahaki Rd. North of Highway (SB)	0	0	0	0	95	75
Two-Way	0	0	4	0	150	175
Ninole Loop Rd. (West) South of Highway (NB)	6	19	6	19	220	300
Ninole Loop Rd. (West) South of Highway (SB)	17	25	17	25	195	345
Two-Way	23	44	23	44	415	645

Appendix J

Assessment of the Marine and Pond Environments in the Vicinity of the Sea Mountain Village at Punalu‘u Project
(Marine Research Consultants, Inc., April 2006)

ASSESSMENT OF THE MARINE AND POND ENVIRONMENTS IN THE VICINITY OF THE SEA MOUNTAIN VILLAGE AT PUNALU'U PROJECT KA'U, HAWAII

Prepared for:

GROUP 70 INTERNATIONAL
925 Bethel St., 5th Fl.
Honolulu, HI 96813

Prepared by:

Marine Research Consultants, Inc.
1039 Waakaua Pl.
Honolulu, HI 96822

May 2006

I. INTRODUCTION AND PURPOSE

Sea Mountain Five, LLC (SMF) is planning the expansion and enhancement of an existing golf course resort community, known as Sea Mountain at Punalu'u, to be called Sea Mountain Village. The project is located on the Ka'u coastline of the island of Hawaii, approximately 60 miles southwest of Hilo and 70 miles southeast of Kailua-Kona. The project site consists of approximately 432 acres of land mauka of Punalu'u Beach Park (Black Sand Beach). The existing Sea Mountain community was developed by C. Brewer Properties around 1969 to 1972, and includes two residential enclaves; Colony I, a 76-unit condominium community; Kalana I, a 19 lot single family residential subdivision; and facilities for other related cultural activities. The proposed Sea Mountain Village will include the re-construction of the golf course as well as a new community consisting of a variety of single and multi-family residences, as well as retail services that will be constructed through 9 development areas over a period of ten years.

The project parcel includes approximately one mile of coastline extending south from the northern edge of Punalu'u Bay. The coastal area consists of a black sand beach bordering Punalu'u Bay, basaltic cliffed shorelines, and basaltic shoreline platforms. Several large brackish ponds also occur within the property boundaries (Figure 1).

While all planning and construction activities for Sea Mountain Village will place a high priority on maintaining the existing relatively pristine nature of the marine and pond environments, it is nevertheless important to address any potential impacts that may be associated with the planned project. None of the proposed land uses includes any direct alteration of the coastal areas or nearshore waters. The potential exists, however, for the project to affect the composition and volume of groundwater that flows beneath the project site, as well as surface runoff emanating from the project. As all groundwater that could be affected by the project subsequently reaches the ocean, it is recognized that there is potential for the project to affect the marine environment. This concern is especially critical for the Sea Mountain Village Project owing to the close proximity of the beach park at Punalu'u Bay, which in addition to a variety of recreational uses, is known as a preferred habitat for federally protected species (sea turtles). Therefore, important questions include the potential impacts from soil, fertilizers, and other chemicals which could cause alterations to water quality and marine life.

In the interest of addressing these concerns and assuring maintenance of environmental quality, a baseline marine environmental assessment and potential impact analysis of the nearshore marine and pond areas off the Sea Mountain Village property was conducted in late 2005 and early 2006. The rationale of this assessment was to determine the present chemical composition of the nearshore marine and pond waters, and to evaluate the contribution of groundwater to the marine and pond environments prior to the commencement of any new construction activities. Combining this information with estimates of changes in groundwater and surface water flow rates and chemical composition that could result from the project will provide a basis to evaluate the potential effects of the project to the marine environments.

II. METHODS

A. Water Chemistry

Five transect survey sites were established off the Sea Mountain Village property. Transect site 1 was located at the southern end of the property; Transect sites 3 and 4 were located along the southern third of the property in the area where the shoreline is composed of flat basaltic beaches; Transect site 2 was located off the shoreline cliff to the south of Punalu'u Bay, and Transect site 5 was located along the northern shoreline of Punalu'u Bay (Figure 1).

Water quality was evaluated at each site on transects that were oriented perpendicular to the shoreline and depth contours. Water samples were collected from the shoreline to the farthest point offshore that was not within the impact zone of breaking surf (~10-50 m offshore). Such a sampling scheme was designed to span the greatest range of salinity with respect to potential freshwater efflux at the shoreline. When water depth exceeded one meter (~3 ft.), two samples were collected at each site; a surface sample was collected within approximately 10 centimeters (cm) of the sea surface, and a bottom sample was collected within 20 cm of the sea floor.

Water samples were also collected in two large coastal ponds located in the southern sector of the property. Samples were collected at the surface, mid-point in the water column, and just above the pond bottom at two locations in each of Ponds 1 and 2 (See Figure 1).
In order to determine chemical concentrations in unaltered groundwater, samples were also collected from three potable wells and Ninole Spring.

Water quality parameters evaluated included the ten specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (Open Coastal waters) of the State of Hawaii Department of Health (DOH) Water Quality Standards. These criteria include: total nitrogen (TN), nitrate + nitrite nitrogen (NO_3^- + NO_2^-, hereafter referred to as NO_3^-), ammonium nitrogen (NH_4^+), total phosphorus (TP), Chlorophyll a (Chl a), turbidity, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{-3}) and silica (Si) were also reported because these parameters are sensitive indicators of biological activity and the degree of groundwater mixing.

All fieldwork was conducted on three dates, December 11, 2005, December 16, 2005, and April 14, 2006. All water samples were collected by swimmers working from shore. Water samples were collected in triple-rinsed one-liter linear polyethylene bottles. Subsamples for nutrient analyses were immediately placed in 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and stored on ice. Analyses for Si, NH_4^+, PO_4^{3-}, and NO_3^- were performed with a Technicon Autoanalyzer using standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). TN and TP were analyzed in a similar fashion following digestion. Total organic nitrogen (TON) and total organic phosphorus (TOP) were calculated as the difference between TN and dissolved inorganic N, and TP and dissolved inorganic P, respectively.

Water for other analyses was subsampled from 1-liter polyethylene bottles and kept chilled until analysis. Chl *a* was measured by filtering 300 ml of water through glass-fiber filters; pigments on filters were extracted in 90% acetone in the dark at -20° C for 12-24 hours. Fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer. Salinity was determined using an AGE Model 2100 laboratory salinometer with a readability of 0.0001‰ (ppt). Turbidity was determined in the field using a 90-degree nephelometer, and reported in nephelometric turbidity units (NTU) (precision of 0.01 NTU).

In-situ field measurements of continuous vertical profiles of water temperature, salinity, dissolved oxygen and pH were acquired using a RBR Model XR-42 CTD calibrated to factory standards (precision of 0.01°C, 0.001‰, 0.001% O_2 saturation, and 0.001 pH units).

All fieldwork was conducted by Dr. Steven Dollar. All laboratory analyses were conducted by Marine Analytical Specialists located in Honolulu, HI (Labcode: HI 00009). This analytical laboratory possesses acceptable ratings from EPA-compliant proficiency and quality control testing.

B. Marine and Pond Community Structure

Weather conditions consisting of strong tradewinds, and accompanying high surf, that occurred during all days of fieldwork precluded safe underwater surveying of the outer reef areas off the project site. The offshore marine areas were qualitatively assessed by divers working from shore within the nearshore area that was inside of the zone of breaking waves. Pond biota was assessed by divers wading through the ponds and qualitatively estimating abundance of biota.

III. RESULTS

A. Environmental Setting

The physical coastal setting of the Sea Mountain Village property consists of a rugged basaltic shoreline, interspersed with black sand beaches. The offshore area along the southern two-thirds of the property consists of a narrow (>50 m) basaltic shelf that extends to a depth of approximately 3 m (10 ft). Seaward of the inner reef shelf, bottom topography slopes sharply to a depth of 18 m (60 ft) within approximately 100 m of the shoreline (Figure 2). The shoreline at the southern third of the property is a low lying region that is termed Ninole Cove. Previous reports have indicated that this area was formerly a wetland, and has been filled in with sand and debris by various storm-associated events. The intertidal zone in the southern third of the property consists primarily of a series of crescent-shaped or elongated marine "inlets" interspersed with basaltic cliffs (Figure 3). The floors of these inlets are composed of bare basaltic pavement, and are essentially devoid of macrobenthos with the exception of a short algal turf mat (Figure 4).

The shoreline comprising the central section of the property consists entirely of Pahoehoe lava flows that form nearly vertical shorelines which directly absorb the force of breaking waves (Figure 5). The shoreline at the northern third of the project site consists of Punalu'u Bay. The

Bay consists of a roughly semi-circular indentation in the shoreline, and is bounded on the inshore edge by a beach composed of coarse black sand. The bottom of the inner Bay consists of rocks interspersed with pockets of black sand (Figure 6). At the mouth of the Bay, the slope angle of the Bay floor steepens to approximately 30° and changes composition from a flat rocky surface to a boulder field that extends seaward to the outer limits of the Bay (Figure 7).

Interspersed along the shoreline are several brackish ponds of varying sizes. Number designations of the ponds are consistent with previous documentation (Punalu'u Resort, Final Environmental Impact Statement 1988). This document also notes that these ponds are not classified as "anchialine" ponds owing to lack of requisite physical and biological attributes. However, all of the ponds are fed by basal groundwater, and are very brackish in terms of salinity (1-6‰).

Pond 1 is an elongated brackish pond that is oriented parallel to the shoreline, and has a direct connection to the ocean through a small discharge stream channel at the southern end (Figure 8). Pond 2 is located at the northern edge of Ninole Cove, and is separated from the ocean by a narrow band of basaltic (Figure 9). Pond 3 is located mauka of the black sand beach at Punalu'u Bay. This pond has undergone various man-made alterations, and the surface is presently covered with a near solid mat of the non-native plant *Pistia statiotes*. A flock of domesticated ducks and geese also permanently reside in the pond (Figure 10). Pond 4 is smaller than the previous three ponds and is a transient or transient pond that occurs in the back-beach area of Ninole Cove (Figure 9). The bottoms of Ponds 1-3 are entirely covered with thick mats of the algae *Rhizoclonium spp*. (Figure 11).

With respect to the physical setting of the Sea Mountain Village project area, two dominant factors influence the composition of biotic community structure, and hence the potential effects of the project on such community structure. The first factor is the comparatively large flux of groundwater to the ocean at the shoreline. While groundwater flux to the ocean has been estimated in the range of 5-6 million gallons per day (mgd) per shoreline mile in West Hawaii, it is likely that the flux in the project area is twice this rate. As a result, the entire pond and nearshore ocean area consists of water of various degrees of brackishness. As discussed in the section below, the most seaward ocean samples collected for this study had salinities of no greater than 33.7‰. In other areas of Hawaii, such ocean samples typically have salinities of 35‰. (Ocean "control" samples collected for the 1988 EIS also had salinities of 33.5‰). Hence all nearshore communities are continually exposed to waters of exceptionally low salinity.

The other dominant physical factor of the Sea Mountain Village area is the consistent turbulent mixing from wind-generated seas. Typical northeast tradewinds are amplified in velocity as they are funneled down the southeastern side of the island of Hawaii. At the southern end of the island, tradewinds generated substantial swells that directly impact the project site. In addition long period swells from the south also produce surf that impacts the coastal zone. As a result, the entire project area is subjected to high levels of wave scour that are a major determinant of marine community composition.

B. Water Chemistry

1. Horizontal Stratification

Tables 1 and 2 show results of all marine water chemistry analyses for samples collected off the Sea Mountain Village site in December 200. Table 1 shows concentrations of dissolved nutrients in micromolar (μM) units; Table 2 shows concentrations in micrograms per liter (μg/L). Concentrations of twelve nutrient constituents and other water chemistry constituents are plotted as functions of distance from the shoreline in Figures 12 and 13.

Several patterns of distribution are evident in Tables 1 and 2 and Figures 12 and 13. It can be seen in Figure 12 that the dissolved nutrients Si, NO_3^-, PO_4^{3-}, TP and TN display substantial elevation in concentration in the samples collected within10 m from the shoreline on all five sampling transects. Salinity displays the opposite trend, with sharply lower concentrations in the samples within 10 m of the shoreline (Figure 3). While the steep gradients of nutrients and salinity occurred at all five sampling sites, the strongest gradients occurred greatest peak in nutrients and lowest salinity of shoreline samples occurred at Transects 3, 4 and 5. Beyond 10 m from the shoreline, horizontal gradients in dissolved nutrients and salinity persist to the terminal seaward points of the transects, but the slope of the gradients is far less than in the nearshore areas (Figures 12 and 13, Tables 1 and 2).

These patterns are a result of concentrated input of groundwater to the ocean at or near the shoreline throughout the region fronting the Sea Mountain Village project site. Low salinity groundwater, which typically contains high concentrations of Si, NO_3^-, and PO_4^{3-} percolates to the ocean at the shoreline, resulting in a nearshore zone of mixing. In many areas of the Hawaiian Islands, particularly off the Island of Hawaii, such groundwater percolation results in steep horizontal gradients of increasing salinity and decreasing nutrients with distance from shore. As mentioned above, the strongest gradients are on Transects 3 and 4, which are offshore of the low lying region containing ponds 1,2 and 4, and Transect 5, which is in Punalu'u Bay directly makai of Pond 3. The steep gradients near the shoreline reflect substantial flow of groundwater through the ponds and the coastal ocean. On transects 1 and 2, which are positioned off of elevated lava flows, groundwater flux to the coastal ocean is substantially less than off the regions where ponds occur.

Water chemistry parameters that are not generally associated with groundwater input (NH_4^+, TON, TOP) show a similar same pattern of decreasing concentration with respect to distance from the shoreline as Si, NO_3^-, PO_4^{3-}, TP and TN. While the pattern of inorganic nutrients display peak at the shoreline and decrease with distance from shore, concentrations of NH_4^+, TON and TOP peak at the shoreline, and then decrease to the lowest values in the nearshore ocean, followed by gradual increase with distance from shore (Figures 12 and 13, Tables 1 and 2).

Unlike the patterns of dissolved inorganic nutrients, the distribution of Chl *a* does not exhibit substantial peaks near the shoreline. Chl a in Pond 2, shown in Transect 3, is substantially higher than all ocean samples (Figure 13). Turbidity displayed distinct horizontal gradients of decreasing values with distance from shore at Stations 1 and 2, but not at Stations 3, 4 or 5

(Figure 13). pH was distinctly lower in nearshore samples as a result of freshwater input and maintained consistent values of about 8.1 from 5 meters from shore seaward (Figure 13).

2. Vertical Stratification

Tables 1 and 2 show concentrations of water chemistry parameters in samples collected from surface and deep water at distances from shore where water depth exceeded one meter. Figure 14 shows both surface and near bottom concentrations of water chemistry constituents from Transect 5 that was located in Punalu'u Bay. It can seen in Figure 14 that salinity was lower in surface samples relative to bottom samples at sampling points within 30 m of the shoreline. At the sampling location 50 m from shore, salinity was nearly identical in both surface and deep samples. Conversely, concentrations of dissolved nutrients were higher in surface samples within the Bay up to a distance of 50 m offshore (Figure 14). Chl a also displayed distinct vertical stratification with near-bottom samples elevated relative to surface samples. Turbidity, however, showed no consistent trend (Figure 14).

The distinct vertical stratification is a result of incomplete mixing of groundwater and ocean water which creates a buoyant surface lens of low salinity, high nutrient water. Within inner Punalu'u Bay, physical mixing by waves and wind is not sufficient to completely homogenize the water column. However, within 50 m of the shoreline at the outer edge of the Bay, physical mixing processes are sufficient to completely stir the water column to the extent that buoyant surface layers are not present. On the wave exposed coastline that comprises the rest of the Sea Mountain Village shoreline, it is evident that wave energy prevents vertical stratification of the water column.

Table 3 shows results of water samples collected at three depths (surface, mid-depth and bottom) at two locations in both Ponds 1 and 2. Figure 15 shows plots of vertical profiles of salinity and temperature acquired at the same sampling locations in the two ponds. It can be seen in Figure 15 and Table 3 that there is relatively little vertical stratification of any constituents in the ponds. In addition, the salinity in the ponds of 1.5-5‰ consists of between 4-14‰ ocean water, and 86-96% freshwater. While bottom samples tend to have slightly higher salinity and lower nutrient concentrations, the differences are small when compared to other anchialine ponds in West Hawaii which display very distinct stratification with a strong transition between a low salinity-high nutrient surface layer and high salinity-low nutrient bottom layer.

It is likely that the relative lack of vertical stratification in the shoreline ponds at Sea Mountain Villages is a result of the large fluxes of groundwater that move through the ponds. The low salinity, as well as the lack of stratification indicates that flow through the ponds is essentially a one-way flow from land to the ocean, and the ponds are influenced little by saltwater.

3. Conservative Mixing Analysis

A useful treatment of water chemistry data for interpreting the extent of material input from land is application of a hydrographic mixing model. In the simplest form, such a model consists of plotting the concentration of a dissolved chemical species as a function of salinity

(Officer 1979, Smith and Atkinson 1992, Dollar and Atkinson 1992). The concept of using such mixing models which scale nutrient concentrations to salinity has been recently used by the State of Hawaii Department of Health for establishing a unique set of water quality standards for the West Coast of the Island of Hawaii [Hawaii Administrative Rules, §11-54-06 (d)].

Comparison of the curves produced by the distribution of data with conservative mixing lines provides an indication of the origin and fate of the material in question. If the parameter in question displays purely conservative behavior (i.e., no input or removal from any process other than physical mixing), data points should fall on, or near, the conservative mixing line. If however, external material is added to the system through processes such as leaching of fertilizer nutrients to groundwater, data points will fall above the mixing line. If material is being removed from the system by processes such as biological uptake, data points will fall below the mixing line.

Figure 15 -17 show plots of the concentrations of Si, NO_3^-, PO_4^{3-}, NH_4^+, TON and TOP as functions of salinity for the samples collected at each sampling station at Sea Mountain Villages. Each graph also shows conservative mixing lines constructed by connecting the end-member concentrations of open ocean water, and the average groundwater concentration from four potable wells located upslope of the Sea Mountain Villages area (Table 4).

Dissolved Si represents a check on the model as this material is present in high concentration in groundwater, but is not a major component of fertilizer. In addition, Si is not utilized rapidly within the nearshore environment by biological processes. It can be seen in Figure 16 that data points for all ocean and pond samples fall in a linear array on, or very close to, the conservative mixing line. Such a pattern supports the assumption that Si is behaving as a conservative tracer and that well water sampled from the upslope wells is similar in composition to groundwater entering the ocean off the Sea Mountain Villages project site.

The plots of NO_3^- versus salinity show a different distribution as Si. All of the data points for samples collected in the ocean (salinity >15‰) fall on the conservative mixing line, showing that there is no input or uptake NO_3^- within the marine environment. Concentrations of NO_3^- in offshore samples are a pure mixture of pristine groundwater and ocean water with no effects from activities on land. Many of the data points representing concentrations of NO_3^- in pond waters, however, fall far below the conservative mixing line. Such a pattern indicates that there is uptake of NO_3^- within the ponds. Such a result is not surprising noting the presence of extensive plant growth in the ponds. The lack of a reflection of the lowered concentrations of NO_3^- in the nearshore ocean samples is likely a result of the swamping out of the reduced pond concentrations by the large volume of groundwater that moves through the shoreline relative to the volume of pond water that moves out of the ponds. From these analyses, it is clear that there is no subsidy of NO_3^- from activities on land inland from the ponds or coastal ocean at the Sea Mountain Villages site.

PO_4^{3-} is also a major component of fertilizer. However, PO_4^{-3} is usually not found to leach to groundwater to the extent of NO_3^-, owing to a high absorptive affinity of phosphorus in soils or rock. It can be seen in Figure 16 that like NO_3^-, all of the PO_4^{3-} data points from ocean

samples fall on a strongly linear array on the conservative mixing line. Within the ponds, concentrations of PO_4^{-3} are scattered around the mixing line, indicating both uptake and release by pond biotic processes. When organic nutrients (NH_4^+, TON, TOP) are plotted versus salinity, it is evident that there is production within the ponds (Figures 16 and 17). Such a result is expected, as these nutrients are the result of respiration. Hence, the results of the conservative mixing analyses reflect the nutrient cycle of a metabolically active plant-based community, which is supported by the observation of dense plant communities within the ponds.

C. Biotic Community Structure

1. Marine Community Structure

As noted in the Methods section, weather conditions during the present survey precluded assessment of marine communities beyond the surf line. Examination of the accessible area, however, provides a qualitative indication of the overall marine community structure of the nearshore region. As noted, the two dominant physical factors that influence nearshore marine community structure are high fluxes of freshwater at the shoreline, and near continuous physical stress from breaking waves. Along the southern part of the property, the shoreline consists of a series of shallow indentations that can be termed "ocean inlets" (Figure 3). While these areas are largely sheltered from wave stress, they are so shallow that they are greatly influenced by tides, and at low tidal stands contain very shallow water. In addition, at low tide salinity can be so low as to be limiting to many marine organisms. As a result, the floors of these inshore areas are largely devoid of macrobenthos (Figure 4). The sparse biota observed was limited to small colonies of the stony corals *Pocillopora damicornis, P. meandrina,* and *Montipora flabellata*. The only other macrobenthos observed were the short-spined sea urchin *Echinometra matheai*.

The basaltic shoreline and intertidal area along the central region of the project that is not subjected to groundwater discharge is characterized by a dense band of the red algae *Ahnfeltia concinna, as well as* a variety of typical splash zone mollusks *(e.g. Littorina spp. Nerita spp.)* and the shingle sea urchin *Colobocentrotus atratus*.

The semi-protected Punalu'u Bay provided a habitat for benthic fauna. While the inner region of the Bay floor was essentially devoid of macrobenthos, the outer area of the bay was colonized by a variety of encrusting corals. The most dominant species were *Porites lobata*, *Monitpora flabellata* and *Pocillopora meandrina* (Figure 7). In addition, many of the boulders comprising the Bay floor were colonized by calcareous red algae. Filamentous macroalgae were not observed in abundance within the Bay. While the inner Bay was depauperate with respect to fish abundance, a variety of reef fish were observed in the deeper outer areas of Punalu'u Bay.

Sea turtles, particularly green sea turtles (*Chelonia mydas*) are often encountered in Punalu'u Bay, and often haul out on the black sand beach (Figure 6). The turtle population at Punalu'u has been one of four populations that have been studied continuously since 1975 (Balasz and Chaloupla 2004). Results of this published work indicate that there has been a

substantial increase in the number of turtles at sites in the Hawaiian Archipelago following cessation of harvesting in the 1970's. However, there has also been a significant long-term decline in size-specific growth rates at all three study sites in the main Hawaiian Islands that presumably reflects local foraging factors such as food availability and possibly the nutritional quality of the food supply. Hence, while there are more turtles, they appear to be growing slower. None of the results of this study indicate any abnormal characteristics to the Punalu'u turtle population.

Table 5 shows results of qualitative surveys of pond biota. Of note was that all ponds contained non-native fish species, which are generally regarded as a negative factor with respect to native populations. Of note was the observation of a green turtle feeding in Pond 1.

IV. DISCUSSION and CONCLUSIONS

The purpose of this baseline survey is to provide the information to make valid evaluations of the potential for impact to the marine environments from the proposed Sea Mountain Village Project. The information collected for this study provides the basis to understand the processes that are operating in the shoreline ponds and nearshore ocean. As a result, it is possible to address any concerns that might be raised in the planning process.

The proposed Sea Mountain Village project does not include any plans for any direct alteration of the shoreline or offshore areas. Therefore, potential impacts to the marine environment can only be considered from activities on land that may result in delivery of materials (fresh water, sediment, nutrients, and potentially toxic materials) to the ocean through infiltration to groundwater, surface runoff and wind transport. The project may have an impact on groundwater as a result of withdrawal of groundwater from the supply wells for the projects potable uses and landscape irrigation, and percolation of excess landscape irrigation water (particularly from the golf course) to the underlying groundwater.

At present, while the total potable water use for the full project has been calculated, it is not known how the withdrawal will affect groundwater fluxes. However, it is possible to make some estimates of the effects of percolation of excess nutrients from landscape irrigation to the nutrient flux to the shoreline environments.

It is assumed that a one mile (~5,000-foot) long section of shoreline centered directly downgradient from the project site will be the portion of the basal aquifer that would be affected. At present, the flow of groundwater discharging into the marine environment along the one mile section is on the order of 12 MGD per shoreline mile per day (Tom Nance, personal communication). According to the Golf Course Integrated Management Plan prepared for the Sea Mountain Village Course prepared by Blankinship and Associates, the maximum annual rate of Nitrogen and Phosphorus fertilizer use for the completed golf course (adjusted for area of greens/tees, fairways and roughs) will be 5.35 lb N and 3.9 lb P per 1000 ft^2. During the initial grow-in and establishment period, which will take a maximum of 6 months (0.5 yr), the area-adjusted total application rates will be about 3.1 lb N and 5 lb P per 1000 ft^2 . Assuming the entire golf course encompasses 120 acres, the annual rate of

fertilizer application for the entire completed course will be 1.22 x 10^4 kg N and 9.25 x 10^3 kg P. For the initial six-month grow-in period, the equivalent rates of application would be 7.35 x 10^3 kg N and 1.18 x 10^4 kg P With a groundwater flux of 12 MGD per mile of coastline per day, and a average concentration of TN and TP in groundwater of 880 μg/L and 98 μg/L, respectively (Table 4), the annual groundwater flux of N and P to the ocean along the one-mile of coastline will be about 1.44 x 10^4 kg N, and 1.61 x 10^3 kg P.

Hence, following completion of the golf course, the maximum fertilization rate will approximately equal the natural groundwater flux of N to the ocean. However, the application of P to the golf course would be about six times the natural flux of P in groundwater. If the initial grow-in period is considered to be six months, the natural groundwater flux would be about 7.2 x 10^3 kg N, and 8.05 x 10^2 kg P. With the estimated fertilizer application during the grow-in period of 7.35 x 10^3 kg N, nitrogen application again approximately equals the natural flux of groundwater N to the ocean. However, the application rate of P during the grow-in phase of 1.18 x 10^4 kg P represents an increase of approximately 15-fold over the natural flux.

However, of the applied N and P, most will be taken up by the turf and not reach basal groundwater. An estimate of uptake calculated by budgeting application rates with groundwater discharge for golf courses in West Hawaii indicated about 10% of the applied N, and 1% of the applied P percolates to groundwater (Dollar and Atkinson 1992). Hence, if the N subsidy to groundwater from the golf course (during both grow-in and normal operation) is about 10%, concentrations of total N could increase in groundwater from the present concentration of about 63 μM (880 μg/L) to 69 μM (968 μg/L). Similarly, if 1% of the applied P reaches groundwater, the concentration would increase by about 15% during grow-in and 6% during normal conditions. Such increases could result in changes of TP in groundwater from 3 .16 μM (97.9 μg/L) to 3.63 μM (112 μg/L) during grow-in, and 3.34 μM (104 μg/L) during normal golf course operations.

While such potential increases are probably measurable, they would not likely cause any alteration to the marine and pond communities for several reasons. First, the maximum increases to groundwater nutrient concentration are within the envelope of natural variability found on the Island of Hawaii. Pristine groundwater collected from wells in the West Hawaii (Kona) area contain average NO_3^- and PO_4^{3-} concentrations of approximately 78 μM and 4 μM, respectively (Dollar and Atkinson 1992). These concentrations in natural groundwater are higher than the projected maximum increases from the Sea Mountain Village golf course.

In addition, as shown in the data presented above, the present nutrient concentrations in groundwater are not limiting to pond biota, as high nutrient concentrations are a normal feature throughout the ponds. Hence, the potential slight increases of nutrient concentrations in water that passes through the ponds would not result in any changes in the nutrient dynamics of these shoreline ponds. With respect to the marine environment, the near-constant physical mixing processes are so intense during normal tradewind wave conditions that the potential increases in groundwater concentrations would not result in any detectable change to delivery to the nearshore coastal zone. During periods when tradewind do not cause intense turbulent mixing, any groundwater flow to the ocean would be maintained in a

buoyant surface layer, hence eliminating any contact with the benthic communities. During either set of shoreline conditions, there is little potential for any alteration of coastal marine biotic structure and function.

In summary, it does not appear that any of the planned activities of the proposed Sea Mountain Village project will result in negative impacts to the marine and pond environments. This conclusion is based on the prevailing natural conditions of the area which include substantial flux of groundwater to the nearshore zone, as well as intense mixing of the nearshore ocean during normal weather conditions. In comparison to these natural factors, the small alterations in groundwater dynamics that may result from the proposed project will not likely have any effect. In fact, should there be any effect of nutrient subsidies, it may be the augmentation of marine algal stocks, which are the main food source of sea turtles which inhabit the area.

V. SUMMARY

1. Evaluation of nearshore and pond water chemistry and biota off the proposed Sea Mountain Village project at Punalu'u, Ka'u Hawaii were carried out in late 2005 and early 2006. Sixty-six water samples were collected at five offshore sites located in the vicinity of the project, as well as from shoreline. Water samples were collected on transects perpendicular to shore, extending from the shoreline to a distance of up to 50 m offshore. Samples were also collected from potable wells upslope of the project site in order to determine chemical composition of unaltered groundwater. Analysis of twelve water chemistry constituents included all specific constituents in DOH water quality standards.

2. Dissolved nutrients (Si, NO_3^-, PO_4^{3-}, TN and TP) displayed strong horizontal gradients at all ocean transect sites with highest values closest to shore and lowest values at the most seaward sampling locations. Correspondingly, salinity was lowest closest to the shoreline, and increased with distance from shore. These patterns are indicative of groundwater efflux at the shoreline, producing a zone of mixing where nearshore waters are a combination of ocean water and groundwater. Chl *a* and turbidity were generally elevated in nearshore samples with decreasing values moving seaward. During the sampling, typical physical forces (breaking tradewind waves) were sufficient to mix the water column within several meters of the shoreline.

3. Water chemistry of shoreline ponds revealed very low salinities in the ponds, and very little vertical stratification. Such patterns indicate very high seaward fluxes of groundwater through the ponds with little mixing of ocean water.

4. Application of a hydrographic mixing model to the water chemistry data was used to indicate if increased nutrient concentrations are the result of mixing of natural groundwater with oceanic water, or are the result of inputs from activities on land. The model indicates that at the time of sampling there was no external subsidies of NO_3^- nitrogen or other nutrients to the ocean at any of the sampling sites. Within the ponds, there was active uptake of NO_3^-, presumably by photosynthetic activity of pond plants. However, even with such uptake, the

concentrations NO_3^- in the ponds never was depleted to the point of nutrient limitation. The lack of any indication of alteration of NO_3^- delivery to the ocean other than from pure mixing of groundwater and ocean water suggests that changes in nutrient concentrations owing metabolic activity within the ponds is small in comparison to the flux of groundwater through the ponds to the ocean.

5. Qualitative evaluation of nearshore marine biota indicates a depauperate community that is the result of very rigorous physical conditions of salinity variation and wave impact. Hence, any changes in groundwater composition owing to the project would not likely have any effect on the biotic composition of the area, as such communities are already subjected to maximal natural stresses.

6. Evaluations of changes to groundwater from golf course irrigation are estimated to potentially add up to 10% to the concentration of total Nitrogen, and 6% during normal operations and 15% during grow-in of total Phosphorus. While such subsidies may be detectable, they are not likely to result in any changes to the composition of marine or pond biotic communities. Groundwater concentrations of N and P in the ponds are already high, and non-limiting to pond biota. Hence, the estimated maximum subsidies would not likely change the overall nutrient dynamics as exists at present. Such subsidies also would not have an effect on the nearshore marine environment as mixing processes are sufficient to remove the input from land within a very narrow nearshore zone.

7. While Punalu'u Bay contains a large population of federally protected turtles, there is little potential for impact to these populations from changes in water chemistry. Long-term studies of turtle populations indicate that the numbers of turtles have increased, while the growth rate has slowed. If the slowed growth rate is a result of decreased food sources (marine algae), the only effect of the project may be a benefit to turtle populations owing to an increase in algal growth through slight increases in nutrient fluxes to the ponds and nearshore marine environment.

8. Overall, if the proposed project utilizes best management practices during construction and operation, there is little potential for impacts to the marine and pond environments.

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Table 1. Results of water sampling along five water sampling transect conducted on December 11, 2005 off the Sea Mountain Village at Punaluu Project in Ka'u Hawaii. Nutrient concentrations are in micromolar (μM) units. "DFS" represents distance from shore. "S" indicates surface sample; "D" indictes deep sample. See Figure 1 for locations of sampling transects.

TRANSECT	DFS (m)	PO_4^{3-} (μM)	NO_3^- (μM)	NH_4^+ (μM)	Si (μM)	TOP (μM)	TON (μM)	TP (μM)	TN (μM)	TURB (ntu)	SALT (o/oo)	pH (rel)	Chl-a (μg/l)
TRANSECT 1	0-S	0.29	3.28	0.06	109.00	0.21	6.30	0.50	9.64	0.44	29.339	8.250	0.682
	1-S	0.27	4.51	0.12	125.74	0.21	6.25	0.48	10.88	0.45	28.358	8.248	0.745
	5-S	0.25	2.55	0.20	84.75	0.23	5.72	0.48	8.47	0.28	30.522	8.243	0.503
	5-D	0.26	2.71	0.22	85.40	0.23	6.11	0.49	9.04	0.24	30.496	8.247	0.524
	10-S	0.17	1.12	0.09	44.77	0.23	5.95	0.40	7.16	0.15	32.709	8.240	0.388
	10-D	0.14	0.98	0.13	41.58	0.25	6.52	0.39	7.63	0.14	32.801	8.208	0.503
TRANSECT 2	0	0.31	3.43	0.13	100.91	0.21	5.46	0.52	9.02	0.67	29.924	8.221	0.451
	1	0.40	4.75	0.16	136.99	0.21	5.41	0.61	10.32	0.27	27.945	8.248	0.388
	2	0.24	2.76	0.26	81.48	0.23	6.66	0.47	9.68	0.25	30.836	8.220	0.325
	5S	0.42	4.89	0.17	138.27	0.20	5.03	0.62	10.09	0.37	27.935	8.245	0.325
	5D	0.25	2.27	0.26	66.67	0.22	5.36	0.47	7.89	0.21	31.631	8.213	0.336
	10S	0.41	3.99	0.27	114.60	0.18	5.85	0.59	10.11	0.20	29.154	8.236	0.241
	10D	0.29	2.62	0.19	78.61	0.23	5.69	0.52	8.50	0.19	31.012	8.223	0.462
	20S	0.44	4.90	0.14	140.59	0.20	5.02	0.64	10.06	0.11	27.853	8.238	0.336
	20D	0.35	3.11	0.24	92.03	0.22	7.36	0.57	10.71	0.10	30.322	8.228	0.462
TRANSECT 3	POND 2-S	1.40	17.00	1.25	683.35	1.30	32.95	2.70	51.20	0.19	1.411	7.683	2.643
	POND 2-B	1.55	17.55	2.05	695.95	1.20	34.70	2.75	54.30	0.22	1.987	7.542	2.496
	POND 2-S	1.50	16.10	0.85	692.70	1.35	34.70	2.85	51.65	0.21	1.467	7.679	3.566
	POND 2-B	1.15	14.95	2.70	646.85	1.45	35.75	2.60	53.40	0.33	2.385	7.775	6.335
	0	0.23	1.88	0.49	76.34	0.25	6.90	0.48	9.27	0.11	31.092	8.255	0.378
	1	0.25	1.44	0.35	48.54	0.22	5.67	0.47	7.46	0.11	32.473	8.225	0.430
	5	0.21	1.60	0.24	53.72	0.24	6.45	0.45	8.29	0.11	32.188	8.252	0.304
	10	0.24	2.22	0.35	65.61	0.24	6.15	0.48	8.72	0.10	31.596	8.245	0.315
TRANSECT 4	POND 1	1.90	26.90	1.20	708.15	0.95	30.35	2.85	58.45	0.10	1.001	7.407	0.545
	SPRING	2.15	31.95	1.70	715.20	0.95	29.50	3.10	63.15	0.06	1.025	7.733	0.105
	SPRING	2.00	29.60	1.20	685.95	1.00	27.15	3.00	57.95	0.09	2.295	7.720	0.430
	0	1.75	26.20	1.00	624.20	1.10	30.45	2.85	57.65	0.07	4.885	7.981	0.252
	1	0.95	14.49	0.10	333.19	0.10	3.81	1.05	18.40	0.07	16.870	8.238	0.199
	2	0.76	10.54	0.23	265.89	0.18	4.93	0.94	15.70	0.07	21.239	8.267	0.409
	5	0.71	10.17	0.14	247.71	0.20	4.82	0.91	15.13	0.07	21.912	8.279	0.535
	5	0.53	7.12	0.30	183.55	0.21	5.44	0.74	12.86	0.08	25.488	8.268	0.294
	10-S	0.32	4.14	0.15	123.84	0.26	6.19	0.58	10.48	0.09	28.652	8.265	0.346
	10-D	0.24	3.67	0.19	116.64	0.27	6.68	0.51	10.54	0.08	29.006	8.267	0.210
	25-S	0.16	1.73	0.28	62.54	0.27	6.48	0.43	8.49	0.09	31.754	8.235	0.294
	25-D	0.22	1.95	0.14	68.57	0.25	7.99	0.47	10.08	0.08	31.448	8.241	0.367
TRANSECT 5	SPRING	1.90	31.75	0.85	711.65	1.10	36.85	3.00	69.45	0.05	0.799	7.937	0.063
	1	2.20	31.60	1.10	700.45	1.05	40.95	3.25	73.65	0.07	1.304	7.828	0.157
	2	0.72	10.86	0.01	253.53	0.15	5.75	0.87	16.62	0.09	21.296	8.326	0.503
	5	0.48	6.97	0.04	174.59	0.22	6.88	0.70	13.89	0.10	25.691	8.314	0.545
	10-S	0.40	4.80	0.00	137.02	0.24	6.35	0.64	11.15	0.08	27.793	8.356	0.357
	10-D	0.30	2.11	0.10	67.90	0.25	7.57	0.55	9.78	0.11	31.444	8.279	0.671
	20-S	0.42	4.21	0.02	118.13	0.20	6.74	0.62	10.97	0.12	28.826	8.299	0.357
	20-D	0.26	1.73	0.05	58.73	0.27	7.18	0.53	8.96	0.08	32.048	8.262	0.514
	25-S	0.13	3.64	0.10	101.89	0.28	7.91	0.41	11.65	0.11	29.688	8.245	0.189
	25-D	0.03	1.29	0.16	47.34	0.28	6.55	0.31	8.00	0.10	32.559	8.226	0.262
	50-S	0.11	0.47	0.23	22.60	0.27	7.50	0.38	8.20	0.08	33.740	8.203	0.241
	50-D	0.14	0.47	0.12	24.10	0.26	8.18	0.40	8.77	0.20	33.656	8.209	0.378

Table 2. Results of water sampling along five water sampling transect conducted on December 11, 2005 off the Sea Mountain Village at Punaluu Project in Ka'u Hawaii. Nutrient concentrations are shown in units of micrograms per liter (μg/L). "DFS" represents distance from shore. "S" indicates surface sample; "D" indictes deep sample. See Figure 1 for locations of sampling transects.

