EXECUTIVE CHAMBERS

HONOLULU

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JOHN WAIHEE
GOVERNOR

January 28, 1987

Honorable John C. Lewin
Director
Department of Health
1250 Punchbowl Street
Honolulu, Hawaii 96813

Dear Dr. Lewin:

Based on the recommendation of your office, I am pleased to accept the final supplemental environmental impact statement for the proposed Hilo Bay Outfall Sewer Extension, Hilo, Hawaii, as satisfactory fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes.

This environmental impact statement will be a useful tool in the process of deciding whether or not the action described therein should be allowed to proceed. My acceptance of the statement is an affirmation of the adequacy of that statement under applicable laws and does not constitute an endorsement of the proposed action.

When the decision is made regarding the proposed action itself, I expect the proposing agency to weigh carefully whether the societal benefits justify the environmental impacts which will likely occur. These impacts are adequately described in the statement, and, together with the comments made by reviewers, provide a useful analysis to the proposed action.

With kindest regards,

Sincerely,

JOHN WAIHEE

cc: Mr. Hugh Y. Ono
Department of Public Works
County of Hawaii
Mr. Kenneth Ishizaki
M&E Pacific, Inc.

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR THE PROPOSED HILO BAY OUTFALL SEWER EXTENSION HILO, HAWAII

M&E Pacific, Inc.
Consulting Engineers

FINAL
SUPPLEMENTAL
ENVIRONMENTAL IMPACT STATEMENT
FOR THE
PROPOSED HILO BAY OUTFALL
SEWER EXTENSION
HILO, HAWAII

Proposing Agency:

Department of Public Works
County of Hawaii

THIS STATEMENT WAS DEVELOPED IN ACCORDANCE WITH THE ENVIRONMENTAL IMPACT STATEMENT REGULATIONS, STATE OF HAWAII, AND SUBMITTED PURSUANT TO:

CHAPTER 343
HAWAII REVISED STATUTES

12-2-86
DATE

HUGH Y. ONO
CHIEF ENGINEER

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PREFACE

The Revised Environmental Impact Statement (former designation--presently defined as final EIS, Chapter 11-200, Department of Health Administrative Rules) for the Hilo Wastewater Management Plan of the Hilo District, South Hilo, Hawaii, was signed and accepted on September 17, 1980. The wastewater management plan is a comprehensive planning document that addressed all aspects of wastewater infrastructure for the Hilo District, including sewerage system improvements, treatment plant improvements, and the outfall extension. At the time of the preparation of this document, the outfall extension was expected to be in a northerly direction, but the precise alignment had not yet been finalized. The only design criterion that had been determined at the time was the planned extension of the outfall diffuser depth from 50 feet to 80 feet for the purpose of increasing the initial dilution. Subsequent to the completion of detailed bathymetric surveys and a benthic biological reconnaissance study, a preferred alternative alignment was selected. Since the biological study contains valuable information that has a direct bearing on the subject project (Section 11-200-27), this Supplemental Environmental Impact Statement (SEIS) has been prepared to facilitate a more in-depth assessment of environmental impacts of the outfall extension.

CHAPTER I
PROJECT DESCRIPTION

LOCATION

The project is located on the northeastern shore of the Island of Hawaii, often called the Big Island. The outfall for the Hilo Sewage Treatment Plant extends into the Puhi Bay on the seaward side of the Hilo breakwater (Figure I-1). The area in the vicinity of the outfall is used for a mix of industrial, residential, and recreational purposes. Hilo Harbor, which provides boat access to coastal waters, is a significant ocean landmark adjacent to the project site.

OBJECTIVES

The objectives of the project are as follows:

1. To increase effluent dilution to lessen the potential for adverse environmental impacts;

2. To protect against shoreward transport of effluent bacteria.

DESCRIPTION

The proposed project will modify and extend the existing outfall such that the effluent is discharged 5,680 feet offshore at a depth of 80 feet (Figures I-2 and I-3). The extension includes a 1,180-foot section of 48-inch reinforced concrete pipe and a 260-foot diffuser with 3-inch ports spaced 12 feet on centers (Figure I-4). Five mgd of primary effluent from the Hilo Sewage Treatment Plant will be discharged through the outfall.

The orientation of the diffusers will be in a northwesterly direction. The purpose of this orientation is to provide adequate dilution during periods of south and easterly currents, and also provide adequate dilution during periods of the predominantly tide-related westerly currents.

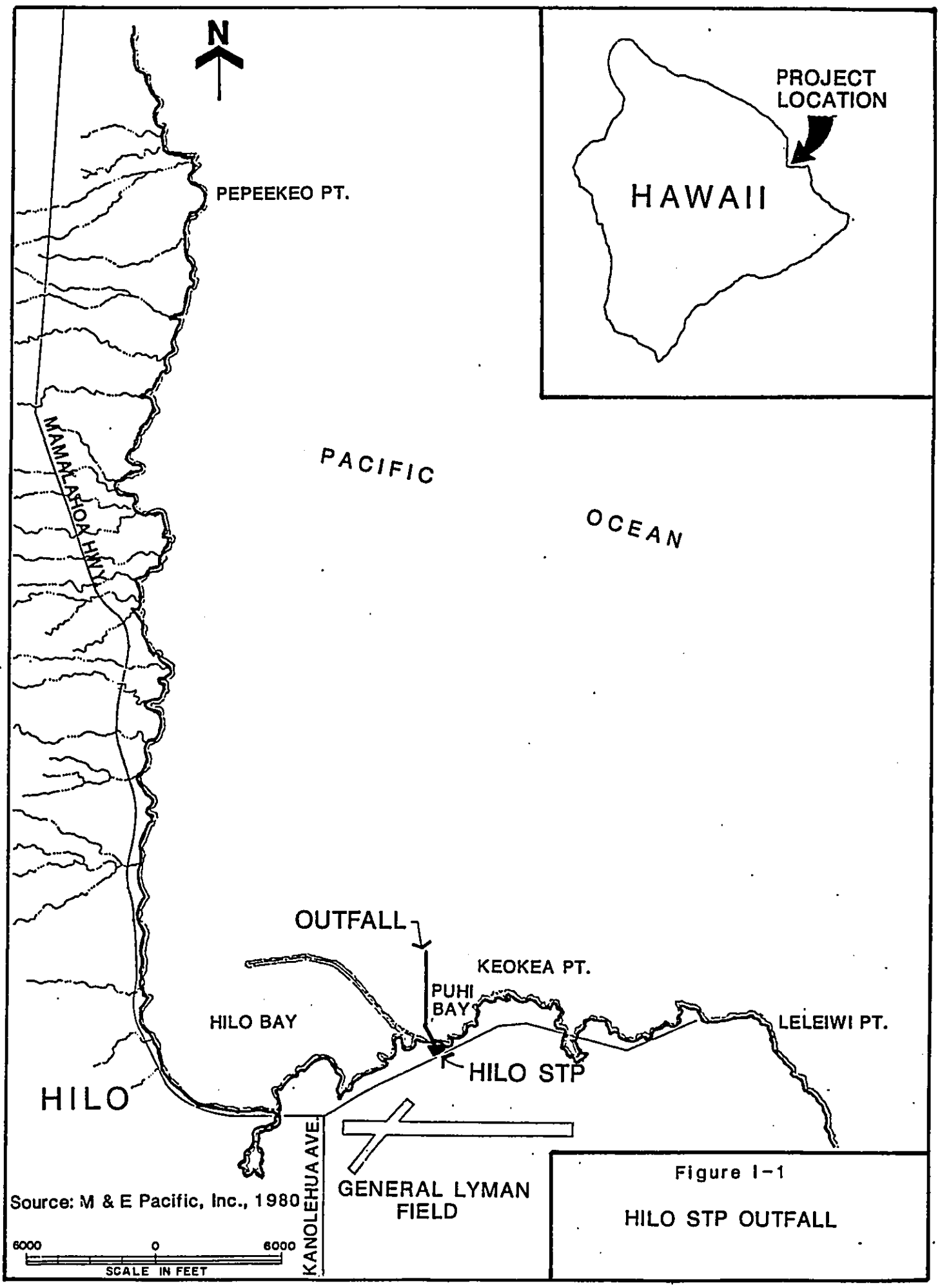
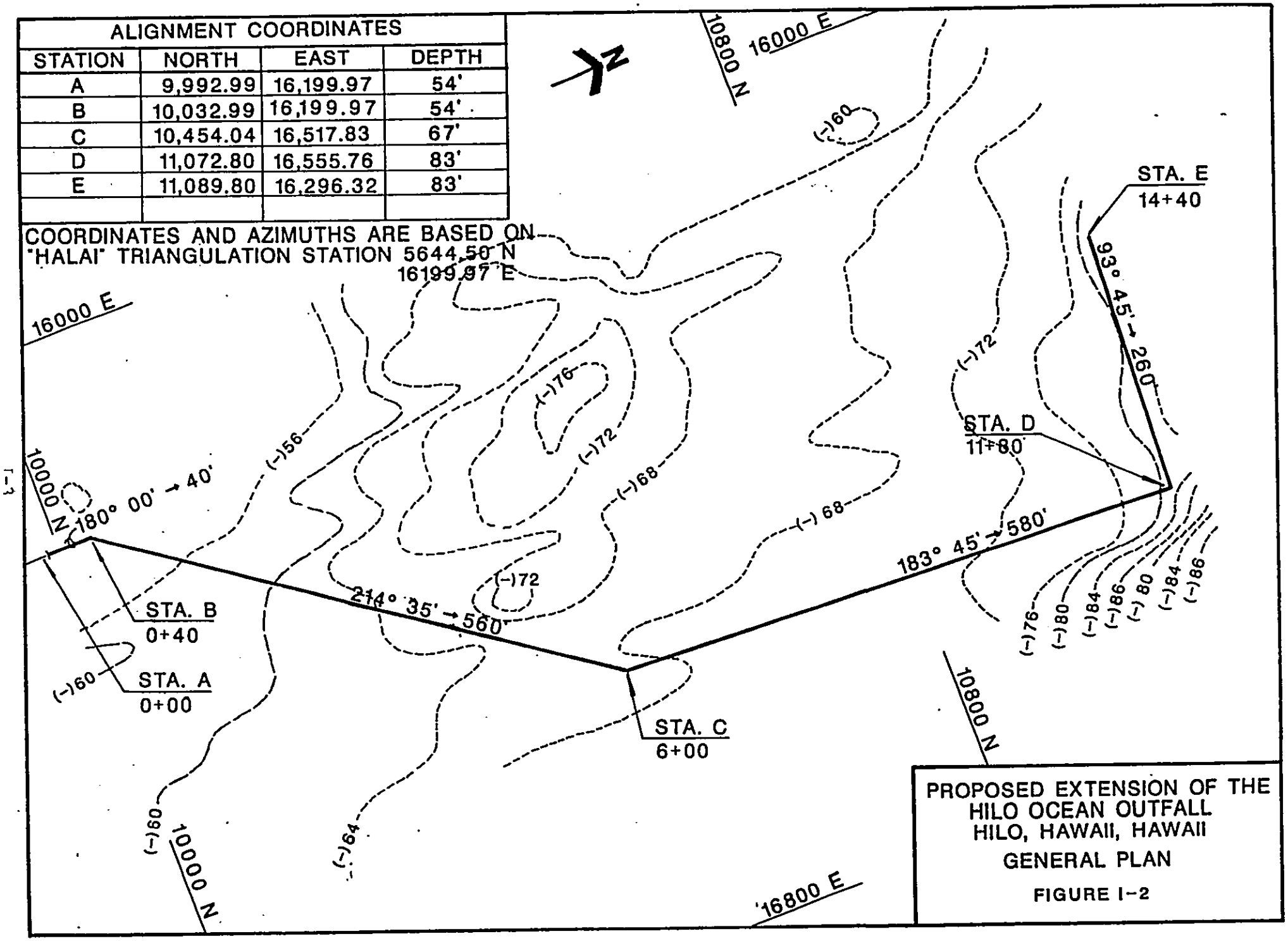


Figure I-1

HILO STP OUTFALL

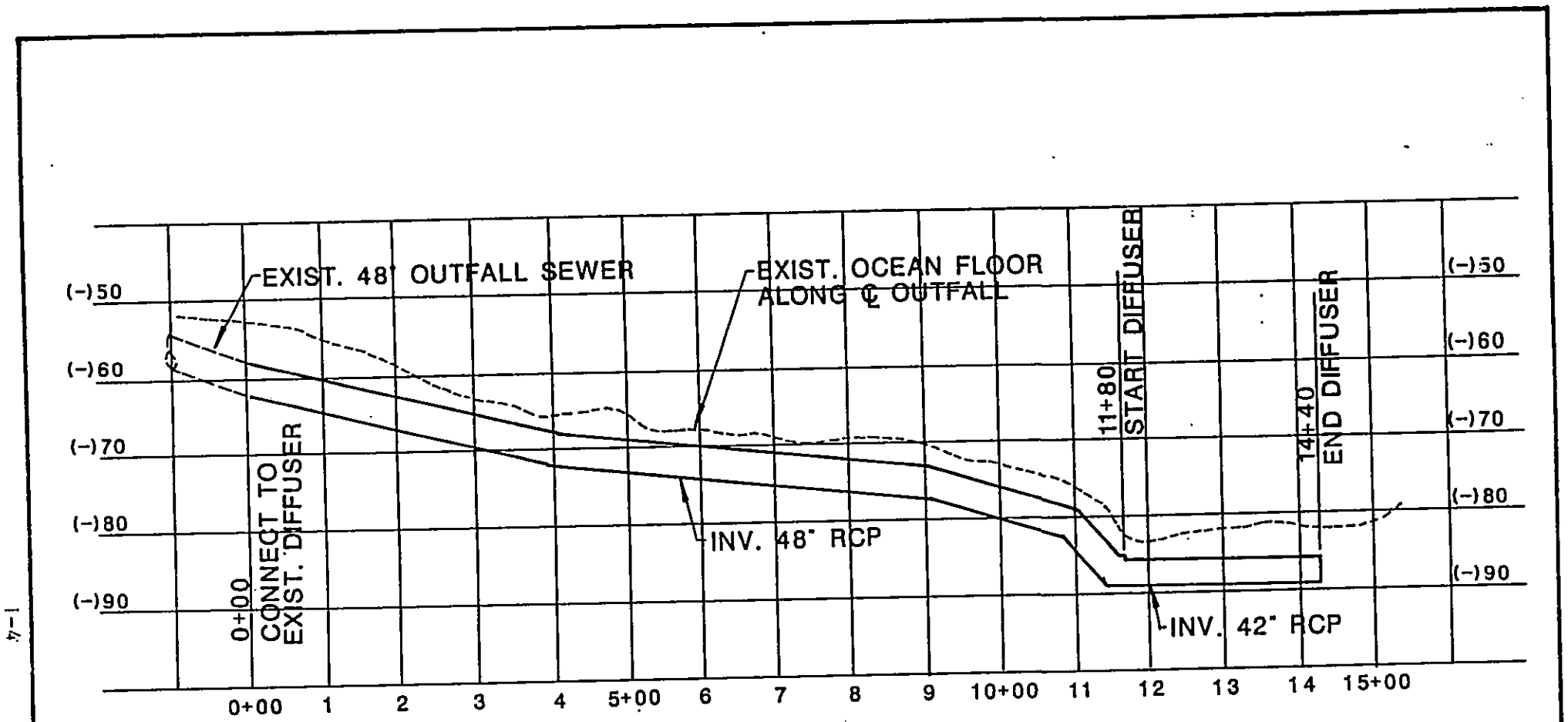
ALIGNMENT COORDINATES			
STATION	NORTH	EAST	DEPTH
A	9,992.99	16,199.97	54'
B	10,032.99	16,199.97	54'
C	10,454.04	16,517.83	67'
D	11,072.80	16,555.76	83'
E	11,089.80	16,296.32	83'

COORDINATES AND AZIMUTHS ARE BASED ON "HALAI" TRIANGULATION STATION 5644.50 N 16199.97 E



PROPOSED EXTENSION OF THE HILO OCEAN OUTFALL
HILO, HAWAII, HAWAII
GENERAL PLAN

FIGURE I-2



GENERAL PROFILE

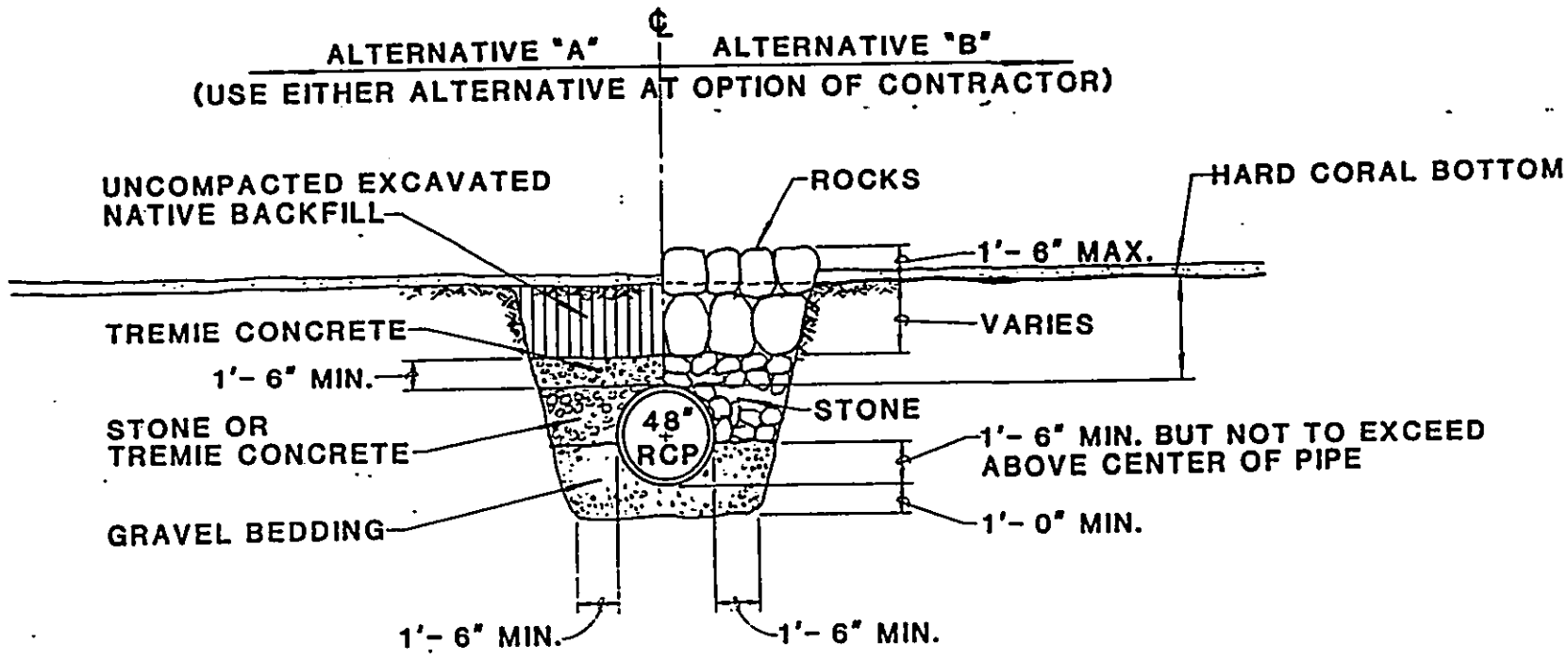
SCALES: HORIZ. 1"=200'
VERT. 1"=20'

NOTES:

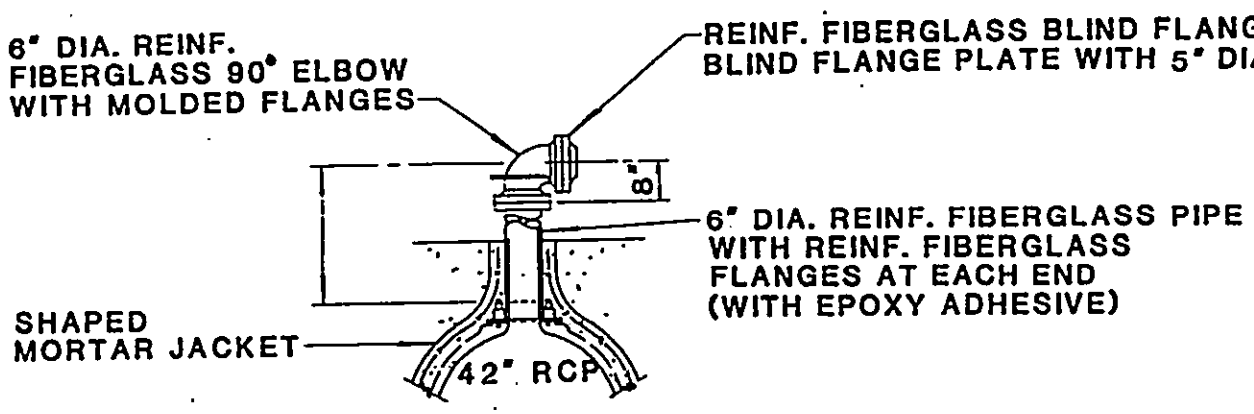
1. EXCAVATED MATERIAL FROM THE TRENCH WILL BE USED AS BACKFILL AS NECESSARY. EXCESS EXCAVATED MATERIAL IS PROPOSED TO BE STOCKPILED ON EITHER SIDE OF THE TRENCH AND IN ADJACENT SURGE CHANNELS.

