1996-09-08-KA-FEA - Submarine Fiber Optic Cable Landing at Wailua Golf Course

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

Submarine Fiber Optic Cable Landing at Wailua Golf Course, Island of Kauai

HAWAIIAN ISLAND FIBER NETWORK (HI FiberNet)

AUGUST 1996

PREPARED FOR:
GST Pacwest Telecom Hawaii, Inc.
91-238 Kalaeloa Blvd., Building One
Kapolei, Hawaii 96707

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FINDING OF NO SIGNIFICANT IMPACT

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ISLAND OF KAUAI, HAWAII

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AUGUST 1996

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PROJECT SUMMARY

Project:	Hawaiian Island Fiber Network (HI FiberNet)
Applicant:	GST Pacwest Telecom Hawaii, Inc. 91-238 Kalaeloa Blvd., Suite 100 Kapolei, Hawaii 96707
Contact: Phone:	Robert Volker, General Manager (808) 682-5123
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: Phone:	Brian Takeda or Chester Koga 842-1133
Existing Land Uses:	County Golf Course, Recreational area, Unimproved beach
State Land Use District:	Conservation
General Plan Land Use Designation:	Conservation
County Zoning Designation:	Public Facilities

SECTION 1
INTRODUCTION

1.1 PURPOSE AND OBJECTIVES

GST Pacwest Telecom Hawaii, Inc., a subsidiary of GST Telecom Inc., proposes to develop an interisland submarine fiber optic cable system which will link the Islands of Kauai, Oahu, Maui, Lanai, Molokai and Hawaii. The Hawaiian Island Fiber Network (HI FiberNet), when completed, will be largest in the State and the first to connect Molokai and Lanai with the other major islands.

In the early 1990's, GTE Hawaiian Tel installed the first interisland fiber optic cable system to enhance its existing interisland radio system. Information for this environmental assessment is derived from earlier reports written for GTE Hawaiian Tel by R. M. Towill Corporation (*January 1993, Environmental Assessment for the GTE Hawaiian Tel Interisland Fiber Optic Cable System; Wailua Golf Course Kauai; Sandy Beach Park, Oahu; Mokapu Beach, Maui; Spencer Beach Park, Hawaii).*

The proposed system will include three interisland submarine cable segments with eight landing sites (Figure 1-1). The main system will include a 24 strand main cable with linkage from Waialua Golf Course, Kauai, to Makaha Beach, Oahu; Makaha Beach to Keawaula, Oahu; Sandy Beach, Oahu, to Mokapu Beach, Maui; and, Mokapu Beach to Spencer Beach, Hawaii. On the Sandy Beach to Mokapu Beach segment, two branching units comprised of up to 8 fiber optic strands will "Branch" off from the main line to connect to landings at Manele Bay, Lanai, and Kaunakakai, Molokai.

The purposes of the proposed project are as follows:

- To provide the public with a viable alternative to interisland telecommunication service that is now provided only by a single vendor. It is anticipated that additional competition will result in higher quality and competitive pricing which will benefit the public;

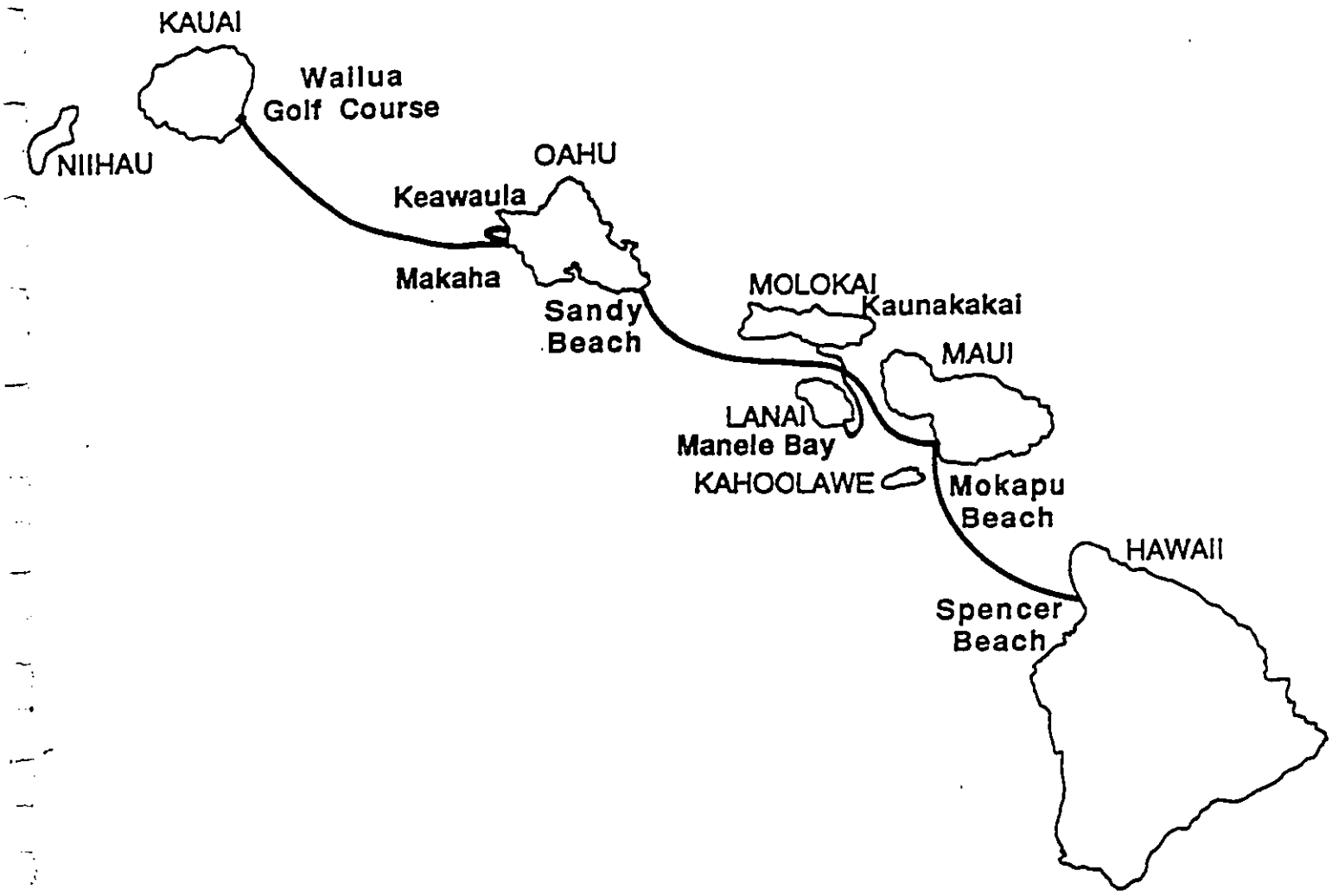

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Figure 1-1
HAWAIIAN ISLAND FIBER NETWORK

GST Pacwest Telecom Hawaii, Inc.
HI FiberNet

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- Fiber optics will allow GST Pacwest Telecom Hawaii, Inc., to enhance service by increasing bandwidth capacity to serve customers. A fiber optic linkage has higher capacity bandwidth which would allow use of high technology services such as telemedicine and real time videotrafficing; and

- To provide redundancy to the existing interisland fiber optic system in the event of system failure or damage to the system.

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 (Figure 1-2). 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.

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.