TRANSECT	DFS (m)	PO_4^{3-} (μg/L)	NO_3^- (μg/L)	NH_4^+ (μg/L)	Si (μg/L)	TOP (μg/L)	TON (μg/L)	TP (μg/L)	TN (μg/L)	TURB (ntu)	SALT (o/oo)	pH (rel)	Chl-a (μg/l)
TRANSECT 1	0-S	8.99	45.92	0.84	3062.90	6.51	88.20	15.50	134.96	0.44	29.339	8.250	0.682
	1-S	8.37	63.14	1.68	3533.29	6.51	87.50	14.88	152.32	0.45	28.358	8.248	0.745
	5-S	7.75	35.70	2.80	2381.48	7.13	80.08	14.88	118.58	0.28	30.522	8.243	0.503
	5-D	8.06	37.94	3.08	2399.74	7.13	85.54	15.19	126.56	0.24	30.496	8.247	0.524
	10-S	5.27	15.68	1.26	1258.04	7.13	83.30	12.40	100.24	0.15	32.709	8.240	0.388
	10-D	4.34	13.72	1.82	1168.40	7.75	91.28	12.09	106.82	0.14	32.801	8.208	0.503
TRANSECT 2	0	9.61	48.02	1.82	2835.57	6.51	76.44	16.12	126.28	0.67	29.924	8.221	0.451
	1	12.40	66.50	2.24	3849.42	6.51	75.74	18.91	144.48	0.27	27.945	8.248	0.388
	2	7.44	38.64	3.64	2289.59	7.13	93.24	14.57	135.52	0.25	30.836	8.220	0.325
	5S	13.02	68.46	2.38	3885.39	6.20	70.42	19.22	141.26	0.37	27.935	8.245	0.325
	5D	7.75	31.78	3.64	1873.43	6.82	75.04	14.57	110.46	0.21	31.631	8.213	0.336
	10S	12.71	55.86	3.78	3220.26	5.58	81.90	18.29	141.54	0.20	29.154	8.236	0.241
	10D	8.99	36.68	2.66	2208.94	7.13	79.66	16.12	119.00	0.19	31.012	8.223	0.462
	20S	13.64	68.60	1.96	3950.58	6.20	70.28	19.84	140.84	0.11	27.853	8.238	0.336
	20D	10.85	43.54	3.36	2586.04	6.82	103.04	17.67	149.94	0.10	30.322	8.228	0.462
TRANSECT 3	POND 2-S	43.40	238.00	17.50	19202.14	40.30	461.30	83.70	716.80	0.19	1.411	7.683	2.643
	POND 2-B	48.05	245.70	28.70	19556.20	37.20	485.80	85.25	760.20	0.22	1.987	7.542	2.496
	POND 2-S	46.50	225.40	11.90	19464.87	41.85	485.80	88.35	723.10	0.21	1.467	7.679	3.566
	POND 2-B	35.65	209.30	37.80	18176.49	44.95	500.50	80.60	747.60	0.33	2.385	7.775	6.335
	0	7.13	26.32	6.86	2145.15	7.75	96.60	14.88	129.78	0.11	31.092	8.255	0.378
	1	7.75	20.16	4.90	1363.97	6.82	79.38	14.57	104.44	0.11	32.473	8.225	0.430
	5	6.51	22.40	3.36	1509.53	7.44	90.30	13.95	116.06	0.11	32.188	8.252	0.304
	10	7.44	31.08	4.90	1843.64	7.44	86.10	14.88	122.08	0.10	31.596	8.245	0.315
TRANSECT 4	POND 1	58.90	376.60	16.80	19899.02	29.45	424.90	88.35	818.30	0.10	1.001	7.407	0.545
	SPRING	66.65	447.30	23.80	20097.12	29.45	413.00	96.10	884.10	0.06	1.025	7.733	0.105
	SPRING	62.00	414.40	16.80	19275.20	31.00	380.10	93.00	811.30	0.09	2.295	7.720	0.430
	0	54.25	366.80	14.00	17540.02	34.10	426.30	88.35	807.10	0.07	4.885	7.981	0.252
	1	29.45	202.86	1.40	9362.64	3.10	53.34	32.55	257.60	0.07	16.870	8.238	0.199
	2	23.56	147.56	3.22	7471.51	5.58	69.02	29.14	219.80	0.07	21.239	8.267	0.409
	5	22.01	142.38	1.96	6960.65	6.20	67.48	28.21	211.82	0.07	21.912	8.279	0.535
	5	16.43	99.68	4.20	5157.76	6.51	76.16	22.94	180.04	0.08	25.488	8.268	0.294
	10-S	9.92	57.96	2.10	3479.90	8.06	86.66	17.98	146.72	0.09	28.652	8.265	0.346
	10-D	7.44	51.38	2.66	3277.58	8.37	93.52	15.81	147.56	0.08	29.006	8.267	0.210
	25-S	4.96	24.22	3.92	1757.37	8.37	90.72	13.33	118.86	0.09	31.754	8.235	0.294
	25-D	6.82	27.30	1.96	1926.82	7.75	111.86	14.57	141.12	0.08	31.448	8.241	0.367
TRANSECT 5	SPRING	58.90	444.50	11.90	19997.37	34.10	515.90	93.00	972.30	0.05	0.799	7.937	0.063
	1	68.20	442.40	15.40	19682.65	32.55	573.30	100.75	1031.10	0.07	1.304	7.828	0.157
	2	22.32	152.04	0.14	7124.19	4.65	80.50	26.97	232.68	0.09	21.296	8.326	0.503
	5	14.88	97.58	0.56	4905.98	6.82	96.32	21.70	194.46	0.10	25.691	8.314	0.545
	10-S	12.40	67.20	0.00	3850.26	7.44	88.90	19.84	156.10	0.08	27.793	8.356	0.357
	10-D	9.30	29.54	1.40	1907.99	7.75	105.98	17.05	136.92	0.11	31.444	8.279	0.671
	20-S	13.02	58.94	0.28	3319.45	6.20	94.36	19.22	153.58	0.12	28.826	8.299	0.357
	20-D	8.06	24.22	0.70	1650.31	8.37	100.52	16.43	125.44	0.08	32.048	8.262	0.514
	25-S	4.03	50.96	1.40	2863.11	8.68	110.74	12.71	163.10	0.11	29.688	8.245	0.189
	25-D	0.93	18.06	2.24	1330.25	8.68	91.70	9.61	112.00	0.10	32.559	8.226	0.262
	50-S	3.41	6.58	3.22	635.06	8.37	105.00	11.78	114.80	0.08	33.740	8.203	0.241
	50-D	4.34	6.58	1.68	677.21	8.06	114.52	12.40	122.78	0.20	33.656	8.209	0.378

TABLE 3. Results of water chemistry analyses of water in shoreline Ponds 1 and 2 in the vicinity of the Sea Mountain Village at Punalu'u, Island of Hawaii sampled on April 14, 2006. Each pond was sompled in the northern (N) and southern (S) portions. Three samples were collected at each site; at the surface (S), mid-depth, and near the bottom (B). Top table shows nutrient concentrations in micromolar units; bottom table shows nutrient concentrations in micrograms per liter (μg/L). See Figure 1 for locations of ponds.

POND NO.	DEPTH	PO_4^{3-} (μM)	NO_3^- (μM)	NH_4^+ (μM)	Si (μM)	TOP (μM)	TON (μM)	TP (μM)	TN (μM)	SALT (o/oo)	pH (rel)	Chl-a (μg/l)
1N	S	1.20	15.52	4.88	642.32	2.64	57.12	3.84	77.52	3.093	7.237	3.912
	M	1.28	10.88	3.84	638.00	2.16	51.52	3.44	66.24	3.377	7.274	4.678
	B	0.80	10.24	4.96	621.60	2.40	61.44	3.20	76.64	3.746	7.240	9.493
1S	S	1.20	13.60	3.52	687.52	2.24	58.80	3.44	75.92	1.926	7.146	0.451
	M	1.20	12.64	7.44	673.68	2.32	62.56	3.52	82.64	2.936	7.166	2.108
	B	1.12	11.36	7.28	608.00	2.48	56.72	3.60	75.36	5.125	7.037	6.724
2N	S	1.28	22.56	3.04	691.76	2.32	56.88	3.60	82.48	1.830	7.526	5.391
	M	1.20	22.16	2.56	688.32	2.32	55.36	3.52	80.08	1.941	7.492	6.776
	B	1.52	13.76	4.88	639.76	2.16	71.68	3.68	90.32	4.543	7.467	12.031
2S	S	1.44	22.80	4.40	698.16	2.32	54.72	3.76	81.92	1.747	7.521	5.412
	M	1.44	22.08	4.88	675.12	2.32	53.68	3.76	80.64	1.755	7.518	4.972
	B	1.12	22.56	5.28	683.28	2.24	59.52	3.36	87.36	1.774	7.465	6.671

POND NO.	DEPTH	PO_4^{3-} (μg/L)	NO_3^- (μg/L)	NH_4^+ (μg/L)	Si (μg/L)	TOP (μg/L)	TON (μg/L)	TP (μg/L)	TN (μg/L)	SALT (o/oo)	pH (rel)	Chl-a (μg/l)
1N	S	37.20	217.28	68.32	18049	81.84	799.68	119.04	1085.28	3.093	7.237	3.912
	M	39.68	152.32	53.76	17928	66.96	721.28	106.64	927.36	3.377	7.274	4.678
	B	24.80	143.36	69.44	17467	74.40	860.16	99.20	1072.96	3.746	7.240	9.493
1S	S	37.20	190.40	49.28	19319	69.44	823.20	106.64	1062.88	1.926	7.146	0.451
	M	37.20	176.96	104.16	18930	71.92	875.84	109.12	1156.96	2.936	7.166	2.108
	B	34.72	159.04	101.92	17085	76.88	794.08	111.60	1055.04	5.125	7.037	6.724
2N	S	39.68	315.84	42.56	19438	71.92	796.32	111.60	1154.72	1.830	7.526	5.391
	M	37.20	310.24	35.84	19342	71.92	775.04	109.12	1121.12	1.941	7.492	6.776
	B	47.12	192.64	68.32	17977	66.96	1003.52	114.08	1264.48	4.543	7.467	12.031
2S	S	44.64	319.20	61.60	19618	71.92	766.08	116.56	1146.88	1.747	7.521	5.412
	M	44.64	309.12	68.32	18971	71.92	751.52	116.56	1128.96	1.755	7.518	4.972
	B	34.72	315.84	73.92	19200	69.44	833.28	104.16	1223.04	1.774	7.465	6.671

TABLE 4. Results of water chemistry analyses of water collected in five groundwater wells in the vicinity of the Sea Mountain Village at Punalu'u, Island of Hawaii sampled on December 16, 2005. Top table shows nutrient concentrations in micromolar units; bottom table shows nutrient concentrations in micrograms per liter (μg/L).

WELL	PO_4^{3-} (μM)	NO_3^- (μM)	NH_4^+ (μM)	Si (μM)	TOP (μM)	TON (μM)	TP (μM)	TN (μM)	SALT (o/oo)
NINOLE SPRING	0.56	22.96	0.56	685.20	2.00	46.56	2.56	70.08	1.252
NINOLE WELL #2	1.36	34.80	0.96	748.48	2.00	32.24	3.36	68.00	0.479
PAHALA DWS WELL	1.44	15.52	1.60	429.76	0.72	35.36	2.16	52.48	0.088
PALIMA WELL	4.16	26.56	0.80	797.28	1.20	34.72	5.36	62.08	0.123
GEOMETRIC MEAN	1.46	23.96	0.91	647.45	1.36	36.84	3.16	62.77	0.284

WELL	PO_4^{3-} (μg/L)	NO_3^- (μg/L)	NH_4^+ (μg/L)	Si (μg/L)	TOP (μg/L)	TON (μg/L)	TP (μg/L)	TN (μg/L)	SALT (o/oo)
NINOLE SPRING	17.36	321.44	7.84	19254	62.00	651.84	79.36	981.12	1.252
NINOLE WELL #2	42.16	487.20	13.44	21032	62.00	451.36	104.16	952.00	0.479
PAHALA DWS WELL	44.64	217.28	22.40	12076	22.32	495.04	66.96	734.72	0.088
PALIMA WELL	128.96	371.84	11.20	22404	37.20	486.08	166.16	869.12	0.123
GEOMETRIC MEAN	45.31	335.39	12.75	18193.44	42.27	515.83	97.93	878.80	0.28

TABLE 5. Abundance of organisms in coastal ponds at Sea Mountain Village, Punalu'u, Ka'u, Hawaii surveyed April 14, 2006.

ABUNDANCE CODE; 1 = Few or 1
2 = Low abundance
3 = Common
4 = Abundant

Pond 1	Abundance	Notes
Species		
Fish		
Mugil Cephalus	4	Juvenile only
Atherinomorus insularum	2	
Kulia xenura	3	Juvenile only
Eleotris sandwicensis	4	
Stenogobius hawaiiensis	4	
Gambusia affinis	2	Non -native
Crustacea		
Palemon debilis	2	
Metapgrapsus thukuhar	1	
Molusca		
Assminea nitida	4	
Thiara granifera	4	
Thiara granifera	1	
Neritina vespertina	2	
Reptilia		
Chelonia mydas	1	

* Pond contained mats of Rhizoclonium spp. and Melosira spp.
2% benthic coveage of Ruppia maritima
* 5% pond surface coverage of Hyacinthus orientalis and Azolla filiculoides

Transient Ponds		
Fish		
Gobidae	3	small <1cm
Gambusia affinis	3	non-native
Mollusca		
Thiara granifera	3	

Pond 2	Abundance	Notes
Fish		
Kuhlia xenura	3	
Eleotris sandwicensis	2	
Gambusia affinis	4	non-native
Crustacea		
Macrobrachium grandimanus	2	

* High turbidity w/ virtually no filamentous algae growth
* <3% surface coverage of Hyacinthus orientalis

Pond 3		
Fish		
Gambusia Affinis	4	non-native
Poecilia sp.	4	non-native
Oreochromis mossambicus	3	non-native
Crustacea		
Procambarus clarkii	3	non-native
Mollusca		
Thiara granfera	3	

* 94% surface coverage Pistia statiotes non-native
* 4% surface coverage Hyachinthus orientalis non-native

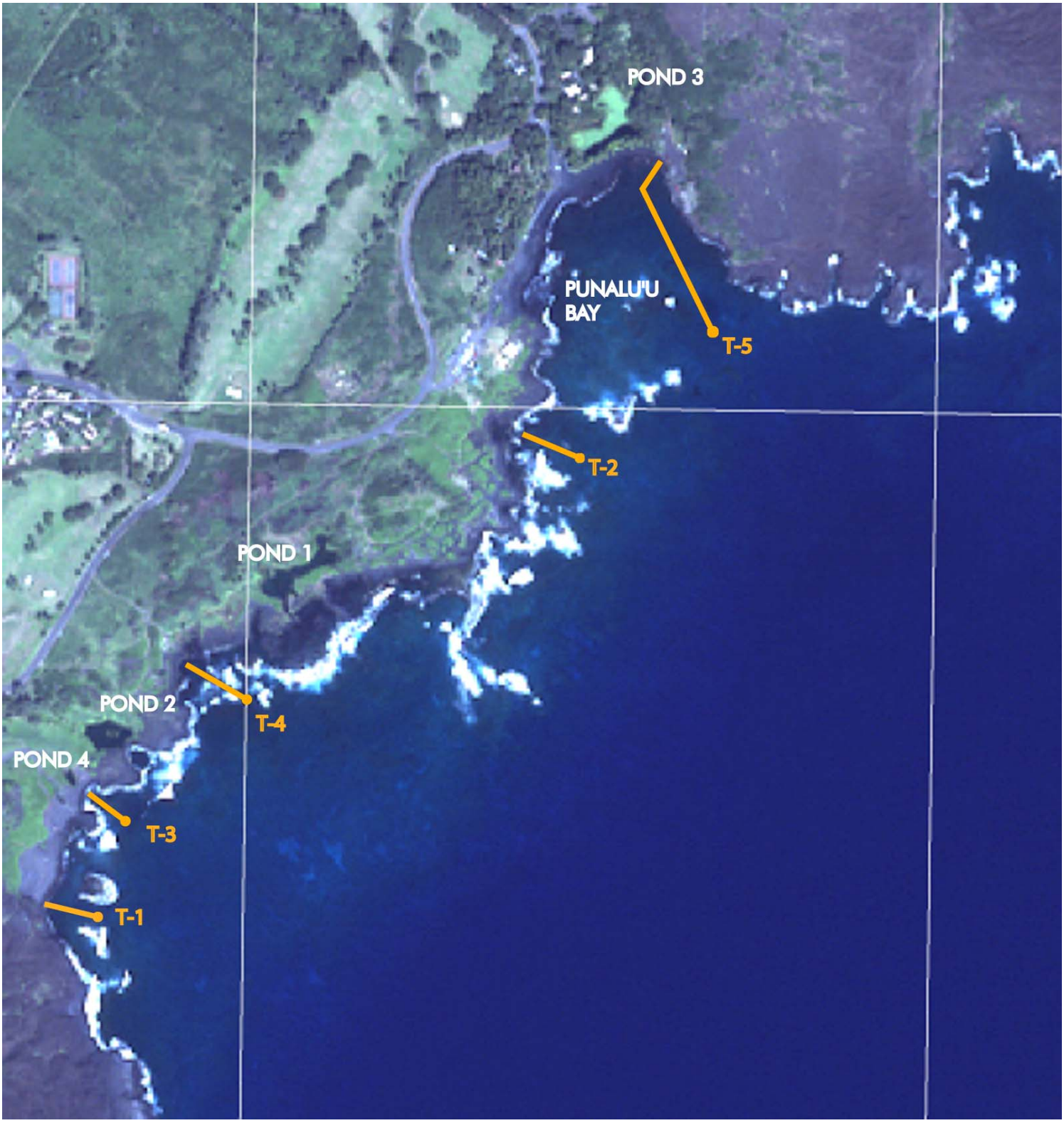


FIGURE 1. Aerial photograph of shoreline of the proposed Sea Mountain Village at Punalu'u project, Ka'u, Island of Hawaii. Also shown are locations of five water sampling transects and four brackish ponds.

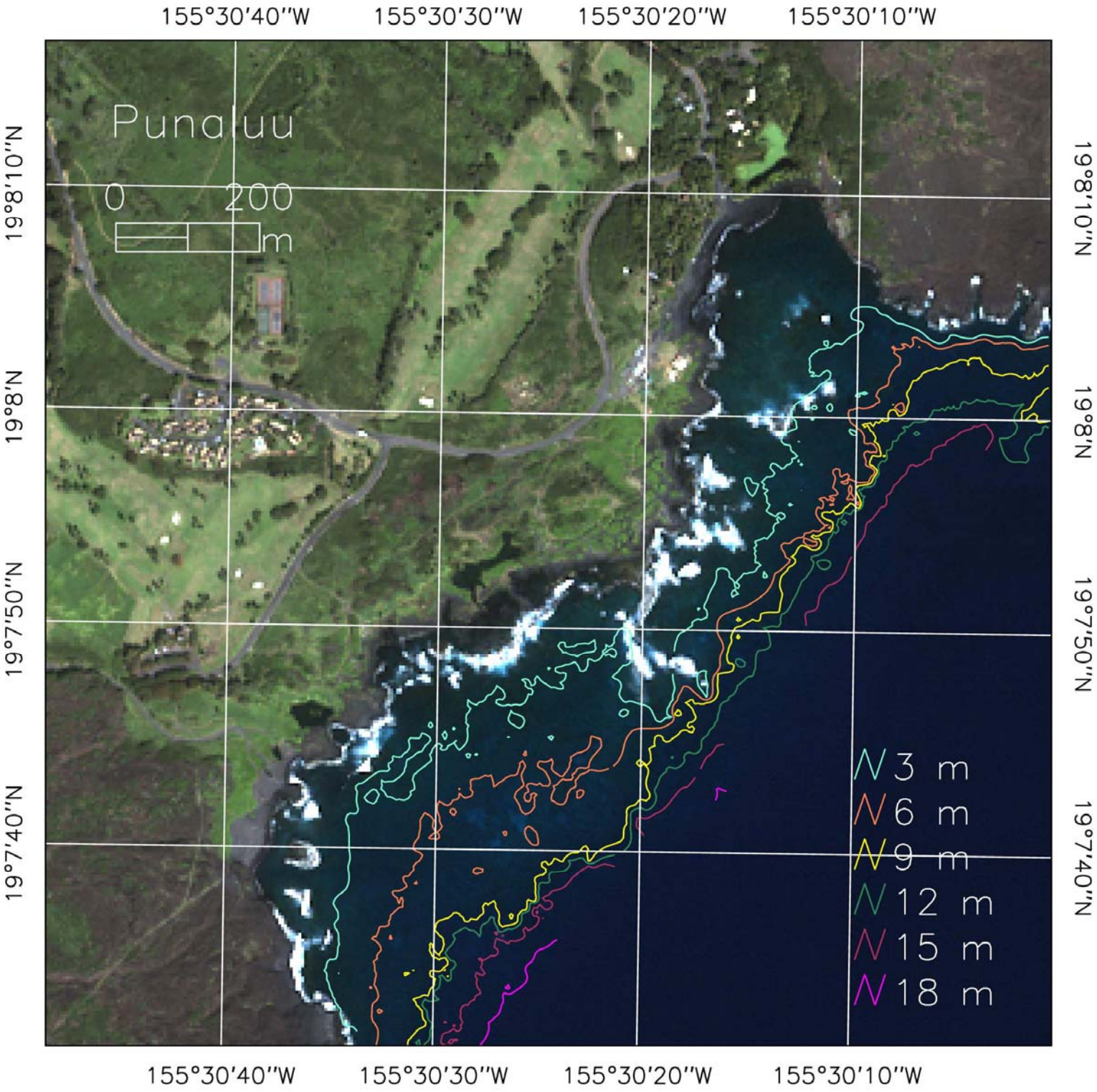
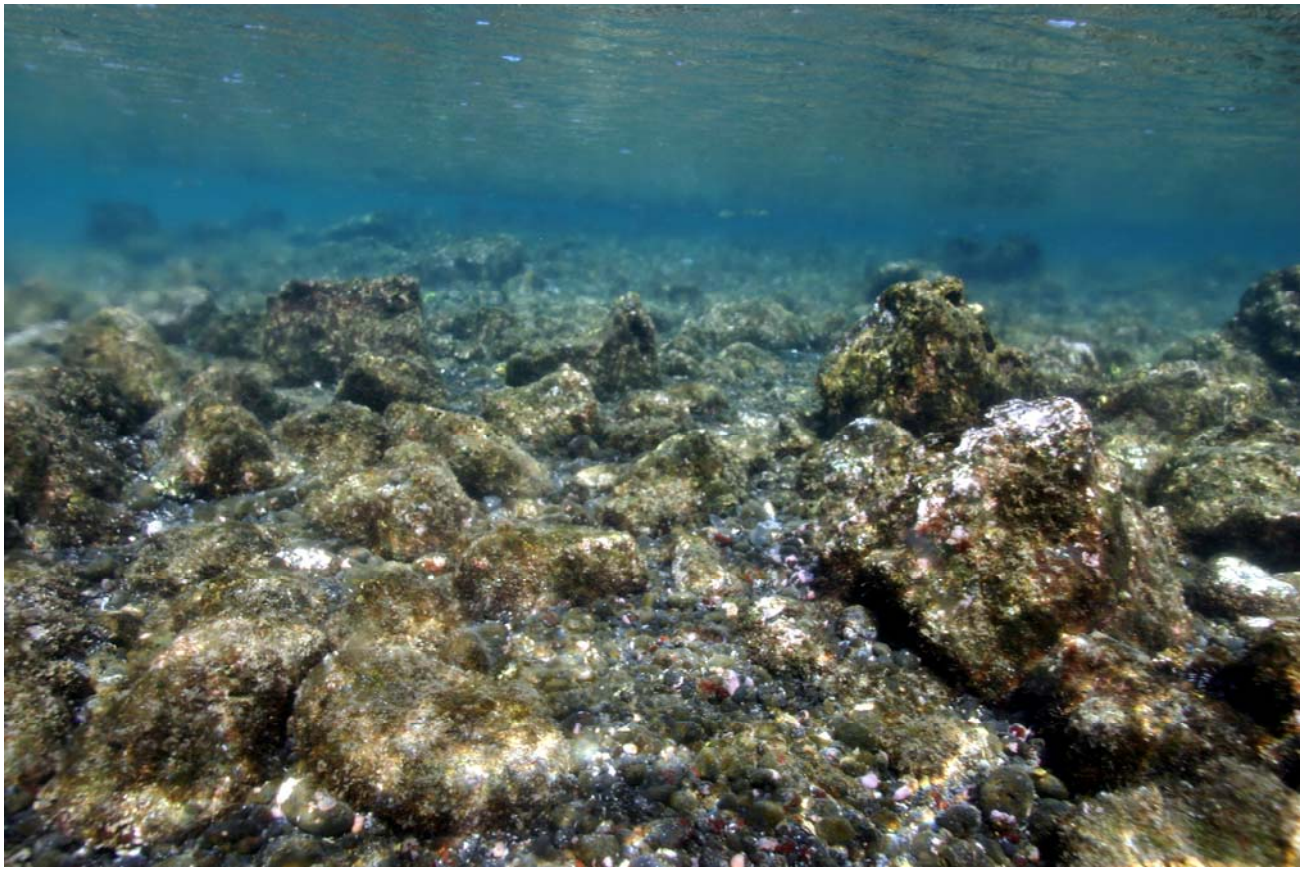


FIGURE 2. IKONOS satellite image of southeast Hawaii showing shoreline and shoreline bathymetry of coastal area of Sea Mountain Village at Punalu'u. Depth contours are in meters.

FIGURE 3. Two views of rocky shoreline "ocean inlets" near the southern boundary of the Sea Mountain Village Project. Top photo is directly offshore of Pond 2; bottom photo is location of water sampling transect T-4.



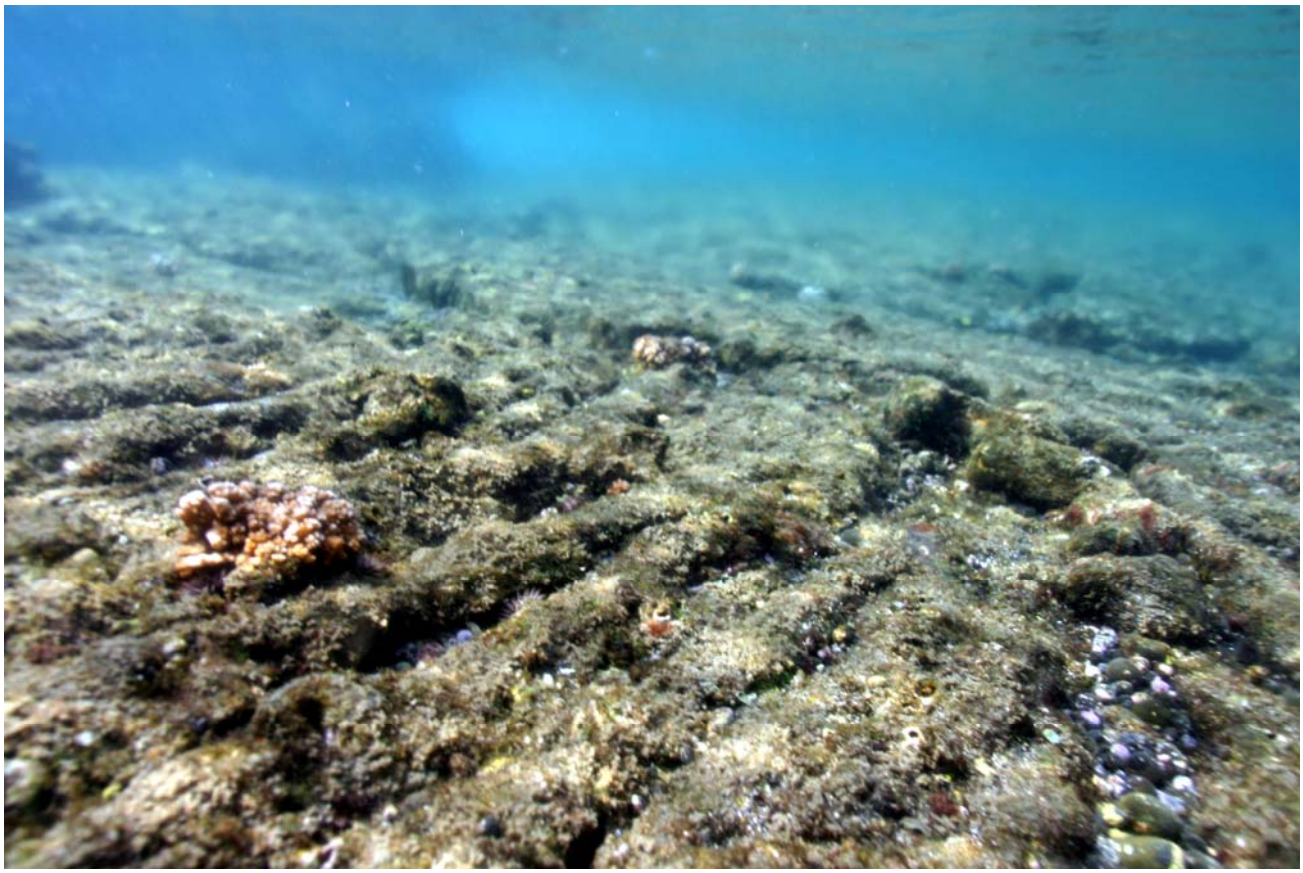


FIGURE 4. Two underwater views of floor of rocky shoreline "ocean inlets" near the southern boundary of the Sea Mountain Village Project. Water depth in both photos is approximately one foot. Small brown coral colonies in lower photo are *Pocillopora damicornis*.

FIGURE 5. Two views of rocky shoreline off the Sea Mountain Village property from the location of Pond 2. Top photo is looking south; bottom photo is looking north. Note vigorous mixing by breaking waves throughout the offshore region. Such conditions are typical during tradewind weather.

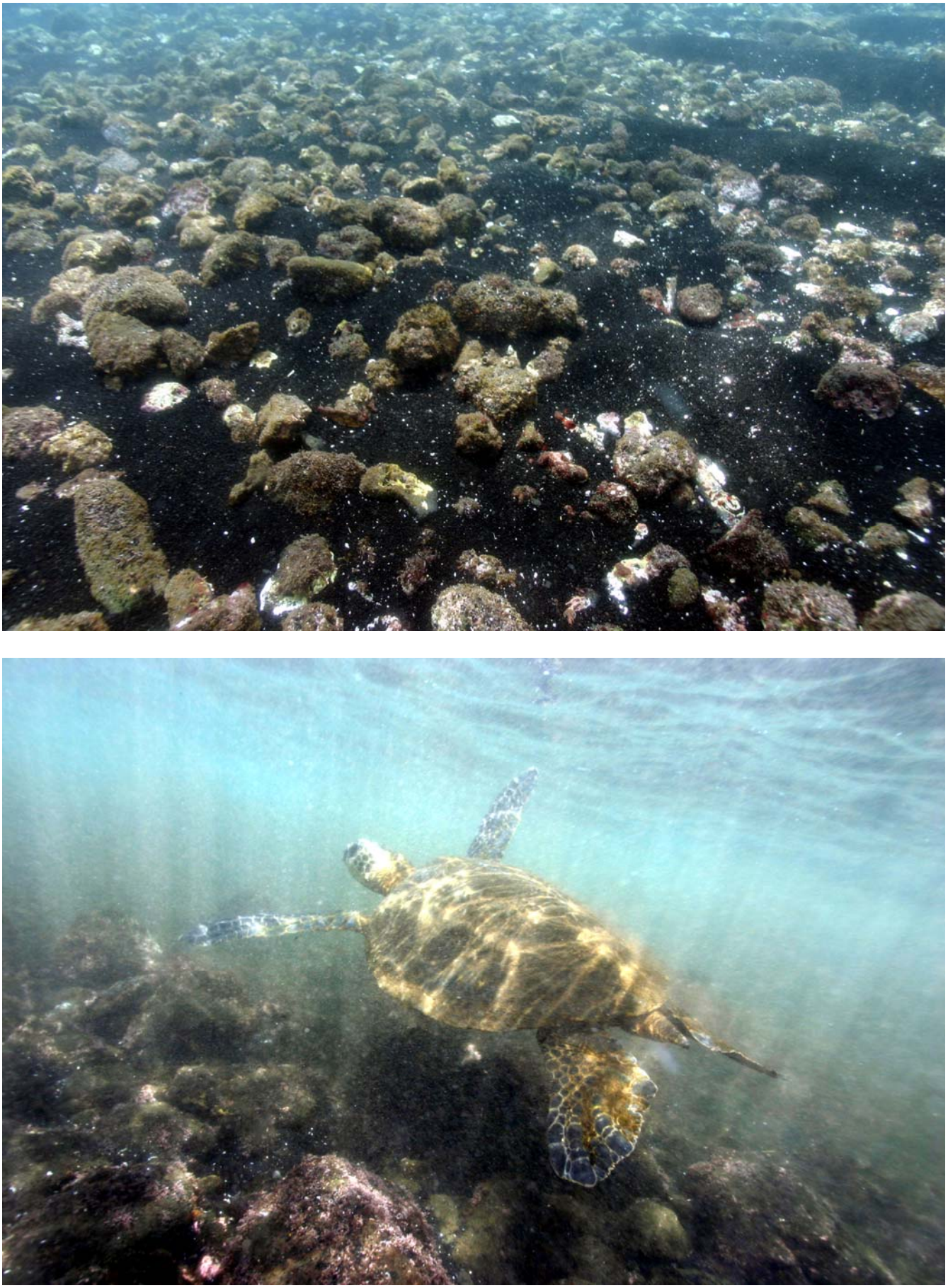


FIGURE 6. Top photo shows rubble and black sand bottom of inner Punalu'u Bay. Bottom photo shows sub-adult green sea turtle (Chelonia mydas) in nearshore area of Punalu'u Bay.

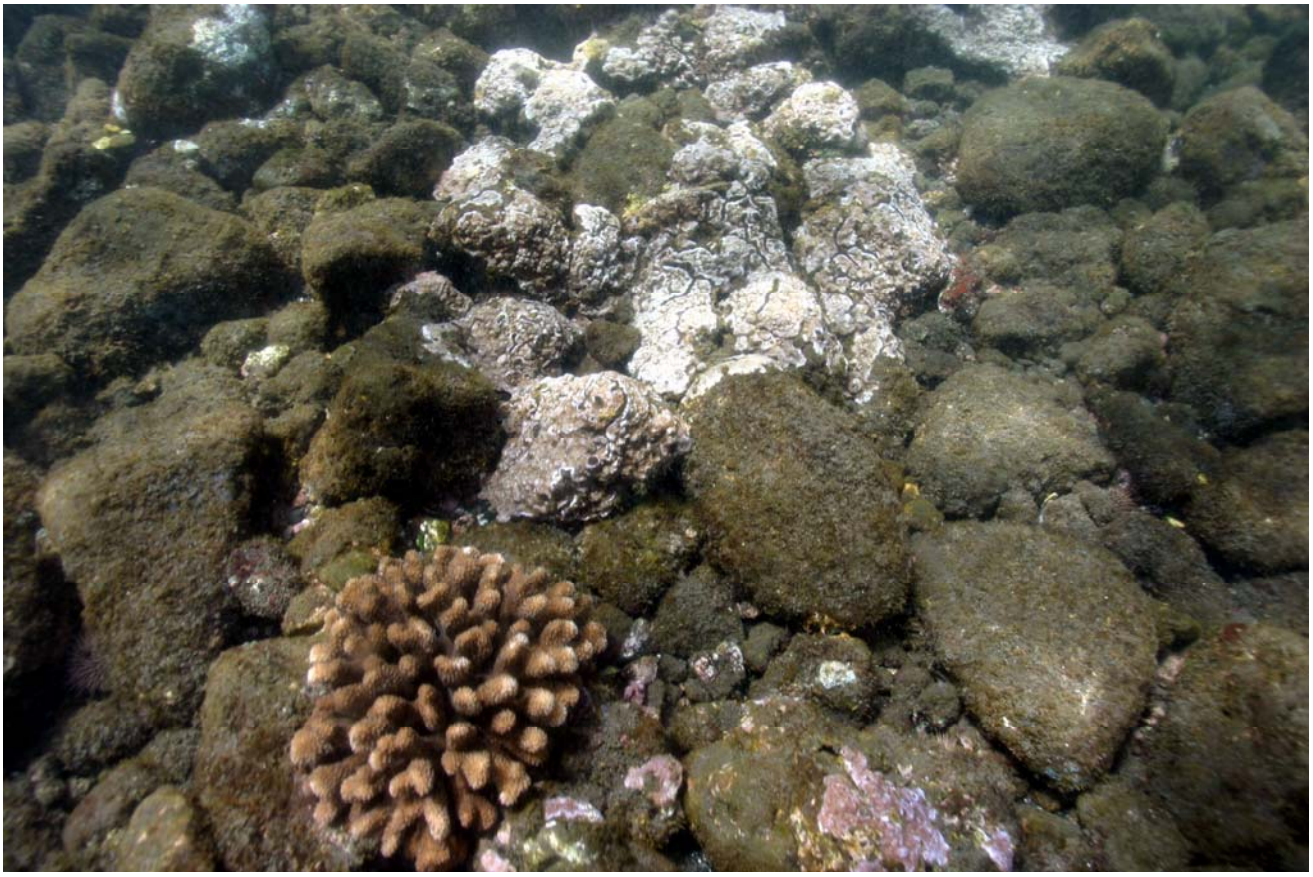


FIGURE 7. Two views of rocky boulder bottom of Punalu'u Bay. Predominant corals colonizing the rock surfaces are encrusting forms of *Monitpora flabellata* (purple colonies), *Porites lobata* (green colonies), and branching colonies of *Pocillopora meandrina* (brown hemispherical colony in bottom photo). Water depth is approximately 7m (22 ft.).

