Aug. 1999 FEIS
Saddle Road improvements
Part III

FHWA-FPHI-EIS-97-1-F

FINAL
ENVIRONMENTAL IMPACT STATEMENT
PART III

Saddle Road (State Route 200)
Mamalahoa Highway (State Route 190) to Milepost 6

County of Hawai'i, State of Hawai'i
FHWA Project No. A-AD-6(1)

U.S. Department of Transportation
Federal Highway Administration
Central Federal Lands Highway Division

State of Hawai'i
Hawai'i Department of Transportation
Highways Division

FHWA-FPHI-EIS-97-1-F

SADDLE ROAD (STATE ROUTE 200)
Mamalahoa Highway (State Route 190) to Milepost 6
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FINAL ENVIRONMENTAL IMPACT STATEMENT
PART III

Submitted Pursuant to Section 42 U.S.C. 4332(2)(c)
and Chapter 343, Hawai'i Revised Statutes by the

U.S. DEPARTMENT OF TRANSPORTATION
Federal Highway Administration (FHWA)
Central Federal Lands Highway Division
and
STATE OF HAWAI'I
Hawai'i Department of Transportation (HDOT)
Highways Division

Cooperating Agencies
U.S. Army Garrison, Hawai'i
Hawai'i Department of Hawaiian Homelands
Hawai'i Department of Health

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ABSTRACT

This Final Environmental Impact Statement (FEIS) presents the Recommended Alternative and the evaluation of impacts associated with the proposed improvement of Saddle Road between the Mamalahoa Highway (State Route 190) and Milepost 6 near Hilo. Twelve action alternatives were under consideration that incorporate use of the existing alignment and potential new alignments. The Recommended Alternative reconstructs the existing substandard two-lane roadway to a two-lane roadway with shoulders for a design speed of 80 to 100 kilometers per hour. Existing Saddle Road is a narrow, winding, two-lane road with steep grades, sharp curves, and poor pavement, with no shoulders. The existing road passes through key training areas of the U.S. Department of the Army's Pohakuloa Training Area (PTA), creating conflict between motorists and military training units. The Recommended Alternative will improve pavement condition, increase safety and capacity, improve quality of traffic flow, decrease cross-island travel times, and stimulate economic growth and development. The Recommended Alternative will realign the road within the PTA to minimize conflicts between military and public uses. Substantive issues have been resolved and included protected species of flora and fauna, Critical Habitat for the Endangered Palila, wetlands and biological habitats of importance, archaeological resources, fire hazard, residential displacement, and noise.

The FEIS consists of three separate documents: Part I, Part II, and Part III. Part I is the FEIS core document, the revised version of the DEIS. It presents the project purpose and need, alternatives considered, affected environment, environmental consequences, mitigation committments, and an Executive Summary. Part II is the documentation of the public/agency involvement process. It includes the project development history, the project mailing list, correspondence and notices associated with the EIS process, hearing transcripts and associated documentation, and agency and public comments and responses regarding the DEIS. Part III comprises the technical addendum. It includes copies of supplemental studies related to social impacts, 404(b)(1) wetland issues, and Traditional Cultural Properties (TCP). It includes the final archaeological inventory survey report, the Memorandum of Understanding (MOA) related to cultural resources, the Endangered Species Act (ESA) Section 7 Biological Opinion (BO), the Palila Mitigation Memorandum of Understanding (MOU), and supporting correspondence and documentation.

Comments on this FEIS are due on or before the close of business October 5, 1999.

All measuresments in this document are in metric.

<u>Conversion Factors</u>
1 meter = 3.281 feet
1 kilometer = 0.621 miles
1 hectare = 2.471 acres
1 foot = 0.305 meters
1 mile = 1.609 kilometers
1 acre = 0.405 hectares

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LIST OF ABBREVIATIONS

AASHTO .... American Association of State Highway and Transportation Officials
ACC/MVM .... accidents per million vehicle miles
ADT .... average daily traffic
ALF .... A'a Lava Flows
ALISH .... Agricultural Lands of Importance to the State of Hawai'i
ASTM .... American Society of Testing and Materials
BA .... Biological Assessment
BCE .... before the Common Era
BMP .... best management practice
BO .... Biological Opinion
BRD .... Biological Resources Division
C .... Celsius
CAA .... Federal Clean Air Act
CAAA .... 1990 Clean Air Act Amendments
CDP .... Hilo Community Development Plan
CDUA .... Conservation District Use Application
CE .... Common Era
CFR .... Code of Federal Regulations
cm .... centimeters
CWA .... Clean Water Act
CZM .... Hawai'i Coastal Zone Management
DAR .... Defense Access Road
dB .... decibels
dBA .... A-weighted decibel scale
DEIS .... Draft Environmental Impact Statement
DHHL .... State of Hawai'i Department of Hawaiian Home Lands
DLNR .... State of Hawai'i Department of Land and Natural Resources
DHHS .... State of Hawai'i Department of Health and Human Services
DOA .... U.S. Department of the Army
DOD .... U.S. Department of Defense
DOFAW .... State of Hawai'i Division of Forestry and Wildlife
DOH .... State of Hawai'i Department of Health
EIS .... Environmental Impact Statement
EMP .... Ecosystem Management Plan
EO-PTA .... Environmental Office of the PTA
EPA .... Environmental Protection Agency
ESA .... Endangered Species Act
F .... Facultative (Vegetation)
FU .... Facultative Upland (Vegetation)
FW .... Facultative Wetland (Vegetation)

FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
GVP	Gross Value Product
ha	hectares
HAR	Hawai'i Administrative Rules
HCM	Highway Capacity Manual
HDLIR	State of Hawai'i Department of Labor and Industrial Relations
HDOT	State of Hawai'i Department of Transportation
HELCO	Hawaiian Electric Light Company, Inc.
HFBS	Hawai'i Forest Bird Survey
HHCA	Hawaiian Homes Commission Act
HHL	Hawaiian Home Land
HHLP	Hawaiian Home Land Program
HRS	Hawai'i Revised Statutes
IFA	Institute for Astronomy (University of Hawai'i at Hilo)
km	kilometers
kV	kilovolt
L	liters
LEDPA	Least Environmentally Damaging Practicable Alternative
L_{eq}	average noise level over a 1-hour period
LOS	Level of Service
LUPAG	Land Use Pattern Allocation Guide
m	meters
m^3	cubic meters
mm	millimeters
MOA	Memorandum of Agreement (Section 106)
MOU	Memorandum of Understanding (Palila MOU)
MP	milepost
MPO	Metropolitan Planning Organizations
MTMC	Military Traffic Management Command
NAAQS	National Ambient Air Quality Standards
NAC	Noise Abatement Criteria
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NPS	National Park Service
NRC	National Research Council
NRCS	U.S. Natural Resource Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory

OBL .... Obligate Wetland (Vegetation)
OHA .... Office of Hawaiian Affairs
PCB .... Polychlorinated Biphenyl
PLF .... Pahoehoe Lava Flows
PM_{10} .... particulate matter smaller than ten microns in diameter
PTA .... Pohakula Training Area
R .... receptors
RCRA .... Resource Conservation Recovery Act
RCRIS .... Resource Conservation and Recovery Information System
ref .... cross reference
ROD .... Record of Decision
ROW .... right-of-way
SEE Team .... Social, Economic, and Environmental Study Team
SHPD .... State Historic Preservation Division
SHPO .... State Historic Preservation Officer
SIPs .... State Implementation Plans
SLU .... State Land Use
SMA .... Special Management Area
SR 200 .... State Route 200 (Saddle Road)
SR 190 .... State Route 190 (Mamalahoa Highway)
SR 19 .... State Route 19
SR 11 .... State Route 11
SRTF .... Saddle Road Community Task Force
SWPPP .... Stormwater Pollution Prevention Plan
TRB .... Transportation Research Board
UPL .... Obligate Upland Plants
URARPAPA .... Uniform Relocation Assistance and Real Property Acquisition Policies Act
U.S. DOT .... U.S. Department of Transportation
USACE .... U.S. Army Corps of Engineers
USAG-HI .... U.S. Army Garrison, Hawai'i
USARPAC .... U.S. Army Pacific Command
USFWS .... U.S. Fish and Wildlife Service
USGS .... U.S. Geological Survey
UST .... underground storage tanks
VA .... Volcanic Ash Deposits
vpd .... vehicles per day

SUPPLEMENT TO SOCIAL IMPACT ASSESSMENT
TERRY 1998

SOCIAL IMPACT ASSESSMENT

SADDLE ROAD

REALIGNMENT AND IMPROVEMENTS

OCTOBER 1998 SUPPLEMENT

Prepared October 1998
for Okahara & Associates
by Ron Terry, Ph.D., Keaau, Hawaii

INTRODUCTION

Background

This supplement has been prepared in fulfillment of the subcontract requirements of GeoMetrician Associates with Okahara & Associates as part of Contract No. DTFH68-97-D-0011 for completion of engineering and environmental services related to the Saddle Road project.

Purpose

The purpose of this report is to contribute to the updating and revision of the *Draft Environmental Impact Statement, Saddle Road (State Route 200), Mamalahoa Highway (State Route 190) to Milepost 6*, prepared by the U.S. Department of Transportation, Federal Highway Administration, Central Federal Lands Highway Division.

Contents

This report consists of three sections: the first presents the results of a survey of motorists on the Mauna Kea Access Road; the second discusses a study of traffic origins and destinations on Saddle and Waikoloa Roads; and the third consists of miscellaneous information concerning recreational resources and usage patterns that has been requested by FHWA subsequent to comments received on the Draft EIS.

1. Mauna Kea Access Road User Survey

Agency and public comments during the public review process that followed release of the Draft EIS in November of 1997 raised several questions concerning use patterns that were not addressed in the original document. The purpose of this section of the report is to provide information and analyses concerning the Mauna Kea Access Road, in particular, answers to the following questions:

- What is the current level of traffic on Mauna Kea Access Road?
- What types of uses are being undertaken by road users, and in roughly what proportions?
- Does the substandard condition of the Saddle Road influence the decision of potential travelers to access the summit of Mauna Kea?
- Will improving the condition of the Saddle Road tend to increase the number of visits to the summit?
- If so, which types of groups are most likely to increase their usage?

Background

Mauna Kea is a valuable natural and cultural resource. At 13,796 feet in elevation, the mountain is the highest point in oceanic Pacific. Although most widely known for its unparalleled collection of astronomical observatories, Mauna Kea also has striking volcanic scenery, unique tropical alpine ecosystems, important archaeological and cultural sites, and high quality outdoor recreation.

The first rough Mauna Kea Access Road was built in 1964 and has been steadily improved since. The road provides access to fourteen observatories of various corporate and government ownership, collectively representing over $600 million in investment. It also leads to the Hale Pohaku Visitor's Center, which features astronomical and natural history exhibits and stargazing. Non-observatory related attractions accessed by the road are the Mauna Kea Forest Reserve (used for hunting and hiking), the Mauna Kea Ice Age Natural Reserve Area, and the Keanakakoi National Historical Landmark, site of an ancient adze quarry.

Traffic Volumes

Mauna Kea Support Services (MKSS) of the University of Hawaii's Institute for Astronomy report that about 40,000 people per year make use of the Visitor Center. When Mauna Kea has snow, as many as 1,000 vehicles per day make the trip to the summit.

Average traffic has been recorded automatically since 1993 at Hale Pohaku. MKSS data shows the following trends in vehicles per day (two-directions):

1993	81	*1994*	106
1995	106	*1996*	122
1997	123		

Relationship of Saddle Road Project to Mauna Kea Access Road

Based on interviews with local officials and input at public workshops concerned with impacts, the EIS hypothesized that improvements to Saddle Road might have the potential to draw more traffic and recreational users into the Saddle and onto the mountains. In the view of workshop participants, this could have both positive and adverse effects. Among beneficial impacts cited were:

- Potential for greater use of roadside areas for education, recreation and gathering; Mauna Kea State Park and Hale Pohaku would be more accessible, especially for day activities; and
- Ecotourism ventures would benefit from better access to attractions on Mauna Kea, Mauna Loa, and in the Saddle.

However, negative aspects include:

- Adverse effects of increased usage of surrounding lands by off-road vehicles and mountain bikes, such as fire hazard, weed transmission and soil erosion; and
- Increase in inappropriate traffic to Mauna Kea Summit, including unauthorized 2-wheel drives, which cause accidents, rescue needs and road damage.

Visitor Survey

In order to assess more accurately the potential for increased traffic, the FHWA commissioned a three-day survey of mountain visitors at the Hale Pohaku Visitor's Center. The intent of the survey was to record the place of residence, trip origin, purpose of trip, and attitudes concerning the existing Saddle Road and potential use of Mauna Kea if the road is improved. A copy of the survey and a summary of results are attached.

A team of two interviewers conducted the survey from 11 AM to 7 PM on March 14 (Saturday), June 13 (Saturday), and June 25 (Thursday), 1998. All days were fair, with no snow at the summit. On both Saturdays there were stargazing shows planned for the evening at the Visitor's Center. A total of 76 parties comprising 246 individuals was interviewed. The team spoke with the leader of each party and as many individuals as possible in order to gather information about both the party and the individuals involved. Based on ambiguities in the original questionnaire detected during the March fieldwork, the questionnaire was revised in several areas.

In the judgement of the author, the survey managed to reach a representative cross-section of Mauna Kea users, including a good geographic balance and a mix of work and pleasure users (see statistical summary, attached as an appendix to this report). Because the sample size is small, however, a large margin of error would have to be assigned to all statistical findings. It should be understood that this survey is intended to indicate *general trends*, and not to provide actual percentages of identity, opinions or behavior about Mauna Kea users.

The top reasons users cited for visiting the summit were to enjoy the summit and the view it affords. Stargazing and visiting observatories was the next most common activity (for the public, the stargazing component occurs at Hale Pohaku, and a summit trip may not be made). Relatively few respondents identified hiking or viewing archaeological sites as part of their agenda.

The main finding of the survey was that for the overwhelming majority of users (75.3 %), the condition of Saddle Road was not a major factor in their decision to make the trip. Similarly, few respondents (12.2%) reported that they would significantly increase their frequency of visits as a result of improvements on Saddle Road. Most (73.6%) who were able to estimate how their usage would vary responded that there would be no change to the number of visits they made.

Most of those who estimated that their number of visits would increase were hikers or native Hawaiians who had visited Mauna Kea for cultural/spiritual reasons.

Conclusions

It is acknowledged that a survey gauging opinions of a small sample of visitors can be quite different from actual behavior of a new generation of visitors who will be driving on a real, improved highway instead of speculating about how they would respond to hypothetical improvements. However, based on the attitudes reported in this survey, use of Mauna Kea would be expected to increase very slightly as a result of improvements in Saddle Road. If current patterns persist, users will focus their activities at the Visitor Center and at the summit. Increasing activity related to scientific investigation, stargazing, hiking and other recreational use is likely to occur.

Potential Impacts and Proposed Mitigation Measures

As discussed above, the potential for increased access to Mauna Kea has many benefits, including increased recreational, scientific and educational opportunities for Big Island residents and visitors. At the same time, there is the potential for more intentional or inadvertent disturbance of natural and cultural resources.

Inasmuch as access to Mauna Kea and monitoring of activity on the summit are controlled by the Hawaii State Department of Land and Natural Resources (DLNR) and the University of Hawaii's Institute for Astronomy (IfA), any practical measures to control access must be undertaken by these agencies. IfA has convened a committee to study all Mauna Kea issues as part of a new Master Plan for development and management of the mountain. The following mitigation measures are recommended for their consideration by this group:

- Increased educational exhibits and programs at Hale Pohaku to inform users of the delicate nature of the resources and to enlist visitors' assistance in preserving them.
- Installation of appropriate regulatory or interpretive signage at Hale Pohaku and/or the intersection of Mauna Kea Access Road and Saddle Road.
- Conducting a study to consider restricting access to Mauna Kea at Hale Pohaku to four-wheel drive vehicles only through use of
  - a) a security guard
  - b) a double gate (a "good" road with a locked gate or electronic card for authorized personnel and an ungated but very rough 4-wheel drive road to prevent access by 2-wheel drives),
  - c) an admission fee, or
  - d) other appropriate measures

2. Origins/Destinations of Trips on Saddle and Waikoloa Roads

The Final EIS for the Saddle Road project will include a recommendation on whether to select W-2 (connecting to the Mamalahoa Highway at Waikoloa Road) or W-3 (connecting several miles to the south). Many factors must be considered, including the quality of natural and cultural resources, cost, impact to adjacent land uses and intersection characteristics.

Another factor that is the subject of this section of the report is the ultimate origin and destination of travelers on Saddle Road. Prior to this study, there were no data concerning ultimate origins and destinations, although the average daily and peak hour traffic volumes for various points along the Saddle, Mamalahoa, and Waikoloa roads were known. It was hypothesized that the majority of motorist trips on Saddle Road were between Hilo and either Kona or Waimea. The percentage of traffic bound to or from Waikoloa Road was unknown. The distribution of trip origins and destinations has a direct and important bearing on the selection of W-2 or W-3, because selection of W-2 favors Waikoloa motorists who would thus not be required to "jog" along Mamalahoa Highway, while W-3 favors Kona motorists by shortening the trip to Kona. It is important to note that the distance to Waimea along W-3 is 1.8 miles longer than along W-2.

Therefore, the FHWA commissioned a study of trip origins and destinations. This study was accomplished on Saturday, February 14, 1998. Parties of observers were assigned to the intersections of Mamalahoa Highway with Saddle Road and Waikoloa Road, where they noted the license plate and turning movement of each motor vehicle during three two-hour periods (7:30 am – 9:30 am, 11:30 am – 1:30 pm, 3:30 pm – 5:30 pm). The results of this survey are presented in Table 1 below.

Table 1

Origin and Destination of Trips on Waikoloa and Saddle Road, February 14, 1998

[All data are percentages]

Ultimate Destination of Vehicles Turning OFF Saddle Road

Saddle Station	To Waimea	To Kona	To Waikoloa
7:30 - 9:30	26	70	5
11:30 - 1:30	33	33	33
3:30 - 5:30	46	33	21

Origin of Vehicles Turning ONTO Saddle Road

Saddle Station	Fr. Waimea	Fr. Kona	Fr. Waikoloa
7:30 - 9:30	29	64	7
11:30 - 1:30	45	40	14
3:30 - 5:30	20	54	26

Ultimate Destination of Vehicles Turning OFF Waikoloa Road

Waikoloa Station	To Waimea	To Kona	To Saddle
7:30 - 9:30	84	14	2
11:30 - 1:30	78	16	6
3:30 - 5:30	76	11	13

Origin of Vehicles Turning ONTO Waikoloa Road

Waikoloa Station	Fr. Waimea	Fr. Kona	Fr. Saddle
7:30 - 9:30	87	11	2
11:30 - 1:30	80	11	9
3:30 - 5:30	79	16	5

The study found that the proportion of motor vehicles travelling between the Saddle Road and Kona via the Mamalahoa Highway was consistently a much higher fraction of the total traffic than the proportion traveling between Saddle Road and Waikoloa Road. The actual amount varied by time period, but in general, Kona vehicles exceed Waikoloa vehicles by more than a 3:1 ratio. It must be noted that the data reflect only a one-day sample and are indicative of current, and not necessarily future, travel patterns. Nevertheless, the results clearly indicate that W-3, which is more than 3 miles shorter between Hilo and Kona, would more effectively serve the majority of traffic using the Saddle Road.

3. Additional Information Concerning Recreational Patterns

This section responds to a series of questions posed by the FHWA as part of responding to comments on and revising the Draft EIS. As the questions are not necessarily related, they are addressed individually. The information is based on both research accomplished for the Draft EIS but not discussed in the Social Impact Assessment, and on new research. The new research included:

1. Examination of records and reports concerning hunting and other recreation maintained by the Hawaii State Department of Land and Natural Resources and the U.S. Army;
2. Research on habitat quality for wildlife biota; and
3. Interviews with the following persons: Ecotourism operators (Hugh Montgomery, Pat Hart); State natural resources officials (Miles Nakahara, Todd Lum, Jon Giffin, Paul Conry); environmental activists (Nelson Ho); hiking and biking club leaders (Virginia Doty, Chris Seymour); hunters (Steve Hurt); biologists (Grant Gerrish, Lena Schnell, Reginald David); and other scientists who use the mountain (James Juvik, Fred Stone, Rick Warshauer).

What is the extent of recreational activities other than hunting that might be affected by the various alternatives of the proposed project? How might they be affected? If adversely, what mitigation measures could avoid, reduce or compensate for these impacts?

As stated in the Social Impact Assessment (SIA), many residents hunt, hike, and gather resources in the Saddle. The Saddle Road provides access to a number of recreational areas, including the Mauna Kea summit, Mauna Kea State Park, and Mauna Loa. In addition to hunting, which was extensively discussed in the SIA, hiking, birding, winter sports, camping, bicycling, runners, plant gathering and other activities occur.

Hiking trails accessed by the Saddle include Pu`u Huluhulu (a short hike up a cinder cone that has been fenced to preserve its fine, mostly native vegetation), Power Line Road, the Wailuku River Trail, and Tree Planting Road. According to hikers interviewed, the only directly affected area of particular concern is the Pu`u O`o Trail, where hikers wish to preserve access and parking. Many tour groups using Mauna Kea also hike in the summit region, including the Adze Quarry, Lake Waiau, and Pu`u Wekiu. For the summit region, other than the indirect effects discussed in Part 1 above, the Saddle Road would have no effects other than the benefit of providing safer, faster access.

Birding can be excellent at elevations above 3,000 feet on the eastern end of the Saddle Road, where many native birds are present. Again, the Pu`u O`o area, particularly the trailhead, is of special concern. Birders also access the forest from other locations on Saddle Road. Preserving reasonable access to the forest is considered important, just as with hunters. Therefore, long stretches where parking is prohibited would interfere with the freedom of birders to select areas for observation.

Winter sports in the area occur exclusively on the summit region of Mauna Kea, which is accessed by but many miles away from the Saddle Road. When Mauna Kea has snow, as many as 1,000 vehicles per day make the trip to the summit, about 10 times the average traffic level (Source: Ron Kohler, Mauna Kea Support Services). Other than indirect effects (discussed in Part 1, above), the Saddle Road would have no effects other than the benefit of providing safer, faster access.

The only designated **camping** area in the Saddle area is at Mauna Kea State Park. The proposed improvements would not affect the park.

Mountain and road biking on and near the Saddle is popular with a small group of local bicyclists. The area also attracts national and international bikers. The Big Island Mountain Biking Association publishes a map of mountain bike trails that includes the Mana Road, which branches off the Mauna Kea Access Road about a mile from its origin on the Saddle Road. Biking is also popular on the Mauna Kea Access Road, Mauna Loa Observatory Road, and on the Saddle Road itself. The high altitude rides are particularly valued for training by professional or amateur racers. The U.S. Army has opened Trail 1 in PTA to mountain biking, and a yearly event takes place there. Mountain bikers also use Parker Ranch and the Pu`u O`o trail. According to local bikers, preservation of the Pu`u Huluhulu parking area (which is also used by hikers as a hunter checking station and by hikers on Pu`u Huluhulu would be appreciated. The wide, paved shoulders planned for the Saddle Road would greatly improve conditions for riders on the road itself.

For **runners**, the Mauna Kea Relay, a 62-mile (100 km) road race held annually in April, traverses the entire Saddle Road. The event has attracted between a few dozen and a few hundred runners since its inception in the 1970s. According to observations of regular users of the Saddle Road, a small number of runners also train independently on an infrequent basis on the Saddle road.

Gathering of traditional plant material occurs at various locations and times, but is especially common just off the shoulder of the highway between approximately mileposts 8 and 13 before parties or important ceremonial occasions such as hula festivals. Maintenance of the corridor of natural vegetation along the road's edge is important.

Another important but often overlooked activity that occurs in this area is **scientific research.** Field trips and experiments in plant ecology, invertebrate ecology, climatology and geology are common. Several universities, including the University of Hawaii at Hilo, the University of Hawaii at Manoa, and Stanford University have ongoing research projects with total budgets in excess of one million dollars.

Recommendations:

Interviews with ecotourism operators, hike leaders, other recreationalists and scientists indicate that in general, the Saddle Road is regarded as useful and beneficial because it provides access to the resources to be enjoyed or studied. There is overwhelming support for the proposed improvements. Because of the precautions that have been undertaken to avoid kipukas and other important natural features, none of the proposed alternatives would directly affect important resources requiring preservation. However, the following recommendations should be considered.

- Provide parking and pullouts at Pu`u O`o, Pu`u Huluhulu, and the Wailuku River Trail. Preserve access to other for hikers, birders, and hunters.
- Maintain the corridor of natural vegetation that fringes the Saddle Road in its eastern section by controlling alien species invasion, in order to preserve the materials needed by plant gatherers.

Was the area known as Kipuka Alala ever officially open to hunting? If so, when, and why and when was it closed?

After extensive research and consultation with the Hawaii State Department of Land and Natural Resources, the U.S. Fish and Wildlife Service, and the U.S. Army, the author was unable to find any evidence indicating that this area was ever open to hunting. It must be stated that few detailed records exist for the period before 1950.

What would be the effects on hunting resources of fragmenting the Trail 1 area with PTA-1 road alignment? If adverse, what mitigation measures could avoid, reduce or compensate for these impacts?

Fragmentation of habitat occurs when an intact area required by an animal population for its nutritional, reproductive, or other needs is divided into fragments that themselves may be too small or widely separated by degraded habitat to support the minimum population size necessary for population health and stability[1]. In dealing with alien wildlife resources, as with the game mammal and bird species at PTA, the focus is to provide a stable supply of sufficient game for hunters. It is important to note that even if the total size of the habitat take may be small, the effects of fragmentation may be large. The discussion that follows considers the effects of how Alternatives PTA-1 and PTA-3 would bisect the habitat of game mammals and birds within the Humuula section of PTA. The maximum area that would be directly taken would be 91 ha (224 acres) (including safety zones) of the Humuula Unit.

Hunter reported data from PTA for 1996 indicate that only 7 sheep and 3 pigs were harvested from Humuula. This is less than 6 percent of the total number of sheep harvested from PTA and less than 8 percent of pigs. In comparison to other areas of PTA (Bobcat - 58 sheep; Kapele 13 pigs) and particularly to State hunting units (Pu'u Anahulu - 113 sheep; Unit B - 243 pigs), these are not substantial harvest numbers. Discussion with hunting officials indicates that 1996 was a fairly representative year in terms of proportions of game mammals taken within various units. Because this area does not support a significant or important population of game mammals, the issue of fragmentation of mammal habitat is moot.

In contrast with mammals, bird hunting in the Humuula unit accounted for a substantial proportion (23.0 percent) of all birds harvested at PTA in 1996. A wide variety of species were represented in what is probably the most diverse assemblage among the PTA hunting units. Humuula compares favorably in terms of both total game harvested and diversity of game resources with the finest of similar-sized State hunting units. However, game bird experts do not believe that highways on the scale proposed for the Saddle Road pose serious obstacles to game bird movement. Birds move freely across roads of similar or larger size. In fact, many hunters report excellent hunting in areas near the existing Saddle Road, Mauna Kea State Park, and other disturbed areas with similarly "fragmented" habitat.

In conclusion, although the road will bisect marginal habitat for game mammals and good habitat for bird hunting, there is no evidence that this division produce fragmentation, i.e., adverse effects to the health and stability of the game bird population.

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1 Richard B. Primack. 1995. *A Primer of Conservation Biology*. Sunderland, Mass.: Sinauer Associates. p. 76.

APPENDIX TO OCTOBER 1998 SUPPLEMENT
MAUNA KEA USAGE SURVEY
SADDLE ROAD IMPROVEMENT E.I.S.

The following survey is being conducted by Okahara & Associates of Hilo, Hawaii on behalf of the Federal Highway Administration. The purpose is to determine current use and predict future use of Mauna Kea. We would appreciate your cooperation in answering the questions below.

1. The number of people in our party is ____________

2 Place(s) of usual residence ____________________________

3. Estimated number of hours on Mauna Kea today ____________________
   Did you visit summit? ____________

4. Reason for being on Big Island ____________________________

5. Our purpose in visiting the mountain is (circle all that apply):

Work:
- Astronomy
- Other scientific research
- Maintenance
- Construction
- Conducting tour
- Other __________

Pleasure:
- Seeing summit
- Enjoying view from summit
- Seeing/visiting the observatories
- Hiking
- Viewing archaeological sights
- Cultural/religious reasons
- Other __________

6. Our *primary* purpose in visiting the mountain is ____________________

7. Did you access Hale Pohaku from the Hilo or Kohala/Kona side? __________

8. Please pick the response which best suits your trip today:

a) The condition of the Saddle Road was a major factor in deciding to make this trip.
b) The condition of the Saddle Road was a minor factor in deciding to make this trip
c) The condition of the Saddle Road was not a factor in deciding to make this trip.

9. How many times per year do you visit Mauna Kea?
a) 1-2 b) 3-4 c) 5-6 d) 7-8 e) 9-10 f) 11-20 g) >20 h) no idea i) this is my first time

10) If the Saddle Road (*not the Mauna Kea Access Road*) is improved to the quality of a standard state highway, how many times per year will you visit Mauna Kea:
a) 1-2 b) 3-4 c) 5-6 d) 7-8 e) 9-10 f) 11-20 g) >20 h) no idea

MAUNA KEA ACCESS ROAD SURVEY QUESTIONNAIRE RESULTS

Dates of survey: June 13 and June 25, 1998
n=35 parties, 135 individuals

1. *Number in party*

Party Size	1	2	3	4	5	6	7	8	9	10+
No. Parties	1	13	6	6	1	1			1	3

Total number of individuals = 135

2. *Place of usual residence (individuals)*

Big I.	Other HI	Mainland	Foreign
26	**51**	**40**	**12**

5. *Purpose in visiting the mountain (percent of respondents in each category):*

Astronomy	**0.8**	Seeing summit	**79.2**
Other scientific	**0.0**	Enjoying view	**53.3**
Maintenance	**0.0**	Winter sports	**0.0**
Construction	**0.0**	Hiking	**7.4**
Conducting tour	**3.1**	Viewing archaeo.	**3.1**
Riding Dirt Bikes	**3.1**	Cultural/religious	**16.2**
		Education	**0.0**
		Observatories/Stargazing	**38.5**

7. *Did you access Hale Pohaku from the Hilo or Kohala/Kona side? (percent individuals)*

Hilo	Kohala/Kona
40.1	**59.9**

8. *How big a factor was Saddle Road in deciding to make trip? (individuals)*

Saddle Road was a major factor	**0.1%**
Saddle Road was a minor factor	**23.7%**
Saddle Road was not a factor	**75.3%**

9. *If the Saddle Road is improved*

Visits would not increase	**73.6%**
Visits would increase slightly	**14.0%**
Visits would increase substantially	**12.2%**

Note: substantial increase is defined as an increase of more than one level in the survey

**404(b)(1) ANALYSIS REPORT
AND RELATED CORRESPONDENCE**

404(b)(1) ANALYSIS REPORT

Saddle Road (State Route 200)
Mamalahoa Highway (State Route 190) to Milepost 6

County of Hawaii, State of Hawaii
FHWA Project No. A-AD-6(1)

U.S. Department of Transportation
Federal Highway Administration
Central Federal Lands Highway Division

MAY 1, 1998

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Section 404(b)(1) Analysis
Hawai'i State Route 200, Mamalahoa Highway to Milepost 6
Saddle Road

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INTRODUCTION

Background

The Federal Highways Administration, Central Federal Lands Highway Division (FHWA) in cooperation with the State of Hawaii Department of Transportation (HDOT) and the Department of Defense (DOD) is proposing to reconstruct the existing Saddle Road to meet modern highway design standards and to provide a safe and efficient roadway. A Draft Environmental Impact Statement (DEIS) was made available for public and agency review in October, 1997 with Notice of Availability published in the Federal Register on November 7, 1997 and the Hawaii Office of Environmental Quality Control on November 8, 1997. Public Hearings were held on December 11 and 13, 1997. Comments on the proposed project were received through February 12, 1998. The Environmental Protection Agency (EPA) requested more information regarding the development and selection of the alternative alignments. The EPA's comment is based upon requirements of the Memorandum of Understanding regarding the National Environmental Policy Act and Clean Water Act Section 404 Integration Process for Surface Transportation Projects in the State of Hawaii (MOU) which was consummated on February 2, 1995. The Saddle Road project commenced prior to the enactment of this MOU and therefore is considered a "pipeline" project. Pursuant to Section X of the MOU, "pipeline projects which were extant on the date of the MOU may proceed to the next concurrence point without prejudice; however, signatory agencies may request and receive information developed in earlier phases of the project". The United States Army Corps of Engineers (USACE) also requested a 404(b)(1) analysis for those sections of the proposed project which impact jurisdictional wetlands.

Purpose of the 404(b)(1) Analysis Report

This report is intended to address both the EPA and USACE concerns and requirements. Much of the following information can be found in the Saddle Road DEIS and the Technical Appendices and is repeated here to provide a clearer understanding of the project in the context of this analysis. The preparation of this report is in accordance with the "Guidance Papers to Facilitate the Implementation of the Memorandum of Understanding for the NEPA and Section 404 Integration Process for Surface Transportation Projects in Hawaii" (Guidance Papers), June 1994, by staff personnel of the MOU Signatory Agencies. This Section 404(b)(1) analysis was also prepared in conformance with the 40 CFR Part 230 Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (Guidelines).

Requested Decisions on 404 Issues

Based on information presented in this report, FHWA is seeking decisions from the MOU signatory agencies on the following items in order for the project to move forward to the Final EIS phase:

- The project proponents request concurrence on the selection of the least environmentally damaging practicable alternative (LEDPA).

- The project proponents seek concurrence on the scientific information, engineering data

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- The project proponents request concurrence on the selection of the least environmentally damaging practicable alternative (LEDPA).

- The project proponents seek concurrence on the scientific information, engineering data and analysis, and factual determinations provided in the attached Section 404 (b)(1) analysis (Appendix A).

- While attempting to implement the MOU for the project, it became apparent that the strict implementation of the MOU would be difficult and not in the best interest of the project proponents or the permitting agencies. The sections of the project requiring an individual Section 404 permit are Sections III and IV. Since funding for these sections is not currently available and may not be available for some time, and since the wetlands delineation necessary to obtain the permit is valid for only 3 years, the project proponents request that the permit application be deferred on these sections.

- A wetlands delineation has been completed and a wetlands report and 404 permit application have been submitted to the USACE. The project proponents are requesting to withdraw the previously submitted permit.

- The project proponents also request concurrence that commitments to mitigation for wetlands impacts should be presented in the Final EIS and Record of Decision in a general, schematic way and that final mitigation commitments are allowed to be determined in specific detail during an EIS and 404(b)(1) re-evaluation when Sections III & IV are advanced at a later date. It is proposed that this commitment to future document re-evaluation will be contained in the Final EIS and Record of Decision. This will allow flexibility and assure that mitigation is in accordance with then currently accepted agency practices and procedures, project specific environmental resource constraints, and the body of scientific knowledge regarding wetlands resources in Hawaii at the time of actual roadway construction.

- The project proponents request concurrence on the conceptual mitigation proposal or plan provided in this report.

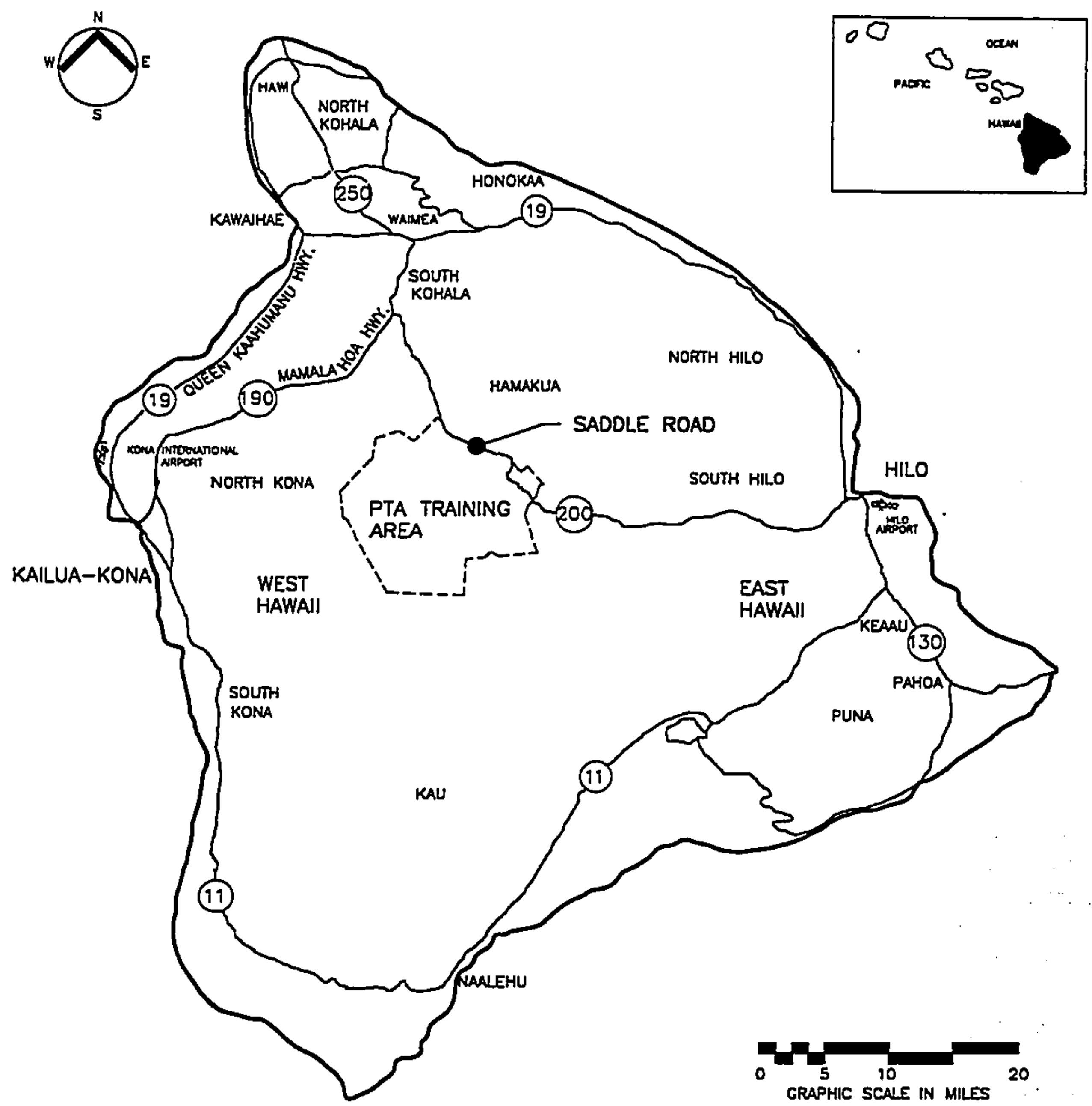
- The project proponents request that decisions by the signatory agencies on the preceding requests are furnished to the FHWA in letter form within the 45 day period allocated for such coordination in the MOU (Section X. Agency Commitments, Para E. Project Development Stage, Subpara 3.).

PROJECT DESCRIPTION

Description of Existing Roadway

Saddle Road, State Route 200 (SR 200), is a two-lane road approximately 85 km in length extending westerly from Hilo to a junction with State Route 190 (SR 190), the Mamalahoa Highway, approximately 10 km south of Waimea, on the Island of Hawai`i.

Saddle Road is a shorter route than Highway 19 (SR 19) and Highway 11 (SR 11), the other two alternative east/west routes (Figure 1). In its current poor condition, Saddle Road does not



ISLAND OF HAWAII MAJOR ROADWAYS

FILE: M-RDWAYS.DWG

FIGURE 1

provide a viable cross-island link. Cross-island traffic uses SR19 predominantly. Saddle Road serves as an alternate route when flooding, landslides, or other emergencies or disasters cause road closures on SR 19 or SR 11. Information on the traffic conditions, traffic patterns, level of service, and accident history of Saddle Road is provided in the Purpose and Need section of this report and in the Draft EIS.

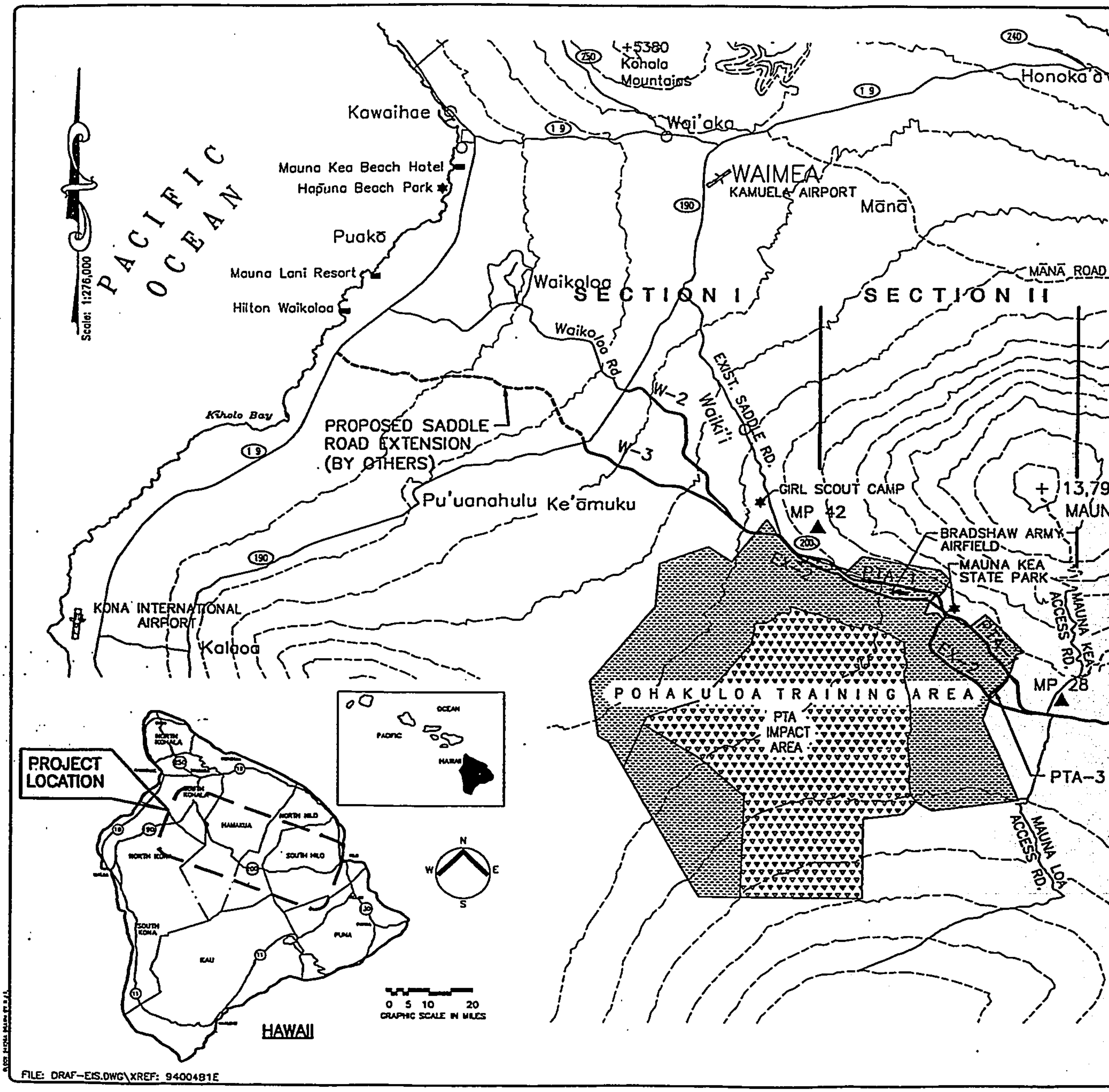
For this project, the logical termini were determined to be the Mamalahoa Highway and MP 6 near Hilo. The Mamalahoa Highway was determined to be the western project terminus because it represents a separate, established transportation route. MP 6 was determined to be the eastern project terminus because it represents the extent of previous road improvements to Saddle Road, and is the site of a future connection with the proposed Puainako Street Extension (Figure 2).

<u>Saddle Road Use Patterns</u>
Saddle Road is the only paved arterial serving the Mauna Kea Science Reserve International Astronomical Observatory Complex (University of Hawai`i Observatory), residential areas of Waiki`i Ranch and Kaumana, Mauna Kea State Recreation Area, and the Kilohana Girl Scout Camp. It serves as access to the state's major hunting areas on Mauna Kea, Kaohe, PTA, Mauna Loa, Kipuka `Ainahou, Hilo Forest Reserve, and Upper Waiakea Forest Reserve. Saddle Road is also important for providing a cross-island transportation route to connect East and West Hawai`i for business travel, the transport of goods and services, tourism/recreation, shopping, and commuting. Commuting patterns between east and west Hawaii are expected to intensify concurrent with expansion of the visitor industry on the west side.

Saddle Road is the only paved arterial serving the PTA. No permanent training units are stationed at the PTA. The facility serves as a light infantry, Division capable live-fire training facility for the U.S. Army Pacific Command (USARPAC) and other Pacific Command Units. The transportation of ammunition, training equipment, and troops from harbors on both the west and east side of the island creates long, slow-moving convoys on Saddle Road. Saddle Road is also used by PTA personnel to commute to and from work and between training areas.

Traffic distribution on Saddle Road is estimated at 50 percent in each direction. Trucks of all axle configurations constitute approximately 10 percent of the total traffic on Saddle Road. Current traffic volumes on Saddle Road are 900 vehicles per day (vpd), both directions, and future volumes for the end of the 20 year design period for the proposed project are anticipated to be 14,000 vpd.

<u>Other Relevant Transportation Projects</u>
Two other relevant transportation projects have been initiated by HDOT that would further enhance the role of Saddle Road as a vital transportation route within the region. These include the proposed extension of Saddle Road from Mamalahoa Highway to Queen Ka`ahumanu Highway, and the Puainako Street Extension (Figure 2). The scoping process has begun for the proposed extension of Saddle Road from the Mamalahoa Highway to Queen Ka`ahumanu Highway. The Preliminary Draft EIS for the Puainako Street Extension has been prepared and



+5380
Kohala
Mountains
Kawaihae
Wai'aka
Honoka'a
Mauna Kea Beach Hotel
Hapuna Beach Park
WAIMEA
KAMUELA AIRPORT
Mānā
PACIFIC
OCEAN
Puakō
Mauna Lani Resort
Hilton Waikoloa
Waikoloa
SECTION I
SECTION II
MĀNĀ ROAD
Scale: 1:276,000
Waikoloa Rd
W-2
Waiki'i
EXIST. SADDLE RD.
Kiholo Bay
PROPOSED SADDLE
ROAD EXTENSION
(BY OTHERS)
W-3
GIRL SCOUT CAMP
MP 42
Pu'uanahulu
Ke'āmuku
BRADSHAW ARMY
AIRFIELD
MAUNA KEA
STATE PARK
MAUNA KEA
ACCESS RD.
KONA INTERNATIONAL
AIRPORT
Kalaoa
EX-2
PTA-1
PTA-2
EX-3
MP 28
POHAKULOA TRAINING AREA
PTA
IMPACT
AREA
PTA-3
MAUNA LOA
ACCESS RD.
PROJECT
LOCATION
OCEAN
PACIFIC
HAWAII
NORTH KOHALA
SOUTH KOHALA
HAMAKUA
NORTH HILO
SOUTH HILO
NORTH KONA
SOUTH KONA
PUNA
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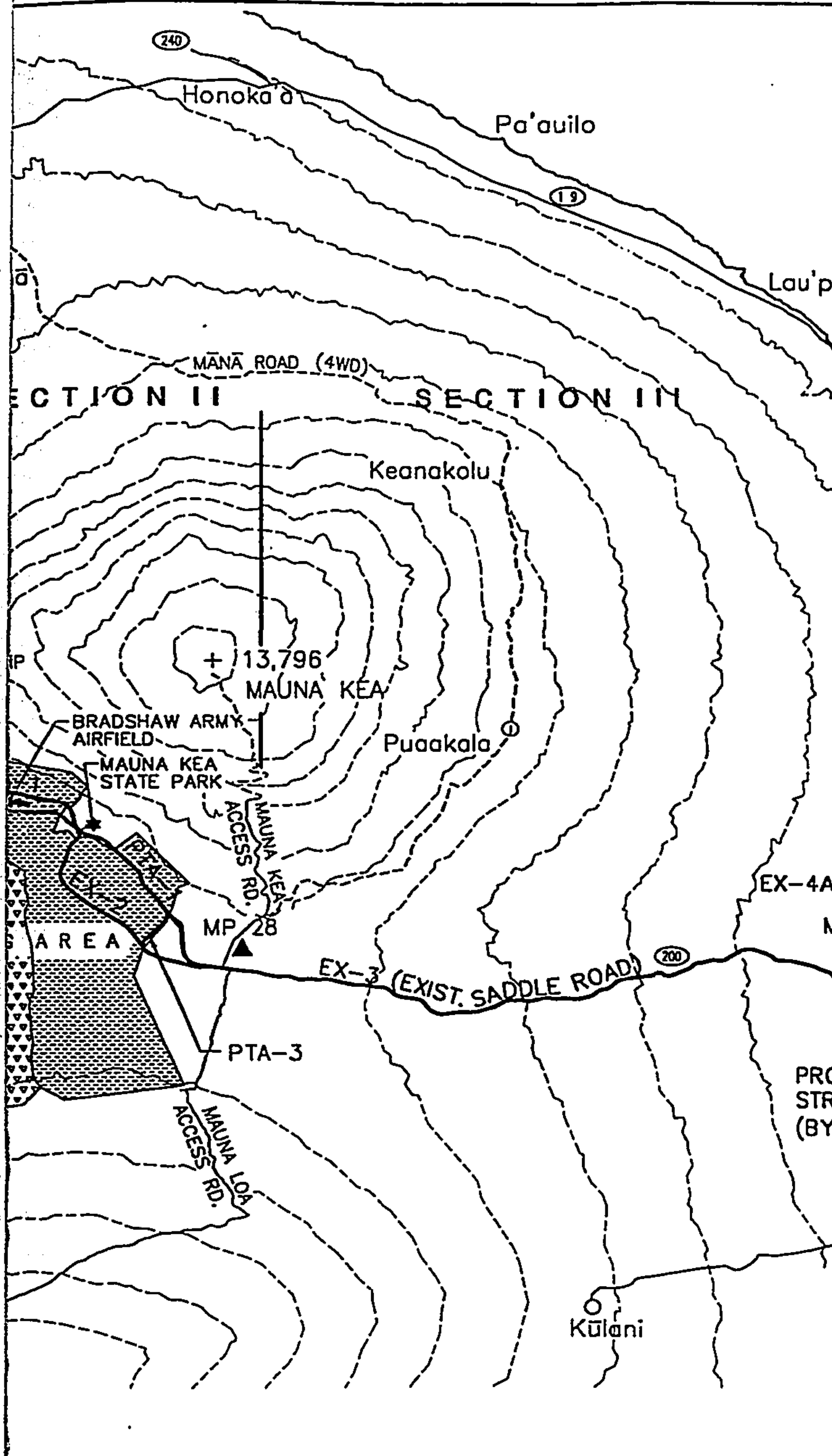


U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

PROPOSED SADDLE ROAD DRAFT EIS ALIGNMENTS

FIGURE 2

preparation of the Draft EIS is underway. The termini for the proposed Saddle Road project addressed in the Draft EIS and this report are logical from a regional transportation needs perspective regardless of whether these two related projects are built.

Design Parameters

Design parameters were agreed upon during the project development scoping phase at SEE Team interagency meetings. The minimum design speed is 80 km per hour with a 100 km per hour design speed used where feasible. The minimum curve radius is 230 m, the maximum superelevation is 8 percent and the maximum grade is 8 percent. Very short lengths of the road will exceed 8 percent where potential social, economic and environmental impacts dictate the use of a steeper slope.

The standard typical section will consist of two 3.6 m (12-foot) travel lanes and two 2.4 m (8-foot) paved shoulders as shown in Figure 3. In areas where standards warrant, an uphill passing lane may be incorporated into the roadway design.

All design parameters were selected to be in conformance with the American Association of State Highway and Transportation Officials national standards for rural arterial roadways and minimum HDOT design criteria. These design standards are required for the roadway to provide the intended function within the State transportation system and meet the proposed project's purpose of providing a safe and efficient facility, capable of accommodating future traffic volumes while serving as viable east/west access route.

PURPOSE AND NEED

Background

Saddle Road was constructed in 1942 by the DOA. In 1945, the road was released by the Federal Government and turned over to the Territory of Hawai'i. The Territory of Hawai'i maintained the road until 1957 when the lack of territorial funds necessitated transfer of road maintenance to the County of Hawai'i. In 1965, the State of Hawai'i authorized the establishment of a State highway system. Saddle Road was included in this State system and an agreement was made in 1968 between the County and the State to exchange the road jurisdiction. This agreement was never implemented however, because of a lack of State funding; thus, the County has continued to maintain Saddle Road up to the present.

Saddle Road is a narrow, winding, two-lane road with steep grades, sharp curves, poor pavement, and substandard drainage (Rust 1996a). Because of poor pavement condition and the absence of roadside safety clear zones, Saddle Road is driven by motorists as a one-lane roadway over most of its length. Between 1988 and 1992, the County of Hawai'i widened and repaved approximately 21 km of the road (MP 19 to 6), however, horizontal and vertical roadway deficiencies still exist because environmental constraints restricted design. Beyond the 1988 to 1992 improvements, Saddle Road has received only minimal maintenance type upgrades since it was originally built. Today, the alignment, grade, sight distances, drainage, and other features remain deficient for current rural collector and arterial highway standards. Photographs documenting the pavement condition and other deficiencies of the road are located in the Visual Resource Assessment prepared for this project (Logan Simpson & Dye 1996, DEIS Technical Appendices, Volume VII).

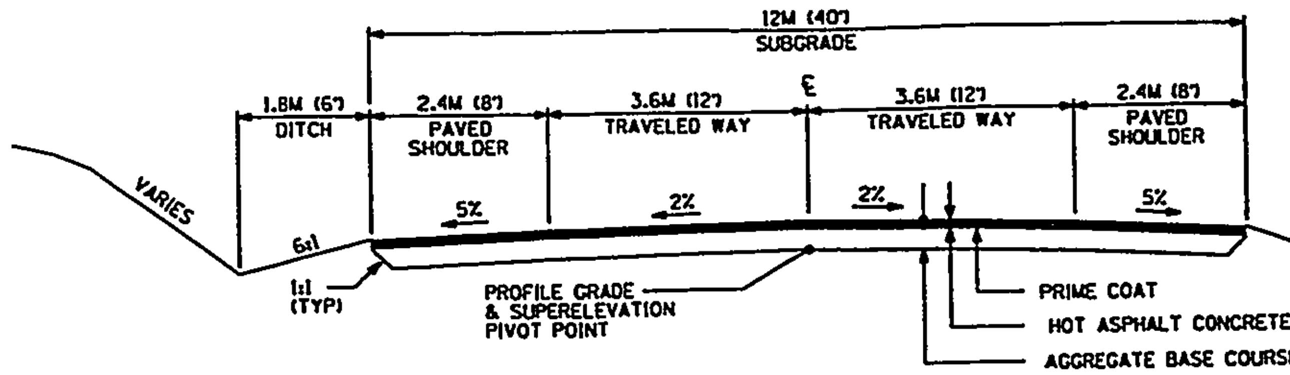
The Draft Hawaii Long Range Transportation Plan places the Saddle Road project in funding tier 1 for the 1998-2005 time frame. The following transportation objectives were identified:

- Linking Hilo to West Hawaii
- Addressing safety concerns along Saddle Road
- Relieving congestion on other routes (Hwy 19)
- Connecting Mamalahoa Highway with PTA

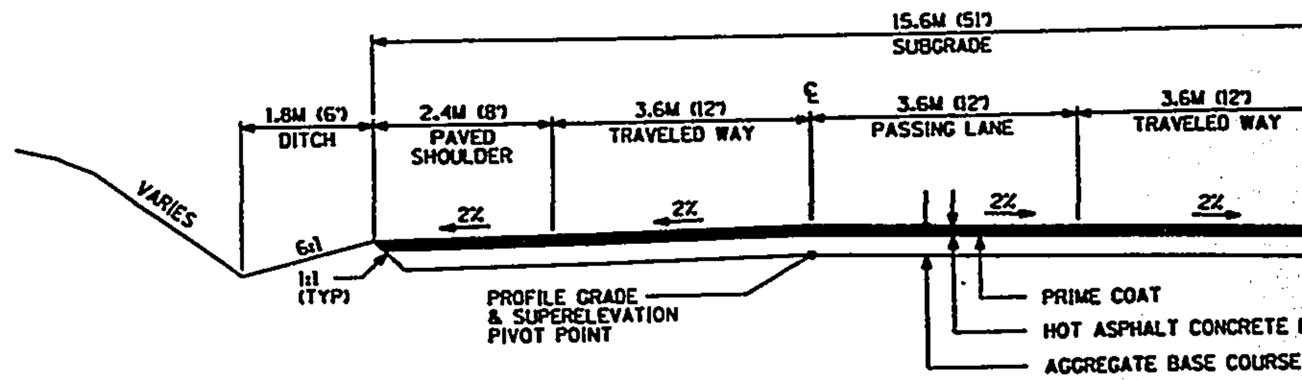
The purpose of this project is to provide a safe and efficient route for access to land uses along Saddle Road and for cross-island traffic between East and West Hawai`i. The proposed improvements to Saddle Road would address five general types of needs: roadway deficiencies, conflicts and hazards with military operations, traffic growth and capacity, motorist safety, and social demand and economic development. The DEIS describes each of these needs in detail.

<u>Alternative Selection Criteria</u>
Alternatives and criteria for evaluation of those alternatives were developed with input from the interagency Social, Economic, and Environmental Team (SEE Team), numerous public scoping meetings, and a citizens task force. To fulfill the project's purpose and need, the following criteria were developed for the selection of alternatives.

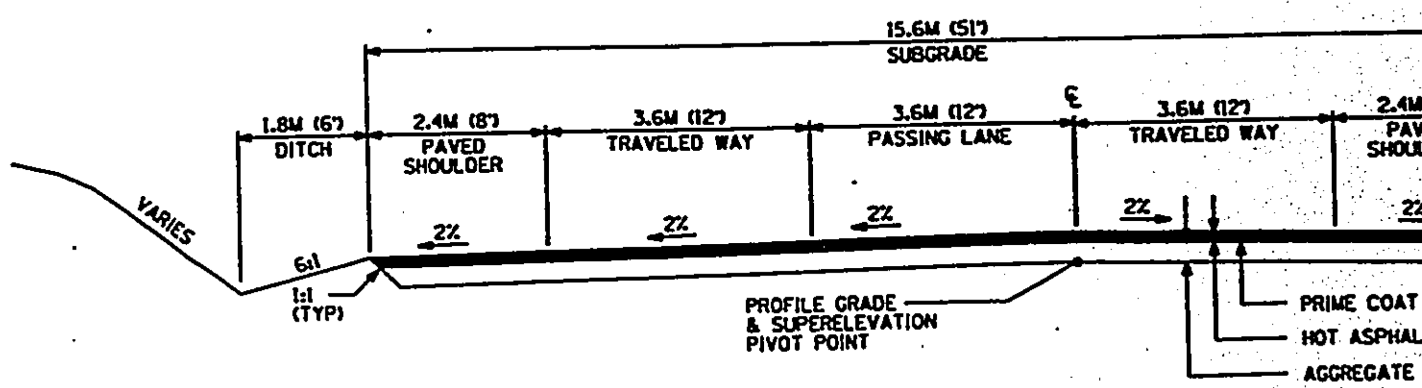
- Eliminate substandard roadway design elements and geometric deficiencies.
- Minimize conflict between the traveling public and PTA military training operations.
- Improve the quality and safety of PTA training activities.
- Improve overall safety.
- Enhance operational function and increase the quality of traffic flow.
- Minimize total environmental impact.
- Improve emergency vehicle and firefighting access.
- Provide an improved, alternate east/west access route on the Island of Hawai`i. .
- Accommodate present and future traffic levels.



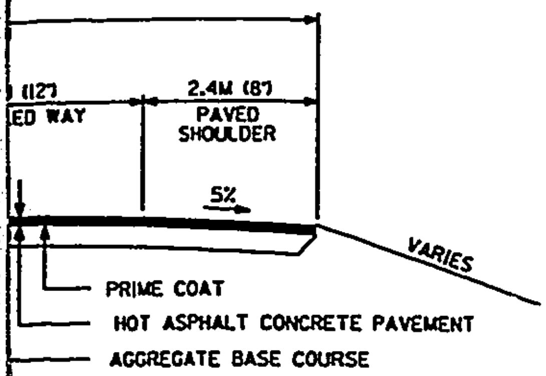
TYPICAL SECTION A

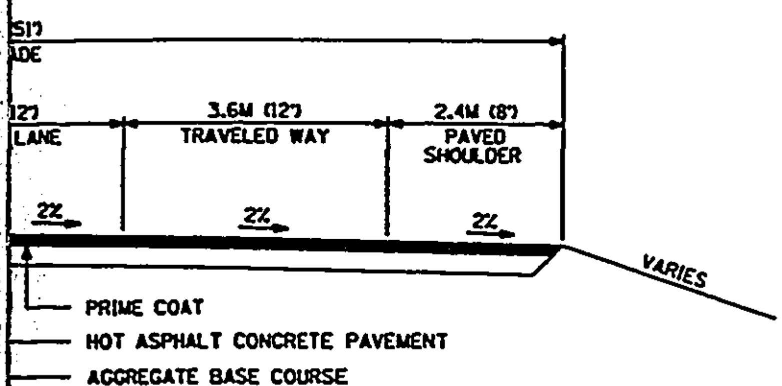


TYPICAL SECTION A WITH PASSING LINE

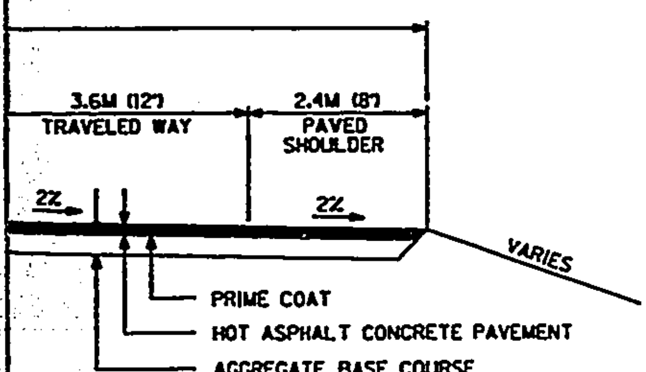


TYPICAL SECTION A WITH PASSING LINE





ASSING LINE



ASSING LINE

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FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO

TYPICAL ROADWAY SECTIONS

FIGURE 3

- Improve pavement condition.

OVERVIEW OF ACTION ALTERNATIVES CONSIDERED

For ease of discussion, the project area has been divided into four sections (Figure 2). Section I begins at the junction with SR 190 and extends east to Saddle Road MP 42 (west end of the PTA). Section II extends through the PTA from MP 42 to MP 28. Section III extends from MP 28 to MP 9 above the upper Kaumana subdivision, and Section IV extends from MP 9 to the eastern project terminus, MP 6. All four sections have independent utility with respect to access and service, and in the context of the EIS, were evaluated separately.

According to the Guidance Papers, in order for an alternative to be considered practicable, it must: 1) meet the project purpose and need, 2) be available and capable of being done, and 3) must not create other unacceptable impacts such as severe operational or safety problems or serious socioeconomic or environmental impacts.

Formulation of alternatives for Saddle Road in Sections I, II, and IV considered use of the existing road alignment as well as potential new alignments. Within Section III, improvement along the existing alignment was considered the only practicable alternative because of the ability to limit impacts to adjacent resources by using as much of the existing roadway footprint as possible. Only Sections III and IV contain special aquatic sites (wetlands) requiring an individual Section 404 permit.

A total of 20 segments within the four Sections previously described were originally considered. Of these, 12 segments were eliminated from further consideration prior to the completion of the Draft EIS. These segments were eliminated because they failed to meet, in part or wholly, the criteria developed in the purpose and need or because their impacts were clearly of a greater degree of magnitude than other alternatives. The remaining eight segments presented for consideration in the Draft EIS were W-2 and W-3 in Section I; PTA-1 and PTA-3 and EX-2 in Section II; EX-3 in Section III; EX-4A and E-3 Section III. All of these alignments are described in detail in the Draft EIS and its Technical Appendices. Detailed descriptions of the alternatives within Sections III and IV are contained in the *Alternatives Containing Jurisdictional Wetlands* section of this report. All alternatives have in common a standard travelway width for arterial roadways, (two 3.6 m lanes), with a variable 80 to 100 km design speed throughout the length, two 2.4 m shoulders for emergency stopping, ditches with foreslopes designed to assist recovery from errant maneuvers, uphill passing lanes, parking pullouts for rest stops, and proper regulatory and warning signs and striping.

Implementing the proposed Saddle Road project within any one section or combination of sections would improve travel conditions whether or not the entire proposed project is implemented. Since segments identified within each section begin and end at a common point on Saddle Road, selection of a particular alternative within any one section would not influence the selection of alternatives within any of the other sections. Because improvement of each section is not dependent on improvement of the others, from a construction standpoint, the improvements for each section are said to have independent utility.

The project can be phased over a number of years as funding becomes available. The DOD has determined that the design and construction of that portion of the Saddle Road improvements within the approximate limits of the PTA would be eligible for Defense Access Road (DAR) funds; however, to date the DOD has not programmed any construction funds. Funds for constructing the DAR section of the proposed project must be authorized and appropriated by Congress as part of defense appropriations legislation. HDOT has agreed to improve the remaining portion of the road over time, as funds become available. Possible funding sources for the remaining sections of the proposed project include State funds, Federal-Aid Highway funds, and DAR funds should the entire project receive a Defense Access Road designation.

SECTION 404 RESOURCE IDENTIFICATION

As stated above only Sections III and IV contain special aquatic sites (wetlands). A detailed description of the resources in relation to Part 230 Section 404 (b)(1) is provided in Appendix A.

Biological Resources of Jurisdictional Wetlands within the Saddle Road Project Area

The jurisdictional wetlands and determination methodology are fully described in the the DEIS Technical Appendices - *Volume III, Wetlands Determination.* A brief description of the wetlands and key methodological considerations are summarized below.

Brief Methodology

Determination of the presence of hydric soils and wetland hydrology were made by personnel of USACE assisted by NCRS personnel. Data were collected during a site visit on 2-3 July, 1997. Eight Delineation Points within Segment EX-3 were visited and evaluated, usually 2 sample points within each Delineation Point. Hydric soils were found in all samples at all sites visited; wetland hydrology was identified at all sites and all sample points except one.

The USACE advised that, because of the ubiquity of hydric soils and wetland hydrology, the presence of hydrophytic vegetation should be used throughout the study area as the critical parameter to determine the presence of jurisdictional wetlands. This is the rationale followed in the determination study. Because the soil forms a discontinuous layer, USACE recommended that the percent cover of soil be determined, and that only the portion with soil cover and hydrophytic vegetation be determined to be wetland. This approach probably results in a generous estimate of jurisdictional wetland areas in the project area.

Distribution of Jurisdictional Wetlands within the Study Area

Wetlands were found within the study area only within a "wetland zone" at and below mile-post 14 (Figure 9). This limit is believed to be linked to declining rainfall at higher elevations. The three community types of native vegetation are described below. Figures 4 through 8 depict vegetation types and wetland conditions within the EX-3, EX-4A and E-3 alignments. The attached *Saddle Road Wetland Zone Map, Section IV Alignments* provides more detailed mapping of the Section IV alignments.

Koa-Ohia Forest - Older Substrates
This is the forest type on older lava substrates (kipuka) between 370 and 900 m elevation. Koa (*Acacia koa*) grows up to 25 m tall, dominating the upper canopy. Ohia usually forms a slightly lower canopy. The understory includes hapuu (tree ferns: *Cibotium spp.*) And various small trees, shrubs and ferns. This vegetation type is described as Old Montane Wet Forest in the DEIS on soils mapped as Keei Extremely Rocky Muck (rKGD).

The vegetation of these forests is not hydrophytic. Koa-Ohia Forest was found within the Right-of-Way (ROW) in kipuka at or near milepost 9, 11, and 12. Koa-Ohia Forest is near, but outside, the ROW near mile-post 10.

Undrained depressions may occur within this vegetation type, supporting a local ground-cover dominated by "wet" species. These wetland inclusions are 1 to 5 m (rarely 10 m) in diameter and have vertical variations of less than 1 to 3 m (rarely 5 m). Such inclusions are reported from the vicinity of the study area (Palmer and Paul 1997) but none were actually seen within the proposed ROW during this wetlands study.

These Koa-Ohia Forests are considered to be one percent wetland, by area, to accommodate possible small wetland inclusions.

Ohia Forest - Older Substrates
Ohia Forest occupies the older lava substrates above 900 m elevation within the project area. Within the Saddle Road corridor, Koa is found only below 900 m and above 1700 m. The Ohia Forest in the study area has a variably closed canopy of ohia up to 20 m tall and a dense understory of hapuu and a diversity of other native plants. Ohia Forests of the study area are described as Old Montane Wet Forest and Old Montane Mesic Forest in the DEIS.

Ohia Forest was found within the ROW only in a single large kipuka near mile-post 14. Within the ROW, this vegetation was found to be hydrophytic in its entirety. These areas may also include depressions or drainageways with distinct hydrophytic ground-cover, similar to those described in the previous paragraph. Ohia Forest is near, but outside, the ROW at several other locations. In the final design, the alignment can be moved to avoid grading or direct damage to the kipuka at mile-post 14 or at any other location.

Ohia Scrub-Young Lava Flows
This is a simple, early successional vegetation dominated by Ohia (*Metrosideros polymorpha*) and uluhe (*Dicranopteris linearis*). The ohia trees are usually less than 10 m tall. The uluhe forms dense, tangled mats, 1 m or more high. Plant diversity is low. Ohia Scrub occurs

throughout the study area on the 1881 and 1855 lava flows. This vegetation type corresponds with New Lowland Wet Shrubland, New Montane Wet Forest, New Montane Wet Shrubland described in the DEIS.

The Ohia Scrub vegetation type was found to be a mosiac of-upland and wetland sites. Wetlands occur in areas where the pahoehoe lava substrate provides inadequate drainage. Figure 9 provides a conceptual drawing of the wetland/upland mosaic. The pattern, or "grain" size, of the mosaic could be analyzed on many scales. However, a fairly coarse scale is dictated by the pattern of the prevailing small ohia trees, usually in a dense mat of the fern, uluhe, which sometimes includes uki (*Machaerina angustifolia*) or waiwaiole (*Lycopodium cernuum*) as dominants, and very few other species in the vegetation.

The substrate is extremely rugged, undulating pahoehoe lava. Most of the soil is found in microtopographic depressions, from 0.25 to 2.0 m in diameter usually with less than 1 m of vertical variation. Ponded water may also be found in these depressions. A rough estimate, based on a limited sample, is that less than 30% of the surface within Delineation Points has 2 cm or more soil; local topography is also undulating with variable slope within the regional topography defined by the slopes of Mauna Kea and Mauna Loa.

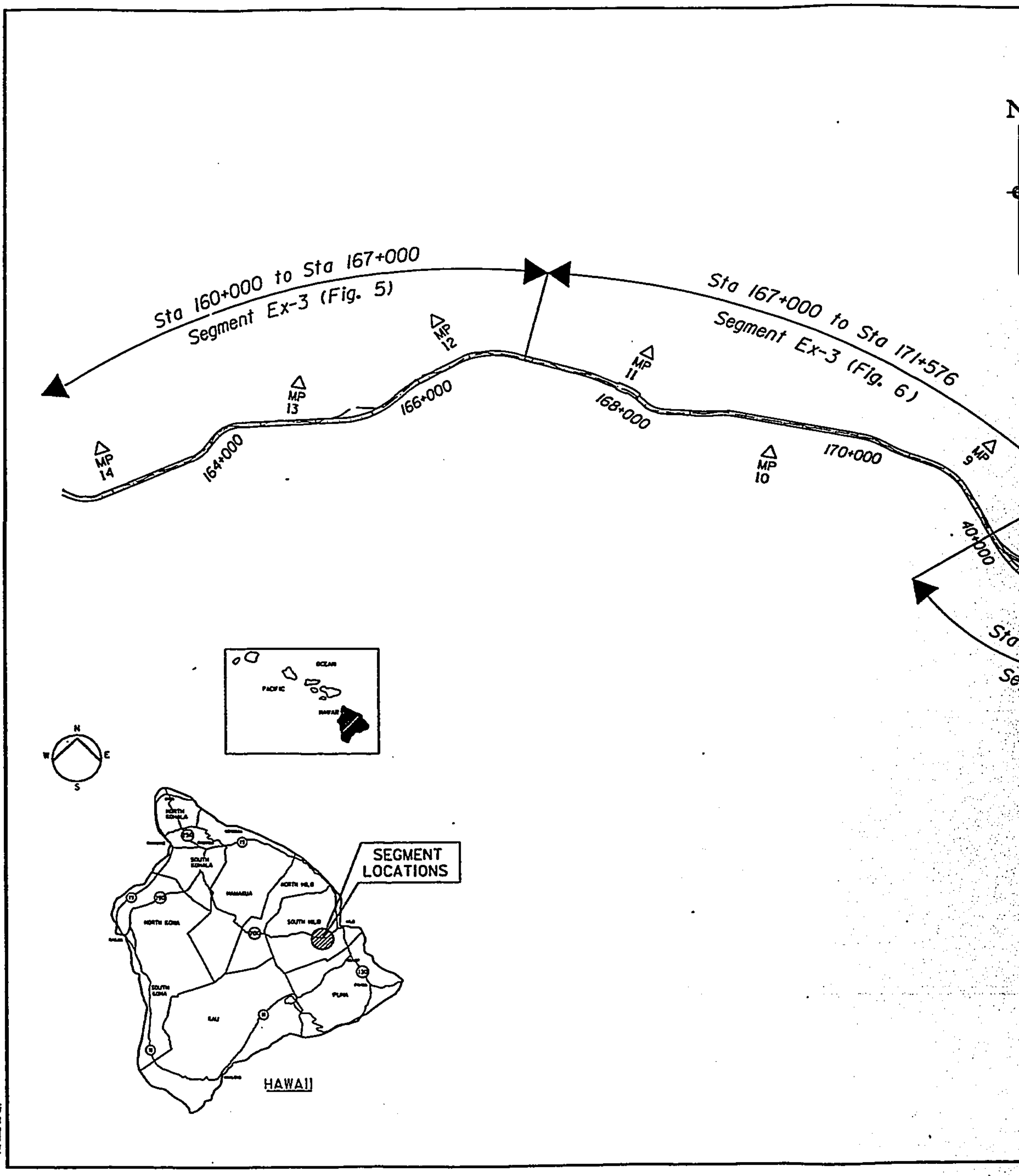
At low elevation within Segment E-3, close to Hilo, the primary vegetation has been disturbed or removed by residential and agricultural uses. Two of these human-altered vegetation types are recognized here.

Disturbed Ohia
This designation is used for areas where the vegetation has been seriously degraded by grazing, logging, or other uses. The landscape is still visually dominated by ohia trees, uluhe, and other native plants. But these native elements exist within an irregular mosaic of grassy clearings. Cattle were observed actively grazing in many areas and the vegetation and soil surface show their influence. This vegetation type occurs in areas with soil mapped as Keei Extremely Rocky Muck (Tropofolist) and Kaiwiki (Hydrandept) series soils and is classified as Old Lowland Wet Forest, originally containing koa.

Agricultural
These areas are, or until recently were, in intensive agricultural use, many as pastures or formerly sugar cane fields. The primary native vegetation has been completely removed, except in ravines or on other rough land. The Agricultural type is found mostly in deep ash soils mapped as Kaiwiki Series.

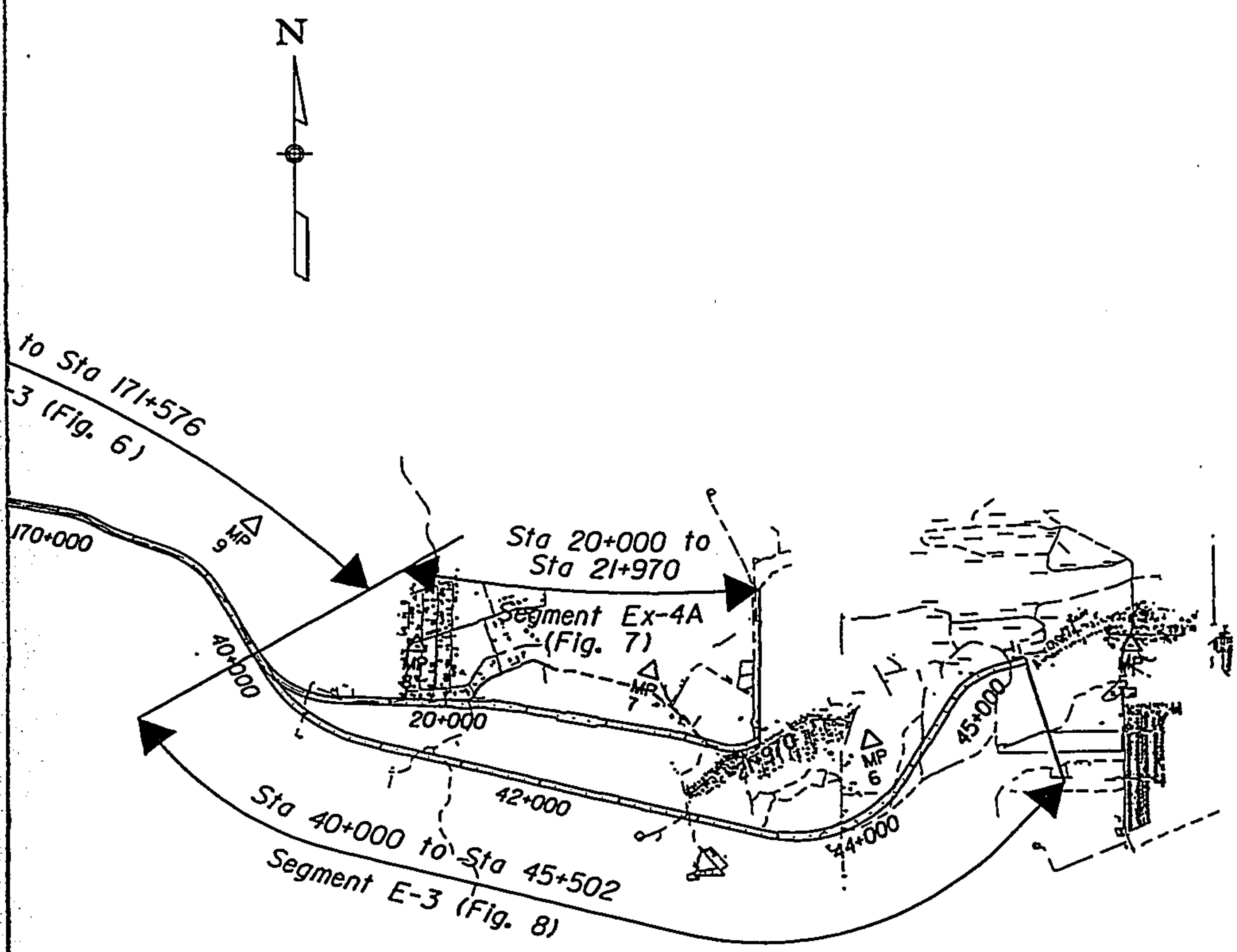
In some areas the two latter types occur together in an irregular mosaic. These areas are designated as Disturbed Ohia & Agricultural.

Information on specific wetland impacts of alternatives and proposals to mitigate these impacts is contained in the following section of this report.



Sta 160+000 to Sta 167+000
Segment Ex-3 (Fig. 5)
Sta 167+000 to Sta 171+576
Segment Ex-3 (Fig. 6)
MP 14
MP 13
MP 12
MP 11
MP 10
MP 9
164+000
166+000
168+000
170+000
40+000
Sta
Se
N
E
S
W
SEGMENT LOCATIONS
NORTH KOHALA
SOUTH KOHALA
HAMAKUA
NORTH HILO
SOUTH HILO
NORTH KONA
SOUTH KONA
KAU
PUNA
HAWAII

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	HI	A-AD-6(1) SADDLE ROAD	.	



0 80000 160000

Graphic Scale in Meters

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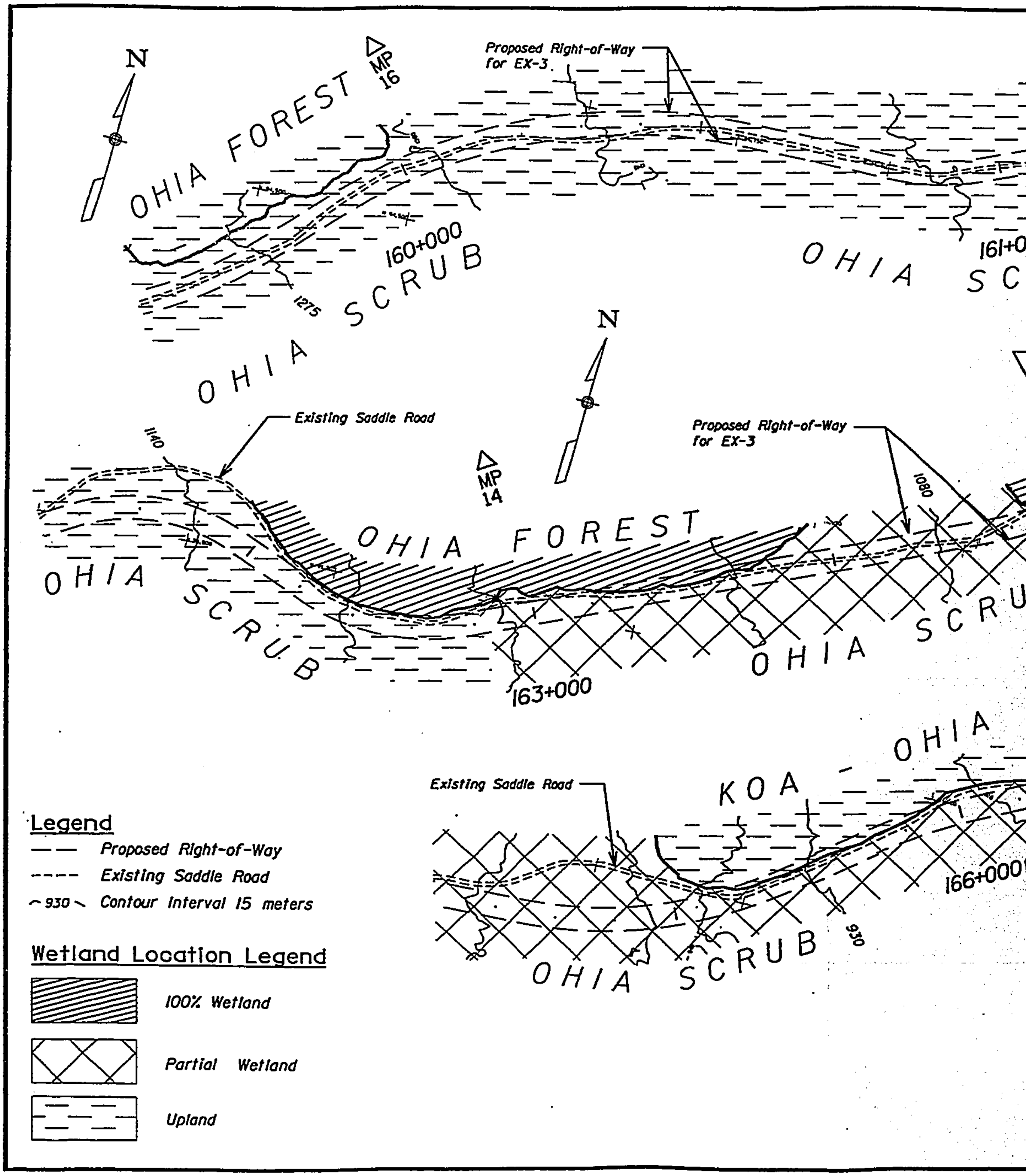
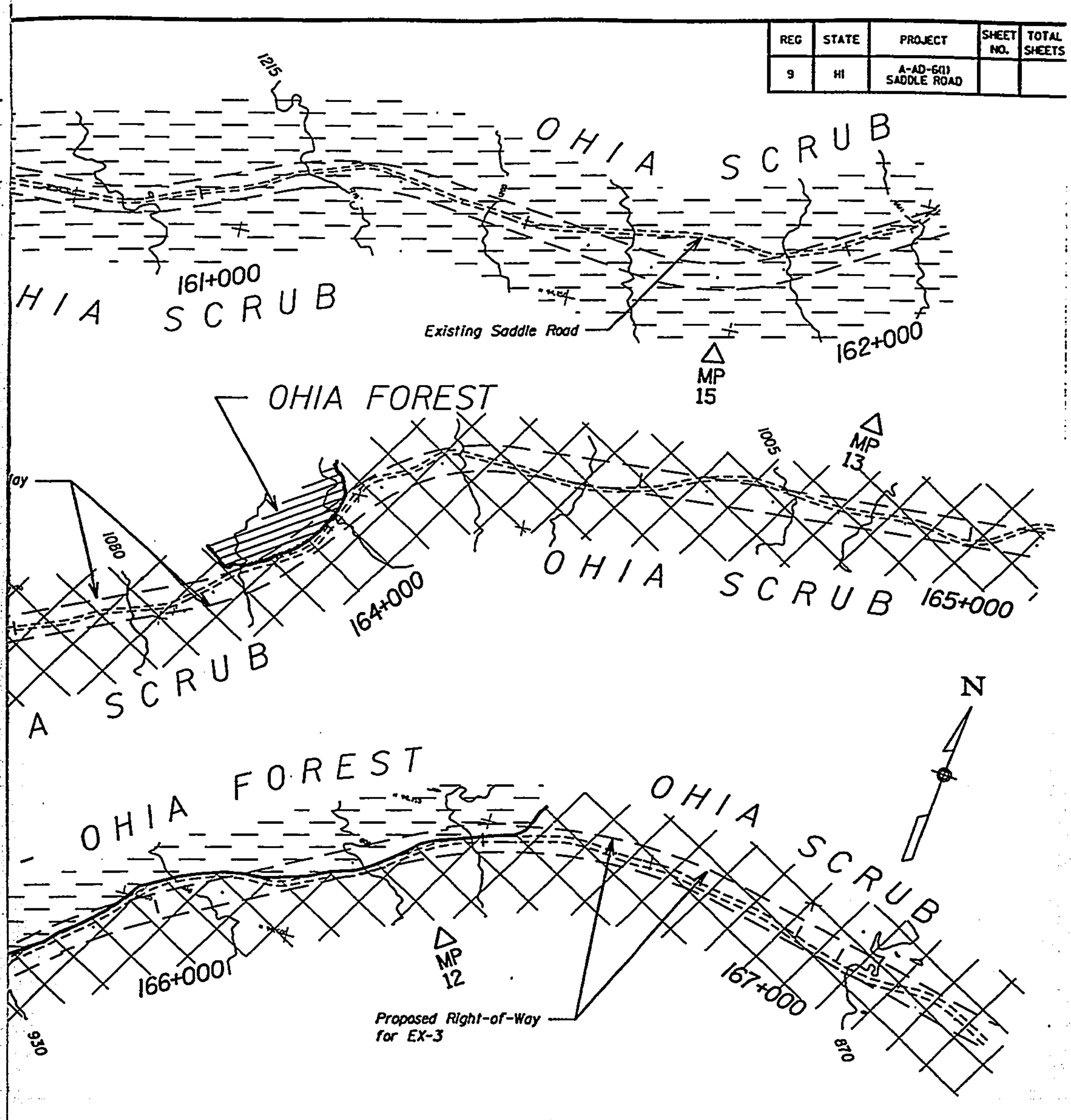
DENVER, COLORADO

PLAN EX-3, EX-4A & E-3 SEGMENTS

FIGURE 4



N
MP 16
OHIA FOREST
Proposed Right-of-Way for EX-3
160+000
OHIA SCRUB
1275
OHIA
161+0
OHIA SC
N
Existing Saddle Road
1140
MP 14
OHIA FOREST
Proposed Right-of-Way for EX-3
1080
OHIA SCRUB
163+000
OHIA SCRU
OHIA
KOA
OHIA
Existing Saddle Road
166+000
930
OHIA SCRUB
Legend
Proposed Right-of-Way
Existing Saddle Road
930 Contour Interval 15 meters
Wetland Location Legend
100% Wetland
Partial Wetland
Upland



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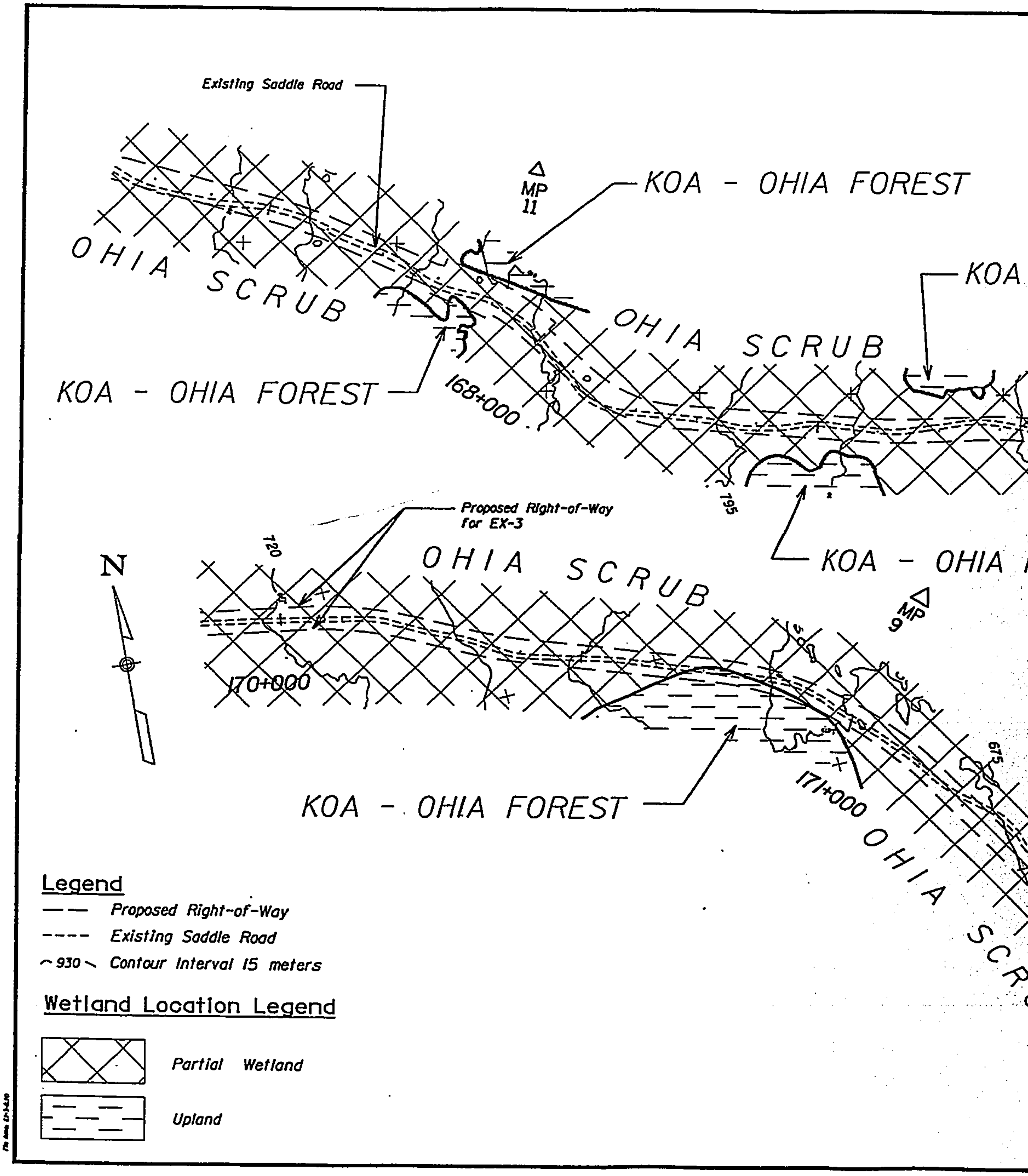
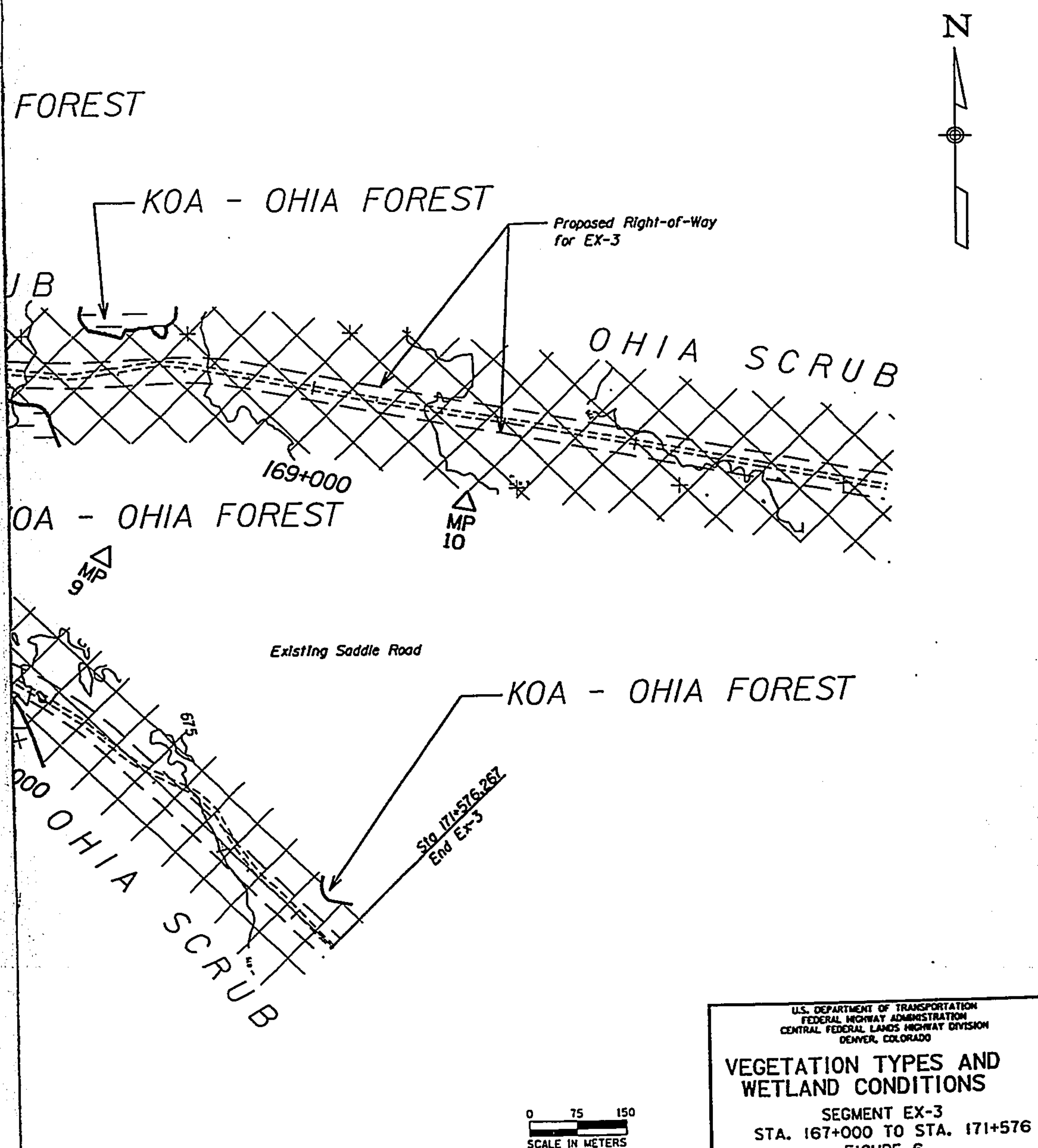
VEGETATION TYPES AND WETLAND CONDITIONS

SEGMENT EX-3
STA. 160+000 TO STA. 167+000
FIGURE 5



Existing Saddle Road
KOA - OHIA FOREST
MP 11
OHIA SCRUB
OHIA SCRUB
KOA
KOA - OHIA FOREST
168+000
795
KOA - OHIA
Proposed Right-of-Way for EX-3
720
N
OHIA SCRUB
MP 9
170+000
KOA - OHIA FOREST
171+000
675
OHIA SCR
Legend
Proposed Right-of-Way
Existing Saddle Road
930 Contour Interval 15 meters
Wetland Location Legend
Partial Wetland
Upland

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	HI	A-AD-6(1) SADDLE ROAD		



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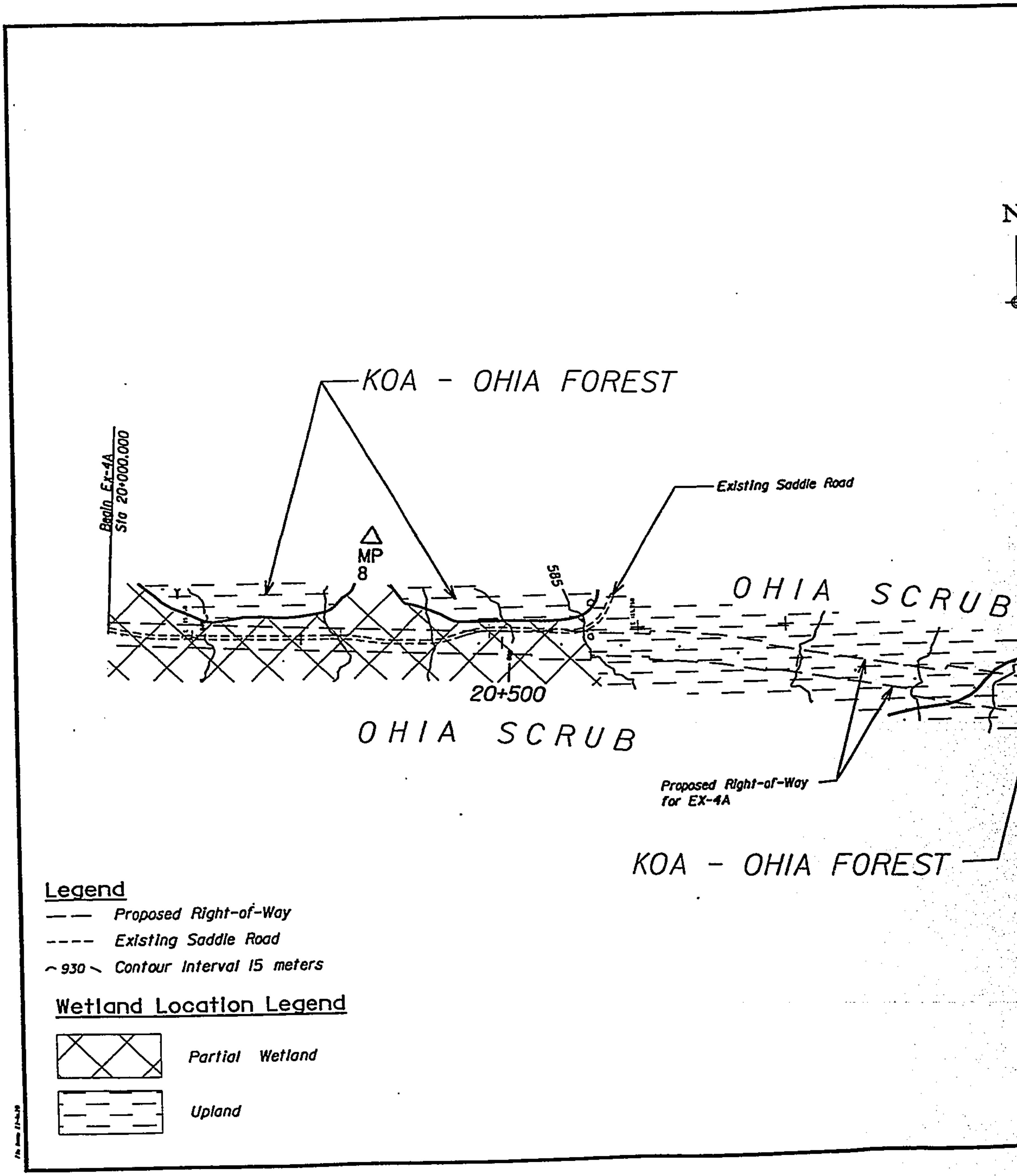
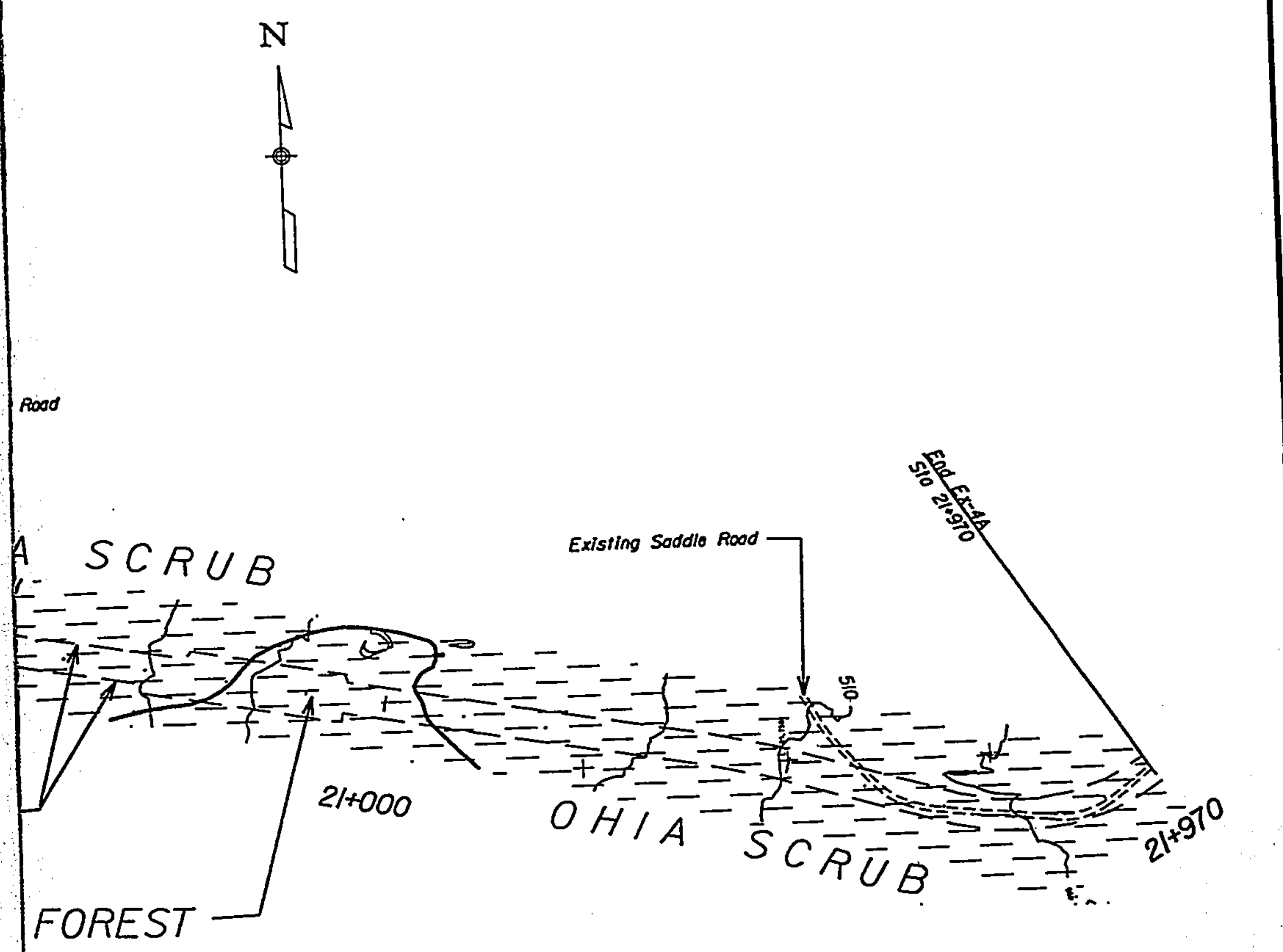
VEGETATION TYPES AND WETLAND CONDITIONS

SEGMENT EX-3
STA. 167+000 TO STA. 171+576
FIGURE 6



KOA - OHIA FOREST
Begin Ex-4A
Sta 20+000.000
MP
8
585
Existing Saddle Road
OHIA SCRUB
20+500
OHIA SCRUB
Proposed Right-of-Way
for EX-4A
KOA - OHIA FOREST
Legend
Proposed Right-of-Way
Existing Saddle Road
930
Contour Interval 15 meters
Wetland Location Legend
Partial Wetland
Upland

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
9	HI	A-AD-6(1) SADDLE ROAD		



0 75 150
SCALE IN METERS

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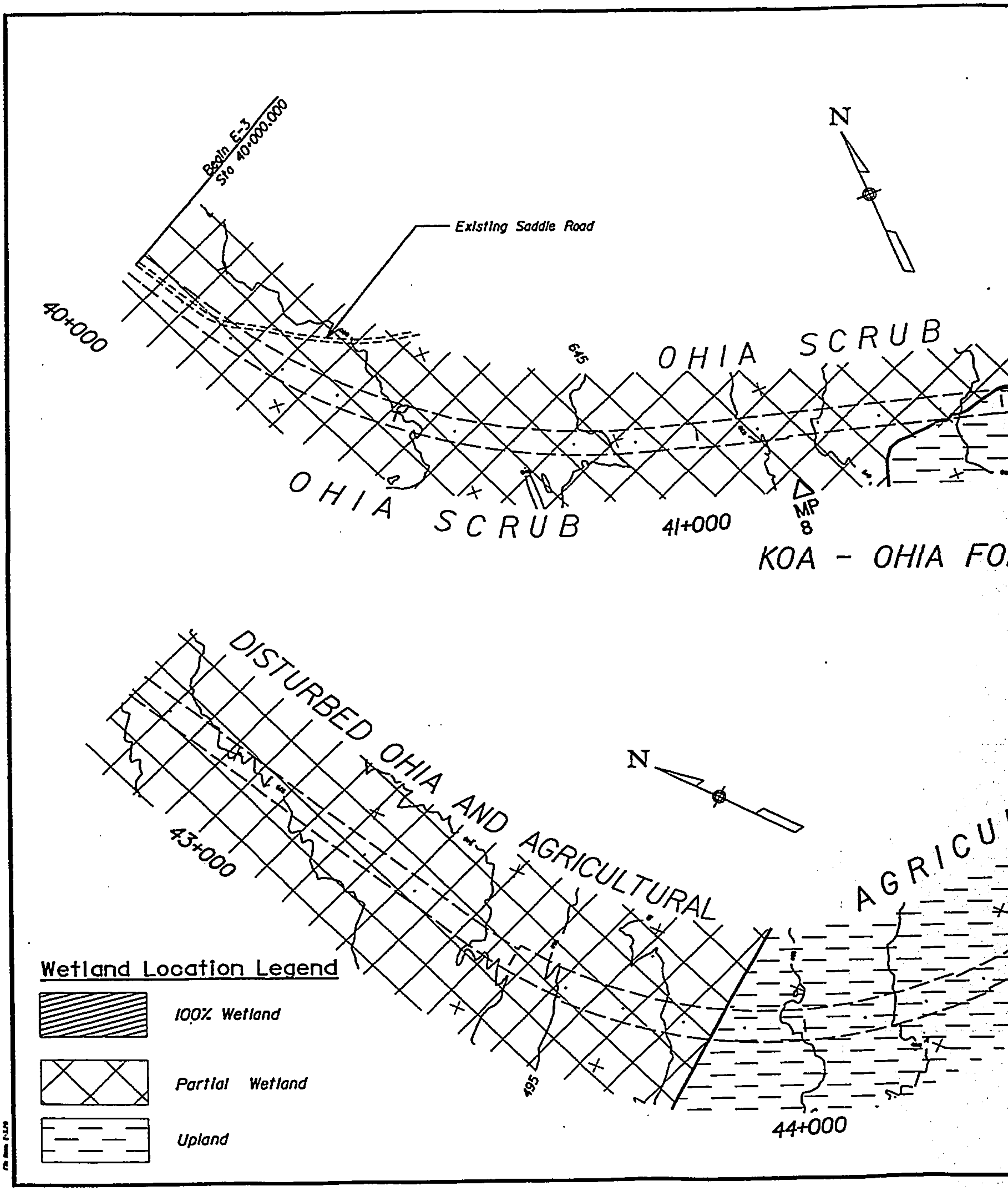
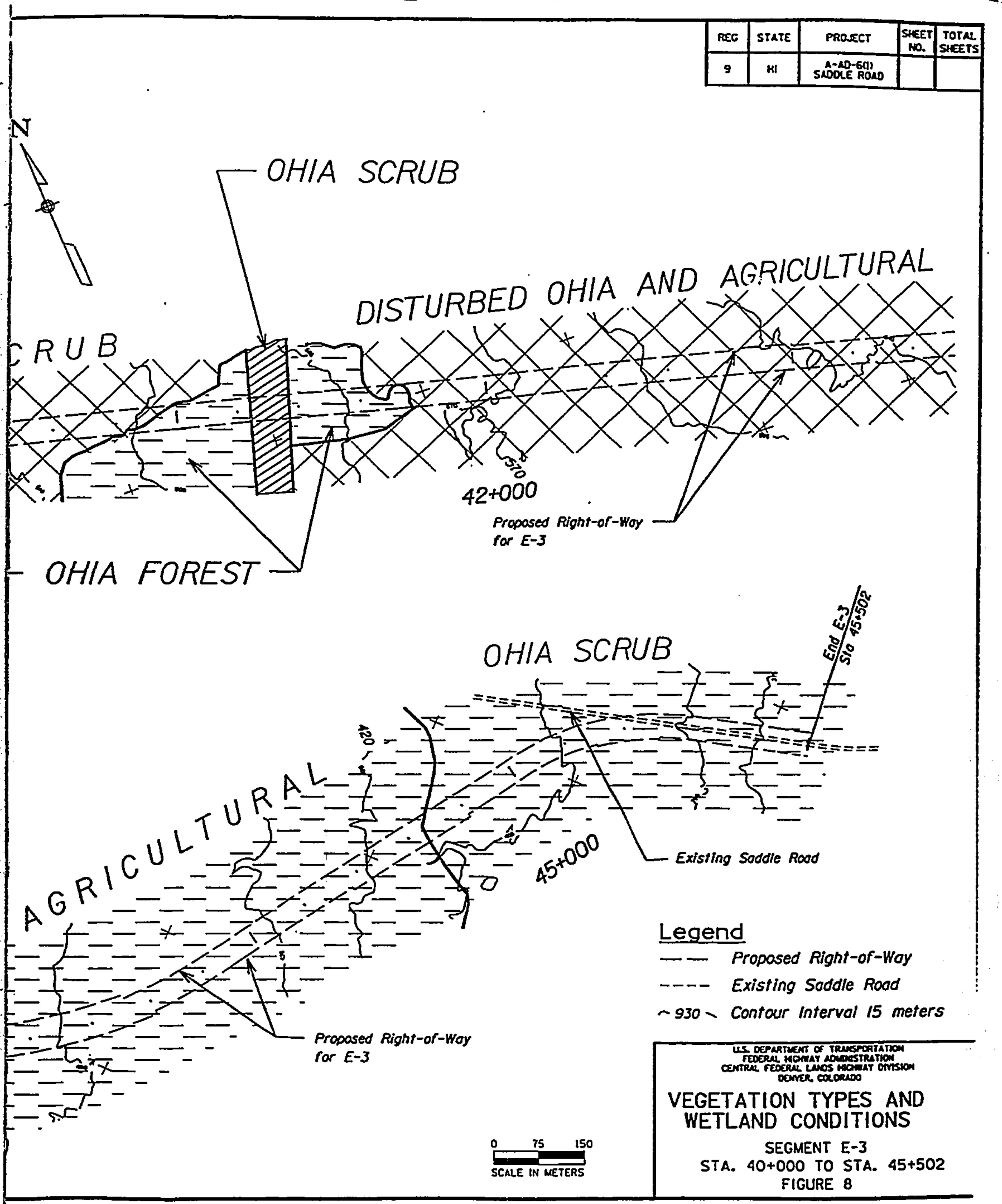
VEGETATION TYPES AND WETLAND CONDITIONS

SEGMENT EX-4A
STA. 20+000 TO STA. 21+970
FIGURE 7


Begin E-3
Sta 40+000.000
Existing Saddle Road
N
40+000
645
OHIA SCRUB
OHIA SCRUB
41+000
MP
8
KOA - OHIA
DISTURBED OHIA AND AGRICULTURAL
N
43+000
495
44+000
Wetland Location Legend
100% Wetland
Partial Wetland
Upland


REG
STATE
PROJECT
SHEET NO.
TOTAL SHEETS
9
HI
A-AD-6(1) SADDLE ROAD
N
OHIA SCRUB
DISTURBED OHIA AND AGRICULTURAL
CRUB
570
42+000
Proposed Right-of-Way for E-3
OHIA FOREST
OHIA SCRUB
End E-3 Sta 45+502
420
AGRICULTURAL
45+000
Existing Saddle Road
Legend
Proposed Right-of-Way
Existing Saddle Road
930 Contour Interval 15 meters
Proposed Right-of-Way for E-3
0 75 150
SCALE IN METERS
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
CENTRAL FEDERAL LANDS HIGHWAY DIVISION
DENVER, COLORADO
VEGETATION TYPES AND WETLAND CONDITIONS
SEGMENT E-3
STA. 40+000 TO STA. 45+502
FIGURE 8

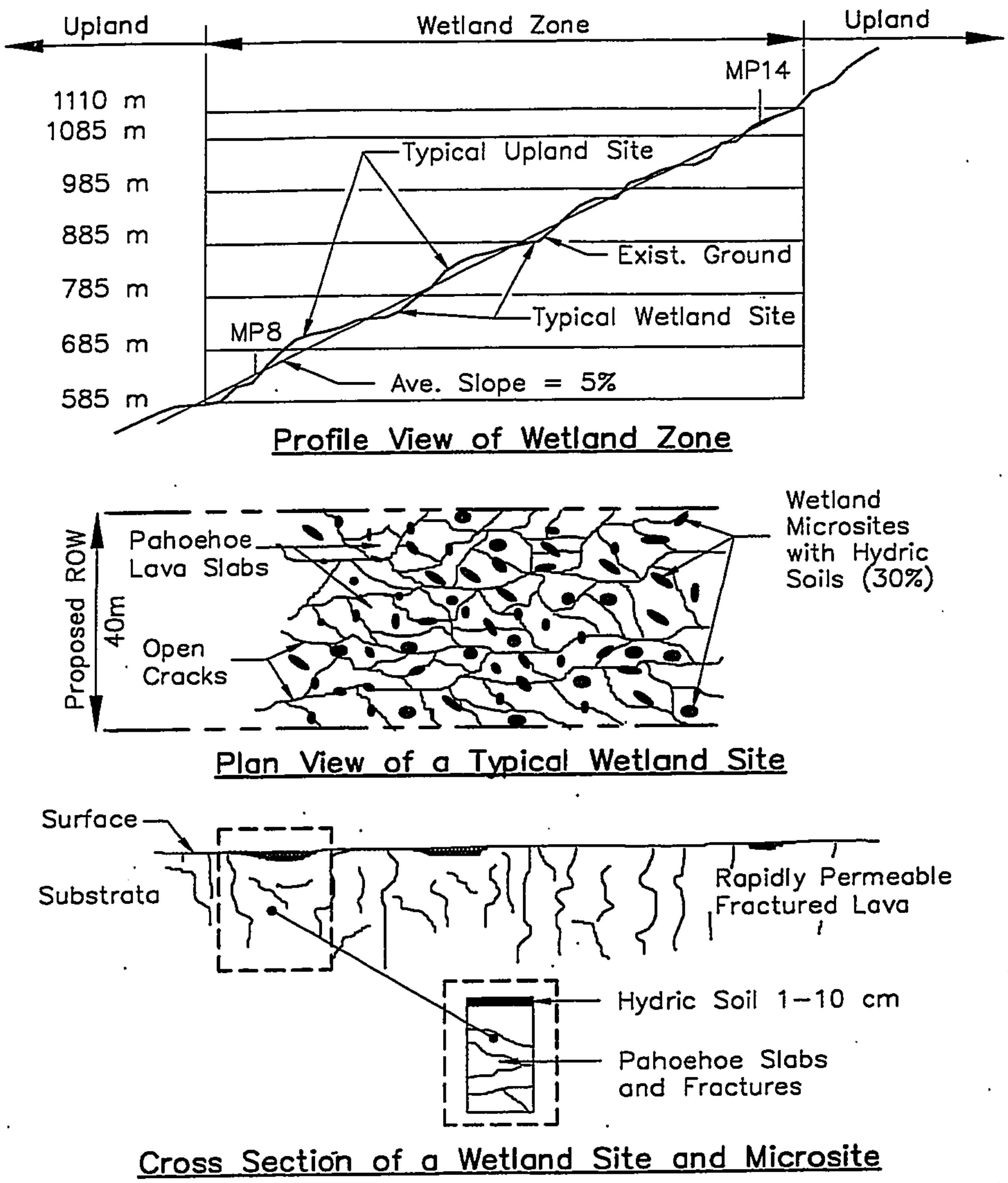


Diagram of Distribution and Geological Characteristics of Wetlands on Young Lava Flows (Ohia Scrub) in Sections III and IV

Figure 9

ALTERNATIVES CONTAINING JURISDICTIONAL WETLANDS

Section III LEDPA Alternative

EX-3

No reasonable or prudent alternatives to the existing road corridor (EX-3) were identified within Section III because of the need to minimize impacts to adjacent environmental resources. The EX-3 alignment would require the reconstruction of Saddle Road with major grade and alignment improvements to bring it up to AASHTO standards. This segment would follow the existing Saddle Road corridor through Section III, from MP 28 to MP 9, a distance of 30.9 km. EX-3 would have a maximum grade of 8.0 percent, a base elevation of approximately 600 m, and a top elevation of approximately 2007 m. Construction of EX-3 would require a 40 to 50 meter wide right-of-way resulting in acquisition or conversion of approximately 60 ha for roadway purposes, predominately in small adjacent strips of land. The estimated construction cost for Segment EX-3 is $60,300,000.

Alternatives Analysis Discussion: EX-3

Alternatives examined during the course of engineering analyses in Section III predominately focused on alignment alternatives utilizing as much of the existing ROW as possible. No other alternatives were available which would provide such minimal resource impacts, therefore, all alternatives on relocated corridors were immediately discounted. Further, because of the narrowness and substandard curvature of the existing roadway, it is impossible to design a modern arterial roadway section completely within the existing footprint in order to avoid adjacent environmental resources altogether. This is also true for a reduced design speed standard of a collector roadway with minimal lane and shoulder widths. Therefore, a complete avoidance of adjacent wetlands is impossible if an upgraded roadway is to be provided in this section.

However, in response to comments from the EPA, a modified EX-3 alternative which would minimize adjacent resource impacts by reducing the roadway width and the design speed was investigated. Such a facility would reduce adjacent wetland impacts by an estimated 15 to 25 percent. This gain in minimization of wetland impacts however, is overshadowed by adverse implications to roadway safety, travel time, and traffic capacity.

Standards of The American Association of State Highway and Transportation Officials (AASHTO) refer to design speed as one of the most important factors in the design of a facility so that the roadway will perform its intended function in the transportation system. AASHTO recommends a design speed of 100 km/hr for a roadway functionally classified as a rural arterial. The design speed used for the project in this section is 80 km/hr, 20 percent below the design standard. As previously stated, the lower design speed of 80 km/hr was applied along the EX-3 alignment to allow more curvature, steeper grades, and less cutting and filling in order to minimize impacts to adjacent sensitive environmental resources. Reducing the design speed to a lower value would further negate the project's purpose to provide a safer and more efficient route from Hilo to Kona, Waikoloa, Waimea, and destinations along Saddle Road.

Time Savings: Reducing the design standards for this alternative to that of a collector, including reduced lane and shoulder widths, would result in a reduction in service flow rates (vehicles per hour) that could be carried by 36 percent. This operating efficiency reduction is primarily related to the decrease in available passing areas and less width which usually prompts motorists to drive at slower speeds over longer reaches. This reduction results in the facility operating at capacity or below most of the time with the projected volume of 14,000 vehicles per day. This equates to a decrease in operating speed from 48 mph for the arterial design to less than 35 mph for the minimum collector design; or, an increase in travel time over the 19 mile section from 23.75 minutes to 32.5 minutes per vehicle. For 14,000 vpd, this results in a total lost time of 745,208 hours per year; or, put another way, a savings of 745,208 hours per year with the selection of the minimum arterial design of 50 mph and full lane and shoulder widths when compared to the minimum collector design standard.

The average weighted value of time savings referenced in the DEIS is $24.18/hour. Assuming constant dollars, total time savings realized in the design year, with the correct design for this alternative's function, are $18,020,000 or approximately $5,620,000 in 1998 dollars using a 6% discount rate. If savings in travel time are reinvested in the Island's economy, the approximately $5.6 million value in time savings per year would result in an increase of 156 jobs/year and total income would increase by approximately $3,900,000 on the Island of Hawaii as a result of more efficient use of business and leisure time (ref. DEIS, Chapter 3, Section 3.4 Economics).

Accident Costs: It can be shown that, on commuter routes, motorists tend to travel beyond the posted speed limit and safe operating speeds even when unadvisable to do so because of traffic or weather limitations. Coupling this section of roadway at a lower design speed and narrower travelway with other sections at a higher design speed and standard widths would exacerbate accident rates because of this tendency. Accident rates and/or severity would be expected to increase, along with the associated cost in property and lives, rendering the provision of a lower design standard on this section a professionally irresponsible design solution.

It is impossible to know at what rates accidents might stabilize along this section with a reduced design; however, a reasonable and conservative estimate of 5% to 10% increase over the state-wide average for 2-lane roads can be made by comparison to other such situations. This would result in a 3.2 to 3.3 accident per million vehicle miles rate (ACC/MVM), or, using the lower estimate, approximately 20 additional accidents per year on this section. This increase would result in an estimated $3,000,000 accident cost/year in the design year, or about $1,000,000 in 1998 dollars.

Summary: Annually recurring disbenefits in 1998 dollars that could be expected to begin accruing in the design year of the proposed project if the lower design standard roadway were constructed are:

Lost Time:	$ 5,620,000
Unrealized Income:	$ 3,900,000
Additional Accident Costs:	$ 1,000,000
Total	$10,520,000

It should be noted that this is a very conservative estimate given the fact that annually recurring disbenefits would begin to accrue prior to the design year and continue thereafter at an increasing rate because of increasing traffic volumes.

Conclusion: The above analysis indicates that, within Section III, the design proposed for the planned arterial function of the roadway is most responsive to the identified needs of: 1) improving overall safety, 2) increasing the quality of traffic flow, 3) accommodating present and future traffic levels, and 4) providing an improved, alternate east/west access route on the Island of Hawaii (ref. DEIS, Chapter1, Section 1.7 Criteria for Selection of Alternatives). From the transportation needs perspective, a reduced design standard to minimize impacts to adjacent wetlands, including the "no-action" alternative, does not completely fulfill the purpose of the proposed project in that it has cost, economic, and safety implications that render it less viable as a practicable alternative (40 C.F.R., Subpart B, 230.10 (a)).

Wetland Impacts: EX-3

The National Wetlands Inventory (NWI) status of all plants found within communities that would be impacted by this alternative range from "upland" to "facultative+", no "obligate" or "facultative wetland" species are present within the wetland areas. The wetland study found that the vegetation changes subtly as soil-saturation of poorly-drained microsites increases within a larger site. These changes were in the form of shifts in percent cover and dominance of species, never in the presence or absence of any species. This is an indication that soil conditions and the vegetation form a continuum; areas with microsites that contain all three criteria of jurisdictional wetlands are *quantitatively, but not qualitatively*, different from surrounding "upland" sites.

While it is reasonable to state that the wetland microsites may have unknown biological function, the data available do not support that position. The only taxonomic group of organisms systematically sampled within the wetland zone is vascular plants; the plants do not show a qualitative response to the wetlands. The response of other groups, such as invertebrates and microorganisms, is not known. The response of plants to drainage conditions can be described as that of "generalists", i.e., they are facultative plants. Since other organisms are often dependent upon the plant species present, in this case, ubiquitous native generalists, there is no indication that the wetland microsites would have a unique, but unseen, flora or fauna.

The following table provides a quantitative analysis of the wetland vegetation types to be impacted by the EX-3 alignment:

TABLE 1
Summary of areas (ha) of potential wetland fill within Cut/Fill limits of Segment EX-3[1,2].

VEGETATION TYPE	AREA OF FILL HECTARES	ACRES
KIPUKA WETLANDS		
Ohia Forest	.2536	.63
Koa-Ohia Forest	.0199	.05
YOUNG LAVA FLOW WETLANDS		
Ohia Scrub	2.1220	5.24
TOTAL WETLANDS	2.3955	5.92

1. See Appendix A for detailed discussion of impacts
2. See DEIS, Technical Appendices-Vol.III, Wetlands Determination for delineation methodology

General Wetland Mitigation Proposal: EX-3
The total wetland disturbance along the EX-3 alignment is 2.3955 ha (5.92 acres). The basic wetland values and functions are described in Appendix A. Within the EX-3 segment the most important wetland value is the biodiversity of the native ecosystem.

Since recreating the lava flows necessary for replication of the wetland areas is impossible, ratio-based replacement mitigation is not being proposed. In addition, it is difficult to define a scientific basis for determining mitigation ratios for wetlands replacement for the wetlands impacted within the EX-3 corridor. A replacement ratio for hydrological function could be determined based on the area needed to maintain water storage , infiltration, and sedimentation. However, the primary hydrological characteristic present in the wetland areas identified is perched or ponded water catchment with intermittent infiltration through cracks in the pahoehoe lava surface. The roadway design will maintain this function regardless of mitigation requirements. If the wetlands were identified as necessary and unique habitat for an animal species or as an essential resource to populations of surrounding organisms different from the interspersed uplands, a necessary replacement area could be calculated to support populations of the same size or density. Since no such populations have been identified, there is little basis for calculating replacement ratio relative to biological requirements.

Although jurisdictional wetlands do occur in the project area and a Department of the Army Permit is required, a focus on protection of the wetlands and mitigation of their fill could result in harm to the environment. A focus on wetlands implies that they are of more significance than upland areas, either outside the wetland zone or those interspersed within the wetland mosaic. This position has been refuted by both USFWS and DOFAW in their comments that the more diverse forest communities should always be avoided, even at the expense of greater wetland fill. The biological values of the region have not been associated with jurisdictional wetlands, except within the regulatory framework. A focus on wetland sites and microsites is an unworkable model since they are embedded in an equally valuable upland vegetation, and the wetland microsites are not seen as viable plant stands.

Further, according to the "Memorandum of Agreement Between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines", November , 1989, in most cases a minimum of 1 to 1 acreage replacement of wetlands will be required to achieve no net loss of values. However, this ratio may be less than 1 to 1 for areas where the functional values associated with the area being impacted are demonstrably low and the likelihood of success associated with the mitigation is high. The MOA also recognizes that no net loss of functions and values may not be achieved in every permit action.

Therefore, the mitigation proposal for Section III is focused more on what might be called a "best practice" approach for the ecosystem and endemic species as a whole and not on a policy based replacement ratio scheme. Some of the mitigation actions proposed include the following (see Appendix A for a detailed discussion):

- move alignment away from kipuka
- minimize cut and fill slopes wherever practical to avoid impacts to native vegetation.
- remove pavement from the existing alignment where the new alignment deviates from the existing road and restore the area with native species.
- restore (with native species) other disturbed areas within the roadway ROW such as abandoned access roads, cut and fill slopes, etc..
- carefully design roadway drainage facilities to avoid erosion and disturbance of native vegetation and to provide runoff infiltration capabilities where feasible.
- developing and implementing Best Management Practices (BMP's) and a Storm Water Pollution Prevention Plan, (SWPPP) as part of the final roadway design - detailed plans will be generated using higher quality topographical data during final roadway design

Specific location and implementation details of mitigation are to be finalized as roadway design on this section progresses at a later date. The Final EIS will contain biological descriptions of areas suitable for applying the above mitigation proposal and any commitments from other agencies required to ensure its implementation. The design will incorporate all measures practical to avoid and minimize disturbance to wetlands and other sensitive areas. Permits such as the National Pollution Discharge Elimination System permit (NPDES), the Section 404 and Section 401 permits, the Conservation District Use (CDU) permit, Underground Injection Control (UIC) permit and County grading permit will all provide measures to protect the aquatic resources and other sensitive elements of the ecosystem.

Section IV LEDPA Alternative

Within Section IV, four alternative alignments were studied, E-1, EX-4, EX-4A, and E-3. Of these, E-1 and EX-4, and EX-4A were eliminated based on results of technical, social, economic, and environmental analyses leaving E-3 as the recommended alternative. The attached *Saddle Road Wetland Zone Map, Section IV Alignments* shows the location of E-1, EX-4, EX-4A and E-3, as well as an older version of the E-3 alignment which was modified to lessen wetland impacts. The following is a description of the alternatives.

E-1

This alternate segment begins at MP 9, Section IV, on the existing road, then swings north of the existing road to avoid all the subdivided and developed area along the existing road. The alignment traverses many kipuka and numerous wetlands for 2,705 m. Botanists for the environmental team have located sensitive plant species in the area of this segment. This segment would also impact some properties along the existing road at the east end where it joins the existing roadway. The E-1 alignment is also located in a "closed watershed" area which is more environmentally sensitive than the watersheds where E-3 and EX-4A are located. As indicated on the attached *Conservation District Map Showing Saddle Road Alignments with Wetland Habitats*, a portion of the E-1 alignment is in a "Protected" conservation district which is the most restrictive of the conservation districts. For these reasons, the SEE Team eliminated this segment from further consideration early on in the alternative evaluation process.

EX-4

Segment EX-4 would follow along the existing Saddle Road alignment through Section IV. It would extend from MP 9 to MP 6, covering a distance of 4.2 km. It would include the reconstruction of Saddle Road with major grade and alignment improvements to bring it up to current standards. This segment would have a maximum grade of 6.5 percent, a base elevation of 447 m, and a top elevation of approximately 660 m.

Construction of EX-4 would require right-of-way acquisition of approximately 8.6 ha. It would require the excavation of 54,439 m^3 of material, and fill of 51,225 m^3. It would generate 3,214 m^3 of waste material. The total estimated construction cost for this segment would be $9,437,270.

Segment EX-4 was evaluated in detail by the project team technical specialists and the results documented in each of the technical reports prepared for the EIS. It would most directly impact the community of Kaumana. Higher traffic volumes and speeds, and a wider roadway footprint would create a more intrusive barrier to this community, making crossings of Saddle Road by automobile, bicycles and pedestrians more hazardous. Community impacts would include increased traffic volume and noise. With Segment EX-4, noise levels would approach or exceed the national Noise Abatement Criteria (NAC) at 18 receptors, or 40 residences. In comparison, EX-4A would result in noise levels that approach or exceed the NAC at 16 receptor sites, or 29 residences and noise levels would not approach or exceed the NAC at any of the receptors along E-3.

Segment EX-4 would require the same number of residential relocations as would EX-4A, but would impact a greater number of property owners with relatively small holdings. Many of these holdings would be reduced to acreages below minimum requirements necessitating replacement purchases. Of all alternatives identified, EX-4 would result in the greatest number of driveways with access directly onto the improved highway resulting in unacceptable safety implications and traffic capacity reductions. Further, the social impacts of the EX-4 alignment in terms of community disruption were considered to be of a much greater magnitude than EX-4A; therefore the SEE Team eliminated this segment from further consideration early on in the alternatives' analysis.

EX-4A

Segment EX-4A represents a more acceptable modified alignment of the eliminated Segment EX-4 through Section IV. EX-4A would follow the existing road on the west and east ends of Section IV, but would split from the existing roadway for a 2-km portion in the middle, following an existing transmission line corridor. This segment extends from MP 9 to 6 and would cover a total length of 4.0 km. EX-4A was identified in an effort to relocate a portion of Section IV away from existing residential development and minimize impacts associated with constructing an arterial roadway through an existing subdivision.

Segment EX-4A would have a maximum grade of 10.9 percent, a base elevation of approximately 474 m, and a top elevation of approximately 600 m. Construction of EX-4A would require right-of-way acquisition of approximately 12 ha. The estimated construction cost for Segment EX-4A is $10,000,000.

E-3

Segment E-3 represents an alternate alignment to EX-4A through Section IV. E-3 would extend from MP 9 tp 6, a length of 5.5 km. This segment was proposed by the SEE Team in an attempt to locate Saddle Road farther from existing development, and the associated impacts previously enumerated.

Segment E-3 would have a maximum grade of 8.0 percent, a base elevation of approximately 390 m, and a top elevation of approximately 654 m. Construction of E-3 would require right-of-way acquisition of approximately 29 ha. The estimated construction cost for Segment E-3 is $17,000,000.

Alternatives Analysis Discussion: EX-4A and E-3

As previously described, alternatives E-1 and EX-4 in Section IV were eliminated early on in the alternatives evaluation process. The DEIS did not recommend a preferred alternative in this section and presented both EX-4A and E-3 as possible alignments so as not to preclude pertinent public and agency comment. The following analysis examines the two remaining alternatives in order to provide the transportation needs assessment necessary for selection as the recommended alternative in the Final EIS.

<u>Operational Analysis</u>
In the design year, E-3 would operate within the range of LOS C with the exception of LOS D briefly during peak hours. EX-4A would operate within the range of LOS D most of the time with design year traffic of 14,000 vehicles per day. The main differences in operational characteristics between the two alignments are; 1) E-3 alignment allows almost 100% passing area versus virtually none on EX-4A; 2) side friction, i.e., turning movements at intersections and ingress/egress movements at driveways on EX-4A would be considerable versus the potential for virtually complete access control on E-3; and, 3) a more curvilinear alignment on EX-4A would tend to slow motorist operating speeds over greater reaches unless adequate additional acceleration, deceleration, and turning lanes were provided. Both alignments offer approximately the same average uphill grade as well as identical cross-sections.

Further, on EX-4A, there are presently a minimum of four access roads for upper Kaumana subdivision residents along this section of roadway. Sometime after the mid-span life of the facility, at least two of these intersections will need to be signalized. By the design year, this would reduce the operation of EX-4A to LOS E (capacity) most of the time, approaching LOS F during the peak hour. The only available remedy for the reduction in operational efficiency for this alternative alignment would be expansion to 4 lanes at this time.

<u>Travel Time Analysis</u>
1. E-3 at LOS C with Avg. Op. Speed of 48 mph for 3 miles = 3.75 minutes total travel time.

2. EX-4A at LOS E with 28 mph Time Mean Speed (estimated, w/signals) for 3 miles = 6.5 minutes total travel time.

3. Total travel time difference = 2.75 min/vehicle.

4. Total lost time per year is = (14,000 X 365 X 2.75) / 60 min/hr = 234,208 hours/year.

<u>Economic Analysis</u>
Time Savings: From the DEIS, based on a 27% to 73% split between business and non-business motorists respectively, the average weighted value of time savings is $24.18/hour. Assuming constant dollars, total time savings realized in the design year with E-3 vs EX-4A are 234,208 X $24.18, or $5,663,150 per year which is about $1,766,000 per year in 1998 dollars using a 6% discount rate. If savings in travel time are reinvested in the Island's economy, the approximately $1.8 Million value in time savings per year would result in an increase of 50 jobs/year and total

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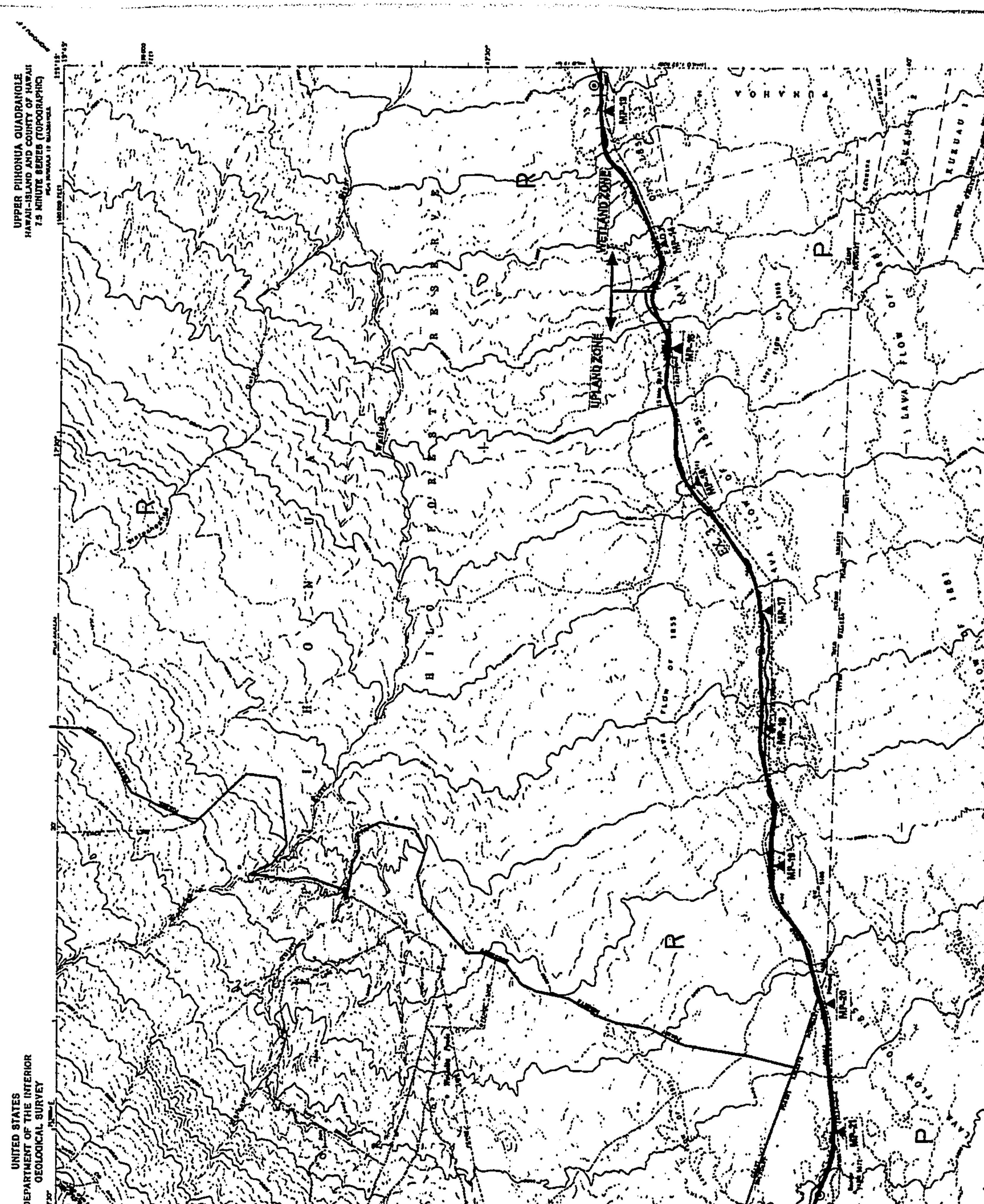

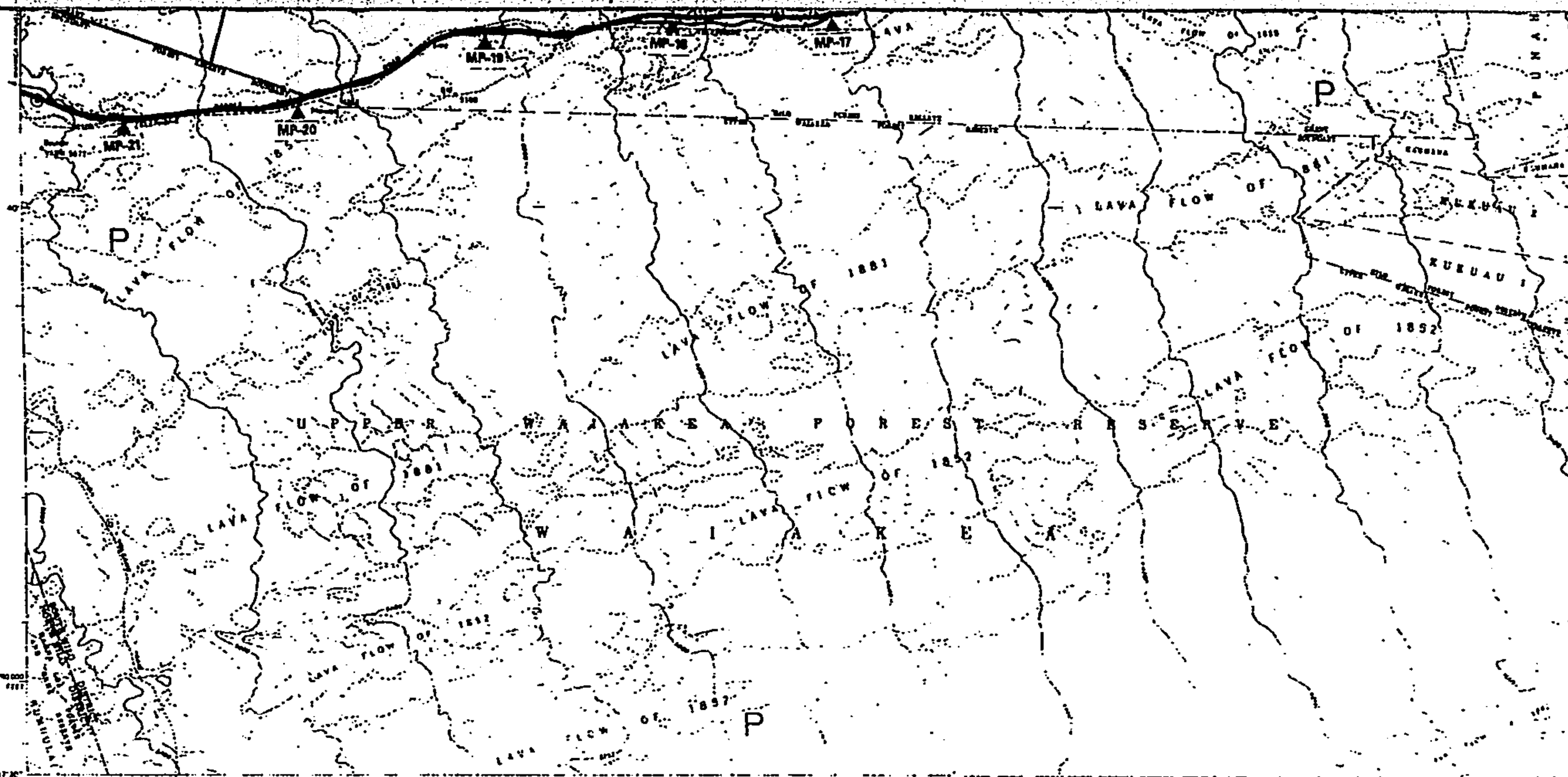

Mapped, edited, and published by the Geological Survey

CONSERVATION DISTRICT SUBZONES

P = PROTECTIVE

R = RESOURCES

L = LIMITED

G = GENERAL

UPPER PIIHONUA, HAWAII

H-55

CONSERVATION DISTRICT MAP SHOWING SADDLE ROAD ALIGNMENT WITH WETLAND HABITATS

H-55

DEPT. OF LAND & NATURAL RESOURCES
P. O. Box 621

EFFECTIVE

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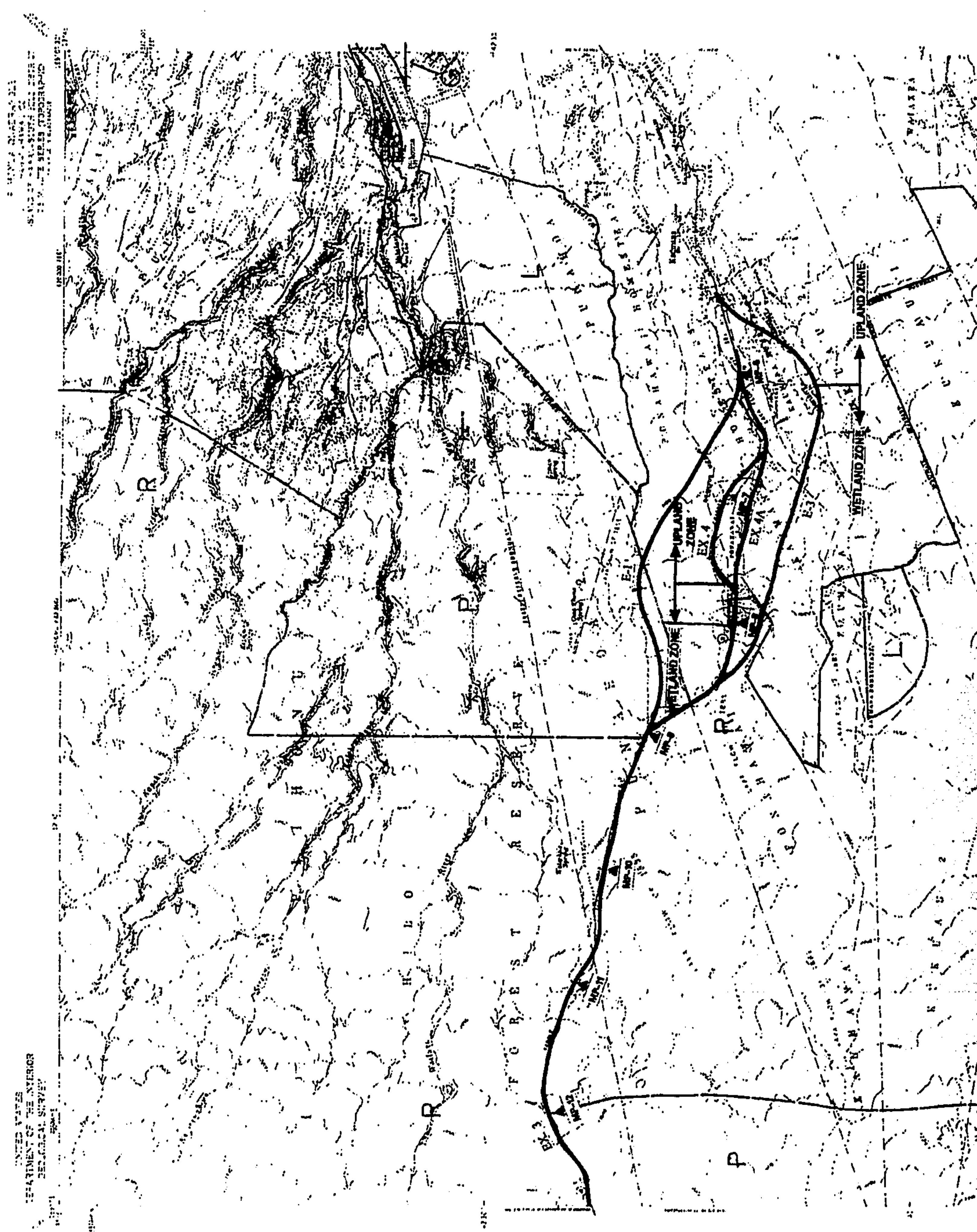

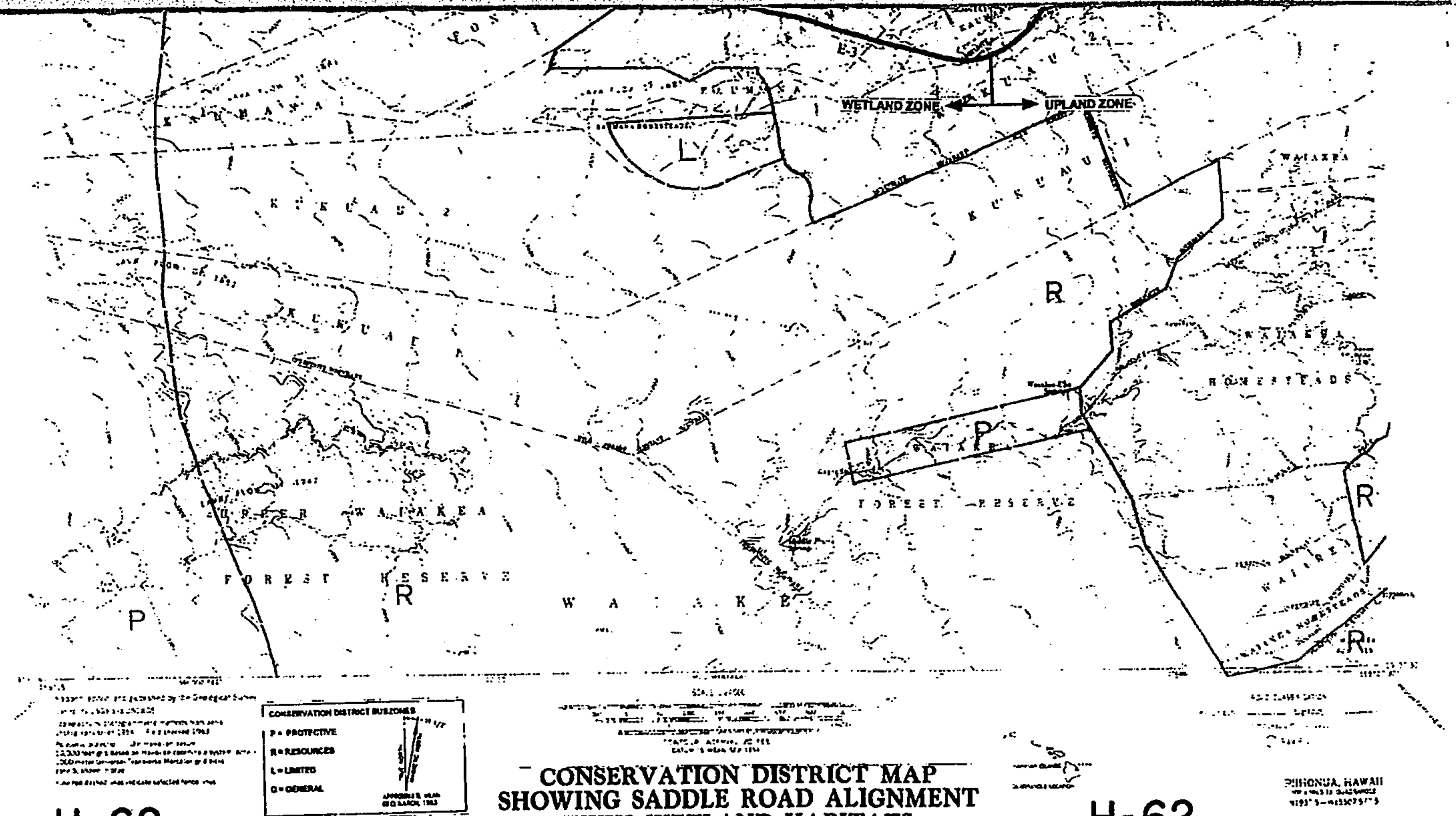

H-62

CONSERVATION DISTRICT MAP SHOWING SADDLE ROAD ALIGNMENT WITH WETLAND HABITATS

H-62

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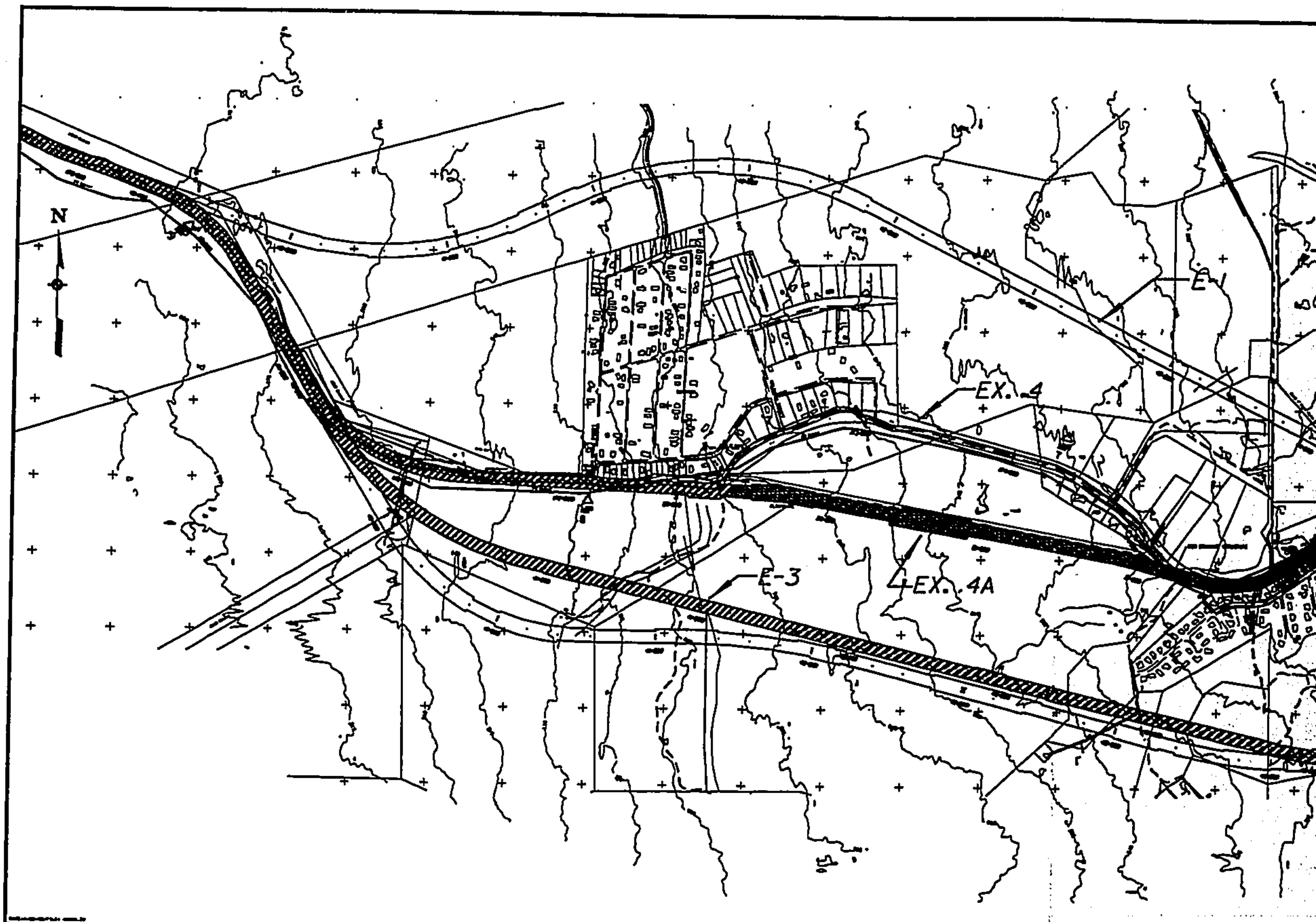

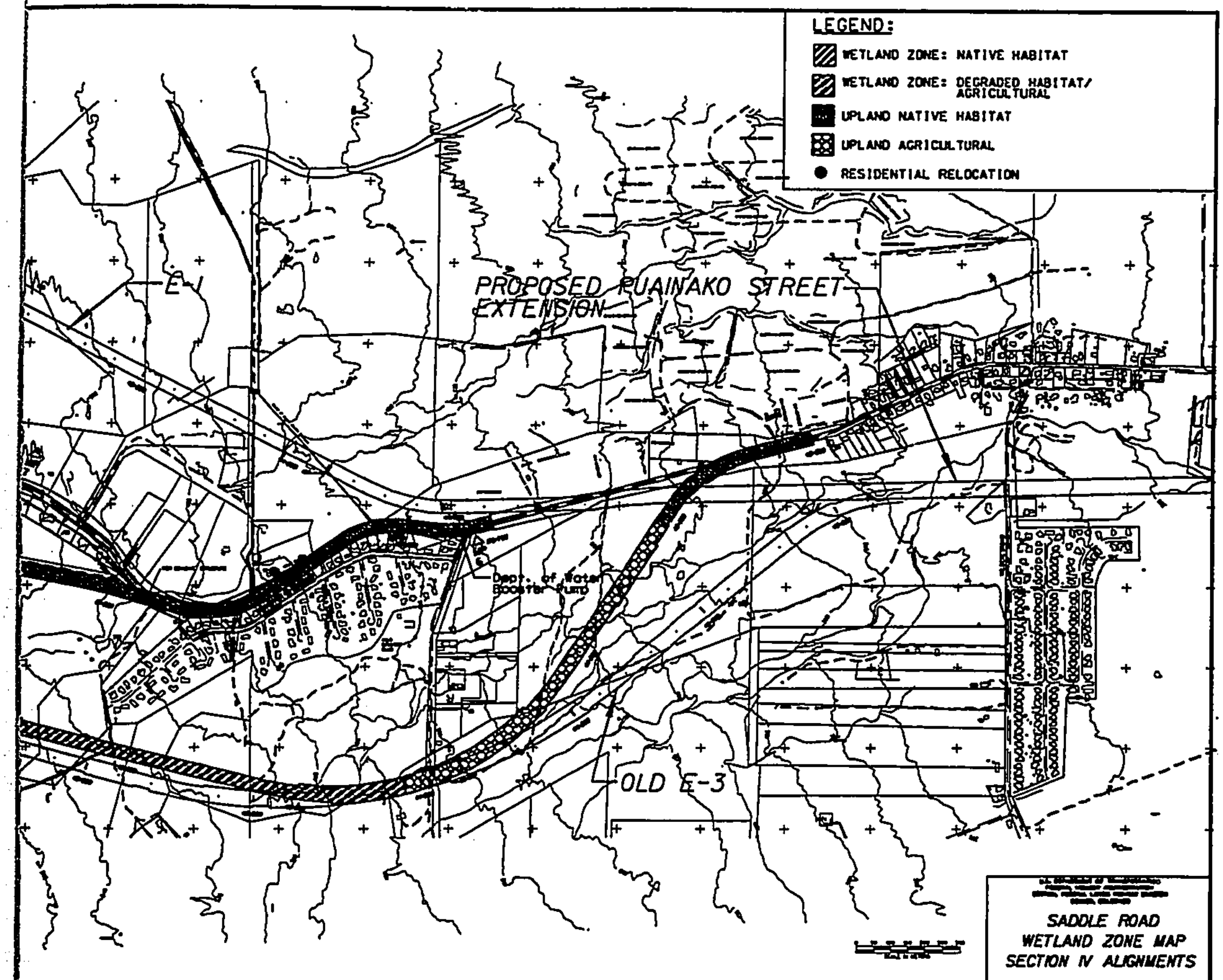
LEGEND:
WETLAND ZONE: NATIVE HABITAT
WETLAND ZONE: DEGRADED HABITAT/ AGRICULTURAL
UPLAND NATIVE HABITAT
UPLAND AGRICULTURAL
RESIDENTIAL RELOCATION
E-1
PROPOSED PUAINAKO STREET EXTENSION
Dept. of Water Booster Pump
OLD E-3
SADDLE ROAD
WETLAND ZONE MAP
SECTION IV ALIGNMENTS

income would increase by slightly under $1.25 Million per year as a result of more efficient use of business time. These estimates are based on results of the State of Hawaii Input/Output Model (DBEDT 1989) referenced in Chapter 3.4 Economics of the DEIS.