2. THE ENTIRE LENGTH OF THE OUTFALL WILL BE LAID IN A TRENCH (EXCEPT POSSIBLY FOR A FEW LOCALIZED AREAS) IN ORDER TO PROVIDE SUFFICIENT PROTECTION FROM THE FORCES GENERATED BY A 100-YEAR HURRICANE WAVE

PROPOSED EXTENSION OF THE
HILO OCEAN OUTFALL
HILO, HAWAII, HAWAII
GENERAL PROFILE
FIGURE I-3



TYPICAL SECTION: OUTFALL & DIFFUSER



DIFFUSER NOZZLE DETAIL

PROPOSED EXTENSION OF THE
HILO OCEAN OUTFALL
HILO, HAWAII, HAWAII

OUTFALL AND DIFFUSER DETAILS

FIGURE I-4

Field investigations indicate that the surface portion of the sewage field would be directed in a southerly direction towards the Hilo Harbor-Puhi Bay area about 20 percent of the time from wind stresses. The orientation of the proposed outfall affords a compromise to accommodate the two oceanographic-climatological conditions.

COSTS AND FUNDING

The approximate budgeting costs for modification and extension of the outfall, reflecting present levels in construction costs, is $4,100,000 (M&E Pacific, Inc., 1980).

Funding for the project is based on the following proportions:

75% Federal
10% State
15% County

SCHEDULE OF CONSTRUCTION

As the final phase of the Hilo Wastewater Management Plan, modification and extension of the Hilo outfall is tentatively scheduled to begin in 1987. The schedule is subject to revision, depending on funding from both federal (EPA) and local (State and CIP) sources.

HISTORY OF OUTFALL

In 1966, the first 2,600-foot portion of the 48-inch reinforced concrete outfall was put into operation, discharging effluent in 37 feet of water. A few years later the outfall was extended to 4,500 feet offshore discharging effluent through a 210-foot diffuser in 56 feet of water. Eight-inch and ten-inch diffuser ports, spaced 15 feet on centers, were located on the diffuser section.

CHAPTER II
RELATIONSHIP TO APPLICABLE STATUTES AND REGULATIONS

The following permits and consistency certification are applicable to the Hilo outfall extension and modification:

1. Department of Health,
   National Pollutant Discharge Elimination System,
   Section 301(h) Permit

2. U.S. Army Corps of Engineers, Refuse Act Permit

3. Department of Land and Natural Resources,
   Conservation District Use Application

4. Department of Transportation, Shorewater Work Permit

5. U.S. Coast Guard, Aids to Navigation Permit

6. Department of Planning and Economic Development,
   Hawaii Coastal Zone Management Program
   Federal Consistency Certification

Section 301(h) of the Clean Water Act provides publicly owned wastewater treatment works an opportunity to apply for variances from secondary treatment requirements for discharges to marine waters. The main criteria of concern for Hilo outfall is Subsection 301(h)(2) which states that a variance will not interfere with the attainment or maintenance of that water quality which ensures protection of water supplies and protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife, and allows recreational activities on and in the water. Compliance with Subsection 301(h)(2) requires monitoring as stated in Subsection 301(h)(3). Water quality monitoring through sampling and testing, and comparison to waters of similar character which are unaffected by effluent discharges, would be required.

The Refuse Act essentially states that it is unlawful to discharge from floating craft or shore, any refuse other than that flowing from streets and sewers in liquid state, into any navigable water. Filing for the Refuse Act Permit, under Sections 10 and 13 of the 1899 River and Harbor Act, assumes compliance with other applicable federal agencies and acts such as the NMFS 1972 Marine Protection, Research and Sanctuaries Act (MPRSA). Authorization of marine discharge is the purpose of this permit.

The state Conservation District Use Application (CDUA) regulates the uses within the conservation districts to protect open space, wildlife habitat, watersheds, and recreational, aesthetic, historic, and cultural values. Of particular concern for Hilo outfall construction is the disturbance of marine communities, including coral, reef fish, and larger mammals such as humpback whales, known to frequent the area. The minimization of adverse impacts to marine biota and the maintenance of water quality would be necessary for permit approval.

The Shorewater Work Permit is established to regulate construction activities in shorewaters of the state for protection of navigation and shoreline resources. The permit applies to all projects with temporary or permanent construction in the shorewaters of Hawaii.

The Coast Guard Aids to Navigation permit applies to offshore construction. The offshore structures are recorded on maps to minimize navigational hazards.

The HCZMP is a network of authorities incorporated into the program as a means of carrying out the CZM objectives and policies in accordance with the implementation and compliance sections of the State's CZM law, Chapter 205A, HRS. The federal consistency review process is a mechanism to ensure continued coordination of state and federal interests, allowing early consultation of activities to minimize and resolve conflicts. The HCZMP

objectives and policies relevant to extension of Hilo outfall fall under the following categories:

Recreational Resources

Coastal Ecosystems

Economic Uses

Coastal Hazards

Managing Development

CHAPTER III
ENVIRONMENTAL SETTING

The coastal water environment and biological environment of Hilo Bay in the vicinity of the outfall expansion will be discussed in this chapter.

COASTAL WATER ENVIRONMENT

The coastal water environment of Hilo Bay, in terms of its water quality and wave stress as reported by Steven Dollar, Marine Research Consultant, is summarized below (Dollar, 1985).

Water Quality

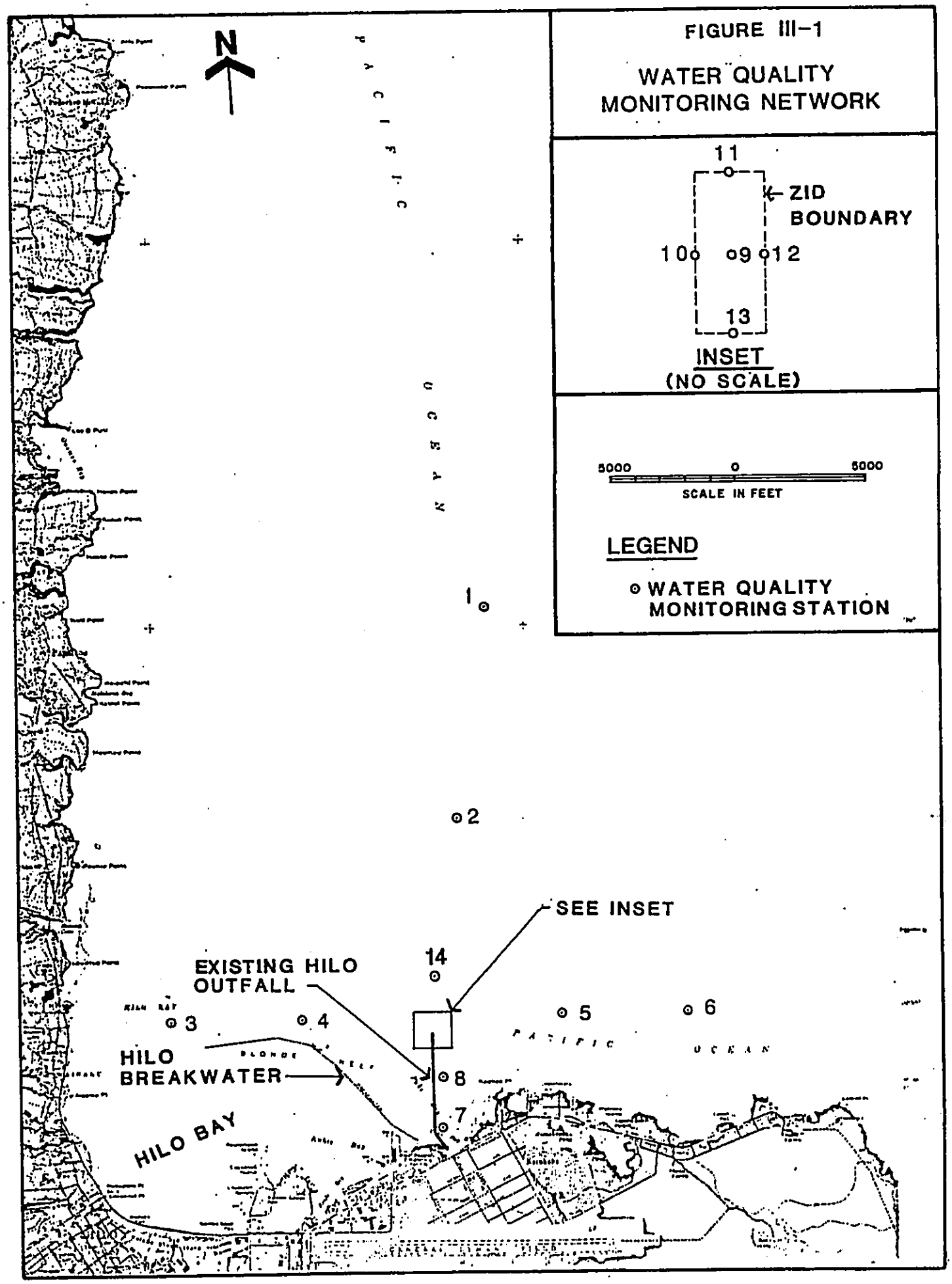
The entire water column in the outer bay is frequently very turbid with high concentrations of suspended particulate material, apparently of terrestrial origin. These high concentrations are potentially damaging to coral colonies that do not have the ability to rapidly remove settling particulates from their living surfaces. These water quality conditions have resulted in the development of an indigenous assemblage of coral suited to these naturally turbid conditions. High turbidity also results in restricted light levels at the reef surface which could slow the growth of corals adapted to the high light levels characteristic of clear water. As a partial requirement of an approved Section 301(h) Modified National Pollutant Discharge Elimination System (NPDES) permit, quarterly water quality monitoring will be required (Figure III-1, Appendix B).

Wave Stress

In the outer regions of Hilo Bay, in the depth range of 40 to 80 feet, shoreline orientation and wave refractive processes are such that wave stress is minimal, even from relatively rare incidences of very large storm waves. At most transect sites evidence of physical destruction due to wave damage was not apparent (Figure III-2). Site F, however, did show some signs of relatively recent storm stress in the form of large overturned coral colonies that had been broken from the reef surface, and accumulations of rubble fragments in low pockets on the reef surface.

FIGURE III-1

WATER QUALITY
MONITORING NETWORK



BIOLOGICAL ENVIRONMENT

This section includes descriptions of the biological environment in Hilo Bay in the vicinity of the outfall expansion.

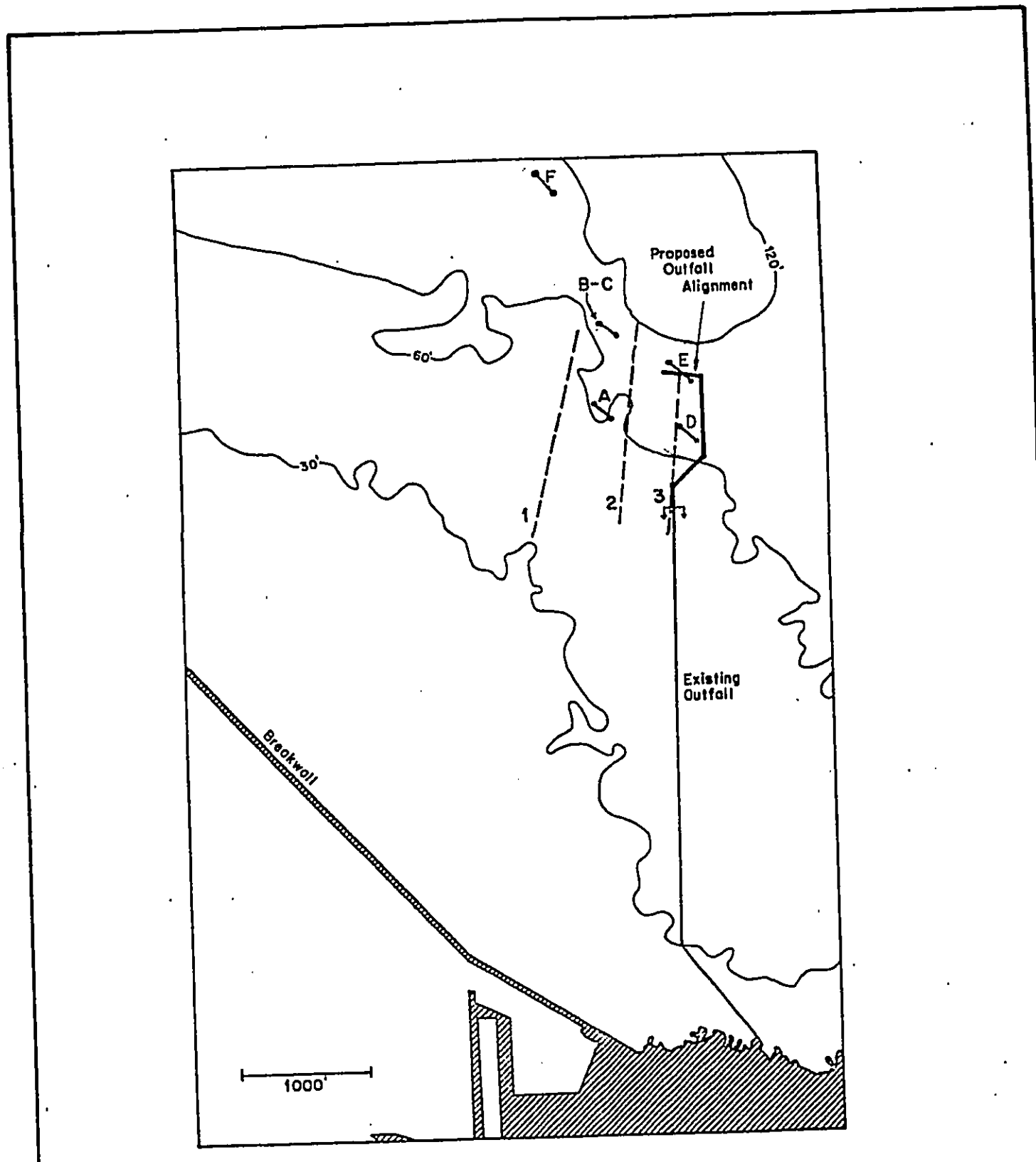
Benthic organisms and nekton were surveyed at six transect sites (Figure III-2). The more seaward transects (B-C, E, and F) were located in the region where depths of 70 to 80 feet existed, while the more landward transects (A and D) were located at depths of 60 to 70 feet. Three reconnaissance swims were also conducted by the investigators to observe bottom topography, biotic community structure, and transition between zones.

The following discussion is a summary of marine biological conditions observed in Hilo Bay in February 1985, submitted for this study by Steven Dollar, Marine Research Consultant (Dollar, 1985).

Benthic Organisms

Table III-1 lists the mean bottom cover of each species of coral and non-coral encountered on each of the five transects, the total coral cover, and the Shannon-Weaver coral species diversity index. The latter statistic is a measure of the degree of evenness of distribution of bottom cover among a given number of coral species. Figure III-3 graphically represents this data and shows the total coral cover at each site as well as how living cover is distributed among genera and species. Interpretation of Figure III-3, and qualitative observations made during the course of the survey indicate several major trends with regard to benthic community structure of Hilo Bay.

First, and probably most significant, is the relatively high coral cover encountered at every transect location. Bottom topography throughout the entire study area of Hilo Bay consists of a relatively flat reef platform intersected by shallow rubble filled surge channels. The platform areas between the channels are characterized by very high levels of coral cover sometimes approaching 100 percent. Mean transect total cover estimates,



Map of Hilo Bay showing location of existing outfall structure and diffuser, as well as the proposed outfall diffuser extension alignment. Paths of reconnaissance swims are shown as dashed lines and numbered 1-3. Transect locations are shown as solid lines and site designation is indicated by letters A-F.

FIGURE III-2

BENTHIC TRANSECT LOCATIONS

Source: Steven Dollar, 1985.

TABLE III-1

MEAN TRANSECT PERCENT COVER OF CORAL SPECIES AND NONCORAL SUBSTRATA IN HILO BAY

Transect Location	A	B-C	D	E	F
CORAL SPECIES					
Montipora verrucosa	25.0	30.3	30.1	37.3	12.8
Montipora patula	4.5	19.7	8.5	6.7	12.6
Porites lobata	17.0	0.2	2.1	1.4	0.0
Porites compressa	14.3	0.0	0.0	0.2	0.4
Leptastrea purpurea	9.0	4.1	18.4	10.5	6.8
Pavona varians	2.9	2.0	1.9	3.7	0.0
Pavona duerdeni	0.2	0.0	0.2	0.0	23.4
Pavona (Pseudocolumnastrea pollicata)	0.0	0.0	0.0	0.0	1.8
Fungia scutaria	0.2	0.0	0.1	0.0	0.0
Palythoa tuberculosa	0.0	0.0	0.0	0.2	0.0
NONCORAL SUBSTRATA					
Limestone	25.6	30.1	38.7	26.2	15.6
Rubble	0.0	8.1	0.0	13.1	27.2
MEAN TRANSECT TOTAL CORAL COVER	74.5	56.3	61.3	60.0	57.1
SPECIES-COVER DIVERSITY	1.60	0.965	1.24	1.14	1.43

Source: Steven Dollar, 1985.

