UNIVERSITY OF HAWAI'I AT HILO

Director's Office
Mauna Kea Astronomy Education Center

August 13, 2002

RECEIVED

'02 AUG 15 A11:19

OFC. OF ENVIRONMENTAL QUALITY CONTROL

Ms. Genevieve Salmonson
Director
Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu, ill 96813

Subject: Finding of No Significant Impact (FONSI) - Mauna Kea Astronomy Education Center, South Hilo, HI TMK: (3) 2-4-01: portion 7

Dear Ms. Salmonson:

The Mauna Kea Astronomy Education Center of the University of Hawai'i at Hilo has reviewed the comments received during the 30-day public comment period, which began on July 8, 2002, and has determined that this project will not have significant environmental effects. A Finding of No Significant Impact (FONSI) has been issued. We would appreciate your publishing this notice in the September 8, 2002 OEQC Environmental Notice.

We have enclosed a completed OEQC Publication Form and four (4) copies of the Final EA. Please feel free to contact our office at (808) 933-3324 or Sidney Fuke, Planning Consultant at (808) 969-1522 if you have any questions.

Thanking you,
Sincerely,

George Jacob, Project Director
MKAEC Co-PI

Dr. Rose Tseng, Chancellor
and Senior Vice President
University of Hawaii-Hilo
MKAEC PI

Enclosures

cc: Alan Ah San, Associate VP for Administration, UH-Manoa
Dr. Jack Whittaker, Vice Chancellor for Administrative Affairs, UH-Hilo
Gerald De Mello, Director of University Relations, UH-Hilo
Sidney Fuke, Planning Consultant

640 North A'ohoku Street, #130, IFA Building, Hilo, Hawai'i 96720-4091 USA
Telephone: (808) 933-3324, Facsimile: (808) 933-3912, www.maunakea.hawaii.edu

EXISTING CONDITIONS

The existing roadway and traffic conditions in the study area were surveyed as part of this analysis.

Roadways

Komohana Street is a two lane collector roadway running in a generally north-south direction through the mauka portion of Hilo. The roadway is in an 80 foot right-of-way and the long range highway plan recommends that it be widened to four lanes in the future.

The Mohouli Street intersection with Komohana Street is north of University Park. Mohouli Street is a two lane collector roadway providing mauka-makai access from downtown Hilo. The roadway was just recently extended mauka from its terminus at Komohana Street. There are turning lanes on all approaches and the intersection was signalized as part of the improvements.

Nowelo Street is the middle of the three study intersections. It is a two lane roadway with separate left and right turn lanes at the Komohana Street intersection. The Nowelo Street approach is stop sign controlled and the southbound approach of Komohana Street has a separate left turn lane into Nowelo Street.

Puainako Street is a two lane State highway running in a generally east-west direction. Its western terminus is currently at Komohana Street and is south of University Park. There are four approaches although the eastbound approach is little used and the intersection operates as a T-intersection. The Puainako Street approach is stop sign controlled and all the approaches are one lane with no separate turning lanes.

Puainako Street is currently undergoing improvements. The eastern section of roadway in the vicinity of Kanoelehua Avenue is being widened to four lanes. The Puainako Street Extension from Komohana Street to Kaumana is currently under construction and is expected to be completed in mid-2003. The Puainako Street Extension terminus on Komohana Street will be located about 200 feet north of the existing Puainako Street intersection, forming an offset intersection. Both intersections will be signalized, creating two closely spaced intersections that would probably operate under one controller, requiring special traffic signal timing plans. There would be left turn lanes to the present Puainako Street and Puainako StreetExtension roadways.

This design will remain until the section of Puainako Street between Kawili Street and Komohana Street is realigned to the north to match the Extension's roadway alignment. When this occurs, the Extension alignment would become the main roadway and the existing Puanako Street approach will be unsignalized and made right-turn in, right-turn out.

Current traffic volumes for the three study intersections were obtained from several sources. Traffic volumes for the Mohouli Street intersection were obtained from The Traffic Management Consultant as part of their study to monitor the impacts of the Mohouli Street extension. The traffic counts were taken during the morning and afternoon commuter peak periods and the worksheet is included in the Appendix.

Traffic counts for the Puainako Street intersection were obtained from the "Traffic Impact Analysis Report for China-U.S. Center at UH-Hilo" (April 10, 2002) by Phillip Rowell and Associates. The traffic counts were taken during the morning and afternoon commuter peak periods in February and May 2002.

Traffic counts for the Nowelo Street intersection were taken on Monday, May 20, 2002, during the mid-morning and afternoon commuter peak periods. Traffic turning movement counts require a surveyor to station themselves by the study intersection and record each vehicle entering the intersection as through or turning movements by 15 minute intervals. The worksheet for this count is included in the Appendix.

The Mohouli Street and Puainako Street counts were taken in the morning peak while this study analyzed the mid-morning hour. The peak morning volumes were adjusted by factoring northbound trips by 50%, southbound trips by 60%, and eastbound trips by 55%. These conversion factors were developed from metered traffic counts taken by the State Department of Transportation at the Komohana Street/Ponahawai Street intersection on April 11-12, 2000. The resultant mid-morning and afternoon peak hour volumes at the three study intersections are summarized on Figure 2. The traffic volumes are rounded to the nearest five vehicles per hour.

TRAFFIC FORECAST

The study year of 2005 was analyzed based on the proposed project's expected opening date in late 2004. During the interim period, ambient traffic on the area roadways can be expected to increase due to regional growth, new projects in the area, and completion of the Puainako Street Extension. The traffic which would be generated by the proposed project was added to the ambient without project traffic forecast to obtain the total with project traffic forecast.

Ambient Traffic Forecast

The ambient traffic forecast is the growth which would occur to the year 2005 without the proposed project. Two separate procedures were used to forecast

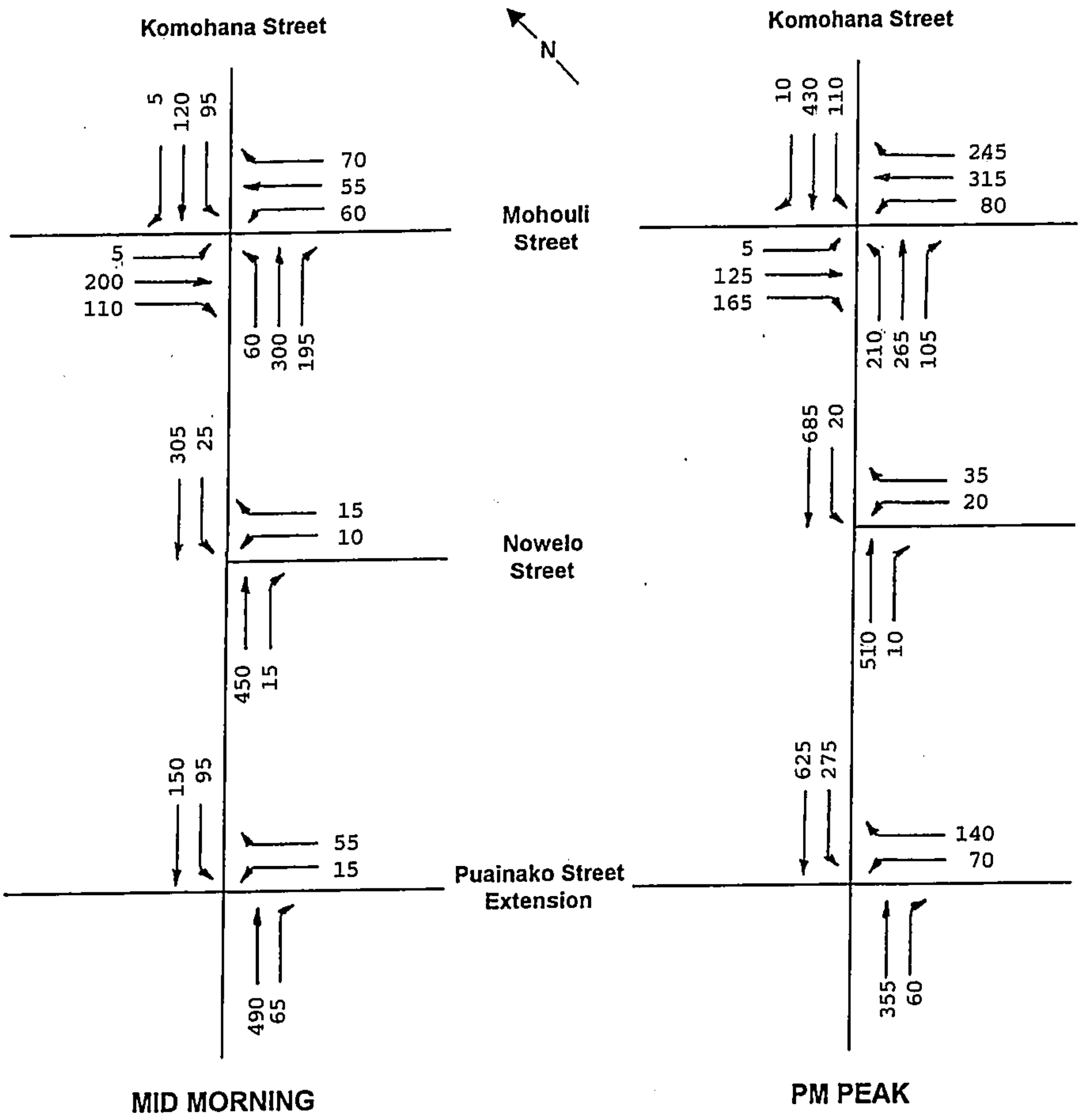


FIGURE 2
EXISTING TRAFFIC VOLUMES

Sources: Mohouli Street PM Count: The Traffic Management Consultant
Puainako Street PM Count: Phillip Rowell and Associates, "China-U.S. Center at UH-Hilo"

each of its two components: regional traffic growth and the traffic to be generated from three proposed projects in the study area.

Regional traffic growth consists of traffic increases due to regional growth and traffic pattern changes brought about by the Puainako Street Extension. To reflect regional growth, the existing traffic volumes at the Mohouli Street and Nowelo Street intersections were increased by four percent over the three year forecast period to obtain the ambient traffic forecasts for these two intersections. The ambient traffic forecasts for the Puainako Street intersection considered the impacts of the traffic pattern changes created by the new Extension roadway and future growth at UHH. The 2020 traffic forecasts from the "Traffic Impact Analysis Report for the Proposed Puainako Street Extension" (February 14, 1997) by The Traffic Management Consultant were factored to 2005 level values. This forecast placed additional traffic onto Komohana Street. This additional traffic was then added to the other two study intersections based on current traffic patterns. The resultant regional growth traffic forecasts at the three study intersections are summarized on Figure 3. The traffic volumes are rounded to the nearest five vehicles per hour.

In addition to the proposed project, there are three other projects being planned at UHH that are in various stages of the approval process. The Smithsonian Astrophysical Observatory SMA Hilo Base Facility would be built on the parcel adjacent to the proposed project. The U.S. Department of Agriculture Pacific Basin Agricultural Research Center would be located on the mauka side of Komohana Street south of the Nowelo Street intersection. Two alternative access driveways are being considered, one south of Nowelo Street and the other directly across Nowelo Street. Finally, the China-U.S. Center at UH-Hilo is being proposed on the east side of campus along Kawili Street. The traffic

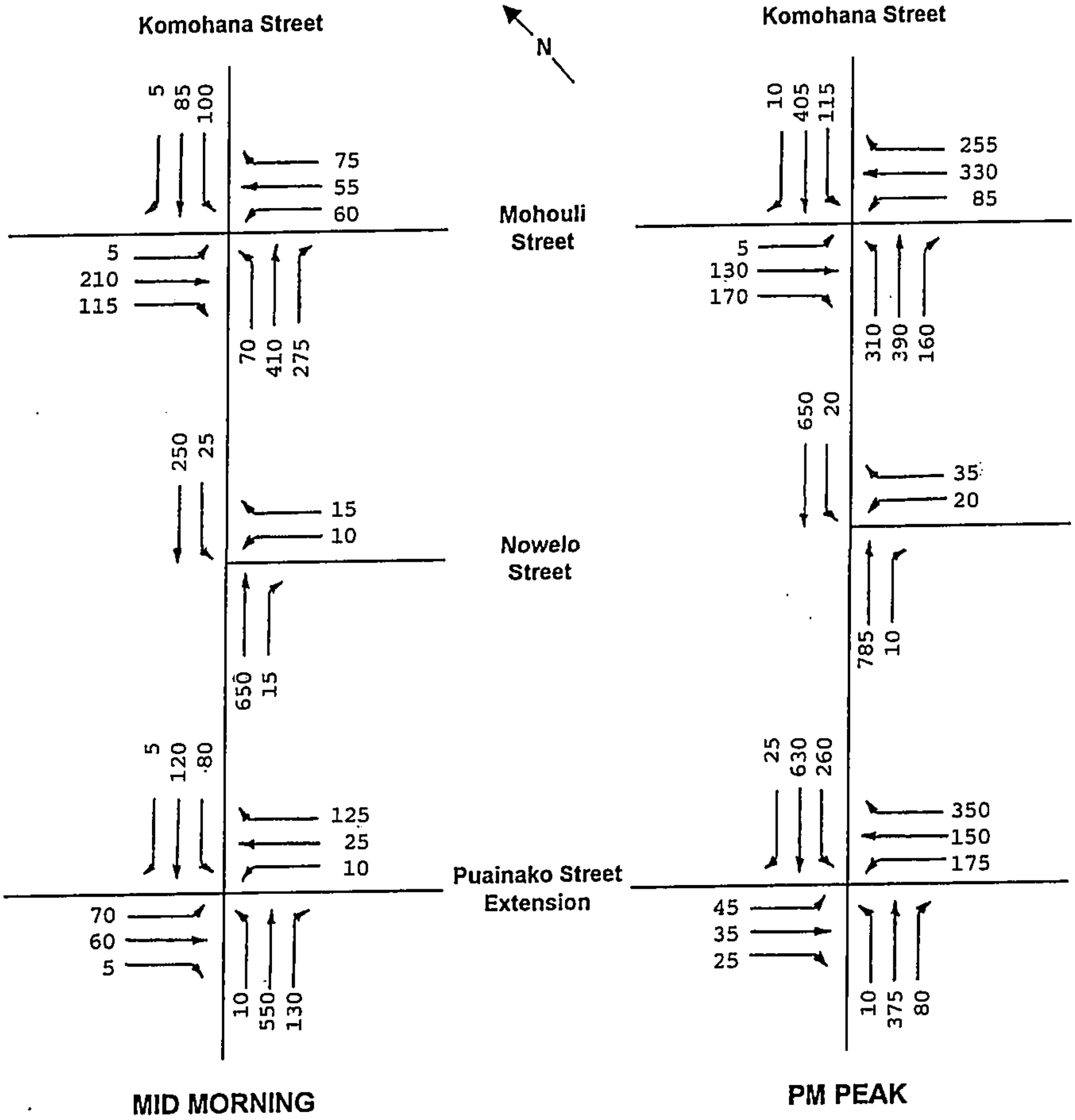


FIGURE 3
2005 TRAFFIC FORECAST
DUE TO GENERAL GROWTH

which would be generated by these three projects were incorporated into the combined ambient forecast.

The "Final Environmental Assessment for the Smithsonian Astrophysical Observatory SMA Hilo Base Facility" only made qualitative remarks on the traffic impacts of the proposed project. Based on the expected 40 employees at this site, a trip generation, distribution and assignment forecast was made for the morning and afternoon peak hours. The morning peak hours volumes were factored by 55 percent to convert it to a mid-morning forecast.

The "Traffic Impact Assessment Report for the U.S. Department of Agriculture Pacific Basin Agricultural Research Center" (draft January 7, 2002) by Phillip Rowell and Associates forecast 124 and 108 trips in the morning and afternoon peak hours, respectively. It shows traffic assignments at the Puainako Street and Nowelo Street intersections of Komohana Street. The project scenario with the access driveway south of Nowelo Street was used for this study. The traffic forecasts were extended to the Mohouli Street intersection based on existing traffic volumes. The morning peak hours volumes were factored by 55 percent to convert it to a mid-morning forecast.

The "Traffic Impact Analysis Report for China-U.S. Center at UH-Hilo" (April 10, 2002) by Phillip Rowell and Associates shows the number of trips which would be added to the Komohana Street/Puainako Street intersection for the morning and afternoon peak hours. The traffic volumes on Komohana Street were extended to the other two study intersections based on existing traffic patterns. The morning peak hour volumes were factored by 55 percent to convert it to a mid-morning forecast.

The mid-morning and afternoon peak hour traffic assignments for these three facilities were then added together to obtain a combined traffic assignment for the proposed projects. These forecast volumes are shown on Figure 4 and are not rounded. The general traffic growth forecast volumes from Figure 3 were added to Figure 4 to obtain the combined ambient without project traffic forecast shown on Figure 5. The traffic volumes are rounded to the nearest five vehicles per hour.

Project Generated Trips

The traditional procedure of trip generation, distribution and assignment was used to estimate the number of vehicle trips which would be generated by the proposed project. The Institute of Transportation Engineers Trip Generation (Sixth Edition, 1997) does not contain any information for land uses similar to the proposed project. Therefore, the expected annual attendance of 250,000 visitors was factored into mid-morning and afternoon peak hourly vehicle trips. The annual visitor forecast was divided by 360 days to obtain a weekday daily value of 695 visitors. Based on the expected 30% student attendance, about 485 non-student and 210 student visitors per weekday were forecast. The daily visitor figure was divided by five (5) hours since most visitors would not be arriving in late afternoon or leaving in mid-morning. The hourly figure of 139 was then used to develop mid-morning and afternoon peak vehicle trips as follows:

- In the mid-morning, it was assumed that there would be 86 students representing two incoming bus loads.
- The remaining 53 were assumed to be non-student visitors arriving in vehicles with an average auto occupancy of two (2). This represents 26 incoming vehicles.
- It was assumed there would also be 10 incoming and 10 outgoing vehicular trips by staff, volunteers and suppliers.
- In the afternoon peak, it was assumed that there would be 42 students representing one outgoing bus load.

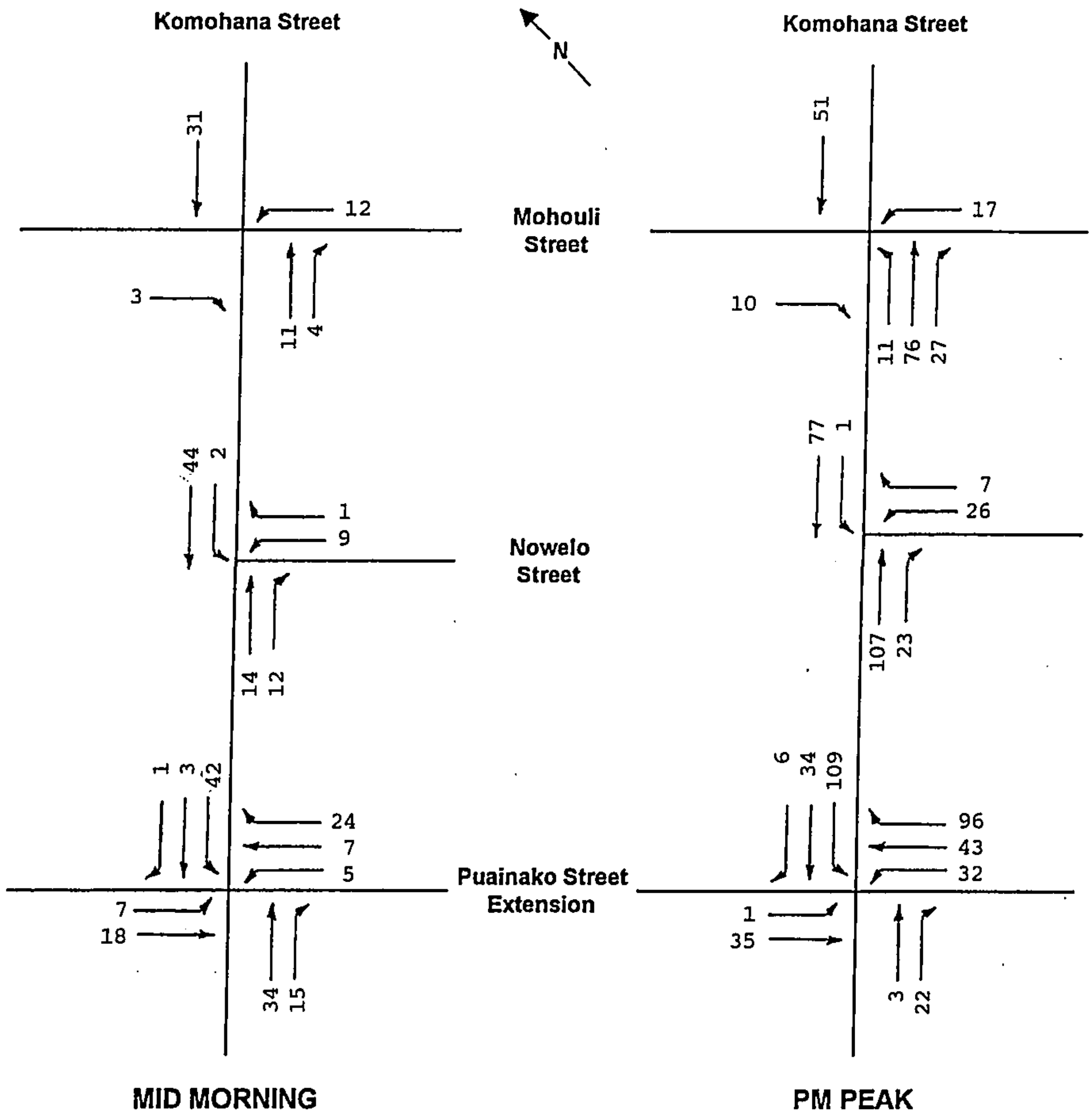


FIGURE 4
COMBINED TRAFFIC ASSIGNMENT FOR THREE PROPOSED LAND USES

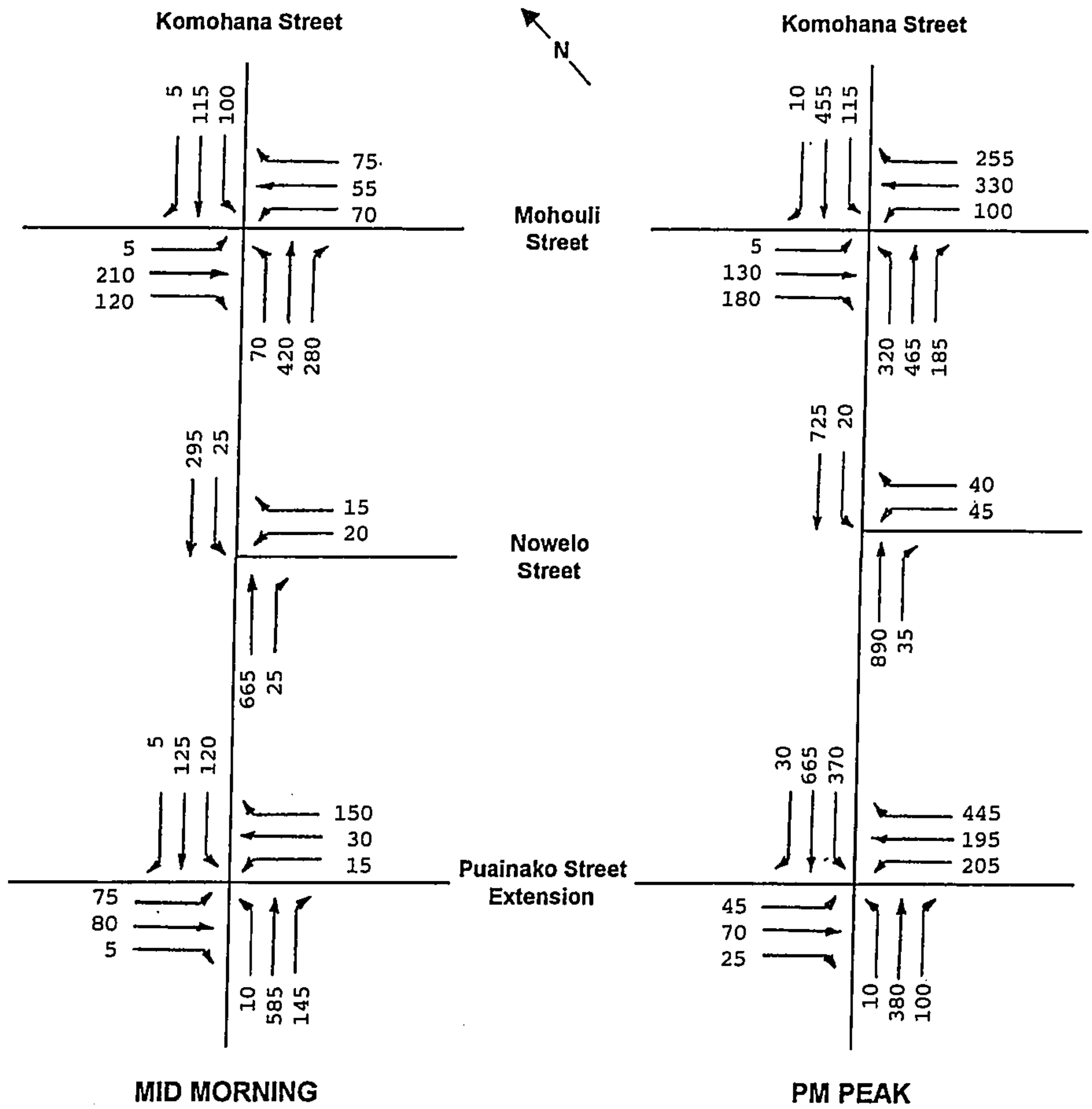


FIGURE 5
COMBINED 2005 AMBIENT TRAFFIC FORECAST WITHOUT PROPOSED PROJECT

- The remaining 97 were assumed to be non-student visitors arriving in vehicles with an average auto occupancy of two (2). This represents 48 outbound vehicles.
- It was assumed there would also be 15 outgoing vehicular trips by staff and volunteers.

In all, there would be 38 incoming and 10 outbound trips in the mid-morning hour and 64 outbound trips in the afternoon peak hour.

The trip distribution step proportions the generated trips to the different directions of travel in the study network. The trip assignment step assigns these distributed trips to specific turning movements at each study intersection. These two steps were combined for this small study network. For the mid-morning hour, the incoming visitor trips were distributed 60% from the south and 40% from the north. Staff-related trips were assumed to equally divided between north and south directions of travel. During the afternoon peak, visitor and staff traffic were distributed two-thirds to the south. At the Puainako Street and Mohouli Street intersections, trips were assigned to the north, south and east directons of travel but not to the new mauka extension roadways. The resultant trip assignment is shown on Figure 6. The traffic assignment volumes are not rounded.

Total Traffic Forecast

The project generated trips from Figure 6 were added to the 2005 ambient traffic forecast volumes on Figure 5 to obtain the 2005 total with project forecast shown on Figure 7. The traffic volumes are rounded to the nearest five vehicles per hour.

TRAFFIC IMPACT ANALYSIS

A level of service analysis was conducted to assess the traffic impacts of the proposed project at the three study intersections. The concept of level of service

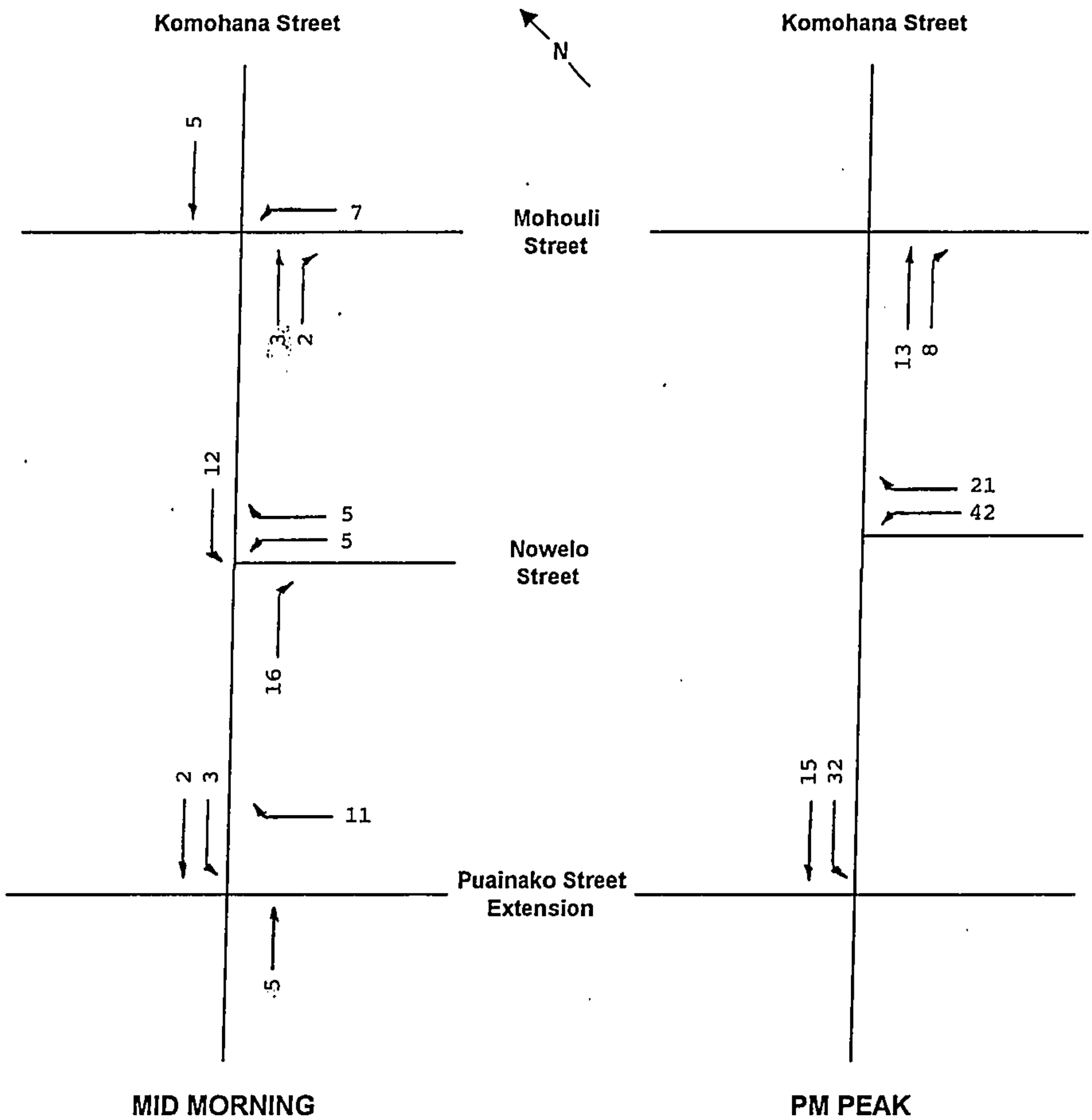


FIGURE 6
PROJECT GENERATED TRAFFIC ASSIGNMENT

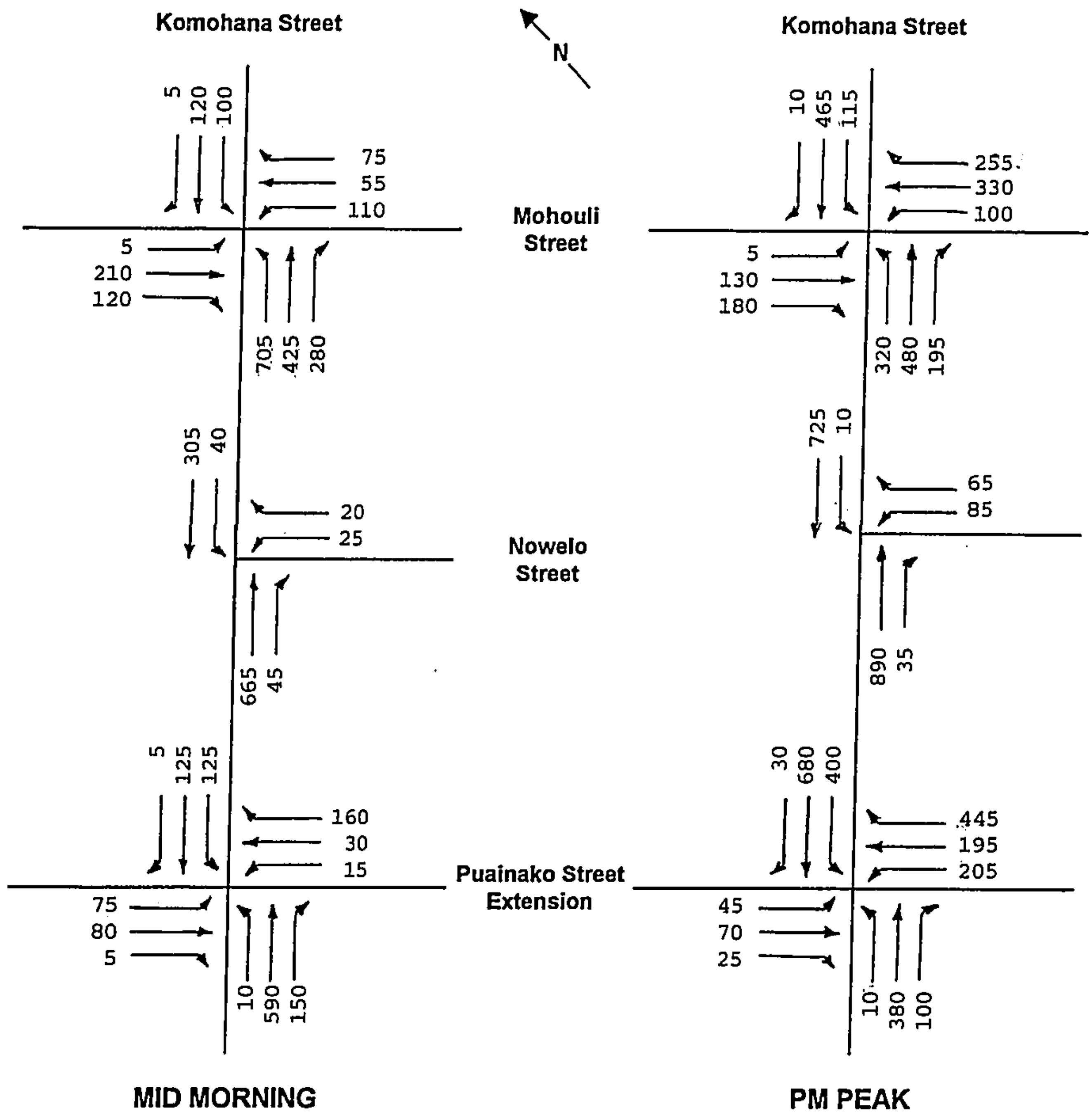


FIGURE 7
TOTAL TRAFFIC FORECAST
WITH PROPOSED PROJECT

is used to quantify the quality of traffic flow on roadway facilities. The Transportation Research Board has developed procedures to calculate level of service value(s) by measuring traffic volumes against the capacities of different types of roadway facilities. Their Highway Capacity Manual, Special Report 209 (Third Edition, 1994) describes the various procedures developed for freeways and ramps, highways, signalized and unsignalized intersections, etc. The procedures used to calculate the levels of service for signalized and unsignalized intersections are summarized in the Appendix.

The procedure used to analyze a signalized intersection calculates levels of service for turning movement lane groups, separate approaches, and the intersection as a whole, based on the average delay. For signalized intersections, levels of service A to C are considered acceptable according to Hawaii County recommendations. Level of service F would indicate the need for mitigating measures.

The procedure used for an unsignalized intersection calculates levels of service on critical turning movements including outbound movements from the stop-controlled approach, and left turns from the main road to the side road. For unsignalized intersections, levels of service A to E are considered acceptable while level of service F is undesirable and would indicate the need for mitigating measures.

The results of the level of service analysis are summarized on Table 1. The table lists unsignalized intersections first, then the signalized intersections. For each of the mid-morning and afternoon peak hours, it shows the levels of service for existing, ambient and total forecast conditions. The Puainako Street intersection shows two level of service values for the signalized intersection analysis, the first for the north (Puainako Street Extension) intersection and the second for the south (Puainako Street) intersection.

TABLE 1

SUMMARY OF LEVEL OF SERVICE ANALYSIS

INTERSECTION AND MOVEMENTS	MID-MORNING HOUR			PM PEAK HOUR		
	Existing	Ambient Without Project	Total With Project	Existing	Ambient Without Project	Total With Project
Unsignalized Intersection Analysis						
Nowelo Street @ Komohana Street						
Nowelo St. left turn	C	C	C	D	F	F
Nowelo St. right turn	A	B	B	B	B	B
Komohana St. SB left turn	A	A	B	A	B	B
Puainako Street @ Komohana Street						
Puainako St.	B	-	-	F	-	-
Komohana St. SB left turn	A	-	-	A	-	-
Signalized Intersection Analysis						
Puainako Street @ Komohana Street	-	B/C	B/C	-	C/D	C/D
Mohouli Street @ Komohana Street	B	B	B	C	D	D

The results show that the mid-morning hour with its lower traffic volumes will not present any traffic operational problems. Levels of service C or better are forecast at all three study intersections, indicating acceptable traffic operations. Therefore, no mitigating actions would be required for the proposed project in the mid-morning period.

However, the higher through traffic volumes on Komohana Street in the afternoon peak hour will affect levels of service. The following paragraphs describe the existing and forecast traffic conditions during the afternoon peak hour at each of the study intersections.

The Nowelo Street intersection is currently unsignalized. The outbound left turn movement is currently operating at level of service D, while the right turn movement is at level of service B. This indicates that there are currently no traffic operations problems at this site, although the outbound left turn movement is minimally acceptable. However, the opening of the Puainako Street Extension, the increased traffic from UHH, and traffic from other proposed projects are forecast to significantly increase the traffic volumes on Komohana Street. This increase in through traffic would cause the level of service on the side street to decrease, even if there were no increase in side street traffic. Left turns from Nowelo Street will face increasingly longer delays in the afternoon peak as evidenced by the progression of level of service from D (existing) to F for ambient without project and total with project forecast conditions. The outbound right turns from Nowelo Street and incoming left turns from Komohana Street are forecast to be at level of service B. This result would indicate the future need for mitigation for the outbound left turn movement by the time the proposed project opens. Traffic signals may be one form of future mitigation as University Park develops. However, traffic signals are installed when certain warrants are met, not just because of a level of service F forecast. Traffic conditions would have to be monitored to determine when traffic signals would be warranted.

There are several factors that make it difficult to determine when traffic mitigation measures would be required. The higher traffic volumes forecast for Komohana Street may not develop if UHH does not develop as forecast. If the access roadway to the U.S. Department of Agriculture project is built directly across Nowelo Street, then the intersection should be signalized. The proposed future widening of Komohana Drive to four lanes at an unknown future date would make the outbound left turn movement more difficult to make in the peak hours and require mitigation. For these reasons, traffic conditions at this intersection should be monitored as this and other projects come on line to determine when mitigation would be required.

The Puainako Street approach to Komohana Street is currently unsignalized and is at level of service F in the afternoon peak period, indicating that vehicles have long delays turning onto Komohana Street. The "Traffic Impact Analysis Report for China-U.S. Center at UH-Hilo" reported that the Puainako Street approach is operating at level of service F in the morning peak hour also. The Puainako Street Extension project currently under construction will mitigate this problem. Intersection levels of service should improve to C and D in the afternoon with the proposed traffic signals. This would indicate that other traffic mitigating actions would not be required at this intersection with the proposed project. The realignment of Puainako Street will also improve future traffic operations by eliminating the offset intersection design.

The mauka extension of Mohouli Street at Komohana Street was recently completed and the intersection signalized. The intersection is currently operating at level of service C in the afternoon peak. It is expected to decrease level of service D for both ambient without project and total with project conditions due to the higher traffic volumes. Although there would be a decrease in the level of service from current levels, level of service D is still considered minimally acceptable and this would indicate that other traffic mitigating actions would not be required at this intersection with the proposed project. As discussed for the Nowelo Street intersection, the higher traffic volumes on Komohana Drive may not develop as quickly as forecast. Traffic conditions would have to be monitored to determine when mitigating measures may be required.

CONCLUSIONS

Komohana Street is forecast to have increases in traffic due to regional growth, new projects in the area, and the future opening of the Puainako Street Extension. Two of the study intersections are not expected to require mitigating measures do to recently completed or forthcoming traffic improvements. The recently installed traffic signals at the Mohouli Street intersection will help maintain acceptable levels of service into the near future. The proposed traffic signals at the new Puainako Street Extension intersection will mitigate an existing problem and help maintain acceptable levels of service into the near future. Traffic conditions at the Nowelo Street intersection would need to be monitored to determine when traffic signals will be required. This could occur several years after the opening of the proposed project.

APPENDIX A

TRAFFIC TURNING MOVEMENT COUNTS

TRAFFIC COUNT DATA

FILE NAME: Mohouli Komohana Sec 3

PROJECT: Puainako Update
LOCATION: Hilo, Hawaii
E-W STREET Mohouli Street
N-S STREET: Komohana Street

PERIOD: AM Peak
NORTH:
TECHNICIAN: Caleb (#69) / Eric
DATE: 4/24/02

			Mohouli Street						Komohana Street						
TIME		EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	TOTAl	HRLY
6:00	6:15	0	27	21	9	4	6	13	75	12	13	29	0	209	
6:15	6:30	0	40	34	8	11	15	19	115	25	19	31	0	317	
6:30	6:45	0	53	34	11	21	16	25	129	32	21	28	2	372	
6:45	7:00	1	69	57	8	14	28	31	139	68	28	41	0	483	1381
7:00	7:15	2	83	50	14	20	36	34	153	93	26	58	1	570	1742
7:15	7:30	0	87	40	31	27	30	30	162	101	45	48	2	603	2028
7:30	7:45	2	113	51	21	28	36	27	149	119	30	42	1	617	2273
7:45	8:00	3	77	39	30	28	34	34	137	78	57	48	1	566	2356
8:00	8:15	2	62	47	24	21	25	18	125	54	34	44	0	458	2242
8:15	8:30	0	49	27	19	26	20	14	85	43	26	48	3	360	1989
AM PEAK HOUR															
7:00	8:00	7	360	180	96	101	136	125	601	391	158	196	5	2356	2356
PHF		0.88	0.80	0.88	1.14	0.97	0.94	1.16	1.01	0.82	1.32	1.17	1.25		
PHF			0.82			1.00			0.95			1.23		0.95 PHF	

TRAFFIC COUNT DATA

FILE NAME: Mohouli Komohana Sec 3

PROJECT: Puainako Update
LOCATION: Hilo, Hawaii
E-W STREET Mohouli Street
N-S STREET Komohana Street

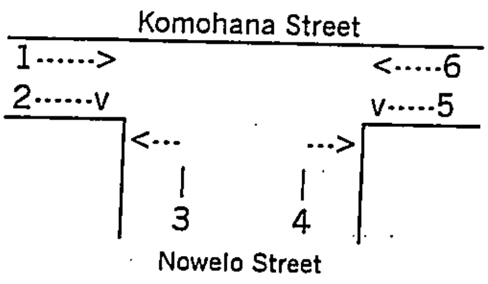
PERIOD: PM Peak
NORTH:
TECHNICIAN: Caleb (#69) / Eric
DATE: 4/23/02

			Mohouli Street						Komohana Street						
TIME		EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	TOTAL	
14:45	15:00	4	37	27	33	46	25	29	85	34	40	78	2	440	
15:00	15:15	0	30	31	48	45	23	26	64	18	30	110	4	429	
15:15	15:30	2	47	33	41	39	19	33	66	32	40	96	2	450	
15:30	15:45	1	48	40	34	61	31	42	75	36	45	92	5	510	1829
15:45	16:00	1	40	40	38	51	27	40	72	34	23	93	2	461	1850
16:00	16:15	2	31	42	32	61	23	47	69	26	33	115	0	481	1902
16:15	16:30	1	30	31	49	60	25	44	41	29	38	99	3	448	1900
16:30	16:45	1	28	39	74	81	13	44	58	30	28	118	2	516	1906
16:45	17:00	0	41	51	64	84	24	55	80	25	34	98	2	556	2001
17:00	17:15	0	33	42	53	81	29	58	57	30	23	125	1	532	2052
17:15	17:30	1	25	35	56	70	12	55	70	21	24	89	3	461	2065
17:30	17:45	1	30	28	39	61	15	53	46	32	19	89	2	415	1964
17:45	18:00	1	40	28	40	56	21	47	70	21	18	88	1	431	1839
PM PEAK HOUR															
16:30	17:30	2	127	167	247	316	78	212	265	106	109	428	8	2066	2065
PHF		1.00	0.77	0.82	0.96	0.94	0.81	0.96	0.83	1.06	0.80	1.11	1.00		
PHF			0.80			0.93			0.91			1.03		0.93 PHF	

Source: The Traffic Management Consultant

TRAFFIC TURNING MOVEMENT COUNT
Mauna Kea Astronomy Education Center

LOCATION: Komohana Street / Nowelo Street
DATE: Monday, May 20, 2002
TIME: 9:00 a.m.-11:00 a.m. / 3:30 p.m.-5:30 p.m.
WEATHER: Sun / Rain
RECORDER: Carole Darby



TIME PERIOD	MOVEMENT NUMBER 1	2	3	4	5	6	TOTAL
9:00a - 9:15a	126	9	0	2	10	63	210
9:15a - 9:30a	92	1	3	5	2	69	172
9:30a - 9:45a	114	2	4	3	5	83	211
9:45a - 10:00a	118	5	4	5	7	88	227
10:00a - 10:15a	89	7	5	5	2	74	182
10:15a - 10:30a	86	2	5	0	1	75	169
10:30a - 10:45a	111	5	7	2	2	82	209
10:45a - 11:00a	100	2	8	5	4	85	204
9:00a - 11:00a	836	33	36	27	33	619	1584
9:00a - 10:00a	450	17	11	15	24	303	820
3:30p - 3:45p	130	2	6	10	2	163	313
3:45p - 4:00p	175	2	6	7	3	156	349
4:00p - 4:15p	125	4	3	8	8	173	321
4:15p - 4:30p	134	3	5	10	6	193	351
4:30p - 4:45p	124	1	17	12	3	243	400
4:45p - 5:00p	129	2	5	13	8	210	367
5:00p - 5:15p	121	1	9	15	4	240	390
5:15p - 5:30p	112	2	5	10	2	171	302
3:30p - 5:30p	1050	17	56	85	36	1549	2793
4:15p - 5:15p	508	11	20	35	19	685	1278

APPENDIX B

ABSTRACT OF METHODOLOGY
FOR THE CAPACITY ANALYSIS FOR
SIGNALIZED AND UNSIGNALIZED INTERSECTIONS

ABSTRACT OF METHODOLOGY FOR THE CAPACITY ANALYSIS FOR SIGNALIZED INTERSECTIONS

ABSTRACT OF METHODOLOGY
for the
LEVEL OF SERVICE ANALYSIS OF SIGNALIZED INTERSECTIONS

A very complex methodology is used to determine the capacity and level of service of signalized signals. The procedure is divided into the five modules shown on Figure 9-3. The input data required for the analysis is shown on Figure 9-4. The level of service criteria is shown below:

LEVEL OF SERVICE (LOS)
CRITERIA FOR SIGNALIZED INTERSECTIONS

Level of Service	Stopped Delay Per Vehicle (Seconds)
A	$\leq$ 5.0
B	5.1 to 15.0
C	15.1 to 25.0
D	25.1 to 40.0
E	40.1 to 60.0
F	$\geq$ 60.0

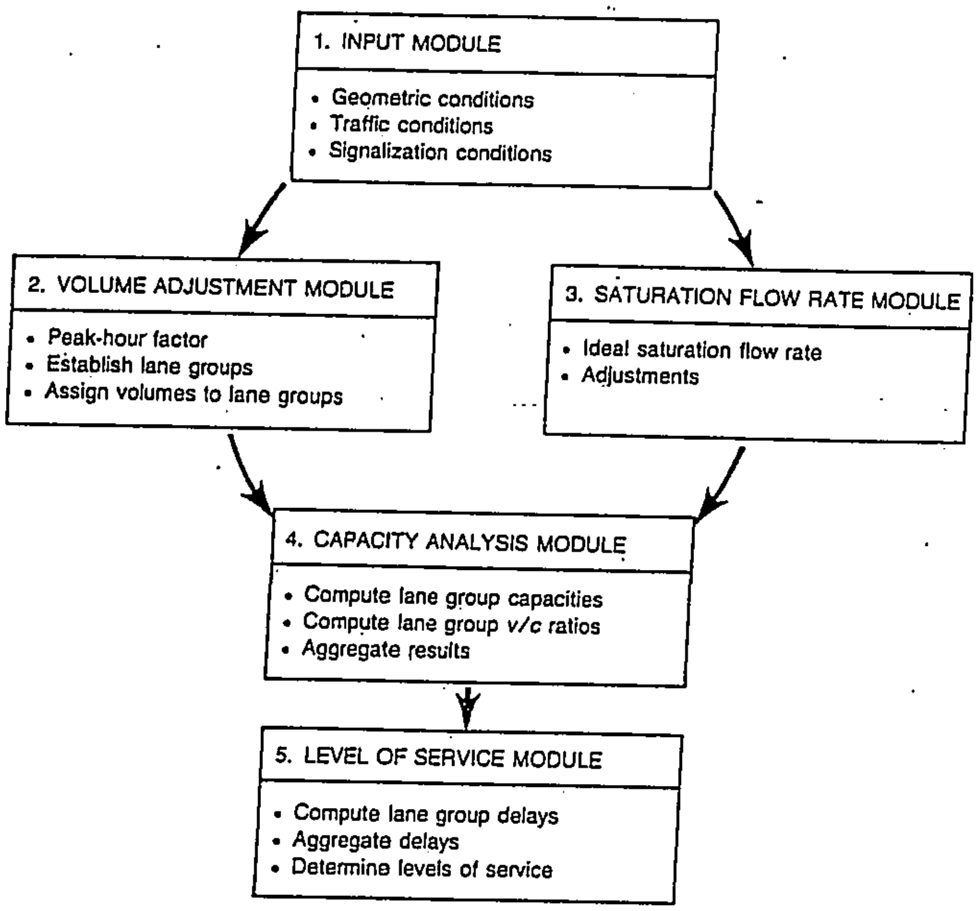


Figure 9-3. Operational analysis procedure.

TYPE OF CONDITION	PARAMETER	SYMBOL
Geometric conditions	Area Type	CBD, Other
	Number of Lanes	N
	Average Lane Widths, ft.	W
	Grades, %	%G
	Existence of Exclusive LT or RT Lanes	None
	Length of Storage Bay, LT or RT Lane	L_s
	Parking Conditions	Yes, No
Traffic conditions	Volumes by Movement, vph	V
	Ideal Saturation Flow Rate by Mov't, pcphgpl	s_o
	Peak Hour Factor	PHF
	Percent Heavy Vehicles	%HV
	Conflicting Pedestrian Flow Rate, peds/hr	PEDS
	Local Buses Stopping in Intersection	N_B
	Parking Activity, pkg maneuvers/hr	N_m
	Arrival Type (1-6)	AT
	Proportion of Vehicles Arriving on Green	P
Signalization conditions	Cycle Length, sec	C
	Green Time, sec	G
	Yellow change interval	Y
	All-red clearance interval	AR
	Actuated or Pretimed Operation	A or P
	Pedestrian Push-Button?	Yes, No
	Minimum Pedestrian Green	G_p
	Phase Plan	None

Figure 9-4. Input data needs for each analysis lane group.

ABSTRACT OF METHODOLOGY FOR THE CAPACITY ANALYSIS FOR UNSIGNALIZED INTERSECTIONS

ABSTRACT OF METHODOLOGY
for the
LEVEL OF SERVICE ANALYSIS OF UNSIGNALIZED INTERSECTIONS

This abstract summarizes the procedures for analyzing the capacities of unsignalized intersections. These procedures are described in the Highway Capacity Manual, Special Report 209 (Third Edition, 1994) by the Transportation Research Board (TRB). This manual "is a collection of techniques for estimating highway capacity that have been judged, through consensus, as the best available at the time of publication." This manual does not set legal standards for highway design but the procedures have become widely accepted and used in the traffic engineering profession.

The capacity analysis procedure is based on a German method originally published in 1972 and translated in 1974, and modified for U. S. conditions by the TRB in 1985, and new data reflected in 1994. It is intended for two-way STOP- and YIELD-controlled intersection and calculates the capacities of movements which cross or turn through the major traffic stream. The capacity of each movement is based on two factors: the gap distribution in conflicting traffic streams and the gap acceptance behavior of drivers at such intersections.

The basic steps in methodology are as follows:

1) Define intersection geometry and traffic volumes.

2) Determine the "conflicting conflicts" through which every minor street movement and major street left turn must cross.

3) Determine the size of the gap in the conflicting stream needed by vehicles in each movement crossing a conflicting traffic stream.

4) Determine the capacity of the gaps in the major traffic stream to accommodate each of the subject movements that will utilize these gaps.

5) Adjust the capacities to account for impedance and the use of shared lanes.

6) Estimate average delay and determine level of service for each movement.

Tables and charts, as well as computer programs, have been developed to facilitate using this methodology.

INTERSECTION DATA

Key geometric factors include: number and use of lanes, channelization, percent grade, curb radii and approach angle, and sight distances. One hour volumes are specified by movement and converted to passenger cars per hour using the passenger car equivalents in TABLE 10-1.

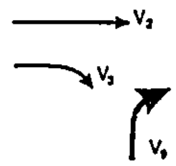
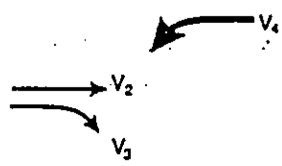
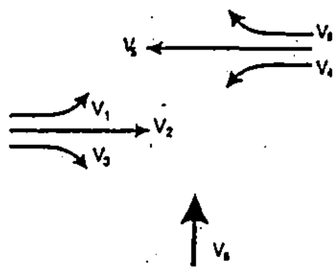
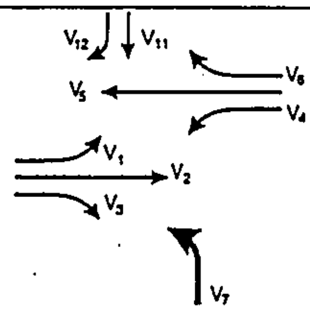
TABLE 10-1. PASSENGER-CAR EQUIVALENTS FOR TWSC INTERSECTIONS

	GRADE (%)				
TYPE OF VEHICLE	−4	−2	0	+2	+4
Motorcycles	0.3	0.4	0.5	0.6	0.7
Passenger Cars	0.8	0.9	1.0	1.2	1.4
SU/RVs[a]	1.0	1.2	1.5	2.0	3.0
Combination Vehicles[b]	1.2	1.5	2.0	3.0	6.0
All Vehicles[c]	0.9	1.0	1.1	1.4	1.7

[a] Single-unit trucks and recreational vehicles.
[b] Includes tractor-trailer combinations and buses.
[c] If vehicle composition is unknown, these values may be used as an approximation.

CONFLICTING TRAFFIC

The conflicting movements and turning movement faces is summarized on Figures 10-3(a) and 10-3(b). The right turn movement from the minor street faces the least number of conflicting movements, the left turn movement from the minor street the most.

Subject Movement	Conflicting Traffic, $V_{c,x}$	Illustration
1. RIGHT TURN from minor street ($V_{c,9}$)	$1/2(V_3)^{(1)} + V_2^{(2)}$	
2. LEFT TURN from major street ($V_{c,4}$)	$V_2 + V_3^{(1)}$	
3. THROUGH MOVEMENT from minor street ($V_{c,8}$)	$1/2(V_3)^{(1)} + V_2 + V_1 + V_6^{(3)} + V_5 + V_4$	
4. LEFT TURN from minor street ($V_{c,7}$)	$1/2(V_3)^{(1)} + V_2 + V_1 + 1/2(V_6)^{(5)} + V_5 + V_4 + 1/2(V_{11} + V_{12}^{(4)})$	

① Where a right-turn lane is provided on major street, and/or where V_3 is STOP-/YIELD-controlled, eliminate V_3

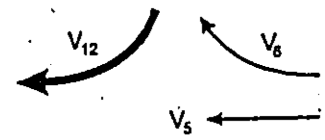
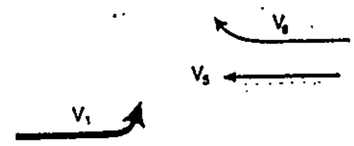
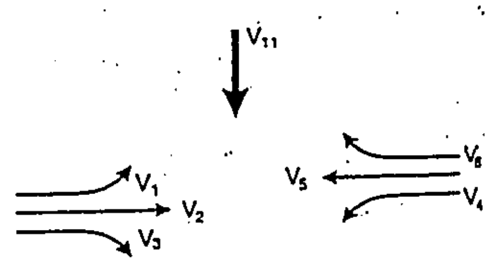
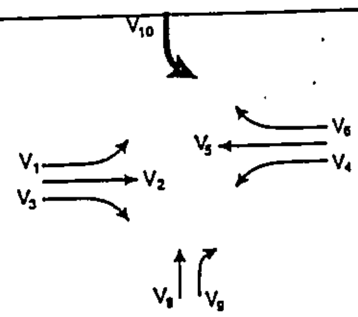
② V_2 includes only the volume in the right hand lane.

③ Where the right-turn is STOP- or YIELD-controlled, eliminate V_3, V_6

④ V_{12} should be eliminated on multi-lane major streets.

⑤ Where a right-turn lane is provided on major street, and/or where V_6 is STOP-/YIELD-controlled, and/or on multi-lane major streets, eliminate V_6

Figure 10-3(a). Definition and computation of conflicting traffic volumes for two minor approaches.

Subject Movement	Conflicting Traffic, $V_{c,x}$	Illustration
5. RIGHT TURN from minor street ($V_{c,12}$)	$1/2(V_6)^{⑥}+V_5^{⑦}$	
6. LEFT TURN from major street ($V_{c,1}$)	$V_5 + V_6^{⑥}$	
7. THROUGH MOVEMENT from minor street ($V_{c,11}$)	$1/2(V_6)^{⑥} + V_5 + V_4 + V_3^{⑩} + V_2 + V_1$	
8. LEFT TURN from minor street ($V_{c,10}$)	$1/2(V_6)^{⑧} + V_5 + V_4 + 1/2(V_3)^{⑧} + V_2 + V_1 + 1/2(V_8 + V_9^{⑨})$	

⑥ Where a right-turn lane is provided on major street, and/or where V_6 is STOP-/YIELD-controlled, eliminate V_6

⑦ V_5 includes only the volume in the right hand lane.

⑧ Where the right-turn is STOP- or YIELD-controlled, eliminate V_6, V_3

⑨ V_9 should be eliminated on multi-lane major streets.

⑩ Where a right-turn lane is provided on major street, and/or where V_3 is STOP-/YIELD-controlled, and/or multi-lane streets, eliminate V_3

Figure 10-3(b). Definition and computation of conflicting traffic volumes for two minor approaches.

CRITICAL GAP SIZE

"The 'critical gap' is defined as the median time headway between two successive vehicles in the major traffic stream that is accepted by drivers in a subject movement that must cross and/or emerge with the major street traffic." It is dependent upon a number of factors, including:

1) The type of maneuver being executed.
2) STOP or YIELD sign control.
3) The average running speed on the major street.
4) The number of lanes on the major street.
5) The geometrics and environmental conditions at the intersection.

The value of the critical gap is selected from TABLE 10-2. The basic critical gap is selected and adjustments and modifications made.

TABLE 10-2. CRITICAL GAPS t_c AND FOLLOW-UP TIMES t_f FOR TWSC INTERSECTIONS

	CRITICAL GAP t_c		
VEHICLE MANEUVER	TWO-LANE MAJOR ROAD	FOUR-LANE MAJOR ROAD	FOLLOW-UP TIME t_f (SEC)
Left turn, major street	5.0	5.5	2.1
Right turn, minor street	5.5	5.5	2.6
Through traffic, minor street	6.0	6.5	3.3
Left turn, minor street	6.5	7.0	3.4

NOTE: The critical gap and follow-up time values presented in this table reflect data obtained on roadways where the average approach speed of the major street through vehicles approximated 30 mph. In cases where no better data are available, these same values may be used to approximate t_c and t_f for roadways with approach speeds other than 30 mph.

POTENTIAL CAPACITY FOR MOVEMENT

"The potential capacity is defined as the 'ideal' capacity for a specific movement," and is selected from Figures 10-4 and 10-5. It is based on the conflicting traffic volume and movement type. The result is read in passenger cars per hour.

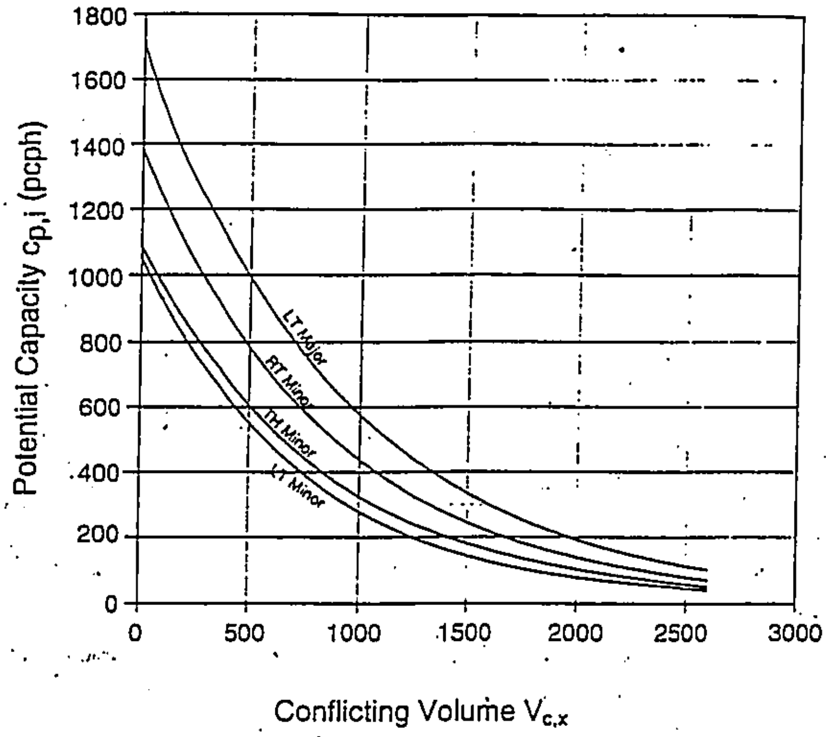


Figure 10-4. Potential capacity based on conflicting volume and movement type (two-lane roadways).

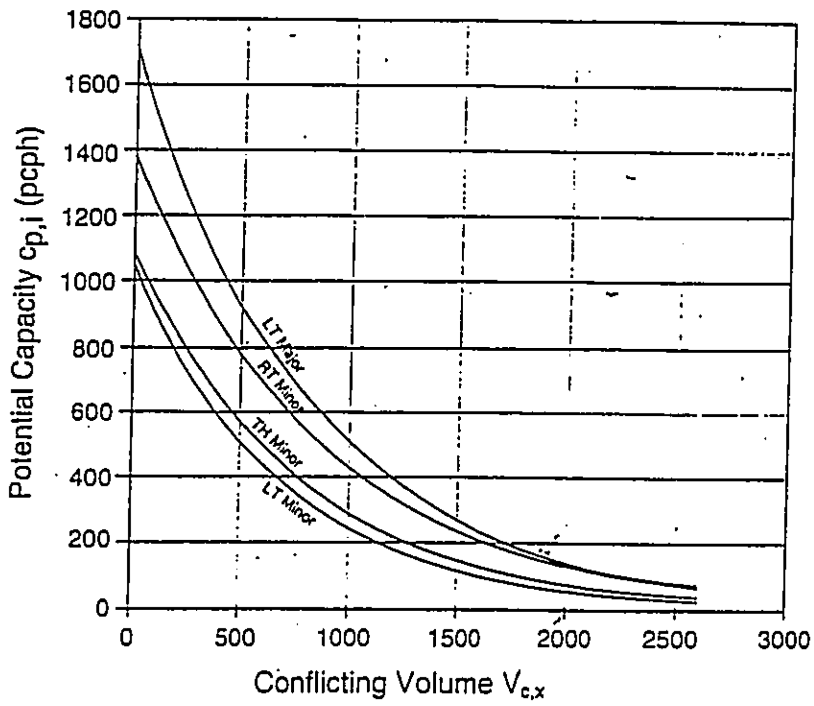


Figure 10-5. Potential capacity based on conflicting volume and movement type (four-lane roadways).

IMPEDANCE EFFECTS

The methodology assumes that vehicles use gaps at an unsignalized intersection in a prioritized manner. Thus, when traffic becomes congested in a high-priority movement, it can reduce the potential capacity of lower priority traffic movements. Given the priority of gap usage:

1) Left turn from the major street impede both through movements and left turns from the minor street.

2) Through movements from the minor streets impede left turns from the minor street.

The impact of impedance is addressed by multiplying the potential capacity of a movement by a series of impedance factors for each higher priority impeding movement. *Impedance factors are derived using Figure 10-6.*

SHARED LANE CAPACITY

The methodology has assumed to this point that each minor street movements has an exclusive lane. In reality, most minor street approaches have two or three movements sharing one lane. An equations used to compute the capacity of the shared lane.

LEVEL OF SERVICE CRITERIA

The above computations yield a capacity solution for each lane in the minor street approaches and for left turn movements from the major streets. The movement capacity and conflicting volumes for each movement are used to calculate the average total delay (seconds/vehicle) per Figure 10-7.

The level of service based on the average total delay is summarized on Table 10-3.

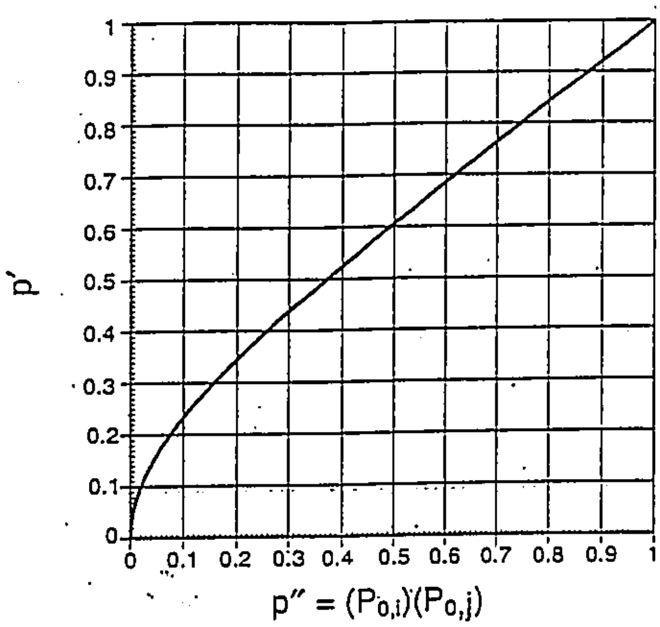


Figure 10-6. Adjustment to the major left, minor through impedance factor (2).

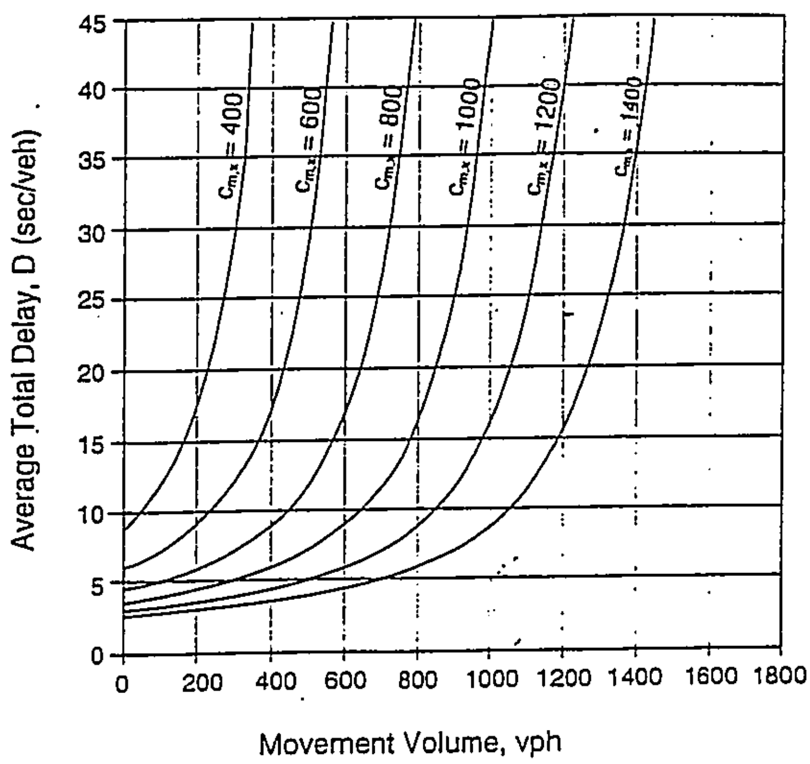


Figure 10-7. Average total delay based on conflicting volume and movement capacity (15-min analysis period).

TABLE 3 - LEVEL OF SERVICE CRITERIA

Level of Service	Average Total Delay (Seconds/Vehicle)
A	≤ 5
B	5.1 to 10.0
C	10.1 to 20.0
D	20.1 to 30.0
E	30.1 to 45.0
F	> 45

APPENDIX C

TRAFFIC CALCULATIONS

SIGNALIZED AND UNSIGNALIZED INTERSECTION LEVEL OF SERVICE (LOS) CALCULATIONS

TRAFFIC CALCULATIONS

SIGNALIZED INTERSECTION
LEVEL OF SERVICE (LOS) CALCULATIONS

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4f 06-23-2002
Center For Microcomputers In Transportation

Streets: (E-W) puainako extension (N-S) komohana st
Analyst: Wy File Name: KOPUAMAM.HC9
Area Type: Other 5-22-2 am peak
Comment: ambient am peak, north intersection

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
No. Lanes	1	0	1	0	0	0	1	1	0	0	2	1
Volumes	75		85				40	750			250	5
Lane W (ft)	12.0		12.0				12.0	12.0			12.0	12.0
RTOR Vols			15						0			0
Lost Time	3.00		3.00				3.00	3.00			3.00	3.00

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left	*				NB Left	*	*		
Thru					Thru	*	*		
Right	*				Right				
Peds					Peds				
WB Left					SB Left				
Thru					Thru	*			
Right					Right	*			
Peds					Peds	*			
NB Right					EB Right				
SB Right					WB Right				
Green	33.0P				Green	31.0P	44.0P		
Yellow/AR	4.0				Yellow/AR	4.0	4.0		

Cycle Length: 120 secs Phase combination order: #1 #5 #6

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
EB	L	501	1770	0.158	0.283	24.5	C	24.5	C
	R	449	1583	0.163	0.283	24.6	C		
NB	L	927	1770	0.045	0.667	6.5	B	9.4	B
	T	1242	1863	0.635	0.667	9.6	B		
SB	T	993	3725	0.278	0.267	26.5	D	26.5	D
	R	422	1583	0.012	0.267	24.6	C		

Intersection Delay = 15.0 sec/veh Intersection LOS = B
Lost Time/Cycle, L = 6.0 sec Critical v/c(x) = 0.494

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4f 06-23-2002
Center For Microcomputers In Transportation

Streets: (E-W) puainako extension (N-S) komohana st
Analyst: Wy File Name: KOPSAMAM.HC9
Area Type: Other 6-21-2 am peak
Comment: ambient am peak, south intersection

	Eastbound L	T	R	Westbound L	T	R	Northbound L	T	R	Southbound L	T	R
No. Lanes	0	0	0	1	0	1	0	1	1	1	1	0
Volumes				15		190		600	150	205	130	
Lane W (ft)				12.0		12.0		12.0	12.0	12.0	12.0	
RTOR Vols						20			30			0
Lost Time				3.00		3.00		3.00	3.00	3.00	3.00	

Signal Operations

Phase Combination	1	2	3	4		5	6	7	8
EB Left					NB Left				
Thru					Thru		*		
Right					Right		*		
Peds					Peds				
WB Left	*				SB Left	*	*		
Thru					Thru	*	*		
Right	*				Right				
Peds					Peds				
NB Right					EB Right				
SB Right					WB Right				
Green	28.0P				Green	28.0P	52.0P		
Yellow/AR	4.0				Yellow/AR	4.0	4.0		

Cycle Length: 120 secs Phase combination order: #1 #5 #6

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
WB	L	428	1770	0.037	0.242	26.5	D	29.9	D
	R	383	1583	0.468	0.242	30.2	D		
NB	T	823	1863	0.768	0.442	24.6	C	23.1	C
	R	699	1583	0.180	0.442	15.5	C		
SB	L	490	1770	0.441	0.708	18.3	C	12.8	B
	T	1319	1863	0.104	0.708	4.2	A		

Intersection Delay = 21.3 sec/veh Intersection LOS = C
Lost Time/Cycle, L = 9.0 sec Critical v/c(x) = 0.621

```
HCM: SIGNALIZED INTERSECTION SUMMARY   Version 2.4f        06-23-2002
                  Center For Microcomputers In Transportation
=======================================================================
Streets: (E-W) puainako extension        (N-S) komohana st
Analyst: Wy                              File Name: KOPUTOAM.HC9
Area Type: Other                         6-21-2 am peak
Comment: total forecast am peak, north intersection
=======================================================================
              |  Eastbound    |  Westbound    |  Northbound   |  Southbound   |
              | L    T    R   | L    T    R   | L    T    R   | L    T    R   |
              | ---- ---- ----| ---- ---- ----| ---- ---- ----| ---- ---- ----|
No. Lanes     | 1    0    1   | 0    0    0   | 1    1    0   | 0    2    1
Volumes       | 75        85  |               | 40   750      |      250    5
Lane W (ft)   |12.0      12.0 |               |12.0 12.0      |     12.0 12.0
RTOR Vols     |           15  |               |           0   |            0
Lost Time     |3.00      3.00 |               |3.00 3.00      |     3.00 3.00
-----------------------------------------------------------------------
                            Signal Operations
Phase Combination 1    2    3    4  |         5    6    7    8
EB  Left          *                 | NB Left  *    *
    Thru                            |    Thru  *    *
    Right         *                 |    Right
    Peds                            |    Peds
WB  Left                            | SB Left
    Thru                            |    Thru  *
    Right                           |    Right *
    Peds                            |    Peds  *
NB  Right                           | EB Right
SB  Right                           | WB Right
Green           33.0P               | Green    31.0P 44.0P
Yellow/AR        4.0                | Yellow/AR 4.0  4.0
Cycle Length: 120 secs  Phase combination order: #1 #5 #6
-----------------------------------------------------------------------
                  Intersection Performance Summary
      Lane   Group:  Adj Sat   v/c     g/C                  Approach:
      Mvmts   Cap     Flow     Ratio   Ratio   Delay  LOS   Delay  LOS
      -----  ----   -------   -----   -----   -----  ---   -----  ---
EB    L       501    1770     0.158   0.283    24.5   C     24.5   C
      R       449    1583     0.163   0.283    24.6   C
NB    L       927    1770     0.045   0.667     6.5   B      9.4   B
      T      1242    1863     0.635   0.667     9.6   B
SB    T       993    3725     0.278   0.267    26.5   D     26.5   D
      R       422    1583     0.012   0.267    24.6   C
            Intersection Delay =  15.0 sec/veh Intersection LOS = B
Lost Time/Cycle, L =   6.0 sec   Critical v/c(x)     = 0.494
-----------------------------------------------------------------------
```

2.

```
HCM: SIGNALIZED INTERSECTION SUMMARY   Version 2.4f        06-23-2002
                  Center For Microcomputers In Transportation
=======================================================================
Streets: (E-W) puainako extension        (N-S) komohana st
Analyst: Wy                              File Name: KOPSTOAM.HC9
Area Type: Other                         6-21-2 am peak
Comment: total forecast am peak, south intersection
=======================================================================
              |  Eastbound    |  Westbound    |  Northbound   |  Southbound   |
              | L    T    R   | L    T    R   | L    T    R   | L    T    R   |
              | ---- ---- ----| ---- ---- ----| ---- ---- ----| ---- ---- ----|
No. Lanes     | 0    0    0   | 1    0    1   | 0    1    1   | 1    1    0
Volumes       |               | 15        190 |      600  150 | 205  130
Lane W (ft)   |               |12.0      12.0 |     12.0 12.0 |12.0 12.0
RTOR Vols     |               |            20 |            30 |            0
Lost Time     |               |3.00      3.00 |     3.00 3.00 |3.00 3.00
-----------------------------------------------------------------------
                            Signal Operations
Phase Combination 1    2    3    4  |         5    6    7    8
EB  Left                            | NB Left
    Thru                            |    Thru       *
    Right                           |    Right      *
    Peds                            |    Peds
WB  Left          *                 | SB Left  *    *
    Thru                            |    Thru  *    *
    Right         *                 |    Right
    Peds                            |    Peds
NB  Right                           | EB Right
SB  Right                           | WB Right
Green           28.0P               | Green    28.0P 52.0P
Yellow/AR        4.0                | Yellow/AR 4.0  4.0
Cycle Length: 120 secs  Phase combination order: #1 #5 #6
-----------------------------------------------------------------------
                  Intersection Performance Summary
      Lane   Group:  Adj Sat   v/c     g/C                  Approach:
      Mvmts   Cap     Flow     Ratio   Ratio   Delay  LOS   Delay  LOS
      -----  ----   -------   -----   -----   -----  ---   -----  ---
WB    L       428    1770     0.037   0.242    26.5   D     29.9   D
      R       383    1583     0.468   0.242    30.2   D
NB    T       823    1863     0.768   0.442    24.6   C     23.1   C
      R       699    1583     0.180   0.442    15.5   C
SB    L       490    1770     0.441   0.708    18.3   C     12.8   B
      T      1319    1863     0.104   0.708     4.2   A
            Intersection Delay =  21.3 sec/veh Intersection LOS = C
Lost Time/Cycle, L =   9.0 sec   Critical v/c(x)     = 0.621
-----------------------------------------------------------------------
```

```
HCM: SIGNALIZED INTERSECTION SUMMARY   Version 2.4f        06-24-2002
                Center For Microcomputers In Transportation
=======================================================================
Streets: (E-W) puainako extension      (N-S) komohana st
Analyst: Wy                            File Name: KOPUAMPM.HC9
Area Type: Other                       6-21-2 am peak
Comment: ambient pm peak, north intersection
=======================================================================
            |  Eastbound     |  Westbound     |  Northbound    |  Southbound    |
            |  L    T    R   |  L    T    R   |  L    T    R   |  L    T    R   |
            | ---- ---- ---- | ---- ---- ---- | ---- ---- ---- | ---- ---- ---- |
No. Lanes   |  1    0    1   |  0    0    0   |  1    1    0   |  0    2    1   |
Volumes     |  45        95  |                |  205  825      |      1035   30 |
Lane W (ft) |12.0       12.0 |                |12.0 12.0       |      12.0 12.0 |
RTOR Vols   |            15  |                |             0  |              5 |
Lost Time   |3.00       3.00 |                |3.00 3.00       |      3.00 3.00 |
-----------------------------------------------------------------------
                          Signal Operations
Phase Combination 1    2    3    4  |           5    6    7    8
EB  Left          *                 | NB  Left  *    *
    Thru                            |     Thru  *    *
    Right         *                 |     Right
    Peds                            |     Peds
WB  Left                            | SB  Left
    Thru                            |     Thru       *
    Right                           |     Right      *
    Peds                            |     Peds
NB  Right                           | EB  Right
SB  Right                           | WB  Right
Green            38.0P              | Green     29.0P 41.0P
Yellow/AR         4.0               | Yellow/AR 4.0   4.0
Cycle Length: 120 secs  Phase combination order: #1 #5 #6
-----------------------------------------------------------------------
                 Intersection Performance Summary
      Lane    Group:   Adj Sat    v/c     g/C                  Approach:
      Mvmts    Cap      Flow     Ratio   Ratio   Delay  LOS   Delay  LOS
      -----    ----    -------   -----   -----   -----  ---   -----  ---
EB    L        575      1770     0.082   0.325   21.3    C    21.7    C
      R        515      1583     0.163   0.325   22.0    C
NB    L        505      1770     0.428   0.625   16.6    C    14.4    B
      T       1164      1863     0.746   0.625   13.9    B
SB    T       1304      3725     0.877   0.350   32.8    D    32.5    D
      R        554      1583     0.049   0.350   19.6    C
                 Intersection Delay = 23.7 sec/veh Intersection LOS = C
Lost Time/Cycle, L =   6.0 sec    Critical v/c(x)    = 0.546
-----------------------------------------------------------------------
```

3.

```
HCM: SIGNALIZED INTERSECTION SUMMARY   Version 2.4f        06-24-2002
                Center For Microcomputers In Transportation
=======================================================================
Streets: (E-W) puainako extension      (N-S) komohana st
Analyst: Wy                            File Name: KOPSAMPM.HC9
Area Type: Other                       6-21-2 am peak
Comment: ambient pm peak, south intersection
=======================================================================
            |  Eastbound     |  Westbound     |  Northbound    |  Southbound    |
            |  L    T    R   |  L    T    R   |  L    T    R   |  L    T    R   |
            | ---- ---- ---- | ---- ---- ---- | ---- ---- ---- | ---- ---- ---- |
No. Lanes   |  0    0    0   |  1    0    1   |  0    1    1   |  1    1    0   |
Volumes     |                |  205      640  |      390  100  |  420  690      |
Lane W (ft) |                |12.0       12.0 |      12.0 12.0 |12.0 12.0       |
RTOR Vols   |                |           100  |            30  |             0  |
Lost Time   |                |3.00       3.00 |      3.00 3.00 |3.00 3.00       |
-----------------------------------------------------------------------
                          Signal Operations
Phase Combination 1    2    3    4  |           5    6    7    8
EB  Left                            | NB  Left
    Thru                            |     Thru       *
    Right                           |     Right      *
    Peds                            |     Peds
WB  Left          *                 | SB  Left  *    *
    Thru                            |     Thru  *    *
    Right         *                 |     Right
    Peds                            |     Peds
NB  Right                           | EB  Right
SB  Right                           | WB  Right
Green            42.0A              | Green     34.0A 32.0A
Yellow/AR         4.0               | Yellow/AR 4.0   4.0
Cycle Length: 120 secs  Phase combination order: #1 #5 #6
-----------------------------------------------------------------------
                 Intersection Performance Summary
      Lane    Group:   Adj Sat    v/c     g/C                  Approach:
      Mvmts    Cap      Flow     Ratio   Ratio   Delay  LOS   Delay  LOS
      -----    ----    -------   -----   -----   -----  ---   -----  ---
WB    L        634      1770     0.341   0.358   18.3    C    44.6    E
      R        567      1583     1.003   0.358   54.6    E
NB    T        512      1863     0.802   0.275   32.3    D    30.7    D
      R        435      1583     0.168   0.275   21.4    C
SB    L        578      1770     0.765   0.592   22.9    C    15.9    C
      T       1102      1863     0.659   0.592   11.6    B
                 Intersection Delay = 28.1 sec/veh Intersection LOS = D
Lost Time/Cycle, L =   9.0 sec    Critical v/c(x)    = 0.897
-----------------------------------------------------------------------
```

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4f 06-24-2002
Center For Microcomputers In Transportation

Streets: (E-W) puainako extension (N-S) komohana st
Analyst: Wy File Name: KOPUTOPM.HC9
Area Type: Other 6-21-2 am peak
Comment: total forecast pm peak, north intersection

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	1	0	1	0	0	0	1	1	0	0	2	1
Volumes	45		95				205	825			1080	30
Lane W (ft)	12.0		12.0				12.0	12.0			12.0	12.0
RTOR Vols			15						0			5
Lost Time	3.00		3.00				3.00	3.00			3.00	3.00

Signal Operations

Phase Combination	1	2	3	4
EB Left	*			
Thru				
Right	*			
Peds				
WB Left				
Thru				
Right				
Peds				
NB Right				
SB Right				
Green	38.0P			
Yellow/AR	4.0			

	5	6	7	8
NB Left	*	*		
Thru	*	*		
Right				
Peds				
SB Left				
Thru		*		
Right		*		
Peds				
EB Right				
WB Right				
Green	27.0P	43.0P		
Yellow/AR	4.0	4.0		

Cycle Length: 120 secs Phase combination order: #1 #5 #6

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
EB	L	575	1770	0.082	0.325	21.3	C	21.7	C
	R	515	1583	0.163	0.325	22.0	C		
NB	L	475	1770	0.455	0.625	17.9	C	14.7	B
	T	1164	1863	0.746	0.625	13.9	B		
SB	T	1366	3725	0.874	0.367	31.6	D	31.3	D
	R	581	1583	0.047	0.367	18.6	C		

Intersection Delay = 23.4 sec/veh Intersection LOS = C
Lost Time/Cycle, L = 6.0 sec Critical v/c(x) = 0.546

4.