Accident Costs: In addition, it can be expected that accident rates would not decline as precipitously with EX-4A as they would on E-3 where ingress/egress conditions could be controlled. Further, it has been shown that, on commuter routes, motorists tend to travel beyond the posted speed limit and safe operating speeds even when unadvisable to do so because of traffic or weather conditions. Using reasonable extrapolations of existing data (Traffic Study, RUST), accident rates on EX-4A could be expected to be at least 25% to 30% higher than on alignment E-3. This rate would equate to approximately 4.0 ACC/MVM, or an increase of 1.0 accident per MVM over that of the two-lane rural roadway average in Hawaii. This increase could result in an estimated 15 additional accidents per year on EX-4A at a cost of approximately $2 Million per year in accident costs in the design year, or about $625,000 in 1998 dollars.

Fuel Costs: Additionally, speed changes resulting from acceleration & deceleration maneuvers on EX-4A could be expected to increase fuel consumption for vehicles traveling along this alignment by an estimated 10%. For 15 million vehicle miles, assuming an average fuel efficiency of 15 miles/gallon, this results in an additional 1,000,000 gallons of fuel consumed annually by vehicles using EX-4A as compared to E-3. This additional fuel consumption results in an added annual cost of about $2 Million to motorists in the design year with the EX-4A alignment or about $625,000 in 1998 dollars.

Capital Improvements: There would also be right-of-way costs associated with EX-4A which would not occur if alignment E-3 is selected. These costs would occur only once and represent residential relocations or property replacements required to construct EX-4A estimated at $5,000,000. There are also potential future capital improvement costs of improving EX-4A near the design year to a 4-lane facility to relieve the capacity situation. These capital expenditures could be expected to cost at least as much as the currently proposed project. This improvement cost is estimated at $10 to $15 Million in future dollars, or about $4 Million in 1998 dollars.

<u>Summary</u>

Assuming that construction on the entire route could begin in 1998, total ***annually recurring*** disbenefits that could be expected to begin accruing in the design year of the proposed project if EX-4A is constructed as compared to E-3 are as follows:

Annual Costs	1998 Dollars	2018 Dollars(1)
Lost time:	$1,766,000	$ 5,665,000
Unrealized Income:	$1,250,000	$ 4,000,000
Additional Accident Costs:	$ 625,000	$ 2,000,000
Additional Fuel Costs:	$ 625,000	$ 2,000,000
Subotals	$4,266,000	$13,665,000

(1) 6% Discount Rate

One-Time Costs	1998 Dollars	2018 Dollars
Capital Improvement Costs:	$9,000,000(2)	$12,500,000(3)
Total Cost (Design Year Only)	$13,266,000	$26,165,000

(2) Includes current residential relocations of $5M
(3) Does not include future residential relocations req'd by widening

The above additional costs which would be borne by the citizens of Hawaii and the road users are extremely conservative estimates because many of the additional costs would begin accruing *before* the 20 year design period is ended. For instance, signalization of a minimum of two intersections along EX-4A would probably be required a little past one-half of the project's design span. These capital improvement costs and the lost time and resultant unrealized income which would begin to accrue at this point have not been included in the above calculations. Additional accident costs as well as additional fuel costs would also begin to accrue at this point in time.

Finally, all of the operational characteristics of EX-4A and E-3 were estimated assuming that abutting land uses and densities would remain unchanged. This is a fairly accurate assumption for alternative E-3, given that conversion of agricultural and Conservation District lands, along with access control, would be regulated. However, with EX-4A, land uses would be much more likely to change to higher trip generation commercial uses or residential densities than with E-3. This would cause the previous Level of Service differences between the two alternatives to be understated resulting in more disparate travel time differences.

Further, it is probably unrealistic to assume that construction on this section of the proposed project could begin this year. Considering phase construction and available funding programs, construction of this section of the project will most likely occur in 6 to 8 years, as indicated in the Draft EIS. Accordingly, the calculations above would need to be adjusted by approximately 3 percent inflation per year to reflect the requisite future year expenditures; i.e., the costs shown will increase by a factor of 1.19 to 1.27 for a 6 to 8 year future implementation schedule.

Conclusion

Taking all of these considerations into account and recognizing that traffic volumes would continue to increase after the design year, it is not unrealistic to estimate that the annually recurring, post-design year disbenefits to citizens and road users from the implementation of EX-4A rather than E-3 would be in the range of $10,000,000 per year in 2006 dollars. This is a minimal amount that could be expected to accrue annually without providing improvements to a 4-lane facility along the EX-4A alignment. Conservatively considering *no* traffic volume increases over a post-design year 10-year period, these annual disbenefits would be equivalent to a 2006 present worth value of about $36,000,000. Assuming improvement to a four-lane facility in the design year, only the design year disbenefit would be added to the additional cost of capital improvements for a one-time added cost of approximately $22,000,000 (2006 dollars; [$9M X 1.27] + $10M) when compared to E-3.

This analysis indicates that, within Section IV, the E-3 alternative is most responsive to the identified needs of; 1) improving overall safety, 2) enhancing operational function and increasing the quality of traffic flow, 3) accommodating present and future traffic levels, and 4) providing an improved, alternate east/west access route on the Island of Hawaii (ref. DEIS, Chapter 1, Section 1.7 Criteria for Selection of Alternatives). Providing a reduced cross-section along the existing alignment (EX-4, "no-action alternative"), with or without a lower design speed, to minimize impacts to adjacent wetlands and/or eliminate or minimize residential relocations or property replacements, would result in even less desirable operational characteristics with greater economic and safety impacts. From the transportation needs perspective, EX-4A, EX-4, the No-Action alternative, *or any alternative along these alignments of lesser design*, does not completely fulfill the purpose and need of the proposed project in that it has cost, economic, and safety implications that render it less viable as a practicable alternative to alignment E-3 (40 C.F.R., Subpart B, 230.10 (a)).

Wetland Impacts: EX-4A and E-3

The wetlands of EX-4A are very similar to those described for EX-3; primarily a mosaic of wetland and upland sites within *Ohia Scrub* and a very small amount of potential fill within *Koa-Ohia Forest* (Table 2). No wetlands occur below 585 m elevation (Figure 7) due to a combination of slope and rainfall conditions.

Several types of wetlands occur within the proposed ROW of E-3 (Figure 8). Above 580 m elevation, the substrate conditions and the wetlands are very similar to EX-4A, i.e. young lava flow with microsites.

Below this elevation the soils are deeper on old lava substrates. These lands have been used for grazing and other agriculture. Intensity of these prior usage impacts on the native vegetation increases downslope (eastward) from this elevation as the proposed alignment approaches the more developed outskirts of Hilo. The habitat between 580 m and 480 m (Country Club Road) is a variable mosaic described as Disturbed Ohia and Agricultural. Within this mosaic, especially at higher elevations, extensive areas of native vegetation occur, but interspersed with clearings dominated by alien grasses and used by cattle. Water was seen standing at the surface in many locations but jurisdictional wetlands were never found at locations where the native fern, uluhe, dominates the ground cover. The wetlands occur in grassy, heavily disturbed areas. Trampling by cattle appears to exacerbate poor drainage due to inadequate slope. The plant species within these wetlands include scattered native ohia trees, but the lower layers are made up almost entirely of alien plants. These aliens include *Rhychospora caduca,* a FACWET sedge, and infrequently *Ludwigia octovalis*, and alien OBLIGATE, and very infrequently *Eleocharis obtusa*, an indigenous OBLIGATE sedge.

It is difficult to determine the relationship between jurisdictional wetlands and the impact of cattle and alien plants. It is probable that some wetlands would have occurred in these habitats before disturbance, but almost certain that disturbance has increased the extent of wetland areas. In Waikane Valley, Oahu, research indicated that replacement of native forests with an alien grassland community resulted in soil waterlogging that led to increased erosion. Grasses transpire less water from the soil than trees, thus disturbance and introduction of alien grasses had altered the hydrology, leading to saturated soils.

As the alignment proceeds downslope, the relative area of disturbance increases, in some places constituting large open pastures. Below Country Club Road, the alignment crosses deep soil previously used for sugar cane plantations. This section is very well-drained.

The following tables provide a quantitative analysis of the wetland vegetation types to be impacted by each alignment:

TABLE 2

Summary of areas (ha) of potential wetland fill within Cut/Fill limits of Segment **EX-4A**[1,2].

	AREA OF FILL	
VEGETATION TYPE	HECTARES	ACRES
KIPUKA WETLANDS		
Koa-Ohia Forest	.0144	.04
YOUNG LAVA FLOW WETLANDS		
Ohia Scrub	.3868	.96
TOTAL WETLANDS	.4012	1.00

1. See Appendix A for detailed discussion of impacts
2. See DEIS, Technical Appendices-Vol.III, Wetlands Determination for delineation methodology

TABLE 3
Summary of areas (ha) of potential wetland fill within Cut/Fill limits of Segment E-3[1,2].

VEGETATION TYPE	AREA OF FILL HECTARES	ACRES
KIPUKA WETLANDS		
Koa-Ohia Forest	.0144	.04
YOUNG LAVA FLOW WETLANDS		
Ohia Scrub	.5040	1.24
DISTURBED OHIA & AGRICULTURAL WETLANDS	2.7216	6.72
TOTAL WETLANDS	3.2400	8.00

1. See Appendix A for detailed discussion of impacts
2. See DEIS, Technical Appendices-Vol.III, Wetlands Determination for delineation methodology

As can be seen in the above tables, the EX-4A alignment impacts an estimated 0.4012 ha (1.0 acre) of wetland area and the E-3 alignment approximately 3.24 ha (8.00 acres). Within the E-3 ROW, approximately 2.7216 ha (6.72 acres) of this wetland area consists of degraded habitat damaged by grazing or other uses and agricultural fields with very little native vegetation.

Since the highest value and function of the wetlands within the Saddle Road corridor is their contribution to the biodiversity of the native ecosystem, a comparison between EX-4A and E-3 was done to determine the extent of disturbance to native habitat. Results showed that the EX-4A alignment disturbed 0.42 ha of native habitat compared to 0.51 ha of native habitat impact along E-3. The linear meters of native habitat disturbed along the EX-4A alignment is 3634 m as compared to 2150 m along E-3. Thus the impacts to biological resources were determined to be roughly equivalent between the E-3 and EX-4A alternatives.

General Wetland Mitigation Proposal: E-3

Basic wetland values and functions are described in Appendix A. Within this alignment, the most important wetland value is the biodiversity of the native ecosystem.

Since recreating the lava flows necessary for replication of the wetland areas is impossible, ratio-based replacement mitigation is not being proposed. In addition, it is difficult to define a scientific basis for determining mitigation ratios for wetlands replacement for the wetlands impacted within the E-3 corridor. A replacement ratio for hydrological function could be determined based on the area needed to maintain water storage , infiltration, or sedimentation.

However, the primary hydrological characteristic present in the wetland areas identified is perched or ponded water catchment with intermittent infiltration through cracks in the pahoehoe lava surface. The roadway design will maintain this function regardless of mitigation requirements. If the wetlands were identified as necessary and unique habitat for an animal species or as an essential resource to populations of surrounding organisms different from the interspersed uplands, a necessary replacement area could be calculated to support populations of the same size or density. Since no such populations have been identified, there is little basis for calculating replacement ratio relative to biological resources.

Further, according to the "Memorandum of Agreement Between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines", November , 1989, in most cases a minimum of 1 to 1 acreage replacement of wetlands will be required to achieve no net loss of values. However, this ratio may be less than 1 to 1 for areas where the functional values associated with the area being impacted are demonstrably low and the likelihood of success associated with the mitigation is high. The MOA also recognizes that no net loss of functions and values may not be achieved in every permit action.

Therefore, the mitigation proposal for the E-3 LEDPA is focused more on what might be called a "best practice" approach for the ecosystem and endemic species as a whole and not on a policy based replacement ratio scheme. Detailed descriptions of proposed mitigation actions are contained in Appendix A. Some of these actions include:

- minimizing cut and fill slopes wherever practical to avoid impacts to native vegetation
- revegetating the roadway ROW with native species.
- securing adjacent uneconomic remnants of ROW in disturbed agricultural lands wherever feasible and fence, remove alien species, and revegetate with native species.
- carefully design roadway drainage facilities to avoid erosion and disturbance of native vegetation and to provide runoff infiltration capabilities where feasible.
- developing and implementing Best Management Practices (BMP's and a Storm Water Pollution Prevention Plan, SWPPP) as part of the final roadway design - detailed plans will be generated using higher quality topographical data during final roadway design

Specific location and implementation details of mitigation are to be finalized as roadway design on this section progresses at a later date. The Final EIS will contain biological descriptions of areas suitable for applying the above mitigation proposal and any commitments from other agencies required to ensure its implementation. The design will incorporate all measures practical to avoid and minimize disturbance to wetlands and other sensitive areas. Permits such as the National Pollution Discharge Elimination System permit (NPDES), the Section 404 and Section 401 permits, the Conservation District Use (CDU) permit, the Underground Injection Control (UIC) permit, and County grading permit will all provide measures to protect the aquatic resources and other sensitive elements of the ecosystem.

Social, Economic, and Environmental Comparative Analysis: EX-4A and E-3
Table 4 provides a summary of the total social, economic, and environmental impacts for comparison purposes.

TABLE 4
SECTION IV COMPARISON OF LEVEL OF IMPACTS

Alternative	**E-3**	**EX-4A**
Affected Environment		
Wetlands	3.24 Hectares (8.00 Acres) ; 2.7216 hectares (6.72 acres, 84% of total) is disturbed Ohia and degraded agricultural wetland	0.4012 Hectares (1.00 Acres). Entire wetland area is native habitat
Native Habitat Adjacent Reach	2.150 km (1.3 miles)	4.183 km (2.6 mi) (>50% within existing roadway area)
Farmland	Direct loss of 8.79 hectares of prime farmland	No direct loss of farmland
Historic Sites	3 sites, all impacts can be mitigated	1 site, impact can be mitigated
Socioeconomic Impacts:	Greater initial construction and mitigation costs	>$10M (2006 dollars) per year in design year disbenefits
Cost (Incl. ROW Mitigation)	$18,000,000	$15,000,000
Home/Business Displacements	None	11 homes
Social Impacts	Reduction in traffic volumes within Kaumana. Increased community cohesion, bicycle and pedestrian opportunities, social interaction, property values.	Construction related impacts to Kaumana. Increased traffic volumes and truck traffic, noise, air pollution, and community disruption.
Visual Impacts	No visual impact to Kaumana community.	Unacceptable visual impact to Kaumana community.

Alternative	E-3	EX-4A
Noise	Does not exceed or approach NAC. Substantial increase in noise at 14 receptors.	Exceeds or approaches NAC at 29 sensitive receptors (residences), substantial increase at 18 addt'l receptors, abatement not feasible.
Safety	No movement of military materiel through residential areas, safer access to Kaumana Drive, less accidents, increased ped/bicycle safety, local traffic only.	Reduced capacity contributes to higher accident rate, local access restricted and less safe, military convoys create unacceptable ques, decreased ped/bicycle safety.
Operational Function and Quality of Traffic Flow	Driveway access and land use can be controlled, intersections strategically placed & designed to enhance traffic flow.	Existing driveway access must be maintained, access to existing subdivisions must be maintained, traffic flow will be impeded.
Accommodate Present and Future Traffic Levels.	Design can be upgraded to provide additional travel and accel/decel lanes, geometrics not constrained, and higher design standards can be accommodated.	Difficult to upgrade design w/o severe impact to existing residences, minor roadway geometric and intersection improvements constrained by adjacent development.

In accordance with procedures outlined in Section VI of the Guidance Papers, the SEE Team eliminated EX-4A from further consideration at a March 17, 1998 meeting after review of the comparative analysis of the two alternatives. In addition, the proposed disposal sites for the discharge of fill material within the E-3 alignment complies with the requirements of Section 404 of the Clean Water Act with the inclusion of appropriate and practicable discharge conditions to minimize pollution or adverse effects to special aquatic sites (wetlands).

Appendix A
CFR PART 230
SECTION 404(b)(1) ANALYSIS

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APPENDIX A
CFR PART 230-SECTION 404(b)(1) ANALYSIS

PURPOSE AND POLICY OF SECTION 404(b)(1) GUIDELINES

Subpart A of the Guidelines states that the purpose of the Guidelines is to restore, and maintain the chemical, physical and biological integrity of waters of the United States through the control of discharges of dredged or fill material. The Guidelines state that dredged or fill material should not be discharged into the aquatic ecosystem unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact either individually or in combination with known and/or probable impacts of other activities affecting the ecosystems of concern.

The Saddle Road project is non-water dependent and an alternative that did not impact wetlands was diligently pursued. However, due the high rainfall on the east side the island, the mosaic nature of the wetlands, and prevalence of wetland soils, there is a vast area on both sides of the existing Saddle Road that more than likely contains wetlands similar to those found within the Saddle Road corridor. Avoiding all wetlands in the design of the project is not practicable. The alignments were carefully designed to avoid as much of the known wetland areas and other environmentally sensitive resources as possible. The E-3 alignment in particular was reworked several times to minimize the impact to wetland areas.

This appendix will demonstrate that the proposed discharge does not have unacceptable adverse impacts to the aquatic ecosystem within the Saddle Road corridor and substantiate that, taking into consideration cost, existing technology, logistics, and other significant adverse environmental consequences, the least environmentally damaging practicable alternative has been selected in light of overall project purpose and need.

RESOURCE IDENTIFICATION AND FACTUAL DETERMINATIONS

Section 404(b)(1) states that factual determinations on the impacts to the aquatic ecosystem must be made in accordance with Section 230.11. Special aquatic ecosystems requiring a Section 404 individual permit are only located within Sections III and IV (segments EX-3, EX-4A, and E-3) at or below milepost 14 of the existing Saddle Road. The following is the determination of effects of the proposed discharge of fill material into the aquatic ecosystem.

230.11 Factual determinations

(a) Physical substrate determinations.

The physical substrate of all aquatic sites consists of wetland soils underlain by pahoehoe lava flows. The wetlands are located in a mosaic pattern within upland areas. Fractures, lava tube voids and blister pockets are found in the shallow subsurface within the pahoehoe rock formation. Springs are known to exist within the project vicinity indicating that permeable subsurface layers transmit groundwater. The majority of the groundwater permeates through open cracks within upland areas. Wetland areas are found in the less permeable portions of the lava formations.

According to the *Soil Survey of Island of Hawaii, State of Hawaii* (USDA Soil Conservation

Service 1973) the soil above the pahoehoe bedrock is rapidly permeable and the lava is very slowly permeable but water moves rapidly through the cracks.

The surface of the wetland areas consisting of eroded soil, rock, and organic material will be changed by excavation and embankment operations required for roadway construction. The wetland surface will be permanently altered. A soil erosion and sediment control plan will be implemented to keep all material within the project construction limits. Possible losses of environmental value include losses of wetland soil and vegetation. Losses will be minimized by designing the vertical and horizontal alignment which requires the least encroachment on sensitive ecosystem areas. Cut and fill slopes will be as steep as practical in order to minimize the roadway footprint.

Water circulation consists of storm water runoff and groundwater flow. The overland flow pattern of the area will be maintained though the use of culverts to carry storm water under the road to existing stream channels. Groundwater flow patterns will be maintained to the extent practical through the use of fractured lava rock subgrade and permeable base course for roadway construction.

(b) Water circulation, fluctuation, and salinity determinations.

Filling of the wetland areas is not expected to have a perceptible effect on water, current patterns, circulation including downstream flows, and normal water fluctuation. The project is not immediately adjacent to any known perennial water bodies. Potential impacts to water circulation patterns include surface drainage patterns and groundwater recharge in the footprint of the fill area. The basic overland drainage pattern of the area will be maintained through the use of culverts to allow water to flow under the road. Culverts will be sized so as to not adversely impact upstream or downstream properties. The use of erosion control measures such as stilling basins and energy dissipaters will be used where appropriate. Drywells will be used if it is determined that an increase in runoff from the road will increase downstream flooding. The use of vegetated roadsides will be use as a measure to filter pollutants from the roadway in order to minimize any potential harm to the environment. Disturbed embankments will be revegetated with native vegetation and function as they do presently.

The segments of the project containing aquatic-type sites are located on the east side of the island on the lower flanks of Mauna Loa. Slopes are generally from 2 to 8 percent towards to ocean. Although some of the flatter areas contain shallow depressions which may store some storm water runoff, the area of depressions in relation to the watershed area is extremely small. In fact, no depression areas are detectable on the 1:2500 scale, 3 meter contour interval topography that was used for the preliminary engineering design. Water levels in small depressions in pahoehoe lava vary significantly with rainfall amounts. The small amount of wetland fill is not expected to have a perceptible impact on flood control in the area. The watersheds tributary to the wetland areas consists of greater than 10,000 acres whereas the total wetland fill area is approximately 13 acres.

(c) Suspended particulate/turbidity determinations.

As required by the Section 401 Water Quality Certification regulations, a Best Management Practices plan will be implemented to minimize soil erosion and pollution of any of the aquatic sites. The practices will include structural measures such as installation of silt fence as well as non-structural measures including pollution and spill prevention plans. All cut and fill areas will be stabilized by hydromulching or native vegetative methods as soon as the excavation or embankment is complete in order to minimize potential sediment problems. BMP installations and revegetative measures will be monitored after construction until no longer required. There are not expected to be any long term impacts to the aquatic environment due to suspended particulate/turbidity.

Culvert discharges are regulated through the National Pollutant Discharge Elimination System (NPDES) permit process. A storm water pollution prevention plan (SWPPP) and best management practices (BMPs) will be submitted as part of the permit application. The SWPPP and BMPs will contain measures to control pollution both during and after construction. The culverts will be designed with velocity dissipation measures and outlet protection to minimize sedimentation. Maintenance of culverts will remove sediments which would be transported downstream.

(d) Contaminant determinations.

The material proposed for discharge will be clean fill free of contaminants. Every attempt will be made to balance earthwork quantities within the wetland areas. If import borrow is required the contract specifications will require that the fill source be approved prior to placement of material within the wetland areas. The borrow site will be inspected to assure the site is free of contaminants.

(e) Aquatic ecosystem and organism determinations.

The aquatic ecosystem within the Saddle Road corridor consists of plant communities that have adapted to the wet conditions within the project area. No aquatic organisms other than wetland plants have been identified.

The wetland plant community ecosystems are fully described in the DEIS Technical Appendix - Volume III *Wetlands Determination.* A brief description of the wetlands and key methodological considerations are summarized below.

<u>Brief Methodology</u>

Determinations of the presence of hydric soils and wetland hydrology were made by personnel of USACE assisted by NCRS personnel. Data were collected during a site visit on 2-3 July, 1997. Eight Delineation Points within Segment Ex-3 were visited and evaluated, usually at two sample points within each Delineation Point. Hydric soils were found in all samples at all sites visited; wetland hydrology was identified at all sites and all sample points except one.

The USACE advised that because of the ubiquity of hydric soils and wetland hydrology, presence of hydrophytic vegetation could be used throughout the study area as the critical parameter to determine the presence of jurisdictional wetlands. This is the rationale followed in this determination study. This approach probably results in a generous estimate of jurisdictional wetland presence in the project area.

Distribution of Jurisdictional Wetlands Within the Study Area

Wetlands were found within the study area only within a "wetland zone" at and below mile-post 14. This limit is believed to be linked to declining rainfall at higher elevations.

Koa-Ohia Forest - Older Substrates
This is the forest type on older lava substrates (kipuka) between 370 and 900 m elevation. Koa (*Acacia koa*) grows up to 25 m tall, dominating the upper canopy. Ohia usually forms a slightly lower canopy. The understory includes hapuu (tree ferns: *Cibotium* spp.) And various native small trees, shrubs and ferns. This vegetation type is described as Old Montane Wet Forest in the DEIS on soils mapped as Keei Extremely Rocky Muck (rKGD).

The vegetation of these forests is not hydrophytic. Koa-Ohia Forest was found within the right-of-way (ROW) in kipuka at or near mile-post 9, 11 and 12. Koa-Ohia Forest is near, *but outside* the ROW near mile-post 10.

Undrained depressions may occur within this vegetation type, supporting a local ground-cover dominated by "wet" species. These wetland inclusions are 1 to 5 m (rarely 10 m) in diameter and have vertical variations of less than 1 to 3 m (rarely 5 m). Such inclusions are reported from the vicinity of the study area (Palmer and Paul 1997) but none were actually seen within the proposed ROW during this wetlands study.

These Koa-Ohia Forests are considered to be one percent wetland, by area, to accommodate possible small wetland inclusions.

Ohia Forest - Older Substrates
Ohia Forest occupies the older lava substrates above 900 m elevation within the project area. Within the Saddle Road corridor, Koa is found only below 900 m and above 1700 m. The Ohia Forest in the study area has a variably closed canopy of ohia up to 20 m tall and a dense understory of hapuu and a diversity of other native plants. Ohia Forests of the study area are described as Old Montane Wet Forest and Old Montane Mesic Forest in the DEIS.

Ohia Forest was found within the ROW only in a single large kipuka near mile-post 14 within the ROW, this vegetation was found to be hydrophytic in its entirety. These areas may also include depressions or drainage ways with distinct hydrophytic ground-cover, similar to that described in the previous paragraph. Ohia Forest is near, but outside, the ROW at several other locations. In the final design, the alignment can be moved to avoid grading or direct damage to the kipuka at mile-post 14 and any other location.

Ohia Scrub - Young Lava Flows

This is a simple, early succession vegetation dominated by Ohia (*Metrosideros polymorpha*) and uluhe (*Dicranopteris linearis*). The ohia trees are usually less than 10 m tall. The uluhe forms dense, tangled mats 1 m or more high. Plant diversity is low. Ohia Scrub occurs throughout the study area on the 1881 and 1855 lava flows. This vegetation type corresponds with New Lowland Wet Forest, New Lowland Wet Shrubland, New Montane Wet Forest, New Montane Wet Shrubland described in the DEIS.

The Ohia Scrub vegetation type was found to be a mosaic of upland and wetland sites. Wetlands occur in areas where the pahoehoe lava substrate provides inadequate drainage. The pattern, or "grain" size of the mosaic could be analyzed on many scales. However, a fairly coarse scale is dictated by the pattern of the prevailing vegetation cover. The Ohia Scrub consists of variably scattered small ohia trees, usually in a dense mat of the fern, uluhe, which sometimes includes uki (*Machaerina angustifolia*) or waiwaiole (*Lycopodium cernuum*) as dominants, and very few other species in the vegetation.

The substrate is extremely rugged, undulating pahoehoe lava. Most of the soil is found in microtopographic depressions, from 0.25 to 2.0 m in diameter, usually with less than 1m of vertical variation. Ponded water may also be found in these depressions. A rough estimate, based on a limited sample, is that less that 30% of the surface within Delineation Points has 2 cm or more soil; the remaining 70% being lava outcrop, often obscured by a dense layer of herbaceous plants. On a slightly broader scale, local topography is also undulating with variable slope within the regional topography defined by the slopes of Mauna Kea and Mauna Loa.

Disturbed/ Agricultural Vegetation

At low elevation within Segment E-3, close to Hilo, the primary vegetation has been disturbed or removed by residential and agricultural uses. Two of these human-altered vegetation types are recognized here.

Disturbed Ohia

This designation is used for areas where the vegetation has been seriously degraded by grazing, logging or other uses. The landscape is still visually dominated by ohia trees, uluhe, and other native plants. But these native elements exist within an irregular mosaic of grassy clearings. Cattle were observed actively grazing in many areas and the vegetation type occurs in areas with soil mapped as Keei Extremely Rocky Muck (Tropofolist) and Kaiwiki (Hydrandept) series soils and is classified as old Lowland Wet Forest, originally containing koa.

Agricultural

These areas are, or until recently were, in intensive agricultural use, many as pastures or formerly sugar cane fields. The primary native vegetation has been completely removed, except in ravines or on other rough land. The Agricultural type is found on deep ash soils mapped as Kaiwiki Series (Typic Hydrandept) (KaC, KaD, KaE). This vegetation is entirely upland.

In some areas, these two latter types occur together in an irregular mosaic. These are designated as Disturbed Ohia and Agricultural.

TABLE 1
Summary of areas (ha) of potential wetland fill within Cut/Fill limits of Segment **EX-3.**

	AREA OF FILL	
VEGETATION TYPE	HECTARES	ACRES
KIPUKA WETLANDS		
Ohia Forest	.2536	.63
Koa-Ohia Forest	.0199	.05
YOUNG LAVA FLOW WETLANDS		
Ohia Scrub	2.1220	5.24
TOTAL WETLANDS	2.3955	5.92

TABLE 2
Summary of areas (ha) of potential wetland fill within Cut/Fill limits of Segment **EX-4A.**

VEGETATION TYPE	AREA OF FILL	
	HECTARES	ACRES
KIPUKA WETLANDS		
Koa-Ohia Forest	.0144	.04
YOUNG LAVA FLOW WETLANDS		
Ohia Scrub	.3868	.96
TOTAL WETLANDS	.4012	1.00

TABLE 3
Summary of areas (ha) of potential wetland fill within Cut/Fill limits of Segment **E-3.**

VEGETATION TYPE	AREA OF FILL	
	HECTARES	ACRES
KIPUKA WETLANDS		
Koa-Ohia Forest	.0144	.04
YOUNG LAVA FLOW WETLANDS		
Ohia Scrub	.5040	1.24
DISTURBED OHIA & AGRICULTURAL WETLANDS	2.7216	6.72
TOTAL WETLANDS	3.2400	8.00

(f) Proposed disposal site determinations.

The proposed disposal site will be within the roadway right-of-way.

(g) Determination of cumulative affects on the aquatic ecosystem.

The direct affects on the aquatic ecosystem will be the reduction in wetland soil types which are available for wetland adapted plant communities. The actual function of the wetland areas with regards to productivity and water quality of existing aquatic ecosystems is not expected to be perceptibly impacted. The wetland areas are mostly isolated pockets of soil within impermeable lava substrate that for the most part are not connected to the groundwater table. Groundwater recharge occurs mostly though crack in the pahoehoe lava associated more with upland areas as opposed to wetland areas within the upland/wetland mosaic.

As stated above, the direct impact to the aquatic ecosystem will be the reduction in the amount of area that is available for habitat. The construction of the roadway is not expected to directly affect future development of other aquatic ecosystems. There is already access to the surrounding areas via the existing Saddle Road. Any development that occurs will be driven by the economy and existing county and state land use plans rather than directly attributed to the road construction. It should be noted that the area surrounding most of the EX-3 alignment is within State Conservation Districts. The uses within a conservation district are limited and Conservation District Use permits must be obtained in accordance with Chapter 13-5 of the Hawaii Administrative Rules, "Conservation District". The attached *Conservation District Map Showing Saddle Road Alignments with Wetland Habitats* shows the conservation district in relation to the roadway corridor on the east side of the project. The Island of Hawaii has a great deal of land protected by conservation districts which restrict development and thus destruction of habitat. Over 51% of the Island is within conservation districts with restrictions to development. Much of this conservation land is within and around the proposed project.

(h) Determination of secondary effects on the ecosystem.

One long term, direct impact considered was the effect of pollutants from highway drainage. According to the U.S. Department of Transportation publication "Retention, Detention, and Overland Flow for Pollutant Removal From Highway Storm Water Runoff : Interim Guidelines for Management Measures", all highway runoff contains pollutants but pollutant loading does not always cause a problem for receiving waters. The documents sites studies that monitored highway pollutant impacts to receiving waters at sites with average daily traffic (ADT) volumes from 7,400 to 135,000 vehicles per day. Results showed that runoff from lower ADT rural highways did not cause discernible toxic stress to aquatic biota. Few significant impacts were detected for roadways with less that 30,000 ADT. The Saddle Road project ADT is estimated to be 14,000 in the year 2014.

The roadway may be used as access for further development of the Kaumauna area. This land is already designated for residential and agricultural development by state and county land use classifications. Construction of the road may quicken the pace of the development although development of the area would most likely take place with or without the roadway. Development of this area is linked to the overall economic climate and not simply to access. The E-3 alignment passes though a large area that is already currently in agricultural use.
Potential secondary impacts would consist of additional fill of wetland areas required for future agricultural and residential developments in the surrounding area. It is impossible to avoid all wetlands due to the upland/wetland mosaic nature of the existing land.

POTENTIAL IMPACTS ON THE BIOLOGICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

230.3 Threatened and endangered species.

The proposed discharge of fill material will not cover or otherwise directly take a threatened or endangered species.

The proposed discharge of fill material will not destroy any habitat which has been identified as being critical to a threatened or endangered species within the wetland areas.

The proposed roadway will not facilitate incompatible activities beyond those activities already facilitated by the existing road; i.e., access to the native forest areas that are adjacent to the road and which contain some rare plant species. It should be noted that there are two rare plant species located in excess of 200 meters from the EX-3 roadway corridor.

230.31 Fish, crustaceans, mollusks and other aquatic organisms in the food web.

Aquatic organisms in the food web located within the wetland areas are not well documented. No known aquatic organisms were identified during the course of the biological studies.

230.32 Other wildlife.

No mammals, birds, reptiles, or amphibians that are dependent on the wetland areas for breeding, nesting, escape cover, travel corridors or preferred food sources have been detected by the project biologists.

POTENTIAL IMPACTS ON SPECIAL AQUATIC SITES

230.40 Sanctuaries and refuges.

There are no federally designated fish or wildlife sanctuaries or refuges within the wetland areas.

230.41 Wetlands

As stated in the EPA document "Beyond the Estuary: The Importance of Upstream Wetlands In Estuarine Processes", upstream wetlands perform various functions within a given watershed. These functions include the following:

- influence water quality of adjacent river or streams by removing pollutants such as sediments, nutrients and organics/inorganics
- increase detention time of floodwaters thereby reducing flow velocity, erosion and flood peaks downstream

- provide habitat for wildlife and unique vegetation

- serve as spawning and nursery grounds for fish

- contribute to the aquatic food chain by providing detritus (decaying organic matter) to the biota of the adjoining waters

- prevent excessive water temperature during summer months which could be lethal to invertebrates or fish

The upstream wetlands within the Saddle Road corridor provide only a very limited range of the above functions as follows:

- The wetland function in relation to the removal of pollutants such as sediment and organics/inorganics is limited since most of the wetland areas consist of small pockets of wetland soils surrounded by upland areas. On the young lava flows much of the surface consists of lava rock which is not easily eroded and therefore there is very little sediment transport. The drainage area tributary to each individual wetland pocket is very small and therefore the overall effectiveness of these wetlands for pollutant removal is limited. In addition, the design of the roadway will incorporate vegetated roadway swales which will act to remove pollutants from storm water runoff. It should be noted that the upstream watershed tributary to the EX-3 segment consists of mostly conservation land and forest reserve land. There is not expected to be a large pollutant load from these lands. The watershed tributary to the EX-4A and E-3 segments contains some residential and agricultural land. These areas are expected to have a greater amount of pollutants in the storm water runoff but much of these pollutants will be removed within the proposed vegetated roadside swales. The pollutant loads are also highly diluted due to the excessive rainfall in the Hilo area.

- Most of the mosaic wetlands within the Saddle Road are too small in relation to the tributary watershed area to greatly influence flood water velocity, erosion and flood peaks. In fact, the upland areas have a greater influence on flood waters as they consist of more permeable substrates with much higher infiltration capacity. Compensation for lost infiltration is usually provided by the use of drywells on the Island of Hawaii. The drywells are usually a minimum of 20 feet deep and usually can dispose of between 6 and 10 cfs. The roadway will be designed to incorporate drywells where required to mitigate possible increases in downstream flooding potential or provide additional infiltration capacity.

- Wildlife impacted by the proposed wetland disturbance has not been identified by project biologists. Most of the wetlands within the E-3 corridor consist of degraded habitat with alien plant communities. Domestic animals use the area for grazing.

- The wetlands along the Saddle Road alignments do not serve as spawning grounds to fish.

- There is little likelihood that wetlands along the Saddle Road provide detritus to adjoining waters since there are no waters immediately adjacent to the wetlands.

- Water temperatures are not regulated by the wetlands within the Saddle Road corridor.

The wetland areas within each alignment have been identified in the Wetlands Determination report included in Technical Appendix Volume III of the Draft Environmental Impact Statement and in 230.11 (e) above.

The area of disturbance of wetland habitat is approximately 2.3955 hectares (5.92 acres) for Segment EX-3, 0.4012 hectares (1.00 acres) for Segment EX-4A, and 3.2400 hectares (8.00 acres) for Segment E-3. The wetland areas are part of a larger similar ecosystem consisting of a mosaic pattern of upland and wetlands areas on pahoehoe lava substrates. The lava flows within the project occurred at different times and the vegetation varies with the age of the flow. As described in the Wetlands Determination report, the Ohia Scrub type of vegetation occurs predominantly on the 1855 and 1881 lava flows. Koa-Ohia of Ohia Forest occurs mostly on older pahoehoe substrates. An estimate of the overall extent of the different ecosystems types within the project vicinity was made by overlaying the Soil Conservation Service soils mapping on the USGS maps. The area of the younger lava flows with wetland potential is 2,345 ha (5,792 ac). The area of the older substrates is estimated at 9,821 ha (24,258 ac). This estimate assumes that wetlands only occur within the range of elevations where they were found within the Saddle Road corridor. The actual areas where wetlands occur may be more or less.

Discharge of fill material for the roadway project is not expected to advance the succession to dryland species, eliminate nutrient exchange by a reduction in the system's productivity, or alter current patterns or velocities. It is not expected to degrade water quality or interfere with filtration functions. It will not change the aquifer recharge capability of the wetlands. It is not expected to change the wetland habitat value for fish and wildlife. It will not change the area's capability to store flood waters and the wetlands do not serve to buffer upland areas from wave action, storm damage and erosion.

POTENTIAL EFFECTS ON HUMAN USE CHARACTERISTICS

230.50 Municipal and private water supplies.

The County of Hawaii Department of Water Supply was contacted to discuss any concern they may have regarding possible affects to the drinking water supply from the roadway construction or operation. Mr. Glenn Ahuna stated that the Department of Water Supply has not experienced any detrimental effects due to roadway runoff to any of their existing wells, many of which are adjacent to roadways. The major source of drinking water pollutants in Hawaii County are agricultural operations that use high levels of pesticides and fertilizers.

The Department of Water Supply is intending to construct a new 1,300 foot deep domestic water well adjacent to the existing Saddle Road near milepost 8 in Kaumana. The well is adjacent to

EX-4A and the alignment would need to be adjusted to avoid the well site. Mr. Glenn Ahuna of the Department of Water Supply was contacted to inquire whether they were concerned that the construction of the road would impact their well. Glenn stated that they often constructed wells adjacent to busy roads and have not had a problem with water quantity or quality due to the roadway. Glenn stated that the bigger concern was from agricultural areas as the use of pesticides and fertilizers can sometimes cause water problems. The Department of Water Supply also submitted a formal comment letter on the Draft EIS which stated that their only concerns were that the project did not interfere with their service lines during construction.

Drywells are not permitted within a quarter mile radius of the Department of Water Supply's well. This would make disposal of drainage more difficult along the EX-4A alignment.

230.53 Aesthetics.

Some of the wetlands that are to be filled consist of native forests which will cause a loss of aesthetic value. A portion of the project also traverses degraded agricultural wetlands which may not have as high an aesthetic value as the native forest areas.

230.54 Parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves.

The roadway alignment does traverse state lands that are used for hunting, recreation and research along the EX-3 alignment. The EX-3 alignment follows the existing alignment closely within these areas and therefore the impacts are expected to be minimal.

EVALUATION AND TESTING

The project will comply with all testing and evaluation requirements of the Clean Water Act Section 404(b)(1) SUBPART G for the discharge material. The extraction site is adjacent to the discharge site and there is little human use of the area. There is low likelihood of contamination and therefore testing was not conducted.

ACTIONS TO MINIMIZE ADVERSE EFFECTS

230.70 Actions concerning the location of the discharge.

The roadway will be designed so as to minimize the amount of wetland disturbance required by minimizing total excavation and embankment and protecting surrounding areas from disturbance. Excavated material will be used in embankments to the extent practical. The roadway drainage system will be designed in order to avoid disruption of periodic inundation patterns to the extent practical. The road will also be located to avoid incompatible human activity by creating rest areas away from sensitive ecological sites and not allowing stopping in the vicinity of sensitive areas.

230.71 Actions concerning material to be discharged

Every effort will be made to balance earthwork quantities so that material to be discharged will consist of excavated material from within the same general area. This will be done in order to maintain existing physiochemical conditions and reduce the availability of pollutants.

230.72 Actions controlling the material after discharge

Best Management Practices will be used to prevent sediment and pollutants from entering the aquatic sites. These measures will consist of installing silt fence, stilling basins and other physical measures to prevent erosion both during and after construction as well as non-structural measures including plans and policies for spill prevention, and good housekeeping practices to prevent pollution.

230.73 Actions affecting the method of dispersion

The fill material will be placed and compacted in such a manner as to keep the material within the limits of grading. Silt fence will be installed and maintained throughout the construction period and will be kept in place and maintained after construction until all vegetated slopes have stabilized.

Construction will take place during the dry season if possible in order to minimize potential for erosion.

230.74 Actions related to technology

Appropriate equipment will be used to excavate, place and compact fill material to ensure minimum disturbance within the right-of-way.

Proper maintenance and operation of equipment and machinery including adequate training, staffing and working procedures will be mandated in the project specifications. Machinery and techniques that are especially designed to reduce damage to wetlands will be required in the project specifications.

Access roads will be designed to include culverts and diversions that will pass both low and high water flows, accommodate fluctuating water levels and maintain circulation. Appropriate machinery and methods will be used to transport fill material.

230.75 Actions affecting plant and animal populations

Throughout the project development, minimization of adverse effects on populations of plants and animals has been a primary goal. The following is a summary of proposed actions to minimize impacts:

Avoidance

"No Action" avoids the short-term impacts only.

Under "No Action", some minor realignment or rehabilitation would most likely be proposed at some time in the future by local entities to alleviate hazardous conditions.

Under "No Action", a four-fold increase of traffic is anticipated, resulting in an increase in any long-term, indirect, and cumulative impacts.

"No Action" in Sections III and IV could still be coupled with a "build alternative" in Sections I and II, still resulting in increased traffic. Future traffic levels with "No Action" in Sections III and IV could be comparable to traffic levels with selection of a build alternative. If so, the long-term, indirect and cumulative impacts of a build alternative would be the same as "No Action".

Any placement of an *improved* alignment from Hilo through the Saddle will impact wetland-containing habitat.

Minimization

Minimizing "degree" of adverse impact is used to mean avoiding areas of high biological value or that are more sensitive to disturbance, by placing the alignment in other areas that may contain wetlands that are less valuable or sensitive (refer to discussions in body of report relative to alternative selections and eliminations)

Minimization of "magnitude" of adverse impact is used to mean reducing the area of wetlands to be filled by choice of roadway design and alignment placement (refer to discussions in body of report relative to practicability of minimization).

Restoration

Restoration is used to mean enabling the native vegetation to cover all areas of disturbance not essential to the operation and maintenance of the roadway.

It is anticipated that some restored areas will contain wetland pockets very similar to those in the surrounding area, but creating such pockets is not the primary goal of restoration.

Areas to be restored include:

a. construction damage outside the footprint of the completed roadway;

b. the cut/fill slopes created by grading, up to the edge of the grassy shoulders;

c. any abandoned segments, of the existing Saddle Road, pavement to be removed;

d. any other disturbed areas, such as currently existing parking areas and service roads (this will be done in consultation with HELCO and DLNR to determine the minimum access required, applied within the ROW.); and

e. where feasible, any uneconomic remnants of ROW requiring purchase in disturbed agricultural lands.

It is estimated that restored habitat will be roughly equivalent in area to the area of wetland filled by alternative segments EX-3 and E-3.

Observations of the present conditions within this portion of the Saddle Road corridor show that restoration of the native vegetation is highly feasible. The existing road and the two power lines, of different ages, show that the vegetation naturally reclaims disturbed sites.

The goal of restoration if a build alternative is selected would be to recreate the appearance of the existing Saddle Road, i.e. paved travel-way, narrow paved shoulders, wider grassy shoulder, and native vegetation up to edge of shoulder, as currently exists in Section III and IV.

Required restoration activities would be mostly:

a. surface preparation,

b. monitoring and management of any woody alien plant species or other noxious alien plants that may become established.

It is recommended that restoration be guided by research of the present response of native vegetation to disturbance within the Saddle Road corridor.

Reducing Impacts Over Time

The goal will be to eliminate or substantially reduce the long term indirect impacts, especially those associated with increased off-road usage and the introduction of alien plants and animals.

Off-road impacts will be prevented by managing access through signage, education, appropriate placement of pullovers, and physical barriers where appropriate. This access-management will be closely coordinated with DLNR and USFWS so as to maintain adequate access for recreational uses and at the same time protect sensitive biological resources.

Alien organism establishment would be prevented through research-directed monitoring and control. Other mitigation measures stated in the DEIS will be incorporated.

A summary of potential mitigation measures is provided in the following table:

MITIGATION SUMMARY

SHORT-TERM IMPACTS (CONSTRUCTION)

Ecosystem Impact:	Proposed Mitigation:
Grading:	Minimize footprint area Minimize degree (avoid Kipuka) Restoration of disturbed area, cuts and fills
Dust, Exhaust, Noise:	Best Management Plan
Existing Drainage Patterns:	Maintain existing drainage patterns through the use of appropriately sized culverts placed within existing swales
Increased Runoff:	Best Management Plan to control sediment Minimize increased runoff through the use of drywells where appropriate
Existing Subsurface Water Flow:	Maintain groundwater movement by using appropriate fill material, i.e. boulder fill where applicable and permeable base course material where applicable
Fire:	Best Management Plan
Rare Species *(Cyanea platyphylla and Clermentia peleana:*	Minimize footprint area Minimize degree (avoid Kipuka) Restoration of disturbed area, cuts and fills Intensive survey around known populations "Off-limits" fencing at sensitive sights Move roadway farther south of *Clermentia pelenea* and out of Ohia forest community around milepost 14 Scarifying and revegetating existing roadway with native species

LONG TERM IMPACTS:

Ecosystem Impacts:	**Proposed Mitigation:**
Noise:	None
Pollution:	National Standards Vegetated roadside swales
Spills:	Retain on roadway shoulders
Fire:	None; highly improbable in wetland areas
Rare Species *(Cyanea platyphylla and Clermentia peleana:*	Discourage motorists from stopping at sensitive locations through the use of signs and fencing where appropriate

INDIRECT IMPACTS:

Ecosystem Impacts:	**Proposed Mitigation:**
Alien organisms:	*Ongoing monitoring*
Off-road use	Access control (see "Reducing Impacts")
Rare Species *(Cyanea platyphylla and Clermentia peleana:*	Manage access near populations including blocking and restoration of service road near *Clermentia peleana*

230.76 Actions affecting human use

The project has been designed to minimize potential damage to aesthetically pleasing aquatic sites. The E-3 alignment has been located in an area of degraded agricultural wetlands and avoids native habitat as much as possible.

Portions of the EX-3 alignment will be realigned slightly to minimize impacts to kipuka and higher quality native ecosystems which were identified in the DEIS and its technical appendices.

230.77 Other actions.

Runoff from the roadway cut and fill areas will be filtered using silt fence or other means in order to prevent sediments from discharging off-site. If dewatering is required, the water shall be filtered and discharged appropriately so as not to degrade wetland areas

U.S. Department of Transportation
Federal Highway Administration

Central Federal Lands Highway Division

555 Zang Street
P.O. Box 25246
Denver, Colorado 80225-0246

APR 2 9 1998

In Reply Refer To:
HPD-16E/Saddle Road

Mr. Kenneth Y. K. Au
Advance Planning Engineer
Hawaii DOT, Highways Division
600 Kapiolani Boulevard, No. 301
Honolulu, HI 96813

Dear Mr. Au:

In accordance with the "Memorandum of Understanding for the National Environmental Policy Act and Clean Water Act Section 404 Integration Process for Surface Transportation Projects in the State of Hawaii" (MOU), we are transmitting herewith a copy of the 404(b)(1) Analysis Report (report) for the proposed Saddle Road Project (SR 200) from Milepost 6 near Hilo, Hawaii to the Mamalahoa Highway (SR 190). This report was prepared at the request of the U.S. Army Corps of Engineers and the Environmental Protection Agency. It contains an analysis of alternatives in Sections III and IV of the proposed project. The report is intended to serve two purposes: 1) address the Clean Water Act Section 404(b)(1) requirements for discharge of fill material in special aquatic sites (wetlands); and, 2) address the requirements of the MOU with respect to the FINAL EIS DEVELOPMENT stage of coordination identified in the Appendix A "concurrent process" guidelines of the MOU (Page 2 of 6).

The analysis of alternatives contained in the report presents our conclusions on selection of the Least Environmentally Damaging Practicable Alternative (LEDPA) in Sections III and IV as required by the MOU. The INTRODUCTION section of the report contains seven bulleted requests for decisions by the signatory agencies to the MOU. We are asking for your review of the enclosed report and a written response to the requests contained therein within 45 days of your receipt of this letter as provided for in the MOU.

We are available to meet with you to address any aspects of the report or findings that require clarification. If you have any questions or need further information, please contact Mr. Bert McCauley, Environmental Project Manager, at (303) 716-2141.

Sincerely yours,

for
Larry C. Smith, P.E.
Division Engineer

Enclosure

cc (with enclosure):
Maj. Gen. Alexis Lum, Exec. Asst., Office of Senator Daniel K. Inouye, Honolulu, HI
Mr. Merrill Deskins, Environmental Protection Spec., FHWA, Region 9, San Francisco, CA
Ms. Nancy Burns, Senior Project Engineer, Okahara & Associates, Kailua-Kona, HI

US Department of Transportation
Federal Highway Administration

Central Federal Lands Highway Division

555 Zang Street
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APR 2 9 1998

In Reply Refer To:
HPD-16E/Saddle Road

Mr. Brooks Harper, Field Supervisor
U.S. Fish & Wildlife Service
Pacific Islands EcoRegion
300 Ala Moana Blvd., Room 3108
Honolulu, HI 96850

Dear Mr. Harper:

In accordance with the "Memorandum of Understanding for the National Environmental Policy Act and Clean Water Act Section 404 Integration Process for Surface Transportation Projects in the State of Hawaii" (MOU), we are transmitting herewith a copy of the 404(b)(1) Analysis Report (report) for the proposed Saddle Road Project (SR 200) from Milepost 6 near Hilo, Hawaii to the Mamalahoa Highway (SR 190). This report was prepared at the request of the U.S. Army Corps of Engineers and the Environmental Protection Agency. It contains an analysis of alternatives in Sections III and IV of the proposed project. The report is intended to serve two purposes: 1) address the Clean Water Act Section 404(b)(1) requirements for discharge of fill material in special aquatic sites (wetlands); and, 2) address the requirements of the MOU with respect to the FINAL EIS DEVELOPMENT stage of coordination identified in the Appendix A "concurrent process" guidelines of the MOU (Page 2 of 6).

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Sincerely yours,

James D. Allen
for
Larry C. Smith, P.E.
Division Engineer

Enclosure

cc (with enclosure):
Mr. Don Palawski, Asst. Field Supervisor, USFWS, Pacific Is. EcoRegion, Honolulu, HI
Maj. Gen. Alexis Lum, Exec. Asst., Office of Senator Daniel K. Inouye, Honolulu, HI
Mr. Merrill Deskins, Environmental Protection Spec., FHWA, Region 9, San Francisco, CA
Ms. Nancy Burns, Senior Project Engineer, Okahara & Associates, Kailua-Kona, HI

U.S. Department of Transportation
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555 Zang Street
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APR 29 1998

In Reply Refer To:
HPD-16E/Saddle Road

Mr. Alexis Strauss, Director
Water Division
U.S. Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, CA 94105

Dear Mr. Strauss:

In accordance with the "Memorandum of Understanding for the National Environmental Policy Act and Clean Water Act Section 404 Integration Process for Surface Transportation Projects in the State of Hawaii" (MOU), we are transmitting herewith a copy of the 404(b)(1) Analysis Report (report) for the proposed Saddle Road Project (SR 200) from Milepost 6 near Hilo, Hawaii to the Mamalahoa Highway (SR 190). This report was prepared at the request of the U.S. Army Corps of Engineers and the Environmental Protection Agency. It contains an analysis of alternatives in Sections III and IV of the proposed project. The report is intended to serve two purposes: 1) address the Clean Water Act Section 404(b)(1) requirements for discharge of fill material in special aquatic sites (wetlands); and, 2) address the requirements of the MOU with respect to the FINAL EIS DEVELOPMENT stage of coordination identified in the Appendix A "concurrent process" guidelines of the MOU (Page 2 of 6).

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Sincerely yours,

James O. Rll
for
Larry C. Smith, P.E.
Division Engineer

Enclosure

cc (with enclosure):
Mr. Dave Carlson, Environmental Protection Agency, Region IX, San Francisco, CA
Ms. Wendy Wiltse, Environmental Protection Agency, PO Box 50003, Honolulu, HI 96850
Maj. Gen. Alexis Lum, Exec. Asst., Office of Senator Daniel K. Inouye, Honolulu, HI
Mr. Merrill Deskins, Environmental Protection Spec., FHWA, Region 9, San Francisco, CA
Ms. Nancy Burns, Senior Project Engineer, Okahara & Associates, Kailua-Kona, HI

U.S. Department of Transportation
Federal Highway Administration

Central Federal Lands Highway Division

555 Zang Street
P.O. Box 25246
Denver, Colorado 80225-0246

APR 29 1998

In Reply Refer To:
HPD-16E/Saddle Road

Mr. Abraham Y. Wong
Division Administrator (HAD-HI)
Federal Highway Administration
Box 50206
Honolulu, HI 96850

Dear Mr. Wong:

In accordance with the "Memorandum of Understanding for the National Environmental Policy Act and Clean Water Act Section 404 Integration Process for Surface Transportation Projects in the State of Hawaii" (MOU), we are transmitting herewith a copy of the 404(b)(1) Analysis Report (report) for the proposed Saddle Road Project (SR 200) from Milepost 6 near Hilo, Hawaii to the Mamalahoa Highway (SR 190). This report was prepared at the request of the U.S. Army Corps of Engineers and the Environmental Protection Agency. It contains an analysis of alternatives in Sections III and IV of the proposed project. The report is intended to serve two purposes: 1) address the Clean Water Act Section 404(b)(1) requirements for discharge of fill material in special aquatic sites (wetlands); and, 2) address the requirements of the MOU with respect to the FINAL EIS DEVELOPMENT stage of coordination identified in the Appendix A "concurrent process" guidelines of the MOU (Page 2 of 6).

The analysis of alternatives contained in the report presents our conclusions on selection of the Least Environmentally Damaging Practicable Alternative (LEDPA) in Sections III and IV as required by the MOU. The INTRODUCTION section of the report contains seven bulleted requests for decisions by the signatory agencies to the MOU. We are asking for your review of the enclosed report and a written response to the requests contained therein within 45 days of your receipt of this letter as provided for in the MOU.

We are available to meet with you to address any aspects of the report or findings that require clarification. If you have any questions or need further information, please contact Mr. Bert McCauley, Environmental Project Manager, at (303) 716-2141.

Sincerely yours,

James O. Bell
for
Larry C. Smith, P.E.
Division Engineer

Enclosure

cc (with enclosure):
Mr. Glenn Yasui, Senior Transportation Engineer, FHWA, HI Division
Maj. Gen. Alexis Lum, Exec. Asst., Office of Senator Daniel K. Inouye, Honolulu, HI
Mr. Merrill Deskins, Environmental Protection Spec., FHWA, Region 9, San Francisco, CA
Ms. Nancy Burns, Senior Project Engineer, Okahara & Associates, Kailua-Kona, HI

US Department of Transportation
Federal Highway Administration

Central Federal Lands Highway Division

555 Zang Street
P.O. Box 25246
Denver, Colorado 80225-0246

APR 2 9 1998

In Reply Refer To:
HPD-16E/Saddle Road

Lt. Col. Ralph H. Graves
District Engineer
U.S. Army Corps of Engineers
Building 230
Fort Shafter, HI 96858-5440

Dear Colonel Graves:

In accordance with the "Memorandum of Understanding for the National Environmental Policy Act and Clean Water Act Section 404 Integration Process for Surface Transportation Projects in the State of Hawaii" (MOU), we are transmitting herewith a copy of the 404(b)(1) Analysis Report (report) for the proposed Saddle Road Project (SR 200) from Milepost 6 near Hilo, Hawaii to the Mamalahoa Highway (SR 190). This report was prepared at the request of the U.S. Army Corps of Engineers and the Environmental Protection Agency. It contains an analysis of alternatives in Sections III and IV of the proposed project. The report is intended to serve two purposes: 1) address the Clean Water Act Section 404(b)(1) requirements for discharge of fill material in special aquatic sites (wetlands); and, 2) address the requirements of the MOU with respect to the FINAL EIS DEVELOPMENT stage of coordination identified in the Appendix A "concurrent process" guidelines of the MOU (Page 2 of 6).

The analysis of alternatives contained in the report presents our conclusions on selection of the Least Environmentally Damaging Practicable Alternative (LEDPA) in Sections III and IV as required by the MOU. The INTRODUCTION section of the report contains seven bulleted requests for decisions by the signatory agencies to the MOU. We are asking for your review of the enclosed report and a written response to the requests contained therein within 45 days of your receipt of this letter as provided for in the MOU.

We are available to meet with you to address any aspects of the report or findings that require clarification. If you have any questions or need further information, please contact Mr. Bert McCauley, Environmental Project Manager, at (303) 716-2141.

Sincerely yours,

James O Rel
for Larry C. Smith, P.E.
Division Engineer

Enclosure

cc (with enclosure):
Ms. Lolly Silva, Environmental Engineer, USACE, Operations Branch, Ft. Shafter, HI
Maj. Gen. Alexis Lum, Exec. Asst., Office of Senator Daniel K. Inouye, Honolulu, HI
Mr. Merrill Deskins, Environmental Protection Spec., FHWA, Region 9, San Francisco, CA
Ms. Nancy Burns, Senior Project Engineer, Okahara & Associates, Kailua-Kona, HI

Distribution: 404(b)(1) Analysis Report

NEPA/404 MOU Staff Level Working Panel

Mr. Kenneth Au, Advance Planning Engineer, Hawaii DOT, Honolulu, HI
Ms. Lolly Silva, Environmental Engineer, USACE, Operations Branch, Ft. Shafter, HI
Mr. Don Palawski, Asst. Field Supervisor, USFWS, Pacific Is. EcoRegion, Honolulu, HI
Mr. Dave Carlson, Environmental Protection Agency, Region IX, San Francisco, CA
Ms. Wendy Wiltse, Environmental Protection Agency, PO Box 50003, Honolulu, HI 96850
Mr. Glenn Yasui, Senior Transportation Engineer, FHWA, HI Division
Mr. Bert McCauley, Environmental Project Manager, FHWA, CFLHD, Lakewood, CO
Ms. Nancy Burns, Senior Project Engineer, Okahara & Associates, Kailua-Kona, HI

NEPA/404 MOU Second Level Dispute Resolution Panel

Mr. Kenneth Y. K. Au
Advance Planning Engineer
Hawaii DOT, Highways Division
600 Kapiolani Boulevard, No. 301
Honolulu, HI 96813

Lt. Col. Ralph H. Graves
District Engineer
U.S. Army Corps of Engineers
Building 230
Fort Shafter, HI 96858-5440

Mr. Brooks Harper, Field Supervisor
U.S. Fish & Wildlife Service
Pacific Islands EcoRegion
300 Ala Moana Blvd., Room 3108
Honolulu, HI 96850

Mr. Alexis Strauss, Director
Water Division
U.S. Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, CA 94105

Mr. Abraham Y. Wong
Division Administrator (HAD-HI)
Federal Highway Administration
Box 50206
Honolulu, HI 96850

BENJAMIN J. CAYETANO
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

KAZU HAYASHIDA
DIRECTOR

DEPUTY DIRECTORS
BRIAN K. MINAAI
GLENN M. OKIMOTO

IN REPLY REFER TO:
HWY-PA
2.9887

JUL - 1 1998

Mr. Larry C. Smith, P.E.
Division Engineer
Central Federal Lands Highway Division
Federal Highway Administration
U. S. Department of Transportation
P. O. Box 25246
Denver, Colorado 80225-0246

Dear Mr. Smith:

Subject: Saddle Road, Project No. A-AD-6(1), Mamalahoa Highway (SR 190) to Milepost 6, National Environmental Policy Act (NEPA), Section 404 Integration Process

Pursuant to our review of the project's Section 404(b)(1) Analysis Report and in accordance with the Memorandum of Understanding on the NEPA and Clean Water Act Section 404 Integration Process for Surface Transportation Projects in the State of Hawaii and the guidance papers to facilitate its implementation, we concur that:

1. Alternatives EX-3 and E-3 present the least environmentally damaging practical alternatives for Sections III and IV, respectively.

2. Due to the time involved in constructing this lengthy project, it would be in the best interest of the public and the participating agencies to advance the project in a timely manner by presenting the commitments mitigating the wetland impacts in a general schematic way in the Final Environmental Impact Statement (EIS) and the Record of Decision.

3. Since construction of the roadway portions outside of the Pohakuloa Training area will probably not occur within the next five years and since a Section 404 permit is valid for only three years, a re-evaluation of the EIS and the Section 404(b)(1) analysis report should be conducted prior to preparation of the construction plans to determine the final mitigation commitments. This will insure that the findings will be current and mitigation measures will be reflective of accepted practices and procedures at the time of construction.

HWY-PA 2.9887

We also feel that the mitigation measures proposed in the Section 404(b)(1) report for wetland impacts for this project are reasonable and adequate and that Alternatives EX-3 and E-3 of Sections III and IV, respectively, should be designated as the preferred alternative in compliance with the Section 404(b)(1) guidelines.

Thank you for coordinating this effort among the signatory agencies.

Very truly yours,

KAZU HAYASHIDA
Director of Transportation

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Ecoregion
300 Ala Moana Boulevard, Room 3-122
Box 50088
Honolulu, Hawaii 96850

JUL 17 1998

Mr. Larry Smith
Division Engineer
Federal Highway Administration
Central Federal Lands Highway Division
555 Zang Street
Denver, CO 80228

Re: 404(b)(1) Analysis Report, Saddle Road (SR 200), Mamalahoa Highway to Milepost 6, Island of Hawaii

Dear Mr. Smith,

The Fish and Wildlife Service (Service) has reviewed the 404(b)(1) Analysis Report (Report) for the proposed Saddle Road (SR 200) Project, Mamalahoa Highway to Milepost 6, Island of Hawaii. This letter has been prepared under the authority of and in accordance with provisions of the National Environmental Policy Act of 1969 [42 U.S.C. 4321 *et seq.*; 83 Stat. 852], as amended, the Fish and Wildlife Coordination Act of 1934 [16 U.S.C. 661 *et seq.*; 48 Stat. 401], as amended, and other authorities mandating Service concern for environmental values. As a signatory agency of the Memorandum of Understanding for the National Environmental Policy Act and Clean Water Act Section 404 Integration Process for Surface Transportation Projects, the Service offers the following comments for your consideration.

The Service concurs with the selection of alignments EX-3 (Section III) and E-3 (Section IV) as the Least Environmentally Damaging Practicable Alternative. The Service has determined that the impacts to native ecosystems of the two alternative alignments in section IV are roughly equivalent. Therefore, selection of the preferred alternative for section IV can justifiably be made using other criteria. The Service concurs on the adequacy and correctness of the scientific information, engineering data and analysis, and the factual determinations in Appendix A of the Report.

In previous communications to your agency, the Service presented its analysis of the importance of the wetlands in sections III and IV of the project area, and outlined the steps we believed would adequately mitigate for the impacts to these wetlands. These steps included acquisition and protective management of a natural forested wetland area near the project area. After review of the detailed wetlands analysis presented in the Report, the Service is substantially in agreement with your consultant, Dr. Grant Gerrish, on the function of these wetlands and their wide distribution within the project area. During follow-up discussions with your agency, the Hawaii Department of Transportation, and the project consultants, mitigation strategies more appropriate to the project area were developed. The conceptual mitigation plans outlined in the Report reflect these cooperatively developed strategies.

The Service concurs that the wetlands mitigation strategy outlined in Appendix A of the Report is adequate for the Final Environmental Impact Statement and Record of Decision, and should be the basis for more detailed mitigation plans to be developed for sections III and IV of the project.

We concur that commitments to mitigation for wetlands impacts and formulation of more detailed mitigation plans may be deferred until funding for development of the relevant road sections is obtained. Similarly, we concur that individual Section 404 permits may be deferred until that time. The Service will be pleased to provide technical assistance on wetland delineation, revegetation techniques, pullout locations, and other aspects of the mitigation proposal at any time.

It should be noted that our concurrance with the proposed wetland mitigation strategy is entirely specific to this project, and reflects the Service's assessment of impact to very narrow wetland strips along an existing road corridor. Therefore, this mitigation strategy should not be considered a precedent or template for future projects, especially projects that impact larger contiguous areas of forested wetlands. The Service looks forward to working further with your agency and design team to minimize impacts to wetlands and native communities as design for sections III and IV proceeds. If you have questions regarding these comments, please contact Don Palawski, Assistant Field Supervisor for Habitat Conservation, at 808/541-3441.

Sincerely,

Robert P. Smith
Pacific Islands Manager

cc: USEPA, Honolulu
USACE, Honolulu

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
FORT SHAFTER, HAWAII 96858-5440

21 July 1998

REPLY TO ATTENTION OF

Operations Branch

Mr. Larry C. Smith, P.E.
Division Engineer
Central Federal Lands Highway Division
Federal Highway Administration
U.S. Department of Transportation
P.O. Box 25246
Denver, Colorado 80225-0246

Dear Mr. Smith:

We have completed our review of the 404(b)(1) analysis report for the Saddle Road Project, Mamalahoa Highway, Island of Hawaii. In accordance with the Memorandum of Understanding for the Integration Process for Surface Transportation Projects in the State of Hawaii (ISTEA), the Corps as a signatory agency offers the following comments for your consideration.

1. The Corps concurs on the selection of EX-3, Section III and E-3, Section IV as the least environmentally damaging practicable alternative.

2. While we accept the methodology used to estimate the acreage amount of impact to wetlands, the current wetland map and corresponding wetland information will require supplemental information for the purposes of a complete application for a Department of the Army (DA) permit. Wetland delineations certified by the Corps are valid for 5 years and may be subject to reverification if changes in the area have caused any impacts to the existing wetlands. We will work with your biologist consultant to ensure that an alternative-specific wetland delineation is conducted that meets the standards of the applicable Corps Wetland Delineation Manual.

3. Mitigation will be required only to replace those functions and values identified in the wetlands which have not been avoided or minimized. According to the 404(b)(1) mitigation summary, some mitigative measures have been identified. Additional field visits will be conducted by the Corps to identify and verify the location and types of wetlands found in these areas, therefore, we reserve the right to form an opinion or determine the amount or type of mitigation required to offset the loss.

4. For planning purposes and the public interest, the Corps agrees to the design concepts as proposed for the road alignments.

5. It is our understanding that funding for Sections III and IV will probably occur within three or five years. Therefore, it would be reasonable for the Corps and other signatory agencies to review supplemental information addressing these sections when funding is available.

6. A letter should be sent to our office withdrawing the 1997 DA permit application on file. A DA permit application should be submitted when funding for Sections III and IV become available.

Thank you for the opportunity to comment. If you have any questions, you may call Ms. Lolly Silva at (808) 438-9258, extension 17 or Mr. Farley Watanabe at extension 14.

Sincerely,

George P. Young
Chief, Operations Branch

Copy Furnished:

U.S. Fish and Wildlife Service, Honolulu, HI
U.S. Environmental Protection Agency, Honolulu, HI
State Department of Transportation, Honolulu, HI
Okahara & Associates, Inc., Kona, HI

USGS
science for a changing world

U. S. Department of the Interior
U. S. GEOLOGICAL SURVEY
BIOLOGICAL RESOURCES DIVISION
PACIFIC ISLAND ECOSYSTEMS RESEARCH CENTER
Hawaii Field Station
PO BOX 44, Building 344
Hawaii National Park, Hawaii 96718
(808) 967-7396 FAX (808) 967-8568

August 7, 1998

Mr. Larry C. Smith, P.E., Division Engineer
Central Federal Lands Highway Division
Federal Highway Administration
P.O. Box 25246
Denver, Colorado 80225-0246

Dear Mr. Smith,

I was asked to provide you with my comments on the issue of potential impact of the proposed realignment of the Saddle Road on the Island of Hawai'i to wetlands found along the road corridors of several of the possible routes. To this end, I have reviewed the botanical sections of the draft Environmental Impact Statement (draft EIS) for this project.

As a preface to my comments, I am a research botanist working on the island of Hawai'i with the Biological Resources Division of the U.S. Geological Survey. I have been conducting field research on this island for over 25 years, with project ranging from vegetation mapping to rare plant distribution and status studies and alien plant research. I was the principal investigator of a project to map the vegetation of the Island of Hawai'i (including a large portion of the area crossed by the Saddle Road) during the 1970's and 1980's with the U.S. Fish and Wildlife Service. My current research program continues to include work in this area.

There are definitely plant communities that qualify as wetlands along the eastern portion of the proposed Saddle Road realignment corridor above Hilo. Sites closer to Hilo are more dominated by introduced grasses, sedges, herbaceous plants, and shrubs. However, the vegetation of the wetland pockets from 3,000 - 5,000 are primarily dominated by native species, most of which are also found as components of adjacent, non-wetland plant communities. As indicated in the draft EIS, several listed endangered native plants (e.g., *Clermontia peleana*, *Cyanea platyphylla*) and a few other non-listed species of concern, are found in some of the sites near the proposed realignment corridor. However, I concur with the conclusion presented in the draft EIS that none of these plants are obligatory wetland species. I further concur that the wetland communities found within this area are local features that do not have a specific large-area function that will be significantly disrupted by site alteration with the road alignment as proposed.

The road alignment should be modified as necessary to keep it at least 200 meters away from sites containing the listed endangered plant species. Additionally, safeguards should be built into the construction and future maintenance of the new roadway to keep additional alien plant species from becoming established within the road corridor and expanding their distribution into the adjacent areas of native vegetation.

Please contact me if you would like additional information on my comments.

Sincerely,

James D. Jacobi
Botanist

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

AUG 1 2 1998

Larry Smith, Division Engineer
Federal Highway Administration
Central Federal Lands Division
555 Zang St.
P.O. Box 25246
Denver CO 80225-0246

Dear Mr Smith:

EPA has received and reviewed the 404(b)(1) Analysis Report (Report) for Saddle Road according to the Memorandum of Understanding (MOU) entitled, "National Environmental Policy Act and Clean Water Act Section 404, Integration for Surface Transportation Projects in the State of Hawaii".

EPA concurs with the information provided by the Federal Highway Administration concerning the overall project purpose, criteria for alternative selection, the project alternatives, and designation of preliminary preferred alternatives for Sections I, II; and III. We continue to have major concerns about the (1) lack of appropriate mitigation measures for wetlands losses in Sections III and IV and (2) selection of the least environmentally damaging alternative (LEDPA) in Section IV. The following is a summary of how EPA views the issues and a recommendation on what next steps FHWA can consider to remedy the remaining issues.

1. Lack of appropriate mitigation to offset losses to "waters"

Sections III and IV pass through areas that are jurisdictional wetlands, including some types of wetlands whose functions are poorly understood. . The Report lacks a conceptual mitigation plan to offset losses to "waters of the United States" and therefore, it would be inappropriate for the EPA to endorse a proposal that would result in a net loss of the reach and extent of the nation's waters.

We agree that it is infeasible to achieve no let loss of the physical extent, functions and values of these wetlands through creation of new habitat. A practical mitigation plan for Saddle Road should include the restoration of degraded habitat or that in combination with preservation of high quality native wetlands ecosystems. We also agree that avoidance and minimization of wetland loss should take into account the preservation of diverse native forest communities (koa-ohia forest).

According to the "Memorandum of Agreement Between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation Under the

Clean Water Act Section 404(b)(1) Guidelines (February 1990), "a minimum of 1:1 replacement may be used as a reasonable surrogate for no net loss of functions and values." Taking into account that replacement is impractical and that success of restoration has not been previously demonstrated for this ecosystem, an approvable wetlands mitigation plan for Sections III and IV must include restoration or preservation of an area equal to or greater than the acres lost. It should also include appropriate planting of native species and control of invasive weeds.

2. LEDPA for Section IV.

Federal Highways has asked that EPA endorse its preferred alternative for Section IV as the LEDPA. Three alternative alignments have been seriously considered but we do not believe that FHWA has shown that its preferred alternative is the LEDPA. This preferred alignment, E3, would result in a greater loss of regulated "wetlands" than the other two alignments, and, according to this Report (Table 4, p.24), would also be the most costly to construct, even after consideration of the need to purchase several private homes in the right-of-way. Under Clean Water Act regulations, it would be inappropriate to issue a permit for an alternative with the largest impacts, particularly when its costs are more than are associated with less-damaging alternatives.

Elsewhere in the Report (P.17-19) FHA claims that operational costs for EX-4A greatly exceed those for E-3. EPA considers the analysis of operational costs to be unacceptable. While factors such as accident rate, fuel costs, and capital improvements are appropriate to consider, the economic benefit of "time savings" is based on an erroneous assumption that 3 to 5.5 min. savings in travel time daily will be reinvested in the island's economy. Additional costs for the EX-4A alignment were presented in a separate email (Burns, June 18, 1998) and indicate that the construction costs for the FHWA preferred alternative would actually be comparable or less costly than the other two alternatives. The additional costs for traffic control, utility relocation, and intersections appear to be real, but are not covered in the Alternatives Analysis Report. We recommend that the FEIS present a complete analysis of construction costs, including mitigation costs, and a revised assessment of operational costs.

Given that Section IV has no funding, would be unlikely to secure such funding in the near future, and that Sections I-III have utility independent of Sections IV, selection of a preferred alternative in the Section IV is premature. The jurisdictional delineation of Saddle Road would expire in 5 years. The Corps would have to revisit that segment of the alignment and prepare a follow-on NEPA document (supplemental EIS or EA) to capture the actual alignment and necessary mitigation at that time. We believe that Section IV should be dropped from discussion at this time. We agree that the alignments on the table now, and perhaps others, will be the alternatives considered in the future, when the LEDPA is ultimately identified for Section IV.

Therefore, we suggest two possible courses of action for FHWA; either 1) select a no build for Section IV, and deal with the segment in a future NEPA document; or, 2) do not select an alternative for that segment at this time and use the FEIS, to explain why there is no selection, and to describe the anticipated course of action once there is momentum (funding etc.) to move forward on that segment. We believe either course of action would be consistent under NEPA, given that none of the Section I-III alignments would affect the range of alternatives for Section IV.

EPA's January 16, 1998 comments on the Draft Environmental Impact Statement raised a question regarding the extent of regulated "waters of the United States." We wish to clarify that this is not a significant concern for segments I and II. The methods of crossing of the intermittent or ephemeral streams would be the same whether or not the streams were jurisdictional "waters," and the environmental impacts associated with the road crossings are minimal.

As always, you may call me at (415) 744-1584 or David Carlson of my staff at (415) 744-1577 to further discuss NEPA issues or call Dr. Wendy Wiltse at (808) 541-2752 regarding 404 issues.

Sincerely,

David Farrel, Chief
Ferderal Activities Office

cc: M.Deskins, FHWA R9
D.Palawski, FWS
L.Silva, USACE

U.S. Department of Transportation
Federal Highway Administration

Central Federal Lands Highway Division

555 Zang Street
P.O. Box 25246
Denver, Colorado 80225-0246

AUG 14 1998

In Reply Refer To:
HPD-16/Saddle Road

Ms. Felicia Marcus, Regional Administrator
U.S. Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, CA 94105

Dear Ms. Marcus:

In accordance with the "Memorandum of Understanding for the National Environmental Policy Act and Clean Water Act Section 404 Integration Process for Surface Transportation Projects in the State of Hawaii" (MOU), we previously transmitted, by letter of April 29, a copy of the 404(b)(1) Analysis Report (Report) for the proposed Saddle Road Project on the Island of Hawaii. Pursuant to the MOU, we requested concurrence within 45 days on several issues regarding our selected alternative alignment in Sections III and IV of the proposed project.

We are in receipt of Mr. David Farrel's letter of August 12, 1998 and do not consider his evaluation responsive to our requests in light of the facts presented in the Report. We have received responses concurring with our analyses and proposals contained in the Report from the Hawaii Department of Transportation (HDOT), U.S. Army Corps of Engineers (USACE), and the U.S. Fish and Wildlife Service (USFWS). In addition, we have received validation of our wetlands functional interpretation and our selected alternatives' non-significant impact premise from Dr. James Jacobi of the Biological Resources Division, USGS, a recognized botanical expert in Hawaii for over 25 years.

Therefore, we are requesting a meeting at the Region IX office with you and appropriate representatives of the Water Division and the Cross-Media Division to resolve all outstanding issues relating to our 404(b)(1) analysis so that we might proceed with preparation of the Final EIS as scheduled. The issues in question are of paramount concern to the State of Hawaii; therefore, the HDOT may be in attendance at the above meeting as well as the Region 9 and Hawaii Division offices of the FHWA. We would prefer to resolve these issues at the Regional level in the cooperative spirit of the MOU rather than advance the debate to higher levels of dispute resolution as provided in the MOU.

Since this project is of considerable importance to the State of Hawaii and has broad public support, further dispute resolution delays of this nature would be an unacceptable scenario from our standpoint as the lead agency. We are requesting that the above meeting at the Region IX office be scheduled as soon as possible. Please call me at your convenience at (303) 716-2002 to discuss scheduling of the meeting. Thank you for your cooperation.

Sincerely yours,

James W. Kurley
For Larry C. Smith, P.E.
Division Engineer

cc: Ms. Alexis Strauss, Director, Water Division, EPA Region IX, San Francisco, CA
Ms. Deanna Wieman, Deputy Director, EPA Region IX, San Francisco, CA
Maj. Gen. Alexis Lum (Ret.), Exec. Asst., Office of Senator Daniel K. Inouye, Honolulu, HI
Mr. Kazu Hayashida, Director, Hawaii D.O.T., Honolulu, HI
LT COL Ralph H. Graves, District Engineer, U.S. Army Corps of Engineers, Ft. Shafter, HI
Mr. Jeff Brooks, Deputy Regional Administrator, FHWA, Region 9, San Francisco, CA
Mr. Abe Wong, Division Administrator, FHWA, Hawaii Division, Honolulu, HI
Mr. Donald Okahara, Okahara & Associates, Hilo, HI

bc: K. Au
L. Silva
G. Yasui
N. Burns
D. Gedeon
R. Cushing
B. McCauley
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

AUG 31

Larry Smith, Division Engineer
Federal Highway Administration
Central Federal Lands Division
555 Zang Street
P.O. Box 25246
Denver, Colorado 80225-0246

Dear Mr. Smith:

Thank you for your letter of August 21 to EPA Region 9 Administrator, Felicia Marcus, in which you expressed the desire to meet with her for the purpose of resolving issues surrounding our NEPA/404 non-concurrence on the proposed Saddle Road Project.

Your letter suggests that we "resolve these issues at the Regional level..." and not "...advance the debate to higher levels of dispute resolution." Given the process set forth in the "Memorandum of Understanding for the National Environmental Policy Act (NEPA) and Clean Water Act Section 404 Integration Process for Surface Transportation Projects in the State of Hawaii" (MOU), it would be inappropriate to elevate the project to our respective Regional Administrators at this time inasmuch as we believe that "all normal and reasonable options" for resolution have not been exhausted. Subsequent to your telephone conversation with David Farrel of our Federal Activities Office on August 27, it is my understanding that you agree that it would be advantageous for our agencies' respective staff members and first line managers to meet in an effort to resolve the issues in question. We will work with you to schedule such a meeting in the late September time-frame.

In preparation for the meeting, I feel it would be worthwhile to provide you with EPA's historical perspective on the issues. As you know, the NEPA/404 process for this project was not initiated by FHWA until after the Draft Environmental Impact Statement (DEIS) was issued - well past the intended time-frame outlined in the MOU. This has placed both of our agencies in an unfortunate situation that the MOU was intended to allay, namely trying to resolve critical environmental issues within a constraining project-related timeframe driven by project funding. Even so, in our letter of August 13, we concurred with the information provided by FHWA concerning the overall project purpose, criteria for alternative selection, the project alternatives and designation of preliminary preferred alternatives for segments I, II, and III. We do not, however, believe that FHWA's record supports its position that the preferred alternative proposed in segment IV is the Least Damaging Practicable Alternative (LEDPA) pursuant to Section 404 of the Clean Water Act. We are also concerned with the lack of appropriate mitigation for the loss of wetlands in segments III and IV.

In our August 13 letter we outlined an option which would meet FHWA time-critical needs while advancing the protection of the wetlands ecosystem present in the proposed alignment in segments III and IV. We recommended that NEPA decisionmaking on segments III and IV be postponed until a LEDPA alignment is identified for segment IV, appropriate mitigation commitments for the loss of wetlands are factored into segments III and IV, and funding to complete the project is obtained. This deference would allow the funded portion of the project to move forward to the FEIS stage. We believe this is a reasonable approach to resolving the current "dispute," especially in light of FHWA's request to defer the actual CWA Section 404 permitting for segments III and IV until funding becomes available. This approach is also supported by the fact that construction on segment IV would not likely take place for years, the current jurisdictional delineation will expire in four years, and a subsequent NEPA document would undoubtedly be required and prepared by the FHWA and/or Corps of Engineers to accommodate Section 404 permit decisionmaking at that time.

As you know, at the conclusion of our review pursuant to Section 309 of the Clean Air Act, EPA rated the DEIS, EO-2, "environmental objections, insufficient information" because of anticipated impacts to wetlands and lack of proposed mitigation. Our EO-2 rating, which could have been more severe, was developed on the basis of informal negotiations which were to have resulted in FHWA taking the "deference"strategy formally proposed above. At this point, it appears that FHWA may not be willing to embrace that strategy. Should the NEPA process go forward without the elements needed to protect, maintain, and preserve native wetland ecosystems, we would re-visit our options to re-rate the EIS. We believe that it would be preferable not to reach that stage in the process, and therefore, unless the unresolved issues we've identified can be fully addressed in this NEPA document, we ask that you reconsider the strategy of deferring decisionmaking on project segments III and IV.

After our agencies meet in September, should the issues remain unresolvable and a second-level dispute resolution session is necessary, feel free to contact me at 415-744-1566. Meanwhile, please contact David Farrel at 415-744-1584, or have your staff contact David Carlson at 415-744-1577 to discuss this matter further.

Sincerely,

Deanna M. Wieman

Deanna M. Wieman
Deputy Director
Cross Media Division

Mc Ca...

U.S. Department of Transportation
Federal Highway Administration

Central Federal Lands Highway Division

555 Zang Street, Room 259
Lakewood, CO 80228

SEP 0 1 1998

In Reply Refer To:
HPD-16E/Saddle Road

Mr. David Farrel, Chief
Federal Activities Office
US Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Dear Mr. Farrel:

This letter is in response to your letter of August 12, which provided the Environmental Protection Agency's (EPA) evaluation of the Federal Highway Administration's (FHWA) 404(b)(1) Analysis Report (Report) for the proposed Saddle Road project. The Report was prepared and submitted to the EPA by letter of April 29 in accordance with the Memorandum of Understanding (MOU) entitled, "National Environmental Policy Act and Clean Water Act Section 404 Integration Process for Surface Transportation Projects in the State of Hawaii". We have reviewed your evaluation comments and are providing the enclosed response entitled "Response to EPA Letter of August 12, 1998".

As a matter of general clarification of statements in the second paragraph of your letter, we assume that the EPA concurs with the entire proposed project's Purpose and Need, the criteria used to evaluate and select alternatives, and the full range of project alternatives in Sections I through IV, which were selected for analysis in the Draft Environmental Impact Statement (DEIS) by the interagency Social, Economic, and Environmental project development team (SEE Team). We also understand that your main objections to the proposed project, with respect to the issues presented in the Report, are: 1.) the selection of alternative E-3 in Section IV as the Least Environmentally Damaging Practicable Alternative (LEDPA) as defined by 40 CFR Part 230 and related guidelines, and 2.) the wetlands impacts and mitigation proposed for the LEDPA in Section IV as well as Section III.

In reviewing the enclosed response, you will find that other MOU signatory agency's opinions and positions are in agreement with the analyses and recommendations presented in the Report. Clearly, EPA seems to hold a dissenting opinion. In the spirit of cooperation of the MOU, we are requesting a meeting with you and your staff, as well as appropriate technical staff persons, to attempt to resolve our differences informally. Should this discussion be unsuccessful, we will request the initiation of formal resolution procedures through the Second-Level Panel pursuant to the MOU.

FEDERAL HIGHWAY ADMINISTRATION
Central Federal Lands Highway Division
Saddle Road Project A-AD-6(1)

August 31, 1998

RESPONSE TO EPA LETTER OF AUGUST 12, 1998

The inability to reach agreement on this issue has been frustrated by a lack of involvement on behalf of the EPA in the EIS development. We invited the EPA to become involved in early discussions of wetlands biological analyses and mitigation plans with other similarly concerned agencies, i.e., USACE and USFWS. However, no response was received to a May, 1996 letter to Mr. David Farrel, Office of Federal Activities, EPA Region IX, requesting Cooperating Agency participation on the project and advising of a planned meeting for presentation of impact analyses to all concerned agencies in September, 1996. Invitations to the referenced meeting were delivered by letter in September, 1996 to 30 federal, state, and local agency representatives who had expressed an interest in the project. The meeting was held in October, 1996 and comments and concerns were received thereafter by most participating agencies.

These agency comments resulted in additional studies and document revisions. Subsequently, copies of the Preliminary Draft EIS for final pre-publication, interagency review were distributed in March, 1997 to all concerned agencies except the EPA. Upon learning of the above distribution, Mr. Dave Carlson, of the above EPA office, requested copies of the environmental document which were subsequently delivered. In response to his request, additional information was transmitted to Mr. Carlson in September, 1997. The EPA was also invited to join the interagency Social, Economic, and Environmental project development team (SEE Team) which included the HDOT, USACE, USFWS, Hawaii County, and U.S. Army. Subsequent invitations to SEE Team meetings to discuss alternatives selection, technical analyses, and resulting impacts and mitigation were declined by the EPA.

Publication of the Draft EIS was completed in October, 1997 without EPA comment and distribution was made to EPA at that time. Comments on the Draft EIS were received from the EPA in January, 1998. These comments included admonishment of the FHWA for not specifically following the interagency coordination requirements of the MOU. However, the FHWA believes that adequate opportunity for involvement was provided and that the positive support of other concerned agencies indicates that those who have been closely involved with this project concur in the analyses, recommendations, and direction presented in the 404(b)(1) Report. Given this, the following is our specific response to the August 12 EPA letter.

1. Lack of appropriate mitigation to offset losses to "waters"

- First paragraph: "...types of wetlands whose functions are poorly understood."

  The jurisdictional wetlands and their functions potentially impacted with the implementation of the project in Sections III and IV are not poorly understood. The Federal Highway Administration (FHWA) enlisted the services of Dr. Grant Gerrish, University of Hawaii, a well known botanist with over 20 years of research and investigative field experience in Hawaiian ecosystems, who has aptly defined the extent of wetlands impacted by the Section III and IV alternatives and their associated values and functions (see SECTION 404 RESOURCE IDENTIFICATION, pg. 7, and Appendix A, RESOURCE IDENTIFICATION AND FACTUAL

DETERMINATIONS, pgs. i through xi, 404(b)(1) Analysis Report). In addition, Dr. James Jacobi, Biological Resources Division, USGS, a well known research botanist with over 25 years of field research on the island of Hawaii agrees that these wetland communities "do not have a specific large-area function..." (see attached letter from James D. Jacobi, BRD/USGS). Further, the U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), and the Hawaii Department of Transportation (HDOT) have concurred with our analysis in this respect (see attached USACE, USFWS, and HDOT letters). Pursuant to the MOU, we request that EPA furnish factual information supporting this comment by providing a functional assessment of these wetlands.

- First paragraph: "The Report lacks a conceptual mitigation plan to offset losses to "waters"...and therefore, it would be inappropriate for EPA to endorse a proposal that would result in a net loss...of the nation's waters".

The Report does provide a conceptual mitigation plan (see General Wetland Mitigation Proposal: EX-3, pg. 13, General Wetland Mitigation Proposal: E-3, pg. 22, and Appendix A, ACTIONS TO MINIMIZE ADVERSE EFFECTS, pgs. xii through xvii, 404(b)(1) Analysis Report). Furthermore, the HDOT has committed to developing specific location and implementation details of mitigation with final roadway design within the framework of the mitigation principles and elements presented in the Report. The conceptual mitigation plan invests in a "best practice" approach for the total native ecosystem and may result in a replacement ratio higher or lower than 1 to 1. This approach is consistent with the demonstrably low functional values identified for these wetlands and the *EPA/Army Memorandum of Agreement Concerning the Determination of Mitigation under the Section 404(b)(1) Guidelines* which states, in part, "In most cases a minimum of 1 to 1 acreage replacement of wetlands will be required to achieve no net loss of values....the ratio may be less than 1 to 1 for areas where the functional values associated with the area being impacted are demonstrably low....".

- Second paragraph: "A practical mitigation plan...should include the restoration of degraded habitat or (restoration) in combination with preservation of high quality native wetlands ecosystems. We also agree that...wetland loss should take into account the preservation of diverse native forests...".

As stated in the Report, the FHWA is proposing to restore agriculturally degraded wetland areas within the Right-of-Way (ROW) and within any uneconomic remnants of ROW that are required to be purchased. Additionally, areas occupied by the existing roadway which will be abandoned and other disturbed areas within the ROW, are to be reclaimed and restoration of native biological communities encouraged without regard to wetlands specifically, but with an emphasis on endemic species and ecosystems. This is considered a "best practice" approach by Dr. Gerrish and gives equal weight to more valuable upland communities consistent with USFWS pacific ecosystem policies. Further, the FHWA cannot support, from a public expenditure perspective, the preservation of high quality native wetlands in a pre-determined compensatory ratio, to replace interspersed wetland pockets of demonstrably low functional value. The preservation approach is not a responsible scientific solution when much more can be accomplished by recognizing the unique wetland/upland mosaic for what it is; i.e., a naturally integrated biological system that should be encouraged to propagate wherever possible. It is the FHWA's scientifically supportable position, that the impact to this ecosystem should be mitigated, within reasonable limits

based upon demonstrated functional values, using unique and system-specific solutions and not within the framework of a rigid mainland wetlands model which does not apply in this case.

- Third paragraph: "(referencing the EPA/Army MOA on 404(b)(1)), a minimum of 1:1 replacement may be used as a reasonable surrogate for no net loss of functions and values. Taking into account that replacement is impractical and that success of restoration has not been previously demonstrated for this ecosystem, an approvable wetlands mitigation plan for Sections III and IV must include restoration or preservation of an area equal to or greater than the acres lost."

We are unable to find the referenced statement from the MOA. Our copy of the referenced MOA makes this statement in different wording, but also recognizes that replacement is directly tied to functional values and that if these values are demonstrably low, the replacement ratio may be less than 1:1. The Report clearly demonstrates that the functional values of these wetlands are marginal when viewed independent of the interspersed uplands and in the context of the factual determinations required by 404(b)(1), Subpart B, para. 230.11 (see Appendix A, RESOURCE IDENTIFICATION AND FACTUAL DETERMINATIONS, pg. i, 404(b)(1) Analysis Report).

Additionally, evidence of the potential success of restoration in Section IV can be seen in locations which have been previously disturbed and were naturally reclaimed by native vegetation in place of alien species. This primarily occurs because the lack of soil and harsh climate in lava fields is conducive to naturally adaptive species and detrimental to alien ones. We believe with specific management practices, this process will be enhanced and will have a very high probability of success.

We are unsure what is meant by an "approvable wetlands mitigation plan must include....an area equal to or greater than the acres lost." This statement seems to refer to a specific location set aside and documented in the Final EIS. If so, it implies rejection of our proposal to provide specific mitigation at a later date within the framework of the mitigation elements presented in the Report. As we have discussed with the EPA's staff on several occasions, designation of specific restoration or preservation areas and providing a commitment to these areas is impossible at this point in time, given the constraints of the Defense Access Road Program funding and the unavailability of HDOT funding for these Sections. Further, it is FHWA's opinion, notwithstanding our position on preservation and ratio-based restoration previously enumerated, that setting aside specific areas now does not take into consideration that future environmental resource distributions and knowledge, as well as permitting procedures, may necessitate a completely different approach to designation of a specific area for restoration. We are of the opinion that our proposal allows for this possibility through a commitment by HDOT to re-evaluate this Section(s) within the 404 permitting process and within the context of conceptual mitigation elements presented in the Report when advancement of these projects is eminent and funded. To designate a specific area(s) now is environmentally insensitive and not responsive to good stewardship in a continually evolving ecosystem such as the one in question.

Given the above discussion and the fact that the 404 permit will require review, updating and re-issuance in 5 years irrespective of our commitments, we requested in the Report a variance to the procedures in the Section 404 Integration MOU to allow for permitting for

Sections III and IV pending advancement of these projects and under the conditions and commitments previously described. We need a specific decision on this issue from the EPA in order to prepare a modification of the MOU for signature by the affected parties.

2. LEDPA for Section IV.

- First paragraph: "....we do not believe that FHWA has shown that its preferred alternative is the LEDPA."

The FHWA is of the opinion that we have fully and clearly demonstrated, in light of the marginal value of the wetlands impacted by alternative E-3, that other alternatives, including additional reduced designs evaluated at the request of EPA, have overbearing social, economic, and environmental impacts rendering them less desirable from a balanced assessment viewpoint (see Alternatives Analysis Discussion: EX-4A and E-3, pgs. 17 through 22 and Table 4, SECTION IV COMPARISON OF LEVEL OF IMPACTS, pgs. 24 and 25, 404(b)(1) Analysis Report). The FHWA, as required by FHWA's Federal-Aid Policy Guide, Section 771.105 (23 CFR 771), must evaluate alternative courses of action "in the best overall public interest based upon a balanced consideration of the need for safe and efficient transportation; of the social, economic, and environmental impacts of the proposed transportation improvement; and of national, State, and local environmental protection goals." We believe that we have made a balanced assessment in the best overall public interest in selecting E-3 and that to make this decision on the basis of wetland "take" alone, as the EPA suggests, would be irresponsible. Pursuant to the MOU, Section VI. C., we request that the EPA provide an explanation of the basis for nonconcurrence with the LEDPA.

- Second paragraph: "EPA considers the analysis of operational costs to be unacceptable. While...accident rate, fuel costs,... are acceptable to consider, the economic benefit of "time savings" is based on an erroneous assumption that...savings in travel time daily will be reinvested in the island's economy."

We are unclear about EPA's initial statement in this instance in that the second sentence states that two components of operational costs; i.e., accident rate and fuel costs, apparently are considered acceptable. As presented in the AASHTO Manual on User Benefit Analysis, travel time savings and their impact on community economic factors has been a widely researched and documented transportation systems analytical tool since the 1960's. When coupled with a community specific economic input/output model (State of Hawaii, DBEDT, 1989, ref. pg. 3-76 Draft EIS), the analysis is a very legitimate means of determining potential economic benefits from travel time savings. The concept is a very simple one and is based upon the fact that, if less time is spent en route between home and employment, engaged in supplies and material delivery, or between interdependent business functions, the time saved is directly proportional, with appropriate adjustments, to higher production rates, more efficient business operations, and greater profit margins; thus enabling business expansion, increases in employment, and more disposable income in circulation.

The operational analysis as presented in the Report is an <u>extremely conservative</u> analysis; i.e., current (1998) or construction year (2006) operational costs were not computed from a stream of costs throughout the 20 year design life beginning at the assumed completion of the project in 2007. They were computed only for the design year (2018) and reduced to

present worth costs. Further, attention should not be focused solely on the magnitude of benefits or disbenefits when comparing alternatives, but also on the differences between the two alternatives. This is to say, all other variables being equal, minor differences in the value of the time are inconsequential in a comparative analysis as long as the same value is used in computations for each alternative or only the *difference* in travel times is considered.

When considering a transportation investment of the magnitude of the Saddle Road Project, it is imperative that the FHWA examine the long-term economic consequences of our decisions. Such an examination must include all reasonable costs which, over time, can result in substantial net benefits or disbenefits to the public.

- Second paragraph: "Additional costs for the EX-4A alignment were presented in a separate email (Burns, June 18, 1998)...additional costs....appear to be real, but are not covered in the Alternatives Analysis Report. We recommend that the FEIS present a complete analysis of construction costs, including mitigation costs, and a revised assessment of operational costs."

We have been in the process of refining our analyses for the Final EIS and furnished the referenced additional costs in the E-mail consistent with the agency commitments referenced in the MOU for Pipeline Projects. Cost estimates transmitted outside of the Report, pursuant to EPA's request, have been documented as to their basis and assumptions and are being transmitted herewith in a revised Table 4 to the Report. With respect to the revised construction costs in Table 4, it should be noted that the construction of E-3 would reduce the required length of the Puainako Street Extension by approximately 1 kilometer, thus saving the State of Hawaii approximately $3.0 Million in construction costs. Since the Puainako project has been identified as a "significant deficiency" for the Hilo Circulation Area in the State Transportation Plan, thus scheduled for eventual construction, these cost savings are benefits to the citizens of Hawaii that can be attributed to the selection of E-3.

The FEIS will contain a complete alternatives analysis, including the assessment of operational costs as contained in the current Report and the revised construction costs contained in the enclosed Table 4. This alternatives analysis will unquestionably support our decision to select E-3 as the preferred alternative when viewed from a balanced perspective.

- Third paragraph: "We believe that Section IV should be dropped from discussion at this time. We agree that the alignments on the table now, and perhaps others will be the alternatives considered in the future...".

This is not an acceptable decision for FHWA at this time. Given that; 1) alternative corridors meeting the definition of "practicable" in Section IV are limited due to physical, social, and environmental constraints, 2) all reasonable and practicable alternatives have been exhaustively evaluated at this time, 3) sufficient information and adequate analyses have been developed to date on those alternatives, and 4) the possibility of near-future funding for this Section is not out of the question, we believe that it is reasonable and responsible to select a preferred alternative in Section IV at this time. This is a particularly cogent argument in the context of our complete proposal; i.e, HDOT's future commitment to evaluate the selected alternative for minor alignment adjustments, ensure absolute minimization of wetland impacts, and develop site specific mitigation during a re-evaluation of the Section at the time of application for 404 permitting. At this point in time, we are certain that an objective future analysis would bear out the fact that the E-3 corridor, located on young lava flows and through an agriculturally degraded wetland area, has the least amount of impact on high quality environmental resources, socioeconomic concerns, and physical human environment concerns when viewed from a balanced perspective. It is only a matter of refining the alignment within that corridor to provide the absolute minimization of low value wetland impacts. Further, if selection of an alternative is delayed in this Section, the impacts to Kaumana from an alternative along the existing alignment can only increase as the community grows. Also, if the E-3 alignment is selected now, a corridor can be administratively "zoned" to preempt development. In view of all of these facts, we strongly believe that E-3 is the LEDPA.

- Fourth paragraph: "...we suggest two...courses of action for FHWA, either 1) select a no build for Section IV...; or, 2) do not select an alternative for that segment..."

To select the "No-Build Alternative" in Section IV would ignore the project's purpose and need as well as public safety and impacts to the residents of Kaumana. It has been shown in the Report that any alternative of lesser design in this Section, including the No-Build Alternative, is not a practicable one in light of the purpose of, and the need for, the proposed project. Our analysis supports the position that the No-Build Alternative is not a reasonable and prudent alternative and therefore, an unacceptable selection for FHWA and HDOT.

To not select an alternative in Section IV in the FEIS is a possible solution; however, this would represent a denial that our information and analyses are adequate to select an alternative at this time. As discussed previously, we believe there is currently sufficient information on which to base a decision for E-3 as the preferred alternative. Further, HDOT, a co-sponsor of this document, agrees with this position and does not wish to be a party to the precedent that a denial of that magnitude would entail. It would represent an admission that all future projects in this type of terrain would be subject to scrutiny beyond reasonable scientific and engineering inquiry. It would also commit HDOT to unjustified future project development costs and delays associated with advancing a project in Section IV through the entire NEPA process.

TABLE 4
SECTION IV COMPARISON OF LEVEL OF IMPACTS
Revised August 25, 1998

Affected Environment	Alternative E-3	Alternative EX-4A
Wetlands	3.2 Hectares (8.0 Acres). 84% is interspersed disturbed Ohia forest and degraded agricultural wetland.	0.4 Hectares (1.0 Acre). Entire wetland area is native habitat.
Native Habitat Adjacent Reach	2.15 km (1.3 miles).	4.18 km (2.6 mi). More than 50% is within existing roadway area.
Farmland	Loss of 8.8 hectares of prime farmland.	No direct loss of farmland.
Historic Sites	3 sites, all impacts can be mitigated	1 site, impact can be mitigated
Socioeconomic Impacts	Greater mitigation costs; lower operating costs.	More than $10M / yr in design year disbenefits (2006 dollars) .vs. E-3.
Construction Cost (incl. ROW, mitigation)	$18,000,000	$20,000,000 [1]
Cost to Puainako Project	$0	$3,000,000
Relocations	None	11 - 28 homes [2]
Social Impacts	Reduction in traffic through Kaumana. Increased community cohesion, bicycle and pedestrian opportunities, social interaction, and property values.	Construction related impacts to Kaumana. Increased traffic volumes and truck traffic, noise, air pollution, and community disruption.
Visual Impacts	No visual impact to Kaumana.	Unacceptable impact to Kaumana.
Noise	Does not exceed or approach NAC. Substantial increase at 14 receptors.	Exceeds or approaches NAC at 29 receptors, substantial increase at 18 receptors, abatement not feasible.
Safety	No movement of military materiel through residential areas, safer access to Kaumana Drive, less accidents, increased ped/bicycle safety, local traffic only.	Reduced capacity contributes to higher accident rate, restricted local access and unacceptable ques created by military convoys; decreased ped/bicycle safety.
Operational Function and Quality of Traffic Flow	Controlled access and land use; i.e., intersections strategically planned & designed to enhance traffic flow.	Traffic flow impeded because of numerous driveways and approach roads which must be maintained.
Accommodate Present and Future Traffic Levels.	Design can be upgraded to provide additional travel or accel/decel lanes, geometrics not constrained; i.e., higher design standards possible.	Future widening may cause relocation of residences and roadway geometric and intersection improvements constrained by development.

[1] Actual costs will vary depending on number of homes or uneconomic remnant property taken, final utility relocations, and number of intersections and locations. See attached *Discussion of Revised EX-4A Construction Costs.*

[2] Actual number of relocations will vary depending on final intersection designs, lot zoning requirements at time of ROW purchase, and property owner compensatory costs.

Discussion of Revised EX-4A Construction Costs

As stated in the June 18, 1998 E-mail (Burns to Silva), construction costs for the EX-4A alignment presented in the DEIS were general costs based on planning level design. The original cost estimate did not account for channelized and/or signalized intersections which may be required for the 4 existing intersecting streets located along the alignment. Estimates for a channelized intersection range from $300,000 to $500,000, depending on signalization requirements. It is assumed that the cost of EX-4A will increase $2,000,000 for construction of 4 signalized intersections. There are a total of 6 possible intersections, including two intersections required to tie the existing Saddle Road to the proposed alignment at either end of the HELCO easement to provide local access to the by-passed segment of existing Saddle Road.

The aforementioned E-mail also stated that the extent of, and cost for, utility relocations and adjustments, traffic control, and increased labor intensive excavation along the existing road are unknown but would add, conservatively, $2,000,000 to overall project costs. In the interest of clarity, the basis of this estimate is as follows:

- Many of the power poles along the existing alignment are 138 kv lines. The cost to relocate the 138 kv poles is estimated to be approximately $40,000 each. The exact number of pole relocations will be determined during final design but it is estimated that 15 poles may need to be relocated. Additional costs for these relocations could thus be in excess of $500,000.

- Approximately 3,000 feet of water line is located in the existing road. Costs for this relocation range from $60,000 to $100,000 or more. It is likely that a water supply booster pump station will also require relocation at a cost of approximately $200,000. Total cost for these relocations could be in excess of $300,000.

- Costs for traffic control within a constricted ROW while maintaining existing traffic averages 5% to 8% of total construction costs. A reasonable estimate for traffic control to construct EX-4A is $1,000,000.

- Unit costs for excavation within existing ROW are 100% higher than in open terrain because of constraints on equipment size and use and the labor intensive nature of the operation. These costs for EX-4A are estimated at approximately $500,000.

In addition, the residential relocations presented in the DEIS included only those homes for which it could be definitely determined that "take" impacts would occur. There are up to 17 additional homes and numerous undeveloped lots or tracts which may also require purchase as the lot size would be reduced below the minimum specified by zoning regulations. While it is

probable that Hawaii County would allow variances for some of these homes and/or properties, compensation to the owners would be required. Further, it is also likely that some of the homes and/or properties would require purchase because of overbearing damages to the gainful use or enjoyment of the property. Compensation for these properties could range from $500,000 to $2,000,000. An estimate at the lower end of this range, say $500,000, is very reasonable at this point in project development.

When considering benefits of selecting the E-3 alignment, costs savings realized by shortening of the Puainako Street Extension project should also be acknowledged. With the construction of E-3, the Puainako Street Extension will be shortened by approximately 1 km resulting in a cost savings of $3,000,000 for that project. Since the Puainako Street project has been identified as a "significant deficiency" for the Hilo Circulation Area in the approved State Transportation Plan and thus scheduled for eventual construction, these cost savings are real net benefits that can be attributed to the selection of E-3 because they will be realized as a cost reduction for the complete cross-island commuter facility from Hilo to Kona. These costs should be considered directly in a cost comparison of EX-4A to E-3 because they can be viewed as a secondary impact resulting in a commitment to higher future transportation system costs to the State for the total cross-island commuter facility should EX-4A, or any variation thereof, be selected.

In summary, the total cost for the EX-4A alignment is somewhat more difficult to estimate than the E-3 alignment because of factors that will become more lucid during final design, such as final intersection designs, actual property takes, and actual utility adjustments and relocations. The cost presented in the Draft EIS assumed minimal costs for these items based upon a 10% to 15% complete design planning level analysis. Given the more detailed examination of costs, as discussed previously, it is not unreasonable to revise the previous EX-4A cost estimate upwards by $5,000,000. Simultaneously, the cost estimate for E-3 does not change because of the absence of the above additional costs along that alignment.

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U.S. Department of Transportation
Federal Highway Administration

Central Federal Lands Highway Division

555 Zang Street, Room 259
Lakewood, CO 80228

SEP 22 1998

In Reply Refer To:
HPD-16/Saddle Road

Ms. Deanna Wieman, Deputy Director
Cross-Media Division
US Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, CA 94105

Dear Ms.Wieman:

I would like to personally thank you for attending the meeting between the Environmental Protection Agency (EPA) and the Federal Highway Administration (FHWA) on September 9, to discuss the wetlands issues for the proposed Saddle Road Project. Your presence was greatly appreciated in initializing the meeting. I also greatly appreciate the quick follow up by Mr. Tom Yocum and believe that we have about worked this out so that we can proceed with the Final EIS.

I am enclosing a copy of our minutes of that meeting for your files. If I can be of any further assistance in providing you with information regarding this project, do not hesitate to call me at (303) 716-2002.

Again, thanks for your timely participation and input.

Sincerely yours,

FOR Larry C. Smith, P.E.
Division Engineer

Enclosure

cc (w/enclosure):
Maj. Gen. Alexis Lum (Ret.), Executive Assistant, Senator Daniel K. Inouye, Honolulu, HI
Ms. Felicia Marcus, Regional Administrator, EPA Region IX, San Francisco, CA
Mr. Tom Yocum, Environmental Scientist, EPA Region IX, San Francisco, CA
bc (w/o enclosure):
D. Gedeon
R. Cushing
B. McCauley
yc: reading file
Central file: HI A-AD-6(1), Saddle Road
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U.S. Department of Transportation
Federal Highway Administration

Central Federal Lands Highway Division

555 Zang Street, Room 259
Lakewood, CO 80228-1103

OCT 26 1998

In Reply Refer To:
HPD-16E/Saddle Rd

Ms. Deanna Wieman, Deputy Director
Cross-Media Division
US Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, CA 94105

Dear Ms. Wieman:

Thank you and your staff for meeting with me and other representatives of the Federal Highway Administration (FHWA) on September 9 to discuss the proposed Saddle Road project on the island of Hawaii. As you know, our discussions focused on two major areas where EPA and FHWA were in disagreement. The EPA has maintained that: 1) The FHWA's preferred alignment within Section IV is not the **Least Environmentally-Damaging Practicable Alternative** (LEDPA); and 2) mitigation measures that have been identified by the FHWA to offset impacts to wetland and aquatic areas within Sections III and IV are insufficient to comply with Clean Water Act regulations.

In our September 9 meeting, the EPA clarified that its position regarding identification of the LEDPA was based on information in our 404(b)(1) Analysis Report (Report) that suggested our preferred alternative had greater wetlands impacts *and* greater construction costs than other alternatives that had been evaluated. In fact, the alternatives analysis in the Report did include cost estimates that showed the LEDPA to be more expensive; however, these construction cost estimates were in error and have subsequently been corrected (see previous FHWA letter dated September 1). Your staff indicated that they are satisfied with the new construction cost estimates in the revised Table 4 to the Report, pending submission of additional traffic operations cost data that we are furnishing herewith (see enclosure). Given this additional operational cost comparison information, in conjunction with the revised construction cost estimate and supporting documentation previously furnished, we understand that the EPA concurs with our determination that E-3 is the LEDPA in Section IV of the proposed project.

The EPA reiterated its concern that impacts to wetland and aquatic areas be fully offset and that efforts be made to assure that the Saddle Road project not result in reduction in the reach and extent of the nation's waters. The EPA also indicated its belief that the issue of compensatory mitigation may need to be revisited if and when funding for Sections III and IV would lead to the need for the project sponsor, the Hawaii Department of Transportation (HDOT), to obtain Department of Army permits at some time in the future. The HDOT has previously agreed to commit to a re-evaluation of the EIS and examining the 404 issues and mitigation in detail relative to specific roadway designs and within the conceptual mitigation strategy presented in the Report when a project(s) in these sections is programmed. This commitment will be contained in the FEIS and the Record of Decision.

Your staff indicated its general support for the restoration measures within the Rights-of-Way (ROW) that the FHWA has identified to date, but stated that, as worded, there is uncertainty that these measures would offset impacts to acreage and function of wetland and aquatic areas. We stated that, while we were apparently still in disagreement on wetland functions and values upon which to base mitigation proposals, it was our goal to commit to mitigation strategies that, when used to guide future development of a specific mitigation plan, would be roughly equivalent to the area of wetland filled by alternative segments EX-3 and E-3. In view of the fact that the EPA and the FHWA are dedicated to pursuing a "no net loss" policy, we agree that language in the mitigation plan, as presented in the Report, should include better definitions and goals to ensure adherence to this policy. We also agree that this policy should be adhered to in the development of a future mitigation plan only to the extent that achieving such goals is reasonable and practicable, as specified in FHWA's regulations [23 CFR 771.105(d)] and EPA's regulations [40 CFR 230.10(d)].

Your staff also suggested that we add additional compensatory mitigation measures, that the project sponsor may consider in the future, when developing a mitigation plan to meet the requirements of the Clean Water Act regulations (40 CFR 230) as revised. These optional measures could include consideration of acquisition, restoration, preservation, dedication, or a combination of these measures utilizing appropriate parcels of land containing comparable wetland values and functions to compensate for losses that could not be offset practicably or in an ecologically viable way on-site or within the ROW. We agree that consideration of such measures would give the project sponsor additional flexibility in mitigating project impacts within a future regulatory framework and body of ecological knowledge, so long as these measures are not unreasonably costly.

We would like to point out that we share HDOT's concern that these measures, their basis of development, and their application in developing specific mitigation plans, should be applicable only to the Saddle Road project. Other transportation projects and developments, whether governmental or private, should not necessarily be required to comply, in blanket fashion, with this type of mitigation approach. We also agree that early coordination between the project sponsor and the US Army Corps of Engineers could help streamline any permit processing that will be required prior to project construction.

Accordingly, we are proposing to modify Appendix A of the Report to include the following language:

> Restoration
>
> Restoration is used to mean enabling native vegetation to cover all areas of disturbance within the ROW not essential to the operation and maintenance of the roadway. Restoration may also include acquisition or preservation of lands beyond those needed for ROW for the purpose of offsetting unavoidable impacts of the project to wetland and aquatic areas disturbed by the roadway footprint. The "roadway footprint" is defined as all areas within the ROW which are regularly maintained for the safe and efficient operation of the roadway.
>
> It is anticipated that some restored areas will contain wetland pockets very similar to those in the surrounding area, but creating such pockets is not the primary goal of restoration.

> Areas that may be considered for restoration include:
>
> a. construction damage outside the footprint of the completed roadway;
>
> b. the cut/fill slopes created by grading, up to the edge of the grassy shoulders;
>
> c. any abandoned segments, of the existing Saddle Road, pavement to be removed;
>
> d. any other disturbed areas, such as currently existing parking areas and service roads (this will be done in consultation with HELCO and DLNR to determine the minimum access required, applied within the ROW.);
>
> e. where feasible, any uneconomic remnants of ROW requiring purchase in disturbed agricultural lands; and/or
>
> f. lands that can be practicably transferred or acquired and preserved or restored for the purpose of offsetting impacts to values and functions of wetland and aquatic areas. Areas that are adjacent to or nearby the areas of impact and that include areas of similar habitat or function would be considered more appropriate for such transferral or acquisition than areas that are farther removed or dissimilar in nature. Such compensatory mitigation parcels may be transferred to resource agencies or non-profit groups whose long-term interest in habitat protection would make them more appropriate managers of the properties; however, the maintenance of these areas, once transferred, would not be the responsibility of the roadway project owner.
>
> It is the goal of the restoration efforts that restored and preserved habitat will be provided during development of future projects to offset the area of wetlands within the footprint of alternative segments EX-3 and E-3.

I believe that these changes address the concerns that you and your staff have raised, and I am hopeful that the EPA can now concur with us and the other federal agencies that 1) W-3, PTA-1, EX-3, and E-3 in Sections I through IV respectively, is the LEDPA for the proposed project; and, 2) the conceptual mitigation plan or strategy that we have developed provides the tools for the project sponsor to comply with Section 404 of the Clean Water Act when it prepares to move forward on Sections III and IV at some future date.

Thanks again for meeting with us on September 9. I am pleased that we appear to have resolved these environmental issues on the Saddle Road project. If you or your staff have further questions regarding this matter, please contact Bert McCauley at (303) 716-2141.

Sincerely yours,

Larry C. Smith, P.E.
Division Engineer

Enclosures

cc (w/enclosures):
Ms. Alexis Strauss, Director, Water Division, EPA Region IX, San Francisco, CA
Ms. Deanna Wieman, Deputy Director, EPA Region IX, San Francisco, CA
Maj. Gen. Alexis Lum (Ret.), Exec. Asst., Office of Senator Daniel K. Inouye, Honolulu, HI
Mr. Kazu Hayashida, Director, Hawaii DOT, Honolulu, HI
LT COL Ralph H. Graves, District Engineer, U.S. Army Corps of Engineers, Ft. Shafter, HI
Mr. Jeff Brooks, Deputy Regional Administrator, FHWA, Region 9, San Francisco, CA
Mr. Abe Wong, Division Administrator, FHWA, Hawaii Division, Honolulu, HI
Mr. Donald Okahara, Okahara & Associates, Hilo, HI

bc (w/enclosures):
K. Au, Advance Planning Engineer, Hawaii DOT-Highway Division, Honolulu, HI
L. Silva, US Army Corps of Engineers, Operations Branch, Ft. Shafter, HI
G. Yasui. Senior Transportation Engineer, FHWA, Honolulu, HI
N. Burns, Senior Project Engineer, Okahara & Associates, Kailua-Kona, HI
D. Gedeon, Project Manager, FHWA, CFLHD, Lakewood, CO
R. Cushing, Environmental Planning Engineer, FHWA, CFLHD, Lakewood, CO
B. McCauley, Staff Environmental Engineer, FHWA, CFLHD, Lakewood, CO

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TRAVEL TIME BENEFITS OF E-3 vs EX-4A

EX-4A (2.6 MILES)

YEAR	AADT VOLUME (1)	DESIGN HOUR VOLUME (2)	LOS (3)	OPERATING SPEED (mph)	TRAVEL TIME (min)	ANNUAL TIME VALUE (4)
2008	1,140	171	A	45	3.5	$581,308.23
2009	1,300	195	A	45	3.5	$662,883.07
2010	1,480	222	A	45	3.5	$754,678.26
2011	1,700	255	B	45	3.5	$866,880.17
2012	1,925	289	B	40	3.9	$1,104,290.61
2013	2,200	330	B	40	3.9	$1,262,046.42
2014	2,500	375	B	40	3.9	$1,434,143.66
2015	2,850	428	B	40	3.9	$1,634,923.77
2016	3,250	488	B	35	4.5	$2,130,727.72
2017	3,700	555	C	35	4.5	$2,425,751.55
2018	4,225	634	C	35	4.5	$2,769,946.03
2019	4,820	723	C	35	4.5	$3,180,033.11
2020	5,500	825	D	35	4.5	$3,605,846.81
2021	6,260	939	D	30	5.2	$4,788,127.62
2022	7,140	1,071	D	30	5.2	$5,461,219.04
2023	8,140	1,221	D	30	5.2	$6,226,095.66
2024	9,275	1,391	D	30	5.2	$7,094,230.62
2025	10,600	1,590	E	30	5.2	$8,107,892.13
2026	12,050	1,808	E	25	6.2	$11,060,115.87
2027	14,000	2,100	E	25	6.2	$12,848,927.16

E-3 (3.4 MILES) / TRAVEL TIME BENEFITS

YEAR	AADT VOLUME	HOURLY VOLUME	LOS	OPERATING SPEED (mph)	TRAVEL TIME (min)	ANNUAL TIME VALUE	E-3 ANNUAL TRAVEL TIME SAVINGS	PRESENT WORTH FACTOR (5)	1998 DOLLARS
2008	1,140	171	A	60	2.8	$435,978.67	$145,329.56	1.000	$145,329.56
2009	1,300	195	A	60	2.8	$497,168.80	$165,723.27	0.943	$156,277.04
2010	1,480	222	A	60	2.8	$566,008.70	$188,669.57	0.890	$167,915.91
2011	1,700	255	A	60	2.6	$650,145.12	$216,715.04	0.840	$182,040.63
2012	1,925	289	A	60	2.6	$736,193.74	$368,096.87	0.792	$291,532.72
2013	2,200	330	A	60	2.6	$841,364.28	$420,682.14	0.747	$314,249.56
2014	2,500	375	A	60	2.6	$956,095.77	$478,047.89	0.705	$337,023.76
2015	2,850	428	A	60	2.6	$1,089,949.18	$544,974.59	0.665	$362,408.10
2016	3,250	488	A	60	2.6	$1,242,924.50	$887,803.22	0.627	$556,652.62
2017	3,700	555	A	60	2.6	$1,415,021.74	$1,010,729.81	0.592	$598,352.05
2018	4,225	634	B	60	2.6	$1,615,801.85	$1,154,144.18	0.558	$644,012.45
2019	4,820	723	B	55	2.8	$2,010,930.16	$1,169,102.95	0.527	$605,377.25
2020	5,500	825	B	55	2.8	$2,294,629.85	$1,311,217.06	0.497	$651,674.88
2021	6,260	939	B	55	2.8	$2,611,705.97	$2,176,421.64	0.469	$1,020,741.75
2022	7,140	1,071	B	55	2.8	$2,978,848.75	$2,482,372.29	0.442	$1,097,208.55
2023	8,140	1,221	C	55	2.8	$3,396,052.18	$2,830,043.48	0.417	$1,180,128.13
2024	9,275	1,391	C	50	3.1	$4,256,538.37	$2,837,692.25	0.394	$1,118,050.75
2025	10,600	1,590	C	50	3.1	$4,864,615.28	$3,243,076.85	0.371	$1,203,181.51
2026	12,050	1,808	D	45	3.5	$6,144,508.82	$4,915,607.05	0.350	$1,720,462.47
2027	14,000	2,100	D	40	3.9	$8,031,204.47	$4,818,722.68	0.331	$1,594,997.21
								TOTAL	$13,947,813.91
							TOTAL IN 1998 DOLLARS =		$7,782,880.18

(1) Total both directions based on linear growth rate of 14% per year.
(2) K = 15%
(3) Based on TRB Special Report 209, Service Flow Rates
(4) $24.18 per hour constant dollars based on 27% business & 73% non-business travel
(5) Based on 6% discount rate

ACCIDENT COSTS OF EX-4A vs E-3

ALTERNATIVE EX-4A				ALTERNATIVE E-3				ACCIDENT SAVINGS		
YEAR	AADT VOLUME (1)	ACCIDENTS PER YEAR (2)	ACCIDENT COSTS (3)	YEAR	AADT VOLUME	ACCIDENTS PER YEAR	ACCIDENT COSTS	E-3 ANNUAL ACCIDENT SAVINGS	PRESENT WORTH FACTOR (4)	2008 DOLLARS
2008	1,140	4.49	$320,413.64	2008	1,140	3.74	$267,011.37	$53,402.27	1.000	$53,402.27
2009	1,300	5.12	$365,383.98	2009	1,300	4.27	$304,486.65	$60,897.33	0.943	$57,426.18
2010	1,480	5.83	$415,975.61	2010	1,480	4.86	$346,646.34	$69,329.27	0.890	$61,703.05
2011	1,700	6.70	$477,809.82	2011	1,700	5.58	$398,174.85	$79,634.97	0.840	$66,893.37
2012	1,925	7.59	$541,049.36	2012	1,925	6.32	$450,874.48	$90,174.89	0.792	$71,418.51
2013	2,200	8.67	$618,342.12	2013	2,200	7.23	$515,285.10	$103,057.02	0.747	$76,983.59
2014	2,500	9.86	$702,661.50	2014	2,500	8.21	$585,551.25	$117,110.25	0.705	$82,562.73
2015	2,850	11.23	$801,034.11	2015	2,850	9.36	$667,528.43	$133,505.69	0.665	$88,781.28
2016	3,250	12.81	$913,459.95	2016	3,250	10.68	$761,216.63	$152,243.33	0.627	$95,456.58
2017	3,700	14.59	$1,039,939.02	2017	3,700	12.15	$866,615.85	$173,323.17	0.592	$102,607.32
2018	4,225	16.65	$1,187,497.94	2018	4,225	13.88	$989,581.61	$197,916.32	0.558	$110,437.31
2019	4,820	19.00	$1,354,731.37	2019	4,820	15.83	$1,128,942.81	$225,788.56	0.527	$118,990.57
2020	5,500	21.68	$1,545,855.30	2020	5,500	18.07	$1,288,212.75	$257,642.55	0.497	$128,048.35
2021	6,260	24.68	$1,759,464.40	2021	6,260	20.56	$1,466,220.33	$293,244.07	0.469	$137,531.47
2022	7,140	28.15	$2,006,801.24	2022	7,140	23.45	$1,672,334.37	$334,466.87	0.442	$147,834.36
2023	8,140	32.09	$2,287,865.84	2023	8,140	26.74	$1,906,554.87	$381,310.97	0.417	$159,006.68
2024	9,275	36.56	$2,606,874.17	2024	9,275	30.47	$2,172,395.14	$434,479.03	0.394	$171,184.74
2025	10,600	41.79	$2,979,284.76	2025	10,600	34.82	$2,482,737.30	$496,547.46	0.371	$184,219.11
2026	12,050	47.50	$3,386,828.43	2026	12,050	39.58	$2,822,357.03	$564,471.41	0.350	$197,564.99
2027	14,000	55.19	$3,934,904.40	2027	14,000	45.99	$3,279,087.00	$655,817.40	0.331	$217,075.56
Totals		410				342				$2,329,128.00
								TOTAL IN 1998 DOLLARS =		$1,299,653.42

(1) Total both directions based on linear growth rate of 14% per year.
(2) Based on State average of 3.0 ACC/MVM for E-3 and 17% higher (3.6) for EX-4A
(3) Based on Roadside Design Guide (AASHTO), $71,300 per accident (1% fatalities, 50% injury, 49% damage)
(4) Based on 6% discount rate.

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ENERGY COSTS OF EX-4A vs E-3

ALTERNATIVE EX-4A				ALTERNATIVE E-3				FUEL SAVINGS			
YEAR	AADT VOLUME (1)	ANNUAL FUEL CONSUMPTION IN GALLONS (2)	FUEL COSTS (3)	YEAR	AADT VOLUME	ANNUAL FUEL CONSUMPTION IN GALLONS (2)	FUEL COSTS	E-3 ANNUAL FUEL SAVINGS (GALLONS)	E-3 ANNUAL FUEL SAVINGS (DOLLARS)	PRESENT WORTH FACTOR (4)	2008 DOLLARS
2008	1,14..	95,703	$191,406.00	2008	1,140	83,220	$166,440.00	12,483	$24,966.00	1.000	$24,966.00
2009	1,300	109,135	$218,270.00	2009	1,300	94,900	$189,800.00	14,235	$28,470.00	0.943	$26,847.21
2010	1,480	124,246	$248,492.00	2010	1,480	108,040	$216,080.00	16,206	$32,412.00	0.890	$28,846.68
2011	1,700	142,715	$285,430.00	2011	1,700	124,100	$248,200.00	18,615	$37,230.00	0.840	$31,273.20
2012	1,925	161,604	$323,207.50	2012	1,925	140,525	$281,050.00	21,079	$42,157.50	0.792	$33,388.74
2013	2,200	184,690	$369,380.00	2013	2,200	160,600	$321,200.00	24,090	$48,180.00	0.747	$35,990.46
2014	2,500	209,875	$419,750.00	2014	2,500	182,500	$365,000.00	27,375	$54,750.00	0.705	$38,598.75
2015	2,850	239,257	$478,515.00	2015	2,850	208,050	$416,100.00	31,207	$62,415.00	0.665	$41,505.97
2016	3,250	272,838	$545,675.00	2016	3,250	237,250	$474,500.00	35,588	$71,175.00	0.627	$44,626.73
2017	3,700	310,615	$621,230.00	2017	3,700	270,100	$540,200.00	40,515	$81,030.00	0.592	$47,969.78
2018	4,225	354,689	$709,377.50	2018	4,225	308,425	$616,850.00	46,264	$92,527.50	0.558	$51,630.35
2019	4,820	404,639	$809,278.00	2019	4,820	351,860	$703,720.00	52,779	$105,558.00	0.527	$55,629.07
2020	5,500	461,725	$923,450.00	2020	5,500	401,500	$803,000.00	60,225	$120,450.00	0.497	$59,863.65
2021	6,260	525,527	$1,051,054.00	2021	6,260	456,980	$913,960.00	68,547	$137,094.00	0.469	$64,297.09
2022	7,140	599,403	$1,198,806.00	2022	7,140	521,220	$1,042,440.00	78,183	$156,366.00	0.442	$69,113.77
2023	8,140	683,353	$1,366,706.00	2023	8,140	594,220	$1,188,440.00	89,133	$178,266.00	0.417	$74,336.92
2024	9,275	778,636	$1,557,272.50	2024	9,275	677,075	$1,354,150.00	101,561	$203,122.50	0.394	$80,030.26
2025	10,600	889,870	$1,779,740.00	2025	10,600	773,800	$1,547,600.00	116,070	$232,140.00	0.371	$86,123.94
2026	12,050	1,011,597	$2,023,195.00	2026	12,050	879,650	$1,759,300.00	131,947	$263,895.00	0.350	$92,363.25
2027	14,000	1,175,300	$2,350,600.00	2027	14,000	1,022,000	$2,044,000.00	153,300	$306,600.00	0.331	$101,484.60
							TOTAL	1,139,402		TOTAL	$1,088,886.40
									TOTAL IN 1998 DOLLARS =		$807,598.61

(1) Total both directions based on linear growth rate of 14% per year.
(2) Based on 15 mpg and 15% increase in fuel consumption on EX-4A.
(3) Based on $2.00/gal average fuel cost.
(4) Based on 6% discount rate.

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PALILA MITIGATION
MEMORANDUM OF UNDERSTANDING (MOU)

MEMORANDUM OF UNDERSTANDING

Regarding Implementation of the Saddle Road Palila Critical Habitat Impact Mitigation

AMONG:

The United States Department of Transportation, Federal Highway Administration (FHWA), the Hawaii Department of Transportation (HDOT), the United States Department of the Army through the U.S. Army Garrison-Hawaii (USAG-HI) and the Military Traffic Management Command (MTMC), the State of Hawaii Department of Land and Natural Resources (DLNR), the United States Fish and Wildlife Service (USFWS), and the Pacific Island Ecosystems Research Center of the Biological Resource Division of the United States Geological Survey (BRD/USGS).

WHEREAS, the United States Department of Transportation, FHWA in cooperation with HDOT are proposing to realign and improve the Saddle Road, State of Hawaii Route 200 (SR 200); and

WHEREAS, the MTMC is serving in concert with the FHWA as co-administrators of the federal funds involved; and

WHEREAS, the purpose and need for the project includes the separation of military and civilian traffic and improved training conditions at Pohakuloa Training Area (PTA); and

WHEREAS, the PTA-1 alignment as presented in the Draft Environmental Impact Statement (DEIS) best fulfills the project purpose and need; and

WHEREAS, the PTA-1 alignment impacts approximately 41.5 hectares of federally designated Palila Critical Habitat (PCH); and

WHEREAS, representatives of the FHWA, USFWS, DLNR, HDOT, USAG-HI, MTMC, and the BRD/USGS as technical consultant have consulted pursuant to the guidelines of Section 7 of the Endangered Species Act (ESA) to develop appropriate mitigation measures to compensate for impacts to the Palila Critical Habitat; and

WHEREAS, the Palila mitigation measures, as presented in the *Biological Opinion of the USFWS for the Saddle Road Realignment and Improvement Project*, July 27, 1998, which includes the provision of the Palila Critical Habitat replacement lands, has been determined to be the appropriate mitigation after considering the impact of the proposed project and the benefits of the proposed mitigation measures; and

WHEREAS, interagency agreements may be required to ensure that the Palila mitigation is implemented as required by FHWA policy under the National Environmental Policy Act (NEPA) and Council for Environmental Quality (CEQ) regulations and by USFWS ESA, and

WHEREAS, mitigation for impacts to endangered plants is agreed to by the affected agencies and this MOU is necessary to address Palila mitigation because of its scope and complexity, and

WHEREAS, the primary objective of all elements of the Palila mitigation shall be to provide reasonable mitigation for the Recommended Alternative within the context of the larger goal of the ultimate recovery of the Palila bird in the State of Hawaii.

THEREFORE, it is mutually agreed that the Stipulations in the Memorandum of Understanding (MOU) provide the basis for implementing the Palila mitigation, as presented in the Biological Opinion (BO) of the USFWS, to advance the proposed Saddle Road Project to completion.

STIPULATIONS

I. Foundation for Agreement

A. The PTA-1 alignment, as presented in the DIES, fulfills the project purpose and need with respect to the Pohakuloa Training Area mission and increased public and military transportation safety and, therefore should be the Recommended Alternative presented in the Final EIS (FEIS) for advancement to construction.

B. The Palila mitigation, as presented in the Biological Opinion for the PTA-1 alignment, is necessary and must be implemented according to the elements specified to ensure the successful completion of the proposed Saddle Road Project.

C. The implementation of PTA-1 and the Palila mitigation is contingent upon the securing of federal funds.

II. Implementation Procedures

A. In order to execute the Record of Decision (ROD) for the proposed Saddle Road project, Memorandum of Agreements (MOA) may be required between the signatory parties to this MOU to further refine the Palila mitigation implementation responsibilities outlined in this MOU.

B. In order to proceed with the proposed Saddle Road project, any MOAs which are required to begin the mitigation process shall be executed by the appropriate signatory parties to this MOU in a timely fashion after federal funds have been appropriated and before construction commences.

C. In order to implement the Palila mitigation, funding in the estimated amounts and scheduled as indicated on the attached Table A, "Palila Mitigation Itemized Cost Estimate and Proposed Implementation Schedule" as amended, will be required.

D. To the extent federal funds are appropriated for the Saddle Road Project, signatory parties agree to accept those funds and to administer, allocate, or authorize use of those funds for the Palila mitigation purposes referenced by this MOU.

E. Mitigation funds allocated to Palila mitigation elements outside the limits of the proposed Saddle Road project and/or in conjunction with the PCH replacement lands may be administered by a mutually agreeable third party provided these funds are not used for any other purposes.

F. The signatory parties agree to use guidance papers as a basis for the implementation of the Palila mitigation and the responsible expenditure of allocated funds. These guidance papers include, but are not limited to, the following:

1. "Biological Assessment of the Hawaii State Route 200-Mamalahoa Highway to Milepost 6 Saddle Road Realignment Project, Island of Hawaii, Hawaii."

2. The Biological Opinion of the USFWS for the Saddle Road Realignment and Improvement Project.

3. The USFWS Palila Recovery Plan, and all updates to this plan.

G. The primary goal of management actions regarding PCH replacement lands shall be the long-term restoration of a viable mamane forest, the expansion and/or re-introduction of Palila population, and the control of Palila predators and alien species detrimental to Palila. Recreational activities, including hunting and similar activities occurring on adjacent lands, that do not compromise the primary goal of Palila recovery may occur within these lands.

H. In the absence of definitive scientific information, any proposed management actions regarding potential usage of the PCH replacement lands shall be empirically evaluated by trial or tests and permitted on the whole of the lands only if the proposed usage does not compromise the primary goal.

I. Recognizing that habitat restoration is not completely understood in this instance, the signatory parties agree that an adaptive management policy should be used to evaluate proposed management actions on the PCH replacement lands. Adaptive management is defined as basing plan implementation decisions on data collected and various management strategy trials conducted both on and off site.

J. Consistent with an adaptive management approach, the signatory parties will be responsible for reviewing ongoing management actions and formulating recommended management plans based on the data gathered on site and on the latest technical information available. These recommendations shall be consistent with the Palila mitigation goals. Any proposed action deemed not consistent with the primary management goals, will be subject to reinitiation of consultation under Section 7 of the ESA.

K. All management plans or actions developed or recommended for the state lands must be approved by the State of Hawaii Department of Land and Natural Resources (DLNR) and activities on these State lands must be in accordance with all DLNR rules and regulations.

L. All management plans or actions developed or recommended for the Army lands must be approved by the USAG-HI.

M. Agency responsibilities for implementation of specific mitigation items will be pursuant to the attached Table A, pending receipt of the required funding.

III. Specific Agency Commitments

A. USAG-HI agrees to:

1. In the case of Kipuka ‘Alala, commit Ecosystems Management Plan funding for the required fencing and ungulate control and to the restoration of Palila by cooperating with necessary predator and alien species control and mamane reforestation or protection efforts.

2. Coordinate fire prevention and suppression activities and planning with the fire ecologist and cooperate in the development of a comprehensive, interagency fire plan.

B. The USFWS agrees to:

1. Provide input to the FHWA environmental manual containing environmental issues and specific mitigation requirements and procedures that will be required of the construction contractor.

2. Cooperate with the fire ecologist in the development of a comprehensive, interagency fire plan.

C. The BRD/USGS agrees to:

1. Provide input to the FHWA environmental manual containing environmental issues and specific mitigation requirements and procedures that will be required of the construction contractor.

2. Cooperate with the fire ecologist in the development of a comprehensive, interagency fire plan.

3. Provide research information to further Palila restoration.

D. The DLNR agrees to:

1. Provide input to the FHWA environmental manual containing

environmental issues and specific mitigation requirements and procedures that will be required of the construction contractor.

2. Coordinate fire prevention and suppression activities and planning with the fire ecologist and cooperate in the development of a comprehensive, interagency fire plan.

3. Assist the FHWA and HDOT in compensation negotiations with current lessees of the State replacement lands.

4. Perform all administrative and right-of-way related work to ensure subdivision and transfer of the PCH replacement land parcels.

E. The FHWA agrees to:

1. Ensure the design and construction of the proposed Saddle Road project in accordance with the requirements of the USFWS Biological Opinion.

2. Coordinate with the DLNR and current lessees of PCH replacement lands to determine appropriate lease termination compensation.

3. Establish accounts from available funds to reimburse the State for all right-of-way related work in securing the transfer of the State replacement land parcels from their existing uses or otherwise effect this transfer with project funds.

F. The HDOT agrees to:

1. Maintain the completed roadway to control alien roadside weed and grass growth throughout the life of the project.

2. Maintain the emergency telephone installation within PTA in good working order throughout the life of the project.

G. The MTMC agrees to:

1. Allow funding of Palila mitigation required for this project from appropriated DAR construction funds, if not identified in other agency appropriations.

2. Allow DAR construction funds to be expended for Palila mitigation either before or during construction of the project.

IV. Appendices

A. Table A- Palila Mitigation Itemized Cost Estimate and Proposed Implementation schedule.

B. Maps of Palila Critical Habitat replacement lands.

Larry C. Smith, Division Engineer
Federal Highway Administration

Date Aug 10, 1999

Kazu Hayashida, Director
Hawaii Department of Transportation

Date 7/9/99

Peter Cline, Senior Engineer
Military Traffic Management Command

Date 17 Jun 99

COL Barry N. Totten, Director
Directorate of Public Works, USAG-HI

Date 12 Jul 99

Robert P. Smith, Manager, U.S. Fish and Wildlife Service,
Pacific Islands Ecoregion

Date 7/9/99

Timothy W. Johns, Chairman
Board of Land and Natural Resources
State of Hawaii

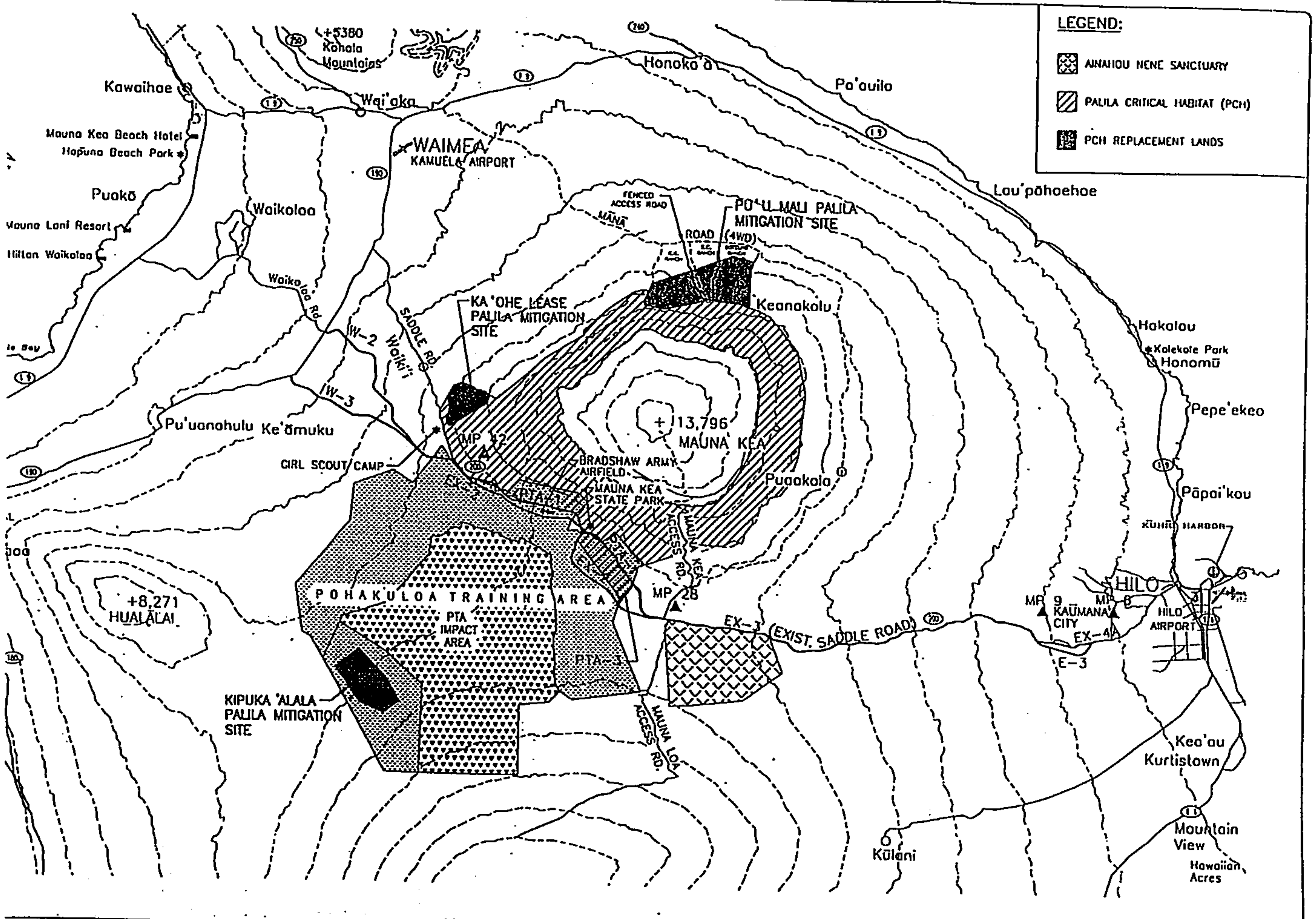
Date 7/19/99

Dr. William Steiner, Director
USGS Biological Research Division
Pacific Islands Ecosystem Research Center

Date 7/16/99

Table A Fauna Mitigation Itemized Cost Estimate and Proposed Implementation Schedule

FISCAL YEAR	ITEM	UNIT COST	RESPONSIBILITY Program	RESPONSIBILITY Agency	COMMENTS
2000	Land Transferral	$2,000,000.00	DAR	FHWA	Includes lessee compensation and subdivision, Land Board application, & administrative costs.
	Biologically Sensitive Contract Requirements	$250,000.00	DAR	FHWA	Assumes Clearing & Grubbing contract with contractor restrictions (included in construction costs).
	Fire ecologist - year 1 of 3	$50,000.00	TBD(1)	USAG/BRD	Does not include other agency costs for coordination efforts.
	Ungulate Fencing at Pu'u Mali	$500,000.00	TBD	DLNR	
	Ungulate Fencing at Kipuka Alala	$291,000.00	EMP	USAG	
	Ungulate control at Kipuka Alala - year 1 of 3	$83,000.00	EMP	USAG	
	Palila relocation and monitoring - year 1 of 5	$450,000.00	TBD	BRD	
	Predator & alien species control - year 1 of 5	$150,000.00	TBD	DLNR	
	Contract administration (variable)	$222,000.00	TBD		24% BRD plus 10% all others except construction items.
	TOTAL	$3,996,000.00			DAR = $2,250,000; EMP = $374,000; TBD = $1,372,000
2001	Additional excavation for fire shoulders	$300,000.00	DAR	FHWA	Assumes grading project for all of PTA-1 (included in construction costs).
	Biologically Sensitive Contract Requirements	$250,000.00	DAR	FHWA	Restricted contractor operations, special equipment handling, etc. (included in construction costs).
	Cattle Fence at Pu'u Mali & Ka'hoe lands	$237,000.00	TBD	DLNR	
	Fire ecologist - year 2 of 3	$50,000.00	TBD	USAG/BRD	
	Ungulate control at Kipuka Alala - year 2 of 3	$83,000.00	EMP	USAG	
	Palila relocation and monitoring - year 2 of 5	$450,000.00	TBD	BRD	
	Predator & alien species control - year 2 of 5	$150,000.00	TBD	DLNR	
	Alien Insect Study	$250,000.00	EMP	BRD	Continued funding of ongoing study by BRD/USGS.
	Mower for Ka'hoe Lease Lands	$30,000.00	TBD	DLNR	
	Mower operator labor - year 1 of 5	$15,000.00	TBD	DLNR	
	Contract administration (variable)	$232,000.00	TBD		24% BRD plus 10% all others except construction items.
	TOTAL	$2,047,000.00			DAR = $550,000; EMP = $333,000; TBD = $1,164,000
2002	Additional excavation for fire shoulders	$240,000.00	DAR	FHWA	
	Paved Fire Break shoulder and appurtenances	$4,335,000.00	DAR	FHWA	Assumes FY '02 project will install paving and other final work (included in construction costs).
	Emergency Telephone installation	$125,000.00	DAR	FHWA	To be maintained by HDOT.
	Fire ecologist - year 3 of 3	$50,000.00	TBD	USAG/BRD	
	Ungulate control at Kipuka Alala - year 3 of 3	$83,000.00	EMP	USAG	
	Palila relocation and monitoring - year 3 of 5	$450,000.00	TBD	BRD	
	Predator & alien species control - year 3 of 5	$150,000.00	TBD	DLNR	
	Mower operator labor - year 2 of 5	$15,000.00	TBD	DLNR	
	Contract administration (variable)	$145,000.00	TBD		24% BRD plus 10% all others except construction items.
	TOTAL	$5,593,000.00			DAR = $4,700,000; EMP = $83,000; TBD = $810,000
2003-04	Palila relocation and monitoring - year 4 and 5	$450,000.00	TBD	BRD	
(each yr)	Predator & alien species control - year 4 and 5	$150,000.00	TBD	DLNR	
	Mower operator labor - year 3 and 4	$15,000.00	TBD	DLNR	
	Contract administration (variable)	$249,000.00	TBD		24% BRD plus 10% all others except construction items.
	TOTAL	$864,000.00			TBD = $864,000/year; $1,728,000 total
2005-09	Palila relocation and monitoring - year 6 - 10	$100,000.00	TBD	BRD	
(each yr)	Predator & alien species control - year 6 - 10	$75,000.00	TBD	DLNR	
	Mower operator labor - year 6 only	[$15,000.00]	TBD	DLNR	Required only in FY 2005.
	Contract administration (variable)	$159,000.00	TBD		24% BRD plus 10% all others except construction items.
	TOTAL	$334,000.00			TBD = $334,000/year; $1,685,000 total (including FY 2005 mower operator).
					Note: Table A does not include $90,000 previously expended on EIS baseline invertebrate study. Total in Table A does
	Grand Total FY 2000 through 2009	$15,049,000.00			not match Table 7 in BA due to refined Contract Administration percentages. Fiscal Year of item implementation may
					vary depending on funding appropriations.
			(1) TBD funding may be EMP or DAR or combination, depending on appropriations. MOAs will be executed with		
			responsible agency when funds are allocated to the project.		mitig_$.wb2 / June 1999



.TE ROUTE 200)

PALILA MITIGATION SITES AND CRITICAL HABITAT

USFWS FINAL
BIOLOGICAL OPINION

BIOLOGICAL OPINION
of the
U.S. FISH AND WILDLIFE SERVICE
for the
SADDLE ROAD REALIGNMENT AND IMPROVEMENT PROJECT

July 27, 1998

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
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In Reply Refer To: 1-2-98-F-01 (kwr)

Larry C. Smith, P.E.
Division Engineer
U.S. Department of Transportation
Federal Highways Administration
Central Federal Lands Highway Division
555 Zang Street
P.O. Box 25246
Denver, Colorado 80225-0246

Dear Mr. Smith:

This responds to your November 6, 1997, request for formal consultation under section 7 of the Endangered Species Act of 1973 (16 U.S.C.1531-1544, Stat. 884), as amended (Act), relative to realignment and improvement of Saddle Road (State Route 200) on the island of Hawaii. The U.S. Department of Transportation, Federal Highways Administration (FHWA) is the action agency for this project. The U.S. Department of the Army, Military Traffic Management Command (MTMC), is serving as co-administrator of the Federal funds involved. Your November 6, 1997, request was received on November 12, 1997. The statutory deadline for completing this draft consultation, March 27, 1998, has been extended by mutual consent of the U.S. Fish and Wildlife Service (Service) and FHWA until April 17, 1998. This document represents the Service's biological opinion on the effects of the proposed project on the endangered palila (*Loxioides bailleui*) and its critical habitat and the threatened plant species *Silene hawaiiensis*, in accordance with section 7(a)(2) of the Act.

