EXECUTIVE CHAMBERS

HONOLULU

GEORGE R. ARIYOSHI
GOVERNOR

November 24, 1980

Mr. Donald A. Bremner, Chairman
Environmental Quality Commission
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. Bremner:

Subject: Environmental Impact Statement for the Hilo Wastewater Management Plan, Hilo, Hawaii

Based upon the recommendation of the Office of Environmental Quality Control, I am pleased to accept the subject document 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 or should not be allowed to proceed. My acceptance of the statement is an affirmation of the adequacy of that statement under the 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 of alternatives to the proposed action.

With warm personal regards, I remain,

Yours very truly,

George R. Ariyoshi

cc: Department of Public Works,
Hawaii County

REVISED

ENVIRONMENTAL IMPACT STATEMENT

FOR THE

HILO WASTEWATER MANAGEMENT PLAN

OF THE

HILO DISTRICT, SOUTH HILO, HAWAII

Prepared for:

Department of Public Works
County of Hawaii

Prepared by:

M&E Pacific, Inc.
Environmental Engineers
190 South King Street
Honolulu, Hawaii 96813

September 1980

REVISED

ENVIRONMENTAL IMPACT STATEMENT

ADMINISTRATIVE ACTION

FOR THE

HILO DISTRICT SEWERAGE SYSTEM

SOUTH 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

SEP 17 1980
Date

EDWARD HARADA, CHIEF ENGINEER

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SUMMARY OF THE

ENVIRONMENTAL IMPACT STATEMENT

FOR THE

HILO WASTEWATER MANAGEMENT PLAN

I. Description of the Proposed Action

The proposed action for the Hilo Wastewater Management Plan includes: 1) expanding the existing sewer collection system to include interceptors and pump stations, 2) constructing a new treatment plant to eventually provide either advanced primary or secondary treatment to incoming sewage flows, and 3) extending the existing ocean outfall sewer to discharge beyond nearshore waters.

The project site is located on the northeastern portion of the island of Hawaii and lies on the eastern slopes of Mauna Loa. The study area encompasses an area of approximately 56 square miles in Hilo and also includes Hilo Bay, one of two major deepwater harbors on the island.

Flows from sewered portions of Hilo are presently provided primary treatment at the municipal Hilo Sewage Treatment Plant. Effluent is discharged through a 48-inch outfall extending 4,500 feet offshore into 56 feet of water. The remainder of the populated areas is served by cesspools.

The choice of alternative systems and facilities is based on the cost effectiveness for meeting the following objectives:

a. To eliminate risks to public health and welfare from sewage disposal;

b. To preserve the quality of nearshore waters;

c. To comply with secondary treatment guidelines of EPA and the effluent disposal constraints outlined in the State Public Health Regulations, Chapters 37, 37A, and 38;

d. To minimize damage to facilities and equipment due to tsunamis and flooding; and

e. To control odors due to septic sewage.

The implementation of the recommended system, including construction of interceptor lines and pump stations, will require financial resources as well as time. For these reasons, it was recommended that the existing Hilo treatment facility continue to be utilized until such time that the new treatment facility and associated interceptor lines and pump stations are completed. Since the existing plant will ultimately be abandoned at the time the new treatment facility is operational, it was also recommended that the existing facility not be upgraded to comply with EPA's secondary treatment requirements. Rather, immediate work on expanding the existing sewer collection system to eliminate potential health hazards is recommended.

The proposed treatment facility is to be constructed in increments, with advanced primary treatment to be provided initially (as may be allowed with the granting of a waiver from EPA requirements for secondary treatment), followed by the addition of secondary treatment components at a later date in the event the waiver is denied. This recommendation is based on environmental studies on the impact of effluent discharged into Hilo Bay.

II. Description of Environmental Setting

A. Physical Environment

The physical characteristics of the Hilo study are as follows:

1. Ground elevations range from sea level at Hilo Bay to 600 feet above sea level along the urban fringe at the lower, southeastern slopes of Mauna Loa.

2. Slopes are generally gentle, ranging from six to ten per cent in the upper areas to zero to five percent in the coastal, urbanized areas.

3. Mean annual rainfall varies from 130 inches per year along the shore to as much as 200 inches per year in the mountain sections. Prevalent cloudy skies are responsible for the area receiving only 40 percent of the possible amount of solar radiation.

4. Tradewinds from the northeast are generally more prevalent in the summer than the winter and are stronger in the afternoon than the evening. These tradewinds are responsible for the year round mild temperatures.

5. Wailuku River is the major perennial stream in the study area, with an average discharge of 300 cfs near the coast. The river also represents the physical division of the area's geologic structure. Formations north of Wailuku River are of Mauna Kea volcanic origin, while areas to the south consist of Mauna Loa volcano formations dating back to the Pleistocene Age.

6. The study area rests on highly permeable and well-drained ash and basalt. The water table exhibits a seaward gradient of one to four feet per mile discharging into several freshwater springs off the coast.

7. Surface currents outside Hilo Bay generally exhibit a northwestern direction. During ebb tide, the generalized current pattern within the Hilo breakwater is in a counter-clockwise direction.

8. Vegetation in the study area consists mainly of guava, fern, kukui, and hala. High elevation vegetation include hapuu trees, olapa, and ohia.

9. The coastal areas of Hilo are prone to flood damage by high surface runoff rates attributable to a combination of high-intensity rainfall and undefined drainage ways.

10. Hilo Bay is very susceptible to tsunamis generated from the eastern Pacific seismic belt. A breakwater approximately 9,000 feet in length encloses portions of Hilo Bay.

11. Water for the Hilo study area is supplied from both surface and basal water sources. For the year 1973 to 1974, water consumption was 4.1 mgd.

12. Water quality sampling of nearshore waters and an evaluation of coral coverage and biological communities along and flanking the existing Hilo STP outfall indicated no measurably detrimental effects attributable to the present primary effluent discharge.

B. Coastal Water Environment

An inventory of environmental conditions of Hilo Bay and adjacent nearshore waters include:

1. The nearshore waters south of Hilo Bay have been designated as "waters whose quality meets state standards now and will continue to meet them," while nearshore waters north of Hilo Bay are designated as "waters that do not meet state standards but will after best practicable treatment."

2. Existing point discharges in Hilo Bay include (1) thermal discharges from Hilo Electric Company, and ()2 primary treated effluent from the county's municipal treatment plant outfall. Previously, agricultural mill waste was also discharged into Hilo Bay.

3. The following is a summary of past investigations of Hilo Harbor (area shoreward of the breakwater) by Neighbor Island Consultant:

   a. Hilo Harbor is characterized by a two-cell, upper layer circulation pattern.

   b. Low salinity measurements were reported near Wailoa River, attributable to spring flow.

c. Dissolved oxygen levels were generally greater than 4.5 mg/l.

d. Average phosphorus and nitrate concentrations in the eastern portion of Hilo Harbor were 0.06 and 0.132 mg/l respectively.

e. Concentrations of chlorophyll-a in Hilo Bay were generally higher than those reported for Kaneohe Bay and other Pacific atolls.

4. The geological structure of the Hilo study area consists of the Kau volcanic series of Mauna Loa, an extremely permeable basalt.

5. Approximately 600 mgd enters Hilo Bay from the groundwater component. Another 100 mgd enters Hilo Bay from the surface flows.

6. A field investigation near the Hilo outfall was undertaken in conjunction with the proposed project. A summary of the findings is as follows:

   a. The overall current structure in the outfall discharge area is a combination of the north equatorial current, tide-related currents, and wind-driven surface currents. The predominant current is generally westerly, both for surface and subsurface currents.

   b. Based on current and drogue studies, a workable diffuser design is to orient the diffuser toward the northwest.

   c. The impact of the existing primary effluent discharge is not measurably significant, based on chemical analyses of the water column and sediment.

III. The Relationship of the Proposed Action to Land Use Plans, Policies, and Controls

State and county ordinances pertaining to land use control, to some extent, control the magnitude and direction of population growth which in turn exert a direct impact upon the emissions of waste material to the environment. Therefore, the sewerage needs of the Hilo study area are closely related to and are in conformance with present land use policies as delineated in the Hilo Community Development Plan.

IV. Probable Impact of the Proposed Action on the Environment

The probable impacts can be distinguished between those associated with the construction (short-term) and those associated with the operational (long-term) phases of the proposed action.

The physical impacts associated with the construction phase for the interceptor sewers, collection system, and treatment plant include:

1. Minor temporary traffic disruption along roadways.

2. Temporary minor noise and dust disturbances to residents in the proximity of the project sites caused by the construction work.

3. Unpleasant aesthetic appearance due to storage areas requirements and sewerline construction.

4. Construction of sewerlines will generally be limited to existing roadways; also the proposed site for the new treatment plant is located at an abandoned quarry. Therefore, the effect on endangered flora and fauna as well as archaeological and historic sites are expected to be insignificant.

5. Potential accelerated soil erosion caused by high intensity rains which could occur during grading operations.

Long-term impacts of the proposed action will be primarily associated with the operation and maintenance of the proposed treatment plant and pump stations which include thê following:

1. An annual expenditure of approximately $450,000 or $300,000 for plant operations for a secondary or advanced primary facility, respectively, based on a flow of 5 mgd.

2. Aesthetic appearance of the facility site involving concrete buildings and tanks surrounded by a chain link fence.

3. Possible effect of noise emanating from the treatment plant and pump stations attributable to pumps and process equipment.

4. Possible odor problems due to the septic nature of the incoming sewage.

5. The proposed plant site is outside of both the 100-year flood area and the estimated inundation limits of a 100-year tsunami and no problems with flooding or erosion is anticipated.

The construction-related impacts associated with the extension of the ocean outfall includes:

1. The problems of noise, traffic and aesthetics due to construction activities and the need of a shoreline staging area to stockpile materials and equipment to accommodate boating/barging operations.

2. Temporary increase in turbidity of water columns in the nearshore waters caused by dredging operations.

3. Possible navigation problems involving the interference of boating and fishing activities in Hilo Bay.

The existing primary sewage discharge from the outfall has no measureable impact on the water quality and marine life in the area. Therefore, the effect of an advanced primary discharge or secondary effluent discharge can be expected to at least remain at present levels because of the large dilutions afforded by ocean outfall.

The secondary impacts as related to population growth are not uncontrolled nor unexpected since the proposed wastewater management plan is in conformance with present land use policies.

V. Adverse Impacts that Cannot be Avoided

The adverse impacts that cannot be avoided are primarily construction related activities, including noise, dust, traffic disruption, aesthetics and erosion. However, these impacts are temporary in nature which can be mitigated through proper construction practices.

VI. Alternatives to the Proposed Action

Three alternative actions were evaluated in lieu of the recommended secondary treatment process which included 1) the discharge of raw sewage, 2) no action with continued use of the present system, and 3) tertiary treatment. The first two alternatives were discarded based on EPA's secondary treatment guidelines. The tertiary treatment alternative was rejected based on the high cost factor. A fourth alternative is still pending in which an application for a modified discharge was submitted to EPA and if granted, an advanced primary treatment system is proposed.

The alternatives on site selection that were considered for the treatment facility included Leleiwi Point and the expansion and upgrading of the existing plant. Both of these alternatives were excluded based primarily on cost-effectiveness. Other factors which precluded the use of the existing site include: 1) there are no assurances of performance dependability when considering the damaging-incurring character of future tsunamis, 2) the maximum insurance coverage for each structure is only $100,000 where many structures exceed this amount, and 3) the proximity to the residential population have been the cause of many odor complaints.

Various alternatives for the treatment processes were evaluated. The criterion for selection of the best alternative was cost-effectiveness dealing with tradeoffs among the resources of land, energy and finance. Alternatives for liquid treatment included pond with filtration units, trickling filter, activated sludge, rotating biological contactor, and physico-chemical treatment. Liquid disposal alternatives included land spreading, injection well and ocean outfall disposal. Solids handling alternatives included anaerobic digestion and incineration while evaluation solids dewatering alternatives consisted of sand beds, vacuum filtration and centrifugation.

VII. Relationship Between Long-Term and Short-Term Use of Man's Environment

The practice of implementing individual sewerage systems is a short-term expedient, but proliferation of these systems can lead to both immediate and long-term problems. Malfunctions in the treatment process would have an immediate impact on the populace in the form of health and nuisance problems with the long-term impact on nearshore water quality impairment.

VIII. Irreversible and Irretrievable Resources Committed by the Proposed Action

Several irreversible and irretrievable resources must be committed to implement the proposed action. These include land, ocean disposal of effluent, financing for design and construction of the facility, and energy. User charge assessments will be required to finance operation and maintenance costs of the system.

IX. Unresolved Issues

The major unresolved issue is whether the proposed treatment facility will provide advance primary or secondary treatment. This issue will remain unresolved pending the approval by the U.S. Environmental Protection Agency of the application for a modified discharge waiving the secondary treatment requirements.

CHAPTER I

DESCRIPTION OF PROPOSED ACTION

The major portion of the population in the Hilo area is presently served by individual disposal units (cesspools). A municipal sewerage system that serves a small portion of the population was constructed as a first increment in a regional system intended eventually to serve the entire population.

Population growth and urban development are projected for the area, causing a possible proliferation of individual disposal systems unless construction of a regional system can be accelerated. The major objections to many individual systems are the following:

1. Water quality monitoring and control are not generally effective and reliable.
2. Cesspools clog in time and increase the risk to public health and welfare.
3. Possible impairment of the groundwater, which is the major source of potable water development, may occur from cesspool seepage.
4. The total cost of construction, operation, and maintenance for small systems is generally higher as compared to a single regional system because of economy of scale.

PROJECT LOCATION

The Hilo study area (Figures I-1 and I-2) is located on the northeastern portion of the island of Hawaii, often called the Big Island, and lies on the lower eastern slopes of Mauna Loa. The study area--encompassing approximately 56 square miles--includes the existing city of Hilo and immediately adjacent areas, as delineated in the Hilo Community Developmental Plan by Belt, Collins and Associates, July 1974. The surrounding areas are either serviced by another sewerage system (Paukaa-Papaikou system) or is zoned for conservation or agriculture.

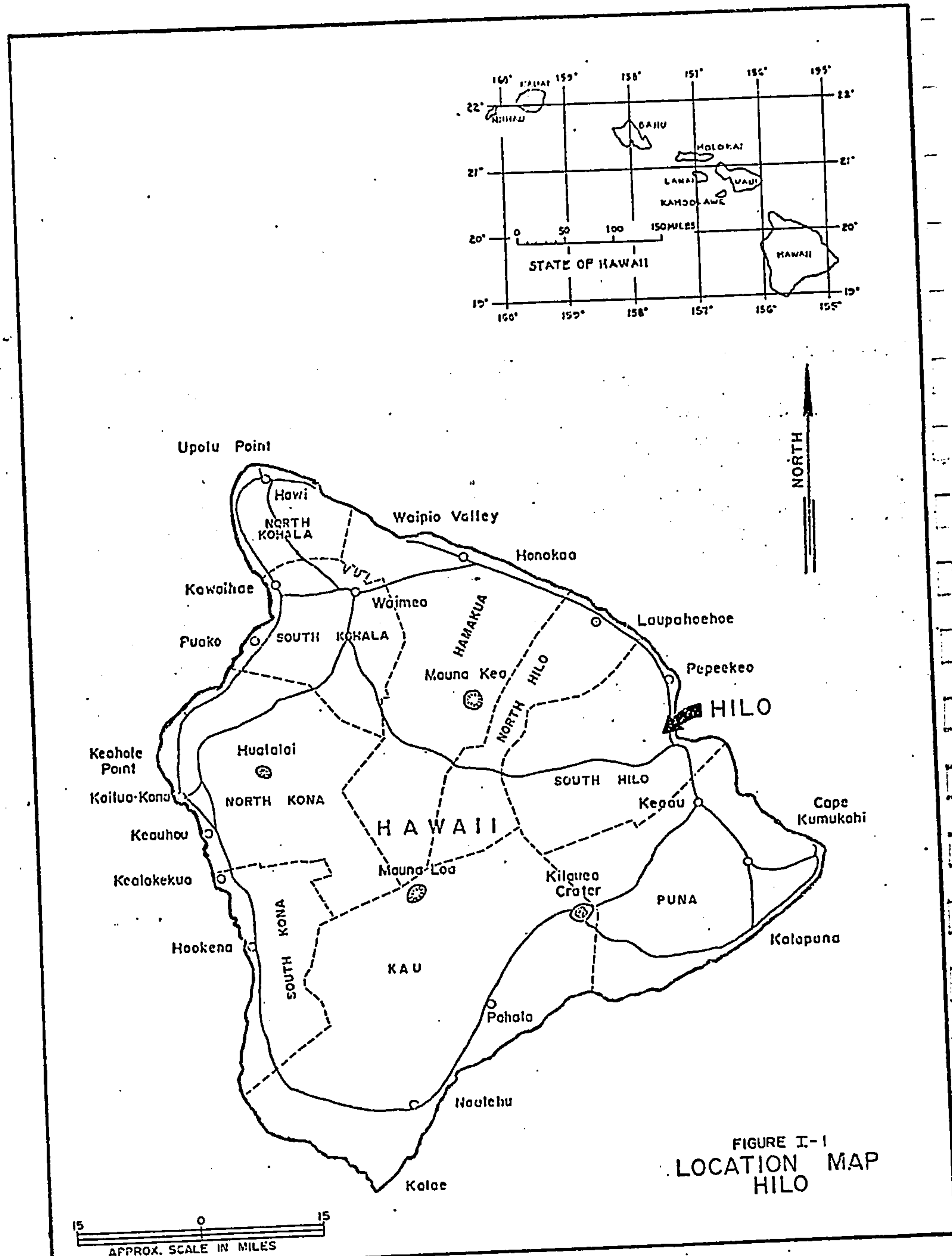


FIGURE I-1
LOCATION MAP
HILO

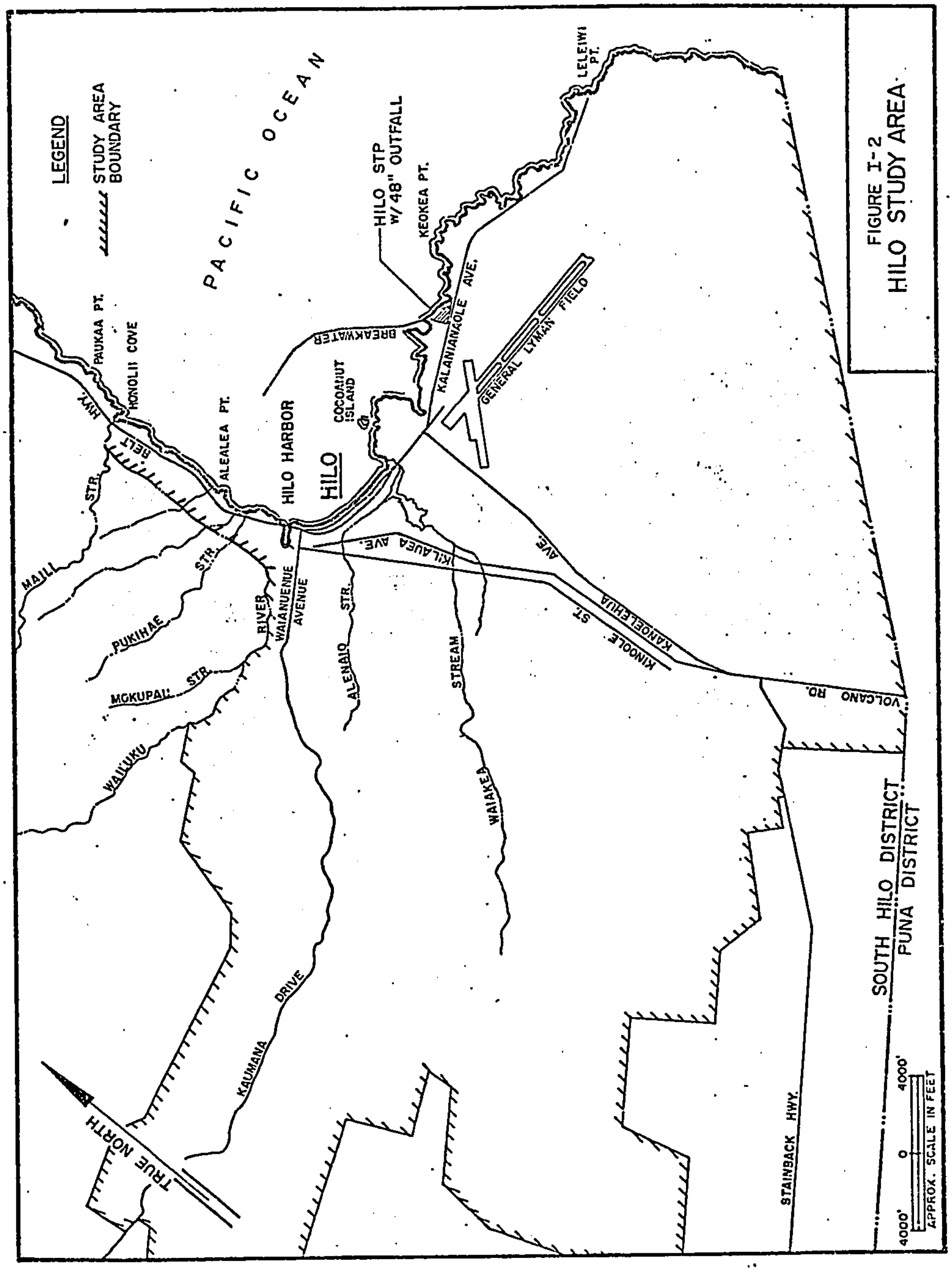


FIGURE I-2
HILO STUDY AREA

(An adjacent southerly district--Puna--is basically agriculture with scattered, isolated towns.)

Hilo is the county seat and the principal center of government, transportation, and commerce. Hilo Bay, which is part of the study area, is one of two major deep-water harbors on the island, while General Lyman Field is the major air terminal.

The general socio-economic characteristics for Hilo include a median family income of approximately $11,000, only slightly less than that of Honolulu. Approximately 8.5 percent of Hilo households were below poverty level ($5,700) as compared to 5 percent for Honolulu. Economic activities are centered about transportation, trade, communication and utilities. Future economic emphasis are also directed toward diversified industries and tourism. Population projections indicate an increase from approximately 30,000 in 1975 to 44,000 by the year 1995.

HISTORIC PERSPECTIVE

Hawaiian legends and chants form the basis for the history of Hilo prior to the 1770's. The Hawaiian derivation of Hilo is somewhat cloudy, meaning twisting river or crescent bay. According to legend, Hilo is the place where Kamehameha I determined his destiny that he would rise to power and become the first ruler to conquer and unite the Hawaiian chain. At the time of Kamehameha several native villages within the study area were already settled, each with a different name; however, it is believed that the Hilo area was uninhabited for centuries prior to Kamehameha.

The first recorded history of this region dates back to the arrival of Captain James Cook in 1778. From that time to the 1850's, Hilo served as a reprovision area for ships engaged in the fur trade and the whaling industry. The emergence of the sandalwood industry also took place during this period.

With the arrival of Christian missionaries and the emergence of the sugar industry, Hilo continued growing to become the county seat and principal center of commerce.

OBJECTIVES

The general objectives of the proposed action are as follows:

1. To eliminate the risks and nuisances to public health and welfare that are attributable to sewage disposal, and

2. To preserve the quality of nearshore waters and groundwaters.

This project is required not only to extend the sewerage service area but also to comply with the 1972 amendments to the Federal Water Pollution Control Act (PL 92-500). This law mandates that best practicable control technology be applied to all point discharges by July 1977 (currently extended to 1983). Guidelines defining best practicable control technology have been promulgated by the Environmental Protection Agency requiring a minimum of secondary treatment for all municipal discharges. It should be noted that this project was planned in accordance with the State's 208 Water Quality Plan.

PROJECTED FLOWS

Projected flows for the Hilo area are formulated from demographic data contained in the Hilo Community Development Plan, July 1974, by Belt, Collins & Associates. The criteria used for flow development are as follows:

	Area (acres)	Units
1. Land Use		
Residential (single family)	7,049*	28,196
Residential (duplex)	62	719
Residential (multifamily)	628	12,560
Agriculture	20,227	--
Resort	81	2,673
Commercial	311	--
Industrial	2,985	--
Open space	4,702	--

* Includes 332 acres of agricultural lands with single-family residential units

2. Population Density

Residential (single family)	4 units/acre @ 3 persons/unit
Residential (duplex)	11.6 units/acre @ 2.5 persons/unit
Residential (multifamily)	20 units/acre @ 2.0 persons/unit
Resort	33 units/acre @ 2.0 persons/unit

3. Design Sewage Flow Criteria

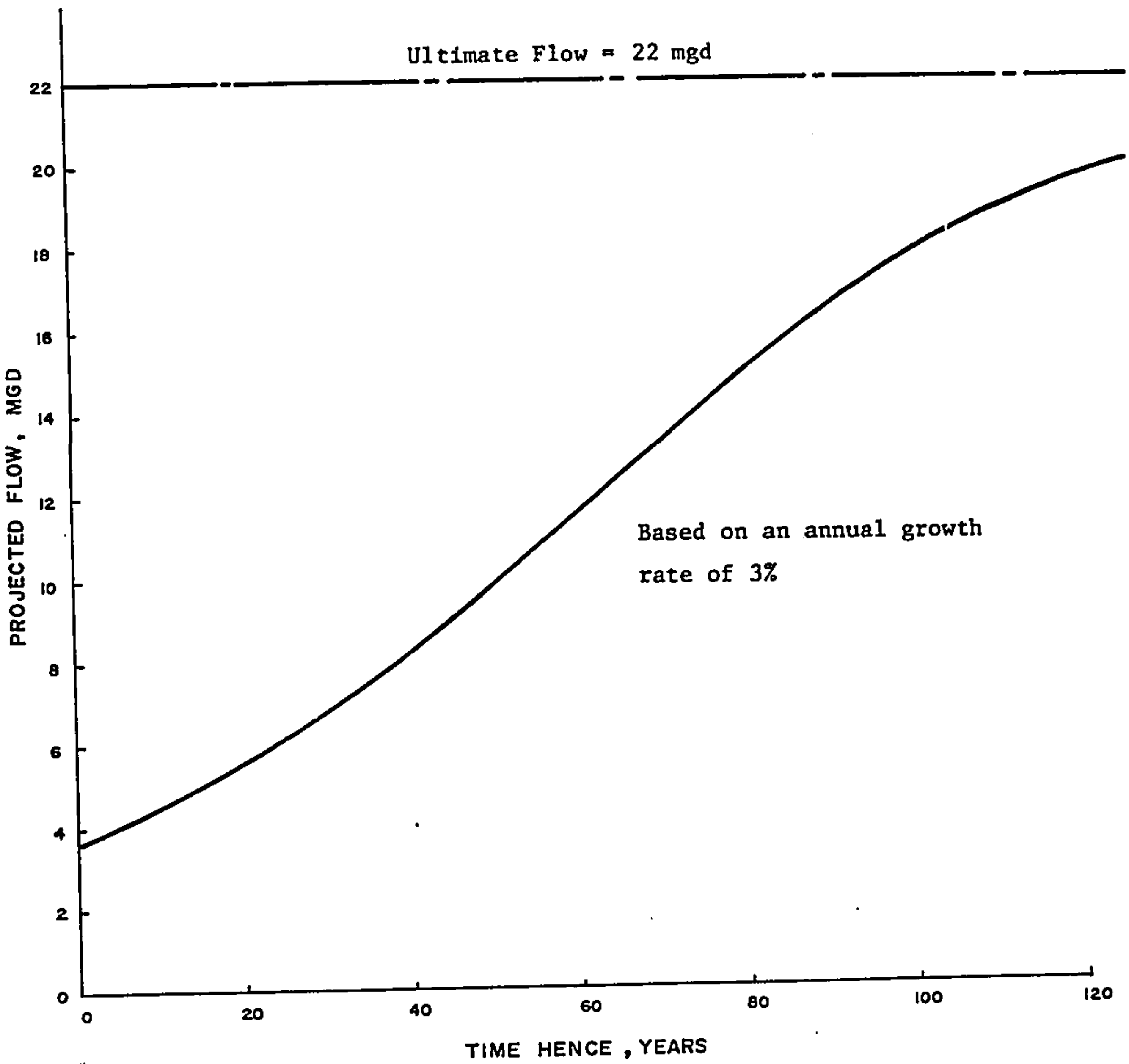
Average flow per person	100 gpd (includes normal infiltration)
Commercial & industrial areas	4,000 gpad
Average design flow	sewage flow + normal infiltration
Wet weather inflow factor	2,500 gpad for areas below elevation 20 feet MSL and 1,500 gpad for areas above elevation 20 feet MSL
Maximum daily flow	sewage flow x Babbit max factor + normal infiltration
Peak flow	max daily flow + wet weather inflow

At present, future waste flows are anticipated to be "domestic" in character, primarily from residential, commercial, and tourist-related (hotels) sources. Economic projections indicate industrial growth to be limited to areas of garments and textiles, building materials, and food processing, where waste flow quantities are not significant.

Basis of Projections

Sewage flow projections (average design flow) are based on a logarithmic growth rate and what can be considered to be the ultimate (saturation) population, based on existing land use classifications and applicable zoning ordinances. The sewage flow projections, as shown on Figure I-3, are based on an annual population growth rate of three percent, as reported on the Wastewater Facilities Plan for the Hilo District.

Sewage flows based on the logarithmic growth curve development are summarized in Table I-1, with 1975 as the base year.



Flows based on all populated areas being sewered.

FIGURE I-3

SEWAGE FLOW PROJECTION FOR HILO

TABLE I-1

SEWAGE FLOW PROJECTION AND PERTINENT DATA FOR THE HILO STUDY AREA[a]

Description	Year 1975	Year 1995	Year 2025	Year Ultimate
Population	30,000	44,000	70,000	117,000
Average Sewage Flow (mgd)	2.1	3.3	6.0	15.4
Infiltration (mgd)	1.4	2.3	3.3	6.6
Design Sewage Flow (mgd)	3.5	5.6	9.9	22.0
Design Maximum Flow (mgd)	7.1	10.5	16.5	34.8
Wet Weather Inflow* (mgd)	5.9	6.6	10.6	20.5
Peak Flow (mgd)	13.0	17.1	27.1	55.3

[a] Flows based on all populated areas being sewered.

* Wet weather inflow based on 2,500 gpd/acre for areas below elevation 20 feet and 1,500 gpd/acre for areas above elevation 20 feet.

Source: M&E Pacific, Inc., Wastewater Facilities Plan for the Hilo District, South Hilo, prepared for the Bureau of Sewers and Sanitation, Department of Public Works, County of Hawaii, 1980.

Rationale in the Use of 5.0 mgd as the 20-year Design Flow

The guidelines mandated by EPA require that the costeffectiveness analysis for pollution abatement facilities be based on a 20-year design flow. As graphically illustrated on Figure I-3, the 20-year design flow for the Hilo study area is 5.6 mgd.

However, when considering the 50-year design flows (design flow of 10 mgd for the Hilo area) which is generally considered to be the useful life of structures and pipes, it would be prudent to construct the facility in two stages, the first being 5.0 mgd (one-half of the "ultimate" design flow). This is near the theoretical design flow of 5.6 mgd. Further, sewer construction and lateral hookup normally lag sewage flow generation, especially in areas where sewer construction programs is in its infancy stages. For these reasons, the design flow of 5.0 mgd was used.

PROPOSED ACTION

The basic concepts and specific objectives of the Hilo regional wastewater management system are described in detail in the Facilities Plan for the Hilo District, South Hilo, Hawaii (February 1980). This system basically consists of implementing the following three actions:

1. Expanding the existing sewer collection system to include interceptors and pump stations. The system is based on a 40-year design period.

2. Constructing a new treatment plant to eventually provide either advanced primary or secondary treatment to incoming sewage flows. The treatment plant will be designed for the 20-year design flow.

3. Extending the existing ocean outfall sewer to discharge beyond nearshore waters.

The proposed regional sewerage system essentially involves extending the existing interceptor trunk lines and collector sewers to provide sewer service to the upper regions of the service area. Further, due to the relocation of the treatment plant site, pressure (force) mains and related pumping stations will need to be constructed to transport the collected sewage. The proposed system will have the capability to serve the existing and the future flows for the entire Hilo area which includes the residential, commercial/industrial and resort users. Excluded are the rural agricultural residences in the outlying areas of Hilo which will continue to utilize cesspools.

The proposed scheme also calls for the construction of a treatment facility near the airport industrial area. The design capacity of this plant is 5.0 mgd and will require an approximate land area of 14 to 20 acres. *The treatment facility will be either an advanced primary or* secondary treatment facility, depending on the outcome of the application for a modified discharge to the Environmental Protection Agency.

The essential components of the proposed secondary treatment scheme are listed in Table I-2, with brief explanations of their purpose. The anticipated effluent characteristics for the proposed secondary treatment scheme are presented in Table I-3. The practice of disposing of the digested-dewatered sludge at a sanitary landfill will be continued.

Further action include the following:

1. Operation and maintenance of the facility and replacement of equipment.
2. Implementation of odor and nuisance control facilities and procedures.
3. Financing, constructing, and operating the collection and treatment works.

A related action includes extension of the existing 48-inch outfall sewer another 2,000± feet into 60-90 feet of water.

PROJECT FUNDING

The approximate budgetary cost of the proposed system, reflecting present levels in construction costs, is $13.3 million, as itemized below:

TABLE I-2

DESCRIPTION OF PROPOSED SECONDARY TREATMENT FACILITIES

Component	Purpose
Bar screen-grit chamber	Removes grit and large solids entering the plant to facilitate the subsequent treatment process.
Primary Clarifiers	Remove settleable solids and floatables for separate treatment and disposal.
Rotating biological contactor	Remove soluble and colloidal BOD by a rotating, biological, fixed film secondary unit.
Final clarifiers	Remove biomass created in the secondary unit.
Chlorination unit	Provides for disinfection of effluent.
Sludge thickeners	Provide concentration of solids slurry for economy and control in subsequent sludge treatment.
Anaerobic digestion	Stabilizes volatile organic solids.
Mechanical dewatering (centrifuge)	Dewaters treated sludge for economical disposal of residue.
Pretreatment aeration basin for secondary waste stream (cesspool, centrate from the dewatering unit, supernatant from the anerobic digester)	Provides partial treatment to preclude plant upset and poor effluent quality.
Odor control	Provide odor abatement facilities in the form of enclosure of odor emitting units and air scrubbing of exhaust gases.

TABLE I-3

ANTICIPATED EFFLUENT CHARACTERISTICS RESULTING FROM SECONDARY AND ADVANCED PRIMARY TREATMENT

Water Quality Parameter (mg/l unless otherwise noted)	Secondary Effluent Characteristics	Advanced Primary Effluent Characteristics
Total Nitrogen	8	8
Suspended Solids	10-25	50-70
Biochemical Oxygen Demand (five-day)	20-30	70-130
Total Phosphorus	6	7
Settleable Solids (ml/l)	Most of the floatables in influent are removed	

Sewage treatment plant**	$ 7,900,000
Modification and extension of existing 48-inch ocean outfall	2,000,000
Interceptor sewers, effluent lines and pump stations	12,500,000
TOTAL	$22,400,000

* Cost does not include design, administration, contingency, and other miscellaneous costs.

** Secondary treatment. Construction cost of $5,200,000 estimated for advanced primary plant.

Funding for the project is based upon these proportions:

Federal:	75%
State:	10%
County:	15%

The County of Hawaii will be responsible for the operation and maintenance (O&M) costs of the treatment system, which is anticipated to be approximately $450,000 per year for 5.0 mgd of flow (based on secondary treatment). The anticipated annual O&M costs for advanced primary treatment would amount to about $300,000.

PHASING AND TIMING OF ACTION

Proper phasing of the construction of the recommended wastewater facilities is essential. This will assure that the most serious of the health hazards and water quality problems will be initially considered within the allocation of available funds.

A set of criteria must be drawn up to formulate the framework under which the priority of one facility in a certain area can be determined over that of another. It should be understood that developing these criteria is partially a subjective process. For this project, the key factors of the health needs in the project area were identified and the priorities of the facilities were determined according to the urgency of the key factors. The key factors selected were (1) the existing public health conditions, (2) the potential impairment of potable water sources,

(3) the present and projected population densities, and (4) past or potential future contamination of nearshore coastal waters. The priority for the funding and implementation of this facilities plan was determined and is shown in Table I-4 and on Figure I-4.

Discussion of Priority

A priority schedule including associated costs and the tentative implementation times are shown in Tables I-4 and I-5 respectively. The target date for completion of the construction of all phases is tentatively scheduled for 1990. The following discussion presents a more detailed description of the priority items.

The first priority is directed at minimizing the odor problems at the existing treatment facility. The Department of Public Works has occasionally received complaints of odors from residents and picnickers. According to the public works personnel, the sources of odors have been attributed to the long detention time in the sewers and to the introduction of supernatant from the anaerobic digester into the waste stream.

The next five priorities are directed at sewering areas, which currently use individual onsite systems that pose public health hazards. Interceptors A and B (priorities 2 and 3), known as the Haili Street interceptor, are required for two reasons:

1. Potable water sources (surface and basal) are located in this area.
2. There have been reports of some malfunctioning cesspools. During periods of heavy runoff, cesspools have been reported to overflow.

Priority 4 (sewerline C in the Waikele Mill area) is required to eliminate existing occurrences of seepage of cesspool leachate into Waikele Stream. This has been documented by dye tracking studies conducted by the State Department of Health.

Priorities 5, 6, 7, and 8 (sewerlines D, E, F, and H) are required because of the reports of malfunctioning cesspools. The service areas

TABLE I-4

PRIORITY SCHEDULE AND COSTS

Priority	Item	Quantity	Cost ($1,000)	Design Equivalent Population	Residential Population in 1972
1	Odor control measures at existing treatment plant		$ 40		
2	Interceptor A 12-, 15-, and 18-inch pipe, in place complete, including manholes, paving, backfill, etc.	10,575 lf	1,530	5,700[a)]	5,170
3	Interceptor B 6-, 8-, and 10-inch pipe, in place complete, including manholes, paving, backfill, etc.	8,400 lf	650		
4	Sewerline C 6-, 8-, and 10-inch pipe, in place complete, including manholes, paving, backfill, etc.	7,000 lf	540	2,000[a)]	180[c)]
5	Sewerline D 6- and 8-inch pipe, in place complete, including manholes, paving, backfill, etc.	7,200 lf	430	900[a)]	900[d)]
6	Collection lines (8-inch) and laterals (Line E)	620 lf	40	87[d)]	87[d)]
7	Collection lines and laterals (Line H)	LS	300	150	150[b)]
8	Collection lines and laterals (Line F)	LS	800	1,800[a)]	610[e)]
9	Force main K - 30 inches	5,500 lf	900		
10	Force main I - 16 inches	8,500 lf	800		
11	Effluent line - 48 inches	14,000 lf	3,600		
12	Pump Station	LS	700		
13	Force main M - 36 inches	3,000 lf	500		
14	a) Advanced Primary STP b) Secondary Treatment STP	LS LS	5,200 7,900		
15	Outfall extension	2,000 lf	2,000		
16	Modification of Wailoa and Pua SPSs	LS	200		
Items Prioritized after Annual Review					
1	Collection lines and laterals (Line N)	12,500 lf	750	1,100[f)]	900[b)]
2	Interceptor G - 18 inches	14,000 lf	1,800		

a) Reference: Final Application for Modification of Secondary Treatment Requirements for the Proposed Hilo Wastewater Treatment Facility, Hilo, Hawaii, September 1979.

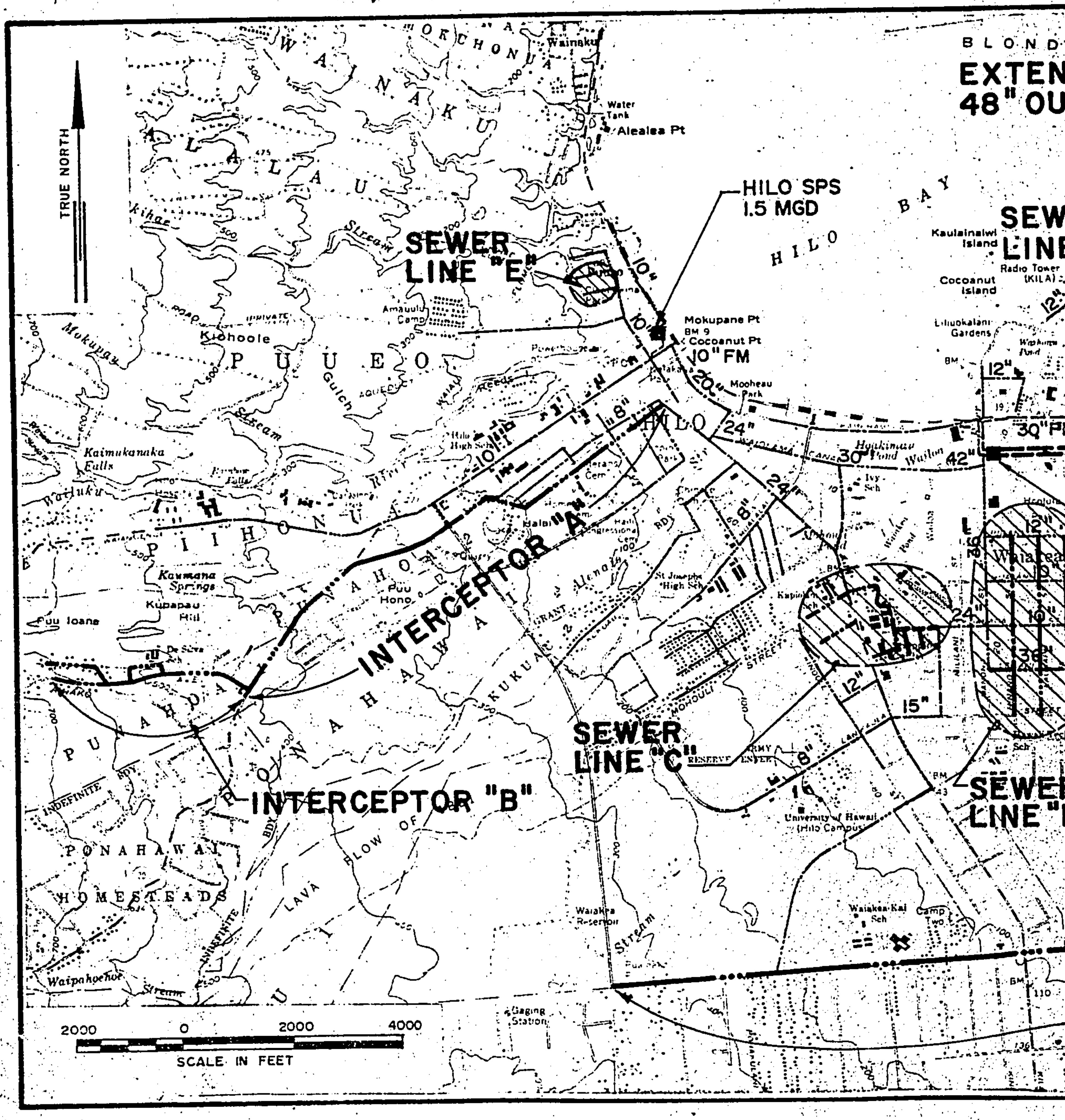
b) Reference: Belt, Collins & Associates, Ltd. Hilo Community Development Plan, May 1975.

c) This area is part of the "old" Hilo area, being fully developed in 1972. Most of the area includes commercial establishments, light-industrial establishments, school and resorts, including the Hilo Shopping Center, the Kapiolani School and the Waikea Village Hotel. It is for this reason there is a large disparity between the 1972 residential population and design population.

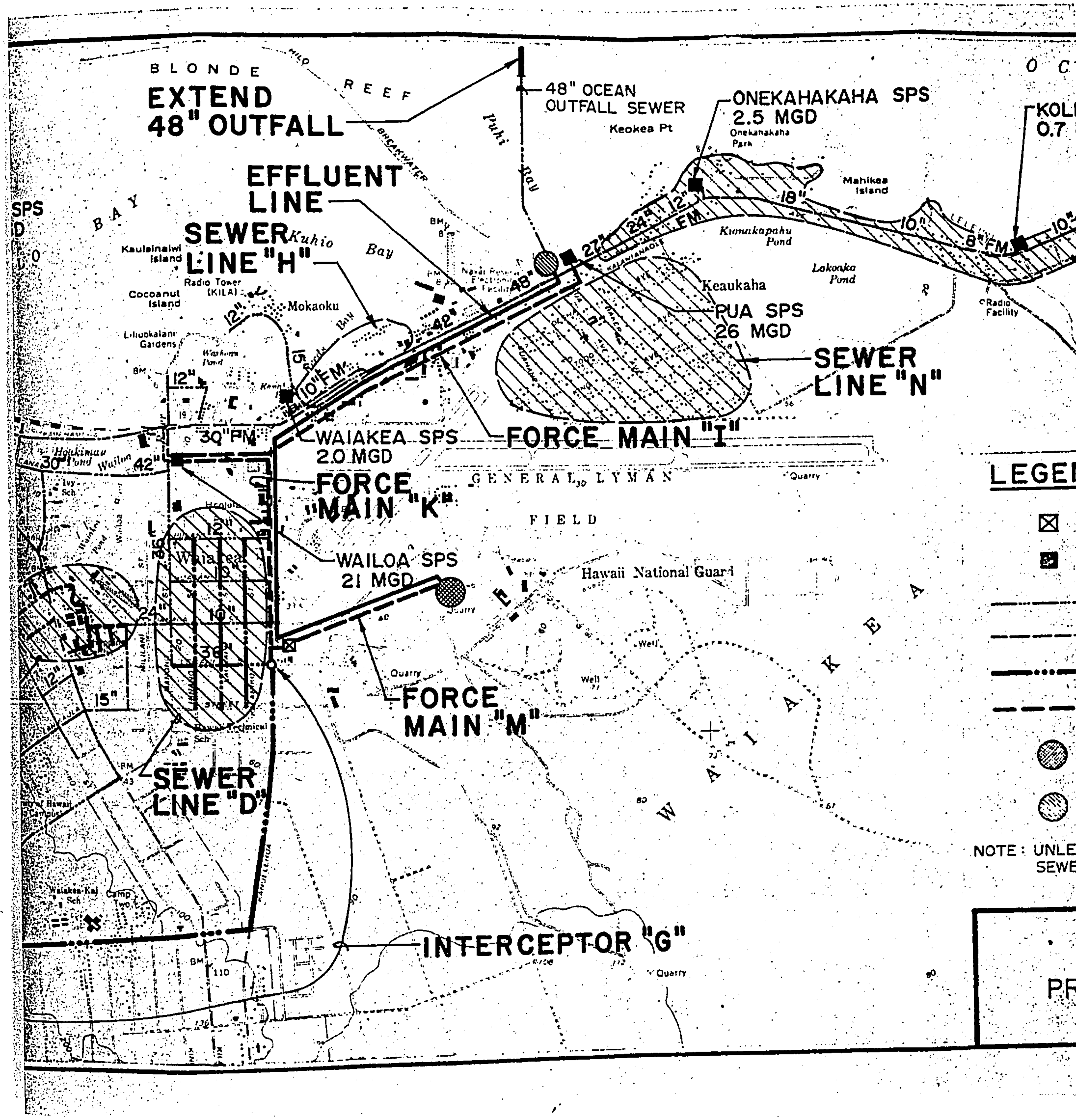
d) Based on a count of residential units and 3 persons per unit.

e) Portions of the flow are generated from the public facilities in the area (James Kealoha Beach Park, Leleiwi Beach Park, Onekahaka Beach Park, etc.) and condominiums, which are rented to tourists who are not reflected in the 1972 residential population.

f) Based on a saturated land use.



EXTEN
48" OU
TRUE NORTH
HILO SPS
1.5 MGD
HILO BAY
SEWER LINE "E"
SEWER LINE "C"
SEWER LINE
INTERCEPTOR "A"
INTERCEPTOR "B"
Alealea Pt
Mokupane Pt
Cocoanut Pt
10" FM
Kaulainaiwi Island
Cocoanut Island
Radio Tower (KILA)
Liliuokalani Gardens
Mooheau Park
Kiohoole
Kubapau Hill
Puu Ioane
Kaumana Springs
Kaimukanaka Falls
University of Hawaii (Hilo Campus)
Waiakea Kai Sch
Camp Two
Waiakea Reservoir
Gaging Station
PONAHAWAI HOMESTEADS
LAVA FLOW OF
2000 0 2000 4000
SCALE IN FEET



BLONDE REEF
EXTEND 48" OUTFALL
48" OCEAN OUTFALL SEWER
Keokea Pt
ONEKAHAKAHA SPS 2.5 MGD
Onekahakaha Park
Puhi Bay
EFFLUENT LINE
SEWER LINE "H"
Kuhio Bay
Mahikea Island
Kionakapahu Pond
Lokoaka Pond
Keaukaha
PUA SPS 26 MGD
SEWER LINE "N"
Kaulainaiwi Island
Radio Tower (KILA)
Cocoanut Island
Mokaoku
Liliuokalani Gardens
Waihonu Pond
WAIAKEA SPS 2.0 MGD
FORCE MAIN "I"
30" FM
42"
Hoakimau Pond
Wailoa
FORCE MAIN "K"
GENERAL LYMAN FIELD
Quarry
WAILOA SPS 21 MGD
Hawaii National Guard
Waiakea
FORCE MAIN "M"
Well
WAIAKEA
Hawaii Technical Sch
SEWER LINE "D"
INTERCEPTOR "G"
Waiakea-Kai Sch
Camp Two
Radio Facility
LEGEN
NOTE: UNLE SEWE
O C
KOL 0.7
SPS D
PR

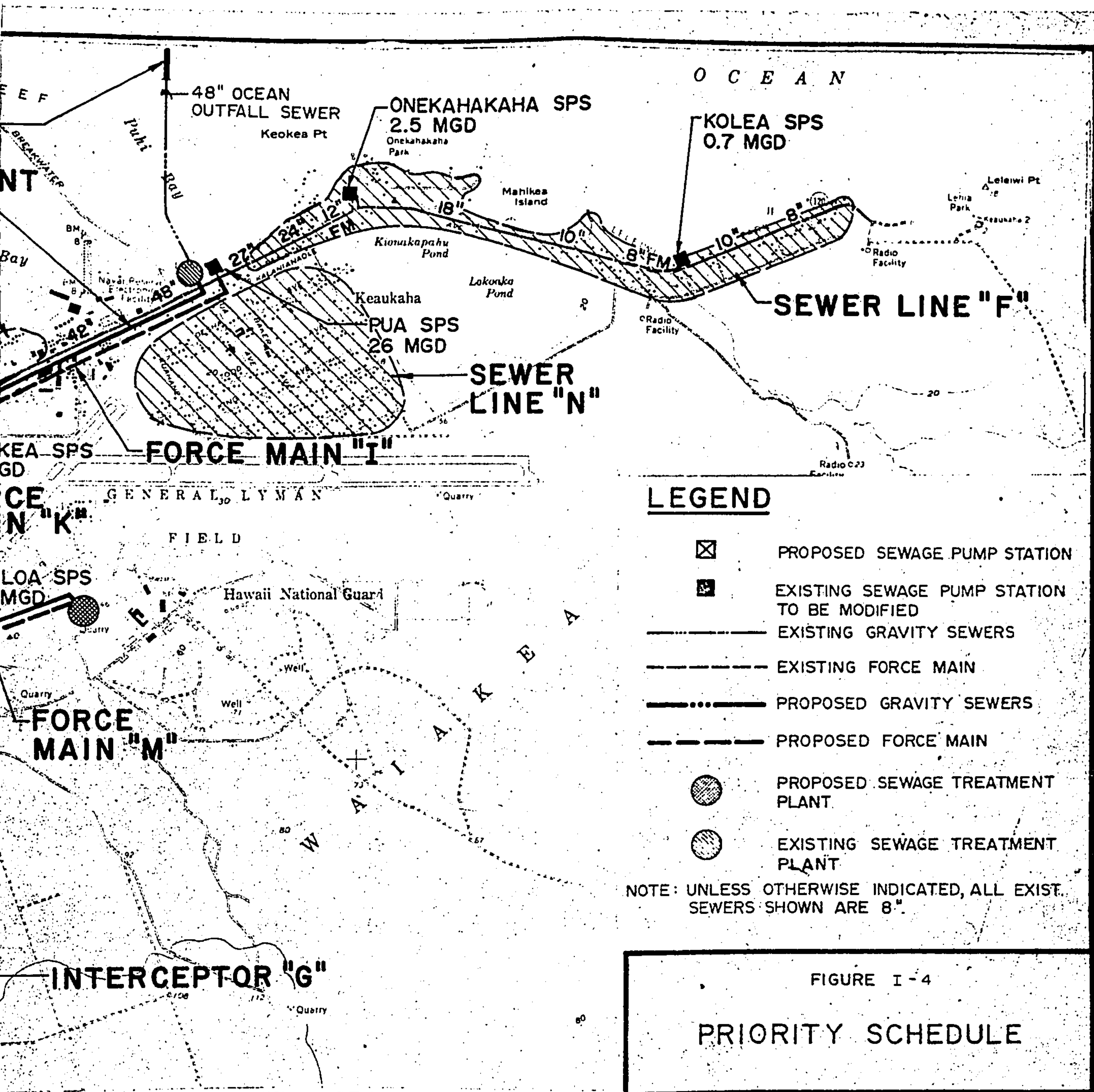


FIGURE I-4

PRIORITY SCHEDULE

TABLE I-5

TENTATIVE IMPLEMENTATION SCHEDULE*

Item	Initiate Construction
Interceptors A and B	FY 1980-81
Sewer Line C	FY 1981-82
Sewer Line D	FY 1982-83
Sewer Line E	FY 1982-85
Sewer Line F	FY 1982-85
Sewer Line H	FY 1982-85
Force Main I	FY 1984-85
Force Main K	FY 1984-85
SPS/Force Main M	FY 1985-86
Effluent Line	FY 1986-87
Sewage Treatment Plant	FY 1986
Outfall Extension	FY 1988

* This schedule is subject to revision, depending upon funding from both federal (EPA) and local (state and CIP) sources.

for sewerline D are the older, built-up residential areas of the study area. Sewerline E will service an area where the soil conditions are inadequate for waste disposal by cesspool. The tributary area for sewerline F contains multi-family units and park pavilions that generate a high quantity of waste flows. Coliform has been reported in the shoreline area of Reeds Bay and are attributable to cesspools in the tributary area of sewerline H. All of these areas are reported to have a high groundwater table, which may be a contributing factor to malfunctioning cesspools.

Priorities 9 through 16 are required to functionally complete the relocation of the treatment facility to the airport industrial area.

Recognizing that funding for all of the items mentioned above will become available over a period of years, it was proposed that the existing primary treatment facility fronting Puhi Bay be operated until the proposed system is completely constructed. This recommendation to continue operation of the existing primary facility is based on the results of field studies that indicated there is no significant impact on the ecosystem from the present discharge of effluent. Moreover, the equipment is in reasonably good condition to continue operation of the facility.

CHAPTER II

DESCRIPTION OF ENVIRONMENTAL SETTING

A. PHYSICAL ENVIRONMENT

The physico-environmental factors of the Hilo study area, as related to the proposed conceptual wastewater management plan, are described briefly in this section.

TOPOGRAPHY

The city of Hilo lies at the base of the lower southeastern slopes of Mauna Loa at elevations ranging from sea level at Hilo bay to 600 feet above sea level along the urban fringe. The slopes are generally very gentle, ranging from six to ten percent in the upper reaches to zero to five percent in the lower, urban areas.

CLIMATE

Hilo is located in the midst of a belt of northeastern trades generated from the semipermanent Pacific high-pressure zone to the city's north and east. In the prevailing wind pattern, orographic rainfall predominates when wind currents force moisture-laden clouds to condense as they move upward along the mountain slopes. Rainfall in Hilo varies from about 130 inches per year along the shore to as much as 200 inches per year in mountain sections (figures represent 30-year normals), as shown on Figure II-1.

Average temperature in Hilo ranges between 65 and 80 degrees. Cloudy skies often prevail; thus, the area receives only about 40 percent of the possible amount of sunshine.