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4f 06-24-2002
Center For Microcomputers In Transportation

Streets: (E-W) 205inako extension (N-S) komohana st
Analyst: Wy File Name: KOPSTOPM.HC9
Area Type: Other 6-21-2 am peak
Comment: total forecast pm peak, south intersection

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	0	0	0	1	0	1	0	1	1	1	1	0
Volumes				205		640		390	100	470	705	
Lane W (ft)				12.0		12.0		12.0	12.0	12.0	12.0	
RTOR Vols						100			30			0
Lost Time				3.00		3.00		3.00	3.00	3.00	3.00	

Signal Operations

Phase Combination	1	2	3	4
EB Left				
Thru				
Right				
Peds				
WB Left	*			
Thru				
Right	*			
Peds				
NB Right				
SB Right				
Green	42.0P			
Yellow/AR	4.0			

	5	6	7	8
NB Left				
Thru		*		
Right		*		
Peds				
SB Left	*	*		
Thru	*	*		
Right				
Peds				
EB Right				
WB Right				
Green	34.0P	32.0P		
Yellow/AR	4.0	4.0		

Cycle Length: 120 secs Phase combination order: #1 #5 #6

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
WB	L	634	1770	0.341	0.358	21.5	C	48.7	E
	R	567	1583	1.003	0.358	59.0	E		
NB	T	512	1863	0.802	0.275	36.9	D	35.2	D
	R	435	1583	0.168	0.275	25.1	D		
SB	L	578	1770	0.856	0.592	32.2	D	21.2	C
	T	1102	1863	0.673	0.592	13.8	B		

Intersection Delay = 32.5 sec/veh Intersection LOS = D
Lost Time/Cycle, L = 9.0 sec Critical v/c(x) = 0.929

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4f 06-23-2002
Center For Microcomputers In Transportation

Streets: (E-W) Mohouli (N-S) komohana
Analyst: Wy File Name: KOMOEXAM.HC9
Area Type: Other 5-19-2 am peak
Comment: existing am peak

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	1	1	1	1	1	< 0	1	1	1	1	1	< 0
Volumes	5	200	110	60	55	70	60	300	195	95	120	5
Lane W (ft)	12.0	12.0	12.0	12.0	12.0		12.0	12.0	12.0	12.0	12.0	
RTOR Vols			30			20			50			1
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Signal Operations

Phase Combination		1	2	3	4
EB	Left	*	*		
	Thru		*		
	Right		*		
	Peds				
WB	Left	*	*		
	Thru		*		
	Right		*		
	Peds				
NB	Right	*			
SB	Right				
Green		5.0P	30.0P		
Yellow/AR		0.0	4.0		

		5	6	7	8
NB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
SB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
EB	Right	*			
WB	Right				
Green		10.0P	40.0P		
Yellow/AR		0.0	5.0		

Cycle Length: 94 secs Phase combination order: #1 #2 #5 #6

5.

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	Approach: LOS
EB	L	437	1752	0.011	0.383	13.7	B	16.4	C
	T	608	1844	0.347	0.330	18.3	C		
	R	684	1568	0.123	0.436	12.0	B		
WB	L	311	1787	0.203	0.383	14.7	B	16.3	C
	TR	576	1747	0.193	0.330	17.2	C		
NB	L	660	1770	0.095	0.553	7.5	B	11.6	B
	T	832	1863	0.380	0.447	13.3	B		
	R	792	1583	0.192	0.500	9.9	B		
SB	L	384	1770	0.260	0.553	8.2	B	10.2	B
	TR	828	1854	0.157	0.447	11.8	B		

Intersection Delay = 13.2 sec/veh Intersection LOS = B
Lost Time/Cycle, L = 12.0 sec Critical v/c(x) = 0.415

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4f 06-23-2002
Center For Microcomputers In Transportation

Streets: (E-W) Mohouli (N-S) komohana
Analyst: Wy File Name: KOMOAMAM.HC9
Area Type: Other 6-21-2 am peak
Comment: combined ambient am forecast

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	1	1	1	1	1	< 0	1	1	1	1	1	< 0
Volumes	5	210	120	70	55	75	70	420	280	100	115	5
Lane W (ft)	12.0	12.0	12.0	12.0	12.0		12.0	12.0	12.0	12.0	12.0	
RTOR Vols			30			20			50			1
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Signal Operations

Phase Combination		1	2	3	4
EB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
WB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
NB	Right	*			
SB	Right				
Green		5.0P	30.0P		
Yellow/AR		0.0	4.0		

		5	6	7	8
NB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
SB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
EB	Right	*			
WB	Right				
Green		10.0P	40.0P		
Yellow/AR		0.0	5.0		

Cycle Length: 94 secs Phase combination order: #1 #2 #5 #6

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	Approach: LOS
EB	L	429	1752	0.012	0.383	13.7	B	16.5	C
	T	608	1844	0.363	0.330	18.4	C		
	R	684	1568	0.137	0.436	12.1	B		
WB	L	296	1787	0.250	0.383	15.6	C	16.6	C
	TR	574	1740	0.202	0.330	17.2	C		
NB	L	668	1770	0.111	0.553	7.5	B	12.8	B
	T	832	1863	0.531	0.447	14.9	B		
	R	792	1583	0.306	0.500	10.6	B		
SB	L	260	1770	0.404	0.553	9.7	B	10.8	B
	TR	828	1854	0.151	0.447	11.7	B		

Intersection Delay = 13.7 sec/veh Intersection LOS = B
Lost Time/Cycle, L = 12.0 sec Critical v/c(x) = 0.502

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4f 06-23-2002
Center For Microcomputers In Transportation

Streets: (E-W) Mohouli (N-S) komohana
Analyst: Wy File Name: KOMOTOAM.HC9
Area Type: Other 6-21-2 am peak
Comment: total forecast am peak with project

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	1	1	1	1	1	< 0	1	1	1	1	1	< 0
Volumes	5	210	120	110	55	75	70	425	280	100	120	5
Lane W (ft)	12.0	12.0	12.0	12.0	12.0		12.0	12.0	12.0	12.0	12.0	
RTOR Vols			30			20			50			1
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Signal Operations

Phase Combination		1	2	3	4
EB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
WB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
NB	Right	*			
SB	Right				
Green		5.0P	30.0P		
Yellow/AR		0.0	4.0		

		5	6	7	8
NB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
SB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
EB	Right	*			
WB	Right				
Green		10.0P	40.0P		
Yellow/AR		0.0	5.0		

Cycle Length: 94 secs Phase combination order: #1 #2 #5 #6

6.

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	Approach: LOS
EB	L	429	1752	0.012	0.383	13.7	B	16.5	C
	T	608	1844	0.363	0.330	18.4	C		
	R	684	1568	0.137	0.436	12.1	B		
WB	L	296	1787	0.392	0.383	18.0	C	17.6	C
	TR	574	1740	0.202	0.330	17.2	C		
NB	L	660	1770	0.112	0.553	7.5	B	12.8	B
	T	832	1863	0.537	0.447	14.9	B		
	R	792	1583	0.306	0.500	10.6	B		
SB	L	256	1770	0.410	0.553	9.8	B	10.9	B
	TR	828	1854	0.157	0.447	11.8	B		

Intersection Delay = 14.0 sec/veh Intersection LOS = B
Lost Time/Cycle, L = 12.0 sec Critical v/c(x) = 0.505

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4f 06-23-2002
Center For Microcomputers In Transportation

Streets: (E-W) Mohouli (N-S) komohana
Analyst: Wy File Name: KOMOEXPM.HC9
Area Type: Other 5-19-2 pm peak
Comment: existing pm peak

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	1	1	1	1	1	< 0	1	1	1	1	1	< 0
Volumes	5	125	165	80	315	245	210	265	105	110	430	10
Lane W (ft)	12.0	12.0	12.0	12:0	12.0		12.0	12.0	12.0	12.0	12.0	
RTOR Vols			30			40			30			1
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Signal Operations

Phase Combination		1	2	3	4
EB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
WB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
NB	Right	*			
SB	Right				
Green		4.0P	25.0P		
Yellow/AR		0.0	4.0		

		5	6	7	8
NB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
SB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
EB	Right	*			
WB	Right				
Green		12.0P	32.0P		
Yellow/AR		0.0	5.0		

Cycle Length: 82 secs Phase combination order: #1 #2 #5 #6

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	Approach: LOS
EB	L	111	1752	0.045	0.366	15.4	C	12.7	B
	T	585	1844	0.226	0.317	15.7	C		
	R	727	1568	0.195	0.463	9.9	B		
WB	L	387	1787	0.217	0.366	14.8	B	41.0	E
	TR	561	1770	0.976	0.317	45.0	E		
NB	L	290	1770	0.762	0.561	18.1	C	14.3	B
	T	772	1863	0.361	0.415	12.7	B		
	R	734	1583	0.108	0.463	9.4	B		
SB	L	462	1770	0.251	0.561	6.9	B	13.5	B
	TR	770	1857	0.601	0.415	15.2	C		

Intersection Delay = 22.0 sec/veh Intersection LOS = C
Lost Time/Cycle, L = 12.0 sec Critical v/c(x) = 0.798

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4f 06-23-2002
Center For Microcomputers In Transportation

Streets: (E-W) Mohouli (N-S) komohana
Analyst: Wy File Name: KOMOAMPM.HC9
Area Type: Other 6-21-2 pm peak
Comment: combined ambient pm forecast

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	1	1	1	1	1	< 0	1	1	1	1	1	< 0
Volumes	5	130	180	100	330	255	320	465	185	115	455	10
Lane W (ft)	12.0	12.0	12.0	12.0	12.0		12.0	12.0	12.0	12.0	12.0	
RTOR Vols			30			40			30			1
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Signal Operations

Phase Combination		1	2	3	4
EB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
WB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
NB	Right	*			
SB	Right				
Green		4.0P	42.0P		
Yellow/AR		0.0	4.0		

		5	6	7	8
NB	Left	*	*	*	
	Thru		*	*	
	Right		*	*	
	Peds				
SB	Left	*		*	
	Thru			*	
	Right			*	
	Peds			*	
EB	Right	*			
WB	Right				
Green		8.0P	12.0P	37.0P	
Yellow/AR		0.0	5.0	5.0	

Cycle Length: 117 secs Phase combination order: #1 #2 #5 #6 #7

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	Approach: LOS
EB	L	78	1752	0.064	0.402	19.9	C	17.4	C
	T	678	1844	0.202	0.368	19.2	C		
	R	683	1568	0.230	0.436	15.8	C		
WB	L	426	1787	0.246	0.402	19.8	C	33.2	D
	TR	651	1770	0.881	0.368	35.7	D		
NB	L	396	1770	0.851	0.547	36.0	D	22.6	C
	T	892	1863	0.548	0.479	16.9	C		
	R	812	1583	0.201	0.513	11.8	B		
SB	L	189	1770	0.640	0.402	23.7	C	30.0	D
	TR	619	1857	0.790	0.333	31.6	D		

Intersection Delay = 26.5 sec/veh Intersection LOS = D
Lost Time/Cycle, L = 12.0 sec Critical v/c(x) = 0.873

7.

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4f 06-23-2002
Center For Microcomputers In Transportation

Streets: (E-W) Mohouli (N-S) komohana
Analyst: Wy File Name: KOMOTOPM.HC9
Area Type: Other 6-21-2 pm peak
Comment: total forecast pm peak with project

	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R
No. Lanes	1	1	1	1	1	< 0	1	1	1	1	1	< 0
Volumes	5	130	180	100	330	255	320	480	195	115	455	10
Lane W (ft)	12.0	12.0	12.0	12.0	12.0		12.0	12.0	12.0	12.0	12.0	
RTOR Vols			30			40			30			1
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Signal Operations

Phase Combination		1	2	3	4
EB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
WB	Left	*	*		
	Thru		*		
	Right		*		
	Peds		*		
NB	Right	*			
SB	Right				
Green		4.0P	42.0P		
Yellow/AR		0.0	4.0		

		5	6	7	8
NB	Left	*	*	*	
	Thru		*	*	
	Right		*	*	
	Peds				
SB	Left	*		*	
	Thru			*	
	Right			*	
	Peds			*	
EB	Right	*			
WB	Right				
Green		8.0P	12.0P	37.0P	
Yellow/AR		0.0	5.0	5.0	

Cycle Length: 117 secs Phase combination order: #1 #2 #5 #6 #7

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	Approach: LOS
EB	L	78	1752	0.064	0.402	19.9	C	17.4	C
	T	678	1844	0.202	0.368	19.2	C		
	R	683	1568	0.230	0.436	15.8	C		
WB	L	426	1787	0.246	0.402	19.8	C	33.2	D
	TR	651	1770	0.881	0.368	35.7	D		
NB	L	396	1770	0.851	0.547	36.0	D	22.5	C
	T	892	1863	0.566	0.479	17.2	C		
	R	812	1583	0.213	0.513	11.9	B		
SB	L	178	1770	0.680	0.402	25.6	D	30.4	D
	TR	619	1857	0.790	0.333	31.6	D		

Intersection Delay = 26.6 sec/veh Intersection LOS = D
Lost Time/Cycle, L = 12.0 sec Critical v/c(x) = 0.873

TRAFFIC CALCULATIONS

UNSIGNALIZED INTERSECTION
LEVEL OF SERVICE (LOS) CALCULATIONS

Center For Microcomputers In Transportation
University of Florida
512 Weil Hall
Gainesville, FL 32611-2083
Ph: (904) 392-0378

Streets: (N-S) komohana (E-W) nowelo
Major Street Direction.... NS
Length of Time Analyzed... 15 (min)
Analyst................... wy
Date of Analysis.......... 5/19/2
Other Information.........existing am peak
Two-way Stop-controlled Intersection

	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R
No. Lanes	0	1	< 0	1	1	0	0	0	0	1	0	1
Stop/Yield			N			N						
Volumes		450	15	25	305					10		15
PHF		.95	.95	.95	.95					.95		.95
Grade		0			0						0	
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's				1.10						1.10		1.10

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	WB	EB
Conflicting Flows: (vph)	482	
Potential Capacity: (pcph)	789	
Movement Capacity: (pcph)	789	
Prob. of Queue-Free State:	0.98	

Step 2: LT from Major Street	SB	NB
Conflicting Flows: (vph)	490	
Potential Capacity: (pcph)	1001	
Movement Capacity: (pcph)	1001	
Prob. of Queue-Free State:	0.97	

Step 4: LT from Minor Street	WB	EB
Conflicting Flows: (vph)	829	
Potential Capacity: (pcph)	351	
Major LT, Minor TH Impedance Factor:	0.97	
Adjusted Impedance Factor:	0.97	
Capacity Adjustment Factor due to Impeding Movements	0.97	
Movement Capacity: (pcph)	341	

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
WB L	12	341		10.9	0.0	C	7.2
WB R	18	789		4.7	0.0	A	
SB L	29	1001		3.7	0.0	A	0.3

Intersection Delay = 0.3 sec/veh

HCS: Unsignalized Intersections Release 2.1f KONOAMAM.HC0 Page 1

Center For Microcomputers In Transportation
University of Florida
512 Weil Hall
Gainesville, FL 32611-2083
Ph: (904) 392-0378

Streets: (N-S) komohana (E-W) nowelo
Major Street Direction.... NS
Length of Time Analyzed... 15 (min)
Analyst................... wy
Date of Analysis.......... 6/21/2
Other Information.........combined ambient am peak
Two-way Stop-controlled Intersection

	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R
No. Lanes	0	1 <	0	1	1	0	0	0	0	1	0	1
Stop/Yield			N			N						
Volumes		665	25	25	295					20		15
PHF		.95	.95	.95	.95					.95		.95
Grade		0			0						0	
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's				1.10						1.10		1.10

Adjustment Factors

2.

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

HCS: Unsignalized Intersections Release 2.1f KONOAMAM.HC0 Page 2

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	WB	EB
Conflicting Flows: (vph)	713	
Potential Capacity: (pcph)	603	
Movement Capacity: (pcph)	603	
Prob. of Queue-Free State:	0.97	

Step 2: LT from Major Street	SB	NB
Conflicting Flows: (vph)	726	
Potential Capacity: (pcph)	773	
Movement Capacity: (pcph)	773	
Prob. of Queue-Free State:	0.96	

Step 4: LT from Minor Street	WB	EB
Conflicting Flows: (vph)	1050	
Potential Capacity: (pcph)	261	
Major LT, Minor TH Impedance Factor:	0.96	
Adjusted Impedance Factor:	0.96	
Capacity Adjustment Factor due to Impeding Movements	0.96	
Movement Capacity: (pcph)	251	

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
WB L	23	251		15.8	0.2	C	11.7
WB R	18	603		6.2	0.0	B	
SB L	29	773		4.8	0.0	A	0.4

Intersection Delay = 0.5 sec/veh

HCS: Unsignalized Intersections Release 2.1f KONOTOAM.HC0 Page 1

Center For Microcomputers In Transportation
University of Florida
512 Weil Hall
Gainesville, FL 32611-2083
Ph: (904) 392-0378

Streets: (N-S) komohana (E-W) nowelo
Major Street Direction.... NS
Length of Time Analyzed... 15 (min)
Analyst................... wy
Date of Analysis.......... 6/21/2
Other Information.........total forecast am peak with project
Two-way Stop-controlled Intersection

	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R
No. Lanes	0	1	< 0	1	1	0	0	0	0	1	0	1
Stop/Yield			N			N						
Volumes		665	45	40	305					25		20
PHF		.95	.95	.95	.95					.95		.95
Grade		0			0						.0	
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's				1.10						1.10		1.10

Adjustment Factors

3.

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

HCS: Unsignalized Intersections Release 2.1f KONOTOAM.HC0 Page 2

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	WB	EB
Conflicting Flows: (vph)	724	
Potential Capacity: (pcph)	595	
Movement Capacity: (pcph)	595	
Prob. of Queue-Free State:	0.96	

Step 2: LT from Major Street	SB	NB
Conflicting Flows: (vph)	747	
Potential Capacity: (pcph)	755	
Movement Capacity: (pcph)	755	
Prob. of Queue-Free State:	0.94	

Step 4: LT from Minor Street	WB	EB
Conflicting Flows: (vph)	1086	
Potential Capacity: (pcph)	249	
Major LT, Minor TH Impedance Factor:	0.94	
Adjusted Impedance Factor:	0.94	
Capacity Adjustment Factor due to Impeding Movements	0.94	
Movement Capacity: (pcph)	234	

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
WB L	29	234		17.5	0.4	C	12.5
WB R	23	595		6.3	0.0	B	
SB L	46	755		5.1	0.1	B	0.6

Intersection Delay = 0.7 sec/veh

HCS: Unsignalized Intersections Release 2.1f KONOEXPM.HC0 Page 1

Center For Microcomputers In Transportation
University of Florida
512 Weil Hall
Gainesville, FL 32611-2083
Ph: (904) 392-0378

Streets: (N-S) komohana (E-W) nowelo
Major Street Direction.... NS
Length of Time Analyzed... 15 (min)
Analyst................... wy
Date of Analysis.......... 5/19/2
Other Information.........existing pm peak
Two-way Stop-controlled Intersection

	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R
No. Lanes	0	1	< 0	1	1	0	0	0	0	1	0	1
Stop/Yield			N			N						
Volumes		510	10	20	685					20		35
PHF		.95	.95	.95	.95					.95		.95
Grade		0			0						0	
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's				1.10						1.10		1.10

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

4.

HCS: Unsignalized Intersections Release 2.1f KONOEXPM.HC0 Page 2

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	WB	EB
Conflicting Flows: (vph)	542	
Potential Capacity: (pcph)	736	
Movement Capacity: (pcph)	736	
Prob. of Queue-Free State:	0.94	

Step 2: LT from Major Street	SB	NB
Conflicting Flows: (vph)	548	
Potential Capacity: (pcph)	940	
Movement Capacity: (pcph)	940	
Prob. of Queue-Free State:	0.98	

Step 4: LT from Minor Street	WB	EB
Conflicting Flows: (vph)	1284	
Potential Capacity: (pcph)	191	
Major LT, Minor TH Impedance Factor:	0.98	
Adjusted Impedance Factor:	0.98	
Capacity Adjustment Factor due to Impeding Movements	0.98	
Movement Capacity: (pcph)	186	

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
WB L	23	186		22.1	0.3	D	
WB R	41	736		5.2	0.0	B	11.3
SB L	23	940		3.9	0.0	A	0.1

Intersection Delay = 0.5 sec/veh

HCS: Unsignalized Intersections Release 2.1f KONOAMPM.HC0 Page 1

Center For Microcomputers In Transportation
University of Florida
512 Weil Hall
Gainesville, FL 32611-2083
Ph: (904) 392-0378

Streets: (N-S) komohana (E-W) nowelo
Major Street Direction.... NS
Length of Time Analyzed... 15 (min)
Analyst................... wy
Date of Analysis.......... 6/21/2
Other Information.........combined ambient forecast pm peak
Two-way Stop-controlled Intersection

	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R
No. Lanes	0	1	< 0	1	1	0	0	0	0	1	0	1
Stop/Yield			N			N						
Volumes		890	35	20	725					45		40
PHF		.95	.95	.95	.95					.95		.95
Grade		0			0						0	
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's				1.10						1.10		1.10

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

5.

HCS: Unsignalized Intersections Release 2.1f KONOAMPM.HC0 Page 2

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	WB	EB
Conflicting Flows: (vph)	956	
Potential Capacity: (pcph)	454	
Movement Capacity: (pcph)	454	
Prob. of Queue-Free State:	0.90	

Step 2: LT from Major Street	SB	NB
Conflicting Flows: (vph)	974	
Potential Capacity: (pcph)	589	
Movement Capacity: (pcph)	589	
Prob. of Queue-Free State:	0.96	

Step 4: LT from Minor Street	WB	EB
Conflicting Flows: (vph)	1740	
Potential Capacity: (pcph)	104	
Major LT, Minor TH Impedance Factor:	0.96	
Adjusted Impedance Factor:	0.96	
Capacity Adjustment Factor due to Impeding Movements	0.96	
Movement Capacity: (pcph)	100	

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
WB L	52	100		69.7	2.0	F	41.1
WB R	46	454		8.8	0.3	B	
SB L	23	589		6.4	0.0	B	0.2

Intersection Delay = 2.1 sec/veh

6.

HCS: Unsignalized Intersections Release 2.1f KONOTOPM.HC0 Page 1

Center For Microcomputers In Transportation
University of Florida
512 Weil Hall
Gainesville, FL 32611-2083
Ph: (904) 392-0378

Streets: (N-S) komohana (E-W) nowelo
Major Street Direction.... NS
Length of Time Analyzed... 15 (min)
Analyst................... wy
Date of Analysis.......... 6/21/2
Other Information.........total forecast pm peak with project
Two-way Stop-controlled Intersection

	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R
No. Lanes	0	1 <	0	1	1	0	0	0	0	1	0	1
Stop/Yield			N			N						
Volumes		890	35	20	725					85		65
PHF		.95	.95	.95	.95					.95		.95
Grade		0			0						0	
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's				1.10						1.10		1.10

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

HCS: Unsignalized Intersections Release 2.1f KONOTOPM.HC0 Page 2

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	WB	EB
Conflicting Flows: (vph)	956	
Potential Capacity: (pcph)	454	
Movement Capacity: (pcph)	454	
Prob. of Queue-Free State:	0.83	

Step 2: LT from Major Street	SB	NB
Conflicting Flows: (vph)	974	
Potential Capacity: (pcph)	589	
Movement Capacity: (pcph)	589	
Prob. of Queue-Free State:	0.96	

Step 4: LT from Minor Street	WB	EB
Conflicting Flows: (vph)	1740	
Potential Capacity: (pcph)	104	
Major LT, Minor TH Impedance Factor:		
Adjusted Impedance Factor:	0.96	
Capacity Adjustment Factor due to Impeding Movements	0.96	
Movement Capacity: (pcph)	0.96	
	100	

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
WB L	98	100		157.6	4.8	F	
WB R	75	454		9.5	0.6	B	93.4
SB L	23	589		6.4	0.0	B	0.2

Intersection Delay = 7.8 sec/veh

```
HCS: Unsignalized Intersections    Release 2.1f    KOPUEXAM.HC0    Page 1
============================================================================
Center For Microcomputers In Transportation
University of Florida
512 Weil Hall
Gainesville, FL    32611-2083
Ph: (904) 392-0378
============================================================================
Streets: (N-S) komohana                        (E-W) puainako
Major Street Direction.... NS
Length of Time Analyzed... 15 (min)
Analyst................... wy
Date of Analysis.......... 5/19/2
Other Information.........existing am peak
Two-way Stop-controlled Intersection
============================================================================
```

	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R
No. Lanes	0	1 <	0	0 >	1	0	0	0	0	0 >	1 <	0
Stop/Yield			N			N						
Volumes		490	65	95	150					15	0	55
PHF		.95	.95	.95	.95					.95	.95	.95
Grade		0			0						0	
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's				1.10						1.10	1.10	1.10

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40


```
HCS: Unsignalized Intersections    Release 2.1f    KOPUEXAM.HC0    Page 2
============================================================================

              Worksheet for TWSC Intersection
----------------------------------------------------------------
Step 1: RT from Minor Street                    WB          EB
----------------------------------------------------------------
Conflicting Flows: (vph)                        550
Potential Capacity: (pcph)                      729
Movement Capacity: (pcph)                       729
Prob. of Queue-Free State:                      0.91
----------------------------------------------------------------
Step 2: LT from Major Street                    SB          NB
----------------------------------------------------------------
Conflicting Flows: (vph)                        584
Potential Capacity: (pcph)                      903
Movement Capacity: (pcph)                       903
Prob. of Queue-Free State:                      0.88
TH Saturation Flow Rate: (pcphpl)               1700
RT Saturation Flow Rate: (pcphpl)
Major LT Shared Lane Prob.
  of Queue-Free State:                          0.87
----------------------------------------------------------------
Step 3: TH from Minor Street                    WB          EB
----------------------------------------------------------------
Conflicting Flows: (vph)                        808
Potential Capacity: (pcph)                      411
Capacity Adjustment Factor
  due to Impeding Movements                     0.87
Movement Capacity: (pcph)                       356
Prob. of Queue-Free State:                      1.00
----------------------------------------------------------------
Step 4: LT from Minor Street                    WB          EB
----------------------------------------------------------------
Conflicting Flows: (vph)                        808
Potential Capacity: (pcph)                      361
Major LT, Minor TH
  Impedance Factor:                             0.87
Adjusted Impedance Factor:                      0.87
Capacity Adjustment Factor
  due to Impeding Movements                     0.87
Movement Capacity: (pcph)                       313
----------------------------------------------------------------
```

HCS: Unsignalized Intersections Release 2.1f KOPUEXAM.HC0 Page 3

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
WB L	18	313 >					
WB T	0	356 >	564	7.5	0.5	B	7.5
WB R	64	729 >					
SB L	110	903		4.5	0.4	A	1.8

Intersection Delay = 1.1 sec/veh

HCS: Unsignalized Intersections Release 2.1f KOPUEXPM.HC0 Page 1

Center For Microcomputers In Transportation
University of Florida
512 Weil Hall
Gainesville, FL 32611-2083
Ph: (904) 392-0378

Streets: (N-S) komohana (E-W) puainako
Major Street Direction.... NS
Length of Time Analyzed... 15 (min)
Analyst................... wy
Date of Analysis.......... 5/19/2
Other Information.........existing pm peak
Two-way Stop-controlled Intersection

	Northbound L	Northbound T	Northbound R	Southbound L	Southbound T	Southbound R	Eastbound L	Eastbound T	Eastbound R	Westbound L	Westbound T	Westbound R
No. Lanes	0	1 <	0	0 >	1	0	0	0	0	0 >	1 <	0
Stop/Yield			N			N						
Volumes		355	60	275	625					70	0	140
PHF		.95	.95	.95	.95					.95	.95	.95
Grade		0			0						0	
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's				1.10						1.10	1.10	1.10

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	WB	EB
Conflicting Flows: (vph)	406	
Potential Capacity: (pcph)	862	
Movement Capacity: (pcph)	862	
Prob. of Queue-Free State:	0.81	

Step 2: LT from Major Street	SB	NB
Conflicting Flows: (vph)	437	
Potential Capacity: (pcph)	1061	
Movement Capacity: (pcph)	1061	
Prob. of Queue-Free State:	0.70	
TH Saturation Flow Rate: (pcphpl)	1700	
RT Saturation Flow Rate: (pcphpl)		
Major LT Shared Lane Prob. of Queue-Free State:	0.51	

Step 3: TH from Minor Street	WB	EB
Conflicting Flows: (vph)	1352	
Potential Capacity: (pcph)	213	
Capacity Adjustment Factor due to Impeding Movements	0.51	
Movement Capacity: (pcph)	109	
Prob. of Queue-Free State:	1.00	

Step 4: LT from Minor Street	WB	EB
Conflicting Flows: (vph)	1352	
Potential Capacity: (pcph)	175	
Major LT, Minor TH Impedance Factor:	0.51	
Adjusted Impedance Factor:	0.51	
Capacity Adjustment Factor due to Impeding Movements	0.51	
Movement Capacity: (pcph)	89	

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
WB L	81	89 >					
WB T	0	109 >	221	131.2	9.6	F	131.2
WB R	162	862 >					
SB L	318	1061		4.8	1.4	A	1.5

Intersection Delay = 18.9 sec/veh

APPENDIX F

PLANNING DEPARTMENT LANDSCAPING RULE NO. 17

(County Planning Department)

RULE 17. LANDSCAPING REQUIREMENTS

17-1 Authority and Applicability

This rule governs the Plan Approval standards for landscaping pursuant to article 2 (Administration and Enforcement), division 7 (Plan Approval), chapter 25 (Zoning Code), Hawaii County Code. Other references to landscaping in the Zoning Code, which are reviewed through Plan Approval, include: sections 25-4-59.3 (parking lot and loading spaces), -5-37 (RM), -5-47 (RCX), -5-97 (V), -5-107 (CN), -5-117 (CG), -5-127 (CV), -5-137 (MCX), -5-147 (ML), -5-157 (MG), -6-3 (PUD), -6-47 (Project District), -7-4 (Kailua Village Design Commission). At no time shall the landscaping requirements pursuant to this rule exceed the requirements of Chapter 25 (Zoning Code), Hawaii County Code.

17-2 Purpose

Landscaping protects the health and welfare of the community by serving the following purposes:

(a) Buffering and screening. Landscaping eliminates or minimizes potential nuisances such as noise, dust, litter, glare of lights, signs, or unsightly areas between adjacent land uses or between a land use and roadways.

(b) Moderating the visual impact and microclimate of expansive paved parking lots. Landscaping along the perimeter and within the interior of parking lots provide visual relief from the rows of parked vehicles or asphalt. Trees add shade that moderate the temperature of parking lots during sunny days.

(c) Enhancing the streetscape of commercial and industrial areas. Landscaping the front yards of commercial and industrial areas provides a human scale and visual continuity from the viewpoint of motorists and pedestrians traveling within the right-of-way.

(d) Promoting ecological and cultural values. Encouraging landscaping with native species, other species adaptable to the environment, and species suitable for the intended function conserves water, promotes ecological and cultural appreciation, and adequately fulfills the intended buffering, screening, or shading functions without causing undue maintenance problems.

17-3 Definitions

(a) BERM: An earthen mound designed to provide visual interest on site, screening of undesirable views, noise reduction, etc.

(b) BUFFER: A combination of physical space and vertical elements, such as plants, berms, fences, or walls, the purpose of which is to separate and screen incompatible land uses from each other.

(c) BUFFERYARD: One of several specific combinations of minimum building setbacks, landscaped yard widths, and plant material requirements set forth in this rule for use in buffering incompatible land uses.

(d) OPAQUE: A level of screening that completely blocks the view.

(e) SCREENING: A method of reducing the impact of visual and/or noise intrusions through the use of plant materials, berms, fences and or walls, or any combination thereof. Screening blocks that which is unsightly or offensive with a more harmonious element.

(f) SHRUB: A woody plant, or small palm smaller than a tree, which consists of a number of small stems from the ground or small branches near the ground.

(g) TREE: A large, woody plant or large palm having one or several self-supporting stems or trunks and numerous branches.

(h) WOODLAND: Existing trees and shrubs of a number, size and type that approximately accomplish the same function as new plantings.

17-4 Submittal Requirements

(a) **Applicability.** Plan approval applications for projects located in the RM, RCX, V, CN, CG, CV, MCX, ML, MG, or Project districts shall include a landscape plan. Plan approval applications for a project located in any zoning district that proposes a loading area or parking lot with 5 or more parking stalls shall also include a landscape plan.

(b) Preparation. A landscape plan meeting the provisions of this rule which is prepared by a landscape architect or landscape contractor, licensed in the State of Hawaii, shall be granted approval. Any landscape plan developed by other means shall be subject to Planning Department Review.

(c) Contents of Landscape Plan. The landscape plan may be submitted on a separate sheet or superimposed on a single sheet with the site plan. The landscape plan shall include the following planting and site information:

(1) Existing vegetation

(A) Location, general type and quality of existing vegetation, specimen trees, and areas of secondary growth;

(B) Existing vegetation to be saved (indicated and noted accurately);

(C) Methods and details for protection of existing vegetation during construction and the approved sediment control plan, if available;

(2) Proposed vegetation

(A) Locations and labels of all proposed plants;

(B) Plant list or schedule to include botanical and common name, quantity, spacing and size at time of planting of all proposed plants;

(3) Location and description of other landscape improvements, such as earth berms, walls, fences, screens, sculptures, fountains, street furniture, lights and courts or paved areas;

(4) Irrigation plan;

(5) Planting installation details as necessary to insure conformance with the standards set forth in this rule.

(6) Site information

(A) North arrow and scale;

(B) Property lines;

(C) Zoning and use of all abutting properties;

(D) Name, location, and right-of-way and paving widths of all abutting streets;

(E) Natural features such as ponds, lakes and streams;

(F) Delineation of 100 year floodplain and non-tidal wetlands;

(G) Required yard depths/widths (i.e., setbacks from all lot lines);

(H) Location, height, dimensions, and use of all existing and proposed buildings and other structures (including parking lots, sidewalks, and other paved areas; fences and walls; and recreational facilities);

(I) Location of any slopes steeper than 3:1;

(J) Location of existing and proposed utilities and utility easement, including water, storm drain, and sanitary sewer pipes; overhead wires; utility poles and boxes; and signs if available; and

(K) Location, size and description of all elements which are required to be screened.

17-5 Review and Approval Procedure

(a) Plan Approval Procedures. The landscape submittals shall be reviewed together with the complete Plan Approval submittal in accordance with the procedures for Plan Approval.

(b) When Landscaping Must Be Completed. All landscaping, unless the director has approved a phasing plan, shall be completed in accordance with the approved landscape plan prior to issuance of a certificate of occupancy for any building on the lot.

17-6 Landscape Standards

(a) Open space requirements in the RM, RCX, and V districts. The Zoning Code requires landscaping on a minimum of 20% of the building site in the RM, RCX, and V districts to ameliorate the potential higher densities permitted in these districts.

(1) Calculation of 20% area. In determining the minimum 20% landscaped area, subtract from the gross building site area the following: building footprint, parking areas, loading areas, and driveways. Interior courtyards, roof gardens, solariums, or other landscaping not visible from the lot perimeter at ground level shall not be included in the 20% landscaped area.

(2) Open space landscaping standard. Landscaping shall include plant materials including grass and/or ground cover, and water features such as ponds. It shall not include hard-surface outdoor recreation areas such as tennis courts or swimming pools. A minimum of one (1) tree is required per 2,000 square feet or fraction of landscaped area. Existing trees exceeding two and one-half (2 1/2) inches caliper located anywhere in the landscaped area on the site may be counted on a one-to-one basis as fulfilling up to 100 % of the requirement for trees on that site.

(b) Bufferyard requirements in the CN, CG, CV, MCX, ML, and MG districts. The Zoning Code requires a landscaped bufferyard within the side yards of building sites within the commercial (CN, CG, CV) district if the building site adjoins any residential district (RS, RD, RM), and within the side and/or rear yards of building sites within the industrial districts (MCX, ML, MG) if the building site adjoins any residential district (RS, RD, RM).

(1) General bufferyard standard. Development on any lot within the CN, CG, CV, MCX, ML, and MG districts that adjoins any residential district shall provide sufficient buffering to shield the residential lot(s) from any adverse external effects of the commercial or industrial development.

(2) Compliance with bufferyard standard. Any of the following landscape treatments may be used singly or in combination to satisfy the general standard:

(A) MCX, ML, MG districts. To exclude all visual contact between the industrial and residential uses and to create a strong spatial separation, with concomitant lessening of noise intrusion, the landscaped buffer shall be opaque from the ground to a height of at least six feet, with intermittent visual screening from the opaque portion to a height of at least 20 feet. Compliance shall be determined on the basis of the average mature height and density of foliage of the subject species, or field observation of existing vegetation. At maturity, the portion of intermittent visual screening should not contain any completely unobstructed openings more than 10 feet wide. Options that presumptively achieve this standard include (see Example 1):

(i) Small trees (20' at maturity) planted 30' on center, with 6' hedge shrubbery planted 3' on center or 6' opaque fence or wall.

(ii) Large trees (20' to 40' at maturity) planted 40' on center, with 6' hedge shrubbery planted 4' on center or 6' opaque fence or wall.

(iii) Tall trees (taller than 40' at maturity) with branches touching near the ground.

(B) CN, CG, CV districts. To partially exclude visual contact between the commercial and residential uses and to create a strong spatial separation, with concomitant lessening of noise intrusion, the landscaped buffer shall be opaque from the ground to a height of at least three feet, with intermittent visual screening from the opaque portion to a height of at least 20 feet. Compliance shall be determined on the basis of the average mature height and density of foliage of the subject species, or field observation of existing vgetation. At maturity, the portion of intermittent visual screening should not contain any completely unobstructed openings more than 10 feet wide. Options that presumptively achieve this standard include (see Example 2):

(i) Small trees (20' at maturity) planted 30' on center with 3' solid fence or wall.

(ii) Small trees (20' at maturity) planted 20-30' on center on top of 3' high seeded earth berm.

(iii) Large trees (20' to 40' at maturity) planted 40' on center with 3' high hedge shrubbery planted 3' on center.

(c) Front yard landscaping requirements in the CN, CG, CV, MCX, ML, and MG districts. Where the Zoning Code requires a front yard in the CN, MCX, ML, and MG districts, or where the front yard option is selected over the rear yard in the CV and CG districts, the front yard shall be landscaped pursuant to the following standards.

(1) General front yard landscaping standard. Front yard landscaping on any lot within the CN, CG, CV, MCX, ML, and MG districts shall provide sufficient plant material that complements the surrounding. The landscaped strip may not include any paved area, except pedestrian sidewalks or trails which cross the landscaped strip.

(2) Compliance with front yard landscaping standard. Any of the following landscape treatments may be used singly or in combination to satisfy the general standard (see Example 3):

(A) Provide a minimum 10 foot wide landscaped strip to be planted with a minimum of one (1) tree and 10 shrubs per 35 linear feet of frontage, excluding driveway openings. Where the plantings required would result in an inappropriate or impractical design due to underground utilities, overhead wires, or other factors, 5 shrubs may be substituted for 1 tree.

(B) Provide a minimum 10 foot wide strip of existing woodlands.

(d) Parking lot landscaping requirements

(1) Perimeter landscaping requirements. The following requirements apply to a parking lot of five or more spaces.

(A) Screening along right-of-way. When a parking lot in any zone is located adjacent to a public right-of-way, a landscape screen shall be provided on the property between the parking lot and the right-of-way. (In circumstances where greater parking lot setbacks are required than those listed below, the greater requirement shall apply). The landscaped strip may not include any paved area except pedestrian sidewalks or trails which cross the landscaped strip. Any of the following landscaped strip treatments may be used singly or in combination (see Example 4):

(i) Provide a minimum 10 foot wide landscape strip between the right-of-way and the parking lot to be planted with a minimum of one (1) tree and 10 shrubs per 35 linear feet of frontage, excluding driveway openings. Where the plantings required would result in an inappropriate or impractical design due to underground utilities, overhead wires, or other factors, 5 shrubs may be substituted for 1 tree.

(ii) Provide a berm, the top of which is at least 2 ½ feet higher than the elevation of the adjacent parking lot pavement. The slope of the berm shall not exceed 33 % (3:1) for lawn areas. Berms planted with ground covers and shrubs may be steeper. However, no slope shall exceed 50% (2:1). Berms should be graded to appear as smooth, rounded, naturalistic forms. Avoid narrow bumps which result from creating too much height for the width of the space. Plant with a minimum of one (1) tree and five (5) shrubs per 35 linear feet of frontage, excluding driveway openings. Where the plantings required would result in an inappropriate or impractical design due to underground utilities, overhead wires, or other factors, 5 shrubs may be substituted for 1 tree.

(iii) Provide a minimum six (6) foot wide landscaped strip and a minimum three (3) foot grade drop from the right-of-way line to the adjacent parking lot pavement. Plant the resulting embankment with a minimum of one (1) tree and five (5) shrubs per 35 linear feet of frontage, excluding driveway openings. Where the plantings required would result in an inappropriate or impractical design due to underground utilities, overhead wires, or other factors, 5 shrubs may be substituted for 1 tree.

(iv) Provide a minimum four (4) foot wide landscaped strip between the right-of-way line and the parking lot, with a maximum three (3) foot high brick, stone or finished concrete wall to screen the parking lot. The wall shall be located adjacent to but entirely outside the four (4) foot landscaped strip. Plant with a minimum of one (1) tree per 35 linear feet of frontage, excluding driveway openings. Where the plantings required would result in an inappropriate or impractical design due to underground utilities, overhead wires, or other factors, 5 shrubs may be substituted for 1 tree.

(v) Provide a minimum 10 foot strip of existing woodlands.

(B) Screening from adjoining RS, RD, RM, RCX, or RA districts. When the adjacent property is zoned RS, RD, RM, RCX, or RA, parking lots shall be set back from adjacent property lines in accordance with the requirements of the Zoning Code. In all other cases, the perimeter of a proposed parking lot adjacent to a property line shall be treated as indicated below. (For the purposes of this Section, a parking lot shall be considered adjacent to a property line when any part of the lot is within 30 feet of the property line and no building is located between the lot and the property line).

(i) Provide a landscaped strip between the parking lot and any adjacent property line, to be a minimum of five (5) feet wide for building sites 10,000 square feet or more. Within this landscaped strip, provide one (1) tree and three (3) shrubs per 35 linear feet of parking lot perimeter adjacent to property line. (This does not mean that trees must be located 35 feet on center.) Any tree planted to fulfill another requirement of this rule which is located within 15 feet of the edge of the parking lot, may count toward fulfillment of this requirement. Where the plantings required would result in an inappropriate or impractical design due to underground utilities, overhead wires, or other factors, 5 shrubs may be substituted for 1 tree.

(ii) Provide a minimum 25 foot wide strip of existing woodland.

(2) Interior landscaping requirements. Parking lots with more than 12 stalls shall provide landscaping within the interior of the parking lot according to the following standards:

(A) At least one (1) canopy tree shall be provided for every 12 parking stalls or fraction thereof. These trees shall have a minimum of 2" caliper, a planting area or tree well no less than 30 s.f. in area, and a clear trunk at least six (6) feet above finished grade level. Trees shall be sited so as to evenly distribute shade throughout the parking lot (see Example 5).

(B) A curb or wheelstop shall be provided for all parking spaces adjacent to planting or pedestrian areas to protect those areas from overhanging by parked vehicles. Continuous planting areas with low ground cover centered at the corner of parking stalls may be located within the three-foot overhand space of parking stalls. Hedges and other landscape elements, including planter boxes over six inches in height, are not permitted within the overhang space of the parking stalls (see Example 6).

(C) Planting islands which are parallel to parking spaces shall be a minimum of nine (9) feet wide to allow car doors to swing open (see Example 7).

(D) In cases where a planting island is perpendicular to parking spaces and the spaces head into the planting island on both sides, the island shall be a minimum of eight (8) feet wide to allow for bumper overhang. If parking spaces are located on only one side of such a planting island, the island shall be a minimum of six (6) feet wide (see Example 8).

(e) Screening requirements, for loading spaces, trash disposal areas, mechanical equipment.

(1) Loading areas

(A) General standard. Except porte cocheres, all loading areas, loading docks, vehicular lanes providing access to the above, and service or maintenance areas shall be screened from any adjoining properties in the RS, RD, RM, RCX, or RA districts; from all public roads; if located within a residential development, from all outdoor living and recreation areas, parking areas, and entrance drives within the development; and if located within a commercial development, from all outdoor recreation areas, retail parking areas and entrance drives within the development. In general, screening materials shall consist of trees and shrubs, vines, walls, fences, and berms; screening fences and walls shall not be constructed of corrugated metal, corrugated fiberglass, sheet metal.

(B) Compliance with general standard. Any of the following landscape treatments may be used, singly or in combination to satisfy the general standard:

(i) 6 ft. high opaque fence or wall (may be plant covered or veneered with natural materials)

(ii) 6 ft. high berm

(iii) 6 ft. plant screen

(2) Trash disposal areas

(A) General standard. All dumpsters or trash storage areas shall be screened from any adjoining properties in the RS, RD, RM, RCX, or RA districts; from all public roads; if located within a residential development, from all outdoor living and recreation areas, parking areas, and entrance drives within the development; and if located within a commercial development, from all outdoor recreation areas, retail parking areas and entrance drives within the development.

(B) Compliance with general standard. Any of the following landscape treatments may be used singly or in combination to satisfy the general standard:

(i) Opaque fence or wall (may be plant covered or veneered with natural materials).

(ii) Plant screen (height, spacing and variety to be determined by size and location of area to be screened).

(3) Mechanical equipment

(A) General standard. All mechanical equipment and meters (including free standing air conditioners, heat pumps, and similar equipment, but not including public utility transformers, electric and other meters attached to single-family dwelling units, and heat pumps or air conditioners for single-family dwelling units, unless placed in a group of three or more) shall be screened from any adjoining properties in the RS, RD, RM, RCX, or RA districts; from all adjacent public roads; if located within residential development, from all outdoor living and recreation areas, parking areas and entrance drives within the development; and, if located within a commercial development, from all outdoor recreation areas, parking areas, and entrance drives.

(B) Compliance with general standard. Any of the following landscape treatments may be used singly or in combination to satisfy the general standard which is intended to shield the equipment from visual contact with concomitant lessening of noise intrusion:

(i) Opaque fence or wall (may be plant covered or veneered with natural materials)

(ii) Plant screen (height, spacing and variety to be determined by size and location of area to be screened)

17-7 Plant Material and Installation Standards

(a) General. Plant material shall be of a size and quality at installation to meet the objectives of the approved landscape plan within 24 months from the date of the certificate of occupancy.

(b) Hedges. Hedges, where required, shall form a partial visual screen of at least 2-1/2 feet in height immediately upon planting and shall be spaced a maximum of 3' on center for a 3' high hedge and 4' on center for a 6' high hedge.

(c) Trees. Root barriers shall be required where there is a potential to damage sidewalks or pavement in the adjoining right-of-way.

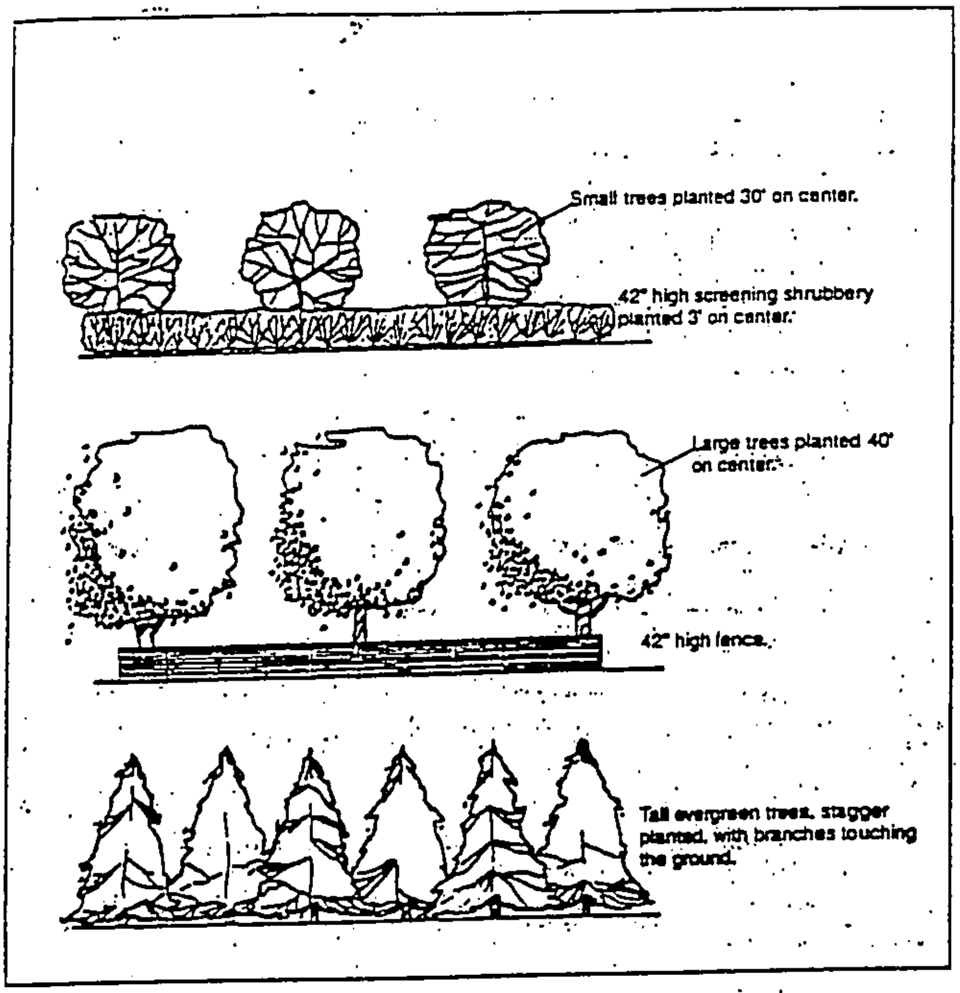
17-8 Maintenance Standards; Irrigation Requirements.

Maintenance Standards. All required landscaping shall be maintained in good growing condition. No plant material shall be allowed to encroach on rights-of-way and easements that interferes with motorists' vision of vehicular traffic, pedestrian use within the rights-of-way or easement, or overhead utility lines.

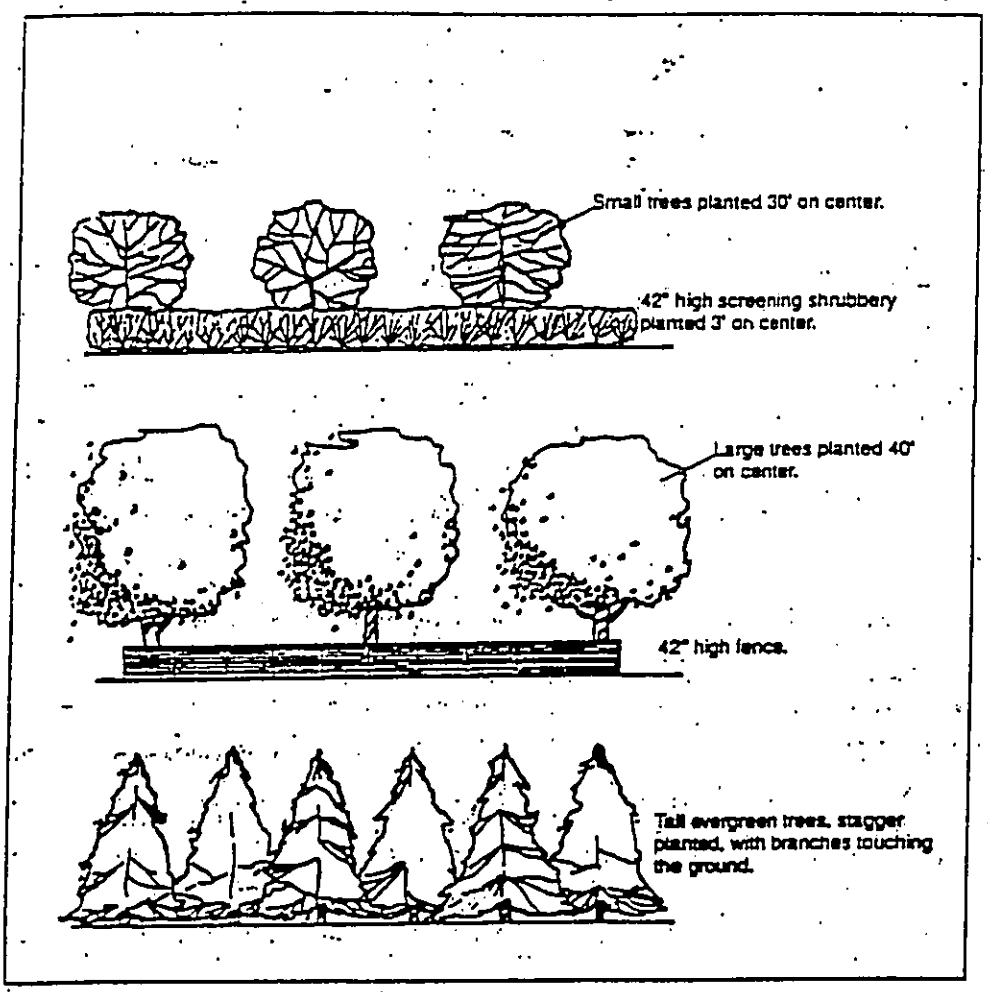
(a) Irrigation Requirement. Irrigation shall be required unless evidence is submitted at plan approval of a maintenance contract or installation guarantee of a minimum of 1 year.

(b) Plant material that dies or is destroyed shall be replaced by comparable plant material.

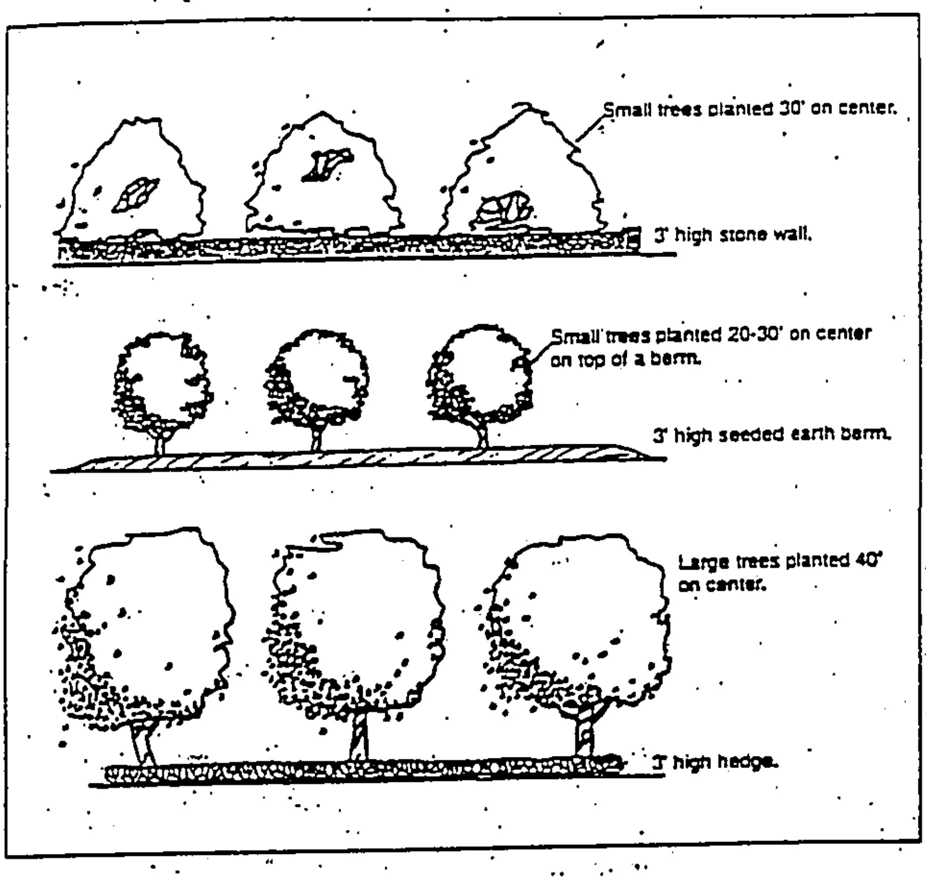
Example 1: Bufferyard Industrial Zone Options



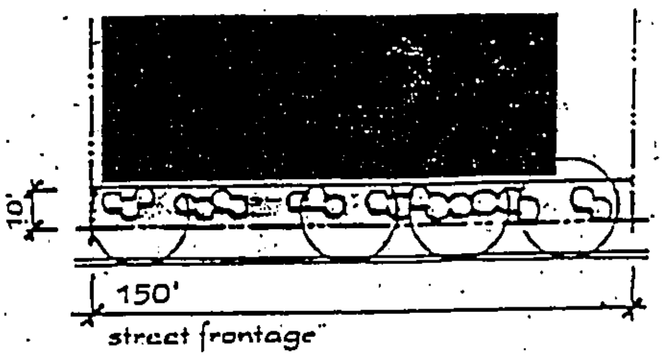
Example 1: Bufferyard Industrial Zone Options



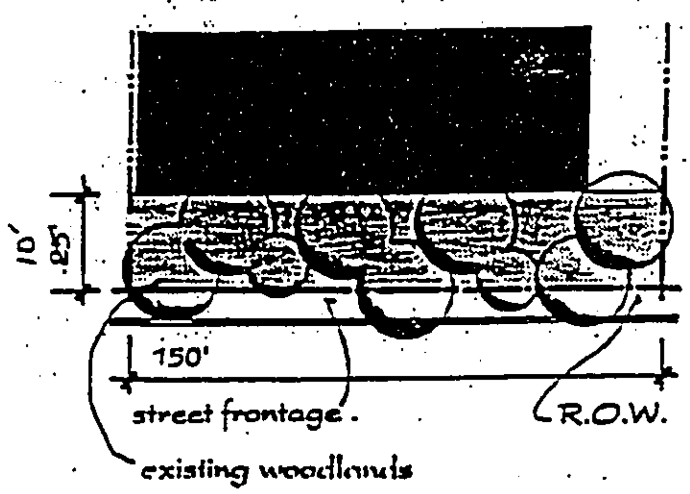
Example 2: Bufferyard Commercial Zone Options



Example 3: Front Yard Landscaping Options

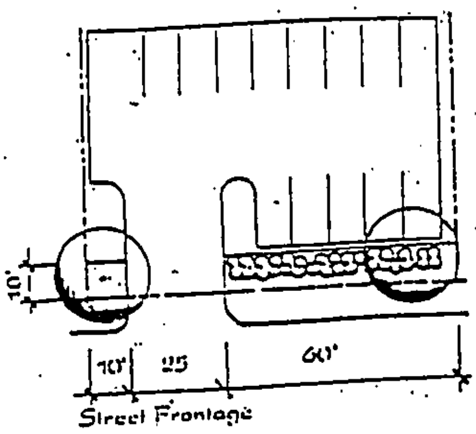


the planting strip is a minimum of 10' wide — planted with one shade tree and 10 shrubs per 35 linear feet.



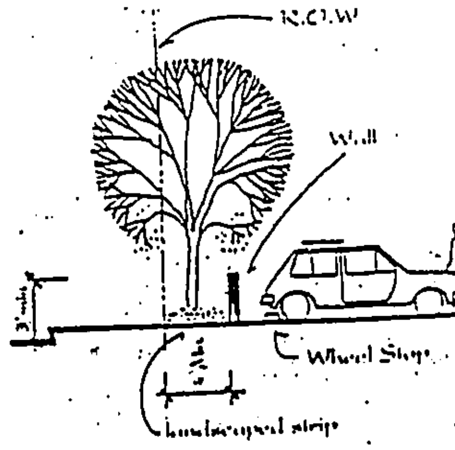
Example 4: Parking Lot Perimeter Screen Along Right-of-Way Options

Parking Lot Landscaped Strip, Option 1



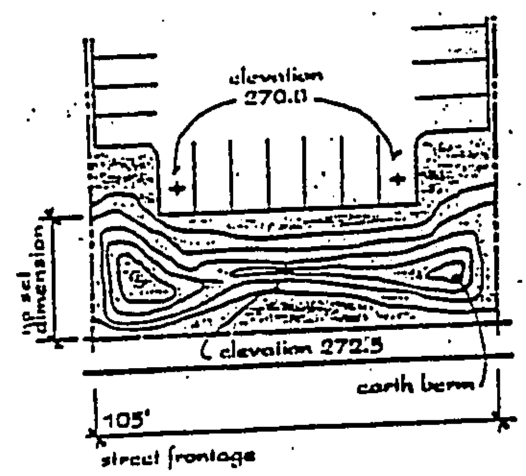
minimum 10'-wide landscaped strip—planted with a minimum of one shade tree and 10 shrubs per 35 linear feet of street frontage.

Parking Lot Landscaped Strip, Option 4



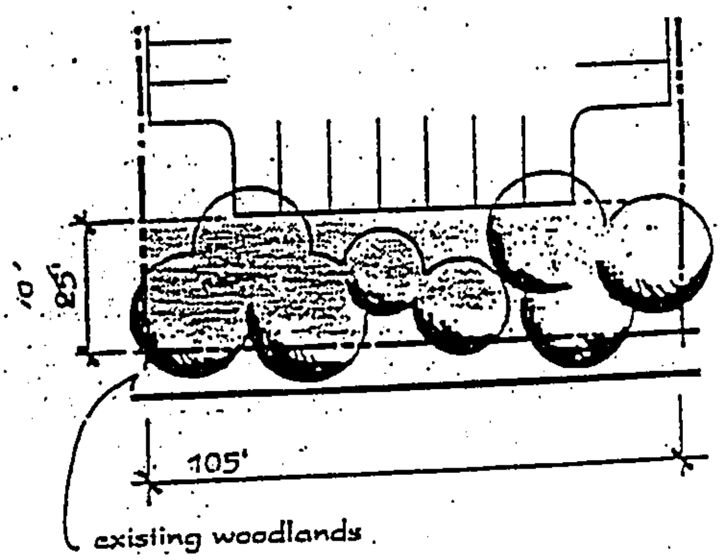
plant landscaped strip along street frontage with a minimum of one shade tree per 35 linear feet

Landscaped Strip, Option 2

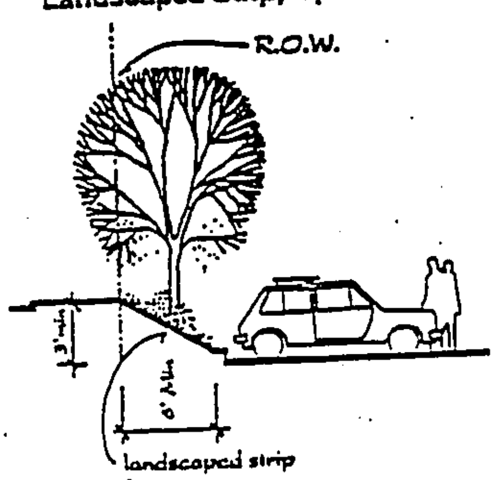


earth berm planted with a minimum of one shade tree and five shrubs per 35 linear feet.

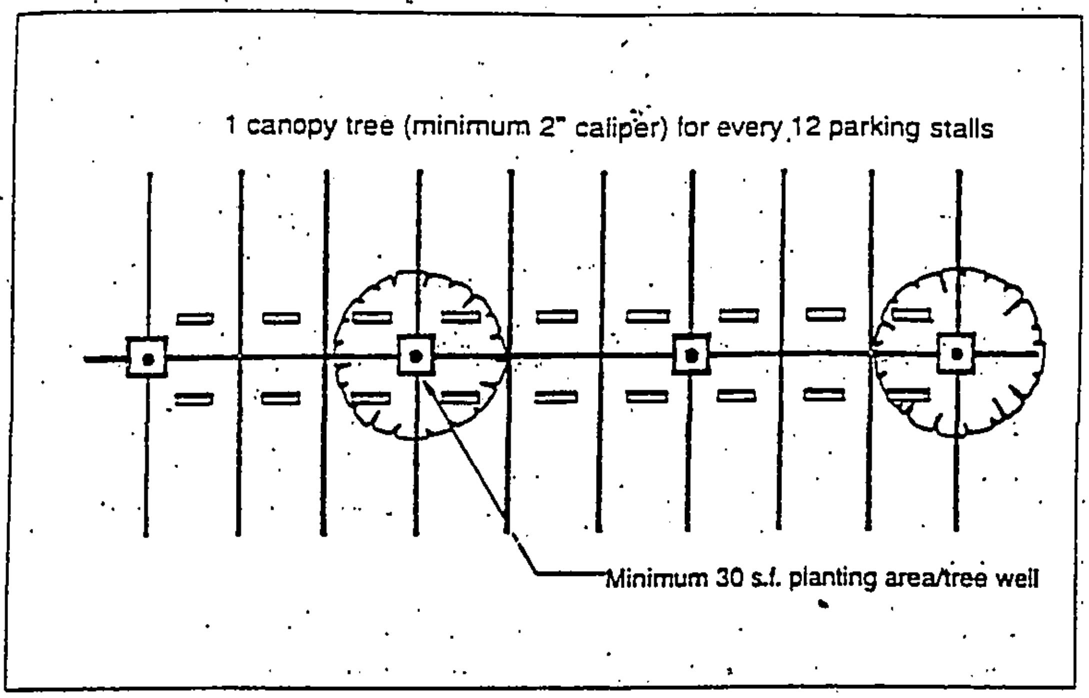
Parking Lot Landscaped Strip, Option 5



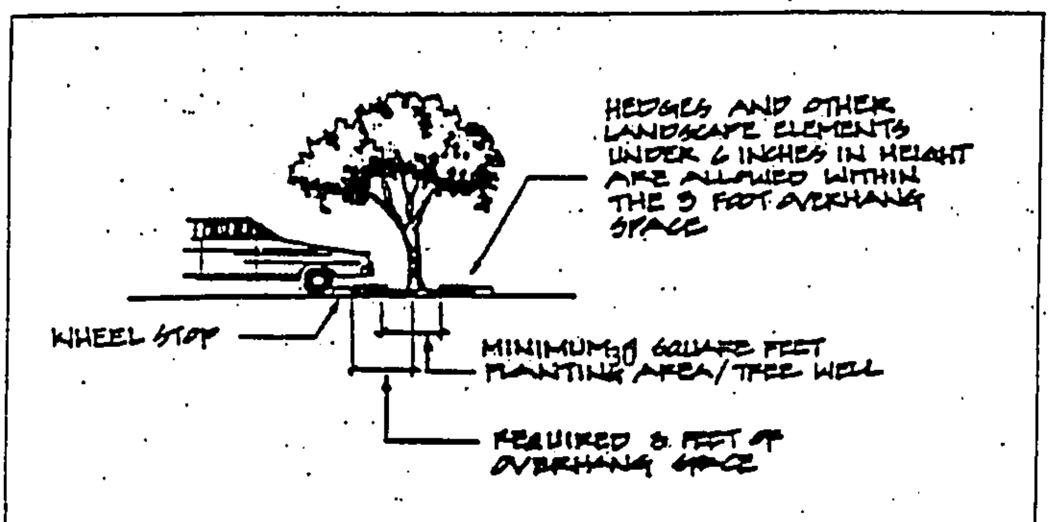
Landscaped Strip, Option 3



Example 5: Parking Lot Interior Trees Requirement



Example 6: Parking Lot Interior Curb Stop Requirement



APPENDIX G

DRAFT EA
CONSULTATION LETTERS AND RESPONSES

Harry Kim
Mayor

County of Hawaii
PLANNING DEPARTMENT
25 Aupuni Street, Room 109 • Hilo, Hawaii 96720-4252
(808) 961-8288 • Fax (808) 961-8742

Christopher J. Yuen
Director

Roy R. Takemoto
Deputy Director

April 1, 2002

TO WHOM IT MAY CONCERN:

University of Hawaii at Hilo
Mauna Kea Astronomy Education Center
TMK: 2-4-01:7

The University of Hawaii at Hilo is proposing the construction of the Mauna Kea Astronomy Education Center (MKAEC). The MKAEC, an interpretative facility, will be located at the University Park in the City of Hilo on a 9.1-acre site identified by Tax Map Key 2-4-01:7. The estimated cost of the project will be $28 million.

The project site in not within the Special Management Area (SMA) and therefore, is not subject to a SMA Use Permit under the provisions of Chapter 205A, Hawaii State Statutes, and the Federal Coastal Zone Management (CZM) of 1972, as amended.

Should you have any questions, please feel free to contact us at (808) 961-8288.

Sincerely,

CHRISTOPHER J. YUEN
Planning Director

NH:pak
P:wpwin60\norm\letter\twimc 4-1-02

SidneyFuke, Planning Consultant
100 Pauahi Street, Suite 212 • Hilo, Hawaii 96720
Telephone: (808) 969-1522 • Fax: (808) 969-7996
• Plannin
• Subdivi
• Enviror

May 28, 2002

Mr. Christopher Yuen, Director
Planning Department
COUNTY OF HAWAII
25 Aupuni Street
Hilo, HI 96720

Dear Mr. Yuen:

Subject: **Draft Environmental Assessment Consultation**
Mauna Kea Astronomy Education Center, TMK: 2-4-01: por 7

Thank you for your letter of April 1, as well as your staff's comments regarding the subject matter.

Please be informed that the proposed height of the structure is very preliminary at this stage. In the event the proposed structure exceeds the height limit of 45 feet in the A-1a or 35 feet in the RS-10 zone, the applicant will either seek the required height variance or redesign the structure to conform to the appropriate limits.

We appreciate your comments and look forward to any other comments you may have on this matter.

Sincerely,

SIDNEY M. FUKE
Planning Consultant

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
345 KEKUANAOA STREET, SUITE 20 • HILO, HAWAII 96720
TELEPHONE (808) 961-8050 • FAX (808) 961-8657

May 22, 2002

Mr. Sidney Fuke
100 Pauahi Street, Suite 212
Hilo, HI 96720

**CONSULTATION BEFORE DRAFT ENVIRONMENTAL ASSESSMENT
MAUNA KEA ASTRONOMY EDUCATION CENTER
TAX MAP KEY: 2-4-001:PORTION OF 007**

For your information, water can be made available from the existing 12-inch waterline in Nowelo Street fronting the subject parcel.

The final environmental assessment should contain the anticipated average day, maximum day and peak-hour water usage as recommended by a registered engineer. The Department reserves the right to make a final determination. These calculations will be needed so that the Department can determine the correct facilities charge for the subject parcel.

If you have any questions, please contact our Water Resources and Planning Branch at 961-8070, extension 1.

Sincerely yours,

Milton D. Pavao, P.E.
Manager

BCM:jkh

SidneyFuke, Planning Consultant
100 Pauahi Street, Suite 212 • Hilo, Hawaii 96720
Telephone: (808) 969-1522 • Fax: (808) 969-7996
• Planning • Subdivisi • Environ

May 28, 2002

Mr. Milton Pavao, Manager
Department of Water Supply
345 Kekuanaoa Street, Suite 20
Hilo, HI 96720

Dear Mr. Pavao:

**Subject: Consultation Request – Draft Environmental Assessment
Mauna Kea Astronomy Education Center, TMK: 2-4-1: Por 7**

Thank you very much for your comments of May 22, 2002 regarding the subject matter.

Please be informed that the appropriate water use calculations will be provided to your office prior to or in conjunction with the building permit process. At that time, the appropriate water facilities charge and meter size can be established. Your comments will be duly noted in the Environmental Assessment.

Again, thank you for the comments.

Sincerely,

SIDNEY M. FUKE
Planning Consultant

SidneyFuke, Planning Consultant
100 Pauahi Street, Suite 212 • Hilo, Hawaii 96720
Telephone: (808) 969-1522 • Fax: (808) 969-7996
• Planning • Variance • Zoning
• Subdivision • Land Use Permits
• Environmental Reports

Klm

May 10, 2002

Mr. Jon Giffin, District Manager
Division of Forestry and Wildlife
STATE DEPARTMENT OF LAND & NATURAL RESOURCES
P.O. Box 4849
Hilo, HI 96720

Dear Mr. Giffin:

Subject: **Consultation Request – Draft Environmental Assessment**
Mauna Kea Astronomy Education Center, TMK: 2-4-01: Por 7

The University of Hawaii at Hilo is proposing the construction of the Mauna Kea Astronomy Education Center (MKAEC), an interpretative facility to be located at the University Park in the City of Hilo on a 9.1+ acre site at an estimated cost of $28 million. The subject area is located on the northeast corner of Nowelu Street and N. Aohoku Place and is a 9.1 acre portion of a parcel identified by TMK: 2-4-01: 007. A map of the proposed site is enclosed.