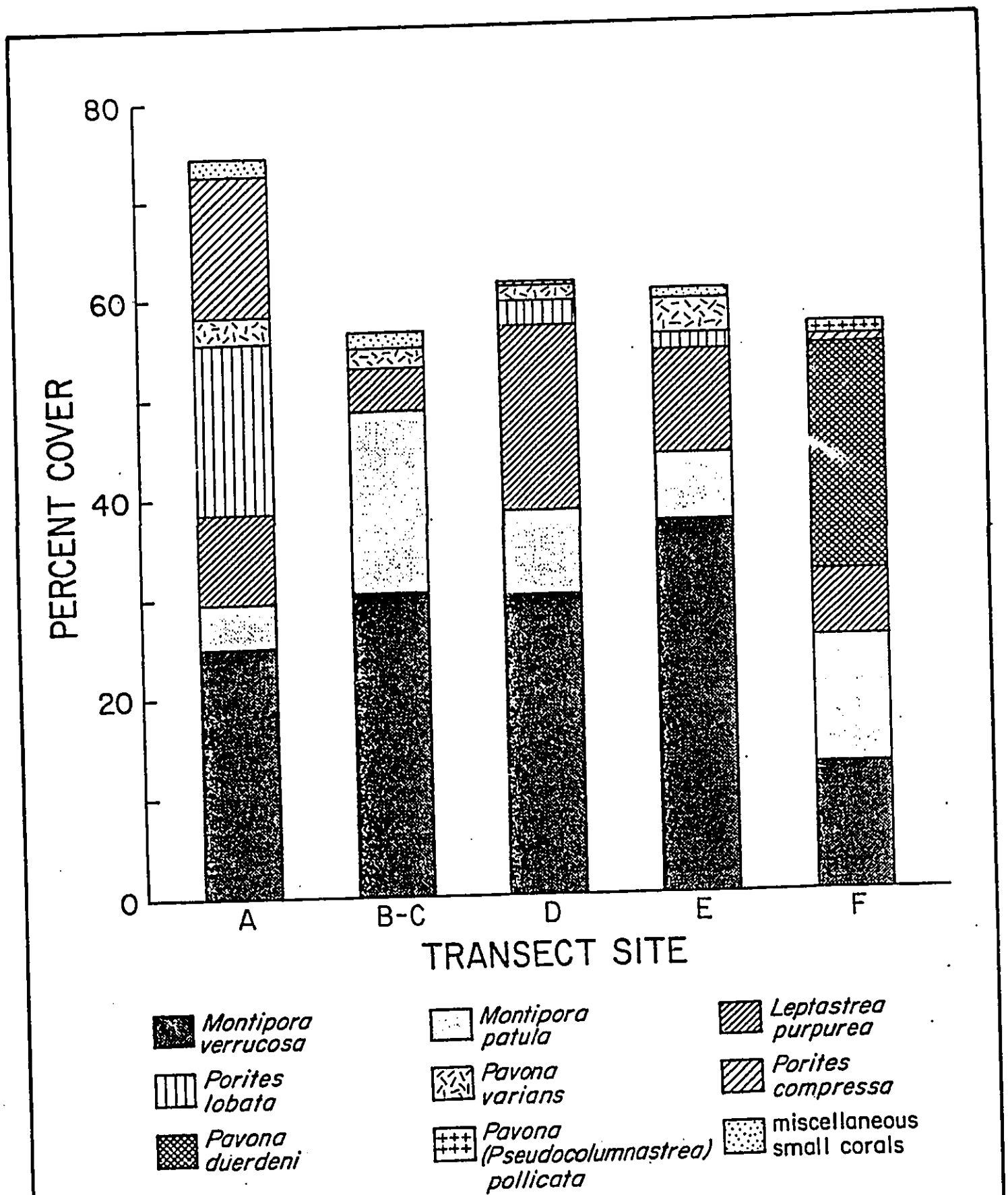


FIGURE III-3 Bar graph showing percent cover of major coral species and total coral cover at each transect site. Cover estimates are calculated as the mean cover for ten random quadrats selected on a 150 foot transect line.

Source: Steven Dollar, 1985.

which integrate cover from both the channels and platforms, ranged from 56 to 75 percent. Such values are considered extremely high for Hawaiian reefs, especially when the poor water quality (high turbidity) that is reportedly the normal condition for Hilo Bay is considered. Other areas of optimal coral cover encountered in Hawaii within the depth range of 60 to 80 feet, such as off the Kona coast, generally occur in areas of extremely clear water. Since the large majority of reef corals require light for growth, it is generally assumed that highly turbid water would serve as a negative influence for highly developed reef structures dominated by living cover. Clearly, such is not the case for Hilo Bay.

The second major trend indicated by the composite species composition of the coral community shown on Figure III-1 is the dominance of genera and species that are normally rather minor components of reef assemblages, while the normally dominant forms are relatively scarce throughout most of the transect regions. In particular, two species of the genus Montipora (M. verrucosa and M. patula) comprise very significant proportions of the coral cover. Both of these species occur predominantly in large overlapping plate-like growth forms that result in a three dimensional aspect to the reef surface. Also occurring with relatively high frequency is the flat encrusting species Leptastrea purpurea. Generally, this species is encountered as small encrustations of several inches in diameter; however, at the Hilo Bay sites, very large expanses of the coral were commonly encountered.

Conspicuous by their absence, or very low occurrence levels, on the mean transect composites were several species of the genus Porites (P. lobata and P. compressa) and Pocillopora meandrina. These three species generally comprise the vast majority of coral cover on Hawaiian reefs. Site A, which was the shallowest transect (60 feet) and was located closest to shore, was the only transect that contained a significant percentage of Porites spp. cover (31 percent). The relatively high species diversity index (1.60 at Site A reflects the high proportion of Porites that coexist with high Montipora cover. Pocillopora meandrina was not encountered on any of the transect quadrats and was only occasionally observed during the entire dive series.

Observations made during the three reconnaissance swims, however, indicate that the community assemblages described above are not typical for the whole of Hilo Bay but just for the depth range of 60 to 80 feet, which encompasses all transect sites. The major observation derived from the swims indicates that the Montipora-Leptastrea communities thrive to the point of complete community domination at depths below 70 feet. At progressively shallow depths, Montipora and Leptastrea became correspondingly less abundant, while both Porites lobata and P. compressa gradually increase. Figure III-4 shows the percent cover of total coral as well as that of Montipora-Leptastrea and Porites at approximate 10-foot depth intervals estimated from photographs taken during reconnaissance swim 2. Since these coverage estimates were made from single photographs taken at points on the reef where coral cover appeared maximal, they indicate higher coral cover than the averaged estimates from the transect-quadrat technique. The trends of the lines on Figure III-4 illustrate the coral community zonal transition as a function of depth in Hilo Bay. While the total coral cover increases only slightly with increasing depth between 40 and 80 feet, the difference in cover between the two species groups is large. Porites dominates almost completely at the shallow depths and decreases to less than 5 percent of total cover at 80 feet, while the pattern for Montipora-Leptastrea is almost exactly reversed. At a depth of 60 feet, the two groups coexist in roughly equal proportions.

While it is nearly impossible to unequivocally determine the environmental factors that lead to the observed zonation pattern, it is possible to speculate on these processes, based on theoretical schemes that have been developed in the past regarding causal factors for coral community structure in Hawaii. Two physical parameters appear to be largely responsible for the observed pattern within Hilo Bay: concussive force from wave stress that can break and abrade coral colonies and high particulate loads in the water column that can restrict light penetration and prevent growth by burial.

The stability inherent to low wave stress, high particulate loads, and low light levels combine to create habitats suited to the plating or encrusting forms of Montipora and Leptastrea. The delicate plates observed to be the

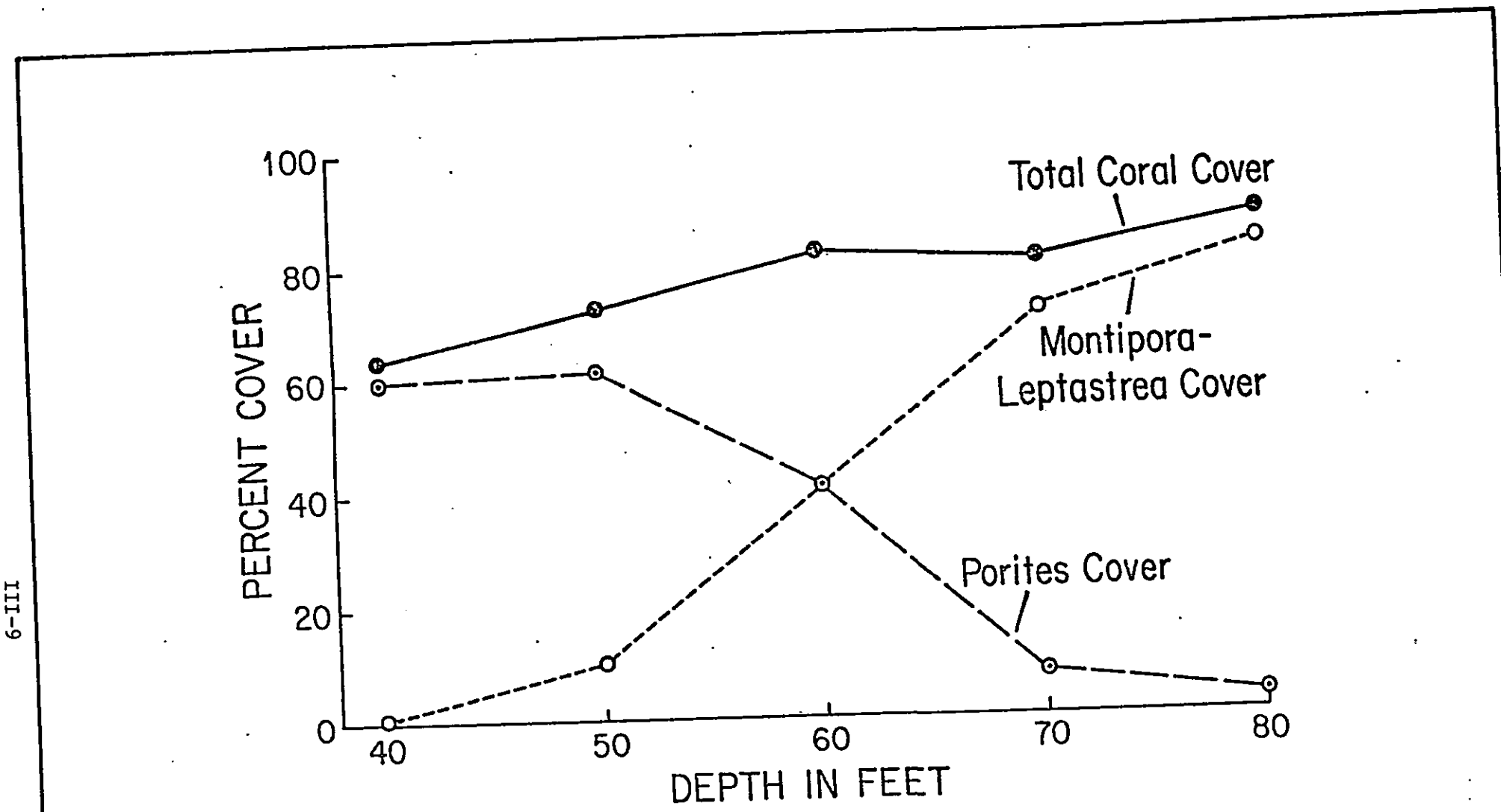


FIGURE III-4 Graph showing relationship of zonation of major coral groups to depth in Hilo Bay. Porites cover dominates community assemblages at 40-50 foot range, while Montipora and Leptastrea comprise the majority of coral at the 70-80 foot zone. At the 60 foot depth the two species co-exist in roughly equal proportions. Data taken from random photographs taken during reconnaissance swim #2.

Source: Steven Dollar, 1985.

dominant growth form at the deep sites would be unable to sustain the physical force of storm waves without extensive breakage. However, this growth form is ideal to maximize utilization of the small quanta of light that reaches the reef surface since maximum surface area is available for incoming light utilization. In addition, the polyps (individual coral animals that comprise a coral colony) of the several species of Montipora are relatively large and the calices (cup-like skeletal structure secreted by the polyps) are raised so that settling sediment fills the inter-calyx space. All of these structural characteristics appear to be adaptations to optimal growth in a stable but turbid environment.

The Porites species have small, flat calices that appear to be much more sensitive to sedimenting particles. While Porites lobata does occur commonly in flat plating forms between 40 and 60 feet, the lack of this coral at the transect sites indicates that perhaps light limitation and high sediment loads restrict the habitat to the shallower zones. Porites is generally considered to be the dominant coral capable of outcompeting other genera in areas of suitable environmental conditions on Hawaiian reefs. The lack of these suitable conditions, presumably due to the turbidity described above, leads to the lack of competitive superiority by Porites and instead Montipora and Leptastrea are competitively superior and able to exploit most of the space available on the deeper reef.

However, as can be seen on Figure III-2, at depths shallower than 60 feet Porites spp. comprises the majority of coral cover. The species cover is divided between stands of the delicate finger coral P. compressa and thin, flat plating forms of P. lobata. Both of these growth forms are rather fragile and would not be expected to be found in areas where conclusive force from breaking waves is a regular characteristic of the environment. While the substrata is qualitatively similar to the deeper areas, it appears that the major environmental difference between the Montipora and Porites dominated zones is the degree of light penetration and turbidity.

It was beyond the scope of this report to survey areas closer to shore and shallower than 30 feet. However, this area would be within the range of predictable force from waves of a magnitude sufficient to damage or

destroy all but the sturdiest growth forms of reef corals. Within this zone species composition would likely to dominated by encrusting or hemispherical colonies of P. lobata and Pocillopora meandrina. Coral cover in this zone would likely be much lower in the two outer zones and the majority of substrata would be bared carbonate reef rock.

Investigators observed the almost complete lack of macrobenthic species other than corals. Only one individual each of the sea urchins Tripnestes gratilla and Heterocentrotus mammillatus were encountered during the entire field period. No observations of sea cucumbers, sea stars, or other motile macroinvertebrates were recorded. In addition, no macrothalloid benthic algae were observed.

Nekton

Quantitative assessments of reef fish were conducted by divers in conjunction with the benthic survey. Care was taken to minimize disturbance and dispersal of fish populations. However, limited visibility due to high turbidity and the tendency for larger nonterritorial fishes to aggregate and avoid divers contributed to a high variability of results.

Results of the fish surveys are presented in Table III-2 and on Figure III-5.

Fishes noted on more than one occasion at intermediate depths (50 to 60 feet) were the herbivores Scarus sordidus, Ctenochaetus strigosus, Acanthurus mata, A. triostegus, A. olivaceus, Zebrasoma flavescens, Naso lituratus, and Stegastes fasciolatus; the butterfly fishes Chaetodon unimaculatus, C. multicinctus, C. quadrimaculatus, C. trifasciatus, and Forcipiger flavissimus; the angelfish Centropyge potteri; the goatfish Parupaneus multifasciatus; the wrasses Thallosoma duperreyi, T. ballieui, and Gomphosus varius; the snapper Lutjanus kasmira; the filefish Pervagor spilosoma; and the triggerfish Rhinecanthus rectangulus.

At the deeper sites (particularly transects E and F) fewer fishes were noted. The predominant species were Ctenochaetus strigosus, Chaetodon

TABLE III-2

HILO BAY QUANTITATIVE FISH ASSESSMENT

Species	Transect Site A	B	D	E	F
Mullidae - Goatfishes					
Parupaneus multifasciatus	1	2	3	4	1
Chaetodontidae - Butterflyfishes					
Chaetodon unimaculatus	6	8	6	2	-
Chaetodon quadrimaculatus	-	-	2	-	-
Chaetodon kleinii	-	-	-	1	-
Chaetodon multicintus	2	2	6	-	2
Chaetodon trifasciatus	2	1	-	-	-
Forcipiger flavissimus	1	-	-	-	1
Pomacanthidae - Angelfishes					
Centropyge potteri	-	-	2	-	-
Pomacentridae - Damselfishes					
Stegastes fasciolatus	-	-	2	-	-
Labridae - Wrasses					
Thalassoma duperreyi	4	-	4	7	1
Thalassoma ballieui	-	1	1	1	-
Bodianus bilunulatus	1	-	-	-	-
Labroides phthirophagus	1	-	-	-	-
Scaridae - Parrotfishes					
Scarus sordidus	-	8	-	-	2
Juvenile Scarus	5	6	-	-	-
Acanthuridae - Surgeonfishes					
Ctenochaetus strigosus	22	26	11	7	28
Acanthurus olivaceus	6	-	-	-	-
Zebrasoma flavescens	-	2	-	-	2
Monocanthidae - Filefishes					
Pevagor spilosoma	-	-	3	3	-
Total Number of Individuals	51	56	40	25	37
Total Number of Species	11	9	10	7	7

Source: Steven Dollar, 1985.

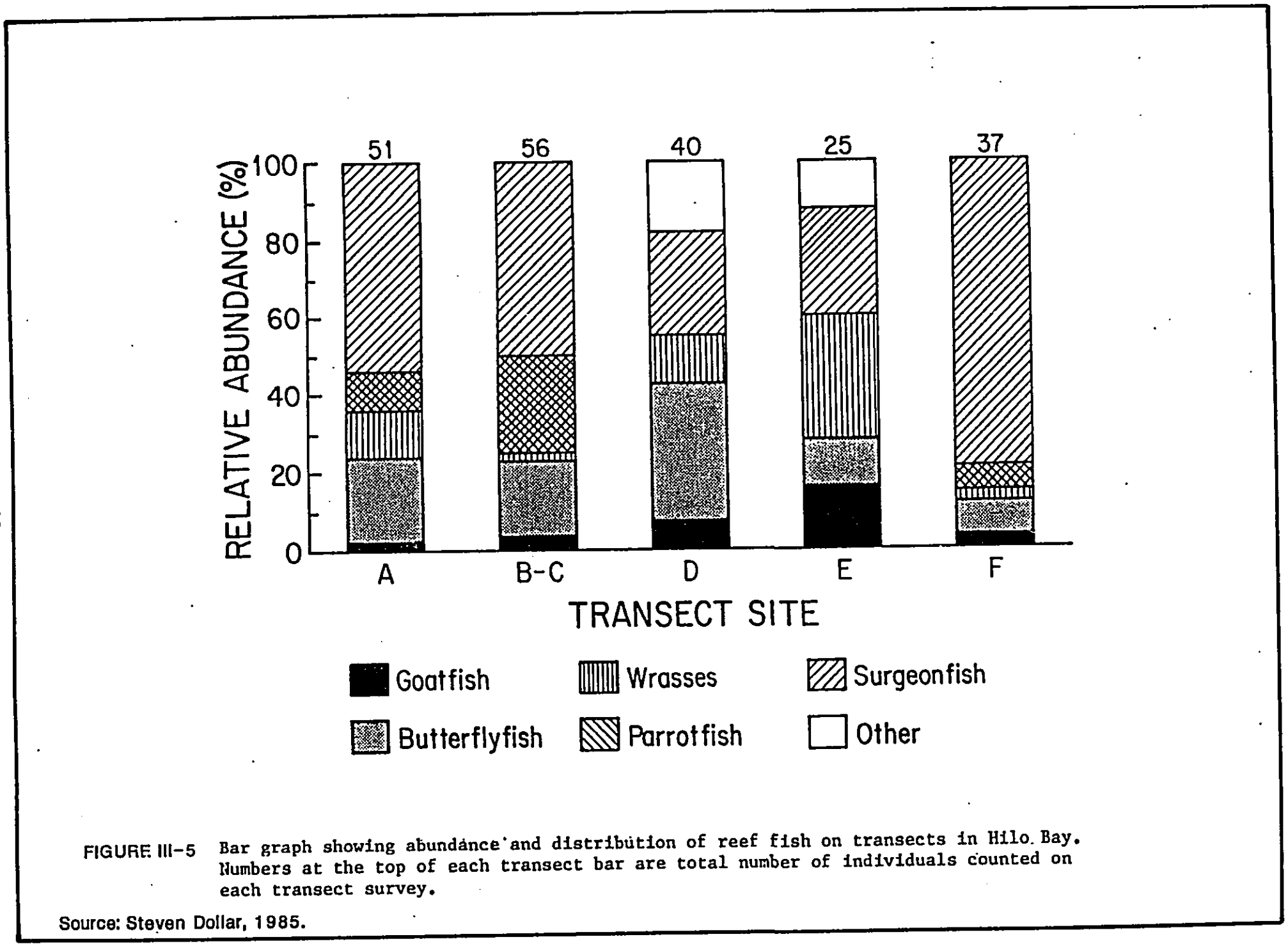


FIGURE III-5 Bar graph showing abundance and distribution of reef fish on transects in Hilo Bay. Numbers at the top of each transect bar are total number of individuals counted on each transect survey.