Generally, tradewinds are more persistent in summer than in winter and are stronger in the afternoon than in the evening. Average wind speed is approximately seven miles per hour. A diurnal shift in wind direction often occurs as heating and cooling of the island give rise to onshore sea breezes during the day and offshore land breezes at night.

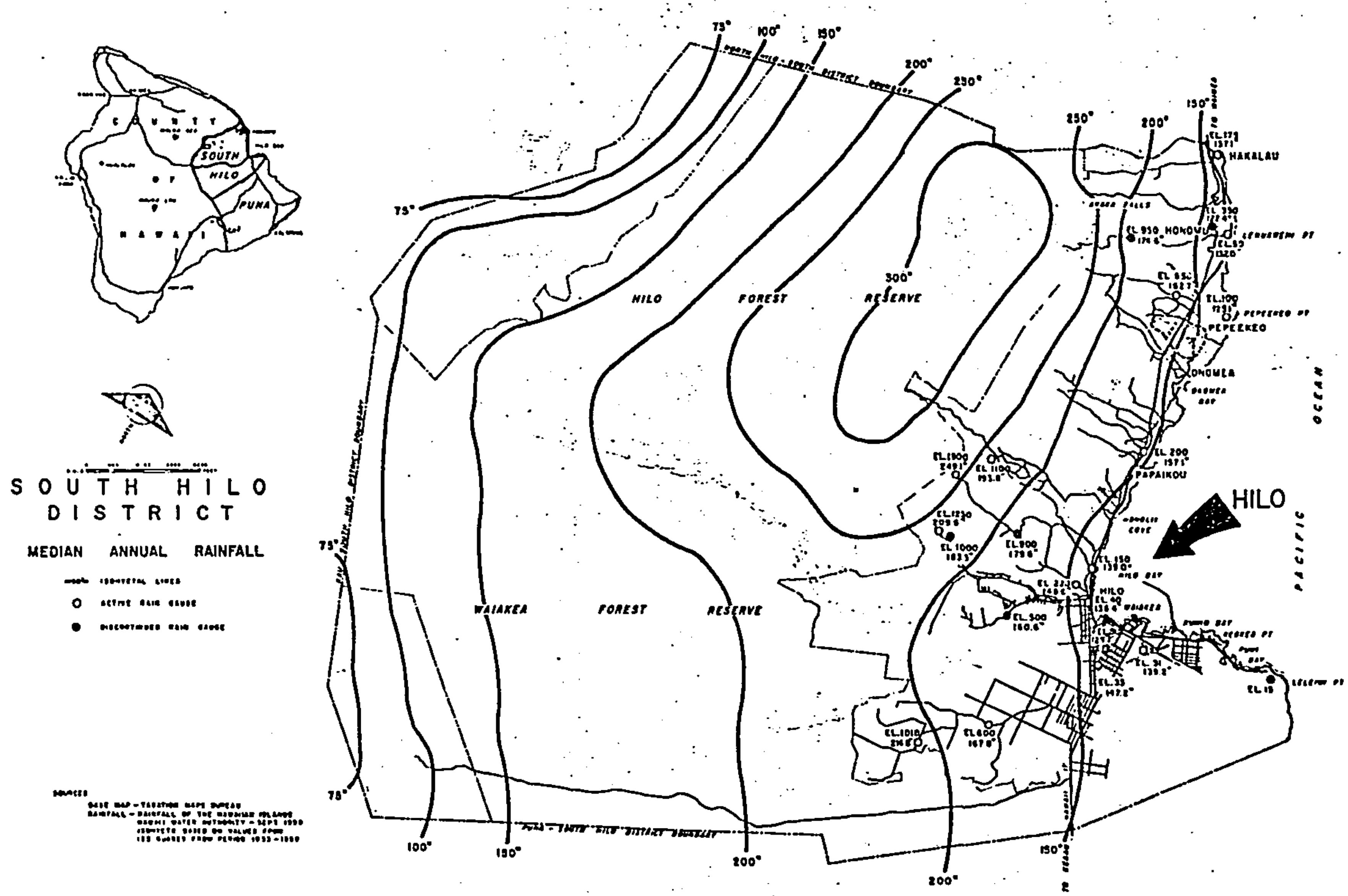


FIG. II-1
MEAN ANNUAL RAINFALL
FOR THE SOUTH HILO DISTRICT

The wind rose for Hilo Airport is shown on Figure II-2.

HYDROGEOLOGY

A physical division of the area's geological structure exists at the Wailuku River. Formations to the north of the river are those of Mauna Kea volcano, while the area to the south consists of Mauna Loa volcano formations, all of which date back to the Pleistocene Age.

Lava formations rarely outcrop, except possibly in gulches and cliffs, as ash deposits of a more recent origin blanket these older formations. However, outcrop of pahoehoe lava is very common in the study area.

Almost all of Hilo rests on highly permeable and well-drained interbedded ash and olivine basalt. The water table exhibits a mild seaward gradient (one to four feet per mile), culminating in several freshwater springs along and off the coast (see Figure II-3).

STREAMS

Wailuku River is the major perennial stream in the study area, with its origin extending far inland and up the slopes to a point close to the summit of Mauna Kea, whose elevation is 13,796 feet, highest in the state. Average discharge, as gauged at a point four miles inland, is 283 cfs. Waiakea Stream is the other perennial stream in the study area, with an average discharge of 12 cfs at a point eight miles inland.

Several intermittent streams, fed during instances of areal storms, exist in the immediate area of these two perennial streams. Drainage is into Waiakea Pond near the shoreline and into Wailoa River, which is tributary to Hilo Bay (Harbor).

OCEAN CURRENTS

Surface currents in the water outside of Hilo are in a northwestern direction. During ebb tide the general surface current in Hilo Harbor is in a counterclockwise direction (see Figure II-4). Tidal variation in the Hilo area is 1.6 feet.

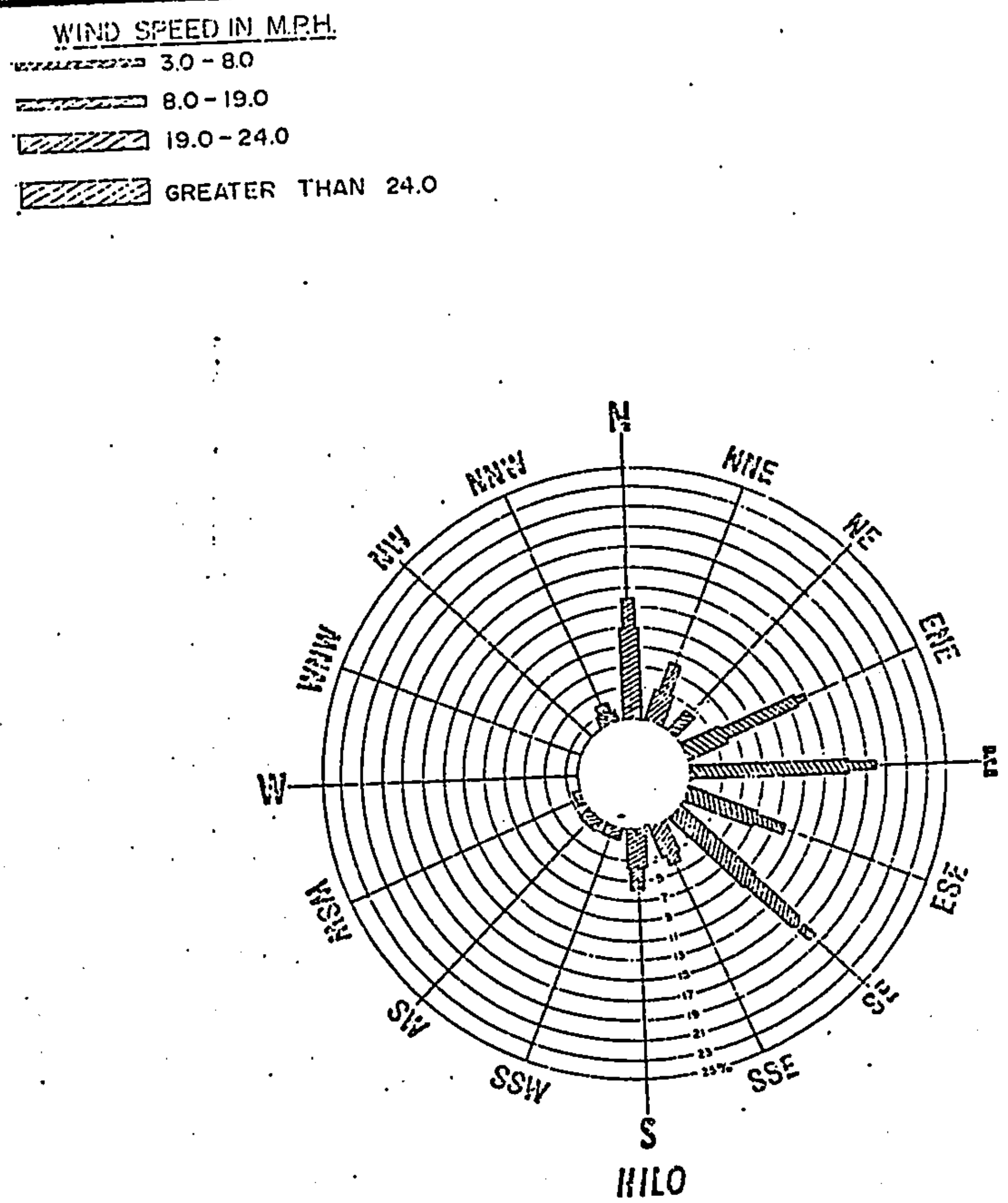


FIG. II-2
WIND ROSE AT HILO

Source: NWS Office, Hilo Airport

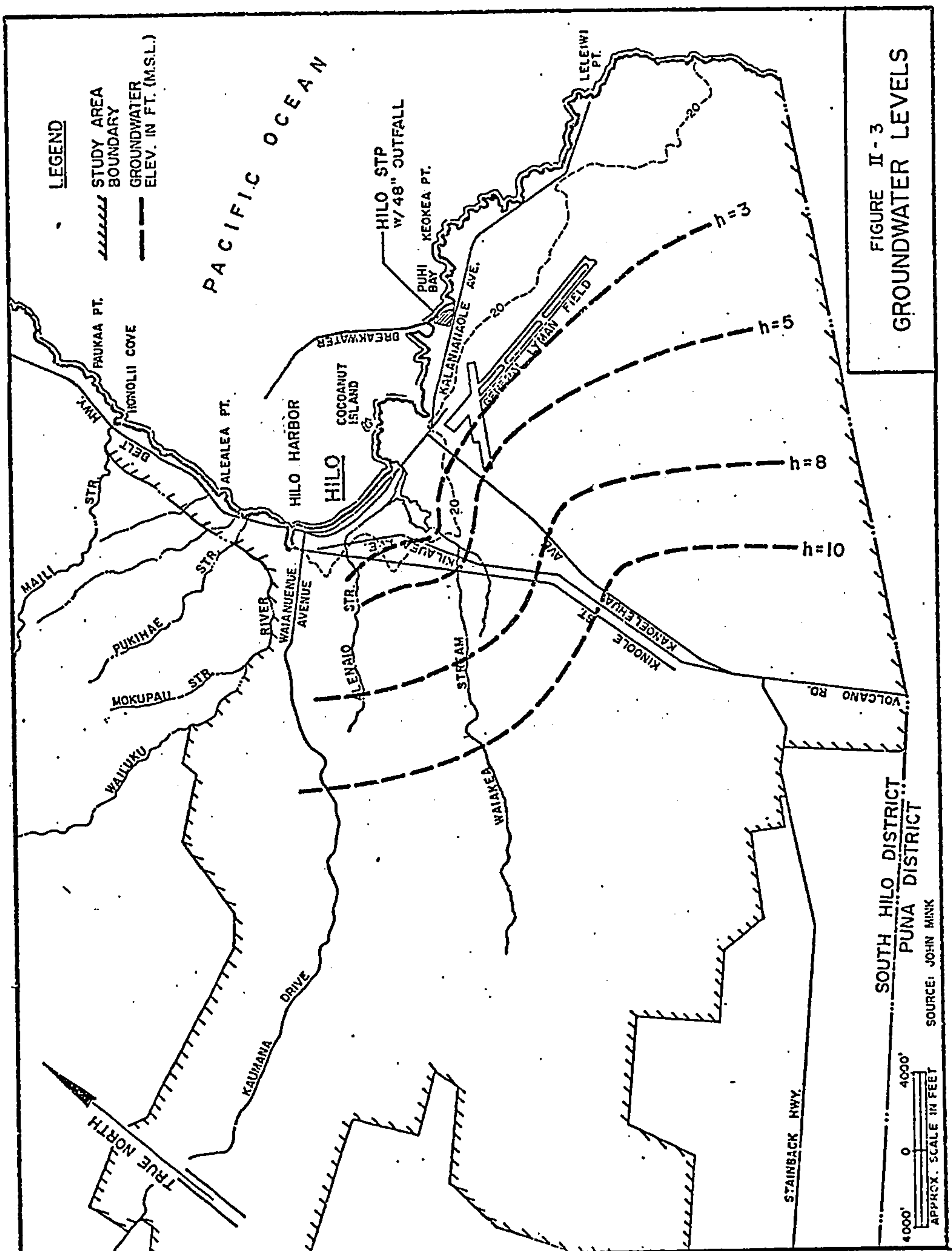
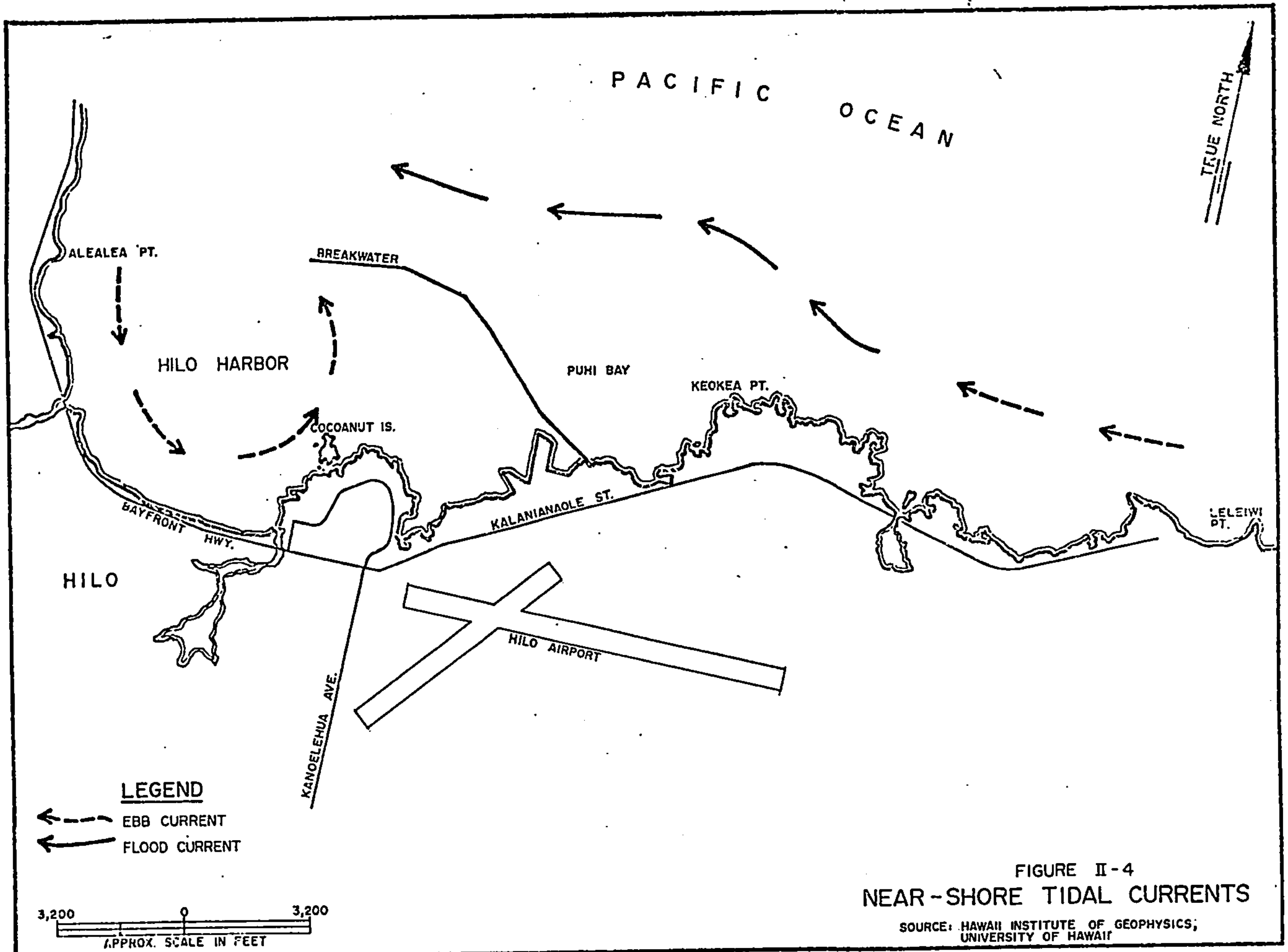


FIGURE II-3
GROUNDWATER LEVELS



PACIFIC OCEAN
TRUE NORTH
ALEALEA PT.
BREAKWATER
HILO HARBOR
PUHI BAY
KEOKEA PT.
COCOANUT IS.
KALANIANAOLE ST.
BAYFRONT HWY.
LELEIWI PT.
HILO
HILO AIRPORT
KANOELEHUA AVE.
LEGEND
EBB CURRENT
FLOOD CURRENT
3,200
0
3,200
APPROX. SCALE IN FEET
FIGURE II-4
NEAR-SHORE TIDAL CURRENTS
SOURCE: HAWAII INSTITUTE OF GEOPHYSICS; UNIVERSITY OF HAWAII

HYDROGEOLOGIC MODEL FOR THE HILO BAY AREA

Geographically, Hilo Bay (inclusive of Hilo Harbor) extends from Pepeekeo Point to Leleiwi Point (Figure II-1). For the purposes of this model, however, the coastline of Hilo Bay is subdivided into (1) the portion lying north of the Wailuku River, arbitrarily reaching to Alealea Point (see Figure II-5) and (2) the much larger portion lying between Wailuku River and the breakwater built on Blonde Reef. Together, both portions constitute the shoreline of Hilo Harbor (designated as part of Hilo Bay but restricted to the area shoreward of the breakwater). These subdivisions differ distinctly in their geological and hydrological characteristics. The harbor is most profoundly affected by the groundwater discharges originating in lands east of Wailuku River and by the surface water output of the river itself. The northern flank of the harbor contributes both surface and groundwaters but in much smaller volume.

Puhi Bay (area lying within Hilo Bay but between the breakwater and Keokea Point) and the coastal waters to the east are nearly solely influenced by the subsurface flow of fresh groundwater (see Figure II-6). Surface water outflow is small in volume and infrequent in occurrence.

Most of the study area falls within the subsurface and surface drainage basin emptying into Hilo Harbor. Much emphasis will be placed on the bay sector between Wailuku River and the breakwater because it is into this natural sink that vast quantities of fresh water drain each day and also because it includes the bulk of present urban development and is slated for most of the future developments.

Geological Environment

The area north of Wailuku River consists of Mauna Kea's Hamakua volcanic series. This series is a permeable basalt, but an overlying Pahala ash layer (up to 25 feet thick) and its derivative soil make the surface less permeable than normal for exposed basalts relative to other surrounding areas, although it is considered among the best permeable soil within the State. As a result, stream flow from this area is substantial and flow in the Wailuku River, which originates on the

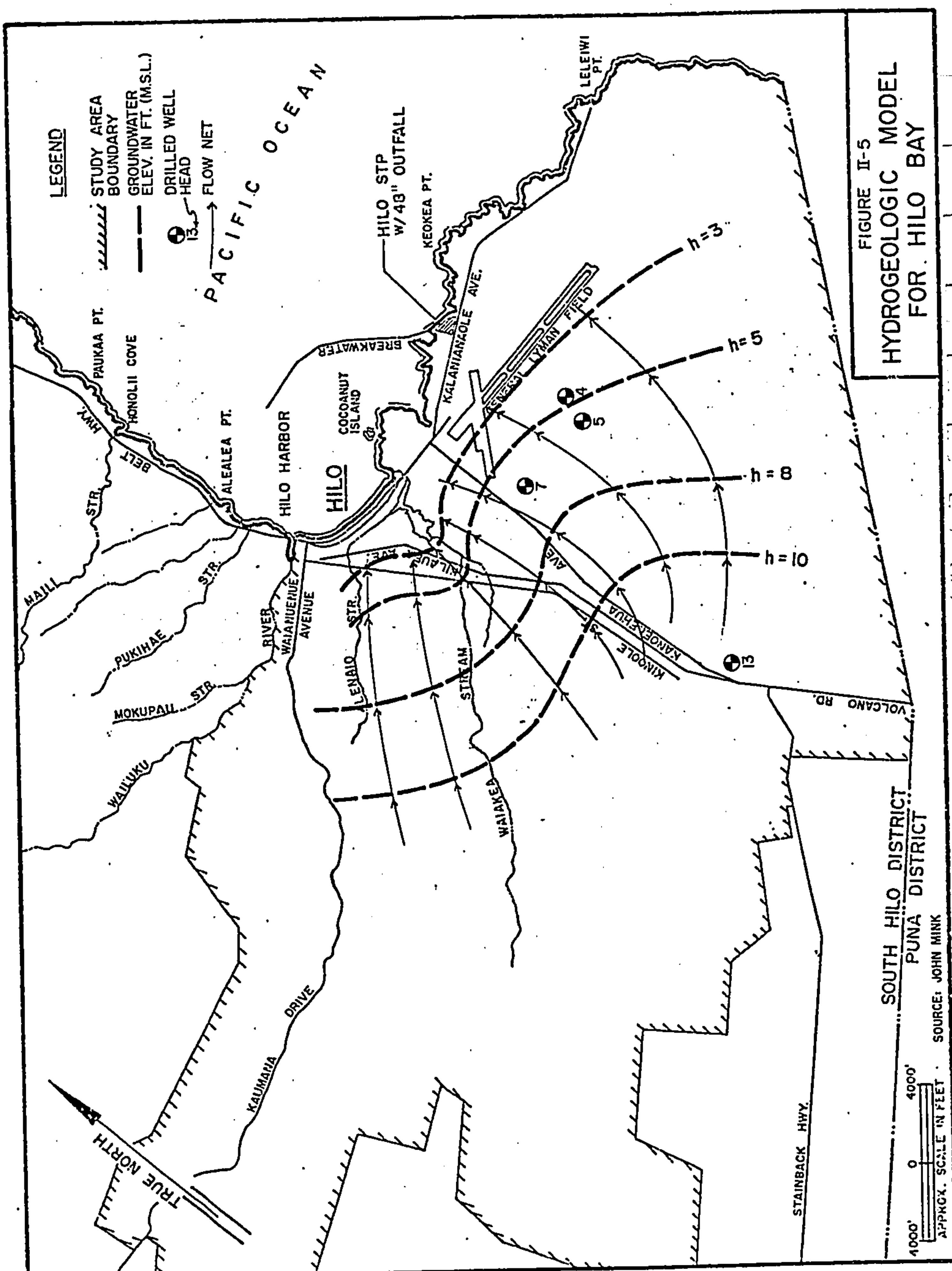


FIGURE II-5
HYDROGEOLOGIC MODEL FOR HILO BAY

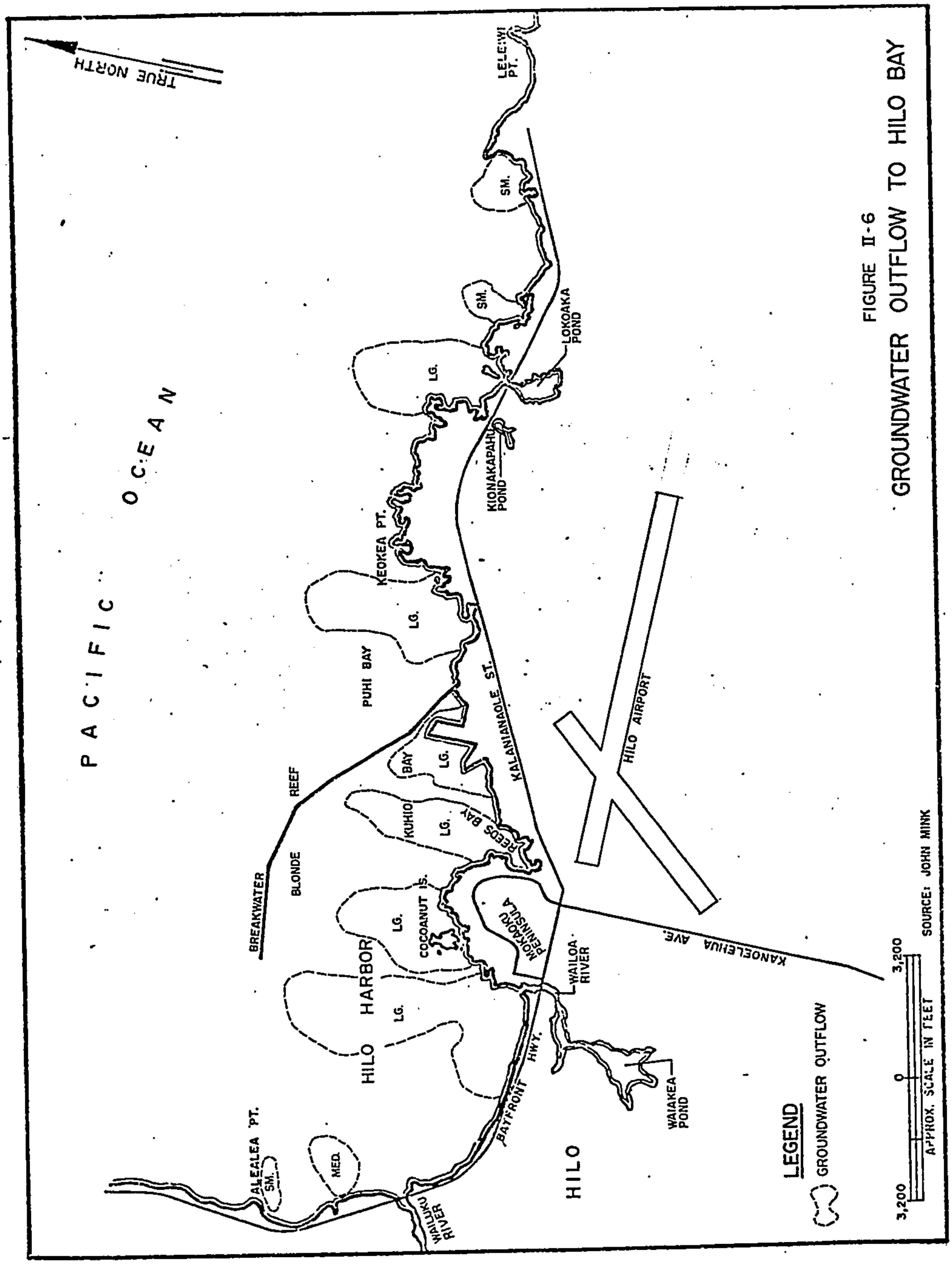


FIGURE II-6
GROUNDWATER OUTFLOW TO HILO BAY

ash-covered surface, averages several hundred million gallons per day. Slopes on the Mauna Kea surface are moderately steep, averaging 0.05 to 0.10, and are incised by numerous small streams.

East of Wailuku River the surface rocks consist of the Kau volcanic series of Mauna Loa, an extremely permeable basalt that is too recent in origin to have had formed a deep soil and saprolite top layer. Patches of Pahala ash lie on some older Mauna Loa lavas near the Wailuku River but are insignificant in contrast to the wide extent of bare Kau lava over the remainder of the study area.

The Kau series, which erupted from Mauna Loa following the main deposition of Pahala ash, is relatively thin in section, perhaps 25 feet thick in the Hilo region. Beneath the ash is the initial Mauna Loa basalt formation--the Kahuku series--also extraordinarily permeable. The result of permeable surface and subsurface formations, even though a discontinuous strata of ash lies between them, is a lack of appreciable surface runoff and the occurrence of high infiltration and subsurface flow rates. Also contributing to the large infiltration rates are low slopes of Kau volcanics over much of the region, varying from 0.005 to 0.05.

The island of Hawaii is too ycung to have drained valleys and a coastal plain formed of land and marine sediments (cap rock), as is typical of the older islands of the chain. Streams cut through fresh rock and the coasts consist of bare lava, sometimes bordered by small banks of coral offshore.

Hydrology

The region draining to Hilo Bay and the coast to the east is very wet, with an annual average rainfall ranging from about 130 to 300 inches for areas below elevation 5,000 feet. Above that elevation annual rainfall decreases sharply and the climate becomes semiarid. Although the isohyetal map is based on relatively few long-term rain gauges, there is no doubt that the average annual rainfall for the drainage region as a whole (below elevation 5,000 feet) is at least 150 inches and more likely closer to 200 inches.

The annual average pan evaporation near Hilo is surprisingly high in view of the total annual rainfall. According to report R34 (State of Hawaii, Department of Land and Natural Resources, 1970), at Hilo Airport (elevation 30 feet) pan evaporation averages 60.3 inches per year; at Hilo Makai (elevation 200 feet), 56.2 inches per year; and at Hilo Mauka (elevation 900 feet), 48.8 inches per year. Since no records for the mean elevation (approximately 2,000 feet) in the Hilo area existed, recordings at other areas were investigated. For a similar wet area in Hamakua, annual pan evaporation readings were 53.3 inches for a gauge station at elevation 2,075 feet.

Experiments with irrigated sugar cane and grass in Hawaii have shown that potential evapotranspiration of these crops is essentially equivalent to pan evaporation. The high rainfall of the Hilo region suggests that sufficient water should always be available to plants to satisfy their potential evapotranspiration.

The following assumptions were used to develop components of the hydrologic budget:

Rainfall:	150 inches/year
Evapotranspiration:	50 inches/year

Based on these figures, the average water yield over the drainage basin is 100 inches per year.

Surface Water

Two distinctly different surface water provinces draining into Hilo Bay are (1) the steep, ash-covered slopes of Mauna Kea (area north of Wailuku River) and (2) the gentle, nearly fresh lava surface of Mauna Loa (east of Wailuku River). The overwhelming portion of the surface water that flows into Hilo Bay drains from the Mauna Kea slopes by way of the Wailuku River. In addition, the northern sector of the bay is fed by surface water from the ash-covered surface between the Wailuku River and Alealea Point, though the volume of runoff is small compared to the Wailuku River flow. East of the river the total surface drainage is quite small, insignificant on a volume basis in comparison with the Wailuku River discharge.

The average flow of the Wailuku River computed on a daily basis is about 300 mgd (Cox and Gordon, 1970). The range of individual daily flows varies from a minimum of about 10 mgd during droughts to billions of gallons per day during heavy rainstorms. The median flow at the mouth of the river is approximated as 100 mgd (Cox and Gordon, 1970). Unfortunately, no continuous record of flow of the river as it enters the bay has been made, but the long-term record at Station 7040 (elevation 1,070 feet) for 125 square miles of the drainage basin can be estimated to reflect the distribution of flows at the estuary. From the modified duration curve computed for Station 7040 (Report R34, Department of Land and Natural Resources, 1970), the flow percentiles for outflow into the bay are estimated as follows:

Percentile	Days	Flow (mgd)
95	347	10
90	329	20
80	292	30
70	256	50
50	183	100
30	110	250
20	73	350
10	37	700

These figures show, for example, that flows from the river to the bay exceed 50 mgd for 256 days of the year. The sector north of Wailuku River contributes an average of 10 to 20 mgd to the bay over a range from zero flow to several hundred mgd.

To the east of the Wailuku River the natural overland runoff to the coast probably averages no more than about 2 mgd per mile of coastline, a value deduced by analogy with other rudely similar areas of the state where stream gauge records are available. In fact, 2 mgd per mile is probably too high, for few other regions have surface rocks as permeable as the Kau volcanics. A value of 2 mgd per mile, nevertheless, would yield an average daily total flow of 6 mgd, which perhaps would be increased by flow accumulation from the urban portions of Hilo.

Direct surface runoff to Puhi Bay and to the coast east of it would be even smaller per unit coastline than runoff from the Kau volcanics to Hilo Bay. A surface drainage pattern on the gently lying lava apron forming the land bulge east of Hilo is just barely becoming established. Most of the rainfall yield infiltrates to groundwater. At an overstated average direct runoff of two mgd per mile of coast, Puhi Bay receives an average of only about one mgd. Except for very infrequent periods, direct runoff from the Kau volcanics is not an important dilutant of coastal waters.

In summary, compared to the surface water input to the bay from the Wailuku River, the other surface water components, in particular, that from the sector east of the river, are insignificant.

Groundwater. Hilo Bay is the greatest sink for fresh groundwater in the entire Hawaiian Archipelago. Indeed, the bay is the catchment for one of the known, great, basal groundwater spring areas of the world. The flow of fresh basal groundwater to the bay exudes at a nearly constant rate in comparison with surface runoff and is often the overwhelmingly dominant freshwater component entering the bay. To the east of the bay the fresh groundwater discharge along the coast is many magnitudes larger than surface flow and is the chief terrestrial influence on near coastal waters.

Groundwater issues from both the Mauna Kea and Mauna Loa lavas, but the largest volume of outflow by far comes from the permeable Mauna Loa lavas lying east of the Wailuku River. To the north, between the river and Alealea Point, 10 to 20 mgd of groundwater flow issues at the coast, about equivalent to the low flow of the river. In Hilo Bay east of Wailuku River, the flow is on the order of 500 mgd. Large groundwater flows also reach Puhi Bay, and lesser, but nevertheless large, volumes issue along the coast to the east and south.

The flow net, shown on Figure II-5, was derived from head readings of several wells. The flow net is restricted to the region east of the Wailuku River and, in particular, to the flows that discharge into Hilo and Puhi bays. It is evident that a great concentration of flow moves toward Waiakea Pond and the Wailoa River and another concentration to Kuhio and Puhi bays. East of Puhi the unit flows decrease but are still large in the vicinity of Kionakapahu and Lokoaka ponds.

The flow net is substantiated by the existence of freshwater springs at the coast, as determined by Fischer et al. (1966) with infrared sensing. The spring indications plotted on Figure II-6 are based on the infrared interpretations. The largest springs flow into Hilo Harbor; very large springs also issue into Reeds Bay and Puhi Bay. Springs become smaller and fewer between Lokoaka Pond and Haena.

By tracing the flow envelope that drains into Hilo Harbor and Puhi Bay to the 5,000-foot elevation contour, it is approximated that about 150 square miles of intake area fall within the envelope boundaries. The 5,000-foot contour is selected as the inland boundary because infiltration in the low-rainfall zone at higher elevations is insignificant.

The average rainfall in the flow envelope is about 150 inches per year, of which it is assumed 50 inches is lost to evapotranspiration, leaving a rainfall yield of 100 inches per year. Over 150 square miles, an average annual rainfall of 100 inches gives 714 mgd on an average daily base. Of this quantity, no more than 10 mgd discharges to the coast as surface runoff; thus, the groundwater flux would have to be on the order of 700 mgd. It is the correct order of magnitude but may be somewhat smaller, or larger, if the true limits of the flow envelop differ appreciably from the assumed limits.

An estimate of groundwater flux also may be made by employing a continuity equation and Darcy's law ($Q = TIL$), in which known head data for wells upgradient from the bays are used. The result of the combined Darcy-continuity equation, as applied to the Hilo area, is about 650 mgd, not greatly different from the value approximated by the water budget analysis. Based on this analysis, it is reasonable to assign a groundwater component to Hilo Harbor of about 500 mgd and to Puhi Bay and the ponds just east of it, a total component of about 100 mgd.

The largest known single groundwater concentration draining into Hilo Bay is Waiakea Pond, which yields an average flow of about 100 mgd

(Hirashima, G.T., 1965). Davis and Yamanaga (1973) gave an estimate for flow into Reeds Bay of 10 to 20 mgd. The infrared work of Fischer et al. (1965) indicates that large springs also issue on Mokaoku Peninsula, in an area west of the Wailoa estuary, and in the area between the breakwater and Reeds Bay. That work also showed a large outpouring of fresh groundwater into Puhi Bay.

Summary of Freshwater Flow into Hilo Bay

Table II-1 shows the flow distribution into the Hilo Bay area.

TABLE II-1

FRESHWATER FLOW DISTRIBUTION IN HILO BAY

	Area	Average Flow (mgd) Surface	Groundwater
1.	Wailuku River north to Alealea Point	10-20	10
2.	Wailuku River	300*	
3.	Area east of Wailuku River to breakwater	6	500
4.	Puhi Bay	1	100
5.	Area east of Puhi Bay	1	100

* Median value; flow ranges from 10 mgd to several billion gallons per day. Median value is approximately 300 mgd.

VEGETATION

Hilo is located immediately south of, but is not included in, the sugar cane belt of the Hamakua Coast. Vegetation in the study area consists mainly of guava, fern, Hilo and barket grass, kukui, and hala. High-elevation vegetation includes the ohia lehua rain forest, hapuu trees, and olapa. This plant distribution reflects the climatic factors of average annual rainfall and temperature at the high and low elevations.

NATURAL HAZARDS

The Hilo area is susceptible to various types of natural hazards. These include flood, tsunami inundation, volcanic activity, and earthquakes.

Flooding

Portions of the Hilo area are prone to flood damage by surface runoff from high intensity rainfalls. Historical records indicate 31 major flooding incidents since 1880 in the Hilo area, with minor flooding occurring yearly. This high incidence of flooding can be attributed to a combination of high-intensity rainfall and undefined drainage ways.

The potential for flood damage has been considered in the developmental plans for the Hilo area and has limited the extent of urban development in flood-prone areas. To mitigate the potential for flooding in certain areas, drainage improvement programs have been initiated by the county.

Flood-prone areas are confined mainly to areas in the upper portions of Hilo where the land steepens to slopes of 6 to 12 percent and where the area is geologically "young" for well-defined drainage areas to have developed. This situation, combined with the shallow soil condition, results in extensive "sheet" flow runoff.

A flood plain map (Figure II-7) has recently been prepared by the U.S. Soil Conservation Service (SCS) for a 100-year storm in Hilo. Results of this study was prepared for the Wailuku-Alenaio PL-566 Watershed Project and shows only the 100-year flood plain for Alenaio Stream.

The only portion of the study area located within the 100-year flood boundary consists of approximately 70 residential lots which lies in the Alenaio Stream flood plain. Facilities to be constructed within this area of concern will consist of sewer collection lines and the effects of flooding can best be mitigated by providing pressure manhole covers to prevent inflow into the sewer collection system.

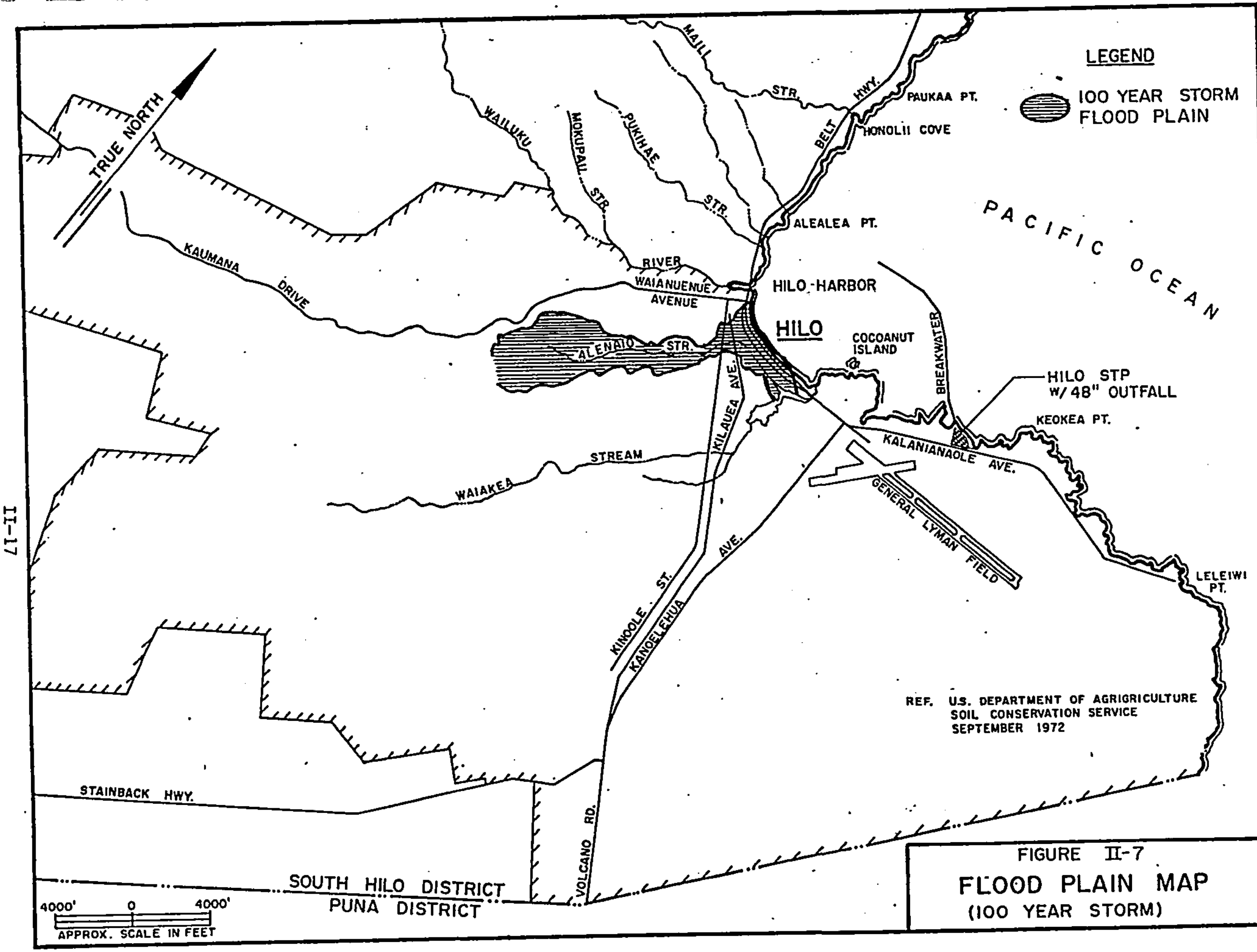


FIGURE II-7
FLOOD PLAIN MAP
(100 YEAR STORM)

Tsunamis

Tsunamis are impulse-generated water waves caused by seaquakes, volcanic eruptions, or explosions. The city of Hilo, with the orientation of crescent-shaped Hilo Bay towards portions of the Pacific seismic belt, is very susceptible to tsunamis from the eastern half-circle of the seismic belt that extends from the Aleutian Islands down to the western coast of South America. An existing breakwater, approximately 9,000 feet in length, encloses portions of Hilo Bay.

Forty-three destructive tsunamis have reached Hilo since 1819, seven of which inflicted much loss of life and property damage. The tsunamis of April 1946 and May 1960 are well documented regarding their inundation and severity of damage and form the basis of tsunami frequency studies.

Several agencies have conducted studies about tsunami frequency analysis and the corresponding extent of inundation potentials, and the U.S. Corps of Engineers has developed a tsunami frequency analysis curve, shown on Figure II-8. (See Table II-2 for a historical record of tsunami characteristics.) Based on the results of the tsunami frequency analysis, a map delineating the potential inundation line from a 100-year tsunami for Hilo City is shown on Figure II-9.

Actions taken to lessen the impact of tsunamis include extension and enlargement of the breakwater (initially constructed in 1930), rezoning of vulnerable areas to open space, and adoption of stricter structural design codes.

Volcanic Activity

Lava flows are the most common volcanic hazards in Hawaii. Generally, there is very little direct danger to human life, but risk to property can be great. The greatest danger from volcanic activity to the Hilo area is from eruptions within the northeast rift zone of Moana Loa. Since 1880, most lava flows from Moana Loa have stopped prior to reaching the urban areas of Hilo. A listing of volcanic activity from 1969 to 1979 is presented in Table II-3.

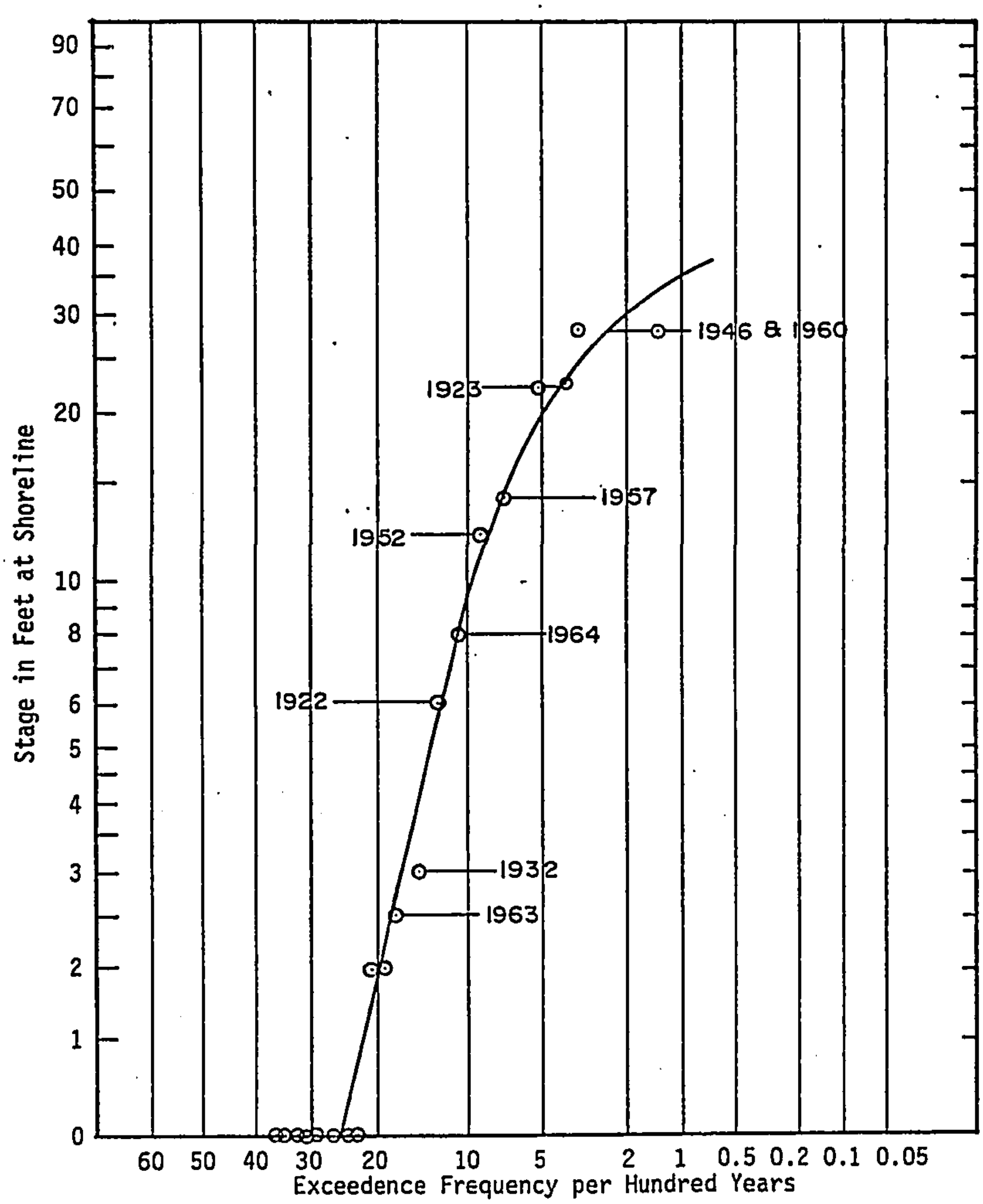


FIGURE II-8

TSUNAMI STAGE FREQUENCY, 1915 TO 1965, HILO, HAWAII

Source: U.S. Army Corps of Engineers, Tsunami Frequency Analysis

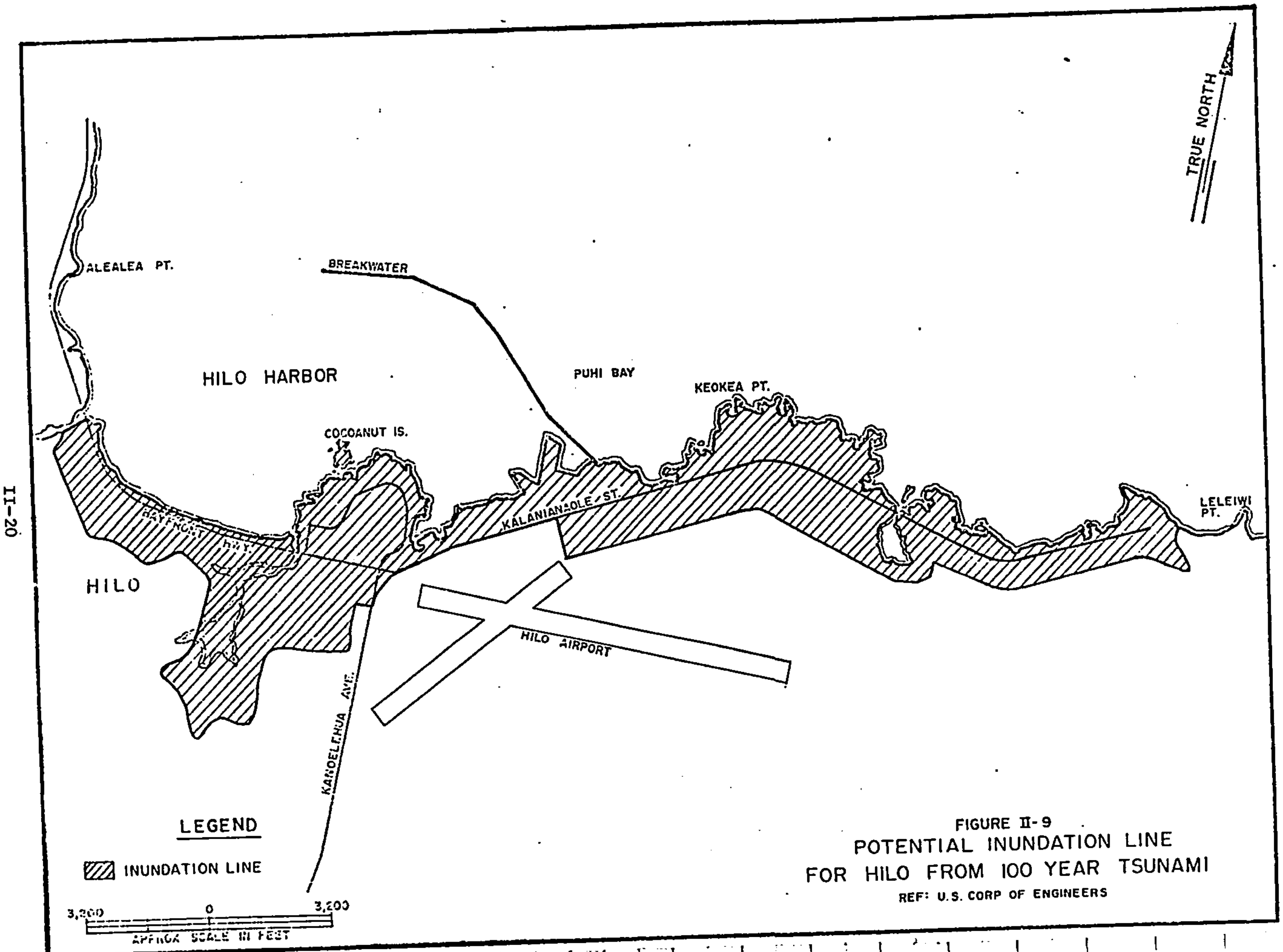


FIGURE II-9
POTENTIAL INUNDATION LINE
FOR HILO FROM 100 YEAR TSUNAMI
REF: U.S. CORP OF ENGINEERS

TABLE II-2

HISTORICAL RECORD OF TSUNAMI HEIGHTS AT HILO (1837-1964)

Date	Month	Day	Source Area	Place	Visual Inundation Height (feet)	Datum
1837	Nov	7	Chile	Hilo	20	hwm
1841	May	17	Kamchatka	Hilo	15	hwm
1868	Apr	2	Hawaii Is.	Hilo	6, 10*	hwm
1868	Aug	13	Peru-Chile			
1872	Aug	23	?	Hilo	4	sl
1877	May	10	Chile	Hilo Waiakea	12 16	lw ?
1896	Jun	15	Japan Is.	Hilo	8	ht
1906	Jan	31	Columbia	Hilo	2-1/2	ht
1906	Aug	17	Chile	Hilo	5	R
1918	Sep	7	Kuril Is.	Waiakea	4 or 5	sl?
1919	Apr	30	Tonga Is.	Hilo	4 or 5	R
1922	Nov	11	Chile	Kuhio	6	sl?
1923	Feb	3	Kamchatka	? Waiakea	25? 20+	? ?
1923	Apr	13	Kamchatka	Waiakea	1	sl?
1927	Nov	4	California	Kuhio	0.8	R
1927	Dec	28	Kamchatka			
1928	Jun	17	Mexico			
1929	Mar	6	Aleutian Is.	Kuhio Waiakea	0.7 1.3	R R
1931	Oct	3	Solomon Is.			
1932	Jun	3	Mexico			
1932	Jun	18	Mexico			
1932	Jun	22	Mexico			
1933	Mar	2	Japan		2 or 3	R
1938	Nov	10	Alaska		1	sl?
1946	Apr	1	Aleutian Is.	Reeds Wainaku	9 30	mllw
1951	Aug	21	Hawaii Is.			
1952	Mar	3	Japan			
1952	Nov	4	Kamchatka	Wainaku Hilo	6 12	mllw
1956	Mar	30	Kamchatka			
1957	Mar	9	Aleutian Is.	Waiakea Hilo	7 14	mllw
1958	Jul	10	Alaska			
1958	Nov	6	Kuril Is.			
1959	May	4	Kamchatka			
1960	May	21	Chile			
1960	May	23	Chile	Reeds Waiakea	10 35	mllw
1960	Nov	21	Peru			
1963	Oct	13	Kuril Is.			
1963	Oct	20	Kuril Is.			
1964	Mar	28	Alaska	Waiakea Radio	2-1/2 10	mllw

Datum

hwm = high water mark
ht = high tide
sl = sea level
msl = mean sea level
lw = low water
mllw = mean lower low water
R = range from high to low

* Two observations made.

TABLE II-3

VOLCANIC ERUPTIONS: 1969 TO 1979

Volcano and date of outbreak	Repose period since previous eruption (months)	Duration (days)	Location	Altitude (feet)	Area (square miles)	Volume (1,000 cubic yards)
Mauna Loa:						
1975: July 5	300	<1	Summit	13,000-12,100	5.2	39,200
Kilauea:						
1969: Feb. 22	4.0	6	E. rift	3,100-2,900	2.3	22,000
May 24	2.0	867	E. rift	3,150	19.3	242,000
1971: Aug. 14	-	<1	Caldera	3,660-3,600	0.8	12,400
Sept. 24	-	5	Caldera, SW rift	3,740-2,730	1.5	10,500
1972: Feb. 4	4.3	455	E. rift	3,150	13.5	163,800
1973: May 5	-	<1	E. rift	3,340-3,250	0.1	1,600
May 7 1/	-	187	...	...	0.2	3,200
Nov. 10	-	30	E. rift	3,250-2,900	0.4	3,700
Dec. 12	1.1	203	E. rift	3,150	3.1	39,300
1974: July 19	-	3	Caldera, E. rift	3,600-3,520	1.2	9,000
Sept. 19	2.0	<1	Caldera	3,680	0.4	14,000
Dec. 31	3.4	<1	Caldera	3,600	2.9	19,600
1975: Nov. 29	11.0	<1	Caldera	3,600	0.05	330
1977: Sept. 13	21.5	18	E. rift	1,600-2,080	3.0	45,000

1/ Listed by the Hawaiian Volcano Observatory staff but not by Macdonald and Hubbard (see source).