Tentatively, the proposed interpretative center is to be housed within a 42,000 square foot structure. The center will have a gallery space, a planetarium, an object theatre, multi-media/3-D projection facility, and cutting edge exhibition to showcase the uniting of science and culture. A preliminary concept plan of the proposed tentative 79± foot tall structure, inclusive of the planetarium/dome, is also enclosed. It is projected that the Center will attract approximately 250,000 visitors annually, many of them students.

Construction of this facility is expected to begin in summer of 2003, with an estimated completion by June 2004.

As public lands and funds are involved, an Environmental Assessment is currently being prepared. In preparing this work, I would appreciate any written comments you may have at this time regarding this project before May 22, 2002. You will also have an opportunity provide comments after the draft EA is prepared and made available for public comment. Thank you very much.

Sincerely,

SIDNEY M. FUKE
Planning Consultant

Enclosure
Copy – Mr. George Jacob, Director MKAEC

ENDORSEMENT: Division of Forestry & Wildlife has no comments.

JON G. GIFFIN

5/20/02
DATE

County of Hawaii
POLICE DEPARTMENT
349 Kapiolani Street • Hilo, Hawaii 96720-3998
(808) 935-3311 • Fax (808) 961-8869

May 21, 2002

Mr. Sidney Fuke
Planning Consultant
100 Pauahi Street, Suite 212
Hilo, Hawaii 96720

Dear Mr. Fuke:

SUBJECT: Consultation Request – Draft Environmental Assessment
Mauna Kea Astronomy Education Center, TMK: 2-4-01:Por 7

Our staff has reviewed the proposed Mauna Kea Astronomy Education Center project and has no comments or objections to offer at this time.

Thank you for the opportunity to comment.

Sincerely,

JAMES S. CORREA
POLICE CHIEF

THOMAS J. HICKCOX
ASSISTANT POLICE CHIEF
FIELD OPERATIONS BUREAU

RN:vta

Harry Kim
Mayor

Darryl J. Oliveira
Fire Chief

County of Hawai'i
FIRE DEPARTMENT
25 Aupuni Street • Suite 103 • Hilo, Hawai'i 96720
(808) 961-8297 • Fax (808) 961-8296

May 21, 2002

Mr. Sidney M. Fuke
Planning Consultant
100 Pauahi Street, Suite 212
Hilo, HI 96720

Dear Mr. Fuke:

RE: CONSULTATION REQUEST – DRAFT ENVIRONMENTAL ASSESSMENT
MAUNA KEA ASTRONOMY EDUCATION CENTER, TMK: 2-4-01:POR 7

This responds to your request for comments on the above-referenced project.

Fire apparatus access roads shall be in accordance with UFC Section 10.207:

"**Fire Apparatus Access Roads**

"Sec. 10.207. (a) **General.** Fire apparatus access roads shall be provided and maintained in accordance with the provisions of this section.

"(b) **Where Required.** Fire apparatus access roads shall be required for every building hereafter constructed when any portion of an exterior wall of the first story is located more than 150 feet from fire department vehicle access as measured by an unobstructed route around the exterior of the building.

"**EXCEPTIONS:** 1. When buildings are completely protected with an approved automatic fire sprinkler system, the provisions of this section may be modified.

"2. When access roadways cannot be installed due to topography, waterways, nonnegotiable grades or other similar conditions, the chief may require additional fire protection as specified in Section 10.301 (b).

"3. When there are not more than two Group R, Division 3 or Group M Occupancies, the requirements of this section may be modified, provided, ir the opinion of the chief, fire-fighting or rescue operations would not be impaired.

"More than one fire apparatus road may be required when it is determined by the chief that access by a single road may be impaired by vehicle congestion, conditio of terrain, climatic conditions or other factors that could limit access.

"For high-piled combustible storage, see Section 81.109.

"(c) **Width.** The unobstructed width of a fire apparatus access road shall meet th requirements of the appropriate county jurisdiction.

"(d) **Vertical Clearance.** Fire apparatus access roads shall have an unobstructe vertical clearance of not less than 13 feet 6 inches.

"**EXCEPTION:** Upon approval vertical clearance may be reduced, provide such reduction does not impair access by fire apparatus and approved sigr are installed and maintained indicating the established vertical clearance.

"(e) **Permissible Modifications.** Vertical clearances or widths required by this section may be increased when, in the opinion of the chief, vertical clearances or widths are not adequate to provide fire apparatus access.

"(f) **Surface.** Fire apparatus access roads shall be designed and maintained to support the imposed loads of fire apparatus and shall be provided with a surface s as to provide all-weather driving capabilities." (20 tons)

"(g) **Turning Radius.** The turning radius of a fire apparatus access road shall be as approved by the chief." (45 feet)

"(h) **Turnarounds.** All dead-end fire apparatus access roads in excess of 150 fe in length shall be provided with approved provisions for the turning around of fire apparatus.

"(i) **Bridges.** *When a bridge is required to be used as access under this section,* shall be constructed and maintained in accordance with the applicable sections ot the Building Code and using designed live loading sufficient to carry the imposed loads of fire apparatus.

"(j) **Grade.** The gradient for a fire apparatus access road shall not exceed the maximum approved by the chief." (15%)

"(k) **Obstruction.** The required width of any fire apparatus access road shall not be obstructed in any manner, including parking of vehicles. Minimum required widths and clearances established under this section shall be maintained at all times.

"(l) **Signs.** When required by the fire chief, approved signs or other approved notices shall be provided and maintained for fire apparatus access roads to identify such roads and prohibit the obstruction thereof or both."

Water supply shall be in accordance with UFC Section 10.301:

"(c) **Water Supply.** An approved water supply capable of supplying required fire flow for fire protection shall be provided to all premises upon which buildings or portions of buildings are hereafter constructed, in accordance with the respective county water requirements.. There shall be provided, when required by the chief, on-site fire hydrants and mains capable of supplying the required fire flow.

"Water supply may consist of reservoirs, pressure tanks, elevated tanks, water mains or other fixed systems capable of providing the required fire flow.

"The location, number and type of fire hydrants connected to a water supply capable of delivering the required fire flow shall be protected as set forth by the respective county water requirements. All hydrants shall be accessible to the fire department apparatus by roadways meeting the requirements of Section 10.207."

Sincerely,

DARRYL J. OLIVEIRA
Fire Chief

RK:lk

SidneyFuke, Planning Consultant
100 Pauahi Street, Suite 212 • Hilo, Hawaii 96720
Telephone: (808) 969-1522 • Fax: (808) 969-7996

May 28, 2002

Mr. Darryl J. Oliveira, Chief
Fire Department
COUNTY OF HAWAII
25 Aupuni Street
Hilo, HI 96720

Dear Chief Oliveira:

RE: Consultation Request – Draft Environmental Assessment
<u>Mauna Kea Astronomy Education Center, TMK: 2-4-01: Pc</u>

Thank you very much for your written comments of May 21, 2002 regarding tl subject matter.

Please be informed that the requirements of the Fire Code relative to building, access, and water will be complied with in conjunction with the building permit proce of this project. All utilities, including water, are available to the subject site. Your comments will be incorporated in the Environmental Assessment.

Again, thank you for the comments.

Sincerely,

SIDNEY M. FUKE
Planning Consultant

Harry Kim
Mayor

Patricia G. Engelhard
Director

Pamela N. Mizuno
Deputy Director

County of Hawai'i

DEPARTMENT OF PARKS AND RECREATION

25 Aupuni Street, Room 210 • Hilo, Hawai'i 96720-4252
(808) 961-8311 • Fax (808) 961-8411

April 2, 2002

To Whom It May Concern:

The University of Hawaii at Hilo is proposing the construction of the Mauna Kea Astronomy Education Center (MKAEC), an interpretative facility to be located at the University Park in the City of Hilo, at an estimated cost of $28 million.

The subject site is located at the northeast corner of Nowelu Street and N. Aohoku Place on a 9.1 acre portion of a parcel identified as TMK: (3) 2-4-01:007.

The County of Hawaii Department of Parks and Recreation does not have any plans to utilize this parcel for any public recreational program or activity. As such, we do not believe that the MKAEC project would have any adverse impacts to our operations and thus we do not have any objection to the MKAEC project.

If you have any questions on this matter, please contact staff planner Glenn Miyao.

Thank you for the opportunity to review the project.

Sincerely,

Patricia G. Engelhard
Director

SidneyFuke, Planning Consultant
100 Pauahi Street, Suite 212 • Hilo, Hawaii 96720
Telephone: (808) 969-1522 • Fax: (808) 969-7996
• Planni
• Subdi
• Enviro

May 28, 2002

Ms. Patricia Englehard, Director
Department of Parks and Recreation
COUNTY OF HAWAII
101 Pauahi Street
Hilo, HI 96720

Dear Ms. Englehard:

Subject: **Draft Environmental Assessment Consultation**
<u>Mauna Kea Astronomy Education Center, TMK: 2-4-01: por</u>

Thank you very much for your letter of April 2 regarding the subject matter. We appreciate your comments that this project would have no adverse impact to your recreational programs or activities and that you have no objections to it.

Please note that your comments will be incorporated in the Environmental Assessment. Again, thank you and if you have any questions on this matter, please feel free to contact me.

Sincerely,

SIDNEY M. FUKE
Planning Consultant

Harry Kim
Mayor

County of Hawaii

DEPARTMENT OF PUBLIC WORKS
Aupuni Center
101 Pauahi Street, Suite 7 • Hilo, Hawaii 96720-4252
(808) 961-8321 • Fax (808) 961-8630

Dennis K. W. Lee
Director

Ronald Ueoka
Deputy Director

April 3, 2002

To Whom It May Concern:

The University of Hawaii at Hilo is proposing the construction of the Mauna Kea Astronomy Education Center (MKAEC), an interpretative facility to be located at the University Park in the City of Hilo on a 9.1 acre site at an estimated cost of $28 million.

The subject area is located on the northeast corner of Nowelu Street and N. Aohoku Place and is a 9.1 acre portion of a parcel identified by TMK: 2-4-01: 007.

It is projected that the Center will generate approximately 250,000 visitors annually. The projected daily visitor count is 600, with an estimated vehicular count (including buses) of 150.

The project will generate a traffic impact to the County's road system, particularly Komohana Street. However, it is our considered opinion at this time that said street is able to accommodate the additional traffic. There may, however, be a need to install traffic signal lights at the intersection of Komohana and Nowelu Streets. If required, the developer will be responsible to install the traffic signal lights. Such a requirement, if any, shall be reserved pending receipt and review of a Traffic Analysis Report that will be made part of the Environmental Assessment process for this project.

Should you have any questions on this matter, please feel free to contact me at (808) 961-8324.

Dennis K.W. Lee

DENNIS K. W. LEE, P. E.
Director

DKWL:jjs

SidneyFuke, Planning Consultant
100 Pauahi Street, Suite 212 • Hilo, Hawaii 96720
Telephone: (808) 969-1522 • Fax: (808) 969-7996

• Planning
• Subdivisi
• Environ

May 28, 2002

Mr. Dennis Lee, Director
Department of Public Works
COUNTY OF HAWAII
101 Pauahi Street
Hilo, HI 96720

Dear Mr. Lee:

Subject: **Draft Environmental Assessment Consultation**
Mauna Kea Astronomy Education Center, TMK: 2-4-01: por 7

Thank you for your letter of April 3 regarding the subject matter. Please be informed that a traffic impact study will be prepared in conjunction with the preparation of the EA. In the event that traffic lights at the intersection of Komohana Street and Nowelo Street are warranted and due to this project, they will be implemented by the UHH.

Again, thank you for your comments, and they will be incorporated in the EA.

Sincerely,

SIDNEY M. FUKE
Planning Consultant

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

HISTORIC PRESERVATION DIVISION
KAKUHIHEWA BUILDING, ROOM 555
601 KAMOKILA BOULEVARD
KAPOLEI, HAWAII 96707

GILBERT S. COLOMA-AGARAN, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCES MANAGEMENT

DEPUTIES
ERIC T. HIRANO
LINNEL NISHIOKA

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND
STATE PARKS

April 17, 2002

LOG NO: 29279
DOC NO: 0204ms02

Mr. Sidney Fuke
Planning Consultant
100 Pauahi Street, Suite 212
Hilo, Hawaii 96720

Dear Mr. Fuke:

**SUBJECT: Request for Archaeological Clearance Letter
Mauna Kea Astronomy Education Center
Waiakea, South Hilo, Hawaii Island
TMK: (3)2-4-01: 7 and 41**

Thank you for your letter of April 1, 2002, requesting our concurrence with a "no historic properties affected" determination for the proposed Mauna Kea Astronomy Education Center located at University Park, University of Hawaii at Hilo.

It is our understanding that you are in the process of preparing an Environmental Assessment for the Center which is proposed to be constructed on a 9.1 acre site in the UHH Research and Technology Park. Funding for the project is being provided by NASA, a federal agency, thus requiring the National Historic Preservation Act - Section 106 Review. The federal agency must evaluate the impacts of the proposed project on significant historic properties. This review process includes the identification of historic properties and assessment of their significance, as well as consultation with interested parties. Until these activities are completed and we have had an opportunity to review the information and assessment of impacts, we cannot comment on the impacts this project may have on significant historic properties.

In reviewing our files we approved an inventory survey report: *Archaeological Survey and Testing of Lands Proposed for Research and Technology Lots at the University of Hawaii at Hilo* (Borthwick, Collins, Folk and Hammatt 1993), with a letter dated October 28, 1994 (log no. 13055). We concurred with their findings that no significant historic properties were present in the project area, and no additional work was requested. This determination suggests no significant historic properties are present; however, consultation may provide information about currently unknown sites that may be present in the project area.

At this time it is premature for us to provide a concurring opinion that no historic properties v be affected by this proposed project. When consultation has occurred, and the information ha been submitted to our office we can then complete the NHPA Section 106 review. If you hav further questions please call Pat McCoy at 692-8029 (Honolulu), or Marc Smith at 933-0482 (Hilo).

Aloha,

GILBERT COLOMA-AGARAN
State Historic Preservation Officer

MS:amk

SidneyFuke, Planning Consultant
100 Pauahi Street, Suite 212 • Hilo, Hawaii 96720
Telephone: (808) 969-1522 • Fax: (808) 969-7996

• Planning • Variance • Zoning
• Subdivision • Land Use Permits
• Environmental Reports

May 28, 2002

Mr. Gilbert Coloma-Agaran
State Historic Preservation Officer
Department of Land & Natural Resources
601 Kamokila Boulevard
Kapolei, HI 96707

Dear Mr. Coloma-Agaran:

Subject: **Draft Environmental Assessment Consultation**
Mauna Kea Astronomy Education Center, TMK: 2-4-01: por 7

Thank you for your letter of April 17, 2002 regarding the subject matter.

Please be informed that the archaeological reports prepared for this area will be re-evaluated and incorporated into the EA. The botanical study will also be reviewed to see whether any of the previously identified endemic or indigenous plants fall within the most current State or Federal endangered or threatened plant list.

We look forward to your comments and participation on this matter through the EA process. Should you have any questions on this matter in the meantime, please feel free to contact this office. Thank you very much.

Sincerely,

SIDNEY M. FUKE
Planning Consultant

BENJAMIN J. CAYETANO
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 916
HILO, HAWAII 96721-0916

BRUCE S. ANDERSON, Ph.D., M.P.H.
DIRECTOR OF HEALTH

May 14, 2002

Mr. Sidney M. Fuke
Planning Consultant
100 Pauahi Street, Suite 212
Hilo, Hawaii 96720

Dear Mr. Fuke:

Subject: Consultation Request – Draft Environmental Assessment
Mauna Kea Astronomy Education Center
Tax Map Key: 2-4-01:Por 7

Thank you for allowing the Department of Health to make preliminary comments to the proposed project. The following comments are shared with you:

1. The Department of Health supports wastewater disposal by means of a sewer system for the proposed project.

2. Underground Injection Systems (Ph. 586-4258) which receive wastewater or storm run-offs from the proposed development need to address the requirements of Chapter 23, Hawaii State Department of Health Administrative Rules, Title 11, "Underground Injection Control."

3. The applicant should contact the Army Corps of Engineers (COE) to identify whether a Federal permit (including a Department of Army (DA) permit) is required for this project. A Section 401 Water Quality Certification (WQC) is required for "Any applicant for Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters...," pursuant to Section 401(a)(1) of the Federal Water Pollution Act (commonly known as the "Clean Water Act (CWA)").

If the project involves the following activities with discharges into State waters, an NPDES general permit is required for each activity:

a. Discharge of storm water runoff associated with construction activities, including clearing, grading, and excavation that result in the disturbance c equal to or greater than five (5) acres of total land area;

b. Construction dewatering effluent;

c. Non-contact cooling water;

d. Hydrotesting water; and

e. Treated contaminated groundwater from underground storage tank remedial activity.

The application for NPDES general permit coverage should be submitted to the Director at least 30 days prior to the discharge to State waters.

If there is any type of process wastewater discharge from the facility into State waters, the applicant may be required to apply for an Individual NPDES permit. The application for an Individual NPDES permit should be submitted to the Director at least 180 days prior to the discharge of process wastewater to State waters.

Should you have any further questions regarding this matter, please contact the Engineering Section of the Clean Water Branch in Honolulu at (808) 586-4309.

4. Construction activities must comply with the provisions of Hawaii Administrati Rules, Chapter 11-46, "Community Noise Control."

a. The contractor must obtain a noise permit if the noise levels from the construction activities are expected to exceed the allowable levels of the rules.

b. Construction equipment and on-site vehicles requiring an exhaust of gas air must be equipped with mufflers.

c. The contractor must comply with the requirements pertaining to construction activities as specified in the rules and the conditions issued with the permit.

Should there be any questions on this matter, please contact the Department of Health at 933-0917.

Sincerely,

AARON UENO
District Environmental Health
Program Chief, Hawaii

SidneyFuke, Planning Consultant
100 Pauahi Street, Suite 212 • Hilo, Hawaii 96720
Telephone: (808) 969-1522 • Fax: (808) 969-7996

May 28, 2002

Mr. Aaron Ueno, District Chief
Environmental Health Division
State of Hawai'i
P.O. Box 916
Hilo, HI 96721-0916

Dear Mr. Ueno:

Subject: **Draft Environmental Assessment Consultation ·**
Mauna Kea Astronomy Education Center, TMK: 2-4-01: p

Thank you very much for your comments of May 28 regarding the subject ma
In response to your comments, please note the following:

1. The wastewater for this project will be disposed into the County's syst

2. In the event an Underground Injection Control (UIC) permit is require accommodate the on-site drainage, it will be processed in conjunction the construction permitting process of this project.

3. The subject site does not have any wetland, neither will any of its wastewater or drainage be discharged into "navigable waters". We w contact the Army Corps of Engineers on this matter, and if permit(s) a required, they will be secured prior to initiation of construction of this project. Likewise, if an NPDES permit is required to accommodate th on-site drainage, it will be processed during the construction permittin phases of this project.

4. The comment on community noise control is well taken. All contract will be required to adhere to the appropriate rules, for conformance wi help mitigate potential adverse short-term noise impacts.

Your comments will be incorporated into the Environmental Assessment. Ag thank you very much for your comments.

Sincerely,

SIDNEY M. FUKE
Planning Consultant

BENJAMIN J. CAYETANO
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF EDUCATION
OFFICE OF THE DISTRICT SUPERINTENDENT
HAWAII DISTRICT
P.O. BOX 4160
HILO, HAWAII 96720-0160

PATRICIA HAMAMOTO
[illegible]
SUPERINTENDENT

May 14, 2002

Mr. Sidney M. Fuke, Planning Consultant
100 Pauahi Street
Suite 212
Hilo, Hawaii 96720

Dear Mr. Fuke:

Re: Consultation Request-Draft Environmental Assessment
Mauna Kea Astronomy Education Center, TMK: 2-4-01: Por 7

I am very pleased that the plans for an Environmental Assessment are currently being prepared. The proposed site for the construction of the Mauna Kea Astronomy Education Center (MKAKEC) as an interpretative facility is well situated. I am delighted and excited that the plans for this center are progressing well and a target date has been derived.

Thank you for providing me the opportunity to respond and comment on this project. At present, I do not have any major comments regarding the site location. I look forward to hearing more about the Center's development.

Thank you again.

Sincerely,

Valerie Takata

Valerie Takata
Complex Area Superintendent

VT:em

SidneyFuke, Planning Consultant
100 Pauahi Street, Suite 212 • Hilo, Hawaii 96720
Telephone: (808) 969-1522 • Fax: (808) 959-7996

• Plan
• Subd
• Envi

May 28, 2002

Ms. Valerie Takata, Complex Area Superintendent
Hawaii District
State Department of Education
P.O. Box 4160
Hilo, HI 96720-0169

Dear Ms. Takata:

Subject: **Consultation Request – Draft Environmental Assessment**
Mauna Kea Astronomy Education Center, TMK: 2-4-01: Por

Thank you very much for your comments of May 14 regarding the subject matte
We appreciate your support and enthusiasm of this project.

The University of Hawai'i at Hilo and the Center intend to work closely with yo
and others to assure the project serves and stimulates the educational needs of the community. Your comments will be made a part of the Environmental Assessment.

Again, thank you very much for your comments and support.

Sincerely,

SIDNEY M. FUKE
Planning Consultant

BENJAMIN J. CAYETANO
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENT QUALITY CONTROL
235 SOUTH BERETANIA STREET
SUITE 702
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185
FACSIMILE (808) 586-4186

GENEVIEVE SALMONSON
DIRECTOR

May 14, 2002

Sidney Fuke
100 Pauahi Street, #212
Hilo, Hawaii 96720

Dear Mr. Fuke:

Subject: **Mauna Kea Astronomy Education Center (MKAEC)**
Draft Environmental Assessment (EA) Preconsultation

We are in receipt of your May 10th 2002 request for preconsultation comments. In the upcoming draft EA provide a description and analysis of the cumulative impacts of your project in relation to others in the immediate area, either recently completed or in the planning stages. We received a finalized EA for the Smithsonian base facility in February 2001 and a final EIS for the UH-Hilo campus expansion in December 1997. Consult with the Hawaii County Planning Department and the UH-Hilo administration for others which may now be in the planning stages.

The EIS law requires an analysis of the cumulative impacts of geographically-related projects. Factors should include noise, air quality, water resources, and drainage. Traffic congestion and parking are also prime concerns for this area.

If you have any questions call Nancy Heinrich at 586-4185.

Sincerely,

Genevieve Salmonson

GENEVIEVE SALMONSON
Director

SidneyFuke, Planning Consultant
100 Pauahi Street, Suite 212 • Hilo, Hawaii 96720
Telephone: (808) 969-1522 • Fax: (808) 969-7996

• Plann
• Subd
• Envir

May 28, 2002

Ms. Genevieve Salmonson, Director
Office of Environmental Quality Control
State of Hawai`i
235 South Beretania Street
Honolulu, HI 96813

Dear Ms. Salmonson:

Subject: **Draft Environmental Assessment Consultation**
Mauna Kea Astronomy Education Center, TMK: 2-4-01: Por

Thank you very much for your comments of May 14, 2002 regarding the subject matter.

Please be informed that the draft EA will include a discussion of the cumulative impacts of the project. The impacts, particularly from the traffic, air quality, water, and drainage perspectives, of the proposed Smithsonian base facility (located adjacent to the subject site), the UHH campus expansion, as well as the proposed Federal Department o Agriculture center on the mauka side of Komohana Street will be considered.

Again, thank you for your comments.

Sincerely,

SIDNEY M. FUKE
Planning Consultant

APPENDIX H

DRAFT EA
COMMENTS AND RESPONSES

PHONE (808) 594-1888

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPIOLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813

FAX (808) 594-1865

HRD02/275 F

July 15, 2002

Ms. Trudy Kortes
Environmental Services Division
NASA Ames Research Center
Mail Stop 218-1
Moffett Field, CA 94035-1000

RE: Draft Environmental Assessment for the Construction of the Mauna Kea Astronomy Education Center, TMK: 2-4-001-007

Dear Ms. Kortes,

The Office of Hawaiian Affairs (OHA) is in receipt of the above referenced document. OHA is mandated by State law to work for the "betterment of Native Hawaiians." This includes insuring OHA's entitlement to income from the ceded lands trust and adherence to all State and Federal laws enacted for the protection of Native Hawaiian cultural and traditional practices, and for the preservation of Native Hawaiian historic and prehistoric sites. The subject EA falls short of addressing these issues of Hawaiian entitlement to ceded land revenue and protection of cultural resources.

The final EA should address the fact that the center's revenue generating operations are subject to the OHA trust provision. Native Hawaiians have a right under the State Constitution to benefit from the ceded lands trust (Haw. Const. art. XII, §4). OHA notes that commercial activities, including retail sales and a restaurant are included in the plans for the education center. As in the past, OHA is entitled to a share of the profits generated on ceded lands. We encourage the Mauna Kea Astronomy Center to accommodate OHA's interests in its plans for retail sales. OHA suggests setting aside some portion of the revenues for scholarships for Native Hawaiians as one way of meeting the constitutionally mandated obligation to Hawaiians

Compliance with Federal law on Native Hawaiian traditional and cultural properties must also be demonstrated in the final EA. NASA is partially funding this project, implicating Federal laws such as the National Historic Preservation Act (NHPA). While the Environmental Assessment references compliance with the National Environmental Policy Act (NEPA) it does not mention compliance with the National Historic Preservation Act (NHPA). Under NHPA, the Federal agency funding a project must assess the area impacted by the project for adverse effects on historic properties, including Native Hawaiian traditional and cultural properties. No such assessment seems to have been done

Furthermore, if an agency deems that the project will have "no effect" it must consult with the State Historic Preservation Officer (SHPO) and Native Hawaiian organizations regarding its decision. OHA is named as a Native Hawaiian Organization to be consulted. The EA makes no reference to consultation with Native Hawaiian organizations or the SHPO, nor has OHA received a formal request for consultation on the project's impacts on cultural resources.

A review of impacts on cultural resources is mandated not only by Federal law but by State law as well. State law requires that a cultural impact assessment be included with the environmental impact assessment (Chapt. 343, HRS). No cultural assessment was done in this instance. An archaeological assessment with no findings does not substitute for an assessment of current cultural uses. OHA notes that uluhe is often used in lei-making, and given the abundant growth of uluhe in the project area, Native Hawaiian practitioners would not have to go far to pick adequate supplies. OHA urges NASA to let the Hawaiian community speak to its own cultural practices and to do an adequate cultural assessment for inclusion in the final EA

This project requires a height variance , however nothing in the EA justifies such a request. Therefore, OHA questions the need for such a tall, obtrusive structure. We also question the need for a dome top, rather than something more in keeping with local or Hawaiian architecture. OHA requests that an analysis of the structure's impact on view planes from neighboring residential areas and from the Hilo Bay area be included in the final EA, should the design not change.

Thank you for the opportunity to comment on this project. Should you have further questions please contact Pua Aiu, Acting Assistant Director, Hawaiian Rights Division at 594-1931 or e-mail her at paiu@oha.org.

Sincerely,

Jalna Keala

Jalna Keala
Acting Director, Hawaiian Rights Division

National Aeronautics and
Space Administration
Ames Research Center
Moffett Field, CA 94035-1000

Reply to Attn of: M/S 218-1

July 31, 2002

Ms. Jalna Keala, Acting Director
Hawaiian Rights Director
State Office of Hawaiian Affairs
711 Kapi'olani Boulevard, Suite 500
Honolulu, Hawai'i 96813

Dear Ms. Keala:

**Subject: Comments on Draft Environmental Assessment
Mauna Kea Astronomy Education Center (MKAEC)
Waiakea, South Hilo, Hawai'i, TMK: 2-4-01: por 7**

This is to acknowledge the receipt of and to respond to your letter of July 15, 2002 providing comments on the subject matter.

In response to your comments, we would like to note the following:

a. The OHA ceded land revenue provision is a State issue on which NASA takes no position. We have been informed that the UHH will be working with OHA on this matter.

b. The Draft Environmental Assessment (EA) did include a discussion of the project's impacts to the area's historic and cultural resources. This is found in Chapters 3.10 Cultural Resources and 5.1.12 Cultural and Archaeological Resources of the Draft EA. You will note that a review of the area's cultural resources performed by Dr. Alan Haun is included in the document (Appendix D). This review is based on extensive archaeological surveys, including considerations of cultural history, which are provided in Appendix C. Enclosed for your information is a letter from the State Historic Preservation Officer who concluded that "no historic properties will be affected by this (MKAEC) undertaking."

c. Prior to preparing the Draft EA, our consultant requested comments from a number of agencies, including the State Historic Preservation Office and OHA. A copy of this consultation letter to your office is enclosed. Based

on comments received during this consultation period as well as other information, the Draft EA was prepared.

d. In spite of the archaeological inventory survey conducted of the site, during the course of construction, there may be inadvertent archaeological finds. In that event, as pointed out in Chapter 6.0 Mitigation and Unavoidable Short- and Long-Term Adverse Impacts, work will stop and appropriate clearances from the State DLNR-HPD will be secured before work in the affected area resumes.

Likewise, should there be legitimate claims prior to construction of the project that the subject site has been used for gathering, access, or other customary activities by native Hawaiians, the UHH and/or MKAEC will respect and honor such claims and make the necessary accommodations. This will be acknowledged in the Final EA.

e. Finally, the concept design in the Draft Federal EA is one of many tentative options available. The architectural firm selected for the project will be advised to solicit public input on the proposed building design concepts. They will be required to take into consideration public comments before submitting final design concepts to the MKAEC Selection and Review Committee.

We sincerely appreciate your comments on this matter. Please note that your comments will be made a part of the Final EA. Thank you very much for participating in this review.

Sincerely,

Trudy Kortes

Trudy Kortes
Environmental Engineer

Enclosures

Copy (w/o enclosures):
Dr. Rose Tseng, Chancellor, UHH
Mr. George Jacob, Project Director, MKAEC
Mr. Sidney Fuke, Planning Consultant

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

HISTORIC PRESERVATION DIVISION
KAKUHIHEWA BUILDING, ROOM 555
601 KAMOKILA BOULEVARD
KAPOLEI, HAWAII 96707

GILBERT S. COLOMA-AGARAN
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCES

HAWAI'I HISTORIC PRESERVATION DIVISION REVIEW

LOG NO.: 30225
DOC NO.: 0207PM02

Agency/Applicant: NASA Ames Research Center (Attn. Ms. Trudy Kortes)
Address: Mail Stop 218-1
Moffett Field, CA 94035-1000

Project: Mauna Kea Astronomy Education Center
Location: Waiakea, South Hilo, Hawaii Island
TMK: (3) 2-04-001:Por. 7

1. We believe there are no historic properties present because:

———a. intensive cultivation has altered the land
———b. residential development/urbanization has altered the land
———c. previous grubbing/grading has altered the land
———d. an acceptable archaeological assessment or inventory survey found no historic properties
———e. other:

2. This project has already gone through the historic preservation review process, and mitigation has been completed. _X__

Thus, we believe that "no historic properties will be affected" by this undertaking.

Signed ______________ Date 7/2/02
Gilbert Coloma-Agaran
State Historic Preservation Officer

National Aeronautics and
Space Administration
Ames Research Center
Moffett Field, CA 94035-1000

Reply to Attn of: 218-1

July 22, 2002

Mr. Gilbert Coloma-Agaran
State Historic Preservation Officer
Department of Land and Natural Resources
601 Kamokila Boulevard
Kapolei, HI 96707

Dear Mr. Coloma-Agaran:

Subject: Comments on Draft Environmental Assessment
Mauna Kea Astronomy Education Center (MKAEC)
Waiakea, South Hilo, Hawai'i, TMK: 2-4-01: por 7

This is to acknowledge the receipt of and to respond to your letter of July 2, 2002 providing comments on the subject matter. We appreciate your review and subsequent conclusion that "no historic properties will be affected by this (MKAEC) undertaking."

Your comments will be made part of the Final Environmental Assessment. Thank you very much for participating in this review.

Sincerely,

Trudy Kortes
Trudy Kortes
Environmental Engineer

Copy – Dr. Rose Tseng, Chancellor, UHH
Mr. George Jacob, Project Director, MKAEC
Mr. Sidney Fuke, Planning Consultant

BENJAMIN J. CAYETANO
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
P.O. Box 2359
Honolulu, HI 96804-2359
Telephone: 808-587-3822
Fax: 808-587-3827

May 28, 2002

Mr. Sidney M. Fuke
Sidney Fuke, Planning Consultant
100 Pauahi Street, Suite 212
Hilo, Hawaii 96720

Dear Mr. Fuke:

Subject: Consultation Request – Draft Environmental Assessment ("Draft EA")
Mauna Kea Astronomy Education Center
TMK Nos: 2-4-01: Por 7
Waiakea, South Hilo, Hawaii

We have reviewed the subject request as transmitted by your letter dated May 10, 2002, for the construction of the Mauna Kea Astronomy Education Center at Waiakea, South Hilo, Hawaii.

Upon review of the subject request, we have the following comments:

1. We confirm that the proposed project area is within the State Land Use Urban District.

2. The plot map for the project shows a reference on the west side of Komohana Street as available for expansion of the University of Hawaii Hilo University Park. We would like to point out that this area is in the Agricultural District based upon the map information.

3. We will provide additional comments when more extensive information is provided in the Draft EA.

Thank you for the opportunity to provide comment on the subject application. Should you require clarification or further assistance in this matter, please contact Russell Kumabe of my staff at (808) 587-3822.

Sincerely,

Anthony J. H. Ching

ANTHONY J. H. CHING
Executive Officer

National Aeronautics and
Space Administration

Ames Research Center
Moffett Field, CA 94035-1000

Reply to Attn of: M/S 218-1

July 22, 2002

Mr. Anthony Ching, Executive Director
State Land Use Commission
P. O. Box 2359
Honolulu, HI 96804-2359

Dear Mr. Ching:

Subject: **Comments on Draft Environmental Assessment**
Mauna Kea Astronomy Education Center (MKAEC)
Waiakea, South Hilo, Hawai'i, TMK: 2-4-01: por 7

This is in response to your letter of May 28, 2002 to planning consultant Sidney Fuke, responding to a request for consultation relative to the subject matter. Please be informed that although your letter was not included in the Draft Environmental Assessment, your comments were noted in the document.

The document did note that the project site is within the State Land Use *Urban* district. No reference to possible use and/or expansion on the west side of Komohana Street for this project was made. It is acknowledged, however, that the west or *mauka* side of Komohana Street is within the State Land Use *Agricultural* district.

Your May 28 letter will be made a part of the Final Federal and State EA. Please note however, that the review period for the draft State EA is August 7, 2002. Any other comments received prior to that date would also be included in the Final State EA.

Thank you very much for your constructive input and for participating in this process.

Sincerely,

Trudy Kortes

Trudy Kortes
Environmental Engineer

Copy – Dr. Rose Tseng, Chancellor, UHH
Mr. George Jacob, Project Director, MKAEC
Mr. Sidney Fuke, Planning Consultant

University of Hawaii at Manoa

Institute for Astronomy
2680 Woodlawn Drive • Honolulu, Hawaii 96822
Telex: 723-8459 • UHAST HR

July 11, 2002

Office of the Director

Ms. Trudy Kortes
Environmental Services Division
NASA Ames Research Center
Mail Stop 218-1
Moffet Field, CA 94035-1000

Dear Ms. Kortes:

Re: Draft Federal EA for the Mauna Kea Astronomy Education Center

Thank you for the opportunity to review and comment on the Draft Federal Environmental Assessment for the Mauna Kea Astronomy Education Center.

We agree with your conclusion (Section 5.1.4) that it will be necessary to install traffic signals at the intersection of Komohana and Nowelo Streets. It is also very important that there be adequate parking space available on-site at MKAEC and adequate space for buses to turn around without having to proceed all the way to the north end of A'ohoku Place.

If the MKAEC were not to be built, there would continue to be no good sea level opportunity for learning about the Mauna Kea Observatories. This would lead to a higher level of visitor traffic on the mountain with the attendant safety risk, especially for those whose health is not the best. We suggest that this factor could be mentioned as an adverse impact of the No Action alternative (Section 5.4).

More generally, we would like to take this opportunity to express our strong support for this project. The MKAEC will be a superb showcase not only for modern observational astronomy, but also for the unique cultural environment within which it is practiced here in Hawaii. The Center will provide a rich diversity of educational and outreach opportunities and will serve as an economic stimulus. We are very pleased to see this project moving forward.

Yours sincerely,

Robert A. McLaren
Associate Director

RAM:kkt

c: George Jacob, Project Director, MKAEC

AN EQUAL OPPORTUNITY EMPLOYER

National Aeronautics and
Space Administration
Ames Research Center
Moffett Field, CA 94035-1000

Reply to Attn of: M/S 218-1

July 22, 2002

Mr. Robert A. McLaren, Associate Director
University of Hawai'i at Manoa
Institute for Astronomy
2680 Woodlawn Drive
Honolulu, HI 96822

Dear Mr. McLaren:

Subject: Comments on Draft Environmental Assessment
Mauna Kea Astronomy Education Center (MKAEC)
Waiakea, South Hilo, Hawai'i, TMK: 2-4-01: por 7

This is to acknowledge the receipt of and to respond to your identical letters of July 11, 2002 to Ms. Trudy Kortes of NASA Ames Research Center and to Dr. Rose Tseng, Chancellor, UHH.

In response to your comments, please note that:

a. Adequate parking and turn around areas for both buses and vehicles will be provided on-site. This is to avoid, as you accurately pointed out, excessive traffic along the north end of A'ohoku Place.

b. Your point on the facility having the potential of reducing traffic at the summit is well taken and will be reflected in the Final Environmental Assessment (EA).

Your comments will be made a part of the Final Environmental Assessment. We appreciate your constructive input and thank you for participating in this review.

Sincerely,

Trudy Kortes

Trudy Kortes
Environmental Engineer

Harry Kim
Mayor

Dennis K. W. Lee
Director

Ronald Ueoka
Deputy Director

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
Aupuni Center
101 Pauahi Street, Suite 7 · Hilo, Hawaii 96720-3043
(808) 961-8321 · Fax (808) 961-8630

July 15, 2002

Ms. Trudy Kortes
Environmental Services Division
NASA Ames Research Center
Mail Stop 218-1
Moffett Field, CA 94035-1000

SUBJECT: DRAFT FEDERAL ENVIRONMENTAL ASSESSMENT
Mauna Kea Astronomy Education Center
University Park of Science and Technology
University of Hawaii at Hilo
Waiakea, South Hilo, Hawaii
TMK: (3) 2-4-01: Portion of 007

We have reviewed the subject draft environmental assessment and have the following comments.

1. All new building construction shall comply with current code requirements.
2. All development-generated runoff shall be disposed of on site and shall not be directed toward any adjac properties.
3. All earthwork activity shall conform to Chapter 10, Erosion and Sedimentation Control, of the Haw County Code.
4. Any work within the County right-of-way shall conform to Chapter 22, Streets and Sidewalks, the Hawaii County Code.
5. Streetlights and traffic control devices shall be installed as required by the Traffic Division, Departm of Public Works. The applicant shall be responsible for the design, purchase, and installation of su devices. The Traffic Division may be contacted at (808) 961-8341.

Questions may be referred to Mr. Kelly Gomes of our Engineering Division at (808) 961-8327.

Kelly Gomes
for BEN ISHII, Acting Division Chief
Engineering Division

KG

National Aeronautics and
Space Administration
Ames Research Center
Moffett Field, CA 94035-1000

Reply to Attn of: M/S 218-1

August 1, 2002

Mr. Ben Ishii, Acting Division Chief
Engineering Division
County Department of Public Works
101 Pauahi Street
Hilo, HI 96720

Dear Mr. Ishii:

Subject: **Comments on Draft Environmental Assessment**
Mauna Kea Astronomy Education Center Waiakea,
South Hilo, HI, TMK: 2-4-01: Portion of 007

Thank you for your comments on the subject matter. In response to said comments, please note the following:

The appropriate design and/or engineering consultants for this project will be responsible for preparing and processing the appropriate plans and permits relating to the site preparation and construction of the proposed project. Said plans and/or permit applications, such as the grading, work within the public rights-of-way, or building, will be submitted to the Department of Public Works for review and approval. The Draft Federal EA addresses the issue of locally generated stormwater in Section 5.1.9, Floodplains and Drainage. In addition, site plans will reflect the disposal and/or containment of locally generated runoff on-site.

The University of Hawai'i at Hilo will install traffic signals at the intersection of Nowelo Street and Komohana Street. Plans for these and all other traffic control improvements will be submitted to the Traffic Division of the Department of Public Works for its review and approval.

Your comments will be incorporated into the Final Environmental Assessment. Again, thank you for participating in this review.

Sincerely,

Trudy Kortes
Trudy Kortes
Environmental Engineer

Cc:
Mr. Sidney Fuke, Planning Consultant
Mr. George Jacob, Project Director, MKAEC
Dr Rose Tseng, Chancellor, UHH

Harry Kim
Mayor

County of Hawai'i
FIRE DEPARTMENT
25 Aupuni Street • Suite 103 • Hilo, Hawai'i 96720
(808) 961-8297 • Fax (808) 961-8296

Darryl J. Olivi
Fire Chief

Desmond K. W
Deputy Fire Chief

June 19, 2002

Ms. Trudy Kortes
Environmental Services Division
NASA Ames Research Center
Mail Stop 218-1
Moffett Field, CA 94035-1000

Dear Ms. Kortes:

RE: DRAFT ENVIRONMENTAL ASSESSMENT
MAUNA KEA ASTRONOMY EDUCATION CENTER

This responds to your request for comments on the above-referenced Draft Environmental Assessment.

We have no comments to offer at this time regarding the Draft EA.

Thank you for the opportunity to comment.

Sincerely,

DARRYL J. OLIVEIRA
Fire Chief

RK:lk

National Aeronautics and
Space Administration
Ames Research Center
Moffett Field, CA 94035-1000

Reply to Attn of:

M/S 218-1

July 22, 2002

Mr. Darryl J. Oliveira, Chief
Fire Department
COUNTY OF HAWAI'I
25 Aupuni Street
Hilo, HI 96720

Dear Mr. Oliveira:

Subject: **Comments on Draft Environmental Assessment**
Mauna Kea Astronomy Education Center (MKAEC)
Waiakea, South Hilo, Hawai'i, TMK: 2-4-01: por 7

This is to acknowledge the receipt of and to respond to your letter of June 19, 2002 providing comments on the subject matter.

We note that you had no comments on the subject matter. We nonetheless appreciate your taking the time to review and respond accordingly. Your comments will be made part of the Final Environmental Assessment. Thank you very much.

Sincerely,

Trudy Kortes
Environmental Engineer

Copy – Dr. Rose Tseng, Chancellor, UHH
Mr. George Jacob, Project Director, MKAEC
Mr. Sidney Fuke, Planning Consultant

Harry Kim
Mayor

James S
Police

County of Hawaii

POLICE DEPARTMENT
349 Kapiolani Street • Hilo, Hawaii 96720-3998
(808) 935-3311 • Fax (808) 961-8869

June 26, 2002

Ms. Trudy Kortes
Environmental Services Division
NASA Ames Research Center
Mail Stop 218-1
Moffett Field, CA 94035-1000

Dear Ms. Kortes:

Subject: Draft Environmental Assessment
Mauna Kea Astronomy Education Center

The University of Hawai'i at Hilo and/or the Mauna Kea Astronomy Education Center's commitment to install traffic lights at the Komohana and Nowelo Streets intersection will mitigate any traffic impact; thus, relieves us of this concern. The extension of Nowelo Street through the campus is also viewed as another avenue of relief and therefore, we are satisfied with the Traffic Impact Analysis Report for the said project.

Thank you for the opportunity to comment.

Sincerely,

JAMES S. CORREA
POLICE CHIEF

RN:vta

cc: Ms. Sandra Olliges
Mr. Sidney Fuke

National Aeronautics and
Space Administration
Ames Research Center
Moffett Field, CA 94035-1000

Reply to Attn of:

M/S 218-1

July 22, 2002

Mr. James S. Correa, Chief
Police Department
COUNTY OF HAWAI'I
349 Kapiolani Street
Hilo, HI 96720

Dear Mr. Correa:

Subject: **Comments on Draft Environmental Assessment**
Mauna Kea Astronomy Education Center (MKAEC)
Walakea, South Hilo, Hawai'i, TMK: 2-4-01: por 7

This is to acknowledge the receipt of and to respond to your letter of June 26, 2002 providing comments on the subject matter. We appreciate your comments noting that the installation of the traffic lights by the UHH at the intersection of Nowelo Street and Komohana Street as well as the use of Nowelo Street through the campus will help mitigate any traffic impact concerns.

We would like to use this means to also acknowledge the receipt of and respond to Assistant Police Chief Thomas J. Hickcox's letter of July 8, 2002 to Dr. Rose Tseng, Chancellor, UHH, commenting on the subject matter. Mr. Hickcox noted that he had "no comments or objections to offer at this time."

Both of your comments will be made a part of the Final Environmental Assessment. Thank you very much for participating in this review.

Sincerely,

Trudy Kortes
Environmental Engineer

Copy – Mr. Thomas J. Hickcox, Assistant Police Chief

Harry Kim
Mayor

County of Hawai'i
DEPARTMENT OF PARKS AND RECREATION
101 Pauahi Street, Suite 6 • Hilo, Hawai'i 96720
(808) 961-8311 • Fax (808) 961-8411

Patricia G. Eng
Director

Pamela N. Mi
Deputy Direc

July 10, 2002

Ms Trudy Kortes
Environmental Services Division
NASA Ames Research Center
Mail Stop 218-1
Moffett Field, CA 94035-1000

Re: Draft EA-Mauna Kea Astronomy Education Center
University of Hawaii at Hilo
TMK: (3) 2-4-01:por 7

Dear Ms Kortes:

We have reviewed the draft assessment and have no adverse comments to offer.

Thank you for the opportunity to review the report.

Sincerely,

Patricia Engelhard
Director

National Aeronautics and
Space Administration
Ames Research Center
Moffett Field, CA 94035-1000

Reply to Attn of: M/S 218-1

July 22, 2002

Ms. Patricia Englehard, Director
Department of Parks and Recreation
COUNTY OF HAWAI'I
101 Pauahi Street
Hilo, HI 96720

Dear Ms. Englehard:

Subject: Comments on Draft Environmental Assessment
Mauna Kea Astronomy Education Center (MKAEC)
Waiakea, South Hilo, Hawai'i, TMK: 2-4-01: por 7

This is to acknowledge the receipt of and to respond to your letters of July 10, 2002 to this office and Dr. Rose Tseng, Chancellor, UHH providing comments on the subject matter. We appreciate your taking the time to review the document and noting that you "have no adverse comments to offer."

Your letters will be made a part of the Final Environmental Assessment. Thank you very much for participating in this review.

Sincerely,

Trudy Kortes
Environmental Engineer

Copy – Dr. Rose Tseng, Chancellor, UHH
Mr. George Jacob, Project Director, MKAEC
Mr. Sidney Fuke, Planning Consultant

Harry Kim
Mayor

County of Hawaii
DEPARTMENT OF RESEARCH AND DEVELOPMENT
25 Aupuni Street, Room 219 • Hilo, Hawaii 96720-4252
(808) 961-8366 • Fax (808) 935-1205
E-mail: chrsdev@interpac.net

Jane T[illegible]
Direc[illegible]

June 20, 2002

Ms. Trudy Kortes
Environmental Services Division
NASA Ames Research Center
Mail Stop 218-1
Moffet Field, CA 94035-1000

Dear Ms. Kortes:

Re: Draft Federal EA for the Mauna Kea Astronomy Education Center

Thank you for the opportunity to comment on the referenced Environmental Assessment.

The only comment from this office is the recommendation that the facility should incorporate concepts advanced in the LEED™ Green Building Rating System, a copy of which may be downloaded from http://www.usgbc.org/programs/LEED-RSv2june01.pdf. Developed by the US Green Building Council under contract to the US Department of Energy, the LEED documents represent efforts to develop a standard that improves environmental and economic performance of commercial buildings using established and/or advanced industry principles, practices, materials and standards.

As noted in the EA, "There is a strong need to diversify Hawaii's economy, particularly into science-based research, high technology and educational industries with minimal environmental impacts." Attainment of LEED certification for this facility will serve as an important statement of adhering to a high standard of environmentally sensitive design.

Yours truly,

Raymond Carr Ph.D.
Economic Development Specialist

c.c. Jane Testa, Director

National Aeronautics and
Space Administration
Ames Research Center
Moffett Field, CA 94035-1000

Reply to Attn of: M/S 218-1

July 22, 2002

Ms. Jane Testa, Director
Department of Research and Development
COUNTY OF HAWAI'I
25 Aupuni Street
Hilo, HI 96720

Dear Ms. Testa:

Subject: Comments on Draft Environmental Assessment
Mauna Kea Astronomy Education Center (MKAEC)
Waiakea, South Hilo, Hawai'i, TMK: 2-4-01: por 7

This is to acknowledge the receipt of and respond to your department's letter of June 20, 2002, providing comments on the subject matter.

Please be informed that NASA has adopted a policy requiring all of its projects to be developed using the concepts and principles outlined in the LEED ™ Green Building Rating System and meet minimum certification requirements established under the program. The respective design consultants for this project will be so advised of this requirement to assure greater economic and environmental efficiencies of this project.

Your comments will be made a part of the Final Environmental Assessment. Thank you very for your constructive input and for participating in this review.

Sincerely,

Trudy Kortes
Environmental Engineer

Copy – Dr. Rose Tseng, Chancellor, UHH
Mr. George Jacob, Project Director, MKAEC
Dr. Raymond Carr, Department of Research and Development
Mr. Sidney Fuke, Planning Consultant

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
345 KEKUANAOA STREET, SUITE 20 • HILO, HAWAII 96720
TELEPHONE (808) 961-8050 • FAX (808) 961-8657

July 1, 2002

Ms. Trudy Kortes
NASA Ames Research Center
Mail Stop 218-1/QE Environmental Services Division
Moffett Field, CA 94035-1000

**DRAFT ENVIRONMENTAL ASSESSMENT
MAUNA KEA ASTRONOMY EDUCATION CENTER
TAX MAP KEY 2-4-001:PORTION OF 007**

We have reviewed the subject document.

While the Department thinks that the water use calculations do not need to be a part of the Environmental Assessment, submitting them prior to or in conjunction with the building permit process would be too late. The water use calculations should be submitted as soon as possible. Their early submission will be helpful in providing you with an estimate of the required charges that will have to be paid before the project will be able to receive water service.

For your information, water availability will be subject to the prevailing water availability guidelines at the time that the water use calculations are submitted. The determination of the facilities charge for the project will include a credit of 26% for the construction of the 1.0-million gallon University reservoir, overflow elevation of 479.50 feet, and 24% for the construction of a 16-inch transmission line from the reservoir to Komohana Street.

If you have any questions, please contact our Water Resources and Planning Branch at 961-8070, extension 1.

Sincerely yours,

Milton D. Pavao, P.E.
Manager

BCM:dms

copy - Mr. Sidney Fuke

...Water brings progress...

National Aeronautics and
Space Administration
Ames Research Center
Moffett Field, CA 94035-1000

Reply to Attn of: M/S 218-1

July 22, 2002

Mr. Milton Pavao, Manager
Department of Water Supply
COUNTY OF HAWAI'I
345 Kekuanaoa Street, Suite 20
Hilo, HI 96720

Dear Mr. Pavao:

Subject: **Comments on Draft Environmental Assessment
Mauna Kea Astronomy Education Center (MKAEC)
Waiakea, South Hilo, Hawai'i, TMK: 2-4-01: por 7**

This is to acknowledge the receipt of and to respond to your letters of July 1, 2002 to this office and July 15, 2002 to Dr. Rose Tseng, Chancellor, UHH, providing comments on the subject matter.

Please be informed that the MKAEC is in the process of selecting the appropriate design consultants for this project. This should be completed within the next month. The selected consultants will immediately begin discussions with your office relating to this matter. As such, the project's water use requirements and required infrastructure and facilities charge can be determined prior to finalizing any building plans for this project.

Both of your letters will be made a part of the Final Environmental Assessment. Thank you very much for participating in this review and for your constructive comments.

Sincerely,

Trudy Kortes
Trudy Kortes
Environmental Engineer

Copy – Dr. Rose Tseng, Chancellor, UHH
Mr. George Jacob, Project Director, MKAEC
Mr. Sidney Fuke, Planning Consultant

Harry Kim
Mayor

James S. Correa
Police Chief

County of Hawaii
POLICE DEPARTMENT
349 Kapiolani Street • Hilo, Hawaii 96720-3998
(808) 935-3311 • Fax (808) 961-8869

July 8, 2002

Ms. Rose Tseng
Chancellor
University of Hawaii at Hilo
200 West Kawili Street
Hilo, Hawaii 96720

Dear Chancellor Tseng:

Our staff has reviewed the proposed Mauna Kea Astronomy Education Center project and has no comments or objections to offer at this time.

Thank you for the opportunity to comment.

Sincerely,

JAMES S. CORREA
POLICE CHIEF

THOMAS J. HICKCOX
ASSISTANT POLICE CHIEF
FIELD OPERATIONS BUREAU

DK:vla

cc: Mr. Sidney Fuke, Planning Consultant
Ms. Genevieve Salmonson, Dir., OEQC

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAI
345 KEKUANAOA STREET, SUITE 20 • HILO, HAWAII 96720
TELEPHONE (808) 961-8050 • FAX (808) 961-8657

July 15, 2002

Ms. Rose Tseng, Chancellor
University of Hawaii at Hilo
200 West Kawili Street
Hilo, HI 96720

DRAFT STATE ENVIRONMENTAL ASSESSMENT
MAUNA KEA ASTRONOMY EDUCATION CENTER
TAX MAP KEY 2-4-001:PORTION OF 007

We have reviewed the subject document.

Water is available for the proposed project from the existing 12-inch waterline in either Nowelo Stree or Aohoku Street, both of which front the project location. Water use calculations should be submitte as soon as possible. Their early submission will be helpful in providing you with an estimate of the required charges that will have to be paid before the project will be able to receive water service.

If you have any questions, please contact our Water Resources and Planning Branch at 961-8070, extension 1.

Sincerely yours,

Milton D. Pavao, P.E.
Manager

BCM:sco

copy - Mr. Sidney Fuke, Planning Consultant
Ms. Genevieve Salmonson, State Office of Environmental Quality Control

...Water brings progress...

Auli'i C. Mitchell
Richard A. Chamberlin

101 Barenaba Lane
Hilo, HI 96720

PH: (808) 933-1451
cham24@interpac.net

9-July-2002

Rose Tseng
Chancellor
University of Hawaii at Hilo
200 West Kawili Street, Room ADM 120
Hilo, HI 96720

Dear Chancellor Tseng:

This letter is in response to the Draft Federal Environmental Assessment (EA) for the Mauna Kea Astronomy Education Center (MKAEC) (June, 2002). In general we agree with the objectives and the physical plan of the MKAEC as outlined in Appendix B of the Mauna Kea Master Plan (June, 2000). However, we are concerned about the physical design and appearance of the MKAEC as proposed in the June, 2002 EA.

In the recent EA, the proposed MKAEC will be a pyramid standing 79 feet high with a sphere on top (EA, Fig. 4, P. 8). The new building will be sited on the UH upper campus where it is intended that the new building will be visible from all over Hilo, and particularly visible to cruise ships entering the harbor (G. Jacob, private communication, 2001). The pyramid shape of the new building is supposed to be "iconic" – presumably evoking Mauna Kea herself with an astronomy dome on top.

We are uncomfortable with the "iconic" theme for the proposed building.

We believe a pyramid with a dome on top does not evoke Mauna Kea. Mauna Kea is not a pyramid; she is not manufactured glass, steel, and concrete; and some of our close friends in East Hawaii sincerely doubt if domes should crown this mountain. If the structure is "iconic", then the icons it represents are not of these islands. Rather than making a home for living Hawaiian values, arts, and culture, the "icons" of this proposed building will entomb them under glass and steel. Potential local visitors, contributors, and even some in the astronomy community will be repelled. We know that is not the intention.

The EA makes a finding of no significant adverse visual impact (p. 44).

We strongly disagree with that finding.

We suggest that the proposed MKAEC building and associated complex on the nine acre UH parcel be redesigned so that it: (1)is not an eyesore; (2) makes better reference to existing Hawaiian architectural and community values; (3) makes better advantage of Hilo's nearly perfect semi-tropical environment rather than encasing visitors and local contributors in a sterile glass, steel, and concrete enclosure.

We are aware that MKAEC Director George Jacob has been hearing community concerns similar to the ones expressed here for more than eight months. While community input as to MKAEC exhibit theme and content were solicited and acquired, it is unfortunate that clearly expressed concerns about the proposed MKAEC building appearance were not addressed. Nevertheless, we and others we know would be happy to meet again with Director Jacob, or anyone else you might designate, to discuss our concerns and possible solutions. In fact, there may be an almost ready made solution to local concerns: the design concept drawings made by the Oda/McCarty design firm prior to June, 2000 could be reconsidered.

Sincerely yours,

Auli'i Mitchell

Auli'i C. Mitchell
Halau O Kahiwahiwa
www.halau-o-kahiwahiwa.com

Richard A. Chamberlin

cc: G. Jacob, S. Fuke, G. Salmonson, T. Kortes

UNIVERSITY OF HAWAI'I AT HILO
Director's Office
Mauna Kea Astronomy Education Center

August 8, 2002

Auli'i C. Mitchell
Richard A. Chamberlain
101 Barenaba Lane
Hilo, HI 96720

Dear Auli'i and Richard:

Subject: Comments on Draft Environmental Assessment
Mauna Kea Astronomy Education Center (MKAEC)
Waiakea, South Hilo, Hawai'i, TMK 2-4-01: por 7

This is to acknowledge the receipt of and respond to your letter of July 9, 2002 to Dr. Rose Tseng, Chancellor, UHH providing comments on the subject matter.

Please be informed that the concept design noted in the Draft Environmental Assessment is purely conceptual at this stage. The ultimate form and function of this project still needs to be developed. Since publication of the Draft EA, the MKAEC Selection and Review Committee has selected the team of Taisei Construction Corporation, Durrant Media Five, and Oda-McCarty Architects, Ltd. for the design/build services. To assure the development of a visually sensitive yet functional design, the selected team has been instructed by the MKAEC to actively solicit and consider public input before submitting the final design concepts to the MKAEC Selection and Review Committee, who in turn will make the final design selection.

It should also be noted that the proposed site has two County zoning designations. It appears that the portion fronting A'ohoku Street is zoned A-1a, while the balance is zoned RS-10. The height limit for the A-1a zone is 45 feet, while the RS-10 zone has a 35-foot limitation. Any portion that exceeds those limits would require a variance from the Planning Director. The variance process requires notices and public commenting opportunity before the Director makes a decision.

In sum, the design of the project is still in its embryonic stage. There will be opportunities for public input. Your comments will be made a part of the Final Environmental Assessment. Thank you very much for your constructive input and for participating in this review process.

Sincerely,

George Jacob
Project Director

cc: Trudy Kortes, NASA Ames
Dr. Rose Tseng, Chancellor UHH
Sidney Fuke, Environmental Consultant

640 North A'ohoku Street, #130, IFA Building, Hilo, Hawai'i 96720-4091 USA
Telephone: (808) 933-3324, Facsimile: (808) 933-3912, www.maunakea.hawaii.edu

2002-09-08-HI-FEA-

FINAL STATE ENVIRONMENTAL ASSESSMENT

For

MAUNA KEA ASTRONOMY EDUCATION CENTER

University Science and Technology Park
University of Hawai`i at Hilo
Waiakea, South Hilo, Hawai`i
TMK: (3) 2-4-01: Por 7

PROPOSING AGENCY:

University of Hawai`i at Hilo (UHH)
Office of the Chancellor
200 W. Kawili Street
Hilo, HI 96720-4091

PREPARED BY:
Sidney Fuke, Planning Consultant
100 Pauahi Street, Suite 212
Hilo, HI 96720

August 2002

This document is prepared pursuant to the Hawai`i Environmental Protection Act, Chapter 343, Hawai`i Revised Statutes (HRS), and Title 11, Chapter 200, Hawai`i Department of Health Administrative Rules (HAR)

MAUNA KEA ASTRONOMY EDUCATION CENTER
Final State Environmental Assessment

TABLE OF CONTENTS

MAUNA KEA ASTRONOMY EDUCATION CENTER
Final State Environmental Assessment

Executive Summary

The University of Hawai`i at Hilo (UHH) proposes the construction of the Mauna Kea Astronomy Education Center (MKAEC). The Center will be an interpretative facility to be constructed on a vacant 9.1- acre (3.7 hectares) area at the University Science and Technology Park in the City of Hilo. This Center will serve as a principal astronomy educational facility in Hawai`i and will be a substantive resource for astronomy programs around the world.

The $28 million facility will be partially funded by a $12 million grant from the National Aeronautics and Space Administration (NASA). The UHH is now working to secure additional public and private funds, which together with the $12 million grant, would be sufficient to cover the basic elements of this $28 million project.

This Environmental Assessment (EA) addresses the environmental consequences of the proposed action and the following alternatives: (1) construction of the MKAEC at other location; (2) reduction of size and scope of MKAEC; and (c) No Action.

A summary of the project follows:

Project Name:	Mauna Kea Astronomy Education Center
Applicants and Approving Agency:	University of Hawai`i at Hilo (UHH) Ms. Rose Tseng, Chancellor UHH and Principal Investigator, MKAEC Contact: Mr. George Jacob, Project Director and Co- Principal Investigator, MKAEC Ph: (808) 933-3912
Class of Action:	Use of State lands
Status:	Final Environmental Assessment (FEA) and Finding of No Significant Impact (FONSI)
Location:	Corner of Nowelo Place and N. A`ohoku Street in the University Science and Technology Park, UHH, and identified by Tax Map Key: 2-4-01: portion of 7
Property Owner:	The site is "ceded" land which is held in trust by the State of Hawai`i and leased to the UHH
Existing Uses:	Vacant

Proposed Action:	Construction of the Mauna Kea Astronomy Education Center
Estimated Cost:	$28 million (estimated design and construction costs)
Project Area:	9.1 acres (3.7 hectares)
State Land Use:	Urban District
County General Plan:	University Use
County Zoning:	RS-10 (Single-family Residence), 10,000 square fee minimum lot size and A-1a (Agriculture), 1-acre minimum lot size
Special Management Area:	The subject site is not within the County Special Management Area as outlined in the State Coastal Zone Management Program.
Summary of Potential Environmental Impacts And Their Mitigation:	During the construction of the MKAEC, there will be short-term noise and dust impacts. Contractors will be required to comply with the State Department of Health regulations governing noise and dust (Chapters 11-46 and 11-60). There will be additional traffic once the MKAEC is open, and the impact will be most pronounced for traffic exiting Nowelo Street onto Komohana Street. A traffic signal light will be installed. Water and sewer transmission lines are available to the site. Although none of those lines need to be upgraded at this time, if there is a need, they will be done in conjunction with construction phases of this project. An archaeological survey indicated no sites in the area of the proposed improvements. Should there be any inadvertent find, work will immediately cease in the area of the find and consultation and approvals from the State DLNR will be secured before work resumes. To mitigate visual/aesthetic issues, public comment will be solicited prior to final design selection by the MKAEC Selection and Review Committee.
Summary of Comments on Draft Environmental Assessment and Responses	Comments on the Draft Federal EA were received from nine (9) government agencies as well as was a joint letter from two members of the public. These comments and responses thereto are found in Appendix H in their entirety. Two agencies (County Departments of Fire and Parks and Recreation) had no comments or objections to the project, while the State Historic Preservation Officer noted that "no historic properties will be affected by this (MKAEC) undertaking." The County Police Department noted that the construction of traffic lights at the intersection of Nowelo Street and Komohana Street, as

well as the use of the University campus road, would alleviate their traffic concerns.

The County Department of Research and Development recommended the use of concepts and principles of the LEED™ Green Building Rating System. As NASA has already adopted such a policy, the respective design consultants will be advised of this requirement, which would then assure greater economic and environmental efficiencies of the project. **(See Section 5.1.3 Infrastructure)**

The County Department of Water Supply recommended that the water use calculation be determined as soon as possible to facilitate the determination of the facilities charge. Once the design consultants have been selected, discussions with the Department of Water Supply will take place. **(See Section 5.1.3 Infrastructure)**

The Engineering Division of County Department of Public Works commented that the project should comply with appropriate building, drainage, grading/earthwork, road right-of-work, and streetlights/traffic control codes and requirements. The appropriate design and/or engineering consultants will be responsible for the preparation of the required plans and securing the appropriate permits. **(See Section 5.1.3 Infrastructure)**

The University of Hawai'i at Manoa Institute for Astronomy commented that the project could relieve traffic congestion at the summit. **(See Section 2.4 Alternative 3: No Action)** It also noted that adequate on-site parking and turnaround areas should be provided to minimize traffic impacts along A'ohoku Place. Adequate parking and bus turnaround areas, meeting with the requirements of the County Zoning Code, will be provided on- site. **(See Section 4.4 Zoning)**

The State Office of Hawaiian Affairs (OHA) offered comments relating to "ceded" land, adequacy of the discussion on the project's cultural and archaeological impacts, absence of consultation, and the design of the project. The "ceded" land issue is a State issue and UHH will be working with OHA on this matter. **(See Section 3.1.1 Location and Land Ownership)** The archaeological inventory survey concluded, as did the State Historic Preservation Officer, that the project would not have any adverse archaeological impacts. The cultural assessment also arrived at the same conclusion. **(See Section 5.1.12 Cultural and Archaeological Resources)** No comments were received from OHA during the "consultation" process. Finally, OHA expressed concerns about the concept design. The concept design in the Draft EA is one of many tentative options available. The archaeological inventory survey concluded, as did the State Historic Preservation Officer, that the project would not have any adverse archaeological impacts. The cultural assessment also arrived at the same conclusion. **(See Section 5.1.12 Cultural and Archaeological Resources)** No comments were received from OHA during the "consultation" process. Finally, OHA expressed concerns about the concept design. The concept design in the Draft EA is one of many tentative options available. The architectural firm selected will be advised to solicit public input on the proposed building design concepts. They will be required to take into consideration public comments before submitting final design concepts to the MKAEC Selection and Review Committee. **(See Section 2.5.1 Project Description; Section 3.11 Scenic Resources and Design Considerations; and Section 5.1.13 Scenic Resources and Design Considerations for a more detailed description of the mitigation measures to be undertaken.)**

The County of Hawai'i Department of Public Works commented on the need to comply with appropriate codes relative to the design and construction of all structures, development-generated runoff, earthwork activity, work within the government road right-of-way, and streetlights and traffic control devices. The respective design and engineering consultants will be directed by the MKAEC Project Office to comply with all appropriate regulations and to secure the required permits (such as building, grading, UIC, right-of-way, and the like) prior to commencement of the respective activities. **(See Sections 5.1.4 Traffic; 5.1.9 Floodplains and Drainage)**

Finally, two public individuals jointly expressed some concerns with the tentative design. As noted earlier, the selected consultants will be instructed to take those concerns into consideration. **(See Section 2.5.1 Project Description; Section 3.11 Scenic Resources and Design Considerations; and Section 5.1.13 Scenic Resources and Design Considerations for a more detailed description of the mitigation measures to be undertaken.)**

List of Acronymns

AAQS	Ambient Air Quality Standards
ALISH	Agricultural Lands of Importance to the State of Hawai'i
CEQ	Council on Environmental Quality
CZM	Coastal Zone Management
DLNR	Department of Land and Natural Resources
DOA	Department of Agriculture
DOH	Department of Health
EA	Environmental Assessment
EIS	Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHA	Federal Housing Authority
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
HAR	Hawai'i Administrative Rules
HELCO	Hawai'i Electric Light Company
HRS	Hawai'i Revised Statutes
HUD	Housing and Urban Development
KV	Kilovolt
LSB	Land Study Bureau
MKAEC	Mauna Kea Astronomy Education Center
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
SMA	Special Management Area
UBC	Uniform Building Code
UH	University of Hawai'i
UHH	University of Hawai'i at Hilo
UIC	Underground Injection Control
UPST	University Park of Science and Technology

List of Figures		*Page*

List of Tables		*Page*

List of Appendices

1.0 Purpose and Need

The University of Hawai`i at Hilo (UHH) proposes the construction of the Mauna Kea Astronomy Education Center (MKAEC). The Center will be an interpretive facility to be constructed on a 9.1-acre (3.7 hectares) site at the University Park of Science and Technology (UPST) in the City of Hilo **(Figures 1, 2, & 3)**. It will serve as a principal astronomy educational facility in Hawai`i, reflective of Hawai`i's unique cultural heritage. It will also serve as a substantive resource for astronomy programs around the world.

When completed, this 42,000 square foot (3,902 m^2) facility will have a gallery space of 26,000 square feet (2,415 m^2) of exhibition area. The remaining 16,000 square feet (1,487 m^2) will include retail, classroom, storage, office, administration, resource rooms and other affiliated functions. In addition, the Center would include a planetarium and large-format, pano-hemispheric motion picture capabilities.

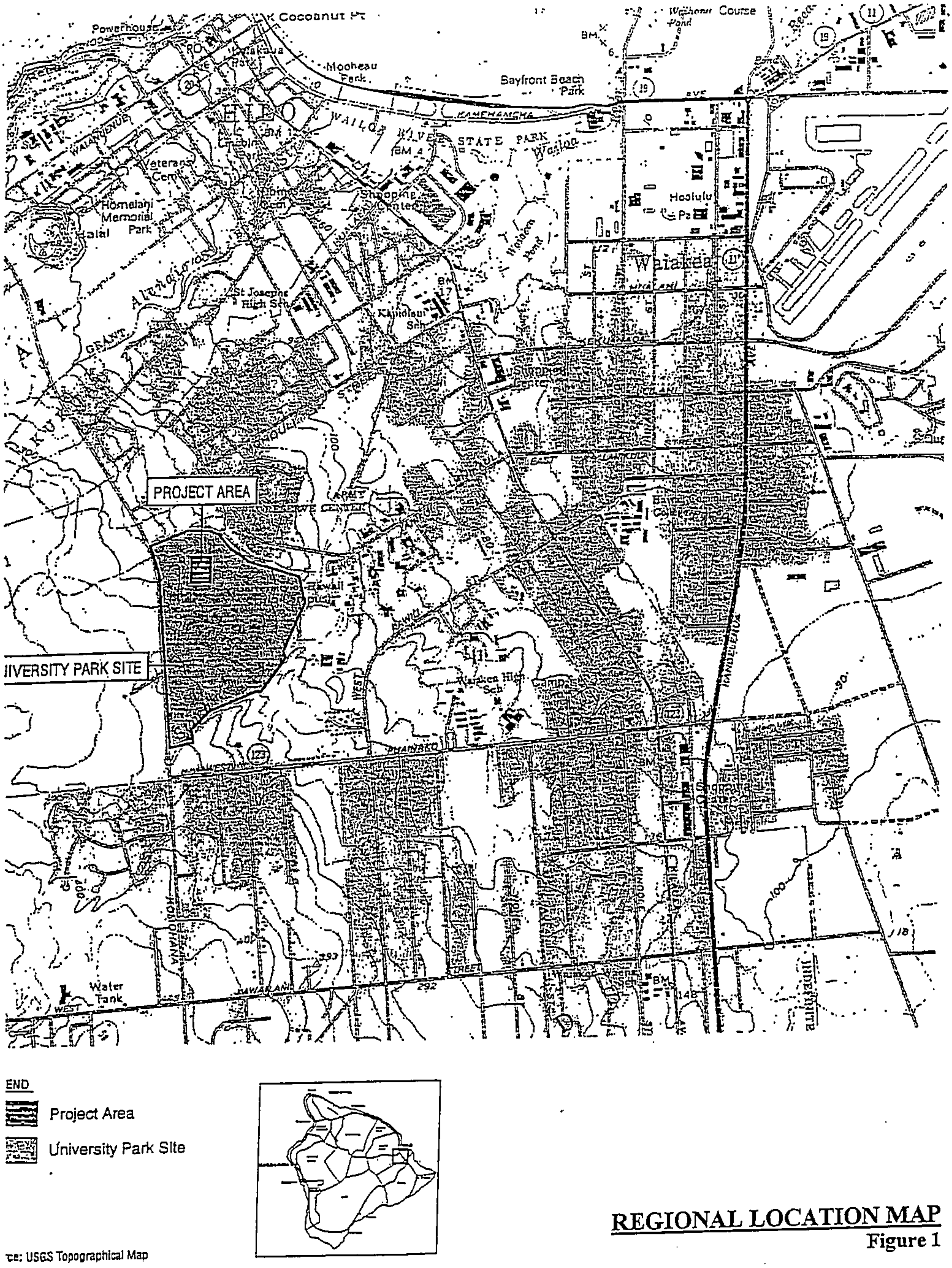
The goals of the MKAEC are multiple. Very broadly, these include the UHH goals of astronomy education, science-based research, high-technology, and educational industries; and UHH goals of enhancing the growth of the UHH as outlined in the *University of Hawai`i at Hilo Long Range Development Plan*, and, in turn, serving as an added catalyst for the economic diversification of the island and State of Hawai`i. More specifically, the goals of the MKAEC are to:

- Serve as a premier astronomy interpretive center that will accommodate exhibition content to showcase past and current scientific discoveries in astronomy while maintaining a continuum with the rich Polynesian traditions of navigation, exploration, and cosmology that allows for an appreciation of the larger socio-cultural context of Hawaiian heritage.

- Provide education in-line with the institutional mission by exciting, inspiring, and motivating a cross-section of audiences about astronomy, space exploration, and our place in the Universe through creative interactive exhibitory, in a culturally sensitive setting.

- Provide education extension services with content-based programming on-site as well as through public outreach initiation off-site in collaboration with Mauna Kea Observatories.

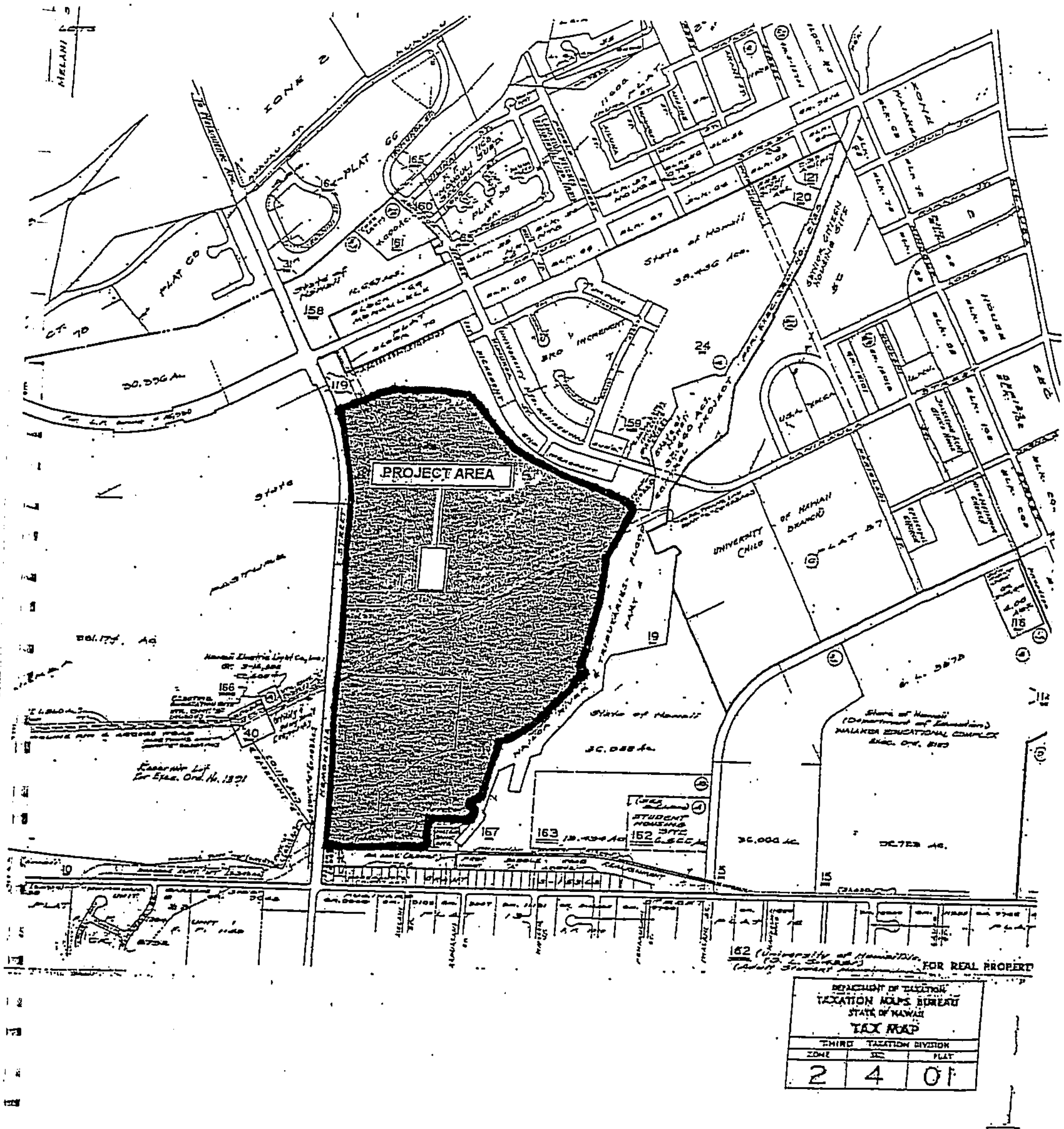
- Develop teacher training modules, curricular materials, traveling exhibitions and offer real-time access to Mauna Kea Telescopes supported by an electronic repository of archived discoveries unfolding atop Mauna Kea.