This biological opinion is based on the following information: 1) FHWA's September 15, 1997, biological assessment and follow-up correspondence; 2) the October 9, 1997, draft environmental impact statement for the Saddle Road realignment and improvement project (FHWA-FPHI-EIS-97-1-D); 3) the Service's 1986 Revised Palila Recovery Plan (USFWS 1986); 4) the Service's 1996 Recovery Plan for the Big Island Plant Cluster (USFWS 1996) and 1997 Addendum (USFWS 1997); information gained during site visits to the project area; 6) the biological literature (see References Cited section at the end of the document); and, 7) other information sources. Our log number for this consultation is 1-2-98-F-01. Copies of pertinent materials and documentation are maintained in an administrative record in the Service's office in Honolulu, Hawaii.

Consultation History

In 1989, the Military Traffic Management Command (MTMC) of the Department of Defense (DOD) determined that improvements to the section of the Saddle Road within Pohakuloa Training Area (PTA) on the island of Hawaii were eligible for funding. The Hawaii Department of Transportation (HDOT) agreed to improve the remaining sections of the road. On November 27, 1990, the Army and the Federal Highway Administration (FHWA), in cooperation with the HDOT, issued a scoping letter announcing a series of public meetings. On December 27, 1990, the Service issued a species list letter and raised concerns regarding the proposal to improve Saddle Road. A botanical survey and bird and mammal survey were undertaken in December 1990 by the FHWA. On January 15, 1991, the FHWA issued a letter requesting an interagency meeting to discuss needs and concerns regarding the project. The Service was represented by Mr. William Kramer. The FHWA wrote to the Service on March 4, 1991, enclosing the survey reports and concluding that the proposed improvement of the Saddle Road was not likely to adversely affect the palila or its critical habitat. The Service responded by letter dated March 8, 1991, that adverse impacts were anticipated and recommended that the FHWA initiate formal section 7 consultation.

On December 2, 1991, the FHWA published in the *Federal Register* its notice of intent tu prepare an environmental impact statement (EIS) for the proposed changes to a portion of Saddle Road. The Service responded by letter dated January 9, 1992, providing another species list letter along with the recommendation to initiate section 7 consultation. Project development planning was suspended, however, until a letter was sent to several agencies and individuals dated April 19, 1994, indicating that the FHWA had resumed its planning efforts on the Saddle Road. New project management was identified and funds were now in place to prepare the EIS.

The letter indicated that since the last interagency scoping meeting of February 11, 1992, the MTMC had endorsed the recommendation of the Army to relocate Saddle Road along the northern boundary of the PTA. It was acknowledged that the scope and complexity of the project had increased substantially. The FHWA was still the lead Federal agency with the cooperation of the State and County of Hawaii and the Department of the Army. The FHWA advised the Service that the preferred realignment would go through designated critical habitat for the palila and asked the Service to assist in identifying measures to minimize the effects of the adverse modification. Agencies were informed that environmental clearance for the entire route of the Saddle Road would be pursued.

A notice dated April 19, 1994, was published by the FHWA announcing a series of additional public scoping meetings. A series of meetings were held to discuss fish and wildlife concerns. A meeting was held on February 21, 1995, to discuss the section 7 consultation process and the contracts associated with mapping and engineering surveys as well as biological surveys.

A meeting between the Service, the Biological Resources Division of the U.S. Geological Survey (BRD), the State of Hawaii's Division of Forestry and Wildlife (DOFAW), and the Army, was held on August 1, 1995, to discuss recovery efforts for the palila, including reintroduction to the Pohakuloa Flats area in palila critical habitat on PTA. Immediately following this meeting, the Army informed the Service that they supported the realignment of Saddle Road through this portion of palila critical habitat and could not, therefore, support the reintroduction of palila to the Pohakuloa Flats area at that time. Steps were then taken to focus on the several other recovery actions identified in the meeting, such as enhanced habitat management and predator control in and immediately adjacent to the core palila habitat on the west slope of Mauna Kea and reintroduction of palila to another area within historic range on Mauna Kea, pending completion of the section 7 consultation with FHWA for the Saddle Road realignment project.

On October 13, 1995, an interagency meeting was held during which the Service agreed to convene a working group of palila experts to assess the likely impacts to the survival and recovery of the palila as a result of aligning the road through designated critical habitat. The working group included members of BRD, DOFAW, and the Service. The Service also recommended that the FHWA consider early consultation as an opportunity to flesh out issues early in the process.

Two more meetings were held, on November 3, 1995, to discuss the project with all agencies and on November 9, 1995, to discuss the early consultation process, and on November 17, 1995, the Service received a request from the FHWA for early consultation, with the acknowledgment that several data gaps still existed for the project. A meeting on November 22, 1995,was held to discuss the alignment of the road through palila critical habitat. Botanical concerns were raised by the Service following a site visit on December 11, 1995, through the proposed PTA alignment.

On March 1, 1996, in a meeting held in Senator Inouye's conference room in Honolulu, the Service presented a summary of the expected impacts to the palila as a result of the proposed realignment of Saddle Road through critical habitat and presented a plan to mitigate for these impacts. The plan was developed by the palila working group and contained four major elements:

1) minimize impacts to existing palila habitat at PTA and further explore the potential of palila restoration at Kipuka Alala;
2) minimize fire risk and increase ability to suppress fire;
3) protect and enhance the existing core population of palila; and,
4) acquire and manage additional palila habitat on Mauna Kea's northern slope.

On March 20, 1996, the Army wrote the Service a letter discussing the palila mitigation package. A revised draft mitigation plan was prepared by the working group on March 27, 1996. An initial informal consultation meeting among technical representatives from FHWA, the Service, BRD, DOFAW, and others was held on April 3, 1996, at the DOFAW Hilo office to begin discussions of the technical elements of the mitigation plan in detail. The plan was revised by the Service on April 4, 1996, and a subsequent joint field review by the above-listed agencies was held on April 10, 1996, in which alignments were examined in relation to the critical habitat.

On June 7, 1996, a meeting among technical representatives of FHWA, the Service, BRD, DOFAW, and others was held to discuss further refinements of the draft mitigation plan and to discuss proposed cost estimates for various plan elements, as well as processes and further coordination required to implement the mitigation. At a later meeting, on September 5, 1996, FHWA asked for additional detailed documentation and justification for securing and managing palila habitat in the Puu Mali and Puu Laau areas of Mauna Kea. The Service responded by letter dated October 9, 1996, to Okahara and Associates.

On October 10, 1996, an interagency meeting was held in Hilo to discuss the developing Saddle Road EIS and findings of the various consultants on the project. At this meeting, the Saddle Road alignment was divided into four sections to increase efficiency in analysis and discussion.

On November 21, 1996, another interagency meeting was held to discuss the palila mitigation and the EIS schedule. By letter dated March 11, 1997, the FHWA transmitted copies of the preliminary draft Environmental Impact Statement (PDEIS) and the draft Biological Assessment to the Service with requests for initiation of early consultation and preparation of a preliminary biological opinion. By letter dated April 2, 1997, the FHWA requested an interagency meeting to discuss the review of the PDEIS. This meeting was held on April 9, 1997. On that same date, at the request of FHWA, the Service provided comments on the preliminary draft biological assessment (PDBA) to Reggie David of Rana Productions, the consultant for FHWA responsible for preparation of the biological assessment. During the meeting, the Service agreed to provide official review comments on both the PDEIS and PDBA by May 2, 1997, which was done. Brooks Harper indicated that the Service would expedite the preparation of its BO to help meet the project deadline and that a preliminary BO associated with early consultation would no longer be necessary or appropriate.

By letter dated October 15, 1997, the FHWA submitted copies of the draft EIS to various agencies for review and comment. The Service received copies of the biological assessment and a cover letter requesting initiation of formal section 7 consultation on November 12, 1997. A meeting between the Service and Reggie David of Rana Productions took place on December 4, 1997, during which Service biologists sought clarification on a number of issues in the biological assessment. The Service agreed to accept the biological assessment and initiate formal consultation, provided the FHWA responded to the several areas of concern discussed during the meeting. The Service agreed to assist by developing a proposed mitigation plan to offset impacts to the endangered 'oha wai (*Clermontia peleana*), and haha (*Cyanea platyphylla*), while Reggie David agreed to ask the FHWA to respond to the Service's other questions and concerns by letter.

On December 9, 1997, the Service provided comments on the draft EIS to the Pacific Island Support Office, National Park Service for incorporation into the Department of the Interior's comments on the draft EIS. On December 29, 1997, the Service wrote a letter indicating that the biological opinion (BO) would be delivered on or before March 27, 1998, and stating that all information required was contained in the biological assessment or otherwise accessible. The proposed mitigation plan to offset and minimize impacts to the 'oha wai and haha, as discussed at the December 4, 1997, meeting, was sent by the Service to Reggie David of Rana Productions on December 31, 1997. The letter indicated that additional mitigation would likely be necessary in order to meet the FHWA's desired date for completion of the BO.

By letter dated February 25, 1998, the FHWA confirmed the mutual agreement to extend the issuance of the Service's BO to April 17, 1998, with the understanding that a meeting to resolve issues relating to the mitigation proposed for the 'oha wai and haha would take place on March 18, 1998. During the March 18, 1998, meeting, FHWA and the Service discussed and agreed upon actions to avoid impacts to the two endangered plants. Since the segment of the proposed project in the vicinity of the endangered plants would be constructed by the State, the FHWA agreed to consult with the HDOT for their concurrence on measures to be proposed and forward concurrence in a letter from that agency. The Service wrote FHWA on March 19, 1998, outlining the actions that were agreed upon at the meeting and reiterating the need for a follow-up letter from FHWA. The letter from HDOT was forwarded to the Service by the FHWA on March 31, 1998.

On April 13, 1998, the Service received FHWA's April 7, 1998, letter addressing and clarifying several points in the biological assessment, as agreed upon in the December 4, 1997, meeting.

BIOLOGICAL OPINION

Description of the Proposed Action

This project description is taken from the October 1997 draft Environmental Impact Statement (FHWA-FPHI-EIS-97-1-D), the September 15, 1997, biological assessment, and project modifications and clarifications identified in FHWA's April 7, 1998, letter and the Director of Transportation's March 31, 1998, letter. The purpose of the proposed action is to reconstruct Saddle Road (State Route 200) from just west of Hilo to the Mamalahoa Highway to improve road conditions and safety, provide an efficient cross-island link for increasing commuter traffic, and regional economic growth, and to increase the quality and safety of military training at PTA.

Saddle Road, which was built in 1942, is a narrow, winding, two-lane road with steep grades, sharp curves, poor pavement, and substandard drainage. The FHWA proposes to improve Saddle Road by upgrading and modernizing approximately 78 kilometers (km) of the road, from the Mamalahoa Highway (SR 190) to Milepost (MP) 6, near Hilo, Hawaii. The action is designed to provide a safe and efficient route for access along Saddle Road and for cross-island traffic between East and West Hawaii.

Saddle Road is the only paved road serving PTA, the Mauna Kea telescope complex, Waiki'i Ranch, upper Kaumana, Mauna Kea State Recreation Area, Kilohana Girl Scout Camp, and several major hunting areas. It is also an important cross-island link for business travel, the transport of goods and services, tourism, recreation, shopping, and commuting. Military traffic on Saddle Road going to and from PTA involves transportation of ammunition, water, training equipment, and troops.

FHWA estimates that the average daily traffic (ADT) on Saddle Road in 1994 was 900 vehicles. By the year 2014, in its present condition, Saddle Road is expected to accommodate an ADT of 4,400 vehicles. Projected figures, based on increased usage associated with commuter traffic, residential development at both ends of the road, tourism and recreation, agriculture, military operations, the Mauna Kea telescope complex, and increasing congestion along alternative cross-island routes, estimate that Saddle Road will need to accommodate an ADT of 14,000 vehicles in the year 2014.

Saddle Road crosses through the northern area of PTA, separating the cantonment area and the Bradshaw Army Airfield from the majority of its training areas, firing points, and impact zones. There is extensive training along and across Saddle Road that has created conflict between public users of the road and the military. Some military operations require troops to fire over Saddle

Road, while others require the troops to move across the road to reach firing ranges on the opposite side. The need to cross a public road in the middle of military training exercises greatly reduces the quality of military training exercises at PTA and creates a hazardous situation for public users of the road as well as military personnel.

The accident rate on Saddle Road is 5.43 accidents per million vehicle miles (ACC/MVM). By contrast, the average rate for rural two-lane highways throughout the State of Hawaii is only 3.0 ACC/MVM. This higher rate of accidents can be directly related to roadway deficiencies, conflicts with military operations, and capacity limitations.

The project has been divided into four sections (Section I, II, III, and IV). All four sections will be improved in accordance with *A Policy on Geometric Design of Highways and Street, 1994*, by the American Association of State Highway and Transportation Officials. Improvement consists of widening the road, straightening it somewhat to create gentler curves and grades, creating adequate shoulders, and allowing adequate sight distance for motorists. Specifically, the typical road section will consist of a two-lane hot asphalt concrete paved roadbed, two 3.6-meter (12-foot) travel lanes with two 2.4-meter (8-foot) paved shoulders, and a 1.8-meter (6-foot) wide ditch on the up slope side of the roadbed. The road will be designed to accommodate 80 kilometer (km) per hour (50-60 mile per hour) speeds, a minimum curve radius of 230 meters (754 feet), an 8 percent maximum superelevation, simple curves with 67 percent of runoff on tangent, and an 8 percent maximum grade. Passing lanes may also be added in some locations. More specific project features are included section-by-section to mitigate for section-specific impacts.

Section I consists of two alternatives under consideration by FHWA, segment W-2 and segment W-3. Segment W-2 would connect Saddle Road to SR 190 at Waikoloa Road. Segment W-3 would connect with SR 190 3 miles south of Waikoloa Road. Section II consists of three alternatives, segments EX-2, PTA-1, and PTA-3. Segment EX-2 would reconstruct Saddle Road along the existing roadway corridor. This segment is not preferred by FHWA, because it would not accomplish the desired separation of motorists from military training exercises. Both PTA-1 and PTA-3 are located north of the existing roadway and would succeed in separating public users of Saddle Road from military maneuvers. Both of these segments go through designated critical habitat for the palila.

Section III consists of only one alternative, segment EX-3. In this section FHWA proposes to reconstruct Saddle Road along the existing roadway corridor. Section IV consists of two alternatives, segment EX-4A and segment E-3. Segment EX-4A would relocate a portion of Section IV away from existing residential development in Kaumana. It would rebuild and improve the existing Saddle Road on the west and east ends of Section IV, but would split from the existing roadway for a 2-km portion in the middle to follow an existing transmission line corridor. Segment E-3 relocates the road farther away from Kaumana.

The MTMC authorized the use of Defense Access Road (DAR) funds to prepare the EIS for the Saddle Road improvement project. They also determined that the design and construction of Saddle Road improvements within the limits of PTA are eligible for DAR funds, which must be authorized and appropriated by Congress. The remaining portions of the Saddle Road improvement project will be funded through future legislative actions. Hawaii Department of

Transportation (HDOT) will be responsible for the design and construction of segments outside of PTA. It has also been agreed that those segments of Saddle Road constructed with DAR funds will be owned and maintained by HDOT.

The following measures have been incorporated into the project description by FHWA and are, therefore, considered part of the proposed project:

1. <u>Lighting Restrictions:</u>

To avoid the potential downing of endangered dark-rumped petrels and threatened Newell's shearwaters, FHWA will prohibit the use of construction or unshielded equipment maintenance lighting after dark between the months of April and October. In addition, in Section III, no lighting will be allowed on staging and equipment storage areas. These prohibitions will be contained in the Special Contract Requirements within the construction contract documents. No street lights are planned for any section of Saddle Road.

2. <u>Minimization of Fire Hazard:</u>

To minimize the risk of wildfire, the road will be designed, as stated above, as two 3.6-meter (12-foot) travel lanes with a 2.4-meter (8-foot) paved shoulder on both sides and a 1.8-meter (6-foot) wide ditch on the up slope side of the roadbed. In addition, in Section II, since the relocation of Saddle Road will result in an increased risk of fire to the west slope palila population and to the *Silene hawaiiensis* populations in the area, FHWA will make the following modifications to the roadway:

a. There will be an additional 2.4-meter (8-foot) paved shoulder along the north side of the roadway from PTA-1 Station 10+000 to 21+500, from the start of PTA-1 at the bottom of the seven steps to the cantonment area adjacent to Mauna Kea State Park, to provide 4.8 meters (15.7 feet) of non-flammable verge to trap a burning cigarette or match thrown from a vehicle traveling along the roadway. There will also be a 0.23-meter (9-inch) extruded asphalt curb at the end of this paved fire break to stop small burning objects from coming into contact with flammable vegetation. The additional 2.4-meter (8-foot) paved shoulder will be separated from the shoulder by a 4-strand smooth wire fence strung between 1.20-meter (4-foot) high metal posts to prevent vehicles from unauthorized excursions into the fire-prone habitat found within this section. Emergency telephones will be installed on the north side of the road, spaced approximately every 2 kilometers (1.2 miles) along the entire length of PTA-1 or PTA-3.

b. For segment PTA-1 Station 21-500 to 27+270, or PTA-3 Station 10+000 to 12+500, these same design features will be incorporated into the road, with the additional paved shoulder, extruded asphalt curb, and 4-strand smooth wire fence occurring on the south side of the roadway.

c. A realistic fire model, or models, will be developed for all of Section II and the eastern end of Section I, as well as for the Puu Lau and Puu Mali areas. This model will be prepared by a fire ecologist with experience in modeling high altitude xeric plant communities working closely with local vegetation ecologists. Following the fire modeling exercise, a comprehensive fire management plan complete with risk assessment protocols and guidelines will be drafted in a manner that is consistent with palila habitat recovery goals and the recovery goals of the native plant species throughout Section II and the eastern portion of Section I.

d. Within PTA, the Army has primary responsibility for suppressing and combating fire, through the PTA Fire Department. The Army has upgraded its fire-fighting capabilities at PTA with the construction of six 80,000 gallon dip tanks and the purchase and deployment of two Humvee pumper trucks. In addition, they have completed a draft Fire Management Plan for PTA (USAG-HI 1996) in which they agree to stockpile and maintain the fire fighting equipment necessary to supply an 86-man fire fighting detail.

3. Endangered and Threatened Plant Mitigation Measures

a. FHWA's original project design for PTA-1 proposed road construction through a population of the threatened plant species *Silene hawaiiensis* made up of 70 individuals found at Station 16+720. To avoid this direct impact, FHWA redesigned the project by moving the construction corridor and roadway south of this population. In addition, both this population and a second population of 24 individuals located outside the construction corridor below Station 132+200 will be fenced with temporary construction fencing at the right-of-way. The exclosures will be declared off-limits to construction personnel and all construction activity will be restricted to within the clearly delineated construction corridor.

b. In Section III, extreme care will be taken to ensure that the construction limits will be kept at least 3 meters (9.8 feet) south of the Pahoehoe shelf on which a population of the endangered plant *Plantago hawaiiensis* is located. In addition, this location will be fenced at the right-of-way line with temporary construction fencing prior to construction and the area designated off-limits to construction personnel. The FHWA and HDOT have agreed to coordinate with the Service when locating vehicle pull offs along the entire length of the project to encourage motorist stopping in designated locations rather than indiscriminately at possible environmentally sensitive areas.

c. A single individual of the endangered haha (*Cyanea platyphylla*) is located in a *kipuka* on private land, approximately 175-200 meters (574 -656 feet) south of the existing centerline of Saddle Road at Station 168+460 in Section III. Instead of moving the existing roadway south in this area, the road design will be modified to maintain the roadway's current distance from this *kipuka*. In addition, HDOT has agreed to specific project description modifications to avoide potential secondary impacts to this plant that are anticipated as a result of increased public users of the road and, thus, possible increased human visitations to the *kipuka*. Such measures include installation of signs in this area along the roadside saying "Emergency Stopping Only" and/or "No Parking" and/or the installation of a visible fence along the right-of-way to block pedestrian access to the plant. Wherever practical, the roadway cut and fill embankments will be designed to discourage the public from walking into the *kipuka* from the roadway.

d. One individual of the endangered 'oha wai (*Clermontia peleana*) is located about 200-250 meters (656-820 feet) from the existing Saddle Road and is immediately adjacent to the existing Hawaii Electric Company (HELCO) power line road approximately 150 meters (492 feet) north of Station 163+030 in Section III. The HDOT has agreed to specific project description modifications to avoid potential secondary impacts to this plant. Such measures include the requirement that grantees of the existing power pole easement in this area construct and maintain vehicle-proof gates with tamper-resistant locks at locations where the power pole easement intersects the proposed Saddle Road alignment between mileposts 13.4 and 14.4. The gates would be constructed along the roadway right-of-way. Only the grantees of the easement and owners and lessees of the subject property would have access to the power pole easement and the State would hold users of the easement access gates responsible for ensuring access is allowed only to authorized users.

4. <u>Alien Species</u>

a. It is recognized by FHWA that construction equipment and material has the potential for being the major vector for alien plant and invertebrate species dispersal during construction. To minimize this potential, all construction equipment will be thoroughly steam cleaned and fumigated before being transported to the construction site. If moved away from the construction site, all equipment and material will again be steam cleaned and fumigated before being allowed back onto the job site. Every effort will be made to balance earthwork quantities so that no outside fill sources will be needed throughout the project. If outside fill is needed, every attempt will be made to sterilize the fill. Additional mitigation proposed to minimize the spread of alien invertebrates is proposed by FHWA in the palila mitigation plan discussed below.

b. To further minimize the spread of alien plant species, every effort will be made to avoid bulldozing from ruderal plant communities and pasture lands into more native-dominated areas. To minimize the potential spread of fountain grass in Sections II and III, FHWA intends to inspect the right-of-way every four months during the course of construction and manually spray any emerging fountain grass with a suitable herbicide, such as Roundup ©. Following construction, HDOT will be responsible for the continuing maintenance of the roadway. In consultation with appropriate vegetation ecologists, HDOT intends to continue mowing and, when needed, using herbicides, to combat alien roadside weed and grass incursions.

5. <u>Measures to Offset Damage to Palila Critical Habitat and Minimize Effects on Palila</u>

FHWA proposes to accomplish, or facilitate accomplishment through consenting agencies, specific measures that would address four key principles to offset both the short and long-term effects of building either segment PTA-1 or PTA-3 through a portion of palila critical habitat. The four key principles are:

a) Mamane forest within palila critical habitat in PTA will not be made unsuitable for future palila restoration efforts;
b) Threats of fire and alien organisms to palila habitat will be minimized within the PTA and elsewhere on the south and west slopes of Mauna Kea;
c) An area of former palila habitat within PTA will be restored and managed for palila

reintroduction; habitat elsewhere on Mauna Kea will be enhanced for palila by securing land (lease, easement or fee purchase) and promoting habitat restoration; and,

d) Effective efforts will be made to reintroduce or enhance backup palila populations in at least two other locations on Mauna Kea and at PTA while enhancing the primary population on the west slope of Mauna Kea.

FHWA intends to address principles a) and b) through measures that include implementation of the fire mitigation plan (see paragraph 2 above) and an alien species mitigation program, consisting of those measures described in paragraph 4 (above) and the funding of a study to determine the impacts of ants, yellowjackets, parasitic wasps and flies on insect foods of the palila and including exploration of control methods for those species that are deemed a threat to these resources. In addition, the Army will does not intend to increase the number of troops training within palila critical habitat and will continue to follow the training restrictions that are currently applicable within palila critical habitat pursuant to previous section 7 consultations with the Service. With these measures, FHWA and the Army believe the mamane forest in palila critical habitat in PTA will remain suitable for future palila restoration efforts and fire and alien species threats will be minimized.

To address key principle c), FHWA intends to provide specific additional lands in the Puu Mali area on the north slope of Mauna Kea and facilitate habitat restoration of these State lands, along with Kipuka Alala in the western portion of PTA, to assist responsible agencies in the reestablishment of palila over a portion of the range of historical habitat both within PTA and elsewhere on Mauna Kea. Habitat restoration on the north slope and at Kipuka Alala will require fencing and the removal of both domestic and feral ungulates and follow-up monitoring. The additional lands in the Puu Mali area that FHWA will provide are currently in State pasture leases to three separate lessees: Botellho Hawaii Enterprises (Portion of - TMK 4-3-10:2), K.K. Ranch (Portion of - TMK 4-4-14:2 & all of 4-4-14:3), and S.C. Ranch (Portion of - TMK 4-3-10:8). These lands will be managed for the reestablishment of palila in accordance with the July 1998 *Memorandum of Understanding Regarding Implementation of the Saddle Road Palila Critical Habitat Impact Mitigation* (MOU) and subsequent Memoranda of Agreement (MOA) among the signatory parties thereto.

Key principle d) will be addressed by the FHWA through: 1) ensuring the execution of MOA to secure continued funding by consenting agencies of the palila restoration project, currently being carried out by the Biological Resources Division-U.S. Geological Survey (BRD), to reintroduce palila onto the northern slope of Mauna Kea in the Puu Mali area; and, 2) the provision of additional lands immediately adjacent to the current palila population on the west slope of Mauna Kea. The additional land identified to be provided by the FHWA for restoration on the west slope is the State-owned Ka'ohe Lease Lands (TMK 4-4-15:2), located immediately northwest of the core palila population. Restoration activities on this land will be in accordance with the MOU and subsequent MOA among the signatory parties thereto.

Management and implementation of the above actions upon the additional lands previously described will be in accordance with the MOU and subsequent MOA among the signatory parties thereto. Coordination of funding requirements and interagency cooperation and coordination in accordance with previously executed MOU and MOA will be monitored and guided by the FHWA for the period of the mitigation plan implementation. A complete and detailed plan describing implementation scheduling of mitigation plan elements, element funding requirements, interagency coordination and related MOA requirements, and FHWA involvement in oversight responsibilities will be outlined as commitments in the Final Environmental Impact Statement and summarized, with applicable MOA consummated, in the Record of Decision for the proposed action.

6. Steps to Avoid Impacts to Hawaiian Hawk

To avoid impacting nesting Hawaiian hawks within Sections III and IV, nest searches of the construction right-of-way and surrounding environs will be conducted by a qualified ornithologist prior to the onset of construction. If an active nest is detected, construction activity will be halted within 1 kilometer (.62 miles) of the nest and consultation will be initiated with the Service.

7. Measures to Avoid *Kipuka*

There are numerous *kipuka* in Sections III and IV that contain important native communities of flora and fauna. Construction activities will avoid all *kipuka* that harbor native species in these Sections during road construction. Several *kipuka* in Section III that are closest to the construction corridor will be fenced with temporary construction fencing and declared off-limits to construction personnel

8. Other Measures

All construction equipment, material, and support structures will be stored and maintained either within the right-of-way or in designated staging areas that have been approved by a biologist as areas where such storaging, servicing, and staging will not adversely impact native species. All staging areas will be clearly demarcated and fenced. Emergency spills treatment, storage, and disposal of all petroleums, oils, and lubricants, both within construction limits and at staging areas, will be handled in strict accordance with current HDOT standard specifications or Special Cvontract Requirements, the FHWA 1996 *Specifications for Construction of Roads and Bridges on Federal Highway Projects*, as well as with Federal Acquisition Regulations and Environmental Protection Agency (EPA) regulations.

A comprehensive manual will be prepared that outlines and discusses the environmental issues and procedures that will be required of the construction company(ies) awarded the project. The manual will be made available to HDOT for their use during construction of other sections of the project. All construction personnel will be required to attend a project orientation meeting where specific environmental considerations and prohibitions will be explained. A project engineer with FHWA's Federal Lands Highway Division (FLHD) or HDOT will be on site at all times during the construction to ensure implementation and compliance with the environmental mitigation requirements. The project engineer will have the authority to shut down construction should violations of the Special Contract Requirements or standard specifications occur.

Biology and Population Status of the Species/Critical Habitat

The following are brief summaries of the species considered by the Service during the consultation period for which no adverse effects are anticipated:

Dark-rumped petrel and Newell's shearwater

Dark-rumped petrels (*Pterodroma phaeopygia sandwichensis*) and Newell's shearwaters (*Puffinus auricularis newelli*) fly over the project area between May and October each year en route to and from their nesting colonies. The only known potential threat to these species as a result of the proposed project is disorientation by lights on their way to the sea, which often results in collision with both man-made and natural structures in their paths. Such collisions may result in death or injury. The lighting mitigation measures described in the FHWA's project description and summarized earlier in this document will avoid adverse effects to the dark-rumped petrel and Newell's shearwater.

Nene

Nene (*Nesochen* (=*Branta*) *sandvicensis*) exist in small numbers in the project area. The main potential threats to this species are predation by introduced mammalian predators and collisions with cars. FHWA asserts that there will be no increase in mammalian predators, such as cats, rats, dogs, and mongoose, as a result of the proposed road improvement, even though public use of the road is expected to increase dramatically with these improvements. They believe that the issue of alien mammalian predators on the island of Hawaii is bigger than the scope of their proposed project and that, until public policies and social values change, little can be done to reduce the potential spread of such predators.

The Service continues to believe that increased traffic on the Saddle Road will likely result in the presence of more feral cats and dogs as a result of pet dumping by public users of the roadway. However, the Service also acknowledges that feral cats are already present in fairly high numbers in the project area and that dogs that have gotten loose from their owners, particularly hunting dogs, are somewhat common in the area. The Service believes that an increased usage of Saddle Road as a result of the improvements proposed by FHWA will not, necessarily, result in an increased threat from feral cats and dogs in the area. Mongoose and rats are not expected to increase solely as a result of the improvement to Saddle Road.

In areas where nene must cross roads with flightless young, or areas where they have become habituated to humans feeding them, such as at Hawaii Volcanoes National Park and Haleakala National Park, mortalities from collisions with cars are common. Such mortalities have not been reported on Saddle Road for at least 20 years (Paul Banko, BRD, personal communication 1998). Even though the improvement of Saddle Road will allow for increased traffic on the road, FHWA asserts that the resulting straightening of the road and increased sight distances will, in fact, lessen the likelihood of nene fatalities on the road. The Service concurs with FHWA's belief that the improvement of Saddle Road is not likely to adversely affect the nene.

Hawaiian hoary bat

Hawaiian hoary bats (*Lasiurus cinereus semotus*) are known to forage throughout the project area. No roost sites or breeding sites are believed to occur within the construction corridor of the road and there are no known direct or indirect impacts anticipated to this species as a result of the proposed project.

'Akiapola'au, Hawaii creeper, and Hawaii 'akepa

No 'akiapola'au (*Hemignathus munroi*) were detected in the project area during the ornithological surveys conducted by FHWA's consultant, Rana Productions, Inc. Nevertheless, they are known to occasionally fly over the area and to occasionally use the *kipuka* in the area. 'Akiapola'au are usually found in koa/ohia forest rather than mamane/naio forest and the few remaining birds that remain in proximity to the project area are on the eastern side of Mauna Kea at Kanakaleonui. Similarly, Hawaii creeper (*Oreomystis mana*) and Hawaii 'akepa (*Loxops coccineus coccineus*) occasionally are seen foraging in the *kipuka* within the project area. Since FHWA intends to avoid impacts to all *kipuka* that harbor native species, any disturbance to these three endangered bird species is expected to be only temporary in nature. No adverse effects are anticipated to these species as a result of the proposed project.

Hawaiian hawk, or 'io

The Hawaiian hawk (*Buteo solitarius*), or 'io, is present throughout the project area. The only known potential threats to this species as a result of the proposed project are removal of nesting trees during the breeding season and disturbance that leads to nest abandonment or failure. As described in the FHWA's project description and summarized earlier in this document, these potential impacts to the 'io will be avoided by FHWA through pre-construction surveys in potential nesting habitat and cessation of road construction in the event a nest is found. Consultation with the Service would follow.

Hawaiian duck, or koloa, and the 'o'u

Hawaiian ducks (*Anas wyvilliana*), or koloa, do not occur in habitat that is within or close to the proposed corridor, although they use small ponds on pasture lands north of the existing Saddle Road. The 'o'u (*Psittirostra psittacea*) was known historically from the project area, but has not been seen since the 1980's. No impacts to these species are anticipated.

Laukahi kuahiwi (*Plantago hawaiiensis*)

As discussed above, FHWA intends to avoid any impacts to the 23 individual endangered plants, laukahi kuahiwi (*Plantago hawaiiensis*), that are located 18 meters (60 feet) north of the survey corridor in Section III by fencing off this population with temporary construction fencing and declaring the area off-limits to construction personnel.

'Oha wai (*Clermontia peleana*)

One individual of the endangered 'oha wai (*Clermontia peleana*) is located about 200-250 meters (656-820 feet) from the existing Saddle Road and is immediately adjacent to the existing Hawaii Electric Company (HELCO) power line road approximately 150 meters (492 feet) north of Station 163+030 in Section III. This individual plant is one of only 9 plants known to exist in the wild. The HELCO power line road is used by HELCO employees, by State officials who must check a nearby stream gauge, and by hunters and traditional gatherers on the island of Hawaii (M. Castillo, Service, personal communication 1998). This plant was seen in flower within the last month or so and should be fruiting in approximately two months, at which time Patty Moriyasu of the Hawaii Volcano Mid-Elevation Plant Propagation Facility plans to collect fruit to attempt propagation (P. Moriyasu, personal communication 1998). She already has one individual plant of this species at her facility, grown from a cutting taken from the Wailuku River population.

FHWA intends to implement measures to avoid secondary impacts to this lone *Clermontia peleana* ssp. *peleana* plant that may be anticipated if increased numbers of public users of the improved Saddle Road are able to use the HELCO power line road and visit the site. The measures being discussed with the Service include gating of the power line road and restricting access. The Service is confident that these measures, or some mutually agreed-upon modification of these measures, will avoid adverse effects to this species.

Haha (*Cyanea platyphylla*)

A single individual of the endangered haha (*Cyanea platyphylla*) is located in a *kipuka* on private land, approximately 175-200 meters (574 -656 feet) south of the existing centerline of Saddle Road at Station 168+460 in Section III. There is only one other natural population of this species, located in the Laupahoehoe Natural Area Reserve and consisting of only 9 individuals. An outplanted population of 12 individuals exists in the Waikea Forest Reserve (USFWS 1997). The single plant within Section III of the proposed project is heavily impacted by pigs and is not known to have naturally reproduced in the last 20 years or so (R. Warshauer, BRD, personal communication 1998). FHWA intends to implement measures to avoid secondary impacts to this lone *Cyanea platyphylla*, as described earlier in this document. The Service is confident that these measures, or some mutually agreed-upon modification of these measures, will avoid adverse effects to this species.

The most serious potential effects of the proposed project are the increased threat of fire and alien species introductions as a result of construction of either PTA-1 or PTA-3 within Section II. For these reasons, the Service finds that the proposed project is likely to adversely affect the palila and *Silene hawaiiensis*. The following species accounts are provided as background information for the examination of the effects of the proposed project in the "Effects of the Action" section:

Palila (*Loxioides bailleui*)

The palila was listed as endangered on March 11, 1967 (*Federal Register* 32:4001) and was included as an endangered species under the Endangered Species Act of 1973, which superseded earlier endangered species legislation. The primary reasons for listing the palila as endangered were: (1) a significant portion of its historical range was no longer occupied; (2) its occupied habitat was being adversely modified by feral ungulate browsing; and (3) the total palila population at that time was estimated to be in the low hundreds. Critical habitat was designated in 1977 (*Federal Register* 42:40685; 50 CFR 17.95(b)).

The palila is a monotypic genus (American Ornithologists Union 1983) within the endemic Hawaiian honeycreeper family Fringillidae, sub-family Drepanidinae. This finch-billed honeycreeper was first collected in the Kona District of Hawaii by Bailleu in 1876 (Wilson and Evans 1890-1899) and scientifically described in 1877 by Oustalet. It is one of the larger Hawaiian honeycreepers with an overall length of 15.0-16.5 centimeters (6.0-6.5 inches) and an adult weight of 38-40 grams (1.3-1.4 ounces).

Adult palila have a yellow head and breast, a greenish wing and tail, and are gray dorsally and white ventrally (Jeffrey *et al.* 1993). Adult females have a yellowish-green head with grayish-yellow forehead and superciliary. The lores are gray rather than black as in males. The head and upper breast of both sexes of juvenile birds are dull yellow-green, and juveniles have double wingbars formed by pale green tips on the greater and middle coverts until the first prebasic molt (Jeffrey *et al.* 1993).

The palila is dependent upon the mamane (*Sophora chrysophylla*) and mamane-naio (*Myoporum sandwicense*) ecosystems. The mamane tree is used for food, nesting, and shelter. The highest densities of palila currently occur in tall, partly closed, mamane-naio with a native understory, although pure mamane woodland appears to support higher densities than structurally similar mamane-naio woodland (Scott *et al.* 1984).

The palila feeds primarily on mamane for immature seeds, flowers, leaf buds, and insects (BRD, unpubl. data). Rarely will they eat seeds in developing pods or in hardened brown pods (van Riper 1980b). Naio berries may also be taken, particularly if mamane seeds are in short supply. Munro (1960) reported that palila also feed on poha (*Physalis peruviana*) fruit and caterpillars and recent studies by BRD suggest that caterpillars and other insects may be an important diet component for palila nestlings (BRD, unpubl. data).

The nesting season usually starts in late March or early April and continues through August or September, with peak nesting usually occurring in April and May. Censuses conducted since 1980 have shown that annual fluctuations in population size may be substantial (Jacobi *et al.* 1996) and that annual fluctuations in mamane pod production affect both reproductive effort and survival (Lindsey *et al.* 1995; BRD, unpubl. data). In years of poor mamane pod production, initiation of nesting may be delayed, fewer palila attempt to nest, and fewer renesting events occur (Pratt *et al.* 1997).

Palila are monogamous and show strong site fidelity (Fancy *et al.* 1993), with individuals nesting in the same general location year after year. There is very limited dispersal and nesting outside of the population center near Puu Laau. Nests are nearly always placed high in larger mamane trees and are built by the female alone. Clutch size is almost always two eggs (van Riper 1980b; Pletschet and Kelly 1990). Palila will renest when a nest is unsuccessful in the early part of the breeding season and some are able to successfully raise two clutches of chicks during the same year (BRD, unpubl. data.). In successful nesting attempts (i.e., nests that do not fail due to predation, infertility, etc.), an average of 1.4 nestlings are fledged (Pletschet and Kelly, 1990).

Historically, the palila is known only from the island of Hawaii, on the upper slopes of Mauna Kea, the northwest slopes of Mauna Loa, and the eastern slopes of Hualalai.. In prehistoric times, palila also occurred at low elevation sites on Oahu (Olson and James 1982). Annual surveys from 1980-1995 have resulted in an estimate of a mean population size of 3,390 ± 333. Approximately 92% of the palila population, and essentially all of the successful breeding (Jacobi *et al.*, in press), occurs on the southwest slope of Mauna Kea in the vicinity of Puu Laau where the elevational extent of mamane forest is greatest (= the core population). There are currently seven palila (two males, 5 females) in captivity at the Keauhou Bird Conservation Center operated by The Peregrine Fund. These birds are being held for captive reproduction and research (The Peregrine Fund, 1997; A. Lieberman, TPF, personal communication 1998).

The elevational extent of mamane forest was the most important habitat variable found by Scott *et al.* (1984) in their analysis of palila habitat response. Mamane trees produce flowers and fruits at different times during the year, depending on elevation. A wide belt of mamane results in more consistent availability of mamane pods within a reasonable daily movement distance for palila, especially during the breeding season (Fancy and Giffin, *in lit.; Banko 1996)*.

The main factor that resulted in the decline of the palila on the island of Hawaii was destruction of the mamane and mamane-naio ecosystems by introduced ungulates. Wild cattle, feral sheep, horses, and pigs became established on Mauna Kea in the early 1800's; goats were established by 1925; and, mouflon sheep (*Ovis musimon*) were introduced to Mauna Kea in 1963. Cattle and horses were removed by early feral animal control measures initiated by territorial foresters in 1928 and 1935 respectively (Tomich 1969).

Feral sheep numbers grew to about 40,000 animals in the early 1930's (Bryan 1937). Studies have shown that feral sheep effectively prevented mamane regeneration on Mauna Kea through excessive grazing and browsing (Scowcroft and Giffin 1983). Tree density continued to decline and the upper tree line effectively moved downslope in these areas because of the grazing pressure. Following a legal ruling under section 9 of the Endangered Species Act, nearly all of the feral sheep, mouflon, and goats were removed from Mauna Kea by July 1982. Small numbers of sheep still persist within the palila critical habitat area, although control measures are ongoing.

In addition to direct damage and destruction of mamane trees, ungulate browsing and grazing resulted in the removal of native understory plants and allowed for the replacement of these native species with alien invasive weeds. One of the most noxious of these is fountain grass (*Pennisetum setaceum*). Fountain grass is a fire-stimulated, tufted perennial (O'Connor 1990). This species, native to tropical Africa (Wagner *et al.* 1990), has spread rapidly on Mauna Kea, where it invades lava flows previously dominated by native plants, particularly in dry shrublands and forests (Cuddihy and Stone 1990). An aggressive colonizer, fountain grass replaces native plants quickly after disturbance, particularly fire. Its presence results in an increaed fuel load and, thus, increased fire risk wherever it is found in the dry forest ecosystems of Hawaii. Military training (e.g., weapon firing, use of explosives, and bivouacking) on PTA and public users (cross-island traffic on Saddle Road, hunters, etc.) present a constant fire threat to the remaining mamane-naio forest on which the palila depends. In 1975, fire destroyed about 500 acres (200 ha) of mamane-naio forest in palila critical habitat.

Other known threats to the continued survival of the palila are predation by introduced mammals, particularly black rats (*Rattus rattus*) and feral cats (*Felis cattus*), avian disease (Fancy and Giffin, in lit.), and, possibly, loss of native insect foods due to predation by introduced insects (BRD, unpubl. data).

Critical habitat for the palila consists of: (1) the State of Hawaii Mauna Kea Forest Reserve, except (a) that portion above the 10,000 foot contour line, (b) that portion south of the Saddle Road (State Highway 20), (c) lands owned by the United States in the Pohakuloa Training Area north of the Saddle Road (State Highway 20) established by Executive Order 1719 (Parcel 6, State of Hawaii Tax Map Key 4-4-16, Third Division), (d) that portion (Parcel 10, Kaohe IV, State of Hawaii Tax Map Key 4-4-16, Third Division) lying north of the Saddle Road (State Highway 20) and south of the Power Line Road; (2) that portion of the State of Hawaii Kaohe Game Management Area (Parcel 4, State of Hawaii Tax Map Key 4-4-15, Third Division) to the north and east of the Saddle Road (State Highway 20); (3) that portion of the Upper Waikii Paddock (Parcel 2, State of Hawaii Tax Map Key 4-4-15, Third Division) northeast of the Saddle Road (State Highway 20); (4) that portion of the lands of Humuula between Puu Kahinahina and Kole lying southeast of the Mauna Kea Forest Reserve fence (portions of Parcels 2, 3, and 7, State of Hawaii Tax Map Key 3-8-1, Third Division) which are included in the State conservation district (50 CFR 17.95(b)).

Critical habitat was designated based on the following information:

1) the designated habitat contains the entire known world population of palila;
2) the habitat supports most of the large and intermediate-sized mamane and naio trees in existence on Mauna Kea;
3) the habitat area is large enough to permit space for population growth of the palila; and,
4) the habitat area includes a full range of altitudinal and geographical sites needed by the palila for normal life cycle movements, in response to shifting seasonal and annual patterns of flowering, seed set, and ensuing pod development of the mamane (USFWS 1986).

Silene hawaiiensis

Silene hawaiiensis was listed as threatened on March 4, 1994 (*Federal Register* 59:10305). Critical habitat was not designated. The primary reasons for listing this taxon were habitat degradation by feral or domestic animals (goats, pigs, cattle, and sheep); fire, the threat of which is exacerbated by introduced grasses; competition for space, light, water, and nutrients by introduced vegetation; and, direct human impacts, such as recreational and military activities. Other threats include pest invertebrates, disease, and vulnerability to random catastrophic events.

Silene hawaiiensis is a sprawling shrub with climbing or clambering stems (Wagner *et al.* 1990). Flowers are arranged in loose, elongate clusters that are highly sticky. Each flower has five petals, green-white above and sometimes maroon or maroon-streaked below. *Silene hawaiiensis* produces a dry fruit, 6.5-8 millimeters (mm) (0.25-0.3 inches) long, which splits apart to release brown seeds that are 0.4-0.7 mm (0.02-0.03 inches) long (Wagner *et al.* 1990).

Silene hawaiiensis is known only from the island of Hawaii. Since 1975, at least 11 populations numbering over 11,000 plants have been identified from the Hamakua district, Humuula Saddle, North Kona, PTA, and Hawaii Volcanoes National Park (USFWS 1996). It occurs in montane and subalpine dry shrubland, on weathered lava and on variously aged lava flows and cinder substrates, at elevations between 900 to 2,575 meters (3,000 to 8,500 feet) (Wagner *et al.* 1990; USFWS 1996).

ENVIRONMENTAL BASELINE

The environmental baseline describes the status of the species and factors affecting the environment of the species or critical habitat in the proposed action area contemporaneous with the consultation in process. The baseline includes State, local, and private actions that affect a species at the time the consultation begins. Unrelated Federal actions that have already undergone formal or informal consultation are also a part of the environmental baseline. Federal actions within the action area that may benefit listed species or critical habitat are also included in the environmental baseline.

Ninety-two percent (92%) of the known palila population and essentially all of the successful breeding (Jacobi *et al.* 1996) occurs on the southwest slope of Mauna Kea in the vicinity of Puu Laau where the elevational extent of mamane forest is greatest (= the core population). PTA-1 transects the palila critical habitat between Station 10+950 just west of Puu Koko, and Station 13+440 east of Puu Maau; and between Station 22+000 just east of Mauna Kea State Park, and Station 27+000 at the DHHL boundary fence. PTA-3 encompasses the same section of PTA-1 between Station 10+950 just west of Puu Koko and Station 13+440 east of Puu Maau. In addition, it transects palila critical habitat from its start at Station 10+000 to approximately Station 11+800 at the edge of the 1853 lava flow. The building of segment PTA-1 will directly modify 41.5 hectares of palila critical habitat. The building of segment PTA-3 will directly modify 46.1 hectares.

Three populations of *Silene hawaiiensis* occur within Section II of the project area. One population, which consists of approximately 50-60 plants (W. Char, Char & Associates, personal communication 1998), is located on the summit and south side of Puu Maau adjacent to Station 13+200 (Char 1996). The second population is located on a rocky knoll at Station 16+720 and consists of approximately 70 individuals (Char 1996). The third and largest population occurs just north of deadman's curve within Training Area #3 of PTA and consists of approximately 5,000 individuals (M. Castillo, personal communication 1998).

State, local, private, and Federal actions occurring in and around Section II of the proposed project, or that have occurred, are as follows:

Military land use occurs within PTA, which is a multi-service training complex operated by the U.S. Army Garrison, Hawaii (USARG-HI). Saddle Road extends through the northern portion of PTA, for approximately 21 km (13 miles), from milepost (MP) 43 to MP 30. The existing road separates the PTA cantonment area and the Bradshaw Army Airfield from most of PTA's training areas, firing points, and impact zones (FHWA-FPHI-EIS-97-1-D).

PTA services all branches of the armed forces located in the Pacific theater, as well as foreign allied forces. Examples of training at PTA include Infantry Brigade Task Force Deployments, Artillery Live Fire, Attach Helicopter Gunnery, Air Defense System Live Fire, Air/Ground

Operations, Combined Arms Live Fire, and Paradrops. PTA is the largest contiguous training area in Hawaii, and all conventional weapons and munitions may be used there (USAG-HI 1996). More than 15,000 military personnel receive training at PTA each year (FHWA-FPHI-EIS-97-1-D).

Approximately 2,024 ha of maneuver area within PTA are on the north side of the existing Saddle Road, including Training Areas 1-4. The current road is a major barrier between maneuver areas and firing points located south of the road. Portions of Training Areas 1, 3, and 4, and all of Training Area 2 are within palila critical habitat. Certain limitations are placed on training activities in these areas, because of the environmental sensitivity of the area and as a result of past consultations with the Service. These limitations are: no open fires, no aerial pyrotechnics, no field mess operations, no ground smoke or CS smoke, no more than 500 men at any time, no more than five helicopters at one time, and no live ammunition (FHWA-FPHI-EIS-97-1-D).

The Army has upgraded its fire-fighting capabilities at PTA with the construction of six 80,000 gallon dip tanks and the purchase and deployment of two Humvee pumper trucks. In addition, they have completed a draft Fire Management Plan for PTA (USAG-HI 1996) in which they agree to stockpile and maintain the fire fighting equipment necessary to supply an 86-man fire fighting detail.

In 1979 and 1981, a Federal court ordered the State of Hawaii to completely remove feral sheep and goats from Mauna Kea due to degradation of palila critical habitat. These animals were effectively removed, with the exception of a few sheep, in 1981. In 1986 and 1988, a Federal court ordered the removal of mouflon from Mauna Kea (Cuddihy and Stone 1990). Efforts to remove sheep and mouflon from palila critical habitat are still underway by the State of Hawaii, Division of Forestry and Wildlife. In addition, public hunting of sheep, goats, pigs, and gamebirds by rifle or archery is popular in several hunting areas accessed via Saddle Road, both within PTA and in hunting units adjacent to PTA.

DOFAW initiated a program to reestablish mamane at upper elevations on Mauna Kea in 1984. They have planted thousands of seedlings above the current tree line and in other areas where mamane have been destroyed by feral sheep. In addition, they fenced the entire perimeter of Mauna Kea Forest Reserve as part of their efforts to remove feral ungulates from Mauna Kea.

A considerable amount of research has been conducted on the palila and its critical habitat since its recognition as an endangered species. Berger (1981), van Riper *et al.* (1978), van Riper (1980a, 1980b), and Scott *et al.* (1984) conducted population and habitat assessment and life history studies in the mid 1970's and 1980's. The original recovery plan was complete in 1978 and was revised in 1986 (USFWS 1986), based largely on the results of these earlier studies.

Studies on the nesting biology and life history of the palila began soon after it was designated as an endangered species (Berger 1970; van Riper 1978, 1980a, 1980b). Population surveys have been conducted since 1975 (van Riper *et al.* 1978; Scott *et al.* 1984; Scott *et al.* 1986). Studies to determine limiting factors and develop restoration techniques for the palila were initiated in 1987 by BRD (formerly part of the Service) and continue to the present day (Pratt *et al.* 1997; BRD, unpubl. data). These studies are ongoing. In 1993, an experimental translocation of adult palila was conducted in which palila were taken from the core population site at Puu Laau on the west slope of Mauna Kea and moved to Kanakaleonui to determine if adult palila would remain and breed at a new site. At least one-half of those birds returned to Puu Laau within one year; however, two pairs nested at Kanakaleonui (Fancy *et al.* 1997).

BRD is currently implementing a palila restoration project, in collaboration with the Army, Service, DOFAW, and The Peregrine Fund. The project began in 1996 and is aimed at enhancing wild productivity through predator control and supplemental feeding, assessing the habitat needs of the palila, determining food availability, removing eggs for captive rearing and release of young birds, monitoring for disease, identifying suitable reintroduction areas, and attempting reestablishment of a palila population in suitable former range. Translocation of young palila from the core population to Puu Mali on the north slope of Mauna Kea was initiated in 1997 and is ongoing. Results of the first year's work are summarized in BRD's December 31, 1996, final report (BRD 1996). Since February-March 1997, 51 birds have been moved to the north slope; currently, 10 birds remain (P. Banko, BRD, personal communication 1998).

In 1993, *Silene hawaiiensis* seeds were germinated at PTA by staff of the Center for Ecological Management of Military Lands (CEMML) of Colorado State University. About 50 seedlings were outplanted on Puu Kapele. Of these, about 20 individuals survived and produced flowers and fruits (USFWS 1996).

<u>Effects of the Action on Listed Species</u>

In total, PTA-1 will directly modify 41.5 hectares of palila critical habitat, while PTA-3 will directly modify 46.1 hectares. The proposed project will bring Saddle Road much closer to the vulnerable core population of the palila, located at Puu Laau on the west slope of Mauna Kea. This proximity will result in a greater risk of fire to the mamane-naio ecosystem on which the palila depends and a greater risk of alien species incursions. In addition, the Pohakuloa Flats area, currently the most suitable area within palila critical habitat for reestablishment of a palila population, will be transected by Saddle Road and subject to increased fire risk and alien species incursions.

The *Silene hawaiiensis* population located on a rocky knoll at Station 16+720 and consisting of approximately 70 individuals (Char 1996) will be in much closer proximity to Saddle Road and, thus, at greater risk from fire and alien species incursions. The largest population, which occurs just north of deadman's curve within Training Area #3 of PTA and consists of approximately 5,000 individuals (M. Castillo, personal communication 1998), will be farther from Saddle Road if PTA-1 is built, and, thus, at a lower risk from fire and alien species incursions. FHWA and the Army assert that there will be no increase in military maneuvers or training exercises in this area of PTA and, therefore, no increased risk from human impacts and fire to this population. The population made up of 50-60 plants at Puu Maau should not be at a higher risk from fire or alien species incursions than is currently the case since the proposed road corridor is north of this population, which occurs on the summit and on the south side of the Puu.

<u>Cumulative Effects</u>

Cumulative effects include the effects of future State, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Future State actions in the proposed action area include continued removal of feral ungulates from Mauna Kea, restoration of the mamane forest, and mammalian predator control in and around the core population of the palila on the west slope and at future reestablishment sites. In addition, the Service, State, and private institutions will likely attempt to collect propagules from *Clermontia peleana* ssp. *peleana* and *Cyanea platyphylla* for purposes of propagation and outplanting into secure areas. The Army will likely continue to undertake efforts to protect and restore endangered and threatened species within the environs of PTA and work with local hunters to enhance public use opportunities at PTA in concert with endangered and threatened species recovery efforts.

Conclusion

After reviewing the current status of the palila and its critical habitat and the current status of *Silene hawaiiensis*, the environmental baseline of the species in the action area, and the effects of the proposed Saddle Road Realignment and Improvement Project, including the cumulative effects, it is the Service's biological opinion that the Saddle Road Realignment and Improvement Project is not likely to jeopardize the continued existence of the palila or *Silene hawaiiensis* and is not likely to adversely modify palila critical habitat. These findings are based in large part on the conservation measures built into the project by the FHWA, as described in the Description of the Proposed Project section (above). The Service believes that the mitigation measures built into the project design by the FHWA will offset the modifications being made to palila critical habitat and enhance the likelihood of survival and recovery of the palila.

INCIDENTAL TAKE

Sections 4(d) and 9 of the ESA prohibit taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or the applicant. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement. This exemption only applies to the ESA, as amended, and does not supersede the requirements of the Migratory Bird Treaty Act.

Sections 7(b)(4) and 7(o)(2) of the ESA do not apply to the incidental destruction of listed plant species. However, protection of listed plants is provided to the extent that the ESA requires a Federal permit for removal or reduction to possession of endangered plants from areas under Federal jurisdiction, or for any act that would remove, cut, dig up, or damage or destroy any such species on any other area in knowing violation of any regulation of any State or in the course of any violation of a State criminal trespass law.

Pursuant to 50 CFR 402.14(g)(7), the Service is to formulate a statement concerning the incidental take of a listed species. This includes identifying the level of take that is anticipated to occur due to the action. The Service is to develop reasonable and prudent measures that will minimize the impacts of the action. The reasonable and prudent measures and the terms and conditions that implement them are non-discretionary and must be undertaken by the Service and be made a binding condition of the Cooperative Agreement. If the level of incidental take is exceeded, formal consultation under section 7 must be re-initiated.

AMOUNT OR EXTENT OF TAKE

Incidental take of the palila is not anticipated or authorized.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA, as amended, directs Federal agencies to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. The term "conservation recommendations" has been defined as suggestions of the Service regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information. The recommendations provided here relate only to the proposed action and do not necessarily represent complete fulfillment of the FHWA's section 7(a)(1) responsibilities for the species.

1. The Service recommends that FHWA and the Army protect the large population of *Silene hawaiiensis* within Training Area #3 from feral ungulates and human impacts. Fencing of this population is strongly recommended.

2. Some individuals of *Silene hawaiiensis* may be lost due to the increased threat from fire that will result from construction of PTA-1 or PTA-3 in Section II. The Service recommends that FHWA commit to mitigate for these anticipated losses by: 1) collection of seeds prior to the beginning of construction; 2) propagation of plants for reintroduction purposes; and, 3) coordination with PTA Environmental Staff to outplant resulting plants into areas of suitable habitat.

3. The increased threat of alien invertebrate species incursions into the Saddle area as a result of the proposed road improvement project is acknowledged by the FHWA. The Service recommends that, in addition to the mitigation measures proposed, the FHWA and HDOT prepare an alien species monitoring and interdiction plan that includes measures for periodic roadside surveys and follow-up control actions. As stated in our consultation meetings and in previous correspondence, the Service is willing to assist in preparation and implementation of this plan.

4. The FHWA acknowledges that the threat of mammalian predators, such as dogs and cats, in the Saddle area is a real one and that it may increase with increased traffic on the road. The Service recommends that FHWA post signs on the roadway telling the public not to

dump their animals and sponsor a public outreach campaign, using the local newspapers, radio, and other media, to inform the public of the unique ecosystem that exists in the Saddle and to explain the vulnerability of its avian inhabitants (the palila and nene, in particular) to these threats. FHWA should work with HDOT and local enforcement agencies to ensure that adequate fines are established against animal dumping in the area.

5. With respect to the *Clermontia peleana* ssp. *peleana* and *Cyanea platyphylla*, the Service believes there may be actions other than gating of the HELCO access road and fencing of the *Cyanea platyphylla* population that would be more likely to avoid impacts to these species. The Service recommends that FHWA proceed with all of the proposed mitigation measures other than the gate placement and fencing and continue discussions with the Service on how best to minimize impacts to these plants. The Service is particularly interested in ensuring that these individual plants are represented *ex situ* and that propagation attempts are continued, along with identification of suitable sites for outplanting.

6. The Service recommends that a separate, biologically oriented entity be appointed to administer mitigation and the associated funds for the entire project. This separate entity should have the ability to ensure that mitigation requirements are being met as agreed prior to the beginning of the project. To assist this entity, the Service also recommends that a biologist be hired and remain on site for the duration of construction. It may be beneficial to set up a trust fund administered by this separate entity to ensure adequate mitigation of impacts.

7. The Service recommends that an educational and informational kiosk be located atop the "7-steps" overlook to increase public awareness of the unique plant communities that exist in the area.

8. Within Section III of the project area, the Service recommends that FHWA and HDOT refrain from using herbicides along the margins of wet forest, since repeated past herbicide application has failed to control invasive grasses in these areas, but has damaged native vegetation. Mowing is the preferred method of control in these areas.

CONCLUSION

This concludes formal section 7 consultation on this action. As required in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation. Furthermore, as stated in our Conclusion (above), the Service's findings of no jeopardy to the palila and *Silene hawaiiensis* and no adverse modification to palila critical habitat are based in large part on the conservation measures built into the project by the FHWA. Should there be a failure to carry out any or all of the described measures, or if these measures are modified in any way, reinitation of formal consultation will be required.

If you have any question, please contact me (phone: 808/541-2749; fax: 808/541-2756) or Assistant Field Supervisor Karen Rosa (phone: 808/541-3441; fax: 808/541-3470).

Sincerely,

Robert P. Smith

Robert P. Smith
Pacific Islands Manager

cc: USFWS, Portland, OR

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Note: The following document replaces the draft published in Technical Appendix Volume IV.

THE SADDLE ROAD CORRIDOR: AN ARCHAEOLOGICAL INVENTORY SURVEY AND TRADITIONAL CULTURAL PROPERTY STUDY FOR THE HAWAI'I DEFENSE ACCESS ROAD A-AD-6(1) AND SADDLE ROAD (SR 200) PROJECT, PHRI 1999

Report 1939-043099

The Saddle Road Corridor: An Archaeological Inventory Survey and Traditional Cultural Property Study for the Hawai'i Defense Access Road A-AD-6(1) and Saddle Road (SR 200) Project

Districts of South Kōhala,
Hāmākua, North Hilo, and South Hilo
Island of Hawai'I

Prepared under the supervision of Paul H. Rosendahl, Ph.D., Principal Investigator, under Contract No. DTFH68-93-C-91009. Funding for this report was provided by the Federal Highway Administration, Denver, Colorado.

PHRI
Paul H. Rosendahl, Ph.D., Inc.
Archaeological • Historical • Cultural Resource Management Studies & Services

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Districts of South Kōhala,
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BY

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James Head, B.A. - Project Supervisor

Prepared under the supervision of Paul H. Rosendahl, Ph.D., Principal Investigator, under Contract No. DTFH68-93-C-91009. Funding for this report was provided by the Federal Highway Administration, Denver, Colorado.

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ABSTRACT

At the request of Okahara & Associates, Inc., Paul H. Rosendahl, Ph.D., Inc. conducted an archaeological and traditional cultural property inventory survey in compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, for the Hawai'i Defense Access Road A-AD-6(1) and Saddle Road (SR 200) undertaking.

A total of 16 sites were observed and recorded within the archaeological area of potential effect. Thirteen of the sites are newly identified, and three are previously identified sites (7119, 5002, and 10309). In addition, three sites beyond the area of potential effect (5003, 14638, and 20852) were evaluated, and 35 modern military sites were recorded but not assigned State Inventory of Historic Places site numbers; these military sites are assessed as not significant and not eligible for listing on the National Register of Historic Places (NRHP).

All 19 non-military sites are evaluated as significant and recommended for listing on the NRHP. Recommended treatments for the 19 sites vary. Sites 5003, 14638, and 20852 are to be avoided. Nine sites (5002, 7119, 20856, 20862, 20865, 20869, 20872, 20877, and 20873) will require no further work because the significant data contained within these sites has been collected in the form of measurements, photographs, descriptions, figures, documentary research, oral interview, and historical research. Data recovery only is recommended for one site (20854). Data recovery with interpretive signage is recommended for four sites (20855, 21150, 10309, 20878). Interpretative signage only is recommended for two sites (20864, 20870).

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INTRODUCTION

BACKGROUND

At the request of Okahara and Associates, Inc. (Okahara), Paul H. Rosendahl, Ph.D., Inc. (PHRI), conducted an archaeological inventory survey and traditional cultural property study in conjunction with the development of the Hawai'i Defense Access Road A-AD-6(1) and Saddle Road (SR 200) Project *(Figure 1)*. The overall objective of the work was to provide information on archaeological and historic sites and traditional cultural properties sufficient for preparation of an Environmental Impact Statement. The inventory survey was conducted by PHRI between January 8 and September 23, 1996 and required 533.5 labor-days to complete. The survey was conducted under the supervision of Projects Supervisors James Head, B.A., and Constance O'Hare, B.A. Principal Investigator Dr. Paul H. Rosendahl and Hawai'i Projects Manager Thomas R. Wolforth, M.S., provided overall guidance for the project. Dr. Charles Langlas, of the Department of Anthropology of the University of Hawaii-Hilo, was subcontracted by PHRI to carry out the documentary and oral history research for the project.

SCOPE OF WORK

The overall objective of this project was to identify and evaluate all archaeological, historical, and traditional cultural properties in the project area and to assess the project effects on those properties. All of the work conducted was designed to meet the performance and content standards of the Hawai'i State Historic Preservation Office (SHPO), and the appropriate federal rules and regulations, as outlined below.

Archaeological Survey and Testing

The scope of work called for a 100% pedestrian survey of the existing roadway and alternative corridors was to be conducted in order to locate and evaluate all cultural properties for eligibility for listing on the National Register of Historic Places. Evaluation, testing, documentation, and reporting of the results was to be conducted in accordance with the Department of Interior's Archaeological and Historic Preservation guidelines as outlined in 36 CFR 66. Archaeological investigations conducted on federal lands during this project were performed in compliance with the Archaeological Resource Protection Act pursuant the permit issued by the U.S. Army Corps of Engineers.

Historical and Ethnographic Study

The objectives of the historical and ethnographic study was to (a) identify Native Hawaiian cultural sites or other historic sites which might be affected by the project, (b) describe the Native Hawaiian cultural or historical context of those sites, (c) evaluate the Hawaiian cultural or historic significance of the sites to determine whether they are eligible for listing on the National Register of Historic Places, and (d) assess the effects of the project on significant sites and recommend mitigation of any adverse effects.

The specific tasks carried out to meet these objectives included: (a) historical documentary research involving both published and unpublished sources; (b) consultation with Native Hawaiian Organizations in order to take into account their concerns about traditional Native Hawaiian cultural sites and to elicit their suggestions of knowledgeable informants; (c) interviewing informants; and (d) contributing information from these sources toward recommendations concerning National Register eligibility, and assessing potential project effects on individual sites.

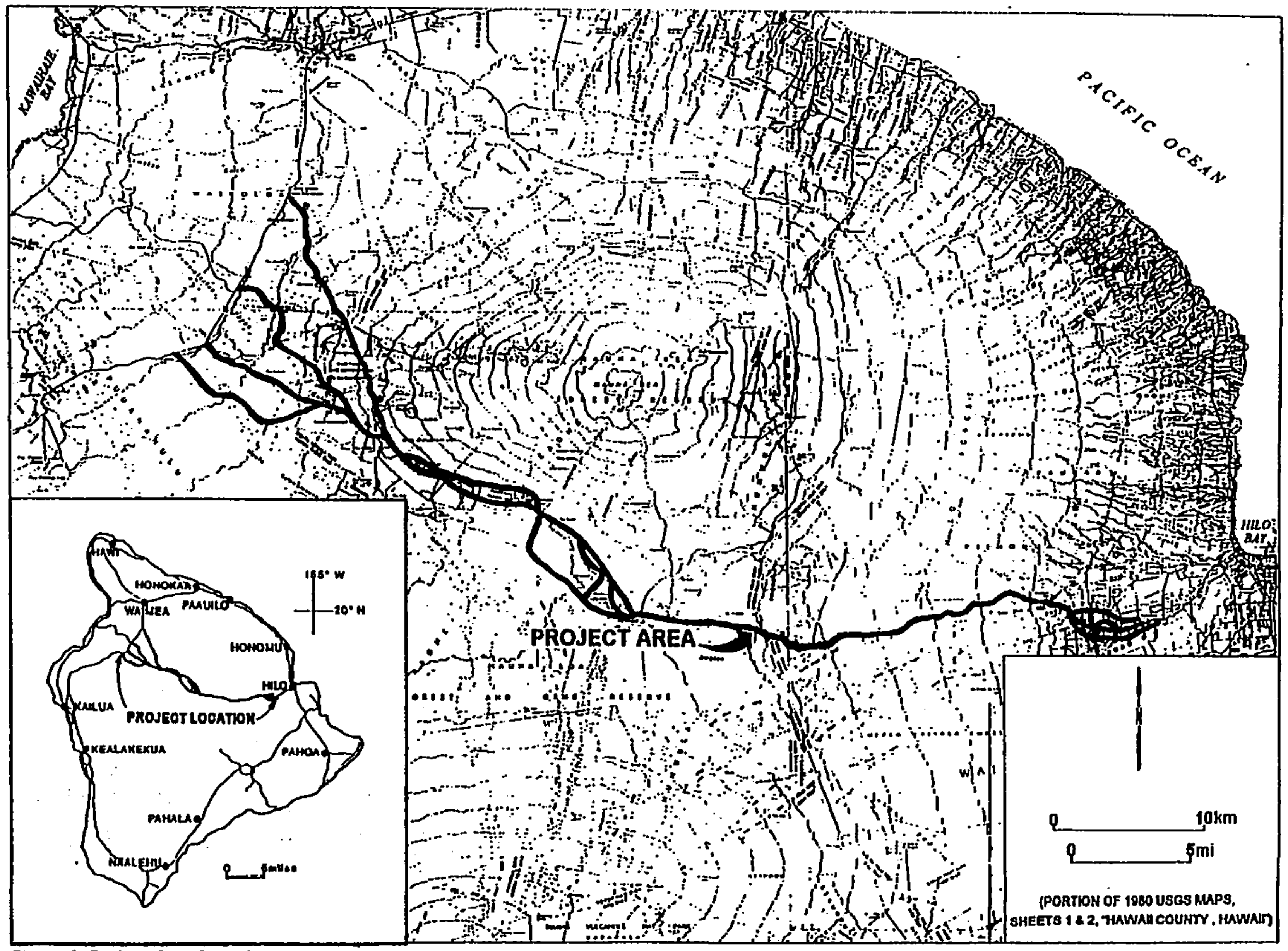

Figure 1. Project Area Location

The basic legislation which mandates the study is the National Historic Preservation Act (NHPA) of 1966, amended in 1992, which requires assessment of the effect of any proposed federal undertaking on a site included in, or eligible for, the National Register of Historic Places. Under the NHPA, those responsible for the undertaking must seek to identify and evaluate historic or traditional cultural properties which might be affected by the undertaking, including sites of traditional importance to Native Hawaiians such as *heiau* and burials. If a site is evaluated as eligible for the National Register of Historic Sites, then the effect of the undertaking must be assessed and any adverse effect would have to be mitigated, if possible. The 1992 amendment to the NHPA requires consultation with Native Hawaiian organizations during the study process, for guidance in locating and evaluating Native Hawaiian cultural sites as "traditional cultural properties" and in working out appropriate mitigation procedures for them.

The Hawaii Defense Access/Saddle Road Project also falls under laws which mandate special treatment for burial sites affected by the project, whether they are burials known before the project starts or are discovered inadvertently during construction. On federal lands (Pohakuloa Training Area) and Hawaiian Home Lands (Humu'ula), federal law 101-601, the Native American Graves Protection and Repatriation Act (NAGPRA), applies. Under NAGPRA, Native Hawaiian burials may not be removed from federal or Hawaiian Home Lands until consultation concerning the disposition of the remains is carried out with designated Native Hawaiian organizations. Elsewhere, Hawai'i state law Chapter 6-E requires the approval of the Hawaii State Historic Preservation Division in determining the disposition of burials. In the case of Native Hawaiian burials, disposition also requires the approval of the appropriate Island Burial Council. In general, inadvertent discovery of burials during project construction would require a delay in construction while the required procedures are carried out.

PROJECT AREA LOCATION

The project area is located on the Island of Hawai'i within the *ahupua'a* of Waikōloa, in South Kōhala District; the *ahupua'a* of Ka'ohe, in the Hāmākua District; the *ahupua'a* of Humu'ula, in North Hilo District, and the *ahupua'a* of Waiākea, Pi'ihonua, Punahoa 2, Ponahawai, and Kaūmana, and Kūkūau in South Hilo District. The project area is owned and managed by the federal, state, and county governments, and by various private groups and individuals *(Appendix A)*.

The western project terminus is approximately 16 km from the east coast of Hawai'i at an elevation of 770 m (2,520 ft) AMSL *(Figure 2)*. The greatest elevation occurs near Pu'u Huluhulu at approximately 2,020 m (6,640 ft) AMSL. The eastern project terminus is at an elevation of 400 m (1,300 ft) AMSL, and is approximately 9.5 km west of Hilo Bay. The corridors surveyed extend 30 m (100 ft) on either side of the staked alignments except in some areas where construction limits exceed this width.

There are 11 proposed corridors in the project area *(Table 1)*. The corridors are grouped into 4 segments for administrative purposes. Corridor PTA-3 is unusual in that it incorporates portions of other alignments. The western portion of PTA-3 is coterminous with PTA-1. PTA-3 deviates from PTA-1 near the State Park (at Sta. 26+900), and connects to EX-2 at Sta. 137+800 (2.9 km south of the point of deviation from PTA-1). PTA-3 is coterminous with EX-2 from Sta. 137+800 to 140+700 along the existing road. Survey methods for the archaeological and traditional cultural property surveys differed over the project area, due to several factors detailed in the Methods section of this report.

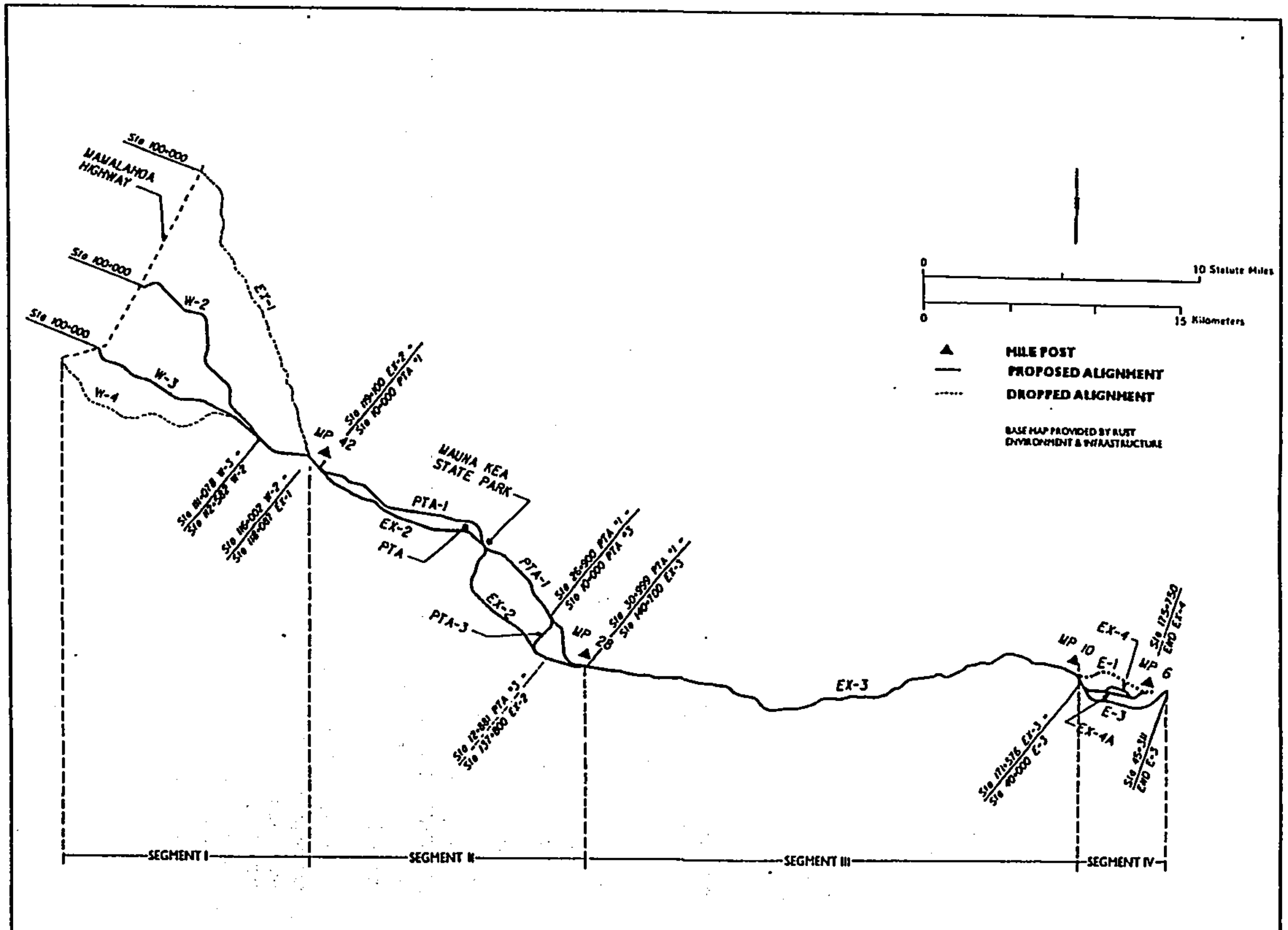

Figure 2. Project and Corridor Location

Table 1. Saddle Road Corridor Parameters

Name	Seg't	West End (Sta.)	East End (Sta.)	East End Matches (Sta.)	Length (km)	Type
EX-1	I	100+000	119+100	EX-2: 119+100	19.1	Existing road
W-2	I	100+000	116+002	EX-1: 118+087	16.0	New road
W-3	I	100+000	111+078	W-2: 112+582	11.1	New road
W-4	I	100+000	113+992	W-3: 112+500	14.0	New road-dropped
EX-2	II	119+100	140+700	EX-3: 140+700	21.6	Existing road
PTA-1	II	10+000	30+999	EX-3: 140+700	30.0	New road
PTA-3	II	10+000	30+999	EX-3: 137+800	*32.7	New and existing road
EX-3	III	140+700	171+576	EX-4: 171+576	30.9	Existing road
EX-4	IV	171+576	175+576	End of project	4.2	Existing road
E-1	IV	40+000	44+940	End of project	4.9	New road-dropped
E-3	IV	40+000	45+311	End of project	5.3	New road

** Includes overlap with portions of PTA-1*

ENVIRONMENTAL CONTEXT

The island of Hawai'i is composed of five shield volcanoes, Kohala, Mauna Kea, Hualālai, Mauna Loa and Kīlauea. The project is situated on flows from Mauna Loa and Mauna Kea. Mauna Kea is now inactive and considerably eroded, with deep soils, while Mauna Loa is still active and little eroded, with shallow soils or none. Relatively recent lava flows from Mauna Loa cover a considerable portion of the project area (Wolfe and Morris 1996).

Geographically the area covered by the project can conveniently be divided into three parts, the West Side, the Saddle and the East Side. The West side is the area from the Mamalahoa Highway (or the Waimea-Kona Belt Road) up to Pohakuloa Training Area incorporating Segment I. The Saddle is the same as Segment II, and the East Side covers Segments III and IV.

The West Side is entirely within the single large *ahupua'a* of Waikōloa. It ranges in elevation from 760 m (2,500 ft) at the Waimea-Kona Belt Road to 1,650 m (5,400 ft) at the upper boundary of Waikōloa. The area is quite dry, with an annual rainfall of 25 to 50 cm (10-20 in.) (Giambelluca et al. 1986). Waikōloa consists mostly of well-developed soils (Sato et al. 1973), covered today by grass and long used for raising sheep and cattle. In the nineteenth century there was an open *māmane-naio* forest in upper Waikōloa that is now mostly gone (Cuddihy and Stone 1990). Toward the south side of Waikōloa there is a scattering of *'ōhi'a* today, which probably was denser in the past.

The Saddle is at an elevation of about 1,800 to 2,100 m (6,000 to 7,000 ft) in the two large *ahupua'a*, Ka'ohe and Humu'ula. The Saddle is dry, with an annual rainfall ranging from 50 cm (20 in.) in the west to 200 cm (80 in.) in the east (Giambelluca et al. 1986). Much of the Saddle in Humu'ula consists of well-developed soils (Sato et al. 1973). The area is covered by grass and open *māmane-naio* forest (Cuddihy and Stone 1990), and has long been utilized for raising sheep and cattle. The 1935 flow covers most of the project corridor (Ex-3) in Humu'ula (Wolfe and Morris 1996), and the present Saddle Road was built on top of it. Ka'ohe has well-developed soils to the north (including PTA-1 corridor), with grass and *māmane-naio* forest. However, it is drier than Humu'ula, the grass is sparser and the area is less suited to raising stock. To the south (including Ex-2 corridor) Ka'ohe is covered with lava flows, including the late prehistoric Keamuku Flow to the west and the 1843 flow to the east. There is scrub *'ōhi'a* forest on older flows, but little development of grass for stock to eat.

The East Side covers the area from the Humu'ula boundary at 1,720 m (5,800 ft), down nearly to Kaumana School (milepost 5.5 on the Saddle Road at 400 m (1,300 ft), in the *ahupua'a* of Waiākea, Pi'ihonua, Punahoa 2 and Ponahawai, Kaūmana, and Kūkūau 2. This area is much wetter than the saddle, with an average of 200 to 600 cm (60 to 240 in.) annual rainfall (Giambelluca et al. 1986). It was covered by *'ōhi'a-koa* forest in the nineteenth century and most of it is still forested (Cuddihy and Stone 1990). Historic lava flows came through the road corridor in 1855, 1881 and 1935, destroying the forest (Wolfe and Morris 1996). The older flows are covered with a scrub *'ōhi'a* forest. The present Saddle Road was built on top of these flows, because it was easier than going through the adjoining forested soil areas. The 1852 and 1942 flows also came through the general area, but were south of the road corridor.

Soils in Hawai'i are generally either residual soils, or transported soils (Sato et al. 1973). The most common soils in the project area are residual soils formed by the chemical or physical breakdown of the basalt beneath them. Transported soils, brought to an area by water or wind are not as common and occur mainly at the base of Mauna Kea. The West Side is mostly composed of sandy loam soils, with some stony land in the W-2 and W-3 corridors. Loamy sand occurs at the base of Mauna Kea in the Saddle, with stony land and lava flows making up most of the rest of the Saddle. On the East Side, the project corridor is mostly recent lava flows with little or no surface soil. Silty clay loam soils that formed in volcanic ash occur to the north and south of the project corridor beyond the narrow lava flows in the lower portion of the E-2 corridor. Vegetation varies widely across the project area, in response to differences in rainfall and elevation. Five major vegetation zones are projected to have occurred in the project area prior to the changes that took place with the introduction of cattle and sheep in the region (Lamoureux in Armstrong 1983:70-71).

1. Mixed open forest (850 to 1,350 m) with *'ōhi'a, koa,* Spanish clover, Bermuda grass on lower West Side.

2. Open *koa* forest (1,350 to 2,400 m) with *koa, māmane, heu pueo* grass, *pūkiawe, 'a'ali'i* on the upper West Side and eastern Saddle.

3. Open *māmane-naio* forest with subalpine shrubs (2,200 to 3,400 m) and *māmane, naio, pūkiawe, 'a'ali'i, ōhelo* in the Saddle.

4. Open *koa* forest (1,350-2,400 m) of *koa, 'ōhi'a,* rattail grass, *hue pueo* grass in the upper East Side.

5. Closed *'ōhi'a* rain forest (500-2,400 m) of *'ōhi'a, hāpu'u and ama'u tree ferns, 'ōlapa* at the mid-level of the East Side. (*Koa* occurs within this forest on the East Side, from 500-850 m, according to McEldowney 1979:25).

The plants that occur within these vegetation zones were traditionally used for a variety of purposes (Neal 1965, Abbott 1992, Krauss 1993). The hardwoods *māmane, naio* and *'a'ali'i* were used in building construction. *'Ōlapa* and *māmane* were used for spears. *Pūkiawe* wood was used to make the anvil for beating *pa'ūpa'ū*, tapa bark cloth . *Koa* was used to carve canoes and surfboards. *'Ōhi'a* was used to carve images of the Hawaiian god Kū and to construct buildings in the *luakini heiau.*

METHODS

AREAS SURVEYED FOR ARCHAEOLOGICAL, HISTORIC, AND TRADITIONAL CULTURAL PROPERTIES

An area of potential effect (APE) was defined for the project pursuant to and in full compliance with 36 CFR 800.4(a). The APE was first defined for archaeological sites as the staked 60 m (200 ft) road corridor, extending 30 m from the centerline on both sides, as described in the project Scope of Work. That was the area to be surveyed archaeologically and it was understood that there would be no roadwork carried out outside of that 60 m corridor. Subsequently it was necessary to redefine the APE for archaeological sites. In August, PHRI discovered that the actual road corridors staked were wider than 60 m in the alternate roadway corridors. For W-3, PTA-1, PTA-3, E-3, and E-4A the staked roadways are 100 to 120 m wide. Only the existing corridor has a staked roadway of 60 m width. Therefore the APE for archaeological sites has now been redefined as 60 m for the corridors associated with the existing roadway, and as staked (between 100 and 120 m) for corridors associated with proposed new roadway.

In April 1996 it became apparent from initial interviews with Henry Auwae that there were likely to be Native Hawaiian burials and ritual sites within the project area. It was decided to define a wider APE for those sites. The APE for burials which might be located during consultation or archaeological survey, and the method for dealing with them, was worked out in consultation with the Hawaii State Historic Preservation Division during May 1996. Any burial located within the 60 m roadwork corridor would have to be removed for reinterment, or the road be re-routed (depending on the decision of the Hawaii Island Burial Council). Burials outside the corridor would be left in place. Mr. Auwae emphasized the need for a buffer between the road construction corridor and any burial site close by, because of the potential for disturbance of a burial adjacent to the corridor. It was decided that the APE for burials would be set as a 120 m corridor, extending 60 m on each side of the centerline. At that time it was still thought that all the road corridors were 60 m wide. Known burials within that larger corridor would have to be investigated, verified as human remains, and either removed for reinterment or protected in place. Beyond the 120 m corridor, any known burials that were "close" to the road would not be investigated. However, the general area of the burial would be noted and the side of the road corridor would be flagged before construction to notify the construction crew to stay out of the area. This would allow for protection of the gravesite and preclude revealing its precise location or conducting any intrusive investigations.

For Native Hawaiian ritual sites, a still wider APE was defined. Such ritual sites would generally be considered "traditional cultural properties," as described in National Register Bulletin 38 (Parker and King 1990). So long as they were fifty or more years old and were still used, ritual sites would be eligible for the National Register of Historic Places. (The question of continued use will be taken up later.) A ritual site used by Native Hawaiians could be adversely affected by a nearby road even if it was outside the road corridor. Ritual activity could be compromised by the sight of a nearby road, by sounds from the road, or by passing motorists who might stop to observe. It was reasoned that such adverse effects would extend much farther in the open terrain of the West Side than in the forested terrain of the East Side. For these reasons, the APE for ritual sites was set as a 300 m corridor (150 m on each side of the centerline) in forested terrain, and 1.6 km corridor (800 m on each side of the centerline) in open terrain.

During the historic documentary research, oral interviews, and field survey work, information was collected on sites beyond the APE. Most of those sites lie far from the road corridor and construction will have no effect on them. Several such sites which were investigated during documentary research and oral interviews are described in *Appendix F*. The descriptions of those sites are included because they provide additional context for sites considered in the body of the report. Three sites that lie beyond the defined APE are treated in the body of the report. Two archaeological sites beyond the APE (50-10-31-5003 and 50-10-31-14638) are included due to their proximity to the APE. The third site is a burial area, Site 50-10-21-20852. The burial area was pointed out by Mr. Auwae beyond the 120 m APE defined for burials, but close enough to require flagging the side of the road corridor (in accordance with the plan worked out beforehand and described above).

HISTORICAL AND ETHNOGRAPHIC STUDY - METHODS

The historical and ethnographic study was conducted by Dr. Charles Langlas of the University of Hawaii, Hilo. The first phase conducted by Dr. Langlas included documentary research, initial consultation with Native Hawaiian organizations, and locating knowledgeable informants for the oral history research. The second phase focused on interviewing informants who had knowledge of the project area, sometimes visiting archaeological/cultural sites with them. Dr. Langlas was aided by four student researchers from the University of Hawaii at Hilo - Ka'ohulani Maguire, Rita Pregana, Leslie Keola Awong, and Lisa Haunani Martin. They helped in carrying out both the documentary research and the oral history research. The study was carried out over a period of ten months, Phase 1 from January to March 1996, and Phase 2 from April to October 1996. Approximately 1,000 labor hours were used by all five researchers during this study: 260 hours for documentary research; 350 hours for oral history research and consultation; and 390 hours for report write-up.

Documentary research was carried out on Hawai'i Island and in Honolulu. The main document repositories and source materials utilized are described below. The University of Hawaii at Hilo library provided published sources, and unpublished Hawaiian Kingdom Boundary Commission testimony, a rich source of information on Native Hawaiian land use and sites in the nineteenth century. The Parker Ranch Files at Dyer Library, Hawaii Preparatory Academy in Waimea, provided records on Parker Ranch and the Humu'ula Sheep Station. In Honolulu, the Hawaii State Archives provided Mahele documents, consulted to determine land ownership at the mid-nineteenth century, and Hawaiian Kingdom Interior Department correspondence, consulted to determine land use in the nineteenth century. The Hawaii State Bureau of Conveyances provided records of changes in land ownership after the Mahele. Hamilton Library, at the University of Hawaii at Mānoa and the Hawaii State Survey Division were sources for old maps which provided information on historic sites in the nineteenth and early twentieth centuries.

The oral history research was started by initiating consultation with Native Hawaiian organizations and by networking to find knowledgeable informants. Consultation with Native Hawaiian organizations is mandated by the 1992 amendment to the National Historic Preservation Act, Section 101 (d)(6)(B). The nature of that consultation is described in draft regulations proposed by the National Advisory Council on Historic Preservation, which oversees the Section 106 process (Proposed Revisions to 36CFR 800, 1997). The draft regulations specify that native Hawaiian organizations shall be consulted early in the planning process for a federal undertaking; that the organizations shall be asked for assistance in identifying historic properties of traditional religious or cultural importance which may be affected; and that the organizations be consulted during the process of evaluating historic properties and assessing project effects on them.

The Office of Hawaiian Affairs (OHA) and Hui Mālama i Nā Kūpuna o Hawai'i Nei are mentioned specifically in the NHPA. These groups were notified by letter at the start of the project. Hui Mālama recommended that Henry Auwae be interviewed regarding the project. (Mr. Auwae, incidentally, had already been contacted.) OHA failed to respond until near the end of the research. Other organizations were consulted later, by an initial telephone call and then a letter. Those organizations included the Waimea Hawaiian Civic Club, Waimea Homesteaders Association, Kona Hawaiian Civic Club, Hilo Hawaiian Civic Club, Prince David Kawananakoa Hawaiian Civic Club [of Hilo], and Ka Lāhui Hawai'i. A log of consultation activities and a sample notification letter are included in *Appendix B*. None of these other organizations responded with the names of additional Hawaiian *kupuna* [elders] who had knowledge of traditional Native Hawaiian sites in the project area.

Twenty-four individuals were contacted, all of them men, who provided information about the project area and its history. Sixteen people were interviewed in depth, because they seemed to have considerable knowledge of some part of the project area. One person was fifty-six years old. The other fifteen were from sixty-eight to ninety years old. Most of these informants knew about the area from working as cowboys for Parker Ranch (between 1918 and 1985) or Pu'u 'Ō'ō Ranch (between 1942 and 1975). A few informants knew about the area from other experiences. Ah San worked as a forester in the Hilo Forest Reserve on the East Side of the project area. Auwae traveled through the Saddle with his great-grandmother to collect Hawaiian medicinal plants as a boy, and later worked on the construction of Saddle Road during World War Two. Blackshear visited Pu'u 'Ō'ō Ranch as a boy when it was owned by his grandfather. Paris went up to Pohakuloa Training Area after World War II for training with the Hawaii National Guard.

The interview process proceeded generally as follows. An initial telephone call was made to determine that the individual had important information and to set a time for the interview. All interviews were conducted as "informal" interviews: questions were asked during the interview based on what the informant said, rather than being determined by a pre-conceived questionnaire. The questions were generally open-ended, and the informant was encouraged to move in the direction of what she or he knew about. The interview was usually tape-recorded and then transcribed. The transcribed interview was given to the informant to review for errors in transcription or for sensitive material that needed to be edited out. A second meeting was set up during which the informant was asked to sign a release form for the edited transcript and the interviewer asked questions to clarify certain points. A sample release form is provided in *Appendix C*. The release form asks for three levels of release of information: (a) for use in this report on historic sites, (b) for use in a subsequent scholarly publication by the researcher, (c) for general public access. It allows the informant to stipulate that particular portions of the transcript, and the unedited tape, will not be made public.

Substantial interviews were conducted with 16 informants, and some of them were interviewed more than once. Two of those informants asked not to be taped. In those cases, notes were taken and were expanded later. The informant was asked to sign a release on the expanded notes. Five site visits were made with informants to locate sites or to make the interview more meaningful. In addition to these substantial interviews, unrecorded conversations with eight other individuals provided a limited amount of information. Notes on these conversations are brief and have not been formally released. The conversations are cited in the text as "personal communications" rather than as interviews. All of the informants are listed in *Appendix D*, with biographical notes to indicate their experience relevant to the research.

In completing these specific tasks for this project, two research goals were paramount. One was to determine the broad historical patterns of land ownership, settlement, and land use in the project area. This effort was designed to provide the historical context for the second goal, which was to gain information about specific historic sites within the project area. The documentary record for the twentieth century is actually less full than it is for the nineteenth century in Hawai'i; interviews were needed to fill out the history of the twentieth century. Broadening the focus of the interviews to cover the larger historical context is also useful because it allows a broader conversation, in which the interviewer can come back to questions about specific sites in more than one way.

ARCHAEOLOGICAL SURVEY METHODS

The pedestrian survey was conducted by walking transects along the designated study corridors, with transect spacing at 10 to 15 m, depending upon terrain and vegetation conditions. At the beginning of each transect, all survey members tied double lengths of engineer's flagging tape identified with the survey transect number and date. As the survey progressed, the crew members on the outside of the transect sweep tied single lengths of flagging tape to define the outer limits of sweeps, and to aid in relocation of the survey corridor and any sites encountered during the survey.

No survey work was conducted for corridors W-4 and E-1, because these two corridors were dropped from consideration prior to commencement of the archaeological survey *(see Table 2)*. Design changes for corridor EX-3 resulted in survey work being conducted between milepost 11 and 16 along the existing highway, and along a portion of proposed new highway.

Table 2. Saddle Road Corridor Survey Coverage

Name	Seg't	Length (km)	Type	Survey Coverage	Survey Width (m)
EX-1	I	19.1	Existing road	Surveyed	60
W-2	I	16.0	New road	Surveyed	120
W-3	I	11.1	New road	Surveyed	120
W-4	I	14.0	New road-dropped	Not surveyed	-
EX-2	II	21.6	Existing road	Surveyed	60
PTA-1	II	30.0	New road	Surveyed	120
PTA-3	II	*32.7	New and existing road	Surveyed	120
EX-3	III	30.9	Existing road	Surveyed	60
EX-4	IV	4.2	Existing road	Surveyed	60
E-1	IV	4.9	New road-dropped	Not surveyed	-
E-3	IV	5.3	New road	Surveyed	120

** Includes overlap with portions of PTA-1*

Most of the EX-2 corridor had been surveyed previously (Welch 1993). The survey limits were 60 m from the centerline (for a total survey width of 120 m), double the survey width for the current project area. The Welch (1993) survey corridor was plotted over the current project APE to determine whether the previous work covered the current project area. Due to design parameters for EX-2, there were two locations that were not covered in the previous work. PHRI surveyed the areas that were not covered by the previous work (two small areas), and relocated all sites previously identified and evaluated by Welch (1993) *[see Findings section: Figures 10 j and l, pages 71 and 73]*.

Sites were flagged when encountered during the pedestrian survey with pink and blue flagging tape, and assigned a PHRI temporary number. Upon completion of each study corridor, all marked sites were revisited and recorded on standard PHRI site record forms and scale-mapped using metric tape and compass or a Topcon GTS-3B Total Station and FC-4 Data Collector. All multi-component sites thought to be more than fifty years old were divided into features, with detailed recording conducted for each one. Military features thought to be less than fifty years old were grouped into structures with varying levels of documentation obtained to demonstrate age and function.

A mapping datum was selected for each recorded site, usually located near the center of the site, or on a feature designated "Feature 1," and "Structure 1" in the case of military sites. The datum was then marked with an aluminum site tag bearing the PHRI project number (94-1522), PHRI temporary number (e.g., 1522-501), and the date. Because multiple crews were working simultaneously, site numbers were assigned by coding for area of the project. PHRI site numbers for this project are three-digit numbers. PHRI site numbers for the West Side are in a 100 series. Sites in the Saddle are in a 300 series, and sites on the East Side are in a 500 series. Site sketch maps reference the compass bearing and distance from the datum to known project features, such as centerline stakes or corridor boundary stakes.

Site testing was undertaken following detailed recording. Formal test excavation units, and shovel test pits were utilized to evaluate the presence and contents of subsurface components at several sites and features. Excavation proceeded in arbitrary 0.1 or 0.2 m levels, and all excavated material was passed through nested 1/4-inch and 1/8-inch mesh hardware cloth. Excavation was terminated when bedrock was encountered, or when excavation had progressed through two consecutive culturally-sterile layers. Artifacts were retrieved from the screens and bagged, noting provenience. Documentation of the excavation units included recording the horizontal and vertical proveniences of recovered portable remains and samples, along with plan and profile drawings. Standard PHRI excavation forms were completed, and black-and-white photographs were taken of each test unit.

Specialized samples suitable for radiocarbon assay, sedimentary analysis of cultural deposits, paleobotanical and faunal analyses were not encountered at any of the sites/features excavated. All material remains encountered during this project were of historic or modern origin.

CULTURAL CONTEXT

INTRODUCTION

The following overview of archaeological work conducted in *ahupua'a* that the project area lies within is structured to provide the basis for understanding land use patterns across the project area. For more detailed discussions of the archaeology of the PTA and Mauna Kea and elaboration on the themes and issues touched on below, the reader should consult Cordy (1994), McCoy (1977), and Streck (1984). Dr. Patrick McCoy and Marc Smith, DLNR staff archaeologists; Jadelyn Moniz, PTA archaeologist; and Kanelei Shun, archaeologist for USACOE, were consulted for information on sites and helped with obtaining available reports relevant to the current project. Reports at the DLNR, PHRI archives, and UH-Hilo were reviewed. This review indicates that few archaeological investigations have taken place within or near the current project area.

A brief discussion of the results of work conducted within the areas that coincide partially or entirely with the current project area is presented first. Information on site type and distribution relevant to the current project that resulted from work conducted in the *ahupua'a* that cross the project area *(Table 3)* is presented in the next section. Only a few of the studies in *Table 3* were conducted in areas relevant to the current project, however. A short summary follows emphasizing chronological developments and settlement patterns that need to be considered during field and analytical investigations in the project area. A detailed discussion of the cultural history and land use patterns during the historic period is presented after the section on the previous archaeological work.

PREVIOUS ARCHAEOLOGICAL STUDIES IN THE PROJECT CORRIDOR

U.S. Army military installations were sample-surveyed by Bishop Museum during 1976 and 1977 (Rosendahl 1977). Ten archaeological sites were identified in the nearly 3,000 acres of Pohakuloa Training Area that were surveyed during this investigation (Rosendahl 1977: Tables 1 and 5). Sites 5001, 5002, and 5003 are in or near the Saddle Road project area. Suggestions for evaluation and significance potential are given for each site, but these do not follow established NRHP evaluation criteria. For example Site 5002 is cited as "evaluation" Category III: properties of value that should be preserved if practicable, but is also listed under "significance potential" as Minimal with no potential for research due to "extreme commonness," poor condition, or lack of integrity (Rosendahl 1977: Table 5). Locational information and detailed recording is not provided. Site descriptions, locational information, and evaluations in the report are not sufficient for the level of research and documentation required for the Saddle Road project, so all areas where the current project coincided with the undefined PTA survey area (Rosendahl 1977) were resurveyed during the current investigation. No archaeological sites were found during the surface survey, conducted along the Saddle Road between mileposts 34 and 37, for proposed U.S. Army projects (Streck 1984).

A corridor for two parallel powerlines between Keamolu, South Kohala, and Kaumana, South Hilo was surface surveyed intermittently from 1985 through 1987 (Barrera 1987). The full length of the survey is not provided in the report, and the maps provide no clear indication of where the corridor is, or where the archaeological sites reported on are. The corridor roughly parallels the Saddle Road project

Table 3. Summary of Previous Archaeological Work

Citation	Coverage	Citation	Coverage
	Waikōloa, South Kohala		
Barrera (1971)	Excavation	Pearsall & Trimble (1984)	Soil Phytolith Analysis
Bevacqua (1972)	Reconnaissance Survey	Bonk (1985)	Reconnaissance Survey
Kirch (1973)	Reconnaissance Survey	Rosendahl & Rosendahl (1986)	Reconnaissance Survey
Rogers-Jourdane & Cleghorn (1976)	Reconnaissance Survey	Bonk (1987)	Data Recovery & Mitigation Plan
Rogers-Jourdane (1978)	Reconnaissance Survey	Kennedy (1987)	Reconnaissance Survey
Kirch (1979)	Excavation	Barrera (1987)	Reconnaissance Survey
McEldowney (1979)	Arch. Inspection & Monitoring	Bonk (1988)	Reconnaissance Survey
Neller & Beggerly (1980)	Reconnaissance Survey	Clark et al. (1990)	Arch. Testing & Data Recovery
Clark & Welch (1981)	Arch. Excavations & Salvage	Jensen (1990)	Inventory Survey
Cox (1983a)	Reconnaissance Survey	Burgett & Jensen (1991)	Inventory Survey
Cox (1983b)	Reconnaissance Survey	Kalima & Rosendahl (1991)	EIS Addendum Report
Barrera (1983)	Reconnaissance Survey	Jensen (1991e)	Archaeological Field Inspection
	Pu'uanahulu, North Kona		
Brock (1972)	Reconnaissance Survey	Haun (1986)	Inventory Survey & Testing
Rosendahl, P. H. (1977)	Reconnaissance Survey	Walker, A. T. (1989a)	Field Inspection
Barrera (1980)	Reconnaissance Survey	Walker, A. T. (1989b)	Field Inspection
Hommon & Ahlo (1983)	Research Design	Walker et al. (1990)	Inventory Survey
Rosendahl, M.L.K. (1983)	Inventory Survey	Jensen (1991c)	Preservation Plan
Cox (1983b)	Reconnaissance Survey	Jimenez (1994)	Additional Inventory Survey
Haun (1985)	Data Recovery Plan & Inventory Survey	Rosendahl, P. H. (1995)	Archaeological Monitoring
	Ka'ohe, Hāmākua		
Hansen (n.d.)	Reconnaissance Survey	Hommon & Ahlo (1983)	Research Design
Goodrich (1833)	Reconnaissance Survey	Barrera (1983)	Reconnaissance Survey
Alexander (1892)	Reconnaissance Survey	Rosendahl, M. L. K. (1983)	Documentation of National Register Site
Brigham (1902)	Data Analysis	McCoy (1984a)	Reconnaissance Survey
Wentworth et al. (1935)	Mauna Kea Synthesis	McCoy (1984b)	Reconnaissance Survey
Emory (1938)	Reconnaissance Survey	Streck (1984)	Reconnaissance Survey
Loo & Bonk (1970)	Reconnaissance Survey	Cordy (1985)	Hāmākua Regional Synthesis
Rosendahl, P. H. (1977)	Inventory Survey	Rosendahl & Rosendahl (1986)	Reconnaissance Survey
McCoy (1977)	Summary of Research	Streck (1986)	Reconnaissance Survey
McCoy & Gould (1977)	Summary of Research	Streck & Watanabe (1986)	Reconnaissance Survey
EISC (1977)	Botanical Survey	Watanabe (1986)	Reconnaissance Survey
Allen (1981)	Archaeo-botanical Assemblage Study at Mauna Kea Adze Quarry	McCoy (1986)	Field Inspection-Data Recovery
McCoy (1982)	Reconnaissance Survey	Allen (1986a)	Archaeobotanical Analysis
Cleghorn (1982)	Tech. Analyses & Exper. Tests at Mauna Kea Adze Quarry	Barrera (1987)	Reconnaissance Survey
Hommon (1982)	Aerial Reconnaissance Survey	Athens & Kaschko (1989)	Inventory Survey & Testing
Kam (1982a)	Reconnaissance Survey	McCoy (1990)	Summary of Work
Kam (1982b)	Reconnaissance Survey	Char (1991)	Botanical Survey
McEldowney (1982)	Reconnaissance Survey	Kalima & Rosendahl (1991)	EIS Addendum Report
McCoy (1982)	Reconnaissance Survey	Welch (1993)	Inventory Survey & Testing
Cox (1983a)	Reconnaissance Survey	Cordy (1994)	Hāmākua Regional Synthesis
Cox (1983b)	Reconnaissance Survey		

Table 3. (cont.)

Citation	Coverage	Citation	Coverage
	Humu'ula, North Hilo		
Wentworth et al. (1935)	Mauna Kea Synthesis	Rosendahl & Rosendahl (1986)	Reconnaissance Survey
HRHP (1973)	Historic Site Form for Site 50-10-32-7119	Barrera (1987)	Reconnaissance Survey
Rosendahl, P. H. (1977)	Inventory Survey	Kalima & Rosendahl (1991)	EIS Addendum Report
Hommon & Ahlo (1983)	Research Design	Welch (1993)	Inventory Survey & Testing
Barrera (1983)	Reconnaissance Survey		
	Waiākea, South Hilo		
Ching & Stauder (1974a)	Reconnaissance Survey	Rosendahl & Talea (1988)	Reconnaissance Survey
Ching & Stauder (1974b)	Reconnaissance Survey	Jensen (1991a)	Field Inspection
McEldowney (1979)	Literature Search & Research Design	Kalima & Rosendahl (1991)	EIS Addendum Report
Bonk (1979)	Reconnaissance (?) Survey	Smith (1991)	Site Inspection
Barrera (1981)	Reconnaissance Survey	Smith (1992)	Field Inspection
Kelly et al. (1981)	Hilo Bay Archaeological & Historical Study	Moniz (1992)	Historical & Archaeological Synthesis
Barrera (1983)	Reconnaissance Survey	Hunt & McDermott (1993)	Inventory Survey
Cordy (1986)	Parcel Assessment	Maly & Walker (1994)	Inventory Survey
Barrera (1987)	Reconnaissance Survey	Rosendahl, P. H. (1994)	Reconnaissance Survey
Rosendahl, M. L. K. (1988a)	Reconnaissance Survey	Walker, A. T. (1994)	Field Inspection
Rosendahl, M. L. K. (1988b)	Reconnaissance Survey		
	Pi'ihonua, South Hilo		
McEldowney (1979)	Literature Search & Research Design	U.S. Army Engineer Corp. (1984)	Hydropower Study (No Archaeological Work Noted)
Kelly et al. (1981)	Hilo Bay Archaeological & Historical Study	Rosendahl & Rosendahl (1986)	Reconnaissance Survey
Barrera (1983)	Reconnaissance Survey	Kalima & Rosendahl (1991)	EIS Addendum Report
Cox (1983)	Reconnaissance Survey		
	Punahoa, South Hilo		
Sinoto (1975)	Reconnaissance Survey	Rosendahl, P. H. (1990a)	Field Inspection
McEldowney (1979)	Literat. Search & Res. Design	Rosendahl, P. H. (1990b)	Hawaiian Legendary Associations
Sinoto (1980)	Reconnaissance Survey	Walker, S. (1990)	Subsurface Test Excavations
Kelly et al. (1981)	Hilo Bay Archaeological & Historical Study	Barrera (1991)	Inventory (?) Survey
Athens (1982)	Reconnaissance Survey	Jensen (1991a)	Inventory Survey
Kelly (1982)	Background Historical Studies	Jensen (1991b)	Mitigation Plan
Cox (1983c)	Reconnaissance Survey	Winkler (1992)	Archaeological and Paleoenvironmental Investigation
Rosendahl & Rosendahl (1986)	Reconnaissance Survey	Walker et al. (1996)	Inventory Survey
Barrera (1986)	Reconnaissance Survey		
	Ponahawai, South Hilo		
Sinoto (1975)	Reconnaissance Survey	Rosendahl, P. H. (1990a)	Field Inspection
McEldowney (1979)	Literature Search & Research Design	Rosendahl, P. H. (1990a)	Hawaiian Legendary Associations
Sinoto (1980)	Reconnaissance Survey	Walker, S. (1990)	Subsurface Test Excavations
Kelly et al. (1981)	Hilo Bay Archaeological & Historical Study	Jensen (1991c)	Inventory Survey
Athens (1982)	Reconnaissance Survey	Goodfellow & Fager (1992)	Inventory Survey
Kelly (1982)	Background Historical Studies	Winkler (1992)	Archaeological & Paleoenvironmental Investigation
Walker, S. (1990)	Field Inspection		

Table 3. (Cont.)

Citation	Coverage	Citation	Coverage
Kaūmana, South Hilo			
Sinoto (1978)	Reconnaissance Survey	McEldowney (1979)	Literat. Search & Res. Design
Kūkūau, South Hilo			
McEldowney (1979)	Literature Search & Research Design	Walker, S. (1990)	Subsurface Test Excavations
Kelly et al. (1981)	Hilo Bay Archaeological & Historical Study	Jensen and Kalima (1990)	Field Inspection
Athens (1982)	Reconnaissance Survey	Winkler (1992)	Archaeological & Paleoenvironmental Investigation
Kelly (1982)	Background Historical Studies	Borthwick et al. (1993)	Inventory Survey
Rosendahl, M. L. K. (1988a)	Reconnaissance Survey		

area. The report indicates that five sites of possible archaeological or historical interest were found, but six are documented in the report. The report does not indicate which of the six sites is not considered of possible archaeological or historical interest. One long wall, and one trail were not given SIHP numbers because they "were unable to trace their entire lengths and thus could not make a complete description of them" (Barrera 1987:10). A cairn lacking associated materials (Site 6997), a crude shelter that probably is a modern military structure (Site 6998), and a feature described as a "well-constructed cairn, rock *ahu* or stone mound" on the 1855 flow without associated material remains (Site 6999) were also found during this survey. Site 10307 has eleven wall segments that may be clearing or boundary walls for agricultural or ranching activities near Kaumana. The unnumbered trail is the Pu'u 'Ō'ō to Hilo trail (Site 20878), and the unnumbered wall is the Humu'ula Wall (Site 7119). There are no significance evaluations and only general recommended treatments for these sites. Site descriptions and locational information in the report are not sufficient for the level of research and documentation required for the Saddle Road project, so all areas where the current project coincided with the 138kv powerline survey (Barrera 1987) were resurveyed during the current investigation.

A survey of a 39 mile segment of the Saddle Road between mileposts 9 and 48 was conducted in 1986 (Rosendahl and Rosendahl 1986). The survey corridor was only 15 to 30 feet (maximum of 9 m) on either side of the highway for a total of about 142 acres inspected. The only two sites encountered during this survey were the Pu'u 'Ō'ō-Volcano Trail (10309), and one of the walls from the Humu'ula Sheep Station (7119). Both sites were recommended as having low research, cultural, and interpretive values, and no further work was recommended. Maps and NRHP evaluations are not provided in this report, so all areas covered during this investigation were resurveyed during the current investigation. A supplement to this report followed (Kalima and Rosendahl 1991). One of the 7119 walls (only one wall is mentioned in the report) is recommended to be significant for information content and as an excellent example of a type. Further data collection and/or preservation "as is" was considered necessary.

The portion of the Saddle Road that passed through the PTA was surveyed and tested for the proposed road expansion in this area (Welch 1993). The survey covered 14.5 miles by a minimum of 200 foot (60 m) wide corridor. Four sites were found: two rock walls (5002 and 7119); a lava tube cave (5003); and a lithic scatter with caves (14638). Investigations at the two cave sites indicated that they were occupied prehistorically, and that a variety of activities took place at the sites, including food consumption, and tool manufacture and use. All four sites were interpreted as significant for the NRHP under Criterion D. This thorough inventory survey report provides locational information, and documentation and evaluations appropriate for Section 106 compliance. All four sites recorded by Welch (1993) were revisited during the current investigation. Wall sites were recorded in more detail, but no additional work was conducted at the prehistoric cave sites by PHRI.

PREVIOUS STUDIES IN THE PROJECT AHUPUA'A

South Kōhala District

The *ahupua'a* of Waikōloa, on the western slope of Mauna Kea, is the only South Kōhala District *ahupua'a in* the project area. It is large and L-shaped and has an upper elevation of just over 1,830 m (6,000 ft). The lowest point in the project area (at about 670 m [2,200 ft] elevation) is within this *ahupua'a*. In this report, discussion of archaeological investigations in this *ahupua'a* is limited to those in the middle and upper elevations; few archaeological remains have been encountered in the limited number of archaeological surveys conducted in the higher elevations.

Walls are a common feature in this part of the South Kōhala District. Some walls have been observed near intermittent drainages (Bevacqua 1972, Burgett and Jensen 1991). These isolated and undated structures are assumed to be associated with agriculture or the retention of alluvial soils. The area also has ranching walls built to contain livestock (Cox 1983a).

There is a variety of prehistoric sites in the middle and higher elevations. Agricultural fields, temporary shelters, and trail systems (Clark and Kirch 1983 IN Cox 1983a:3) are present near Pu'u Pa, near Waimea. Also present at these elevations is a large cave, Bishop Museum Site 50-Ha-E2-16, relocated during a power line survey (Barrera 1983). The site was listed as "of extremely high significance." A cairn (Site 6977) without associated artifacts was located at about 1,580 m (5,200 ft) elevation, along the power line. Other surveys conducted in the area encountered no archaeological remains (Kalima and Rosendahl 1991; Rosendahl and Rosendahl 1986).

North Kona District

The project as originally defined included one corridor (W-4) that was located within a portion of the *ahupua'a* of Pu'uanahulu in the North Kona District. Although the final project area does not include the North Kona District, the archaeological properties in this area provide data relevant to the understanding of prehistoric and historic settlement patterns at high elevations of the leeward side of the island of Hawai'i. The majority of archaeological sites encountered within the upper elevations of this *ahupua'a* have been documented during work conducted on the Pohakuloa Training Area (Cox 1983b; Haun 1986; Hommon and Ahlo 1983; P. H. Rosendahl 1977). The Bobcat Trail Habitation Cave (Site 5004) listed on the NRHP, the Naohuelelua [sic] Kerbstone Trail (Site 5006), and the Naohuelelua Foot Trail (Site 5008) have been the focus of archaeological survey and research in the area. Excavations and additional survey in the area near the Site 5004 resulted in the recordation of seven shelter caves, two trail segments, cairns, and a volcanic glass lithic scatter. Material at these sites included marine shell, fish bone, adze-cut wood chips, coconut fiber cordage, gourd, *kukui* and ti (Haun 1986). Radiocarbon dating and volcanic glass age determination analysis indicated that Site 5004 and nearby *kipuka* were utilized from about the middle of the 11th century to the historic period. The most intensive use occurred between the mid-12th to mid-18th centuries (Haun 1986). Investigations in the middle elevations of the *ahupua'a* (at about 650 m) indicate that habitation, burial, ceremonial, and agricultural activities were conducted during the late prehistory near Pu'uanahulu (Jimenez 1994; Walker et al. 1990).

Hāmākua District

The central portion of the project area crosses the *ahupua'a* of Ka'ohe, within Hāmākua District. The *ahupua'a* includes the summit of Mauna Kea as well as the northern slopes of Mauna Loa. Archaeological investigations in this *ahupua'a* have taken place to the south of the current project area (within PTA) and north of the area (on Mauna Kea), as well as along the current project corridors.

Pohakuloa Training Area (PTA)

Caves and trails dominate the archaeological sites in the PTA. The first recorded research in the area resulted in documenting two small caves (Site 5000 and 5001) (Hansen n.d. IN Cordy 1994:108). Subsequently, an extensive aerial survey with some surface sampling encountered more late-prehistoric and historic period occupation caves and trails (P.H. Rosendahl 1977). Later, David Cox of the Corps of Engineers examined the route of another firebreak road and located additional small caves probably associated with Site 5000 (Cox 1983a). Streck (1984, 1986), Streck and Watanabe (1986), and Watanabe (1986) located additional habitation caves in the western portions of the PTA. Radiocarbon samples from the caves yielded age ranges of AD 900-1700 (Streck 1986:36).

Several caves were located and tested by Athens and Kaschko (1989). Radiocarbon results indicate the sites were initially occupied between AD 1000 and 1200, and were heavily used from AD 1400 to 1450. Bird bone was recovered from the sites; the assemblage indicated that activities at the sites consisted primarily of obtaining juvenile petrels and collecting birds for feathers. The younger birds are thought to have been exclusively reserved for high-ranking *ali'i* (Henshaw 1902:120).

An inventory survey along the route of SR 200 through the PTA encountered previously recorded sites (5002, 5003, 7119) and one new site (14638) (Welch 1993). Site 14638 is a lithic scatter with three associated small caves. Test excavations in the cave at Site 5003 revealed deposits containing large amounts of faunal material (both birds and mammals), lithic material, wood samples, and charred matter.

There have been several surveys associated with a power line, firebreaks, and the middle area of the Saddle Road (Barrera 1983, 1987; Cox 1983b; Kam 1982, 1983; Kalima and Rosendahl 1991; Rosendahl and Rosendahl 1986). No archaeological sites, however, were encountered during these surveys

Mauna Kea Adze Quarry

The prehistoric basalt quarries near the summit of Mauna Kea were identified as early as the early 1800s (Goodrich 1833 IN McCoy 1977). The quarries have since been an area of interest (Alexander 1982; Brigham 1902; Cordy 1994; Emory 1938; Loo and Bonk 1970; Wentworth et al. 1935). The Mauna Kea Adze Quarry Site (4136) is listed on the NRHP and is a National Historic Landmark.

Significant research investigations have taken place at the quarries within the last two decades. Excavations in the quarry locality (Cleghorn 1982; McCoy 1977, 1982, 1990; McCoy and Gould 1977) have revealed layers containing midden, lithic reduction materials, and artifacts. Midden remains include shellfish and plants brought from lower elevations. Food plants included taro (Allen 1981, McCoy 1990) presumably brought from lower elevations. Radiocarbon dates in the quarry complex indicated initial use by about AD 1100 with more intensive use after AD 1400 (Cleghorn 1982). Use of the quarry diminished substantially prior to Western contact.

Shrines, consisting of large upright stone slabs, are in the quarry area (McCoy 1981, 1990). These features reflect the importance of ritual in association with the quarrying. Most of the shrines were conspicuously located near the workshops and above the entrances to rockshelters. Shelters were found in association with springs on the southern slope of the mountain just above the treeline (McCoy 1990). Subsistence debris, partially ground preforms, and hearths occur at these sites. These treeline camps probably were used while acclimatizing to the high elevation, and for gathering water, wood, and bird meat from the nearby springs and forests below (McCoy 1986). Radiocarbon dates indicate that these sites were occupied between AD 1100-1800.

North Hilo District

The project area crosses one *ahupua'a* within the North Hilo District, Humu'ula. The only previously identified site in the *ahupua'a* is the Humu'ula Sheep Station (Site 7119), which was investigated during earlier Saddle Road surveys (Rosendahl and Rosendahl 1986; Welch 1993). The sheep station includes single-story wood structures, pens, and rock walls at the perimeter of the station. Other investigations within the *ahupua'a* encountered no archaeological sites (Barrera 1983, 1987; Kalima and Rosendahl 1991; P. H. Rosendahl 1977).

South Hilo District

The project area crosses several *ahupua'a* within the South Hilo District: Waiākea, Pi'ihonua, Punahoa 2, Ponahawai, Kaūmana, and Kūkūau 2. These *ahupua'a* are substantially smaller than the others crossed by the project corridor. A number of archaeological sites have been recorded in these *ahupua'a,* and these are discussed below. Several surveys in these *ahupua'a* did not encounter any archaeological sites (Barrera 1983; Kalima and Rosendahl 1991; Rosendahl and Rosendahl 1986; Walker 1994).

Waiākea Ahupua'a

In the *ahupua'a* of Waiākea, the current project corridor extends from 975 m (3,200 ft) to 1,770 m (5,800 ft) elevation. Much of this area is covered in lava flows post dating the mid 1800s, with many flows dating to the 20th century. Consequently, sites encountered in the few investigations in this *ahupua'a* are historic. Wall segments near the main power line near Saddle Road may be the remains of a boundary wall or livestock enclosure (Barrera 1987). Survey and interviews with local informants for a project near the southern limits of the current project encountered 88 features in 11 sites (Hunt and McDermott 1993). It was determined that all of these features were historic constructions, associated with sugar cane cultivation and transportation.

Pi'ihonua Ahupua'a

The *ahupua'a* of Pi'ihonua is between 1,950 m (6,400 ft) and 550 m (1,800 ft) elevation. No archaeological sites have been located in the few investigations conducted near the Saddle Road in this *ahupua'a* (Barrera 1983, 1987; Rosendahl and Rosendahl 1986).

Punahoa 2 Ahupua'a

Water control channels are common features in these lower elevations (Sinoto 1975, 1980; Kelly 1982; Walker et al. 1996). One channel, located east beyond the current project boundaries, may be prehistoric (Kelly 1982), and another may be early historic (Walker et al. 1996). Historic sites in the area include structures related to domestic and corporate activities associated with the sugar cane industry, such as a cane-field house and the Hilo Chinese Cemetery (Athens 1982; Jensen 1991a; P. H. Rosendahl 1990a).

PHRI investigated two of the *'auwai* in this *ahupua'a* during an archaeological inventory survey in 1996 (Walker et al. 1996). The survey disclosed that "Site 20848 is possibly an early historic period ditch that provided water to downslope residential and agricultural sites, and Site 20849 is a more recent historic ditch that may have been built to channel run-off from the Pi'ihonua House Lots 3rd Subdivision" (ibid.:ii).

Ponahawai Ahupua'a

This *ahupua'a* extends from sea level, at Hilo Bay, to 860 m (2,820 ft) elevation. In 1992, PHRI conducted an archaeological inventory survey in a parcel called the Kaumana Property, located in the Land of Ponahawai (Goodfellow and Fager 1992). Located about 1.5 km northeast of the termination of the EX-4 alignment, the approximately 150 ha area contained five historic/modern archaeological sites consisting of a terrace, walls, and mounds.

Kaūmana Ahupua'a

The upper elevation of the *ahupua'a* of Kaūmana is at about 1,100 m (3,600 ft) and the lower elevation is at 223 m (730 ft). A reconnaissance-level survey conducted in Kaūmana, at 190 m elevation, encountered six clusters of sites, including stone alignments, terrace remnants, irrigation ditches, mounds, walls, and enclosures (Sinoto 1978). The sites were not tested, but many appeared to be prehistoric, while a few, especially the stone walls, appeared to be historic cattle or boundary walls.

Kūkūau 2 Ahupua'a

The *ahupua'a* of Kūkūau 2 is located between sea level, at Hilo Bay, and 1,160 m (3,800 ft) elevation. No prehistoric sites have been found during the few archaeological investigations in the portion of the *ahupua'a* near the current project area (Athens 1982; Jensen and Kalima 1990; Kelly 1982; M. L. K. Rosendahl 1988a) Potential historic sites nearby include a school, graves, taro pondfields, and houses, although these have not been confirmed through survey work (Athens 1982; Kelly 1982).

Summary of Previous Archaeological Work Pertaining to Site Distribution within the Project Area

Results of previous archaeological investigations conducted in the Saddle area of Hawai'i consistently emphasize that propositions concerning site distribution in these areas are based on very limited information from very few archaeological surveys. The West Side and Saddle areas may have been used as early as AD 1000, and have been used continuously since then (Streck 1986). The area was used more intensively between AD 1400 and 1540, a period corresponding to the development of the ranked hierarchical political system on the island (Athens and Kaschko 1989). The declining use of the region after AD 1540 may be due to the depletion of forest and birds, an important resource in the area (Athens and Kaschko 1989:94-97,99).

Prehistoric archaeological sites in these areas occur most commonly within or near sinkholes and other lava tube features. In part, cave features were preferred because of their retention of water (Cordy 1985). Some caves may have served as short-term habitation areas associated with movement through the region, while others were used for prolonged occupation during resource collection (Athens and Kaschko 1989; Cordy 1985). While the caves provide an indication of where people may have camped, resource collection probably took place over much broader forested areas. Trails constitute the other major feature type in these regions. Similar expectations for site distribution have been generated for the East Side *(Table 3)*, although there are no known prehistoric sites within or near the current project area.

The date and type of lava flow has some predictive value for locating archaeological sites (Hammatt and Shideler 1991:38). Although old (greater than two thousand years) *pāhoehoe* flows comprise only 10

Table 4. East Hawaii Island Settlement Zones (Adapted from McEldowney 1979)

Zone	Name	Elevation Range	Expected Site Types	Crops and Activities	Other Available Resources
I	Coastal Settlement	0 to 15 m elevation, or 1 km inland	Permanent villages and/or temporary habitation	Sea exploitation, aquaculture, marshland taro	Ash and organic soils for cultigens, fresh and brackish water
II	Upland Agricultural	15 m to 450 m elevation	Scattered huts with garden plots and tree species	Swidden agriculture, wet-dry taro, Mai'a	Kukui, hala, 'ōhi'a'ai, hau, ulu, 'ōhelo, ti, and pia.
III	Lower Forest	450 to 750 m elevation	Temporary huts, small religious structures, paths	Koa for canoes, catching birds for feathers	Mai'a, taro, ti, 'ie'ie, olanā, māmaki, uhi, hapu'u
IV	Rain Forest	750 to 1,700 m elevation	Temporary huts, paths, trails	Koa for canoes, catching birds for feathers	'ie'ie, olanā, māmaki
V	Subalpine or Montane	1,700 to 3,000 m elevation	Trails, possible reoccurring habitation in caves or huts	Historic exploitation of cattle and sandalwood	Māmane, 'ua'a (petrels), basaltic glass

percent of the PTA area, over half of the known archaeological sites occur on them. This correlation may be related to particular resources associated with the older *pāhoehoe* such as usable lava tube caves, fresh water, mature vegetative regime, and locales for particular bird species (Cordy 1985; Hommon and Ahlo 1983; Streck 1986).

The types of flora that occurred prehistorically within the project area also occurred in other, more populated parts of the island. Consequently, it has been suggested that it is unlikely that these resources were sought out for extraction and use as food or raw material (Hammatt and Shideler 1991:39), although it is likely that they were exploited locally. The *māmane-naio* forest was the location of birds, but the widespread distribution of the forest stands and the seasonality of the target birds complicate the utility of these factors in site patterning.

CULTURAL HISTORY, SETTLEMENT, AND LAND USE

The historical background of the project area is complex, because it covers various environmental zones over a period of more than two centuries. Information on the interior on the island of Hawaii from pre-contact times to about 1850 is summarized in the first section: *Early History of the Project Area.* The second section, *History of the Saddle Road*, deals specifically with the trails and developments that are directly related to what eventually came to be known as the Saddle Road. The bulk of the historical information on the project area dates from 1850 and has been developed in two sections that deal with traditional and non-traditional use after the Mahele: *Later History of the Saddle and West Side*, and *Later History of the East Side.* The history of the Saddle area is included with the West Side, based on the similarity in events associated with the grassland environment, as opposed to the forested lands in the East Side.

Early History of the Project Area

Up to the mid nineteenth century, the northern interior of the island – the Saddle and upper slopes of Mauna Kea above c. 1,370 m (4,500 ft) elevation – was exploited to a limited degree. Prior to the coming of Westerners, Hawaiians used the interior in several ways – for traveling across the island, for getting basalt at the Mauna Kea adze quarry (Ka-lua-kā-ko'i*) and processing it, for bird-catching, and probably as a place where prophets (*kāula*) sought communication with the gods.

Such traditional use of the area continued into the nineteenth century, but became less important. Through the nineteenth century, many Western explorers and travelers made trips into the interior, crossing the Saddle and climbing Mauna Kea. With the establishment of wild herds of cattle in the interior grasslands, both Western settlers and Hawaiians began to hunt them. Several earlier publications provide good discussions of early use of the interior: McEldowney (1979) for the East Side and Hommon and Ahlo (1983), Athens and Kaschko (1989), and Cordy (1994) for the Saddle.

Adze-making and Bird-catching

At the summit of Mauna Kea is the well-known adze quarry, which was extensively worked by Hawaiians because its dense basalt provided excellent rock for making adzes. Adze preforms were chipped out at the quarry and then were further processed at various workshop/habitation sites. Many processing sites near the quarry have been investigated; also investigated were two other sites a bit lower, on the south side of Mauna Kea, at Hopukani Spring and Liloe Spring (Cordy 1994:85-103.) All of the sites lie outside the project area, to the north. In the Saddle itself, most of the cave shelters investigated lie on the west side of PTA. An argument was made by Hommon and Ahlo (1983: 48) that the shelters were occupied by people bringing basalt from the quarry and working it in the shelters. However, later research has failed to discover any appreciable number of basalt fragments or adze blanks. Most researchers now assume the west PTA sites have no connection with the adze quarry, and were used instead to exploit birds (Athens and Kaschko 1989: 54; Cordy 1994:114). Recently, Welch (1993: *passim* especially pp. 85-87) has reported on a cave shelter (Site 50-10-31-5003), in the Saddle Road corridor (Ex-2) just south of Mauna Kea State Park, which does seem connected with the quarry. Excavation recovered numerous basalt flakes, indicating that the Hawaiians who used the cave were processing adzes. Welch's interpretation is that Hawaiians used the cave shelter on their return from the quarry to the lowlands, and did some processing while they stopped. There may be other such shelter-cave sites connected to use of the quarry in the area. The adze quarry presumably was in the *ahupua'a* of Ka'ohe, and all the processing sites so far reported lie within Ka'ohe. However, there is some evidence that not only Ka'ohe people exploited the quarry. Waiki, one of the witnesses to the Boundary Commission stated that his parents told him that Humu'ula people used to go up to the quarry to get adzes.† Local informants familiar with the Pu'u 'Ō'ō area told Dr. Langlas of a couple of caves there which contain adze fragments, including one called Ioane's cave (Bergin Int.).

The interior of the island in general was exploited for birds, especially perhaps the relatively large *nēnē*, *koloa*, and *'ua'u*, valued for their meat. The *'ua'u* nested in burrows or under rocks in the saddle area in great numbers in the nineteenth century. Lyons (1903: 25) indicates that it was mainly Ka'ohe where they nested, and Henshaw (1903:130-31) was told that they nested "in the lava." The plump juveniles were considered a delicacy by Hawaiians. They were pulled out of their burrows, carried down and presented to the *ali'i*. Archaeologist Eric Pearthree (personal communication) reported finding a "layered, easily broken" lava flow in the central part of PTA which appears to have been a nesting place for *'ua'u*, exploited by Hawaiians. The flow seems to have been dug up, and a habitation cave in the area contains *'ua'u* bones. By 1900, the *'ua'u* were practically gone from the Saddle, having been eliminated by mongoose (Henshaw 1903:131). Although the PTA area may have been a rich area for *'ua'u* it was not the only one. Boundary Commission testimony mentions catching *'ua'u* at the top of the Kohala mountains and on the slopes of Mauna Loa. In 1954, Richardson and Woodside (1954) found nesting

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* *See TCP supplement page 11 for discussion of this Hawaiian name.*

†*Note however that Waiki's testimony might be considered suspect. He was one of the men who guided the first survey of Humu'ula by Wiltse and who claimed that the boundary of Humu'ula went up to the adze quarry at the summit of Mauna Kea. Other witnesses denied that claim.*

sites and recently killed birds on the east and south slopes of Mauna Kea, at 2,740–3,050 m (9,000–10,000 ft) elevation.

Athens and Kaschko (1989: 85–90) investigated sixteen archaeological sites in the western part of Ka'ohe (MPRA section, Pohakuloa Training Area), south of the Saddle Road. They argue that the sites were occupied on a short-term basis by birdcatchers. They recovered a large quantity of *'ua'u* bone, and lesser quantities of *nēnē* and of forest birds. Forest birds caught for their feathers - the *mamo, 'o'o, 'i'iwi, 'o'u, 'apapane,* and *'amakihi* - were probably commoner in the windward *'ōhi'a* forest than in the Saddle, but were also caught in Humu'ula and Ka'ohe. Scott et al. (1986:106-7,159,164) note that three of the feather birds, the *mamo*, the *'ō'ō* and the *'i'iwi*, moved into *māmane* forest (found in both Humu'ula and Ka'ohe) to feed during the blooming season. According to Athens and Kaschko (1989: 24-5) ornithologist Kjargaard states that *'i'iwi, 'apapane,* and *'amakihi* are still found in the Pohakuloa Training Area, mainly in *'ōhi'a* forest.

Historical evidence as well as archaeological evidence indicates that Ka'ohe and Humu'ula were exploited by birdcatchers, just as the uplands of the East Side and West Side were. An early map refers to a story about Naohuleelua at the southeast corner of Ka'ohe, said to be the "scene of battle between Hāmākua and Kona birdcatchers, settled with bows" (Map Reg. 1641, 1891). The Boundary Commission testimonies make clear that birdcatchers were active in Humu'ula, on the *pili* and *māmane* lands situated above the woods that lay on the *makai* (shoreward) side of Humu'ula:

> I used to go bird catching on Pi'ihonua with Malo and others. Humuula people catching birds outside of the woods, and Pi'ihonua people catching them to the mauka edge of the woods. That was the boundary and my kupuna told me fights used to occur if the Humuula men went below the edge of the woods or if the Pi'ihonua people went above them. (Testimony of Kamalo, BC Book B: 22-23)
>
> [I] used to go onto Humuula after birds. . .If folks from the makai lands came after birds in the mamane, the Humuula people would take them from them, and if we went into the bush after birds, the people of the makai lands would take them away from us. (Testimony of Hanioa, BC Book B: 44-45)
>
> In olden times only three men [the men of three lands?] ran after Uau on the mountain along the side up Kaohe above, Humuula below and Piihonua the foot of the mountain. (Testimony of Hoakimoa, BC Book D: 53)

The historical evidence is not specific as to the birds that Hawaiians caught in the Saddle, aside from the last reference to *'ua'u*. It seems likely that the larger meat birds were a more important resource than the feather birds. In addition to the *'ua'u, kōloa* (Hawaiian duck) and *nēnē* (Hawaiian goose) were also present in the area. G.T. Allan (Anon 1847b) describes hunting for *nēnē* in the eastern saddle area, where they fed on wild strawberries near pools of water. W. D. Alexander (1892) says that both the *nēnē* and the *kōloa* were found near Kala'i'ehā in the "Middle Ground," the name used then for Kīpuka 'Ainahou. Probably *kōloa* frequented some of the upland ponds because they were called *wai kōloa* (duck ponds) (see BC Book B: 34 for ponds in Hakalau, near the Humu'ula boundary; see McEldowney [1979:29] for ponds in Pi'ihonua near the Humu'ula boundary).

Western Explorers

Many Western travelers trekked through the interior of the island during the nineteenth century, with the aim of exploring the Saddle or climbing Mauna Kea *(Table 5)*. Generally the travelers' accounts are frustratingly vague about what they saw and it is not even possible to be sure what trail they took.

Table 5. Eighteenth and Nineteenth Century Western Travelers in the Interior

Year of Visit	Traveler	Route	Reference
1794	Archibald Menzies	Hualalai–toward Mauna Loa–Kealakekua	Menzies 1920:163-7
1822	Joseph Goodrich	Waimea–Mauna Kea, prob. from West side up ravine	Ellis 1963:289-91
1823	Blatchely and Mr. Ruggles	Hilo–Mauna Kea	Ellis 1963:291-2
1825	James Macrae	Laupahoehoe–Mauna Kea from north	Macrae 1922:47–60
1826	Joseph Goodrich	Hilo–Mauna Kea	Ellis 1963:292
1830	Hiram Bingham	Kilauea–Waimea–Kealakekua	Bingham 1955:394-398
1830	G. P. Judd	Mauna Loa–Mauna Kea	Hommon & Ahlo 1983:27, reference to P. McEldowney notes on personal communication from Dr. C. Judd on unpublished Judd diary held by Judd family
1833	William Patterson Alexander and Mr. Armstrong	Waimea–Mauna Kea via Keanakolu–Volcano	Alexander 1934:127-30
1834	David Douglas	Hilo–Mauna Kea	Hooker 1839:396-407
1840	Hall's party, Wilkes expedition	Kailua–Ahu a 'Umi-toward Mauna Kea and along its southern base, south to Volcano	Wilkes 1845:99-102
1841	Charles Pickering and W. D. Brackenridge	Hilo–Mauna Kea	Pickering nd:169-177
1847	G. T. Allan	Waimea–around Mauna Loa	Anonymous 1847a,b
1873	Isabella Bird	Waimea–Kala'i'ehā	Bird 1974:231-33
1889	E. D. Baldwin	Hilo–Pu'u 'Ō'ō–Mauna Kea	Baldwin 1890:59 (See Map Reg. 718)
1891	W. D. Alexander	Waimea–Kala'i'ehā–Mauna Kea	Alexander 1892

Cattle-hunters

As the mid-elevation slopes of Mauna Kea were covered with *pili* grass mixed with *māmane* trees, they provided a natural pasture where wild cattle multiplied. Cattle (along with sheep and goats) were first released by Vancouver in 1792. Ellis (1963[1827]: 291) indicates that wild cattle were already numerous on Mauna Kea when he traveled Hawaii Island in 1823. They became a target for "bullock-hunters" who killed them for their hides and tallow, usually leaving the meat to rot. They were shot, trapped in pits, or driven into corrals that had long wings to entrap them. The earliest hunters seem to have been Westerners, such as John Parker, who was already hunting cattle for the king when Ellis passed through (Ellis 1963 [1827]: 274). On his 1834 ascent of Mauna Kea, botanist David Douglas met two partners from Hilo, James Castle and a Mr. Miles, who had a lodge in Humu'ula above the forest near Pu'u 'Ō'ō. Castle and Miles were engaged in killing cattle and drying the meat (Hooker 1839: 400). While Castle and Miles operated at Pu'u 'Ō'ō in the 1830s, G. A. Simmons and Ned Gurney operated at Lahohinu, near Keanakolu (BC Book B:30). In his 1873 testimony to the Boundary Commission (BC

Book B:30), Simmons says that the cattle are killing the trees and have pushed the forest line shoreward in the last twenty years.

Native Hawaiians became cattle hunters a bit later, including Waikiiliilii and Hoakimoa, natives of Humu'ula who gave testimony to the Boundary Commission in 1873 and 1891, respectively (BC Book B:53, Book D:52). In 1841, Pickering (n.d.:170-1), while climbing Mauna Kea from Hilo, came across Hawaiians drying beef. This was at about 1,520 m (5,000 ft) and probably in Pi'ihonua. Farther on he reported seeing a ruined cattle pen near a "bed of clinkers" and Castle's now-abandoned lodge near Pu'u 'O'o. Probably the cattle-hunting business was no longer so productive by that time; 1841 was the year that Governor Kuakini placed a five-year *kapu* on killing wild cattle because so many had been killed (Brundage 1971:9). Castle was again shooting wild cattle "a great deal of the time" in 1853-54, according to testimony of Frederick Lyman (BC Book B:58-59).

Ranching began in Waimea in the mid-nineteenth century with Mexican *vaqueros* arriving in 1832 (Brennan 1978). Native Hawaiians learned the ranching techniques and participated in the growing demand to supply meat to South America and the whaling boats. Many wild cattle were still being killed for their hides up to 1900 (Brundage 1971:15; Wellmon 1969:1834). When the Waimea Grazing Company leased Humu'ula from Kamehameha III in 1862 (Map Reg. 668), it bought the right to kill the wild cattle there (LF, R. A. Lyman letter, Nov. 9, 1869). Isabella Bird (1974:233) wrote that on her 1873 journey there were many wild cattle on Mauna Kea and many men, ". . .who live half savage lives in the woods, gaining their living by lassoing and shooting these animals for their skins." Still later, Eben Low described the killing of wild bulls for their hides up on Mauna Kea in the 1900s (Hobbs 1939:97-101). By that time, the animals were roped from horseback and killed with a knife. Low said that rifles were "prohibited" because they would scare the animals away and spoil the hides by making holes in them.

Trails

It is difficult to determine where prehistoric trails ran through the northern interior, or even how many trails there were. McEldowney (1979: 29) makes this point after examining the evidence for trails running up into the Saddle from Hilo. Neither historic accounts nor archaeological surveys provide firm evidence for the prehistoric trails. Some prehistoric trails have surely been covered by historic lava flows and others have been replaced by historic trails or roads, so that historic accounts of trails used don't necessarily reflect the prehistoric trails in the area. Archaeological surveys have been limited in extent. Moreover, the physical evidence of a "trail" is often itself limited. Judging by the accounts of those who have taken old trails in open country (Paris and Ah Sam Ints.; Eric Pearthree, personal communication) the evidence is discontinuous. There was probably no built trail over grassland or *pāhoehoe* lava flows, only a route between known land marks. That is presumably the reason why early travelers (e.g., Bird 1974 [1890]: 231) sometimes say there was "no trail." Where the trail goes over a rougher *'a'ā* flow, the trail becomes evident because it was cleared to make for easier travel.

Figure 3 shows a network of nine probable early trails through the interior, based on accounts by historic travelers, early maps, and trail descriptions by archaeologists and informants. The evidence for the various trails is summarized below. Often the evidence is late, and prehistoric use of the trail can only be conjectured.

Waimea to Kala'i'ehā/Pu'u 'Ō'ō Trail (A on Figure 3) - The route of the present Saddle Road is probably the approximate route of a prehistoric Hawaiian trail, the Waimea to Kala'i'ehā/Pu'u 'Ō'ō Trail. It is the route taken by many nineteenth century Western travelers from Waimea into the Saddle, including G. T. Allen in 1847 (Anonymous 1847a,b). The accounts of the travelers are not specific about where the trail ran. The earliest evidence found for this trail is a drawing of the eastern portion of the trail on Witlse' 1862 Humuula Survey map. By 1873, the trail had already become a "cart road,"

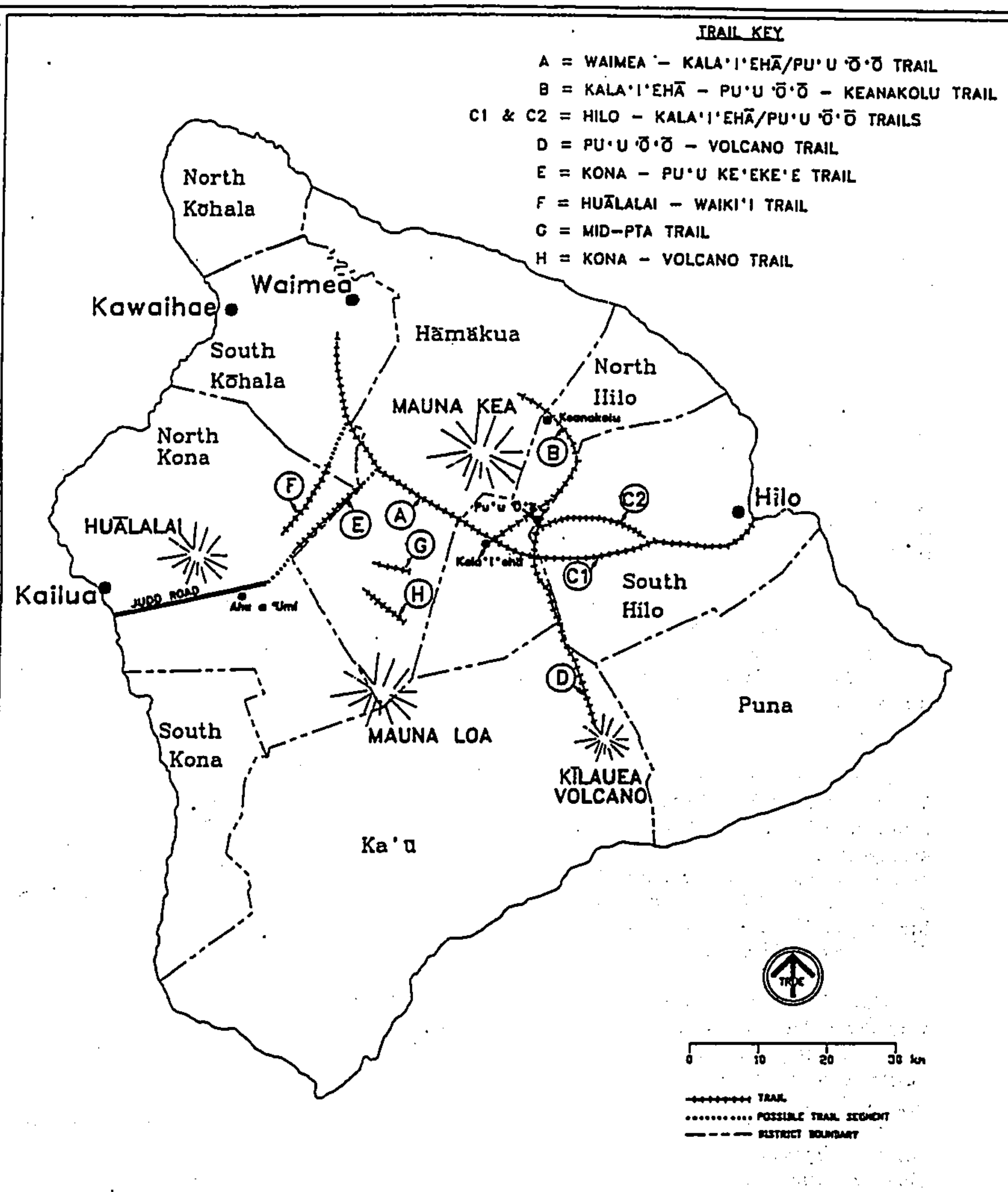

Figure 3. Early Trails Through the Interior of Hawai'i Island

according to testimony given to the Boundary Commission (BC Book B:41). (See also Alexander 1892:7, who calls it a "wagon road.")

Kala'i'ehā to Pu'u 'Ō'ō to Keanakolu Trail (B on Figure 3) - The present Mānā-Keanakolu Road is probably the route of another prehistoric Hawaiian trail, the Kala'i'ehā to Pu'u 'Ō'ō to Keanakolu Trail. It is the likely route taken by G. T. Allan on his return to Waimea from the Saddle in 1847. Early evidence for the trail includes a drawing on the Wiltse map and a description in the 1873 Boundary Commission testimony (BC Book B: 31, 43, 45, 52). *Kama'āina* (natives) of Humu'ula describe the "old road" as leading from Keanakolu along the eastern boundary of Humu'ula to Pu'u 'Ō'ō. The trail also appears on maps drawn at the end of the nineteenth century (Reg. 1848, 1895; Donn Map of Hawaii, 1901).

Hilo to Kala'i'ehā/Pu'u 'Ō'ō Trail (C1 and C2 on Figure 3) - The best-known nineteenth century trail, the Hilo to Kala'i'ehā/Pu'u 'Ō'ō trail was built over the 1855 lava flow and therefore is relatively recent. There is some evidence for two earlier trails, but the routes are only described approximately. One trail (c1) is described as an "old road" by *kama'āina* of Pi'ihonua and Kūkūau 1 (BC Book B: Manuia testimony, pp. 23-4, Kapu testimony, p. 163). It ran from Nahuina at the top of Ponahawai, up along the Pi'ihonua boundary to Mawae (and presumably on to Humu'ula). Another trail (c2) was taken by the Western botanists Douglas, in 1834, and Pickering and Brackenridge in 1841. It takes a more northerly route. Part way up from Hilo the trail hit the Wailuku River and followed it northwest, then turned southwest again to Waikōloa and Pu'u 'Ō'ō (Hooker 1939; Pickering n.d.: 169-172; McEldowney 1979: 29, apparently referring to Brackenridge's journal).

