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KM

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COUNTY OF KAUAI
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4280 RICE STREET
LIHUE, KAUAI, HAWAII 96766

RECEIVED

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OFC. OF ENVIRONMENTAL
QUALITY CONTROL

September 4, 1992

Mr. Brian J. J. Choy, Director
Office of Environmental Quality Control
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

RE: GTE Hawaiian Tel InterIsland Fiber Optic Cable System
Wailua Golf Course
TMK: 4-3-9-02: 4 Wailua, Kauai
Final Environmental Assessment and Negative Declaration

This letter is to inform you that the Planning Department has not received any comments during the 30 day commenting period for the Draft Environmental Assessment for the project.

Should you have any questions, please contact Myles Hironaka of my staff at 245-3919.

Not correct! See comment letters/responses in Sec. 11 of EA. KM

JEFFREY LACY
Planning Director

156

1992-09-23-KA-FEA - Wailua GTE Hawaiian Tel SEP 2 3 1992
Interisland fiber optic cable system

FINAL

ENVIRONMENTAL ASSESSMENT for the

GTE HAWAIIAN TEL
INTERISLAND FIBER OPTIC CABLE SYSTEM
Wailua Golf Course, Island of Kauai

AUGUST 1992

PREPARED FOR:

GTE Hawaiian Tel
1177 Bishop Street
Honolulu, Hawaii 96813

RMTC
R. M. Towill Corporation

420 Waiakamilo Rd., Suite 411
Honolulu, Hawaii 96817-4941
(808) 842-1133 • Fax: (808) 842-1937

<u>FINAL</u>

ENVIRONMENTAL ASSESSMENT

FOR THE

GTE HAWAIIAN TEL
INTERISLAND FIBER OPTIC CABLE SYSTEM

WAILUA GOLF COURSE, WAILUA, KAUAI

Prepared for:

GTE HAWAIIAN TEL
1177 Bishop Street
Honolulu, Hawaii 96813

AUGUST 1992

Prepared By:

R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941

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PROJECT SUMMARY

Project:	GTE Hawaiian Tel Interisland Fiber Optic Cable System
Applicant:	GTE Hawaiian Tel 1177 Bishop Street Honolulu, Hawaii 96814 Contact: Larry Hartshorn 546-2095
Accepting Authority:	County of Kauai Department of Planning
Tax Map Key:	3-9-02:4
Location:	Wailua Golf Course, Wailua, Kauai
Lot Area:	11,000 Square Feet
Owner:	Department of Public Works Division of Parks and Recreation County of Kauai 4193 Hardy Street Lihue, Kauai, Hawaii 96766
Agent:	R. M. Towill Corporation 420 Waiakamilo Road, Suite 411 Honolulu, Hawaii 96817 Contact: Brian Takeda 842-1133
Existing Land Uses:	County Golf Course, Recreational area, Beach usage
State Land Use District:	Conservation
General Plan Land Use Designation:	Conservation
County Zoning Designation:	Public Facilities

SECTION 1
INTRODUCTION

1.1 PURPOSE AND OBJECTIVES

GTE Hawaiian Tel proposes to develop an interisland submarine fiber optic cable system which will link the islands of Kauai, Oahu, Maui, and Hawaii. The system will include three interisland submarine cable segments with 5 landing sites (see Figure 1). The proposed landing sites are in the vicinity of Wailua Golf Course on Kauai; Kahe Point and Sandy Beach Park on Oahu; Mokapu Beach on Maui; and Spencer Beach Park on Hawaii. The purposes of the project are to provide additional telecommunication capacity to accommodate projected interisland telecommunication traffic; to increase system integrity; and, to provide additional path diversity.

GTE Hawaiian Tel is Hawaii's largest phone service provider. In 1990, Hawaiian Tel processed over 7 million calls per day, or over 4,800 calls per minute. Annually, this accounted for approximately 2.6 billion calls. The current level of service experienced by GTE Hawaiian Tel is at the forefront of a growth trend that has continued uninterrupted, since at least 1981, when Hawaii had almost 432,000 telephone access lines. Today that number has increased by almost 30 percent to over 555,000 lines (The State of Hawaii Data Book, 1990).

GTE anticipates that by 1993 its existing radio facilities will be unable to adequately process interisland phone transmissions, due to continuing and increasing levels of service demand. To overcome this limitation GTE proposes to carry out planning and implementation of a submarine fiber optic interisland cable network to handle the increasing volume of telephone traffic.

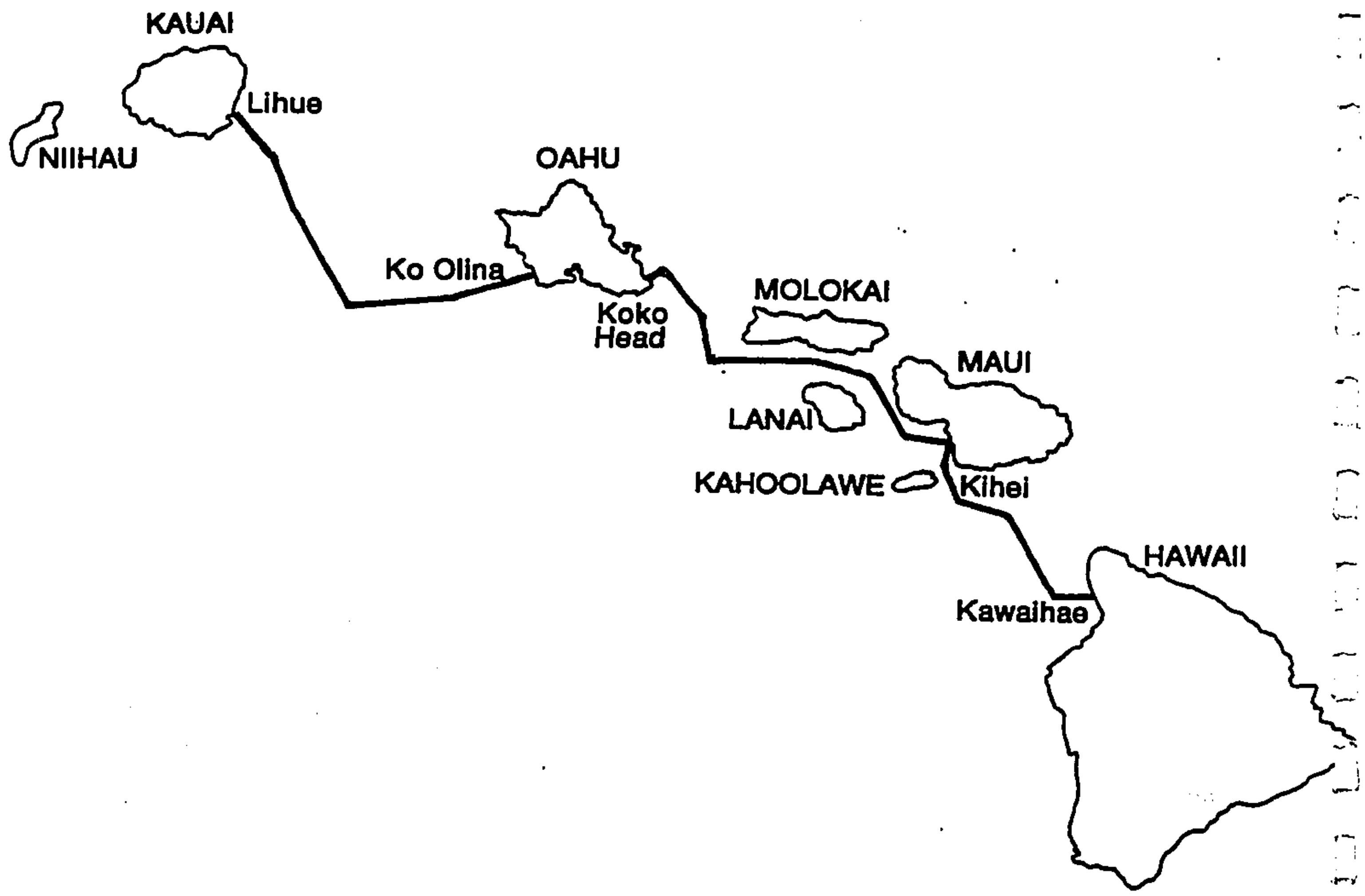

Figure 1
INTERISLAND SUBMARINE FIBER

GTE Hawaiian Tel Interisland
Fiber Optic Cable Project

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1.2 PROJECT LOCATION

The proposed landing site on Kauai for the Kauai to Oahu segment of the submarine interisland fiber optic cable system is Wailua Golf Course along the east coast of the Island of Kauai (see Figure 2). The nearshore conditions have good access to a sand channel which begins immediately offshore and continues into deeper water. The proposed landing site is currently developed as a golf course with related accessory uses. The proposed landing site for the cable will be at a location adjacent to the driving range, between the front nine holes located toward the Lihue section of the course and the back nine holes located toward the Kapaa section of the course which was selected to avoid directly crossing any greens and fairways to minimize interruptions to golf play. From there the cable will be routed subsurface to the nearest overhead utility pole located at the southern intersection of the golf course loop road with Kuhio Highway for routing along the makai side of the highway to the GTE Hawaiian Telephone Central Office (CO), near the Lihue Shopping Center. The beach in the vicinity of the landing site is about 175 feet wide with a gentle slope. Mauka of the beach are mature ironwood trees and the fairways and greens of the golf course beyond. Although the beach is accessible to the public, it is not generally used by the public as frequently due to unfavorable climate and marine conditions. However, fishing, boating and diving have been activities observed taking place in the area. Figure 3 illustrates the proposed alignment of the GTE Hawaiian Tel submarine cable from the landing site to the CO.

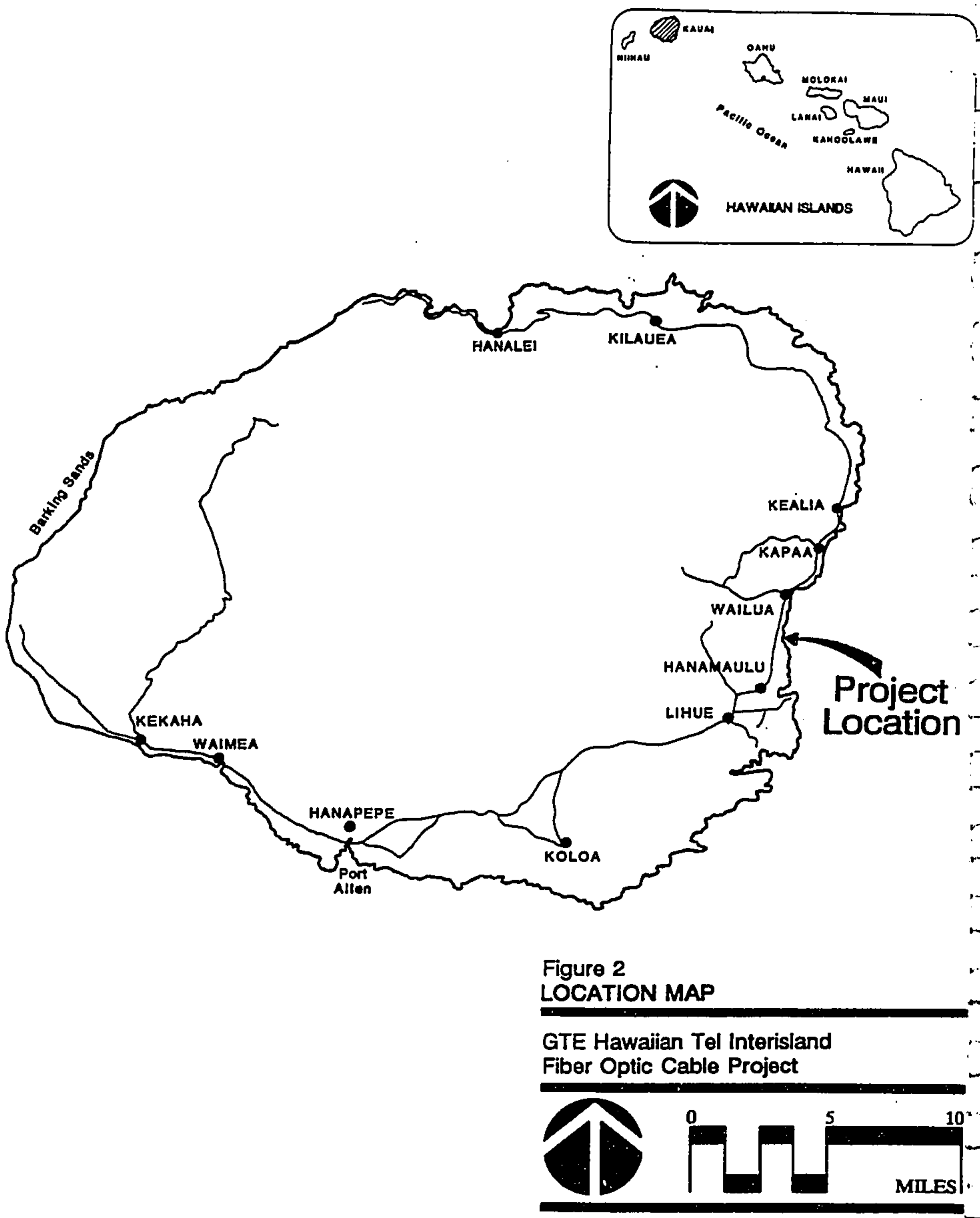

Figure 2
LOCATION MAP

GTE Hawaiian Tel Interisland
Fiber Optic Cable Project

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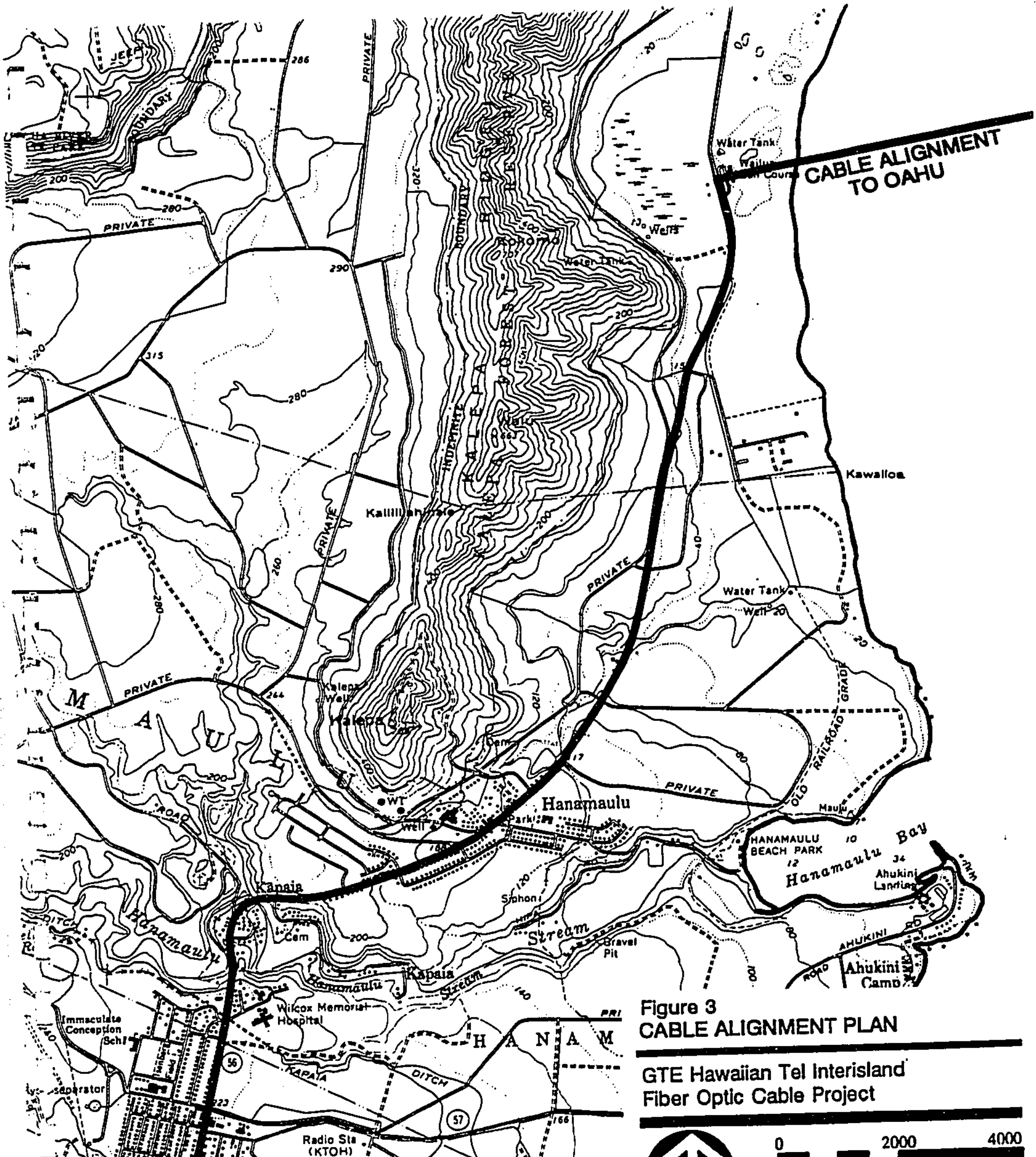

Figure 3
CABLE ALIGNMENT PLAN

GTE Hawaiian Tel Interisland Fiber Optic Cable Project

0 2000 4000 FEET

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SECTION 2

PROJECT BACKGROUND

2.1 CABLE TECHNOLOGY

The following is a discussion of existing telecommunication cable technology and how the determination was made to use fiber optics.

2.1.1 Copper and Fiber Optic Cables

The alternative to fiber optic cable is the use of copper wire cable. Copper wire cables function using a large number of plastic-coated copper wires housed within a plastic or synthetic outer casing. If necessary, steel or other protective materials would be added to ensure strength and resistance to abrasion and breakage. In order to receive a voice transmission an electrical signal must be sent through a pair of copper wires to a receiver, where the electrical signal is converted back into sound. A typical cable, approximately 4 inches in diameter (without the outer protective casing), would house 600 copper wires with the capacity of approximately 3,600 voice circuits.

The copper wire cable will also require use of a repeater to boost the electrical signal over long distances to ensure adequate signal strength at the receiving station. Repeaters will be necessary approximately every 6,000 feet and require a high voltage power source to operate. Repeater dimensions for a 1,200 voice circuit will be approximately 1 to 2 feet in diameter by 3 feet long. Therefore, to accommodate the 4-inch diameter copper cable described above, at least 3 repeaters would be required every 6,000 feet with a requisite power source supplying power to the cable.

In contrast, fiber optic technology relies on use of optical fibers and the transmission of light pulses which are converted into voice signals by the telephone company receiving station. The proposed fiber optic cable would contain approximately 12 fiber optic strands and would be housed in a plastic and steel casing no more than approximately 3 inches in diameter (see Figure 4). Like the copper cable, steel or other protective materials would be added as

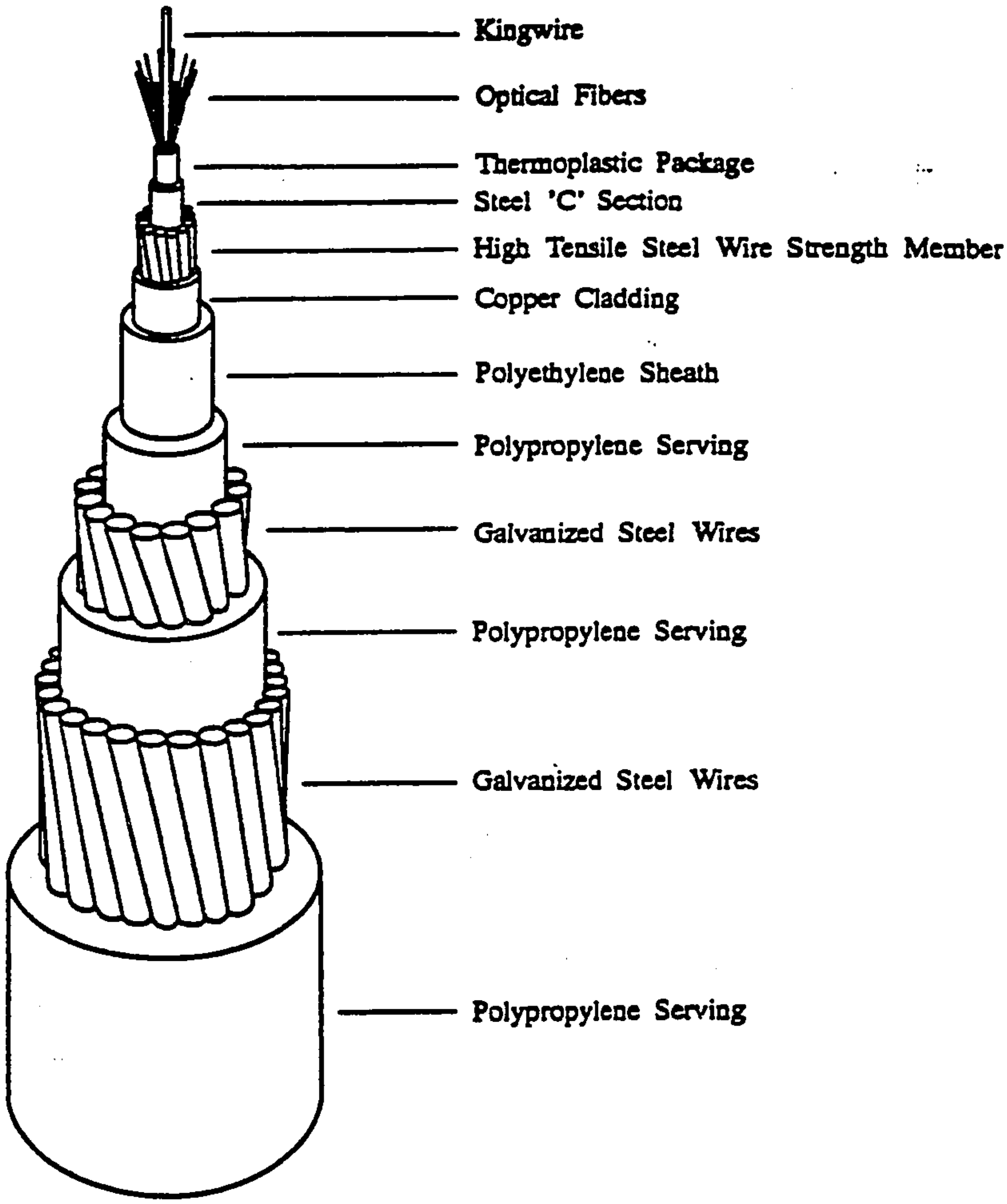

Figure 4
DOUBLE ARMOR FIBER OPTIC CABLE

GTE Hawaiian Tel Interisland
Fiber Optic Cable Project

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needed for strength. Each pair of fiber optic strands would be capable of handling approximately 8,000 voice circuits, for a combined total on the order of 40,000 voice circuits (2 strands = 1 pair, 12 strands = 5 pairs working plus 1 pair spare, and 5 pairs x 8,000 voice circuits = 40,000 voice circuits. In addition, in order for a copper cable to achieve the capacity of a fiber optic cable, it would have to approach a diameter of approximately 8 to 10 feet, would require repeaters, and a high-voltage power line in addition to the copper cable.