REGIONAL LOCATION MAP

Figure 1

ce: USGS Topographical Map



LEGEND

Project Area

University Park of Science and Technology

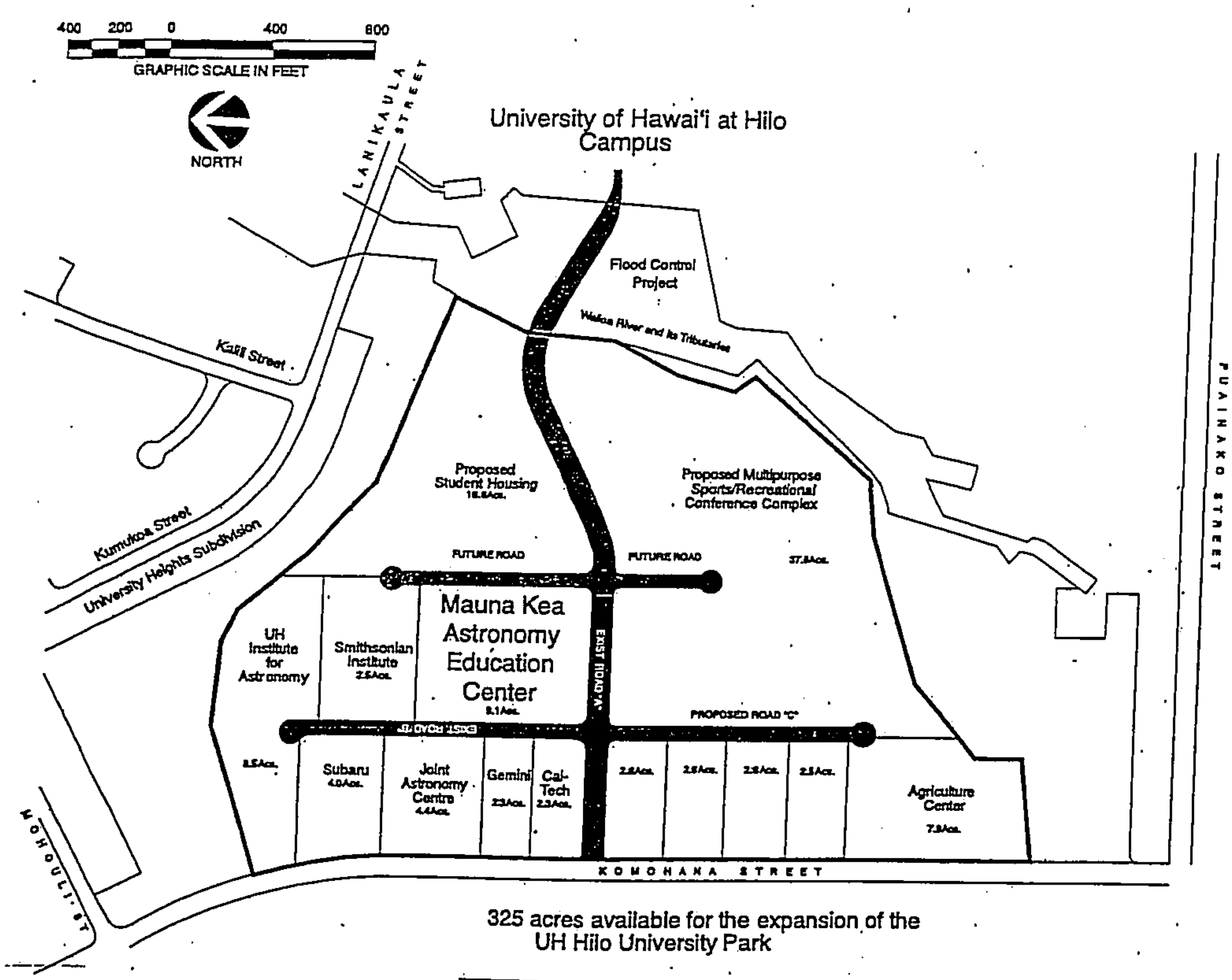
Tax Map Key

TAX MAP KEY

Figure 2

University Park, University of Hawai`i at Hilo

Mauna Kea Astronomy Education Center



325 acres available for the expansion of the UH Hilo University Park

Mauna Kea

This graphic is a plot plan depicting the location of the Mauna Kea Astronomy Education Center in University Park adjacent to the University of Hawai`i at Hilo and across the street from the Observatory Base Facilities.

PLOT PLAN
Figure 3

- Develop and offer distance learning opportunities and internship programs for students and teachers in conjunction with various UHH departments, including Astronomy, Education, Hawaiian Language, Tourism, Business, Anthropology, Communication, and the College of Continuing Education.

There is a strong need to diversify Hawai'i's economy, particularly into science-based research, high technology and educational industries with minimal environmental impacts. This is, in part, attributable to the decline of strong agricultural industry production such as sugar and pineapple and an over-reliance on the fragile tourism industry. As such, this Center, in addition to facilitating astronomy education and raising global scientific literacy, is needed to help diversify the economic base of the island and State of Hawai'i.

The educational and development goals outlined in the *University of Hawai'i at Hilo Long-Range Development Plan* visualized the UPST as an integral part of the campus. It would accommodate the UHH's future needs of academic and ancillary programs. At the same time, the research and technology activities at the UPST would increase the visibility and role of the UHH and, in turn, serve as a significant source of attraction for students and scholars worldwide. Relatedly, the growth and expansion of the UHH would offer community-wide benefits not only in terms of the island's economy but its education and cultural diversity and stimulation.

This Center would have another important use within the UPST. While capable of operating independently, it does have a symbiotic relationship with the UHH and the entire science and technology community in the State and especially the Big Island. It is intended to showcase science and technology as well as their relationship to culture not only in a general way but specifically as they may relate to Hawai'i.

Accordingly, in pursuit of this $28 million project, the UHH sought and received a $12 million grant from NASA. The UHH is now working to secure an additional $2.81 million of "local" public and private funds, which together with the $12 million grant, would be sufficient to cover the basic elements of this $28 million project. The UHH will actively seek the remaining $14 million through federal, state, corporate and private sources and other developmental channels for restricted and un-restricted grants.

Since the project involves the use of State lands, the environmental review and approval requirements must be in compliance with Hawai'i, Revised Statutes, Chapter 343 and Hawai'i Administrative Rules, Chapter 11-200. Furthermore, Federal funds through NASA are also involved. Accordingly, compliance with National Environmental Policy Act (NEPA) regulations (40 CFR) and NASA NEPA Regulations (14 CFR) must also be demonstrated. A Final Federal Environmental Assessment was prepared and a Finding of No Significant Impact (FONSI) was issued. <u>This</u> document is intended to satisfy <u>State</u> Environmental Assessment requirements only.

2.0 *Description of Proposed Action and Alternatives*

2.1 Proposed Action: Construction of the Mauna Kea Astronomy Education Center

The UHH proposes to construct the MKAEC, a 42,000 square foot (3,902 m^2) interpretive facility on a 9.1 acre (3.7 hectares) site within the UPST in the City of Hilo, Hawai`i.

2.2 Alternative 1: Construction of the MKAEC at other locations

Alternative sites consisting of 9 acres (3.7 hectares) were considered. These were State-owned lands in the City of Hilo or at the mid-level facility on Mauna Kea or other parts of the island. These alternatives, however, would be more costly to develop due to infrastructure considerations, may have specific environmental issues, and would be inconsistent with the UHH Long Range Development Plan. While some privately owned lands were considered, they were dismissed due to the initial acquisition cost and possible infrastructure costs.

2.3 Alternative 2: Reduction of size and scope of MKAEC

The basic structure and/or features of this facility could be reduced (with similar environmental impacts as the proposed action) and that would result in some measure of fiscal savings. However, such a reduction may compromise the educational and economic goals sought to be achieved by this facility and thus have potentially adverse socioeconomic effects.

2.4 Alternative 3: No Action

Under the No Action Alternative, the existing 9.1-acre (38,826 m^2) site would continue to remain undeveloped, and UHH must continue its search for another user. During the interim, the UHH will have to maintain and pay the costs of the infrastructure that currently services the UPST.

In addition, astronomy education of the public would continue to be limited to conventional settings and mostly in a classroom. As there would be limited sea level opportunity for learning about the Mauna Kea Observatories, there would be potentially increased vehicular traffic and visitations at the summit. The higher level of visitor traffic poses traffic safety risks, as well as potential health risks. This alternative would potentially have adverse socioeconomic and environmental impacts through loss of visitors and increased traffic to the summit of Mauna Kea.

2.5 Nature and Components of Proposed Action

2.5.1 Project Description

As noted earlier, the MKAEC hopes to achieve goals of UHH relating to astronomy education, science-based research, high-technology, and educational industries, the growth of the UHH and in turn, diversification of the state and island's economy.

In that regard, the UHH selected a 9.1 acre (3.7 hectares) area, identified by Tax Map Key: (3) 2-4-01: portion of 007, located in the UHH's UPST in the City of Hilo **(See Figure 2)**. The site is located on the northeast corner of Nowelo Street and N. A'ohoku Place. Other existing and planned facilities are adjacent and/or proximate to the subject site **(See Figure 3)**.

The Center will be an interactive, interpretive facility that is set in the cultural context of Hawai'i's unique heritage. The 42,000 square foot (3,902 m^2) facility will house a planetarium, an Object Theatre, Multi-media/3-D projection facility, exhibits and displays on Polynesian culture and astronomy, among others. Under one tentative design option, the structure would be approximately 79 feet (24 m) tall, inclusive of the planetarium/dome **(Figure 4)**. However, the concept design is one of the many tentative options available. The architectural firm selected will be required to solicit public input on the proposed building design concepts. They will be required to take into consideration public comments before submitting final design concepts to the MKAEC Selection and Review Committee. (See *Section 5.1.13 Scenic Resources and Design Considerations* for a more detailed description of the mitigation measures to be undertaken.)

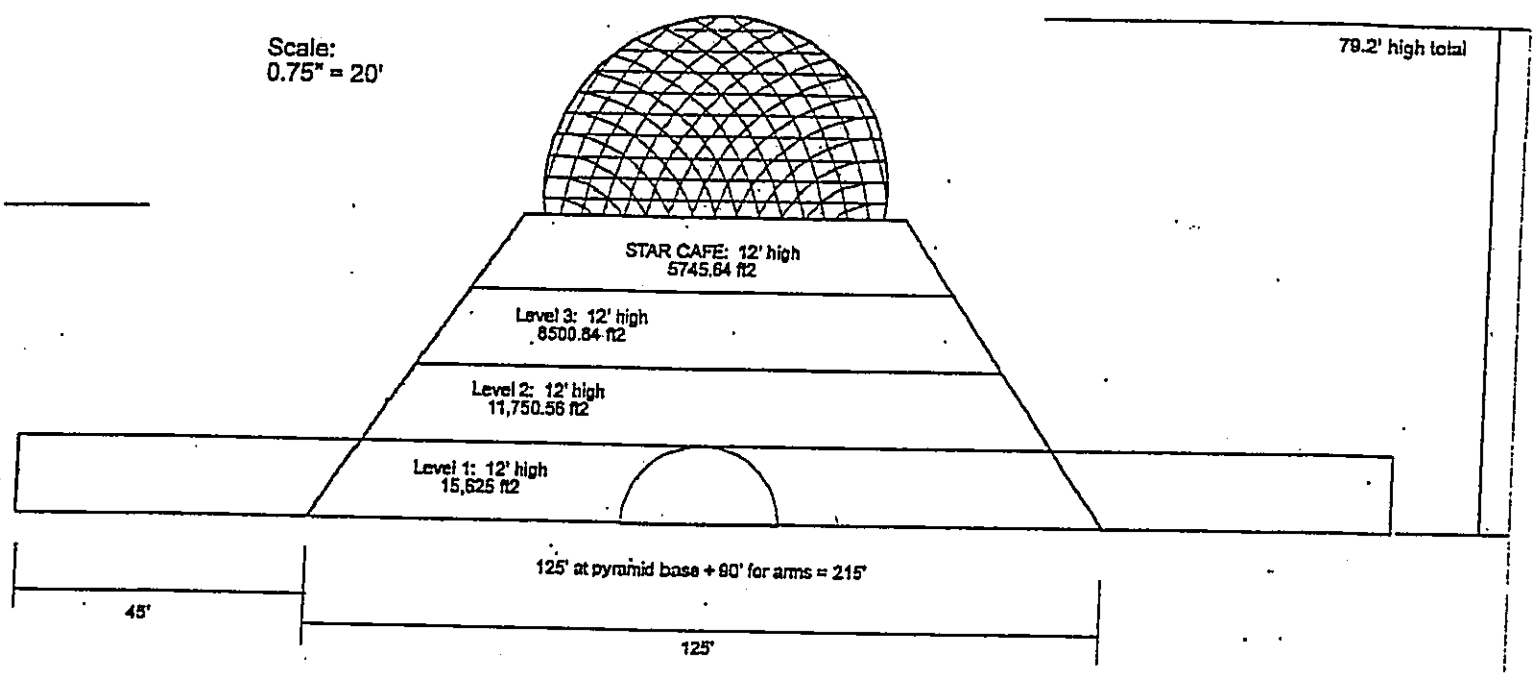
Public parking and as much native landscaping meeting with the requirements of the County Zoning Code will be constructed on-site **(Figure 5)**. NASA policy requires the use of native landscaping to the maximum extent possible.

The facility is expected to attract approximately 250,000 visitors annually, most of them students.

2.5.2 Timetable and Cost

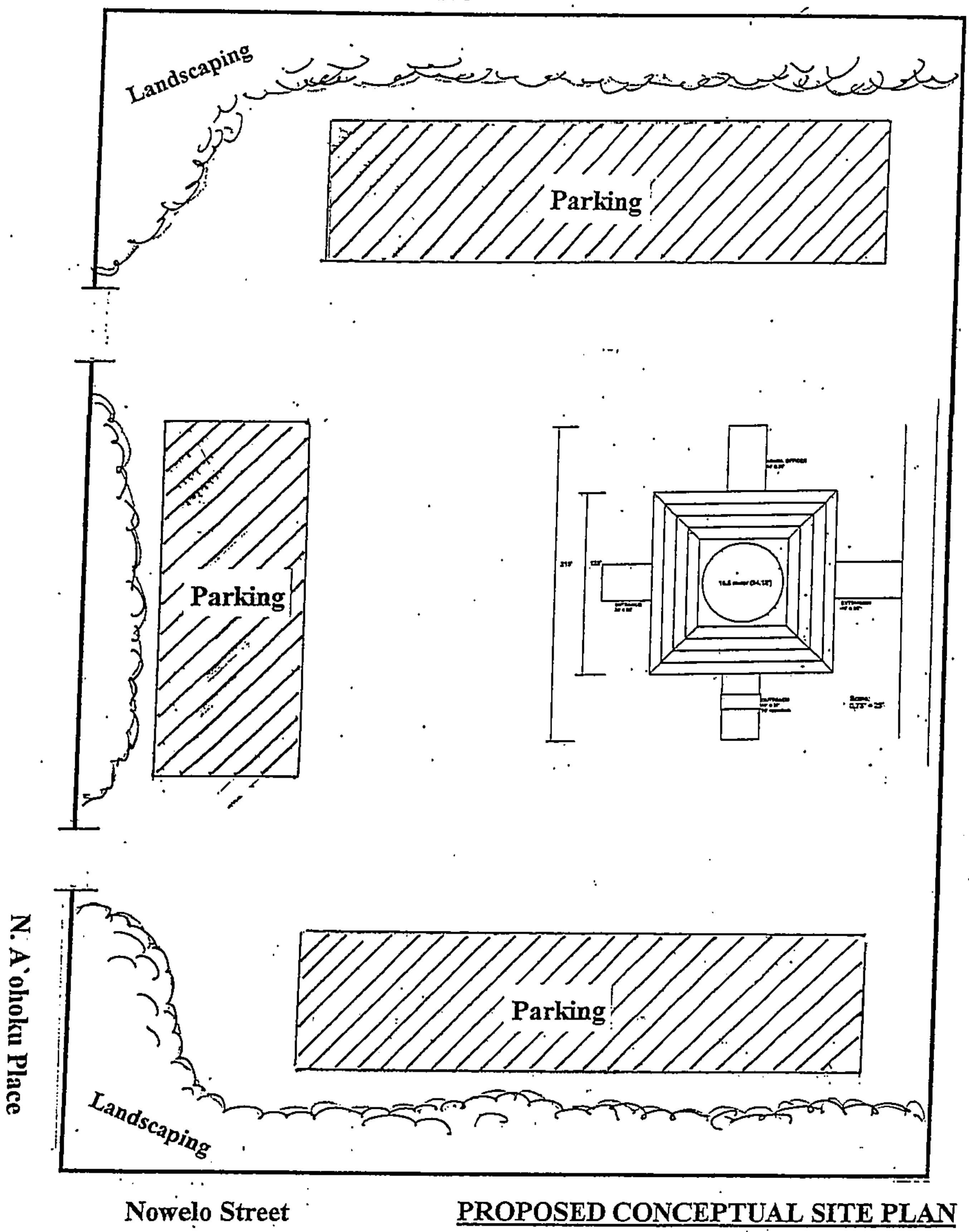
Construction is anticipated to begin immediately upon securing all necessary construction permits, which is anticipated to be in the summer of 2003. The project is estimated to be completed by June 2005.

The estimated cost of this project is $28 million. Of this amount, at least $14.81 million is needed to complete the essential structural and functional components of this project. To date, NASA has committed $12 million through two federal earmarks ($8 million and $4 million), with a possibility of a third earmark within the near future. The UHH will seek



PROPOSED CONCEPTUAL ELEVATION PLAN
Figure 4

NOT TO SCALE



PROPOSED CONCEPTUAL SITE PLAN
Figure 5

other public and private and corporate funds for the remaining $2.81 million. The balance of the project, which would cover exhibition planning, design, fabrication, installation, and audio-visual technical support and improvements, would be covered under possible separate federal earmarks coupled with possible funding from other public and/or private sources.

3.0 Existing Environment

3.1 Description of Site

3.1.1 Location and Land Ownership

The subject site is a 9.1-acre (3.7 hectares) area located at the northeast corner of Nowelo Street and N. A'ohoku Place in the UPST **(See Figure 3)**. The UPST is located on the east side of Komohana Street, generally between Pu'ainako and Mohouli Streets, Waiakea, South Hilo, Hawai'i and is identified by TMK: 2-4-01: 7 **(See Figure 2)**. Based on the tax map, the subject parcel within which the UPST is located consists of 142.951 acres (57.8 hectares).

The entire parcel, which is ceded land, is held in trust by the State of Hawai'i. It is leased to and utilized by the UHH with a portion of the total parcel - which includes the subject area - being set aside for the UPST. The MKAEC Project Office and UHH will work with OHA on this matter in the ensuing months.

3.1.2 Physical Description

The 9.1- acre (3.7 hectares) site is presently vacant of any structures or agricultural activity. In the past, there has been some form of agricultural use in either sugar cane production or cattle grazing in this general area. Scattered *'ohi'a-uluhe* (which is a native canopy tree) and an introduced mixed forest material dominate the site, as well as the adjoining areas.

The topography slopes toward the ocean in a westerly to easterly direction. The overall slope of the UPST ranges from six to ten percent, although there are areas where the slope may slightly exceed ten percent. Elevation of the site varies from about 280 feet (85.4 m) to approximately 230 feet (70.2 m), mean sea level.

The corner site is generally rectangular in shape. It stretches 740 feet (226 m) along N. A'ohoku Place and 560 feet (171 m) along the Nowelo Street frontage.

3.1.3 Climate

The mean annual rainfall in this area is approximately 141 inches. Rainfall is more frequent during the months of October through April. Hilo, being located on the easterly or windward side of the island, is exposed to the traditional "trade" wind. Daytime temperatures range between the upper 70's to the low 80's (degree Fahrenheit) during the days; and from the low 60's to the upper 70's (°F) during the evenings.

3.1.4 Topography and Soils

Terrain of the subject site is comprised predominantly of lava flows covered with thick vegetation. The University of Hawai'i Land Study Bureau's *Detailed Land Classification Report – island of Hawai'i* designates the site E 306, which is essentially poorly suited for intensive agricultural activities (LSB, 1965). The soil series is almost bare smooth, unbroken type of lava called *pahoehoe* with very little or no soil material. It is moderately drained, with slopes generally less than 35 percent. It is very poorly suited for machine tillability.

The *U.S. Soil Conservation Service Soil Survey Report* using its own classification system, designates this site *Pahoehoe* lava flows *(rLW)* and *Keaukaha* extremely rocky muck *(rKFD)* (SCS, 1973). The *Pahoehoe* lava flows is characterized by relatively smooth, billowy, glassy surface which has little or no soil covering. This classification covers that portion of the site adjacent to A'ohoku Place. The balance of the site is classified *Keaukaha* extremely rocky muck. This series is characterized as being rapidly permeable, dark brown muck underlain by pahoehoe lava bedrock. The runoff is medium and the erosion hazard is slight.

The *Agricultural Lands of Importance to the State of Hawai'i (ALISH)* map provides three classifications of agricultural lands – Prime, Unique, and Other (State of Hawai'i Department of Agriculture, 1979). As the site is within an urban area, this site is not classified as agricultural land.

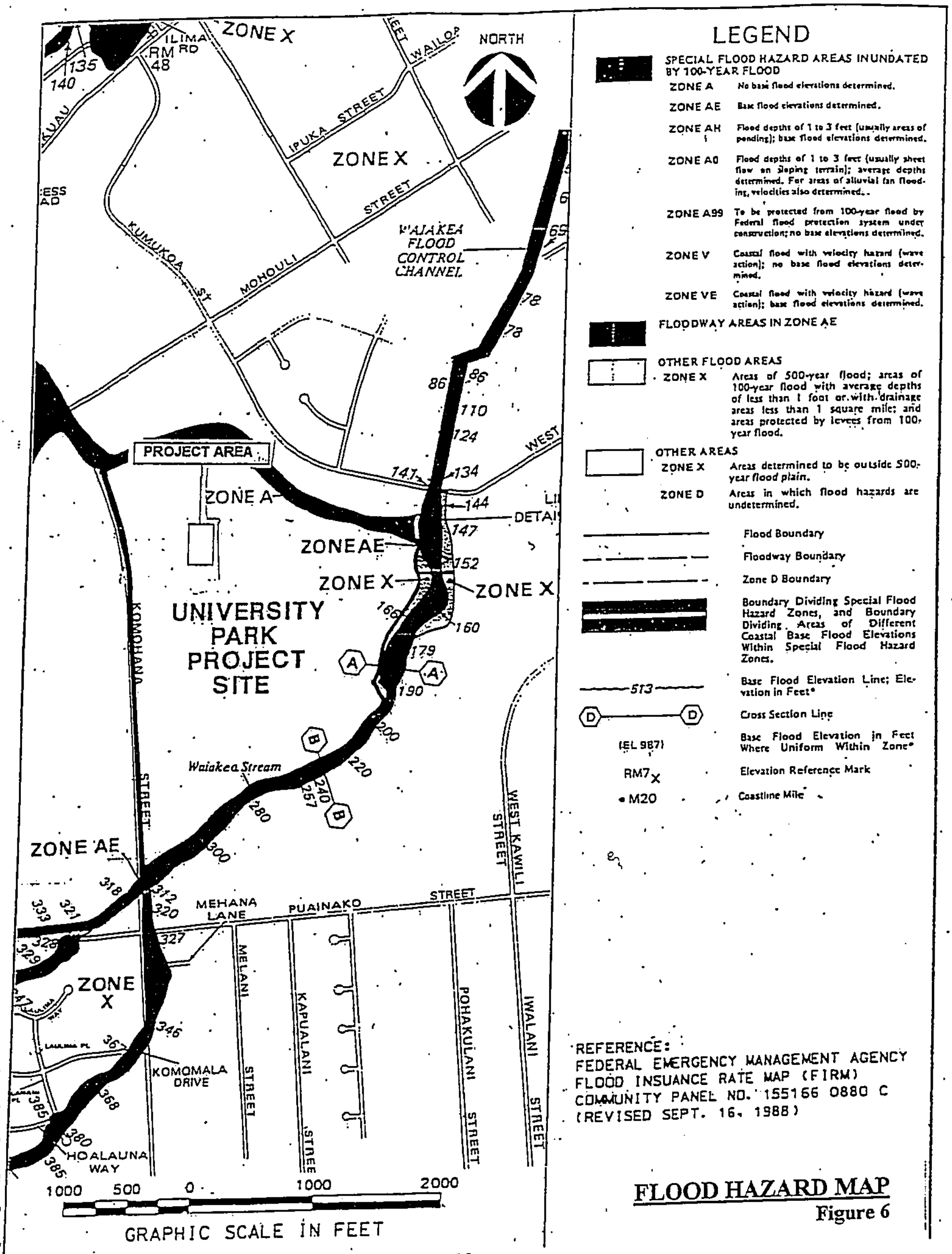
3.1.5 Natural Hazards

Tsunami, earthquake and subsidence, and lava flow represent the major natural hazards on the island of Hawai'i. This site is subject to the same natural hazards as the rest of Hawai'i in varying degrees.

The subject site is located more than two miles from the shoreline. As such, unlike coastal properties, this site would not be vulnerable to tsunamis and tsunamis generated by subsidence.

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), the subject site is designated zone X, areas determined to be outside of the 100- and 500-year flood plain **(Figure 6)**.

The U. S. Geologic Survey report notes that the degree of volcanic hazard in this area is 3 out of a scale of 9. The lower the number, the greater the degree of hazard. While this may be of concern, it should be noted that the entire city of Hilo has been designated Zone 3 (Heliker, 1990). In 1881, an historic lava flow from Mauna Loa flowed within one mile of Hilo Bay. About a century later in 1984, a 22-day eruption stopped at least six miles (9.7 km) from the upper slopes of Hilo in Kaumana.



FLOOD HAZARD MAP
Figure 6

In terms of earthquakes or seismic activity, the entire island of Hawai`i was redesignated from Zone 3 to the more restrictive Zone 4 on the Seismic Probability Rating of the Uniform Building Code 1997 edition. Construction and building standards are now more restrictive, to minimize risk of seismic hazards.

3.2 Land Uses

There are other related uses adjacent and/or immediately proximate to the site within the UPST. These include the Joint Astronomy Centre, UH Institute for Astronomy, and the headquarters/base facility for other astronomy operations at the summit, such as the California Institute of Technology, AURA, Inc. for the Gemini project, and the National *Astronomy Observatory of Japan for the Subaru.* There are also undeveloped areas within the UPST, as well as its immediate area that have been set aside for the expansion of the UHH campus.

In a broader land use context, surrounding land uses include the UHH campus complex and its related student housing, single-family residential areas, and vacant land populated with vegetation.

The proposed action will not involve the relocation of residents, as the site is currently vacant.

3.3 Infrastructure

3.3.1 Utilities

Electrical service provided by a privately owned utility company regulated by the State Public Utilities Commission, Hawai`i Electric Light Company (HELCO), is currently available to the area. There is an overhead 69 kilovolt (kV) line along Komohana Street. This serves the existing facilities as well as all proposed facilities within the UPST.

Verizon Hawai`i provides telephone service for this area through an overhead line along Komohana Street. Hawaiian Cablevision provides cable television service using the utility poles along Komohana Street.

It should be noted that the project would be designed using the principles and concepts outlined in the LEED™ Green Building Rating System and will meet the minimum certification requirements established under this program.

3.3.2 Storm Water

There are drainage catch basins in the vicinity of the proposed site within the road rights-of-way of Nowelo Street and N. A`ohoku Place. These basins dispose of locally generated storm water from the streets in the area.

As noted in section 3.1.5 above, the subject site falls within Zone "X", areas outside of the 100- and 500-year flood plain, on the FIRM map (Figure 6). Notwithstanding this designation, an on-site drainage system must still be designed and implemented in a manner meeting with the approval of the County Department of Public Works in conjunction with the development of this project. County policy requires additional storm water resulting from a project to be captured on-site and not be disposed of into the drainage basins within the road rights-of-way.

3.3.3 Potable Water and Fire Suppression Systems

There is a twelve-inch (30.5 cm) water main within Nowelo Street that comes in from Komohana Street. The capacity of these lines is such that it can readily accommodate the potable and fire protective water requirements of the project. The fire flow requirement calls for 2,000 gallons per minute plus maximum daily flow. During the initial stages of the design process, the anticipated average day, maximum day, and peak-hour water usage information will be provided to the Department of Water Supply so that the appropriate facilities charge can be determined.

3.3.4 Wastewater System

Presently, the UHH is serviced by on-site transmission lines that intersect with an eight-inch (20.3 cm) County sewer line along Lanikaula Street. The on-site transmission line has been extended to the subject area. Although the project's wastewater will be disposed into the County system, there may be a need to upgrade some of the off-site transmission lines. This will be determined during the building permit process. If this is required, UHH will work with the County in getting this line upgraded.

3.3.5 Transportation and Roads Systems

The Hilo International Airport is located approximately three miles (4.8 km) from the subject property. It provides daily flights to the other Hawai'ian islands, as well as to mainland cities via Honolulu or Maui.

The County's Hele On bus system provides bus service to this area and other outlying areas. Private taxi service is also available.

Komohana Street serves as the principal access to the UPST and the proposed facility. This two-lane County road has an 80-foot (24.8 m) right-of-way with 24 feet (7.3 m) of pavement and improved shoulders in the vicinity of the entrance to the Park. There is also a left-turn storage lane leading into the Park.

Nowelo Street intersects with Komohana Street (**See Figure 3)** and N. A`ohoku Place. Nowelo Street is a divided roadway within a 60-foot (18.3 m) right-of-way. N. A`ohoku Place is a cul-de-sac, and this road has also been built to County dedicable standards with curb, gutters, and sidewalk.

3.4 Socioeconomics

3.4.1 Community Demographics

Since 1970, the average population growth rate of the State of Hawai`i has been at the 10% level. The County of Hawai`i however, has sustained a greater level. Between 1970 and 1980, it grew from 63,468 to 92,053 (45%). The following decade, the growth rate was 30.7% (to 120,137), while between 1990 to 2000 the rate was by 23.6% (to 148,677). The State projects Hawai`i County will continue this greater than average rate of growth, where the population may exceed 200,000 by the year 2010.

Most of this growth has been in West Hawai`i and the Puna District in East Hawai`i. The population of the South Hilo District (where the UPST is located) grew much slower than the island's rate. Although it grew 27% (33,195 to 42,278) between 1970 to 1980, the growth rate averaged 6% over the next two decades (to 44,639 in 1990 and 47,386 in 2000). The State projects East Hawai`i (which includes Hilo, Hamakua, and Puna) will grow at an annual rate of 2.24%, reaching 95,385 by 2010 **(Table 3-1)**.

It should be noted that East Hawai`i, particularly the City of Hilo, has retained a socioeconomic and ethnic structure that resembles the pre-1960 patterns. This ethnic pattern is one characterized by a predominance of Asians, Hawaiians, and non-white ethnic groups. The demography of West Hawai`i, on the other hand, has changed significantly due to an influx of workers and retirees from the U.S. mainland.

3.4.2 Housing

The preliminary draft of the Hawai`i County General Plan (Draft 2, January 19, 2001) estimated that in 1997, there were 54,643 dwelling units on the Big Island. Of this amount, nearly 50% or over 29,000 units were found in East Hawai`i, most of them in the South Hilo and Puna Districts. In 1999, there was an estimated 124,930 parcels on the Big Island, of which nearly 80,000 were in East Hawai`i. Again, most of these lots were found in the South Hilo and Puna Districts.

The 2000 census noted 62,674 housing units in the County, of which 16,026 were within the Hilo Census District. Eighty-four and one-half (84.5) percent of the units were owner-occupied within the County, while this figure was even higher for Hilo at 91%. The island-wide vacancy rate was 7.6%, while Hilo had a higher rate of 10.9% **(Table 3-2)**.

Table 3-1
Selected Social Characteristics, 2000 Census

CHARACTERISTIC	Hawai'i Island	Hilo
Total Population	148,677	40,759
Percent Caucasian	31.5	17.1
Percent Asian	26.7	38.3
Percent Hawaiian	9.7	13.1
Percent Two or More Races	28.4	29.7
Median Age (Years)	38.6	38.6
Percent Under 18 Years	26.1	24.7
Percent Over 65 Years	13.5	16.7
Percent Households with Children	21.3	30.6
Average Household Size	2.75	2.70
Percent Housing Vacant	15.5	9.0

Source: U.S. Bureau of the Census, 2001

Table 3-2
Selected Housing Data, 2000 Census

	Hilo CDP	Hawai'i County	State of Hawai'i
Housing Stock:	16,026	62,674	460,542
Occupied Units	14,577	52,985	403,240
% occupied	91.0%	84.5%	87.5%
Vacant	1,499	9,689	57,302
---For seasonal use, etc.	216	5,101	25,584
% for seasonal use	14.4%	52.6%	44.6%
Rental Vacancy Rate	10.9%	7.6%	8.2%
Owner-occupied Units	8.873	34,175	277,888
(% of occupied units)	60.9%	65.5%	56.5%
Renter-occupied Units	5,704	18,810	175,352
(% of occupied units)	39.1%	35.5%	43.5%
Average population per			
Household	2.70	2.75	2.92
Family	3.19	3.24	3.42

Source: U.S. Bureau of the Census, 2001

3.4.3 Recreation

There are over 54 private and public parks totaling 590 (2.4 km^2) acres within the South Hilo District. Proximate to the proposed MKAEC are two active parks - the University Heights Park and Mohouli Park. These parks are located less than one mile (1.6 km) from the project site. There are also a public golf course and a nine-hole private golf course, a number of parks offering passive recreational activities (such as the Wailoa State Park and Li'ilioukalani Gardens), and ocean parks within the City.

3.4.4 Schools

There are private and public schools proximate to the UPST. These include the public Waiakea Complex (K-12) and the Hilo School Complex (K-12) as well as the St. Joseph School (K-12), all within two miles (3.2 km) of the project site. There are also a number of smaller private schools within the City and outlying areas.

The UPST is part of the UHH campus. The heart of the campus is located less than one mile (1.6 km) from the subject site.

3.4.5 Police and Fire Services

Hawai'i County's main station of the Police Department is located less than two miles (3.2 km) from the project site, with a five-minute traveling time. There are also a number of fire stations, all of which provide emergency medical services. The central and Kawailani Street fire stations are located about two miles (3.2 km) from the subject site, which is less than five minutes traveling time.

3.4.6 Medical Services

The Hilo Medical Center (also known as the Hilo Hospital) is located about two miles (3.2 km) from the site, with a traveling time of about ten minutes. There are also a number of outpatient private, surgical clinics all within two miles (3.2 km) and a five to ten minute traveling time of the proposed site.

3.4.7 Labor Force and Income

The historical economic root of the Big Island is founded in agriculture. Although there have been some significant islandwide job losses in some of the large-scale agricultural activities – particularly sugar production – agriculture still plays an important economic role. Coffee and macadamia nuts have and still continue to be the island's major agricultural products. There is also significant growth in the diversified agricultural sectors – such as papayas, vegetables, cut flowers, and nursery products. Additionally, there are aquacultural and ranching activities.

Beginning in the 1960s, tourism began to provide an increasing number of jobs. Its importance and growing dominance has continued over the past 40 years. On the Big Island, much of the tourist growth has occurred in West Hawai'i.

Employment opportunities are more readily found in West than in East Hawai'i. The unemployment situation in East Hawai'i has been exacerbated with the closure of various sugar plantations along the Hamakua Coast and Ka'u. Since 1993, over 1,000 sugar industry-related jobs have been lost.

The UHH and the growth of the astronomy and high technology industries have helped strengthen East Hawai'i's economy. The Environmental Impact Statement for the proposed China-US Center cited a study (Hammes 1994) which pointed out that the University contributed at least $28 million into the local economy during FY 1993-1994. Furthermore, expenditures by students and their visitors, plus other functions (such as conferences and athletic activities) account for $66 million, making the total annual contribution nearly $100 million.

3.4.8 Environmental Justice

On February 11, 1994, the President of the United States issued an Executive Order on Environmental Justice requiring agencies to address Federal Actions as they may relate to impacts on minority and low-income population (Executive Order 12898). Specifically, agencies must evaluate a project to assure that a proposed action would not disproportionately burden or adversely impact low-income and minority populations.

Pursuant to said Order, NASA has developed an Environmental Justice Implementation Plan and has adapted its NEPA process to ensure that environmental justice concerns are addressed in each Environmental Assessment and Environmental Impact Statement, as appropriate. This section examines the MKAEC project relative to its impact to low-income and minority populations

Minority Population

The Federal Department of Housing and Urban Development (HUD) defines "minority" as non-white and a "minority community" as one that has more than 40 percent minority populations. According to the U.S. Census for 2000, there were 40,759 persons living in all census tracts within the City of Hilo. Of this amount, 15,611 persons or 38.3 percent were of Asian descent; 5,340 or 13.1 percent were of native Hawaiian descent; and 12,105 or 29.7 percent persons were classified as having multiple races. The number of Whites or Caucasians was 6,970 or 17.1 percent **(Table 3-1)**. This breakdown is generally consistent with the County's ethnic demographic. Thus, based on HUD's definition, the City of Hilo is technically considered a "minority community".

Low-Income Population

According to the 2000 County of Hawai'i Data Book, the County unemployment rate was 8.7 percent (6,050 persons) in 1999. During the same period, the South Hilo, Puna, North Hilo/Hamakua and Ka'u Districts had an 8.2 percent (2,050 persons), 14.2 percent (1,500 persons), 9 percent (350 persons), 9.9 percent (250 persons) unemployment rate, respectively. These four districts make up East Hawai'i **(Table 3-3)**.

In the U.S. Census for 2000, the estimated median household income in 1998 for the State was $41,627, with the County of Hawai'i being the lowest at $34,411 **(Table 3-4)**. The State's poverty level was estimated at 10.5 percent (122,841), with the County of Hawai'i having the highest percentage at 15.1 percent (21,448) **(Table 3-5)**.

Pursuant to Federal HUD requirements, the County Office of Housing and Community Development prepared a Consolidated Plan (CP) for program years 2000 – 2004. This CP, which identifies low and moderate-income family areas within the County, is required to make the County eligible for Federal funds and/or grants.

As defined by the Federal HUD, low-income households are those households with incomes that earn 51 to 80 percent of the mean household income. The CP defines "low-income" as those families whose family income does not exceed 50 percent of the median family income for the area, while a "moderate-income" family's income is pegged at 80 percent. Although the CP has two categories (low and moderate), collectively they are still considered low-income households under the Federal HUD definition.

As indicated in **Figure 7**, the MKAEC project falls within census tract 205. Using 1990 census data, the CP identified 58.7 percent of the families to be "low- and moderate-income" (L/M) within this tract. One of the adjoining census tract (204) had a higher L/M rate at 60.4 percent, making that also a "low income" community. The four remaining adjoining tracts (206, 207.01, 207.2, and 208) were not considered "low income" as they had a L/M rate of less than 50 percent, ranging from to 26.3 percent to 45.6 percent.

3.5 Noise

The State Department of Health's rules governing noise (Chapter 11-46, HAR) outlines three classes of noise zoning districts (Agriculture, Residential, Commercial) and the corresponding maximum permissible sound levels due to stationary noise sources – such as air conditioning units, exhaust systems, and equipment related to agricultural, construction, and industrial activities. The noise level cannot be exceeded for more than 10 percent of the time during any 20-minute period. In the case of construction noise, that limit would be 70 decibels between 7 a.m. to 10 p.m.

Table 3-3
Employment Status of the Civilian Labor Force, By Census Tract, Hawai`i County: 1999

District & Census Tract	Civilian Labor Force	Employed	Unemployed	Unemployment Rate
Hawai`i County	69,900	63,850	6,050	8.7
South Hilo				
201.00	2,550	2,250	300	11.1
202.00	900	850	50	6.8
203.00	2,200	1,850	300	14.4
204.00	1,850	1,650	200	10.8
205.00	3,100	2,750	350	11.2
206.00	2,350	2,050	300	13/4
206.99	--	--	--	--
207.01	2,600	2,450	150	5.7
207.02	2,900	2.800	100	3.2
208.01	1.600	1.550	50	4.4
208.02	3,000	2,900	100	3.5
209.00	2,150	2,000	150	7.6
Puna				
210.01	3,450	3,000	500	13.8
210.02	3,750	3,350	450	11.7
211.00	3,400	2,850	550	15.7
Kau				
212.00	2,450	2,150	300	12.7
South Kona				
213.00	3,250	2,900	350	11.3
214.00	1,750	1,550	200	11.3
North Kona				
215.01	4,150	3,900	250	5.7
215.02	2.050	2,000	50	3.3
215.97	--	--	--	--
215.98	1.700	1,550	150	8.2
216.00	6.450	6,100	350	5.5
South Kohala				
217.00	5.900	5,600	300	5.3
North Kohala				
218.00	2.500	2,300	200	7.4
Hamakua				
219.00	2,150	1,900	250	10.7
220.00	1,000	950	50	5.1
North Hilo				
221.00	750	700	50	8.9

Source: County of Hawai`i Data Book, 2000

Table 3-4
Estimated State & County Median Household Income: 1998

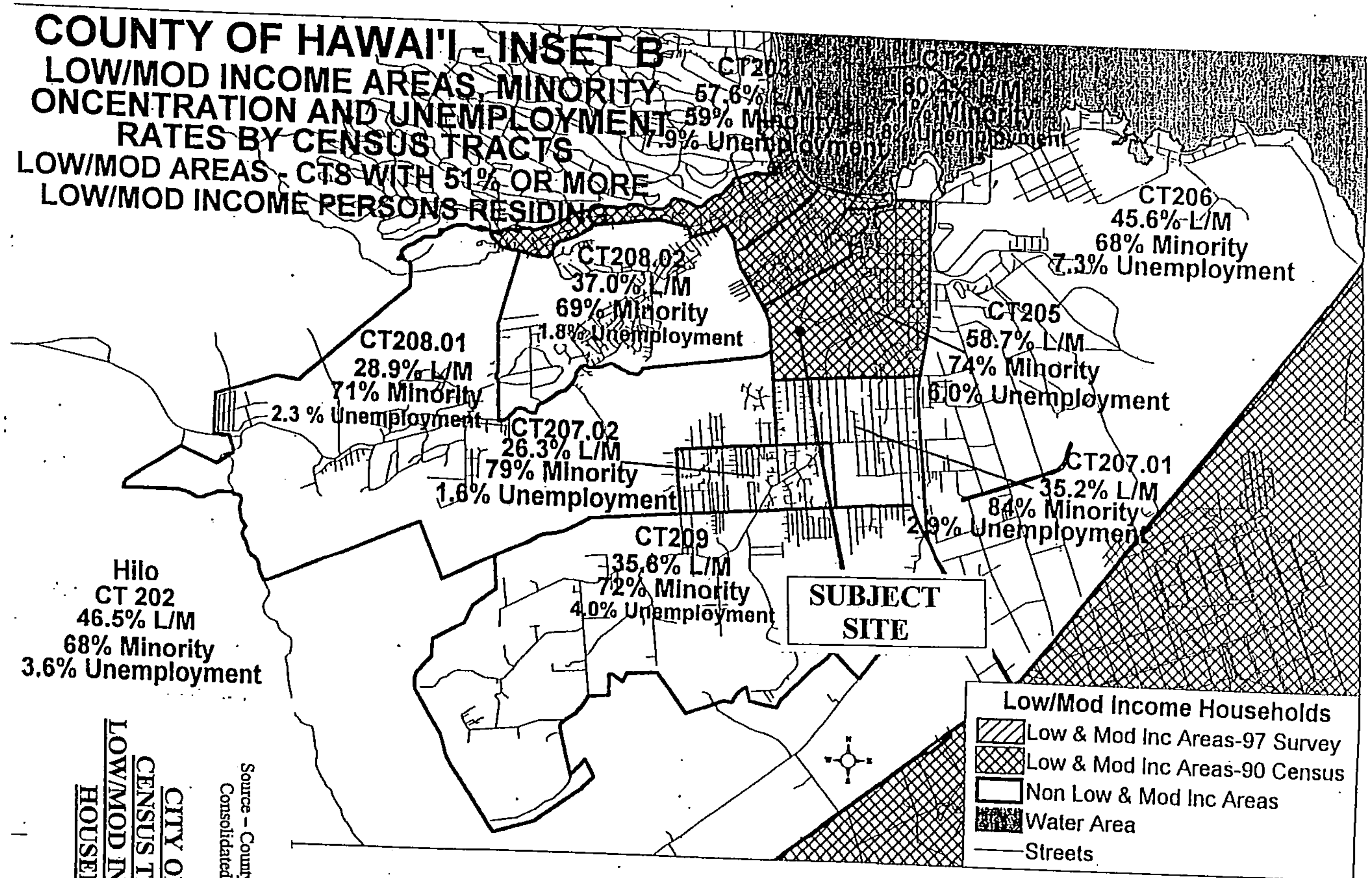
State & County	Median Household Income Estimate
Hawai`i	$41,627
• Hawai`i County	$34,411
• Honolulu County	$44,934
• Kalawao County	$9,859
• Kauai County	$38,552
• Maui County	$40,635

Source: U.S. Bureau of the Census: December 2001

Table 3-5
Estimated Number of All Ages in Poverty - State & County: 1998

	People of All Ages in Poverty	
State & County	Estimate	Percent
Hawai`i	122,841	10.5
• Hawai`i County	21,448	15.1
• Honolulu County	82,253	9.7
• Kalawao County	0	0.0
• Kauai County	6,428	11.3
• Maui County	12,712	10.4

Source: U.S. Bureau of the Census: December 2001



Source – County of Hawai'i Consolidated Plan - 2000

CITY OF HILO CENSUS TRACTS LOW/MOD INCOME HOUSEHOLDS

Figure 7

According to a noise impact study done in conjunction with the Environmental Impact Statement for the development of the UPST, the ambient traffic and background noise in this area ranges from "Moderate Exposure, Acceptable" and "Significant Exposure, Normally Unacceptable" levels along the rights-of way of Komohana, Lanikaula and West Kawili Streets. (Engineering Concepts, Inc., 1997) Along Komohana Street, the noise approximates 70 Day-Night Sound Level (Ldn) at a distance of 50 feet (15.2 m) from the street centerline. As the proposed facility would be situated more than 500 feet (152 m) from Komohana Street, the ambient traffic and background noise should be 50Ldn, which is compatible for residential uses. That level is below the Federal Housing Authority and Department of Housing and Urban Development noise abatement standard of 65 Ldn **(Table 3-6)**.

3.6 Air Quality

No specific air quality study of this project was conducted. The information contained in this EA was derived largely from air quality studies performed by B.D. Neal and Associates for the March 2000 Draft EA for the U.S. Pacific Basin Agricultural Research Center Facility of the Department of Agriculture and Jim Morrow for the 1997 EIS for the development of the University Park. It should be noted that the MKAEC site is located within the University Park, while the DOA's Agricultural Facility would be situated less than 1,000 feet (305 m) west of the MKAEC. The Facility, like the MKAEC, would also utilize Komohana Street as its primary access.

3.6.1 Ambient Air Quality Standards

The Federal and state ambient air quality standards (AAQS) limit ambient pollutant concentrations. As noted in the summary of the AAQS, Hawai`i's air quality standards are more stringent than the Federal standards, except for sulfur dioxide and particulate matter.

SUMMARY OF FEDERAL AND STATE AMBIENT AIR QUALITY STANDARDS

Pollutant	Sampling Period	NAAQS Primary	NAAQS Secondary	State Standards
Particulate Matter Less than 10 Microns (PM_{10})	Annual	50	50	50
	24-hour	150	150	150
Sulfur Dioxide	Annual	80	n/a	80
	24-hour	365	n/a	365
Nitrogen Dioxide	Annual	100	n/a	70
Carbon Monoxide	8-hour	10	n/a	5
	1-hour	40	n/a	10
Ozone	1-hour	235	n/a	100
Hydrogen Sulfide	1-hour	n/a	n/a	35
Lead	Quarter	1.5	n/a	1.5

Note: All concentrations in micrograms per cubic meter (ug/m^3) except for carbon monoxide, which is in milligrams per cubic meter (mg/m^3)

Table 3-6
Exterior Noise Exposure Classification
(Residential Land Use)

Noise Exposure Class	Day-Night Sound Level	Equivalent Sound Level	Federal (1) Standard
Minimal Exposure	Not Exceeding 55 Ldn	Not Exceeding 55 Leq	Unconditionally Acceptable
Moderate Exposure	Above 55 Ldn But Not Above 65 Ldn	Above 55 Leq But Not Above 65 Leq	Acceptable (2)
Significant Exposure	Above 65 Ldn But Not Above 75 Ldn	Above 65 Leq But Not Above 75 Leq	Normally Unacceptable
Severe Exposure	Above 75 Ldn	Above 75 Leq	Unacceptable

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) FHWA uses the Leq instead of the Ldn descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 Leq.

3.6.2 Existing Conditions

Motor vehicle emissions, industry, and natural sources affect the air quality in the South Hilo district. The natural sources come from the ongoing volcanic activity, which emits sulfur dioxide that converts into particulate sulfate that causes a volcanic haze (vog). The vog affects the Hilo area when trade winds are absent, usually 3% to 4% annually. The industrial sources come from oil-fired power plants, which emit sulfur dioxide, nitrogen ozides, and particulate matter. Automobile emissions include carbon monoxide, nitrogen oxides, and smaller amounts of other pollutants.

The State Department of Health does not frequently monitor air quality in the Hilo area. According to both the Neal and Morrow reports, the results of the monitoring indicated very low pollutant levels. The Neal report went on to note that the annual average concentration levels for the various measured items in 1999 and 2000 were very low. It also indicated that:

- Sulfur dioxide represented about 4 percent of the State and National standards while particulate matter represented only about 20 percent;
- There were no violations during this 2-year measuring period; and
- There were no reported measurements of lead, ozone, nitrogen dioxide or carbon monoxide, pollutants that are primarily motor vehicle oriented.

Notwithstanding the absence of any detailed monitoring of this area, in summarizing Neal's report, the Draft EA for the U.S. Pacific Basin Agricultural Research Center concluded that "Air quality in the project area is believed to be relatively good, except for occasional impacts from nearby volcanic emissions and localized traffic congestion." (Page 88).

The Morrow report, conducted for the EIS for the USPT, also arrived at the same favorable conclusion. It concurred that the air quality in this area is generally good, influenced heavily by the dispersive effects of the trade winds and the island's relative isolation from any major industrial sources of pollution. The existing ambient air quality was considerably lower than the State of Hawai'i and National Ambient Air Quality Standards. Thus, the County of Hawai'i is in attainment with the measured pollutants, which include particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, hydrogen sulfide, and lead. The report also concluded that even with the full development of the UPST, the air quality would not exceed the State or the National Ambient Air Quality Standards.

3.7 Floodplains and Drainage

According to the FEMA FIRM **(Figure 6)**, the subject site is designated zone "X" (areas of minimal flood hazard and/or drainage hazards and outside the 100- and 500-year flood way). The southeastern portion of the UPST borders the Waiakea Stream. That area is designated zone "AE" (areas inundated by 100-year flood where the base flood elevation has been determined) on the FIRM map. The site of the MKAEC, however, is located at least 800 feet (244 m) from this stream and outside of the 100-year flood plain.

3.8 Water Quality

3.8.1 Surface Water

The nearest stream to the subject site is the Waiakea Stream, located over 800 feet (244 m) away. This stream flows intermittently, particularly during heavy rainfall. Surface runoff from upstream residential and agricultural activities frequently feed into this stream.

In 1997, AECOS, Incorporated prepared a report, entitled *"An Assessment of Stream Impacts for a Bridge Crossing of Waiakea Stream at University of Hawai'i, Hilo, Hawai'i"* in conjunction with the EIS for development of the UPST and surrounding properties. The report noted that there were numerous pools, which supported a dense growth of blue-green algae at the bottom. Several freshwater fauna were found, including the guppy (*Poecilia reticulata)* swordtail (*Procambarus clarki*), tadpoles (*Bufo marinus* and *Rana catesbeiana*) and dragonfly naiads (*Pantala flavescens*). No indigenous fauna were found during this survey.

3.8.2 Groundwater

Due to the porous nature of the subject and surrounding area, surface water quickly infiltrates into the ground. Due to the limited agricultural activity and upslope of the subject site, pesticides and herbicides have not been used intensively in the past. Furthermore, historically, no industrial activities have taken place in this area. As such, it is unlikely that the groundwater is contaminated.

The closest potable well is situated in Panaewa, approximately three miles (4.8 km) from the site.

3.9 Biological Resources

3.9.1 Wetlands

The subject area is not designated as a wetland on the County General Plan. Neither the archaeological nor botanical field investigations conducted for the UPST identified any wetland within the subject area.

3.9.2 Vegetation

Char and Associates conducted a walk-through field study of the subject parcel and the surrounding area's botanical resources in November 1992 and again in 1996. It also re-evaluated its study in conjunction with this assessment **(Appendix A)**. The survey noted, among other plants, a number of endemic (i.e., native only to the Hawaiian islands) plants. These were *'ohi'a lehua* (Metrosideros polymorpha), *neneleau* (Rhus sandwicensis), *hapu'u* (Cibotium glaucum), and *'ahanui* (Machaerina mariscoides). Other plants noted were the matted *uluhe* ferns (Dicranopteris linearis), melastoma (Melastoma candidum), bamboo orchid (Arundina graminifolia), and strawberry guava (Psidium cattleianum). It also found pockets of introduced mixed forest consisting mainly of large gunpowder and melochia trees.

None of the plants inventoried were listed on the current list of threatened or endangered species; nor were any proposed or candidate for such status.

3.9.3 Wildlife

In 1997, Rana Productions prepared a report, entitled *"An Assessment of the Faunal Makeup of the Proposed UH-Hilo University Park Infrastructure Improvement Project, Phase IIA Sites, Hilo, Island of Hawai'i, Hawai'i"* **(Appendix B)**. This assessment was made a part of the EIS for the UPST's infrastructure improvements.

The habitat of the subject area was considered almost completely alien. As such, it was unlikely to harbor native forest bird species. Nonetheless, the Hawaiian Hawk or *I'o* which is endemic to the island of Hawaii, has been found proximate to this area. The author noted that the Short-eared owl or *Pueo*, which is endemic to Hawaii, may also be occasionally found in this general area. These birds may occasionally forage but not nest within the site.

The Hawaiian hoary bat (*Lasiurus cinereus semotus*) or *'Ope'ape'a* may use the site occasionally to roost. The bat is an endemic Hawaiian sub-specie and is listed as endangered by the US Fish and Wildlife Service. Little is known of this species range, population density or habitat preferences. The assessment concluded "Taking into consideration the current knowledge and understanding of the abundance, distribution, and biology of the Hawaiian hoary bat, it is unlikely that the construction on either of these (UPST) sites will have a deleterious impact on this endangered mammalian species."(Page 16).

Other probable species found in this general area are all introduced such as the Norway and Roof rat, European house mouse, domestic dog, small Indian mongoose, cat, and similar species.

3.10 Cultural Resources

3.10.1 Archaeological Resources

An archaeological inventory survey was conducted of the subject parcel (December 1992 to January 1993) by Cultural Surveys Hawaii **(Appendix C)**. This survey was done in conjunction with an Environmental Assessment for the construction of on-site infrastructure improvements within the UPST. The survey, which included the subject site, covered 163 acres (.66 km^2).

The report noted that bulldozing had occurred within the study area for an old water main and an electric power line. In addition, two structures (Agriculture Center and the Joint Astronomy Centre) and their associated parking lots and paved roadways were completed prior to the archaeological survey.

Sites were located within the southern portion of the parcel, of which four were described and mapped. None of these sites are located within or even proximate to the area of the proposed MKAEC **(See Figure 8)**. Two agricultural complex sites (18668 and 18669) and a mound feature of a third site (18667) were hand excavated and tested to document stratigraphy in the sites and to search for cultural remains to date the sites. No subsurface cultural deposits were found. No further archaeological research for the sites found was recommended based on the type and age indicated by the date collected and analyzed.

In September 1993, a supplemental archaeological survey was done by Cultural Surveys Hawaii, covering approximately 11 acres (4.45 h) in the vicinity of the Waiakea Stream. This stream also serves as a flood control channel in this area.

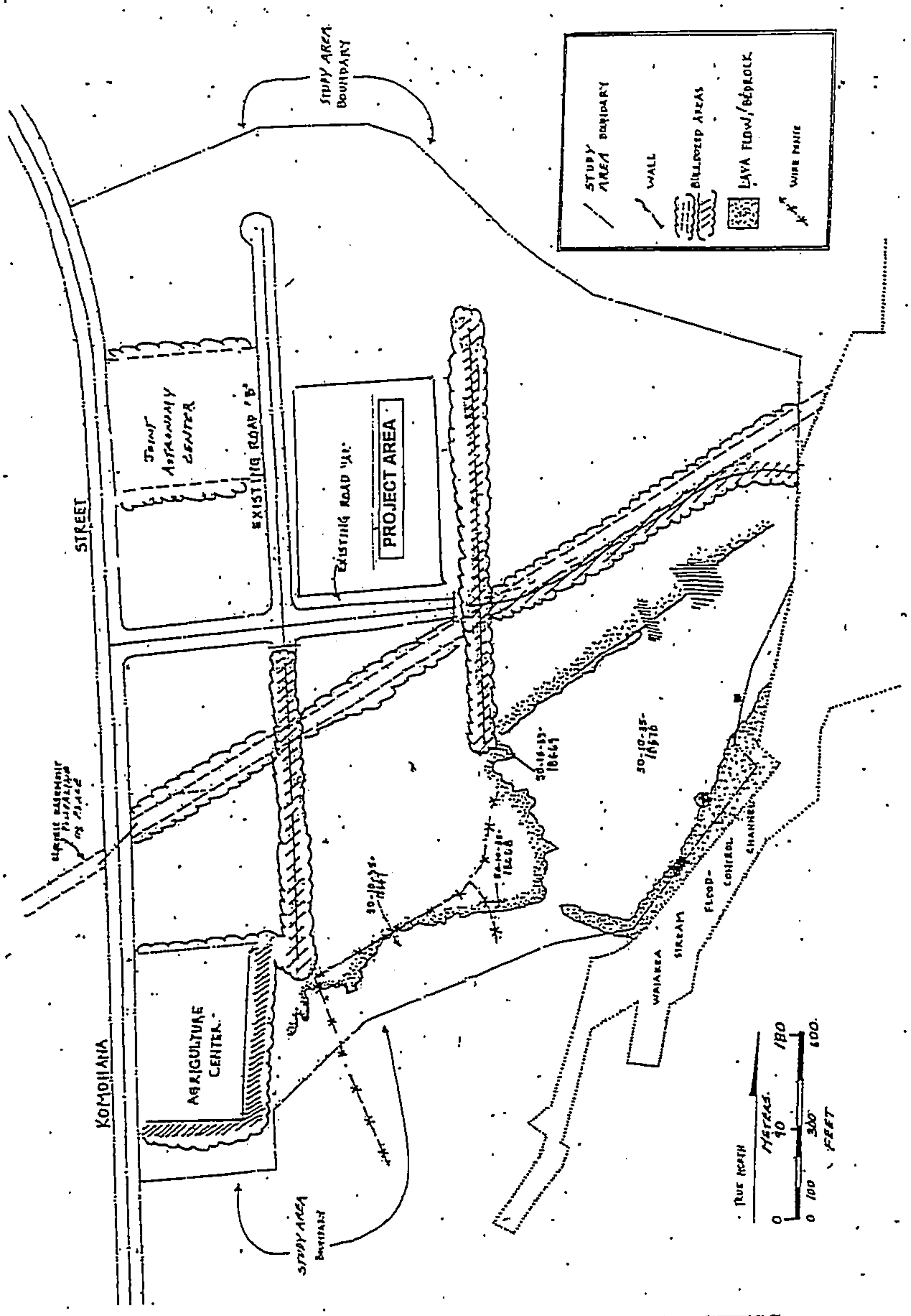
Four plantation era (circa 1870 to 1940) rock clearance features (or mounds) and a portion of a rock wall continuing from the state-owned parcel were identified. These features were included in the original survey under State Historic Site No. 50-10-35-18670. Based on subsurface testing of the largest mound within the Waiakea Stream, and another mound located within the state-owned parcel, these features were determined to be part of the commercial sugarcane cultivation of the Waiakea Cane Lots. As such, no further archaeological research was deemed necessary.

Relative to the proposed site, no archaeological features were found.

3.10.2 <u>Cultural Resources</u>

The archaeological reports discussed above did not indicate the presence of sites in the general area that require physical preservation. The sites were noted to be more agricultural in nature, some of which were of more recent vintage (i.e., associated with the sugar crop). No trails were identified. Furthermore, of the identified sites, none were found within or proximate to the proposed MKAEC.

In its review of the archaeological reports, Alan E. Haun, Ph.D. of Haun and Associates **(Appendix D)** concluded, "Based on the findings of the archaeological survey, there are no traditional Hawaiian cultural or historical resources in the project area." The proposed development would not affect such resources and no protective actions are necessary.



ARCHAEOLOGICAL SITES

Figure 8

The assessment of the area's botanical resources conducted by Char and Associates (see Section 3.9.2) did not identify any rare or endangered plant life in this area. The *uluhe* fern was observed on the site and the general vicinity. This fern is fairly common in this area. There was no visible evidence of native Hawaiians using the subject area for gathering of plants.

While no oral interviews were conducted with area native Hawaiians, based on the botanical report and the archaeological inventory reports and their cultural assessment by Dr. Haun, it does not appear likely that the subject site is used for gathering, access, or other customary activities by native Hawaiians.

3.11 Scenic Resources and Design Considerations

In the Natural Beauty element of the County General Plan, the views of Mauna Kea, Mauna Loa, and Hilo Bay are noted as providing the backdrop of this beauty. Specific sites reflecting this beauty and other natural features are also identified by tax map key (Figure 2). While the subject property and site are not specifically identified by tax map key, the project's visual relationship to the views of Mauna Kea, Mauna Loa, and Hilo Bay are also important.

Relative to the proposed site, the views of Mauna Kea and Mauna Loa would occur from the University campus. Because of the height of the mountains combined with the distance of all prevailing University uses from the proposed site, the mountains would still be visible. From Hilo Bay, the proposed structure would not obstruct views of Mauna Kea and Mauna Loa.

Hilo Bay is located generally east of the subject site. However, due to the existing stand of trees and bushes along Komohana Street in this area, most of the view is somewhat impaired. Temporarily, the outer portions of the Bay become visible in the area of Nowelo Street. As such, the tentative 79-foot (24 m) tall structure may partially affect this brief view of the Bay when traveling along Komohana Street. (See *Section 5.1.13 Scenic Resources and Design Considerations* for a detailed description of the mitigation measures to be undertaken.)

3.12 Solid Waste

The County does not provide solid waste collection services. This service is provided by either commercial haulers or the respective homeowner/business entity. The landfill in Hilo is rapidly approaching its capacity and is anticipated to close within the next few years. As such, the County is developing a long-range solid waste management plan, which may include operating a solid waste transfer station in its place for processing and recompaction, prior to transporting it to the Pu'uanahulu landfill in West Hawaii.

Like the UHH, the MKAEC intends to engage in recycling and composting. Recycling collection stations will be placed throughout the facility with collection service being provided by private contractors. Composting of green wastes will also be utilized for the area's landscaping. A Solid Waste Management Plan will also be prepared by the UHH meeting with the requirements of the County Department of Environmental Management, prior to the operation of the facility.

3.13 Toxic Substances

The subject site is vacant of any structures. There is also no evidence that there were structures or uses on the site that would result in residual asbestos, lead, or polychlorinated biphenyls (PCBs). There has not been any active agricultural use of this area within the past 50 years which would have required the extensive use of herbicides or pesticides.

3.14 Health and Safety

The subject site is outside of any airport flight or noise zone. There are no aviation easements within or proximate to the subject site. The Hilo airport is located nearly three miles (4.8 km) from the subject site.

There are no hazardous waste sites within or proximate to the subject site. The nearest solid waste disposal station is located more than three miles (4.8 km) from the subject site, at a lower elevation.

4.0 *Regulatory Environment*

4.1 State Land Use Law

The parcel is classified *Urban* by the State Land Use Commission. No further action and/or land use permit is required by the State.

4.2 Hawai`i County General Plan

The subject site is designated for *University Use* on the County General Plan Land Use Pattern Allocation Guide map **(Figure 9)**. The proposed use would thus be consistent with that designation, and no land use amendment would be required.

It should also be noted that in the General Plan document, one of the policies states that *"The County shall encourage the implementation of existing State and University of Hawaii plans for the establishment of a Research and Technology Park on the campus of the University of Hawaii at Hilo."*

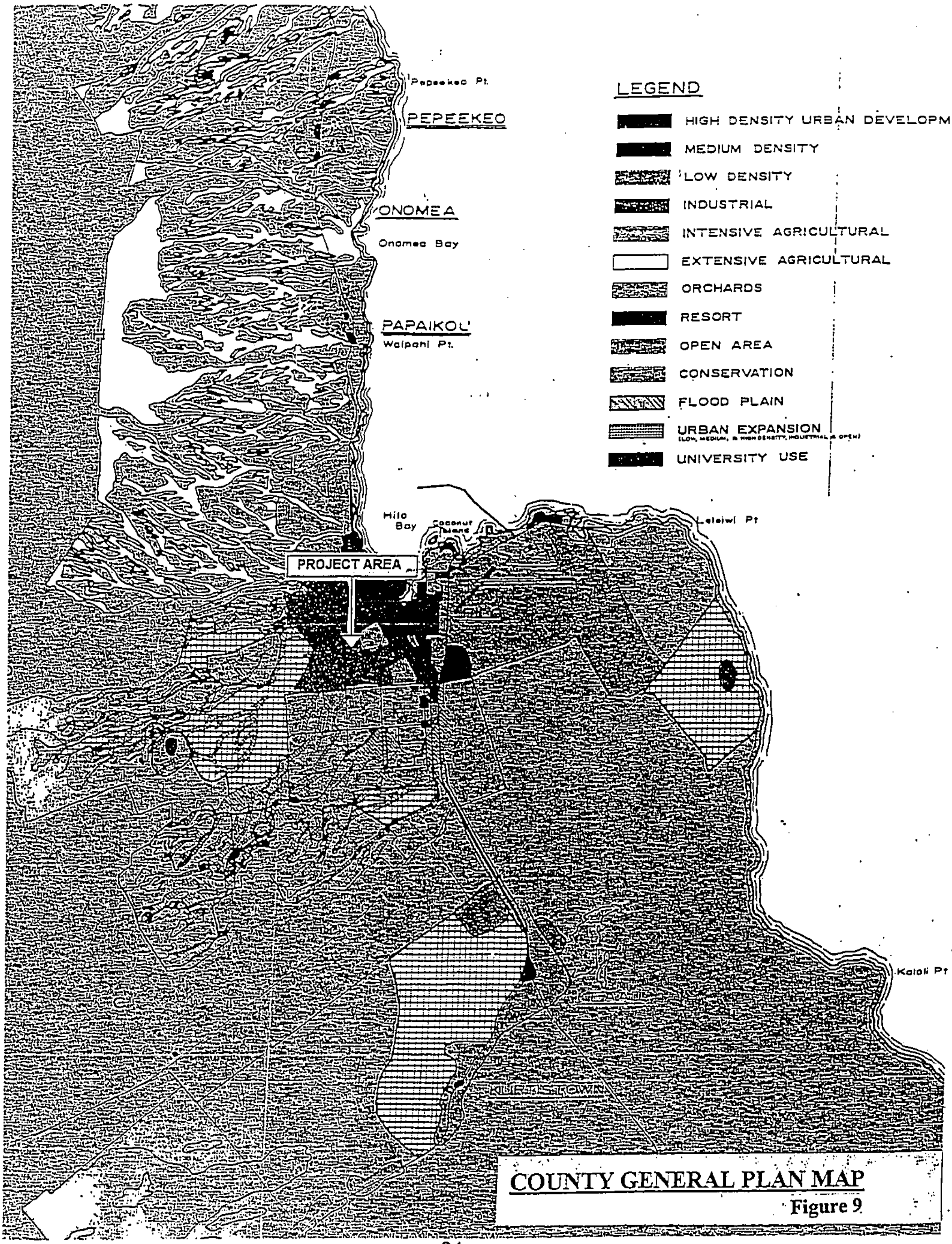
4.3 Hilo Community Development Plan

The Community Development Plan was adopted by the Planning Commission in 1975. The land use guide map of this Plan suggests a single-family residential, minimum 10,000 square feet (93 m^2) per lot (*RS-10*) for the balance of the University site **(Figure 10)**. As a land use guide, no amendment to this plan is needed to accommodate the requested use.

4.4 Zoning

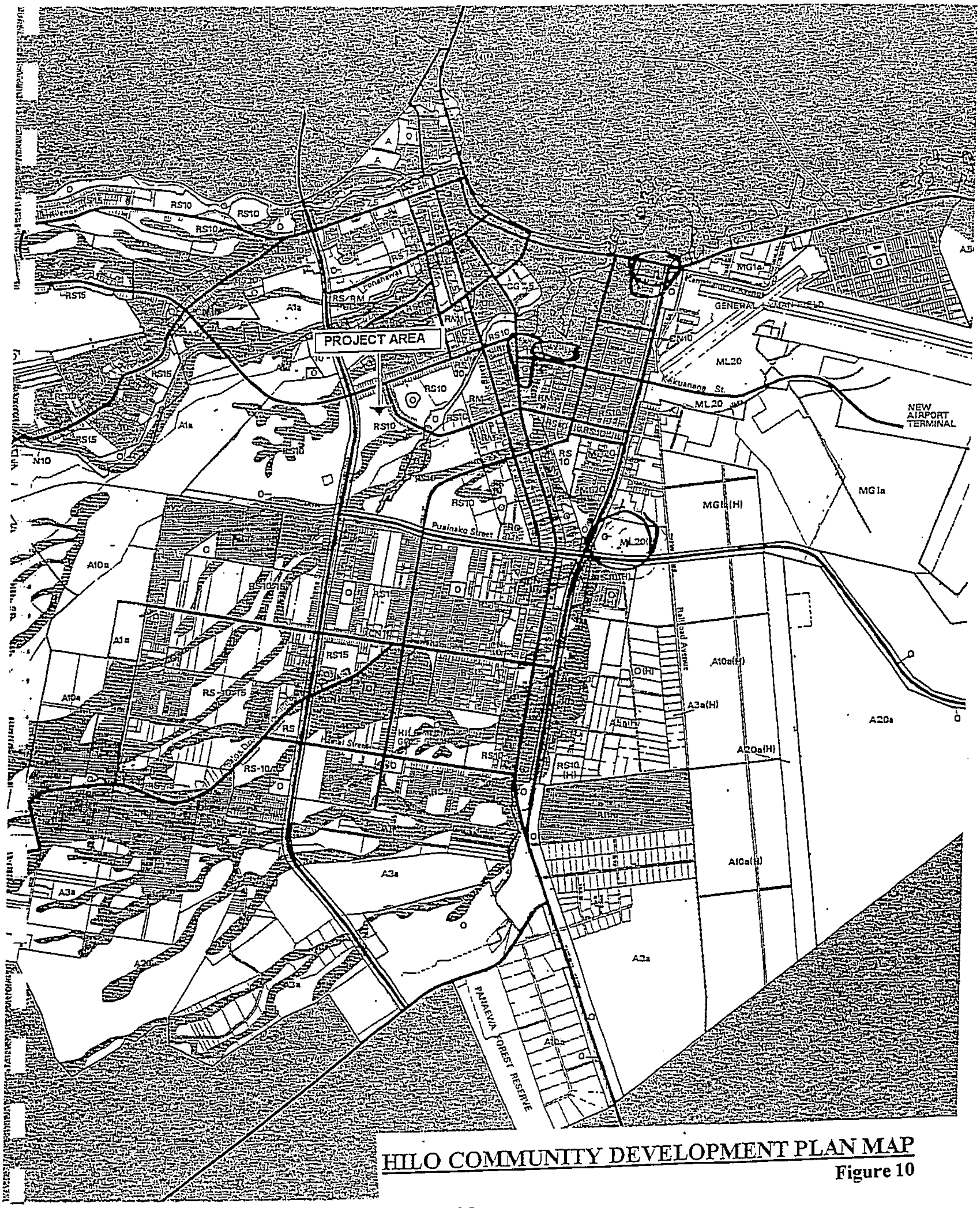
The County zoning of the entire site is split between *RS-10* and Agriculture, 1-acre minimum lot size (*A-1a*). The area of the proposed facility is zoned *A-1a*. Under the County Zoning Code, schools would be allowed in both of those zones, provided that the Planning Commission approves a Use Permit application. In this case, the use would be related to the University. All of the other facilities in this area are considered part of the University and thus were not subject to the Use Permit process. It is believed that this would continue to hold true for the proposed project.

All site planning requirements of the zoning code, such as parking, height, and setback will be met. Adequate on-site parking for both vehicles and buses with turn around areas will be provided on site. A height variance may be required, as the maximum allowable height within the *A-1a* zone is 45 feet (13.7 m), while the tentative height of one of the many tentative concept designs of the structure (because of the dome) is 79 feet (24 m). To the extent practicable, however, the structure will be designed to conform to the prevailing height requirements. Should a variance not be favorably considered, the structure will have to be redesigned to conform to the prevailing height requirements.



COUNTY GENERAL PLAN MAP

Figure 9



HILO COMMUNITY DEVELOPMENT PLAN MAP

Figure 10

4.5 Other Requirements

4.5.1 Special Management Area (SMA) and Coastal Zone Management (CZM)

The Federal CZM Act encourages the management of coastal areas and provides grants to participating States to help with the management of these areas. The State of Hawai'i is a participant in this program. The State's CZM policies and requirements are outlined in Chapter 205A, Hawai'i Revised Statutes. The CZM program requires all Federal and State actions to be consistent with the CZM plans and policies.

In addition to designating all lands within the State in the CZM area, Hawai'i's CZM program includes a special permitting process for areas within the Special Management Area (SMA). The subject site is not located within the County Special Management Area (SMA) and thus not subject to any additional permitting process. The County of Hawai'i Planning Department agreed with this conclusion in a letter, dated April 1, 2002 (see Appendix H).

The proposed project is consistent with the State CZM program. As it is located more than three miles from the shoreline and will not affect any streams or similar water uses, the recreational and coastal ecosystem policies and objectives would not be affected or applicable. There are no archaeological resources within the area of the proposed improvements. In terms of scenic and open space resources, view plans to and from the shoreline from the project site as well as to other natural landmarks such as Mauna Kea and Mauna Loa would not be significantly affected.

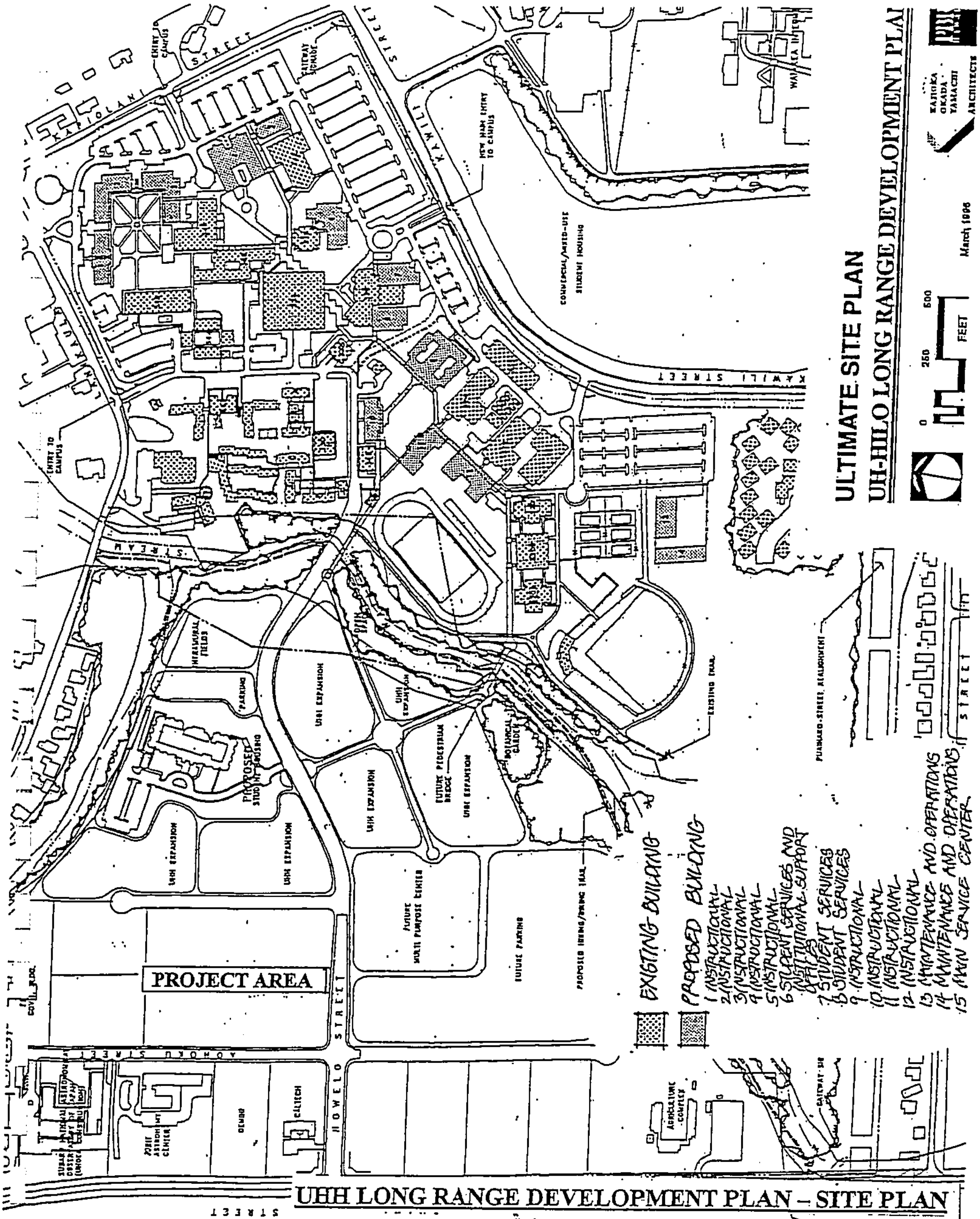
4.5.2 UH at Hilo Long Range Development Plan

The University of Hawai'i at Hilo Long Range Development Plan, developed in 1981, includes an "Ultimate Site Plan", guidelines for the campus development, including its architecture and landscaping plans to maintain a consistent design character with the existing campus buildings. The proposed use would be consistent with the Ultimate Site Plan **(Figure 11)**. Further, the proposed building will follow the development plan's guidelines as well as the State and County building codes.

4.6 Status of Required Permits

The following permits are or may be required for this project, and to date, none have been applied for:

- Use Permit
- Plan Approval
- Height Variance
- Underground Injection Control (UIC) Permit



UHH LONG RANGE DEVELOPMENT PLAN – SITE PLAN

Figure 11

- Grading Permit
- Building Permit
- Stormwater NPDES Permit

It should be noted that in conjunction with the building permit process, other permits will be needed, such as the electrical, plumbing, and air conditioning.

5.0 Environmental Impacts and Proposed Mitigation

5.1 Proposed Action

5.1.1 Geology and Hydrogeology

There are no soil or geological limitations to the construction of the MKAEC on the proposed site. The site is designated "X", areas determined to be outside the 100-year flood plain, on the FIRM map (Figure 6).

