Kealakaha Stream Bridge Replacement

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HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
HWY-DS
2.3289

January 28, 1997

TO: GARY GILL, DIRECTOR
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

FROM: KAZU HAYASHIDA, DIRECTOR
DEPARTMENT OF TRANSPORTATION

SUBJECT: FINAL ENVIRONMENTAL ASSESSMENT (EA) FOR KEALAKAHA STREAM BRIDGE REPLACEMENT, HAWAII BELT ROAD PROJECT NO. BR-019-(26)

The Draft Environmental Assessment has been reviewed and the Department of Transportation, Highways Division, has determined that this project will not have significant impacts on the environment and issued a Finding of No Significant Impact (FONSI). Please publish notice of availability in the February 8, 1997 OEQC bulletin.

We have enclosed a completed OEQC Bulletin Publication form and four copies of the Final Environmental Assessment.

If you have any question, please contact Mr. Herbert Tao of the Highways Division at 587-2124.

Enclosures

11

1997-02-08-HI-FEA-Kealakaha Stream Bridge Replacement

KEALAKAHA STREAM BRIDGE REPLACEMENT
HAWAII BELT ROAD

County of Hawaii
Federal Project No. BR-019-2(26)

FINDING OF NO SIGNIFICANT IMPACT (FONSI)
and
FINAL ENVIRONMENTAL ASSESSMENT

Submitted pursuant to 42 U.S.C. 4332(2)(c)
and
Chapter 343, Hawaii Revised Statutes (HRS)

U.S. Department of Transportation
Federal Highway Administration

and

State of Hawaii
Department of Transportation
Highways Division

Prepared by:

Engineering Concepts, Inc.
250 Ward Avenue, Suite 206
Honolulu, Hawaii 96814

January 1997

KEALAKAHA STREAM BRIDGE REPLACEMENT
HAWAII BELT ROAD
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January 1997

NOTICE OF DETERMINATION
FINDING OF NO SIGNIFICANT IMPACT (FONSI)
for
KEALAKAHA STREAM BRIDGE REPLACEMENT
HAWAII BELT ROAD
County of Hawaii
Federal Project No. BR-019-2(26)

A. Proposing Agency

Highways Division, Department of Transportation, State of Hawaii

B. Accepting Authority

Department of Transportation, State of Hawaii

C. Description of the Proposed Action

The State Department of Transportation, in cooperation with the Federal Highway Administration, proposes to construct a new bridge over Kealakaha Stream on the Hawaii Belt Road in the Hamakua District, County of Hawaii. The proposed project is located approximately 10 miles east of Honokaa, 26 miles northwest of Hilo, and 1 mile from the coast. The improvements include construction of a new two-lane bridge structure with the centerline approximately 120 feet downstream from the existing bridge.

D. Determination

The proposed action will not have a significant effect on the environment. Section 12, "Significance Criteria", of the Hawaii Administrative Rules Title 11, Chapter 200, "Environmental Impact Statement Rules" were reviewed and analyzed. Based on the analysis, the following conclusions were made:

1. No irrevocable commitment to loss or destruction of any natural or cultural resource would result.

2. The proposed action will not curtail the range of beneficial uses of the environment.

3. The proposed action does not conflict with the state's long-term environmental policies or goals and guidelines.

4. The economic or social welfare of the community or state will not be substantially affected.

5. The proposed action does not substantially affect public health.

6. No substantial secondary impacts, such as population changes or effects on public facilities, are anticipated.

7. No substantial degradation of environmental quality is anticipated.

8. The proposed action does not involve a commitment to larger actions, nor would cumulative impacts result in considerable effects on the environment.

9. No rare, threatened or endangered species or their habitats would be affected.

10. Air quality, water quality and ambient noise levels will not be detrimentally affected.

11. The proposed project will not affect environmentally sensitive areas such as flood plains, tsunami zones, erosion-prone areas, geologically hazardous lands, estuaries, fresh waters or coastal waters.

12. Scenic vistas and viewplanes identified in county or state plans or studies will not be substantially affected.

13. Substantial energy consumption will not be required.

E. Reasons Supporting Determination

The Environmental Assessment (EA) for the proposed action documenting the potential environmental impacts and the coordination undertaken with affected agencies and parties is attached to support the determination of a Finding of No Significant Impact (FONSI).

F. Name, Address and Phone Number of Contact Person

Mr. Herbert Tao
Highways Division
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813-5097
Phone: 587-2124

RECEIVED AND ACCEPTANCE RECOMMENDED

By ______________________ 1-17-97
Hugh Y. Ong, Administrator
Highways Division
Date

CONCURRENCE

By ______________________ 1/17/97
Kazu Hayashida, Director
Department of Transportation
Date

FEDERAL HIGHWAY ADMINISTRATION (FHWA)
FINDING OF NO SIGNIFICANT IMPACT (FONSI)
for
KEALAKAHA STREAM BRIDGE REPLACEMENT
HAWAII BELT ROAD
County of Hawaii
Federal Project No. BR-019-2(26)

The FHWA has determined that the proposed project will not have any significant impact on the human environment. This FONSI is based on the attached Environmental Assessment (EA), which has been independently evaluated by the FHWA and determined to adequately and accurately discuss the environmental issues and impacts of the proposed project. It provides sufficient evidence and analysis for determining that an environmental impact statement is not required. The FHWA takes full responsibility for the accuracy, scope and content of the attached EA.

1/24/97	Abraham Wong	Division Adm.
Date	For FHWA	Title

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CHAPTER 1
PERTINENT DATA

APPLICANT:	Department of Transportation State of Hawaii 869 Punchbowl Street Honolulu, Hawaii 96813-5097 Contact: Mr. Herbert Tao (587-2124)
PROJECT TITLE:	Kealakaha Stream Bridge Replacement Hawaii Belt Road, County of Hawaii Federal Project No. BR-019-2(26)
PROPOSED ACTION:	Construction of a new bridge over Kealakaha Stream serving the Hawaii Belt Road.
LOCATION:	Hamakua, Hawaii TMK: 4-1-03: portion of parcels 2, 10, 19, 32, 36 and 43

AGENCIES CONSULTED IN THE ASSESSMENT PROCESS:

Federal Government	U.S. Army Corps of Engineers Natural Resources Conservation Service Fish and Wildlife Service
State of Hawaii	Department of Agriculture Land Use Commission Department of Health Department of Land and Natural Resources State Historic Preservation Division Office of Environmental Quality Control Office of Hawaiian Affairs Office of State Planning U.H. Environmental Center
County of Hawaii	Fire Department Planning Department Police Department Department of Public Works

GOVERNMENT PERMITS AND APPROVALS:

Building Permit	County Building Department
Grubbing/Grading Permit	County Department of Public Works
In Stream Use Permit	Commission on Water Resource Management

CHAPTER 2
DESCRIPTION OF THE PROPOSED PROJECT

PROJECT LOCATION

Kealakaha Stream Bridge is located on Hawaii Belt Road (Route 19) near the town of Kukaiau in the Hamakua District on the Island of Hawaii. It is situated approximately 10 miles east of Honokaa, 26 miles northwest of Hilo, and 1 mile from the coast (**Figure 2-1** and **2-2**). Hawaii Belt Road provides the primary transportation link between Hilo (the county seat) and Kona (a major resort and tourist destination area).

Kealakaha Stream arises on Mauna Kea at around the 5,400-foot elevation and flows in a northerly direction toward the Hamakua Coast. The Hawaii Cooperative Park Service Unit lists the stream as perennial and continuous; however, during a reconnaissance survey in July 1994, investigators found no flowing water at the project site and observed that the stream was interrupted at lower elevations.

PROPOSED ACTION

The State of Hawaii Department of Transportation proposes to construct a new bridge over Kealakaha Stream as part of the Hawaii Belt Road. The proposed bridge will be located adjacent to the existing bridge. It will be 645 feet long and will consist of two 12-foot lanes with 12-foot wide shoulders on both sides. Three piers ranging in height from 60 to 130 feet and four spans of 140 to 180 feet each are proposed. The centerline of the proposed bridge alignment will be approximately 120 feet downstream of the existing bridge structure (1,800-foot radius). **Figure 2-3** shows the existing and proposed bridge alignments, and **Figure 2-4** shows a partial longitudinal section of the proposed bridge.

PROJECT SCHEDULE AND CONSTRUCTION COST

Construction is estimated to begin in 1998 should be completed in the summer of 2000. Construction phasing will be required in order to maintain traffic flow over the existing bridge while the new bridge is under construction. The estimated construction cost is $14 million, with funding provided by the State Department of Transportation and the Federal Highway Administration. The project has been included in the Statewide Transportation Improvement Program (STIP) for 1997.

STATEMENT OF OBJECTIVES

The State Department of Transportation proposes to replace the existing substandard bridge. This bridge over Kealakaha Stream is the last of five bridges remaining along the Hamakua

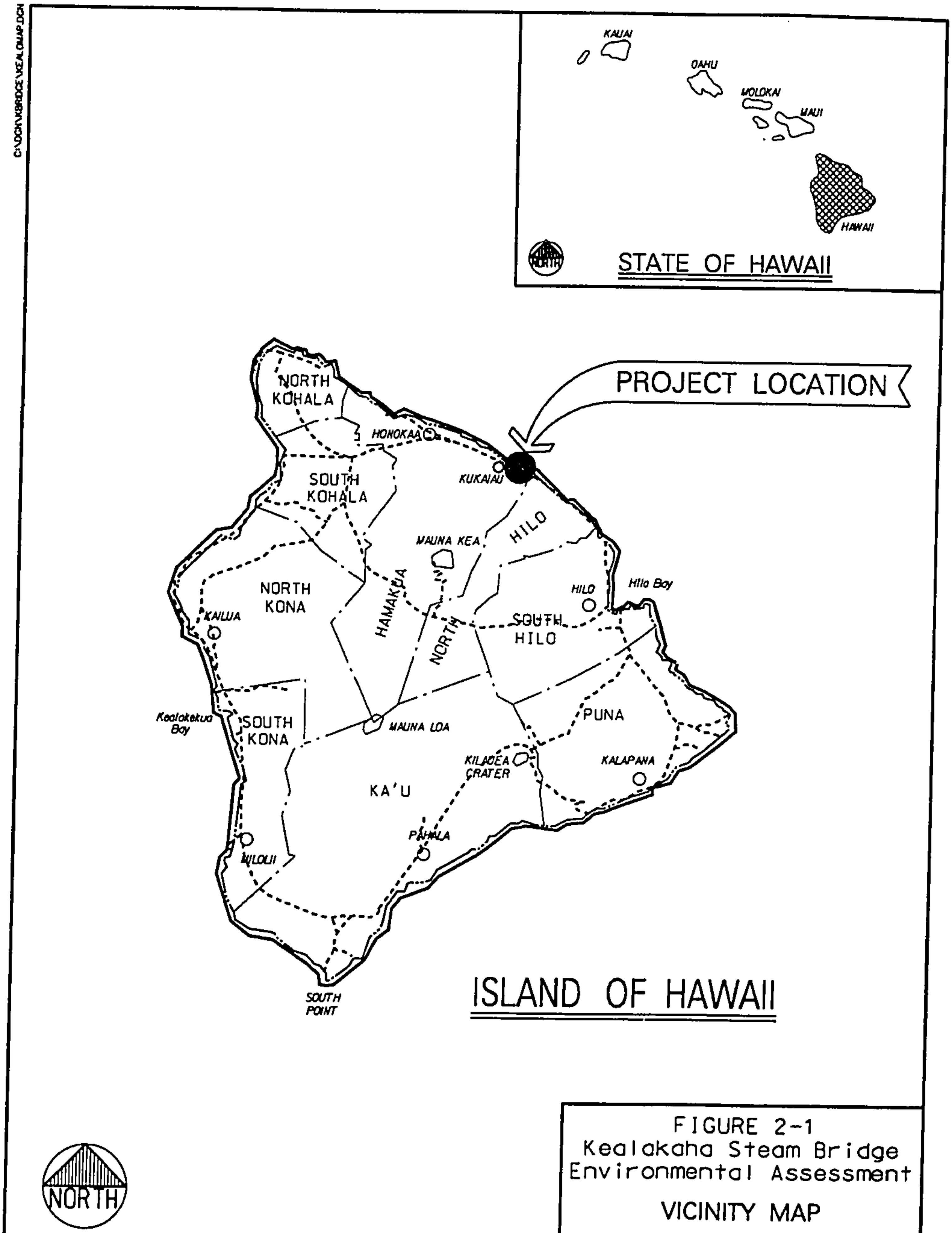


FIGURE 2-1
Kealakaha Steam Bridge
Environmental Assessment

VICINITY MAP

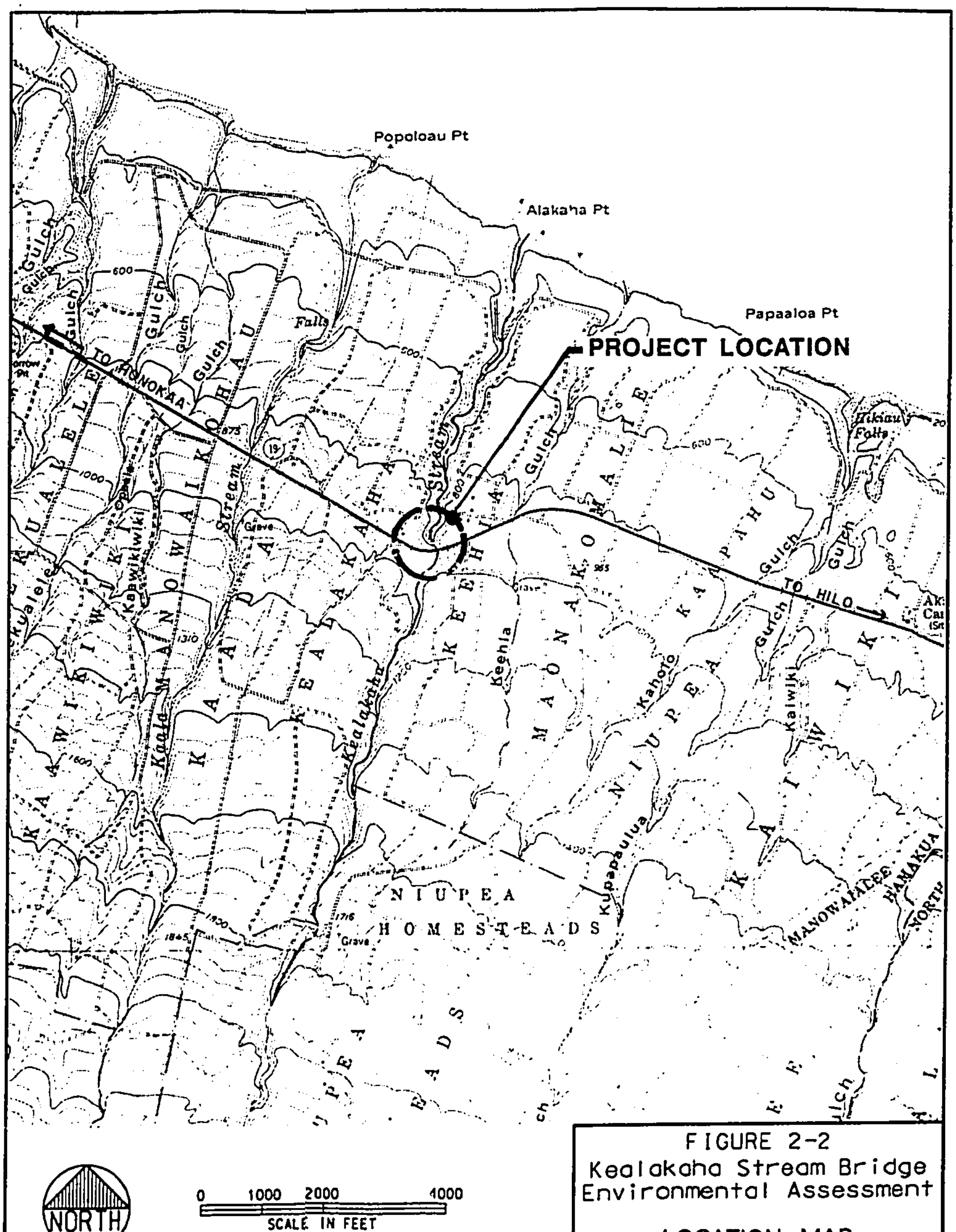


FIGURE 2-2
Kealakaha Stream Bridge
Environmental Assessment

LOCATION MAP

Source: USGS MAP, KUKAIAU, QUADRANGLE

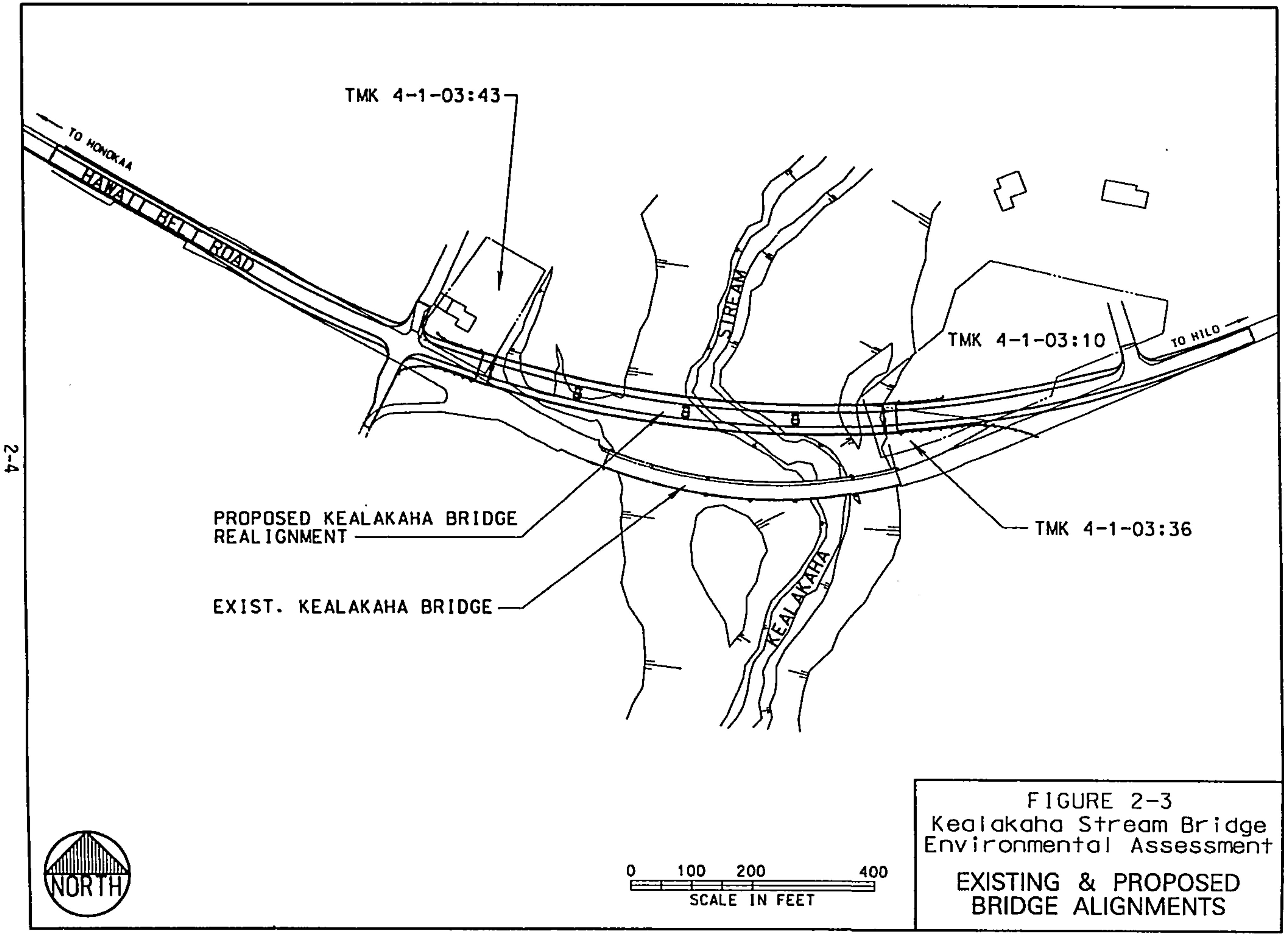


FIGURE 2-3
Kealakaha Stream Bridge
Environmental Assessment

EXISTING & PROPOSED
BRIDGE ALIGNMENTS

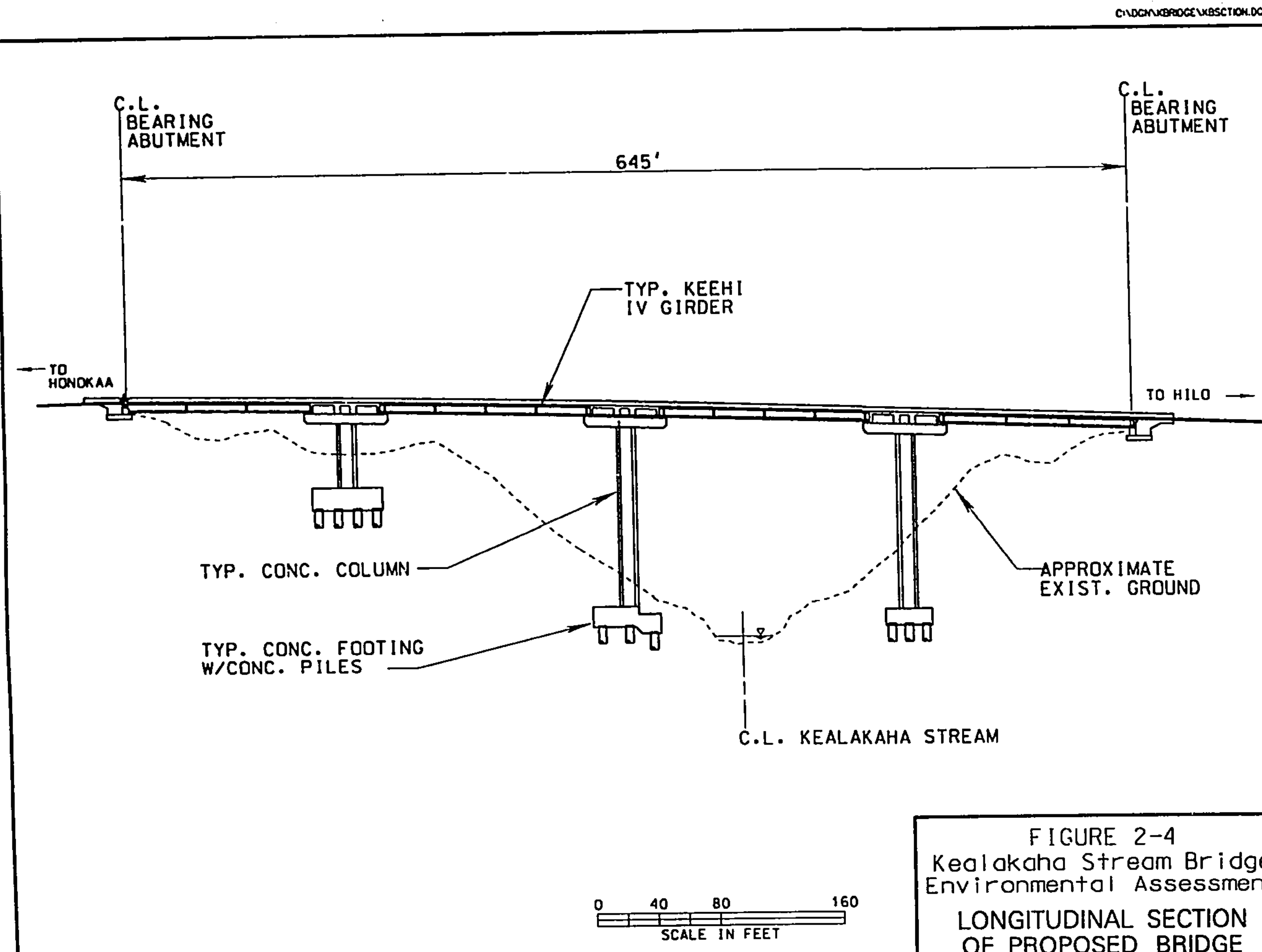


FIGURE 2-4
Kealakaha Stream Bridge
Environmental Assessment

LONGITUDINAL SECTION OF PROPOSED BRIDGE

Coast that the State has scheduled for replacement. A wider structure with a more direct alignment will be constructed to provide a safer and more efficient route between east and west Hawaii.

Under current design standards, the existing bridge does not meet the stopping sight distance requirements for crest vertical curves or horizontal curves to satisfy a 45 mph design speed. With a posted speed limit on the bridge of 40 mph and a design speed of 45 mph (design speed is usually 5 mph higher than the posted speed), the required curve length should be 950 feet versus the actual distance of 600 feet for crest vertical curves and the stopping sight distance should be 400 feet versus 255 feet for horizontal curves. The existing conditions would accommodate a posted speed of 25 mph.

The existing bridge also does not provide efficient traffic flow. Drivers are inconvenienced and traffic slows when two large trucks or similar vehicles cannot pass on the bridge in opposite directions at the same time. Cars must wait outside the bridge while each truck crosses.

According to information received from the State Department of Transportation, the existing bridge is also showing signs of structural wear and sustained damage to the rocker bearings during an earthquake.

Based on the information received from the Hawaii State Earthquake Advisory Board, from data compiled by the U.S. Geological Survey, the State Highway Bridge Design Engineer (Hawaii DOT) amended the acceleration coefficients (Hawaii County) found in the current AASHTO Standard Specifications for Highway Bridges to higher values due to the seismic sensitivity of the area. Currently, the State as well as the County of Hawaii are proceeding with seismic retrofitting of numerous bridge structures along the Hamakua Coast using the higher acceleration coefficient values. The estimated acceleration coefficient value used for this project is 0.35.

CHAPTER 3
ALTERNATIVES CONSIDERED

Two alternatives to the proposed action were considered.

NO ACTION

In the "no action" scenario, use of the existing bridge would continue, despite the substandard conditions. Specifically, the stopping sight distance requirements for both crest vertical and horizontal curves under present design standards cannot be achieved. Lowering the posted speed limit from 40 mph to less than 30 mph would be recommended under this alternative.

In addition, drivers would continue to be inconvenienced by slow or stopped traffic when large trucks cross the bridge.

This alternative is not acceptable because of the potential impacts to public safety.

DIFFERENT ALIGNMENT

An alternative alignment along a centerline radius of 1,400 feet was considered. The bridge would be 550 feet long and 50 feet wide, with three piers ranging from 90 to 140 feet in height and four spans ranging from 130 to 160 feet. An advantage of this alternate alignment is less impact to the nearby residents due to the smaller radius. However, the stream crossing associated with the more compact radius is longer, impacting the size of precast girders. Transport and erection of the larger, heavier girders would be more difficult due to steep terrain.

The estimated construction cost is $14 million.

This alternative is not acceptable for the following reasons:

1. The bridge abutment on the west end would be constructed on a steep slope.
2. Construction phasing may be more difficult since the alignment is closer to the existing bridge.
3. The steep slope of the gulch may necessitate constructing costly temporary or permanent retaining walls.
4. The lateral clearance is not sufficient for the stopping sight distance on horizontal curves for a design speed of 50 mph.

CHAPTER 4
SUMMARY DESCRIPTION OF THE AFFECTED ENVIRONMENT

PROJECT SITE

The project site lies almost entirely within Kealakaha Stream Gulch, which descends over 150 feet to a narrow, intermittent stream bed at the bottom. Elevation at the site ranges from 770 feet above mean sea level at the stream bed to about 930 feet at the proposed bridge abutments.

The channel of Kealakaha Stream is confined to a steep and narrow canyon about 100 to 150 feet deep. The stream bed is a mixture of large, loose boulders and smoothed, dense basalt. Sandy soil and small deposits of clay and silt are found scattered along the channel.

A few residential units are located on the makai (ocean) side of Hawaii Belt Road. The nearest home is about 70 feet from the existing roadway. There are no commercial establishments in the immediate vicinity of the project site. The area was primarily used for sugar cane cultivation.

Existing Bridge

Built in 1935 as part of Hawaii Belt Road, Kealakaha Stream Bridge was constructed of concrete girders and cast-in-place concrete slab supported by concrete columns on spread footings. There are two 11-foot wide lanes with a 5-foot wide sidewalk on the makai side of the bridge. The six-span, concrete T-beam bridge measures approximately 483 feet long, with a centerline radius of 764.5 feet and a superelevation rate of 5.2 percent. Ornamental features included haunched girders, brackets under the railings, molded pier columns, and molded railings. The posted speed limit on the bridge is 40 mph.

Kealakaha Stream Bridge is classified as a Category I historic bridge by the State of Hawaii Department of Land and Natural Resources Historic Preservation Division. Category I includes bridges with the most claim to historical significance. Any alterations to the bridge must be approved by the Historic Preservation Division. Due to its historic significance, the existing bridge will not be demolished. Instead, the Department of Transportation is considering maintaining the existing bridge as an overlook for pedestrian or other use.

LAND OWNERSHIP

Additional land on both the Hamakua and Hilo sides of the bridge will be needed since the proposed bridge will be approximately 160 feet longer than the existing bridge. These lands are presently owned by the State of Hawaii and a private land owner (**Figure 4-1**). Additional right-of-way requirements are estimated to be 2.65 acres, based on side slope grading at a ratio of 2 ft horizontal to 1 ft vertical.

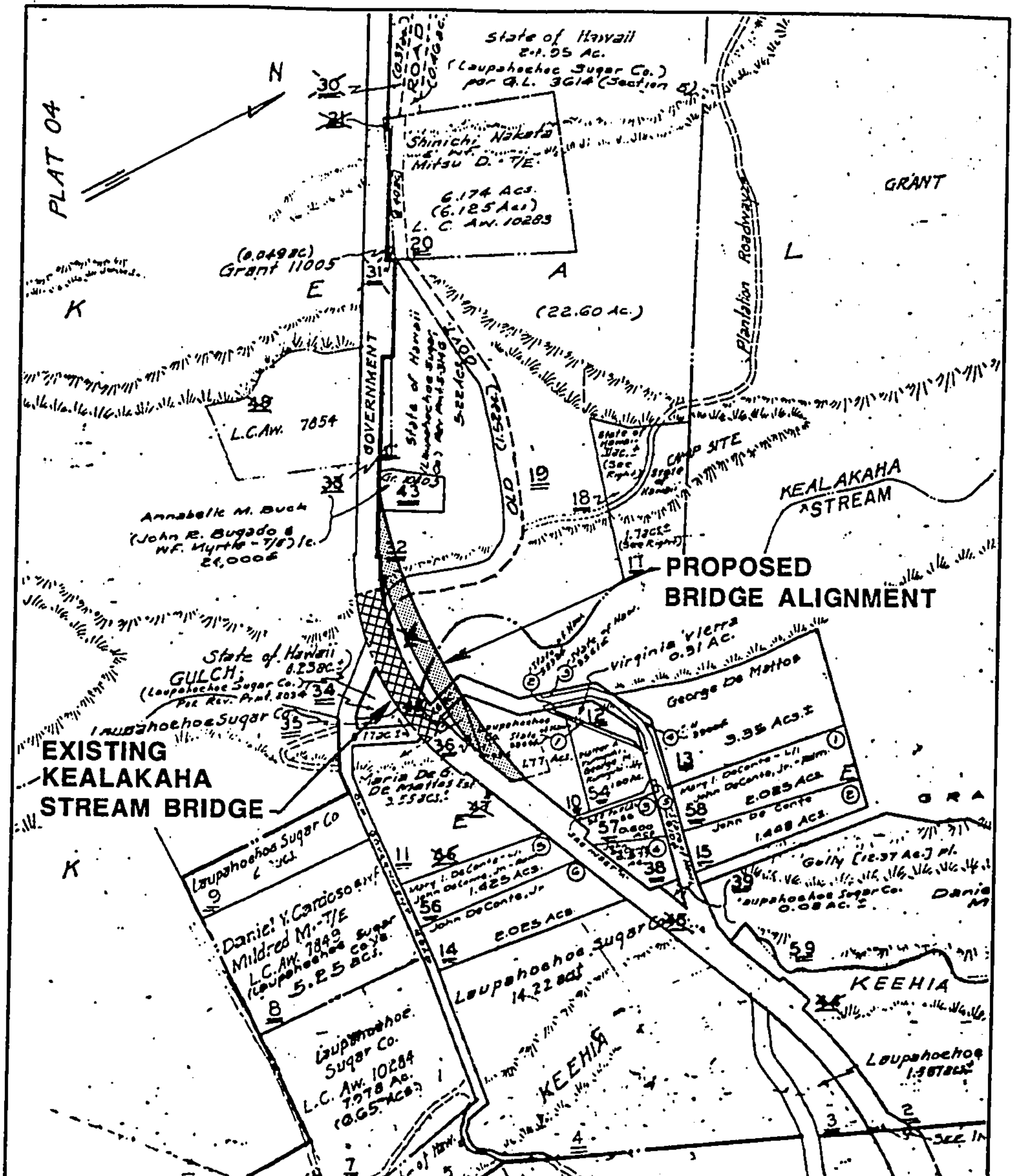


FIGURE 4-1
Kealakaha Stream Bridge
Environmental Assessment

TMK MAP 4-1-03

TOPOGRAPHY

Volcanic activity has shaped the topography of the island. Where volcanic flows have not recently occurred, such as at the project site, the terrain has been eroded by rivers and streams.

Wave action has formed the high sea cliffs bordered by narrow strips of land that are found along the Hamakua Coast.

GEOLOGY/SOILS

Geologically, the Island of Hawaii is the youngest island in the Hawaiian group. The island was formed by the outpouring of lava from five volcanoes: Mauna Kea, Mauna Loa, Kilauea, Hualalai, and Kohala. The land at the project site has been formed by lava flows from Mauna Kea and by the build up of olivine basalt and volcanic ash.

Soil types are identified in *Soil Survey of Island of Hawaii, State of Hawaii* (U.S. Department of Agriculture, Soil Conservation Service, December 1973). The soil in the project area is categorized as silty clay loam of the Ookala Series with 12 to 20 percent slope. The surface layer is dark reddish-brown loam about 12 inches thick, while the subsoil is dark brown to dark yellowish-brown loam about 43 inches thick. This layer is underlain by dark grayish-brown, partly weathered Aa lava fragments.

Permeability is moderately rapid, runoff is medium, and erosion hazard is moderate. This type of soil is primarily used for sugar cane cultivation.

Land in Kealakaha Gulch is classified as rough broken land (RB), which is comprised of very steep, precipitous land broken by intermittent drainage channels. Slopes may range from 35 to 70 percent. Stone and rock outcrops are common on these lands.

CLIMATE

The project site is located on the northeast side of the island and is subject to prevailing northeast tradewinds throughout most of the year. During the winter months, the tradewinds tend to weaken and give way to kona (southerly) winds.

Annual rainfall ranges from approximately 75 to 150 inches. Rainfall is heaviest between December and March; the drier months are between June and September. Kealakaha Gulch is prone to frequent flooding due to the heavy rainfall.

There is little seasonal or diurnal temperature variation. The annual average temperature ranges from a high of 75°F at sea level to 68°F at the 2,000-foot elevation. The warmest months are July and August; the coolest are January and February.

FLOOD AND TSUNAMI HAZARD

According to the Department of Land and Natural Resources, a Federal Emergency Management Area (FEMA) Community Map, identifying areas prone to flooding, has not been printed for the project area; and the project site is located in an area of minimal tsunami inundation.

STATE AND COUNTY LAND USE DESIGNATION

The proposed site is located within the State Land Use Agricultural District (**Figure 4-2**). The Hawaii County General Plan has designated the project land for intensive and extensive agricultural uses. The County of Hawaii has zoned the site A-40A (Agriculture - 40-acre minimum lot size). The project site is situated outside of the county's Special Management Area.

FLORA

A botanical survey was conducted by Char & Associates in July 1994. See **Appendix A** for the complete report.

Two vegetation types (mixed forest and roadside vegetation) are identified in the survey. The mixed forest type is found on the slopes and bottom of the gulch and along the stream. On the level areas outside the gulch, vegetation primarily consists of various grasses and weedy herbaceous species. **Table 4-1** lists the various types of vegetation identified at the site. No wetlands were identified.

Only seven native plant species were found during the survey: ohi'a (Metrosideros polymorpha), mamaki (Pipturus albidus), hapu'u (Cibotium glaucum), ho'i'o (Diplazium sandwichianum), Pycreus polystachyos, pakahakaha (Pleopeltis thunbergiana), and Macrothelypteris torresiana. The first four plant species are endemic and the others are indigenous. All of these plants can be found in similar environments throughout the state.

The study concludes that none of the plants found at the site are a listed, proposed, or candidate threatened or endangered species, nor is any considered rare or vulnerable. Therefore, the proposed project will not have a significant impact on the botanical resources at the site. The U.S. Fish and Wildlife Service concurs with the determination that the proposed action will not affect federally listed threatened or endangered species, and believes that requirements of Section 7 of the Endangered Species Act have been satisfied.

AQUATIC SURVEY

A survey of Kealakaha Stream was conducted by AECOS, Inc. in July 1994 to assess the aquatic resources at the project site. See **Appendix B** for the complete report. The area surveyed was limited to the segment of Kealakaha Stream in the immediate vicinity of the project site, approximately 500 feet downstream and 2,000 feet upstream from the highway.

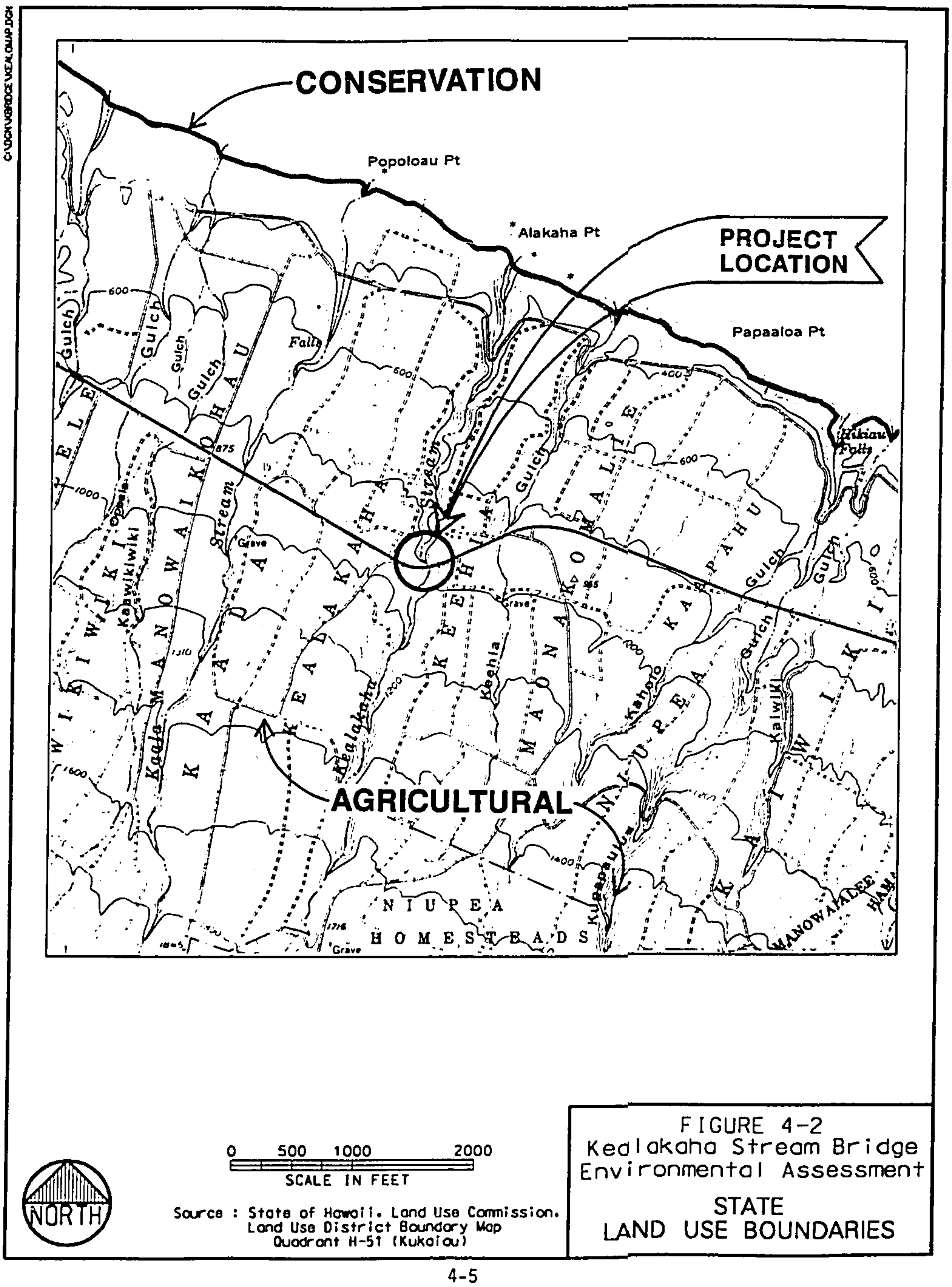


FIGURE 4-2
Kealakaha Stream Bridge
Environmental Assessment

STATE
LAND USE BOUNDARIES

TABLE 4-1
BOTANICAL SURVEY SUMMARY

SPECIES	COMMON NAME	MIXED FOREST			ROADSIDE			NATIVE SPECIES
		WEST SLOPE	EAST SLOPE	ALONG STREAM	WEST END	EAST END	LOW RIDGE	
Adiantum raddianum	Maidenhair Fern			X				
Aleurites moluccana	Kukui Tree	X	X	X				
Bidens alba					X			
Brachiaria mutica	California Grass	X			X			
Casuarina equisetifolia	Ironwood Tree	X						
Chamaecrista nictitans	Partridge Pea					X		
Christella parasitica	Wood Fern		X			X		
Cibotium glaucum	Tree Fern (Hapuu)		X					X
Commelina diffusa	Honohono				X	X		
Cordyline fruticosa	Ti Leaf		X					
Desmodium incanum	Ka'imi	X			X			
Desmodium triflorum	3-Flowered Beggarweed				X			
Diplazium sandwichianum	Hoio							X
Drymaria cordata	Pilipili				X			
Eriobotrya japonica	Loquat						X	
Galinsoga parviflora	Galinsoga					X		
Hedychium flavescens	Yellow Ginger			X				
Impatiens wallerana	Impatiens		X					
Litchi chinensis	Lychee Tree				X			
Livistonia chinensis	Chinese Fan Palm		X					
Macrothelypteris torresiana			X					X
Mangifera indica	Mango Tree		X	X				
Melinis minutiflora	Molasses Grass	X				X	X	
Melochia umbellata	Melochia		X					
Metrosideros polymorpha	Ohia Tree		X				X	X
Mimosa pudica	Sensitive Plant					X		
Murdannia nudiflora						X		
Nephrolepis multiflora	Hairy Sword Fern						X	

TABLE 4-1 (Continued)
BOTANICAL SURVEY SUMMARY

SPECIES	COMMON NAME	MIXED FOREST			ROADSIDE			NATIVE SPECIES
		WEST SLOPE	EAST SLOPE	ALONG STREAM	WEST END	EAST END	LOW RIDGE	
Oplismenus compositus	Basketgrass	X	X					
Paspalum conjugatum	Hilo Grass					X		
Paspalum urvillei	Vasey Grass				X			
Persea americana	Avocado		X				X	
Pipturus albidus	Mamaki	X						X
Pityrogramma calomelanos	Silver Fern						X	
Plantago major	Plantain				X	X		
Pleopeltis thunbergiana	Pakahakaha							X
Pluchea symphytifolia	Pluchea	X				X	X	
Polygala paniculata	Milkwort					X		
Psidium cattleianum	Strawberry Guava		X					
Psidium guajava	Guava	X		X			X	
Pycreus polystachyos						X		X
Rhynchelytrum repens	Natal Redtop Grass					X		
Sacciolepis indica	Glenwood Grass					X		
Setaria gracilis	Yellow Foxtail					X		
Spermacoce mauritiana						X		
Stachytarpheta dichotoma	Owi						X	

At the time of the survey, no flowing water was found at the proposed site. There were, however, numerous scattered pools that harbored some aquatic fauna, mostly insects. **Table 4-2** lists the animals that were observed or reported. No fishes or crustaceans were observed in any of the pools.

Despite the fact that only limited aquatic habitat were observed at the time of the survey, Kealakaha Stream should not be dismissed as of little aquatic resource value. A high rainfall belt exists on the southeast slope of Mauna Kea, which is known to have numerous perennial streams that harbor native aquatic fauna. Many of these native Hawaiian stream fauna may migrate between fresh water and the sea during high flow periods, some by way of Kealakaha Stream. Construction activities may have a short-term impact on water quality. Long-term impacts, however, should not be significant since the bridge supports will be located outside of the stream bed.

AIR QUALITY

An air quality study was conducted by J.W. Morrow in August 1994. See **Appendix C** for the complete report.

The State Department of Health reduced its neighbor island air quality monitoring network in 1985. Consequently, there has been no permanent air monitoring of regulated pollutants in East or West Hawaii after 1985. The latest available data from stations in Hilo and Honokaa indicate that total suspended particulate matter and sulfur dioxide standards in the area are below the standard, established by the State Department of Health. The investigator concluded that air quality probably continues to be good most of the time based on the historical monitoring data (1972-1985) and given the rural, undeveloped nature of the project site.