Pu'u 'Ō'ō to Volcano Trail (D on Figure 3) - This trail appears on the 1924 Kilauea Quadrangle, but not on earlier maps. Informants describe its use for driving cattle in the early twentieth century after the establishment of Pu'u 'Ō'ō Ranch. It seems likely that the route followed an earlier prehistoric trail, described in 1873 Boundary Commission testimony by Kenoi at Kapāpala (BC Book A:4). It is probably the route taken from Mauna Kea to Kilauea by Alexander in 1833, and by Hall's party of the Wilkes expedition in 1840 *(see Table 4)*.

Kona to Pu'u Ke'eke'e Trail (E on Figure 3) - This is a probable trail that parallels the jeep road known as Bobcat Trail Road. The trail runs just northwest of the road and the Ka'ohe/Pu'uanahulu boundary and meets the Waimea-Kala'i'ehā Trail above Pu'u Ke'eke'e. Athens and Kaschko (1989: 42-44, Figure 5, p. 53) describe the evidence for it as a prehistoric Hawaiian trail. Three trail segments have been described by archaeologists (Sites 5008, T-110, and 5009) and the southern portion of the trail appears on early USGS Quadrangle maps (Naohuleelua 7.5 Minutes, c. 1927; Waikii and Kaohe 15 Minutes, 1930). Athens and Kaschko argue that this trail connected on the southwest to another trail, the forerunner of Judd Road.

Hualālai-Waiki'i Trail (F on Figure 3) - This is a probable prehistoric trail which runs parallel to the Kona to Pu'u Ke'eke'e Trail, but farther northwest. Segments of the trail appear on early USGS Quadrangle maps (Keamoku 7.5 Minutes, c. 1927; Kaohe 15 Minutes, 1930). Archaeologist Eric Pearthree, who surveyed the area, describes the middle portion as a curbstone trail (Pearthree, personal communication). At the southwest end the trail may include the curbstone trail segment designated as Site 5006 (Cordy 1994: 112, Figure 52, p. 110). Mr. Pearthree also surveyed an area farther east, and noted an alignment of three *ahu* which may mark an extension of the trail east of the Keamoku flow, although there is no visible trail there (Pearthree, personal communication). Informant Bill Paris (Interview [Int.]) described a trail known to his uncle, Eben Low, which seems to be the same trail. It was said to lead from the back of Hualālai toward Waiki'i. Informant Henry Auwae also described the trail as one known to him, and he called it the Alakahuamoe (Int. 9). The curbstones indicate the trail was constructed during the historic era for travel on horseback, probably in the mid-nineteenth century when other interior trails were improved, such as the "Judd Road" (Apple 1965). This curbstone trail might have been an improvement of an earlier prehistoric trail in the same location, or more likely was built as an alternative to the Kona to Pu'u Ke'eke'e trail.

Mid-PTA Trail (G on Figure 3) - This is a possible prehistoric trail which runs parallel to the Waimea-Kala'i'ehā Trail, but further south. A trail segment appears on the 1930 USGS Ka'ohe Quadrangle over the Keamoku flow. Farther east is an alignment of three *ahu* without trail paving, which, according to archaeologist Eric Pearthree (personal communication), appears to mark a trail. Whether these three *ahu* are the remnants of Mid-PTA Trail is unclear.

Kona-Volcano Trail (H on Figure 3) - Three segments of trail are shown on the 1930 USGS Humuula Quadrangle. The segments align to indicate a possible prehistoric trail extending from the Kona side of Ka'ohe, southeast across Pohakuloa Training Area, toward Volcano.

These trails across the Saddle or along the northern base of Mauna Kea were of importance because the open interior provided the easiest way to get from the one side to the other. Coastal routes were longer and sometimes more difficult. The coastal route north from Hilo, for example, required crossing numerous gorges. The Saddle and northern base trails were probably used to go across the island by small parties of travelers, by *kūkini*, runners who carried messengers for the chief, and by war parties. Kamakau (1992) describes four instances of army movements prior to 1800 as follows:

1. 'Umi's army traveled to Mauna Kea and thence down to the top of Kaūmana and to Hilo to fight the Hilo chief Kulukulu'ā. (pp. 16-17)

   "It was shorter to go by way of the mountain to the trail of Poli'ahu and Poli'ahu's spring at the top of Mauna Kea and then down toward Hilo. It was an ancient trail used by those of Hāmākua, Kōhala and Waimea to go to Hilo." [Note: Certainly they did not go up to the summit. Cordy 1994:87 assumes they took the trail north of Mauna Kea, but they could have taken the trail through the saddle.]

2. Keawenui-a-'Umi brought an army from Hilo side to Kona to fight his brother Kali'iokaloa-a-'Umi. His warriors from Hilo, Puna and Ka'ū met at Kīlauea and they traveled through the Saddle on "the mountain road" between Mauna Kea and Mauna Loa to the north flank of Hualālai, where the met in battle near Ahu-a-'Umi. (p.35)

3. Kamalalawalu of Maui brought his army against Lono-i-ka-makahiki of West Hawaii (excluding Hilo and Hāmākua). The two armies met at Waimea, the warriors of Kona coming up from Hu'ehu'e and the warriors of Puna and Ka'ū coming "down from Mauna Kea" [presumably having come through the Saddle from Kilauea]. (p. 58)

4. At the battle of Moku'ōhai in 1782 Kamehameha killed Kīwala'ō, but was contesting with Keōua Kuahu'ula for the rule of Hawaii. Sometime afterward, Kamehameha brought his warriors "over the mountain" from Kona to Kilauea to fight the warriors of Keōua waiting at Kapāpala in Ka'ū. (pp. 124-5)

It is clear that the warriors took a route through the Saddle in three and possibly four cases, but one cannot be certain which route.

History of the Saddle Road

There was an early attempt to build a cross-island road in the nineteenth century. Under Kamehameha III, the Privy Council allocated money for the building of a road from Kaumalumalu in Kona through the Saddle toward Hilo, which became known as the Judd Road. In 1849 Government Minister Gerritt Judd and Kamehameha III sailed to Hawai'i Island to initiate the project (Elwes 1854:193-5). The roadwork was supervised first by Kinimaka and then by S. Haanio (LF letter from Isaac Davis, May 15, 1851). Work stopped when the road was about "two miles" above Ahu-a-'Umi, short of Ka'ohe and the 1859 lava flow. Bryan (1960) says that Benjamin Macy began building (or perhaps improving) a trail from Hilo toward the Saddle at about the same time. No further government attempts were made to build a cross-island road until World War II.

The corridor of the present Saddle Road is probably the location of an old Hawaiian trail, as previously described. The western section of the trail from Waimea to Kala'i'ehā (Humu'ula Sheep Station) had become a "cart road" by 1873. Informants Roy Blackshear and Bill Paris took it by car in the early 1930s. It was only a dirt road through the pasture then and in rainy weather it turned to mud. Mr. Blackshear described his first trip on the road up to Pu'u 'Ō'ō ranch above Hilo, owned by his grandfather. Because there was no road up from Hilo, they drove all the way around through Waimea and back east through the Saddle:

> The first time I went to Pu'u 'Ō'ō was about 1931. But at that time, of course there was no Saddle Road there, and to get to Pu'u 'Ō'ō Ranch we left Kea'au before sunrise in the morning, traveled north along the Hamakua Coast, going through all the valleys and small bridges and so on and finally we reached Waimea and had lunch at Waimea. And then we continued from Waimea along the Mamalahoa Highway. Out to where, I think it was just about where the present Saddle Road takes off. I just might mention our means of transportation was a 1931 station wagon that Herbert had the Ford Motor Company make specifically for him. It had a bigger engine and had compound low in it. Very, very low gear. And of course any car going up at that time would have to carry chains because they did run into mud. Anyway, so we stopped at Waiki'i radio station and talked to Mr. Buzzard and then just beyond there they had a trough that the horses and cattle drank out of. So they would fill up the radiator with the water and fill their [tanks]. They carried extra tanks of water. And then we headed on east from there, climbing all the time.
>
> So then we continued on and we reach Humuula sheep station. And they put more water in the radiator. And then we started from there up towards the Keanakolu road, and about – oh I don't know, I guess it was about three or four miles – we left the Keanakolu road and started down through the pasture. It took us all day to get there. And then we came down over the pasture to Pu'u 'Ō'ō Ranch. And I recall it had been raining and just before we got to – they called it the Pu'u 'Ō'ō gate – the car got stuck as we went through the gate and my grandfather said, let's get out and you and I will walk up to the ranch house. And we walked to the ranch house and they got the car out. So even with chains and compound low and everything they would get stuck occasionally.
>
> It was like a trail. And, really that's what it was. I mean you just go over, over the pasture and if they saw a place where the ruts in the road were too deep, well they just circle, go around it. (Roy Blackshear Int.)

The cart road in 1920 took approximately the same route as the present Saddle Road. It left the Waimea/Kona road at Pu'u Nohona'ohae and went through Waiki'i village to The Saddle (Kimura Int. 1, Greenwell Int. 1). The cart road began a little farther north, however, passing to the north of both Pu'u Nohona'ohae Iki and Pu'u Nohona'ohae Nui. Later the manager of Parker Ranch, A. W. Carter, got the entrance of the road moved so that it passed between Pu'u Nohona'ohae Iki to the north, and Pu'u Nohona'ohae Nui to the south (Greenwell Int. 1)*. In the saddle area, the old cart road ran directly east from Pōhakuloa to Kala'i'ehā (Humu'ula Sheep Station), running north of Pu'u 'Ōma'okō'ili and Pu'u Nēnē instead of jogging south of them and then east.

The eastern section, from Kala'i'ehā down to Hilo, remained a trail until World War II, except at the Hilo end. Informants say that "Kaumana Road" was built (paved) up to the Country Club Road intersection in Kaūmana by the "FTRA" about 1936. From there to the 'Ōla'a Flume Road (about milepost 8) it was an (unpaved) wagon road until World War II and above there a horse trail (Kaumana group Int.).

The Saddle Road was built by the Civilian Conservation Corps (CCC) and the U. S. Army Engineer District, Honolulu (USED, now called the U.S. Army Corps of Engineers) during World War II in order to provide an access route in case of Japanese invasion. The army had a camp right below the flume road and barred everyone who didn't work there from traveling up into the interior (Fujii Int.). Henry Auwae ran the lead bulldozer to clear the road in 1943, coming up from Hilo on the 1881 and 1855 lava flows (Auwae Int. 4) and choosing a route which kept to no more than a 6% grade. Cinders were then hauled down from Humu'ula toward Kaūmana by the CCC and later the USED, then oiled to make a narrow "gravel" road (Imoto Int.; Kaumana group Int.). The west section of the road was paved right after the war (Paris Int.). The east section of the road was not paved until later, about 1949. At that time the road was moved at several points to cut off some large loops (Ah San Int.; Bergin Int.). These old loops still exist, including one north of the road around milepost 9 and another around milepost 22.

Later History of the East Side

Traditional Hawaiian Use in the Nineteenth Century

In the Mahele of 1848, the various *ahupua'a* were awarded to the crown, to the government, or to high-ranking *ali'i*. The *ahupua'a* within the East Side of the project area were awarded as follows. Kūkūau 2 went to Hu'eu Davis (son of Isaac Davis). Ponahawai, Pi'ihonua, and Waiākea went to the crown. Punahoa 2 went to the American Board of Commissioners for Foreign Missions, the Congregational mission. Kaūmana (earlier called Ka'aumana) was unassigned. It was later claimed by Lot Kamehameha, whose claim was inherited by Ruth Ke'elikolani and in turn by Bernice Pauahi Bishop. As a result of a dispute about the ownership of various Bishop Estate lands after the death of

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**The following excerpt from Rally Greenwell's interview explains how the road was moved:*

RG: This is the old road, the old road used to come down and I guess this is big Nohonohae and there's another little hill here they call small Nohonohae or Nohonohae Iki. The right of way came down like that.
CL: On the Waimea side [of Nohona'ohae Iki].
RG: That's right, Waimea side. That was a public right of way. So as I said that people [were] going up to Waiki'i and Mr. Carter didn't want them coming up but it was a public right of way, all the way up. So in order to sort of stop them coming up he changed the bottom end of the road and instead of coming this way it came across here [on the Kona side of Nohonohae Iki, between the two hills]. And then he put a locked gate on this. There was still a gate here but it was still unlocked because public right of way you couldn't lock the gate. But they never repaired this road. Parker Ranch repaired this [private] road and did a good job. So all the ranch employees go through the locked gate and up and the public did not want to go through the rough road. So that kind of stopped the people from going to Waiki'i.

Pauahi, Kaūmana was turned over to the government in 1890 (Indices of Land Commission Awards by Awardee:48-49).

After the *ahupua'a* were awarded to the high-ranked, the *maka'āinana* (commoners) were allowed to claim the lands they cultivated, called *kuleana*. Kuleana were awarded within all of the *ahupua'a* under consideration, with the possible exception of Punahoa 2. Almost all of those *kuleana* were located near Hilo Bay and well below the project area. The exception is LCA 4983, located at about 275 m (900 ft) elevation at the *makai* (downslope) tip of the *ahupua'a* of Kaūmana and just below the project area. The lack of *kuleana* claims in the *mauka* (upslope) area is an indication that the area was of lesser importance.

Traditional Hawaiian land use in the area in the early nineteenth century can be determined from the testimony given by elderly kama'āina to the Boundary Commission in 1872-3 for the various ahupua'a. In 1873, there had been only limited change in use of the mauka forested region and the witnesses spoke mainly of traditional Hawaiian use and landmarks. Figure 3a shows the sites named by the kama'āina (BC Book 1:104-6, Book 2:1-27, 160-66). All place names appear as they do in the testimony, without diacritical marks. The locations are approximate, except for a few names that appear on old maps, namely Mawae, Kahiliku, Waialoa [or perhaps Maialoa], Kaapa, Kapuapilau, and Puuakokoke. Kahawaialena can also be located because of its description as a stream which crosses Ponahawai and then turns west and becomes the Ponahawai/Punahoa 1 boundary. The testimony consistently gives the name Kaaumana [Ka'aumana] for the ahupua'a now known as Kaūmana. Interestingly, the testimony indicates a boundary for Punahoa 2 (awarded to the Congregational missionaries at Hilo) different from the one which was established by the commission. The kama'āina all indicate that Punahoa 2 ended at about the same point as Punahoa 1, rather than extending farther inland (See BC Book A:105-106, Book B:20-22).

Figure 4 a presents information on land use from about 274.5 m (900 ft) elevation up, as derived from the testimony. In Kaūmana-Ponahawai the forest began at about 340 m (1,100 ft) elevation. The tree line shown on the map approximates the tree line shown on an 1895 map (Reg. 1748) and also matches the locations given in the testimony. Below the forest was a relatively open *kula* where the main crops were grown by shifting cultivation. The *kama'āina* give the names of many *kauhale* (house compounds) within the forest up to about 760 m (2,500 ft), especially on the Kaūmana-Ponahawai boundary. These forest *kauhale* are associated with cultivation of yams (up to about 430 m; 1,400 ft), then cultivation of bananas and canoe making (up to about 610–760 m; 2,000–2,500 ft). Above 760 m (2,500 ft) (and sometimes lower down in the forest) are *kauhale* associated with bird-catching. The place Halehaleokalani, up above the top of the *ahupua'a* of Kaūmana is described as a place "where the birdcatchers used to meet the ones who carried up the food" (BC Book B:20). This is an indication that those who caught birds far up in the forest were supplied with food by others. At the *mauka* boundary of Pi'ihonua sleeping caves that were presumably used by the birdcatchers are described, as well as a few *kauhale*.

There were probably a number of *heiau* in the upland forest associated with canoe-making and/or bird-catching. One upland *heiau* is named in the Boundary Commission testimony for the East Side - Ahuliipe, on the boundary of Kūkūau 1 and Waiākea *(Figure 4)*. The place called Paalaau (or Polaau) on the boundary of Kaūmana and Kūkūau 2 may have been a *heiau* as well. It is described in the testimony as: ". . .thence to Polaau, a very large ohia tree now fallen down, where the natives used to worship. . . " (Testimony of Kaluahine, BC Book B:7). The site is probably quite near the alternative E-3 corridor, above the former Hilo Country Club, but covered by the 1881 lava flow. There is evidence for two *heiau* in the *ahupua'a* of Pi'ihonua. Thrum (1908:40) gives the name of Papio, in "Piihonua, back in the forest; a *heiau* for canoe builders and bird catchers." Based on Thrum's information, Hudson (n.d.:229ff) attempted to locate Papio in 1930. An informant to Hudson, John Akau, thought it was near Laiaole Falls in the Wailuku River, but Hudson could find no remains of it when he searched there. Henry Auwae (Int. 4) mentioned a *heiau* named Po'ipo'i that he knew of below Laumai'a on the Pi'ihonua/Humu'ula

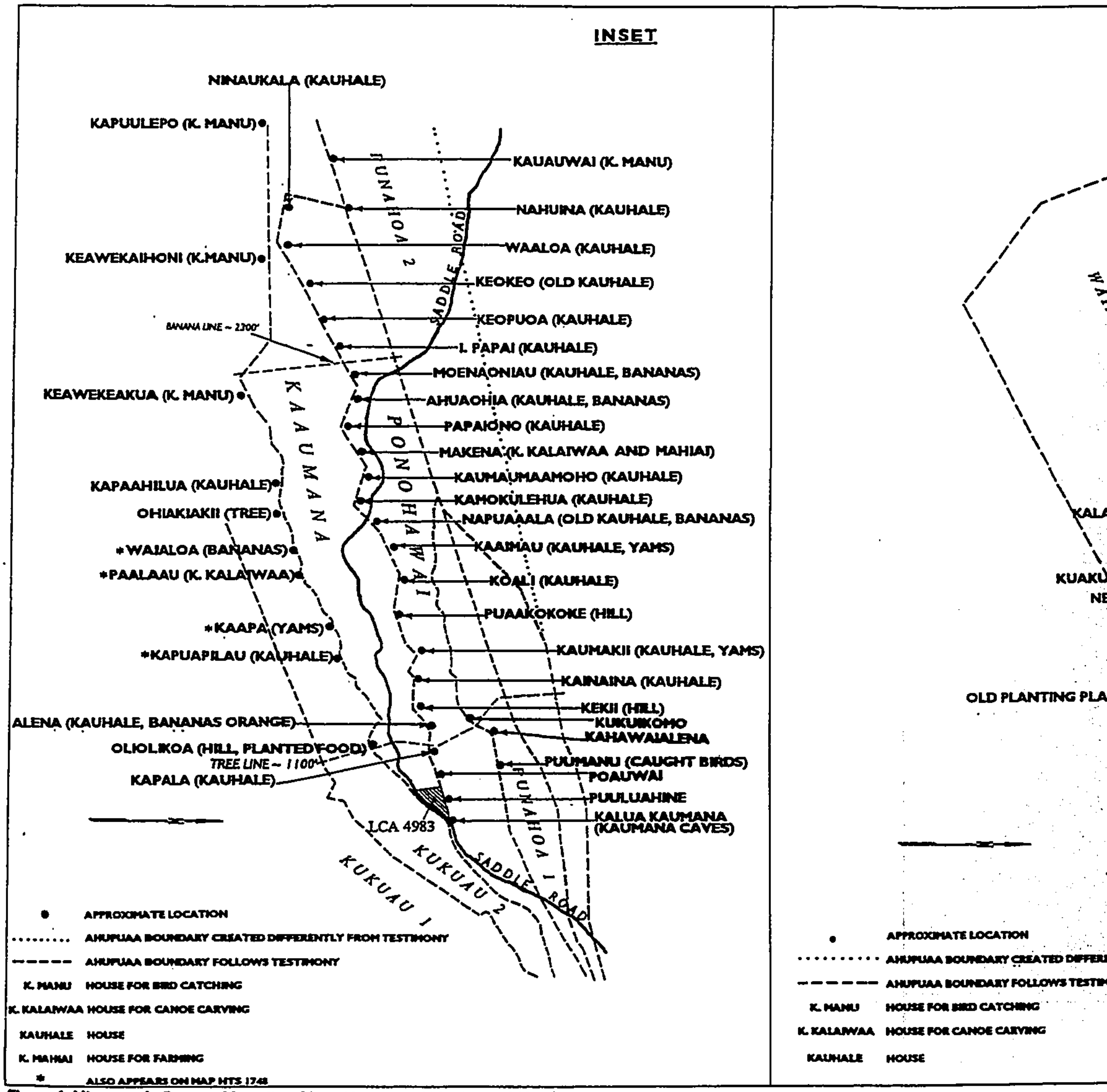
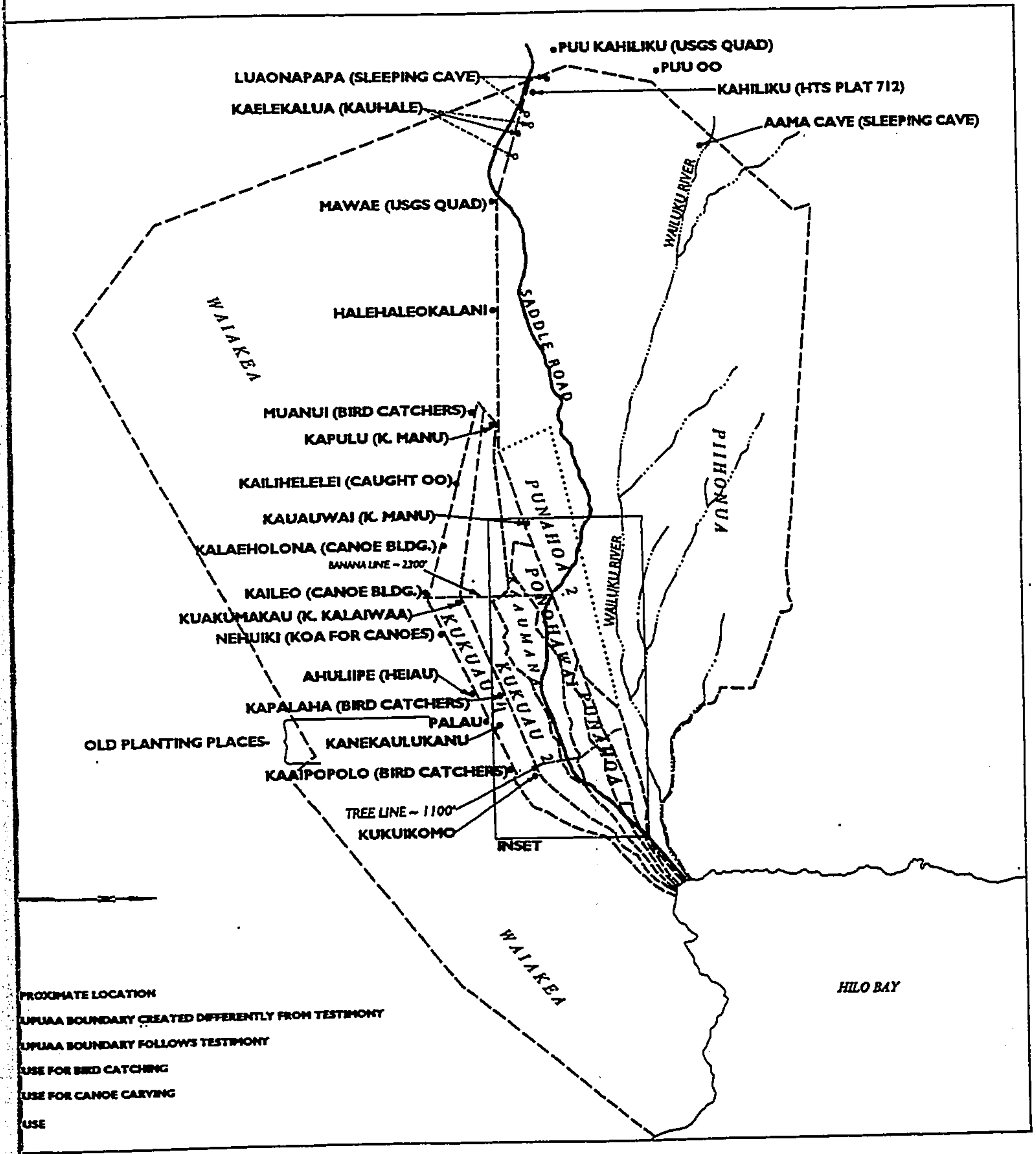


Figure 4. Nineteenth Century Hawaiian Place Names and Traditional-Use Areas



PUU KAHILIKU (USGS QUAD)
PUU OO
LUAONAPAPA (SLEEPING CAVE)
KAHILIKU (HTS PLAT 712)
KAELEKALUA (KAUHALE)
AAMA CAVE (SLEEPING CAVE)
WAILUKU RIVER
MAWAE (USGS QUAD)
HALEHALEOKALANI
SADDLE ROAD
WAIAKEA
MUANUI (BIRD CATCHERS)
KAPULU (K. MANU)
PIIHONUA
KAILIHELELEI (CAUGHT OO)
PUNAHOA 2
KAUAUWAI (K. MANU)
KALAEHOLONA (CANOE BLDG.)
BANANA LINE ~ 2300'
WAILUKU RIVER
KAILEO (CANOE BLDG.)
PONOHAWAI
KUAKUMAKAU (K. KALAIWAA)
KUMANA
NEHUIKI (KOA FOR CANOES)
KUKUAU 1
KUKUAU 2
AHULIIPE (HEIAU)
PUNAHOA
KAPALAHA (BIRD CATCHERS)
PALAU
OLD PLANTING PLACES
KANEKAULUKANU
KAAIPOPOLO (BIRD CATCHERS)
TREE LINE ~ 1100'
KUKUIKOMO
INSET
WAIAKEA
HILO BAY
PROXIMATE LOCATION
UPUAA BOUNDARY CREATED DIFFERENTLY FROM TESTIMONY
UPUAA BOUNDARY FOLLOWS TESTIMONY
USE FOR BIRD CATCHING
USE FOR CANOE CARVING
USE

boundary. Mr. Auwae also described three other ritual sites on the East Side and fairly near the project area, although he did not call them *heiau*. They are covered later in the report in the section on traditional Hawaiian cultural sites.

On the East Side, the hunting of birds for feathers continued through the nineteenth century. About 1870, Kamehameha V placed a *kapu* on the birds of Pi'ihonua, probably because they were becoming scarce as a result of the use of shotguns. A petition from Manuia and other residents (LF Document No. 89) requests that the *kapu* on the *'ō'ō* and the *mamo* be lifted. Not long after, both species were hunted to extinction on Hawai'i island. The last substantial population of *mamo* was apparently shot in 1880, by hunters who went up to the Mauna Loa lava flow coming down toward Hilo (Berger 1981:159). One man shot twelve in a single day, according to Munro (1944:91). The last substantial population of *'ō'ō* was apparently shot in 1898, when a remnant flock of 1,000 was found in *mauka* Pi'ihonua (Henshaw 1902:85-6). After 1900, the *'ō'ō* became scarce, and Munro (1944:86) failed to located a single bird on his 1936-37 survey.

Customary native tenancy continued after the Mahele on the crown lands of Pi'ihonua and Ponahawai, but eventually gave way to Western style individual lease. Letters to the Interior Minister show that 30 Hawaiian tenants of Pi'ihonua were paying rent to the crown as a group up to 1874. Their use rights were evidently limited. In 1866, the East Hawaii land agent for the crown, R. A. Lyman (LF letter of Sept. 10, 1866) complained that, "The natives are taking the *olonā* from Pi'ihonua and selling it." (*Olonā* was grown in the wet uplands and used to produce cordage valued for its resistance to salt water. The cordage was sold to Western ship captains in the nineteenth century.) He had promised the *olonā* lease to an individual. After 1874, there is a gap in the record until 1893. By 1895, customary tenancy seems to have ended. A substantial part of Pi'ihonua was leased to the prominent Hawaiian, John Baker, who was subleasing part to a coffee planter named Winter (LF, Dec. 7, 1895 letter). There is less evidence of customary tenancy for Ponahawai. Most of the good lower land was privately held (LF, Kenway letter of March 13, 1866). Five tenants were thrown off the land by the *konohiki* (local land manager) about 1865 (LF, Kahele letter of Jan 16, 1865). By 1893, J. Ena apparently held a lease of the whole of upper Ponahawai (LF, Loebenstein letter, Dec. 10, 1893).

Non-traditional Land Use in the Nineteenth Century

Non-traditional use of the East Side by both Hawaiians and non-Hawaiians occurred before the Mahele, but is harder to document than traditional Hawaiian use. Non-traditional use includes the harvesting of sandalwood in the 1820s (described for Waiākea by Ellis 1963[1827]:227)) and the processing of *koa* into shingles and lumber for wooden buildings during the 1830s and 1840s. A sawmill was set up by chief Kuakini in 1829 to produce lumber for the Hilo Congregational Church (Barrere and Kelly:41, referring to Bingham 1847:337). Later, a commercial sawmill was operated by businessmen Castle and Mills at Kapahukea, Pi'ihonua in the forest above Hilo. It produced *koa* shingles and presumably lumber (Douglas, letter in Hooker 1839:400; Pickering journal of 1841:148; BC Book B:28,47).

Some clues to non-traditional use from the Mahele to the turn of the century come from the correspondence of the Hawaiian Interior Department. The upland forest was apparently used to produce firewood and charcoal for sale in Hilo. In 1866, a Hawaiian named Nape attempted to lease upper Ponahawai in order to harvest and sell firewood (LF Ponahawai, Lyman letter, Sept. 10, 1866). In 1882, Joseph Flores obtained a lease from D. B. Lyman for the *mauka* portion of his Punahoa land in order to make charcoal for sale in Hilo (LF Agreement, May 1, 1882). Surely the production of lumber from *koa* continued in the area as well. In the 1860s, there was some harvesting of *pulu*, the hairy fiber on the young shoots of tree ferns. From 1862 to 1875 the industry flourished on Hawai'i Island, the *pulu* being collected and exported for stuffing mattresses (Thrum 1929). L. Kipi, one of the witnesses to the Boundary Commission, says that he was picking *pulu* on Humu'ula in 1868 (BC Book B:48).

By 1869 the cattle that had multiplied initially in the interior grassland had spread into the eastern forest (LF Pi'ihonua, R. A. Lyman, Nov. 9, 1869 letter) and were being hunted. D. Howard Hitchcock was hunting cattle in *mauka* Pāpa'ikou and Pi'ihonua in the 1880s (Maxon 1987:16), especially at Kīpuka Ahīna. Kīpuka 'Āhina was a grassy area at the top of Pi'ihonua and south of Pu'u 'Ō'ō, where cattle congregated (Hitchcock Family Collection [HFC], Pua Akala Logbook:19). Hitchcock hunted cattle for family use and also to supply the plantation workers at Pāpa'ikou (Maxon 1974:12-13). On one occasion 700 pounds of dried beef were carried down.

D. Howard Hitchcock was the son of D. H. Hitchcock, Hilo surveyor, lawyer and businessman. D. H. Hitchcock and his brother, E.G. Hitchcock, started the Hitchcock & Co. sugar plantation in the *ahupua'a* of Pāpa'ikou in 1876 (*Pacific Commercial Advertiser* 1899). Only the lower portion of the land was cleared for sugar, the upper portion remaining in forest. The two brothers built a bark cabin at Puakala (or Pua 'ākala) at the top of Pāpa'ikou. Although they lost the plantation, they kept the cabin and the lease at Puakala and in 1884 they replaced the cabin with a substantial *koa* house. The logbook kept at Pua Akala (HFC) from 1883-1895 shows that the Hitchcocks used it as a rest house, a base for hunting and exploring Mauna Kea. They regularly entertained White guests there from Hilo and Honolulu. Entries in the Pua Akala logbook describe coming up on the Hilo trail to Puakala. The trail they used is shown on old maps Reg. 1718 (1891) and HTS Plat 712 (1913). It appears to be approximately the same as the trail shown on the 1930 USGS Humuula Quadrangle (15 min.), coming up over the 1855 flow to Māwae. *Figure 5a,b* shows the trail as it appears on the USGS Quad. Below the 1855 flow, however, the trail the Hitchcocks used came up from Hilo on the Punahoa 1/Punahoa 2 boundary instead of through Kaūmana. Above Māwae, the trail they used continued around on the Pi'ihonua boundary to Pu'u 'Ō'ō instead of cutting directly up to the *Pu'u* as the 1930 trail does. The Hitchcocks often stayed overnight at a house they called Hale Aloha (shown on both maps cited above), just above Māwae. Then they went on to Kīpuka 'Āhina south of Pu'u 'Ō'ō (shown on HRS Plat 712), where they had a bark house and kept horses so they could have fresh mounts available.

Land Use After 1895

Kaūmana and Ponahawai - The most important shift in land use in the project area occurred in Kaūmana and Ponahawai when they were surveyed for homesteading in 1893 (LF, Loebenstein letter, Dec. 10, 1893). As described earlier, Kaūmana became government land in 1890. A number of prominent Western residents of Hilo had already made applications for homesteads in Kaūmana by the time of Loebenstein's survey. He felt there wouldn't be enough land for them without adding the land at Ponahawai:

> . . .the lava flow of 1880-81 has coursed down about the middle of the land, leaving an undestroyed strip or remainder on each side. . .The remainder on the South side is covered by applications from E. G. and D. H. Hitchcock and W. R. Castle, on the North side adjoining Ponahawai by the various other applicants. The whole section is one of extreme richness and fertility but there is not enough to go around without taking in Ponahawai. (Loebenstein, cited above)

Between 1896 and 1899, all the land of Kaūmana and upper Ponahawai not covered by lava was given out in large lots (20 to 100 some acres), mostly to *haole* and Portuguese homesteaders (Commission of Public Lands 1916). By 1900, the homesteads were being use to grow cane or vegetables to supply Hilo (Stacker 1901:131).

Although the homesteads were taken up by Westerners, including Portuguese, the Kaūmana community soon became mostly Japanese. According to Kaūmana informants (Kaūmana group Int.) the first Japanese settlers came not long after the turn of the century. The Westerners who owned land

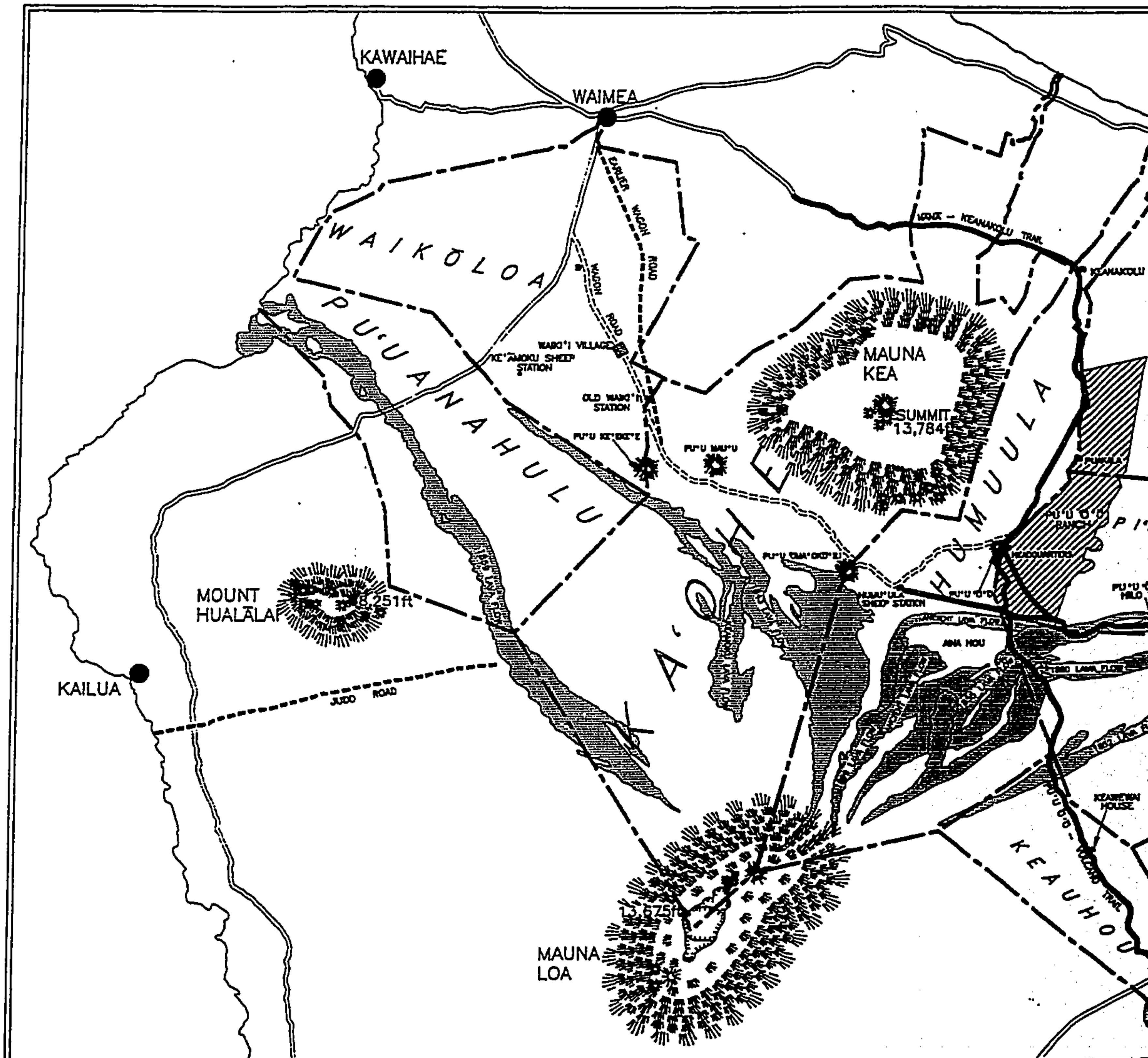
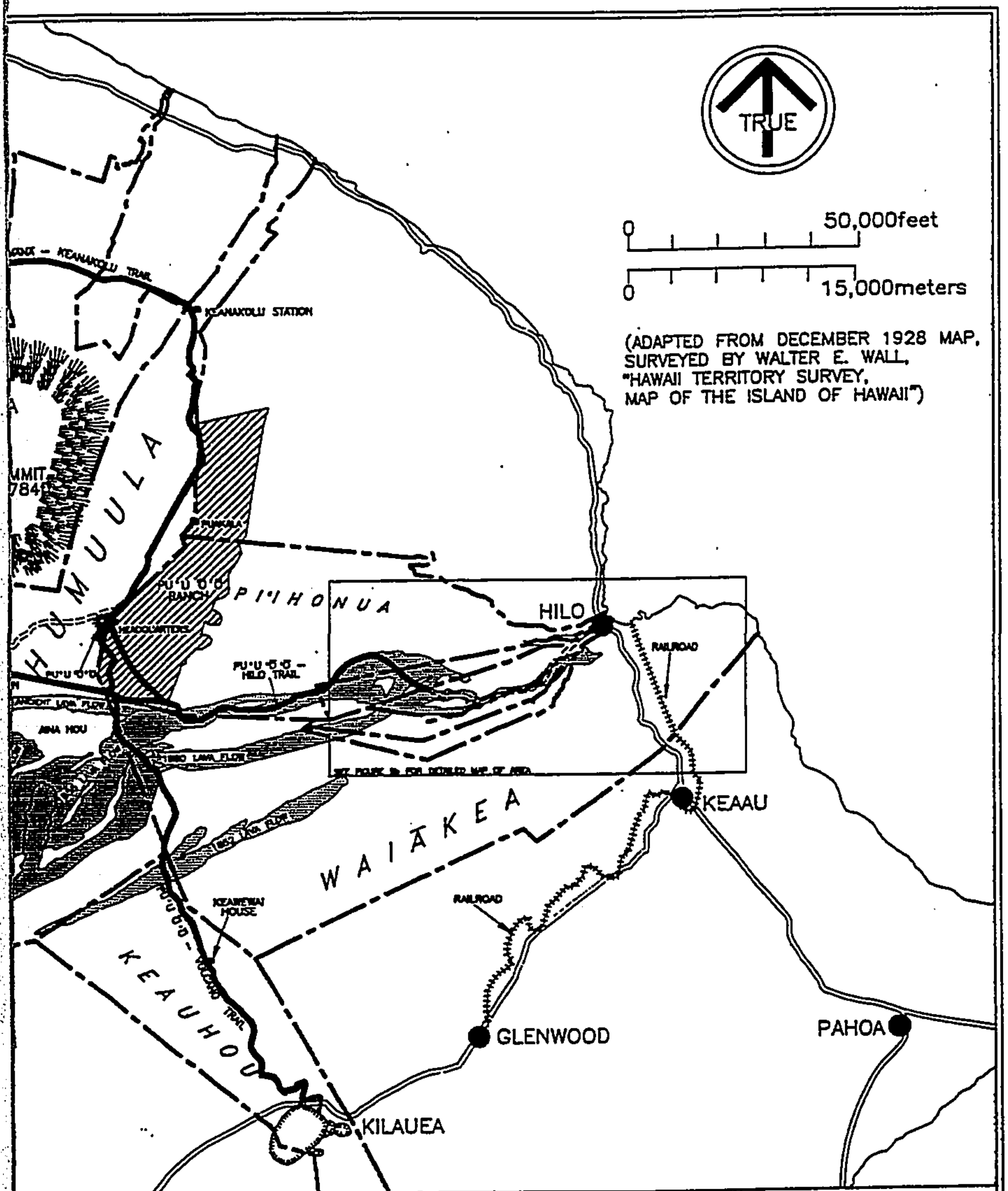
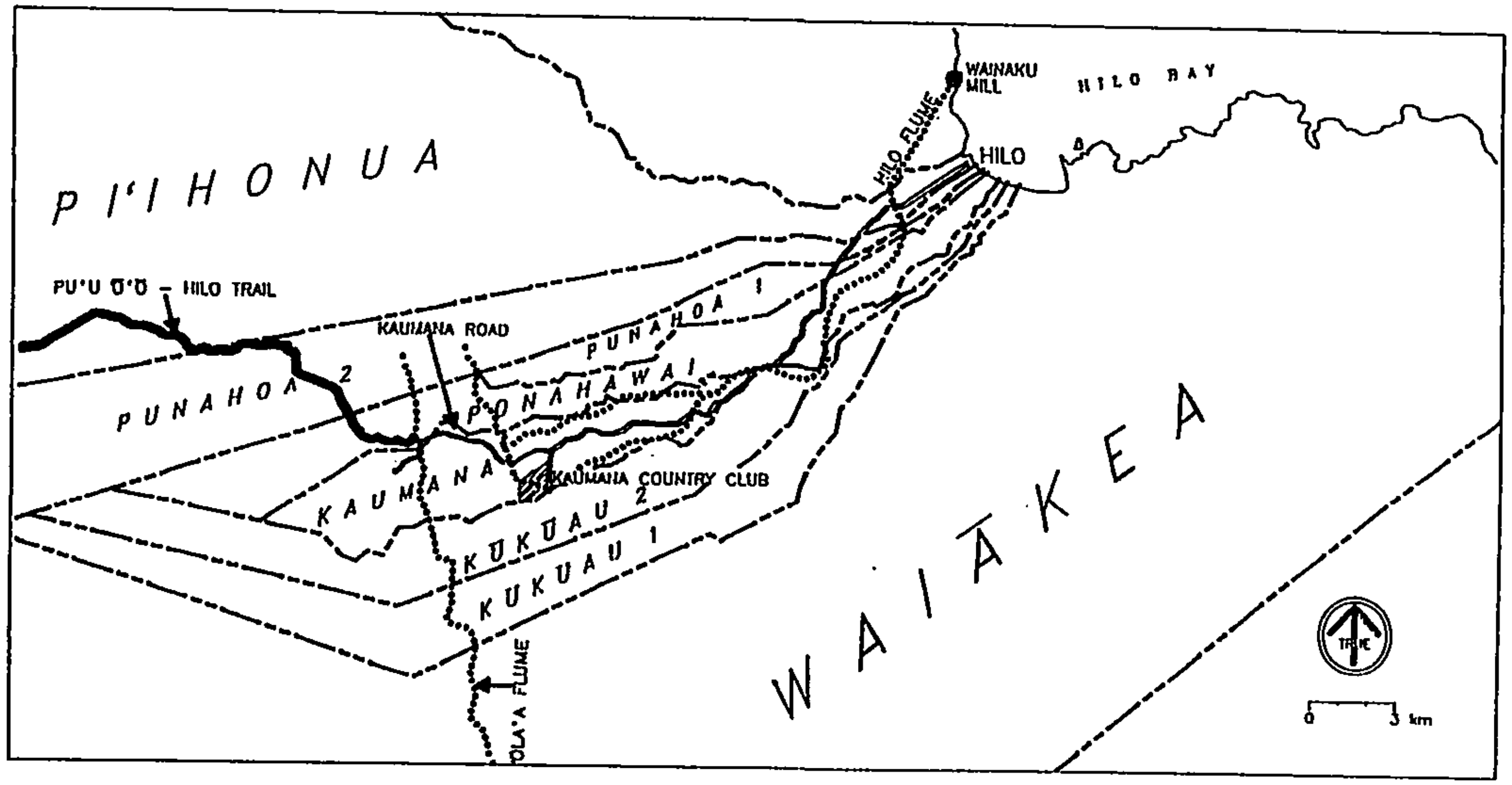


Figure 5a. Hawai'i Island c. 1925



ai'i Island c. 1925

INSET FOR FIGURE 5a:



(ADAPTED FROM 1917 USGS MAP, "HILO QUADRANGLE, HAWAII, HILO, ISLAND AND COUNTY OF HAWAII")

Figure 5b. Hawaii Island c. 1925, Detail

(Hitchcock, Canario, Lyman) leased out it to the Japanese, who grew sugar cane as independent growers for Hilo Sugar Company. Some of them grew cane on land owned by the plantation itself. The village of Kaūmana grew up on the lava flow, which could not be used for cane. It had two stores and two Japanese language schools.

One of the first Japanese settlers was S. Miyamoto, whose operation was described as follows:

> Tadao Tanouye: I wonder who were the first here though? One thing is sure though. Many of this, mauka land especially, was used to be virgin forest you know. And then they chopped the wood down and they sell that wood as a firewood too, down town. They used to have people doing some contract you know. They had the store here. They were also in charcoal business and they were also cutting a lot of those big ohia trees. Oh this was way [back], probably the turn of the century.
>
> So I notice one thing too. When we were growing up Miyamoto had lot of cane fields see. This is why – I think he used to open up virgin land. But of course the land belongs to the plantation, see. He open up virgin land, so after he sell all that firewood, then they would give him the lease and he would raise sugar cane. And then he would in turn sell. Actually what they were doing, they were not selling the field itself but they were selling the right to raise sugar cane from one party to [another], but it's all underneath the table kind of thing you know. And all they do is go down to the plantation and say well, we like to change name from this party to that name. As long as the two party agree that's okay you know. That's way we, but money has been exchanged. And that's the way it was done. (Kaumana group Int.)

The Japanese cane growers had their cane harvested by the plantation and it was carried down to C. Brewer's Wainaku mill by the Hilo flume, fed from Lyman Spring north of middle Kaūmana *(Figure 5b)*. It was one of many flumes built in East Hawaii between 1880 and 1900 that used water flowing from upland sources to transport sugar cane down to the mills (McEldowney 1979:39). Besides the Hilo flume, there was another called the ʻŌlaʻa flume (SIHP Site 20870) which crossed Kaūmana farther up. ʻŌlaʻa flume carried water to Puna and was used to flume cane down to Shipman's mill at Keaʻau. The two flumes are further described below.

Farther down toward Hilo (below Chong Street and well below the project area) was an area occupied by Portuguese, who mostly raised cattle in a small way, except for the Serrao's, who had a winery. One of those Portuguese living below Kaūmana was August Mattos, who bought several homestead lots (Grants 4149, 4266, 5101) at the top of Kaūmana from the original owners, Westerners, about 1930 (S. Mattos, personal communication). These lots were above the Hilo flume, so they could not be used for sugar cane because there was no way to transport the cane down. Mattos cleared the land, built a house and raised cattle there. Below the Mattos property and above the Hilo flume were other lots that by 1930 had been bought by Portuguese (Sonny Osorio and Mr. Medeiros) from the original owners and were used for raising cattle.

Although the landowners, who were Westerners, did not live at Kaūmana, they did build a golf course there. Hilo Country Club was built in the early 1920s (Tanouye Int.). It catered to the Western elite of Hilo, as recounted by Susumu Tanimoto below, who became a golf pro there in 1958.

> To begin with that golf course was put up by the plantations, all the C. Brewer and all the Big Fives. All the plantation managers were the members and directors so whenever we want something like fertilizer, we got it from the plantations. That's

the only way we could have survived then. Mostly it was managers and the bank, the judges, the police chief and all those. Mostly haoles. Well when I first there they won't take any Orientals or any other nationality. (quoted from Susumu Tanimoto Int., portions deleted to improve readability)

The clubhouse would have provided the members a grand view of the sugar plantations, which brought them their wealth, and of the city of Hilo. The membership policy of the country club changed in the late 1950s. Mr. Tanimoto was brought in as golf pro in order to recruit his Japanese professional friends as members.

Upper Punahoa, Pi'ihonua and Waiākea - At the turn of the century, the upper portion of Pi'ihonua (above 1,525 m; 5,000 ft elevation) became Pu'u 'Ō'ō Ranch. The rest of the upland project area was designated as forest reserve by the territory, i.e., the Pi'ihonua forest from about 460 m (1,500 ft) up to 1,520 m (5,000 ft), all of Punahoa and Waiākea above about 460 m (1,500 ft), and upper Ponahawai and Kaūmana above about 610 m (2,000 ft).

Pu'u 'Ō'ō Ranch was first established by John Timoteo Baker, a Hawaiian-Tahitian-Caucasian protégé of Kalākaua (Taylor 1951). He came to Hawai'i Island in 1886 when his high-ranking wife, Ululani, was appointed governess of the island (*Honolulu Star Bulletin*, 1921). He became a successful rancher and businessman in Hilo, and in 1892-93 served as Hawai'i Island governor. Baker obtained a lease in Pi'ihonua in 1887 (Territory of Hawaii 1904:50) and must have started ranching at Pu'u 'Ō'ō some time after that.* Henke (1929:43) says, "He had built some fences, and about 600 head of mixed cattle, including some Longhorns, were found on the ranch at that time." Baker used to go up to the ranch every September with an entourage (Donn Carlsmith, personal communication). Informant Toshi Imoto's father worked for Baker at the ranch, and cooked *kālua* dogs (in an *imu*) for him when he came (Imoto Int.).

In 1899, Baker sold the ranch lease to W. C. Shipman. Shipman introduced Hereford bulls to upgrade the stock and increased the number of cattle to about 4,000 head. He expanded the ranch to 23,000 acres, including the upper portions of all the *ahupua'a* owned by the sugar plantations north to Honohina (Henke 1929:42-4). In the early part of the century, the ranch included two government leases in Pi'ihonua and leases of sugar plantation lands to the north in the *ahupua'a* of Pauka'a, Pāpa'ikou, Makahanaloa, Hakalau Nui and Honohina (Blackshear Int.; Devine Int) *(Figure 5)*. Two smaller parcels were bought in fee simple, an 80-acre piece with a spring on it *makai* of the Pu'u 'Ō'ō ranch house, and a 500-acre parcel in Pāpa'ikou which contained the old Hitchcock house at Puakala. In the 1940s the ranch got the lease of Kīpuka 'Āinahou in Humu'ula, just south of the Humu'ula Sheep Station, and ran cattle there until about 1950.

Pu'u 'Ō'ō Ranch was part of W. H. Shipman's larger operations, mostly centered in Puna. Shipman had a sugar plantation at 'Ōla'a, with the mill at Kea'au. He had three ranches in Puna: Kea'au Ranch on the lava land of Kea'au *ahupua'a*, Keauhou Ranch north of Kilauea Crater, and Ainahou Ranch south of Kilauea Crater.† Shipman also had a controlling interest in the Hilo Meat Company, which slaughtered most of the cattle from Big Island ranches (other than Parker Ranch) and which supplied the local market. The cattle were slaughtered at Kea'au and the meat was sold at Hilo Meat Company on Front Street in Hilo (Devine Int.). Of Shipman's four ranches, Pu'u 'Ō'ō was the most productive, being both large and well watered. Informant Dick Devine began to work for Shipman in 1933. He estimated that they ran 5,000 head of cattle at Pu'u 'Ō'ō, 1,500 at Keauhou, and only "a few" at Ainahou. Kea'au

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**Henke (1929: 43) says that Baker started his ranch at Pu'u 'Ō'ō about 1896, probably based on information from Shipman. This date may be too late.*

†Keauhou Ranch was started by D. T. Shipman in 1900. In 1923 it was bought by A. M. Brown (Henke 1929: 31-32). W. H. Shipman bought it later and ran it during the 1940s.

Ranch was once well maintained, but by his time it was neglected and produced few cattle. ". . .It was categorized as a ranch, but it was more like a wild cattle operation. You know, it wasn't controlled like Pu'u 'Ō'ō (Devine Int.)."

There were three stations built on Pu'u 'Ō'ō Ranch: the main Pu'u 'Ō'ō headquarters and the Puakala house station, which were built early, and the Saddle House, built later *(Figure 6)*. Informants Eugene Olivera and Toshi Imoto both worked as cowboys at the ranch, beginning in the 1940s, and the following information on ranch operations comes from them. In the 1940s, there were permanent personnel at the ranch responsible for fencing, maintaining the ranch houses, breaking horses, and watching the cattle. Many of the cowboys, who did the driving, branding, and so on, were based at Kea'au or at Keauhou Ranch and only came up when there was a big job to do; these cowboys were mostly Hawaiian and Portuguese. The permanent personnel were mostly Japanese. The Pu'u 'Ō'ō headquarters had a *koa* ranch house for the owners, a couple of bunkhouses and a cottage for the cowboys and fence-men, a stable, and barn. The Puakala station had a *koa* house built by Hitchcock, a couple bunkhouses, and a barn. The cowboys lived up there when they worked that end of the ranch.

In the early days of the ranch, the cattle were driven to market down the Pu'u 'Ō'ō-Volcano Trail to Keauhou Ranch, then down to Glenwood Station where they were loaded onto railroad cars and shipped down to Kea'au or Hilo:*

> EO: Going take you about three days now. About three days. As you come from Pu'u 'Ō'ō you come sleep Keawewai house [on the north side of Keauhou Ranch]. Cause there, the trail is only about three feet wide now. So you cannot force these cattle go. And when you get into Keawewai house, they all *manene*. What I mean, already they all sore, their legs, cause it's all *'a'ā, pāhoehoe*. Only what in-between they have Kīpuka Nēnē. That's out in the open. So they come to the Kīpuka Nēnē they rest. From there down, is all *pāhoehoe* and *'a'ā*. Till hit the Hō'aikea, right in the back of Kūlani, the Hō'aikea. Then from there they ride out to Keawewai house then they camp Keawewai house. Get big holding, big corral.
>
> CL: So if you start early in the morning and get to Keawewai house that night?
>
> GO: That evening. It's six, seven o'clock in the evening. Cause you cannot pressure, pressure. You gotta go real easy because they bleed. You know, when they fight they push the other one. They mean eh. They want to go go go. And they get out of the trail, it's all *pāhoehoe*.
>
> CL: They just stay on the trail? They don't try to get out too much?
>
> GO: Oh no can. It's all *pāhoehoe*. All stone. They wouldn't, unless they can come reach Hō'aikea. That's a pasture land again. They can maneuver. But no, no. So long you get the tame one go, they follow the tame one. They come right down. The next day you come down to Keauhou, the ranch. And then when you get, they [the various ranches in the area] get their date all certain up, Kapāpala [Ranch] send out, get Na'alehu Ranch and the Kahuku. And they used to bring, hit Na'alehu. From Na'alehu hit Kapāpala and then come Keauhou. They sleep at Keauhou. From Keauhou next morning down to Glenwood. Oh just follow the

**During the 1920s when A. M. Brown held Keauhou Ranch, Shipman often sent cattle from Pu'u 'Ō'ō Ranch to Kawaihae instead of driving them to Volcano (Henke 1929: 32). They did drive cattle up from Kea'au to Pu'u 'Ō'ō Ranch during that period to fatten, though, and must have used the Volcano–Pu'u 'Ō'o trail.*

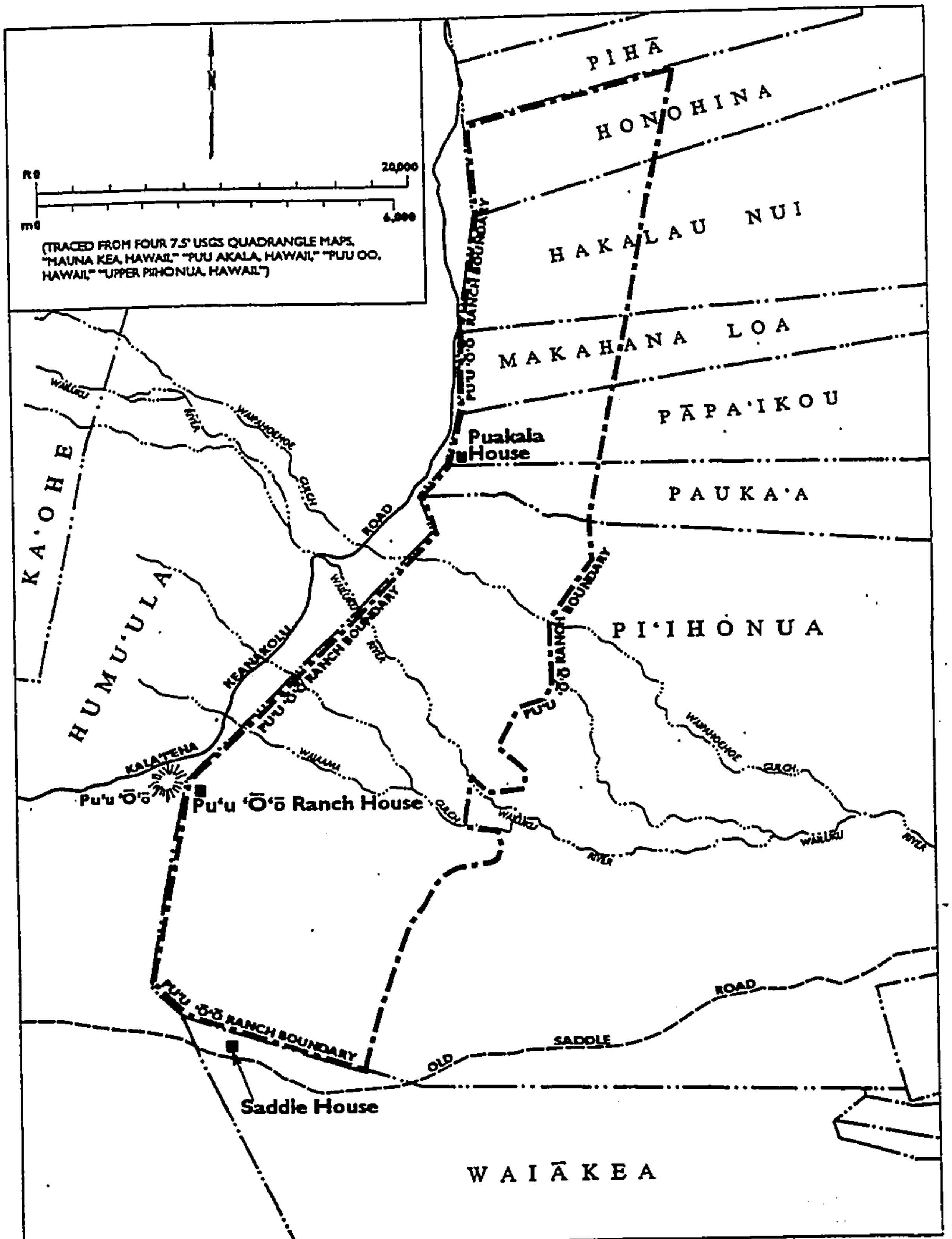


Figure 6. Pu'u Ō'ō Ranch c. 1950

highway. They used to use up all the highway to bring the cattle all the way down. (Eugene Olivera Int.1, portions deleted to improve readability)

These cattle drives probably began in 1903, about the time the railroad was completed up to Glenwood (Territory of Hawaii 1902:38). Eugene Olivera saw one of the last drives to Glenwood when he was a young teenager working at Volcano, about 1937. After that the cattle were still driven down to Volcano, but from there they were trucked down to Kea'au. Once Saddle Road was built, in 1943, Shipman trucked the cattle down that way instead.

The Hilo-Pu'u 'Ō'ō trail was also used by the Pu'u 'Ō'ō cowboys. The trail was shifted from the one used by the Hitchcocks in 1886-1895 to the one shown in *Figure 3*. The bottom of the trail extended up through Kaūmana; at the top it ran from Māwae directly to Pu'u 'Ō'ō Ranch headquarters. A private magneto telephone line was installed by Shipman from Hilo Meat Company up to Pu'u 'Ō'ō ranch house and it ran on from there to Puakala. According to Roy Blackshear, the line was already installed by 1913. The trail ran alongside the telephone line (Olivera Int.) and probably the trail was shifted when the line was put in. In the early days the cowboys took the trail to get back and forth to Kea'au or Hilo. By 1940, though, the cowboys were usually brought by truck through Waimea (Imoto Int.). By then, they only rode the trail to check the telephone line for problems. Hunters used the trail to come up from Hilo and they often came into the ranch on the lower side and killed cattle.

About 1960 the ranch began to break up, as the economic interests of W. H. Shipman, Ltd. shifted. Shipman gave up the lease on the north Pi'ihonua parcel (where the ranch headquarters was located) when it came up for renewal (Blackshear Int.). The lease went to Benlehr, who ran it as a dairy operation, and later to Doc Stanley. Shipman continued to run cattle on the south Pi'ihonua parcel and the Puakala section of the ranch and built a new ranch house down near the Saddle Road called the Saddle House. About 1974, the lease on the south Pi'ihonua parcel came up for renewal and Shipman let it go. The south Pi'ihonua parcel lease went to Parker Ranch and later to Fred Nobriga Jr., who still runs cattle there (Blackshear Int.). The Puakala section was taken over by Fred Nobriga Sr. (Nobriga, personal communication).

The Saddle House was built after Saddle Road was put through, when Shipman decided to ship cattle directly by truck down to Hilo and Kea'au instead of driving them to Volcano and shipping them from there. Shipman acquired a lease on 200 acres of Waiākea at that time, and the ranch came right down to the Saddle Road (Bergin Int.). At that time, the Saddle House was just a one-room building used for storing saddles and cooking for the cowboys when cattle were being shipped. When Shipman lost the north Pi'ihonua lease with the Pu'u 'Ō'ō headquarters in the later 1950s, additional rooms were added on, and cowboys moved into the house (Bergin and Olivera Ints).

In 1905, the Hilo Forest Reserve, including Punahoa 2 and Pi'ihonua, below Pu'u 'Ō'ō Ranch, was formally established (Territory of Hawaii 1906) The creation of the reserve was a cooperative effort between the Hawaii Sugar Planters Association and the Territorial government (Tomonari-Tuggle 1996:33-5). In 1901, forest fires burned many acres of Hilo forests. The Hilo area plantations were concerned about preventing fires and maintaining the forest above the sugar lands, because they depended on the forest to keep the streams flowing, which fed the flumes leading to the mills. By 1904, Shipman had already built a fence along the boundary between Pu'u 'Ō'ō Ranch and the upper boundary of the forest reserve and was engaged in hunting out the wild cattle from the forest (Tomonari-Tuggle 1996:32-33, citing Hosmer 1904:316). The fence was useful to Shipman, but the hunting out of wild cattle was a condition imposed by the plantations from which Shipman leased the ranch land. The 1920 lease renewals all contained clauses requiring that Shipman make and keep repaired fences along the forest reserve boundary and use his "best efforts to kill all wild cattle and pigs within the forest area" (copies of leases in Bryan's Collected Papers). The plantations were attempting to keep hunters out of their forest lands because they were worried about the danger of fires started by hunters (Oct. 7, 1921 letter from Harold Lyon, Bryan's Collected Papers).

This fear of fire was not an idle one. Informants make it clear that there were many hunters in the Pi'ihonua forest in the 1920s and up to the present (Ah San, Auwae, Kaumana group, Olivera, Imoto Ints). In the pre-World War II years, hunters camped in the forest for days, hunting pigs and cattle and smoking the meat. Most of the hunters were Portuguese; a few were Hawaiian and Puerto Rican. The hunters used two camps - Morita Camp, close to Pu'u 'Ō'ō Ranch, and Puerto Rican Camp, lower down. Puerto Rican Camp was located just below milepost 10, where the old Saddle Road loops out to the north from the present road (Olivera Int.). According Eugene Olivera (Int.2) the hunters had built crude shelters when he saw it in the 1940s. Poles held up sheets of iron roof, which allowed them to catch rainwater for drinking. The sides of the structures were made of *hāpu'u* fern fronds. Morita Camp was a name apparently given to camps at several different locations. The earliest Morita camp was established by Japanese fencers on the Wailuku River, on the boundary of Pu'u 'Ō'ō Ranch and the Hilo Forest Reserve, where the boundary bulges shoreward in a "pocket." The fencers were hired by Shipman to build the original boundary fence around the turn of the century, according to John Ah San (Int.). A later hunter camp was established just below the forest line, on the Wailuku River, and was also called Morita Camp. The hunters who camped there when Ah San was young (c. 1920) shot Shipman's cattle as well as wild pigs and cattle in the woods. The ranch had trouble with hunters poaching their cattle for years. It got worse during World War II when Shipman was short-handed. The fence went down and the cattle got into the forest. After World War II, that camp was broken up by John Ah San, the forester for the Hilo Forest Reserve, together with one of the Pu'u 'Ō'ō cowboys. Eugene Olivera, a cowboy at Pu'u 'Ō'ō Ranch in the 1940s and 1950s, remembers going with his boss to Morita Camp to complain to the hunters about killing ranch cattle that got through the fence. The rule was that they were not to kill any cattle within a mile of the ranch boundary (Imoto Int.). Olivera (Int.) describes the camp then as a cave under a falls in the Wailuku River. Today, there is another camp called Morita Camp, on the water-gauge station road at the 16 milepost, about two-thirds of the way in to the Wailuku River (Ron Bachman, personal communication).

Later History of the Saddle and West Side

Traditional Hawaiian Land Use in the Nineteenth Century

In the Mahele of 1848, Waikōloa was awarded to Hu'eu Davis, the son of Isaac Davis, an English sailor who became one of Kamehameha's lieutenants. Humu'ula was awarded to the crown and Ka'ohe to the government. All three *ahupua'a* cover huge portions of the interior, but have little or no coastal area. For that reason, there were few *kuleana* claimed. There were apparently no *kuleana* at all claimed in Waikōloa and Humu'ula, and only one was claimed in Ka'ohe, at the coast. Ka'ohe is divided into six parts in the land records and tax maps, with Ka'ohe 1 at the coast and Ka'ohe 2 and 6 farther up. Ka'ohe 3 covers Mauna Kea and Ka'ohe 4 and 5 are in the Saddle. The Saddle Road runs through Ka'ohe 3 (on the west) and Ka'ohe 4 (on the east), with Ka'ohe 5 lying farther to the south.

At the time of the Mahele, Waikōloa was called Waikōloa Nui, to distinguish it from Waikōloa Iki, now called Lālāmilo. Before the Mahele, Waikōloa Nui had been given to Isaac Davis by Kamehameha I. At that time, the shore lands of 'Anaeho'omalu and Kalāhuipua'a were detached from Waikōloa Nui and were given to others (BC Book A:6-12, summarized in Clark and Kirch 1983:28-29). The rest of the shore was made part of Waikōloa Iki (now Lālāmilo), which remained part of the larger land of Waimea, claimed in the Mahele by the crown.

Although it is a very large *ahupua'a*, Waikōloa Nui had little value at the time of the Mahele. The boundary testimony of 1865 says that all the agricultural land, irrigated from Waikōloa Stream, was on the Waimea side.* Waikōloa had only *pili* grass and birds:

> I am a kamaaina of Puukapu [a land within Waimea] only. Kainea was the konohiki when I lived there. There was no pili grass on that land – my father was not a bird catcher, he used to mahiai [farm]. Waikoloa was the land that had the birds. (Testimony of Ehu, BC Book A:6)
>
> They kept all the valuable part of the lands and gave the poor land outside to Isaac Davis. . . .the pili was all South, on Davis land. . . (Testimony of Mi, BC Book A:7)
>
> All the pili from Ouli, to the aa of Kona, belonged to Waikoloa. (Testimony of Moolau, BC Book A:8)

The implication is that there was no agriculture in Waikōloa.

There was apparently a dry forest of *māmane* and *'ōhi'a* in the upland portion of Waikōloa in the nineteenth century, and the forest apparently was sufficient to support the birds and birdcatchers mentioned in the boundary testimony. An 1867 map drawn by Kaelemakule (Reg. 574) indicates forest, probably *māmane*, on the interior corners of the *ahupua'a*, upslope from Holoholokā and upslope from Waiki'i-Kilohana. William Alexander passed through the area, traveling the wagon road from Waimea to Kala'i'ehā in 1892. He reported that the forests which formerly grew in the area were gone:

> The ancient forests here, as at Waimea, have been nearly exterminated, but a fine grove of mamane trees still survives at the Auwaiakeakua Ranch. The manienie grass is gradually spreading and will in time add immensely to the value of the land. (Alexander 1892:col. 1)

Informant Johnny Lindsey (Int. 3) said that he saw quite a bit of *māmane* growing above Waiki'i in 1931-2, but that it was being cut for use as fence posts. Scattered *'ōhi'a* still grows on the south side of upland Waikōloa.

Traditional Hawaiian land use in interior portions of Ka'ohe and Humu'ula has been considered earlier in the report. The main Hawaiian uses for the saddle area were for cross-island travel, for bird catching, for reaching the Mauna Kea adze quarry and for supplementary adze processing. Adze production may have continued for some years after the initial introduction of iron, but probably ended by about 1800.† Bird catching probably continued in the later nineteenth century; however, there is little historical evidence of this. The only evidence is Henshaw's statement (referred to earlier) that the prized *'ua'u*, perhaps the most important bird caught in the saddle area, disappeared around 1900.

Non-traditional Land Use in the Nineteenth Century

Non-traditional exploitation of the saddle area and West Side of the project area is largely a result of the development of ranching in Waimea. In the latter part of the nineteenth century two large enterprises

**Clark and Kirch (1983: 197-191, 235-7) give evidence that at one time the irrigation system from Waikōloa Stream extended just over the boundary from Waimea into Waikōloa Nui. Probably it was extended about 1790 to support the building of Pu'ukohola Heiau at Kawaihae, then abandoned again afterward.*

†Cordy (1994: 88) mentions the possibility that adze production may have continued as long as the 1840s at Mauna Kea, based on Waiki's testimony to the Boundary Commission (BC Bk B: 43). But Waiki was born about 1820 and merely says that his parents told him that Humu'ula people "used to" go up to the quarry for adzes.

developed and competed for control of the ranch country, Parker Ranch and the Waimea Grazing and Agricultural Company (the latter formed by Janion, Spencer, and Louzada). By the end of the century, Spencer and his associates had sold out and Parker Ranch had won control of the whole area. The following account of these developments relies largely on Wellmon's authoritative history of Parker Ranch (1969). Wellmon had access to many unpublished sources, which have now disappeared, especially the Parker Ranch files, and to informants who have now passed on.*

The first half of the nineteenth century saw the development of wild cattle hunting in Waimea and then a shift from hunting wild cattle to ranching. Cattle were already numerous in the Waimea area before the death of Kamehameha I (1819). During his reign, a wall was built on the boundary of Waikōloa Nui and Waimea (called the Pā of Kauliokamoa after the *konohiki* who oversaw its building) to keep the cattle on Waikōloa Nui out of the gardens on the Waimea side (Clark and Kirch 1983:236 and Figure 6, p. 183). The first cattle-hunters in Waimea, John Parker and a couple others, hunted the wild cattle on foot with guns in the 1820s. Soon, however, the more efficient method of lassoing the cattle from horseback was adopted. In 1828, horses were imported to Waimea. Shortly thereafter a number of Spanish-American vaqueros from California and Mexico came to Waimea and began to catch wild cattle. A number of them were stationed at Lihue, south of Waimea town, in 1836 (Wellmon 1969:47, n.6). The *vaqueros*, and eventually the Hawaiians who learned cowboy skills from them, later came to be called *paniolo* (Spaniards).

The *paniolo* were so effective at catching wild cattle that the wild Waimea herds were depleted. In 1840, King Kauikeaouli (Kamehameha III) reacted to this scarcity by announcing a *kapu* on the killing of wild cattle, which lasted for a period of four years. Meanwhile, in 1840, William Beckley was appointed *konohiki* (overseer) of the government land of Waimea. Up to the time of the Mahele, Beckley had *paniolo* brand all the wild cattle in Waimea, effectively claiming them as government property. By *1859*, there were too few wild cattle left to support the *vaqueros* and they left (Wellmon *1969:104*).

Between 1835 and 1840, merchant William French established a tame herd in Waimea to supplement the hunted wild cattle. In the same period, hunter John Parker established a herd in the Waiki'i area (Wellmon 1969:54, 63, n.16). Besides selling hides, French began shipping live cattle and salt beef to Honolulu. French went bankrupt about the time of the Mahele, but Parker continued to prosper. John Parker I began his ranch at Mānā in Waimea, on a two-acre *kuleana* award and a purchase of 1,640 acres of adjoining government land. He expanded the ranch with the purchase of the *ahupua'a* of Pa'auhau, in 1858. Later in the nineteenth century Parker Ranch began leasing land in the *ahupua'a* Kawaihae and Waikōloa (Wellmon 1969:154 for Kawaihae; 164, 173 for Waikōloa).

Sheep ranching also began in Waimea in the nineteenth century. Sheep were first brought to Hawai'i Island by Vancouver in 1794. By 1826 wild sheep were numerous. In that year Joseph Goodrich saw a number of dead sheep near the top of Mauna Kea (Ellis 1829:292). By the 1840s, the merchant French was raising sheep in Waimea, as well as cattle. G. T. Allan (Anon 1847a) wrote that French had imported two merino rams in 1842. In 1847, French had a flock of sheep and goats, kept by a Hawaiian named Kauhini in the area between Waimea and Kawaihae. French was exporting wool as early as 1844 (Wellmon 1969:57).

The Waimea Grazing and Agricultural Company, which was in competition with Parker Ranch during the nineteenth century, was a partnership formed by three men, Frank (or Francis) Spencer, James

**The Parker Ranch files contained a great deal of documentation collected by the long-time manager of the ranch, A. W. Carter. It included letters, deeds, and notes written by Carter about the history of the ranch and about the recollections of old Waimea cowboys. Wellmon also found records of the Waimea Grazing Company in the attic of the old Spencer home in Waimea. Much of this documentation has now disappeared, reportedly taken to the Waimea dump. Part of the files were deposited at the Dyer Library, Hawaii Preparatory Academy.*

Louzada, and Robert Janion. Louzada and Spencer came to Waimea in the 1850s and gained ownership of a tract of land called Lihue. At that time, they had a store at Kawaihae and packed salt meat for shipment to Honolulu. They raised sheep at Lihue and on leased land in the Waimea area according to Wellmon (1969:76,113). In 1860, Robert Janion came to Waimea and bought out French's interests. He then formed the Waimea Grazing and Agricultural Company with Spencer and Louzada. The company had many operations, killing wild cattle for hides and exporting them, slaughtering cattle and making salt beef for export, raising sheep at Lihue and exporting wool, and selling goods at stores in Waimea.

Part of the land the company used for sheep must have been in the *ahupua'a* of Waikōloa, including the site known as Ke'āmoku Sheep Station *(see Figure 5a)*. An 1867 map (Reg. 574) shows a structure at the spot named "Hale o Spencer" (Spencer's house). Probably Spencer leased the land from the Davis family, who kept the ownership of Waikōloa through the nineteenth century (according to Bureau of Conveyances Records, 1869 to 1898). The company also had the lease of the *ahupua'a* of Pu'uanahulu south of Waikōloa about that time (LF Pu'uanahulu, letter April 11, 1870). By 1862, the company had obtained the lease of the crown land of Humu'ula (as indicated by a note on Witlse' 1862 map, Reg. 668). Letters (LF Humu'ula, Lyman letter, November 16, 1866; LF Pi'ihonua, Lyman letter, Nov. 9, 1869) indicate that the lease gave the privilege of killing wild cattle and pasturing tame ones. Within Humu'ula, the company established stations at Lahohinu, Keanakolu and in the Saddle at Kala'i'ehā (Wellmon 1969:113). In addition to handling cattle, they were also raising sheep according to traveler Isabella Bird, who visited Humu'ula in 1873. She describes Kala'i'ehā Station as including a house, a wool shed, a couple huts and 9,000 sheep (Bird 1974 [1890]:232-3). Wellmon (1969.255, n.13) identifies the owner's son, who was then running the station, as Spencer's son, Ashford.

Janion and his associates attempted to monopolize the cattle business in Waimea. They came into conflict with Parker during the 1860s. In 1860, Janion bought the right to kill the wild cattle running on government land at Waimea. He interpreted this to mean that he had the right to unbranded cattle on Parker's land at Pa'auhau as well, and Parker had to appeal to the king to stop him from taking them (Wellmon 1969:101-2). In 1866, Spencer contested Parker's claim to a 17,800 acre tract of land known as Ka'ohe and Kamaui (Wellmon 1969:119). In 1877, a drought hit Waimea and many cattle died. The Waimea Grazing and Agricultural Company went out of business. The company's lease of Humu'ula and its operation there were sold to James Gay. Spencer managed to hold on to the Waimea, Waikōloa and Pu'uanahulu sheep operation, which became the Puuloa Sheep and Stock Company. In 1875, he placed the Pu'uanahulu lease in his daughter's name (LF Interior Dept. Bk. 13:66). In 1883, he deeded various properties – land, leaseholds, buildings and livestock in Waimea, etc. – to the Puuloa Sheep and Stock Co. (Bureau of Conveyances record). By 1886, Spencer had to mortgage the company to G. W. MacFarlane (Bureau of Conveyances record). Spencer died in 1897 (*The Friend* 1897). The MacFarlane family became the owners of the company and it was sold at auction in 1904 (Brundage 1971:62; Wellmon 1969:174). A. W. Carter, then manager of Parker Ranch, bought it for the ranch.

Humu'ula Sheep Station Company - In 1876, James Gay bought the Humu'ula lease and the sheep and cattle operation there from the Waimea Grazing and Agricultural Company.* In 1883, the operation was incorporated by Gay as the Humu'ula Sheep Station Company, which took over the lease. The company was mortgaged in 1885 to Hackfields (Bureau of Conveyances record) which apparently took control of the sheep station about that time. A. Haneberg became manager of the station for Hackfields in 1887 (Haneberg testimony, BC Book D5:52) and probably continued as manager up to 1895 or so (Blacksheep 1902, A.F. Carter Recollections in Parker Ranch Files [PRF], Humuula File). Baldwin's 1891 survey book (1892:48) contains a sketch of the station, which shows "Haneberg's house" (the "boss house" which still stands), a separate office, another house, the sheep shearing barn (which still stands),

* *Note that this history of Humu'ula Sheep Station differs somewhat from the account given in Wentworth et al. (nd: 52-53), which is based on Alfred Carter's Recollections (PRF). Both sources wrongly state that James Gay brought the first sheep to Humu'ula in 1876 or 1877.*

and a couple other buildings. It does not show the Humu'ula stone walls, so presumably they were not yet built.

According to a 1902 publication (Blacksheep 1902), it was Haneberg who laid out the paddocks and had the stone walls built. Stone perimeter walls survive today on both the north and the south sides of the sheep grazing area. The south wall lies along the present Saddle Road. The north wall is up on Mauna Kea. The walls were evidently built between 1892-1895 by Japanese laborers. Diaries kept by the Humu'ula manager (presumably Haneberg) and an employee are described and excerpted in Wentworth et al. (n.d.:22, 54). The diaries indicate that walls were built on the north (Laumai'a) side just prior to 1893 and on the south ('Āinahou) side in 1895.* A camp was established for 10-14 Japanese laborers who worked on the southern wall.

Developments in Ka'ohe - The interior portions of Ka'ohe were used for ranching in the later nineteenth century, but that use can only be roughly sketched. Evidently Parker had a lease at Ka'ohe prior to 1876. In 1876, John Parker II renewed his lease for 15 more years, extending it to 1891 (LF Parker letter, Jan 19, 1876; reply, March 27, 1896). Probably Parker was catching wild cattle on the land, because in 1871 Spencer unsuccessfully applied to lease land at Ka'ohe for that purpose (LF Spencer letter, May 17, 1871). In 1891, the lease of Ka'ohe 4 in the Saddle (government lease # 451), went to Hackfields' Humu'ula Sheep Station Company (Chronological Record; Territory of Hawaii 1901:14). Their 15-year lease of 137,200 acres probably included both Ka'ohe 4 and Ka'ohe 5. Ka'ohe 3 on the west side of Mauna Kea (government lease # 436), was still leased to Parker Ranch from 1891-1901 (Territory of Hawaii 1901:14; Wellmon 1969:155).

A historic wall (SIHP 5002) in Ka'ohe 4 is described by Welch (1993:40-43), some distance west of the Humu'ula boundary, along the Saddle Road at about milepost 34. Welch (1993:85) suggests that the wall was built by Parker Ranch to keep cattle off the 1848 *'a'ā* flow southeast of the wall. It seems just as likely that it was built by Hackfields when they had the Ka'ohe 4 lease. That was the era when Hackfields built the stone walls at Humu'ula. Apparently Hackfields installed a pipe line to bring water down from the springs above Pōhakuloa to the area of the present Mauna Kea State Park in Ka'ohe. The pipe line was already in place in 1900 according to a report fragment (PRF, Water File).

Land Use After 1895

In 1900, Alfred W. Carter became manager of Parker Ranch and began expanding its operations. A year earlier, Carter had been appointed the guardian of Thelma Parker, great-granddaughter of John Parker I and heir to one-half of Parker Ranch. The other heir was Thelma's uncle, Colonel Sam Parker. Sam Parker objected to Carter's plans for expansion and in 1906, sold out his share to Thelma. Under Carter, Parker Ranch bought additional land, improved its ranching practices to increase cattle production, and branched out into subsidiary operations like dairying and raising corn. The ranch soon controlled all the West Side and Saddle portion of the project area, as well as much of the other ranch land on the northwest half of the island.

Carter felt that the ranch was depending too much on leased land – it was costly as well as insecure. Parker Ranch had for some time run cattle on land leased from the Davis family in the Waiki'i area of Waikōloa. The only problem with that range was that it lacked water in the dry season. Carter had water piped up to Waiki'i in 1902, greatly increasing the number of cattle that could be pastured there in the dry season. In 1903, he purchased Waikōloa for the ranch from Lucy Peabody, a descendant of Isaac Davis, and the next year he bought out the Puuloa Sheep and Stock Company's sheep operation at

** Unfortunately the diaries have now disappeared. A search of the Parker Ranch Files at Dyer Library turned up various materials on Humu'ula Sheep Station Company, but not the relevant diaries.*

Waikōloa (Wellmon 1969:173-4). That included their leases and the Ke'āmoku sheep station, which had a shearing shed and wool press, shearing equipment and 6,000 sheep.

Ke'āmoku - Parker Ranch continued raising sheep at Ke'āmoku at least up to 1909. In that year, Donald Macalister was in charge of the station "looking after sheep" (PRF, Employee File, Reminiscences). The area of the sheep operation is indicated by Yutaka Kimura (Int. 1), who began working for Parker Ranch in 1919. Kimura was told that the sheep range was not fenced, but that two men with dogs kept the sheep from wandering away. A Hawaiian named Nahulu lived on the lower side, in a shack at Pu'u Hīnei, and a Chinese named Akuna lived on the upper side, in another shack *makai* of Pu'u Ke'eke'e. The Ke'āmoku sheep operation ended not too long after Parker Ranch took it over. Mr. Kimura said that the sheep were taken from there up to Humu'ula "before my time." Old-timers from the area said that the sheep operation was given up at Ke'amoku (as it was at Pu'uwa'awa'a and in *mauka* Kona) because of the invasion of weeds. *Kī* (Spanish needle) and *kikania* (a burr) got into the wool, and the sale price was lowered to the point that the operation was unprofitable (Paris Int.).

The Ke'āmoku Sheep Station has been described by informants who saw it in the 1930s (Kaniho Int. 2, Greenwell Int. 2, Ah Sam Int.) (*Figure 7*). Although it was then being used as a cattle station, the buildings were from the sheep station era. The informants remembered a main house, with a *lānai* (porch), several bedrooms, living room, and kitchen. There was a shear barn, with a baler (or wool press) larger than the one up at Humu'ula Sheep Station. There was also a smaller cottage, described as the oldest building there (Kimura Int. 3), which might be the building shown as Spencer's house on the 1867 map referenced earlier. In the 1930s, a dirt road led up to the station from the Waimea-Kona Belt Road and then up to Waiki'i village.

As early as 1907, Parker was pasturing cattle at Ke'āmoku as well as sheep (Wellmon 1969:178). Several of the informants worked there in the 1930s, long after the sheep were gone and the range was used only for cattle. Three or four men stayed at Ke'āmoku station in the 1930s and 1940s (Greenwell Int. 1, Ah Sam). They repaired fences, pulled weeds and generally kept watch on the cattle. If there was need to drive cattle, though, then the cowboy gang from Waimea would come out. The Ke'amoku crew took care of the whole area from the beach up to Ka'ohe, from Pu'uanahulu over to Nohona'ohae (at the Saddle Road junction with the Kona-Waimea Belt Road). The boundary with Pu'uanahulu had been fenced to keep out the goats that overran that area (Greenwell Int. 1). However, in the 1930s the north side of Pu'uanahulu, known as Kipuka Kalawamauna, was used for cattle by Parker Ranch. It was subleased from the Hind family, who ran Pu'uwa'awa'a Ranch (Kimura Int. 2).

Apparently there was some farming above Ke'āmoku station early in the twentieth century, although no detailed picture can be given of it. Henry Auwae traveled in the area of the station around 1915. He remembers a number of Portuguese rancher-farmers living there at the time, raising sheep and goats in a small way and growing corn, pumpkin and sweet potato (Auwae Ints. 4, 5, 6). There is also a reference in the Parker Ranch Files (Employee File, Reminiscences) to a Japanese who planted corn on shares located on the side of a hill below Pu'u Ke'eke'e. This was perhaps about 1920. None of the other informants visited Ke'āmoku before 1930, and by that time this farming activity had definitely ended.

Waiki'i - Shortly after Carter became the manager of Parker Ranch, he started agricultural activities at Waiki'i, and Waiki'i village was established on 'Auwaiakeakua gulch to support those activities (*see Figure 5*). Waiki'i village was a new site. There was an older Waiki'i station farther southeast on Waiki'i gulch, and below the present Saddle Road. W. D. Alexander (1892) describes it, writing, "At the halfway station, called Waikii, water tanks and a rest house have been provided for teamsters [who worked the wagon road]." Informants Ah Sam (Int.) and Kimura (Int. 1) remember seeing posts there, the remains of the old house. It was either built by Parker Ranch when it raised cattle at Waiki'i in the nineteenth century, or by the sheep operation at Humu'ula.

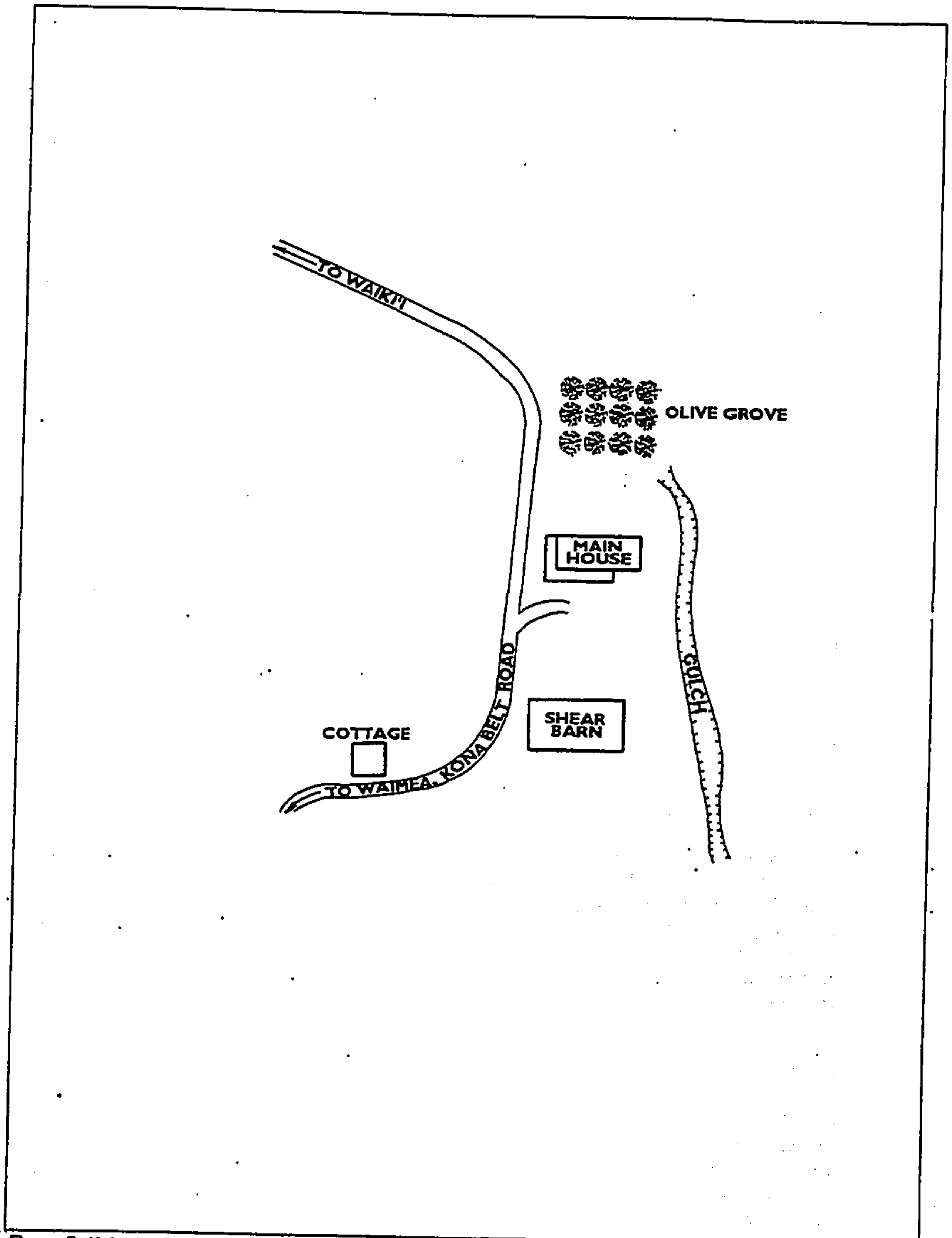


Figure 7. Ke'āmoku Sheep Station (Adopted from a Sketch by Rally Greenwell)

Waiki'i village was established after the completion of the water pipeline from the Kōhala Mountains to Waiki'i in 1902. In 1903, bees were brought to Waiki'i for honey production. Never very successful, the honey business ended in 1931 when the bees were affected by a disease (Wellmon 1969:222, n. 37). By 1906, Wilmot Vredenberg had been established as foreman at Waiki'i and he began planting corn and fruit trees (Wellmon 1969:209, Brennan 1974:41, ref. to Carter's Journal). By 1911, 1500 acres were planted in corn (Brennan:137) and by World War II almost 5,000 acres (Kimura 1983:24).

It appears that initially the agricultural workers at Waiki'i were mostly Japanese. According to a letter to Macalister, the boss at Waiki'i in 1910, Carter felt they didn't work hard enough and wanted to replace them (PRF, Employee File, Carter to Macalister):

> The labor at Waikii has been unsatisfactory. The cost of handling the corn crop is excessive. I do not, however, blame you for this in any way. I know that the discipline has been very lax, and a full day's work has not been the rule at Waikii. This was more or less unavoidable on account of the attitude of the Japs, but I hope before long that conditions will be materially better. With a gang of Chinese there and if I succeed in getting some Russians, it will make a great difference, I think in the expense of operating the place.

In 1910, Carter succeeded in bringing in a number of Russian families from Manchuria to farm at Waiki'i. Brundage (1971:103) gives the names of fourteen of them – Teakanoff, Lareonoff [Elarionoff], Walueff, Costichenko, Krasnoff, Shustoff, Costoff, Franka, Neskromnyh, Zimin, Colbatoff, Vearhoff, Sivicio, Dombrovsky. Shortly after the Russians were settled at Waiki'i, Carter got the territorial government to start a public school there (Brundage 1971:103). However, the Russians did not stay. By 1925 they were gone, with a few exceptions such as the son of Elarionoff who became foreman at Waiki'i (Kimura Int. 2). While they were there, the Russians set up outdoor ovens to bake bread, a feature remarkable to the Japanese and Hawaiian informants. The ovens were built of stones and dome-shaped (Kaniho Int. 2).

Yutaka Kimura (Ints. 1-3) described the operations at Waiki'i in some detail and drew a sketch map of the village about 1920 which is the basis for *Figure 8*. The most important operation there was the corn-growing. In 1920, the fields were plowed and the planting was done with tractors –initially with steam-driven tractors, and then gas-driven tractors (Kimura Int. 2). Cultivating was, however, done with horses pulling a one-row cultivator. There was also considerable hand work to be done, cutting suckers and picking the corn. For those two jobs contract laborers were brought in from Waimea. That was how Mr. Kimura first went up to Waiki'i.

> Hand pick. When I was fifteen years old, we picked with the hand. They had a little picker you attached on the finger, you just pull the husk off and then you break off that – corn is an easy breaking [thing] – and throw them in the wagon. A loaded farm wagon, you would pick contract, one load was $1.15. A good picker usually picked two loads a day. But like me, I got a hard time pick one load a day. Most people one load they pick before lunch. I was a young kid yet, and we cannot go that fast, so we cannot beat the mens. So they take me about to 2:00 to get one load. (Kimura 1983, Tape 2:24, edited by C.L.)

The upper bunkhouse shown on the Waiki'i map was for the contract corn workers. There was a big corn crib in the village (shown on the map) with a barn beside it containing a corn sheller and grinder to process the corn. On the other side of the crib was a pigpen, where corn was fed to pigs. There were five or six other corn cribs out in the corn fields, and pig-pens with them. Some of the corn was fed to the pigs at Waiki'i, but the bulk was sold – to Honolulu to feed pigs and to plantations on Hawai'i Island to

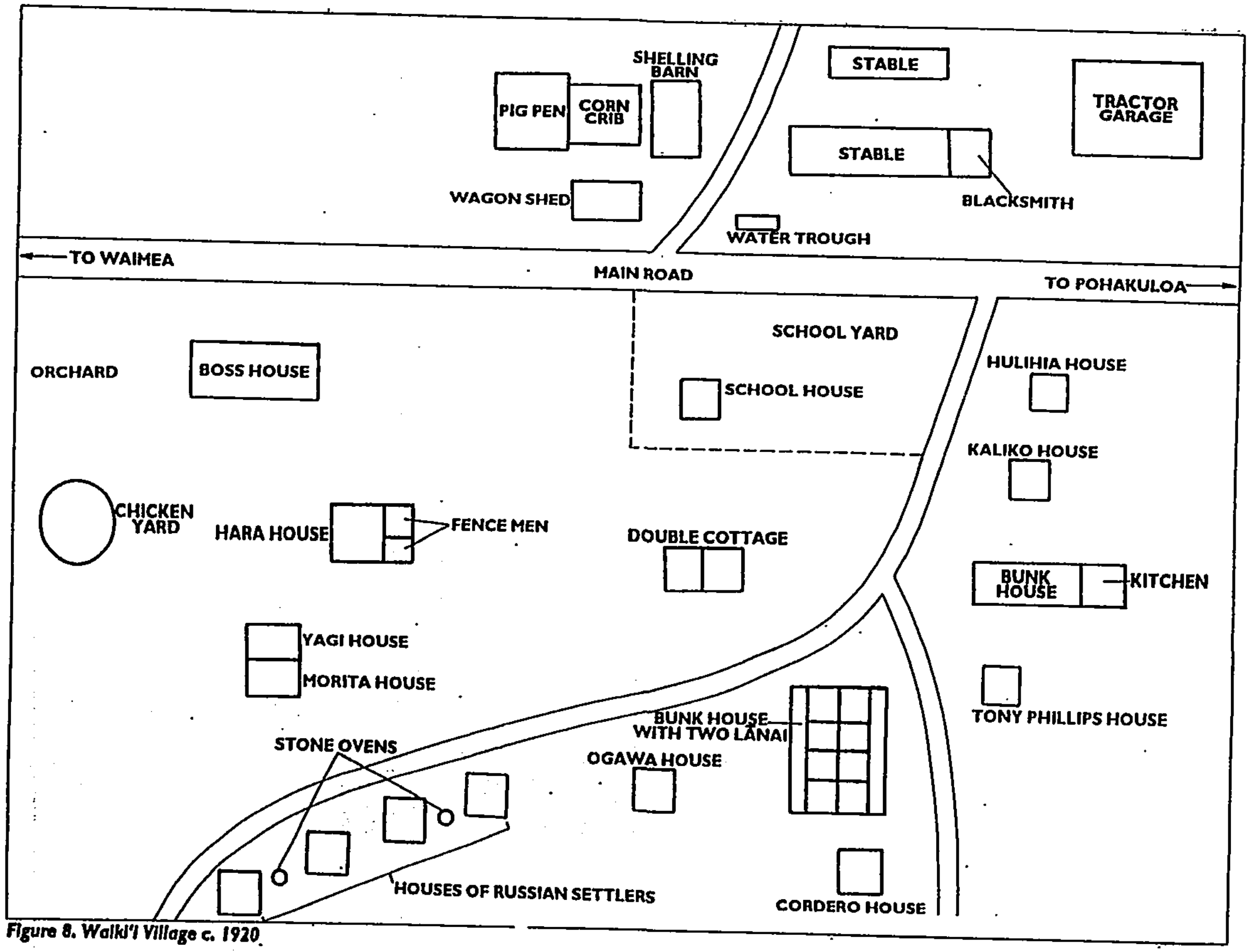


Figure 8. Waiki'i Village c. 1920

feed their mules. Carter had silos built to preserve corn silage to feed the cattle, but the silage didn't work out very well, according to Mr. Kimura (Int. 3).

Part of the men at Waiki'i planted corn, but not all of them. Connected with the corn-growing operation, was the pig-feeding operation (cared for by Yagi), the tractors and the man who kept them in repair (Ogawa), the chicken yard, which raised poultry for ranch use (cared for by On Kiso). There was an eight-horse wagon kept at Waiki'i, with a driver Hulihia and a "swamper" who helped him maneuver the horses. The eight-horse wagon carried the corn to Waimea and to Kawaihae for shipping to Honolulu and also carried wool down from Humu'ula. They also raised turkeys at Waiki'i.

> In the beginning they had 'em around there. They feed corn and keep 'em around, but then gradually they started get wild and they just left and nobody cared to catch the turkey. But then almost in December, before, November is their [time], they have couple men work nights, go out moonlight nights to find turkeys on the trees. Catch the turkey on the tree, put all in a bag and bring back. They had a place where they feed them, and then during the Thanksgiving and Christmas they ship 'em over to Honolulu (Kimura Int. 3).

Besides these subsidiary activities connected with corn-growing, there were also some men stationed at Waiki'i who took care of the cattle operation there, mostly fence-men who stayed in the lower bunkhouse.

By 1950, Waiki'i village began to decline. First the operation was more mechanized, with tractors replacing horses for cultivating the corn and trucks replacing wagons for hauling, so that fewer people were needed at Waiki'i. Then about 1950, following some years when the crop failed for lack of rain, the ranch gave up growing corn there. The school was closed because there were no longer enough children. In the 1960s, the workers' houses were moved to Waimea, although the manager's house and some other buildings are still there.

Humu'ula - Sam Parker bought a controlling interest in the Humu'ula Sheep Station Company about 1900 (PRF, Humu'ula File, Chronological Record) and his son Sam Parker Jr. became the manager of the company (Blacksheep 1902). In 1902, the company was running 20,000 to 30,000 sheep at Humu'ula, mainly merinos, and also some horses and mules. (There is no mention of cattle.) Both wool and mutton were sold. The shearing was done by Japanese laborers paid by the animal, and the sheep were dipped afterward. There were five stations at Humu'ula in 1902, connected by a private telephone line. The five stations were probably Kala'i'ehā, Pu'u 'Ō'ō, Laumai'a, Hopuwai and Keanakolu. Early maps show houses at all five locations, and all those stations were utilized in later years except for Pu'u 'Ō'ō (shown only in Baldwin's 1902 survey book). The 1910 census indicates that twenty men were living at Humu'ula then, in addition to Sam Parker Jr. and his brother. Most of them were single, although a few had families. About half were Hawaiian and half Japanese. Among them was the famous Waimea cowboy Ikua Purdy, known for winning the world roping championship in Cheyenne, Wyoming. Henry Auwae (Int. 5) says that he went to the sheep station when he was a boy to visit his grandfather George Charles Allen, who ran the sheep station then, perhaps about 1912 to 1918*.

**Mr. Auwae says that his grandfather Allen also ran the sheep station during an earlier period and that his mother Abigail Allen was born up there then. Attempts to document Allen's involvement at Humu'ula Sheep Station through the archives have been unsuccessful. He may be the Allen who made an application in 1873 to settle the boundary of* the ahupua'a *of Waiki'i, in the Kawaihae area (BC Book A: 170). He must be different from the George T. Allan who is identified in the Hawaii State Archives as an agent of the Hudson's Bay Company and as a visitor to Waimea in 1849 (see Anonymous 1847a and b).*

After his father's stroke in 1913, Sam Parker Jr. sold out to A. W. Carter of Parker Ranch in 1914 (Wellmon 1969:230). There were then 23,000 sheep at Humu'ula, 513 horses and 525 cattle (Wellmon 1969:232). Parker Ranch continued the sheep operation but gradually increased the number of cattle and decreased the number of sheep. In 1929 and 1935, there were 12,000 sheep (Henke 1929:39; Wentworth et al. n.d.:56). Rally Greenwell (personal communication) estimated about 2,000 cattle at Humu'ula during the wet season when he first worked up there in 1936. By 1950, there were about 3,000 cattle and only 6,000 to 8,000 sheep, according to Tom Fujii (Int.) who worked then at Humu'ula. In the years before 1950, Parker Ranch had made a number of ponds with bulldozers to increase the water supply so as run more cattle. About 1965, the sheep operation was phased out completely (Greenwell Int. 1).

Informants described the Humu'ula operation over the whole period 1912 to 1970, but the fullest information is for the 1930s, the same period as a description by the Mauna Kea Expedition of 1935 (Wentworth et al. n.d.). Throughout these years, sheep were grazed in the grassy plateau around the sheep station at Kala'i'ehā, bounded by walls on the south and on the north. On the south, the wall ran just south of the present Saddle Road (for the most part) and kept the sheep from wandering onto the lava farther south. On the north, the wall kept the sheep from wandering out of Humu'ula and up Mauna Kea. The 1935 lava flow covered a part of this grassy plateau, the strip where the present Saddle Road runs through. Only the northeast section of Humu'ula was used for cattle. There were three cattle stations with bunkhouses, one at Laumai'a, one at Hopuwai and one at Keanakolu. That end was suited to cattle because it was wetter and had water available in several tributaries of the Wailuku river. The sheep station area had no standing water. The sheep could survive on the dew which collected on the grass each night, but cattle could not. The area south of the sheep station, called Kīpuka 'Āinahou was not used by Parker Ranch according to informants. In the 1940s, however, Shipman's Pu'u 'Ō'ō Ranch ran cattle there during the rainy season (Olivera, Fujii Ints.).

A sketch of the sheep station at Kala'i'ehā in the 1930s is shown in *Figure 9*. The sketch is based on information gathered during site visits to the station with informants Sonny Kaniho and Johnny Lindsey, who stayed there about 1930, as well as on a 1973 site plan made for the Hawaii Register of Historic Places. There was a boss house, a couple of cottages (occupied by families when Sonny Kaniho lived there from 1923 to 1930), and a bunkhouse and kitchen for the shearers when they came up. The bunkhouse had a wooden platform where all the men slept side by side, each under his own blanket. There was also a storeroom/saddle house, a forge, a meat house and a shear barn. The meat house was used to hang the sheep carcasses after butchering before they were taken down to Waimea for sale (Auwae Int. 6). The shear barn was the largest structure, the west end being used for shearing and the east end for baling the wool. There was a motor at the east end that ran all the cutters used for shearing *(see Figures 48-50)*.

There were a few permanent workers stationed at the sheep station. Yutaka Kimura (Int. 2) remembered three workers there in 1919, when he first went up for shearing, the *haole* manager "Haineki" (Ernest Campbell), an old *haole* worker named Dennis, and a Japanese worker named Yama. Additional workers were brought up for major operations like shearing, dipping to prevent ticks, marking the young sheep, and driving the wethers (castrated males) to Kawaihae for sale to Honolulu.

> They drive sheep shearing time, not branding but marking the sheep and castrating, yeah. And dipping time. At least three times they drive the sheep. Cause when they drive sheep more when they land they cut the ear, cut the tail. Female they cut 'em till real short, and the male one they cut 'em little bit long. And the ear we mark will be different [for male than female]. (Tom Fujii Int.)

Shearing took about six weeks during April and May. Dipping was done a couple months later and took about two weeks. The shearing was done by contract workers, mostly young Japanese men from

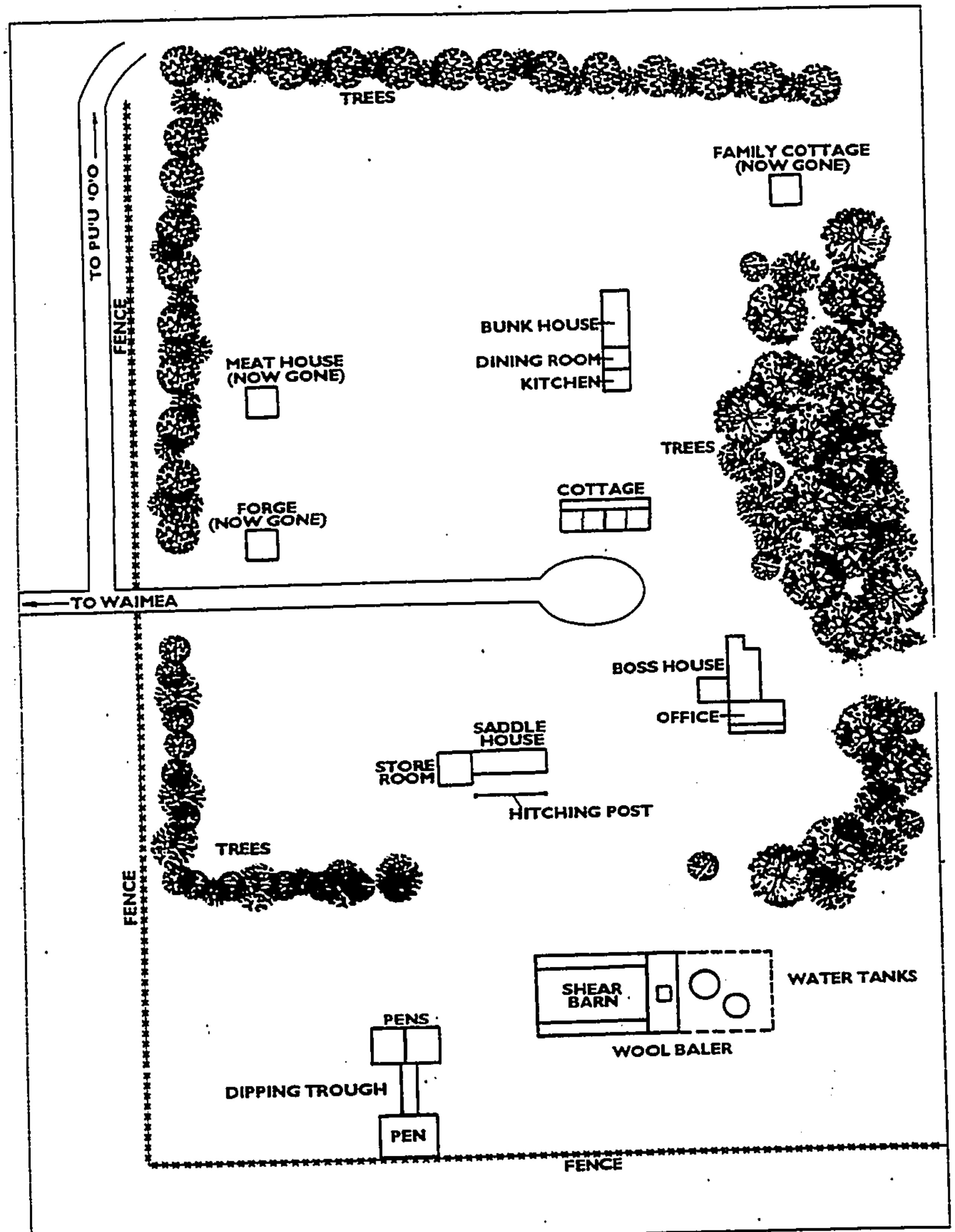


Figure 9. Kala'i'eha Sheep Station c. 1930

Waimea. The wool was pressed into bales in the shear barn and taken down to Waimea in wagons. In 1929, the ranch sold 70,000 pounds of wool (Henke 1929:39). Johnny Lindsey and Tom Fujii described shearing in the 1930s and 1940s, respectively.

> Shearing time they used to be about May, April, May. They used to shear about the beginning, had so many, I don't know, about eighteen to twenty thousand head of sheep. So the shearing man came from Waimea. They give 'em a contract. One head let's say was about five cents, I think. So whatever you shear, that's your day's work already. Where they used to shear, two hour in the morning. . . Let's say they start 7:00, they take a break 9:00, then they start again till 11:00, and they stop shearing again for another two hour. So actually it was only about short time, only about six hours.
>
> Fast one they could shear over a hundred. That's some going, yeah. But they were smart. You know, the old timers, they know what one to grab. You know, depends on the wool. It's soft, easier to cut. At the end, I know it's going to be all kinda hard to shear yeah. Not cut too easy.
>
> I was more on the baler. You know where they bale the wool. They had that box built where you put your bag. Then when you put your bag inside, you shut the door, you get the clamp, that with a board. So you just press it down. Press it down with the hand with a long pipe. (Tom Fujii, Kaumana group Int.)
>
> The faster ones they shear about a hundred, a hundred ten, hundred and thirty at the most. Average about eighty or ninety. But there was one old man, Japanese old man. Oh, he can bend down all day like that to shear. So the younger guys, they was some guys pretty fast. Faster than he though. But they were men [already]. They never beat the old man one time, never. They respect that old guy. That's his place, eh? So they come within five, four, but they never beat him. (Johnny Lindsey Int. 3)

During the 1930s, cowboys went up to Humu'ula in the summer and drove the wethers and old ewes down to Kawaihae, to be shipped to Honolulu for slaughter and sale. It took about four days altogether.

> We used to bring the sheep down in the afternoon from Humu'ula, down to a corral they call Pu'u Mau [Mau'u]. And that hill is on the Humu'ula side of Pu'u Ke'eke'e on the right hand side of the Saddle Road as you come down. Pu'u Mau, we used to put the sheep in there and then ride back to Humu'ula, spend the night at Humu'ula and leave Humu'ula about 2:00 in the morning, ride down to Pu'u Mau, pick up the sheep and bring 'em down to Nohonohae and leave 'em at Nohonohae.
>
> Right where the big pasture. Then from there the sheep were brought into Waimea for about a night and then from there down to Pu'u Iki, half way to Kawaihae. And the next morning early they would take 'em to Kawaihae and put on the boat, send to Honolulu. (Rally Greenwell Int. 1)

About 1945, after Saddle Road was built, the drives ended, and the sheep were taken down by truck instead.

Besides the sheep station at Kala'i'ehā, Parker Ranch maintained three cattle stations for fence-men and cowboys, at Laumai'a, Hopuwai, and Keanakolu. There were one or two men who stayed permanently at each station, but otherwise cowboys just bunked there when they came up from Waimea to work in the area (Kimura Int. 2). Parker Ranch used northeast Humu'ula as a fattening pasture for yearling heifers up to the 1960s. Every year a new batch was brought up through Keanakolu, and the old batch was driven down to Waimea to be sold (Lindsey, Fujii Ints.). In the 1960s, a calving operation replaced the fattening operation at Humu'ula, about the same time that the sheep operation was being phased out.

Rally Greenwell and Yutaka Kimura, both part of Parker Ranch Management in the 1960s, explained why Parker Ranch got out of sheep raising. One reason was that the wool was bringing a lower price. New weeds were coming into the Humu'ula pasture, with seeds that got into the wool and reduced the market price. A second reason was that it had become difficult to find men who would do the shearing. "It was awfully difficult to get anybody to go up and shear sheep at that time. We'd have to take a cowboy, and a plumber, and you get 'em up there once and they never want to go again" (Rally Greenwell Int. 1). A third reason was that there was an increasing problem with lambs being killed by boars, according to Yutaka Kimura (Int. 1). When the corn-growing operation was going at Waiki'i, large numbers of wild pigs fed on the corn left in the fields. When the corn-growing operation ended, the pigs moved up toward Humu'ula and began to go after newborn lambs. All of these problems with the sheep operation occurred at a time when more water had become available for cattle from the ponds built in the 1940s, so it was feasible to shift entirely to cattle.

Parker Ranch at Ka'ohe - Parker Ranch used Ka'ohe as a pasture for horses and mules in the early part of the century. The ranch held the lease to Ka'ohe 3 all the way through from the nineteenth century to the later 1940s (Kimura 1:15, Greenwell 1:6-8). The Ka'ohe 4 lease was held by the Humu'ula Sheep Station Company to 1906, and then went to A.M. Brown (Territory of Hawaii 1905:57). In 1916, the lease went to Parker Ranch until 1930 (Territory of Hawaii 1916:43). Parker Ranch never leased Ka'ohe 4 after that (Greenwell Int. 1). In 1930, the lease was obtained by a Portuguese who intended to hunt goats, according to Johnny Ah San (Int. 2-3), but he was unsuccessful and gave it up. In 1935, most of Ka'ohe 4 was added to the Mauna Kea Forest Reserve, which had been established earlier (Wentworth n.d.:60-61).

Up to the 1930s, Ka'ohe was used by Parker Ranch to pasture horses and mules (Kimura Int. 1, Greenwell Int. 1). There was little water there, and horses could survive longer without water than could cattle. On the West Side, the horses went down to Ke'amoku station for water. On the East Side, water was piped down from the springs above Pōhakuloa to a watering trough in the area of the present Mauna Kea State Park. Yutaka Kimura (Ints. 1 and 2) described the pasturing operation. Each cowboy had a string of about sixteen work horses in the early days, and every two months half of them were turned out to graze and rest up at Ka'ohe. The horses were taken from Waimea past Pu'u Holoholokū and above Pu'u Ahumoa on Mauna Kea and then turned out into the area between Pu'u Ke'eke'e and Pōhakuloa. The rested horses were rounded up and ridden back. Young mules and work horses were also pastured at Ka'ohe to toughen their hooves. Parker Ranch had a great number of horses and mules to pasture at that time, 2,200 according to Henke (1929:39). The ranch raised mules for the sugar plantations, breeding them using a donkey stud and a Percheron mare so the mules were large enough for heavy work. Then they were trained at Waimea.

> They have a pasture for 'em [in Waimea]. And the young ones, wean 'em, handle 'em. They lead, and all that. Touch all the leg and lead around. Then you turn 'em out [to pasture] at one year. When they come to three years old, they bring 'em down and they handle again. Usually they don't sell 'em too young. Before they sell 'em, put 'em on wagon, pull the wagons. He [The trainer] get his swamper and he goes out one mule, one Percheron wagon horse, tame horse. Put 'em on the side. Train 'em to do that. They had men to do that all the time, nothing but train – they train wagon horse, train mule. (Yutaka Kimura Int. 2)

Sonny Kaniho (Int. 1) said that Parker Ranch used the water at Pōhakuloa in the 1920s and 1930s, and that earlier it was used by Sam Parker's operation at Humu'ula. The pipeline was apparently first laid by Hackfields, when they owned the Humu'ula Sheep Company, prior to 1900. In 1909, the pipeline was in need of repair (PRF, Humuula Sheep Station Company Report for 1909). A man named Joe Mehrtens lived alone in a cottage at the bottom of the pipeline for years and tended the water (PRF, Humuula File, Recollections). He also caught wild cattle, according to informant Johnny Lindsey (Int. 3). In 1934, informant Johnny Ah San (Int. 3) went to inspect the pipeline prior to the establishment of the CCC camp at Pōhakuloa. He found that the line had frozen and burst. The trough and old cottage were still there. By 1946, the cottage was gone (PRF, Humuula File, Letter from E. H. Bryan).

U.S. Government Operations - Beginning in the 1930s, the United States government became a presence in the project area, first building fences and roads and eventually establishing Pohakuloa Training Area, at Ka'ohe.

In 1935-36, as part of the effort to eradicate wild sheep from the mountain, the Civilian Conservation Corps (CCC) took on the project of building a fence around the Mauna Kea Forest Reserve (Wentworth et al., n.d.:59-61). As early as 1907, ranchers had built fences on the upper side of their pastures to keep their cattle from straying up onto Mauna Kea. In 1909, 66,000 acres of land (mainly Ka'ohe 3) was designated as the Mauna Kea Forest Reserve. In 1928 and 1935, the reserve was expanded to 85,000 acres, particularly by the addition of most of Ka'ohe 4. By that time, the wild sheep had become a significant problem, preventing the *māmane* from regenerating. About 1920, ranchers poisoned most of the wild dogs on the mountain, and the wild sheep multiplied rapidly after that. Wentworth et al. (n.d.:59) estimates that there were 40,000 wild sheep in 1935. When the CCC was established in Hawai'i, one of its first projects was to build the fence around the reserve. Sheep drives were then carried out in an attempt to eliminate the sheep from the reserve.

The CCC recruited teenaged boys to carry out its projects and they lived in camps at various places on Hawai'i Island. For the Mauna Kea fence project, seven cabins were built around the base of the mountain, with water tanks to provide drinking water. Informant Johnny Ah San worked as a cook at the cabin located at Pōhakuloa, the present location of Mauna Kea State Park. The Mānā Road to Keanakolu was upgraded from a wagon road to an auto road by the CCC so that supplies could be brought in on the north side of the mountain (Ah San 2, Greenwell 1 Ints.). The fence itself was built with *māmane* posts from the forest. Sonny Kaniho (Int. 1) noted that the CCC project, designed to save the *māmane* forest, was itself responsible for eliminating much of the *māmane* from Humu'ula.

In the 1940s, a number of interior roads were built or improved. The attack on Pearl Harbor, in 1941, created an atmosphere in which everyone feared another Japanese attack. Barbed wire was strung on beaches and lookouts posted above the coast watched for an enemy invasion. In this context, the U.S. Government felt it advisable to build roads that would allow movement through the interior if the enemy should take over part of the coast. The Saddle Road was built in 1943 by the CCC and the USED, as described earlier. The USED also worked on the Keanakolu Road (still a trail from Keanakolu to the Saddle before World War II). They finished the road from the Saddle Road through to about Laumai'a before they stopped (Imoto Int.).

The American military was a large presence in Waimea and the Saddle during the war. From 1942 to 1945 both army and marines were stationed at Waimea, some 30,000 to 50,000 men (Brennan 1974:160; Brundage 1971:109-110). They lived in tents and Quonset huts south of the village, at a place christened Camp Tarawa, after the island in the Marshalls where the marines fought a bloody World War II battle. An area of 50,000 acres below the Kona-Waimea Belt Road (including much of Waikōloa) was used as a firing range for artillery practice. According to Yutaka Kimura (Int. 2), tanks went up to the Saddle for maneuvers during the war, and there was already an army camp established at Pōhakuloa, with tents and Quonset huts. A dirt track for tank travel was established from Kawaihae up to Pu'u Ke'eke'e, which ran *makai* of the Saddle Road. Richardson (c. 1946:356) mentions Camp Pohakuloa as operating between 1943 and 1945, and says there was an anti-tank range and a large artillery range and impact area adjacent. The Hawaii Island map in Part III, Annex P of Richardson (c. 1946) shows the camp at what looks like the present cantonment area. The army also took over the old CCC camp house at Pōhakuloa and used it during the war (Ah San Int. 2).

After the war, the USED did further road work. About 1948, they built a jeep road from Pu'u Ke'eke'e down toward Kona (Ah San Int. 1). The Saddle Road was improved and paved, first the west side, to Humu'ula, and then the east side (Paris Int.). On the east side, the road was straightened, cutting off several loops (Ah San Int. 3). Informant William Bergin (Int.) said that the work was finished before he began to work at Pu'u 'Ō'ō Ranch, in 1950.

After the war, the old Pōhakuloa camp house became part of the Pohakuloa Ranger Station. It was used by the territorial Forestry Service and the Division of Fish and Game. (Johnny Ah San says it was used for a "hunting lodge.") In 1949, a *nēnē* breeding project was started there, to try to prevent the *nēnē* from sliding into extinction (Kear and Berger 1980:50-60). The breeding project was started with two pairs of geese donated by Herbert Shipman, who kept a flock at Kea'au. Initially Johnny Ah San worked there. Then from 1955 until the project closed down in 1984, Ah Fat Lee raised the geese. *Nēnē* were released in several upland areas on Hawai'i Island, including Hualālai, Keauhou (east slope of Mauna Loa) and Volcano. In 1974, the 'Āinahou area of Humu'ula south of the sheep station, where *nēnē* were known to feed, was designated as Kīpuka Ainahou Nene Sanctuary.

Not long after the end of the war the Hawaii National Guard established a camp at Pōhakuloa. Informant William Paris went up in 1948 with a National Guard survey gang to establish survey points so that the Guard could do artillery practice and be able to check the accuracy of their firing. In 1949, both the Hilo and Kona National Guard artillery batteries started going up to Pōhakuloa for practice and camped up there. There may have been a few Quonset huts in the area, but the men were mostly housed in tents (pers. comm. from Bill Paris, John Kaiawe). Planes were landed on the Saddle Road or on the flat near Pu'u Ahi. The camp was built up more during the Korean War (c. 1953), both the U.S. Army and the Hawaii National Guard working to put up more Quonset huts (Paris Int.).

Pohakuloa Training Area was created in 1956, as a U.S. Army installation of some 116,000 acres (History of Pohakuloa, c. 1965). Two parcels of land in Ka'ohe 4, totaling 758 acres, were transferred to the U.S. government by Governor King's Executive Order No. 1719. The cantonment and airfield were built within that area north of the Saddle Road. An additional 84,000 acres was transferred by Presidential Executive Order No. 11167, taking in all of Ka'ohe south of Saddle Road. That area became the impact area for firing practice. Adjacent land totaling about 31,600 acres was leased from the state and from private owners. As of February 1956, there were 120 Quonset huts at PTA, and the marines were to construct 110 more in March. Bradshaw Airfield was constructed about the same period (1956-58) according to William Paris (Int.).

Summary

The project area was used by Hawaiians long before Western contact began. Prehistoric trails crossed the Saddle from west to east and from south to north, both for ease of travel between districts and for access to interior resources. On the West Side, the project area has been thought too dry to have been exploited by Hawaiians for agriculture. The dry upland forest was mainly exploited by birdcatchers hunting birds valued for their feathers.

The Saddle was exploited by birdcatchers. The *'ua'u* (dark-rumped petrel), *nēnē* (Hawaiian goose) and *kōloa* (Hawaiian duck) were taken for meat, and various smaller birds were collected for their feathers. Based on the distribution of camp sites on the southern slope of Mauna Kea above the Saddle, travel to the summit of Mauna Kea for quarrying may have taken place, in part, from the Saddle.

The forested East Side, downslope from the Saddle, was again exploited mainly by birdcatchers, who sheltered in caves or built houses. From about 2500' on down (from milepost 9), the forest was also used to obtain *koa* logs to carve canoes and to plant bananas in forest clearings. Near the eastern end of the project area, yams were planted in forest clearings as well. The permanently cleared *kula* (open land), which was heavily used by Hawaiians for agriculture, began just below the project area at about 330 m (1,100 ft) (milepost 5).

During the nineteenth century, traditional Hawaiian use of these interior resources gave way to Western-inspired exploitation. Herds of wild cattle, sheep and goats multiplied on the grasslands of the West Side and Saddle. Western settlers and Hawaiians began to hunt these wild herds, and later they established ranches. The whole area eventually came under Parker Ranch, centered at Waimea. By the late nineteenth century, a wagon trail connected Waimea to Humu'ula in the Saddle. In the twentieth century automobiles used the old wagon trail to reach the Saddle from Waimea, until it was replaced by the Saddle Road during World War II.

The forested East Side was less valuable to Westerners, although there was some lumber milling of *koa* and *'ōhi'a*. The middle elevation forest (from 1,800 m to 450 m) was little used in the nineteenth century and was turned into a forest reserve in the twentieth. The trail which had passed through the forest and connected Hilo with the Saddle became little-used in the twentieth century. The upper elevation forest (above 1650 m) was cleared for ranching, and became Pu'u 'Ō'ō Ranch, owned by the Shipman family of Kea'au. The lower elevation forest (below 480 m), including the lower parts of Kaūmana and Ponahawai, was cleared for growing sugar cane, which was carried by a flume system to Hilo to be milled.

EXPECTED SITE AND FEATURE TYPES

The previous archaeological research, the evaluation of historical documentary sources, and the results of oral interviews provide the basis for a determining the types of sites and features that are to be expected within the project area. Formal types include the following categories.

Alignment - A linear structure composed of just one course of three or more stones in a line; stones may be placed so ends overlap, touch end to end, or are slightly apart. The alignment may form a straight line, or a series of lines, or it may curve and even form a complete circle.

Cairn - A cairn is usually an informal stacking of stones, more than two stones high around its entire periphery, with no core filling or facing. It has little top surface and tends to be cylindrical in profile rather than dome-shaped, like a mound. Cairns are generally small, usually with a maximum dimension of less that 3.0 m.

Causeway - A raised road, usually constructed of stacked rocks; used to elevate a portion of the road over a void or drainage.

Concrete Structure - A construction utilizing poured concrete, usually as the foundation for a wood superstructure. It may consist of poured perimeter walls or poured concrete slabs.

Enclosure - Circular to rectangular constructions that enclose at least 75% of an interior space. One or more sides of the enclosure may be formed by natural features, such as the side of an outcrop, or the side of an elevated lava flow.

Fence - A line of posts or poles that are or were perpendicular to the ground, linked with barbed or smooth wire that is attached with fencing staples or other wire.

Flume - A raised channel for conveying water.

Modified Outcrop - A feature in which the stone outcrop itself constitutes at least 75% of the feature, this feature type is usually assigned after eliminating other feature types (e.g., not piled enough to be a mound; rocks are scattered rather than aligned, etc.). It usually consists of a scatter of rocks on top of bedrock or a bedrock outcrop. The rocks sometimes form rough rings. The surface is usually irregular, and bedrock is often exposed in the center of the feature or at various other locations within it.

Overhang - A collapsed lava tube or blister, where the long axis is usually side to side, rather than front to back. As with lava tube caves, modifications may be present inside the overhang, including, for example, small terraces and cleared areas.

Paving - A layer of rock, usually relatively small basalt pieces, that creates a level surface.

Pipeline - A steel, concrete, or wooden pipe for conveying liquids (usually water) over long distances.

Road - A linear feature that forms a level surface. It can be constructed with crushed basalt, or may be limited to parallel wagon tracks. It may also be constructed in a manner that the sides are even with the surrounding area or may be built slightly above or somewhat depressed.

Terrace - A free-standing, flat-topped structure with at least one side flush with the adjacent ground surface. Terraces may be rock-filled or earth-filled.

Trail - Trails are transportation routes formed by wear from repeated use and are in many cases cleared or partially cleared of rubble and obstructions. Steppingstone trails are alignments of *pāhoehoe* slabs used as steppingstones. Kerbstone trails are historic trails lined with kerbstones.

Wall (Including C-shape, L-shape, U-shape Walls) - A linear structure at least two stones high and longer than it is wide. .Walls generally have stacked sides and a flat top surface, while linear mounds have sloping sides and irregular surfaces. Curving walls or sets of contiguous walls form L-shapes, U-shapes and C-shapes.

Functional types consist of the following:

Animal Husbandry - Sites related to animal husbandry may be prehistoric or historic, and include wall segments and larger enclosures. Most of the examples within the project area appear to be associated with Humuʻula Sheep Station and/or Parker Ranch. This interpretation is supported by historic artifacts such as cans, glass fragments, wire, and bits of metal that were observed in association or nearby.

Boundary - A feature is assigned a boundary function if it appears to delineate a *line*. This function is usually restricted to linear mounds, walls, and alignments, but it can also be used for an alignment of features (e.g., an alignment of cairns). There is usually little cultural material with these features.

Habitation - Features are assigned permanent or temporary habitation functions if they are considered to have been used as living space or associated with living space. Temporary habitations usually evidence one-time or short-term use, or repeated use with longer periods of abandonment than use. They usually do not contain substantial cultural remains such as midden or artifacts. Structurally, temporary habitations usually have small surface areas that were used for rest or sleep. Feature types that may have been used for temporary habitation include alignments, small terraces or platforms, walls, mounds, overhangs, modified outcrops, and small enclosures. Usually, these features are isolated and their construction is informal, evidencing little time and effort expended. These features appear to be quite rare within the current project area. No features representing likely permanent habitation were encountered within the project area.

Marker - A feature is assigned a marker function if its location appears to have been selected to identify the location of a site, the perimeter of a site, the end of a trail, etc. Within the project area, this functional designation was applied to mounds and cairns.

Military - Several military sites are located within the APE, and while a few were judged to be more than 50 years old (based on location at Mauna Kea State Park and surface material remains), many were determined to be not subject to 106 review since they are more recent. Rather than assigning these features a simple "military" function, it was determined through discussions with HSS-DLNR that it would be useful to define actual functions. The following four functional types were chosen:

1. Gun Emplacement - Marked by the presence of any military ammunition cartridges such as .30 caliber, 5.56 mm, 7.62 mm, .90 mm, and rarely .16 and 20 gauge shotgun shells.

2. Bivouac - This functional type is indicated by the presence of military food items, typically such things as cans, utensils and cardboard from C-Ration foods or more recently, aluminum foil and plastic bags from MRE (Meals-Ready-to-Eat) provisions. Also included under this division are glass bottles, aluminum cans, unknown metal fragments, tape, milled lumber, and rubber.

3. Communication Post - This was determined based on the presence of communication wire (usually a twisted pair of wires with a rubber coating) and/or dry-cell batteries or battery packs indicating that communications between field phones have taken place at these structures. It is believed that these items are also indicative of a command location, but this cannot be stated upon the basis of the surface artifacts.

4. Indeterminate Military - Typically surface material culture was recorded if it was found either inside of or within five meters of the outside of the structure. Several structures possessed no materials within this area and so were judged to be indeterminate.

Transportation - Features are given a transportation function if they are trails or roads; trails may also serve to mark boundaries (see trails, under feature types); this function was also assigned if the feature was used to transport water for agriculture (flumes) or animal husbandry (pipelines).

Water Catchment - Features at which domestic or agricultural water was obtained are assigned a water catchment function. Examples of these features may include overhangs where drips were collected or small check dams across drainages where water was ponded.

Indeterminate - Features where a definite function could not be established.

Archaeological sites in Hawai'i are numbered using a four-number system. The first number refers to the state of Hawai'i and is "50" in all cases. The second number refers to the island, and for this project is "10" (Island of Hawai'i). The third number refers to the USGS 7.5 minute quadrangle map on which the site is located. For specific reference to each third number used in this report, please contact the Hawaii SHPO. The fourth number is assigned to each site, and begins from "1" for each island. In this report the full site number is provided at least once for each site, and thereafter the site is usually referenced by its last set of numbers.

ARCHAEOLOGICAL SITES

A total of 16 sites were observed and recorded within the archaeological APE *(Figure 10a-q, Table 6)*. Thirteen of the sites are newly identified, and three are previously identified sites (7119, 5002, and 10309). Only non-military sites were assigned State Inventory of Historic Places numbers. In addition, 35 modern military sites were identified within the APE. Structures constructed of stacked stone associated with military activities are common within the project corridors. Approximately 600 of these military stone structures were located, flagged, and described within the corridors that passed through Pohakuloa Training Area, and the Parker Ranch Lands to the west and east. These sites are less than 50 years old and are not considered as having exceptional historic significance. Consultation with the State Historic Preservation Division at the time of the pedestrian survey confirmed that these structures do not constitute historic properties. A description of these sites and modern military sites located beyond the APE, and their structures, is given in *Appendix E*.

Other structures associated with modern military activities occur at the cantonment (base camp) and Bradshaw Airfield of PTA in or near the PTA-1 Alignment *(Appendix E)*. These structures consist of Quonset huts, framed buildings and the old Bradshaw Airfield Control Tower that were constructed between 1953 and 1958 during the major building episodes at the base. Most are still in use.

The sixteen non-military sites within the APE are described below. Five sites represent walls or fences associated with animal husbandry activities (5002, 20862, 20865, 20877, and 7119). Another site (20854) consists of enclosures relating to habitation and animal husbandry. Five sites are transportation sites (20855, 21150, 10309, 20878, and 20864) consisting of roads or trails. The remaining sites are a surveyor's marker (20869), a flume (20870), a country club (20872), a 20th century habitation (20873), and a terrace (20856). All of the sites are historic sites. In addition, one trail *(10309)* may also be associated with prehistoric activities. Sites are presented in order from west to east.

SITE DESCRIPTIONS

Site 50-10-21-20852

This is a burial site that was pointed out by Mr. Auwae. The exact location and characteristics of the burial site are not known. The burial location was determined to be more than 100 m from the northern edge of the project corridor. Following the procedures that were determined in consultation with the DLNR (see Methods section of this report), and later correspondence with DLNR, the site is considered a historic property, but only a general location is provided *(Figure 10g)*.

Site 50-10-21-20854

This historic site consists of two enclosures (Features 1 and 2) and a historic trash scatter *(Figure 11)* situated on relatively level terrain near a silted-in gully in Waikoloa, South Kohala. Koa and mamane probably existed here prior to contact, but the area is now covered in grass, and is used for cattle grazing. The site is roughly 70 meters in diameter (345 m2) at about 780 meters AMSL.