FIGURE 8. Two views of Pond 1, located near the shoreline of the Sea Mountain Village Project at Punalu'u. Top photo is looking south; bottom photo is looking north.

FIGURE 9. Top photo shows Pond 2 and bottom photo shows Pond 4 located in the southern part of the Sea Mountain Village at Punalu'u. See Figure 1 for locations of ponds.

FIGURE 10. Two views of Pond 3 located mauka of Punalu'u Bay at the site of Sea Mountain Village. Water plant covering most of pond surface is the non-native species Pistia statiotes. Ducks shown in bottom photo are permanent residents of the pond. See Figure 1 for locations of ponds.

FIGURE 11. Underwater views in Pond 1 showing near complete coverage of pond bottoms with the algae *Rhizoclonium* spp. Water depth in both photos is approximately 1 m (2-3 ft).

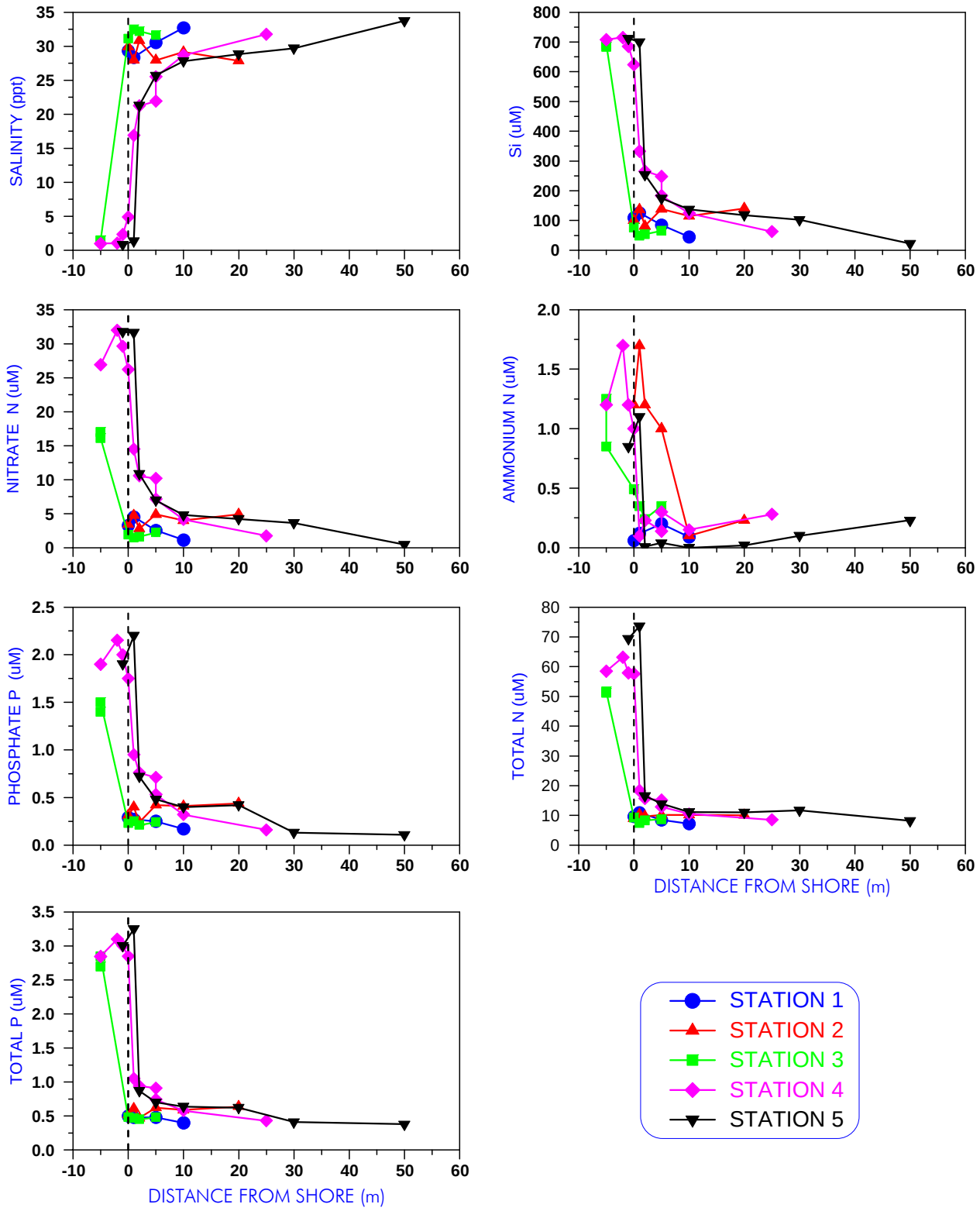


FIGURE 12. Plots of Salinity, and six dissolved nutrients in surface ocean water and ponds as functions of distance from the shoreline off the Sea Mountain Village at Punalu'u project on the south-eastern coast of the Island of Hawaii. Samples were collected along five transects that extended from the shoreline to the surf line, which ranged from 5 to 50 m offshore. Dashed vertical line indicates shoreline. All samples were collected on December 11, 2006 during a period of typical tradewind conditions. For locations of sampling transect stations, see Figure 1.

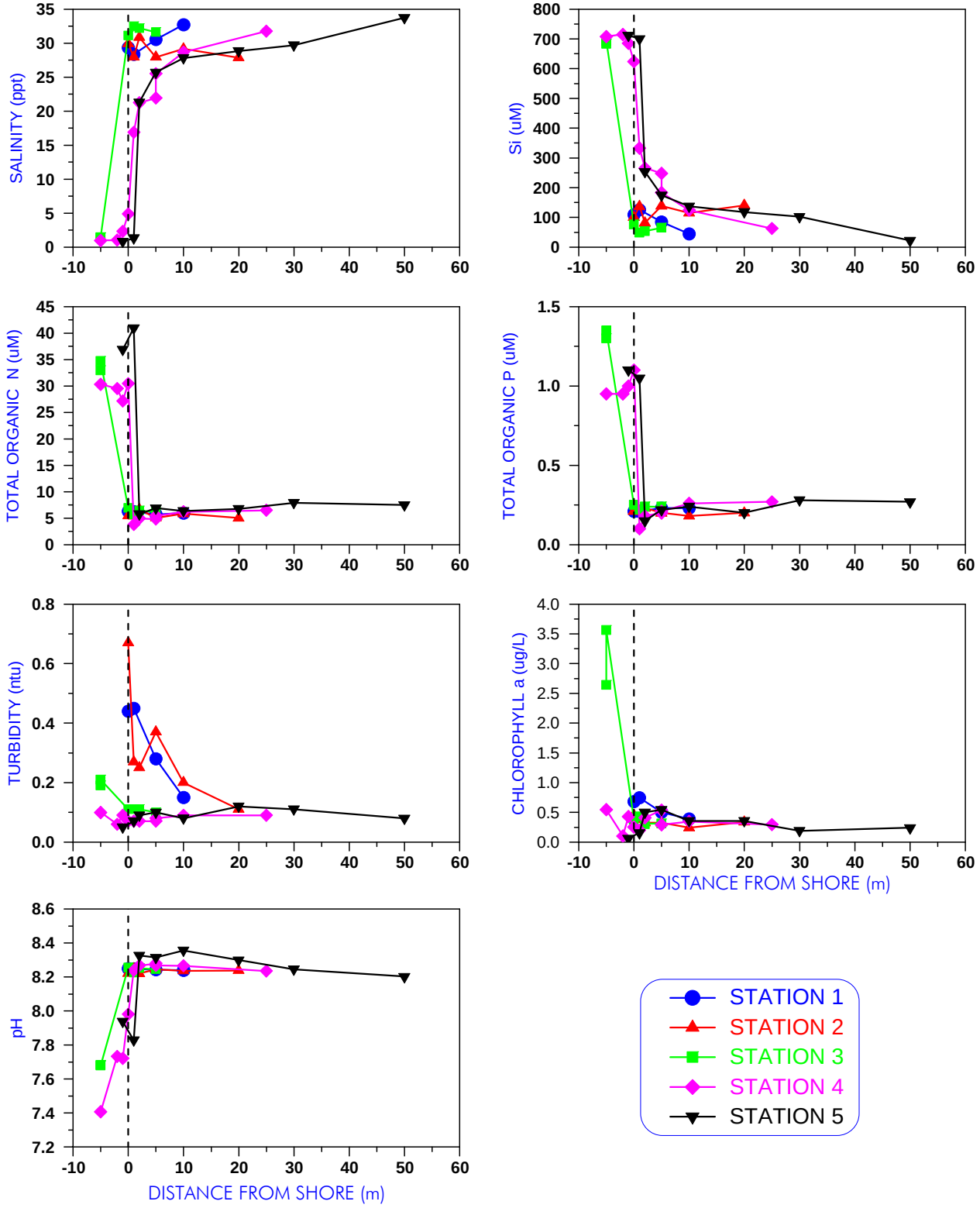


FIGURE 13. Plots of Salinity, Si, and five water chemistry constituents in surface ocean waters and ponds as functions of distance from the shoreline off the Sea Mountain Village at Punalu'u project on the south-eastern coast of the Island of Hawaii. Samples were collected along five transects that extended from the shoreline to the surf line, which ranged from 5 to 50 m offshore. Dashed vertical line indicates shoreline. All samples were collected on December 11, 2006 during a period of typical tradewind conditions. For locations of sampling transect stations, see Figure 1.

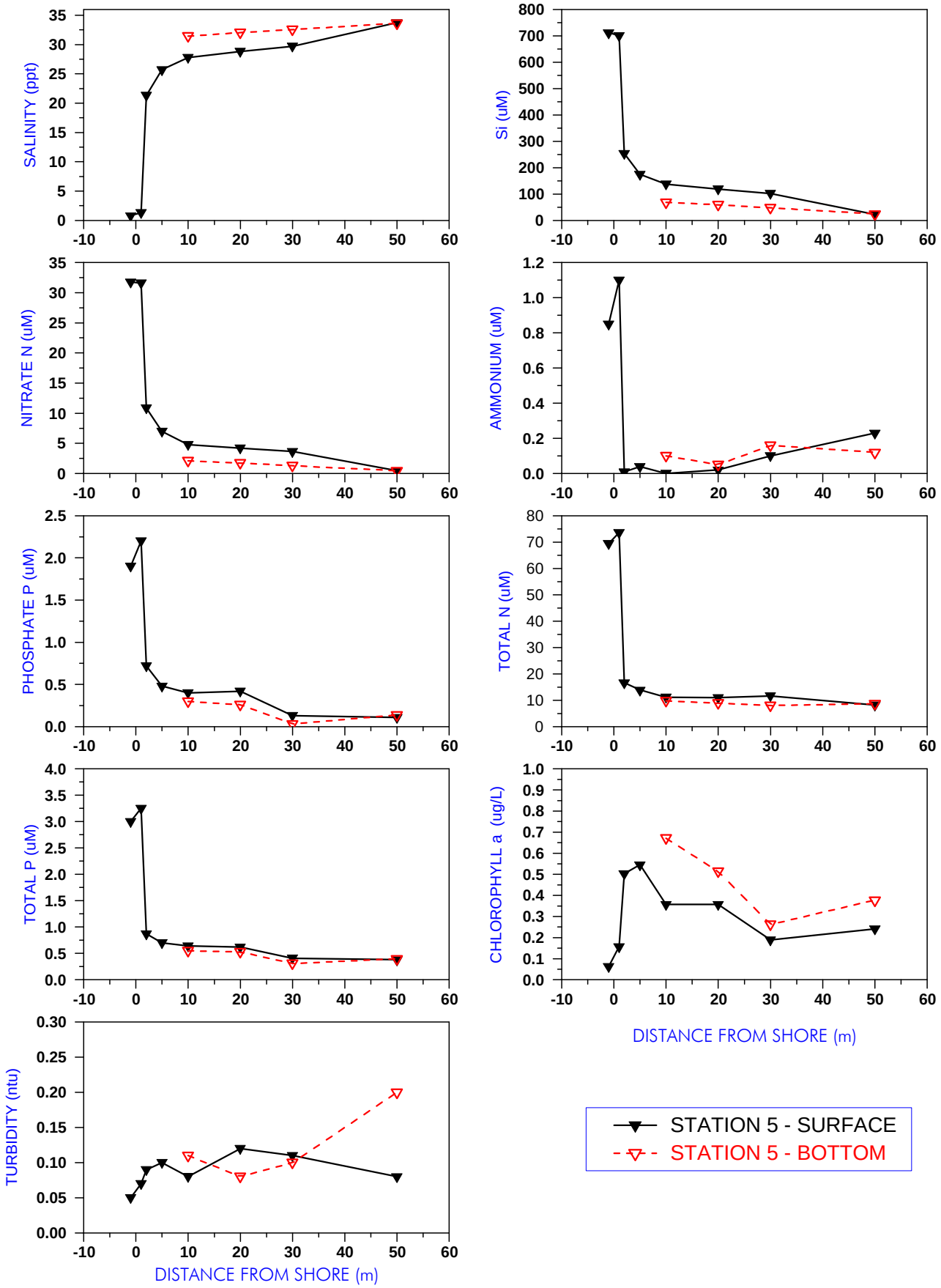


FIGURE 14. Plots of Salinity and eight dissolved nutrients in surface ocean waters and ponds as functions of distance from the shoreline off the Sea Mountain Village at Punalu'u project on the southeastern shoreline of the Island of Hawaii. Samples were collected along five transects that extended from the shoreline to the surf line, which ranged from 5 to 50 m offshore. All samples were collected on December 11, 2006 during a period of typical tradewind conditions. For locations of sampling transect stations, see Figure 1.

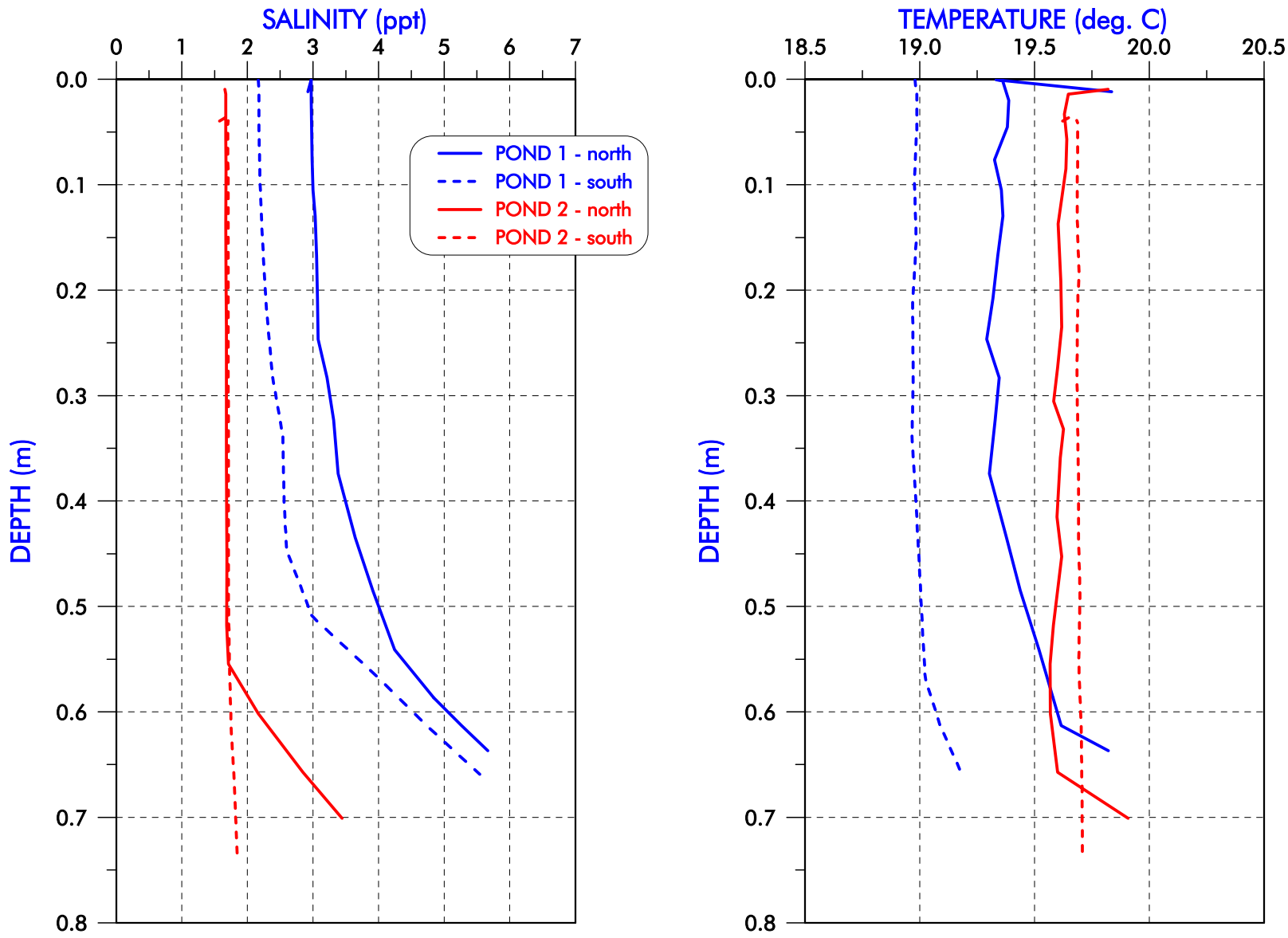


FIGURE 15. Vertical profiles of salinity and termperature at two locations (north and south) of Ponds 1 and 2 on the shoreline of the Sea Mountain Village project in Ka'u, Island of Hawaii. For locations of ponds 1 and 2, see Figure 1.

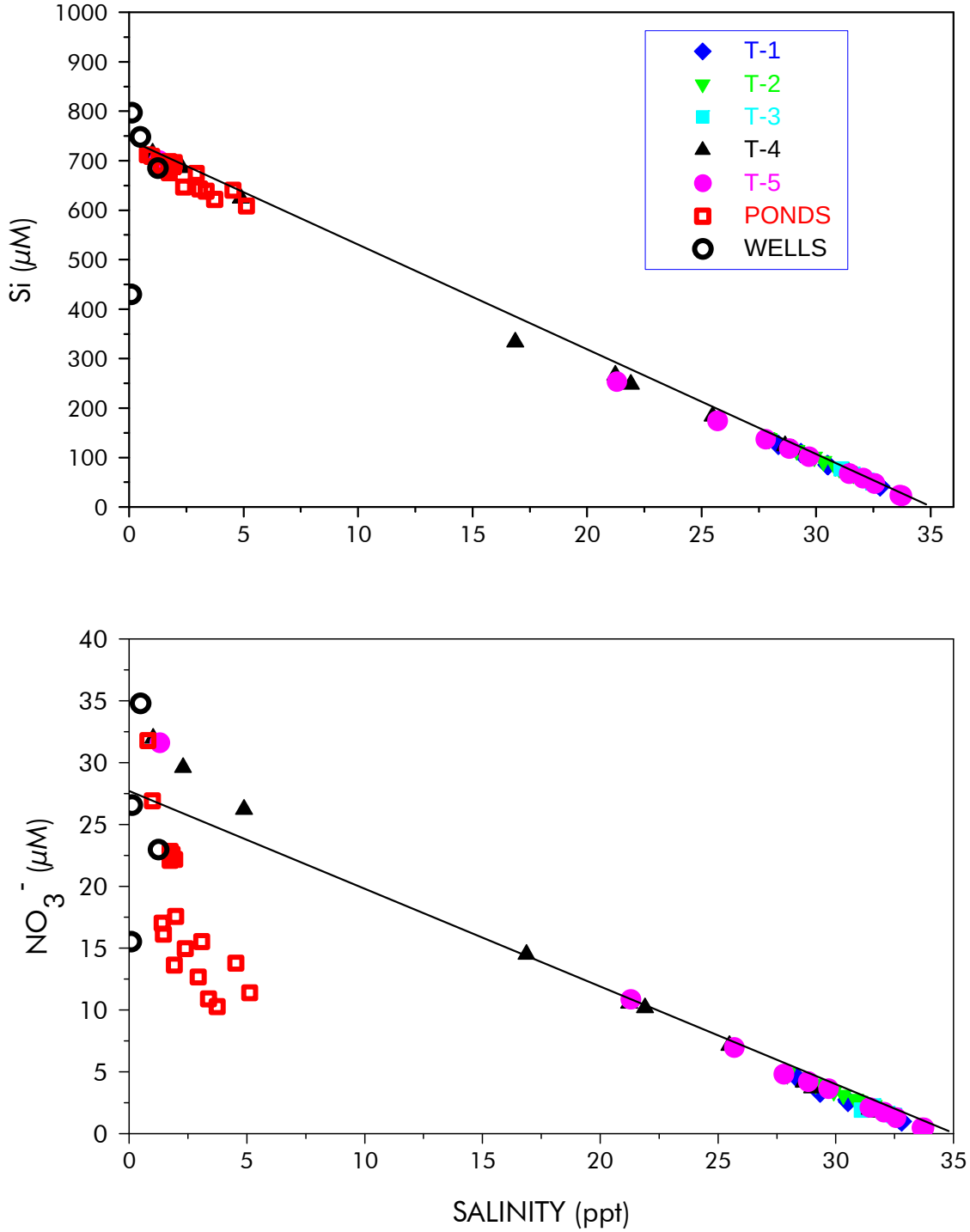


FIGURE 16. Plots of silicate and dissolved nitrate measured in water samples collected at all sampling stations off the Sea Mountain Village at Punalu'u site as functions of salinity. Straight lines in each plot are conservative mixing lines constructed by connecting the concentrations in open ocean water and average concentrations in four potable wells in the area.

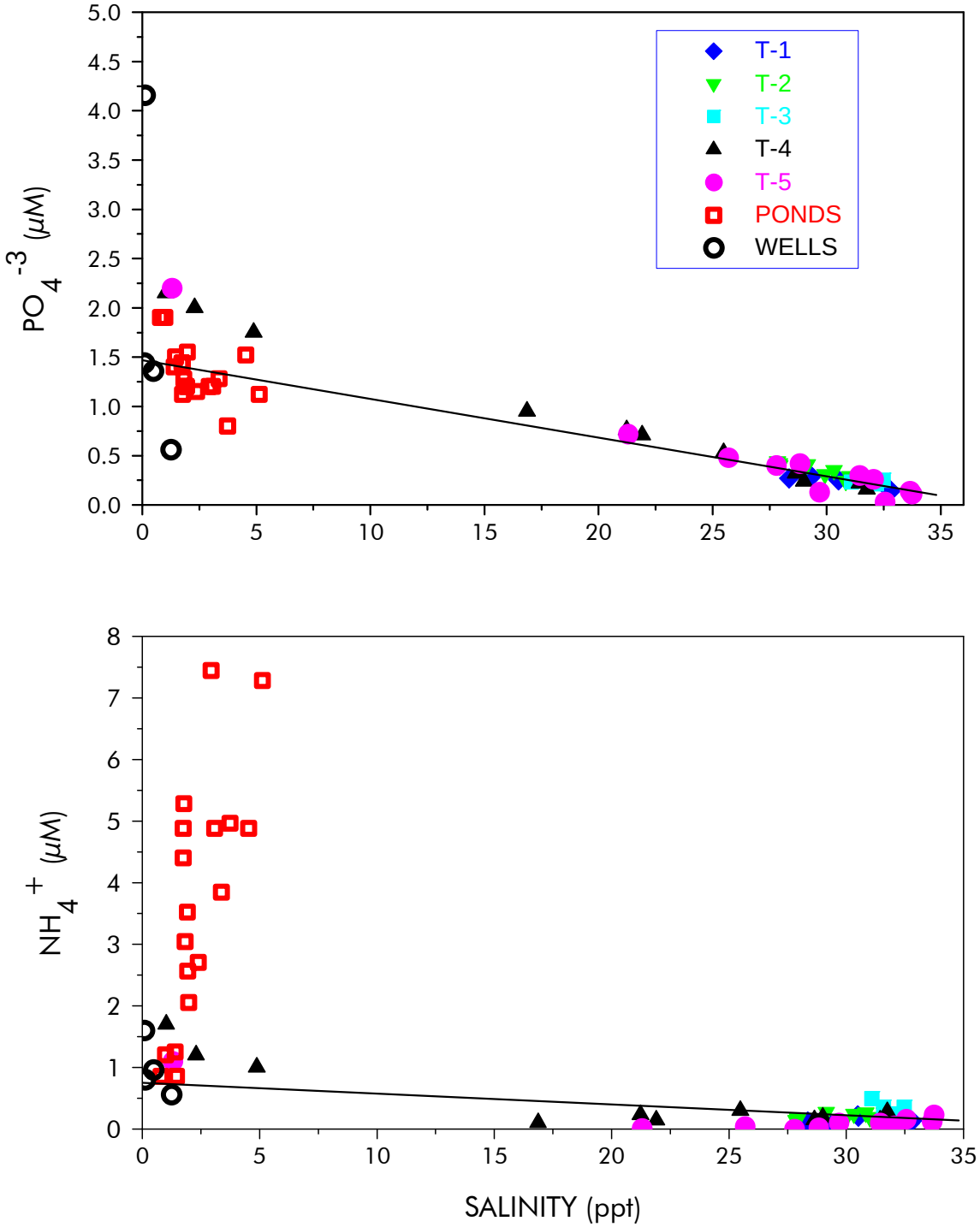


FIGURE 17. Plots of phosphate phosphorus and ammonium nitrigen measured in water samples collected at all sampling stations off the Sea Mountain Village at Punalu'u site as functions of salinity. Straight lines in each plot are conservative mixing lines constructed by connecting the concentrations in open ocean water and average concentrations in four potable wells in the area.

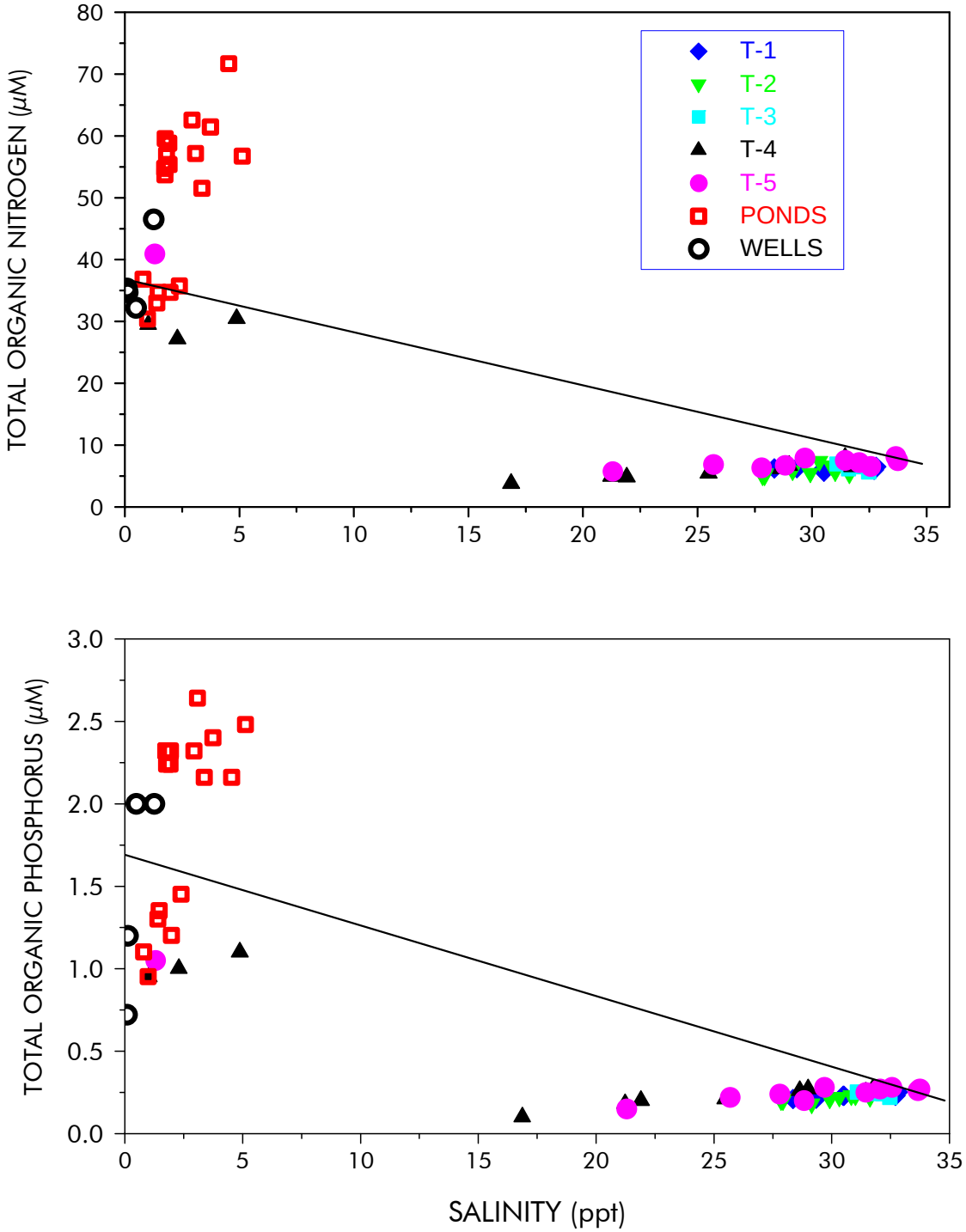


FIGURE 18. Plots of TON and TOP measured in water samples collected at all sampling stations off the Sea Mountain Village at Punalu'u site as functions of salinity. Straight lines in each plot are conservative mixing lines constructed by connecting the concentrations in open ocean water and average concentrations in four potable wells in the area.

Appendix K

Traffic Impact Analysis Report Sea Mountain at Punalu‘u
(M&E Pacific, Inc. Feb. 2006)

Traffic Impact Analysis Report
Sea Mountain at Punalu‘u

Punalu‘u, Island of Hawai‘i, Hawai‘i

Tax Map Key Number (3)9-5-019: 11, 15, 24, 26, 30, 31, 33, 35
(3)9-6-001: 1, 2, 3, 6, 11, 12, 13
(3)9-6-002: 8, 38, 41, 53

FEBRUARY 2006

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Prepared by:

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Davies Pacific Center, 841 Bishop Street
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Sea Mountain at Punalu'u

Punalu'u, Island of Hawai'i, Hawai'i

Traffic Impact Analysis Report

TMKs: (3)9-5-019: 11, 15, 24, 26, 30, 31, 33, 35;
(3)9-6-001: 1, 2, 3, 6, 11, 12, 13;
(3)9-6-002: 8, 38, 41, 53

February 2006

WARREN M. YAMAMOTO
LICENSED PROFESSIONAL ENGINEER
NO. 3893-C
HAWAII, U.S.A.

Expiration Date:
April 30, 2006

This work was prepared by me or under my direct supervision.

Signature
M & E Pacific, Inc.
METCALF & EDDY | AECOM

16 FEB 06
Date

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TRAFFIC IMPACT ANALYSIS REPORT
for the
SEA MOUNTAIN AT PUNALU‘U

A world-class destination resort/residential community is being proposed in Punalu‘u, Hawai‘i. This report documents a study that was conducted to identify the traffic impacts of the proposed project and to recommend any mitigating measures.

PROJECT DESCRIPTION

Sea Mountain at Punalu‘u is envisioned as a world-class destination resort/residential community with recreational amenities of a championship golf course, cultural/marine center, and a village center. The project site is situated on both sides of Mamalahoa Highway midway between Pahala and Waiohinu, as shown on **Figure 1**. Most of the project site is makai of the highway. The project site would include lots identified by TMKs: (3)9-5-019: 11, 15, 24, 26, 30, 31, 33, 35; (3)9-6-001: 1, 2, 3, 6, 11, 12, 13; and (3)9-6-002: 8, 38, 41, 53.

There would be 1,823 resort and residential units grouped into nine (9) areas of the project identified on **Figure 1**:

Area	Number of Units	Type of units
1	142	Single family dwelling units (3 bedrooms)
2	185	Duplex Dwelling units (3 bedrooms)
3	248	Triplex Dwelling Units (3 bedrooms)
4	180	Cluster townhouses
5	282	Cluster townhouses
6	220	Cluster townhouses
7	114	Lanai stacked flat (3 bedrooms)
8	332	Stacked flat (3 bedrooms)
9	120	Stacked flat (3 bedrooms)

The number of units/density projections may be adjusted subject to existing zoning requirements.

A series of low-rise residential enclaves would be created in areas 1 through 7, each with its own character. Each enclave would be surrounded by golf course fairways or other open space areas. The expected market for these residences is 70% second home buyers and 30% primary home buyers. About half of the second buyer homes are expected to be vacant at any one time. The residential units in areas 8 and 9 would be based on for-sale condominiums in architecture that is configured to work and act like a full service hotel and resort.

The existing 18-hole golf course would be expanded and refurbished to become a championship course. An 8,000 square foot Golf Club Center would be located in area 7 adjacent to the course and would provide food and beverage services, concierge, and other club amenities. Besides the Golf Club Center, the course would be equipped with walking/golf cart paths, open space and ample parking areas. The course is projected to play 80 rounds of golf per day.

A 50,000 square foot Village Center in area 8 would serve as a community gathering place for the resort with shopping and services for guests and local residents. The architecture would be low-rise and accessible.

A 15,000 square foot cultural/marine center is proposed for area 9 that would also include a gift shop and possibly restaurant.

Currently there is no affordable housing requirement for the proposed project. Applicable affordable housing requirements will be met contingent to rezoning the mauka portion. Sea Mountain Five, LLC, will either provide affordable units in area 2 as part of the planned 185 units, or provide affordable units at an off-site location.

The roadway network for the proposed project is also shown on **Figure 1**. The existing Ninole Road that loops through the makai portion of the project would be retained as the collector roadway for the proposed project. The west roadway would provide primary

access to the highway system while the east roadway would also be available for access to the highway. A system of internal circulation roadways would be built to provide access to each residential enclave and resort area. A new mauka road would be built from the west intersection of the highway to serve areas 1 and 2. Public beach access to Punalu'u Beach Park will be maintained, and the park lands will be dedicated to the County. Some public spaces will be reserved to provide support for public beach access. Based on the design of the proposed roadway system, the two intersections of Ninole Road with Mamalahoa Highway were identified as study intersections.

Full occupancy of the proposed project is expected in about ten years. This study analyzed a 2015 forecast year.

EXISTING CONDITIONS

A survey of the existing roadway and traffic conditions was made in September 2005.

Existing Roadways

The proposed project straddles Mamalahoa Highway midway between Pahala and Waiohinu. Ninole Road loops through the makai portion of the project site and intersects the highway at two points. There are two very short roadways mauka of these two intersections.

Mamalahoa Highway (Highway 11) is the primary arterial roadway in the area. Highway 11 is part of the southern section of the circle island route around the island of Hawai'i and is under the jurisdiction of the State of Hawaii Department of Transportation (State DOT). It is a two-lane highway with horizontal and vertical curves due to the rolling terrain. The posted speed limit is 55 miles per hour (mph) in the vicinity of the project.

Ninole Road is a two-lane local roadway serving the area makai of the highway. The west roadway leg serves the existing Sea Mountain development that includes a golf course and small cluster of condominiums. After reaching the beach area, the east

roadway leg returns to the highway passing through private lands that are not part of the proposed project. The west roadway intersection with the highway was improved to provide channelized lanes on all approaches. Both highway approaches have left turn, through and right turn lanes. Both side street approaches have a through/left turn lane controlled by a stop sign, and a channelized right turn lane controlled by a yield sign. The east roadway intersection has no channelized approaches; each approach has only one lane. The side street intersections are stop sign controlled.

The west mauka roadway is identified on maps as Alahaki Road and serves a small group of residents. Although the roadway is channelized at the highway, there is a "Road Ends 500'" warning sign just mauka of the intersection. The east mauka roadway is identified on maps as Hilea Road and is a private roadway with only one lane, and is not drivable at this time.

Traffic Volumes

Traffic turning movement counts were taken at the two existing study intersections on Mamalahoa Highway on Wednesday and Thursday, September 7 and 8, 2005, during the morning and afternoon peak periods. Traffic turning movement counts require a traffic surveyor to observe traffic flow and record the movements of each vehicle crossing the intersection as through or turning movements by 15 minute intervals. The worksheets from these traffic counts are included in **Appendix A**. Only the traffic on the highway and makai legs was counted due to very little traffic on the mauka roadways. Traffic counts taken by the State DOT indicate less than 40 vehicles per day and no vehicles in the peak hours leaving and entering Alahaki Road, compared to 700 vehicles per day on Ninole Road.