Source: Steven Dollar, 1985.

GEORGE R. ARIYOSHI
GOVERNOR

JACK K. SUWA
CHAIRPERSON, BOARD OF AGRICULTURE

SUZANNE D. PETERSON
DEPUTY TO THE CHAIRPERSON

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
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Honolulu, Hawaii 96822-0159

September 30, 1986

MEMORANDUM

To: Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control

Subject: Supplemental Environmental Impact Statement (EIS)
for the Proposed Hilo Bay Outfall Sewer Extension
Department of Public Works, County of Hawaii
Hilo Harbor-Puhi Bay Area

The Department of Agriculture has reviewed the subject Environmental Statement and offers the following comment.

According to the proposal, the construction of the proposed concrete outfall would be located entirely within the Hilo Harbor-Puhi Bay area. No development is planned along the shore other than temporary support facilities for construction of the outfall in Hilo Harbor. The project does not appear to adversely affect the agricultural resources of the area nor the plans, programs and activities of the Department of Agriculture.

Thank you for the opportunity to comment.

Jack K. Suwa

JACK K. SUWA
Chairman, Board of Agriculture

cc: Mr. Hugh Y. Ono, Chief Engineer
Mr. Kenneth Ishizaki
Hawaii County Planning Department

A1

unimaculatus, Chaetodon multicinctus, Thallosoma duperreyi, Parupaneus multifasciatus, and Pervagor spilosoma. At the top of the steep slope located at the seaward boundary of the transect area (approximately 85 feet in depth), large groups of the planktivorous damselfish Chromis agilis were observed. At Site E several specimens of the two introduced species of snapper Lutjanus kasmira and grouper Cephalopholis argus were seen in coral near the edge of the slope. A small school of the large parrotfish Scarus perspicillatus and a large kahala Seriola dumerilii were also observed near the slope.

In general, there was a distinct lack of all fish fauna that are generally regarded for commercial or recreational value as "food fish." In the total of approximately ten hours underwater, only six individuals of commercially valuable food fish and one small lobster were observed. The apparent lack of carangids (jacks, ulua), squirrelfish (menpachi, aweoweo), and large goatfish (kumu) is surprising, particularly considering the high coral cover and structural complexity of the reef. Generally, fish abundance and diversity are positively correlated with substratum complexity due to the increased shelter to small individuals created by dense three dimensional coral structures.

The National Marine Fisheries Service (NMFS) has stated that endangered humpback whales inhabit Hilo Bay. A typical population in Hilo Bay at any time is five to six humpbacks. During the mating season (December to May), males "sing" at mid-depth or near the ocean floor. When calving, the humpbacks are near the surface and near shore. Whales begin to congregate off the Big Island during November. The bulk of the population then migrate along the archipelago and are near Kauai from April to May (NMFS and DLNR, 1984).

Green sea turtles are also an endangered species that may be found in the area. However, the NMFS reports that the turtles are distributed throughout the archipelago, with most of the population near the leeward isles (NMFS and DLNR, 1984).

CHAPTER IV
PROBABLE IMPACT AND MITIGATION MEASURES OF THE PROPOSED ACTION

This chapter presents the probable impacts, mitigation measures, and negative effects that cannot be mitigated for Hilo outfall modification and extension that were not mentioned in previous reports (M&E Pacific, Inc., 1980).

PROBABLE IMPACTS

Probable impacts discussed in this section are direct impacts (short-term and long-term) and indirect impacts.

Direct Impacts

Short-term direct impacts are those temporary impacts resulting from and occurring during the construction of the outfall extension. Long-term direct impacts are potentially significant effects that may occur over time as a direct result of the proposed outfall expansion.

Modification and extension of Hilo outfall requires blasting of the ocean floor to excavate a trench for the new pipeline and diffusers. Blasting is expected to have a direct effect on the marine environment. Ignition of explosive charges will disturb nekton and damage coral and other benthic organisms in the blast path. A temporary increase in turbidity at the site would also result from blasting. Similarly, increased siltation on coral formations and disturbance of fish habitat would result.

Another major short-term impact of the outfall expansion is stockpiling of the excavated coral and rock resulting from trench construction. Onsite stockpiling near the trench excavation would damage nearby coral communities and increase turbidity. An alternative to stockpiling at the site is transporting the excavated material offsite to a location on shore. This alternative would require expensive equipment and could increase turbidity during transport to shore.

Long-term direct impacts of the outfall modification are expected to have a positive effect on the human and marine environments. Environmental quality would be improved over the existing situation as a result of the following:

1. Improved water quality;

2. Increased diffuser depth would provide better initial dilution of outfall effluent and lessen the potential for sediment accumulation of discharged solids on the sea bed even further;

3. Outfall pipeline would provide a good surface for new coral growth; and

4. Colloidal material in the effluent would attract feeding fish to the area.

Indirect Impacts

Indirect impacts associated with the project are:

1. Less chance of recreational contact with effluent due to increased distance to the new diffuser from shore.

2. Increased population of demersal fish and cryptofauna due to high relief habitat resulting from increased coral growth.

MITIGATION MEASURES

The following mitigation measures would reduce the direct, indirect, or cumulative impacts resulting from the outfall expansion.

Blasting

A safe blast range analysis involving selection of the most conservative parameters for source and target depth would be used. The use of highly directional shape charges would minimize the percent of energy propagated

through the water. The National Marine Fisheries Service (NMFS) recommends restricting blasting from December to March to protect humpback whales that migrate to Hilo Bay during the mating season. The NMFS also recommends restricting the explosive weight based on the contractor's needs after examination of substratum analysis. Careful analysis of test blast results would help to prevent unnecessary damage to the benthic community. Finally, adequate warning signals and a pre-blast survey of 2000-yard radius around the blast zone prior to each ignition would alert and disperse boats, people, whales, and green sea turtles from the area.

Stockpiling

Mitigation of adverse impacts would be minimized by use of surge channels parallel to the proposed outfall for stockpiling. Stockpiling in the existing rubble-filled surge channels would minimize damage to living coral communities. Stockpiling in surge channels would also eliminate the need for equipment to stockpile on shore and avoid spilling of material during transport to shore. A temporary increase in turbidity within the surge channels during the construction period is expected. Turbidity from stockpiling of material is not anticipated to migrate beyond the immediate environs of the construction area because of the depressed elevation of the surge channels.

NEGATIVE EFFECTS THAT CANNOT BE MITIGATED

Coral damage, disturbance of marine life, and temporary increase in turbidity are impacts that cannot be mitigated. However, the effect of these impacts is not permanent.

With respect to extension of the Hilo sewage outfall, it appears inevitable that reef areas with high percentages of living coral will be traversed. However, it appears that such a situation will not represent any manner of significant detrimental activity. The corridor of the reef cleared for the location of the outfall extension will probably recover in terms of coral cover within several years. Indeed, the outfall structure itself will undoubtedly serve as a settling surface for coral, leading to an eventual increase in cover over the present. This is the case with the existing

outfall and diffuser structure, which was observed to be almost totally covered with living coral colonies.

With respect to susceptibility of marine organisms to temporary alterations of water quality characteristics, Hilo Bay communities may be significantly more resilient than communities occurring in waters that are generally free of high levels of particulate material. The most likely alteration to environmental conditions that might be associated with construction activities would be a temporary increase in water column turbidity. However, natural conditions of turbidity in Hilo Bay are presently relatively high, so that the incremental increase due to the construction of the outfall extension would most likely be indistinguishable.

Results of the marine research consultant's survey indicate that the area is suboptimal with respect to reef fish, both in terms of species number and total individuals. In particular, fish of commercial or recreational value are absent or very scarce, either as a result of undesirable habitat or excessive fishing. In either event, the slight temporary environmental alterations that could accompany outfall construction would not appear to cause any changes in fish populations. In a similar manner, the area does not represent any sort of recreational resource for skin or scuba diving due to the unusually low visibility in the water column. Thus, there does not appear to be potential for any type of negative environmental resource-related consequences related to the proposed outfall extension.

CHAPTER V
ALTERNATIVES TO THE PROPOSED ACTION

Two alternatives to the proposed outfall extension are described in this section.

DIFFERENT ALIGNMENT

Altering the proposed outfall alignment would not have a significant effect on the overall marine environment. The marine research consultant has stated in his report that the living coral assemblages are not limited to a small restricted zone. Virtually all of the bottom surveyed during the course of the field work was consistently covered with living colonies according to the distributions described previously. At a minimum, the area of coral cover encompassed several square miles. Therefore, altering the alignment would not decrease the short-term impact of construction on the overall benthic community.

NO ACTION

The no-action alternative would preserve the existing Hilo outfall as is. The advantage to this alternative is the avoidance of short-term direct impacts resulting from construction. Disadvantages to this alternative are less initial effluent dilution and poorer water quality.

CHAPTER VI

CONSULTED PARTIES AND PARTICIPANTS IN THE PREPARATION PROCESS

The following agencies were consulted during the preparation of the Draft Supplemental EIS:

A. County of Hawaii

1. Planning Department

B. State of Hawaii

1. Department of Planning and Economic Development

2. Department of Land and Natural Resources

C. Federal Government

1. Department of Interior, Fish and Wildlife Service

2. Department of Commerce, National Marine Fisheries Service

3. Army Corps of Engineers

CHAPTER VII

COMMENTS AND RESPONSES RECEIVED DURING PREPARATION

The Environmental Impact Statement Preparation Notice for the proposed Hilo Bay Outfall Sewer Extension was published in the OEQC Bulletin on July 23, 1986. The thirty-day review period, announced in the OEQC Bulletin, ended on August 22, 1986. There were no letters received in response to the EIS Preparation Notice. Three agencies responded by telephone and requested to be included in the distribution of the Draft Supplemental EIS. The agencies are:

1. Department of Interior, Fish & Wildlife Service

2. Department of Commerce, National Marine Fisheries Service

3. Department of Planning and Economic Development

In response to the requests from the agencies listed above, preliminary copies of the Draft Supplemental EIS were sent to each party. Each agency was also informed that the Draft Supplemental EIS would be available after August 22, 1986.

REFERENCES

1. Dollar, Steven. 1985. Environmental Assessment of Hilo Bay: Marine Biological Community Structure in the Vicinity of the Proposed Hilo Sewage Outfall Extension.

2. State of Hawaii, Department of Land and Natural Resources. Conservation District Use Permit.

3. M&E Pacific, Inc. 1980. Facilities Plan for the Hilo District, South Hilo, Hawaii.

4. M&E Pacific, Inc. 1980. Revised EIS for the Hilo Wastewater Management Plan of the Hilo District, South Hilo, Hawaii.

5. U.S. Army, Corps of Engineers. 1971. Permits for Work and Structures in, and for Discharges or Deposits into Navigable Waters.

6. U.S. Environmental Protection Agency. 1982. Revised Section 301(h) Technical Support Document.

Other Sources

1. Hawaiian Dredging & Construction Co. and M&E Pacific, Inc. 1984. Letter from Harry H. Isobe of Hawaiian Dredging to Norman Ikei.

2. National Marine Fisheries Service, Department of Land and Natural Resources, and M&E Pacific, Inc. Meeting on January 11, 1984.

3. National Marine Fisheries Service, Department of Land and Natural Resources, Department of Health, and M&E Pacific, Inc. Meeting on December 17, 1984.

APPENDIX A

PUBLIC COMMENTS

APPENDIX A
PUBLIC COMMENTS

A. Respondents to Draft SEIS (No Comments)

1. State of Hawaii Department of Agriculture
2. State of Hawaii Department of Transportation
3. State of Hawaii Department of Health
4. State of Hawaii Department of Planning and Economic Development
5. State of Hawaii Department of Defense
6. State of Hawaii Public Works Engineer
7. U.S. Department of the Navy
8. U.S. Department of the Interior
9. U.S. Soil Conservation Service
10. U.S. National Marine and Fisheries Service
11. U.S. Department of the Army, Corps of Engineers
12. County of Hawaii Department of Water Supply
13. County of Hawaii Department of Parks and Recreation
14. Hawaiian Electric Company

B. Respondents to Draft SEIS and Response Letters

1. Water Resources Research Center
2. State of Hawaii Board of Land and Natural Resources
3. State of Hawaii Office of Environmental Quality Control
4. County of Hawaii Planning Department
5. University of Hawaii Environmental Center
6. Mr. Rodrick Stone Thompson

GEORGE R. ARIYOSHI
GOVERNOR

JACK K. SUWA
CHAIRPERSON, BOARD OF AGRICULTURE

SUZANNE D. PETERSON
DEPUTY TO THE CHAIRPERSON

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

Mailing Address:
P. O. Box 22159
Honolulu, Hawaii 96822-0159

September 30, 1986

MEMORANDUM

To: Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control

Subject: Supplemental Environmental Impact Statement (EIS)
for the Proposed Hilo Bay Outfall Sewer Extension
Department of Public Works, County of Hawaii
Hilo Harbor-Puhi Bay Area

The Department of Agriculture has reviewed the subject Environmental Statement and offers the following comment.

According to the proposal, the construction of the proposed concrete outfall would be located entirely within the Hilo Harbor-Puhi Bay area. No development is planned along the shore other than temporary support facilities for construction of the outfall in Hilo Harbor. The project does not appear to adversely affect the agricultural resources of the area nor the plans, programs and activities of the Department of Agriculture.

Thank you for the opportunity to comment.

Jack K. Suwa

JACK K. SUWA
Chairman, Board of Agriculture

cc: Mr. Hugh Y. Ono, Chief Engineer
Mr. Kenneth Ishizaki
Hawaii County Planning Department

GEORGE R. ARIYOSHI
GOVERNOR

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

WAYNE J. YAMASAKI
DIRECTOR

DEPUTY DIRECTORS
JONATHAN K. SHIMADA, Ph.D.
WALTER T.M. HO
CHERYL D. SOON
ADAM D. VINCENT

IN REPLY REFER TO:

STP 8.1596

September 23, 1986

MEMORANDUM

TO: The Honorable Letitia N. Uyehara, Director
Office of Environmental Quality Control

FROM: Director of Transportation

SUBJECT: SUPPLEMENTAL EIS FOR THE PROPOSED
HILO BAY OUTFALL SEWER EXTENSION
HILO, HAWAII

After reviewing the subject supplementary EIS, we expect that the proposed action will not adversely impact our plans or facilities. We support any effort that will improve the water quality of Hilo Bay.

Except in special situations, all Shorewaters Construction Permits will be reviewed and approved as part of the Conservation District Use Application process. Consequently, a separate application for the permit will not be necessary for this sewer extension project.

We appreciate this opportunity to provide comments.

for Wayne J. Yamasaki

A2

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

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

LESLIE S. MATSUBARA
DIRECTOR OF HEALTH

September 24, 1986

In reply, please refer to:
EPHSD

MEMORANDUM

To: Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control

From: Deputy Director for Environmental Health

Subject: Environmental Impact Statement (EIS) for Proposed Hilo Bay Outfall Sewer Extension, Hilo, Hawaii

Thank you for allowing us to review and comment on the subject EIS. On the basis that the project will comply with all applicable Administrative Rules, please be informed that we do not have any objections to this project.

We realize that the statements are general in nature due to preliminary plans being the sole source of discussion. We, therefore, reserve the right to impose future environmental restrictions on the project at the time final plans are submitted to this office for review.

JAMES K. IKEDA

cc: Mr. Hugh Y. Ono, DPW
Mr. Kenneth Ishizaki, M&E Pacific ✓

A3

RECEIVED OCT 1986

DEPARTMENT OF PLANNING AND ECONOMIC DEVELOPMENT

KAMAMALU BUILDING, 250 SOUTH KING ST., HONOLULU, HAWAII
MAILING ADDRESS: P.O. BOX 2359, HONOLULU, HAWAII 96804 • TELEX: 7430250 HIDPED

Ref. No. P-5200

September 30, 1986

MEMORANDUM

TO: Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control

FROM: Kent M. Keith / Murray E. Towill

SUBJECT: Supplemental Environmental Impact Statement for the Proposed Hilo Bay Outfall Sewer Extension, Hilo, Hawaii

We have reviewed the subject supplemental environmental impact statement and find that the proposed outfall sewer extension will increase effluent dilution and improve water quality.

Thank you for the opportunity to review the subject document.

cc: Mr. Hugh Y. Ono, Chief Engineer
Dept. of Public Works, County of Hawaii
Mr. Kenneth Ishizaki
M & E Pacific, Inc.

A4

DPW
9/16/86

GEORGE R. ARIYOSHI
GOVERNOR

LETITIA N. UYEHARA
DIRECTOR

TELEPHONE NO.
548-6915

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
465 South King Street, Room 104
HONOLULU, HAWAII 96813

September 8, 1986

Dear Reviewer:

Attached for your review is an Environmental Impact Statement (EIS) that was prepared pursuant to Chapter 343, Hawaii Revised Statutes and Chapter 11-200, Administrative Rules, EIS Rules:

TITLE: Supplemental EIS for the Proposed Hilo Bay Outfall Sewer Extension

LOCATION: Hilo, Hawaii

CLASSIFICATION: Agency Action

Your comments or acknowledgments of no comments on the EIS are welcomed. Please submit your reply to the accepting authority or approving agency:

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Please send a copy of your reply to the proposing party:

Mr. Hugh Y. Ono, Chief Engineer
Dept. of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

AND

Mr. Kenneth Ishizaki
M&E Pacific, Inc.
Pauahi Tower, Suite 500
1001 Bishop Street
Honolulu, Hawaii 96813

Your comments must be received or postmarked by: October 8, 1986

If you have no further use for this EIS, please return it to the Office of Environmental Quality Control.

Thank you for your participation in the EIS process.

9/10/86
No comments.
Energy Division - DPE

SEP 1 0 1996

HIENG

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King St., Rm. 104
Honolulu, HI 96813

Dear Ms. Uyehara:

Supplemental EIS for the Proposed
Hilo Bay Outfall Sewer Extension
Hilo, Hawaii

Thank you for providing us the opportunity to review the above subject project.

We have no comments to offer at this time regarding this project.

Yours truly,

signed

Jerry H. Matsuda
Major, Hawaii Air
National Guard
Contr & Engr Officer

cc: Dept. of Public Works, County of HI
P&E Pacific, Inc.

A5

RECEIVED SEP 16 1986

(P)1897.6

SEP 15 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Subject: Supplemental EIS for the
Proposed Hilo Bay Outfall

We have reviewed the subject document and have no comments to offer.

Very truly yours,

J. Tominaga

TEUANE TOMINAGA
State Public Works Engineer

/jnt
cc: Mr. Hugh Y. Ono
Mr. Kenneth Ishizaki

A6

RECEIVED SEP 12 1986

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO:
5090
Ser 002B/5985
11 SEP 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE PROPOSED HILO BAY OUTFALL SEWER EXTENSION

The Supplemental EIS for the Proposed Hilo Bay Outfall Sewer Extension has been reviewed and we have no comments to offer. Since we have no further use for the EIS, the EIS is being returned.

Thank you for the opportunity to review the EIS.

Sincerely,

HENRY J. RINNERT
Captain, CEC, U. S. Navy
Facilities Engineer
By direction of the Commander

Enclosure

Copy to:
Mr. Hugh Y. Ono, Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Mr. Kenneth Ishizaki
M&E Pacific, Inc.
Pauahi Tower, Suite 500
1001 Bishop Street
Honolulu, Hawaii 96813

A7

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 ALA MOANA BOULEVARD
P.O. BOX 50167
HONOLULU, HAWAII 96850

IN REPLY REFER TO:
ES
Room 6307

OCT 9 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Re: Supplemental Environmental Impact Statement for the Proposed Hilo Bay Outfall

Dear Ms. Uyehara:

We have reviewed the referenced document and have no comments to offer at this time. This report will be used in preparing our comments on the Department of Army permit PODCO-O 1954-SD for the Hilo Bay sewage outfall.