Table 6. Summary of Sites Within the Proposed Project Corridors

SIHP Site No.	Seg-ment	Corridor	Formal Site Type	Site Function	Period
20854	I	W-3	Enclosures (2)	Habitation and animal husbandry	Historic
20855	I	W-2, W-3	Road	Transportation	Historic
20852	I	W-2	Burial	Burial	Historic
5002	II	EX-2	Linear wall	Animal husbandry	Historic
5003	II	EX-2	Lava tube cave	Temporary habitation	Prehistoric
14638	II	EX-2	Lithic scatter	Temporary habitation	Prehistoric
20862	III	EX-3	Linear wall	Animal husbandry	Historic
20865	II	PTA-1	Fence	Animal husbandry	Historic
20877	III	EX-3	Linear wall	Animal husbandry	Historic
21150	II	PTA-1, PTA-2	Road	Transportation	Historic
7119	II, III	EX-2, EX-3	Linear wall	Animal husbandry	Historic
10309	III	EX-3	Trail	Transportation	Historic
20856	III	EX-3	Paving	Indeterminate	Historic
20878	III	EX-3	Trail	Transportation	Late prehistoric-historic
20864	All	EX-1, EX-2, EX-3, EX-4	Road	Transportation	Historic
20869	IV	EX-4A	Cairn	Marker	Historic
20870	IV	E-3	Flume	Agriculture	Historic
20872	IV	E-3	Country club	Recreation	Historic
20873	IV	E-3	Concrete structure	Habitation	Historic
35 sites				Military	Historic

Figure 10a. Universal Key for Figures 10c-q

Site Functional Interpretation	Site(s) Inside Corridor	Site(s) Outside Corridor
Agriculture	■	□
Burial	⬢	⬡
Possible Burial		
Ceremonial		
Habitation	◆	◇
Temporary Habitation		
Possible Temp. Habitation		
Marker		
Military	▲	△
Military Group	▲▲▲	△△△
Midden	●	○
Quarry		
Ranch	★	☆
Ranch Group	★★★	☆☆☆
Transportation		
Water Feature		

GROUP SITE BOUNDARY

SITE ###	SITES WITH THREE DIGITS ARE PHRI TEMPORARY SITE NUMBERS
SITE #### / SITE #####	SIHP SITES NUMBERS ARE FOUR-DIGIT AND FIVE-DIGIT NUMBERS PREFIXED BY STATE NUMBER (50), ISLAND NUMBER (10), AND USGS 7.5' QUAD. MAP NUMBER (THIS LATTER NUMBER VARIES DEPENDING ON THE QUAD MAP ON WHICH THE SITE IS LOCATED)

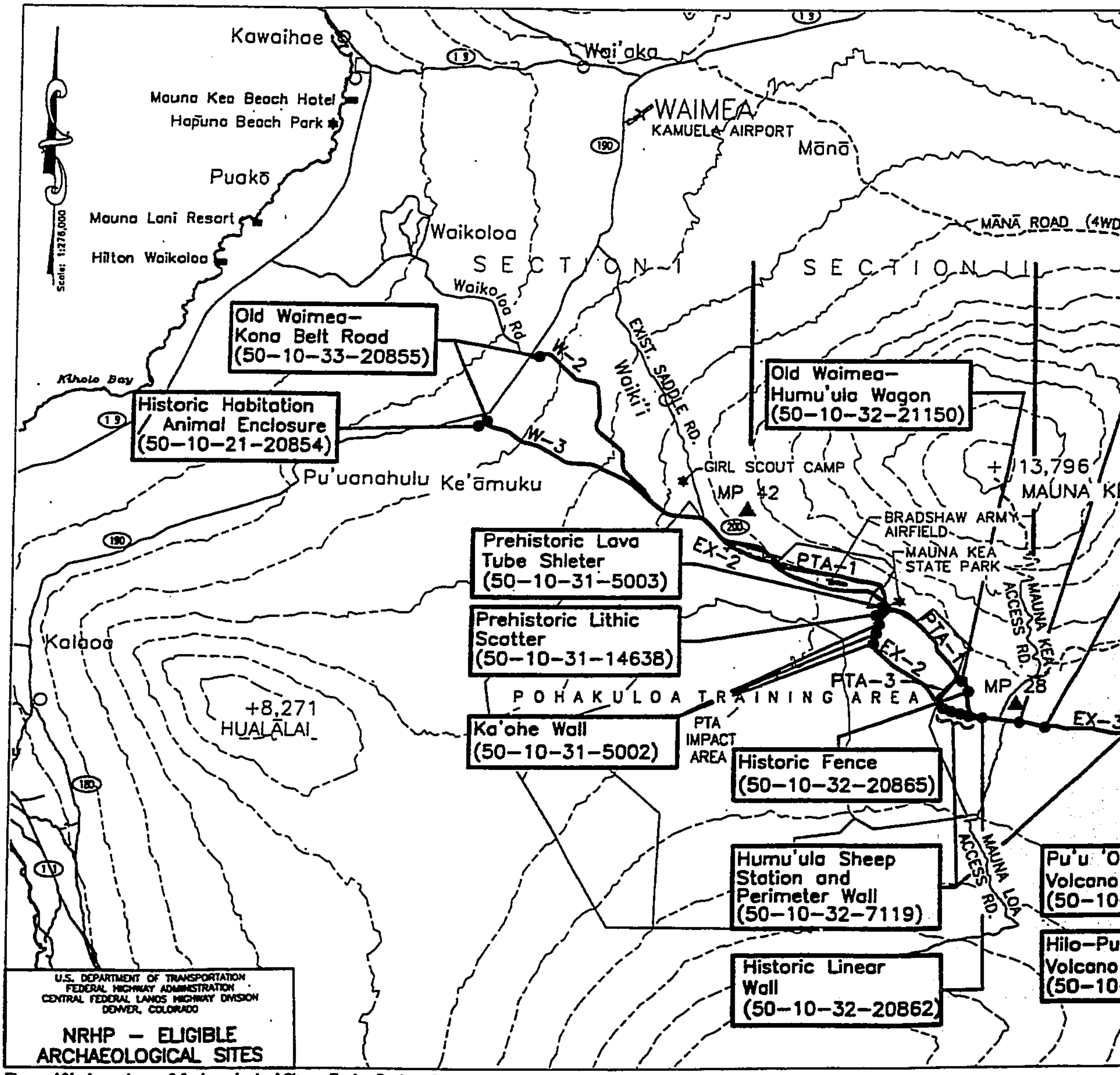
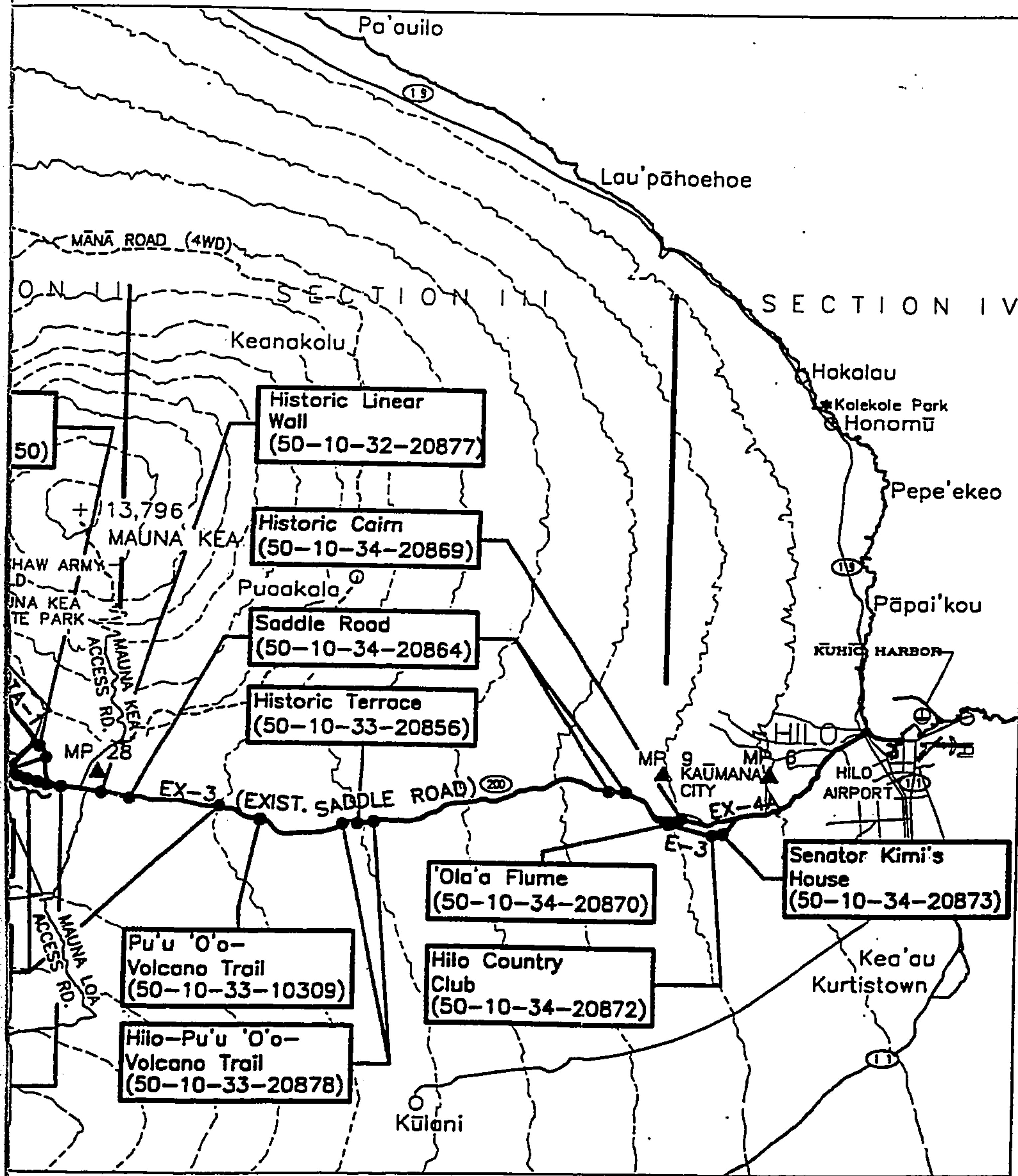


Figure 10b. Locations of Archaeological Sites - Entire Project Area



Pa'auilo
19
Lau'pāhoehoe
MĀNĀ ROAD (4WD)
SECTION III
SECTION IV
Keanakolu
Hakalau
Kolekole Park
Honomū
Pepe'ekeo
Historic Linear Wall (50-10-32-20877)
Historic Cairn (50-10-34-20869)
Saddle Road (50-10-34-20864)
Historic Terrace (50-10-33-20856)
13,796
MAUNA KEA
Puaakala
Pāpai'kou
KUHIO HARBOR
MAUNA KEA ACCESS RD.
MP 28
EX-3 (EXIST. SADDLE ROAD)
200
HILO
MP 9
MP 6
KAUMANA CITY
EX-4
HILO AIRPORT
E-3
Senator Kimi's House (50-10-34-20873)
'Ola'a Flume (50-10-34-20870)
Hilo Country Club (50-10-34-20872)
Pu'u 'O'o-Volcano Trail (50-10-33-10309)
Hilo-Pu'u 'O'o-Volcano Trail (50-10-33-20878)
MAUNA LOA ACCESS RD.
Kea'au
Kurtistown
11
Kūlani

FIGURE REMOVED FROM
PUBLIC RELEASE VERSION
BECAUSE OF SENSITIVITY OF INFORMATION

Figure10c. Locations of Archaeological Sites - West Terminus of EX-1

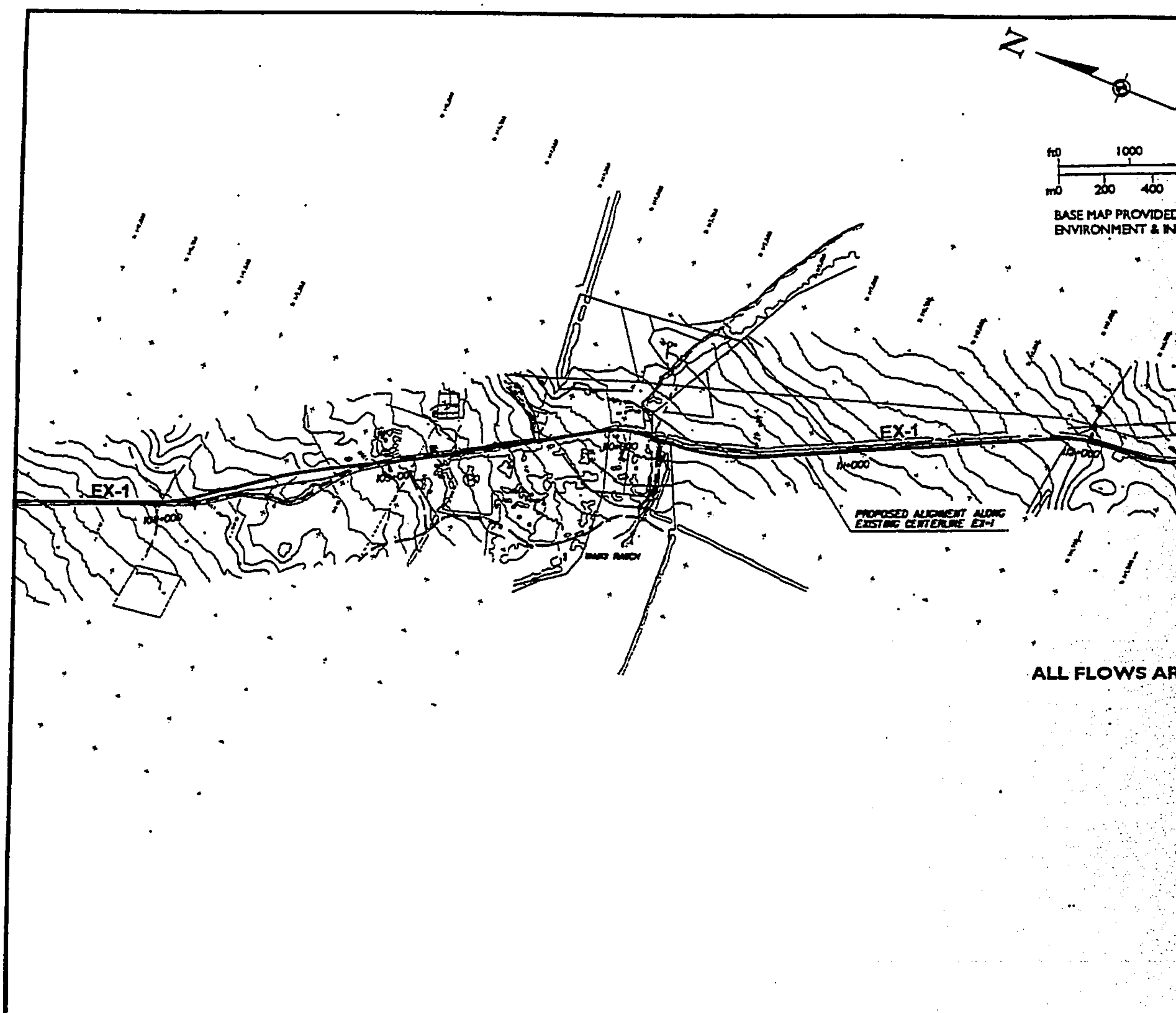
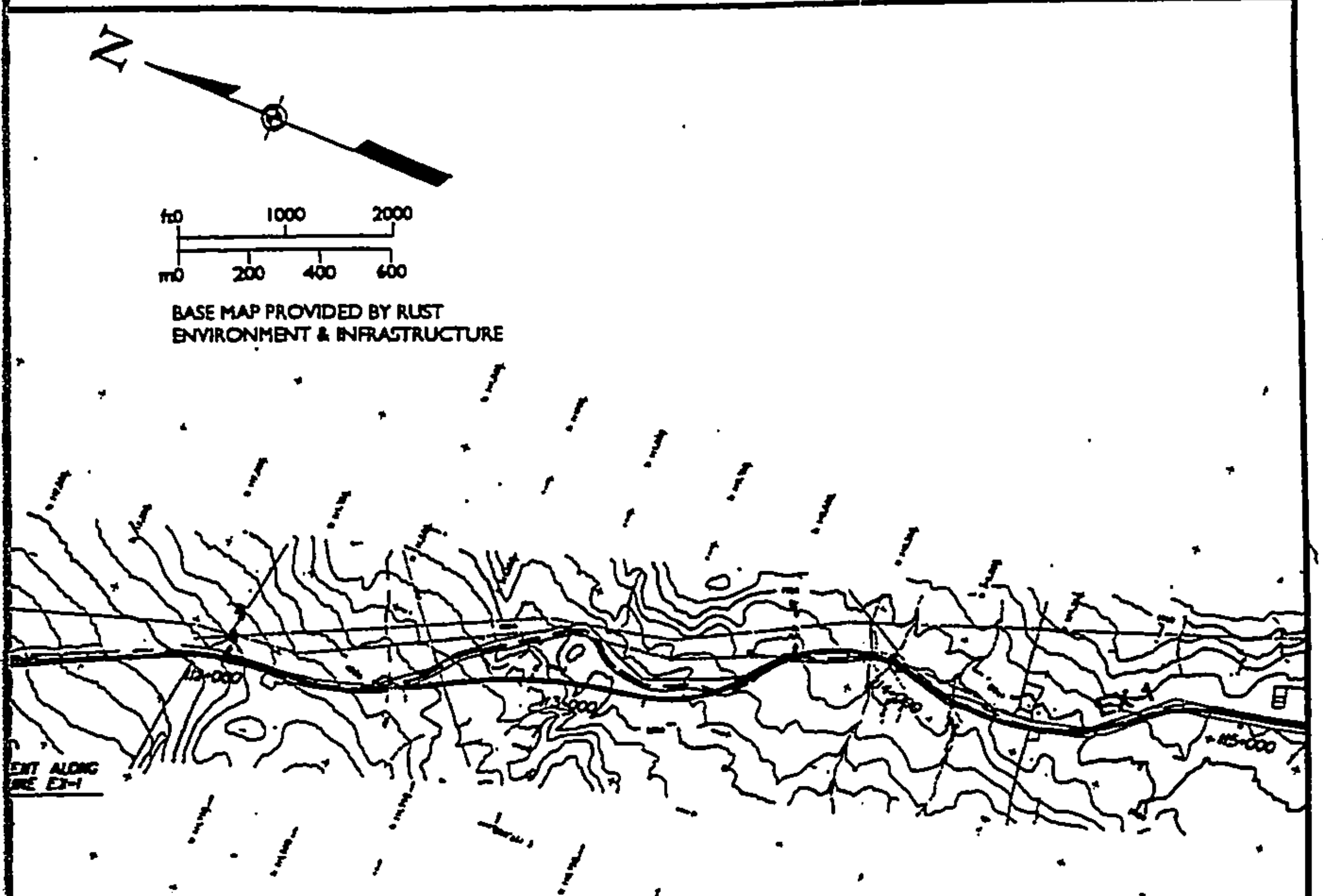


Figure 10d. Locations of Archaeological Sites – Middle Segment of EX-1



ALL FLOWS ARE PRE-8000 BC

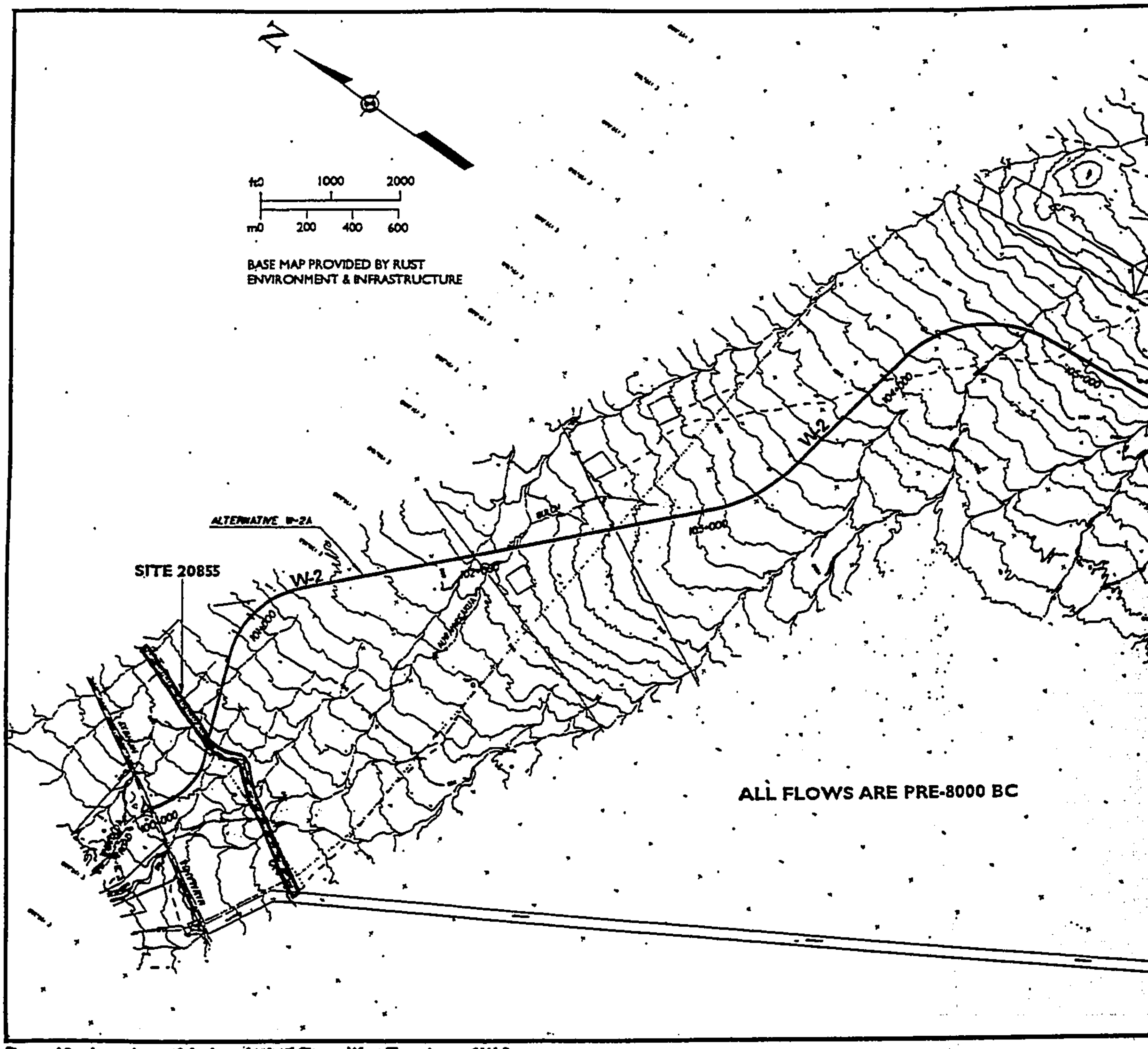
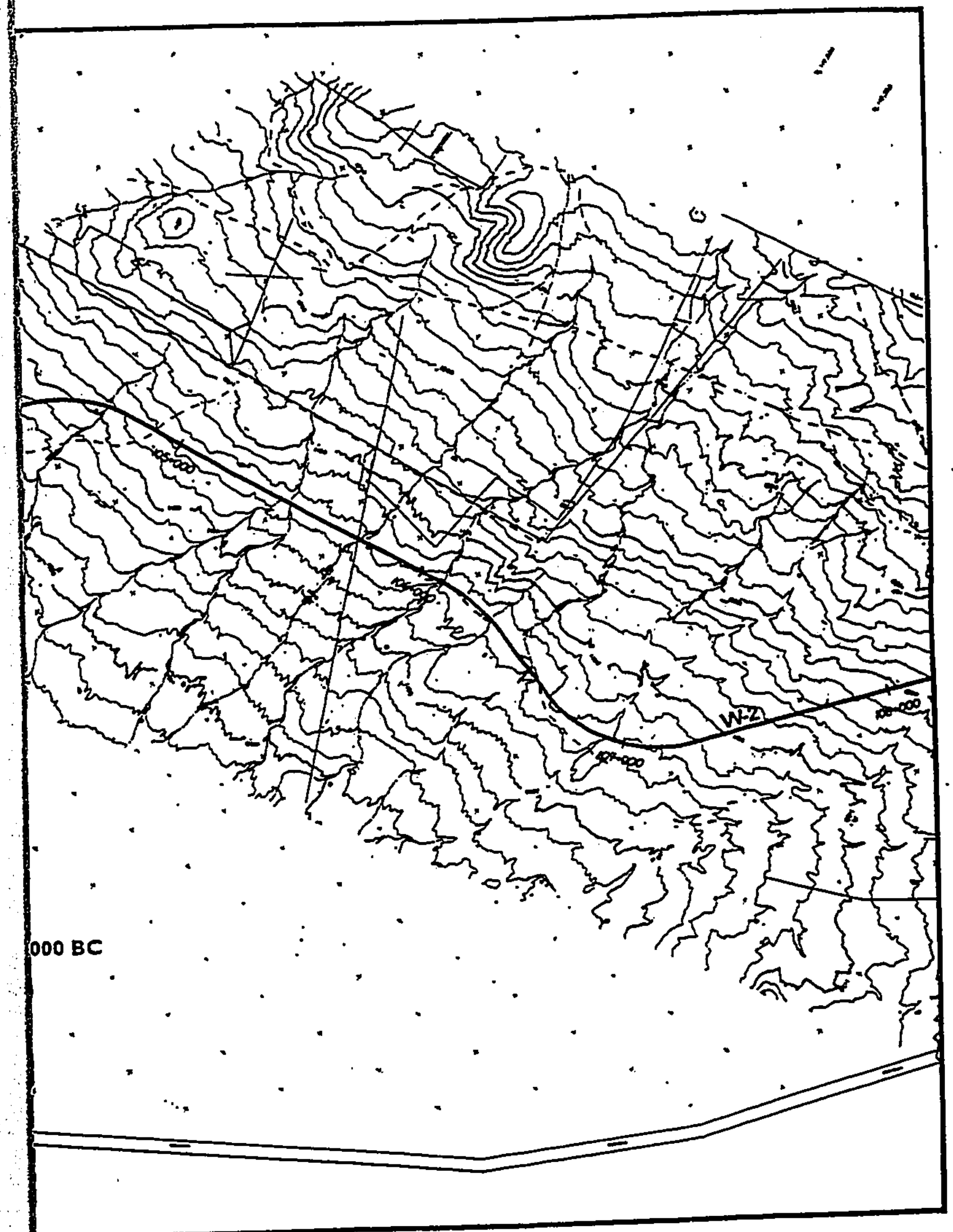


Figure 10e. Locations of Archaeological Sites - West Terminus of W-2


W-Z
000 BC

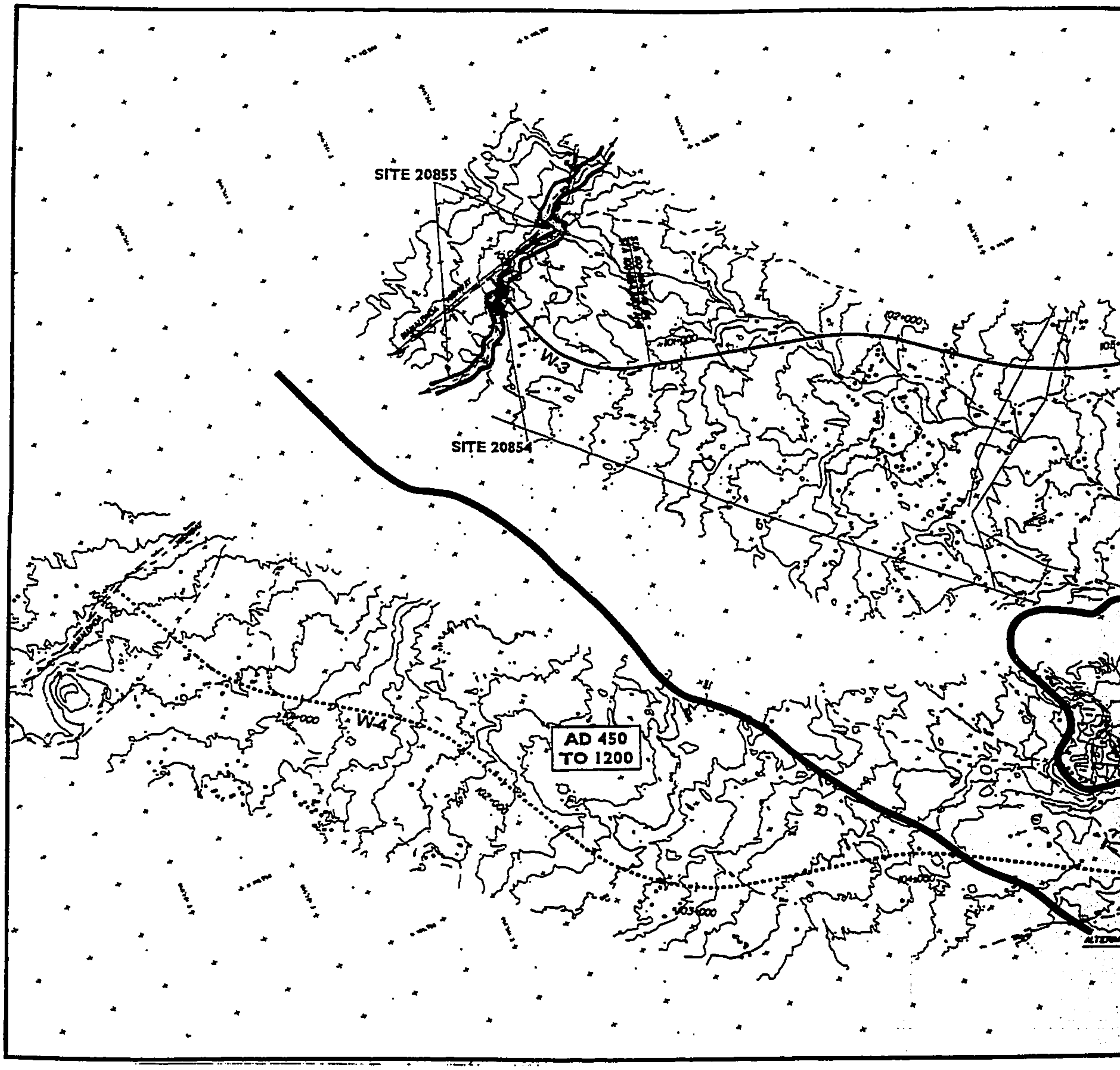
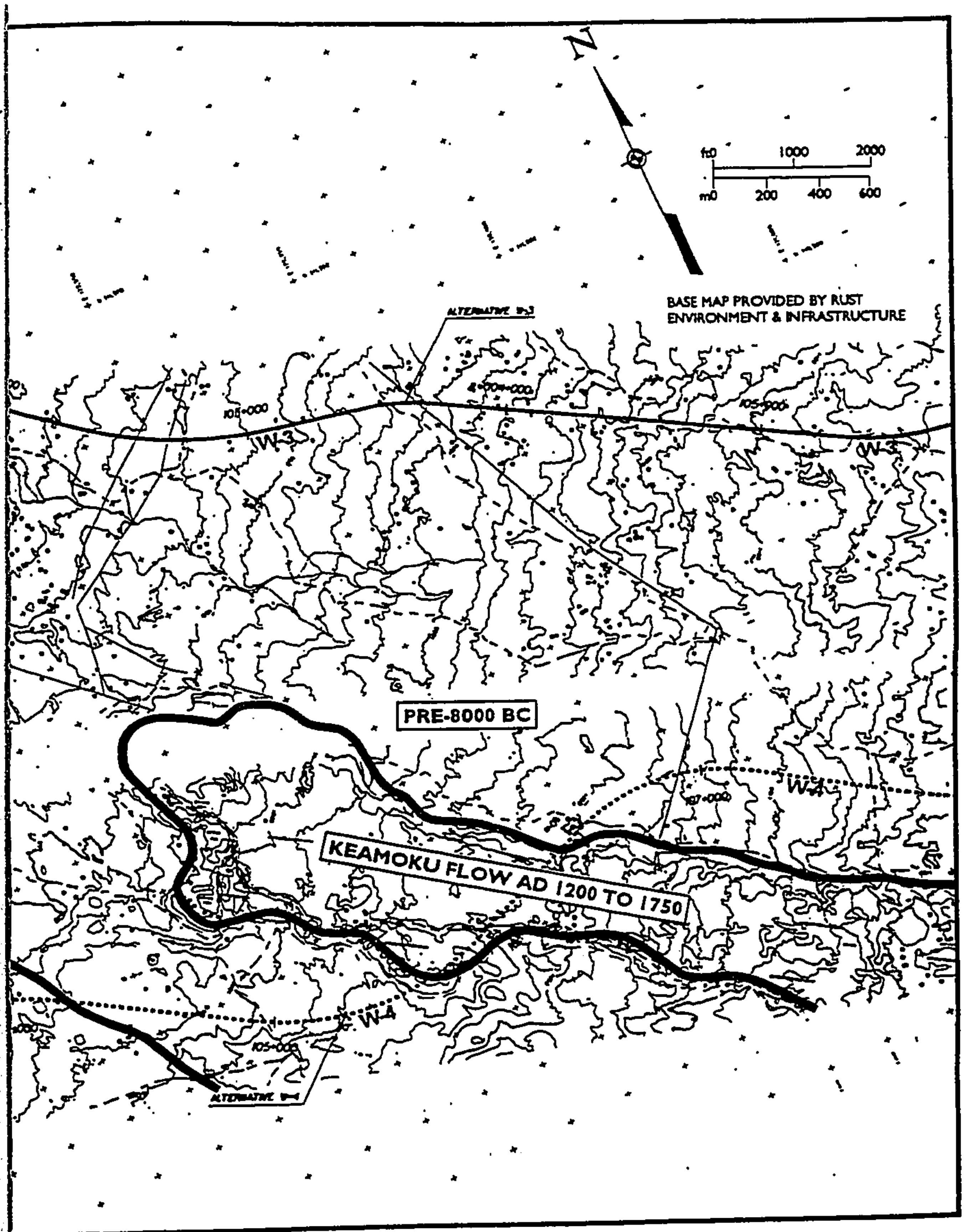


Figure 10f. Locations of Archaeological Sites - West Termini of W-3 and W-4



N
ft 0 1000 2000
m 0 200 400 600
BASE MAP PROVIDED BY RUST
ENVIRONMENT & INFRASTRUCTURE
ALTERNATIVE W-3
W-3
W-4
PRE-8000 BC
KEAMOKU FLOW AD 1200 TO 1750
ALTERNATIVE W-4

FIGURE REMOVED FROM
PUBLIC RELEASE VERSION
BECAUSE OF SENSITIVITY OF INFORMATION

Figure10G. Locations of Archaeological Sites - East Terminus of W-3 and W-4; Middle Segment of W-2

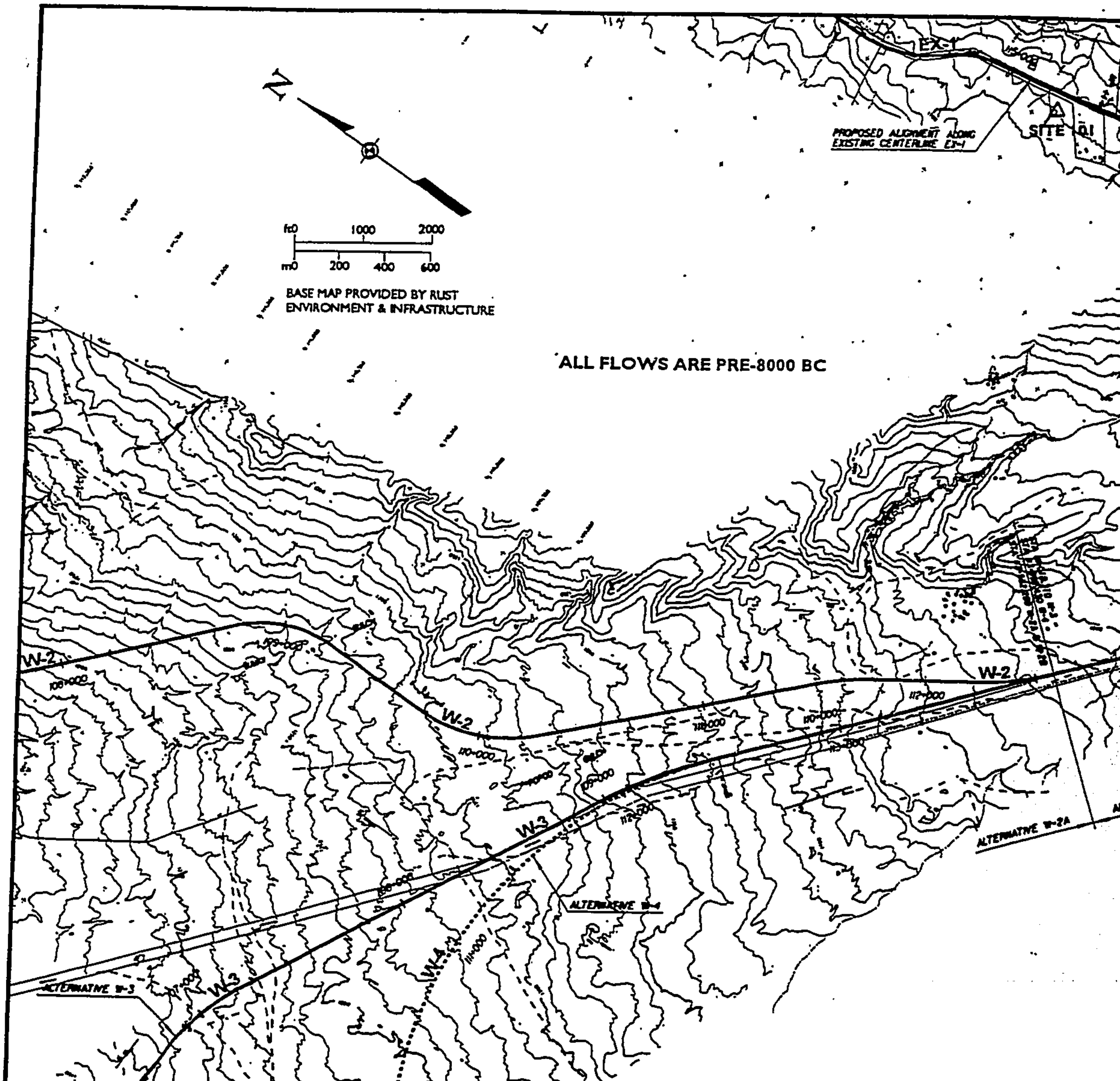
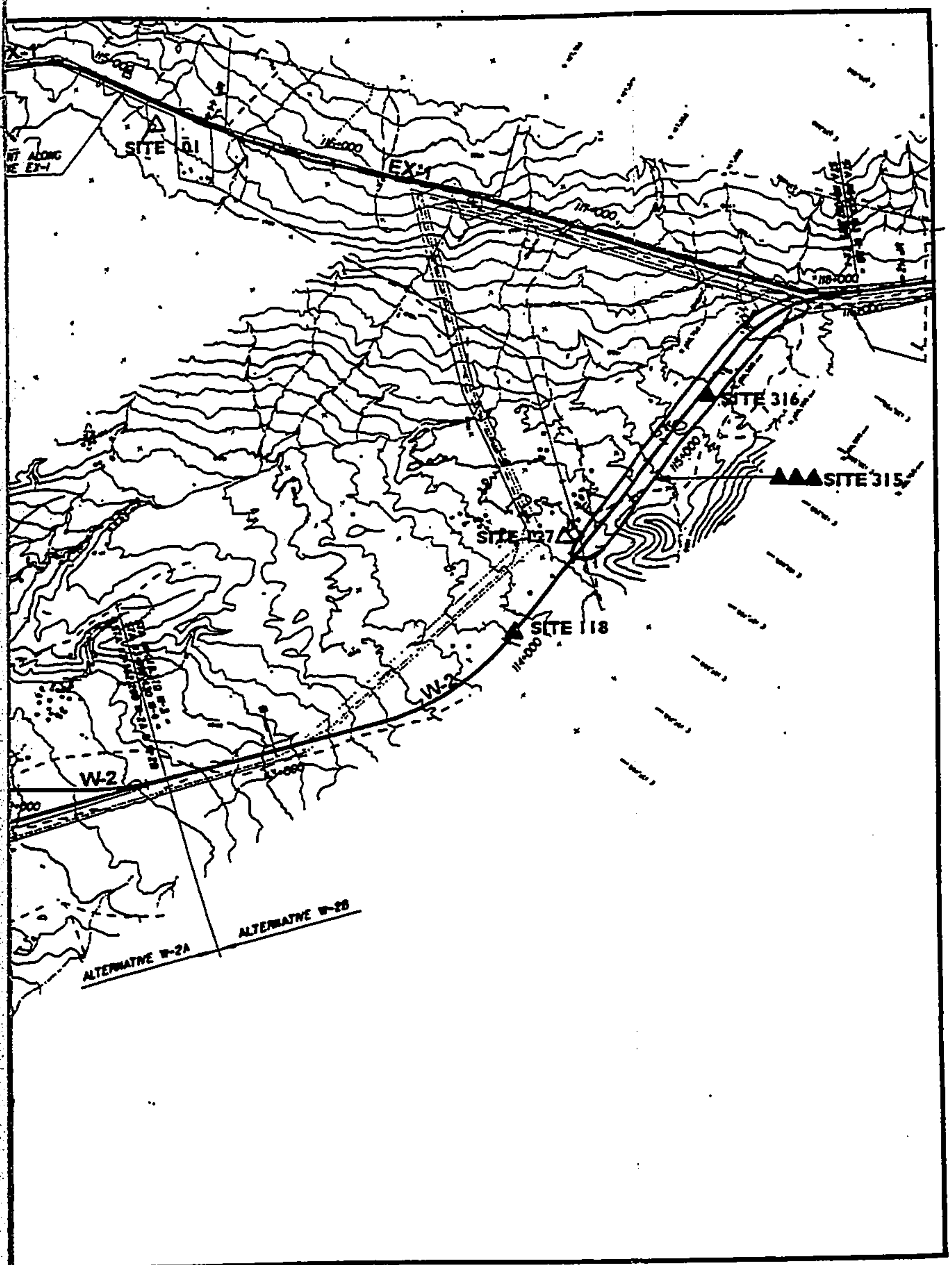


Figure 10h. Locations of Archaeological Sites -- East Terminus of W-2; Middle Segment of EX-1



EX-1
SITE 61
EX-1
SITE 316
SITE 315
SITE 127
SITE 118
W-2
W-2
ALTERNATIVE W-2A
ALTERNATIVE W-2B

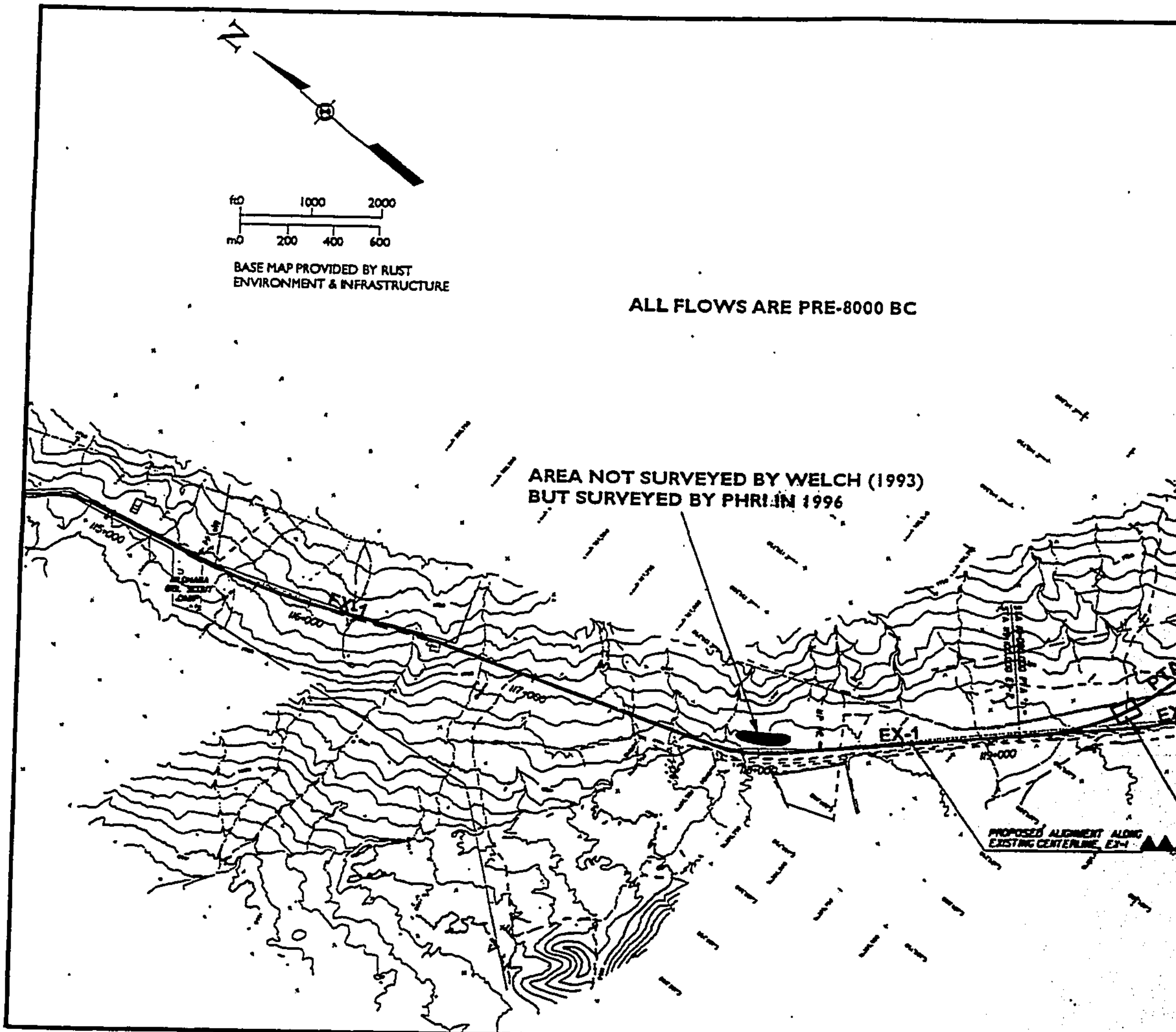
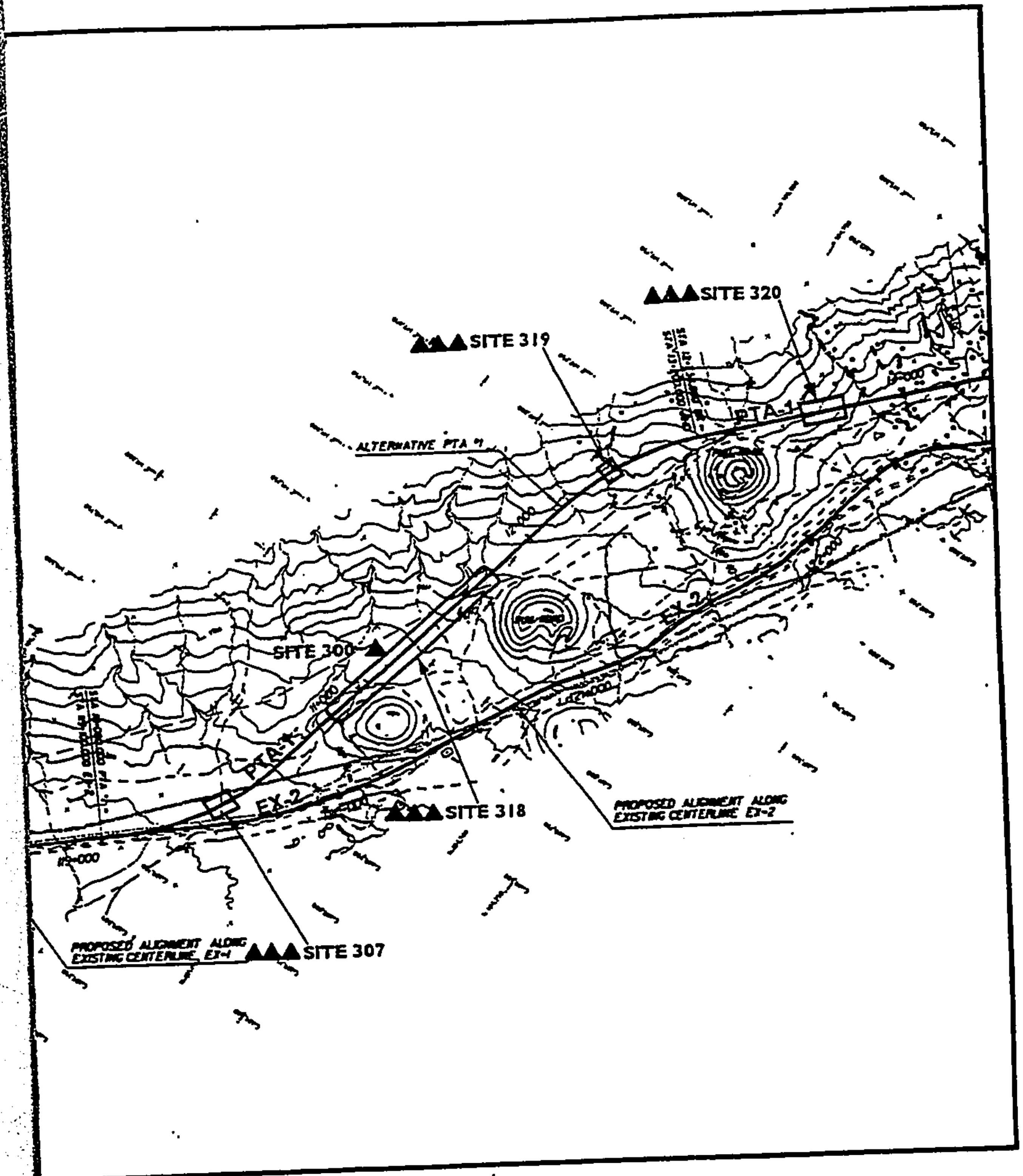


Figure 10i. Locations of Archaeological Sites - East Terminus of EX-1; West Terminus of PTA-1 and EX-2


SITE 320
SITE 319
ALTERNATIVE PTA #1
PTA-1
SITE 300
PTA-1
EX-2
SITE 318
PROPOSED ALIGNMENT ALONG EXISTING CENTERLINE EX-2
PROPOSED ALIGNMENT ALONG EXISTING CENTERLINE EX-1
SITE 307

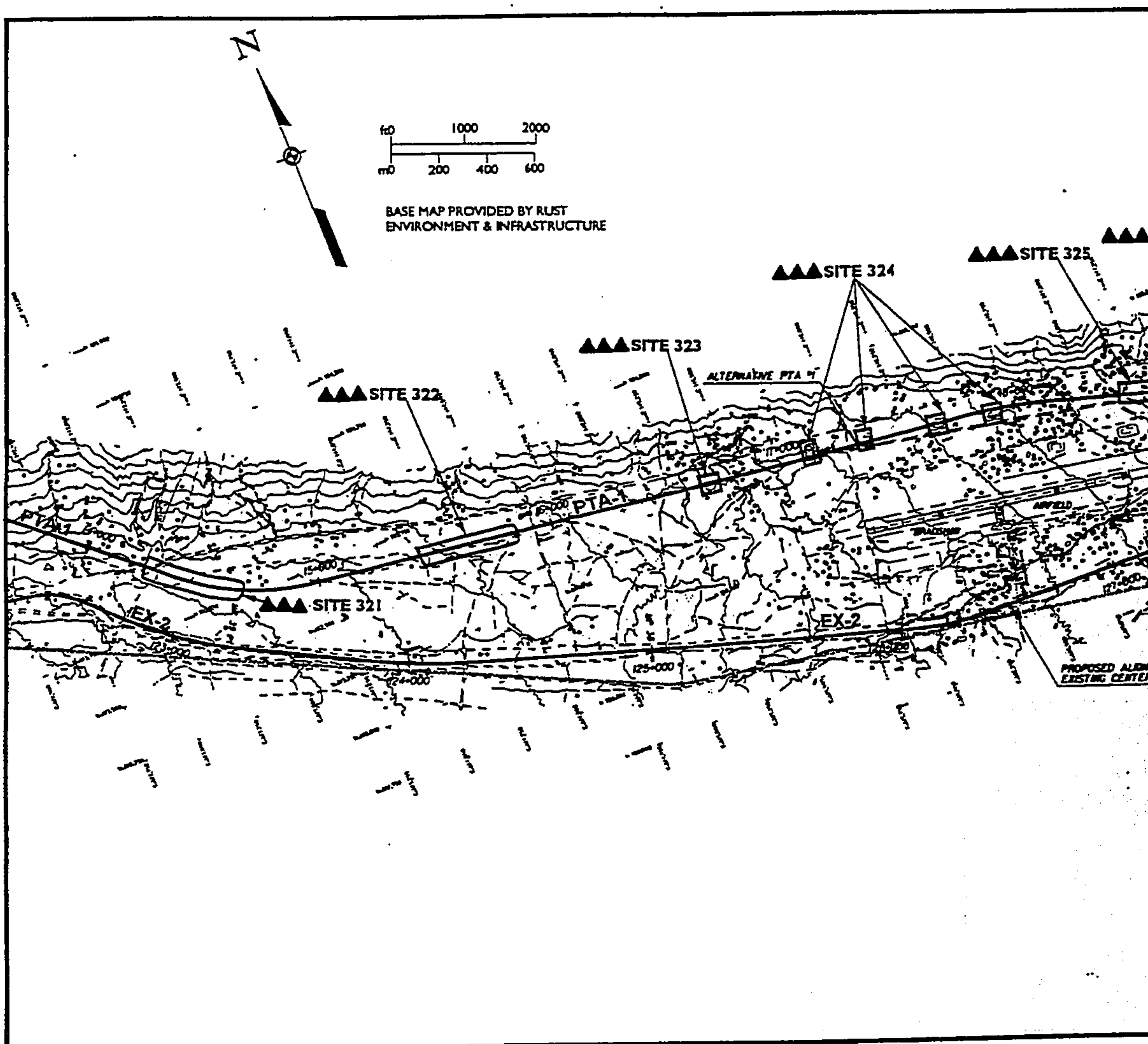
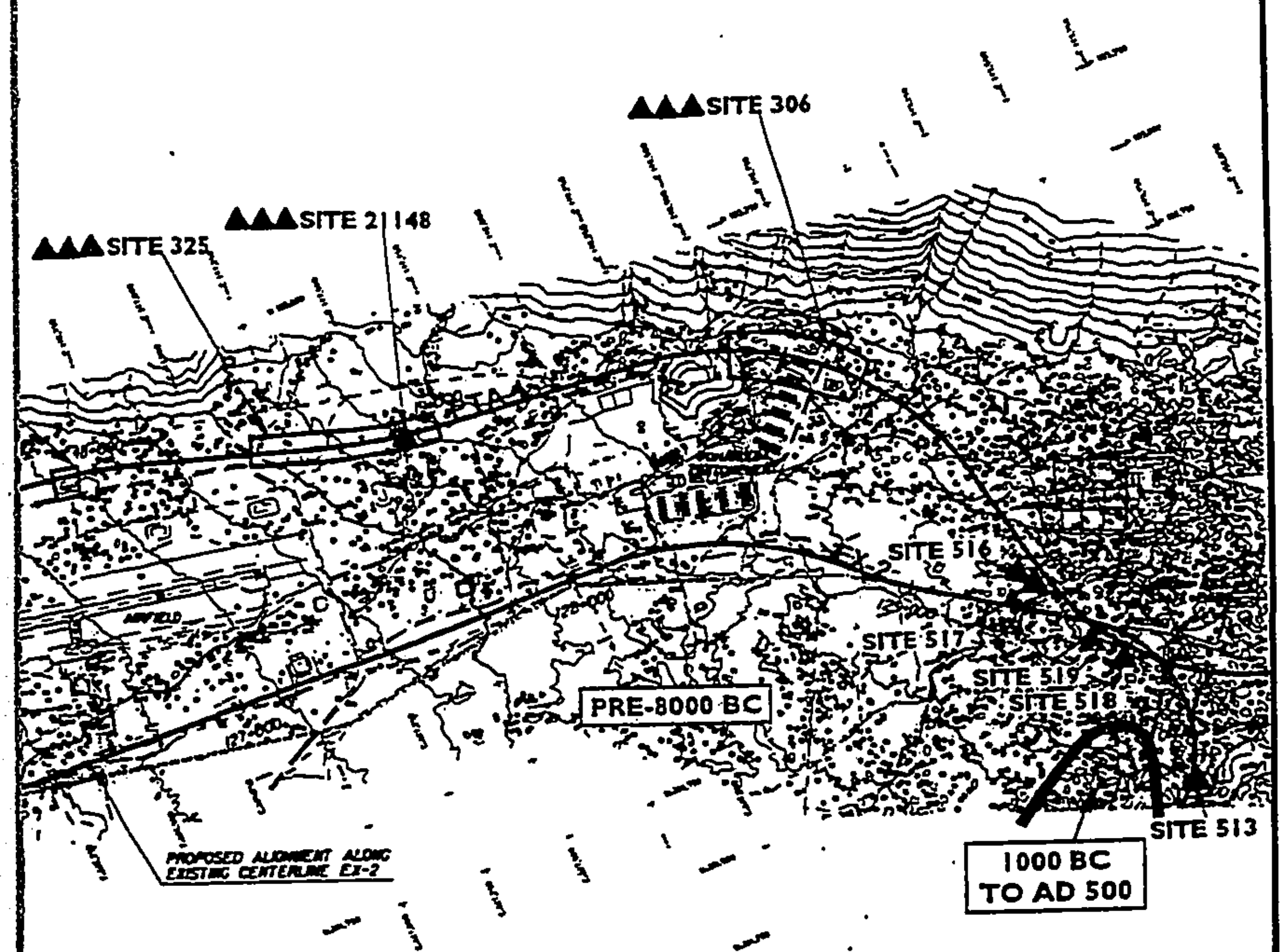


Figure 10j. Locations of Archaeological Sites - West Portion of PTA-1 and EX-2


SITE 306
SITE 2148
SITE 325
SITE 516
SITE 517
SITE 519
SITE 518
SITE 513
PRE-8000 BC
1000 BC
TO AD 500
PROPOSED ALIGNMENT ALONG
EXISTING CENTERLINE EX-2

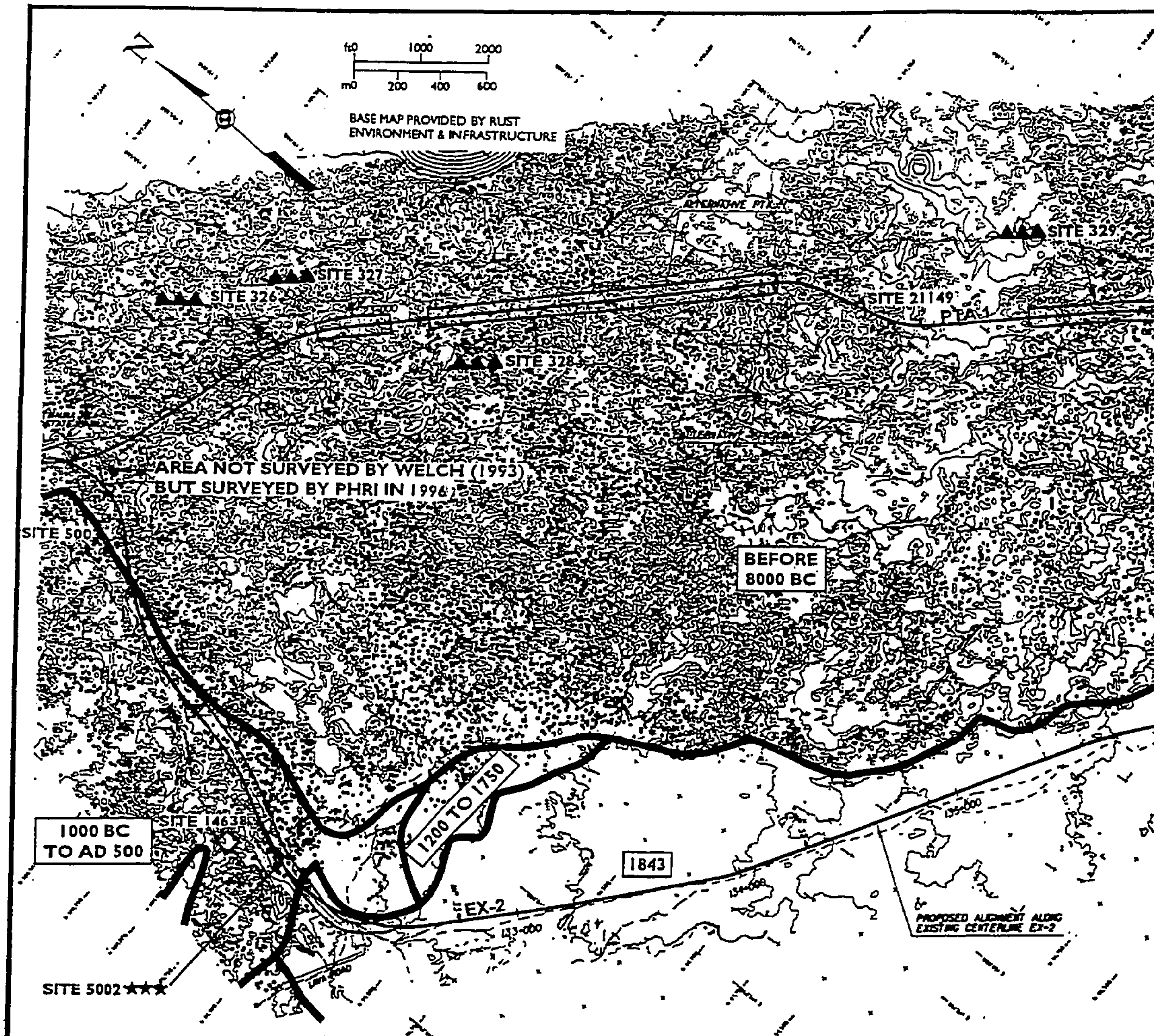
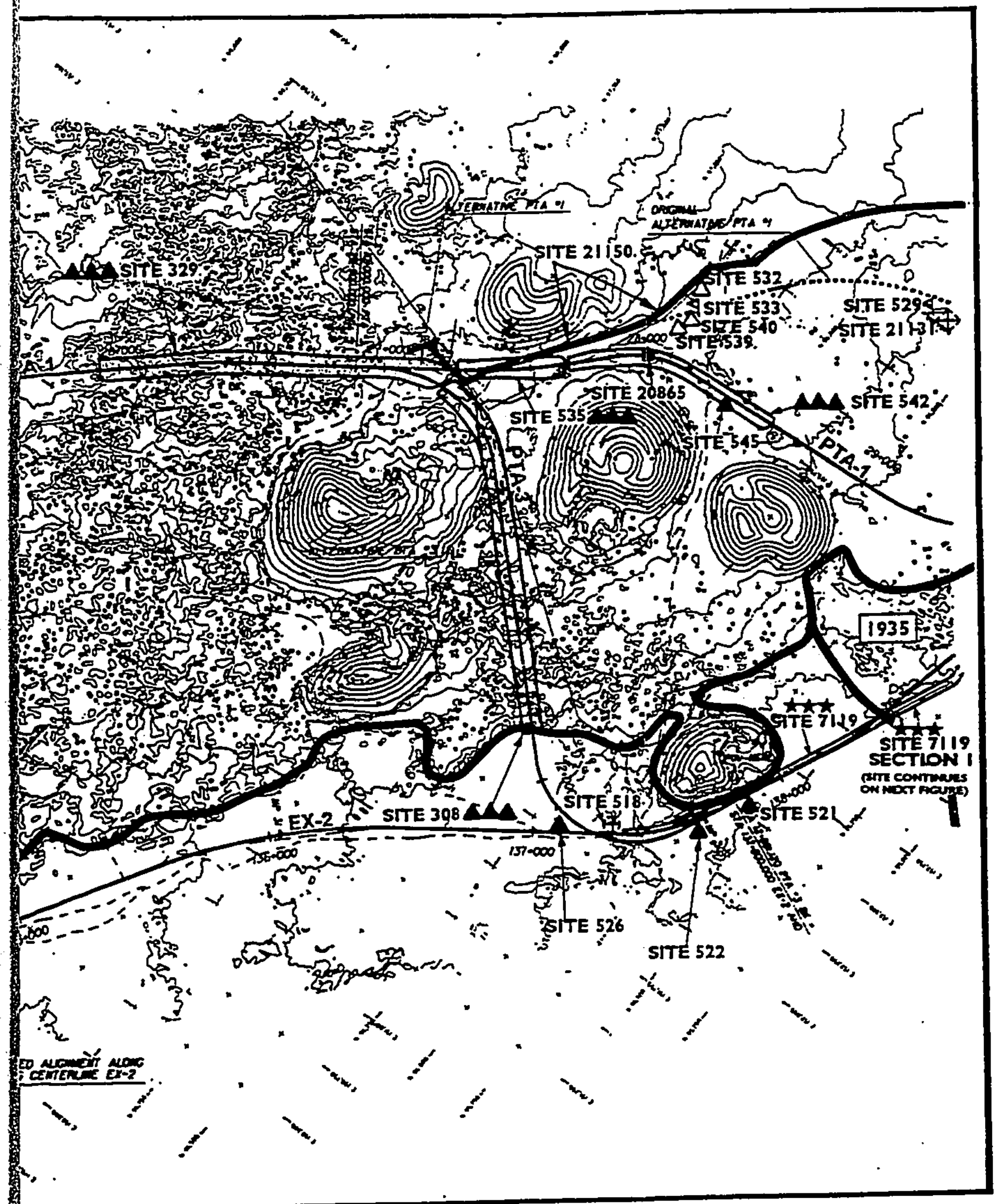


Figure 10k. Locations of Archaeological Sites - East Portion of PTA-1 and EX-2; PTA-3



SITE 329
SITE 21150
ORIGINAL ALTERNATIVE PTA #1
SITE 532
SITE 533
SITE 540
SITE 539
SITE 529
SITE 21131
SITE 20865
SITE 535
SITE 545
SITE 542
PTA-1
1935
SITE 7119
SITE 7119
SECTION I
(SITE CONTINUES ON NEXT FIGURE)
EX-2
SITE 308
SITE 518
SITE 521
SITE 526
SITE 522
137+000

DOCUMENT CAPTURED AS RECEIVED

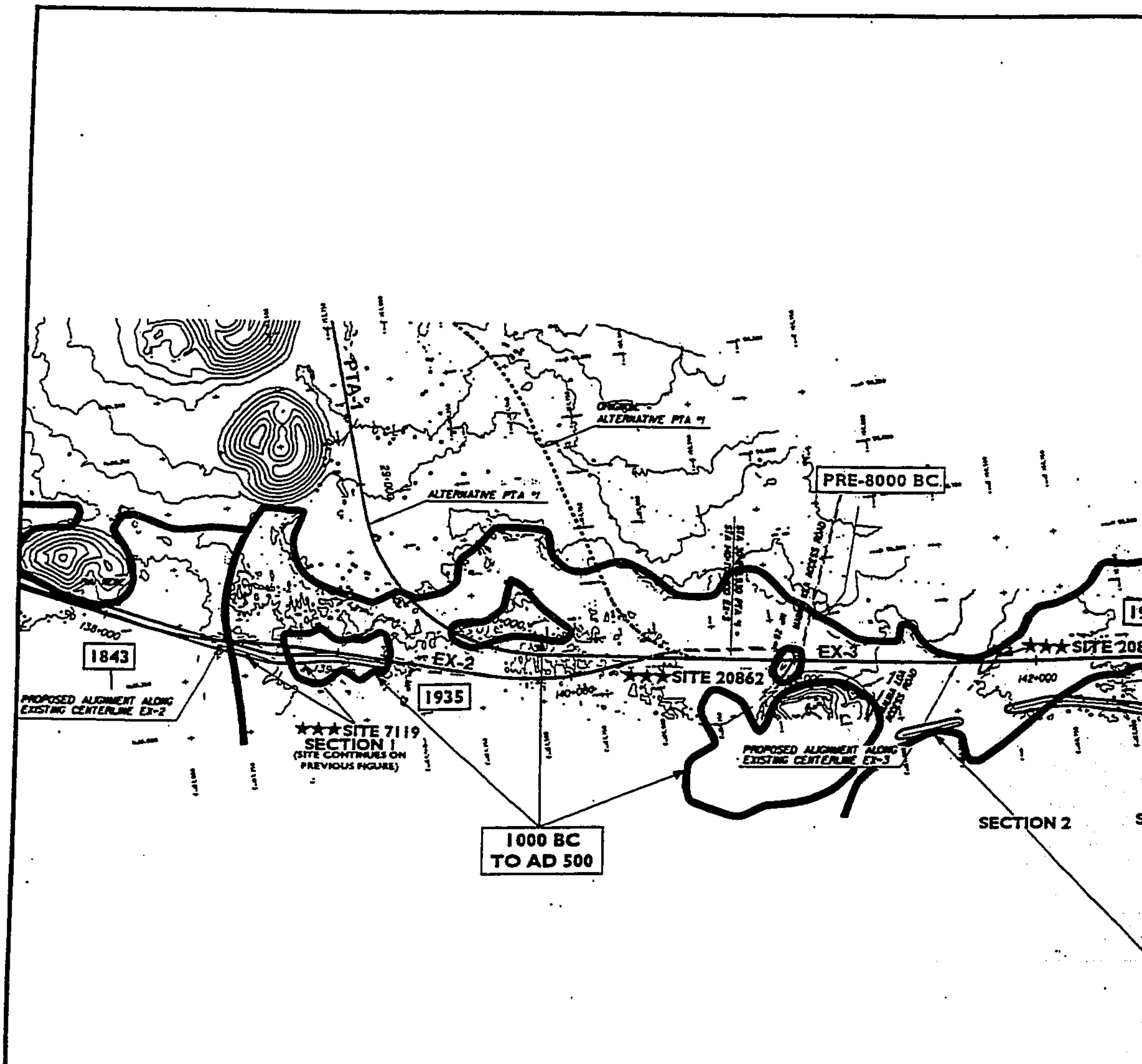
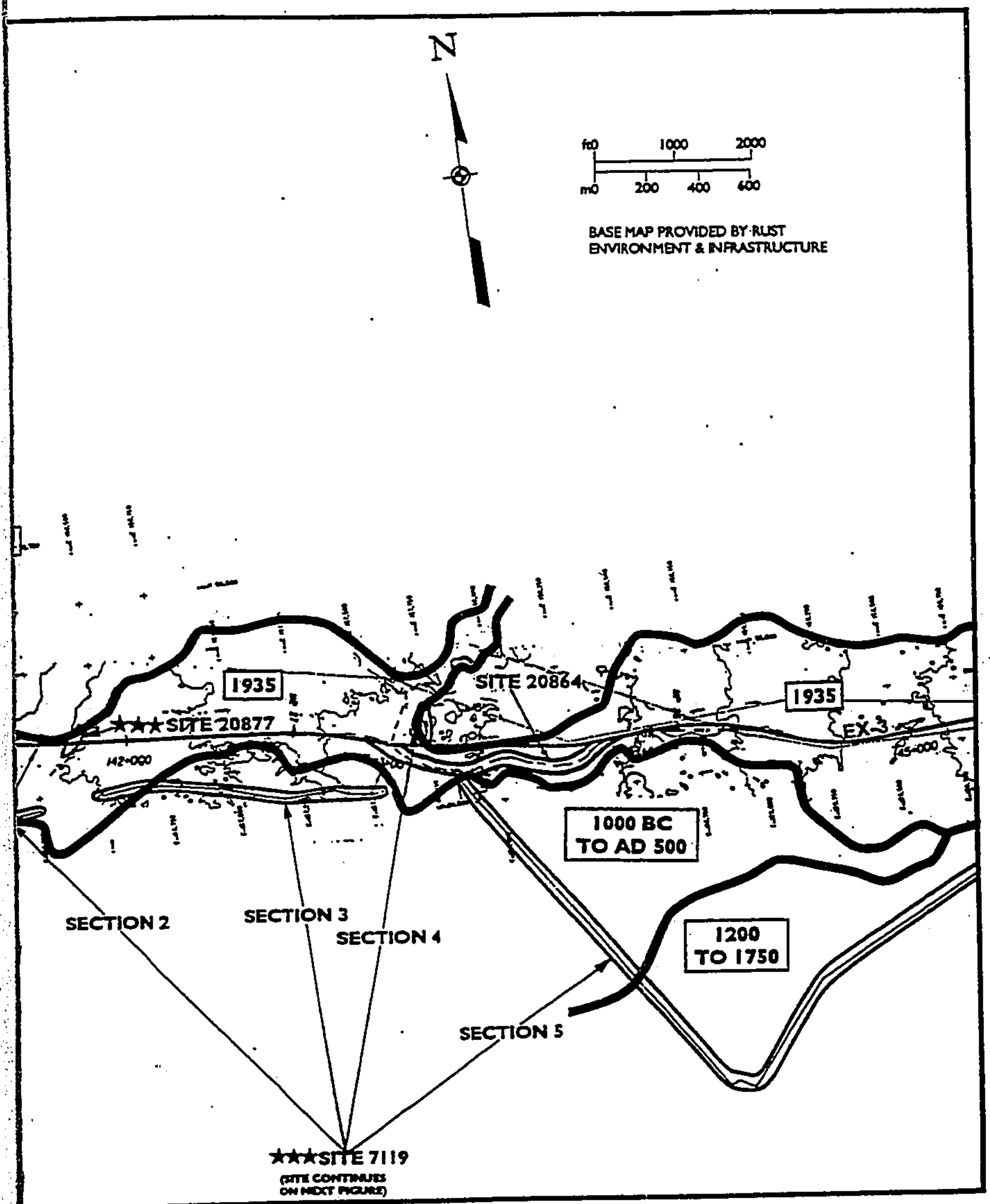


Figure 101. Locations of Archaeological Sites - East Terminus of PTA -1, EX-2, and PTA-3; West Terminus of EX-3


N
ft0
1000
2000
m0
200
400
600
BASE MAP PROVIDED BY RUST
ENVIRONMENT & INFRASTRUCTURE
1935
SITE 20877
SITE 20864
1935
EX-3
1000 BC
TO AD 500
1200
TO 1750
SECTION 2
SECTION 3
SECTION 4
SECTION 5
SITE 7119
(SITE CONTINUES
ON NEXT FIGURE)

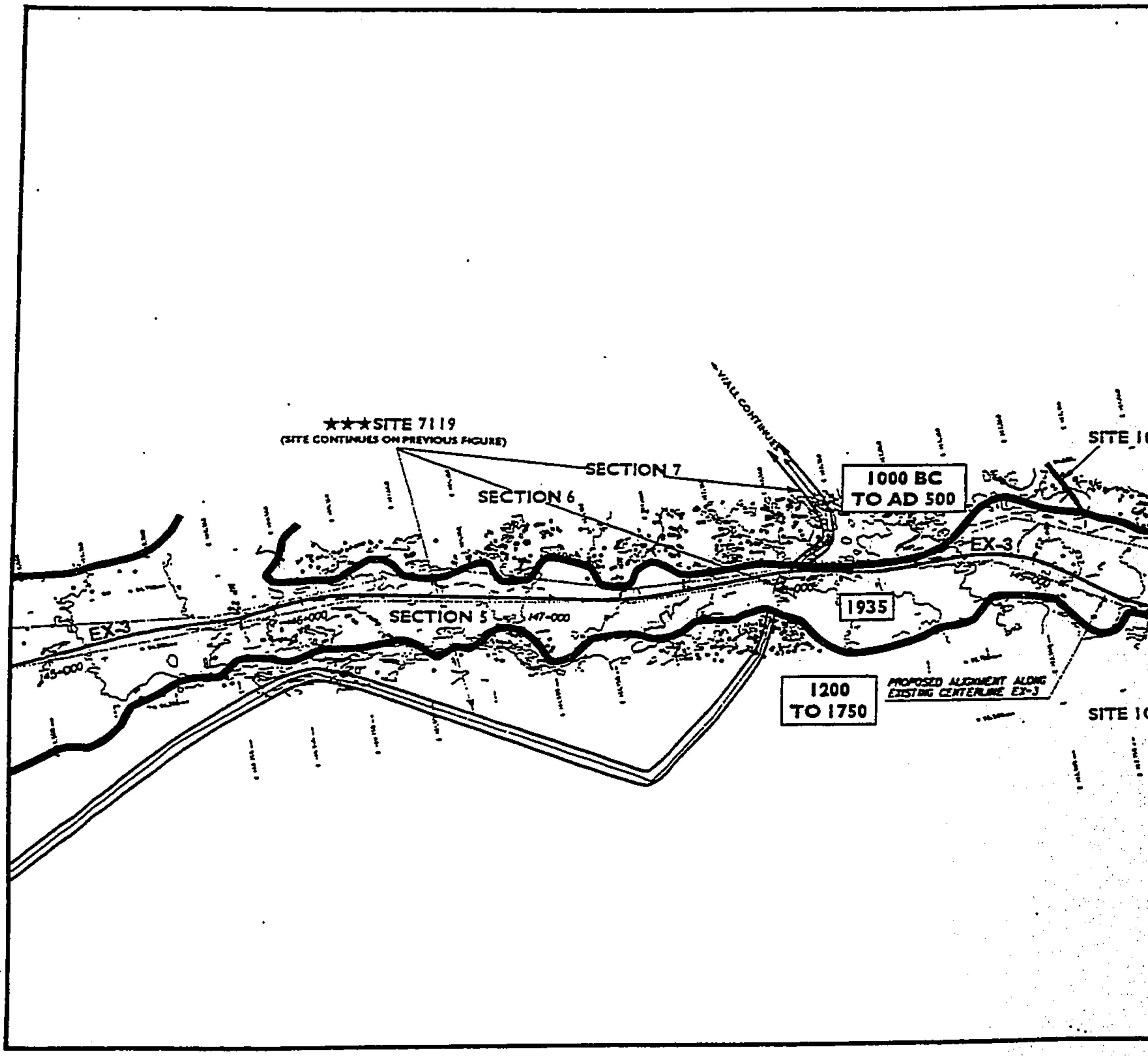
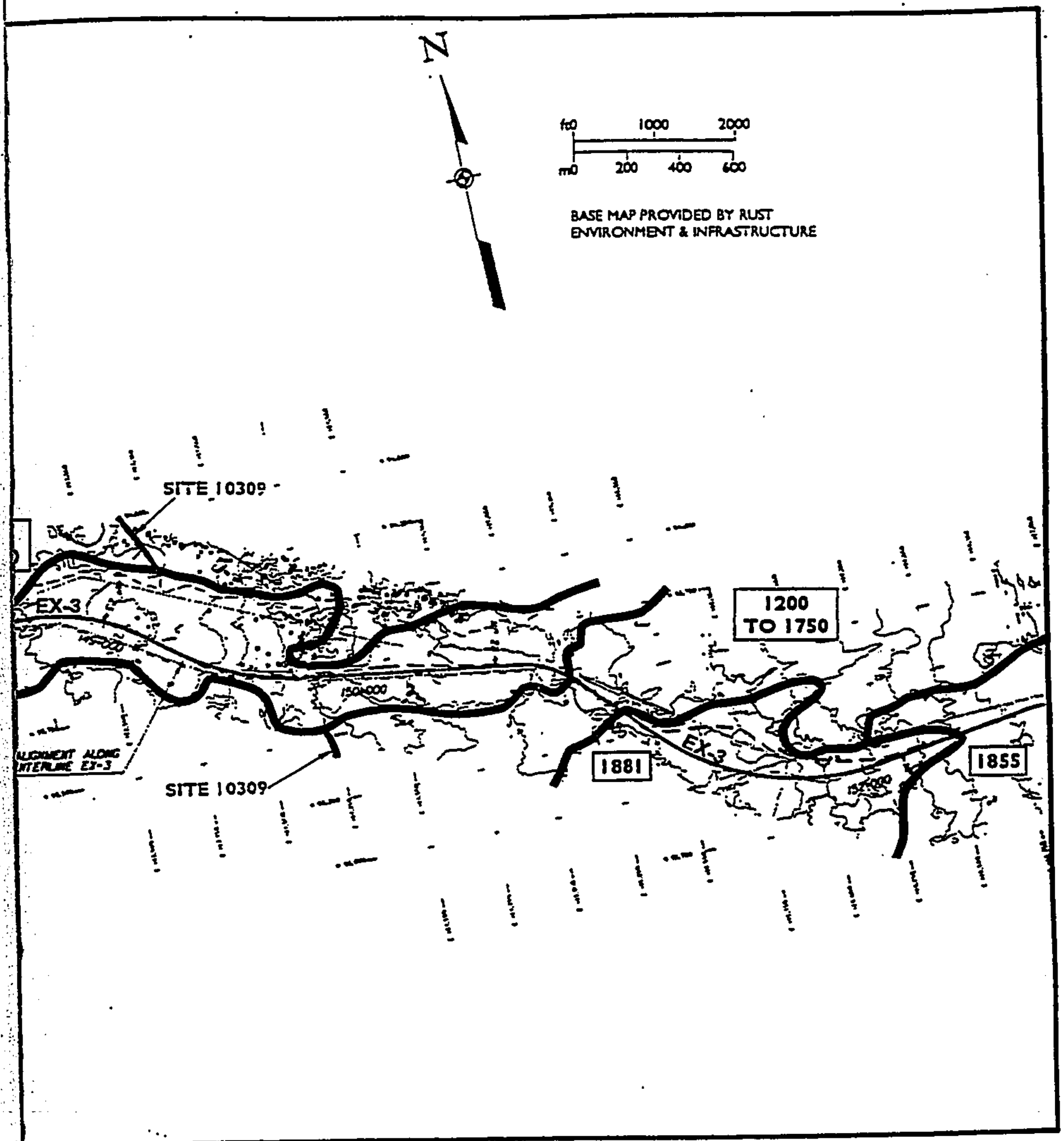


Figure 10m. Locations of Archaeological Sites - West Portion of EX-3


N
ft0 1000 2000
m0 200 400 600
BASE MAP PROVIDED BY RUST
ENVIRONMENT & INFRASTRUCTURE
SITE 10309
EX-3
1200
TO 1750
1881
1855
SITE 10309
EX-3

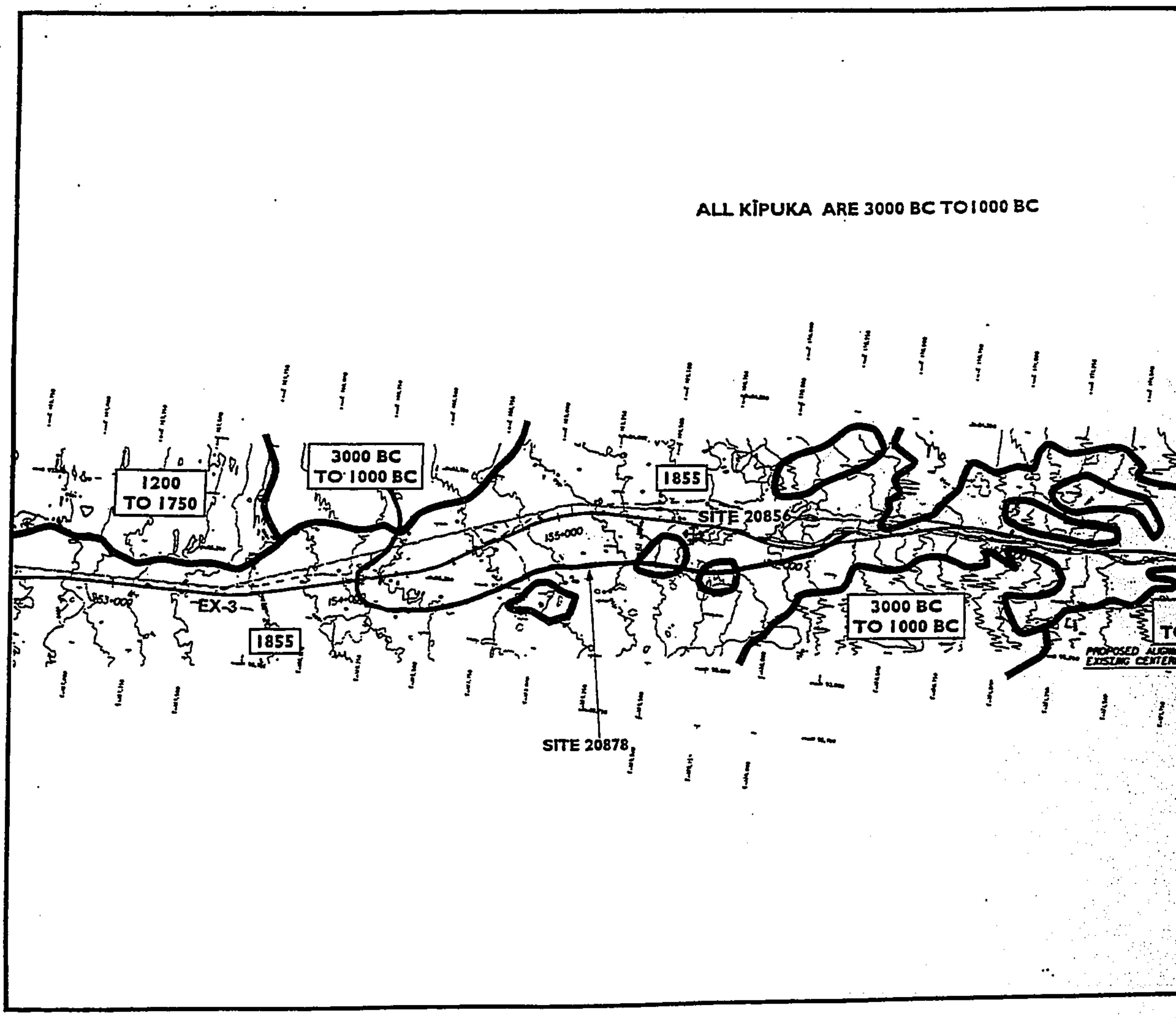
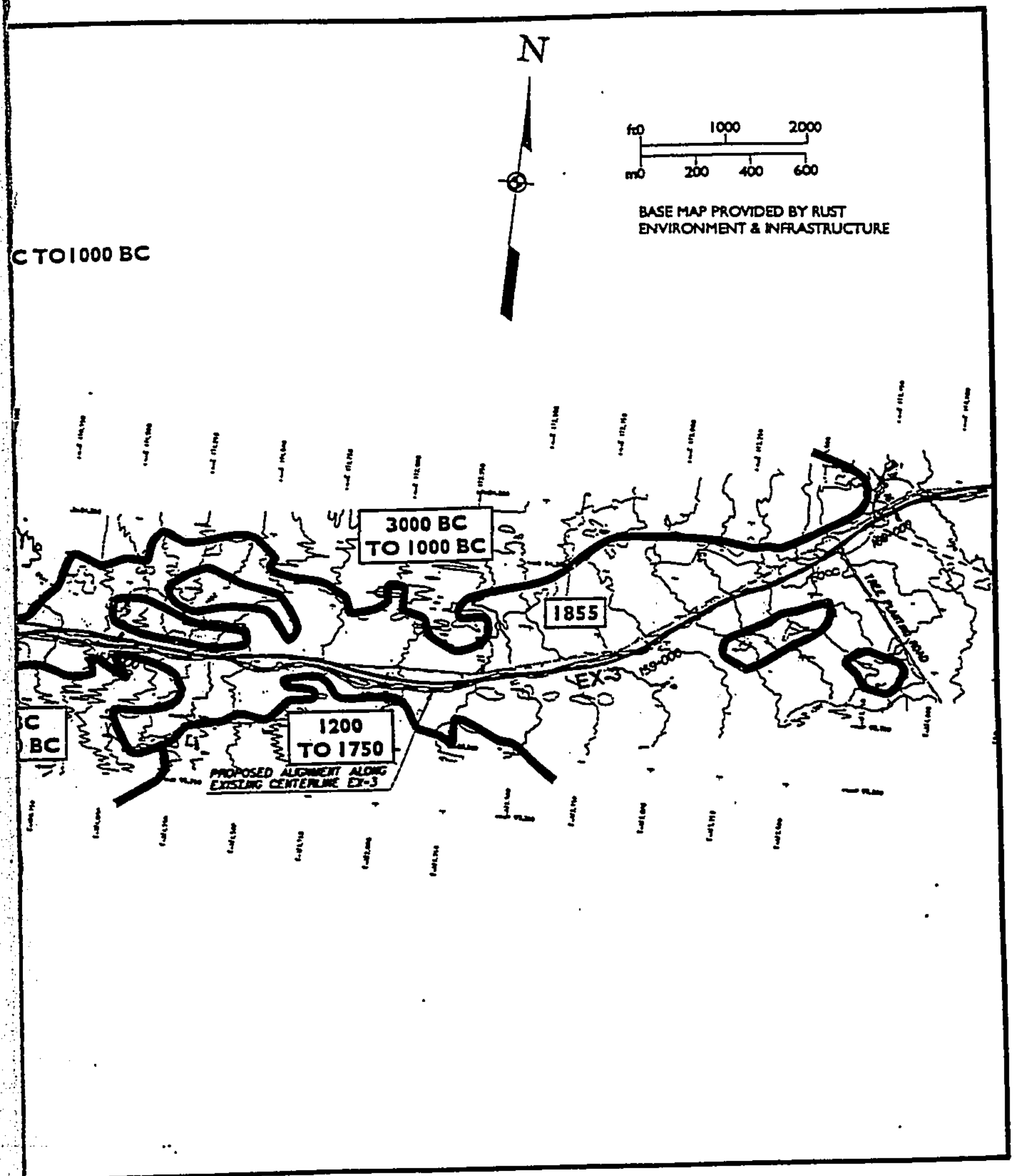


Figure 10n. Locations of Archaeological Sites - Middle Portion of EX-3


N
ft0 1000 2000
m0 200 400 600
BASE MAP PROVIDED BY RUST
ENVIRONMENT & INFRASTRUCTURE
C TO 1000 BC
3000 BC
TO 1000 BC
1855
EX-3
1200
TO 1750
C
BC
PROPOSED ALIGNMENT ALONG
EXISTING CENTERLINE EX-3

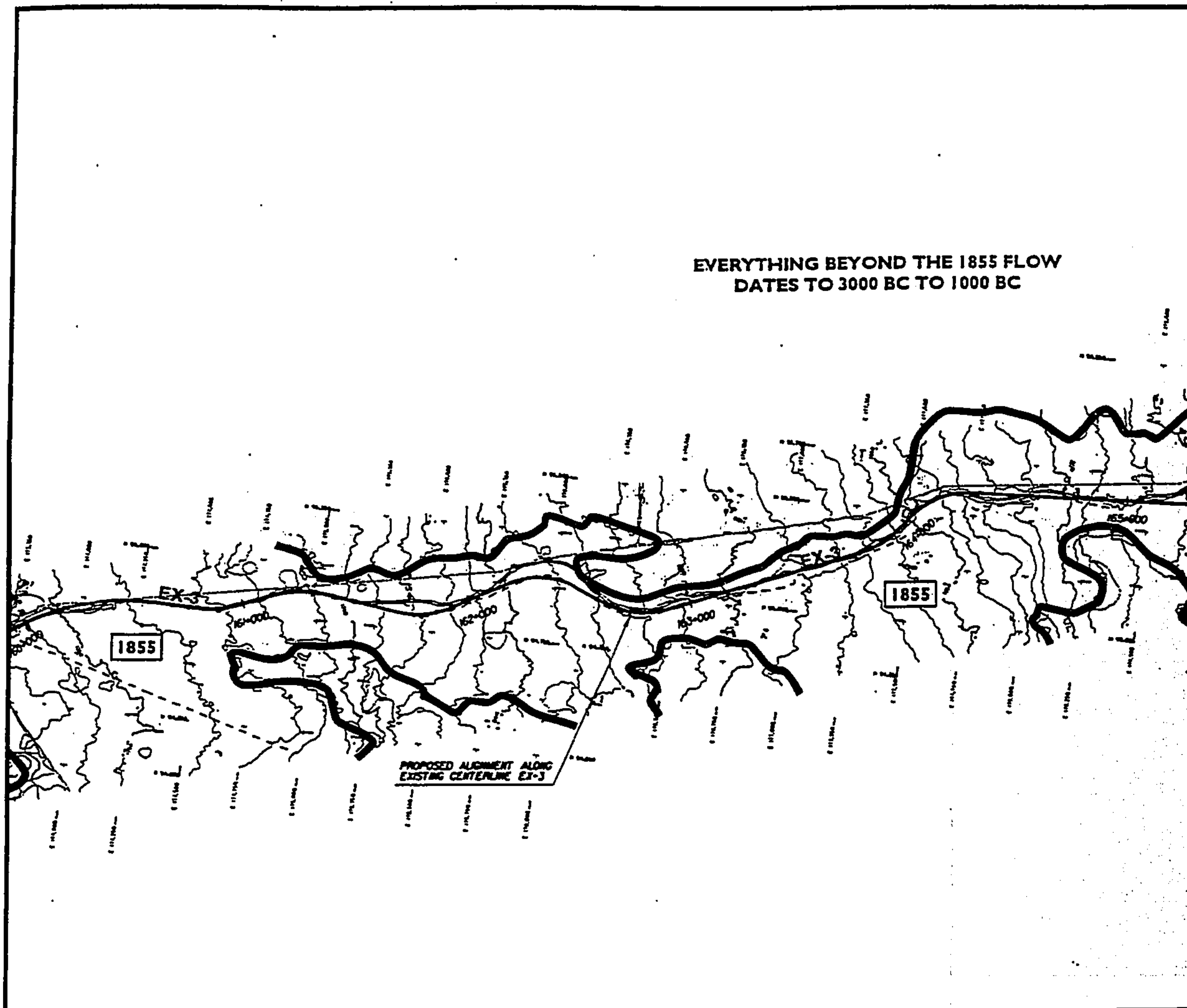
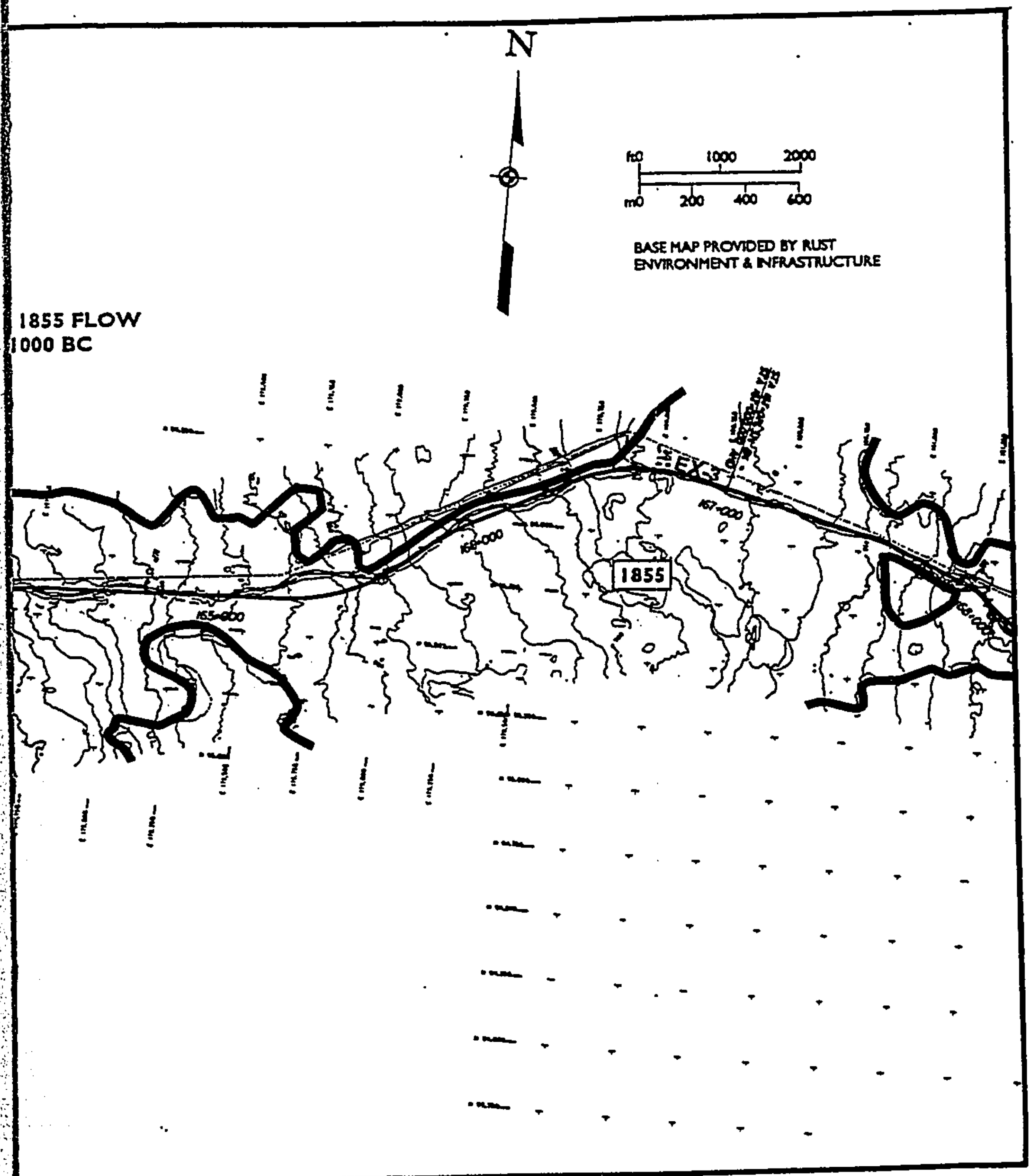


Figure 10a. Locations of Archaeological Sites - East Portion of EX-3


N
ft0 1000 2000
m0 200 400 600
BASE MAP PROVIDED BY RUST
ENVIRONMENT & INFRASTRUCTURE
1855 FLOW
1000 BC
EX-3
1855

DOCUMENT CAPTURED AS RECEIVED

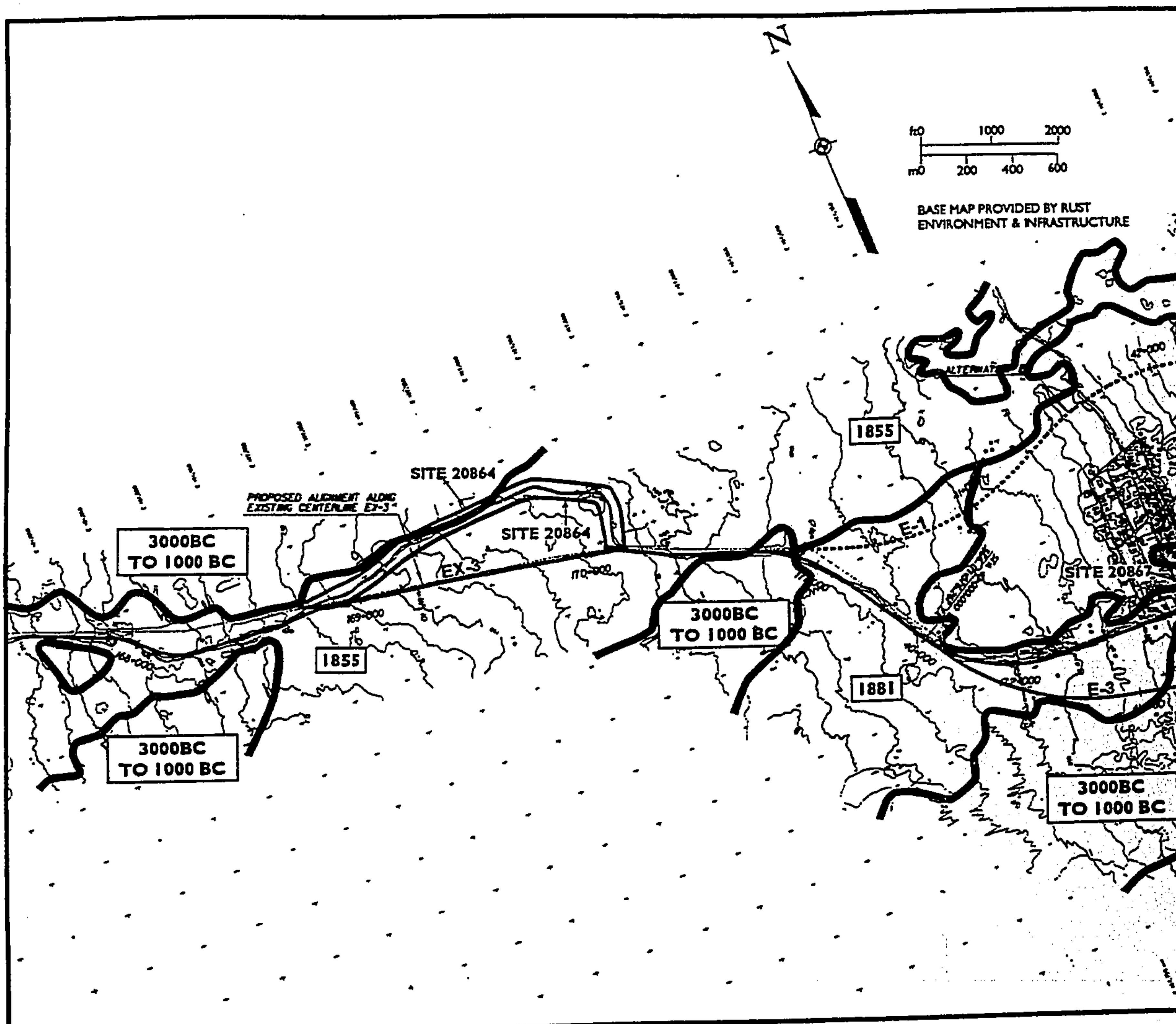
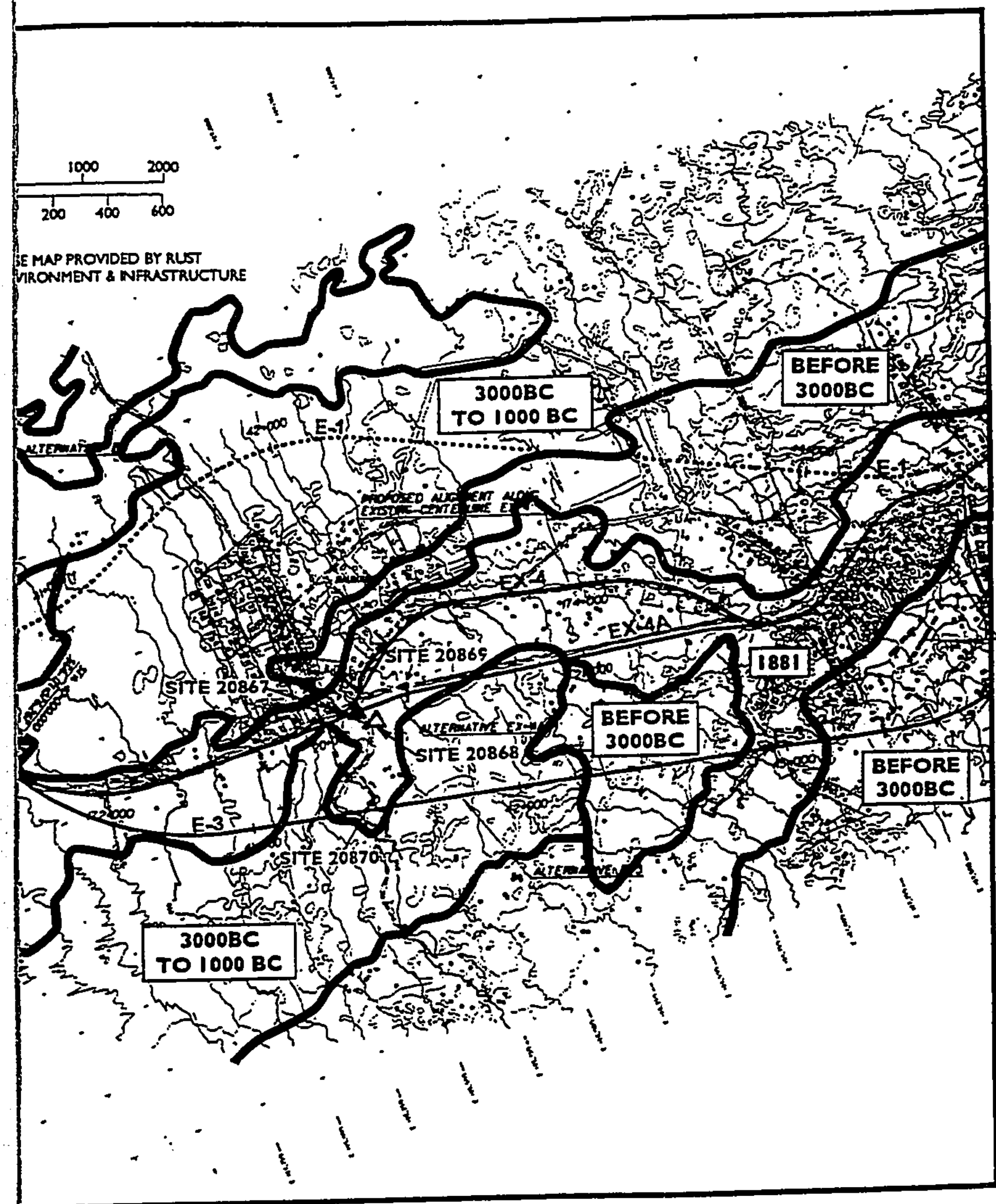


Figure 10p. Locations of Archaeological Sites - East Terminus of EX-3; West Terminus of E-1, EX-4, EX-4A, and E-3


1000
2000
200
400
600
E MAP PROVIDED BY RUST
VIRONMENT & INFRASTRUCTURE
3000BC
TO 1000 BC
BEFORE
3000BC
E-1
PROPOSED ALIGNMENT ALONG
EXISTING CENTERLINE
EX-4
EX-4A
1881
SITE 20869
SITE 20867
SITE 20868
BEFORE
3000BC
BEFORE
3000BC
E-3
SITE 20870
3000BC
TO 1000 BC

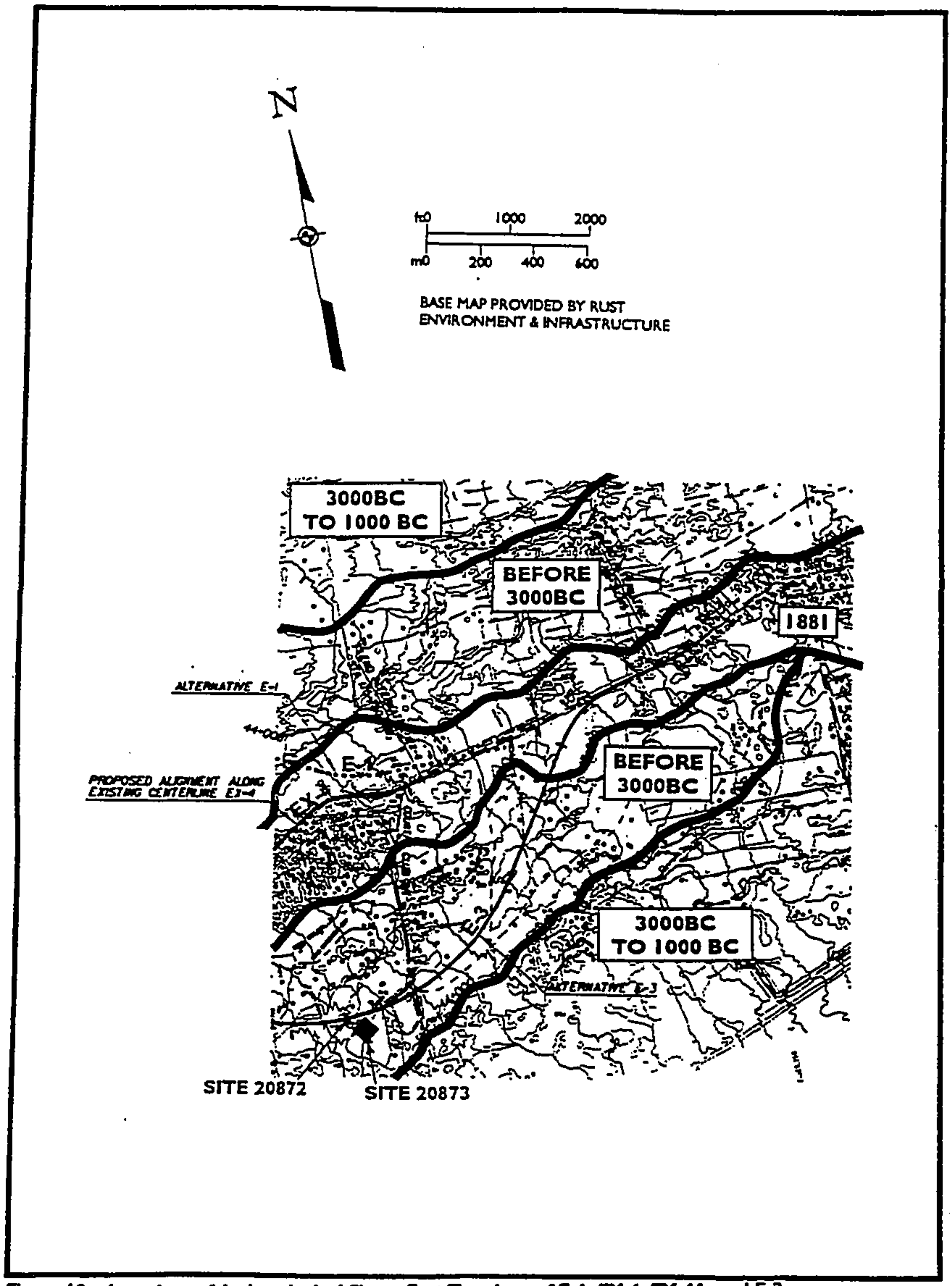


Figure 10q. Locations of Archaeological Sites - East Terminus of E-1, EX-4, EX-4A, and E-3

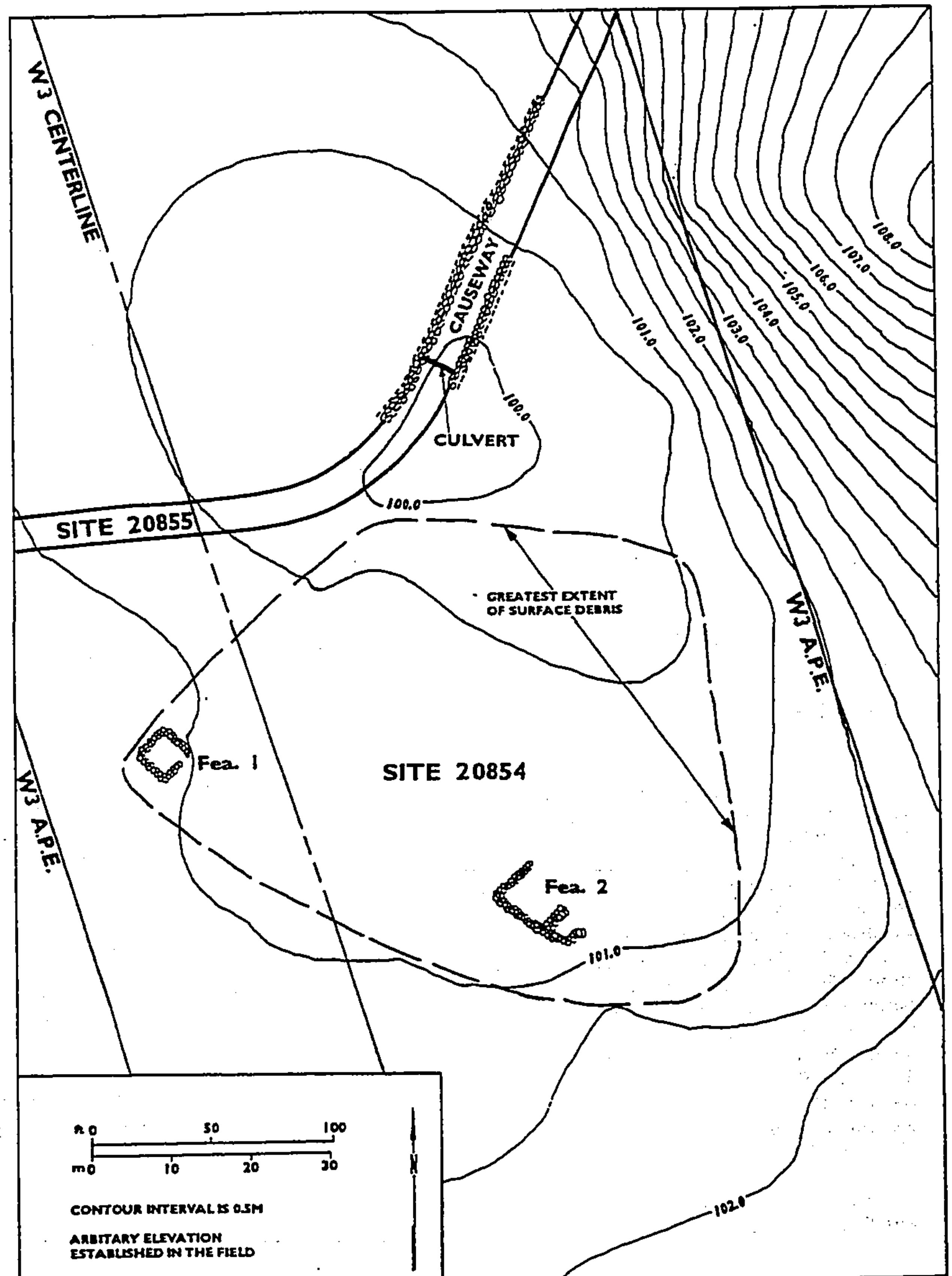


Figure 11. Site 20854

Feature 1 is 5 by 5 by 1.5 m high, with a datum about 40 meters at 272° from a stake marked RT W3 100+120. It has cobbles and small boulders (10 to 90 cm diameter) stacked one to four courses high. There is an entrance in the southeast corner. The northwest portion of the enclosure wall appears to be faced. The north and west sides are built against a hill and are therefore much higher above ground surface on the interior than on the exterior. Feature 2 is 12 by 7 by 0.7 m high, with a datum 15.7 meters at 164° from a stake marked RT W3 100+120. This is a double U-shaped enclosure constructed of cobbles 10 to 45 cm in diameter, some consisting of aa, stacked up to four courses high. The southern "L" portion of the enclosure may have been constructed later than the northern "U" section, because the southern wall abuts the northern set of walls. Surface remains in the area include rusty cans, a ceramic cup, and a glass bottle. A scatter of modern historic debris occurs on the surface between the enclosures covering an area approximately 30 by 25 meters. The material consists of bottle glass, sheets of corrugated metal, and several heavy iron metal pieces.

The exact function of each of the enclosures in uncertain. Based on the type of material remains (associated with human food consumption and shelters), permanent habitation may have occurred at the site. Alternatively, the occupation may have been temporary at the site. Feature 1 was constructed to have a level floor surface, which may have been done to accommodate human occupation. Feature 2 is open to one side, suggesting use as an stall, or storage/work building. The corrugated metal at the site suggests that at least one of the features had some kind of roofing.

The broken glass, corrugated metal, and rusty metal fragments do not provide specific dates of use or manufacture. The proximity of the site to the road (Site 20855: see description below) may indicate that the site was built after the wagon road (1909) or stone-paved road (1920) was built in this location. Based on the information provided above, the site probably represents a small homestead that was built in the early 20th century. *Feature 1 was probably a house, and the other enclosure (Feature 2) may have held* animals or machinery. Alternatively, the site may be a ranching area where cattle were corralled and moved to transport along the highway, with ranchers staying there only during those periods. In any event, it is likely that the site was first used after 1909.

Site 50-10-21-20855

This site, referred to as the Old Waimea-Kona Belt Road, is a long historic road (about 63 kilometers) from Waimea to Kona that corresponds in many locations to the current Mamalohoa Highway. A portion of the road is in two project corridors (W-2 and W-3) in Waikoloa, South Kohala. The old Belt Road dates to about 1920. In 1909 there was just a wagon track through the pasture where the Waimea-Kona Belt Road now runs. The first paved road was built by Hawaii County, from Waimea to Ka'ūpūlehu, during the years 1916-1922, mostly using prison labor (Territory of Hawaii 1916-1922). One camp for the prisoners who built the road was located on the downslope side of the Saddle Road intersection, where a grove of eucalyptus trees stands today (see Kimura Int. 1, Lindsey Int. 3). They built the road from there south, to near the Waikōloa/Pu'uanahulu boundary (150 m north of the W-3 corridor), setting rocks, rolling with a steam roller, and pouring tar heated in a pot (Kimura Int. 2). The 1982 USGS Keamuku Quadrangle and personal inspection indicate that the paving ended a little south of the W-2 intersection with the road. The southern portion from there on was unpaved and so was the road section from the Saddle Road intersection north to Waimea (Paris Int.). From Pu'uanahulu south to Pu'u Wa'awa'a the road was built under the direction of Eben Low, by prisoners living at a second camp located downslope of the road, at Ke'enakī, at about the 18 mile marker (Paris Int.). About 1939, the Waimea-Kona road was rebuilt and straightened, in the area downslope from Ke'āmoku Sheep Station, by contractor Medeiros, leaving the old road to the east (Greenwell Int.).

Both the W-2 and W-3 corridors cross the Old Waimea-Kona Belt Road. The W-2 corridor coincides with Site 20855 just upslope of the current Waimea-Kona Belt Road (Hwy 190) near Station 100+400 at

800 meters AMSL. This portion of the old road is paved with concrete. The W-3 corridor crosses the Old Waimea-Kona Road just east of the Hwy 190 at Station 100.080 at 780 meters AMSL *(see Figure 11)*. This road segment is made of rock without concrete paving. Site 20855 is built up 3 m high with stone and earth to span a shallow gully within the W-3 corridor. A stone-lined culvert 80 by 50 cm occurs at the base of the road *(Figures 12 through 15)*.

Site 50-10-31-5002

This site is a historic wall that will be referred to in this report as the Ka'ohe Wall *(Figure 16)*, a modern name applied to the site. Three segments remain, and combined they cover a total length from north to south of about 1.2 km between Sta. 130+170 and 132+270, at an elevation of 1,960 m AMSL in Ka'ohe, Hamakua. The full extent of the original wall is unknown. In some places the wall is 1.5 m high, but generally it is only 0.7 to 1.0 m high and on average 1.6 m wide, and has been extensively impacted over the years *(Figures 17 through 20)*. Occasionally, posts extend upward from the low stone wall that may have had barbed wire on them in the past, or may be a recent modification to the disturbed wall. The wall appears on the 1927 USGS Puu Koli Quadrangle, which shows the wall about 3 km long at that time. The wall is located along the boundary of a Mauna Kea flow dating to before 8000 B.C., and a Mauna Loa flow dating to between 1000 B.C. and A.D. 500 (Wolfe and Morris 1996). The southern portion of the 5002 wall is situated on the A.D. 1843 flow.

This area was under Parker lease by 1876, and was used to catch wild cattle at least by 1871 (see Cultural Context). The previous interpretation of the function of the wall is that it may have been built by Parker Ranch in the 1870s to keep cattle off the 1843 flow to the southeast of the wall (Welch 1993:85). The wall is not situated along a boundary of Parker Ranch, however. Also, a large portion of the wall is situated on a pre-A.D. 500 flow, and is not oriented to block passage to the 1843 flow. Alternatively, the wall may have been built by Hackfields when they acquired the Ka'ohe 4 lease in 1891, during the time when Hackfields built the stone walls at Humu'ula.

Site 50-10-31-5003

This is a lava tube in Mauna Loa pahoehoe dating to 1250 B.C. to A.D. 450; the tube is at 1,965 m AMSL in Ka'ohe, Hamakua *(Figure 10k)*. The cave is 9.0 m long and a maximum of 7.5 m wide. Modified basalt and volcanic glass flakes were present on the surface around the cave entrance. Three 0.5 by 0.5 m test units were dug into the greater than a meter deep sediments inside the cave. Maps, photographs, and details on cave dimensions, location of test units, and inventory of material remains are included in Welch (1993). Multiple strata containing cultural debris and ash lensing occurs in the cave. Fish, mammal, and bird bone, *kukui*, shell, and charcoal are present in deposits that may date to as early as A.D. 1659 (full range of radiocarbon dates: A.D. 1526 to 1955). Several indigenous avian species are present – Hawaiian goose, hawk, rail and crow, Short-eared owl, and Dark-rumped petrel, suggesting that the occupation occurred during pre-contact times. The cave has been interpreted as a shelter for quarriers moving to and from the Mauna Kea adze quarry, and as a station for bird hunters gathering food and feathers (Welch 1993:85).

Site 50-10-31-14638

This is a surface lithic scatter with a few small lava tube caves at 1,950 m AMSL in Ka'ohe, Hamakua *(Figure 10k)*. Volcanic glass nodules and basalt flakes are scattered over an area approximately 38 by 18 m in between the caves. Map and photographs are included in Welch (1993). The quality of the basalt suggests that it was taken from the Mauna Kea quarry (Welch 1993:52). This area may have served primarily as a quarry site for volcanic glass (Welch 1993:85) with some temporary habitation at the site.

Figure 12. Site 20858, Culvert, Facing West (Neg.5194-5)

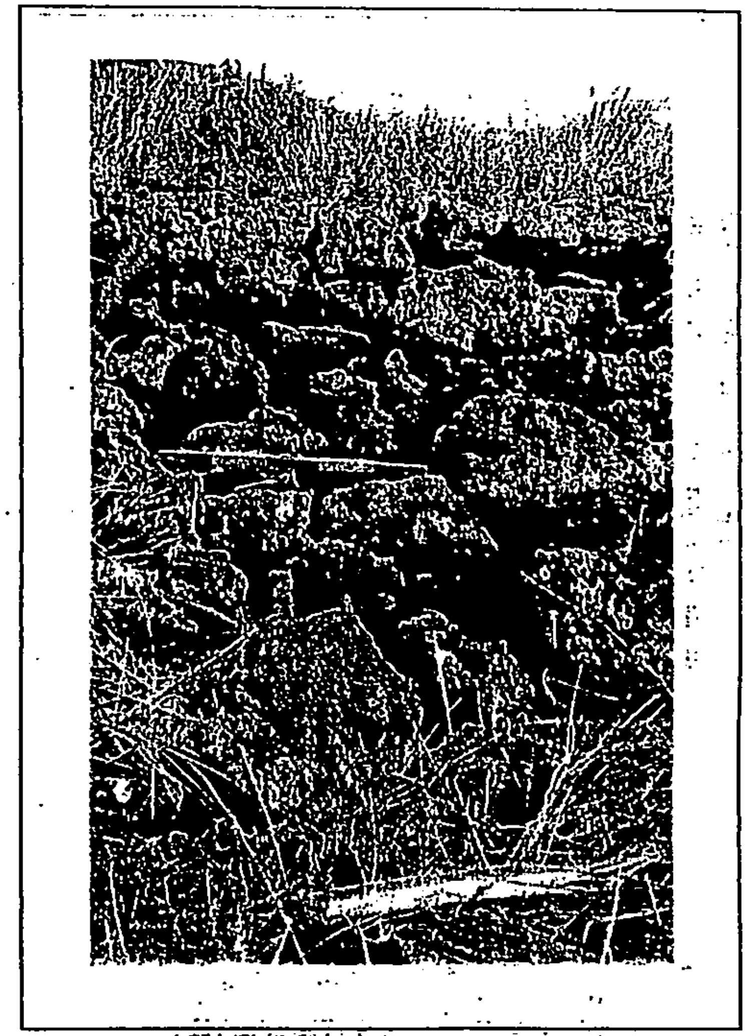


Figure 13. Site 20855, Culvert Construction, Facing West (Neg.3194-12)

Figure 14. Site 20855, Structure, Facing North (Neg.5195-18)

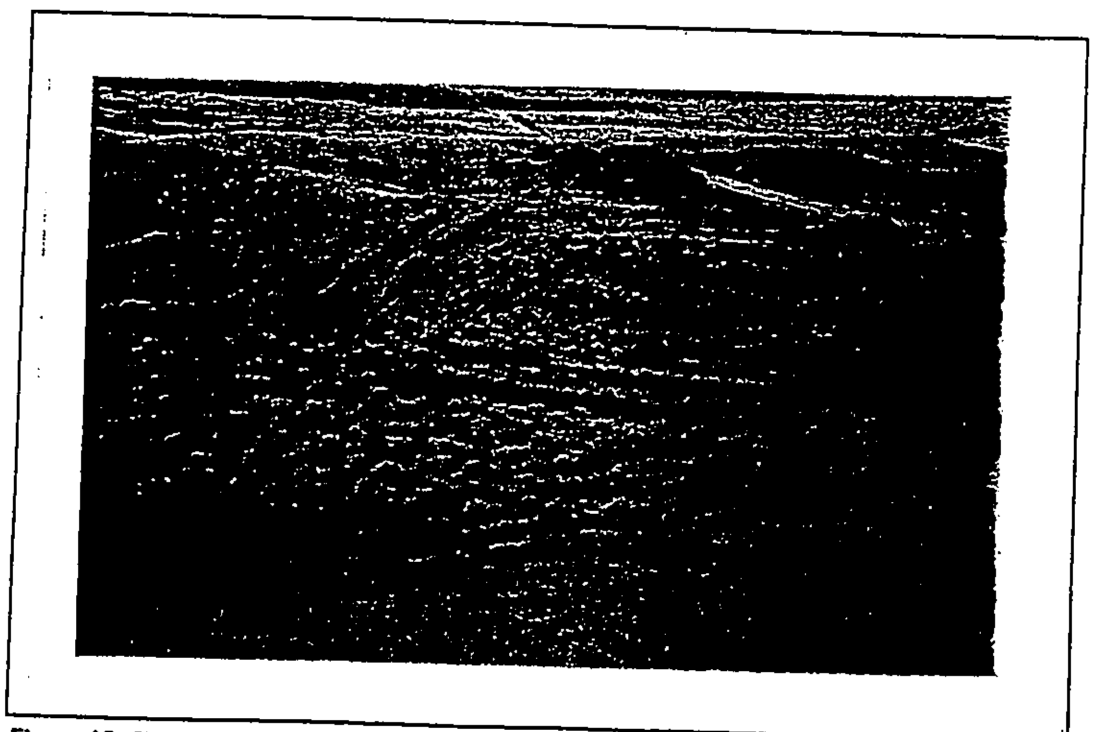


Figure 15. Site 20855, Overview, Facing South (Neg.5194-20)

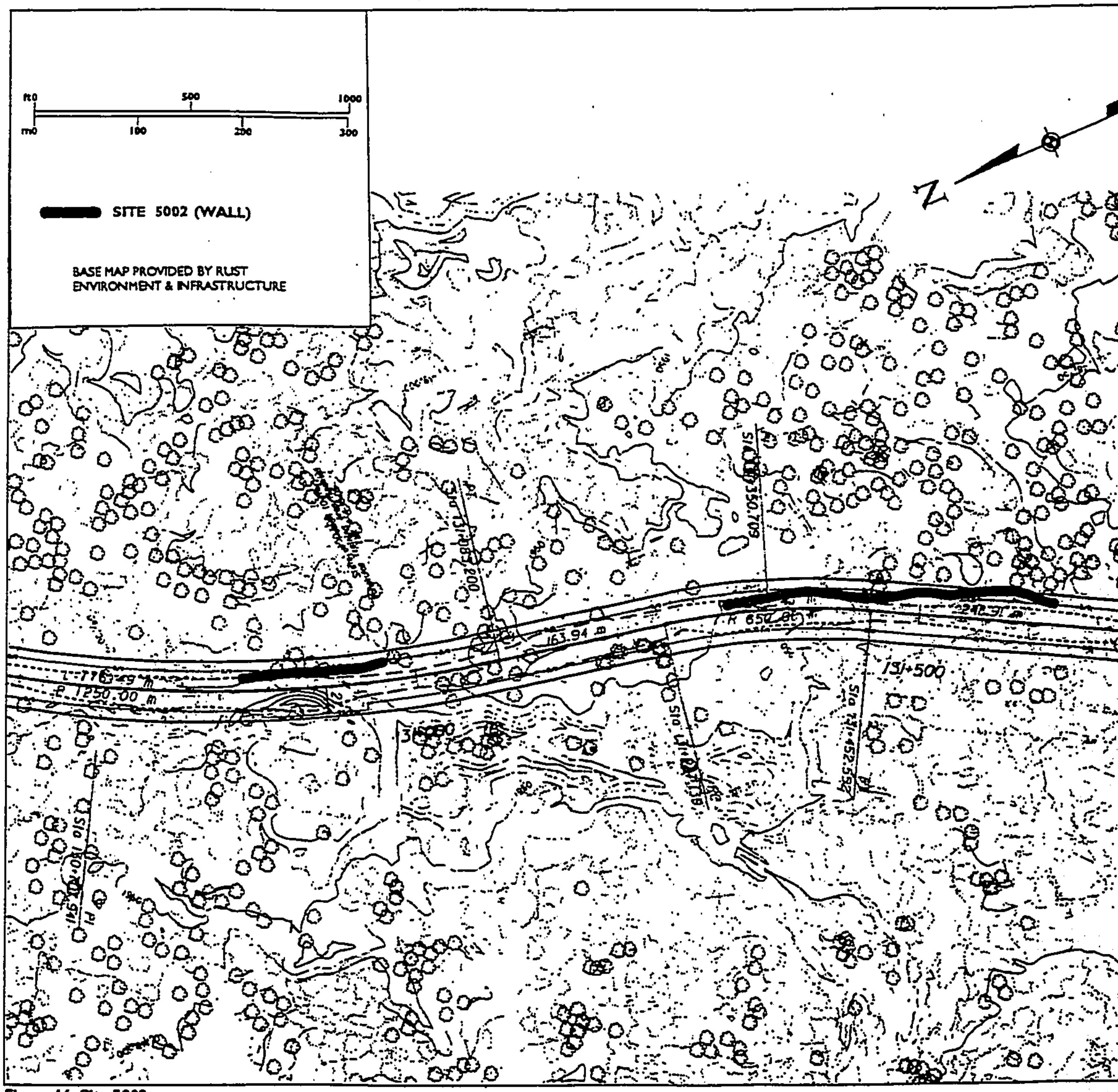
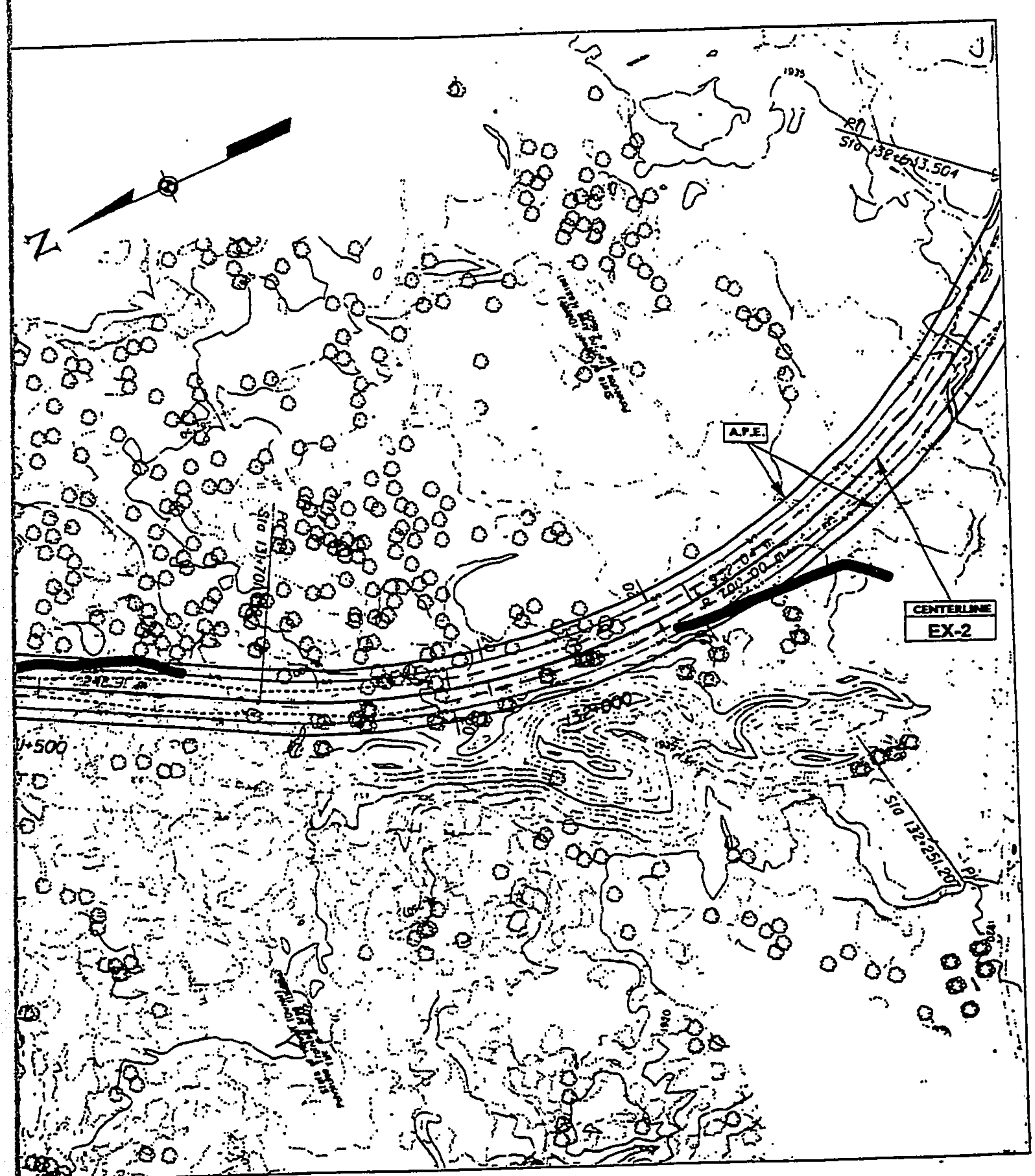


Figure 16. Site 5002


N
A.P.E.
CENTERLINE
EX-2
Sta 132+613.504
Sta 132+251.207
132+600

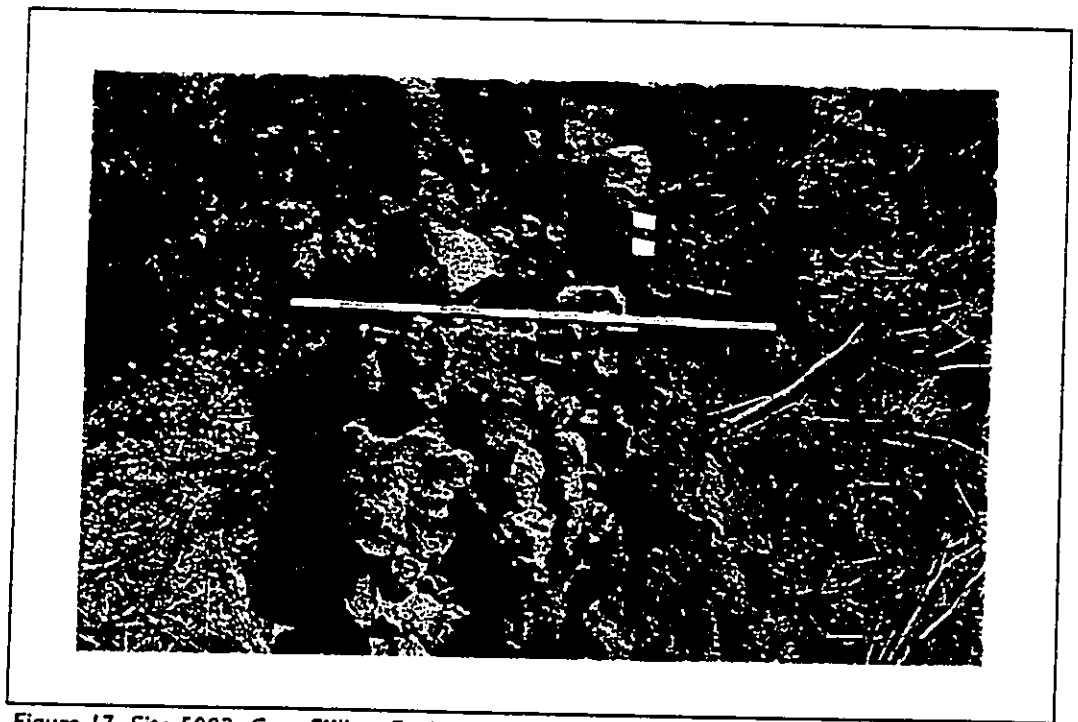


Figure 17. Site 5002, Core Filling, Facing North (Neg.5126-26)

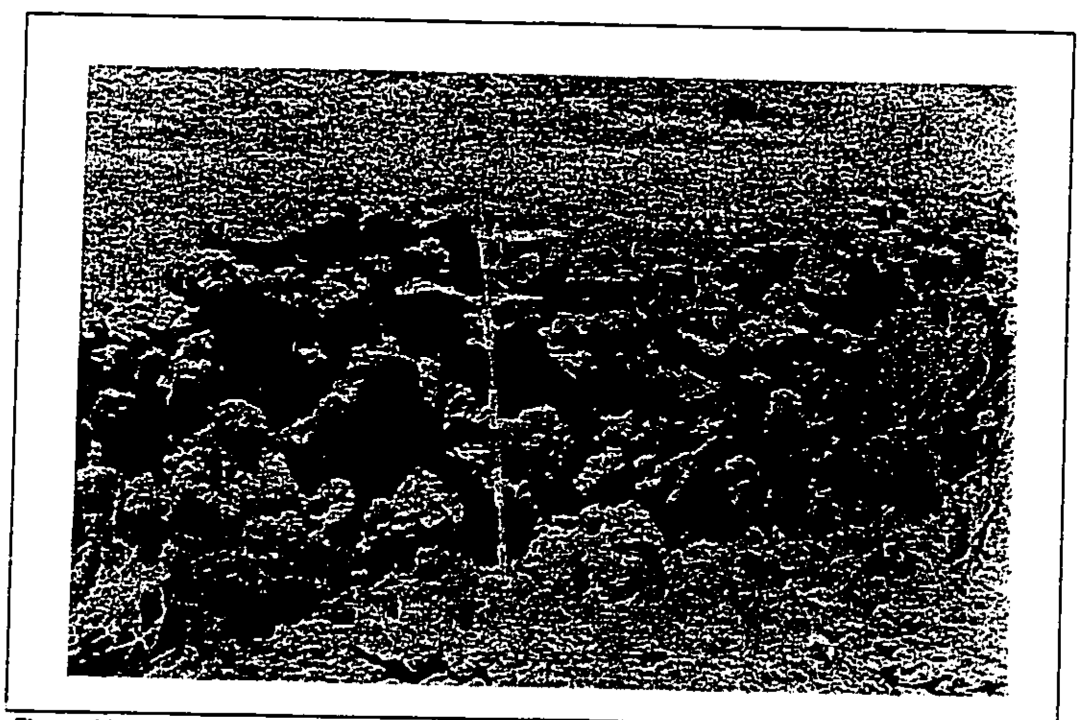


Figure 18. Site 5002, Facing West (Neg.5127-21)

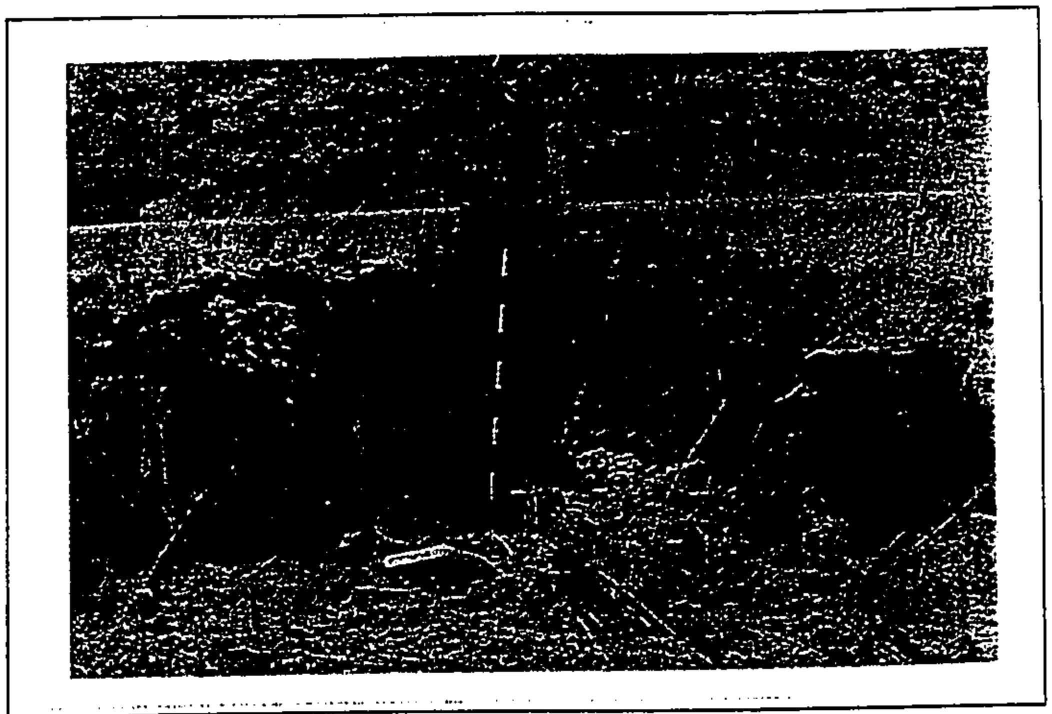


Figure 19. Site 5002, Facing West (Neg.5128-3)

Figure 20. Site 5002, Core Filling, Facing North (Neg.5128-10)

Site 50-10-32-20862

The site is a segment of a historic rock wall that is located near the centerline Sta. 140.920 and 140.980 of EX-3 corridor at about 2,000 m elevation in Humu'ula, North Hilo. The wall segment is at the southwest corner of the existing Saddle Road intersection with the Mauna Kea Access Road *(Figure 21)*. The wall is generally oriented to the southwest, and is an average of 1.3 m high and 85 cm wide. It extends beyond the project inspection corridor. The constituent cobbles are subrounded to nearly tabular (7 to 50 cm long/diameter) reddish rough *pāhoehoe (Figures 22 through 25)*. The wall is stacked eight to ten stones high and is roughly faced. Portions are bifaced and have a rubble core (especially the southern portion). The wall is partially buried by the Mauna Kea 1935 flow. Only a short segment of the wall at the northern end (about 25 m) is entirely exposed, while the wall further to the south only protrudes above the 1935 flow that encases it. About 20 m past the southern boundary of the study corridor, the wall is completely buried by the 1935 flow. Further to the southwest the wall is fully exposed on the pre-A.D. 500 flow. The wall is 2.0 m high and 1.6 m wide in this location.

The wall was constructed prior to being covered by the 1935 flow. It is situated in alignment and between Sections 1 and 2 of the Site 7119 wall, suggesting that it is contemporaneous with, and functioned as a part of, the Humu'ula Sheep Station wall network (see discussion of Site 7119). Site 20862 was given a separate site number during investigation and analysis, because this wall differs from the 7119 in two ways: (1) it comprises rough, red cobbles, and (2) it is lacking wooden posts. Although distinct from the 7119 walls, it is likely that the 20862 wall was part of the 7119 wall network. See the discussion of Site 7119 for a detailed discussion of the site.

Site 50-10-32-20865

This is a historic fence on the pre-8000 B.C. Mauna Kea flow *(see Figure 10k)* at about 2,050 m AMSL in Humu'ula, North Hilo. The area is now grazed grassland, but was once *māmane-naio* forest with subalpine shrubs. The fence consists of debarked, saw-cut wooden posts, 1.2 to1.4 m long and 13 to 25 cm in diameter, within the Humu'ula Sheep Station property *(Figure 26)*. About 30% of the posts in the several hundred meters area where the fence line was observed have fallen. Woven wire connects the posts at about 1.2 m above ground, and no barbed-wire is present. The wire fencing is on the south side of the pole alignment, suggesting that it was intended to stop animals from moving further upslope. The west end of the fence line is the PTA boundary. The fence crosses the centerline of PTA-1, on the southeast slope of a small *Pu'u*, at Sta. 28+068. The fence extends to the east toward the Humu'ula Sheep Station for at least 2.5 km.

The fence line is probably associated with the Humu'ula Sheep Station, and may be contemporaneous with the rock walls further south (Site 7119). The line is on relatively deep soils that allow for the placement of wooden posts as an alternative to rock walls for boundary marking and animal control. The fence line parallels the Old Waimea-Humu'ula Wagon Road (Site 21150).

Site 50-10-32-20877

This is a portion of a historic wall in Humu'ula, North Hilo that has been almost entirely covered by the 1935 flow *(see Figure 10l)*. Only a 7.3 m portion remains *(Figure 27)*. The site datum is 32.55 m at 195° from stake marked EX-3 PT Centerline 141+792.785, and is at about 1,990 m AMSL. The full height of the wall is unknown, because the wall base is below the flow; 80 cm of wall is exposed. The size and construction of the wall is similar to the Humu'ula Sheep Station wall Site 7119, except no wooden posts occur at Site 20877 *(Figures 28 and 29)*. The wall is bifaced and is core-filled with rubble.

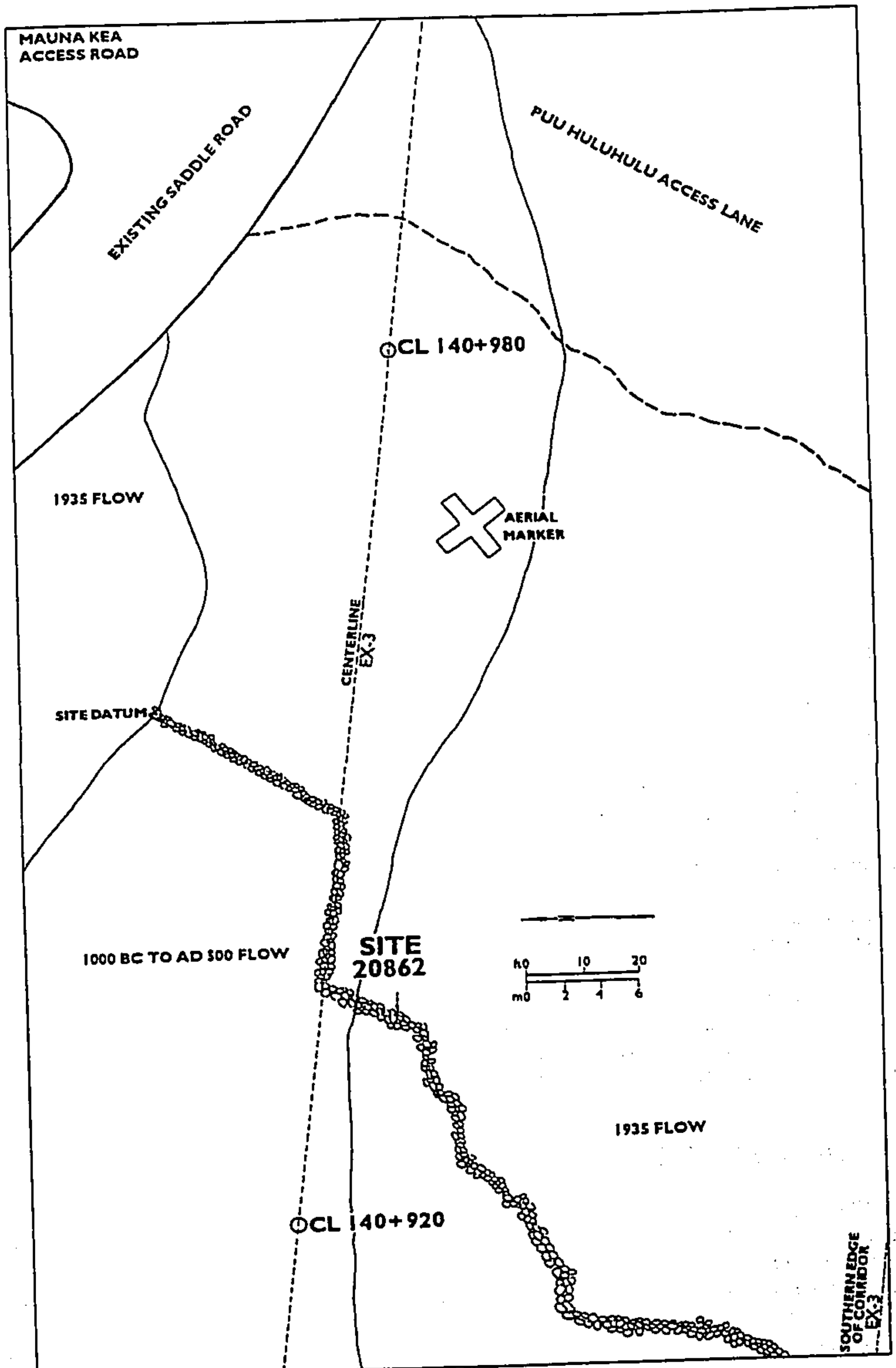


Figure 21. Site 20862

Figure 22. Site 20862, Southern End of Wall, Facing Northwest (Neg.5125-30)

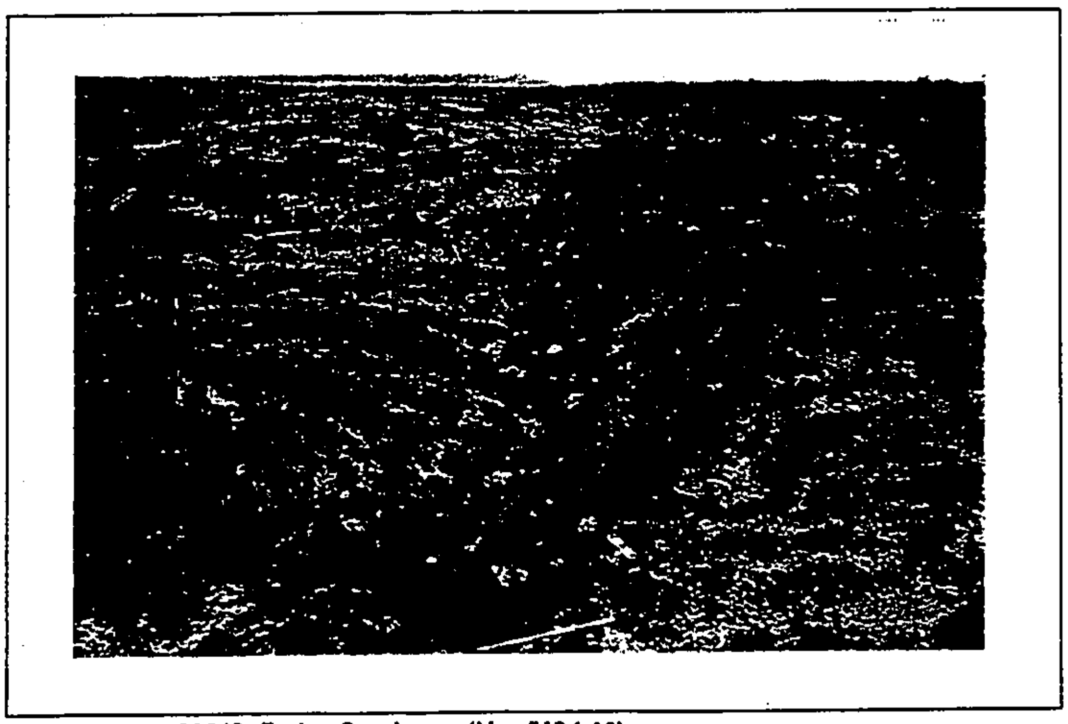


Figure 23. Site 20862, Facing Southwest (Neg.5124-18)

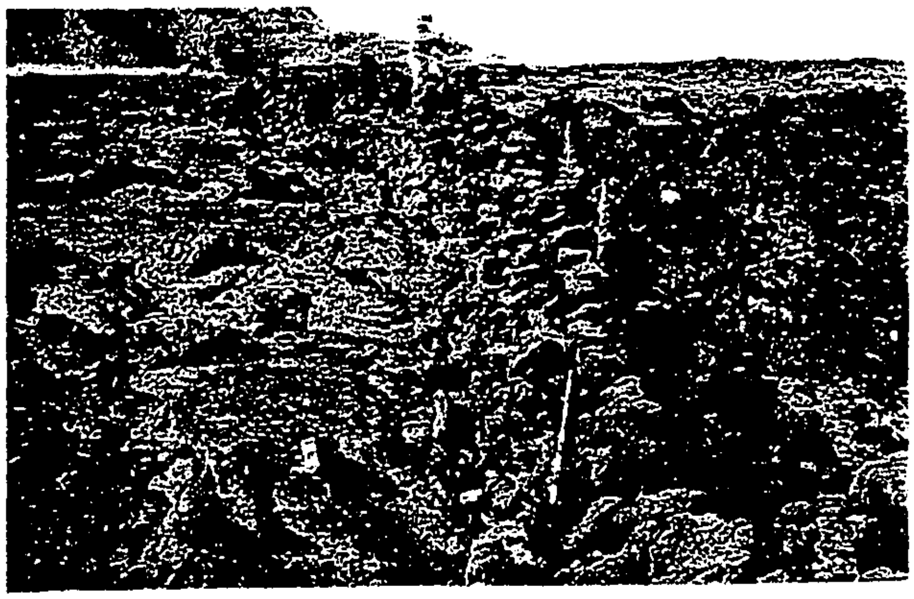


Figure 24. Site 20862, Facing South (Neg.5125-27)

Figure 25. Site 20862, Facing Southwest (Neg.5125-4)

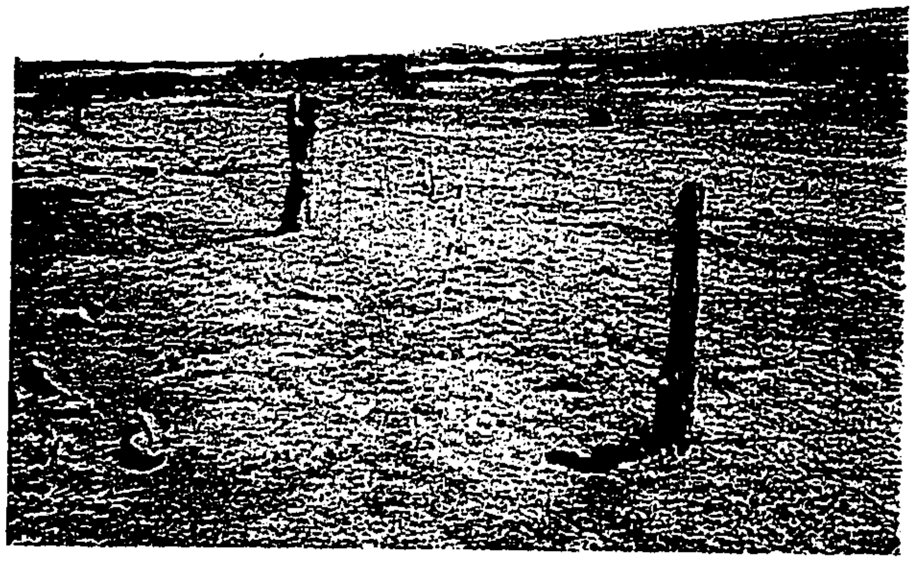


Figure 26. Site 20865, Facing Northeast (Neg.5068-13)

The exteriors of the wall are built of subrounded to almost tabular pieces of scoriaceous basalt (20 to 40 cm dia.). The core is filled with similar material 2 to 15 cm in diameter. The wall generally extends towards the Humu'ula Sheep Station at a bearing of 345°. No other portions of the wall are present along this bearing beyond the 1935 flow. Based on the location and physical characteristics of Site 20877, it is probably part of and contemporaneous with the network of walls associated with the Humu'ula Sheep Station.

Site 50-10-32-21150

This is a portion of the Old Waimea-Humu'ula wagon road *(Figure 10; Figures 31-34)* in Humu'ula, North Hilo. The wagon road was established between Waimea and Humu'ula Sheep Station by 1873. It probably took a direct route from Waimea to Pu'u Ke'eke'e. From there on, early maps (Reg. 1718, drawn in 1891; HTS Plat 713, reproduced in 1913 from an earlier map) show the road running east from Pu'u Ke'eke'e to Pōhakuloa, and then running north of 'Ōma'okō'ili to Kala'i'ehā (Humu'ula Sheep Station). The first detailed rendering of the wagon road is shown on the Ka'ohe and Humu'ula USGS Quadrangles, surveyed in 1926–1927 *(Figure 34)*. The old wagon road was apparently obliterated by the construction of the Saddle Road between Pu'u Ke'eke'e and Pohakuloa/Mauna Kea State Park. The Saddle Road turns southward at Mauna Kea State Park, while Old Waimea-Humu'ula wagon road continued east there toward Kala'i'ehā.

An approximately 5.5 kilometer segment of the Old Waimea-Humu'ula wagon road is situated between the State Park and the eastern boundary of PTA. This portion of the Old Waimea-Humu'ula wagon road has been used as a transportation route for military vehicles for over 40 years. Consequently, the path of the Old Waimea-Humu'ula wagon road within this part of PTA has been tranformed into a deeply-rutted two-track. There are no vestiges of the morphology that identify this route as the Old Waimea-Humu'ula wagon road.

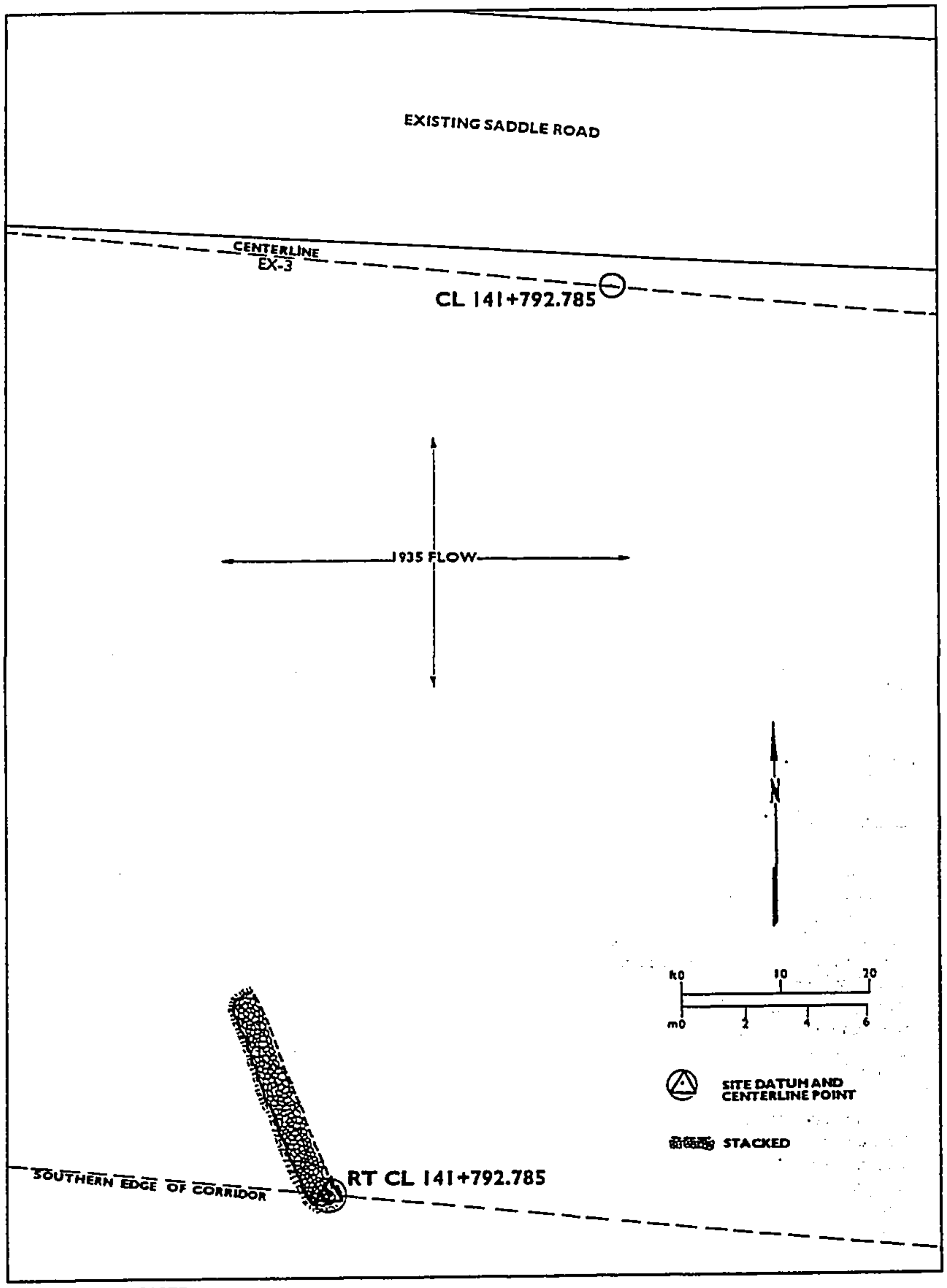


Figure 27. Site 20877

Figure 28. Site 20877, Facing North (Neg.5061-1)

Figure 29. Site 20877, Facing Northeast (Neg.5061-3)

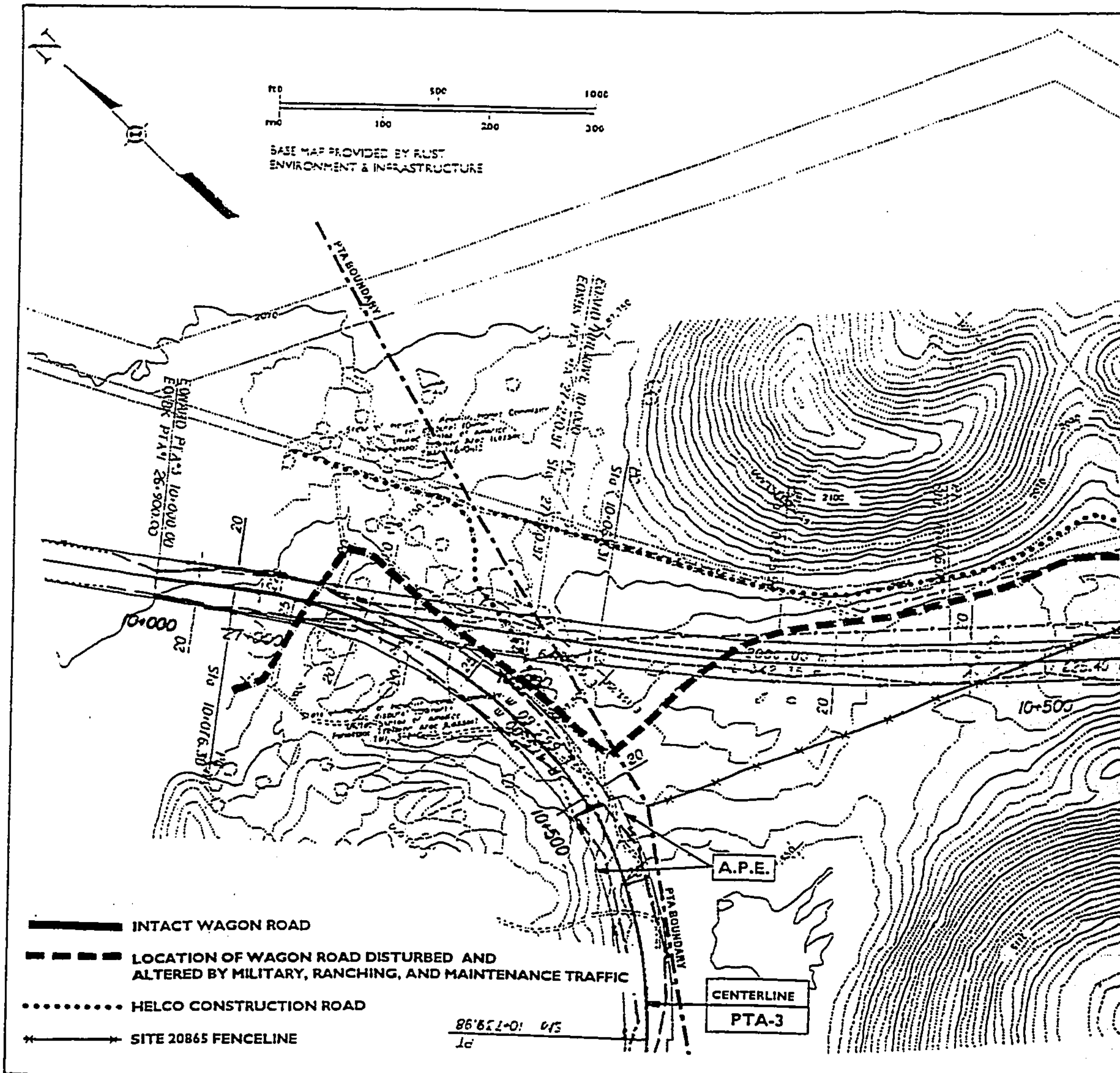
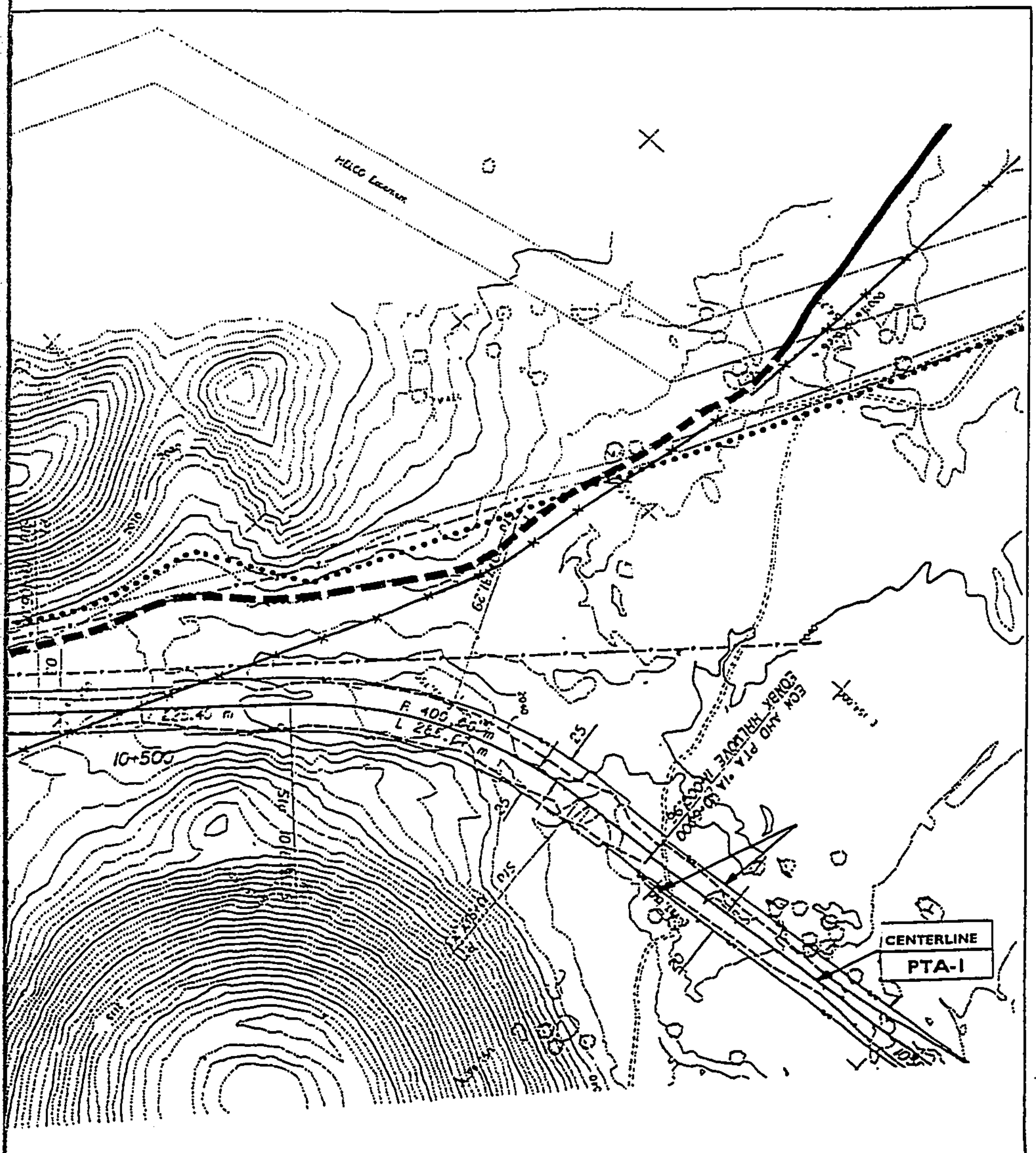


Figure 30. Site 21150


CENTERLINE
PTA-1
10+500

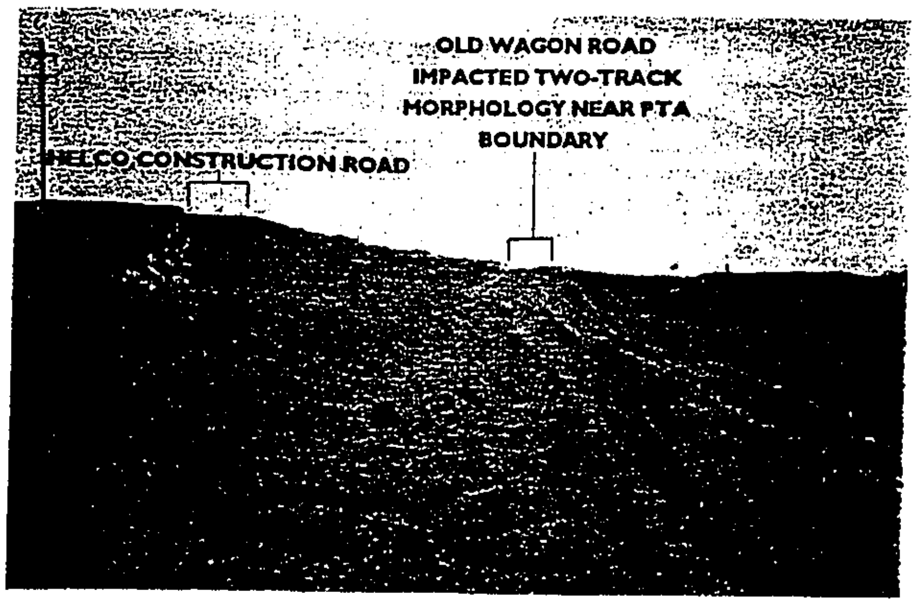


Figure 31. Site 21150, Facing East (Neg.5144-30)

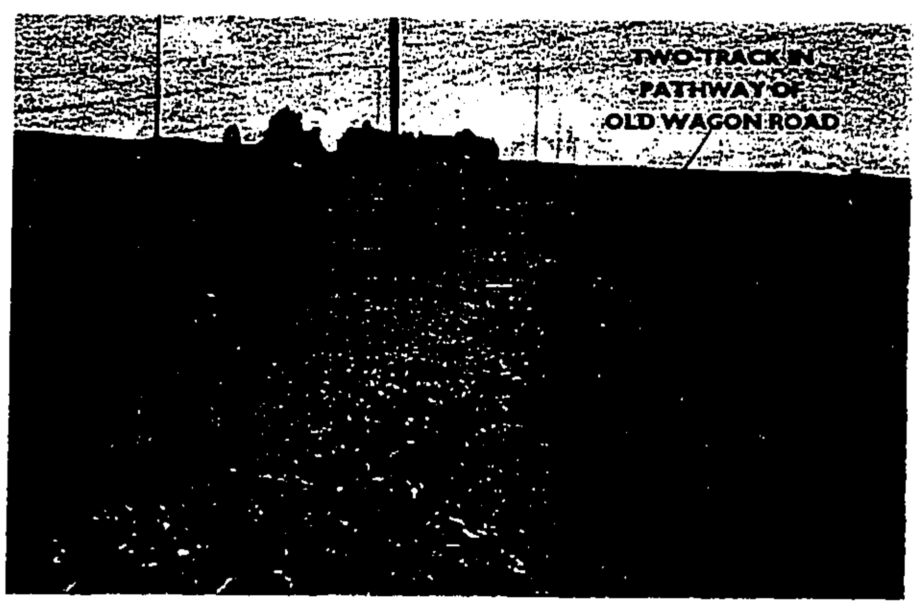


Figure 32. Site 21150, Facing East (Neg.5144-32)

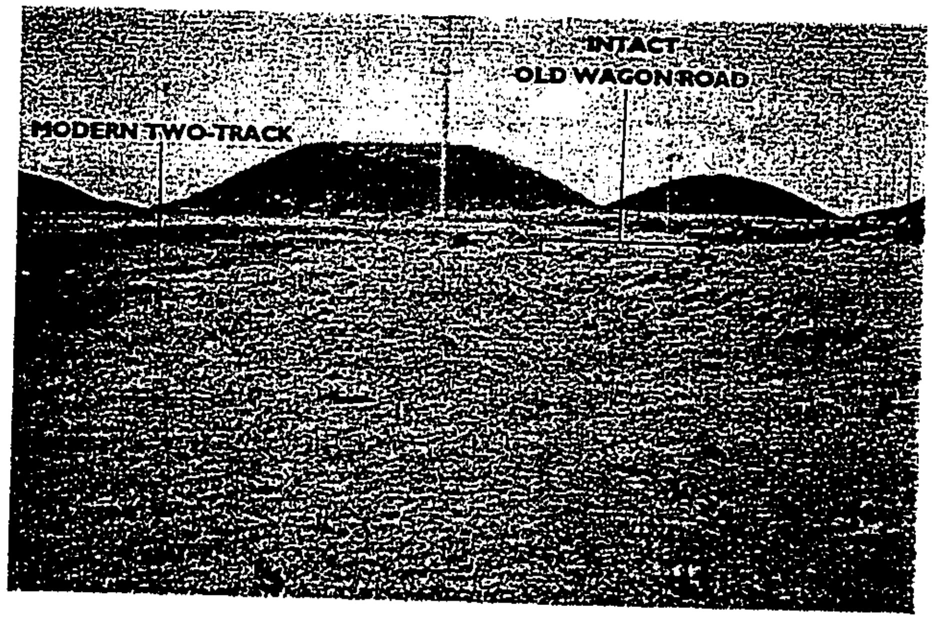


Figure 33. Site 21150, Facing West (Neg.5144-37)

The Old Waimea-Humu'ula wagon road has also been impacted for about 1.0 kilometers east of the PTA's eastern boundary *(Figure 30)*. This portion of the trail has been disturbed by military and powerline maintenance vehicles. The gate at the PTA boundary is situated over the Old Waimea-Humu'ula wagon road route, so all vehicles that cross the boundary must travel over the site. Consequently, vehicular traffic has been and continues to be concentrated over the Old Waimea-Humu'ula wagon road for a kilometer east of the PTA boundary. The Old Waimea-Humu'ula wagon road is this location exhibits two-track morphology with deeper ruts (up to 50 centimeters deep) along the outer edges of the pathway, and a hump down the centerline *(Figure 31 and 32)*.