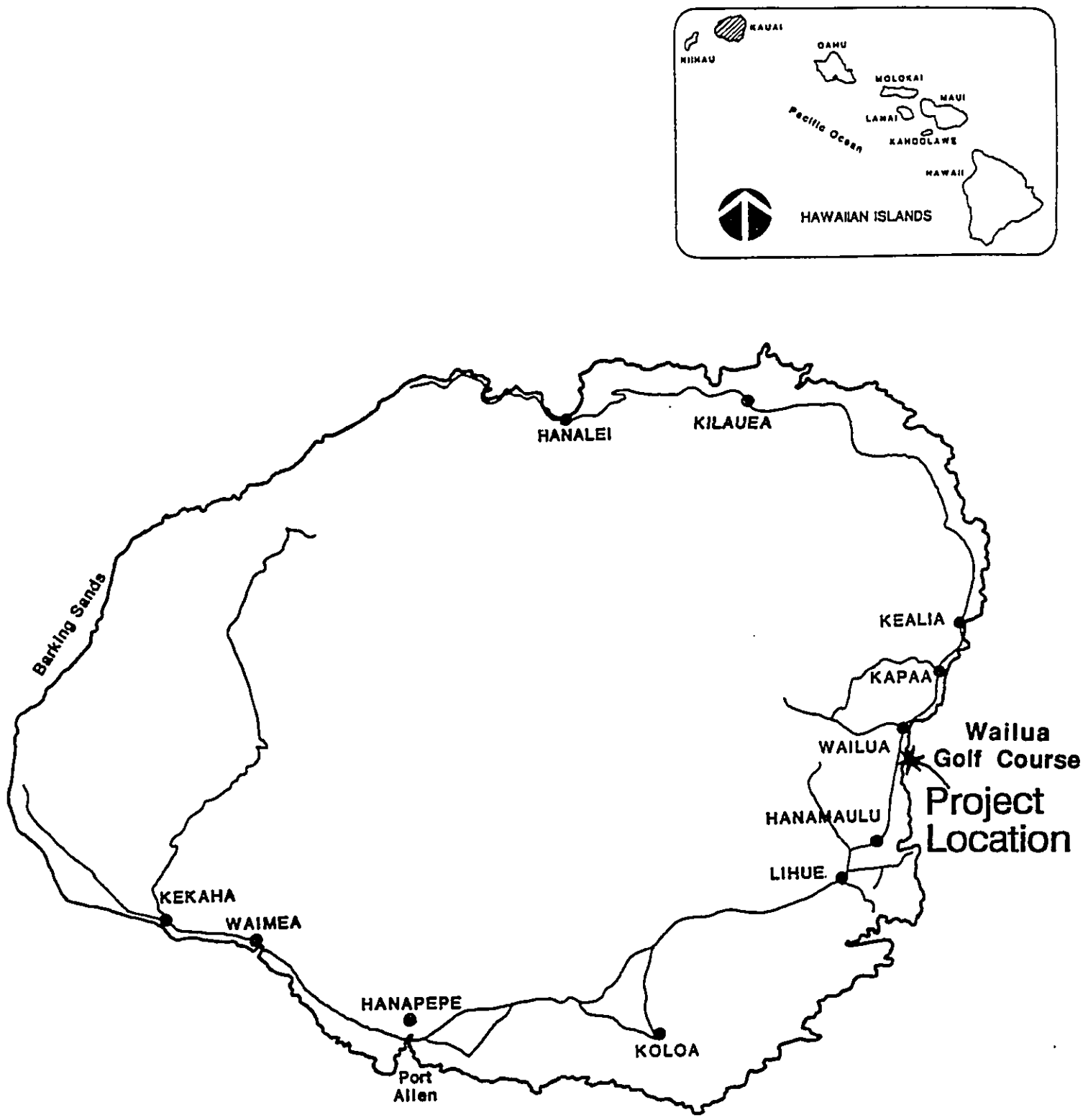

Figure 1-2
LOCATION MAP
Wailua Golf Course, Kauai

Not to Scale

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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 are added to ensure 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.

Copper wire cables require use of a repeater to boost electrical signals over long distances to ensure adequate signal strength at the receiving station. Repeaters are necessary 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.

In contrast, fiber optic technology relies on the use of optical fibers and the transmission of light pulses which are converted into voice or data signals by the telephone company receiving station. The proposed fiber optic cable would contain approximately 24 fiber optic strands and would be housed in a plastic and steel casing no more than approximately 17 to 51mm in diameter (Figure 2-1). Like the copper cable, steel or other protective materials would be added as 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 88,000 voice circuits (2 strands = 1 pair, 24 strands = 11 pairs working plus 1 pair spare, and 11

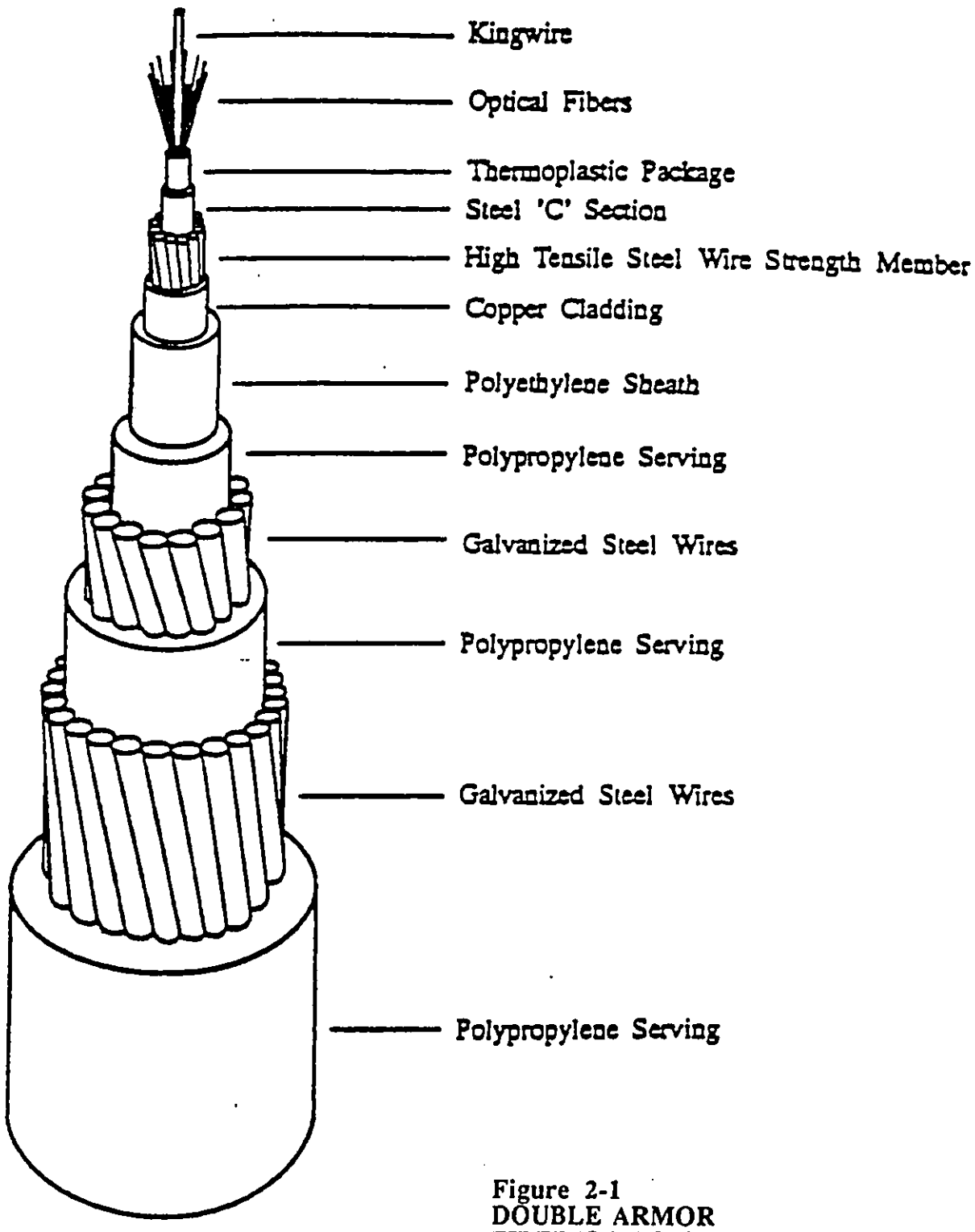

Figure 2-1
DOUBLE ARMOR
FIBER OPTIC CABLE

GST Pacwest Telecom Hawaii, Inc.
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pairs x 8,000 voice circuits = 88,000 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 10 to 20 feet, would require repeaters, and a high-voltage power line in addition to the copper cable.

A summary of reasons for selection of fiber optic technology includes:

- 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 17 to 51mm diameter cable.

- Sensitive areas that might otherwise be disturbed because of larger equipment, 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 contractor and therefore would minimize potential hardships on beach users including swimmers, fishermen, surfers and other users.

2.2 SUBMARINE CABLE ROUTE

Most of the proposed alignment follows the previous route used by GTE Hawaiian Tel. The submarine cable route selection process involved identification of areas warranting study, based on a set of minimum evaluation criteria. The criteria included consideration of 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 the 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. Rapid erosion places large volummes 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 is 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 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

The cable will be laid next to the GTE Hawaiian Tel-Cable. 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.

The proposed HI FiberNet cable in some nearshore segments will be laid next to the existing GTE Hawaiian Tel cable. Wherever possible the ICPC guidelines for separation will be followed for all other crossings in deep ocean water.

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. There will be no submerged repeaters, however, signals will be phonetically amplified at each landside station. The fiber optic cable will operate on a single light transmission source generated from a Central Office and transmitted to a receiving Central Office. Since repeaters will not be required, 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 a basis for comparison.

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 site should not be within proximity to rare or endangered species or their habitats. Impacts to shoreline and ocean water quality should also be kept to a minimum. A site 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 surveyed by GTE Hawaiian Tel 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 sitting 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

GST Pacwest Telecom Hawaii, Inc., is requesting shared use of existing GTE Hawaiian Tel manholes and ductlines to land and connect the terrestrial portion of its interisland fiber optic cable system. Construction of fiber optic cable landing facilities at the shore-end, therefore, will involve one of two alternatives, neither of which would result in adverse potential for impacts.

Alternative A will involve excavation from the shoreline at Wailua Golf Course to a new manhole and ductlines which will be constructed to accept the cable. This would occur if insufficient capacity is available or due to technical circumstances involving shared use of the GTE Hawaiian Tel manhole and ductlines.

Alternative B would involve use of the existing GTE Hawaiian Tel manhole and ductlines. Construction to establish a connection from the GST fiber optic cable to the GTE facility will entail excavation from the shoreline to the existing manhole. From the manhole the fiber optic cable would be routed largely underground along an existing utility right-of-way.

Project Phasing

Proposed construction will take place in two phases. The first phase involves landside construction activities including trenching of the beach and nearshore area, and placement of temporary landing targets. This phase will be described in 3.2 LAND-SIDE ACTIVITY.

The second phase will involve actual landing of the cable, installation of the cable into an existing or new manhole, and beach restoration. Phase two will be described in 3.3 NEARSHORE ACTIVITIES.

3.4 CABLE LANDING PROCESS provides a detailed description of the cable landing, and 3.5 SAFETY CONSIDERATIONS identifies precautions that will be exercised to ensure safety of the public.

Both alternatives will be discussed separately in each phase.

3.2 LAND-SIDE ACTIVITY

Temporary access will be made to mobilize construction equipment such as a backhoe from Kuhio Highway to the project location adjacent to the driving range. Construction access will be selected to minimize the direct crossing of any greens or fairways. This access will be used only for mobilization of equipment to the site. Therefore, use of the adjoining driving range or golf course should not be impacted from mobilization of equipment. During construction equipment will be left on-site.