The subject site is located more than two miles (3.2 km) from the shoreline. It is outside of the Civil Defense tsunami evacuation zone. Construction of the MKAEC must comply with the 1997 edition of the Uniform Building Code (UBC) which upgraded the seismic zonation of Hawai'i County from Zone 3 to Zone 4.

5.1.2 Land Use

No adverse land use impacts are anticipated by this project. The proposed use is consistent with the County General Plan, Zoning Code, and UHH Long Range Development Plan. The proposed use is consistent with the immediately adjacent uses within the UPST. Further, no person or business will be displaced from this site.

5.1.3 Infrastructure

The UHH recently installed a 12-inch (30.5 cm) water line along Nowelo Street. That system should be sufficient to address the water quantity and pressure needs of the MKAEC. Discussions with the County Department of Water Supply will be initiated by the selected in the near future to establish a projected water use and the appropriate water facilities charge. The wastewater will be disposed of into an existing sewer transmission line within Nowelo Street, which connects to the County's 8-inch (20.3 cm) line along Lanikaula Street. Any upgrades to this line, if required, will be coordinated by the UHH with the County. All other utilities – such as electricity and telephone – are available to the subject site. Inasmuch as the building will be designed to meet the minimum certification requirements established under the LEED™ Green Building Rating System, there will be some measure of savings on the consumption of energy.

The project would not have any adverse impact on the area's existing wastewater, water, and utility infrastructure. Whatever impacts that may result from this project would be mitigated by additional improvements made by the UHH.

5.1.4 Traffic

A **revised** Traffic Impact Analysis Report (TIAR) for this project was prepared by M&E Pacific, Inc. **(Appendix E)**. The report reviewed the project's impact to three intersections on Komohana Street proximate to the subject site: Pu'ainako Street (and Extension), Nowelo Street, and Mohouli Street. Based on the projected opening of 2005, the report noted that the mid-morning hours would have acceptable traffic operations, with the levels of service at level C or better. The afternoon peak hours would be more problematic for left-turn movements exiting Nowelo Street. The levels of service would deteriorate from "D" to "E" to "F". Traffic signals would mitigate this problem. It should be noted that this deteriorative condition would occur with or without this project.

Having traffic signals at the other two intersections would mitigate traffic impacts. The Mohouli Street intersection is already signalized, while the Pu'ainako Street intersection will be signalized in 2003. Thus, the only outstanding intersection would be Nowelo Street. The UHH and/or MKAEC will install traffic lights at the intersection of Komohana Street and Nowelu Street. Based on this mitigation, the project would have no significant traffic impact.

5.1.5 Socioeconomics

The estimated construction cost of this project is nearly $28 million. Over the short term, this would greatly help the construction industry. Furthermore, this activity would occur in an area that would not result in any displacement of existing businesses, residences, or agricultural uses.

Over the long run, the project's operation would mean additional funds into the island's economy and would help broaden the island's tax base. It would also attract more interests in the research and technology fields to the island, and thus serve as an important catalyst for more growth in these fields.

At the same time, this project would help enrich and expand the island's – particularly East Hawai'i's – and the State's educational and cultural environment.

The proposed project is anticipated to generate at least fifteen full- and five part-time jobs. Existing residents can fill most of these positions. The 2000 census indicated nearly 1,500 vacant residential units in Hilo alone and additional 9,689 units for the rest of the island. As such, the additional housing demand directly generated by this project can be readily absorbed in Hilo.

Parks, medical, police, fire, and other public facilities are available within a three-mile (4.8 km) radius of the project site.

5.1.6 Environmental Justice

The on-site development issues associated with the MKAEC project itself would not cause any direct substantial impacts to adjoining properties relative to drainage or stormwater runoff, wastewater, and utilities. The nature of the project itself would not generate direct substantial noise or air quality impacts.

However, potential sources of environmental justice issues would be traffic and air and noise pollution associated with the increase in traffic during the construction and post-construction periods. As discussed in sections 5.1.4, 5.1.7, and 5.1.8, these impacts, while not substantial, will still be mitigated. Nonetheless, it is still important to examine whether the construction and operation of the MKAEC would cause disproportionate impacts on minority and low-income communities proximate to the subject site.

Minority Populations

Using HUD's definition, all census tracts – including census tract 205, the tract of the proposed MKAEC - within the City of Hilo would be considered a "minority community". The 2000 Census identified over 82 percent of the City of Hilo's population to be non-white. Thus, the project's traffic and associated air quality impacts resulting from the construction and operation of the MKAEC would not disproportionately affect minority communities. Given the population demographics of the City of Hilo, the "minority community" really makes up the majority of the population. In that regard, all of the census tracts would be affected similarly by the MKAEC. As such, there would be no disproportionate affects on minority communities from traffic generated by the construction and operation of the MKAEC.

Low Income Populations

The MKAEC falls within census tract 205, a tract that has over 58 percent low- and moderate-income families. One of the adjoining tracts had an even higher rate of low- and moderate-income families at 60.4 percent. Three of the other adjoining census tracts (CT 207.01, 207.02, and 208.2) would also sustain traffic and associated air quality impacts resulting from this project. Those tracts also front either Pu`ainako Street and Komohana Street, the principal accesses to the MKAEC.

The traffic and vehicular related air quality impacts resulting from the MKAEC would thus not disproportionately affect those living within census tract 205. It will affect all tracts equally. In addition, traffic impacts will be mitigated largely through the construction of traffic lights at the Nowelo Street/Komohana Street intersection.

There would thus not be any significant environmental justice impacts resulting from the construction and operation of the MKAEC.

5.1.7 Noise

There will be short-term impacts associated with the construction of the facility that would occur during normal working hours and days, not on weekends. All construction noise levels will comply with existing Department of Health regulations (Chapter 11-46) governing noise, including construction noise. It should be noted that there are no immediate surrounding residential use areas.

The subject area is generally associated with ambient noise levels associated with traffic along Komohana Street. The proposed MKAEC will generate its own noise. However, as the uses are intended to be limited, for the most part, to daytime and indoor activities, the noise level would not be significant and for the most part be comparable to the acceptable residential decibel level of 55. As such, no adverse noise impacts are expected.

5.1.8 Air Quality

During the construction phase of this project, there will be short-term direct and indirect impacts to the area's air quality. This impact would be largely through the fugitive dust resulting from vehicular movements and soil excavation as well as the emissions from the exhaust of the vehicles and other construction equipment.

The State Department of Health's regulations (Chapter 11-60, HAR) prohibits visible emissions of fugitive construction dust beyond the construction line.

The use of the MKAEC would generate vehicular traffic, and traffic would be singularly the most important contributor affecting air quality. Although the annual volume of visitors is projected at 250,000, many of these will be students who will arrive by buses. That plus the higher emission control standards for motor vehicles should help abate excessive pollutants indirectly resulting from the MKAEC project.

As noted Section 3.6.2 of this Assessment, the major vehicular-related pollutants are lead, ozone, nitrogen dioxide and carbon monoxide. With the exception of carbon monoxide, the State does not monitor the other pollutants in this vicinity.

The air quality report prepared by B.D. Neal and Associates this year for the Draft EA for the US Pacific Basin Agricultural Research Center (USPBARC) prepared a model to project carbon monoxide concentrations in this area. It took an estimated worst-case 8-hour carbon monoxide concentrations by multiplying the worst-case 1-hour morning and afternoon ambient carbon monoxide concentrations by a persistence factor of 0.5. The model measured carbon monoxide concentrations at the intersections of Komohana Street and Pu`ainako Street and Komohana Street and Nowelo Street.

The Draft EA for USPBARC noted the estimated worst-case 8-hour concentrations of carbon monoxide at the Pu`ainako Street intersection to be 2.8 milligrams per cubic meter (mg/m$^3$), while the Nowelo Street intersection had a much lower level at 1.3 mg/m$^3$. In projecting this level to the year 2010, the Pu`ainako Street intersection had a level of 3.9 mg/m^3, while the Nowelo Street intersection was higher at 4.4 mg/m^3. This value was the same, with or without the project. This was attributed not so much to the project's traffic generation but the anticipated uses within the UPST and other planned major uses in this area, such as the China-U.S. Center and the UHH multi-purpose sport and recreational complex. (Pages 91-92).

Accordingly, the Neal model did account for the development and in-filling of uses within the UPST, such as the proposed MKAEC. The 8-hour worst case concentration of carbon monoxide in this area is estimated at 4.4 mg/m^3 at the Nowelo Street intersection.

Further, the traffic study prepared for this EA by M&E Pacific, Inc. (Appendix E) projected 38 *incoming and 10 outbound trips in the mid-morning* hour and 64 outbound trips in the afternoon peak hour. Based on this projected volume as well as recent and planned traffic improvements in this area (notably the completion of Mohouli Street extension, the on-going construction of the Pu`ainako Street extension, and the signalization of Nowelo Street), the study concluded that the current level of service along Komohana Street will be maintained. However, while the level of service for left-turn traffic exiting Nowelo Street would deteriorate from level of service D to F, a signalized intersection would improve the existing level of service.

Thus, while the volume of vehicles in this area will increase, the wait time (which adds to the level of carbon monoxide concentration) would not change significantly with all of the planned and on-going improvements in the area.

Given all of those circumstances, it is maintained that the carbon monoxide concentration level attributable to the MKAEC would be well within the National limit of 10 mg/m^3 and the more stringent State standard of 5 mg/m^3. This conclusion was also reached in the EIS for the UPST and the Draft EA for the USPBARC. As such, the overall air quality impacts resulting from the MKAEC project would not be significantly adverse.

5.1.9 Floodplains and Drainage

The floodplain impact resulting from this project would not be adverse. The project site is outside of any designated flood plain area. The proposed parking and structures should increase the area of semi-impervious surface. Given the existing permeable condition of the land, on-site drainage problems are not anticipated.

The County requires all locally generated stormwater to be captured and disposed on site. The conventional means is through natural percolation, and in certain situations, the construction of drywells at a depth of 10 feet (3.05 m). Because of potential groundwater impacts, all drywells are subject to an Underground Injection Control (UIC) permit from the State Department of Health.

In this situation, this project will have, if needed, drywells (subject to the UIC permit) and any other drainage systems as may be required by the County. This will be installed and properly maintained by UHH.

5.1.10 Water Quality

As the proposed site is located at least 800 (244 m) feet from the Waiakea Stream, the surface water impact resulting from this project would be negligible.

Likewise, impacts to the groundwater resulting from this project would not be adverse. The nearest potable well is located approximately three miles (4.8 km) from the project site. Furthermore, all drywell constructed on site to handle on-site drainage would require an Underground Injection Control permit from the State Department of Health. Said permit is evaluated relative to the impact of a drywell to the groundwater.

5.1.11 Biological Resources

No adverse impacts to biological resources are anticipated from the development of this project. According to the botanical assessment of this area prepared by Char and Associates in 1996 (Appendix A), there were no rare or endangered plant species or animal life found within the project site. A re-review of the current list of threatened or endangered plant species also noted that none of the inventoried site was listed.

5.1.12 Cultural and Archaeological Resources

Archaeological inventory surveys were conducted of the site and immediately surrounding areas. The surveys did not find any historic trail or anything of archaeological significance within the area of the proposed project. In its comments on the Draft Environmental Assessment, the State Historic Preservation Officer concluded that "no historic properties will be affected" by this project (See Appendix H). A cultural assessment of the archaeological reports (Appendix D) also concluded that there would be no adverse cultural impacts.

The botanical study also did not identify any rare or endangered plants within the project site. The Office of Hawaiian Affairs noted that "*uluhe* is often used in lei-making, and given the abundant growth of *uluhe* in the project area, Native Hawaiian practitioners would not have to go far to pick adequate supplies." The *uluhe* fern is not unique to the subject site. It grows in abundance in the general area and many other parts of the island. Thus, while the site and surrounding area may have been used in the past for gathering of the *uluhe*, because of its abundance the development of this site for the MKAEC or any other use would have little impact on the overall *uluhe* population. The MKAEC will also use native plants for its landscaping, and the *uluhe* fern could be incorporated into its landscaping program and subsequently made accessible to those with legitimate access claims.

Based on archaeological surveys conducted and input from the Hawai`i State Preservation Officer and other parties, the UHH has determined that no property that would meet the criteria for listing in the National or State Register of Historic Places lies within the area of the proposed project's effects. Consequently, there would be no adverse effect on such properties.

5.1.13 Scenic Resources and Design Considerations

The project site itself is not designated as a scenic resource on the County General Plan. Relative to its impacts to other identified resources (Mauna Kea, Mauna Loa, and Hilo Bay), one of the tentative design concepts heights noted in the Draft EA reflected the height of the structure to be 79 feet (24 m) tall. By itself, that height may be imposing.

However, the views of the identified resources would not be significantly impacted by this project. The existing vegetation along Komohana Street partially impairs the view of Hilo Bay. In addition, the elevation at Komohana Street is at least ten feet greater than the project site. Together, the impacts to Hilo Bay from Komohana Street would not be significantly compromised.

When viewed immediately from the project site to Mauna Kea and Mauna Loa, the views may be somewhat impaired. However, when viewed from existing uses at different parts along the UHH campus or from Hilo Bay, the views of Mauna Kea and Mauna Loa would not be affected at all, given the prominence of those mountains. Accordingly, this project would not result in creating significantly adverse visual impacts.

It should also be noted that any structure that exceeds the maximum height limit of 35 feet (10.7m) or 45 (13.7m) feet, depending on the zoning of the affected area, would require a height variance. During that process, there will be opportunities for public comments, and the visual impacts of the additional height would again have to be closely examined by the County of Hawai`i Planning Director before a decision is rendered.

It should be emphasized that the concept design in the Draft EA is one of the many tentative options available. Since publication of the Draft EA, the MKAEC Selection and Design Committee selected the team of Taisei Construction Corporation, Durrant Media Five and Oda/McCarty Architects, Ltd. for the design/build services. To assure the development of a visually sensitive yet functional design, the selected architectural/design firm has been instructed by the MKAEC project office to:

- Actively solicit and consider input from the surrounding community and public before submitting final design concepts to the MKAEC Selection and Review committee;
- Provide written evidence to the MKAEC project office that it has actively sought public input on the design; and
- Provide to the MKAEC project office copies of all comments received in writing and a written summary of oral comments received.

The MKAEC project office shall provide all public comments to the MKAEC Selection and Review Committee in a timely manner for its consideration during the final design selection process. It should be noted that as one of the funders of this project, NASA has strongly encouraged the MKAEC project office to seek a building design that is consistent with the functional needs of the facility, yet reduces the height of the building to the extent practicable. In addition, NASA has strongly encouraged the MKAEC project office to make visual and aesthetic compatibility with the surrounding environment a factor in making the final design selection. The MKAEC Selection and Review Committee will make the final design selection.

5.1.14 Solid Waste

A solid waste management plan will be prepared by UHH for this facility and shall conform to the rules and regulations of the County Department of Environmental Management. The plan will include many of UHH's existing conservation and recycling measures.

While the project will have a solid waste impact, its proposed and on-going practices would help mitigate the problem. Like the UHH, this facility will engage in recycling and composting. Recycling collection stations will be placed throughout the facility with collection services being provided by private contractors. Composting of green waste will also be utilized for the area's landscaping. As such, this project is not anticipated to create a significantly adverse solid waste impact.

5.1.15 Toxic Substances

There is no evidence or knowledge that the project site was used to store toxic waste or any chemicals. It has not been used for any urban type of uses and has been used for very low level agricultural use in the past. In addition, the proposed MKAEC will not use or produce any hazardous material. As such, there would be no adverse impact resulting from or affecting the subject project.

5.1.16 Health and Safety

There would be no adverse health and safety impacts resulting from this project. The project site is not located within any flight zones or aviation easements. It will not generate and/or use any toxic material or chemical.

5.2 Alternative 1: Construction of the MKAEC at other locations

This alternative would not be practical or cost effective. Infrastructure costs would potentially be much higher. All required infrastructure exists for the proposed site. Furthermore, the proposed site is consistent with the UHH Long Range Development Plan, while other sites would require a re-examination of all applicable land use plans.

5.3 Alternative 2: Reduction of Size and Scope of MKAEC

By not including a dome, the project could be scaled back in both size and function, with similar environmental impacts as the proposed action. However, if the height of the structure were reduced to 45 feet (13.7 m), it would compromise the function served by the dome. It may also require construction of a number of freestanding structures to accomplish the objectives of the Center. Having multiple structures could be more costly and would require a larger land area.

A reduction in the scope of the MKAEC could achieve potential construction savings. However, because programs and/or functions of the Center would have to be eliminated, it could also affect the interest and quality of the project. That, in turn, could adversely affect the level of public and professional interest in this project, and thus have potentially adverse socioeconomic effects.

5.4 Alternative 3: No Action

Under this alternative, the MKAEC would not be constructed. The site would be left in its present undeveloped state, surrounded with a number of astronomy-related offices and facilities and the UHH campus. There would be no short-term construction impacts or long-term impacts relative to traffic and other infrastructure.

At the same time, the educational, scientific, and cultural growth and expansion of the UHH, the UPST, and the community would be diminished. The economic impacts of such a facility both in terms of employment and expanded tax base would also be adversely affected. Relatedly, there would potentially be continued and expanded visitor traffic on the summit of Mauna Kea. Such an increase would compound the traffic hazard as well as the health and welfare of the visitors. This alternative would potentially have adverse socioeconomic and environmental impacts through loss of visitors and increased traffic to the summit of Mauna Kea.

6.0 *Mitigation and Unavoidable Short- and Long-Term Adverse Impacts*

In conjunction with the development of this project, certain mitigation work is required by UHH. These include:

- the active solicitation of public input by the architectural/design firm and the consideration of public comments on the proposed building design concepts by the architectural/design firm and the MKAEC Selection and Review Committee prior to finalization of the building design;
- the installation of a traffic signal light at the intersection of Komohana and Nowelo Streets to help mitigate potential traffic impacts;
- the installation of landscaping consistent with the County Planning Department Rule No. 17 **(Appendix F)** and NASA policies encouraging the use of native vegetation for landscaping and incorporating *uluhe* fern into its landscaping program and allowing its gathering to those Native Hawaiians with legitimate claims;
- adherence to appropriate State Department of Health noise and dust emission control standards and regulations during the construction phase of this project;
- the preparation and implementation of a Solid Waste Management Plan to mitigate impacts to the County's solid waste sites;
- the possible data recovery and/or physical preservation of inadvertent archaeological finds during the course of construction. This will include the preparation and approval of a data recovery and/or physical preservation plan, by the Department of Land & Natural Resources – Historic Preservation Division prior to its implementation.
- the installation of drywells and any other drainage system that may be required by the County of Hawai`i;
- the incorporation of the principles and concepts outlined in the LEED™ Green Building Rating System to achieve greater design economic and environmental efficiencies.

All of the other mitigation will take place during the normal permitting and construction process. These would include activities such as designing and constructing all structures to address appropriate seismic requirements; installing County-approved drainage systems, which may include drywells meeting with the approval of the State Department of Health through the issuance of the underground injection control permits to address groundwater concern; and installation of utility connections.

6.1 Unavoidable Adverse Short-Term Impacts

In spite of the mitigation work, there will be some unavoidable short-term adverse impacts. These, which are associated with the construction activity, include:

a. some measure of traffic slow down and congestion along local streets;
b. construction noise and dust; and
c. some negligible construction dust runoff, including possible mud and dirt on Nowelo Street and North A`ohoku Place.

6.2 Unavoidable Adverse Long-Term Impacts

Although some of the long-term impacts can be mitigated, there will still be some adverse long-term impacts. These include:

a. loss of open space and possible brief loss of view of Hilo Bay from Komohana Street;
b. alteration of existing topopgraphy; and
c. loss of some vegetation in the area of the proposed improvements.

7.0 List of Agencies and Individuals Contacted

7.1 Consulting Parties

The following public agencies were consulted in the process of preparing this environmental assessment:

<u>Federal</u>

- US Fish and Wildlife Service

<u>State</u>

- Department of Land and Natural Resources
  - Division of Historic Preservation
  - Division of Forestry and Wildlife
  - Division of Land
- Department of Transportation, Highways Division
- Office of Hawaiian Affairs
- Office of Environmental Quality Control
- Land Use Commission
- Department of Education – Hilo Area Complex
- Business, Economic Development & Tourism
- Department of Health – Environmental Services Division

<u>County</u>

- Planning Department
- Department of Public Works
- Department of Water Supply
- Department of Environmental Management
- Department of Research and Development
- Police Department
- Fire Department
- Department of Parks and Recreation
- Office of Housing and Community Development

A content advisory panel has also been formed by the UHH consisting of 24 members of the community.

7.2 Comments and Responses (Consultation Period)

During the consultation period, comments from various agencies were received. Their comments and responses thereto are found in **Appendix G**. The comments have been incorporated into this Draft EA.

7.3 Comments and Responses (Draft EA)

The Draft State EA was published in the July 8, 2002 OEQC Environmental Notice. As Federal funds are involved, a Draft Federal EA (which contained the substantively the same information as the Draft State EA) was prepared and a notice of its availability with a request for public comments was published in the island's two most widely circulated newspapers, the West Hawaii Today and the Hawaii Tribune Herald, on June 12, 2002. Copies of the Draft EA were made available at 8 public libraries in the County. Additionally, a copy was provided to thirty-two (32) government agencies and interested parties. A complete list of these agencies and parties as well as the comment and response letters are found in **Appendix H**.

Comments on either the Draft Federal EA or Draft State EA were received from nine (9) government agencies and a joint letter from two members of the public. These comments and responses thereto are found in Appendix H in their entirety. It should be noted that with one exception, all responses originated from NASA. The UHH concurred with and was provided a copy of all response letters.

Two agencies (County Departments of Fire and Parks and Recreation) had no comments or objections to the project, while the State Historic Preservation Officer noted that "no historic properties will be affected by this (MKAEC) undertaking." The County Police Department noted that the construction of traffic lights at the intersection of Nowelo Street and Komohana Street, as well as the use of the University campus road, would alleviate their traffic concerns.

The County Department of Research and Development recommended the use of concepts and principles of the LEED™ Green Building Rating System. As NASA has already adopted such a policy, the respective design consultants will be advised of this requirement, which would then assure greater economic and environmental efficiencies of the project. **(See Section 5.1.3 Infrastructure)**

The County Department of Water Supply recommended that the water use calculation be determined as soon as possible to facilitate the determination of the facilities charge. Once the design consultants have been selected, discussions with the Department of Water Supply will take place. **(See Section 5.1.3 Infrastructure)**

The Engineering Division of County Department of Public Works commented that the project should comply with appropriate building, drainage, grading/earthwork, road right-of-work, and streetlights/traffic control codes and requirements. The appropriate design and/or engineering consultants will be responsible for the preparation of the required plans and securing the appropriate permits. **(See Section 5.1.3 Infrastructure)**

The University of Hawai'i Institute for Astronomy commented that the project could relieve traffic congestion at the summit. **(See Section 2.4 Alternative 3: No Action)** It also noted that adequate on-site parking and turnaround areas should be provided to minimize traffic impacts along A'ohoku Place. Adequate parking and bus turnaround areas, meeting with the requirements of the County Zoning Code, will be provided on- site. **(See Section 4.4 Zoning)**

The State Office of Hawaiian Affairs (OHA) offered comments relating to "ceded" land, adequacy of the discussion on the project's cultural and archaeological impacts, absence of consultation, and the design of the project. The "ceded" land issue is a State issue, and UHH will be working with OHA on this matter. **(See Section 3.1.1 Location and Land Ownership)** The archaeological inventory survey concluded, as did the State Historic Preservation Officer, that the project would not have any adverse archaeological impacts. The cultural assessment also arrived at the same conclusion. **(See Section 5.1.12 Cultural and Archaeological Resources)** No comments were received from OHA during the "consultation" process. Finally, OHA expressed concerns about the concept design. The concept design in the Draft EA is one of the many tentative options available. The architectural firm selected will be advised to solicit public input on the proposed building design concepts. They will be required to take into consideration public comments before submitting final design concepts to the MKAEC Selection and Review Committee. **(See Section 2.5.1 Project Description; Section 3.11 Scenic Resources and Design Considerations; and Section 5.1.13 Scenic Resources and Design Considerations for a detailed description of the mitigations measures to be undertaken.)**

Finally, two public individuals jointly expressed some design issues. As noted earlier, the selected consultants will take those concerns into consideration. **(See Section 5.1.13 Scenic Resources and Design Considerations.)**

8. **Determination, Findings, and Reasons for Supporting Determination – Chapter 343, HRS and Rule 11-200-12, HAR**

The Department of Health's Administrative Rules (Title11, Chapter 200) establish "Significance Criteria" to help the agency make a determination of whether a proposed action would have a significant environmental impact. This assessment is designed to consider the "significance" of potential environmental effects, which includes the overall and cumulative effects of the proposed action. The significance criteria and the project's relationship are discussed below.

1. Involves an irrevocable commitment to loss or destruction of any natural or cultural resource.

The site upon which the proposed facility would be located does not have any significant natural resources. There would be no destruction or loss of any significant, endangered, or threatened botanical, faunal, geological, or other natural resources.

While there are some archaeological features on the property, none are located in the area of the proposed facility. The *Uluhe* fern is abundant in this general vicinity. It will be incorporated into the MKAEC's landscaping program and made accessible to Native Hawaiians with legitimate gathering claims.

2. Curtails the range of beneficial uses of the environment.

The requested use would not interfere with any of the existing surrounding uses. The proposed MKAEC is consistent and compatible with the on-going research and scientific activities at the University Park.

Its noise and vehicular impacts will be accommodated through appropriate mitigative measures. Any associated drainage and wastewater requirements will be handled in a manner meeting with the requirements of the appropriate government agencies. Thus, environmental options for the surrounding area should still exist in spite of the proposed facility.

3. Conflicts with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions or executive orders.

The EA addressed probable environmental impacts of the proposed action and demonstrated that the impacts would not be significant. All potential adverse impacts are mitigatable. All required improvements – wastewater, traffic, and drainage- will be done in accordance with the requirements of the State and/or County. Any impacts on other public infrastructure would not be significantly adverse.

4. *Substantially affects the economic or social welfare, cultural practices of the community or State.*

During the construction phase, the project will generate construction jobs for more than a year. When completed, the project is expected to inject over $10 million annually to the island's economy. There will be more than 15 full time and 5 part time jobs created. These jobs and funds will mean a lot to the Big Island, which is hovering at the double-digit unemployment figure.

As the archaeological and botanical reports noted, there are no historic trails within the subject site. Neither is there any recent evidence of gathering of plants by Native Hawaiians for customary or traditional purposes on the site. Nonetheless, the Office of Hawaiian Affairs has pointed out that this general area has at times being used to harvest the *uluhe* fern. As such, the MKAEC has elected to incorporate the *uluhe* fern into its landscaping program and make the fern accessible to those Native Hawaiians with legitimate gathering claims. As such, there would be no significantly adverse impacts to the cultural practices of the community or the State.

5. *Substantially affects public health.*

As the project will not have an adverse impact on the environment, its impacts to public health should equally not be adverse. All improvements relating to public health – such as wastewater and drainage system – will be pursuant to County requirements. The wastewater for example will be disposed of into the County's system. Air emission and noise controls during the construction period will be implemented pursuant to the State Department of Health air quality and noise control regulations.

6. *Involves substantial secondary impacts, such as population changes or effects on public facilities.*

The proposed MKAEC is consistent with the UHH's plans for the Park and surrounding area as outlined in its Long-Range Development Plan. The development of this Park, which would include uses such as the MKAEC were considered and addressed in the Final EIS for the construction of the Park's required infrastructure in 1997.

7. *Involves a substantial degradation of environmental quality.*

The development of the MKAEC would not result in a substantial degradation to the area's environmental quality. The assessment noted that while there will be changes to the physical landscape of the area, there will also be mitigation measures taken, including the replanting of native vegetation. All of the required infrastructure exists and where they do not, will be constructed by the UHH or MKAEC.

8. *Is individually limited, but cumulatively has considerable effect upon the environment or involves a commitment for larger actions.*

The probable impacts of the MKAEC have been discussed in this document, which did take into account the existing and planned facilities in this area. This assessment included the cumulative impacts of the traffic and other infrastructure.

This project is a stand-alone project. It is not reliant on any other facilities being built within or outside of the University Park.

9. *Substantially affects a rare, threatened, or endangered species or its habitat.*

As noted in this report, the biological and faunal resources of this area would not be threatened. No rare, threatened, or endangered plant or animal life was found on the subject site or purported to be vulnerable to the proposed action.

10. *Detrimentally affects air or water quality or ambient noise levels.*

The project would not affect air, water quality, or ambient noise levels. There will be impacts particularly during the short-term construction phase, impacts that will be mitigated. From a long-term perspective, there will be no such significantly adverse impacts. The project itself is not a pollutant activity; all wastewater will be disposed of into the County system; and much of the activity will be conducted indoors.

11. *Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land area, estuary, fresh water, or coastal waters.*

The subject site is situated more than 2 miles from the shoreline. As such, the usual issues of tsunami or beach erosion are absent. There are no wetlands on the site, and the site is designated zone "X", areas outside of the 500-year floodplain, on the FIRM map. As such, the project should not have adverse impacts to any environmentally sensitive area.

12. *Substantially affects scenic vistas and viewplanes identified in county or state plans or studies.*

As noted in this report, there should be no visual impacts to Mauna Kea and Mauna Loa. There may be some impact to Hilo Bay. This impact, however, should not be significant, as the site is somewhat lower than Komohana Street and the stand of vegetation along the Street already interferes with any views of the Bay. Furthermore, there are other areas along Komohana Street where the views are more commanding.

The selected architectural/design consultants will be required to solicit public input prior to finalizing and submitting their design alternatives to the MKAEC Selection and Review Committee for determination.

13. *Requires substantial energy consumption.*

The project will increase energy consumption. The increase, however, is not expected to significantly exceed the requirements of other facilities in the area. The facility will also be designed to be energy efficient in terms of lighting and air circulation. It will also follow the principles and concepts of the LEED™ Green Building Rating System. This energy-efficient design emphasis will help reduce what would otherwise have been a more substantial energy consuming facility.

Based on the analysis performed through the Environmental Assessment process, the Accepting Authority (University of Hawai`i at Hilo) has determined that a Finding of No Significant Impact (FONSI) for this project is warranted and has so issued such a finding.

9.0 List of References

AECOS, Inc. March 1997. *An Assessment of Stream Impacts for a Bridge Crossing of Waiakea Stream at University of Hawaii, Hilo, Hawaii.* Kailua, Hawai'i.

B. D. Neal and Associates. January 2002. *Draft Air Quality Study, USDA Pacific Basin Agricultural Research Center, Hilo, Hawaii.* Honolulu.

Char and Associates. May 2002. *Letter Review of Botanical Resources – Mauna Kea Astronomy Education Center.* Honolulu.

Char and Associates. December 1992. *Botanical Survey, University of Hawai'i at Hilo, Proposed Infrastructure for Research and Technology Lots, South Hilo District, Island of Hawai'i.* Honolulu.

Council on Environmental Quality (CEQ). 1997. *Considering Cumulative Effects Under NEPA.* Washington: CEQ.

County of Hawai'i Office of Housing and Community Development. May 2000. *County of Hawai'i Consolidated Plan For Program years 2000 – 2004.* Hilo.

County of Hawai'i Planning Department. November 1989. *The General Plan, County of Hawai'i.* Hilo.

County of Hawai'i Planning Department. January 19, 2001. *County of Hawaii General Plan Revision Program – General Plan Preliminary Draft II.* Hilo.

County of Hawai'i Planning Department. August 1998. *Planning Department Rule No. 17 – Landscaping Requirements.* Hilo.

County of Hawai'i, Department of Research and Development. October 2001. *Data Book 2000 County of Hawaii.* Hilo.

County of Hawai'i. 1983, as amended. *Hawai'i County Code, Chapter 25 (Zoning Code).* Hilo.

Cultural Surveys Hawai'i. November 1993 (revised). *Archaeological Survey and Testing of Lands Proposed for Research and Technology Lots at the University of Hawaii at Hilo (TMK: 2-4-01: 7 and 41).* Honolulu.

Engineering Concepts, Inc. September 1997. *Final Environmental Impact Statement – University of Hawaii at Hilo University Park, Hilo, Hawaii.* Honolulu.

Federal Emergency Management Agency (FEMA). 1988. *Flood Insurance Rate Map-Community Panel No. 155166 0880 C,* Washington.

Giambelucca, T.W. Nullet, M.A., and T.A. Schroeder. 1986. *Rainfall Atlas of Hawaii.* Honolulu: Hawaii, Department of Land and Natural Resources.

Heliker, Christina. 1990. *Volcanic and Seismic Hazards on the Island of Hawaii.* Washington: U.S. Department of Interior, Geological Survey.

M&E Pacific. May 2002. *Traffic Impact Analysis Report – Mauna Kea Astronomy Center.* Honolulu.

Morrow, J. W. March 1997. *Air Quality Impact Report (AQIR) University of Hawaii at Hilo – University Park.* Honolulu.

Rana Productions, Ltd. 1997. *An Assessment of the Faunal Makeup of the Proposed UH-Hilo University Park Infrastructure Improvement Project, Phase IIA sites, Hilo, Island of Hawai'i, Hawai'i.* Kailua-Kona, Hawai'i.

SSFM International. March 2002. *Draft Environmental Assessment for U.S. Pacific Basin Agricultural Research Center Project TMK: (3) 2-4-001: portion of 122 Hilo, Hawaii.* Honolulu.

State of Hawai'i, Department of Agriculture (DOA). 1979. *Agricultural Lands of Importance to the State of Hawai'i (ALISH).* Honolulu.

State of Hawai'i, Office of State Planning (OSP). 1991. *Hawai'i State Plan.* Honolulu.

Terry, Ron, Ph.D. and SSFM International, Inc. March 2002. *Final Environmental Impact Statement – China-U.S. Center, Waiakea, South Hilo District, Hawai'i Island, State of Hawai'i, TMK: 2-4-01: 05 (por).* Hilo.

University of Hawai'i at Hilo, Department of Geography. 1998. *Atlas of Hawai'i. 3rd ed.* Honolulu: University of Hawaii Press.

University of Hawai'i , Land Study Bureau. 1965. *Detailed Land Classification – Island of Hawai'i.* L.S. Bulletin No. 6. University of Hawai'i. Honolulu.

University of Hawai'i at Hilo, PBR HAWAII, et al. March 1996. *University of Hawaii at Hilo Long Range Development Plan.* Honolulu.

U.S. Bureau of the Census. May 2000. *Profiles of General Demographic Characteristics. 2000 Census of Population and Housing, Hawai'i.* (U.S. Census Bureau Web Page).

U.S. Soil Conservation Service. 1973. *Soil Survey of Island of Hawaii, State of Hawaii.* Washington: U.S. Department of Agriculture, Soil Conservation Service.

APPENDIX A

BOTANICAL RESOURCES ASSESSMENT STUDIES
and UPDATED LETTER
(Char and Associates)

CHAR & ASSOCIATES
Botanical/Environmental Consultants
4471 Puu Panini Ave.
Honolulu, Hawaii 96816
(808) 734-7828

25 May 2002

Sidney Fuke
Planning Consultant
100 Pauahi Street, Suite 212
Hilo, Hawaii 96720

SUBJECT Mauna Kea Astronomy Education Center
Review of Botanical Resources

Dear Mr. Fuke:

In 1992, Char and Associates conducted studies of the botanical resources on the University of Hawai'i, Hilo, research and technology lots. The site of the proposed Mauna Kea Astronomy Education Center (TMK: 2-4-1: portion 7) was included in the 116-acre State-owned parcel that was surveyed.

I have reviewed the 1992 report which also includes a checklist of the plants found on the site. The field notes from the 1992 study were also examined.

Sixteen native species were inventoried from the site. Twelve species were indigenous, that is, they are native to the Hawaiian Islands and elsewhere, and four were endemic, that is, they are native only to the Hawaiian Islands. These endemic species were: hapu'u (Cibotium glaucum), 'ahanui (Machaerina mariscoides subspecies meyenii), 'ohi'a lehua (Metrosideros polymorpha), and neneleau (Rhus sandwicensis). All of the native species can be found in similar lowland, wet forests throughout the Hilo and Puna districts. None of the plants recorded from the research and technology lots, including the proposed education center, is on the most recent lists of threatened and endangered species; nor is any plant a species of concern (U.S. Fish and Wildlife Service 1999a, 1999b; Wagner et al. 1999).

In conclusion, the proposed education center is not expected to have a significant negative impact on the botanical resources.

Please do not hesitate to call me should you have any questions regarding these findings.

Sincerely,

Winona P. Char

Winona P. Char

References

Char, W.P. (Char & Associates). 1992. Botanical Survey, University of Hawai'i - Hilo, Proposed Infrastructure for Research and Technology Lots, South Hilo District, Island of Hawai'i. Prepared for Engineering Concepts, Inc. December 1992.

U.S. Fish and Wildlife Service. 1999a. U.S. Fish and Wildlife Service species list, plants. March 23, 1999. Pacific Islands Office, Honolulu, HI.

U.S. Fish and Wildlife Service. 1999b. Endangered and threatened wildlife and plants. 50 CFR 17.11 and 17.12. December 31, 1999.

Wagner, W.L., M.M. Bruegmann, D.R. Herbst, and J. Q.C. Lau. 1999. Hawaiian vascular plants at risk: 1999. Bishop Museum Occasional Papers No. 60.

CHAR & ASSOCIATES
Botanical/Environmental Consultants
4471 Puu Panini Ave.
Honolulu, Hawaii 96816
(808) 734-7828

May 1996

BOTANICAL RESOURCES ASSESSMENT STUDY
STREAM CHANNEL AREA
UNIVERSITY OF HAWAI'I - HILO
HILO, ISLAND OF HAWAI'I

INTRODUCTION

The proposed project along Waiakea Stream is for improvements to the stream channel and construction of a bridge to connect University Park to the main UH Hilo campus. The study area is located mauka (west of) the student dorms and the College of Agriculture facilities.

Field studies to assess the botanical resources found on the project site were conducted on 16 April 1996 by a team of two botanists. The primary objectives of the walk-through field survey were to describe the vegetation, search for threatened and endangered species, and identify areas of potential environmental problems or concerns, particularly the presence of wetlands, and propose appropriate mitigation measures.

A discussion of the vegetation found on the project site follows. The plant names used are in accordance with Wagner et al. (1990) for the flowering plants and Lamoureux (1988) for the ferns.

DESCRIPTION OF THE VEGETATION

The vegetation on the University Park parcel was surveyed by Char in November 1992 for the proposed infrastructure for the research and technology lots. Introduced mixed forest composed primarily of large gunpowder (Trema orientalis) and melochia (Melochia umbellata) trees as well as several other tree species in smaller numbers occurs on the University Park land adjacent to the stream channel study area. Locally abundant near the study area is a grove of Alexandra or king palm (Archontophoenix alexandrae). On the UH Hilo campus side, the vegetation consists of mats of California grass (Brachiaria mutica) with sourbush or pluchea (Pluchea symphytifolia) shrubs and small stands of gunpowder and melochia trees. This area appears to be infrequently maintained.

Wedelia (Wedelia trilobata), a commonly used ground cover species, is abundant along both banks of the stream. California grass occurs as small scattered patches. Other species occasionally encountered here include small clumps of palmgrass (Setaria palmifolia), downy woodfern (Christella parasitica), and yellow ginger (Hedychium flavescens); a few small guava shrubs (Psidium guajava); and smaller herbaceous species such as oriental hawksbeard (Youngia japonica), bubble-gum plant (Polygala paniculata), and maile hohono (Ageratum houstonianum).

The stream has been eroded down to the bedrock of solid, dense pahoehoe lava. Scattered here and there in depressions are a few shallow pools of water. Some of the herbaceous plants and seedlings of the woody components mentioned previously occur in the stream bed where there are small pockets of soil and gravel. Much of the stream bank is also solid bedrock.

No wetlands occur within the project site. All three criteria for determining wetlands must be present; these are the presence of hydric soils, wetland indicator species (hydric vegetation), and hydrology (Environmental Laboratory 1987). On the project site, there are no areas with hydric soils as the stream bed and most of the stream bank is solid bedrock. Wetland indicator species (Reed 1988) do not cover 50% or more of the site and the vegetation is composed largely of upland species.

DISCUSSION AND RECOMMENDATIONS

The vegetation on the site proposed for the stream channel improvements and the bridge are dominated by alien or introduced plant species; these are all those plants which were brought to the Hawaiian Islands by humans after Western contact, that is, Cook's discovery of the islands in 1778. None of the plants encountered during the survey is a threatened and endangered species (U.S. Fish and Wildife Service 1994a, 1994b); nor is any plant considered rare or vulnerable (Wagner et al. 1990). No wetlands occur within the project site. Similar findings were recorded for the adjacent University Park parcel (Char 1992).

Given the findings above and the limited nature of the project, no significant negative impacts to the botanical resources are expected. No recommendations are proposed at this time.

LITERATURE CITED

Char, W.P. 1992. Botanical survey, University of Hawai'i -Hilo, Proposed infrastructure for research and technology lots, South Hilo District, Island of Hawai'i. Prepared for Engineering Concepts, Inc.

Environmental Laboratory. 1987. "Corps of Engineers Wetlands Delineation Manual", Technical report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Lamoureux, C.H. 1988. Draft checklist of Hawaiian pteridophytes, "Kupukupu O Hawai'i Ne'i". Lyon Arboretum, University of Hawai'i, Manoa.

Reed, P.B., Jr. 1988. National list of plant species that occur in wetlands: Hawaii (Region H). U.S. Fish and Wildlife Service Biological Report 88(26.13).

U.S. Fish and Wildlife Service. 1994a. Endangered and threatened wildlife and plants. 50 CFR 17.11 & 17.12. August 20, 1994.

________. 1994b. Plants, Hawaiian Islands, Listed, proposed or candidate species under the U.S. Endangered Species Act, Updated: December 15, 1994. Unpublished list, Pacific Islands Office, Honolulu.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1990. Manual of the flowering plants of Hawai'i. 2 vols. University of Hawai'i Press and B.P. Bishop Museum Press, Honolulu. B.P. Bishop Museum Special Publication 83.

CHAR & ASSOCIATES
Botanical/Environmental Consultants
4471 Puu Panini Ave.
Honolulu, Hawaii 96816
(808) 734-7828

May 1996

BOTANICAL RESOURCES ASSESSMENT STUDY
UH HILO UNIVERSITY PARK
INFRASTRUCTURE IMPROVEMENTS, PHASE IIA
RESERVOIR AND WATER LINE ALIGNMENT
HILO, ISLAND OF HAWAI'I

INTRODUCTION

The proposed offsite water improvements will consist of a 0.5 MG reservoir and an influent line which will connect to an existing water line. The project site is located immediately east (makai) of the Sunrise Estates Subdivision. The proposed 200 ft. long by 200 ft. wide reservoir site is located within a much larger parcel which is 500 ft. long by 300 ft. wide. The proposed connecting water line alignment or corridor is 40 ft. wide by roughly 1,200 ft. long.

Field studies to assess the botanical resources found on the larger reservoir parcel and the water line corridor were made on 16 April 1996 by a team of two botanists. The primary objectives of the field survey were to describe the vegetation on the project site, search for threatened and endangered species as well as rare and vulnerable plants, and identify areas of potential environmental problems or concerns and propose appropriate mitigation measures.

A walk-through survey method was used. Notes were made on plant associations and distribution, substrate types, topography, exposure, drainage, etc. The project site was accessed from the makai end of Puloku Street. The water line corridor follows along an old grub line now overgrown by various grasses and weedy herbs and shrubs. Portions of the reservoir parcel were staked and flagged prior to our field studies. The parcel is covered by dense vegetation consisting of an 'ohi'a/uluhe community with scattered patches of strawberry guava and melastoma shrubs.

DESCRIPTION OF THE VEGETATION

A description of the vegetation found on the reservoir parcel and the water line corridor is presented below. The plant names used in the discussion follow Wagner _et al_. (1990) for the flowering plants and Lamoureux (1988) for the ferns.

Reservoir Parcel: A portion of the vegetation on the parcel was surveyed by Gerrish (1992) for the future Puainako Street Extension project. Gerrish noted that the vegetation along this portion of the roadway corridor consisted of an 'ohi'a (_Metrosideros polymorpha_)/uluhe fern (_Dicranopteris linearis_) forest, but with many areas dominated by strawberry guava or waiawi (_Psidium cattleianum_) and other alien or introduced species.

On Hawai'i island, the 'ohi'a/uluhe forest is associated with young lava flows and shallow soils on the lower, windward slopes of the Puna and Hilo Districts (Cuddihy and Stone 1990). Typically, it is composed of dense, almost impenetrable, mats of uluhe fern with scattered, widely spaced 'ohi'a or 'ohi'a lehua trees up to 40 ft. tall. Because of the thick cover of uluhe fern, there are only a few other species associated with this vegetation type. On the reservoir site, the other native species which occur infrequently are 'ahaniu (_Machaerina mariscoides_), hapu'u (_Cibotium glaucum_), _Scleria testacea_, huehue (_Cocculus trilobus_), neneleau

(Rhus sandwicensis), and 'ama'u (Sadleria cyatheoides).

Strawberry guava and melastoma (Melastoma candidum) shrubs form 6 to 12 ft. tall thickets throughout the 'ohi'a/uluhe forest on the project site. Melastoma cover is denser along the lower half of the reservoir parcel. Both strawberry guava and melastoma are alien or introduced plants; these are plants which were brought to the islands by humans after Western contact, that is, Cook's discovery of the Hawaiian Islands in 1778. Since their introduction, both species have spread rapidly and invaded lowland mesic to wet habitats (Cuddihy and Stone 1990).

Ground cover under the melastoma and strawberry guava thickets is sparse, with much leaf litter and barren lava. A few blechnum fern plants (Blechnum occidentale) form small clumps here and there along with seedlings of the two alien shrub species. Under the dense mats of uluhe, ground cover is almost always absent; leaf and stem litter and barren lava predominate.

Water Line Corridor: The water line corridor follows along an old grub line for the most part. The vegetation on this disturbed area consists of a varied assemblage of mostly weedy, alien grasses, herbs, and shrubs. Broomsedge grass (Andropogon virginicus), and owi (Stachytarpheta dichotoma) are the most abundant components of the weedy vegetation in most places. Other species occasionally encountered include Glenwood grass (Sacciolepis indica), bamboo orchid (Arundina graminifolia), Spanish clover (Desmodium incanum), Hilo grass (Paspalum conjugatum), sleeping grass or puahilahila (Mimosa pudica), yellow foxtail (Setaria gracilis), hairy sword-fern or 'okupukupu (Nephrolepis multiflora), Spermacoce mauritiana, etc. Hairy swordfern is locally abundant where the corridor approaches the end of Puloku Street. Along the northern half of the corridor, sourbush (Pluchea symphytifolia) and young, 4 to 6 ft. tall melastoma and strawberry guava shrubs cover roughly 50%

of the corridor.

Along the corridor's edge, the 'ohi'a/uluhe forest is more disturbed and open. It supports patches of broomsedge and hairy swordfern as well as a number of alien plants which include melochia (<u>Melochia umbellata</u>), guava (<u>Psidium guajava</u>), and gunpowder tree (<u>Trema orientalis</u>). The uluhe fern cover is patchy with large thickets of strawberry guava and melastoma in between. Some native plants such as <u>Scleria</u>, pala'a fern (<u>Sphenomeris chinensis</u>), and neneleau prefer these more open, sunny areas.

A list of all the native species observed on the reservoir parcel and the water line corridor during the field studies is presented in Table 1.

DISCUSSION AND RECOMMENDATIONS

The native-dominated 'ohi'a/uluhe forest occurs on the reservoir parcel and along the edges of the water line corridor as well as the adjacent undeveloped lands. In places, the forest supports dense thickets of strawberry guava and melastoma. The 'ohi'a/uluhe forest represents a fairly early stage in plant succession on wet lava flows and does not support a rich diversity of native plant species. This vegetation type or plant community is fairly common on the relatively young lava flows in the Hilo and Puna Districts.

A large number of weedy species as well as a few native plants are found on the water line corridor. The corridor follows along an old grub line just makai of the subdivision.

No listed, proposed, or candidate threatened and endangered plant species (U.S. Fish and Wildlife Service 1994a, 1994b) were found during the survey. Nor did we find any plants considered rare or vulnerable (Wagner et al. 1990).

Given the findings above and the limited nature of the project, the proposed project is not expected to have a significant negative impact on the botanical resources. There are no botanical reasons to impose any restrictions, inmpediments, or conditions to the proposed project.

TABLE 1. List of native plants found on the reservoir parcel and water line alignment, Hilo, Hawai'i.

Scientific name	Common name	*Status
<u>FERNS</u>		
BLECHNACEAE (Blechnum Fern Family)		
Sadleria cyatheoides Kaulf.	'ama'u, 'ama'uma'u	E
DICKSONIACEAE (Tree Fern Family)		
Cibotium glaucum (J. Sm.) Hook. & Arnott	hapu'u, hapu'u pulu	E
GLEICHENIACEAE (Vine Fern Family)		
Dicranopteris linearis (Burm.) Underw.	uluhe, unuhe	I
LINDSAEACEAE (Lace Fern Family)		
Sphenomeris chinensis (L.) Maxon	pala'a, pala pala'a	I
<u>FLOWERING PLANTS</u>		
ANACARDIACEAE (Mango Family)		
Rhus sandwicensis A. Gray	neneleau	E
CONVOLVULACEAE (Morning-glory Family)		
Ipomoea indica (J. Burm.) Merr.	koali 'awa	I
CYPERACEAE (Sedge Family)		
Machaerina mariscoides ssp. meyenii (Kunth.) T. Koyama	'ahaniu, 'uki	E
Scleria testacea Nees		I
MENISPERMACEAE (Moonseed Family)		
Cocculus trilobus (Thunb.) DC	huehue	I
MYRTACEAE (Myrtle Family)		
Metrosideros polymorpha Gaud.	'ohi'a lehua, 'ohi'a	E

TABLE 1. List of native plants. (Continued)

Scientific name	Common name	*Status
POACEAE (Grass Family)		
Paspalum scrobiculatum L.	ricegrass, mau'u laiki	I?
STERCULIACEAE (Cacao Family)		
Waltheria indica L.	'uhaloa, hi'aloa, kanakaloa	I?

*Status
- E = endemic = native only to the Hawaiian Islands.
- I = indigenous = native to the Hawaiian Islands <u>and</u> also elsewhere throughout the Pacific and/or tropics.
- I? = questionably indigenous = data not clear if dispersal by natural or human-related mechanisms, but weight of evidence suggests probably indigenous.

LITERATURE CITED

Cuddihy, L.W. and C.P. Stone. 1990. Alteration of native Hawaiian vegetation: Effects of humans, their activities and introductions. Cooperative National Park Resources Studies Unit, University of Hawai'i, Manoa.

Gerrish, G. 1992. Flora report for Puainako Street Extension, Country Club Drive to Komohana Street, Hilo, Hawaii. Prepared for Department of Public Works, County of Hawaii. June 15, 1992.

Lamoureux, C.H. 1988. Draft checklist of Hawaiian pteridophytes, "Kupukupu O Hawai'i Ne'i". Lyon Arboretum, University of Hawai'i, Manoa.

U.S. Fish and Wildlife Service. 1994a. Endangered and threatened wildlife and plants. 50 CFR 17.11 & 17.12. August 20, 1994.

__________. 1994b. Plants, Hawaiian Islands, Listed, proposed or candidate species under the U.S. Endangered Species Act, Updated: December 15, 1994. Unpublished list, Pacific Islands Office, Honolulu.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1990. Manual of the flowering plants of Hawai'i. 2 vols. University of Hawai'i Press and B.P. Bishop Museum Press, Honolulu. B.P. Bishop Museum Special Publication 83.

BOTANICAL SURVEY
UNIVERSITY OF HAWAI'I - HILO
PROPOSED INFRASTRUCTURE FOR RESEARCH AND TECHNOLOGY LOTS
SOUTH HILO DISTRICT, ISLAND OF HAWAI'I

by

Winona P. Char

CHAR & ASSOCIATES
Botanical Consultants
Honolulu, Hawai'i

Prepared for: ENGINEERING CONCEPTS, INC.

December 1992

Table of Contents

BOTANICAL SURVEY
UNIVERSITY OF HAWAI'I - HILO
PROPOSED INFRASTRUCTURE FOR RESEARCH AND TECHNOLOGY LOTS
SOUTH HILO DISTRICT, ISLAND OF HAWAI'I

INTRODUCTION

The proposed infrastructure for research and technology lots is located within a 116 acre State-owned parcel. The parcel is bounded by Komohana Road to the west, the Wailoa River and the existing University of Hawai'i Hilo (UHH) campus to the east and south, and a small, unnamed stream to the north. An existing 50-foot wide electrical easement runs through the property, roughly in a mauka-makai direction. Portions of the property are currently in use by the UH Agriculture Center (8.0 acres) and by the Joint Astronomy Center (JAC) Facility (4.4 acres). In addition, parts of the main access road (Road "A") and the road below the JAC facility (Road "B") have already been constructed.

Field studies to assess the botanical resources found on the project site were conducted on 06-07 November 1992; a total of three botanists were used for the field studies. The primary objectives of the survey were to: 1) provide a description of the general vegetation types; 2) compile an inventory of the flora; and 3) search for threatened and endangered plant species protected by Federal and State laws.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. Topographic maps, the preliminary lot layout map, and soil maps (overlay of soil types on a photobase) were examined to determine acess, boundaries, reference points, terrain characteristics, and vegetation cover patterns.

The less disturbed areas, which are more likely to harbor native plant communities, and, perhaps, rare plants were more intensively surveyed. The electrical easement served as the primary access; from the easement a number of surveyor's transects and long overgrown trails can be found.

A walk-through (pedestrian) survey method was used. Notes were made on plant associations and distribution, substrate types, topography, exposure, drainage, etc. Plant identifications were made in the field; plants which could not be positively identified were collected for later determination in the herbarium (UH, Manoa - HAW) and for comparison with the most recent taxonomic treatment of the flora.

The species recorded are indicative of the season ("rainy" vs. "dry") and the environmental conditions at the time of the survey. A survey taken at a different time and under varying environmental conditions would no doubt yield slight variations in the species list, especially of the weedy, annual plants.

DESCRIPTION OF THE VEGETATION

To our knowledge, there have been no detailed botanical reports dealing specifically with the project site. A short, but incomplete list of the "predominant flora" was compiled for the University of Hawaii Hilo Long Range Development Plan (State of Hawai'i 1977).

The mauka (west) half of the project site, along Komohana Road, is mapped as "rLW", pahoehoe lava flow (Sato *et al*. 1973), although, in places, there are jumbled heaps of 'a'a lava outcroppings. This flow is part of the 1881 Mauna Loa flow (Macdonald and Abbott 1970). Along the northern and central portion of the site, the substrate is mapped as "rKFD", Keaukaha extremely rocky muck, 6 to 20% slopes (Sato *et al*. 1973). This consists of well-drained, thin organic soils overlying pahoehoe lava bedrock. Both the 1881 flow and the Keaukaha soil series support a native-dominated forest of 'ohi'a trees and dense, matted uluhe ferns. Along the south and eastern portion of the site, the substrate is mapped as "PeC", Panaewa very rocky silty clay loam, 0 to 10% slope (Sato *et al*. 1973). This is a moderately well-drained, dark brown silty clay loam over pahoehoe bedrock; the depth to pahoehoe bedrock ranges from 15 to 20 inches. The vegetation on this soil series is composed largely of introduced species, mostly secondary forest trees, and the area appears to have been cultivated. There are a number of rock terraces and other features on this part of the site.

More detailed descriptions of the 'ohi'a-uluhe forest and the introduced mixed forest are presented below. All the plants inventoried during the field studies are presented in the checklist at the end of this report.

'Ohi'a-Uluhe Forest

The 'ohi'a-uluhe forest occurs on wetter areas of the island, on both 'a'a and pahoehoe substrates. Its general physiognomy is of widely spaced 'ohi'a trees (*Metrosideros polymorpha*) within an almost continuous mat of uluhe fern (*Dicranopteris linearis*).

There are three variants of this vegetation type on the project site. On the relatively younger 1881 Lava Flow, around the JAC facility and the Agriculture Center, the forest is typical of the earlier stages of succession. The majority of the 'ohi'a trees are of about even age and size, ranging from 15 to 25 ft. tall. The uluhe fern is very dense and forms an almost impenetrable mat between the trees, varying in height from 6 to 9 ft.; in places where the fern has climbed onto the trees, the tangled mats can be 12 ft. high. Because the uluhe cover is so dense, there are few other smaller species. Occasionally, a few plants of melastoma (Melastoma candidum), bamboo orchid (Arundina graminifolia), and strawberry guava (Psidium cattleianum) may be observed.

Where the forest occurs on the somewhat geologically older flow which has been mapped as "rKFD", Keaukaha rocky muck, the uluhe mat becomes patchy. Hala or pandanus (Pandanus tectorius) is frequently observed; if left undisturbed, the next step in natural succession would probably be to an 'ohi'a-hala dominated forest. However, the forest in this area supports a number of introduced species. Some fairly large-sized thickets of strawberry guava and melastoma shrubs, 12 to 15 ft. tall, are found here. Emerging above the 25 to 40 ft. tall 'ohi'a are scattered plants of gunpowder tree (Trema orientalis) and melochia (Melochia umbellata). The ground cover consists largely of strawberry guava and melastoma seedlings along with patches of hairy sword fern (Nephrolepis multiflora). Blechnum fern (Blechnum occidentale) and shampoo ginger (Zingiber zerumbet) may be locally common. Moss-covered rocks are also frequent. Lygodium japonicum, a lacy, slender, climbing fern, is locally abundant along the edges of this forest and along the trails cut through the forest, especially along the powerline easement. Lygodium has escaped from gardens around Hilo town and has established itself in surrounding woods and gulches (Char 1992).

The third and minor variant of this vegetation type includes the plants found in the disturbed areas within the 'ohi'a-uluhe forest. The plants in these areas consist of an assortment of largely introduced grasses, herbs, shrubs, and saplings. These include torpedo grass (Panicum repens), molasses grass (Melinis minutiflora), broomsedge (Andrpogon virginicus), partridge pea (Chamaecrista nictitans), sensitive plant or puahilahila (Mimosa pudica), pluchea (Pluchea symphytifolia), melastoma, a number of Desmodium and Crotalaria species, and saplings of melochia and gunpowder tree. Two native species occur in fairly large numbers in these more open, sunny areas. Neneleau (Rhus sandwicensis), a small tree, 6 to 24 ft. tall, belonging to the mango family, is common along the powerline easement. Scleria testacea, a sedge with sharp-edged leaf margins, is locally abundant along "Road B", near the JAC facility. Also found in this area are a few plants of 'akiohala (Hibiscus furcellatus), a native, pink-flowered hibiscus.

Introduced Mixed Forest

This vegetation type occurs on the portion of the property with Panaewa soil ("PeC"), a relatively deep, dark brown silty clay loam. The forest consists primarily of large gunpowder and melochia trees, 30 to 50 ft. tall. Other tree species found in this forest type include Chinese banyan (Ficus microcarpa), guarumo (Cecropia obtusifolia), bingabing (Macaranga mappa), African tulip (Spathodea campanulata), satin leaf (Chrysophyllum oliviforme), and avocado (Persea americana). Large groves of Alexandra or king palm (Archontophoenix alexandrae) are common along the western portion of this forest, near the Waiola River and across from the University of Hawai'i Hilo campus. A stand of very old mango trees (Mangifera indica) is also found in this forest type.

The common yellow guava (Psidium guajava) forms somewhat dense shrub layers in some places of the forest. Seabean (Dioclea wilsonii), a large woody liana which produces clusters of dark purple flowers, is occasionally observed climbing over the trees and shrubs.

Ground cover is variable. Where the tree canopy cover is dense, only the more shade-tolerant plants such as wood fern (Christella parasitica) and Oplismenus compositus can be found, however, much of the ground is barren, wet soil. Where the trees thin out and there is more light available, clumps of palmgrass (Setaria palmifolia), up to 3 ft. tall, and low, rambling prickly shrubs of thimbleberry (Rubus rosifolius) are abundant.

Along the eastern edge of the forest where it abuts the Waiola River, it is open and the ground is covered by a thick blanket of California grass (Brachiaria mutica) and wedelia (Wedelia trilobata). Scattered through the California grass and wedelia are plants of honohono (Commelina diffusa), primrose willow (Ludwigia octovalvis), and a few guava shrubs. Also found along or near the river are clumps of banana (Musa X paradisiaca), ti (Cordyline fruticosa), elephant grass (Pennisetum purpureum), and yellow ginger (Hedychium flavescens).

DISCUSSION AND RECOMMENDATIONS

In summary, the native-dominated 'ohi'a-uluhe forest occurs on the younger substrates -- the 1881 Lava Flow and Keaukaha extremely rocky muck. The geologically older Panaewa soil type supports a forest composed primarily of introduced species. The 'ohi'a-uluhe forest represents a fairly early stage in plant succession on wet lava flows, and, although, both of these native species make up the bulk of the vegetation, this type of forest does not have a rich array of other native species.

Of a total of 122 species inventoried on the site, 100 (82%) are introduced or alien species, 6 (5%) are originally of Polynesian introduction, and 16 (13%) are native. Of the natives, 12 are indigenous, that is, they are native to the Hawaiian Islands and also elsewhere, and 4 are endemic, that is, they are native only to the islands. The majority of the introduced species are weedy plants which prefer open, disturbed sites. The native species can be found in similar environmental habitats throughout the islands. None of the plants inventoried on the State-owned parcel are officially listed threatened and endangered species; nor are any proposed or candidate for such status (U.S. Fish and Wildlife Service 1989, 1990).

Given the findings above, the proposed project is not expected to have a significant negative impact on the botanical resources. Whenever possible native plants should be used for landscaping. The following recommendations are offered. On portions of the property covered by the 'ohi'a-uluhe forest, there are some areas with slopes greater than 10% and it would be difficult to build on these areas without substantial grading. It is suggested that these areas be left intact, and incorporated into the landscape design wherever feasible. These strips of 'ohi'a-uluhe forest would provide a buffer between the different facilities planned for the site; they would function as a noise screen and also protect the visual quality of the site. Costs for grading and then revegetating these areas could be eliminated.

As for landscaping material, it is recommended that some of the more easily cultivated native species found in the general region (Hamakua-Hilo-Puna) be used. These include 'ohi'a, tree ferns (Cibotium), 'ahanui (Machaerina), 'ohe (Tetraplasandra), loulu palm (Pritchardia), etc. Botanists and horticulturists on the UH Hilo and Hilo Community College facility, who are more familiar with the local flora, can also be approached to provide a list of native species suitable for landscaping the project site.

LITERATURE CITED

Char, W.P. 1992. Botanical survey, Pu'u'eo Makai project site, South Hilo District, island of Hawai'i. Prepared for PBR Hawaii. March 1992.

Lamoureux, C.H. 1984. Checklist of the Hawaiian pteridophytes. Unpublished manuscript, University of Hawai'i, Manoa.

Macdonald, G.A. and A.T. Abbott. 1970. Volcanoes in the sea, the geology of Hawaii. 5th printing. University of Hawaii Press, Honolulu.

Sato, H.H., W. Ikeda, R. Paeth, R. Smythe, and M. Takehiro, Jr. 1973. Soil survey of the island of Hawaii, State of Hawaii. U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C.

State of Hawaii. 1977. Final EIS, U.H. Hilo Long Range Development Plan. June 1977.

U.S. Fish and Wildlife Service. 1989. Endangered and threatened wildlife and plants. 50 CFR 17.11 & 17.12.

____________. 1990. Endangered and threatened wildlife and plants; Review of plant taxa for listing as endangered and threatened species; Notice of review. Federal Register 55 (35): 6184-6229.

Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1990. Manual of the flowering plants of Hawai'i. 2 vols. University of Hawai'i Press and Bishop Museum Press, Honolulu. Bishop Museum Special Publication No. 83.

PLANT SPECIES LIST -- Proposed Infrastructure for Research and Technology Lots at UH - Hilo

A checklist of all those terrestrial, vascular plant species inventoried on the project site during the field studies is presented below. The species are arranged alphabetically within each of three groups: Ferns, Monocots, and Dicots. The taxonomy and nomenclature of the Ferns follow Lamoureux (1984); the flowering plants, Monocots and Dicots, are in accordance with Wagner et al. (1990), for the most part.

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name, when known.
3. Biogeographic status. The following symbols are used:
   E = endemic = native only to the Hawaiian Islands
   I = indigenous = native to the Hawaiian Islands and also elsewhere throughout the Pacific
   P = Polynesian = plants originally of Polynesian introduction prior to Western contact (Cook's discovery of the islands in 1778); not native
   X = introduced or alien = all those plants brought to the islands by humans, intentionally or accidentally, after Western contact; not native.
4. Presence (+) or absence (-) of a particular species within each of two vegetation types recognized on the project site (see text for discussion):
   o = 'Ohi'a-Uluhe Forest
   i = Introduced Mixed Forest

Scientific name	Common name	Status	Vegetation type o	Vegetation type i
FERNS				
BLECHNACEAE (Blechnum Family)				
Blechnum occidentale L.	blechnum fern	X	+	+
DICKSONIACEAE (Tree Fern Family)				
Cibotium glaucum (J. Sm.) Hook. & Arnott	hapu'u	E	+	–
GLEICHENIACEAE (Vine Fern Family)				
Dicranopteris linearis (Burm.) Underw.	uluhe	I	+	+
HEMIONITIDACEAE (Gold Fern Family)				
Pityrogramma calomelanos (L.) Link	silver fern	X	–	+
LINDSAEACEAE (Lace Fern Family)				
Sphenomeris chinensis (L.) Maxon	pala'a	I	+	–
LYGODIACEAE (Climbing Fern Family)				
Lygodium japonicum (Thunb.) Sw.	lygodium	X	+	+
NEPHROLEPIDACEAE (Sword Fern Family)				
Nephrolepis multiflora (Roxb.) Jarrett ex Morton	hairy sword fern	X	+	+
POLYPODIACEAE (Common Fern Family)				
Phlebodium aureum (L.) J. Sm.	laua'e-haole	X	–	+
Phymatosorus scolopendria (Burm.) Pic.-Ser.	laua'e, lauwa'e	X	–	+
Pleopeltis thunbergiana Kaulf.	pakahakaha, 'ekaha-'akolea	I	–	+
THELYPTERIDACEAE (Woodfern Family)				
Christella parasitica (L.) Levl.	woodfern, oakfern	X	+	+

Scientific name	Common name	Status	Vegetation type o	Vegetation type i
FLOWERING PLANTS				
MONOCOTS				
AGAVACEAE (Sisal Family)				
Cordyline fruticosa (L.) A. Chev.	ti, ki	P	+	+
ARACEAE (Aroid Family)				
Dieffenbachia picta Schott	dieffenbachia	X	+	–
ARECACEAE (Palm Family)				
Archontophoenix alexandrae (F. v. Muell.) H.A. Wendl. & Drude	king palm, Alexandra palm	X	+	+
COMMELINACEAE (Dayflower Family)				
Commelina diffusa N.L. Burm.	honohono	X	–	+
CYPERACEAE (Sedge Family)				
Cyperus halpan L.		X	+	–
Fimbristylis dichotoma (L.) Vahl.		I	+	–
Kyllinga brevifolia Rottb.	green kyllinga, kili'o'opu	X	+	–
Machaerina mariscoides ssp. meyenii (Kunth) T. Koyama	'ahaniu, 'uki	E	+	–
Pycreus polystachyos (Rottb.) P. Beauv.		I	+	–
Scleria testacea Nees		I	+	–
DIOSCOREACEAE (Yam Family)				
Dioscorea bulbifera L.	bitteryam, pi'oi	P	+	–
Dioscorea pentaphylla L.	pi'ia	P	+	–
MUSACEAE (Banana Family)				
Musa X paradisiaca L.	banana, maia	P	–	+

Scientific name	Common name	Status	Vegetation type o	Vegetation type i
ORCHIDACEAE (Orchid Family)				
Arundina graminifolia (D. Don) Hochr.	bamboo orchid	X	+	–
Spathoglottis plicata Blume	Philippine *ground orchid*	X	+	+
PANDANACEAE (*Hala* Family)				
Pandanus tectorius S. Parkinson ex Z.	pandanus, hala	I?	+	–
POACEAE (Grass Family)				
Andropogon virginicus L.	broomsedge	X	+	–
Brachiaria mutica (Forsk.) Stapf	California grass	X	+	+
Coix lachryma-jobi L.	Job's tears	X	+	+
Digitaria sp.	crabgrass	X	+	–
Eragrostis sp.	Hamakua eragrostis	X	+	–
Melinis minutiflora P. Beauv.	molasses grass	X	+	–
Oplismenus compositus (L.) P. Beauv.		X	–	+
Panicum maximum Jacq.	Guinea grass	X	+	–
Panicum repens L.	torpedo grass, Wainaku grass	X	+	–
Paspalum conjugatum Bergius	Hilo grass, mau'u Hilo	X	–	+
Paspalum scrobiculatum L.	ricegrass, mau'u laiki	I?	+	–
Pennisetum purpureum Schumach.	napier grass, elephant grass	X	–	+
Rhynchelytrum repens (Willd.) Hubb.	Natal redtop	X	+	–
Sacciolepis indica (L.) Chase	Glenwood grass	X	+	–
Setaria gracilis Kunth	yellow foxtail	X	+	–
Setaria palmifolia (J. König) Stapf	palmgrass	X	+	+
ZINGIBERACEAE (Ginger Family)				
Hedychium flavescens N. Carey ex Roscoe	yellow ginger	X	–	+
Zingiber zerumbet (L.) Sm.	shampoo ginger, 'awapuhi kuahiwi	P	+	–
DICOTS				
ACANTHACEAE (Acanthus Family)				
Justicia betonica L.	white shrimp plant	X	+	–

Scientific name	Common name	Status	Vegetation type o	Vegetation type i
ANACARDIACEAE (Mango Family)				
Mangifera indica L.	mango, manako	X	+	+
Rhus sandwicensis A. Gray	neneleau	E	+	–
Schinus terebinthifolius Raddi	Christmas berry	X	–	+
APIACEAE (Parsley Family)				
Centella asiatica (L.) Urb.	Asiatic pennywort, pohe kula	X	+	–
ARALIACEAE (Ginseng Family)				
Schefflera actinophylla (Endl.) Harms	octopus tree, umbrella tree	X	+	+
ASTERACEAE (Sunflower Family)				
Ageratina riparia (Regel) R. King & H. Robinson	pamakani	X	–	+
Ageratum houstonianum Mill.	maile hohono	X	+	–
Bidens alba var. radiata (Schultz-Bip.) Ballard ex Melchert	white-flowered bidens	X	–	+
Crassocephalum crepidioides (Benth.) S. Moore	crassocephalum	X	+	–
Eclipta alba (L.) Hassk.	false daisy	X	+	–
Emilia fosbergii Nicolson	pua lele	X	+	–
Erechtites valerianifolia (Wolf) DC.	fireweed	X	+	–
Pluchea symphytifolia (Mill.) Gillis	pluchea, sourbush	X	+	–
Sonchus oleraceus L.	sow thistle, pua-lele	X	+	–
Wedelia trilobata (L.) Hitchc.	wedelia	X	+	+
BALSAMINACEAE (Touch-me-not Family)				
Impatiens wallerana J.D. Hook.	impatiens	X	–	+
BEGONIACEAE (Begonia Family)				
Begonia foliosa var. miniata (Planch.) L.B. Sm. & B.G. Schubert	fuschia begonia	X	–	+
Begonia hirtella Link	white-flowered begonia	X	+	–
BIGNONIACEAE (Bignonia Family)				
Spathodea campanulata P. Beauv.	African tulip	X	–	+

Scientific name	Common name	Status	Vegetation type o	Vegetation type i
BOMBACACEAE (Bombax Family)				
Indet. sp.		X	–	+
BUDDLEIACEAE (Butterfly Bush Family)				
Buddleia asiatica Lour.	Asiatic butterfly bush, huelo-'ilio	X	+	–
CAMPANULACEAE (Bellflower Family)				
Hippobroma longiflora (L.) G. Don	star-of-Bethlehem	X	+	–
CARYOPHYLLACEAE (Pink Family)				
Drymaria cordata (L.) Willd. ex Roem.	pipili	X	–	+
CECROPIACEAE (Cecropia Family)				
Cecropia obtusifolia Bertol.	guarumo	X	–	+
CLUSIACEAE (Mangosteen Family)				
Clusia rosea Jacq.	autograph tree, copey	X	+	+
CONVOLVULACEAE (Morning-glory Family)				
Ipomoea alba L.	moonflower, koali pehui	X	+	–
Ipomoea indica (J. Burm.) Merr.	koali 'awahia	I	+	–
Ipomoea triloba L.	little bell, pink bindweed	X	+	–
EUPHORBIACEAE (Spurge Family)				
Macaranga mappa (L.) Müll. Arg.	bingabing	X	–	+
Phyllanthus debilis Klein ex Willd.	niruri	X	+	–
Ricinus communis L.	castor bean, koli, pa'aila	X	+	–
FABACEAE (Bean Family)				
Caesalpinia major (Medik.) Dandy & Exell	kakalaioa, hihikolo	X?	+	–
Chamaecrista nictitans (L.) Moench	partridge pea, lauki	X	+	–
Crotalaria cf. lanceolata E. Mey.		X	+	–
Crotalaria pallida Aiton	smooth rattlepod, pikakani	X	+	–
Crotalaria retusa L.		X	+	–

Scientific name	Common name	Status	Vegetation type o	Vegetation type i
Desmodium cajanifolium (Kunth) DC.	tick clover	X	+	–
Desmodium incanum DC.	Spanish clover, ka'imi	X	+	–
Desmodium intortum (Mill.) Urb.		X	–	+
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	X	+	–
Desmodium sp. 1		X	+	–
Desmodium sp. 2		X	+	–
Dioclea wilsonii Standl.	sea bean, maunaloa	X?	–	+
Mimosa pudica var. unijuga (Duchass. & Walp.) Griseb.	sensitive plant, sleeping grass, pua hilahila	X	+	–
LAMIACEAE (Mint Family)				
Hyptis pectinata (L.) Poit.	comb hyptis	X	+	–
LAURACEAE (Laurel Family)				
Persea americana Mill.	avocado, alligator pear	X	–	+
LYTHRACEAE (Loosestrife Family)				
Cuphea carthagenensis (Jacq.) Macbr.	tarweed, Colombian cuphea	X	+	–
MALVACEAE (Mallow Family)				
Hibiscus furcellatus Desr.	'akiohala, 'akiahala, hau hele	I	+	–
Sida rhombifolia L.	Cuba jute	X	+	–
MELASTOMATACEAE (Melastoma Family)				
Dissotis rotundifolia (Sm.) Triana	dissotis	X	+	–
Melastoma candidum D. Don	melastoma	X	+	+
MORACEAE (Mulberry Family)				
Ficus microcarpa L. f.	Chinese banyan	X	–	+
MYRTACEAE (Myrtle Family)				
Metrosideros polymorpha Gaud.	'ohi'a, 'ohi'a lehua	E	+	–
Psidium cattleianum Sabine	strawberry guava	X	+	+
Psidium guajava L.	guava, kuawa	X	+	+

Scientific name	Common name	Status	Vegetation type o	Vegetation type i
ONAGRACEAE (Evening Primrose Family)				
Ludwigia octovalvis (Jacq.) Raven	primrose willow, kamole	P?	–	+
OXALIDACEAE (Wood Sorrel Family)				
Oxalis corymbosa DC.	pink wood sorrel, ihi pehu	X	–	+
PASSIFLORACEAE (Passionflower Family)				
Passiflora edulis Sims	passionfruit, liliko'i	X	–	+
Passiflora foetida L.	scarlet-fruited passionflower, pohapoha	X	+	–
PIPERACEAE (Pepper Family)				
Peperomia leptostachya Hook. & Arnott	'ala 'ala wai nui	I	–	+
POLYGALACEAE (Milkwort Family)				
Polygala paniculata L.	bubble-gum plant	X	+	–
POLYGONACEAE (Buckwheat Family)				
Polygonum sp.		X	–	+
ROSACEAE (Rose Family)				
Rubus rosifolius Sm.	thimbleberry	X	+	+
RUBIACEAE (Coffee Family)				
Hedyotis corymbosa (L.) Lam.		X	+	–
Paederia scandens (Lour.) Merr.	maile-pilau	X	+	+
Spermacoce assurgens Ruiz & Pav.	buttonweed	X	+	–
Spermacoce mauritiana Gideon		X	+	–
SAPINDACEAE (Soapberry Family)				
Filicium decipiens (Wight & Arnott) Thwaites ex J.D. Hook.	fern tree	X	–	+
SAPOTACEAE (Sapodilla Family)				
Chrysophyllum oliviforme L.	satin leaf	X	–	+

Scientific name	Common name	Status	Vegetation type o	Vegetation type i
SCROPHULARIACEAE (Figwort Family)				
Castilleja arvensis Cham. & Schlechtend.	Indian paintbrush	X	+	–
STERCULIACEAE (Cacao Family)				
Melochia umbellata (Houtt.) Stapf	melochia	X	+	+
Waltheria indica L.	'uhaloa, hi'aloa, kanakaloa	I?	+	–
ULMACEAE (Elm Family)				
Trema orientalis (L.) Blume	gunpowder tree, charcoal tree	X	+	+
URTICACEAE (Nettle Family)				
Pilea microphylla (L.) Liemb.	artillary plant, rockweed	X	–	+
VERBENACEAE (Verbena Family)				
Lantana camara L.	lantana, lakana	X	+	–
Stachytarpheta dichotoma (Ruiz & Pav.) Vahl	owi, oi	X	+	–

APPENDIX B

FAUNAL ASSESSMENT
(Rana Productions, Ltd.)

REPORT:

AN ASSESSMENT OF THE FAUNAL MAKEUP OF THE PROPOSED UH - HILO UNIVERSITY PARK INFRASTRUCTURE IMPROVEMENT PROJECT, PHASE IIA SITES, HILO, ISLAND OF HAWAI'I, HAWAI'I.

Prepared by:

Reginald E. David
Rana Productions, Ltd.
P.O. Box 1371
Kailua-Kona, Hawai'i 96745

Table of Contents

Tables

Figures

Introduction

This report addresses the probable faunal makeup of a 116 acre parcel of land located west of the existing UH Hilo campus, and a 2 acre parcel of state land adjacent to the existing Sunrise Estates subdivision, located in the District of Hilo, Island of Hawai'i, Hawai'i (TMK: 2-4-01:7 and 41) { Fig.1}. No field surveys were undertaken on the subject properties. This assessment is based on published reports, personal experience and the faunal makeup of similar habitat on the Island of Hawai'i.