Source: Gordon A. Macdonald and Douglas H. Hubbard, Volcanoes of the National Parks in Hawaii, 7th edition (Hawaii Natural History Association, December 1974), pp. 14 and 29, as corrected by Dr. Macdonald, May 5, 1976, and updated by the staff of the Hawaiian Volcano Observatory, April 28, 1976, May 21, 1976, March 25, 1977, February 8, 1978, and March 9, 1979. Correct to March 9, 1979.

Earthquakes

According to reports by the U.S. Geological Survey, earthquakes in the Hilo area can be expected in the future. Since the risk of major damage from earthquakes is considerable for all areas of the island, stringent earthquake resistant design of structures have been implemented. A listing of earthquakes of magnitude 5 or greater on the Richter Scale on the island of Hawaii during the period between 1969 to 1978 is shown in Table II-4.

ARCHAEOLOGICAL SITES

Archaeological sites are a rich preserve of the cultural heritage of ancient Hawaii and represent a physical expression of the past. Three significant, ancient Hawaiian sites, described in the Hilo Community Development Plan (Belt, Collins & Associates, 1974), are shown on Figure II-10 and are listed below:

1. Mokuola (Coconut Island). This island and the area adjacent to it were formerly a "place of refuge." There is a heiau on the coast apposite Mokuola.
2. Maui's Canoe. This place is often mentioned in Hawaiian legends.
3. Puueo Hill. In ancient history, it was a place of battle and for playing ancient Hawaiian games.

The following is a list of historical sites as designated by the State Historic Preservation Officer:

1. Harbor Breakwater
2. Waianuenue School
3. Chinese Language School
4. Suisan Fish Market
5. Lilioukalani Park
6. Sousa House
7. T. Cook House
8. Stermemann House

TABLE II-4

EARTHQUAKES OF MAGNITUDE 5 OR GREATER - 1969 TO 1978

Date	Location	Magnitude (Richter Scale)
May 9, 1969	Hawaii	5
August 1, 1971	S.E. of Hawaii	4.5-5
December 23, 1972	W. of Kona	5
April 26, 1973	Hawaii	6.2
October 9, 1973	Hawaii	4.8-5
November 30, 1974	Hawaii	5.5-6
January 1, 1975		
2:41 am	Near Pahala, Hawaii	5.1
3:20 am	Mauna Loa, Hawaii	5.1
January 2, 1975	Near Pahala, Hawaii	5.6
January 5, 1975	Mauna Loa, Hawaii	5.1
November 29, 1975		
3:35 am	Puna, Hawaii	5.7
4:47 am	Puna, Hawaii	7.2

Source: Augustine S. Furumoto, N. Norby Nielsen, and William R. Philipps, A Study of Past Earthquakes, Isoseismic Zones of Intensity and Recommended Zones for Structural Design for Hawaii (University of Hawaii, Center for Engineering Research, June 15, 1972), pp. 16-19; Hawaii Institute of Geophysics, records. Complete to December 31, 1978.

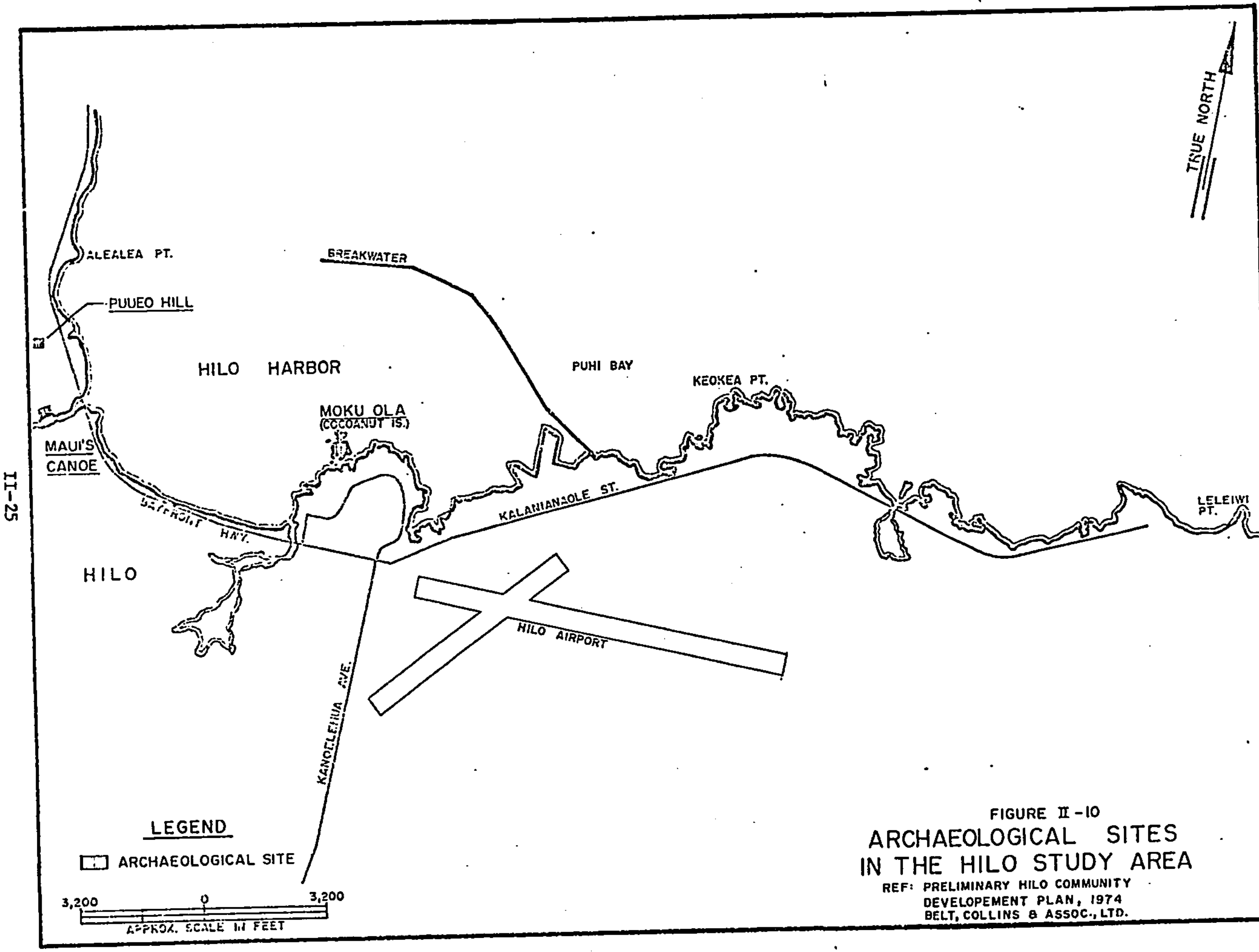


FIGURE II-10
ARCHAEOLOGICAL SITES IN THE HILO STUDY AREA
REF: PRELIMINARY HILO COMMUNITY DEVELOPEMENT PLAN, 1974 BELT, COLLINS & ASSOC., LTD.

9. Will House
10. Wylie House
11. Clock
12. Hilo Hospital
13. Villa Franca
14. Branco House
15. Osorio House
16. Kahaulopua Hosue
17. Ariale House
18. Perreira House
19. St. Joseph
20. St. Mary
21. Kuhio Memorial
22. United Comm. Church
23. Puueo
24. Miyamoto Store
25. Serrao House
26. Takaku House
27. Volcano Roads
28. Kamahele House
29. Honolii Stream Bridge
30. Various Hilo House

AIR QUALITY

The air quality in the Hilo area can be termed good. Records of the State Department of Health, Pollution Investigation and Enforcement Branch, indicate that particulate matter concentrations in the air average 34 micrograms per cubic meter (Hawaii State regulations require concentrations of particulate matter shall not exceed 55 micrograms per cubic meter of air) and concentrations of sulfur dioxide is less than 5 micrograms per cubic meter (Hawaii State regulations require concentrations of sulfur oxides shall not exceed 20 micrograms per cubic meter).

This quality of air in Hilo can be attributable to the absence of "heavy" industries in Hilo and the prevailing tradewinds.

BIRDS AND MAMMALS OF THE HILO AREA

As shown in Table II-5, the following birds and mammals are found in the Hilo area. This list is based on discussions with personnel of the Wildlife Branch, Division of Fish and Games, Department of Land and Natural Resources, State of Hawaii.

It is noted that the birds categorized as "endangered" are found in the uplands (cane field-forested areas) or in the marsh areas near the Waiakea, Kionakapuha and Lokoaka ponds. The only mammal currently found in the Hilo area that is categorized as "endangered" is the Hawaiian bat.

WETLANDS

According to the wetlands survey conducted by the U.S. Corps of Engineers, wetlands in the Hilo area are limited to the Lokoaka and Kionakapahu Ponds, located in the Keaukaha area, fronting the Pacific Ocean (see Figure II-11).

Marsh vegetation which occurs primarily on the edges of the ponds and in patches of wetland south of Loloaka Pond includes mainly of *Brachiaria mutica* with lesser abundance of *Commelina diffusa*, *Scirpus validus*, and *Cladium leptostachym*. Other plants found are listed in Table II-6.

TABLE II-5

BIRDS AND MAMMALS OF THE HILO AREA

Scientific Name	Common Name	Category	Description
Family PROCELLARIIDAE			
Puffinus pacificus chlororphynchus	Wedge-tailed shearwater	Not Endangered	Generally found in the cane field, forested areas, and wetlands
Pterodroma phaeophygia sandwichensis	Dark-rumped Petrel	Endangered	ditto
Family ARDEIDAE			
Nycticorax mycticorax hoactli	Black-crowned Night Heron	Not Endangered	ditto
Bubulcus ibis	Cattle Egret	Not Endangered	ditto
Family ANTIDAE			
Anas acuta	Pintail Duck	Not Endangered	Found near ponds of Waiakea, Kionakapuha and Lokoaka
Spatula clypeata	Shoveler	Not Endangered	ditto
Anas americana	American Widgeon	Not Endangered	ditto
Anas platyrhnchos	Mallard Duck	Not Endangered	ditto
Aythya affinis	Lesser Scaup	Not Endangered	ditto
Family ACCIPITRIDAE			
Buteo Solitarius	Hawaiian Hawk	Endangered	Generally found in cane fields and forested areas

Table II-5, Cont.

Scientific Name	Common Name	Category	Description
Family TYTONIDAE			
Tyto alba pratincola	Barn Owl	Not Endangered	Generally found throughout study area
Family COLUMBIDAE			
Streptopelia chinensis	Lace-necked Dove	Not Endangered	ditto
Geopelia striata	Barred Dove	Not Endangered	ditto
Family STRIGIDAE			
Asis flammeus	Hawaiian Short-earred Owl	Not Endangered	ditto
Family TIMALIIDAE			
Leiothrix lutea	Red-billed Leiothrix	Not Endangered	ditto
Family TURDIDAE			
Phaeornis obscurus	Hawaiian Thrush	Not Endangered	ditto
Family STURNIDAE			
Acridotheres tristis	Indian Mynah	Not Endangered	ditto
Family ZOSTEROPIDAE			
Zosterops japonica	White Eye	Not Endangered	ditto

Table II-5, Cont.

Scientific Name	Common Name	Category	Description
Family PHASIANIDAE			
Phasianus colchicus torquatus	Ring-necked Pheasant	Not Endangered	Generally found in cane fields and forested areas
Family RALLIDAE			
Gallinula chloropus sandwicensis	Hawaiian Gallinule	Endangered	Found near ponds of Waiakea, Kionakapuha and Lokoaka
Fulica americana alai	Hawaiian Coot	Endangered	ditto
Family CHARADRIIDAE			
Pluvialis dominica fulva	Pacific Golden Plover	Not Endangered	Same as Family ANATIDAE
Squatarola squatarola	Black-bellied Plover	Not Endangered	ditto
Arenaria interpres	Ruddy Turnstone	Not Endangered	ditto
Family SCOLOPACIDAE			
Heteroscelus brevipes	Wandering Tattler	Not Endangered	Found throughout area
Crocethia alba	Sanderling	Not Endangered	ditto

Table II-5, Cont.

Scientific Name	Common Name	Category	Description
Family FRINGILLIDAE			
Passer domesticus	English Sparrow	Not Endangered	Generally found throughout area
Lonchura punctulata	Ricebird	Not Endangered	ditto
Richmondena cardinalis	Cardinal	Not Endangered	ditto
Family VESPERTILIONIDAE			
Lasiurus cinereus semotus	Hawaiian bat	Endangered	ditto
Family MURIDAE			
Rattus rattus	Black rat	Not Endangered	ditto
Rattus norvegicus	Brown rat	Not Endangered	ditto
Rattus exulans hawaiiepsis	Hawaiian rat	Not Endangered	ditto
Mus musculus domesticus	House mouse	Not Endangered	ditto
Family CANIDAE			
Canis familiaris	Feral dog	Not Endangered	Generally found in the cane field and forest areas
Family VIVERRIDAE			
Herpestes auropunctatus	Feral pig	Not Endangered	ditto

Table II-5, Cont.

Scientific Name	Common Name	Category	Description
Family FELIDAE			
Felis catus	Feral cat	Not Endangered	Generally found in the cane field and forest areas
Family SUIDAE			
Sus scrofa	Feral pig	Not Endangered	ditto

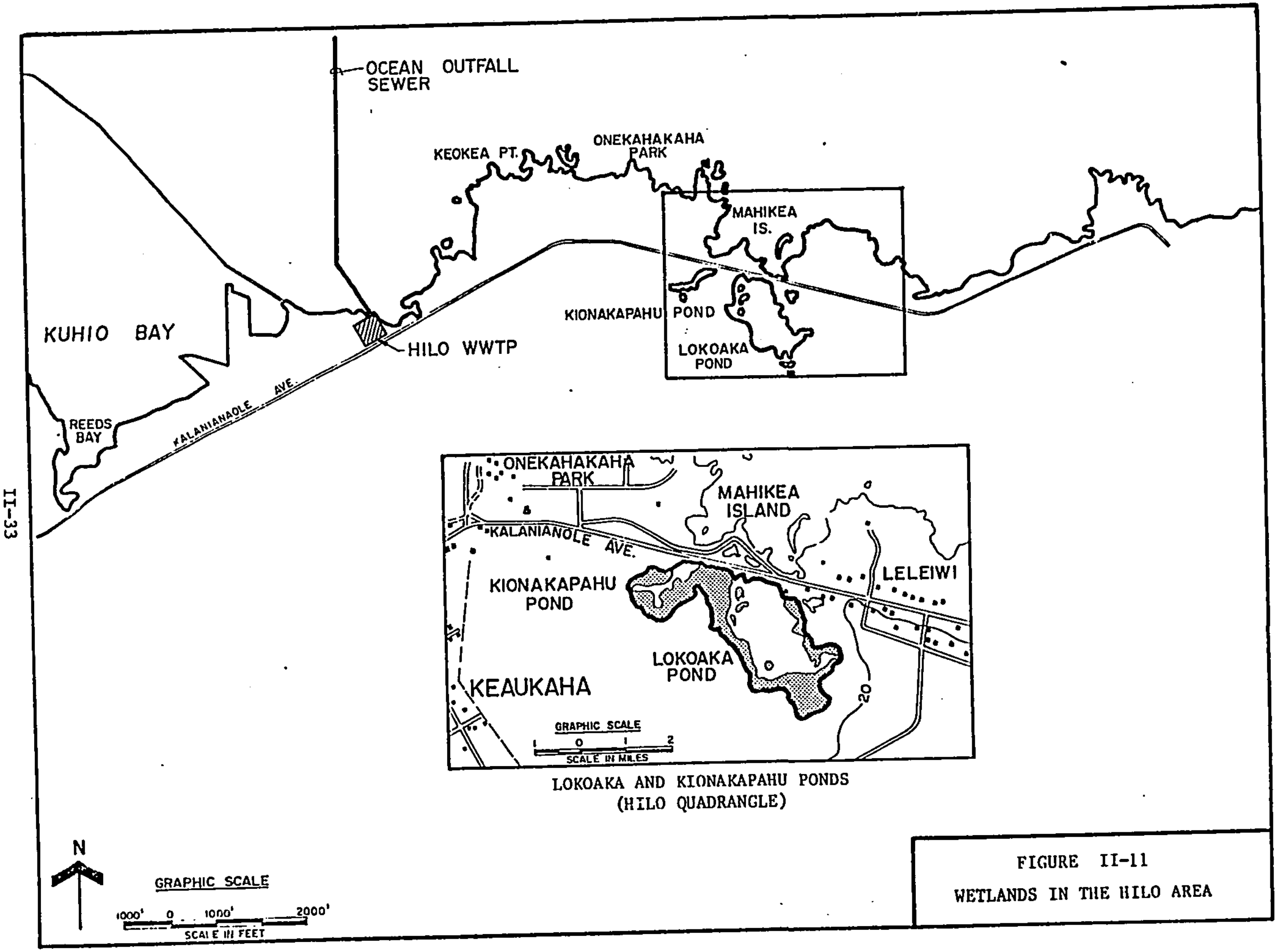


FIGURE II-11
WETLANDS IN THE HILO AREA

TABLE II-6

SPECIES LIST FOR LOKOAKA POND, HAWAII

		Cover	Abundance
FILICINAE			
PARKERIACEAE			
**Ceratopteris siliquosa	Swamp fern	1	R
POLYPODIACEAE			
Nephrolepis exaltata	Sword fern	1	R
SALVINIACEAE			
**Azolla filiculoides	Azolla	1	R
MONOCOTYLEDONAE			
COMMELINACEAE			
*Commelina diffusa	Honohono	1	O
CYPERACEAE			
**Cladium leptostachyum	Native sawgrass	1	O
**Cyperus papyrus	Papyrus	1	R
Cyperus polystachyus	--	1	R
**Scirpus validus	Great bulrush	1	O
GRAMINEAE			
*Brachiaria mutica	California grass	4	V
Cynodon dactylon	Bermuda grass	1	R
Oplismenus hirtellus	Basket grass	1	R
Paspalum conjugatum	Hilo grass	1	O
Paspalum orbiculare	Rice grass	1	O
Paspalum urvillei	Vasey grass	1	R
DICOTYLEDONAE			
ANACARDIACEAE			
Schinus terebinthifolius	Christmas berry	1	R
APOCYNACEAE			
Alyxia olivaeformis	Maile	1	R
ARALIACEAE			
Brassaia actinophylla	Octopus tree	1	R
COMPOSITAE			
*Pluchea odorata	Pluchea	1	R
LEGUMINOSAE			
Desmodium uncinatum	Spanish clover	1	O
LOBELIACEAE			
Laurentia longiflora	Star of Bethlehem	1	R

Table II-6, Cont.

		Cover	Abundance
MALVACEAE			
MALVACEAE			
*Hibiscus tiliaceus	Hau	2	O
MYRSINACEAE			
Ardisia humilis	Shoebutton ardisia	1	R
MYRTACEAE			
Eucalyptus robusta	Swamp mahogany	1	R
Psidium guajava	Guava	1	R
OXALIDACEAE			
Oxalis corniculata	Yellow wood sorrel	1	R
ROSACEAE			
Rubus rosaefolius	Thimbleberry	1	R
SCROPHULARIACEAE			
**Bacopa monnieria	Water hyssop	1	R
UMBELLIFERAE			
Centella asiatica	Asiatic pennywort	1	R
Hydrocotyle verticillata	Marsh pennywort	1	O

** Obligate species
 * Faculative species

1 = 5% cover; 2 = 5-25%; 3 = 26-50%; 4 = 51-75%; 5 = 76-100%

R = Rare; O = Occasional; F = Frequent; A = Abundant; V = Very abundant

Ref: U.S. Corps of Engineers

B. COASTAL WATER ENVIRONMENT

This section is devoted to describing the coastal water environment for Hilo Bay in terms of its water use classifications, known existing sources of pollutants, circulation characteristics, water quality, and marine biology. Portions of this discussion will be focused upon evaluating the environmental impacts of the existing Hilo STP sewage effluent disposal outfall.

The subject study area is shown on Figure II-12 along with the coastal water uses designated by the State Department of Health for the Hilo Bay area, herein defined as the area from Pepeekeo Point to Leleiwi Point. Hilo Harbor, an area within Hilo Bay, is the area shoreward of the breakwater.

According to the state's system of classifying water uses, the nearshore waters flanking Hilo Harbor are designated as Class A. The uses to be protected in these waters are recreational and aesthetic enjoyment. Hilo Harbor waters (Class B) are intended for small boat and aesthetic enjoyment uses and generally refer to those waters of Hilo Bay located within the breakwater. (See Appendix A for a description of the classification system.) Further, in accordance with EPA's National Pollutant Discharge Elimination System (NPDES), the waters south of Hilo from Leleiwi Point have been designated by state authorities as the Puna Eastern Effluent Segment #2; i.e., waters whose quality meets state standards now and will continue to meet them after implementation of the EPA requirement of "best practicable treatment." The nearshore waters immediately north of Hilo Harbor from Paukaa Point to Pepeekeo Point, however, are designated as the Hamakua Effluent Limitation Segment #1; i.e., waters that do not now meet state standards but will after "best practicable treatment" is implemented. Coast waters from Paukaa to Keokea Point are designated as water quality segments; i.e., coastal waters that do not now meet state standards and will not, even with "best practicable treatment."

The outfall for the Hilo Sewage Treatment Plant is located in Puhi Bay on the seaward side of the Hilo breakwater (Figure II-13). The first 2,600-foot portion of the 48-inch diameter reinforced concrete

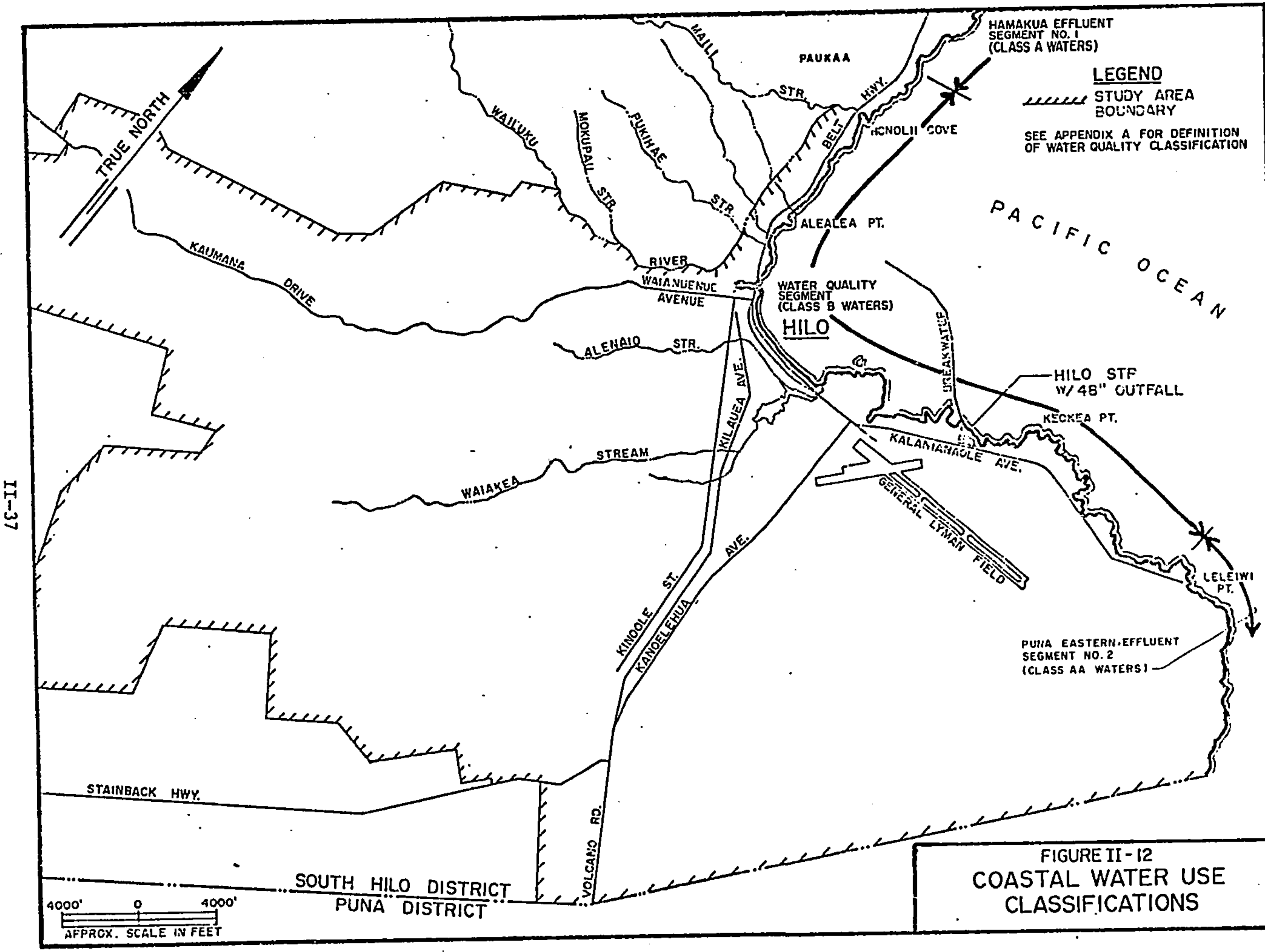


FIGURE II-12
COASTAL WATER USE
CLASSIFICATIONS

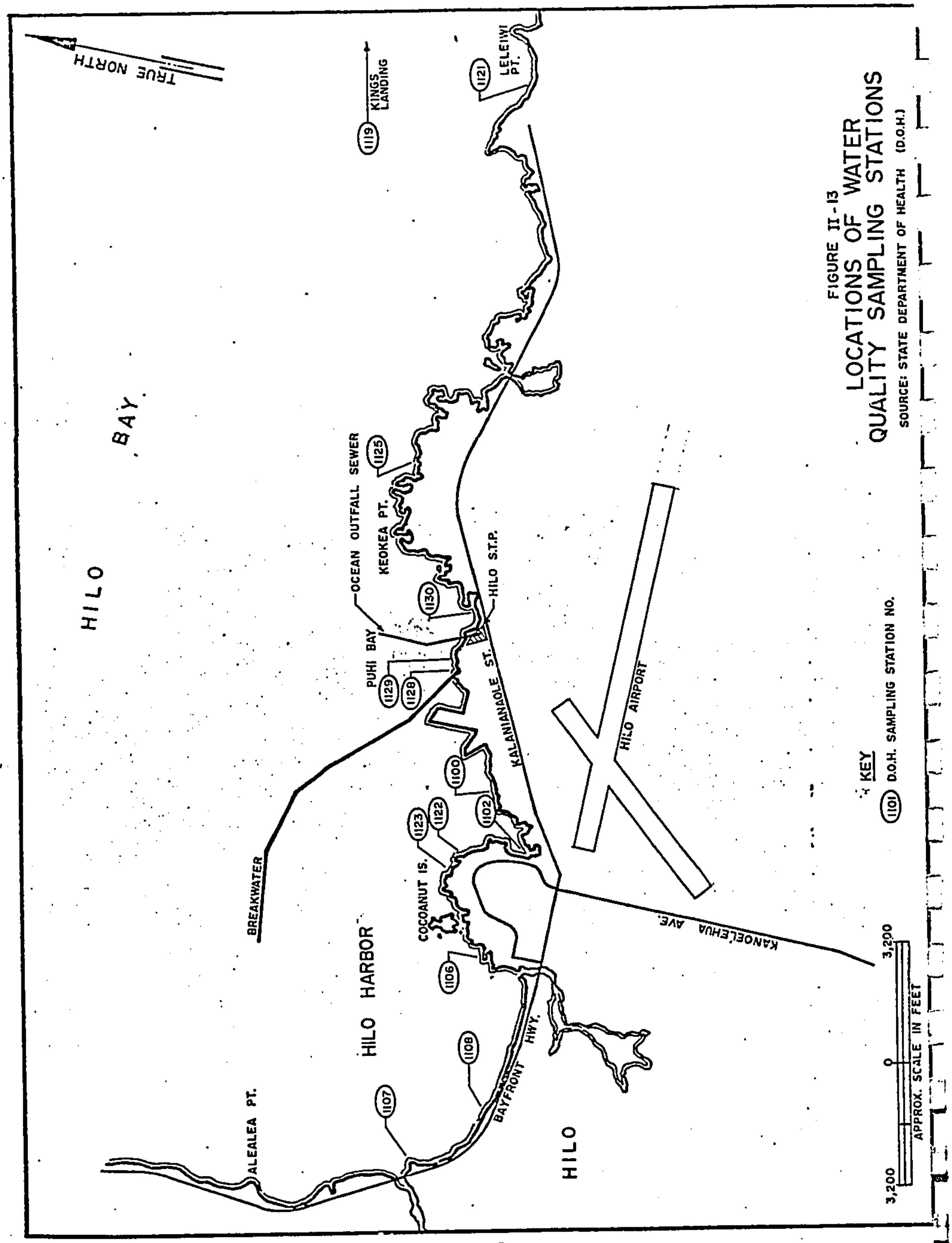


FIGURE II-13
LOCATIONS OF WATER QUALITY SAMPLING STATIONS
SOURCE: STATE DEPARTMENT OF HEALTH (D.O.H.)

outfall line was placed into operation in 1966 and discharged effluent in about 37 feet of water. A few years later the outfall was extended to about 4,500 feet offshore and discharged effluent at a depth of about 56 feet through a 210-foot diffuser section.

The location of the outfall allows direct exposure to tradewind-generated swells from the north. The area is not directly exposed to southerly swells.

SOURCES OF POLLUTANTS IN HILO BAY

Historically, the coastal water extending from Pepeekeo Point to Leleiwi Point has served as a sink for natural and man-related pollutants from numerous point and nonpoint sources along the coast. Since the turn of the century, these pollutant sources have included wastewater from sugarcane processing operations, a canec plant, surface runoff from agricultural lands, raw sewage discharges, periodic shipboard waste disposal in Hilo Harbor, cesspool overflow and leachate, and the thermal discharges of Hilo Electric Company into Wailoa River.

Over more recent years, efforts have been directed toward curbing these pollutant sources because of apparent adverse effects upon the coastal waters particularly within Hilo Harbor. In fact, the sanitary quality of Hilo Harbor (as indicated by consistently high coliform levels) was so poor prior to 1965 that the State Department of Health prohibited the use of these waters for swimming, recreational boating, and fishing for a number of years. With the cessation of the major raw sewage discharges into the Hilo Harbor area since 1965, however, the sanitary quality of Hilo Harbor waters has improved substantially (Neighbor Island Consultants, 1973, and Chan et al. 1971).

Point Sources

At present, the major point source of pollutants entering Hilo Bay is the county's municipal treatment plant at Puhi Bay. Previously, processing waters from sugar mills were also discharged into the coastal waters. The Hilo Electric Company's thermal discharge (i.e., condenser cooling waters) of about 28 mgd into Wailoa River can also be included with these point sources, although its actual pollutant loads may be relatively small.

The practice of disposing of sugar mill wastes into Hilo Bay has had serious ecological effects over the years (EPA, 1971). However, current regulatory controls aimed at curtailing this practice of ocean disposal of mill processing waste are effectively reducing this source of pollutants in Hilo Bay. Today, only the Pepeekeo sugar mill is in operation along the northern coastline. (This mill is located approximately 8 miles north of the entrance of Hilo Harbor.) The sugar mill is expected to achieve "zero discharge" of its wastes into coastal waters in the near future (State Department of Health, personal communication). Up to 1977, the sugar mill at Papaikou was in operation and discharged its processing waters into the coastal waters.

The implementation of the Hilo municipal sewage treatment plant in 1966 eliminated the major raw sewage discharges and their attendant detrimental effects in Hilo Harbor. This facility has a design capacity of 7.0 mgd. At present, it is discharging approximately 3 mgd of primary-treated chlorinated effluent through a 48-inch, 4,500-foot long ocean outfall (offshore of Puhi Bay) at a depth of 56 feet.

Nonpoint Sources

For Hilo Bay, the two important nonpoint sources of pollutants are surface runoff from agricultural lands and subsurface discharges of pollutants from cesspools entering the bay through large groundwater influxes. It is interesting to note that these two types of sources can also be geographically separated due to the hydrogeological characteristics of the Hilo Bay area (see chapter on Physical Environment).

The primary surface sources are the Wailuku River and other streams to its north that drain agricultural runoff into Hilo Bay. It should be noted that these sources (via Wailuku River) previously received pollutants from household sewage and other types of discharges. In comparison, urban runoff has been found to be relatively insignificant in the area north of the Wailuku River.

In the area south of the Wailuku River, the leachate from subsurface (i.e., cesspool) sewage disposal systems is a significant nonpoint source. The highly permeable geology of this area (south of Wailuku River) appears to allow the transmissibility of pollutants in the groundwater. Recent water quality monitoring results (April and June, 1977) indicate that Class B standards for coliforms, total nitrogen, and total phosphorus are frequently exceeded in the vicinities of some of these subsurface discharges (i.e., Wailoa River, Reeds Bay, and the area adjacent to the commercial port) (unpublished data, U.S. Army Corps of Engineers). In addition, dye tracking studies conducted by the State Department of Health confirm that leachate from cesspools is seeping into the Waikele Stream near Kilauea Street.

EXISTING DATA ON HILO BAY

Water Quality Data

Water quality data, collected by the State Department of Health (DOH) as part of monitoring investigations, are compiled in Appendix B for inspection. (See Figure II-13 for sampling locations.) All sampling stations are limited to the shoreline; therefore, the results generally indicate the influence of terrestrial elements and are not representative of the nearshore water characteristics.

Past Investigation of Hilo Harbor

The most comprehensive environmental investigation of Hilo Bay was conducted by Neighbor Island Consultants in 1973 under the auspices of the Corps of Engineers, Department of the Army. The extent of the study, however, was limited to areas shoreward of the breakwater (referred to hereafter as Hilo Harbor). Although the interest of this report is focused on the waters seaward of the breakwater, the results of the study by Neighbor Island Consultants are included herein to provide insight into the overall condition of the bay and the interactions between the various water segments within the bay.

Currents. Hilo Harbor is characterized by a two-cell upper layer (approximately six feet thick) circulation pattern, with the convergence area being the end of the breakwater and Cocoanut Island. The eastern cell (Blonde Reef-Kuhio Bay) circulates clockwise; the western cell, counterclockwise.

This study also concluded that the net outflow from Hilo Harbor is seaward, with the substantial flows from the Wailuku River and springs along the eastern shoreline of the bay playing an integral part in the circulation system. This is substantiated in the Study of Dispersion in Hilo Bay, Hawaii, by the U.S. Public Health Service (1963) in the observance that "cane trash discharged by the sugar mills just north of Hilo has often been observed to travel in a southerly direction along the coast, yet this material usually does not enter Hilo Bay but is swept seaward before reaching the bay entrance."

Movement of the deep layer in Hilo Harbor indicated a seaward outflow in the western portion of the bay. In the eastern portion, however, only a vacillating movement of drogues was observed.

Physical and Biological Characteristics (see Table II-7).

Salinity. Salinity measurements generally indicated low salinity near the shoreline near Wailoa River and Kuhio Bay, attributable to spring flows. Salinity readings increased to that of seawater as distance from the shoreline increased. It was noted that a "skin" layer of fresh water existed over the majority of the eastern cell.

Dissolved Oxygen. Dissolved oxygen (DO) levels were generally greater than 4.5 mg/l. Dissolved oxygen readings provided further credence to the two-layered structure in Hilo Harbor with high DO readings at the three- to four-meter depth.

Nutrients. Results of a single day's sampling indicated that the average phosphorus concentration within the eastern portion of Hilo Harbor was 0.06 mg/l, with variations from 0.028 mg/l to 0.234 mg/l. The higher readings were noted at sample points near the shoreline. Average nitrate concentrations in eastern Hilo Harbor varied from 0.0003 mg/l to 0.507 mg/l, with an average of 0.132 mg/l.

Nutrient concentrations in western Hilo Harbor were low compared to those found in the eastern portion.

Chlorophyll-a. Concentrations of chlorophyll-a provide an indication of the plant productivity in a water body. Measurements of 4.5 mg/m^3 of chlorophyll-a in eastern Hilo Harbor were recorded. When

TABLE II-7

WATER QUALITY DATA IN HILO HARBOR*

(July to August 1972)

Parameter	Mean	Standard Deviation	Range
1. Salinity (parts per thousand)			
Surface	19.2	4.9	6.8-29.8
Two Meters	29.9	1.9	23.7-33.4
Three Meters	31.6	1.8	28.5-33.7
Five Meters	32.5	2.0	29.0-34.0
2. Temperature (°C): Surface	24.8	1.1	22.0-26.1
3. Dissolved Oxygen (ppm)			
Surface	7.5	1.0	5.9-9.3
Five Meters	7.4	0.5	7.0-8.1
Seven Meters	7.3	0.4	7.0-7.6
Dissolved Oxygen (mg/l)			
Surface	5.0	0.7	3.2-7.9
Bottom	3.9	0.7	2.0-5.6
4. Turbidity (secchi disc) Meters Depth to Disappearance	3.9	0.7	1.5-4.3 (clear to bottom)
5. Total Phosphorus (mg/l)	0.059	0.054	.028-.234
6. Nitrites (mg/l) as N	0.002	0.0007	.001-.003
7. Nitrates (mg/l) as N	0.132	0.15	.0002-.507
8. Chlorophyll-a (mg/m^3)	4.47	1.72	1.66-7.35

* Means of ten stations in Hilo Harbor as calculated by the U.S. Army Corps of Engineers.

Source: Neighbor Island Consultants, "Baseline Environmental Investigation of Hilo Harbor," March 1973.

compared with data from other investigations on isolated Pacific atoll lagoons (chlorophyll-a values range from 0.17 to 0.33 mg/m^3) and relatively productive Kaneohe Bay (0.925 mg/m^3), results indicate an order of magnitude increase over that of Kaneohe Bay and almost two orders of magnitude above those of the atoll lagoons.

CIRCULATION IN HILO BAY

The data available to describe circulation, stratification, and mixing in Hilo Bay are primarily the results of oceanographic studies initiated by the County of Hawaii to evaluate the environmental impact of discharging primary-treated sewage effluent through its sewer outfall offshore off Puhi Bay. These data consist of drogue measurements, salinity-temperature profiles, and dye dispersion data. Supplemental data are also available from investigations conducted within Hilo Harbor (Neighbor Island Consultants, 1973, and unpublished data, U.S. Army Corps of Engineers).

Drogue Measurements

The first drogue study was conducted by the firm of Sunn, Low, Tom & Hara, Inc. (1963) in May 1963, prior to construction of the outfall. This study investigated the current pattern within Puhi Bay. The following summary statement was made in the study report.

> "From these limited studies, it was surmised that there is a continuous flushing of the Puhi Bay waters. At rising tide, a northeasterly surface current flow outward and around Keokea Point is indicated. At ebbing tide, a northwesterly surface current flow outward and around the breakwater is evident. At slack water period, high or low tidal stages, the currents may flow inward toward the shore lines, but at reduced velocities generally less than 10 fpm."

The drogues used in the 1963 study were primarily surface drogues, with a few "deep" drogues at a depth of about 15 feet. The release points at 1,000 and 2,000 feet offshore were well within the embayment, as defined by a line from Keokea Point to the northernmost point of the breakwater. These release points are also shoreward of the present diffuser location. The wind direction varied from the northwest to the northeast during the 1963 study.

The general tide-related current structure just outside of Hilo Bay (as defined by a line from Leleiwi Point to Pepeekeo Point) is indicated by the Hawaii Institute of Geophysics in The Atlas of Hawaii (University of Hawaii Press, 1973) to be toward the northwest under both flood and ebb conditions. A counterclockwise ebb-related current is also shown to occur within Hilo Bay.

In May 1975, a preliminary five-day dilution zone study of the Hilo outfall was conducted as part of the investigation of the Hilo Facilities Plan. Subsequent to the study (over the period September 1976 to June 1977), four week-long field investigations were conducted by Sunn, Low, Tom & Hara, Inc. to supplement the existing data for the Hilo Facilities Plan. The data from these field trips were used to formulate the following discussions.

General Current Patterns. Circulation in Hilo Bay is influenced by the north equatorial and tide-related currents, winds, and freshwater influxes, as well as wave-induced currents near the surf zone.

Surface transport is primarily governed by the effects of winds and the generally seaward-moving freshwater superimposed upon tide-related currents. Naturally, the velocities of these surface currents are variable depending on prevailing wind and seasonal conditions and locality.

The effect of the freshwater lens "floating" on the denser seawater is well exhibited in certain areas. Along the mouth of Hilo Harbor, for instance, the surface layer has been observed to move continuously outward due to the vast amount of freshwater that continuously enters Hilo Harbor from both surface and groundwater sources (Neighbor Island Consultants, 1973, and unpublished data, U.S. Army Corps of Engineers). A similar phenomenon was observed in Puhi Bay, where a large groundwater discharge exists (SLTH, 1963.)

Table II-8 is a statistical summary of drogue speeds measured in the vicinity of the outfall diffuser at various depths. As would be expected, current speeds were observed to decrease with depth. The mean

TABLE II-8

STATISTICAL SUMMARY OF DROGUE SPEEDS
IN THE VICINITY OF THE DIFFUSER

Drogue Depth (feet)	Number of Measurements	Median Velocity (knots)	Mean Velocity (knots)	Standard Deviation (knots)	Coefficient of Variation (%)	Range (knots)
Surface	25	0.30	0.33	0.19	58	0.05 - 0.79
10	16	0.12	0.13	0.07	54	0.03 - 0.29
15	14	0.10	0.10	0.06	60	0.03 - 0.24
30	28	0.10	0.09	0.04	44	0.02 - 0.16

speed for surface transport was found to be 0.33 kts and that for the 30-foot depth was 0.09 kts. The mid-depth speeds for 10 and 15 feet were 0.13 and 0.10 kts respectively.

The slower subsurface transport appears to exhibit the combined effects of tide-related currents and bathymetry. While a well-defined, tide-related current pattern is not clearly discernible, the drogue data (see Appendix D) do indicate that the predominant direction of subsurface (10 feet and deeper) transport is from east to west and along Blonde Reef. At times, there also appears to be a reversal in direction. Unfortunately, the drogue results do not yield a better description of this reversal, although indications are that this phenomenon is not strictly tide-related.

The general current pattern in the area of the Hilo STP outfall is indicated on Figure II-14. The wind rose for the nearby airport is given on Figure II-2. Most frequently, the sewage field will move in a westerly direction, both at the surface and subsurface. Less frequently, the subsurface portion of the field will move easterly, while the surface will be reflected toward the northeast, as illustrated by the drogue pattern on May 21, 1975 (see Appendix D).

About 20 percent of the time, wind stress in the area is in a southerly direction and, hence, would deflect the surface portion of the sewage field directly toward the Puhi Bay area. The depth of this surface portion is estimated to be one to two feet, except when the wind is steady for a long duration, in which case the depth may be greater. It should be noted, however, that the large continuous discharge of freshwater from Puhi Bay would serve to retard this shoreward transport to some, as yet unknown, extent.

STRATIFICATION IN HILO BAY

Vertical stratification in Hilo Bay waters is caused by large freshwater influxes (estimated to total over 400 million gallons per day) from surface and subsurface sources along its coast. This phenomenon is an important aspect of circulation since it is intimately related to vertical mixing and horizontal dispersion (hence, mass exchange).

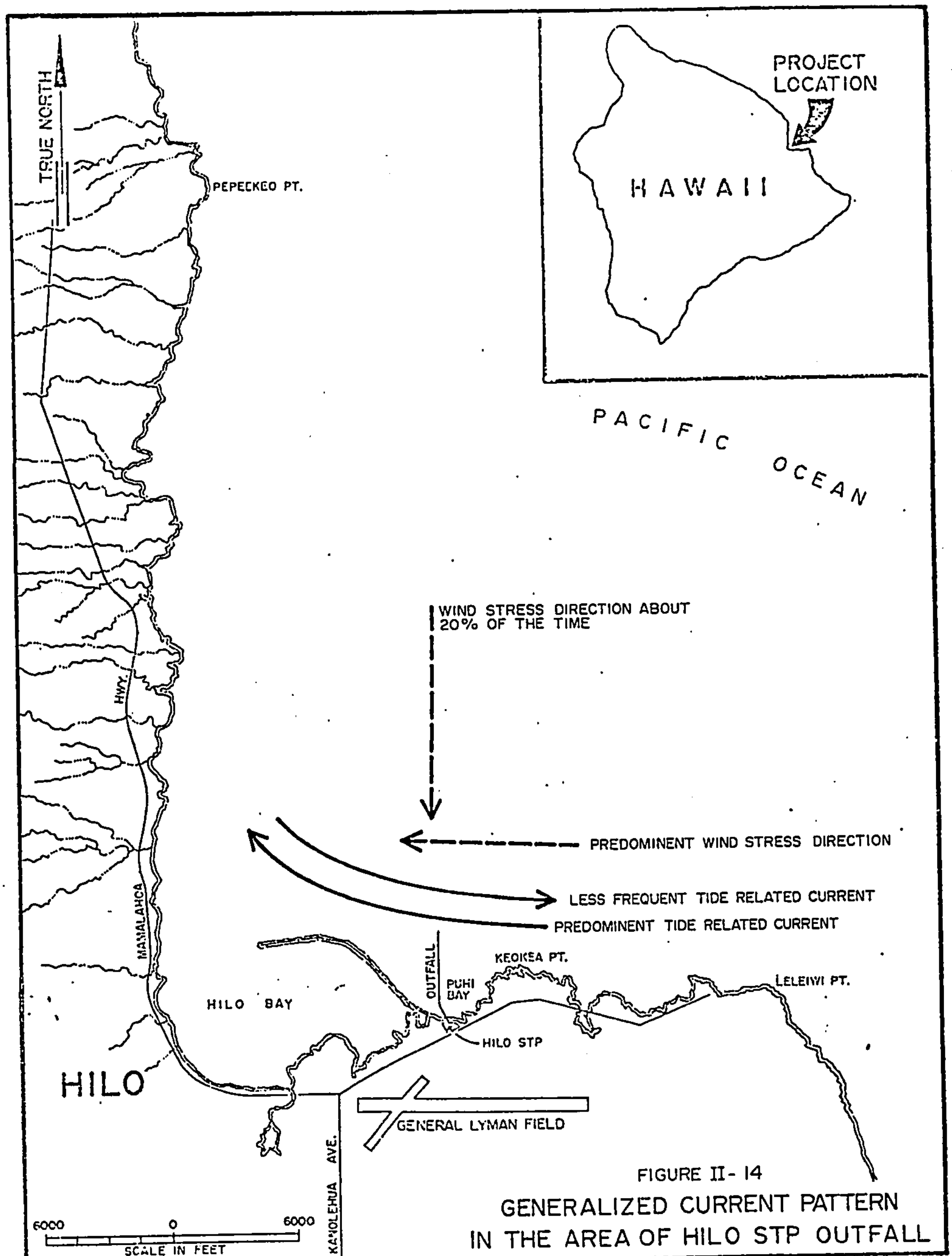


FIGURE II- 14

GENERALIZED CURRENT PATTERN IN THE AREA OF HILO STP OUTFALL

To identify the extent of freshwater influences in Hilo Bay, vertical measurements of salinity and temperature were gathered as part of the field investigations. Salinity-temperature profiles plotted from data collected on three different occasions are presented in Appendix C.

The variable extent of stratification (both temporally and spatially) is clearly illustrated by these profiles. Naturally, the surface layer is most well defined near the major freshwater sources (e.g., along the mouth of Hilo Harbor and at Puhi Bay). Proceeding seaward, the salinity and temperature gradients are observed to diminish as mixing (depending primarily on available wind energy) occurs.

The depth of the freshwater influence in Hilo Bay appears to generally vary with season (wind and freshwater influx). This depth was observed to range from about 10 to 30 feet. At times, it is suspected that strong winds may extend this surface layer to even greater depths. The profiles for April 12, 1977 are representative of typical wet weather conditions in Hilo and indicate the extensiveness of stratification.

Within Hilo Harbor, stratification has been found to be a year-round phenomenon due to its proximity to continuous freshwater discharges (Neighbor Island Consultants, 1973, and unpublished data, U.S. Army Corps of Engineers). Of course, the surface layer is much better defined in the harbor area.

A review of aerial photographs of Hilo Bay has also disclosed that exchange at the surface along the open mouth of the bay is restricted at times. This information and the fact that significant stratification appears to extend out to the bay mouth, at least at times, pose an interesting question; namely, identifying the mechanism responsible for restricting exchange with the open area. While it is suspected that wind and freshwater inputs play major roles in this scheme, the actual mechanics of this observed condition are not presently understood.

WATER QUALITY CHARACTERISTICS OF HILO BAY

The historical water quality data base for Hilo Bay can be described as generally lacking. The existing data are primarily the result of investigations conducted within Hilo Harbor (i.e., within the breakwater) by Neighbor Island Consultants (1973) and Chan et al. (1971). It is therefore not surprising to find that the only data available for assessing ambient water quality conditions outside of Hilo Harbor are the result of field investigations initiated by the County of Hawaii and performed by the firm of Sunn, Low, Tom & Hara, Inc. to evaluate the environmental impact of the effluent discharge from the existing Hilo STP outfall.

The first of these investigations was conducted in May 1975 as a preliminary study. Subsequently (since September 1976), four sets of water quality data have been gathered. These data are contained in Appendix E and were used in formulating the following discussion. The sampling locations established for this area are shown on Figure II-15.

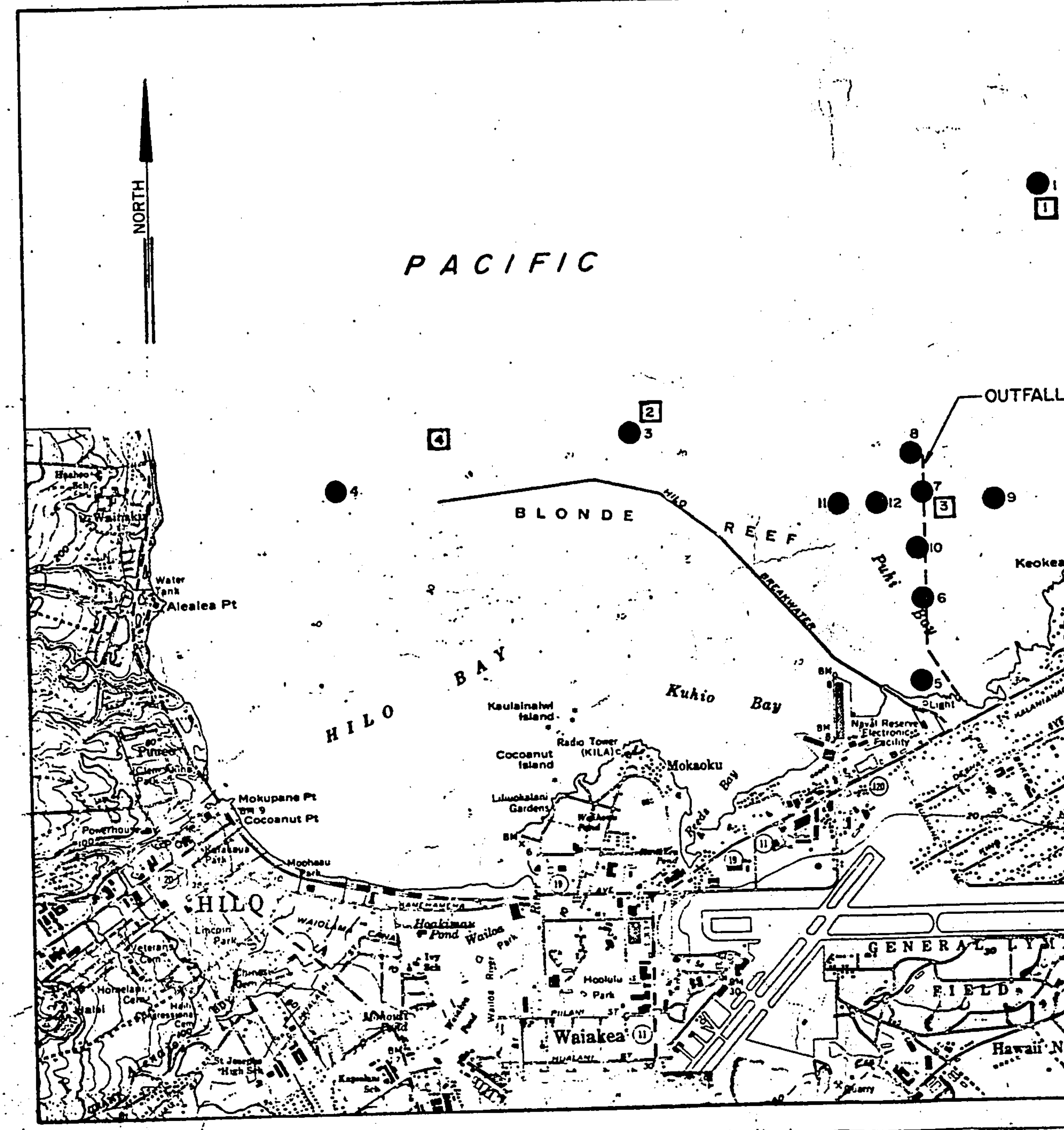
Physical Parameters

The pH levels measured (8.2 to 8.4) were typical of seawater levels found in Hawaiian waters. The slight variations found are within the limits of natural variability and those of instrument precision. The State Water Quality Standards states that the pH should not deviate more than 0.5 units from natural conditions, but not lower than 7.0 nor higher than 8.5 from other than natural causes.

As discussed previously, salinity and temperature measurements revealed the influence of the large freshwater influx into Hilo Bay. At times, the stratification caused by the freshwater was found to extend beyond Station No. 1 (open sea control) and to depths of 20 to 30 feet.

The turbidity and suspended solids (TSS) data are consistent with the observed turbid conditions in Hilo Bay. Turbidity measurements ranged from 0.3 to 1.3 NTU (for all stations) with a mean of 0.6 NTU. Turbidity in open coastal waters around Hawaii is, on the average, about 0.3 NTU (unpublished SLTH data). Diver observations during the first three field trips further disclose that turbid conditions were most evident in a surface layer that ranged from 10 to 20 feet in depth. Below the surface layer, underwater visibility was found to improve.