Alternative A - Construction of new manhole and ductlines:

The first phase involves land-side construction which includes installation of a new manhole located makai of Wailua Golf Course and approximately 1,000 lineal feet of underground ducts and cable to Kuhio Highway (Figure 3-1). From the manhole the fiber optic cable will be located to a new Terminal Building owned by GST Pacwest Telecom, Hawaii, Inc.

The new 5' x 10' x 6' deep reinforced concrete manhole will be constructed in the vicinity of the GTE manhole at Wailua Beach (Figure 3-2). The manhole will be the terminus of the land-side activities and shall be constructed to receive the submarine cable. Approximately 1,000 lineal feet of ductline will be installed in a trench from the manhole, along the Wailua Golf Course, to Kuhio Highway. The ductline will be comprised of four, 4 inch diameter conduits encased in concrete. Only one ductline will be used. The remaining vacant ductlines will be capped and retained should their future use be necessary. Traffic on Kuhio Highway is not expected to be affected. As required traffic will be maintained at all times through use of appropriate traffic control measures.

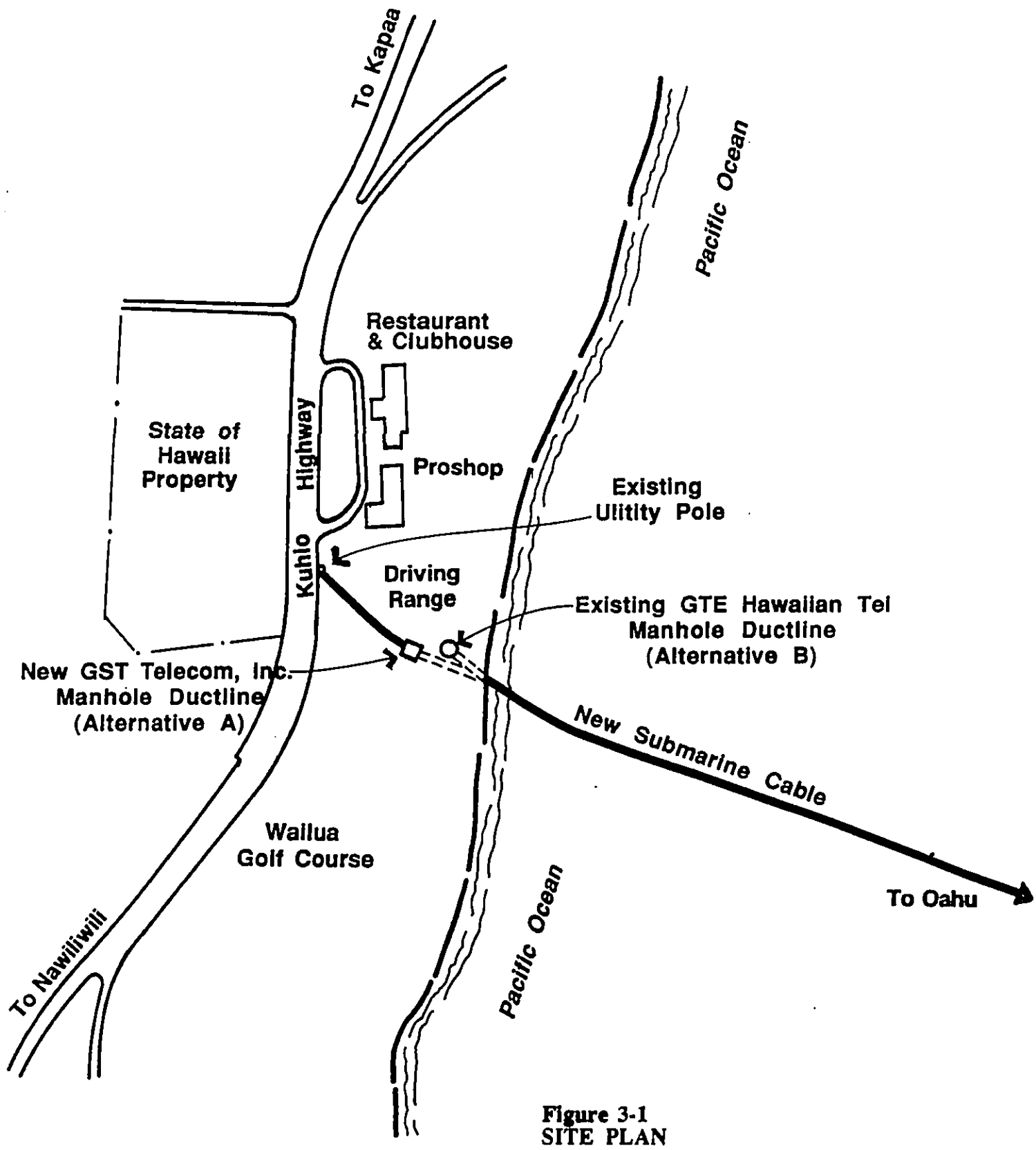

Figure 3-1
SITE PLAN
Wailua Golf Course, Kauai

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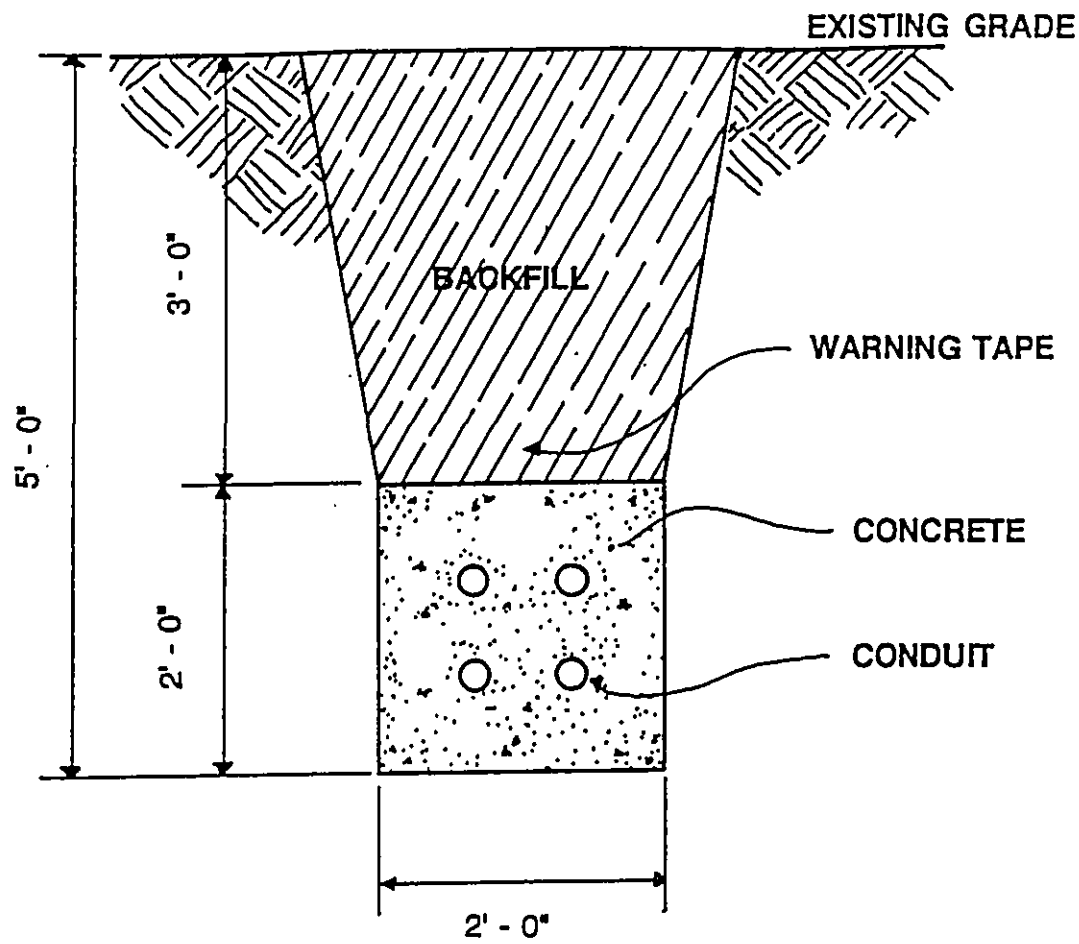

NEW MANHOLE AT WAILUA BEACH

Figure 3-2
TRENCH SECTION
Wailua Golf Course, Kauai

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Alternative B - GST will utilize existing GTE Hawaiian Tel Facilities:

Land-end construction activities will involve excavation of sand to expose the trench which contains the existing ductlines (Figure 3-1). This work will be done just prior to the landing of the cable. The existing ductlines are buried in the sand at a depth of 3 to 7 feet. The upper layer of sand will be removed by machinery (either clamshell or backhoe). Layers of the sand that are closer to the existing cable will be removed manually. The excavated sand will be stored on the beach adjacent to the work site for later placement back into the excavated trench. 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.

During the period of actual construction (excavation of the trench), that portion of the beach will be closed to beach users (approximately 5 to 7 days).

Two range targets (alignment markers) will be placed on land just prior to the landing of the cable 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.

3.3 NEARSHORE ACTIVITY

The greatest danger to a cable system is the submarine (underwater) portion of the route, and this necessitates more construction effort than the landside activity. Protection of the cable and public safety are the major factors for ensuring the fiber optic cable is covered or anchored in nearshore waters. Approximately 50 to 60 feet of water will be required before wave forces diminish to levels where wave action does not affect the cable. Until the cable reaches this depth it must be protected. Trenching is preferred, because it provides maximum protection against wave forces and is best for public safety. Public safety is at risk if the cable is left exposed along the nearshore, because someone could hit their foot and/or trip over it. Therefore, it is suggested that trenching or cable armoring be used to protect the cable and for public safety.