We appreciate this opportunity to comment.

Sincerely,

Ernest Kosaka

Ernest Kosaka
Project Leader
Office of Environmental Services

cc: NMFS - WPPO
EPA, San Francisco
Mr. Hugh Y. Ono, Chief Engineer
Mr. Kenneth Ishizaki, M&E Pacific, Inc.

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

A6

RECEIVED OCT 8 1986

UNITED STATES
DEPARTMENT OF
AGRICULTURE

SOIL
CONSERVATION
SERVICE

P. O. BOX 50004
HONOLULU, HAWAII
96850

October 7, 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, HI 96813

Dear Ms. Uyehara:

Subject: Proposed Hilo Bay Outfall Sewer Extension, Hilo, Hawaii

We reviewed the subject draft supplemental environmental impact statement and have no comments to make.

Thank you for the opportunity to review the document.

Sincerely,

RICHARD N. DUNCAN
State Conservationist

cc:
Mr. Hugh Y. Ono, Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, HI 96720

Mr. Kenneth Ishizaki
M&E Pacific, Inc.
Pauahi Tower, Suite 500
1001 Bishop Street
Honolulu, HI 96813

A9

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858 -5440

REPLY TO
ATTENTION OF:

September 18, 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality
Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Thank you for the opportunity to review and comment on the Supplementary Environmental Impact Statement for the Proposed Hilo Bay Outfall Sewer Extension, Hilo, Hawaii. We have no substantive comments on the document; however, our Operations Branch is presently processing a permit application for the project, and future correspondence or questions should be addressed to them (telephone 438-9258).

Sincerely,

Kisuk Cheung
Chief, Engineering Division

Copies Furnished:

Mr. Hugh Y. Ono, Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Mr. Kenneth Ishizaki
M & E Pacific, Inc.
Pauahi Tower
1001 Bishop Street
Honolulu, Hawaii 96813

A11

COPY

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII

25 AUPUNI STREET • HILO, HAWAII 96720

September 12, 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, HI 96813

SUPPLEMENTAL EIS FOR THE PROPOSED HILO BAY OUTFALL SEWER EXTENSION

We have reviewed the subject Environmental Impact Statement (EIS) and have no comments to offer.

H. William Sewake
Manager

BI

cc - Mr. Hugh Ono
Mr. Kenneth Ishizaki

CORRECTION

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

COPY

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII

25 AUPUNI STREET • HILO, HAWAII 96720

September 12, 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, HI 96813

SUPPLEMENTAL EIS FOR THE PROPOSED HILO BAY OUTFALL SEWER EXTENSION

We have reviewed the subject Environmental Impact Statement (EIS) and have no comments to offer.

H. William Sewake
Manager

BI

cc - Mr. Hugh Ono
Mr. Kenneth Ishizaki

Dante K. Carpenter
Mayor

Eugene N. Tiwanak
Managing Director

Patricia G. Engelhard
Director

Ronald Okamura
Deputy Director

DEPARTMENT OF PARKS & RECREATION
COUNTY OF HAWAII

September 16, 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 So. King Street, Room 104
Honolulu, HI 96813

RE: Supplemental EIS for the Proposed Hilo Bay Outfall Sewer Extension

Dear Ms. Uyehara:

We have no adverse comments to offer and are pleased to note that water quality will be improved and that the possibility of recreational contact with effluent is lessened due to the increased distance between the diffuser and the shoreline.

Thank you for the opportunity to review the report.

Sincerely,

Pat Engelhard

Patricia Engelhard
Director

PE:GM:ai

cc: Hugh Ono, Chief Engineer
Dept. of Public Works

Kenneth Ishizaki
M&E Pacific, Inc.

• 25 AUPUNI STREET • HILO, HAWAII 96720 • TELEPHONE 961-8311

ENV 2-1
NV/G

HEI

September 16, 1986

Brenner Munger, Ph.D., P.E.
Manager
Environmental Department
(808) 548-6880

Mr. Hugh Y. Ono,
Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Subject: Supplemental Environmental Impact Statement for Proposed Hilo Bay Outfall Sewer Extension

We have reviewed the above statement and have no comments.

Sincerely,

Brenner Munger

cc: Mr. Kenneth Ishizaki
M&E Pacific, Inc.

University of Hawaii at Manoa

Water Resources Research Center
Holmes Hall 283 • 2540 Dole Street
Honolulu, Hawaii 96822

14 October 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Subject: Draft Supplemental Environmental Impact Statement for the Proposed Hilo Bay Outfall Sewer Extension, Hilo, Hawaii, September 1986

We have reviewed the subject DSEIS and offer the following comment. It would be helpful if the coastal survey was appended so that reviewers can study it also.

Thank you for the opportunity to comment. This material was reviewed by WRRC personnel.

Sincerely,

Edwin T. Murayabashi
EIS Coordinator

ETM:jm

cc: H.Y. Ono, DPW, County of Hawaii
K. Ishizaki, M & E

M&E Pacific, Inc.

Engineers & Architects

Suite 500, Pauahi Tower
1001 Bishop Street
Honolulu, Hawaii 96813
(808) 521-3051 Telex 7430065

November 5, 1986

Mr. Edwin T. Murabayashi
EIS Coordinator
Water Resources Research Center
Holmes Hall 283
2540 Dole Street
Honolulu, Hawaii 96822

SUBJECT: Draft Supplemental EIS for the
Proposed Hilo Bay Outfall Sewer Extension

Thank you for your comments of October 14, 1986. The coastal current survey was incorporated in the original Revised EIS for the Hilo Wastewater Management Plan of the Hilo District and will be incorporated in the Final SEIS by reference.

for JAMES S. KUMAGAI, Ph.D.
Vice President

RM/bs

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

SUSUMU ONO, CHAIRMAN
BOARD OF LAND & NATURAL RESOURCES

EDGAR A. HAMASU
DEPUTY TO THE CHAIRMAN

DIVISIONS:
AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

FILE NO.: HA-1951
DOC. NO.: 1811B

OCT 08 1985

Ms. Letitia Uyehara, Director
Office of Environmental Quality Control
465 So. King Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

We have completed our review of the draft Supplemental Environmental Impact Statement for the proposed Hilo Bay Outfall sewer extension, Hilo, Hawaii. Our comments are as follows:

The draft Supplemental Environmental Impact Statement concurs with our previous recommendations (in comments dated 11/21/84) of using small, shaped explosives for blasting, and of not blasting during the humpback whale season. The applicant further proposes to use existing surge channels as temporary storage for dredged spoils needed as backfill. The bottom of these channels are described as already being partially filled with coral rubble.

Although the use of surge channels for holding spoils may have merit, information to permit impact evaluation is lacking (such as the number of, volume of, and proximity of these surge channels to the proposed extension alignment).

Very truly yours,

SUSUMU ONO, Chairperson
Board of Land and Natural Resources

cc: Mr. Hugh Ono
Mr. Kenneth Ishizaki

B2

M&E Pacific, Inc.

Engineers & Architects

Suite 500, Pauahi Tower
1001 Bishop Street
Honolulu, Hawaii 96813
(808) 521-3051 Telex 7430065

November 5, 1986

Mr. Susumu Ono, Chairperson
Board of Land and Natural
Resources
State of Hawaii
P. O. Box 621
Honolulu, Hawaii 96809

SUBJECT: Draft Supplemental EIS for the
Proposed Hilo Bay Outfall Sewer Extension

Thank you for your comments of October 8, 1986.

A more detailed bathymetric map in the vicinity of the outfall extension will be included in the Final Supplemental EIS; surge channel and ridge features should be visible from the topographic contours.

JAMES S. KUMAGAI, Ph.D.
Vice President

RM/bs

cc: Mr. Hugh Y. Ono, Director, DPW, County of Hawaii

September 10, 1986

Mr. Hugh Y. Ono, Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Ono:

Subject: Supplemental EIS for the Proposed Hilo Bay Outfall Sewer Extension, Hilo, Hawaii

According to the EIS, the original outfall extended 2,600 feet and discharged effluent in 37 feet of water. A few years later the outfall was extended to 4,500 feet and discharged effluent in 56 feet of water. Now the outfall will be extended to 5,680 feet and will discharge effluent in 80 feet of water. This historical review of the project would be enhanced with a brief disclosure of the reasons the outfall was extended in the project and whether future extensions are anticipated.

If the present extension is being proposed as a means of utilizing the Clean Water Act's 301(h) waiver provision, the EIS should include a discussion on the impacts of the advanced primary wastewater treatment process.

Thank you for providing us the opportunity to review this EIS.

Sincerely,

Letitia N. Uyehara
Director

cc: M&E Pacific, Inc.

SEP 11

M&E Pacific, Inc.

Engineers & Architects

Suite 500, Pauahi Tower
1001 Bishop Street
Honolulu, Hawaii 96813-3497
(808) 521-3051 Telex 7430065

December 18, 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality
Control
State of Hawaii
465 South King Street, Room 104
Honolulu, Hawaii 96813

SUBJECT: Final Supplemental Environmental Impact Statement for the Proposed Hilo Bay Outfall Sewer Extension, Hilo, Hawaii

Thank you for your comments of September 11, 1986. Responses are as follows:

1. Comment: In 1966, the outfall was constructed to extend 2,800 feet offshore and to discharge effluent in 37 feet of water. A subsequent extension to 4,500 feet offshore discharged effluent in 56 feet of water. Now, the proposed extension to 5,680 feet offshore will result in a discharge at a depth of 80 feet. The SEIS should disclose the reasons for the extension and whether future extensions are being considered.

   Response: The 4,500-foot outfall had been selected as the appropriate length for the engineering design life that would satisfy the planning projections at the time of implementation. Due to funding constraints, however, the project had to be constructed in two phases of 2,800 feet and 4,500 feet. Wastewater projections based on estimated population growth for the Hilo Wastewater Treatment Facility (WTF) service area has indicated that initial dilutions could approach marginal acceptability (according to U.S. Environmental Protection Agency guidelines) in the next 20 years. The proposed extension to 5,680 feet shall improve discharge dilutions and provide the capacity to meet future growth needs. No further extensions are planned for the immediate future.

2. Comment: The SEIS should discuss the impacts of the advanced primary process under the Clean Water Act's Section 301(h) permit.

Response: Approval of the Section 301(h) Modified National Pollutant Discharge Elimination System (NPDES) permit application for the Hilo WTF presently pending review would allow the discharge of primary effluent. Since the commencement of outfall discharges in 1966, the wastewater has received primary treatment. Approval of the Section 301(h) Modified NPDES permit would allow the continuation of the same level of treatment (i.e., no change from existing conditions).

Should you have any questions, please contact Ken Ishizaki at 521-3051.

JAMES S. KUMAGAI, Ph.D.
Vice President

RM/bs

cc: Mr. Hugh Y. Ono, Chief Engineer
Department of Public Works, County of Hawaii

RECEIVED OCT 8 1986

COPY

PLANNING DEPARTMENT
25 AUPUNI STREET

COUNTY OF HAWAII
HILO, HAWAII 96720

October 3, 1986

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Supplemental EIS for the
Proposed Hilo Bay Outfall Sewer Extension

We have reviewed the supplemental EIS for the subject project and have the following comments to offer:

According to the stated objectives, this project is intended to:

1. Increase the effluent dilution to lessen the potential for adverse environmental impacts; and

2. Protect against shoreward transport of effluent bacteria.

This document does not show or refer the reader to a document that illustrates and demonstrates that there are problems which the project intends to correct. Assuming there are problems, there is not a presentation/argument made to show that this project will correct the problem. Further, assuming there are problems, and the proposed project is intended to correct the problem, there is no discussion on monitoring the water quality to demonstrate that the project is working properly. As examples:

1. Page I-1, last paragraph, states "The purpose of this orientation is to provide adequate dilution during periods of south and easterly currents, and also provide adequate dilution during periods of the predominately tide-related westerly currents." The document does not include any quantitative data to evaluate either the present situation, the impact that the proposed action would have, in the likelihood that the proposed action will correct the present situation.

B3

2. There has been no discussion why the extension needs to be constructed with the three angle changes and why this alignment is superior to a straight extension with a similar diffuser.

3. Page II-1, last paragraph, presents Clean Water Act requirements. The second sentence states: "The main criteria of concern for Hilo outfall is Subsection 301(h)(2) which states that a variance will not interfere with the attainment or maintenance of that water quality which ensures protection of water supplies and protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife, and allows recreational activities on and in the the water." As mentioned previously, the lack of quantitative data makes it very difficult, if not impossible, to evaluate what is occurring now and what is likely to occur after the project. The paragraph goes on to state that specific water quality monitoring is required. Serious consideration should be given to the inclusion in the Supplemental EIS of the baseline water quality data.

Thank you for giving us the opportunity to comment on the subject property.

Sincerely,

Albert Lono Lyman
Planning Director

RN/AK:aeb

cc: Hugh Y. Ono, Chief Engineer, DPW
✓Kenneth Ishizaki, M&E Pacific, Inc.

M&E Pacific, Inc.

Engineers & Architects

Suite 500, Pauahi Tower
1001 Bishop Street
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(808) 521-3051 Telex 7430065

November 5, 1986

Mr. Albert L. Lyman, Director
Planning Department
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

SUBJECT: Draft Supplemental EIS for the
Proposed Hilo Bay Outfall Sewer Extension

Thank you for your comments of October 3, 1986. Responses are as follows:

1. Comment: "This document does not show or refer the reader to a document and illustrates that there are problems which the project ends to correct... The document does not include any quantitative data to evaluate the present situation, the impact that the proposed action would have... Serious consideration should be given to the inclusion of...baseline water quality data."

   Response: There are no "problems" with the receiving waters or the marine biological population. Laboratory reports of the recent water quality monitoring conducted in June, July, and August of this year were obtained subsequent to the release of the Draft SEIS; these data will be included in the Final EIS. Based on the preceding data base, the minimum initial dilution estimated for the projected year 2002 0.464 cubic meters/sec discharge would be 104. Although there are no quantitative regulatory requirements for initial dilution, an initial dilution of less than 100 is considered "marginal" in terms of acceptability (U.S. Environmental Protection Agency, November 1982, Revised Section 301(h) technical support document).

2. Comment: "There has been no discussion why the extension needs to be constructed with the three angle changes and why this alignment is superior to a straight extension with a similar diffuser."

Response: The proposed alignment was specifically selected to avoid areas of severe topographic relief. The additional information that will be provided in the Final EIS in accordance with the preceding comment shows that the proposed alignment skirts around the large depression. Extension of the outfall due north beneath this depression would require lowering the invert of the pipe so some areas of trench would be in excess of 15 feet deep. The depth of excavation is a major factor in excavation costs that must be taken into consideration. Crude cost estimates based on average cost per foot factors are simply inappropriate. Furthermore, a deeper excavation would result in a wider trench, disturbing a wide area of live coral communities. Extending the outfall northeast to the 80-foot depth would result in the placement of the diffuser on a steep slope and require deep excavation at the head of the slope.

3. Comment: "There is no discussion on water quality monitoring."

Response: As stated in the Draft SEIS, monitoring requirements of the Section 301(h) Modified National Pollutant Discharge Elimination System (NPDES) permit will require quarterly monitoring to assure compliance with state water quality standards. The monitoring program will be structured in accordance with the requirements of the U.S. Environmental Protection Agency when a tentative decision is reached on the Section 301(h) Modified NPDES Permit application. The preceding application is presently still pending review by the EPA.

JAMES S. KUMAGAI, Ph.D.
Vice President

RM/bs

University of Hawaii at Manoa

Environmental Center
Crawford 317 • 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (808) 948-7361

October 7, 1986

RE:0443

Ms. Letitia N. Uyehara, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Ms. Uyehara:

Supplemental EIS
Hilo Bay Outfall Sewer Extension
(Hilo Wastewater Management Plan)
Hilo, Hawaii

The proposed project for which this Supplemental EIS has been prepared involves the extension and modification of the Hilo Bay Sewage Outfall. The Environmental Center review has been prepared with the assistance of Keith Chave, Oceanography; Hans Krock, Ocean Engineering; and Walington Yee, Environmental Center. Some general comments regarding the format and scope of the present Draft Supplemental EIS are warranted:

Basis for EIS

The information provided in the DSEIS provides no explanation as to the reason for its preparation and only cursory reference to the original document that it is "supplemental" too. The DSEIS contains only the briefest description of the physical characteristics of the project and instead concentrates solely on a descriptive survey of the biological community in Hilo Bay with little or no interpretation significant to the construction of the sewer outfall extension. A brief summary of the basis for the supplemental statement and a description of the project should be provided in the final SEIS.

Earlier Environmental Center Review, November 7, 1984

The Draft Supplemental EIS completely omits the major issues cited by the Environmental Center in our November 7, 1984 review of the earlier application for a Corps of Engineers permit for this project. In that review (copy enclosed), we called attention to the need to determine if the proposed extension will actually result in significant improvement in the water quality of Hilo Bay and whether the same improvement could be achieved at a cost materially less than that proposed in the 1984 permit.

B4

Since no answer was received to our November 7, 1984 review, and the issues we raised are not addressed in this latest DSEIS, we can only conclude that these issues have not yet been addressed.

Water Quality

Presumably the purpose of the outfall extension is to improve the water quality in Hilo Bay. The Draft Supplemental EIS does not provide information as to the existing water quality charactistics in Hilo Bay, the initial dilution, or the anticipated water quality after the extension. It is our understanding that recent measurements of various water quality parameters have been made. Data, or a summary thereof, should be provided in the Final Supplemental EIS as to the present water quality conditions and how these conditions will be improved by the proposed extension.

Monitoring Program

The 1984 Corps of Engineers permit application cited the need for a monitoring program. We assume that even though the present Draft Supplemental EIS apparently represents a change in the alignment from that put forth in the earlier permit application, the need for a monitoring program will still be applicable. The Draft Supplemental EIS should describe the required monitoring program and provide maps showing the monitoring stations and the results of any baseline studies that have been undertaken as part of the environmental assessment process to evaluate the presumed effectiveness of the proposed alignment of the outfall. In this regard, the need for special emphasis on water quality monitoring should be stressed.

Tsunami and Hurricane structural requirements

In our earlier review (November 7, 1984) we called attention to the need to consider the wave and current forces associated with tsunamis in addition to those generated by hurricanes. The recent failure of the existing outfall and leakage of sewage into Hilo Bay further calls attention to the need for a review of the structural design of the project. It is our understanding that strong currents have resulted in major erosion and undermining of the existing outfall and that collapse of other eroded sections is highly probable. The trenching and burial of the new section and proposed use of coral rubble, sand and basalt for backfill as described in the just issued Corps of Engineers public notice (9/25/86) is likely to require a solid cap of tremie concrete with appropriate tie-ins to the walls or bedrock to avoid eventual erosion of the backfill material and undermining of the new section. The structural design to withstand high currents and wave forces generated by tsunami and storm waves needs much more careful attention. In this latter case, we note that engineers from the local engineering firm of Sea Engineering Inc. have considerable experience in this specialised type of ocean engineering work. You may wish to contact them or other local firms with special

expertise for a second opinion on the potential undermining and structural needs of this project.

While it is unlikely that significant ecological problems will be experienced with the proposed action, the present document provides insuffient data upon which to make definitive decisions with regard to water quality benefits and structural adequacies and therefore sets a poor precedent for future actions in the marine environment. We appreciate the opportunity to comment and hope you will find our review helpful.

Yours truly,

Jacquelin N. Miller
Acting Associate Director

Enclosure

cc: Patrick Takahashi
Hugh Ono, DWP
Kenneth Ishizaki, M & E Pacific
Hans Krock
Keith Chave
Walington Yee

M&E Pacific, Inc.