Onsite air sampling was conducted on August 10 and 11, 1994. A sampling site was set up within 10 meters of the road's edge on the southeast side in the morning and on the northwest side during the afternoon peak traffic hours. Carbon monoxide and onsite surface wind data were gathered. A manual traffic count was also performed. On the afternoon of August 10, wind speed was less than 9 mph, with winds from the east. On the morning of August 11, winds were less than 5 mph, with wind direction initially from the south and then from the east.

Modeling was performed for the Kealakaha Stream Bridge segment on Hawaii Belt Road to evaluate existing (1994) and future (2004) conditions. Carbon monoxide was selected for modeling because it comprises the largest fraction of automotive emissions and has a relatively long half-life in the atmosphere. The results of the modeling suggest that current carbon monoxide levels are well below the federal and state standards and there should only be a slight increase in the future.

TABLE 4-2
CHECKLIST OF AQUATIC ANIMALS OBSERVED OR REPORTED FROM KEALAKAHA STREAM

SPECIES	COMMON NAME	STATUS	ABUNDANCE
INVERTEBRATES			
ARTHROPODA, INSECTA			
Coleoptera - Dytiscidae			
Rhantus pacificus (Boisduval)*	Diving Beetle (larva)	Ind.	Common
Rhantus pacificus (Boisduval)*	Diving Beetle (adult)	Ind.	Common
Odonata - Aeshnidae			
Anax cf. junius (Drury)	Pinao, Darner (adult)	Ind.(?)	Uncommon
Odonata - Libellulidae			
Pantala flavescens Fabricius*	Skimmer, Dragonfly (naiad)	Ind.	Common
Pantala flavescens Fabricius	Skimmer, Dragonfly (adult)	Ind.	Common
VERTEBRATES			
AMPHIBIANS - RANIDAE			
Rana catesbeiana Shaw	American Bullfrog	Nat.	Uncommon

* Identification made by Dan A. Polhemus of the Bishop Museum, Entomology Department.

NOISE AND VIBRATION

Y. Ebisu and Associates assessed future traffic noise levels in the vicinity of the proposed project (see **Appendix D** for the complete report).

Presently there are three dwelling units within 300 feet of the proposed bridge that will be affected by noise. Of the three units, the closest residence is situated about 50 feet from the proposed bridge. There are no other residences or commercial establishments nearby. Due to the higher design speed on the proposed bridge and the reduced buffer distance between the highway and the nearest residence, the estimated traffic noise level will increase by several decibels (dB). This increased traffic noise level may exceed Federal Highway Administration and FHA/HUD standards without appropriate mitigation.

Typical levels of noise from construction activities (excluding pile driving) are shown on **Figure 4-3**. The noise level of impact pile drivers would be approximately 15 dB higher than the levels shown on the figure, while the noise level of vibratory pile drivers would be at the upper end of the range.

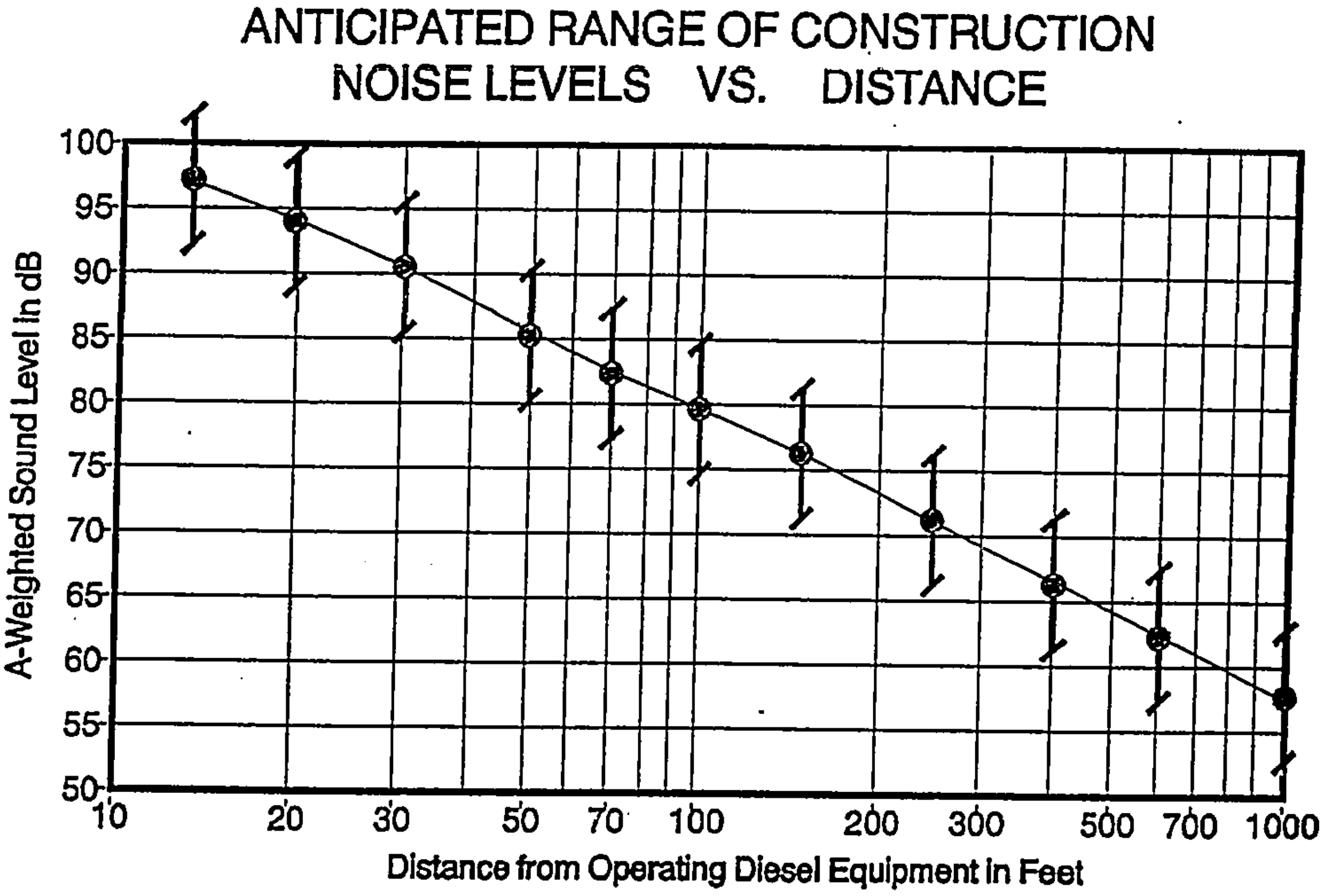
Vibrations from pile driving have the potential to cause structural damage. Ground vibrations are generally described in terms of peak particle (or ground) velocity in units of inches per second. Humans are very sensitive to ground vibrations, which may be perceptible at particle velocities of 0.01 to 0.04 inches/second. Structural damage, however, occurs at higher levels (see **Table 4-3**).

Figure 4-4 shows the estimated vibration levels that may be encountered for various soil conditions. When coral layers must be penetrated, the vibration loads are expected to be higher than those shown on the figure, particularly if adjacent structures are supported by the same coral layer.

ARCHAEOLOGICAL/HISTORIC SITES

An archaeological survey was conducted by Cultural Surveys Hawaii in August 1994. The complete report is included in **Appendix E**. The boundary of the area surveyed included a minimum 200-foot radius from both ends of the bridge, the gulch bottom, and (where accessible) the sides of the gulch under the bridge at least 100 feet mauka and 200 feet makai of the bridge deck edges.

The archaeological survey revealed that the top of the gulch at both ends of the bridge had been completely altered when the current bridge was constructed. All evidence of prior use was destroyed. The sides of the gulch are considered too steep for traditional and historic land use, except for transportation-related use. Past activities related to road and bridge construction were evident on the bottom of the gulch. Although there are some areas on the gulch floor large enough for agricultural use, such use appears unlikely since access is difficult due to the steep slopes, the area is prone to flooding, the stream does not provide a consistent water source, and the gulch floor receives little direct sunlight.



Source: Y. Ebisu & Assoc., Acoustic Study for the Kealakaha Stream Bridge Replacement, August 1995

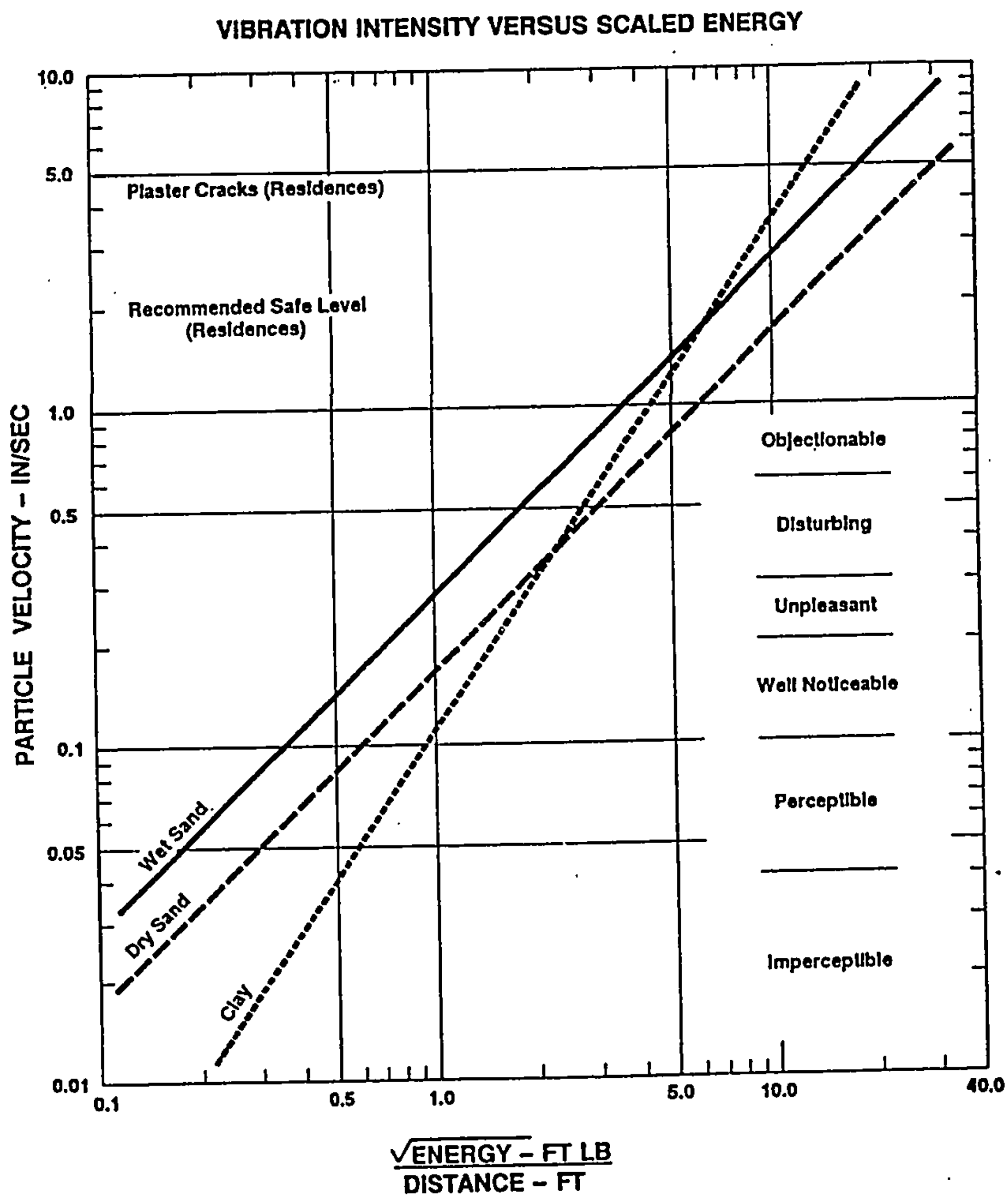
FIGURE 4-3
Kealakaha Stream Bridge
Environmental Assessment

CONSTRUCTION NOISE LEVELS VS. DISTANCE

TABLE 4-3
SUMMARY OF BUILDING DAMAGE CRITERIA

Peak Ground Velocity (mm/sec)	Peak Ground Velocity (in/sec)	Comment
193.04	7.60	Major damage to buildings (mean of data).
137.72	5.40	Minor damage to buildings (mean of data).
101.16	4.00	"Engineer Structures" safe from damage.
50.80	2.00	Safe from damage limit (probability of damage <5%).
		No structural damage.
33.02	1.30	Threshold of risk of "architectural" damage for houses.
25.40	1.00	No data showing damage to structures for vibration <1in/sec.
15.24	0.60	No risk of "architectural" damage to normal buildings.
10.16	0.40	Threshold of damage in older homes.
5.08	0.20	Statistically significant percentage of structures may experience minor damage (including earthquake, nuclear event, and blast data for old and new structures).
		No "architectural" damage.
3.81	0.5 to 0.15	Upper limits for ruins and ancient monuments.
1.00	0.04	Vertical vibration clearly perceptible to humans.
0.32	0.01	Vertical vibration just perceptible to humans.

Source: "State-of-the-Art Review: Prediction and Control of Groundborne Noise and Vibration from Rail Transit Trains"; U.S. Department of Transportation; December 1983.



Source: Y. Ebisu & Assoc., Acoustic Study for the Kealakaha Stream Bridge Replacement, August 1995

FIGURE 4-4
Kealakaha Stream Bridge
Environmental Assessment
MINIMUM VIBRATION INTENSITIES EXPECTED FROM PILE DRIVING

The only historic site identified by Cultural Surveys Hawaii is Kealakaha Stream Bridge itself. The present bridge is included in the *Historic Bridge Inventory and Evaluation, Island of Hawaii*, and has been assigned State Site #50-10-09-7512. In this inventory, bridges were grouped into seven construction types (masonry arch, timber girder, steel girder, concrete arch, concrete deck girder, concrete slab, or concrete culvert) and evaluated on the basis of integrity, historicity, and technology. Kealakaha Stream Bridge was judged the most significant of its type (concrete deck girder bridge) and was placed in Category I of the inventory, which contains bridges with the most claim to historical significance. Because of its historic significance, the existing bridge will not be demolished. The State Historic Preservation Division has recommended that the existing bridge be utilized and maintained as an overlook to prevent it from falling into ruins. The recommended treatment and ultimate use of the existing bridge will be coordinated by the State Department of Transportation and the State Historic Preservation Division.

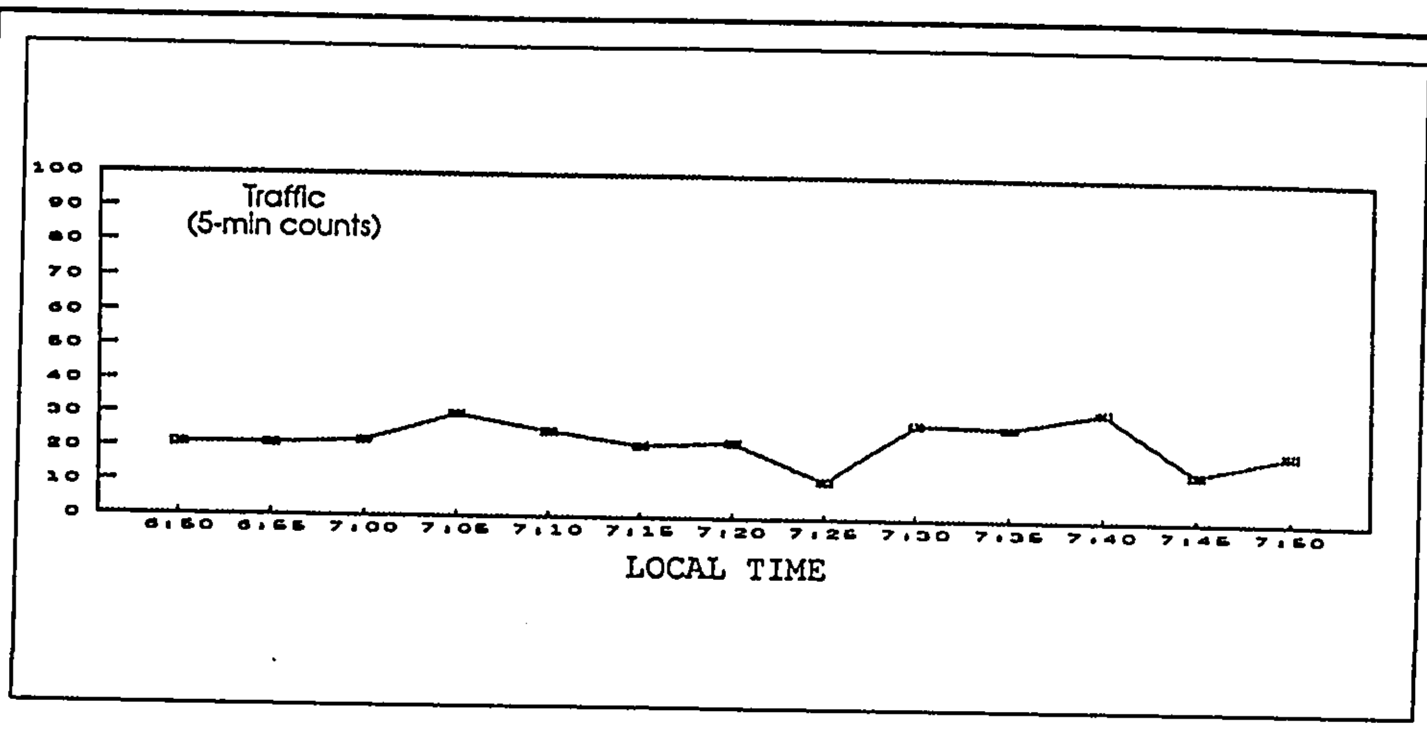
TRAFFIC

A manual traffic count was taken on Hawaii Belt Road in August 1994 during the morning and afternoon peak hours. **Figure 4-5** presents the results of this count.

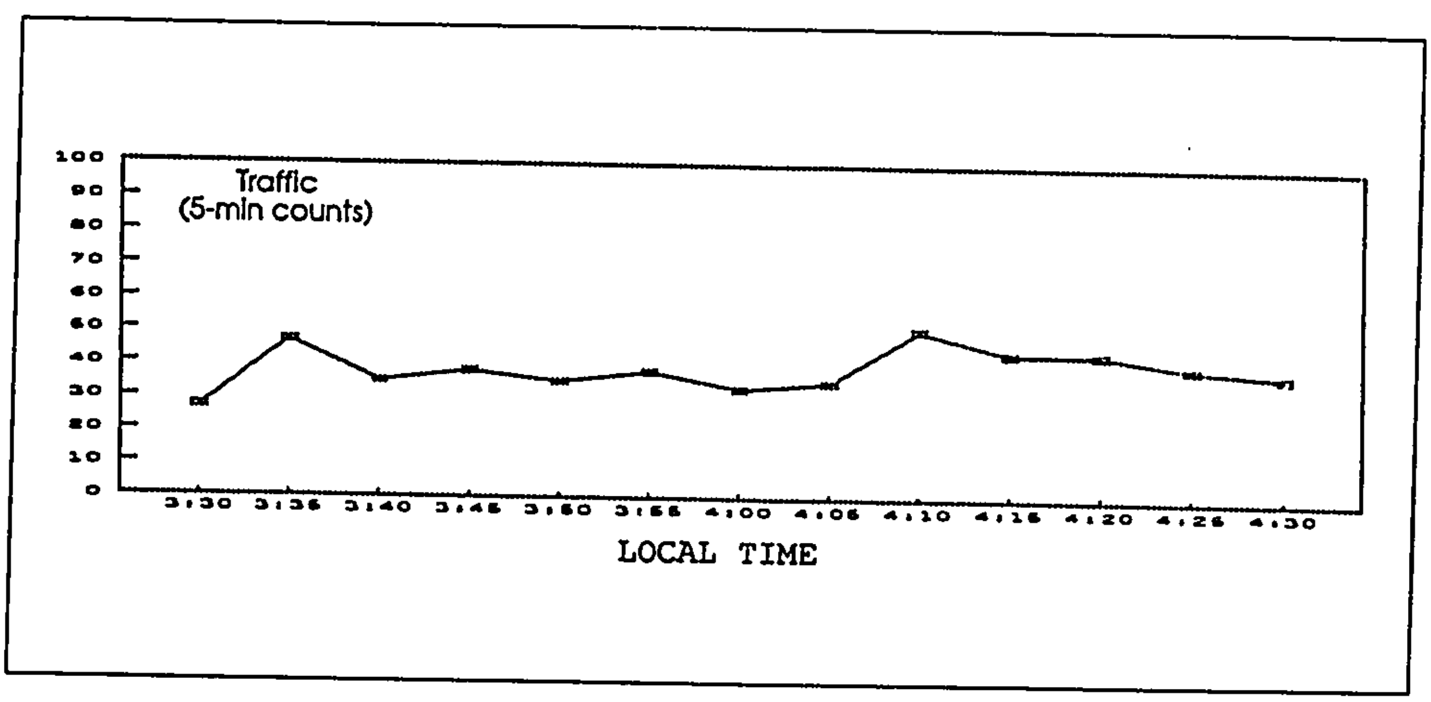
There should be no appreciable change in traffic volume due to the proposed project. Any increase in traffic would be due to population growth on the island. The Department of Transportation has indicated average daily traffic (ADT) to be 5,750 vehicles in 1995, and estimated the design year (2015) ADT to be 8,180 vehicles.

AESTHETICS

The view of the existing bridge will be altered by the proposed construction. However, the proposed bridge will provide a new vantage point from which to view the historic structure.



MORNING PEAK TRAFFIC
August 11, 1994



AFTERNOON PEAK TRAFFIC
August 10, 1994

Source : J.W. Morrow, Air Quality Impact Report,
August 20, 1994.

FIGURE 4-5
Kealakaha Stream Bridge
Environmental Assessment
TRAFFIC COUNT AT
KEALAKAHA STREAM BRIDGE

CHAPTER 5
IDENTIFICATION AND SUMMARY OF MAJOR IMPACTS AND PROPOSED MITIGATION MEASURES

This chapter identifies the major impacts attributable to the proposed project. Major impacts are categorized into short-term impacts (normally of short duration and confined to the length of the construction period) and long-term impacts (resulting from operational activities).

The proposed project is not expected to have any adverse social or economic impacts. Furthermore, it is not anticipated that the project will induce growth in the area. The proposed project merely replaces a structurally deficient bridge. The number of traffic lanes and, hence, its carrying capacity, will not increase.

SHORT-TERM IMPACTS

Short-term impacts during the construction period will include dust, air pollutant emissions, noise, vibration, and traffic disruptions from construction activities, construction vehicles, grading operations, and concrete and asphalt work. Trees and shrubs in the area of the proposed bridge will be removed and wildlife habitat will be destroyed. There may also be erosion of the cleared and graded areas by storm runoff.

Residents in the immediate vicinity of the project site will be affected by noise generated by earthwork and pile driving activities and from operation of concrete and asphalt concrete batching plants that emit particulate matter and other gaseous pollutants. The dwelling unit on TMK parcel 4-1-03:43 will probably be affected the most by noise since it is situated close to the project site. Other residential units are situated farther away.

A short-term gain would be the creation of jobs in construction and related fields, including suppliers of construction materials, and concrete and asphalt concrete plant staff.

LONG-TERM IMPACTS

A major long-term impact of the proposed project is the construction of a safer and more efficient bridge on Hawaii Belt Road, which is the main route between East and West Hawaii. The existing bridge exhibits signs of structural wear and does not meet current design standards.

Other impacts associated with the proposed project include increased traffic noise levels due to the higher design speed that will be especially apparent to residents north of the bridge. The carbon monoxide level may also increase slightly.

Electric and telephone lines will need to be relocated. Land acquisition will be required on both sides of the bridge due to its alignment, length and side slope grading.

MITIGATION MEASURES

Adverse construction-related impacts will be governed by federal, state, and county laws and the contract documents.

Air Pollution

Air quality degradation can be expected in the immediate vicinity of construction activity and is primarily attributable to fugitive dust and exhaust emissions from construction equipment and vehicles. To minimize air quality degradation, the contractor will be required to implement measures such as inspecting construction vehicles for exhaust emissions, watering to retard airborne dust and erecting dust screens. Erosion control measures will be employed as soon as possible.

Dust and air pollution control will be governed by Chapter 60, "Air Pollution Control", of Title 11, *Hawaii Administrative Rules*, State Department of Health.

Particulate matter and other gaseous pollutants may be generated from operation of the concrete and asphalt concrete batching plants. A permit must be obtained from the State Department of Health Clean Air Branch.

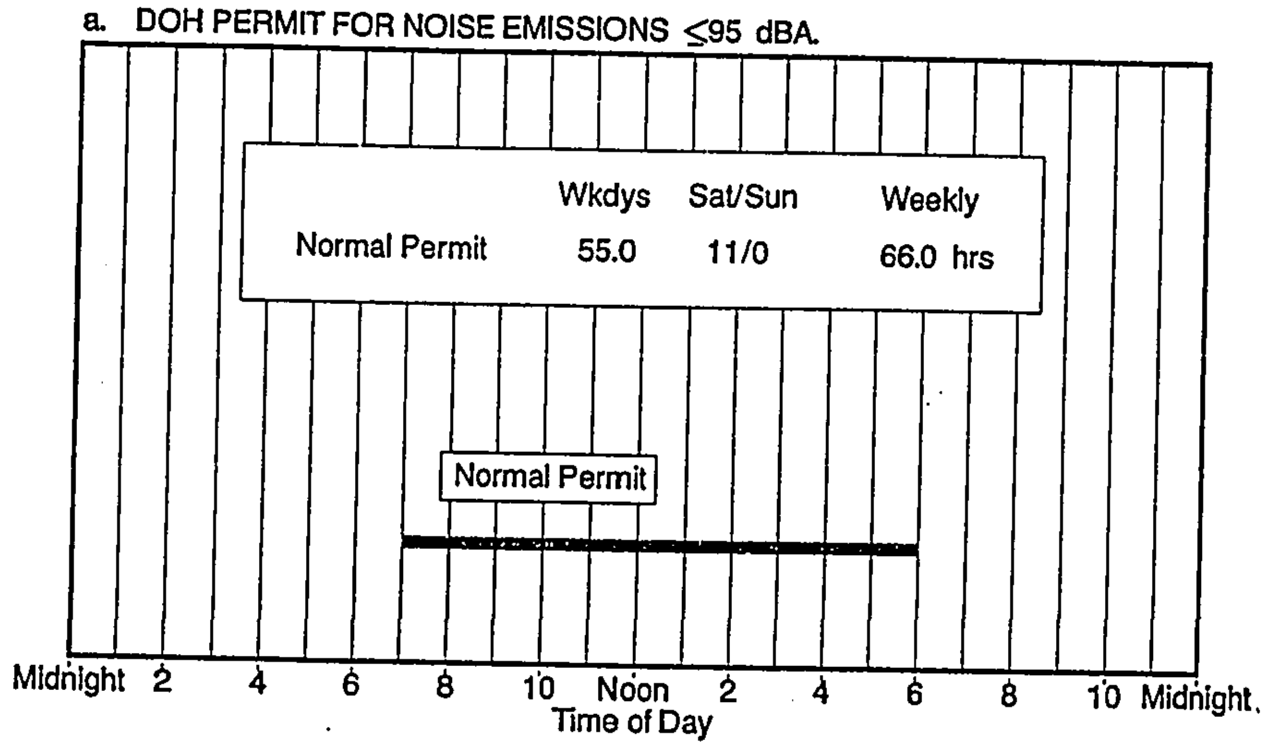
The neighboring residences shall be notified of any negative air quality conditions which may occur as a result of construction activities.

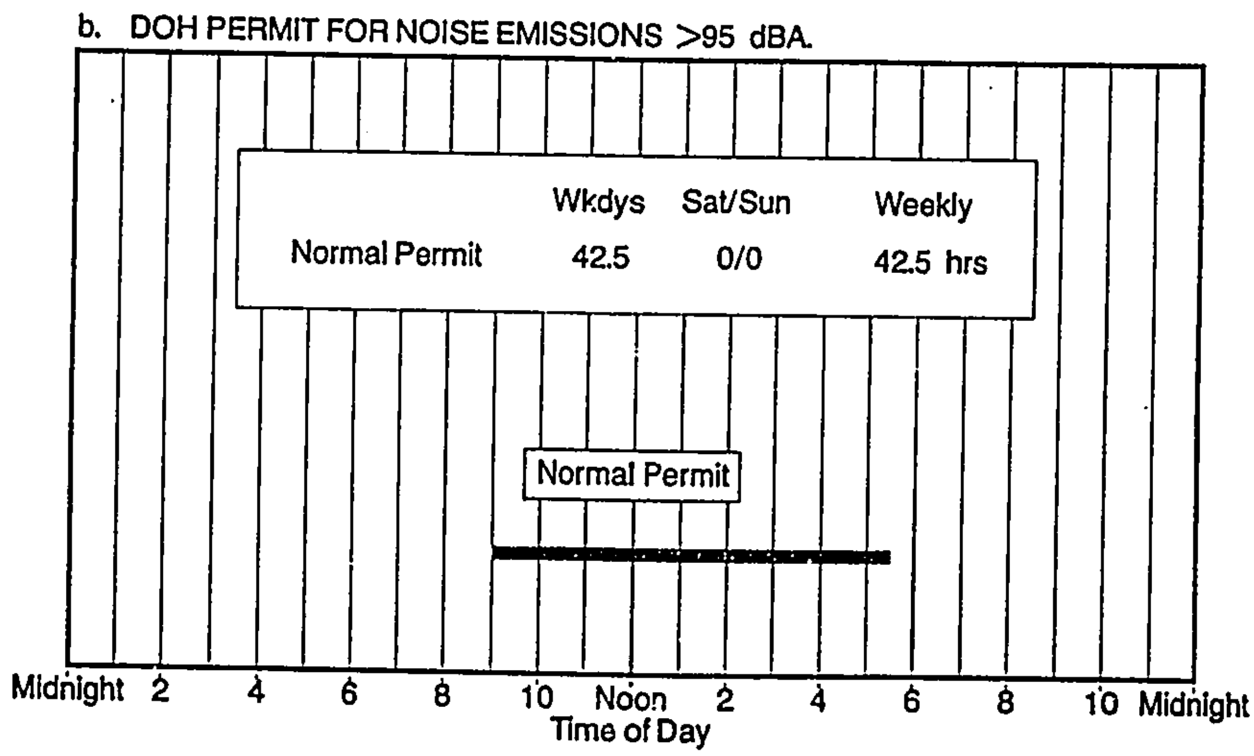
Noise and Vibration

It is not possible to mitigate construction noise generated by earthwork and pile driving operations to inaudible levels. The contractor will be required to install mufflers on construction equipment and onsite vehicles requiring an exhaust of gas or air. The contractor will also incorporate the allowed hours of construction for normal construction noise levels (less than or equal to 95 decibels) and for construction noise exceeding 95 decibels as shown in **Figure 5-1**. Pile driving operations generally fall in the second category, where such activities are not allowed on holidays, Saturdays, Sundays, before 9:00 AM, and after 5:30 PM. The contractor shall obtain a noise permit if noise levels from construction activities are expected to exceed the allowable levels in the regulations.

In addition, construction of a six-foot high sound attenuation wall at TMK 4-1-03:43 (**Figure 5-2**) will reduce traffic noise levels at the existing dwelling to meet Federal Highways Administration and FHA/HUD standards for residences.

Noise will be governed by applicable Hawaii County and State Department of Health regulations, including Chapter 11-46, "Community Noise Control" of Title 11, Hawaii Administrative Rules, State Department of Health. It is also suggested that Chapter 42, "Vehicular Noise Control for Oahu," and Chapter 43, "Community Noise Control for Oahu," be incorporated for this project. The following limitations are included:





Source: Y. Ebisu & Assoc., Acoustic Study for the Kealakaha Stream Bridge Replacement, August 1995

FIGURE 5-1
Kealakaha Stream Bridge
Environmental Assessment
AVAILABLE WORK HOURS UNDER
DOH PERMIT PROCEDURES
FOR CONSTRUCTION NOISE

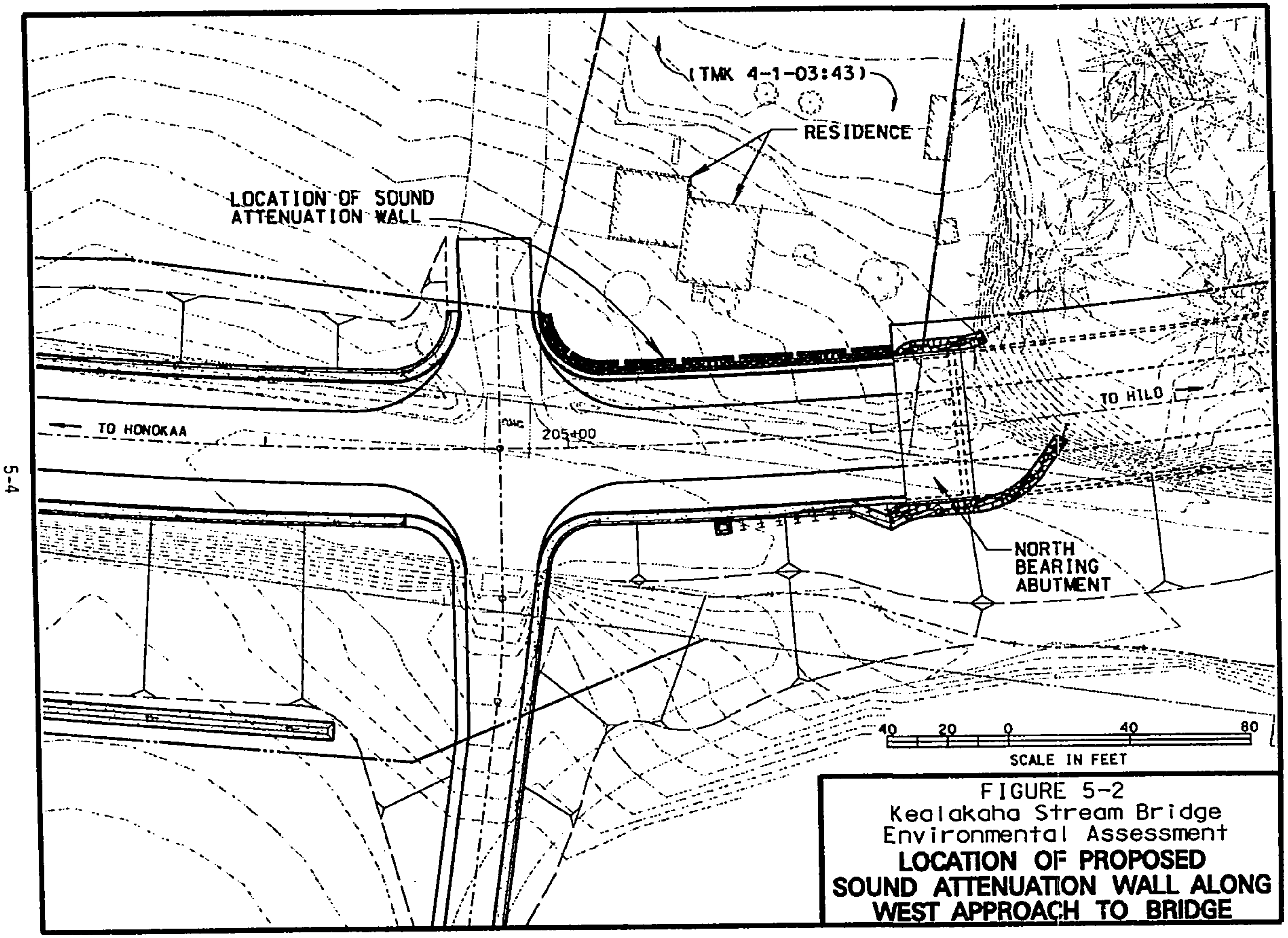


FIGURE 5-2
Kealakaha Stream Bridge
Environmental Assessment
LOCATION OF PROPOSED SOUND ATTENUATION WALL ALONG WEST APPROACH TO BRIDGE

1. No construction activities shall create excessive noise when measured at or beyond the property line for the hours before 7:00 AM and after 6:00 PM of the same day.

2. No construction activities shall emit noise in excess of 95 dBA at or beyond the property line of the construction site, except between 9:00 AM and 5:30 PM of the same day.

3. No construction activities shall exceed the 95 dBA noise level on Saturdays, Sundays, and on holidays.

Seismograph monitoring of ground vibrations during pile driving operations is recommended because of the potential for damage to nearby residences. It is also recommended that design of the supporting piles and the construction methods used be optimized such that the risk of damage to adjacent structures is minimized. Alternate types of piles or foundations may also be considered.

Traffic

During construction of the proposed bridge, motorists using Hawaii Belt Road in the vicinity of the project site will experience traffic inconveniences. Traffic will be interrupted periodically by trucks hauling construction material to the site and by concrete batch trucks. Through traffic may also be limited to one lane on Hawaii Belt Road in the immediate vicinity of construction.

Construction of the proposed bridge will proceed in phases and will involve temporary traffic detouring. A temporary road adjacent to the mauka shoulder will be built in order to maintain through traffic.

The contractor shall conform to the requirements of the Federal Highway Administration, *Manual on Uniform Traffic Control Devices for Streets and Highways, Part VI*, "Traffic Controls for Highway Construction and Maintenance Operations" and the "Rules and Regulations Governing the Use of Traffic Control Devices at Work Sites on or Adjacent to Public Streets and Highways," of the Highway Safety Coordinator.

Other conditions that may be imposed on the contractor to minimize traffic disruptions include--

1. Covering the trenches with steel plates during nonworking hours.
2. Opening all lanes to traffic during nonworking hours.
3. Hiring special duty police officers to direct the flow of traffic.
4. Maintaining all accesses to and from driveways and public streets in passable condition.

Stream Water Quality

If practicable, construction should be scheduled during the drier months of the year in order to reduce adverse water quality impacts.

Erosion

During construction, temporary erosion control measures may include mulching to protect the exposed areas; constructing temporary berms, drains, sediment traps, and siltation basins; hydromulching or seeding with quick-growing grasses; or other appropriate measures. If possible, construction should be scheduled so that most of the grading work is completed during the drier months.

Permanent erosion control measures may include planting ground cover on all exposed slopes. Rock revetments and fast-growing plants may be used to protect new areas exposed to stream flow. Drainage outlets may be protected by rock or other dissipators to reduce the discharge velocity from the outlet structures.

The contractor shall comply with the requirements of Section 639, "Temporary Project Water Pollution Control (Soil Erosion)," of the *Standard Specifications for Road and Bridge Construction*, State of Hawaii.

All earthwork and grading shall be in conformance with Chapter 10, "Erosion and Sediment Control", of the Hawaii County Code.

Botanical Resources

Wherever possible, as little of the vegetation in the gulch should be disturbed, and areas cleared of vegetation should be replanted as soon as possible to prevent soil erosion and the discharge of sediment into the Kealakaha Stream.

Aquatic and Riparian Resources

Approximately 3.7 acres of riparian vegetation will be removed in order to access sites where bridge footings will be constructed. The stream and adjacent riparian habitat support several endemic and indigenous plant and aquatic species. As recommended by the U.S. Fish and Wildlife Service, the following mitigation measures will be incorporated into the project to minimize impacts to aquatic and riparian resources.

1. All project-related materials shall be placed or stored in ways to avoid or minimize disturbance to the aquatic environment.

2. All project-related materials shall be free of pollutants.

3. No contamination of the aquatic environment (e.g. trash and debris disposal) shall result from project activities.

4. A contingency plan to control accidental spills of petroleum products shall be developed. Absorbent pads and containment booms shall be stored onsite to facilitate cleanup of petroleum spills.

5. Turbidity and siltation from excavation activities shall be minimized and contained to the immediate vicinity of excavation through the use of effective silt containment devices and the curtailment of excavation during adverse weather conditions.

6. Upon completion of the project, all stream bank areas cleared for the project shall be revegetated with native or Polynesian-introduced plants. The U.S. Fish and Wildlife Service recommends revegetating the cleared area with kukui tree (*Aleurites moluccana*), tree fern or hapu'u (*Cibotium glaucum*), and ohia tree (*Metrosideros polymorpha*).

Archaeological/Historic Sites

In an inventory of historic bridges on the Island of Hawaii, Kealakaha Stream Bridge was placed in Category I, which contains bridges with the most claim to historical significance. This bridge was ranked first in order of significance for concrete deck girder bridges. There are no other known archaeological or cultural sites in the project area.

Due to its historic significance, the State Historic Preservation Division has declared that there can be no impact on the existing bridge. It was therefore decided by the State Department of Transportation that the existing bridge would not be demolished and that a new bridge would be constructed adjacent to the old. The Department of Transportation is considering maintenance of the existing bridge for pedestrian use.

CHAPTER 6
CONSULTATION

PARTICIPANTS

This environmental assessment was prepared for the state Department of Transportation by Engineering Concepts, Inc. The following organizations were also involved in preparation of this report.

Organization	Area of Expertise
AECOS, Inc.	Water Quality, Aquatic Biota
Char & Associates	Botanical Resources
ControlPoint Surveying, Inc.	Topographic Survey
Cultural Surveys Hawaii	Archaeology, Cultural/Historical Significance
Y. Ebisu & Associates	Noise
Hawaii Geotechnical Group, Inc.	Geotechnical Engineering
Harold T. Miyamoto & Assoc., Inc.	Structural Engineering
J.W. Morrow	Air Quality

PARTIES CONSULTED DURING PREPARATION OF THE FINAL EA

The following list of 27 agencies, organizations and individuals were consulted with in preparation of the EA. Those who responded with comments are marked with an asterisk (*). Those who responded with no comments are marked with a plus (+). A total of 10 letters were received. Copies of all comment and response letters are included in Appendix F.

Federal Agencies

U.S. Army Corps of Engineers
U.S. Department of Agriculture, Natural Resources Conservation Service
* U.S. Department of the Interior, Fish and Wildlife Service

State Agencies

State Representative, District 1
State Senator, District 1
Department of Agriculture
* Department of Business, Economic Development and Tourism, Land Use Commission
* Department of Health, Environmental Management Division
* Department of Land and Natural Resources, Land Division
* Department of Land and Natural Resources, State Historic Preservation Division
* Office of Environmental Quality Control
Office of Hawaiian Affairs
Office of State Planning

University of Hawaii, Environmental Center

County Agencies

Councilmember, District 1
+ Fire Department
* Planning Department
Police Department
* Department of Public Works

Others

American Lung Association
GTE Hawaiian Tel
Hawaii Electric Light Company, Inc.
* Brenda Carreira
John Dale, Western Farm Credit Bank
Gerald Carter, Hamakua Development Council
Lucille Chung, North Hilo Community Council
Lorraine Mendoza, Rural South Hilo Community Association

PUBLIC NOTIFICATION

Availability of the Draft EA was published in the September 23 and October 8, 1996 issues of "The Environmental Notice" (a semi-monthly bulletin of the Office of Environmental Quality Control).

In addition, notices were published in the Honolulu Advertiser on September 20, 1996 and the Hawaii Tribune-Herald on September 17, 1996. These newspaper notices announced the availability of the Draft EA for public review and afforded an opportunity to request a public hearing on construction of the proposed project. No requests for public hearing were received in response to the newspaper notices.

CHAPTER 7
REFERENCES

1. City and County of Honolulu, Department of Public Works, Soil Erosion Standards and Guidelines, November 1975.

2. County of Hawaii, Land Use Pattern Allocation Guide Map, County of Hawaii General Plan, November 1989.

3. Engineering Concepts, Inc., Evaluation of Proposed Alignments for the Kealakaha Stream Bridge Replacement, January 1995.

4. State of Hawaii, Department of Land and Natural Resources, Conservation District Inventory - Island of Hawaii.

5. State of Hawaii, Department of Land and Natural Resources, Prime Forest Land Inventory.

6. State of Hawaii Land Use District Map

7. U.S. Dept. of Agriculture Soil Conservation Service, Erosion and Sediment Control Guide for Hawaii, March 1981.

8. U.S. Dept. of Agriculture Soil Conservation Service, Soil Survey of Island of Hawaii, State of Hawaii, December 1973.

9. U.S. Federal Emergency Management Agency, National Flood Insurance Program, Flood Insurance Rate Map, Hawaii County, Hawaii, July 16, 1990.

10. University of Hawaii, Dept. of Geography, Atlas of Hawaii, second edition, 1983.

APPENDIX A

Botanical Resources Assessment, Kealakaha Stream
Bridge Replacement, Hamakua District, Island of Hawaii

BOTANICAL RESOURCES ASSESSMENT
KEALAKAHA STREAM BRIDGE REPLACEMENT
HAMAKUA DISTRICT, ISLAND OF HAWAI'I

by

Winona P. Char

CHAR & ASSOCIATES
Botanical Consultants
Honolulu, Hawai'i

Prepared for: Engineering Concepts, Inc.

August 1994

BOTANICAL RESOURCES ASSESSMENT
KEALAKAHA STREAM BRIDGE REPLACEMENT
HAMAKUA DISTRICT, ISLAND OF HAWAI'I

INTRODUCTION

The Kealakaha Stream Bridge is located on Route 19 along the Hamakua coast, between the towns of 'O'okala and Pa'auilo. The bridge was built in 1935 and is a concrete T-beam structure with 6 spans. The present bridge is structurally deficient and will be demolished. The new replacement bridge will be constructed makai of the existing structure on a more direct alignment. Two alignments are being considered: centerline R=1400.00 (closest to the present bridge) and centerline R=1800.00 (farthest from the present bridge).