In contrast, water clarity during June 1977 was found to have improved substantially over what was found during previous trips. These



NORTH
PACIFIC
OUTFALL
1
2
3
4
5
6
7
8
9
10
11
12
BLONDE REEF
HILO BREAKWATER
Puhi Bay
Keokea
HILO BAY
Kuhio Bay
Reeds Bay
Kaulainahee Island
Cocoanut Island
Radio Tower (KILA)
Mokaoku
Liliuokalani Gardens
Naval Reserve Electronic Facility
Light
Waiakea Pond
Alealea Pt
Water Tank
Waiakea
Puueo
Mokupane Pt
Cocoanut Pt
Powerhouse
Mooheau Park
HILO
Lincoln Park
Veterans Cem
Hookiinau Pond
Wailoa Park
Hoolulu Park
Waiakea
GENERAL LYMAN
FIELD
Hawaii N

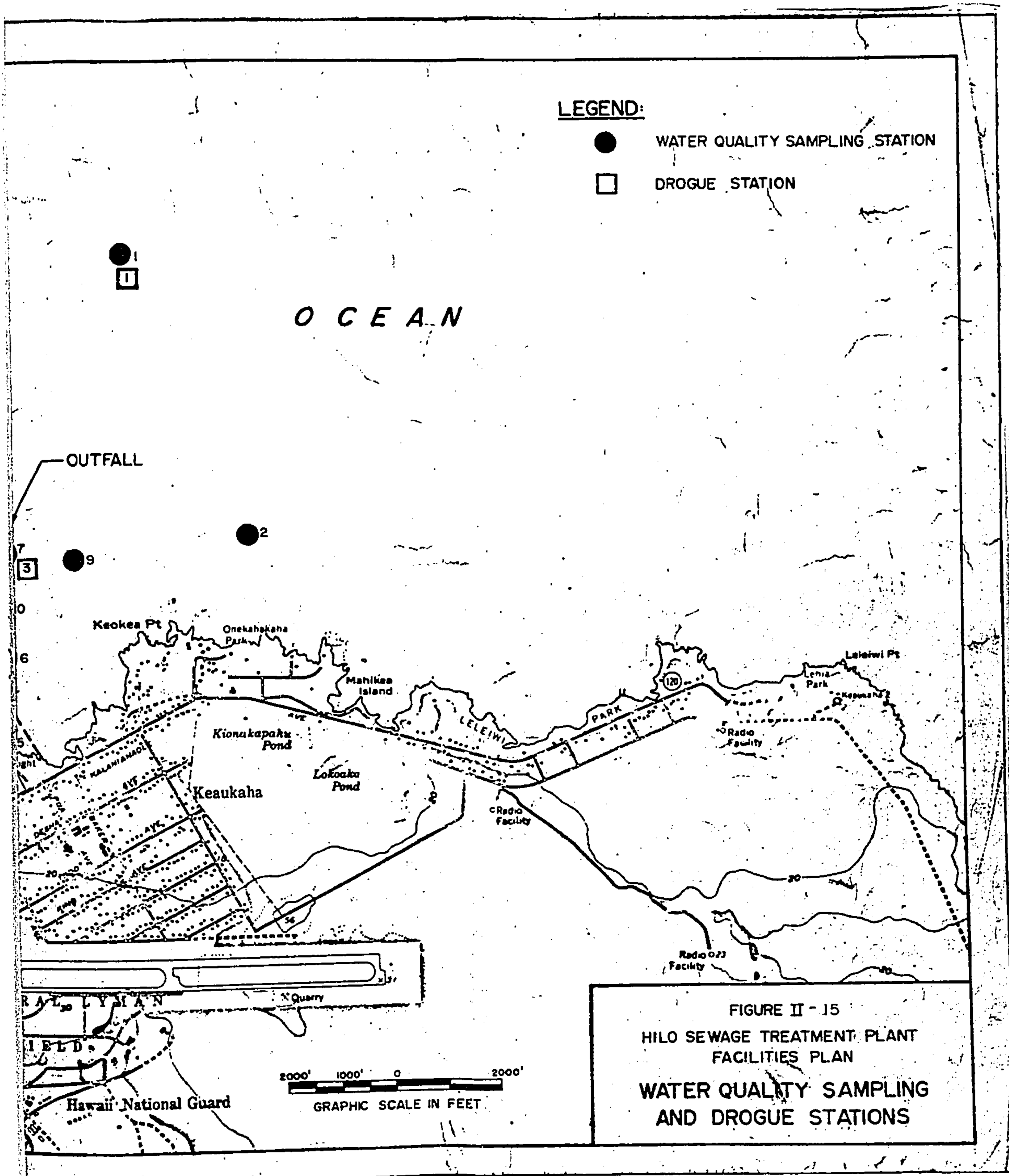


FIGURE II - 15
HILO SEWAGE TREATMENT PLANT FACILITIES PLAN
WATER QUALITY SAMPLING AND DROGUE STATIONS

observations indicate that turbidity in Hilo Bay may be season-related phenomenon and, possibly, one that reflects the apparent restricted exchange, at times, of bay waters with the open ocean.

Dissolved Oxygen

The dissolved oxygen (DO) measurements have been summarized and are presented in Table II-9. As is evident upon reviewing this table, DO levels in Hilo Bay were found to be very high during daylight hours and often measured at supersaturation levels due to the synthesis of oxygen by photosynthetic plant organisms (i.e., phytoplankton).

Nutrients

Table II-10 is a summary of the nutrient (i.e., total nitrogen and total phosphorus) data gathered. For purposes of discussion, similar values for chlorophyll-a (a measure of the abundance, on standing crop, of phytoplankton) are included in this table.

As shown in Table II-10, the levels of total nitrogen in Hilo Bay were frequently found to be in exceedence of the currently applicable State Department of Health Class A water use standard of 150 ug/l. It is important to note, however, that these relatively high levels were found at all stations. Only slightly higher levels measured at the Hilo STP outfall discharge site (Station No. 7) appear to indicate that the relative impact of this effluent disposal practice upon Hilo Bay is insignificant. These findings thus indicate that the major contributors of nitrogen in Hilo Bay are point and nonpoint sources other than discharge from Hilo STP.

On the average, total nitrogen levels in open coastal waters around Hawaii have been estimated to be about 100 ug/l (unpublished SLTH data). The substantially higher levels found in Hilo Bay appear to be another indication of restricted exchange, at least at times, with pristine ocean waters along the open mouth of the bay.

Total phosphorus levels, unlike those of nitrogen, were found to be within the State Department of Health Class A standard of 25 ug/l. Even the data collected over the outfall discharge site were found to be

TABLE II-9

SUMMARY OF DISSOLVED OXYGEN MEASUREMENTS[1]

Station No.	Station Description	Mean (mg/1)	Range[2] (mg/1)	% DO Saturation Range
1	Control	7.2	6.5-7.0	97-100
2	Control	7.2	6.5-6.9	96-100
3	Breakwater	7.4	6.4-7.6	96-109
4	Mouth of Hilo Harbor	7.7	6.3-8.2	94-119
5	Nearshore	7.1	6.6-7.0	93-101
6	Midway to Shore	7.1	6.2-7.2	93-101
7	Break in Outfall[3]	6.8	5.2-7.7	76-110
8	Diffuser	7.7	7.2-7.5	101-112
9	Zone of Mixing	6.8	6.4-6.8	90-96
10	Zone of Mixing	6.9	6.4-6.9	90-101
11	Zone of Mixing	7.1	6.1-7.4	90-106
12	Zone of Mixing	7.0	5.9-7.4	87-106

(1) All measurement taken at 5-foot depth.
(2) Range of four measurements.
(3) Repaired in May 1977.

TABLE II-10

SUMMARY OF NUTRIENT AND CHLOROPHYLL-a DATA[(1)]

	Total Nitrogen (ug/l as N)	Total Phosphorus (ug/l as P)	Chl-a (mg/M^3)
Class A Standards	150	25	-
Station No. (depth, feet)			
1(5)	256	15	1.13
1(30	321	14	1.06
2(5)	270	14	1.47
2(30)	268	18	1.26
3(5)	247	20	1.21
3(30)	283	24	0.96
4(5)	293	21	2.00
4(30)	351	21	1.78
5(5)	319	20	1.74
5(15)	289	14	0.64
6(5)	305	19	2.22
6(30)	188	17	1.09
7(5)	391	24	1.20
7(30)	250	16	1.24
8(5)	217	16	1.73
8(30)	214	18	1.05
9(5)	207	16	1.59
9(30)	201	13	1.09
10(5)	168	16	1.12
10(30)	204	14	0.99
11(5)	168	16	0.78
11(30)	234	20	0.86
12(5)	240	20	1.20
12(30)	196	19	1.16

(1) Mean values of four sets of data.

typically within the standard and only slightly higher than background levels.

The chlorophyll-a data parallel the nitrogen levels found. The levels of phytoplankton abundance are substantially higher than those of open coastal areas in Hawaii that are, on the average, about 0.15 mg/M^3 (unpublished SLTH data). They are also comparable to the levels found during the dry season in the south sector of Kaneohe Bay (Oahu) from 1970 to 1973 (SLTH, 1976).

These high levels of chlorophyll-a are also indicative of enriched conditions in Hilo Bay and may be responsible, in part, for the relatively high turbidity found in bay waters.

Sanitary Quality

Bacteriological tests for total and fecal coliforms were performed at each water quality station to monitor the sanitary quality of Hilo Bay waters. Table II-11 is a summary of these data.

While the data gathered exhibited considerable variability, the levels found, particularly in the vicinity of the outfall, were generally low and well within the Class A standards (i.e., a median of 1,000 organisms/100 ml for total coliform and a mean of 200 organisms/100 ml for fecal coliform). There low coliform levels at and around the treated effluent discharge site are an indication of the effective disinfection achieved by chlorination at the Hilo STP.

It should be noted that, although only at low levels, both total and fecal coliforms were also found at control Station No. 2. This finding is an indication that sources other than the Hilo STP outfall are also discharging enteric bacteria into Hilo Bay.

The sanitary quality of Hilo Harbor waters (area shoreward of the breakwater) was also monitored on two different days in April 1977 as part of the Hilo Area Comprehensive Study (unpublished data, U.S. Army Corps of Engineers). The parameters measured were fecal coliform and fecal strep and did not include total coliform. Nevertheless, the data collected at certain stations are presented below (Table II-12) to generally indicate the poorer sanitary quality of the harbor waters compared to the waters outside of the breakwater.

TABLE II-11

SUMMARY OF TOTAL AND FECAL COLIFORM DATA(1)

Station No.	Station Description	Total Coliform (No./100 ml)	Fecal Coliform (No./100 ml)
1	Control	6	3
2	Control	15	2
3	Breakwater	7	2
4	Mouth of Hilo Harbor	33	2
5	Nearshore	2	2
6	Midway to Shore	24	2
7	Break in Outfall(2)	56	2
8	Diffuser	536	20
9	Zone of Mixing	5	2
10	Zone of Mixing	73	2
11	Zone of Mixing	57	2
12	Zone of Mixing	467	2

(1) Mean values for the first three sets of data. The data for June 8, 1977 were not representative of typical conditions due to a malfunctioning chlorinator at Hilo STP. This set of coliform data can be found in Appendix F.

Note: Coliform data taken from surface sample only.

TABLE II-12

SANITARY QUALITY OF HILO HARBOR WATERS

Location	Fecal Coliform (#/100 ml) April 1	Fecal Coliform (#/100 ml) April 5	Fecal Strep (#/100 ml) April 1	Fecal Strep (#/100 ml) April 5
Wailuku River	560	50	8,400	11,600
Wailoa River	10	4	330	670
Ice Pond	300	320	440	3,800
Reeds Bay	206	2	660	2
Commercial Port	24	2	740	2
Hilo Harbor Mouth	10	8	80	50

As illustrated in Table II-12, certain areas in the harbor (viz., Wailuku River, Wailoa River, and Ice Pond) appear to receive enteric bacteria from continuous sources, while others (viz., the commercial port area and Reeds Bay) appear to be affected by periodic discharges (e.g., shipboard wastes). The continuous surface outflow at the harbor mouth appears to be a steady source of these enteric bacteria for outer bay waters.

As part of the field investigations, the T-90 die-off rate for coliform bacteria (i.e., the time it takes for 90 percent of the coliform bacteria to die) in Hilo Bay waters was also determined on two separate occasions. The results of these field tests were 17 and 23 minutes and are comparable to similar data gathered for other Hawaiian coastal areas. For design purposes, it appears reasonable to apply a conservative estimate of 30 minutes for the T-90 coliform die-off rate in Hilo Bay waters.

Toxic Substances

To investigate the presence of toxic substances in Hilo Bay, water and sediment samples were collected and analyzed for heavy metals and pesticides (i.e., chlorinated hydrocarbons). The results of these analyses are shown in Table II-13.

TABLE II-13

HEAVY METAL CONCENTRATIONS IN HILO BAY WATERS

Heavy Metal	Control (Sta. No. 1)	Breakwater (Sta. No. 3)	Outfall Discharge (Sta. No. 7)
Nickel	0.03	0.04	0.07
Copper	0.05	0.04	0.02
Chromium	0.06	0.02	0.02
Zinc	0.13	0.03	0.11
Cadmium	0.002	0.002	0.002
Mercury	0.0002	0.0002	0.0002

Note: All samples were collected at the five-foot depth. All units are expressed in mg/l.

All of the above heavy metal concentrations are near the detectable limits of the analytical procedures used.

As shown in Table II-13, the concentrations of metals found in the samples taken over the outfall discharge are equal to or less than the concentrations of metals found at the "control" station, with the exception of nickel. This is anticipated since the concentration of metals in the effluent from the Hilo facility is also low (see Table II-14).

Metal concentrations in the sediment are reported in Table II-15. While the values of metal concentrations in the sediment near the discharge site are higher than those at the breakwater site, these values are lower than those found in so-called pristine areas (Kahana Bay). Furthermore, published data by the State Department of Health on concentrations of trace metals in sediment from various embayments in the state indicate significantly higher values for Hilo Harbor (shoreward of the breakwater). This can be be primarily attributable to the poor circulation character of the harbor.

TABLE II-14

WASTEWATER CHARACTERISTICS OF HILO TREATMENT PLANT

Parameter	Influent	Effluent
BOD (mg/l)	95	44
Suspended Solids (mg/l)	117	51
pH	7.2	6.6
Ammonia Nitrogen (mg/l)	8.4	9.1
Total Phosphorus (mg/l)	9.2	8.2
Settleable Solids (mg/l)	4.0	1.1
Fecal Coliform (no./100 ml)	4,160	147

Source: Department of Public Works, Bureau of Sewers and Sanitation, County of Hawaii, for period December 1976 to March 1977.

TABLE II-15

HEAVY METAL CONCENTRATIONS IN SEDIMENT

Heavy Metal	Sediment near Discharge Site (Sta. No. 7)	Sediment near Breakwater (Sta. No. 3)	Pristine Area: Kahana Bay*	Hilo Harbor*
Cadmium	0.16	0.09	12.1	5.0
Zinc	12.30	0.23	44.0	161.0
Copper	20.12	9.23	28.4	82.0
Chromium	5.35	0.38	ND	0.43
Mercury	0.10	0.01	ND	0.43
Arsenic	—	—	18.0	156.7

Note: All concentrations are on the dry weight basis. All units are expressed in mg/kg.

* Hawaii State Department of Health, 1976 to 1977.

It should be noted that an extremely high value of arsenic was reported by the State Department of Health. This high value can be attributed to the industrial waste discharge from a cenac processing plant of which arsenic is a byproduct. The waste flow was discharged into Waiakea Pond, which eventually leads into Hilo Harbor. This discharge was terminated in the late 1960s. As indicated from the data of heavy metals concentration in sediment, the high concentrations found in sediment are limited to areas shoreward of the breakwater.

The pesticides results showed that all of the chlorinated hydrocarbons tested were below detectable limits (i.e., less than 1 part per trillion). The chlorinated hydrocarbons investigated included alpha chlorelane, gamma chlordane, aldrin, heptachlor, heptachlor epoxide, DDT, DDE, DDD, and dieldrin.

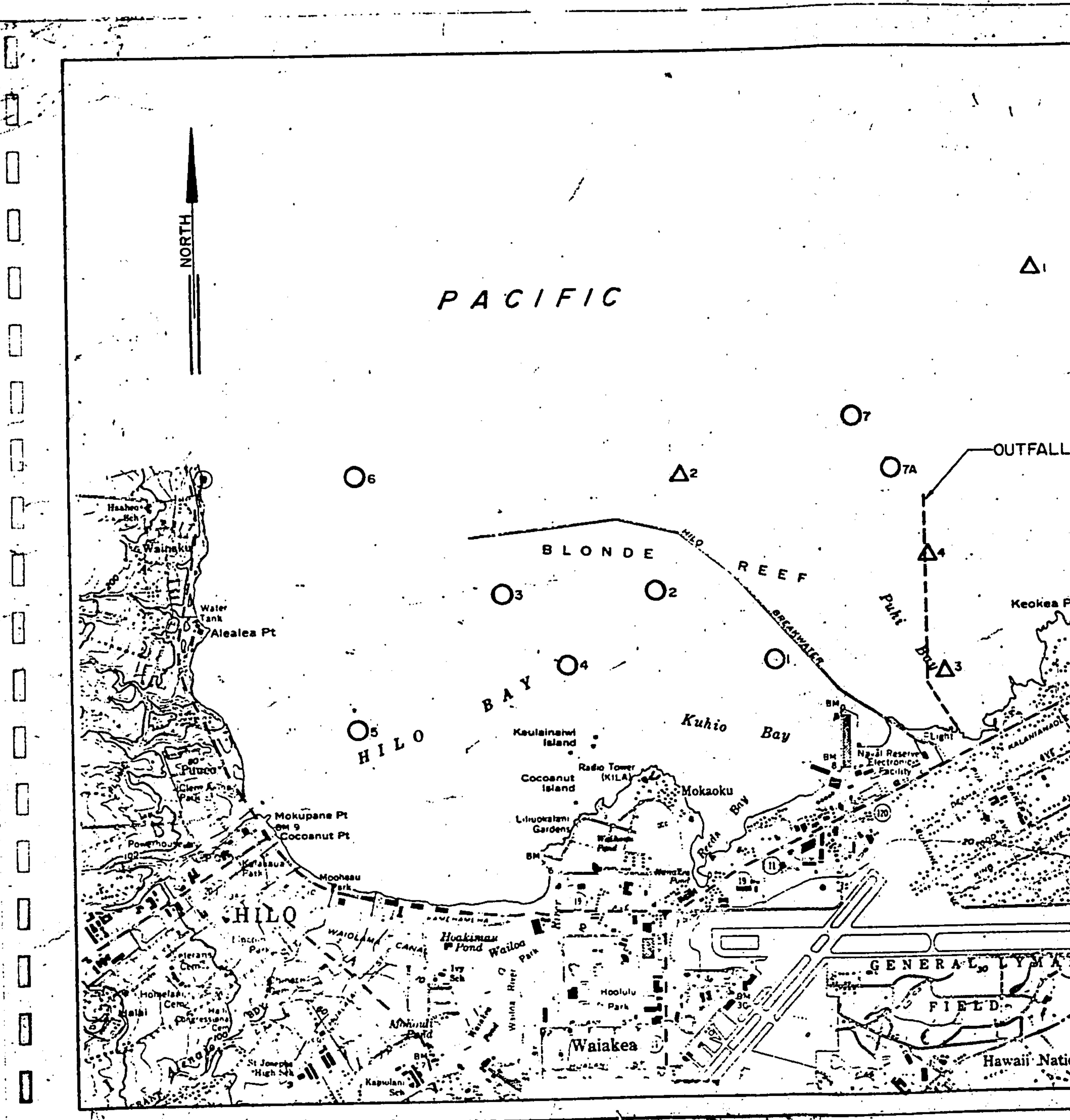
MARINE BIOLOGY

The following discussion is a summarization of marine biological conditions observed in Hilo Bay since May 1975. The detailed reports submitted for this study by Dr. Ralph Bowers are contained in Appendix F. Figure II-16 is a map of the biological sampling stations established for this study.

Plankton

Plankton samples were collected with a 5-inch plankton net (200-u mesh size) during the four water quality monitoring trips discussed previously, preserved with formalin, and later analyzed by Dr. Bowers using the multiple subsample method.

The four sets of plankton results (Appendix F) exhibit considerable variability and may, in part, reflect seasonal effects upon plankton populations in Hilo Bay. As is common in Hawaiian waters, copepods were found to be the most abundant of the zooplanktons. The data collected also show that their densities varied directly with those of phytoplankton (i.e., short-chain colonial diatoms), their primary food source. The number of zooplankton types found at all stations varied from 9 to 17.



NORTH
PACIFIC
OUTFALL
BLONDE
HILO REEF
BREAKWATER
Puhi Bay
Keokea
HILO BAY
Kuhio Bay
Keaukaha Island
Cocoanut Island
Radio Tower (KILA)
Mokaoku
Liliuokalani Gardens
Alealea Pt
Water Tank
Wainaku
Mokupane Pt
Cocoanut Pt
Mooheau Park
Puueo
Powerhouse
HILO
Hoakimau Pond
Wailoa Park
Waiakea
Hoolulu Park
Naval Reserve Electronics Facility
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Hawaii Nati

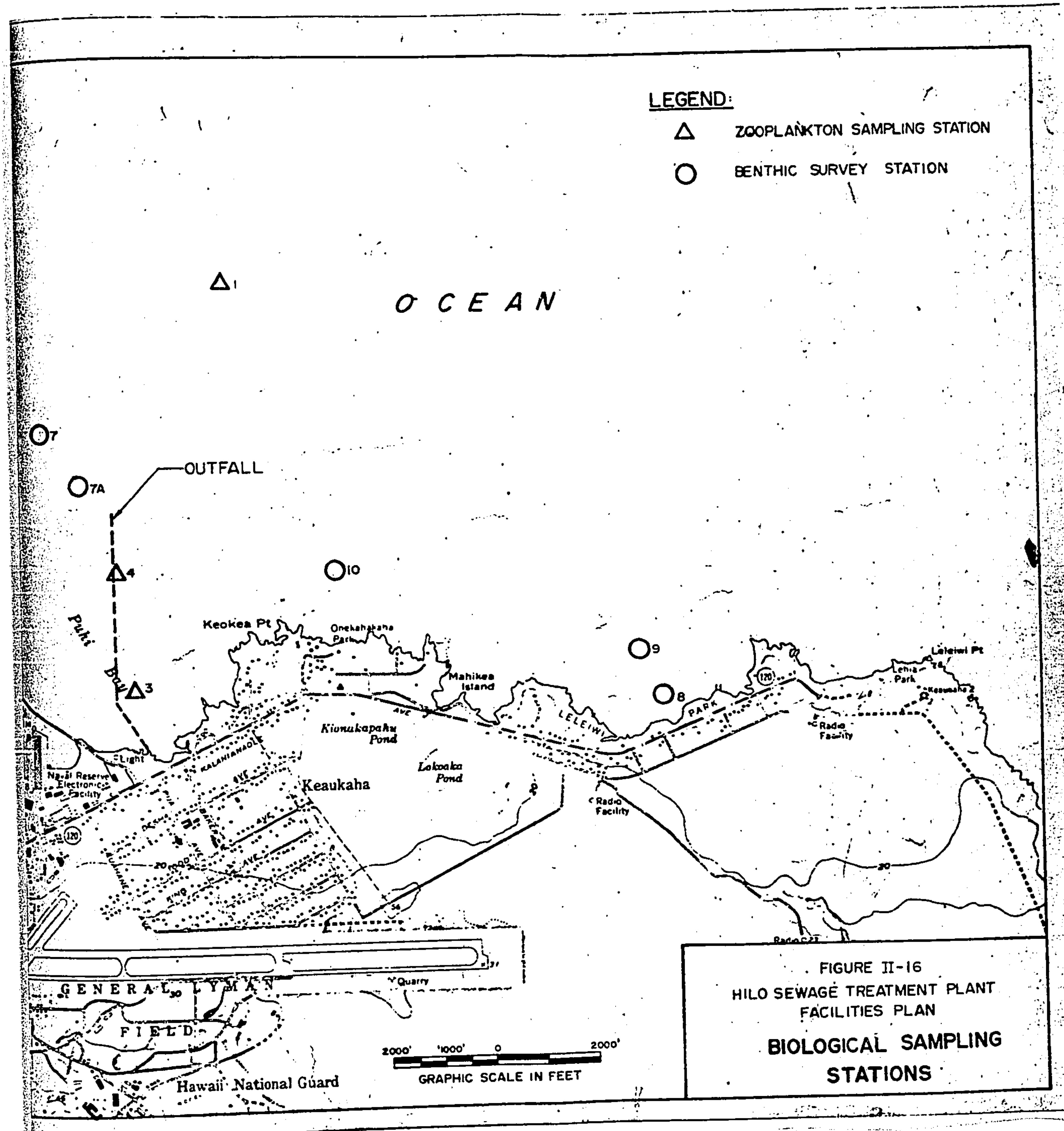

FIGURE II-16
HILO SEWAGE TREATMENT PLANT
FACILITIES PLAN

BIOLOGICAL SAMPLING STATIONS

In terms of copepod densities and number of zooplankton types, the levels found in Hilo Bay are not significantly different from those of other Hawaiian coastal areas. These zooplankton populations are particularly comparable to the area seaward of Hawaii Kai Marina (Oahu), the area seaward of the Honolulu International Airport Reef Runway (Oahu), and Nawiliwili Harbor (Kauai).

The variations in the zooplankton data gathered are most likely the result of "patchy" distributions caused by the influences of current patterns, prevailing winds, and groundwater flows rather than those of the Hilo STP outfall.

Benthic Environment

The data used to describe the benthic environment of Hilo Bay were collected on three separate occasions. In May 1975, a preliminary survey was conducted along the sewer outfall and at two control stations seaward of the breakwater. Subsequently, the stations shown on Figure II-17 were surveyed in January and, again, in June 1977. As shown, several stations were located within Hilo Harbor (i.e., inside of the breakwater) to collect data for comparative purposes. Tabulated estimates of substratum coverage, macroinvertibrate (other than corals) densities, and relative fish abundance are presented in Appendix F.

The topography and substratum found to the east of the breakwater and extending past the Hilo STP are generally characterized by a series of ridges and channels that run at an angle to the alignment of the outfall pipe. These ridges and channels vary in width (approximately 10 to 40 meters) and produce a depth difference of about 10 to 15 feet. The substratum is primarily hard bottom with small patches of sand.

Most of the corals observed in this area are characterized by a low, flat, platelike or encrusting type of growth. The most commonly observed genera include Porites, Montipora, Pavona, and Leptastrea, all of which are capable of growth where light levels may be reduced and sediment loads may be relatively high (Montipora and Porites are common in Kaneohe Bay, where these conditions prevail). It is interesting to note that one of the dominant forms of coral, Porites lobata, almost always grows as a flat, encrusting form in the areas observed. This type of coral generally forms massive, pyramid-shaped heads in other areas of the Hawaiian Islands. Only a very few large heads of *Porites lobata* were observed throughout this area, suggesting that its growth may be slower or possibly controlled by periods of heavy surge that would destroy the larger coral heads.

Very few heads of the finger coral, *Pocillopora meandrina*, were observed. The paucity of this coral suggests that the area is subject to reduced light levels and possibly reduced salinity levels. *Pocillopora* is much less tolerant of decreased salinity than either *Porites* or *Montipora*. If the reduced salinity is a problem, it is not a result of the outfall but, rather, of groundwater discharge, since most of the *Pocillopora* coral heads that were observed were located on the concrete reinforcement blocks near the effluent discharge.

Total estimated live coral coverage varies from 36 to 56 percent. A comparison of these coral coverages with those of other areas in the Hawaiian Islands suggests that coral coverage in this portion of Hilo Bay falls within an "expected" range. For example, coral coverage surrounding the island of Lanai, measured by the same methods, averaged 43 percent; at Sandy Beach on Oahu, coverages average 50 percent at the control site; and seaward of the Reef Runway in Honolulu, coverages average 38 percent. These coral coverages were measured at depths between 40 and 55 feet. The area seaward of the Reef Runway has been subjected to prolonged turbid conditions (unpublished SLTH data).

Coralline algae, macroinvertebrates (e.g., sea urchins and sea cucumbers), and demersal (bottom-dwelling) fishes were more abundant near the outfall than at the control sites. Along the outfall, the biostimulatory effect of the effluent upon these benthic marine organisms is evident as the most abundant populations were observed to be in the immediate vicinity of the discharge. In terms of coral coverage, however, the effluent effects are not discernible since the estimates for the outfall area and the control stations show no significant differences.

These biological data and other observations made at stations within the Hilo Harbor area and at control stations offshore of Onekahakaha Park and Richardsons (Leleiwi) Beach Park generally indicate that the marine environment steadily improves eastwardly along the coast. The poorest conditions were found within the harbor and the best conditions were offshore of Richardsons Beach Park.

In relation to this spectrum of marine biological conditions, the Hilo STP outfall discharges into an environment that has been and continues to be exposed to natural and man-related stresses (e.g., large freshwater discharges and high sediment, nutrient and organic loadings). It therefore appears that the existing conditions around the outfall overshadow the negative effects, if any, of this relatively small point discharge.

CHAPTER III

THE RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS, POLICIES, AND CONTROLS

Sewerage needs of the Hilo study area are closely related to and in conformance with growth and existing land use policies. The specific factors relating to those policies that affected the conceptual development of a wastewater management plan are outlined in this section.

LAND USE PROJECTIONS AND PRESENT STATUS

State and county ordinances pertaining to land use control, to some extent, control the magnitude and direction of population growth and, indirectly, socio-economic activities. To a greater extent, population and related activities, in turn, exert a direct impact upon the emissions of waste material to the environment.

The Hilo Community Development Plan, recognizing the potential of the area for growth and expansion, forecast a continued growth trend and, accordingly, proposed allocating various land uses for the individual planning areas, as shown on Figure III-1 and summarized in Table III-1. Existing agricultural, residential, commercial-industrial, resort, and public land uses were evaluated in this plan and compared with land uses proposed in the Hawaii County General Plan (adopted December 1971) and the State Land Use Map as shown on Figures III-2 and III-3 respectively.

Under present state and county land use policies, lands designated for agricultural use presently occupy approximately 21,980 acres in Hilo. Actual agricultural land use of 4,730 acres is comprised of livestock farms, sugar cane fields, flower and macadamia nut orchards, forests, and diversified agriculture. The existing agriculture zoning provides the area with an attractive greenbelt setting to complement the urban development.

The existing distribution of land use districts for the Hilo area is shown in Table III-2. Lands classified urban are, in general, subject to county land use control. Agricultural land requirements are established

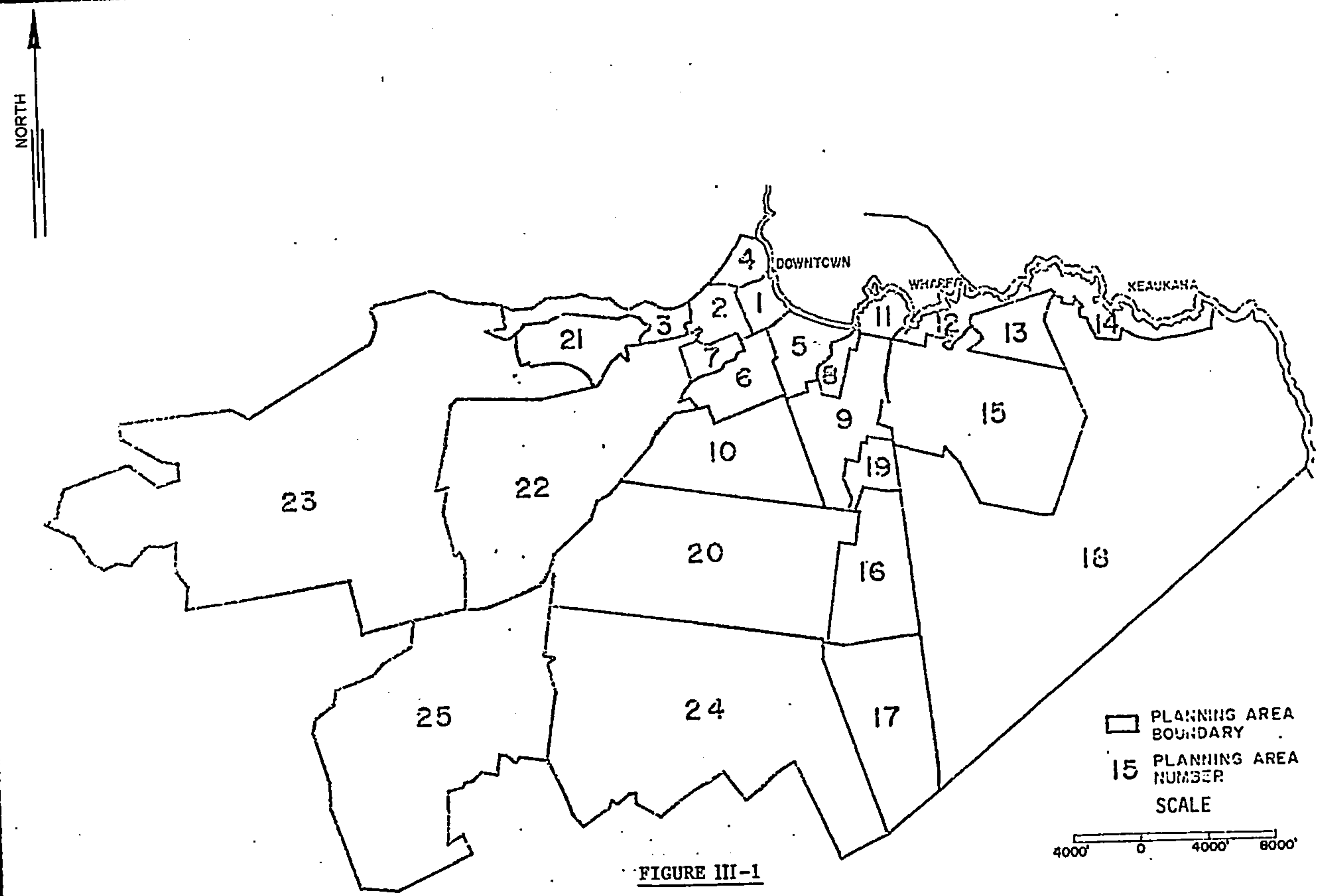

FIGURE III-1

PLANNING AREAS FOR THE HILO STUDY AREA

TABLE III-1

SUMMARY OF PROPOSED ZONING ALLOCATION BY PLANNING AREA

(in acres)

	Planning Area	Size of Planning Area	Single-Family Residential	Duplex Residential	Multi-Family Residential	Agri-culture	Resort	Commercial	Industrial	Open Space
1	Downtown	120	-	-	20	-	-	94	-	5
2	Halai	210	141	-	42	-	-	-	-	27
3	Wailuku	298	230	-	-	-	-	2	-	67
4	Puueo	149	10	-	76	29	24	-	-	10
5	Kaiko'o	301	33	5	5	-	-	80	-	173
6	Kukuau/Mohouli	369	156	37	91	6	-	30	-	49
7	Upper Ponahawai	126	5	-	50	41	-	-	-	30
8	Waiakea Pond	122	-	-	10	-	31	-	-	81
9	Waiakea House Lots	692	164	-	280	-	-	83	68	97
10	University	1,060	806	20	50	44	-	-	-	140
11	Banyan Drive	180	-	-	-	-	26	-	4	150
12	Wharf	205	-	-	-	-	-	-	155	50
13	Keaukaha Homesteads	340	334	-	-	-	-	-	-	6
14	Keaukaha	316	130	-	4	10	-	-	-	172
15	Airport	2,010	-	-	-	45	-	-	1,964	1
16	Lower Waiakea Homesteads	822	314	-	-	367	-	-	64	77
17	Panaewa	1,063	-	-	-	982	-	-	-	81
18	Hawaiian Homesteads	7,198	-	-	-	6,400	-	-	564	234
19	Waiakea Industrial Area	173	2	-	-	-	-	-	166	5
20	Upper Waiakea Homesteads	2,665	1,884	-	-	516	-	8	-	257
21	Ainako	433	245	-	-	-	-	-	-	199
22	Kaumana	2,818	720	-	-	1,974	-	4	-	120
23	Upper Kaumana/Piihonua	6,377	932	-	-	3,432	-	2	-	2,011
24	Waiakea-Uka/Haihai	4,207	611	-	-	2,973	-	8	-	615
25	Upper Waiakea-Uka	3,459	-	-	-	3,408	-	-	-	51
	TOTAL	35,713	6,717	62	628	20,227	81	311	2,985	4,702

Source: Belt, Collins & Associates, Hilo Community Development Plan (Preliminary), July 1974.

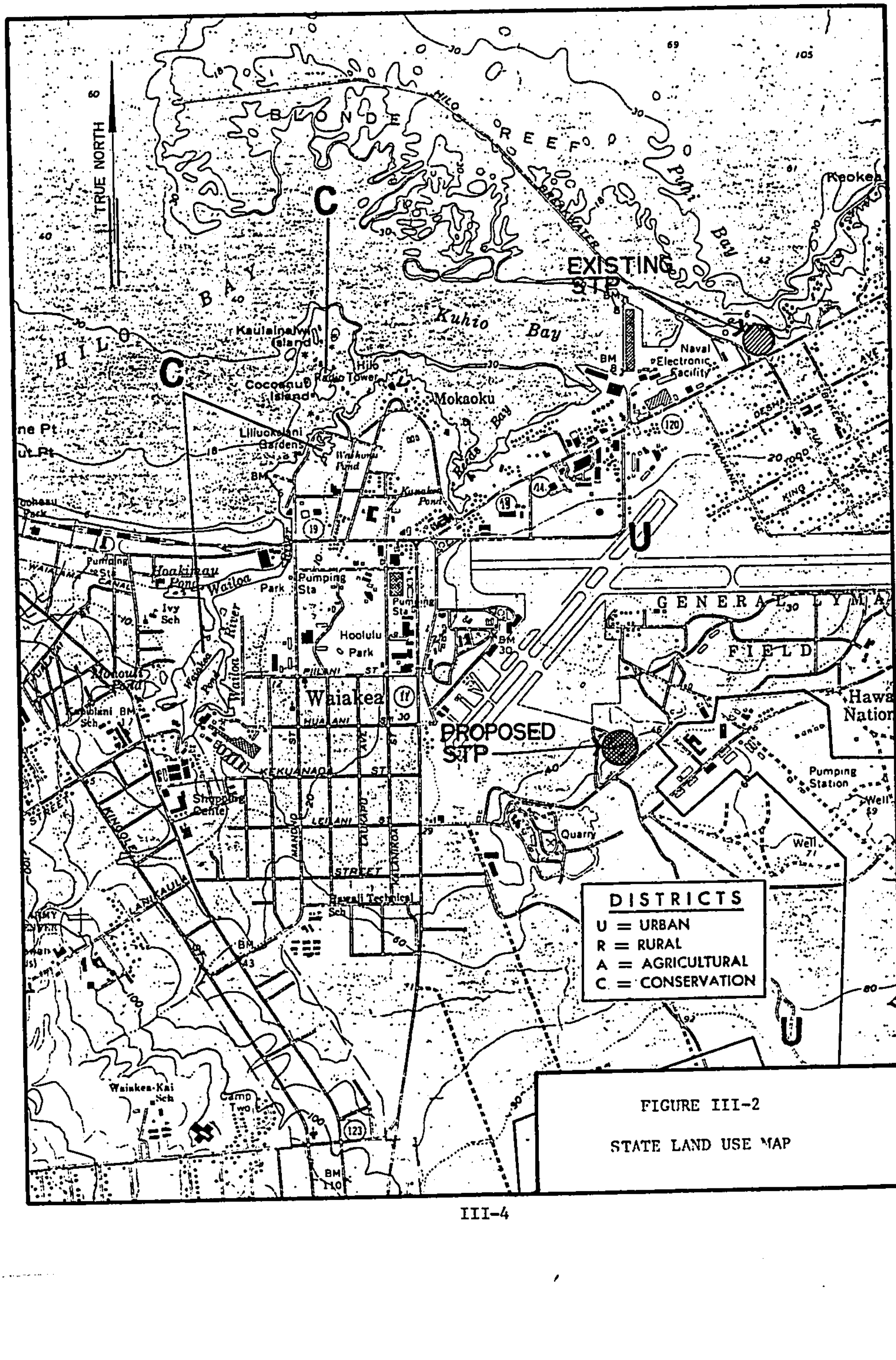

FIGURE III-2

STATE LAND USE MAP

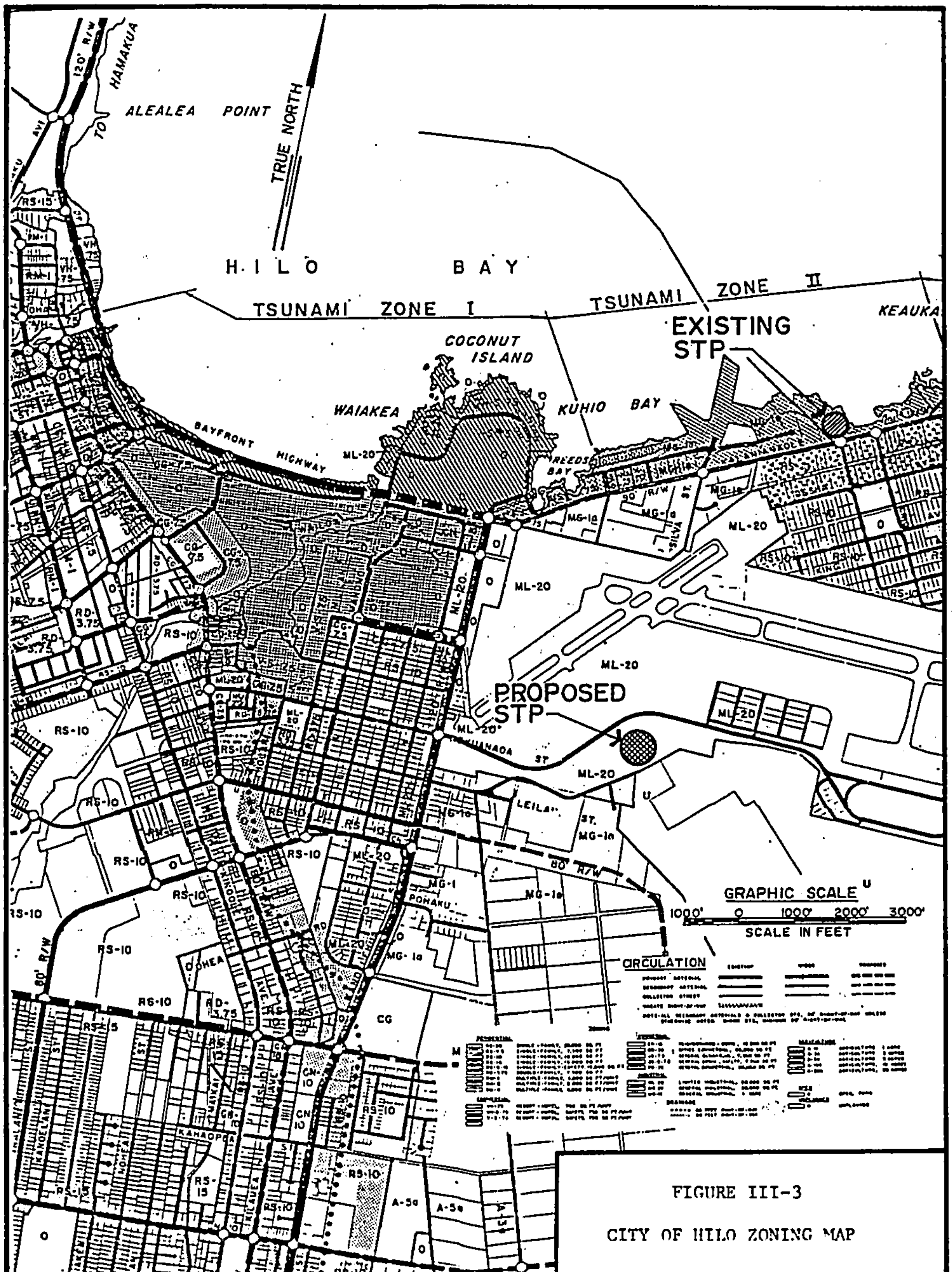

FIGURE III-3

CITY OF HILO ZONING MAP

by the state and administered by the county. Conservation lands are under the control of the State Board of Land and Natural Resources.

TABLE III-2

STATE LAND USE DISTRICTS IN HILO (1973)

District	Acres	Percent of Hilo Area
Urban	10,867	30
Agriculture	21,981	62
Conservation	2,865	8
	35,713	100

Hawaiian Home Lands

The Federal Hawaiian Homes Act of 1920 set aside certain lands statewide to be used by descendents of native Hawaiians. Large acreages of land (3,935 acres) in the eastern part of Hilo were so designated for homestead (residential) use, agriculture, and commerce, as dictated by county zoning. Presently, a portion of the Keaukaha area of Hawaiian Home lands has been developed as a single-family residential area.

Recreation

According to the State Comprehensive Outdoor Recreation Plan, there is a high participation in swimming, jogging, and outdoor events among the residents in the Hilo area. However, natural features presently constrain shoreline recreation in the Hilo area because of the small acreage of sandy beaches and the inclement weather. Of the County's 305.5 miles of shoreline, only 1.2 miles are prime sand beach which are generally favorable for swimming and other water-oriented activities.

There are approximately 60 acres of neighborhood recreational facilities. However, according to the Hilo Community Development Plan, approximately 80 more acres are required. By 1980-85, an additional 35 acres will be required. It should be noted that a possibility exists such that the existing treatment plant site may be converted to a recreational park when the new treatment plant becomes operational.

CHAPTER IV

PROBABLE IMPACT OF THE PROPOSED ACTION ON THE ENVIRONMENT

The overall impact of the proposed Hilo sewerage system will be a beneficial one to the human environment, with only marginal effects on the natural environment. This system has been formulated to effectively eliminate the undesirable practice of using cesspools and septic tanks for sewage disposal and to meet anticipated sewerage needs of the Hilo study area in accordance with federal and state requirements. Furthermore, the proposed system will impose less of an impact on the natural environment than the present concept of employing many dispersed disposal facilities.

Any action that requires construction for improvements involves tradeoffs. The following discussion identifies and evaluates the tradeoffs as unavoidable short-term and potentially significant long-term impacts of the proposed plan. The unavoidable adversities will be temporary, construction-related inconveniences, such as noise, traffic disruptions, dust, and unpleasant aesthetics, to the residents and visitors to the Hilo area. Potentially significant long-term impacts are those effects that may occur over time as direct results of the proposed plan.

INTERCEPTOR SEWERS AND COLLECTION SYSTEM

Expanding the existing sewer collection system will involve the excavation of trenches, installation of interceptor and collector sewers, and backfill operations. This expansion will proceed in segments until the completion of the system. Accompanying these construction activities will be noise, dust, and traffic inconveniences as well as other undesirable aesthetic aspects. While mitigating measures will be employed, these temporary inconveniences will be unavoidable to some extent. These short-term impacts are as follows:

1. Traffic disruption. Traffic disruption along roadways will, in some instances probably restrict traffic to a single lane pattern, with vehicular speeds reduced accordingly. Construction vehicular traffic, generated by disposal of excavated

material and other construction-related activities, will be regulated to minimize interruptions to normal traffic flow.

2. Fugitive dust. Fugitive dust will be created during construction periods from activities such as clearing, excavating, and backfilling. These activities could cause minor disturbances to residents in proximity to the area. Such an impact, however, would be temporary, with no continuous air quality impairment anticipated.

3. Noise. Noise will be generated by various vehicular and construction equipment used in the construction activities. The anticipated noise level for construction equipment will be between 90 to 100 dBA measured at 50 feet. For comparative purposes, the noise level at the edge of a highway (where sewer line construction will take place) with dense traffic is 70 to 85 dBA. Also, in relation to the proximity of the airport, the noise level of a jetplane at 1,000 feet is 100 to 105 dBA. Noise levels from machinery and motors will be limited to conform with state and county regulations.

4. Storage areas. Storage areas for material, equipment, and supplies will be required. The contractor shall be responsible for selecting a site that meets all applicable laws and regulations. Generally, storage areas present an unpleasant aesthetic appearance. Landscaping is not normally required because of its temporary nature.

5. Other inconveniences. Other inconveniences to the resident and visitor populations due to sewerline construction will be in the form of unpleasant aesthetic effects and restrictions to pedestrian movement. Alteration of the environment will present a significant, temporary non-aesthetic effect. Pedestrian traffic will be controlled by safety barricades in the immediate area of the work.

6. Endangered flora and fauna species. Construction of the sewer will generally be limited to existing roadways and highways.

The impact on endangered flora and fauna species, therefore, will be insignificant.

7. Archaeological and historic sites. Construction of the sewers will generally be limited to existing roadways and highways. The impact therefore will be insignificant.

8. Erosion. Construction activities will have the inevitable result of exposing otherwise undisturbed soil and are subject to erosion by the weathering effects of the wind and rain. These effects can be minimized through the implementation of proper construction erosion techniques and are therefore considered short-term. The resultant impacts of erosion and sedimentation upon the coastal water quality and marine organisms is not anticipated to be a significant problem when compared to the 2,600 tons of sediment which is transported and discharged by the Wailuku and Wailoa Rivers each year.

TREATMENT PLANT

Short-Term Impacts

Construction of the onsite treatment facilities have its short-term impacts, such as noise and dust, on surrounding areas. These short-term, construction-related impacts will be similar to those discussed in the previous section dealing with the collection and interceptor sewer system.

Long-Term Impacts

Long-term impacts of the proposed action will be primarily associated with the operation and maintenance of the proposed facility.

1. Logistic requirements of the secondary treatment facility. An annual expenditure of approximately $450,000 (based on a flow of 5.0 mgd) is anticipated for plant operations, including labor cost. It is estimated that 10 full-time staff members will be required, augmented by support specialists and supervisory personnel. (The estimated annual O&M cost for an advanced primary treatment facility is $300,000).

2. Aesthetics. The facility site will consist of concrete buildings and tanks, surrounded by a chain-link fence. Landscaping will be incorporated in the design to provide some aesthetic appeal. The facility will be visible to persons (including visitors) using the airport road.

3. Noise. Noise emanating from the treatment plant site will be attributable to process equipment; however, noise levels are not expected to exceed normal background levels. All noise-generating equipment will be housed within structures with specially-installed noise abatement features. Air blowers will be equipped with intake and exhaust mufflers whenever required to reduce noise levels to conform to applicable codes and regulations.

4. Odors and air quality. Objectionable odors have probably been the major detrimental effect of the existing Hilo treatment plant. The frequent occurrence of this odor problem is due to the septic nature of the incoming sewage and the long detention times of the sewage in the open primary treatment units.

   The proposed plant design calls for enclosing the preliminary treatment units and scrubbing the exhaust gases prior to discharge. Provisions for adding oxidizing chemicals to the influent flow are included. Provisions to treat secondary waste flows prior to discharge in the main flow stream will also mitigate odor problems.

   Aside from the temporary effects of construction activities and equipment, it is not anticipated that the proposed action will significantly affect air quality in the Hilo district. Incineration, which is often a principal source of air pollutants, is not included as a unit process of the proposed treatment scheme.

5. Solids handling. The proposed sludge treatment and disposal scheme calls for anaerobic digestion, followed by chemical conditioning and mechanical dewatering, with final disposal

into a sanitary landfill. The grit removed from the incoming sewage will also be disposed of at the sanitary landfill.

At present, the proposed disposal site is the municipal landfill shown on Figure I-4 located approximately half of a mile from the proposed site of the new treatment plant. The disposal site is on land currently zoned for general industrial use. The estimated life varies from 35 to 50 years according to County personnel.

6. Flooding and erosion. The proposed plant site is outside of both the 100-year flood area and the estimated inundation limits of a 100-year tsunami.

7. Fauna and Flora. The proposed plant site is a former quarry site near the airport-industrial area. The site is presently overgrown with brush and replanted with pine trees. The surrounding area including the proposed site appears to have been previously disturbed during the quarry operations. Based on this observation, the impact to the endangered fauna and flora species specifically the Hawaiian Bat, will be insignificant.

EFFLUENT DISPOSAL SYSTEM

The present system, which has not been found to have had significant detrimental effects, discharges primary treated effluent within nearshore waters at a depth of 56 feet and at a distance of about 4,500 feet from shore. The proposed system calls for discharging an effluent that has undergone a higher degree of treatment (i.e., advanced primary or secondary treatment) at a deeper depth (about 70-90 feet).

Short-Term Impacts

1. Shoreline staging area. A construction staging area will be required along the shoreline to stockpile materials and equipment and to accommodate boating/barging operations. The activities at this yet undesignated site will have attendant

noise, traffic, aesthetic, and related impacts during the construction period.

2. Turbidity. Excavation and pipe installation activities will temporarily increase water turbidity at the offshore construction site.

3. Navigation. The presence of the construction barge and boating/barging operations in the waters of Hilo Bay may temporarily interfere with boating and fishing activities in this area.

4. Other short-term impacts. Other temporary adverse effects, sites, such as noise and unsightly aesthetics, normally experienced at construction sites are not anticipated to be significant since construction will start over one-half mile from shore and proceed offshore.

Long-Term Impacts

1. Recreation. The designated area of study for recreational usage in the vicinity of the Hilo outfall extends approximately from Alealea Point on the west to Leleiwi Point on the east. Included in this area are the Bayfront, Cocoanut Island, Onekahakaha, James Kealoha, and Leleiwi Beach Parks. As indicated on Figure IV-1, shoreline activities are generally those associated with picnicking. Water contact activities at these parks include swimming, diving, surfing and nearshore fishing.

   In general, most of the water contact activities occur within the nearshore waters, extending offshore to approximately 1,000 feet and to a depth of about 20 feet, for which no limitations on any water contact activity have ever been imposed by the State Department of Health. Also, neither the State Department of Health nor the Department of Fish and Game has placed any limitations on the consumption of fish caught in the vicinity of the outfall diffuser. Data on concentrations

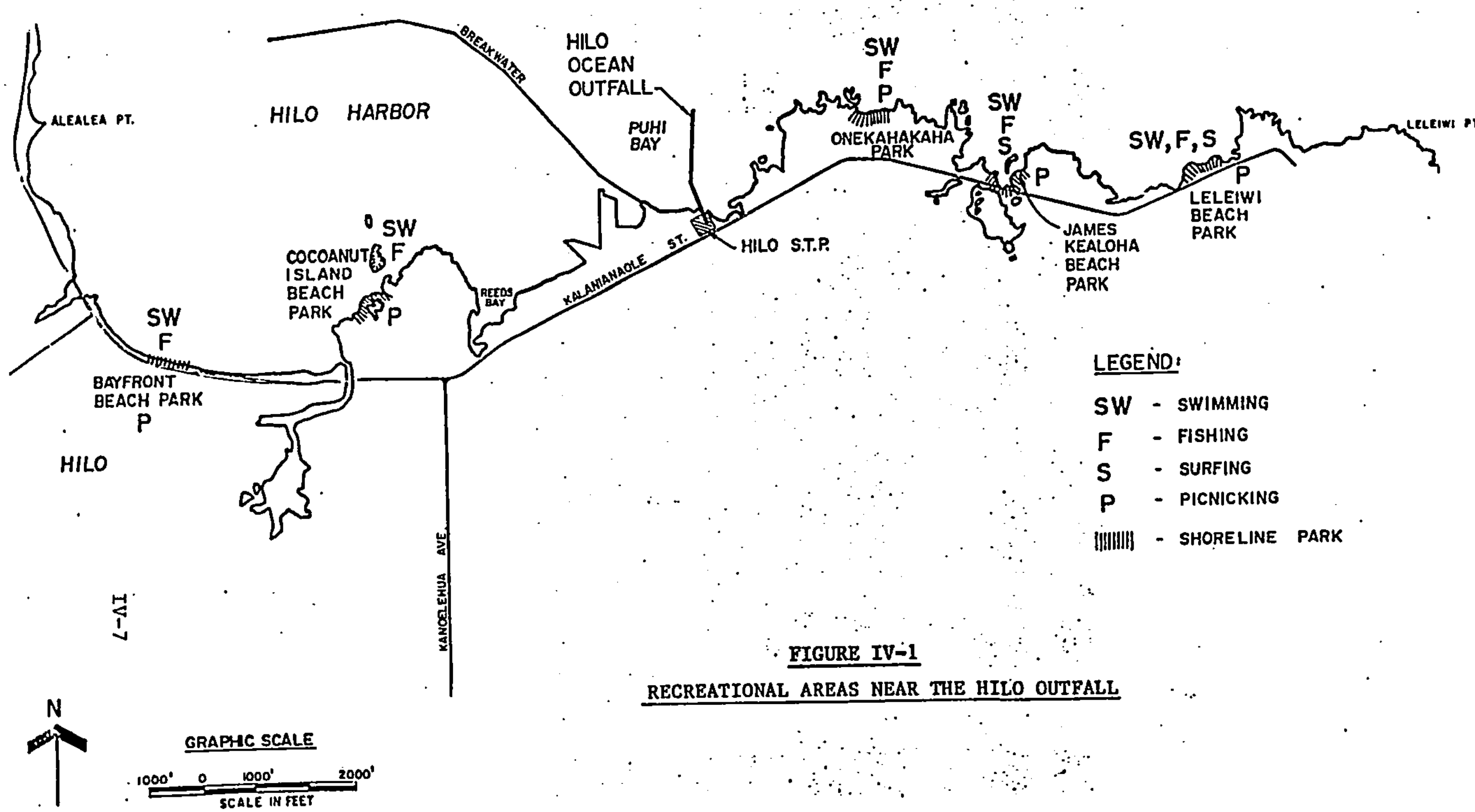

FIGURE IV-1

RECREATIONAL AREAS NEAR THE HILO OUTFALL

of toxic pollutants in fish or shellfish tissue are not available, but the levels of these constituents in the effluent are expected to be low and therefore not be a problem with respect to fish catches.

Review of available data on water quality parameters of the receiving waters of the existing discharge shows that the quality of the receiving waters is not being significantly altered by the discharge and that all chemical water quality criteria, which may be of consequence relative to water contact activities, are being met after initial dilution of the discharge. Because these criteria, which are embodied in the State Department of Health Regulations, Chapters 37 and 37-A (Hawaii Revised Statutes, Chapter 242), were established to protect the beneficial uses of the receiving waters, no adverse impacts on recreational activities should result from the chemical components of the discharge. In addition, the impacts on the microbiological quality of the receiving waters are expected to be minimal due to (1) the initial dilution obtained through the design of the outfall diffuser, (2) dispersion obtained through the ocean currents, and (3) the high coliform die-off rate (T-90).