Alternative A - Construction of new manhole and ductlines:

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

A 300-foot long trapezoidal shaped trench will be excavated between the end of the ductline and the mean low water mark. The trench will have a 2-foot base and be approximately 5 feet deep, with 1:1 side slopes. Approximately 580 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 completion of work.

During construction, which is projected for 7 to 10 days, the open trench will be barricaded from the public and a security guard may be required at night and weekends to ensure public safety and integrity of the trench site.

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, sandbags will be used to prevent sand from reentering the open trench. Rock outcrops and other hard substrate which cannot be avoided will also be removed using a backhoe or other similar mechanical means.

To reduce potential for turbidity due to construction related work, silt screens will be utilized. Upon completion of construction activities, the construction crew will make every reasonable effort to return the ground to the existing preconstruction contours through use of existing excavated 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.

The second phase of work involves landing the submarine fiber optic cable and establishing a connection to a new ductline emanating from a manhole at Wailua Beach.

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 cable ship 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 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 recommended route is located next to the existing GTE Tel-Cable alignment 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. 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.

Depending on subsurface conditions coral, rock and other hard surfaces that cannot be avoided will have to be removed using various means such as:

1. Coral and limestone beds may need to be trenched to a width and depth of approximately 1 to 2 feet, or more, to accept the fiber optic cable. If necessary, tremie concrete can be poured into the trench where it can harden under water. The impacts can be minimized depending on the depth of trenching necessary to accommodate the relatively narrow diameter of the cable. If tremie concrete is used, it will provide a new surface for growth of coral and other marine organisms; or,

2. Shielded cable may be laid with split pipe fastened around the cable and then bolted to the hard rock or coral bed using pneumatic or mechanically driven bolts. This practice will result in minimal environmental impact since little or no coral will have to be displaced to site the cable.

The shore landing will be specially prepared to accept the cable. As the cable nears the shore, it will be fed into the conduit previously buried in the sand and pulled to the 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.

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. Approximately 1,000 feet of the cable will be encased in an armor protection from the end of the conduit seaward. This encasement will provide the cable added protection in the nearshore area. The cable will be permanently installed in the manhole at this time.

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.

Alternative B - GST will utilize existing GTE Hawaiian Tel facilities:

The second phase of work involves landing the submarine fiber optic cable and establishing a connection at the manhole previously installed at Wailua Beach. Operations will be short-term, will be based on the need for public safety and protection of the cable, and will not constitute a long-term impact.

There will be no permanent storage of any construction equipment on the beach. Equipment will only be on the beach during the beach construction phase, approximately 1-2 days.

A 300-foot long trapezoidal shaped trench will be excavated between the end of the ductline and the mean low water mark. The trench will have a 2-foot base and be approximately 6 feet deep, with a 1:1 side slopes. Approximately 580 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 completion of work.

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, sandbags will be used to prevent sand from reentering the open trench. Rock outcrops and other hard substrate which cannot be avoided will also be removed using a backhoe or other similar mechanical means.

The shore landing will be specially prepared to accept the cable. As the cable nears the shore, it will be fed into the conduit previously buried in the sand and pulled to the existing 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.

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. Approximately 1,000 feet of the cable will be encased

in an armor protection from the end of the conduit seaward. This encasement will provide the cable added protection in the nearshore area. The cable will be permanently installed in the manhole at this time.

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

Alternative A -Construction of manhole and ductlines:

The cable landing process includes the use of the landslide range targets (alignment markers) 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 rope connected to land based pulling equipment (i.e., winch) and pulled ashore. Once the cable is placed within the new steel conduit, the leading end of the cable will be secured within the new manhole and spliced together with cable emanating from the GST Terminal Building.

Once the cable has been secured, the open trench will be backfilled and efforts taken to restore the beach as much as practicable to its original preconstruction condition.

Alternative B - GST will utilize existing GTE Hawaiian Tel facilities:

The cable landing process includes the use of the landslide range targets (alignment markers) 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 rope connected to land based pulling equipment (i.e., winch) and pulled ashore. Once the cable is placed within the existing conduit, the leading end of the cable will be secured within the manhole and spliced together with cable emanating from a central office.

Once the cable has been secured, the open trench will be backfilled and efforts taken to restore the beach as much as practicable to its original preconstruction condition. The contractor will maintain stability of the shoreline through use of vegetative controls as well as structural measures including rip rap boulders (already in use on-site). This protection of the embankment will be coordinated with the County of Kauai, Department of Public Works, Division of Parks and Recreation.

3.5 SAFETY CONSIDERATIONS

During the construction phase on the beach (approximately 5 to 7 calendar days), the portion of the beach which contains the open trench will be barricaded from public entry. Lateral access will be provided in designated areas. During the construction period, a security guard may be required at night and weekends to ensure public safety and integrity of the job site.

During the cable laying process (approximately 10-12 hours depending on the 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 to 150 feet wide and 1,000 to 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.

It should be noted that due to the proximity to the driving range construction workers may be at a risk of being hit by mis-hit golf balls from the driving range. As required, screens will be built to protect construction workers.

3.6 SCHEDULE AND ESTIMATED COST

Alternative A - Construction of new manhole and ductlines:

The first phase (land-side activities) of the project is scheduled tentatively for Fall 1996. The second phase (installation of the interisland cable and cable landing operation) is also scheduled tentatively for Fall 1996. Construction cost for the first phase is estimated at + $250,000.

Alternative B - Authorization for joint use of GTE Hawaiian Tel facilities:

The installation of interisland cable and cable landing operations is scheduled tentatively during the 4th quarter of 1996. Construction costs for this phase are estimated at +$100,000.

SECTION 4

DESCRIPTION OF THE AFFECTED ENVIRONMENT

4.1 PHYSICAL ENVIRONMENT

4.1.1 Climate

The project site 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.

4.1.2 Topography, Geology, Soils

The project area is located at the base of a single shield volcano which was eroded and layered by other volcanic activity. Mauka of the shore is altered with golf course development. At the end of the vegetative line, the elevation drops vertically seven to eight feet to the foot of upland bank. The beach areas from the foot of vegetated upland bank to the shoreline, where the landing will take place, are fairly flat. A 500-foot wide fringing reef is almost continuous off the southern part of the beach, but becomes intermittent past the golf course.

The predominant soil type classified by U.S. Department of Agriculture, Soil Conservation Services is (BS) Beaches. This soil type can be described as sandy, gravelly areas found on all islands which are washed and rewashed by ocean waves. The beach consists mainly of white sand and gravel or coral material. However, coastal turbidity primarily from runoff associated with agricultural activity have discolored the sand. Beaches have no value for agriculture but where accessible they are highly suitable for recreational uses.

Impacts

With respect to the segment of the cable to be installed subsurface, no long term surface or subsurface impacts are anticipated since the project involves temporary excavation and filling with the same material. All reasonable efforts will be taken to ensure that excavated portions are returned to present preconstruction contours by reusing the excavated beach sand for backfill.

4.1.3 Hydrology

There are no perennial streams in the subject area. 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 water requirements.

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. Existing flora and fauna of the project site consists mainly of introduced species.

With respect to animal wildlife for the area, no rare or endangered animals are known to inhabit the site. The area is subject to frequent flooding, has sparse vegetation, and does not provide good habitats for rare animals.

Impacts

The site of the excavation contains previously disturbed beach sand due to the installation of the GTE cable system. Since 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 as needed to ensure stability of the site.

4.1.5 Marine Flora and Fauna

A qualitative reconnaissance of the waters fronting the Wailua County Golf Course was conducted by Sea Engineering in June 1991 (Marine Environmental Analysis of Selected Landing Sites, Sea Engineering, Inc., and Environmental Assessment Company., January 1992). 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. 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 biotope of sand covers the entire project site. The substratum in the biotope of sand is dominated by sand. The benthic species found in sand habitats are generally adapted for life on an unstable and frequently abrading environment because of its shifting nature. 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 this 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 identified during the survey work in the waters fronting the Wailua County Golf Course. Additionally, no macroalgae in the vicinity of the cable alignment or shelter that may be appropriate as green turtle resting sites were found. 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.

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. Many of these forms are motile, deployment of the cable across such a substratum presents little chance of negative impact to resident species because it is anticipated that as the fiber optic cable is laid that most, if not all of the marine organisms present would simply move out of the way for the temporary duration of work. Additionally since the substratum shifts, the deployed cable will sink into the substrate and eventually bury itself in areas with loose sand and sediments.

A major consideration in the selection of the route for the HI FiberNet cable is the route followed by the existing GTE Hawaiian Tel Fiber Optic Cable. In addition, the underlaying sand offers little chance of negative impact to benthic communities relative to the impact that could occur to benthic communities situated on hard substratum. Since the proposed cable alignment is through a sand channel to the shoreline, little impact to the surrounding marine communities is anticipated.

Another concern may be with disturbance to threatened or endangered species. 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; 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 (here noise) are of short duration, and all activity will be concentrated in a small area. Finally no known adverse impacts on whales were reported during the laying of the GTE cable system.

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, 1990). 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).

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 re-suspending 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 construction activities. 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., Dollars and Grigg, 1981) have found that the impact must be at a high level and chronic to affect adult corals.

Underwater construction (principally dredging) will generate fine particulate material that could impact hard substratum communities such as corals if in close proximity to the proposed landing site. However, we are not aware of any well developed hard bottom communities close to the proposed cable alignment.