Field studies to assess the botanical resources found on the two proposed alignments were conducted on 28 July 1994. A wider survey corridor was made for the lower-most alignment (R=1800.00) to allow for any later design changes; the corridor was widened by an additional 50 ft. downslope. The primary objectives of the survey were to: 1) describe the vegetation; 2) search for threatened and endangered species as well as rare and vulnerable plants; and 3) identify areas of potential environmental problems or concerns and propose appropriate mitigation measures.

DESCRIPTION OF THE VEGETATION

Two vegetation types are recognized on the proposed alignments. Mixed forest occupies the slopes and bottom of the gulch as well as along the stream. On the level areas outside of the gulch, adjacent to Route 19, the vegetation is periodically maintained and consists primarily of various grasses and weedy herbaceous species.

The two vegetation types are described in more detail below. The plant names used in the discussion follow Wagner et al. (1990) for the flowering plants and Lamoureux (1988) for the ferns.

Mixed Forest

The majority of the plants found in this vegetation type are introduced or alien species. This is not unexpected as much of the windward, low elevation forests in the Hawaiian Islands have been disturbed by humans, and the original native vegetation replaced by Polynesian introductions such as kukui (*Aleurites moluccana*), or by later introductions such as guava (*Psidium guajava*) (Cuddihy and Stone 1990).

On the west slopes of the gulch, adjacent to the existing residence, the two alignments will cross over a somewhat dense grove of ironwood trees (*Casuarina equisetifolia*), 30 to 45 ft. tall. Scattered among the ironwood trees are a few kukui trees. Ground cover, primarily basketgrass (*Oplismenus compositus*) and ka'imi (*Desmodium incanum*), is patchy under the ironwood trees as the thick mat of fallen "needles" tends to exclude smaller species. Where the ironwood trees are less dense, guava shrubs, 15 to 18 ft. tall, form a subcanopy layer. Other shrubs found in these more open areas are pluchea (*Pluchea symphytifolia*) and mamaki (*Pipturus albidus*). California grass (*Brachiaria mutica*) and molasses grass (*Melinis minutiflora*) form low, rolling mats between the woody components.

On the east slopes of the gulch, the forest contains several large mango trees (*Mangifera indica*) as well as kukui, Chinese fan palm (Livistonia chinensis), avocado (Persea americana), melochia (Melochia umbellata), and a small stand of 'ohi'a trees (Metrosideros polymorpha). Shrubs of strawberry guava (Psidium cattleianum) and a few tree ferns or hapu'u (Cibotium glaucum) and ti leaf (Cordyline fruticosa) are also found in this area. Ground cover consists of basketgrass, impatiens (Impatiens wallerana), wood fern (Christella parasitica), and Macrothelypteris torresiana.

Along the stream, guava forms a somewhat dense thicket with a few scattered trees of kukui and mango. Moist, rocky banks along the stream support mosses and liverworts along with maiden-hair fern (Adiantum raddianum). Clumps of yellow ginger (Hedychium flavescens) are also found lining the stream.

Roadside Vegetation

On the western end of the alignments where they pass in front of the existing residence, a mowed grassy area containing mainly Vasey grass (Paspalum urvillei), California grass, honohono (Commelina diffusa), pilipili (Drymaria cordata), ka'imi, and three-flowered beggarweed (Desmodium triflorum) is found. Locally common in smaller patches are Bidens alba and broad-leaved plantain or laukahi (Plantago major). Alignment R=1800.00 will cross over a lychee tree (Litchi chinensis) fronting the home.

On the eastern portion of the alignments, the mowed area next to the highway consists of a mixture of grasses and mostly herbaceous species. On areas with soil, molasses grass and sensitive plant or puahilahila (Mimosa pudica) are abundant. Also found associated with this area are Natal redtop grass (Rhynchelytrum repens), Glenwood grass (Sacciolepis indica), yellow foxtail (Setaria gracilis), Pycreus polystachyos, wood fern, partridge pea

(Chamaecrista nictitans), honohono, etc. Stonier soils support an abundance of milkwort (Polygala paniculata), a weedy Chamaesyce species, galinsoga (Galinsoga parviflora), Spermacoce mauritiana, and Murdannia nudiflora. Low-lying, wet areas with soil support Hilo grass (Paspalum conjugatum) and broad-leaved plantain.

A portion of the alignments will be sited on a low ridge which is covered by molasses grass, and scattered trees of avocado, loquat (Eriobotrya japonica), young 'ohi'a, pluchea, and guava shrubs. Also common on this ridge area on the eastern portion of the alignments are patches of hairy sword fern (Nephrolepis multiflora), silver fern (Pityrogramma calomelanos), owi (Stachytarpheta dichotoma), and a few of the weedy species found closer to the highway.

DISCUSSION AND RECOMMENDATIONS

The two alignments will cross over vegetation dominated primarily by introduced or alien species; these are all those plants introduced by humans, intentionally or accidentally, after Cook's discovery of the Hawaiian Islands in 1778. Only 7 native species were found during the field studies. They are: 'ohi'a (Metrosideros polymorpha), mamaki (Pipturus albidus), hapu'u (Cibotium glaucum), ho'i'o (Diplazium sandwichianum), Pycreus polystachyos, pakahakaha (Pleopeltis thunbergiana), and Macrothelypteris torresiana. The first 4 are endemic, that is, they are native only to the Hawaiian Islands, while the others are indigenous, that is, they are native to the islands and also elsewhere. All of the plants found along the two alignments can be found in similar environmental habitats throughout the Hawaiian Islands. None of the plants found during the survey is a listed, proposed, or candidate threatened and endangered species (U.S. Fish and Wildlife Service 1989, 1990, 1994a, 1994b); nor is any considered rare or vulnerable (Wagner et al. 1990). There are no sensitive native plant-dominated vegetation types on or adjacent to the two alignments.

Given the findings above and the limited nature of the project, neither of the alignments will have a significant negative impact on the botanical resources. There are no botanical reasons to choose one alignment over the other. It is recommended, however, that wherever possible as little of the vegetation should be disturbed within the gulch. Areas cleared of vegetation should be replanted as soon as possible to prevent soil erosion and discharge of sediments into the stream. Plants already on the project site can be used for revegetation. These include the faster growing grasses such as Hilo grass and California grass, and also some of the ornamental species such as impatiens and yellow ginger.

References

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.

Lamoureux, C.H. 1988. Draft checklist of the Hawaiian pteridophytes, "Kupukupu O Hawai'i Ne'i". Lyon Arboretum, University of Hawai'i.

U.S. Fish and Wildlife Service. 1989. Endangered and threatened wildlife and plants. 50 CFR 17.11 & 17.12.

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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 No. 83.

APPENDIX B

Reconnaissance Survey of Kealakaha Stream in the Vicinity of a Proposed New Highway Bridge

AECOS No. 781

RECONNASSANCE SURVEY OF KEALAKAHA STREAM IN THE VICINITY OF A PROPOSED NEW HIGHWAY BRIDGE

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September 1994

KEALAKAHA STREAM

INTRODUCTION

The State of Hawaii, Department of Transportation proposes to replace the State Highway 19 bridge over Kealakaha Stream in the Hamakua District of the Island of Hawaii. The existing, two-lane bridge structure (about 30 feet wide) would be replaced by a similar (~40 feet wide), but more modern structure crossing some 150 feet above the stream bed. Two proposed routes are being considered, both positioned downstream of the existing bridge structure: one with a centerline approximately 100 feet downstream of the existing bridge centerline and the other nearly 200 feet downstream centerline to centerline. Both proposed structures are curved (as is the existing Kealakaha Bridge), and would be supported on footings and columns that are outside of the 100-year flood profile.

This report considers the impact that the proposed new bridge crossing will have on water quality and aquatic biology of Kealakaha Stream.

AREA DESCRIPTION

The Hamakua Coast of the Big Island represents the windward slopes of Mauna Kea and Kohala Mountain. These slopes, particularly the east side of Mauna Kea west from Hilo where median annual rainfall reaches 7600 mm (300 inches), are among the wettest on the Island of Hawaii. A zone between 600 and 1200 meters (2000 and 4000 feet) elevation where median annual rainfall reaches or exceeds 2500 mm (100 inches) extends all along the slope above the Hamakua coast (Taliaferro, 1959). Parts of the Puna District, south of Hilo, are as wet or wetter, but stream development in this latter area is poor because of the highly porous recent lavas from Mauna Loa and Kilauea.

Stream channel development is extensive along the Hamakua coast and most of the streams have cut narrow canyons between 30 and 60 m (100 and 200 feet) deep in the Hamakua Series lavas of Mauna Kea. These streams are mostly perennial within the high rainfall zone. The extent of stream development relative to the island as a whole, may be gaged by the listing of perennial streams in the Hawaii Stream Assessment (Hawaii Cooperative Park Service Unit, 1990). The total number of streams listed for the Island of Hawaii is 132. Of these, 128 drain to the Hamakua coast between Hawi (North Kohala) and Hilo, with 68 listed in the North Kohala and Hamakua Districts and 60 in the North Hilo and South Hilo Districts. Kealakaha Stream is assigned the code number 8-1-86 in the assessment report.

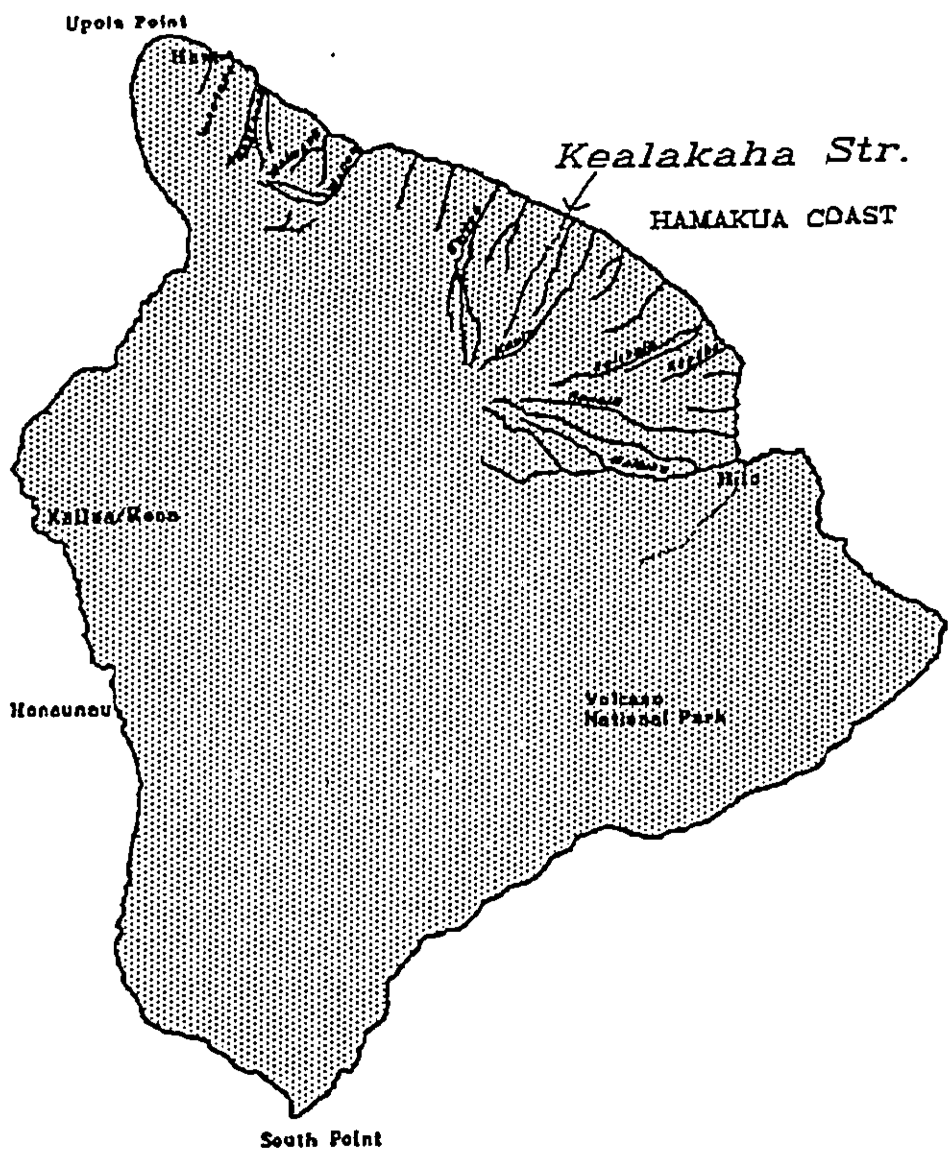

Figure 1. Island of Hawaii showing distribution of perennial streams and the location of Kealakaha Stream.

Reference to USGS topographic maps (7.5 minute series, Keanakolu and Kukaiau quad sheets) shows that Kealakaha Stream arises in the vicinity of Keanakolu Road at around 5400 feet elevation about one-half mile west of the Keanakolu Ranger Station. Two larger drainages, Ka'ula and Kapoholimu'ele Gulches, intercept the flows from drainages further upslope on Mauna Kea. The latter is a tributary of Lauhala Gulch. Above 1200 m (4000 feet) in this area, rainfall decreases with increasing elevation. Kealakaha Stream flows northward towards the coast from pasturelands above 1200 m, through the Manowaialee Forest Reserve (between 1200 and 800 m elevations), and the Niupea Homesteads (between 800 and 400 m elevations). The Highway 19 bridge is located at about the 250 m (820 feet at the stream bed) elevation.

Although Kealakaha Stream is listed as perennial and continuous (Hawaii Cooperative Park Service Unit, 1990), this classification seems erroneous. Our observations (detailed below) indicate that the stream is interrupted at lower elevations.

Table 1 lists the streams and gulches which drain the slopes of Mauna Kea in the vicinity of Kealakaha Stream. This list is intended to provide a sense of the known characteristics of nearby drainages as potentially applicable of Kealakaha Stream. Unfortunately, not much more is known about any of these streams. The drainages are listed in order as encountered along Highway 19. Several are tributaries of other listed adjacent drainages, the confluence occurring below the highway. In the table, vertical bars connect streams that have a common outlet at the shore. Information is from the Hawaii Stream Assessment and USGS topographic maps. Numereous, smaller drainages that might have culverts passing under Highway 19 were ignored as these would not be classified as streams.

Only two of the streams have origins in drainages at significantly higher elevations than Kealakaha, and these two streams define a triangular drainage area within which all of the other drainages arise (i.e., this area more or less defines the limits set for the table and arises from the radial pattern of drainages on volcanic islands). Kukaiau Stream is included (although outside of the area) because it is a perennial stream treated in the Hawaii Stream Assessment and is the next drainage northwest of the Lauhala drainage. Within this defined area, most of the streams appear to arise below 4000 feet (where the rainfall maximum occurs). Thus, the fact that Kealakaha and nearby Ka'ala Stream arise above 5000 feet may influence peak flows, but not necessarily median flows.

No gage information exists for Kealakaha Stream. Only Ke'ehia Stream, of those listed in Table 1, has ever been gaged (presently active and in place since 1962), with a peak flow (crest stage) recorder. Kealakaha is listed as a water supply stream for Hamakua Sugar Company. Aquatic resources for only two of the streams listed in Table 1 are even considered in the Hawaii Stream Assessment. Kaiwiki Stream (8-1-89) and Kaula Stream (8-1-90) are not ranked, however, and no information is provided on occurrence of native species. Along this part of the Hamakua coast, however, Ka'awali'i Stream (located between Lapahoehoe and O'okala) and Kilau Stream (near Lapahoehoe) are listed as outstanding streams. Indeed, many of the streams which drain the very wet, southeastern slope of Mauna Kea to the Hamakua Coast in the North Hilo and South Hilo Districts, are listed as outstanding for aquatic biological resources. About 30% of

Kealakaha Stream flows through native forest (Hawaii Cooperative Park Service Unit, 1990). None of these streams was surveyed by Timbol and Maciolek (1978).

Table 1. Summary of stream characteristics and other information for Hamakua Coast streams and gulches near Kealakaha Stream.

Stream	Code	Class[1]	"Headwaters" Elevation[2]	Aquatic Resources[3]	Survey Data
Honoka'a ↑					
Kuka'iau	8-1-82	Pi	2400		
Lauhala	8-1-83	I *(P)*	>9000		
Mohuna	--	*P*	1200		
Kalapawale	--	*P*	1700		
Pu'umaile	8-1-83.01	*P*	2100		
Kekualele	8-1-84	I *(P)*	3600?		
Opeala	--	*P*	1700		
Ka'awikiwiki	--	*P*	2100		
Ka'ala	8-1-85	Pi	5600		
Kealakaha	8-1-86	Pi*	5400		
Ke'ehia	8-1-87	I *(P)*	3000		
unnamed	--	*I*	1400		
Kaholo	--	*P*	2600		
Kupapaulua	8-1-88	Pi	3400		
Kaiwiki	8-1-89	Pc	2500	U	
unnamed	--	*I*	2500		
Ka'ula	8-1-90	Pc	>13000	U	DLNR, 1969
Hilo ↓					

NOTES:
1 - P= perennial; I = intermittant; c = continuous; i = interrupted. Where given in *italics*, the class is inferred from topographic sheet by solid, dash-dotted, or no blue line. Class is for reach within the rain forest and downstream; all are intermittant above the rain forest. * = from present study.
2 - In feet, estimated (from topographic sheets) upper elevation of drainage basin; generally somewhat higher than headwaters.
3 - Summary from Hawaii Stream Assessment (Hawaii Cooperative Park Service Unit, 1990); U = Unknown (aquatic ranking).

FIELD SURVEY

A survey of Kealakaha Stream was conducted on July 30, 1994 for the purpose of assessing aquatic resources in the area of the proposed new Kealakaha Bridge. Only the segment of the stream in the immediate area of the existing and proposed bridges was surveyed. The survey extended approximately 150 m (500 feet) downstream and 600 m (2000 feet) feet upstream from the highway.

The channel of Kealakaha Stream is confined to a steep-sided and relatively narrow canyon between 30 and 45 m (100 and 150 feet) deep. The stream bed is a mixture of large, loose boulders and smoothed, dense basalt. Sandy soil and even small deposits of clay/silt occur at scattered points along the channel. These different materials reflect differences in the resistance to erosion of the layers of lava flows encountered as the stream cuts its channel. Escarpments occur where resistent layers are encountered, resulting in a hard rock ledge which can be traced for tens of meters upstream. Deposits of sand are found particularly at the base of these escarpments, where rushing water has created a plunge pool in the less resistent layer below. Fine sediments are deposited here as the stream flow decreases from a freshet (a rush of water running off from a storm event). In this part of Kealakaha Stream, escarpments are on the order of 5 to 6 m (15 to 20 feet) high.

The occurrence of water in the stream observed during the field survey (and presumed to be typical of at least the dry season) is closely tied to the type of stream bed. Areas of relatively loose material and jumbled, large boulders are dry, whereas areas of hard rock ledges hold water in shallow surface depressions. For the most part, these pools range from very small to 2 or rarely 3 meters (5 to 10 feet) in horizontal dimension. Water depths are generally on the order of 10 to 30 cm (3 to 12 inches). These pools were seen to be isolated from one another except in an area at the upstream end of the July survey where a small amount of water was found flowing in the stream bed between pools. Thus, the water in the pools in the vicinity of the highway must represent either local direct rainfall or residual water following brief periods of stream flow from either local or upslope rain events.

The stream bed proper lacks vegetation, with the exception of some larger boulders that are covered with mosses. However, beyond the banks of the mostly rocky bed, is found a second, wider gulch floor, usually as an elevated (relative to the active stream bed) shelf on one or both sides of the stream were some soil and vegetation are present. Presumably, the margins of this wider canyon floor represent the stream bed occupied during exceptional peak flows.

The traverse downstream from the project site extended only about 150 m (500 feet) because of a difficult-to-negotiate escarpment some 80 m downstream of the bridge. However, the stream bed was observed (viewed from along a trail higher on the canyon margin) to be absent pools of water, so the reconnaissance was discontinued about 150 m downstream from the bridge. The upstream trek also encountered escarpments, including one that was scaled using ropes. However, pools of water are more prevalent in this direction, and a thin stream of water was observed trickling over the uppermost waterfall encountered. Above this latter escarpment, nearly 500 m (1600 ft) upstream from the highway, flowing water was seen connecting pools for a distance of some 25 to 30 m (8 to 100 feet), above which the stream bed was again dry and composed of worn, but angular boulders.

WATER QUALITY

No flowing water was found in the proposed bridge construction area. Water samples for analyses were collected from one of several pools beneath the existing bridge (Sta. 2) and from a pool in an area of slight flow some 500 m (1600 feet) upstream (Sta. 1). Both samples were from pools of at least 2 square meters surface area with maximum depths of about 20 to 25 cm. and located a short distance above escarpments (dry waterfall areas) on the stream course. Samples from isolated pools must be interpreted with caution because physical and biological processes can alter the chemistry significantly over time. Only a limited number of analytes were measured, because the relevance of others, such as conductivity, pH, temperature, and dissolved oxygen would be questionable coming from these possibly stagnant pools.

Table 2. Water quality from pools on Kealakaha Stream, 1000-1030, July 30, 1994.

	Turbidity (ntu)	NO_3+NO_2 (μg N/l)	Total N (μg N/l)	Total P (μg P/l)	Silicates (μg Si/l)
Sta. 1	0.75	1	34	10	6100
Sta. 2	1.26	1	162	13	2320

These values are not unusual in any respect, except perhaps that some of the analyte values are dissimilar. However, as these samples represent small, isolated pools with unknown histories of stream flow, rainfall, evaporation, and inputs of litter, such disparities are expected.

RIPARIAN ZONE

A survey of the vegetation in the project area has been prepared by Winona Char. Our observations of the character of the riparian (stream side) zone are limited to a general description of the plants observed during the aquatic survey.

The sides of the canyon in the project area are forested in upper area, along "ridgelines" with ironwood trees (*Casuarina equisetifolia*), and down into the canyon floor with silk oak (*Grevellia*), kukui (*Aleurites molluccana*), guava (*Psidium guajava*), fan palm (*Livistonia chinensis*), mango (*Mangifera indica*), rose apple (*Syzygium jambos*), and avocado (*Persea americana*). Common plants along the margins of the stream are yellow ginger (*Hedychium flavescens*), basketgrass (*Oplismenus hirtellus*), hilo grass (*Paspalum conjugatum*), balsam (*Impatiens wallerana*), Begonia (*Begonia* sp.), and a large variety of ferns (*Adiantum hispidalum, A. nigrum, Gonocormus minutus, Polypodium lineare, Dryopterus dentata, Blechnum oriental, Nephrolepis* sp.). Observed at various locations along the margins of the canyon, not necessarily close to the dry stream bed, are the above shrubs, grasses, and ferns, as well as thimbleberry (*Rubus rosifolius*), ti (*Cordyline fruticosa*), mamaki (*Pipturus* sp.), coffee (*Coffea arabica*), shampoo ginger (*Zingiber zerumbet*), and Hilo holly (*Ardisia crispa* or *A. crenulata*). The only invertebrate of note in this habitat was the introduced carnivorous snail, *Euglandina rosea*.

Extensive beds of yellow ginger occur upstream of the project area, along the stream bed and lower margins of the canyon. Trees form a nearly continuous canopy over the stream. Signs of wild pig (*Sus scrofa*) are common. Other plants seen in this area were pamakani (*Ageratina adenophora*), dracaena (*Pleomele fragrans*), plantain (*Plantago* sp.), molasses grass (*Melinis minutiflora*), and air plant (*Kalanchoë pinnata*). The endemic neleau tree (*Rhus sandwicensis*) was seen near the upper end of the surveyed area.

AQUATIC BIOTA

Although flowing water was essentially absent, the numerous, scattered pools harbored some aquatic fauna. This fauna was mostly limited to insects (Table 3). Common in most pools were the adults and immatures of a large diving beetle (*Rhantus pacificus*). Dragonfly larvae were seen in some pools, but these specimens were mostly very small. Two species of dragonflies were observed along the stream. The pantropical species (*Pantala flavescens*) was identified from a captured specimen, and was abundant in the project area. A much larger, blue species believed to be the lowland pinao (*Anax junius*) was observed as a single specimen in the project area. This specimen was not captured.

No fishes, native or introduced, or crustaceans, native or introduced, were observed in any of the pools despite a careful examination of numerous pools, including sweeps made with a fine-mesh net. No snails were observed either. The only, non-arthropod aquatic fauna was a single young frog (*Rana* cf. *catesbeiana*) which was observed and heard, but could not be captured for closer examination because the small pool in which it disappeared had a layer of silt and several narrow crevices between rocks. This observation was at the upper end of the area of flowing water described above.

TABLE 3. Checklist of aquatic animals observed or reported from Kealakaha Stream

Species	Common name	Status	Abundance
	INVERTEBRATES		
ARTHROPODA, INSECTA			
COLEOPTERA - DYTISCIDAE			
Rhantus pacificus (Boisduval)†	diving beetle (larva)	ind.	Common
Rhantus pacificus (Boisduval)†	diving beetle (adult)	ind.	Common
ODONATA - AESHNIDAE			
Anax cf. *junius* (Drury)	*pinao*, darner (adult)	?ind..	Uncommon
ODONATA - LIBELLULIDAE			
Pantala flavescens Fabricius†	skimmer, dragonfly (naiad)	ind.	Common
Pantala flavescens Fabricius	skimmer, dragonfly (adult)	ind.	Common
	VERTEBRATES		
AMPHIBIANS - RANIDAE			
Rana catesbeiana Shaw	American bullfrog	nat.	Uncommon

† - Identification made by Dan A. Polhemus of the Bishop Museum, Entomology Department.

PROJECT ASSESSMENT

Kealakaha Stream within the project area is an intermittent stream with very limited aquatic habitat present during the dry season. Although, not examined as part of this survey, it is suspected that a perennial reach exists within the forested, wetter zone above 600 m (2000 feet) elevation and below 1500 m (5000 feet) elevation. This segment of Kealakaha has not been surveyed to our knowledge. However, Kealakaha lies on the edge of the high rainfall belt which occurs along the southeast slope of Mauna Kea, and this latter area is well known to have numerous perennial streams of outstanding value in terms of harboring native aquatic fauna within a native forest setting. The native Hawaiian stream fauna is well adapted to inhabit perennial stream reaches above seasonally dry lower stream reaches, despite the requirement for the diadromous elements (native fishes and crustaceans) to migrate between the fresh water and the sea as part of the life cycle. For this reason, lower Kealakaha Stream cannot be dismissed as of little aquatic resource value. Native species might well migrate through the area during freshets (high flow periods resulting from rain storms) or wetter periods.

The proposed construction of a new highway bridge over Kealakaha Stream may have short-term impacts on water quality because of the difficulty of isolating the construction area from the stream during periods of local rainfall. Construction during the drier months of the year would reduce the opportunities for adverse water quality impacts.

No long term impacts on stream ecology will attend this project. The bridge supports for both alternatives are to be located outside of the 100-year flood zone, which is outside of the stream bed. Aquatic habitat which exists in the area is confined to pools found mostly above an escarpment more or less under the existing bridge. Proposed new routes would avoid this area, crossing parts of the stream bed characterized by loose material and little or no standiung water.

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APPENDIX C

Air Quality Impact Report,
Kealakaha Stream Bridge Replacement

AIR QUALITY IMPACT REPORT
(AQIR)

KEALAKAHA STREAM BRIDGE REPLACEMENT

20 August 1994

PREPARED FOR:

Engineering Concepts, Inc.
Honolulu, Hawaii

and

State of Hawaii
Department of Transportation

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1. INTRODUCTION

The State of Hawaii Department of Transportation is proposing to replace the existing Kealakaha Stream Bridge on the island of Hawaii. The bridge is located on the Hawaii Belt Road in the vicinity of Ookala between Laupahoehoe and Honoka'a (Figure 1).

The existing bridge is a concrete girder structure built in 1935. It is starting to show signs of structural wear in the bearings. The existing radius does not meet the standard for a design speed of 60 mph. Furthermore, the narrow 2-lane structure does not allow the simultaneous passage of two large vehicles, e.g., canehaul trucks.

The new bridge would be constructed parallel to and makai of the existing bridge. It will be designed on a more direct alignment and thus eliminate the curved nature of the present bridge.

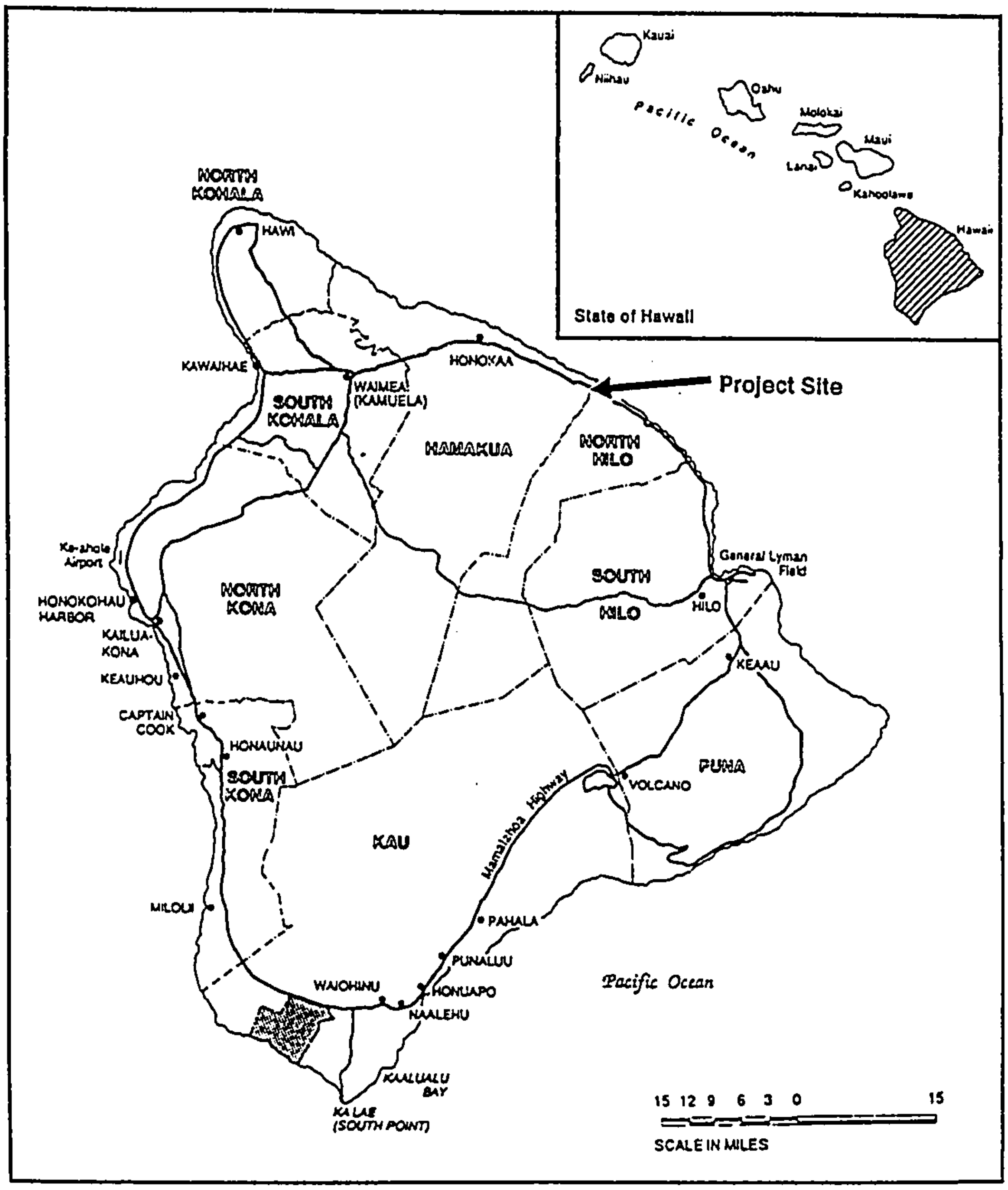
The purpose of this report is to assess the impact of the proposed development on air quality on a local and regional basis. The overall project can be considered an "indirect source" of air pollution as defined in the federal Clean Air Act [1] since its primary association with air quality is due to its inherent association with mobile sources, i.e., motor vehicle, activity. Much of the focus of this analysis, therefore, is on the project's effects on traffic and the resultant impact on air quality. Air quality impact was evaluated for existing (1994) and future (2004) conditions.

During construction of the new structure air pollutant emissions will be generated onsite and offsite due to vehicular movement, grading, concrete and asphalt batching, and general dust-generating construction activities. These impacts have also been addressed.

2. AIR QUALITY STANDARDS

A summary of State of Hawaii and national ambient air quality standards is presented in Table 1 [2, 3]. Note that Hawaii's standards are not divided into primary and secondary standards as are the federal standards.

Primary standards are intended to protect public health with an adequate margin of safety while secondary standards are intended to protect public welfare through the prevention of damage to soils, water, vegetation, man-made materials, animals, wildlife, visibility, climate, and economic values [4].

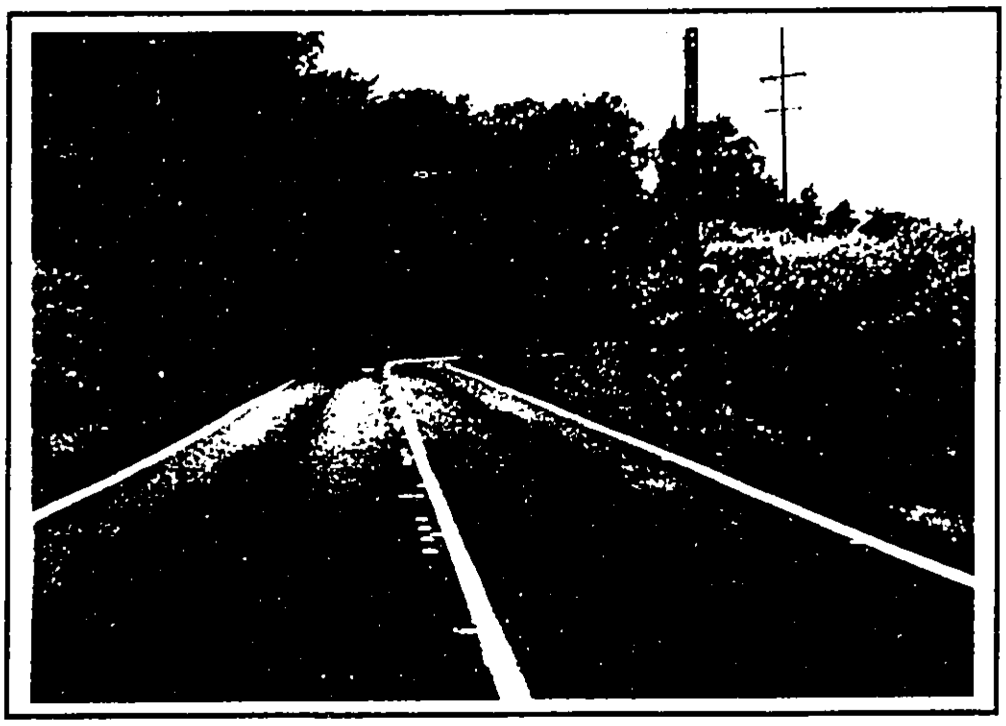


Kauai
Niihau
Oahu
Molokai
Pacific Ocean
Maui
Lanai
Kahoolawe
Hawaii
State of Hawaii
Project Site
NORTH KOHALA
HAWI
KAWAIHAE
WAIMEA (KAMUELA)
HONOKAA
SOUTH KOHALA
HAMAKUA
NORTH HILO
Ke-ahole Airport
HONOKOHAU HARBOR
NORTH KONA
KAILUA-KONA
KEAUHOU
CAPTAIN COOK
HONAUNAU
SOUTH KONA
General Lyman Field
SOUTH HILO
HILO
KEAAU
PUNA
VOLCANO
Mamalahoa Highway
KAU
MILOLII
PAHALA
PUNALUU
WAIOHINU
HONUAPO
NAALEHU
KAALUALU BAY
KA LAE (SOUTH POINT)
Pacific Ocean
15 12 9 6 3 0 15
SCALE IN MILES

FIGURE 2

EXISTING SITE CONDITIONS
AUGUST 1994

Northwest Approach
(facing southeast)



Southeast Approach
(facing northwest)

TABLE 1

SUMMARY OF STATE OF HAWAII AND FEDERAL
AMBIENT AIR QUALITY STANDARDS

POLLUTANT	SAMPLING PERIOD	NAAQS PRIMARY	NAAQS SECONDARY	STATE STANDARDS
PM_{10}	Annual	50	50	50
	24-hr	150	150	150
SO_2	Annual	80	---	80
	24-hr	365	---	365
	3-hr	---	1,300	1,300
NO_2	Annual	100	---	70
CO	8-hr	10	---	5
		40	---	10
O_3	1-hr	235	---	100
H_2S	1-hr	---	---	35
Pb	Calendar Quarter	1.5	---	1.5

KEY:
- TSP - total suspended particulate matter
- PM_{10} - particulate matter < 10 microns
- SO_2 - sulfur dioxide
- NO_2 - nitrogen dioxide
- CO - carbon monoxide
- O_3 - ozone
- Pb - lead

All concentrations in micrograms per cubic meter ($\mu g/m^3$) except CO which is in milligrams per cubic meter (mg/m^3).

Some of Hawaii's standards (CO, NO_2, and O_3) are clearly more stringent than their federal counterparts but, like their federal counterparts, may be exceeded once per year. It should also be noted that in November 1993, the Governor signed amendments to Chapter 59, Ambient Air Quality Standards [3], adopting the federal standard for particulate matter equal to or less than 10 microns in diameter (PM_{10}). Since measurement data in Hawaii indicate that PM_{10} comprises about 50% of total suspended particulate matter (TSP), the adoption of that federal standard with a numerical value equal to the original state TSP standard of 150 $\mu g/m^3$ represents a substantial relaxation of the standard (approximately doubling it).

In the case of the automotive pollutants [carbon monoxide (CO), oxides of nitrogen (NOx), and photochemical oxidants (Ox)], there are only primary standards. Until 1983, there was also a hydrocarbons standard which was based on the precursor role hydrocarbons play in the formation of photochemical oxidants rather than any unique toxicological effect they had at ambient levels. The hydrocarbons standard was formally eliminated in January, 1983 [5].

The U.S. Environmental Protection Agency (EPA) is mandated by Congress to periodically review and re-evaluate the federal standards in light of new research findings [1]. The last review resulted in the relaxation of the oxidant standard from 160 to 235 micrograms/cubic meter (ug/m^3) [6]. The carbon monoxide (CO), particulate matter, sulfur dioxide (SO_2), and nitrogen dioxide (NO_2) standards have been reviewed, but no new standards were proposed.

Finally, the State of Hawaii also has fugitive dust regulations for particulate matter (PM) emanating from construction activities [7]. There simply can be no visible emissions from fugitive dust sources.

3. EXISTING AIR QUALITY

3.1 General. The State Department of Health maintains a limited network of air monitoring stations around the state to gather data on the following regulated pollutants:

- o particulate matter $\leq$ 10 microns (PM_{10})
- o total suspended particulate matter (TSP)
- o sulfur dioxide (SO_2)

- carbon monoxide (CO)
- ozone (O_3

In the case of PM_{10} and SO_2, measurements are made on a 24-hour basis to correspond with the averaging period specified in State and Federal standards. Samples are collected once every six days in accordance with U.S. Environmental Protection Agency (EPA) guidelines. Carbon monoxide and ozone, however, are measured on a continuous basis due to their short-term (1-hour) standards. Lead concentrations are determined from the TSP samples which are sent to an EPA laboratory for analysis. It should also be noted that the majority of these pollutants are monitored only in Honolulu.

While there is currently no Department of Health (DOH) air monitoring station in the immediate vicinity of the project site, there was a station at Honoka'a during the 1979 - 1982 period. The DOH also operated a station at Hilo, some 40 miles to the southeast, for many years.

3.2 Department of Health Monitoring. Since 1985 when the State Department of Health reduced its monitoring network on the Neighbor Islands, there has been no permanent air monitoring of regulated pollutants in East or West Hawaii. The last available data from the Honoka'a and Hilo stations are summarized in Tables 2 and 3. The data indicate that total suspended particulate matter (TSP) and sulfur dioxide (SO_2) standards were being met. In fact, much of the time sulfur dioxide concentrations were below the detectable limit of the measurement method being employed. Given the rural, undeveloped nature of the project area, it seems safe to assume that air quality continues to be good most of the time.

The worst air pollution episodes experienced in Hawaii County are due to the infrequent and unpredictable volcanic eruptions. While volcanic emissions are somewhat variable and have not been fully characterized, it is well known that visibility is affected by the presence of fine particulates resulting directly from volcanic activity as well as secondarily from forest fires caused by lava flows.

Analysis of the airborne particulate matter during the eruption revealed some rather interesting results as unusually high concentrations of selenium, arsenic, indium, gold, and sulfur were found along with strikingly high concentrations of iridium [8].

TABLE 2

AIR MONITORING DATA
HILO, HAWAII
1972 - 1985

YEAR	TSP		SO_2		NO_2	
	Range	Mean	Range	Mean	Range	Mean
1972	14-95	34	<5-16	<5	<20-78	29
1973	15-51	30	<5-<5	<5	<20-23	<20
1974	12-59	26	<5-14	<5	<5-29	16
1975	12-89	30	<5-32	5	9-29	20
1976	11-64	30	<5-<5	<5	-----	---
1977	15-80	32	<5-<5	<5	-----	---
1978	13-169	34	<5-45	<5	-----	---
1979	8-65	22	<5-20	<5	-----	---
1980	10-84	21	<5-17	<5	-----	---
1981	10-46	19	<5-11	<5	-----	---
1982	8-31	16	<5-6	<5	-----	---
1983	7-50	17	<5-23	<5	-----	---
1984	7-27	15	<5-7	<5	-----	---
1985	8-28	15	<5-6	<5	-----	---

Notes:
1. SO_2 = sulfur dioxide
2. NO_2 = nitrogen dioxide
3. All concentrations are in micrograms per cubic meter.
4. NO_2 monitoring ceased on 1 April 1976.
5. Site shut down on 1 October 1985.
6. Source: State Department of Health

TABLE 3

AIR MONITORING DATA
HONOKA'A, HAWAII
1979 - 1982

Year	TSP ($\mu g/m^3$)	
	Range	Mean
1979	10-43	22
1980	10-49	23
1981	12-66	24
1982	10-25	16

Notes:
1. $\mu g/m^3$ = micrograms per cubic meter
2. Site shut down on 3 August 1982
3. Source: State Department of Health

In addition, there can be substantial increases in the ambient concentrations of sulfur dioxide. Measurements of SO_2 taken during the January 1983 eruptive phase, for example, indicated 24-hour concentrations as high as 982 $\mu g/m^3$ at the Volcano Observatory and 654 $\mu g/m^3$ in Hilo. Recent studies also suggest that much of the SO_2 emissions are converted to particulate sulfates [9].

3.4 Onsite Carbon Monoxide Sampling. In conjunction with this study, air sampling was conducted in August 1994, in the project area. The sampling site was within 10 meters of the road edge on the southeast side during the a.m. and northwest side during the p.m. peak traffic hours. A continuous carbon monoxide (CO) instrument was set up and operated during the a.m. and p.m. peak traffic hours. An anemometer and vane were installed to record onsite surface winds during the air sampling. A simultaneous manual count of traffic was also performed. The variability of each of the parameters measured during the peak hours is clearly seen in Figures 3 and 4.

Onsite weather conditions during the afternoon of 10 August 1994 were light easterly winds with a neutral atmosphere. The traffic count was somewhat lower than the peak values reported in State Department of Transportation (DOT) reports [10].