The resultant morning and afternoon peak hour traffic volumes are shown on **Figure 2**. The volumes are rounded to the nearest five vehicles per hour (vph), except for volumes less than 5 vph. The traffic on the highway during both peak hours can be described as light. The current and forecast traffic operations levels of service are discussed in the "Level of Service Analysis" section. The dominant direction of traffic

flow is eastbound toward Hilo in the morning peak. During the afternoon peak hour, the westbound traffic volumes are slightly higher. There are very few turns into and out of the project site, especially in the morning peak.

The State DOT takes metered traffic counts at selected locations on Hawaii roadways in even numbered years. One station is on Mamalahoa Highway at the Ninole (west) Road (Station 4-A) intersection, which is the west study intersection. The data from these counts provides the historic trend in daily traffic volumes on different legs of the intersection over a ten year period ending in 2004. The increases in daily traffic volumes on the west leg of Mamalahoa Highway and Ninole Loop Road are shown in tabular and graph form on **Figure 3**. Mamalahoa Highway showed a 7.4% increase over the 10 year period, for a compounded annual growth rate of 0.72%.

The State DOT data also shows the hourly traffic volumes through the course of the day. **Figure 4** shows the hourly volumes in each direction of travel on the west leg of Mamalahoa Highway on May 3 and 4, 2004. Eastbound traffic was higher than westbound traffic for most of the day, showing a midday peak and a late afternoon peak on both days. Westbound traffic remained relatively level for most of the day then peaked in the late afternoon.

TRAFFIC FORECASTS

Full occupancy of the proposed project is expected by about 2015. During the ten-year period from the traffic count date to expected full occupancy, ambient traffic on the area roadways can be expected to increase due to regional growth and new projects in the area. The traffic that would be generated from the proposed project was added to the ambient traffic forecast to obtain the total with project traffic forecast.

Ambient Traffic Forecast

There are no new major projects planned in the vicinity of the proposed project. Ambient traffic on the highway fronting the project site will increase due to regional

growth in other areas. Therefore, the 7.4% ten-year traffic growth rate indicated by the State DOT traffic volumes was used as the index of regional traffic growth from 2005 to 2015. The existing through traffic volumes at the two study intersections shown on **Figure 2** were increased by 7.4%. The volumes of traffic entering and exiting the project site were not changed. The results of the ambient traffic forecast are summarized on **Figure 5**, with volumes rounded to the nearest five vph, except for volumes less than 5 vph.

Project Generated Traffic

The traditional three-step process of trip generation, trip distribution and trip assignment was used to forecast future traffic that would be generated by the proposed project. The trip generation step forecasts the number of new trips that would be produced in each of the two study periods. The trip distribution step allocates these new trips by direction of travel. Finally, the trip assignment step assigns the trips to the specific turning movements at the study intersections.

The trip generation and distribution analyses are summarized on **Table 1**. The trip generation step forecasts the volume of vehicle trips that would be generated by the proposed project during the morning and afternoon peak hours. The proposed project would have a mix of primary and second buyer homes: single-family, multi-family and resort units. The following types of residential units were identified:

- Primary single family units
- Second home buyer single family units
- Primary multi-family units (including affordable housing units)
- Second home buyer multi-family units
- Resort units

The Institute of Transportation Engineers' Trip Generation (Seventh Edition, 2003) report has trip generation equations or rates to calculate the number of morning and afternoon peak hour trips that would be generated by various land uses. The report also provides the proportion of inbound and outbound trips in each peak hour. The following trip generation equations based on number of units and the proportion of inbound/ outbound trips were utilized for the above types of residential units:

- Primary single family units (LU 210, Single Family Dwelling Unit)
  AM Peak Hour - $T = 0.7(X) + 9.43$, 25% inbound, 75% outbound
  PM Peak Hour - $Ln(T) = 0.9Ln(X) + 0.53$, 63% inbound, 37% outbound;
- Primary multi-family units (LU 231, Low-riseTownhouse)
  AM Peak Hour - $T = 0.67(X)$, 25% inbound, 75% outbound
  PM Peak Hour - $T = 0.78(X)$, 58% inbound, 42% outbound;
- Second home buyer single family and multi-family units (LU 260, Recreational Homes)
  AM Peak Hour - $T = 0.24(X) + 20.78$, 49% inbound, 51% outbound
  PM Peak Hour - $T = 0.26(X) + 14.87$, 44% inbound, 56% outbound;
- Resort units (LU 260, Recreational Homes)
  AM Peak Hour - $T = 0.24(X) + 20.78$, 49% inbound, 51% outbound
  PM Peak Hour - $T = 0.26(X) + 14.87$, 44% inbound, 56% outbound;

  Where, T = Trips generated by residential units; and
  X = Number of residential units.

The residential units in areas 1 to 7 are expected to be occupied by 30% primary home buyers and 70% second home buyers, with the latter units half occupied at any one time. Therefore, 30% of the housing units in each area were analyzed as primary homes while half of the remaining homes were analyzed as recreational homes. The Trip Generation report has the following definition for recreational homes. "Recreational homes are usually located in a resort containing local services and complete recreational facilities. These dwellings are often second homes used by the owner periodically or rented on a seasonal basis. A large number of internal trips were made for recreational purposes in resort communities containing recreational homes." The residential resort units in areas 8 and 9 were analyzed as 100% recreational homes at 100% occupancy.

For the trip generation analysis, it was assumed that there would be 55 affordable housing units would be in area 2. These units were analyzed as primary multi-family housing units. Therefore, area 2 was assumed to have 94 primary units: 39 market and 55 affordable units, and 91 second home buyers. If the affordable housing were located off-site, all 185 units in area 2 would be market units. Then this area would generate about 30% less trips. For this reason, the latter assumption was not analyzed.

The trip generation analysis is summarized on **Table 1**. The residential units in areas 1 to 9 are forecast to generate 277 inbound and 441 outbound trips in the morning peak hour, and 367 inbound and 345 outbound trips in the afternoon peak hour.

Non-residential trip generators are planned for areas 7 to 9 including an 18-hole championship golf club and Golf Club Center in area 7, a 50,000 square foot resort Village Center in area 8, and a 15,000 square foot cultural/marine center with gift shop and possibly restaurant in area 9. Trip generation equations from the Trip Generation report were used for the first two land uses, where the equations for a shopping center was used as a surrogate for the village center. There are no trip generation equations or rates for a cultural/marine center; therefore, the number of trips was estimated. The center would not be open during the morning peak hour and is not expected to generate any trips at that period. During the afternoon peak hour, it was assumed to generate about 50 vehicle trips as center visitors and employees would be leaving while restaurant employees and guests would be arriving.

The following equations/rates and proportions of inbound/outbound trips were used for the non-residential land uses:

- Golf Club Center (LU 430, Golf Course)
  AM Peak Hour - T = 2.22(X), 79% inbound, 21% outbound
  PM Peak Hour - T = 3.56(X), 43% inbound, 57% outbound
  Where, T = Trips generated by golf clubhouse, and
  X = Number of holes;

- Village Center (LU 820, Shopping Center)
  AM Peak Hour - Ln(T) = 0.60(X) + 2.29, 61% inbound, 39% outbound
  PM Peak Hour - Ln(T) = 0.66(X) + 3.40, 48% inbound, 52% outbound
  Where, T = Trips generated by Village Center, and
  X = Square feet of gross leasable area;

- Cultural/marine center and retail
  AM Peak Hour - T = 0;
  PM Peak Hour - T = 50, 50% inbound, 50% outbound;
  Where, T = Trips generated by cultural/marine center.

The non-residential land uses are forecast to generate 95 inbound and 49 outbound trips in the morning peak hour, and 243 inbound and 268 outbound trips in the afternoon peak hour, as shown on **Table 1**.

The project generated trips were then distributed by direction of travel to the west on Mamalahoa Highway, east on Mamalahoa Highway, and internal to the project. Initial trip distribution factors for the residential land uses were based on the existing proportions of trips turning into and out of the project site at the two study intersections. Then the number of internal trips produced by the non-residential land uses was calculated. It was assumed that all the internal trips to the non-residential land uses would come from the project residents. The initial distribution factors for the residential land uses were then recalculated to account for the internal trips. The final trip distribution factors are summarized on **Table 2**. The trip distribution factors were then used in the trip distribution analysis on **Table 1**. The volumes may not add up to the total number of generated trips due to rounding.

A unique aspect of trips generated by commercial centers such as the Village Center is that a portion is pass-by and diverted trips. Pass-by trips are attracted from traffic passing the site on an adjacent roadway and have direct access to the commercial center. Therefore, these trips do not add to the through volumes on the roadway. Diverted trips are attracted from the roadways in the vicinity of but not adjacent to the commercial center, but require a diversion from that roadway and add traffic to streets adjacent to the site. Due to the resort nature and location of the village center, it is not expected to attract diverted trips from Mamalahoa Highway, although it could divert pass-by trips being made within the resort. For the purposes of this study, the Village Center was assumed not to attract any pass-by or diverted trips.

The project generated traffic volumes were assigned to the study area network encompassing the entire project site. Trips to/from the mauka areas 1 and 2 were assigned to only the west study intersection since only one access route would be provided to mauka area residents. Trips from the remaining makai areas 3 to 9 were assigned to both the west and east roadways. Due to the layout of the proposed project and roadway system, most of the trips were assigned to the west roadway. Only a portion of the trips from areas 4, 8 and 9 were assigned to the east roadway and intersection. The results of the traffic assignment analysis are shown on **Figure 6** with the volumes not rounded.

Total Forecast Volumes

The project generated traffic assignment volumes from **Figure 6** were added to the 2015 ambient traffic forecasts from **Figure 5** to obtain the 2015 total with project traffic forecasts shown on **Figure 7**. The traffic volumes are rounded to the nearest five vph except for volumes less than 5 vph. The proposed project is forecast to increase traffic volumes at the two study intersections and on the highway relative to the ambient forecast conditions. The implications of this increase are discussed in the next section.

LEVEL OF SERVICE ANALYSIS

The concept of level of service is used to quantify the quality of traffic flow on roadway facilities. The Transportation Research Board (TRB) has developed procedures to calculate level of service value(s) by measuring traffic volumes against the capacities of different types of roadway facilities. Their Highway Capacity Manual 2000 (HCM2000) describes the various procedures developed for freeways, highways, signalized and unsignalized intersections, etc. The two procedures pertinent to this study are for two-way two-lane highways and unsignalized intersections.

Tables 3 and **4** summarize the two-way, two-lane highway and the unsignalized intersection level of service analyses, respectively. Both tables provide a comparison of levels of service for the different forecast scenarios to give an indication of the traffic impacts of ambient traffic growth and the proposed project. For each of the AM and PM peak hour study periods, the 2005 existing, 2015 ambient forecast, and 2015 total with project forecast levels of service are placed side by side to facilitate this comparison.

Two-Way, Two-Lane Highway Analysis

Mamalahoa Highway is a two-lane highway in the vicinity of the project site. The capacity of a two-way, two-lane highway is 1,700 passenger car equivalents per hour per lane, and 3,200 passenger car equivalents per hour for both directions of travel. This is lower than the capacity of a multi-lane highway that can range from 2,000 to 2,200 passenger car equivalents per hour per lane. The analysis procedure for two-way, two-lane highways takes into account the more restrictive aspects of its operations relative to wider multi-lane highways. The procedure considers the impact of geometric data: lane width, shoulder width, type of terrain, free flow speed, percent no passing zones; and demand characteristics: volumes, percent of heavy vehicles; as some of the inputs.

There are two sets of criteria for level of service. For Class I highways where efficient mobility is important and drivers expect to drive at relatively high speeds, level of service is defined in terms of both percent time spent following and average travel speeds. On Class II highways where mobility and high travel speeds are less critical, level of service is defined only in terms of percent time spent following and does not include average travel speeds. Class I highways are typically arterials serving longer trips but an arterial that cannot handle high speeds could be classified as a Class II highway. The portion of Highway 11 in the vicinity of the project site is a Class I highway.

The level of service criteria for Class I two-lane highways is shown below:

LEVEL OF SERVICE	PERCENT TIME SPENT FOLLOWING	AVE. TRAVEL SPEED (Miles/Hour)
A	< 35	> 55
B	>35 to 50	>50 to 55
C	>50 to 65	>45 to 50
D	>65 to 80	>40 to 45
E	> 80.0	< 40

Level of service F occurs when the traffic volumes exceed the capacity of the highway. Level of service C or better is considered desirable for highway operations in rural areas. Most rural communities would consider level of service D to be minimally desirable or undesirable and would indicate the need to plan for future improvements.

Levels of service were calculated both east and west of the project site and the results are shown on **Table 3**. Ambient forecast levels of service are not expected to change from existing level B due to the low rate of traffic growth assumed. The additional traffic generated by the proposed project would change the level of service by one level to C, which is still considered acceptable. Hence, the analysis indicates that the proposed project would not have an adverse traffic impact on highway operations. The level of service calculations are provided in **Appendix B.**

Unsignalized Intersection Analysis

Both study intersections are currently unsignalized. The procedure used for analyzing unsignalized intersections calculates vehicle delays and levels of service based on the distribution of gaps in traffic on the major street and driver judgment in selecting gaps through which to execute turns. For two-way stop intersections where only the minor street traffic is controlled by a stop sign, levels of service are calculated for the critical turning movements including outbound movements from the stop-controlled approach, and left turns from the major street to the minor street. The procedure does not calculate an overall intersection level of service.

The Highway Capacity Manual defines the relationship between level of service and delay (in seconds/vehicle) for unsignalized intersections as shown below:

LEVEL OF SERVICE	DELAY (Seconds/Vehicle)
A	< 10.0
B	10.1 to 15.0
C	15.1 to 25.0
D	25.1 to 35.0
E	35.1 to 50.0
F	> 50.1

Levels of service A to E are considered acceptable for unsignalized intersections. Level of service F (with average delays longer than 50 seconds) is considered undesirable for unsignalized intersections and would indicate the possible need for mitigation. Level of service F conditions could be tolerated if the delays are not much higher than 60 seconds, traffic queues are short, and there are no reasonable mitigating measures available.

The calculated levels of service and average delays in seconds per vehicle for the critical turning movements at each study intersection are shown on **Table 4**. The results for the southbound (mauka) movements and the eastbound left turns are not

shown for the existing and ambient scenarios at both intersections since these movements were not counted. As previously stated, the State DOT traffic counts showed no inbound and outbound traffic volume on the north (mauka) leg of the west intersection during the peak hours. The level of service calculations are provided in **Appendix C**.

The west intersection is fully channelized and shows two (right turn and left turn/through) movements on the northbound and southbound approaches. During the morning peak hour, both northbound (makai) lanes are currently running at level of service A and are forecast to remain the same for the ambient forecast condition. The right turn lane is forecast to remain at level of service A for the total with project scenario. The northbound left turn lane is forecast to change to level of service B for the total with project scenario, still a very acceptable level. With the proposed project, the southbound (mauka) right turn lane is forecast to be at level of service A while the left turn/through lane is forecast to be at level of service B. The two left turn lanes on Mamalahoa Highway are forecast to operate at level of service A for all current and future conditions.

During the afternoon peak hour, the northbound (makai) right turn lane is currently operating at level of service A while the left turn/through lane is operating at level B. The right turn lane is forecast to remain at level of service A for all three future scenarios. The left turn/through lane is forecast to remain at level of service B for the ambient forecast and change to level E for the total with project forecast, indicating minimally acceptable conditions. With the proposed project, the southbound (mauka) right turn lane is forecast to be at level of service A while the left turn/through lane is forecast to be at level of service C. The two left turn lanes on Mamalahoa Highway are forecast to operate at level of service A for all current and future conditions.

The east intersection currently has single lanes on all four approaches. Additional traffic at this intersection can be expected from portions of the proposed project that would utilize the makai leg of this intersection, and through traffic from the west intersection.

During the morning peak hour, the northbound (makai) lane is currently running at level of service A and is forecast to remain the same for the ambient forecast condition but change to level of service B for the total with project scenario. The westbound left turn lane on Mamalahoa Highway is forecast to operate at level of service A for all current and future conditions. The afternoon peak hour traffic has the same pattern of results.

The east intersection westbound left turn lane on Mamalahoa Highway would require a separate left turn lane despite the level of service A forecast for the movement. This conclusion was arrived when using the PM peak hour volumes in "Figure 8, Volume Warrants for Left Turn Lanes" from the Federal Highway Administration Guidelines for the Control of Direct Access to Arterial Highways, Report No. FHWA-RD-76-86 (1975). The graph on the figure uses hourly advancing and opposing volumes, and percent of left turns in the advancing volume as input variables. The PM peak hour total with project forecast traffic volumes from **Figure 7** were charted on the FHWA Figure 8 and the results are shown on **Figure 8**.

The above analyses indicate that study both intersections could operate under the existing stop sign control although the east intersection should be improved to provide a fully channelized design like the west intersection. Improvements on Mamalahoa Highway include a separate left turn lane on the westbound approach and a right turn deceleration lane on the eastbound approach. Improvements on the south leg of Ninole Road include a channelized right turn lane controlled by a yield sign and a left turn lane controlled by a stop sign.

If the proportion of primary buyers exceeds the 30% estimate assumed in the study, the number of external trips generated by the proposed project could exceed the volume of trips forecast in this study. Should this occur, additional mitigating measures may be required including the installation of traffic signals at the west intersection when warrants for installing traffic signals are met. The State DOT should also consider reducing the speed limit in the area from 55 to 45 miles per hour if traffic signals are installed.

CONCLUSIONS

The proposed project will add to traffic on Mamalahoa Highway in the vicinity of the project site. However, the proposed project is not expected to have an adverse traffic impact due to the current low volume of traffic in the study area. Both study intersections could operate under stop sign control although the east intersection should be improved to provide a fully channelized design like the west intersection. Additional mitigating measures such as the installation of traffic signals at the west intersection may be required if the proportion of primary buyers exceeds the 30% estimate assumed in the study.

References

References

1. *Highway Capacity Manual*, Transportation Research Board, National Research Council, Washington, D.C., 2000 Edition.

2. *Highway Capacity Analysis Program, Version 1*, Catalina Engineering, Inc., 2003.

3. *Technical Guidelines for the Control of Direct Access to Arterial Highways*, Federal Highway Administration (FHWA), Report No. FHWA-RD-76-86, Volume I and Volume 2, Washington, D.C., 1975.

4. *Trip Generation*, Institute of Transportation Engineers, Seventh Edition, 2003.

Figures

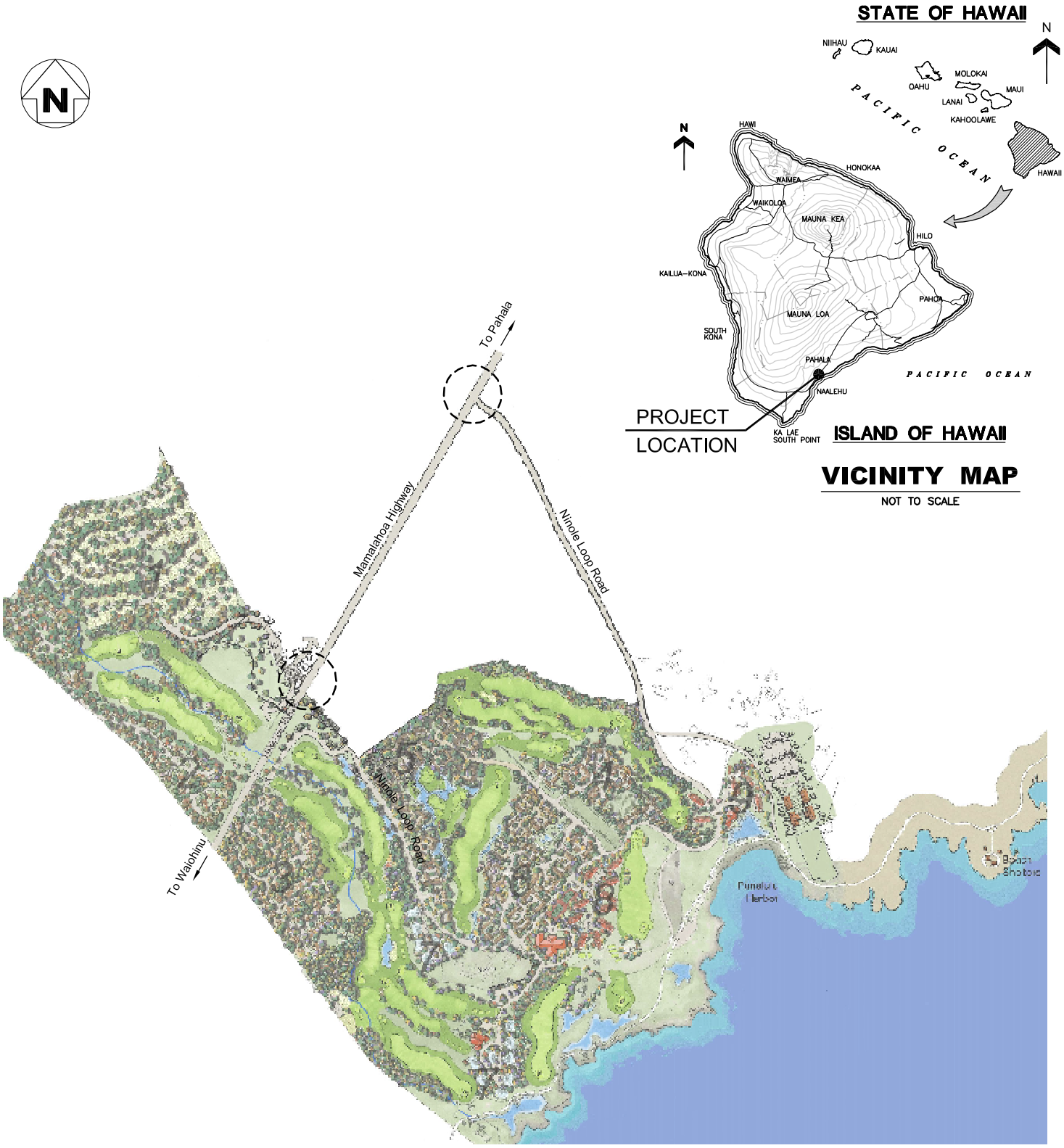

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Figure 1
Location Map
Traffic Impact Analysis Report
Sea Mountain at Punalu'u
February 2006

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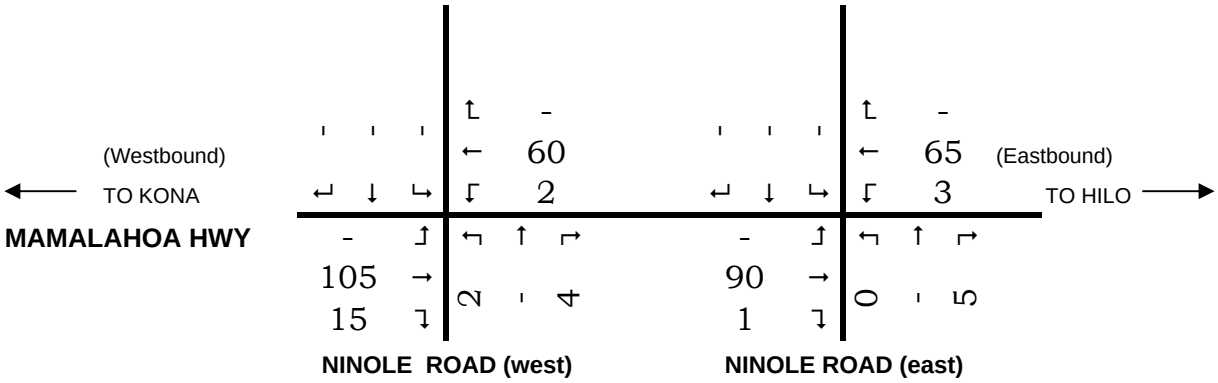
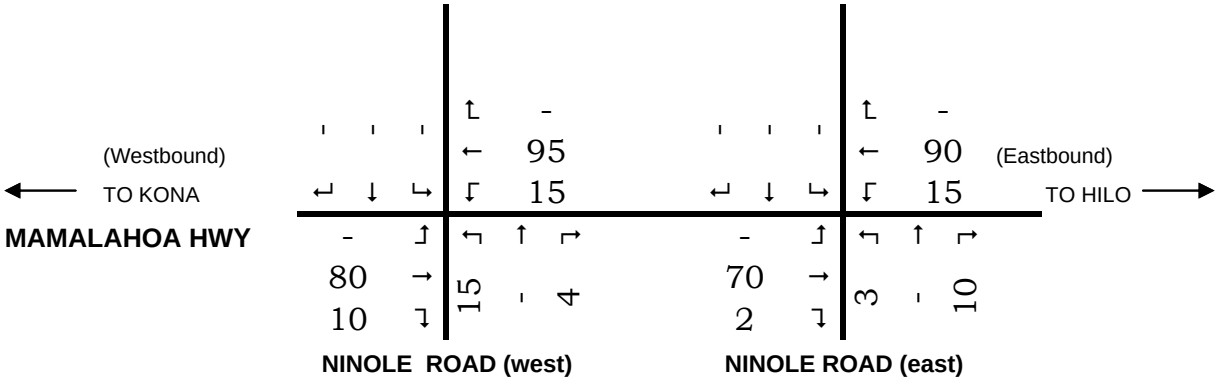


AM PEAK HOUR



PM PEAK HOUR

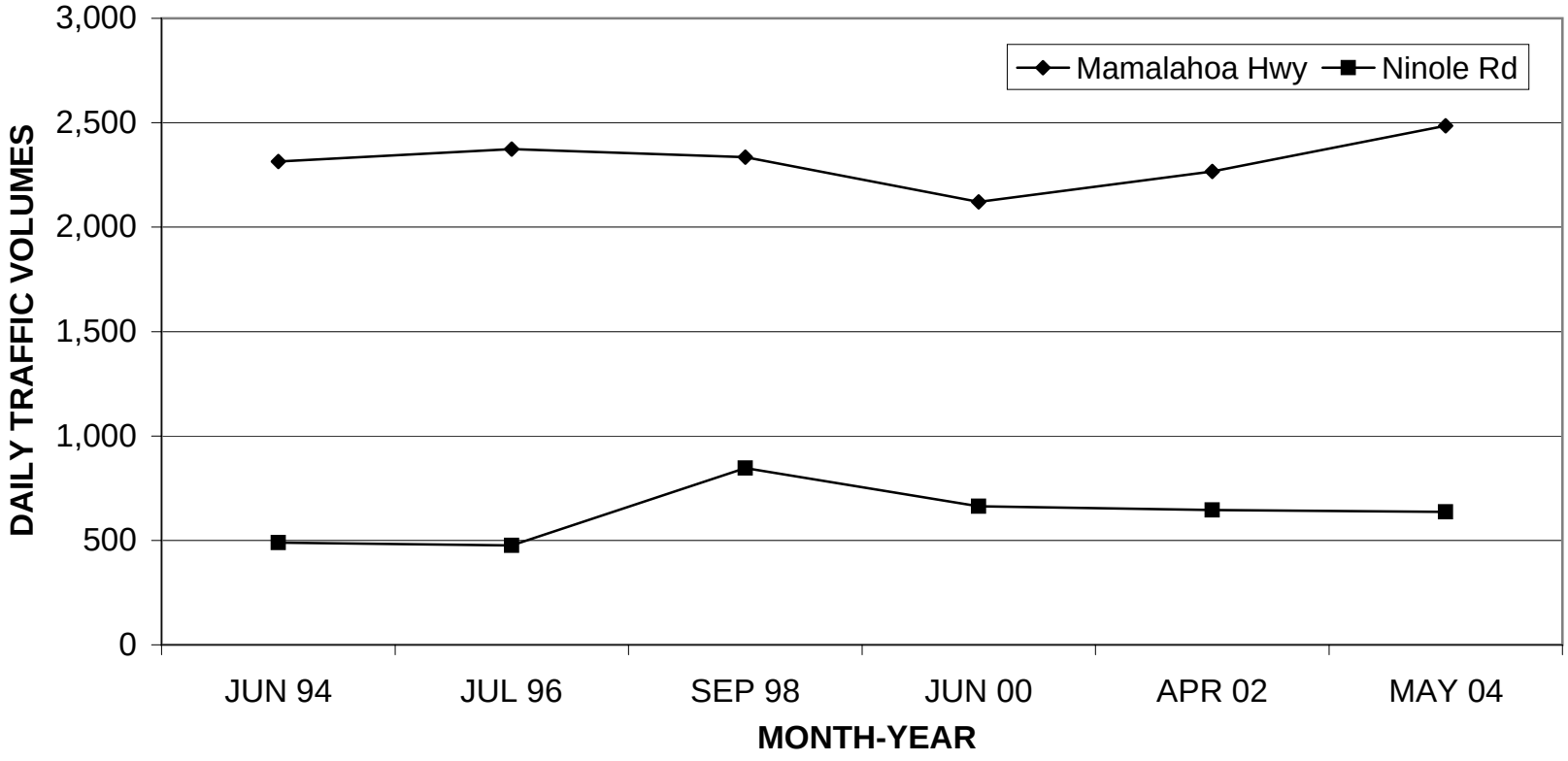
2005 EXISTING TRAFFIC VOLUMES

FIGURE 2

DAILY TRAFFIC VOLUMES AT STATION NO. 4-A
Mamalahoa Highway at Ninole Road (May 3-4, 2004)

DATE OF COUNT	DAILY TRAFFIC VOLUMES MAMALAHOA HIGHWAY	NINOLE ROAD
JUN 94	2,315	490
JUL 96	2,374	476
SEP 98	2,335	846
JUN 00	2,121	663
APR 02	2,266	646
MAY 04	2,486	637

Source: State of Hawaii Department of Transportation

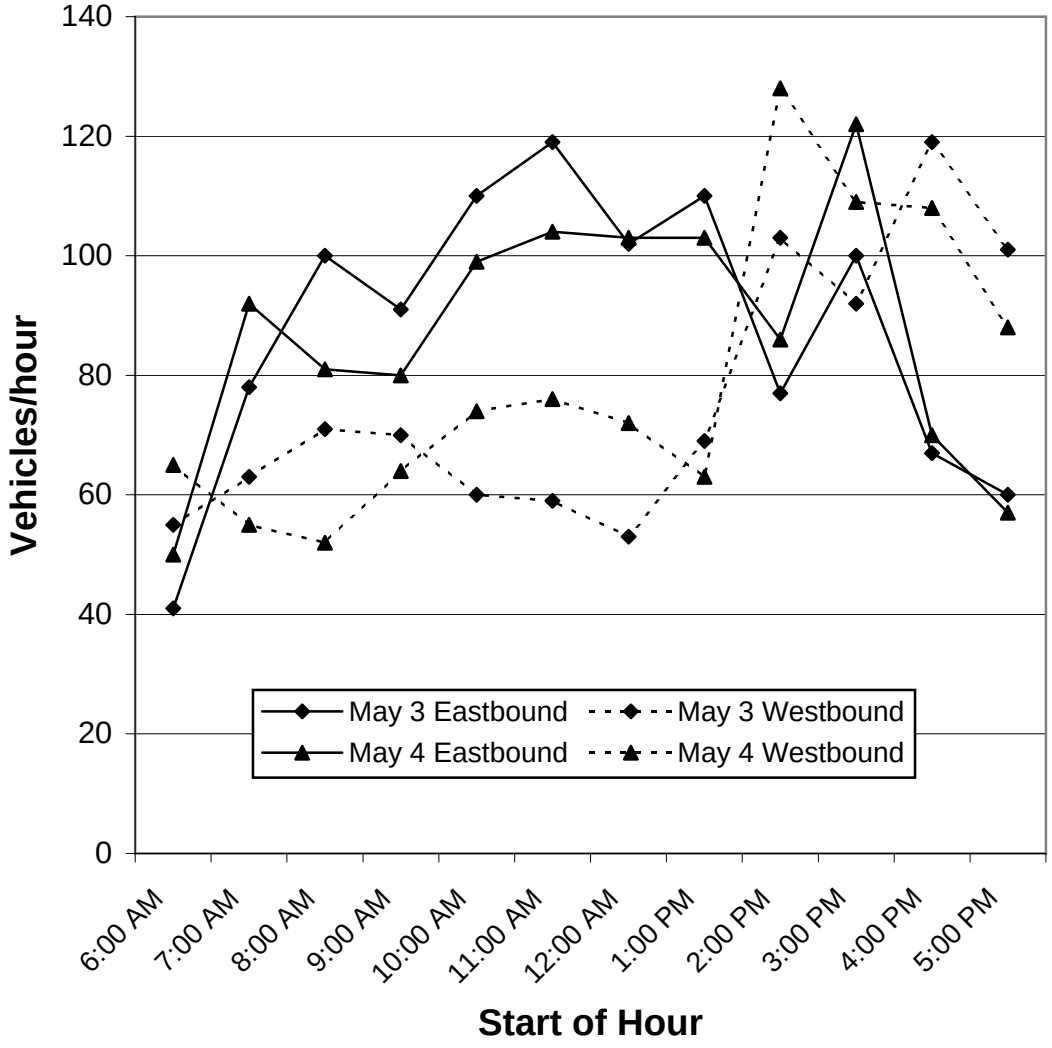


DAILY TRAFFIC VOLUMES ON MAMALAHOA HIGHWAY AND NINOLE ROAD
FIGURE 3

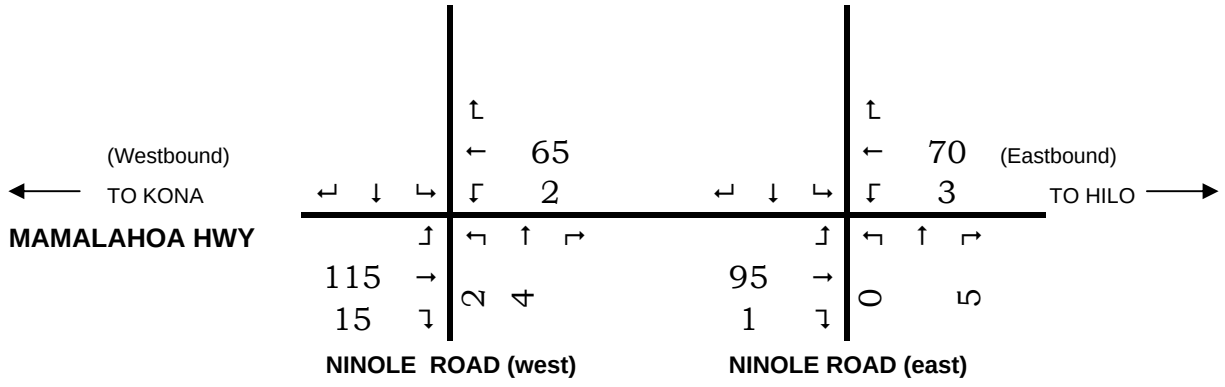
HOURLY TRAFFIC VOLUMES AT STATION NO. 4-A
Mamalahoa Highway at Ninole Road (May 3-5, 2004)

	Vehicles/Hour			
	May 3, 2004		May 4, 2004	
Start of Hour	East-Bound	West-Bound	East-Bound	West-Bound
6:00 AM	41	55	50	65
7:00 AM	78	63	92	55
8:00 AM	100	71	81	52
9:00 AM	91	70	80	64
10:00 AM	110	60	99	74
11:00 AM	119	59	104	76
12:00 AM	102	53	103	72
1:00 PM	110	69	103	63
2:00 PM	77	103	86	128
3:00 PM	100	92	122	109
4:00 PM	67	119	70	108
5:00 PM	60	101	57	88

Source:
State of Hawaii Department of Transportation



HOURLY TRAFFIC VOLUMES ON MAMALAHOA HIGHWAY AND NINOLE ROAD
FIGURE 4



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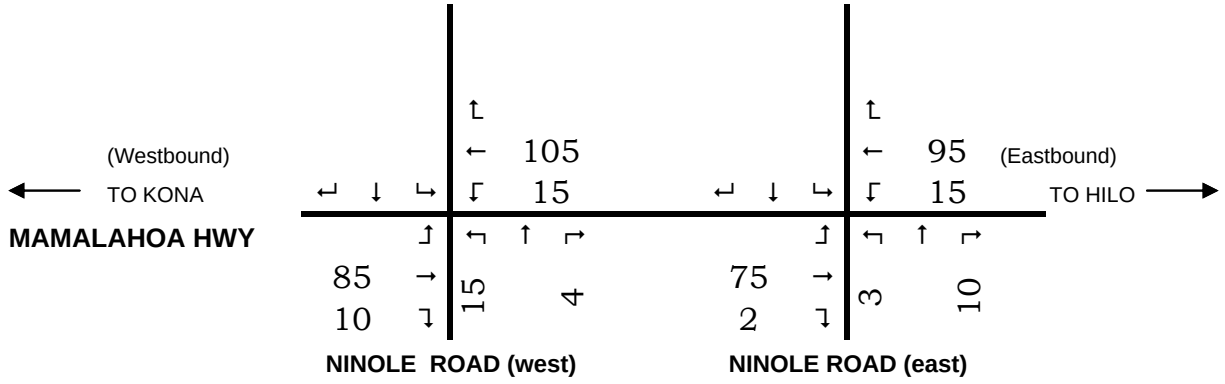
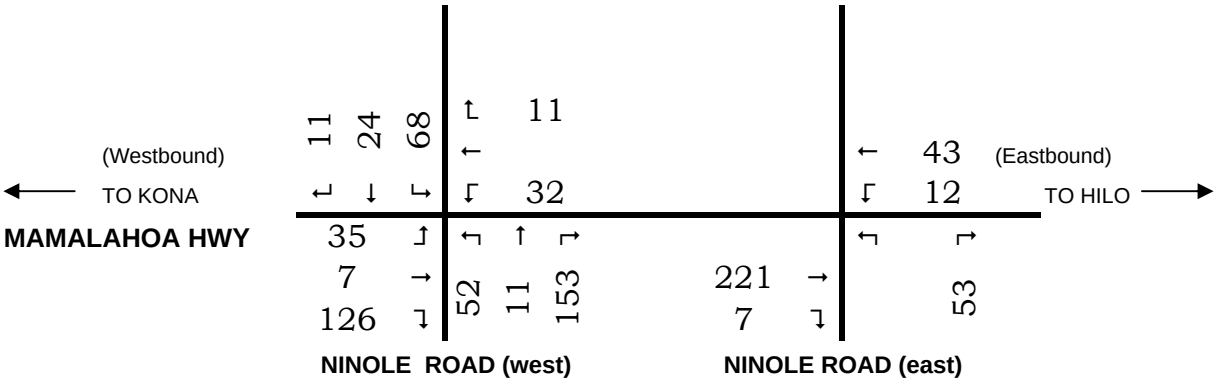