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November 5, 1986

Ms. Jacquelin N. Miller
Acting Associate Director
Environmental Center
Crawford 317
2550 Campus Road
Honolulu, Hawaii 96822

SUBJECT: Draft Supplemental EIS for the
Proposed Hilo Bay Outfall Sewer Extension

Thank you for your comments of October 7, 1986. Responses are as follows:

1. Comment: "The information provided in the DSEIS provides no explanation as to the reason for its preparation and only cursory reference to the original document that it is "supplemental" too [sic]. The DSEIS contains only the briefest description of the physical characteristics of the project and instead concentrates solely on a descriptive survey of the biological community in Hilo Bay with little or no interpretation significant to the construction of the sewer outfall extension. A brief summary of the basis for the supplemental statement and a description of the project should be provided in the final SEIS."

Response: The Revised EIS for the Hilo Wastewater Management Plan accepted on September 17, 1980 is a comprehensive planning document that addressed improvements to wastewater infrastructure, including an outfall extension. Since the various proposed alignments traversed areas that are habitats for coral communities, it was deemed prudent to conduct a detailed study of marine biota. A Supplemental EIS (SEIS) was prepared to facilitate a more in-depth assessment of environmental impacts of the subject project (Section 27 of Chapter 11-200, Department of Health Administrative Rules). The Draft SEIS will be revised in the final to describe the basis for the SEIS.

The focus of the SEIS has been the "new evidence" provided by the biological study (Section 11-200-27); physical characteristics are discussed primarily in relation to biotic impacts. Two findings of the study have direct implications regarding outfall alignment selection:

a. There are no known rare, endangered, or unique individual species of corals; however, the assemblage of corals is unique because of the environmental conditions of the bay.

b. Live coral communities are not restricted to small areas; rather, community structure is expected to be similar over most areas of similar depth.

Based on the preceding findings, it can be concluded that there is no azimuthal alignment that would have any advantage over any other. Minimization of the length and width of excavation would lessen the area of coral communities directly impacted by short-term construction impacts. As noted in the biological study, however, the coral communities would eventually regenerate. Additional hard substrate provided by the outfall could result in an even higher coral density than the present.

Additional information regarding the physical nature of the outfall will be added in the Final EIS. The Draft SEIS will be revised in the final to incorporate items covered in the Revised EIS by reference to avoid redundancy (Section 11-200-28).

2. Comment: "The Draft Supplemental EIS completely omits the major issues cited by the Environmental Center in our November 7, 1984 review of the earlier application for a Corps of Engineers permit for this project. In that review, we called attention to...:

a. Continuation of present alignment due north, or northeast would result in a shorter extension to achieve a diffuser depth of 80 feet. By a rule-of-thumb cost estimate of $3,000 per foot, a savings of $5 million or more could be attained.

b. With a greater diffuser depth, there will be more effective diffusion before the effluent reaches the surface. However, the total input of nutrients and other contaminants to bay waters remains unchanged, and the predominantly onshore winds will tend to keep the diffused effluent in the bay.

c. Total phosphorus and chlorophyll a are the most important constituents to be included in any water quality monitoring program.

d. Tsunami hazards are equally important as hurricane wave forces as design considerations.

Response: a. The proposed alignment was specifically selected to avoid areas of severe topographic relief. The additional information that will be provided in the Final EIS in accordance with the preceding comment shows that the proposed alignment skirts around the large depression. Extension of the outfall due north beneath this depression would require lowering the invert of the pipe so some areas of trench would be in excess of 15 feet deep. The depth of excavation is a major factor in excavation costs that must be taken into consideration. Crude cost estimates based on average cost per foot factors are simply inappropriate. Furthermore, a deeper excavation would result in a wider trench, disturbing a wide area of live coral communities. Extending the outfall northeast to the 80-foot depth would result in the placement of the diffuser on a steep slope and require deep excavation at the head of the slope.

b. The purpose of extending the outfall to achieve greater diffuser depth was the mitigation of adverse impacts during the most critical period of combined stagnant conditions and maximum water column stratification. During maximum stratification conditions, the effluent plume does not reach the surface, nor does the plume rise to the wind-influenced layer (top 5 meters).

c. As stated in the Draft SEIS, monitoring requirements of the Department of Army permit will probably be encompassed by the Section 301(h) Modified National Pollutant Discharge Elimination System (NPDES) permit requirements. Section 301(h) Modified NPDES permits require quarterly monitoring to assure compliance with state water quality standards. Total phosphorus and chlorophyll a are two parameters included in the state water quality standards (Chapter 11-54, Department of Health Administrative Rules).

d. Tsunami hazards were taken into consideration during the design of the project.

3. Comment: "Presumably the purpose of the outfall extension is to improve the water quality in Hilo Bay. The Draft Supplemental EIS does not provide information as to the existing water quality characteristics in Hilo Bay, the initial dilution, or the anticipated water quality after the extension. It is our understanding that recent measurements of various water quality parameters have been made. Data, or a summary thereof, should be provided in the Final Supplemental EIS as to the present water quality conditions and how these conditions will be improved by the proposed extension."

Response: Laboratory reports of the recent water quality monitoring conducted in June, July, and August of this year were obtained subsequent to the release of the Draft EIS; these data will be included in the Final EIS.

Assuming that the available computerized numerical models are representative of the behavior of the actual plume, initial dilution is predicated on the water column density profile. Due to the relatively scarce water quality data, the identification of an absolute "typical" dilution or range of dilutions would be somewhat tenuous; however, relative improvements in initial dilution can be ascertained with much more certainty. Based on the same discharge rates, the water column density profile that represented maximum stratification conditions within the set of recently collected water quality conditions, it can be shown that the proposed 80-foot deep diffuser would result in an initial dilution that would be approximately double the initial dilution of the existing 50-foot deep diffuser.

An attempt to project anticipated water quality conditions based on effluent concentrations, effluent flow rates, and estimated initial plume dilutions would be quite dubious. The nonconservative nature of the effluent parameters, possible synergistic reactions that may occur between effluent and sea water constituents, the undetectability of relative constituent changes due to the diluted effluent, and/or the complexities to the receiving water current structure would be too difficult to accurately model (reference: Division of Wastewater Management, Department of Public Works, City and County of Honolulu, October 4, 1984, Sand Island Outfall inaugural water quality monitoring report, 1970-1983, volume I, chapter IV). The best indicator of projected water quality conditions would be an

extrapolation of pre-discharge baseline water quality versus existing conditions; unfortunately, extensive pre-discharge baseline data do not exist.

4. Comment: "The 1984 Corps of Engineers permit application cited the need for a monitoring program. We assume that even though the present Draft Supplemental EIS apparently represents a change in the alignment from that put forth in the earlier permit application, the need for a monitoring program will still be applicable. The Draft Supplemental EIS should describe the required monitoring program and provide maps showing the monitoring stations and the results of any baseline studies that have been undertaken as part of the environmental assessment process to evaluate the presumed effectiveness of the proposed alignment of the outfall. In this regard, the need for special emphasis on water quality monitoring should be stressed."

Response: (Refer to preceding responses to comments 2.c and 3.) The data to be incorporated in the Final EIS (response to preceding comment 3) represent "baseline" data representative of "pre-extension" conditions. A map showing station locations will be included. As previously noted, the monitoring program will be structured according to requirements of the U.S. Environmental Protection Agency (EPA) when a tentative decision is reached on the Section 301(h) Modified NPDES Permit application. The preceding application is presently still pending review by the EPA.

5. Comment: "In our earlier review (November 7, 1984) we called attention to the need to consider the wave and current forces associated with tsunamis in addition to those generated by hurricanes. The recent failure of the existing outfall and leakage of sewage into Hilo Bay further calls attention to the need for a review of the structural design of the project. It is our understanding that strong currents have resulted in major erosion and undermining of the existing outfall and that collapse of other eroded sections is highly probable. The trenching and burial of the new section and proposed use of coral rubble, sand and basalt for backfill as described in the just issued Corps of Engineers public notice (9/25/86) is likely to require a solid cap or tremie concrete with appropriate tie-ins to the walls or bedrock to avoid eventual erosion of the backfill material and undermining of the new section. The structural design to withstand high currents and wave forces generated by tsunami and storm waves needs much more careful attention."

Response: The coral rubble utilized for the uppermost layer of backfill for the existing outfall was inadequately sized to withstand wave and current uplift forces. The use of properly anchored tremie concrete is a viable alternative; however, in areas of deep and wide expanses of sand, the volume of excavation required to anchor the periphery of the tremie concrete cap to prevent undermining could possibly be enormous, and thus impracticable. Anchor rock would still be used if the rock was properly sized to resist the design wave and current uplift forces.

Kim Bohnet

JAMES S. KUMAGAI, Ph.D.
Vice President

RM/bs

cc: Mr. Hugh Y. Ono, Director, DPW, County of Hawaii

372 Haili St.
Hilo, HI 96720
Sept. 11, 1986

Letitia Uyehara, Director
Office of Environmental Quality Control
465 South King St. Room 104
Honolulu, HI 96813

Dear Ms. Uyehara,

A copy of the Draft Supplemental EIS for the Proposed Hilo Bay Outfall Sewer Extension has come to my attention. I am responding as an individual.

In the first paragraph on page I-1 of the DEIS is the statement, "The area in the vicinity of the outfall is largely industrial." The statement is inaccurate.

Part of the shoreline area facing the outfall is industrial. Another substantial area is residential, consisting of the well-populated Keaukaha area of Hawaiian Home Lands.

People from Keaukaha make very active recreational use of the shoreline of Puhi Bay, immediately adjacent to the sewage treatment plant. The usage includes a semi-permanent camp of about a dozen tents.

Therefore, an accurate statement about the shoreline would be:

"The area in the vicinity of the outfall is used for a mix of industrial, residential, and recreational purposes."

Sincerely,

Rodrik Stone Thompson

Rodrik Stone Thompson

Copies:

Hugh Ono, Dept. of Public Works, Hawaii County
Kenneth Ishizaki, M&E Pacific, Inc.

B5

M&E Pacific, Inc.

Engineers & Architects

Suite 500, Pauahi Tower
1001 Bishop Street
Honolulu, Hawaii 96813
(808) 521-3051 Telex 7430065

October 8, 1986

Mr. Rodrik Stone Thompson
372 Haili Street
Hilo, Hawaii 96720

SUBJECT: Supplemental Environmental Impact Statement for the Proposed Hilo Bay Outfall Sewer Extension, Hilo, Hawaii

Thank you for your comment on the Draft Supplemental EIS. Your comment about the mixed land use within the shoreline area facing the outfall is legitimate. The EIS will incorporate your suggestion and will be revised to state--

> "The area in the vicinity of the outfall is used for a mix of industrial, residential, and recreational purposes."

We appreciate your comment on the Draft Supplemental EIS. Your letter and this response will be appended to the Final Supplemental EIS..

JAMES S. KUMAGAI, Ph.D.
Vice President

DM/bs

cc: Hawaii County Department of Public Works

APPENDIX B

WATER QUALITY MONITORING DATA

TABLE B-1
WATER QUALITY DATA

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT.* EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	1	06/16/86	10:56 AM	0.30	25.17	34.31													
2	1	06/16/86	10:56 AM	0.61	25.12	34.31													
3	1	06/16/86	10:56 AM	0.91	25.17	34.15	6.27	1	1	112	6	11	0.4		0.220	0.253	8.35	1	1
5	1	06/16/86	10:56 AM	1.52	25.04	34.46													
10	1	06/16/86	10:56 AM	3.05	25.08	34.27													
15	1	06/16/86	10:56 AM	4.57															
20	1	06/16/86	10:56 AM	6.10	25.18	34.47	6.16												
25	1	06/16/86	10:56 AM	7.62															
30	1	06/16/86	10:56 AM	9.14	24.38	35.02													
40	1	06/16/86	10:56 AM	12.19	24.37	34.97	6.38												
50	1	06/16/86	10:56 AM	15.24	24.25	34.88		1	2	151	6	11	1.0		0.270	0.184	8.40	1	1
60	1	06/16/86	10:56 AM	18.29	24.36	35.00													
70	1	06/16/86	10:56 AM	21.34	24.34	35.09													
80	1	06/16/86	10:56 AM	24.38	24.36	35.02													
90	1	06/16/86	10:56 AM	27.43	24.31	34.98													
100	1	06/16/86	10:56 AM	30.48	24.14	34.94		1	16	174	6	9	0.4		0.230	0.163	8.35	1	1
1	2	06/17/86	09:35 AM	0.30	25.19	31.08													
2	2	06/17/86	09:35 AM	0.61	25.22	31.82													
3	2	06/17/86	09:35 AM	0.91	25.10	32.78	6.68	1	1	121	5	9	1.8		0.560	1.360	8.40	1	
5	2	06/17/86	09:35 AM	1.52	24.89	33.88													
10	2	06/17/86	09:35 AM	3.05	24.61	34.69													
15	2	06/17/86	09:35 AM	4.57															
20	2	06/17/86	09:35 AM	6.10	24.56	34.78	6.50												
25	2	06/17/86	09:35 AM	7.62															
30	2	06/17/86	09:35 AM	9.14	24.43	34.94													
40	2	06/17/86	09:35 AM	12.19	24.39	34.81	6.36												
50	2	06/17/86	09:35 AM	15.24	24.12	34.94		1	1	105	6	6	0.7		0.200	0.131	8.40	1	1
60	2	06/17/86	09:35 AM	18.29	24.38	35.10													
70	2	06/17/86	09:35 AM	21.34	24.30	34.86													
80	2	06/17/86	09:35 AM	24.38	24.19	34.90													
90	2	06/17/86	09:35 AM	27.43	24.18	34.75													
100	2	06/17/86	09:35 AM	30.48	24.22	34.95		1	2	103	6	6	0.7		0.250	0.233	8.40	1	1

* Instrument malfunction.

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT.* EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	3	06/17/86	04:15 PM	0.30	26.15	27.40													
2	3	06/17/86	04:15 PM	0.61	26.28	27.32													
3	3	06/17/86	04:15 PM	0.91	26.00	31.86	8.50	1	1	164	6	15	3.0		0.380	4.020	8.50	1	
5	3	06/17/86	04:15 PM	1.52	25.56	33.90													
10	3	06/17/86	04:15 PM	3.05	25.20	34.33													
15	3	06/17/86	04:15 PM	4.57															
20	3	06/17/86	04:15 PM	6.10	24.48	34.63	6.27												
25	3	06/17/86	04:15 PM	7.62															
30	3	06/17/86	04:15 PM	9.14	24.26	34.65		1	2	115	3	11	1.4		0.280	1.260	8.40	1	1
40	3	06/17/86	04:15 PM	12.19	24.10	34.72	6.25												
50	3	06/17/86	04:15 PM	15.24	24.09	34.73													
60	3	06/17/86	04:15 PM	18.29	24.05	34.76		1	23	120	7	9	1.2		0.310	1.420	8.40	1	1
1	4	06/17/86	05:00 PM	0.30	26.24	30.90													
2	4	06/17/86	05:00 PM	0.61	26.26	31.51													
3	4	06/17/86	05:00 PM	0.91	26.28	32.07	7.60	1	1	131	5	33	2.1		0.520	2.590	8.45	1	1
5	4	06/17/86	05:00 PM	1.52	26.16	33.04													
10	4	06/17/86	05:00 PM	3.05	25.27	33.77													
12	4	06/17/86	05:00 PM	3.66				1	1	122	7	10	0.6		0.270	0.323	8.40	1	1
15	4	06/17/86	05:00 PM	4.57			6.25												
20	4	06/17/86	05:00 PM	6.10	24.40	34.73													
25	4	06/17/86	05:00 PM	7.62	24.38	34.78	5.96	1	1	120	8	8	1.1		0.230	0.655	8.40	1	1
1	5	06/17/86	03:15 PM	0.30	26.17	33.12													
2	5	06/17/86	03:15 PM	0.61	25.70	33.08													
3	5	06/17/86	03:15 PM	0.91	25.60	33.30	6.50	1	1	122	6	7	1.4		0.320	1.190	8.40	1	2
5	5	06/17/86	03:15 PM	1.52	25.54	33.33													
10	5	06/17/86	03:15 PM	3.05	24.78	34.27													
15	5	06/17/86	03:15 PM	4.57															
20	5	06/17/86	03:15 PM	6.10	24.53	34.89	6.28												
25	5	06/17/86	03:15 PM	7.62															
30	5	06/17/86	03:15 PM	9.14	24.45	34.92													
40	5	06/17/86	03:15 PM	12.19	24.56	34.92	6.20												
45	5	06/17/86	03:15 PM	13.72				1	1	116	6	6	1.0		0.160	0.165	8.40	1	1
50	5	06/17/86	03:15 PM	15.24	24.43	34.90													
60	5	06/17/86	03:15 PM	18.29	24.30	34.90													
70	5	06/17/86	03:15 PM	21.34	24.34	34.91													
80	5	06/17/86	03:15 PM	24.38	24.34	34.99													
90	5	06/17/86	03:15 PM	27.43	24.24	34.93		1	6	103	6	6	1.0		0.170	0.245	8.40	1	1

* Instrument malfunction.

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT.* EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	6	06/17/86	02:30 PM	0.30	26.18	32.23													
2	6	06/17/86	02:30 PM	0.61	26.00	32.17													
3	6	06/17/86	02:30 PM	0.91	25.66	32.53	6.70	1	1	118	4	9	1.4		0.390	1.060	8.40	1	1
5	6	06/17/86	02:30 PM	1.52	25.28	32.73													
10	6	06/17/86	02:30 PM	3.05	25.36	32.94													
15	6	06/17/86	02:30 PM	4.57															
20	6	06/17/86	02:30 PM	6.10	24.58	34.64	6.54												
25	6	06/17/86	02:30 PM	7.62															
30	6	06/17/86	02:30 PM	9.14	24.53	34.93													
40	6	06/17/86	02:30 PM	12.19	24.47	34.97	6.31												
50	6	06/17/86	02:30 PM	15.24	24.42	35.00		1	2	116	8	8	0.6		0.120	0.094	8.40	1	12
60	6	06/17/86	02:30 PM	18.29	24.42	34.94													
70	6	06/17/86	02:30 PM	21.34	24.29	35.02													
80	6	06/17/86	02:30 PM	24.38	24.28	34.81													
90	6	06/17/86	02:30 PM	27.43	24.37	34.90													
100	6	06/17/86	02:30 PM	30.48	24.36	34.90		1	10	115	8	9	0.1		0.120	0.186	8.40	1	1
1	7	06/16/86	02:05 PM	0.30	25.09	30.91													
2	7	06/16/86	02:05 PM	0.61	24.98	31.55													
3	7	06/16/86	02:05 PM	0.91	24.89	31.91	6.36	40	22	184	18	27	2.2		0.490	1.180	8.35	247	
5	7	06/16/86	02:05 PM	1.52	25.17	32.95													
10	7	06/16/86	02:05 PM	3.05	25.28	34.01													
15	7	06/16/86	02:05 PM	4.57			5.94	2	8	165	6	9	1.4		0.320	1.310	8.35	30	1
20	7	06/16/86	02:05 PM	6.10	25.19	34.21													
25	7	06/16/86	02:05 PM	7.62			7.13												
30	7	06/16/86	02:05 PM	9.14	24.88	34.44		17	17	144	10	17	0.8		0.480	0.229	8.35	3	34
1	8	06/16/86	03:00 PM	0.30	25.55	32.59													
2	8	06/16/86	03:00 PM	0.61	25.47	32.65													
3	8	06/16/86	03:00 PM	0.91	25.41	32.75	6.73	1	1	752	5	8	1.2		0.390	2.570	8.35	1	25
5	8	06/16/86	03:00 PM	1.52	25.11	33.09													
10	8	06/16/86	03:00 PM	3.05	25.19	33.84													
15	8	06/16/86	03:00 PM	4.57															
20	8	06/16/86	03:00 PM	6.10	24.94	33.93	6.87	1	1	106	6	9	*1.2		0.280	0.983	8.40	1	1
25	8	06/16/86	03:00 PM	7.62															
30	8	06/16/86	03:00 PM	9.14	24.96	34.40													
40	8	06/16/86	03:00 PM	12.19	24.15	34.46	6.29	10	1	113	9	11	0.8		0.230	0.234	8.40	1	10

* Instrument malfunction.