Avian phylogenetic order used in this report follows *Birds Of The World: A Checklist* (Clements 1991); scientific nomenclature follows *The AOU Checklist of North American Birds* (AOU 1983) and the *35th through the 40th Supplements to The AOU Checklist* (AOU 1985-1995). Mammal scientific names follow *Mammals in Hawaii* (Tomich 1986), and plant names follow *Manual of the Flowering Plants of Hawaii* (Wagner et al. 1990).

General Site Description

The approximately 116 acre University Park Site is located immediately west of the existing UH-Hilo campus. The site is bound by the University Heights subdivision to the north, Komohana Street to the west, and the Wailoa Flood Control Project to the east. Two existing paved roads transverse the site, Nowelo Street running east-west and Aohoku Street running north-south, parallel to Komohana Street. The existing development located along the western border of the site is comprised of various structures that make up the UH-Hilo Research and Technology Park. The site slopes form west to east, starting at approximately 320 feet elevation and ending at approximately 140 feet above sea level. The remaining vegetation on the site is dominated by alien species, as is much of the lowland area on the Hilo side of the Island. The reservoir site is located north of Komhana Street on a parcel of state land adjacent to the existing Sunrise Estates subdivision at approximately 460 feet elevation. The vegetation on this site retains more native vegetation than the University Park site; however, it is also dominated by alien species.

Historical Perspective

The isolation of the Hawaiian Islands from the nearest continental land mass coupled with the volcanic nature of their creation has resulted in the penultimate display of adaptive radiation and endemism in the world. The high degree of adaptation and specialization displayed by many of Hawaii's endemic avian species has contributed to their vulnerability in a rapidly changing world. To date more than 60% of Hawaii's endemic avifauna has gone extinct. Within historical times a total of 69 endemic avian species and sub-species have been described from Hawai'i (Pyle 1992). Of these, 23 have gone extinct. Of the remaining 46 a total of 32 are currently listed as endangered or threatened by the United States Fish and Wildlife Service (USFWS 1992).

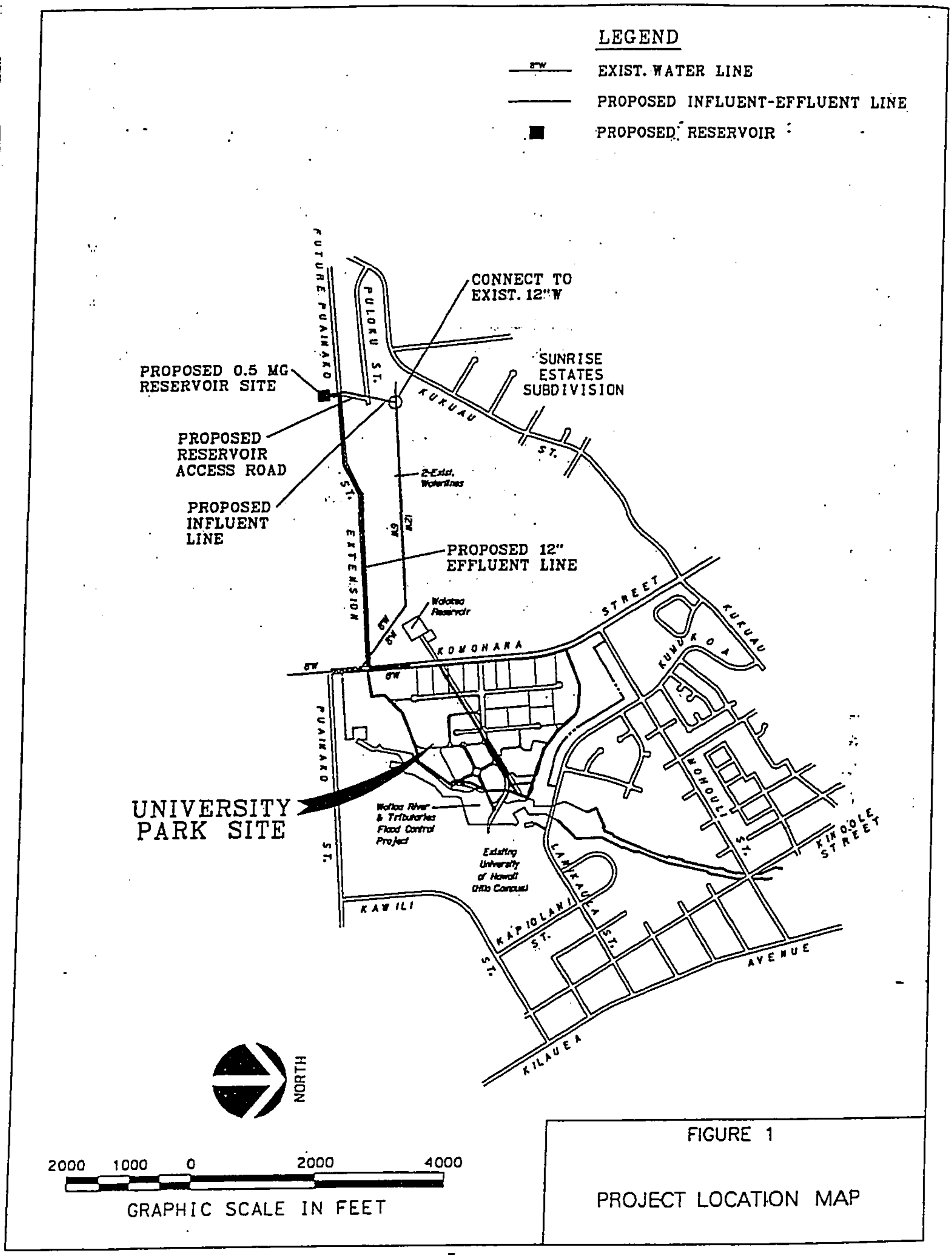


FIGURE 1

PROJECT LOCATION MAP

Thirteen of these are critically endangered or may in fact have already gone extinct. To add to the dismal picture of the status of Hawaii's endemic avifauna, a further 35 species of extinct endemic birds have been described from sub-fossil remains (Olsen & James -1982, 1991,; James & Olsen 1991). There may be as many as 26 more undescribed species amongst the bones that have already been collected (Olsen & James 1991, James & Olsen 1991, Giffin 1993). In addition, the only endemic terrestrial mammalian species in Hawai'i, the Hawaiian hoary bat (*Lasiurus cinereus semotus*), is also listed as endangered (USFWS 1992). Of the 32 currently listed endangered avian species and sub-species found in Hawai'i a total of 13 are found on the Island of Hawai'i. Two of these can be expected to at least occasionally utilize parts of the proposd development sites, while one additional endangered and one threatened pelagic species probably overfly both of the sites occasionally between the months of April and October (Tables 2 & 3).

Migratory waterbirds and shorebirds make up a large part of the winter avian population of Hawai'i. These annual visitors are found throughout the Islands from August through May. Currently 82 separate migratory and extralimital waterbird and shorebird species have been documented from the Islands (Pyle 1992, David 1996 d, in prep.). Most of these species are generally associated with wetland habitat, however; three of them, the Pacific Golden Plover (*Pluvialis fulva*), Ruddy Turnstone (*Arenaria interpres*) and Sanderling (*Calidris alba*) are among the commonest of our winter migrants and are regularly found in open, grassy areas, parking lots and other cleared areas.

During the last hundred years more than a 160 species of alien birds have been introduced to the Hawaiian Islands (Long 1981, HAS 1993); a markedly larger number than introduced to any other area on the planet. Many of these species were game birds introduced by a combination of private landowners, the Territorial Board of Agriculture and Forestry, and following statehood, by the State of Hawai'i's Division of Forestry and Wildlife. These birds were introduced in the hope that they would become established and provide a recreational hunting resource which, in turn, would generate federal funding through the Pittman Robinson Act for the maintenance of game bird hunting. Less than a quarter of these introductions have been successful. On the island of Hawai'i more than 60 species of game birds have been introduced. Currently, 14 of these alien introductions have survived and are considered to be established on the Island (Pyle 1992, David 1996 c, in prep.). Little is known of the effect that these species have on Hawai'i's native bird populations. Many of these alien birds out compete Hawai'i's native species for food, cover and nesting resources. They have been implicated in the spread of alien plant species which all too often, have proven to have a deleterious effect on Hawai'i's' native ecosystems. Some of these species are thought to be reservoirs for diseases, which negatively impact Hawai'i's endemic avifauna. Systematic scientific studies of these problems have commenced, but all are nascent. The bulk of the avian species within and close to the study areas were introduced to Hawai'i by man and have managed to sustain viable wild populations.

Most of Hawai'i's endemic avian species have little or no tolerance to most of the common continental avian diseases such as avian malaria and avian poxes. These recently established diseases have taken a stunning toll on native Hawaiian avian species.

The Hawaiian hoary bat or 'Ope'ape'a is Hawai'i's only endemic terrestrial mammal. All the other resident mammalian species were introduced to the Hawaiian Islands by man. This process started when the first aboriginal settlers landed in the Islands some 1500 years ago (Stone and Scott 1985). The aboriginal peoples brought numerous alien species such as pigs (*Sus scrofa*), dogs (*Canis familiaris*) and Polynesian rats (*Rattus exulans*); as well as non-native plants and insects of many kinds with them. Many of Hawai'i's endemic birds, especially the flightless and ground nesting ones, were easy prey for the introduced dogs and hungry humans (Kirch 1982, Steadman 1989, Banko et al. 1991). Both the aboriginal people and their pigs proceeded to markedly alter the endemic ecosystems. The humans cleared and burned the lowlands for agricultural purposes and the pigs moved into the wet forests where they found abundant food in the myriad of endemic understory plants (Kirch 1982). Very little is known of what effect the introduced insect species had, but it is safe to surmise that they had a large effect on the endemic insect and plant populations and in turn on the native avian species. The European re-discovery of the Islands in the late 1700's heralded another wave of introductions that included European rabbits (*Oryclolagus cuniculus*), roof rats (*Rattus rattus*), Norway rats (*Rattus norvegicus*), European house mice (*Mus domesticus*), small Indian mongooses (*Herpestes auropunctatus auropunctatus*), cats (*Felis catus*), horses (*Equus caballus*), cattle (*Bos taurus*), goats (*Capra hircus*) and sheep (*Ovis aries*), as well as countless insect and plants species. All of the introduced mammalian species including man, with the possible exception of the European house mice (*Mus domesticus*) have had a deleterious effect on the native avian and mammalian populations of the Islands.

Table 1.

EXTANT ENDEMIC AVIAN AND BAT SPECIES & SUB-SPECIES ON THE ISLAND OF HAWAI'I		
COMMON NAME	HAWAIIAN NAME	SCIENTIFIC NAME
Dark-rumped Petrel	Ua'u	*Pterodroma phaeopygia sandwichensis*
Newell's Shearwater	'A'o	*Puffinus newelli*
Hawaiian Goose	Nene	*Branta sandvicensis*
Hawaiian Duck	Koloa	*Anas wyvilliana*
Hawaiian Hawk	'Io	*Buteo solitarius*
Hawaiian Coot	'Alae ke'oke'o	*Fulica alai*
Black-necked Stilt	Ae'o	*Himantopus mexicanus knudseni*
Black Noddy	Noio, 'Eki'eki	*Anous minutus melanogenys*
Short-eared Owl	Pueo	*Asio flammeus sandwichensis*
Hawaiian Crow	'Alala	*Corvus Hawai'iensis*
Hawai'i 'Elepaio	'Elepaio	*Chasiempi ssandwichensis sandwichensis*
Hawai'i 'Elepaio	'Elepaio	*Chasiempis sandwichensis bryani*
Hawai'i 'Elepaio	'Elepaio	*Chasiempis sandwichensis ridgwayi*
Hawai'i Thrush	'Oma'o	*Myadestes obscurus*
'O'u **	'O'u	*Psittirostra psittacea*
Palila	Palila	*Loxoides bailleui*
Hawai'i 'Amakihi	'Amakihi	*Hemignathus virens virens*
'Akiapola'au	'Akiapola'au	*Hemignathus munroi*
Hawai'i Creeper	'Alauahio	*Oreomystis mana*
Hawai'i 'Akepa	'Akakane	*Loxops coccineus coccineus*
'I'iwi	'I'iwi	*Vestiaria coccineus*
'Apapane	'Apapane	*Himatione sanquinea sanquines*
Hawaiian hoary bat	'Ope'ape'a	*Lasiurus cinereus semotus*

** Indicate species which is critically endangered, or possibly extinct.

Table 2.

ENDANGERED AND THREATENED TERESTRIAL VERTEBRATE SPECIES ON THE ISLAND OF HAWAI'I		
COMMON NAME	**HAWAI'IAN NAME**	**SCIENTIFIC NAME**
Dark-rumped Petrel	Ua'u	*Pterodroma phaeopygia sandwichensis*
Newell's Shearwater	'A'o	*Puffinus newelli*
Hawaiian Goose	Nene	*Branta sandvicensis*
Hawaiian Duck	Koloa	*Anas wyvilliana*
Hawaiian Hawk	'Io	*Buteo solitarius*
Hawaiian Coot	'Alae ke'oke'o	*Fulica alai*
Black-necked Stilt	Ae'o	*Himantopus mexicanus knudseni*
Hawaiian Crow	'Alala	*Corvus Hawai'iensis*
'O'u **	'O'u	*Psittirostra psittacea*
Palila	Palila	*Loxoides bailleui*
'Akiapola'au	'Akiapola'au	*Hemignathus munroi*
Hawai'i Creeper	'Alauahio	*Oreomystis mana*
Hawai'i 'Akepa	'Akakane	*Loxops coccineus coccineus*
Hawaiian hoary bat	'Ope'ape'a	*Lasiurus cinereus semotus*

** Indicate species which is critically endangered, or possibly extinct.

All of the above species and sub-species are listed as endangered by the USFWS, with the exception of the Newell's Shearwater which is listed as threatened (USFWS 1992).

Previous Surveys

The first systematic surveys of the avifauna of Hawai'i were not undertaken until 1976: Starting in that year and continuing until 1983 the U.S. Fish & Wildlife Service (USFWS) conducted a state wide survey of the avifauna of Hawai'i (Scott et al. 1986). During the course of the Hawai'i Forest Bird Surveys (HFBS) no transects were counted through either of the two development sites addressed in this report, since the existing habitat was considered almost completely alien harboring no native forest bird species. Several Environmental Assessments, and faunal studies have been conducted within recent years of areas adjacent to, or near the proposed sites (Kepler 1986, Kjargaard 1991, 1992, David 1996).

There have only been four comprehensive bat surveys conducted on the Island of Hawai'i (Jacobs 1994, Cooper et al. 1995, Cooper and David 1995, David 1996a). Two of these surveys addressed lands close to the proposed development sites. David Jacobs conducted an Island wide survey between 1990-1993 which attempted to ascertain the distribution and abundance of Hawaiian hoary bats by sampling along paved principal roadways around the Island of Hawai'i (Jacobs 1994). During the course of the recently completed faunal studies for the Saddle Road Project Environmental Impact Statement the author sampled for bats along the Saddle Road, west of the sites (David 1996a). The bulk of the remaining published literature relies heavily on anecdotal and incidental information on bat distribution and abundance on the Island (Baldwin 1950, Bryan 1955, Tomich 1986).

Avian Resources

The avifauna currently found below 500 feet in elevation in the Hilo area, on the Island of Hawai'i, is dominated by introduced species, as are most of the ecological disturbed areas in the State. Of the 22 extant endemic avian species and sub-species currently found on the Island of Hawai'i (Table 1), 2 can be expected to at least occasionally be recorded within the subject properties, and another 2 probably overfly the sites between the months of April and October. An additional species may occasionally been recorded within the reservoir site. The resident avifauna is augmented from September to the end of April by several species of migratory shorebirds from the 82 plus migrant and extralimital vagrant species which have been recorded in Hawai'i to date (P. Pyle et al. 1988, R. Pyle 1992, R. David 1996 d, in prep.).

The species listed in Table 2 represent the avian species that given the location, altitude and vegetation found on the sites probably utilize the habitat present, forage over, or overfly the area at least occasionally. Five of these are endemic to the Hawaiian Islands at either the specific or sub-specific level. Three are considered native migratory species, and the remaining 15 are alien species introduced to Hawai'i by man.

Table 3.

AVIAN SPECIES LIKELY TO UTILIZE OR BE RECORDED FROM THE UH-HILO PROPOSED DEVELOPMENT SITES AT LEAST OCCASIONALLY	
Common Name	*Scientific Name*
PETRELS & SHEARWATERS - Procellarridae	
Dark-rumped Petrel (Hawaiian)	*Pterodroma phaeopygia sandwichensis*
Newell's Shearwater.	*Puffinus newelli.*
HERONS - Ardeidae.	
Cattle Egret.	*Bubulcus ibis.*
Black-crowned Night Heron.	*Nycticorax nyticorax hoacili.*
HAWKS & EAGLES - Accipitridae	
Hawaiian Hawk.	*Buteo solitarius.*
SANDPIPERS & ALLLIES - Scolopacidae	
Ruddy Turnstone.	*Arenaria interpres*
Sanderling.	*Calidris alba.*
PLOVERS & LAPWINGS - Charadriidae	
Pacific Golden Plover.	*Pluvialis fulva.*
PIGEONS & DOVES - Columbidae	
Rock Dove.	*Columba livia.*
Spotted Dove.	*Streptopeia chinensis.*
Zebra Dove.	*Geopelia striata.*
BARN OWLS - Tytonidae	
Barn Owl.	*Tyto alba*
OWLS - Strigidae	
Hawaiian Owl.	*Asio flammeus sandwichensis.*
STARLINGS - Sturnidae	
Common Myna.	*Acridotheres tristis.*
SILVEREYES - Zosteropidae	
Japanese White-Eye.	*Zosterops japonica.*
BABBLERS - Timaliidae	
Melodius Laughing Thrush.	*Garulax canorous.*
Red-billed Leiothrix.	*Leiothrix lutea.*
OLD WORLD SPARROWS - Passeridae	
House Sparrow.	*Passer domesticus*
WAXBILLS & ALLIES - Estrilididae	
Nutmeg Manikin (Scaly-breasted Munia)	*Lonchura punctulata topela*
Java Sparrow.	*Padda oryzivora.*
FRINGILLIDS - Fringillidae	
House Finch.	*Carpodacus mexicanus mexicanus.*

HAWAIIAN HONEYCREEPERS- Drepanididae	
Hawaii Amakihi.	*Hemignathus virens*
EMBERIZIDS - Emberizadae	
Saffron Finch.	*Sicalis flaveola.*
Northern Cardinal.	*Cardinalis cardinalis.*

Avian Species Accounts

In the following species accounts I briefly discuss the natural history and origin of 5 endemic avian species which may either utilize the sites or be detected from them. Federally listed species are addressed first, followed by the remaining native species.

Endangered Avian Species

Dark-rumped Petrel: *Pterodroma phaeopygia sandwichensis* Ua'u

The endemic Hawaiian subspecies of the Dark-rumped Petrel was formerly very common on the Island of Hawai'i (Wilson & Evans 1890-1899). This pelagic seabird reportedly nested in large numbers on the slopes of Mauna Loa and in the saddle area between Mauna Loa and Mauna Kea (Henshaw 1902), as well as the mid to high elevations of Mount Hualalai. The author detected 2 individuals of this species on the northern flank of Mauna Loa during the recently completed radar and visual studies of seabirds and bats of PTA (Cooper & David 1995). There is also a recent record of an individual found stuck on a fence just east of the Mauna Kea summit access road (J. Jeffrey, pers. comm.). Dark-rumped Petrels were a food source of the Hawaiians, and bones of this species are common in ancient Hawaiian middens excavated in numerous locations on Hawai'i (Banko 1980b). By the turn of the century the decline in this species had been noted by local residents, and by the early 1940's at least one observer, George Munro, feared for this species survival in Hawai'i (Munro 1941, 1960). Dark-rumped Petrels were finally listed as endangered by the United States Fish & Wildlife Service in 1967 (USFWS 1992). Seabirds are especially vulnerable to predation by terrestrial mammals. Their nesting burrows are quite odoriferous, especially when there are young birds present, thus making it easy for cats, rats, mongooses and humans to find them. A secondary threat, especially to fledging birds, is being disoriented by lights on their way to sea. When disoriented, seabirds often collide with manmade structures and if not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals. There is no suitable nesting habitat for this species within either site, it is probable that small numbers of this species occasionally over fly the development sites on their way to nesting areas in the mountains.

Newell's Shearwater: *Puffinus newelli* 'A'o

Newell's Shearwaters were listed as threatened by the USFWS in 1975 (USFWS 1992). It is probable that at least a few birds fly over both of the proposed development sites during the breeding season. This species breeds on Kaua'i, Hawai'i and Moloka'i in extremely small numbers Newell's Shearwater populations have dropped precipitously since the 1880's (Banko 1980 b). The taxonomy of this species is poorly resolved. It has long been considered a sub-species of the Manx Shearwater (*Puffinus puffinus*) In 1983 the AOU separated the Pacific forms of the Manx Shearwater from this species. Hawaii's race became a sub-species of the Townsend's Shearwater (*Puffinus auricularis*) (AOU 1983), although other authors, myself included, prefer to consider this a separate species (*Puffinus newelli*) (Pratt 1987, Clements 1991). This pelagic species nests high in the mountains in burrows excavated under thick vegetation, especially uluhe fern (*Dicranopteris linearis*). Although there is no recent record of nesting Newell's Shearwater from the immediate vicinity of either of the sites, there are numerous records of this species being seen, heard or collected close to the Saddle Road (SR 200) on the Hilo side of the Island (Banko 1980a, Kepler et al. 1979, Conant 1980). S. Conant recovered a dead bird on Kaumana drive in 1978 (Conant 1980). Newell's Shearwater have been heard along the Wailkuku river north of (SR 200) (Kepler et al 1979), and numerous downed birds have been recovered from different locations in and around Hilo (R. David pers. obs., Banko 1980 b, Kepler et al. 1979).

Newell's Shearwaters, like Dark-rumped Petrels are extremely vulnerable to predation by terrestrial mammals. Their nesting burrows are quite odoriferous, especially when there are young birds present, this making it easy for cats, rats and mongooses to find them. A secondary threat especially to fledging birds is being disoriented by lights on their way to sea. When disoriented, seabirds often collide with man made structures and if not killed outright, the dazed or injured birds are easy targets of opportunity for feral mammals. It is likely that the numerous birds recovered in and around Hilo were victims of just this phenomena.

Hawaiian Hawk : *Buteo solitarius* 'Io

The Hawaiian Hawk is the only extant falconiform in Hawaii; it currently is endemic to the Island of Hawai'i. Sub-fossil remains indicate that it was also formerly found on Moloka'i (Olsen & James 1982). Several incidental unconfirmed sightings of this species exist from Kaua'i (Dole 1879, Beaglehole 1980) and Mau'i (Banko 1980 c). This species was scientifically described by Peale in 1848 from a specimen collected from Kealakekua (Banko 1980 c). The Hawaiian Hawk was first listed as endangered in 1967 (USFWS 1992). This species has seemingly adapted better then any other endemic avian species to the alien dominated lowland areas of the Island. Hawaiian Hawks occupy a wide variety of habitats, in fact they are to be found in almost all habitats not lacking trees .They are all but absent from treeless or close to treeless grasslands and lava fields. The current population of this species is estimated to be 1600 birds (Morrison et al. 1994). It is generally thought that the population as a whole is healthy and maintaining itself, unlike many other endemic species. This species is currently under review by the USFWS for down listing from endangered to threatened status (USFWS 1993). I have repeadedly seen Hawaiian Hawks close to the developmnet sites, it is probable that they occasionally forage within both sites - there is little remaining tree cover suitable for nesting within either site.

Native Avian Species

Short-eared Owl: *Asio flammeus sandwichensis* Pueo

The Pueo is a Hawaiian endemic sub-species of the widely distributed Short-eared Owl (*Asio flammeus*). On Hawai'i it is ubiquitous, being found in almost all habitats. It has been suggested that this species did not become established in the Islands until after the Polynesian arrival and their introduction of Polynesian rats (*Rattus exulans*). It has also been suggested that the Short-eared Owl's population started to decline with western mans arrival and the attendant increase in the clearing of the forests for agriculture (Perkins 1903). From the authors observations over the past 15 years it does appear as if the population is decreasing. During the course of the HFBS no population estimate was made, due in part to the fact that as with most owls Pueo do not meet the basic assumptions that are used in computing forest bird community densities (Scott et al. 1986). During the 1993 Hawaiian Forest Birds Conservation Assessment and Management Plan Workshop a best guess estimate was made of a statewide population of between 500 - 2000 birds (J. Jacobi, pers. comm.). Short-eared Owls eat a diet of mice and small rats augmented by large insects and the occasional bird. It is probable that this species forages on either or both of the proposed development sites at least occasionally.

Hawai'i 'Amakihi: *Hemignathus virens virens* 'Amakihi

The nominate race of 'Amakihi was described by Gmelin in 1788 from one of several specimens collected by Captain Cook's party at Kealakekua in 1779 (Medway 1981). This species is the most adaptive of the drepanids; it was extremely common in Cook's day, and is still numerous. Recent genetic studies by Johnson et al. (1989) and mitochondrial DNA investigations by Tarr and Fleisher (1993) has resulted in the American Ornithologists Union (AOU) splitting the Common Amakihi complex into three separate species. Hawai'i 'Amakihi (*Hemignathus virens*) found on Hawai'i , Mau'i, Moloka'i and formerly Lana'i; the O'ahu 'Amakihi (*Hemignathus chloris*) on O'ahu; and the Kaua'i Amakihi (*Hemignathus kauaiensis*) on Kaua'i (AOU 1995). Hawaii 'Amakihi are currently found as low as 150 meters (500') and are also found in the highest reaches of vegetation on the Island (Banko 1984a, David 1989, 1990, 1991b, 1992, 1993). During the course of the HFBS it was estimated that there was a total population on the Island of some 870,000 ± 11000 (95% CI)birds. They were found in all of the HFBS study areas. It was calculated that 20% of the entire Island population is found in the Hamakua District with population densities reaching levels of 1600 birds/km², near Pu'u La'au. (Scott et al. 1986). Hawai'i 'Amakihi, unlike other drepanids, have adapted to exploit a wide selection of food sources ranging from insects and invertebrates to nectar and fruit, often in highly disturbed areas. They are to be found feeding in the canopy, sub-canopy, branches, and even on the ground (Richards and Bock 1973, R. David, pers. obs.). At present this species is doing well. Hawai'i 'Amakihi are not usually encountered below 500 feet in elevation; however given the presence of scrub ohia on the reservoir site it is certainly possible that there is occasional usage of the site by this species.

Mammalian Resources

With the lone exception of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) or 'Ope'ape'a as it is better known here in Hawai'i, all the terrestrial mammalian species currently on the Island of Hawai'i are alien species introduced by man. In Table 3 the mammalian species which probably at least occasionally utilize one or both of the sites are tabulated.

Table 4.

MAMMALIAN SPECIES LIKELY TO UTILIZE THE UH-HILO PROPOSED DEVELOPMENT SITES AT LEAST OCCASIONALLY

COMMON NAME	SCIENTIFIC NAME
Hawaiian hoary bat	*Lasiurus cinereus semotus*
Norway rat	*Rattus norvegicus norvegicus*
Roof rat	*Rattus rattus*
Polynesian rats	*Rattus exulans Hawai'iensis*
European house mouse	*Mus domesticus*
Domestic dog	*Canis familiaris familiaris*
Small Indian mongooses	*Herpestes auropunctatus auropunctatus*
Cat	*Felis catus*
Horse	*Equus caballus caballus*
Pig	*Sus scrofa scrofa*
Domestic Cattle	*Bos taurus*

Endangered Mammalian Species

Hawaiian hoary bat: *Lasiurus cinereus semotus* 'Ope'ape'a

The Hawaiian hoary bat is Hawai'i's only endemic terrestrial mammal. It was first listed as endangered by the USFWS in 1970 (USFWS 1992). Originally considered to be a distinct species, it is now taxonomically classified as an endemic Hawaiian sub-species of the American hoary bat (Tomich 1986). There has been very little scientific work attempted on this species, in no small part due to the fact that this bat is usually a solitary arboreal rooster and therefor difficult to study. The existing scientific evidence is conflicting as to what effect alien species, plant or otherwise, may have had on this species (Jacobs, 1994, Kepler and Scott 1990, Tomich 1986). It should be borne in mind that little is known about the possible changes in this species range, population density or habitat preferences since the advent of humans and their impacts on the native Hawaiian ecosystems. It is almost a certainty that this species utilizes both sites at least occasionally.

Limitations of this Report

No field surveys were undertaken on the subject properties. This assessment is based on published reports, personal experience and the faunal makeup of similar habitat on the Island of Hawai'i.

Discussion of Potential Impacts

Given the fact that the avifauna of the proposed development sites is dominated by alien species, and that any usage of either site by endemic avian species is best described as incidental - no impacts are expected to native avian populations by development of either site. Taking into consideration the current knowledge and understanding of the abundance, distribution, and biology of the Hawaiian hoary bat it is unlikely that the construction on either of these sites will have a deleterious impact on this endangered mammalian species.

Literature Cited

American Ornithologist's Union. 1983. Check-list of North American Birds. 6th edition. AOU. Washington D.C. 877 pp.

_____ 1985. 35th Supplement to AOU Checklist. Auk vol. 102: 680-686.

_____ 1987. 36th Supplement to AOU Checklist. Auk vol. 104: 591-596.

_____ 1989. 37th Supplement to AOU Checklist. Auk vol. 106: 532-596.

_____ 1991. 38th Supplement to AOU Checklist. Auk vol. 108: 750-754.

_____ 1993. 39th Supplement to AOU Checklist. Auk vol. 110: 675-682.

_____ 1995. 40th Supplement to AOU Checklist. Auk vol. 112: 819-830.

Baldwin, P. H. 1950. Occurrence and behaviour of the Hawaiian bat. J. Mammal. 31 (4): 455-456.

Banko, W. E. 1980 a. *Population Histories- Species Accounts Seabirds: Hawaiian Dark-rumped Petrel ('Ua'u). Cooperative National Park Resources Studies Unit, University of Hawaii at Manoa, Department of Botany, Technical Report #5B.*

_____ 1980 b. Population Histories- Species Accounts Seabirds:Newell ('A'o). Cooperative National Park Resources Studies Unit, University of Hawaii at Manoa, Department of Botany, Technical Report #5A.

_____ 1980 c. Population Histories- Species Accounts Forest Birds: Hawaiian Hawk ('Io). Cooperative National Park Resources Studies Unit, University of Hawaii at Manoa, Department of Botany, Technical Report #6A.

Banko, W. E., P. C. Banko, R. E. David 1991. First and Subsequent Specimens, Breeding Activity, and Observations of the Band-rumped Storm-Petrel (*Oceanodroma castro*) on the Island of Hawaii. The Wilson Bulletin, Vol. 103, No. 4.

Beaglehole, J. C., ed.1967. The journals of Captain James Cook on his voyages of discovery. Vol. 3, The voyage of the Resolution and Discovery 1776-1780. 2 pts. Hakluyt Society Extra Series, no. 36 Cambridge University Press.

Bryan, E. H., Jr. 1955. The Hawaiian bat. 'Elepaio Vol. 15: 63-64.

Clements, J.F. 1991. Birds Of The World: A Checklist. Ibis Publishing Co., Vista, California. 617 pp.

Conant, S. 1980. Recent records of the 'U'au (Dark-rumped Petrel) and "A'o (Newell's Shearwater) in Hawai'i. 'Elepaio, Vol. 41: 11-13

Cooper, B. A. and R. E. David 1995. Radar and Visual Surveys of Seabirds in the HELCO SSP Unit 71, Puna, Hawaii, During July 1995. Prepared for R. M. Towill Corporation & Hawaii Electric Light Co. 19 pp.

Cooper, B.A., David, R.E. and R.J. Blaha 1995. Radar and Visual Surveys of Endangered Seabirds and Bats in the Pohakuloa Training Area, Hawai'i, During Summer 1995.

Prepared for R.M. Towill Corporation and the U.S. Army Corps of Engineers, Pacific Division (POD).

David, R. E. 1989. North Kona Christmas Count - 1988 -. 'Elepaio Vol.49, No. 9.

_____ 1990. North Kona Christmas Count 1989. 'Elepaio Vol. 50, No. 5 : 41-42.

_____ 1991. North Kona Christmas Count 1990. 'Elepaio Vol. 51, No. 6 : 37.

_____ 1992. North Kona Christmas Count 1991. 'Elepaio Vol. 52, No. 3: 20-21.

_____ 1993. North Kona Christmas Count 1992. 'Elepaio Vol. No. 7: 47-48.

_____ 1996 a. Ornithological and Mammalian Surveys of the Proposed Improvement and Realignment Corridors of the Saddle Road (State of Hawaii Route 200), Island of Hawai'i, Hawaii. Prepared for: Rust E&I & The Federal Highways Administration, Central Federal Lands Highway Division. 99pp.

_____ 1996 c. Close-barred Francolin (*Francolinus adspersus*). Hawaii's forgotten Francolin (in prep.).

_____ 1996 d. First Record of a Whiskered Tern (*Chilonias albostriatus*) from the Northern Pacific. (in prep.).

Giffin, J.G. 1993. New Species of Fossil Birds Found at Pu'u Wa'awa'a. 'Elepaio Vol. 53 (1) pg.1-3.

1975. Third edition. Hawaii's Birds. Hawaii Audubon Society, Honolulu, Hawaii 104 pp.

Hawaii Audubon Society 1993. R. David editor Fourth edition. Hawaii's Birds. Hawaii Audubon Society, Honolulu, Hawaii 112 pp.

Henshaw, H.W. 1902. Complete list of birds of the Hawaiian Possessions with notes on their habits. Thrum, Honolulu.

Jacobs, D.S. 1994. Distribution and Abundance of the Endangered Hawaiian Hoary Bat, *Lasiurus cinereus semotus*, on the Island of Hawai'i. Pacific Science, Vol. 48, no. 2: 193-200.

James H.F., S.L. Olsen 1991. Descriptions of Thirty-two New Species of Birds from the Hawaiian Islands: Part 2. Passeriformes. American Ornithological Union, Washigton D.C. 88 pp.

Johnson, N. K. , J. A. Marten and C. J. Ralph. 1989. Genetic evidence for the origin and relationships of Hawaiian Honeycreepers (Aves: Fringillidae).Condor 91:379-396

Kepler, A. K. 1986. Avifauna., In: Associated Engineering Consultants, Wailuku Hydropower Site E. I. S.

Kepler. C. B., and J. M. Scott 1990. Notes on the distribution and behaviour of the endangered Hawaiian Hoary Bat (*Lasiurus cinerus semotus*) 1964-1993. 'Elepaio 50(7):59-64.

Kirch, P.V. 1982. The Impact of the prehistoric Polynesians on the Hawaiian ecosystem. Pac. Sc. 36 (1): 1-14

Kjargaard. M. S. 1991. An Avifaunal Survey of the Proposed Water Pipeline South Hilo to South Kohala and Hamakua Districts, Hawai'i Island, Hawai'i. Unpl. Report.

______. 1992. An Assessment of the Fauna of the Proposed Puainako Street Extension District of South Hilo, Hawaii. Unpl. Report.

Long, J.L. 1981. Introduced Birds of the World. Universe Books, New York. 528 pp.

Medway, D.G. 1981. The contribution of Cook's third voyage to the ornithology of the Hawaiian Islands. Pac. Sci. 35: 105-175.

Morrsion, M. L., L. S. Hall and P. H. Bloom. 1994. Hawaiian Hawk (*Buteo solitarius*) population Survey. Upbl. Report. 50 pp.

Munro, G.C. 1941. Birds of Hawaii and adventures in bird study. The dark-rumped petrel. 'Elepaio 2 (4): 24-27.

Munro, G.C. 1944 (1960 reprint). Birds of Hawaii. Tuttle, Vermont 192 pp.

Olsen, S.L., and H.F. James 1982. Prodromus of the fossil aviafauna of the Hawaiian Islands. Smithsonian Contr. Zool. 365: 1-59.

______ 1991. Descriptions of Thirty-two New Species of Birds from the Hawaiian Islands: *Part 1. Non Passiformes . American Ornithological Union*, Washigton D.C. 88 pp.

Perkins. R. C. L. 1903. Vertebrata (Aves). In Fauna Hawaiiensis, (D. Sharp, ed.). The University Press, Cambridge.

Pratt. H. D., P.L. Bruner and D.G. Berrett. 1987. A Field guide to the birds of Hawaii and the tropical Pacific. Princeton University Press. N.J. 409 pp. + 45 plates.

Pyle, P. B., P. V. Donaldson, R. E, David and R. L. Pyle 1988. The Status of Small *Calidris* Sandpipers in the Hawaiian Islands, Documentation of Three First Records for the State. 'Elepaio Vol. 48, No. 9. (Pg. 71-77).

Pyle, R. L. 1992. Checklist of the Birds of Hawaii - 1992. 'Elepaio 52:(8) 53-62.

Richardson, F. and J. Bowles, 1964. A Survey of the Birds of Kaua'i. Hawaii. Bulletin Bernice P. Bishop Museum. 227: 1-51.

Scott, J. M., S. Mountainspring, F. L. Ramsey and C. B. Kepler. 1986. Forest Bird Communities of the Hawaiian Islands: Their Dynamics, Ecology, and Conservation. Studies in Avian Biology No. 9. Lawrence, Kansas: Allen Press Inc. 431 pp.

Steadman, D. W. 1989. Extinction of Birds in Eastern Polynesia: A Review of the Record, and Comparisons with Other Pacific Island Groups. Journal of Archaeological Sci. (16): 177-205.

Stone, C.P. and J. M. Scott 1985. Hawai'i's Terrestrial Ecosystems Preservation and Management. CPSU, University of Hawaii, Honolulu, Hawaii. 584 pp.

Tarr, C. L., and R.C. Fleischer. 1993. Mitochondrial-DNA variation and evolutionary relationships in the amakihi complex. Auk 110: 825-831.

Tomich, P.Q. 1986. Mammals in Hawaii. Bishop Museum Press. Honolulu, Hawaii. 375 pp.

U.S. Fish and Wildlife Service 1992. Endangered & Threatened Wildlife and Plants. 50CFR 17:11 & 17:12. United States Department of the Interior. Washington. 34 pp.

Wagner, W.L., D.R Herbst, S.H. Sohmer 1990. Manual of the Flowering Plants of Hawai'i. University of Hawaii Press, Honolulu, Hawaii 1854 pp.

Wilson, S. B., and A. H. Evans 1890-1899. Aves Hawaiiensis: The birds of the Sandwich Islands. R. H. Porter, London.

APPENDIX C

ARCHAEOLOGICAL SURVEYS/STUDIES And RELATED CORRESPONDENCES

(Cultural Surveys of Hawaii)

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

MICHAEL D. WILSON, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES

GILBERT COLOMA-AGARAN

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND DIVISION
STATE PARKS
WATER AND LAND DEVELOPMENT

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

February 13, 1997

LOG NO: 18942 ✓
DOC NO: 9702PM09

RECEIVED

FEB 19 1997

ENGINEERING CONCEPTS

Dr. Hallett Hammatt
Cultural Surveys of Hawaii
733 North Kalaheo Avenue
Kailua, Hawaii 96734

Dear Dr. Hammatt:

SUBJECT: "Archaeological Survey of a Proposed Reservoir and Waterline Easement for the University of Hawaii at Hilo, Infrastructure Improvements Phase IIA" (Winieski, Borthwick and Hammatt 1996) Waiakea, South Hilo, Hawaii Island TMK: 2-4-03: 26 and 2-4-01: 12

Thank you for your transmittal sheet dated November 19, 1996 and our apologies for the delay in reviewing the subject report.

The report meets with our approval. We believe that the survey of the 5.23 acre parcel was adequate. Few, if any, historic sites were anticipated in the subject area and, indeed, none were found.

Since no historic sites were found during this survey, use of this parcel will have "no effect" on significant historic sites.

Aloha,

DON HIBBARD, Administrator
State Historic Preservation Division

PM:amk

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

October 28, 1994

RECEIVED
NOV 2 1994
ENGINEERING CONCEPTS

Dr. Hallett Hammatt
Cultural Surveys of Hawaii
733 North Kalaheo Avenue
Kailua, Hawaii 96734

LOG NO: 13055
DOC NO: 9410PM23

Dear Dr. Hammatt:

SUBJECT: **Replacement Pages for Final Report: "Archaeological Survey and Testing of Lands Proposed for Research and Technology Lots at the University of Hawaii at Hilo" (Borthwick, Collins, Folk and Hammatt 1993)**
Waiakea, South Hilo, Island of Hawaii
TMK: 2-4-01: 7, 41

Thank you for sending us the two replacement pages for the subject report that we had requested in our review letter of August 9, 1994. Now that we have these pages we can officially accept the report. This concludes the historic preservation review process for this project.

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

PM:jk

c. Mr. Ken Ishizaki, Engineering Concepts

Archaeological Survey of a Proposed Reservoir and Waterline Easement for the University of Hawaii at Hilo, Infrastructure Improvements Phase IIA (TMK 2-4-03:26 and 2-4-01:12)

by

John Winieski, M.A.
Douglas Borthwick, B.A
and
Hallett H. Hammatt, Ph.D.

for

Engineering Concepts, Inc.

by

Cultural Surveys Hawaii
November 1996

ABSTRACT

An archaeological inventory survey was conducted in Hilo, Hawai'i at the 5.23 acre site of a proposed reservoir and waterline easement adjacent to Sunrise Estates subdivision for the University of Hawai'i at Hilo, University Park Infrastructure Improvements Phase IIA (TMK 2-4-03:26 and 2-4-01:12). Since no archaeological sites or cultural resources were discovered, no impact to historic sites of any kind are anticipated.

TABLE OF CONTENTS

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

ABSTRACT

An archaeological inventory survey was conducted in Hilo, Hawai'i at the 5.23 acre site of a proposed reservoir and waterline easement adjacent to Sunrise Estates subdivision for the University of Hawai'i at Hilo, University Park Infrastructure Improvements Phase IIA (TMK 2-4-03:26 and 2-4-01:12). Since no archaeological sites or cultural resources were discovered, no impact to historic sites of any kind are anticipated.

ACKNOWLEDGEMENTS

We would like to thank Dana Yamamoto of Engineering Concepts, Inc. for coordinating the project, and providing maps and helpful information.

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

On October 17, 1993 Cultural Surveys Hawaii conducted an archaeological inventory survey of forested land in Waiākea *ahupua'a*, South Hilo district on the island of Hawai'i (Figure 1-3). The parcel under study, located at the end of Puloku Street in the new Sunrise Estates sub-division, is the site of a proposed UH Hilo University Park reservoir and waterline easement (Figure 4).

Scope of Work

At the request of Engineering Concepts, Inc., Cultural Surveys agreed to perform a full archaeological inventory survey of the UH Hilo University Park reservoir and waterline easement. This survey would satisfy state and county requirements. Results of the survey would be provided in a report, which would also include any necessary background information.

Study Area Description

The study area comprises approximately 5.23 acres in the *ahupua'a* of Waiākea, in South Hilo, on the windward coast of Hawai'i Island (TMK 2-4-03:26 and 2-4-01:12). It is presently accessible from the eastern end of Puloku Street, which intersects a previously bulldozed grub line which runs roughly north-east/south-west. The grub line, approximately 20-40 feet wide, is proposed as the waterline easement which will run from the proposed reservoir site to an existing waterline. The reservoir site will be located on a lot directly makai of the grub line at its south-west end. The reservoir parcel is bounded on the north side by existing channelized drainage, and on all other sides by undeveloped forested land.

Elevations within the study area range from roughly 450 ft. a.m.s.l. to 500 ft.

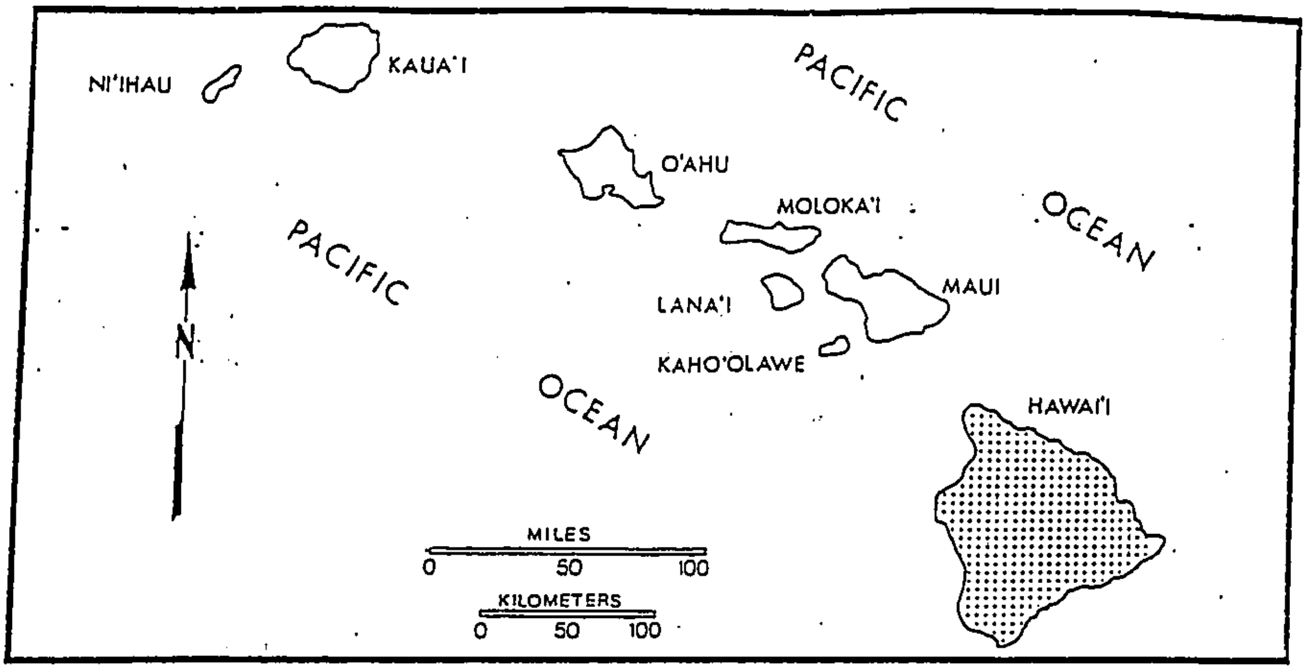


Figure 1 State of Hawai'i

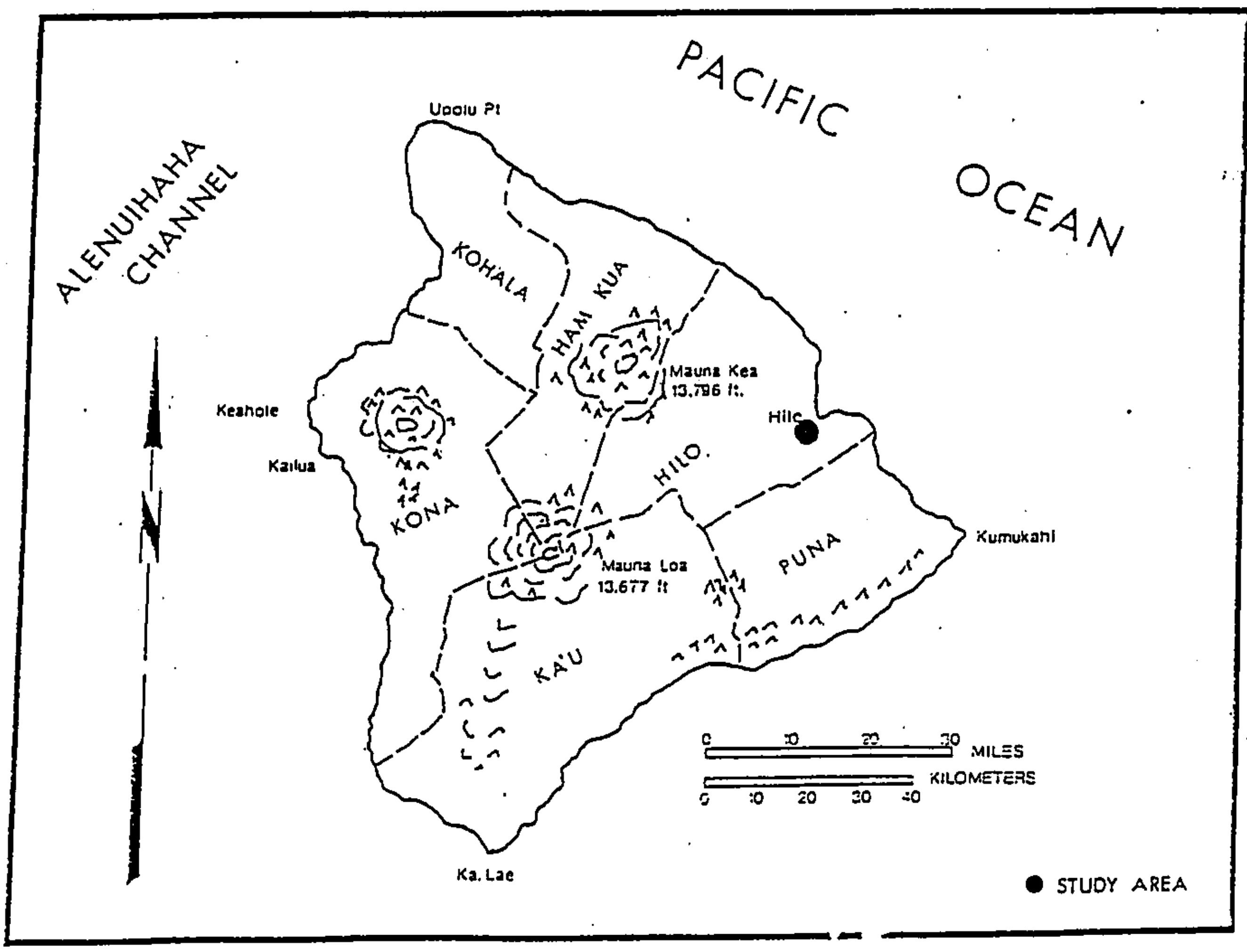


Figure 2 General Location Map, Hawai'i Island

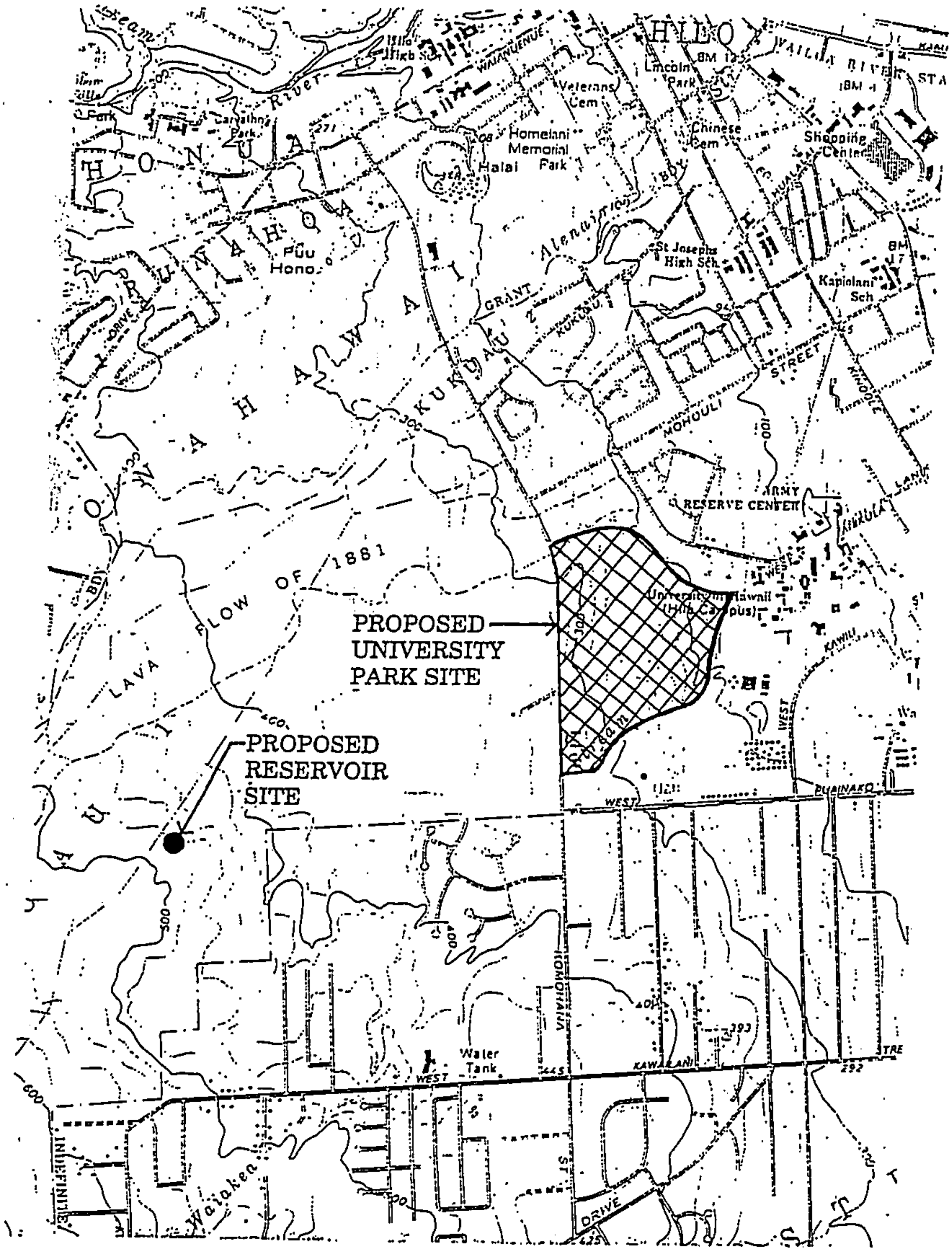


Figure 3 Portion of USGS Topographical Map, 7.5 Minute Series, Hilo Quadrangle, Showing Approximate Location of Study Area

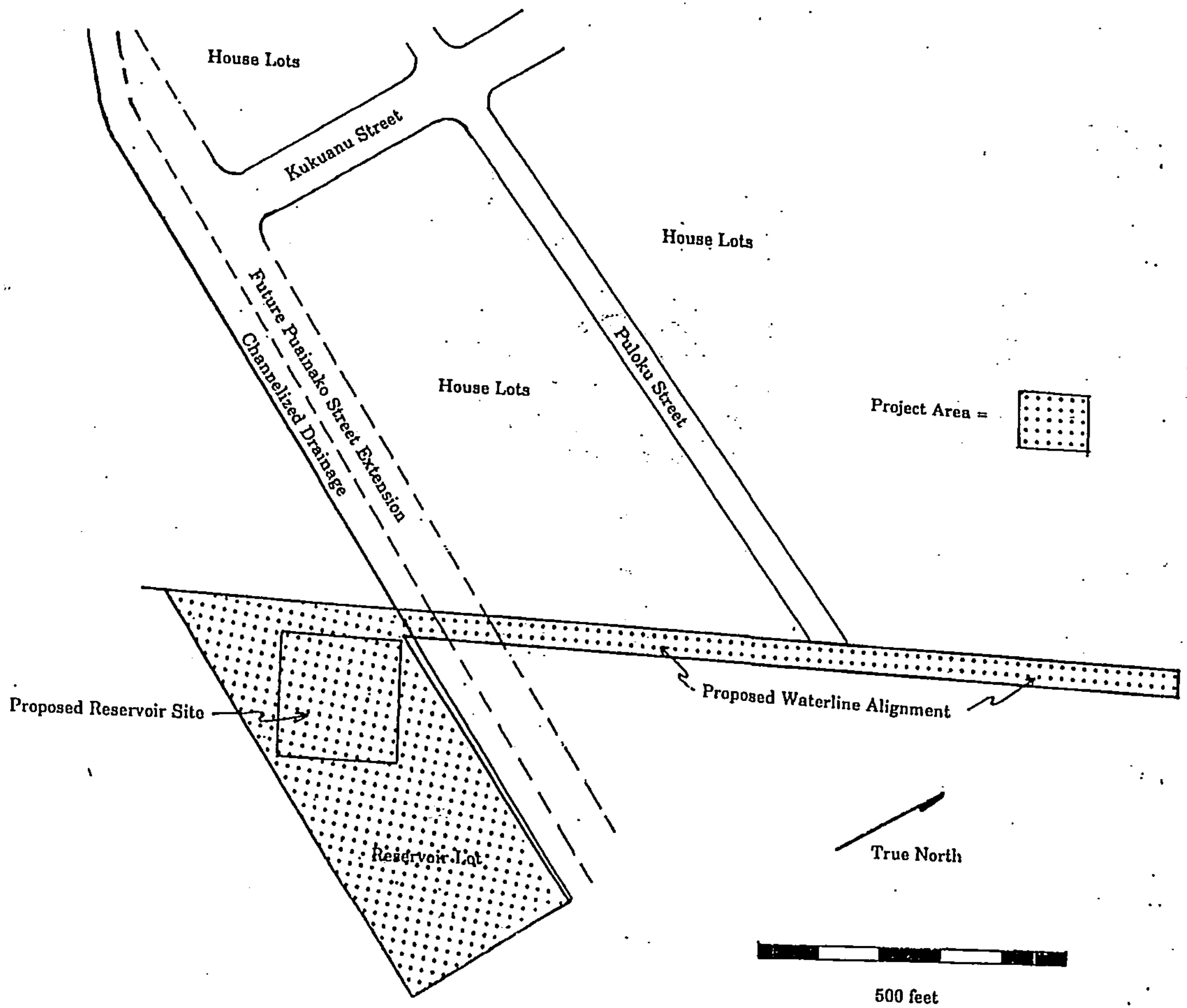


Figure 4 Project Area Map

a.m.s.l. on the lower east slope of Mauna Loa Volcano.

Several historic flows from Mauna Loa Volcano have affected the terrain along its eastern slope. An 1881 flow affected much of the Waiākea *Ahupua'a*, flowing to within a mile of Hilo Bay. A part of the east end of this 1881 flow is present just to the north of the study area. However, the 1881 flow did not impact the study area which is located on an older pahoehoe lava flow which pre-dates it.

Although virtually unweathered pahoehoe lava dominates the study area, vegetation is dense due to the vast amounts of rain on the windward side of Hawaii Island. The vegetation in this area is characterized by *uluhe* fern (*Diacranopteris linearis*), except for stands of strawberry guava trees (*Psidium cattleianum*) with little or no understory.

CULTURAL HISTORY

The *ahupua'a* of Waiākea, South Hilo, is large, encompassing some 95,000 acres. It extends from the coast to approximately the 6,000 feet elevation on the windward slope of Mauna Loa. In 1979 Holly McEldowney prepared an "Archaeological and Historical Literature Search and Research Design," as part of a "Lava Flow Control Study" (McEldowney 1979). In her report McEldowney describes five zones of land use and associated resources. The five zones, which are applicable to Waiākea, include: I. Coastal settlement; II. Upland Agricultural; III. Lower Forest; IV. Rain forest; and V. Sub-Alpine or Montaine (*Ibid.*). The zones are described below from *mauka* (Zone V) to *makai* (Zone I) or in order of ascending importance in terms of settlement patterns.

Zone V (Sub-alpine), which is defined as being above the 5,500 ft. elevation, was probably of only marginal importance in terms of land utilization during prehistoric (pre-A.D. 1776) times. As McEldowney indicates "Use of major trails, although important to settlement and land use in all zones, probably dominated the utilization of this zone" (*Op.*

cit:30). Resources probably procured from this zone include birds like *nene* (geese) and *'ua'u* (petrel) for food, timber products, and possibly lithic materials.. Though Waiākea extends into this sub-alpine zone it is not one of the major *ahupua'a* associated with this zone or the saddle region like Humu'ula which "cuts off" Waiākea at roughly the 6,000 foot elevation.

Zone IV (Rain Forest) is defined as ranging from 2,500 to 5,500 feet in elevation. Resources of bird feathers, medicinal plants, and possibly some timber products would have been procured from this zone with bird feathers probably of greatest importance. Habitation within this zone was probably exclusively temporary though possibly lava tubes or other site areas were utilized recurrently. In general, as McEldowney states because of "the less diversified use of this zone, and the implications of overnight visits rather than extended stays, make the overall potential for sites in this zone even lower" (i.e., compared to Zone III) (*Ibid.*).

Zone III (Lower Forest) is defined as ranging from 1,500 to 2,500 feet in elevation. McEldowney suggests that it is within this zone that the upper limits of the pre-historic farming took place. However, the main usage was probably still resource procurement of naturally occurring forest products. The farming or "supplemental food sources" would have included, "banana, wet and dry-land taro, ti, and yams (*Dioscorea* sp.) which were planted along streams and trails and in small patches of cleared forest" (*Op. cit.*:26). The forest products would have included a variety of timber, including Koa for canoes, bird feathers, dye and medicinal plants, mamaki which was used for a variety of bark cloth or kapa, *'ie'ie* for basketry, *olonā* for cordage and a source of famine type foods, such as *hapu'u*. Habitation was still dominantly temporary though recurrent use is indicated by forest cultivation and the probably tending of specific forest products such as *olonā* (*Ibid.*).

Zone II (Upland Agricultural) is defined as ranging from 50 to 1,500 feet in elevation. The zone was described by "early visitors to Hilo Bay" as "an open park land gently sloping to the base of the woods." ... "an expanse broken by widely spaced cottages" or huts, neatly tended gardens, and small clusters of trees" (*Op. cit.:* 19).

The present study area is situated within this upland agricultural zone. Though described as a vast "expanse" it would appear that only the more agriculturally productive areas were intensively farmed. In the 1820s it was "estimated that 1/20 of the expanse (i.e., zone of cultivation) in N. and S. Hilo was planted in crops" (Goodrich 1826:4 in McEldowney 1979:21). The reasons for what appeared to the early visitors as a "lack of more extensive planting " (*Ibid.*) include, the need for fallow periods especially in soils where nutrients are rapidly leached out, but more important to intensive agricultural use in the Hilo area is soil type or lack there of. Intensive agricultural in Zone II was focused on area with a soil mantle leaving younger exposed lava areas for plants not needing continuous care (e.g., grasses, ferns).

Habitation within the upland agricultural zone (i.e., Zone II) apparently including some permanent occupation sites but was still dominantly temporary. The description of habitations refer to "scattered huts" with adjacent "garden plots" or "cottages" with "neatly tended gardens " (*Op. cit.*: 18-19) but no descriptions of village complexes like those along the coast.

Zone 1 (Coastal Settlement) is defined as " from sea level to roughly 20 to 50 ft. elevation or 1/2 mile inland" (*Op. cit.*: 15). This zone contained the majority of the population in village settings. The Hilo Bay area, of which Waiākea ahupuaʻa encompasses the southern half, was described "as a nearly continuous complex of native huts and garden plots interspersed with shady groves of trees, predominately breadfruit (*Artocarpus altilis*) and coconut (*Cocos nucifera*)." (*Op cit.:16*). Additional sites mentioned included, "canoe sheds, several heiau, and large complexes catering to chiefs and their retainers" (*Ibid.*). Thus the coastal zone included virtually all of the permanent habitation sites and was the focal point of resource utilization procured elsewhere within the ahupua'a.

Based on the above zonal characterization of Waiākea the tradition or pre-contact (i.e., pre-A.D. 1776) settlement pattern included, a heavily populated coastal zone, an upland agricultural zone with forest zones beyond. The coastal zone included the village clusterings of the permanent habitations with direct access to rich and varied marine resources including fishponds, and probably the majority of agricultural production as well.

The upland agricultural zone was probably expanded into as the prime lands *within the coastal zone* were intensively utilized. Over time the upland agricultural zone was converted from forest to an "open park land" where plantings occurred on soil mantled lava flows. Habitation for most part was probably temporary with a few scattered permanent occupation complexes.

Beyond the upland agricultural zone was the forest which ranged from rain forest to sub-alpine forest. In Waiākea these forest zones were quite large which allowed for extensive gathering of forest products. The products in part included, timber, especially Koa for canoes, birds, for consumption (nene, 'ua'u) and feathers, medicinal and dye plants, and famine type foods.

Late Prehistoric Early Historic ca. 1790-1840

The rich and varied resources that Waiākea offered made it one of the most important locales on Hawaii Island. Traditional accounts concerning Waiākea include references to it being the seat of chiefly residences as early as ca. A.D. 1550 (Kelly, Nakamura, Barrère 1981). Chiefly associations with Waiākea continued through traditional times and into the historic era. Kamehameha retained Waiākea after he had conquered all of the islands (ca. 1800), and upon " his death his personally held Hilo lands, including Pi'i-honua, Punahoa, and Waiākea, descended to Liholiho, his son and heir to the kingdom,"..additionally " Kamehameha had given the ili kupono of Pi'opi'o to his favorite wife Ka'ahumanu" (*Op. cit.*: 11). The 'ili of Pi'opi'o is in Waiākea and is situated between Hilo Bay and Wailoa River and its associated fishponds.

Land use during the early historic period was still essentially subsistence based though aspects of major changes were occurring. The sandalwood trade, establishment of the American Board of Commissioners for Foreign Missions (ABCFM) station in Hilo, and the arrival of whalers began the shift away from subsistence to a market based economy. Settlement was still focussed on the coastal zone as was *most of the agricultural* production of both indigenous food crops and newly introduced plants.

During this early historic period the Forest and Sub-Alpine Zones land use was changing also. Besides the more traditional procurement of timber products and even bird feathers for taxes (McEldowney 1979:35). Cattle, goats, and sheep were being hunted in the upper zones. These animals were introduced in the 1790s and after an imposed 10 year prohibition on their killing had spread over large portions of the interior of Hawaii Island, especially the Waimea area. However, "by the 1830s substantial amounts of hides, jerked meat, and tallow were exported from Hilo" (*Op. cit.*:36).

Mid 1800s

Traditional land tenure changed during this time span to the privatization of land ownership. Generally referred to as the "Great Mahele" privatization actually included a number of government acts from the late 1840s to the mid 1850s. The Kamehameha dynasty's control over the valuable Waiākea *ahupua'a* was evidenced in that virtually the entire *ahupua'a* became Crown Lands with the *'ili* of Pi'opi'o awarded to Victoria Kamamalu (LCA 7713:16), a granddaughter of Kamehameha I and heir to Ka'ahumanu as well.

Twenty-six (26) Land Commission Awards (LCAs) were granted within Waiākea. None of these LCAs are within the present study area. The LCAs were all within the coastal zone, except for two (2663 and 2402) which were in the lower portion (i.e., ca. 100 ft. a.m.s.l.) of the upland agricultural zone. The LCAs or *kuleana*(s) were for the most part focused around the edges of the large fishponds of Waiākea. Land use information of the *kuleana* generally refer to cultivated fields with house lots indicating habitation and agricultural production within the same zone, unlike leeward Hawaii Island where in many cases *kuleana* included coastal house lots with the need of corresponding upland agricultural lots, because of elevation dependent rainfall.

Interior land use during this period was progressing toward more organized ranching, especially cattle ranching. Timber for firewood and housing was also still being exploited, as Hilo was being transformed into an entirely wooden-framed "New Bedford type Whaling Town" (*Op. cit.*:37).

Though the coastal zone still contained the vast majority of the population houses and stores were concentrated in the northern half of the bay, away from Waiākea, because the main pier for Hilo was at the mouth of Wailuku River. This indicates a substantial change from the traditional settlement pattern of a "nearly continuous complex of native huts" along the bay's shoreline.

Late 1800s

During this period commercial sugar cane became the economic mainstay of the Hilo area with Waiākea Mill Company becoming one of the largest. Plantation operations generally developed ca. 1860s and for Waiākea this was on leased Crown lands. Waiākea Mill Company was in operation by the late 1870s and through its agents, Theo H. Davies and Alexander Young, had procured the lease of all of Waiākea by 1888 (Kelly, Nakamura, Barrère 1981:89). The mill was located at the head (*mauka* end) of Waiākea Fishpond and sugar was transported by barge through the pond and down Wailoa River to Hilo Bay.

Immigrant labor (Chinese, Japanese, Portuguese) were living in "camps" set up by the plantation for its workers. Waiākea Mill Co. would eventually have some 10 camps situated along major rail lines of the plantation.

Land use was dominated by commercial cane activities within Zones I to III (Coast to Lower Rain Forest). Ranching became formalized though not specific to Waiākea. "Other examples of business, not directly related to sugar cultivation, were the continued use of the Waiākea fishponds, an active Chinese fish market, small pastures above Hilo supporting dairy cattle, and scattered vegetable gardens" (McEldowney 1979:39).

Early 1900s

Sugar and its associated industries continued to expand during this period. The Hawaii Consolidated Railway was built eventually extending "from Waiākea Mill and wharf through Puna, most of Ōla'a and along the N and S Hilo coast" (*Op. cit.*:41). Many of the immigrant laborers from the late 1800s moved off the plantation, being replaced by new Filipino laborers. Hilo continued to grow and become the second largest urban center in the new Territory of Hawaii.

Ranching in the Hilo areas, but not specifically in Waiākea, came under the control of two large enterprises; the Parker and Shipman Ranches. In Waiākea a large portion of Zone II (Upland Agricultural Zone) too rocky for sugar cane cultivation became available for lease as Waiākea pasture lands. The present study area is mostly former Waiākea pasture land. The specific use of the pasture land is not known but McEldowney indicates that "A substantial amount of grazing land adjacent to Hilo or to sugarcane fields supported dairy cows for Hilo's several dairies" (*Ibid.*).

In 1918 the 30-year lease of the Waiākea Mill Co. expired and because Hawaii had become a Territory the "land fell under homesteading laws that required the government to put some of it up for lease to homesteaders who would be willing to grow sugar cane on it. Waiākea Mill was to grind the crop for them. A total of about 700 acres of land was divided into cane lots (between 10 and 76 acres each) and house lots ranging from 1 to 3 acres..." (Kelly, Nakamura, Barrère 1981:121). The homestead and cane lots eventually reverted to the overall mechanized cultivation of the mill company as the homestead and cane lots "experiment was declared a failure" (*Op. cit.*:121).

By the 1920s the Waiākea Mill Co. had some 7,000 acres in cane production. Also, in the 1920s large tracts of remaining forest in Waiākea were "designated as forest reserve" (McEldowney 1979:42). The main reason appears to have been for maintaining the "forest as a 'watershed' to capture, retain, and support the continuous flow of water necessary to the sugar industry" (*Ibid.*). Clearly, sugar was the dominate economic factor during this period including the formation of settlements (i.e. camps).

Mid 1900s till present

Plantation life dominated the early portion of this time span but in 1948 Waiākea Mill Co. was liquidated (Condé and Best 1973:119). However, a major industry associated with cane by-products, canec, was begun in 1928. The canec plant was located adjacent to Waiākea Mill with bagasse, the cane by-product utilized, pumped through pipes from the mill to the plant. The canec plant shut down operations in 1966.

During this period major construction jobs started in the 1920s were completed. These major construction jobs, in part, included Hilo Bay, wharfs and breakwater and bridges. Some of these projects were actually major reconstruction work from damage during the winter of 1923, which included storm surf in January and a tidal wave in February (Kelly, Nakamura and Barrère 1981:171). During the World War II period in

Hilo, expansion and designation of Hilo airport as General Lyman Field and the construction of the Saddle Road were major projects undertaken as part of the military presence on the island, which was very substantial.

Prior to the closing of the Waiākea Mill Co. there were at least 10 "camps" or plantation villages. Only Camp 1 was within the coastal zone with Camps 2 to 10 within the upland agricultural zone with Camp 10 the highest at ca. 1300 ft. a.m.s.l. The present study area included active mechanized cane cultivation probably right up until closing (1948), and leased pasture lands. The lease of the Waiākea pasture lands during *this period was to a Mr. Kazuo Miyasaki (G.L. #2751 exp. 6/17/60).* Specific use of the pasture is not known, but as mentioned previously, dairy cattle pasturage is a distinct possibility.

After statehood (1959) and with the closing of the mill and canec plant, tourism was looked at as the next economic mainstay. In Waiākea, C. Brewer & Co. built a hotel complex at the site of the old canec plant. Other hotels were built along the Hilo Bay frontage of Waiākea near Coconut Island or Mokuola. Large tracts of former Waiākea Homestead and Cane lots were converted to housing or sub-division tracts adjacent to the study area. U.H. Hilo campus was expanded as it continues to do presently. The study area itself ceased to be utilized for pasturage (ca 1960s?) and other buildings recently constructed there are: the School of Agriculture building, the Joint Astronomy building, CalTech Building; Subaru Building.

Summary

In summary, the traditional settlement pattern included, almost exclusively, permanent coastal habitation with associated intensive agriculture. Immediately up slope of the coastal zone was an area cleared for extensions of agricultural production though not as intensively utilized as in the coastal zone. Beyond or *mauka* of the cleared upland agricultural zone was forest which ranged from dense rain forest to sub-alpine forest at the upper limit of Waiākea (ca. 6,000 feet). Habitation for the zones beyond the coastal zone was essentially temporary in nature, associated with exploitation of forest products. This pattern changed over time as the historically introduced religion(s), economy, and socio-political system replaced the traditional Hawaiian system. The major impetus for change was the development of commercial sugar cane within Waiākea. Settlement patterns during the period from the mid 1800s to the mid 1900s were almost exclusively set by the Waiākea Mill Co. Camps for immigrant laborers were constructed at specific locations based on the plantation organization. Most of these permanent housing locations were in areas previously associated with sparsely scattered temporary habitations in the upland agricultural zone of Waiākea. Because most of the study area was too rocky (i.e. exposed pahoehoe) for commercial cane, associated camps were not present. It appears that historically, most of the area within which the project area lies was utilized as pasture land.

Hilo eventually became the second largest urban center in the State of Hawaii. Permanent housing is no longer dependent on a specific set of environmental conditions as it was during traditional Hawaiian times. The large acreage involved in subsistence agriculture and utilization of resources specific to certain elevations is no longer a necessity because of the market-based economy of today.

PREVIOUS ARCHAEOLOGICAL RESEARCH

There have been a number of archaeological and historic studies that are pertinent to the *ahupua'a* of Waiākea within which the study area lies. Notable among these somewhat regional studies are, Alfred E. Hudson's 1930s East Hawaii Site Survey, Holly

McEldowney's "Archaeological and Historical Literature Search and Research Design, Lava Flow Control History," and "Hilo Bay: A Chronological History" (Marion Kelly, Barry Nakamura and Dorothy B. Barrère 1981). Review of these documents, and others, indicate that no previously documented sites with state site numbers were located within the present study area. These regionally oriented studies, however, were the basis for describing the settlement pattern specific to Waiākea *ahupua'a*. The discussion of settlement patterns is contained within Cultural History section of this report.

Additionally, a "Summary of Prior Archaeological Work" compiled by Ms. Jadelyn J. Moniz (1992) for Waiākea list ten studies ranging from field inspections to inventory surveys. The studies include research from 1979 to 1992. The description of each of the ten previous studies includes a basic review of findings and relating "adequacy" for the individual reports in terms of inventory level survey," based on Title 13, Subtitle 6, Chapter 147: Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports" (Moniz 1992).

There have been no previous inventory-level archaeological surveys specific to the current study area. However, an archaeological inventory survey and testing for proposed western expansion of the UH Hilo campus (Borthwick *et al.*, 1993), and an inventory survey for a proposed Pu'ainako Street extension project (Hunt and McDermott, 1993) indicate the presence of archaeological sites within approximately one mile *makai* of the present study area.

Hunt and McDermott (1993) identified 11 sites, comprising 88 individual features, within or adjacent to alternative alignments for the proposed Pu'ainako Street extension. The Pu'ainako Street extension survey included areas immediately on the northern side of the channelized drainage with the project area on the southern side. Thus, the survey covered lands some 50-100 feet away, as well as bisecting the proposed waterline easement. Hunt and McDermott located no sites in the vicinity, or on the type of terrain of the present project area. All the sites they located lacked construction stability (a characteristic of prehistoric Hawaiian sites), and test excavations yielded numerous historic period artifacts. This field evidence, along with historic research, indicated the historic origin of the sites consistent with late nineteenth and early twentieth century commercial sugar cane cultivation in the area.

Borthwick *et al.* (1993) surveyed and tested the land area mauka of the UH Hilo campus, and located definitive evidence of sugar cane cultivation as recently as the 1940s. The south end of the study area contained a field bounded by a continuous rock wall within which was tillable land with furrows still visible. Rock mounds within the field system were tested by excavation, and contained no prehistoric cultural material. The mounds were built upon field sediments or upon shallow bedrock up-croppings, indicating that they were contemporaneous with sugar cane cultivation in the area, and probably were field clearing mounds. Two additional small sites located on the northern fringe of the tilled land were found to contain no stratified deposits or prehistoric cultural materials. Mid-twentieth century bottles were located on the surface within the sites, and the sites were interpreted as lunch stations - temporary or single use sites - of field workers. Portions of the study area which were comprised of pahoehoe lava flow, with no tillable soil, were found to contain no cultural resources related to archaeology.

ANTICIPATED FINDINGS

A low likelihood of locating cultural resources within the present study was anticipated based on previous research and archaeology in the area. The study area falls within McEldowney's (1979) Upland Agricultural range (ie. Zone II), where only soil mantled areas would have been extensively farmed and associated habitation primarily temporary in nature, leaving areas of exposed lava flow (as in the present project area) largely uncultivated and uninhabited. This is consistent with the findings of the previously cited archaeological studies *makai* of the project area (Borthwick *et al.*, 1993 and Hunt and McDermott, 1993), which, though finding evidence of historic agricultural activities within areas containing adequate soil, found no archaeologically relevant materials or sites, prehistoric or historic, on areas of exposed pahoehoe lava flow.

SURVEY RESULTS

Methodology

The study area was surveyed by two Cultural Surveys Hawaii archaeologists, Douglas Borthwick and John Winieski, who traversed the property on foot. The dense vegetation was a seriously inhibiting factor in visibility within the reservoir lot, horizontally as well as of the actual ground surface. The most difficult vegetation to survey through was *uluhe* or false staghorn fern which dominates the reservoir lot. Range of the *uluhe* conforms closely with the pahoehoe lava. Visibility was somewhat improved within the scattered and dense stands of strawberry guava (*Psidium cattleianum*) which cover portions of the lot. The trees grow on the average less than 12 inches apart making passage extremely difficult, but are only one to 4 or 5 centimeters thick and visibility is surprisingly good. One can see a minimum of 20 to 30 feet horizontally and the ground underfoot is clear except for leaf litter and sphagnum moss on the unweathered pahoehoe lava of low undulating topography. Visibility was somewhat improved on the previously bulldozed grub line, which though overgrown with various tall grasses, was largely absent of *uluhe* fern.