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.

Nowhere in the vicinity of the proposed cable alignment were any diverse benthic communities noted due to occasional high surf coupled with the frequently moving sand. The proposed cable alignment was selected to avoid hard substratum, and thus deployment of the cable on this alignment should not result in any significant impact to marine communities. The small scale and anticipated short duration of the project suggest minimal impact. In addition, through the use of silt curtains at the end of the cable ductline, adverse effects due to turbidity can be minimized by leaving a barrier of sand in place at the water's edge until the day of the cable pull. Finally, no negative impacts were reported during the laying of the GTE cable system which used this same installation methodology.

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

standing crop of fish (>2 to 20g/m^2). Goldman and Talbot (1975) note that the upper limit to fish biomass on coral reefs is about 200g/m^2. Thus the few fishes encountered in this qualitative reconnaissance of the sand flats fronting the Wailua County Golf Course is not unexpected.

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

The beach will be returned as much as practicable to its existing condition at the conclusion of the cable installation. Excess material not utilized for fill will be removed and disposed of in accordance with applicable County and State Regulations.

4.1.7 Historic/Archaeological Resources

The archaeological testing of the proposed fiber optic cable route, conducted on-site in 1993 for the GTE Hawaiian Tel interisland submarine cable system, found no significant prehistoric cultural materials or human burials. However, during the landing of the cable itself, human remains were discovered which required appropriate treatment in coordination with the State Historic Preservation Division, DLNR.

Impacts

According to coordination with Ms. Nancy McMahon, State Archaeologist for Kauai, State Historic Preservation Division (SHPD), DLNR (July 1996), although no historic sites were found in the previous report Archaeological Inventory Survey, TMK: 3-9-02 and 05, Wailua, Lihue, Kauai, (Folk, Ida, Novack and Hammatt, Cultural Surveys Hawaii, 1993, Revised January 1994), monitoring during construction did uncover human burials which

required mitigation. SHPD therefore recommends the following mitigation measures to prevent potential for adverse impacts:

1) A qualified archaeologist shall be used to conduct on-site monitoring during trenching to install the fiber optic cable. Prior to starting work, an acceptable monitoring plan (scope of work) will be submitted to SHPD for review and approval. The monitoring plan will spell out a process for treating sites that are found: 1) for evaluating significance in consultation with SHPD; and 2) for developing and executing mitigation work with the approval of SHPD. It must be clear that if historic sites, including burials, are uncovered during the monitoring, construction must stop in the immediate vicinity and the archaeologist shall be allowed sufficient time to evaluate the site and carry out mitigation as needed. The plan must include provisions for an acceptable monitoring report, documenting all findings to be approved by SHPD.

2) A burial treatment plan shall be prepared for inadvertent burials encountered during monitoring. In addition, consultation with appropriate ethnic groups using procedures outlined in Chapter 6E-43, HRS, shall be followed. It will be necessary for the treatment plan to be prepared after consultation with native Hawaiians, such as the Kaua'i Island Burial Council, Office of Hawaiian Affairs, and Hui Malama I Na Kupuna O Hawaii Nei.

3) A final report documenting the monitoring work shall be submitted to SHPD for review and approval. This report shall include the following:
   a) Detailed plan drawings of any burials found, to scale;
   b) Photographs shall be taken of any burials found;
   c) Sketches and photographs of any major types of artifacts found, including any grave goods;
   d) Stratigraphic profiles drawn to scale of any burials found (when they are in place) and of representative samples of any habitation deposits found;
   e) Site locations placed on an overall map of the project area;
   f) Initial significance evaluations for each historic site found; and
   g) Discussion of the nature, size, and age of any sites found.

The above measures will be followed as prescribed by SHPD. It is expected that potential for adverse impacts, however, should be further lessened during the proposed landing because the work will be confined to the same shoreline segment and alignment which has already been disturbed during the landing of the GTE Hawaiian Tel cable system.

4.1.8 Beach Erosion and Sand Transport

The beach fronting Wailua Golf Course is approximately 175 feet wide and 14,000 feet long stretching from beyond Kawailoa in the south to Lydgate State Park and Wailua River to the north. The nearshore bottom is predominantly sand. The existing submarine cables are laid directly on the ocean bottom except for that portion of cable near the shore.

The beach along the southern half of the golf course has undergone significant erosion, most resulting due to Hurricane Iniki. 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.

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 remain preserved.

4.1.9 Noise From Construction Activity

Noise will be generated during the construction phase of the project. Cable laying and excavation equipment and machinery will be used, which will be sources of noise.

Impacts

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.

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. No long term adverse impacts, however, are anticipated.

4.1.11 Water Quality

Nearshore waters are rated Class "A" 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 potential for increased turbidity may occur in nearshore waters of the project sites during the trench excavation and backfilling operations. Silt screens to lessen turbidity effects will be erected to minimize this impact. Adverse effects due to turbidity can be minimized by leaving a barrier of sand in place at the water's edge until the day of the cable pull.

4.2 SOCIO-ECONOMIC ENVIRONMENT

4.2.1 Population

Although the population within the Island of Kauai was approximately 54,200 in 1992, the population is projected to increase to 84,600 by 2010 (The State of Hawaii Data Book, 1990 & 1993-4). 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, beachcombing, swimming, diving and walking along the shore.

Impacts

No long term impacts are expected from development of the proposed project. However, development will temporarily impact shore side recreational uses. During construction the portions of the beach will have to be closed for safety reasons. Lateral access will be provided in designated areas. When completed the cable route will result in very little to no visible impact to the surrounding area.

4.3 PUBLIC FACILITIES AND SERVICES

4.3.1 Transportation Facilities

The project site is served by Kuhio Highway. Construction will primarily involve preparing the

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 used the beach fronting the Wailua County Golf Course for subsistence fishing. 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 200g/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

site to land the fiber optic cable and installing the cable.

Impacts

The proposed project is expected to have no impact on the existing traffic or bus services.

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, beachcombing, diving, fishing, and walking. Wailua Golf Course is an 18-hole course with a driving range, clubhouse, restaurant, parking and related accessory uses (Figure 4-1).

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. Construction will take 5 to 7 days. Lateral access will be provided in designated areas. Impacts will be short term, lasting only until construction is completed.

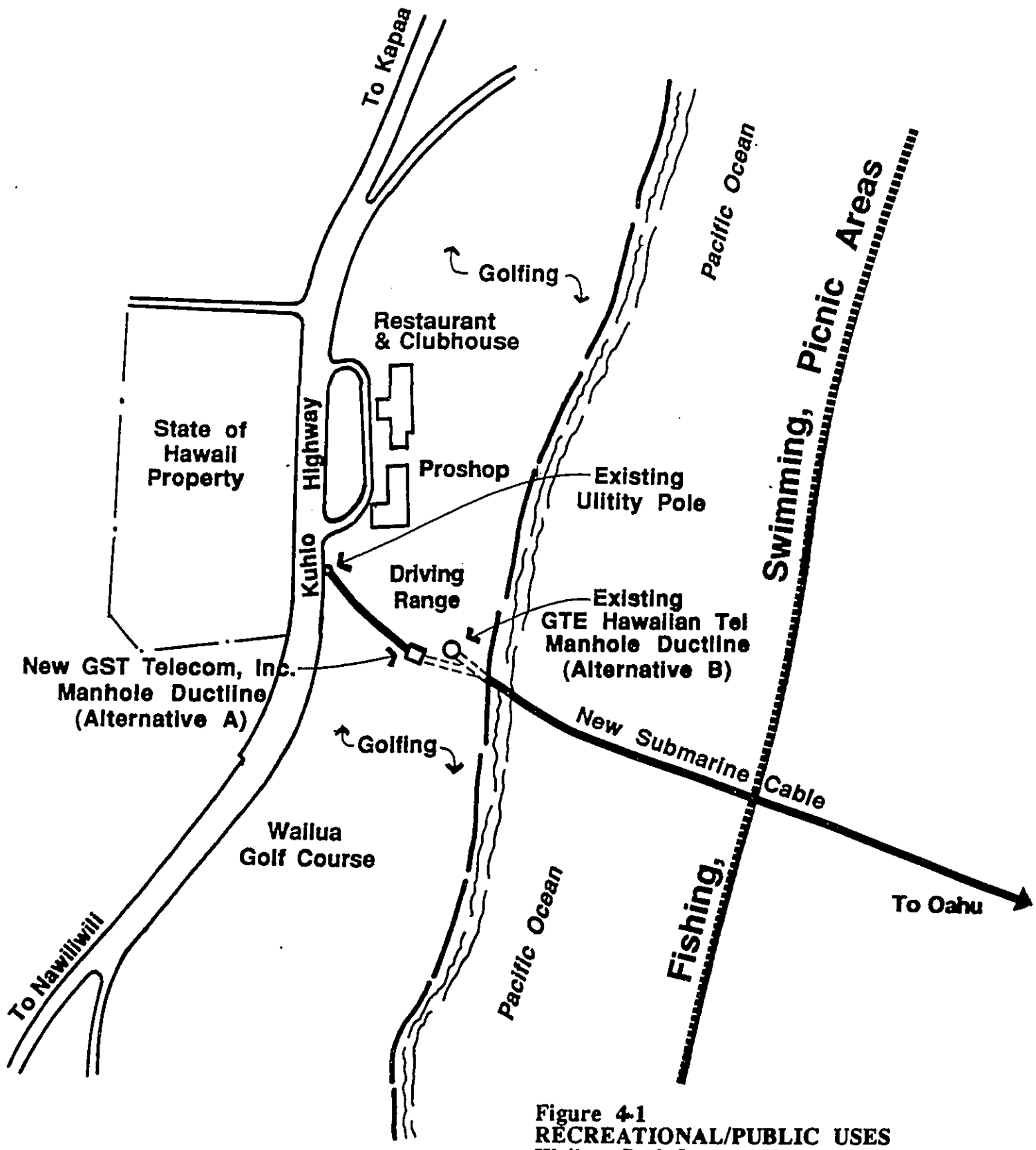


Figure 4-1
RECREATIONAL/PUBLIC USES
Wailua Golf Course, Kauai

Not to Scale

GST Pacwest Telecom Hawaii, Inc.
HI FiberNet

R. M. TOWILL CORPORATION

April 1996

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.