At one kilometer east of the PTA boundary, military activity decreases dramatically and modern transportation pathways diverge from the Old Waimea-Humu'ula wagon road. The fenceline associated with the Humu'ula Sheep Station (Site 20865), and two modern overhead utility lines converge with the Old Waimea-Humu'ula wagon road at this location. From here eastward 2.3 kilometers to the Humu'ula Sheep Station, the Old Waimea-Humu'ula wagon road roughly parallels the fenceline. In contrast, the modern transportation paths follow along the utility corridors. Consequently, the Old Waimea-Humu'ula wagon road has had almost no impacts from this location eastward to the Humu'ula Sheep Station.

The morphology of the intact Old Waimea-Humu'ula wagon road is more subtle than the two-track manifestations further to the west *(Figure 33)*. The intact road is shallow (less than 15 centimeters maximum), and often barely recognizable on the surface. Significantly, the intact Old Waimea-Humu'ula wagon road does not exhibit any two-track morphology. Instead, the path is flat across the entire route width. A wagon pulled by draft animals would account for a flat pathway. While the wooden wheels would create impressions along the outer edges of the path, hooved draft animals would trample down the center of the path.

Based on the inspection of several kilometers of the Old Waimea-Humu'ula wagon road route, it appears that two-track morphology is directly associated with impacts by modern, rubber-tired, motorized vehicles. There is a correlation between high-intensity vehicular activity (west of the PTA boundary) with deeper ruts, and low-intensity vehicular activity (for 1 kilometer east of the PTA boundary) with shallower ruts. Only when modern vehicle traffic has not occurred over the Old Waimea-Humu'ula wagon road can the original morphology of the route be observed. Modern utility lines deviate from the Old Waimea-Humu'ula wagon road about 1 kilometer east of the PTA boundary, so the old road has been avoided from this location east to the Humu'ula Sheep Station.

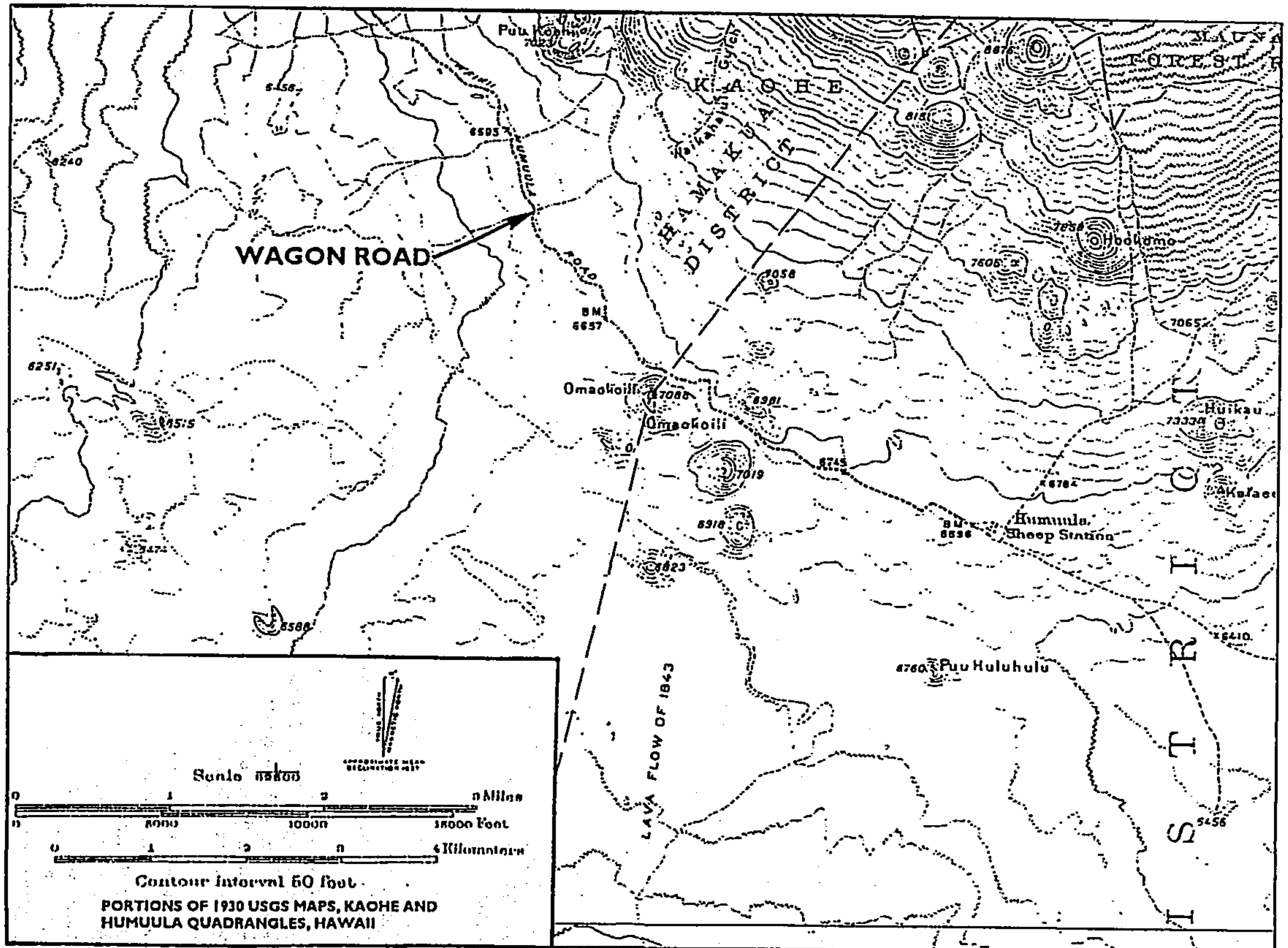


Figure 34. Site 21150 on USGS Topo 1930 Humuula Quadrangle

Site 50-10-32-7119

The first description of the Humu'ula Sheep Station as historic Site 7119 was made in a Hawaii Register of Historic Places form dated June 1973. The form gives the site size as approximately eight acres, but does not provide a map or text that explains the boundaries of that acreage. Constituent elements noted are dwellings (emphasized and described), offices, sheds, and pens, but there is no mention of the walls and fences. One rock wall segment is included under the 7119 site designation for the first time much later (Rosendahl and Rosendahl 1986; Kalima and Rosendahl 1991). Site 7119 was delisted from the Hawai'i Register of Historic Places, because the landowner had not been notified or consulted during the listing process.

As part of Site 7119, a network of stone walls is associated with the southern boundary of the Humu'ula Sheep Station *(see Figures 9 and 10k,l,m)* around 2,010–1,830 m AMSL in Humu'ula, North Hilo. Another network of stone walls is associated with the northern boundary (shown on the 1982 USGS Pu'u Ō'ō Quadrangle). This southern boundary wall is generally parallel to and near the Saddle Road across the Humu'ula *ahupua'a*. Much of the wall is clearly visible to motorists on the Saddle Road, especially at the western end where it is closest to the road. The wall is faced and is core-filled. The exterior stones are 10 to 50 cm long, and are subrounded to nearly tabular. The core stones are 4 to 20 cm in diameter. The wall is 1.6 to 2.3 m high (five to twelve courses high) and 0.9 to 1.2 m wide, and is wider at the base. The top of the wall is often flat and parallels the surface of the lava flow. There are wooden posts on top the wall, about 1.5 to 2.0 m apart. Most of the posts are saw cut and some have staples, which once held barbed wire.

The southern perimeter wall crosses the Saddle Road at several locations along the EX-2 and EX-3 corridors. Near Sta. 148+000, the wall angles northward as an eastern boundary for the sheep station, continuing well beyond the project area for couple of kilometers toward Pu'u 'Ō'ō. The western wall terminus is just west of Pu'u Nēnē at the boundary of the 1843 Mauna Loa flow. The older Mauna Kea flow to the north is covered in soil, and could have supported wooden fences like that observed with Site 20865. The intact portions of the wall are in good condition. The wall was built on the 1843 Mauna Loa flow. The 1935 flow has fully covered portions of the wall, and partially covered some parts *(see Figures 10k,l,m)*.

Because this wall is over 11 km long, it has been divided into seven sections for clarity of description. Of the seven sections, only Section 1 (on the west), Section 4, Section 6, and Section 7 are partially within the current project area. Sections 2, 3, and 5 are located well to the south and beyond the APE. Photographs were taken of each of the wall sections, and at 100 m intervals for long wall sections.

Section 1 - This is a long, well-preserved section beginning at the boundary of the 1843 Mauna Loa flow and the pre-8000 B.C. Mauna Kea flow near Pu'u Nēnē. This section roughly parallels and crosses Saddle Road, with an eastern terminus near milepost 29. Here it curves slightly to the northeast and crosses under the road. A small section can be seen on the north side of the road before it is buried by the 1935 lava flow *(Figure 35)*.

Section 1 wall (approximately 1.8 km) was described and photographed at 22 locations, at roughly 100 m intervals *(Figures 36 through 39)*. The intact, nondisturbed wall varies in height from 1.1 (5 to 6 courses of stacking) to 1.9 m (10 to 12 courses) high, with an average height of approximately 1.7 m (9 courses of stacking). Width varies from 0.8 to 2.0 m. The portion of Section 1 wall that is north of Saddle Road (near Pu'u Nēnē) is in good condition with 'ōhi'a logs and wire noted occasionally on the north face of the wall. The portion of Section 1 wall on the south side of Saddle Road varies in condition, with poorer integrity along the western third of this southern portion. From Stas 138+400 to 138+415 the wall is less than a meter high with only 3 to 4 courses of stacking present. The wall is

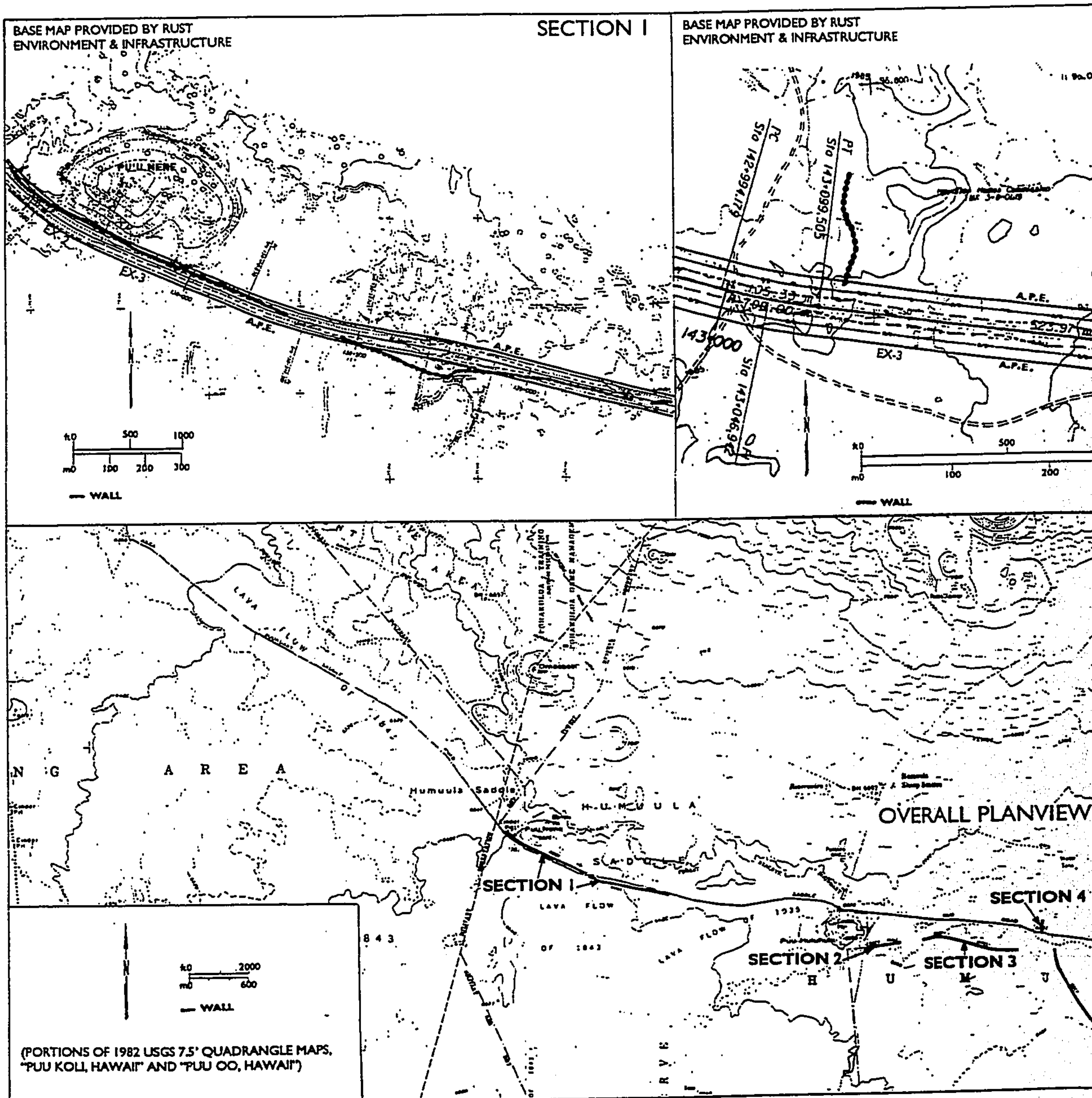
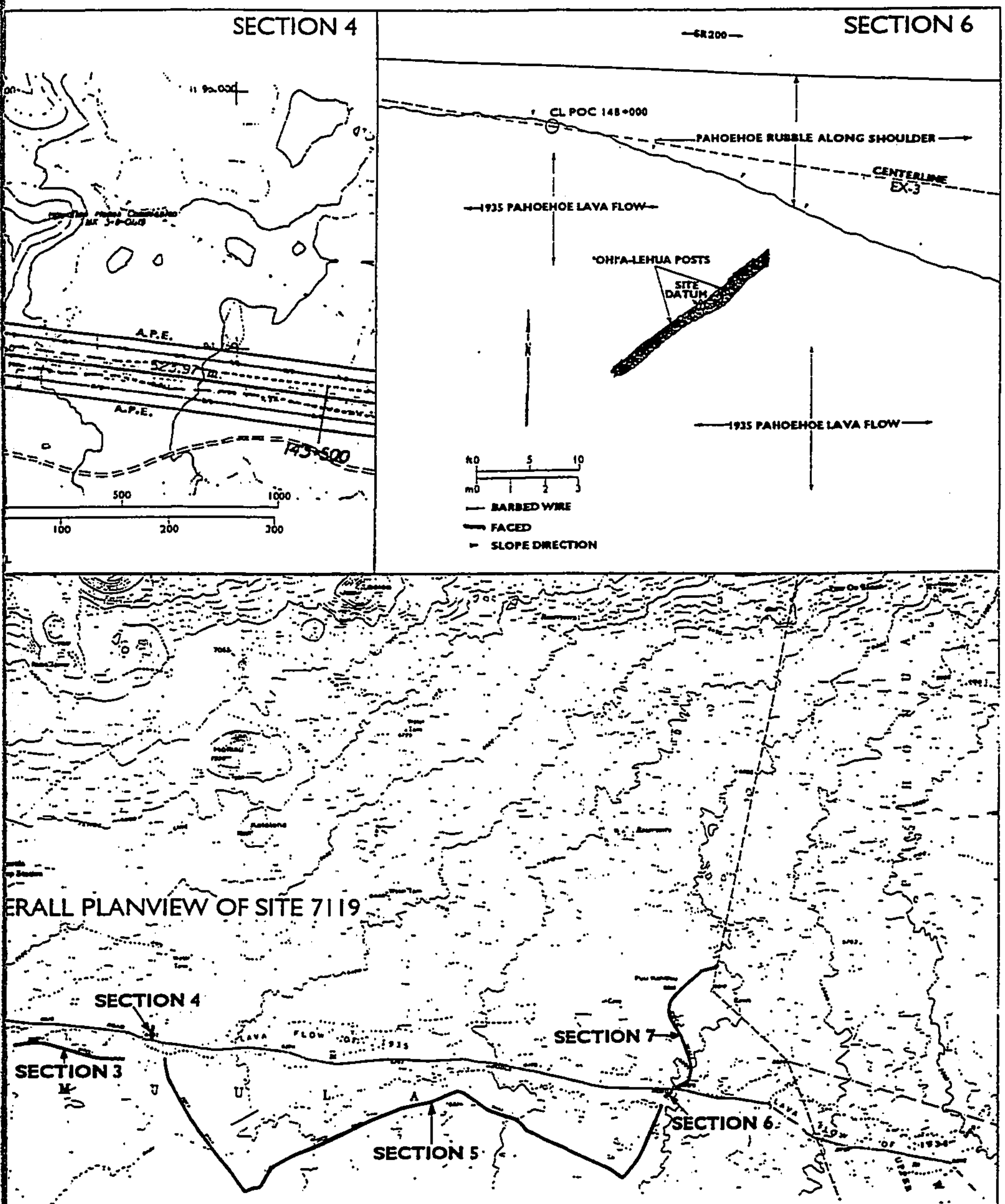


Figure 35. Site 7119


SECTION 4
A.P.E.
523.97 m
A.P.E.
143+500
500
1000
100
200
300
SECTION 6
CL POC 148+000
PAHOEHOE RUBBLE ALONG SHOULDER
CENTERLINE
EX-3
1935 PAHOEHOE LAVA FLOW
'OHI'A-LEHUA POSTS
SITE DATUM
1935 PAHOEHOE LAVA FLOW
ft0
5
10
m0
1
2
3
BARBED WIRE
FACED
SLOPE DIRECTION
ERALL PLANVIEW OF SITE 7119
SECTION 4
SECTION 3
SECTION 7
SECTION 6
SECTION 5

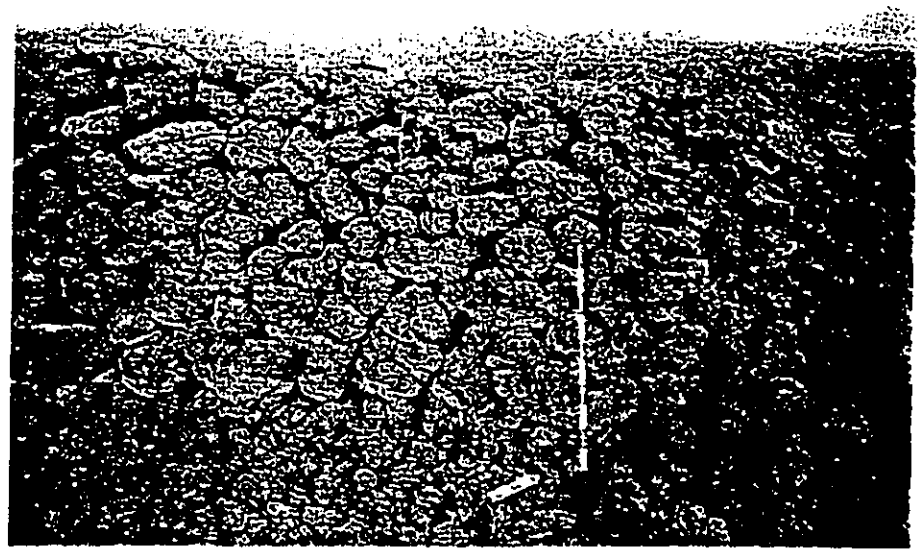


Figure 36. Site 7119, Section I, Facing Northwest (Neg.5054-13)

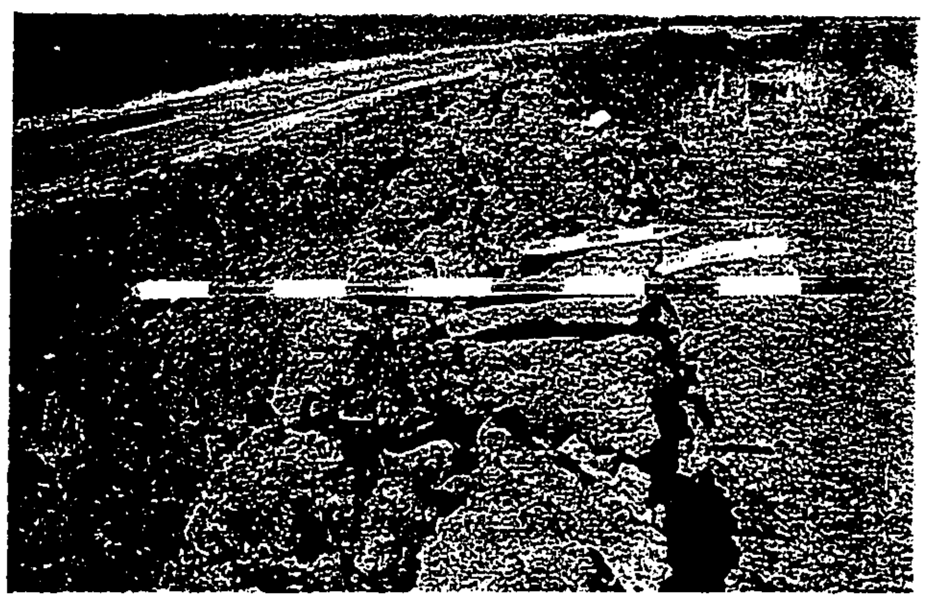


Figure 37. Site 7119, Section I, Facing West (Neg.5054-26)


Figure 38. Site 7119, Section 1, Facing South (Neg.5055-32)


Figure 39. Site 7119, Section 1, Facing West (Neg.5056-34)

disturbed to varying degrees between Stas 38+400 to 38+480. This portion of the wall is near the existing Saddle Road. The integrity of the wall improves with distance from the existing road. Areas of collapse are more common on the south portion of Section 1 wall, probably due to the proximity of the wall to a bulldozed path. Recent cairns are also present along the southern wall, which may represent increased activity and impact to the wall in this area.

Section 2 - This section is southeast of Pu'u Huluhulu, and is partially buried by the 1935 flow. The alignment is oriented about 82-262° and the overall length is roughly 320 m. This approximately 260-meter-long section is over 200 m beyond the APE and was not described and photographed.

Section 3 - This section is about 170 south of and parallel to the project corridor, and is approximately 1.1 km long. It was not described and photographed. The western portion of this section is buried by the 1935 flow.

Section 4 - This 132 m long section is located on the north side of the existing Saddle Road. The northern and southern ends of this segment correspond to the 1935 flow. The wall is in good condition, has *'ōhi'a* logs and wire on both sides of the wall, and varies little in height or width *(Figures 40 through 43)*. The wall averages 1.6 m (8 to 9 courses of stacking) in height and is 1.5 m wide with faced sides and core filling. Approximately 20 m of the Section 4 wall is located within the APE. This section was recorded by Rosendahl and Rosendahl (1986) as part of Site 7119 (Humu'ula Sheep Station). Section 4 and the northern part of Section 5 run at right angles to Section 3. The north end of Section 4 appears to have tied into a barbed wire fence running on the north across the pasture.

Section 5 - This is a long section (approximately 6.2 km), located south of the existing Saddle Road and beyond the APE, that was not recorded.

Section 6 - This is a short section (12.6 m long) south of the existing Saddle Road near Sta 148+000. The wall is exposed within a tiny *kipuka* in the 1935 lava flow. The wall has *'ōhi'a* posts and barbed wire along the northern wall face. The wall is approximately 1.7 m high (8 to 11 courses) and 0.9 m wide *(Figures 44 and 46)*.

Section 7 - This section is at the northern edge of the 1935 lava flow, and corresponds to the eastern boundary of the sheep station. Approximately 4.0 m of this long section is within the APE. The intact wall ranges from 6 to 12 courses high, with an average of 8 to 9 courses. It is a bifaced, core-filled wall, averaging 1.1 m wide *(Figures 45 and 47)*. It trends to the northwest, then to the northeast, where, based on the USGS Quadrangle (Puu Oo-7.5'-1982), it ends at about 1,830 m (6,000 ft) above sea level, on the border between North and South Hilo Districts. (Another rock wall, indicated on the same quad, is located upslope of Humu'ula Sheep Station. This wall appears to have been the upper perimeter wall for the sheep station. Although the wall is far outside of the project area it was briefly investigated. The wall was found to be similar to the lower wall in that it was also bifaced, core-filled, and had posts.)

The walls are part of the Humu'ula Sheep Station. The first station buildings were built by Frank Spencer's Waimea Grazing and Agricultural Company between 1861 and 1873. The northern and southern stone perimeter walls were built about 1892-95 by August Haneberg, manager for the Humuula Sheep Station Company when it was owned by Hackfields. In 1891, the station (under Haneberg) already had the boss house and the shear barn. The station has been changed since the time of Haneberg, but two of the most significant buildings remain from his time, the boss house and the shear barn *(Figure 48)*.

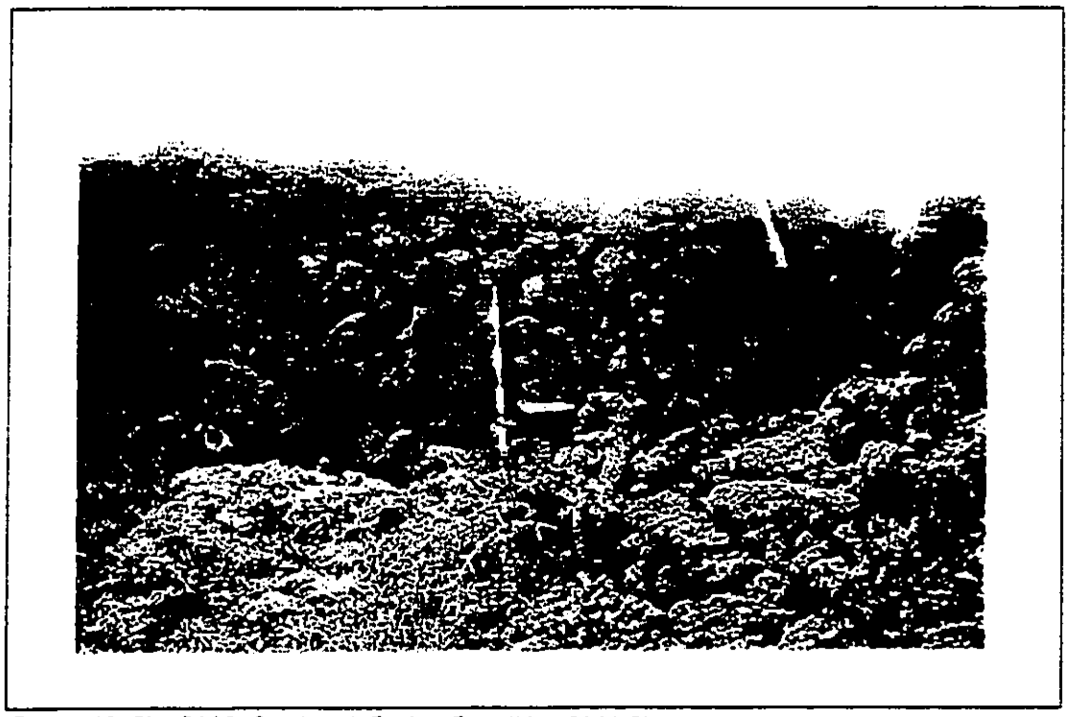


Figure 40. Site 7119, Section 4, Facing East (Neg.5061-7)

Figure 41. Site 7119, Section 4, Facing North (Neg.5061-21)

Figure 42. Site 7119, Section 4, Facing West (Neg.5061-15)

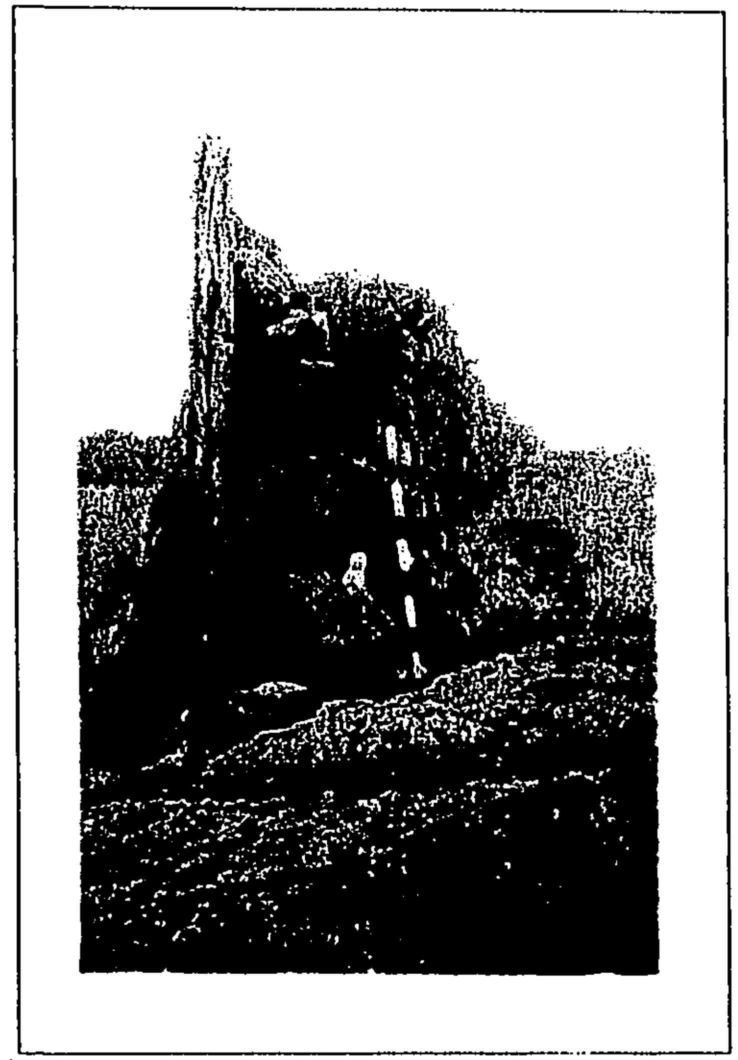


Figure 43. Site 7119, Section 4, Facing Southeast (Neg.5061-13)

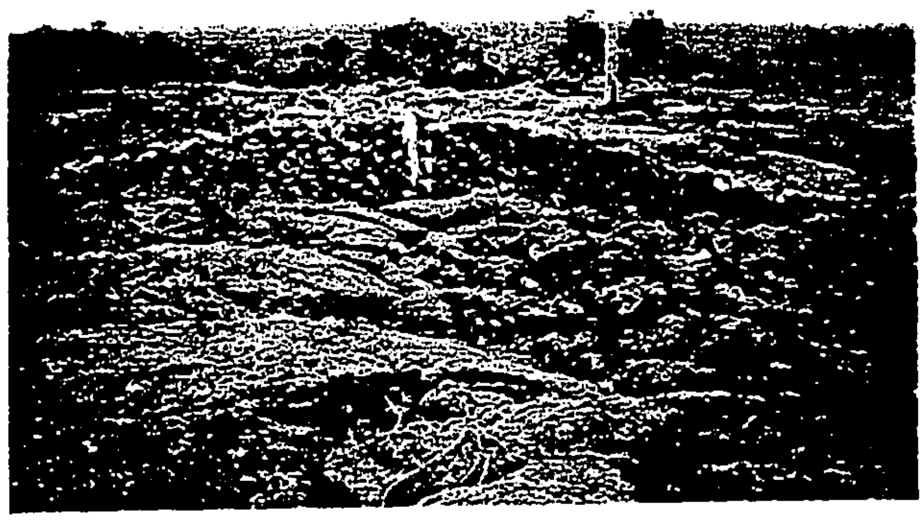


Figure 44. Site 7119, Section 6, Facing Northeast (Neg.5063-2)

Figure 45. Site 7119, Section 7, Facing West (Neg.5063-14)

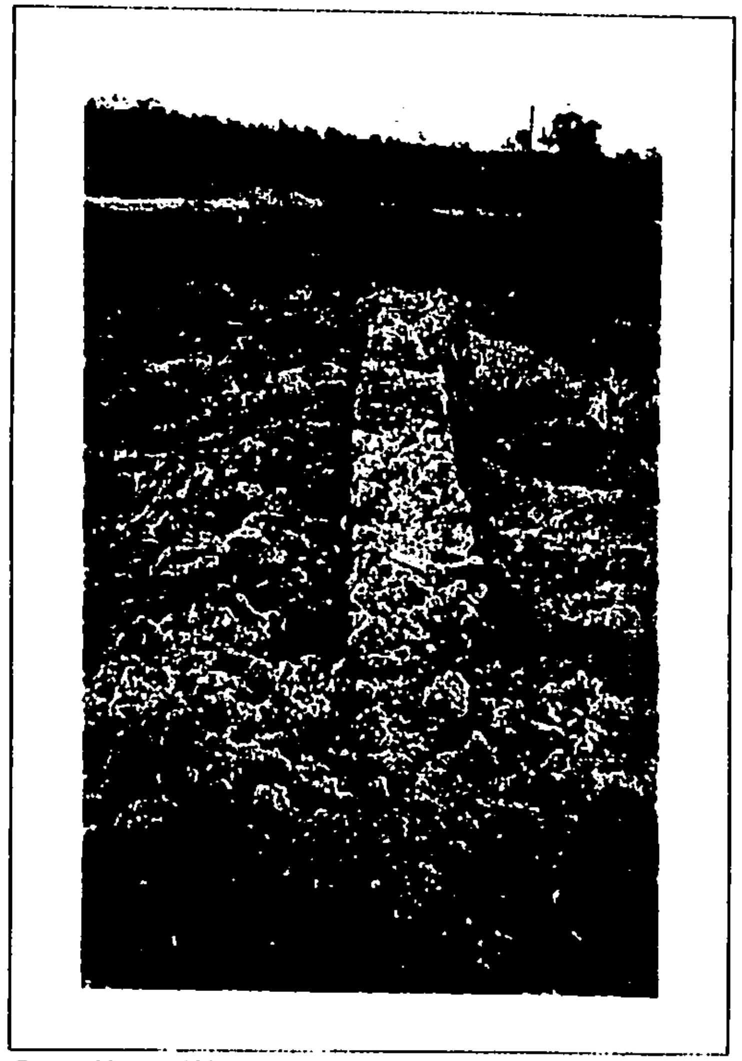


Figure 46. Site 7119, Section 6, Facing Southwest (Neg.5063-4)

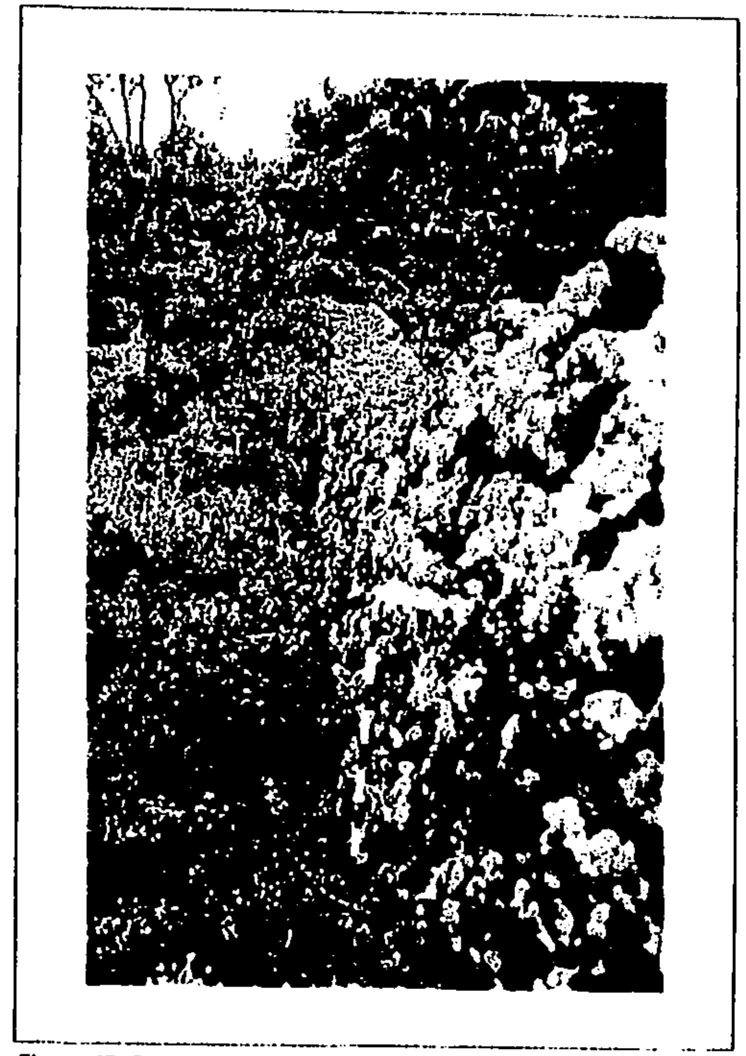


Figure 47. Site 7119, Section 7, Facing Northeast (Neg.5063-19)

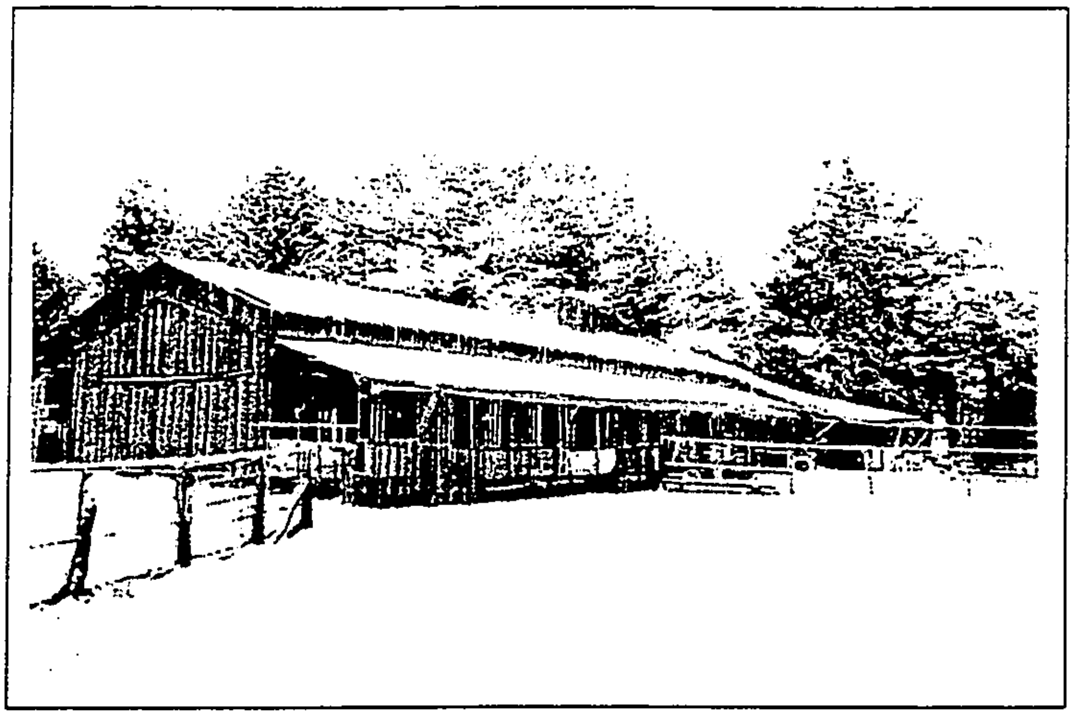


Figure 48. Site 7119, the Shear Barn at Humu'ula Sheep Station

Some later additions were made to the original boss house, called Haneberg's house on Baldwin's 1891 drawing of the station (Baldwin 1890:43). A south office wing, east cookhouse wing and north bedroom were added later (Hawaii State DLNR, Sheep Station Site Description, p. 4). The boss house is still standing today, but it is unused and beginning to deteriorate. The shear barn is in better shape. Inside it are the wool press, used to bale the wool *(Figure 49)* and a shearing machine *(Figure 50)*, which had a motor and flywheel that ran clippers for all the shearers. The shearing machine dates from at least the 1930s and the wool press is probably older yet. Several other buildings remain from the 1920-1930 period, a cottage, bunkhouse/kitchen and saddle-house/storeroom *(see Figure 9)*. The old forge, meathouse, dipping trough and family cottage are gone. Other structures have been built since 1930, a couple of houses and a couple Quonset huts brought up after World War II. They are occupied today by Parker Ranch cowboys who work at Humu'ula. Although the station is different from what it was 100 years ago or even 50 years ago, the most important part of the station, historically, is the shear barn, and that remains intact, its function clearly visible.

The wall network forms the southern, and parts of the southwest and eastern boundaries for the Humu'ula Sheep Station. The western boundary is a barbed wire fence, and the northern boundary is a rock wall. Barbed wire fences would effectively pen in the animals, but the rock walls apparently required greater height and barbed wire along the top to keep the sheep, with their notorious climbing ability, in the station.

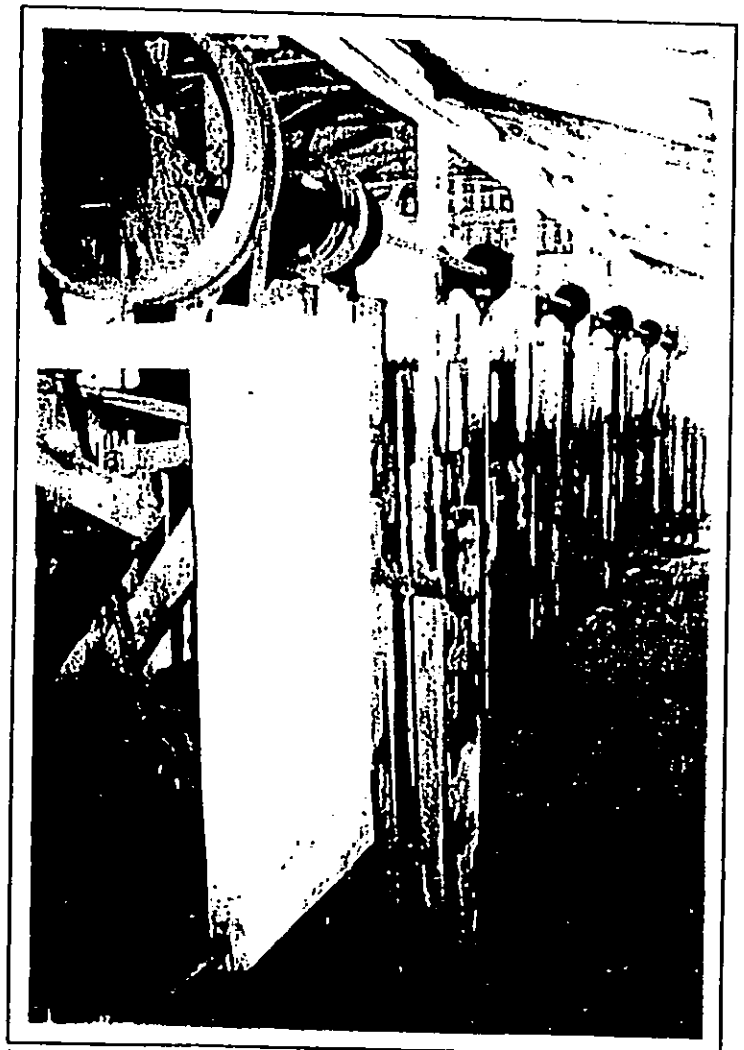


Figure 49. Site 7119, the Shearing Machine at the Humu'ula Shear Barn. The flywheel at the front turned the pulleys farther back, which ran a series of mechanized wool clippers.

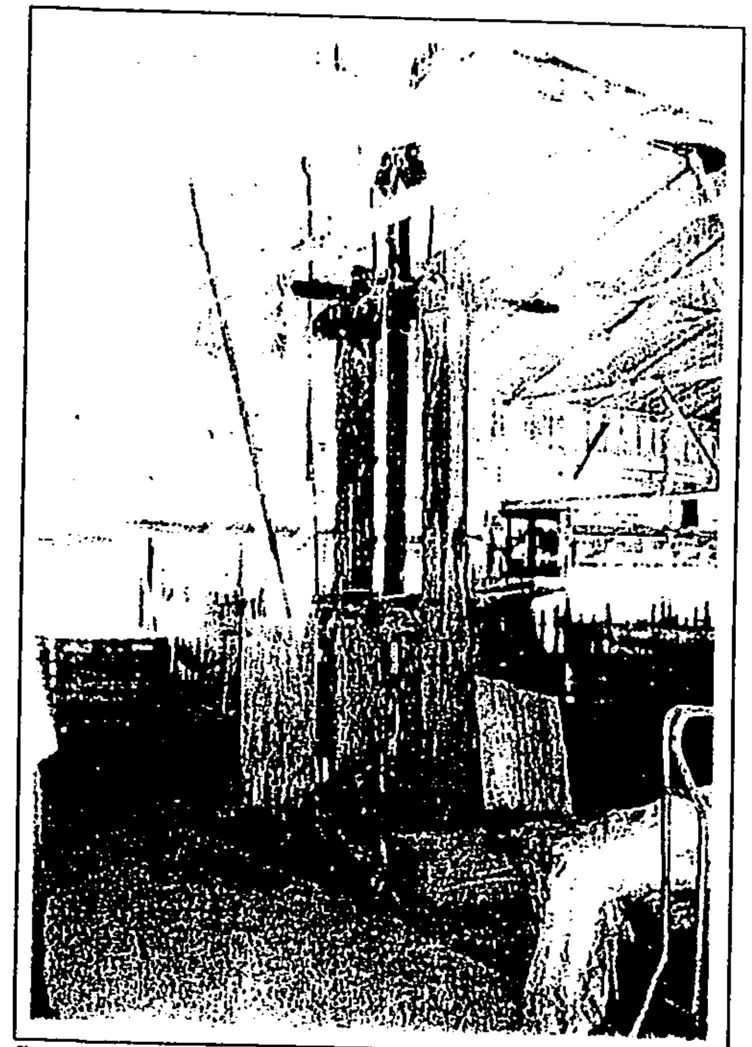


Figure 50. Site 7119, the Wool Press (Baler) at the Humu'ula Shear Barn. Wool was heaped in the box at the bottom and then compressed into a bale.

Site 50-10-33-10309

This site is the Pu'u 'Ō'ō to Volcano Trail in Waiākea, South Hilo. It crosses Saddle Road EX-3 at right angles at Sta. 149+800 between mileposts 22 and 23 at an elevation around 1,750 m AMSL *(Figure 51)*. The full extent of the trail is about 35 kilometers from Pu'u 'Ō'ō Ranch on the slopes of Mauna Kea, to the highway near Kilauea Volcano. South of the road, the trail path is most often manifest as unmodified *pahoehoe* lava from 0.8 to 1.5 meters wide. Occasionally, low spots in the lava are filled with small *'a'ā* cobbles and gravel. North of the road, the trail is a low trough-like indentation in the Mauna Kea soils. This archaeological site may have been created during the Prehistoric Period, but subsequent use during the Historic Period has modified or covered any evidence of earlier use. A lava flow covered a portion of the Site 10309 trail in 1935, and the Saddle Road was built on the 1935 flow. It is about 300 meters from the Saddle Road project impact area to the northern edge of the 1935 flow and the non-covered portion of Site 10309. There is 150 meters between the Saddle Road project impact area and the intact trail at the southern edge of the 1935 flow. Consquently, there are no intact portions of the trail are within the project impact area. An informal parking area has been created in the 1935 flow by bulldozing to provide access to the trail. There are signs in the lot identifying the trailhead *(Figures 52 and 53)*. The trail is currently used for recreational hiking and for access to hunting areas.

Informants who worked for Shipman at Pu'u 'Ō'ō Ranch in the 1940s (Olivera, Imoto) agreed that this trail followed roughly the route shown on the 1956 USGS Puu Oo Quadrangle. They described the trail as "about three feet wide" and generally well-defined from Saddle Road down to Keauhou Ranch, because it passed through rough lava (Olivera Int.). Prior to their time, the original trail was covered in the area of the Saddle Road by the 1935 lava flow and then rebuilt. The only trail currently observable on the 1935 flow is a bulldozed path from the parking lot on the south side of Saddle Road to the trail south of the 1935 flow.

The southern section of the trail, roughly from the old Saddle Road south to Keauhou Ranch and Volcano, cannot be definitively documented by early maps until the 1920s (1924 USGS Kilauea Quadrangle, 1930 Humuula Quadrangle), but there is other evidence in the Boundary Commission testimony for the prehistoric status of the Pu'u 'Ō'ō – Volcano trail. Kenoi of Kapāpala testified in 1873 that an old trail known to him ran from Kapāpala to Keawewai and on to Kala'i'ehā (BC Book A:439). (The trail from Keawewai north to Pu'u 'Ō'ō could also be taken to Kala'i'ehā.) The trail is probably the one used by Hawaiian armies passing through the Saddle from Volcano to Kona in the pre-contact period (referred to in Cultural History, Settlement, and Land Use). When Shipman's cowboys drove cattle south from Pu'u 'Ō'ō to Volcano, they probably used the existing prehistoric trail and perhaps upgraded it. Additional research along selected segments of the trail, and further consideration of the trail's relationship to lava flows that intersect it, might better establish the feature's age.

The northern section of the trail, roughly from the northern right-of-way of the old Saddle Road and further to the north, is the same as the old Hilo-Pu'u 'Ō'ō trail (see later discussion of Hilo - Pu'u 'Ō'ō trail). It was in existence in the 1880s and 1890s according to the evidence of early survey maps. It was used by the Hitchcock family of Hilo during that era.

Site 50-10-33-20856

This is a paving (1.4 by 0.8 m) of irregular shape situated on a boulder in the 1855 low at an elevation of about 1,530 m AMSL, 32 m at 150° from centerline Sta. 155.6 along the EX-3 corridor *(Figure 54)* in Piihonua, North Hilo. Vegetation in this area is dominated by ferns. The pavement consists of one layer of small cobbles (10 to 20 cm in diameter) situated on an *'a'ā* boulder that is 4.5 by 1.9 by 1.4 m high *(Figures 55 and 56)*. The cobbles are piled mainly in the center and on the western portion of the boulder. The western and northeast edges are somewhat faced. The paving makes a level surface on the boulder. A single test unit was excavated at Site 20856. The test unit (EU 55) was 1.0 by 1.0 m, and was excavated to bedrock at 20 cmbs. The small stone cobbles compose the entire profile, and no cultural material was encountered.

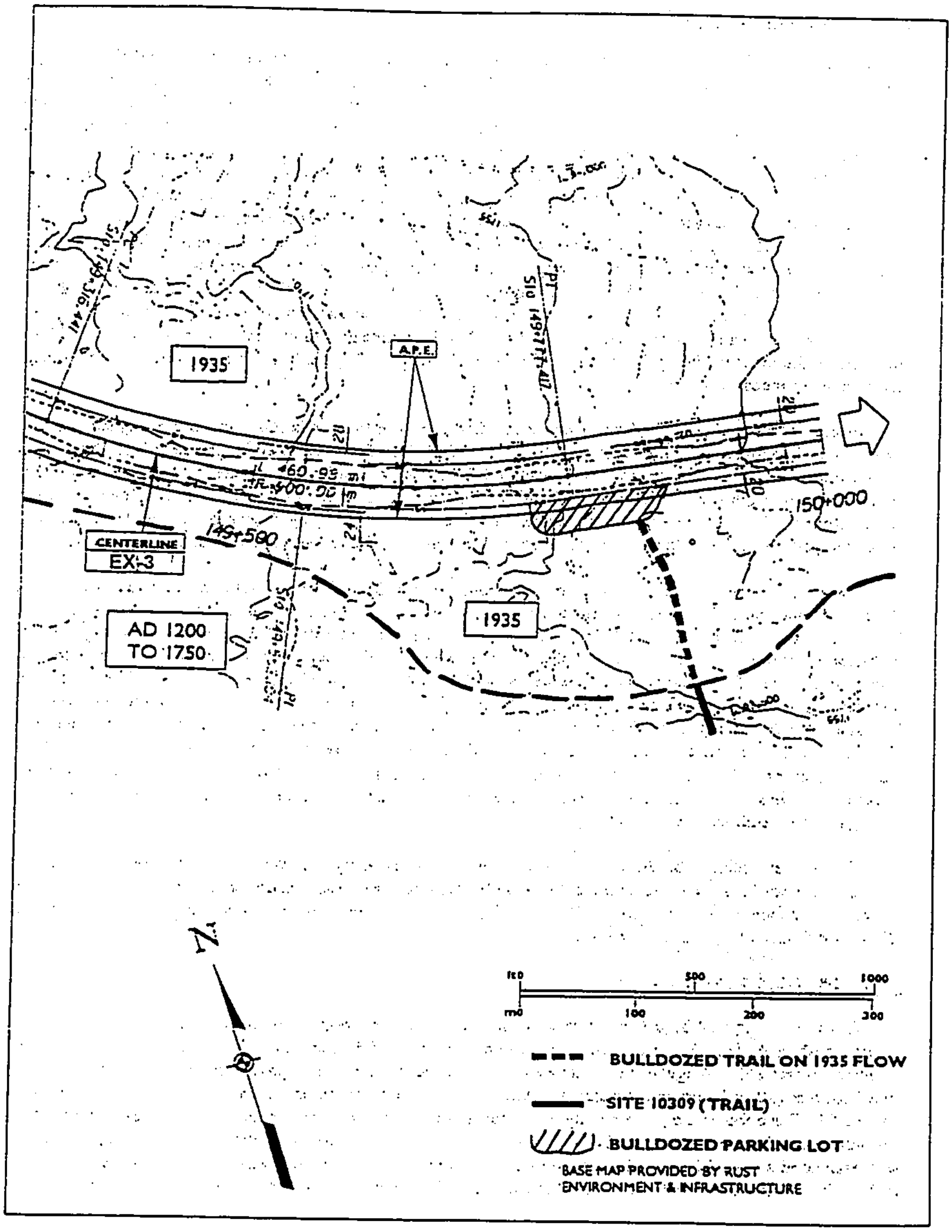


Figure 51. Site 10309

Figure 52. Site 10309, Facing Southeast (Neg.5104-2)

Figure 53. Site 10309, Facing Southwest (Neg.5104-4)

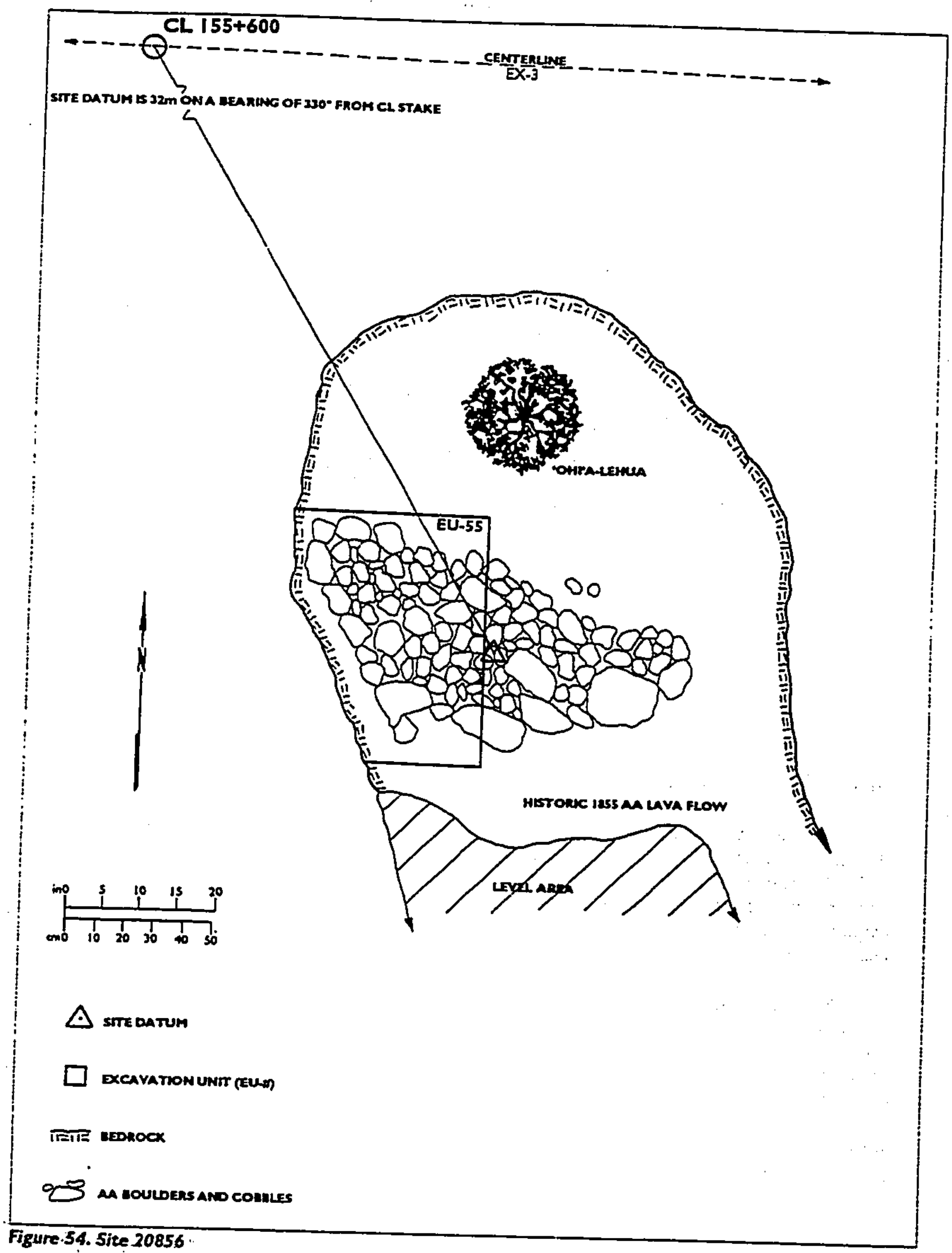


Figure 54. Site 20856

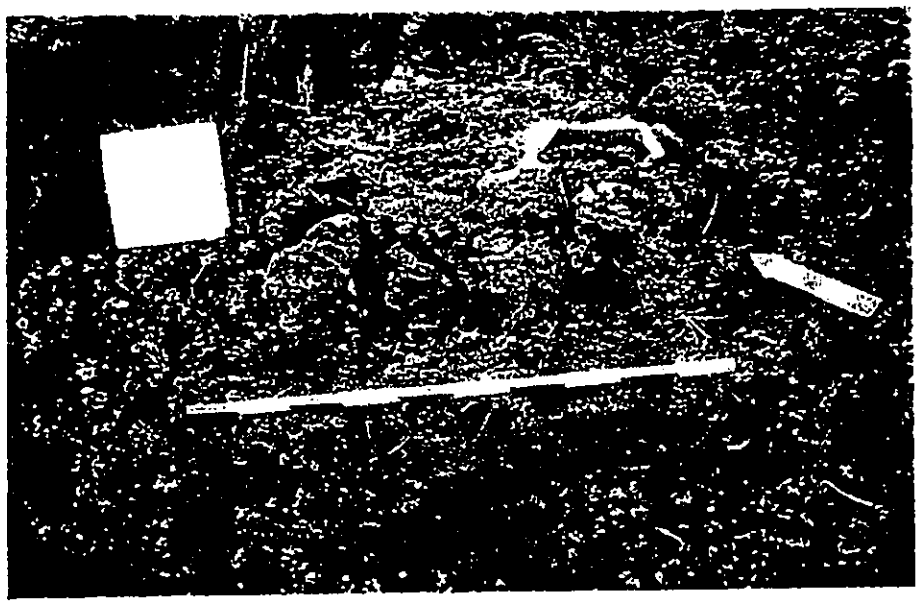


Figure 55. Site 20856, Facing Northeast (Neg.5053-3)

Site 50-10-33-20878

This site is the Hilo to Pu'u 'Ō'ō Trail at 1,340 to 1,610 m AMSL in Piihonua, North Hilo, and Waiākea, South Hilo. The eastern (downslope) terminus of the trail is located within the EX-3 APE at Sta. 156+300, near milepost 18 south of the existing Saddle Road *(Figure 57)*. The trail is situated on 1885 *pahoehoe* lava. The trail continued further east, but has been covered by the current Saddle Road. The trail continues west, paralleling Saddle Road for approximately 2.1 km, and crosses the road at Sta. 154+170, near milepost 20.

The morphology of the trail varies with the topography and type of lava flow present. The trail south of the road is mostly unmodified *pahoehoe*, so the exact width of the trail is not measurable. These portions are marked by small basalt cairns. Thirty eight cairns were observed along the trail. Only one, near the crossing at Sta. 154+170, is located within the APE. There are several areas near the eastern terminus of the trail that have been built up with small basalt cobbles (5 to 15 cm in diameter) to fill in low areas in the terrain *(Figures 58 through 61)*. The 2.1 km portion of the trail located south of Saddle Road is used by hikers and hunters. Part of the trail north of the road is a winding trough through the *'a'ā* constructed by removing stones from the path and piling them along the margins.

Figure 56. Site 20856, Facing East (Neg.5053-5)

The full length of the remaining portions of Site 20878 is about 10 kilometers. The section from just above Mawae (above milepost 20) down to the Punahoa 2/Ponahawai boundary (below milepost 9) is shown on survey maps dating from the 1890s (Reg. 1718, dated 1891; Reg. 1748, dated 1895; HTS 712, tracing dated 1913 but based on an earlier Loebenstein map) *(Figure 62)*. Since this section lies entirely on 1855 lava flows (*'a'ā* and *pāhoehoe*) it must have been built after that. Perhaps it is the trail built by Benjamin Macy in the mid-19th century, described by W. H. Bryan (1960). The trail segment in question

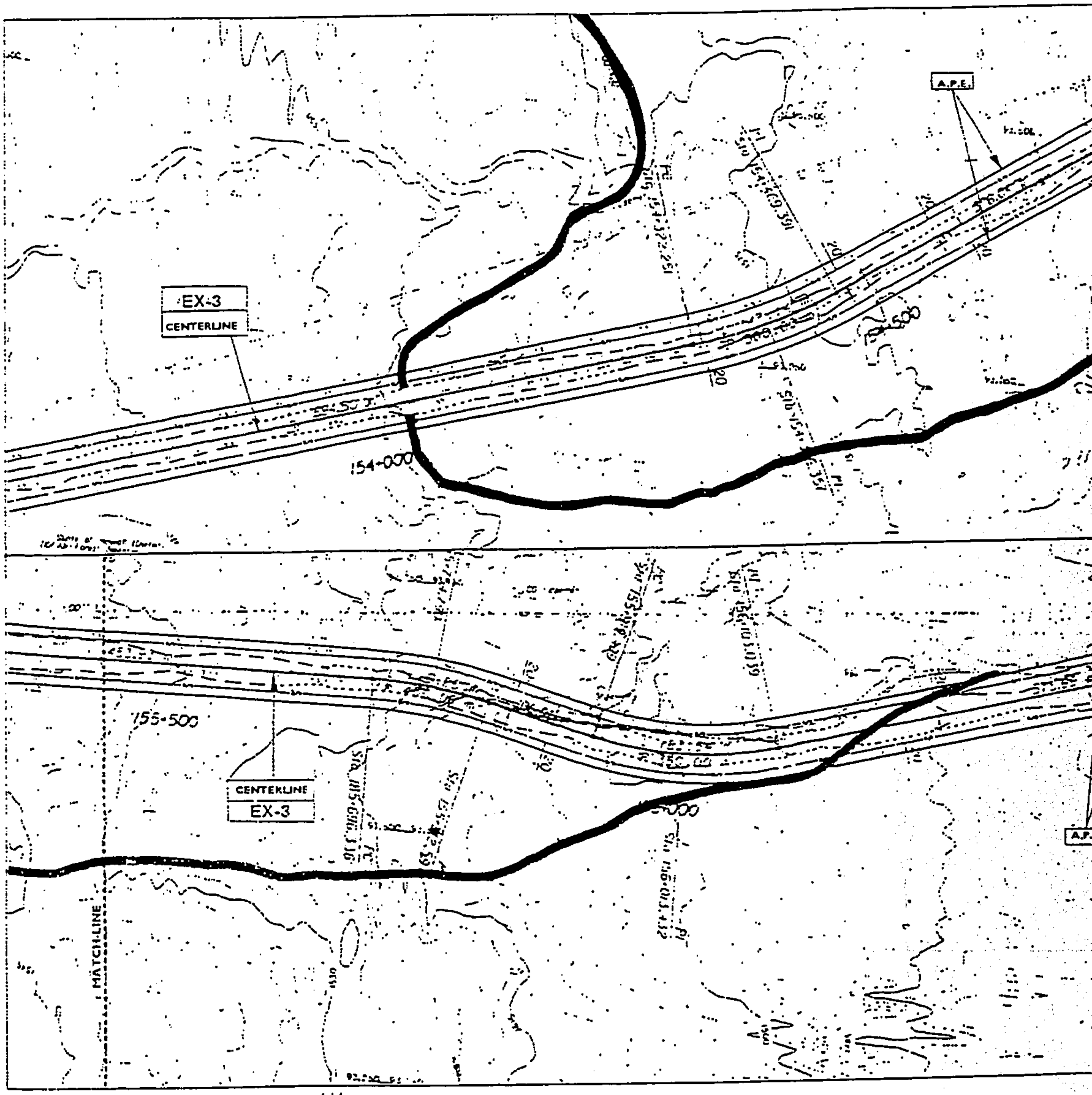
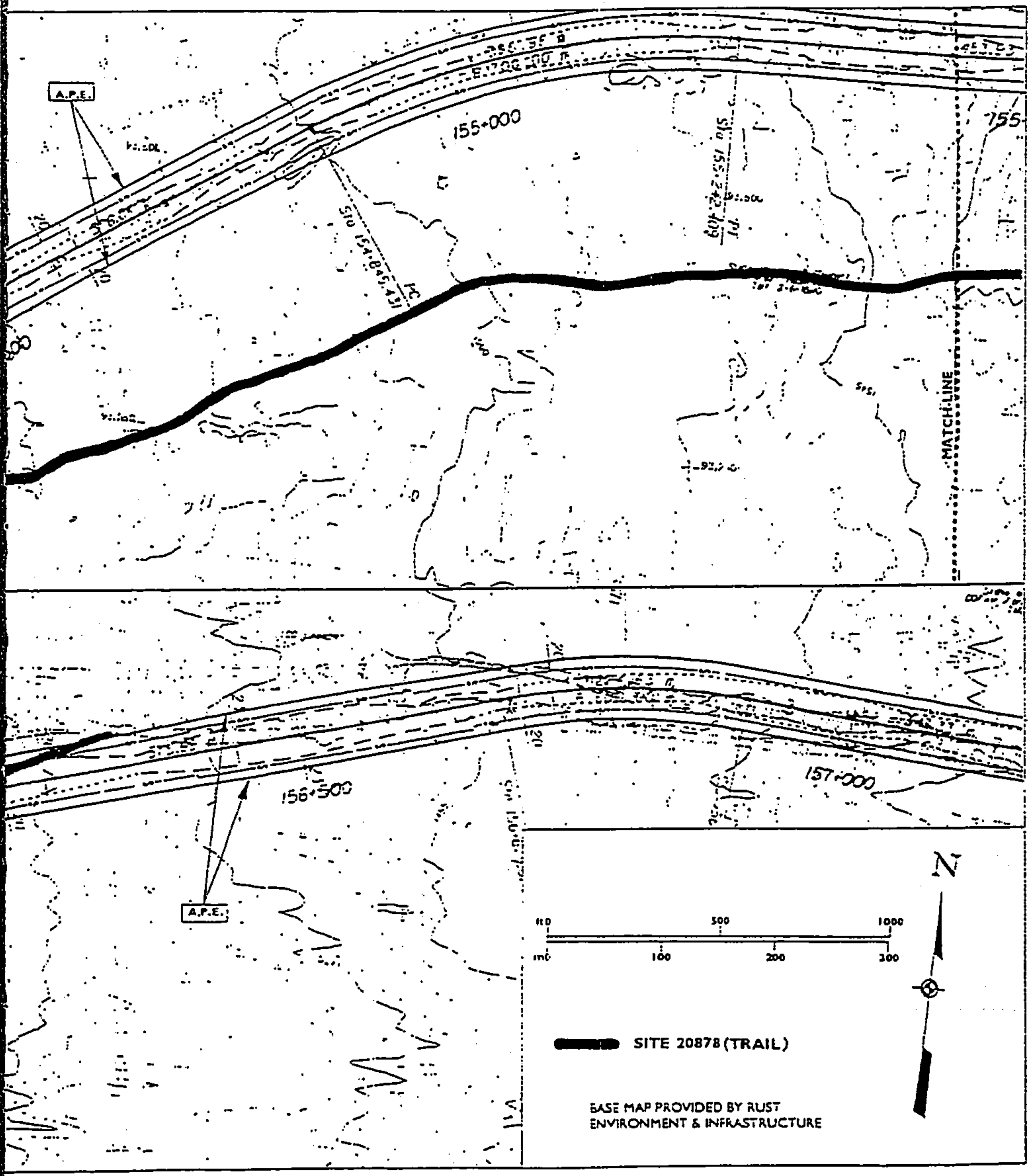


Figure 57. Site 20878


A.P.E.
155+000
MATCH LINE
156+500
157+000
A.P.E.
0
500
1000
0
100
200
300
N
SITE 20878 (TRAIL)
BASE MAP PROVIDED BY RUST
ENVIRONMENT & INFRASTRUCTURE

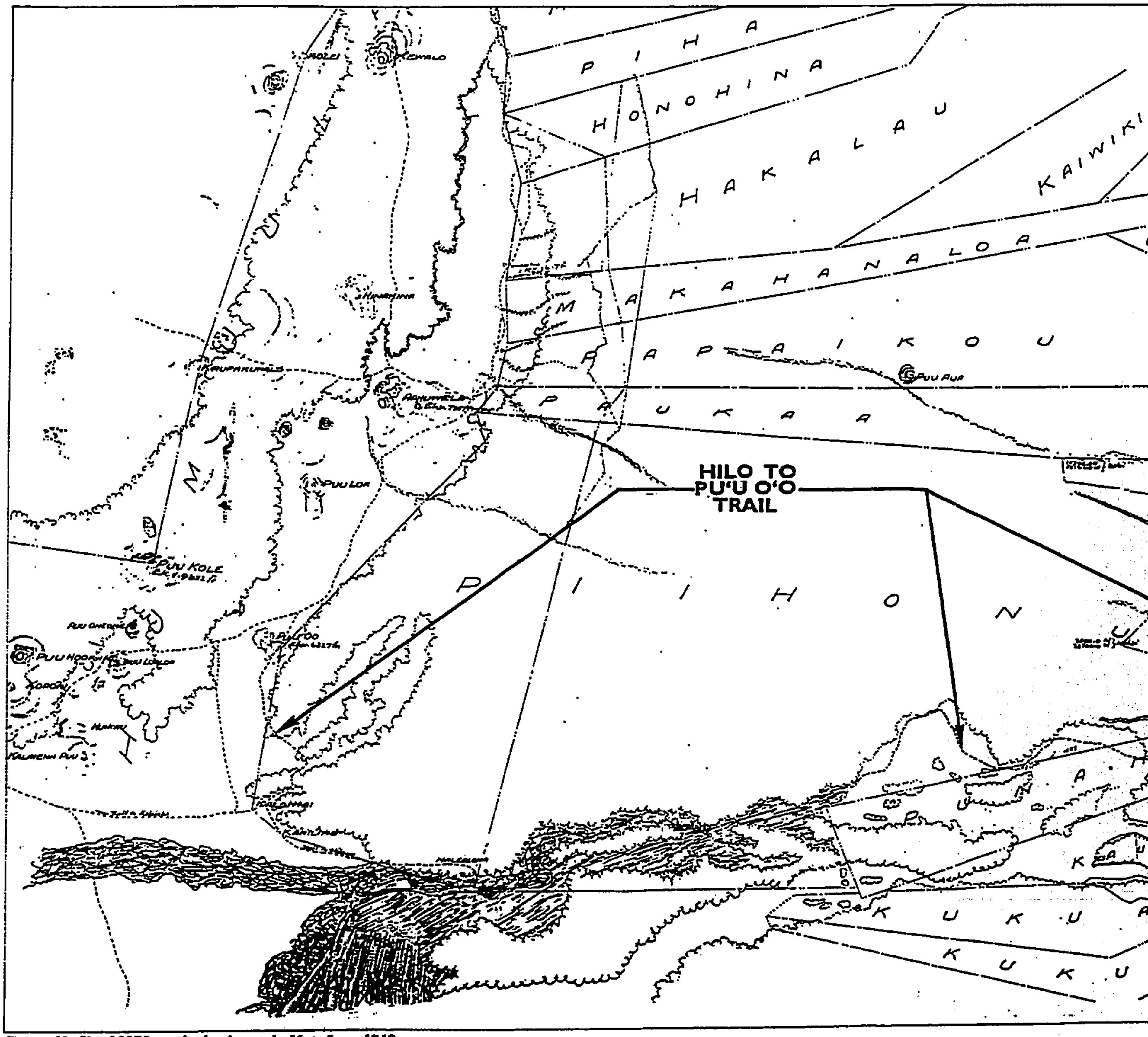
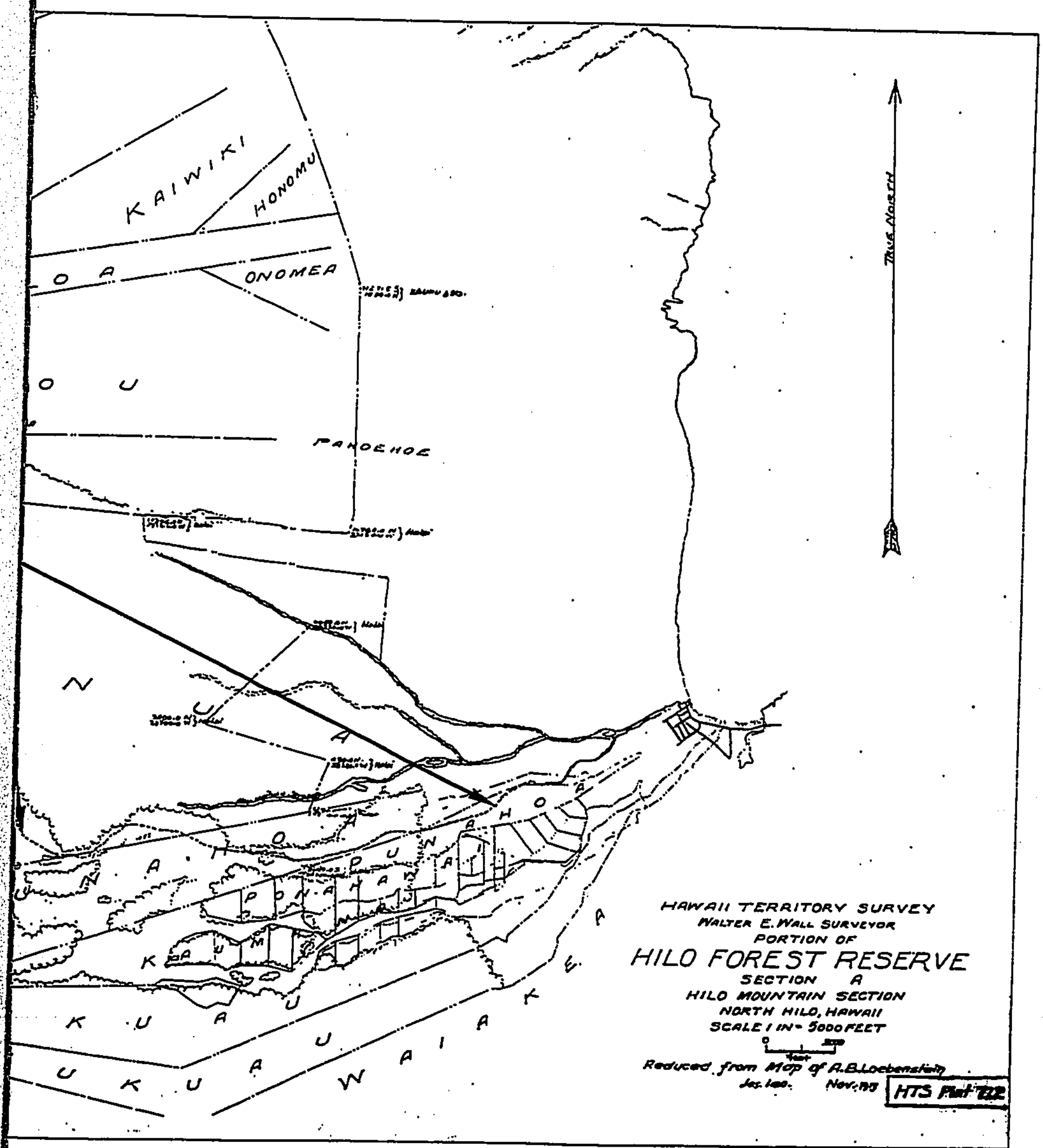


Figure 62. Site 20878 on the Loebenstein Map from 1913


KAIWIKI
HONOMU
ONOMEA
PAHOEHOE
TRUE NORTH
HAWAII TERRITORY SURVEY
WALTER E. WALL SURVEYOR
PORTION OF
HILO FOREST RESERVE
SECTION A
HILO MOUNTAIN SECTION
NORTH HILO, HAWAII
SCALE 1 IN = 5000 FEET
Reduced from Map of A.B. Loebenstein
HTS Plat

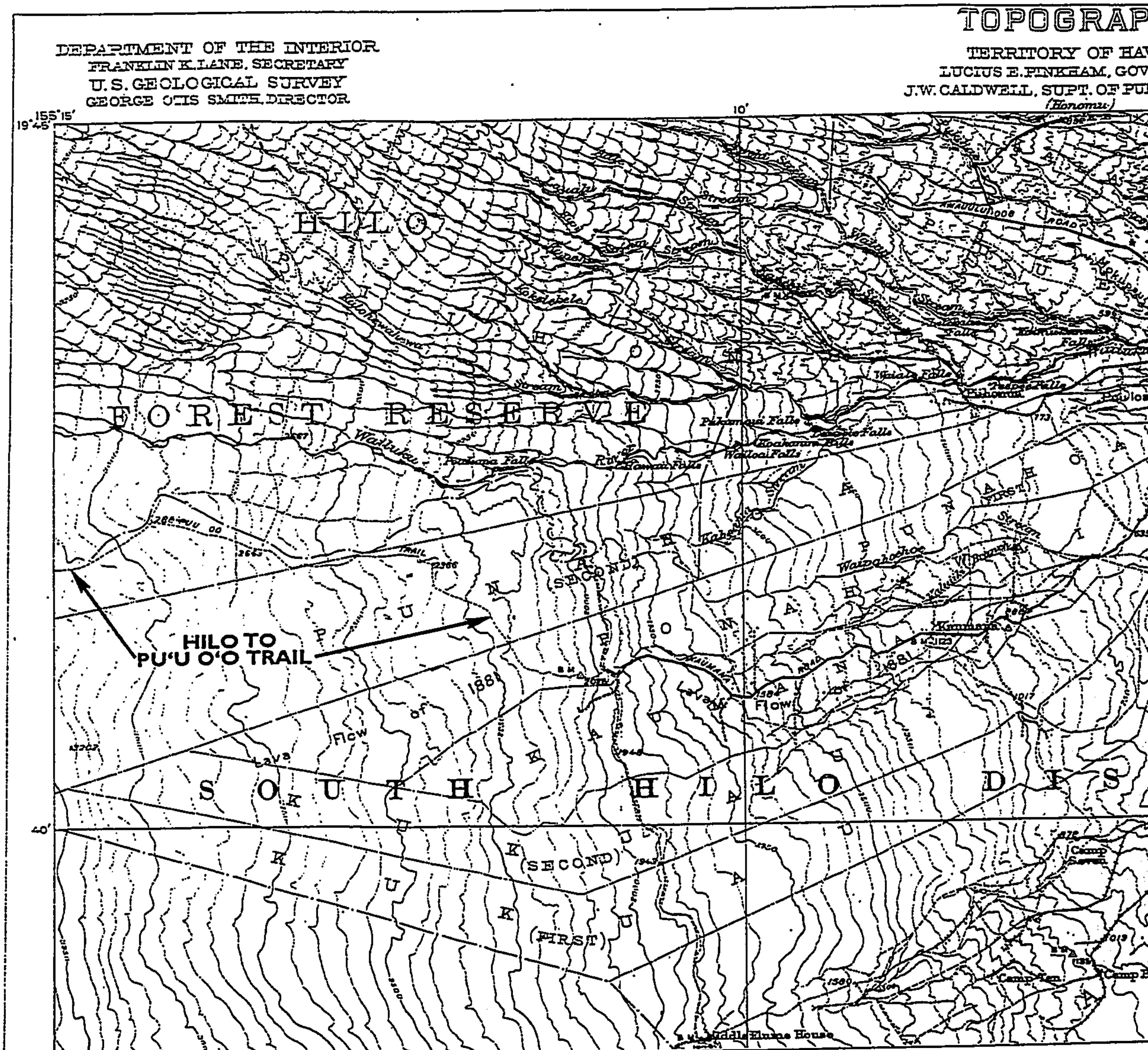
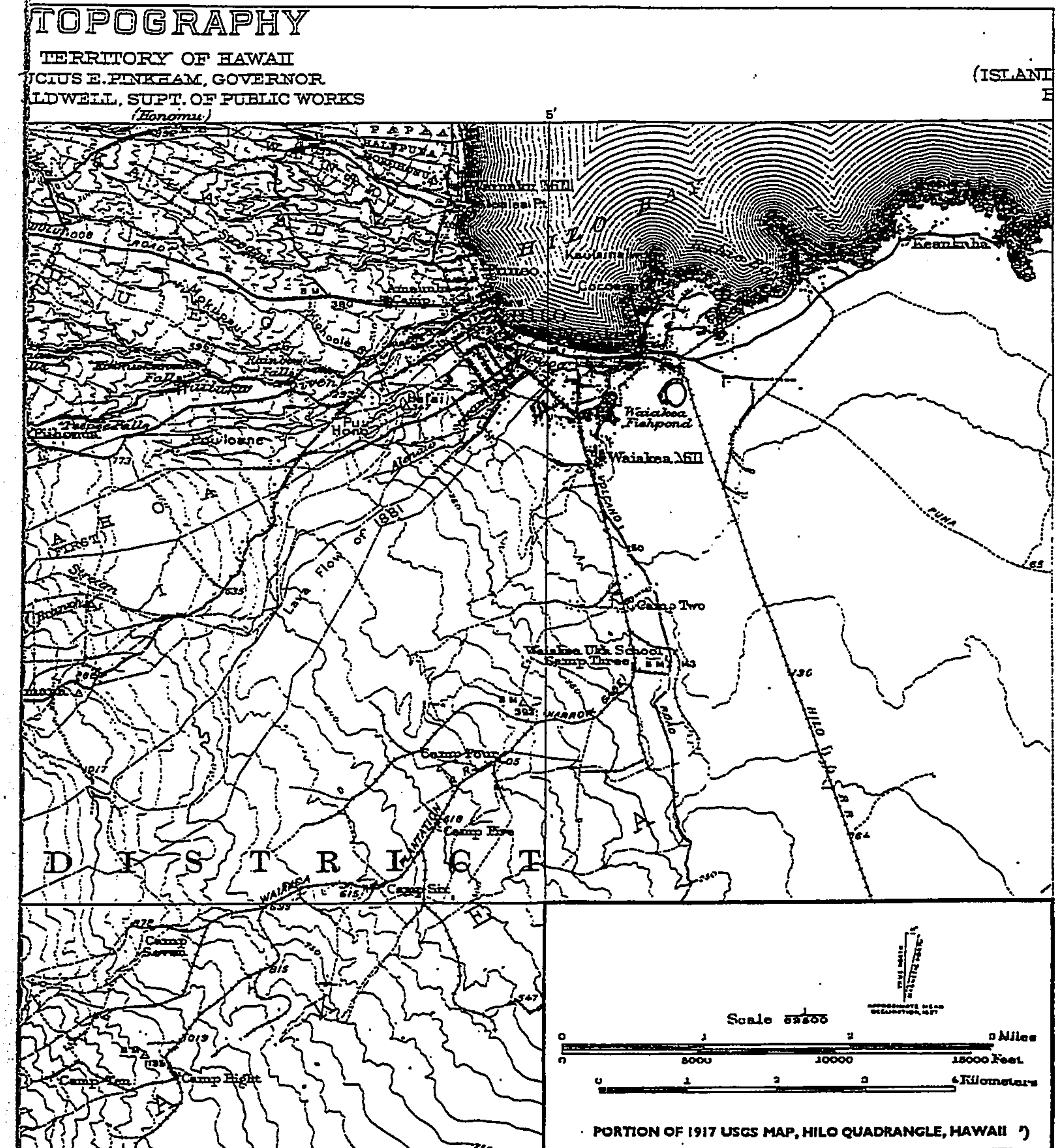


Figure 63. Site 20878 on the USGS Topo 1917, Hilo Quadrangle



PORTION OF 1917 USGS MAP, HILO QUADRANGLE, HAWAII

Figure 58. Site 20878, Facing Southwest (Neg.5053-9)

was used by the Hitchcock family in the 1880s and 1890s. Later it was used by Shipman's cowboys traveling up to Pu'u 'Ō'ō Ranch and by hunters coming up from Hilo. Informants who worked at the ranch in the 1940s and 1950s (Olivera 1, Imoto Ints) agree that the trail followed the route shown on the 1956 USGS Upper Piihonua Quadrangle. It is different from the "old trail" described by the *kama'āina* in the Boundary Commission testimony, which ran farther south along the Pi'ihonua/Waiākea boundary. Above milepost 20, and below milepost 9 the twentieth century trail is different from the nineteenth century trail shown on early maps. Above milepost 20, the nineteenth century trail used by the Hitchcocks is shown on survey maps (Reg. 1718, HTS 712). After crossing Saddle Road and looping northwest to Halealoha (used by the Hitchcocks), the maps show the trail returning to the Pi'ihonua/Waiākea boundary until it reaches Humu'ula, then turning north. Much of this section of the old trail would have been covered by the 1935 flow. The twentieth century trail heads directly for Pu'u 'Ō'ō ranch house from the milepost 20 point. The trail paralleled Shipman's (private) magneto telephone line which connected the Pu'u 'Ō'ō ranch house to Shipman's Hilo Meat

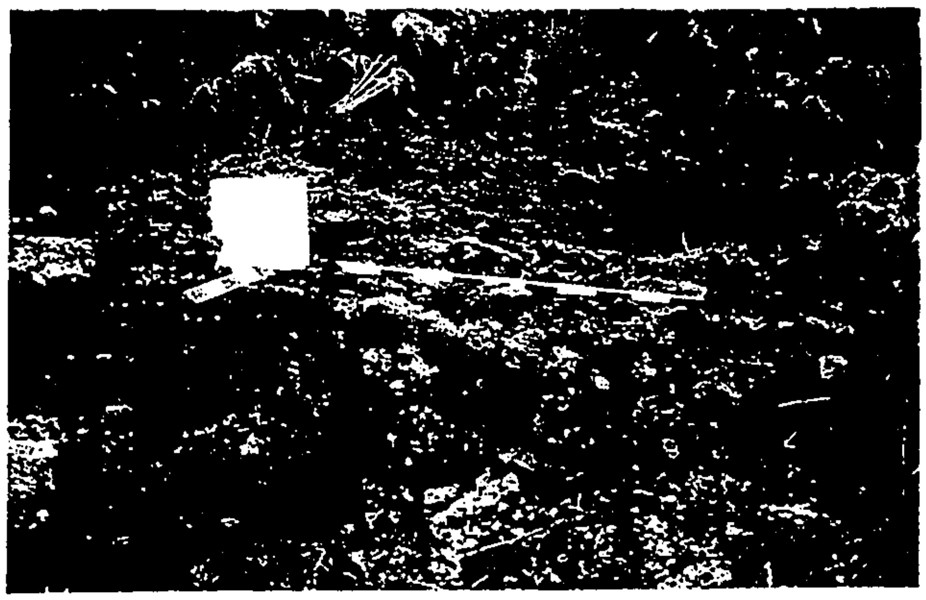


Figure 59. Site 20878, Facing Northwest (Neg.5053-11)

Figure 60. Site 20878, Facing Southeast (Neg.5053-19)

Figure 61. Site 20878, Facing Northwest (Neg.5053-21)

Market on Front Street and Wailuku Drive, in use by 1913 (Blackshear, Devine Ints). That route appears on the USGS Humuula Quadrangle, c. 1930 (but the earlier route along the boundary does not). It is reasonable to suggest that the new trail was built when Shipman put in the telephone line up to the ranch house between 1900 and 1913.

Below milepost 9, the nineteenth century trail used by Hitchcock's is also shown on early survey maps (Reg. 1718, dated 1895; HTS 712, traced 1913). It follows the southern Punahoa 2 boundary toward Hilo (the boundary with Ponahawai and then with Punahoa 1), passing the Hitchcock's old place called Bougainville. Neither of these older maps shows the twentieth century trail through Ponahawai and Kaūmana along the route of the present Saddle Road. The twentieth century trail is shown on the 1917 USGS Hilo Quadrangle *(Figure 63)*. It runs on the 1881 lava flow below milepost 9 (as does the Saddle Road). Below the 'Ōla'a Flume Road at milepost 8 there was already a road down to Hilo, labeled the "Kaumana Road" on the map. There was probably an earlier trail through Kaūmana, mentioned in 1873 Boundary Commission testimony as the "Kaumana Road" (BC Book B:163), but it would have been a different route, predating the 1881 flow.

The trail segment is not a prehistoric trail, because it was built on the 1855 lava flow. Historic use of the trail segment recorded during the present project is documented from 1883 by the Hitchcock family's Pua Akala Logbook. Although it was probably used in the nineteenth century (after 1855) by Native Hawaiians for hunting and gathering, that use cannot be documented. Use of the trail segment continued until the building of Saddle Road in 1943 and to a lesser extent after that. After Saddle Road was built in 1943, the Shipman cowboys took the trail less often, mainly to check the telephone line when it had problems (Imoto, Olivera 1 Ints).

Site 50-10-34-20864

Site 20864 is the Saddle Road. The full extent of the current Saddle Road is 86 km, reaching a maximum elevation of 1,980 m AMSL. The Saddle Road was built by the Civilian Conservation Corps (CCC) and the U.S. Army Corps of Engineers during World War II in order to provide an access route in case of Japanese invasion. The roadway between Kaūmana and PTA was cleared by bulldozer in 1943. The road west of PTA (previously the Old Waimea-Humu'ula Wagon Road) was paved soon after 1945, and the road east of PTA was paved circa 1949. The route east of PTA was modified during the 1949 paving, with the result that two non-paved portions of the post-World War II road exist east of PTA along EX-3 corridor. The easternmost loop connects to corridor EX-3 near Sta. 170+300 and Sta. 168+640 *(see Figure 10p)*. The westernmost loop of old road connects to corridor EX-3 near Sta. 143+000 and Sta. 143+750 *(see Figure 10l)*.

Site 50-10-34-20869

Site 20869 is a historic cairn built on 1881 flow at an elevation of 580 m AMSL in Ponahawai, North Hilo. The site datum is 25 m at 330° from E2 corridor PT 20+394.698. This cairn is constructed of *pāhoehoe* stones 15 to 40 cm in diameter fitted and stacked up to 13 courses high *(Figure 64)* for a total height of 2.1 m. The cairn is flat on top and slopes to a base that is about 1.8 m in diameter. The cairn is built on unlevel terrain, with the base of the west half 0.8 m higher than the east *(Figures 65 and 66)*.

The morphology and location of the cairn suggest that it is probably a surveyor's marker. The loose stacking and large size are not indicative of native Hawaiian construction and function. The cairn's location coincides with a corner boundary within the Kaumana Homestead properties. The Kaumana Homestead parcels were surveyed by Loebenstein in the late 1800s, and appear on his 1895 map. The delineation of the individual properties within the Kaumana Homestead is not represented on subsequent USGS topographic maps (1917, 1932, 1981), but the outer boundary of the homestead parcel does appear on the 1981 USGS topographic map. The cairn's location corresponds to an angle in the Kaumana Homestead boundary located approximately 222 m east of the water tank depicted on the 1981 USGS topographic map in upper Kaūmana.

Site 50-10-34-20870

Site 20870 is the 'Ōla'a Flume. The main flume trough is about 25 kilometers long, with numerous associated segments near Keaau. The flume crosses the E-3 corridor at about Station No. 41+660 *(Figure 67)* at about 600 m AMSL in Ponahawai and Kaumana, North Hilo. There are no intact portions of the flume within the APE or nearby. All elevated segments have collapsed to the ground, and the metal trough has rusted and has broken apart in many places. The descriptions and drawings of the flume in this report are idealized versions and are not present in the field.

The flume trough is of galvanized metal. It is semicircular in cross section and 1.3 m wide and 0.6 m deep *(Figures 68 through 71)*. Sections of the flume are tied together with 3/8" metal rods threaded through small (10 by 7 cm, and 0.5 cm thick) steel plates. The trough is supported by a wooden

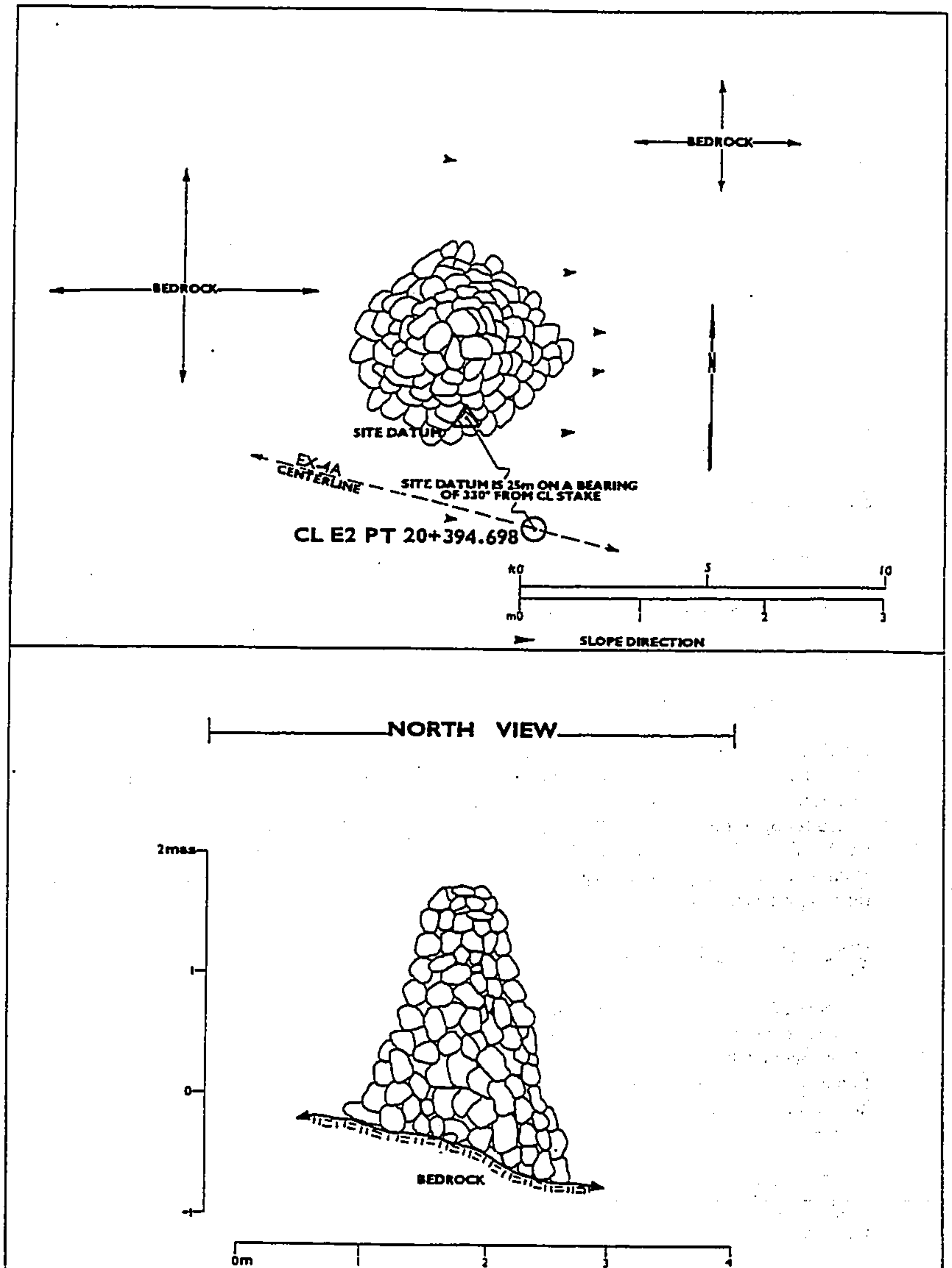


Figure 64. Site 20869

Figure 65. Site 20869, Facing West (Neg.5092-12)

Figure 66. Site 20869, Facing North (Neg.5092-14)

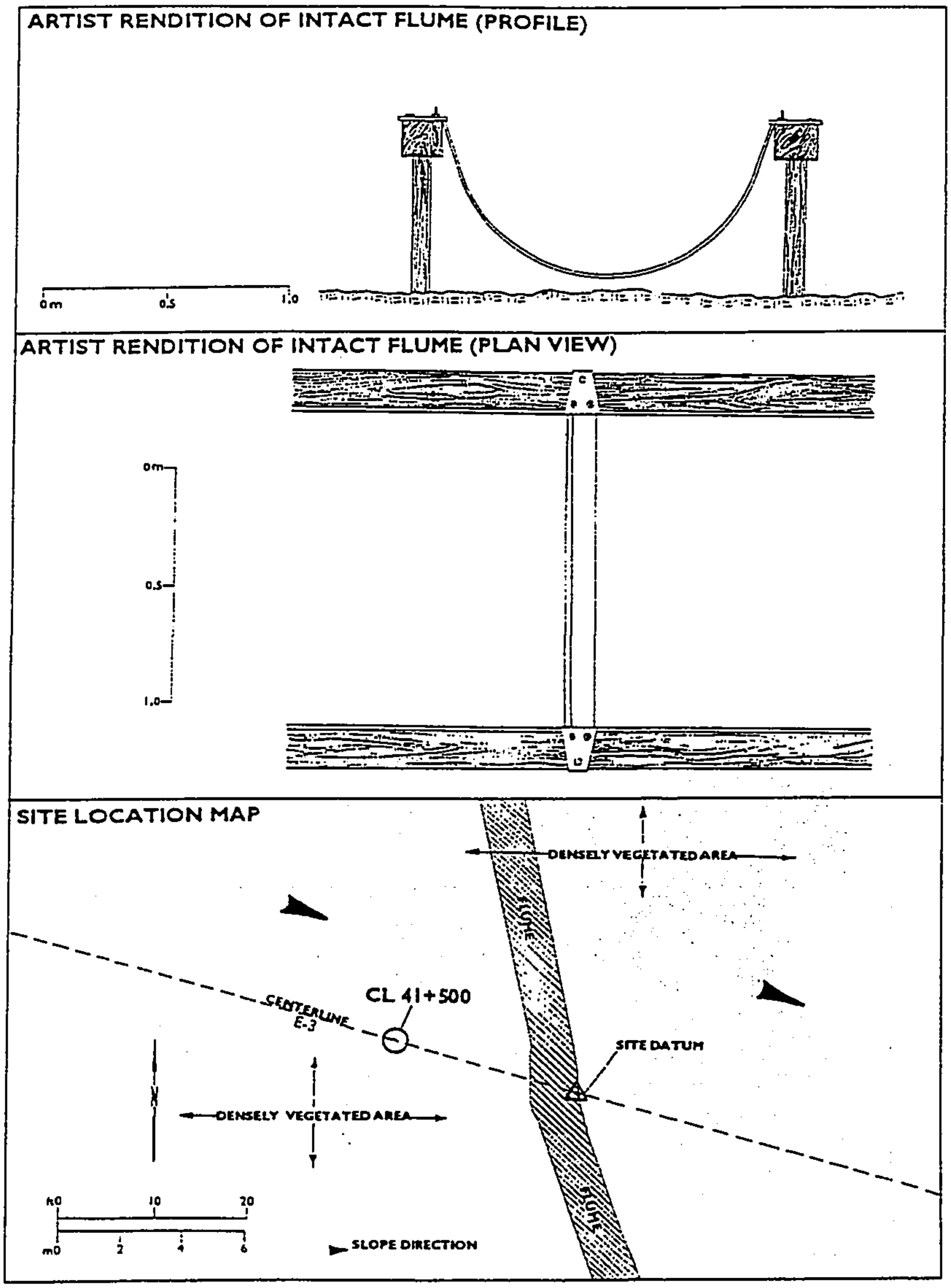


Figure 67. Site 20870

Figure 68. Site 20870, Facing Northwest (Neg.5131-13)

Figure 69. Site 20870, Facing Northwest (Neg.5132-21)

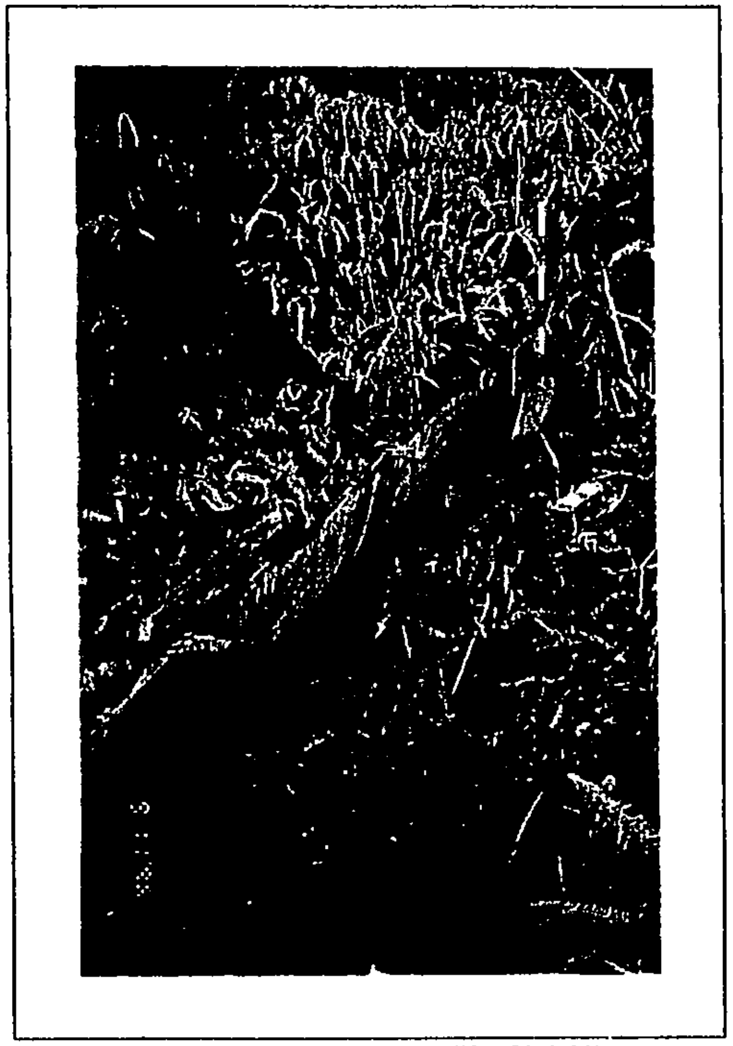


Figure 70. Site 20870, Facing Northwest (Neg.5132-30)

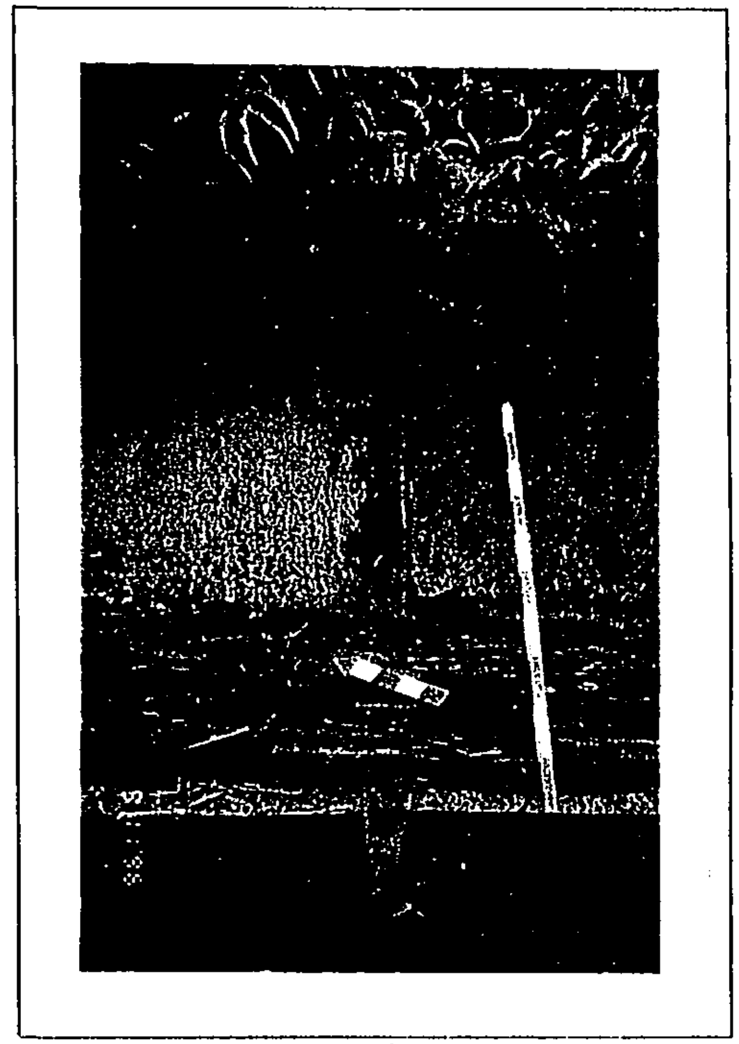


Figure 71. Site 20870, Facing Northeast (Neg.5132-33)

substructure of planed 4 x 4's and 2 x 4's; the above-mentioned plates are nailed to the substructure. The cross-pieces of the sub-structure support the flume joints from below. The interior of the trough is tarred to aid in water retention. The trough rested on the ground on redwood runners in high spots, and was built up on a redwood frame in low spots. The flume formerly crossed the Saddle Road just below milepost 9 according to Tadao Tanouye (Int.). A concrete underpass must have been constructed in later years to cross the Saddle Road and the flume disappears into the underpass. North of the Saddle Road the flume has been destroyed by bulldozing for the Kaumana City subdivision. North of the subdivision, the middle subdivision road turns into the old 'Ōla'a Flume Road and leads up to the spring. The old flume may still exist up toward the spring, but no field survey work was conducted in this area. The flume was used to carry water from 'Ōla'a Flume Spring in the land of Punahoa 2, north of the Saddle Road down to Shipman's 'Ōla'a plantation in Puna. It ran for about 17 kilometers south from the spring to a location just north of the Peck Road intersection with the Volcano Highway, at about milepost 16. Branch flumes carried the cane down to the 'Ōla'a mill just below the present town of Kea'au, or alternatively carried the cane to be loaded onto cars of the Hilo Railroad line which ran down to 'Ōla'a from Glenwood (Olaa Sugar Company, Annual Report for 1901:14-15). The whole flume system is shown on the 1917 USGS Hilo Quadrangle. According to informants, the flume was also used as a source for drinking water for the plantation camps.

Olaa Sugar Company constructed the flume between 1900 and 1903, having made arrangements with the Lyman Estate and the Hilo Sugar Company to lease the land where the spring is found (Olaa Sugar Company, Annual Reports, especially the April 1900 Report:18). Eventually the flume was replaced by trucks for transporting cane. The last year when cane was flumed was 1945 (Annual Report for 1945). Only 3% of the crop was flumed to the mill that year. Kaūmana informants Tadao Tanouye and Kiyomi Omoto, who were born in the early 1920s, saw the flume as children (Kaumana group Int.). They described the flume as a metal half-moon-shaped trough, held up by redwood "legs." It had a wooden walkway on top so that workmen could walk along to inspect and repair it. At that time, the paved Kaumana Road ended below the flume in Kaumana Village but a "wagon road" led up along the present Saddle Road route and then north up to the spring. Where the road turned up to the spring lived a watchman who kept people out of the watershed. There was also a rough road which paralleled the flume from the spring down to 'Ōla'a called the Olaa Flume Road (Geological and Topographic Map of the Island of Hawaii, in Stearns and MacDonald 1946).

Site 50-10-34-20872

Site 20872 is the historic Hilo Country Club at 480 m AMSL in Kaumana, North Hilo. The former Hilo Country Club is south of the Saddle Road on Country Club Road at milepost 6 *(Figure 72)*. The country club included a golf course and a clubhouse. The E-3 corridor extends through the south portion of the old golf course, well below the old clubhouse. Tadao Tanouye provided information he had learned from S. Miyamoto on the establishment of the country club. Mr. Miyamoto was born in the area in 1904 and raised there. He said the forest was cleared for the country club about 1920. The first clubhouse burned down and the second clubhouse (which can still be seen) was built in 1928. When the country club golf course was made, a section of the Hilo Flume (which carried cane down to Wainaku Mill) called the Square Flume was buried under the soil. An attempt was made to specifically locate the Square Flume within the country club, but this effort was unsuccessful.

The golf course layout was described by Susumu Tanimoto (Int. 1). Mr. Tanimoto first began working at the country club as a custodian in 1945. In 1958 he became the golf pro at the club and he continued working as the golf pro until about 1980. Besides the placement of the greens, Mr. Tanimoto described other features of the course. Mr. Tanimoto described three footbridges that used to cross the gully which ran through the golf course. During the present archaeological survey, two of these were identified and recorded. The membership of the Hilo Country Club was restricted to the Caucasian elite of Hilo. It wasn't until the late 1950s that Oriental professional men were admitted as members. Local

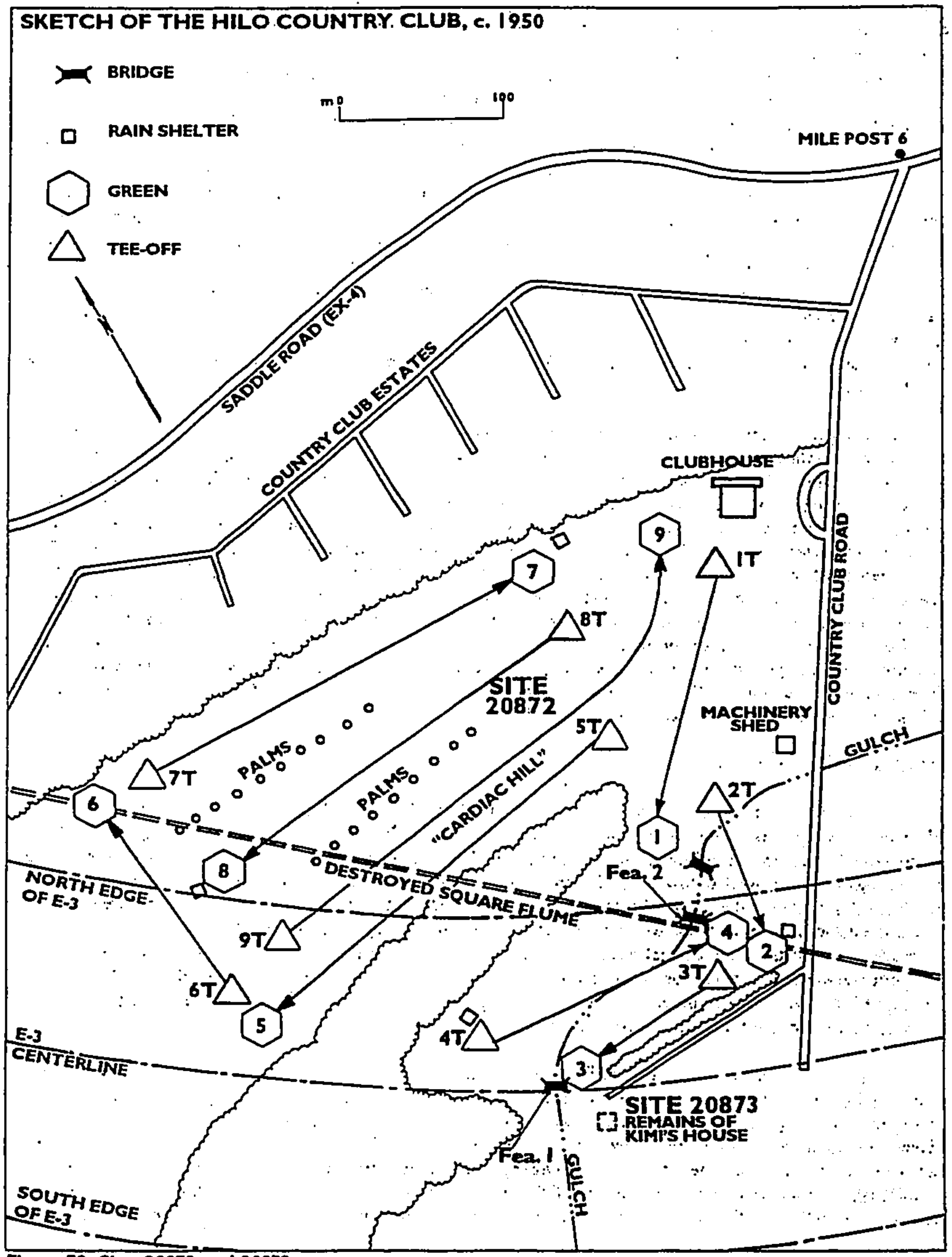


Figure 72. Sites 20872 and 20873

Japanese and Portuguese informants from Kaūmana remember working as caddies at the country club when they were boys.

The Hilo Country Club, including the golf course, footbridges and club house, exhibit only minimal physical integrity. The clubhouse still stands, but the inside of the structure has been gutted by fire, and is located outside the study area, so was not recorded. The golf course is completely overgrown by Wainaku grass and guava and no longer resembles a golf course. Two cart bridges made of stone are within the study area, and have been designated Features 1 and 2.

The western end of Feature 1 is at a stake marked E3 43+630. It is 17 by 3.5 m, and 1.8 m above a small gully. This features is near the western edge of a large cleared area just west of Country Club Drive. The causeway crosses a small drainage and water flows through a culvert in the causeway *(Figure 73)*. The causeway is composed of stacked *pāhoehoe* stones, 20-to 40 cm in diameter, stacked eight to nine courses high. Although not totally cleared, the upper surface of the causeway is primarily of fitted stones that form a rough pavement *(Figures 74 and 75)*. The upper surface of the north-central portion of the structure consists of three logs, side by side, running along the long axis of the structure. The causeway is roughly faced on the south. Some slumping has occurred near the east end. Both the eastern and western ends of the feature grade into the walls of the drainage.

Feature 2 is 3.3 m long, 2.1 m wide, and 0.8 m high and is located 63 m at 320° fr PT3 CL 43+690. There is a 28 cm diameter iron drainage pipe at the bottom of the bridge. The bridge is constructed of concrete with *pāhoehoe* boulders and cobbles (5 to 25 cm in diameter) as aggregates.

Site 50-10-34-20873

Site 20873 is the remains of the old house lot of Senator Kimi; the lot is at about 500 m AMSL in Kaumana, North Hilo. The site, consisting solely of a concrete slab with modern water heater and electrical outlets, is located in the E3 corridor with a site datum 5.0 m at 100° from stake E3 POC-43+750.2. The concrete slab is 16 by 10 m. Both informants, Susumu Tanimoto and Tadao Tanouye, identified the site as the house of former Territorial Senator Kimi I *(Figure 72)*. Senator Kimi was still living there in about 1945, but no further information is available regarding date of construction and abandonment.

TEST UNITS

Test units were placed at ten locations *(Table 7)*. Units were placed at locations that had potential for prehistoric occupation, and at stone alignments to determine whether they were in fact associated with modern military activities. In all cases, the results of the tests indicated that either (a) no prehistoric activity occurred within the potential sites, or (b) the unusual alignments were associated with modern military activities.

Table 7. Results of Test Units

Site No.	Unit No.	No. of Layers	Depth to bedrock (cm)	Unit size (m)	Material	Results
111	1	3	12	1.0 x 1.0	None	Not a site
111	2	3	34	1.0 x 1.0	None	Not a site
111	3	2	44	1.0 x 1.0	None	Not a site
20854	4	1	27	.25 x .25	None	No additional data on site
20854	5	1	15	.25 x .25	None	No additional data on site
20854	6	4	45	.25 x .25	None	No additional data on site
20854	7	1	13	.25 x .25	None	No additional data on site
20854	8	4	37	.25 x .25	None	No additional data on site
20854	9	2	37	.25 x .25	None	No additional data on site
20854	10	2	37	.25 x .25	None	No additional data on site
20854	11	3	40	.25 x .25	Rusted metal	No additional data on site
20854	12	3	64	.25 x .25	None	No additional data on site
20854	13	3	27	.25 x .25	None	No additional data on site
301	14	2	8	.50 x.50	None	Not a site
301	15	2	8	.50 x.50	None	Not a site
301	16	4	10	.50 x.50	None	Not a site
301	17	4	16	.50 x.50	None	Not a site
302	18	4	59	1.0 x 1.0	None	No additional data on site
516	19	5	100*	1.0 x 1.0	Plastic, foil	No additional data on site
20856	20	1	20	1.0 x 1.0	None	No additional data on site
541	21	3	80*	1.0 x 1.0	None	No additional data on site
529	22	2	60*	.50 x.50	Nail, MRE† bag, tape	No additional data on site
545	23	2	60*	1.0 x 1.0	MRE bag, foil	No additional data on site

**Test unit terminated prior to reaching bedrock.*
†Meals-Ready-to-Eat

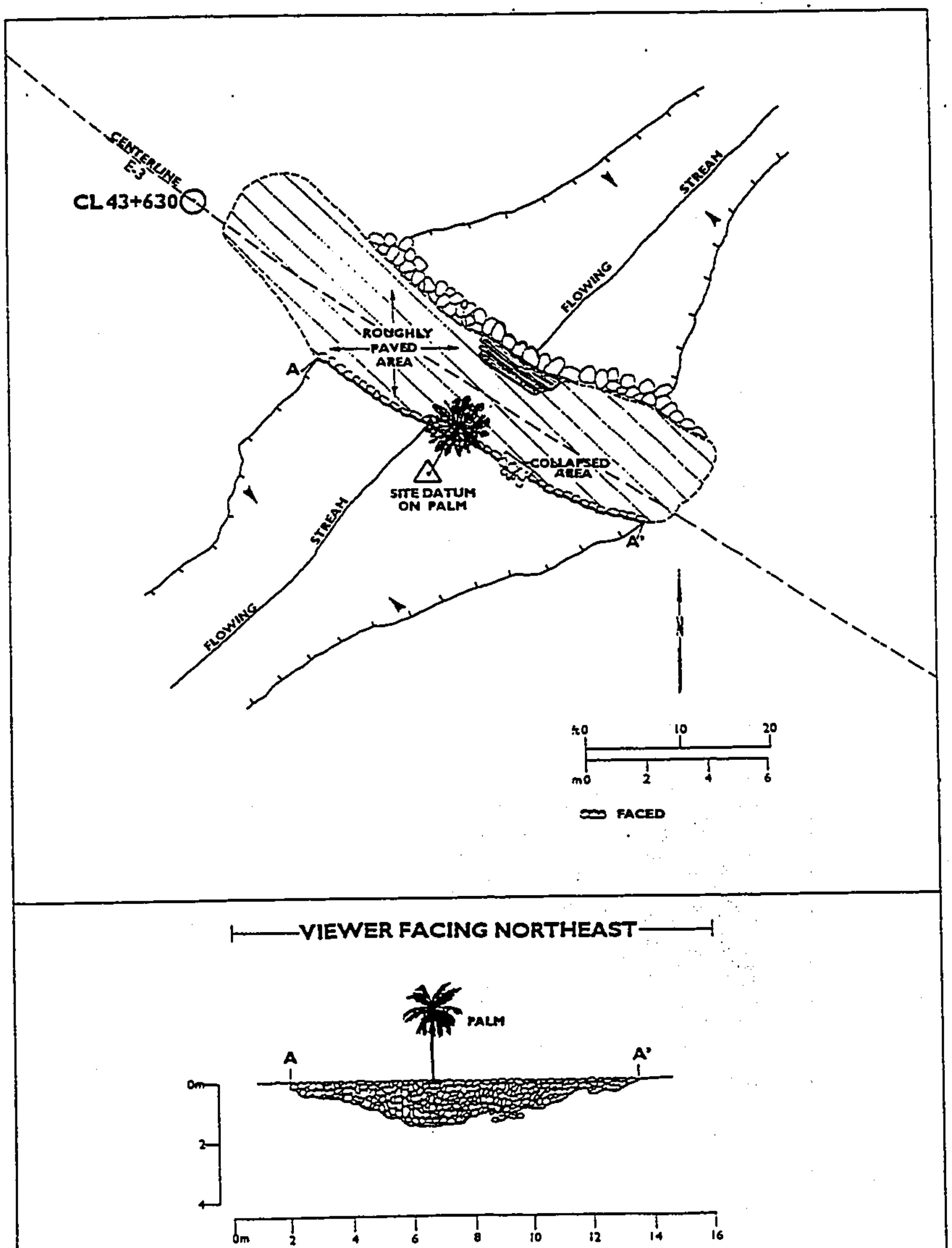


Figure 73. Site 20872, Feature 1

Figure 74. Site 20872, Facing West (Neg.5092-24)

Figure 75. Site 20872, Facing Northwest (Neg.5092-26)

TRADITIONAL HAWAIIAN CULTURAL SITES

INTRODUCTION

The sites discussed here include a Native Hawaiian burial and Native Hawaiian ritual sites of several kinds. Generally such sites are considered eligible for either the Hawaii or National Register of Historic Sites. It was not possible to definitively locate the ritual sites, although a substantial effort was made. Apparently, though, all of the sites fall outside the Area of Potential Effect, so that none of them is affected by the Saddle Road Improvement Project.

All of the information on the sites comes from "Papa" Henry Auwae. He believes he is the only individual alive today who still has knowledge of either the burials or the ritual sites, and that appears to be the case. A considerable attempt was made to locate additional informants with knowledge of Native Hawaiian sites in the project area, without success. Older Hawaiians in Waimea (Sonny Kaniho, Johnny Lindsey) and Hilo (Genesis Lee Loy, Pua Kanahele) and Native Hawaiian Organizations in both areas were asked if they knew of any *kupuna* who might have such knowledge, but they could not suggest anyone. In this century, the Hawaiians familiar with the project area would mainly have been the Hawaiian cowboys who worked for Parker Ranch at Ke'āmoku, Waiki'i, and Humu'ula, and for Shipman at Pu'u 'Ō'ō Ranch. Men like Willie Kaniho, who lived at Humu'ula, and David Kaiawe, who worked at Pu'u 'Ō'ō Ranch, may have gained knowledge of traditional sites. But if so, that knowledge did not pass down to Willie's son Sonny Kaniho (Int. 1) or to David's nephew John Kaiawe (personal communication). It is not difficult to understand why Henry Auwae's knowledge of these sites is unique. Early in this century when he was a boy, he journeyed several times through the Saddle together with his great-grandparents. They both had specialist knowledge of ritual sites, and they pointed those sites out to him as they traveled. His great-grandmother was an expert healer (*kahuna lā'au lapa au*) and his great-grandfather a prophet (*kāula*), who came from a line of prophets. Mr. Auwae has not revisited the sites since that time.

The ensuing discussion is based on six interviews. A series of five recorded interviews (Auwae Ints 4-6, 8-9) was done with Mr. Auwae for this project, and a sixth was from a helicopter trip to attempt to locate the sites he described (Auwae Int. 7, unrecorded). Life-history information is also taken from an interview done for an earlier project (Auwae Int. 1).

BIOGRAPHICAL SKETCH OF HENRY AUWAE

Henry Auwae was born in Puakō in 1906 and raised at Kawaihae, just to the north. He was hānai'd (adopted) by his great-grandmother Kapua Pai and her husband Kaniahiku Pai. In the traditional form of adoption, he lived with his great-grandparents, although he also knew his parents who lived close by.

> During those days they *hānai* me. They raised me. I never remember about my mother raising me but I remember my great-great-grandmother raising me. In fact I remember her, I used to call her mama dear, because she was my mama that I remember, not my real mother. Cause my real mother had seven other children. (Henry Auwae Int. 1)

Their daughter Kanalu married his grandfather George Charles Allen. Great-grandfather Kaniahiku Pai died when Mr. Auwae was only about five years old, but great-grandmother Kapua Pai lived until he was about fourteen. From childhood, Mr. Auwae was taught healing by his great-grandmother. He was expected to pay close attention, to learn everything she taught.

> [With the grandparents on the father's side] if you don't want to do it, it's next time. But my great-great-grandmother, no. This is the time and this is the only time. You learn it now and it keep on putting that learning into your mind, your head, until you [know it]. (Henry Auwae Int. 1)

His great-grandmother traveled quite a bit, in order to see people who were sick and to collect medicinal plants (*lā'au*) to heal them. He went with her on trips into the Ke'āmoku area, to Waiki'i and up through the Saddle to Humu'ula Sheep Station where his grandfather Allen lived, and through Keanakolu to Pi'ihonua. His great-grandparents pointed out all the ritual sites they passed by, because of their continuing spiritual significance.

> Because we were following where the medicines were. And also watching out that we don't cross the sacred places that we're not allowed. You see because my grandparents were watching, eh? We don't want to cross those kinds places that we're not allowed, so we don't have any problems on our trail or where we're going, or something happen to us. (Henry Auwae Int. 8)

After Kapua Pai died, Mr. Auwae spent a couple years working for Parker Ranch, training mules. At age eighteen he left Kōhala and moved to Hilo to find work. He married in Hilo and has lived there since.

RITUAL SITES

Mr. Auwae told Dr. Langlas of five ritual sites in the general project area, which he called Papa Hemolele, 'Āina Kao, 'Āina Hānau, 'Āina 'Ākau and 'Āina Kahukahu. (See *Figure 76* for approximate locations.)

Papa Hemolele

Papa Hemolele is a flat area just *mauka* of the old trail leading from Waimea to Humu'ula on the south side of Waiki'i Gulch. It was at the intersection of three old trails, one leading toward Kona, one toward Waiki'i and Waimea, one toward Humu'ula and Hilo *(see Figure 3)*. Papa Hemolele and the old trail intersection were about a mile above the present Saddle Road (Auwae Ints 6, 7). Henry Auwae and his grandparents stopped there sometimes on their way to Humu'ula. He knows it as place to rest and to pray before continuing the journey.

About a quarter mile or so below the flat rest area (on the *makai* side of the old trail) Mr. Auwae knows of three stone altars.

> Altars, yeah. A place where *ahu*, yeah? stone ahu's, eh? Three. I remember three. A different shape ahu's. The square *ahu*, round *ahu*, and had two round ahu's and one square. The two top ahu's is round and the first *ahu*, the small *ahu* is square. Well that's *ahu*'s where people used to put their image on there and to prayer for peace, prayer for rain, prayer for this and prayer for that. Lot of, ah, they stipulate the type of *ahu* and the type of sacrifices they doing. Even human sacrifice. (Henry Auwae Int. 6)

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Figure76. Ritual and Historic Sites

His great-grandparents told him little about these *ahu.* It was a site from the past that he should know of, but it was connected with practices they did not want him to follow.

> A: So again there was not a good sign for me to keep in my mind. They told me that's no good. The good ones they used to explain to me. The bad ones they made sure that I don't know more than what's been told to me, that's all. So that I don't have to work those things in my mind. I don't.

> CL: Just so that you know that it's there.

> HA: Yeah and what is the purpose for it and then forget about it. Don't go follow through. And then don't do anything about it. Don't make no researches or anything. (Henry Auwae Int. 6)

'Āina Kao

'Āina Kao was a ritual site in Pi'ihonua, near the southwest corner of Pu'u 'Ō'ō Ranch and just south of the horse trail from Hilo up to the ranch headquarters *(Figure 76).* Henry Auwae and his great-grandparents used to pass it when they came around on the trail from Waimea to Keanakolu and Laumai'a. When we went up to locate it by helicopter, we discovered that it had been covered by the 1935 lava flow. Mr. Auwae said that the site formerly had walls and ritual platforms. There were also water holes there that they used to use when traveling the trail.

Mr. Auwae says it was a site for testing warriors to see if they were qualified to serve the king:

> 'Aina Kao they call that you know, goat country they call that. In that area that used to ordain the warriors there to be warriors. If they can pass to be warriors or they not gonna be warriors. Yeah, they gonna be farmers or you know whatever their vocation is you know. But that's where they look for the qualified people to be the warriors for the king.
>
> They used to only take the liver from the goat and they barbecue it. But those they have to live three days only on goat liver. But before that they used human liver. But the more, the well accepted stories they would talk about goat liver instead of human liver. Yeah, yeah. And human liver is not a men's liver, the woman's liver. They kill a woman. Take the liver out of the woman. Only for the liver, yeah. (Henry Auwae Int. 4)

His grandparents didn't tell him too much about the place.

> Oh, there's a lot of things [about 'Āina Kao] that are secret, they don't tell you. That's what you call *hūnā* [secret], they no tell you nothing. But they tell only certain things and that's enough. You shouldn't even ask. Oh yes, I learned that. (Henry Auwae Int. 6)

It was another site that they made him aware of, but told him to avoid.

> HA: Well that was area that you not suppose to go stamping around. I was taught just pass there unless you have business to do. Then you stop there and rest. But if you don't have business to do, you continue. That's not place that's good to rest your body. That's a place that you're forbidden to even take a breather. So I follow that. Otherwise I don't stop, I go. But I know in that area has a lot of, well, Hawaiians say *'aumakua* [spirits], eh? Which is not our business. We keep away

from those things. They have their rights and we don't have rights there. That's all their rights so keep away from anything like that. If you hear people calling or someone hear voices, you don't turn back. You just go ahead. If you smell something, you don't follow.

CL: What kind of smell?

HA: Oh they say beautiful perfume smell like *maile* or you know, some kind sweet smell, flowers. You don't smell. You have to keep agoing until you reach the other point. (Henry Auwae Int. 6)

ʻĀina Hānau

ʻĀina Hānau is a ritual site in Piʻihonua, south of Saddle Road at about milepost 13 *(Figure 76)*. As the name implies, it is a site where women were ritually prepared for giving birth. It had a small stone-walled enclosure where the woman waited, and a rock that she clung to while giving birth (Auwae Int. 8). It was still in use in his childhood he said:

> Lot of women used to go there [to] give birth. They used [it] to give birth because they believe in the old traditions. And they believe that when they give [birth], the baby's born in that area that the baby come out strong and without no sickness or contagious diseases that the white man bring. They don't want the air or the breath from the white man in that area where they giving birth. They believe the white man breath contaminate the earth. . . .they want to make sure that they have no *contamination to their child that's born. So it was really, again it's a ritual way of* giving birth. They have the priest, the *kahuna* and everybody, but they not in there in the walls that she giving birth.
>
> And as soon the baby is born and the baby's clean then they bring the baby out to the priest and the priest bless the baby, ordain the baby, bless the baby towards this world, and make sure the baby doesn't infect with any kind of disease. So mother have to stay there at least seven days. They cannot leave that area until the kahuna, the priest finish his doings, his rituals and his medicine with that baby. Then they can go home to wherever they go. (Henry Auwae Int. 9)

ʻĀina ʻĀkau

ʻĀina ʻĀkau lies closer to Hilo, probably in Punahoa 2 south of Saddle Road between mileposts 9 and 10 *(Figure 76)*. Mr. Auwae said it was a site used for preparing bodies of high *aliʻi* for burial (Auwae Int. 5, 8). After being prepared, the body would be carried to a burial site elsewhere. He described the site as a tiered platform:

> Well they have platforms there. Some platforms they was square, some was long and some was round. All depends who the king was at that time. And when they change the king they have to change the king's platform. They rebuild it. They break out the old one and they put a new one. I seen at one time I went up there, there was a big round platform where they used to prepare the body, embalm the body. I'd say was about 35 feet in diameter and where the center part was maybe 25 feet. Height was 5 [feet] and the highest part where they put the body on was 7 feet from the ground. And they had five steps I know, five steps going up. And that platform where they put the body on I'd say not more than 10 feet. That was when my grandfather was still at Humuʻula. And that was the last time I seen. But

when I seen that, they changed the form of that site there. It was square, big square. The first time was round but this last time was square. But the steps going up, everything was the same. Only the form was different. That's all that I seen. (Henry Auwae Int. 8)

ʻĀina Kahukahu

ʻĀina Kahukahu lies south of Saddle Road, between mileposts 8 and 9, in Ponahawai *(Figure 76)*. It was located at the intersection of a number of trails coming up from the Hilo side which joined together there to go up to the Saddle (Auwae Int. 9). Mr. Auwae (Int. 8) described it as quite a large structure, with several "altars." The largest altar he guessed at 45 m (150 ft) long by 23 m (75 ft) wide and 7.5 m (25 ft) high. It was used to bless travel and make it safe. Individual travelers would stop there on their journey to perform rituals for a safe journey. Periodically larger group rituals were held there as well:

> Āina Kahukahu is where they. . .come together and they do praying. Just like they prepare medicine, they prepare food and then they give blessings, special blessings. And they put it on the *ahu* [altar] to remember the people in that area, the people that passed [away]. The people was assassinated on the trail. And to make sure that their spirits are being taken care of, they find homes for their spirits. That's what the mean[ing] of *kahukahu*, ʻĀina Kahukahu. To give blessings and to make sure that there are people that been taking care, the spirits have been taken care [of]. And you leave food, you make food and everything and people they do rituals. That's what. It's an important place that because it's more of peace and ritual area. And they only allowed one *ahu* there.
>
> And then there's branches coming in meeting the main [trail], so they [travelers] always stopped there. They had to pass there. So they have to stop and give blessing before they continue, so that they have safe trips and nobody, no outlaws get to them, eh? Yeah, that place there was before the broken paddle [the Law of Mamalahoa proclaimed by Kamehameha] where people, you know Paiʻea [Kamehameha], where Kamehameha get conk on the head because he mistreated a commoner. (Henry Auwae Int. 9)

Puʻu Kamokumoku

Mr. Auwae was taught that the original name for Puʻu Kalaʻiʻehā (just northeast of Humuʻula Sheep Station) was Puʻu Ka-mokumoku.

> Ka-mokumoku they call that, that's why [because] they tear up, you know all the wishes of whoever make the rules and laws of the Saddle, between the two mountains. That's where they break all the rules and the laws, all in pieces. And *mokumoku* means break it all in pieces. So that they don't find the solid intention of the aliʻi's. (Henry Auwae Int. 4)

He said that the area around the *Puʻu* was the place where powerful prophets (*kāula*) lived. They worshipped ʻIo, God in Heaven, and drew their power from ʻIo. If an *aliʻi* acted against the will of the prophets, his plans would be thwarted and he would disappear.

> The kings and all, they would not author any motions or suggest anything unless it was cleared by the prophesies. And these prophesies are the prophesies of God, of ʻIo. You know. He claims he get all his know how, his wisdom, and everything

come from 'Io. And then he tell the kings what to do and what not to do. But he was always against wars you know. Because God does not like war. Yeah.

'Io, that's God in heaven. They never mention anything about Jesus Christ or anything. But only God in heaven, 'Io. That's the utmost, more well respect for life, for light. And the heavens for rain eh? Yeah. There was no worshipping of any kind of gods like they say, oh that they all do the different gods, you know.

And anybody that they're not, or had any intention or any thoughts of not even following the rules, they don't see the person no more. Or they don't see the *ali'i* more. You know, he's banished, you know.

Burials and Homesteads

Mr. Auwae was concerned about two areas where people used to live and where he knew of Hawaiian burials, one on the west side and one in the Saddle. On the west side, he used to go with his great-grandmother to visit people living near Ke'āmoku Sheep Station (Auwae Ints 5,6,8). They stayed with the Kahaealii family there. Above the sheep station were several Portuguese families that farmed and raised stock in a small way. Mr. Auwae said there were a lot of Hawaiian graves in the area between the west side alternative routes W-2 and W-3 that he was concerned about. In the Saddle, Mr. Auwae said there once were "villages" north of the present Saddle Road on the lower slopes of Mauna Kea, at an elevation where several springs existed (Auwae Ints 4,5,7). He knows of Hawaiian burials in that area. He said there had also been many Hawaiian burials in the area of Bradshaw Field in Pohakuloa Training Area (PTA), and to the southeast of Mauna Kea State Park in PTA. Both areas were heavily bulldozed by the army after World War II and he thinks nothing is left of the graves.

Attempts to Locate Burials and Ritual Sites

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Burial Location

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DISCUSSION

Four of the ritual sites discussed above are potentially eligible for the National Register of Historic Sites as traditional cultural properties; the other two are not. ʻĀina Kao is gone, covered by the lava. The Puʻu Kamokumoku area is too diffuse to be easily considered a traditional cultural property, and Mr. Auwae did not wish to claim that sort of status for it. Of the four remaining sites, ʻĀina Kahukahū, ʻĀina ʻAkau, ʻĀina Hānau and Papa Hemolele, none is presently being used by Hawaiian religious practitioners. In general, however, Hawaiians believe that *heiau* and other ritual sites still have *mana* (religious power) because of their previous use. In Western terms, they are still sacred sites. Henry Auwae was quoted earlier on this topic *(see p. 134)*. When he described traveling with his grandparents he said in reference to such sites, ". . .we don't cross the sacred places that we're not allowed." Former ritual sites still have religious importance to Native Hawaiians, even if they are not being actively used for religious rituals. And there is potential for ritual use of those sites to be revived. Since none of the four sites in question has been definitely located and inspected to determine physical integrity, none of them can be evaluated as eligible for the register. In any case, the weight of evidence indicates that all four sites lie outside the area of potential effect established for the Saddle Road Improvement project for Native Hawaiian ritual sites. ʻĀina Hemolele lies in open terrain on the west side, where the APE was set at one-half mile from the centerline. It lies considerably more than one-half mile from the Ex-1 centerline. The other three sites lie in forested terrain on the east side, where the APE was set at 152 m (500 ft) from the centerline. All of them lie considerably more than 152 m from the Ex-3/Ex-4 centerline, according to the approximate locations determined with Mr. Auwae. The project should have no effect on those sites. Mr. Auwae agreed with that assessment:

> C. Langlas: So I think those two sites, ʻĀina Kahukahu and Hānau are not that close to the road [based on our helicopter trip to locate them].

H. Auwae: No.

C. Langlas: So not really something we need to be too concerned about?

H. Auwae: Oh yeah, it's far, far away.
(Henry Auwae Int. 8)

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CONCLUSION

SIGNIFICANCE OF RESEARCH FOR PRE-HISTORY AND HISTORY

The basic patterns of prehistoric and historic use of the larger project area – the Saddle and the adjoining interior to east and west – were well known before the study began. This study has not produced any radical shift in our understanding. However, it has brought to light previously unknown information and created a more complete synthesis of the cultural history of the area.

Our understanding of prehistoric use of the Saddle by Native Hawaiians is based on earlier archaeological work, which has been synthesized by several writers (Hommon and Ahlo 1982, Athens and Kaschko 1989, Cordy 1994).. The East Side is much less known. There has been little archaeological work, particularly at the upper elevations where the project corridor is located. However, McEldowney (1979) provides a good discussion of Native Hawaiian use in the early historic period, based on documentary evidence. The West Side is virtually unexplored archaeologically, except near the shore.

No clearly prehistoric sites were found by the archaeological survey in any of the project corridors. Ethnographic research provided several new pieces of information regarding traditional Native Hawaiian use of the general area, which likely dates back to the time of first Western contact. On the East Side, the Boundary Commission testimony proved to be a rich source of information on Native Hawaiian use of the forest in the early nineteenth century, which can be projected back to the time of contact. The testimony describes trails, houses and sleeping caves, bird catching, canoe making, planting of yams and bananas, and *heiau*. For the most part this information confirms the pattern described by McEldowney (1979) and adds detail. However, it shows that the line between *kula* and forest was at about 330 m (1,100 ft) in the project area, not 450 m (1,500 ft), as indicated by Western accounts for the general vicinity of Hilo.

Five previously undocumented ritual sites were described by Henry Auwae, one on the West Side and four on the East Side. Unfortunately none of them could be located and physically described. In addition, Mr. Auwae described the area around Pu'u Kala'i'ehā in the Saddle as a place where Hawaiian prophets (*kāula*) used to live and receive visions. This interview material indicates the importance of upland religious sites (most of which have now been forgotten) to Native Hawaiians. The main upland religious site still known today is Ahu a 'Umi, a *heiau* lying to the southeast of Hualālai, near the Saddle.

Two previously known trails were found by the archaeological survey and also investigated by documentary and oral history research. The Hilo-Pu'u 'Ō'ō Trail (SIHP 50-10-33-20878) is clearly historic, although it probably follows the general route of an earlier prehistoric trail. The middle portion of the trail (the part which crosses the project corridor) was built between 1855 and 1880. The trail was used in the twentieth century by travelers from Hilo up to the Saddle and by cowboys employed by Shipman to work at Pu'u 'Ō'ō Ranch. The Volcano-Pu'u 'Ō'ō Trail (SIHP 50-10-33-103878) is apparently a prehistoric trail, because it was described as an "old road" in 1873. The trail was used during the first half of the twentieth century to move cattle to and from ranches in the Saddle. It was important enough to maintain and rebuild when it was covered by lava flows.

The history of the general project area has been previously described by several writers, most importantly by Wellmon (1969) for the West Side and Saddle, and by McEldowney (1979) and Kelly et al. (1981) for the East Side. The present study adds to our understanding mainly by providing detail on the twentieth-century use of the area, derived from interviews with individuals who lived and worked there. For example, the study describes in detail Parker Ranch's farming operation at Waiki'i between 1920 and 1950, and documents the establishment of a largely Japanese farming community in upper Kaūmana at the turn of the century.

Ranching played a significant role in shaping the historic landscape of the West Side and the Saddle, which came under the control of Parker Ranch, and the upper East Side, which came under Shipman's Pu'u 'Ō'ō Ranch. Pasture lands were marked out with barrier walls made of stone. The historic southern boundaries of the Humu'ula Sheep Station occur within the project area. Trails were co-opted or built, and maintained, to facilitate the movement of cowboys and stock across the island, from pasture to market and between pasture areas. The old wagon road between Waimea and Humu'ula was created to carry wool from Humu'ula Sheep Station to the harbor at Kawaihae west of Waimea. In the era of automobile traffic, it became the main route to the Saddle, used even by cowboys and tourists going up there from the east coast.

Transportation across the Saddle has taken a variety of forms over the past. During prehistory, foot travel took place over unmodified *pāhoehoe* and grassland, and on stepping stones over rough *'a'ā* flows. Trails were modified and/or built with basalt cobbles in thin, meandering pathways during historic times, to facilitate the movement of horses, mules and cattle. Carts and wagons required different paths. The portion of the old wagon road to Humu'ula, investigated during the archaeological survey, is notably different in morphology than the prehistoric or historic stone trails. The deep and wide path in the soil at the base of Mauna Kea was likely created as the result of the passage of wagons, rather than created prior to their passage. Multiple parallel tracks are common, probably created as the result of expeditious maneuvering around temporary obstacles.

Further development of roads in the area was stimulated by World War II and the need to travel through the interior in case of a Japanese attack which might hinder travel along the coast. Roads capable of carrying cars, trucks, and tanks were created by bulldozing. The path chosen for the World War II-era Saddle Road included portions of the old wagon road to the west, some previously unmodified areas in the Saddle, and portions of the Hilo-Pu'u 'Ō'ō trail on the east. Historic walls associated with earlier ranching activities were breached. Later, maintenance and upgrading of the Saddle Road resulted in some deviation from the original World War II route.

Remains of the sugar industry are found at the eastern end of the project area. The eleven-mile 'Ōla'a Flume ran south through the project area at about 600 m (2,000 ft) elevation and continued south through forest land to 'Ōla'a, Puna. There it fed the flume system that carried harvested cane down to Kea'au for milling. Farther down, the Hilo Flume ran through the project area, the flume which carried cane grown at Kaūmana down to Wainaku Mill, in Hilo. The flume systems were part of a large complex of sugar fields, mills, transportation routes, and camps that formed the dominant economic force in East Hawai'i from the 1860s up to the 1970s.