FIGURE 3

P.M. PEAK HOUR CONDITIONS
HAWAII BELT ROAD (KEALAKAHA BRIDGE)
10 AUGUST 1994

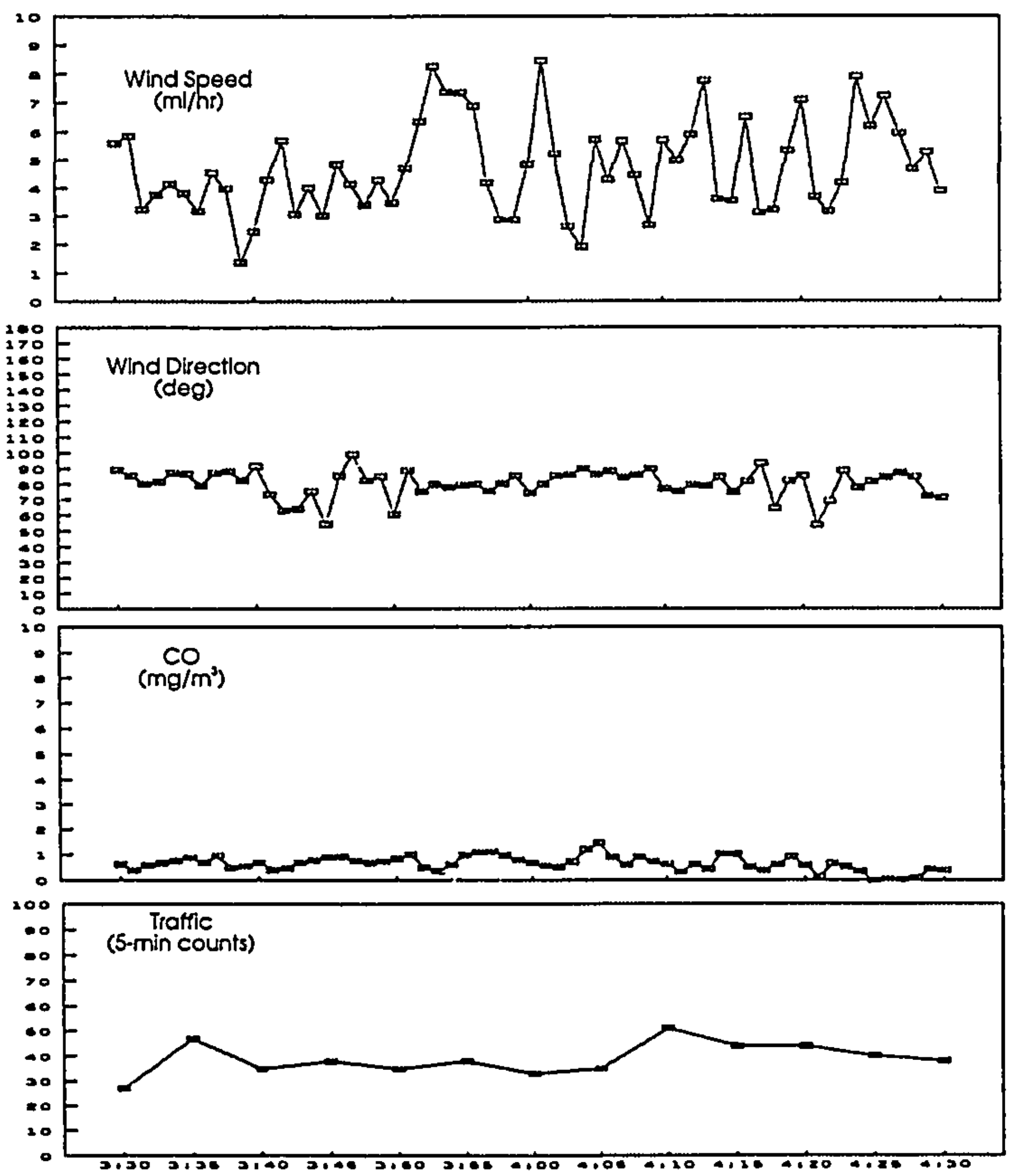
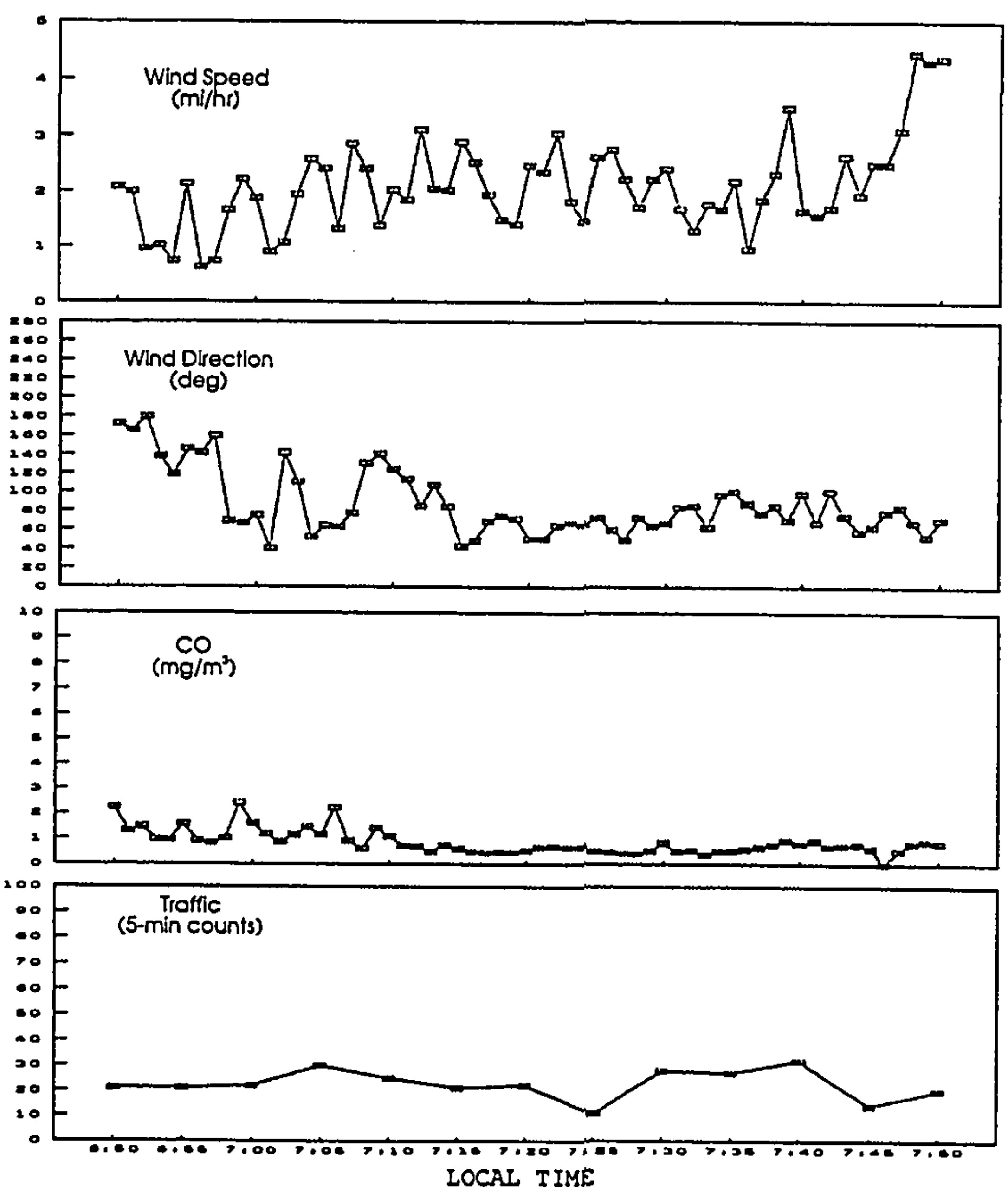


FIGURE 4

A.M. PEAK HOUR CONDITIONS
HAWAII BELT ROAD (KEALAKAHA BRIDGE)
11 AUGUST 1994



CO concentrations were of the same order of magnitude as the computer-predicted concentrations discussed in Section 6 of this report, i.e., about 1 mg/m^3.

On the morning of 11 August 1994, winds were less than 5 mph, started out southerly (nighttime downslope drainage winds) and then turned easterly. Atmospheric stability was neutral throughout most of the time but gradually became slightly unstable as the sun rose. The traffic count and CO level were again low as they were the previous afternoon.

4. CLIMATE AND METEOROLOGY

4.1 Temperature and Rainfall.
The project area is typical of Hawaii's climate with little seasonal or diurnal temperature variation. Monthly temperature averages vary by only about 6 degrees from the warmest months (July and August) to the coolest (January and February) [11]. Annual average temperature ranges from 75 F at sea level to 68 F at 2,000 feet elevation [12].

The area experiences significants of orographically induced rainfall. Annual precipitation ranges from approximately 75 to 150 inches [13]. With this temperature and rainfall profile, the area has a Thornwaite precipitation/evaporation (P/E) index [14] ranging from 109 to 235 thereby giving it climatic descriptors of humid to wet.

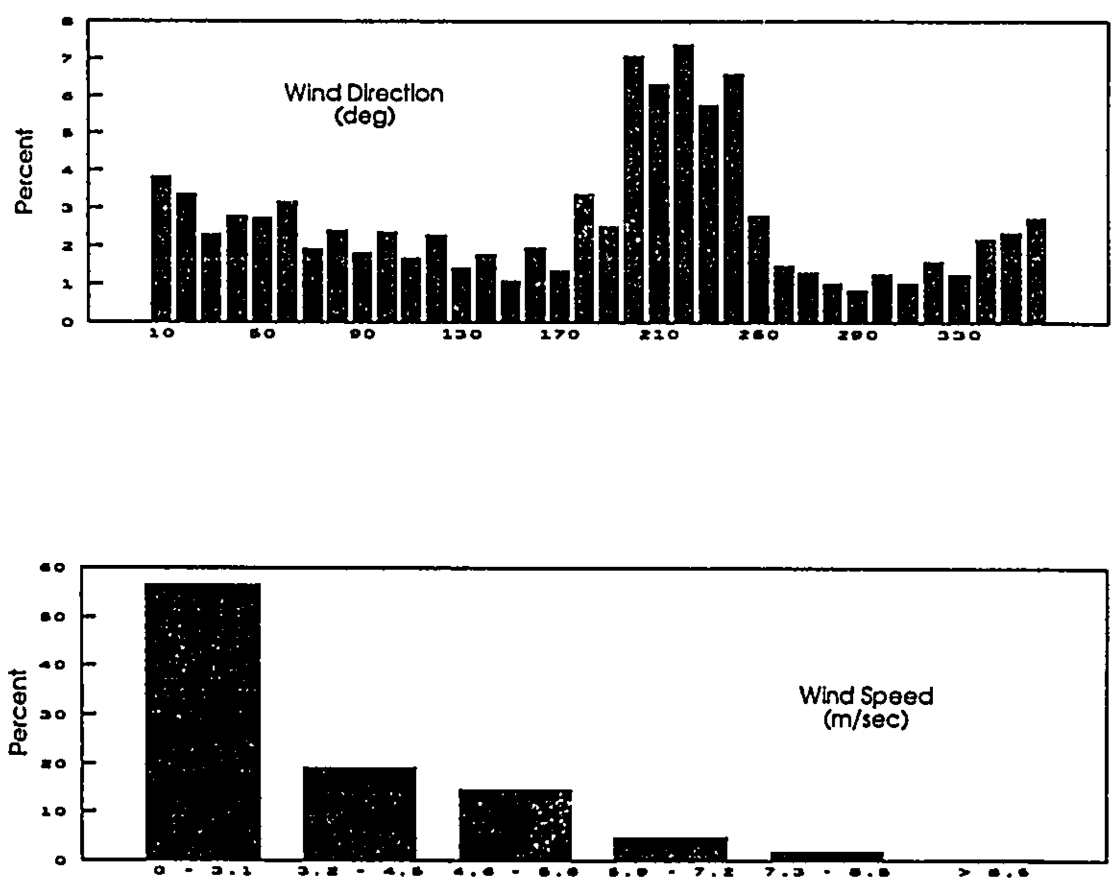
4.2 Surface Winds. Winds in the area are typical of the windward side of Hawaii which is subject to the effects of the semi-permanent Pacific high pressure cell situated north and east of the island [15]. Northeasterly trade winds prevail throughout much of the year superimposed on daytime seabreezes in the coastal area. Nighttime downslope drainage winds with southerly and westerly components also occur. Such downslope flows can be seen in the 1992 Hilo wind data with the high frequency of southwesterlies (Figure 5). During the winter months, the trade winds tend to weaken and give way to "kona" (southerly) or light and variable winds.

5. SHORT-TERM IMPACTS

5.1 Onsite Impacts. The principal source of short-term air quality impact will be construction activity. Construction vehicle activity will increase automotive pollutant concentrations along the Hawaii Belt Road. Because of the low level of existing traffic volumes, the additional construction vehicle traffic should not exceed road capacities although the presence of large trucks can

FIGURE 5

DISTRIBUTION OF WIND SPEED AND DIRECTION
HILO, HAWAII
1992



reduce a roadway's capacity as well as lower average travel speeds. The site preparation and earth moving will create particulate emissions as will onsite road construction. Construction vehicles movement on unpaved on-site roads will also generate particulate emissions. EPA studies on fugitive dust emissions from construction sites indicate that about 1.2 tons/acre per month of activity may be expected under conditions of medium activity, moderate soil silt content (30%), and a precipitation/ evaporation (P/E) index of 50 [14,16].

There are silty clay loams in this area of the island and, such soils are likely to have silt contents greater than the 30% cited above. However, due to the wet local climate (P/E Index 109 - 235), the potential for dust emissions will be reduced.

5.2 Offsite Impacts. In addition to the onsite impacts attributable to construction activity, there will also be offsite impacts due to the operation of concrete and asphalt concrete batching plants needed for construction. Such plants routinely emit particulate matter and other gaseous pollutants. It is too early, however, to identify the specific facilities that will be providing these materials and thus the discussion of air quality impacts is necessarily generic. The batch plants which will be producing the concrete and asphalt must be permitted by the Department of Health's Clean Air Branch pursuant to state regulations [7]. In order to obtain these permits they must demonstrate their ability to continuously comply with both emission [7] and ambient air quality [3] standards. Under the recently promulgated federal Title V operating permit requirements [17], now incorporated in Hawaii's rules [7], air pollution sources must regularly attest to their compliance with all applicable requirements.

6. MOBILE SOURCE IMPACTS

6.1 Mobile Source Activity. State DOT traffic data in the project area served as the basis for this mobile source impact analysis [10]. Existing peak-hour traffic volumes and projections for 2004 along the Hawaii Belt Road in the project vicinity were provided.

6.2 Emission Factors. Automotive emission factors for carbon monoxide (CO) were generated for calendar years 1994 and 2004 using the Mobile Source Emissions Model (MOBILE-5A) [18]. To localize the emission factors as much as possible, the September 1988 age distribution for registered vehicles in the City & County of Honolulu [19] was input in lieu of national statistics. That same age distribution was the basis for the distribution of vehicle miles travelled as well.

6.3 Modeling Methodology. Due to the present state-of-the-art in air quality modeling, analyses such as this generally focus on estimating concentrations of non-reactive pollutants. For projects involving mobile sources as the principal source, carbon monoxide is normally selected for modeling because it has a relatively long half-life in the atmosphere (ca. 1 month)[20], and it comprises the largest fraction of automotive emissions.

Using the available traffic data, modeling was performed for that segment of the Hawaii Belt Road including the Kealakaha Stream Bridge for 1994 and 2004 with the project.

Because of the generally rural nature of the area, a stable atmosphere (Category "F") was assumed in the morning and a neutral atmosphere (Category "D") [21] in the afternoon. A 1 meter per second (m/sec) wind speed was also assumed as worst case meteorological conditions.

The EPA guideline model CAL3QHC [22,23] was employed to estimate near-intersection carbon monoxide concentrations. An array of 24 receptor sites at incremental distances of 10 meters from the road edge were input to the model. Because of the rural nature of the area, a background CO concentration of 0.1 milligram per cubic meter (mg/m^3) was assumed. The model uses an iterative process to identify the wind direction producing the maximum CO concentration at each receptor location.

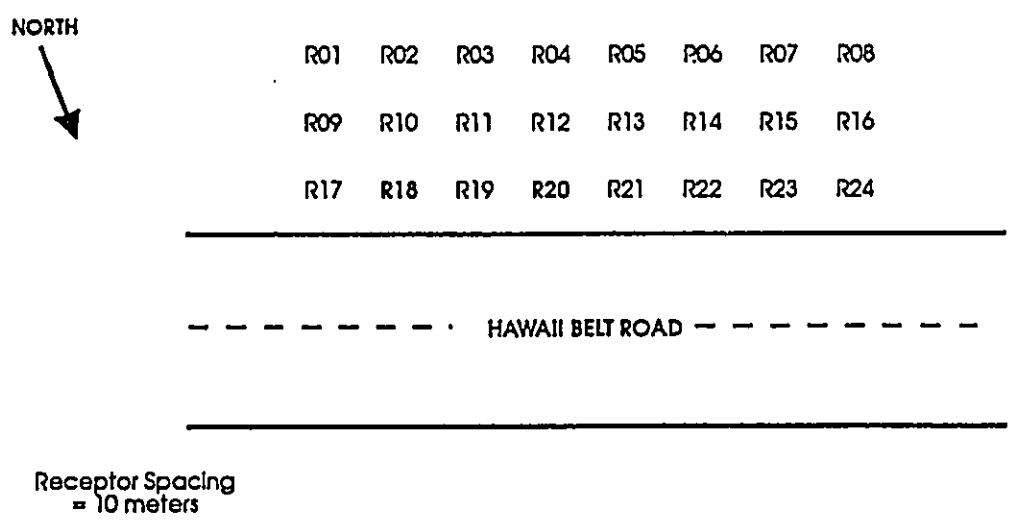
6.4 Results: 1-Hour Concentrations. The results of this modeling are presented in Figure 6. The figure depicts the locations of the 24 receptor sites along the road segment. Maximum estimated concentrations in milligrams per cubic meter (mg/m^3) for each of the evaluated scenarios are also presented along with the particular receptor location at which they were predicted.

The results suggest that current CO levels are well below both federal and the more stringent state 1-hour standards and that in the future there will be only a slight increase in these levels.

6.5 Results: 8-Hour Concentrations. Since the maximum 1-hour concentrations are less than the 8-hour standards, it can be assumed that these latter standards will also be met.

FIGURE 6

ESTIMATES OF MAXIMUM 1-HOUR
CARBON MONOXIDE CONCENTRATIONS
Hawaii Belt Road (Kealakaha Stream Bridge)
Peak Traffic Hours
1994 - 2004



Estimated Maximum Concentrations
(mg/m³)

Period	1994	2004 w/ proj
A.M.	0.68 (R18)	1.03 (R18)
P.M.	0.57 (R20)	0.80 (R20)

7. DISCUSSION AND CONCLUSIONS

7.1 Short-Term Impacts. Even though, as noted in Section 5, there appears to be a low potential for fugitive dust due to the wet climate, it will still be important for adequate dust control measures to be employed during the construction period. Dust control could be accomplished through frequent watering of unpaved roads and areas of exposed soil. The EPA estimates that twice daily watering can reduce fugitive dust emissions by as much as 50% [16]. The soonest possible landscaping of completed areas will also help.

7.2 Mobile Source Impacts. As noted in Section 6, there will be a small increase in traffic-related ambient CO levels attributable to traffic growth, but both 1- and 8-hour carbon monoxide standards are predicted to be met during peak traffic hours even in close proximity to the highway. The significant increase in traffic volume is offset by the reduced emissions resulting from EPA's emission control program for new vehicles and the higher average speeds that the new bridge will be designed for.

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APPENDIX D

Acoustic Study for the
Kealakaha Stream Bridge Replacement

ACOUSTIC STUDY FOR THE KEALAKAHA STREAM BRIDGE REPLACEMENT HAMAKUA, HAWAII

Prepared for:

ENGINEERING CONCEPTS, INC.

Prepared by:

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1126 12th Avenue, Room 305
Honolulu, Hawaii 96816

AUGUST 1995

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CHAPTER I. SUMMARY

The existing and future traffic noise along the corridor of the proposed Kealakaha Stream Bridge Replacement Project near Ookala on the island of Hawaii were studied to evaluate potential noise impacts associated with the No Build and two Build Alternatives of the bridge replacement project. Noise measurements were obtained, traffic noise predictions developed, and noise abatement alternatives evaluated. The Build Alternatives evaluated involved two proposed alignments of the new bridge, Alternatives #1 and #2, with Alternative #2 identified as the preferred alternative.

Existing traffic noise levels along Mamalahoa Highway at Kealakaha Stream Bridge do not exceed federal noise abatement criteria or standards. Future traffic noise levels under the No Build Alternative are also not expected to exceed federal noise criteria or standards.

Under Build Alternative Alignment #1, there is a small risk of exceeding a federal noise abatement criteria or standard. Under the preferred Build Alternative Alignment #2, there is a high risk of exceeding federal noise abatement criteria or standards. Potential traffic noise impacts were identified at an existing residence along the north approach to the bridge under the preferred Alignment #2 alternative. Noise mitigation measures, in the form of a 5 to 6 foot (1.5 to 1.8 meter) high wall are available to comply with federal noise abatement criteria and standards under the preferred Alignment #2 alternative. Additional noise mitigation measures should not be required to mitigate future traffic noise impacts along the project corridor.

CHAPTER II. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

A general consensus has developed for use of the Day-Night Sound Level (Ldn) in describing environmental noise in general, and for relating the acceptability of the noise environment for various land uses. The Day-Night Sound Level represents the 24-hour average sound level for a typical day, with nighttime noise levels (10:00 P.M. to 7:00 A.M.) increased by 10 decibels prior to computation of the 24-hour average.

The Ldn descriptor employs a process of averaging instantaneous A-Weighted sound levels as read on a standard Sound Level Meter, which are normally referred to as meter readings in dBA. A brief description of the acoustic terminology and symbols used are provided in **APPENDIX B**. The average noise level during a one hour period is called the hourly equivalent sound level, and is designated as Leq(h) or Leq. The maximum A-Weighted sound level occurring during an intermittent event (or single event) is referred to as the Lmax value. The mathematical product (or integral) of the instantaneous sound level times the duration of the event is known as the Sound Exposure Level, or Lse, and is analogous to the energy of the time varying sound levels associated with the intermittent noise event. Current noise standards and criteria which associate land use compatibility or adverse health and welfare effects with various levels of environmental noise are normally described in terms of Ldn rather than the single event (Lmax or Lse) noise descriptors. The reasons for this are based on the relatively good correlation between the cumulative Ldn descriptor and annoyance reactions of the exposed population. However, at very low levels of environmental noise (55 Ldn or less), other attitudinal variables and biases (besides noise) of the exposed population tend to influence annoyance reactions, and the correlation between annoyance reactions and Ldn levels deteriorates.

TABLE 1, extracted from **Reference 1**, categorizes the various

TABLE 1

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

NOISE EXPOSURE CLASS	DAY-NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL (1) STANDARD
Minimal Exposure	Not Exceeding 55 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.

Ldn levels of outdoor noise exposure with severity classifications. A general consensus among federal agencies has developed whereby residential housing development is considered acceptable in areas where exterior noise does not exceed 65 Ldn. This value of 65 Ldn is used as a federal regulatory threshold for determining the necessity for special noise abatement measures when applications for federal funding assistance are made.

Federal agencies (HUD and EPA) recognize 55 Ldn as a desirable goal for exterior noise in residential areas for protecting the public health and welfare with an adequate margin of safety **(References 2 and 3)**. Although 55 Ldn is significantly quieter than 65 Ldn, the lower level has not been adopted for regulatory purposes by federal agencies due to economic and technical feasibility considerations.

The U.S. Federal Highway Administration (FHWA) uses the Leq or L10 descriptors rather than the Ldn noise descriptor in assessing highway noise impacts and noise mitigation requirements **(Reference 4)**. The L10 descriptor represents the noise level exceeded ten percent of the time during the peak traffic hour of interest. The Leq is normally evaluated during the peak traffic hour, and has been selected for use in this study. **TABLE 2**, which was extracted from **Reference 4**, presents the current FHWA Noise Abatement Criteria which are normally applied in evaluations of potential noise impacts on federally sponsored roadway improvement projects. In general, the 67 Leq threshold for Activity Category B is applied at all residences in the vicinity of these roadway improvement projects. In addition to the 67 Leq threshold, the Hawaii State Department of Transportation (DOT) has determined that a significant noise increase (and noise impact) occurs if the background ambient noise level increases by more than 15 dB as a result of the highway project **(Reference 5)**.

TABLE 2

FHWA NOISE ABATEMENT CRITERIA
[Hourly A–Weighted Sound Level– –Decibels (dBA)]

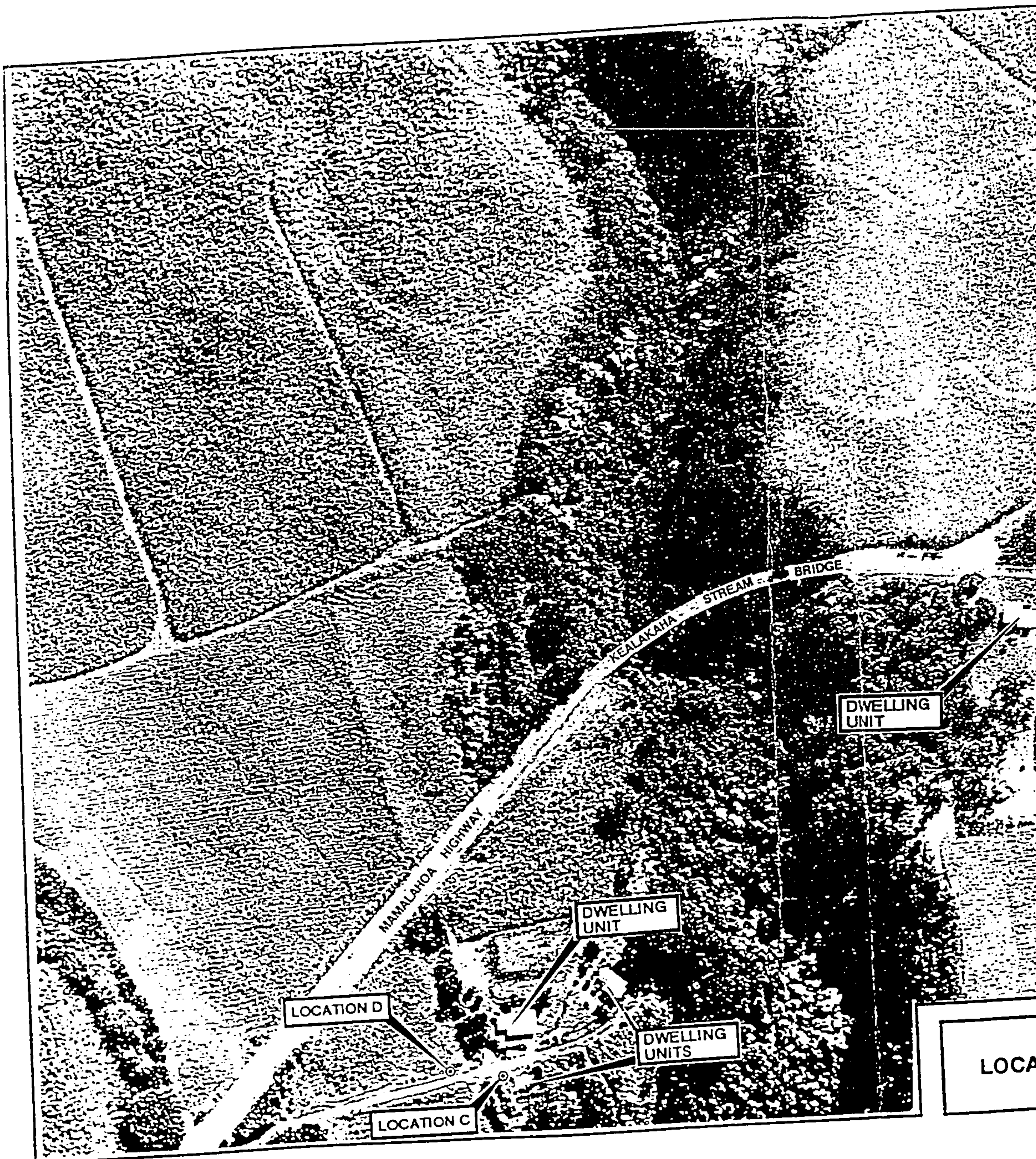
ACTIVITY CATEGORY	LEQ (h)	DESCRIPTION OF ACTIVITY CATEGORY
A	57 (Exterior)	Lands on which serenity and quiet are of extra–ordinary significance and serve an important public need and where the preservation of those qualities is essential if the areas are to continue to serve their intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, activity sports areas, parks, residences, motels, hotels, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Cateriories A or B above.
D	------	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

CHAPTER III. GENERAL STUDY METHODOLOGY

Noise Measurements. Existing traffic and background ambient noise levels at six locations in the project environs were measured in August 1995. The traffic noise measurements were used to calibrate the traffic noise model which was used to calculate the Base Year and future year traffic noise levels under two bridge alignment alternatives (Alternatives #1 and #2). The background ambient noise measurements were used to define existing noise levels at noise sensitive receptors which may be affected by the project, and to determine if future traffic noise levels are predicted to "substantially exceed" existing background ambient noise levels at these noise sensitive receptors and therefore exceed FHWA (U.S. Federal Highway Administration) and State DOT (Department of Transportation, Highways Division) standards.

The noise measurement locations are shown in **FIGURE 1**. The results of the traffic and background ambient noise measurements are summarized in **TABLE 3**. Histograms of the background ambient noise measurements are included as **FIGURES 2 thru 5**. In the tables and histograms, Leq represents the average (or equivalent), A-Weighted, sound level; L10 and L50 represent the sound levels exceeded 10 and 50 percent of the time, respectively; and Lmax and Lmin represent the maximum and minimum sound levels.

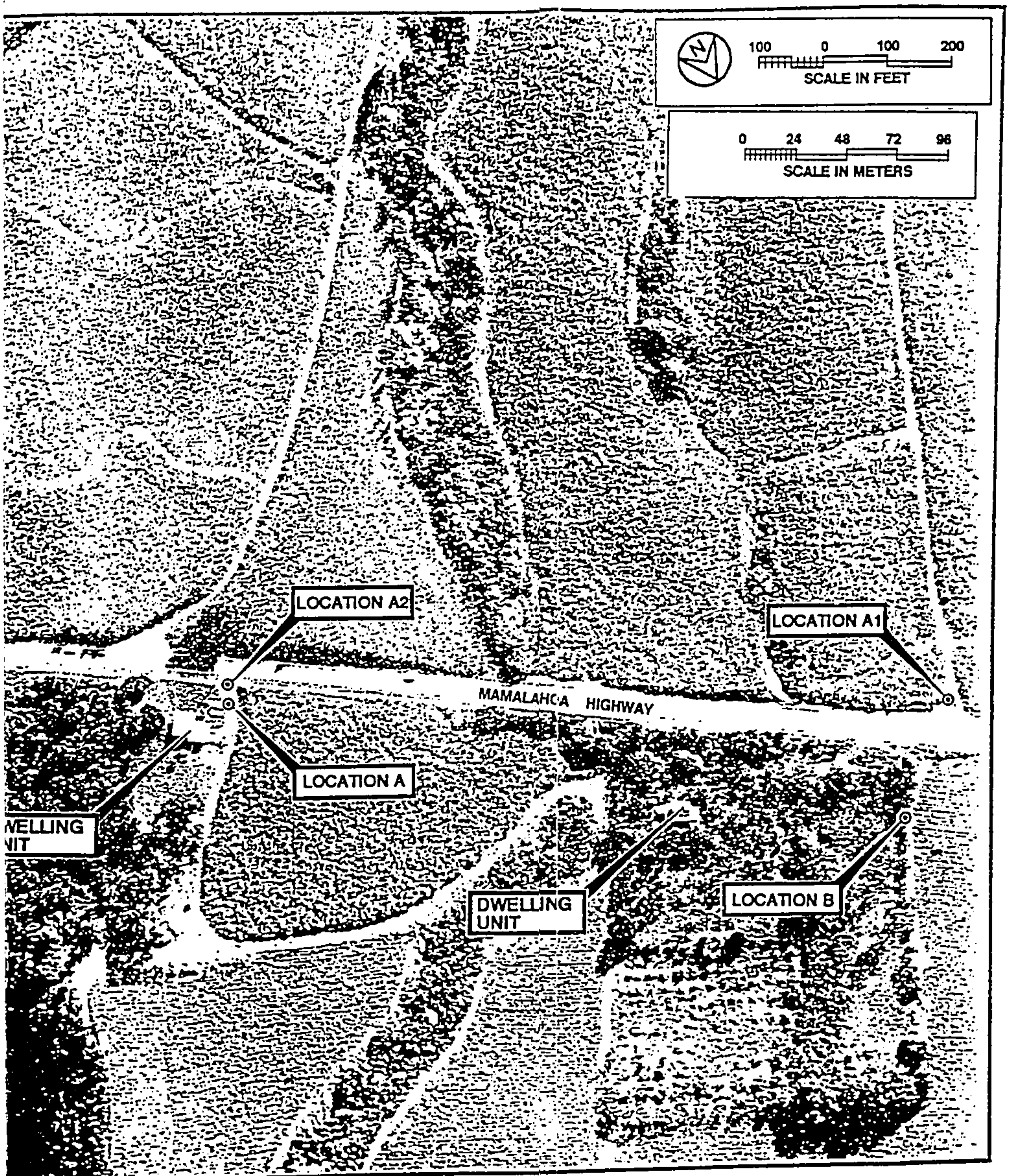
Traffic Noise Predictions. The Federal Highway Administration (FHWA) Traffic Noise Prediction Model (**Reference 6**) was used as the primary method of calculating Base Year and future traffic noise levels, with model parameters adjusted to reflect terrain, ground cover, and local shielding conditions. At the six traffic noise measurement locations along Mamalahoa Highway (Sites A thru D), the measured noise levels were compared with model predictions to insure that measured and calculated noise levels for the existing conditions were consistent and in general agreement. As indicated in **TABLE 3**, spot counts of traffic volumes were obtained


KEALAKAHA STREAM BRIDGE
MAMALAHOA HIGHWAY
DWELLING UNIT
DWELLING UNIT
LOCATION D
DWELLING UNITS
LOCATION C
LOCA

CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

KEALAKAHA STREAM BRIDGE
MAMALAHOA HIGHWAY
DWELLING UNIT
DWELLING UNIT
DWELLING UNITS
LOCATION D
LOCATION C
LOCA



LOCATIONS OF NOISE MEASUREMENT SITES

FIGURE 1

TABLE 3

TRAFFIC AND BACKGROUND AMBIENT NOISE MEASUREMENT RESULTS

LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	--Hourly Traffic Volume-- AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
A. 50 FT from the center-line of Mamalahoa Hwy. (8/08/95)	1605 TO 1705	55	426	7	12	62.0*	62.0
A. 50 FT from the center-line of Mamalahoa Hwy. (8/09/95)	1500 TO 1525	55	410	15	10	61.5*	61.5
A1. 50 FT from the center-line of Mamalahoa Hwy. (8/09/95)	1330 TO 1400	60	304	7	4	64.8	64.4
A1. 50 FT from the center-line of Mamalahoa Hwy. (8/09/95)	1605 TO 1705	60	368	13	12	67.2	66.7
A2. 27 FT from the center-line of Mamalahoa Hwy. (8/09/95)	1530 TO 1555	55	370	5	5	68.0	67.7

TABLE 3 (CONTINUED)

TRAFFIC AND BACKGROUND AMBIENT NOISE MEASUREMENT RESULTS

LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	--Hourly Traffic Volume-- AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
B. 145 FT from the center-line of Mamalahoa Hwy. (8/09/95)	1115 TO 1145	60	344	2	11	52.3*	56.4
C. 350 FT from the center-line of Mamalahoa Hwy. (8/09/95)	0955 TO 1025	55	365	5	18	46.9*	53.2
D. 260 FT from the center-line of Mamalahoa Hwy. (8/09/95)	1420 TO 1450	55	329	7	14	50.1*	52.5

Note:

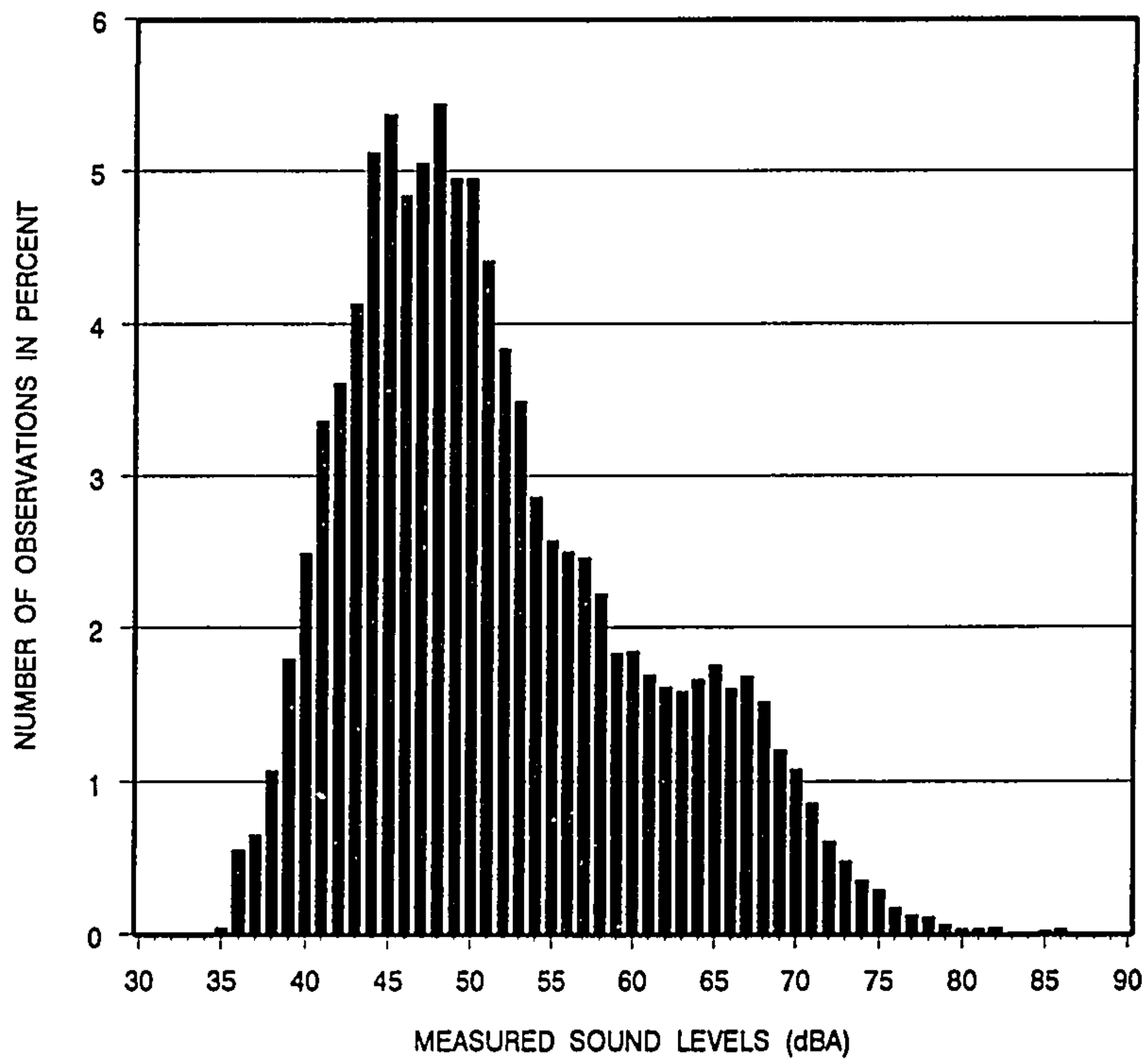
* Partial shielding of road noise was present at measurement locations.

FIGURE 2

HISTOGRAM OF MEASURED SOUND LEVELS AT LOCATION "A"

DATE: AUGUST 8, 1995
TIME: 1605–1705 HOURS

METER RESPONSE: FAST



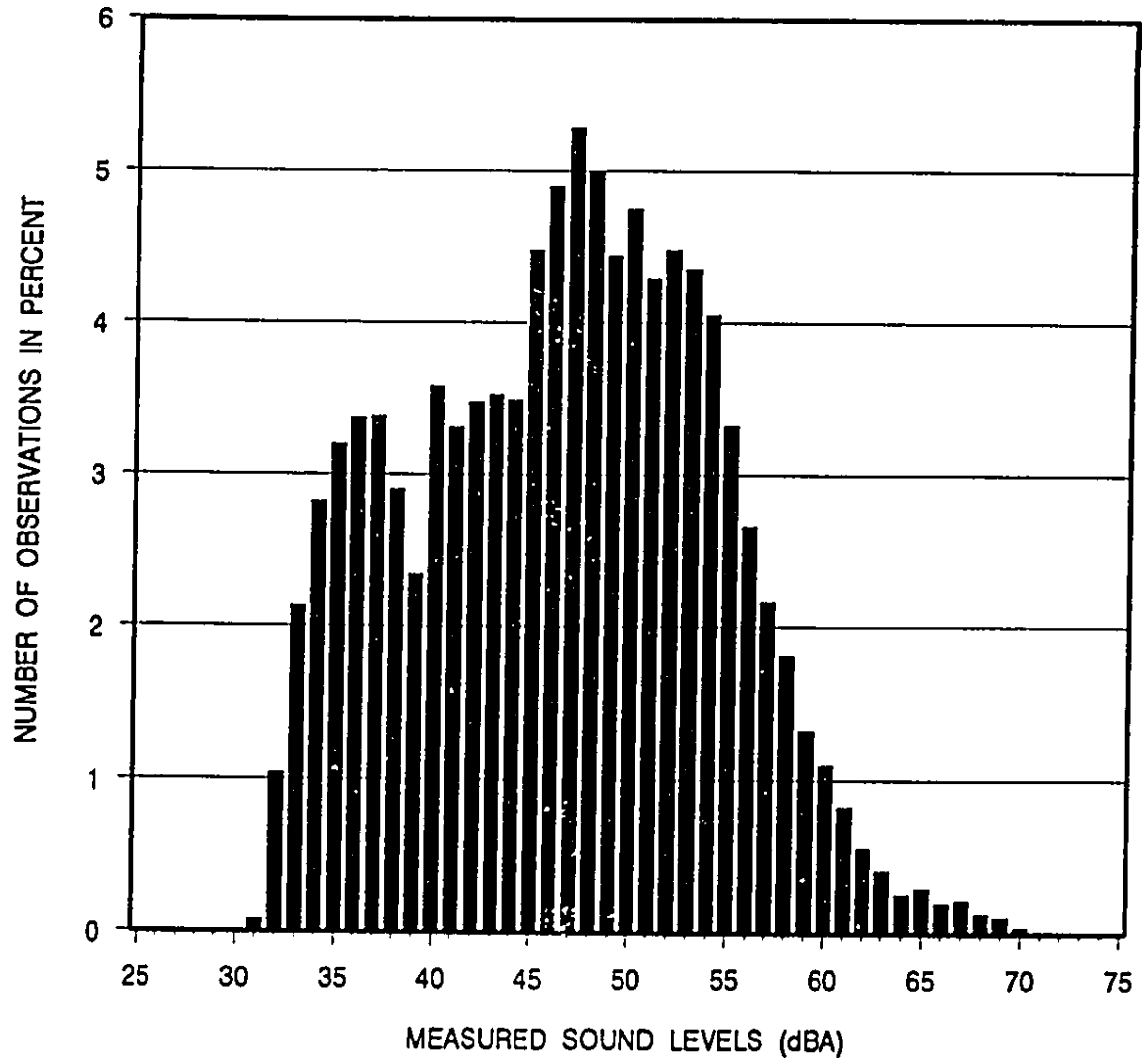
Lmax: 85.8 dBA
L10: 65.1 dBA
L50: 49.1 dBA
Leq: 62.0 dBA
Lmin: 34.1 dBA

FIGURE 3

HISTOGRAM OF MEASURED SOUND LEVELS AT LOCATION "B"

DATE: AUGUST 9, 1995
TIME: 1115-1145 HOURS

METER RESPONSE: FAST



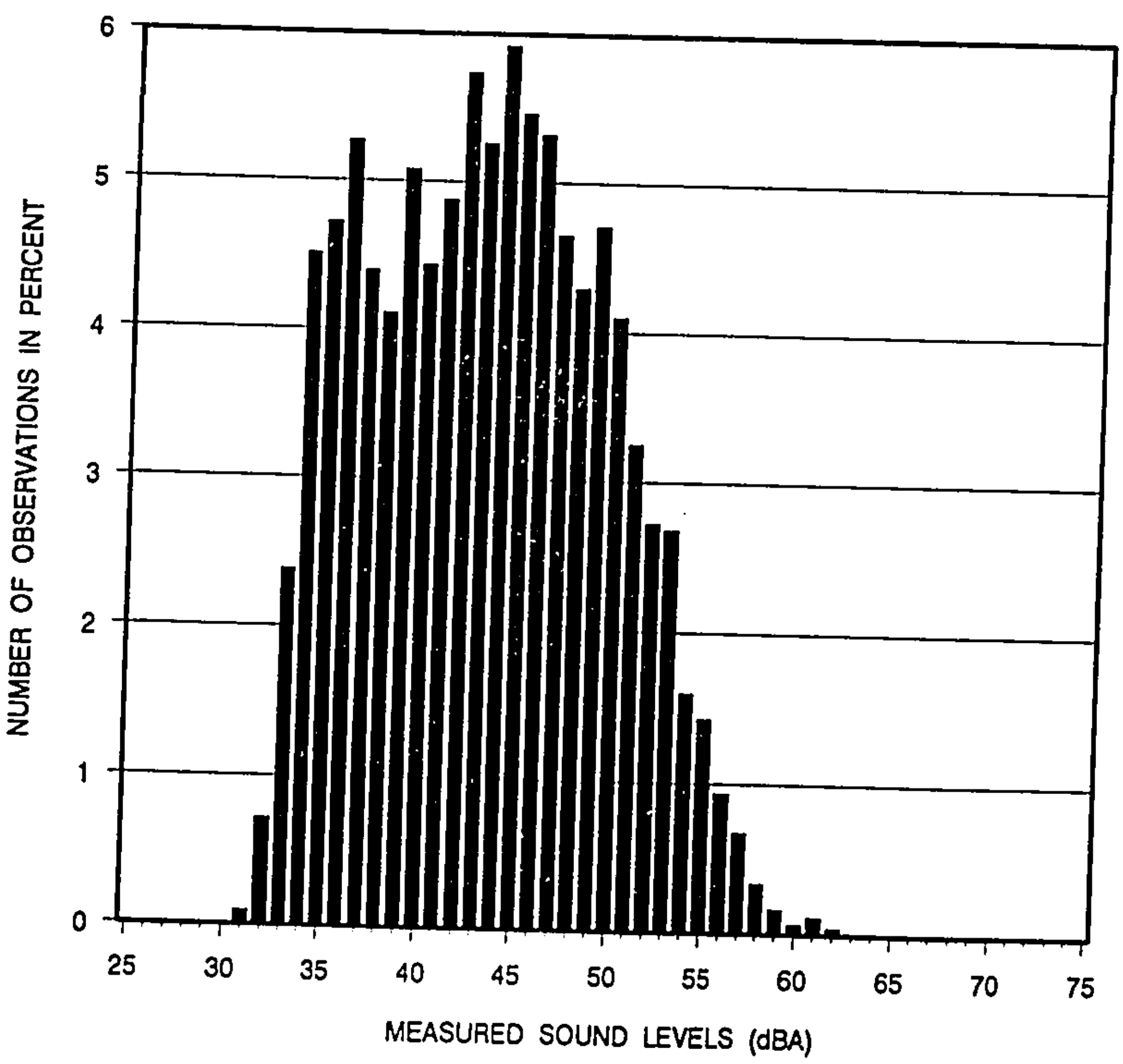
Lmax: 69.8 dBA
L10: 55.6 dBA
L50: 46.1 dBA
Leq: 52.3 dBA
Lmin: 30.4 dBA