Fiber optic technology was selected because:

- Fiber optic cables provide superior capacity and do not require high-voltage repeaters;

- The smaller diameter fiber cable ensures there will be minimal disturbance necessary to site the cable. There is less land needing to be graded, cleared and stockpiled in order to site a 3-inch diameter cable versus a 10' diameter cable;

- Sensitive areas that might otherwise be disturbed because of larger equipment and increased mobilization and noise problems would be greatly reduced; and

- Length of time on site would be greatly minimized. Sensitive public or open space areas would not require a lengthy stay by the construction team and therefore would minimize any hardships upon beach users including swimmers, fishermen, surfers and other users.

2.2 SUBMARINE CABLE ROUTE

The submarine cable route selection process involved identification of areas warranting study, based on a set of minimum evaluation criteria. The criteria includes rapid erosion, giant landslides, drowned coral reefs, seismic activity, dumping areas, ship and airplane wrecks, other cables, and the length of routes.

In August 1991 a study was conducted by Seafloor Surveys International (SSI) to preliminarily identify an ocean route for the GTE Hawaiian Tel Submarine Fiber Optic Cable System. The route selected was one that minimized potential hazards to the installation, and eased maintenance and operation of the cable over a projected 25 year lifetime.

The following provides a detailed description of each of these criteria:

2.2.1. Rapid Erosion

The greatest danger to this cable system is in the submarine portion of the route as it is related to the geologically young age of the "Hawaiian Islands and the resulting extremely high erosion rates. The rapid erosion places large volumes of unconsolidated sediment into the shallow waters surrounding the islands. These sediment deposits move rapidly down the steep island slopes when they become unstable. This down-slope sediment movement can be initiated by earthquakes, storm runoff, and storm waves. Installation of cables on steep, sediment-covered submarine slopes should be avoided if possible. Where these slopes cannot be avoided, the cable should traverse as directly up the slope as possible (SSI, August 1991)."

2.2.2 Giant Landslides

Over the past several years, mapping of the Hawaiian Exclusive Economic Zone by the U.S. Geological Survey through the use of the long range Gloria sonar system, a relatively low-resolution, reconnaissance sonar, has discovered a series of large landslides surrounding the Hawaiian Islands (Moore, et.al., 1989). "The primary danger presently posed to the cable by these inactive landslides is their extremely rough surface. The seafloor in the slide areas are known to be littered with huge volcanic boulders. These boulders have been observed from submersibles to often be the size of a house. These slide surfaces pose a serious threat by producing unacceptable cable spans where the cable is draped over individual blocks, as well as the possibility of having the cable getting tangled if it had to be retrieved for repair (SSI, August 1991)."

2.2.3 Drowned Coral Reefs

A series of drowned coral reefs surrounding the islands are considered dangerous to the Interisland Fiber Optic Cable System. "Locally steep slopes associated with these reefs could cause unacceptable cable spans in areas where strong bottom currents can be expected (SSI, August 1991)."

2.2.4 Seismic Activity

"The greatest danger to the cable from earthquakes is not the actual fault displacement itself, but the possibility they will initiate movement of unstable sediment deposits on the slopes of the islands. Epicentral locations of earthquakes with magnitude 3 or larger in the Hawaiian region should be avoided by the fiber optic cable (SSI, August 1991)."

"Seismic activity in the Hawaiian Islands is concentrated in the vicinity of the active volcanoes on the Island of Hawaii, where it is primarily related to the on-going volcanic activity. There are also earthquakes related to the tectonic subsidence of the islands due to the load that the growing volcanoes is putting on the earth's crust. These tectonic earthquakes are also concentrated in the area surrounding the island of Hawaii, where the greatest subsidence is taking place (SSI, August 1991)."

2.2.5 Dumping Areas

"A large, presently inactive, explosive dump is located west of Oahu. This dump will have to be avoided by the fiber optic cable. Navy authorities maintain this area has not been used for ordinance disposal since shortly after World War II. However, they advise against laying cables through the area (SSI, August 1991)."

"Dredge Spoils disposal sites authorized by the U.S. Army Corp of Engineers are also located close to all major island harbors and should be avoided by the cable route (SSI, August 1991)."

2.2.6 Ship and Airplane Wrecks

A complete, high resolution side-scan survey of the proposed cable route should be carried out to determine that the route is free of man-made hazards such as ship wrecks and lost airplanes. There have been numerous ships and airplanes lost at sea in the Hawaiian area which have never been located.

2.2.7 Other Cables

There are several other cables in the planning stage including Pac Rim East (from Hawaii to New Zealand), HAW-5 (from California to Hawaii), the Hawaii deep water electric transmission cable (from Hawaii to Oahu via Maui), and the Tri-Island power cables (linking Maui, Molokai and Lanai). Aside from these commercial cables, the University of Hawaii plans to install a fiber optic cable for neutrino research offshore from Keahole Point north of Kailua, Kona.

Along parts of this route the cable will have to be laid in close proximity to other, presently existing communications cables. In these areas, the recommendations of the International Cable Protection Committee (ICPC) should be used as a guideline. At their 1985 Plenary Meeting in Sydney, Australia, ICPC recommended that no previously existing cable be crossed at less than a 45 degree angle, the closer the crossing can be to a right angle the better, and where possible a spacing of five miles should be maintained.

Prior to making final decisions on cable placement, ICPC also recommends that American Telephone and Telegraph (AT&T) be contacted to determine if there are conflicts with military or other government cables.

2.2.8 Length of Routes Less Than 200 Kilometers

All routes are designed to be less than 200 kilometers in length in order to be serviced by repeaterless cables. The fiber optic cable will operate on a single light transmission source generated from its Central Office and transmitted to a receiving Central Office. Since repeaters will not be required to retransmit the signal, no electrical power will need to be routed through the cable.

2.3 LANDING SITES SELECTION

In August of 1991 a study was conducted to select landing sites for the GTE Hawaiian Tel Fiber Optic Cable System connecting the Islands of Kauai, Oahu, Maui, and Hawaii. A set of criteria was used to reduce the field of potential landing sites. The advantages and disadvantages of each site were evaluated to provide the basis for comparing the sites.

The following is a brief discussion of criteria for determining landing sites:

2.3.1 Shoreline/Nearshore Conditions

The shoreline and nearshore conditions are a consideration because the depth of the water from the landing site towards the ocean must be deep enough to protect the cable. Approximately 50 to 60 feet of water will be required before wave forces diminish to levels where wave action does not affect the cable. Areas with extensive shallow water far from shore (i.e.4,000'+) were considered difficult or suboptimal in providing protection during storms and other high wave conditions.

The composition of bottom conditions limits acceptable landing sites. Sandy bottoms are preferred in order to minimize any possible environmental impacts of anchoring, armoring, or trenching through rock or coral in order to securely fasten the fiber optic cable. Also if the ocean bottom has extensive sand deposits, especially adjacent to the shoreline the cable can eventually be covered by sand, providing maximum protection against wave forces.

2.3.2 Public Use Considerations

It is anticipated that impacts to public recreational areas will be minimal given the short-term and relatively minor requirements for installing a fiber optic cable. However, because of potential for difficulties with area users, landing sites in areas of major public use are considered a constraint to selection.

Areas of potential historical and archaeological significance in close proximity to cable landing sites are also considered a constraint to selection, due to the possibility of destroying a historic site.

2.3.3 Environmental/Natural Resource Considerations

The landing sites should not be within proximity to rare or endangered species or their habitats in order not to disturb them.

Impacts to shoreline and ocean water quality should be kept to a minimum. Sites which would require extensive ocean anchoring and cable protection work (i.e., shielding/dredging) and/or on-shore excavation in ground conditions which promote soil erosion should be avoided.

2.3.4 Alternative Landing Sites

Three possible landing sites were identified for the Oahu to Kauai segment of the fiber optic cable where underwater geology would be most suitable: Wailua Golf Course, Wailua Bay, and Hanamaulu Bay. Wailua Golf Course was selected as the preferred landing site because the nearshore conditions of the site have good access to a sand channel which begins immediately offshore and continues into deeper water. This continuous sandy bottom into deeper water condition is not readily available at either the Wailua Bay or Hanamaulu Bay sites.

Should Wailua Golf Course be removed from consideration, it is recommended that Wailua Bay be considered for an alternative landing site. Primary features of Wailua Bay over Hanamaulu Bay are: 1) Wailua Bay is situated on public lands; 2) the physical features of Wailua Bay are significantly better for siting a fiber optic cable; and 3) Hanamaulu Bay contains private land immediately mauka of a potential shore landing site which would add to development costs and potential delays.

SECTION 3
CONSTRUCTION ACTIVITIES

3.1 GENERAL

Construction of the project will be accomplished in two phases: the first phase involves all land side construction activities; and the second phase includes all work necessary to prepare the landing site and actually landing the interisland cable submarine cable.

The first phase involves the construction of a new manhole located makai of Wailua Golf Course and the installation of approximately 1,000 feet of underground ducts and cable from the manhole to an existing utility pole (No. P-124) located on the makai shoulder of Kuhio Highway. The cables will then be diverted overhead onto existing utility poles along Kuhio Highway connecting utility Pole P-124 to the GTE Hawaiian Tel Central Office (CO) located immediately adjacent to the Lihue Shopping Center (Tax Map Key 3-9-02:4).

The second phase of work involves landing of the submarine fiber optic cable and connecting it to the new manhole at the Wailua Golf Course.

The following provides a detailed description of each of these phases:

3.2 LAND-SIDE ACTIVITY

The new 5' x 10' x 4' deep reinforced concrete manhole will be constructed approximately 1,000 feet makai of Kuhio Highway (see Figure 5). It is not anticipated that traffic on Kuhio Highway will be affected because of the distance of the manhole from the highway. Work will be accomplished in one or two days.

The terminus of the landside activities will be the manhole which will need to be constructed to accept the submarine cable. Four 4-inch diameter PVC ducts will be installed in a trench from the manhole, along the Wailua Golf Course, to utility Pole P-124 on Kuhio Highway adjacent to the golf course loop road. A 4' x 6' concrete handhole will be installed within

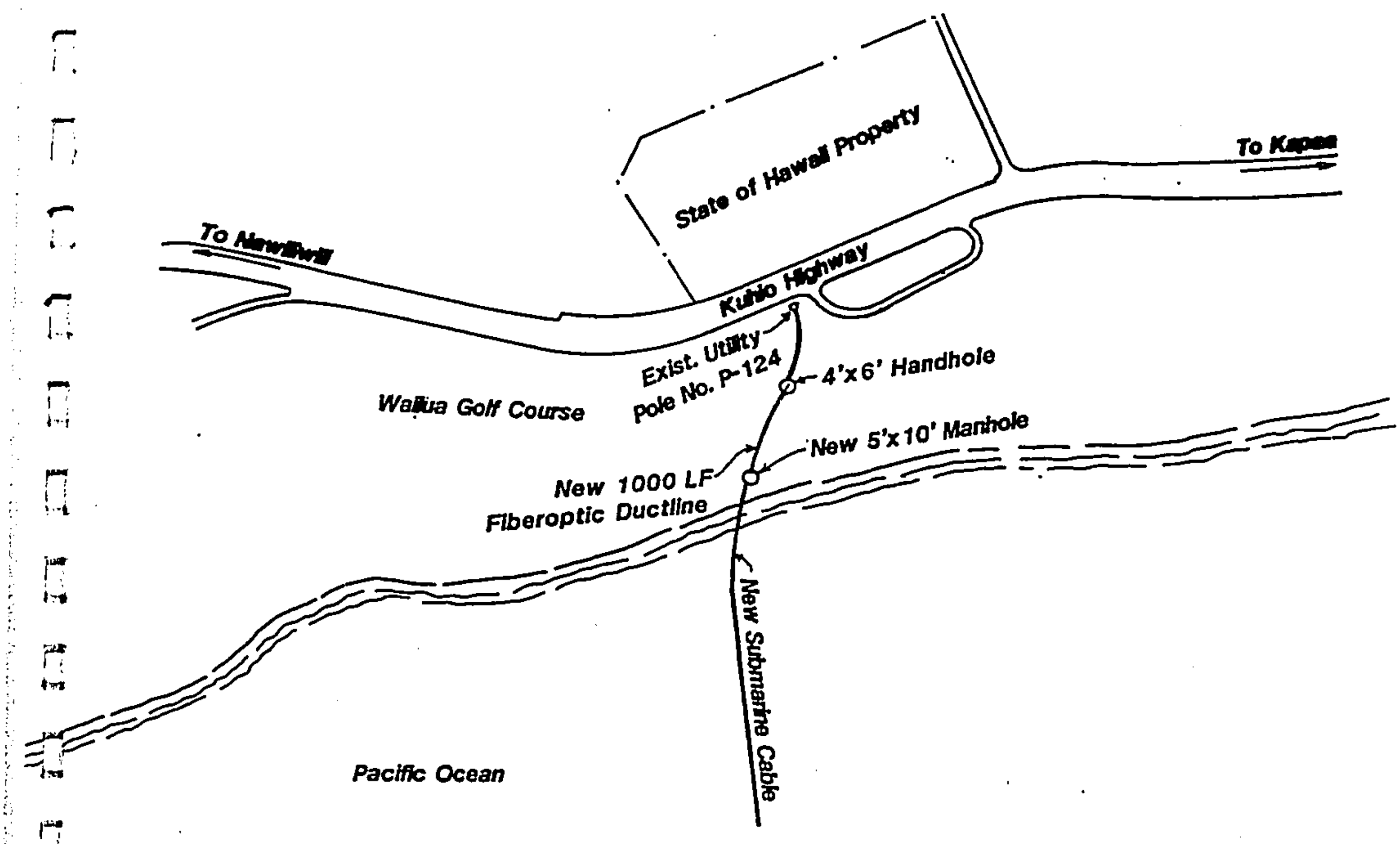

Figure 5
SITE PLAN

GTE Hawaiian Tel Interisland
Fiber Optic Cable Project

Not to Scale

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FEBRUARY 1992

the Wailua Golf Course midway between the new manhole and Pole P-124. The PVC ducts will be encased in concrete and buried under 3 feet of earth cover (see Figure 6A). Only one duct will be utilized while the others remain vacant and retained for future use. The trench will cut across the golf course driving range, but use of the golf course should not be affected during the trenching operations. Safety measures such as wooden barricades will be constructed around the excavation, and wooden walkways will be provided across the trenches for golfers. Traffic on Kuhio Highway will not be affected by the construction.

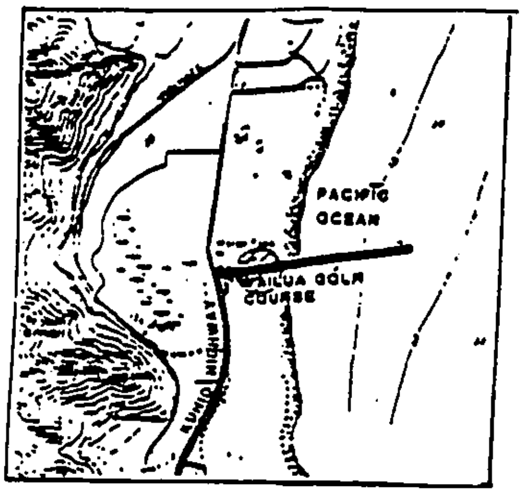
3.3 NEARSHORE ACTIVITY

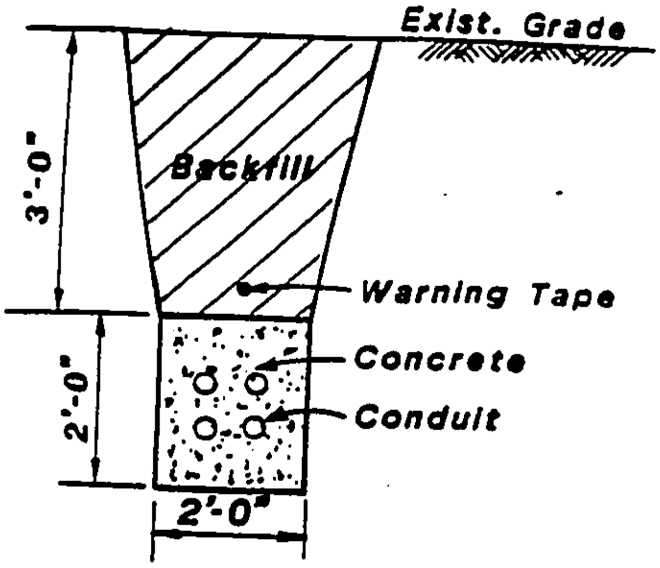
This second work phase involves landing the submarine fiber optic cable and establishing a connection to the new manhole at Wailua Golf Course.

A 300-foot long trapezoidal shaped trench as indicated in Figure 6B (trench section) will be excavated between the new manhole and the mean low water mark and four 6-inch steel conduits encased in concrete will be installed within the trench. Only one conduit will be used while the others are plugged and retained should their future use be necessary. The trench will have a 2-foot base and will be approximately 4 feet deep, with a 1:1 side slope. Approximately 267 cubic yards of sand and rubble excavated from the trench will be stored on the beach adjacent to the cable easement for later use as backfill. The trench will be backfilled after the concrete jacket has cured.

Sand and rubble covering the proposed cable segment may require removal below the level of the prevailing tides. For this process, a backhoe, shovels, or other mechanical means will be used to remove the upper layers. Remaining sand or rubble will be removed using a hydro-jet. If necessary, sand bags will be used to prevent sand from reentering the open trench. Rock outcrops and other hard substrate which cannot be avoided will be also removed using a backhoe or other similar mechanical means.

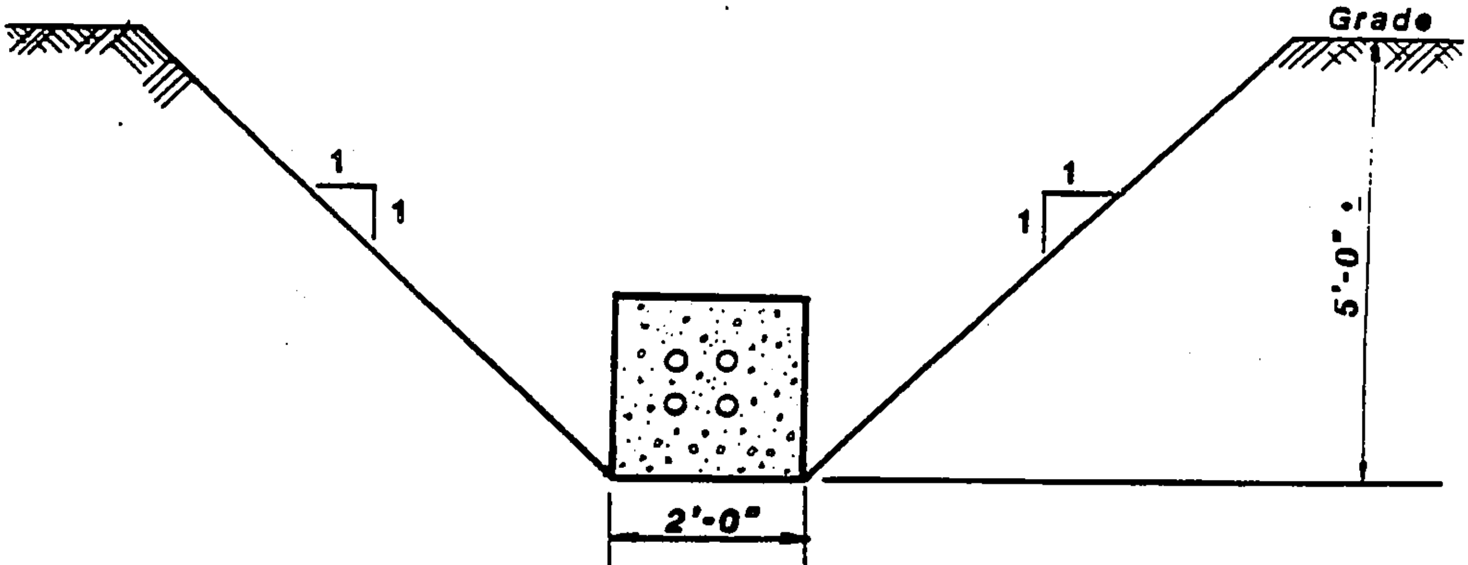
To reduce potential for turbidity due to construction related work, silt screens or filters will be utilized within the nearshore construction area. Upon completion of construction





NEW MANHOLE TO EXIST.UTILITY POLE, NO.- P124

Figure 6-A



NEW MANHOLE TO OCEAN

Figure 6-B

Figure 6 A and B
TRENCH SECTIONS

GTE Hawaiian Tel Interisland
Fiber Optic Cable Project

R. M. TOWILL CORPORATION
FEBRUARY 1992

activities, the construction crew will make every reasonable effort to return the ground to existing preconstruction contours through use of existing graded materials for backfill.