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT.* EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	9	06/17/86	11:00 AM	0.30	25.72	32.90													
2	9	06/17/86	11:00 AM	0.61	25.49	32.60													
3	9	06/17/86	11:00 AM	0.91	25.34	33.11	6.47	1	1	88	2	8	0.8		0.370	1.170	8.40	1	5
5	9	06/17/86	11:00 AM	1.52	25.14	33.70													
10	9	06/17/86	11:00 AM	3.05	25.06	33.85													
15	9	06/17/86	11:00 AM	4.57															
20	9	06/17/86	11:00 AM	6.10	24.46	34.72	6.18												
25	9	06/17/86	11:00 AM	7.62				1	1	95	4	8	0.4		0.230	0.351	8.40	2	16
30	9	06/17/86	11:00 AM	9.14	24.34	34.88													
40	9	06/17/86	11:00 AM	12.19	24.41	24.95	6.20												
50	9	06/17/86	11:00 AM	15.24	24.44	34.84		2	6	112	4	10	0.1		0.470	0.281	8.40	1	14
1	10	06/17/86	11:30 AM	0.30	25.70	32.83													
2	10	06/17/86	11:30 AM	0.61	26.02	33.29													
3	10	06/17/86	11:30 AM	0.91	25.23	33.35	6.41	1	1	96	3	9	0.9		0.310	1.160	8.35	2	5
5	10	06/17/86	11:30 AM	1.52	25.23	33.63													
10	10	06/17/86	11:30 AM	3.05	24.98	33.98													
15	10	06/17/86	11:30 AM	4.57															
20	10	06/17/86	11:30 AM	6.10	24.50	34.57	6.19												
25	10	06/17/86	11:30 AM	7.62				1	1	123	4	9	0.2		0.200	0.381	8.40	143	1
30	10	06/17/86	11:30 AM	9.14	24.36	34.82													
40	10	06/17/86	11:30 AM	12.19	24.38	34.97	6.35												
50	10	06/17/86	11:30 AM	15.24	24.44	34.90		1	1	88	4	12	0.9		0.160	0.211	8.40	32	1
1	11	06/17/86	05:30 PM	0.30	26.26	32.58													
2	11	06/17/86	05:30 PM	0.61	26.20	32.77													
3	11	06/17/86	05:30 PM	0.91	26.20	32.46	7.00	1	1	115	8	12	2.1		0.430	1.700	8.40	2	1
5	11	06/17/86	05:30 PM	1.52	25.76	33.12													
10	11	06/17/86	05:30 PM	3.05	25.19	33.66													
15	11	06/17/86	05:30 PM	4.57															
20	11	06/17/86	05:30 PM	6.10	24.84	34.62	6.15												
25	11	06/17/86	05:30 PM	7.62				1	7	112	6	11	0.2		0.160	0.328	8.40	17	1
30	11	06/17/86	05:30 PM	9.14	24.60	34.88													
40	11	06/17/86	05:30 PM	12.19	24.38	34.93	6.28												
50	11	06/17/86	05:30 PM	15.24	24.40	35.00		1	2	97	10	11	0.8		0.130	0.210	8.40	1	5

* Instrument malfunction.

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT. * EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	12	06/17/86	10:30 AM	0.30	25.07	33.16													
2	12	06/17/86	10:30 AM	0.61	25.35	33.50													
3	12	06/17/86	10:30 AM	0.91	25.50	33.28	6.61	1	2	111	6	11	0.8		0.280	1.290	8.35	1	1
5	12	06/17/86	10:30 AM	1.52	25.10	33.40													
10	12	06/17/86	10:30 AM	3.05	24.86	33.86													
15	12	06/17/86	10:30 AM	4.57															
20	12	06/17/86	10:30 AM	6.10	24.44	34.75	6.21												
25	12	06/17/86	10:30 AM	7.62				1	3	104	6	11	0.4		0.250	0.374	8.40	2	25
30	12	06/17/86	10:30 AM	9.14	24.22	35.16													
40	12	06/17/86	10:30 AM	12.19	24.20	35.08	6.09												
50	12	06/17/86	10:30 AM	15.24	24.20	34.97		2	1	91	5	11	0.2		0.140	0.234	8.40	2	4
1	13	06/17/86	12:10 PM	0.30	25.80	33.06													
2	13	06/17/86	12:10 PM	0.61	25.68	33.20													
3	13	06/17/86	12:10 PM	0.91	25.74	33.34	6.09	1	1	97	5	8	1.7		0.260	1.190	8.40	1	1
5	13	06/17/86	12:10 PM	1.52	25.30	33.63													
10	13	06/17/86	12:10 PM	3.05	24.99	34.05													
15	13	06/17/86	12:10 PM	4.57															
20	13	06/17/86	12:10 PM	6.10	24.40	34.90	6.16	1	1	87	6	7	0.1		0.140	0.356	8.40	6	11
25	13	06/17/86	12:10 PM	7.62															
30	13	06/17/86	12:10 PM	9.14	24.49	34.84													
40	13	06/17/86	12:10 PM	12.19	24.36	34.97	6.25	1	1	94	6	10	0.1		0.120	0.243	8.40	1	5
50	13	06/17/86	12:10 PM	15.24	24.44	34.92													
1	14	06/16/86	04:00 PM	0.30	25.21	33.56													
2	14	06/16/86	04:00 PM	0.61	25.29	33.51													
3	14	06/16/86	04:00 PM	0.91	25.29	33.59	6.67	1	3	174	6	10	0.6		0.250	1.540	8.35	1	1
5	14	06/16/86	04:00 PM	1.52	25.20	33.50													
10	14	06/16/86	04:00 PM	3.05	25.07	33.60													
15	14	06/16/86	04:00 PM	4.57															
20	14	06/16/86	04:00 PM	6.10	25.06	34.34	6.55												
25	14	06/16/86	04:00 PM	7.62															
30	14	06/16/86	04:00 PM	9.14	24.75	34.53													
35	14	06/16/86	04:00 PM	10.67				1	12	144	9	15	0.9		0.270	0.240	8.40	1	2
40	14	06/16/86	04:00 PM	12.19	24.79	34.59	6.66												
50	14	06/16/86	04:00 PM	15.24	24.53	34.64													
60	14	06/16/86	04:00 PM	18.29	24.37	34.73													
70	14	06/16/86	04:00 PM	21.34	24.24	34.60		3	22	152	6	9	0.7		0.250	0.281	8.40	1	

* Instrument malfunction.

Source: M&E Pacific, Inc.

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT. EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	1	07/25/86	11:46 AM	0.30	25.64	34.90													
2	1	07/25/86	11:46 AM	0.61	25.66	34.88													
3	1	07/25/86	11:46 AM	0.91	25.60	35.06	6.45	1	2	130	5	10	0.7	0.68	0.460	0.210	8.30	1	1
5	1	07/25/86	11:46 AM	1.52	25.64	34.88													
10	1	07/25/86	11:46 AM	3.05	25.58	35.06													
15	1	07/25/86	11:46 AM	4.57	25.60		6.51												
20	1	07/25/86	11:46 AM	6.10	25.22	34.88								0.145					
25	1	07/25/86	11:46 AM	7.62	25.40		6.58												
30	1	07/25/86	11:46 AM	9.14	25.20	35.00								0.09					
40	1	07/25/86	11:46 AM	12.19	25.18	35.01													
50	1	07/25/86	11:46 AM	15.24	25.09	35.00													
60	1	07/25/86	11:46 AM	18.29	24.94	34.97		1	1	175	7	7	1.2		0.380	0.190	8.30	1	2
70	1	07/25/86	11:46 AM	21.34	25.04	35.02													
80	1	07/25/86	11:46 AM	24.38	25.00	35.05													
90	1	07/25/86	11:46 AM	27.43	24.84	34.99													
100	1	07/25/86	11:46 AM	30.48	24.90	34.97													
1	2	07/25/86	11:01 AM	0.30	25.16	35.20		1	1	140	4	12	1.2		0.300	0.160	8.30	1	3
2	2	07/25/86	11:01 AM	0.61	25.29	34.78													
3	2	07/25/86	11:01 AM	0.91	25.11	34.84	6.52	1	2	142	4	9	0.5	0.577	0.260	0.320	8.35	1	1
5	2	07/25/86	11:01 AM	1.52	25.20	34.77													
10	2	07/25/86	11:01 AM	3.05	25.22	34.79													
15	2	07/25/86	11:01 AM	4.57	25.70		6.51												
20	2	07/25/86	11:01 AM	6.10	25.17	34.76								0.128					
25	2	07/25/86	11:01 AM	7.62	25.50		6.50												
30	2	07/25/86	11:01 AM	9.14	25.20	34.74								0.082					
40	2	07/25/86	11:01 AM	12.19	25.22	34.84													
50	2	07/25/86	11:01 AM	15.24	25.24	34.83													
60	2	07/25/86	11:01 AM	18.29	25.18	34.82		1	1	143	6	10	1.4		0.240	0.160	8.35	1	1
70	2	07/25/86	11:01 AM	21.34	25.00	34.87													
80	2	07/25/86	11:01 AM	24.38	25.00	34.88													
90	2	07/25/86	11:01 AM	27.43	24.80	34.89													
100	2	07/25/86	11:21 AM	30.48	24.80	34.91		1	1	143	8	9	1.2		0.280	0.280	8.40	1	7

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT. EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	3	07/26/86	10:39 AM	0.30	24.97	27.00													
2	3	07/26/86	10:39 AM	0.61	25.60	29.56													
3	3	07/26/86	10:39 AM	0.91	25.60	33.58	6.36	69	1	139	9	14	2.6	0.447	0.550	1.900	8.35	1	1
5	3	07/26/86	10:39 AM	1.52	25.85	34.23													
10	3	07/26/86	10:39 AM	3.05	25.40	34.50													
15	3	07/26/86	10:39 AM	4.57	25.60		6.44							0.159					
20	3	07/26/86	10:39 AM	6.10	25.58	34.74													
25	3	07/26/86	10:39 AM	7.62	25.60		6.51							0.11					
30	3	07/26/86	10:39 AM	9.14	25.50	34.64		1	1	140	8	12	1.1		0.210	0.250	8.30	1	1
40	3	07/26/86	10:39 AM	12.19	25.44	34.66													
50	3	07/26/86	10:49 AM	15.24	25.40	34.66													
60	3	07/26/86	10:49 AM	18.29				1	1	133	5	3	1.0		0.260	0.410	8.35	1	1
1	4	07/26/86	10:10 AM	0.30	25.60	34.06													
2	4	07/26/86	10:10 AM	0.61	25.80	34.20													
3	4	07/26/86	10:10 AM	0.91	25.88	34.41	6.37	1	1	134	4	15	1.2	0.339	0.300	0.570	8.35	1	1
5	4	07/26/86	10:10 AM	1.52	25.56	34.41													
10	4	07/26/86	10:10 AM	3.05	25.45	34.55													
12.5	4	07/26/86	10:10 AM	3.81				1	1	142	4	10	0.8		0.220	0.270	8.35	1	1
15	4	07/26/86	10:10 AM	4.57	25.90		6.36							0.064					
20	4	07/26/86	10:10 AM	6.10	25.60	34.70													
25	4	07/26/86	10:26 AM	7.62	25.70		6.50	3	1	137	7	10	1.6	0.061	0.230	0.260	8.35	1	1

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT. EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	5	07/26/86	08:46 AM	0.30	25.47	34.50													
2	5	07/26/86	08:46 AM	0.61	25.46	34.34													
3	5	07/26/86	08:46 AM	0.91	25.60	34.49	6.56	4	1	125	6	8	1.1	1.102	0.230	0.440	8.30	1	6
5	5	07/26/86	08:46 AM	1.52	25.50	34.63													
10	5	07/26/86	08:46 AM	3.05	25.50	34.68													
15	5	07/26/86	08:46 AM	4.57	25.40		6.42												
20	5	07/26/86	08:46 AM	6.10	25.30	34.63								0.261					
25	5	07/26/86	08:46 AM	7.62	25.30		6.40												
30	5	07/26/86	08:46 AM	9.14	25.13	34.53								0.165					
40	5	07/26/86	08:46 AM	12.19	25.14	34.71													
45	5	07/26/86	08:46 AM	13.72				4	1	131	5	5	0.6		0.200	0.620	8.30	1	9
50	5	07/26/86	08:46 AM	15.24	25.08	34.71													
60	5	07/26/86	08:46 AM	18.29	25.09	34.68													
70	5	07/26/86	08:46 AM	21.34	25.08	34.73													
80	5	07/26/86	09:14 AM	24.38	25.07	34.71													
90	5	07/26/86	09:14 AM	27.43															
1	6	07/26/86	09:33 AM	0.30	24.82	33.27		5	1	133	6	7	1.1		0.310	0.350	8.30	1	38
2	6	07/26/86	09:33 AM	0.61	25.24	34.02													
3	6	07/26/86	09:33 AM	0.91	25.19	34.08	7.80	2	1	150	5	9	0.8	0.494	0.250	0.360	8.35	1	2
5	6	07/26/86	09:33 AM	1.52	25.25	34.24													
10	6	07/26/86	09:33 AM	3.05	25.40	34.48													
15	6	07/26/86	09:33 AM	4.57	25.40		6.85												
20	6	07/26/86	09:33 AM	6.10	25.30	34.78								0.109					
25	6	07/26/86	09:33 AM	7.62	25.30		6.55												
30	6	07/26/86	09:33 AM	9.14	25.02	34.70								0.071					
40	6	07/26/86	09:33 AM	12.19	25.22	34.68													
50	6	07/26/86	09:33 AM	15.24	25.04	34.65		1	1	152	4	22	0.9		0.180	0.170	8.40	1	1
60	6	07/26/86	09:33 AM	18.29	24.99	34.69													
70	6	07/26/86	09:33 AM	21.34	24.99	34.70													
80	6	07/26/86	09:33 AM	24.38	25.04	34.69													
90	6	07/26/86	09:33 AM	27.43	25.10	34.80													
100	6	07/26/86	09:56 AM	30.48	25.19	34.77		1	1	145	4	17	0.8		0.220	0.150	8.35	1	3

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT. EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	7	07/25/86	09:12 AM	0.30	24.00	33.24													
2	7	07/25/86	09:12 AM	0.61	24.70	34.45													
3	7	07/25/86	09:12 AM	0.91	24.70	34.63	6.04	9	1	143	6	21	1.2	0.178	0.350	0.230	8.30	56	135
5	7	07/25/86	09:12 AM	1.52	24.79	34.72													
10	7	07/25/86	09:12 AM	3.05	24.73	34.91													
15	7	07/25/86	09:12 AM	4.57	24.90		6.15	4	1	165	6	15	1.1	0.062	0.330	0.280	8.35	1	10
20	7	07/25/86	09:12 AM	6.10	24.48	34.82													
25	7	07/25/86	09:12 AM	7.62	24.80		6.02												
30	7	07/25/86	09:23 AM	9.14	24.45	34.87		12	1	156	8	19	0.9	0.07	0.240	0.230	8.30	8	31
1	8	07/25/86	09:43 AM	0.30	24.49	34.91													
2	8	07/25/86	09:43 AM	0.61	24.87	33.78													
3	8	07/25/86	09:43 AM	0.91	24.88	34.69	6.12	6	1	150	5	10	0.8	0.445	0.260	0.260	8.30	1	3
5	8	07/25/86	09:43 AM	1.52	24.87	34.76													
10	8	07/25/86	09:43 AM	3.05	24.85	34.86													
15	8	07/25/86	09:43 AM	4.57	24.90		6.16							0.058					
20	8	07/25/86	09:43 AM	6.10	24.74	34.92		5	3	145	7	16	1.0		0.230	0.250	8.30	1	8
25	8	07/25/86	09:43 AM	7.62	24.90		6.18												
30	8	07/25/86	09:43 AM	9.14	24.69	34.92													
40	8	07/25/86	10:01 AM	12.19	24.73	34.93		5	1	150	8	13	0.7	0.046	0.240	0.250	8.30	3	6
1	9	07/25/86	03:01 PM	0.30	25.40	34.56													
2	9	07/25/86	03:01 PM	0.61	25.40	34.52													
3	9	07/25/86	03:01 PM	0.91	25.48	34.56	6.41	1	1	150	4	14	0.9	0.607	0.240	0.250	8.40	1	1
5	9	07/25/86	03:01 PM	1.52	25.46	34.74													
10	9	07/25/86	03:01 PM	3.05	25.32	34.70													
15	9	07/25/86	03:01 PM	4.57			6.60							0.131					
20	9	07/25/86	03:01 PM	6.10	25.26	34.78													
25	9	07/25/86	03:01 PM	7.62			6.45	1	2	133	6	14	0.5	0.071	0.210	0.300	8.40	1	1
30	9	07/25/86	03:01 PM	9.14	25.17	34.81													
40	9	07/25/86	03:01 PM	12.19	25.07	34.80													
50	9	07/25/86	03:01 PM	15.24	24.94	37.78		1	1	137	9	16	0.6		0.250	0.460	8.40	26	355

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT. EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	10	07/25/86	02:35 PM	0.30	25.51	34.48													
2	10	07/25/86	02:35 PM	0.61	25.57	34.51													
3	10	07/25/86	02:35 PM	0.91	25.53	34.55	6.51	1	1	135	6	14	1.3	0.557	0.220	0.230	8.40	1	1
5	10	07/25/86	02:35 PM	1.52	25.45	34.52													
10	10	07/25/86	02:35 PM	3.05	25.45	34.42													
15	10	07/25/86	02:35 PM	4.57	25.60		6.46							0.124					
20	10	07/25/86	02:35 PM	6.10	25.21	34.70													
25	10	07/25/86	02:35 PM	7.62	25.40		6.48	1	1	133	3	8	0.9	0.08	0.270	0.300	8.40	1	12
30	10	07/25/86	02:35 PM	9.14	25.30	34.70													
40	10	07/25/86	02:49 PM	12.19	25.09	34.61													
50	10	07/25/86	02:49 PM	15.24				1	1	145	10	10	0.9		0.230	0.470	8.40	1	8
1	11	07/25/86	03:31 PM	0.30	25.40	34.46													
2	11	07/25/86	03:31 PM	0.61	25.44	34.45													
3	11	07/25/86	03:31 PM	0.91	25.43	34.50	6.42	1	1	134	7	19	1.1	0.536	0.230	0.230	8.40	1	1
5	11	07/25/86	03:31 PM	1.52	25.38	34.54													
10	11	07/25/86	03:31 PM	3.05	25.49	34.63													
15	11	07/25/86	03:31 PM	4.57	25.67		6.28							0.065					
20	11	07/25/86	03:31 PM	6.10	25.40	34.75													
25	11	07/25/86	03:31 PM	7.62	25.50		6.49	1	1	133	2	12	1.3	0.084	0.230	0.270	8.40	1	1
30	11	07/25/86	03:31 PM	9.14	25.33	34.66													
40	11	07/25/86	03:31 PM	12.19	25.08	34.78													
50	11	07/25/86	03:52 PM	15.24	25.00	34.70		1	1	139	8	8	1.2		0.270	0.280	8.40	1	1
1	12	07/25/86	02:07 PM	0.30	25.48	34.48													
2	12	07/25/86	02:07 PM	0.61	25.53	34.44													
3	12	07/25/86	02:07 PM	0.91	25.51	34.46	6.63	1	1	159	5	14	0.6	0.524	0.250	0.260	8.40	1	1
5	12	07/25/86	02:07 PM	1.52	25.58	34.38													
10	12	07/25/86	02:07 PM	3.05	25.46	34.42													
15	12	07/25/86	02:07 PM	4.57	25.70		6.51							0.119					
20	12	07/25/86	02:07 PM	6.10	25.22	34.58													
25	12	07/25/86	02:07 PM	7.62	25.50		6.42	1	1	131	2	12	2.5	0.08	0.230	0.340	8.40	1	1
30	12	07/25/86	02:07 PM	9.14	25.20	34.68													
40	12	07/25/86	02:07 PM	12.19	25.10	34.71													
50	12	07/25/86	02:27 PM	15.24	24.90	34.70		1	1	139	4	10	0.9		0.260	0.470	8.40	2	11