FIGURE 4

HISTOGRAM OF MEASURED SOUND LEVELS AT LOCATION "C"

DATE: AUGUST 9, 1995
TIME: 0955-1025 HOURS

METER RESPONSE: FAST



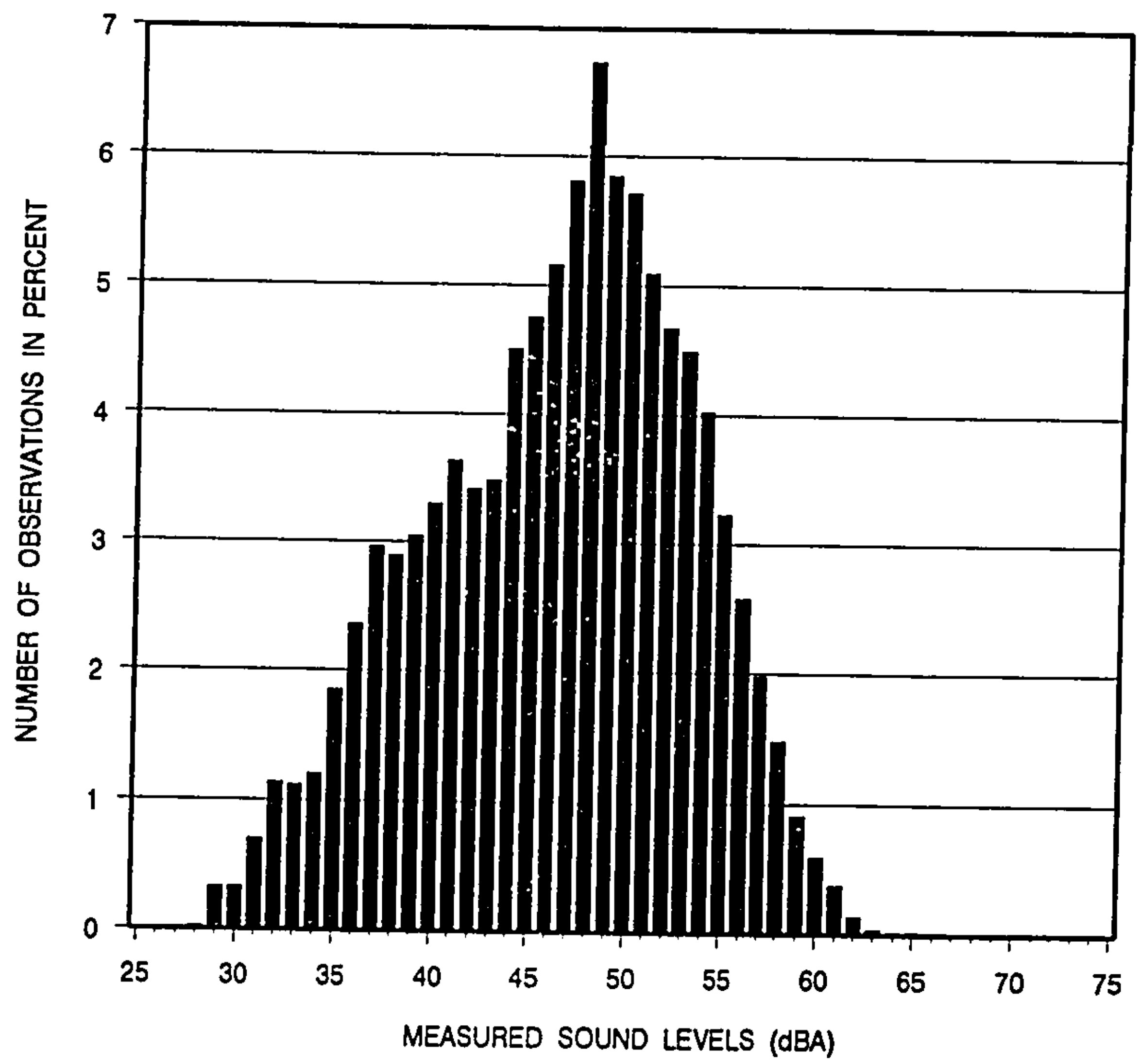
Lmax: 61.6 dBA
L10: 51.1 dBA
L50: 42.6 dBA
Leq: 46.9 dBA
Lmin: 29.8 dBA

FIGURE 5

HISTOGRAM OF MEASURED SOUND LEVELS AT LOCATION "D"

DATE: AUGUST 9, 1995
TIME: 1420–1450 HOURS

METER RESPONSE: FAST



Lmax: 64.5 dBA
L10: 54.1 dBA
L50: 46.6 dBA
Leq: 50.1 dBA
Lmin: 27.6 dBA

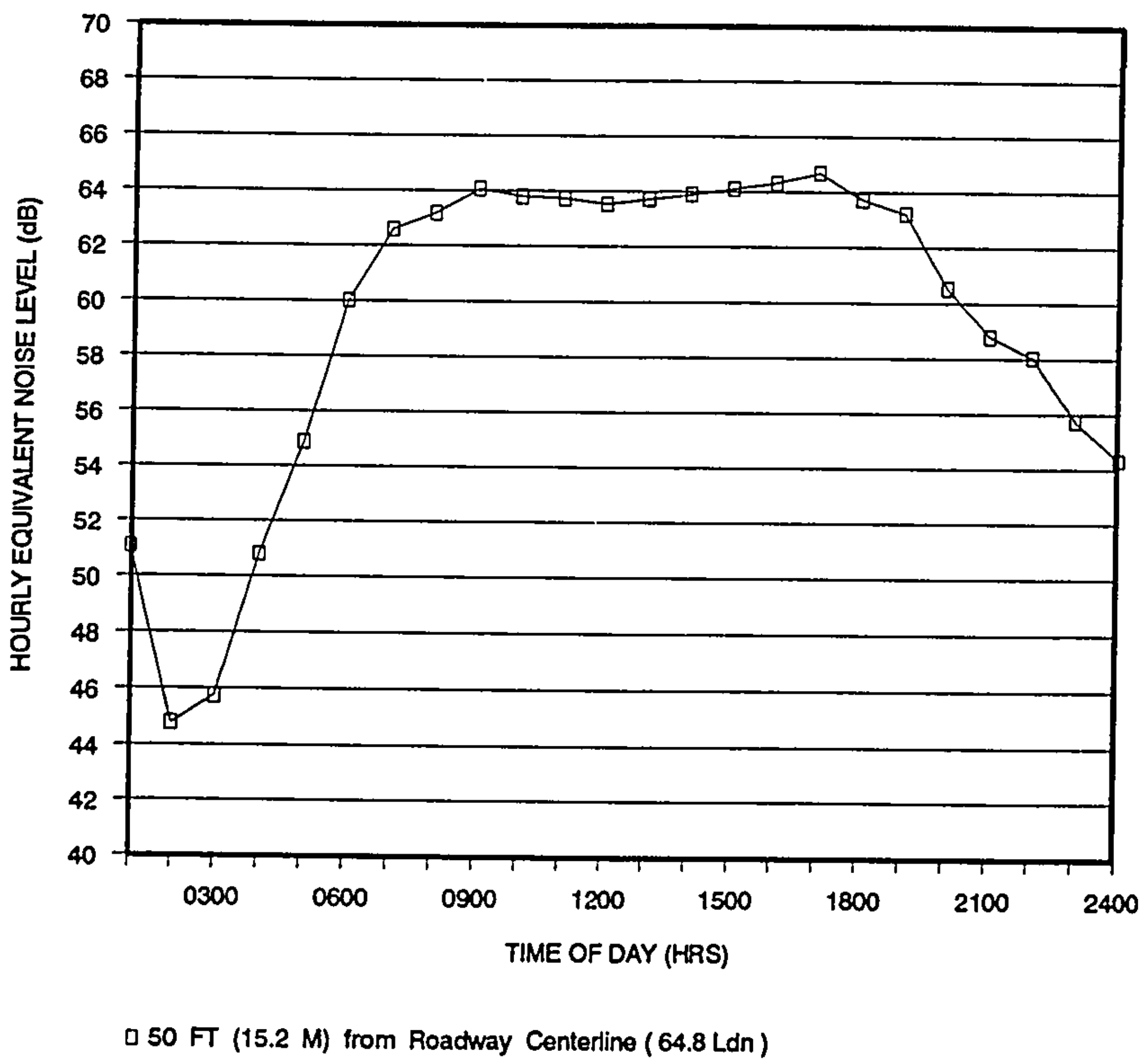
during the measurement periods and were used to generate the Equivalent Sound Level (Leq) predictions shown in the table. The agreement between measured and predicted traffic noise levels was considered good, and sufficiently accurate to formulate the Base Year and future year traffic noise levels.

Base Year traffic noise contours were then developed along Mamalahoa Highway using Base Year (1995) traffic volume data for the PM peak hour from **References 7 and 8**. Traffic mix by vehicle types and average vehicle speeds for the various sections of the existing and future roadway alignments were derived from observations during the noise monitoring periods and from **References 7 and 8**. The determination of the PM peak period as the hour with the highest hourly traffic volume along Mamalahoa Highway was made after a review of the Base Year AM and PM traffic volumes from **Reference 8**. The Equivalent (or Average) Hourly Sound Level [Leq(h)] noise descriptor was used to calculate the Base Year and all future year traffic noise levels as required by **Reference 4**. From **FIGURE 6** and **Reference 8**, it was also concluded that the traffic noise levels as described by the PM Peak Hour Leq was approximately equal to the traffic noise levels as determined by the Ldn descriptor. Topographic maps and project plans (where available) of the area were used to determine terrain, ground cover, and local shielding effects from building structures, which were entered into the noise prediction model.

Future year (2015) traffic noise levels were then developed for the No Build and Build Alternatives using the future traffic forecasts of **Reference 7**, the topographic and existing development features described previously, and the bridge and approach alignments and profiles of Alternative Alignments #1 and #2. The CY 2015 traffic volume and traffic noise level during the PM peak hour under the No Build Alternative were calculated for unconstrained conditions (i.e., average vehicle speeds similar to existing conditions).

FIGURE 6

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT (15.2 M) FROM THE CENTERLINE OF MAMALAHOA HIGHWAY SOUTHEAST OF OOKALA ACCESS ROAD (JUNE 20-21, 1994)



__**Impact Assessments and Mitigation**__. Following the calculation of the future traffic noise levels for the two bridge alignments, comparisons of the future traffic noise levels and impacts for the two alternatives were made. Comparisons of predicted CY 2015 traffic noise levels with FHWA and FHA/HUD noise abatement criteria and standards were made to determine specific locations where noise abatement measures would be necessary. In addition, the State DOT's criteria of "greater than 15 dB increase above existing background noise levels" was also used as a noise abatement threshold for this project (from **Reference 5**). The FHWA 67 Leq(h) criteria shown in **TABLE 2**, the FHA/HUD 65 Ldn standard shown in **TABLE 1**, and the State DOT "greater than 15 dB increase" criteria were applied to all existing dwellings near the bridge. No existing churches, schools, public parks should be affected by future traffic noise levels along the bridge or its approaches. Where noise mitigation measures were required, the use and configuration of noise barriers of various heights and locations were tested to determine if the barriers would be effective in mitigating adverse noise impacts.

CHAPTER IV. EXISTING ACOUSTICAL ENVIRONMENT

For the purposes of this study, 1995 was used as the Base Year for computing changes in traffic noise levels resulting from the bridge replacement project. The Base Year noise environments along the bridge and its approaches (Mamalahoa Highway) were described by computing the Hourly Equivalent Sound Level [Leq(h)] along the existing roadways for the 1995 time period. The Leq(h), expressed in decibels, represents the average level of traffic noise for a given hour of the day. From the field traffic counts performed in conjunction with the noise measurements in August 1995 as well as from State DOT traffic counts, the hour with the highest traffic noise levels along Mamalahoa Highway was determined to be the PM Peak Hour.

TABLES 4A and 4B present the traffic volume, speed, and mix assumptions used to calculate the Base Year and CY 2015 noise levels along the bridge, approach, and other segments of the existing and proposed highway segments. Shown in the tables are the calculated PM Peak Hour Leq(h)'s at a reference distance of 100 feet (30.5 meters) from the centerline of the bridge and roadway segments, and the calculated distances to the various noise contour lines (from 57 to 72 Leq) under unobstructed, line-of-sight conditions. The actual distances to the contour lines will generally be less than indicated in **TABLES 4A and 4B** when intervening structures or walls exist between the highway and a receptor. This reduction (or shrinkage) of the traffic noise contour distances from the highway centerline are the result of noise shielding (or attenuation) affects caused by the intervening structures or walls.

By using the traffic assumptions of **TABLES 4A and 4B**, and aerial photos of the existing dwellings near the project corridor, the relationship of the existing free-field traffic noise contours to the dwellings along the existing roadway were obtained. **FIGURE 1** depicts the locations of the existing bridge and existing dwell-

TABLE 4A

PM PEAK HOUR NOISE LEVELS AND SETBACK DISTANCES
(ENGLISH UNITS)

ROADWAY SEGMENT	SPEED	VEHICLE MIX (%A/%MT/%HT)	TOTAL VPH	Leq @ 100' (dB)	CHANGE	SETBACK ** DISTANCES (FT) FROM CENTERLINE ** 57 Leq	60 Leq	65 Leq	67 Leq	72 Leq
EXISTING CONDITIONS; YEAR 1995										
(1)	60 MPH	94.0/3.0/3.0	489	63.1	N/A	253	160	74	55	25
(2)	55 MPH	94.0/3.0/3.0	489	61.8	N/A	210	133	62	45	21
(3)	50 MPH	94.0/3.0/3.0	489	60.5	N/A	172	109	50	37	17
NO BUILD; FUTURE CONDITION; YEAR 2015										
(1)	60 MPH	94.0/3.0/3.0	695	64.6	1.5	320	202	94	69	32
(2)	55 MPH	94.0/3.0/3.0	695	63.4	1.6	266	168	78	57	27
(3)	50 MPH	94.0/3.0/3.0	695	62.1	1.6	218	137	64	47	22
ALTERNATIVES #1 AND #2; YEAR 2015										
(1)	60 MPH	94.0/3.0/3.0	695	64.6	1.5	320	202	94	69	32
(2)	55 MPH	94.0/3.0/3.0	695	63.4	1.6	266	168	78	57	27
(3)	55 MPH	94.0/3.0/3.0	695	63.4	2.9	266	168	78	57	27

ROADWAY SEGMENT	DESCRIPTION
(1)	Mamalahoa Highway Section North and South of Project.
(2)	Approach segments to Kealakaha Stream Bridge.
(3)	Kealakaha Stream Bridge.

TABLE 4B

PM PEAK HOUR NOISE LEVELS AND SETBACK DISTANCES
(METRIC UNITS)

ROADWAY SEGMENT	SPEED	VEHICLE MIX (%A/%MT/%HT)	TOTAL VPH	Leq @ 30.5 M (dB)	CHANGE	SETBACK ** DISTANCES (M) FROM CENTERLINE ** 57 Leq	60 Leq	65 Leq	67 Leq	72 Leq
EXISTING CONDITIONS; YEAR 1995										
(1)	97 KPH	94.0/3.0/3.0	489	63.1	N/A	77	49	23	17	8
(2)	89 KPH	94.0/3.0/3.0	489	61.8	N/A	64	41	19	14	6
(3)	80 KPH	94.0/3.0/3.0	489	60.5	N/A	52	33	15	11	5
NO BUILD; FUTURE CONDITION; YEAR 2015										
(1)	97 KPH	94.0/3.0/3.0	695	64.6	1.5	98	62	29	21	10
(2)	89 KPH	94.0/3.0/3.0	695	63.4	1.6	81	51	24	17	8
(3)	80 KPH	94.0/3.0/3.0	695	62.1	1.6	66	42	20	14	7
ALTERNATIVES #1 AND #2; YEAR 2015										
(1)	97 KPH	94.0/3.0/3.0	695	64.6	1.5	98	62	29	21	10
(2)	89 KPH	94.0/3.0/3.0	695	63.4	1.6	81	51	24	17	8
(3)	89 KPH	94.0/3.0/3.0	695	63.4	2.9	81	51	24	17	8

ROADWAY SEGMENT	DESCRIPTION
(1)	Mamalahoa Highway Section North and South of Project.
(2)	Approach segments to Kealakaha Stream Bridge.
(3)	Kealakaha Stream Bridge.

ings near the project corridor. Based on the results shown in **TABLES 4A and 4B**, as well as the traffic noise measurements obtained in August 1995, it was concluded that existing traffic noise levels do not exceed the FHWA 67 Leq criteria or the FHA/HUD 65 Ldn standard for dwelling units.

Existing traffic and background ambient noise levels at the dwelling units east of the bridge (noise measurement Locations "C" and "D" are less than 57 Leq(h), and possibly as low as 45 Leq(h). At these two locations, local or distant roadway traffic, birds, dogs, or wind and foliage tend to be the dominant noise sources. Existing noise levels at these locations which are removed from Mamalahoa Highway are typically less than both FHWA exterior noise abatement criteria of 67 and 57 Leq(h).

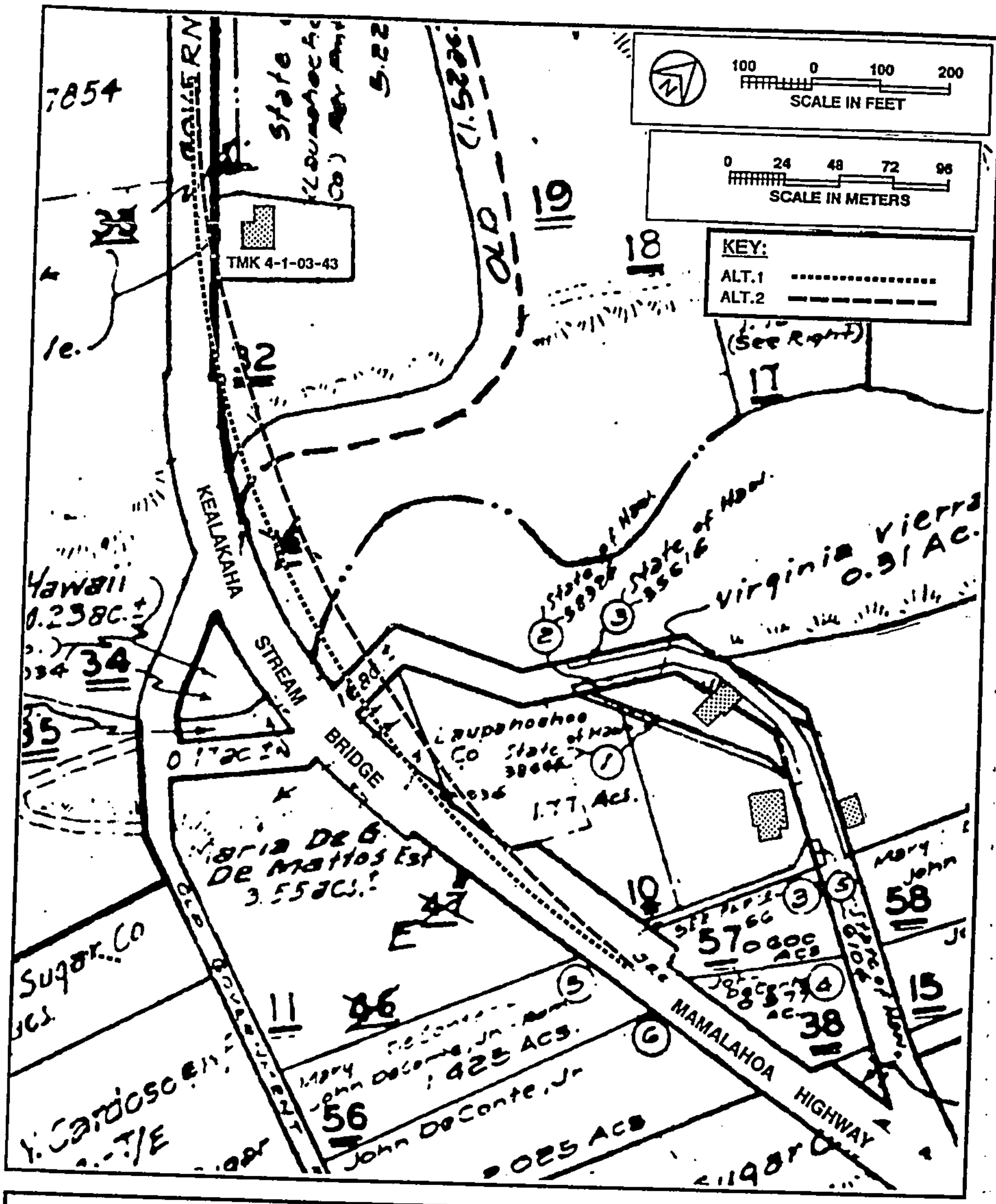
The existing dwelling unit near noise measurement Location "A" currently experiences traffic noise levels of approximately 62 Leq during the PM peak hour. Because of the lower elevation of the lot below the existing highway, approximately 3 to 4 dB of traffic noise attenuation currently exists for ground level receptors in the vicinity of Location "A".

CHAPTER V. COMPARISONS OF FUTURE TRAFFIC NOISE LEVELS UNDER THE VARIOUS ALTERNATIVES

The future traffic noise levels along the Kealakaha Stream Bridge and its approaches during CY 2015 were evaluated for the various study alternatives. These alternatives were: No Build or Base Condition Alternative; Kealakaha Stream Bridge Alignment #1; and Kealakaha Stream Bridge Alignment #2. The locations of the centerlines of Alignments (or Alternatives) #1 and #2 in relationship to the existing bridge alignment are shown in **FIGURE 7**. The same methodology that was used to calculate the Base Year noise levels was also used to calculate the Year 2015 noise levels for the alternatives listed above. As indicated in **FIGURE 7**, both Alignments #1 and #2 would shift the center of the existing highway's traffic lanes toward the dwelling units which are alongside the two approaches to the bridge.

The future (CY 2015) traffic volume, speed, and mix assumptions used for the No Build and two Build Alternatives are also shown in **TABLES 4A and 4B**. Also shown in **TABLES 4A and 4B** are the future traffic noise levels at a reference distance of 100 feet (30.8 meters) from the roadway segments' centerlines, the changes in traffic noise levels from the Base Year (CY 1995) values along each roadway segment, and the future setback distances to the 57 thru 72 Leq(h) noise contours for unobstructed, line-of-sight conditions. The predicted changes in traffic noise levels along the indicated roadway sections between CY 1995 and CY 2015 are anticipated to be relatively small, and range between 1.5 to 2.9 dB. **TABLES 4A and 4B** are useful for presenting an overview of the changes in future traffic noise levels that can be expected within and beyond the project corridor, but without consideration of the changes resulting from the proposed realignments of the bridge and its approaches.

TABLE 5 presents a comparison of existing and future traffic noise levels at the dwelling units (or noise measurement loca-



PROJECT LOCATION MAP

FIGURE 7

TABLE 5

SUMMARY OF EXISTING AND PREDICTED TRAFFIC NOISE LEVELS AT NOISE SENSITIVE RECEPTOR LOCATIONS

RECEPTOR LOCATION	DIST. FROM CENTERLINE	(CY 1995) Leq	FUTURE (CY 2015) Leq / CHANGE			
			W/O BAR.			
No Build Alternative:						
Location "A4"	79 ft (24.1 m)	63.3	64.7 / 1.4			
Location "A5"	67 ft (20.4 m)	64.2	65.8 / 1.6			
Location "C"	350 ft (106.7 m)	53.6	55.2 / 1.6			
Location "D"	260 ft (79.2 m)	53.1	54.7 / 1.6			
Alignment Alternative #1:				1ft (0.3m) Wall	2ft (0.6m) Wall	3ft (0.9m) Wall
Location "A4"	72 ft (21.9 m)	63.3	64.7 / 1.4	64.0 / 0.7	63.9 / 0.6	63.4 / 0.1
Location "A5"	60 ft (18.3 m)	64.2	65.3 / 1.1	65.1 / 0.9	64.3 / 0.1	63.1 / −1.1
Location "C"	350 ft (106.7 m)	53.6	55.2 / 1.6	N/A	N/A	N/A
Location "D"	260 ft (79.2 m)	53.1	54.7 / 1.6	N/A	N/A	N/A
Alignment Alternative #2:				4ft (1.2m) Wall	5ft (1.5m) Wall	6ft (1.8m) Wall
Location "A4"	52 ft (15.8 m)	63.3	67.8 / 4.5***	67.6 / 4.3***	65.3 / 2.0*	65.0 / 1.7
Location "A5"	40 ft (12.2 m)	64.2	69.4 / 5.2**	69.4 / 5.2**	66.9 / 2.7	63.3 / −0.9
Location "C"	350 ft (106.7 m)	53.6	55.2 / 1.6	N/A	N/A	N/A
Location "D"	260 ft (79.2 m)	53.1	54.7 / 1.6	N/A	N/A	N/A

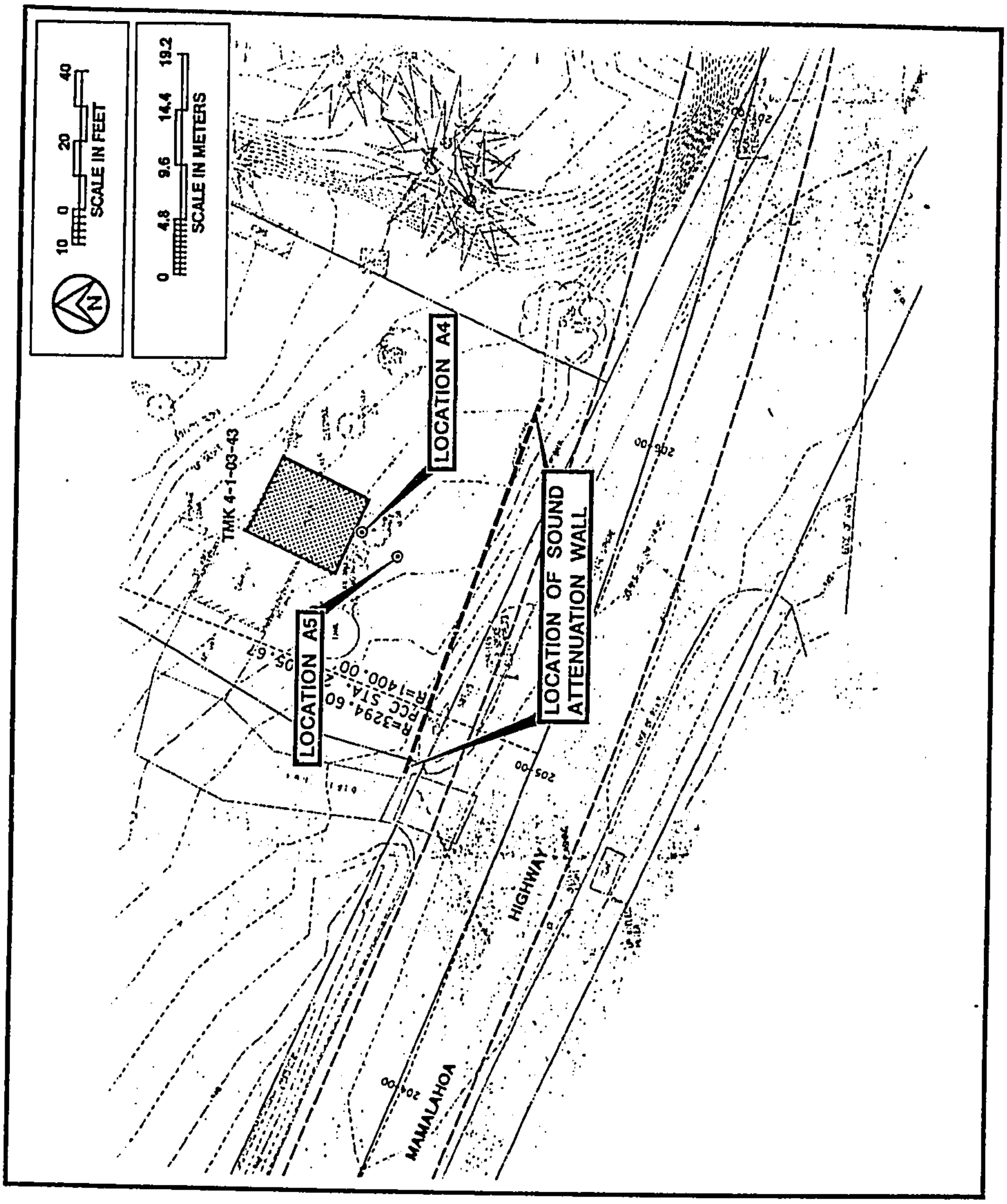
Notes:

1. Sound attenuation wall location as shown in FIGURES 8 and 9.
2. * Denotes exceedance of FHA/HUD 65 Ldn standard for residences.
3. ** Denotes exceedance of FHWA 67 Leq standard for residences.
4. *** Denotes exceedance of FHWA 67 Leq and FHA/HUD 65 Ldn standard for residences.

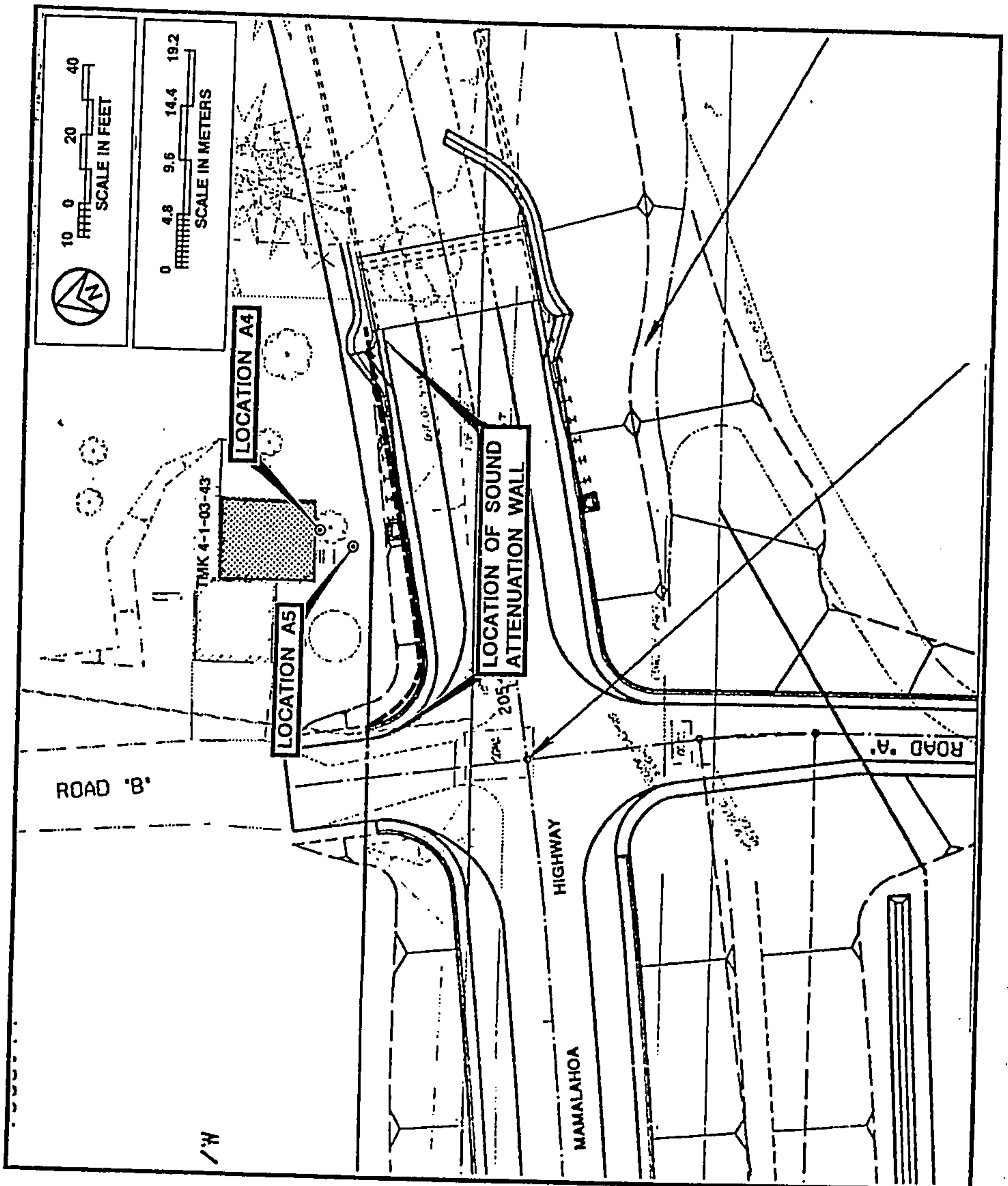
tions) for the No Build and Build Alternatives. Future traffic noise levels with or without the project should not exceed FHWA, FHA/HUD, or State DOT noise standards or abatement criteria at the dwelling units southeast of the bridge near noise measurement Locations "C" and "D". This is due to the relatively large distances of the dwelling units from the south approach to the bridge and the relatively small increases in traffic volumes anticipated between CY 1995 and CY 2015. As indicated in **TABLE 5**, future traffic noise levels at these dwelling units are not expected to exceed 56 Leq (or Ldn), and the increases in future traffic noise levels are predicted to be relatively small at 1.6 dB. For these reasons, traffic noise mitigation measures should not be required at the dwelling units alongside the south approach to the bridge.

For the existing dwelling unit alongside the north approach to the bridge, future traffic noise levels were calculated at both receptor Locations "A5" (in the front yard) and "A4" (at the dwelling unit) for the No Build and Build Alternatives (see **FIGURES 8 and 9**). Receptor elevations were assumed to be 5 feet (1.5 meters) and 8 feet (2.4 meters) above grade at Locations "A5" and "A4", respectively. Without special noise mitigation measures, future traffic noise levels at Locations "A5" and "A4" are expected to range between 67 and 70 Leq during the PM peak hour under the preferred Alignment #2. Both the FHWA 67 Leq noise mitigation threshold and the FHA/HUD 65 Ldn standard are expected to be exceeded at these two locations under the preferred Alignment #2. The increase in future traffic noise levels above the Base Year noise levels are expected to not exceed 6 dB at these two locations, so the State DOT's ">15 dB" criteria should not be exceeded.

The following general conclusions can be made in respect to the effects of the two bridge alignment alternatives on the traffic noise levels at existing dwelling units alongside the project corridor:



RELATIONSHIP OF PROPOSED ALIGNMENT #1 TO THE EXISTING DWELLING UNIT ALONG THE NORTH APPROACH TO THE BRIDGE	FIGURE 8



RELATIONSHIP OF PREFERRED ALIGNMENT #2 TO THE EXISTING DWELLING UNIT ALONG THE NORTH APPROACH TO THE BRIDGE

FIGURE 9

A. Under the No Build Alternative, traffic noise levels are predicted to increase no more than 1.5 to 1.6 dB or Leq(h). In order for these increases to occur, no significant changes in traffic conditions (average vehicle speed and vehicle mix) must occur by CY 2015 along Mamalahoa Highway. Because actual traffic conditions during the PM peak hour may worsen under the No Build Alternative, with reduced speed during the peak hour, the predicted increases in traffic noise levels may be less than the range of 1.5 to 1.6 dB. However, increases in traffic noise levels during the historical off-peak hours may be of this magnitude.

B. Under the Build Alignment #1 or #2 Alternatives, traffic noise increases are expected to be similar to those expected under the No Build Alternative along south approach to the Keakaha Stream Bridge. FHWA, FHA/HUD, and State DOT noise criteria and standards should not be exceeded at existing dwelling units alongside the south approach to the bridge, and noise mitigation measures would not be required under either of the Build Alternatives.

C. Under the preferred Alignment #2 Alternative, traffic noise increases are expected to be greater than those under Alignment #1 at the existing dwelling unit along the north approach to the bridge. In addition, where the FHWA 67 Leq criteria would not be exceeded under Alignment #1, it is expected to be exceeded under Alignment #2 at the existing dwelling unit (see **TABLE 5**). The State DOT ">15 dB increase" noise criteria should not be exceeded at the existing dwelling unit alongside the north approach to the bridge under either Alignment #1 or #2. The FHA/HUD 65 Ldn standard would be exceeded at the existing dwelling unit only under Alignment #2.

CHAPTER VI. POSSIBLE NOISE MITIGATION MEASURES

Possible noise mitigation measures considered included the following:

A. Restricting the Growth In the Number of Noisy Buses, Heavy Trucks, Motorcycles, and Automobiles with Defective Mufflers. The percentage contribution to the total traffic noise by heavy trucks, buses, and noisy vehicles is currently in the order of 50 percent, and elimination of these noise sources would reduce total traffic noise levels by approximately 3 dB. Restricting the growth rate of these vehicles (to growth rates below passenger automobile growth rates) could produce noise reductions in the order of 1 or 2 dB, which are not considered significant for the level of regulatory efforts required.

B. Alteration of the Horizontal Or Vertical Alignment of the Bride and Its Approaches. The proposed project involves the alteration of the existing highway alignment toward, rather than away from, existing dwelling units. Other possible realignments of the bridge and its approaches were not considered to be practical for the following reasons:

1. Decreasing the curvature of the existing bridge alignment requires that the new bridge alignment be located toward, rather than away from existing dwelling units (see FIGURE 7). In other words, locating the new bridge alignment on the mauka (inland or southwest) side of the existing bridge would increase the curvature rather than decrease the curvature of the new bridge.

2. Increasing the distance of the north bridge approach to the existing dwelling unit would require that an inland jog in the new north approach alignment be constructed to meet the

existing highway. Construction costs for this additional section of roadway are expected to be greater than the costs of a sound attenuating wall for the affected dwelling unit.

C. Acquisition of Property Rights for Construction of Noise Barriers, and/or Construction of Noise Barriers Along the Right-of-Way. For the existing dwelling unit alongside the north approach to Kealakaha Stream Bridge, construction of a noise barrier will probably be the preferred noise mitigation measure. The 3 to 7 dB of noise attenuation achievable with a 6 FT high wall will be sufficient for the single story structure and the front yard areas. Although site specific plans and section details were not available for the project, preliminary calculations based on existing topographic maps and generalized roadway sections indicated that the use of a noise barrier near the Right-of-Way will probably be the primary noise mitigation measure employed to meet FHWA and/or FHA/HUD noise abatement criteria.

D. Acquisition of Real Property Interests To Serve As A Noise Buffer Zone. Because the available buffer space between the existing highway and the dwelling unit alongside the north approach to the bridge is relatively narrow (less than 100 feet, or 30.5 meters), use of this noise mitigation measure is not possible. Relocation of the existing dwelling unit and yard area would be involved if this mitigation measure was applied. In general, the acquisition of property for the creation of noise buffer zones or noise mitigation has seldom been applied in Hawaii. The use of sound barriers or the application of sound insulation treatment should be evaluated prior to consideration of property acquisition for noise mitigation.

E. Noise Insulation of Public Use or Nonprofit Institutional Structures. No public use or nonprofit institutional structures are affected by this project, so noise mitigation measures should not be required for this project to meet FHWA or State DOT noise abatement criteria.

CHAPTER VII. FUTURE TRAFFIC NOISE IMPACTS AND RECOMMENDED NOISE MITIGATION MEASURES

A detailed examination of the noise mitigation measures which would be required to comply with FHWA, FHA/HUD, and State DOT noise criteria and standards was performed along the north approach to the Kealakaha Stream Bridge where the existing dwelling unit is located. This examination was based on preliminary plans and profiles of the preferred Alignments #1 and #2 which were available in August 1995. Detailed highway cross-sections of the area of interest were not available in the August 1995 plan set.

By FHWA standards (**Reference 4**), noise mitigation measures are normally required if 67 Leq is exceeded at the existing residence (dwelling or middle of the yard) along the north approach as a result of traffic noise following project completion, or if the future traffic noise levels will "substantially exceed" existing background ambient noise levels at these residences. FHWA does not define the increases, in decibels, which would require noise mitigation by the "substantially exceed" standard, and has required that State highway agencies provide this definition. The State DOT has recently provided an interim definition of "substantial increase" as that which is greater than 15 dB (**Reference 5**).

Because the preferred Alignment #2 is expected to result in a reduction of the distances between the traffic lanes and the existing dwelling unit alongside the north approach to the bridge, increases in future traffic noise levels are expected to occur at this dwelling unit. In addition, by CY 2015, due to expected increases in traffic volumes as well as the construction of Alignment #2, traffic noise levels at this dwelling unit are expected to exceed FHWA and FHA/HUD noise criteria and standards. Hawaii State DOT's ">15 dB increase" criteria is not expected to be exceeded under the preferred Alignment #2.

In order to determine the minimum noise mitigation measures which would be required at the existing dwelling unit so as to not exceed the 67 Leq FHWA or 65 Ldn FHA/HUD noise mitigation criteria, the performances of various sound attenuating barrier heights were tested for both Alignments #1 and #2. The location of the sound attenuation barriers which would be required to the meet the FHWA 67 Leq or FHA/HUD 65 Ldn criteria for Alignments #1 and #2 are shown in **FIGURES 8 and 9**. The resulting traffic noise levels expected behind the barriers of various heights are shown in **TABLE 5**. The barrier heights shown are relative to the planned roadway elevations for Alignments #1 and #2. It should be noted that the sound attenuation barriers shown in **FIGURES 8 and 9** will not reduce traffic noise levels at second floor receptor locations of any new 2-story dwelling unit which may be constructed on the existing lot. For any future second floor rooms which may face the improved highway and bridge approach, closure and air conditioning would be the recommended noise mitigation measure.

From **TABLE 5**, it was concluded that minimal barrier heights would be required for Alignment #1, and primarily to meet the FHA/HUD noise standard of 65 Ldn in the yard (at Location "A5") of the existing residence. No barrier would be required to meet the FHWA 67 Leq criteria under Alignment #1.

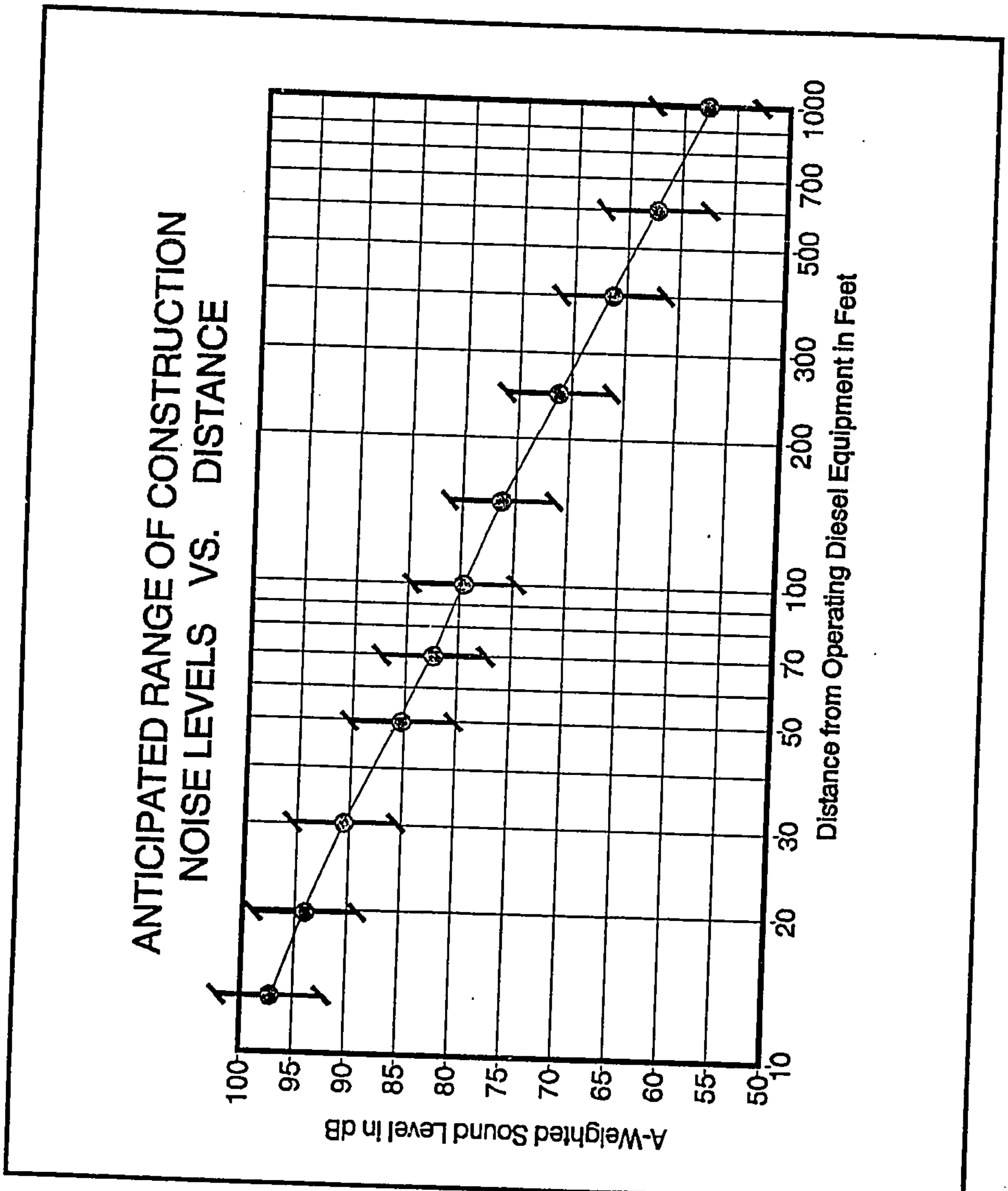
Under the preferred Alignment #2, a 5 to 6 foot (1.5 to 1.8 meter) high wall would be required to meet FHWA or FHA/HUD noise standards. A 5 foot (1.5 meter) high wall would meet the FHWA 67 Leq, but not the FHA/HUD 65 Ldn standard. A 6 foot (1.8 meter) high wall is recommended where shown in **FIGURE 9** if Alignment #2 is selected. The sound attenuation wall should be constructed from materials with a minimum surface weight of 7#/SF, and should not have any see-through openings or cracks. Use of concrete masonry units for the wall is acceptable.