Two range targets (alignment guide) will be placed on land just prior to the landing of the cables to aid in the cable laying process. The range targets will be placed on temporary structures and will be removed following the cable landing. The range targets will not disrupt traffic movements along Kuhio Highway.

A cable laying ship provided by the cable vendor will serve as the primary means of laying the fiber optic cable. The following procedures describe the activities involved during the cable landing operations:

The ship's captain will approach the landing site using the two range targets to align the ship as it approaches the shore. The range targets will be placed by a cable receiving party according to previously surveyed coordinates. Once the ship approaches the shore landing to the minimum depth allowable, it will fix its position relative to the landing site using anchoring, tugboats, side-thrusters, or other means. As the ship fixes its position, it will begin laying out cable.

The ship will lay cable while its personnel attach suspension floats at regular intervals to the cable. As the cable is lowered to the water, it will float, allowing it to be pulled toward shore using a winch, small motor boat, or other mechanical means.

The shore landing will be specially prepared to accept the cable. Upon landing, the cable will be fed into the steel conduit previously buried in the sand, and pulled to the new manhole. When the cable is secured in the manhole, it will be temporarily anchored while the divers readjust the suspension floats in the water to obtain a proper nearshore to shoreline alignment.

A study of the ocean bottom along the proposed cable alignment indicates that no offshore cable protection, anchoring or trenching is anticipated. There are several small sand deposits on the reef flat off the central and north parts of the golf course, but most terminate on hard bottom or the 60-foot ledge, which parallels much of the windward coast off Kauai. The recommended route is located in the only sand channel found that bisects the ledge and the reef and extends into deeper water. The bottom is sand from the shoreline to at least the 120-foot depth, the seaward limit of the visual inspection. There is hard bottom, with the typical 60 foot ledge, both north and south of this sand channel. The 60-foot depth contour is located 2200 feet from shore. From that point seaward, the bottom slope becomes steeper, and the 110 foot depth contour is located only 2600 feet offshore. The sand deposit was not probed, but it appears to be thick. The sand is medium to coarse grained, with pronounced sand waves in shallow water, due to wave action. There are no visible outcrops of coral or rock along the route. The flat and sandy ocean bottom provides an ideal landing condition as the cable will eventually be covered by sand providing protection from wave action.

Once the cable is aligned, the divers will cut the remaining floats away, allowing the rest of the cable to sink to the ocean bottom, and the cable will be permanently installed in the manhole.

Following this action, the cable ship will commence cable laying operations to the next landing site. The ship will follow a prescribed survey route until it reaches the other landing site where the end of the cable can be similarly connected.

3.4 CABLE LANDING PROCESS

The cable landing process includes the use of the landside range targets to assist in the alignment of the cable as it is being installed. The cable laying ship may be assisted by two tugboats to maintain proper alignment of the cable ship. This assistance is essential to ensure that the cable is placed within the cable easement. Once the cable laying ship is properly aligned, the cable will be towed from the ship by one of the tugs to a transfer location nearshore. At this location, the leading end of the cable will be attached to a wire rope connected to land based pulling equipment (i.e., winch) and pulled ashore. Once the cable is placed within the steel conduit, the leading end of the cable will be secured within the manhole and spliced together with cable emanating from the central office.

Once the cable has been secured, the open trench will be backfilled and all reasonable efforts will be taken to restore the beach to its original condition.

3.5 SAFETY CONSIDERATIONS

During the construction phase on the beach (approximately 7-10 calendar days in May-June 1993), the portion of the beach which contains the open trench will be barricaded from public entry. During the construction period, a security guard may be required at night and on weekends to ensure public safety and integrity of the job site.

During the cable laying process (approximately 2 days depending on weather conditions), the nearshore waters will be closed to ocean activities (surfing, diving, boating, swimming) to ensure the safety of ocean users. The area that will be closed will be approximately 100-150 feet wide and 1,000-2,000 feet long. The actual area may be more or less depending on the tides. The period when the waters will be closed is not expected to be more than two days, weather permitting. This short-term "closure" of nearshore water areas will be achieved by publishing a notice to advise mariners to avoid the area. Further, during the cable laying process, project personnel will advise beach users to avoid the project site both on land and in the water via small powered water crafts.

All work shall be performed in conformance to prevailing County, State, and Federal regulations regarding noise and dust control, the disposal of dirty or polluted water and construction debris and other issues which may arise.

3.6 SCHEDULE AND ESTIMATED COST

The first phase (land-side activities) of the project is scheduled tentatively for March and April 1993. The second phase (installation of interisland cable and cable landing operations) is scheduled tentatively for May and June 1993. Construction cost for the first phase is estimated at $461,000.00.

SECTION 4

DESCRIPTION OF THE AFFECTED ENVIRONMENT

4.1 PHYSICAL ENVIRONMENT

4.1.1 Climate

The project site and surrounding area is located on the eastern side of Kauai which is generally warm and moist. The mean annual temperature is between 70 and 82 degrees Fahrenheit and the annual rainfall is between 60 to 96 inches, most of it occurring during winter months (Atlas of Hawaii, 1983).

As with most windward facing coastal areas of the Hawaiian Islands, conditions are generally windy and with frequent rainfall.

Impacts

The proposed project is not expected to impact the local climate of the project area and vicinity.

4.1.2 Topography, Geology, Soils

The project area lies at the base of a single shield volcano which was eroded and layered by other volcanic activity. The Koloa volcanic series covers about half of the eastern section of Kauai and the Waimea volcanic series covers the balance. The property's elevation ranges from sea level to only less than 20 feet above sea level. The predominant underlying soil type for the affected area, as described in the August 1972 U.S. Department of Agriculture, Soil Conservation Service publication, "Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," consists of the Mokuleia Series particularly Mokuleia fine sandy loam (Mr), dune land (DL) and beach sand land types (BS). The representative profile of Mokuleia fine sandy loam is very dark grayish-brown clay loam about 16 inches thick. The next layer, 34 to more than 48 inches thick, is dark-brown and light-gray, single-grain sand and loamy sand. The surface layer is neutral in reaction, and the underlying material is moderately alkaline. Permeability is moderately rapid in the surface layer and rapid in the subsoil. Runoff is very slow and the erosion hazard is slight.

Soils at the landing site consist of beach sand which is typically made of white sand and gravel or coral material. However, coastal turbidity primarily from runoff associated with agricultural activity have discolored the sand.

Dune land consists of hills and ridges of sand-size particles drifted and piled by wind. The sand is predominantly from coral and sea shells. Dune lands consist of the majority soil type of the cable route.

Most if not all of the above soil types have been covered by golf course turf grass and accessory uses such as paved areas or other types of vegetation used primarily for windbreak.

Impacts

No long term surface impacts are anticipated since the project involves only temporary excavation and filling with the same material. This will only apply to the segment of the cable to be installed subsurface. The excavated portions will be returned to existing preconstruction contours and turf grass removed by trenching, will be retained and replanted upon completion of construction activities. Any remaining areas not adequately grassed will be replanted with additional turf grass so as to minimize impacts to golf play.

4.1.3 Hydrology

There are no perennial streams in the subject area. The major drainage feature for the area is an unnamed wetland to the west and Wailua River to the north. A portion of the wetland area has been developed by the State for a prison facility.

Groundwater for the area is basal and is not a source for domestic use (Atlas of Hawaii, 1983).

Impacts

No adverse impacts are anticipated on surface water or groundwater since the project will not alter existing drainage patterns or have any long term water requirements. No impacts are anticipated on the adjacent wetland since the cable route will be on existing utility poles in the area which are makai of Kuhio Highway.

4.1.4 Terrestrial Flora/Fauna

The area is developed with a golf course and related accessory uses (i.e., driving range). Any naturally occurring flora have long since been removed during the development of the course. No rare or endangered species of plants are known to inhabit the site.

Concerning fauna, no rare or endangered animals are known to inhabit the site or the surrounding area.

Impacts

Because the project area is not known to contain any rare plants or animals, adverse impacts are not anticipated. As part of the proposed development the exposed areas within the cable easement will be replanted with the same types of vegetation as found on site.

4.1.5 Marine Flora and Fauna

Sea Engineering conducted a qualitative reconnaissance of the waters fronting the Wailua County Golf Course in June 1991 (see marine Environmental Analysis of Selected Landing Sites, Sea Engineering, Inc., and Environmental Assessment Company., January 1992). To obtain an overall perspective on the extent of the major communities occurring in the study area, divers were towed slowly behind a skiff over most the study site from shore seaward to at least the 60-80 contour. Examination of other nearshore and deeper water characteristics were conducted using SCUBA. "Because the substratum of the entire corridor was found to be sand, no quantitative sampling of the marine communities was carried out at this site. The qualitative survey extended from shore to about the 100 foot isobath approximately 2,800 feet from shore. In this area only one zone or biotope was defined, the biotope of sand."

"The biotope of sand lies covers the entire project site. As the name implies, the substratum in the biotope of sand is dominated by sand. Because of its shifting nature, the benthic species found in sand habitats are generally adapted for life on an unstable and frequently abrading environment. Many species that are found in this habitat will bury into the sand to avoid predators and the abrasion that occurs with storm waves. Other species will swim above the substratum (e.g., fish) to avoid abrasion. Thus many species in the sand biotope are either cryptic and difficult to see or will just pass through sand environments well off the bottom; among the cryptic species are many of the molluscs and crustaceans such as the Kona crab (Ranina serrata). Hence, without considerable time spent searching, many species in the sand habitat will not be seen. The fauna of the biotope of sand is best developed at greater depths; where it enters the shallow water, many of the characteristic species become less abundant.

Benthic communities on sand substrates usually have their greatest development at depths below which wave impact occurs (below 100 feet). Because of constraints with bottom time at these depths and the general lack of meaningful results from quantitative surveys in shallower water over sand, only a qualitative survey was done. Species commonly seen in the deeper regions of the biotope of sand include a number of molluscs: the helmet shell (Cassis cornuta), augers (Terebra crenulata, T. maculata and T. inconstans), the leopard cone (Conus leopardus) and flea cone (Conus pulicarius) as well as the sea hare (Brissus sp.), starfish (Mithrodia bradleyi), brown sea cucumber (Bohadschia vitiensis), the Kona crab (Rania serrata), opelu or mackerel scad (Decapterus macarellus), nabeta (Hemipteronotus umbrilatus), the goby-like fish (Parapercis schauslandi), uku or snapper (Aprion virescens), hihimanu or sting ray (Dasyatis hawaiiensis) and the weke or white goatfish (Mulloides flavolineatus). In our qualitative reconnaissance, the only species seen in water of less than 30 feet in depth was a school of newly settled juvenile gobies of a species not determined. These fishes were transparent with only the eyes apparent and were about 18-20mm in length. These fishes were seen at a depth of about 8 feet near the shoreline of the proposed cable site. Undoubtedly, with greater searching, many more fish species would be encountered in this biotope. Most of these species become less evident in the shallower portions of this biotope.

The intertidal region at this proposed cable landing site is sand; a short inspection of the beach noted ghost crab holes (Ocypode ceratophthalma) and several sand crabs (Emerita pacifica).

No green turtles (Chelonia mydas) were seen during our survey work in the waters fronting the Wailua County Golf Course. Additionally, we found no macroalgae in the vicinity of the cable alignment or shelter that may be appropriate as green turtle resting sites. The lack of these components is due to a lack of hard substratum. We have found no information to suggest that nesting of sea turtles in the vicinity of the Wailua County Golf Course has occurred in historical times.

The biological survey of the proposed cable alignment at offshore of Wailua County Golf Course did not find any rare or unusual species or communities. Another protected species, the humpback whale (Megaptera novaeangliae), was not seen offshore of the study area during the period of our field effort, but whales are known to be seasonally present along the windward coast of Kauai."

Impacts

"The potential for impact to the shallow marine communities will probably be greatest with the construction phase of this proposed project. From the sea, the proposed cable alignment passes through the biotope of sand prior to landfall. As a substrate to support marine communities, sand is inappropriate for many coral reef forms because many species require a stable bottom (e.g.,corals and many of the associated invertebrates). Thus the species usually encountered in sand areas are usually those that are adapted to exist in an ever-changing, moving substratum. Similarly, much of the benthic production on coral reefs occurs on hard substratum, (i.e., macroalgae require a solid substratum for attachment). Because sand substrates are subject to movement, they may abrade and scour organisms on this substratum. Thus the characteristics of most species encountered in Hawaiian sand communities are (1) that they typically burrow into the substrate to avoid scouring, (2) that they frequently occur in low abundance which may be related to food resources, and (3) that they are mobile because of the shifting nature of the substratum and potential for burial. Since many of these forms are motile, deployment of the cable across such a substratum presents little chance of negative impact to resident species because they would probably "just move out of the way as the cable was deployed". Additionally since the substratum shifts, it is probable that the deployed cable will "sink into" the substrate. Personal observations made on other deployed cables shows them to often be partially buried by the natural movement of the sand.

It is expected that the cable will be buried in the sand at the shoreline. This will probably entail a combination of trenching across the backshore of the beach and water jetting the cable to grade in the vicinity of the water line. This will temporarily generate some level of turbidity that could impact hard substratum communities if in close proximity to the proposed project site. However, we are not aware of any well developed hard bottom communities close to the proposed cable alignment.

With any construction is the concern over possible impact to corals due to their sessile nature and usual slow growth characteristics. Because there is no hard substratum in the alignment path (or near it) in shallow water, we do not expect that corals will be directly impacted by this activity. Additionally, the small scale of this project suggests that the turbidity levels generated will be considerable less than the those caused by two natural occurrences: 1) turbidity input from the Wailua River that empties into the ocean about 7,000 feet to the north, particularly following heavy rainfall, and 2) turbidity due to resuspension of sand in the Wailua area due to the frequently rough sea conditions. The episodic input of stormwater runoff has probably been an important parameter in structuring benthic communities in this area; this coupled with storm surf and the movement of sand that scours the bottom will retard benthic community development.

We expect that there would be no direct impacts to the threatened green sea turtle or to endangered humpback whales (Megaptera novaeangliae). As far as the impact to humpback whales is concerned, if construction activities are restricted to the period between April through October, there would be no impacts because the whales are seasonal and are only in island waters from November through March. Even assuming that the cable deployment occurs when the whales are present in Hawaiian waters, it is anticipated that the impacts would be minimal. The cable laying ship should not be on site more than one or two days. The most probable source of impact to whales would be noise generation by the cable ship, the support tugs and the small boats used for the cable landing. There are variable and conflicting reports as to the impact of vessel traffic on whales (Brodie, 1981; Matkin and Matkin, 1981; Hall, 1982; and Mayo, 1982). With respect to the response of individual humpback whales, there is sufficient information to demonstrate that boating and other human activities do have an impact on behavior (Bauer and Herman, 1985). Thus it is probably valid to assume that impact to whales could occur if individuals are within several kilometers of the deployment site. However, as noted above, these impacts are of short duration, and all activity will be concentrated in a small area.

Sea turtles are permanent residents in inshore Hawaiian habitats thus the potential exists for problems during the construction phase if extensive turbidity is generated and if turtles are present in the area. However, the generation of fine particulate material from dredging did not appear to hinder the green turtle in one Hawaiian study; at West Beach, Oahu, green turtles moved from an offshore diurnal resting site about one 3,300 feet offshore to a point about 600 feet from the construction site within days of the commencement of dredging and the generation of turbid water. The turtles appeared to establish new resting areas in the turbid water directly offshore of the construction site (Brock 1990a). The reason(s) for this shift in resting areas is unknown but may be related to the turtles seeking water of poor clarity to possibly lower predation by sharks (a major predator on green sea turtles)."

4.1.6 Scenic and Visual Resources

The area is developed with a golf course and provides open space views to the ocean and to the mountains. The site contains a clubhouse, golf proshop, restaurant, and parking with necessary roads and utility facilities.

Impacts

No long term adverse impacts are anticipated on the beach or the golf course since the proposed cable will be located below surface until beyond the golf course. From there the cable will be routed to the nearest existing telephone pole near the vicinity of the loop road for further routing towards the central office in the Lihue Shopping Center.

For seven to ten days there will be a temporary impact on the coastal views from construction activities. During the construction period, the beach portion of the project site will have construction equipment and a mound of sand from the excavated trench.

The beach will be returned to its existing condition at the conclusion of the cable installation. Excess material not utilized for fill will be removed.

With respect to construction activity on the golf course, a similar trench will be prepared to accept the cable facility. Any turf grass removed will be retained for replanting upon completion. In addition, any irrigation facilities affected by the trenching will be repaired or rerouted as required by the County Department of

Parks and Recreation. Therefore, after the cable is installed no long-term impacts are anticipated.

4.1.7 Historic/Archaeological Resources

Cultural Surveys Hawaii conducted an archaeological assessment of the Wailua Golf Course cable landing site on 13 March 1992 (see Archaeological Assessment of the Proposed Fiber Optic Cable Landing for Wailua, Kauai, Cultural Surveys Hawaii, March 1992). The work at the proposed landing site consisted of the following:

A. A field check of the cable landing and a corridor - up to a few hundred feet wide - to Kuhio Highway, including a stratigraphic profile visible in the wave cut bank along the shoreline;

B. Interviews with two individuals familiar with events and discoveries of Hawaiian remains in the area during the period from 1946 to the present;

C. Field check of two burial sites discovered in the vicinity of the fiber optic cable corridor; and

D. Limited historical research on Wailua ahupua'a.

The archaeological study found, "No archaeological sites or buried cultural remains except for human burials to be known to exist within or in close proximity to the present study area" (Cultural Surveys Hawaii, March 1992).

Impacts

Due to potential for presence of archaeological sites, Cultural Surveys Hawaii, recommends a test trench following the exact cable alignment be carried out prior to construction activities. Any historic sites issues will be addressed through appropriate mitigative measures such as further surveys involving recovery or avoidance in coordination with the State DLNR, Historic Preservation Office. According to Cultural Surveys, continuous on-site monitoring by archaeologists is also recommended during all excavation work in undisturbed beach and dune sand deposits between the wave cut bank at the shoreline and Kuhio Highway. An archaeologist should be on-site during excavation to insure that any remains uncovered will be treated in accordance with current regulations governing cultural deposits.

4.1.8 Beach Erosion and Sand Transport

The beach fronting Wailua Golf Course is approximately 175 feet wide and stretches from beyond Kawailoa in the south to Lydgate State Park and Wailua River to the north. The beach along the southern half of the golf course has undergone significant erosion in the last 40 years. The vegetation line has eroded over 50 feet since 1950 along segments of the beach. A 3500-foot long revetment was constructed between 1987 and 1988 to protect this portion of the golf course. The beach area in front of the club house has since been relatively stable, while to the north the beach has accreted up to 60 feet since 1950. Since then, the portion makai of the golf course has not exhibited significant aversion nor accretion in the last 10 years and is not expected to vary in the near future. No offshore structures that affect sand transport are proposed.

Impacts

The proposed project is not expected to impact beach processes. Upon completion of construction activities, the construction crew will make every reasonable effort to return the ground to existing preconstruction contours through use of existing graded materials for backfill. The existing basal shelf which has kept the beach relatively stable will not be destroyed and any part of it which is removed will be reconstructed. If necessary, additional boulders similar to those utilized to stabilize the stabilize the existing shelf may be employed.

4.1.9 Noise From Construction Activity

During the construction phase of the project excavation work and cable laying equipment and machinery will be used which will be sources of noise. Noise generated from machinery can be mitigated to some degree by requiring contractors to adhere to State and County noise regulations. This includes ensuring that machinery are properly muffled. Some work at night may be required. Night activities include cable splicing, cable pulling, operation of machinery, etc.

Impacts

Boats (tugs and a small craft) that are used during the construction period will also be a source of noise. The impact of noise from these vessels cannot be mitigated.

The noise impact will be temporary in nature and will not continue beyond the construction and cable laying period.

4.1.10 Air Quality

Air quality of the proposed project area is good due to low emission levels and the almost continual presence of tradewinds or on-shore breezes. The major factor affecting air quality in the area is vehicular traffic.

Impacts

During the excavation process, loose sand and dirt may be cast into the air by wind. The release of sand into the air can be prevented by requiring the contractor to periodically wet down the work area. The areas that are used for the placement of the range targets will also be exposed during the construction period. The target sites should be similarly wetted to control fugitive dust. The work site will be returned to its original state after the cable laying process is completed.

Operation of construction vehicles is expected to temporarily contribute carbon monoxide pollutants in the project vicinity.

4.1.11 Water Quality

Nearshore waters are rated Class "_" by the State Department of Health. Shallow waters experience considerable turbidity even when surf is minimal. Offshore waters generally have good underwater visibility during low turbidity conditions. However, frequent rains tend to increase runoff with sediments from mauka agricultural activities to the area from Wailua River causing extended periods of low underwater clarity.

Impacts

It is anticipated that the nearshore waters may be clouded during the trench excavation and backfilling operations. A screen to lessen turbidity effects will be erected as needed to minimize this impact. Water collected during the dewatering process will be discharged on the beach adjacent to the work area.

4.2 SOCIO-ECONOMIC ENVIRONMENT

4.2.1 Population

Although the population within the Island of Kauai was approximately 54,100 in 1990, the population is projected to increase to 84,600 by 2010 (The State of Hawaii Data Book, 1990). This projected population increase of 56 percent over 1990 population requires that the County's communication system be upgraded and expanded to meet future communication needs.