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT. EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL ($/100ml)	COLIFORM TOTAL (#/100ml)
1	13	07/25/86	03:58 PM	0.30	25.45	34.52													
2	13	07/25/86	03:58 PM	0.61	25.42	34.59													
3	13	07/25/86	03:58 PM	0.91	25.49	34.61	6.46	1	1	123	6	15	0.5	0.419	0.250	0.260	8.40	1	1
5	13	07/25/86	03:58 PM	1.52	25.40	34.60													
10	13	07/25/86	03:58 PM	3.05	25.37	34.67													
15	13	07/25/86	03:58 PM	4.57	25.80		6.51							0.113					
20	13	07/25/86	03:58 PM	6.10	25.36	34.78		1	2	105	4	13	0.7		0.300	0.300	8.40	1	1
25	13	07/25/86	03:58 PM	7.62	25.40		6.55							0.072					
30	13	07/25/86	03:58 PM	9.14	25.17	34.86													
40	13	07/25/86	04:12 PM	12.19	25.27	34.64		2	1	104	3	11	1.0		0.270	0.350	8.40	1	3
1	14	07/25/86	10:15 AM	0.30	24.94	34.60													
2	14	07/25/86	10:15 AM	0.61	25.09	33.70													
3	14	07/25/86	10:15 AM	0.91	25.18	33.91	6.46	3	1	129	6	10	1.2	0.738	0.270	0.220	8.35	1	1
5	14	07/25/86	10:15 AM	1.52	25.04	34.62													
10	14	07/25/86	10:15 AM	3.05	25.02	34.87													
15	14	07/25/86	10:15 AM	4.57	25.10		6.42							0.158					
20	14	07/25/86	10:15 AM	6.10	24.88	34.78													
25	14	07/25/86	10:15 AM	7.62	25.10		6.49							0.098					
30	14	07/25/86	10:15 AM	9.14	24.92	35.21													
35	14	07/25/86	10:15 AM	10.67	24.92			2	1	125	5	11	1.1		0.210	0.200	8.35	1	3
40	14	07/25/86	10:15 AM	12.19	24.91	34.84													
50	14	07/25/86	10:15 AM	15.24	24.92	34.84													
60	14	07/25/86	10:15 AM	18.29	24.89	34.85													
70	14	07/25/86	10:15 AM	21.34	24.82	34.96		1	1	115	5	12	1.1		0.200	0.200	8.35	1	1
80	14	07/25/86	10:15 AM	24.38	24.80	34.86													
90	14	07/25/86	10:35 AM	27.43	24.72	34.88													

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT. EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	1	08/06/86	11:13 AM	0.30	26.92	33.44													
2	1	08/06/86	11:13 AM	0.61	26.97	33.70													
3	1	08/06/86	11:13 AM	0.91	26.92	34.46	6.10	1	2	152	3	11	1.7	0.43	0.330		8.35	1	1
5	1	08/06/86	11:13 AM	1.52	26.83	34.54													
10	1	08/06/86	11:13 AM	3.05	26.84	34.78													
15	1	08/06/86	11:13 AM	4.57	27.10		6.98												
20	1	08/06/86	11:13 AM	6.10	26.78	34.68								0.1					
25	1	08/06/86	11:13 AM	7.62	26.90		6.00												
30	1	08/06/86	11:13 AM	9.14	26.76	34.85								0.065					
40	1	08/06/86	11:13 AM	12.19	26.66	34.79													
50	1	08/06/86	11:13 AM	15.24	26.65	34.82		1	2	134	6	15	1.6		0.170		8.40	1	1
60	1	08/06/86	11:13 AM	18.29	26.50	34.74													
70	1	08/06/86	11:13 AM	21.34	26.46	34.75													
80	1	08/06/86	11:13 AM	24.38	26.50	34.86													
90	1	08/06/86	11:13 AM	27.43	26.54	34.77													
100	1	08/06/86	11:36 AM	30.48	26.46	34.77		1	2	142	5	11	0.5		0.210		8.40	1	1
1	2	08/06/86	10:33 AM	0.30	26.56	32.80													
2	2	08/06/86	10:33 AM	0.61	26.72	34.25													
3	2	08/06/86	10:33 AM	0.91	26.91	34.32	5.94	1	4	187	3	11	1.9	1.25	0.370		8.40	1	1
5	2	08/06/86	10:33 AM	1.52	26.73	34.60													
10	2	08/06/86	10:33 AM	3.05	26.71	34.60													
15	2	08/06/86	10:33 AM	4.57	27.20		6.00												
20	2	08/06/86	10:33 AM	6.10	26.72	34.77								0.263					
25	2	08/06/86	10:33 AM	7.62	26.90		5.97												
30	2	08/06/86	10:33 AM	9.14	26.62	34.84								0.165					
40	2	08/06/86	10:33 AM	12.19	26.44	34.72													
50	2	08/06/86	10:33 AM	15.24	26.46	34.80		1	2	150	4	10	1.6		0.150		8.40	1	1
60	2	08/06/86	10:33 AM	18.29	26.24	34.80													
70	2	08/06/86	10:33 AM	21.34	26.34	34.62													
80	2	08/06/86	10:33 AM	24.38	26.39	34.78													
90	2	08/06/86	10:33 AM	27.43	26.37	34.83													
100	2	08/06/86	10:47 AM	30.48	26.12	34.86		1	2	132	5	11	0.8		0.140		8.40	1	1

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT. EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	3	08/07/86	10:53 AM	0.30	27.36	31.36													
2	3	08/07/86	10:53 AM	0.61	27.61	31.86													
3	3	08/07/86	10:53 AM	0.91	27.11	32.66	6.45	1	6	180	3	15	3.1	0.376	1.070		8.40	1	1
5	3	08/07/86	10:53 AM	1.52	27.22	33.72													
10	3	08/07/86	10:53 AM	3.05	26.93	34.42													
15	3	08/07/86	10:53 AM	4.57	27.40		5.50							0.138					
20	3	08/07/86	10:53 AM	6.10	26.64	34.30													
25	3	08/07/86	10:53 AM	7.62	26.80		5.29							0.116					
30	3	08/07/86	10:53 AM	9.14	26.50	34.66		1	4	157	5	10	1.4		0.560		8.35	1	1
40	3	08/07/86	10:53 AM	12.19	26.68	34.70													
50	3	08/07/86	10:53 AM	15.24	26.35	34.46													
60	3	08/07/86	10:53 AM	18.29	26.12	34.48		3	8	160	5	18	3.7		0.750		8.35	1	1
1	4	08/07/86	10:20 AM	0.30	27.47	33.41													
2	4	08/07/86	10:20 AM	0.61	27.40	33.52													
3	4	08/07/86	10:20 AM	0.91	27.22	33.79	6.01	1	4	154	3	10	2.2	0.396	0.350		8.40	1	1
5	4	08/07/86	10:20 AM	1.52	27.25	33.80													
10	4	08/07/86	10:20 AM	3.05	27.10	33.98													
12.5	4	08/07/86	10:20 AM	3.81				1	2	151	4	13	1.9		0.470		8.40	1	1
15	4	08/07/86	10:20 AM	4.57	27.30		5.40							0.094					
20	4	08/07/86	10:20 AM	6.10	26.83	34.48													
25	4	08/07/86	10:20 AM	7.62	26.90		4.86	5	4	132	6	11	0.8	0.059	0.520		8.35	1	1

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT. EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	5	08/07/86	08:55 AM	0.30	26.44	32.76													
2	5	08/07/86	08:55 AM	0.61	26.40	33.43													
3	5	08/07/86	08:55 AM	0.91	26.33	33.49	5.97	1	4	125	2	15	1.6	0.456	0.630		8.40	2	4
5	5	08/07/86	08:55 AM	1.52	26.43	33.86													
10	5	08/07/86	08:55 AM	3.05	26.48	34.51													
15	5	08/07/86	08:55 AM	4.57	26.70		5.57												
20	5	08/07/86	08:55 AM	6.10	26.47	34.53								0.16					
25	5	08/07/86	08:55 AM	7.62	26.80		5.75												
30	5	08/07/86	08:55 AM	9.14	26.44	34.63								0.1					
40	5	08/07/86	08:55 AM	12.19	26.54	34.65													
45	5	08/07/86	08:55 AM	13.72				1	4	133	4	11	1.1		0.300		8.40	3	33
50	5	08/07/86	08:55 AM	15.24	26.44	34.67													
60	5	08/07/86	08:55 AM	18.29	26.44	34.66													
70	5	08/07/86	09:10 AM	21.34	26.46	34.65													
90	5	08/07/86	09:10 AM	27.43															
1	6	08/07/86	09:35 AM	0.30	26.77	33.29		10	6	104	6	11	0.7		0.420		8.40	1	4
2	6	08/07/86	09:35 AM	0.61	26.47	34.06													
3	6	08/07/86	09:35 AM	0.91	26.51	34.40	5.83	1	1	146	3	17	1.1	0.492	0.650		8.40	1	6
5	6	08/07/86	09:35 AM	1.52	26.56	34.58													
10	6	08/07/86	09:35 AM	3.05	26.48	34.76													
15	6	08/07/86	09:35 AM	4.57	27.20		5.77												
20	6	08/07/86	09:35 AM	6.10	26.52	34.72								0.108					
25	6	08/07/86	09:35 AM	7.62	26.80		5.38												
30	6	08/07/86	09:35 AM	9.14	26.50	34.78								0.07					
40	6	08/07/86	09:35 AM	12.19	26.37	34.90													
50	6	08/07/86	09:35 AM	15.24	26.41	34.78		1	3	143	4	11	0.6		0.210		8.40	1	1
60	6	08/07/86	09:35 AM	18.29	26.23	34.81													
70	6	08/07/86	09:35 AM	21.34	26.42	34.83													
80	6	08/07/86	09:35 AM	24.38	26.20	34.90													
90	6	08/07/86	09:35 AM	27.43	26.15	34.87													
100	6	08/07/86	09:57 AM	30.48	26.27	34.68		1	2	107	4	7	0.9		0.330		8.40	1	11

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT. EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	7	08/06/86	09:05 AM	0.30	25.30	33.52													
2	7	08/06/86	09:05 AM	0.61	26.58	33.94													
3	7	08/06/86	09:05 AM	0.91	26.86	34.11	5.79	1	1	147	4	12	1.5	0.71	0.410		8.35	1	1
5	7	08/06/86	09:05 AM	1.52	26.78	34.18													
10	7	08/06/86	09:05 AM	3.05	26.90	34.56													
15	7	08/06/86	09:05 AM	4.57	27.10		5.47	1	2	144	4	8	1.2	0.196	0.240		8.40	1	6
20	7	08/06/86	09:05 AM	6.10	26.80	34.64													
25	7	08/06/86	09:05 AM	7.62	26.10		5.27							0.091					
30	7	08/06/86	09:25 AM	9.14	26.70	34.58		17	2	118	5	9	1.1		0.190		8.40	1	10
1	8	08/06/86	09:34 AM	0.30	26.80	33.34													
2	8	08/06/86	09:34 AM	0.61	26.82	34.07													
3	8	08/06/86	09:34 AM	0.91	26.93	34.13	5.84	2	3	126	4	13	1.0	0.617	0.320		8.40	1	8
5	8	08/06/86	09:34 AM	1.52	26.78	34.54													
10	8	08/06/86	09:34 AM	3.05	26.81	34.55													
15	8	08/06/86	09:34 AM	4.57	27.00		5.72							0.139					
20	8	08/06/86	09:34 AM	6.10	26.63	34.62		1	2	115	6	8	0.7		0.170		8.40	1	3
25	8	08/06/86	09:34 AM	7.62	26.80		5.58							0.086					
30	8	08/06/86	09:34 AM	9.14	26.60	34.69													
40	8	08/06/86	09:52 AM	12.19	26.65	34.46		6	2	122	6	6	1.1		0.230		8.40	1	3
1	9	08/06/86	03:28 PM	0.30	27.23	33.43													
2	9	08/06/86	03:28 PM	0.61	27.20	33.51													
3	9	08/06/86	03:28 PM	0.91	27.17	33.86	6.52	5	1	154	4	17	2.5	0.611	0.260		8.40	1	2
5	9	08/06/86	03:28 PM	1.52	27.10	33.90													
10	9	08/06/86	03:28 PM	3.05	27.06	34.34													
15	9	08/06/86	03:28 PM	4.57			6.20							0.141					
20	9	08/06/86	03:28 PM	6.10	26.87	34.57													
25	9	08/06/86	03:28 PM	7.62			6.00	8	3	113	6	13	1.3	0.093	0.190		8.40	1	3
30	9	08/06/86	03:28 PM	9.14	26.41	34.71													
40	9	08/06/86	03:28 PM	12.19	26.26	34.71													
50	9	08/06/86	03:40 PM	15.24				9	1	113	6	11	2.0		0.260		8.40	1	1

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT. EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	10	08/06/86	01:42 PM	0.30	27.61	33.63													
2	10	08/06/86	01:42 PM	0.61	27.35	33.93													
3	10	08/06/86	01:42 PM	0.91	26.94	34.34	6.30	2	20	199	9	13	1.3	0.445	0.350	1.780	8.40	1	1
5	10	08/06/86	01:42 PM	1.52	26.94	34.52													
10	10	08/06/86	01:42 PM	3.05	26.95	34.63													
15	10	08/06/86	01:42 PM	4.57	27.10		6.03							0.116					
20	10	08/06/86	01:42 PM	6.10	26.79	34.55													
25	10	08/06/86	01:42 PM	7.62	27.10		6.13	1	7	193	7	11	0.5	0.078	0.220	0.470	8.40	1	1
30	10	08/06/86	01:42 PM	9.14	26.96	34.60													
40	10	08/06/86	01:42 PM	12.19	26.62	34.70													
50	10	08/06/86	02:00 PM	15.24	26.50	34.70		8	2	154	6	9	1.8		0.300	0.240	8.40	1	1
1	11	08/06/86	03:59 PM	0.30	27.06	33.54													
2	11	08/06/86	03:59 PM	0.61	27.10	33.52													
3	11	08/06/86	03:59 PM	0.91	27.09	33.76	6.61	3	2	171	4	11	1.2	0.545	0.340		8.40	14	23
5	11	08/06/86	03:59 PM	1.52	27.05	33.80													
10	11	08/06/86	03:59 PM	3.05	26.98	34.03													
15	11	08/06/86	03:59 PM	4.57	26.80		6.21							0.12					
20	11	08/06/86	03:59 PM	6.10	26.80	34.19													
25	11	08/06/86	03:59 PM	7.62	26.50		5.98	6	22	160	10	19	1.0	0.083	0.400		8.40		
30	11	08/06/86	03:59 PM	9.14	26.48	34.76													
40	11	08/06/86	03:59 PM	12.19	26.36	34.73													
50	11	08/06/86	04:20 PM	15.24	26.24	34.68		6	1	159	5	13	1.9		0.290		8.40	4	53
1	12	08/06/86	02:59 PM	0.30	27.12	33.90													
2	12	08/06/86	02:59 PM	0.61	27.12	33.95													
3	12	08/06/86	02:59 PM	0.91	27.22	33.96	6.73	1	2	144	7	13	1.2	0.554	0.340	1.080	8.40	8	98
5	12	08/06/86	02:59 PM	1.52	27.22	33.87													
10	12	08/06/86	02:59 PM	3.05	27.16	33.83													
15	12	08/06/86	02:59 PM	4.57	27.20		6.43							0.128					
20	12	08/06/86	02:59 PM	6.10	26.87	34.60													
25	12	08/06/86	02:59 PM	7.62	27.00		6.29	1	2	126	6	11	2.0	0.096	0.230	0.230	8.40	1	11
30	12	08/06/86	02:59 PM	9.14	26.54	34.75													
40	12	08/06/86	02:59 PM	12.19	26.48	34.73													
50	12	08/06/86	02:59 PM	15.24	26.50	34.69		8	3	111	8	11	1.1		0.390	0.530	8.40	1	19
60	12	08/06/86	03:12 PM	18.29															

Table B-1, Cont.

DEPTH (FT)	STA	DATE	TIME	DEPTH (m)	TEMP (C)	SALINITY (oo/oo)	DO (mg/l)	NO3+ NO2 (ug/l)	NH4 (ug/l)	TKN (ug/l)	OP (ug/l)	TP (ug/l)	SS (mg/l)	LGT. EXT. COEFF. (K)	TURBIDITY (NTU)	CHL a (ug/l)	pH	COLIFORM FECAL (#/100ml)	COLIFORM TOTAL (#/100ml)
1	13	08/06/86	04:29 PM	0.30	27.11	33.72													
2	13	08/06/86	04:29 PM	0.61	26.97	33.71													
3	13	08/06/86	04:29 PM	0.91	27.04	33.77	6.54	4	1	206	7	11	0.9	0.573	0.290		8.35		
5	13	08/06/86	04:29 PM	1.52	27.00	33.88													
10	13	08/06/86	04:29 PM	3.05	27.08	33.93													
15	13	08/06/86	04:29 PM	4.57	27.00		6.39							0.133					
20	13	08/06/86	04:29 PM	6.10	27.04	34.17		1	1	171	7	10	0.5		0.200		8.35	140	
25	13	08/06/86	04:29 PM	7.62	26.70		6.10							0.095					
30	13	08/06/86	04:29 PM	9.14	26.40	34.80													
40	13	08/06/86	04:47 PM	12.19	26.48	34.67		7	2	154	8	10	0.1		0.330		8.35	23	81
1	14	08/06/86	10:01 AM	0.30	26.56	33.05													
2	14	08/06/86	10:01 AM	0.61	26.58	33.62													
3	14	08/06/86	10:01 AM	0.91	26.50	33.94	5.90	1	2	188	2	10	1.1	0.717	0.470		8.40	1	1
5	14	08/06/86	10:01 AM	1.52	26.78	34.32													
10	14	08/06/86	10:01 AM	3.05	26.86	34.15													
15	14	08/06/86	10:01 AM	4.57	27.00		5.75							0.168					
20	14	08/06/86	10:01 AM	6.10	26.77	34.64													
25	14	08/06/86	10:01 AM	7.62	26.70		5.95							0.1					
30	14	08/06/86	10:01 AM	9.14	26.57	34.72													
35	14	08/06/86	10:01 AM	10.67				1	2	194	10	10	0.9		0.180		8.40	1	1
40	14	08/06/86	10:01 AM	12.19	26.57	34.72													
50	14	08/06/86	10:01 AM	15.24	26.53	34.73													
60	14	08/06/86	10:01 AM	18.29	26.56	34.80													
70	14	08/06/86	10:01 AM	21.34	26.48	34.69		1	2	161	7	8	1.3		0.280		8.40	1	2
80	14	08/06/86	10:12 AM	24.38	26.32	34.70													

Source: M&E Pacific, Inc.