PM PEAK HOUR

2015 AMBIENT TRAFFIC FORECAST

FIGURE 5



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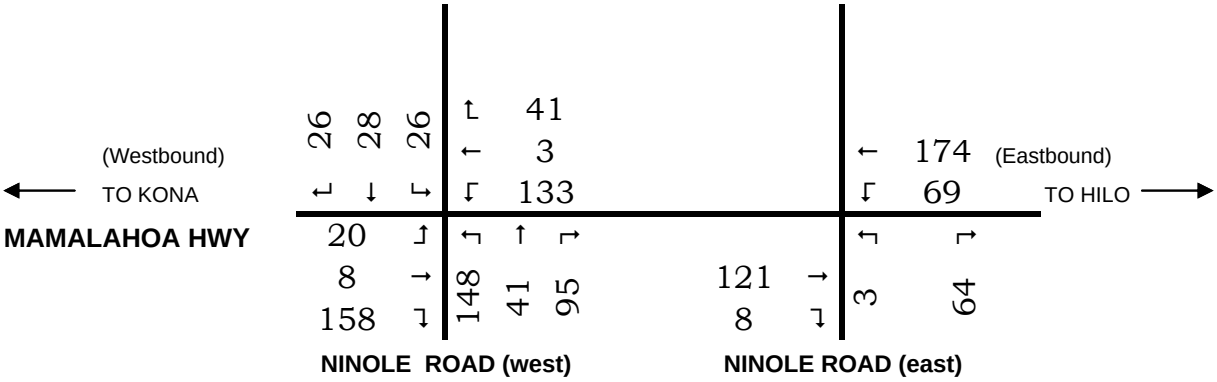
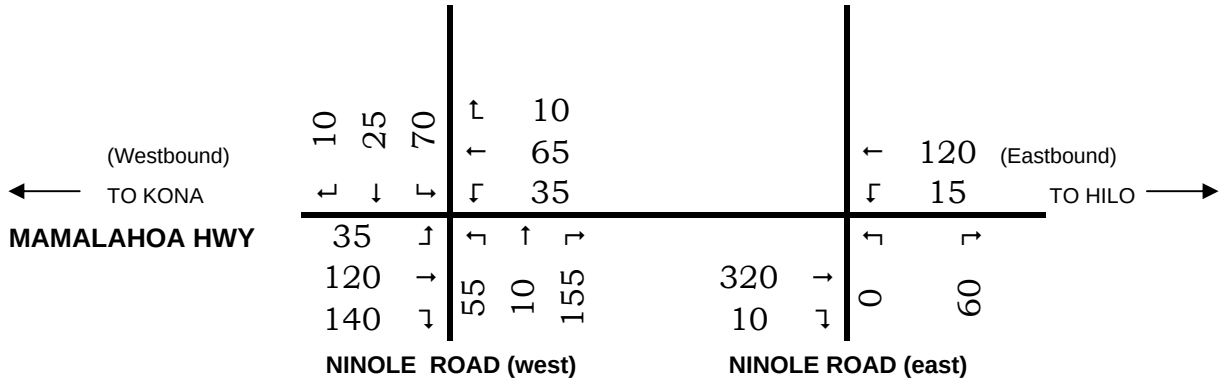


PM PEAK HOUR

PROJECT GENERATED TRAFFIC ASSIGNMENT

FIGURE 6



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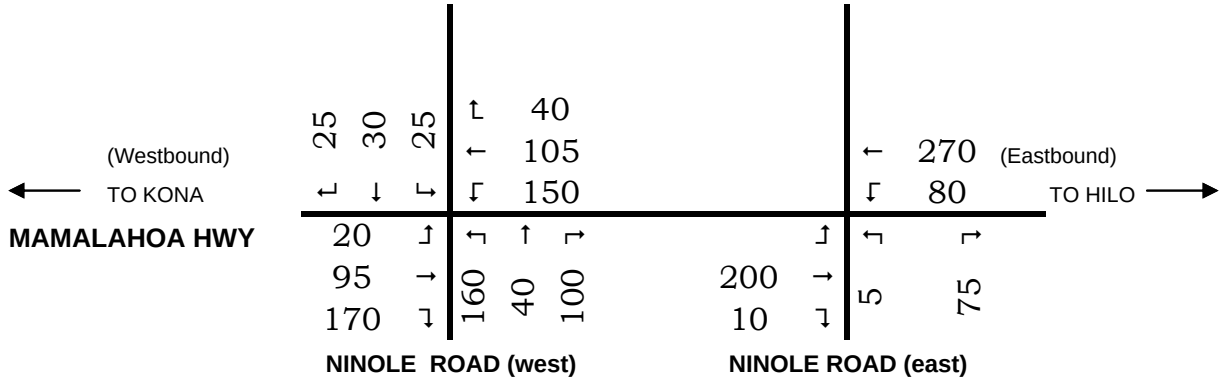

PM PEAK HOUR

2015 TOTAL WITH PROJECT TRAFFIC FORECAST

FIGURE 7

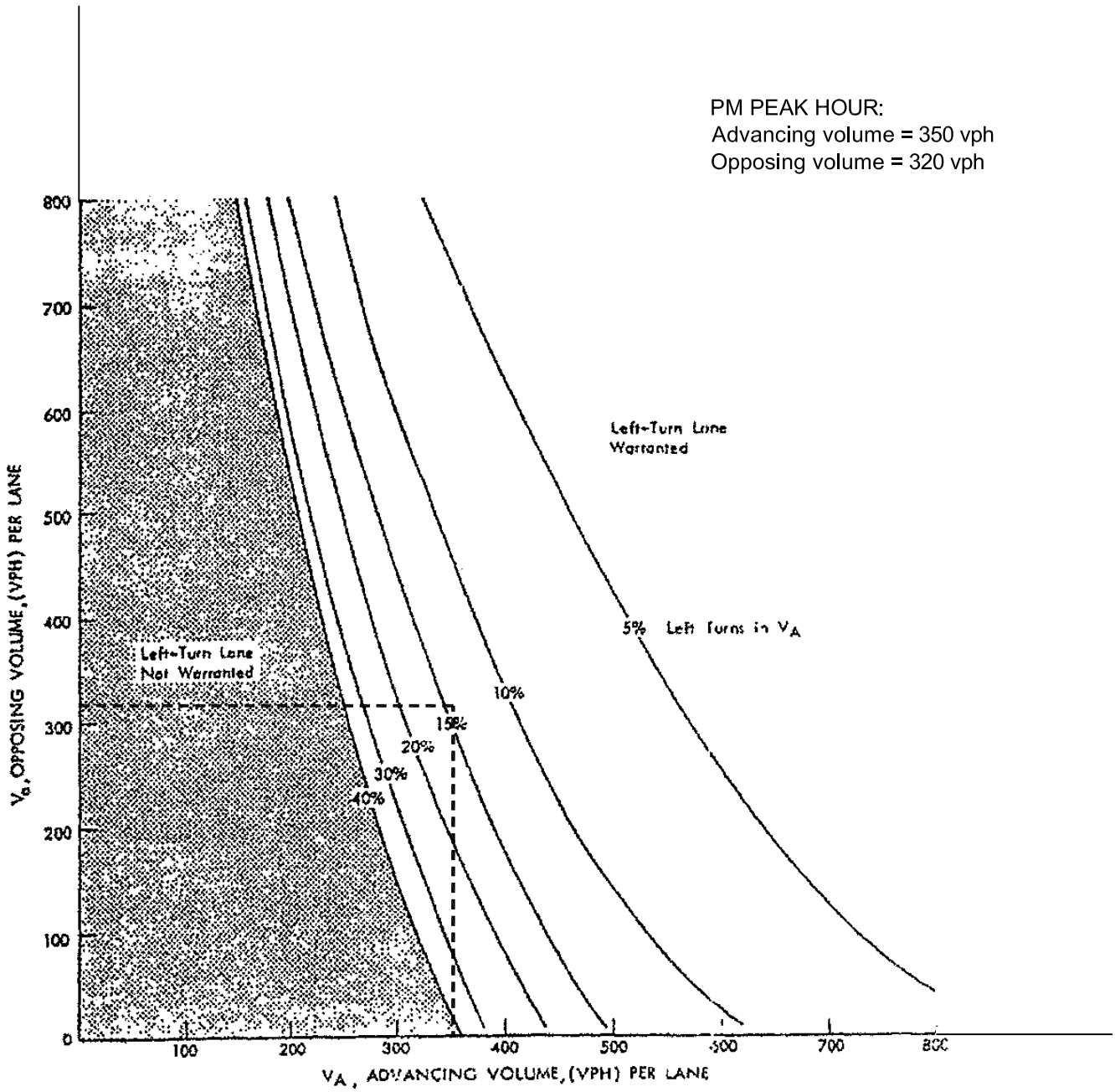

Figure 8. Volume Warrants for Left Turn Lanes

Reference: FHWA–RD–76–86
"Guidelines for the Control of Direct Access to Arterial Highways," (1975)

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Figure 8
Left Turn Warrant Analysis
Traffic Impact Analysis Report
Sea Mountain at Punalu'u
February 2006

Tables

TABLE 1
TRIP GENERATION AND DISTRIBUTION ANALYSIS

AREA	Trips	Entering	Exiting
AM TRIP GENERATION			
1 142 Single Family Units			
43 Primary Units (LU 210, SFDU)			
T = 0.70(X) + 9.43		25%	75%
T =	40	10	30
99 2nd Homes w/50% Occupancy (LU 260, Recreational Homes)			
T = 0.24(X) + 20.78		49%	51%
T =	33	16	17
T(sum) =	72	26	46
2 185 Duplex Units			
77 Primary Units (LU 231, Low-Rise Townhouse)			
T = 0.67(X)		25%	75%
T =	52	13	39
108 2nd Homes w/50% Occupancy (LU 260, Recreational Homes)			
T = 0.24(X) + 20.78		49%	51%
T =	34	17	17
T(sum) =	85	29	56
3 248 Triplex Units			
74 Primary Units (LU 231, Low-Rise Townhouse)			
T = 0.67(X)		25%	75%
T =	50	12	37
174 2nd Homes w/50% Occupancy (LU 260, Recreational Homes)			
T = 0.24(X) + 20.78		49%	51%
T =	42	20	21
T(sum) =	91	33	58
4 180 Cluster Townhouse Units			
54 Primary Units (LU 231, Low-Rise Townhouse)			
T = 0.67(X)		25%	75%
T =	36	9	27
126 2nd Homes w/50% Occupancy (LU 260, Recreational Homes)			
T = 0.24(X) + 20.78		49%	51%
T =	36	18	18
T(sum) =	72	27	45
5 282 Cluster Townhouse Units			
85 Primary Units (LU 231, Low-Rise Townhouse)			
T = 0.67(X)		25%	75%
T =	57	14	43
197 2nd Homes w/50% Occupancy (LU 260, Recreational Homes)			
T = 0.24(X) + 20.78		49%	51%
T =	45	22	23
T(sum) =	101	36	65

Direction	Trips	M. Hwy	M. Hwy	Internal
AM TRIP DISTRIBUTION				
Entering		61%	20%	19%
Exiting		16%	62%	22%
Entering	26	16	5	5
Exiting	46	7	29	10
Entering	29	18	6	6
Exiting	56	9	35	12
Entering	33	20	7	6
Exiting	58	9	36	13
Entering	27	16	5	5
Exiting	45	7	28	10
Entering	36	22	7	7
Exiting	65	10	41	14

TABLE 1
TRIP GENERATION AND DISTRIBUTION ANALYSIS

AREA	Trips	Entering	Exiting
AM TRIP GENERATION			
6 220 Cluster Townhouse Units			
66 Primary Units (LU 231, Low-Rise Townhouse)			
T = 0.67(X)		25%	75%
T =	44	11	33
154 2nd Homes w/50% Occupancy (LU 260, Recreational Homes)			
T = 0.24(X) + 20.78		49%	51%
T =	39	19	20
T(sum) =	83	30	53
7 114 Stacked Flat Units			
34 Primary Units (LU 231, Low-Rise Townhouse)			
T = 0.67(X)		25%	75%
T =	23	6	17
80 2nd Homes w/50% Occupancy (LU 260, Recreational Homes)			
T = 0.24(X) + 20.78		49%	51%
T =	30	15	15
T(sum) =	53	21	33
8,000 SF Golf Club Center (LU 430, Golf Course)			
T = 2.22(X)		79%	21%
T =	40	32	8
8 332 Stacked Flat Units (LU 260, Recreational Homes)			
T = 0.24(X) + 20.78		49%	51%
T =	100	49	51
50,000 SF Village Center (LU 820, Shopping Center)			
Ln(T) = 0.60Ln(X) + 2.29		61%	39%
Ln(T) = 4.637213803	103	63	40
9 120 Stacked Flat Units (LU 260, Recreational Homes)			
T = 0.24(X) + 20.78		49%	51%
T =	50	24	25
15,000 SF Cultural Center and Retail			
T =	0	0	0
TOTAL RESIDENTIAL TRIPS	709	275	434
TOTAL NON-RESIDENTIAL TRIPS	143	95	49
TOTAL PROJECT TRIPS	852	370	483

Direction	Trips	M. Hwy	M. Hwy	Internal
AM TRIP DISTRIBUTION				
Entering	30	18	6	6
Exiting	53	9	33	12
Entering	21	13	4	4
Exiting	33	5	20	7
Entering		0%	0%	100%
Exiting		0%	0%	100%
Entering	32	0	0	32
Exiting	8	0	0	8
Entering	49	30	10	9
Exiting	51	8	32	11
Entering		0%	0%	100%
Exiting		0%	0%	100%
Entering	63	0	0	63
Exiting	40	0	0	40
Entering	24	15	5	5
Exiting	25	4	16	6
Entering		0%	0%	100%
Exiting		0%	0%	100%
Entering	0	0	0	0
Exiting	0	0	0	0
Entering	275	168	55	52
Exiting	434	69	269	95
Entering	95	0	0	95
Exiting	49	0	0	49
Entering	370	168	55	147
Exiting	483	69	269	144

TABLE 1
TRIP GENERATION AND DISTRIBUTION ANALYSIS

AREA		Trips	Entering	Exiting
PM TRIP GENERATION				
1	**142 Single Family Units**			
	43 Primary Units (LU 210, SFDU)			
	Ln(T) = 0.90Ln(X) + 0.53		63%	37%
	Ln(T) = 3.915080104	50	32	19
	99 2nd Homes w/50% Occupancy (LU 260, Recreational Homes)			
	T = 0.26(X) + 14.87		44%	56%
	T =	28	12	16
	T(sum) =	78	44	34
2	**185 Duplex Units (LU 231, Low-Rise Townhouse)**			
	77 Primary Units (LU 231, Low-Rise Townhouse)			
	T = 0.78(X)		58%	42%
	T =	60	35	25
	108 2nd Homes w/50% Occupancy (LU 260, Recreational Homes)			
	T = 0.26(X) + 14.87		44%	56%
	T =	29	13	16
	T(sum) =	89	48	41
3	**248 Triplex Units (LU 231, Low-Rise Townhouse)**			
	74 Primary Units (LU 231, Low-Rise Townhouse)			
	T = 0.78(X)		58%	42%
	T =	58	33	24
	174 2nd Homes w/50% Occupancy (LU 260, Recreational Homes)			
	T = 0.26(X) + 14.87		44%	56%
	T =	37	16	21
	T(sum) =	95	50	45
4	**180 Cluster Townhouse Units (LU 231, Low-Rise Townhouse)**			
	54 Primary Units (LU 231, Low-Rise Townhouse)			
	T = 0.78(X)		58%	42%
	T =	42	24	18
	126 2nd Homes w/50% Occupancy (LU 260, Recreational Homes)			
	T = 0.26(X) + 14.87		44%	56%
	T =	31	14	18
	T(sum) =	73	38	35
5	**282 Cluster Townhouse Units (LU 231, Low-Rise Townhouse)**			
	85 Primary Units (LU 231, Low-Rise Townhouse)			
	T = 0.78(X)		58%	42%
	T =	66	38	28
	197 2nd Homes w/50% Occupancy (LU 260, Recreational Homes)			
	T = 0.26(X) + 14.87		44%	56%
	T =	41	18	23
	T(sum) =	107	56	51

Direction	Trips	M. Hwy	M. Hwy	Internal
PM TRIP GENERATION				
Entering		21%	42%	37%
Exiting		32%	32%	36%
Entering	44	9	18	16
Exiting	34	11	11	12
Entering	48	10	20	18
Exiting	41	13	13	15
Entering	50	10	21	18
Exiting	45	14	14	16
Entering	38	8	16	14
Exiting	35	11	11	13
Entering	56	12	24	21
Exiting	51	16	16	18

TABLE 1
TRIP GENERATION AND DISTRIBUTION ANALYSIS

AREA		Trips	Entering	Exiting	Direction	Trips	M. Hwy	M. Hwy	Internal
PM TRIP GENERATION					**PM TRIP GENERATION**				
6	**220 Cluster Townhouse Units (LU 231, Low-Rise Townhouse)**								
	66 Primary Units (LU 231, Low-Rise Townhouse)								
	T = 0.78(X)		58%	42%					
	T =	51	30	22					
	154 2nd Homes w/50% Occupancy (LU 260, Recreational Homes)								
	T = 0.26(X) + 14.87		44%	56%					
	T =	35	15	20					
	T(sum) =	86	45	41	Entering	45	9	19	17
					Exiting	41	13	13	15
7	**114 Stacked Flat Units (LU 231, Low-Rise Townhouse)**								
	34 Primary Units (LU 231, Low-Rise Townhouse)								
	T = 0.78(X)		58%	42%					
	T =	27	15	11					
	80 2nd Homes w/50% Occupancy (LU 260, Recreational Homes)								
	T = 0.26(X) + 14.87		44%	56%					
	T =	25	11	14					
	T(sum) =	52	27	25	Entering	27	6	11	10
					Exiting	25	8	8	9
	8,000 SF Golf Club Center (LU 430, Golf Course)				Entering		17%	33%	50%
	T = 3.56(X)		43%	57%	Exiting		25%	25%	50%
	T =	64	28	37	Entering	28	5	9	14
					Exiting	37	9	9	18
8	**332 Stacked Flat Units (LU 260, Recreational Homes)**								
	T = 0.26(X) + 14.87		44%	56%					
	T =	101	45	57	Entering	45	9	19	16
					Exiting	57	18	18	20
	50,000 SF Village Center (LU 820, Shopping Center)						17%	33%	50%
	Ln(T) = 0.66Ln(X) + 3.40		48%	52%			25%	25%	50%
	Ln(T) = 5.981935184	396	190	206	Entering	190	32	63	95
					Exiting	206	52	52	103
9	**120 Stacked Flat Units (LU 260, Recreational Homes)**								
	T = 0.26(X) + 14.87		44%	56%					
	T =	46	20	26	Entering	20	4	9	8
					Exiting	26	8	8	9
	15,000 SF Cultural Center and Retail						17%	33%	50%
							25%	25%	50%
	T =	50	25	25	Entering	25	4	8	13
					Exiting	25	6	6	13
	TOTAL RESIDENTIAL TRIPS	699	360	339	Entering	372	78	156	138
					Exiting	356	114	114	128
	TOTAL NON-RESIDENTIAL TRIPS	510	243	268	Entering	243	41	80	121
					Exiting	268	67	67	134
	TOTAL PROJECT TRIPS	1209	602	607	Entering	615	119	237	259
					Exiting	623	181	181	262

TABLE 2
SUMMARY OF TRIP DISTRIBUTION FACTORS

LAND USES	AM PEAK HOUR			PM PEAK HOUR		
	VIA MAMALAHOA HWY		INTERNAL	VIA MAMALAHOA HWY		INTERNAL
	WEST	EAST		WEST	EAST	
RESIDENTIAL LAND USES						
Entering	61%	20%	19%	21%	42%	37%
Exiting	16%	62%	22%	32%	32%	36%
GOLF COURSE						
Entering	0%	0%	100%	17%	33%	50%
Exiting	0%	0%	100%	25%	25%	50%
VILLAGE CENTER						
Entering	0%	0%	100%	17%	33%	50%
Exiting	0%	0%	100%	25%	25%	50%
CULTURAL CENTER & RETAIL						
Entering	0%	0%	0%	17%	33%	50%
Exiting	0%	0%	0%	25%	25%	50%

TABLE 3
TWO-WAY TWO-LANE HIGHWAY LEVEL OF SERVICE ANALYSIS

HIGHWAY SEGMENT	2005 EXISTING			2015 AMBIENT			2015 TOTAL W/PROJECT		
	LOS	A.SPD	PTSF	LOS	A.SPD	PTSF	LOS	A.SPD	PTSF
AM PEAK HOUR									
Mamalahoa Highway (west of project)	B	51	25	B	51	26	C	49	39
Mamalahoa Highway (east of project)	B	52	23	B	51	24	C	49	44
PM PEAK HOUR									
Mamalahoa Highway (west of project)	B	51	25	B	51	26	C	48	46
Mamalahoa Highway (east of project)	B	51	25	B	51	26	C	48	50

LEGEND:

LOS Level of Service

A.SPD Average Speed (mph)

PTSF Percent of Time Spent Following (another vehicle)

TABLE 4
UNSIGNALIZED INTERSECTION LEVEL OF SERVICE ANALYSIS

INTERSECTION APPROACH	AM PEAK HOUR						PM PEAK HOUR					
	2005 EXISTING		2015 AMBIENT		2015 TOTAL		2005 EXISTING		2015 AMBIENT		2015 TOTAL	
	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY	LOS	DELAY
NINOLE ROAD (west intersection)												
NB RT lane	A	8.9	A	8.9	A	9.9	A	8.7	A	8.8	A	9.3
NB LT/THRU lane	A	9.7	A	9.8	B	12.9	B	10.1	B	10.3	E	37.1
SB RT lane	NC		NC		A	8.7	NC		NC		A	9.0
SB LT/THRU lane	NC		NC		C	16.1	NC		NC		C	20.1
Mamalahoa Hwy EB LT	NC		NC		A	7.4	NC		NC		A	7.5
Mamalahoa Hwy WB LT	A	7.5	A	7.5	A	7.6	A	7.4	A	7.4	A	7.7
NINOLE ROAD (east intersection)												
NB lane	A	8.8	A	8.8	B	10.8	A	9.0	A	9.0	B	10.6
Mamalahoa Hwy WB LT	A	7.4	A	7.4	A	8.1	A	7.4	A	7.4	A	7.9

LEGEND:

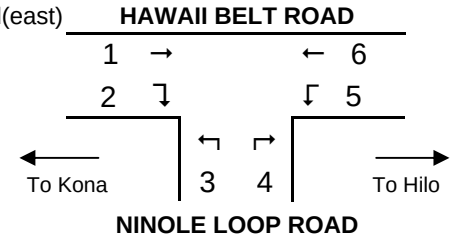
LOS	Level of Service	EB	Eastbound	RT	Right turn
DELAY	Control Delay (seconds)	WB	Westbound	LT	Left Turn
NC	Not counted	NB	Northbound	THRU	Through
		SB	Southbound		

Appendix A

Traffic Turning Movement Counts

TRAFFIC TURNING MOVEMENT COUNT
SEA MOUNTAIN DEVELOPMENT

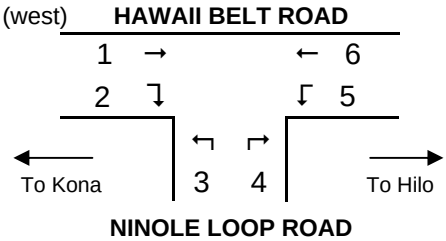
LOCATION: Hawaii Belt Road/Ninole Loop Road(east)
DATE: September 7, 2005, Wednesday
TIME: 6:30a-8:30a / 3:30p-5:30p
WEATHER: Clear
RECORDER: Carole Darby



TIME PERIOD	MOVEMENT NUMBER 1	2	3	4	5	6	TOTAL
6:30-6:45a	16	0	0	0	0	10	26
6:45-7:00a	12	0	0	0	2	15	29
7:00-7:15a	12	0	0	1	0	16	29
7:15-7:30a	20	0	0	1	1	13	35
7:30-7:45a	33	0	0	1	2	20	56
7:45-8:00a	24	1	0	2	0	18	45
8:00-8:15a	7	0	0	1	2	14	24
8:15-8:30a	19	0	0	1	1	13	34
6:30-8:30a	143	1	0	7	8	119	278
7:00-8:00a	89	1	0	5	3	67	165
PHF	0.68				0.80		
3:30-3:45p	22	2	2	5	3	20	54
3:45-4:00p	21	0	0	0	1	24	46
4:00-4:15p	13	0	0	1	6	26	46
4:15-4:30p	16	0	1	5	3	20	45
4:30-4:45p	18	0	0	3	5	18	44
4:45-5:00p	8	0	2	3	4	21	38
5:00-5:15p	21	0	2	4	1	24	52
5:15-5:30p	20	2	1	1	3	28	55
3:30-5:30p	139	4	8	22	26	181	380
3:30-4:30p	72	2	3	11	13	90	191
PHF	0.77				0.80		

TRAFFIC TURNING MOVEMENT COUNT
SEA MOUNTAIN DEVELOPMENT

LOCATION: Hawaii Belt Road/Ninole Loop Road (west)
DATE: September 8, 2005, Thursday
TIME: 6:30a-8:30a / 3:30p-5:30p
WEATHER: Cloudy
RECORDER: Carole Darby



TIME PERIOD	MOVEMENT NUMBER 1	2	3	4	5	6	TOTAL
6:30-6:45a	12	0	1	0	0	8	21
6:45-7:00a	12	0	2	0	2	14	30
7:00-7:15a	19	4	0	1	1	13	38
7:15-7:30a	19	4	1	1	1	16	42
7:30-7:45a	31	0	1	2	0	14	48
7:45-8:00a	36	6	0	0	0	19	61
8:00-8:15a	10	0	3	0	0	16	29
8:15-8:30a	7	0	0	0	0	18	25
6:30-8:30a	146	14	8	4	4	118	294
7:00-8:00a	105	14	2	4	2	62	189
PHF	0.71				0.84		
3:30-3:45p	14	2	6	1	2	22	47
3:45-4:00p	21	3	2	1	2	19	48
4:00-4:15p	19	3	3	1	1	20	47
4:15-4:30p	19	1	0	2	4	22	48
4:30-4:45p	18	5	5	1	4	29	62
4:45-5:00p	19	4	5	0	6	22	56
5:00-5:15p	22	2	4	1	2	23	54
5:15-5:30p	14	6	4	0	1	20	45
3:30-5:30p	146	26	29	7	1	177	386
4:15-5:15p	78	12	14	4	16	96	220
PHF	0.98				0.85		

Appendix B

Two-Way, Two-Lane Highway Level of Service (LOS) Calculations

CHAPTER 20 - TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: EX AM 2005
Comment: 2005 EXISTING AM

Site Information

Jurisdiction/Date: 12/1/05
Highway: MAMALAHOA HWY (WEST)
From/To: WEST OF SEAMOUNTAIN

☐ Operational (LOS) ☐ Design (v_p) ☑ Planning (LOS) ☐ Planning (v_p)

Input Data

Shoulder width 6 ft
Lane width 12 ft
Lane width 12 ft
Shoulder width 6 ft
Segment length, L_t 2 mi

Show North Arrow

☑ Class I highway ☐ Class II highway
Terrain ☐ Level ☑ Rolling
Two-way hourly volume 182 veh/h
Higher directional split (%) 67
Peak-hour factor, PHF .9
% Trucks and buses, P_T 1 %
% Recreational vehicles, P_R 0 %
% No-passing zone 5 %
Access points/mi 5 /mi

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	.71
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	2.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	1.1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.985
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	289
v_p * highest directional split proportion[2] (pc/h)	194
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed
Field measured speed, S_{FM} ___ mi/h Observed volume, V_f ___ veh/h Free-flow speed, FFS 53.8 mi/h $FFS = S_{FM} + 0.00776(\frac{V_f}{f_{HV}})$	Base free-flow speed, BFFS 55 mi/h Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5) 0 mi/h Adj. for access points, f_A (Exhibit 20-6) 1.3 mi/h Free-flow speed, FFS 53.8 mi/h $FFS = BFFS - f_{LS} - f_A$
Adj. for no-passing zones, f_{np} (mi/h) (Exhibit 20-11)	.3
Average travel speed, ATS (mi/h) $ATS = FFS - 0.00776v_p - f_{np}$	51.2

Percent Time-Spent-Following

Grade adjustment factor, f_G (Exhibit 20-8)	.77
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	1.8
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.992
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	265
v_p * highest directional split proportion[2] (pc/h)	177
Base percent time-spent-following, BPTSF (%) $BPTSF = 100(1 - e^{-0.000879v_p})$	20.8
Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) (Exhibit 20-12)	4.6
Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{d/np}$	25.4

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	B
Volume to capacity ratio, v/c $v/c = \frac{v_p}{3,200}$	.09
Peak 15-min vehicle-miles of travel, VMT_{15} (veh-mi) $VMT_{15} = 0.25L_t(\frac{V}{PHF})$	101
Peak-hour vehicle-miles of travel, VMT_{60} (veh-mi) $VMT_{60} = V * L_t$	364
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = \frac{VMT_{15}}{ATS}$	2

Notes

1. If $v_p \geq 3,200$ pc/h, terminate analysis—the LOS is F.
2. If highest directional split $v_p \geq 1,700$ pc/h, terminate analysis—the LOS is F.

HICAP 2000 ™

CHAPTER 20 - TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: AMB AM 2015
Comment: 2105 AMBIENT AM

Site Information

Jurisdiction/Date: 12/1/05
Highway: MAMALAHOA HWY (EAST-WI
From/To: WEST OF SEAMOUNTAIN

☐ Operational (LOS) ☐ Design (v_p) ☑ Planning (LOS) ☐ Planning (v_p)

Input Data

Shoulder width 6 ft
Lane width 12 ft
Lane width 12 ft
Shoulder width 6 ft
Segment length, L_t 2 mi

Show North Arrow

☑ Class I highway ☐ Class II highway
Terrain ☐ Level ☑ Rolling
Two-way hourly volume 195 veh/h
Higher directional split (%) 65
Peak-hour factor, PHF .9
% Trucks and buses, P_T 1 %
% Recreational vehicles, P_R 0 %
% No-passing zone 5 %
Access points/mi 5 /mi

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	.71
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	2.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	1.1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.985
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	310
v_p * highest directional split proportion[2] (pc/h)	201
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed
Field measured speed, S_{FM} ___ mi/h Observed volume, V_f ___ veh/h Free-flow speed, FFS 53.8 mi/h $FFS = S_{FM} + 0.00776(\frac{V_f}{f_{HV}})$	Base free-flow speed, BFFS 55 mi/h Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5) 0 mi/h Adj. for access points, f_A (Exhibit 20-6) 1.3 mi/h Free-flow speed, FFS 53.8 mi/h $FFS = BFFS - f_{LS} - f_A$
Adj. for no-passing zones, f_{np} (mi/h) (Exhibit 20-11)	.3
Average travel speed, ATS (mi/h) $ATS = FFS - 0.00776v_p - f_{np}$	51

Percent Time-Spent-Following

Grade adjustment factor, f_G (Exhibit 20-8)	.77
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	1.8
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.992
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	284
v_p * highest directional split proportion[2] (pc/h)	184
Base percent time-spent-following, BPTSF (%) $BPTSF = 100(1 - e^{-0.000879v_p})$	22.1
Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) (Exhibit 20-12)	4.3
Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{d/np}$	26.4

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	B
Volume to capacity ratio, v/c $v/c = \frac{v_p}{3,200}$	.097
Peak 15-min vehicle-miles of travel, VMT_{15} (veh-mi) $VMT_{15} = 0.25L_t(\frac{V}{PHF})$	108
Peak-hour vehicle-miles of travel, VMT_{60} (veh-mi) $VMT_{60} = V * L_t$	390
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = \frac{VMT_{15}}{ATS}$	2.1

Notes

1. If $v_p \geq 3,200$ pc/h, terminate analysis—the LOS is F.
2. If highest directional split $v_p \geq 1,700$ pc/h, terminate analysis—the LOS is F.

HICAP 2000 ™

CHAPTER 20 - TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: TOT AM 2015
Comment: 2015 TOTAL W/PROJ AM

Site Information

Jurisdiction/Date: 12/20/05
Highway: MAMALAHOA HWY (WEST)
From/To: WEST OF SEAMOUNTAIN

☐ Operational (LOS) ☐ Design (v_p) ☑ Planning (LOS) ☐ Planning (v_p)

Input Data

Shoulder width 6 ft
Lane width 12 ft
Lane width 12 ft
Shoulder width 6 ft
Segment length, L_t 2 mi

Show North Arrow

☑ Class I highway ☐ Class II highway
Terrain ☐ Level ☑ Rolling
Two-way hourly volume 425 veh/h
Higher directional split (%) 69
Peak-hour factor, PHF .9
% Trucks and buses, P_T 1 %
% Recreational vehicles, P_R 0 %
% No-passing zone 5 %
Access points/mi 5 /mi

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	.93
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	1.9
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	1.1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.991
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	512
v_p * highest directional split proportion[2] (pc/h)	354

Free-Flow Speed from Field Measurement
Field measured speed, S_{FM} ____ mi/h
Observed volume, V_f ____ veh/h
Free-flow speed, FFS 53.8 mi/h
$FFS = S_{FM} + 0.00776(\frac{V_f}{f_{HV}})$

Estimated Free-Flow Speed
Base free-flow speed, BFFS 55 mi/h
Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5) 0 mi/h
Adj. for access points, f_A (Exhibit 20-6) 1.3 mi/h
Free-flow speed, FFS 53.8 mi/h
$FFS = BFFS - f_{LS} - f_A$

Adj. for no-passing zones, f_{np} (mi/h) (Exhibit 20-11)	.4
Average travel speed, ATS (mi/h) $ATS = FFS - 0.00776v_p - f_{np}$	49.4

Percent Time-Spent-Following

Grade adjustment factor, f_G (Exhibit 20-8)	.94
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	1.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.995
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	505
v_p * highest directional split proportion[2] (pc/h)	348
Base percent time-spent-following, BPTSF (%) $BPTSF = 100(1 - e^{-0.000879v_p})$	35.8
Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) (Exhibit 20-12)	3.4
Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{d/np}$	39.2

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	C
Volume to capacity ratio, v/c $v/c = \frac{v_p}{3{,}200}$	.16
Peak 15-min vehicle-miles of travel, VMT_{15} (veh-mi) $VMT_{15} = 0.25L_t(\frac{V}{PHF})$	236
Peak-hour vehicle-miles of travel, VMT_{60} (veh-mi) $VMT_{60} = V * L_t$	850
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = \frac{VMT_{15}}{ATS}$	4.8

Notes

1. If $v_p \geq 3{,}200$ pc/h, terminate analysis—the LOS is F.
2. If highest directional split $v_p \geq 1{,}700$ pc/h, terminate analysis—the LOS is F.

CHAPTER 20 - TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: EX PM 2005
Comment: 2005 EXISTING PM

Site Information

Jurisdiction/Date: 12/1/05
Highway: MAMALAHOA HWY (EAST-WI
From/To: WEST OF SEAMOUNTAIN

☐ Operational (LOS) ☐ Design (v_p) ☑ Planning (LOS) ☐ Planning (v_p)

Input Data

Shoulder width 6 ft
Lane width 12 ft
Lane width 12 ft
Shoulder width 6 ft
Segment length, L_t 2 mi

Show North Arrow

☑ Class I highway ☐ Class II highway
Terrain ☐ Level ☑ Rolling
Two-way hourly volume 200 veh/h
Higher directional split (%) 55
Peak-hour factor, PHF .95
% Trucks and buses, P_T 1 %
% Recreational vehicles, P_R 0 %
% No-passing zone 5 %
Access points/mi 5 /mi

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	.71
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	2.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	1.1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.985
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	301
v_p * highest directional split proportion[2] (pc/h)	166

Free-Flow Speed from Field Measurement
Field measured speed, S_{FM} ____ mi/h
Observed volume, V_f ____ veh/h
Free-flow speed, FFS 53.8 mi/h
$FFS = S_{FM} + 0.00776(\frac{V_f}{f_{HV}})$

Estimated Free-Flow Speed
Base free-flow speed, BFFS 55 mi/h
Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5) 0 mi/h
Adj. for access points, f_A (Exhibit 20-6) 1.3 mi/h
Free-flow speed, FFS 53.8 mi/h
$FFS = BFFS - f_{LS} - f_A$

Adj. for no-passing zones, f_{np} (mi/h) (Exhibit 20-11)	.3
Average travel speed, ATS (mi/h) $ATS = FFS - 0.00776v_p - f_{np}$	51.1

Percent Time-Spent-Following

Grade adjustment factor, f_G (Exhibit 20-8)	.77
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	1.8
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.992
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	276
v_p * highest directional split proportion[2] (pc/h)	152
Base percent time-spent-following, BPTSF (%) $BPTSF = 100(1 - e^{-0.000879v_p})$	21.5
Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) (Exhibit 20-12)	3.3
Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{d/np}$	24.8

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	B
Volume to capacity ratio, v/c $v/c = \frac{v_p}{3{,}200}$	.094
Peak 15-min vehicle-miles of travel, VMT_{15} (veh-mi) $VMT_{15} = 0.25L_t(\frac{V}{PHF})$	105
Peak-hour vehicle-miles of travel, VMT_{60} (veh-mi) $VMT_{60} = V * L_t$	400
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = \frac{VMT_{15}}{ATS}$	2.1

Notes

1. If $v_p \geq 3{,}200$ pc/h, terminate analysis—the LOS is F.
2. If highest directional split $v_p \geq 1{,}700$ pc/h, terminate analysis—the LOS is F.