Effluent Discharge into Ocean Regime

Present Situation: Primary Effluent Discharge. The Hilo sewage outfall dilution zone study (conducted in conjunction with the EPA's Section 201 facilities plan study) indicated that the existing primary sewage discharge from the outfall has no measurable impact on the water quality and marine life in the area when compared to control stations. Coral types and coverages appear to be nearly identical in the vicinity of the sewage discharge and at the "control" stations. Further, both benthic organisms and fishes were found to be more abundant and as diverse near the outfall than elsewhere. This is probably attributable to the biota utilizing the discharged collodial materials as a food source. It has been suggested in the study that marine life in the area is largely a result of a combination of factors; turbidity, due to wave action and surface runoff, surge, and possibly fresh groundwater discharge. The scarcity of coral growth of the Pocillopora meandrina species and the preponderance of Porites or Montipora suggest that the area is subject to reduced light levels (attributable to turbidity due to wave action and surface runoff) and possibly reduced salinity levels (attributable to the large groundwater discharge). If reduced salinity is a factor, the future outfall discharge should not be significant, since the magnitude of sewage discharge is on the order of one-tenth that of an average, combined groundwater and surface water discharge into Puhi Bay. (Overall, Hilo Bay--of which Puhi Bay is a portion--receives greater than 600 mgd over 50 percent of the time.)

The field investigations of the outfall revealed higher concentrations of heavy metals in the sediment in the immediate area of the outfall. It should be noted, however, that no large amounts of sediment were observed in the area, and samples taken were from small patches of sand. Further, metal concentrations in the samples were low when compared to samples measured by the Water Resources Research Center of the University of Hawaii from many other so-called "pristine" locations around the state.

Effect of Advanced Primary Effluent Discharge as Proposed in this Project. The implementation of the advanced primary treatment shall improve plant effluent characteristics, most notably the reduction of floatables and suspended solids. Ambient marine water quality can be expected to remain at present levels due to the large dilution and dispersion afforded by the ocean currents.

While less suspended solids will be removed by the advanced primary process as compared to the secondary treatment process, the problem of sludge deposit is not anticipated. Field investigation in the area of the existing outfall revealed the absence of sludge deposits, even with primary effluent. This absence can be attributed to the large "surge" action in Hilo Bay.

Effect of Secondary Effluent Discharge as Proposed in this Project. With implementation of secondary degree of treatment, plant effluent characteristics can be expected to improve significantly, with reductions in the standard pollutant parameters of suspended solids, settleable solids (turbidity), and BOD (oxygen-demanding materials). Anticipated effluent characteristics resulting from the secondary treatment process and outfall extension have been discussed earlier and is anticipated to meet effluent limitations of the State Water Quality Standards and National Pollutant Discharge Elimination System.

Ambient marine water quality can then be expected to at least remain at present levels because of the large dilutions afforded by ocean disposal. Bacterial concentrations in the water column attributable to this discharge should not differ markedly from that for the existing discharge. Concentrations should remain within the allowable limits of the State Water Quality Standards due to chlorination of effluent prior to discharge and the high rate of bacterial die-off in the seawater environment.

Effects of residual toxic substances (heavy metals, pesticides, etc.) can be minimized with proper considerations in ocean outfall design such that the increase above background is not significant. In practice, these pollutants would be widely dispersed predominantly seaward for effective dispersion.

In summary, the major long-term impact is the establishment of effective water quality control of both groundwater and nearshore waters due to the eventual elimination of cesspool seepage. Risks to public health and welfare attendant with malfunctioning cesspools would be minimized. Effectiveness and economy of scale are the advantages to be gained by upgrading the sewerage system.

SOCIO-ECONOMICS

Financing for operation, maintenance, and replacement (OM&R) costs is presently obtained from the county's sewer user charge to those using the sewerage system. The current user charge is assessed on a percentage of the water bill--currently 75 percent of the water bill, with a maximum of $10 for residential units per two-month period. Deficits are covered by the county's general tax funds.

To qualify for a 75 percent federal construction grant under Public Law 92 500, however, the county is currently revising the existing user charge ordinance to cover OM&R costs of the expanded sewerage and sewage treatment plant system.

The new user charge rates have not yet been determined, but the total cost for operation and maintenance of the secondary treatment plant is estimated at approximately $450,000 per year when flows reach 5.0 mgd ($300,000 per year for advanced primary treatment). An additional $45,000 per year will be expended for power to operate the pump station.

Although many have expressed objections to this direct method of assessment, the current requirements leave no other alternative. Funds are needed to operate and maintain the plant and related facilities, and Public Law 92-500 requires user charges as a condition for obtaining federal construction grants.

SECONDARY IMPACTS OF THE PROPOSED ACTION

The degree to which this project will ultimately affect the growth rate and character of the area is not quantifiable. Development has proceeded even without municipal facilities in certain areas of the state of Hawaii. Single-family residences have utilized cesspools, while multi-unit structures (hotels, commercial developments, apartments) have utilized private treatment facilities.

Many factors contribute to the degree to which development may occur in the study area. Any significant residential development will depend primarily upon a market for sale of houses. Where a market is likely to occur will, in turn, depend upon where there is available land. Commercial and industrial development will similarly occur only where a potential for profitmaking exists, and that depends upon the availability of materials at a reasonable price, transportation, and labor. Should any of these ingredients not materialize, the potential for development is decreased, regardless of whether sewage service is available or not. Adequate sewer and water service serve only to create a climate in which residential and commercial development will be able to proceed in a planned orderly fashion and not serve to provide a stimulus for uncontrolled development.

Ultimate Effect of the Project on the Character of the Area

The direction and character of development of the area are controlled to some extent by land use plans, which in turn, are reviewed periodically for evaluation of past growth and future trends. Present planning policies indicate that the area will continue to develop primarily in a residential fashion to support labor needs in the commercial, tourist, governmental and diversified industries fields. It is expected that public services will need to be correspondingly expanded to accommodate the projected growth, and the proposed project is essential to the orderly development of the area.

Extent To Which the Area Will Be Sewered

Most of the major interceptors are already installed to convey flows from existing residences, hotels, apartments and commercial developments to the existing municipal sewage treatment plant. Where extensive development has occurred in the study area, sewage service is intended to be provided to eliminate the use of private facilities. Undeveloped areas in the upper reaches of the study area will not be served in the immediate future and will continue to utilize individual sewage disposal systems (cesspools). Ultimately, these areas will be served as they develop in a manner guided by future sewerage planning studies.

Relationship Between the Project's Effect on Growth and the Type of Growth Desired by Area Residents

The type of growth in the study area will continue to be guided to a large degree, by land use policies and implementation of zoning codes.

It is possible that the rate of growth may exceed that desired by area residents, in which case a new plan calling for staged development will have to be prepared through a process of public participation and legislation.

Effect of Project on Implementation of Land Use Planning

Land use planning may be implemented where basic services, including water and sewer, can be provided. Where designations of land use categories may change, the availability of basic services is a primary consideration in reaching new determinations. Such changes would be reviewed by the public as provided for in the county's zoning code.

Effect of Proposed Project on Employment and Income for Residents of the Study Area

The proposed project will create short-term employment and income for residents of the area, but the extent of this short-term employment demand is not quantifiable. For the longer term, approximately 7-10 persons will be employed to operate the treatment facility and related facilities.

CHAPTER V

ADVERSE IMPACTS THAT CANNOT BE AVOIDED

The adverse impacts would be most pronounced during construction. Dust, noise, and traffic disruption would be the most noticeable irritants, but they can be mitigated by watering for dust, regulating hours of construction to minimize noise impact, and scheduling construction traffic during off-peak hours. Traffic would be affected primarily by the trucks and heavy equipment entering and leaving the plant site. Construction outside of the plant area is not anticipated under the proposed action. Traffic guides and scheduling of construction to avoid the early morning and evening traffic flows would be necessary, especially near commercial and residential developments.

The particular impacts and mitigating conditions are summarized in Table V-1.

Besides the construction-related impact, there is a potential odor problem. Some complaints have been voiced about odor from the existing treatment plant. This problem has been recognized by the Bureau of Sewers and Sanitation, Department of Public Works, and remedial action is being taken. Future facilities will have special provisions for odor control; the grit chamber and screening facilities will be covered to prevent emanating odor compounds from escaping into the atmosphere. These facilities will also be located away from the highway frontage.

Backup power generation facilities designed to automatically operate during instances of power outages should assure that odor problems do not materialize and that operations will not be significantly interrupted.

Special provisions also are being made to process the digester supernatant, which is another source of odor. Another source of odor attributable to digester operation is leaking gas lines, but strict maintenance procedures will mitigate this problem.

TABLE V-1

SUMMARY OF PROBABLE ADVERSE EFFECTS

Probable Effect	Duration	Mitigating Measures
Construction		
Inconveniences	Temporary	Regulating hours of construction. Staging localized construction. Public information. Rapidly completing construction in critical areas.
Noise	Temporary	Same as above.
Dust	Temporary	Watering.
Disruption of traffic	Temporary	Traffic aids and flagmen. Regulating hours to avoid peak traffic hours.
Soil erosion	Temporary	Conformance with erosion control techniques of the 208 Plan, and local grading ordinances.
Visible Structures		
Treatment plant	Permanent	Architectural design and landscaping. Location away from residential areas.
Treatment Plant Operation		
Noise	Permanent	Housing of noisy equipment: air blowers, pumps. Insulation of office and laboratory.
Odor	Temporary	Implement odor control facilities. Infrequent occurrence. Control of operations.
Disposal of Effluent via Ocean Outfall		
Slick net transport toward shore	Temporary	Dependent upon climatological and oceanographic conditions.
Disposal of Solids	Permanent	Implement proper sanitary landfill operation.

CHAPTER VI

ALTERNATIVES TO THE PROPOSED ACTION

ALTERNATIVE TO SECONDARY TREATMENT

Several alternatives and subalternatives, some of which can meet the stated objectives of public health and water quality, were evaluated for the Hilo Wastewater Management Plan. The overriding constraint, however, is the EPA's secondary treatment guidelines, which specify effluent limitations of 30 mg/l BOD, 30 mg/l SS, and a pH between 6.0 and 9.0 as monthly averages.

Discharge of Raw Sewage

An alternative is the disposal of raw sewage through the existing or an extended ocean outfall. Several findings relating to the impact of such a disposal practice upon the marine environment, however, discourage implementation of this alternative. Benthic and water quality studies in areas currently receiving raw sewage discharges (most notably, the Southern California Bight and the Sand Island outfall area) reveal that the pollutants of major concern include settleable solids and toxic organics and metals. Settleable solids suppress growth of benthic organics by a "smothering" effect. Metals enrichment of sediments represented a significant alteration of the ambient conditions. Some organics were found to be persistent and toxic, most notably the pesticides and some oils and organic acids. Other particulates and organics attributable to the raw sewage discharge were rapidly degradable, generally nontoxic, and possibly beneficial or essential to some marine life.

For the situation at Hilo, wherein the composition of sewage is predominantly domestic in nature, significant amounts of persistent pollutants are not expected to pose any problems. Rather, aesthetic considerations and the problem of settleable solids would primarily be a governing factor, dictating the removal of floatable materials.

Tertiary Treatment

Tertiary treatment involves not only the removal of suspended solids and organic oxygen-demanding substances but also simple inorganic ions and complex synthetic organic compounds normally unaffected by secondary treatment. Concomitant with this high degree of treatment is the need for extensive, highly complex mechanical and electrical equipment and a high operational cost. Based on the high cost factor related to tertiary treatment, this alternative was discounted. Further, the incremental degree of tertiary treatment over that of secondary is not cost beneficial, especially when applied to effluent disposal into an open ocean regime.

No Action with Continued Use of Present System

In addition to alternative types of treatment, another possible alternative is not to implement the proposed action but to continue with the development of the present system of cesspools and primary treatment of sewage. The proliferation of cesspools resulting from population growth and urban development would continue then (controlled if deemed necessary by curtailment of development through appropriate institutional constraints) until such a time that the collection system can be expanded to incorporate these areas and reduce the cesspool systems. Risks to public health and welfare and possible impairment of the basal lens as a drinking water source would still exist but be reduced as cesspool malfunctions and overflow diminish.

Fiscal constraints, should they be imposed upon public works construction programs, may justify continued operation of the existing primary treatment facility with available funds directed at expanding the collection system to eliminate cesspool-troubled areas, or in areas where seepage from cesspools pose a potential hazard to the basal lens or to the nearshore coastal waters. Federal legislation, however, presently mandated under Public Law 92-500, precludes the existance after mid-1977 of any discharge not selected to secondary degree of treatment as a minimum. Further, provisions for federal assistance in the form of sewerage facilities construction grants (of which up to 75 percent of the total project costs are eligible) supplemented by state assistance in funding (see project funding) warrant qualification and therefore implementation according to above-described federal guidelines.

ALTERNATIVES ON THE SITE OF THE TREATMENT FACILITY

It is proposed to construct a 5.0-mgd secondary treatment facility at another site, calling for subsequent abandonment of the existing facility. A site located in the proximity of Leleiwi Point was evaluated and discarded on the basis of cost-effectiveness. To expand and upgrade the existing facility involves a risk factor, a factor that is difficult to assess because the frequency, type, and damage-incurring character of future tsunamis cannot be determined readily over the life of the facility.

Several factors preclude the use of the existing site.

1. There are no assurances of performance dependability when considering the damaging-incurring character of future tsunami.
2. Flood insurance coverage can be obtained for the plant facility at an expensive annual premium; however, the maximum coverage for each structure is only $100,000, where many structure exceed this coverage.
3. The proximity to residential unit have been the cause of many odor complaints.

ALTERNATIVES TO TREATMENT FACILITIES

The evaluation of alternative facilities deals with tradeoffs among the resources of land, energy, and finance. The criterion for selection of the best alternative is cost effectiveness, as noted earlier, and the overriding objective prescribed by law is the secondary treatment guidelines. The choice of alternatives, therefore, is based on the least cost for meeting these guidelines.

The least-cost secondary treatment alternative in terms of present worth is the rotating biological contactor process, which also features low power demands. Land requirements are not high and do not pose significant acquisition problems. The treatment process requiring the least power--the oxidation pond--conversely requires the greatest land area and initial capital cost.

The present situation of developed areas in the vicinity of the existing plant site precludes the use of ponds to meet immediate and foreseeable needs. Lands used for treatment works elsewhere (valued at $7,000 per acre in the Hilo area) reduce what is available for urban or agricultural activity.

The physico-chemical treatment alternative, although requiring less land than any of the other alternatives, requires considerable operation and maintenance costs. The OMR costs are attributable to the use of large quantities of chemicals and the operation of large amounts of mechanical and electrical equipment.

In summary, the rotating biological contactor process has the lowest present worth based on construction and operation, maintenance, and replacement costs. It also provides for some flexibility in operator control of effluent quality and has a demonstrated reliability in meeting the secondary treatment guidelines, as reported in recent publications.

An application for a modified discharge has been submitted to EPA. If granted, the advanced primary treatment system is proposed.

Solids Handling

The major alternatives for solids reduction are anaerobic digestion and incineration. The factors affecting cost include capital cost of the process and the ultimate disposal of solids residue. Where extensive hauling is required, it is desirable to have a minimum quantity, which is generally provided by the incinerator. Where hauling is not significant, anaerobic digestion has the advantage and the flexibility for solids treatment and disposal.

The least-cost alternative for sludge treatment and disposal is anaerobic digestion and dewatering by centrifuge, followed by landfill disposal of sludge residues with municipal refuse. One potential advantage of anaerobic digestion is reclaiming methane for energy; another is using digested sludge for fertilizing and soil conditioning. These are only potential uses and do not yet merit early implementation because of cost. The system is flexible, however, and reclamation can be implemented in the future when a larger capacity plant makes the economics more favorable.

Using sludge for fertilizer is not a new idea. Landspreading of raw sludge for crops was commonly practiced in the past until concern over public health reduced its application. Digested sludge has been used as fertilizer for several decades, but the demand has never been great enough to reduce the need for disposal facilities.

The alternative of heat treatment has the advantage of conditioning the sludge for increased susceptibility to dewatering with minimum chemical requirements and a reduction in sizing requirements of subsequent solids-handling equipment. Cost savings in equipment and in the solids disposal scheme due to moisture content reduction, however, are not significant enough to justify implementation of heat treatment at this time.

The alternative of sludge incineration has an advantage of reducing the mass of organics and inorganics to a small quantity of ash suitable for economic hauling to a landfill site. A disadvantage, however, is the large capital expenditure required to implement the system. Because of this cost, sludge incineration constitutes an almost irreversible commitment early in the implementation plan and rules out reclamation of methane or digested sludge.

Disposal of sludge residue from either the incinerator or the digester must be coordinated with the municipal refuse disposal program. The quantity and character of solids to be incorporated in this program should be negligible in comparison to projected solid waste quantities, thus exerting a minimal impact upon landfilling practices and sites.

Effluent Disposal

The alternatives to ocean outfall disposal of effluent are (1) land spraying, which is a means for reclaiming effluent for irrigational purposes, or (2) ground injection.

The annual rainfall of 100 to 150 inches in the Hilo area minimizes the demand for irrigation. Should this alternative be implemented in any event, standby provisions for effluent disposal during extended rainy periods will also be required. In addition, agricultural land use designations are concentrated in the upper regions and will require either pumping of effluent to a high elevation reservoir or directly to the irrigation field itself.

A further constraint on sewage effluent reclamation is the brackish nature of the effluent due to salt water infiltration into sewers. In summary, costs would be considerable where the need is minimal.

Another alternative for effluent disposal is injection wells. Advantages are low construction costs and flexibility in construction staging. Injection of effluent at 5 mgd would mean a possible build-up of contaminants in the groundwater, with the likelihood of seepage into the nearshore coastal waters through fresh water springs present in Hilo Bay. Water supply development near the coastline, although not now intended by the Department of Water Supply, will be severely constrained in the future if injection wells are used.

Major cost items for the injection well alternative include initial construction of the wells and their replacement over a period of time. On the basis of reliability of performance, the injection well disposal method is not as desirable as the ocean outfall alternative.

CHAPTER VII

RELATIONSHIP BETWEEN LONG-TERM AND SHORT-TERM USES OF MAN'S ENVIRONMENT

The practice of implementing individual sewerage systems is a short-term expedient, but proliferation of these systems can lead to problems in the long term. Part of the problem is that these systems rely entirely on land disposal facilities within the populated areas. Malfunctions in the treatment process would have an immediate impact on the populace in the form of health and nuisance problems or nearshore water quality impairment.

By contrast, the centralized sewerage system possesses the factors of economy of scale, reliability of performance and control, and effectiveness absent in the present individual system. With an ocean outfall already in use malfunctioning treatment processes would have a negligible effect on the disposal system and hence on the environment. To take advantage of these factors, the County must construct suitable facilities now and include provisions for handling future flows. This means that larger expenditures must be made, but, in the long run, the total cost to society in terms of tangible and intangible values would be less.

High expenditures required at one time often lead to problems of insufficient funds as other competing demands for municipal services are being satisfied. The result is a delay in construction that, in turn, leaves no alternative but to implement or maintain a small, individual system to satisfy immediate needs. The end result is the same as before without the regional system.

The issue of long-term productivity, therefore, reduces itself to financing, recognizing that those agencies influencing the appropriation of funds must weigh factors on a broader scale of satisfying the many requests and demands for municipal funds.

CHAPTER VIII

IRREVERSIBLE AND IRRETRIEVABLE RESOURCES COMMITTED BY THE PROPOSED ACTION

There are several irreversible commitments of resources, the most prominent being land and capital investment in facilities for collection, transmission, treatment, and disposal of sewage. Additional land area committed to the proposed project will be required for the treatment plant site.

Capital investment in facilities for treatment plants is generally staged over short-term periods to match as closely as practicable the needs arising during those periods. Because of the large investment required, a commitment to certain facilities is almost irreversible.

Commitment of manpower and energy to sustain operations, procurement of supplies, and replacement of defective equipment are required over the long term. From the public's viewpoint, the commitment to the proposed action means a commitment to support these costs through user charges as dictated by Public Law 92-500.

In addition to the capital investments, wastewater effluent which will be disposed of by an ocean outfall system will be an irretrievable resource.

CHAPTER IX

SUMMARY OF UNRESOLVED ISSUES

The major unresolved issue is whether the treatment facility will provide advanced primary or secondary treatment, depending on the outcome of the Hilo County's application to the Environmental Protection Agency for a modified discharge whereby the secondary treatment requirements would be waived. The application was submitted to the EPA on September 7, 1980, and to this date, is still in the process of being evaluated. The review of the waiver applications by EPA is currently running behind schedule and a decision on the waiver application for Hilo is expected in or about 1981 or 1982. In any event, the initiation of the design and construction of the treatment facility will not proceed until a decision of the waiver application for Hilo is made.

CHAPTER X

ORGANIZATIONS AND PERSONS CONSULTED

The following is a list of governmental agencies which were consulted with regards to aspects of the description and impacts of the proposed project:

A. County of Hawaii

1. Planning Department
2. Department of Water Supply
3. Department of Research and Development
4. Department of Parks and Recreation

B. State of Hawaii

1. Department of Planning and Economic Development
2. Department of Health
3. Department of Land and Natural Resources
   Fish and Game Division, Division of State Parks
4. Department of Transportation

C. Federal Government

1. Department of Agriculture, Soil Conservation Service
2. Department of Interior; National Park Service,
   Fish and Wildlife Service
3. Department of Commerce; National Oceanic and
   Atmospheric Administration, National Fisheries Service
4. U.S. Geological Survey, Water Resources Division

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REFERENCES

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APPENDIX A

State of Hawaii Public Health Regulations

as Related to Classification of Water Uses and Water Quality

APPENDIX A

CLASSIFICATION OF WATER USES

A. Classification of Coastal Water Uses

Coastal waters are classified in accordance with the uses to be protected in each class as follows:

1. *Class AA waters*

The uses to be protected in this class of waters are oceanographic research, the support and propagation of shellfish and other marine life, conservation of coral reefs and wilderness areas, compatible recreation, and aesthetic enjoyment.

It is the objective of this class of waters that they remain in as nearly their natural, pristine state as possible with an absolute minimum of pollution from any source. To the extent possible, the wilderness character of such areas shall be protected. No zones of mixing will be permitted in these waters.

The classification of any water area as Class AA shall not preclude other uses of such waters compatible with these objectives and in conformance with the standards applicable to them.

2. *Class A waters*

The uses to be protected in this class of waters are recreational (including fishing, swimming, bathing, and other water-contact sports), aesthetic enjoyment, and the support and propagation of aquatic life.

It is the objective for this class of waters that their use for recreational purposes and aesthetic enjoyment not be limited in any way. Such waters shall be kept clean of any trash, solid materials or oils, and shall not act as receiving waters for any effluent which has not received the best degree of treatment or control practicable under existing technology and compatible with the standards established for this class.

3. *Class B waters*

The uses to be protected in this class of waters are small boat harbors, commercial and industrial shipping, bait fishing, compatible recreation, the support and propagation of aquatic life, and aesthetic enjoyment.

It is the objective for this class of waters that discharges of any pollutant be controlled to the maximum degree possible and that sewage and industrial effluents receive the best degree of treatment control practicable under existing technology and compatible with the standards established for this class.

The Class B designation shall apply only to a limited area next to boat docking facilities in bays and harbors. The rest of the water area in such bay or harbor shall be Class A unless given some other specific designation in Section 5.

Source: Public Health Regulations, Chapter 37-A, Department of Health, State of Hawaii

TABLE A-1

WATER QUALITY STANDARDS OF NEARSHORE WATERS

Parameter	Class A	Class B
Median Coliform Bacteria	<1,000 per 100 ml <2,400 per 100 ml (90% of time)	<1,000 per 100 ml (90% of time)
Fecal Coliform (arithmetic mean)	<200 per 100 ml for 30-day period	<400 per 100 ml for 30-day period
pH	One-half unit difference from natural conditions but 7.0 and 8.5 from other than natural causes	
Total Phosphorus	<0.025 mg/l	<0.030 mg/l
Total Nitrogen	<0.15 mg/l	<0.20 mg/l
Dissolved Oxygen	<5.0 mg/l	<4.5 mg/l
Turbidity (extinction coefficient)	Not more than 10% from natural conditions	Not more than 20% from natural conditions

Source: Chapter 37A, Public Health Regulations, Department of Health, State of Hawaii.

APPENDIX B

Shoreline Water Quality Data

Water quality data included in this appendix represent the tabulated summary of data gathered by the State Department of Health as part of their shoreline monitoring program. The data represent a cross section of points of sampling scattered throughout the study area.

TABLE B-1

SHORELINE WATER QUALITY DATA

(See Figure V-2 for sampling station locations)

Station Number	Statistical Parameter	Water Quality Parameters (mg/l unless otherwise specified)									
		Coliform (no. per 100 ml)		pH	TDS	Temp (oC)	Turbidity (JTU)	$NO_2 + NO_3$	Nitrogen Kjeldahl	Total	Total-P
		Total	Fecal								
1100 Baker's Beach	Median	240	23	7.60							
	Mean	380	145	7.60							
	Range	7-2,400	3-2,400	7.60-7.60							
Class B	Samples	21	21	6							
1101 Coconut Island	Median	-	4	7.60			1.4	0.055	0.16	0.270	0.026
	Mean	390	6	7.60			1.4	0.065	0.18	0.243	0.026
	Range	0-2,400	3-15	7.60-7.60			-	0.02-0.13	0.01-0.39	0.02-0.41	0.020-0.031
Class B	Samples	66	20	17			1	4	4	4	4
1102 Exit of Pond	Median	1,300	240	7.60							
	Mean	3,140	312	7.60							
	Range	4-2,400	4-1,100	7.60-7.60							
Class B	Samples	80	40	11							
1105 Hilo Bay (Boat Landing)	Median	700		7.60							
	Mean	1,350		7.60							
	Range	240-2,400		7.60							
Class B	Samples	11		7							
1107 Hilo Bay (Mocheau Park)	Median	460	23	7.00							
	Mean	710	23	7.60							
	Range	7-2,400	-	7.60-7.60							
Class B	Samples	10	1	2							
1121 Leleiwi Beach Park	Median	1,100	315								
	Mean	1,610	657								
	Range	150-11,000	9-2,400								
Class A	Samples	38	38								
1122 Halii	Median	240	9	7.60							
	Mean	1,055	34	7.60							
	Range	15-11,000	4-240	7.60-7.60							
Class B	Samples	20	19	7							

Table B-1, Cont.

Station Number	Statistical Parameter	Water Quality Parameters (mg/l unless otherwise specified)									
		Coliform (no. per 100 ml)		pH	TDS	Temp (oC)	Turbidity (JTU)	NO2 + NO3	Nitrogen Kjeldahl	Total	Total-P
		Total	Fecal								
1123 Naniloa Hotel	Median	43	3	7.60							
	Mean	177	16	7.60							
	Range	7-1,100	3-93	7.60-7.60							
Class B	Samples	19	19	7							
1124 Onekahakaha Sea Wall	Median	12	8								
	Mean	160	27								
Class A	Range	3-2,400	3-240								
	Samples	38	38								
1125 Onekahakaha Shoreline	Median	58	6	7.60							
	Mean	120	23	7.60							
	Range	3-460	4-240	7.60-7.60							
Class A	Samples	20	20	7							
1128 Puhi Bay #1	Median	20	6	8.3	35,700	25	0.65	0.033	0.06	0.13	0.015
	Mean	135	27	8.3	35,700	25	2.36	0.048	0.11	0.15	0.016
Class B	Range	0-2,400	4-9	-	-	-	0-9.42	0.010-0.14	0.01-0.5	0.02-0.51	0.005-0.026
	Samples	46	4	1	1	1	7	10	10	10	7
1129 Puhi Bay #2	Median	240	33	7.60							
	Mean	480	44	7.60							
Class B	Range	23-2,400	15-93	7.60-7.60							
	Samples	40	4	27							
1130 Puhi Bay #3	Median	26	6	7.60							
	Mean	195	9	7.61							
Class B	Range	0-2,400	4-21	7.60-7.90							
	Samples	46	4	27							