Traverses throughout the study area were done by two individuals who first went north-east from the south end of Puloku Street along the proposed 40' wide waterline alignment down to the existing waterline which is located beneath existing powerline poles. They then walked back up the grub line (south-west), along the proposed waterline alignment, to the proposed reservoir lot. Using the drainage channel which runs the length of the northern border of the reservoir lot as access, incursions were made into the thick and sometimes impenetrable vegetation wherever possible. Access was adequate in several spots so that full penetration into the lot was possible. The result was that several traverses, both east-west and north-south, were accomplished, covering the full extent of the lot, and including the survey staked reservoir site itself. The individuals, upon exiting on the western border of the lot, were able to additionally survey the entire extent of the existing grub line which borders this western side.

Results

The archaeological survey located no archeological sites or cultural materials, in the study area. Evidence of recent grubbing of the waterline easement portion of the project area was provided by numerous bulldozer pushed piles of pahoehoe boulders located on the edge of the entire length of the easement. Additional piles of boulders within the reservoir lot indicated that some bulldozing may have occurred there as well. The whole project area was, as expected, found to be on undulating pahoehoe lava flow, with little soil, and with vegetation (predominantly *uluhe*) consistent with this type of terrain.

SUMMARY AND SIGNIFICANCE

An archaeological inventory survey of forested land in Waiākea *ahupua'a*, in Hilo Town, on the island of Hawai'i, was conducted by Cultural Surveys Hawaii. The project area is located at the end of Puloku Street adjacent to the new Sunrise Estates sub-division. It is the proposed site of a UH Hilo University Park reservoir and waterline easement.

The site is located on undulating pahoehoe lava flow terrain, and falls within a settlement zone characterized by McEldowney (1979) as the Upland Agricultural (ie. Zone

II). The prevalence of pahoehoe lava in the study area, and the results of two archaeological surveys in similar terrain (one of which (Hunt and McDermott, 1993) surveyed lands adjacent to the north of the reservoir site, and bisected the proposed waterline easement), led to the expectation that few, if any, archaeological sites would be present in the project area.

In the survey of the project area, which involved complete coverage of the proposed waterline easement, and transverses of the proposed reservoir lot, no archaeological sites were discovered. Bulldozed piles of pahoehoe boulders evidenced previous grubbing along the waterline easement, as well a some bulldozing within the reservoir lot.

The absence of any archaeological sites thus allows for placement of the proposed reservoir anywhere within the reservoir parcel, without archaeological impact. However, if in the unlikely event that archaeological features are encountered during reservoir construction, the appropriate state and county agencies should be notified in order to determine an appropriate course of action for mitigation.

REFERENCES

Borthwick, Douglas, Joy Collins, William H. Folk and Hallett H. Hammatt
1993 *Archaeological Survey and Testing of Lands Proposed for Expansion of the University of Hawaii at Hilo (TMK 2-4-01:40 and 157)*, Cultural Surveys Hawaii, Kailua, HI.

Condé, Jesse C. and Gerald M. Best
1973 *Sugar Trains: Narrow Gauge Rails of Hawaii*, Glenwood Publishers, Felton Calif.

Hunt, Terry L. and Matthew J. McDermott
1993 *Archaeological Inventory Survey Pu'ainako Street Extension Project, Lands of Waiakea, Kukuau 1 and 2, and Ponahawai, South Hilo District, Island of Hawai'i.*

Kelly, Marion, Barry Nakamura and Dorothy B. Barrère
1981 *Hilo Bay: A Chronological History, Land and Water Use in the Hilo Bay Area, Island of Hawai'i*, Bishop Museum, Honolulu.

McEldowney, Holly
1979 *Archaeological and Historical Literature Search and Research Design: Lava Flow Control Study*, Department of Anthropology, Bishop Museum, Honolulu.

Hunt, Terry L.
1992 *Interim Report: Archaeological Inventory Survey Puainako Street Extension Project: Lands of Waiākea, Kukuau 1 and 2, and Ponohawai, South Hilo District, Island of Hawai'i,*

Moniz, Jadelyn J.
1992 "Summary of Prior Archaeological Work" *Historical and Archaeological Synthesis of Land Use and Settlement Patterns Waiākea Ahupua'a, Hilo Hawaii*, UH Anthropology 645: Historic Preservation, Fall 1992, Honolulu.

PHOTO APPENDIX

Figure 5 Photograph Showing East View of Access to Project Area from Puloku Street

Figure 6 Photograph Showing South-West View of Bulldozed Grubline Proposed for Waterline Easement

Figure 7 Photograph Showing Existing Waterline at North-East End of Bulldozed Grubline

Figure 8 Photograph Showing South View of Typical Vegetation within Reservoir Parcel

Archaeological Survey and Testing of Lands Proposed for Research and Technology Lots at the University of Hawaii at Hilo (TMK 2-4-01:7 and 41)

by

Douglas Borthwick, B.A.
Joy Collins, B.A.
William H. Folk, B.A.
and
Hallett H. Hammatt, Ph.D.

for

Engineering Concepts

by

Cultural Surveys Hawaii
April 1993
Revised November 1993

ABSTRACT

During the weeks beginning December 14, 1992 and January 5, 1993 Cultural Surveys Hawaii conducted an archaeological inventory survey of approximately 163 acres of forested land in Waiākea *ahupua'a*, South Hilo district on the island of Hawai'i. The parcel under study is owned by the University of Hawaii at Hilo. Portions of this parcel are slated for the development of three research and technology lots. Construction of water, sewer, drainage, and electrical systems to service the three lots are proposed. The purpose of the study was to locate, and describe any and all archaeological resources within the survey area.

Two recent structures - the School of Agriculture Building at the southwest corner of the study area, and the Joint Astronomy Building in the central, *mauka* portion - are extant within the study area as well as portions of the access road system. Large swaths have also been bulldozed across the study area in a northwest-southeast orientation for an old water main, and in a generally east-west direction for an electric power line.

Archeological sites were located in the southern portion of the study area. Four sites were described and mapped to scale. Two of the sites - 18668, and 18669 - and a mound-feature within a third site - 18667 - were tested by hand excavations to document stratigraphy in the sites and to search for cultural remains to help in dating the sites.

The larger of the sites are two (2) expansive historic, agricultural fields (sites - 18667 and -18670). Field-rock clearing mounds are dispersed throughout both fields. The two other sites identified - 18668 and 18669 - were tested by excavation and were found to have no subsurface cultural deposits.

Based on the type and age of the sites found, and the data collected and analyzed, no further archaeological research specific to the sites within the study area is recommended.

Supplemental Inventory Survey

Cultural Surveys Hawaii was requested to conduct an inventory level archaeological survey of an approximately 11-acre parcel adjacent to the 163-acre study area reported on in this report. The parcel is at the *makai* (east) side of the proposed U.H. Hilo Research and Technology Park and includes a section of the Waiakea Flood Control Channel. The survey was done as proposed infrastructure-related construction, associated with the development of the Research and Technology Park, is planned to traverse through this adjoining area.

During the supplemental survey, four (4) plantation-era (ca. 1870s-1940s) rock clearance features (mounds) and a wall were observed and recorded. These features were associated with commercial sugar cane cultivation within the former Waiakea Cane Lots. The four mounds and wall are included under State Historic Site # 50-10-35-18670 which was designated during the original survey.

Subsurface testing was conducted at two mounds within Site -18670 to address functional, chronological, and sampling concerns. Testing confirmed plantation-era style of construction. A supplemental report for the newly surveyed area - which details the survey and testing results is included here as an attachment.

ACKNOWLEDGEMENTS

Field work for this project was carried out by Cultural Surveys Hawaii crew members Bryce Myers, Tyler Campbell, John Winieski, Tim Barr, Paul Kim and the authors. Each of us learned something new about ourselves from the *uluhe*.

Site descriptions for the report were compiled by Tim Barr. Drafting of field maps was done by Paul Kim and Joy Collins. Dr. Vickie Creed contributed her indefatigable energies and her typing and computer skills to the production of this report.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

For a period of seven days during the weeks beginning December 14, 1992 and January 5, 1993 Cultural Surveys Hawaii conducted an archaeological inventory survey of approximately 163 acres of forested land in Waiākea *ahupua'a*, South Hilo district on the island of Hawai'i (Figure 1-3). The parcel under study is located north of Waiākea Stream, *mauka* of the University of Hawaii at Hilo campus - a portion of which will be developed into 3 research and technology lots. The bed of Waiākea Stream has been rerouted recently, by mechanized equipment, probably under the name of flood control. The old stream bed is the actual south boundary of the study area, with the new stream bed farther south.

Two structures - the School of Agriculture building at the southwest corner of the study area, and the Joint Astronomy building in the central, *mauka* portion - are extant within the study area as well as portions of the access road system (Figure 4). Two sections of the new access road alignments are completed and in use, while other areas have been bulldozed although they are currently overgrown with vegetation. Large swaths have also been bulldozed around the Joint Astronomy building, across the study area in a northwest-southeast orientation for an old water main, and in a generally east-west direction for an electric power line.

Study Area Description

The study area comprises approximately 163 acres in the *ahupua'a* of Waiākea. The lands are located within the district of South Hilo on the windward coast of Hawai'i Island. The study area, located in Hilo Town on the campus of the University of Hawai'i at Hilo, is bound by Komohana Street to the west, Waiākea Stream flood control channel

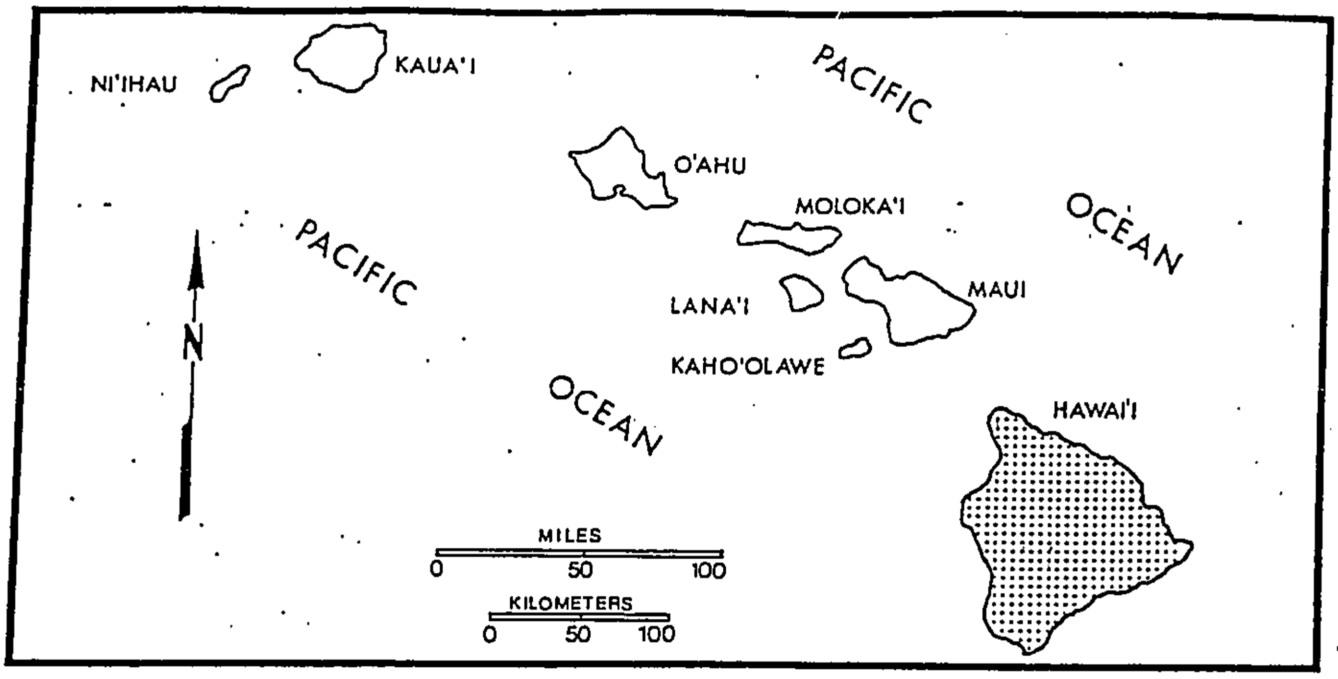


FIGURE 1
State of Hawai'i

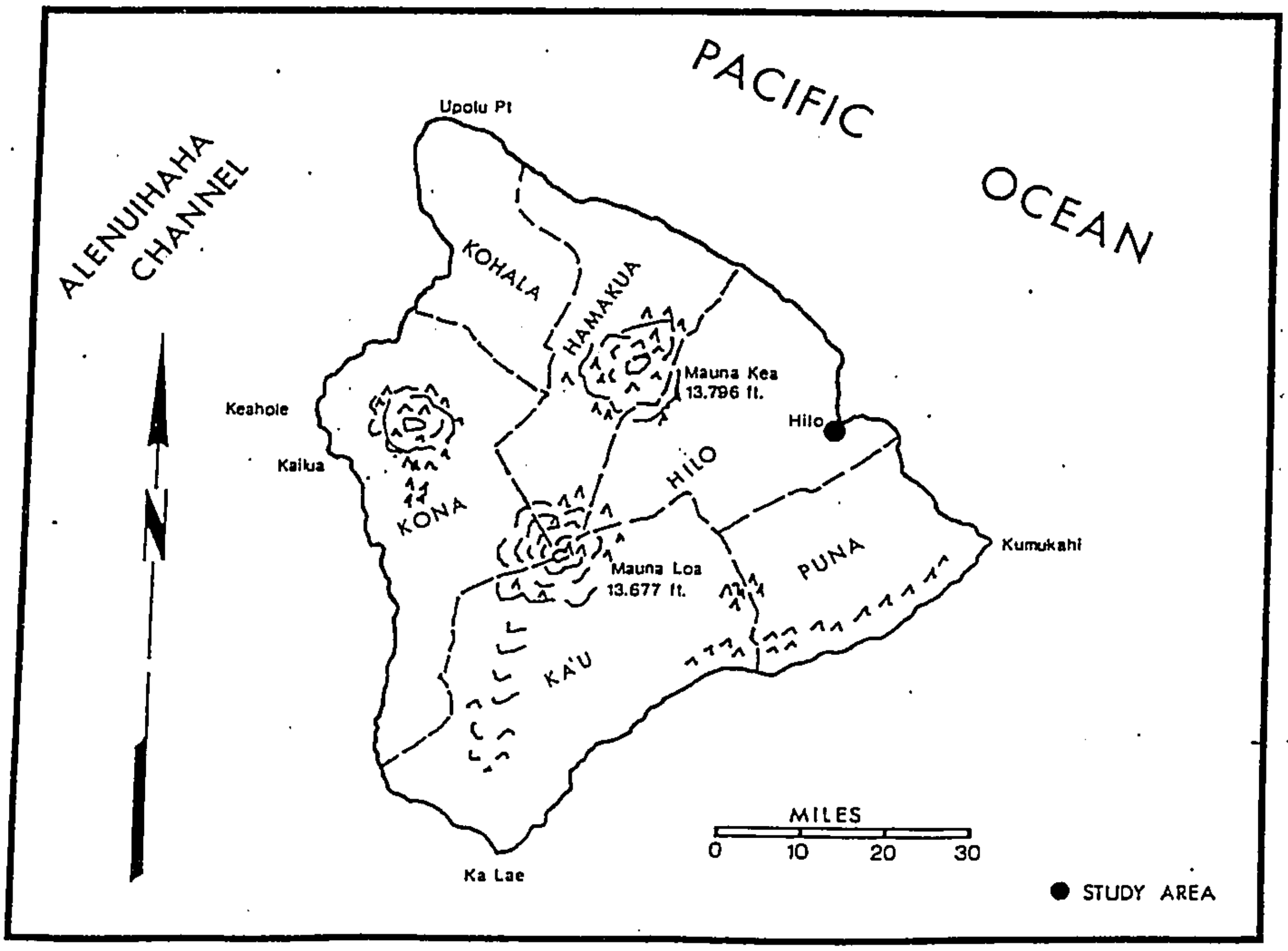


FIGURE 2
General Location Map, Hawai'i Island

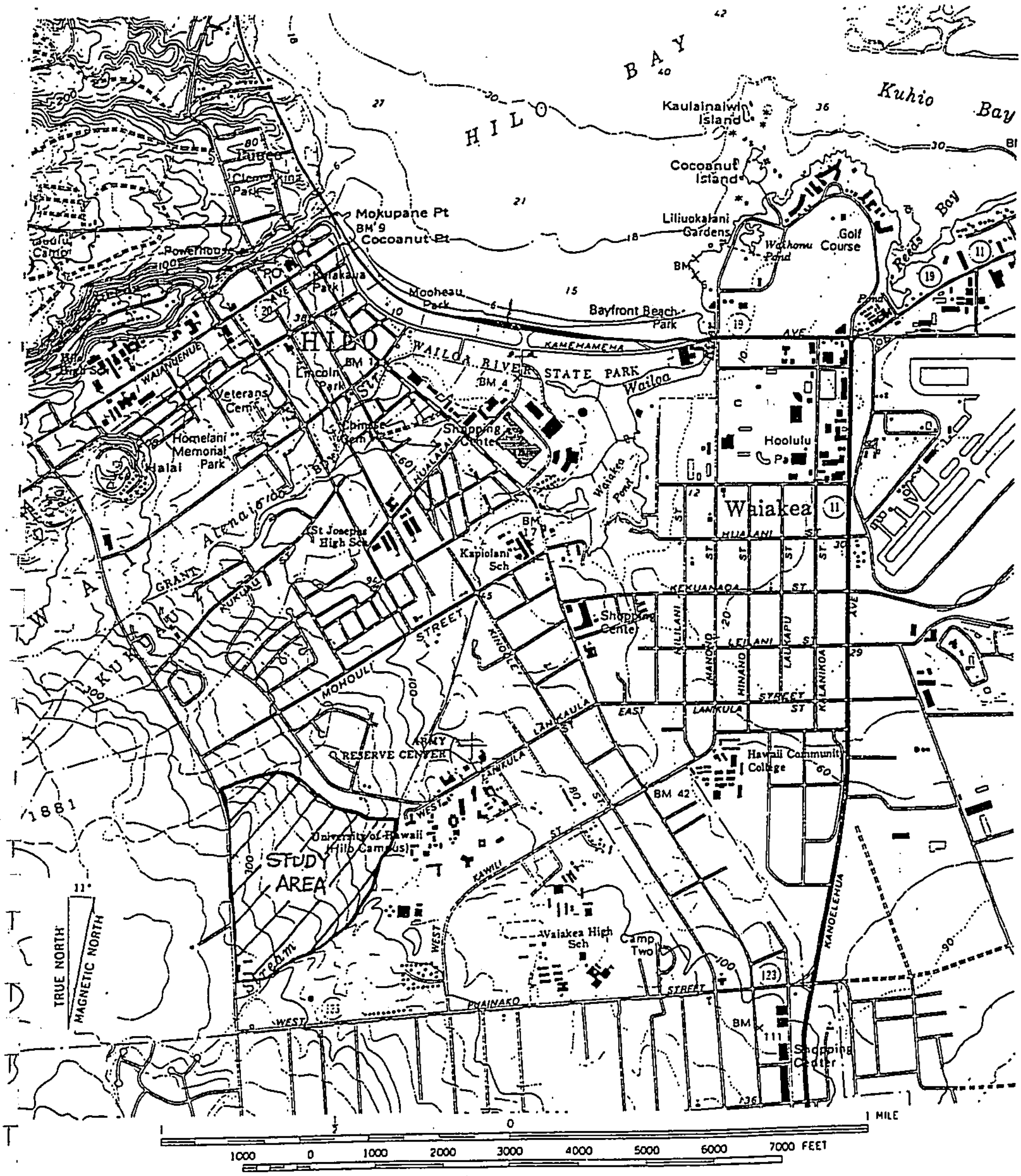


Figure 3 Portion of USGS Topographical Map, 7.5 Minute Series, Hilo Quadrangle, Showing Study Area

to the east, the old Waiākea Stream bed to the south, and a man-made drainage ditch to the north. Elevations within the study area range from roughly 140 ft. a.m.s.l. to 330 ft. a.m.s.l. on the lower east slope of Mauna Loa Volcano.

Several historic flows from Mauna Loa Volcano have affected the terrain along its eastern slope. An 1881 flow affected much of the Waiākea *Ahupua'a*, flowing into Hilo to within a mile of Hilo Bay. A part of the east end of this 1881 flow is present along the north side of the study area.

Rainfall in Waiākea *Ahupua'a* below the 5,000 ft. elevation averages 150 to 200 inches per year (Kelly et al. 1981); *makai* lands above the 5,000 ft. elevation receive an average of 30 inches of rain per year (McEldowney 1979). Waiākea Stream represents the only fresh water source within the study area.

The terrain is comprised predominately of lava flows thickly covered by vegetation. The *Soil Survey of the Island of Hawaii* (Sato *et al.*, 1973) classifies the study area lands in three basic types as follows: 1) Pana'ewa very rocky, silty clay loam, 2) Keaukaha extremely rocky muck, and 3) pahoehoe lava flow. Although lava flows predominate in the study area, vegetation is dense due to the vast amounts of rain on the windward side of Hawaii Island.

The Pana'ewa very rocky, silty clay loam occurs along the southeast side of the study area. The vegetation in this area is characterized predominately by large guava trees (*Psidium cattleianum*) with little or no understory.

The Keaukaha extremely rocky muck which covers the largest portion of the study area, occurs in the central and north sections of the study area. The vegetation is characterized by guava thicket (*Psidium cattleianum*).

The pahoehoe lava flow occurs within the western half of the study area. The vegetation is characterized by *uluhe* fern.

Development within the study area includes the aforementioned buildings; (Agriculture and Astronomy) associated parking lots, paved roads, and bulldozed swaths. In addition, a path for a water line has been cleared by bulldozing. These recent alterations to the landscape are a marked difference to the "jungle" of the rest of the study area. The speed of re-vegetation is quite evident where the bulldozed areas are in some cases barely discernible from the surrounding "jungle."

CULTURAL HISTORY

The *ahupua'a* of Waiākea, South Hilo, is large, encompassing some 95,000 acres. It extends from the coast to approximately the 6,000 feet elevation on the windward slope of Mauna Loa (Figure 4). In 1979 Holly McEldowney prepared an "Archaeological and Historical Literature Search and Research Design," as part of a "Lava Flow Control Study" (McEldowney 1979). In her report McEldowney describes five zones of land use and associated resources. The five zones, which are applicable to Waiākea, include: I. Coastal settlement; II. Upland Agricultural; III. Lower Forest; IV. Rain forest; and V. Sub-Alpine or Montaine (*Ibid.*). The zones are described below from *mauka* (Zone V) to *makai* (Zone I) or in order of ascending importance in terms of settlement patterns.

Zone V (Sub-alpine), which is defined as being above the 5,500 ft. elevation, was probably of only marginal importance in terms of land utilization during prehistoric (pre-A.D. 1776) times. As McEldowney indicates "Use of major trails, although important to settlement and land use in all zones, probably dominated the utilization of this zone" (*Op. cit*:30). Resources probably procured from this zone include birds like *nene* (geese) and *'ua'u* (petrel) for food, timber products, and possibly lithic materials. Though Waiākea extends into this sub-alpine zone it is not one of the major *ahupua'a* associated with this zone or the saddle region like Humu'ula which "cuts off" Waiākea at roughly the 6,000 foot elevation.

Zone IV (Rain Forest) is defined as ranging from 2,500 to 5,500 feet in elevation. Resources of bird feathers, medicinal plants, and possibly some timber products would have been procured from this zone with bird feathers probably of greatest importance. Habitation within this zone was probably exclusively temporary though possibly lava

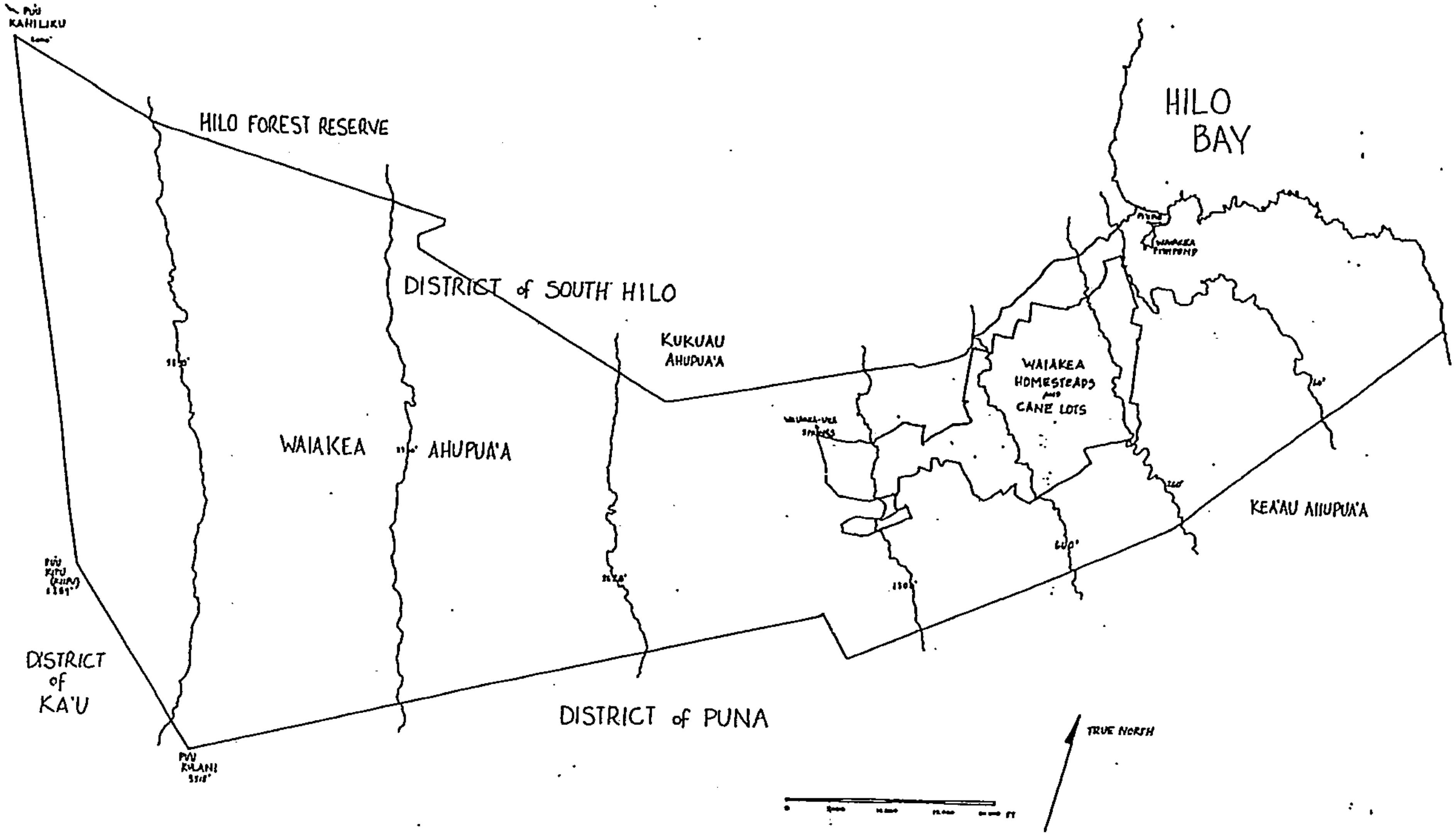


Figure 4 *Ahupua'a* of Waiakea (after USGS Topographic Map)

tubes or other site areas were utilized recurrently. In general, as McEldowney states because of "the less diversified use of this zone, and the implications of overnight visits rather than extended stays, make the overall potential for sites in this zone even lower" (i.e., compared to Zone III) (*Ibid.*).

Zone III (Lower Forest) is defined as ranging from 1,500 to 2,500 feet in elevation. McEldowney suggests that it is within this zone that the upper limits of the pre-historic farming took place. However, the main usage was probably still resource procurement of naturally occurring forest products. The farming or "supplemental food sources" would have included, "banana, wet and dry-land taro, ti, and yams (*Dioscorea* sp.) which were planted along streams and trails and in small patches of cleared forest" (*Op. cit.*:26). The forest products would have included a variety of timber, including Koa for canoes, bird feathers, dye and medicinal plants, mamaki which was used for a variety of bark cloth or kapa, *'ie'ie* for basketry, *olonā* for cordage and a source of famine type foods, such as *hapu'u.* Habitation was still dominantly temporary though recurrent use is indicated by forest cultivation and the probably tending of specific forest products such as *olonā* (*Ibid.*).

Zone II (Upland Agricultural) is defined as ranging from 50 to 1,500 feet in elevation. The zone was described by "early visitors to Hilo Bay" as "an open parkland gently sloping to the base of the woods." ... "an expanse broken by widely spaced cottages" or huts, neatly tended gardens, and small clusters of trees" (*Op. cit.:* 19).

The present study area is situated within this upland agricultural zone. Though described as a vast "expanse" it would appear that only the more agriculturally productive areas were intensively farmed. In the 1820s it was "estimated that 1/20 of the expanse (i.e., zone of cultivation) in N. and S. Hilo was planted in crops" (Goodrich 1826:4 IN McEldowney 1979:21). The reasons for what appeared to the early visitors as a "lack of more extensive planting " (*Ibid.*) include, the need for fallow periods especially in soils where nutrients are rapidly leached out, but more important to intensive agricultural use in the Hilo area is soil type or lack there of. Intensive agricultural in Zone II was focused on area with a soil mantle leaving younger exposed lava areas for plants not needing continuous care (e.g., grasses, ferns).

Habitation within the upland agricultural zone (i.e., Zone II) apparently including some permanent occupation sites but was still dominantly temporary. The description of habitations refer to "scattered huts" with adjacent "garden plots" or "cottages" with "neatly tended gardens " (*Op. cit.*: 18-19) but no descriptions of village complexes like those along the coast.

Zone 1 (Coastal Settlement) is defined as " from sea level to roughly 20 to 50 ft. elevation or 1/2 mile inland" (*Op. cit.*: 15). This zone contained the majority of the population in village settings. The Hilo Bay area, of which Waiākea ahupua'a encompasses the southern half, was described "as a nearly continuous complex of native huts and garden plots interspersed with shady groves of trees, predominately breadfruit (*Artocarpus altilis*) and coconut (*Cocos nucifera*)." (*Op cit.:16*). Additional sites mentioned included, "canoe sheds, several heiau, and large complexes catering to chiefs and their retainers" (*Ibid.*). Thus the coastal zone included virtually all of the permanent habitation sites and was the focal point of resource utilization procured elsewhere within the ahupua'a.

Based on the above zonal characterization of Waiākea the tradition or pre-contact (i.e., pre-A.D. 1776) settlement pattern included, a heavily populated coastal zone, an upland agricultural zone with forest zones beyond. The coastal zone included the village clusterings of the permanent habitations with direct access to rich and varied marine resources including fishponds, and probably the majority of agricultural production as well.

The upland agricultural zone was probably expanded into as the prime lands within the coastal zone were intensively utilized. Over time the upland agricultural zone was converted from forest to an "open parkland" where plantings occurred on soil mantled lava flows. Habitation for most part was probably temporary with a few scattered permanent occupation complexes.

Beyond the upland agricultural zone was the forest which ranged from rain forest to sub-alpine forest. In Waiākea these forest zones were quite large which allowed for extensive gathering of forest products. The products in part included, timber, especially Koa for canoes, birds, for consumption (nene, ʻuaʻu) and feathers, medicinal and dye plants, and famine type foods.

Late Prehistoric Early Historic ca. 1790-1840

The rich and varied resources that Waiākea offered made it one of the most important locales on Hawaii Island. Traditional accounts concerning Waiākea include references to it being the seat of chiefly residences as early as ca. A.D. 1550 (Kelly, Nakamura, Barrère 1981). Chiefly associations with Waiākea continued through traditional times and into the historic era. Kamehameha retained Waiākea after he had conquered all of the islands (ca. 1800), and upon " his death his personally held Hilo lands, including Piʻi-honua, Punahoa, and Waiākea, descended to Liholiho, his son and heir to the kingdom,"..additionally " Kamehameha had given the ili kupono of Piʻopiʻo to his favorite wife Kaʻahumanu" (*Op. cit.*: 11). The ʻili of Piʻopiʻo is in Waiākea and is situated between Hilo Bay and Wailoa River and its associated fishponds.

Land use during the early historic period was still essentially subsistence based though aspects of major changes were occurring. The sandalwood trade, establishment of the American Board of Commissioners for Foreign Missions (ABCFM) station in Hilo, and the arrival of whalers began the shift away from subsistence to a market based economy. Settlement was still focussed on the coastal zone as was most of the agricultural production of both indigenous food crops and newly introduced plants.

During this early historic period the Forest and Sub-Alpine Zones land use was changing also. Besides the more traditional procurement of timber products and even bird feathers for taxes (McEldowney 1979:35). Cattle, goats, and sheep were being hunted in the upper zones. These animals were introduced in the 1790s and after an imposed 10 year prohibition on their killing had spread over large portions of the interior of Hawaii Island, especially the Waimea area. However, "by the 1830s substantial amounts of hides, jerked meat, and tallow were exported from Hilo" (*Op. cit.*:36).

Mid 1800s

Traditional land tenure changed during this time span to the privatization of land ownership. Generally referred to as the "Great Mahele" privatization actually included a number of government acts from the late 1840s to the mid 1850s. The Kamehameha dynasty's control over the valuable Waiākea *ahupua'a* was evidenced in that virtually the entire *ahupua'a* became Crown Lands with the *'ili* of Pi'opi'o awarded to Victoria Kamamalu (LCA 7713:16), a granddaughter of Kamehameha I and heir to Ka'ahumanu as well.

Twenty-six (26) Land Commission Awards (LCAs) were granted within Waiākea (Figure 5). None of these LCAs are within the present study area. The LCAs were all

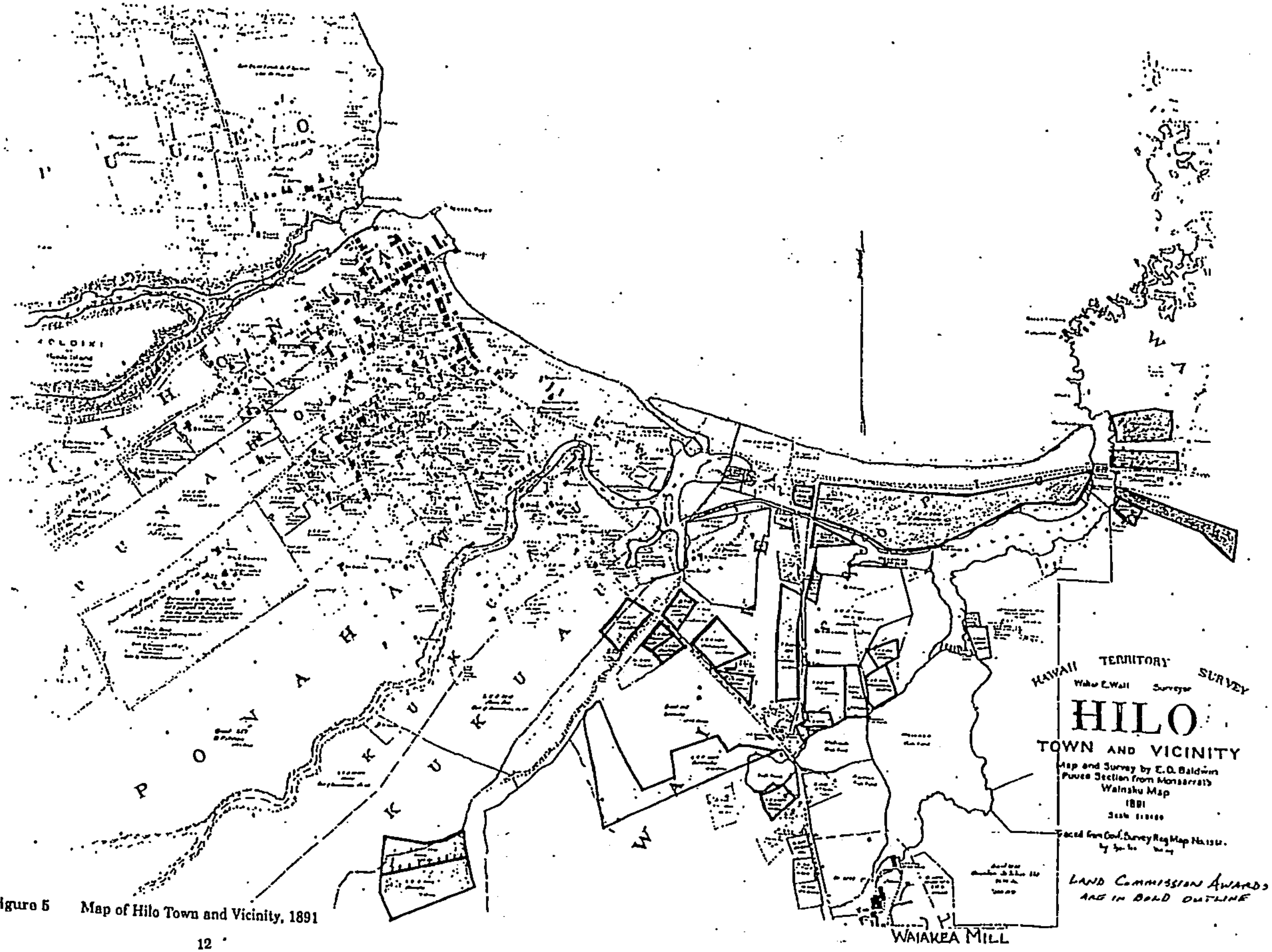


Figure 5 Map of Hilo Town and Vicinity, 1891

within the coastal zone, except for two (2663 and 2402) which were in the lower portion (i.e., ca..100 ft. a.m.s.l.) of the upland agricultural zone. The LCAs or *kuleana*(s) were for the most part focussed around the edges of the large fishponds of Waiākea. Land use information of the *kuleana* generally refer to cultivated fields with house lots indicating habitation and agricultural production within the same zone, unlike leeward Hawaii Island where in many cases *kuleana* included coastal house lots with the need of corresponding upland agricultural lots, because of elevation dependent rainfall.

Interior land use during this period was progressing toward more organized ranching, especially cattle ranching. Timber for firewood and housing was also still being exploited, as Hilo was being transformed into an entirely wooden-framed "New Bedford type Whaling Town" (*Op. cit.*:37).

Though the coastal zone still contained the vast majority of the population houses and stores were concentrated in the northern half of the bay, away from Waiākea, because the main pier for Hilo was at the mouth of Wailuku River (See Figure 5). This indicates a substantial change from the traditional settlement pattern of a "nearly continuous complex of native huts" along the bay's shoreline.

Late 1800s

During this period commercial sugar cane became the economic mainstay of the Hilo area with Waiākea Mill Company becoming one of the largest. Plantation operations generally developed ca. 1860s and for Waiākea this was on leased Crown lands. Waiākea Mill Company was in operation by the late 1870s and through its agents, Theo H. Davies and Alexander Young, had procured the lease of all of Waiākea by 1888 (Kelly, Nakamura, Barrère 1981:89). The mill was located at the head (*mauka* end) of Waiākea

Fishpond and sugar was transported by barge through the pond and down Wailoa River to Hilo Bay.

Immigrant labor (Chinese, Japanese, Portuguese) were living in "camps" set up by the plantation for its workers. Waiākea Mill Co. would eventually have some 10 camps situated along major rail lines of the plantation (Figure 6).

Land use was dominated by commercial cane activities within Zones I to III (Coast to Lower Rain Forest). Ranching became formalized though not specific to Waiākea. "Other examples of business, not directly related to sugar cultivation, were the continued use of the Waiākea fishponds, an active Chinese fish market, small pastures above Hilo supporting dairy cattle, and scattered vegetable gardens" (McEldowney 1979:39).

Early 1900s

Sugar and its associated industries continued to expand during this period. The Hawaii Consolidated Railway was built eventually extending "from Waiākea Mill and wharf through Puna, most of Ōla'a and along the N and S Hilo coast" (*Op. cit.*:41). Many of the immigrant laborers from the late 1800s moved off the plantation, being replaced by new Filipino laborers. Hilo continued to grow and become the second largest urban center in the new Territory of Hawaii.

Ranching in the Hilo areas, but not specifically in Waiākea, came under the control of two large enterprises; the Parker and Shipman Ranches. In Waiākea a large portion of Zone II (Upland Agricultural Zone) too rocky for sugar cane cultivation became available for lease as Waiākea pasture lands. The present study area is mostly former Waiākea pasture land. The specific use of the pasture land is snot known but McEldowney indicates that "A substantial amount of grazing land adjacent to Hilo or to sugarcane

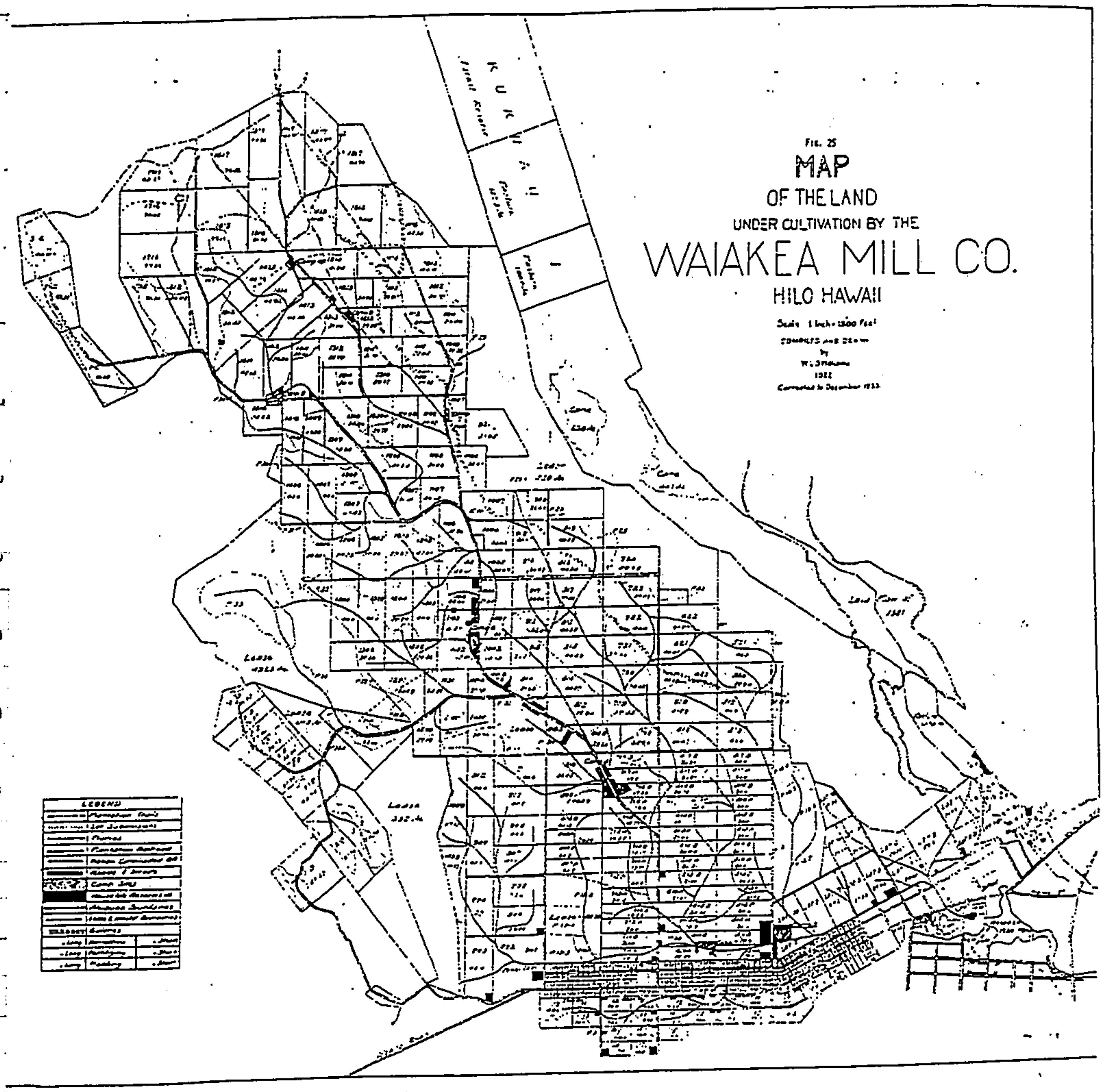


Figure 6 Waiākea Mill Co. Map ca. 1930, Showing Homestead, Cane Lots, and Camps

fields supported dairy cows for Hilo's several dairies" (*Ibid.*).

In 1918 the 30-year lease of the Waiākea Mill Co. expired and because Hawaii had become a Territory the "land fell under homesteading laws that required the government to put some of it up for lease to homesteaders who would be willing to grow sugar cane on it. Waiākea Mill was to grind the crop for them. A total of about 700 acres of land was divided into cane lots (between 10 and 76 acres each) and house lots ranging from 1 to 3 acres..." (Kelly, Nakamura, Barrère 1981:121). The present study area includes a portion of cane lot #16 (refer to Figure 6). The homestead and cane lots eventually reverted to the overall mechanized cultivation of the mill company as the homestead and cane lots "experiment was declared a failure" (*Op. cit.*:121).

By the 1920s the Waiākea Mill Co. had some 7,000 acres in cane production. Also, in the 1920s large tracts of remaining forest in Waiākea were "designated as forest reserve" (McEldowney 1979:42). The main reason appears to have been for maintaining the "forest as a 'watershed' to capture, retain, and support the continuous flow of water necessary to the sugar industry" (*Ibid.*). Clearly, sugar was the dominate economic factor during this period including the formation of settlements (i.e. camps).

Mid 1900s till present

Plantation life dominated the early portion of this time span but in 1948 Waiākea Mill Co. was liquidated (Condé and Best 1973:119). However, a major industry associated with cane by-products, canec, was begun in 1928. The canec plant was located adjacent to Waiākea Mill with bagasse, the cane by-product utilized, pumped through pipes from the mill to the plant. The canec plant shut down operations in 1966.

During this period major construction jobs started in the 1920s were completed.

These major construction jobs, in part, included Hilo Bay, wharfs and breakwater and bridges.. Some of these projects were actually major reconstruction work form damage during the winter of 1923, which included storm surf in January and a tidal wave in February (Kelly, Nakamura and Barrère 1981:171). During the World War II period in Hilo, expansion and designation of Hilo airport as General Lyman Field and the construction of the Saddle Road were major projects undertaken as part of the military presence on the island, which was very substantial.

Prior to the closing of the Waiākea Mill Co. there were at least 10 "camps" or plantation villages. Only Camp 1 was within the coastal zone with Camps 2 to 10 within the upland agricultural zone with Camp 10 the highest at ca. 1300 ft. a.m.s.l. (Refer to Figure 6). The present study area included active mechanized cane cultivation probably right up until closing (1948), and leased pasture lands. The lease of the Waiākea pasture lands during this period was to a Mr. Kazuo Miyasaki (G.L. #2751 exp. 6/17/60). Specific use of the pasture is not known, but as mentioned previously, dairy cattle pasturage is a distinct possibility.

After statehood (1959) and with the closing of the mill and canec plant, tourism was looked at as the next economic mainstay. In Waiākea, C. Brewer & Co. built a hotel complex at the site of the old canec plant. Other hotels were built along the Hilo Bay frontage of Waiākea near Coconut Island or Mokuola. Large tracts of former Waiākea Homestead and Cane lots were converted to housing or sub-division tracts adjacent to the study area. U.H. Hilo campus was expanded as it continues to do presently. The study area itself ceased to be utilized for pasturage (ca 1960s?) and recently there has been construction of the School of Agriculture building and the Joint Astronomy building.

Summary

In summary, the traditional settlement pattern included, almost exclusively, permanent coastal habitation with associated intensive agriculture. Immediately upslope of the coastal zone was an area cleared for extensions of agricultural production though not as intensively utilized as in the coastal zone. Beyond or *mauka* of the cleared upland agricultural zone was forest which ranged from dense rain forest to sub-alpine forest at the upper limit of Waiākea (ca. 6,000 feet). Habitation for the zones beyond the coastal zone was essentially temporary in nature, associated with exploitation of forest products. This pattern changed over time as the historically introduced religion(s), economy, and socio-political system replaced the traditional Hawaiian system. The major impetus for change was the development of commercial sugar cane within Waiākea. Settlement patterns during the period from the mid 1800s to the mid 1900s were almost exclusively set by the Waiākea Mill Co. Camps for immigrant laborers were constructed at specific locations based on the plantation organization. Most of these permanent housing locations were in areas previously associated with sparsely scattered temporary habitations in the upland agricultural zone of Waiākea. Because most of the study area was too rocky (i.e. exposed pahoehoe) for commercial cane, associated camps were not present. It appears that historically most of the study area was utilized as pasture land.

Hilo eventually became the second largest urban center in the State of Hawaii. Permanent housing is no longer dependent on a specific set of environmental conditions as it was during traditional Hawaiian times. The large acreage involved in subsistence agriculture and utilization of resources specific to certain elevations is no longer a necessity because of the market-based economy of today.

PREVIOUS ARCHAEOLOGICAL RESEARCH

There have been a number of archaeological and historic studies that are pertinent to the *ahupua'a* of Waiākea within which the study area lies. Notable among these somewhat regional studies are, Alfred E. Hudson's 1930s East Hawaii Site Survey, Holly McEldowney's "Archaeological and Historical Literature Search and Research Design, Lava Flow Control History," and "Hilo Bay: A Chronological History" (Marion Kelly, Barry Nakamura and Dorothy B. Barrère 1981). Review of these documents, and others, indicated that no previously documented sites with state site numbers were located within the present study area. These regionally oriented studies, however, were the basis for describing the settlement pattern specific to Waiākea *ahupua'a*. The discussion of settlement patterns is contained within Cultural History section of this report.

Additionally, a "Summary of Prior Archaeological Work" compiled by Ms. Jadelyn J. Moniz (1992) for Waiākea list ten studies ranging from field inspections to inventory surveys. The studies include research from 1979 to 1992. The description of each of the ten previous studies includes a basic review of findings and relating "adequacy" for the individual reports in terms of inventory level survey," based on Title 13, Subtitle 6, Chapter 147: Rules Governing Minimal Standards for Archaeological Inventory Surveys and Reports" (Moniz 1992).

The following discussion of previous research will focus on work specifically related to the present study area (Figure 7).

There have been no previous inventory-level archaeological surveys specific to the current study area. However, "field inspections" and a reconnaissance-level survey for the proposed Puainako Street Extension (Hunt, 1992) indicate the presence of archaeological sites in an area adjacent to the present study area.

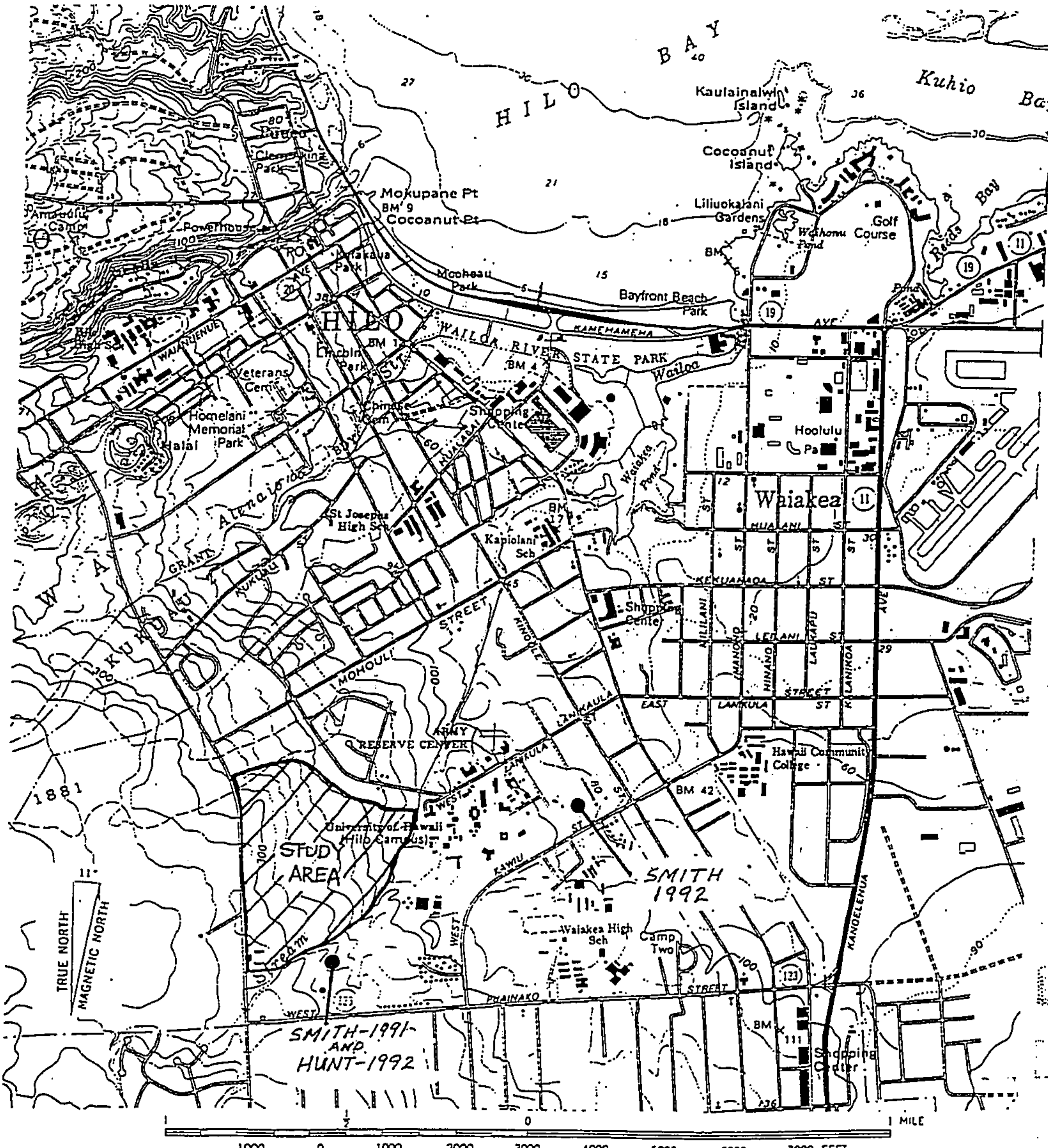


Figure 7 Portion of USGS Topographic Map, Hilo Quadrangle Showing Areas of Study Adjacent to the Present Project Area

Field inspections were conducted by Mr. Marc Smith, a staff member of the State Historic Preservation Division of the Department of Land and Natural Resources (SHPD/DLNR). The locations of the inspections include portions of the present study area and an undeveloped lot (Waiākea Cane Lots) abutting Ululani St.

Field inspections in to the present study area were conducted in October 1991. The impetus for these inspections were "calls from concerned students and faculty of University of Hawaii-Hilo about the possible presence of historic sites in the proposed Research & Technology Park" (SHPD/DLNR 5/7/92). Marc Smith conducted three separate field checks, October 18, 24, and 27, 1991. Observed during the field checks were a number of historic sites including "large faced platforms, modified outcrops, enclosures which may be house sites, and a large walled enclosure" (Smith 11/8/91).

Additionally, Smith noted three different lava flows in the area. The flows include: 1) a portion of the 1881 Mauna Loa pahoehoe flow; 2) a pahoehoe flow "dating to 1.5 - .75 KA (1,500 to 750 B.P)"; and 3) the oldest flow which has "a more level soil surface" and dates to ">4,0 KA (greater than 4,000 B.P.)" (*Ibid.*). The lava-flow age determinations are based on work by Lovelace as referenced in Marc Smith's letter.

The age of the flows has a direct correlation to site distribution. The only sites observed were "on the >4,000 year old flow," except one site which "appears to be constructed along the margin of the 1,500-to-750-year-old flow, suggesting others may exist" (Smith 11/8/91). Based on the field checks it was recommended that an inventory survey be conducted for the proposed area of the construction of utilities.

In December 1991 Marc Smith (SHPD/DLNR) conducted a field inspection for the proposed Department of Water Supply Office project site. The project area, bounded by Ululani, Kawili, and Kapiolani Streets, is located within the former "Waiākea Cane Lots" with "apparently the same soil type and flow underlying archaeological site types recorded above the University of Hawaii Hilo in the proposed Research and Technology Park" (Smith, 1/3/92). Observed within the parcel were "several stacked stone walls and linear mounds, ... a large rectangular enclosure ... several wall remnants and C-shapes" (*Ibid.*). An inventory level survey was recommended prior to any land disturbance.

The survey for the proposed Puainako Street Extension (Hunt 1992) covered an area approximately 150 ft. wide from the 200 to 1500 feet in elevation, through "multiple *ahupua'a* including Waiākea, Kukuau 1 and 2, and a small part of Ponohawai" (*Op. cit.*:5). A total of 48 sites were observed and recorded. Site types included "walls, mounds, platforms, and faced terraces" (*Op.cit.*:9). The highest concentration of sites is "in one area... Alternative B (Lower section) near the University of Hawaii-Hilo" (*Op.cit.*:11). This cluster of sites, which "appear to be associated with Hawaiian occupation and cultivation along the intermittent drainage during prehistoric and historic times" (*Ibid.*)[1], includes some of the same sites observed by Marc Smith during his field inspections of the proposed Research and Technology Park (Smith 11/8/91). The sites are situated within the former Waiākea Cane Lots and also appear to be on the same soil-mantled lava flow (i.e., >4,000 B.P.) as described by Marc Smith (Smith 11/8/91 and 1/3/92).

Based on the field checks by Smith and survey by Hunt, the site distribution (including that within the present study area) correlates to the lava-flow ages. The three different ages and relative degrees of soil development include: 1) a small portion of the 1881 flow with no soil cover or development; 2) the 1500-to-750-year-B.P. pahoehoe flow with no soil or weathering-related development but with some pockets of organically derived soil (i.e., leaf litter) - this flow covers the majority of the study area; and 3) the soil-mantled >4,000- year B.P. flow. Archaeological sites within and near the present

[1] Additional survey and archival findings showed all sites to be plantation era structures (Hunt 1994)

study area are confined to the oldest, soil-mantled flow associated with the former Waiākea Cane Lots. Site types, function and probable ages have ranged from agricultural mounds and platforms, habitation enclosures, and platforms with both prehistoric- and historic-era usage hypothesized.

Based on the information gathered from the field inspections and reconnaissance-level survey discussed above, three expectations regarding site distribution in the current study area can be stated. First, the 1881-flow portion of the study area would contain no sites. Second, the 1500-to-750-year-old pahoehoe flow comprising the majority of the study would contain few sites concentrated along the perimeter or edge of the flow. Third, the oldest flow would contain a higher site density with the understood possibility that earlier (i.e., prehistoric) sites might have been altered for commercial sugar cane cultivation.

SURVEY RESULTS

Methodology

The study area was surveyed by traversing the property on foot. The dense vegetation in disturbed areas was a seriously inhibiting factor in visibility, horizontally as well as of the actual ground surface.

The most difficult vegetation to survey through was *uluhe* or false staghorn fern which predominated in the western portion of the study area especially between Komohana Street and the existing "Road B" alignment that extends to the south of existing "Road A" as a previously bulldozed strip. Range of the *uluhe* conforms closely with the reconnaissance soils type of rLW or pahoehoe lava, and with the mechanically disturbed areas. North-south traverses were pushed through the forest north of "Road A" (Figure 8), and east-west traverses through the triangular parcel delineated by Komohana Street, "Road A", and the previously bulldozed powerline easement. The *uluhe* covers as much as 70 percent of this area *mauka of the "Road B"* alignment.

Roughly east-west traverses were walked through the remaining land east or *makai* of "Road B" and north of the powerline easement. The existing "Road A" and the powerline easement were used to guide on through the dense stand of strawberry guava (*Psidium cattleianum*) which covers this portion of the study area. The trees grow on the average less than 12 inches apart making passage extremely difficult, but are only one to 4 or 5 centimeters thick and visibility is surprisingly good. One can see a minimum of 20 to 30 feet horizontally and the ground underfoot is clear except for leaf litter and sphagnum moss on the unweathered pahoehoe lava of low undulating topography.

East-west traverses were also made through the lands south of the powerline easement, which completed the coverage of the entire study area. The undeveloped

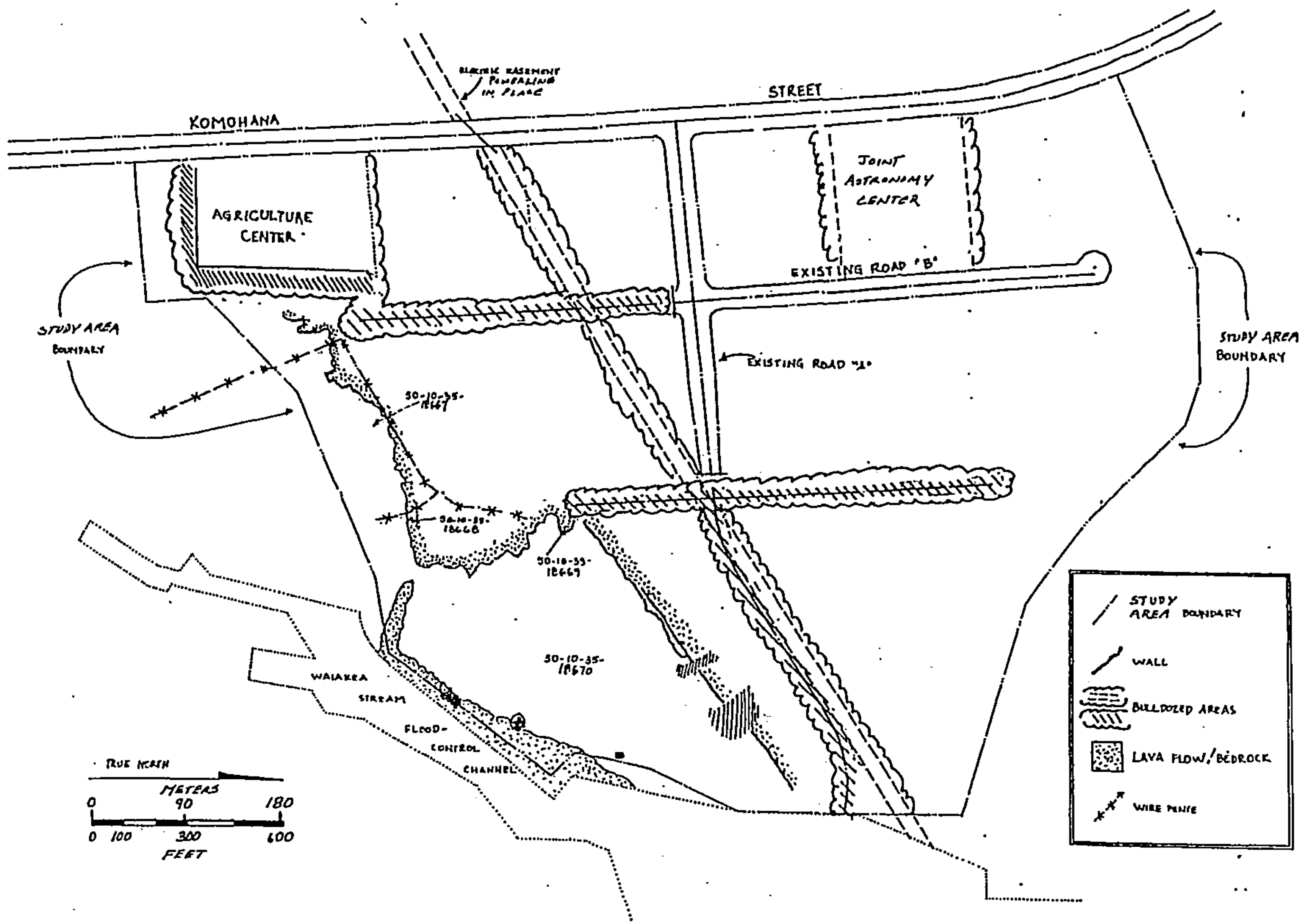


Figure 8 Study Area, Showing Existing Roads, Powerline Easement and Areas of Previous Bulldozing

portion of this land between Komohana Street, the powerline, and the bulldozed extension of the "Road B" alignment is covered with *uluhe*. The undeveloped southern extension of "Road B" and a portion *makai* have been bulldozed and since revegetated. Going *makai* on the south side of the powerline the ground underfoot changes to the undisturbed, little weathered pahoehoe lava supporting the strawberry guava thicket, and visibility of the ground becomes good again.

Traverses througout the study area were done by two to six individuals at intervals from one another of 20 feet to 100 feet depending upon vegetation.

Test excavations were done and the testing process included: pre-excavation photographs, removal of rocks from the specified test unit; excavation of soil by natural stratigraphic layer (or 10 cm. level within natural strata); screening of all soil sediments through 1/8" mesh screen; recovery of all cultural material (artifacts, midden, charcoal); one profile and stratigraphic description per unit; post excavation photographs; and reconstruction of test unit locale.

The site of the existing School of Agriculture is at the southwest corner of the study area. The Waiakea Stream floodplain and its associated alluvial sediments extends along the southern study area boundary widening to *makai*. This is the old sugarcane field and vegetation here is larger guava trees with almost no understory. As much as 90 percent of the ground is bare with excellent visibility.

Fieldwork

The archaeological survey and testing located archeological sites in the southern portion of the study area. Four sites were described and mapped to scale. Two of the sites - 18668, and 18669 - and a mound-feature within a third site - 18667 - were tested by hand excavations to document stratigraphy in the sites and to search for cultural remains to help in dating the sites.

The larger of the sites are two (2) expansive historic, agricultural fields (sites -18667 and -18670) bounded by low rock walls and fences that follow the natural boundaries of stream bank and unweathered lava flow (Figure 9). Field-rock clearing mounds are dispersed throughout both fields. The two other sites identified were assigned State site numbers 18668 and 18669 and were tested by excavation. These latter two sites each have a low wall defining their interiors and have historic bottles on the surface within the sites. The sites and the test excavation results are described in detail in the following *Site Descriptions section.*

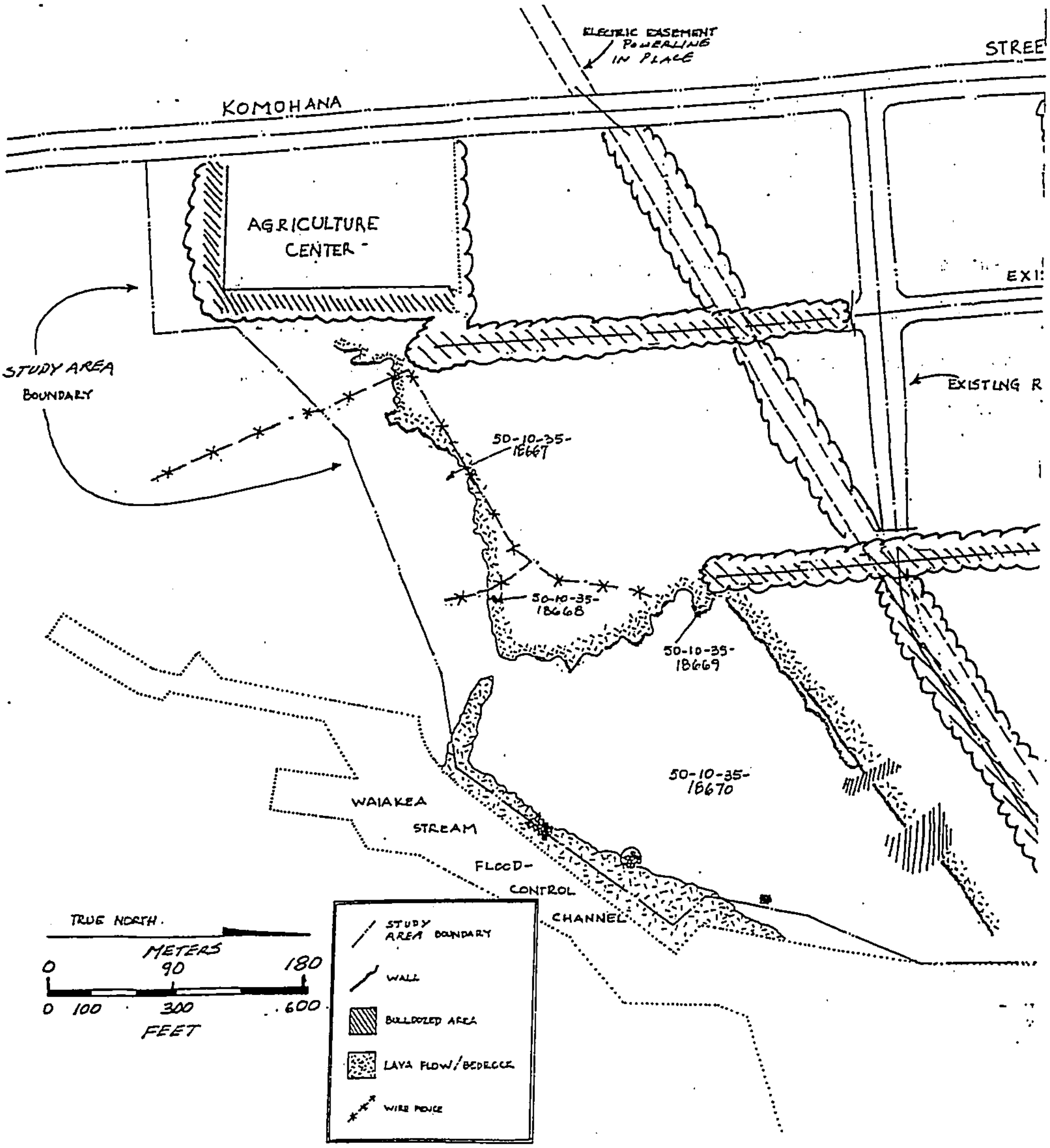


Figure 9 Portion of Study Area Showing Archaeological Sites

SITE DESCRIPTIONS

The table below summarizes the basic site information. It is followed by a detailed description of sites.

Table: Site Summary of Survey Area

State Site #50-10-35-	CSH Site #	Site Type	Function	Signi-ficance	Age	Recommen
18667	10	Field Complex	Agriculture	D	Historic	NFW
18668	11	Enclosure	20 century camp	D	1900s	NFW
18669	40	Enclosure/Wall	Lunch station	D	1900s	NFW
18670	12&13	Field	Agriculture	D	1900s	NFW

D - Site may be likely to yield information important in prehistory or history
NFW - No Further Work

CSH Site: 10

State Site # 50-10-35-18667
Site Type: Field Complex
Function: Agriculture
Features (#): 3
Dimensions: 6500.0 m^2 (21325.2 ft^2)

Description: Site 18667 (Figure 10) is a large area consisting of two discontinuous and separate walls and numerous (approx. 25) mounds. The site is located in the southwest corner of the study area and Feature A, a wall, in part runs along the study area boundary. To the south of Feature A, outside of the study area, there is what appears to be an old stream gulch. A large undulating expanse of guava forested terrain lies to the north of Feature A - dotted intermittently by mounds (Feature B). Feature C is a wall

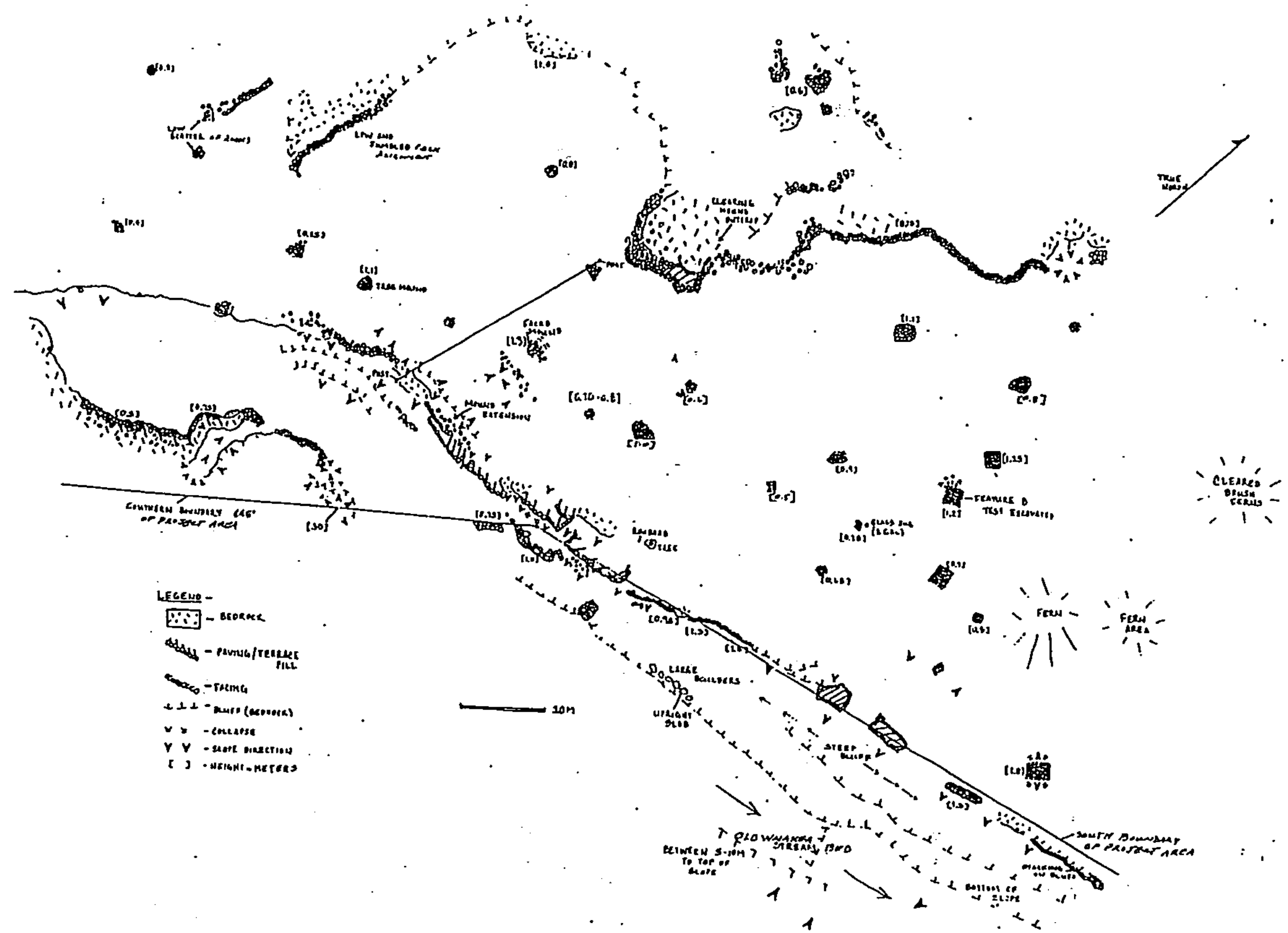


Figure 10 State Site 50-10-35-18667, Plan View

which runs roughly parallel to Feature A but is generally more discontinuous and in poorer condition than Feature A. Feature C lies between 40-60 m. (131.2 ft. to 196.8 ft.) to the north of Feature A. The mounds are located between the walls.

Feature A is a long and discontinuous wall which runs along the upper bank of the old stream gulch. Feature A is oriented roughly northeast/southwest. The entire length of Feature A measures approximately 140.0 m. (459.2 ft.). The wall is generally well-faced to the downslope side, toward the stream. Facing in these sections measures to a maximum height of 1.5 m. (4.9 ft.). Several constructed breaks exist along the wall and appear to serve as pathways through the wall to the stream. Toward the northeast end of the feature the wall becomes thicker and resembles narrow platforms or "ramparts." The wall varies in width from 1.0 m. (3.3 ft.) to 3.0 m. (9.8 ft.) at the "ramparts."

Parallel sections of wall lie to the south of Feature A. One parallel section is located at the southwest end of Feature A in the stream bottom and runs approximately 35.0 m. (114.8 ft.) long, at a distance of 10.0 m. (32.8 ft.) south of Feature A. A second parallel section is located approximately midway along the length of Feature A. This section measures 10.0 m. (32.8 ft.) long and is nearer the top edge of the stream bank.

No midden or artifacts were observed.

Feature A is in fair condition and excavation potential is poor.

Feature B comprises approximately 25 mounds - located primarily between Features A and C. The mounds vary in both size and formality of construction. Several of the larger mounds are well-faced and measure up to 4.0 $m.^2$ (43.0 $ft.^2$). The mounds are arranged randomly; they do not appear to be aligned in rows. The mounds of Feature B range in height from 0.6 m. (2.0 ft.) to 1.4 m. (4.6 ft.). Feature B mounds are probably agricultural clearing mounds.

No midden or artifacts were observed.

The mounds of Feature B are in fair condition and excavation potential is poor (see **Testing Results** and Figure 11).

Feature C is a second wall feature located to the north of Features A and B. Feature C runs roughly northeast/southwest, but unlike Feature A, this wall follows the edge of a pahoehoe flow. Pahoehoe outcropping connects the discontinuous segments of Feature C. The construction of Feature C is poor compared to Feature A and less vertical facing was observed. Feature C measures approximately 70.0 m. (229.6 ft.) long and ranges in width from 1.0 m. (3.3 ft.) to 2.0 m. (6.6 ft.). The heights range from 0.4 m. (1.3. ft.) to 1.0 m. (3.3 ft.).

No midden or artifacts were observed.

Feature C is in poor condition.

Site 18667 complex is agricultural in function, but the age of the site is difficult to determine. However, based on historical information concerning field boundaries of the Waiākea Mill Co. it would appear that this complex represents sugar cane cultivation practices.