Impacts

No adverse impact on existing resident and worker populations of Kauai are expected.

4.2.2 Surrounding Land Use

Wailua Golf Course is owned and managed by the County of Kauai. Lands mauka of the golf course are used by the State for a correctional facility with surrounding vacant agricultural land. Lands to the north before Wailua River is also used for public purposes and contains the Lydgate State Park. Lands to the south at Kawailoa are in resort use. Along the shoreline are recreational uses associated with marine recreation such as fishing, swimming, diving and walking along the shore.

Impacts

No long term impacts are expected from development of the proposed project. The cable route will be subsurface from before the shoreline to existing utility poles and will be carried overhead within street rights-of-ways and will not adversely impact surrounding uses. The only permanent structures proposed are two manholes which will be virtually unnoticed and therefore, unobtrusive to golf course users.

Short term impacts will include a temporary 7 to 10 day period of construction which would require the minimal blockage of specified areas due to safety considerations. This includes temporary closure of limited nearshore areas to prevent injury to recreational users. Public access will still be provided laterally in designated areas.

4.3 PUBLIC FACILITIES AND SERVICES

4.3.1 Transportation Facilities

The project site is served by Kuhio Highway which connects to Lihue Shopping Center. No roadway improvements are anticipated since the cable will utilize existing utility poles for routing into Lihue. Kuhio Highway has sufficient width and shoulders to accommodate cable line installation equipment without interrupting traffic flow. The applicant will coordinate installation activities with the responsible county agencies prior to construction to mitigate any traffic concerns.

Impacts

The proposed project is expected to have no impact on the existing traffic or bus services, after completion of construction activities. Construction will take seven to ten days.

4.3.2 Recreational Facilities

The principal recreational facility in the vicinity of the project site is Wailua Golf Course and the shore side beach area. The beach is used occasionally for swimming, diving, fishing, and walking. Wailua Golf Course is an 18-hole course with a driving range, clubhouse, restaurant, parking and related accessory uses (see Figure 7).

Impacts

No long term impacts are expected from the development of the proposed project. However, development will temporarily impact land and shore side recreational uses. During construction the portions of the shore side area will have to be closed for safety reasons. Lateral access will be provided in designated areas.

With respect to the golf course, minimal inconvenience is anticipated to golfers using the 18-hole course in that the route proposed through the course will not cross any greens or fairways. Crossings over any golf cart paths would result in temporarily relocating paths to designated areas. Steel plates covering open trenches would allow for continued cart access between the front nine and the back nine holes.

Since the cable route would cross the existing driving range, use of the range will be halted until that section of the construction activity has been completed. To mitigate this loss of practice time, the construction activity will be completed in as little time as possible by excavating this section last.

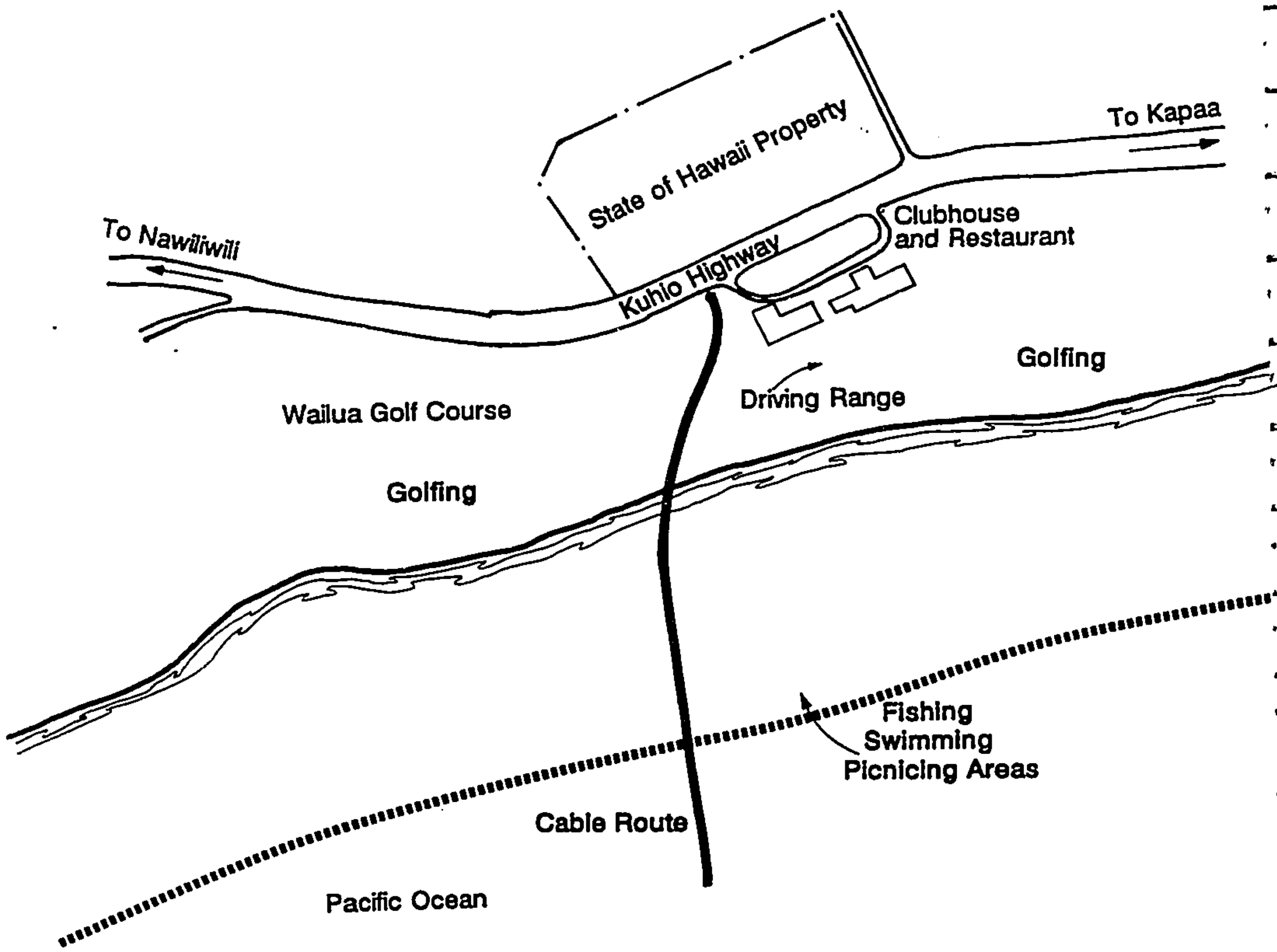


Figure 7
PUBLIC USES

GTE Hawaiian Tel Interisland Fiber Optic Cable Project

Not to Scale

R. M. TOWILL CORPORATION
MARCH 1992

SECTION 5
RELATIONSHIP TO STATE AND COUNTY LAND USE PLANS AND POLICIES

5.1 THE HAWAII STATE PLAN

The Hawaii State Plan (Chapter 226, Hawaii Revised Statutes) provides a guide for the future of Hawaii by setting forth a broad range of goals, objectives, and policies to serve as guidelines for growth and development of the State. The proposed project is generally consistent with the Hawaii State Plan. The following objectives of the State Plan are relevant to the proposed project:

Section 226-10.5: Economy - Information Industry
The proposed project serves to assist in the State's objective of positioning Hawaii as the leader in providing information services in the Pacific Rim. The proposed project will continue development and expansion of Hawaii's telecommunications infrastructure and will help to accommodate future growth in the information industry.

Section 226-14 Facility Systems - In General
The proposed project supports the State's goals for achieving telecommunications systems necessary for Statewide social, economic, and physical objectives.

Section 226-18: Facility System - Energy/Telecommunications
The proposed project will help to ensure adequate and dependable telecommunication services for Hawaii by promoting efficient management and use of existing and proposed facilities and by promoting installation of new telecommunications cables.

5.2 STATE FUNCTIONAL PLANS

The Hawaii State Functional Plan (Chapter 226) provides a management program that allows judicious use of the State's natural resources to improve current conditions and attend to various societal issues and trends. The proposed project is generally consistent with the State Functional Plans. The following objectives of the State Functional Plans are relevant to the proposed project:

Education Implementing Action A(4)(c):
The proposed project will help to ensure adequate telecommunication services necessary for Hawaii's schools objectives.

Education Implementing Action B(3)(d):
The proposed project serves to promote and expand the appropriate use of telecommunications to deliver distance education as well as enhance the learning process and communication competencies of students.

Education Implementing Action(3)(e):
The proposed project enables school library media centers to effectively manage and provide access to information and knowledge through telecommunications.

5.3 STATE LAND USE LAW

The State of Hawaii Land Use District classification designates Wailua Golf Course and the adjacent shoreline area within the Conservation District. The project site is designated by the State Department of Land and Natural Resources as being within the Limited Subzone (see Figure 8). A Conservation District Use Permit will be applied for as part of this project. A State Land Use District Boundary Amendment will not be required.

5.4 COUNTY ZONING

The County of Kauai does not zone State Conservation District lands but defers to the State Land Use District Classification. Figure 9 identifies the existing County zoned lands in this area.

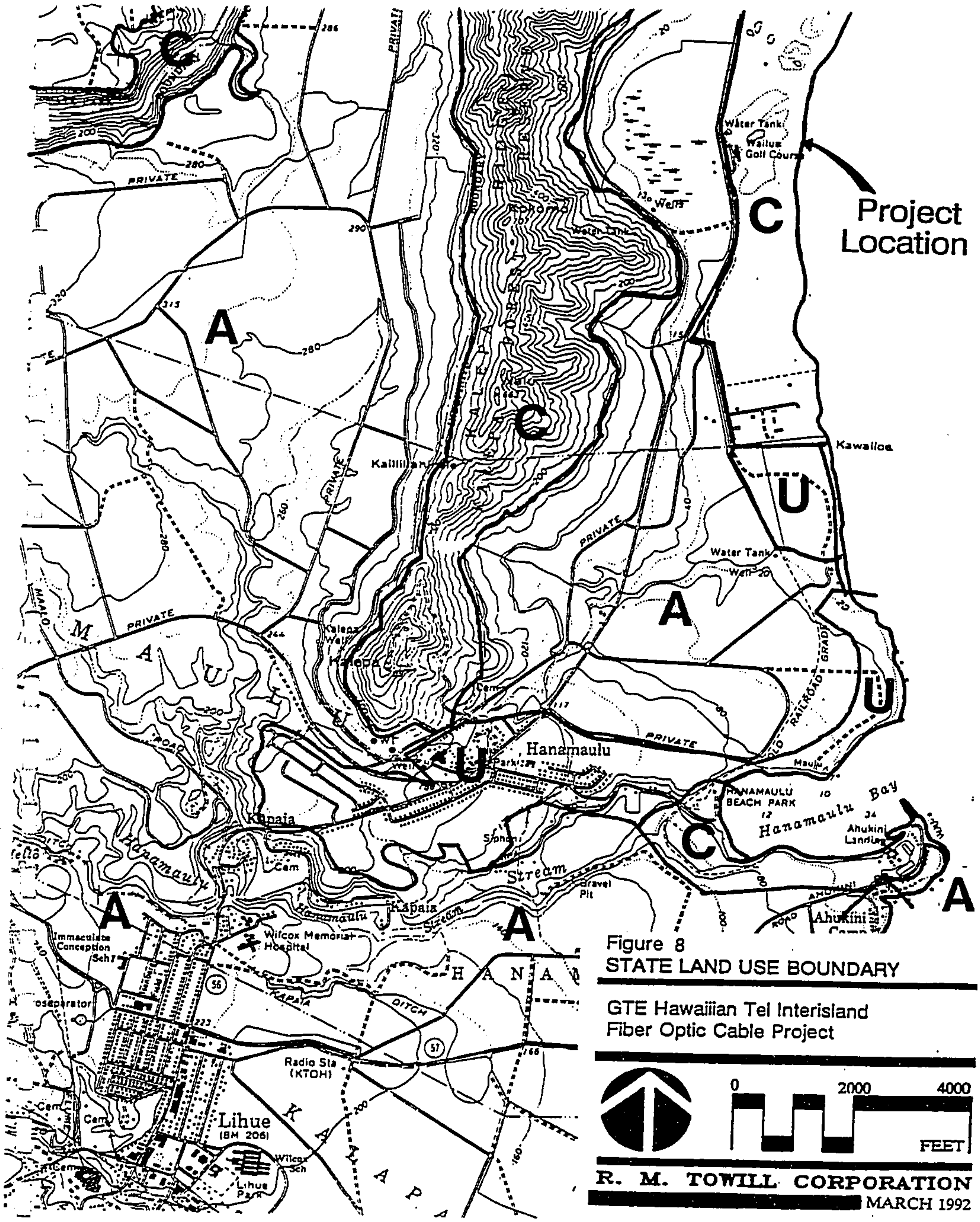


Figure 8
STATE LAND USE BOUNDARY

GTE Hawaiian Tel Interisland
Fiber Optic Cable Project

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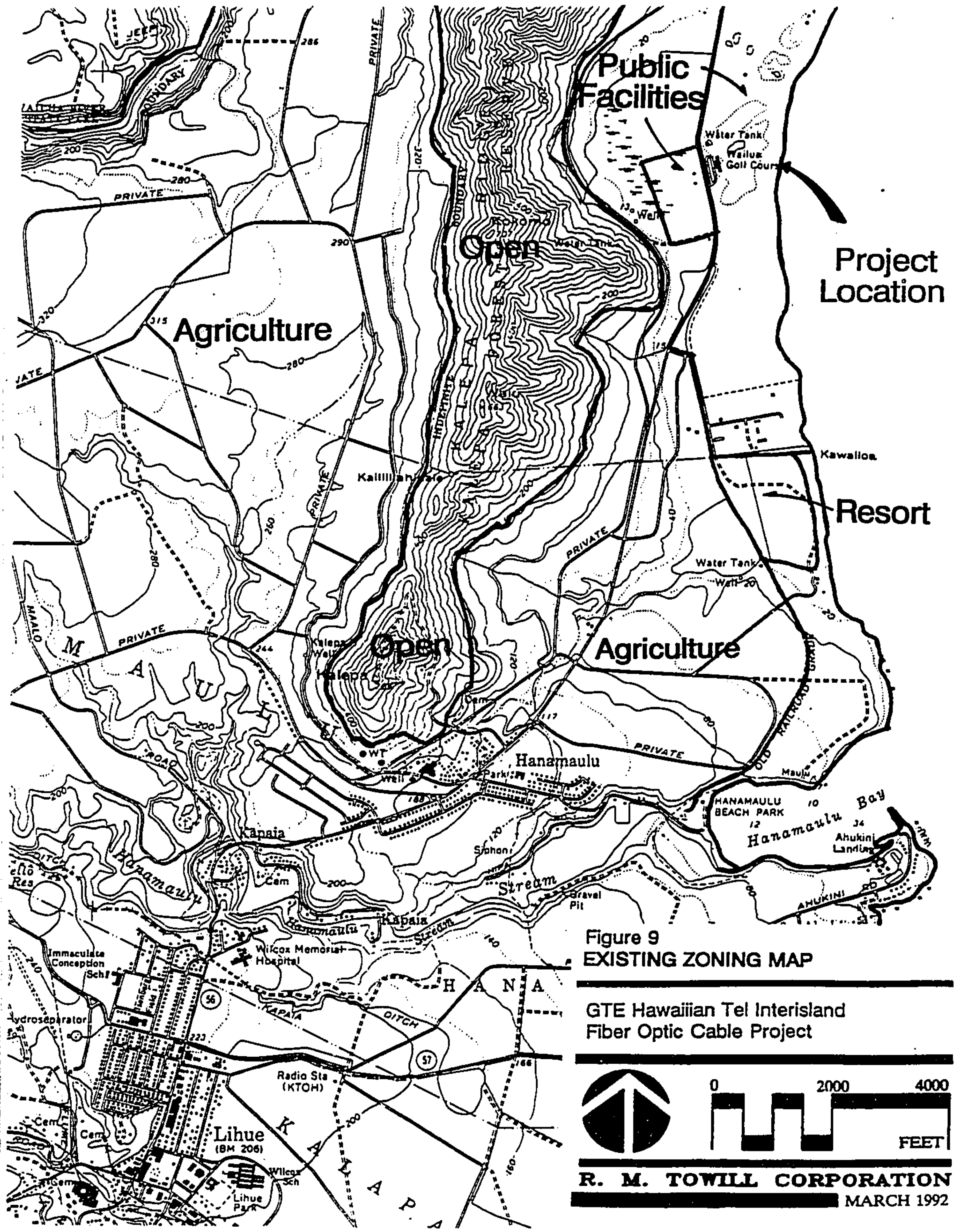

Figure 9
EXISTING ZONING MAP

GTE Hawaiian Tel Interisland
Fiber Optic Cable Project

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5.5 COUNTY OF KAUAI GENERAL PLAN

The County of Kauai General Plan provides a statement of long range social, economic, environmental, and design objectives for the island with a statement of policies necessary to meet these objectives. A specific objective of the General Plan relating to the proposed project is the maintenance and expansion of existing utilities systems. The proposed project is generally in conformance with the goals and objectives of the County General Plan.

5.6 SPECIAL MANAGEMENT AREA

The County of Kauai has designated the shoreline and certain inland areas of Kauai as being within the Special Management Are (SMA). SMA areas are felt to have a sensitive environment and should be protected in accordance with the State's coastal zone management policies. The project area is within the SMA Boundary as defined by the County of Kauai (see Figure 10). A SMA permit will be necessary for development of the proposed project. Review of the project under SMA criteria will be conducted during the processing of the SMA permit with the County Planning Department.

The proposed project, portions of which are within the shoreline setback area, is also subject to the provisions of the Shoreline Setback Rules and Regulations of the City and County of Honolulu. Figure 10 shows the certified shoreline and shoreline setback line in the area where the project crosses the shoreline setback area. A Shoreline Setback Variance Permit will be required.

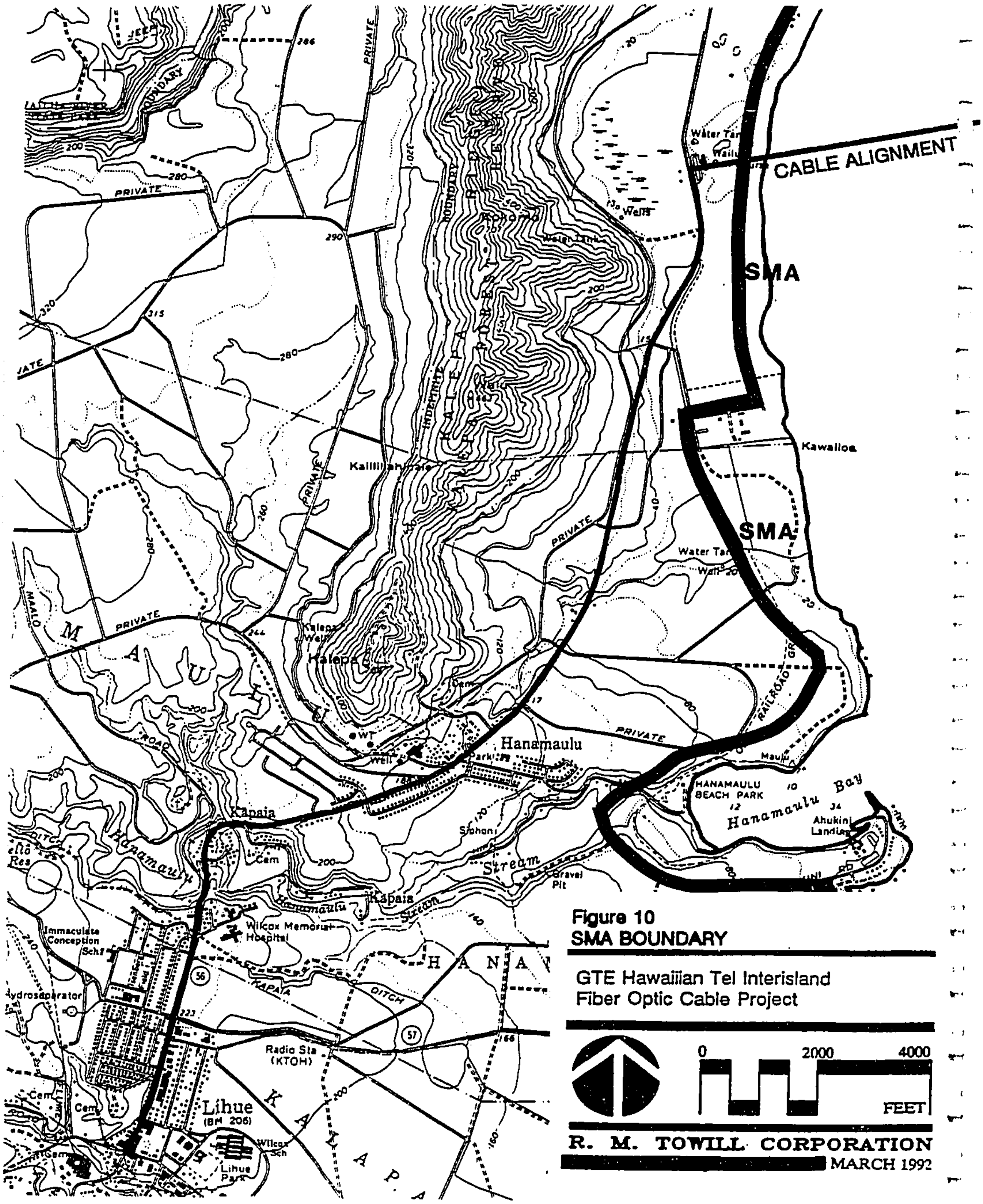

Figure 10
SMA BOUNDARY

GTE Hawaiian Tel Interisland
Fiber Optic Cable Project

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MARCH 1992

SECTION 6

ALTERNATIVES TO THE PROPOSED ACTION

6.1 NO ACTION

The no action alternative will contribute to further degradation of current inadequate interisland telecommunications facilities. A primary disadvantage of this alternative would be that without the development of a interisland fiber optics cable GTE will not have sufficient capacity to meet all interisland traffic in 1993. Losses resulting from this alternative would include:

- Lost employment opportunities which would have been realized in connection with the cable laying procedure, maintenance and operation; and
- Lost tax revenues for City and State governments from the cable vendor, and increased public and private telecommunication usage; and
- Lost attainment of the County of Kauai General Plan's objective of expansion of existing utilities systems.