The primary World War II military headquarters on the island of Hawai'i were located at Camp Tarawa in Waimea, beyond the project area. Tank training maneuvers and artillery practice did take place at Camp Pohakuloa in the Saddle, located in the same area as the present Pohakuloa Training Area cantonment. Structures associated with this war training include tents, a few Quonset huts, and the CCC camp house located farther east (at the site of the current Mauna Kea State Park). The current airfield and cantonment were built during the early and mid 1950s.

Structures used in field training are located within and beyond the limits of Pohakuloa Training Area. These include walls of various shapes (C-shaped, L-shaped, linear), low enclosures, refuse disposal and filled excavations (foxholes). Field training structures occur most commonly to the east of Mauna Kea State Park, with the high densities continuing into the Parker Ranch lands at Humu'ula, to the east of PTA, as far as the intersection of PTA-1 and the 1935 lava flow. Fewer training structures are located west of Mauna Kea State Park, most of them occurring in Waikōloa, beyond the western boundary of PTA.

The results of the archaeological survey and testing provide no additional information concerning World War II activities and structures. Material remains on the surface and within test units conducted at rock wall features indicate that the numerous basalt features located within and near the PTA were created and used during the post World War II era, most likely beginning during the Korean War.

SIGNIFICANCE EVALUATIONS

Sites identified during this survey were assessed for their eligibility for listing on the National Register of Historic Places (NRHP) Criteria for Evaluation, as outlined in 36 CFR 60. To be assessed as significant a site must possess integrity of location, design, setting, materials, workmanship, feeling, and association and must be characterized by one or more of the following four criteria:

(A) It must be associated with events that have made a significant contribution to the broad patterns of our history, or be considered a traditional cultural property;

(B) It must be associated with the lives of persons significant in the past;

(C) It must embody distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic value or represent a significant and distinguishable entity whose components may lack individual distinction; or

(D) It must have yielded or may be likely to yield, information important in prehistory or history.

Significance assessments have been made in consultation with the Hawai'i State Historic Preservation Office (SHPO). Many of the sites that will be impacted by the Saddle Road undertaking are long and linear with a relatively small width. Only small portions of the long sites are within the APE. Consequently, identification, assessment of site integrity, and significance evaluation efforts are confined to the those portions of the sites that are within and adjacent to the APE (Table 8). Other criteria of significance may apply to these sites beyond the APE.

No military sites or structures dating to the World War II-era activities were encountered within the APE. The buildings now found in the cantonment area were erected in the early 1950s when the PTA was officially established. No specific activity areas, structures, or features dating to World War II activities were identified. This is a reflection of the expedient and temporary use of the areas within the APE; soldiers were housed in the main camp facilities at Tarawa, and mostly used tents during maneuvers in PTA. None of the 35 military sites are recommended as eligible for listing on the NRHP.

Pursuant to the guidelines for determining site significance, graves and cemeteries can only be considered eligible for the NRHP if they meet special requirements. The fundamental criterion for considering a grave site as eligible under Criteria A, B, or C is: "a birthplace or grave of a historical figure is eligible if the person is of outstanding importance and if there is no other appropriate site of building directly associated with his or her productive life" (USDOI 1991:32). However, a grave can be eligible "under Criterion D if it contains important information on research, e.g., demography, pathology, mortuary practices, socioeconomic status differentiation" (USDOI 1991:33). In Hawai'i, "it has been clearly documented that, for native Hawaiians, burials and religious places are considered to (have) cultural significance" (DLNR 1996 Chapter 280-2). However, for Site 20852, the ethnicity of the interred

Table 8. Site Significance

SIHP #	Description	Site Name	Criteria for Significance
20852	Historic burial		D
20854	Historic ranching		D
20855	Historic transportation	Waimea-Kona Road	D
5002	Historic ranching	Ka'ohe Wall	D
5003	Prehistoric temporary habitation		D
14638	Prehistoric temporary habitation		D
20862	Historic ranching		D
20865	Historic ranching		D
20877	Historic ranching		D
21150	Historic transportation	Humu'ula Wagon Road	D
7119	Historic ranching	Humu'ula Walls	D
10309	Historic transportation	Pu'u 'Ō'ō-Volcano Trail	D
20856	Historic paving		D
20878	Historic transportation	Hilo-Pu'u 'Ō'ō Trail	D
20864	Historic transportation	Saddle Road	D
20869	Historic survey marker		D
20870	Historic agriculture	'Ōla'a Flume	D
20872	Historic recreation	Hilo Country Club	D
20873	Historic habitation	Senator Kimi's House	D

individual(s) has not been established or suggested. Based on the unknown ethnicity of the interments (they could be native Hawaiian, Japanese, Euro-American, or other), and no indication from the informant that identified the grave site, Site 20852 is considered as eligible under Criterion D only, for the information that the site contains on mortuary practices. The other eighteen sites are also eligible for Criterion D only *(Table 8)*.

RECOMMENDED TREATMENTS

Seven of the sites (20862, 20856, 20865, 20869, 20872, 20877, and 20873) will require no further work, because the significant data contained within these sites has been collected in the form of measurements, photographs, descriptions, figures, documentary research, oral interview, and historical research context *(Table 9)*. The appropriate research has been conducted for the seven sites, and further study would not contribute any new information.

Two of the sites (5003 and 14638) already eligible for the NRHP (Welch 1993) will not be affected by the project. These sites are beyond the APE and construction impact areas. Site 20852 is also beyond the APE and will not be impacted. Pursuant to procedures worked out with the DLNR discussed previously, the area between the site and the project corridor will be fenced off, and the construction crew will be briefed on their responsibility to avoid the area at all costs. Recommended treatments for nine sites (20854, 20864, 5002, 10309, 20855, 21150, 7119, 20878, and 20870) have been established based on consultation with the Hawai'i SHPO.

Historic Enclosures (20854)

The undertaking will affect the historic enclosure (Site 20854), and minor data recovery work is recommended for this site. The data recovery work could concentrate on establishing the function and age of the site. Detailed methods and strategies for recovering data sufficient to address these issues will be documented in a Mitigation Plan and through consultation with SHPO.

Saddle Road (20864)

The construction will affect the old Saddle Road by destroying very small parts of sections (less than 10 meters) that remain unaltered from their original unpaved character.

Table 9. Recommended Mitigation

SIHP #	Description	Site Name	Recommended Mitigation
20852	Historic burial		Avoid
20854	Historic ranching		Data recovery
20855	Historic transportation	Waimea to Kona road	Data recovery, interpretation
5002	Historic ranching	Ka'ohe wall	None
5003	Prehistoric temporary habitation		Avoid
14638	Prehistoric temporary habitation		Avoid
20862	Historic ranching		None
20865	Historic ranching		None
20877	Historic ranching		None
21150	Historic transportation	Humu'ula wagon road	Data recovery, interpretation
7119	Historic ranching	Humu'ula walls	Interpretation, monitor periodically
10309	Historic transportation	Pu'u 'O'o Trail	Data recovery, monitor periodically
20856	Historic paving		None
20878	Historic transportation	Hilo Pu'u 'O'o Trail	Data recovery, interpretation
20864	Historic transportation	Saddle Road	Interpretation
20869	Historic survey marker		None
20870	Historic agriculture	'Ola'a Flume	Interpretation
20872	Historic recreation	Hilo Country Club	None
20873	Historic habitation		None

The Ka'ohe Wall (5002)

The undertaking will affect Ka'ohe Wall by destroying a portion of the wall. Information that makes the site significant, including morphology, location, history, methods of construction, and use patterns has been collected in the form of photographs, measurements, oral interviews, and historical documentation during this investigation.

The Pu'u 'Ō'ō-Volcano Trail (10309)

A lava flow covered a portion of the Site 10309 trail in 1935, and the Saddle Road was built on the 1935 flow. Consequently, there are no intact portions of the trail within the project impact area, and there will be no direct impacts to Site 10309. The indirect effects of constructing Saddle Road over the buried trail path can be mitigated by way of an approved mitigation plan. Treatment of the property could include data recovery that documents trail morphology and adaptations to the varying terrain outside of the construction impact area. Treatment of the property should also include interpretative signage where the trail meets the south side of the Saddle Road (in addition to the present signs which merely name the trail). The signage should include a description of its pathway, dates of use, and how it was used for cattle drives.

Old Waimea-Kona Belt Road (20855)

Two separate portions of the undertaking may impact the Old Waimea to Kona Belt Road. The undertaking will have an effect in both the W-2 and W-3 corridors. For the portion in W-2, the information that makes the site significant, including morphology, dates and methods of construction, use, and abandonment, and use patterns, has been collected in the form of photographs, measurements, oral interviews, and historical documentation during this investigation.

The W-3 construction corridor was moved to avoid impacting the causeway situated within the APE. Impacts will be limited to an approximately 50 meter long segment of Site 20855 that was constructed at grade. The site in this area is two-track, unpaved pathway on pahoehoe. Data recovery to mitigate the otherwise adverse effects to this portion of Site 20855 should include documentation of the road morphology within the impact area, and an inventory of causeway structures along a portion of the old Waimea-Kona Belt Road.

Old Waimea-Humu'ula Wagon Road (21150)

The undertaking will not have an effect on the intact portion of Old Waimea-Humu'ula Wagon Road. The segment of the old wagon road 1.0 kilometer east of the PTA boundary will retain its physical integrity and demonstrate its historical association with the Humu'ula Sheep Station. Data recovery should be conducted for the portion of the wagon road within the PTA 1 corridor prior to road construction to retrieve the information that makes the site significant. Data recovery should include thorough and complete measurements and photo documentation of the portion of the road within the APE. The adverse effect can be mitigated by way of an approved mitigation plan. Treatment of the property should include interpretative signage and auto pull-off area where the trail meets the east side of the proposed corridor. The content of the signage should include description of its pathway, dates of use, and how it was used for transportation of goods and people across the Saddle. Periodic monitoring during construction should be conducted to insure a minimum impact to the property.

The Humu'ula Sheep Station and Perimeter Wall (7119)

The undertaking will affect some of the wall segments of the Humu'ula Sheep Station and Perimeter Wall. Several segments of the southern perimeter wall extend into the EX-2 and EX-3 corridors. Short segments of Section 1 will be impacted by construction. Other segments extend into the EX-3 corridor for short distances. At Station No. 143+150, east of Pu'u Huluhulu, the south 10 m of Section 4 wall extends into the corridor. On the east end of the Section 6 wall (at Sta.148+000), a short segment lies entirely within the corridor.

Information that makes the site significant including morphology, location, history, methods of construction, and use patterns has been collected in the form of photographs, measurements, oral interviews, and historical documentation during this investigation. Effects can be mitigated by way of an approved mitigation plan. Treatment of the property should include interpretative signage with a place for motorists to pull off Saddle Road. The content of the signage should include description of Humu'ula Sheep Station, its role in the history of the Saddle area, and a discussion of the walls paralleling the road. Appropriate locations for two pull-off areas with signage are at the intersection of the Saddle Road with the road to the Mauna Kea summit, at milepost 28, and at the east end of Section 1 wall. Construction activities that will impact the walls at this site should be periodically monitored by archaeologists to insure that destruction to the walls is restricted to the absolute minimum.

Hilo-Pu'u 'Ō'ō Trail (20878)

The EX-3 corridor will have an effect on the Hilo to Pu'u 'Ō'ō Trail. Approximately 190 m of trail occurs within the eastern impact zone within EX-3 (near milepost 18). About five m of trail occurs within the western impact zone (where the trail crosses near milepost 20). The adverse effect can be mitigated by way of an approved mitigation plan. Elements of the agreement may include avoidance and construction of a pull-off area with signage containing locational and historical information. Data recovery should be conducted to retrieve significant information from the eastern portion of the site within the construction impact area. Data recovery should include evaluation of the modes of construction as they apply to chronological, functional, and maintenance activities. Development of a comprehensive, island-wide informational map of Hawaiian historical trails suitable for distribution through the Hawaii Department of Transportation could be considered as part of the treatment of the site.

'Ōla'a Flume (20870)

A segment (less than 40 meters long) of the 'Ōla'a Flume will be impacted by the E-3 Corridor. Information that makes the site significant, including methods of construction, function, and dates of construction, use, and abandonment has been collected in the form of photographs, measurements, and historical documentation. The adverse effect can be mitigated by way of an approved mitigation plan. Treatment could include interpretative signage placed at the flume site. The signage should contain information on the location of the flume system, and its historical use. Construction of a pull-out for motorists adjacent to the flume would be appropriate for encouraging safe access to the sign.

Overall

There is always the possibility, however remote, that potentially significant, unidentified cultural remains might be encountered in the course of future development activities. In such a situation, archaeological consultation should be sought immediately. If human skeletal remains are inadvertently discovered during the road building activities, work in the area that could damage the remains must cease until the procedures detailed in the Hawaii Revised Statutes 6E-43 have been carried out. Treatment of inadvertently discovered human skeletal remains should also take into account the lands from which they were recovered (such as Department of Hawaiian Home Lands or federal lands, where NAGPRA would be invoked).

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HSA	Hawaii State Archives
HFC	Hitchcock Family Collection
PRF	Parker Ranch Files
RTG	Report of the Territorial Governor
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MAPS

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Piihonua Quadrangle, surveyed 1912-14

15 minute series, scale 1/62,500:
Waikii, Kaohe, Humuula Quadrangles, 1930-31
Hilo Quadrangle, 1917
Kilauea Quadrangle, 1924

APPENDIX A: LIST OF TMKS AND OWNERS

TMK	Owner	Owner Address
2 4 .008 :035	State of Hawaii	
2 .5 .001 :005	Orlando H. Lyman Trust 50% & Orlando Lyman Charitable Trust 50%, c/o Fred Koehnen	111 Kapaa St.
2 .5 .001 :009	Orlando Lyman, Charitable Trust	FHB Box 897
2 .5 .003 :022	Tanouye, Tadao / Yuriko TR	2147 Kaumana Dr.
2 .5 .003 :023	Tanouye, Tadao / Yuriko S. TR	2147 Kaumana Dr.
2 .5 .003 :025	Kapololu, William K. Jr. et al.	1326 . 1328 10th Ave.
2 .5 .003 :026	Roman Catholic Church	Real Prop. Tax Spec . Box 3170
2 .5 .003 :027	Mauna Kea Agribusiness Co. Inc. 45% & Kaumana Country Club, Inc. 55%	733 Bishop St. #1560
2 .5 .003 :039	Kobayashi, Michael S. & Kim P.	2760 Kaumana Dr
2 .5 .003 :044	State of Hawaii	
2 .5 .003 :080	State of Hawaii	
2 .5 .003 :084	Roman Catholic Church c/o Hawaiian Trust Co. Ltd.	Real Prop Tax Spec - PO Box 3170
2 .5 .003 :085	Island Tropicals, Inc. (961-0606)	PO Box 4847
2 .5 .003 :086	Island Tropicals, Inc. c/o Ted H. Miyahara, CPA Inc.	357 Waianuenue Ave.
2 .5 .003 :090	Hilo Hongwanji Mission	398 Kilauea Ave.
2 .5 .003 :091	Island Tropicals, Inc. & Mueller Horticultural Part	357 Waianuenue Ave.
2 .5 .003 :092	Ching, Rollin & Elaine & Yamamoto, Takashi & Mitsuko	132 Scherer St.
2 .5 .003 :093	County of Hawaii, Department of Water Supply	25 Aupuni Street
2 .5 .004 :009	Shimokusu, James A. TR	1852 Eames St.
2 .5 .004 :014	McCumiskey, Francis/ Ruth H. (969-6837)	2015 Kaumana Dr.
2 .5 .004 :015	Yoneoka, Manabu/Kiyoko M. (935-0247)	2005 Kaumana Dr.
2 .5 .004 :016	Hisashima, Hisako/Bert (935-7681)	1995 Kaumana Dr.
2 .5 .004 :017	Sako, Tokuma TR 50%, Sako, Sadako TR 50% (959-5751)	1281 Komohana St.
2 .5 .004 :018	Miyamoto, Edward E. Trust: c/o Clayton Isa	1976 Kaumana Dr.
2 .5 .004 :019	Hoshida, Iwao/Miyoko (935-0929)	1990-A Kaumana Dr.
2 .5 .004 :022	Wilbur, Stanley E. & Emily B. (961-3521)	2014 Kaumana Dr.
2 .5 .004 :026	Miro Inc.	Parcel is a roadway. No address at RPT
2 .5 .004 :042	Tatsumi Watanabe Trust (Previously 2-5-004:057)	2051 Kaumana Drive
2 .5 .004 :050	Cunningham, William AT/Louise; Bishop Trust Co., Ltd.	PO Box 1752
2 .5 .004 :051	Montibon, Fileman B./Lulu L.	211 Kaumana Drive
2 .5 .004 :052	Sakamoto, Tsuiko (935-4195)	2101 Kaumana Drive
2 .5 .004 :053	Nagata, Yoshio/Yukie (935-4394)	2091 Kaumana Drive
2 .5 .004 :054	Fujii, Tomoichi/Misako, (o) Jean L. Itagaki (935-4494)	2081 Kaumana Drive
2 .5 .004 :055	Horie, Tsuneko K. (935-2372)	2071 Kaumana Drive
2 .5 .004 :056	Daimaru, Glenn M./Gayle S.	2061 Kaumana Drive
2 .5 .004 :057	Parcel dropped. Became (3) 2-5-004:042	
2 .5 .004 :058	Watanabe, Chisawo (935-2703)	2041 Kaumana Drive
2 .5 .004 :059	Nakashima, Makoto/Ineko Yazaki (935-0184)	2025 Kaumana Drive
2 .5 .004 :062	Otsu, Bonnie T. Trust	2139 Kaumana Dr.
2 .5 .004 :063	Yanagihara, Myra H. & Children of	RR1 Box 380 A-120
2 .5 .004 :064	Tanouye, Tadao TR & Yuriko S TR (935-0130)	2147 Kaumana Dr.
2 .5 .004 :065	Muramaru, Mieko TR (935-2032)	2153 Kaumana Dr.
2 .5 .004 :066	Kanaele, Denise D.	2161 Kaumana Dr.
2 .5 .004 :067	Yoshitsugu, Albert T. (935-2150)	2167 Kaumana Dr.
2 .5 .004 :068	Asuka, Isao & Chitsuko	2181-A Kaumana Dr.
2 -5 .004 :069	Fujita, Susumu et al.	94-357 Niau St
2 .5 .004 :070	Kapahu, Joseph P./Alice A. (935-2519)	2040 Kaumana Drive

Appendix A: List of TMKs and Owners (cont.)

2 .5 .004 :071	Kawachi, Torao/Sumiko (935-2795)	2030 Kaumana Dr.
2 .5 .004 :073	Hawaii Community Foundation; c/o First Hawaiian Bank	PO Box 3200
2 .5 .004 :074	Fujii, Tsutako /Carlene K.	2098 Kaumana Drive
2 .5 .004 :075	Hoshida, Nancy H./Lloyd	c/o Lloyd Hoshida; 2070 Kaumana
2 .5 .004 :076	Nakagawa, Kiyoshi (935-2554)	2050 Kaumana Drive
2 .5 .004 :077	Hoshida, Lloyd/Anne Marie	2070 Kaumana Drive
2 .5 .004 :078	Sawada, Hideo W./Sayoko	2088 Kaumana Drive
2 .5 .004 :079	Roehrig, Stanley H. Trust/Janice Roehrig Trust (969-1441)	PO Box 217
2 .5 .004 :080	Victorino, Joseph D./Ruth L. (935-9839 or 969-7144	2114 Kaumana Drive
2 .5 .004 :081	Tsang, Hansen/Neva Marie (961-5118)	PO Box 4502
2 .5 .004 :087	Takeshima, Maurice H. 25%, Yoshiyama, Loisa K. 25%, Takeshima, Kameji, Takeshima, Kameji 25%, Tsuda, Sam 50%, Misuno, Doris T. 75%, Takeshima, Kameji 25%, Takeshima, Masayo Maurice: 961-6889	(M. Takeshima) 20+G5480-B Kaumana,Dr, (L. Yoshiyama) 2080-C Kaumana,Dr, (K. Takeshima) 2080-A Kaumana,Dr,(S. Tsuda) 2088-B Kaumana Dr.,
2 .5 .004 :092	Kapahu, Alice A/Joseph P. (935-2519)	2040 Kaumana Dr.
2 .5 .005 :035	Yoneoka, Shizuo (935-0620)	1865 Kaumana Dr.
2 .5 .005 :046	Murakami, Tsuyoshi & Alice K.	1945 Kaumana Drive
2 .5 .005 :049	Komatsu, Roy J. TR	1955 Kaumana Dr.
2 .5 .005 :050	Murakami, Alice K. (Dropped) Became 2-5-005:046	
2 .5 .005 :051	Nagai, Edward A.	1931 Kaumana Dr.
2 .5 .005 :052	Kawachi, Yutaka	1915 Kaumama Dr.
2 .5 .005 :053	Nagata, Hideki/Bertha	1901 Kaumana Dr.
2 .5 .005 :054	Horio, Yoshino	1888 Uhaloa Rd.
2 .5 .005 :055	Nishimoto, Fujino	1883 Kaumana Dr.
2 .5 .005 :060	Oyama, Blaine Y.	1878 Kaumana Dr.
2 .5 .005 :061	County of Hawaii - Department of Parks & Recreation	25 Aupuni Street
2 .5 .005 :062	Family CCS TR/Brilhante, William V.	1342 Kilauea Ave.
2 .5 .005 :064	Omoto, Kazuko TR	20 Wilder Ave.
2 .5 .005 :065	Ikeda, Hideo	2220 Allesandro
2 .5 .005 :068	Wilson, Ernest K.	1964 Kaumana Dr.
2 .5 .005 :069	Wilson, Ernest K.	1964 Kaumana Dr.
2 .5 .005 :070	Montibon, Vernon	12 Wilder Rd.
2 .5 .005 :085	Omoto, Kiyomi TR	20 N. Wilder Rd.
2 .5 .005 :090	County of Hawaii, Department of Water Supply	25 Aupuni Street
2 .5 .005 :091	County of Hawaii, Department of Water Supply	25 Aupuni Street
2 .5 .005 :100	Komatsu, Donald M. TR	1963 Kaumana Dr.
2 .5 .038 :078	Hoshida, Iwao & Miyoko	1990 Kaumana Dr.
2 .5 .038 :079	Kelly, Charles & Joy	209 Valley Dr.
2 .5 .040 :012	State of Hawaii	
2 .5 .040 :020	Anthony R. Lawrence	46-376 Holopu Place
2 .5 .040 :024	County of Hawaii - Department of Water Supply	25 Aupuni Street
2 .5 .040 :034	Clyde M. Rapozo, Sr.	c/o Pat Rapozo, 440 Kapiolani St
2 .5 .040 :038	Gayle Swanick	1688 Kaumana Drive
2 .5 .043 :020	Takayama, Al K TR 25%; Takayama, Elaine H. TR 25%; Summit Land & Cattle Co 50%, c/o Hilo Country Club Development Co.	1588 Kalaniuka Pl.
2 .5 .044 :007	David A. & Mary P. Young	18725 Geldhill St
2 .5 .044 :017	John & Dororthy P. Pregil	1716 Moani St
2 .5 .044 :020	Huston, Darrell & Wf. Marilou F.	PO Box 1624
2 .5 .045 :010	MIO, Inc.	4340 Pahoa Ave., 16-C
2 .5 .045 :012	County of Hawaii Water Commission	25 Aupuni Street
2 .5 .046 :001	Takagi Biru Co., Ltd	4340 Pahoa Ave. 16-C
2 .5 .055 :040	Shimabukuro, Yong H	1427 Ala Kula Loop
2 .5 .055 :044	Fulton, James L.	Wa
2 .5 .055 :046	Hanagami, Barry S.	2574 Pulima St.
2 .5 .057 :001	Joseph M. & Joyce Okuna	34 Terrace Drive

Appendix A: List of TMKs and Owners (cont.)

2 .6 .018 :012	State of Hawaii	
3 .8 .001 :003	Hawaiian Homes Commission	PO Box 1879
3 .8 .001 :016	State Of Hawaii	
4 .4 .016 :001	State of Hawaii	
6 .7 .001 :010	Smart, Richard Trust - Parker Ranch	Parker Ranch
6 .7 .004 :001	8/31/95 DELETE PER MN - Delaunay, Daniel E./Jacque A.	PO Box 6532
6 .7 .004 :006	Kremkow Properties, Inc.	PO Box 357
6 .7 .004 :007	Kremkow Properties, Inc.	PO Box 357
6 .7 .004 :008	Kremkow Properties, Inc.	PO Box 357
6 .7 .004 :016	Chi Ting Cheong, Ltd.	7/F Wang Kee Building 34/37 Connaught Road
6 .7 .004 :046	Waikii Ranch Homeowner's Association	PO Box 6389
6 .8 .002 :010	Waikoloa Land & Cattle Co.	150 Waikoloa Beach Drive
7 .1 .004 :008	State of Hawaii	
2 .4 .006 :034	State of Hawaii	
2 .4 .008 :001	State of Hawaii	
2 .4 .008 :004	State of Hawaii	
2 .4 .008 :008	State of Hawaii	
2 .4 .008 :017	State of Hawaii	
2 .4 .045 :010	Kunikazu/Marrie M. Machida (959-8970)	5 Aloalo St.
2 .5 .001 :001	Mauna Kea Agribusiness (Land Administration 935-7399)	PO Box 18
2 .5 .001 :002	State of Hawaii	
2 .5 .001 :003	Mauna Kea Agribusiness	PO Box 18
2 .5 .001 :004	Hawaii Conference Foundation	15 Craigside Pl.
2 .5 .001 :006	State of Hawaii	
2 .5 .001 :007	Mauna Kea Sugar Co., Inc.	PO Box 18
2 .5 .001 :008	State of Hawaii	
2 .5 .001 :011	Hawaii Conference Foundation	15 Craigside Ave.
2 .5 .001 :012	Hawaii Conference Foundation	15 Craigside Pl.
2 .5 .001 :013	Hawaii Conference Foundation	15 Craigside Pl.
2 .5 .001 :014	County of Hawaii Water Commission	25 Aupuni Street
2 .5 .002 :001	State of Hawaii	
2 .5 .002 :005	Phoebe DeLuz	334 Huali Way
2 .5 .002 :006	10 different owners.	
2 .5 .002 :008	Ponahawai Partners	1210 Auahi St. Ste. 204
2 .5 .002 :010	Herbert H.K. Loui, Trs. et al.	R R 1, Box 469
2 .5 .002 :011	Nakamura Mitsuyo et al.	2726 Kaumana Dr.
2 .5 .002 :012	State of Hawaii	
2 .5 .002 :013	Deluz, Frank III 50% & Brilhante, William V 50%	330 Huali Way
2 .5 .002 :014	State of Hawaii	
2 .5 .002 :017	Young, Wallace Hook Kwock 20%; Wong, Lily Trust 20%;Young, Henry S H 10%; Chun, Gladys Y 10%; Young, Alan S C 6.67%; Young, Michael S H 6.67%; Young, Robert S Y 6.67%; Young, Kenneth H K Estate 20%	PO Box 1513
2 .5 .002 :023	Shinsato, Shari Y. & Inaba, Daryl H.	201-D Paiko Dr.
2 .5 .002 :024	State of Hawaii	
2 .5 .002 :025	Ooma Associates	PO Box 5346
2 .5 .002 :026	Hua Nani Inc. et al.	PO Box 388
2 .5 .002 :027	Takamoto, Stanley & Aimee	355 Kalili St.
2 .5 .002 :028	Lee, Gordon Paul	728 W Mendoza Circle
2 .5 .002 :029	Inamine, Gary S. & Joy E.	1578 St. Louis Dr.
2 .5 .002 :030	Ooma Associates	PO Box 5346
2 .5 .002 :031	Uohara, John K. & Karendawn	2988 Kaumana Dr.
2 .5 .002 :032	Ooma Associates	PO Box 5346
2 .5 .002 :033	Kumasaki, Kenneth T. & Sau Lin K.	2849 Kaumana Dr.
2 .5 .002 :034	Hanaumi, Ernest F. & Shizuko	98-1750 Nahele St.
2 .5 .002 :035	Gilbert Chang	265 D. Kekunaoa Street

Appendix A: List of TMKs and Owners (cont.)

2 .5 .003 :020	State of Hawaii	
2 .5 .003 :021	State of Hawaii	
2 .5 .003 :024	Hawaiiana Investment Co. Inc. . C. Brewer Properties, Inc.	234 Waianuenue Avenue Suite 219
2 .5 .003 :038	Nakamura, Mitsuyo	2726 Kaumana Dr.
2 .5 .003 :043	Tanouye, Tadao / Yuriko S TR	2147 Kaumana Dr.
2 .5 .003 :081	County of Hawaii - Department of Water Supply	25 Aupuni Street
2 .5 .003 :093	County of Hawaii	25 Aupuni Street
2 .5 .003 :094	State of Hawaii	
2 .5 .003 :095	Nakamura, Frederick H. & Maxine S.	2740 Kaumana Dr.
2 .5 .006 :003	State of Hawaii	
2 .5 .008 :001	Mauna Kea Agribusiness	PO Box 18
2 .5 .008 :009	Mauna Kea Agribusiness	Mr. Willie K Tallett, C. Brewer & Co.,Ltd. P.O. Box 1826
2 .5 .008 :023	Water Commission, County of Hawaii	25 Aupuni Street
2 .5 .038 :080	Costales, Michael	25-05 Ua Nahale Street
2 .5 .038 :081	Hee, Myrtle W.	2452 Burbank St
2 .5 .038 :082	Belcher, Karen E. 8239340	25-3571 Opalipali St
2 .5 .038 :083	DeCosta, Reynold I & Marilyn M	984 Ainalako Rd.
2 .5 .038 :084	De Lima, Herbert E.	2463 Kilauea Ave.
2 .5 .038 :085	Weir, Donald G & Carol P.	PO Box 11217
2 .5 .038 :086	Miyasato, Carl Y & Diane S.	1455 Akeakamai St.
2 .5 .038 :087	Kunimura, Sharon T.	1465 Akeakamai St.
2 .5 .038 :088	Louaillier, Ernest Noa & Midge H.	25-3535 Opalipali St.
2 .5 .038 :089	Gomes, Michael J. Tr	1133 Manono St. Bay #5
2 .5 .041 :046	Dolan, William R. & Glynnis T. 66.66% & Umeda, Kean & Patti 33.33%	16.A Railroad Ave.
2 .5 .041 :047	County of Hawaii (Board of Water Supply)	
2 .5 .041 :048	(O1). Kalili, Thomas P. & Kimber K. 50% & (O2) Napeahi, Sibi K. Tr 50%	25-3445 Opalipali St, Hilo, HI 96720& 370 King Ave
2 .5 .041 :108	Ha, Richard Jr. & June	421 Lama St.
2 .5 .041 :109	Hannum, Charles R. & Una E.	120 Roosevelt St.
2 .5 .041 :110	Haman, Frank J & Lillian A Family Trust	4155 Yarrow Ct.
2 .5 .041 :111	Torres, Benjamin D. & Laina A.	PO Box 11329 (Undeliverable Address. No listing in ph. bk)
2 .5 .041 :112	Mattos, Kevin J. Abel Jr. Malie L.	184 Kualua Pl.
2 .5 .041 :113	Dolan, William R. & Glynnis T.	16.A Railroad Ave.
2 .5 .041 :?		
2 .5 .043 :007	Tanouye, Tadao & Yuriko S.	2147 Kaumana Dr.
2 .5 .043 :008	Espinoza, Maria	PO Box 7534
2 .5 .043 :009	Samuel Chun & Wife Rosaline et al.	1211 Kumukoa St.
2 .5 .043 :012	Robert S & Carol Oshiro	2155 Kilauea Avenue
2 .5 .043 :013	Chuhachi Takahashi & Wife Hisayo; Tatsue Tajiri & Wife Tsume	37 Kilua Rd.
2 .5 .043 :014	Kathy Larosa	2939A Pulima Drive
2 .5 .043 :015	Mauna Kea Sugar et al.	PO Box 18
2 .5 .043 :016	Tsuji Corporation	PO Box 578
2 .5 .044 :001	Lyman, Orlando H. Trust 50%; 1988 Scott Family Trust 50% c/o Fred Koehnen	11 Kapaa St
2 .5 .044 :002	Mauna Kea Agribusiness	PO Box 18
2 .5 .044 :002	Mauna Kea Agribusiness	PO Box 18
2 .5 .044 :008	Kudo, Ray T. Revocable Trust & Kenji & Ann Kawai	31 Kiele Pl.
2 .5 .044 :009	Takahama, Jerry K & Elaine K.	899 Country Club Dr.
2 .5 .045 :001	Orlando H. Lyman Charitable Trust & Scott 1988 Family Trust c/o Fred Koehnen	111 Kapaa St
2 .5 .045 :014	Ernest M. Mattos	579 Kaumana Drive
2 .5 .053 :033	Raguindin, Marcelino R. & Andrea C.	2832 Pulima Dr
2 .5 .053 :034	Pereira, Ronald P. & Ronna Lynn	2828 Pulima Dr
2 .5 .053 :035	Victorino, Harriet M.	2820 Pulima Dr.
2 .5 .053 :036	Yugawa, Craig K. & Teresa Marie	2812 Pulima Dr.
2 .5 .053 :037	DeSilva, Patrick Frank & Patty Lee	112 Waenakonu St.

Appendix A: List of TMKs and Owners (cont.)

2 .5 .054 :040	Ferranti, Coline Aiu	5705 Kalanianaole Hwy.
2 .5 .054 :041	Tamosan, Dennis K. & Nancy J 33.33% & Krug, Mary 33.33% & Tamosan, Marghret 33.33	2770 Pulima Dr
2 .5 .054 :042	Shiraishi, Wendy T. & Ichino	2740 Kuilei St. 908
2 .5 .054 :043	Beggs, Donnie R. & Jane D.	PO Box 305
2 .5 .054 :044	Hotnlansky, George E. & Karen A.	110 Likeke St
2 .5 .054 :045	Revell, Linda Y.	2734 Pulima Dr.
2 .5 .054 :046	Motoishi, Michael M. & Donna	2726 Pulima Dr.
2 .5 .054 :047	Rapozo, Bryan D. & Chan, Mun W A	2712 Pulima Dr.
2 .5 .054 :048	Mata, Gavien B. & Jacqueline S.	2706 Pulima Dr.
2 .5 .054 :049	Madriaga, Mario R. & Clarie Ann K.	47-661 Melekula Rd.
2 .5 .055 :033	Kaneko, Doreen J P	2684 Pulima Dr.
2 .5 .055 :034	Kaliiuli, Dennis M. & Clara M.	2672 Pulima Dr.
2 .5 .055 :035	Hayashi, Scott T. Trust	2666 Pulima Dr.
2 .5 .055 :036	Denis, Lawrence B. Jr & Carol Ann	2654 Pulima Dr.
2 .5 .055 :037	Estabillo, Delis M. & Laureen S.	2648 Pulima Dr.
2 .5 .055 :038	Topliff, Francis Lee & Dixie Lee	2640 Pulima Dr.
2 .5 .055 :039	Tanigawa, Paul M. & Dioma J.	2634 Pulima Dr.
2 .5 .055 :041	Rice, Rose Marie	2635 Kaumana Dr.
2 .5 .055 :042	Weiser, Beatrice H.	2625 Kaumana Dr.
2 .5 .055 :043	Mahuna, Richard Trust & Elizabeth A. Trust	45-1084 Grote Rd.
2 .5 .055 :045	Liete, Wendell K. Tr & Shirley M. Tr	1624 Wailuku Dr.
2 .5 .055 :047	State of Hawaii	
2 .5 .055 :047	State of Hawaii	
2 .5 .057 :002	*Steaveson, John O. & Eufemia*	3535 Sierra Rd.
2 .5 .057 :003	Espina, Elias N. & Demie D.	25-3385 Opalipali St
2 .5 .057 :004	Martin, George A.	PO Box 15
2 .5 .057 :005	Chock, Lorrin S.K. & Takemoto-Chock, Naomi	1978 Komohana Ext.
2 .5 .057 :006	Chock, Lorrin S.K. & Takemoto-Chock, Naomi	1978 Komohana Ext.
2 .5 .057 :007	Ikezawa, Chihiro I	1909 Ala Wai Blvd. #810
2 .5 .057 :008	Bocalbos, Mila G.	1484 Halekoa Dr.
2 .5 .057 :009	Thornton, John P.	865 Piilani St.
2 .5 .057 :010	Yamauchi, James T. & Kala, Judy	5313 Uwai St.
2 .5 .062 :001	Medeiros, TY A; Medeiros, Laurie KB	3051 Kaumana Dr.
2 .5 .062 :002	Martin, Henry P. & Renee L.	46-324 Haiku Rd. #105
2 .5 .062 :003	Fasone, Maria L S TR	554 Auwina St.
2 .5 .062 :004	Scambos, Ernest Taso & Marilyn S.	HQ USEUCOM ECJ2-R Bx 649 Unit 30400
2 .5 .062 :005	Kerr, Ava F.	Moved; forwarding address expired
2 .5 .062 :006	Hanapepe Enterprises Inc., HI. Corp.	210 Ward Ave. #336
2 .6 .018 :001	State of Hawaii	
2 .6 .018 :004	State of Hawaii	
2 .6 .018 :010	State of Hawaii	
3 .8 .001 :001	State of Hawaii	
3 .8 .001 :007	Hawaiian Homes Commission	PO Box 1879
3 .8 .001 :008	Hawaiian Homes Commission	PO Box 1879
3 .8 .001 :013	(O) State of Hawaii / (O1)Hawaiian Homes Commission	PO Box 1879
3 .8 .001 :019	Hawaiian Homes Commission	PO Box 1879
4 .4 .015 :002	State of Hawaii	
4 .4 .015 :004	State of Hawaii	
4 .4 .015 :005	Girl Scout Council of the Pacific, Inc.	PO Box 934
4 .4 .015 :008	State of Hawaii	
4 .4 .015 :013	State of Hawaii	
4 .4 .016 :003	State of Hawaii	
4 .4 .016 :005	State of Hawaii	
4 .4 .016 :006	State of Hawaii	
4 .4 .016 :007	State of Hawaii	
4 .4 .016 :010	State of Hawaii	
6 .7 .001 :003	Richard Smart Trust - Parker Ranch	PO Box 458

Appendix A: List of TMKs and Owners (cont.)

6 .7 .001 :006	Richard Smart Trust - Parker Ranch	PO Box 458
6 .7 .001 :021	Kremkow Properties, Inc.	PO Box 357
6 .7 .001 :022	Kremkow Properties, Inc.	3077 Wailani Rd.
6 .7 .001 :024	Hawaii Electric Light Co, Inc. SU Public Utility	1200 Kilauea Ave.
6 .7 .001 :025	Smart, Richard Trust - Parker Ranch	Parker Ranch
6 .7 .001 :026	Agorastos, Christopher II & Leslie M.	PO Box 337
6 .7 .001 :027	Cole, William C. & Heather M. 50%; Brown, Alan L. & Suzanne K 50%	PO Box 2188
6 .7 .004 :004	Waikii Ranch Homeowner's Association	PO Box 6389
6 .7 .004 :005	Kremkow Properties, Inc.	PO Box 357
6 .7 .004 :009	Kremkow Properties, Inc.	PO Box 357
6 .7 .004 :010	Hawaiian Trust Co. Ltd. Trs c/o Higgins, David D.	742 Mokulua Dr.
6 .7 .004 :011	Hawaiian Trust Co. Ltd. Trs c/o Higgins, David D.	PO Box 3170
6 .7 .004 :012	Mizumaki, Yoshiko TR c/o Hawaiian Trust Co., Ltd.	75-5742 Hualalai Road
6 .7 .004 :013	Clark, James K. TR	95 Lunalilo St.
6 .7 .004 :014	Leslie Agorastos Ritr Tr 50%& Melvin Hewett Profit Sharing 50%	PO Box 337
6 .7 .004 :015	Pu'umana Ranch Partners	1357 Kapiolani Blvd. #850
6 .7 .005 :001	Yotsuyaken Corp.	PO Box 88183
6 .7 .005 :002	Ventura, James F. Tr, & Libkuman, R.	1516 Akea Place (735 Bishop St. 200)
6 .7 .005 :003	Rosedale, Harry E. Trustee	PO Box 7074
6 .7 .005 :004	Libkuman, Ronald D. Trs	737 Bishop St. Ste. 3000
6 .7 .005 :005	Banning, Scott L. & Souza-Banning, Myra	PO Box 1320
6 .7 .005 :006	Suzuki, Yasuhiro 50% & Suzuki, Takehiro 50%	1-6-4 #301 I Kejiri
6 .7 .005 :007	Sasaki, Kaneomi	2-7-32-304 Edobori
6 .7 .007 :001	Tousignant, James C. & Terry L (property sold to Christopher Agorastos & Wf Leslie (50%), Robert C. Hons (50%))	PO Box 337
6 .8 .001 :001	Richard Smart Trust; Parker Ranch	PO Box 458
6 .8 .002 :007	Waikoloa Land & Cattle Co.	150 Waikoloa Beach Drive
6 .8 .002 :008	Waikoloa Land & Cattle Co.	150 Waikoloa Beach Drive
6 .8 .002 :011	Pangilnan, Marciano & Guadalupe T. c/o Mary A. Alton	2736 Puuhonua St.
6 .8 .002 :012	Waikoloa Land & Cattle Co.	150 Waikoloa Beach Drive
6 .8 .002 :013	Waikoloa Land & Cattle Co.	150 Waikoloa Beach Drive
7 .1 .003 :001	State of Hawaii	
7 .1 .004 :001	State of Hawaii	

APPENDIX B: SUMMARY OF CONSULTATIONS WITH NATIVE HAWAIIAN ORGANIZATIONS

Dr. Charles Langlas consulted with eight Native Hawaiian organizations in the course of research in order to ask for advice on the conduct of research and for suggestions for informants to interview. It seemed especially important to contact organizations based in Waimea, since networking had indicated that Waimea Hawaiians were the ones most likely to be knowledgeable about the project area.

In all, eight organizations were contacted, most by telephoning the organization president, or by letter (see sample consultation letter on the following page). All of the organizations were asked to respond by letter, but only two of them did so: the Office of Hawaiian Affairs (OHA) and Hui Mālama I Nā Kūpuna ʻO Hawaiʻi Nei. Hui Mālama suggested interviewing Henry Auwae, who had already been contacted by the Dr. Langlas. OHA did not respond until late in the investigation, despite repeated letters from Dr. Langlas. In early September, OHA asked that Dr. Langlas explore Mr. Auwae's concerns about burials in the project area, and he did so (see letter to OHA concerning burials, at end). No return letters were received from the other six organizations. Follow-up telephone calls were made to the two Waimea organizations—the *Waimea Hawaiian Civic Club* and the Waimea Homesteaders Association. Both organizations contacted local *kūpuna* to ask if they had information about Native Hawaiian sites in the project area. They learned of no such sites. They also had no suggestions for informants to interview, beyond those already interviewed by Dr. Langlas. Follow-up telephone calls were not made to the other four organizations.

A log of contacts with the Native Hawaiian organizations is provided in the table below.

Table B-1. Log of Contacts with Native Hawaiian Organizations

Organization	Initial Phone Call	Letters Sent	Letters Received	Follow-up Phone Call
OHA	-	2/6,5/16,8/29,	9/3	9/5
Hui Mālama	-	2/6	2/22	-
Waimea Hawaiian Civic Club	6/18	6/24	-	7/12,7/23
Waimea Homesteaders Assn.	6/24	6/25	-	7/12
Ka Lāhui Hawaiʻi	6/24	6/24	-	-
Kona Hawaiian Civic Club	6/25	6/25	-	-
Prince David Kawānanakoa Hawaiian Civic Club (Hilo)	7/23	7/25	-	-
Hilo Hawaiian Civic Club	7/23	7/25	-	-

Sample Consultation Letter

To Whom It May Concern:

This is a letter to inform you of an upcoming project of the U.S. Department of Defense and the U.S. Department of Transportation to improve the Saddle Road on the Island of Hawaii. The enclosed map shows the present Saddle Road (marked W-1, PTA-5, E-2) and some possible new routes that may be used instead of the existing route (W-2 and W-3 on the west side, PTA-1 and PTA-3 in Pohakuloa Training area, E-3 in the Kaumana area on the east).

I (Chuck Langlas) have been hired by the main consultant, Rust Environment and Infrastructure, Inc., to do historical documentary and oral history research to comply with the state and national historic preservation laws, as part of the Draft Environmental Impact Statement for the project. I am searching historical documents and interviewing knowledgeable individuals to (1) learn about the history of the saddle road area (and the areas of the possible road re-alignments), and to (2) identify historic and traditional Hawaiian sites in the area. Any sites identified will be evaluated to determine if they are eligible for the National (or State) Historic Register, and the impact of the road improvement project on the sites will be assessed.

If your group has any suggestions concerning the research-- information on sites or the names of old-timers who may know the history of the various areas--please contact Mr. Langlas (968-6197). If possible, I would appreciate a written response to this letter.

If your group wants to learn more about the project itself, then you may contact Bill Moore (935-0311) who is a planner for the project. If you have concerns about the impact of the project on customary Hawaiian activities in the area, like hunting and gathering, you may contact Pua Kanahele (959-9832), who is acting as consultant for Hawaiian concerns.

Yours sincerely,

Charles M. Langlas
P.O. Box 284
Mt. View, Hawaii 96771

Letter Sent to OHA Concerning Burials

September 24, 1996

Linda Delaney
Land and Natural Resources Division
Office of Hawaiian Affairs
711 Kapi'olani Blvd, Suite 500
Honolulu, HI 96813

Dear Ms. Delaney:

A few weeks ago I spoke with Lynn Lee from your office about the Saddle Road Improvement Project. She told me that concerns about the project were expressed by Henry Auwae at an OHA Board meeting in Waimea on 7/22/96, that he knew of burials in the project area and had asked for help from OHA in making sure the burial sites were handled properly. She asked me to be sure that Mr. Auwae concerns were addressed.

I have been working with Mr. Auwae for some time concerning this project and I spoke with him about his concerns at our last two meetings on 9/17/96 and 9/23/96. I think that he no longer has any concern about the burials he knows about in relation to the project. He said that someone from OHA could call him (961-3669) if there were any question on your part.

On 7/21/96 we (Mr. Auwae and I and Jim Head of PHRI) flew by helicopter along the proposed road corridors in Pohakuloa Training Area (corridor PTA-1) from Mauna Kea State Park west and continued west of PTA (corridors W2 and W3), in order for him to check whether there were burial sites that he knew near to those corridors. We found only one burial site close to the W2 corridor, about 1000 feet away. The site was not pin-pointed, nor inspected. We plan to warn the road construction people to avoid disturbing the area. After the flight, Mr. Auwae still had some question about the how close the corridors were to burials he knows of in between the two corridors. But we looked at the map of the corridors on 9/17/96 and he concluded that the burials were far from both corridors.

On 9/23/96 we flew again by helicopter, this time along the proposed road corridor from Mauna Kea State Park east to Humu'ula Sheep Station (corridor PTA-1) in order to check whether there might be known burial sites close to the corridor in that area. He con concluded that the burials he knows of are far north of the corridor.

I hope this will answer your questions about the issue. If you need further information please let me know.

Sincerely,

Charles Langlas

Dr. Charles Langlas.

APPENDIX C: SAMPLE RELEASE FORM AND NOTE TO INFORMANT

All interview transcripts were given to the informant to review and then the informant was asked to sign a release form. In most cases, the transcripts were sent out with the following "note to interviewee" and the release form, and then the informant was contacted later to determine whether any changes needed to be made in the transcript before the interview material was released. The release form used in this project was designed so that the interviewee could authorize release of the interview material either for the project investigation only, or on a broader level, for general public access.

Note to Interviewee:

I am grateful for your time in letting me interview you for the Saddle Road Improvement Project. I want to use some of the information that you gave me in my report on the history of the Saddle Road area and its historic and traditional cultural places. I may quote you or refer to your interview in the report. Before I use the interview material, I want to make sure that you agree to release it for the public to read. If you do agree to release the information, please sign and return the release form.

Please read over the interview records and make sure that the information seems accurate. Make sure there is nothing which you want to have restricted so that it will not be made public. If there is anything you want changed because it is inaccurate or anything you want restricted from public reading, you should let me know. I'll take care of the changes and give you a revised copy of the interview records before you sign the release form. Otherwise, just keep the interview records as your copy.

Aloha,

Charles (Kale) Langlas.

Telephone: 968-6197
Address: P.O. Box 284, Mt. View, HI 96771

RELEASE OF INTERVIEW RECORDS

Tape recordings made on dates: ______________________________

____

Expanded notes from unrecorded interviews on dates:

____

I, ______________________, hereby grant the rights to these interviews done by me (including tape-recordings, transcripts, notes) to Dr. Charles Langlas, researcher and to his employer, PHRI (Paul H. Rosendahl, Inc.) and I release my rights in the interview records to them, as follows, subject to any restrictions listed below.

(a) Quotes from the interviews may be used as part of the final report on historic and cultural sites for the Saddle Road Improvement Project or reference may be made to the information in them. Copies of interview records may be made available to the Hawaii State Historic Preservation Division, if they wish to check the evidence.

Yes or no __________

(b) The interview records may be used by Dr. Langlas for scholarly publication.

Yes or no __________

(c) The interview records may be deposited in a library for general public access.

Yes or no __________

Restrictions:

Narrator	Interviewer-witness
Date of Release	Date of Release

APPENDIX D: INFORMANTS INTERVIEWED

A. EAST SIDE

Kaumana and Piihonua

Ah San, Johnny (b. 1907, from 1933 worked for Forestry Dept. at Piihonua and elsewhere; 2 untaped interviews)

Auwae, Henry (b. 1906, visited area sites between 1912 and 1918; taped interviews # 4, 5, 8, 9; untaped interview & site visit # 7)

Bachman, Ron (Hawaii State Forestry and Wildlife; brief telephone conversation)

Fujii, Tomoichi (b. 1922 at Kaumana and raised there; "Kaumana group" taped interview, later individual interview)

Mattos, Albert and Mattos Stephen (b. at Kaumana and raised there, untaped conversations)

Nobriga, Fred (b. 1951 at Waipi'o and ranches today at Pu'u 'Ō'ō; untaped conversation)

Omoto, Kiyomi (b. 1923 at Kaumana, lived there to present; "Kaumana group" taped interview)

Tanouye, Tadeo (b. 1923 at Kaumana, lived there to present; "Kaumana group" taped interview; later untaped interview & site visit)

Shipman's Pu'u 'Ō'ō Ranch

Bergin, Bill (b. 1940, worked at Shipman ranch c. 1952-1954, caretaker of Saddle House from 1976; one taped interview & site visit)

Blackshear, Roy (b. 1923, Shipman descendant, first visited Pu'u 'Ō'ō Ranch 1931, President of W. H. Shipman, Ltd. 1976-1994; one taped interview)

Carlsmith, Donn W. (Pu'u 'Ō'ō area resident; telephone conversation)

Devine, Dick (b. 1907, manager of Shipman's Hilo Meat Market 1933-1972, first visited Pu'u 'Ō'ō Ranch c. 1940; one taped interview)

Imoto, Toshi (b. 1928 and raised at Pu'u 'Ō'ō Ranch, and worked there 1945-1960; one taped interview)

Kalawe, John (raised in Hilo, uncle worked at Pu'u 'Ō'ō)

Olivera, Eugene (b. 1923, worked at Pu'u 'Ō'ō Ranch c. 1942-1975; two taped interviews)

B. SADDLE AND WEST SIDE

Humu'ula and Ka'ohe

Ah San, Johnny (See above; worked for CCC at Pohakuloa c. 1935, for Forestry Department there c. 1949)

Auwae, Henry (See above; visited at Humu'ula Sheep Station between 1912 and 1918; taped interviews # 4, 5, 6, 9; untaped interview & site visit # 7)

Fujii, Tomoichi (See above; worked for Parker Ranch at Humu'ula c.1941-1960,1970-1985; "Kaumana group" taped interview; individual taped interview by Rita Pregana)

Greenwell, L. Radcliffe (Rally) (b. 1913, worked for Parker Ranch 1934-45,1956-71, in charge of shearing at Humu'ula 1934-45; two taped interviews)

Kaniho, Sonny (b. 1922, lived at Humu'ula Sheep Station 1923-28, visited there 1937-40; father worked for Parker Ranch; untaped interview and site visit #1, taped interview #2)
Kimura, Yutaka (b. 1905, worked for Parker Ranch 1918-1967, at Humu'ula for shearing season 1919, 1924-6; two taped interviews)
Lee, Ah Fat (b. 1919, worked at Pohakuloa Ranger Station 1955-1984, conversation)
Lindsey, Johnny (b. 1914, worked for Parker Ranch 1929-1941, worked at Humu'ula for shearing season from c. 1930; taped interview #3 by C. Langlas and Keola Awong)
Paris, Bill (b. 1922, at PTA in National Guard from 1948; one taped interview by C. Langlas)
Pearthree, Eric (archaeologist, worked on cave survey of PTA in 1995; one untaped conversation)

Waiki'i and Ke'āmoku

Auwae, Henry (See above; visited area sites 1912 to 1918)
Ah Sam, Henry (b. 1923, worked for Parker Ranch at Ke'āmoku 1940-1942,1948-71; two short untaped interviews)
Fujii, Tomoichi (See above; worked for Parker Ranch at Waiki'i c.1960-1970)
Greenwell, Rally (See above; in charge of Ke'āmoku section 1934)
Kaniho, Sonny (See above; first went to Ke'āmoku c. 1932)
Keakealani, Sonny (b. 1943 and raised at adjoining Pu'uanahulu, worked for Pu'u Wa'awa'a Ranch there 1962-1975, learned trails from father and grandfather who lived at Pu'uanahulu; one untaped conversation)
Kimura, Yutaka (See above; first went to Waiki'i to pick corn 1920)
Paris, Bill (See above; visited from young age at grandfather's Pu'u Wa'awa'a Ranch, which borders Ke'āmoku; parts of taped interviews by C. Langlas and Kepā Maly concern Ke'āmoku area)

APPENDIX E: DESCRIPTIONS OF MILITARY SITES

There are thirty five military sites within the project APE *(Figure 10)*. No State Inventory of Historic Place numbers were assigned to the military sites. *Table E-1* (at the end of this appendix) contains measurements for all structures encountered, and is located at the end of this appendix.

Temporary Site No: 1522-112
Feature Type: Enclosure
Feature Function: Military
Apparent Age: Historic-Recent
Adjacent Terrain: Upland pasture
Vegetation Zone: Open *koa* forest with *mamane*
Location: Alternative W-3; it is c. 21 m at 146° from a staked marked W3 Centerline 110+980 to the site datum
Elevation: 1,490 m
Dimensions: 2.6 m by 2.0 m by 0.76 m
Description: This is a collapsed enclosure located on a small pahoehoe knoll. The feature is C-shaped in plan view and is constructed of basalt cobbles stacked two-three courses high. The interior of the feature is filled with loose cobbles and small boulders 0.20-0.60 m in diameter. Ammunition and linkage belts were found both within and outside of the structure.

Temporary Site No: 1522-118
Feature Type: Depression (9)
Feature Function: Military
Apparent Age: Historic-Recent
Adjacent Terrain: Rolling hills; upland pasture with pahoehoe outcrops throughout the area
Vegetation Zone: Open *koa* forest with *mamane*
Location: Alternative W-2; Site datum is c. 41 m at 287° from a stake marked W2 Centerline 114+100.
Elevation: 1565 m
Dimensions: 140 m by 130 m
Description: The site boundaries run from about 20 m east of the LT W2 114+100 stake to the LT W2 113+980 stake. All structures at the site are depressions, probably used by the military as foxholes for training exercises. Recent military trash (cans, cartridges, MRE bags) was found within and near the depressions.

Temporary Site No: 1522-121
Feature Type: Complex (5)
Feature Function: Military
Apparent Age: Historic-Recent
Adjacent Terrain: Parker Ranch pasture consisting of rolling hills with scattered basalt outcrops
Vegetation Zone: Open *koa* forest with *mamane*
Location: Alternative W-3; datum at Structure 121-1 is found 43.1 m at 43.40° from a stake marked W3 centerline 113+800
Elevation: 1,540 m
Dimensions: 130 m by 200 m by 0.90 m high

Description: This site consist of three foxholes and two stacked walls. All structures were recorded as a single site. Recent military trash (cans, cartridges, MRE bags) was found inside and outside the structures.

Temporary Site No: 1522-300
Feature Type: Complex (15)
Feature Function: Military
Apparent Age: Historic to Present
Adjacent Terrain: Flat plain on the south side of Mauna Kea
Vegetation Zone: Uplands; grasses, *naio*, and *mamane* trees
Location: PTA-1 CL 11+380 (site datum)
Elevation: 1,730 m
Dimensions: 50 m by 50 m
Description: This site includes two probable walkways, a jeep road, a trench, foxholes, and trash. The two walkways and the road are defined by parallel alignments of large cobbles to small boulders. The trench (3 m by 0.8 m by 1.1 m) has straight sides, suggesting it may have been a latrine. The foxholes are 1-1.8 m by 1.5 m. Most of the foxholes are partially to completely filled. Trash is lightly scattered over the site. The trash includes a wooden squad tent stake and iron bar, aluminum top tent stakes, communication wire, electrical wiring from a truck, steel beer cans opened with both openers and knife blades, C-ration cans opened with P-38 and a knife blade, MRE Ration envelopes, 5.56 mm and 7.62 mm blank rounds, linked blanks, military first aid remains, and miscellaneous WWII era trash. Much of the portable remains date to pre-Vietnam era. This area is probably a semi-permanent training area dating to WWII and later.

Temporary Site No: 1522-302
Feature Type: C-Shaped Wall
Feature Function: Military Training
Apparent Age: Early Historic/Recent
Adjacent Terrain: Located on glacial outwash terrace with two-three m deep entrenched drainage about 25 m to the west and smaller drainage about 10 m to the east.
Vegetation: Grasses, *naio*, and *māmane* trees
Location: 14.3 m at 252° from stake #1 RT 18+940. The north end of the feature is about three-four m south of the RT side of PTA-1 corridor.
Elevation: 1,910 m
Dimensions: 9 m by 5.5 m by 1.3 m
Description: Waterworn stones obtained from nearby drainage were used in the construction of this feature. The stones are 0.10–1.3 m in diameter, and it appears the larger stones were placed first, and smaller stones were then placed around the larger ones. The smaller stones are stacked up to five high between the boulders. There is a gap roughly 0.60 m wide in the wall, and there is silt in the gap.

A single test unit was excavated at Site 21148. The test unit (EU-35) was 1 by 1 m square, and located near the center of the feature. Four natural layers were encountered, and excavation was terminated at bedrock 0.54 mbs. No cultural material of any type occurred within the test unit.

Temporary Site No: 1522-305
Feature Type: Cairn
Feature Function: Marker
Apparent Age: Historic
Adjacent Terrain: Fairly level to slight western trending slopes with thin stony soils
Vegetation: Grasses; *naio* and *māmane* trees, fennel, *'āheahea*
Location: Site datum is about 27.5 m at 320° from a stake marked CL 25+180. Datum is five-seven m west of CL.

Elevation: 2,030 m
Dimensions: 2.5 m by 1.5 m
Description: There is a small alignment joined to the cairn by *pāhoehoe* outcropping; the alignment extends to the northwest. The cairn alone measures 1.3 m by 1.2 m by 0.8 m high. The alignment is 1.3 m long. The cairn consists of four courses of roughly stacked small to medium *pāhoehoe* boulders. The alignment is constructed of three *pāhoehoe* boulders (0.15–0.30 m in diameter).

Temporary Site No: 1522-306
Feature Type: Complex (30)
Feature Function: Military Base Cantonment
Apparent Age: Historic-Recent
Adjacent Terrain: Fairly level to slight western trending slopes with thin stony soils
Vegetation: Grasses; *naio* and *māmane* trees, fennel, *"āheahea*
Location: Site is partially within PTA-1, and begins at Station 19+800 on the west, and ends at 20+200 on the east.
Elevation: 1,950 to 1,980 m
Dimensions: 400 m along corridor.
Description: These buildings are located within the larger base cantonment *(Figure E-1)*. All of the buildings are currently being used at the base. Each building is constructed on a formed cement foundation *(Table E-1)*.

Temporary Site No: 1522-307
Feature Type: Complex (8)
Feature Function: Various Military
Apparent Age: Historic-Modern
Adjacent Terrain: Gently south sloping terrain cut by intermittent drainage
Vegetation Zone: *Naio* and *mamane* trees, *'aheoheo*, fountain grass
Location: Site begins at Station 10+220 on the west and extends to Station 10+300 on the east
Elevation: 1,695 m
Dimensions: 80 m along corridor
Description: Eight basalt structures are located along the PTA-1 alignment as it crosses along the south slopes of Mauna Kea through Pohakuloa Training Area. The structures consist of stacked walls either with or without an associated excavation. There are also excavations that are not associated with wall structures. The surface remains at the site consist of cartridges and military trash as well as other miscellaneous civilian trash.

Temporary Site No: 1522-308
Feature Type: Complex (103)
Feature Function: Various Military
Apparent Age: Historic-Modern
Adjacent Terrain: Gently south sloping terrain cut by intermittent drainage
Vegetation Zone: Uplands; grasses, *naio* and *mamane* trees, *'aheoheo*, fountain grass
Location: Site begins at Station 10+300 and extends down the PTA-3 alignment to Station 11+800
Elevation: 2,075 to 1980 m
Dimensions: 1.5 kilometer by 100 m wide
Description: This site consists of military structures within the PTA-3 alignment where it crosses the western portion of Pohakuloa Training Area. Structure 308-1 is on the west (just as PTA-3 turns south of the parallel-running P.A.-1) and Structure 308-103 is just north of the AD 1843 lava flow (heavily bulldozed in this area). Many stacked walls of various configurations (C-, L-, U-shaped) were found; as well as numerous excavations, both filled and unfilled. The surface remains consisted of cartridges and other military trash. The soil deposit at the site consisted of three m of non-cultural volcanic ash.

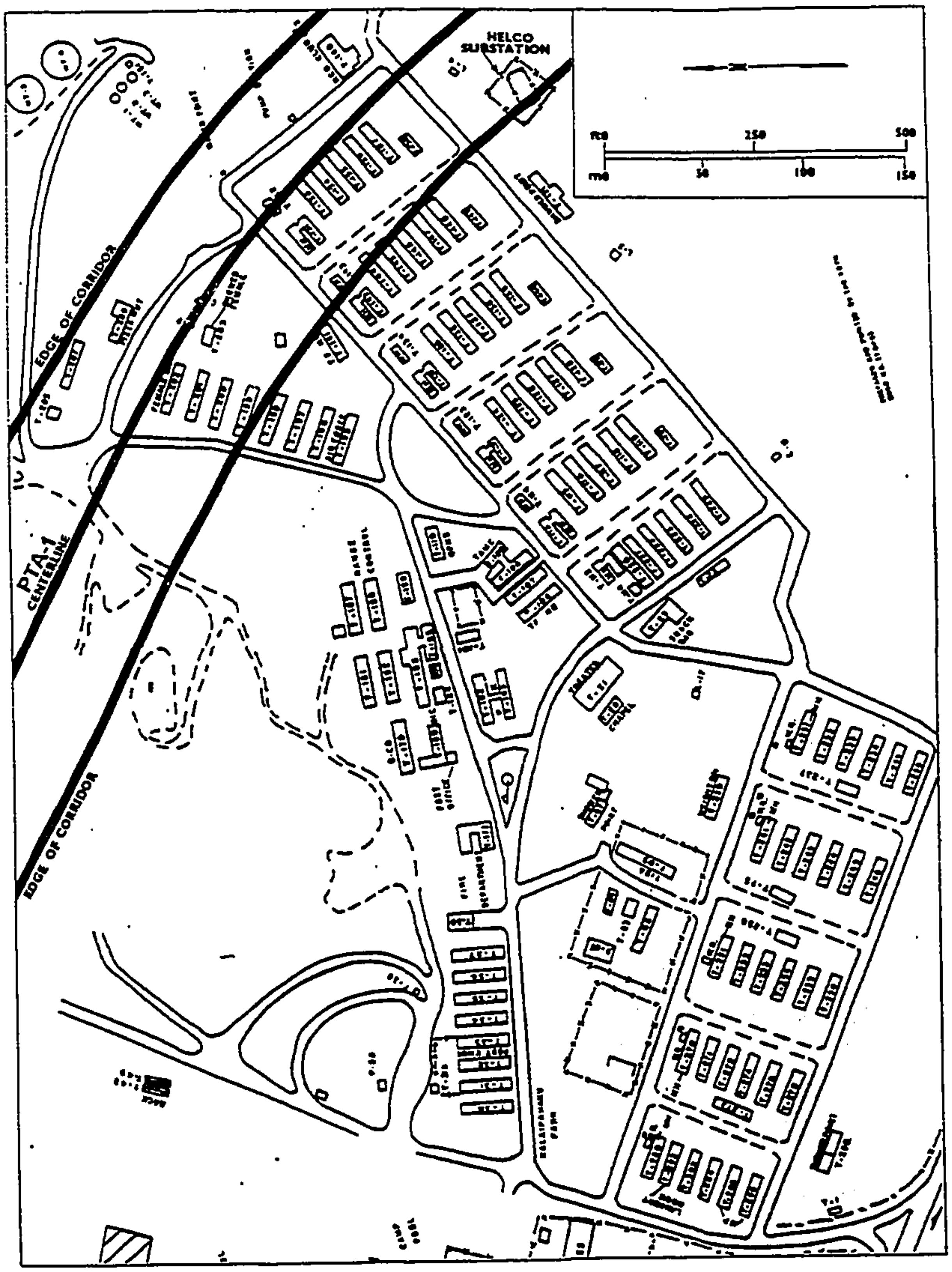

Figure E-1. Site 306, PTA Base Cantonment

Temporary Site No: 1522-315
Feature Type: Complex (65)
Feature Function: Various Military
Apparent Age: Historic-recent
Adjacent Terrain: Gentle slopes on southwest side of Mauna Kea, near Pu'u Ke'eke'e
Vegetation Zone: Uplands, *naio* and *mamane* trees, *'aheoheo,* and fountain grass**Location:** Structures begin at Sta. 114+520 on the west and extends to the east to about Sta. 115+720. No overall site datum was set at this site.
Elevation: 1,585–1,664 m
Dimensions: 1.2 km by 100 m
Description: The site consists of military structures found within the W-2 corridor as it passes through Pohakuloa Training Area. Structure 315-1 is on the west near the western PTA boundary, while 315-64 lies to the east, near the intersection of W-2 and Ex-1. Many stacked walls and structures of different plan view shapes were noted, as were a number of excavations, both unfilled and filled. There was military trash and
cartridges scattered in the site area. The soil deposit at the site consisted of two-three meters of non-cultural volcanic ash.

Temporary Site No: 1522-318
Feature Type: Complex (34)
Feature Function: Various Military
Apparent Age: Historic-Modern
Adjacent Terrain: Gently south sloping terrain cut by intermittent drainage
Vegetation Zone: *Naio* and *mamane* trees, *'aheoheo,* fountain grass
Location: Site begins at Station 10+860 on the west and extends to Station 11+740.
Elevation: 1,720 to 1,760 m
Dimensions: 0.9 km along corridor
Description: Thirty four basalt structures are located along the PTA-1 alignment as it crosses along the south slopes of Mauna Kea through Pohakuloa Training Area. The structures consist of stacked walls either with or without an associated excavation. There are also excavations that are not associated with wall structures. The surface remains at the site consist of cartridges and military trash as well as other miscellaneous civilian trash.
Temporary Site No: 1522-319
Feature Type: Complex (2)
Feature Function: Various Military
Apparent Age: Historic-Modern
Adjacent Terrain: Gently south sloping terrain cut by intermittent drainage
Vegetation Zone: *Naio* and *mamane* trees, *'aheoheo,* fountain grass
Location: Site begins at Station 11+960 on the west and extends to Station 12+090.
Elevation: 1,800 m
Dimensions: 130 m along corridor
Description: Two basalt structures are located along the PTA-1 alignment as it crosses along the south slopes of Mauna Kea through Pohakuloa Training Area. The structures consist of stacked walls either with or without an associated excavation.

Temporary Site No: 1522-320
Feature Type: Complex (9)
Feature Function: Various Military
Apparent Age: Historic-Modern
Adjacent Terrain: Gently south sloping terrain cut by intermittent drainage
Vegetation Zone: *Naio* and *mamane* trees, *'aheoheo,* fountain grass
Location: Site begins at Station 13+610 on the west and extends to Station 13+770.

Elevation: 1,800 m
Dimensions: 160 m along corridor
Description: Nine basalt structures are located along the PTA-1 alignment as it crosses along the south slopes of Mauna Kea through Pohakuloa Training Area. The structures consist of stacked walls either with or without an associated excavation.
Temporary Site No: 1522-321
Feature Type: Complex (7)
Feature Function: Various Military
Apparent Age: Historic-Modern
Adjacent Terrain: Gently south sloping terrain cut by intermittent drainage
Vegetation Zone: *Naio* and *mamane* trees, *'aheoheo*, fountain grass
Location: Site begins at Station 14+330 on the west and extends to Station 14+740.
Elevation: 1,795 m
Dimensions: 410 m along corridor
Description: Seven basalt structures are located along the PTA-1 alignment as it crosses along the south slopes of Mauna Kea through Pohakuloa Training Area. The structures consist of stacked walls either with or without an associated excavation.

Temporary Site No: 1522-322
Feature Type: Complex (8)
Feature Function: Various Military
Apparent Age: Historic-Modern
Adjacent Terrain: Gently south sloping terrain cut by intermittent drainage
Vegetation Zone: *Naio* and *mamane* trees, *'aheoheo*, fountain grass
Location: Site begins at Station 15+490 on the west and extends to Station 15+810.
Elevation: 1,810 to 1,815 m
Dimensions: 320 m along corridor
Description: Eight basalt structures are located along the PTA-1 alignment as it crosses along the south slopes of Mauna Kea through Pohakuloa Training Area. The structures consist of stacked walls either with or without an associated excavation.

Temporary Site No: 1522-323
Feature Type: Complex (3)
Feature Function: Various Military
Apparent Age: Historic-Modern
Adjacent Terrain: Gently south sloping terrain cut by intermittent drainage
Vegetation Zone: *Naio* and *mamane* trees, *'aheoheo*, fountain grass
Location: Site begins at Station 16+740 on the west and extends to Station 16+760.
Elevation: 1,835 m
Dimensions: 20 m along corridor
Description: Three basalt structures are located along the PTA-1 alignment as it crosses along the south slopes of Mauna Kea through Pohakuloa Training Area. The structures consist of stacked walls either with or without an associated excavation.

Temporary Site No: 1522-324
Feature Type: Complex (4)
Feature Function: Military revetments
Apparent Age: Historic-Modern
Adjacent Terrain: Gently south sloping terrain cut by intermittent drainage
Vegetation Zone: *Naio* and *mamane* trees, *'aheoheo*, fountain grass
Location: Site begins at Station 17+150 on the west and extends to Station 17+950.
Elevation: 1,860 to 1,880 m

Dimensions: 0.8 km along corridor
Description: Four earthen revetments are located along the PTA-1 alignment as it crosses along the south slopes of Mauna Kea through Pohakuloa Training Area. The revetments are structures consist of stacked walls either with or without an associated excavation.

Temporary Site No: 1522-325
Feature Type: Complex (7)
Feature Function: Various Military
Apparent Age: Historic-Modern
Adjacent Terrain: Gently south sloping terrain cut by intermittent drainage
Vegetation Zone: *Naio* and *mamane* trees, *'aheoheo*, fountain grass
Location: Site begins at Station 18+500 on the west and extends to Station 18+950.
Elevation: 1,900 to 1,925 m
Dimensions: 450 m along corridor
Description: Seven basalt structures are located along the PTA-1 alignment as it crosses along the south slopes of Mauna Kea through Pohakuloa Training Area. The structures consist of stacked walls either with or without an associated excavation.

Temporary Site No: 1522-326
Feature Type: Complex (3)
Feature Function: Various Military
Apparent Age: Historic-Modern
Adjacent Terrain: Gently south sloping terrain cut by intermittent drainage
Vegetation Zone: *Naio* and *mamane* trees, *'aheoheo*, fountain grass
Location: Site begins at Station 22+350 on the west and extends to Station 22+500.
Elevation: 2,008 to 2,010 m
Dimensions: 150 m along corridor
Description: Three basalt structures are located along the PTA-1 alignment as it crosses along the south slopes of Mauna Kea through Pohakuloa Training Area. The structures consist of stacked walls either with or without an associated excavation.

Temporary Site No: 1522-327
Feature Type: Complex (5)
Feature Function: Various Military
Apparent Age: Historic-Modern
Adjacent Terrain: Gently south sloping terrain cut by intermittent drainage
Vegetation Zone: *Naio* and *mamane* trees, *'aheoheo*, fountain grass
Location: Site begins at Station 22+700 on the west and extends to Station 23+110.
Elevation: 2,015 m
Dimensions: 410 m along corridor
Description: Three basalt structures are located along the PTA-1 alignment as it crosses along the south slopes of Mauna Kea through Pohakuloa Training Area. The structures consist of stacked walls either with or without an associated excavation.

Temporary Site No: 1522-328
Feature Type: Complex (62)
Feature Function: Various Military
Apparent Age: Historic-Modern
Adjacent Terrain: Gently south sloping terrain cut by intermittent drainage
Vegetation Zone: *Naio* and *mamane* trees, *'aheoheo*, fountain grass
Location: Site begins at Station 23+250 on the west and extends to Station 24+820.
Elevation: 2,015 to 2,035 m

Dimensions: 1.6 km along corridor
Description: Sixty two basalt structures are located along the PTA-1 alignment as it crosses along the south slopes of Mauna Kea through Pohakuloa Training Area. The structures consist of stacked walls either with or without an associated excavation.

Temporary Site No: 1522-329
Feature Type: Complex (59)
Feature Function: Various Military
Apparent Age: Historic-Modern
Adjacent Terrain: Gently south sloping terrain cut by intermittent drainage
Vegetation Zone: *Naio* and *mamane* trees, *'aheoheo*, fountain grass
Location: Site begins at Station 25+850 on the west and extends to Station 26+900.
Elevation: 2,015 to 2,035 m
Dimensions: 1.2 km along corridor
Description: Sixty two basalt structures are located along the PTA-1 alignment as it crosses along the south slopes of Mauna Kea through Pohakuloa Training Area. The structures consist of stacked walls either with or without an associated excavation.

Temporary Site No: 1522-513
Feature Type: Complex (4)
Site Function: Military
Apparent Age: Historic/Recent
Adjacent Terrain: Mostly flat area with a few small drainages
Vegetation: Open *māmane-naio* forest with subalpine shrubs
Location: Alternative EX-2; c. 20 m east of Centerline Sta. 130.120 along the main alignment through Mauna Kea State Park
Elevation: 1,970 m
Dimensions: 42.0 m by 8.0 m
Description: All features are located on a ridge overlooking Saddle Road. The site is obviously for military training. According to the UXO (Unexploded Ordinance) advisor, the site appeared to be a 'Deliberate Firing Position' used perhaps as an overnight camp. There was military gear on the surface of the site, including cartridges and ammunition clips.

Temporary Site No: 1522-514
Feature Type: Concrete Structure
Feature Function: Military Training
Apparent Age: Historic/Recent
Adjacent Terrain: Flat plain running south from the south slope of Mauna Kea
Vegetation: Open *māmane-naio* forest with subalpine shrubs
Location: This feature was found on the Alternate PTA-1 corridor about 24.3 m at 292° from stake marked #1 POC 21+400. It is also located 33 m at 40° from stake marked #RT POC 21+400.
Elevation: 1,980 m
Dimensions: 3.4 m by 2.1 m by 0.4 m high
Description: This is a concrete pad located just to the west of the entrance to Mauna Kea State Park. This area is quite flat and there are indications throughout that the area has been used for military camping. The pad is not over 0.4 m high and is broken in areas. It is constructed of concrete mixed with basalt pebbles. No rebar or other reinforcement appears to have been used in construction. There were originally two sections, with the southeastern section measuring c. 1.9 square m and the northeast measuring about 2.0 m by 0.9 m (interior measurements). There are a few small pieces of broken concrete running ESE from the eastern wall. There is also a broad metal "trough" embedded in the top of the eastern wall. Surface material at the feature included planed 2x4 lumber, rubber, metal, and cardboard.

Temporary Site No: 1522-515
Feature Type: Concrete Structure
Feature Function: Military Training
Apparent Age: Historic/Recent (1950s)
Adjacent Terrain: Flat plain running south from the south slope of Mauna Kea
Vegetation: Open *māmane-naio* forest with subalpine shrubs
Location: Alternative PTA-1; this feature is located c. 39.9 m at 249° from a stake marked #1 Centerline POC 21+280. The feature is also about 3.0 m inside of the right corridor line of the #1 corridor.
Elevation: 1,980 m
Dimensions: 15.0 m by 8.0 m
Description: This site is located in the same flat area as Site 514. There is military trash throughout the area and a concrete storage bunker for explosives is outside the corridor to the southwest. There is also a large tent pad nearby. This feature is built of concrete and is reinforced with 6 by 6 inch gridded wire. The west wall of the feature has been pushed in by heavy machinery and is lying in the interior of the feature. To the north of the feature is a trench and a mound full of basalt and broken concrete.

Temporary Site No: 1522-516
Feature Type: C-shaped Wall
Feature Function: Military Training
Apparent Age: Historic/Recent
Adjacent Terrain: The site is located in the uplands on a southwest-trending slope on the southwest side of Mauna Kea. The terrain is gently sloping land with low hummocks. There is an intermittent drainage to the east.
Vegetation: Open *māmane-naio* forest with subalpine shrubs; east side of a small grove of *māmane* and *naio* trees.
Location: This site was found along Alternative PTA-1 across Mauna Kea State Park. It is about 19.55 m at 290° to the site from a stake marked #1 Centerline 21+010.12, and 13.65 m at 09° from the datum of Site 517, it is 25.5 m at 208° from Centerline 20+980.
Elevation: 1,983 m
Dimensions: 4.0 m by 3.0 m by 0.3 m high
Description: Stones for constructing the feature were obtained from cobble terraces resulting from the Post-Pleistocene run-off of Makanaka Glacial Member (Porter 1979). The stones are 0.10-0.55 m in diameter and are basalt. The wall is roughly stacked; it is three-four rocks wide at the base, but tapers to about two wide in the upper course. The structure opens at 305°. There is a shallow depression in the center of the C-shape. Three rusted cans were found near the datum, with another about 6.0 m at 35° from the datum. A dog skull (with right mandible) lies c. 4 m at 10° from the datum. This feature appears to be associated with Site 1522-517.

One test unit was excavated at Site 20860. The test unit was 1 by 1 m square, and placed in the interior the low C-shape constructed of cobbles and small boulders. Three cultural layers and two natural layers were encountered. The upper three layers contained small quantities of aluminum foil, metal cans, and plastic eating utensils. No cultural materials were encountered in the lower two layers.

Temporary Site No: 1522-517
Feature Type: Circular Alignment
Feature Function: Military Training
Apparent Age: Historic/Recent
Adjacent Terrain: The site is located in the uplands on a southwest-trending slope on the southwest side of Mauna Kea.
Vegetation: Open *māmane-naio* forest with subalpine shrubs

Location: This site was found along Alternate PTA-1 across Mauna Kea State Park. It is about 13.65 m at 189° from the site datum at Site 516.
Elevation: 1,980 m
Dimensions: 4.0 m by 3.5 m by 0.3 m high
Description: This site is located very near to Site 516 and was probably associated with the site. The feature consists of a circular alignment of waterworn basalt cobbles 0.13-0.35 m in diameter. The alignment is generally one-stone wide. There is a gap about 0.4 m wide in the northeast portion of the feature. There are three small waterworn basalt boulders outside of the ring, 06°, 27°, and 89° from the datum.

Temporary Site No: 1522-521
Feature Type: L-shaped Wall
Feature Function: Military
Apparent Age: Recent
Adjacent Terrain: This site sits on the 1843 'a'ā lava flow. Pu'u Nene is about 50 m to the north.
Vegetation Zone: Open *koa* forest with *mamane*
Location: Alternative EX-2; the datum for this site 8.7 m at 257° from Sta. 137.860. It is also 19.7 m at 206° from Sta. 137.860 stake to Section 1 of Site 519.
Elevation: 2,015 m
Dimensions: 6.0 m by 3.0 m by 0.7 m high
Description: Section 1 of Site 519 is c. 25 m north of this site, and SR 200 is about 15 m to the north. This site may be a quickly constructed "Deliberate Firing Position." The two legs of the "L" intersect toward SR 200. The wall is constructed of 'a'ā 0.03-0.70 m in diameter piled up to five courses high. The northern wall abuts a rocky ridge on the northwest, and the wall continues to the west. This western extension abuts a large boulder about 1.5 m long. The western wall consists of large 'a'ā cobbles (c. 0.40 m dia.) stacked up to three high. The area southeast of this wall may have been excavated slightly to serve as another firing position.

Temporary Site No: 1522-522
Feature Type: C-shaped Wall (2)
Feature Function: Military
Apparent Age: Recent
Adjacent Terrain: This sites sits on the 1843 'a'ā flow.
Vegetation Zone: Open *koa* forest with *mamane*
Location: Alternative EX-2 & PTA-3; Sta. 137+620 is 35.6 m at 10° from the site datum. The stake marked #3 12+700 is 28.50 m at 10° from site datum.
Elevation: 2,013 m
Dimensions: 7.3 m (160-340°) by 0.70 m by 1.30 m high
Description: One wall is constructed of tabular pieces of 'a'ā 0.05 to 0.30 m in diameter. The pieces are stacked three to four courses high. The inside of the C-shape measures 2.9 by 4.2 m. The second C-shape is 12 to 13 m to the south of the first. It consists of 'a'ā cobbles and small boulders (to 0.8 m diameter) roughly stacked seven or eight courses high. On the interior floor of this feature are blank cartridges and parachute cord.

Temporary Site Number: 1522-524
Feature Type: Enclosure
Feature Function: Military
Apparent Age: Recent
Adjacent Terrain: The site is on the 1855 'a'ā flow
Vegetation Zone: Open *koa* forest with *mamane*
Location: Alternative EX-3; site datum is located c. 56.50 m at 296° from a stake marked Centerline POC 142+994.179 and 31 m from stake marked Centerline 143+080.

Elevation: 1,952 m
Dimensions: 1.5 m by 1.3 m by 0.75 m high
Description: The structure is no more that eight meters south of SR 200. The enclosure is generally oval in plan view with the long axis oriented northwest to southeast. There are three boulders on the western side of the feature, and one large boulder, over a meter in diameter, on the southeastern side. The enclosure walls (0.3-0.6 m in diameter) consist of 'a'ā boulders stacked three-four courses high; the walls encircle a depression. Cardboard and brown bottle glass were found at the feature.

Temporary Site No: 1522-526
Feature Type: U-shaped Wall
Feature Function: Military
Apparent Age: Recent
Adjacent Terrain: 1843 'a'ā flow.
Vegetation Zone: Open *koa* forest with *mamane*
Location: Alternative EX-2; the datum for this site is c. 10-12 m northeast of Centerline Sta. 137.165. It is also 27.7 m at 125° from Centerline Sta. 137.140 (eastern boundary of PTA).
Elevation: 2,010 m
Dimensions: 6.0 m by 5.0 m by 0.85 m high
Description: This site is built on a fairly flat shelf of basalt. The wall consists of slabs and chunks of stones 0.13-0.60 m in diameter. These stones are two wide on the bottom, and one wide above that, and are stacked up to five courses high. The curved portion of the U-shape is the highest section of the feature. The structure opens up at about 280°. Surface material at the site consisted of broken clear and brown bottle glass and a rifle cartridge.

***Temporary Site No:** 1522-535*
Feature Type: Wall (16)
Feature Function: Military
Apparent Age: Recent
Adjacent Terrain: Uplands; south slope of Mauna Kea in a broad area between two *pu'u.*
Vegetation Zone: Open *mamane-naio* forest with subalpine shrubs
Location: Alternative PTA-1; the site begins at the eastern boundary of the PTA at Sta. #1 CL 27+286.57 and passes c. 780 m east to Sta. #1 CL 28+069.57.
Elevation: 2,110 m
Dimensions: 783 m by 60 m
Description: The structures in this site occurred in six groups based on association with distinct topographic features (e.g. ridges, rises, and outcrops). When multiple structures were found in the group, they were numbered sequentially starting with the centerline and moving out toward the staked corridor boundaries.

Temporary Site Number: 1522-541
Feature Type: Complex (3)
Feature Function: Military
Apparent Age: Modern
Adjacent Terrain: This site is located on a bedrock outcrop in rolling pasture
Vegetation: Open *māmane-naio* forest with subalpine shrubs
Location: Alternative Original PTA-1; site datum is c 15.9 m at 240° from Sta. #1 RT 29+320
Elevation: 2,020 m
Dimensions: 26.0 m by 17.0 m by 1.6 m high
Description: This site consists of three features discussed below. The shape of features 1 and 2 were unique within the project area. A test unit was excavated within Feature 1 to assist in determining the age and function of the site. The lack of any cultural debris precludes a definitive assessment of age and

function, but their location on a 1935 flow, and proximity to military training features suggests that the site is of modern military origin.

Temporary Site No: 1522-542
Feature Type: Wall (46), Depression (18)
Feature Function: Military
Apparent Age: Recent
Adjacent Terrain: North-south flowing 'a'ā ridges with pasture in between
Vegetation Zone: Open *mamane-naio* forest with subalpine shrubs
Location: Alternative PTA-1; this site begins at Sta. #1A CL 10+540 and extends south to Sta. #1A CL 11+320. All structures up to 30 m away on either side of the CL were included.
Elevation: 2,028 m
Dimensions: 790 m by 60 m
Description: This site consists of many structures on top of and alongside a narrow 'a'ā ridge. The walls at this site are roughly stacked and include straight walls as well as C-shaped, U-shaped, and L-shaped walls. Many of the enclosing walls have small depressions (possible excavated areas) in the interior. Surface materials at the site include various military hardware such as cartridges (7.62 and 5.56 mm), steel cans, batteries, and wire.

Temporary Site Number: 1522-545
Feature Type: Complex (4)
Feature Function: Military
Apparent Age: Recent
Adjacent Terrain: Scattered 'a'ā ridges separated by pastureland
Vegetation Zone: Open *mamane-naio* forest with subalpine shrubs
Location: Alternative PTA-1; about 30 m at 202° from the stake marked #1A Centerline 11+140
Elevation: 2,028 m
Dimensions: 72 m by 54 m by 0.66 m high
Description: This site consists of short pahoehoe walls. All features are constructed of stacked rocks and appear to be associated with 'a'ā ridges: the walls are near 'a'ā ridges and one wall incorporates a portion of a ridge.

Temporary Site Number: 1522-553
Feature Type: Concrete Structure
Feature Function: Military Training
Apparent Age: Historic-recent
Adjacent Terrain: Flat *pāhoehoe* from the AD 1881 flow
Vegetation: Closed *'ōhi'a* rain forest
Location: Alternative E-3; the site datum is located c. 28 m at 344° from the staked marked Centerline E2 20+180.
Elevation: 580 m
Dimensions: 11.0 m by 5.0 m by 0.9 m high
Description: This site is in a mostly flat area south of SR 200 R-O-W. It is also south (160°) of the water tank at Upper Kaūmana City. This site is a foundation; it has concrete footers with bolts projecting from the top. The concrete includes gravel. Exterior footings are 0.16 m wide by 0.12 m high. The exterior footings have three openings that may have served for doorways. There are two doorways on the north that step down onto a porch. The porch measures c. 5.25 m by 1.10 m by 0.45 m high, and the porch is built of basalt stones stacked four to five courses high. The stones are faced and cemented. The northeast corner of the porch sits on a square (0.25 square m by 0.33 m high) concrete footer. Just to the south of the doorway, on the southeast, is a single step 1.2 m by 0.35 m by 0.30 m high), also of concrete. The interior wall footings are 0.10 m wide by 0.12 m high. The interior of the feature is divided into five or more smaller compartments. One compartment, near the southwest corner, measures c. 0.9 m square by

0.15 m deep. The bottom of the compartment is slightly below the surrounding floor level and at the time of this recording was full of water. The central portion of the foundation (measuring 5.7 m by 1.6 m) is broken and the broken material has been piled into a mound on the east. The mound measures 0.3-0.4 m high. There are two other small concrete structures (appearing to consist of a box and a support) located c. 100 m at 40° from the center of this structure. These structures are well outside of the present corridor.

Specific function for each structure was determined based upon the following parameters. The numbers for each function used in the Military Structure table.

1. Gun Emplacement - Marked by the presence of any military ammunition cartridges such as .30 caliber, 5.56 mm, 7.62 mm, .90 mm, and rarely .16 and 20 gauge shotgun shells.

2. Bivouac - This functional type is indicated by the presence of military food items, typically such things as cans, utensils and cardboard from C-Ration foods or more recently, aluminum foil and plastic bags from MRE (Meals-Ready-to-Eat) provisions. Also included under this division are glass bottles, aluminum cans, unknown metal fragments, tape, milled lumber, and rubber.

3. Communication Post - This was determined based on the presence of communication wire (usually a twisted pair of wires with a rubber coating) and/or dry-cell batteries or battery packs indicating that communications between field phones have taken place at these structures. It is believed that these items are also indicative of a command location, but this cannot be stated upon the basis of the surface artifacts.

4. Indeterminate Military - Typically surface material culture was recorded if it was found either inside of or within five meters of the outside of the structure. Several structures possessed no materials within this area and so were judged to be indeterminate.

Table E-1. Inventory of Military Structures

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
112	1	Enclosure	1	2.6	2.0	0.7	3	Ammunition, linkage belts.
118	1	Depression	1,2	1.3	1.1	0.2	0	Military trash (cans, cartridges, MRE bags)
118	2	Depression	1,2	1.6	1.4	0.2	0	Military trash (cans, cartridges, MRE bags)
118	3	Depression	1,2	1.5	1.1	0.1	0	Military trash (cans, cartridges, MRE bags)
118	4	Depression	1,2	1.6	1.3	0.3	0	Military trash (cans, cartridges, MRE bags)
118	5	Depression	1,2	1.9	1.7	0.2	0	Military trash (cans, cartridges, MRE bags)
118	6	Depression	1,2	3.6	2.6	0.3	0	Military trash (cans, cartridges, MRE bags)
118	7	Depression	1,2	2.9	2.0	0.4	0	Military trash (cans, cartridges, MRE bags)
118	8	Depression	1,2	1.7	1.5	0.2	0	Military trash (cans, cartridges, MRE bags)
118	9	Depression	1,2	1.9	1.1	0.2	0	Military trash (cans, cartridges, MRE bags)
121	1	Excavation	1,2	2.8	2.3	0.5	0	Ammunition (5.56 mm), wood fragments, burlap bag fragment.
121	2	Wall	1,2	1.9	0.0	0.4	3	Cow bones, MRE cans, ammunition.
121	3	Depression	2,3	58.0	44.8	0.1	0	Milled lumber, communication wire, cans, green tape, cardboard, metal.
121	4	Wall	2	2.5	2.2	0.9	5	Glass bottle, cigarette butt.
121	5	Depression	4	1.7	1.1	0.3	0	None
300	1	Alignment (3)	1,2,3				3	Tent stake, iron bar, communications/electrical wire, beer cans, c-ration cans/envelopes,blank rounds (5.56 & 7.62mm),first aid remains
300	2	Trench	4	3.0	0.8	1.1	3	None
300	3	Foxhole	4	1.0	1.8	1.5	0	None
300	4	Alignment	4	35.0	10.0	0.5	1	None
300	5	Foxhole	4	1.2	1.5	0.2	0	None
300	6	Foxhole	2	2.1	1.5	0.7	0	Rope, MRE's, duct tape, aluminum foil
300	7	Foxhole	4	2.4	1.2	0.5	0	None
300	8	Foxhole	4	1.3	1.1	1.1	0	None
300	9	Foxhole	4	1.8	0.9	1.0	0	Tent stake

Table E-1. (cont.)

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
300	10	Foxhole (filled)	4	1.3	0.5		0	None
300	11	Alignment	4				1	None
300	12	Foxhole	4	1.5	0.9	0.4	0	None
300	13	Foxhole	4	0.8	1.0	0.1	0	None
300	14	Foxhole	4	1.1	1.1	0.8	0	None
300	15	Foxhole	4	3.0	1.1	1.3	0	None
302	1	Wall	4	9.0	5.5	1.3	5	None
307	1	Foxhole	4	1.5	1.2	0.3	0	None
307	3	Shell scatter	1	12.0	10.0		0	
307	4	Foxhole	2	1.2	1.2	1.1	0	MRE bags, sand bag, plastic fiber
307	5	Foxhole	2	2.0	0.9	0.4	0	MRE bags, brown glass bottles
307	6	Enclosure	1,2,3	3.6	3.2	0.9	2	Sand bag, communication wires, 7.62mm shells (68 stamp on top), MR-2's
307	7	Foxhole	4	1.3	0.9	0.5	0	None
307	8	Foxhole	4	2.7	1.9	2.0	0	None
318	1	Shell scatter	1	1.0	1.0		0	7.62mm shells (68 stamp on top)
318	2	Foxhole (filled)	4	1.5	1.0	0.3	0	None
318	3	Foxhole	1,2	2.2	1.5	0.8	0	5.56mm round (89 stamp on top), MRE bags
318	4	Foxhole	2	2.5	3.6	0.7	0	C-ration can, pull-tab cans
318	5	Foxhole	4	3.0	3.0	0.8	0	None
318	6	Foxhole w/Wall	1,2	4.0	3.4	0.9	4	MRE bags, 5.56mm shells (86 stamp on top)
318	7	Foxhole	2	2.2	1.6	0.4	0	C-ration cans (2)
318	8	Hole	1,2	1.3	0.9	0.4	0	C-ration can, 5.56mm shell (85 stamp on top)
318	9	Foxhole	3	3.3	2.7	0.7	0	Communication wire, wood and metal tailgate
318	10	Foxhole	4				0	None
318	11	Military trash	2,3	13.0	1.0		0	Trip wire, metal posts, communication, disintegrating cans
318	12	Foxhole	4	1.3	1.1	0.4	0	None
318	13	Foxhole	2	1.3	2.0	1.0	0	MRE bags, tent peg
318	14	Foxhole	1	2.0	1.9	1.1	0	5.56mm shells (88 stamp on top)
318	15	Foxhole (filled)	1	12.0	1.8	0.4	0	5.56mm shells (77 stamp on top)
318	16	Foxhole	1,2	1.8	1.6	0.7	0	5.56mm shells (77 stamp on top), MRE bags
318	17	Foxhole	2,3	1.7	1.6	0.7	0	MRE bags, sand bags, first aid trash, communication wire
318	18	Foxhole	2	1.6	1.6	0.9	0	MRE bags, plastic garbage bag
318	19	Enclosure	4	2.5	2.4	0.4	4	None

Table E-1. (cont.)

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
318	20	Hole	1,2,3	1.1	1.0	0.7	0	MRE bags, military battery, first aid trash, M-60 vintage shell, 5.56mm shell (88 stamp on top)
318	21	Foxhole	4	3.0	2.5	1	0	None
318	22	Foxhole	4	1.6	0.8	0.7	0	None
318	23	Foxhole	4	1.6	0.8	0.7	0	None
318	24	Foxhole	4	1.6	0.8	0.7	0	None
318	25	Enclosure	2,3	3.6	0.6	0.6	2	MRE boxes, communication wire
318	26	Foxhole	4	1.9	1.7	0.2	0	None
318	27	Foxhole	4	3.5	1.8	0.7	0	None
318	28	Foxhole	4	1.5	0.5	0.5	0	None
318	29	Foxhole	4	1.2	0.7	0.3	0	None
318	30	Foxhole	4	1.5	0.8	0.9	0	None
318	31	Foxhole	1,2	1.6	0.6	0.3	0	Steel cans (12), M-19 linkage (53,54 stamp on top), 30 caliber shells
318	32	Wall	4	1.3	0.3	0.4	4	None
318	33	Wall	4	3.0	0.3	0.4	4	Wooden shipping crate
318	34	Enclosure	1	2.5	2.2	1.3	2	1919 30 & 50 caliber (mg) link., M-1 Garand clip, 5.56mm shells (77 stamp on top)
318	35	Foxhole	4	1.5	0.8	0.4	0	None
318	36	Structure	4	2.9	1.9	0.8	305	None
319	1	Enclosure	4	2.0	1.6	0.5	2	None
319	2	Foxhole	4	2.6	2.0	0.6	0	None
320	1	Structure	4	2.1	2.4	0.4	3	None
320	2	Wall	4	2.4	0.9	0.4	4	None
320	3	Structure	4	1.7	1.5	0.5	3	None
320	4	Foxhole (filled)	2	1.1	0.8	0.2	0	Wine bottles (2), C-ration can, steel cans (2)
320	5	Firepit	4	0.8	0.7	0.4	0	Hinges, nails, metal posts
320	6	Structure	4	2.3	1.6	0.4	3	None
320	7	Structure	1,2,3	2.2	1.8	0.4	3	7.62 shells (74 stamp),5.56 shells (83 stamp), battery, ferrous steel,camouflage net
320	8	Structure	1	3.2	1.5	0.3	2	50 caliber (mg) link
320	9	Shell scatter	1				0	50 30 caliber linkage & shells (43-57 stamp on top)
321	1	Foxhole	4	1.3	0.9	0.3	0	None
321	2	Foxhole	3	1.9	0.9	0.3	0	Plastic filling, communication wire
321	3	Fired rifle grenade	4	0.2	0.1		0	None
321	4	Military disturbance	4	20.0	20.0		0	None
321	5	Foxhole	2	1.8	1.1	0.2	2	Sand bags, milled wood
321	6	Foxhole	1,2,3	2.3	0.9	0.7	0	MRE bags, C-ration cans, milled wood,commun.wire,5.56mm shells (84 stamp on top)

Table E-1. (cont.)

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
321	7	Enclosure	1,2	4.5	1.7	0.7	5	30 caliber rifle clip & shells (52,53 stamp on top), 12 gauge shells, milled wood
322	1	Outhouse	4	1.0	0.9	0.3	0	None
322	2	Metal post	4	0.1		1.4	0	Duct tape
322	3	Outhouse	4	1.5	0.8	0.3	0	None
322	4	Foxhole	2	1.2	0.7	0.3	0	C-ration cans
322	5	Stove pipe	2	0.6			0	C-ration cans
322	6	Foxhole	4	3.0	2.2	0.4	0	None
322	7	Foxhole	2	3.3	2.8	1.1	0	Burlap sand bags, wooden tent post
323	1	Sand bag concentratio n	1	4.7	4.4	0.4	0	5.56mm shells (71 stamp on top), shrapnel scatter
323	2	Foxhole	1,2	2.6	2.2	0.4	0	5.56mm shells (71 stamp on top), MRE bags
323	3	Wall	1	2.6	0.7	0.5	3	Camouflage netting, 30 caliber shells, 7.62mm shells (76,75 stamp on top)
324	1	Revetment	4	60.0	40.0	3.0	0	None
324	2	Revetment	4	60.0	40.0	3.0	0	None
324	3	Revetment	4	115.0	70.0	3.0	0	None
324	4	Revetment	4	50.0	30.0	3.0	0	None
325	1	*Enclosure*	*4*	*150.0*	*30.0*	*5.0*	0	None
325	2	Bradshaw Control Tower	3				0	None
325	3	Foxhole (filled)	4	2.5	1.0	0.6	0	None
325	4	Foxhole	4	1.7	0.7	0.9	0	None
325	5	Firepit	4	1.3	1.3	0.4	3	None
325	6	Foxhole	4	2.4	1.2	1.0	0	None
325	7	Foxhole	4	2.0	1.0	1.1	0	None
326	1	Trench	4	1.7	0.7	0.3	0	Milled wood
326	2	Sign post	4	0.1	0.1	1.7	0	None
326	3	Dump	2,4	9.0	6.0		0	Barbed wire rolls, metal fence posts, cans
327	1	Dump	2,4	1.2	1.4		0	Pallets (2), metal post, milled wood
327	2	Foxhole	1	1.3	1.0	0.9	0	5.56mm links & shells (87 stamp on top), auto weather stripping, 12 gauge shell
327	3	Foxhole	1	1.0	1.0	0.2	0	5.56mm shells
327	4	Firepit	2,3	1.4	1.1		0	Commun. wire, milit. battery, glass, pull-tabs, MRE bags
328	1	Shell scatter	1	1.1	1.1		0	7.62mm linkage & shells (89,90 stamp on top), 5.56mm shells (92 stamp)
328	2	Foxhole	4	1.4	0.9	1.1	0	None
328	3	Foxhole	4	1.0	0.9	0.4	0	None
328	4	Wooden Enclosure	2	5.0	5.0	1.3	0	Snuff can, camouflage (nylon, cloth), cigarette butts and matches

Table E-1. (cont.)

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
328	5	Foxhole	2	1.1	0.7	1.0	0	Aluminum foil, MRE bags
328	6	Alignment	1,2	7.0	36.0	0.2	1	MRE foil, 7.62mm shells (62 stamp on top)
328	7	Foxhole (filled)	2	3.0	2.0	0.3	0	Plastic hairbrush
328	8	Foxhole	3	2.5	2.0	0.3	0	None
328	9	Foxhole	3	1.8	0.7	0.2	0	None
328	10	Foxhole	3	2.1	2.0	0.3	0	None
328	11	Foxhole	3	2.6	2.1	0.3	0	None
328	12	Foxhole, Alignment	1,2	5.0	3.0	0.5	1	Linked 7.62 cartridges (61 stamp on top), MRE bags
328	13	Wall	2	2.5	2.5	0.5	2	C-ration cans, aluminum pull-tops, bottle of aspirin, bottle
328	14	Foxhole	3	2.2	1.4	0.4	0	Radio battery, radio clip
328	15	Foxhole w/Wall	1,2	3.0	2.7	0.4	2	5.56mm shell (70 stamp on top), tinfoil
328	16	Foxhole w/Wall	2	3.9	3.2	0.5	2	MRE foil
328	17	Foxhole w/Wall	2	3.8	3.2	0.5	2	MRE foil and plastic, black plastic
328	18	Monument	4	0.2	0.2	0.1	0	None
328	19	Foxhole w/Enclosure	1,2	2.9	1.8	0.2	2	7.62mm shells w/linkage, MRE foil
328	20	Foxhole	2,3	1.6	1.0	0.1	0	Communication wire, condensed milk can
328	21	*Cement marker*	4	0.3	0.3		0	*None*
328	22	Foxhole	4	2.3	2.2	0.4	0	None
328	23	Foxhole	4	2.9	2.1	0.2	0	None
328	24	Foxhole w/Enclosure	2	1.8	0.7	0.3	2	C-ration cans, MRE foil, green glass fragments
328	25	Structure	1	2.9	2.9	0.5	4	5.56mm shells
328	26	Foxhole w/Enclosure	2	4.6	4.4	1.0	2	MRE foil, scattered 7.62mm (68 stamp on top), 5.56mm shells (91-94 stamp on top)
328	27	Foxhole	2	1.8	1.4	0.4	0	MRE's, utensils, cigarettes, condiments,paper,5.56mm shells (86 stamp on top)
328	28	Foxhole	2	1.6	0.9	0.6	0	MRE foil
328	29	Foxhole	2	1.8	1.5	0.6	0	MRE's, sterno can, plastic tent stake, 70's pop top
328	30	Wall	2	1.1	0.2	0.3	3	MRE foil, cigarette butts
328	31	Enclosure	2	4.5	3.0	0.5	4	Duct tape, MRE packs
328	32	Foxhole	1,2	2.7	2.3	0.0	0	5.56mm shell (84 stamp on top), utensils, condiments
328	33	Foxhole	4	1.4	1.3	0.3	0	None
328	34	Dump	2	10	6.0		0	MRE's, cans, bottles, boxes, utensils, Skoal can, glo sticks, paper products
328	35	Foxhole (3)	1,2	1.5	2.0	0.4	0	Cans, C-ration, burnt wood, hinges, nails, M-60 links, 7.76mm shells (70-76 stamp on top)

Table E-1. (cont.)

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
328	36	Dump	2	10.0	4.0		0	MRE's, razor wire, trash bag, duct tape, charcoal, condiments
328	37	Foxhole, Alignment	4	1.5	1.4	0.3	1	None
328	38	Foxhole	4	1.6	1.0	0.6	0	None
328	39	Firepit	2	1.0	0.9	0.2	0	Metal, nails, MRE's, brown glass, poss. medicine bottle
328	40	Foxhole (filled)	2	1.2	0.7	0.3	0	Condiments, Bic lighter, cord
328	41	Foxhole (filled)	4	1.4	1.3		0	None
328	42	Alignment	4	2.6	0.3	0.3	3	None
328	43	Foxhole	1,2	1.6	1.0	0.1	0	5.56mm shells (86 stamp on top), MRE foil
328	44	Foxhole (filled)	2,3	1.8	1.3	0.2	0	Communication wire, C-ration cans
328	45	Foxhole	2	5.5	2.5	1.0	0	MRE bags, cigarette butts, plastic cover, 5.56mm shells, condiments, clothing
328	46	Foxhole	2	5.0	2.0	0.6	0	MRE's, metal packing strips, plywood, gauze and bandages
328	47	Foxhole	2	1.7	1.6	0.5	0	Field desk, beer can, MRE foil
328	48	Foxhole	2	1.7	1.6	0.5	0	Field desk, beer can, MRE foil
328	49	Foxhole	2	1.7	1.6	0.5	0	Field desk, beer can, MRE foil
328	50	Foxhole	2	1.7	1.6	0.5	0	Field desk, beer can, MRE foil
328	51	Firepit	2	5.2	2.0		1	Condiments, MRE's, C-rations
328	52	Foxhole	1	3.1	1.7	0.6	0	2-20 gauge shotgun shells
328	53	Foxhole	4	1.9	1.1	0.7	0	None
328	54	Foxhole	4	1.7	0.9	0.6	0	None
328	55	Foxhole	4	1.5	1.4	0.5	0	None
328	56	Foxhole	2	1.0	0.8	0.3	0	Condiments
328	57	Trench	2	4.6	1.8	0.5	0	MRE's, plywood
328	58	Foxhole	2	1.1	1.4	0.3	0	MRE's
328	59	Foxhole	4	3.0	1.7	0.4	0	None
328	60	Foxhole	1	3.0	3.0	1.0	0	2-7.62mm shells (63 stamp on top)
328	61	Firepit	1,2	1.2	0.9	0.3	0	7.62mm link & shells (89 on top), MRE's, condiments, wood, ammo pouches
328	62	Hole (bomb crater)	4	4.0	4.0	1.0	0	None
328	63	Hole (bomb crater)	4	4.0	4.0	1.0	0	None
328	64	Hole (bomb crater)	4	4.0	4.0	0.8	0	None
328	65	Hole	4	1.0	1.0	0.4	0	None

Table E-1. Inventory of Military Structures

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
328	66	Foxhole	1	1.7	1.0	0.3	0	7.62mm shells (57 stamp on top), M-1 clips, 5.56mm shells (88 stamp on top)
328	67	Alignment	4	2.4	3.2	1.0	1	None
328	68	Firepit	2	2.2	2.1	0.2	1	Condiment
329	1	Foxhole	4	1.6	1.5	0.6	0	None
329	2	Foxhole	4	1.2	3.4	0.4	0	None
329	3	Enclosure	4	3.9	3.4	0.4	2	None
329	4	Foxhole (filled) w/Wall	1	2.4	0.7	0.5	4	5.56mm shells (78,84,83 stamp on top)
329	5	Foxhole (filled)	4	1.5	1.3		0	None
329	6	Enclosure	1	2.4	2.4	0.4	2	M-1 clip, 30 caliber shell (53 stamp on top)
329	7	Structure	4	3.2	0.5	0.6	4	None
329	8	Foxhole w/Enclosure	1,3	4.8	3.3	0.7	4	30 caliber shells (48,53 stamp on top), 5.56mm shells (73 stamp on top), commun. wire
329	9	Foxhole (filled)	1	1.9	1.3		0	M-1 135 caliber shells
329	10	Enclosure	4	2.2	1.7	0.6	3	None
329	11	Foxhole (filled) w/Enclosure	4	2.0	1.5	0.5	2	None
329	12	Foxhole (filled) w/Enclosure	2	3.0	1.6	0.7	2	MRE's, utensils
329	13	Foxhole (filled) w/Enclosure	4	1.4	0.3	0.6	3	None
329	14	Enclosure	1,2	4.0	4.0	0.6	3	12 gauge shotgun shells, green bottle glass
329	15	Foxhole (filled)	1	1.7	1.1		0	5.56mm shells
329	16	Foxhole (filled) w/Wall	1,2	2.5	0.5		3	5.56mm shells (77 stamp on top), MRE packet
329	17	Foxhole (filled) w/Enclosure	4	2.0	1.7	0.6	3	None
329	18	Foxhole (filled)	4	1.3	1.1		0	None
329	19	Foxhole (filled) w/Alignment	4	1.9	1.5	0.4	1	None
329	20	Foxhole (filled) (2)	4	1.2	1.2	0.5	0	None
329	21	Depression (2)	4				0	None
329	22	Wall	1,2	4.0	0.8	0.5	2	5.56mm shells (82 stamp on top), C-ration condiments, metal lid

Table E-1. (cont.)

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
329	23	Enclosure	1,2	2.5	1.5	0.9	6	Tent peg, 5.56 rounds (76 stamp on top), arrow shaft, plastic baton
329	24	Enclosure	1	2.0	1.2	0.5	2	5.56mm shells
329	25	Enclosure	1	2.8	1.9	0.6	4	M-1 clip, 30 caliber shell (54 stamp on top)
329	26	Modified outcrop	1,2	3.0	2.0	1.2	2	5.56mm rounds (84 stamp on top), C-ration condiments, 30 caliber (52 stamp on top)
329	27	Enclosure	1,2,3	2.0	1.7	0.7	5	C-ration cans,battery,7.62mm rnds (64 stamp),5.56mm rnds(89 stamp),M-1 clip, MRE uten., milled wood
329	28	Enclosure	4	2.6	1.5	0.8	5	M-1 clip
329	29	Wall remnant	1,2	2.5	1.3	0.3	2	Condiments, 30 caliber round (42 stamp on top)
329	30	Structure	1,2	1.8	1.5	0.8	3	5.56mm shells (73 stamp on top), machine gun link (60 stamp), 30 cal.(mg) link, C-ration cans
329	31	Enclosure	1,2	3.2	2.5	0.6	4	5.56mm (83 stamp on top), M-1 clip, 30 cal. (53 stamp on top), C-ration cans
329	32	Enclosure	1	3.0	2.4	0.9	6	5.56mm (88 stamp on top), 30 cal. (45-53 stamp on top), 5.56mm cardboard box
329	33	Enclosure	1	4.0	3.2	0.5	3	M-60 30 cal.link, M-1 clips,30 calib.(54 stamp),7.62mm (88 stamp),5.56mm (75-92 stamp),duct tape
329	34	Wall	4	1.6	0.4	0.4	2	None
329	35	Wall	4	1.5	0.5	0.6	4	None
329	36	Mod. outcrop	4	1.7	0.5	0.5	3	None
329	37	Wall	1,2	3.0	0.2	0.5	2	C-ration cans,7.62mm shell w/link. (61 stamp), 16 gauge shotgun shell
329	38	Foxhole (filled) w/encl	1	2.0	2.0	0.4	3	7.62 cartridge (77 and 79 stamp on top)
329	39	Enclosure	1	2.4	1.5	0.5	3	30 caliber linkage
329	40	Cartridges	1	1.0	1.0		0	30 caliber
329	41	Enclosure	2	2.2	2.4	0.8	3	MRE utensils
329	42	Cairn	1	0.8	0.8	1.0	3	5.56mm shells (88 stamp on top), 20 gauge shotgun shells
329	43	Enclosure	1,2	4.0	2.1	1.0	2	7.62mm shells (77 stamp on top), MRE & Crations, 30-30's
329	44	Enclosure	4	4.0	2.0	0.6	5	None
329	45	Enclosure	1,2	2.5	1.3	0.8	5	5.56mm shells (76 stamp on top), MRE's
329	46	Enclosure	2	2.0	2.0	1.0	5	C-ration cans
329	47	Enclosure	4	2.3	2.1	0.8	5	None
329	48	Foxhole w/Wall	2	2.7	1.7	0.5	2	MRE's

Tc... :-I. (cont.)

Sites	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
329	49	Foxhole	4	4.0	4.0	0.5	0	None
329	50	Foxhole	4	2.0	2.0	0.5	0	None
329	51	Foxhole	2	1.8	1.4	0.4	0	MRE's, trash bags (Glad)
329	52	Foxhole w/Enclosure	1	2.1	2.0	0.6	4	5.56mm shells (82 stamp on top), plastic wrap
329	53	Foxhole w/Enclosure	2	4.0	2.0	0.5	2	Plastic trash, wood
329	54	Foxhole	4	3.0	3.0	0.5	0	None
329	55	Foxhole w/Enclosure	2	1.0	1.0	0.4	0	MRE's
329	56	Foxhole w/Wall	4	1.5	0.6	0.5	2	None
329	57	Foxhole w/Wall	2	1.5	0.6	0.5	2	MRE's
329	58	Foxhole	2	1.5	1.5	0.4	0	MRE's, safety matches, plastic utensils
329	59	Foxhole w/Enclosure	4	1.5	0.8	0.5	2	None
329	60	Structure	2	3.0	1.5	0.6	0	MRE's, plastic utensils
329	61	Foxhole w/Mound	2	0.8	0.8	0.4	0	MRE's, plastic utensils
329	62	Structure	2	2.0	0.6	0.5	0	MRE's, plastic utensils
329	63	Enclosure	2	1.0	1.0	0.4	2	MRE's, plastic utensils
329	64	Foxhole	4	1.0	1.0	0.3	0	None
329	65	Structure	1,2	5.0	2.0		5	Foil, MRE's, shotgun shells, 5.56mm shells (88 stamp on top)
329	66	Foxhole	4	0.8	0.8	0.5	0	None
329	67	Wall	4	3.0	0.4	0.5	2	None
308	1	Foxhole (filled) w/Alignment	1	4.0	1.8	0.5	1	5.56mm shells (78 stamp on top), 7.62mm shells (68 stamp on top)
308	2	Wall	4	2.3	0.5	0.7	3	None
308	3	Cairn	1	1.4	1.4	0.6	2	5.56mm and 7.62mm shells
308	4.1	Foxhole	4	5.0	1.6	0.6	0	None
308	4.2	Foxhole	4	5.0	1.6	0.6	0	None
308	5	Wall	2	8.0	0.6	0.5	3	MRE's
308	6	Double Wall	4	4.5	3.5	0.7	3	None
308	7	Wall	2	4.5	0.6	0.7	4	MRE's
308	8	Wall	4	1.6	0.5	0.5	2	None
308	9	Modified outcrop	2	2.1	1.3	0.5	0	C-ration cans
308	10	Foxhole (filled)	1	1.8	1.3		0	5.56mm shells (78 stamp on top)
308	11	Foxhole (filled)	4	1.4	1.3		0	None
308	12	Foxhole (filled)	4	2.6	2.5	0.4	0	None
308	13	Foxhole	4	1.8	0.7	0.7	0	None
308	14	Modified outcrop	4	2.4	1.4	0.4	0	None
308	15	Foxhole w/Wall	4	1.8	1.0	0.5	3	None

Table E-1. (cont.)

Site#	Fea .#	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
308	16	Modified outcrop w/Wall	2	2.6	1.8	0.6	3	C-ration cans
308	17	Structure	2	2.1	1.9	0.6	3	C-ration cans
308	18	Foxhole w/Wall	2,3	2.5	1.6	0.4	2	Palettes, communication wire, MRE's
308	19	Terrace	2	2.0	0.7	0.7	3	MRE's
308	20	Foxhole	2	1.8	0.9	0.9	0	MRE's
308	21	Foxhole, Alignment	4	1.4	0.8	0.6	1	None
308	22	Foxhole	1	1.6	1.4	0.6	0	5.56mm shells
308	23	Enclosure	1	1.8	1.7	0.7	4	5.56mm shells (78 stamp on top)
308	24	Foxhole w/Wall	2	2.0	1.8	0.7	2	scattered
308	25	Foxhole	4	1.8	1.2	0.6	0	None
308	26	Modified outcrop	4	3.5	3.5	1.7	2	scattered
308	27	Enclosure	3	3.0	2.7	0.6	3	Military batteries
308	28	Enclosure	4	8.0	3.0	1.0	4	scattered
308	29	Modified outcrop	1	3.0	2.9	1.1	2	5.56mm shells (71 stamp on top)
308	30	Wall	4	1.8	0.4	0.7	3	None
308	31	Enclosure	2	7.0	3.0	1.4	5	MRE's, foil
308	32	Foxhole w/Enclosure	2	3.6	2.7	1.2	4	MRE's, C-ration cans
308	33	Foxhole	2	1.8	1.0	0.4	0	C-ration cans
308	34	Structure	4	3.3	2.9	0.5	2	None
308	35	Foxhole, Alignment	4	1.3	3.5	0.5	0	None
308	36	Wall	2	2.4	0.4	0.6	2	MRE's, plastic utensils
308	37	Foxhole w/Modified outcrop	2	1.5	1.3	0.4	0	C-ration cans, cloth, trash
308	38	Double wall	1	1.9	0.6	0.6	2	50 caliber, M-9 links
308	39	Structure	1	2.0	1.3	0.6	5	5.56mm shells (76 stamp on top)
308	40	Structure	2	3.6	1.8	0.6	5	MRE's, foil, plastic, cans
308	41	Structure	4	2.3	0.8	0.9	5	None mentioned
308	42	Structure	1,2	2.6	0.9	0.8	5	C-ration cans, plastic, 5.56mm shells (82 stamp on top)
308	43	Wooden blind	4	4.6	0.9	1.0	0	None
308	44	Foxhole	4	3.6	3.0	0.8	0	None
308	45	Foxhole	4	1.9	1.6	0.9	0	None
308	46	Wall	2	2.1	0.7	0.6	4	MRE's
308	47	Foxhole w/Enclosure	2	3.0	0.6	1.0	4	MRE's
308	48	Structure	4	3.5	0.6	0.5	3	None
308	49	Structure	4	2.3	1.4	0.7	0	Milled wood
308	50	Foxhole	2	1.6	1.3	0.6	0	MRE's

Table E-1. (cont.)

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
308	51	Modified outcrop, Wall	2	4.0	0.7	1.0	2	MRE's
308	52	Foxhole	1,3	1.3	1.2	0.5	0	5.56mm shells (78 stamp on top), communication wire
308	53	Modified outcrop, Enclosure	4	2.1	2.0	0.5	2	None
308	54	Foxhole	4	1.8	0.9	0.7	0	None
308	55	Alignment	4	3.1	0.8	0.2	1	None
308	56	Foxhole w/Wall	4	1.6	1.2	0.5	3	None
308	57	Wall	4	2.8	0.7	0.7	3	None
308	58	Filled-in pit	4	3.1	3.0	0.4	0	None
308	59	Pit	1,2	5.5	4.0	1.5	0	5.56mm shells (83 stamp on top), brown glass bottle
308	60	Shell scatter	1	1.0	1.0		0	7.62mm shell and linkage (78 stamp on top)
308	61	Foxhole	1	1.1	0.9	0.4	0	5.56mm shells (78 stamp on top)
308	62	Foxhole	1	1.3	0.8	0.6	0	5.56mm shells (53 & 70 stamp on top)
308	63	Foxhole	4	2.0	1.3	0.6	0	None
308	64	Structure	3	2.4	2.2	0.7	3	Communication wire
308	65	Foxhole, Alignment	4	4.0	2.2	0.4	2	None
308	66.1	Structure	1	3.0	2.0		4	30 caliber (41 stamp on top)
308	66.2	Structure	4	1.5	1.0	0.6	4	None
308	67	Foxhole	2	2.4	1.6	0.4	0	Cans
308	68	Foxhole w/Wall	4	1.0	0.5	0.6	2	None
308	69	Enclosure	2	3.8	3.6	0.7	3	MRE's, plastic insole
308	70	Modified outcrop, Wall	4	1.4	0.4	0.8	3	None
308	71	Modified outcrop	1	2.0	1.0	0.8	2	Shotgun shells
308	72	Structure	1,2	2.2	1.5	0.8	5	12 gauge shotgun shells, C-ration cans
308	73	Foxhole	1	1.9	0.5	0.4	0	Wire, 7.62mm linkage (61 stamp on top)
308	74	Wall remnant	1	1.5	0.4	0.6	2	16 gauge shotgun shell
308	75.1	Structure	2	2.9	1.8	0.9	3	Foil, cans
308	75.2	Wall	2	2.5	2.0	0.6	4	Foil, cans
308	75.3	Foxhole	2	3.0	1.8	1.2	0	Foil, cans
308	75.4	Pit	2	6.0	5.0	1.5	0	Foil, cans
308	76	Structure	1,2,3	2.0	2.0	0.5	3	Foil, MRE's, 30 caliber shells
308	77	Foxhole (filled) w/Structure	2	1.5	1.5	0.6	3	Condiments (Pepsi can), military can opener (P-38), MRE's, shotgun shells
308	78	Wall	4	4.2	3.4	0.6	3	None
308	79	Enclosure	2	3.6	2.8	0.9	4	Can lid

Table E-1. (cont.)

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
308	80	Wall	1,2	5.2	2.0	0.4	2	MRE's, rubber fragments, 7.62mm shells (58 stamp on top), tin foil
308	81	Enclosure	2	2.0	3.5	0.7	6	MRE's
308	82	Foxhole	2	1.8	1.0	0.5	0	C-ration can
308	83	Wall	4	1.3	3.5	0.6	4	None
308	84	Enclosure	4	2.0	1.5	0.5	3	None
308	85	Military trash	2	3.0	5.0		0	Green milk bottle, plastic knife, foil, C-ration cans
308	86	Foxhole (filled)	2	2.2	2.2		0	Can
308	87	Foxhole	2	2.0	1.1	0.3	0	MRE's
308	88	Foxhole	2	1.5	10.7	0.3	0	C-ration box
308	89	Wall	2	2.1	0.4	0.6	3	MRE's
308	90	Structure	4	2.4	1.0	0.6	3	None
308	91	Modified outcrop	2,3	3.4	0.9	0.7	2	MRE's, communication wire
308	92	Foxhole	2	1.0	1.0	0.3	0	MRE's, duct tape, animal bone, plastic, C-ration cans, utensil (spoon)
308	93	Metal posts (fence)	4	10.0	4.0		0	None
308	94	Foxhole	4	1.6	1.3	0.5	0	None
308	95	Foxhole, Alignment	4	1.3	0.9	0.8	0	None
308	96	Modified outcrop, Structure	1,2	2.0	2.0	0.5	2	MRE's, shotgun shell
308	97	Modified outcrop	4	1.0	0.5	0.7	3	None
308	98	Foxhole	1,2	3.2	2.9	1.2	0	12 gauge shotgun shells, green glass bottle
308	99	Modified outcrop	3	1.8	0.6	1.0	3	Communication wire
308	100	Structure	1,2	2.5	2.0	0.6	4	MRE's; 4x6 milled wood, 5.56mm cartridges, metal can lid, "fresh PAX"
308	101	Wall	4	1.2	0.4	0.6	4	None
308	102	Modified outcrop	4	1.4	0.7	0.6	2	None
308	103	Structure	4	2.2	1.4	0.5	3	None
315	1	Enclosure	4	3.0	2.0	0.8	4	None
315	2.1	Foxhole	4	2.0	1.8	0.6	0	None
315	2.2	Foxhole	4	3.0	3.0	0.7	0	None
315	3	Foxhole	4	3.2	2.7	0.6	0	None
315	4	Foxhole	4	3.1	2.5	0.7	0	None
315	5	Foxhole	4	1.8	0.9	0.7	0	None
315	6	Foxhole	1				0	30 caliber links and shells (52-57 stamp on top)
315	7	Foxhole	1,2				0	C-ration cans, MRE's, 7.62mm shells (89 stamp)
315	8	Metal post (fence)	1	1.3	1.0		0	5.56mm shell (82 stamp)

Table E-1. (cont.)

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
315	9	Modified outcrop, Structure	4	2.4	2.4	0.4	3	None
315	10	Foxhole	4	2.3	1.7	0.4	0	None
315	11	(3) Foxhole (filled)	2	8.0	6.0	0.3	0	C-ration cans
315	12	Trench	2	3.2	0.8	0.9	0	C-ration cans, pull tabs
315	13	Modified outcrop	1,2,3	5.0	1.0	0.6	2	C-ration cans, batteries, 7.62mm & 5.56mm shells (72 & 74 stamp on top)
315	14	Wall	4	5.0	1.5	0.6	2	None
315	15	Enclosure	1	3.1	1.6	0.4	3	5.56mm shells (71 stamp on top)
315	16	Wall	4	2.6	1.6		2	None
315	17	Foxhole (filled)	2	1.0	1.0	0.4	0	MRE's, C-ration cans, condiments (soda/beer cans)
315	18	Modified outcrop, Wall	4	3.2	2.9	0.6	2	Not mentioned
315	19	Sinkhole (filled), Wall	2,3	10.0	0.5	0.4	2	Batteries, cans
315	20	Enclosure	1	2.6	2.4	0.7	3	5.56mm shells (77 stamp on top)
315	21	Modified outcrop, Enclosure	1,2	12.4	1.8	0.6	2	C-ration cans, 5.56mm shells (72 stamp on top)
315	22	Foxhole w/Modified outcrop	4	1.9	1.5	1.2	0	None
315	23	Structure	4	3.2	1.7	0.5	3	None
315	24	Modified outcrop, Enclosure	1	2.6	1.7	0.8	3	30 caliber shells (54 stamp on top)
315	25	Foxhole w/Enclosure	1,2	3.2	2.6	0.4	0	7.62mm shells (63 stamp on top), 12 gauge shotgun shells, barbed wire, links, cans
315	26	Wall	4	2.5	0.7	0.3	2	None
315	27	Wall	1,2	2.4	2.1	0.6	3	M-1 clips & shells (52 & 53 stamp on top), aluminum tent stake
315	28	Modified outcrop	4	2.0	0.6	1.0	3	None
315	29	Structure	1,2	2.5	0.6	0.5	3	MRE's, metal strips, 7.62mm shells (62 stamp on top),
315	30	Enclosure	4	1.8	1.5	0.4	3	None
315	31	Wall	1,2	3.0	1.6	0.6	4	M-1 clips & shells (52 & 53 stamp on top), aluminum tent stake
315	32	Foxhole	4	1.4	1.0	1.1	0	None
315	33	Foxhole w/Metal bar inside	4	1.3	0.9	0.4	0	None

Table E-1. (cont.)

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
315	34	Modified outcrop	1	2.2	0.9	0.8	0	7.62mm shells (61 stamp on top)
315	35	Modified outcrop, Enclosure	4	3.5	2.2	1.4	3	None
315	36	Wall	4	3.8	0.4	0.6	4	None
315	37	Modified outcrop	4	2.0	0.4	0.6	3	None
315	38	Modified outcrop	4	2.0	0.4	0.8	3	None
315	39	Modified outcrop/Wall	2	2.0	0.4	0.6	3	C-ration cans
315	40	Modified outcrop	4	1.5	0.6	0.6	2	None
315	41	Wall	4	3.0	0.6	0.7	4	None
315	42	Foxhole (filled)	1	1.8	0.9		0	7.62mm linkage and shells (68 stamp on top)
315	43	(2) Metal rods in cement cans	4	0.5	0.8		0	None
315	44	Modified outcrop	1	2.0	0.7	0.4	0	None
315	45	Military trash	1,2,3				0	M-1 clips (53 stamp on top), aluminum cans, a headlight, communication wire
315	46	Modified outcrop, Enclosure	1	4.0	3.0	0.8	4	M-1 clips (71 stamp on top)
315	47	Wall	1,2	4.0	2.0	0.8	4	C-ration cans, 5.56mm shells (84 stamp on top)
315	48	Enclosure	1,2	3.0	4.0	1.5	4	MRE's, C-ration cans, 5.56mm shells (84 stamp)
315	49	Structure	1	3.0	1.5	0.3	2	5.56mm shells (84 stamp on top), 7.62mm shells (63 stamp), 30 caliber shells (33 stamp on top)
315	50	Wall	4	3.5	0.8	0.7	3	None
315	51	Modified outcrop, Enclosure	1,2	3.0	0.2	0.6	2	Tent peg, 7.62mm shells (80 stamp on top)
315	52	Structure	1	3.0	1.5	0.6	0	7.62mm shells (43,54,62 stamp on top), 5.56mm shells linked (86 stamp on top)
315	53	Foxhole	1,4	1.0	0.9	0.7	0	Ammo can lid, five smoke grenade carrying cases
315	54	Foxhole	2	1.3	1.2	0.9	0	Aluminum foil, metal can
315	55	Foxhole	1	1.9	1.5	0.5	0	5.56mm shells with linkage (86 stamp on top)
315	56	Foxhole w/Wall	4	1.6	1.1	0.5	0	None
315	57	Foxhole w/Modified outcrop	4	3.0	2.7	0.5	0	None

Table E-1. (cont.)

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
315	58	Foxhole w/Wall	4	1.5	1.3	1.0	3	None
315	59.1	Foxhole	1,2	2.0	1.5	0.3	0	MRE's, aluminum foil, utensils (spoons), 5.56mm shell (86 stamp on top)
315	59.2	Modified outcrop	1,2	2.0	1.6	0.6	0	MRE's, aluminum foil, utensils (spoons), 5.56mm shell (86 stamp on top)
315	60	Foxhole w/Mod. outc.	4	1.6	1.4	05	0	None
315	61	Modified outcrop	2,3				0	MRE's, plastic, batteries
315	62	Double foxhole	2	2.5	1.8	0.1	0	MRE's, cans
315	63	Foxhole w/Modified outcrop	2	2.7	1.6	0.7	3	MRE's
315	64	Double wall	4	3.0	3	0.7	3	None
315	65	Foxhole	4	1.8	1.3	0.6	0	None
513	1	Enclosure	1,2	6.0	5.0	0.9	3	Rusted steel can, broken glass bottle, 2 NATO 7.62 mm rifle cartrdg., ammo clip.
513	2	Wall	4	5.0	4.0	0.5	3	None
513	3	Wall	4	2.3	2.0	0.7	4	None
513	4	Wall	4	2.3	2.0	1.0	2	None
514	1	Concrete structure	2	3.4	2.1	0.3	0	Planed 2x4 lumber, rubber, metal, cardboard.
515	1	Concrete structure	4	15.0	8.0		0	None
516	1	Wall		4.0	3.0	0.2	4	Three rusted cans, dog skull (with right mandible)
517	1	Alignment		4.0	3.5	0.3	1	None
521	1	Wall	4	6.0	3.0	0.7	3	None
522	1	Wall	4	2.9	4.2	0.7	4	None
522	2	Wall	4	4.0	3.0	1.3	8	None
526	1	Wall	1,2	6.0	5.0	0.8	5	Broken glass bottle, rifle cartridge.
535	1.1	Wall	2	3.1	1.7	0.7	4	Military MRE bags, cans.
535	2.1	Wall	2	2.3	0.0	0.7	3	Two rusted steel cans.
535	3.1	Wall	4	2.0	0.0	0.7	3	None
535	4.1	Wall	1,2	1.9	1.6	0.5	4	5.56 mm shells, plastic spoon.
535	5.1	Wall	3	1.9	0.0	0.4	3	None
535	6.1	Wall	1	1.6	0.0	0.6	2	None
535	7.2	Wall	1	6.5	0.0	0.8	3	5.56 mm cartridges.
535	8.3	Wall	4	1.6	0.0	0.4	3	None
535	9.3	Wall	2		0.0		2	Rusted steel can.
535	10.3	Wall	4	2.4	0.0	0.5	3	None
535	11.3	Wall	2	3.2	1.6	0.4	4	Plastic spoon.
535	12.3	Wall	2	3.2	0.0	0.6	4	Aluminum foil.
535	13.3	Wall	2	1.2	0.0	0.4	2	Aluminum, plastic spoon and fork.

Table E-1. (cont.)

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
535	14.4	Wall	2	3.6	0.0	0.7	3	Aluminum foil.
535	15.5	Modified outcrop	2	3.2	1.0	0.7	4	MRE bags
535	16.6	Wall	4	2.8	2.7	0.7	3	None
535	17.6	Wall	4	1.9	0.0	0.5	2	None
542	1	Modified outcrop	2	2.4	1.7	1.2	3	Rusted steel cans.
542	2	Wall	4	1.9	0.0	0.8	2	None
542	3	Modified outcrop	4	1.6	1.1	1.0	3	None
542	4	Wall	4	4.6	3.5	0.8	6	None
542	5	Trench	4	35.0	1.6	1.3	0	None
542	6	Wall	4	3.4	2.0	0.9	4	None
542	7	Wall	4	0.8	0.0	0.4	3	None
542	8	Enclosure	4	3.5	3.3	0.7	1	None
542	9	Enclosure	2	3.8	2.7	0.7	3	Steel cans.
542	10	Wall	4	3.1	0.0	0.6	3	None
542	11	Wall	4	2.0	0.0	0.7	4	None
542	12	Wall	4	6.0	0.0	1.0	4	None
542	13	Wall, depression	1,2	1.8	0.0	0.5	3	MRE bags, unfired 7.62 and 5.56 rounds, belt of machine gun (7.62 mm) rounds.
542	14	Enclosure	2	4.0	4.0	1.0	4	MRE bags.
542	15	Modified outcrop	4	4.5	1.4	1.0	4	None
542	16	Wall	4	2.3	2.3	0.6	3	None
542	17	Wall	4	2.0	1.8	0.8	3	None
542	18	Wall	4	1.9	0.3	0.5	3	None
542	67	Wall	4	2.7	0.5	0.6	3	None
542	19	Wall	4	4.9	3.0	0.8	4	None
542	20	Wall	2	1.8	0.0	0.4	4	Unidentified metal.
542	21	Wall	2	1.8	0.0	0.4	4	Unidentified metal.
542	22	Wall	4	4.1	2.3	0.6	4	None
542	23	Wall	4	2.2	2.1	0.8	4	None
542	24	Wall	4	2.1	0.5	0.5	3	None
542	68	Wall	2	0.7	0.4	0.9	5	Metal cans, MRE foil.
542	25	Enclosure	4	2.7	1.7	0.6	2	None
542	26	Depression	4	1.5	0.8	0.7	0	None
542	27	Depression	1,2	1.8	1.2	0.8	0	Military trash, cartridges.
542	28	Wall	4	2.2	1.9	0.9	3	None
542	29	Modified outcrop	1,2	2.4	2.3	0.5	2	MRE alum. foil, unfired ammunition, rusty met. cans.
542	30	Depression	4	3.0	1.5	0.1	0	None
542	31	Enclosure	4	3.9	3.9	1.4	4	None
542	32	Depression	1	1.8	1.4	0.1	0	Military cartridges (5.56 mm)
542	33	Wall	1	2.3	1.4	0.9	4	Machine gun (7.62 mm) cartridges.
542	34	Modified outcrop	1,2	2.3	1.2	0.6	4	Military cartridges (5.56 and 7.62 mm), rusted steel can.
542	35	Depression	2	2.5	1.4	0.2	0	Plastic eating utensils (knife, fork).
542	36	Depression	1	2.2	1.3	0.5	0	Military cartridges.

Table E-1. (cont.)

Site#	Fea #	Feature type	Function	L (m)	W (m)	H (m)	# of courses	Material remains
542	37	Depression	1,2	2.3	2.2	0.2	0	Aluminum MRE bags, military cartridges.
542	38	Wall	1	2.7	1.5	0.8	4	Cartridges.
542	39	Depression	4	1.9	1.3	0.2	0	None
542	40	Depression	1	1.8	1.1	0.8	0	Military 5.56 mm cartridges.
542	41	Wall	4	3.9	1.7	1.0	4	None
542	42	Wall	1	1.7	0.5	0.8	3	None
542	43	Wall, depression	2	2.6	2.6	1.2	4	Steel can
542	44	Wall	4	2.7	2.3	1.2	4	None
542	45	Wall	4	2.6	2.4	0.4	1	None
542	46	Wall	4	2.8	2.5	0.5	3	None
542	47	Terrace	2	2.7	2.6	1.4	5	Military trash.
542	48	Terrace	2	3.9	2.8	1.1	5	Military trash.
542	49	Depression	4	1.5	1.3	0.4	0	None
542	50	Depression	4	1.7	1.3	0.4	0	None
542	51	Wall	4	1.7	0.8	0.6	4	None
542	52	Wall	2	3.3	2.8	0.7	5	Rusted steel can, aluminum foil.
542	53	Wall, depression	4	3.3	1.8	0.7	4	None
542	54	Wall	2	4.0	2.7	0.6	4	Military trash.
542	55	Depression	4	2.4	1.4	0.4	0	None
542	56	Depression	4	2.6	1.4	0.6	0	None
542	57	Depression	4	2.6	1.0	0.5	0	None
542	58	Modified outcrop	4	8.0	1.0	0.9	4	None
542	59	Wall	4	2.4	1.9	0.8	4	None
542	60	Wall	4	3.5	1.0	1.0	5	None
542	61	Wall	4	4.2	0.9	1.2	5	None
542	62	Wall	4	3.1	1.1	0.9	4	None
542	63	Depression	4	2.2	1.4	0.8	0	None
542	64	Depression	1,2	2.2	1.5	0.8	0	Military cartridges (7.62 mm), links, rusted steel cans.
542	65	Depression	4	1.8	1.0	0.2	0	None
542	66	Depression	4	2.1	1.6	0.5	0	None
545	1	Wall	4	3.0	1.6	0.5	2	None
545	2	Wall	4	2.3	2.2	0.4	2	None
545	3	Wall	4	2.0	1.5	0.6	4	None
545	4	Wall	4	2.3	2.1	0.6	5	None
554	1	Wall	4	8.0	4.0	0.8	6	None

Table E-2. Inventory of Cantonment Buildings within APE

Structure	Size (m)	Age	Quonset Hut	Material	Roof Type	Comments
HELCO Substation	26.0 x 5.0	1980s		Electrical equipment	None	Eastern structure at PTA Base Camp. Sign: Danger-High Voltage Pohakuloa Substation
Sand Filter Station	20.0 x 0.0	1980s		Cement, fiberglass	None	Tied to water tanks outside of corridor by three six-inch (?) pipes
Water Unloading Docks (2)	20.0 x 5.0	1980s		Cinder block, cement	Corrugated tin\aluminum (sloping)	Small pumps-pipes connect to large water storage tanks above.
T-142	16.0 x 5.0	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Two parallel huts, connected by oblong room.
T-143	10.0 x 6.0	?		None: pad only	Cement	Located on west side of Quonset Hut Complex
T-144	30.6 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Located between T-154 and T-151 and T-152 in long row of Quonset huts.
T-145	30.6 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Located between T-155 and T-153 in long row of Quonset huts.
T-146	30.6 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Located between T-156 and T-154 in long row of Quonset huts.
T-147	30.6 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Located between T-157 and T-155 in long row of Quonset huts.
T-148	30.6 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Located between T-158 and T-156 in long row of Quonset huts.
T-149	16.0 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	East of row of occupied Quonset huts.
T-151	16.0 x 5.0	1950s		Tin/steel	Tin/steel with sprayed insulation	Two parallel huts, connected by oblong room.
T-152	10.0 x 6.0	?		None: pad only	Cement	Located on west side of Quonset hut complex
T-153	30.6 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Located between T-154 and T-151 and T-152 in long row of Quonset huts.
T-154	30.6 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Located between T-155 and T-153 in long row of Quonset huts.
T-155	30.6 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Located between T-156 and T-154 in long row of Quonset huts.
T-156	30.6 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Located between T-157 and T-155 in long row of Quonset huts.

Table E-2 (cont.)

Structure	Size (m)	Age	Quonset Hut	Material	Roof Type	Comments
T-157	30.6 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Located between T-158 and T-156 in long row of Quonset huts.
T-158	16.0 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	East of row of occupied Quonset huts.
T-160	32.0 x 9.0	1960s		Wood frame with clapboard, corrugated tin	Sloping corrugated tin	Power and telephone lines present. Sign: Community Center-84th Engineer Battalion Only
T-199	40.0 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Found between T-200 and T-198 (outside of project area). Sign: Reserved for Male Soldiers
T-200	40.0 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Found between T-201 and T-199. Sign: Reserved for Male Soldiers
T-201	40.0 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Found between T-202 and T-200. Sign: Reserved for Male Soldiers
T-202	40.0 x 6.5	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	North of T-201. Sign: Reserved for Female Soldiers
T-203	8.0 x 7.0	1950s		Wood, tarpaper exterior	Sloped corrugated tin	Marked as Female Shower on map. Located about 10 m from the east end of T-201.
T-205	10.0 x 4.5	1950s		Framed plywood, cement	Peaked corrugated tin with sprayed insulation	
T-207	30.0 x 6.0	1950s	Yes	Tin/steel	Peaked tin/steel with sprayed insulation	
T-209-1	50 x 17	1970s		Wood frame, corrugated aluminum	Peaked corrugated aluminum	East side of the connects to T-209-2
T-209-2	50 x 17	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	East side connects to T-209-3, west side to T-209-1. Three m wide sidewalk to street.
T-209-3	50 x 17	1950s	Yes	Tin/steel	Tin/steel with sprayed insulation	Open porch on south side. Whole complex known as "Mile High Club." Power lines to 1 and 2.

APPENDIX F: SITES FROM DOCUMENTARY SOURCES AND ORAL INTERVIEWS THAT ARE BEYOND THE APE

By Charles Langlas, Ph.D.

KE ALANUIKU'I AND KE ALAKAHUAMOE (HUALĀLAI-WAIKI'I TRAIL)

Both trails have been described by informants. There is no evidence for either trail within any of the proposed road corridors (so far as I know), but the trails are reported to have passed through the W-3 or W-2 corridors in the *ahupua'a* of Waikōloa.

Bill Paris (Int) described the Alanuiku'i (his name for it) as the old road from Pu'u Wa'awa'a to Ke'āmoku Sheep Station. He learned about the road as a child, when he visited Pu'u Wa'awa'a Ranch, run by his grandfather Robert Hind and uncle Eben Low. He said that the road can be seen as a "hand-worked" trail running north through lava flows in Pu'uanahulu, up to the 1859 lava flow. It is covered by the 1859 flow and then "picks up" again on the north side of the flow. Farther north there is no need for a worked trail because the route would run through dirt in the Kīpuka Kalawamauna area and Waikōloa to Ke'āmoku. Sonny Keakealani (personal communication) grew up at the Pu'uanahulu settlement. He knows the road as the "Old Mail Road," which runs through the *ahupua'a* of Pu'uanahulu at about the 950 foot level. He was told by his father that it ran from Pu'u Wa'awa'a to Ke'āmoku. Henry Ah Sam (Ints), who worked as a cowboy at Ke'āmoku Station in the 1940s, saw the trail when he rode south from Waikōloa. He too said the trail was visible in Pu'uanahulu, south of Kīpuka Kalawamauna. Mr. Ah Sam described the trail as fifteen feet wide and made by placing stones by hand. He found several sleeping-caves beside the road, with historic artifacts in them.

The second trail lies at a higher elevation. Bill Paris (Int) was told of this trail, which he said leads from the Ahu 'Umi area, in back of Hualālai to Waiki'i. His father and his uncle Eben Low rode the trail in the early 1930s, from Ahu 'Umi to Kīpuka Kalawamauna. They reported C-shaped wind-screen structures along the trail. His uncle had ridden the trail once before, but it was overgrown in the 1930s and difficult to follow. This seems to be the trail that Henry Auwae calls the Alakahuamoe (Sleeping-place trail) (Ints 7, 9).[1] He described this trail as one which ran from Kona to a junction at 'Āina Hemolele, on the Waiki'i Gulch, passing well *makai* of Pu'u Ke'eke'e. That would fit the trail described earlier as the Hualālai-Waiki'i trail, based on evidence from archaeological survey and old maps. The 1927 USGS Keamuku Quadrangle shows the trail crossing the Keamuku (Ke'āmoku) flow at about the 4,750-foot elevation. If it continued northeast in the same direction, it would come to the old Waiki'i Station, where the Saddle Road crosses Waiki'i gulch.

[1] Henry Auwae (Int 9) said he knew of three trails that run in the same general direction as the *Alakahuamoe*. The *Alakahuamoe* is the farthest *makai*, running below Pu'u Ke'eke'e. The middle one, *Alapanalua*, runs from Pu'u Ke'eke'e southwest toward Kona. That would correspond with the trail described earlier (p. 19) under the name "Kona to Pu'u Ke'eke'e Trail." The farthest *mauka* is the *Alapanakahi*, which runs above Pu'u Ke'eke'e. Cordy (1994: 112) identifies archaeological sites that probably represent portions of all three trails.)

KE'ĀMOKU SHEEP STATION

The former Ke'āmoku Sheep Station lies in the *ahupua'a* of Waikōloa, between the W-2 and W-3 corridors *(see Figure 74)*. It is well outside the APE for archaeological sites for both corridors. Some attention was given to the sheep station because it seemed to be an important historic site in the area. It seemed likely that there might be historic walls connected with the sheep station that might cross the road corridors, but that is evidently not the case.

The history of Ke'āmoku Station has been described earlier. Frank Spencer had built a house there by 1867. Spencer's companies, the Waimea Grazing and Agricultural Company and then the Pu'uloa Sheep and Stock Company evidently raised sheep at Ke'āmoku after that. When the Pu'uloa Sheep and Stock Company was sold to Parker Ranch in 1904, the company assets included a "wool press, shearing equipment, a shearing shed, and other necessities for the sheep business" at Ke'āmoku (Wellmon 1969: 174-5, n.36, p. 178). The sheep were removed from the station by Parker Ranch before 1920, and subsequently it was used as a cattle station. In the 1930s the shear barn, with its wool press, was still at the station. There was also a large house and a smaller cottage *(see Figure 7)*. By 1972, the station was no longer being used by Parker Ranch, and the ranch gave the buildings away. The Buddhist church in Waimea tore down the larger house and Willie Kaniho tore down the shear barn (Kimura Int 3). Little remains of Ke'āmoku Station.

WAIKI'I VILLAGE

Waiki'i village is outside the corridor on both sides of the road, from about Station No. 109+500 to 110+250. The history of Waiki'i village has been described earlier. It was established about 1906 by A. W. Carter as the locus of corn-growing and other activities for Parker Ranch. Corn-growing continued at Waiki'i until about 1950. The village as it existed about 1920 was described earlier, and illustrated with a sketch *(see Figure 8)*. Many of the 1920-era buildings still remain at Waiki'i, but not all of them. The schoolhouse and workers' cottages were removed in the 1960s. The corncrib, shelling shed, wagon sheds, and boss house still remain. Although part of the village is gone, the most historically significant part of the village remains, the corn crib and shelling shed. The old structures left at Waiki'i are in good shape and retain their physical integrity.

Waiki'i village is evaluated as eligible for the National Register of Historic Sites under Criterion A, association with important historical events (local and state significance) because of its importance in the development of Parker Ranch, which had a big role in the economy of the whole state (then territory). Parker Ranch was (and still is) the largest ranch in Hawai'i. It had important economic connections to Honolulu. Carter established the Hawaii Meat Company in 1909, which was the main slaughterhouse in Honolulu. Parker Ranch owned a substantial interest in the company and sent most of its cattle there for slaughter. Parker Ranch also had important economic ties to the sugar plantations on Hawai'i Island, breeding and training the mules which the plantations used for field work. When Parker Ranch began growing corn at Waiki'i, it furthered its central economic role in the state (then territory). The corn was ground and sold to Honolulu for feeding pigs there, and it was also sold to the plantations on Hawai'i Island to feed their mules. Many of the men from Waimea went up to Waiki'i seasonally to pick corn, and they have memories of the village. The site is also evaluated as eligible under Criterion D, likely to yield important historical information.

SADDLE HOUSE

The Saddle House is a ranch house formerly used by Shipman's cowboys at Pu'u 'Ō'ō Ranch. It is located about 700 feet north of the present Saddle Road (Ex-2), at about milepost 22.3. It is just south of the old Saddle Road, which loops north of the present Saddle Road in that area. The site is well outside the corridor.

As described earlier, the Saddle House was first built about 1945, as a one-room house for cooking and for storing saddles. Shipman built the house just after the Saddle Road was built, for use by the cowboys when the ranch began shipping cattle by truck, down the road to Hilo. When Shipman lost the northern Pi'ihonua lease, with the main Pu'u 'Ō'ō ranchhouse, in the late 1950s, the Saddle House was enlarged and used as the main ranchhouse. A four-room bachelors' cabin was brought up from Ōla'a Sugar Plantation and joined to the original house by a dining room. When Shipman lost the southern Pi'ihonua lease about 1974, the 200-acre parcel with the Saddle House was returned to the Forest Reserve (the parcel is mostly forested.) Since then, the Saddle House has been taken care of by Dr. William Bergin, under on an informal arrangement with the State. Dr. Bergin showed me the Saddle House. The house is still in good repair and there are a couple water tanks and an outhouse, as well.

The Saddle House is evaluated as not eligible for the National Register of Historic Sites, or the State Register. The house is associated with historically significant Pu'u 'Ō'ō Ranch, but only for the last half-century. The composite structure is only about forty years old.

PUERTO RICAN CAMP

Puerto Rican Camp was a hunter camp close to the Saddle Road. Informant Eugene Olivera (Int 1) located it on the USGS Piihonua Quadrangle at a spot about 500 feet north of the present Saddle Road (Ex-3), *around milepost 9.5*. It lay just to the east of the loop of the old Saddle Road there. He described the camp as a group of crude shelters during the 1940s (described earlier). The camp probably dates to before World War Two (Kaumana Group Int). We searched the area for remains of the camp on the first helicopter trip with Henry Auwae, but nothing could be seen.

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Supplement to

Archaeological, Historical and Traditional Cultural Property Assessment for the Hawai`i Defense Access Road A-AD-6(1) and Saddle Road (SR200) Project

by Charles Langlas, University of Hawaii-Hilo, July 1998 (Revised February 1999)

Introduction

This supplement describes additional ethnographic research carried out for the Hawai'i Defense Access Road and Saddle Road Project, requested by the Hawai'i State Historic Preservation Division (or SHPO). A draft copy of the main report was submitted in April 1997. Review comments on the draft were made by the SHPO in July 1997 (see Appendix G to the main report: SHPO Comments on an Earlier Draft) and a revision of the report was submitted in April 1998.

In addition to the review comments, the SHPO requested further ethnographic research in a letter written on November 14, 1997 (see Appendix H to this supplement). Specifically, the SHPO asked for research on two areas which might be considered traditional cultural properties under the National Historic Preservation Act, the <u>māmane-naio</u> forest which lies east of the cantonment and airfield in Pohakuloa Training Area (PTA) and the mountain Mauna Kea which lies north of the Saddle Road. (See Figure 1.) The upper zone of Mauna Kea is most easily reached via the Mauna Kea Access Road which starts up from the Saddle Road some ways east of PTA. Within the general area of these two properties there are two possible routes for the Saddle Road improvement project: Ex-2 is a reconstruction along the existing Saddle Road alignment, and PTA-1 is a new alternative route. PTA-1 has been determined by the project to be the preferred route, when the various impacts and design considerations are weighed. (See the forthcoming EIS for a complete discussion.)