CHAPTER VIII. CONSTRUCTION NOISE IMPACTS AND RECOMMENDED NOISE MITIGATION MEASURES

General Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for construction is unknown. Because the excessively noisy work may move from one location on the project site to another during that period, actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of exterior noise from construction activity (excluding pile driving activity) are shown in **FIGURE 10**. The impulsive noise levels of impact pile drivers are approximately 15 dB higher than the levels shown in **FIGURE 10**, while the intermittent noise levels of vibratory pile drivers are at the upper end of the noise level ranges depicted in the figure. Typical levels of construction noise inside naturally ventilated and air conditioned structures are approximately 10 and 20 dB less, respectively, than the levels shown in **FIGURE 10**.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 FT distance), and due to the exterior nature of the work (pile driving, grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. The dwelling unit closest to the project site may experience construction noise levels of 80 to 90 dB during the earthwork phase of the project.

The incorporation of State Department of Health construction noise limits and curfew times, which are applicable on the island of Oahu (**Reference 9**) are other noise mitigation measures which are normally applied to construction activities when residential receptors are involved. **TABLE 6** depicts the allowed hours of construction for normal construction noise (levels which do not



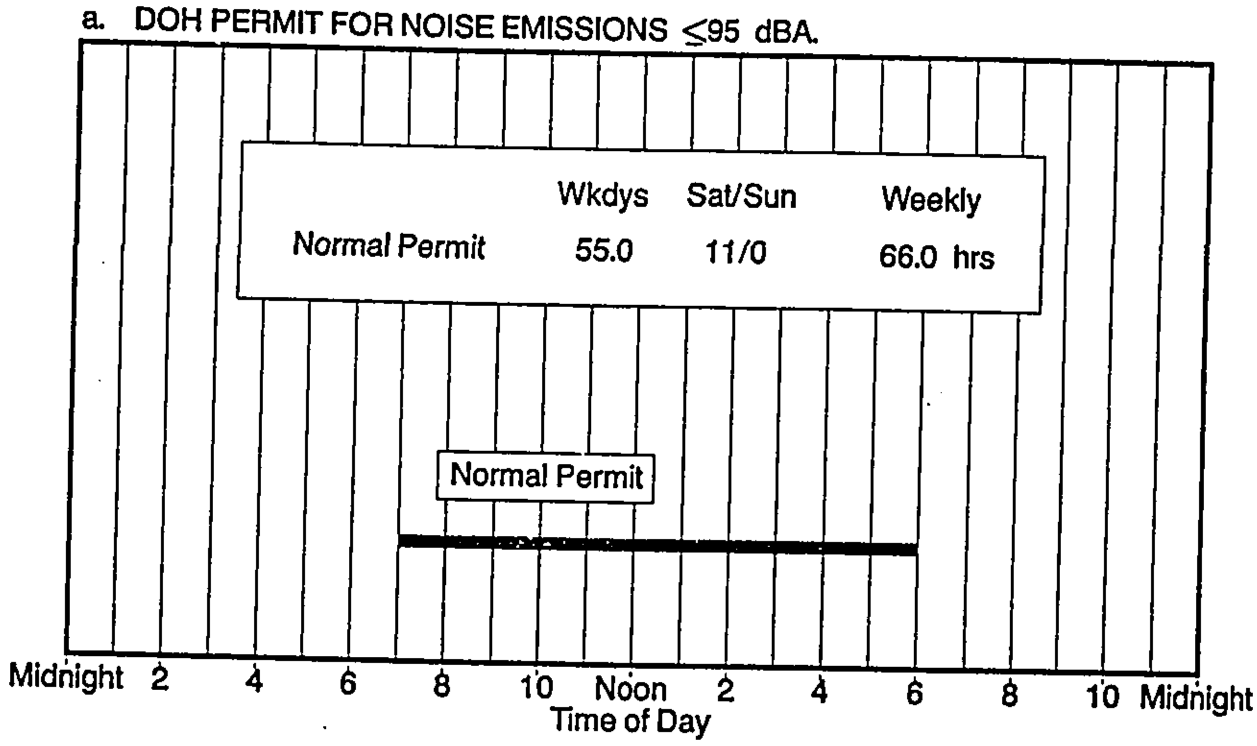
CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 10

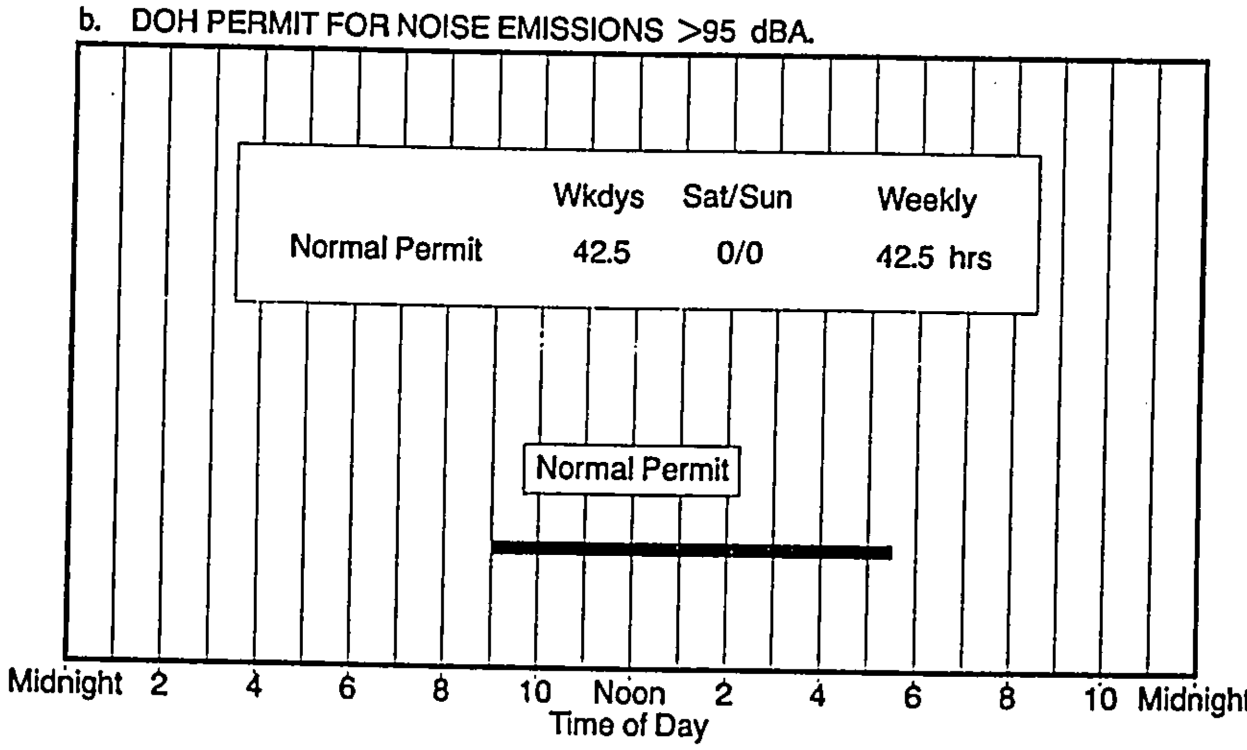
TABLE 6

AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

a. DOH PERMIT FOR NOISE EMISSIONS ≤95 dBA.



b. DOH PERMIT FOR NOISE EMISSIONS >95 dBA.



exceed 95 dB at the project's property line) and for construction noise which exceeds 95 dB at the project's property line. Pile driving activities generally fall within the second category whose noise levels exceed 95 dB at the property line. Excessively noisy construction activities, such as pile driving, are not allowed on holidays, Saturdays, Sundays, during the early morning, and during the late evening periods under the DOH permit procedures.

Consideration should be given to employing the curfew system of the State Department of Health regulations relating to excessive construction noise. In this way, construction noise impacts on noise sensitive receptors can be minimized. In addition, the use of quieted portable engine generators and diesel equipment should be specified for use within 500 FT of noise sensitive properties. Heavy truck and equipment staging areas should also be located at areas which are at least 500 FT from noise sensitive properties whenever possible. The use of 8 to 12 FT high construction noise barriers should also be used where close-in construction work to noise sensitive structures are unavoidable.

Pile Driving Noise. Typical maximum (or Lmax) noise levels of impact pile drivers are expected to range between 98 dB at 100 FT distance to 78 dB at 1,000 FT distance. Typical median (L50, or noise level exceeded 50 percent of the time) noise levels during impact pile driving activities are expected to range between 93 dB at 100 FT distance to 71 dB at 1,000 FT distance. Indoors, typical levels of pile driving noise within naturally ventilated and air conditioned structures are approximately 10 and 22 dB less, respectively, than the outdoor levels listed above.

Vibration from Pile Driving. Pile driving may be necessary to implant concrete piles into the ground over the project site. Induced ground vibrations from these pile driving operations have the potential to cause architectural and structural damage to structures.

Ground vibrations generated during pile driving operations are generally described in terms of peak particle (or ground) velocity in units of inches/second. The human being is very sensitive to ground vibrations, which are perceptible at relatively low particle velocities of 0.01 to 0.04 inches/second. Damage to structures, however, occur at even higher levels of vibration as indicated in **TABLE 7**. The most commonly used damage criteria for structures is the 2.0 inches/second limit derived from work by the U.S. Bureau of Mines. A more conservative limit of 0.2 inches per second is also used for the more lightweight or fragile structures.

Based on measured vibration levels during pile driving operations under various soil conditions and at various distances, estimates of ground vibration levels vs. distance from the pile driver have been made for various soil conditions and for various energy ratings of the pile drivers. **FIGURE 11** may be used to predict vibration levels for the soil conditions indicated. When coral layers must be penetrated, vibration levels can be expected to be higher than those shown in **FIGURE 11**, particularly if the adjacent structures are supported by the common coral layer.

Predictions of peak ground vibration levels vs. scaled energy distance factor from the driven pile are not precise, with initial uncertainty factor for a given location in the order of 10:1. For this reason, it is standard practice to employ seismograph monitoring of ground vibrations during pile driving operations with a 3-axis geophone or accelerometer. Monitoring alone, however, may not be a practical mitigation measure unless there are alternative pile driving methods or foundation plans which can be employed if the damage criteria are exceeded. For these reasons, the following preventive measures are recommended for implementation during the planning and design phases of the project:

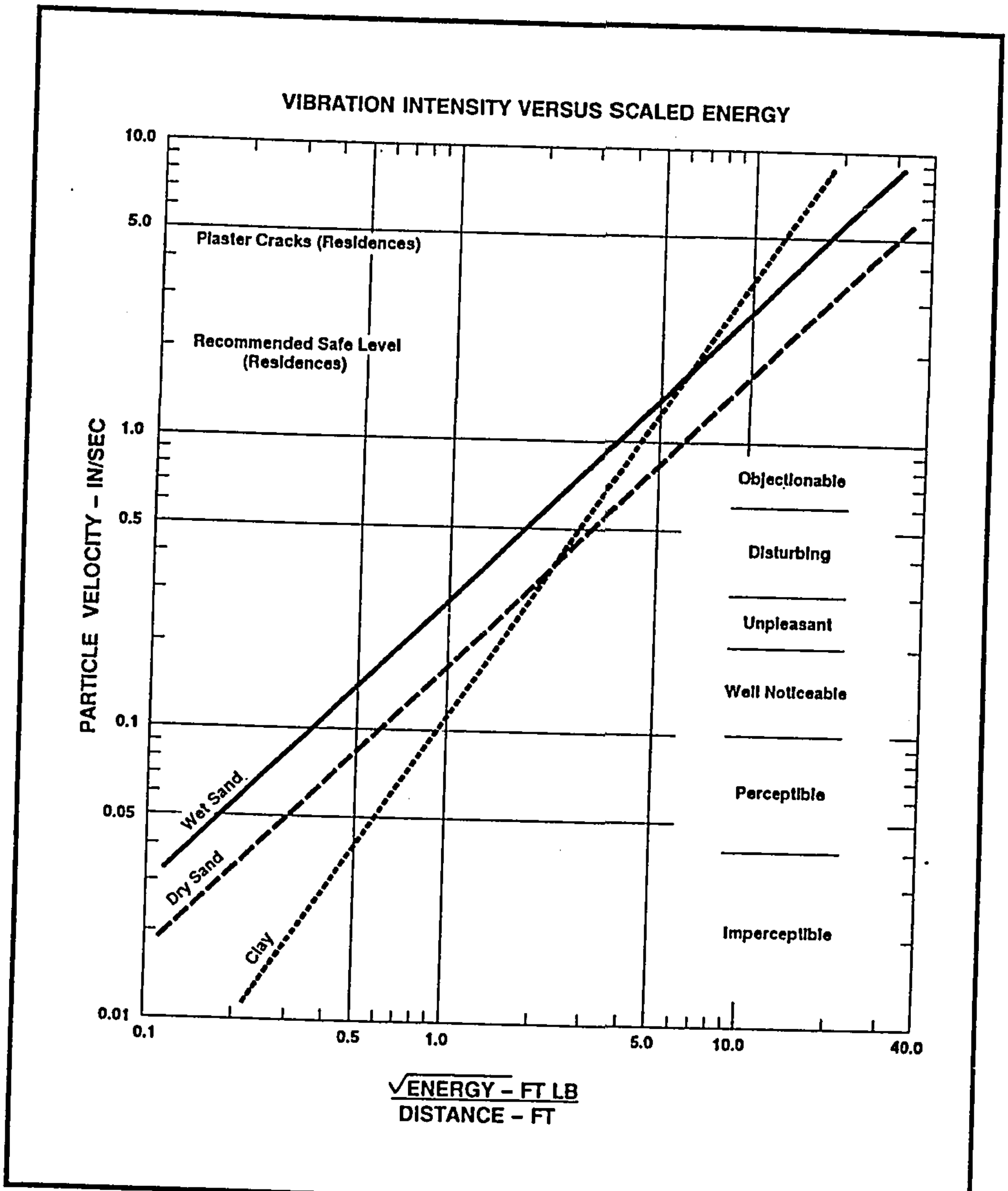
- o In addition to the normal planning and design concerns regarding potential damage due to settling and heaving during

TABLE 7

SUMMARY OF BUILDING DAMAGE CRITERIA

PEAK GROUND VELOCITY (mm/sec)	PEAK GROUND VELOCITY (in/sec)	COMMENT
193.04	7.6	Major damage to buildings (mean of data).
137.72	5.4	Minor damage to buildings (mean of data).
101.16	4.0	'Engineer structures' safe from damage.
50.8	2.0	Safe from damage limit (probability of damage <5%).
		No structural damage.
33.02	1.3	Threshold of risk of 'architectural' damage for houses.
25.4	1.0	No data showing damage to structures for vibration <1 in./sec.
15.24	0.6	No risk of 'architectural' damage to normal buildings.
10.16	0.4	Threshold of damage in older homes.
5.08	0.2	Statistically significant percentage of structures may experience minor damage (including earthquake, nuclear event, and blast data for old and new structures).
		No 'architectural' damage.
3.81	0.5 to 0.15	Upper limits for ruins and ancient monuments.
1.0	0.04	Vertical vibration clearly perceptible to humans.
0.32	0.01	Vertical vibration just perceptible to humans.

Source: 'State-of-the-Art Review: Prediction and Control of Groundborne Noise and Vibration from Rail Transit Trains'; U.S. Department of Transportation; December 1983.



MINIMUM VIBRATION INTENSITIES EXPECTED FROM PILE DRIVING

FIGURE 11

construction, consideration should also be given to risks of damage due to vibration from pile driving.

- If predicted vibration levels from pile driving exceed the levels which may result in damage to nearby buildings, and predicted levels cannot be reduced by sizing of the pile driver or through the use of alternate types of piles (bored or non-displacement types), test piles should be driven and its vibrations monitored and recorded prior to completion of the foundation design. The monitoring of the test piles should be designed to measure the expected peak, 3-axis vibration levels at the nearest buildings. The results of the monitoring should be used to define the empirical distance from the driven pile to the damage risk location, and to evaluate the risks of structural damage to the adjacent structures during actual construction.

- If predicted vibration levels from pile driving exceed the levels associated with damage to nearby buildings, the use of alternate types of piles or foundations should be considered for implementation during the design phase.

APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control;" Federal Interagency Committee on Urban Noise; June 1980.

(2) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; July 12, 1979.

(3) "Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety;" U.S. Environmental Protection Agency; EPA 550/9-74-004; March 1974.

(4) Federal Highway Administration; "Procedures for Abatement of Highway Traffic Noise and Construction Noise;" 23 CFR Chapter I, Subchapter J, Part 772; July 8, 1982.

(5) Letter to AMFAC/JMB Hawaii, Inc. from Ron Tsuzuki, State DOT, dated February 1, 1995; HWY-PA 2.4400.

(6) Barry, T. and J. Reagan, "FHWA Highway Traffic Noise Prediction Model;" FHWA-RD-77-108, Federal Highway Administration; Washington, D.C.; December 1978.

(7) Hawaii State Department of Transportation CY 1995 and CY 2015 traffic volumes and design values for the Kealakaha Stream Bridge Replacement Project; TA 95-36; August 22, 1995.

(8) Hawaii State Department of Transportation Traffic Counts and Vehicle Type Classifications for Station C-14-E; June 20-22, 1994.

(9) "Title 11, Administrative Rules, Chapter 43, Community Noise Control for Oahu;" Hawaii State Department of Health; November 6, 1981.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "LepN" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

TERM	SYMBOL
1. A-Weighted Sound Level	L_A
2. A-Weighted Sound Power Level	L_{WA}
3. Maximum A-Weighted Sound Level	L_{max}
4. Peak A-Weighted Sound Level	L_{Apk}
5. Level Exceeded x% of the Time	L_x
6. Equivalent Sound Level	L_{eq}
7. Equivalent Sound Level over Time (T) (1)	$L_{eq(T)}$
8. Day Sound Level	L_d
9. Night Sound Level	L_n
10. Day-Night Sound Level	L_{dn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$
12. Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78, NOISE REGULATION REPORTER.

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

TERM	A-WEIGHTING	ALTERNATIVE(1) A-WEIGHTING	OTHER(2) WEIGHTING	UNWEIGHTED
1. Sound (Pressure) (3) Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% of the time	L_x	L_{Ax}	L_{Bx}	L_{px}
6. Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7. Equivalent Sound Level (4) Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8. Day Sound Level	L_d	L_{Ad}	L_{Bd}	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average value over (non-time domain) set of observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level exceeded x% of the total set of (non-time domain) observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

APPENDIX E

Archaeological Inventory Survey of the Proposed New
Kealakaha Stream Bridge at Kealakaha,
Hamakua District, Island of Hawaii

Archaeological Inventory Survey of the Proposed New Kealakaha Stream Bridge at Kealakaha, Hamakua District, Island of Hawai'i

by

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and
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for

Engineering Concepts, Inc.

Honolulu, Hawaii

Cultural Surveys Hawaii
August, 1994

ABSTRACT

At the request of Mr Ken Ishizaki of Engineering Concepts, Inc., Cultural Surveys Hawaii conducted an inventory level archaeological survey for a proposed new bridge at Kealakaha, Hamakua, Hawaii. The inventory survey consisted of a ground survey of all accessible areas and compilation of historical documentation and previous archaeological research.

The project area consists of the current Kealakaha Bridge and the area underneath and surrounding the bridge; approximately 100 feet from the south, east and west sides of the bridge, and 200 feet from the north side (as the proposed new bridge will be slightly north of the current one). The Kealakaha Bridge is located on Route 19, approximately 26 miles northwest of Hilo and one mile back from the coast. The bridge is at an elevation of 940 feet above mean sea level (AMSL). The project area lies almost entirely within the Kealakaha Stream Gulch, which is very narrow and descends 170 feet to an intermittent stream bed at the bottom.

Aside from the bridge itself which is considered to be an historic site, no archaeological sites were found within the project area. The current Kealakaha Stream Bridge was included in the *Historic Bridge Inventory and Evaluation, Island of Hawaii* prepared for the State of Hawaii Department of Transportation. It has been assigned State Site # 50-10-09-7512, and its final significance and recommended treatment are presently being determined by the Department of Transportation and the State Historic Preservation Department. Outside of the project area, a cement bridge abutment was observed within the gulch and an historic roadway was observed on the southeastern side of the gulch. Both are considered to be remnants of the post-1904 Government Road indicated on the 1925 Survey Map.

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I. INTRODUCTION

Project Area Description

The project area is located primarily underneath and adjacent to the current Kealakaha Stream Bridge on Route 19. It lies approximately 26 miles northwest of Hilo and 1 mile from the coast (Alakaha Point), at an elevation range between 770 feet and 940 feet AMSL (Figures 1-4).

The project area is within the traditional land division or *ahupua'a* of Kealakaha, which is a small *ahupua'a* within the Hamakua District. It lies less than two miles west of the North Hilo District border. Ross Cordy, who did an extensive report on the Hamakua District of Hawaii (1994), categorizes Kealakaha as one of 87 *ahupua'a* which make up the Mauna Kea Windward Slopes Subregion of the East Hamakua Region. This subregion encompasses the area between the coast and 5000 to 6000 feet above sea level, between the uplands above Waipi'o southeast to the North Hilo border.

Geologically, Kealakaha is comprised of Mauna Kea lava flows of the Hamakua Volcanic Series that have been covered by subsequent volcanic ash falls (Stearns and Macdonald 1946:152-3). The soils are categorized as consisting of silty clay loams of the Ookala Series (Sato et. al. 1973:32-33).

The terrain of the *ahupua'a* is characterized by sea cliffs bordering a narrow marine bench on the coast, with gradually ascending uplands above (average 13% grade above the 300 foot interval [Hawaii Sugar Plantation History 1936:10]). The upland portion of the *ahupua'a* is broken by the steep and narrow Kealakaha Stream Gulch which lies along the eastern border of the *ahupua'a*. The upper regions of the upland slopes are forested, at one time dominated by *'ohi'a* and *koa* trees. The *mauka* boundary of Kealakaha *ahupua'a* is not clearly delineated on USGS and other maps, as it merges with several other small *ahupua'a* in this area into the Kaala *ahupua'a* which extends into the upper slopes of Mauna Kea.

The project area is situated within the Kealakaha Gulch and around the bridge ends on the top of the gulch. The gulch steeply descends approximately 170 feet to a narrow intermittent stream bed at the bottom. The stream bed is exposed bedrock with some alluvial deposits along the sides. Annual rainfall is between 100 and 125 inches per year and it is expected that this gulch is prone to frequent flooding. Average temperatures are between 62 and 82 degrees fahrenheit (Armstrong 1973:57). Vegetation within the gulch includes: ironwood (*Casuarina glauca*); *kukui* (*Aleurites moluccana*); avocado (*Persea americana*); guava (*Psidium guajava*); *'ohi'a* (*Metrosideros polymorpha*); loquat (*Eriobotrya japonica*); ginger (*Zingiber zerumbet*); *loulu* palm (*Pritchardia beccariana*) and *hapu'u* fern (*Cibotium* sp.).

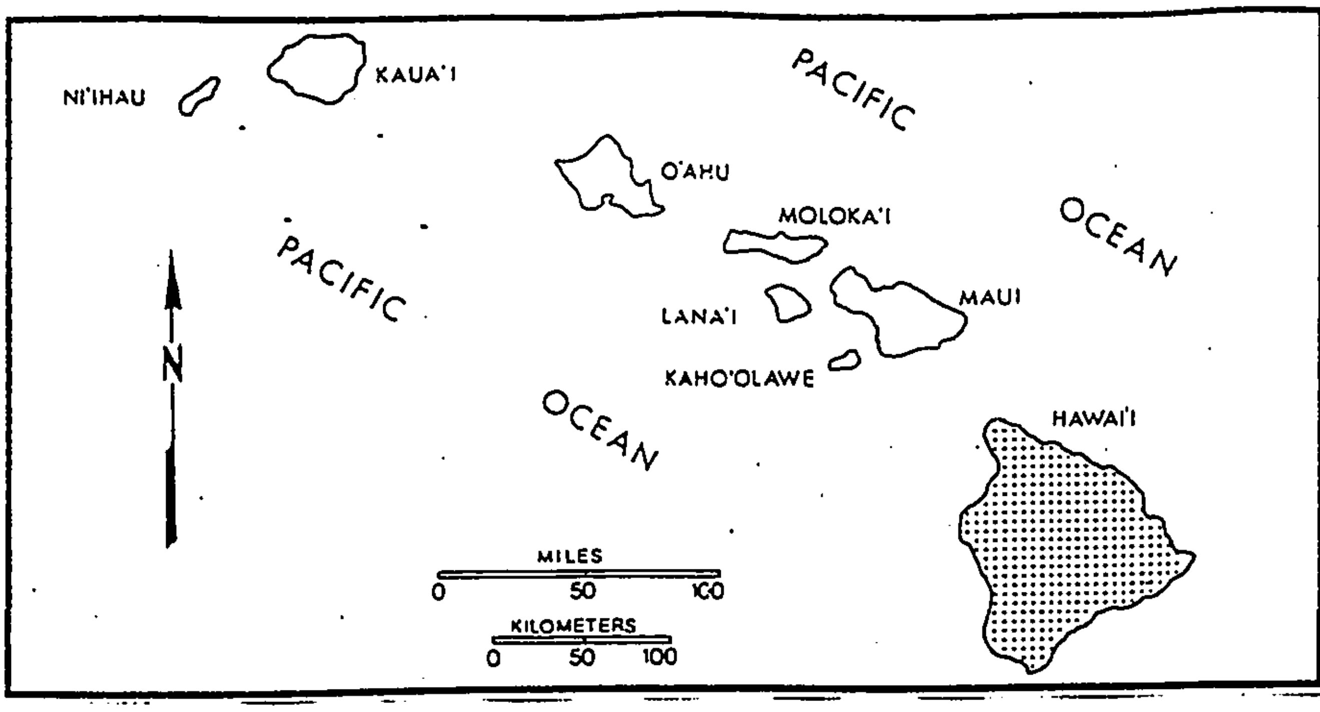


Figure 1 State of Hawai'i

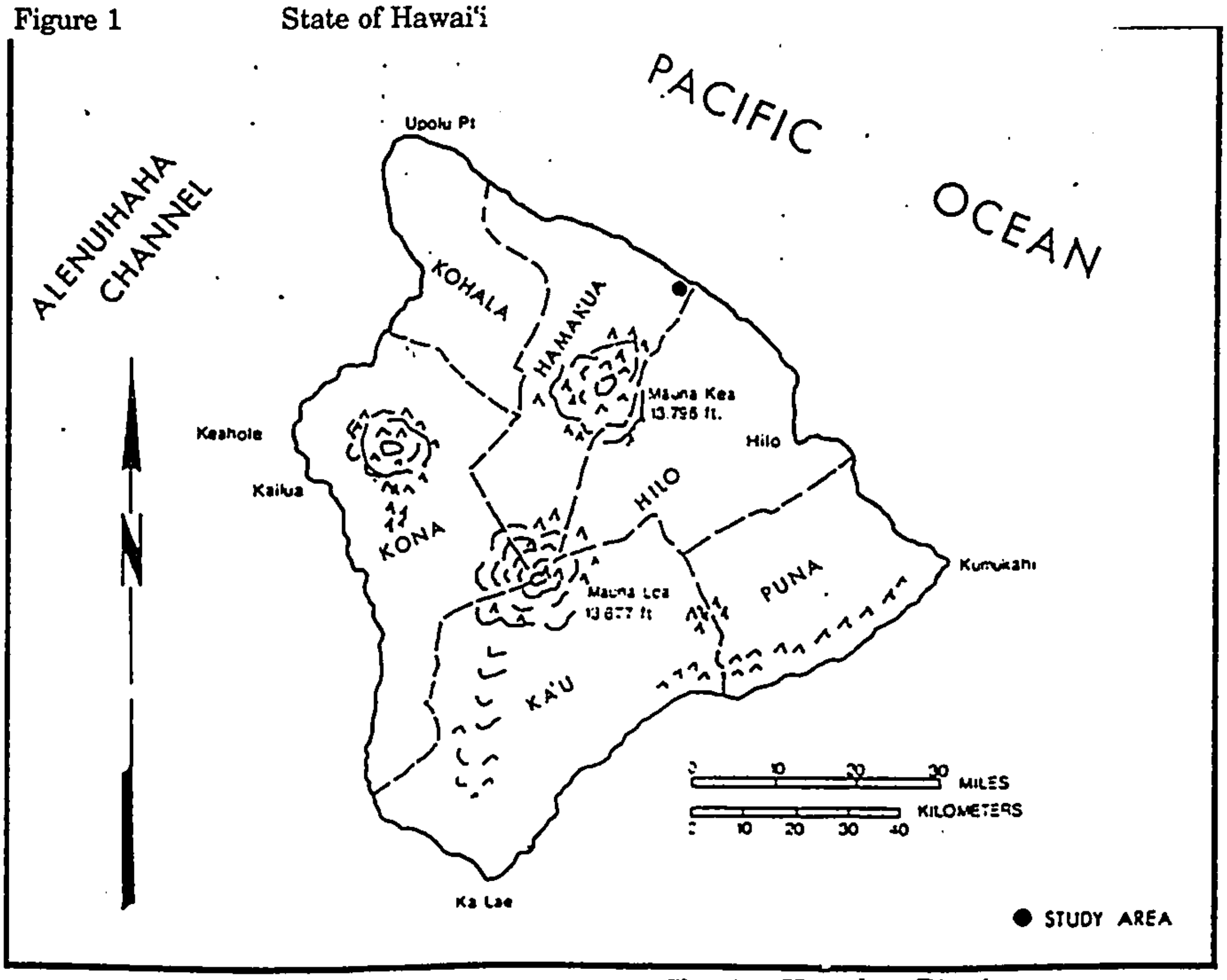


Figure 2 Hawai'i Island Location Map Showing Hamakua District

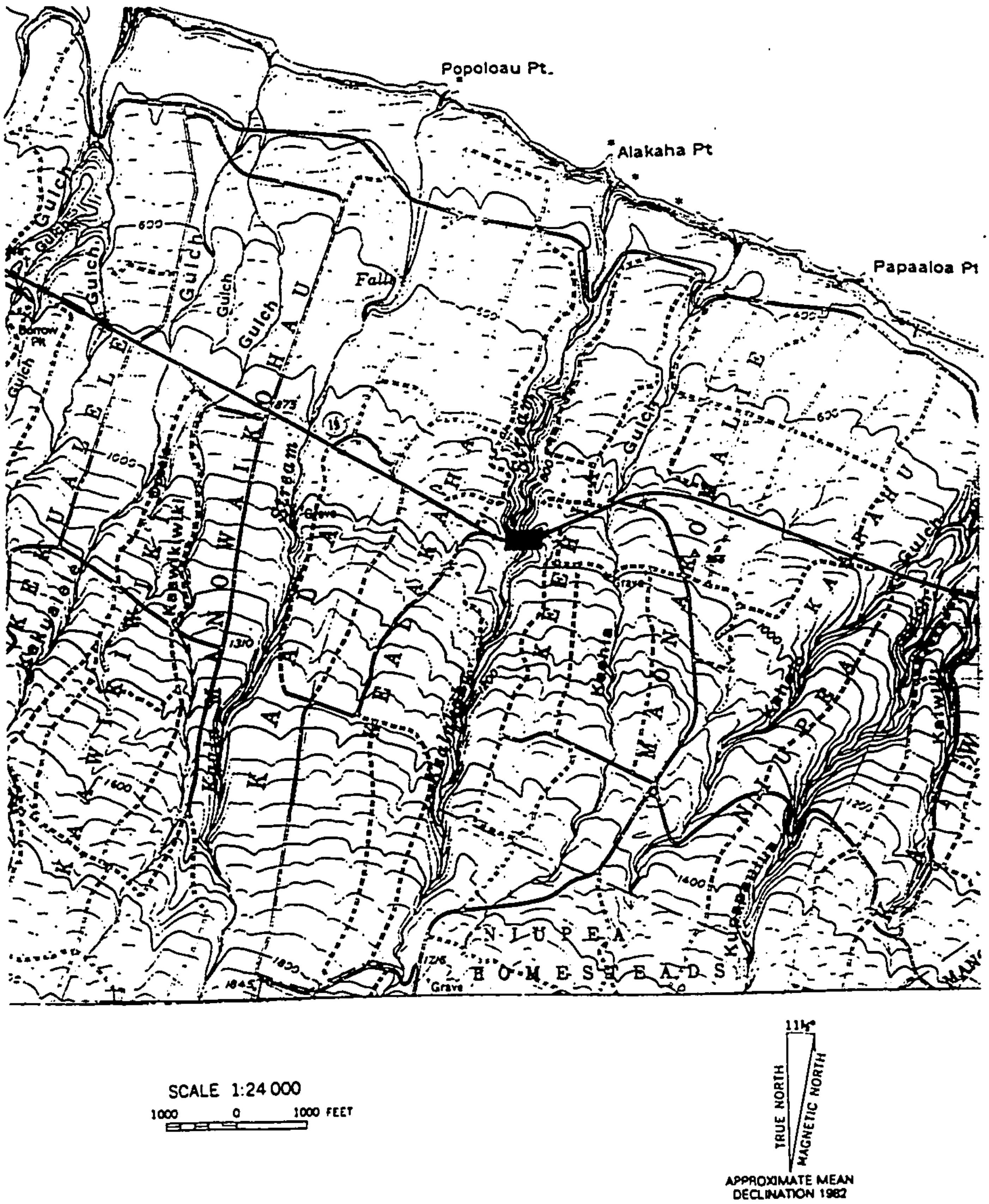


Figure 3 USGS 7.5 Minute Series Topographic Map, Portions of Kukaiau and Keanakolu Quads, Showing Project Area Location

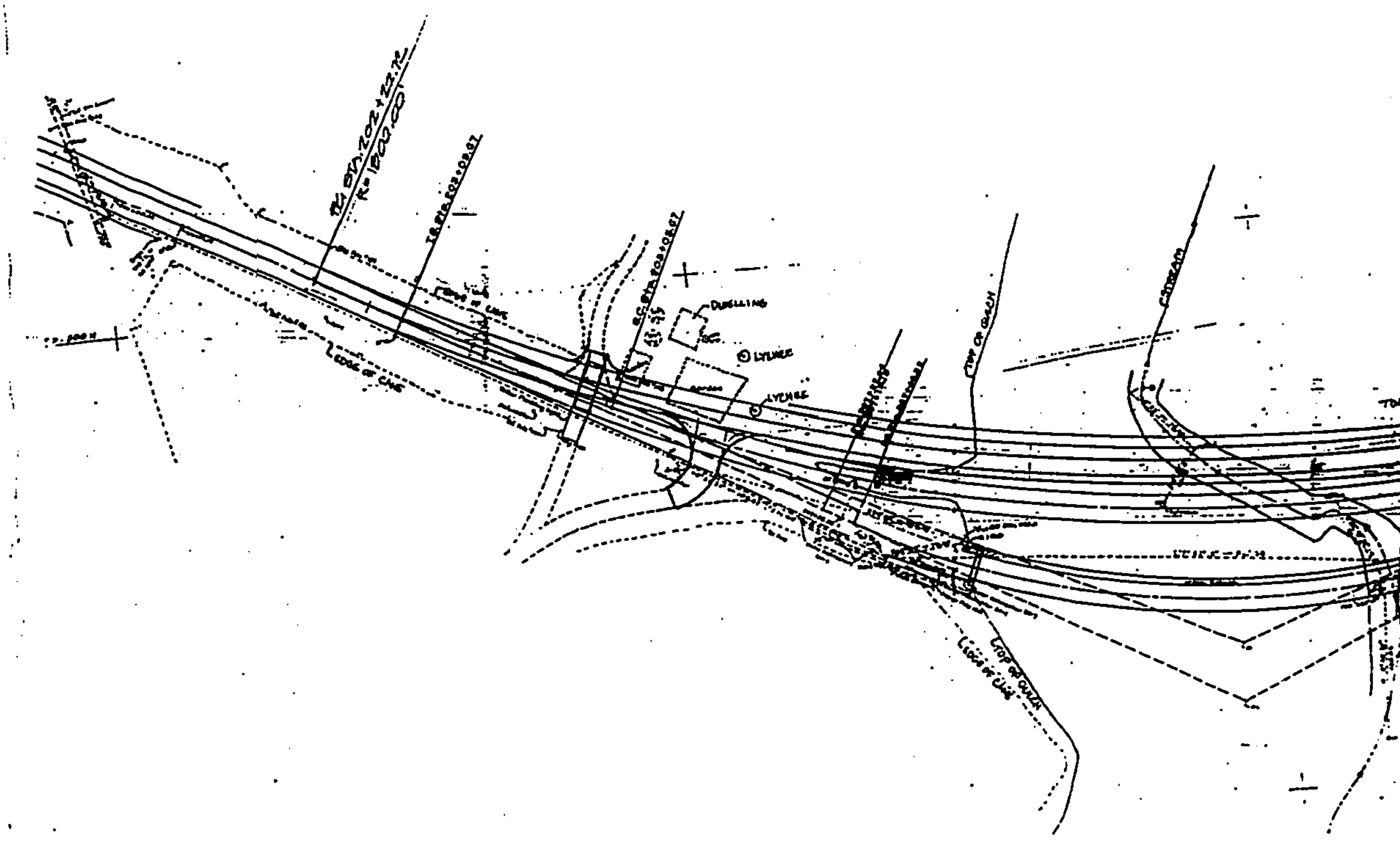
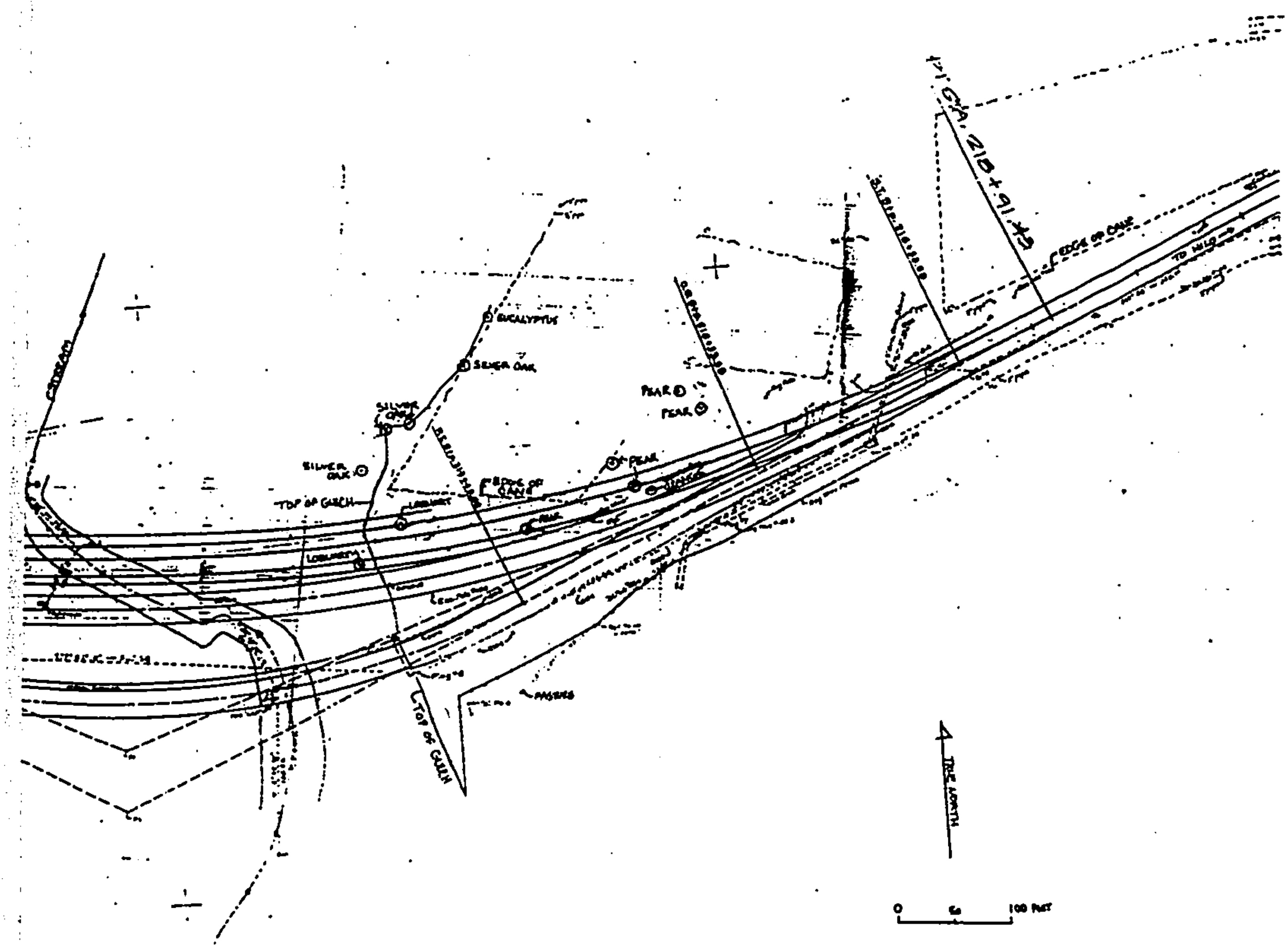


Figure 4 Project Area Map (Reduced from "Revised Bridge Map" Provided by Engineering Concepts)


EUCALYPTUS
SILVER OAK
PEAR
TOP OF GULCH
EDGE OF CANE
TO HILO
TRUE NORTH
0
50
100 FEET

Scope of Work and Methods

The principal objective of the inventory survey was the identification of any and all cultural resources within the project area. The inventory survey is necessary for assessing the impacts of the project and planning for appropriate mitigation. The scope of work was designed to meet the requirements of the State Historic Preservation Division, Department of Land and Natural Resources (SHPD-DLNR). Survey procedures included:

1. A complete ground survey of the entire project area for the purpose of site inventory. All sites would be located, described, and mapped with evaluation of function, interrelationships, and significance. Documentation will include photographs and scale drawings of selected sites and complexes. All sites will be assigned State site numbers.

2. Limited subsurface testing to determine depth and quantity of cultural materials within archaeological sites and to obtain datable samples for chronological information if none is available for sites in the immediate area from previous studies.

3. Research on historic and archaeological background, including search of historic maps, written records, Land Commission Awards, and Native Testimony. This research will focus on the specific area with general background on the *ahupua'a* and district and will emphasize settlement patterns.

4. Preparation of a survey report which will include the following:
   a. A map of the survey area showing all archaeological sites and site areas;
   b. Description of all archaeological sites with selected photographs, scale drawings, and discussions of function;
   c. Historical and archaeological background sections summarizing prehistoric and historic land use as they relate to the archaeological features;
   d. A summary of site categories, their significance in an archaeological and historic context;
   e. Recommendations based on all information generated which will specify what steps should be taken to mitigate impact of development on archaeological resources - such as data recovery (excavation) and preservation of specific areas. These recommendations will be developed in consultation with the landowner and the State and County agencies.

The inventory level survey fieldwork consisted of two person-days of survey, conducted on August 11, 1994 by Hallett H. Hammatt and Patrick O. Walsh. The surface survey consisted of pedestrian sweeps over the project area which included: a minimum of 200 foot radius from both ends of the bridge on the top of Kealakaha Stream Gulch; the gulch bottom, from approximately 1000 feet *mauka* to 300 feet *makai* of the bridge driplines; and those portions of the sides of the gulch underneath the bridge and at least 100 feet *mauka* and 200 feet *makai* of the bridge driplines which were accessible.

Since no archaeological sites were found within the present project area except for the current Kealakaha Bridge, an historic site, no subsurface testing was conducted.

II. BACKGROUND

Historical Setting

Early Reference

The *ahupua'a* of Kealakaha is considered to have been in existence at least from the 1500s, for according to the early Hawaiian historian, S.M. Kamakau, it is the birthplace of Umi-a-Liloa, the chief "who united all the chiefdoms of Hawai'i through war." Kamakau (1992:1-22) relates the story of how Chief Liloa, after ascending the Kealakaha Gulch while on a heiau building journey, encountered a beautiful woman bathing in a stream. The result of this encounter was a son, Umi-a-Liloa. The *ahupua'a* later became a gift from Liloa to Umi's mother for her "good care" in raising Umi.