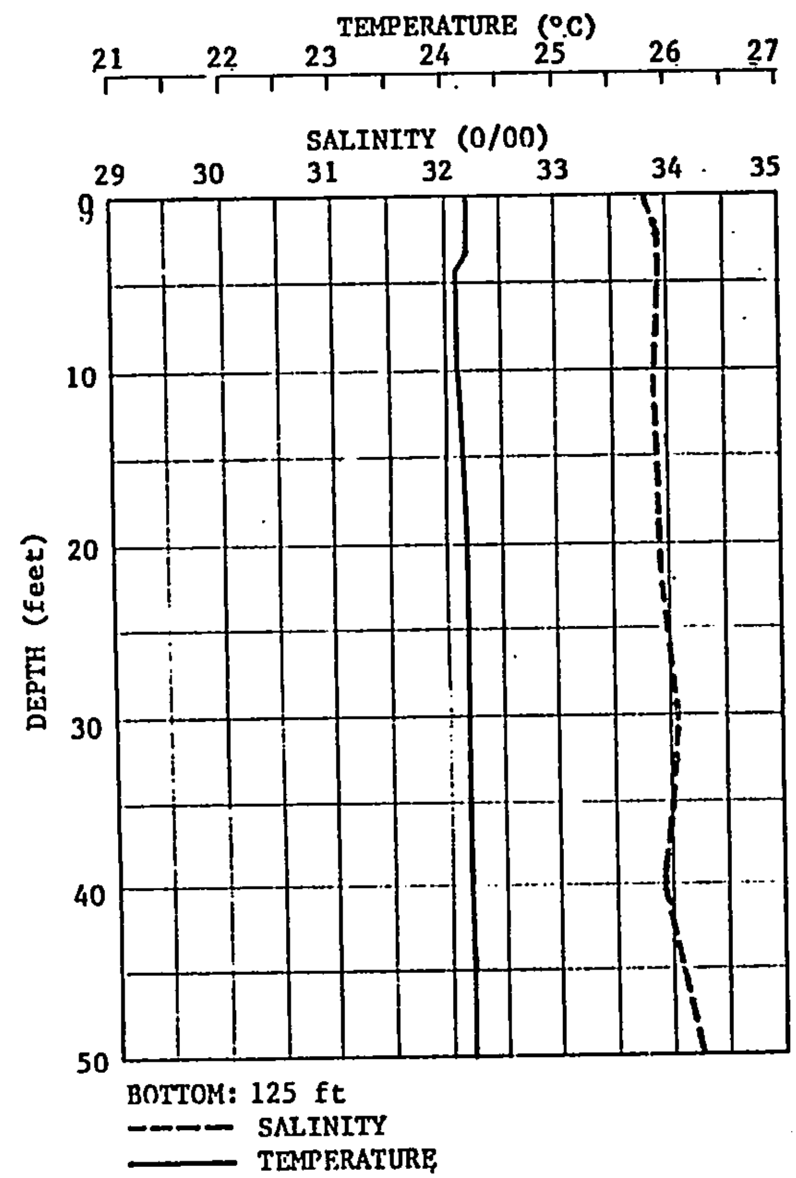
APPENDIX C

Salinity - Temperature Profiles in Hilo Bay

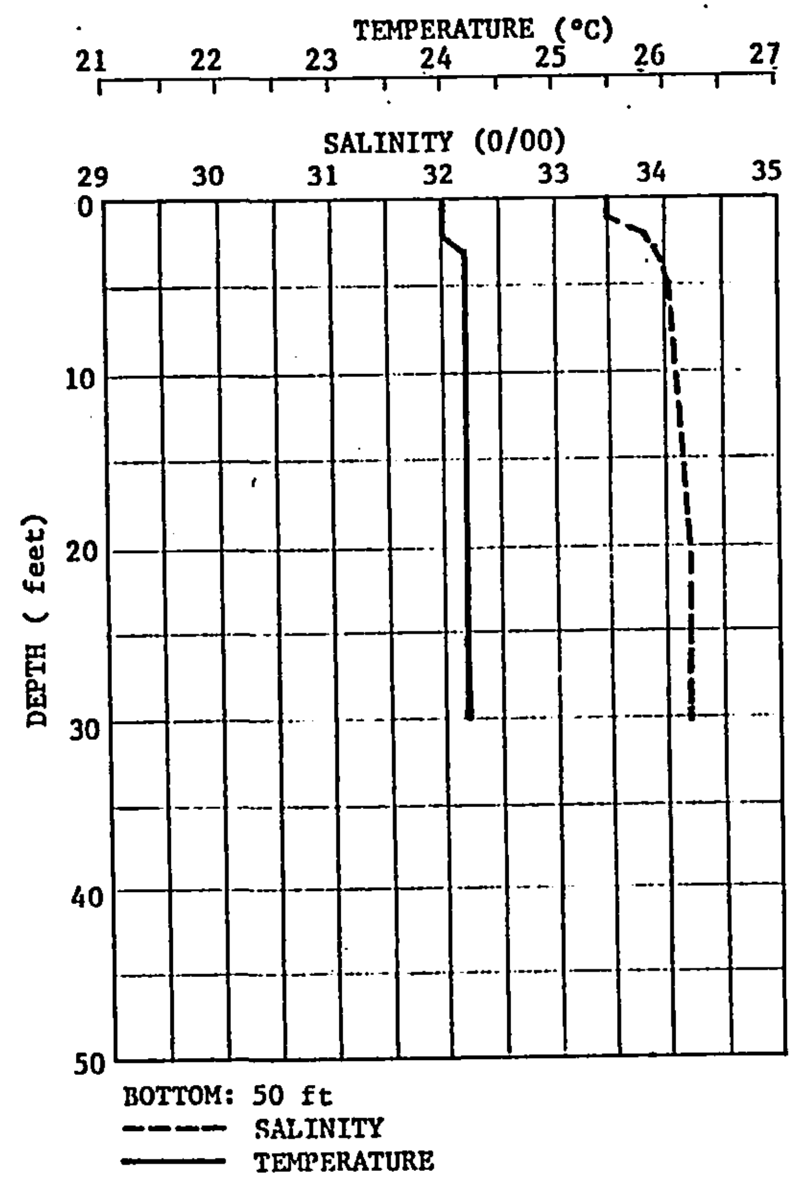
SALINITY-TEMPERATURE PROFILES

DATE: December 14, 1976

WATER QUALITY STATION: 1   TIME: 0913



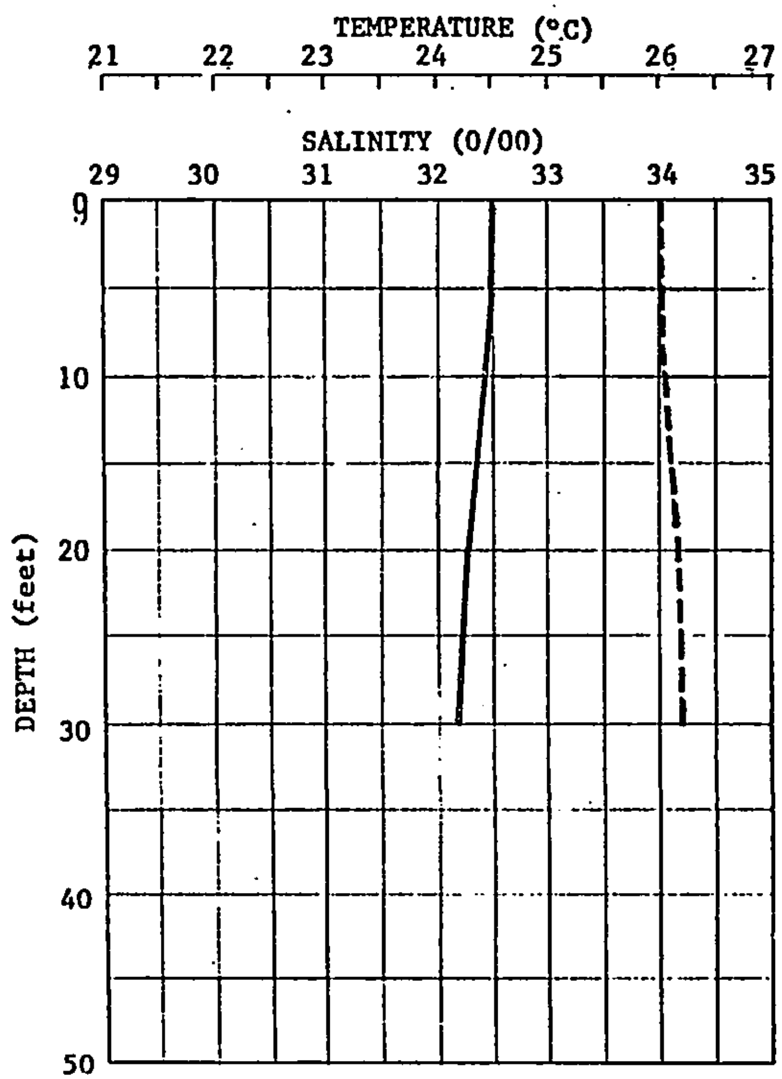
WATER QUALITY STATION: 2   TIME: 0940



SALINITY-TEMPERATURE PROFILES

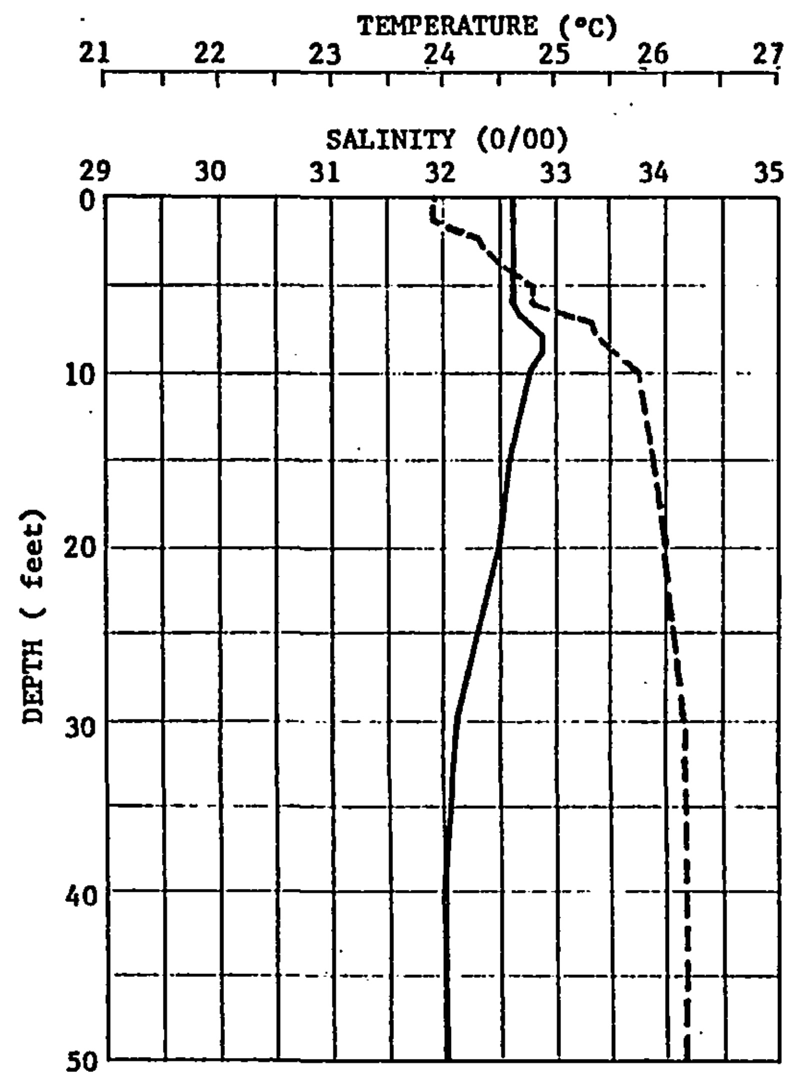
DATE: December 14, 1976

WATER QUALITY STATION: 3 TIME: 1420



BOTTOM: 33 ft
----- SALINITY
—— TEMPERATURE

WATER QUALITY STATION: 4 TIME: 1440

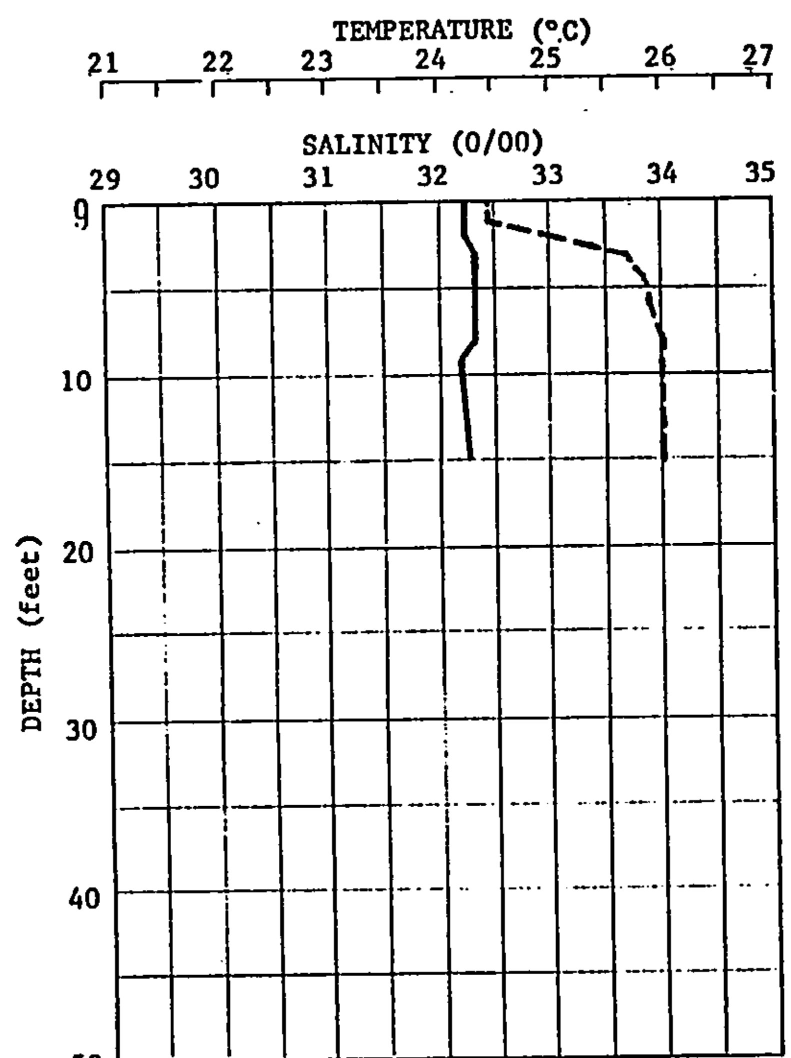


BOTTOM: 55 ft
----- SALINITY
—— TEMPERATURE

SALINITY-TEMPERATURE PROFILES

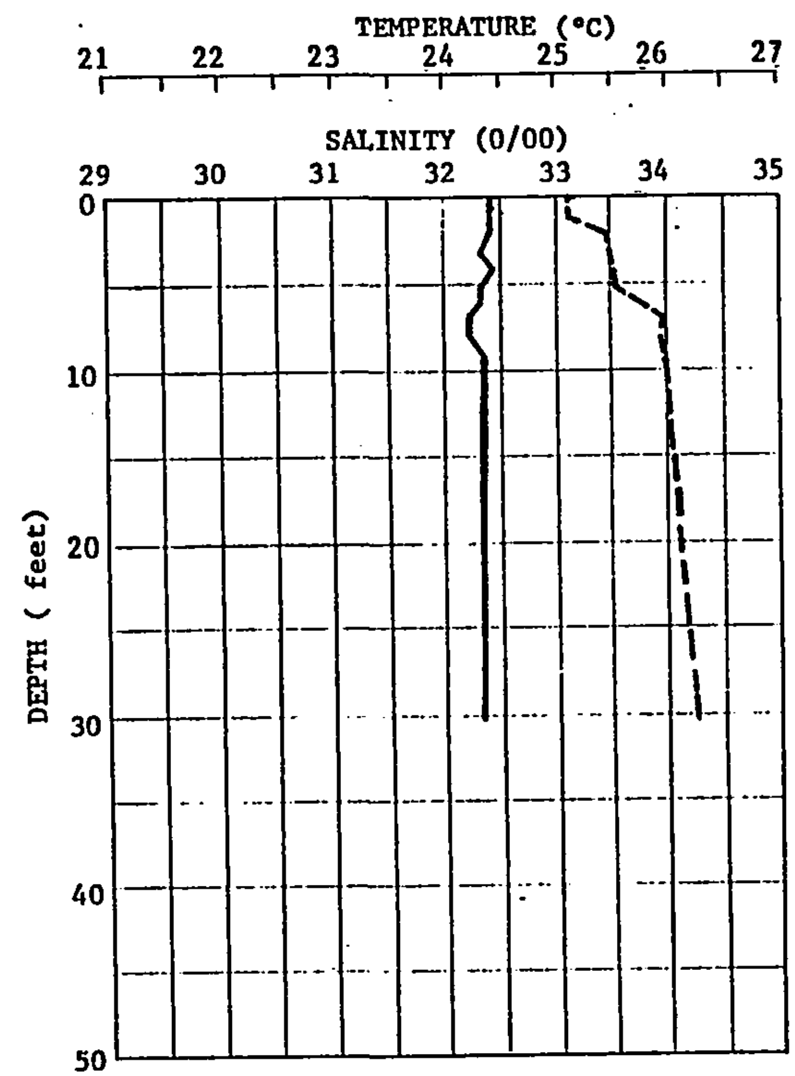
DATE: December 14, 1976

WATER QUALITY STATION: 5 TIME: 1242



BOTTOM: 16 ft
---- SALINITY
—— TEMPERATURE

WATER QUALITY STATION: 6 TIME: 1220

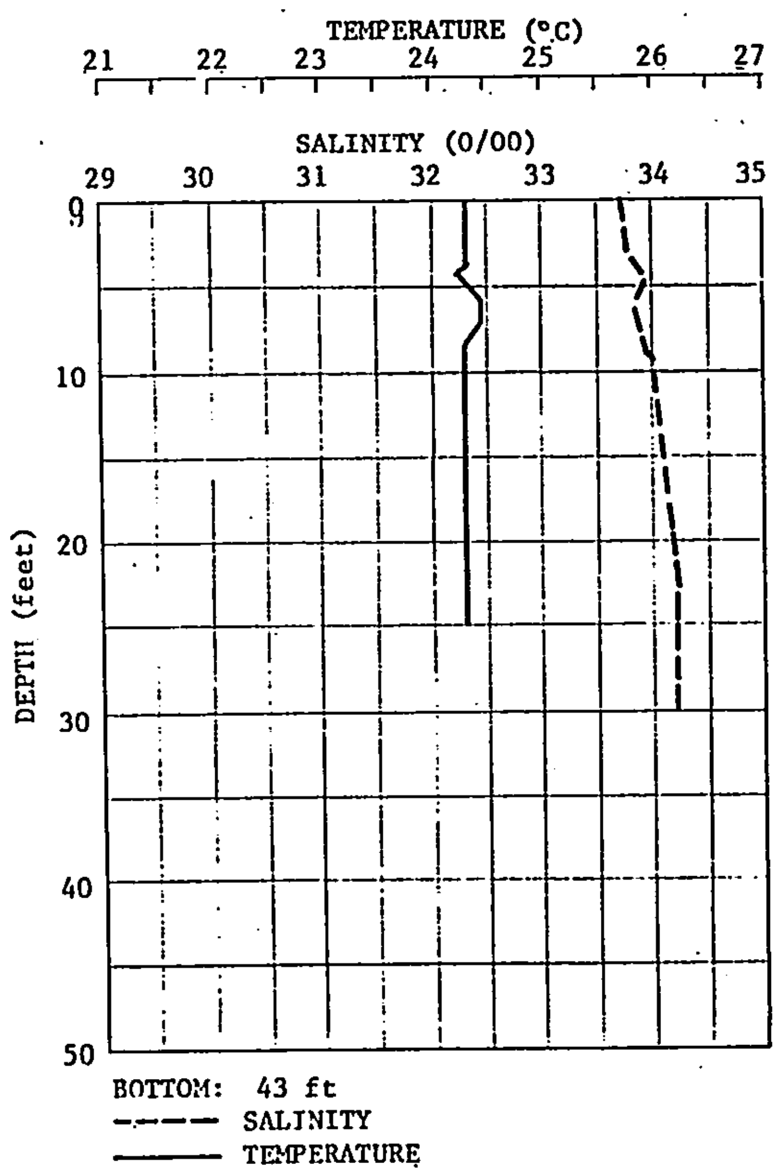


BOTTOM: 35 ft
---- SALINITY
—— TEMPERATURE

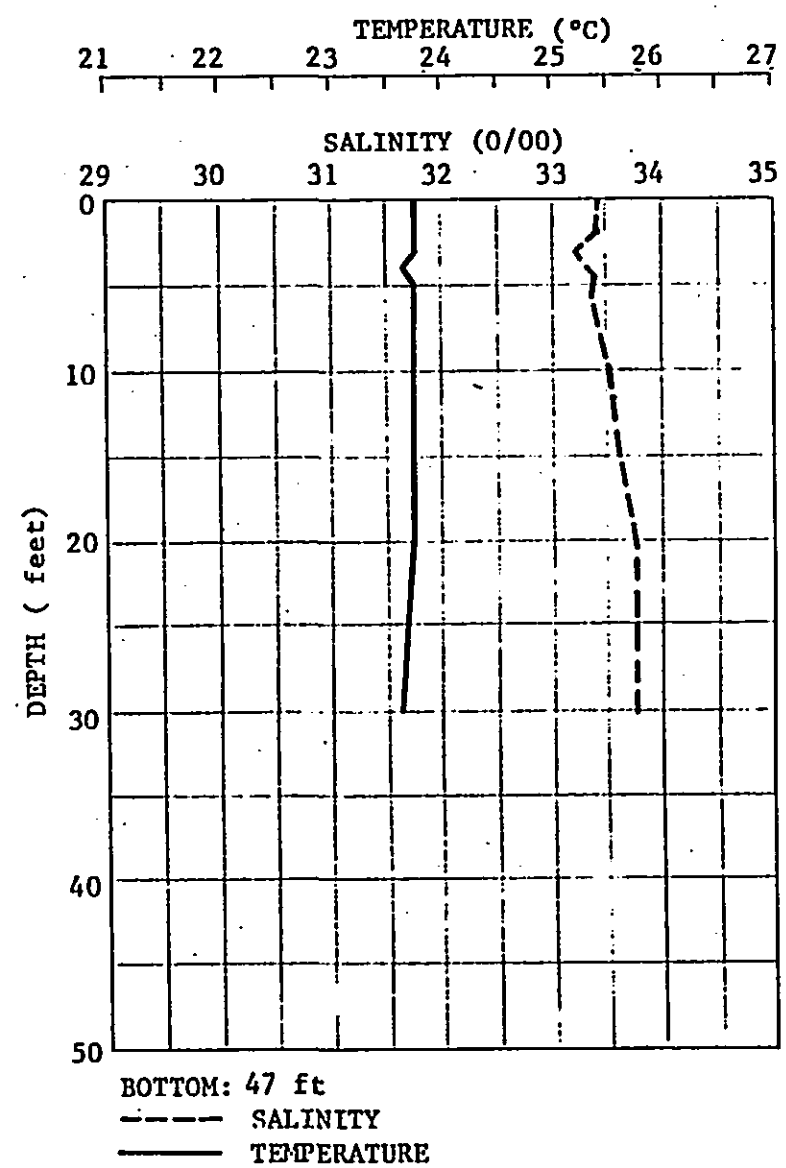
SALINITY-TEMPERATURE PROFILES

DATE: December 14, 1976

WATER QUALITY STATION: 7 TIME: 1115



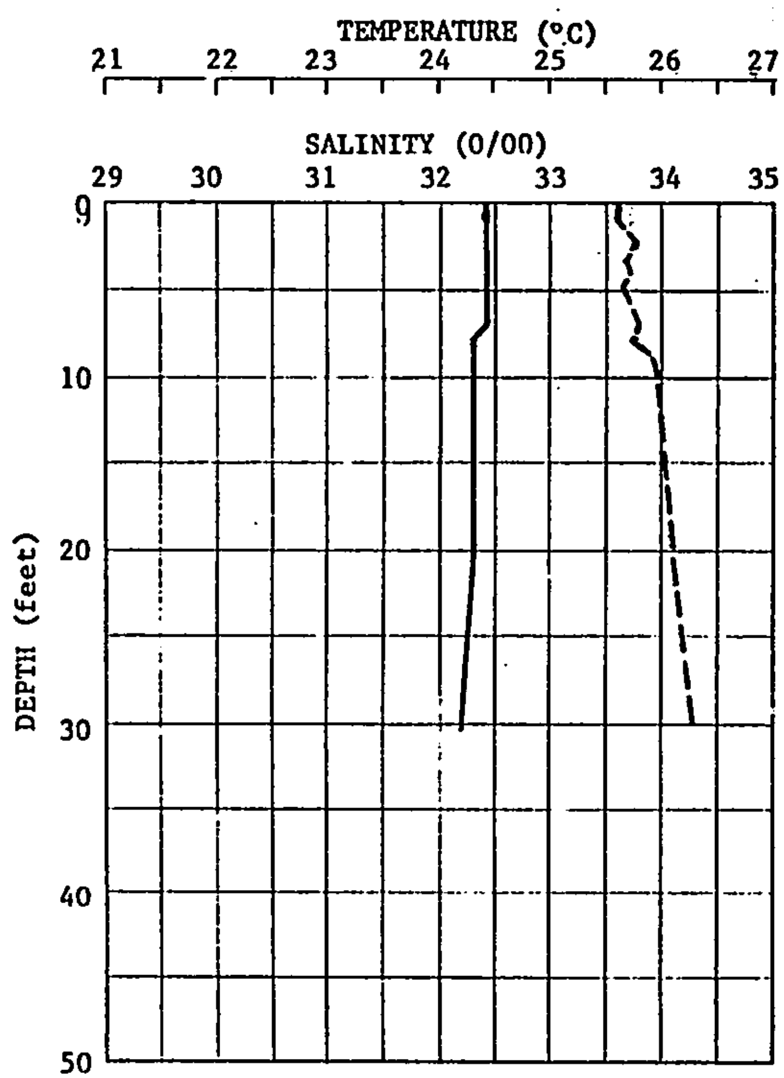
WATER QUALITY STATION: 8 TIME: 1025



SALINITY-TEMPERATURE PROFILES

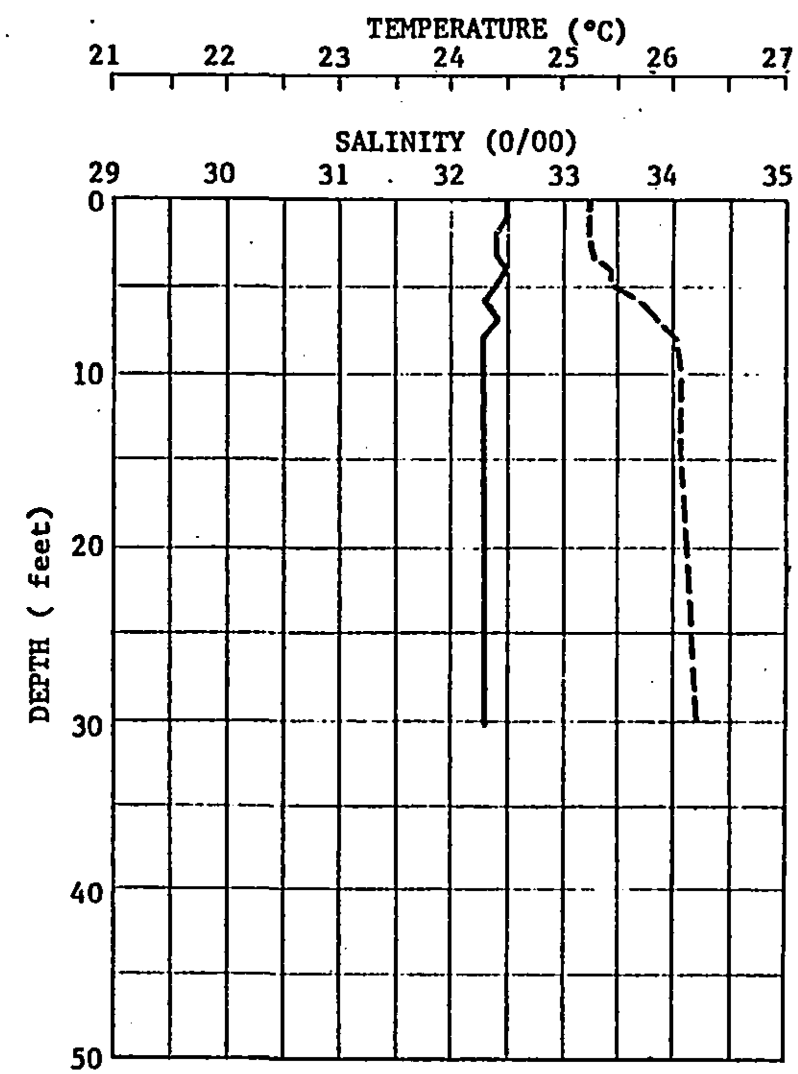
DATE: December 14, 1976

WATER QUALITY STATION: 9 TIME: 1328



BOTTOM: 65 ft
---- SALINITY
—— TEMPERATURE

WATER QUALITY STATION: 10 TIME: 1200

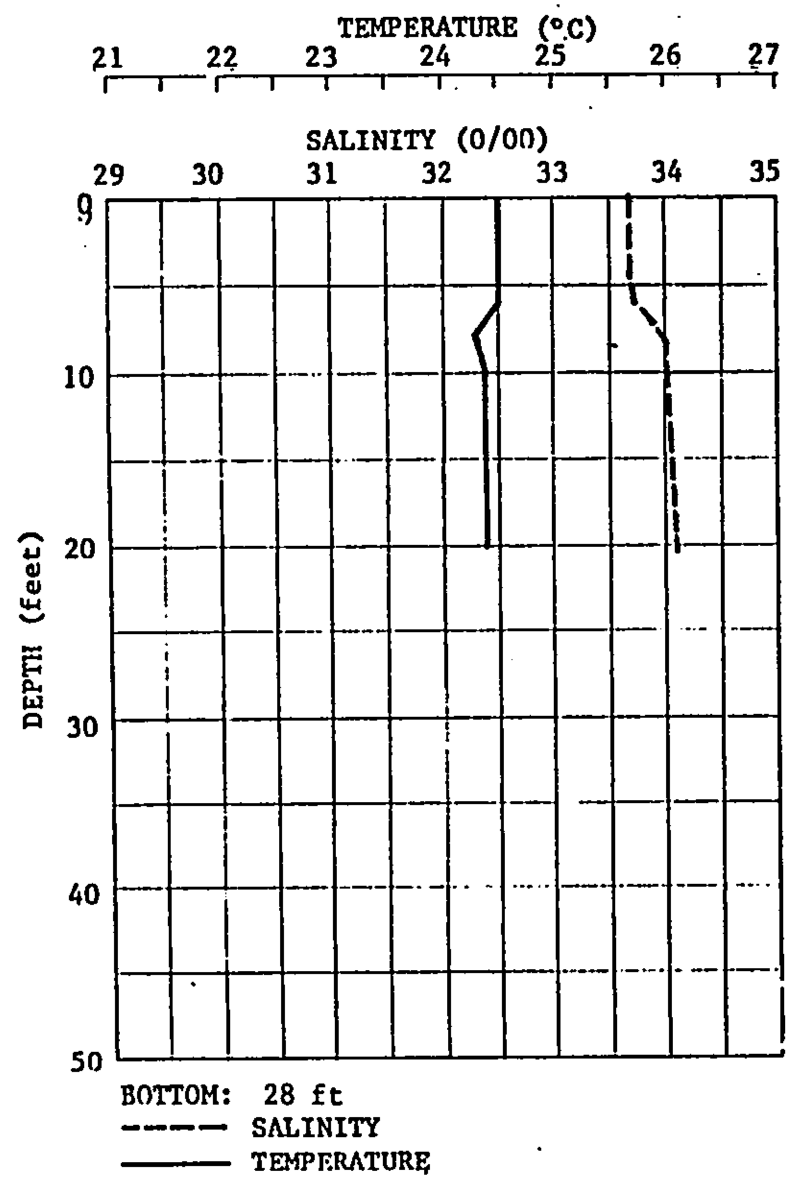


BOTTOM: 37 ft
---- SALINITY
—— TEMPERATURE

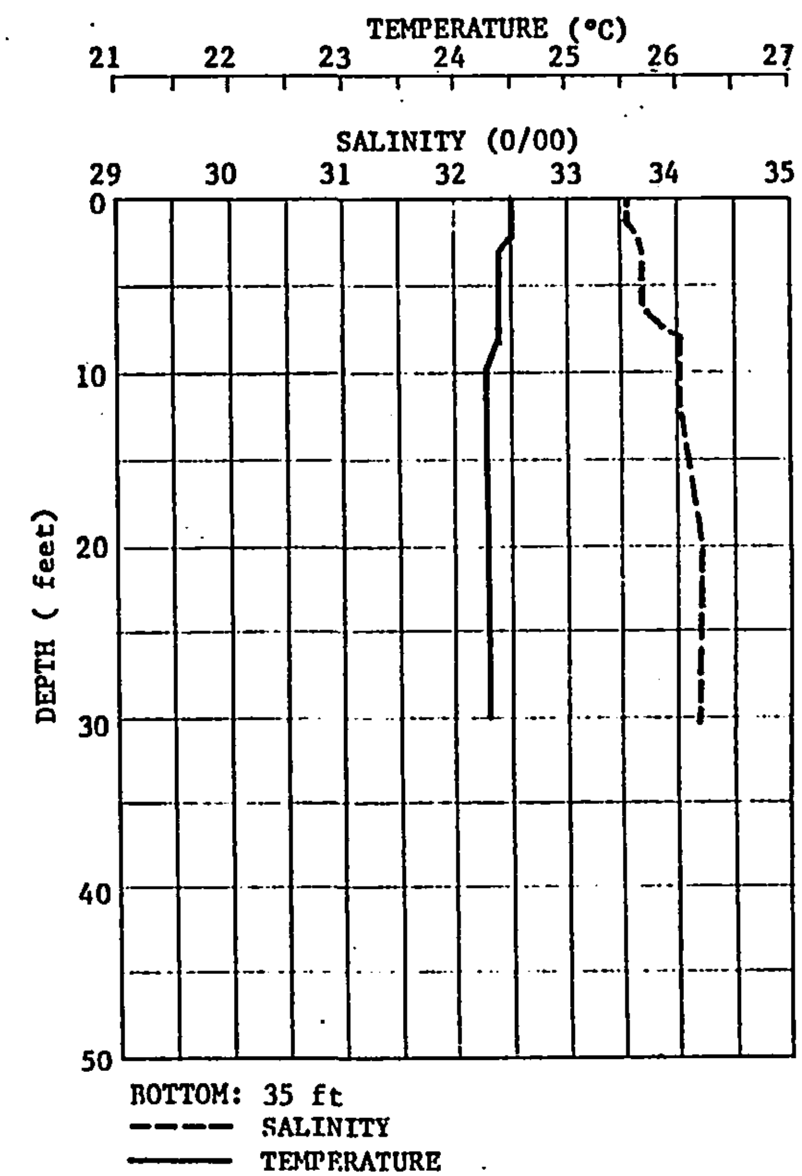
SALINITY-TEMPERATURE PROFILES

DATE: December 14, 1976

WATER QUALITY STATION: 11 TIME: 1358



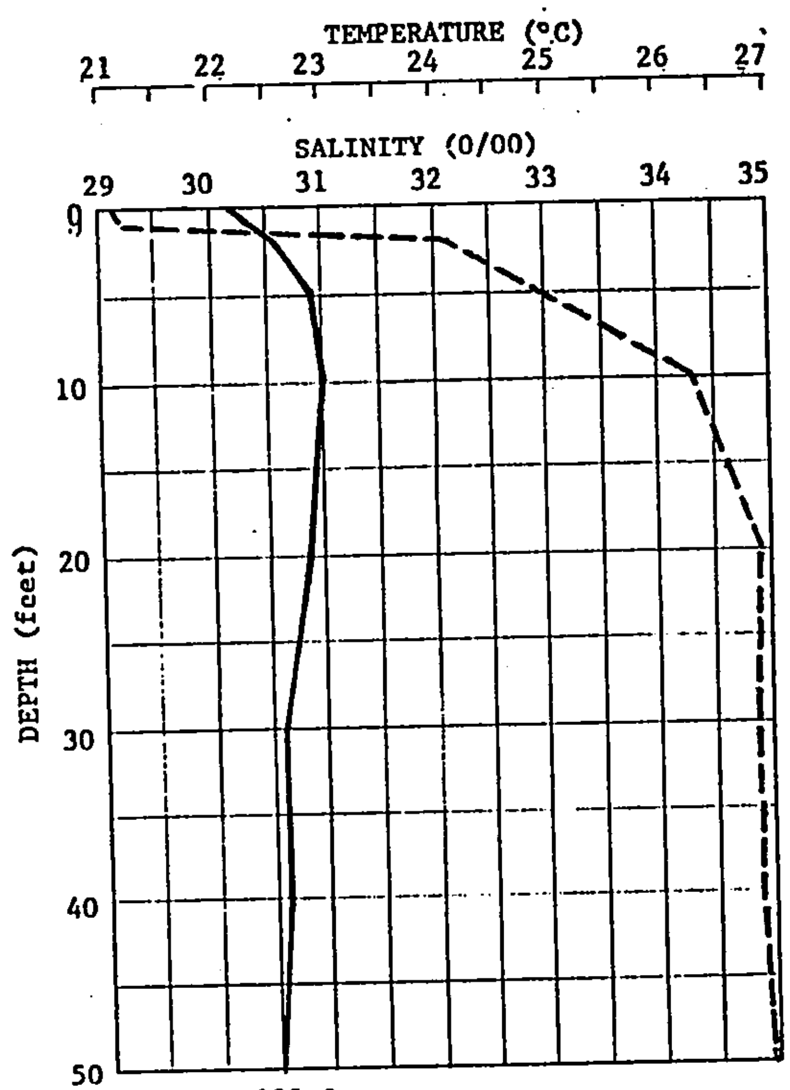
WATER QUALITY STATION: 12 TIME: 1349



SALINITY-TEMPERATURE PROFILES

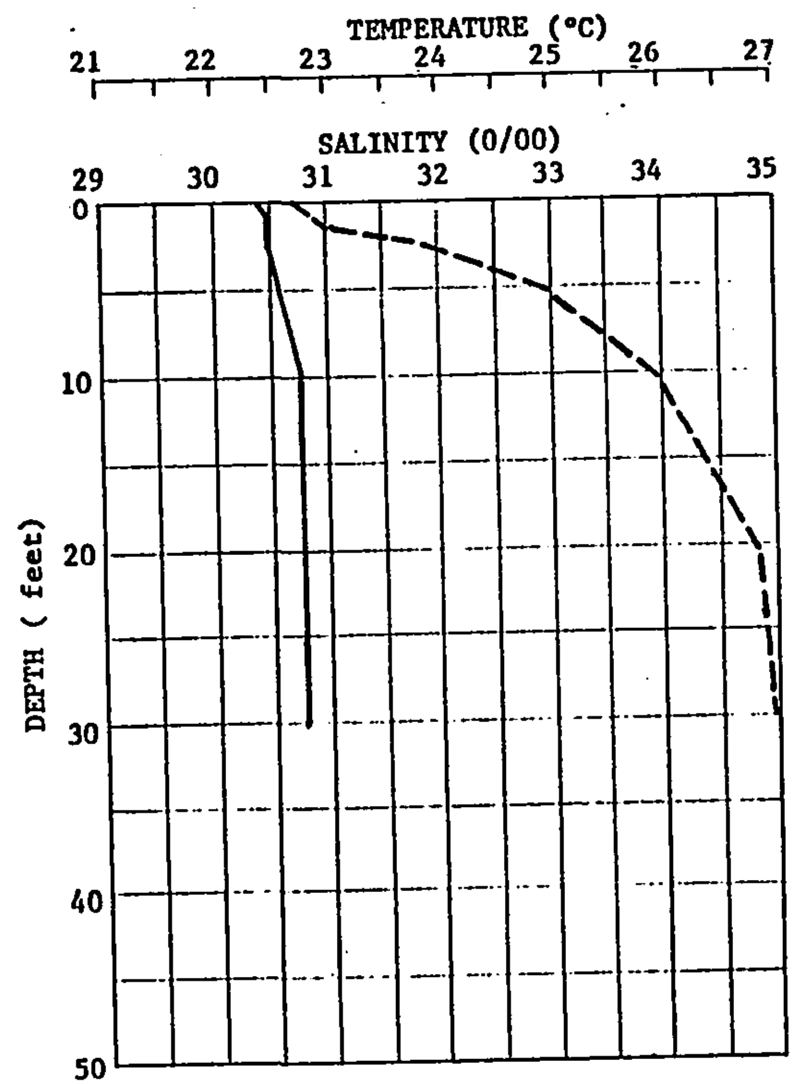
DATE: April 12, 1977

WATER QUALITY STATION: 1   TIME: 0930



BOTTOM: 125 ft
- - - - SALINITY
——— TEMPERATURE

WATER QUALITY STATION: 2   TIME: 1010

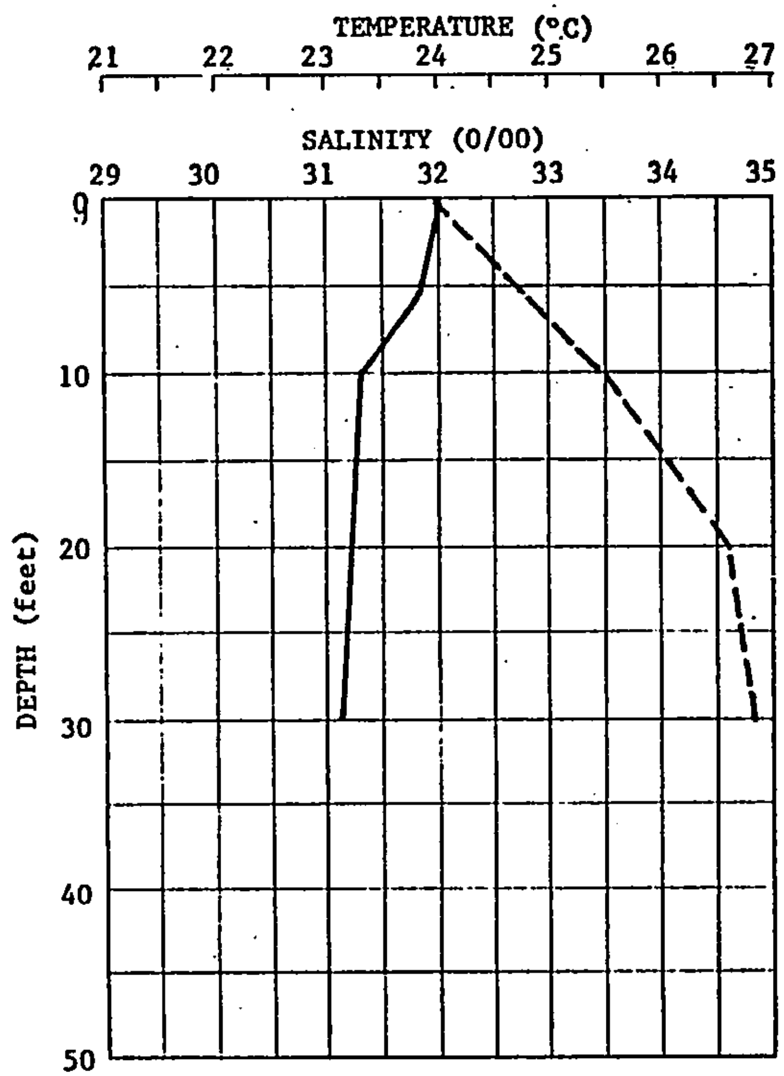


BOTTOM: 50 ft
- - - - SALINITY
——— TEMPERATURE

SALINITY-TEMPERATURE PROFILES

DATE: April 12, 1977

WATER QUALITY STATION: 3 TIME: 1450



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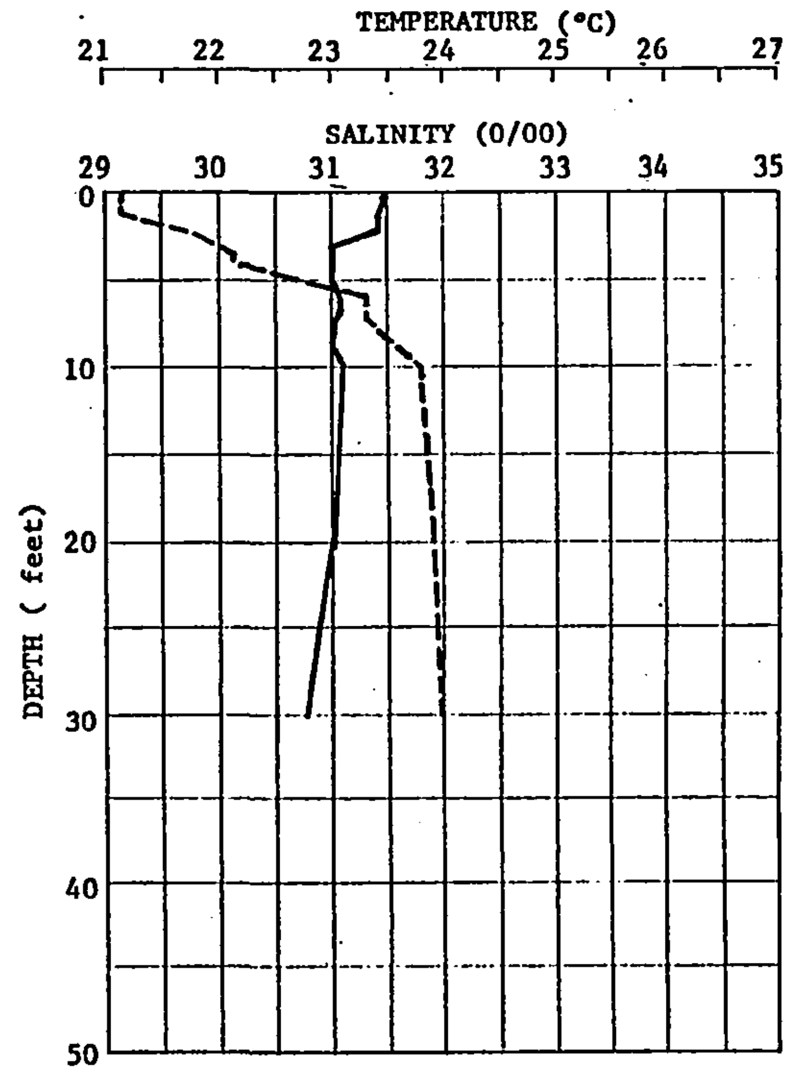
----- SALINITY
—— TEMPERATURE

WATER QUALITY STATION: 4 TIME: 1515



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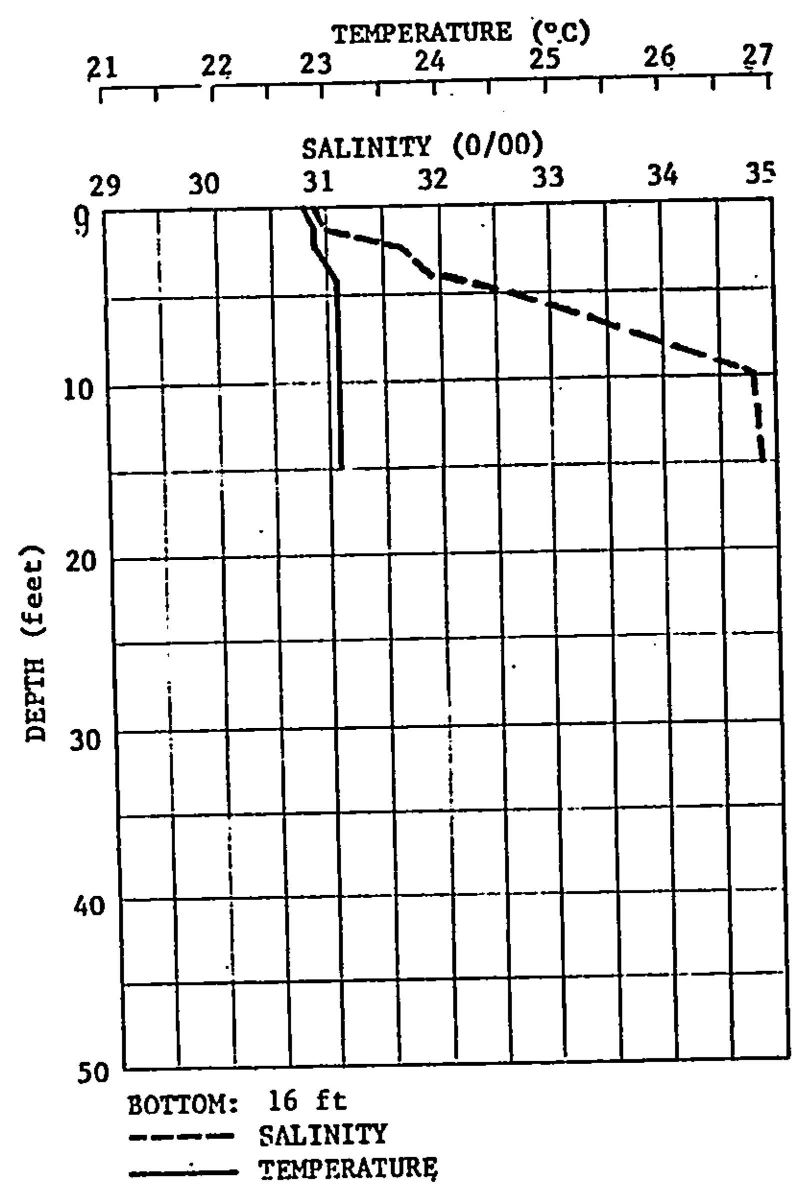
----- SALINITY
—— TEMPERATURE