6.2 ALTERNATIVE SITES

A site selection study was prepared in August 1991 and included the Ahukini Coast for consideration. However, this site was removed from further consideration due to poor geologic conditions such as rocky and irregular inshore bottom with numerous rock and coral outcrops which require extensive cable anchoring and armoring. In addition, a steep underwater offshore ledge and a high and a steep on-shore bank make cable laying procedures difficult and expensive.

The site selection study points out that the overall criteria was best met with Wailua Golf Course. The continuous sandy bottom into deeper water is not available at either the Wailua Bay or the Hanamaulu Bay site. In addition, public land ownership lowers easement costs. Although this is true for Wailua Bay, an offsetting factor is that Wailua Bay is being considered by the State Department of Land and Natural Resources for inclusion in the National Register of Historic Sites location.

Hanamaulu Bay, which contains privately owned lands immediately behind the landing site, is being considered for future development by AMFAC/JMB, would likely make acquisition costs high. In addition, an inshore sand channel which extends into the Bay is very irregular and narrow at the tip of the breakwater. Hard bottom is suspected in this immediate vicinity. Toward the ocean, there is at least 500 feet of reef that would have to be crossed by trenching and/or anchoring and cable armoring.

If Wailua Golf Course is removed from consideration, Wailua Bay would be the first alternate. The advantages of Wailua Bay over Hanamaulu Bay are that Wailua Bay is situated on publicly-owned lands; has more conducive physical features; and does not require crossing privately-owned lands mauka of the landing site.

6.3 ALTERNATIVE TECHNOLOGY

The following describes the alternatives to fiber optic cable technology:

6.3.1 Microwave Radio Systems

The use of additional or modification of Hawaiian Tel's existing interisland microwave radio systems is not a feasible alternative due to the linear arrangement of the main Hawaiian Islands. The linear arrangement of the main Hawaiian Islands limits the possible transmission paths between the islands and leads to transmission congestion. Problems associated with transmission congestion of microwave radio systems include:

- Introduction of distortion to voice band data and voice transmission; and
- Loss of signal strength and signal reliability.

In comparison with microwave radio systems, fiber optic technology is the only means of providing the capacity necessary for interisland digital circuits without distortion in voice band data and transmission, and problems with signal strength and reliability.

6.3.2 Satellites

Satellites are not a feasible alternative based on the large interisland capacity requirements projected in the GTE Hawaiian Tel forecasts. Extreme disadvantages associated with use of satellites include:

- Transmission delays due to technical and atmospheric limitations involving the distance the radio waves must travel;
- Visual and aesthetic intrusion caused by the need for ground stations and radio antennas which must be constructed to accept the satellite transmissions; and
- Difficulties associated with "double hops" which occur when data must be retransmitted in order to establish a secure voice circuit.

In comparison with satellites, fiber optic technology is the only means of providing the capacity necessary for interisland digital circuits without transmission delays and major visual and aesthetic problems.

6.4 RECOMMENDED ACTION

The recommended action is to proceed with the establishment of a submarine fiber optic cable system with a landing at Wailua Golf Course. From there, the cable would be located underground or overhead within existing right-of-ways.

SECTION 7

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

No short-term exploitation of resources resulting from development of the project site will have long-term adverse consequences. The appearance of the land portion of the existing site will not be altered. The cable will be visible on the ocean bottom portion of the project site and will alter its appearance.

Once construction activities are completed there will be no affect on recreational activities, marine life, or wildlife.

Long-term gains resulting from development include provision of more effective State telecommunications systems (by means of fiber optic cables). The proposed project will maintain and enhance economic productivity by increasing telecommunications service between islands.

SECTION 8

IRREVERSIBLE/IRRETRIEVABLE COMMITMENT OF RESOURCES BY THE PROPOSED ACTION

Development of the proposed project will involve the irretrievable loss of certain environmental and fiscal resources. However, the costs associated with the use of these resources should be evaluated in light of recurring benefits to the residents of the region, the State of Hawaii and the County of Kauai.

It is anticipated that the construction of the proposed project will commit the necessary construction materials and human resources (in the form of planning, designing, engineering, construction labor, landscaping, and personnel for management and maintenance functions). Reuse for much of these materials and resources is not practicable. Although labor is compensated during the various stages of development, labor expended for project development is non-retrievable.

SECTION 9

NECESSARY PERMITS AND APPROVALS

9.1 STATE

Department of Land and Natural Resources

- Conservation District Use Permit
- Right-of-Entry
- Establishment of Offshore Easement

Office of State Planning

- Coastal Zone Management Federal Consistency Review

Department of Health

- Section 401, Water Quality Certification

Department of Transportation

- State Highway Rights-Of-Way

9.2 COUNTY

Planning Department

- Shoreline Management Area Permit
- Shoreline Setback Variance

9.3 FEDERAL

U.S. Army COE

- Corps of Engineers Section 404/Section 10

SECTION 10

CONSULTED AGENCIES AND PARTICIPANTS IN THE PREPARATION OF THE ENVIRONMENTAL ASSESSMENT

10.1 FEDERAL AGENCIES

U.S. Army Corps of Engineers

U.S. Coast Guard

10.2 STATE AGENCIES

Department of Land and Natural Resources

- Office of the Chairperson
- Aquatic Division
- Land Management Division
- Conservation and Environmental Affairs Division
- Historic Preservation Division

Department of Transportation

Department of Health

Department of Business, Economic Development & Tourism

10.3 COUNTY OF KAUAI

Office of the Mayor

Kauai County Council

Department of Planning

Department of Parks & Recreation

Department of Public Works

10.4 INDIVIDUALS AND GROUPS

Kauai Golfer's Association

Hawaii's Thousand Friends, Kauai Chapter

Sierra Club, Kauai Chapter

Mr. Herbert Apaka

SECTION 11

COMMENTS AND RESPONSES TO THE DRAFT ENVIRONMENTAL ASSESSMENT

1000 Friends of Kaua'i
PO Box 99
Hanalei, Hawai'i
96714

June 8, 1992

Mr. Patrick K.S. Mau
GTE Hawaiian Tel
P.O. Box 2200
Honolulu, HI 96841

Dear Mr. Mau:

Thank you for giving 1000 Friends of Kauai the opportunity to review your preliminary draft of the environmental assessment for the GTE Hawaiian Tel interisland fiber optic cable system. Members of our board of directors have reviewed it and we have discussed it at our board meetings. We would like to make the following comments and suggestions concerning the preliminary draft.

ARCHAEOLOGICAL ASPECTS

It is obvious from the references provided and the consultants' report that the Wailua golf course area is a significant burial ground for ancient Hawaiians. The consultants note that a disadvantage of the Wailua area is "the potential archaeological sensitivity of the sand dunes along the backshore" (page IV-1). Three burial sites were located in the vicinity of the proposed trench and there is ample reason to suspect that additional sites will be uncovered. You recommend on-site monitoring of trenching activity, but you provide no information as to what will happen if human remains or artifacts are uncovered. Will all activity stop? Will the cable be moved to a new area? What is your burial treatment pla? We suggest that before a firm commitment is made to locate the cable at this site, that a thorough survey be made using non-intrusive electronic sensing devices. 1000 Friends of Kauai cannot support the location you have chosen without assurances that no remains will be disturbed.

BIOLOGICAL ASPECTS

It appears that the submarine survey work was done by a scuba diver swimming transects in shallow water and by simply being towed at the surface behind a boat in 60' to 80' depths. Apparently no quantitative or sediment subsurface survey was made in water >30' depth, so we really don't know what animals are there. Also, no survey was made in very deep water, where significant biological communities, including precious black coral, may exist. No mention is made whether an environmental assessment will be made for that portion of the cable that will extend between the islands in deeper water. Will the cable affect black coral communities? Will it interefere with movements of ground fish, shrimps or cetaceans? We suggest that a more complete survey be done, perhaps using television cameras, in deeper waters.

No mention is made of the endangered Hawaiian monk seal. Has it been seen in that area? Does it haul out on that beach?

Your report states that whales are only present through March when, in fact, they are common through May and sometimes remain around Kauai into June. Your work should not be conducted during that extended period.

Your report inadvertently deletes the information on fisheries considerations and water quality considerations that are found on pages IV-8 and IV-9 of your consultants' report. That should be included.

MISCELLANEOUS ITEMS

The alignment of the cable in Figure 1 is markedly different from that shown in subsequent figures. There does not seem to be a consensus as to where the cable will go once it leaves the shoreline.

How deep will the trench be and how wide? On page 16 your report says 4' deep, but in figure 6 it is 5' deep, making it 2' wider.

On page 16 you also mention the use of a hydrojet, which will cause heavy turbidity in nearshore waters since screening cannot stop turbidity in the surf zone. This is not mentioned on page 32. What about the sand dam recommended by the consultants on page IV-4?

On page 31 you contradict yourself by saying that the existing basal shelf will not be destroyed, and then saying that any part of it which is removed (=destroyed) will be reconstructed. We are very interested in how this will be done.

Finally, 1000 Friends of Kauai is not associated with Hawaii's Thousand Friends, as stated on page 49.

If you want additional clarification of these points, please contact us.

Sincerely,
Fred Jagger
Fred Jagar
President, 1000 Friends of Kauai

POI POI
Preserve Our Islands

R. M. TOWILL CORPORATION

420 Waiakamilo Rd #411 Honolulu HI 96817-4941 (808) 842-1133 Fax (808) 842-1937

July 1, 1992

Fred Jager, President
1000 Friends of Kauai
P.O. Box 99
Hanalei, Hawaii 96714

Dear Mr. Jager:

SUBJECT: Reply to Comments on Draft Environmental Assessment (DEA)
GTE Hawaiian Tel Interisland Fiber Optic Cable System,
Wailua Golf Course, Wailua, Kauai

Thank you for your letter to GTE Hawaiian Tel dated June 8, 1992 on the DEA for the subject project. On behalf of Patrick Mau, GTE Hawaiian Tel, we offer the following comments:

ARCHAEOLOGICAL ASPECTS
The sand dunes along the backshore of Wailua Golf Course are recognized as being potentially archaeologically sensitive, and the cable route selected will avoid known sites. Only two isolated human burials are known to be in the vicinity of the proposed cable corridor. After reviewing the proposed cable alignment, Cultural Surveys Hawaii believes that groups of burials - i.e., cemeteries or conscribed graveyards - within the proposed corridor are not expected. The Department of Land and Natural Resources Historic Preservation Division, has indicated that use of x-rays and other electronic equipment to detect human burials and archaeological sites in Hawaii is still in the experimental stage and not feasible for usage. The Historic Preservation Division, however, has recommended that we conduct subsurface testing along a staked and marked alignment where the fiber optic cable is to be located. This will help to give an accurate determination whether historic sites are present. Should archaeological artifacts or human burials be encountered during the course of the project, the State Historic Preservation Office will be notified. Work affecting the resource will continue according to a plan worked out in advance should a discovery be made.

BIOLOGICAL ASPECTS
Sea Engineering, Inc., which conducted the submarine survey work did more than tow a diver behind a boat and swim transects in shallow water to conduct the survey work. Two divers investigated bottom conditions down to 100 feet, and one diver extended the examination to 120 feet. Bottom conditions throughout the survey area indicated thick, coarse sand deposits. Dr. Richard Brock's examination of the marine biology also indicated

a sparse biological community which is consistent with the presence of extensive sand deposits. In addition, fathometer runs down to the 180 foot depth confirmed the continuation of a gently downward slope with no drop offs immediately beyond the area following the cable route.

No survey of black coral populations was conducted in deep ocean water. It is not anticipated that the proposed fiber optic cable would constitute an adverse impact to any possible black corals in the vicinity of the cable alignment. This is based on:

1) The fiber optic cable is composed of inert materials, produces no electromagnetic fields, is narrow in diameter, and is expected to remain stable (lateral movement will be minimal) in deep ocean water where black corals might be found; and

2) At most, the only damage to black corals that might occur, is if the cable were to land directly on top of a coral during the cable laying process. This possibility has already been minimized by selection of a cable route in a location that avoids ledges and other hard substrate that are required for black coral growth. This is in contrast to other sites which were investigated which have conditions more conductive to black coral growth including Hanamaulu Bay, Ahukini Coastline (adjacent to Lihue Airport), and Nawiliwili Harbor.

It is not anticipated that there will be adverse impacts to movements of fish (including ground fish), shrimps, whales, and Hawaiian monk seals. These species are all very mobile, and deployment of the cable across the substratum presents little chance of negative impacts because the species would simply move out of the way as the cable is deployed. Even assuming that the cable deployment occurs when whales or monk seals are present in Hawaiian waters, it is anticipated that the impacts would be minimal. There will be no blasting or off-shore excavation of any type, all construction activity will be temporary and of short duration, work will be confined to a small area, and when complete the cable project will leave the beach and its existing on-going processes unaffected.

In the deeper water portions great care has been taken to select a cable route that will allow the cable to lay flat resting on the ocean floor, avoiding structures including but not limited to sea mounts, underwater ridges, sunken vessels, explosives dumps, and old aircraft. Once the cable is laid it is expected that substratum shift, a naturally occurring process, will provide good opportunity for the deployed cable to sink into the substrate. Sea Engineering has observed that other deployed cables often become buried by this natural movement of the sand. Therefore, once the cable is deployed it is expected to remain a stable and relatively permanent part of the ocean bottom.

In addition the National Marine Fisheries Service, who is responsible for ensuring protection of rare and endangered species, will also be reviewing this project to ensure that no adverse impacts to rare and endangered species and their habitats will be allowed to occur. This includes not only the whales and monk seals you describe, but also various species of sea turtles.

MISCELLANEOUS ITEMS
A 300-foot long trapezoidal shaped trench will be excavated between the new manhole and the mean low water mark and four 6-inch steel conduits encased in concrete will be installed within the trench. The trench will have a 2-foot base and will be approximately 5-feet deep, with a 1:1 slope.

All excavation will be done behind a sand dam, which will remain in place until the cable is spliced into the manhole. After that, the cable will be jetted down to the design depth. The turbidity will be temporary, and will consist only of natural beach sand. The effects, when compared to the sand resuspended during typical or rough tradewind conditions, will be minimal. This area already has a great amount of sand in suspension during normal conditions.

The existing basal shelf which has kept the beach relatively stable will not be destroyed.

Thank you for your participation in the planning stages of this project. Please do not hesitate to call if you have any further questions or comments.

Very truly yours,

Brian Takeda

Brian Takeda
Senior Planner

cc: Patrick Mau, GTE Hawaiian Tel
SK, RDE, CK, KY, RMTC

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

WILLIAM W. PATY, CHAIRPERSON
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AQUACULTURE DEVELOPMENT PROGRAM
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CONSERVATION AND ENVIRONMENTAL AFFAIRS
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CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

April 15, 1992

DOC NO: 5077
LOG NO: 1873w

Brian Takeda, Senior Planner
R.M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941

Dear Mr. Takeda:

SUBJECT: Historic Preservation Review -- Archaeological Assessment of the Proposed Fiber Optic Cable Landing for Wailua, Kaua'i (Folk and Hammatt, Cultural Surveys Hawaii, March 13, 1992)
Wailua, Lihue, Kauai

Thank you for submitting the above report for our review. Unfortunately, we cannot accept this document as an acceptable archaeological inventory survey. It is only a field assessment.

There are a few concerns with the document that we can immediately see upon a brief review. For example, a brief limited background (with some oral information) is included. Ahupua'a and project area settlement patterns based on archaeological and archival information is needed (which is vital for predicting likely site patterns and evaluating significance of any sites found). Subsurface test excavations were not conducted, and the oral information indicates that burials could be present -- suggesting testing is necessary to give a more accurate determination whether significant historic sites are present.

In order for our office to conclude a review for this area (evaluating if significant historic sites are present and how they should be properly treated), we will need to receive an archaeological inventory survey report. Subsurface testing is needed. Once a inventory survey is completed, if significant historic sites are present, then a mitigation plan would be required. If you have any questions please call Ms. Nancy McMahon at 587-0006.

Sincerely,

Ross Cordy
for DON HIBBARD, Administrator
State Historic Preservation Division

NM:sty

cc: Planning Department, County of Kauai

R. M. TOWILL CORPORATION
420 Waiakamilo Rd. #411 Honolulu, HI 96817-4941 (808) 842-1133 Fax (808) 842-1937

April 24, 1992

Miles Hironaka
Planning Department
County of Kauai
4280 Rice Street
Lihue, Kauai, Hawaii 96766

Dear Mr. Hironaka:

SUBJECT: Follow-up Concerning Archaeological Testing Pursuant to Filing of SMA Permit for GTE Hawaiian Tel to Land a Fiber Optic Cable at Wailua Golf Course, Wailua, Kauai

This is in follow-up to our earlier phone discussion on April 22, 1992, regarding our current work efforts with Ms. Nancy McMahon, DLNR, Historic Preservation Office.

Ms. McMahon has requested that we conduct subsurface testing of a staked alignment where the proposed cable will cross the golf course driving range. We have already contacted an archaeologist to assist us and to coordinate all testing requirements with DLNR. We will also notify the Planning Department and the Department of Public Works to ensure all requirements are met prior to conducting any scheduled field work, e.g., right-of-entry and repair of ground cover following tests as necessary.

Please do not hesitate to call if you have any questions concerning our planned activities. We will be more than happy to discuss this important project with you.

Very truly yours,

Brian Takeda
Brian Takeda
Senior Planner

cc Patrick Mau, GTE Hawaiian Tel
SK, RDE, CK, BT RMTC

REFERENCES

1. Atlas of Hawaii, Second Edition, Department of Geography, University of Hawaii, 1983.

2. Beach Changes on Oahu as Revealed by Aerial Photographs, Dennis Hwang, July 1981.

3. GTE Hawaiian Tel Interisland Fiber Optic Cable System: Marine Environmental Analysis of Selected Landing Sites, Sea Engineering Inc, January 1992.

4. The Hawaii State Plan: Education, Department of Education, 1989.

5. Hawaii Interisland Submarine Fiber System Project: Desk Top Study, Seafloor Surveys International, August 1991.

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7. The State of Hawaii Data Book 1990: A Statistical Abstract, Department of Planning and Economic Development, State of Hawaii, 1990.

8. Discussion with GTE Hawaiian Tel, December 1991.

9. Hawaii State Plan, Chapter 226

10. Humpback Whales in Hawaiian Waters: A Study in Historical Ecology, L.M. Herman, 1979.

11. Prodigious Submarine Landslides on the Hawaiian Ridge, J.G. Moore, 1989.

APPENDIX A

Marine Environmental Analysis of Selected Landing Sites

GTE Hawaiian Tel
Interisland Fiber Optic Cable System

MARINE ENVIRONMENTAL ANALYSIS OF SELECTED LANDING SITES

Prepared For:

R.M. Towill Corporation
420 Waiakamilo Rd., Suite 411
Honolulu, Hawaii 96817

Prepared By:

Sea Engineering, Inc.
Makai Research Pier
Waimanalo, Hawaii 96795

AND

Environmental Assessment Co.
1804 Paula Drive
Honolulu, Hawaii 96816

March 1992

91-85

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I. INTRODUCTION

GENERAL

GTE Hawaiian Tel is planning the installation of an Interisland Fiber Optic Cable System linking the islands of Kauai, Oahu, Maui and Hawaii. The site selection and evaluation process has been underway since early 1991, and Sea Engineering, Inc. has been retained over that period by the R.M. Towill Corporation to evaluate the marine considerations for potential landing sites and to assist in the preparation of the Environmental Assessments for the recommended landing sites. Dr. Richard Brock of the Environmental Assessment Company, a subconsultant to Sea Engineering, Inc., was responsible for characterizing the nearshore marine biological conditions along the cable routes and also assisted with the impact evaluation.

This report describes the nearshore marine selection process, the alternatives considered, the physical and biological characteristics of the nearshore cable routes, and the anticipated marine environmental impacts.

Figure I-1 shows the interisland cable configuration and the recommended landing sites.

ROUTE SELECTION PROCESS

This report describes only the nearshore marine considerations of the selection process. Other considerations included land suitability, deep ocean conditions, public usage and terrestrial and marine impacts. A series of two Working Papers, prepared by the R.M. Towill Corporation (1991), describe in detail the overall selection process, the alternatives considered, and the rationale for the recommended routes.

The coastal sector boundaries for the potential cable landing sites were initially defined by two primary constraints:

1. The total cable length between central offices was limited to a maximum of 200 kilometers, and preferably to less than 185 km. Cable lengths over 200 km would require an expensive subsea repeater.

2. Proximity of the cable landing site to a central office was desirable, along with relatively easy access to the central office via available pole lines, duct lines, or other GTE infrastructure.