CHAPTER 20 - TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: AMB PM 2015
Comment: 2015 AMBIENT PM

Site Information

Jurisdiction/Date: 12/1/05
Highway: MAMALAHOA HWY (EAST-WI
From/To: WEST OF SEAMOUNTAIN

☐ Operational (LOS) ☐ Design (v_p) ☑ Planning (LOS) ☐ Planning (v_p)

Input Data

Shoulder width 6 ft
Lane width 12 ft
Lane width 12 ft
Shoulder width 6 ft
Segment length, L_t 2 mi

Show North Arrow

☑ Class I highway ☐ Class II highway
Terrain ☐ Level ☑ Rolling
Two-way hourly volume 215 veh/h
Higher directional split (%) 55
Peak-hour factor, PHF .95
% Trucks and buses, P_T 1 %
% Recreational vehicles, P_R 0 %
% No-passing zone 5 %
Access points/mi 5 /mi

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	.71
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	2.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	1.1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.985
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	324
v_p * highest directional split proportion[2] (pc/h)	178
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed
Field measured speed, S_{FM} ___ mi/h	Base free-flow speed, BFFS 55 mi/h
Observed volume, V_f ___ veh/h	Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5) 0 mi/h
Free-flow speed, FFS 53.8 mi/h $FFS = S_{FM} + 0.00776(\frac{V_f}{f_{HV}})$	Adj. for access points, f_A (Exhibit 20-6) 1.3 mi/h; Free-flow speed, FFS 53.8 mi/h; $FFS = BFFS - f_{LS} - f_A$
Adj. for no-passing zones, f_{np} (mi/h) (Exhibit 20-11)	.3
Average travel speed, ATS (mi/h) $ATS = FFS - 0.00776v_p - f_{np}$	50.9
Percent Time-Spent-Following	
Grade adjustment factor, f_G (Exhibit 20-8)	.77
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	1.8
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.992
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	296
v_p * highest directional split proportion[2] (pc/h)	163
Base percent time-spent-following, BPTSF (%) $BPTSF = 100(1 - e^{-0.000879v_p})$	22.9
Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) (Exhibit 20-12)	3.3
Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{d/np}$	26.2
Level of Service and Other Performance Measures	
Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	B
Volume to capacity ratio, v/c $v/c = \frac{v_p}{3,200}$	.101
Peak 15-min vehicle-miles of travel, VMT_{15} (veh-mi) $VMT_{15} = 0.25L_t(\frac{V}{PHF})$	113
Peak-hour vehicle-miles of travel, VMT_{60} (veh-mi) $VMT_{60} = V * L_t$	430
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = \frac{VMT_{15}}{ATS}$	2.2

Notes

1. If $v_p \geq 3,200$ pc/h, terminate analysis—the LOS is F.
2. If highest directional split $v_p \geq 1,700$ pc/h, terminate analysis—the LOS is F.

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CHAPTER 20 - TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: TOT PM 2015
Comment: 2015 TOTAL W/PROJ PM

Site Information

Jurisdiction/Date: 12/20/05
Highway: MAMALAHOA HWY (WEST)
From/To: WEST OF SEAMOUNTAIN

☐ Operational (LOS) ☐ Design (v_p) ☑ Planning (LOS) ☐ Planning (v_p)

Input Data

Shoulder width 6 ft
Lane width 12 ft
Lane width 12 ft
Shoulder width 6 ft
Segment length, L_t 2 mi

Show North Arrow

☑ Class I highway ☐ Class II highway
Terrain ☐ Level ☑ Rolling
Two-way hourly volume 575 veh/h
Higher directional split (%) 51
Peak-hour factor, PHF .95
% Trucks and buses, P_T 1 %
% Recreational vehicles, P_R 0 %
% No-passing zone 5 %
Access points/mi 5 /mi

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	.93
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	1.9
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	1.1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.991
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	657
v_p * highest directional split proportion[2] (pc/h)	335
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed
Field measured speed, S_{FM} ___ mi/h	Base free-flow speed, BFFS 55 mi/h
Observed volume, V_f ___ veh/h	Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5) 0 mi/h
Free-flow speed, FFS 53.8 mi/h $FFS = S_{FM} + 0.00776(\frac{V_f}{f_{HV}})$	Adj. for access points, f_A (Exhibit 20-6) 1.3 mi/h; Free-flow speed, FFS 53.8 mi/h; $FFS = BFFS - f_{LS} - f_A$
Adj. for no-passing zones, f_{np} (mi/h) (Exhibit 20-11)	.4
Average travel speed, ATS (mi/h) $ATS = FFS - 0.00776v_p - f_{np}$	48.3
Percent Time-Spent-Following	
Grade adjustment factor, f_G (Exhibit 20-8)	.94
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	1.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.995
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	647
v_p * highest directional split proportion[2] (pc/h)	330
Base percent time-spent-following, BPTSF (%) $BPTSF = 100(1 - e^{-0.000879v_p})$	43.4
Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) (Exhibit 20-12)	2.7
Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{d/np}$	46
Level of Service and Other Performance Measures	
Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	C
Volume to capacity ratio, v/c $v/c = \frac{v_p}{3,200}$	.205
Peak 15-min vehicle-miles of travel, VMT_{15} (veh-mi) $VMT_{15} = 0.25L_t(\frac{V}{PHF})$	303
Peak-hour vehicle-miles of travel, VMT_{60} (veh-mi) $VMT_{60} = V * L_t$	1150
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = \frac{VMT_{15}}{ATS}$	6.3

Notes

1. If $v_p \geq 3,200$ pc/h, terminate analysis—the LOS is F.
2. If highest directional split $v_p \geq 1,700$ pc/h, terminate analysis—the LOS is F.

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CHAPTER 20 - TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: EX AM 2005
Comment: 2005 EXISTING AM (EAST)

Site Information

Jurisdiction/Date: 12/1/05
Highway: MAMALAHOA HWY (EAST-WI
From/To: EAST OF SEAMOUNTAIN

☐ Operational (LOS) ☐ Design (v_p) ☑ Planning (LOS) ☐ Planning (v_p)

Input Data

Shoulder width 6 ft
Lane width 12 ft
Lane width 12 ft
Shoulder width 6 ft
Segment length, L_t 2 mi

Show North Arrow

☑ Class I highway ☐ Class II highway
Terrain ☐ Level ☑ Rolling
Two-way hourly volume 165 veh/h
Higher directional split (%) 58
Peak-hour factor, PHF .9
% Trucks and buses, P_T 1 %
% Recreational vehicles, P_R 0 %
% No-passing zone 5 %
Access points/mi 5 /mi

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	.71
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	2.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	1.1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.985
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	262
v_p * highest directional split proportion[2] (pc/h)	152
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed
Field measured speed, S_{FM} ____ mi/h	Base free-flow speed, BFFS 55 mi/h
Observed volume, V_f ____ veh/h	Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5) 0 mi/h
Free-flow speed, FFS 53.8 mi/h	Adj. for access points, f_A (Exhibit 20-6) 1.3 mi/h
$FFS = S_{FM} + 0.00776(\frac{V_f}{f_{HV}})$	Free-flow speed, FFS 53.8 mi/h
	$FFS = BFFS - f_{LS} - f_A$
Adj. for no-passing zones, f_{np} (mi/h) (Exhibit 20-11)	.2
Average travel speed, ATS (mi/h) $ATS = FFS - 0.00776v_p - f_{np}$	51.5

Percent Time-Spent-Following

Grade adjustment factor, f_G (Exhibit 20-8)	.77
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	1.8
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.992
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	240
v_p * highest directional split proportion[2] (pc/h)	139
Base percent time-spent-following, BPTSF (%) $BPTSF = 100(1 - e^{-0.000879v_p})$	19
Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) (Exhibit 20-12)	3.7
Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{d/np}$	22.7

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	B
Volume to capacity ratio, v/c $v/c = \frac{v_p}{3,200}$	.082
Peak 15-min vehicle-miles of travel, VMT_{15} (veh-mi) $VMT_{15} = 0.25L_t(\frac{V}{PHF})$	92
Peak-hour vehicle-miles of travel, VMT_{60} (veh-mi) $VMT_{60} = V * L_t$	330
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = \frac{VMT_{15}}{ATS}$	1.8

Notes

1. If $v_p \geq 3,200$ pc/h, terminate analysis—the LOS is F.
2. If highest directional split $v_p \geq 1,700$ pc/h, terminate analysis—the LOS is F.

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CHAPTER 20 - TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: AMB AM 2015
Comment: 2015 AMBIENT AM (EAST)

Site Information

Jurisdiction/Date: 12/1/05
Highway: MAMALAHOA HWY (EAST-WI
From/To: EAST OF SEAMOUNTAIN

☐ Operational (LOS) ☐ Design (v_p) ☑ Planning (LOS) ☐ Planning (v_p)

Input Data

Shoulder width 6 ft
Lane width 12 ft
Lane width 12 ft
Shoulder width 6 ft
Segment length, L_t 2 mi

Show North Arrow

☑ Class I highway ☐ Class II highway
Terrain ☐ Level ☑ Rolling
Two-way hourly volume 176 veh/h
Higher directional split (%) 57
Peak-hour factor, PHF .9
% Trucks and buses, P_T 1 %
% Recreational vehicles, P_R 0 %
% No-passing zone 5 %
Access points/mi 5 /mi

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	.71
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	2.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	1.1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.985
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	280
v_p * highest directional split proportion[2] (pc/h)	159
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed
Field measured speed, S_{FM} ____ mi/h	Base free-flow speed, BFFS 55 mi/h
Observed volume, V_f ____ veh/h	Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5) 0 mi/h
Free-flow speed, FFS 53.8 mi/h	Adj. for access points, f_A (Exhibit 20-6) 1.3 mi/h
$FFS = S_{FM} + 0.00776(\frac{V_f}{f_{HV}})$	Free-flow speed, FFS 53.8 mi/h
	$FFS = BFFS - f_{LS} - f_A$
Adj. for no-passing zones, f_{np} (mi/h) (Exhibit 20-11)	.3
Average travel speed, ATS (mi/h) $ATS = FFS - 0.00776v_p - f_{np}$	51.3

Percent Time-Spent-Following

Grade adjustment factor, f_G (Exhibit 20-8)	.77
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	1.8
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.992
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	256
v_p * highest directional split proportion[2] (pc/h)	146
Base percent time-spent-following, BPTSF (%) $BPTSF = 100(1 - e^{-0.000879v_p})$	20.2
Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) (Exhibit 20-12)	3.5
Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{d/np}$	23.7

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	B
Volume to capacity ratio, v/c $v/c = \frac{v_p}{3,200}$	.087
Peak 15-min vehicle-miles of travel, VMT_{15} (veh-mi) $VMT_{15} = 0.25L_t(\frac{V}{PHF})$	98
Peak-hour vehicle-miles of travel, VMT_{60} (veh-mi) $VMT_{60} = V * L_t$	352
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = \frac{VMT_{15}}{ATS}$	1.9

Notes

1. If $v_p \geq 3,200$ pc/h, terminate analysis—the LOS is F.
2. If highest directional split $v_p \geq 1,700$ pc/h, terminate analysis—the LOS is F.

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CHAPTER 20 - TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: TOT AM 2015
Comment: 2015 TOTAL W/PROJ AM (EAST)

Site Information

Jurisdiction/Date: 12/20/05
Highway: MAMALAHOA HWY (EAST)
From/To: EAST OF SEAMOUNTAIN

☐ Operational (LOS) ☐ Design (v_p) ☑ Planning (LOS) ☐ Planning (v_p)

Input Data

Shoulder width 6 ft
Lane width 12 ft
Lane width 12 ft
Shoulder width 6 ft
Segment length, L_t 2 mi

Show North Arrow

☑ Class I highway ☐ Class II highway
Terrain ☐ Level ☑ Rolling
Two-way hourly volume 505 veh/h
Higher directional split (%) 74
Peak-hour factor, PHF .9
% Trucks and buses, P_T 1 %
% Recreational vehicles, P_R 0 %
% No-passing zone 5 %
Access points/mi 5 /mi

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	.93
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	1.9
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	1.1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.991
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	609
v_p * highest directional split proportion[2] (pc/h)	450
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed
Field measured speed, S_{FM} ____ mi/h	Base free-flow speed, BFFS 55 mi/h
Observed volume, V_f ____ veh/h	Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5) 0 mi/h
Free-flow speed, FFS 53.8 mi/h	Adj. for access points, f_A (Exhibit 20-6) 1.3 mi/h
$FFS = S_{FM} + 0.00776(\frac{V_f}{f_{HV}})$	Free-flow speed, FFS 53.8 mi/h
	$FFS = BFFS - f_{LS} - f_A$
Adj. for no-passing zones, f_{np} (mi/h) (Exhibit 20-11)	.4
Average travel speed, ATS (mi/h) $ATS = FFS - 0.00776v_p - f_{np}$	48.6

Percent Time-Spent-Following

Grade adjustment factor, f_G (Exhibit 20-8)	.94
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	1.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.995
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	600
v_p * highest directional split proportion[2] (pc/h)	444
Base percent time-spent-following, BPTSF (%) $BPTSF = 100(1 - e^{-0.000879v_p})$	41
Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) (Exhibit 20-12)	3.1
Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{d/np}$	44.1

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	C
Volume to capacity ratio, v/c $v/c = \frac{v_p}{3{,}200}$	.19
Peak 15-min vehicle-miles of travel, VMT_{15} (veh-mi) $VMT_{15} = 0.25L_t(\frac{V}{PHF})$	281
Peak-hour vehicle-miles of travel, VMT_{60} (veh-mi) $VMT_{60} = V * L_t$	1010
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = \frac{VMT_{15}}{ATS}$	5.8

Notes

1. If $v_p \geq 3{,}200$ pc/h, terminate analysis—the LOS is F.
2. If highest directional split $v_p \geq 1{,}700$ pc/h, terminate analysis—the LOS is F.

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CHAPTER 20 - TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: EX PM 2005
Comment: 2005 EXISTING PM (EAST)

Site Information

Jurisdiction/Date: 12/1/05
Highway: MAMALAHOA HWY (EAST-WI
From/To: EAST OF SEAMOUNTAIN

☐ Operational (LOS) ☐ Design (v_p) ☑ Planning (LOS) ☐ Planning (v_p)

Input Data

Shoulder width 6 ft
Lane width 12 ft
Lane width 12 ft
Shoulder width 6 ft
Segment length, L_t 2 mi

Show North Arrow

☑ Class I highway ☐ Class II highway
Terrain ☐ Level ☑ Rolling
Two-way hourly volume 185 veh/h
Higher directional split (%) 57
Peak-hour factor, PHF .9
% Trucks and buses, P_T 1 %
% Recreational vehicles, P_R 0 %
% No-passing zone 5 %
Access points/mi 5 /mi

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	.71
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	2.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	1.1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.985
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	294
v_p * highest directional split proportion[2] (pc/h)	167
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed
Field measured speed, S_{FM} ____ mi/h	Base free-flow speed, BFFS 55 mi/h
Observed volume, V_f ____ veh/h	Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5) 0 mi/h
Free-flow speed, FFS 53.8 mi/h	Adj. for access points, f_A (Exhibit 20-6) 1.3 mi/h
$FFS = S_{FM} + 0.00776(\frac{V_f}{f_{HV}})$	Free-flow speed, FFS 53.8 mi/h
	$FFS = BFFS - f_{LS} - f_A$
Adj. for no-passing zones, f_{np} (mi/h) (Exhibit 20-11)	.3
Average travel speed, ATS (mi/h) $ATS = FFS - 0.00776v_p - f_{np}$	51.2

Percent Time-Spent-Following

Grade adjustment factor, f_G (Exhibit 20-8)	.77
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	1.8
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.992
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	269
v_p * highest directional split proportion[2] (pc/h)	153
Base percent time-spent-following, BPTSF (%) $BPTSF = 100(1 - e^{-0.000879v_p})$	21.1
Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) (Exhibit 20-12)	3.5
Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{d/np}$	24.6

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	B
Volume to capacity ratio, v/c $v/c = \frac{v_p}{3{,}200}$	.092
Peak 15-min vehicle-miles of travel, VMT_{15} (veh-mi) $VMT_{15} = 0.25L_t(\frac{V}{PHF})$	103
Peak-hour vehicle-miles of travel, VMT_{60} (veh-mi) $VMT_{60} = V * L_t$	370
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = \frac{VMT_{15}}{ATS}$	2

Notes

1. If $v_p \geq 3{,}200$ pc/h, terminate analysis—the LOS is F.
2. If highest directional split $v_p \geq 1{,}700$ pc/h, terminate analysis—the LOS is F.

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CHAPTER 20 - TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: AMB PM 2015
Comment: 2015 AMBIENT PM (EAST)

Site Information

Jurisdiction/Date: 12/1/05
Highway: MAMALAHOA HWY (EAST-WI
From/To: EAST OF SEAMOUNTAIN

☐ Operational (LOS) ☐ Design (v_p) ☑ Planning (LOS) ☐ Planning (v_p)

Input Data

Shoulder width 6 ft
Lane width 12 ft
Lane width 12 ft
Shoulder width 6 ft
Segment length, L_t 2 mi

Show North Arrow

☑ Class I highway ☐ Class II highway
Terrain ☐ Level ☑ Rolling
Two-way hourly volume 200 veh/h
Higher directional split (%) 55
Peak-hour factor, PHF .9
% Trucks and buses, P_T 1 %
% Recreational vehicles, P_R 0 %
% No-passing zone 5 %
Access points/mi 5 /mi

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	.71
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	2.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	1.1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.985
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	318
v_p * highest directional split proportion[2] (pc/h)	175
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed
Field measured speed, S_{FM} ___ mi/h Observed volume, V_f ___ veh/h Free-flow speed, FFS 53.8 mi/h $FFS = S_{FM} + 0.00776(\frac{V_f}{f_{HV}})$	Base free-flow speed, BFFS 55 mi/h Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5) 0 mi/h Adj. for access points, f_A (Exhibit 20-6) 1.3 mi/h Free-flow speed, FFS 53.8 mi/h $FFS = BFFS - f_{LS} - f_A$
Adj. for no-passing zones, f_{np} (mi/h) (Exhibit 20-11)	.3
Average travel speed, ATS (mi/h) $ATS = FFS - 0.00776v_p - f_{np}$	51

Percent Time-Spent-Following

Grade adjustment factor, f_G (Exhibit 20-8)	.77
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	1.8
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.992
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	291
v_p * highest directional split proportion[2] (pc/h)	160
Base percent time-spent-following, BPTSF (%) $BPTSF = 100(1 - e^{-0.000879v_p})$	22.6
Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) (Exhibit 20-12)	3.3
Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{d/np}$	25.8

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	B
Volume to capacity ratio, v/c $v/c = \frac{v_p}{3,200}$	.099
Peak 15-min vehicle-miles of travel, VMT_{15} (veh-mi) $VMT_{15} = 0.25L_t(\frac{V}{PHF})$	111
Peak-hour vehicle-miles of travel, VMT_{60} (veh-mi) $VMT_{60} = V * L_t$	400
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = \frac{VMT_{15}}{ATS}$	2.2

Notes

1. If $v_p \geq 3,200$ pc/h, terminate analysis—the LOS is F.
2. If highest directional split $v_p \geq 1,700$ pc/h, terminate analysis—the LOS is F.

CHAPTER 20 - TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: TOT PM 2015
Comment: 2015 TOTAL W/PROJ PM (EAST)

Site Information

Jurisdiction/Date: 12/20/05
Highway: MAMALAHOA HWY (EAST)
From/To: EAST OF SEAMOUNTAIN

☐ Operational (LOS) ☐ Design (v_p) ☑ Planning (LOS) ☐ Planning (v_p)

Input Data

Shoulder width 6 ft
Lane width 12 ft
Lane width 12 ft
Shoulder width 6 ft
Segment length, L_t 2 mi

Show North Arrow

☑ Class I highway ☐ Class II highway
Terrain ☐ Level ☑ Rolling
Two-way hourly volume 620 veh/h
Higher directional split (%) 56
Peak-hour factor, PHF .9
% Trucks and buses, P_T 1 %
% Recreational vehicles, P_R 0 %
% No-passing zone 5 %
Access points/mi 5 /mi

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	.93
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	1.9
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	1.1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.991
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	747
v_p * highest directional split proportion[2] (pc/h)	419
Free-Flow Speed from Field Measurement	Estimated Free-Flow Speed
Field measured speed, S_{FM} ___ mi/h Observed volume, V_f ___ veh/h Free-flow speed, FFS 53.8 mi/h $FFS = S_{FM} + 0.00776(\frac{V_f}{f_{HV}})$	Base free-flow speed, BFFS 55 mi/h Adj. for lane width and shoulder width, f_{LS} (Exhibit 20-5) 0 mi/h Adj. for access points, f_A (Exhibit 20-6) 1.3 mi/h Free-flow speed, FFS 53.8 mi/h $FFS = BFFS - f_{LS} - f_A$
Adj. for no-passing zones, f_{np} (mi/h) (Exhibit 20-11)	.4
Average travel speed, ATS (mi/h) $ATS = FFS - 0.00776v_p - f_{np}$	47.6

Percent Time-Spent-Following

Grade adjustment factor, f_G (Exhibit 20-8)	.94
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	1.5
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	1
Heavy-vehicle adjustment factor, f_{HV} $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$	.995
Two-way flow rate,[1] v_p (pc/h) $v_p = \frac{V}{PHF * f_G * f_{HV}}$	737
v_p * highest directional split proportion[2] (pc/h)	412
Base percent time-spent-following, BPTSF (%) $BPTSF = 100(1 - e^{-0.000879v_p})$	47.7
Adj. for directional distribution and no-passing zone, $f_{d/np}$ (%) (Exhibit 20-12)	2.3
Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{d/np}$	50

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	C
Volume to capacity ratio, v/c $v/c = \frac{v_p}{3,200}$	.234
Peak 15-min vehicle-miles of travel, VMT_{15} (veh-mi) $VMT_{15} = 0.25L_t(\frac{V}{PHF})$	344
Peak-hour vehicle-miles of travel, VMT_{60} (veh-mi) $VMT_{60} = V * L_t$	1240
Peak 15-min total travel time, TT_{15} (veh-h) $TT_{15} = \frac{VMT_{15}}{ATS}$	7.2

Notes

1. If $v_p \geq 3,200$ pc/h, terminate analysis—the LOS is F.
2. If highest directional split $v_p \geq 1,700$ pc/h, terminate analysis—the LOS is F.

Appendix C

Unsignalized Intersection Level of Service (LOS) Calculations

CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: EX AM 2005
Comment: 2005 EXISTING AM

Site Information

Jurisdiction/Date: 11/13/05
Major Street: MAMALAHOA HIGHWAY
Minor Street: NINOLE LOOP RD (WEST)

Input Data

Lane Configuration	EB			WB			NB			SB		
Lane 1 (curb)	R			R			R			R		
Lane 2	T			T			LT			LT		
Lane 3	L			L								
	EB			WB			NB			SB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)		105	15	2	60		2		4			
PHF	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9
Proportion of heavy vehicles, HV	3	3	3	3	3	3	3	3	3	3	3	3
Flow rate		117	17	2	67		2		4			
Flare storage (# of vehs)									0			0
Median storage (# of vehs)							0			0		

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft
Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
NB	1	R	4	933	.004	<1	8.9	A	9.1
	2	LT	2	770	.003	<1	9.7	A	
	3								A
SB	1	R				<1			
	2	LT				<1			
	3								
		①							
		④	2	1466	.002	<1	7.5	A	

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: AMB AM 2015
Comment: 2015 AMBIENT AM

Site Information

Jurisdiction/Date: 11/13/05
Major Street: MAMALAHOA HIGHWAY
Minor Street: NINOLE LOOP RD (WEST)

Input Data

Lane Configuration	EB			WB			NB			SB		
Lane 1 (curb)	R			R			R			R		
Lane 2	T			T			LT			LT		
Lane 3	L			L								
	EB			WB			NB			SB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)		115	15	2	65		2		4			
PHF	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9
Proportion of heavy vehicles, HV	3	3	3	3	3	3	3	3	3	3	3	3
Flow rate	0	128	17	2	72	0	2	0	4	0	0	0
Flare storage (# of vehs)									0			0
Median storage (# of vehs)							0			0		

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft
Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
NB	1	R	4	920	.004	<1	8.9	A	9.2
	2	LT	2	750	.003	<1	9.8	A	
	3								A
SB	1	R				<1			
	2	LT				<1			
	3								
		①	0						
		④	2	1452	.002	<1	7.5	A	

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst	WY
Agency or Company	M&E PAC
Analysis Period/Year	TOT AM 2015
Comment	2015 TOTAL W/PROJ AM

Site Information

Jurisdiction/Date	2/11/06
Major Street	MAMALAHOA HIGHWAY
Minor Street	NINOLE LOOP RD (WEST)

Input Data

Lane Configuration	EB			WB			NB			SB		
Lane 1 (curb)	R			R			R			R		
Lane 2	T			T			LT			LT		
Lane 3	L			L								
	EB			WB			NB			SB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	35	120	140	35	65	10	55	10	155	70	25	10
PHF	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9
Proportion of heavy vehicles, HV	3	3	3	3	3	3	3	3	3	3	3	3
Flow rate	39	133	156	39	72	11	61	11	172	78	28	11
Flare storage (# of vehs)									0			0
Median storage (# of vehs)							0			0		

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft

Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
NB	1	R	172	913	.188	1	9.9	A	10.8
	2	LT	72	527	.137	<1	12.9	B	
	3								B
SB	1	R	11	987	.011	<1	8.7	A	15.4
	2	LT	106	429	.247	1	16.1	C	
	3								C
		1	39	1521	.026	<1	7.4	A	
		4	39	1445	.027	<1	7.6	A	

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst	WY
Agency or Company	M&E PAC
Analysis Period/Year	EX PM 2005
Comment	2005 EXISTING PM

Site Information

Jurisdiction/Date	11/13/05
Major Street	MAMALAHOA HIGHWAY
Minor Street	NINOLE LOOP RD (WEST)

Input Data

Lane Configuration	EB			WB			NB			SB		
Lane 1 (curb)	R			R			R			R		
Lane 2	T			T			LT			LT		
Lane 3	L			L								
	EB			WB			NB			SB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	0	80	10	15	95		15		4			
PHF	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9
Proportion of heavy vehicles, HV	3	3	3	3	3	3	3	3	3	3	3	3
Flow rate	0	89	11	17	106	0	17	0	4	0	0	0
Flare storage (# of vehs)									0			0
Median storage (# of vehs)							0			0		

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft

Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
NB	1	R	4	966	.004	<1	8.7	A	9.9
	2	LT	17	719	.024	<1	10.1	B	
	3								A
SB	1	R				<1			
	2	LT				<1			
	3								
		1	0						
		4	17	1500	.011	<1	7.4	A	

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: AMB PM 2015
Comment: 2015 AMBIENT PM

Site Information

Jurisdiction/Date: 11/13/05
Major Street: MAMALAHOA HIGHWAY
Minor Street: NINOLE LOOP RD (WEST)

Input Data

Lane Configuration	EB			WB			NB			SB		
Lane 1 (curb)	R			R			R			R		
Lane 2	T			T			LT			LT		
Lane 3	L			L								
	EB			WB			NB			SB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)		85	15	15	105		15		4			
PHF	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9
Proportion of heavy vehicles, HV	3	3	3	3	3	3	3	3	3	3	3	3
Flow rate		94	17	17	117		17		4			
Flare storage (# of vehs)									0			0
Median storage (# of vehs)							0			0		

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft
Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
NB	1	R	4	960	.004	<1	8.8	A	10
	2	LT	17	701	.024	<1	10.3	B	
	3								A
SB	1	R				<1			
	2	LT				<1			
	3								
		①							
		④	17	1493	.011	<1	7.4	A	

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: TOT PM 2015
Comment: 2015 TOTAL W/PROJ PM

Site Information

Jurisdiction/Date: 2/11/06
Major Street: MAMALAHOA HIGHWAY
Minor Street: NINOLE LOOP RD (WEST)

Input Data

Lane Configuration	EB			WB			NB			SB		
Lane 1 (curb)	R			R			R			R		
Lane 2	T			T			LT			LT		
Lane 3	L			L								
	EB			WB			NB			SB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	20	95	170	150	105	40	160	40	100	25	30	25
PHF	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9
Proportion of heavy vehicles, HV	3	3	3	3	3	3	3	3	3	3	3	3
Flow rate	22	106	189	167	117	44	178	44	111	28	33	28
Flare storage (# of vehs)									0			0
Median storage (# of vehs)							0			0		

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft
Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
NB	1	R	111	946	.117	<1	9.3	A	27.9
	2	LT	222	324	.685	5	37.1	E	
	3								D
SB	1	R	28	933	.03	<1	9	A	16.6
	2	LT	61	299	.204	1	20.1	C	
	3								C
		①	22	1466	.015	<1	7.5	A	
		④	167	1479	.113	<1	7.7	A	

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: EX AM 2005
Comment: 2005 EXISTING AM

Site Information

Jurisdiction/Date: 11/13/05
Major Street: MAMALAHOA HWY
Minor Street: NINOLE LOOP RD (EAST)

Input Data

Lane Configuration	EB	WB	NB	SB
Lane 1 (curb)	LTR	LTR	LTR	LTR
Lane 2				
Lane 3				

	EB			WB			NB			SB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	0	90	1	3	65				5			
PHF	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9
Proportion of heavy vehicles, HV	3	3	3	3	3	3	3	3	3	3	3	3
Flow rate	0	100	1	3	72	0	0	0	6	0	0	0
Flare storage (# of vehs)									0			0
Median storage (# of vehs)							0			0		

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft
Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
NB	1	LTR	6	952	.006	<1	8.8	A	8.8
	2								
	3								A
SB	1	LTR				<1			
	2								
	3								
		①	0						
		④	3	1485	.002	<1	7.4	A	

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: AMB AM 2015
Comment: 2015 AMBIENT AM

Site Information

Jurisdiction/Date: 11/13/05
Major Street: MAMALAHOA HWY
Minor Street: NINOLE LOOP RD (EAST)

Input Data

Lane Configuration	EB	WB	NB	SB
Lane 1 (curb)	LTR	LTR	LTR	LTR
Lane 2				
Lane 3				

	EB			WB			NB			SB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)		95	1	3	70				5			
PHF	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9
Proportion of heavy vehicles, HV	3	3	3	3	3	3	3	3	3	3	3	3
Flow rate		106	1	3	78				6			
Flare storage (# of vehs)									0			0
Median storage (# of vehs)							0			0		

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft
Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
NB	1	LTR	6	945	.006	<1	8.8	A	8.8
	2								
	3								A
SB	1	LTR				<1			
	2								
	3								
		①							
		④	3	1478	.002	<1	7.4	A	

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: TOT AM 2015
Comment: 2015 TOTAL W/PROJ AM

Site Information

Jurisdiction/Date: 2/11/06
Major Street: MAMALAHOA HWY
Minor Street: NINOLE LOOP RD (EAST)

Input Data

Lane Configuration	EB			WB			NB			SB		
Lane 1 (curb)	LTR			LTR			LTR					
Lane 2												
Lane 3												
	EB			WB			NB			SB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	0	320	10	15	120				60			
PHF	.9	.9	.9	.9	.9	.9	.9	.9	.9			
Proportion of heavy vehicles, HV	3	3	3	3	3	3	3	3	3			
Flow rate	0	356	11	17	133	0	0	0	67			
Flare storage (# of vehs)									0			
Median storage (# of vehs)							0					

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft

Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
NB	1	LTR	67	681	.098	<1	10.9	B	10.9
	2								
	3								B
SB	1								
	2								
	3								
		1	0	1445	0	<1	7.5	A	
		4	17	1186	.014	<1	8.1	A	

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: EX PM 2005
Comment: 2005 EXISTING PM

Site Information

Jurisdiction/Date: 11/13/05
Major Street: MAMALAHOA HWY
Minor Street: NINOLE LOOP RD (EAST)

Input Data

Lane Configuration	EB			WB			NB			SB		
Lane 1 (curb)	LTR			LTR			LTR			LTR		
Lane 2												
Lane 3												
	EB			WB			NB			SB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	0	70	2	15	90		3		10			
PHF	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9
Proportion of heavy vehicles, HV	3	3	3	3	3	3	3	3	3	3	3	3
Flow rate	0	78	2	17	100		3		11			
Flare storage (# of vehs)									0			0
Median storage (# of vehs)							0			0		

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft

Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
NB	1	LTR	14	914	.015	<1	9	A	9
	2								
	3								A
SB	1	LTR				<1			
	2								
	3								
		1	0	1486	0	<1	7.4	A	
		4	17	1512	.011	<1	7.4	A	

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: AMB PM 2015
Comment: 2015 AMBIENT PM

Site Information

Jurisdiction/Date: 11/13/05
Major Street: MAMALAHOA HWY
Minor Street: NINOLE LOOP RD (EAST)

Input Data

Lane Configuration	EB			WB			NB			SB		
Lane 1 (curb)	LTR			LTR			LTR			LTR		
Lane 2												
Lane 3												
	EB			WB			NB			SB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	0	75	2	15	95		3		10			
PHF	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9
Proportion of heavy vehicles, HV	3	3	3	3	3	3	3	3	3	3	3	3
Flow rate	0	83	2	17	106		3		11			
Flare storage (# of vehs)									0			0
Median storage (# of vehs)							0			0		

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft
Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
NB	1	LTR	14	905	.015	<1	9	A	9
	2								
	3								A
SB	1	LTR				<1			
	2								
	3								
		1	0	1479	0	<1	7.4	A	
		4	17	1505	.011	<1	7.4	A	

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst: WY
Agency or Company: M&E PAC
Analysis Period/Year: TOT PM 2015
Comment: 2015 TOTAL W/PROJ PM

Site Information

Jurisdiction/Date: 2/11/06
Major Street: MAMALAHOA HWY
Minor Street: NINOLE LOOP RD (EAST)

Input Data

Lane Configuration	EB			WB			NB			SB		
Lane 1 (curb)	LTR			LTR			LTR					
Lane 2												
Lane 3												
	EB			WB			NB			SB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	0	200	10	80	270	0	6		75			
PHF	.9	.9	.9	.9	.9	.9	.9	.9	.9			
Proportion of heavy vehicles, HV	3	3	3	3	3	3	3	3	3			
Flow rate	0	222	11	89	300	0	7		83			
Flare storage (# of vehs)									0			
Median storage (# of vehs)							0					

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft
Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
NB	1	LTR	90	726	.124	<1	10.7	B	10.7
	2								
	3								B
SB	1								
	2								
	3								
		1	0	1255	0	<1	7.9	A	
		4	89	1328	.067	<1	7.9	A	

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Appendix L

Analysis of Punalu‘u Beach Carrying Capacity
(Group 70 International, Inc. Feb. 2006)

1. CONCEPT OF CARRYING CAPACITY

1.1 Definitions

Sustainable development: An approach to development that values existing natural resources and seeks to plan growth as well as leave these resources unchanged for future generations.

Sustainable development of tourism: An approach to tourism that uses natural and cultural resources to increase the number of visitors and the profit from tourist activities but preserve the resources for future generations (UNEP/MAP/PAP, 1999).

Carrying capacity: The World Tourism Organization defines carrying capacity as, "the maximum number of people that may visit the tourist destination without causing destruction of the physical, economic and socio-cultural environment and an unacceptable decrease in the quality of visitor's satisfaction" (UNEP/MAP/PAP, 1999).

1.2 Traditional "Scientific" Approach

The traditional approach to carrying capacity takes into account only the physical constraints of a space, in other words, how many persons fit within a defined space at any given time.

Traditional carrying capacity philosophy teaches that by limiting the number of persons that can use a site at any given time it can help to prevent overcrowding which can lead to deterioration of site resources, and hinder user's ability to move freely and fully enjoy the natural setting (Florida Div. of Parks and Rec.).

One traditional method for limiting carrying capacity is to limit the capacity/size of infrastructure that supports the recreational facility. This includes the number of parking spaces, size of the restrooms, and other supporting features.

To calculate the carrying capacity of a beach, area requirements for optimum carrying capacity are chosen, and a number is arrived at. Beach facilities are then appropriately sized around this number so as to limit the number of users.

Example:
Usable beach area is the first step to the calculation. The beach area at Punalu‘u is somewhat difficult to pinpoint since the sand areas are often infiltrated with lava outcroppings, some porous and some jagged. We will assume that Punalu‘u beach is approximately 80,000 square feet (see attached map for outline of beach area used for this calculation). Our second assumption will be that beaches can accommodate one beach user/swimmer per 500 square foot of beach space (see ** note). Turnover rate, or the rate at which people come and go at the beach, varies from destination to destination. At locations where people sunbathe, people come prepared to stretch out on a beach towel and visits tend to be several hours. Sunbathing locations would have a typical turnover rate of 2 persons per day. At locations such as Punalu‘u where tour bus traffic is popular and people tend to spend 15-30 minutes walking to different locations to sightsee prior to departing on the bus, a more accurate turnover rate of 4

persons per space per day would be appropriate (see *** note). Based on the above assumptions, a maximum carrying capacity for the Punalu'u beach of 640 persons per day was calculated.