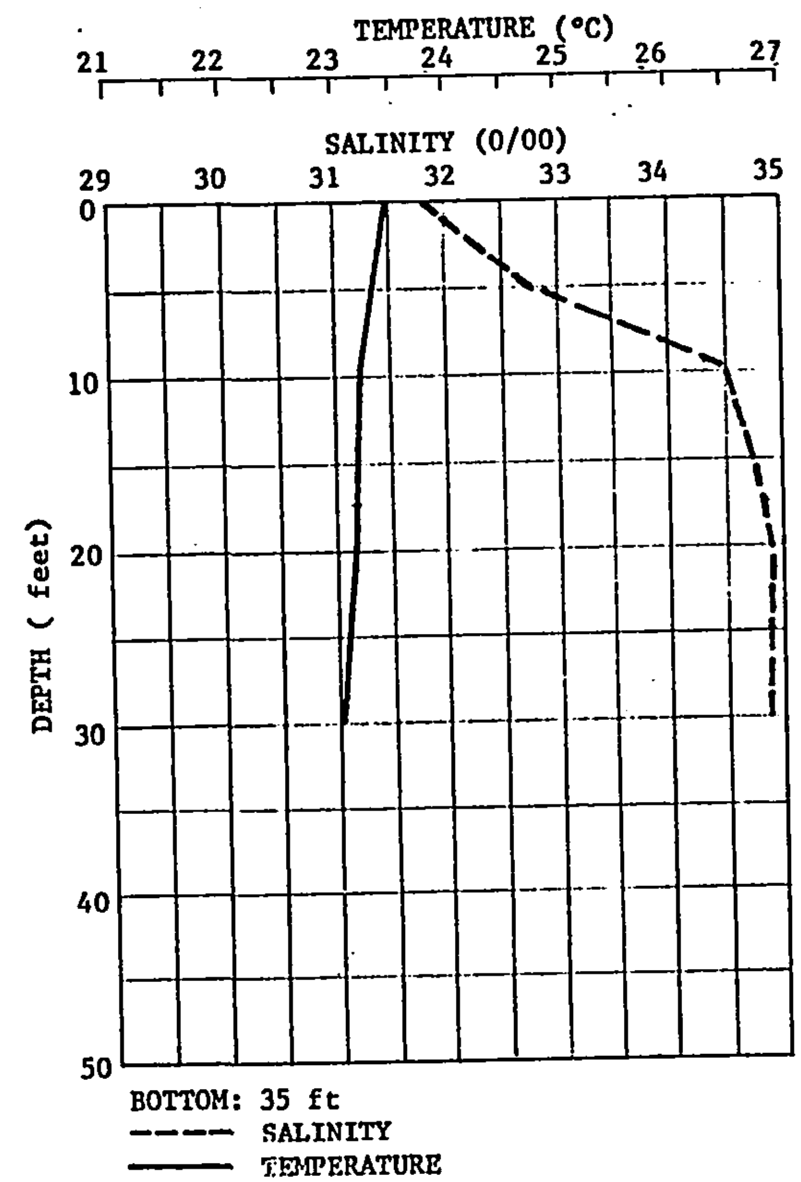
SALINITY-TEMPERATURE PROFILES

DATE: April 12, 1977

WATER QUALITY STATION: 5 TIME: 1120



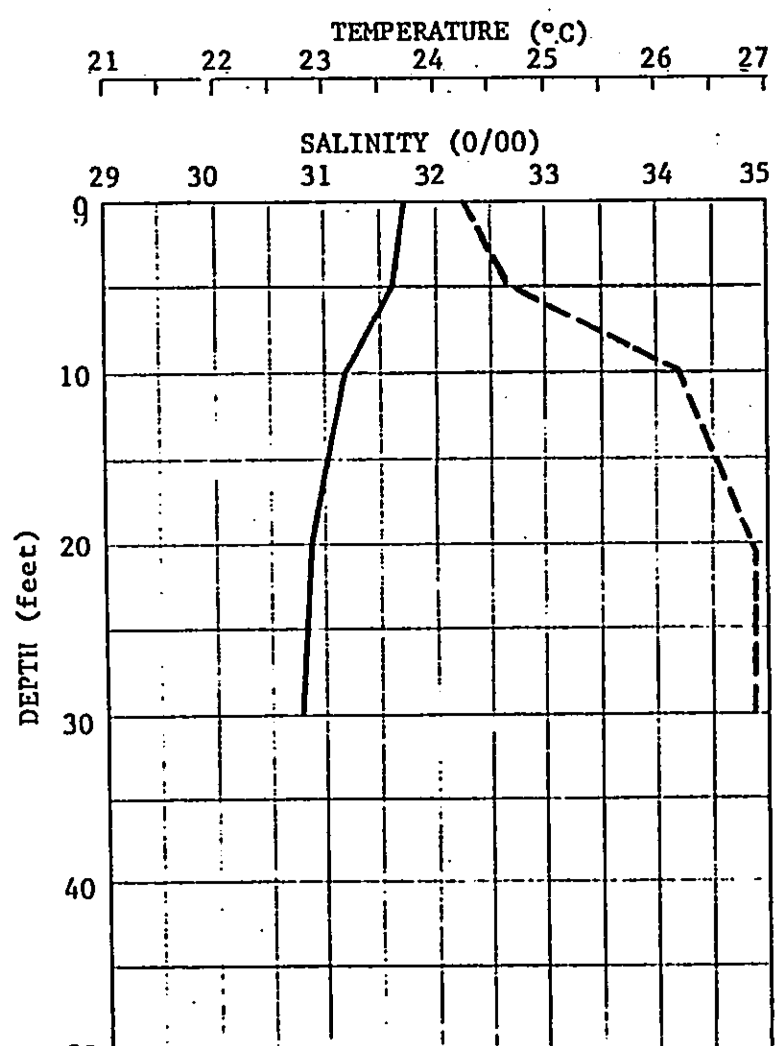
WATER QUALITY STATION: 6 TIME: 1235



SALINITY-TEMPERATURE PROFILES

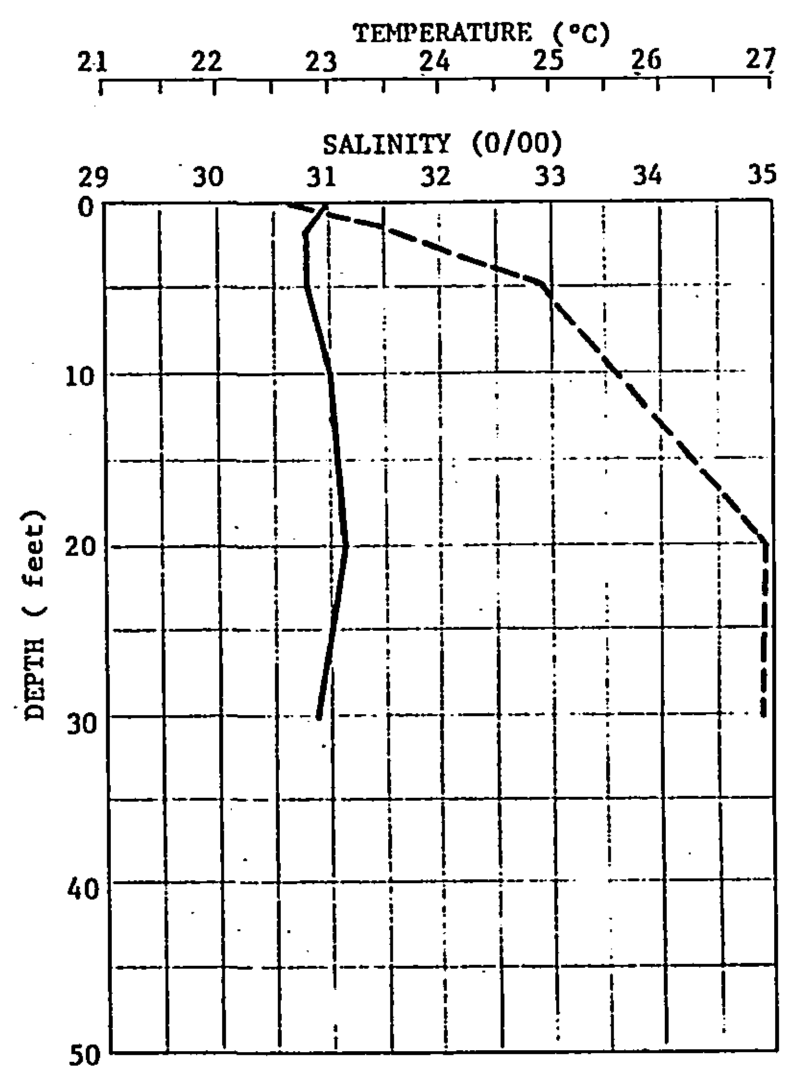
DATE: April 12, 1977

WATER QUALITY STATION: 8 TIME: 1410



BOTTOM: 47 ft
---- SALINITY
—— TEMPERATURE

WATER QUALITY STATION: 9 TIME: 1045

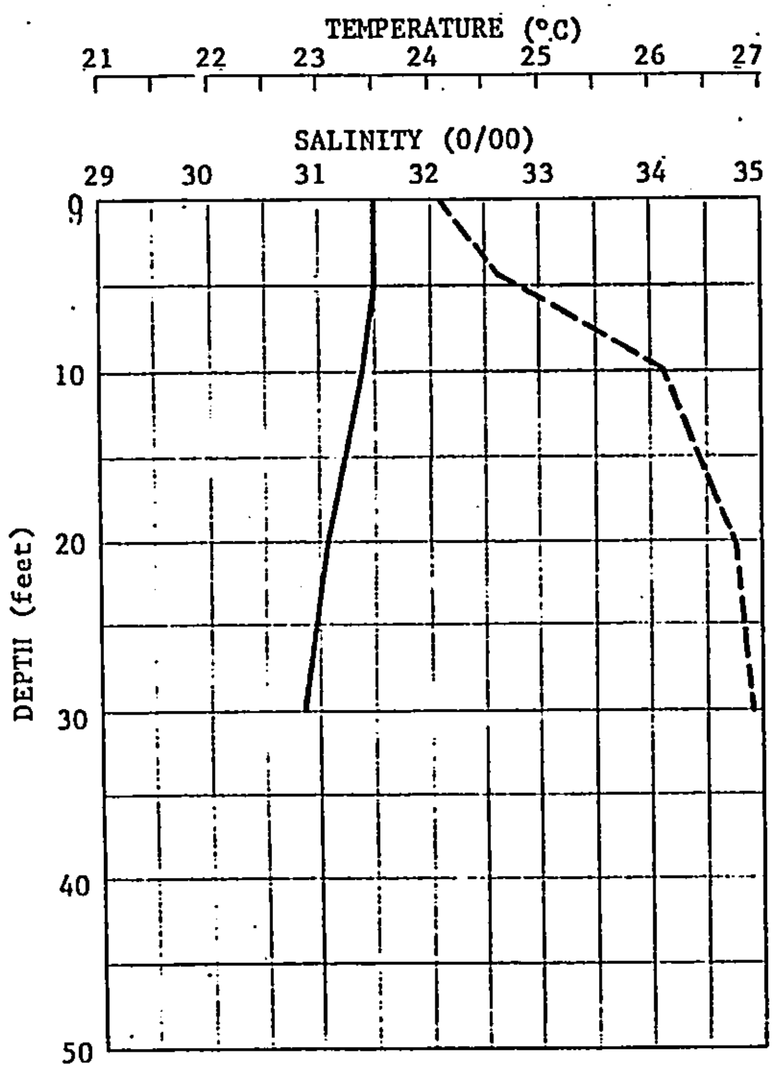


BOTTOM: 65 ft
---- SALINITY
—— TEMPERATURE

SALINITY-TEMPERATURE PROFILES

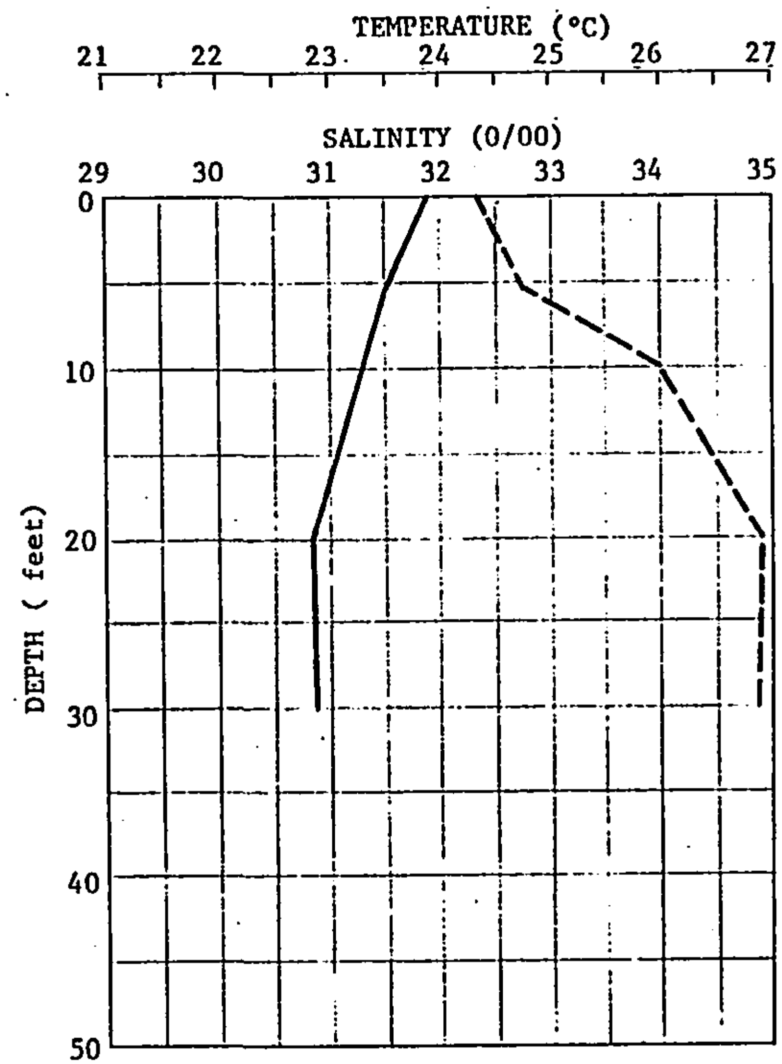
DATE: April 12, 1977

WATER QUALITY STATION: 10 TIME: 1255



BOTTOM: 37 ft
- - - - SALINITY
——— TEMPERATURE

WATER QUALITY STATION: 11 TIME: 1325

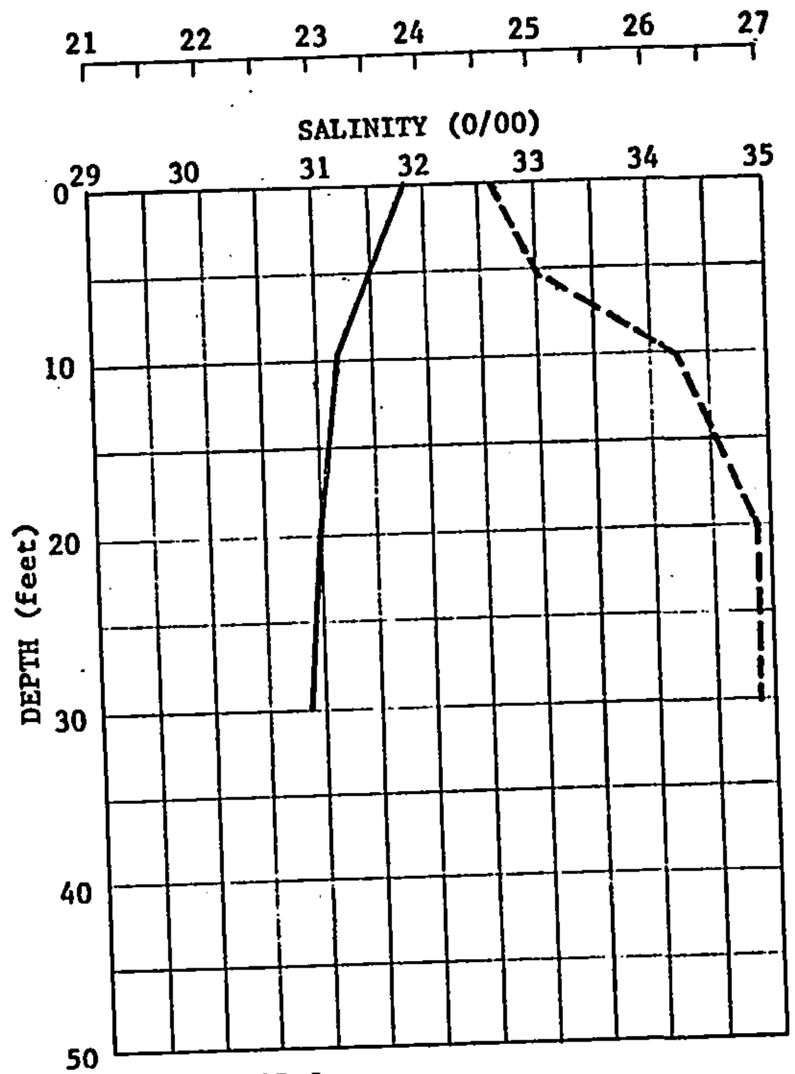


BOTTOM: 28 ft
- - - - SALINITY
——— TEMPERATURE

SALINITY-TEMPERATURE PROFILES

DATE: April 12, 1977

WATER QUALITY STATION: 12 TIME: 1345

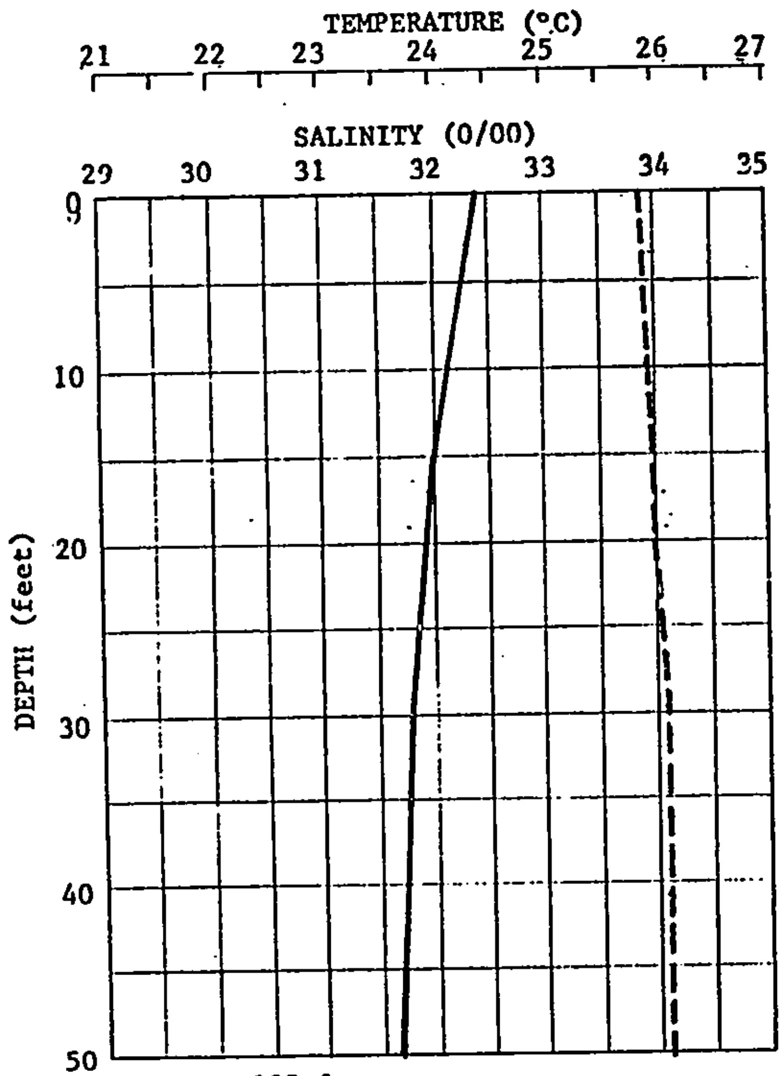


BOTTOM: 35 ft
----- SALINITY
—— TEMPERATURE

SALINITY-TEMPERATURE PROFILES

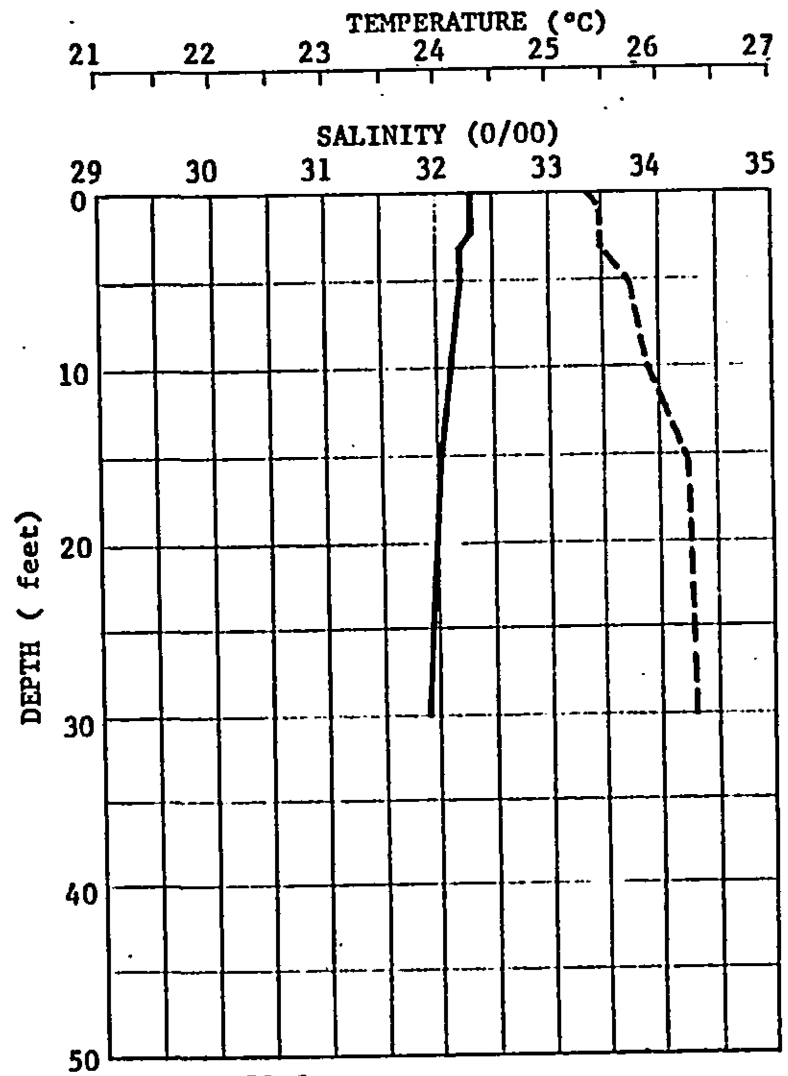
DATE: June 8, 1977

WATER QUALITY STATION: 1 TIME: 1230



BOTTOM: 125 ft
- - - - SALINITY
——— TEMPERATURE

WATER QUALITY STATION: 2 TIME: 1308

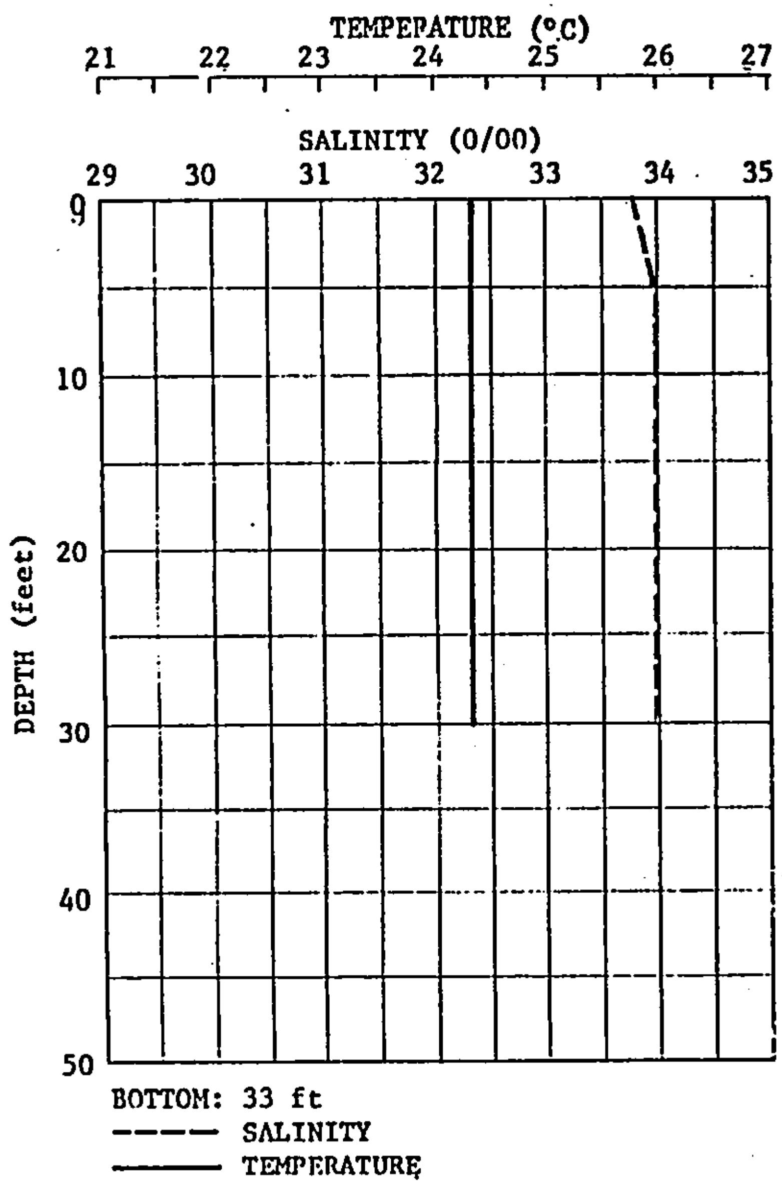


BOTTOM: 50 ft
- - - - SALINITY
——— TEMPERATURE

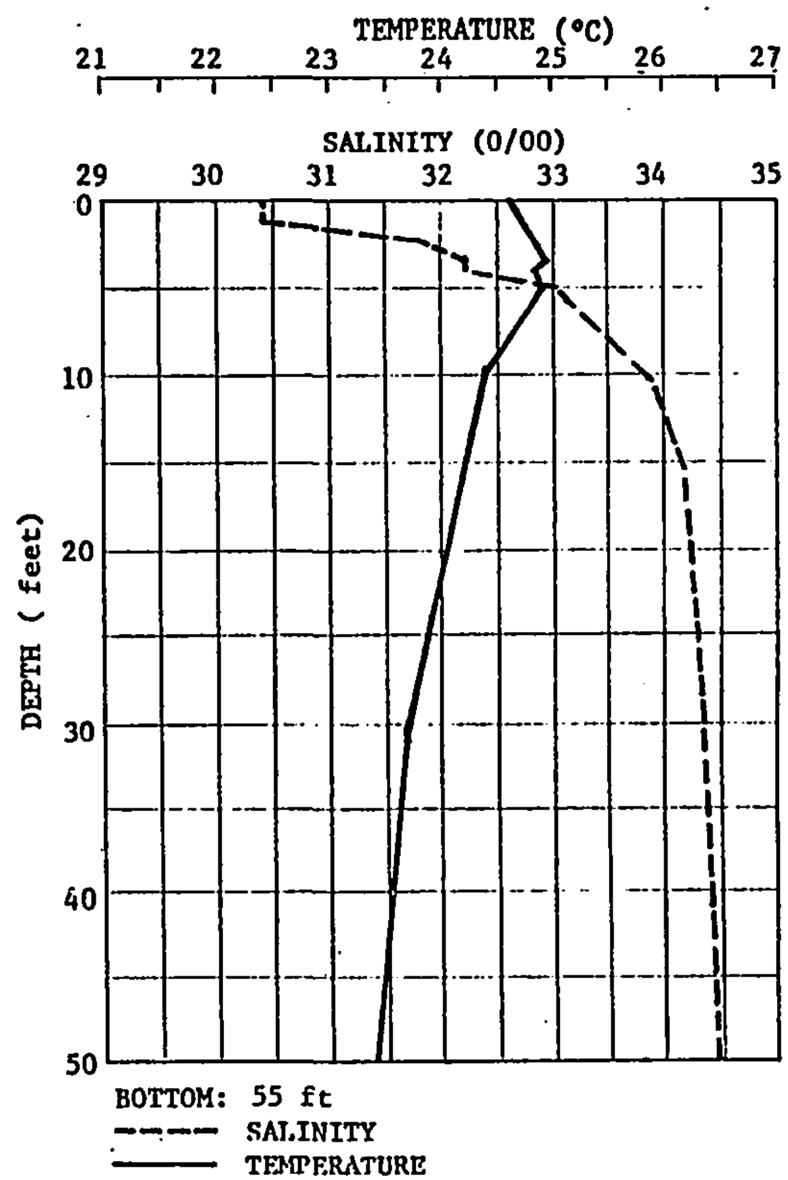
SALINITY-TEMPERATURE PROFILES

DATE: June 8, 1977

WATER QUALITY STATION: 3 TIME: 1650



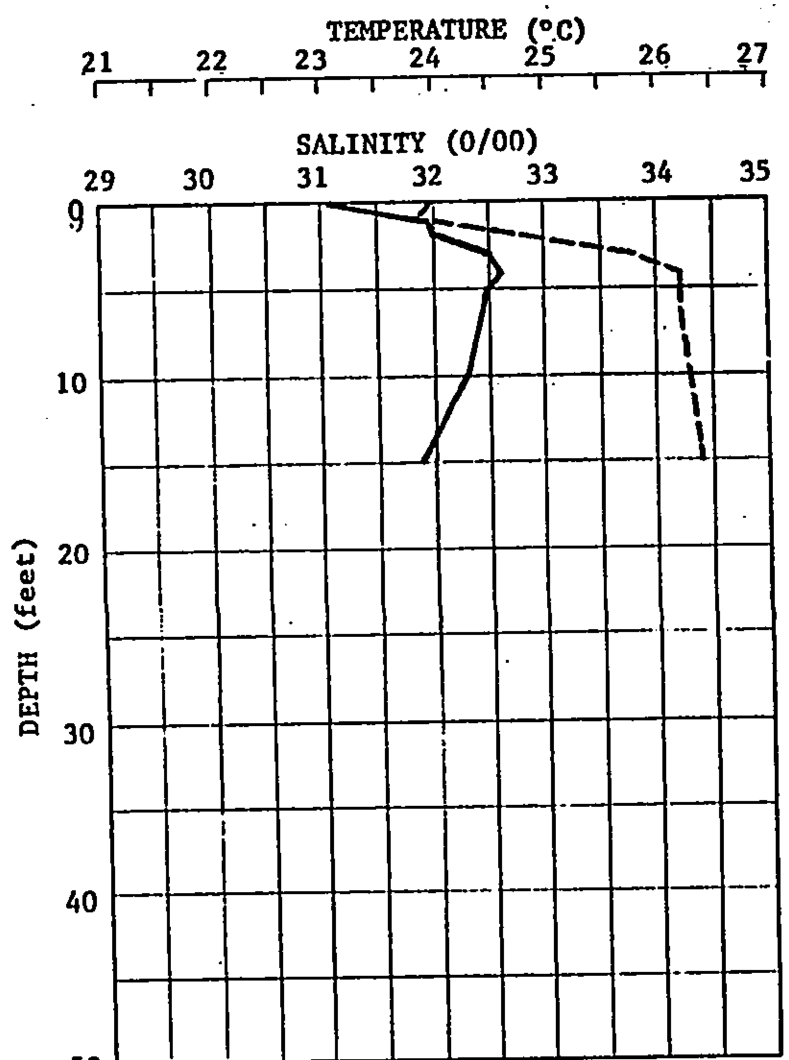
WATER QUALITY STATION: 4 TIME: 1710



SALINITY-TEMPERATURE PROFILES

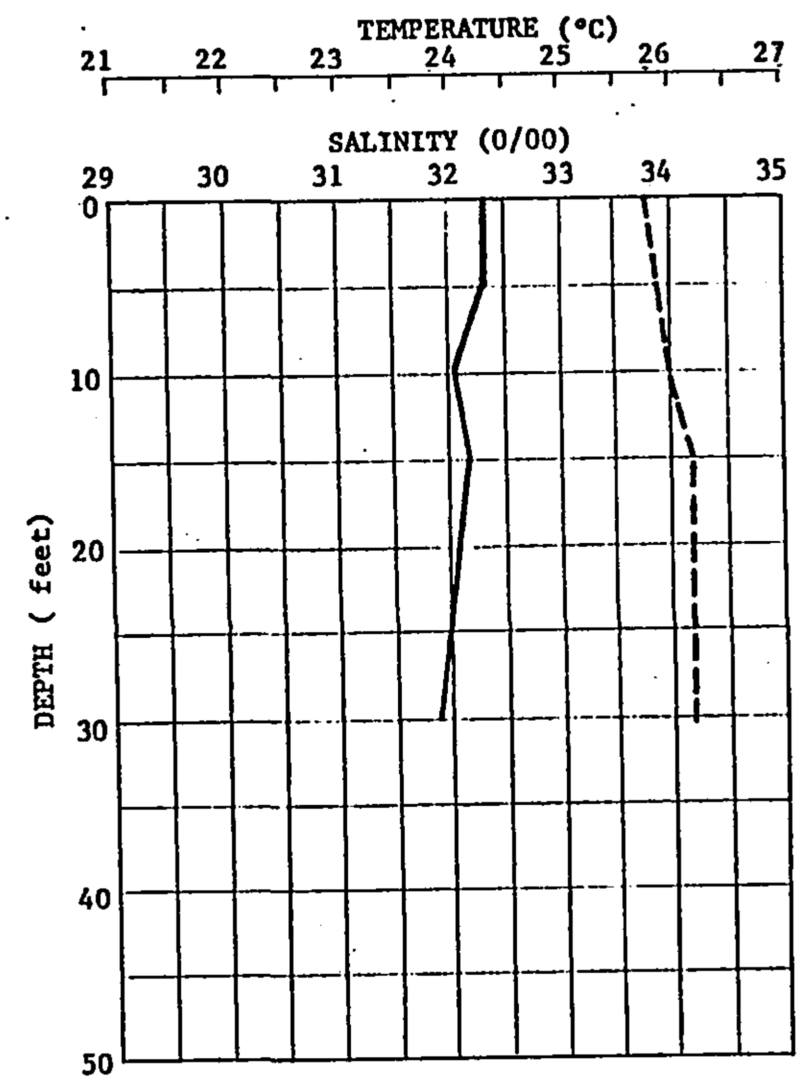
DATE: June 8, 1977

WATER QUALITY STATION: 5 TIME: 1337



BOTTOM: 16 ft
- - - - SALINITY
——— TEMPERATURE

WATER QUALITY STATION: 6 TIME: 1435

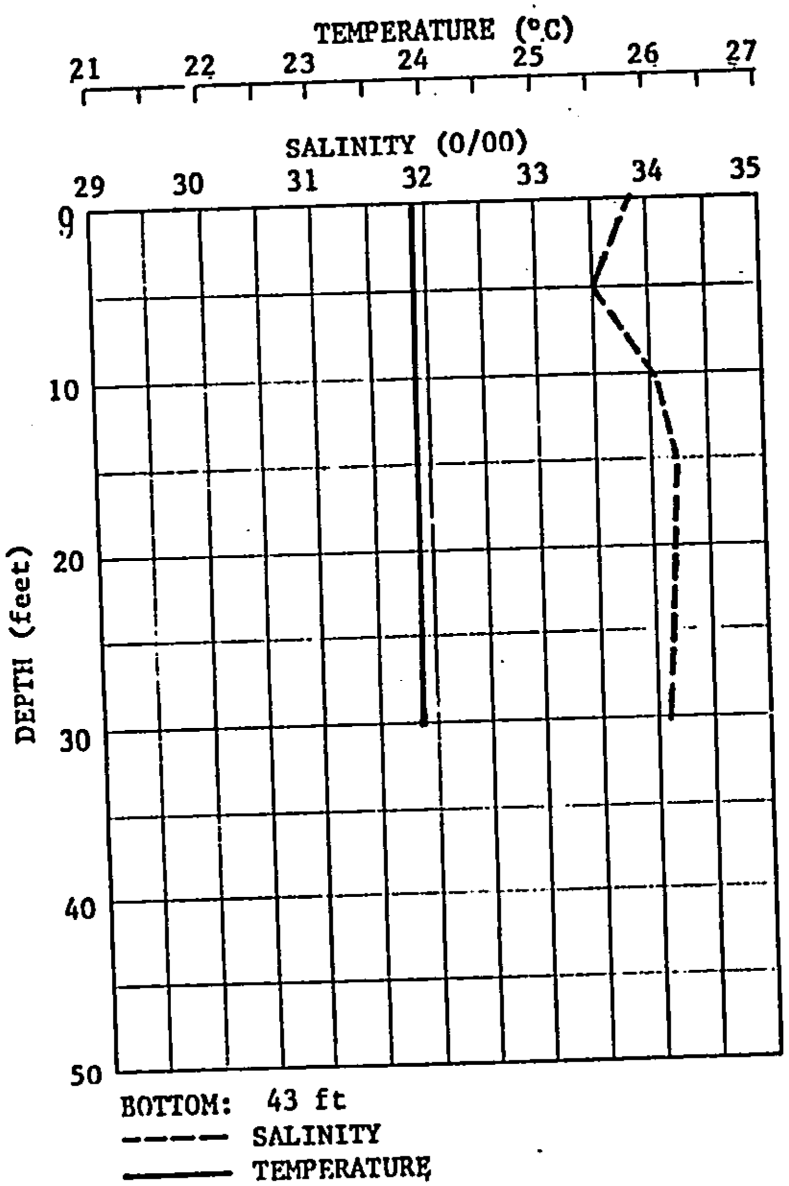


BOTTOM: 35 ft
- - - - SALINITY
——— TEMPERATURE

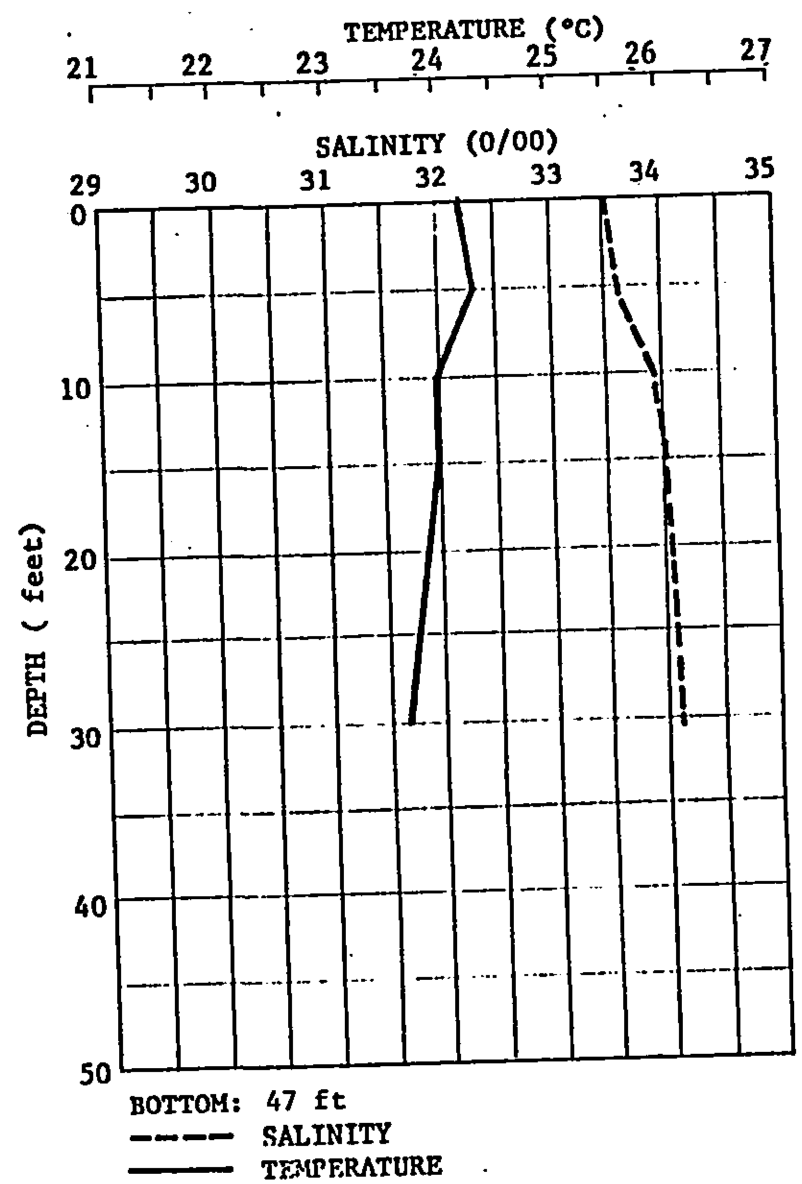
SALINITY-TEMPERATURE PROFILES

DATE: June 8, 1977

WATER QUALITY STATION: 7 TIME: 1535



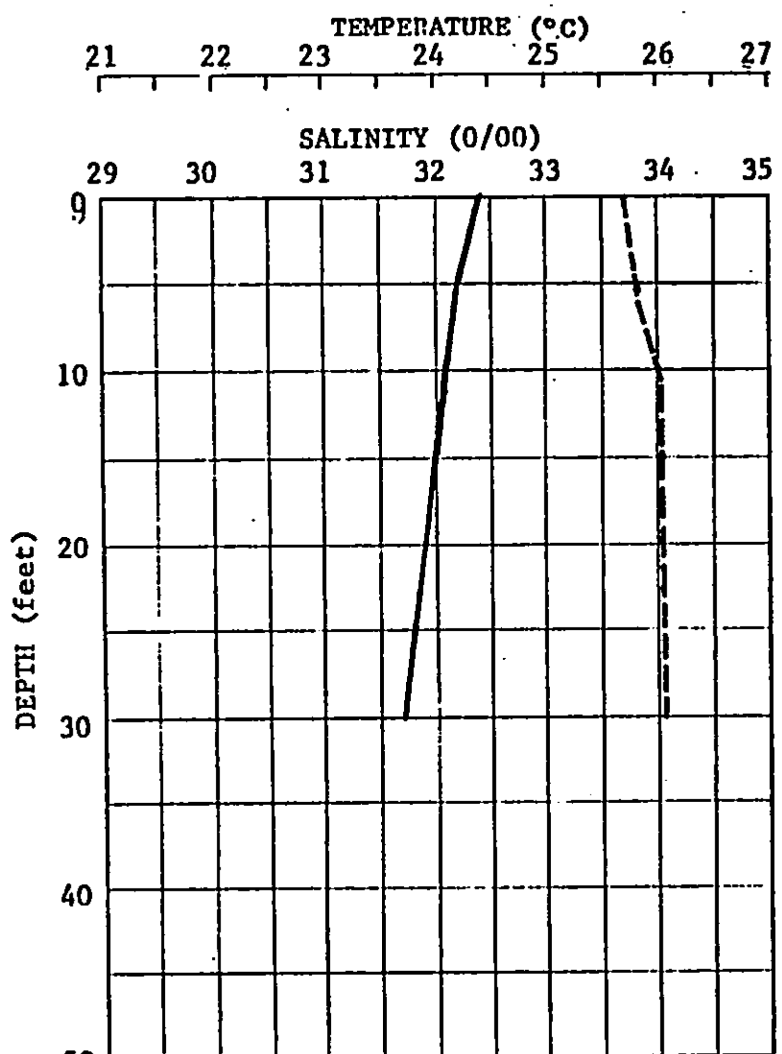
WATER QUALITY STATION: 8 TIME: 1616



SALINITY-TEMPERATURE PROFILES

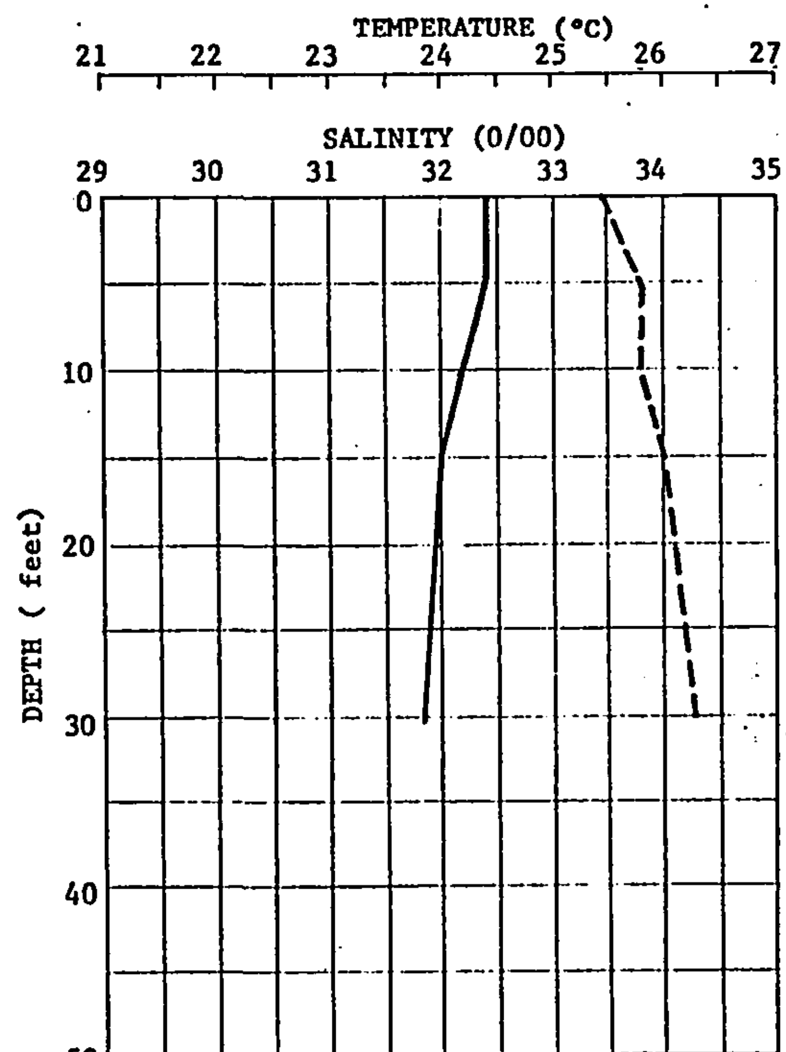
DATE: June 8, 1977

WATER QUALITY STATION: 9 TIME: 1520



BOTTOM: 65 ft
- - - - SALINITY
——— TEMPERATURE

WATER QUALITY STATION: 10 TIME: 1500

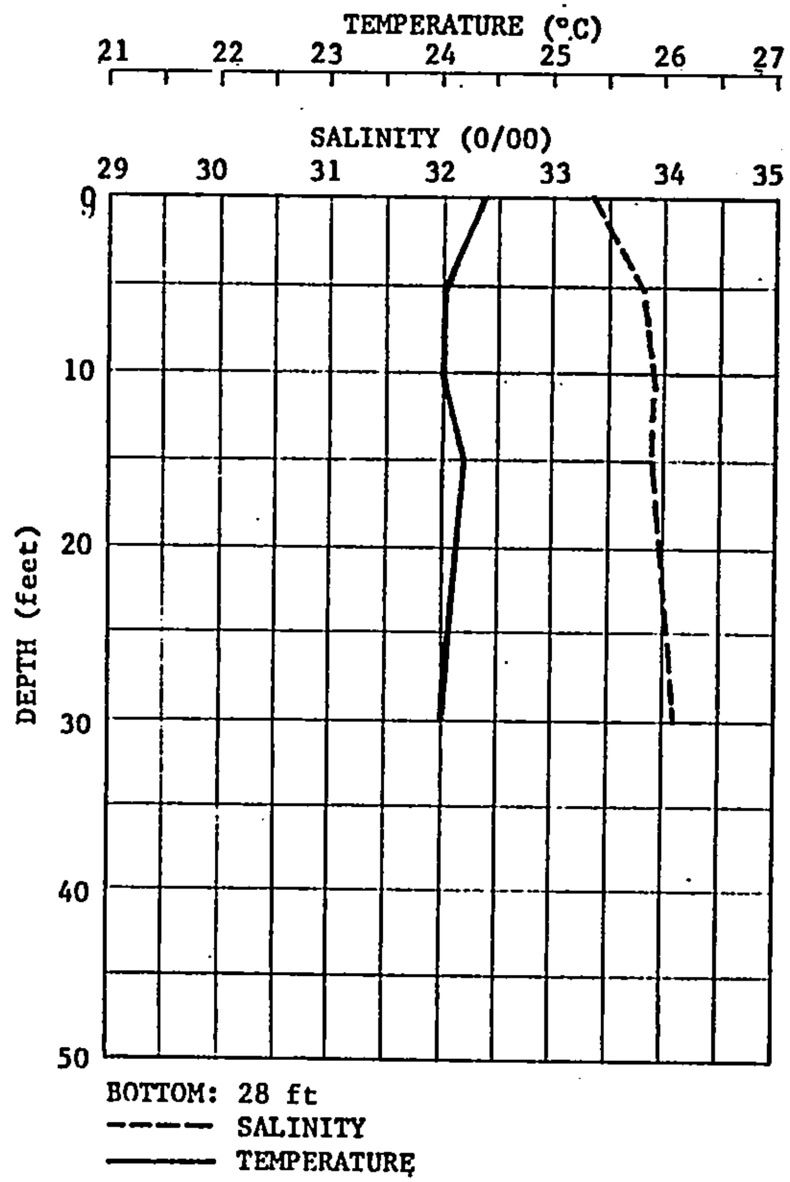


BOTTOM: 37 ft
- - - - SALINITY
——— TEMPERATURE

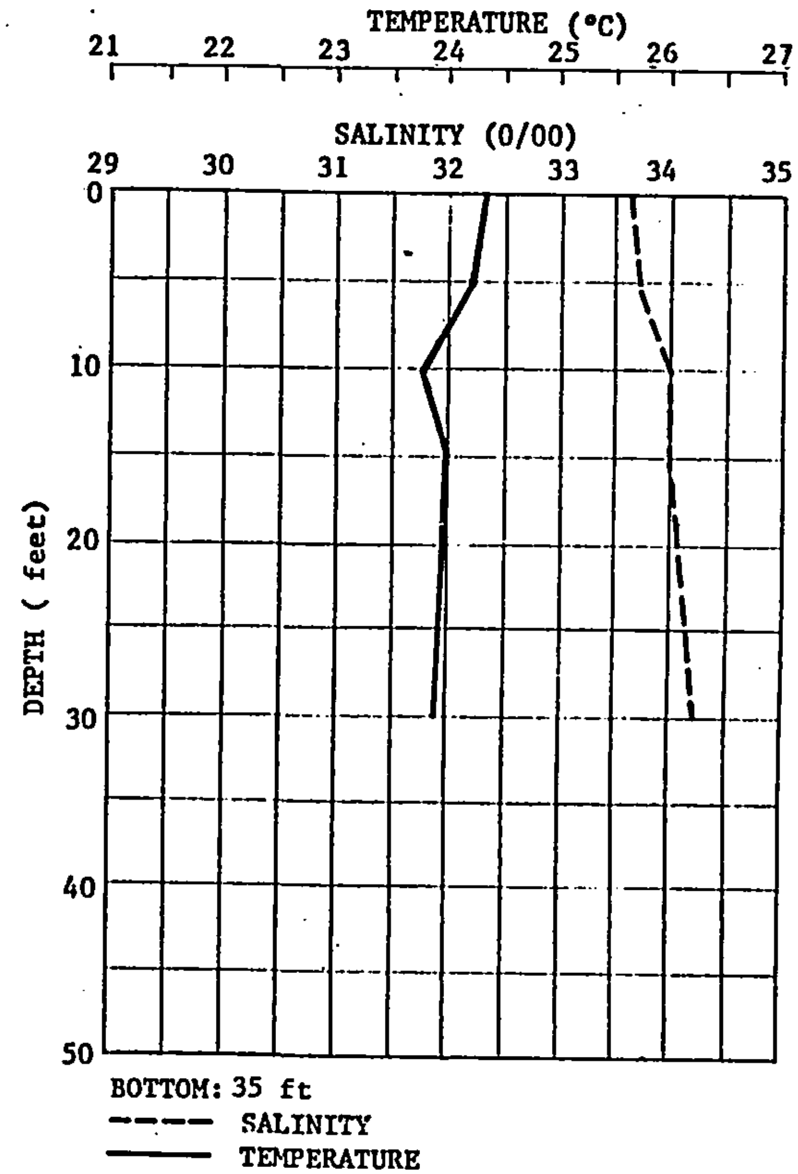
SALINITY-TEMPERATURE PROFILES

DATE: June 8, 1977

WATER QUALITY STATION: 11 TIME: 1600



WATER QUALITY STATION: 12 TIME: 1608



A P P E N D I X D

Drogue Data

TABLE D-1

DROGUE VELOCITIES

Point of Release Time and Date	Depth of Drogue (feet)	Distance Traveled (feet)	Time (minutes)	Velocity (knots)
Station B May 19 3:20 p.m.	Surface	185	31	0.06
		300	22	0.14
		135	17	0.08
	5	450	28	0.16
		600	21	0.29
		225	15	0.15
	20	750	23	0.33
		960	23	0.42
		450	14	0.32
Diffuser May 20 11:20 a.m.	Surface	180	35	0.05
		710	23	0.31
		1275	37	0.35
		1200	25	0.48
	10	225	39	0.06
		360	27	0.13
		375	39	0.10
		240	30	0.08
	30	450	33	0.14
		450	29	0.16
		405	37	0.11
		315	29	0.11
Diffuser May 20 3:20 p.m.	Surface	930	37	0.25
		930	42	0.22
		1050	35	0.30
	10	525	35	0.15
		870	41	0.21
		300	33	0.09
	30	390	32	0.12
		410	41	0.10
		450	32	0.14
Diffuser End May 21 9:52 a.m.	Surface	1350	53	0.26
		1965	25	0.79
		1470	63	0.23
	10	675	49	0.14
		690	24	0.29
		1080	53	0.20
	30	450	44	0.10
		330	44	0.08
		375	62	0.06
Station B May 22 10:52 a.m.	Surface	1125	29	0.39
		2325	43	0.54
		2475	44	0.56
	10	330	33	0.10
		870	52	0.17
		840	48	0.18
	30	300	38	0.08
		525	57	0.09
		780	48	0.16

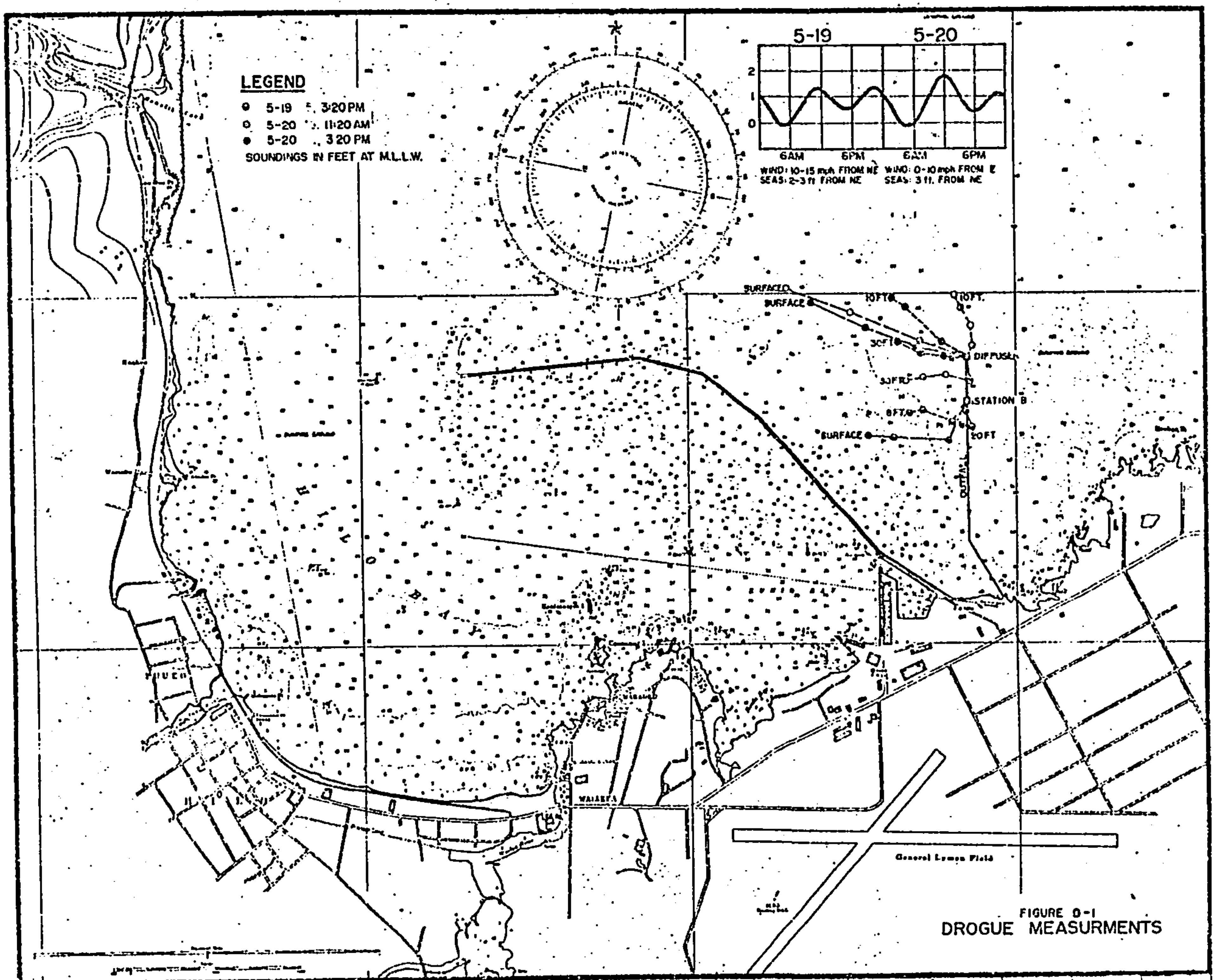


FIGURE D-1
DROGUE MEASURMENTS

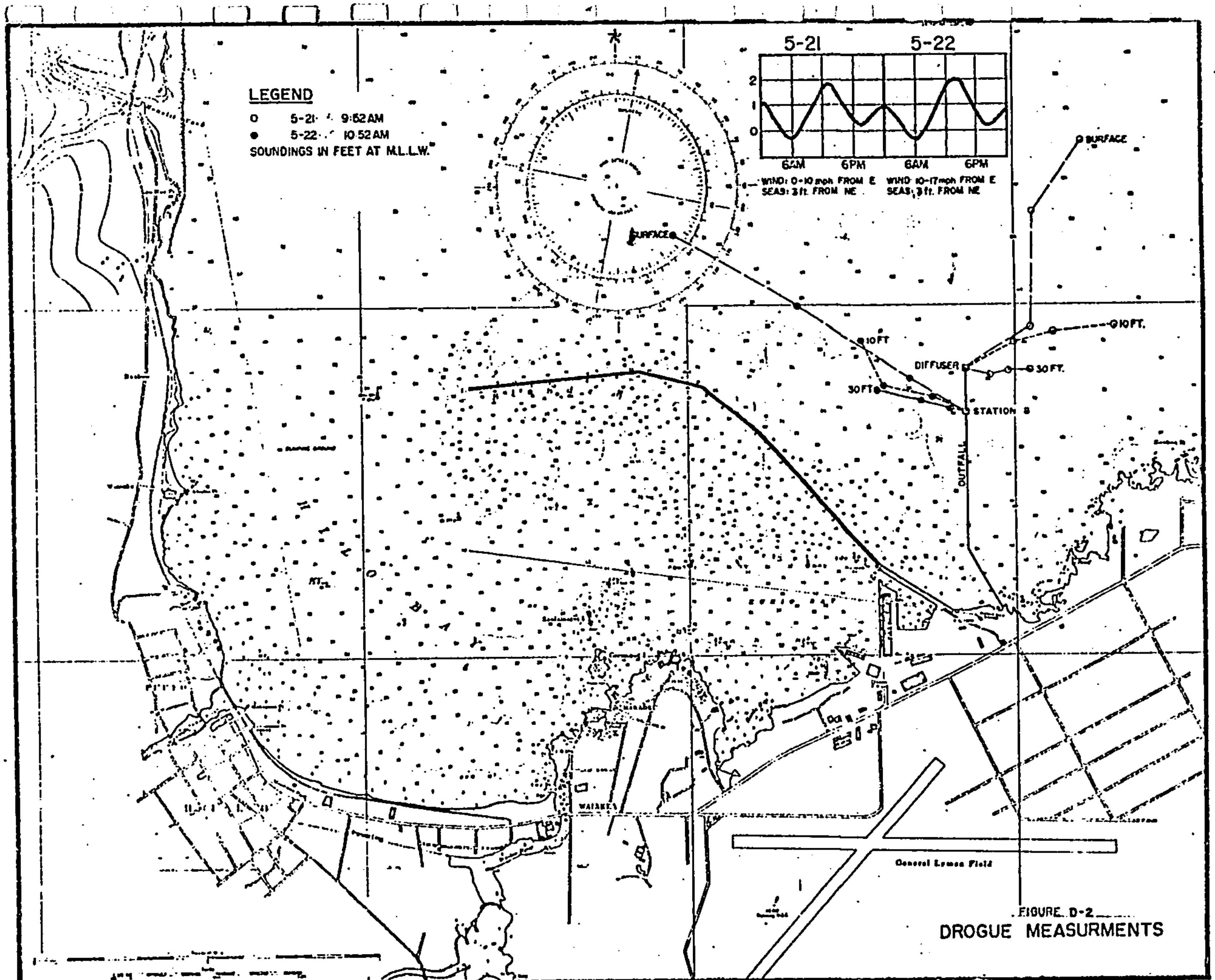
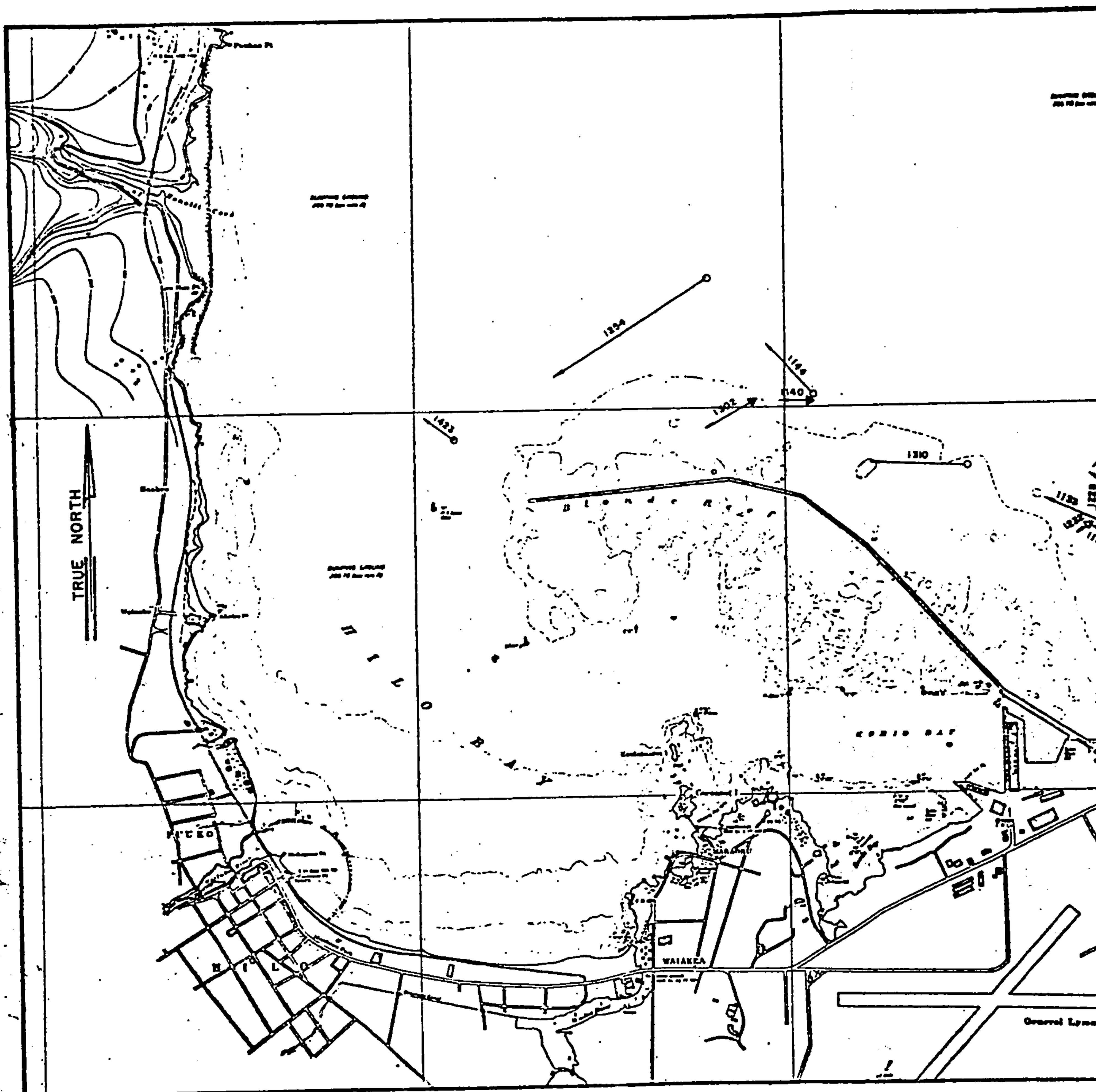
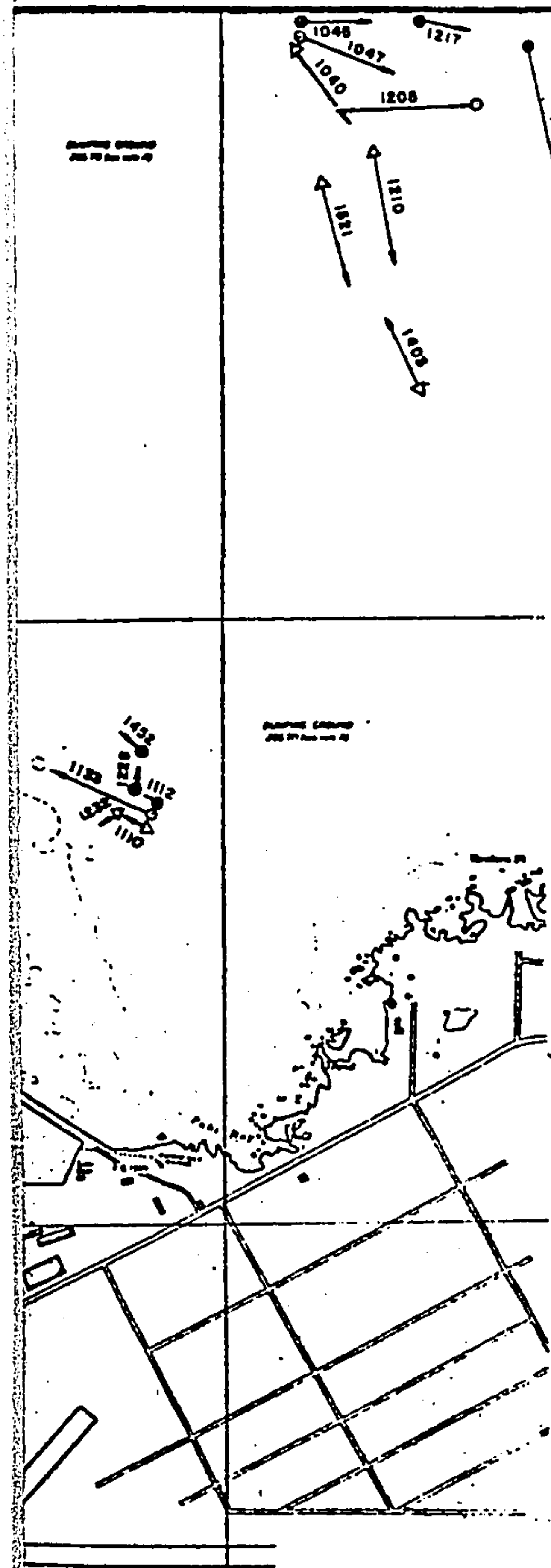


FIGURE D-2
DROGUE MEASURMENTS



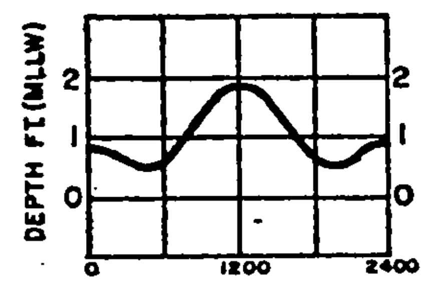
TRUE NORTH
1254
1144
1140
1302
1422
1310
WAIAKEA



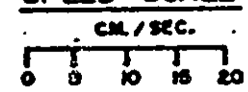
DEPTH OF DROGUE

- ○ SURFACE
- ● 10 FEET
- ▲ 20 FEET
- △ 30 FEET

PREDICTED TIDE



SPEED SCALE



NWS WIND DATA (HILO, HAWAII)		
TIME (HOURS)	DIRECTION (° FROM TN)	SPEED (KTS)
0555	220	4
0655	220	6
0758	230	4
0859	340	5
0959	10	5
1059	60	8
1156	100	10
1256	50	8
1358	70	9
1457	40	5
1555	50	6
1656	30	4
1757	70	5

0 — 1/2
SCALE IN MILES

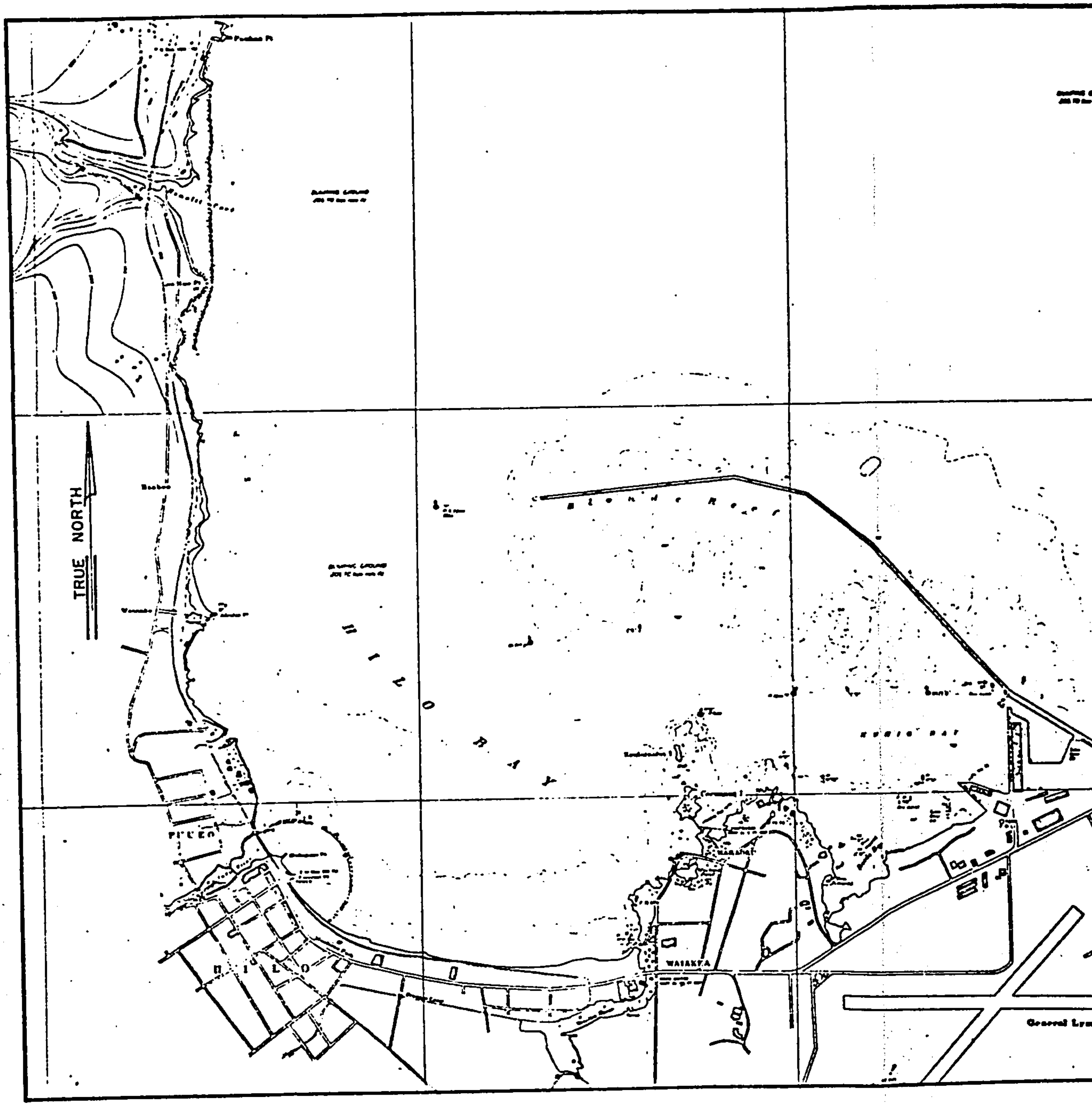
MAP SOURCE:
NOAA May 1974

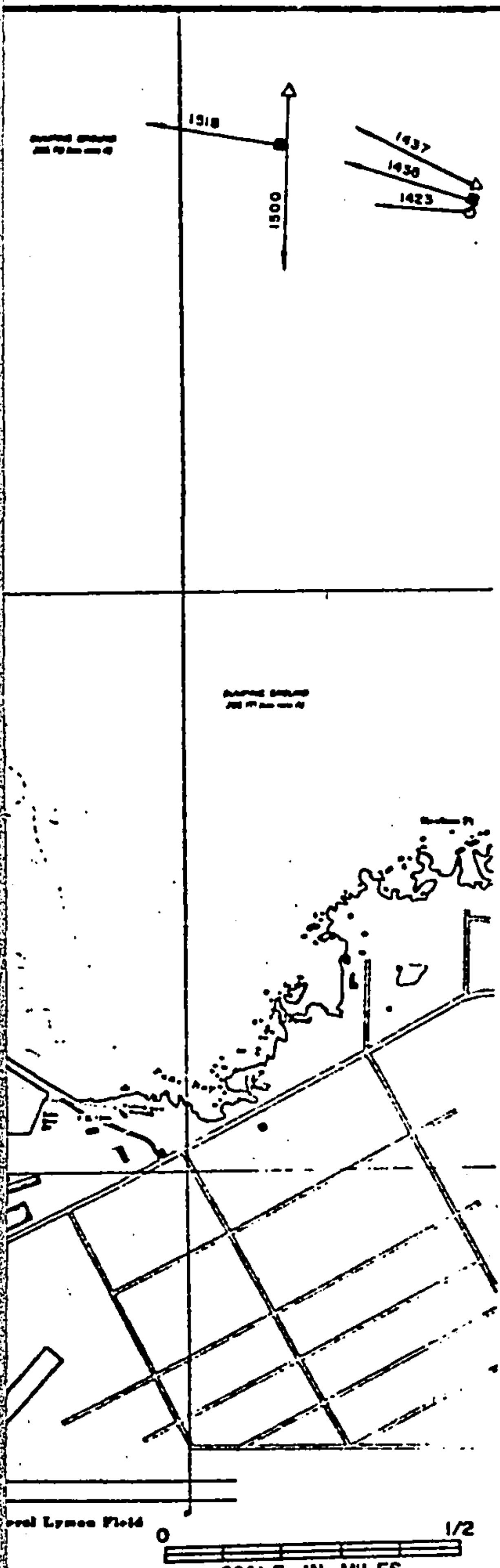
FIGURE D-3

HILO SEWAGE TREATMENT PLANT
FACILITIES PLAN

DROGUE VECTORS

9-17-76


TRUE NORTH
HILO BAY
HILO
WAIAKEA

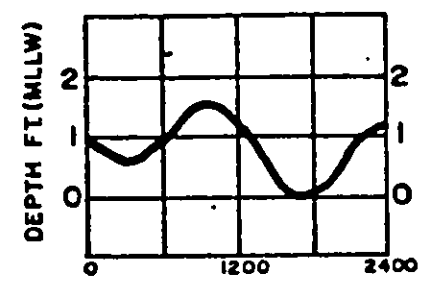


MAP SOURCE:
NOAA May 1974

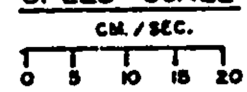
DEPTH OF DROGUE

- O SURFACE
- ■ 15 FEET
- △ 30 FEET

PREDICTED TIDE



SPEED SCALE



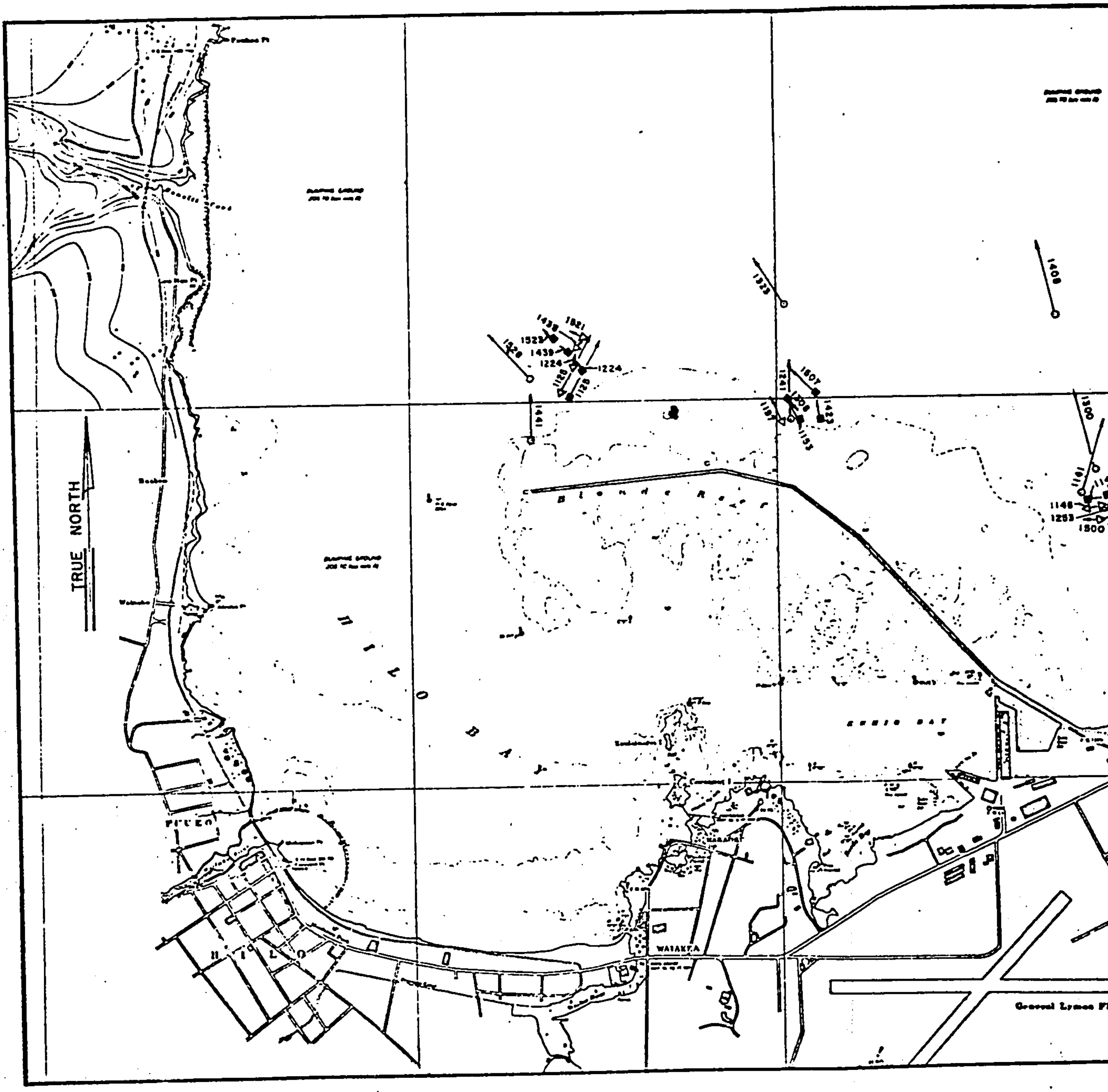
NWS WIND DATA (HILO, HAWAII)		
TIME (HOURS)	DIRECTION (° FROM TN)	SPEED (KTS)
0558	240	7
0655	240	6
0757	CALM	0
0856	230	7
0956	190	3
1057	50	6
1156	110	9
1256	90	10
1359	130	11
1459	120	8
1558	90	8
1657	110	8
1757	140	7

FIGURE D-4

HILO SEWAGE TREATMENT PLANT
FACILITIES PLAN

DROGUE VECTORS

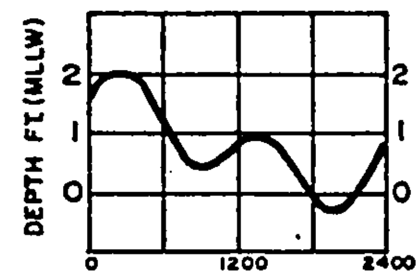
12-13-76


TRUE NORTH
HILO BAY
Blonde Reef
HILO
WAIAKEA
General Lyman Fi
KUHIO BAY

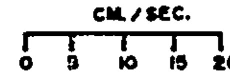
DEPTH OF DROGUE

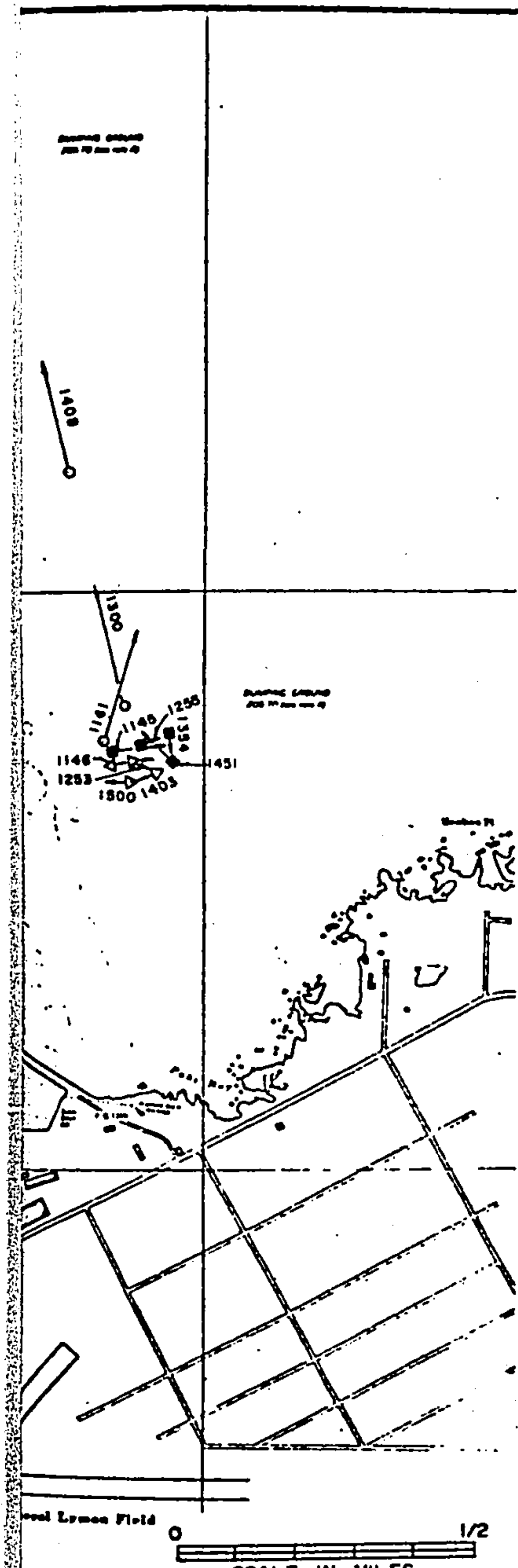
- O SURFACE
- ■ 15 FEET
- Δ 30 FEET

PREDICTED TIDE



SPEED SCALE





NWS WIND DATA. (HILO, HAWAII)		
TIME (HOURS)	DIRECTION (° FROM TN)	SPEED (KTS)
0558	210	5
0641	230	6
0659	80	4
0756	240	7
0836	150	4
0852	180	3
0856	170	4
0902	190	5
0947	220	5
0955	190	6
1055	220	5
1155	110	10
1255	140	7
1356	120	7
1458	90	7
1558	110	7
1658	120	6
1758	290	3

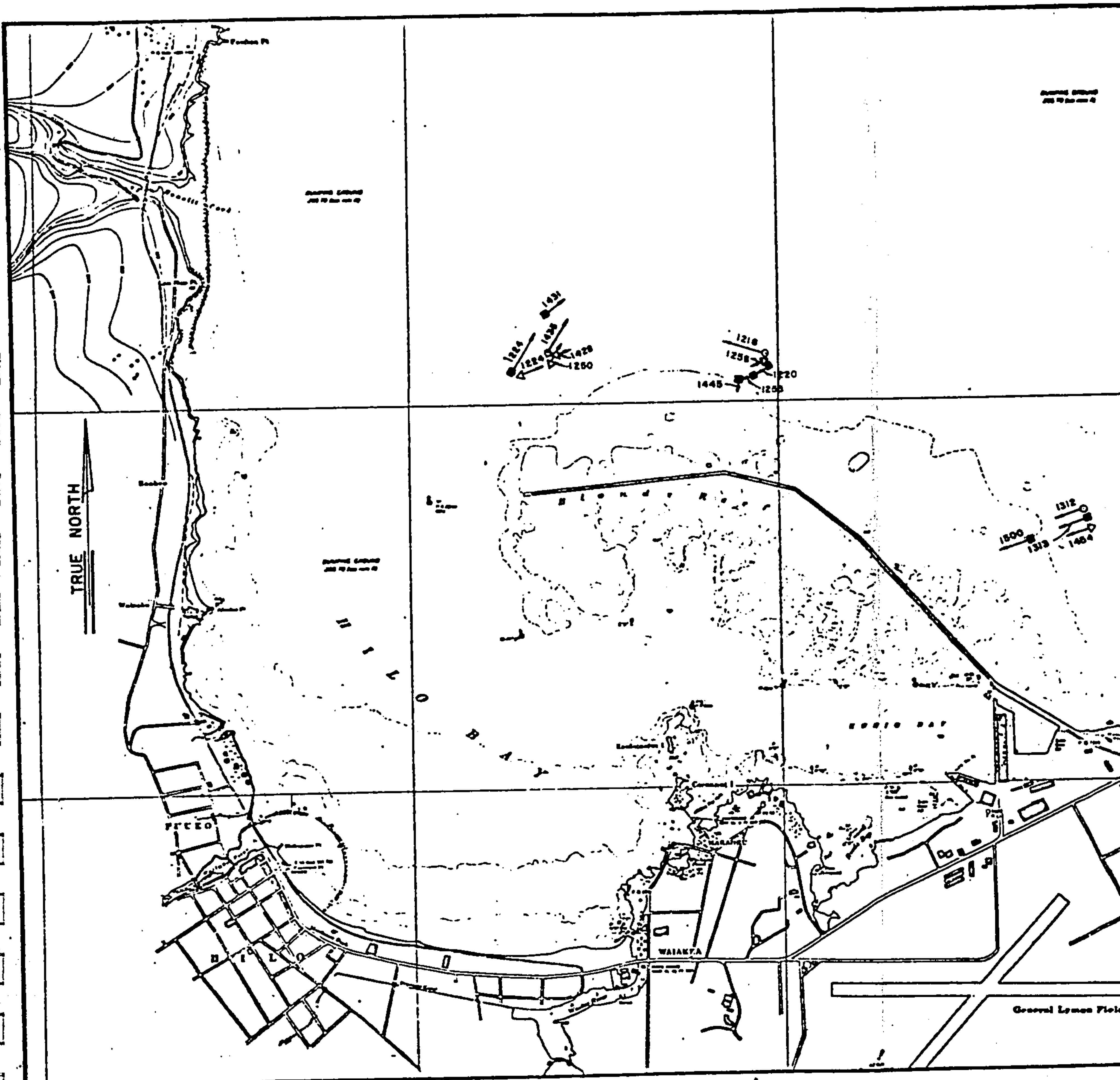
MAP SOURCE:
NOAA May 1974

FIGURE D-5

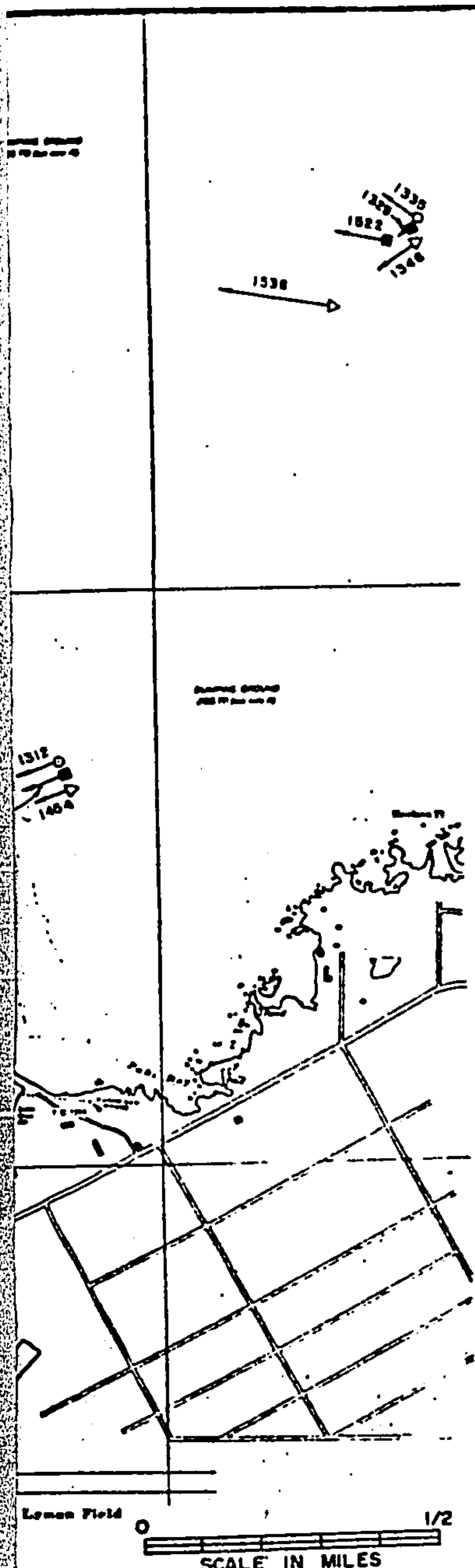
HILO SEWAGE TREATMENT PLANT
FACILITIES PLAN