SHPO's request was prompted by another report produced as part of the Environmental Impact Statement for the Saddle Road project by Pualani and Edward Kanahele, entitled <u>A Social Impact Assessment: Indigenous Hawaiian Cultural Values of the Proposed Saddle Road Alignments</u> (1997). Research with informants and consultation with Native Hawaiian Organizations was carried out from January to May 1998, designed (1) to evaluate the two areas as to their potential eligibility for the National Register of Historic Places, and (2) if eligible, to determine the effect of the project and how to mitigate any adverse effect. The consultation carried out is described in Appendix I to this supplement.

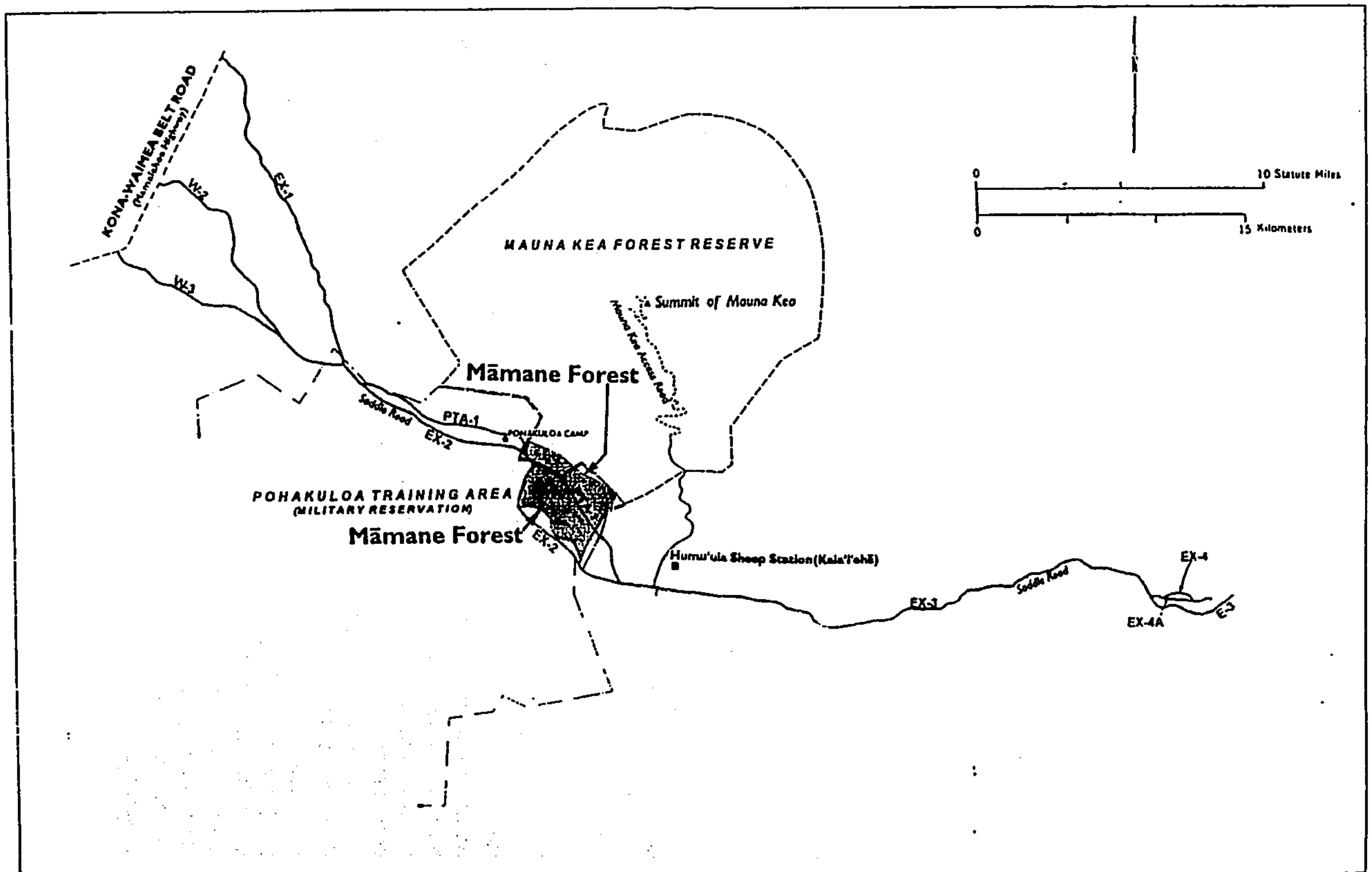
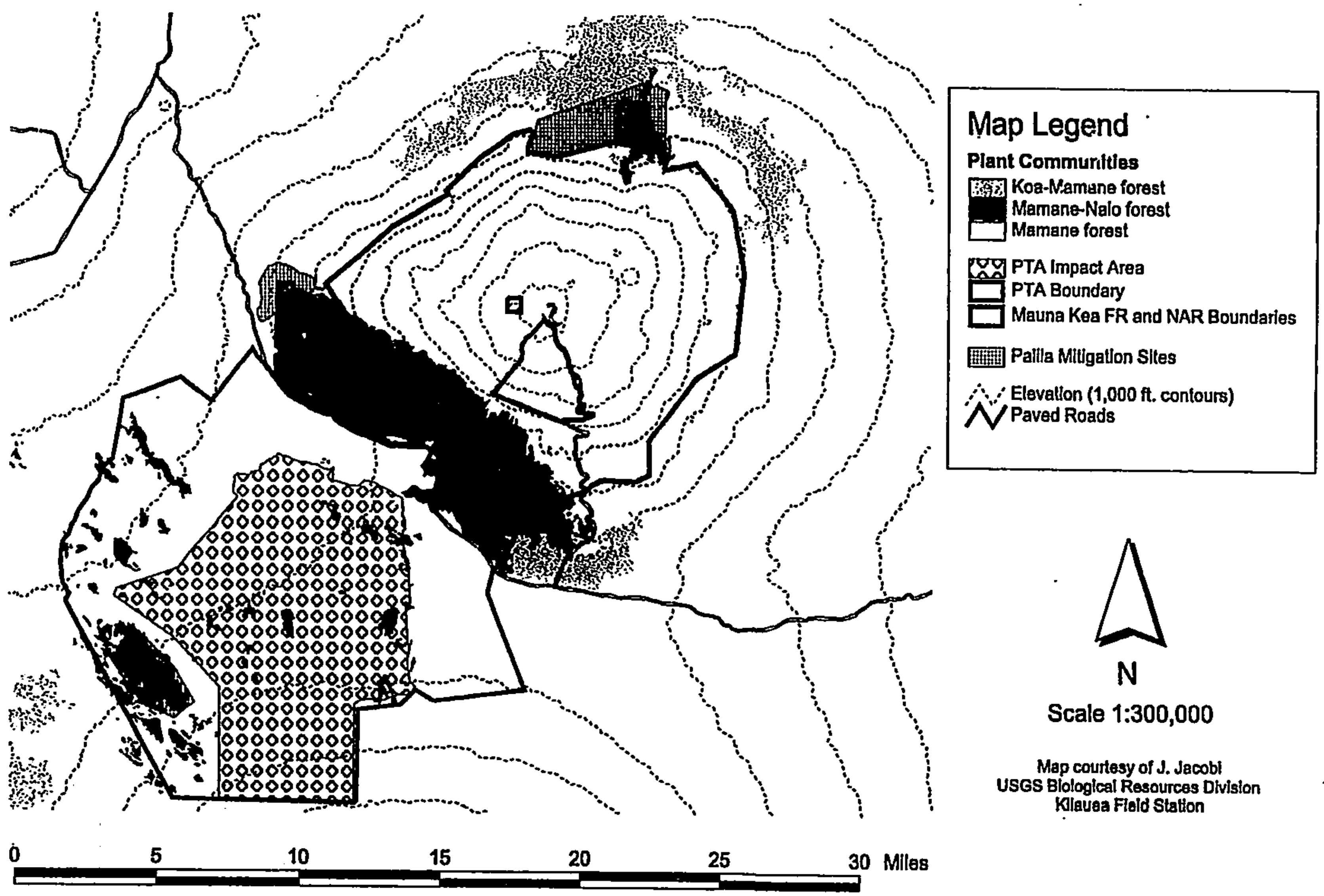


Figure 1. Project Corridors in Relation to PTA Māmane Forest and Mauna Kea

Figure 2. Distribution of Mamane Forest on Mauna Kea With Proposed Palila Mitigation Sites



Part I. PTA Māmane-Naio Forest

The Hawaiian cultural material presented here is based on the report written by Kanahele and Kanahele (1997) and on a subsequent interview with them concerning the Hawaiian cultural view of the PTA mamāne forest. Because they are concerned with conserving the PTA māmane forest, I have attempted to put their concerns into a larger context, considering the biology of māmane forests in the area more generally. Material on the biology of the forest is based on conversations with Reggie David, an ornithologist who is working on the EIS for the Saddle Road project, and with Jim Jacobi, biologist at the Biological Resources Division, USGS, who has done work on the distribution of māmane on Mauna Kea.

Māmane forest once covered Mauna Kea from about 9600 feet (2950m) down to about 6000 feet (1845m). Figure 2 shows the potential distribution of māmane forest on Mauna Kea. On the southwest side of the mountain, above the present Saddle Road in Pohakuloa Training Area (PTA) and extending up the mountain, the māmane was mixed with naio. On the north side of the mountain, it was mixed with koa at lower elevations. The māmane forest is the habitat for the palila bird, which feeds on its green seed pods. Today, much of the mamāne has been eliminated from Mauna Kea by ranching and by wild ungulates and the palila is endangered. Grazing by cattle, sheep and goats prevents regeneration of new trees because the ungulates eat the new shoots. In general the māmane is more decimated where there has been ranching of cattle or sheep.

Thus, where the present Saddle Road runs through the Saddle east of PTA (Humu'ula ahupua'a) there is no māmane to be seen, because the many years of sheep ranching there and later cattle ranching have eliminated the forest. (See Fig. 1.) Further west in PTA (Ka'ohe ahupua'a), the Saddle Road runs on lava flows along the south and west edge of a nice-looking māmane-naio forest until the road reaches the Pōhakuloa cantonment and Bradshaw airfield. Presumably the forest persisted there because Ka'ohe was less used for sheep grazing than Humu'ula. The forest here has been designated as critical habitat for the palila, although the bird does not live in the area at present. The PTA māmane-naio forest is subject to grazing by feral ungulates and to use by military vehicles for training exercises, both activities which are detrimental to the forest. The ungulate grazing is causing a gradual shift in the balance of trees. away from the māmane and toward the naio. West from the Pōhakuloa cantonment and the airfield in Pohakuloa Training Area (still Ka'ohe ahupua'a) the māmane has been eliminated in the Saddle area where the road runs. Farther upslope on Mauna Kea, however, there is a good stand of māmane-naio, particularly the section designated as the Ka'ohe Game Management Area on the west side of Mauna Kea which is the main home of the palila at present.

The Federal Highway Administration (1997: 3-179) is proposing to mitigate potential impacts of the Saddle Road Improvement Project on the palila critical habitat (māmane forest) if the PTA-1 alternative is used for the Saddle Road by enhancing the forest elsewhere on the island as habitat for the palila. The PTA-1 alternative would use 102 acres of the māmane-naio forest for the roadway. In return, under the proposed mitigation plan, three tracts (at Pu'u Mali, Ka'ohe Game Management Area, Kīpuka 'Alalā) totalling nearly 10,000 acres in the Mauna Kea/Saddle area are to be fenced to exclude ungulates and allow regeneration of the māmane and create viable habitat for the palila. Several regulatory agencies must agree to the tradeoff, including the U.S. Fish and Wildlife Service, the Biological Resources Division of the USGS and the Hawai'i State DLNR.

The Kanahele and Kanahele report (1997: 13-16) describes the PTA māmane forest east of the Pōhakuloa cantonment as a remnant of the old growth forests which formerly covered most of the upper elevations of Hawai'i Island--the kualono, "mountain slopes" and then the waoakua, "upper-level forest inhabited by the gods." The old growth forests lay above the regions heavily used by Native Hawaiians--the waokanaka, "lower-level forest frequented by man" and then the kula, "open country." Before Hawai'i's landscape was altered by the introduction of cattle, sheep and goats, and the beginning of ranching, the boundary between waoakua and waokanaka was around 2500 to 3000 feet elevation (770 to 925m), the upper limit for growing banana and for canoe-making (see Fig. 4 in the body of this report). Traditionally, Hawaiians respected the old growth forests of the kualono and the waoakua (such as the PTA māmane forest) and avoided disturbing them, seeing them as important to attract rain, to provide seeds to regenerate the forests lower down in the waokanaka and to provide a home for the spirits (nā kini akua). The PTA māmane forest is seen as particularly important:

> The mamane forest as shown in "Exhibit D & E" is very old and perhaps the last stand of mamane left. According to the [Hawaiian] hierarchy system the important entity is the food source not the one who feeds off it. The mamane forest is the consideration not the palila. The forest is not mobile and therefore this cultural resource is the focus. (Kanahele and Kanahele 1997: 17)

They argue, therefore, that construction of the new Saddle road through the māmane forest east of the Pōhakuloa cantonment along the PTA-1 route would have a "negative cultural impact," since it would destroy trees that Hawaiians traditionally respected and avoided cutting. However, they also allow that the Federal Highways Administration proposal to fence three tracts to regenerate māmane in exchange, would mitigate the negative effect (Kanahele and Kanahele 1997: 23).

The māmane forest in question is evaluated here as not eligible for the National Register of Historic Places as a traditional cultural property, based on the guidelines published in National Register Bulletin 38 (Parker and King 1992). It is true that a natural feature or area may be considered a traditional cultural property under certain conditions.

> Thus, a property may be defined as a "site" as long as it was the location of a significant event or activity, regardless of whether the event or activity left any evidence of its occurrence.

> A natural object such as a tree or a rock outcrop may be an eligible object if it is associated with a significant tradition or use.
> (Parker and King 1992: 9)

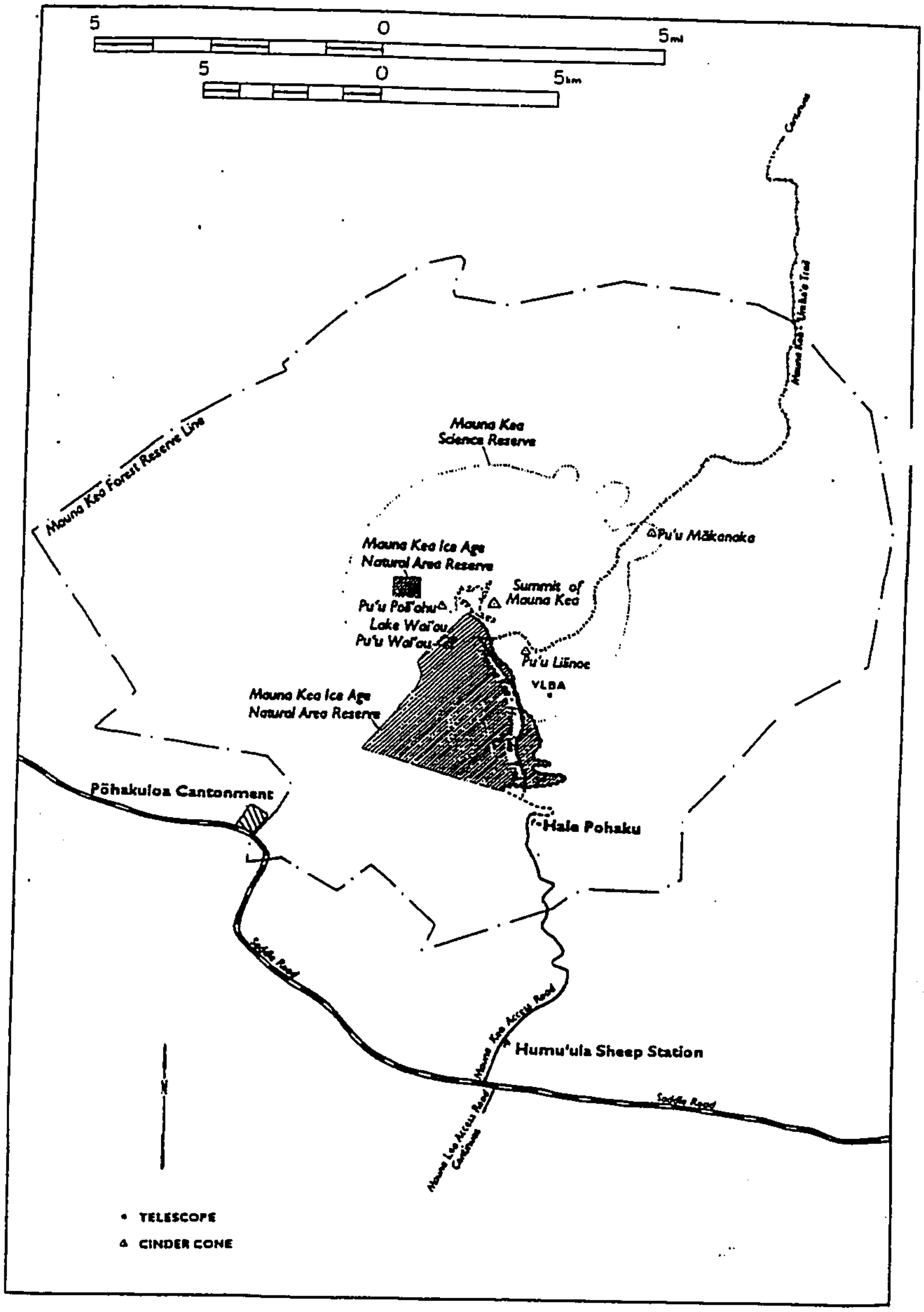
A number of examples are given in the bulletin of natural features which are eligible as traditional cultural properties. The examples are of two categories. One category consists of features used for traditional subsistence or ritual activities--a sedge preserve used for Pomo basketry, sandbars in the Rio Grande used by Sandia Pueblo folk, the forest of the Helkau Historic District used by various Indian tribes to communicate with spirits. The other category consists of features connected with creation traditions--a mountain in Truk where the societal founder established the first meeting house, Tahquitz Canyon where the Cahuilla ancestors emerged, Goose Egg Hill where a Yakima goddess' heart landed when she was torn apart. In all these cases the natural feature is connected with specific traditional activities carried on by past generations or with specific events in the group's history.

For the PTA māmane forest in question there is no assertion of specific traditional activities or historic events connected with the PTA māmane forest either in the Kanahele and Kanehele report or in my interview with the Kanaheles. Likewise, no traditional Hawaiian cultural activities connected with the forest were mentioned by any other Native Hawaiian informants interviewed during work on the Saddle Road Project. The only historic activity mentioned was the use of māmane wood for fence posts in the Saddle area, both by Parker Ranch and by the Civilian Conservation Corps in the 1930s. Following the Kanahele and Kanehele report, it may be agreed that the forest has value to Native Hawaiians according to their traditional cultural values, but the assertion of generalized respect for forests is not a sufficient reason to designate this forest as a traditional cultural property. Moreover, this generalized respect would apply to all upland forests in Hawai'i. The concept of "traditional cultural property" was surely intended to protect specific sites of traditional cultural importance and not as a general zoning tool.

Part II. Mauna Kea

Introduction

The evidence and the issues involved in considering Mauna Kea as a traditional cultural property and the effects of the Saddle Road improvement project on Mauna Kea are very complex. That is partly because there are many specific Hawaiian cultural sites on Mauna Kea to be considered and evaluated and partly because Mauna Kea is already being managed by various state entities--the Institute for Astronomy, an arm of the University of Hawai'i, and the several divisions of the Department of Land and Natural Resources. Arguably, the Hawaiian cultural sites on Mauna Kea are



5 0 5mi
5 0 5km
Mauna Kea Forest Reserve Line
Mauna Kea Science Reserve
Pu'u Mākanaka
Mauna Kea Ice Age Natural Area Reserve
Summit of Mauna Kea
Pu'u Poli'ahu
Lake Wai'au
Pu'u Wai'au
Pu'u Lilinoe
VLBA
Mauna Kea Ice Age Natural Area Reserve
Pōhakuloa Cantonment
Hale Pohaku
Saddle Road
Mauna Kea Access Road
Humu'ula Sheep Station
Saddle Road
Mauna Kea Access Road Continues
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not being adequately managed under the current management plan (promulgated in 1995) in order to minimize adverse effect on those sites. A recent report by the State Auditor (February, 1998) makes that argument, although it is stated in different terms:

> We found that the University of Hawaii's management of the Mauna Kea Science Reserve [the summit area above 12000 feet or 3690m] is inadequate to ensure the protection of natural resources [including cultural or religious sites].
> The university's control over public access was weak and its efforts to protect natural resources were piecemeal. The university neglected historic preservation, and the cultural value of Mauna Kea was largely unrecognized. (Hawaii State Auditor 1998: Overview)

It is difficult to untangle current adverse effects on Mauna Kea sites due to inadequate state management from potential adverse effects due to the proposed Saddle Road improvement project. In order to do so, it is necessary to examine the current state management of Mauna Kea.

This ethnographic study should be regarded as only a contribution toward understanding the Hawaiian cultural significance of Mauna Kea and how to manage adverse effects on Hawaiian cultural sites there. It is by no means an exhaustive study. In my view an exhaustive study would require a larger effort and should be the responsibility of the state agencies responsible for managing Mauna Kea--the University of Hawai'i and the DLNR.

The material on Hawaiian cultural sites presented here is based on interviews with Native Hawaiians, on the 1997 report written by Edward and Pualani Kanahele for the Saddle Road project referred to earlier and on a survey of historical resources for the Mauna Kea summit by Holly McEldowney (1982) and of the archaeological resources by Pat McCoy (1982). (McCoy and McEldowney did that work as consultants while working for Bishop Museum, but now work for the Historic Preservation Division of the DLNR.) The material on current management of Hawaiian cultural sites on Mauna Kea is based on the 1998 Auditor's report, on interviews with local officials in charge of managing Mauna Kea and commercial tour operator Doug Arnott, and on consultation with concerned Native Hawaiian organizations.

Ethnographic Evidence for Hawaiian Cultural Sites

Interviews were carried out with several Native Hawaiians knowledgeable about Hawaiian cultural sites on Mauna Kea, including Kupuna X (kupuna means elder), Edward and Pualani Kanahele, Kupuna Y and Kealoha Pisciotta. Both Kupuna X and Kupuna Y gave important information about cultural sites on Mauna Kea, but decided not to allow their names and interviews to be made public. I suspect that there are other Native Hawaiians to be interviewed who have knowledge about Hawaiian cultural sites on Mauna Kea. However, it proved impossible to locate any others during the period allocated for research (January to June 1998), despite considerable effort at networking through Native Hawaiian organizations and despite the placement of ads in the Hawai'i Island newspapers requesting assistance.

Kupuna X

Kupuna X learned about Mauna Kea from his great-grandparents. They taught him that there were two sites of ritual importance on Mauna Kea, the summit peak and Lake Wai'au, together with Pu'u Wai'au which surrounds it. The summit peak was used "in the early days" as a place to go and pray to the gods for mana, to cleanse the person and give him health. It was used especially for first-born children. Lake Wai'au was used as a place to deposit the navel cords of newborn children to ensure them a long life. Its water has mana, so it was used to purify people and to cure sickness. Kupuna X said that Lake Wai'au needs to be protected from contamination by people bathing in it. In particular, if a menstruating woman bathes in the water it will contaminate the water and make it dangerous to those who use it later.

Pualani Kanaka'ole Kanahele and Edward Kanahele

Pualani and Edward Kanahele are widely respected in the Hawaiian community as authorities on Hawaiian culture. Pualani and her sisters are known for the knowledge passed down to them through their mother Edith Kanaka'ole--knowledge of Hawaiian language, of chant and hula kahiko, of Pele and other Hawaiian gods, and of wahi pana (places of traditional cultural importance). They have formed a nonprofit organization, the Edith Kanaka'ole Foundation, to perpetuate traditional Hawaiian culture. Pualani and sister Nalani are the kumu hula of the hālau hula named Hālau o Kekuhi.

The interviews held with the Kanahele's reiterated and sometimes amplified the points made about Mauna Kea in their report for the Saddle Road project (Kanahele and Kanahele 1997: 5-9). The statements in the report are based on family teachings and material from Pualani's Hawaiian newspaper story collection. The chants Mele a Paku'i and 'O Hānau ka Mauna a Wākea describe, respectively, the birth of Hawai'i island from the union of Papa and Wākea, the ancestors of Native Hawaiians, and the birth and "budding upward" of Mauna Kea a mountain named for Wākea. As the first-born of Papa and Wākea, Hawai'i island is the hiapo, the respected older sibling of all Native Hawaiians. The mountain of Mauna Kea is the piko or origin point for the island, more specifically for its northern half, and therefore is a place of great mana. Because of the mana of the mountain and of Lake Wai'au at its summit, Queen Emma went there to bathe in the water in 1874. She was at that time in competition with David Kalākaua for election as the new mō'ī of Hawai'i, after the death of Lunalilo left the throne vacant. According to the newspaper story (Kanahele and Kanahele 1997: 9) Kalākaua went to Kaho'olawe (the body of the ocean-god Kanaloa) to bathe in its waters and gain mana; Queen Emma went to Lake Wai'au to bathe in its waters to purify herself and gain mana. In two interviews, the Kanahele's made further points. First, the whole of Mauna Kea is sacred, a place of mana, from the summit down to the zone frequented by man--not just specific ritual sites. As described earlier, in pre-contact times the upper zones of the island (mountain summits and upper forests) were inhabited by the gods, while the lower zones (lower forests and open country near the sea) were used by Hawaiians. In their view, that means that everything above the lower forest zone is sacred. Of course, much of the upper forest has been eliminated from Mauna Kea today. When pressed to say how much of the mountain deserved protection as a sacred area, Pualani Kanahele said it should at least include all of the forest reserve area. Second, Mrs. Kanahele said that all three pu'u, Poli'ahu, Lilinoe and Wai'au, are important religious sites. The pu'u are named for three sister goddesses who are female forms of water, Poli'ahu embodied in snow, Lilinoe in mist, Wai'au in the lake. She said that the pu'u is a place where the goddess manifests herself, just as the gods manifested themselves in heiau images. So the pu'u is a good place to pray to, or make requests of the goddess.

Kupuna Y and Kealoha Pisciotta

Kupuna Y is a member of a Kona family with ties to Mauna Kea because they are "of the Poli'ahu line" (meaning that Poli'ahu is one of their 'aumakua or ancestral gods). Her family has passed down traditions regarding Poli'ahu and Mauna Kea. In recent years, they have chosen Kealoha Pisciotta (who works at one of the telescopes on Mauna Kea) as their kahu for worship of Poli'ahu, and their spokesperson concerning Mauna Kea. Ms. Pisciotta has constructed a shrine on Mauna Kea for that purpose and incorporated into it a special stone given her by the family. The material summarized here is based on an initial consultation with the Mauna Kea Coalition that included Ms. McCord and Ms. Pisciotta, on a subsequent interview with Kupuna Y and telephone conversation with Ms. Pisciotta.

Kupuna Y said that she learned about the family traditions regarding Poli'ahu and Mauna Kea from her mother and her great-grandmother. She said that her family traditionally deposited piko of their children in Lake Wai'au and buried their dead on Mauna Kea. She herself has never gone up Mauna Kea, but she said that others of her family do go up there. She said further that although her own family is connected particularly to Poli'ahu, Mauna Kea is not only a place for Poli'ahu but for all the Hawaiian gods.

Both Kupuna Y and Ms. Pisciotta said that the whole mountain is sacred. There are traditional shrines (found during archaeological surveys) and traditional ritual areas, including the summit, Pu'u Poli'ahu, Pu'u Lilinoe and Lake Wai'au. But it is appropriate to worship anyplace on the mountain if one is spiritually guided there. Worship shouldn't be limited only to the traditional sites. In fact Ms. Kealoha built her shrine to Poli'ahu at a new place that she was guided to, at about 11000 feet (3075m), just above Hale Pōhaku and close to the Mauna Kea Access Road. She feels it has just as much mana as the traditional places.

Both women are very disturbed that this shrine has been repeatedly desecrated, and they lay the blame on a member of the staff of Mauna Kea Support Services, Institute for Astronomy. There have been three incidents. The first time the altar was torn down and the stone brought from Kona was taken to the Hilo dump, where it was later found. The second time Ms. Pisciotta was accosted by the staffmember at the shrine. The third time the stone was taken again and has not been found.

Discussion and Evaluation of Hawaiian Cultural Sites

The ethnographic interview evidence presented above can now be put together with the documentary and archaeological survey work done by McEldowney (1982) and McCoy (1982) and the various sites mentioned can be evaluated as to their eligibility for the National Register of Historic Places.

Mauna Kea

Both sets of informants considered above have made explicit statements that the whole upper zone of the mountain was traditionally considered a place of mana. Certainly that conception fits with our knowledge of numerous Native Hawaiian burials on Mauna Kea and of numerous shrines near to the summit. There is documentary evidence of burials on the north and east slopes of Mauna Kea from about 7800 feet (2400m) up to 13,000 feet (4000m) (McEldowney 1982: 8). Mauna Kea may have been chosen as a place for burial because the bones were more safe from disturbance there, as suggested by McEldowney (1982: 9). But it is also likely that they were taken there because of the sacredness of the area. In particular, those families with ties to Poli'ahu or Lilinoe as 'aumakua may have taken their dead there because Mauna Kea was the place sacred to those goddesses. McCoy (1982) found 21 prehistoric shrines in a survey of the summit area, all of them having one or more upright slabs. The bulk of the shrines were at the north edge of the summit plateau at about 13,000 feet (4000m), where the steep mountain slope flattens out. As McCoy (1982: 9-11) notes, the function of these shrines is unknown, they have no connection with an occupational activity like the shrines at the adze quarry, but their number is remarkable. He suggests as one hypothesis, that "The high density shrine area on the edge of the plateau is the lower, northern boundary of an upper mountain god/spirit zone." A later survey conducted by McCoy in 1984 on the eastern and southeastern slopes of Mauna Kea identified 20 additional shrines above 13,000 feet (4000m) (Pat McCoy, personal communication). Within this summit plateau of Mauna Kea are a number of specific named sites as well which are known to a greater or lesser degree as ritual sites, including Lake Wai'au, Pu'u Poli'ahu, Pu'u Poli'ahu and the summit peak. Those sites are discussed individually below.

There are some indications of ritual and burial sites below the 13,000 foot (4000m) elevation, but limited survey work has been down lower down. Recent unreported survey work was done by McCoy and McEldowney (personal communication). Survey transects were carried out to the north of the summit and to the southwest and shrines were found along the transect lines down to 12,000 feet (3700m) or so. Many shrines also occur in the area of the Mauna Kea Adze Quarry, mostly between 12,000 feet (3700m) and 12,700 feet (3900m) (Cordy 1994: 95). In addition there is a single shrine at 10,400 feet (3200m) connected with the adze working site at Hopukani Spring and two shrines at 9500 feet (2920m) near Hale Pōhaku, connected with the Pu'u Kalepeamoa quarry used for making octopus lure sinkers and hammerstones (Cordy 1994: 90, 96). Burials are located lower down as well. Burials are known to the northeast of the summit at Pu'u Kanakaleonui at about 9400 feet (2890m) elevation (McEldowney, personal communication) and at 'Iolehaehae, Pu'u-o-Kuka'iau and/or Pu'u-o-Kihe at about 8000 feet (2460m) (McEldowney 1992: 8, referring to Boundary Commission testimony). A single burial is known at Pu'u Ahumoa on the west side of Mauna Kea at 7000 feet (2150m) (Cordy 1994: 91, 96).

The author recommends that the whole upper zone of Mauna Kea be evaluated as eligible for the National Register of Historic Places as a traditional cultural property under Criterion A, association with significant historical events, based on the information provided above regarding traditional burials and shrines, on informant statements about its spiritual importance and on continued ritual use. Beliefs in and ritual activities connected with this upper zone go back at least to the time of the great-grandparents of Kupuna X and Kupuna Y. Ritual activities are still being carried out today by practitioner Kealoha Pisciotta. Although Ms. Pisciotta and other Native Hawaiians are concerned about the impact of development for telescopes on Mauna Kea, it can still be considered to maintain its integrity as a place of mana. This report does not attempt to set a boundary where this upper zone begins, whether at 10,000 feet (3400m)--below most of the prehistoric shrines and burials, and below Ms. Pisciotta's recent shrine--or at some other elevation. To the writer, it seems that as a practical matter, for the purposes of nomination to the National Register and protection of the site, the boundary should be a matter for consultation involving the principals--Native Hawaiian organizations and ritual practitioners on one side, the University of Hawai'i and the DLNR on the other.

Lake Wai'au and Pu'u Wai'au

Taken together, Lake Wai'au and Pu'u Wai'au which contains it are the best attested specific ritual site at the top of Mauna Kea. Kupuna X was taught that the water of the lake had mana and was used traditionally to purify and heal. The newspaper story noted by the Kanahele's about Queen Emma bathing in the lake water to gain spiritual power in her competition with David Kalākaua bears out the Hawaiian belief in the mana of the lake. Kupuna X and Kupuna Y both describe it as a place where children's navel cords were placed, with the ritual purpose of giving the children long life. Belief in the spiritual power of the lake and ritual activities connected with it go back in time to the time of their great-grandparents and before. The use of the name Wai'au for the lake goes back at least to the nineteenth century. The name Waiau [presumably Wai'au] was given by elderly Hawaiians testifying to the

Boundary Commission in 1873 and was given by Alexander in 1892 as a "genuine native name" (McEldowney 1982: 14, Table 1.2). Protection of the lake's mana is still important to Kupuna X, who indicated that individuals who entered the lake carelessly could contaminate its mana. The informants cited above have not spoken much about the pu'u which contains Lake Wai'au. However, there is archaeological evidence that the pu'u slopes were also ritually important (McEldowney, personal communication). Cairns probably used for burial have been found on the south edge of the pu'u and a shrine has been found on the slope above the lake on the north side. Based on the foregoing, the author recommends that Lake Wai'au/Pu'u Wai'au be evaluated as a site eligible for the National Register of Historic Places as a traditional cultural property under Criterion A, association with significant historical events.

Summit Peak

The summit peak is known on current USGS maps as Pu'u Wēkiu, but this is not a traditional Hawaiian name for it. Traditionally it was named Pu'u-o-Kūkahau'ula (McEldowney 1982: 14; Boundary Commission Book B: 35). Kūkahau'ula is a particular manifestation of the god Hawaiian god Kū and an 'aumakua for fishermen (Kamakau 1992: 215). The name suggests some ritual association with that god. The first known white explorer to reach the summit, Joseph Goodrich, found a "heap of stones" there (Ellis 1963: 290). This might have been a shrine. Two photos of the summit of Mauna Kea taken during the 1935 Mauna Kea expedition (Bryan 1979: 35) show a heap of rocks which may well be the remains of that shrine. Among the rocks in the photos is a slab of tabular basalt similar to the uprights found in the many shrines described by McCoy (1982: 8). Specific interview evidence regarding use of the summit peak was given only by Kupuna X. Kupuna X stated that the peak was used "in the early days" as a place to go and ask the gods for mana and good health, especially for first-born children. Kupuna Y and Kealoha Pisciotta mentioned the summit as a place used traditionally for ritual and a place they wish to protect for future ritual use; but they did not specify that ritual at all.

The author regrets that he cannot recommend that the summit peak be evaluated as a site eligible for the National Register of Historic Places at this time. The information given by Kupuna X does indicate that the summit peak was used as a ritual site prior to 1900. That evidence would make it eligible as a traditional cultural property under Criterion A, association with significant historical events, but it cannot be made public. Native Hawaiians may presently practice rituals at this traditional site, but none have yet been found. Further information should be sought before a definitive evaluation is made. Further inquiry should be made of current ritual practitioners (if such can be found) to determine how to best protect the site for ritual activity.

Pu'u Poli'ahu and Pu'u Lilinoe

Relatively little information has been collected about these two pu'u. In her survey of place names at the summit plateau, McEldowney (1982: 13-15, Tables 1.1 and 1.2) found that there is no certain evidence linking the names Poli'ahu and Lilinoe to the two pu'u that now bear their names. Certainly Poli'ahu is an old name applied to a place in the summit area according to the testimony given by old residents to the Boundary Commission in 1873. However, it is not certain what feature it named. Kamakau (1961: 17) speaks of Poli'ahu's spring at the top of Mauna Kea. One reference in the Boundary Commission testimony speaks of a pond Poli'ahu, another of a cave Poli'ahu. McEldowney cites evidence that surveyor W. A. Alexander was the one who attached the name Poli'ahu to what was a "nameless peak" (McEldowney 1982: Table 1.2, Note 2). Lilinoe is not mentioned in the Boundary Commission testimony, except as the resident of the cave Poli'ahu. Kamakau (1992: 285) too speaks of "...the bones of Lilinoe on Mauna Kea where her body was said to have lain for more than a thousand years...." The earliest documented use of Lilinoe for the pu'u that now bears its name is by the surveyors Lyons in 1884-91 and Alexander in 1892 (McEldowney 1982: Table 1.2). Of the informants questioned on this, Kupuna Y and Pualani Kanahele believe that the names of Pu'u Poli'ahu and Pu'u Lilinoe are traditional ones and that the two pu'u are important as ritual sites for the worship of Poli'ahu and Lilinoe, respectively. Kupuna Y also stated that descendants of both Poli'ahu and Lilinoe buried their dead on Mauna Kea.

At this point, the evidence is suggestive that Pu'u Poli'ahu and Pu'u Lilinoe were traditional ritual sites and that some Native Hawaiians may still use them as ritual sites today. Further information should be sought before a definitive evaluation is made.

Kaluakāko'i (adze quarry)

In the nineteenth century, the Mauna Kea adze quarry was known as Keanakāko'i or as Kaluakaakoi [presumably Kaluakāko'i], literally "the cave or pit where adzes are made"). Kaluakāko'i appears earlier, in the Boundary Commission testimony (Boundary Commission Book B: 37, 41). Keanakāko'i appears a bit later, on Alexander's 1892 map (McEldowney 1982: Table 1-2.) Probably both names were used interchangeably, since there meaning is very similar.

The quarry is located in the Mauna Kea Ice Age Natural Area Reserve west of the Mauna Kea Access Road and above Hale Pōhaku. Survey of the site found numerous debitage piles left from adze-making composed mostly of basalt flakes, and a few abandoned adze preforms. (Preforms were apparently chipped out roughly at the quarry and then carried down for final working.) There are also numerous shrines with upright slabs, presumably used by the adze makers in rituals connected with their work, and rock shelters where Hawaiians stayed while working at the quarry (Cordy 1994: 92-100). The quarry covers a large area, lying mainly between 12,000 feet (3700m) and 12,700 feet (3900m) elevation, but with some outlying sites lower down. The Humu'ula-Mauna Kea trail runs through the quarry on the east side.

The adze quarry is listed on the National Register of Historic Sites and is a National Historic Landmark because of its unique status as an archaeological site under

Criterion C. It should be noted that it would also be eligible for the register as a traditional cultural property (under Criterion A, association with significant historical events). The quarry would qualify as a traditional cultural property because there has been sporadic use of basalt from the adze quarry by Native Hawaiians in modern times, which will probably continue. Recently, the Polynesian Voyaging Society collected basalt at the quarry for an adze to carve a koa sailing canoe (Bill Stormont, personal communication).

Discussion

It is recommended that the whole upper zone of Mauna Kea be nominated to the National Register of Historic Places as a historic district. Not only is the whole upper zone evaluated here as eligible for the register as a traditional cultural property, but there are two specific sites within the upper zone which are individually evaluated above as eligible as traditional cultural properties (Pu'u/Lake Wai'au and Kaluakāko'i), as described above. There are three additional specific sites which may be found eligible for the register as traditional cultural properties with further ethnographic work, the summit peak, Pu'u Poli'ahu and Pu'u Lilinoe. Besides those sites, there are also a large number of shrines and burials which have not been enumerated. It is also recommended that the boundary of this upper zone be defined by further consultation between Native Hawaiian organizations and ritual practitioners on one side and the University of Hawai'i and DLNR on the other.

Current Management of Mauna Kea

At present, the responsibility for management of Mauna Kea, including its Hawaiian cultural sites, is divided between the State Department of Land and Natural Resources (and its Board) and the Institute for Astronomy (IfA) of the University of Hawai'i. The state Board of Land and Natural Resources leases to the University of Hawai'i the upper section of Mauna Kea, designated the Mauna Kea Science Reserve, for the construction and operation of telescopes (see Figure 3). Individual telescope operators lease sites from the university, and construct and run the telescopes. At present there are twelve telescopes at the summit and a radio antenna called the Very Long Base Array (VLBR) farther down at 12,200 feet (3760m). The science reserve includes the summit area above 12,000 feet (3700m) except for the area included in the Mauna Kea Ice Age Natural Reserve. It also includes the Hale Pōhaku area (19.3 acres, 7.7 ha) which serves as a staging area for astronomy operations, and the road built from Hale Pōhaku up to the summit, along with a corridor 1200 feet (370m) wide on both sides of the road except where it bounds the natural area reserve. Mauna Kea Support Services, part of the IfA, handles certain logistic and maintenance services for the telescope operators and runs the facilities at Hale Pōhaku, including a Visitor Information Station and Elison Onizuka Center for International Astronomy.

There have been a series of management plans instituted since 1977 (Hawaii State Auditor 1998: 4-8), developed by the IfA and approved by the Board of Land and Natural Resources. The 1985 plan gave overall management responsibility of the science reserve to the IfA, but the 1995 plan which superseded it returns overall responsibility to the DLNR to manage public and commercial use (tours) of the science reserve.

Commercial Tours

Commercial tour operations are managed by the DLNR Land Division by means of a permitting process. The Board of Land and Natural Resources has authorized twelve permits for tour operations to the summit and at present permits have been given for nine operators (Charlene Unoki, DLNR Land Division, Hilo Office, personal communication). Each operator is allowed to make two trips a day, using a vehicle that carries 13 passengers and a driver; a maximum of eighteen tour vehicles may be at the summit at any one time (Revised Management Plan, 1995). The operators must comply with certain conditions or have their permit revoked. A reading of the permits indicates that those conditions include the requirements to register at the Visitor Information Station on the way up, to report to the DLNR Land Division their monthly total of visitors carried, to keep the summit area "in a clean, sanitary and orderly condition," to form a Tour Operators Association and to refrain from leading tours to the adze quarry. Ms. Unoki of the DLNR Land Division, Hilo office, said that the tour operators are also supposed to avoid taking tours to Lake Wai'au because of its status as a cultural site mentioned in the Revised Management Plan (1995: 5), although that condition is not clearly stated on the permits. At present none of the tour operators is running close to the maximum number of tours allowed (Unoki, personal communication; confirmed by inspection of DLNR files). Doug Arnott, who runs Arnott's Lodge and Hiking Adventures, one of the bigger tour operators to the Mauna Kea summit and secretary of the tour operators association, was interviewed about his operations. Arnott's run three standard tours a week to the summit (one vehicle), and occasional special tours. The standard tour stops at the Visitor Information Station and then goes up to the summit, past the telescopes. The driver stops at the summit to let the group hike up to the summit peak. If the weather is clear, the vehicle goes up to the top of Pu'u Poli'ahu on the road built there for a view of Lake Wai'au. Then the tour returns. The main effects on Hawaiian cultural sites would be from the tourists who hike up the summit peak and the vehicles which drive up Pu'u Poli'ahu, which could be disturbing to ritual practitioners who use those sites. Mr. Arnott said that he and the other tour operators know that they are not permitted to take visitors to Lake Wai'au.

Two of the permit holders are set up to take skiers during periods of snowfall at the summit. The effects of the ski tours are perhaps greater than those of the regular tours, which mostly stick to the road. The ski tours are required to use "designated staging areas" according to the terms of the permits, but no inquiry was otherwise made into the nature of the tours.

Private Vehicles

DLNR also has overall responsibility for management of visitors who come up Mauna Kea in private vehicles. Within the science reserve, visitors who come by private vehicle are allowed access during the day to do skiing, hiking on existing roads and trails, hunting, and "cultural activities" so long as they do not involve physical impact (Revised Management Plan 1995: 4-5). The Natural Area Reserve System (NARS) has jurisdiction over Lake Wai'au and the Mauna Kea Adze Quarry, which fall into the Mauna Kea Ice Age Natural Area Reserve. The reserve is supervised by Bill Stormont at the Hilo office of the DLNR Forestry and Wildlife Division. Forestry and Wildlife also has jurisdiction over the rest of the Mauna Kea Forest Reserve. However, they have no personnel on Mauna Kea. Certain management responsibilities have been given to the University of Hawai'i. Above Hale Pōhaku, the university can prohibit two-wheel drive vehicles when conditions are hazardous and can install a barrier to prevent access during nighttime hours (Revised Management Plan 1995: 8, 12). Since there are no DLNR personnel on Mauna Kea, monitoring for violation of regulations is done by personnel of Mauna Kea Support Services, (especially the staff of the Visitor Information Station) and by those who work at the telescopes (personal communications from Ron Koehler, Bill Stormont, Kealoha Pisciotta). In the event of a report of a violation to regulations (such as swimming in Lake Wai'au, driving offroad or disturbing an archeological site), Forestry and Wildlife informs the Division of Conservation and Resources Enforcement (DOCARE) to handle the violator, but there are no DOCARE personnel on Mauna Kea either so enforcement is difficult.

The university handles education of visitors at the Visitor Information Station, including giving advice on safety, and statements of the rules which prohibit hiking offtrail or driving offroad and prohibit disturbing the adze quarry and swimming in Lake Wai'au (personal communication from Hugh Grossman, staffer at the Visitor Information Station). Visitors are advised by sign to stop at the station, but at present it is only staffed from Friday through Sunday. (Beginning in June the staffing was to increase to Thursday through Monday.) In addition there are signs posted which tell visitors not to drive offroad, not to disturb the landscape, not to build rock piles. There seems to be little attempt to notify visitors about the Hawaiian cultural status of Mauna Kea as a place of spiritual power or of the cultural importance of specific ritual sites like Lake Wai'au.

An attempt was made to gauge the number of private vehicle visitors who currently come up to the summit and their effect on Hawaiian cultural sites by conversations with Ron Koehler, Director of Mauna Kea Support Services, and with Bill Stormont who supervises the NAR. Ron Koehler (personal communication) estimated that there are over a hundred vehicles coming up to the summit every day, two-thirds of them astronomers and one-third visitors (both local and off-island). The majority of visitors come in two-wheel drive cars, the minority in four-wheel drive commercial or private vehicles. The visitors do a limited amount of hiking according to Mr. Koehler: many of them hike the short distance from the road up to the summit peak; perhaps twelve visitors a week hike to Lake Wai'au; few hike to the adze quarry; very few hike north from the summit to the area where most of the shrines are.

According to Mr. Stormont (personal communication) he is notified only three to four times a year by university personnel of violations in the NAR, about violations such as graffiti seen at the adze quarry, off-road vehicles, hang-gliding from Pu'u Keonehehe'e. Mr. Stormont said he was also aware that hikers occasionally take adze blanks or rocks from the quarry. In the 1970s there was a road open from the Mauna Kea Access Road to Lake Wai'au, and at that time visitors often swam in Lake Wai'au. Since the road was closed in the 1980s that happens rarely. The present monitoring system appears to have only a limited ability to notice violations of the rules protecting Hawaiian cultural sites. The telescope personnel would usually be concentrating on their jobs, and not looking for violations. The Visitor Information Station is not staffed fulltime. Moreover, the main cultural sites in the NAR, the adze quarry and Lake Wai'au, are not visible from the Hale Pōhaku or the telescope sites where university personnel work or from the Mauna Kea Access Road.

University Personnel

The personnel of Mauna Kea Support Services are supposed to play a positive role in managing Hawaiian cultural sites, but there is some evidence that they sometimes have played a negative role so far as Native Hawaiian ritual practitioners are concerned. The main issue here is whether Native Hawaiians are free to build rock shrines on Mauna Kea and under what conditions. The 1995 Management Plan does not directly address this issue, as regards the science reserve. It states only that "Cultural activities which are otherwise consistent with this plan and do not involve physical impacts are permitted (Revised Management Plan 1995: 5). Mauna Kea Support Services had assumed that this meant that no building of rock piles (which would include Native Hawaiian-built shrines) was allowed. They have installed signs which warn against disturbing the landscape and building rock piles. They have also removed rock piles, assuming they were built by tourists (Ron Koehler, personal communication). Mr. Koehler stated on May 1, 1998, that after they received a complaint that a shrine built by a Native Hawaiian had been removed, they changed the policy. The present policy is that they do not restrict the building of rock shrines by Native Hawaiians and will no longer remove rock piles. But Mr. Koehler would like to receive some direction from Native Hawaiian community on this policy. This statement conflicts with the perception of Kealoha Pisciotta, the builder of the shrine, as described on page 9. At the least, this indicates a need for the IfA to engage in active consultation with Native Hawaiian organizations to resolve the problem.

Assessment of Effect and Discussion of Mitigation

Effects of the Current Situation

Only a preliminary exploration has been made here of the effects of the present roadway access system--the unimproved Saddle Road and Mauna Kea Access Road--under the present management regime carried out by the university and the DLNR. However, it seems clear that it results in adverse effects on Hawaiian cultural sites which are evaluated here as eligible for the National Register of Historic Places (Lake Wai'au/ Pu'u Wai'au) or which have already been placed on the register (Mauna Kea adze quarry). There is a low level of visitor traffic to the Mauna Kea adze quarry which results in some disturbance of the archaeological sites, moving and removal of adze blanks and graffiti. Likewise there is a low level of visitor traffic to Lake Wai'au, which sometimes leads to swimming in lake by individuals who are not properly prepared and who may spiritually pollute the lake from the point of view of Native Hawaiians. There is a much higher level of visitor traffic to the summit peak. Because the summit peak is a traditional place for rituals, the visitor traffic would probably create an adverse effect on ritual practitioners who wished to practice there. However, this is not confirmed as an adverse effect because no ritual practitioner was located who currently uses the summit peak.

The present management regime and roadway access system also impact Pu'u Poli'ahu and Pu'u Lilinoe, potentially eligible for the National Register of Historic Places as specific sites. More broadly, it also impacts the whole upper zone of the mountain, evaluated here as eligible for the National Register as a historic district. There is considerable vehicle traffic to Pu'u Poli'ahu because it is used as a viewpoint by tour operators. Probably that would create an adverse effect for ritual practitioners wished to carry out rituals at Pu'u Poli'ahu, due to the noise of the vehicle and the likelihood of an unwanted audience. But again this is unconfirmed because no ritual practitioner was located who currently uses Pu'u Poli'ahu. In considering the impact on the upper zone of the mountain, the most obvious effect to consider is the effect on ritual practitioners such as Kealoha Pisciotta who build shrines at "new" locations, locations to which they are spiritually led. The most disturbing adverse effect has been the repeated destruction of Ms. Pisciotta's shrine, which she attributes to IfA personnel.

Toward Mitigation of Adverse Effects of the Current System

It is not strictly the role of the present study to recommend mitigation treatment for the adverse effects of the roadway access and management regime now in place. However, it seems obvious that mitigation of ongoing adverse effects needs to be considered first, before mitigation of the potential effects of the Saddle Road Improvement Project. The university is currently beginning work on a new management plan for the Mauna Kea Science Reserve which will likely alter the management regime by the year 2000; the Saddle Road Improvement Project will not be completed for eight to ten years. Clearly, the IfA needs to do additional research with Native Hawaiian ritual practitioners, beyond what has been done in this study, in order to complete evaluation of Hawaiian cultural sites, and additional consultation with Native Hawaiian organizations to determine how best to manage them and mitigate adverse effects due to the existing situation. By way of mitigation, the IfA could do more to educate visitors about Mauna Kea as a place of spiritual importance to Hawaiians, which deserves their respect. This could include installation of additional signs and provision of more information at the Visitor Information Center. Probably the IfA should also take more responsibility for preventing damage to Hawaiian cultural sites. It could fund a DOCARE position for an individual stationed at Hale Pōhaku with responsibility to monitor effects on Hawaiian cultural sites and apprehend violators of regulations. The measures just discussed seem to me to be part of the responsibility of the IfA under the present system. They should only be introduced after consultation with Native Hawaiian organizations. IfA would be well advised to also consult with Native Hawaiian ritual practitioners such as Ms. Pisciotta who wish to build shrines on Mauna Kea and find a way to facilitate their practice.

Effects of the Saddle Road Improvement Project and Mitigation

Under the current management of access, the Saddle Road Improvement Project would be likely to increase in a minor way the traffic going up the Mauna Kea Access Road to Hale Pōhaku and to the summit. Under a revised management regime which restricted visitor access, the project would not increase traffic up to Hale Pōhaku and the summit. Survey research concerning traffic on the Saddle Road and the Mauna Kea Access Road has been carried out by Ron Terry, a consultant for the Saddle Road EIS (personal communication). Most Hawai'i island residents (about 80%) currently use the Saddle Road, despite its substandard condition. A smaller group travels up Mauna Kea on the more difficult Mauna Kea Access Road. A two-day survey of vehicles that stopped at Hale Pōhaku was carried out, which polled 49 parties. Most of the visitors were people who visit Mauna Kea several times a year, a group of "regular users." Mr. Terry argues that increase in traffic up to the summit area once the Saddle Road is improved would come mostly from this group of regular users. The survey at Hale Pōhaku also asked how the Saddle Road improvement project would affect the frequency with which they visit Mauna Kea. Of the 49 parties polled, 22 were uncertain if they would visit more often, 23 said their number of visits would stay they same, four indicated that they would visit more often. This indicates that only a minor increase in traffic to the summit would be likely to result from the Saddle Road improvement project.

It has been argued that there are adverse effects at present on various Hawaiian cultural sites eligible for the National Register of Historic properties due to visitor traffic, mainly due the private vehicle visitor traffic. Mitigation measures which could be instituted by IfA, visitor education and funding a DOCARE position at Hale Pōhaku, would reduce those present adverse effects but wouldn't totally eliminate them. With a slight increase in visitor traffic when the Saddle Road improvement project is built, adverse effects would likely increase slightly on all the sites under consideration.

More visitors would hike and might impinge on rituals. A certain percentage of the additional hikers would presumably move adze blanks at the quarry, swim in Lake Wai'au, disturb shrines and otherwise harm properties, just as the present group of hikers does.

The easiest way to mitigate the effects of increased traffic due to the Saddle Road Improvement Project would be to limit access above Hale Pōhaku by the general public in some way. It would be simple to limit access by commercial tours simply by changing the permit conditions. Access by private vehicles could be limited in various ways--by disallowing access by two-wheel vehicles, or by instituting a quota on the number of private vehicles admitted per day for recreational purposes. Private vehicles admitted for Hawaiian cultural or religious purposes could be exempted from the recreational quota. Although limiting public access would be an easy solution, it cannot be recommended at this point because it is not very acceptable to Native Hawaiians, and probably not to the general public either. Limiting public access was explored in consultation with Native Hawaiian organizations, but they did not agree that it is a good idea. Some saw the suggestion to limit public access by private vehicles as a proposal that would work to the benefit of IfA but counter to Native Hawaiian interests. An atmosphere of distrust exists on the part of Native Hawaiians toward the IfA which makes it difficult to discuss such mitigation measures with Native Hawaiians.

The first mitigation measure should be to address the adverse effects caused by the present road system and management regime by improving visitor education, monitoring and enforcement of regulations. The second step of limiting visitor access to the mountain above Hale Pōhaku should not be taken except as a last resort, only if visitor traffic increases substantially and only with the agreement of the concerned Native Hawaiian organizations. The position taken here is that it is premature to assess effects due to the Saddle Road Improvement Project and to consider mitigation of adverse effects due to the project, since those effects depend on the management policies put in place by DLNR and the University of Hawai'i, policies that are currently being reconsidered. The adverse effects due to the Saddle Road improvement project seem small compared to the adverse effects being created by the deficiencies in the present management regime for the Mauna Kea summit area. Mitigation measures to deal with visitor traffic to the Mauna Kea summit have been considered here, but that mitigation is more properly seen as the responsibility of the DLNR and the University of Hawaii than of the agencies which are undertaking the Saddle Road improvement project.

Conclusion

Lake Wai'au and Pu'u Wai'au, and the whole upper zone of the mountain have been evaluated here as eligible for the National Register of Historic Places. The Mauna Kea Adze Quarry has already been placed on the register. Effects of federal projects on all those sites should therefore be assessed. However, consideration of the adverse effects that may be created by the Saddle Road Improvement Project and how to mitigate those adverse effects cannot really be addressed before the adverse effects of the present situation are addressed and the University of Hawai'i's new management plan is created. Consideration of the effects of visitors on Mauna Kea and of mitigation to reduce adverse effects properly resides within the context of a Section 106 (National Historic Preservation Act) process relating to planned actions of the IFA and DLNR within the Mauna Kea Science Reserve, not the Saddle Road project.

Finally, it is important to reiterate that this ethnographic study is only a contribution toward understanding the Hawaiian cultural significance of Mauna Kea and how to mitigate adverse effects on Hawaiian cultural sites there. It is not an exhaustive study of the Hawaiian cultural sites on Mauna Kea. A further search for ritual practitioners needs to be carried out and further information needs to be sought, particularly for the summit peak, for Pu'u Poli'ahu and Pu'u Lilinoe. In my view an exhaustive study would require a larger effort and should properly be the responsibility of the state agencies responsible for managing Mauna Kea--the University of Hawai'i and the DLNR.

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Personal communication (telephone conversation)
Unoki, Charlene (DLNR, Land Division, Hilo office)
Personal communication (two telephone conversations)

Appendix H. SHPO Request for Further Work

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

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FILE

MICHAEL D. WILSON, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

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STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

November 14, 1997

Mr. Larry C. Smith, Division Engineer
Federal Highways Administration
Department of Transportation
555 Zang Street
Denver, Colorado 80228

LOG NO: 20535
DOC NO: 9711dh04

Dear Mr. Smith:

As a follow-up to the meeting of October 28, 1997, which was held in Honolulu with Bert McCauley and other staff from FHWA, I wish to apprise you of several points with regards to the proposed Saddle Road project.

Nathan Napoka, the head of the SHPO's History and Culture Branch, and myself met with Pua and Ed Kanahele, the authors of "A Hawaiian Cultural Impact Assessment of the Proposed Saddle Road Alignments". As a result of discussing their report with them, we believe that portions of the contents appear to have potential Section 106 implications. Specifically, we suspect the mamane forest and Mauna Kea might be considered traditional cultural properties which could meet the criteria for listing in the National Register of Historic Places. A portion of the mamane forest lies within a proposed alignment for the Saddle Road, and Mauna Kea might be indirectly impacted by the road improvements, which would facilitate access to its summit region. Thus the State Historic Preservation Office requests FHWA to undertake further ethnographic work to place these two areas and their cultural significance within a 106 context.

We view this additional ethnographic work to be supplemental to that already provided. The purpose of this work is to gather sufficient information to determine if these two areas do meet the criteria for listing in the National Register of Historic Places as traditional cultural properties in accordance with Bulletin 38.

Should it appear that these two areas are indeed significant traditional cultural places, we would expect the supplemental information to explore the potential effect of the proposed alignments on the sites, and recommend appropriate treatment. Such efforts would involve consultation with appropriate native Hawaiian organizations, as stipulated in Section 101(d)(6)(B) of the National Historic Preservation Act of 1966, as amended.

It was good to have the opportunity to meet with FHWA staff from the Denver office and discuss this project. I look forward to continuing to work with you and your staff on this project.

Aloha!

Don Hibbard, Administrator and
Deputy State Historic Preservation Officer

DH:jk

c: Glen Yasui
✓Tom Wollforth

Appendix I. Summary of Consultations with Native Hawaiian Organizations

As requested by the Hawaii State Historic Preservation Division, consultation was initiated with Native Hawaiian organizations concerning (1) mitigation of adverse effect on the southern boundary wall of the Humu'ula Sheep Station, particularly by erecting explanatory signs along the new roadway, and (2) investigation of Mauna Kea as a possible traditional cultural property and of potential adverse effect on sites there as a result of the Saddle Road Improvement Project.

A log of contacts with organizations is given in the following table. Organizations were contacted by telephone call and/or letter. (See the sample letter appended.) The organizations were asked to respond by letter, if possible. Only Ka Lāhui Hawai'i responded by letter. (See the appended copies of letters from Ka Lāhui Hawai'i, dated May 7 and May 11, 1998, together with enclosed material.)

Table S-1. Log of Contacts with Native Hawaiian Organizations, concerning supplementary research

Organization	Initial Phone call or discussion	Letter Sent	Wants to be Consulted on Mitigation for: HSS sign	Mauna Kea
OHA	4/14	4/14	no	yes
Hui Mālama	----	4/14	?	yes
Waimea Hawaiian Civic Club	4/8	4/14	yes	yes
Kona Hawaiian Civic Club	4/10 discussion 8/6	4/14	no	yes
Prince David Kawananakoa Hawaiian Civic Club	4/6	4/14	yes	yes
Hilo Hawaiian Civic Club	4/8	4/14	?	yes
Edith Kanaka'ole Foundation	discussion 4/9	----	no	yes
Ka Lāhui Hawai'i	discussion 5/7	5/1	no	yes

The main points made by the organizations in the consultation process thus far as follows.

(a) The Hawaiian Civic Clubs of Hawai'i Island are all working together and are very interested in preventing impacts to Hawaiian cultural sites on Mauna Kea. The Kona and Waimea clubs are presently taking the lead on this. Primarily the Hawaiian Civic Clubs are concerned about astronomy development on the summit. They oppose the building of any additional telescopes. Generally, the clubs are not very clear about what cultural sites exist on Mauna Kea that may need protection. Mabel Tolentino, President of the Waimea Hawaiian Civic Club, was very concerned about visitor damage to the adze quarry. She didn't favor ending public access to the summit altogether, but felt that access needs to be better controlled, that travel by two-wheel drive rent-a-cars up to the summit needs to be ended and that hunting on the mountain should also be ended. In response to requests, Dr. Langlas spoke about Mauna Kea at the District Meeting of the Hawaiian Civic Clubs of Hawai'i Island in August, and at the August meeting of the Kona Hawaiian Civic Club. The Kona club made clear at their meeting that they do not accept the conclusion of this report that the increase in traffic resulting from the Saddle Road improvement project will be minimal.

(b) Lynn Lee of OHA's Land Division said that OHA will definitely need to be party to any MOA concerning the Saddle Road Improvement, and that OHA would like to have input into any recommendations concerning mitigation of adverse effect on Mauna Kea sites.

(c) Ka Lāhui Hawai'i has been very concerned about the management of Mauna Kea since 1994, and has formed the Mauna Kea Coalition with Sierra Club in order to work for change in the management of Mauna Kea. (See the appended 1995 Ka Lāhui Hawai'i resolution). The Mauna Kea Coalition objected to the decision to give out permits for commercial tour operations, arguing that there was not adequate provision for protection of cultural sites. They have been pushing the DLNR and the IfA to finish the archaeological and ethnographic research on Mauna Kea and to revise the management plan to better protect cultural sites and the environment. In their response letter, Ka Lāhui Hawai'i requested that public notice be posted requesting input from Native Hawaiian families and groups unaware of the study. A notice was published in both the Hilo Herald-Tribune and West Hawaii Today. (See the appended "Notice Concerning Mauna Kea Sites.") Two individuals called the author in response to the notice, but they had no new information to add.

(d) Several of the Hawaiian Civic Clubs are interested in the signs for the Humu'ula Sheep Station recommended by us as a mitigation measure for adverse effect on the southern boundary wall and the old wagon road connected with the sheep station. In response to requests, Dr. Langlas talked about the sheep station at their District Meeting in August and at the august meeting of the Kona Hawaiian Civic Club. The Civic Clubs have agreed to leave consultation on the signs to the Waimea club, since it's in their area.

To Whom It May Concern:

This is a followup letter concerning research to locate and evaluate traditional Hawaiian cultural properties and historical sites that may be affected by the proposed Saddle Road Improvement Project. I sent you an earlier letter about this research when I began in Spring 1996. I apologize for the length of this letter, but it seems unavoidable.

I was hired by PHRI (Paul H. Rosendahl, Inc.) to do historical documentary and oral history research for the U.S. Department of Transportation, to comply with the state and national historic preservation laws. (Initially we worked as a subcontractor under Rust Environment and Infrastructure, but Rust is no longer working on the project.)

I have completed a draft report on the research, together with Tom Wolforth of PHRI who wrote about the archaeological survey work. We sent the report to the state Historic Preservation Division for review in May 1997 and received a mostly favorable review. Hopefully the report will be approved soon, and we will be able to send out copies.

There are two matters that still need to be handled by us, on which I need to consult with concerned Native Hawaiian organizations.

Firstly, there are historic sites in the Saddle that will be adversely affected by the project. We found that the proposed routes for the Saddle Road Improvement pass through two sites associated with the former Humu'ula Sheep Station, a rock boundary wall built to keep the sheep from wondering south into the lava and an old wagon road which led west from the sheep station headquarters and was used to transport the wool to Waimea. Both of these sites extend for miles and the proposed road improvement passes through the site at one or more points. We have recommended that road construction in the area of these sites be done carefully to minimize the effect on them. Archaeologists from PHRI are to monitor the construction work to ensure this. We have also recommended that the adverse effect (destruction of a limited portion of the sites) be mitigated (reduced) by installing informational signs where the road passes through the sites. I need to ask you if your group wants to be consulted on the mitigation for these sites, particularly on content of the signs and where they will be placed. If so, please let me know in writing if that is possible.

Secondly, the Historic Preservation Division asked us to do some additional work. We were asked to examine the possibility that there are sites at the Mauna Kea summit that qualify as traditional Hawaiian cultural properties (perhaps because they are used for ritual). So far, I have interviewed two informants knowledgeable about sites on Mauna Kea, ----- ----- and Pualani Kanahele. They indicate that there are indeed important Hawaiian cultural sites on Mauna Kea (in addition to the archaeological sites), especially Lake Wai'au.

We were further asked to consider whether the Saddle Road Improvement will result in increased traffic to the summit and thus have an adverse effect on Hawaiian cultural sites there. According to the February 1998 report by the State Auditor on the management of Mauna Kea, it seems likely that Hawaiian cultural sites at the summit are already being adversely affected, because of the road built up to the summit and because of weak management of visitor traffic by the University of Hawaii and the DLNR. We will recommend mitigation measures to prevent or reduce the impact of visitors to the summit (both tourists and local people)--perhaps by better educating visitors or by limiting where they can go. Again I need to ask you if your group wants to be consulted on this mitigation, so that you can offer suggestions. If so, please let me know in writing if that is possible.

We will probably be submitting our final report to the Historic Preservation Division (including a section on Mauna Kea) at the end of May. However, some of the mitigation details will not be worked out until later. The actual wording and placement of signs at Humu'ula will probably be worked out at the end of summer.

Yours sincerely,

Dr. Charles M. Langlas.

Telephone: 968-8197 (home), 974-7639 (office)

Notice Concerning Mauna Kea Sites

Dr. Charles Langlas is investigating traditional Hawaiian ritual and cultural sites on Mauna Kea--to document and provide protection to those sites. The investigation is part of the EIS for the Saddle Road Improvement Project.

Native Hawaiians with family knowledge of such sites and concerned Native Hawaiian Organizations are invited to contact Dr. Langlas if they are willing to provide information.

Please write Dr. Langlas c/o
Social Sciences Division, U.H.Hilo
200 W. Kawili St., Hilo, HI 96720
Or call 974-7639 (ofc), 968-6197 (home)

KA LĀHUI HAWAI'I

P.O. Box 4964, Hilo, Hawai'i 96720 • 934-7723

Mililani B. Trask
Kia'āina, Governor

Paul Neves
Ukānela Kia'āina, Lt. Governor

P. Coochie Cayan
Kākau 'Ōlelo, Secretary

Valeen N. Andrade
Puku Lāhui, Treasurer

May 7, 1998

Chuck M. Langlas
Social Science Division
University of Hawaii at Hilo
200 W. Kawili St.
Hilo, HI 96720

Re: Mauna Kea

Aloha Chuck:

Please list Ka Lahui Hawaii as a Hawaiian organization to be consulted. Ka Lahui Hawaii is part of the Mauna Kea coalition which has worked on this issue for over 2 years. You should also contact:

1. Native Lands Institute - Lehua Lopez
   Hilo - 933-1641

2. Sierra Club - Nelson Ho
   Hilo - 968-6278

The Kona Civic Club and OHA have also indicated their concern about historic properties and have recently gone to the mountain.

I am contacting Kealoha Pisciotta on this matter as well. The shrine on Mauna Kea were we worship was vandalized and destroyed for the third time just two weeks ago.

I am suggesting a meeting as soon as possible on this issue. Please let me know your availability.

Sincerely,

Mililani B. Trask

cc: Nelson
Lehua
Kealoha

KA LĀHUI HAWAI'I

P.O. Box 4964, Hilo, Hawai'i 96720 • 934-7723

Paul Neves
Lukānela Kia'āina
Lt. Governor

P. Coochie Cayan
Kākau 'Ōlelo, Secretary

Naleen N. Andrade
Treasurer

May 11, 1998

Chuck M. Langlas
Social Science Division
University of Hawaii at Hilo
200 W. Kawili St.
Hilo, HI 96720

Re: Mauna Kea

Aloha Chuck:

It was a pleasure meeting with you to discuss the Mauna Kea Issue. I am sending this letter to confirm that Ka Lahui Hawaii. as a Hawaiian organization, does want to be consulted on matters impacting the summit and changes or alterations to the road.

Attached is the Ka Lahui Hawaii Resolution on Mauna Kea and a copy of the ASUH Resolution on Mauna Kea. Please include these in your report.

Ka Lahui Hawaii views the entire summit area and mountain as a 'cultural property', not only the geophysical features known as Puu Poliahu and Lake Waiau. There are several 'shrines' on the mountain which are cultural properties and as you are aware, there are many archeological sites for which the archeological assessment has yet to be completed. We believe that a thorough archeological report will confirm that there are significant 'cultural sites' on the mountain and that these relate to each other.

Our belief is based not only on information received from Hawaiian Kupuna (Papa Auwai, Pua Kanahele) but the current practice of Hawaiians (including Kealoha Pisciotta and her Aunty Leina'ala McCard who you met at the May 7th meeting) who worship at various locations on the mountain. Current Hawaiian religious practice is not limited to Puu Poliahu and Lake Waiau.

The Mauna Kea coalition has sought for nearly 5 years to have the archeological work and the oral history work for Mauna Kea completed. As the 1998 Legislative Audit verifies, IFA and the State have not met the requirements of the initial Master Plan. It is ironic that you have been retained to address the issue of cultural properties before the base line data is available. Without this information we do not know how any valid determination can be made regarding cultural properties on the mountain.

Lastly, we believe that there may be other Hawaiian organizations who should be consulted. We request that some form of public notice be posted to solicit input from groups and ohana who may be unaware of your undertaking and contract.

Please include this letter with your report and forward a copy to me at the above address.

Sincerely,

Mililani B. Trask

cc: Pua Kanahele
Edith Kanakaole Foundation
Nelson Ho
Lehua Lopez
Kealoha Pisciotta

KA LAHUI HAWAI'I
A Resolution Relating to the Protection and Preservation of the Cultural
Religious and Environmental Resources of Mauna Kea

Submitted by: Hawai'i Island

WHEREAS, Mauna Kea, Hawai'i is a place of unique cultural, religious, and historic significance, and is sacred to the Kanaka Maoli, and;

WHEREAS, there is Lake Wai'au, Keanako'i Adze Quarry, Na Iwi of our ancestors, and many 'Ahu and Marae, and;

WHEREAS, the Mauna Kea summit and lower regions are the sole habitat for some of the most rare and endangered plant and animal species on earth, and;

WHEREAS, on 2 June, 1968, the Board of Land and Natural Resources (BLNR) leased 13,321 acres of Ceded Lands to the University of Hawai'i Institute of Astronomy (IFA) for a Science Reserve for a term of 65 years, and;

WHEREAS, the 1985 Mauna Kea Science Reserve Development Plan (MKSRDP) Environmental Impact Statement (EIS) allowed for a total of thirteen (13) telescopes inclusive of the six (6) observatories previously built, and;

WHEREAS, on 18 November, 1994, the BLNR approved a Conservation District Use Permit (HA-2728) to the Smithsonian Astrophysical Observatory for a Submilimeter Array Telescope (SMA) or Interferometer; that would consist of an array of six (6) eight (8) meter telescopes, and;

WHEREAS, the SMA Interferometer covers an area nearly 1/2 of a mile across, and is currently under construction, and;

WHEREAS, developments in "Astronomical Interferometry" have made the terms "Observatory" and "Telescope" ambiguous and obsolete for the purpose of assessing cultural and environmental impact, and;

WHEREAS, the total number of telescopes including the individual telescopes within the SMA Interferometer would bring the total number of Telescopes atop Mauna Kea up to twenty (20) at the completion of the SMA Interferometer, and;

WHEREAS, the IFA has publicly (see Hilo Tribune Herald 9 June 1995) announced its plans to request from the BLNR permission to allow for even greater expansion atop the summit of Mauna Kea, and;

WHEREAS, there currently is no comprehensive cultural and environmental Management Plan, nor is there an adequate plan to regulate and control commercial tourist and recreational uses on Mauna Kea, and;

WHEREAS, the original Mauna Kea Science Reserve Management Plan designated regulations of the commercial and recreational activities and cultural and environmental preservation outside the Natural Area Reserve to the UH/IFA, and;

WHEREAS, since 1968 few of the conditions originally agreed to by UH/IFA and BLNR have been met by the UH/IFA, and;

WHEREAS, the 1995 Revised Mauna Kea Management Plan returned these specific responsibilities to BLNR, and;

WHEREAS, Ka Lahui Hawai'i supports measures to protect and preserve sites of sacred, cultural, or historic significance, and;

WHEREAS, in accordance with the Ka Lahui Hawai'i Constitution (Article I, Section 16), Ka Lahui Hawai'i shall enact laws for the protection, conservation, and management of its natural resources within the Hawaiian archipelago.

THEREFORE, LET IT BE RESOLVED THAT within its financial means and resources, Ka Lahui Hawai'i will work cooperatively with other concerned groups to help to ensure that the above conditions may be achieved, and to ensure that protection of our cultural, religious and natural resources may be preserved for future generations.

THEREFORE, BE IT FURTHER RESOLVED THAT further development on Mauna Kea be suspended until the following conditions have been met:

1) A *satisfactory mechanism* that ensures the preservation of the cultural and environmental resources are in place and operational;
2) A new metric is developed for assessing the impact of further development on Mauna Kea;
3) That an agreement is reached between all interested parties as to the maximum extent to which development will be allowed to proceed in the future.

Certification

This is to certify that the above resolution was adopted pursuant to the authority vested in the Ka Lahui Hawai'i Legislature.

Date: 1/03/96

Mililani B. Trask, Kia'aina
Ka Lahui Hawai'i

MEMORANDUM OF AGREEMENT (MOA)
NHPA SECTION 106 PROCESS

MEMORANDUM OF AGREEMENT
Among the
ADVISORY COUNCIL ON HISTORIC PRESERVATION
and
FEDERAL HIGHWAY ADMINISTRATION
and
HAWAI'I STATE HISTORIC PRESERVATION OFFICER

Regarding the Saddle Road (SR 200) and
Hawai'i Defense Access Road (A-AD-6-1) Improvement Project on the
Island of Hawai'i, Hawai'i

WHEREAS, the Federal Highway Administration (FHWA) has determined that the proposed Saddle Road (SR 200) Improvement Project from Kaumana (at Milepost 6 on Saddle Road) to the intersection of Saddle Road with the Mamalahoa Highway will have an effect on 20 historic properties (Final Environmental Impact Statement, Section 3.19) which by consensus determination appear to meet the criteria for listing on the National Register of Historic Places (NRHP), and have consulted with the Hawai'i State Historic Preservation Office (SHPO) and the Advisory Council on Historic Preservation (Council) pursuant to 36 CFR Part 800 regulations implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470f); and

WHEREAS, the Hawai'i SHPO has reviewed and concurred with the evaluations and recommendations provided in the report entitled *The Saddle Road Corridor: An Archaeological, Historical, and Traditional Cultural Property Inventory Survey, Evaluation and Assessment for the Hawai'i Defense Access Road A-AD-6(1) and Saddle Road (SR 200) Project* and with the *Supplemental Traditional Cultural Properties Assessment* prepared to address issues presented in the *Draft Environmental Impact Statement, Saddle Road (State Route 200), Mamalahoa Highway (State Route 190) to Milepost 6, Technical Appendix Volume V, Social Impact Assessment, Appendix B: Indigenous Hawaiian Cultural Values,* and;

WHEREAS, the Hawai'i SHPO has acknowledged that data recovery of the portions of the seven linear archaeological sites impacted by the recommended alternative (Attachment 1) is appropriate mitigation, and;

WHEREAS, Mauna Kea, as described in the Supplemental Traditional Cultural Properties Assessment to The Saddle Road Corridor: An Archaeological, Historical, and Traditional Cultural Property Inventory Survey, Evaluation and Assessment for the Hawai'i Defense Access Road A-AD-6(1) and Saddle Road (SR 200) Project appears to meet the criteria for placement on the NRHP as a Traditional Cultural Property (TCP) as defined by National Register Bulletin Number 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, U.S. Department of the Interior, National Park Service, and;

WHEREAS, the effects of the Saddle Road Project on Mauna Kea are indirect, and mitigation of any potential effects can best be addressed as part of the University of Hawai'i's (UH) new management plan for Mauna Kea, and;

WHEREAS, the State of Hawai'i Department of Transportation (HDOT) and the Office of Hawaiian Affairs (OHA) have been consulted in preparation of this Memorandum of Agreement (MOA), and concur with the stipulations contained herein;

NOW, THEREFORE, the Council, FHWA, and SHPO agree that the undertaking shall be implemented in accordance with the following stipulations in order to take into account the effects of the undertaking on historic properties.

STIPULATIONS

FHWA shall ensure that the following measures are carried out:

1. FHWA shall develop and implement an archaeological Data Recovery Plan for those sites indicated on Attachment 1 that is consistent with the Secretary of the Interior's *Standards and Guidelines for Archaeological Documentation* (48 CFR 44734-37) and takes into account the Council publication, *Treatment of Archaeological Properties*, and the SHPO minimal standards for archaeological data recovery and interim protection. The Data Recovery Plan will:

- Identify sites that require data recovery (see Attachment 1),
- Present research context and questions to be addressed during data recovery, with an explanation of their relevance and importance,
- Specify methods to be used, with reference to their relevance to the research questions,
- Establish how and to what agencies and interested organizations or individuals the plan will be distributed,
- Provide procedures for consideration of comments on the plan from those to whom it was distributed,
- Specify procedures for interim protection through archaeological monitoring of work during construction, as applicable to specific sites,
- Itemize contents of the Data Recovery Report (Report),
- Indicate Report review procedures to be followed,
- Provide a Report completion date,
- Establish procedures by which agencies and interested organizations or individuals will be provided with a summary of the Report findings and how they will be notified when the work is beginning.

FHWA shall submit the Data Recovery Plan to the SHPO and OHA for a 30 day review period. Unless the SHPO has specific concerns to procedures, methods, and treatments outlined in the plan within 30 days after receipt and responds in writing, the FHWA may assume SHPO concurrence. If SHPO objects to the Data Recovery Plan within 30 days of receiving the plan, it shall be revised as applicable and submitted for another 30 day review period. OHA shall provide written comments on the plan to the FHWA within the 30 day review period. FHWA will consult with OHA as necessary to address all comments. In the absence of comments received by the FHWA from OHA within the 30 day review period, the FHWA may assume concurrence by this agency.

2. FHWA shall ensure that all archaeological materials and records are curated by an institution acceptable to the SHPO in accordance with 36 CFR Part 79.

3. FHWA shall develop and implement a Treatment Plan for interpretative mitigation of designated sites (Attachment 1). Efforts will be made to design the proposed roadway footprint to minimize impact to the sites. Portions of the sites that cannot be avoided during construction will be included within the data recovery activity and incorporated into the Data Recovery Plan outlined above. The Treatment Plan shall include:

- A list of agencies and interested organizations or individuals to whom the plan will be distributed for review,
- Procedures for consideration of comments on the plan from those to whom it was distributed,
- A brief description of the project location and roadway design in the site vicinity,
- A brief summary of previous archaeological research performed in the vicinity,
- Schematic maps locating the site and depicting the roadway design and treatments, and
- Separate subsections describing the scope of the treatment methods for data recovery, interim protection by archaeological monitoring as applicable, preservation methods for remaining site features as applicable, and roadway design features and interpretive aids applicable to enhancing the site.

FHWA shall submit the Treatment Plan to the SHPO and OHA for a 30 day review period. Unless the SHPO has specific concerns to procedures, methods, and treatments outlined in the plan within 30 days after receipt and responds in writing, the FHWA may assume SHPO concurrence. If SHPO objects to the Treatment Plan within 30 days of receiving the plan, it shall be revised as applicable and submitted for another 30 day *review period. OHA shall provide* written comments on the plan to the FHWA within the 30 day review period. FHWA will consult with OHA as necessary to address all comments. In the absence of comments received by the FHWA from OHA within the 30 day review period, the FHWA may assume concurrence by this agency.

4. The Federal Highway Administration agrees to cooperate with the UH in planning for access restriction facilities or signage at the intersection of Mauna Kea Access Road and Saddle Road by providing design or Right-of-Way accommodations as might be reasonably considered part of the Saddle Road Project at the time the project is advanced.

5. If a previously unknown archaeological site is encountered during project construction, the FHWA shall notify the Hawaii SHPO and OHA immediately. The FHWA shall ensure that all work ceases in the area of the discovery and in any adjacent areas where associated resources are likely to be encountered. The FHWA, Hawai'i SHPO and OHA shall then consult on the potential significance of the resource and appropriate treatment measures. The Hawai'i SHPO and OHA shall participate in such consultation in an expedited manner consistent with the timely advancement of the project with the intent of minimizing construction delays. When agreement has been reached on data recovery, interim protection, preservation, or interpretive measures and such measures have been implemented, construction may proceed in the area of the discovery.

6. Should any signatory or concurring party to this agreement object to a proposed Data Recovery Plan or Treatment Plan within the 30 day review period pursuant to this agreement, the FHWA shall consult with the objecting party to resolve the objection. If the FHWA determines that the objection cannot be resolved, the FHWA shall forward all documentation relevant to the

dispute to the Council. Within 30 days after receipt of all pertinent documentation, the Council will:

- Provide the FHWA with recommendations to be considered in reaching a final decision regarding the dispute, or
- Notify the FHWA that it will comment pursuant to 36 CFR 800.6(b), and proceed to comment.

Any Council comment provided in response to such a request will be considered by the FHWA in accordance with 36 CFR 800.6(c)(2) with reference to the subject of the response. Any recommendations or comments provided by the Council will be understood to pertain to the subject of the dispute; however, the FHWA's responsibility to carry out all actions under this agreement that are not subject to dispute will remain unchanged.

7. Any party to this MOA may request that it be amended, where upon the parties will consult in accordance with 36 CFR 800 to consider such amendment.

Execution of the MOA and the implementation of its terms evidence that the FHWA afforded the Council an opportunity to comment on the Saddle Road (SR 200) Improvement Project and it effects on historic properties, and that the FHWA has taken into account the effects of the undertaking on historic properties.

ADVISORY COUNCIL ON HISTORIC PRESERVATION

(for) By: ______ Executive Director Date: 5/[illegible]/99

FEDERAL HIGHWAY ADMINISTRATION

By: ______ Date: 5/11/99

for STATE OF HAWAI'I HISTORIC PRESERVATION OFFICER

By: ______ Date: 5/3/99

CONCUR:

OFFICE OF HAWAIIAN AFFAIRS

By: ______ Date: April 29-99

HAWAI'I DEPARTMENT OF TRANSPORTATION

By: Date: 4/30/99

ATTACHMENT 1

Mitigation for NRHP Eligible Archaeological Sites and Associated Significance Criteria for Site Segments within the A.P.E. of the Recommended Alternative for the Saddle Road Improvement Project

SHIP #	DESCRIPTION	CRITERIA	IMPACT	MITIGATION
20852	Burial[1]	D	no	Avoid
20854	Ranching - Habitation & Animal Enclosures	D	yes	Data Recovery Only
20855	Transportation- Old Waimea-Kona Rd.	D[3]	yes	Data Recovery, Interpretation
5002	Ranching-Ka'ohe Wall[1]	D	no	Avoid
5003	Temporary Habitation[1]	D	no	Avoid
14638	Temporary Habitation[1]	D	no	Avoid
20862	Ranching- Linear Wall	D	yes	None[2]
20865	Ranching- Linear Post Fence	D	yes	None[2]
20877	Ranching- Linear Wall	D	yes	None[2]
21150	Transportation- Humu'ula Wagon Trail	D[3]	yes	Data Recovery, Interpretation
7119	Ranching-Humu'ula Sheep Station Walls	D[3]	yes	Data Recovery, Interpretation
10309	Transportation- Pu'u 'O'o Volcano Trail	D[3]	yes	Data Recovery, Interpretation
20856	Paving	D	yes	None[1]
20878	Transportation- Hilo Pu'u 'O'o Trail	D[3]	yes	Data Recovery, Interpretation
20864	Transportation- Old Saddle Road	D[3]	yes	Interpretation[2]
20869	Survey Marker	D	no	None[2]
20870	Agriculture- 'Ola'a Flume	D[3]	yes	Interpretation[2]
20872	Recreation- Hilo Country Club	D	no	None[2]
20873	Habitation- Senator Kimi's House	D	no	None[2]
TCP	Mauna Kea[1]	TCP	indirect	Avoid: defer to Univ.of Hawai'i Management Plan study

1. Not within the Recommended Alternative APE but identified as eligible during alternate alignment investigations.
2. Data Recovery has been completed, either as part of this project or other independent surveys.
3. Additional Significance Criteria may apply outside of road corridor crossing.

SUPPORTING DOCUMENTATION

CHRONOLOGY OF 404 & EPA COORDINATION EVENTS

1. April 1994: Letter of Intent (LOI) sent to agencies and public and Notice of Intent (NOI) published in Federal Register advising of our intent to start EIS; notice of Public Scoping meetings sent to all agencies and public. Project Mailing List had over 300 records; Region IX EPA, EIS Review Section, was on our mailing list at the time and received these notices.

2. November 1994: First Saddle Road Newsletter published and mailed to mailing list (see above).

2. January 1995: NEPA/404 MOU execution completed, document is in force. Saddle Road EIS is thus, by definition, a "Pipeline Project". Project could have been inserted into the MOU process at this time at <u>DRAFT EIS DEVELOPMENT</u> (See Appendix A, pg 1).

3. May 1996: Letter inviting EPA to be a Cooperating Agency. Lead agency's are required to send this letter pursuant to CEQ Regs and it is important for agencies to respond affirmatively or decline. This Letter should be sent immediately after LOI, NOI. No response was received from EPA.

4. October 1996: First interagency and SEE Team meeting held in Hilo to discuss DEIS findings and receive input. EPA did not have regulatory personnel in Hawaii at this time and were not invited. Accordingly, the Corps advised that it was standard procedure in Hawaii to proceed on 404/wetlands issues through USACE/POD maintaining contact with EPA Region IX. Alternatives EX-4 and E-1 in Section IV were eliminated by SEE Team at this meeting for substantial community and wetlands impacts respectively (USACE was member of SEE Team, was present, and voted).

5. November 1996: Smith and McCauley trip to Hawaii. Met with Kathy Dadey and discussed wetlands procedure. We were advised that following the MOU and standard delineation procedures did not apply to this project process-wise or scientifically. Field trip conducted with USACE, USFWS, FHWA to view wetlands and discuss procedures for jurisdictional delineation and permitting requirements. Agreements were reached on how to proceed, i.e., as so to date.

6. March 1997: Preliminary DEIS distributed *locally* to all agencies who had expressed concern or participated in development of project to date. EPA did not have regulatory personnel in State at this time, thus did not receive a copy. Informal discussions with Corps continued and comments received from Dr. Dadey indicated more detailed work required for wetlands delineation and writeup for DEIS. Included wetlands delineation study and report by Dr. Grant Gerrish in new task order.

7. May 1997: Letter to Corps confirming conversations with Pat Billington, USACE/POD Counsel, and Dr. Dadey on how to proceed consistent with MOU and proposed wetlands delineation and wetlands study procedure. EPA, Region IX, sent copy of letter.

8. June 1997: Letter from Corps concurring with MOU and delineation/study procedures. EPA, Region IX copied letter. Field trip to review wetlands findings was scheduled for July.

9. July 1997: Field trip with USACE, NCRS, FHWA, and Consultants, to help Corps determine jurisdiction and to review wetlands findings with Dr. Gerrish and discuss impacts and mitigation scenarios. During this time, FHWA was discussing internally the risks associated with complying with the MOU by sending out preliminary information on the Purpose/Need, Alternatives, etc., and asking for written concurrence from USACE, USFWS, EPA on those items under DRAFT EIS DEVELOPMENT, pg.1, Appendix A. It was determined that this would confuse the issues and cause significant delays to the DEIS release (planned for October) because participating agencies had not been involved during the initial scoping and alternative development phases due to the "pipeline" nature of the project. It was determined that a more accurate picture of the alternatives development and criteria for their selection could be presented within the context of the entire document, leaving resolution of any issues to proceed in a more lucid framework at the next step in the MOU.

10. August 1997: Letter sent to Corps requesting jurisdictional determination for east end and to confirm that no "waters of U.S." present in PTA or west alignments; EPA Region IX copied letter. EPA gets regulatory personnel in Hawaii (Wendy Wiltse). FHWA became aware of EPA's displeasure with not being copied on pre-DEIS and not involved in NEPA/404 MOU process through informal contacts with Dave Carlson. Carlson requested additional information on alternatives analysis and other wetlands information.

11. September 1997: Confirmation received informally from Corps on jurisdictional delineation and individual 404 Permit submitted to USACE/POD; EPA Region IX copied letter w/permit. Letter sent to Dave Carlson transmitting additional information which consisted of draft revised Chapters 1,2,3 of DEIS from comments on pre-DEIS, copies of previous letters between FHWA/USACE which were cc'd to EPA. Comments on all material were requested by early October from EPA (4 weeks response time afforded).

12. October 1997: Meeting held with EPA, USACE, USFWS, FHWA, Consultants, to discuss wetlands findings, potential mitigation scenarios, and process to follow henceforth on MOU involvement. Agreed that FHWA would enter MOU process at FINAL EIS DEVELOPMENT (Appendix A, pg 2). This meeting was our introduction to Wendy Wiltse and first notice by EPA that they thought that not enough alternatives had been studied on east end and that they did not agree with our biological functions evaluation; however, no specific alternatives or information on wetland functions and values were forthcoming from EPA.

13. November 1997: Field trip with USFWS, HDOT, EPA, Consultants, to introduce EPA to wetlands findings and discuss impacts and mitigation. Ms. Wiltse indicated that they did not agree with Corps on several "waters" or wetlands determinations. Suggested that we needed to arrange field trip for their experts from Region IX to view the ecosystems in question.

14. December 1997: Field trip with EPA Region IX (Tom Yocum, Dave Carlson), FHWA, USFWS, Consultants, to view wetlands and "waters" and discuss impacts, mitigation, and alternative scenarios. Meeting with Dave Carlson at O&A in which FHWA presented mapping and results of all previous studies on alignments on east end. Mr. Carlson indicated that this information would need to be compiled into a report before his acceptance and had no specific suggestions for

alternative alignments that we should pursue. He suggested that we needed to look more closely at other "avoidance" alternatives, select the "no-build" alternative, or make a non-selection decision in Sections III and IV. It was explained to Mr. Carlson that to select the No-Build would be non-responsive to our Purpose and Need and was not practicable and that a non-selection decision was possible but that HDOT and FHWA would have significant reservations about committing to further NEPA documents, hearings, etc., and those project development costs in the future; especially when both agencies were of the opinion that our analyses and information were accurate and complete enough to make a selection now. Public hearings were held, EPA invited and declined to attend citing that they wished to avoid confrontational issues which usually occur when they attend.

15. January 1998: SEE Team Meeting Agenda sent to all agencies including EPA stating the purpose of the meeting was to review input received on DEIS and discuss the implications of that input with respect to additional studies or analysis needs and upon alternative analysis selection. SEE Team meeting held to discuss results of all agency and public input and possible additional alignments for study prior to selecting recommended alternative for the FEIS. USFWS, USACE, US ARMY, FHWA, Senator's office, and County present; EPA declined to participate.

No comments on DEIS had been received by USACE as of this date; however, we were informed in meeting that a 404(b)(1) study would need to be prepared on eastern alignments. Comments had been received from EPA which required further analysis of alignments, clarification of functions and values of wetlands, etc.. USACE expressed dissatisfaction with not being copied EPA's letter of comment on the DEIS although the USFWS had been copied. FHWA proceeded with preparation of the 404(b)(1) document to double as an expanded alternatives analysis that the EPA had requested and to satisfy the Corps 404 requirement.

The letter received from EPA commenting on DEIS contained admonishment of FHWA for not following the MOU process. Stated that FHWA should have received written agreement that we have met all MOU requirements before release of environmental document. Further stated that the project should not proceed to the Final stage until FHWA had obtained concurrence from all signatory agencies. Suggested FHWA review Appendix A of MOU to determine the type of information to send to EPA to solicit concurrence.

16. March 1998: Meeting with EPA, USFWS, USACE, FHWA, to discuss draft of 404(b)(1) study which included our comparative analysis of alternatives and leaning toward selection of E-3 and mitigation concept proposed as well as the fact that we needed to deviate from the MOU because of the staged nature of the project. EPA and USFWS did not agree with our conceptual mitigation plan or that we had studied enough alternatives. They did suggest reduced design alternatives which were included in the analysis thereafter.

SEE Team meeting held to discuss comparative analysis in all Sections of the project and solicit team input on recommended alternative for FEIS. EPA declined to attend; Corps subsequently declined because EPA's absence rendered meeting unsatisfactory for their purposes. FHWA subsequently excused USFWS from attending also. SEE Team recommended W-3, PTA-1, EX-3, and E-3. County of Hawaii Chief Engineer expressed concerns regarding safety and community impacts in

Section IV should EX-4A be selected and strongly recommended avoiding any alignments along the existing roadway if at all possible.

17. May 1998: 404(b)(1) Report submitted by letter of April 29 pursuant to MOU, Appendix A, FINAL EIS DEVELOPMENT, as previously agreed; comments requested within 45 day period as specified in MOU.

18. June 1998: Received phone call from USACE, EPA (Yocum, Wiltse), on 45 day deadline date (June 15) for agency comments on 404 Report to say that they did not agree with our LEDPA or our mitigation proposal. Yocum said he would call in next week or two with a proposal. FHWA called Yocum after two weeks and was told that Dave Carlson was preparing an 'opinion' paper to send. Mr. Carlson ultimately promised this by fax on July 10th, Friday.

On June 16, O&A met with USACE. USACE had met previous day with EPA; EPA had suggested an alternate alignment in Section IV, questioned costs for E-3 alignment, and proposed specific mitigation plan. Two days later O&A provided USACE, EPA, and FHWA with analysis of impacts of EPA's suggested alignment, cost comparison clarifications on E-3, and mitigation proposal clarifications. The correspondence stated that the mitigation proposed was based on guidance contained in the 1989 USACE/EPA MOA on the determination of mitigation under 404(b)(1) guidelines. The correspondence requested that EPA provide supporting evidence for our justification of expenditure of public monies on their proposed mitigation for project. No evidence was provided by EPA to support their presumption of "high" wetland values and functions.

19. July 1998: Dave Carlson called on July 29 to say he had been pulled off of Saddle Road and would get right on the opinion paper for FHWA.

20. August 1998: Letter received from EPA 104 days after distribution of the 404 Report stating nonconcurrence with LEDPA and mitigation proposal; however, no "explanation of basis for nonconcurrence" was included (as required by MOU).

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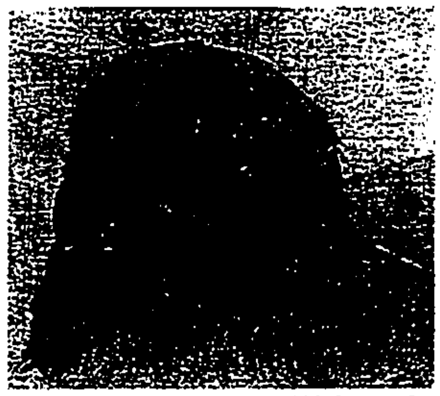
SCIENTIFIC BASES FOR MITIGATION PLAN



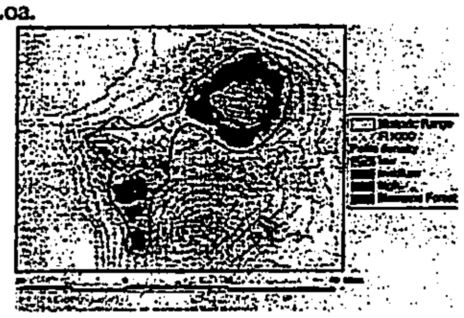
Paul C. Banko, Wildlife Biologist
Pacific Island Ecosystems Research Center
USGS-BRD

SCIENTIFIC BASES FOR MITIGATION PLAN

Paul C. Banko, Wildlife Biologist
Pacific Island Ecosystems Research Center
USGS-BRD

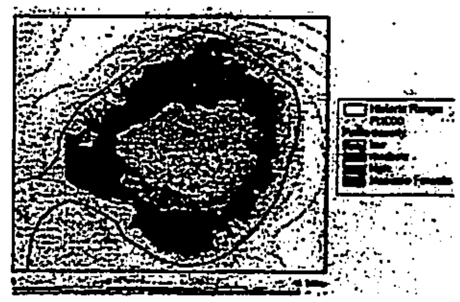
Distribution of Palila and Mamane Forest on Hawaii Island.

Palila historically inhabited mamane forests on Mauna Kea, Hualalai, and western Mauna Loa.

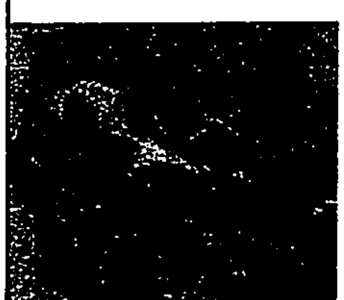


Palila Distribution on Mauna Kea

- Today palila are restricted to Mauna Kea



Palila Specialize on Mamane Seeds



- Bill is adapted for ripping open seedpods
- Seeds and flowers are needed throughout the year to sustain palila populations
- Caterpillars that also eat mamane seeds are important foods of palila

Palila Life History

- Palila specialize on mamane seeds and flowers
  - Bill is adapted for ripping open tough pods to extract seeds
- Mamane seeds or flowers must be available throughout the year in order to sustain palila populations
- Palila also require insects - especially caterpillars
  - Caterpillars are relatively easy for a seed-eater to glean
- Breeding effort and success depend heavily on the availability of mamane seeds and insects
- Predation by alien predators may limit populations
- Diseases may contribute to nestling mortality

Nestling Palila

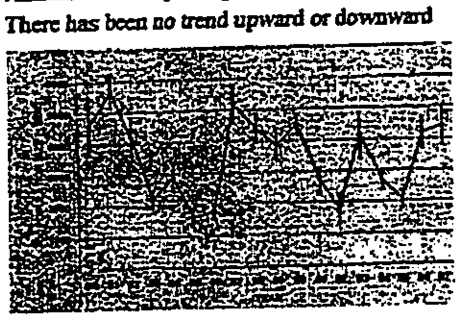
- Mamane seeds and flower parts are fed to nestlings but caterpillars also are important
- Availability of mamane seeds affects breeding effort and recruitment
- Chicks grow slowly and many die

Factors Contributing to Decline of Palila

- Degradation and loss of mamane forests
  - Feral ungulates decimate seedlings and saplings
  - Conversion of habitat to ranch land
- Alien predators
  - Feral cats and rats kill palila at nests and roosts
- Alien food competitors
  - Alien wasps parasitize caterpillars
- Disease
  - Malaria and pox below 5,000 ft. elevation
- Life history characteristics
  - Highly specialized diet
  - Relatively sedentary

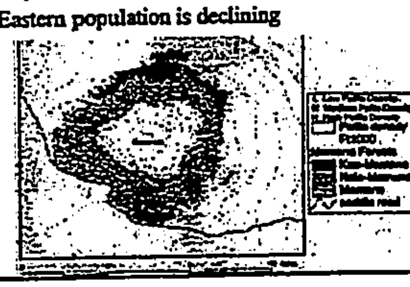
Palila Population Trends: 1980-1997

- Annual variability is high
- There has been no trend upward or downward



Palila Population Density

- Population was 4,395 +/- 625 SE in 1997
- 90 % of population is concentrated on western slope
- Eastern population is declining

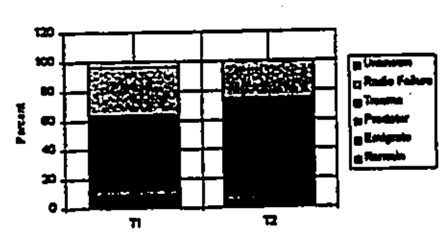


Restoration Techniques

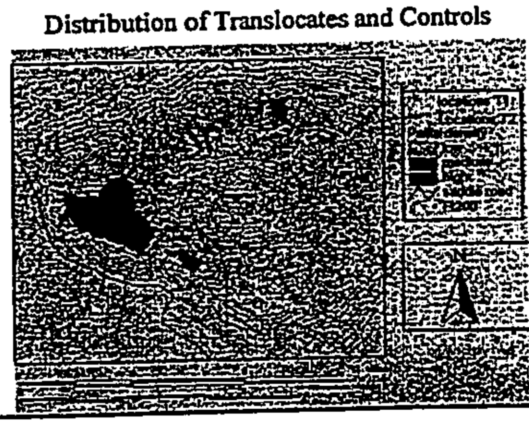
- Translocation
- Captive breeding & release to wild
- Enhance productivity & survival of wild birds
- Habitat management

Translocation

Results 8 Weeks After Translocation 1 (Jan-Mar 97) and Translocation 2 (Oct 97-Mar 98)



Distribution of Translocates and Controls



Captive Breeding

- Wild pairs renested quickly after we removed eggs from their nests
- Most viable eggs hatched in captivity (The Peregrine Fund)
- Nearly half of the chicks died before fledging
  - *Mycoplasma* bacteria or other disease
- Captive stock may not nest until 1999

Enhancing Productivity & Survival

- Supplemental feeding of nestlings
  - Does extra protein (insects) enhance chick growth and survival?
  - How can the nestling diet be supplemented efficiently?
- Disease
  - About 10 % of adult palila have *Mycoplasma*
  - Does *Mycoplasma* cause nestling mortality in the wild?

Habitat Management

Habitat Management Objectives

- Reducing threats to mamane forests
  - Feral ungulate removal
  - Fire management
  - Alien weed prevention and control
  - Plant pathogen monitoring
- Reducing threats to palila food resources
  - Alien parasitoid wasps
  - Alien ants and predatory wasps
- Reducing threats from alien predators
  - Feral cats and rats
- Monitoring threats from potential pathogens
  - *Mycoplasma*

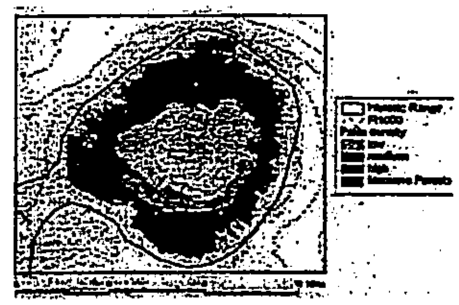
Forest Structure and Composition

- Dense stands of mamane trees
  - Palila nest and forage primarily where mamane is most abundant
  - Mamane regeneration is reduced by feral ungulates
- Large mamane trees
  - Food resources (seeds, flowers, insects) are produced in greater quantity by large trees
  - Palila prefer to forage and nest in medium and large trees
    - Small trees and saplings are seldom used

Elevation and Rainfall Gradients

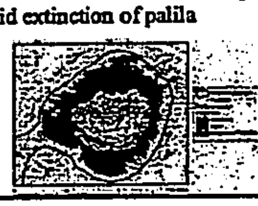
- Where elevation and rainfall gradients are substantial, food resources are produced in large amounts throughout most of the year
  - Mamane flowers and pods are produced first at high elevation and months later at low elevation
- Palila respond to changing availability of food
  - However, they do not travel far around Mauna Kea to search for food

Where on Mauna Kea Can Palila Be Recovered?

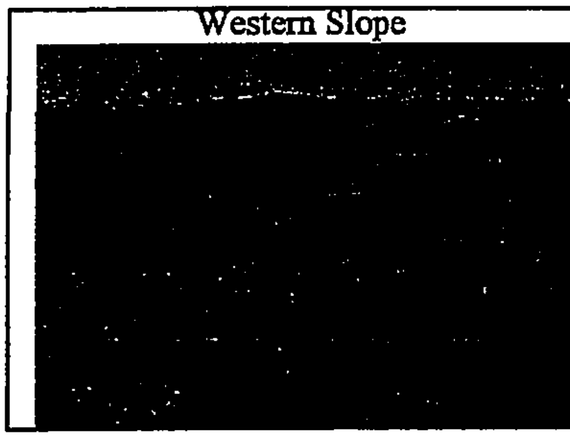


Western Slope

- Palila are concentrated in the best available habitat
  - *Large area of forest with many large trees and much regeneration*
  - Elevation gradient is substantial
  - Food usually available most of the year
- Fire is greatest threat to western slope and could cause rapid extinction of palila



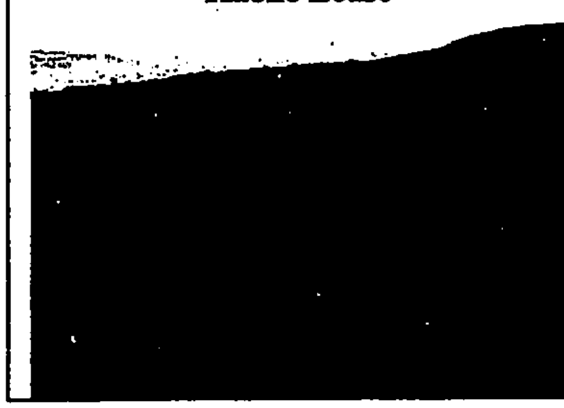
Western Slope



Kaohe Lease

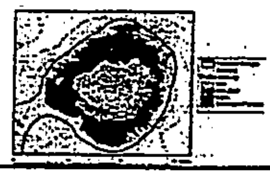
- State land leased for pasture is adjacent to recovering forest and primary palila population
- Management for palila
  - Remove cattle and prevent invasion by feral ungulates
  - Plant mamane in lower pastures if necessary
  - Predator control
- Management for hunting
  - Mowed strips for gamebirds

Kaohe Lease



Southern Slope

- Forest area and elevation gradient is large
  - Moderate rainfall gradient
  - Mamane regeneration is progressing
  - Palila are scarce on southern slope and need intensive management
- Realignment of Saddle Road will diminish recovery potential

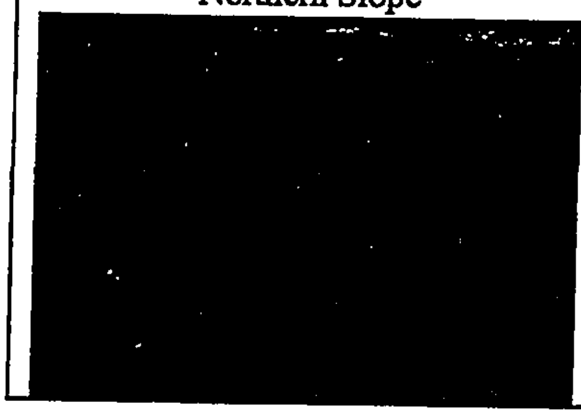


Southern Slope

Northern Slope

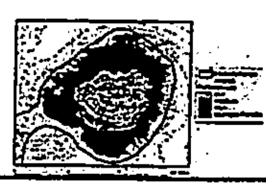
- Palila have not occupied northern slope for > 25 yr
  - Ranch land limits size and elevation gradient of forest
    - Forested lava flow extending into ranchland greatly increases recovery potential
    - Recovery of mamane in pastures will eventually be of great value to palila
  - Palila must be reintroduced and sustained by intensive management until forest recovery is more advanced

Northern Slope

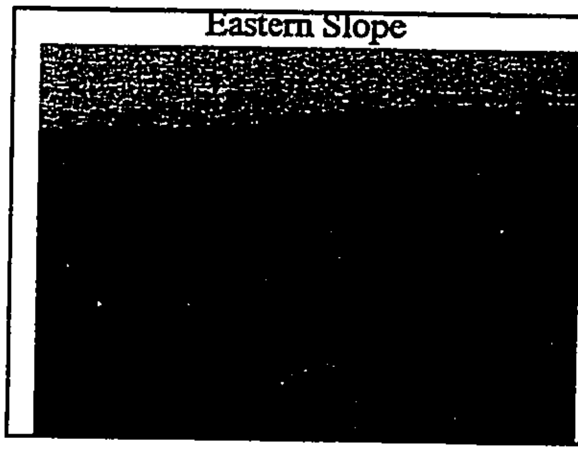


Eastern Slope

- Palila are declining rapidly
  - Kanakaleonui population may be extinct
- Elevation gradient is small because of ranch land below the forest reserve



Eastern Slope



Where Besides Mauna Kea Can Palila Be Recovered?

Potential for Recovering Palila in Kipuka Alala (PTA)

- Palila could be reintroduced when forest recovers
  - Size of forest is relatively small and isolated
    - Ungulate control must begin now and be permanent
    - Fire management is critical
    - High density of large trees required to support palila
- No gradients of elevation or rainfall
  - Intensive management required to sustain palila
    - Releases of birds may be necessary occasionally
    - Supplemental feeding may be needed occasionally
    - Predator management must be highly effective

Acknowledgments

- Funding
  - US Army Garrison, Hawaii (since FY96)
  - USGS-BRD (before FY96)
- Permits and Support
  - US Fish and Wildlife Service
  - Hawaii Division of Forestry and Wildlife
- Captive Breeding
  - The Peregrine Fund
- Technical Support
  - Drs. Greg Massey and Thierry Work
  - Pacific Island Ecosystems Research Center biologists and staff

SCIENTIFIC BASES FOR SADDLE ROAD MITIGATION
30 JUNE 1998
PAUL C. BANKO
Pacific Island Ecosystems Research Center
Biological Resources Division - USGS

- Palila once occurred on Mauna Loa, Hualali, and Mauna Kea
  - Fossils indicate that palila also once lived on Oahu. Perhaps they occurred on other islands with mamane forests.
  - Palila have been restricted primarily to Mauna Kea for at least 75 years.
    - However, palila were seen in Kipuka Alala (Mauna Loa lava flows) as late as 1950.
  - Palila once occurred at much lower elevations than where they are found today.
    - On Mauna Loa palila occurred as low as 4,000 ft elevation 100 years ago.
    - On Oahu, palila fossils were found on the coast.

- Palila are extremely specialized on mamane seeds and flowers for their diet.
  - Few other birds in the world are so highly specialized in their diet and, therefore, their habitat requirements.
    - Other finch-billed members of the family to which palila belong (Hawaiian honeycreepers) are extinct on the main Hawaiian Islands.
  - Mamane seeds and flowers must be available throughout most of the year in order to sustain palila populations.
    - Only about 63 % of adult palila survive annually in the best portion of their existing range, and many birds that die probably cannot find sufficient food.
  - Palila require insect foods in addition to mamane seeds and flowers.
    - Insects provide additional protein for growth and survival of young.
    - Caterpillars are the chief food of palila.
      - They are relatively easy to catch, even with a bill that has evolved for ripping open mamane pods.
  - Breeding effort (number of pairs attempting to nest) and success (number of fledglings produced) depend heavily on the availability of mamane seeds and insect foods.

- Palila populations may also be limited by predation, but the role of disease is less clear.
  - Predation by feral cats and rats occurs at nests and roosts.
    - Palila tend to roost in the same tree for many nights, and mammalian predators may be attracted to their scent more readily (feces do accumulate on branches under roosts).
  - Bacterial diseases (possibly *Mycoplasma*) may contribute to chick mortality, but avian pox and malaria is not a problem in the current range of palila (mosquitoes do not generally occur above 6,000 ft).

- Palila population fluctuates annually but has not increased overall since about 1981, when efforts were begun to reduce populations of feral sheep (and later mouflon sheep).

- Population was 4,395 ± 625 SE in 1997.
- Population is highly concentrated and vulnerable to fire or other catastrophe
  - About 90 % of the population occurs in approximately 16 square miles of forest on the west slope of Mauna Kea.
- Population on eastern slope of Mauna Kea is declining and seems destined to become extinct in near future
  - Elevational width of eastern forest has become too narrow to sustain populations in the long-term
  - Population at Kanakaleonui seems to have gone extinct within last 2 years

- Palila are unlikely to become extinct within the next decade, but the species requires an active management and research program so that they do not decline to the point where heroic efforts are necessary (for example: Alala, Poouli, Ou, and about 10 other species).
  - Palila recovery ultimately must go far beyond restoring populations on Mauna Kea, although that is where recovery must start.
    - Palila also must be reintroduced and sustained within former range on Hualalai and Mauna Loa.
    - Population must also be restored to eastern Mauna Kea.
  - Species recovery will require many decades of management because mamane trees grow slowly and forest recovery may be difficult to achieve in many areas.

- Restoration techniques must be developed now while there are enough birds available to test methods.
  - Translocation.
  - Captive breeding and release of young into the wild.
  - Enhancing productivity and survival.
    - Supplemental feeding.
    - Disease control, if necessary.
  - Habitat management.
    - Reducing threats to mamane forests
      - Feral ungulates
      - Fire
      - Alien weed invasions
      - Forest diseases
    - Reducing threats to palila food resources.
      - Alien parasitoid wasps
        - Caterpillar species that are important palila foods are parasitized heavily by alien parasitoid wasps (wasp eggs are laid in the caterpillar, and the wasp larvae eventually consume the host).
      - Alien ants and predatory wasps.

- Habitats best able to sustain palila in the long-term are large areas of forest which: 1) contain dense stands of large mamane trees and 2) incorporate significant elevation or rainfall gradients.

- Large trees can produce many more resources (seeds, flowers, insects, nest sites) than small trees and are preferred by palila
- Elevation and rainfall gradients result in food resources (especially mamane seeds and flowers) being available to palila in relatively large quantities throughout the year.
  - Where elevation and rainfall gradients are substantial, mamane flowers (and the seeds that follow) are produced in large quantities first at high elevation (or where rainfall is higher) and later at low elevation (or where rainfall is lower).
  - Palila respond to this changing availability of food but do not travel to distant portions of the mountain.
  - Where elevation and rainfall gradients are insignificant, mamane seeds and flowers are produced in large quantities usually once per year and are relatively scarce the rest of the year.
- Few areas are available where relatively dense stands of large mamane occur along a substantial gradient of elevation or rainfall.

- What areas other than the western slope of Mauna Kea are available for palila restoration?
  - Southern slope of Mauna Kea (including Pohakuloa Flats) is the next largest area of mamane forest occurring along gradients of elevation and rainfall.
    - However, realignment of Saddle Road through critical habitat diminishes opportunities for active palila recovery action.
  - Northern slope (Puu Mali) also supports a recovering mamane forest.
    - Elevation gradient is substantial, if the lava flow extending into ranch land below the forest reserve is protected from cattle and other ungulates.
    - Rainfall is higher on northern slope than on more arid western slope.
      - Forest recovery may precede more quickly
  - Kipuka Alala may be restored such that palila may eventually be reintroduced (perhaps after several decades).
    - However, the relatively small size of the mamane forest and lack of large elevation and rainfall gradients make long-term sustainability of palila problematic.
      - More intensive management may be needed than in more suitable areas.
        - Periodic release of captive-reared or surplus wild birds.
        - Supplemental feeding.

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U. S. Department of the Interior
U. S. GEOLOGICAL SURVEY
BIOLOGICAL RESOURCES DIVISION
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Hawai`i Field Station
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January 7, 1998

William L. Moore
Senior Planner
Okahara & Associates
200 Kohola St.
Hilo, HI 96720

Dear Bill,

Enclosed is a copy of the map showing the distribution of mamane forest types on Mauna Kea. As we discussed, I did not include the mamane forests that extend southwest of the Saddle Rd. since they are not yet part of my GIS map database. I tried to put it on a quad map background, but it looked very confusing - so I left it like this.

Let me know if you or Reggie need any additional maps for this area.

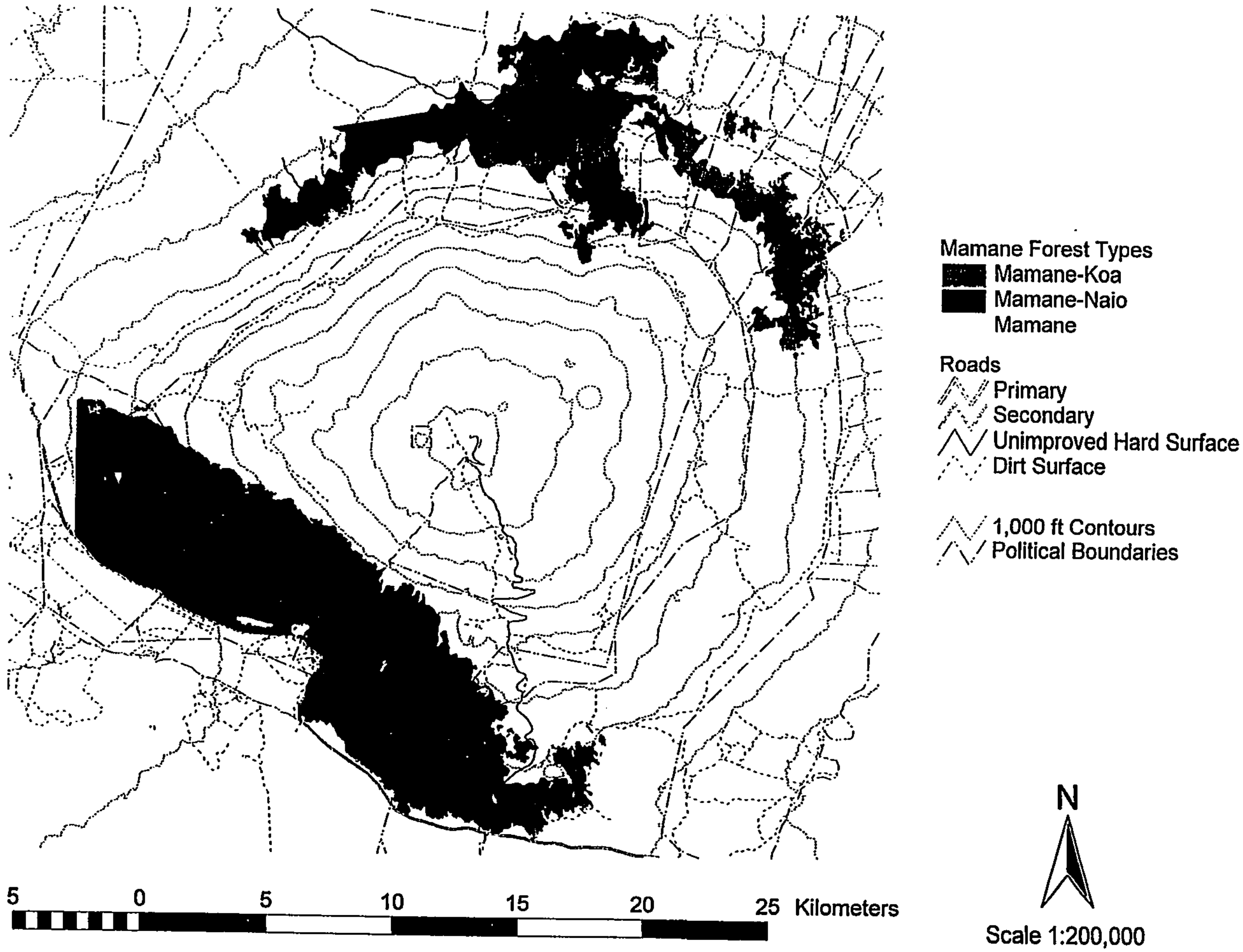
Aloha,

Jim

James D. Jacobi

RECEIVED
JAN 8 1998
OKAHARA & ASSOC., INC.
HILO OFFICE

Distribution of Mamane Forest on Mauna Kea



4 April 1996

SADDLE ROAD REALIGNMENT MITIGATION PLAN FOR PALILA

If the Saddle Road realignment passes through and next to palila Critical Habitat at Pohakuloa Training Area (PTA), both recovery and survival of the species is made more difficult unless action is taken to mitigate the impacts. The lower extension of forest on western Mauna Kea is the primary habitat that sustains most of the remaining birds at present, and its proximity to the increased risks associated with realigning the Saddle Road make its continued existence even more tenuous.

The effects of the new road on palila recovery potentially extend far beyond the actual road realignment. This is because the road will greatly increase the number of people traveling through or closer to palila habitat. Raising civilian traffic volume is of major concern because of elevated exposure to the real risks of fire, predation, and spread of alien weeds and pests to this vulnerable remnant of palila.

In addition, increased military activity within palila Critical Habitat (resulting from the road realignment) and highway impacts may effectively preclude restoration of the palila on the mountain's lower south slope. A wide elevational expanse of forest is crucially important to palila survival and recovery, and such places now are protected only on the west and south slopes of Mauna Kea.

Until other separate populations of palila are established in restored former portions of its range, the current remnant concentration of palila on the arid western slope is potentially subject to sudden extinction from catastrophic fire, the risk of which is elevated by the proposed realignment of the Saddle Road. Similarly, although less suddenly, the introduction of ants, increased cat predation or other potential adverse consequence of the road construction and use could also lead to a loss of this very vulnerable remnant of palila population.

Despite the anticipated risks to the palila of realigning and improving the Saddle Road, it may be possible for military training to continue and the road to pass through Critical Habitat if four major conditions are met:

> *1) mamane forests within palila Critical Habitat in PTA are not made unsuitable for future palila restoration efforts,*
>
> *2) threats of fire and alien organisms to palila habitat are minimized within PTA and elsewhere on the south and west slopes of Mauna Kea,*

3) an area of former palila habitat at PTA is restored and managed for palila reintroduction; habitat elsewhere on Mauna Kea is enhanced for palila by securing land (lease, easement, or fee purchase) and promoting habitat restoration.

4) effective efforts are made to translocate backup palila populations in at least two other locations on Mauna Kea and at PTA while enhancing the primary population on the west slope of Mauna Kea.

We recommend a combination of fire prevention, habitat acquisition, habitat protection and management, and palila translocation to mitigate the effects of realigning Saddle Road through and adjacent to Critical Habitat. Some of the proposed mitigation occurs off PTA and is intended to protect and enhance the existing core palila population on the west slope of Mauna Kea and to establish a backup population in another area. The following sections outline essential mitigation activities.

1. Mamane forests within palila Critical Habitat in PTA are not made unsuitable for future palila restoration efforts.

- **Provide a continuous series of digital, multi-spectral images (minimum 1 m pixel resolution) of Area 1 that covers the vegetation northwest and southeast of the new highway alignment through this habitat.**

  - Starting in 1996, these images should be taken every five years, with a set taken on a dry season day and on a day following a rainy period.

- **Conduct sampling of vegetation composition and structure within Area 1.**

- **Conduct sampling of current levels of predator and indicator invertebrate populations within Area 1.**

In general, the goal should be to maintain the forest in Area 1 in a condition that allows for the potential reintroduction of palila into this section of Critical Habitat. Fires must not be allowed to occur and forest structure and species composition must not deteriorate from its present condition. In addition, predators and alien weeds and pests should be monitored and controlled. Training activities permitted in the Pohakuloa Flats area should not preclude reestablishment of breeding palila in nearby portions of the south slope. These activities and traffic along the new highway alignment should not inhibit palila use of adjacent Critical Habitat.

2. Threats of fire and alien organisms to palila habitat are minimized within PTA or elsewhere on the south and west slopes of Mauna Kea.

- Construct roadway through and adjacent to palila Critical Habitat with very wide, paved shoulder with a barrier preventing regular traffic from access to vegetated edge of the road. This road plus shoulder should be wide enough to serve as an effective firebreak.

- Install phone boxes along roadside to facilitate quick reporting of fires and other emergencies.

- Develop and implement fire management plan covering PTA and entire south and west slope of Mauna Kea palila Critical Habitat.

- Implement fire hazard monitoring system and quick response fire crew similar to that used in Hawai`i Volcanoes National Park.

- Monitor and prevent establishment of alien organisms that threaten palila habitat, such as ants, wasps, fountain grass, etc.

Roadsides have been and continue to be a frequent site for wildfires to be started. Moving portions of the Saddle Road closer to and through the palila critical habitat and increasing traffic can elevate the risk of road-related wildfires. Fire is the greatest threat to palila today because the population is highly concentrated in only a few square miles of dry montane and subalpine forest near the Saddle Road. Heavy accumulations of dead grasses along the roadsides, primarily alien species, could rapidly carry intensely hot fires through large areas of critical importance to palila. Ignition sources include discarded cigarettes, catalytic converters of vehicles parked along or off roads, military activities (e.g. flares, weapons use, cigarettes), and illegal campfires.

Fires must be prevented along Saddle Road throughout the mamane-naio forest and in dry shrub grasslands from the 1933 lava flow to approximately Waiki`i. To reduce fire risks from cars parked on road shoulders and from discarded cigarettes along this portion of Saddle Road, the east shoulder of the road should be wide and paved to a width of about 40 feet to prevent the growth of flammable vegetation. This non-flammable shoulder should be separated from the westbound traffic lane by a physical barrier so that vehicles cannot travel or park on it. The shoulder could be made available to bicyclists, if desired, but need not be built to be load-bearing. Cellular phone voice boxes should be posted near the ends of this stretch of roadway to enable motorists to report fires to PTA Range Control and civilian fire fighters. In addition, a sign at the PTA Base Camp entrance should clearly direct motorists needing to report a fire. Finally, military training exercises should be curtailed everywhere mauka of the new road alignment. 7

In addition, a program to prevent, detect, and rapidly suppress fire in and near palila habitat is urgently needed to protect the dangerously vulnerable west slope population. Funding for personnel, equipment, and facilities is needed immediately to monitor and control human entry and activity, reduce fire fuels along jeep roads and maintain other fuel breaks, and quickly suppress fires in and near palila habitat. Similar fire prevention and suppression measures are needed in PTA, especially in areas with potential for palila restoration and within rare plant habitat. An example of a successful fire prevention and suppression program can be found in Hawai`i Volcanoes National Park.

3. An area of former palila habitat at PTA is restored and managed for palila reintroduction; habitat elsewhere on Mauna Kea is enhanced for palila by securing land (lease, easement, or fee purchase) and promoting habitat restoration.

- **Identify and secure site on PTA for management and reintroduction of palila.**

  - NBS has found the mamane forest in and adjacent to Kipuka Alala to be the best site on PTA lands for the reestablishment of another palila population.

- **Identify and secure the principal habitat areas on north slope of Mauna Kea for immediate management and reintroduction of palila.**

  - NBS has identified the area above, below, and adjacent to Pu`u Mali on Mauna Kea as the only currently appropriate site on Mauna Kea for immediate palila reintroduction. Several leased parcels of land comprising this reintroduction site are state owned and currently leased for ranching operations. The principal upper portion of this habitat is within the Mauna Kea Forest Reserve above Pu`u Mali and is already covered by the State's ungulate management control program, and has been recovering.

- **Identify an area at lower elevation which is contiguous to the presently occupied palila habitat on the west slope of Mauna Kea for habitat management and expansion of existing palila population.**

  - NBS has identified the area below and north of Pu`u La`au (TMK 4-4-15:2) as the most appropriate site for allowing expansion of the existing palila population into lower elevations at this time. This expansion site is state-owned and currently leased for cattle ranching.

- **Determine ownership/lease conditions for specified parcels and potential for acquisition or lease.**

* Determine and resolve other management concerns (e.g., predator control) necessary within these reintroduction target areas to be initiated prior to reintroduction of palila.

Former palila habitat within PTA includes the area of Critical Habitat and Kipuka Alala. Studies are in progress to assess the suitability of these areas and to make recommendations for reestablishing palila populations in them. Funding will be necessary to implement these recommendations. Until recommendations are available, however, it is necessary to minimize the unnatural destruction or debilitation of mamane trees and seedlings or other native trees and plants in palila habitat. In general, military activities and browsing by feral ungulates should not be allowed to result in significant reductions of mamane tree density and seedling recruitment, or native ground cover vegetation.

In order for a palila population to reproduce successfully, the birds need to move up and down an adequate elevational width of forest habitat to utilize seasonally available portions of the food resources. Except for the west slope, there is a lack of protected suitable forest habitat along the lower edge, particularly below about 6500 ft. elevation. As only these south and west slopes of Mauna Kea Forest Reserve presently have forest with adequate elevational width to sustain the palila, the birds have been disappearing from other portions of the mountain where they once occurred. South slope birds are also depleted now, most likely due to other causes, such as predation and military activity.

Because realignment of the Saddle Road and military activity impede the restoration of palila on the south slope of Mauna Kea in Area 1 and increases the chance of wildfire, it is crucial to strengthen the west slope population and well as to reestablish backup breeding populations elsewhere in suitable mamane forest habitat. Such additional populations are essential for the long-term survival of the species to insure against fire, storm, or other catastrophes depleting the highly concentrated primary population on the west slope.

The two best of such locations are the Kipuka Alala part of west PTA, and the north to northeast slope of Mauna Kea. The latter is a wetter, less isolated site and more amenable to rapid rehabilitation and initial translocation efforts. In addition, this northeast Mauna Kea location has potential to have both the broad elevational width necessary to be consistently good habitat and also a lower fire risk, even in dry periods. An essential first step in each location is securing and managing key lands dedicated for palila, and removal of the factors degrading their habitat (e.g., ungulates and training activities).

The most crucial of these sites is adjacent to Pu`u Mali on the northeast slope because it is believed to be ready for immediate translocation efforts. This area includes State land within and below Mauna Kea Forest Reserve (MKFR). The latter (roughly 3500-5500 acres) is currently leased for grazing. As envisioned, the Pu'u Mali area contains a combination of: recovering MKFR mamane forest and scrub (already within Critical Habitat), a core of partially degraded mamane-akoko forest on a lightly grazed 'a'a flow, and adjoining heavily grazed and degraded pasture area. Habitat management in the combination of these areas should allow a population of palila to be reestablished over a recovering habitat which has both elevational and moisture breadth. The backup population of birds in this site, while initially small, should grow along with a recovering habitat. No other site on Mauna Kea is as ready as is Pu'u Mali for immediate translocation of a backup sample of palila. However, this site alone is not believed to be sufficient to maintain enough birds to substitute for a possible catastrophic loss of the primary west-slope population.

Another area suitable for translocation of palila is the Kipuka Alala region in western PTA. The roughly 2500-3000 acre area is far away from the palila Critical Habitat, but it was still occupied by palila in recent years. Although ungulates have been preventing mamane regeneration for many years, the native forest structure remains. Translocation of some birds into this area could begin in the near future. To become suitable palila habitat, a permanent commitment to ungulate removal is an essential prerequisite for an earnest translocation effort. The habitat in this area is very dry and is limited to the mamane-containing kipukas, so the potential size of a backup population here is limited.

The third habitat-oriented mitigation area is the "Lau Ranch" portion of lower west Mauna Kea, immediately northwest of the core population of palila. This 1739 acre parcel is within the Critical Habitat and is presently leased to Parker Ranch for cattle grazing. Mamane forest on it is variable in tree density and restoration needs. Similar former pasture areas adjacent to it have recovered following cessation of grazing, and they now support breeding palila. Securing of this area will expand the low elevation mamane forest crucial for palila, and could help cushion a partial loss of low elevation forest to possible highway-origin fire.

Cats, and perhaps mongooses, prey upon palila and other native forest birds and will increase in numbers as human activity increases as a result of improving the Saddle Road. Control of these predators is essential along the Saddle Road, at Mauna Kea State Park, and within palila breeding habitat on Mauna Kea and PTA. Rats are also serious predators of palila and may reduce nesting success in naio-mamane forest. Reducing predator loss of palila is necessary for translocation areas and also for bolstering the core population. Funding is needed to immediately begin poisoning and trapping programs, as well as for improving methods and for monitoring effectiveness of these control programs.

Road construction and use are known to result in the introduction of potentially harmful alien plants and invertebrates into the regions through which they are constructed. House cats, a serious predator of the palila, are frequently dumped along roadsides and become feral. To protect palila and their habitat, long-term monitoring and control of alien weeds and pests along the entire Saddle Road are essential throughout PTA and within the translocated palila's habitat. Monitoring and control are especially important during road construction to eradicate undesirable species before they spread. The DOD would be responsible for alien species control within PTA and DLNR would operate throughout Mauna Kea Forest Reserve through resources management funding provided as part of the Saddle Road mitigation. Alien species of special concern include fountain grass (*Pennisetum setaceum*), yellowjackets (*Vespula* spp.), and Argentine ants (*Linepithema humile*).

4. Effective efforts are made to restore palila populations in at least one other location on Mauna Kea and at PTA while enhancing the primary population on the west slope of Mauna Kea.

- **Refine and implement techniques for restoring palila into recovering habitat.**

  - Translocate and release captive-reared birds at the northern reintroduction site near Pu`u Mali while managing existing habitat with ungulate control, predator control, and other pest species control. If possible, initiate translocation of palila into this area before the end of 1996.

  - Manage habitat at Kipuka Alala (PTA) for palila reintroduction and restoration and, when conditions are deemed suitable, translocate or release-captive reared palila into this habitat.

- **Annually monitor palila populations on Mauna Kea and within the PTA site to evaluate overall population trends and success of the restoration efforts.**

  - Manage habitat (control predators, ungulate populations, and other alien pests, and prevent fires within the restoration sites to allow natural growth and expansion of the palila population in these areas.

  - Develop techniques to enhance palila productivity, including nest manipulation and supplemental feeding, to aid with the restoration efforts in main population and two new population sites.

Research to refine palila restoration techniques is just beginning and will require additional support for up to 5 years. When techniques have been satisfactorily developed, funding will be needed for up to 15 years to implement palila recovery in suitable habitat on Mauna Kea and PTA. Possible sites for palila restoration include Kipuka Alala in PTA and Pu`u Mali on the north slope of Mauna Kea. These and other sites will be evaluated during 1996 but additional habitat assessment should be funded in the future. Research has also begun to develop techniques for enhancing productivity of the primary palila population on the west slope. Funding for this effort and concurrent predator control, ungulate exclusion and removal, and fire prevention is needed for at least five years.

SECURING AND MANAGING ADDITIONAL PALILA HABITAT IN THE PUU MALI AND PUU LAAU AREAS OF MAUNA KEA, HAWAII

NATIONAL BIOLOGICAL SERVICE
Pacific Islands Science Center
Hawaii Field Station

Prepared by P. C. Banko, F. R. Warshauer, and J. D. Jacobi

20 August 1996

Because realignment of the Saddle Road and military activity impede the restoration of palila on the south slope of Mauna Kea in Area 1 and increase the probability of wildfire and spread of alien species, it is crucially important to 1) reestablish a viable breeding population elsewhere in suitable mamane forest habitat, and 2) protect and enhance the primary palila population and its habitat near Puu Laau on the west slope of Mauna Kea. Essential to the long-term survival of the species, additional populations of palila would mitigate losses to fire and alien species invasion, both of which are increased with the proposed road realignment. Additional population also would insure against storms and other catastrophes depleting the highly concentrated primary population on Mauna Kea's west slope.

In order for palila populations to thrive, birds must move within forest areas that are adequately large and distributed along a wide range of elevation to enable them to utilize seasonally available food resources. Except for the west slope, there are no protected, forest habitats suitable for palila along the lower edge of Mauna Kea Forest Reserve (MKFR), particularly below about 6500 ft. elevation. As only the south and west slopes of MKFR presently are forested to an adequate elevational width to sustain palila, the birds have been disappearing from other portions of the mountain where they once occurred. South slope birds are also depleted now, most likely due to other causes, such as predation and military activity.

Excluding the south slope of Mauna Kea from consideration, two other areas appropriate for reintroducing palila are Kipuka Alala in western Pohakuloa Training Area (PTA), and Puu Mali on the north slope of Mauna Kea. Compared to Kipuka Alala, the Puu Mali area is wetter and less isolated and is more suitable for rapid forest rehabilitation and initial reintroduction of palila. For example, tree density and sapling recruitment in palila Critical Habitat above Puu Mali are presently similar to portions of the Puu Laau area where palila exist and nest in relatively high numbers. The condition and extent of the recovering forest should continue to improve now that browsing ungulates are being eliminated. In addition, the north slope of Mauna Kea has greater potential to provide the broad elevational band of forest and a moisture gradient necessary to provide palila with year-round food availability and there is a lower risk of fire, even during dry periods. If forests between Puu Mali and Puu Laau continue to recover from ungulate damage, there eventually may be a corridor of habitat linking the new population on the north slope with the main population on the west slope. Essential steps in reestablishing a second population on Mauna Kea's north slope are 1) securing lands that are dedicated for palila recovery and removing factors, especially ungulates, that degrade palila habitat, and 2) reintroducing palila into this habitat.

The proposed palila restoration area in the Puu Mali area includes State land within and below MKFR and contains a combination of 1) recovering mamane forest and native shrubland already within palila Critical Habitat in MKFR, and 2) about 3500-5500 acres below MKFR leased for grazing that includes a core of partially degraded mamane-akoko forest on a lightly grazed 'a'a flow and adjoining heavily grazed and degraded pasture. Habitat management in this combination of areas should allow a population of palila to be reestablished over a range of recovering habitat situated along suitably broad elevation and moisture gradients. A reintroduced population of birds in this site, while initially small, should expand with recovering habitat. No other site on Mauna Kea is better suited than Puu Mali for immediate reintroduction of palila.

Not knowing in advance how many palila can, in fact, be reestablished in rehabilitating forests, it is essential to provide at least as much habitat on the north slope as is currently occupied on the west slope, or an area of about 11 sq. miles. About half this area already exists within palila Critical Habitat above Puu Mali. To provide the remaining portion of necessary habitat, the minimum boundaries of the proposed north slope palila restoration site below MKFR, including the leased grazing lands to be secured and managed, are approximately: from near Puu Ulaula north 2 miles to 5600 ft. elevation, then to Apakuie, then to the lower base (6400 ft. elevation) of Kaluamakani. These leased grazing areas together with lands within MKFR provides nearly 11 sq. miles of recovering and potential forest along an elevation gradient extending from about 9000 to 5600 ft. (3400 ft.) and forming a belt of forest about 3.3 miles wide when the lower portion is eventually reforested. Palila habitat on the west slope of Mauna Kea, in comparison, extends from 9400 to 6200 ft. (3200 ft.), forming a belt of forest about 4 miles wide.

Appropriate management of presently-grazed lands is of great importance if palila are to be reestablished on Mauna Kea's north slope. Predator removal and alien weed and pest monitoring and control are required throughout the north slope recovery site. Supplementary boundary fencing must be erected and cattle removed as soon as possible. Grazing, even on a limited or sporadic basis, would be entirely incompatible with mamane forest rehabilitation and palila restoration. It may not even be necessary to plant mamane seedlings in areas that have been heavily grazed if, as has occurred in many other localities where ungulates have been removed, natural germination and seedling growth occur at relatively high rates. Commercial forestry operations also would be inappropriate within the palila restoration area. Gamebird hunting may not interfere with forest recovery as long as mamane germination and growth are not compromised by activities to improve gamebird habitat (e.g. planting gamebird food crops, clearing or thinning trees, disking). However, gamebird hunting would need to be carefully regulated to ensure that it did not interfere with palila restoration. For example, it would be inappropriate and dangerous to allow hunting around the time when palila were being translocated or released. Some other recreational activities (e.g. motorcycle races, wilderness marathons, and public camping) should also be prohibited. As a guiding principle, the area should be managed foremost for the benefit of palila and their habitat - not for multiple use.

At the same time that a second viable population of palila is initiated on Mauna Kea's north slope, essential mitigation of the proposed highway realignment includes additional protection and enhancement of the primary population and habitat on the west slope. The most important west slope area to rehabilitate and make available to palila is "Lau Ranch" (TMK 4-4-15:2), immediately northwest of the core population of palila. This 1739 acre parcel is within Critical Habitat and is presently leased to Parker Ranch for cattle grazing. Pastures are variable with respect to mamane tree density and restoration needs. Similar former pasture areas adjacent to "Lau Ranch" have recovered following removal of cattle, and they now support breeding palila Securing this area will expand the low elevation mamane forest necessary for palila population expansion and would help reduce any limited loss of low elevation forest due to fires originating from the new or existing highway. Nevertheless, it is important that fires be prevented from occurring in or near the west slope habitat.

ERRATA SHEET
(TECHNICAL APPENDICES,VOLUME III)

ERRATA SHEET
(BIOLOGICAL ASSESSMENT)

ERRATA SHEET

Technical Appendices, Volume II
Wetlands Determination
Grant Gerrish
September, 1997

Page 37, Section 4.121 Direct Construction Impact, Paragraph 3: The reference to 14 hectares in sentence 2 should be changed to 6 hectares, as follows.

> *Although the total area proposed to be filled might approach 6 hectares (EX-3 with E-3), this area would be dispersed as narrow strips bordering about 11 km (7 miles) of the Saddle Raod, an already-existing disturbance feature.*

ERRATA SHEET
(BIOLOGICAL ASSESSMENT)

Biological Assessment, Volume III
Appendix A
USFWS Letter Discussing Specific Palila Migitation, October 1999

Portion of letter missing from Volume III. Entire letter published as follows.

United States Department of the Interior

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OCT. - - 1996

William, Moore, Senior Planner
Okahara & Associates, Inc.
73-5574 Maiau Street, Bay 6B
Kailua-Kona, HI 96740

Dear ~~Mr. Moore~~ Bill:

Based on our meeting of September 5, 1996, concerning the Saddle Road realignment mitigation for palila, you requested more detailed documentation and justification for securing and managing additional palila habitat in the Puu Mali and Puu Laau areas of Mauna Kea, Hawaii. Additionally, you asked for written cost estimates for conducting palila restoration activities associated with the mitigation proposal. This letter is intended to address these questions and not reiterate the four major conditions that the Fish and Wildlife Service (Service) believes could offset Saddle Road realignment impacts to palila critical habitat and to the existing viable palila population on the west slope of Mauna Kea as outlined in a April 4, 1996, National Biological Service's report "Saddle Road Realignment Mitigation Plan for Palila".

Essential to the long-term survival of the species, additional populations of palila are necessary to offset the increased fire and alien species risks associated with the proposed road realignment. Additional palila populations also would insure against storms and other catastrophes depleting the highly concentrated primary population on Mauna Kea's west slope.

In order for palila populations to thrive, birds must move within forest areas that are adequately large and distributed along a wide range of elevation to enable them to utilize seasonally available food resources. Except on the west and south slopes, there are no protected habitats suitable for palila along the lower edge of Mauna Kea Forest Reserve (MKFR), particularly to or below 6500 ft. elevation. Palila have been disappearing from formerly occupied areas on Mauna Kea where the forest belt has become diminished and degraded. South slope birds also have become depleted, most likely due to predation and military activity rather than large-scale reduction of forest.

Immediate opportunities for rehabilitating palila populations anywhere within their historical range are limited because of severe, long-term habitat degradation. On the west slope of Mauna Loa, for example, some areas of mamane forest may have considerable potential for palila reintroduction, but cooperative agreements with private landowners are needed before habitat evaluation and management and palila restoration can proceed. The same is true of portions of former palila habitat on Hualalai. On Mauna Kea's east slope, rescue efforts to prevent the extinction of the dwindling palila population at Kanakaleonui should start soon as part of a comprehensive recovery effort.

However, cooperative agreements with DHHL and many years of forest recovery and expansion are needed before palila restoration efforts can have meaningful effect there.

When considering all possible areas within the former range of palila for reintroduction and habitat management, only two sites seem suitable: 1) Kipuka Alala in western Pohakuloa Training Area (PTA), and 2) Puu Mali on the north slope of Mauna Kea. The initial area to be used for translocation activities, however, should have habitat suitable for reintroducing palila within the next 12 months.

The criteria for selecting this area are:

1) size and elevational range of mamane forest sufficient to allow palila to find food throughout the year;

2) density of mamane trees sufficient to provide adequate foraging, sheltering, and nesting sites;

3) age structure of mamane forest distributed to enable long-term forest perpetuation; the forest currently must include a large cohort of seedlings and saplings complementing a large cohort of medium to large trees; alternatively, ungulates and other factors limiting mamane regeneration must be quickly removed so that regeneration can proceed;

4) relatively consistent, large annual production of mamane seeds and flowers to ensure adequate breeding effort and survival within the palila population;

5) availability of suitable insect foods, particularly caterpillars;

6) predator populations that are currently low or that can be quickly and effectively reduced;

7) low incidence of avian diseases and vectors;

8) low incidence or potential for infestation by unmanageable alien weeds and pests;

9) low risk of wildfire; and

10) low risk of human disturbance.

Biological Resources Division (BRD) (formerly National Biological Service) is currently assessing conditions at Kipuka Alala (and Pohakuloa Flats within the Critical Habitat of PTA) and Puu Mali to determine which area is best suited for reintroduction of palila. Although final results will be reported in December 1996, it is not premature to suggest that Puu Mali will be determined to be the site where palila reintroduction first should proceed. First among the factors leading to the selection of Puu Mali is that the size of the forest (both existing and potential) is larger than at Kipuka Alala. Presently, the mamane forest extends substantially below MKFR on a rough 'a'a flow immediately northeast of Puu Mali. The forest is regenerating naturally because cattle have not intruded onto the lava flow in recent years due to dilapidation of the water system. In addition, the condition and extent of the forest above Puu Mali should continue to improve rapidly now that browsing ungulates are being eliminated within MKFR. If forests between Puu Mali and Puu Laau continue to recover from ungulate damage, there eventually may be a corridor of habitat within MKFR linking a new population on the north slope with the existing main population on the west slope. The Puu Mali area also receives substantially more rainfall than Kipuka Alala, consequently it is more suitable for rapid forest rehabilitation. In addition, the north slope of Mauna Kea has greater potential to provide the broad elevational band of forest and a moisture gradient necessary to provide palila with year-round food availability.

Puu Mali also ranks ahead of Kipuka Alala on the basis of the other criteria for selecting the first palila reintroduction site. In this regard, the density of medium to large mamane trees in palila Critical Habitat above Puu Mali is similar to portions of the Puu Laau area where palila exist and nest in relatively high numbers. Mamane sapling recruitment above Puu Mali also is similar to Puu Laau, whereas there is little mamane regeneration at Kipuka Alala because of severe ungulate browsing damage and more arid conditions. Greater rainfall at Puu Mali lowers the risk of fire, even during dry periods.

From previous research by BRD, we know that annual production of mamane flower and seed crops is likely to be consistently higher at Puu Mali than at Kipuka Alala. Greater mamane seed production suggests that important caterpillar foods, particularly Cydia sp., also will be more available. Finally, rat populations are expected to be smaller and more easily controlled at Puu Mali because naio is not abundant there, whereas rats are likely to be more abundant at Kipuka Alala because naio is very abundant there.

At this time, there seems to be no obvious differences between Puu Mali and Kipuka Alala in terms of threats from avian diseases, alien weeds and pests, ungulate presence, and human disturbance. Essential steps in reestablishing a second population of palila near Puu Mali are 1) securing and managing lands that are dedicated for palila recovery, and 2) removing factors, especially ungulates, that degrade palila habitat. The proposed palila restoration area in the Puu Mali area is all State land within and below MKFR, and it contains a combination of recovering mamane forest and native shrubland already within palila Critical Habitat in MKFR in addition to about 5000 acres below MKFR leased for grazing that includes a core of partially degraded mamane-akoko forest on a lightly grazed 'a'a flow and adjoining heavily grazed and degraded pasture. Habitat management in this combination of areas should allow a population of palila to be reestablished over a range of recovering habitat situated along suitably broad elevation and moisture gradients. A reintroduced population of birds in this site, while initially small, should expand with recovering habitat. No other site on Mauna Kea or elsewhere is better suited than Puu Mali for immediate reintroduction of palila.

Not knowing in advance how many palila can, in fact, be reestablished in this rehabilitating north slope forest, it is essential to provide at least as much habitat there as is currently occupied on the west slope, or an area of about 11 sq. miles. Less than half this area already exists within palila Critical Habitat above Puu Mali. To provide the remaining portion of necessary habitat, the minimum boundaries of the proposed north slope palila restoration site below MKFR, including the leased grazing lands to be secured and managed, are approximately: from near Puu Ulaula north 2 miles to 5600 ft. elevation, then west to Apakuie, then southwest to the lower base (6400 ft. elevation) of

Kaluamakani. These leased grazing areas together with lands within MKFR provides about 11 sq. miles of recovering and potential forest along an elevation gradient extending from about 9000 to 5600 ft. (3400 ft.) and forming a belt of forest about 3.3 miles wide when the lower portion is eventually reforested. Palila habitat on the west slope of Mauna Kea, in comparison, extends from 9400 to 6200 ft. (3200 ft.), forming a belt of forest about 4 miles wide.

Appropriate management of presently-grazed lands is of great importance if palila are to be reestablished on Mauna Kea's north slope. Grazing and browsing ungulates must be removed to allow forest recovery to begin in pasture areas or to continue within MKFR. Similarly, ungulates in Kipuka Alala need to be removed and the area fenced before any habitat recovery can be expected to begin. Predator removal and alien weed and pest monitoring and control also are essential throughout the north slope recovery site.

At the same time that a second viable population of palila is initiated on Mauna Kea's north slope, essential mitigation of the proposed highway realignment includes additional protection and enhancement of the primary population and habitat on the west slope. The most important west slope area to rehabilitate and make available to palila is "Lau Ranch" (TMK 4-4-15:2), immediately northwest of the core population of palila. This 1739 acre parcel is within Critical Habitat and is presently leased to Parker Ranch for cattle grazing. Pastures are variable with respect to mamane tree density and restoration needs. Similar former pasture areas adjacent to "Lau Ranch" have recovered following removal of cattle, and they now support breeding palila. Securing this area will expand the low elevation mamane forest necessary for palila population expansion and would help reduce any limited loss of low elevation forest due to fires originating from the new or existing highway. Nevertheless, it is important that fires be prevented from occurring in or near the west slope habitat.

Written cost estimates for conducting palila restoration activities related to the mitigation proposal are as follows:

> $450,000 per year for first 5 years, then $100,000 per year for additional 5 years for translocation and breeding enhancement at Puu Laau and Puu Mali. (Total cost- $2,750,000 for 10 years).
>
> $150,000 per year for first 5 years, then $75,000 per year for additional 5 years for predator control and monitoring at Puu Laau and Puu Mali. (Total cost - $1,125,000 for 10 years).

This concludes our response to your request. Technical questions or cost estimates can be addressed to Paul Banko on the Big Island at 967-7396. Regulatory and policy questions can be directed to me on Oahu at 541-3441.

Sincerely,

Brooks Harper

Brooks Harper
Field Supervisor