Given these constraints, sectors of coastline were delineated which bounded the potential landing areas. An office evaluation of each coastal sector was then completed, utilizing existing literature, color aerial photographs, marine charts, coastal inventories prepared by state and Federal agencies, and personal knowledge of nearshore physical and biological

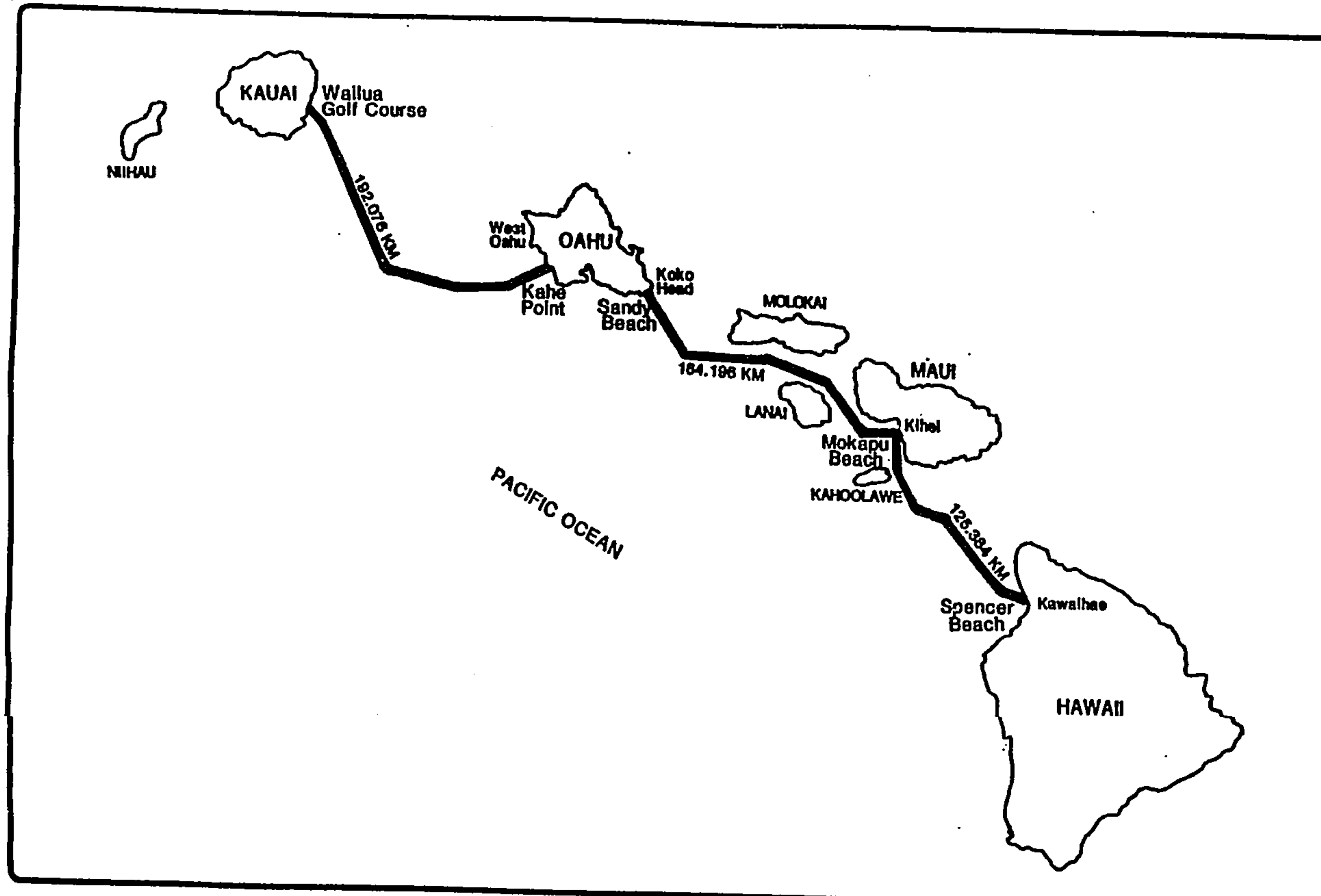

FIGURE 1. SUMMARY OF RECOMMENDED GTE HAWAIIAN TEL FIBER OPTIC LANDING SITES – STATE OF HAWAII

characteristics and uses. A one day field reconnaissance was then conducted in each sector to select three potential landing sites in each sector. If no suitable sites were found within the sector limits, the sector was enlarged as required.

Following the consolidation of all planning considerations mentioned above (terrestrial and marine) a more detailed field study was conducted at each site by an ocean engineer and marine biologist. The objective of this phase was to select the primary and secondary route alternatives.The marine biologist was incorporated into this phase of the study to conduct a preliminary assessment of the selected alternatives and to ensure that there were no overriding environmental constraints.

After initial approval by the client of the recommended route, a detailed bathymetric survey was conducted at each site. During this survey, while accurate positioning equipment was available, a diver was towed along the route centerline, and his visual observations were correlated with the track line and the water depth. This step provided valuable information about the precise conditions along the route, and also ensured that there were no unexpected conditions in the nearshore area.

One additional field trip was made to each site, for the express purpose of describing the physical and biological characteristics of the route and adjacent areas, and to evaluate the potential environmental impacts.

The limit of the diving surveys was the 100 foot depth contour. However, the diving support vessels were equipped with fathometers, and track lines were run to the 180 foot depth to ensure that no steep ledges were encountered beyond the limit of the visual survey.

MARINE SELECTION CRITERIA FOR NEARSHORE
CABLE ROUTE EVALUATION

Throughout the cable route selection and evaluation process the primary objective was to find a suitable, safe cable route which would also result in the minimum environmental impacts possible in that sector.

Specific selection criteria included the following:

1. Sandy bottoms and coastlines were preferred, both for integrity of the cable and to minimize environmental impacts. Experience at other cable landing sites on Oahu (Makua Beach, Makaha Beach and Nanakuli Beach) indicates that cables on sandy bottoms tend to sink into the sand. No cable cross section is exposed, and wave forces on the cables are therefore minimal. In most of these areas, the winter surf and shorebreak can be very large, yet the numerous cables making landfall there have remained stable.

   Hawaii beaches are usually in a dynamic balance with a large offshore sand deposit, and the two are frequently linked by a continuous sand channel, thus providing the ideal configuration for a cable route. In addition to the engineering advantages, the environmental effects of a placing a cable on a sandy bottom are much less than placing one across a diverse coral community.

2. Minimizing the horizontal distance from the shoreline to the 60 foot depth was another important factor. This is the zone of maximum wave forces, and the assumption was made that some form of cable protection or anchoring would be required when crossing any hard bottom inshore of the 60 foot contour. This distance is also an important factor in the cable landing process. The cable ship can approach shore to approximately the 50 or 60 foot depth, where it is then held in place by tugs. As the cable is towed to shore by a small boat or tug, floats are attached to the cable as it is paid out, so that it floats on the surface until the shore connection is secured. During this time, the cable position must be maintained along the route centerline. Strong currents or long distances make this process more difficult. The goal was to select a route where the distance from shore to the 60 foot contour was less than 4000 feet.

3. There is a semi-continuous ledge which drops off from the 60 foot contour, and extends through many of the coastal sectors of Hawaii. This ledge was formed during an ancient stand of the sea, and typically has a vertical drop of 30 feet or more. This ledge was present in the Kauai sector, both Oahu sectors and the Maui sector. It was therefore important to find a route which either avoided the ledge or passed through a channel in the ledge. Fortunately, the sand channels connecting the beaches to the deeper offshore deposits often bisect the ledge.

4. Routes were selected to avoid, to the maximum extent possible, environmentally sensitive areas or areas frequented by rare or endangered species. A specific example was the avoidance of areas used by green sea turtles for resting or forage. The marine biological consultant was an early participant in the study, so that environmental input was received during the initial route evaluations.

II. GENERAL OCEANOGRAPHIC CHARACTERISTICS

WINDS

The predominant winds in the Hawaiian Islands are the northeast trades, which are present approximately 70 percent of the time with an average speed of 13 mph. The frequency of tradewinds varies greatly with the season. They occur 90-percent of the time during the months of April to October. The winter season (November to March) is defined by a weakening of the high pressure system generating the tradewinds, and the frequency of occurrence decreases to approximately 50-percent. During the winter season, low pressure systems periodically displace the tradewinds, resulting in south or southwest winds known as "Kona" winds. Kona winds, which occur rarely in summer and 17-percent of the time in the winter, range from light and variable to gale or hurricane force.

PREVAILING WAVE CLIMATE

The general Hawaiian wave climate can be described by four primary wave types; the northeast tradewind waves, south swell, North Pacific swell and kona storm waves. These wave types and their general approach direction are shown on Figure II-2.

Tradewind waves may be present in Hawaiian waters throughout the year, but are most frequent in the summer season, between April and September, when they usually dominate the Hawaiian wave climate. They result from the strong and steady tradewinds blowing from the northeast quadrant over long fetches of open ocean. Typical deepwater tradewind waves have periods of 5 to 8 seconds and heights of 4 to 10 feet. During gale conditions tradewind waves may reach heights in excess of 20 feet.

South swell is generated by southern hemisphere storms, and is most prevalent during the months of April through October. These long, low waves approach from the southeast through southwest, with typical periods of 12 to 20 seconds and deepwater heights of 1 to 4 feet. Although their deepwater height is relatively low, the long period results in considerable shoaling near shore with resultant large breaker heights. The surf along the exposed south shores of the islands occasionally reaches heights of 15 feet.

North Pacific swell is produced by winter storms in the North Pacific Ocean and by mid-latitude low pressure areas. North swell may arrive in the Hawaiian Islands throughout the year, but is largest and most frequent during the winter months of October through March. North Pacific swell typically has periods of 12 to 20 seconds and deepwater heights of 5 to 15 feet. The approach direction is typically from the west-northwest through north-northeast. North Pacific swell results in some of the largest waves in Hawaiian waters.For example, breaking wave heights approaching 50 feet were observed in December 1969.

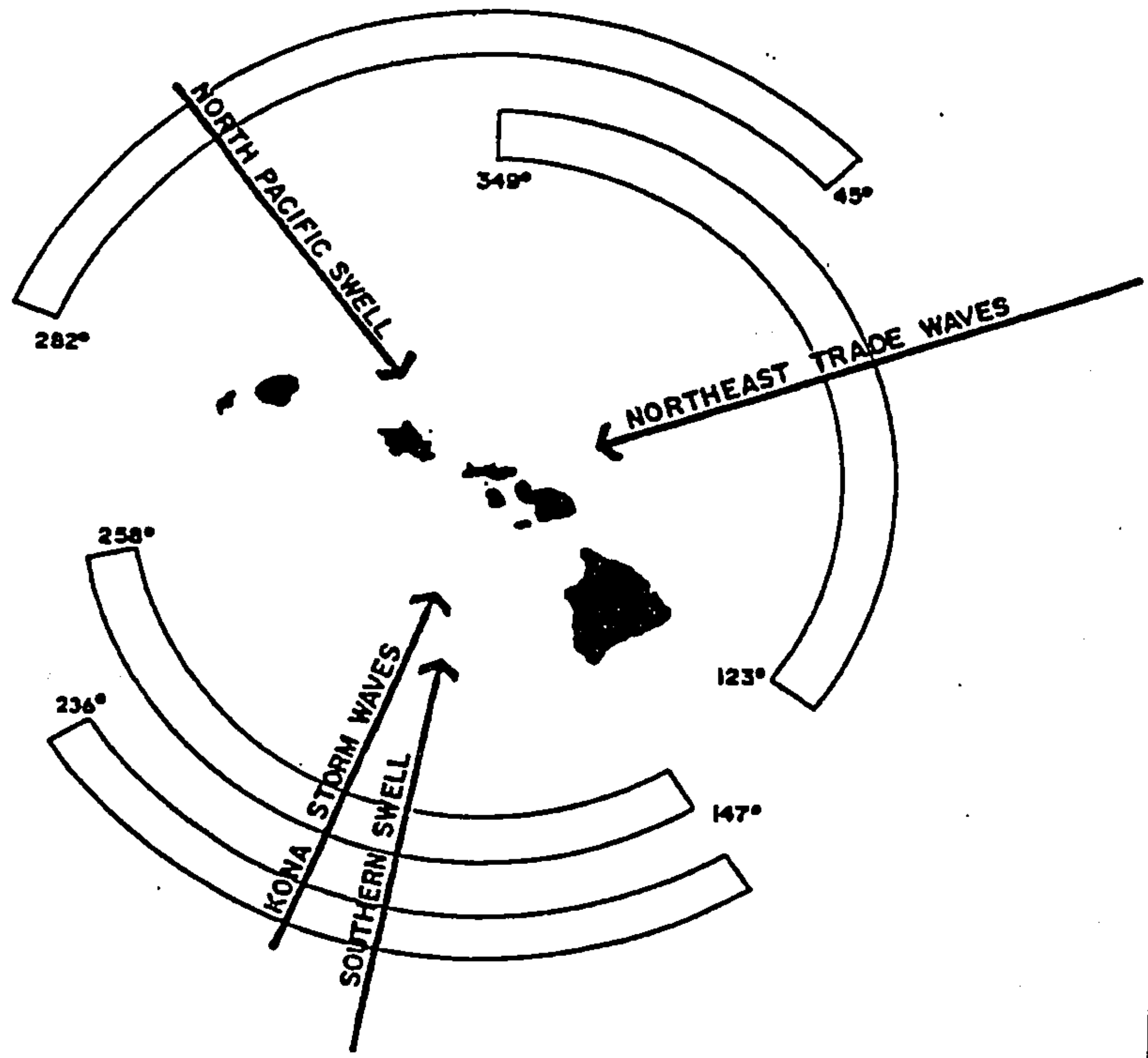

FIGURE 2.

GENERALIZED WAVE TYPES

(Adapted From The Atlas of Hawaii)

Kona storm waves are generated by intense winds associated with local fronts or low pressure systems and typically have periods ranging from 6 to 10 seconds and typical heights up to 10 feet, but during severe storms heights can approach 20 feet. These waves are most common in late winter and early spring, approaching from the south to southwest.

Hurricane Storm Waves

Hurricanes form near the equator, and in the central North Pacific usually move toward the west or northwest. The primary hurricane season is July through September. These tropical storms or hurricanes usually pass south of the Hawaiian Islands, with a northward curvature near the islands. Late season tropical storms and hurricanes follow a somewhat different track, forming south of Hawaii and moving north toward the islands.

There are many recorded tropical storms or hurricanes which have approached the Hawaiian Islands during the past 35 years, and hurricane waves are generally selected as the design criteria for coastal projects. Most of these storms passed well south or west of the islands, or weakened in intensity as they reach Hawaii, but there have been notable exceptions. Hurricanes Hiki, Della, Nina and Fico passed within about 200 miles of the islands, Dot passed over Kauai, and Iwa passed with 30 miles of Kauai. The report Hurricanes in Hawaii (Haraguchi, 1984), prepared for the U.S. Army Corps of Engineers presents hypothetical model hurricanes for the Hawaiian Islands. The model Hawaiian Hurricane is defined as the probable hurricane that will strike the Hawaiian Islands in the future. The characteristics of the model hurricane are based on the characteristics of hurricanes Dot and Iwa. The predicted wave height and period for the model hurricane are calculated to be 31 feet and 12.0 seconds.

This is a worst case scenario; the actual likelihood of this occurring at one particular site is very low. It is more likely that the storm would pass at some distance, thus the wave height at a particular site would depend on the storm track and decay distance over which the waves travel.

TIDES

The tides in Hawaiian waters are semi-diurnal, with pronounced diurnal inequalities (i.e. two tidal cycles per day with the range of water levels being unequal). The average daily tidal range is approximately 2 feet, the maximum range is 2.8 feet.

COASTAL CURRENTS

Coastal currents in Hawaii are influenced by several factors: large scale oceanic currents, tidal currents, wind-driven currents, waves, and island topography. Hawaii is located in the region of the Pacific North Equatorial current, which generally flows to the west with north current speeds ranging from 0.1 to 1 knot. The current direction may vary from west southwest to north-northwest, and the average speed is estimated to be approximately 0.5 knots. Eddies may form in this current as it passes through the islands. Large scale eddies may also be caused by wind circulation patterns around the large mountains on the islands, and small scale eddies may be caused by local landforms.

In most nearshore locations in Hawaii, the tidal flow is the primary current component. Tidal currents are reversing and generally follow bathymetric contours. The maximum tidal current speed in most locations is 2 knots, with speeds of 0.3 to 1.0 knot being typical. Surface currents are modified by the prevailing winds. Past studies around Oahu have indicated that the top 5 to 15 feet of the water column is influenced during moderate trade wind conditions.

The circulation at any particular location is due to a combination of the above factors.

TSUNAMIS

Tsunami, or seismic sea waves, are primarily generated by submarine earthquakes and earth movement with magnitudes greater than about 6.5 on the Richter scale. Coastal and submarine landslides and volcanic eruptions can also generate tsunamis. The Hawaiian Islands are directly exposed to the major tsunami wave generating areas in the Pacific Ocean: the Kuril-Kamchatka-Aleutian region of the north and northwestern Pacific, the west coast of South America, and the seismically active southwest Pacific. Over 80 tsunamis have been observed in the Hawaiian Islands since 1813, and 22 of them resulted in significant damage. The most damaging occurred in 1946 when an earthquake in the East Aleutian Islands generated a tsunami which killed 173 people in Hawaii and caused $26 million in property damage in Hilo alone.

Tsunami wave periods vary from 5 minutes to over 1 hour. Tsunami wave heights in the deep ocean are only a foot or two and their passage is generally not noticeable. However, in coastal regions, the tsunami wave may be subject to extensive transformation by the shallow water processes of refraction and shoaling, and also resonance in bays and harbors, and it may result in a much amplified wave height at the shoreline. Procedures have been developed for the U.S. Army Corps of Engineers, Pacific Ocean Division to determine tsunami wave elevations along the coastlines of Hawaii for various frequencies of occurrence (Manual For Determining Tsunami Runup Profiles on Coastal Areas of Hawaii, 1978). Tsunami runup elevations computed for 50 and 100 year tsunamis in the landing site areas are presented in later sections of this report.

III. METHODOLOGY FOR MARINE BIOLOGICAL SURVEYS

GENERAL

The quantitative sampling of macrofauna of marine communities presents a number of problems; many of these are related to the scale on which one wishes to quantitatively enumerate organism abundance. Marine communities in the areas surveyed for this surveyed may be spatially defined in a range on the order of a few hundred square centimeters (such as the community residing in a Pocillopora meandrina coral head) to major biotopes covering many hectares. Recognizing this ecological characteristic, the sampling program was designed to delineate all major communities in the limits of the study areas and to quantitatively describe these communities. Thus a number of methods were used.

To obtain an overall perspective on the extent of the major communities or "zones" occurring in the study area, divers were slowly towed behind a skiff over most of the study site from shore seaward to at least the 80 foot contour. This exercise allowed the qualitative delineation of major biotopes based partially on the presence of large structural elements (e.g., amount of sand, hard substratum, fish abundance, coral coverage or dominant coral species). Within each of these, stations were established and quantitative studies were conducted, including a visual enumeration of fish, counts along benthic transect lines and cover estimates in benthic quadrats. Besides these quantitative measures, a qualitative reconnaissance was made in the vicinity of each station by swimming and noting the presence of species not encountered in the transects. All assessments were carried out using SCUBA.

Biotopes are defined by physical characteristics including water depth, relative exposure to wave and current action, and the major structural elements present in benthic communities. The latter include the amount of sand, hard substratum, and vertical relief present as well as the biological attributes of relative coral coverage, fish abundance, and dominant species of the coral community. Biotopes are named for the distinctive features of the zone. It should be noted that the boundaries of each zone are not sharp but rather grade from one to another; these are ecotones or zones of transition.

The locations of stations were subjectively chosen as being representative of a given biotope. Immediately following station selection, a visual census of fishes was undertaken to estimate their abundance. These censuses were conducted over a 4 x 25 meter corridor and all fishes within this area from the bottom to the water surface were counted. Data collected included the number of individuals of each species as well as an estimate of individual lengths of all fishes seen; the length data were later utilized in estimating the standing crop of fishes present at each station using linear regression techniques (Ricker 1975, Brock and Norris 1989). A single diver equipped with SCUBA, transect line, slate and pencil would enter the water, count and note all fishes in the prescribed area (method modified from Brock 1954). The 25m transect line was paid out as the census progressed, thereby avoiding any previous underwater activity in the area which could frighten wary fishes.

Fish abundance and diversity is often related to small-scale topographical relief over short linear distances. A long transect may bisect a number of topographical features (e.g., coral mounds, sand flats and algal beds), thus sampling more than one community and obscuring distinctive features of individual communities. To alleviate this problem, a short transect (25m in length) has proven adequate in sampling many Hawaiian benthic communities (Brock and Norris 1989).

Besides frightening wary fishes, other problems with the visual census technique include the underestimation of cryptic species such as moray eels or puhis (family Muraenidae) and nocturnal species, e.g., squirrelfishes or ala'ihis (family Holocentridae), áweoweos or bigeyes (family Priacanthidae), etc. This problem is compounded in areas of high relief and coral coverage affording numerous shelter sites. Species lists and abundance estimates are more accurate for areas of low relief, although some fishes with cryptic habits or protective coloration (e.g., the nohus or rockfishes, family Scorpaenidae; the flat fishes or paki'is, family Bothidae) might still be missed. Obviously, the effectiveness of the visual census technique is reduced in turbid water and species of fishes which move quickly and/or are very numerous may be difficult to count and to estimate sizes. Additionally, bias related to the experience of the diver conducting counts should be considered in making any com- parisons between surveys. In the present study, one individual carried out all of the visual censuses. In spite of these drawbacks, the visual census technique probably provides the most accurate nondestructive method available for the assessment of diurnally active fishes (Brock 1982).