Square Feet of Beach*:	80,000
Area Requirements**:	÷ 500 (500 sf of beach per person)
	160 persons
Turnover factor:	x 4 (4 persons per day turnover rate)
Total Carrying Capacity	640 persons per day

* Area is approximate. See attached map Exhibit 1 for what is defined as recreational beach area.

** Based on Optimum Carrying Capacity for Water-Based Outdoor Recreation Activities Standard of 200-500 sf of beach per swimmer (Florida Division of Parks and Recreation)

*** Based on tourist habits, most stay for short durations to explore coast on foot, rather than sunbathe for hours

The above analysis would also indicate what level of crowdedness would occur at the beach at maximum carrying capacity. If 160 persons use 80,000 square feet of beach at any given time, each person would be allotted 500 square feet of space (80,000 sf/160 persons), meaning each visitor is spaced approximately 22 feet from the next visitor (square root 500 sf).

1.3 Problems with Traditional Approach

Traditional carrying capacity analysis is straightforward. However, this method uses many assumptions and simplifies the issue. There are many factors that are integral to understanding carrying capacity that a numeric equation may not account for. The following list explores some of the other dimensions for assessment.

<u>Environmental</u>
How many visitors can the beach accommodate while sustaining the site's unique natural resources?

<u>Social</u>
Resident perceptions: How many visitors are socially acceptable to the host community? When is the beach considered crowded?

Tourist perceptions: Is this destination perceived as crowded or open? Is it a desirable tourist destination?

Other recreational options: Are there other recreational options for residents and tourists to participate in to off-set impacts to the beach area?

<u>Economic</u>
Assesses economic cost to the supplier. Is operation of the beach area efficient? What are maintenance costs?

Physical

What are the physical size limitations of the space? What is the number of people per day or per square foot the beach can accommodate? What size is the supporting infrastructure? Where are access points? How many parking spaces are provided? Da Silva's article in the Journal of Coastal Research actually suggests that perceived carrying capacity has more to do with how easily accessible the space is and how much parking is provided than the actual number of persons in the beach area (da Silva, JCR, 2002).

1.4 Our Approach/Methodology

When development is proposed, different stakeholders in the community often have conflicting or competing interests. Given the fact that the reality of politics demands tradeoffs, our approach will seek to balance development planned for by existing land use designations and preservation efforts in order to secure a sustainable use pattern for the black sand beach.

Although the traditional analysis calculated for Punalu'u above provides a helpful equation for comparison, we would like to move beyond this by asking the questions, how much change to existing beach use patterns is acceptable for both residents and visitors? How do environmental, social, economic and physical factors influence this outcome?

2. ANALYSIS OF PUNALU'U BEACH CARRYING CAPACITY

The following section will evaluate carrying capacity for the Punalu'u black sand beach in light of environmental, social, economic and physical factors. Part of the research for this analysis was conducted through an informal Beach Carrying Capacity surveys completed by local residents.

2.1 Environmental

To evaluate environmental factors, we ask the question, how many visitors can the beach accommodate while sustaining the site's unique natural resources? Unique natural resources at this location include the attraction of the black sand, the Hawksbill turtles, and the coastal resources (fish, limu, seaweed) gathered by local people.

Black Sand Beach

The primary concern with the black sand beach is erosion. Locals have said that the beach seems to be retreating toward the pond area. Erosion is a naturally occurring process on the beach, but it can be augmented by human factors. Uneducated visitors could take sand samples home as souvenirs, track sand out in their shoes, or, large volumes of visitors would inevitably cause disturbance to sandy areas due to over use. Visitor impacts can be curbed through educational programs on erosion and provision of wooden walkways for viewing the beach without walking on it.

Curbing the effects of natural beach erosion is more difficult. Beach nourishment is one way of addressing both the natural effects of erosion, and the effects of visitor traffic. Beach nourishment is a widely practiced way of slowing or stopping the erosion process. Beach nourishment consists of importing manufactured sand to match the color and consistency of the natural sand, and adding back to areas of the beach that are diminishing. At a microscopic level the sand at Punalu'u is roundly polished and finding the appropriate sand source may be difficult. Appropriate sources may exist in off shore sand cells.

Erosion-slowing vegetation could also be planted on the beach area, however, this would require further evaluation to determine appropriate planting locations, materials and measures.

Hawksbill Turtles

Increased beach use would likely result in increased visitor curiosity and proximity to the turtles and their habitat. To prevent visitors from approaching turtles, touching them or playing with them, educational programs on turtles, educational signage about turtles, and designated turtle viewing areas can be provided for visitors. In the future project security personnel and local residents can function as rangers to protect these animals.

Coastal Resources

Punalu'u is a place where locals fish, pick opihi and gather limu along the coastal areas. Unaware visitors may inadvertently trample resources or interfere with fishing and gathering practices. To prevent impact to coastal resources, visitors should be educated about these resources and how to avoid impacting them.

Environmental mitigation measures: Visitor education programs on erosion, wooden walkways for viewing beach, beach nourishment, erosion-slowing plants, educational programs on turtles, educational signage about turtles, and designated turtle viewing areas, educational program on delicate coastal resources

2.2 Social

Resident perceptions:
To evaluate resident perceptions, we ask the questions, how many visitors are socially acceptable to the host community? When does the host community consider the beach crowded? To obtain this information, a limited survey was conducted regarding their perceptions of the beach area. Unfortunately, only five beach carrying capacity surveys were completed for use in this study. However, the results are nevertheless telling concerning the resident perceptions of the beach. A more comprehensive survey may be needed in the future.

The questionnaires produced a range of results as illustrated below.

Question: How would you characterize the crowdedness or emptiness of the beach area given the choices of empty, less empty, moderate, somewhat full, and full?

Answer: four persons answered moderate, and one person answered moderate to somewhat full.

Question: How many persons on average would you guess actively use the beach for sunbathing or swimming at any given time in the afternoon?
Answer: Answers ranged from 20 – 150 with an average of 54.

Question: How many people would the beach be able to physically accommodate at any given time?
Answer: Answers ranged from 50 – 300 with an average of 140.

Question: When would you consider the beach crowded? With the addition of how many more people?
Answer: Answers ranged from 50 – 750 with an average of 250.

Question: How many additional visitors to the beach are acceptable?
Answer: Range from 50 – 200 with an average of 125 (three surveys did not specify a number)

Question: How many additional visitors to the beach are acceptable in light of local economic growth spurred by tourism?
Answer: Range from 50 – 300 with an average of 183 (two surveys did not specify a number)

Question: How far away should another beach user be in order to not feel crowded on the beach?
Answer: Answers ranged from 10 – 30 with an average of 17.5 (one survey did not specify a distance)

It is clear from the range of answers above that carrying capacity is a subjective issue in which people's opinions can differ greatly. There are also some commonalities in the answers. Most agreed that the beach area is moderately crowded and that other beach users should be between 10 and 30 feet away.

Those that responded felt that an average of 183 additional visitors to the beach would be acceptable in light of local economic growth spurred by tourism.
Although residents have expressed that the beach can accommodate a certain amount of additional visitors, residents also expressed their concern about the following issues: access for local people, marine life, erosion, continued access for local fisherman, enforcement of warning signs, and tour bus traffic.

The questionnaire also requested ideas on how these concerns could be addressed at the beach area. A variety of recommendations were noted, including: clear signage indicating the location of natural and historic resources and trails, enforcement of warning signs to protect swimmers from rough currents, buffers to separate visitors from sensitive resources, and raised walkways to help direct desired traffic patterns. These measures are included as mitigation in section C below.

Tourist perceptions: Evaluation of tourist perceptions is challenging, as this is also subjective depending on the expectations of the individual tourist. There are essentially two genres of tourists that will visit the project site, those that visit the site on vacation and stay in the resort

or in their vacation rental or home, and those that arrive via tour bus and stop by for a short duration of time to see the black sand beach and the turtles. We will speculate if the beach area is perceived as crowded or open and if it is perceived as a desirable tourist destination?

Vacationers in Residence: A majority of the vacationers in residence may not have prior experience at the beach and may perceive existing levels of crowding as typical. Many "mainland" type vacationers also may not perceive the black sand beach as a desirable area to sunbathe and swim. They are likely to be accustomed to and expecting gentle white sand beaches with clear water. The rough rocky shoreline may discourage many vacationers from swimming and they may seek alternative recreational areas for swimming and sunbathing.

Tour Bus Tourists: Resident surveys indicate that approximately 8-10 tour busses visit the black sand beach each day. Tourists from the buses engage in activities on the beach such as taking pictures, touching the water, looking at turtles, using the restroom at beach park, and minimal sunbathing and swimming. Concerns regarding tour bus traffic include disturbance of turtles and tracking of black sand away from the beach through shoes and blankets. Suggestions for improving tour bus tourist patterns included designated bus parking areas away from the beach, raised walkways to direct foot traffic, education of bus drivers concerning the area, educational brochures, enforcement of warning signs regarding the rough ocean current and turtles.

Other Recreational Options: A mitigating factor for the introduction of additional residents in one locality seeking recreational resources is to provide these new residents with additional recreation options than the existing black sand beach. New residents in the Sea Mountain development would have opportunities to use the resort and/or residential pool and deck areas for sunbathing and swimming. There will also be hiking/walking/biking trails, a renovated beach park, and possibly a new restored recreational area around Ninole Cove. These other recreational options for residents and tourists to participate in are expected to off-set impacts to the beach area. The boat landing area might also be injured to provide a picnic area available to the public. Additionally, many "mainland" visitors are expected to choose recreational options other than the black sand beach.

Social mitigation measures: Signage indicating the location of natural and historic resources and trails, buffers to separate visitors from sensitive resources, raised walkways to help direct desired traffic patterns, designated bus parking areas away from the beach, education of bus drivers concerning the area, educational brochures, enforcement of warning signs regarding the rough ocean current and turtles, provide a variety of recreational options for residents in addition to the black sand beach area (pools, walking, hiking and biking trails, picnic areas)

2.3 Economic

An economic assessment evaluates the economic cost to the supplier, the tourist efficiency compared to unit costs and maintenance costs. Economic costs will include beach park maintenance, landscaping upkeep, solid waste removal, facility upkeep (buildings, trails, signage etc.), and possibly beach nourishment. It is too early in the planning process for the project to know the cost details for many of these economic issues. This will need to be an item of future evaluation.

Economic mitigation measures: None.

2.4 Physical

Da Silva's article in the Journal of Coastal Research actually suggests that perceived carrying capacity has more to do with how easily accessible the space is and how much parking is provided than the actual number of persons in the beach area (da Silva, JCR, 2002).

To determine the physical impacts we must examine physical constraints. What are the physical size limitations of the space? What size is the supporting infrastructure? Where are access points? How many parking spaces are provided?

Again, many of the details regarding future facilities are not available due to the early stage of the planning process. However, it is not the intention of the developer to limit access to the area by limiting access and parking to the beach area. Current plans (subject to change) indicate that the beach area will be accessible from two locations, a parking lot at the beach park and a parking lot behind the old restaurant area. It is possible that the existing parking area where tour busses park will be eliminated and busses will be asked to park further away and tourists walk to the beach on designated pathways in order to protect the beach from further erosion impacts. Proposed facilities will inevitably provide more access and parking for locals and tourists than is currently available. A new parking and recreational area is also proposed around a restored Ninole Cove and will increase beach resources available to the public.

Physical mitigation measures: Boardwalks, improved beach areas, and restoration of Ninole Cove.

3. MITIGATION OPTIONS

The following mitigation measures are recommended to reduce total impact per visitor on the Punalu'u black sand beach.

Environmental mitigation measures:

1. Visitor education programs on erosion,
2. Wooden walkways for viewing beach,
3. Beach nourishment,
4. Erosion-slowing plants,
5. Educational programs on turtles,
6. Educational signage about turtles,
7. Designated turtle viewing areas,
8. Educational program on delicate coastal resources

Social mitigation measures:

1. Signage indicating the location of natural and historic resources and trails,
2. Buffers to separate visitors from sensitive resources,
3. Raised walkways to help direct desired traffic patterns,
4. Designated bus parking areas away from the beach,
5. Education of bus drivers concerning the area,
6. Educational brochures,

7. Enforcement of warning signs regarding the rough ocean current and turtles,
8. Provide a variety of recreational options for residents in addition to the black sand beach area (pools, walking, hiking and biking trails, picnic areas)

Economic mitigation measures: None.

Physical mitigation measures:
1. Construction of raised walkways.
2. Restoration of Ninole Cove.
3. New improved park area

4. CONCLUSIONS

The desire of the Sea Mountain development is to balance what the residents and tourists want. Unanimously, people want access and parking and the ability to enjoy this amazing natural resource along with protection of sensitive resources that make this place special.

The approach of this development is to focus on desired beach conditions, not numbers. Rather than just reducing the number of visitors, through implementation of educational programs and signage we intend to create "smart" visitors and reduce the impact per visitor.

Through the mitigation measures listed above we intend to meet the needs of residents and visitors and involve everyone in the protection and perpetuation of resources at the Punalu'u black sand beach.

5. SOURCES

da Silva, Carlos Pereira. "Beach Carrying Capacity Assessment: How Important Is It?" *Journal of Coastal Research SI 36,* 2002.

Florida State Department of Environmental Protection, Division of Recreation and Parks. *Visitor Carrying Capacity Guidelines.*

Trousdale, William. Carrying Capacity Considerations: The Need for Managing Change in a Unique Tourism Destination, Borcay Island, Philippines. Ecoplan International, Inc., November 1997.

UNEP, Mediterranean Action Plan, Priority Actions Programme. Carrying Capacity Assessment for Tourism Development, June 1999.

Beach Carrying Capacity Surveys completed by members of the Environmental and Economic Committee on XXX, XX 2006.

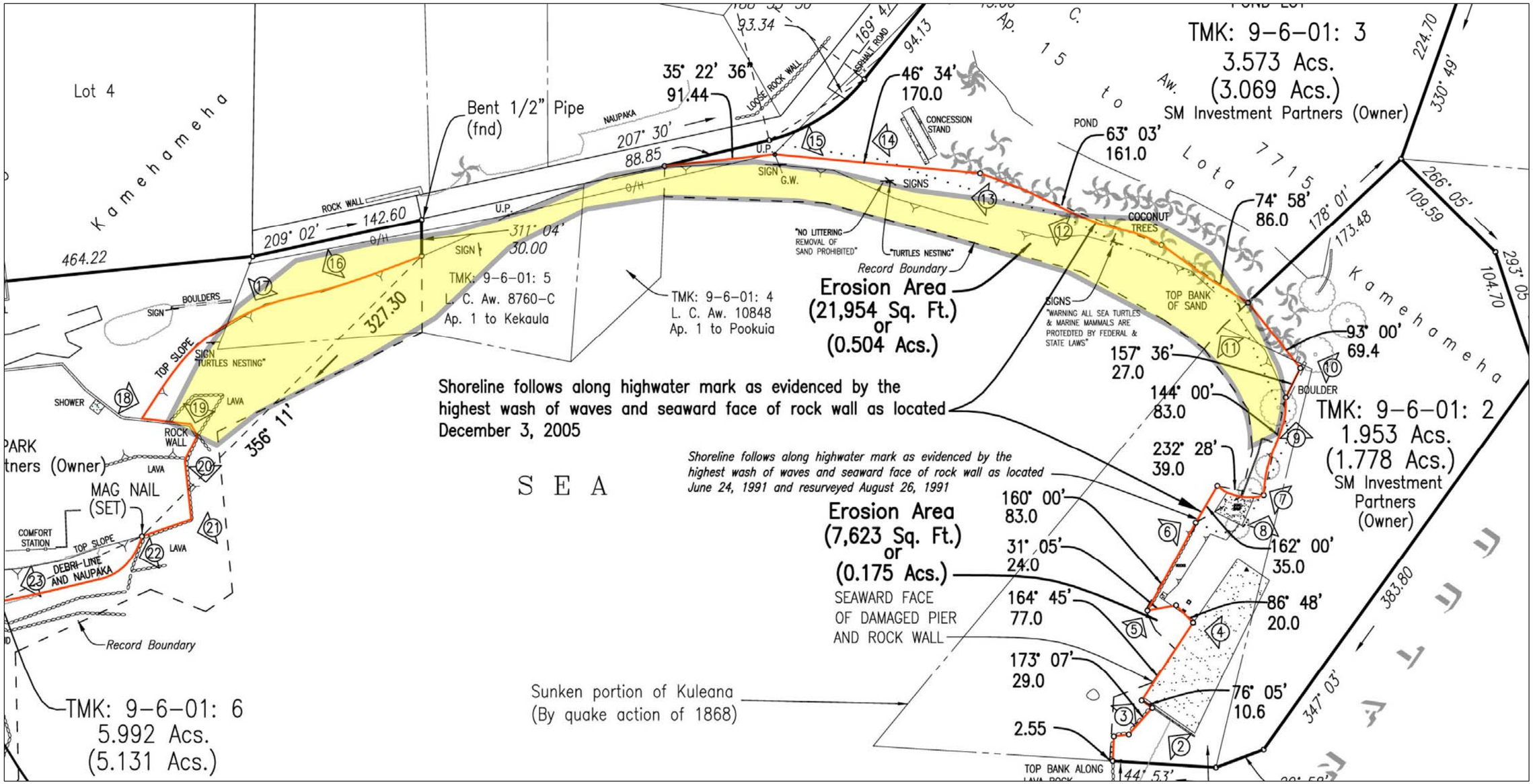

Exhibit 1: Recreational Beach Area Map

Appendix M

Sea Mountain at Punalu‘u Solid Waste Plan
(Group 70 International, Inc., June 2006)

Plan:
Project-generated solid wastes will be collected at a central location on site and disposed of at approved County solid waste disposal facilities. Recycling of solid wastes and minor hazardous materials will be accommodated and implemented to the extent practicable. Green wastes generated by golf course and landscape maintenance will be composted at appropriate green waste facilities. Solid waste systems will be designed to comply with the applicable DOH and County requirements. Solid waste from multifamily, commercial and institutional uses will be handled by private solid waste hauling contractors.

Solid Waste Stream:
The solid waste stream expected to be generated includes waste from construction and from operation of the proposed project. Pre-construction waste will be generated from demolition of existing structures and from site clearing. Approximately 4,204 tons of solid waste per year are expected to be generated from the construction of the proposed 1823 residential units. Approximately 120 tons of solid waste per year are expected to be generated from the construction of the proposed 73,000 square feet of commercial activities. Solid waste typically generated by construction activities includes wood, drywall, cardboard, metals and other materials. After build out, solid waste generated during the operational life of the residential and commercial activities includes paper, plastic, yard waste, glass, metals, other organics and other solid wastes. Sea Mountain is expected to reach full build out in 2016. Solid waste generated by operational activities from the residential units is estimated at 1,852 tons a year and 83 tons per year for commercial activities.

Impact on County Landfill:
Pu‘uanahulu Landfill is the closest solid waste disposal facility to the proposed project. According to the Draft EIS for the East Hawaii Regional Sort Station, September 2003, “At the end of 2002 the Pu‘uanahulu Landfill had slightly more that 12 million cubic yards of permitted air space. Assuming the in-place density averages 1,100 pounds per cubic yard, and cover materials make up 20% of the volume, the remaining capacity of the Pu‘uanahulu Landfill is 5.28 million tons.” For use in this study, to account for additional used capacity since 2003, we have estimated current landfill capacity at 5 million tons. Approximately 1,935 tons of solid waste are estimated to be generated a year from the operation of the residential and commercial components of the proposed project. Using recycling and reduction efforts, we estimate a 15-40% reduction in the amount of solid waste generated a year for a reduced total of 1,645 - 1,161 tons of solid waste per year. The proposed project will contribute less than .0003% of total capacity of solid waste to the landfill a year. In effect, this project will have a very small impact on the life of the landfill.

Recycling and Solid Waste mitigation efforts:
A 15-40% reduction in solid waste production is expected through planned recycling and sustainable design measures.

During site excavation and grading, green waste will be generated. This waste will be hauled to Big Island Recycling at the Kealakehe Transfer Station. According to the Recycle Hawaii website this is the only company on the Kona side of the Big Island dealing with green waste. Once construction begins, recycling will be encouraged and practiced as practicable and to the level available within the County. Ideally, construction waste will be sorted on site, and hauled to the appropriate facility. Atlas Recycling, or a similar company in Kona, may be the receiving party of any recycled construction waste. It is estimated that weekly truck pick ups could take any recycled materials to Atlas. Waste which cannot be recycled will be transported directly to the Pu'uanahulu Landfill.

The project site will include a centralized location for waste disposal and recycling. Residents will be encouraged to implement a recycling program. The Department of Environmental Management does not allow the use of County transfer stations for any commercial development. Sea Mountain Five, LLC intends to contract with a private waste and recycling hauling company to transport waste from the commercial portion of the development to the Pu'uanahulu Landfill. Potential hauling service companies are Aloha Rubbish Company, Atlas Recycling, Pacific Waste, PFI Rubbish Service, Inc. Research will continue on behalf of Sea Mountain Five, LLC as to which company provides the best services and arrangements will be made. Weekly pick up trucks will travel along Māmalahoa Highway to the landfill. Frequency of pick-ups and routes traveled to the appropriate disposal areas will be determined once a hauling company is chosen.

Sea Mountain Five, LLC intends to reduce the impact the development may have on the County landfill by encouraging recycling within both the Residential and Commercial components of the proposed development. Waste collection areas will have waste receptacles to support separation of aluminum, cardboard, glass, and newspaper. Grounds and gardening maintenance crew will also be encourage to separate out green waste for appropriate disposal. Chipping and composting will be utilized to the extent practicable; especially during the operational phase. Yard and landscape maintenance may use compost and chipped material for mulching and soil conditioning. These activities will reduce the amount of green waste that needs to be transported off site.

Commercial and food retailers within the resort and village commercial areas will be encouraged to separate their waste stream for recycling, specifically cardboard and bottles. Cardboard often generates the most waste in retail developments because it is frequently used for packaging. Green waste generated by the project will be separated out. Recycled items, green waste, and rubbish will need to be picked up and hauled by private companies. Sea Mountain Five, LLC will contact them to organize green waste re-use, composting, and disposal.

<u>Conclusion:</u>
Sea Mountain Five, LLC intends to make every effort practicable to minimize waste generated by both the commercial and residential development during construction and operation.

- First, they will prevent waste before it occurs, also called source reduction. During construction they will plan efficiently for material use. During operation they will implement procedures that minimize waste generation, such as limiting the number of non-reusable products.
- Second, practicable efforts to re-use materials will be a component of the solid waste program. In the construction phase efforts will be taken to reuse materials as much as possible, such as scrap generated on the site or used materials/scrap from other jobs. The primary re-use taking place in the operational phase will be composting/ re-use of green waste.
- Lastly, recycling will be an important part of both the construction and operational phase of the development. Recyclable materials will be separated out from non-recyclable materials, hauled from the site to the appropriate company, and eventually processed to make new products.

Source:
http://www.recyclehawaii.org/where.htm

SEA MOUNTAIN SOLID WASTE ESTIMATES

I. PROGRAM

note: total buildout in 2015

Planning Area	Unit Type	Residential (DU)	Commercial (SF)
1	Single Family	142	
2	Duplex	185	
3	Triplex	248	
4	Cluster Townhome	180	
5	Cluster Townhome	282	
6	Cluster Townhome	220	
7	Lanai Stacked Flat	114	
	Clubhouse Retail		8,000
8	Stacked Flat	332	
	Retail Services		50,000
9	Stacked Flat	120	
	Retail Services		15,000
	Total:	**1823**	**73,000**

RESIDENTIAL

1681	Number Multi-Family Units (including hotel)
142	Number Single-Family Units
1823	Total Number of Residential Units
1,300	Average Square Foot per Unit (assumption)
2,369,900	TOTAL SF

II. ASSUMPTIONS

1400	Average SF per Residential Unit
2240 lbs	equals 1 Long Ton
7	lbs per 1000 square feet per day. Generation rate for commercial activities
6	lbs per dwelling unit per day. Generation rate for Multifamily units
9	lbs per dwelling unit per day. Generation rate for Single Family units
5	million tons of space left in Puuanahulu Landfill

III. WASTE GENERATION

A. CONSTRUCTION

WASTE STREAM PER TYPE OF MATERIAL

Residential

Materials	Lbs per SF	Total Residential SF	total pounds of waste	Amount of residential waste measured in TONS
Wood	1.3	2,552,200	3,317,860	1,481
Drywall	1.1	2,552,200	2,807,420	1,253
Cardboard	0.3	2,552,200	765,660	342
Metals	0.09	2,552,200	229,698	103
Others	0.9	2,552,200	2,296,980	1,025
TOTAL	3.69	2,552,200	9,417,618	4,204

Assumes 1 LONG TON = 2240 LBS

Commercial

Materials	Lbs per SF	Total SF - Commercial	total pounds of waste	Amount of Commercial waste measured in TONS
Wood	1.3	73,000	94,900	42
Drywall	1.1	73,000	80,300	36
Cardboard	0.3	73,000	21,900	10
Metals	0.09	73,000	6,570	3
Others	0.9	73,000	65,700	29
TOTAL	3.69	73,000	269,370	120

Assumes 1 LONG TON = 2240 LBS

B. OPERATION

POUNDS OF WASTE PER DAY

Residential

10,086	lbs waste per day for m-f units (6lbs/day*1349units)
1,278	lbs waste per day for s-f units (9lbs/day*142units)
11,364	lbs waste per day for the 1823 residential units

Commercial

511	lbs waste per day for Commercial (7lbs*73/day)

WASTE STREAM PER TYPE OF MATERIAL

Multi Family - Average Waste Composition

Materials	% of Waste Stream	lbs per day (10,086 LBS*%)	Pounds each year (LBS*365 DAYS)	Tons one year
Paper	33%	3328.38	1,214,859	542
Plastic	11%	1109.46	404,953	181
Yard Waste	7%	706.02	257,697	115
Glass	4%	403.44	147,256	66
Metals	4%	403.44	147,256	66
Organics	36%	3630.96	1,325,300	592
Other Waste	5%	504.3	184,070	82
TOTAL		10086	3,681,390	1,643

Assumes 1 TON = 2240 LBS

Commercial Waste Stream

Materials	% of Waste Stream	Pounds each day (LBS*%)	Pounds each year (LBS*365DAYS)	Tons one year
Paper	40%	204	74,606	33
Plastic	5%	26	9,326	4
Yard Waste	7%	36	13,056	6
Glass	7%	36	13,056	6
Metals	3%	15	5,595	2
Organics	33%	169	61,550	27
Other Waste	5%	26	9,326	4
TOTAL		511	186,515	83

Single Family - Average Waste Composition

Materials	% of Waste Stream	lbs per day (1,278 LBS*%)	Pounds each year (LBS*365)	Tons one year
Paper	33%	422	153,935	69
Plastic	10%	128	46,647	21
Yard Waste	13%	166	60,641	27
Glass	4%	51	18,659	8
Metals	4%	51	18,659	8
Other Organi	32%	409	149,270	67
Other Waste	4%	51	18,659	8
TOTAL		1,278	466,470	208
Total Multi Family & Single Family Waste				1,852

IV. IMPACT ON PUUANAHULU LANDFILL (over 10 years, 2016 buildout)

Project Component	Waste Generated (tons per year)	Portion of the Landfill Used	15% Reduction using Recycling (tons a year)	Reduced impact on landfill
Construction of Residential	4,204	0.0008%	3,574	0.0007%
Construction of Commercial	120	0.0000%	102	0.0000%
Operation of Residential	1,852	0.0004%	1,574	0.0003%
Operation of Commercial	83	0.0000%	71	0.0000%

Conclusion: Proposed development has very small impact on the life of landfill

V. SOURCES

www.stopwaste.org/table_es4.html
www.circlejroll-offsinc.com
Estimated Solid Waste Generation Rates www.ciwmb.ca.gov/WasteChar/WasteGenRates
www.opala.org
U of N Bencorp Solid Wste Management Plan
Palamanui Solid Waste Management Plan

Appendix N

Socio-economic Tables
(compiled by Group 70 International, Inc., April 2006)

Labor Force Size and Characterisistcs, County of Hawaii and Various Parts of Study Area, 2000

	County of Hawaii		Captain Cook		Ocean View		Na'alehu		Pahala		Volcano	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
EMPLOYMENT STATUS												
Total Population 16 years and over	114,647	100%	19,956	100%	1,667	100%	1,422	100%	1,194	100%	2,262	100%
In labor force	70,791	61.7%	70,791	61.7%	824	49.4%	779	54.8%	697	58.4%	1,300	57.5%
Civilian labor force	70,592	61.6%	70,592	61.6%	824	49.4%	775	54.5%	697	58.4%	1,295	57.3%
Employed	64,979	56.7%	64,979	56.7%	732	43.9%	625	44%	556	46.6%	1,193	52.7%
Unemployed	5,613	4.9%	5,613	4.9%	92	5.5%	150	10.5%	141	11.8%	102	4.5%
Percent of civilian labor force	8		8		11.2		19.4		20.2		7.9	
Armed Forces	199	0.2%	199	0.2%			4	0.3%			5	0.2%
Not in labor force	43,856	38.3%	43,856	38.3%	843	50.6%	643	45.2%	497	41.6%	962	42.5%
OCCUPATION												
Construction, extraction, and maintenance occupations	6,454	9.9%	542	5.1%	140	19.1%	197	31.5%	100	18%	146	12.2%
Farming, fishing, and forestry occupations	2,449	3.8%	0	0.0%	22	3%	105	16.8%	131	23.6%	26	2.2%
Management, professional, and related occupations	19,607	30.2%	4,790	44.9%	176	24%	112	17.9%	90	16.2%	470	39.4%
Production, transportation, and material moving occupations	5,757	8.9%	603	5.7%	63	8.6%	63	10.1%	125	22.5%	87	7.3%
Sales and office occupations	16,309	25.1%	2,958	27.7%	182	24.9%	83	13.3%	57	10.3%	256	21.5%
Service occupations	14,403	22.2%	1,778	16.7%	149	20.4%	65	10.4%	53	9.5%	208	17.4%
INDUSTRY												
Agriculture, forestry, fishing and hunting, and mining	4,600	7.1%	6	0.1%	54	7.4%	102	16.3%	159	28.6%	95	8%
Construction	5,057	7.8%	407	3.8%	99	13.5%	75	12%	30	5.4%	105	8.8%
Manufacturing	1,685	2.6%	577	5.4%	29	4%	35	5.6%	36	6.5%	62	5.2%
Wholesale trade	1,786	2.7%	328	3.1%	4	0.5%	18	2.9%	3	0.5%	8	0.7%
Retail trade	7,826	12%	1,329	12.5%	133	18.2%	78	12.5%	36	6.5%	120	10.1%
Transportation and warehousing, and utilities	3,546	5.5%	244	2.3%	32	4.4%	37	5.9%	15	2.7%	58	4.9%
Information	1,159	1.8%	1,244	11.7%	9	1.2%	3	0.5%	5	0.9%	12	1%
Finance, insurance, real estate, and rental and leasing	3,346	5.1%	665	6.2%	36	4.9%	11	1.8%	15	2.7%	35	2.9%
Professional, scientific, management, administrative, and waste management services	5,596	8.6%	1,711	16.0%	83	11.3%	13	2.1%	41	7.4%	99	8.3%
Educational, health and social services	12,287	18.9%	1,954	18.3%	118	16.1%	167	26.7%	121	21.8%	201	16.8%
Arts, entertainment, recreation, accommodation and food services	11,462	17.6%	1,245	11.7%	84	11.5%	48	7.7%	62	11.2%	200	16.8%
Other services (except public administration)	2,911	4.5%	741	6.9%	35	4.8%	18	2.9%	17	3.1%	60	5%
Public administration	3,718	5.7%	220	2.1%	16	2.2%	20	3.2%	16	2.9%	138	11.6%
COMMUTING TO WORK												
Mean travel time to work (minutes)	24.5		25		60.2		33.8		31.3		33.5	

Sources: Hawai`i Business Research Library (HBRL) from data at the U.S. Census Bureau: 2000 Summary File 1 (Profile of General Demographic Characteristics) and 2000 Summary File 3 (Profiles of Social, Economic, and Housing Characteristics). Retrieved April 19, 2006, http://www.hbrl-sbdc.org/commprof/hcpindex.htm

Total Population and Demographic Breakdowns, County of Hawaii and Various Parts of Study Area, 2000

	County of Hawaii		Captain Cook		Ocean View		Na'alehu		Pahala		Volcano	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
TOTAL POPULATION	148,677	100%	19,956	100%	2,112	100%	1,930	100%	1,466	100%	2,855	100%
SEX AND AGE												
Male	74,499	50.1%	9644	48.3%	1,123	53.2%	991	51.3%	738	50.3%	1,520	53.2%
Female	74,178	49.9%	10312	51.7%	989	46.8%	939	48.7%	728	49.7%	1,335	46.8%
Under 5 years	9,130	6.1%	838	4.2%	116	5.5%	119	6.2%	72	4.9%	131	4.6%
5 to 9 years	11,033	7.4%	940	4.7%	153	7.2%	154	8%	87	5.9%	196	6.9%
10 to 14 years	11,568	7.8%	987	4.9%	149	7.1%	158	8.2%	125	8.5%	189	6.6%
15 to 19 years	11,089	7.5%	959	4.8%	136	6.4%	167	8.7%	155	10.6%	181	6.3%
20 to 24 years	8,232	5.5%	1470	7.4%	60	2.8%	80	4.1%	94	6.4%	121	4.2%
25 to 34 years	16,050	10.8%	4224	21.2%	177	8.4%	162	8.4%	122	8.3%	324	11.3%
35 to 44 years	22,838	15.4%	3626	18.2%	361	17.1%	260	13.5%	184	12.6%	532	18.6%
45 to 54 years	24,452	16.4%	2819	14.1%	425	20.1%	297	15.4%	217	14.8%	587	20.6%
55 to 59 years	8,163	5.5%	825	4.1%	162	7.7%	131	6.8%	68	4.6%	173	6.1%
60 to 64 years	6,003	4%	677	3.4%	107	5.1%	105	5.4%	70	4.8%	110	3.9%
65 to 74 years	10,923	7.3%	1041	5.2%	178	8.4%	179	9.3%	124	8.5%	183	6.4%
75 to 84 years	7,064	4.8%	914	4.6%	70	3.3%	101	5.2%	108	7.4%	108	3.8%
85 years and over	2,132	1.4%	636	3.2%	18	0.9%	17	0.9%	40	2.7%	20	0.7%
Median age (years)	38.6		36.4		42.9		39.9		40		40.9	
RACE												
White	46,904	31.5%	12,573	63.0%	1,184	56.1%	527	27.3%	166	11.3%	1,299	45.5%
Black or African American	698	0.5%	1,730	8.7%	27	1.3%	17	0.9%	3	0.2%	13	0.5%
American Indian and Alaska Native	666	0.4%	161	0.8%	25	1.2%	8	0.4%	1	0.1%	17	0.6%
Asian	39,702	26.7%	1,589	8.0%	134	6.3%	549	28.4%	671	45.8%	365	12.8%
Asian Indian	96	0.1%	147	0.7%	2	0.1%	3	0.2%	2	0.1%	2	0.1%
Chinese	1,603	1.1%	430	2.2%	12	0.6%	4	0.2%	13	0.9%	49	1.7%
Filipino	13,551	9.1%	160	0.8%	75	3.6%	378	19.6%	448	30.6%	54	1.9%
Japanese	20,147	13.6%	461	2.3%	36	1.7%	131	6.8%	159	10.8%	202	7.1%
Korean	911	0.6%	228	1.1%	3	0.1%	1	0.1%	2	0.1%	23	0.8%
Vietnamese	123	0.1%	33	0.2%			1	0.1%			1	0%
Other Asian 1	3,271	2.2%	130	0.7%	5	0.2%	31	1.6%	47	3.2%	34	1.2%
Native Hawaiian and Other Pacific Islander	16,724	11.2%	24	0.1%	239	11.3%	256	13.3%	155	10.6%	326	11.4%
Native Hawaiian	14,461	9.7%	7	0.0%	181	8.6%	250	13%	152	10.4%	311	10.9%
Guamanian or Chamorro	103	0.1%	2	0.0%							1	0%
Samoan	405	0.3%	2	0.0%			6	0.3%			6	0.2%
Other Pacific Islander 2	1,755	1.2%	13	0.1%	58	2.7%	0	0%	3	0.2%	8	0.3%
Some other race	1,695	1.1%	2,797	14.0%	46	2.2%	14	0.7%	7	0.5%	47	1.6%
Two or more races	42,288	28.4%	1,082	5.4%	457	21.6%	559	29%	463	31.6%	788	27.6%

Sources: Hawai`i Business Research Library (HBRL) from data at the U.S. Census Bureau: 2000 Summary File 1 (Profile of General Demographic Characteristics) and 2000 Summary File 3 (Profiles of Social, Economic, and Housing Characteristics). Retrieved April 19, 2006, http://www.hbrl-sbdc.org/commprof/hcpindex.htm

Total Population and Demographic Breakdowns, County of Hawaii and Various Parts of Study Area, 2000 Cont…

	County of Hawaii		Captain Cook		Ocean View		Na'alehu		Pahala		Volcano	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
NATIVITY AND PLACE OF BIRTH												
Native	133,469	89.8%	13,663	68.3%	1,955	92.3%	1,619	84.5%	1,193	78.5%	2,683	95.6%
Born in United States	131,331	88.3%	13,424	67.1%	1,937	91.4%	1,610	84.1%	1,185	78%	2,624	93.5%
State of residence	94,166	63.3%	7,300	36.5%	874	41.2%	1,050	54.8%	1,081	71.1%	1,543	55%
Different state	37,165	25%	6,124	30.6%	1063	50.2%	560	29.2%	104	6.8%	1,081	38.5%
Born outside United States	2,138	1.4%	239	1.2%	18	0.8%	9	0.5%	8	0.5%	59	2.1%
Foreign born	15,208	10.2%	6,331	31.7%	164	7.7%	296	15.5%	327	21.5%	124	4.4%
RESIDENCE 5 YRS. PREVIOUS												
Same house	80,654	57.7%	9,876	51.4%	941	47.4%	1,270	69.6%	1,033	70.9%	1,409	53.2%
Different house in the U.S.	55,629	39.8%	8,189	42.6%	1,006	50.7%	517	28.3%	405	27.8%	1,212	45.8%
Same county	37,019	26.5%	5,575	29.0%	664	33.5%	257	14.1%	334	22.9%	680	25.7%
Different county	18,610	13.3%	2,614	13.6%	342	17.2%	260	14.2%	71	4.9%	532	20.1%
Same state	6,687	4.8%	888	4.6%	58	2.9%	23	1.3%	2	0.1%	216	8.2%
Different state	11,923	8.5%	1,726	9.0%	284	14.3%	237	13%	69	4.7%	316	11.9%
Elsewhere in 1995	3,510	2.5%	1,163	6.0%		1.9%	38	2.1%	19	1.3%	26	1%
EDUCATIONAL ATTAINMENT												
Population 25 years and over	97,708	100%	14,974	100%	1472	100%	1,219	100%	974	100%	2,006	100%
Less than 9th grade	5,796	5.9%	1,467	9.8%	9	0.6%	112	9.2%	196	20.1%	80	4%
9th to 12th grade, no diploma	9,292	9.5%	1,329	8.9%	160	10.9%	115	9.4%	177	18.2%	187	9.3%
High school graduate (includes equivalency)	30,653	31.4%	2,496	16.7%	526	35.7%	435	35.7%	321	33%	511	25.5%
Some college, no degree	21,539	22%	3,056	20.4%	429	29.1%	348	28.5%	125	12.8%	509	25.4%
Associate degree	8,833	9%	890	5.9%	87	5.9%	76	6.2%	63	6.5%	134	6.7%
Bachelor's degree	14,303	14.6%	3,505	23.4%	161	10.9%	104	8.5%	79	8.1%	372	18.5%
Graduate or professional degree	7,292	7.5%	2,231	14.9%	100	6.8%	29	2.4%	13	1.3%	213	10.6%
Percent high school graduate or higher	84.6		81.3		88.5		81.4		61.7		86.7	
Percent bachelor's degree or higher	22.1		38.3		17.7		10.9		9.4		29.2	

Sources: Hawai`i Business Research Library (HBRL) from data at the U.S. Census Bureau: 2000 Summary File 1 (Profile of General Demographic Characteristics) and 2000 Summary File 3 (Profiles of Social, Economic, and Housing Characteristics). Retrieved April 19, 2006, http://www.hbrl-sbdc.org/commprof/hcpindex.htm

Appendix O

Survey of Insects, Sea Mountain at Punalu‘u
(Robert Peck, July 2006)

Survey of insects listed as Endangered, Threatened, Candidate, and Species of Concern at Sea Mountain at Punalu'u

20 July 2006

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Introduction and objectives

This report describes results of a survey for rare insects at Sea Mountain at Punalu'u. Specifically, the primary objective of this work was to survey for and identify insects that have been listed as "Endangered", "Threatened", "Candidate", and "Species of Concern". Endangered species are those that are in danger of extinction throughout all or a significant portion of their range. Threatened species are in slightly less jeopardy of extinction, and are defined as those that are likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Species within both of these categories are formally protected under federal law. Species listed as Candidate have been recognized by the US Fish and Wildlife Service as potentially in need of federal protection, but specific actions have not yet been taken. Although in most cases these species are known to be uncommon or rare, for many, relatively little is known about their biology and life-history requirements (these species were previously listed in C2 status). In many cases, insufficient funding has prevented Candidate species from obtaining Threatened or Endangered status. Currently, Candidate status provides no legal protection. Finally, Species of Concern is an informal designation for species that are either known to be uncommon, have extremely restricted ranges, or have not been collected for many years. Very little is known about many of these species. For several herbivorous species on this list, the host plant is not known. The Species of Concern list is largely based on Gagne's (1974) compilation of "Rare and Endangered (some possibly extinct) species". A secondary purpose of this survey was to identify the most common insects that were collected while surveying Sea Mountain for the rare species.