Ellis' Visit

One of the early foreign visitors to the Hamakua District was the Reverend William Ellis. Some of his general observations of Hamakua included noting that the land along the trail he took was generally woody, and that there were scattered houses and occasional rich fields of potatoes or taro, or large plantations of sugar cane and bananas. Ellis noted that the population appeared quite sparse, remarking that it was "less than what we had seen inhabiting some of the most desolate parts of the island" (1974:349). Ellis thought that the frequent rainfall and mild climate, which contrasted with that of Kona, should have provided natural advantages, however, "the inhabitants... did not appear better supplied with the necessaries of life than those of Kona"(1974:352). He did remark though, that "they had better houses, plenty of vegetables, some dogs and a few hogs, but hardly any fish" (1974:352).

Ellis travelled north from Hilo in 1823 along a trail which he described as "narrow and bordered with grass or passing through well-cultivated plantations" (Ellis 1963:254). This trail, later referred to as the *alanui aupuni* or, later, the Government Road, ran between 0.3 and 1.3 miles back from the sea cliff parallel to the coast (approximately 1.0 miles from the coast in Kealakaha). The trail extended along the length of the Hamakua District, and seems to have been where the majority of late prehistoric and early historic settlement was concentrated. Ellis mentioned the names of many villages and settlements he encountered while following this trail, including Kealakaha, in which he and his entourage "collected the people and preached to them" (Ellis 1974:352).

Other observations made by Ellis include the boundaries separating different districts or larger divisions from each other. In addition to natural boundaries, such as streams or gulches, Ellis noticed others that were "artificial." These boundaries included: "a stone image, a line of stones somewhat distant from each other, a path or a stone wall." Ellis also noted the existence of a *heiau* in the nearby Kaula Gulch:

> On descending to the bottom of the valley, we reached a heiau dedicated to Pele, with several rude stone idols, wrapped up in white and yellow cloth, standing in the midst of it. A number of wreaths of flowers, pieces of sugar cane, and other presents, some of which were not yet faded, lay strewed around, and we were told that every passing traveller left a trifling offering before them. Once a year, we were also informed, the inhabitants of Hamakua, brought large gifts of hogs, dogs, and fruit, when the priests and kahu of Pele assembled to perform certain rites, and partake of the feast. (Ellis 1974:350)

The sparse population noted by Ellis in 1823 seems to have declined dramatically within a few decades after his visit. Based on a compilation of missionary census records with adjustments made for post-contact population reductions, Cordy (1991:28) estimates that the population of the *ahupua'a* of the Ka'ala District (presumably comprised of the *ahupua'a* which merge into Ka'ala, including Kealakaha) by the time of European contact was around 51 persons each, a figure that places Kealakaha among the least populated *ahupua'a* within east Hamakua. The population was reduced by 54% by 1831-32 to 24 persons and continued to decline to 19 persons in 1842.

Land Commission Awards

Land Commission Awards of the mid-nineteenth century were limited to two (Figure 5) within Kealakaha; No.s 7854 and 10283 (shown as 10285 on the 1925 Survey Map, Figure 6). While neither of the LCA's are within the present project area, both are located fairly close by at the same elevation as the top of the gulch. Both are fairly small parcels (around five acres each) located on the uplands adjacent to the old Government Road. Both awardees claimed eight land sections each (although S. Moi No. 10283 claimed his sections were in Manawaialee, located two *ahupua'a* to the east) including a house lot and the remainder in cultivated fields. Taro was the predominate crop, claimed in ten sections, potato was claimed in one, and *olona* in two others. In neighboring Keehia *ahupua'a*, there were also two LCA's (LCA 7849 and LCA 10284), both of which were also located adjacent to the old Government Road. Native testimonies indicated a wider variety of cultigens, in addition to taro and potatoes, they also grew coffee, *awa*, banana, and *ape*. The testimonies associated with all LCAs cited above are included in Appendix 1.

The Kaiwiki Sugar Company

The remaining land within the *ahupua'a* was either retained by the government or distributed in the form of grants. Much of it was subsequently sold or leased in large tracts to theKaiwiki Sugar Company. The Kaiwiki Sugar Company was "one of the oldest sugar estates on the island of Hawaii" (Conde 1972:55), and was operational at least by the 1860s. Smaller scale sugar growing probably preceded the plantation in Hamakua, however, accounting for the plantations observed by Ellis in 1823. It is reported that "the making of sugar and molasses was general in 1823-1824," and that some Chinese had a sugar mill near Hilo in 1828. By 1844, Hilo is reported to have exported 42 tons of sugar (Paradise of the Pacific 1919:50-52).

The *ahupua'a* of Kealakaha was almost entirely subsumed within the Kaiwiki sugar plantations (Figure 6). It was characterized as difficult land for cane growing because of the steepness (13% grade above 300 feet elevation [op. cit.]) and because of the numerous gulches, including Kealakaha Gulch (Conde, 1973:55). The gulches were not suitable for cane growing, and also did not contain a water supply steady enough for irrigation or for the practice of "fluming" which was common in other plantations of the Hamakua District. Cane harvested from the uplands had to be transported by mule-drawn sleds to an overhead cable system. The cane was then loaded onto slings that slid down cables, stopped by a wooden wall at the end. The cane then dropped into train cars (and later, trucks) for transport to the mill in Ookala (Hawaiian Sugar Plantation History, 1936:10).

Within Kealakaha *ahupua'a*, there was also a laborers' camp. It was located on the edge of the Kealakaha Gulch around 400 feet *makai* of the present highway, and adjacent to a road identified as a plantation road on a 1925 surveyors map (Figure 7). According to the map there were at least nine building structures and two water tanks.

The Kaiwiki Sugar Company merged with the Laupahoehoe Sugar Company in 1957, and much of the plantation was presumably still in operation at that time.

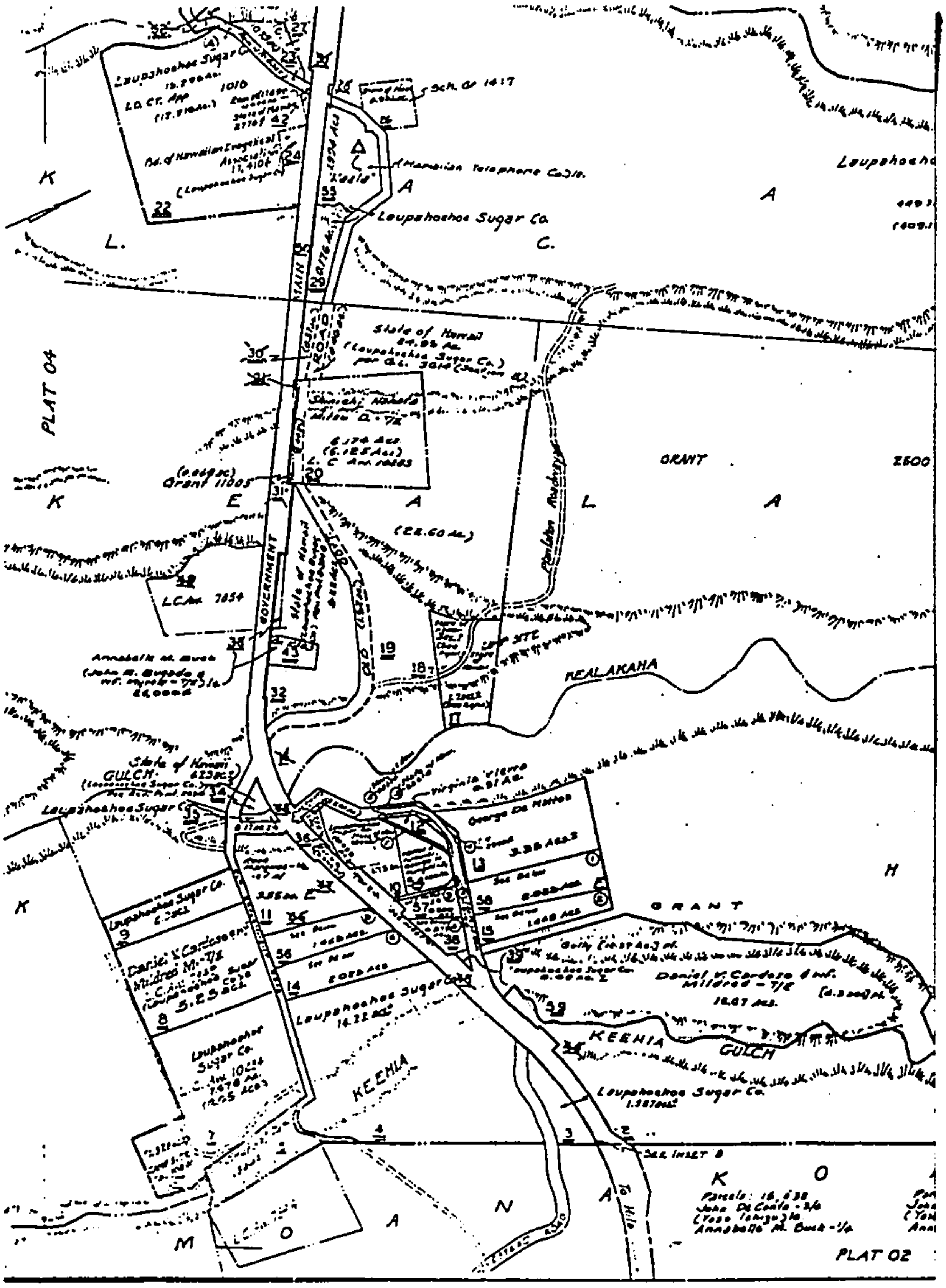


Figure 5 Portion of Tax Map 4:1:03 Showing Location of LCAs

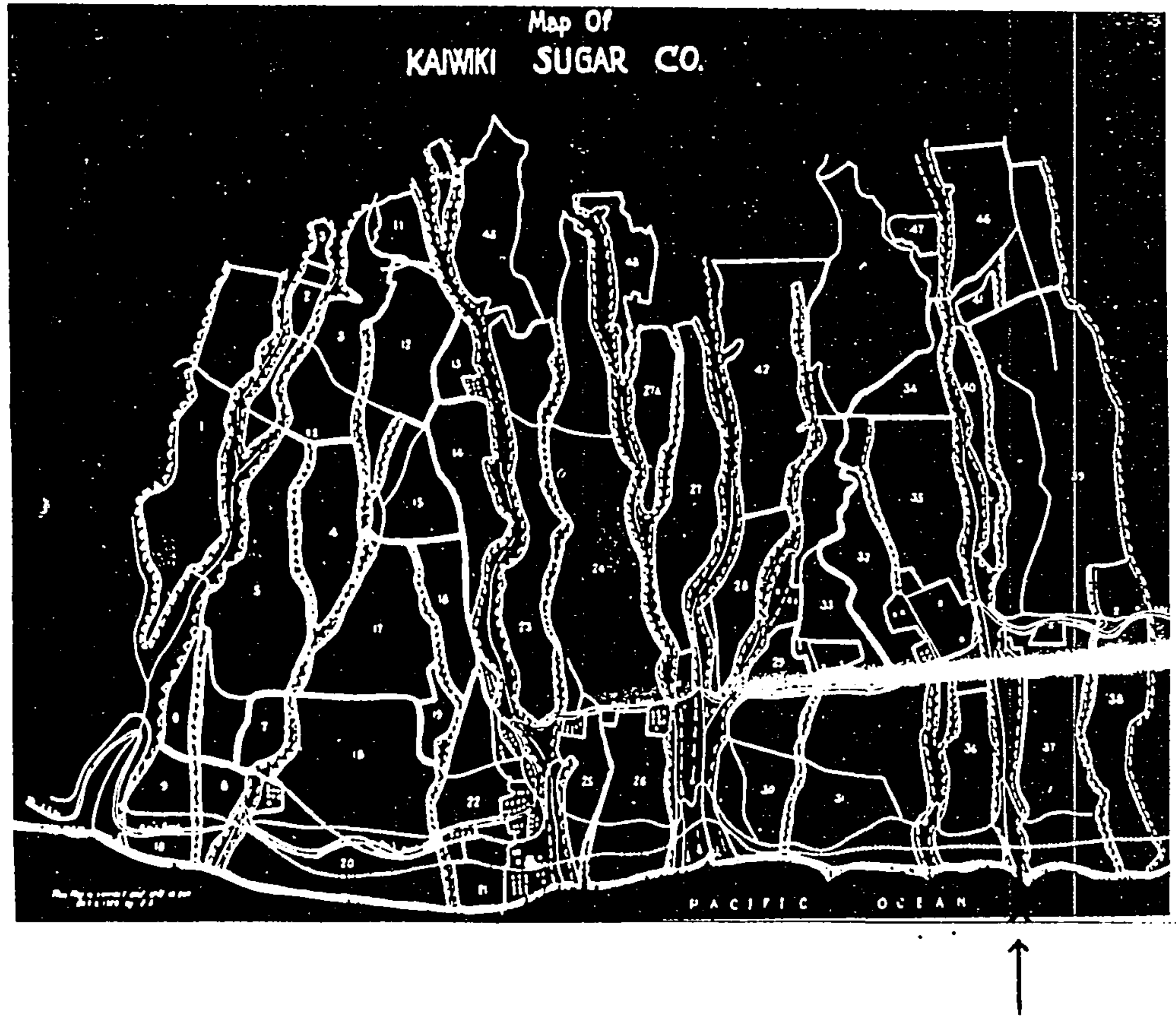


Figure 6 Map of Kaiwiki Sugar Company (From Conde and Best, 1973), Arrow indicates Kealakaha Gulch

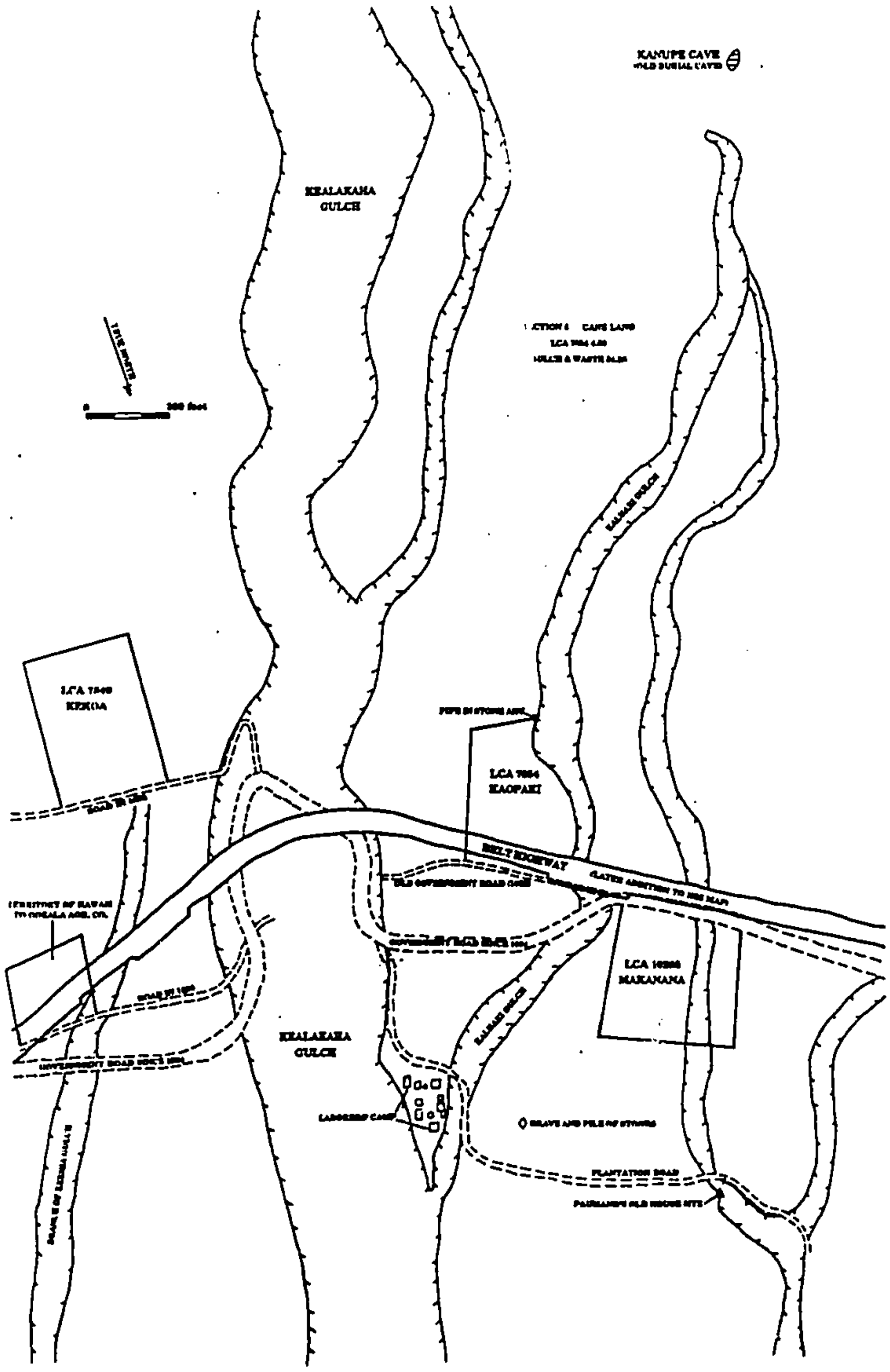


Figure 7 Traced Portion of 1925 Hawaii Territory Survey Map, by E.W. Hockley (R.M. 2708)

Previous Archaeology

Previous archaeology within the entire Mauna Kea Windward Slopes subregion is limited to three reconnaissance surveys conducted between 1908 and 1932, and two inventory surveys by Paul H. Rosendahl, Inc. (PHRI), conducted in 1990 and 1992.

The three early surveys include Stokes in 1919 (Stokes 1991), Hudson in 1932 (Hudson 1932), and Handy and Handy in the 1930s (Handy and Handy 1972). These surveys are characterized by Ross Cordy as, "extremely limited reconnaissances" which took place, "before the advent of modern archaeology and after the major development of the sugar cane industry in this region" (1992:150). "In sum," Cordy continues, "only three archaeological sites appear to have been identified in this subregion. One [the Ka Loa *heiau* identified by Stokes] was destroyed by 1930-32, and one [a cliff cave at Kukuihaele in which a wooden religious image was found] is unlocated" (1991:150-151). The other site is an irrigated agricultural site located by Handy and Handy in Waiko'eko'e *ahupua'a*.

The two more recent inventory surveys within the Mauna Kea Windward Slopes subregion were both within sugar cane lands, one on the western end of the Hamakua coast, near Waipi'o Valley, and one near the town of Paauilo, located approximately five miles to the northwest of the present project area. In the latter survey (Head and Rosendahl 1992), three sites were identified and all were historic, transportation-related and "probably associated with Hamakua Sugar Company agricultural activities" (1992:6). The remainder of the project area was either cane fields which had been extensively plowed, or gulches which contained no evidence of agriculture or habitation-related use. Although there were no LCA's within this PHRI project area, the authors concluded that it was probable there were houses scattered along the *alanui aupuni*, with other trails running *mauka* to the *'ohi'a-koa* forest zone, similar to the land-use pattern of this subregion discussed by Cordy.

Although not strictly an archaeological study, the *Historic Bridge Inventory and Evaluation, Island of Hawaii*, by Patricia M. Alvarez (Alvarez 1987), inventoried all historic bridges on the island, including the current Kealakaha Stream Bridge, and evaluated their historical significance (see SIGNIFICANCE AND RECOMMENDATIONS section of this report).

III. SETTLEMENT PATTERN

A comprehensive study of the Hamakua District, entitled *A Regional Synthesis of Hamakua District, Hawai'i Island*, was undertaken by Ross Cordy (1994). In this study, a wide range of historical documents, including the accounts of early visitors to the region and testimonies associated with the Mahele land divisions, were analyzed for the purpose of determining late prehistoric and early historic land use patterns in the district. Much of the following discussion of late prehistoric and early historic land use in Kealakaha was derived from this report.

Late Prehistoric and Early Historic Settlement

The Coast

The seashore is characterized by a very narrow marine bench surrounded by sea cliffs. No houses were documented along the shore of any *ahupua'a* in East Hamakua in any of the references consulted by Cordy. Cordy concluded that it was apparently "solely a marine resource exploitation zone."

The Seaward Upland Slopes

The seaward upland slopes are characterized by Cordy as the "farming and housing zone," and seems to have been where late prehistoric and early historic settlement was concentrated. Documents include references to clusters of houses linked by a major trail, referred to as the Government Road or *alanui aupuni*. The Belt Highway closely follows this trail. Within Kealakaha and neighboring Keehia *ahupua'a*, Land Commission Awards are few, but all are located in close proximity to the Government Road. Claimants indicated that agriculture consisted primarily of the dryland cultivation of taro, as well as bananas, sweet potatoes, *olona*, coffee, *ape* and *awe*. By the time of European contact, much of the upland slopes of the subregion were grasslands, fields and scattered groves of trees, and Cordy suggests that these were probably agricultural fields that were abandoned by the mid-1800s.

The 1925 Hawaii Survey map (see Figure 7) also indicated other land-use features within the upland slopes of Kealakaha. These include; an old house site, called "Paumano's House", located on the edge of a gulch branch approximately 1100 feet *makai* of the old Government Road; a cave, called the Kanupe Cave, which was apparently "used for burials" located approximately 3000 feet *mauka* of the old Government Road; and a burial site located approximately 900 feet *makai* of the old Government Road. Without further investigation, however, the nature, extent and age of these features and their relation to the settlement pattern of Kealakaha will remain unknown.

The Gulches

It remains unknown if the numerous gulches within the subregion, including Kealakaha Gulch, were used for habitation or agriculture in late prehistoric and early historic times, as there is little documentary evidence of such use, and the archaeological study of the region has been minimal. Nevertheless some indications of such use does exist. Isabella Bird, describing her travels in Hamakua in 1873, provides a snippet of evidence for habitation-related use of the gulches, noting that "each gulch opens on a velvet lawn close to the sea, and most of them have space for a few grass houses, with cocoanut trees, bananas and *kalo* patches" (1990:73). Handy and Handy, in their survey in the 1930s, located one example of traditional agricultural use of a gulch within the East Hamakua region, having identified an irrigated agricultural site in one of the larger gulches of the region, in Waiko'eko'e *ahupua'a*.

Outside of the larger gulches and where the gulches widen and meet the sea, the majority of gulches within East Hamakua were likely too steep and narrow for sustained occupation or agricultural use. In addition, given the amount of rainfall on the Hamakua Coast, most are likely highly prone to flooding (on the day following our field survey, on August 13, 1994, this area received fifteen inches of rain).

Other use of the gulches included transportation, as the trail and later the Government Roads were known to have descended into the gulches. And at least one gulch, the Kaula Gulch, was also the setting for religious worship, as it was known to contain a *heiau* in the 1820s (see the Historical Setting section of this report).

The Upland Forest

The upland *'ohi'a-koa* forest is characterized as having been used as a place for gathering bark and birds, harvesting timber and possibly limited agriculture. Cordy suggests that the people exploiting these resources would have had campsites which, in at least one *ahupua'a*, seems to have included a cave (1994:62).

Historic Settlement

Beginning at least by the 1860s, much of the East Hamakua Region was extensively converted to sugarcane lands and plantation towns. In Kealakaha, this development primarily impacted the upland slopes.

As a portion of the Kaiwiki Sugar Company plantation, Kealakaha was extensively cultivated in sugar cane. The Kaiwiki Sugar Company map (see Figure 6) shows that virtually the entire *ahupua'a* outside of the Kealakaha Gulch was under cultivation by the early twentieth century. In addition to the land alteration required for sugar cane cultivation, there was also a network of roads and overhead cable systems built for transporting cane from the uplands to the mill located in Ookala. A laborers' camp was also built in Kealakaha, and was located approximately 300 feet *makai* of the old Government Road, on the edge of a bluff overlooking the Kealakaha Gulch.

The impact of the sugar cane industry on the coast of Kealakaha is unclear, for although the cane grown throughout the uplands was transported to the mill in Ookala, it is unclear if it was transported across the plantation in the uplands (perhaps along the Government Road), or if it was transported down the slopes and then across via ships or railway. The Kaiwiki Sugar Company is known to have had a small rail system, but it is unknown in which *ahupua'a* it functioned.

Other historic-era developments in Kealakaha include improvements to the Government Road which passed through Kealakaha Gulch. Sometime in the early twentieth century, a concrete bridge was constructed across Kealakaha Stream (referred to as the Post-1904 Government Road Bridge because although its construction date is not known, the construction of concrete arch bridges began in 1904 [Alvarez 1987:3]). After 1925, "Federal Road Aid became available to the Territory, resulting in large concrete arch, slab and girder bridges" (ibid). The current Kealakaha Stream Bridge, built in 1935, was constructed in association with this new wave of bridge construction (see Bridge Inventory data in Appendix 3).

Predictions for Land Use Within the Current Project Area

Since the project area lies almost wholly within the Kealakaha Gulch underneath the current Kealakaha Stream Bridge, the terrain was expected to be very steep with a narrow stream bed at the bottom of the gulch. For this reason, both prehistoric and historic use of the gulch was likely minimal.

Nevertheless, based on land use documented within Kealakaha and other *ahupua'a* of this region, there was expected to be a good possibility of finding evidence of:

Trails and Roads; including cross-*ahupua'a* trails (alanui aupuni), old Government Roads (at least two based on historical maps), and plantation roads.

and only a slight possibility of finding evidence of:

Irrigated or Dryland Agriculture; since much of this area has not undergone archaeological survey, it is possible that smaller gulches such as Kealakaha may be found to have been used for agriculture, despite the paucity of documentary evidence of such use.

Historic Habitation; such as the Laborers' camp located close to the Kealakaha Stream Bridge on the edge of the gulch, and the old Paumano House Site indicated on the 1925 Survey map as also being on the edge of the gulch.

Sugar Cane Cultivation and Transportation; such as remnants of the Kaiwiki Sugar Company railroad, the overhead cable system, or other related structures and equipment.

Ahupua'a or other land division boundary markers; such as those discussed by Ellis.

IV. SURVEY RESULTS

The project area consisted of the Kealakaha Stream Bridge, the land beneath the bridge and a certain amount of the land surrounding the bridge (land area specified below). The project area lands consisted of three distinct types of terrain including: the relatively level area on both sides of the bridge on the top of the gulch; the steep sides of the gulch beneath the bridge; and the floor of the gulch beneath the bridge which consisted of the gently sloping intermittent stream bed and adjacent meander bars.

The areas surveyed on the top of the gulch consisted of a 200 foot radius surrounding both ends of the bridge. These areas were found to have been completely altered by either the construction of the current bridge or from the cultivation of sugar cane.

The areas surveyed on the sides of the gulch included the land directly beneath the bridge, and a minimum of 100 feet *mauka* and 200 feet *makai* of the bridge edge driplines. These areas also seem to have been impacted in the construction of the current bridge. Portions of these areas were prohibitively steep and largely inaccessible. No archaeological sites were found. Outside of the project area on the southwest side and toward the bottom of the gulch, approximately 300 feet *mauka* of the current bridge dripline, an old roadbed was observed. Based on the 1925 survey map (see Figure 7), this was a portion of the post-1904 Government Road.

The area surveyed on the floor of the gulch included the land directly beneath the bridge, and a minimum of 100 feet *mauka* and 200 feet *makai* of the bridge driplines. The stream bed covered approximately 50% of the flood plain surface, and small alluvial deposits, or meander bars, made up the remainder. The stream bed was exposed bedrock with scattered soil and gravel pockets. The meander bars consisted of undulating soil with scattered cobbles and boulders overlying bedrock. No archaeological sites were found.

On the floor of the gulch outside of the project area, a bridge abutment was observed. It is located approximately 300 feet *mauka* of the bridge dripline, on the southwest side of the gulch floor (see Figure 11). The bridge abutment has two vertical cement walls, each approximately 40 feet wide and 20 feet high. The walls are approximately 30 feet apart at the base and narrow to 20 feet apart at the top. They are connected by two horizontal cement slabs between them. The structure is aligned so that the stream would be channelled between the walls. Based on its construction style and its alignment with the road segment mentioned above, it is considered to have been an abutment for the post-1904 Government Road bridge which spanned Kealakaha Stream. The abutment on the other side of the stream was not found and was likely destroyed during the construction of the current bridge.

The only historic site identified within the project area is the Kealakaha Stream Bridge itself, and it has been assigned State site number 50-10-09-7512. The bridge was constructed in 1935 and was included in the 1986 Historic Bridge Inventory and Evaluation prepared for the State of Hawaii Department of Transportation Highways Division (Alvarez 1987). In that study, the bridge was described as,

> a large, continuous concrete tee-beam bridge. It is the only curved bridge of this size built on the island of Hawaii and is therefore considered complex for its time, a time when calculations for such a bridge were done in long hand. (ibid:229)

The bridge is categorized as a "Concrete Deck Girder Bridge", 487 feet in length and 29.5 feet wide. The bridge height (soffit to stream bed) is 90 feet, and its ornamental features include; haunched girders, brackets under the railings, molded pier columns, and molded railings. The bridge was designed by William R. Bartels, the contractor was George Freitas, and construction costs were $107,000.

Discussion

Within the area surrounding the bridge ends on the top of the gulch and that portion of the gulch surveyed, there was no indication of prehistoric or historic habitation or agriculture related use. The top of the gulch appears to have been completely altered in the construction of the current bridge, and any evidence of prior use has been destroyed.

The sides of the gulch are clearly too steep for most traditional and historic land use activities, except for transportation-related use such as road and bridge construction. Evidence for any use of the gulch sides was limited to the historic roadway observed outside the project area.

The bottom of the gulch contains evidence of historic road and bridge construction and use of the gulch floor seems to have been limited to such transportation related usage. Even though there are soil-covered meander bars adjacent to the stream bed on the bottom of the gulch that may have been large enough for agricultural use, such use was unlikely for the following reasons:

1. Access would have been very difficult given the steepness of the gulch sides;

2. The area is highly prone to flooding;

3. During those times that flooding is least likely (the summer months), the stream is intermittent and would not have provided a consistent water source.

4. The gulch floor receives little direct sunlight year round, the least during the winter months when the stream could have been used as a water source.

Evidence of land use activities within the surveyed portion of the gulch is limited to road and bridge structures and remnants. This evidence includes the current Kealakaha Stream Bridge within the project area, and remnants of the post-1904 government road and associated bridge outside the project area. It is likely that evidence of any other use of the gulch (such as boundary markers, other roads or trails, or sugar cane related roads or equipment), could not survive the periodic flooding which is a common occurrence along the Hamakua coast.

V. SIGNIFICANCE AND RECOMMENDATIONS

The current Kealakaha Stream Bridge (State Site 50-10-09-7512) was included in the *Historic Bridge Inventory and Evaluation, Island of Hawaii* (Alvarez 1987). In this inventory, the 117 bridges surveyed were typed by construction into seven categories and evaluated on a variety of criteria which were divided into three sections; Integrity, Historicity, and Technology. A point-value system was employed in which each criteria was given a point value, the sum of which for each bridge determined its significance rank within its bridge type. Recommendations for preservation were based upon this point-value system.

> Each bridge was evaluated against bridges of its own type and placed in a category *according to its historical significance.* Category I *contains those bridges with the most claim* to historical significance. Category II contains those bridges that have considerable historical significance but not enough at this time to warrant being placed in Category I. Category III contains those bridges with little historical importance
>
> In this evaluation, there was no predetermined number needed for a bridge to be judged significant. In general, those accruing the most points for their type were judged to be in Category I or Category II. (ibid:6-7)

Kealakaha Stream Bridge was judged to be the most significant of its type (ranked first in order of significance of Concrete Deck Girder Bridges). It was classified as one of the eight Category I bridges on the island of Hawai'i. Several lists and information specifically referring to Kealakaha Bridge from the Historic Bridge Inventory are included in Appendix 3.

Although the current Kealakaha Stream Bridge is slated to be replaced, plans are in the process of being drafted by the State of Hawaii Department of Transportation to preserve and maintain the current bridge, perhaps to be used as an overlook (Personal Communication with Tonia Moy, State Historic Preservation Department Architect, 1/18/95). The final significance and recommended treatment of the bridge are being determined by the Department of Transportation in consultation with the State Historic Preservation Department.

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Hamakua, Oct. 30, 1848

No. 10283 - Moi, S.

Kahue sworn: He has seen in Manawaialee ahupuaa of Hamakua, Hawaii, 8 sections.

Section 1:	House lot All konohiki boundaries, 1 house for Moi, enclosed.
Section 2:	" " " " cultivated taro kihapai.
Section 3:	" " " " " " "

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Section 4:	All konohiki boundaries, 1 cultivated taro kihapai.
Section 5:	" " " " " " "
Section 6:	" " " " " olona "
Section 7:	" " " " " " "
Section 8:	" " " " " kihapai.

Moi's land from Paakana in 1838; no objections to this day.

Palamimo sworn: He has known exactly as Kahue had related here.

Hamakua, Oct. 30, 1848

No. 7854 - Koapaki, L.

Kahue sworn: He has seen in Healakaha ahupuaa of Hamakua, Hawaii, 8 sections.

Section 1:	House lot All konohiki boundaries, partially enclosed, 5 houses for Koapaki only.
Section 2:	All konohiki boundaries, 1 cultivated taro kihapai.
Section 3:	" " " " " kihapai.
Section 4:	" " " " " taro kihapai.
Section 5:	mauka Kaaiaka's land Kohala and all around konohiki 2 cultivated taro kihapais.
Section 6:	All konohiki boundaries, 1 cultivated potato kihapai.

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Section 7:	All konohiki boundaries, 1 cultivated taro kihapai.
Section 8:	" " " " " " "

Land from Kapa'u, Koapaki's old land.
No one has objected to this day.

Kapa'u sworn: He has known exactly as Kahue had related here.

Hamakua, Oct. 31, 1848

/late claim/
No. 10,285 - Makanana

Kahalau sworn: He has seen in Ulakaha ahupuaa of Hamakua, Hawaii, 12 sections.

	Section 1:	House lot All konohiki boundaries, fenced, 1 house of Makanana 1 adjoining arrowroot kihapai.		

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	Section 2:	All konohiki boundaries, 1 cultivated arrowroot kihapai.		
	" 3:	" " " , 2 coconut trees.		
	" 4:	" " " , 1 cultivated potato kihapai.		
	" 5:	1 orange tree, Kumaaiku had planted.		
	" 6:	All konohiki boundaries, 1 cultivated taro kihapai.		
	" 7:	" " " , " " " "		
	" 8:	mauka Kohala & makai Hilo 1 cultivated kihapai		Kuhi's land konohiki Kahoe's land
?	" 9:	mauka Kohala makai Hilo 1 cultivated taro kihapai	?	konohiki Thursday konohiki kihapai Kahue's land konohiki
	" 10:	Mauka, Kohala, also makai Hilo 1 cultivated taro kihapai		" Thursday Konohiki Kihapai
	" 11:	All konohiki boundaries, 1 cultivated banana kihapai.		
	" 12:	" " " " " . " "		

Their /makanana/ old place for their parents since Kamehameha I. Now Makanana has it from Keoahi /konohiki/ in 1847; no one has objected to this day.

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Palamimo sworn: He has known exactly as Makanana had related here.

Hamakua, Oct. 30, 1848

No. 7849 - Kekoa, D.

Mahi sworn: He has seen in Keehia 2 ahupuaa, 13 sections.

Mahi sworn (contd.)

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Section 1: House site
All konohiki boundaries, no fence, 1 house for Kekoa.

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1 cultivated taro kihapai.

Section 2:	All	konohiki	boundaries,	1	cultivated	taro	kihapai.
Section 3:	"	"	"	"	"	"	"
Section 4:	"	"	"	"	"	"	"
Section 5:	"	"	"	"	"	"	"
Section 6:	"	"	"	"	"	"	"
Section 7:	"	"	"	"	"	coffee	"
Section 8:	"	"	"	"	"	"	"
Section 9:	"	"	"	"	"	awa	"
Section 10:	"	"	"	"	"	olono	"
Section 11:	"	"	"	"	"	banana	"
Section 12:	"	"	"	"	"	ape	"
Section 13:	"	"	"	2	"	taro	"

Old land from Kekoa's parents since the time of Kam. I and now to Kekoa; no one has objected.

Kaui sworn: He has known exactly as Mahi had related here.

No. 10284B - Meheula

Mahi sworn: He has seen in Keehia 1 ahupuaa of Hamakua, Hawaii, 7 sections.

Section 1: House site
All konohiki boundaries, no fence, 1 house for Meheula.
1 cultivated kihapai.

Section 2:	All	konohiki	boundaries,	1	cultivated	taro	kihapai.
Section 3:	"	"	"	"	"	"	"
Section 4:	"	"	"	"	"	"	"
Section 5:	"	"	"	"	"	"	"
Section 6:	"	"	"	"	"	"	"

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Section 7: All konohiki boundaries, 1 cultivated coffee kihapai.
Land from Kuhi in 1847; no one has objected to him to this day.

Pakele sworn: He has known exactly as Mahi had related here.

APPENDIX 2 PROJECT AREA PHOTOGRAPHS

Figure 8 Project Area, South Side of Bridge, View West

Figure 9 Project Area View, North Side of Bridge, View West

Figure 10 Kealakaha Stream Bed, View South

Figure 11 Post-1904 Government Road Bridge Abutment, View West

APPENDIX 3 HISTORIC BRIDGE INVENTORY EXTRACTS

HISTORIC BRIDGE

INVENTORY AND EVALUATION

ISLAND OF HAWAII

by
Patricia M. Alvarez

Prepared for the State of Hawaii
Department of Transportation Highways Division
In Cooperation with the U.S. Department of Transportation
Federal Highway Administration

HPR 0010 (9)

July 1987

ASSUMPTIONS AND CRITERIA FOR EVALUATION

Hawaii's historic bridges were typed by construction method and material used. This resulted in seven categories of bridges: Masonry Arch, Timber Girder, Steel Girder, Concrete Arch, Concrete Deck Girder, Concrete Slab, and Concrete Culvert. One hundred seventeen bridges were included in the survey.

PART I - INTEGRITY

This section attempted to evaluate if the location, setting, design, materials, and workmanship of the original bridge remain the same. Each criterion yielded a maximum of 5 points, and 25 points was the maximum for the entire section.

None of the bridges in the survey had been moved and therefore all bridges received the maximum rating of 5 for Location.

It was assumed that the Setting of most bridges was originally rural. Therefore, any nearby housing or buildings caused a rating of 3 or 0, depending on the amount of change. Bridges located in urban areas which had experienced considerable change were also rated at 3.

The Design of the bridge was a critical factor in evaluating integrity. Unless the original plans were available, however, this was somewhat conjectural. Small but obvious changes in the bridge or its approaches were considered to detract from its integrity. For example, guard-rails were considered a change in design, especially if they were larger than the bridge itself. Almost all timber bridges have been rebuilt through the years, so most of them received a rating of 3. Damage to the parapets also was considered a change in design.

Materials added to the bridge itself, either as repair work or as an addition, detracted from the bridge's integrity. Depending on the type of material added, the bridge received a rating of 3 or 0. However, metal guard-rails were not deducted a second time here.

Workmanship refers to the methods used to rebuild a bridge. Methods for constructing timber bridges have not changed substantially in the last 40 or 50 years, according to state and county engineers, so most of the timber bridges were rated at 3 for workmanship, unless the reconstruction was so obvious as to rate a 0.

Integrity is a prime consideration for the placement of properties on the National Register of Historic Places. There- a total of 15 of the 25 possible points for Integrity was considered necessary for further evaluation in Part II.

PART II - HISTORICITY

Each criterion yielded a maximum of 5 points, and 35 points was possible for this section.

Several periods in bridge building were discernible. A definite Construction Date within one of these periods is an important indicator of historical significance.

Stone and timber were the predominant materials of the earliest period, 1850 to 1904. Iron and steel girder bridges were also built in the last two decades of the nineteenth century, but none survive from that period. A new era in bridge design began in 1904 with the construction of the first concrete arch bridges. Bridge building was accelerated in 1911 when the Territorial Legislature created a special Loan Fund Commission for road development. Concurrently, the Hilo Railroad Company was building its large steel girder bridges. In 1925, Federal Road Aid became available to the Territory, resulting in large concrete arch, slab and girder bridges.

Design plans, newspaper accounts and other sources showed some of the county's estimated constuction dates to be inaccurate. Corrected dates, with corroborating sources, were substituted wherever possible.

The same names appear over and over among the designers of Hawaii's bridges. Considered noted Builders because of the extent of their work and the substance of their designs were William R. Bartels, an engineer for the Territorial Highway Department from 1932 to 1957, who designed most of the Federal Aid bridges of the 1930s; En Leong Wung and William H. Chun, the County Engineer and his Assistant for much of the 1920s and 1930s; and John Mason Young, who designed the Hilo Railroad bridges.

Of the known contractors on these bridges, many were prolific builders. They included Louis M. Whitehouse, George and Henry Freitas, Peter and Charles Arioli, and Otto Medeiros.

Not many of the bridges were Associated with a Noted Historic Person or Historic Event. The exceptions would be the steel girder bridges put up by the Hilo Railroad Company and the Waiolama Canal bridges (on Kumu Street and Piopio Street) which serve as a reminder of the 1960 Tidal Wave. The association with a certain period in bridge building was noted for some of the bridges.

All of the bridges were rated as to how good a Representative they were of a certain Type, Period or Method.

Their overall Artistic Value in terms of proportion and choice of construction details was noted.

All of the bridges <u>Communicate a Sense of Times Past by Feeling and Association</u>, but some do this more than others, especially if the construction method is no longer used. A bridge which occasions a second look and encourages speculation about how things were done in the past has this quality to a high degree.

<u>Vantage Point</u> allows the bridge to be seen, appreciated and evaluated by all. If the outer sides of the bridge can not be seen because of overgrown vegetation or because there is no nearby landing, it received a 0 rating. Bridges, one or more of whose sides were partially visible either from public or private property, were rated at 3. Bridges easily visible from a variety of locations were given a full 5 points.

<u>PART II - TECHNOLOGY</u>

Each criterion yielded a maximum of 5 points, and 30 points was possible for this section.

The total <u>Length</u> of the bridge, the <u>Maximum Span Length</u>, and the <u>Height</u> of the bridge from the soffit (the underside of the deck) all are indications of technological development and were awarded points. The figures used are those from the Bridge Inventories of the Hawaii State Department of Transportation and the County of Hawaii.

Ornamental Features were added to some bridges and increased their artistic value, even if they served no structural function. These include molded parapets, Italianate railings, brackets and molded pier columns.

The Engineering Complexity of a bridge was determined by an estimate of the standard bridge methods of an era and whether a bridge exceeded or conformed to the standard. Every new method on the island was considered a milestone design.

The bridge's significance was measured in part by how many of its type remain. The fewer the specimens, the more important the individual bridge becomes. Its Uniqueness among Standing Structures on the Big Island measured its significance in 1985 among extant structures.

RECOMMENDATIONS FOR PRESERVATION

Each bridge was evaluated against bridges of its own type and placed in a category according to its historical significance. Category I contains those bridges with the most claim to historical significance. Category II contains those bridges that have considerable historical significance but not enough at this time to warrant being placed in Category I. Category III contains those bridges with little historical importance.

In this evaluation, there was no predetermined number needed for a bridge to be judged significant. In general, those accruing the most points for their type were judged to be in Category I or Category II. Because mansonry arch, concrete arch and steel girder bridges are no longer being built, these types predominate.

INDEX TO BRIDGE EVALUATIONS

In this report, the bridges are grouped by type, ranked in descending order by the number of points accrued in Part II. Bridges failing to pass the test of integrity are placed at the end of each section.

Bridges which were included in the original inventory list but which have since been replaced or abandoned, or which were incorrectly identified as pre-1941 bridges, are listed in the final section under the heading OTHER BRIDGES.

SOURCES

All information dealing with bridge type, highway classification, and physical properties were derived from the Hawaii State and Hawaii County Bridge Inventories, taken in 1970 and 1980 respectively. Location descriptions for state bridges were also on the inventory sheets, but county location descriptions were written by this historian. Most of the heights were found in the 1951 Bridge Inventory.

Recent sketches of the bridges, included in several of the bridge profiles, were taken from the state and county inventories. General information on road and bridge development is derived from "A History of Road and Bridge Development on the Island of Hawaii," (Hawaii State Department of Transportation, 1985) by this historian. All other sources are listed separately.

CAT I

CATEGORY I BRIDGES

TYPE	NAME	POINTS (PART II)
Masonry Arch	Mamalahoa/Pukihae 26-1	25
Masonry Arch	Mamalahoa/Kalalau 26-2	24
Steel Girder	Hakalau FAP 19	50
Concrete Arch	Mamalahoa/Honolii 26-6	50
Concrete Arch	Keawe Street/Wailuku River 23-1	48
Timber Girder	Auwaiakeakua FAS 190	33
Concrete Deck Girder	Kealakaha FAP 19	52
Concrete Deck Girder	Honolii FAP 19	44

LIST OF CONCRETE DECK GIRDER BRIDGES IN ORDER OF SIGNIFICANCE

CONCRETE DECK GIRDER BRIDGES (CONCRETE)

TYPE Concrete Deck Girder

NAME Kealakaha Stream Bridge

LOCATION 4.54 miles east of Paauilo Plantation Road in Hamakua

OWNER/CUSTODIAN State of Hawaii

HIGHWAY CLASSIFICATION Federal Aid primary

PHYSICAL PROPERTIES (IN FEET)

LENGTH 487

NUMBER OF SPANS 6

MAXIMUM SPAN LENGTH 98

RISE (OF ARCH) n.a.