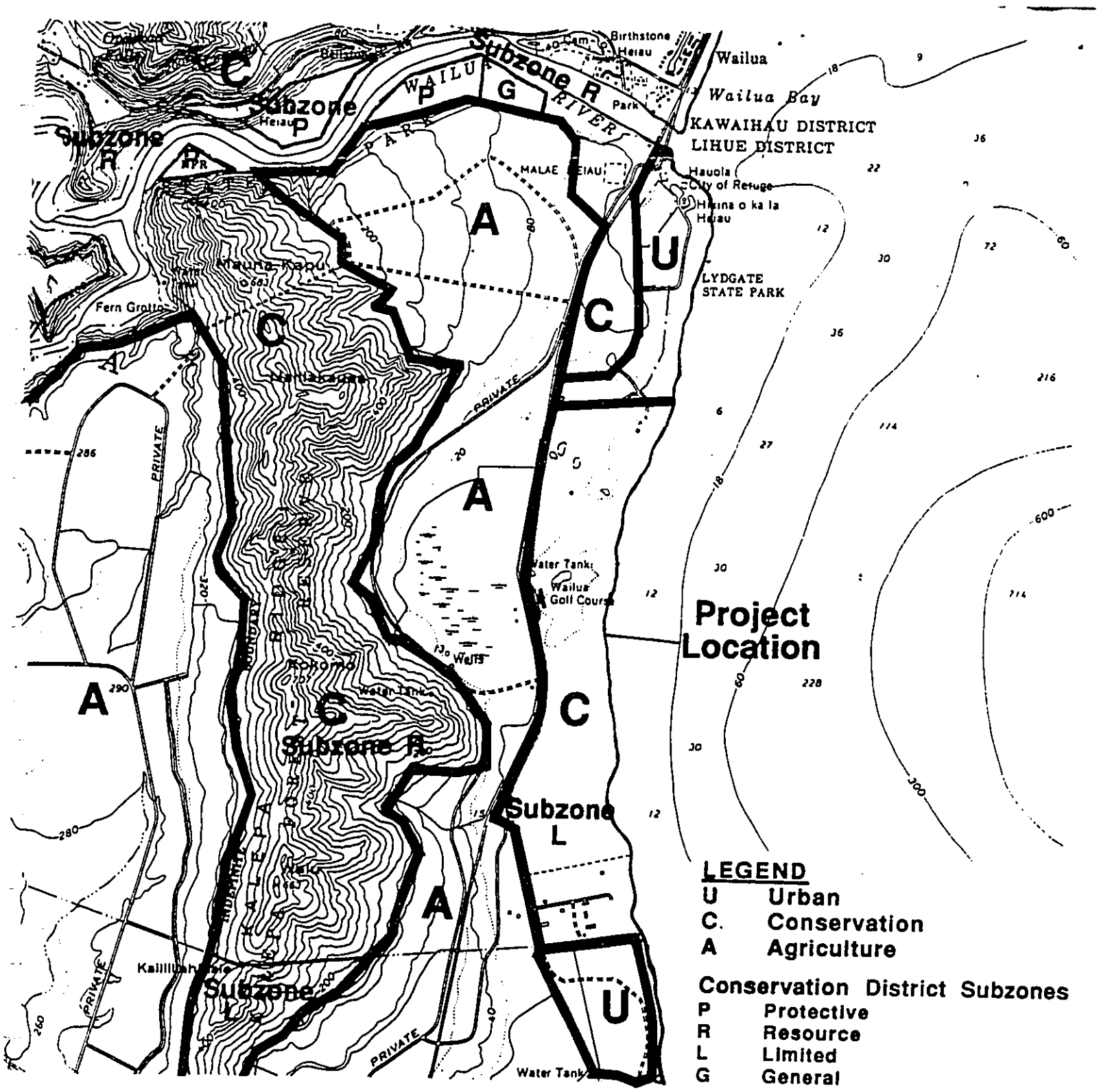
Education Implementing Action(3)(e):

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 land use classification for the Wailua Golf Course landing is Conservation (Figure 5-1). The project site is designated by the State Department of Land and Natural Resources as being within the Limited Subzone. A State Land Use District Boundary Amendment will not be required. However, because the landing will require work in the Conservation District, a Conservation District Use Permit (CDUP) will be necessary. In addition, further coordination with the State Department of Transportation (DOT), Harbors Division, and the U.S. Coast Guard will be required to advise mariners of the proposed action.

DOCUMENT CAPTURED AS RECEIVED



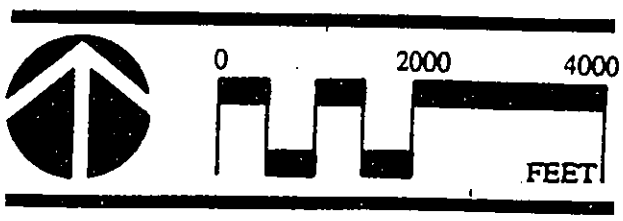


Figure 5-1
STATE LAND USE
Wailua Golf Course, Kauai

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JANUARY 96

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 5-2 identifies the existing County zoned lands in this area.

5.5 COUNTY OF KAUAI GENERAL PLAN

The General Plan of the County of Kauai 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 COASTAL ZONE MANAGEMENT, SMA RULES AND REGULATIONS

The County of Kauai has designated the shoreline and certain inland areas of Kauai as being within the Special Management Area (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 (Figure 5-3). A county 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.

A Shoreline Setback Variance (SSV) will be required for the landing because the project will require siting a cable from the certified shoreline, to the open end of the ductline that would accept the fiber optic cable. The proposed project, therefore, will be subject to the provisions of the Shoreline Setback Rules and Regulations of the State of Hawaii. An application for a Shoreline Setback Variance will also be submitted to the County of Kauai.

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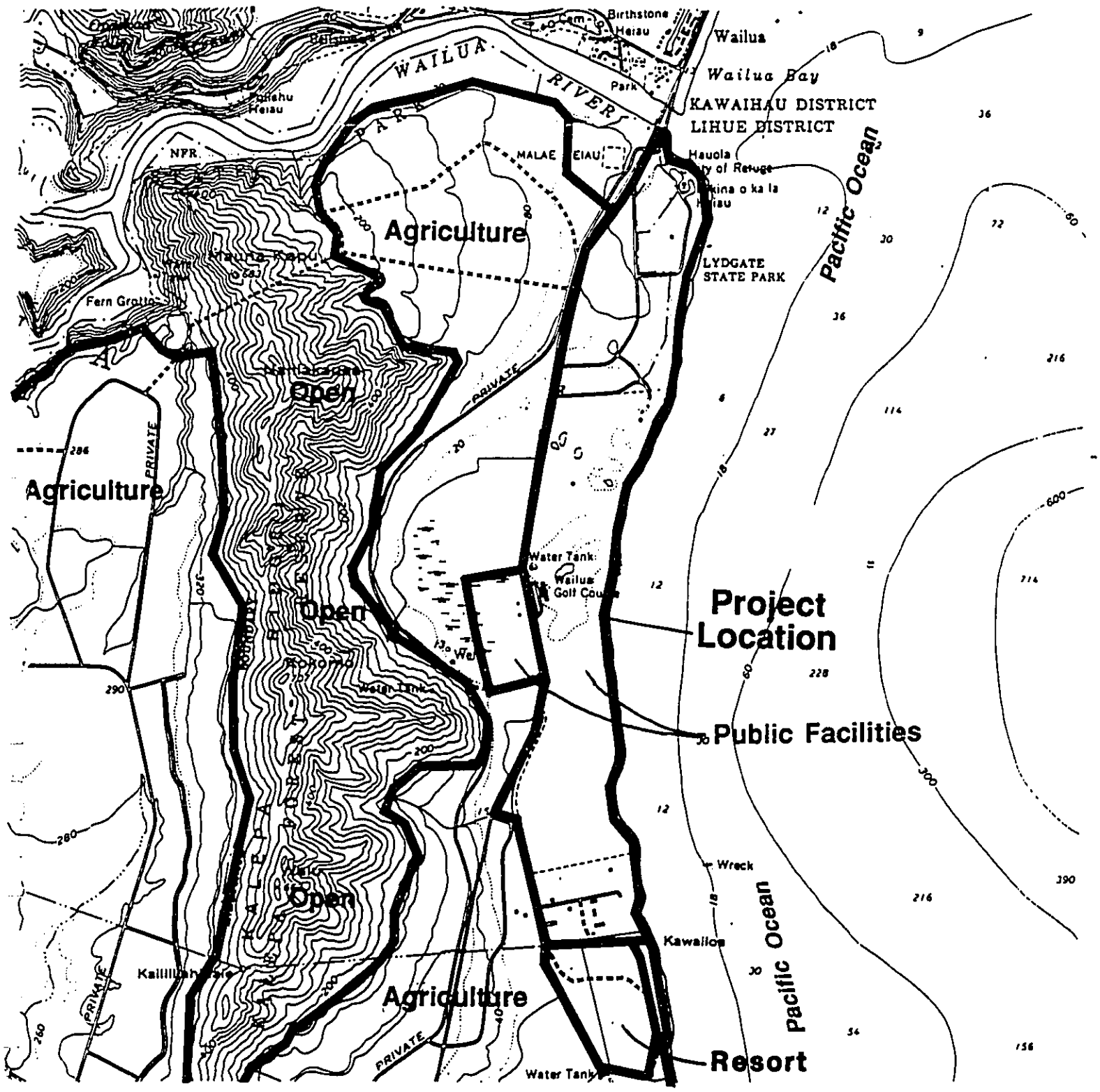