After the assessment of fishes, an enumeration of epibenthic invertebrates (excluding corals) was undertaken using the same transect line as established for fishes. Exposed invertebrates usually greater than 2cm in some dimension (without disturbing the substratum) were censured in a 4 x 25m area. As with the fish census technique, this sampling methodology is quantitative for only a few invertebrate groups, e.g., some of the echinoderms (some sea urchins and sea cucumbers). Most coral reef invertebrates (other than corals) are cryptic or nocturnal in their habits making accurate assessment of them in areas of topographical complexity very difficult. This, coupled with the fact that the majority of these cryptic invertebrates are small, necessitates the use of methodologies that are beyond the scope of this survey (see Brock and Brock 1977). Recognizing constraints on time and the scope of this survey, the invertebrate censuring technique used here attempted only to assess those few macroinvertebrate species that are diurnally exposed.

Exposed sessile benthic forms such as corals and macrothalloid algae were quantitatively surveyed by use of quadrats and the point-intersect method. The point-intersect technique only notes the species of organism or substratum type directly under a point. Along the previously set fish transect line, 50 such points were assessed (once every 50cm). These data have been converted to percentages. Quadrat sampling consisted of recording benthic organisms, algae and substratum type present as a percent cover in six one-meter square frames placed at five-meter intervals along the transect line established for fish censuring (at 0, 5, 10, 15, 20 and 25m).

If macrothalloid algae were encountered in the 1 x 1m quadrats or under one of the 50 points, they were quantitatively recorded as percent cover. Emphasis was placed on those species that are visually dominant and no attempt was made to quantitatively assess the multitude of microalgal species that constitute the "algal turf" so characteristic of many coral reef habitats.

During the course of the fieldwork notes were taken on the number, size and location of any green sea turtles and other threatened or endangered species seen within or near to the study area. With green turtles, efforts were made to record the size (straight line carapace length) of the individuals seen as well as the presence of tags, tumors or any deformities. We also attempted to note the presence of appropriate resting and foraging areas for green turtles.

IV. WAILUA GOLF COURSE, KAUAI

ALTERNATIVES CONSIDERED

Areas considered for a fiber optic cable landing site extended from Nawiliwili Harbor to Wailua Bay, a distance of approximately 8 miles. Figure IV-1 shows this coastal sector.

Nawiliwili Harbor was eliminated from consideration during the initial office study, because of the potential threat to cable integrity from commercial shipping activity and the periodic maintenance dredging of the harbor entrance channel.

The selected landing site is located off the Wailua Golf Course, and is described in detail later in this report. Other areas investigated but not selected are discussed below.

The 12,000 foot long coastline south of Hanamaulu Bay and the Ahukini Recreation Pier State Park was investigated during the first field reconnaissance. The inshore bottom consists of limestone rock and coral, and is very irregular, with depressions, ledges and surge channels. A very steep ledge was located approximately 3500 feet offshore. This ledge would present a serious obstacle to placement of a cable. The top of the ledge was at 60 feet and the bottom at 150 feet. An additional drawback was a high steep bank at the shoreline which would make equipment access difficult for the shore landing. This site was eliminated from further consideration due to the unfavorable physical conditions.

Hanamaulu Bay offers marginal conditions for a cable landing. An offshore sand channel extends partially into the bay, but to take advantage of the channel the cable would have to approach the shoreline obliquely from the east-northeast. This would require crossing 500 feet of hard bottom near shore and an undetermined length of hard bottom beyond the breakwater. The shape of the sand channel is irregular, and the route might also cross hard bottom in the vicinity of the breakwater tip. The site was not investigated in enough detail to determine whether or not the ledge at the 60 foot depth could be avoided. This site was dropped from consideration due to the marginal offshore conditions and on-land constraints.

There is a pronounced sand channel in Wailua Bay, connecting the sandy beach with an extensive offshore sand deposit. The south side of the channel was checked during the site visit, and the sand appeared to be thick and bounded by limestone and reef outcrops. The sand channel is slightly undulating, and the north side would have to be carefully mapped to ensure that a cable could be aligned in the channel. The main disadvantage of this site is the distance to the 60 foot contour, which is located approximately 5000 feet offshore. Other disadvantages include the potential instability of the beach during flooding of the Wailua River, and the potential archaeological sensitivity of the sand dunes along the backshore.

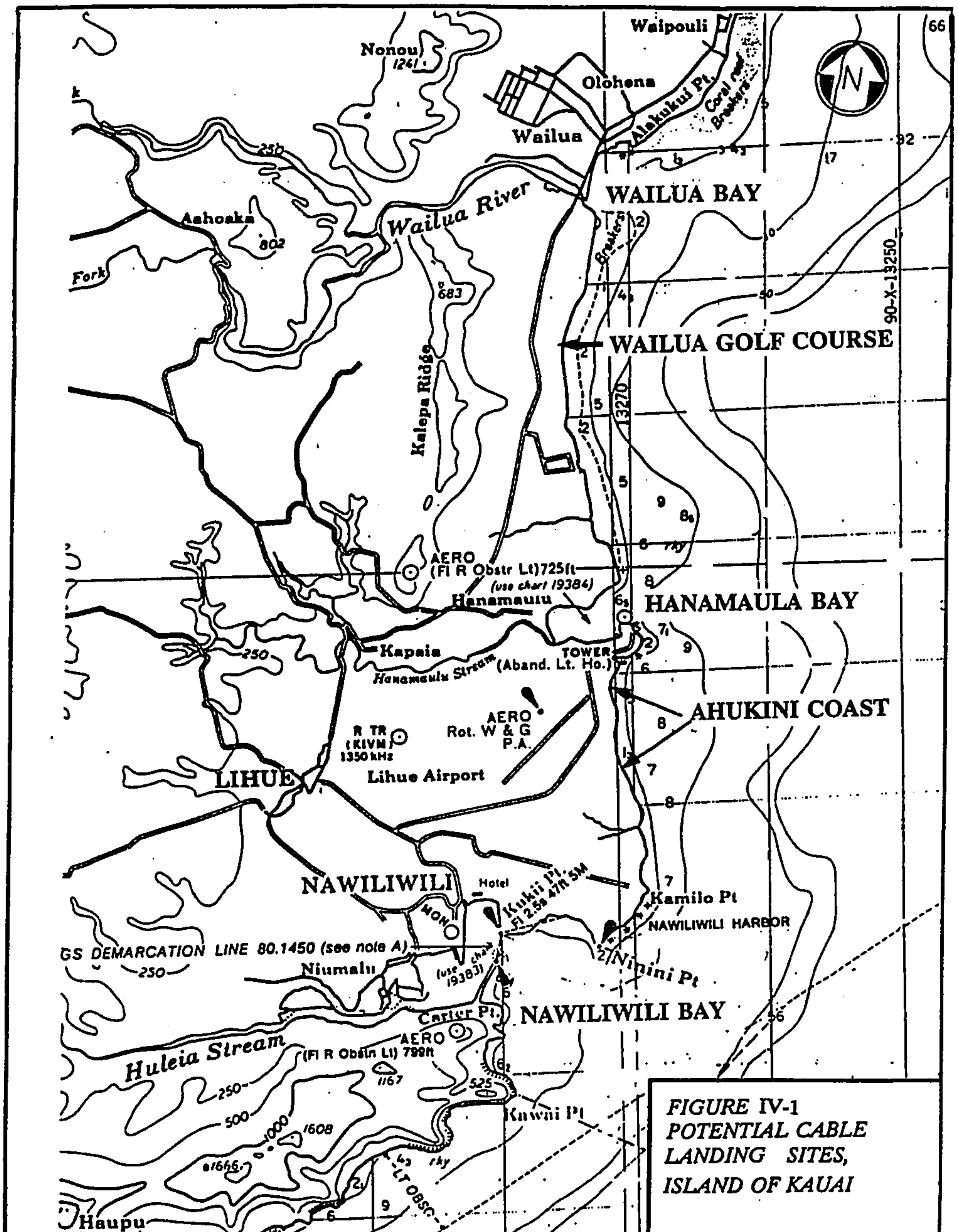

FIGURE IV-1
POTENTIAL CABLE LANDING SITES, ISLAND OF KAUAI

DESCRIPTION OF THE SELECTED ROUTE

General Description: The Wailua Golf Course landing site is located adjacent to the Wailua Golf Course along the east coast of Kauai. A 14,000 foot long narrow sand beach extends from the Kauai Hilton to the Wailua River. The sector fronting the golf course is part of this beach. A 500 foot wide fringing reef is almost continuous off the southern part of the beach, but becomes intermittent off the golf course.

Shoreline History: The beach along the southern half of the golf course has undergone significant erosion in the last 40 years. The vegetation line has eroded over 50 feet since 1950 along segments of the beach. A 3500 foot long revetment was constructed between 1987 and 1988 to protect this portion of the golf course. The beach area in front of the club house has been relatively stable, while to the north the beach has accreted up to 60 feet since 1950.

Existing Usage: The Wailua Golf Course occupies the backshore of the entire landing site area. Two fairways and a green are located along the vegetation line; in the remaining areas, the golf course is set inland, and there is a band of trees and shrubs between the golf course and the vegetation line. Nukolii Beach Park is located to the south of the golf course, and Lydgate State Park is located to the north. The beach is relatively narrow, and the nearshore bottom is shallow. The beach is used for recreation. Turbulence created by waves breaking on the wide reef reduces water visibility in this area. Spearfishing, however, is popular at the seaward edge of the reef while gillnet fishermen, thrownet fisherman, and seaweed harvesters frequent shallower portions of the reef.

Physical Characteristics of the Selected Route

There are several small sand deposits on the reef flat off the central and north parts of the golf course, but most terminate on hard bottom or the 60-foot ledge, which parallels much of the windward coast off Kauai. The recommended route is located in the only sand channel found that bisects the ledge and the reef and extends into deeper water. The bottom is sand from the shoreline to at least the 120-foot depth, the seaward limit of the visual inspection. There is hard bottom, with the typical 60 foot ledge, both north and south of this sand channel. The 60-foot depth contour is located 2200 feet from shore. From that point seaward, the bottom slope becomes steeper, and the 110 foot depth contour is located only 2600 feet offshore. The sand deposit was not probed, but it appears to be thick. The sand is medium to coarse grained, with pronounced sand waves in shallow water, due to wave action. There are no visible outcrops of coral or rock along the route.

OCEANOGRAPHIC CONDITIONS

This landing site is on the windward side of the island, and is directly exposed to the prevailing tradewinds and the tradewind generated waves. The tradewind waves occur throughout the year, but are most consistent between April and September. Typical heights range from 4 to 10 feet, and periods from 5 to 8 seconds. During northeast gales wave heights of up to 25 feet can occur. Both south swell and north Pacific swell could refract into this area, but tradewind waves are the predominant source of wave energy.

There is a wide breaker zone along this coast. At the site of the proposed route, the 20 foot contour is 1400 feet offshore, and during moderate to strong trade winds, the breaker zone extends out to this depth. On the first day of the R.M. Towill hydrographic survey of this site, the 30-foot survey vessel could not proceed inshore of the 20 foot contour due to the shoaling waves.

Currents along the Kapaa-Wailua coast are dominated by the tidal flow, and generally are oscillatory; flood currents flow to the south, and ebb currents flow to the north. The currents tend to parallel the coastline or bottom contours. Studies conducted by Sunn, Low, Tom, and Hara, Inc. (1972) indicated that currents in the waters off the golf course were weaker than those in the Kapaa area, and did not correlate as consistently with the tide stage. Currents were predominantly to the south, with inconsistent flow to the north during ebb tide.

The waters along this stretch of coastline are classified "A" in State Department of Health water quality regulations.

The estimated 50 and 100 year tsunami elevations for this coast are 7.2 and 10.5 feet above mean sea level.

DESCRIPTION OF THE PROPOSED PROJECT

Construction and diving activities related to the cable landing should be relatively straightforward, given the very favorable physical characteristics of the selected route. Preparing the shoreline and backshore area will be the most significant work item. A portion of the existing revetment will have to be removed. As this revetment is at or above the normal high tide reach of the waves, there should be little or no turbidity generated at this stage of the work. A trench to receive the cable will also have to be cut across the beach. Depending upon the depth of excavation, temporary sheetpiling may or may not be used to stabilize the trench sides. It is anticipated that a sand "dam" will be left in place at the seaward end of the trench to prevent the generation of turbidity in the nearshore waters. Duration of this preliminary work should not exceed two weeks.

The cable ship should be able to approach to about the 50 foot water depth, or approximately 2500 feet from shore. After the cable is pulled to shore and secured, the floats will be cut by divers, and the cable will sink to the bottom. The sand "dam" at the shoreline will then be excavated or the cable will be waterjetted down to the desired elevation. The sheetpile will then be removed and the beach restored to its natural condition. The revetment will also be reconstructed.

No offshore protection, anchoring or trenching is anticipated.

MARINE BIOLOGICAL SETTING

The qualitative reconnaissance of the waters fronting the Wailua County Golf Course was carried out in June 1991. Because the substratum of the entire corridor was found to be sand, no quantitative sampling of the marine communities was carried out at this site. The qualitative survey extended from shore to about the 100 foot isobath approximately 2,800 feet from shore. In this area only one zone or biotope was defined, the biotope of sand.

The Biotope of Sand

The biotope of sand lies covers the entire project site. As the name implies, the substratum in the biotope of sand is dominated by sand. Because of its shifting nature, the benthic species found in sand habitats are generally adapted for life on an unstable and frequently abrading environment. Many species that are found in this habitat will bury into the sand to avoid predators and the abrasion that occurs with storm waves. Other species will swim above the substratum (e.g., fish) to avoid abrasion. Thus many species in the sand biotope are either cryptic and difficult to see or will just pass through sand environments well off the bottom; among the cryptic species are many of the molluscs and crustaceans such as the Kona crab (Ranina serrata). Hence, without considerable time spent searching, many species in the sand habitat will not be seen. The fauna of the biotope of sand is best developed at greater depths; where it enters the shallow water, many of the characteristic species become less abundant.

Benthic communities on sand substrates usually have their greatest development at depths below which wave impact occurs (below 100 feet). Because of constraints with bottom time at these depths and the general lack of meaningful results from quantitative surveys in shallower water over sand, only a qualitative survey was done. Species commonly seen in the deeper regions of the biotope of sand include a number of molluscs: the helmet shell (Cassis cornuta), augers (Terebra crenulata, T. maculata and T. inconstans), the leopard cone (Conus leopardus) and flea cone (Conus pulicarius) as well as the sea hare (Brissus sp.), starfish (Mithrodia bradleyi), brown sea cucumber (Bohadschia vitiensis), the Kona crab (Rania serrata), opelu or mackerel scad (Decapterus macarellus), nabeta (Hemipteronotus umbrilatus), the goby-like fish (Parapercis schauslandi), uku or snapper (Aprion virescens), hihimanu or sting ray (Dasyatis hawaiiensis) and the weke or white goatfish (Mulloides flavolineatus). In our qualitative reconnaissance, the only species seen in water of less than

30 feet in depth was a school of newly settled juvenile gobies of a species not determined. These fishes were transparent with only the eyes apparent and were about 18-20mm in length. These fishes were seen at a depth of about 8 feet near the shoreline of the proposed cable site. Undoubtedly, with greater searching, many more fish species would be encountered in this biotope. Most of these species become less evident in the shallower portions of this biotope.

The intertidal region at this proposed cable landing site is sand; a short inspection of the beach noted ghost crab holes (Ocypode ceratophthalma) and several sand crabs (Emerita pacifica).

No green turtles (Chelonia mydas) were seen during our survey work in the waters fronting the Wailua County Golf Course. Additionally, we found no macroalgae in the vicinity of the cable alignment or shelter that may be appropriate as green turtle resting sites. The lack of these components is due to a lack of hard substratum. We have found no information to suggest that nesting of sea turtles in the vicinity of the Wailua County Golf Course has occurred in historical times.

The biological survey of the proposed cable alignment at offshore of Wailua County Golf Course did not find any rare or unusual species or communities. Another protected species, the humpback whale (Megaptera novaeangliae), was not seen offshore of the study area during the period of our field effort, but whales are known to be seasonally present along the windward coast of Kauai.

POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Impacts with Construction

The potential for impact to the shallow marine communities will probably be greatest with the construction phase of this proposed project. From the sea, the proposed cable alignment passes through the biotope of sand prior to landfall. As a substrate to support marine communities, sand is inappropriate for many coral reef forms because many species require a stable bottom (e.g.,corals and many of the associated invertebrates). Thus the species usually encountered in sand areas are usually those that are adapted to exist in an ever-changing, moving substratum. Similarly, much of the benthic production on coral reefs occurs on hard substratum, (i.e., macroalgae require a solid substratum for attachment). Because sand substrates are subject to movement, they may abrade and scour organisms on this substratum. Thus the characteristics of most species encountered in Hawaiian sand communities are (1) that they typically burrow into the substrate to avoid scouring, (2) that they frequently occur in low abundance which may be related to food resources, and (3) that they are mobile because of the shifting nature of the substratum and potential for burial. Since many of these forms are motile, deployment of the cable across such a substratum presents little chance of negative impact to resident species because they would probably "just move out of the way as the cable was deployed". Additionally since the substratum shifts, it is probable that the deployed cable will "sink into" the substrate. Personal observations made on other deployed cables shows them to often be partially buried by the natural movement of the sand.

It is expected that the cable will be buried in the sand at the shoreline. This will probably entail a combination of trenching across the backshore of the beach and water jetting the cable to grade in the vicinity of the waterline. This will temporarily generate some level of turbidity that could impact hard substratum communities if in close proximity to the proposed project site. However, we are not aware of any well developed hard bottom communities close to the proposed cable alignment.

With any construction is the concern over possible impact to corals due to their sessile nature and usual slow growth characteristics. Because there is no hard substratum in the alignment path (or near it) in shallow water, we do not expect that corals will be directly impacted by this activity. Additionally, the small scale of this project suggests that the turbidity levels generated will be considerable less than the those caused by two natural occurrences: 1) turbidity input from the Wailua River that empties into the ocean about 7,000 feet to the north, particularly following heavy rainfall, and 2) turbidity due to resuspension of sand in the Wailua area due to the frequently rough sea conditions. The episodic input of stormwater runoff has probably been an important parameter in structuring benthic communities in this area; this coupled with storm surf and the movement of sand that scours the bottom will retard benthic community development.

We expect that there would be no direct impacts to the threatened green sea turtle or to endangered humpback whales (Megaptera novaeangliae). As far as the impact to humpback whales is concerned, if construction activities are restricted to the period between April through October, there would be no impacts because the whales are seasonal and are only in island waters from November through March. Even assuming that the cable deployment occurs when the whales are present in Hawaiian waters, it is anticipated that the impacts would be minimal. The cable laying ship should not be on site more than one or two days. The most probable source of impact to whales would be noise generation by the cable ship, the support tugs and the small boats used for the cable landing. There are variable and conflicting reports as to the impact of vessel traffic on whales (Brodie, 1981; Matkin and Matkin, 1981; Hall, 1982; and Mayo, 1982). With respect to the response of individual humpback whales, there is sufficient information to demonstrate that boating and other human activities do have an impact on behavior (Bauer and Herman, 1985). Thus it is probably valid to assume that impact to whales could occur if individuals are within several kilometers of the deployment site. However, as noted above, these impacts are of short duration, and all activity will be concentrated in a small area.

Sea turtles are permanent residents in inshore Hawaiian habitats thus the potential exists for problems during the construction phase if extensive turbidity is generated and if turtles are present in the area. However, the generation of fine particulate material from dredging did not appear to hinder the green turtle in one Hawaiian study; at West Beach, Oahu, green turtles moved from an offshore diurnal resting site about one 3,300 feet offshore to a point about 600 feet from the construction site within days of the commencement of dredging and the generation of turbid water. The turtles appeared to establish new resting areas in the turbid water directly offshore of the construction site (Brock 1990a). The reason(s) for this shift in resting areas is unknown but may be related to the turtles seeking water of poor clarity to possibly lower predation by sharks (a major predator on green sea turtles).

Fishery Considerations

Fishermen and other beach users have lateral access to the shoreline fronting the Wailua County Golf Course. This section of coastline has probably been used since prehistoric times. Although we did not see anyone using this beach during the period of our sampling, it is probable that fishermen fish this area both from shore as well as offshore from small boats. Some commercial fishing may occur offshore of the proposed cable alignment. We are unaware of any individuals that specifically and exclusively use the beach fronting the Wailua County Golf Course for subsistence fisheries. Probably most of the fishing activity in and around this beach is by recreational fishermen.

With most Hawaiian recreational fisheries, species targeted include papio and ulua (family Carangidae), o'io or bonefish (Abula vulpes), moi (Polydactylus sexfilis), goatfishes (family Mullidae), snappers (family Lutjanidae), surgeonfishes (family Acanthuridae), parrotfishes (family Scaridae), and a host of smaller species such as the aholehole (Kuhlia sandvicensis), aweoweo (Priacanthus cruentatus) and menpachi (Myripristes amaenus). Fishing methods used include nets, spears, traps as well as hook and line.

The qualitative reconnaissance did not note any fishes of commercial or recreational interest at depths less than 30 feet. This is probably related to the lack of hard bottom and shelter in the vicinity of the proposed cable alignment. However, many of the species noted above are frequently caught in sand bottom areas as they wander through in search of prey; in many instances encounters with these fishes over sand bottom may be considered a random or chance event.

The standing crop of fishes on coral reefs is usually in the range from less than 2 to about $200 g/m^2$ (Brock 1954, Goldman and Talbot 1975, Brock et al. 1979). Eliminating the direct impact of man due to fishing pressure and/or pollution, or to chance encounters, the variation in standing crop appears to be related to the variation in local topographical complexity of the substratum. Thus habitats with high structural complexity affording considerable shelter space usually harbor a greater estimated standing crop of coral reef fish; conversely, transects conducted in structurally simple habitats (e.g., sand flats) usually result in a lower estimated standing crop of fish (>2 to $20 g/m^2$). Goldman and Talbot (1975) note that the upper limit to fish biomass on coral reefs is about $200 g/m^2$. Thus the few fishes encountered in this qualitative reconnaissance of the sand flats fronting the Wailua County Golf Course is not unexpected.