Testing Results

Subsurface testing was conducted at Site 18667, Feature B (See Figure 11), in an effort to better interpret site function. A 1.0 by 1.5 m. trench was placed in a single mound of Feature B. The excavation demanded that the mound be disassembled. No

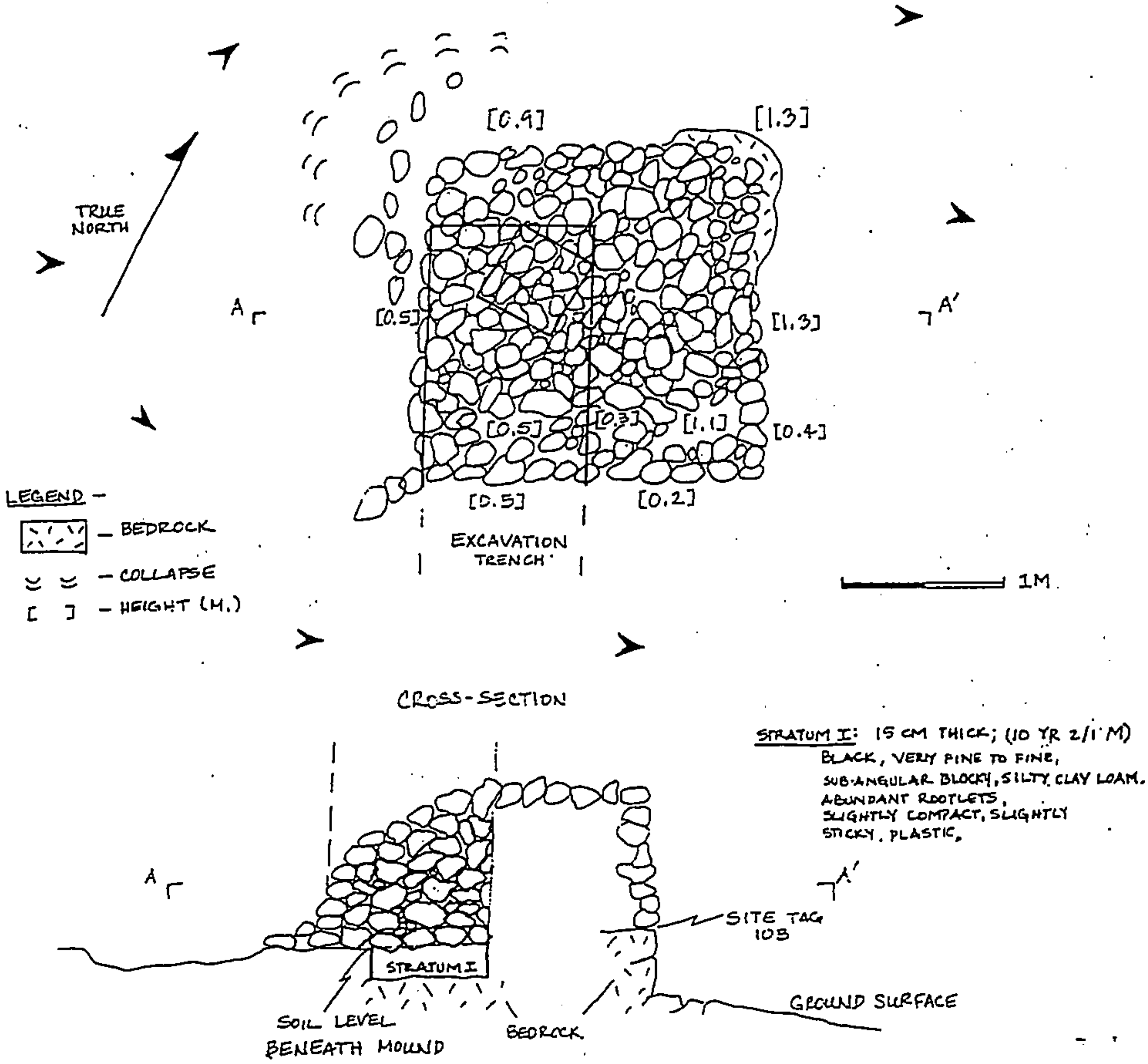


Figure 11 Site 50-10-36-18667 Feature B, Plan View of Mound (Top), and Cross Section Showing Stratigraphic Relationship of Rock Mound to Sediments (Bottom)

midden or artifacts were encountered through the mound construction. At the base of the mound was exposed bedrock and soil. The excavation continued through the 15 cm. thick deposit of soil (Stratum I) until bedrock was encountered there also. Stratum I (Munsell 10 YR 2/1 black) consisted of very fine to fine subangular, blocky, firm, slightly compact and sticky, silty clay loam. No midden or artifacts were observed. The mound was reconstructed subsequent to recording the excavation data. The excavation confirmed the rock clearing functional interpretation.

State Site #:	50-10-35-18668	**CSH Site #:** 11
Site Type:	Enclosure	
Function:	20th century camp	
Features (#):	1	
Dimension:	24.0 m.^{2} (258.2 ft.^{2})	

Description: Site 50-10-35-18668 (Figure 12) comprises an oval enclosure and adjacent L-shaped wall segment located on the edge of undulating pahoehoe terrain. In the site area, there are shallow soil deposits supporting moderately dense strawberry guava trees, ferns, three mango trees, and one royal palm tree.

The enclosure is a single course alignment of pahoehoe stones measuring 4.0 m. (13.1 ft.) N/S by 3.0 m. (9.8 ft.) E/W. The height of the alignment above the ground surface measures 0.1 m. (0.3 ft.). A pahoehoe outcrop ridge is located to the northeast of the enclosure and is approximately 1.0 m. (3.3 ft.) high. See **Testing Results** below.

The adjacent L-shaped wall segment lies directly south of the enclosure. The long leg of the wall measures 2.4 m. (7.9 ft.) long N/S and the short leg of the wall extends 1.8 m. (5.9 ft.) to the west from the long leg's south end. The wall measures 0.4 m. (1.3 ft.) thick and (2 to 3 courses) 0.8 m. (2.6 ft.) high, maximum.

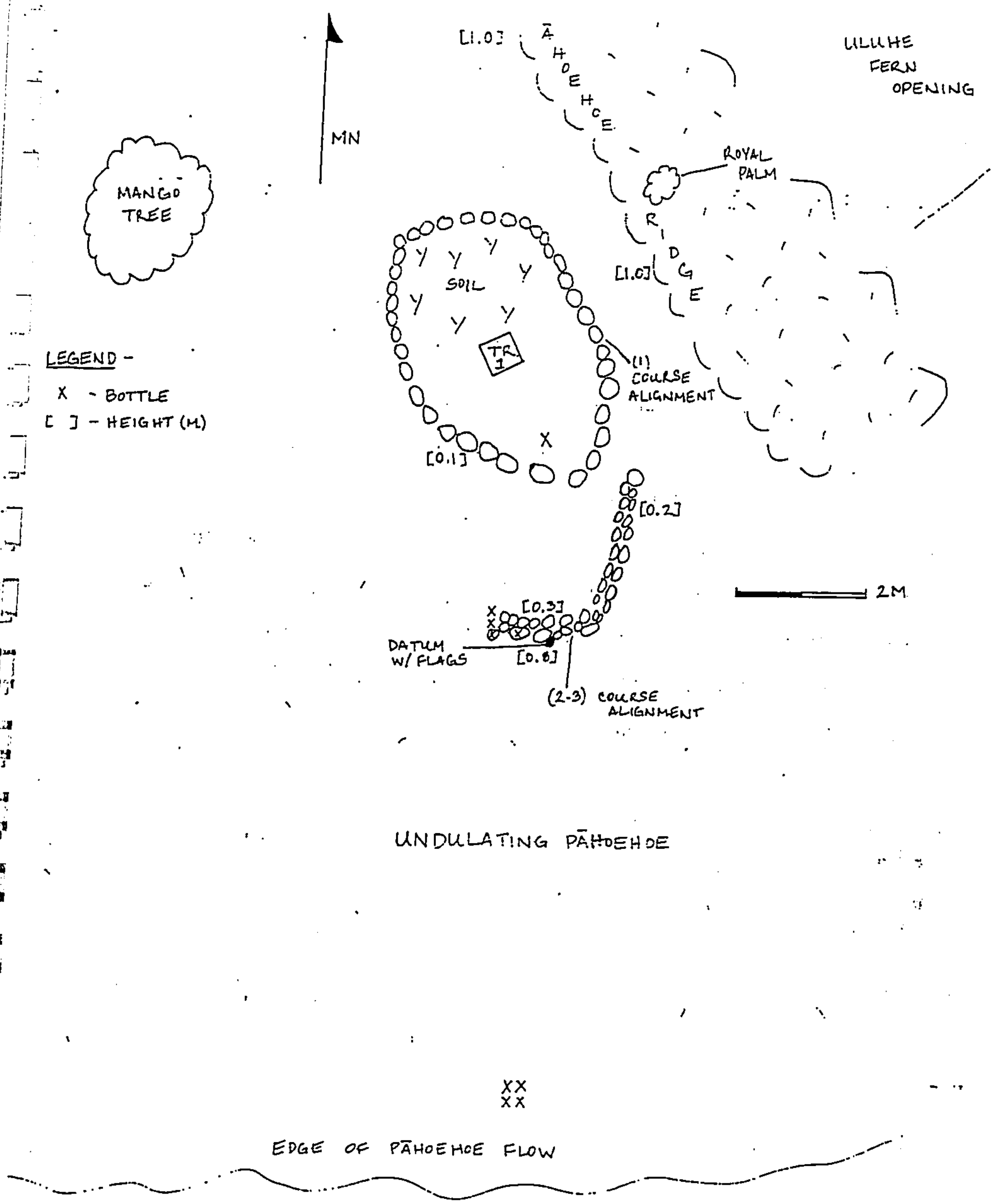


Figure 12 Site 50-10-35-18668, Plan View Showing Excavation Unit

No indigenous artifacts or midden were observed. Several clear and brown liquor glass bottles were observed at this site.

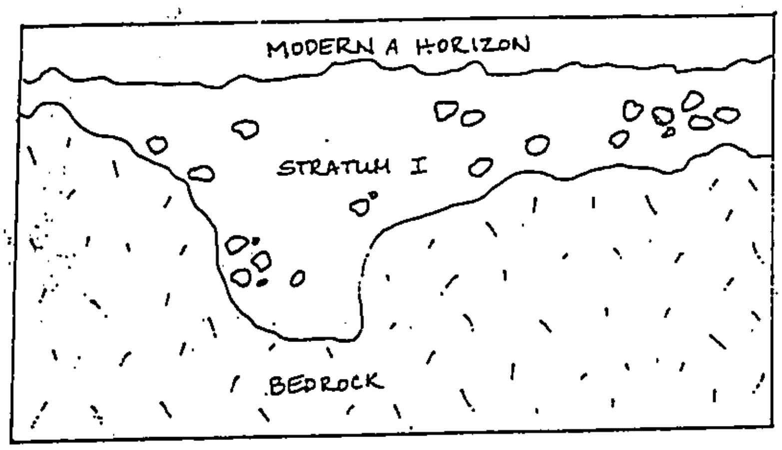
Site 18668 is probably a temporary camp with the oval single course alignment representing the perimeter of a tent pitching site.

Testing Results

Subsurface testing was conducted at Site 18668 (Figure 13). A single 0.5 m. by 0.5 m. trench was placed in the center of the enclosure. The trench was excavated through 4 cm. of modern forest litter and through Stratum I to a maximum depth of 25 cm., where bedrock was encountered. Stratum I measured between 4 to 25 cm. below the ground surface. Stratum I consisted of a dark brown to black, compact, moist, silty clay. The soil was organized into small (5 mm. diameter) peds or grains. There was high root and rootlet intrusion. Approximately 10% of Stratum I consisted of small pahoehoe cobbles. No cultural material was observed in this trench.

State Site #:	50-10-35-18669		**CSH Site #:** 40
Site Type:	Site complex		
Function:	Lunch station		
Features (#):	2		
Dimension:	224 m.^{2}	(2409.9 ft.^{2})	

Description: State site 18669 (Figure 14, top) is a site comprised of an enclosure and a wall segment, designated Features A and B. The site is located in gently sloping terrain of moderately deep soil deposits. Vegetation at the site includes guava, ti, royal palm, and hibiscus.



STRATUM I: 25 CM. THICK; BLACK-DARK BROWN, COMPACT, STRUCTURELESS, MOIST, ROOTS AND ROOTLETS ABUNDANT, 10% COBBLE INCLUSION; NO CULTURE

Figure 13 State Site 50-10-35-18668, Trench 1 Profile: East Face

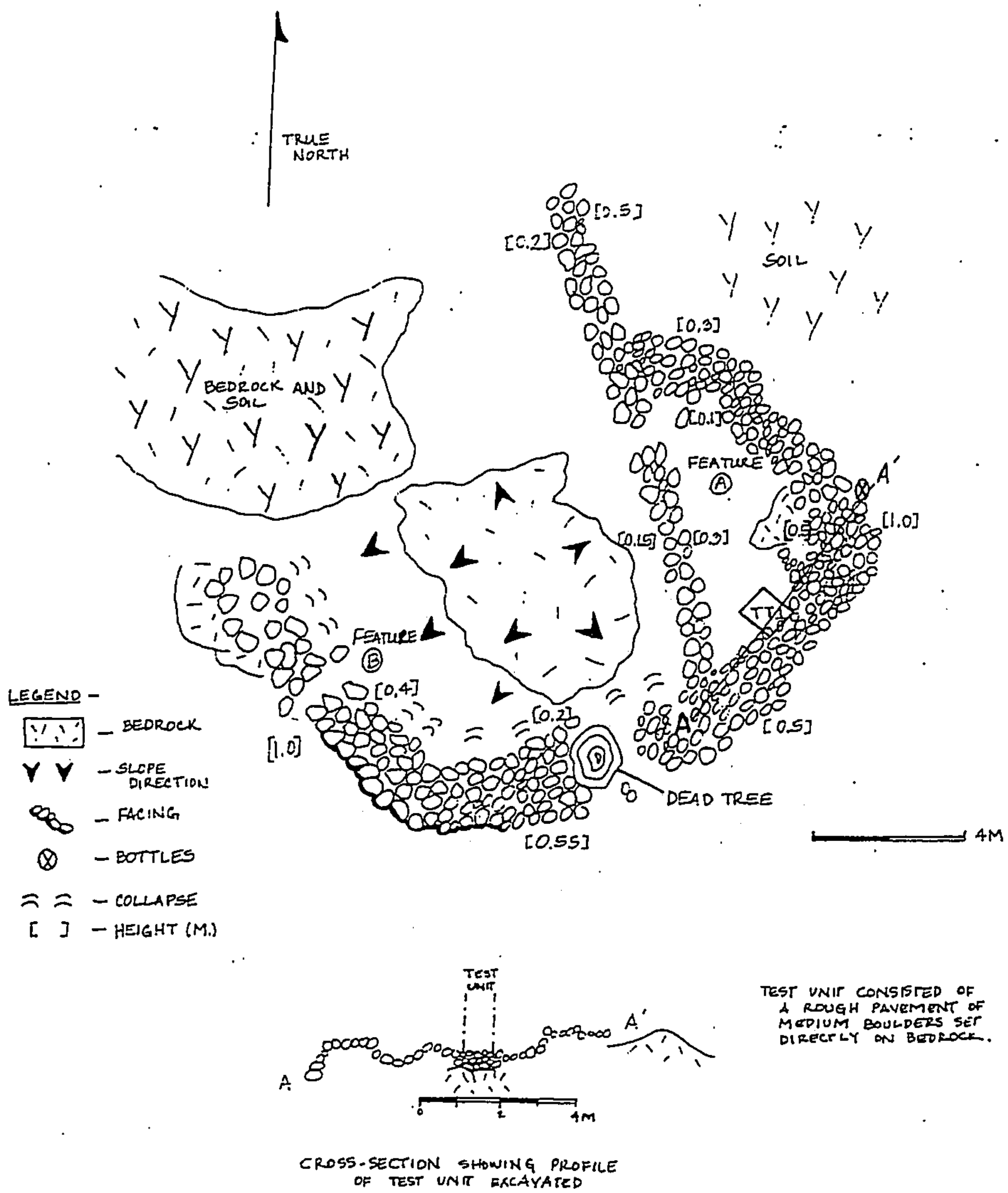


Figure 14 Site 50-10-35-18669, Plan View and Cross Section Showing Excavation Unit

Feature A is a rough, irregular, modified outcrop enclosure, measuring 11.0 m. (36.1 ft.) N/S by 6.4 m. (21.0 ft.) E/W. The walls of this enclosure are generally thick, measuring 1.8 m. (5.9 ft.) maximum, and 1.0 m. (3.3 ft.) average. A maximum wall height of 1.0 m. (3.3 ft.) is measured at the south exterior side of Feature A. The interior of the enclosure consists of a shallow soil deposit covering bedrock. At the north end of the west wall there is a constructed break measuring 0.75 m. (2.5 ft.). A 4.0 m. (13.1 ft.) long wall extends to the northwest off of the north corner of Feature A. See **Testing Results** below.

Feature B is a wall extension contiguous to the southwest corner of Feature A. The wall extends west for 6.0 m. (19.7 ft.) then doglegs to the north for an additional 2.3 m. (7.5 ft.). The wall measures 2.0 m. (6.6 ft.) thick, and 1.0 m. (3.3 ft.) high. A pahoehoe outcrop lies between Features A and B.

No midden was observed but Soda bottles, three railroad ties, and barbed wire were present at this site.

Site 18669 is in fair condition.

Testing Results

Subsurface testing was conducted at Site 18669, Feature A (Figure 14, bottom). A single 1.0 m. by 0.8 m. trench was placed in Feature A, against the south wall, near a concentration of 7 "Pacific Sodaworks" bottles. A single soil layer was present, Stratum I, which ranged in depth from 10 to 25 cmbs. Stratum I consisted of a very dark brown (Munsell 10YR 2/2) silty clay soil, slightly compact, and organized into small blocky grains or peds. No cultural materials were observed.

State Site #:	50-10-35-18670	**CSH Site #:** 12&13
Site Type:	Field	
Function:	Agricultural	
Features (#):	1	
Dimension:	36.0 m.^{2} (387.3 ft.^{2})	

Description: Site 50-10-35-18670 (refer to Figure 9) is a remnant of a commercial sugar cane agricultural field. This site is defined by a pahoehoe lava flow to the north and west by a stream gulch to the south. The lava flow and stream gulch converge at both *mauka* and *makai* ends of the site area, resulting in an "almond" shape. The site is generally level with undulations following the pahoehoe substrate. The field area has a substantial soil deposit and moderately dense guava and fern vegetation. There are also some isolated royal palm trees in areas where pahoehoe bedrock is exposed

The site area is characterized by long, shallow, and narrow furrows, oriented generally north/south (cross-slope). This cross-slope orientation of the furrows suggest that contour plowing to reduce erosion was being utilized. The furrows measure, from trough to trough, 1.4 m. (4.6 ft.) wide and 0.2 m. (0.7 ft.) deep.

Within the site area there are subfeatures indicative of rock-clearing activity. One subfeature is a square enclosure located in level pahoehoe lava terrain (Figure 15). The enclosure measures 7.0 m. (23.0 ft.) N/S by 6.5 m. (21.3 ft.) E/W. The north and south sides of the enclosure are natural, raised pahoehoe outcrop ridges, measuring 0.7 m. (2.3 ft.) high. The east and west sides are constructed of pahoehoe boulders and cobbles, measuring 0.8 m. (2.6 ft.) thick and to a maximum height of 0.55 m. (1.8 ft.). A constructed break in the west wall measures 1.2 m. (3.9 ft.) wide. Three royal palms are growing within the enclosed area. A single plastic milk crate (Foremost 1979) was observed 3.4 m. (11.2 ft.) to the south of the enclosure.

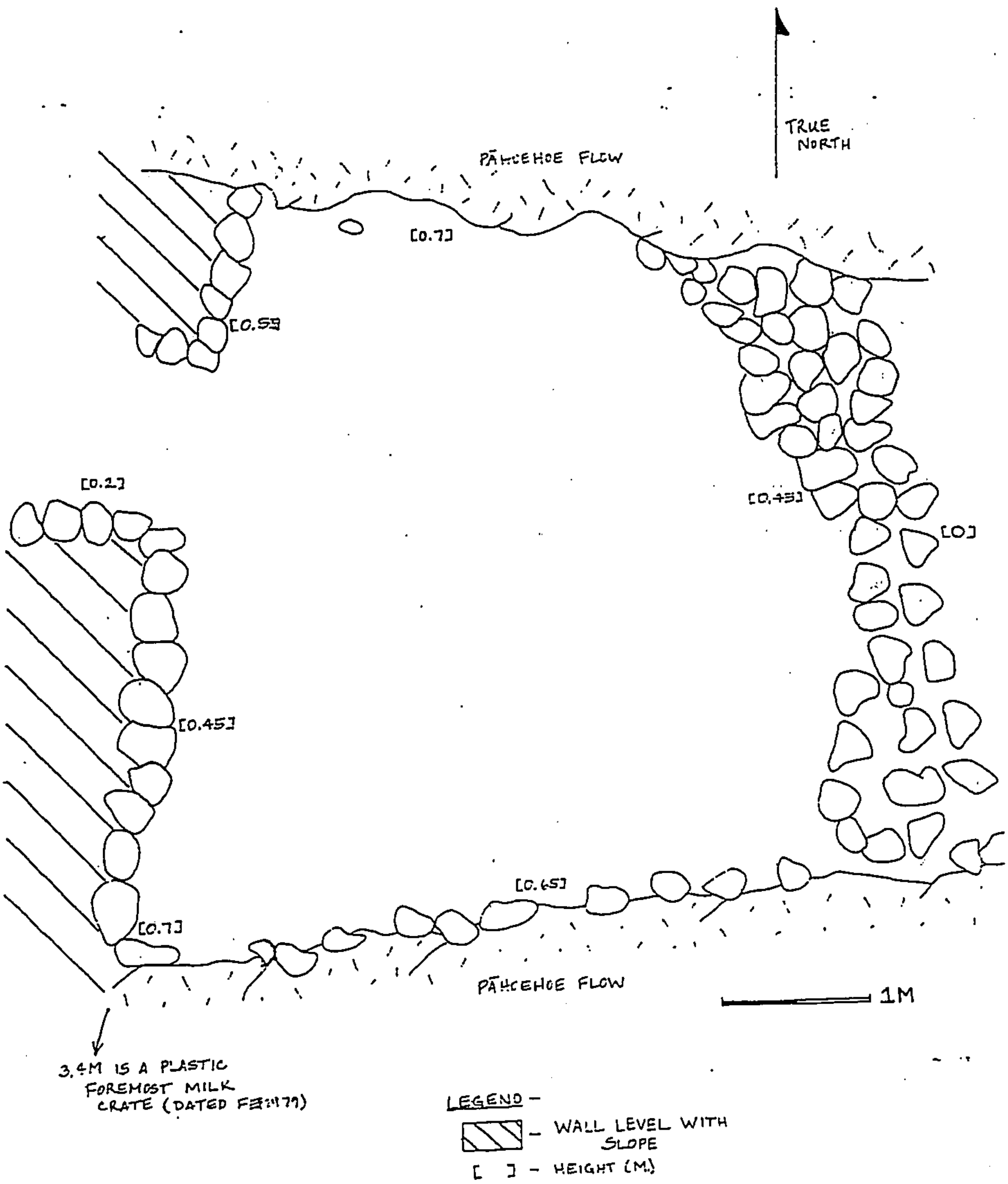


Figure 15 Enclosure Sub-Feature of Site 50-10-35-18670 (CSH12)

Another subfeature (Figure 16) example of rock-clearing is a large, rectangular mound. The mound measures 8.2 m. (26.9 ft.) N/S by 7.5 m. (24.6 ft.) E/W. The top of the mound surface measures approximately 2.5 m. (8.2 ft.) above the surrounding ground surface. Some vertical facing still exists though most of the sides are somewhat collapsed.

Approximately 14 other amorphous rock clearing features exist within the field. These consist of mounds, piled rocks on bedrock ledges and in one case a pile of rocks within a shallow bedrock drainage channel. A large banyan tree grows out of the piled rocks at the head of the channel.

Based on historic research including a review of the Waiākea Mill Co. map (See Fig. 6 in Cultural History Section) Site 18670 field was once Cane Lot #16. Lot 16 encompassed some 22 acres of which .13 was "waste" or areas of rock (i.e., clearing mounds, etc.).

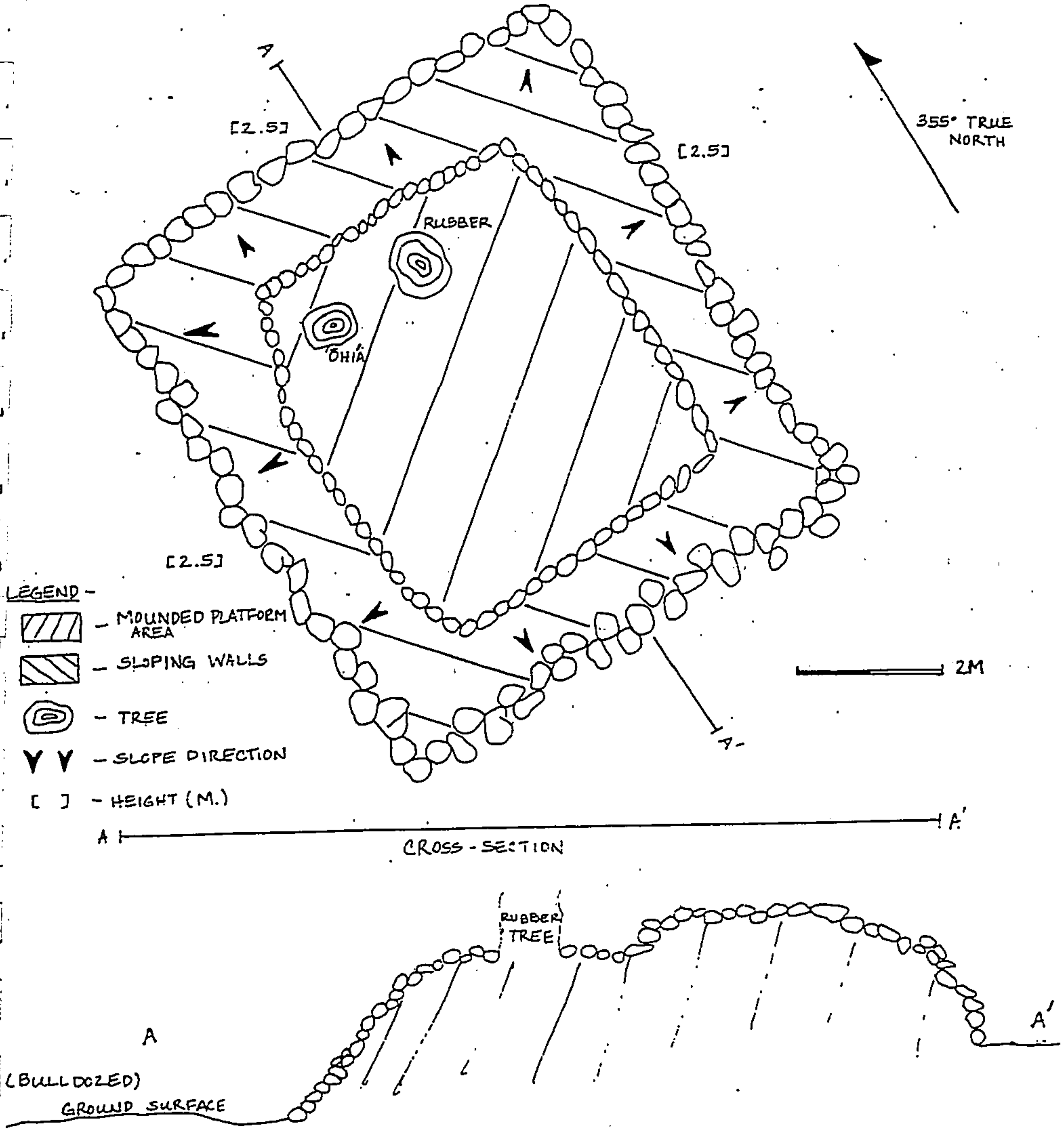


Figure 16 Larger Rock Clearance Mound within Site 560-10-35-18670, Plan View and Cross Section

SUMMARY AND SIGNIFICANCE

Archaeological survey of the land area *mauka* of the University of Hawaii at Hilo Campus has located definitive evidence that the agriculturally productive land there was plowed and planted in sugar cane as recently as the 1940s. Furrows are still visible in the tillable lands that comprise the south end of the study area, and a sample of the rock mounds tested by excavation contained no cultural material. Stratigraphically the mounds are built upon the sediments of the fields or upon shallow bedrock up-croppings, thus are contemporaneous with sugar planting in the study area - in all probability field-rock clearing mounds. The entire field is bounded by a continuous low rock wall. Along the north field boundary the wall follows the natural edge of tillable soil, delineated by the edge of a pahoehoe flow whilch has not weathered significantly from its original state. The wall along the south boundary of the field follows the natural edge of the old bed of Waiākea Stream. This wall is essentially the south boundary of the study area. At the west (*mauka*) and east (*makai*) ends of the field the wall is disturbed by the rerouting of the Waiākea Stream bed and construction of the School of Agriculture building, and by the flood control 'improvements' to the stream bed, respectively.

Two small sites - 18668 and 18669 - located along the northern fringe of the tilled land were tested and were found to contain no stratified deposits or cultural material below the surface. On the surface within the sites were twentieth century bottles, for whiskey and soda water at sites 18668 and 18689 respectively. These sites are interpreted as lunch stations - temporary or single use sites - of the sugar field workers, homesteaders, or possible the cowboys or mule skinners associated with the pasture land.

Site 18667 is nothing more than the constricting *mauka* end of the sugar field.

Furrows were not observed on the bare ground here, which is the primary reason for differentiating it from the *makai* portion of the field. The ubiquitous field-rock clearing mounds are more numerous, but smaller, generally no larger than 2 meters by 2 meters square with maximum heights of and a meter and a half. There stratigraphic relationship to the surrounding sediments is similar to the mounds in the *makai* portion of the field, that is, of recent historic age and without any cultural material to suggest they are anything other than clearing mounds.

The entire remaining portion of the study area contained no cultural resources related to archaeology. This land is comprised mostly of a pahoehoe lava flow little altered by weathering. Vegetation is supported primarily by quantities of humus and leaf litter deposited by gravity in the low basins of the lava flow's undulating surface, their roots finding moisture ponded in the basins or deep in the natural cracks and fissures of the lava sealed by a thick, but discontinuous carpet of sphagnum moss. It is likely that prehistoric use of this land was for collection of feral or wild plants and animals. Variation between this pahoehoe lava of old and the lavas of the 1881 flow that entered the study area at the northwest corner is not clearly discernable due to the mechanized land alteration and the present heavy, ground-obscuring vegetation.

Significance

Archaeological remains in the study area, which are limited to the southern portion where old sediments are present, are borderline to even be considered historical properties in that they were last in use at least as recently as the mid-1940s. Initial homesteading of these "cane lots" occurred around 1918. So it is possible that construction of some of the field-stone clearing mounds had been begun by this time, and the mounds could have been continuously added to through the years as is the nature of such mounds. Nevertheless, based on the archaeological mapping of the fields, and the testing results of type-mounds we believe all of the archaeological sites and features within the study area to be without other significance than Criterion D (i.e., site is likely to yield information important to prehistory or history) as historical properties, according to National Register significance and State Historic Preservation Division draft rules on significance criteria.

Recommendations

Archaeological work accomplished includes, scale mapping of the limits of the cane field and its boundary walls, testing of two peripheral sites, and testing of a field-stone clearing mound feature. Thus, it is felt sufficient data has been collected, analyzed, and reported on to satisfy Criterion D. Therefore, no further archaeological work is recommended for the study area.

Archaeological monitoring is not recommended for site grading and preparation work or other construction activities, based on the results of the archaeological survey and testing in the study area. However, as is the general case with historic preservation concerns in the event inadvertent discoveries are made during any phase of construction the State Historic Preservation Division shall be notified in each incidence to determine an appropriate course of action for mitigation.

REFERENCES

Condé, Jesse C. and Gerald M. Best
1973 *Sugar Trains: Narrow Gauge Rails of Hawaii*, Glenwood Publishers, Felton Calif.

Kelly, Marion, Barry Nakamura and Dorothy B. Barrère
1981 *Hilo Bay: A Chronological History, Land and Water Use in the Hilo Bay Area, Island of Hawai'i*, Bishop Museum, Honolulu.

McEldowney, Holly
1979 *Archaeological and Historical Literature Search and Research Design: Lava Flow Control Study*, Department of Anthropology, Bishop Museum, Honolulu.

Hunt, Terry L.
1992 *Interim Report: Archaeological Inventory Survey Puainako Street Extension Project: Lands of Waiākea, Kukuau 1 and 2, and Ponohawai, South Hilo District, Island of Hawai'i,*

Moniz, Jadelyn J.
1992 "Summary of Prior Archaeological Work" *Historical and ARchaeological Synthesis of Land Use and Settlement Patterns Waiākea Ahupua'a, Hilo Hawaii*, UH Anthropology 645: Historic Preservation, Fall 1992, Honolulu.

Sato, H. et al.
1973 *Soil Survey of the Island of Hawaii*, U.S. Department of Agriculture and Univ. of Hawaii Agricultural Experiment Station.

Smith, Marc
1992 *Field Inspection for State Land Disposition of the Proposed Department of Water Supply Office Site in Hilo, Waiākea Cane Lots, Waiākea, South Hilo, Hawaii Island (TMK: 3-2-4-56:1)*, January 3, 1992, State Historic Preservation Division, Department of Land and Natural Resources, Honolulu.

Smith, Marc
1991 *Site Inspection of the University of Hawaii - Hilo Perimeter Road Alignment, Research and Technology Park Phase I, Waiākea, South Hilo, Hawaii Island (TMK: 3-2-4-01:7)*, November 8, 1991, State Historic Preservation Division, Department of Land and Natural Resources, Honolulu.

Supplemental Archaeological Survey and Testing of the Proposed University of Hawaii at Hilo Expansion Area (TMK 2-4-01:19)

by

Douglas F. Borthwick, B.A.
and
Hallett H. Hammatt, Ph.D.

for

Engineering Concepts

by

Cultural Surveys Hawaii
November 1993

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

Cultural Surveys Hawaii conducted, at the request of Engineering Concepts, an archaeological inventory survey of an approximately eleven (11) acre parcel located adjacent to the proposed U.H. Hilo Research and Technology Park. The purpose of the survey was to locate and describe any archaeological sites and/or features within the specific area through which infrastructure-related construction is proposed.

The present inventory survey project area is situated along the Waiakea Flood Control Channel adjoining (to the east) the larger parcel of the Research and Technology Park previously surveyed by Cultural Surveys Hawaii (Borthwick and Hammatt 1993) (Fig. 1). The need to conduct this additional survey was reached after survey and report production of the larger parcel was completed. The present research is thus included as a supplemental report to the previous Cultural Surveys Hawaii's study which detailed background research pertinent to the entire Research and Technology Park.

SURVEY RESULTS

Methodology

The present inventory survey was conducted by two archaeologists, Douglas Borthwick and Dr. Hallett H. Hammatt on Sept 30, 1993. The first phase of the survey included walking roughly north/south-oriented transects to locate any archaeological sites. The space between archaeologists during the transects was never greater than 15 meters and averaged 10 meters. The entire area was covered in four transects. The vegetation ranged from fairly dense grass-covered areas to open terrain under Royal Palms and/or Guava, thus ground visibility ranged from fair to good. A portion of the Waiakea Flood Control Channel is encompassed within the project area. The channel and associated land alterations generally define the southern and eastern boundaries of the project area. The northern boundary is a bulldozed swath related to existing water and overhead power lines. The western or *mauka* boundary is a surveyed line marked by survey flags, from the previous Cultural Surveys Hawaii's project, and more recently survey work by R.M. Towill Corp. The contour and boundary map developed by R.M. Towill's work was utilized to accurately plot site locations (Fig. 2).

Test excavations were conducted at two rock mounds. The testing process included: pre-excavation photographs, removal of rocks from the specified test unit; excavation of soil by natural stratigraphic layer (or 10 cm. level within natural strata); screening of all soil sediments through 1/8" mesh screen; recovery of all cultural material (artifacts, midden, charcoal); one profile and stratigraphic description per unit; post excavation photographs; and reconstruction of test unit locale.

Results

Survey of the flood control channel and the area to the east of the channel, indicated that this portion of the project area had been entirely mechanically altered. Mechanical alteration includes bulldozing, cut and fill, and channel embankment construction. Due to these modern alterations no archaeological sites exist within the channel or along the channel's embankment, including the area between the eastern embankment and the existing UH Hilo structures. The existing U.H. Hilo structures include dormitories and associated grounds (i.e., parking lot and landscaped areas).

West of the flood channel four rock clearance mounds and a rock wall were observed and plotted on the survey map (See Fig. 2). The mounds range in size from a

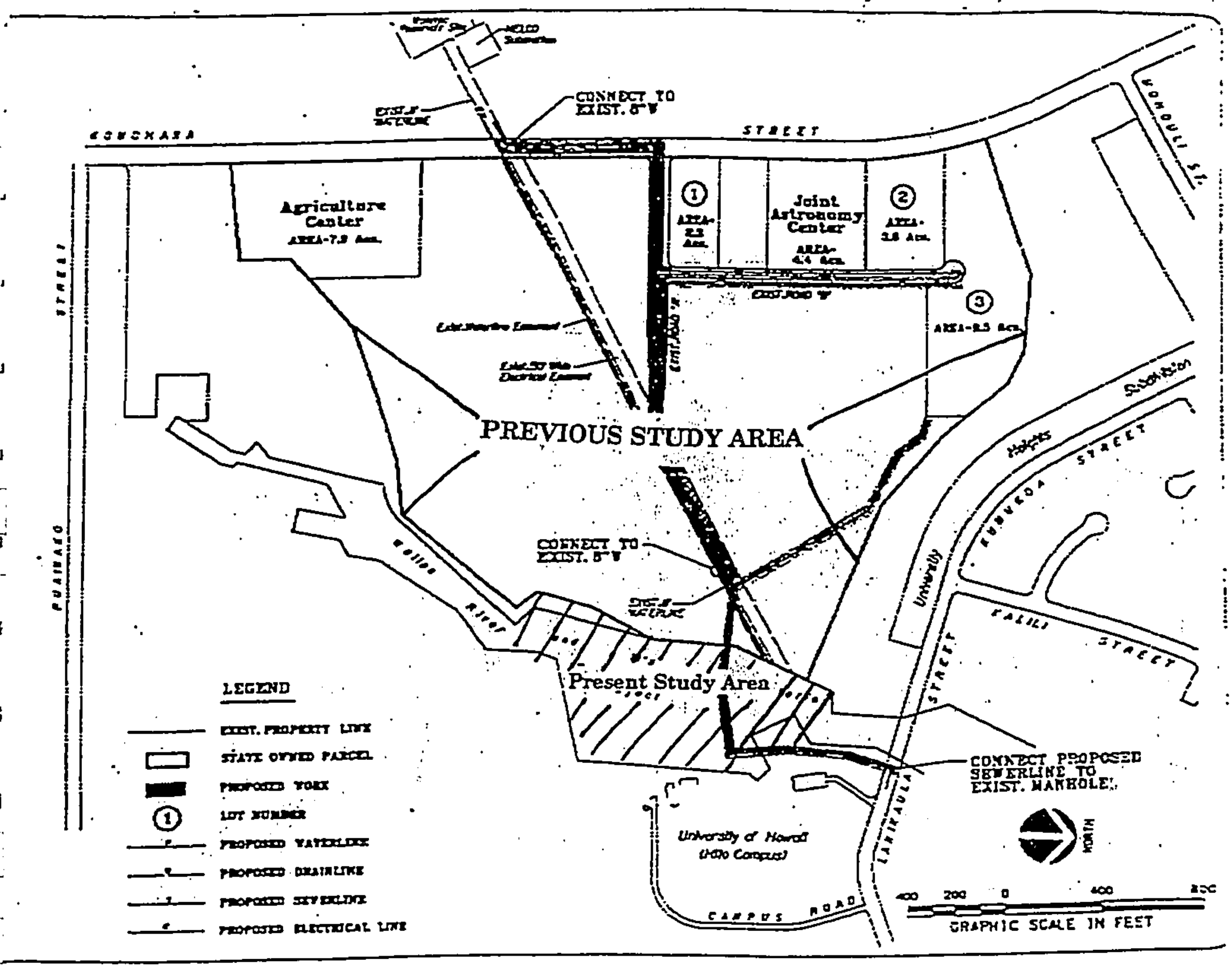


Fig. 1 Locational Map of University of Hawaii Hilo Proposed University Park, Showing Previous and Present Study Areas

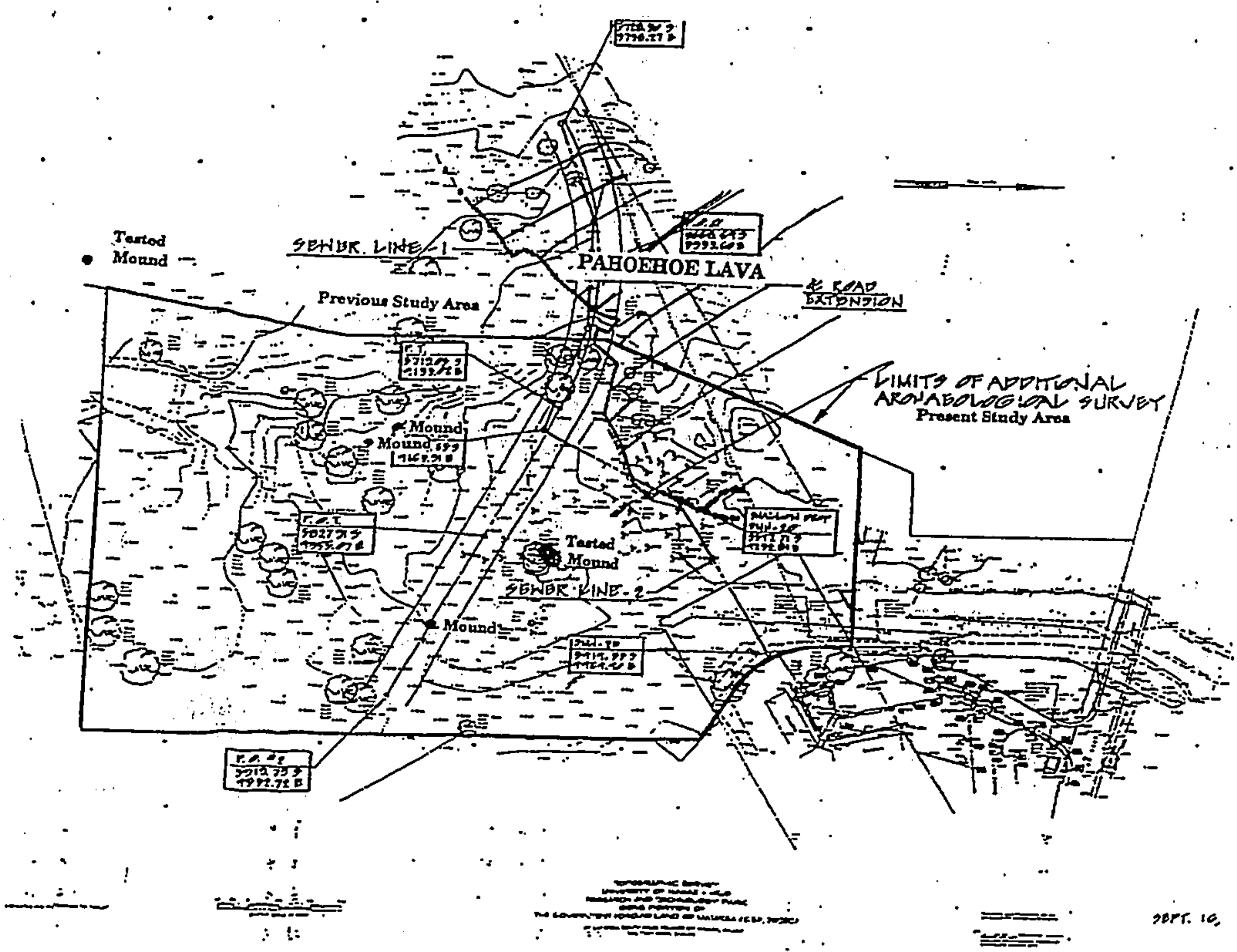


Fig. 2 Project Area Map Showing Archaeological Features

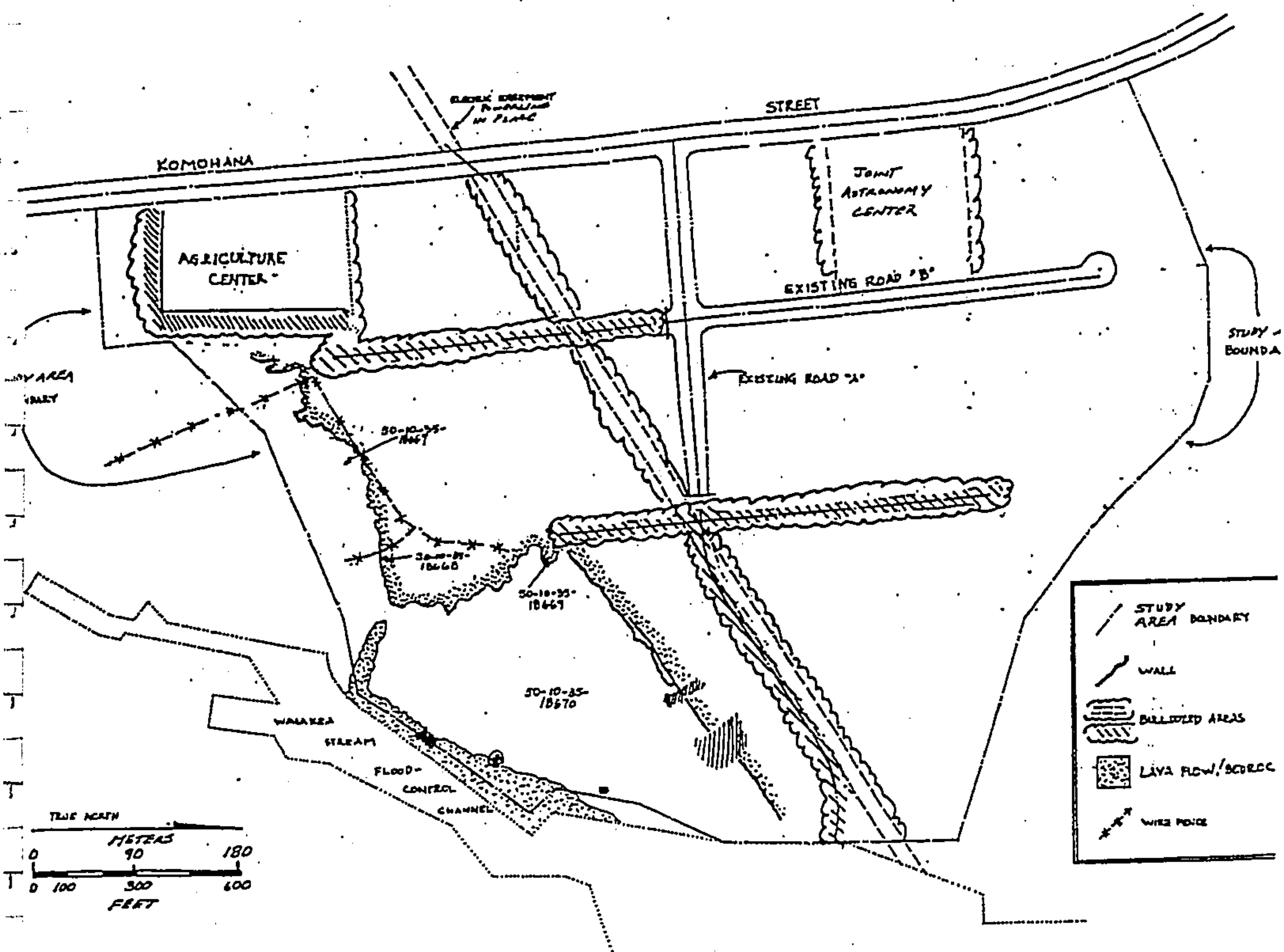


Fig. 3 Previous Study Area Map with Archaeological Sites (Borthwick et al. 1993:Fig. 8)

maximum of 5 meters by 10 meters to 2 meters by 6 meters. The mounds are constructed on high points (i.e., bedrock undulations) in the mostly soil terrain where former cane furrows are still visible. The wall observed, which is of mounded construction, is the *makai* extension of the wall noted and described previously (Borthwick *et al.* 1993:25-27, and 43) (See Fig. 3). The wall defines the interface between soil-mantled terrain to the south, which was formerly under commercial sugar cane cultivation and the non-cultivated soil-less pahoehoe terrain to the north. The wall varies greatly in condition and size throughout its length but averages 1.5 m. wide and .50 m. in height.

The largest, most visibly distinct of the four newly identified mounds, was mapped to scale (Fig. 4), photographed and subjected to limited surface testing. A 1 m. by 2 m. test unit was excavated into the roughly faced west edge of the mound. The excavation revealed a maximum thickness of rock construction of 50 cm. The construction was of loosely piled boulders, of fairly consistent size (15-25 cm. in diameter), with no filtered soil matrix. No cultural material (artifacts, midden, or charcoal) was present within the rock fill. Below the rock structure three soil stratigraphic layers (I, II and III) were encountered (Fig. 5). Stratum I was 2 to 4 cm. thick, and consists of very loose, very dark grayish brown (10YR 3/3) silt loam with a high percentage of organics (leaf litter). Stratum I represents the modern filtered forest litter postdating the mound's construction. Stratum II was a maximum of 25 cm. thick and consists of loose dark brown (7.5YR 3/2) silt loam with 5 to 10 percent rockiness. One fragment of volcanic glass (.9 grams) and a piece of *kukui* nut (.2 grams) were recovered from Stratum II. Stratigraphically, Stratum II represents a natural soil layer predating the construction of the mound, thus the volcanic glass and *kukui* nut fragments are not associated with construction and/or use of the mound. Stratum III consists of slightly compact rocky dark yellowish brown

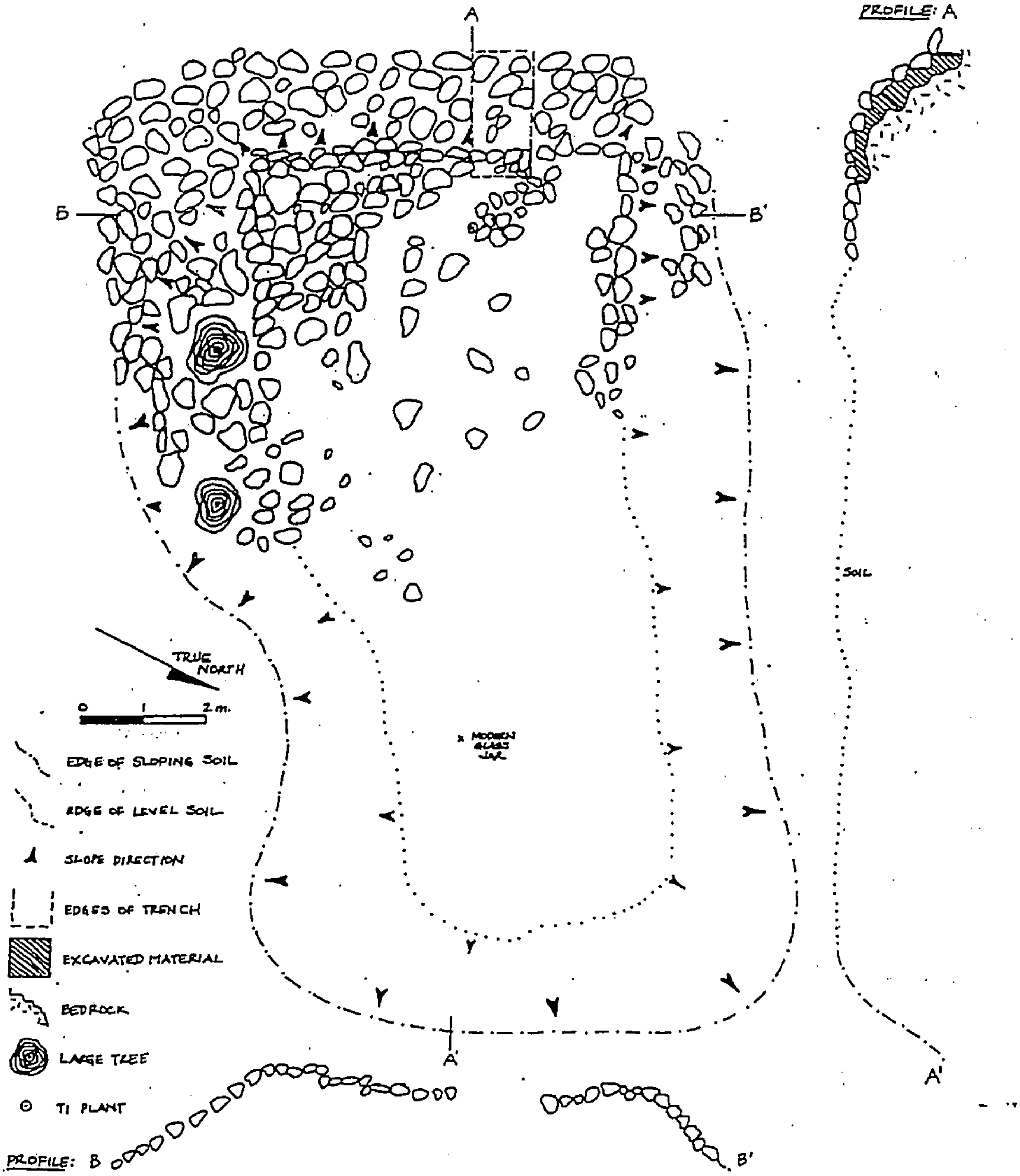


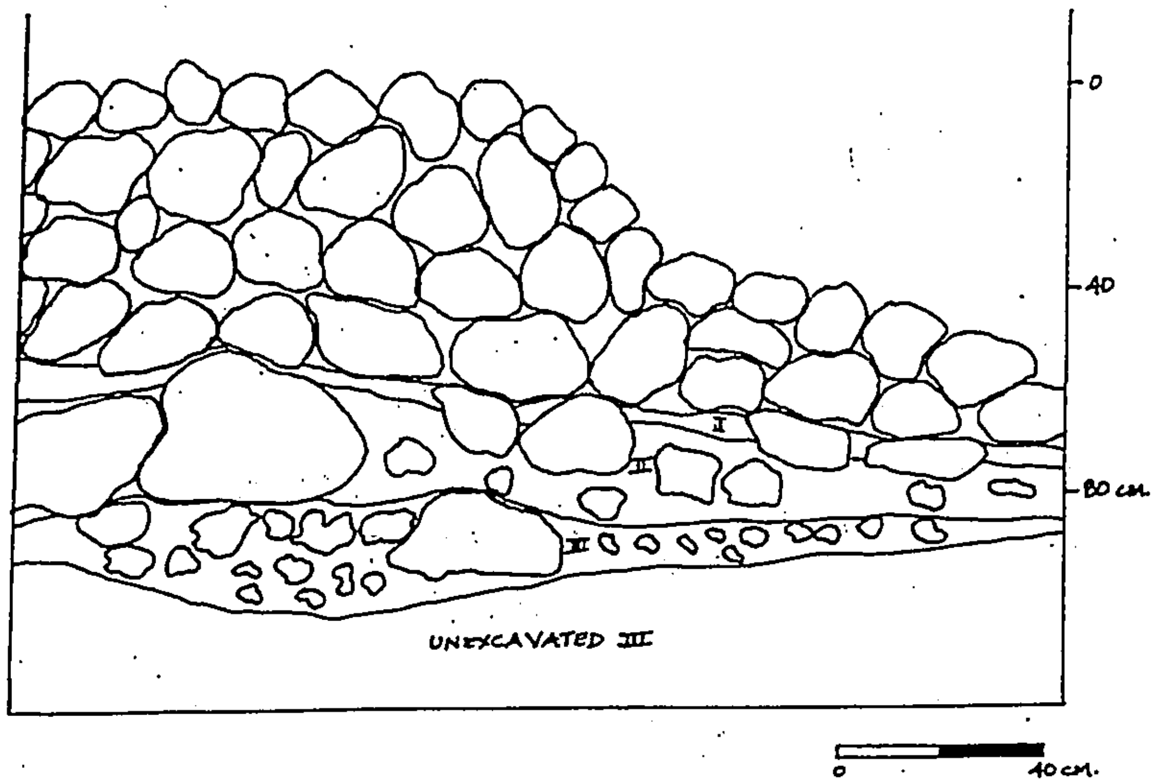
Fig. 4 Plan View and Cross Section of Tested Mound within Present Project Area, Feature of Site -18670

(10YR 3/6) silt loam. Stratum III represents the parent material soil layer or C Horizon which contains a high percentage of soft decomposing rock. No cultural material was within Stratum III.

The survey and testing within the present project area and previous background research for the Research and Technology Park (Borthwick *et al.* 1993:6-23) indicates that the features observed were associated with commercial sugar cane cultivation. Specifically, the features are situated within the former Waiakea Cane Lots (Portion of Lot #16). During the previous study a State Historic Site number (50-10-35-18670) was allotted for the cane lots' associated features within that specific project area (*ibid.*:39-42) (See Fig. 3). Since the four newly identified mounds were also associated with the same lot or sugar cane field we are including these features under the same State site number, 50-10-35-18670.

To further address functional interpretation, feature association, and sampling concerns, another mound within Site -18670 was subjected to sub-surface testing. The particular mound was chosen because of its size and location. The mound represents the largest, best defined stacked stone feature within Site -18670 boundaries (Fig. 6). The mound had been previously noted and drawn to scale (Borthwick *et al.* 1993:41,42), and accurately plotted on the study area map (*ibid*, Figure 8:25) thus facilitating locational and feature type sampling choices as well as necessary field tasks (i.e., mapping and location).

A roughly 1.5 m. by 1.5 m. test unit was excavated into the southern side of the mound. The excavation revealed that the rock structure of the mound consists of a loose network of small boulders with no paving, no cultural material (i.e., midden or artifacts), and no filtered soil matrix. The mound is essentially sitting on top of underlying soil



STRATUM I: 4 cm. THICK; (10 YR 3/2) VERY DARK GRAYISH BROWN SILT LOAM; HIGH % ORGANICS; VERY LOOSE GRANULAR STRUCTURE; NO CULTURE

STRATUM II: 25 cm. THICK; (7.5YR 3/2) DARK BROWN SILT LOAM; LOWER % ORGANICS; GRANULAR AND LOOSE; 5-10% ROCKS; ONE PIECE OF VOLCANIC GLASS AND ONE BURNT KUKUI SHELL

STRATUM III: 22+cm. THICK; (10YR 3/6) DARK YELLOWISH BROWN SILT LOAM; "C HORIZON"; NO CULTURE.

Fig. 5 South Profile of Test Unit within Tested Mound in Present Project Area, Feature of Site -18670

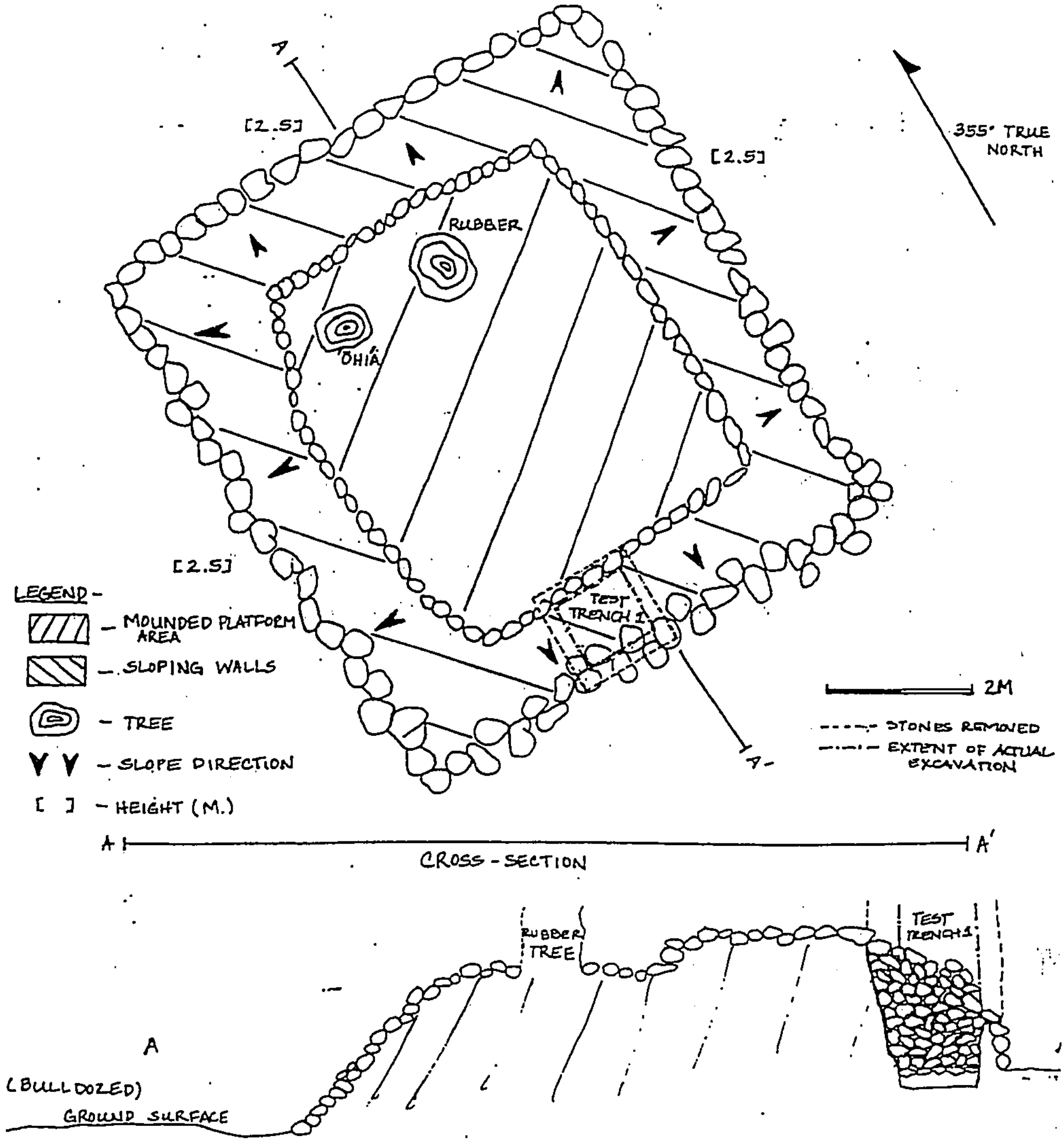
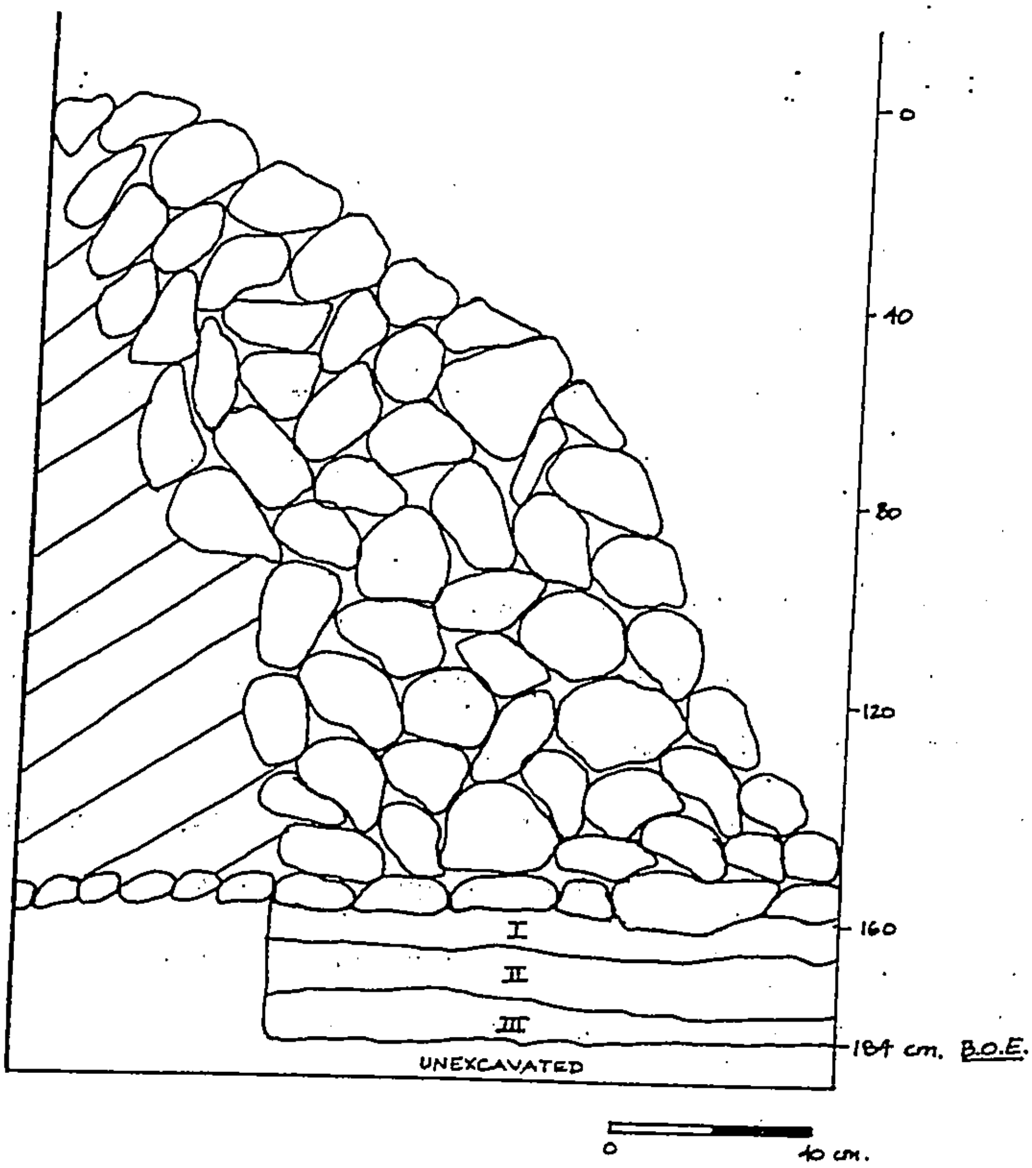


Fig. 6 Plan View and Cross Section of Tested Mound in Previous Study Area Portion of Site -18670 (Based on Figure 16 Borthwick *et al.*:42)

layers which, inclusive of the above-listed attributes, indicates the structure is relatively youthful age as there has not been sufficient time for soil to have filtered through the rocks and accumulated as a soil matrix within the mound. Additionally, the absence of cultural material and surface paving (pebble and/or coarse surface) argues against traditional Hawaiian usage (i.e. habitation and/or ritual).

Below the rock structure three soil stratigraphic layers (I, II and III) were encountered. No cultural material (midden, artifacts or charcoal) was within any of the strata which ranged from very dark brown (10YR 2/2) silty clay loam (Str. I) to dark yellowish brown (10YR 3/4) silty clay loam (Str. III). The degree of rockiness increased with depth ranging from 10% rockiness in Stratum I to a maximum of 40% in Stratum III. The soil layers clearly predate the construction of the mound and the profile represents natural *in situ* soil development (Fig. 7).

The sub-surface testing of this large mound did not reveal any evidence of traditional Hawaiian usage associated with the mound. The rock free, furrowed soil area surrounding the mound, construction style, and absence of cultural material indicate that the mound is a rock clearance feature associated with historic commercial sugar cane cultivation practices.



STRATUM I: 9 cm. THICK; (10 YR 2/2) VERY DARK BROWN SILTY CLAY LOAM TO SILT LOAM; 10% ROCKS

STRATUM II: 10 cm. THICK; (10 YR 3/2) VERY DARK GRAYISH BROWN SILTY CLAY LOAM; 10-20% ANGULAR PEBBLES

STRATUM III: 10+cm. THICK; (10 YR 3/4) DARK YELLOWISH BROWN SILTY CLAY LOAM; 20-40% ANGULAR PEBBLES; STRONG CRUMB STRUCTURE

Fig. 7 East Profile of Test Unit within Previously Located Mound, Site -18670

SUMMARY AND RECOMMENDATIONS

The present project area includes four rock clearance features (mounds) and a portion of a stacked boulder wall. The features were constructed and maintained historically as part of Waiakea Mill Co.'s sugar cane operations. The construction and maintenance of the mounds and wall were done to increase the cultivatable soil area by removing rocks from the fields and piling them into mounds and/or along field edges (e.g., the wall).

The extremely sparse material collected from the roughly 3 square meters of excavation (1 volcanic glass fragment and 1 *kukui* nut fragment) precludes any meaningful analysis. Both items could be naturally occurring within Waiakea Flood Plain soils. The volcanic glass fragment has not been utilized as a tool, based on absence of edge wear and/or retouching, as well as the poor vesicular quality of the material. The burnt *kukui* nut fragment may indicate previous forest clearing. However, such an assumption (or any other) based on a single .2 gram fragament is tentative at best.

Research for the proposed Pu'ainako Street Extension (Hunt and McDermott 1993), which includes similar stacked stone features within the former Waiakea Cane Lots, also indicated commercial sugar cane-related construction and maintenance of the rock structures. Hunt and McDermott, after "compiling diverse lines of complimentary evidence," which included oral interviews, photographs, newspaper articles, historic map analysis, inventory survey, and sub-surface testing, conclude that "The archaeological structures documented in the inventory survey are plantation-era in origin dating to the late nineteenth and early twentieth" (*ibid.*:93, 94).

The same conclusions were reached independently for the structural features reported on in our original report (Borthwick *et al.* 1993) for the survey of the Research and Technology Park. The four mounds and wall, noted during the present survey are component features of the furrowed field (portion former Cane Lot #16) given State Site number 50-10-35-18670 (*ibid*:39-42) and thus should be included under the same (-18670) site designation.

Site -18670 was preliminarily (Cultural Surveys Hawaii recommendation) assessed solely under Significance Criterion D (site may be likely to yield information important in prehistory or history) and we are recommending inclusion of the four newly identified mounds (wall is already part of -18670) under the same significance assessment. That is, we are still recommending Criterion D only for Site -18670 and that the four mounds become part of the site.

The present study has neither altered significance assessment nor the recommendations of the original survey, for no further archaeological work specific to Site -18670, inclusive of the four newly-identified mounds. Sufficient data has been collected, analyzed, and reported on to define age and functional interpretation of Site -18670. Therefore it is our opinion that no further archaeological work is necessary. These significance assessments and recommendations are consistent with those made previously, for Site -18670 and described previously in the main body of the report.

REFERENCES

Borthwick, Douglas F. and Hallett H. Hammatt
1993 *Archaeological Survey and Testing of Lands Proposed for Research and Technology Lots at the University of Hawaii at Hilo (TMK 2-4-01:40 and 157)*, Cultural Surveys Hawaii, Kailua, Oahu.

Hunt, Terry L. and Matthew McDermott
1992 *Interim Report: Archaeological Inventory Survey Puainako Street Extension Project: Lands of Waiākea, Kukuau 1 and 2, and Ponohawai, South Hilo District, Island of Hawai'i.*

APPENDIX D

CULTURAL ASSESSMENT OF ARCHAEOLOGICAL SURVEYS/STUDIES
(Haun and Associates)

Haun & Associates

Archaeological, Cultural, and Historical Resource Management Services
HCR 1 Box 4730, Keaau, Hawaii 96749 Phone: 982-7755 Fax: 982-6343

Project 208

May 28, 2002

Mr. Sidney Fuke
Planning Consultant
100 Pauahi Street, Suite 212
Hilo, Hawaii 96720

Subject: Cultural Impact Assessment
Mauna Kea Astronomy Education Center
Land of Waiakea, South Hilo District, Island of Hawaii

Dear Mr. Fuke:

The subject project is a 9-acre parcel situated in the University of Hawaii Research and Technology Lots. An archaeological survey (Borthwick et al. 1993) of approximately 163 acres included the subject project area. The survey did not identify any sites within the project area.

The project area is situated within the Upland Agricultural Zone (McEldowney 1979) that extended between approximately 50 ft and 1,500 ft elevation. Traditional Hawaiian use of the zone consisted of scattered residences among economically beneficial trees and agricultural plots of dryland taro and bananas. A pattern of shifting cultivation is believed to have converted the original forest cover to parkland of grass and scattered groves of trees. The very rocky nature of the project area terrain probably limited traditional use to gathering floral and faunal resources. Historic use was probably limited to cattle grazing because the terrain is too rocky for sugar cane cultivation.

Today, the 9-acre parcel is bordered south and west by roads. Several astronomy facilities are situated across the street to the west. A bulldozed swath borders the area to the east. The terrain consists of a relatively unweathered pahoehoe lava flow vegetated with guava (*Psidium cattleianum*) and ferns.

Based on the findings of the archaeological survey, there are no traditional Hawaiian cultural or historical resources in the project area. The proposed development will not affect such resources and no protective actions are necessary.

If you have any questions, please contact me at 982-7755.

Sincerely,

Alan E. Haun, Ph.D.
Principal Investigator

APPENDIX E

TRAFFIC IMPACT ANALYSIS REPORT And LETTER REPORT

(M&E Pacific, Inc.)

M&E Pacific, Inc.

May 23, 2002

Mr. Sidney Fuke
Sidney Fuke and Associates, Inc.
100 Pauahi Street, Suite 212
Hilo, HI 96720

Subject: Mauna Kea Astonomy Education Center
Traffic Impact Analysis Study

Dear Mr. Fuke:

M&E Pacific, Inc., was retained to conduct a traffic impact analysis of the proposed Mauna Kea Astronomy Education Center in Hilo, Hawaii. This letter summarizes the methodology and findings of the study. A forthcoming report will document the study methodology, results and findings in detail.

We understand that the proposed project will be located in the University Park area of the University of Hawaii Hilo campus on the makai side of Komohana Street. Access to the research park site will be via Nowelo Street from Komohana Street. It is expected to attract about 200,000 visitors annually and will be open daily except holidays. The center's hours will be from 9:00 AM to 5:00 PM. The facility is scheduled to open in late 2004.

Our study area encompassed three adjoining intersections on Komohana Street: Puainako Street (and Extension), Nowelo Street, and Mohouli Street. Puainako Street is currently unsignalized and a mauka extension to Kaumana is under construction. This improvement is scheduled for completion in 2003 and will result in a signalized intersection. Nowelo Street is an unsignalized intersection that provides access to University Park. Mohouli Street was recently improved with a mauka extension and signalization.

A study year of 2005 was analyzed based on the expected late 2004 project completion date. The mid-morning hour and the afternoon peak hour were analyzed based on the proposed operating hours. The morning commuter peak hour was not analyzed since the project is not expected to be open during that period. Therefore, ambient traffic volumes for the year 2005 mid-morning and afternoon peak hours were forecast at the three study intersections. The existing traffic volumes at the Nowelo Street and Mohouli Street intersections were increased by 4% (2% annual growth rate). The traffic forecasts for Puainako Street were handled in a different manner due to the large changes in traffic volumes forecast to be caused by the new and realigned roadway extension. This resulted in additional traffic being placed on Komohana Street.

The traditional three step procedure of trip generation, distribution and assignment was utilized to forecast the traffic volumes from the proposed facility. Since there are no equivalent land uses in the ITE Trip Generation Handbook, the annual attendance was factored into mid-morning and afternoon peak hour vehicle trips. The mid-morning was forecast to have twenty-six (26) incoming auto vehicle and two (2) incoming bus trips by visitors, and twenty (20) auto vehicle trips by staff. The afternoon peak hour was forecast to have forty-eight (48) outbound auto trips and 1 outbound bus trip by visitors, and fifteen (15) outbound auto trips by staff. These trips were assigned to the three study intersections based on their expected origins and destinations. The project generated trips were added to the ambient traffic volumes to obtain the total forecast with project traffic volumes.

1001 Bishop Street
Suite 500, Pauahi Tower
Honolulu, HI 96813
Voice: (808) 529-7267 Fax: (808) 524-0246

A level of service analysis was conducted to determine the quality of traffic operations at the three intersections. The results of the analysis are summarized on the table below:

INTERSECTION AND MOVEMENTS	MID-MORNING HOUR exist	amb.	total	PM PEAK HOUR exist	amb.	total
Unsignalized Intersection Analysis						
Nowelo Street @ Komohana Street						
Nowelo St. left turn	C	C	C	D	E	F
Nowelo St. right turn	A	B	B	B	B	B
Komohana St. SB left turn	A	A	A	A	B	B
Puainako Street @ Komohana Street						
Puainako St.	B	-	-	F	-	-
Komohana St. SB left turn	A	-	-	A	-	-
Signalized Intersection Analysis						
Puainako Street @ Komohana Street	-	-	B	-	-	C
Mohouli Street @ Komohana Street	B	B	B	C	C	C

The above results show that the mid-morning hour with its lower volumes will not present any traffic problems. Levels of service are expected to be level C or better, indicating acceptable traffic operations. However, the higher through traffic volumes on Komohana Street in the afternoon peak hour will present some problems.

Traffic exiting University Park by making left turns from Nowelo Street will face increasing difficulty as evidenced by the progression of level of service from D to E to F. The proposed future widening of Komohana Drive to four lanes will make this movement more difficult in the morning and afternoon peak hours. Traffic signals may be one form of future mitigation as University Park develops.

The Puainako Street approach to Komohana Street is already at level of service F in the afternoon peak. Other studies indicate the it is operating at level of service F in the morning peak also. The proposed improvements at this intersection, including signalization, should mitigate this problem, as indicated by the levels of service B and C for the signalized analysis.

The mauka extension of Mohouli Street at Komohana Street was recently completed and the intersection was signalized. It is forecast to operate at acceptable levels of service in the future and no mitigation is required. Thank you for the opportunity to conduct the traffic impact analysis for this project.

Sincerely,

Warren M. Yamamoto

WARREN M. YAMAMOTO, P.E.

TRAFFIC IMPACT ANALYSIS REPORT

MAUNA KEA ASTRONOMY EDUCATION CENTER

By:

M&E Pacific, Inc.
100 Pauahi Street, Suite 212
Hilo, Hawaii 96720
Telephone: (808)961-2776
Fax: (808)935-5934

July 22, 2002

TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

Page No.

Appendices:

TRAFFIC IMPACT ANALYSIS REPORT
MAUNA KEA ASTRONOMY EDUCATION CENTER

The Mauna Kea Astronomy Education Center is being proposed in Hilo, Hawaii. A study was conducted to determine if any traffic mitigating measures would be required. This report documents the methodology, results and conclusions of the study.

PROJECT DESCRIPTION

The Mauna Kea Astronomy Education Center is being proposed within the University of Hawaii Hilo (UHH) University Park of Science and Technology. The proposed project is expected to open in late 2004 and will be open daily except holidays. The visiting hours will be from 9:00 AM to 5:00 PM. The facility anticipates attracting about 250,000 visitors annually, 30% of whom are expected to be students. Based on the proposed project's operating hours, the study analyzed a mid-morning hour rather than the morning commuter peak hour, and the afternoon commuter peak hour. The mid-morning would correspond to the center's opening time and the afternoon commuter peak hour to the closing time.

University Park forms the western part of the UHH campus. The site is bounded by Komohana Street on the west and residential lots on the north and south sides. The Nalakea Stream forms the eastern boundary and physically separates University Park from the main campus. Access to the park is via Nowelo Street which connects to Komohana Street. The location of the proposed project in relation to University Park and the local roadway network is shown on Figure 1. Based on the project's location, the study area encompassed the three adjacent intersections on Komohana Street: Mohouli Street, Nowelo Street, and Puainako Street.

FIGURE 1

LOCATION MAP