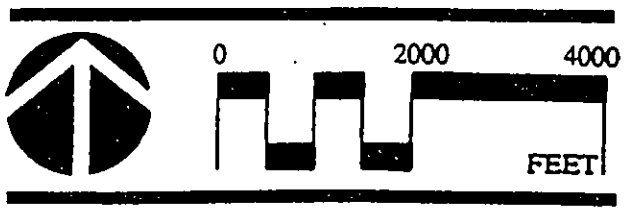

Figure 5-2
COUNTY ZONING
Wailua Golf Course, Kauai

GST Pacwest Telecom Hawaii, Inc.
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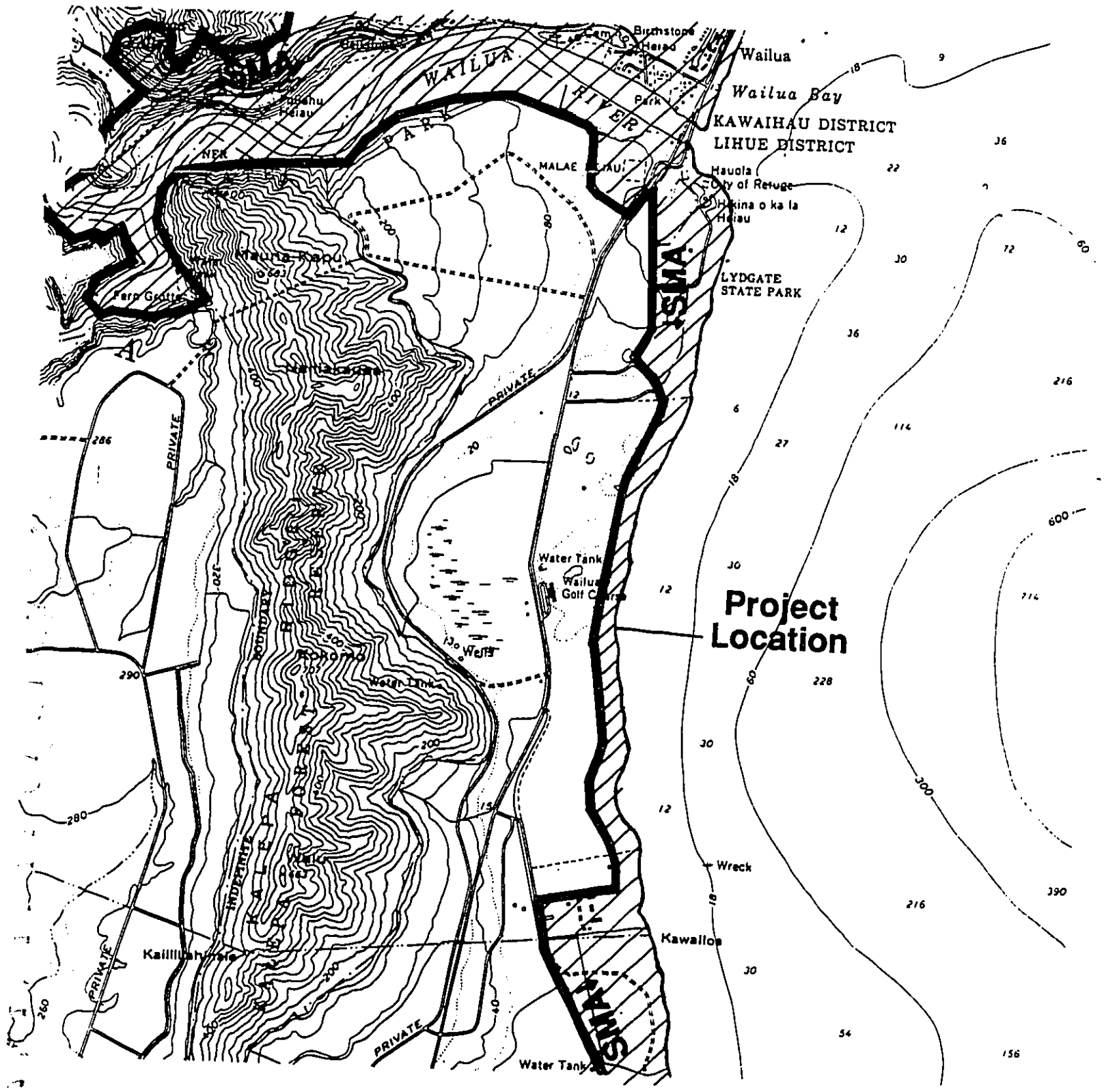
JANUARY 96

DOCUMENT CAPTURED AS RECEIVED



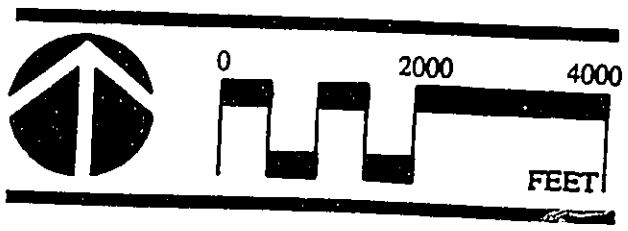


Figure 5-3
SPECIAL MANAGEMENT AREA (SMA) BOUNDARY
Wailua Golf Course, Kauai

GST Pacwest Telecom Hawaii, Inc.
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JANUARY 96

SECTION 6
ALTERNATIVES TO THE PROPOSED ACTION

6.1 NO ACTION

No action would result in the lost opportunity to provide an alternative to existing interisland telecommunications service which is now provided solely by a single vendor. A major feature would be the loss of a new competitor to the market place that could benefit both government and the private sector through competitive pricing.

In addition to the lost opportunity imposed by no action, the following would also result:

- Lost employment opportunities which would have been realized in conjunction with the cable laying, and subsequent maintenance and operation activities;
- Lost tax revenues for State government 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

The proposed landing site was selected after the study of alternative landings for the Oahu to Kauai segment (1992). The area considered for the Oahu to Kauai segment of the fiber optic cable landing extended from Nawiliwili Harbor to Wailua Bay, a distance of approximately 8 miles. 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 Ahukini Coast 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. Wailua Golf Course was selected as the preferred landing site because the site exhibits positive characteristics including nominal land side conditions and workable nearshore waters.

The following is a discussion of the areas initially considered but not selected:

Hanamaulu Bay

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.

Wailua Bay

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.

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 bandwidth necessary for interisland digital circuits without distortion in data transmission and problems with signal strength and reliability.

6.3.2 Satellites

Satellites are not a feasible alternative based 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 bandwidth 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, Kauai.

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 effect 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 competitive 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.

In it 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

- Permit to Work in Ocean Waters

9.2 COUNTY

Planning Department

- Shoreline Management Area Permit (major)
- Shoreline Setback Variance

9.3 FEDERAL

U.S. Army Corps of Engineers

- Department of the Army Permit, 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

10.2 STATE AGENCIES

Department of Land and Natural Resources

Land Division

Department of Health

Department of Business, Economic Development & Tourism

Office of Coastal Zone Management

10.3 COUNTY OF KAUAI

Department of Planning

10.4 Individual Groups

Ms. Laurie Ho, Garden Island Resource Council, Community Development

Mr. Rob Colbertson, Sierra Club, Kauai Chairperson

Mr. Ken Carlson, Nominal Chair, Hawaii's Thousand Friends

SECTION 11

COMMENTS AND RESPONSES TO THE DRAFT ENVIRONMENTAL ASSESSMENT

The following responses were prepared during the Draft Environmental Assessment comment phase.

BENJAMIN J. CAYETANO
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185
FACSIMILE (808) 586-4186

GARY GILL
DIRECTOR

DK		KTS	
WEB		NM	
BTT		3F	
REC'D JUL 8 1996 RMTC			

July 5, 1996

Dee M. Crowell
Kauai Planning Department
4444 Rice Street, Suite 473
Lihue, Hawaii 96766

ATTN: Myles Hironaka

Dear Mr. Crowell:

RE: Draft Environmental Assessment (EA) for GST Pacwest Telecom Hawaii Fiber Optic Cable Landing at Wailua Golf Course, Kauai; TMK: 3-9-2: 4

In the final EA please include the following:

1. Archeological remains: Include full documentation of your consultation with the State Historic Preservation Division of the Department of Land & Natural Resources.

2. Community contacts: Consult with community or interested organizations, such as 1000 Friends of Kauai, and document your contacts.

3. Permits and applications: List application filing dates and/or status.

4. Project start date: Given the lengthy processing time for some agency applications and the public review period required before project commencement, do you think that the fall of 1996, listed in the draft EA as the anticipated project start-up, is realistic, especially since this is part of a statewide project?