Water Quality Considerations

With any disturbance to the seafloor, sediment will be generated which will manifest itself as turbidity. This may occur through natural events such as storm surf resuspending fine material that had previously come into the area through natural events and settled, or by human activities including the directing of storm water runoff into the ocean or by underwater/shore line construction activities. These activities will generate fine particulate material that could impact corals. The generation of fine sedimentary material could have a negative impact to corals and other benthic forms if it occurs in sufficient quantity over sufficient time. Studies (e.g., Dollar and Grigg 1981) have found that the impact must be at a high level and chronic to affect adult corals.

The small scale of the trenching activities that would be necessary to protect the cable across the sand beach at Wailua would probably produce little sediment. The small scale and anticipated short duration of the project suggest a minimal impact. High water motion will keep fine particulate and sedimentary material suspended in the water column, reducing the settlement on benthic organisms in shallow water habitats thus assisting in the advection of this material out of these areas (less than 300 feet in depth) where corals are found.

The lack of hard substratum has precluded the development of the usual coral reef communities in the vicinity of the proposed cable alignment. The input of considerable freshwater and occasional sediment via storm runoff from the nearby Wailua River has played a role in the local development of benthic communities. Occasional high surf coupled with the movement of sand will scour adjacent hard substratum retarding benthic community development. Nowhere in the vicinity of the proposed cable alignment were any diverse benthic communities noted and this is probably related to the above factors. The proposed cable alignment was selected to avoid hard substratum thus the deployment of the cable on this alignment should not result in any significant impact to marine communities.

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APPENDIX B

Archaeological Assessment of the Proposed Fiber Optic Cable Landing for Wailua, Kauai

**ARCHAEOLOGICAL ASSESSMENT OF
THE PROPOSED FIBER OPTIC CABLE LANDING
FOR WAILUA, KAUA'I**

by

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for

R.M. Towill Corporation

Cultural Surveys Hawaii
March 13, 1992

ABSTRACT

Cultural Surveys Hawaii conducted an archaeological surface survey of a corridor of land on the island of Kaua'i extending from the ocean to Kuhio Highway through the Wailua Golf Course (TMK 3-9- portions plat 02 and 05) for the proposed fiber-optic transmission cable. No surface archaeological sites were found. The locations of two isolated human burials are known to be in the vicinity of the proposed cable corridor and others are known farther north near Lydgate Park and near the Wailua River. Single, random human interments are expected to be unearthed during trenching in the proposed corridor.

Groups of burials - *i.e.*, cemeteries or conscribed graveyards - within the proposed corridor are not expected and subsurface testing strictly confined to the actual corridor of about 20 feet in width is recommended to confirm this, after the exact corridor is surveyed and staked in the field.

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INTRODUCTION

Cultural Surveys Hawaii conducted archaeological assessments for four proposed fiber optic cable landing sites on three of the Hawaiian islands. The proposed sites are located on O'ahu at Sandy Beach Park and Kahe Point Beach Park, on Hawai'i at Spencer Beach Park, and on Kaua'i at the Wailua Golf Course (Fig. 1-4).

This report treats the Wailua Golf Course cable landing site on Kaua'i.

The assessments, requested by R.M. Towill Corp., include background research and on-site inspections to determine the potential for encountering archaeological resources at the four proposed cable landing sites. Sub-surface testing was carried out at the Spencer and Sandy Beach Park Sites to gather additional information on stratigraphy.

Individual reports treat each of the proposed cable landing sites. Contained in each report are a site specific scope of work, field methods, a review of previous research pertinent to the individual landing site, research results, and recommendations for mitigation of existing cultural-archaeological resources.

Scope of Work

The scope of work at the cable landing site at the Wailua Golf Course on Kaua'i consisted of the following:

A. A field check of the cable landing and a corridor - up to a few hundred feet wide - to Kuhio Highway, including a stratigraphic profile visible in the wave cut bank along the shoreline.

B. Interviews with two individuals familiar with events and discoveries of Hawaiian remains in the area during the period from 1946 to the present.

C. Field check of two burial sites discovered in the vicinity of the fiber optic cable corridor.

D. Limited historical research on Wailua *ahupua'a*.

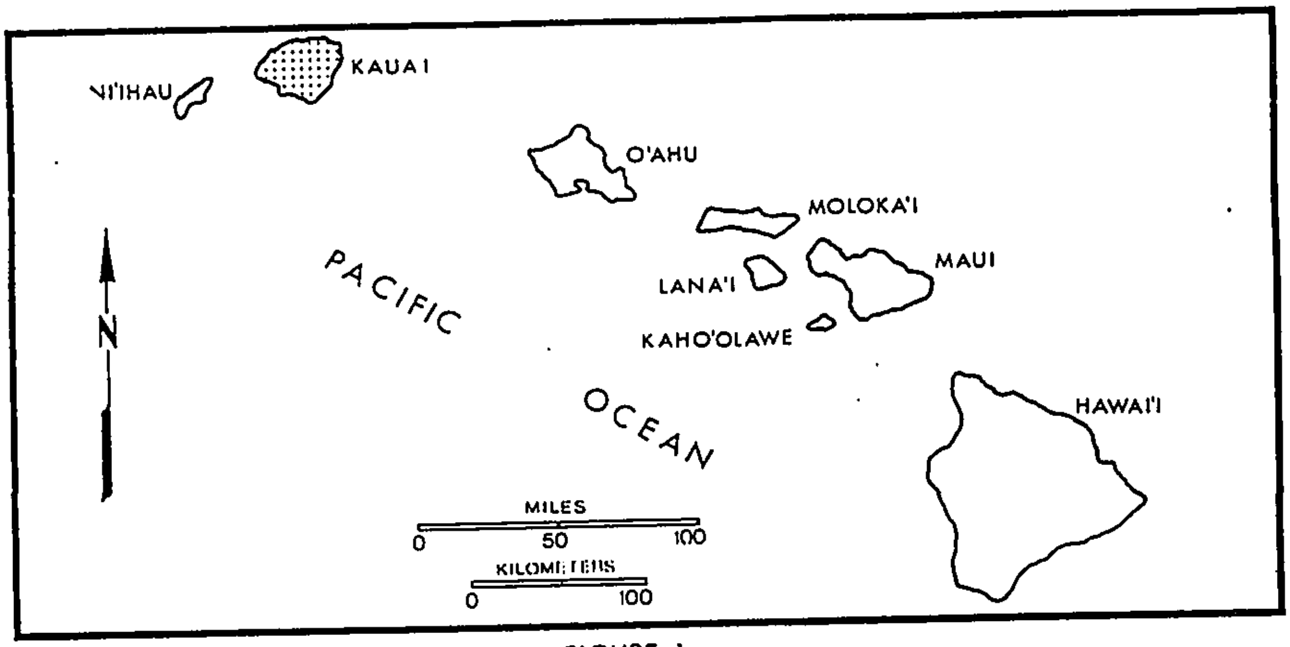

FIGURE 1
State of Hawai'i

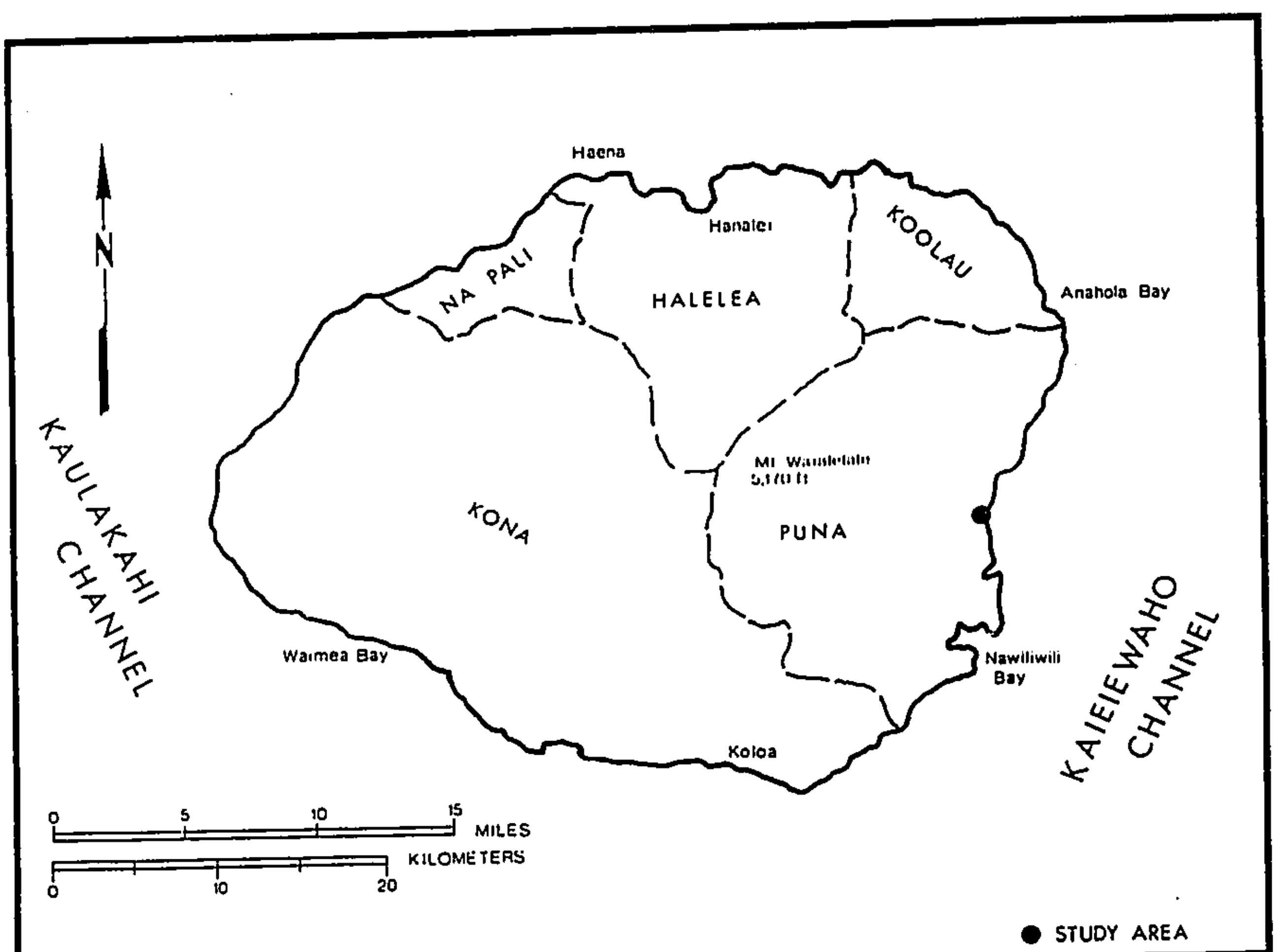

FIGURE 2
General Location Map, Kaua'i Island

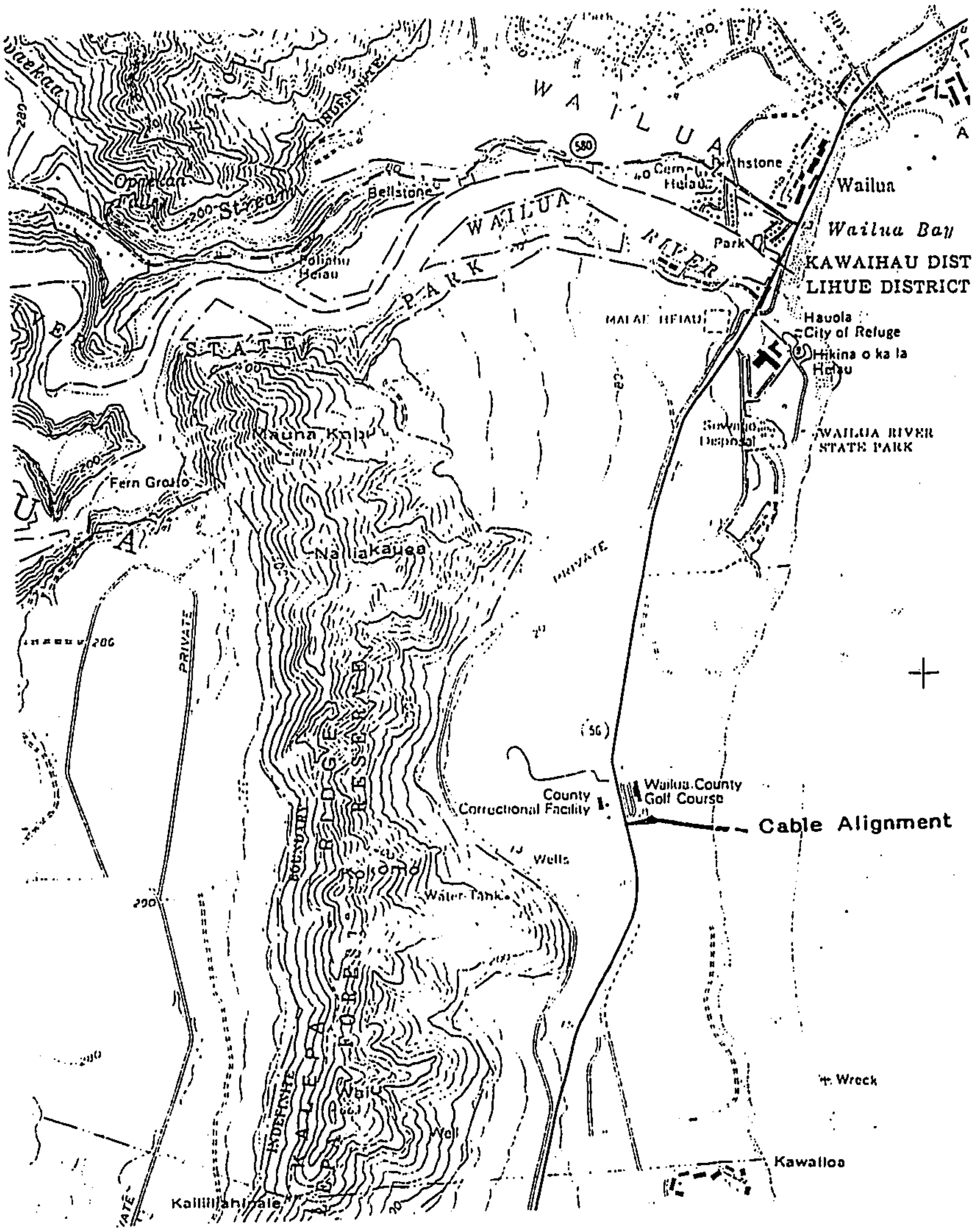

Figure 3 Portion of USGS 7.5 Minute Series Topographical Map, Kapa'a Quadrangle Showing Cable Landing and Corridor

Figure 4 Portion of Aerial Photo Showing Cable Corridor Alignment

BACKGROUND

Natural History

Wailua *ahupua'a*, located on the eastern side of the island of Kaua'i, is exposed to the prevailing northeast tradewinds and thus experiences 40 to 50 inches of rainfall annually at the seashore. This increases to 75 to 100 inches in more inland (western) localities. The Wailua River, largest in the state, and its tributaries comprise the major drainage system for the central area of the Līhu'e basin. The Līhu'e basin is bounded by the Haupu mountains to the south, Waialeale to the west and the Makaleha mountains to the north. Sea level changes in recent geologic time on this side of Kaua'i have submerged the eastern edge of the Līhu'e basin, resulting in the deposition of alluvium, beach and dune sand, and lagoonal clays and marls along the seaward (eastern) side of the Kalepa-Nonou Ridge through which the Wailua River flows. The present study area at the Wailua Golf Course is located along the seaward side of the Kalepa Ridge south of the Wailua River where beach and dune sand deposits predominate.

Cultural History

Events and activities in pre-contact Wailua *ahupua'a*, as summarized by Gerald "Kamalu" Ida (Folk and Ida 1981), are centered almost exclusively at Wailuanuiho'ānu - "great, sacred Wailua" (Dickey 1916) - situated on either side of the Wailua River between the confluence of the north and south forks, and the sea. This was a place where the *ali'i* resided and their offspring were raised and trained.

The *ahupua'a* (traditional land unit) of Wailua was retained as Crown Lands in the Mahele of 1848 and recipients of Land Commission Awards (*kuleana*) in the *ahupua'a* include high status individuals. These *kuleana* are concentrated in the areas closest to the Wailua river, predominantly on the north bank where the best agricultural land is located.

There are no known references to habitation, agriculture or *kuleana* in the immediate area of the project area, where the active sand dune environment is generally not suitable for agriculture, although annual rainfall today measures 40 to 50 inches. The presence of burials here, reported in personal communications with Toyo Shirai (retired golf course supervisor) and Abraham Koga (the current course supervisor), is certainly in line with traditional land use patterns. This type of use of the study area lands may have precluded other uses such as habitation and agriculture.

Archaeology

Archaeology in Wailua *ahupua'a* began to be addressed in the early 20th century by: L.A. Dickey (1917) and J.M. Lydgate (1916) with the Hawaiian Historical Society; Sloggett (1934) with the Kauai Historical Society; Thomas Thrum (1907) in the Hawaiian *Almanac and Annual*; M. Salisbury (1936) in the Honolulu Star Bulletin; and Wendell C. Bennett (1931) who conducted the first comprehensive survey of Kaua'i island archaeological sites. Other early traditional and non-traditional data on the Wailua area are recorded on maps constructed in part from data collected during 19th century surveys of the Boundary Commission and later, during the early 20th century, Territory of Hawaii and U.S. Geological Survey topographical surveys. Ethnohistorical data focusing on agriculture and the Hawaiian as an agriculturalist was collected in some detail in this century by Elizabeth and E.S. Craighill Handy (1940; 1972).

Recent archaeological studies are primarily the result of modern development in

Wailua. The bulk of this work documents cultural remains that include objects or structures, buried stratigraphic layers, and human burials. As might be expected, based on legendary history, the physical remains of Hawaiian society in Wailua are also focused on the Wailua River. No archaeological sites or buried cultural remains except for human burials are known to exist within or in close proximity to the present study area.

SURVEY RESULTS

Fieldwork, conducted on February 19,1992, consisted of walking over the proposed cable corridor from the shoreline to Kuhio Highway, and interviewing present and past superintendents of the Wailua Golf Course to gather information on the construction of the golf course. Subsurface testing of the cable corridor was not done at this time because of the disturbance testing would have caused to current use of the golf course. Also, the present approximated cable corridor covers a much wider area (100 feet or more) than will be utilized by the actual corridor (only 20 feet in width), and would require testing of a larger area than necessary. Thus testing before the precise corridor is selected would unnecessarily disturb any burials outside that specific area. Data on the stratigraphic layers present in the study area was recorded at a wave-cut face about eight feet in height. At the foot of the cliff face is active beach sand that is awash during maximum high tides and storm surf conditions. At the top of the cliff face is the rough of the first fairway of the golf course, along the north side of which runs the cable corridor. Further, on the north side of the cable corridor, is the practice driving range (Fig. 5 through Fig. 8).

The strata exposed in the wave cut face consists of a natural, wind deposited layer of very fine, well sorted coralline sand extending from sea level or below to about eight feet above sea level. A layer of imported alluvium was deposited upon the sand layer as top soil or leveling fill during the golf course construction, but *mauka* (inland) of the wave cut face this alluvium is not present and the golf course grasses are growing directly upon the natural sand layer.

Information from interviews with Mr. Abraham Koga, golf course superintendent,

Figure 5 Fiber Optic Cable Landing Corridor from the Shoreline to the Wave Cut Bank

Figure 6 Fiber Optic Cable Corridor from the Wave Cut Bank to *Mauka* (West)

Figure 7 Fiber Optic Cable Corridor Continuing to *Mauka* (West). Note Clubhouse and Other Facilities in Background.

Figure 8 View to Southeast (*Makai*) Across Driving Range with Project Corridor at Far Right. Known Burials Present Beneath Dead Tree at Left and in Center of Driving Range

and Mr. Toyo Shirai, superintendent from 1946 to 1978, included the locations of three burials found previously. One burial was uncovered at the north end of the course near Lydgate Park which is a considerable distance from the proposed cable corridor, but is an area of similar environs. Another was found in the area of the practice driving range during its construction. The third burial was found when Hurricane Iwa - in November of 1982 - uprooted a large kiawe tree along the north side of the driving range. Each of the three finds was reburied at the place of their discovery. The latter two burials are within about 1000 feet of the proposed cable corridor.

These finds are consonant with archaeological evidence from other areas around Wailua, sites around Kaua'i and sites on other islands of the Hawaiian group which have been used to predict the location of burials in sand beach and dune deposits along or near the shoreline. Information from the interviews with Mr. Koga and Mr. Shirai also revealed that little or no grading was done to construct most of the golf course. Thus there has been little, or in some areas, no disturbance of the sand beach and dune deposits in the project area. More extensive grading appears to have been necessary for the practice golf driving range where the previously noted single burial was found.

RECOMMENDATIONS

The established presence of human burials in the beach and dune sand deposits along the coast of Wailua *makai* of Kalepa-Nonou Ridge indicates a strong probability that burials will be encountered during excavation of the trench through the golf course for the proposed fiber-optic cable. Although only individual isolated burials have been reported near the cable corridor we believe that archaeological subsurface testing of the precise trench line should be conducted once the exact line is surveyed and staked in the field. This testing is necessary to ensure that such burials as may be encountered are not grouped or concentrated in the manner of a cemetery or family graveyard.

Continuous on-site monitoring by archaeologists is recommended during all excavation work in undisturbed beach and dune sand deposits between the wave cut bank at the shoreline and Kuhio Highway. This recommendation is based on the probability of undisturbed sand beach and dune deposits in the cable corridor, and our knowledge of apparently individual and isolated human burials within the bounds of the Wailua Golf Course.

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