Methods

This survey consisted of two parts. The first part included a review of the literature aimed to obtain information on the distribution, host-plant associations and habitat requirements of all species listed within the four "rare" categories defined above. This information was used to guide the second part of the study, the field collecting. Because the list of rare species was large, and possible collecting techniques numerous, the literature review allowed the field sampling effort to be focused and efficiently make the most of the available resources. The methods for these two components are described below.

Literature review:
Lists of insects within the categories Endangered, Threatened, Candidate, and Species of Concern were primarily taken from the Hawaiian Biological Survey, Bishop Museum website (http://hbs.bishopmuseum.org/endangered/endangered.html). The only exception to this was for several species of pomace fly (Diptera: *Drosophila*) that were recently up-listed from Candidate status to Threatened or Endangered status. Information pertaining to the many rare species recognized on these lists is widespread in the literature, but much has been published in the Proceedings of the Hawaiian Entomological Society and within the Insects of Hawaii series (University of Hawaii Press). Unfortunately, little collecting of insects appears to have been done previously within the Sea Mountain part of the Big Island, so records specific to that area are largely unavailable. Regardless of this fact, information from similar habitats elsewhere on the island provides useful information on species distributions and habitat preferences.

The many references used in compiling this report have not been cited throughout the text as it would have been repetitive and unnecessarily lengthened the document. Only a few of the most important references have been cited. A list of the other references used in this report can be made available upon request.

Field survey:
Field surveys were carried out on five occasions during June and July 2006. In total, nearly 30 person-hours of survey work was conducted at Sea Mountain. Although the entire site was surveyed, the effort was focused on the coastal strand community as that habitat was by far the area most likely to support rare native insects. In contrast to this area, the dry shrub (between the strand community and the highway) and dry woodlands habitats (above the road) are highly degraded and are currently dominated by non-native vegetation. Because most native insects are sensitive to habitat disturbance, and are strongly associated with native plants, the probability of finding native insects (rare or common) in these areas is extremely low.

The collection methods we used included:

Hand netting: Hand nets were primarily used to collect flying insects that gathered around flowers to obtain pollen and nectar or on and around vegetation to prey on other species of insects. This method is commonly used to collect Hymenoptera (bees and wasps), Diptera (flies), Odonata (damselflies) and some Coleoptera (beetles). Hand nets were also used in a generalized fashion to sweep vegetation to gather insects living on plant surfaces. Adult damselflies are generally conspicuous (perching on vegetation along the margins of ponds) but because they can be skittish, and often perch out of reach, they can be difficult to capture with a net. As a result, binoculars were sometimes used to identify these strikingly colored insects without catching them.

Beating sheets: Beating sheets are 36 x 36 inch white nylon sheets supported by a frame (similar to an inverted umbrella) that are held beneath the branch of a tree or shrub to collect insects that are dislodged from foliage when branches are vigorously shaken. This is an effective method of sampling most insects (except some strong fliers) associated with the foliage.

Pan traps: Pan traps are used to collect insects that are attracted to flowers and are particularly effective for catching Diptera and Hymenoptera, but also collect a variety of other insects. Because flowers come in numerous colors, a variety of colored traps are often used. Yellow and white traps were used in this survey as they are generally most effective at catching *Hylaeus* bees, a group of insects that was of particular interest. Each trap consisted of 8 inch diameter plastic dish filled with soapy water placed on ground. The soapy water decreases surface tension helping trap the insects.

In the lab, insects were sorted into morpho-species and mounted on pins for identification. Identifications were made using taxonomic keys and by comparing our specimens to previously identified voucher material.

Results from this survey represent a snapshot in time of the insect fauna at Sea Mountain, and should be viewed as a subset of the total fauna that may exist at the site over the course of the year (or over a series of years). For example, some species, such as Yellow-faced bees (*Hylaeus* spp.), may feed on the inflorescences of only a few particular plants that may flower only for a few months of the year. Although these bees often shift plants on which they feed to take advantage of the flowers that are in bloom at any one time, there may be periods of the year when the bees are absent from an area due to lack of appropriate flowers. A significantly greater effort over a longer period of time would be required to ensure that all insects that are found at Sea Mountain are collected.

Results

Literature review:
From the Big Island, 3 insect species have been listed as Endangered, 1 species is listed as Threatened, 9 species are listed as Candidate, and 78 species have been listed as Species of Concern. Table 1 (below) shows the status and general habitat for those listed as Endangered, Threatened or Candidate. Information from the literature review is further used to summarize species descriptions that follow.

Field survey:
Overall diversity of insects at Sea Mountain was low, with alien species far exceeding native species. Many plants, including those that dominated the dry shrub and dry woodlands, supported very few insects. Insects on those plants tended to be widespread generalists (able to live on a wide range of plants) such as the planthopper *Melormenis basalis* (Homoptera: Flatidae), the ladybeetles *Curinus coerulens* and *Olla v-nigrum* (Coleoptera: Coccinelidae), the ant *Cardiocondyla wraughtoni* (Hymenoptera: Formicidae) and the domestic honeybee *Apis mellifera* (Hymenoptera: Apidae).

No Endangered or Threatened species were found at Sea Mountain, but one species, *Megalagrion xanthomelas*, listed as Candidate, was found to inhabit the site. This species is discussed in detail below. For the vast majority of the other 90 species targeted in this study, their likely distribution, habitat type, or in the case of herbivorous species, their host plant, were not found at Sea Mountain. So for all but a few species (e.g. *Hylaeus* bees, discussed below), the likelihood of finding them, even with additional effort, is extremely low.

The following section discusses each of the rare insect species targeted in this study.

Table 1. Summary of Endangered, Threatened, and Proposed and Candidate species found on the Big Island. Status is as defined as follows: E = Endangered; T = Threatened, and; C = Proposed and Candidate.

Order	**Family**	**Name**	**Common name**	**Status**	**Habitat**
Lepidoptera	Sphingidae	Manduca blackburni	Blackburn's sphinx moth	E	Dry forest
Odonata	Coenagrionidae	Megalagrion nesiotes	Nesiotes megalagrion	C	Possibly in moist leaf litter
Odonata	Coenagrionidae	Megalagrion nigrohamatus nigrolineatum	Blackline megalagrion	C	Pools along streams
Odonata	Coenagrionidae	Megalagrion pacificum	Pacific megalagrion	C	Pools along streams
Odonata	Coenagrionidae	Megalagrion xanthomelas	Orangeblack megalagrion	C	Coastal wetlands
Diptera	Drosophilidae	Drosophila heteroneura	Pomace fly (no common name)	E	Mesic to wet forest
Diptera	Drosophilidae	Drosophila ochrobasis	Pomace fly (no common name)	E	Mesic to wet forest
Diptera	Drosophilidae	Drosophila mulli	Pomace fly (no common name)	T	Wet forest
Diptera	Drosophilidae	Emperoptera hawaiiensis	Pomace fly (no common name)	C	Wet forest
Diptera	Drosophilidae	Drosophila alsophila	Pomace fly (no common name)	C	Mesic forest
Diptera	Drosophilidae	Drosophila digressa	Pomace fly (no common name)	C	Mesic to wet forest
Diptera	Drosophilidae	Drosophila psilotarsalis	Pomace fly (no common name)	C	Mesic forest
Diptera	Drosophilidae	Phaeogramma sp.	Fly, Po'olanui	C	Mesic forest

Insects listed as Endangered Species

***Manduca blackburni* (Blackburn's sphinx moth) (Lepidoptera: Sphingidae)**
Until recently, Blackburn's sphinx moth was thought to be extinct in Hawaii. In 1984, however, a small population was rediscovered on leeward Maui. More recently, individuals have been found in dry forests on the Kona side of the Big Island, where its larvae feed on the rare native tree 'Aiea (*Nothocestrum breviflorum*). It also has been found to occasionally feed on the weedy tree tobacco (*Nicotiana glauca*, also within the family Solanaceae). Its range and population size is currently unknown on the Big Island. Considering that neither 'Aiea nor tree tobacco are found at Sea Mountain, it is highly unlikely that this species exists at the site.

***Drosophila heteroneura* (Pomace fly; no common name) (Diptera: Drosophilidae)**
More than 500 species of Pomace flies have been described from the Hawaiian Islands, representing one of the most spectacular radiations within the archipelago. Most are found at higher elevations in wet or mesic forests and the vast majority are associated with only one or a few host plants. The high degree of specificity is largely a requirement of the larvae, which often feed on decaying leaves, under bark or within plant stems

Along with *D. ochrobasis*, the listing of this species recently changed from Candidate to Endangered (09 May 2006). This species has a very restricted range (3800 – 5500 ft) (1158 – 1675m) within mesic and wet forest habitats. It has primarily been found associated with the decomposing bark and stems of 'Oha (*Clermontia* sp.) and *Delissia* sp. but also within decomposing portions of 'Olapa (*Cheirodendron* sp.). We did not collect any *D. heteroneura* at Sea Mountain and it is highly doubtful that this species exists on the site due to dry conditions and lack of appropriate host plants.

***Drosophila ochrobasis* (Pomace fly; no common name) (Diptera: Drosophilidae)**
This species is historically widespread, having been recorded from 10 localities ranging from 3900 to 5300 ft (1189 and 1615m) on the Big Island. But since 1975, its distribution and abundance has declined greatly; a single individual was last located in a kipuka off the saddle road in 1986. The larvae of this species have been record living within decomposing tissues of 'Oha (*Clermontia* sp.), *Marattia* sp., and Kolea (*Myrsine* sp.). We did not collect any *D. ochrobasis* at Sea Mountain and it is highly doubtful that they exist on the site due to dry conditions and lack of appropriate host plants.

Insects listed as Threatened Species

***Drosophila mulli* (Pomace fly; no common name) (Diptera: Drosophilidae)**
This species is historically known from two wet forest locations between 2300 and 4000 ft (985 and 1220 m) on the windward slope of the Big Island (Olaa and Upper Waiakea Forest Reserves). Adult flies are found on the undersides of the leaves of the lolu palm (*Pritchardia breccariana*). The larval feeding site of this pomace fly is still unknown. We did not collect any *D. mulli* at Sea Mountain and it is highly doubtful that they exist on the site.

Insects listed as Candidate Species

Damselflies – *Megalagrion* spp. (4 species on the Big Island) (Odonata: Coenagrioinidae)
Hawaii has a rich Damselfly fauna with 29 described species or subspecies. Of these, 14 have been found on the Big Island. Habitat availability generally limits their distribution as the immature stages (naiads) are primarily restricted to aquatic, semi-aquatic or very damp environments. Unfortunately, their aquatic requirements have made them highly vulnerable to predation by alien fish; today, the highest diversity, and greatest abundances, are found in high mountain streams that are isolated from lower reaches by waterfalls that act as barriers to migration of fish. Four Big Island species have received Candidate listings. *Megalagrion nigrohamatum nigrolineatum* is found in pools and seepages in upland streams. *Megalagrion nesiotes* naiads have been found in steep, moist, fern-covered banks. For this species, only historic records exist for the Big Island; none have been collected in recent times. Naiads of *M. pacificum* are usually found in pools along channels supporting thick vegetation bordering perennial streams. *Megalagrion xanthomelas* is found at low elevations, particularly in pools and small ponds, and on the Big Island, along the Puna, Kau and North Kona coasts.

Megalagrion xanthomelas was the only rare species collected during our survey of Sea Mountain. In Kau, it has previously been recorded at Punalu'u, as well as Ninole Springs, the mouth of Hilea stream at Hawa Bay, Hawa Springs, and Whittington Beach Park (Polhemus 1995). Our survey found *M. xanthomelas* at several locations, both along the margins of pools and perching on high vegetation (shrubs) approximately 30-100m from water. Locations at which *M. xanthomelas* were found are listed in Table 2. Photographs of the aquatic habitats (locations 1-3) are shown in Figs. 1-3.

Table 2. Locations where *Megalagrion xanthomelas* was found at Sea Mountain (UTM Hawaii NAD83).

Location	Easting	Northing	Comment
1	0235915	2117004	Small pond at west end of site
2	0235926	2117041	Very small pond near, but isolated from, much larger pond
3	0236194	2117240	Large pond
4	0236278	2117384	Perched on Christmas berry near the coast
5	0236031	2117361	Perched on Haole koa along road leading to golf parking lot

Figure 1. *Megalagrion xanthomelas* location 1. This pond appears to be largely isolated from tidal influences as witnessed by large differences in its size between June and July sample dates.

Figure 2. *Megalagrion xanthomelas* location 2. This very small pool (center; approximately 1 x 3 m) is isolated from an adjacent, much larger pond. Its size did not appear to change over the course of the survey.

Figure 3. *Megalagrion xanthomelas* location 3. Like the other ponds at Sea Mountain, this large pond also supports non-native damselflies.

In addition to the three aquatic sites, *M. xanthomelas* was also commonly found perching on Christmas berry (*Schinus terebinthifolius*) and Haole koa (*Leucana leucocephala*), 30 to 100+ meters away from the ponds. The observations on Christmas berry were not a chance events as *M. xanthomelas* was observed on these plants each time the site was surveyed. It is unclear why Christmas berry was used but it may simply have been because it was the tallest vegetation in the area.

We did not find *M. xanthomelas* in the large pond directly behind the black sand beach or within the sewage effluent ponds along the golf course. While these bodies of water may contain suitable habitat, the abundance of fish in these ponds may prevent them from being used. Fish prey upon the aquatic, nymphal stages and have been suggested to limit distributions of this damselfly. Apparently, *M. xanthomelas* is able to tolerate the presence of some fish, as small fish were seen in each pond except the very smallest (but they may have been in the pool but not seen). We did not attempt to identify the fish in the ponds. It is also possible that *M. xanthomelas* does breed in the large pond behind the beach and/or the sewage effluent pond but we failed to detect them during our survey.

The coastal and sewage ponds were used by three non-native species of damselfly. *Ischnura ramburii* (Rambur's forktail damselfly) was the most abundant damselfly on the site, but *Ischnura posita* (Fragile forktail damselfly) and *Enallagma civile* (Familiar bluet damselfly) were also present. Each of these alien species is widespread among habitats and is generally found throughout the main Hawaiian islands. Little, if anything, is known about their competitive impacts on *M. xanthomelas*.

The other species of damselfly that are listed as Candidates for federal protection, *M. nesiotes*, *M. nigrohamatum nigrolineatum*, and *M. pacificum* were not found on the site. Each of these species is associated with stream side pools found at higher elevations and would not be expected to be found at Sea Mountain.

Other Pomace flies (3 spp.) (Diptera: Drosophilidae)
Four additional pomace flies are listed as Proposed and Candidate species. Each of these has been rarely collected and probably has a very restricted distribution today. *Drosophila psilotarsus* is only known from six specimens collected at a single mesic forest location. It was found near a collapsed lava tube; its host plant is thought to be a species of Papala (*Charpentiera* sp.) growing at the site. *Drosophila alsophila* is similarly poorly known, with fewer than 10 individuals collected. It is found in wet forests, probably associated with the plant Papala kepau (*Pisonia* sp.) Finally, *Drosophila digressa* likely only breeds on the stems of a wet forest species of *Charpentiera*. Its current population size and range is unknown.

***Emperoptera hawaiiensis* (Mauna Loa flightless fly) (Diptera: Drosophilidae)**
This fly appears to be restricted to high elevation wet forests of the Big Island, and may have a limited distribution. It has been reared from a mixture of litter containing the leaves of the wet forest plants Ohia, ‘Olapa, Kawa’u (*Ilex*), and tree ferns collected from kipukas along saddle road (at approximately 5100 ft elevation).

***Phaeogramma* sp. (Po’olanui gall fly) (Diptera: Tephritidae)**
Only a handful of populations of this fly have been recorded from the Big Island and Kauai. The larvae form galls in the stems of its host plant, Ko'oko'olau (*Bidens cosmoides*). It appears limited to higher elevation mesic areas along ridges where the host plant is found.

<u>Insects listed as Species of Concern</u>

***Hylaeus* spp. (16 species) (Hymenoptera: Colletidae)**
Yellow-faced bees within the genus *Hylaeus* are important pollinators of many native Hawaiian plants. Out of 61 species recorded statewide, 16 are found on the Big Island have been listed as Species of Concern. Of these, six are known to live within coastal strand communities: *H. anthracinus*, *H. difficilis*, *H. flavipes*, *H. niloticus*, *H. ombrias*, and *H. sphecodoides*. Like most *Hylaeus*, these six coastal species forage for pollen on plants that are considered to be dominant within the community (Daly and Magnacca 2003). In coastal strand habitats on the Big Island, this includes *Scaevola sericea*, *Sida fallax*, and *Tournefortia argentea*. While each of these plants is found at Sea Mountain, no *Hylaeus* were collected in this study in spite of a focused effort using hand nets and pan traps. It is not clear why none of these bees were found, but a variety of pressures, including competition from alien pollinators (e.g. honeybees) and predation from alien species such as ants and the yellowjacket wasp (*Vespula pensylvanicus*) have led to significant declines in populations of numerous species, and may have impacted populations at Sea Mountain as well. *Hylaeus* bees are particularly susceptible to predation by ants due to their habits of nesting in burrows in the ground or in cavities in dry or rotting wood.

Even though we did not collect any *Hylaeus* bees during our survey, there is moderate-high probability that they are found on the site, at least in small numbers during some parts of the year, particularly at times when plants are flowering more profusely. This assumption is based on their presence on similar vegetation at South Point, an area that has been collected fairly intensively (Daly and Magnacca 2003).

***Deinomimesa* spp. (2 species) (Hymenoptera: Sphecidae)**
Two species of *Deinomimesa* wasp have been listed as Species of Concern. This species hunts for leafhoppers (Delphacidae including *Perkinsiella*) which it paralyzes and uses to provision its nest. The larvae then feed on the living but paralyzed insects. The nests are built in the soil or in decaying wood and are thus likely easily destroyed by aggressive ants. None of these wasps were collected in our survey.

***Ectemnius* spp. (5 species) (Hymenoptera: Sphecidae)**
Five species of *Ectemnius* wasp has been listed as Species of Concern. They feed almost exclusively on adult Diptera from a wide range of families, including both native and alien species. Nests are built either in the soil or in wood cavities, with soil being preferred in dry or lowland areas. Being ground nesters, they are likely highly susceptible to depredation by aggressive ants such as Big-headed and Long-legged ants. None were collected in our surveys.

***Odynerus nigripennis* (Hymenoptera: Vespidae)**
Historically, *Odynerus* wasps have been described as "numerous both in species and numbers". They primarily feed on caterpillars. *Odynerus nigripennis* has been found to prey on caterpillars of the native genus *Omioides* (several of which are also Species of Concern) as well as some within the Geometridae. *Odynerus nigripennis* has been recorded from sea level to at least 4000 ft. Because of their dependence on caterpillars for food, the decline of the wasps has paralleled the decline of their prey, which has been depleted in many areas by alien parasitoid wasps and ants. None were collected in our surveys.

***Plagithmysus* spp. (13 species) (Coleoptera: Cerambycidae)**
Plagithmysus long-horned beetles have evolved into more than 130 species, and are among Hawaii's most remarkable beetles. Many are associated with a single host plant, and are thus at risk due habitat loss and degradation, and the resultant reduction in numbers of their host plants. Alien parasitoids have likely also played a role in their demise as witnessed long ago by Perkins (1913), who found over 90% of one species (*P. solitarius*) parasitized by foreign *Ischiogonus* wasps. Thirteen species found on the Big Island have been listed as Species of Concern. None of the host plants identified for these species is found at Sea Mountain. None of these beetles were collected in our surveys.

***Deinocossonus nesiotes* (Coleoptera: Curculionidae)**
This weevil has been found associated with the tree Kaulu (*Pteralyxia macrocarpa*) on Oahu. It is unclear where the Big Island specimen(s) is from and what its host plant is.

***Nesotocus* spp. (2 species) (Coleoptera: Curculionidae)**
Both of these weevils, *N. giffardi* and *N. munroi*, are associated with dying and dead wood of the wet forest tree 'Olapa. 'Olapa is not found at Sea Mountain.

***Rhyncogonus giffardi* (Coleoptera: Curculionidae)**
This species of weevil was described from a single specimen collected in 1917 at 3700 ft on Koa (*Acacia koa*) at Puu Waa waa, North Kona. Koa was not found at Sea Mountain.

***Eopenthes* spp. (2 species) (Coleoptera: Elateridae)**
Although the number of species within this morphologically variable and poorly known group is unclear, at least 31 species are recognized. *Eopenthes* are generally found on vegetation in mountain forests. The larvae feed on and in decaying wood, and are presumably predaceous on other insects. Adults commonly visit flowers for nectar. Historically, most species have been considered rare, with nine species described only from a single individual. None of these beetles were collected in this study.

***Metrarga obscura* (Heteroptera: Lygaeidae)**
The biology of this species is poorly known, but many members of the Lygaeidae feed on plant seeds and other tissues. Ohia is the recorded host plant for *Metrarga obscura* and was originally described from 4000 ft on Mauna Loa. During the middle of the 20th century, Zimmerman (1948) spoke of members of this group already being much rarer than in Perkins' day (early 1900's).

***Nesocryptias villosa* (Heteroptera: Lygaeidae)**
As a result of greatly reduced wing size, this species is flightless. It has generally been found within decaying vegetation and damp ground litter beneath several forest plant species including *Byronia*, 'Ie'ie (*Freycinetia*) and Naio (Myoporum sandwicense). None were found during or survey.

***Oceanides bryani* (Heteroptera: Lygaeidae)**
Oceanides is a diverse group of lygeid bugs, with 27 described species. Most species feed on seeds and are tightly associated with one to a few host plants. *Oceanides bryani* is no exception, having been recorded only from Hawaiian spurge Akoko (*Euphorbia*) and Kopiko (*Straussia*). Neither of its known host plants was found at Sea Mountain.

***Cavaticovelia aaa* (Heteroptera: Mesoveliidae)**
Members of this family are often associated with wet areas, with some species known as water treaders. The unique species *Cavaticovelia aaa* appears restricted to caves and crevices in lava. It can be very difficult to detect insects associated with lava tubes and crevices since their habitat is often inaccessible. Our survey did not include searching for, or in, lava tubes.

***Kalania hawaiiensis* (Heteroptera: Miridae)**
There appears to be two species of the genus *Kalania* in Hawaii but only *K. hawaiiensis* is found on the Big Island. Its host plant appears to be unknown. None were collected in our study.

***Oechalia* spp. (2 species) (Heteroptera: Pentatomidae)**
Bugs within the genus *Oechalia* are predators of other insects. Thirteen species have been described from the Hawaiian Islands, with two, *O. grisea* and *O. patruelis*, listed as Species of Concern on the Big Island. While most species are single-island endemics, *O. grisea* has been

found on Kauai, Oahu and the Big Island. In general, *Oechalia* occur mostly in middle and upper forest zones although they have occasionally have been found in the lowlands. *Oechalia grisea* has been considered to be relatively widespread. None were found in this survey.

***Empicoris pulcher* (Heteroptera: Reduviidae)**
Empicoris are thread-legged bugs, predators of Psocoptera and other small insects. In Zimmerman's (1948) review of *Empicoris*, he states that he has not seen authentic specimens of *E. pulcher*, and has not been able to separate them from other species. It is not clear where on the Big Island this species was collected. It has likely been rare for a long time. No specimens were collected during our survey.

***Nesidiolestes* spp. (3 species) (Heteroptera: Reduviidae)**
All four species within this genus of predatory bugs are listed as Species of Concern, including three species found on the Big Island. One of these three species, *Nesidiolestes ana* is an inhabitant of lava tubes. Unfortunately, little is known about the other two species. One species, *N. selium*, has been collected in wet forests of Olaa area. Even less is known of the third species, *N. insularis*, and it may be the same species as *N. selium*.

***Ithamar* spp. (2 species) (Heteroptera: Rhopalidae)**
Ithamar is a small, endemic genus of true bugs associated with the plants Akoko (*Euphorbia*), Ma'o (*Gossypium*), Pukiawe (*Styphelia*), 'Ilima (*Sida*) and Mamane (*Sophora*). Although already rare as early as 1948, they had at one time been abundant on the coasts of some islands, especially on 'Ilima between 1500 to 3000 ft. While unlikely, it is possible that *Ithmar* may still be found at Sea Mountain since 'Ilima grow on the site. None, however, were collected in the survey.

***Coleotichus blackburniae* (Heteroptera: Scutelleridae)**
The koa bug (*C. blackburniae*), associated with Koa (*Acacia koa*) and A'ali'i (*Dodonea viscosa*), is perhaps Hawaii's most colorful insect. Even though its host plants are still common in many areas, it has declined in abundance considerably over the past 50 years. The cause of their decline is unknown, but parasitism from introduced Diptera may have played a role. Although the koa bug is not particularly common anywhere, it is widespread on the Big Island. No individuals were collected in the survey, but considering that A'ali'i is found on the site, the koa bug may be present in low numbers at certain times of the year.

***Nesosydne cyrtandricola* (Homoptera: Delphacidae)**
The genus *Nesosydne* contains more than 80 species in Hawaii. As feeders of plant sap, most are restricted to one or a few species of host plant. *Nesosydne cyrtandricola* appears to be associated with the wet forest plants Papala (*Charpentiera obovata*) (at Olaa & Glenwood on the Big Island), and Ha'iwale (*Cyrtandra* sp.) (on Maui).

***Glyphodes cyanomichla* (Lepidoptera: Crambidae)**
Although few records of the moth *Glyphodes cyanomichla* exist, it appears to be widespread in the state (found on Kauai, Oahu, Molokai and the Big Island). Within wetter forests, it is associated with the uncommon tree Aiai (*Pseudomorus* sp.), but has also been found on cultivated mulberry in Hilo.

***Omiodes* spp. (9 species) (Lepidoptera: Crambidae)**
Moths within the genus *Omiodes* are very interesting for two reasons. First, many species are widespread among the islands rather than being restricted to single islands as are most Hawaiian insects. Second, several species have evolved to feed exclusively on cultivated bananas, two of which had become economic pests. Unfortunately, parasitoids introduced to fight these pests have also attacked many other native Lepidoptera possibly leading to reductions in their numbers, or possibly extinctions. Of the nine species listed as Species of Concerns, three feed on wild bananas (*O. euryprora*, *O. fullawayi*, and *O. meyricki*), two feed on sedges (*O. anastrepta*, *O. anastreptoides*), and one each feeds on grasses (O. giffardi), native lilies (*O. iridias*), a palm (*O. pritchardii*), and a tree (*O. monogona*). The last species, *O. monogona*, feeds on the Wiliwili (*Erythrina sandwichensis*), a dry forest tree that was likely originally found at Sea Mountain. None of the other known host plants for *Omiodes* are found on the site.

***Stemorrhages exaula* (Lepidoptera: Crambidae)**
Larvae of this moth feed in clusters woven together among young leaves of their host plants Hao (*Rauvolfia sandwicensis*) and Holei (*Ochrosia sandwicensis*). Neither of these plants are at Sea Mountain.

***Philodoria* sp. (Lepidoptera: Gracillaridae)**
The host plant of this species appears to be unknown. It was most recently collected (1987) at about 500 ft near Pahoa, Big Island, and is as yet undescribed.

***Agrotis* spp. (2 species) (Lepidoptera: Noctuidae)**
The host plants of the two species of *Agrotis* listed as Species of Concern have not been discovered. *Agrotis melanoneura* was originally collected at 4000 ft from the Kona area. *Agrotis microreas* was originally collected at Kilauea, but has not been found since 1913.

***Anomis vulpicolor* (Lepidoptera: Noctuidae)**
Anomis vulpicolor has been colleced on Oahu, Molokai and the Big Island. Its host plant is ‘Ulea (*Osteomeles anthyllidifolia*), a plant that is not found at Sea Mountain.

***Micromus usingeri* (Neuroptera: Hemerobiidae)**
Members of the genus *Micromus* represent the majority of Hawaii’s predatory brown lacewings, and consists of least 23 species. Numerous species, including *M. usingeri*, are flightless. Flightlessness is a common evolutionary adaptation in lacewings. While the loss of the ability fly must have been advantageous to these lacewings, it also has made them particularly vulnerable to predation by alien insects such as ants. *Micromus usingeri* is only known from a few specimens. None were collected during our survey.

***Distoleon perjurus perjurus* (Neuroptera: Myrmeleontidae)**
Distoleon represent Hawaii’s antlions. Outside of Hawaii, the larvae of antlions generally reside at the base of funnel-shaped depression within loose soil where they catch surface-dwelling insects (including ants) that fall into the funnel. Interestingly, the habits of larvae of Hawaii’s antlions are unknown and only adults have been collected. *Distoleon perjurus perjurus* is known from all of the main islands except Kauai. None were collected during our survey.

***Caconemobius varius* (Orthoptera: Gryllidae)**
The Kaumana cave cricket scavenges the floors and walls of wet caves for food. It is only known from lava caves on the eastern slopes of Mauna Loa and Kilauea volcanoes.

***Thaumatogryllus cavicola* (Orthoptera: Gryllidae)**
The Volcanoes cave cricket feeds on the roots of trees and other plants that have penetrated the ceiling of lava caves. So far, it has been found in the Kilauea area and on west slope of Mauna Loa volcano, including Kealakekua Ranch.

Recommended mitigation measures

No endangered or threatened species were identified during our survey of Sea Mountain, but one species listed as a Candidate for federal protection, *Megalagrion xanthomelas*, was found within the coastal strand habitat. This species requires the coastal ponds and small pools for development of its juvenile stages. Eggs are laid just below the surface on aquatic vegetation. The nymphs primarily feed on small aquatic invertebrates. The primary threats to this species include predation by alien fish and degradation of habitat due to direct disturbance, but may also include chemical runoff from upslope development. *M. xanthomelas* does seem to be able to tolerate the presence of carp, but suffers in habitats containing guppies or top minnows (Polhemus 1996). To maintain populations of this rare damselfly throughout its range, it is important to maintain its habitat at Sea Mountain; mitigating impacts of future development on this habitat is recommended.

Mitigation measures should focus on protecting, and perhaps improving, the coastal strand habitat at Sea Mountain. Foremost, pools should be protected from direct disturbance, such as altering the configuration and integrity of their shores. Controlling alien fish would also likely enhance the habitat for this damselfly. While it may not be feasible to eliminate alien fish within the pools, a reduction in their numbers, particularly during the damselfly's peak breeding periods, may increase reproductive output of the species. Discussions with biologists who have experience with this type of management would be required before initiating a program aimed to modify the pool environment in any way. The pools are also likely sensitive to pollution from adjacent use of the shoreline as well from runoff from upslope activities. In particular, an influx of chemicals from the maintenance of the golf course, lawns and ornamental plants could be detrimental to the pond ecosystem. At least in some instances, *M. xanthomelas* have not been found to be adversely affected by commercial anti-algal treatments used to treat water in some developments (Polhemus 1996). Hydrologists or others familiar with this problem should be consulted to mitigate these potential impacts.

While the coastal strand habitat is clearly critical for maintaining populations of *Megalagrion xanthomelas*, this habitat also may be important for several species of native Yellow-faced bees (*Hylaeus* spp.). These important pollinators of native plants were not collected during our survey, but based on known distributions on the Big Island, combined with the presence of several plants known to be important pollen sources for the bees, it is likely that additional surveys at other times of the year would yield one or more species. Mitigation measures for

these bees would be to maintain, and perhaps enhance, the coastal strand habitat on the Sea Mountain property. This may entail removing non-native plants and re-planting with select native species. Caution should be exercised before modifying this habit, however, as the non-native shrub Christmas berry (*Schinus terebithifolius*) was a favored perching location for *Megalagrion xanthomelas*. Future studies would reveal whether this shrub was simply preferred because it was the tallest perching point in the area or whether it offers other advantages to the damselfly.

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Insects commonly found at Sea Mountain during site survey June-July 2006

Order	Family	Species	Status
Blatteridae	Blaberidae	Diplotera punctata	alien
Coleoptera	Cerambycidae	Syrba alterans	alien
Coleoptera	Coccinelidae	Cryptoloemus montrouzieri	alien
Coleoptera	Coccinelidae	Curinus coerulens	alien
Coleoptera	Coccinelidae	Olla v-nigrum	alien
Hemiptera	Pentatomidae	Plautia stali	alien
Hemiptera	Plataspidae	Coptosoma xanthogramma	alien
Homoptera	Flatidae	Melormenis basalis	alien
Hymenoptera	Anthophoridae	Xylocopa sonorina	alien
Hymenoptera	Apidae	Apis mellifera	alien
Hymenoptera	Evaniidae	Evania apendigaster	alien
Hymenoptera	Formicidae	Anoplolepis longipes	alien
Hymenoptera	Formicidae	Cardiocondyla wraughtoni	alien
Hymenoptera	Formicidae	Plagiolepis alluaudi	alien
Hymenoptera	Ichneumonidae	Pristomerus hawaiiensis	alien
Hymenoptera	Sphecidae	Trypoxylon bicolor	alien
Hymenoptera	Vespidae	Delta sp.	alien

Hymenoptera	Vespidae	Polistes aurifer	alien
Lepidoptera	Hesperiidae	Hyephila phyleus	alien
Lepidoptera	Lycaenidae	Tmolus echinon	alien
Lepidoptera	Nymphalidae	Agraulis vanillae	alien
Lepidoptera	Pieridae	Pieris rapae	alien
Odonata	Coenagrionidae	Enallagma civile	alien
Odonata	Coenagrionidae	Ischnura posita	alien
Odonata	Coenagrionidae	Ischnura ramburii	alien
Odonata	Coenagrionidae	Megalagrion xanthomelas	native
Odonata	Libellulidae	Orthemis ferruginea	alien
Orthoptera	Pyrgomorphidae	Atractomorpha ambigua	alien