HEIGHT (SOFFIT TO STREAM BED) 90

WIDTH (CURB TO CURB) 22

WIDTH (OUT TO OUT) 29.5

LOAD CAPACITY H-15

ABUTMENTS concrete

PARAPETS concrete

ORNAMENTAL FEATURES haunched girders, brackets under the railings, molded pier columns, molded railings

ARTISTIC VALUE high

VANTAGE POINT The sides of the bridge are easily viewed:

CONSTRUCTION INFORMATION

DATE 1935

INITIATING AGENCY Territory of Hawaii

GOVERNMENT OFFICIAL Louis S. Cain, Superintendent of Public Works

DESIGNER William R. Bartels[1]

CONTRACTOR George Freitas

OTHER BRIDGES ON CONTRACT none

COST $107,000[2]

FUNDING NRH 14G

HISTORICAL SIGNIFICANCE

The Kealakaha Stream Bridge is a large, continuous-concrete tee-beam bridge. It is the only curved bridge of this size built on the island of Hawaii and is therefore considered complex for its time, a time when calculations for such a bridge were done in long hand.

William Bartels was the designer of this and most of the other territorial bridges of the 1930s. The German-born engineer joined the Territorial Highway Department in 1932. He developed a reputation as a "cracker-jack" engineer who enjoyed the challenge of difficult assignments.[3]

The contractor was George Freitas, son of another island contractor, Henry Freitas. Both father and son built many of the Federal Aid bridges of this era. George also built the Advertiser building in Honolulu[4] and founded Pacific Construction Company.[5]

Kealakaha is one of many bridges built on the Hawaii Belt Road in the 1930s, made possible by the appropriation of Federal Aid money for the territory. It is an excellent example of these substantial structures which were mostly of concrete deck-grider or slab design, spanning gulches high above sea level. They enabled the road, with only a few exceptions such as at Kealakaha, to run a straight course. These bridges were precursors of the highway development of the 1950s along the Hamakua Coast.

Federal Aid bridges did not scrimp on ornament, and every attempt was made to add beauty to utility. Kealakaha's girders were haunched to give the impression of an arch, and brackets were added under the railings at each pier column. The pier columns themselves were molded into rectangular arches. The railings were cut in the conventional pattern.

According to the Superintendent's Report for 1936, 2,276 cubic yards of concrete and 501,000 pounds of reinforcing steel were used in Kealakaha's construction.[6] The concrete used in the parapets has weathered faster than that used in the pier columns, giving the bridge a two-tone effect today.

The bridge's integrity remains intact, although vehicles have done some damage to the parapets through the years.

---

1. Design Plans, Hawaii State Department of Transportation.

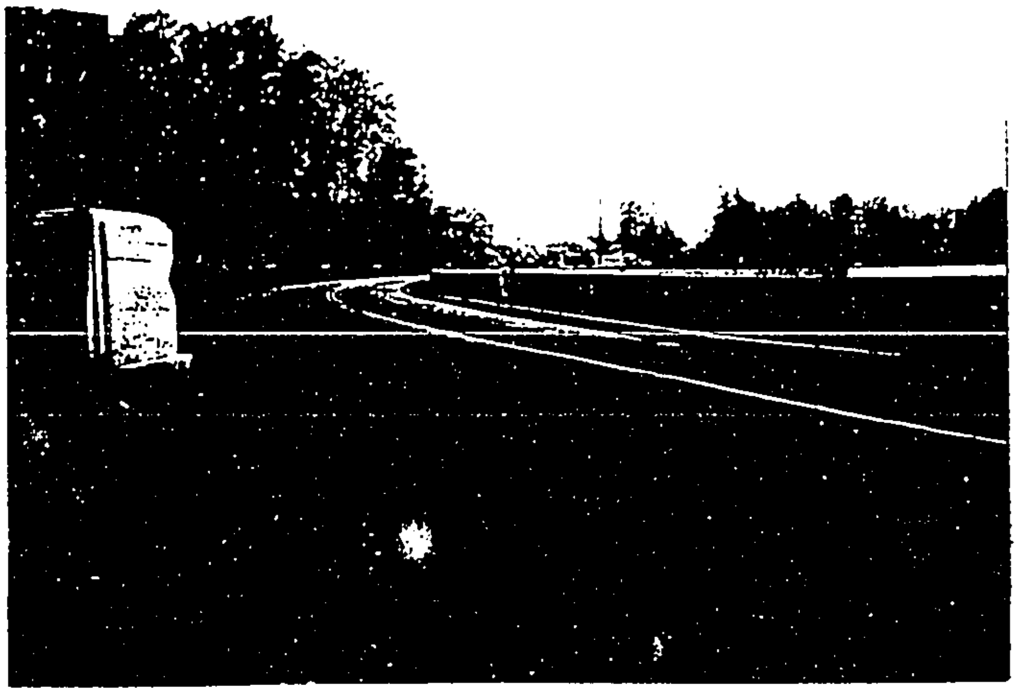
2. Hawaii, Report to the Governor Territory of Hawaii by the Superintendent of Public Works for the Year Ending June 30, 1936, p. 12.

3. "Obituaries," Honolulu Advertiser, October 9, 1969, p. C3; interview with Bruce McClure, Hawaii State Department of Transportation, January 3, 1985.

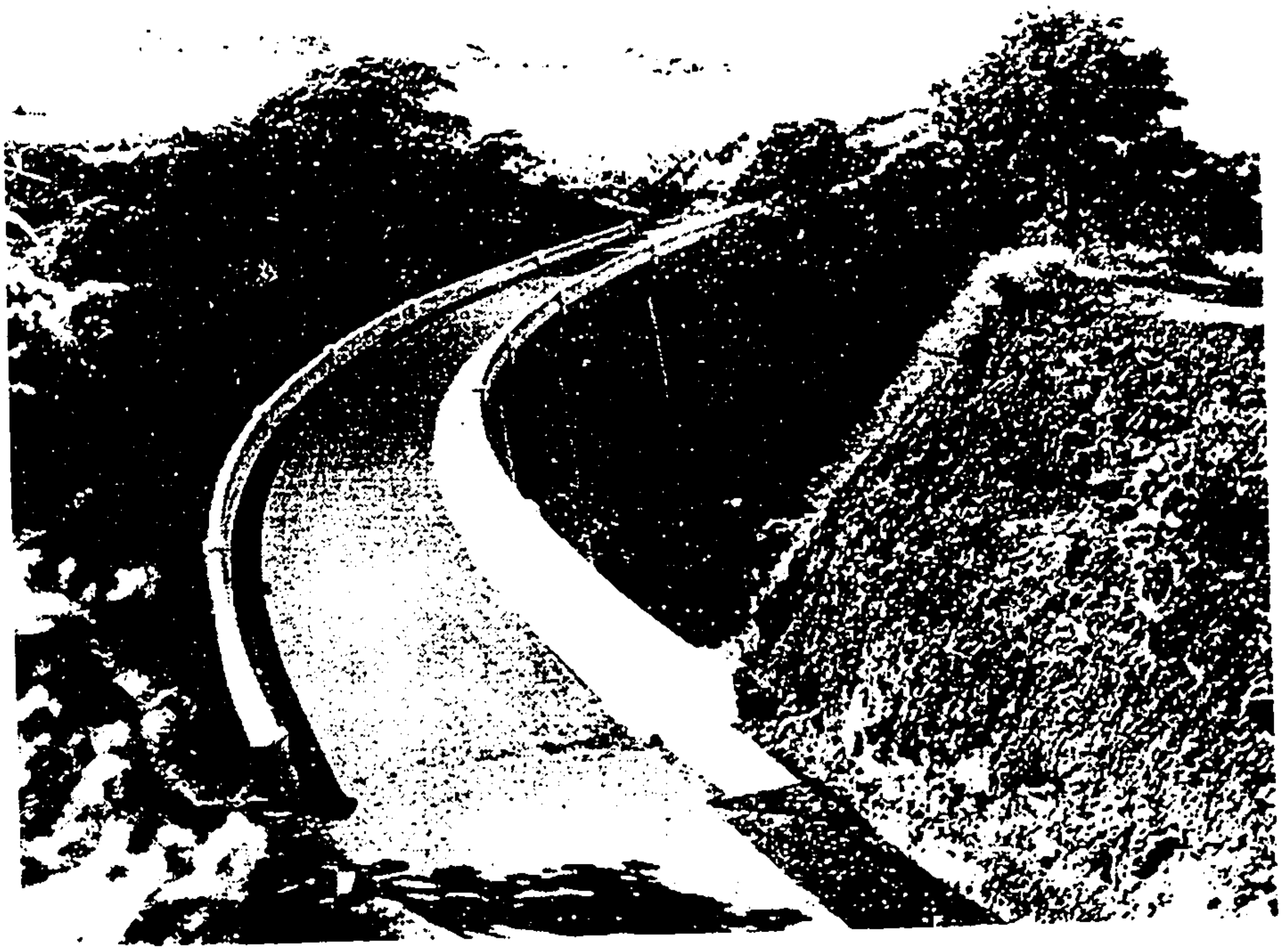
4. Honolulu Advertiser, December 8, 1944, p. 1.

5. Pacific Business News, September 8, 1986, p. 2.

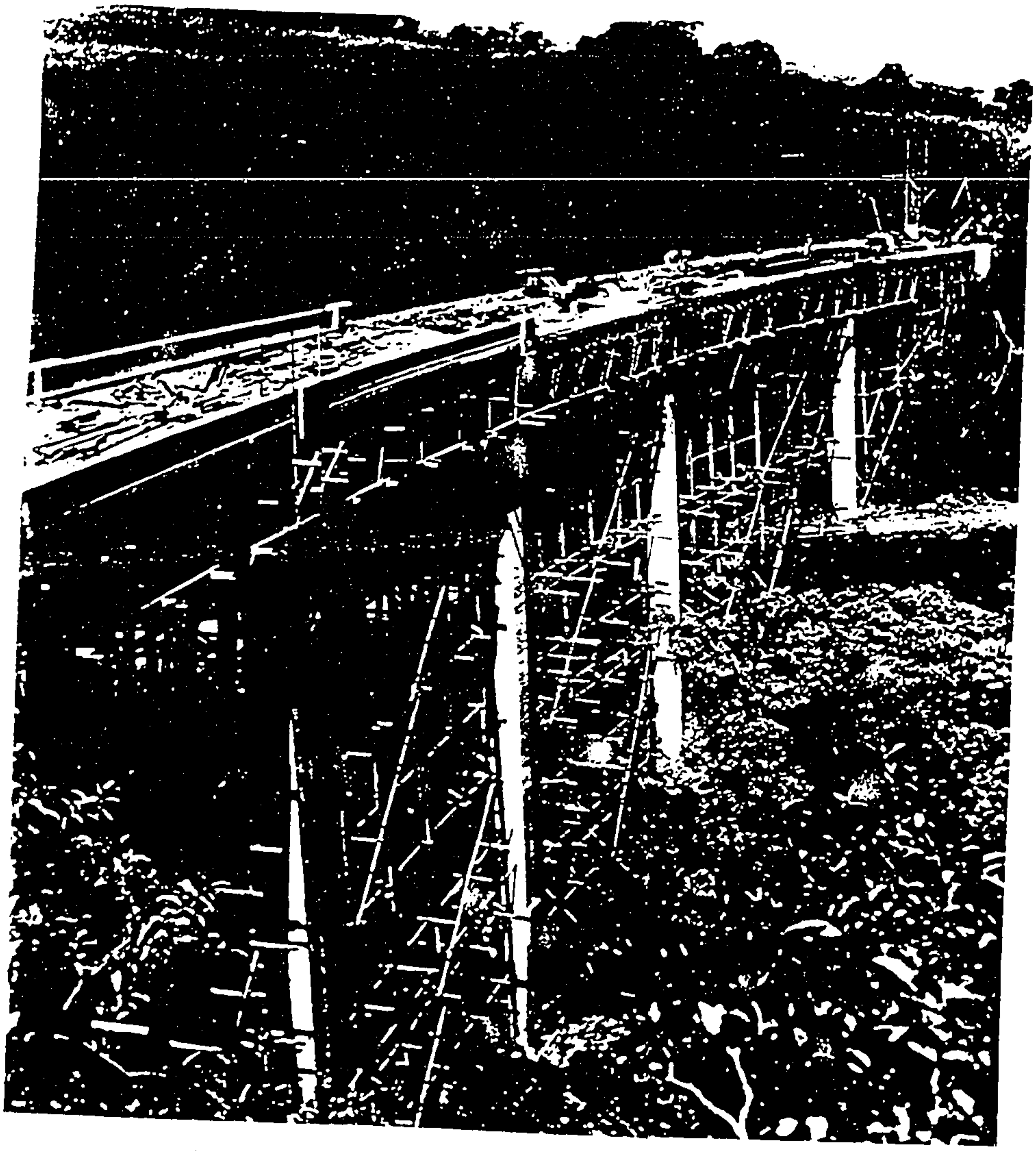
6. Hawaii, Report, p. 12.



KEALAKAHA STREAM BRIDGE



THE KEALAKAHA BRIDGE SHORTLY AFTER ITS CONSTRUCTION. REPORT TO THE GOVERNOR TERRITORY OF HAWAII BY THE SUPERINTENDENT OF PUBLIC WORKS, 1935. HAWAII STATE ARCHIVES.



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In the Hawaii County Department of Public Works

Bridge Design Plans.

Information and Assistance Given By Employees or Former Employees of:

The Hawaii State Department of Transportation

Bruce McClure
Tetsuo Mitsui
E. Claude Moore
John Okamato
Charles Schuster
Clarence Yamamoto
Kenneth Yamamoto
Paul T. Yamashita

The Hawaii County Department of Public Works

Virginia Goldstein
Gilbert Kobatake
Kazuichi Hirose
Raymond Ikeda
Arthur Isemoto
David Murakami
Wallace Ogawa
Glenn Okada
Hugh Ono
Robert Yanabu

Others

Hugh Clark, author of "clark's big isle, *Sunday Advertiser and Star Bulletin*

Vernon Ching, Honolulu County Department of Public Works

Staff, Hawaii State Archives

APPENDIX F

Comments and Responses to the Draft Environmental Assessment

United States Department of the Interior

FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS ECOREGION
300 ALA MOANA BOULEVARD, ROOM 3108
BOX 50088
HONOLULU, HAWAII 96850
PHONE: (808) 541-3441 FAX: (808) 541-3470

In Reply Refer To: KF

OCT 28 1996

Herbert Tao
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Re: Kealakaha Stream Bridge Replacement, Hawaii Belt Road, Island of Hawaii, Hamakua District

Dear Mr. Tao:

The U.S. Fish and Wildlife Service (Service) received your September 10, 1996, request to review and provide comments on the Kealakaha Stream Bridge Replacement, Hawaii Belt Road Draft Environmental Assessment. The proposed bridge construction project is located in the Hamakua District, Island of Hawaii. The project sponsors are the U.S. Department of Transportation, Federal Highway Administration and the State of Hawaii Department of Transportation, Highways Division. This letter has been prepared under the authority of and in accordance with provisions of the National Environmental Policy Act of 1969 [42 U.S.C. 4321 *et seq.*; 83 Stat. 852], as amended, the Fish and Wildlife Coordination Act of 1934 [16 U.S.C. 661 *et seq.*; 48 Stat. 401], as amended, the Endangered Species Act of 1973 [16 U.S.C. 1531 *et seq*; 87 Stat. 884], as amended, and other authorities mandating Service concern for environmental values. Based on these authorities, the Service offers the following comments for your consideration.

The proposed bridge project will be built adjacent to and replace the existing bridge that currently spans the Kealakaha Stream. The existing bridge, which shows signs of structural wear and sustained damage, will be abandoned in place. The replacement bridge is expected to improve traffic flow. Project-related construction is estimated to begin in 1997.

We have reviewed the maps prepared by The Nature Conservancy's Hawaii Natural Heritage Program and the Service's National Wetland Inventory Program. Based on this information, there are no federally listed endangered or threatened species at the proposed construction site. Therefore, the Service will concur with a determination that the proposed action will not adversely affect federally listed threatened or endangered species. In view of this, we believe that requirements of section 7 of the Endangered Species Act (Act) have been satisfied. However, obligations under section 7 of the Act must be reconsidered, if: 1) new information reveals impacts of this identified action that may affect listed species or critical habitat in a manner that was not previously considered; 2) this action is subsequently modified in a manner not previously considered in this

assessment; or 3) a new species listed or critical habitat determined that may be affected by the identified action.

You indicated during a telephone conversation with Mr. Kevin Foster of my staff that approximately 3.7 acres of riparian vegetation will be removed in order to access sites where bridge footings will be constructed. It is important to note that the stream and adjacent riparian habitat support several endemic and indigenous plant and aquatic species. Therefore, the Service recommends that the following measures be incorporated into the project to minimize impacts to aquatic and riparian resources:

(1) all project-related materials should be place or stored in ways to avoid or minimize disturbance to the aquatic environment;

(2) all project-related materials should be free of pollutants;

(3) no contamination of the aquatic environment (trash or debris disposal etc.) should result from project activities;

(4) a contingency plan to control accidental spills of petroleum products should be developed. Absorbent pads and containment booms should be stored on-site to facilitate the clean-up of petroleum spills;

(5) turbidity and siltation from excavation activities should be minimized and contained to the immediate vicinity of excavation through the use of effective silt containment devices and the curtailment of excavation during adverse weather conditions; and

(6) upon completion of the project, all stream bank areas cleared for the project should be revegetated with native or Polynesian-introduced plants. The Service recommends revegetating the cleared area with kukui tree (*Aleurites moluccana*), tree fern or hapu'u (*Cibotium glaucum*), and ohia tree (*Metrosideros polymorpha*). These species may be obtained by contacting local tree/plant nurseries identified on the attached list.

The Service appreciates the opportunity to provide comments on the proposed project. If you have any questions regarding these comments, please contact Fish and Wildlife Biologist Kevin Foster at 808/541-3441 (fax: 808/541-3470).

Sincerely,

for Brooks Harper
Field Supervisor
Ecological Services

Attachment

Re: Kealakaha Stream Bridge Replacement, Hawaii Belt Road, Island of Hawaii, Hamakua District

ATTACHMENT

(1) Aikane Nursery, P.O.Box 981 Kapaau, Telephone Number: 808/889-5906

(2) Hawaii Gardens, Palani Road, Telephone Number: 808/329-5702

(3) Island Supply, 30 Halekauila, Telephone Number: 808/ 935-2881

*Partial list of nurseries on the Island of Hawaii that sell native and Polynesian-introduced plants.

BENJAMIN J. CAYETANO
GOVERNOR

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

IN REPLY REFER TO:

HWY-DS
2.2550

November 14, 1996

Mr. Brooks Harper, Field Supervisor
Ecological Services
Fish and Wildlife Service
U.S. Department of the Interior
P.O. Box 50088
Honolulu, Hawaii 96850

Dear Mr. Harper:

Subject: Draft Environmental Assessment (EA)
Kealakaha Stream Bridge Replacement
Hawaii Belt Road, Project No. BR-019-2(26)
(Reference: KF)

Thank you for your letter regarding the Draft EA for the proposed bridge replacement project. We appreciate your efforts in reviewing the document and provide the following response to your concerns.

Section 7, Endangered Species Act

We acknowledge your concurrence with our determination that the proposed action will not adversely affect federally listed threatened or endangered species and that requirements of section 7 of the Endangered Species Act have been satisfied. We will keep you informed of any new information or modifications to the proposed action for your reevaluation.

Impacts to Aquatic and Riparian Resources

The six mitigation measures described in your letter will be incorporated into the Final EA and the construction documents to minimize impacts to aquatic and riparian resources.

Should you have any questions, please contact Mr. Herbert Tao of the Highways Division at 587-2124.

Very truly yours,

HUGH Y. ONO
Administrator
Highways Division

BENJAMIN J. CAYETANO
GOVERNOR

ESTHER UEDA

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

September 26, 1996

Mr. Herbert Tao
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Dear Mr. Tao:

Subject: Draft Environmental Assessment (DEA) for the Kealakaha Stream Bridge Replacement, Hawaii Belt Road, Hamakua District, Island of Hawaii, TMK 4-1-03: 10 and 36

We have reviewed the DEA for the subject project and have the following comments:

1) We confirm that the project site, as represented on Figure 2-2, is located within the State Land Use Agricultural District. We note that said district is incorrectly referenced as "Agriculture" on page 4-4 and Figure 4-2 of the DEA.

2) We note that Figure 4-2 incorrectly depicts the State Land Use Conservation District boundary in the vicinity of Alakaha and Popoloau Points, as well as in the area in the far left corner of the figure. Please refer to the enclosed copy of a portion of the Commission's official map, quadrant H-51 (Kukaiau), for the correct representation of the Conservation District boundary.

We have no further comments to offer at this time. We appreciate the opportunity to comment on the DEA.

Should you have any questions, please feel free to call me or Bert Saruwatari of our office at 587-3822.

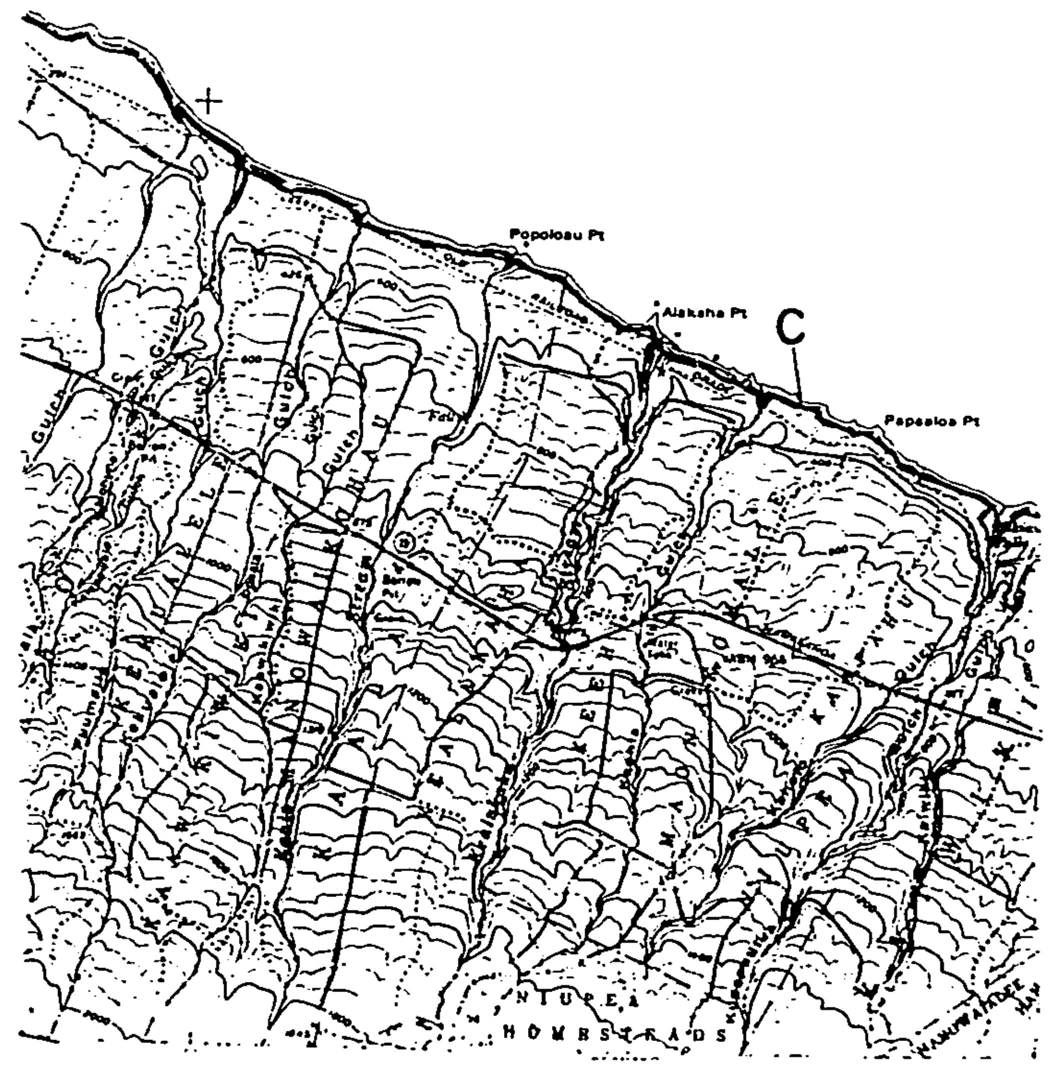
Sincerely,

ESTHER UEDA
Executive Officer

EU:th

encl.

cc: OEQC (w/encl.)
Ken Ishizaki (w/encl.)



BENJAMIN J. CAYETANO
GOVERNOR

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

KAZU HAYASHIDA
DIRECTOR

DEPUTY DIRECTORS
JERRY M. MATSUDA
GLENN M. OKIMOTO

IN REPLY REFER TO:
HWY-DS
2.2544

TO: MS. ESTER UEDA, EXECUTIVE OFFICER
LAND USE COMMISSION
DEPARTMENT OF BUSINESS, ECONOMIC, DEVELOPMENT AND TOURISM

FROM: KAZU HAYASHIDA
DIRECTOR OF TRANSPORTATION

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT (EA)
KEALAKAHA STREAM BRIDGE REPLACEMENT
HAWAII BELT ROAD, PROJECT NO. BR-019-2(26)

Thank you for your letter regarding the Draft EA for the proposed bridge replacement project. We appreciate your efforts in reviewing the document and provide the following response to your concerns.

1. Page 4-4 and Figure 4-2 will be revised in the Final EA to identify the State Land Use District as "Agricultural" instead of "Agriculture."

2. Figure 4-2 will be revised in the Final EA to correct the Conservation District boundary.

Should you have any questions, please contact Mr. Herbert Tao of the Highways Division at 587-2124.

STATE OF HAWAII
DEPARTMENT OF HEALTH
P O BOX 3378
HONOLULU HAWAII 96801

October 24, 1996

96-151/epo

Mr. Herbert Tao
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Dear Mr. Tao:

Subject: Draft Environmental Assessment (DEA)
Kealakaha Stream Bridge Replacement
Hawaii Belt Road
Island of Hawaii, Hamakua District
TMK: 4-1-03:10 and 36

Thank you for allowing us to review and comment on the subject project. We have the following comments to offer:

Water Pollution

1. The owner of the project should contact the Army Corps of Engineers to identify whether a Federal permit (including a Department of Army permit) is required for this project. A Section 401 Water Quality Certification is required from the Department of Health 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.

2. If the project involves any of the following discharges into state waters, a National Pollutant Discharge Elimination System (NPDES) general permit is required for each of the following activities:

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

   c. Hydrotesting effluent;
   d. Noncontact cooling water; and
   e. Treated contaminated groundwater from underground storage tank remedial activity.

3. An NPDES individual permit is required if the operation of the proposed facility involves any discharge into State waters.

Should you have any questions on this matter, please contact Ms. Kris Poentis of the Clean Water Branch at 586-4309.

Noise Concerns

1. Activities associated with the construction phase of the project must comply with the provisions of Chapter 11-46, Hawaii Administrative Rules, "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 regulations.

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

   c. The contractor must comply with the conditional use of the permits as specified in the regulations and conditions issued with the permit.

Should there be any questions on this matter, please call Jerry Haruno, Environmental Health Program Manager, Noise, Radiation and Indoor Air Quality Branch at 586-4701.

Sincerely,

Bruce S. Anderson, Ph.D.
Deputy Director for Environmental Health

c: Hawaii DHO
NR & IAQB
CWB

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

IN REPLY REFER TO
HWY-DS
2.2548

November 12, 1996

TO: BRUCE S. ANDERSON, Ph.D.
DEPUTY DIRECTOR FOR ENVIRONMENTAL HEALTH
DEPARTMENT OF HEALTH

FROM: HUGH Y. ONO, ADMINISTRATOR
HIGHWAYS DIVISION

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT (EA)
KEALAKAHA STREAM BRIDGE REPLACEMENT
HAWAII BELT ROAD, PROJECT NO. BR-019-2(26)

We received your comments on the Draft EA for the proposed bridge replacement project, and respond as follows:

Water Pollution

1. The Army Corps of Engineers has been sent a copy of the Draft EA for their review. The need for a Department of the Army permit is not anticipated since the bridge piers and footings will be constructed in an area outside of the normal high water level of the stream. In the event a federal license or permit is required, we will contact the Clean Water Branch for the Section 401 Water Quality Certification application requirements.

2. The need for a NPDES permit (either an individual permit or general permit coverage) is not presently anticipated. However, we will contact the Clean Water Branch in the event a NPDES regulated discharge is anticipated.

Noise Concerns

The Final EA and the construction documents will include your statements regarding compliance with the provisions of Chapter 11-46, Hawaii

Administrative Rule, "Community Noise Control"; the need for a noise permit; and the need for mufflers on construction equipment.

Should you have any questions, please contact Mr. Herbert Tao of the Highways Division at 587-2124.

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
ENGINEERING BRANCH

REF.WL LK

OCT 3 1996

Mr. Herbert Tao, Project Manager
State Department of Transportation
Highways Division
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Dear Mr. Tao:

Draft Environmental Assessment
Kealakaha Stream Bridge Replacement, Hawaii Belt Road
Hamakua District, Island of Hawaii, TMK 4-1-03: 10 and 36

The following is in response to a letter from Engineering Concepts, dated September 10, 1996, requesting comments on the subject draft environmental assessment.

The proposed project site is located in an area of minimal tsunami inundation. A FEMA Community Map has not been printed for the project area.

Thank you for the opportunity to review the draft environmental assessment. Should you have any questions, please contact Mr. Dennis Imada of the Planning Section at 587-0257.

Sincerely,

ANDREW M. MONDEN
Chief Engineer

c. OEQC
Ken Ishizaki, Engineering Concepts

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

IN REPLY REFER TO:
HWY-DS
2.2546

November 12, 1996

TO: ANDREW M. MONDEN, CHIEF ENGINEER
LAND DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES

FROM: HUGH Y. ONO, ADMINISTRATOR
HIGHWAYS DIVISION

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT (EA)
KEALAKAHA STREAM BRIDGE REPLACEMENT
HAWAII BELT ROAD, PROJECT NO. BR-019-2(26)

Thank you for your letter regarding the Draft EA for the proposed bridge replacement project. We appreciate your efforts in reviewing the document. Your comments will be incorporated in the Final EA.

Should you have any questions, please contact Mr. Herbert Tao of the Highways Division at 587-2124.

BENJAMIN J. CAYETANO
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

September 30, 1996

MEMORANDUM

LOG NO: 18100
DOC NO: 9609PM14

TO: Herbert Tao
Department of Transportation

FROM: DON HIBBARD, Administrator
Historic Preservation Division

SUBJECT: **Draft Environmental Assessment for Kealakaha Stream Bridge Replacement, Hawaii Belt Road Kealakaha, Hamakua, Hawaii Island TMK: 4-1-03: 10 and 36**

The Kealakaha Bridge (State Site Number 50-10-09-7512), which is the most significant bridge of its kind (concrete deck girder bridge) on the island of Hawai'i, is listed in the *Historic Bridge Inventory and Evaluation, Island of Hawaii.* Because of its significance the bridge will be preserved. We have previously recommended that it be utilized and maintained as an overlook as a way of preventing it from falling into ruins.

PM:amk

c. OEQC
Ken Ishizaki, Engineering Concepts, Inc.

BENJAMIN J. CAYETANO
GOVERNOR

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

IN REPLY REFER TO:
HWY-DS
2.2545

November 12, 1996

TO: DON HIBBARD, ADMINISTRATOR
STATE HISTORIC PRESERVATION DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES

FROM: HUGH Y. ONO, ADMINISTRATOR
HIGHWAYS DIVISION

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT (EA)
KEALAKAHA STREAM BRIDGE REPLACEMENT
HAWAII BELT ROAD, PROJECT NO. BR-019-2(26)

Thank you for your memo regarding the Draft EA for the proposed bridge replacement project. We appreciate your efforts in reviewing the document, and acknowledge your comment on the significance of the existing bridge. The Final EA will incorporate recommendation that the existing bridge be utilized and maintained as an overlook as a way of preventing it from falling into ruins.

Should you have any questions, please contact Mr. Herbert Tao of the Highways Division at 587-2124.

BENJAMIN J. CAYETANO
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

GARY GILL
DIRECTOR

October 23, 1996

The Honorable Kazu Hayashida, Director
State of Hawai'i
Department of Transportation
869 Punchbowl Street
Honolulu, Hawai'i 96813

Dear Mr. Hayashida:

We submit for your response (required by Section 343-5(b), Hawai'i Revised Statutes) the following comments on an August 1996, joint federal-state draft environmental assessment prepared by Engineering Concepts, Inc., for the "Kealakaha Stream Bridge Replacement, Hawai'i Belt Road, County of Hawai'i, Federal Project No. BR-109 2(26), TMK: 4-1-03:36 & 10". The document was submitted by your September 10, 1996, memorandum (HWY-DS 2.1802) to our office. Notice of availability of this draft environmental assessment was published in the September 23, 1996, edition of the Environmental Notice.

1. The island of Hawai'i is subject to periodic earthquakes. Please discuss the seismic sensitivity of bridges in Hawai'i County.

2. Please discuss what specific actions were/will be undertaken to comply with section 106 of the National Historic Preservation Act.

3. Please discuss if DOT has a long-term plan for seismic maintenance/replacement of bridges and whether a programmatic environmental impact statement has been or will be prepared for such a program.

Please include this letter, your response, along with all timely-received letters and responses in the final environmental assessment for this project. If there are any questions, please call Mr. Leslie Segundo, Environmental Health Specialist at 586-4185 Thank you.

Sincerely,

GARY GILL
Director

c: Herbert Tao, Department of Transportation
Kenneth Ishizaki, Engineering Concepts, Inc.

BENJAMIN J. CAYETANO
GOVERNOR

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

KAZU HAYASHIDA
DIRECTOR

DEPUTY DIRECTORS
JERRY M. MATSUDA
GLENN M. OKIMOTO

IN REPLY REFER TO
HWY-DS
2.2541

November 18, 1996

TO: GARY GILL, DIRECTOR
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

FROM: KAZU HAYASHIDA
DIRECTOR OF TRANSPORTATION

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT (EA)
KEALAKAHA STREAM BRIDGE REPLACEMENT
HAWAII BELT ROAD, PROJECT NO. BR-019-2(26)

Thank you for your letter regarding the Draft EA for the proposed bridge replacement project. We appreciate your efforts in reviewing the document and provide the following response to your concerns.

1. The seismic sensitivity of bridges in Hawaii County will be discussed.

2. The State Historic Preservation Division (SHPD), project archaeologist, has been informed about the project through the Draft EA review and consultation process. There has been no mention by SHPD for specific compliance with section 106 of the National Historic Preservation Act.

3. The State DOT long-term plan for seismic maintenance/replacement of bridges are being considered and will be discussed in the Final EA.

Your letter and all timely-received letters and responses will be included in the Final EA. Should you have any questions, please contact Herbert Tao of the Highways Division at 587-2124.

Stephen K. Yamashiro
Mayor

Nelson M. Tsuji
Fire Chief

Edward Bumatay
Deputy Fire Chief

County of Hawaii

FIRE DEPARTMENT

777 Kilauea Avenue • Mall Lane, Room 6 • Hilo, Hawaii 96720-4239
(808) 961-8297 • Fax (808) 961-8296

September 27, 1996

Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, HI 96813-5097

Attention: Herbert Tao

Subject: Draft Environmental Assessment
Kealakaha Stream Bridge Replacement
Hawaii Belt Road
Island of Hawaii, Hamakua District
Tax Map Key: 4-1-03: 10 and 36

We have no comments on the above-referenced draft enviromental assessment.

NELSON M. TSUJI
Fire Chief

NMT/mo

cc: OEQC
Engineering Concepts, Inc.

BENJAMIN J. CAYETANO
GOVERNOR

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

IN REPLY REFER TO

HWY-DS
2.2543

November 14, 1996

Nelson.

Mr. Nelson M. Tsuji, Fire Chief
Fire Department
County of Hawaii
777 Kilauea Avenue
Mall Lane, Room 6
Hilo, Hawaii 96720-4239

Dear Mr. Tsuji:

Subject: Draft Environmental Assessment (EA)
Kealakaha Stream Bridge Replacement
Hawaii Belt Road, Project No. BR-019-2(26)

Thank you for your letter regarding the Draft EA for the proposed bridge replacement project. We appreciate your efforts in reviewing the document and acknowledge that you have no comments at this time.

Should you have any questions, please contact Mr. Herbert Tao of the Highways Division at 587-2124.

Very truly yours,

HUGH Y. ONO
Administrator
Highways Division

Stephen K. Yamashiro
Mayor

County of Hawaii
PLANNING DEPARTMENT
25 Aupuni Street, Room 109 • Hilo, Hawaii 96720-4252
(808) 961-8288 • Fax (808) 961-9615

Virginia Goldstein
Director

Norman Olesen
Deputy Director

RECEIVED
'96 OCT -8 A9:32

September 30, 1996

Mr. Herbert Tao
State Department of Transportation
869 Punchbowl Street
Honolulu, HI 96813-5097

Dear Mr. Tao:

Draft Environmental Assessment for the Proposed Kealakaha Stream
Bridge Replacement, Hawaii Belt Road
Tax Map Key: 4-1-03:10 and 36; Kealakaha & Keehia, Hamakua, Hawaii

Thank you for your letter dated September 10, 1996, requesting our review and comment on the above-described draft environmental assessment.

The proposed Kealakaha Stream Bridge replacement will traverse over lands designated for Intensive and Extensive Agricultural uses by the Hawaii County General Plan. The affected parcels are also designated as Agriculture by the State Land Use Commission and Agricultural-40 acres (A-40a) by the County. The project site is situated outside of the County's Special Management Area (SMA).

We do not have any further comments to offer. Thank you for allowing us the opportunity to comment on the draft environmental assessment.

Sincerely,

VIRGINIA GOLDSTEIN
Planning Director

DSA:cmr

BENJAMIN J. CAYETANO
GOVERNOR

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

IN REPLY REFER TO:
HWY-DS
2.2547

November 19, 1996

Ms. Virginia Goldstein, Planning Director
Planning Department
County of Hawaii
25 Aupuni Street, Room 109
Hilo, Hawaii 96720-4252

Dear Ms. Goldstein:

Subject: Draft Environmental Assessment (EA)
Kealakaha Stream Bridge Replacement
Hawaii Belt Road, Project No. BR-019-2(26)

Thank you for your letter regarding the Draft EA for the proposed bridge replacement project. We appreciate your efforts in reviewing the document. Your comments will be incorporated in the Final EA.

Should you have any questions, please contact Mr. Herbert Tao of the Highways Division at 587-2124.

Very truly yours,

KAZU HAYASHIDA
Director of Transportation

Stephen K. Yamashiro
Mayor

Donna Fay K. Kiyosaki
Chief Engineer

Jiro A. Sumada
Deputy Chief Engineer

County of Hawaii
DEPARTMENT OF PUBLIC WORKS
25 Aupuni Street, Room 202 • Hilo, Hawaii 96720-4252
(808) 961-8321 • Fax (808) 959-7138

October 22, 1996

MR HERBERT TAO
DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII
869 PUNCHBOWL STREET
HONOLULU HAWAII 96813-5097

SUBJECT : DRAFT ENVIRONMENTAL ASSESSMENT
Kealakaha Stream Bridge Replacement, Hawaii Belt Road
Hamakua, Hawaii
TMK: 4-1-03

We acknowledge receipt of your letter concerning the subject matter, and provide you with our comments as follows:

1. All earthwork and grading shall be in conformance with Chapter 10, Erosion and Sediment Control, of the Hawaii County Code.

2. Any construction including alteration of any known watercourses shall be in conformance with Chapter 27, Flood Control, of the Hawaii County Code.

3. Application should be submitted to the Planning Department for their review and comments.

4. The Old Mamalahoa Highway fronting parcels 15, 58 & 13 up to the western boundary of TMK: 4-1-03:13 is maintained by the County. The remainder of this road is a DLNR unmaintained/paper road.

Should there be any questions concerning this matter, please feel free to contact Mr. Casey Yanagihara in our Engineering Division at (808)961-8327.

Galen M. Kuba, Division Chief
Engineering Division

CR

cc: Planning Department
Office of Environmental Quality Control
Engineering Concepts, Inc.

BENJAMIN J. CAYETANO
GOVERNOR

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

IN REPLY REFER TO:
HWY-DS
2.2542

November 14, 1996

Mr. Galen M. Kuba, Division Chief
Engineering Division
Department of Public Works
County of Hawaii
25 Aupuni Street, Room 202
Hilo, Hawaii 96720-4252

Dear Mr. Kuba:

Subject: Draft Environmental Assessment (EA)
Kealakaha Stream Bridge Replacement
Hawaii Belt Road, Project No. BR-019-2(26)

Thank you for your latter regarding the Draft EA for the proposed bridge replacement project. We appreciate your efforts in reviewing the document and provide the following response to your concerns.

(1) The Final EA will state that all earthwork and grading shall be in conformance with Chapter 10, Erosion and Sediment Control, of the Hawaii County Code.

(2) Alteration of watercourses is not anticipated.

(3) The Draft EA was submitted to the Planning Department for their review.

(4) We acknowledge your comment on the maintenance aspects of Old Mamalahoa Highway.

HWY-DS
2.2542

Should you have any questions, please contact Mr. Herbert Tao of the Highways Division at 587-2124.

Very truly yours,

HUGH Y. ONO
Administrator
Highways Division

October 23, 1996

Mr. Herbert Tao
Department of Transportation, State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Re: Kealakaha Stream Bridge Replacement,
Hawaii Belt Road, Island of Hawaii.
Hamakua District, TMK: 4-1-03: 10 & 36

Dear Mr. Tao:

Thank you for sending me the Draft Environmental Assessment for the above project. My brother, Randall Joseph Carreira is the owner of the house and property for Tax Map Key 4-1-03:43. His residence is the closest to the proposed bridge. and he asked me to review the Assessment. After reviewing the Assessment, I have the following questions/concerns:

<u>Land Acquisition</u>

How much land will be acquired?
How will my brother be compensated for this acquisition?
Who will determine the value of the land?
What are my brother's rights regarding this acquisition?

<u>Air Pollution</u>

Will my brother's family need special equipment to minimize the air quality degradation caused by the proposed construction?
If yes, what kind of equipment and who will provide such equipment?
We do request compensation for any medical problems that occur as a result of this project.
We formally request that we be notified by the contractor of any "negative" results of all inspections.

<u>Attenuation Wall</u>

We do request construction of a six-foot wall (at least).
May we assume that this is a permanent fixture?
If yes, then we formally request perpetual care maintenance of the wall.

<u>Noise and Vibration</u>

Our main concern is compensation for any medical problems and/or structural damages that occur as a result of the project.

<u>Miscellaneous</u>

What is the projected completion date of this project?

My brother has animals. We have concerns about the effect the project may have on the animals.

Some of the information and/or charts in the assessment were difficult to understand and we need clarification. We also may have other concerns as we continue to review the assessment. Therefore, we wish to reserve the right to tender additional concerns/comments to you regarding this project.

Thank you for inviting us to review the assessment and give input to you.

Sincerely,

Brenda L. Carreira

Brenda L. Carreira

cc: Office of Environmental Quality Control
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

Engineering Concepts, Inc.
250 Ward Avenue, Suite 206
Honolulu, Hawaii 96814

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

IN REPLY REFER TO
HWY-DS
2.2549

November 18, 1996

Ms. Brenda L. Carreira
1312 Komohana Street
Hilo, Hawaii 96720

Dear Ms. Carreira:

Subject: Draft Environmental Assessment (EA)
Kealakaha Stream Bridge Replacement
Hawaii Belt Road, Project No. BR-019-2(26)

Thank you for your letter regarding the Draft EA for the proposed bridge replacement project. We appreciate your efforts in reviewing the document and provide the following response to your concerns.

Land Acquisition

We anticipate approximately 3,100 sq.ft. of land within TMK parcel 4-1-03:43 will need to be acquired by the state for the realigned highway right-of-way. The value of this land will be determined by a certified land appraiser with compensation based on the review of the appraisal amount.

Air Pollution

As stated in the Draft EA, the contractor will be required to employ measures to minimize fugitive dust and exhaust emissions, and comply with the state Department of Health (DOH) regulations. These regulations include the need for a permit to operate concrete or asphalt concrete batching plants. The need for "special equipment" to protect residences is not anticipated.

Should medical problems arise as a result of construction, any claims received for construction related medical expenses will be reviewed by the State and the contractor.

Your request for notification of negative air quality results will be incorporated in the Final EA and construction documents.

Sound Attenuation Wall

The proposed six-foot tall sound attenuation wall will be a permanent feature and will be constructed within the realigned highway right-of-way. The wall and other structures within the highway right-of-way will be maintained by the Department of Transportation.

Noise and Vibration

We acknowledge your concern regarding medical problems and/or structural damage as a result of noise and vibration during construction. As stated in the Draft EA, the contractor must comply with the DOH regulations. In addition, the mitigation measures section in the Final EA will be expanded to include the need for a noise permit from DOH, and reference to Hawaii Administrative Rules, Chapter 11-46, "Community Noise Control".

The contractor will be required to closely monitor his work to minimize the impacts to the neighboring residences due to noise, vibration, dust and other nuisances. The policy on compensation for structural damage or other damages resulting from construction activities is the responsibility of the contractor. Claims for medical expenses due to the construction of this project will be reviewed by the State and the contractor.

Miscellaneous

The estimated completion for the construction of the new bridge is the summer of 1999.

We are open to further discussion with you and/or your brother on the impact of construction on his animals. Clearly, certain animals will be more sensitive to construction noise and vibration than others.

HWY-DS
2.2549

The Final EA is being prepared but we continue to welcome your questions and comments on the proposed project. Should you have any questions, please contact Mr. Herbert Tao of the Highways Division at 587-2124.

Very truly yours,

HUGH Y. ONO
Administrator
Highways Division