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

Sincerely,

GARY GILL

c: Brian Takeda, RM Towill
Robert Volker, GST Pacwest Telecom

R. M. TOWILL CORPORATION

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

August 17, 1996

Mr. Gary Gill
Office of Environmental Quality Control
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

ATTN: Ms. Nancy Heinrich

Dear Mr. Gill:

SUBJECT: Draft Environmental Assessment for Fiber Optic Cable Landing at Wailua Golf Course, Kauai, TMK: 3-9-02:04

We have received your comments dated July 5, 1996, and have prepared the following response.

1. *Archaeological Remains*

We have coordinated the proposed activity with Ms. Nancy McMahon, Historic Preservation Division, Department of Land and Natural Resources (July 1996). According to Ms. McMahon, because the proposed work will involve almost the same effort and alignment as the previous landing of the GTE Hawaiian Tel fiber optic cable, a designated individual should be present during the construction period for monitoring purposes. In the event any new discoveries are made, all work is to stop until the Historic Preservation Division can be contacted for further instructions.

Attached for your reference is a copy of the previous coordination undertaken with Ms. McMahon during the landing of the GTE Hawaiian Tel fiber optic cable system. It is our intention to prepare a similar report documenting the installation of the proposed cable.

2. *Community Contacts*

The following groups and individuals have been contacted for the Wailua Golf Course segment of this project:

Ms. Laurie Ho, Garden Island Resource Counsel, Community Development (246-0091)

Mr. Rob Colbertson, Sierra Club, Kauai Chairperson (246-8748)

Mr. Ken Carlson, Nominal Chair, Hawaii's Thousand Friends (828-2166)

3. *Permits and applications*

The application filing dates for environmental permits are as follows. All permits are currently under agency review.

County of Kauai,
Special Management Area Permit,
April 29, 1996

Department of Health
Section 401 WQC
May 30, 1996

State of Hawaii,
Conservation District Use Permit,
May 31, 1996

Office of Planning
CZM Federal Consistency Determination
May 16, 1996

Department of the Army Permit,
Section 404/Section 10
May 16, 1996

4. *Project start date*

The proposed start date for this project is fall 1996. At this time GST Telecom Hawaii, Inc., is actively working with agencies to address all requirements necessary for this project.

Thank you for this opportunity to comment. Should you have any further questions please contact us at 842-1133.

Sincerely,

Brian Takeda
Senior Planner

Attachments
BT/bt
cc Jack Lewis, GST Telecom Hawaii, Inc.
CK 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

BENJI ANUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES

JOHN P. KEPPELER II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

January 21, 1994

Hallett Hammatt, Ph D
Cultural Surveys Hawaii
733 North Kalaheo Avenue
Kailua, Hawaii 96734

LOG NO: 10563
DOC NO: 9401NM06

Dear Dr. Hammatt:

SUBJECT: **Historic Preservation Review – Archaeological Inventory Survey (Folk, Ida, Novack, and Hammatt, Cultural Surveys Hawaii, 1993, Revised January 1994)**
TMK: 3-9-02 & 05
Wailua, Lihue, Kauai

Thank you for submitting the above revised report (Folk, Ida, Novack, and Hammatt, Cultural Surveys Hawaii, 1994). The requested changes are now included in this report. No historic sites were found.

However, due to the high probability that inadvertent burials and subsurface habitation cultural deposits could be discovered during trenching, we concur with your recommendation that an archaeologist should be present to monitor the rest of the trench construction. This contingency action would reduce impacts to any site that might be inadvertently uncovered. An acceptable report documenting the monitoring work must be submitted to the State Historic Preservation Division. The report shall include:

1) Detailed plan drawings of any burials found, to scale;
2) Photographs shall be taken of any burial found;
3) Sketches and photographs of any major types of artifacts found, including any grave goods;
4) Stratigraphic profiles drawn to scale of any burials found (when they are in place) and of representative samples of any habitation deposits found,

5) Site locations placed on an overall map of the project area;
6) Initial significance evaluations of any sites found,
7) Discussion of the nature, size and age of any sites found,

If you have any questions, please call Nancy McMahon at 587-0006.

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

NM.jen

cc: Dee Crowell, County of Kauai
Roger Evans, OCEA

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

COPY

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

MICHAEL D. WILSON, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
GILBERT COLOMA-AGARAN

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

DK		KTS	
WES			

RECD AUG 20 1996 NMC

Your application in error ?

LOG NO: 17225
DOC NO: 9608NM02

August 14, 1996

Mr. Dee Crowell, Director
County of Kauai
Planning Department
4444 Rice Street, Suite 473
Building "A"
Lihue, Kauai, Hawaii 96766

Dear Mr. Crowell:

SUBJECT: **Chapter 6E-42, Historic Preservation Review –**
Shoreline Set Back Variance SSV-96-2,
(GST PACWEST TELECOM HAWAII, INC.)
TMK: 3-9-2: 04
Wailua, Kauai

Thank you for the opportunity to comment on the Shoreline Set Back Variance for GST PACWEST TELECOM HAWAII INC.. We disagree with several sections of the application (4.5.c.1 (p.4-3); 4.5.d.B.(p. 4-13); and 5.2.4 (p. 5-6)), which deal with the historic resources. In summary, these sections state that no historic sites have been found in the area. This is not correct. The application includes the report titled Archaeological Inventory Survey with Subsurface Testing for the Proposed Fiber Optic Cable Landing, Wailua, Kaua'i (Folk, Ida, Novack, and Hammatt, Cultural Surveys Hawaii, 1993). This report was revised in 1994 to address our concerns. No historic sites were found during the trenching for the survey. We did accept the revised report. We concur with the recommendations of the consulting archaeologist that a qualified archaeologist should be present to monitor the rest of the trench construction of the fiber optic due to the high probability that burials and exposed cultural deposits could be discovered. Human burials have been found throughout the Wailua Golf Course (e.g. Folk and Hammatt, 1992; Erkelens and Welch, 1993: Kukuichi, 1978; and Cox, 1977). In addition, 7 burials were discovered inadvertently during the trenching for the GTE Fiber Optic line (Hammatt and Folk, 1994).

Therefore, we recommend the following conditions be placed on this application:

1) A qualified archaeologist shall be hired to conduct on-site monitoring during the trenching of the fiber optic line. Prior to starting the monitoring work, an acceptable monitoring

plan (scope of work) shall be submitted to the State Historic Preservation Division for review and approval. That monitoring plan will spell out a process for treating sites that are found - for evaluating significance in consultation with our Division and for developing and executing mitigation work with the approval of our Division. It must be clear that if historic sites, including burials, are uncovered during the monitoring, construction must stop in the immediate vicinity and the archaeologist shall be allowed sufficient time to evaluate the site and carry out mitigation, as needed. The plan must include provisions for an acceptable monitoring report, documenting all the findings, to be approved by our Division.

2) A burial treatment plan shall be prepared for inadvertent burial discoveries encountered during the monitoring of the project. In addition, consultation with the appropriate ethnic groups, the procedures outlined in Chapter 6E-43 shall be followed. Previously inadvertent burials found during the GTE project, were analyzed and determined to be Hawaiian. It is necessary for the treatment plan to be prepared after consultation with native Hawaiians, such as the Kaua'i Island Burial Council, the Office of Hawaiian Affairs and Hui Malama I Na Kupuna O Hawaii Nei.

3) A report documenting the monitoring work shall be submitted to the State Historic Preservation Division for review and approval. The report shall include: 1) Detail drawings of burials and deposits to scale. 2) All artifacts shall be sketched and photographed. 3) Analyses of all perishable and datable remains shall be conducted. 4) Stratigraphic profiles shall be drawn and made to scale. 5) All locations of historic sites shall be on an overall map of the project area. 6) Initial significance evaluations shall be included for each historic site found. and 7) Documentation on the nature and age of the historic sites shall be done.

If you have any questions, please call Nancy McMahon at 742-7033.

Aloha,

DON HIBBARD, Administrator
State Historic Preservation Division

NM:amk

c: Brian Takeda, RM Towill

R. M. TOWILL CORPORATION

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

August 21, 1996

Mr. Don Hibbard, Administrator
State Historic Preservation Division
Department of Land and Natural Resources
33 South King Street, 6th Floor
Honolulu, Hawaii 96813

ATTN: Ms. Nancy McMahon

Dear Mr. Hibbard:

SUBJECT: Historic Preservation Review for Submarine Fiber Optic Cable Landing at Wailua Golf Course, Wailua, Kauai, TMK: 3-9-02:04

We have received your comments dated August 14, 1996 and have prepared the following in response.

Thank you for your correction concerning the discovery of human remains during the landing of the previous GTE Hawaiian Tel fiber optic cable. This information will be provided in the forthcoming Final Environmental Assessment for this project. The potential for discovery of future burials and exposed cultural deposits will be addressed by following the recommendations as outlined in your letter. It is our intention to use the services of Cultural Surveys Hawaii, for this work.

Your assistance with the review of this project has been very much appreciated. Should you have any further questions or comments please contact us at (808) 842-1133.

Very truly Yours,

Brian Takeda

Brian Takeda
Senior Planner

BT/bt
cc Mr. Jack Lewis, GST Telecom Hawaii, Inc.
CK RMTC

REFERENCES

1. Archaeological Assessment of the Proposed Fiber Optic Cable Landing for Wailua, Kauai, Prepared for R.M. Towill Corporation, W.H. Folk and H.H. Hammatt, 1992.

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18. The State of Hawaii Data Book 1993-94: A Statistical Abstract, Department of Planning and Economic Development, State of Hawaii, 1993-4.

19. Discussion with GTE Hawaiian Tel, December 1991.

20. Hawaii State Plan, Chapter 226

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

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