DROGUE VECTORS

12-17-76



TRUE NORTH
1431
1224
1250
1218
1220
1445
1312
1500
WAIAKEA

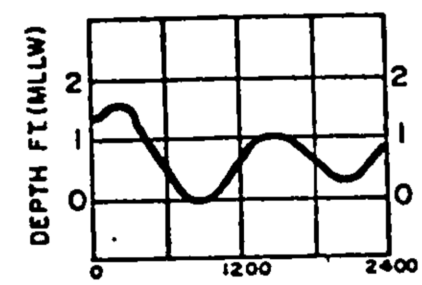


MAP SOURCE:
NOAA May 1974

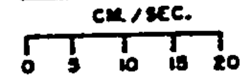
DEPTH OF DROGUE

- O SURFACE
- ■ 15 FEET
- Δ 30 FEET

PREDICTED TIDE



SPEED SCALE

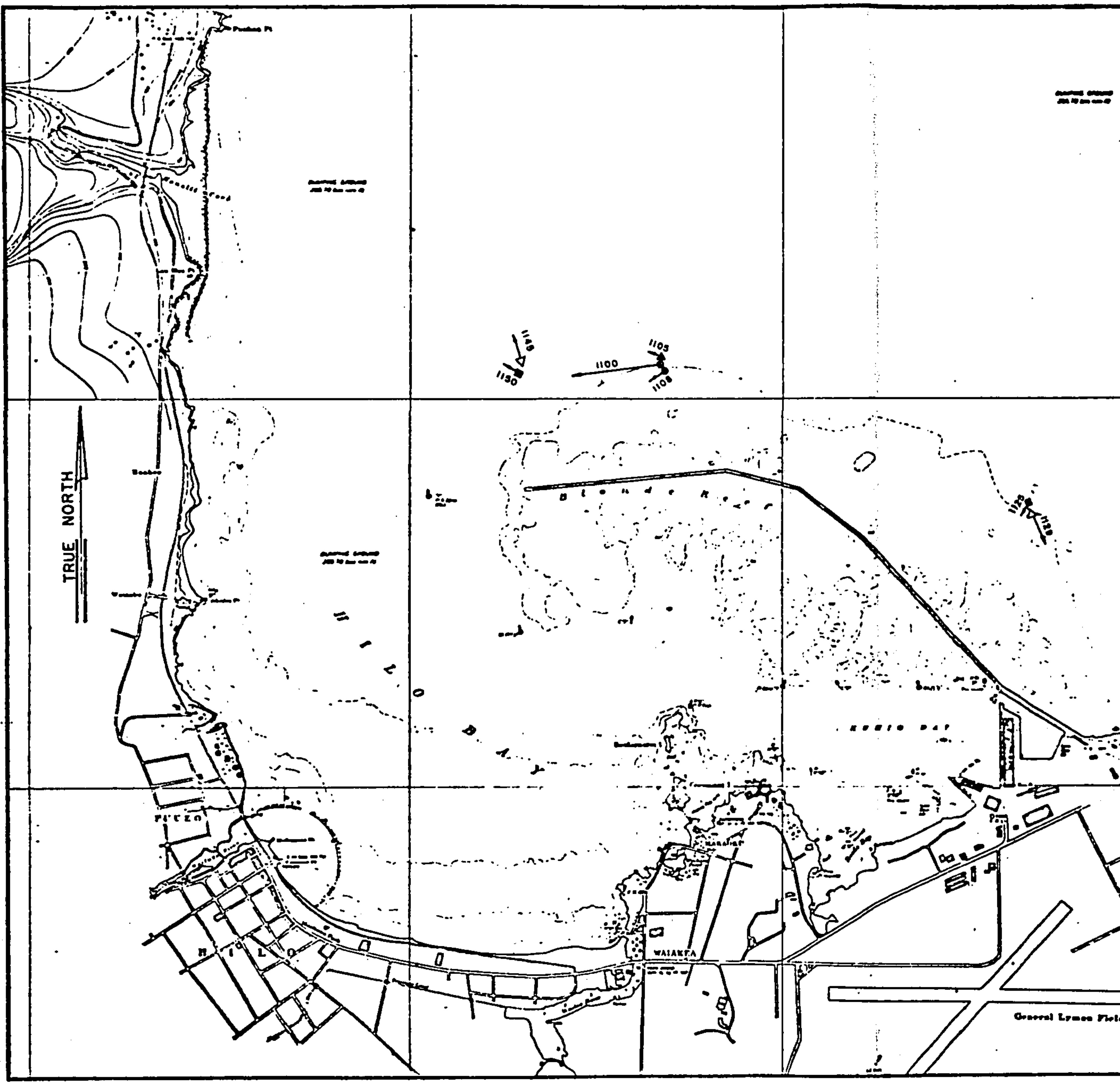


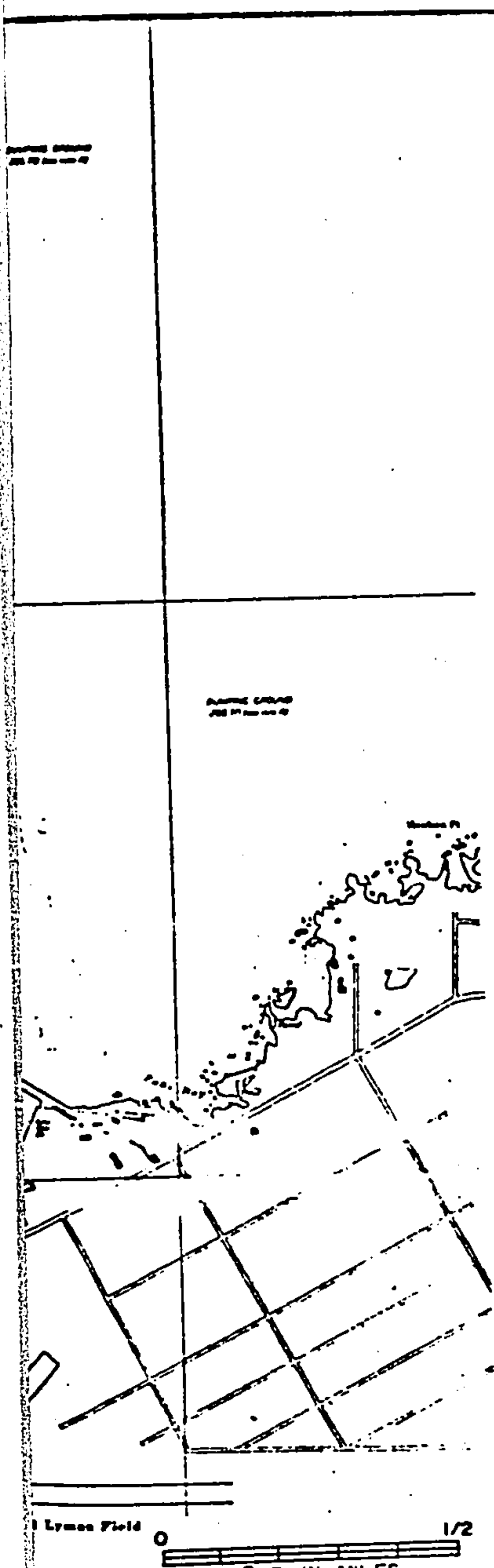
NWS WIND DATA (HILO,HAWAII)		
TIME (HOURS)	DIRECTION (° FROM TN)	SPEED (KTS)
0555	230	6
0657	310	7
0715	260	6
0757	270	5
0859	270	4
0956	70	11
1057	60	5
1156	90	4
1258	70	8
1359	50	9
1456	50	7
1556	70	10
1656	320	4
1756	240	9

FIGURE D-6
HILO SEWAGE TREATMENT PLANT
FACILITIES PLAN

DROGUE VECTORS

4-13-77

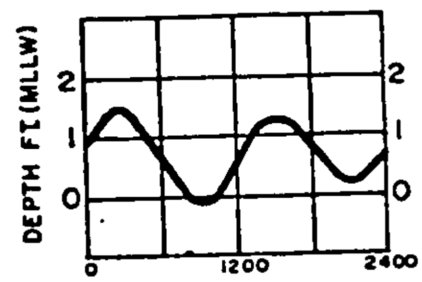

TRUE NORTH
HILO BAY
Blonde Reef
WAIAKEA
HILO
1100
1103
1108
1130
General Lyman Fiel



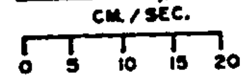
DEPTH OF DROGUE

- O SURFACE
- ● 10 FEET
- ■ 15 FEET
- ▲ 20 FEET
- △ 30 FEET

PREDICTED TIDE



SPEED SCALE



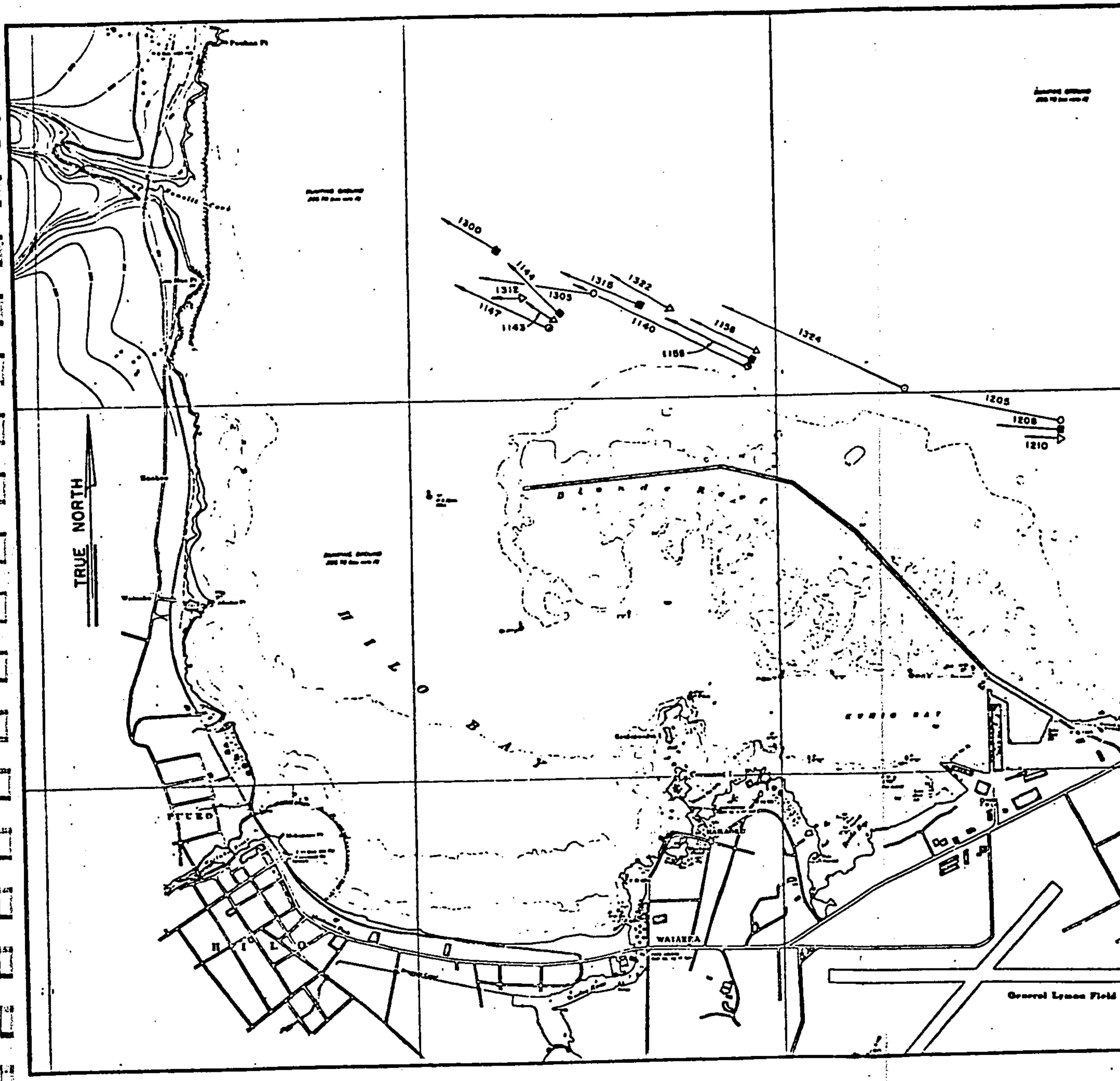
NWS WIND DATA (HILO, HAWAII)		
TIME (HOURS)	DIRECTION (° FROM TN)	SPEED (KTS)
0555	CALM	0
0632	CALM	0
0655	240	7
0721	240	7
0756	250	7
0838	60	7
0859	50	5
0955	40	5
1059	120	15
1158	20	6
1255	240	6
1308	70	3
1317	210	8
1359	240	8
1424	340	7
1457	350	7
1555	280	7
1656	30	4
1729	20	5
1755	70	5

MAP SOURCE:
NOAA May 1974

FIGURE D-7
HILO SEWAGE TREATMENT PLANT
FACILITIES PLAN

DROGUE VECTORS

4-14-77



TRUE NORTH
1300
1144
1312
1305
1147
1143
1318
1322
1140
1158
1155
1324
1205
1208
1210
HILO BAY
WAIAKEA
HILO
General Lyman Field

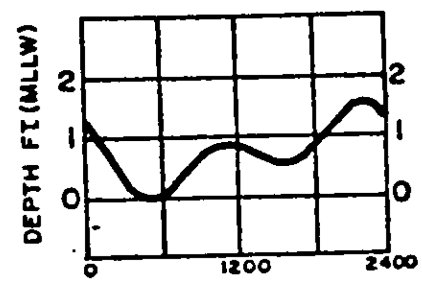
DEPTH OF DROGUE

○ SURFACE

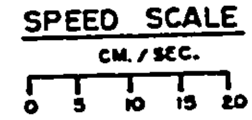
■ 15 FEET

△ 30 FEET

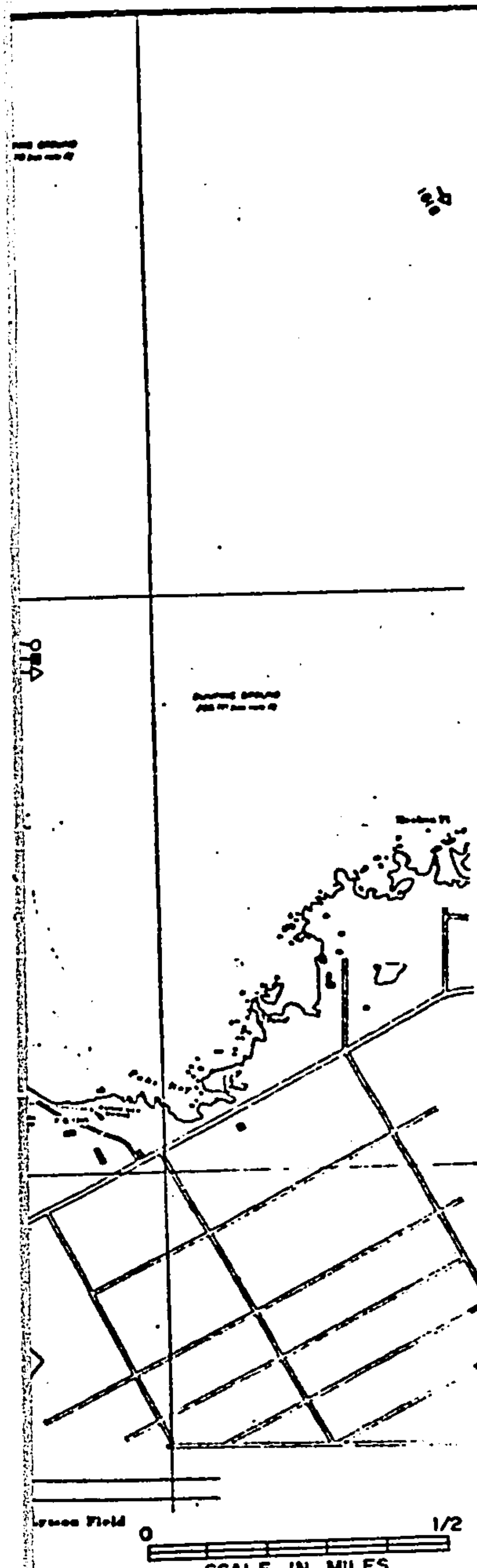
PREDICTED TIDE



SPEED SCALE

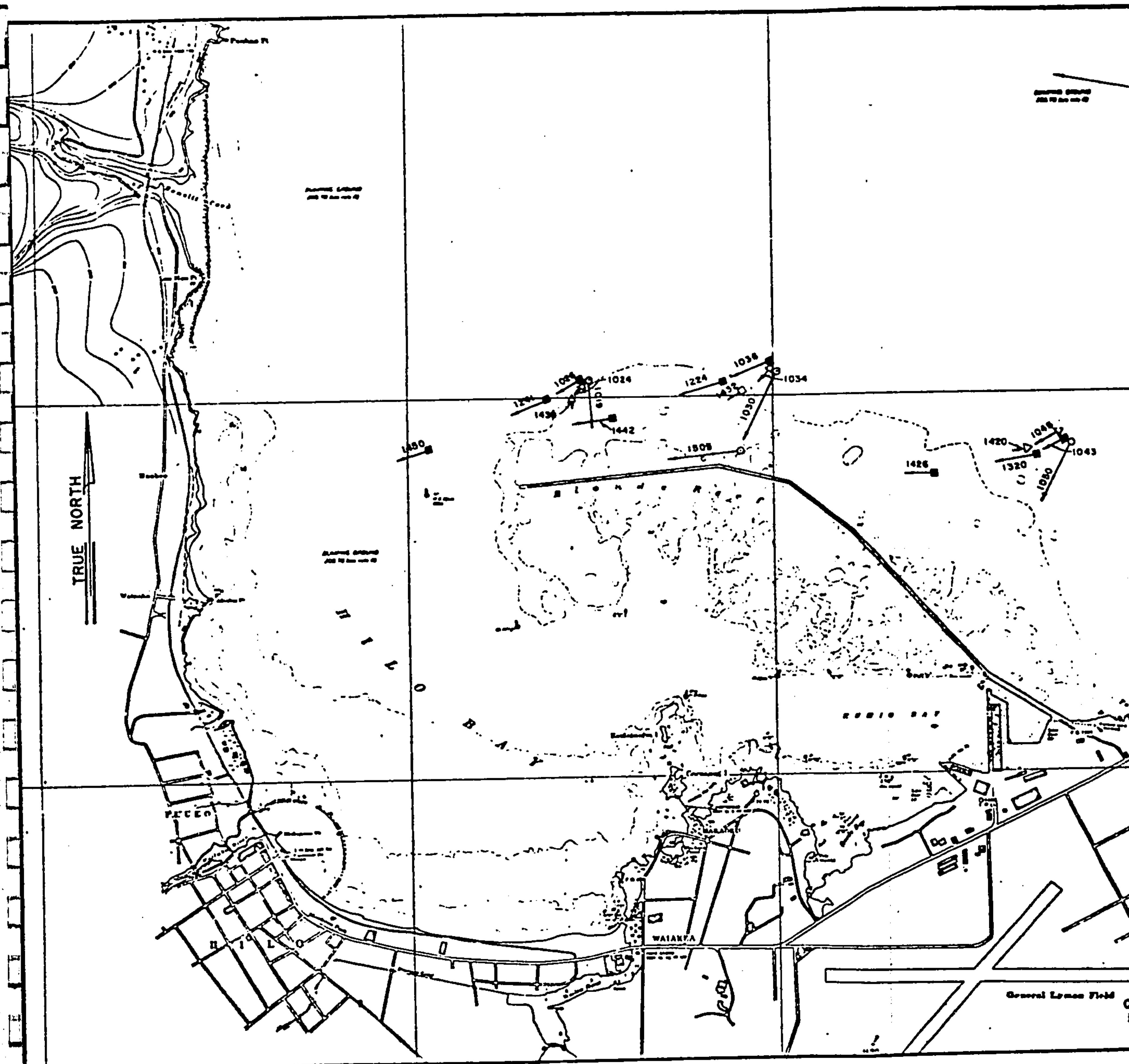


NWS WIND DATA (HILO, HAWAII)		
TIME (HOURS)	DIRECTION (° FROM TN)	SPEED (KTS)
0555	180	3
0655	210	4
0758	150	8
0859	140	8
0959	110	11
1055	120	12
1159	90	10
1258	100	11
1357	80	10
1458	70	6
1556	70	6
1655	40	8
1757	60	6

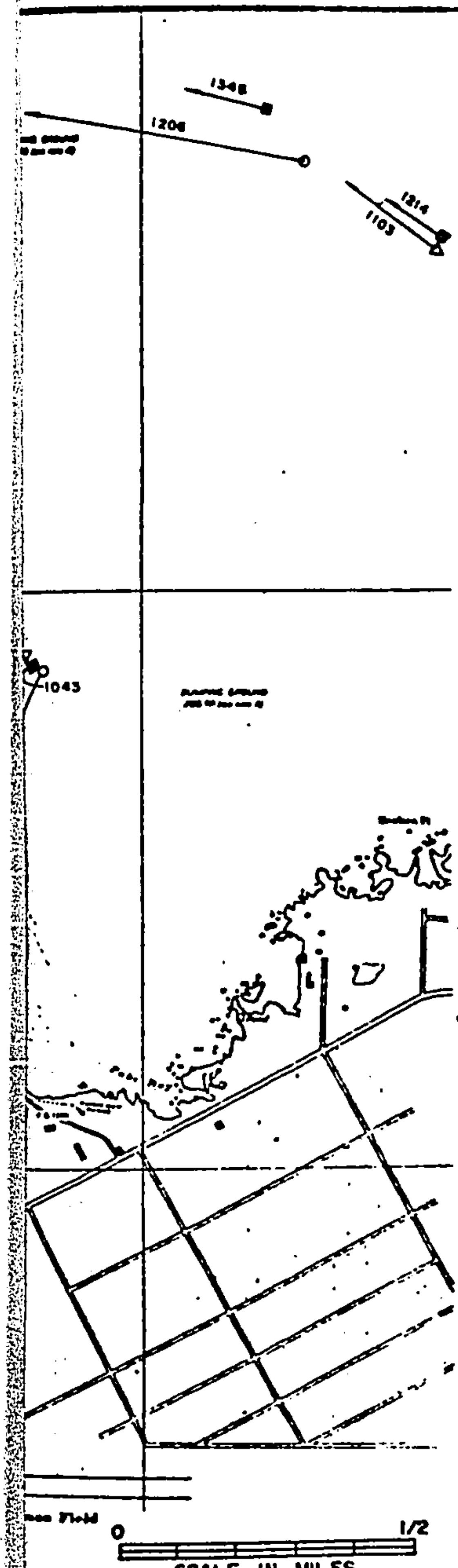


MAP SOURCE:
NOAA May 1974

FIGURE D-8
HILO SEWAGE TREATMENT PLANT
FACILITIES PLAN
DROGUE VECTORS
6-7-77



TRUE NORTH
H I L O B A Y
WAIAKEA
H I L O
General Lyman Field
1024
1224
1036
1034
1030
1436
1442
1450
1505
1420
1320
1426
1043
1050

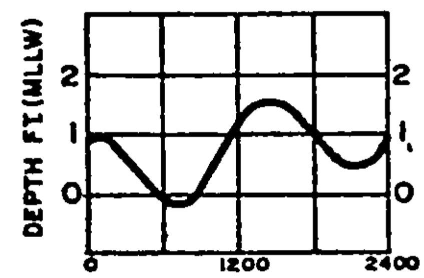


MAP SOURCE:
NOAA May 1974

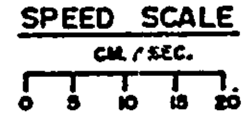
DEPTH OF DROGUE

- ○ SURFACE
- ■ 15 FEET
- △ 30 FEET

PREDICTED TIDE



SPEED SCALE



NWS WIND DATA (HILO, HAWAII)		
TIME (HOURS)	DIRECTION (° FROM TN)	SPEED (KTS)
0558	280	3
0658	230	7
0757	310	3
0857	20	5
0957	30	7
1056	10	6
1155	60	9
1256	60	8
1358	70	9
1459	30	10
1559	60	7
1656	50	10
1758	70	9

FIGURE D-9

HILO SEWAGE TREATMENT PLANT
FACILITIES PLAN

DROGUE VECTORS

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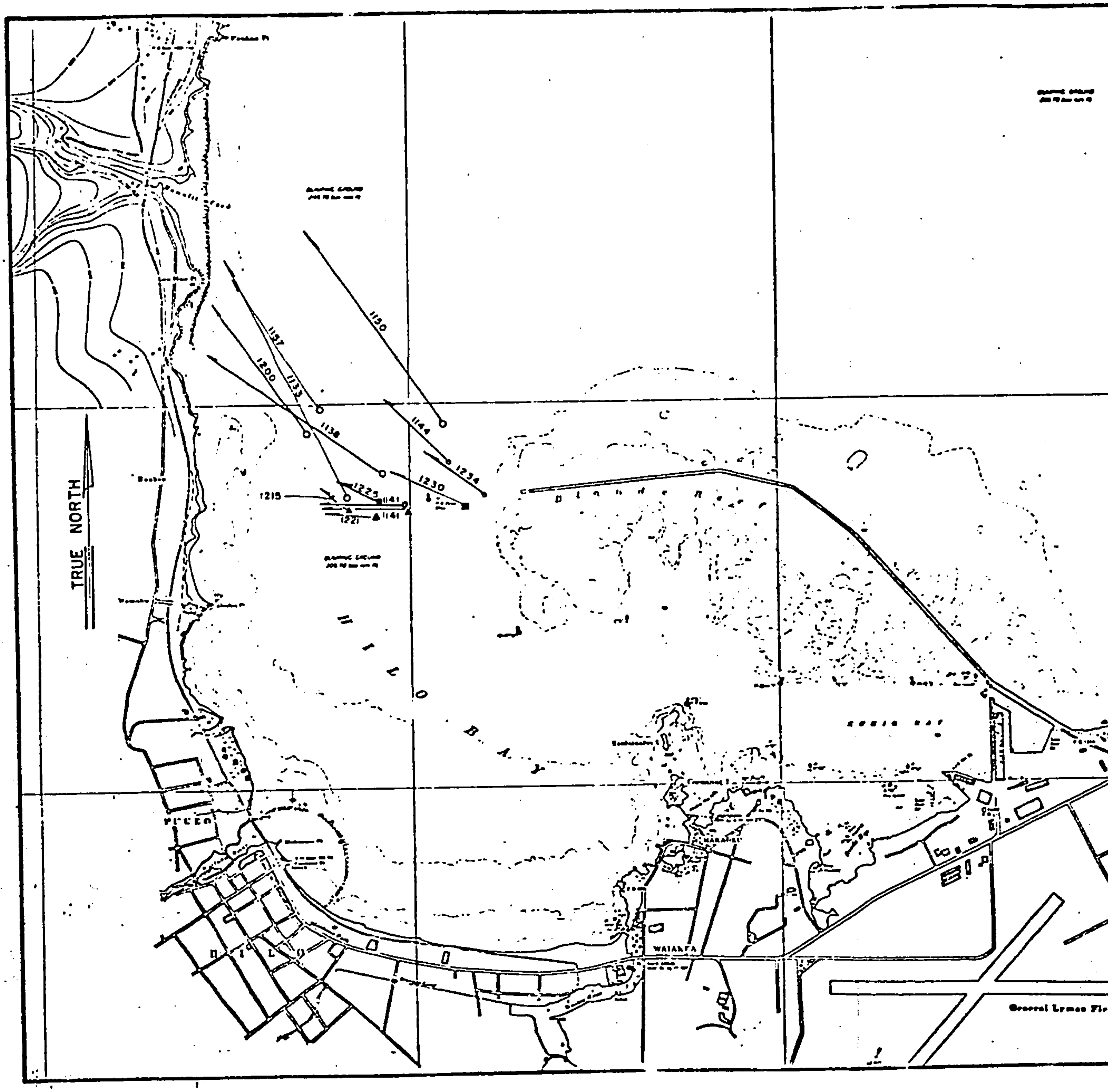
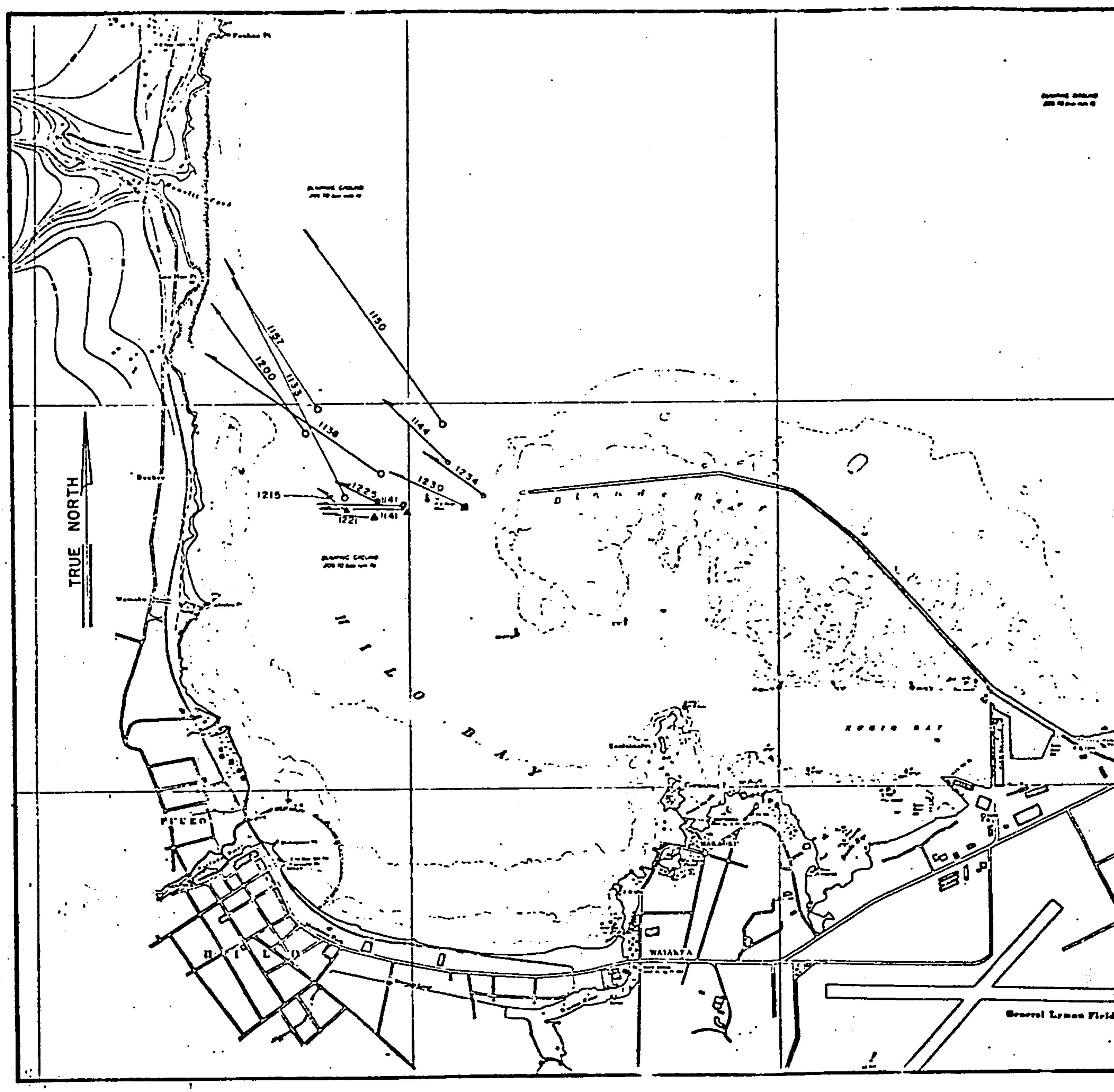

TRUE NORTH
1150
1137
1133
1200
1138
1144
1234
1230
1225
1215
1141
1221
H I L O   B A Y
WAIAKEA
General Lyman Fie

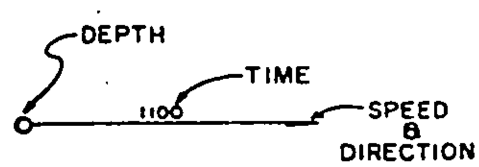
CORRECTION

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



TRUE NORTH
1150
1137
1133
1200
1138
1144
1234
1230
1215
1225
1141
1221
1141
H I L O B A Y
H I L O
WAIAKEA
General Lyman Field

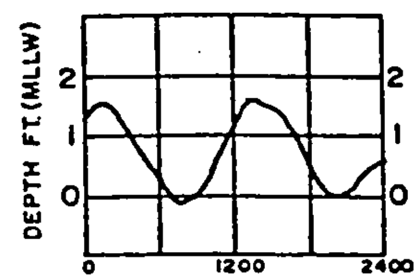
DROGUE VECTORS



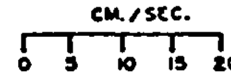
DEPTH OF DROGUE

- ○ SURFACE
- □ 5 FEET
- △ 10 FEET
- ◓ 15 FEET
- ● 20 FEET
- ■ 30 FEET
- ▲ 40 FEET

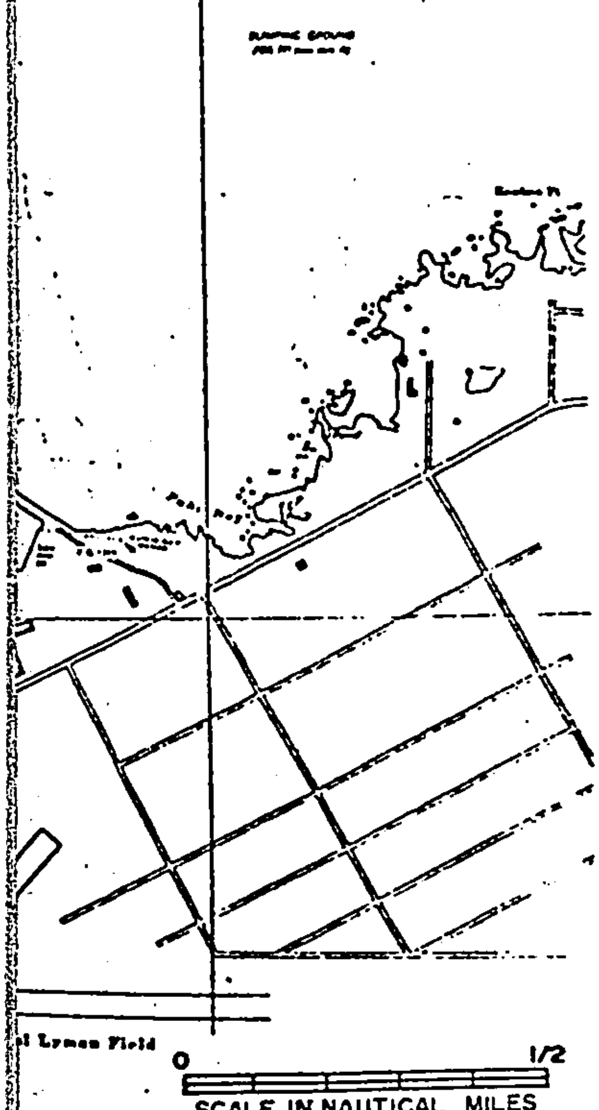
PREDICTED TIDE



SPEED SCALE



NWS WIND DATA (HILO, HAWAII)		
TIME (HOURS)	DIRECTION (° FROM TN)	SPEED (KTS)
0556	210	4
0656	180	6
0757	230	4
0855	150	9
0958	120	17
1059	140	12
1159	120	15
1255	140	19
1358	110	16
1458	140	18
1558	130	11
1657	140	10
1726	150	7
1756	110	4



DATA SOURCE: U.S. ARMY CORPS OF ENGINEERS

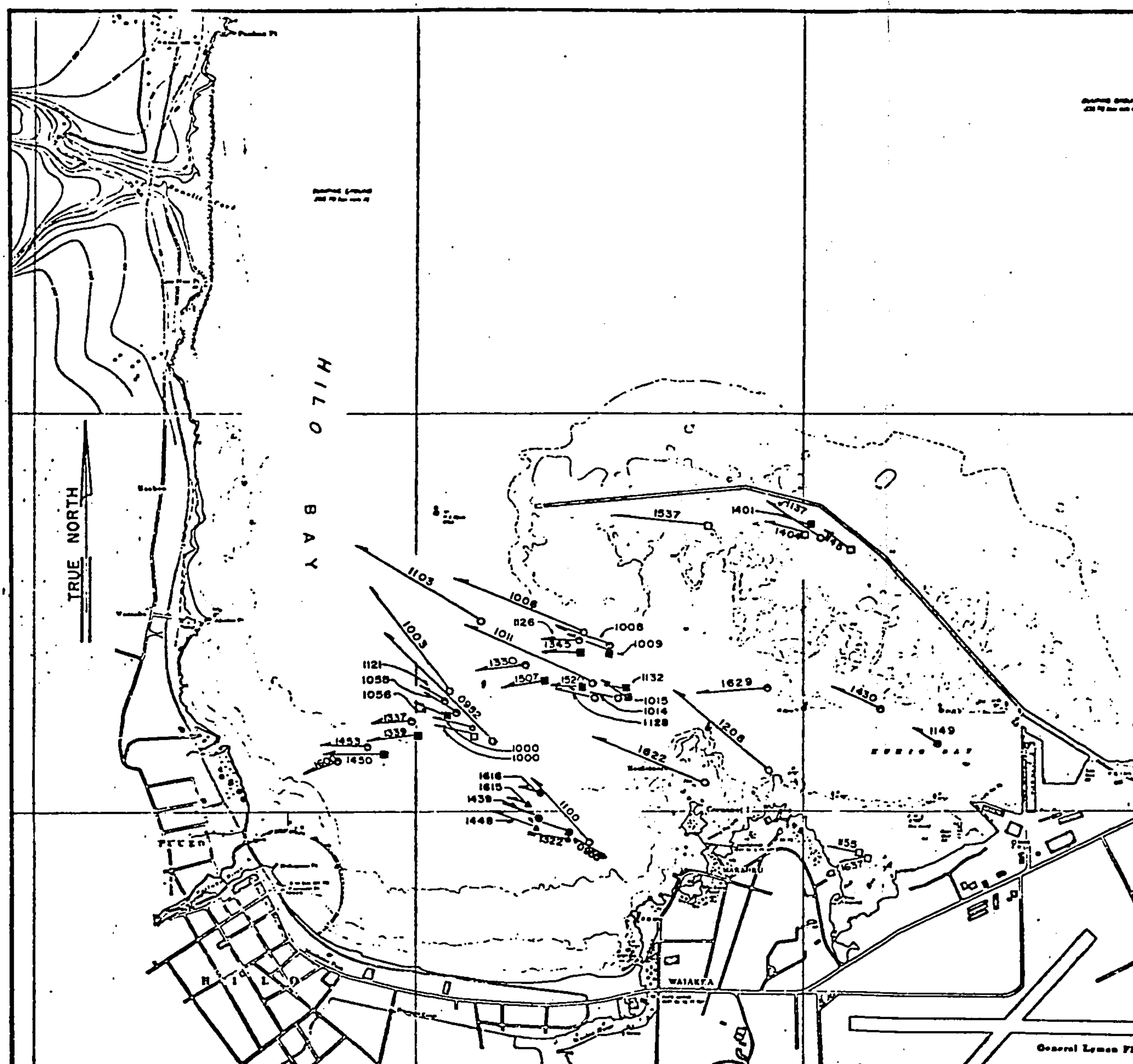
MAP SOURCE: NOAA May 1974

HILO SEWAGE TREATMENT PLANT FACILITIES PLAN

DROGUE VECTORS

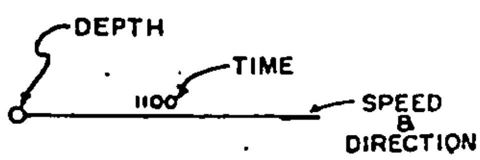
4-2-77

FIGURE D-10



TRUE NORTH
HILO BAY
HILO
WAIAKEA
1537
1401
1137
1103
1008
1011
1003
1126
1009
1345
1330
1121
1058
1056
1507
1132
1015
1014
1128
1000
1629
1430
1149
1208
1622
1453
1450
1339
1616
1615
1439
1448
1100
1322
1637

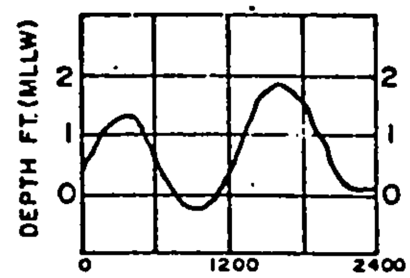
DROGUE VECTORS



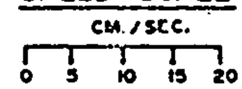
DEPTH OF DROGUE

- SURFACE
- 5 FEET
- 10 FEET
- 15 FEET
- 20 FEET
- 30 FEET
- 40 FEET

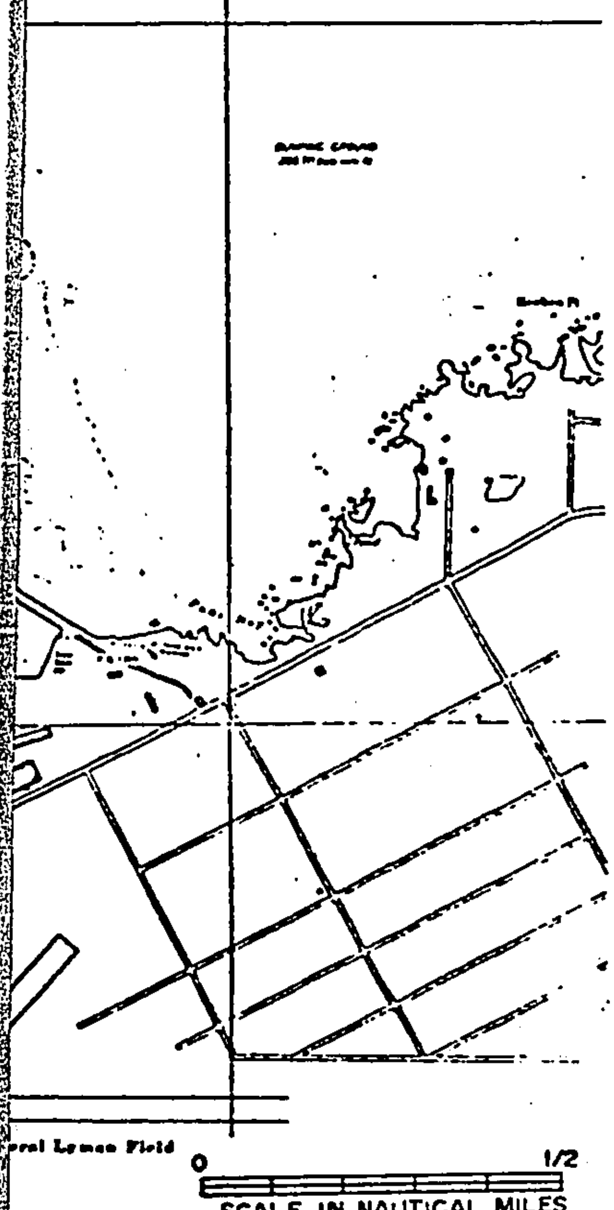
PREDICTED TIDE



SPEED SCALE



NWS WIND DATA (HILO, HAWAII)		
TIME (HOURS)	DIRECTION (° FROM TN)	SPEED (KTS)
0555	220	4
0659	210	5
0758	180	6
0859	130	7
0956	110	10
1034	100	10
1058	110	11
1157	100	9
1256	120	14
1358	110	14
1459	100	17
1555	80	13
1655	110	11
1755	100	8



DATA SOURCE: U.S. ARMY CORPS OF ENGINEERS

MAP SOURCE: NOAA May 1974

HILO SEWAGE TREATMENT PLANT FACILITIES PLAN

DROGUE VECTORS

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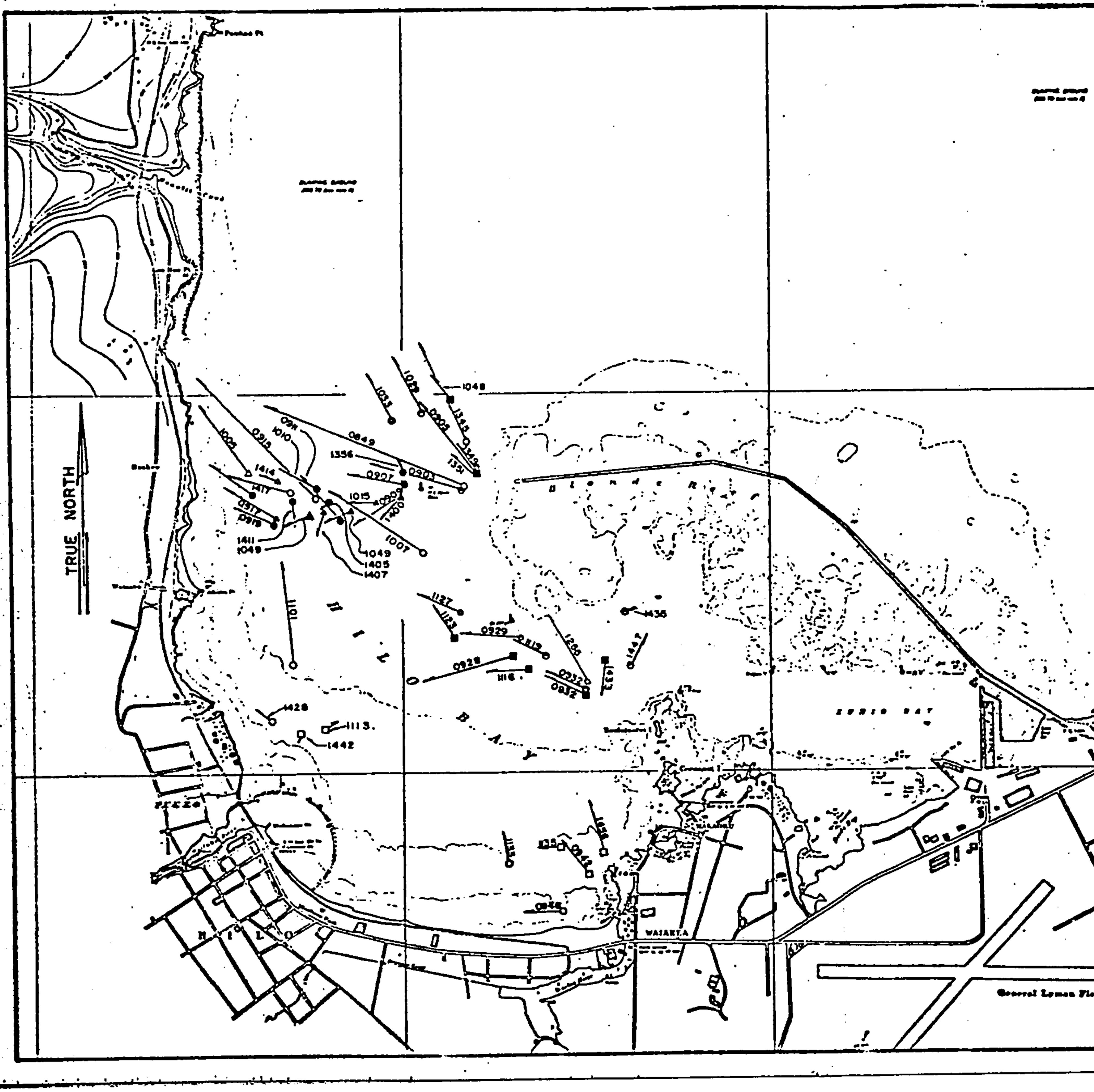
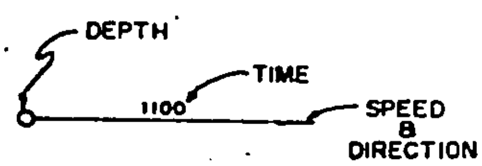
FIGURE D-11


TRUE NORTH
HILO BAY
WAIAKEA
HILO
1048
1345
1351
0849
1356
0907
0903
1015
1007
1049
1405
1407
1411
1414
1417
1101
1127
0929
0919
0928
1116
0932
1436
1442
1428
1113

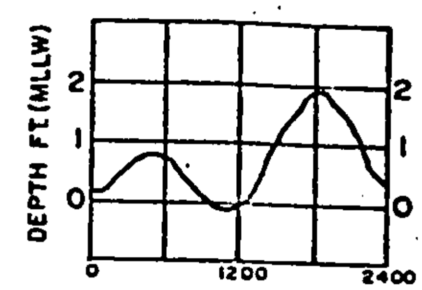
DROGUE VECTORS



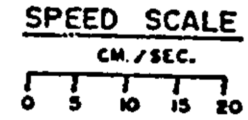
DEPTH OF DROGUE

- ○ SURFACE
- □ 5 FEET
- △ 10 FEET
- ● 15 FEET
- ● 20 FEET
- ■ 30 FEET
- ▲ 40 FEET

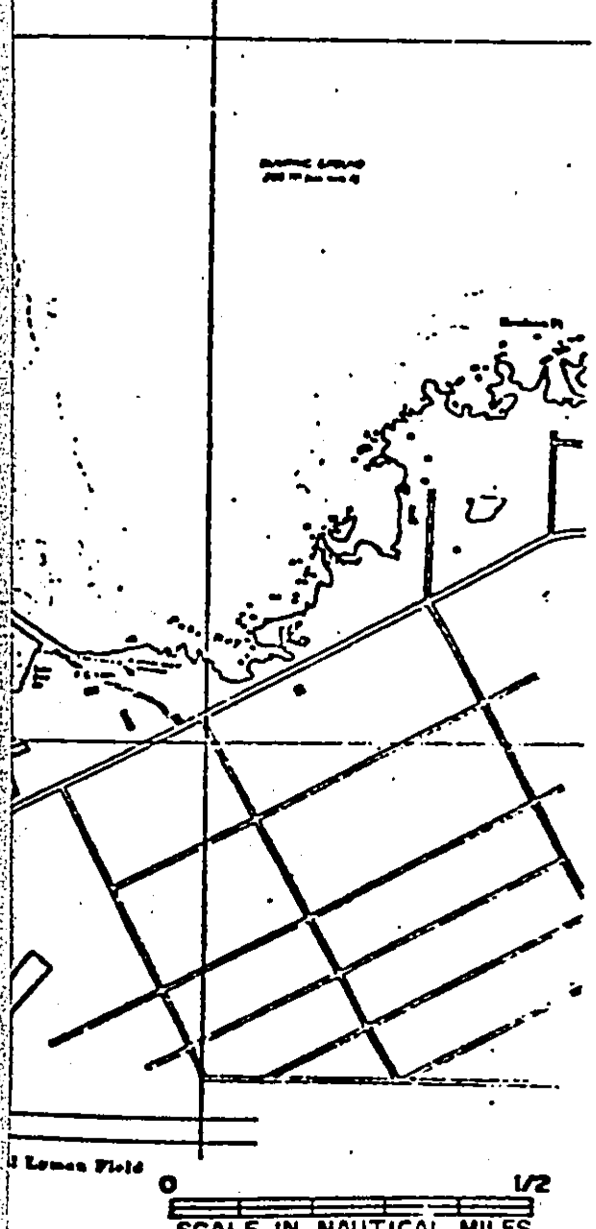
PREDICTED TIDE



SPEED SCALE



NWS WIND DATA (HILO, HAWAII)		
TIME (HOURS)	DIRECTION (°FROM TN)	SPEED (KTS)
0559	70	6
0659	70	10
0759	80	8
0858	60	7
0957	100	8
1056	50	6
1159	90	8
1256	CALM	0
1306	70	8
1343	350	4
1358	320	7
1428	60	5
1448	70	8
1457	40	6
1558	70	4
1642	60	7
1657	20	7
1722	30	6
1756	20	4



DATA SOURCE: U.S. ARMY CORPS OF ENGINEERS

MAP SOURCE: NOAA May 1974

HILO SEWAGE TREATMENT PLANT FACILITIES PLAN

DROGUE VECTORS

4-7-77

FIGURE D-12

APPENDIX E

Water Quality Data included in
this Appendix represents the Summary of
Data Gathered by Sunn, Low, Tom & Hara, Inc.
September 16, 1976 to June 8, 1977

HILO SEWAGE TREATMENT PLANT FACILITIES PLAN

WATER QUANITY MONITORING RESULTS: JUNE 8, 1977

Station (Depth, Ft)	pH	Temp (°C)	Salinity (°/oo)	Turbidity (NTU)	TSS (mg/1)	DO (mg/1)	NO_2+NO_3-N (µg/1 N)	TKN (µg/1 N)	Total N (µg/1 N)	Total P (µg/1 P)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)	Chl.a (g/m³)
1T (5')	8.2	24.4	33.9	-	1	7.0	4	406	410	11	1	-	1.90
1B (30')	8.2	23.8	34.1	-	1		4	406	410	11			0.40
2T (5')	8.2	24.2	33.7	-	2	6.7	1	406	407	14	8	-	3.10
2B (30')	8.2	23.9	34.3	-	1		1	371	372	13			0.60
3T (5')	8.2	24.3	34.0	-	2	7.6	1	350	351	14	4	-	0.40
3T (30')	8.2	24.3	34.0	-	1		4	420	424	12			0.20
4T (5')	8.2	24.9	33.0	-	4	8.2	4	327	331	15	40	-	2.30
4B (30')	8.2	23.7	34.3	-	1		2	464	466	13			0.20
5T (5')	8.1	24.5	34.2	-	4	6.5	2	499	501	16	172	-	1.80
5B (30')	8.2	23.9	34.4	-	2		3	336	339	12			0.10
6T (5')	8.2	24.3	33.9	-	3	6.7	1	280	281	18	180	-	1.80
6B (30')	8.2	23.9	34.2	-	2		2	210	212	13			2.10
7T (5')	8.3	23.9	33.5	-	4	7.7	5	441	446	30	22	-	1.60
7B (30')	8.3	23.9	34.1	-	3		4	399	403	20			1.60
8T (5')	8.2	24.3	33.6	-	1	7.5	4	182	186	19	64	-	2.70
8B (30')	8.2	23.7	34.1	-	1		4	196	200	19			0.60
9T (5')	8.2	24.2	33.8	-	1	6.3	2	308	310	17	100	-	2.00
9B (30')	8.2	23.7	34.0	-	1		1	273	274	23			2.20
10T (5')	8.2	24.4	33.8	-	2	6.3	1	224	225	17	134	-	0.50
10B (30')	8.3	23.9	34.3	-	1		1	182	183	16			0.30
11T (5')	8.3	24.0	33.8	-	1	7.4	1	210	211	19	8	-	0.40
11B (30')	8.3	24.0	34.1	-	1		2	224	226	19			0.50
12T (5')	8.2	24.2	33.7	-	2	7.4	3	210	213	24	12	-	1.70
12B (30')	8.2	23.9	34.2	-	1		2	175	177	13			1.60

Note: Bacteriological(TC and FC) analyses for top samples only.
No turbidity measurements for this day.
No fecal coliform data for this day.

HILO SEWAGE TREATMENT PLANT FACILITIES PLAN

WATER QUANITY MONITORING RESULTS: APRIL 12, 1977

Station (Depth, Ft)	pH	Temp (°C)	Salinity (°/oo)	Turbidity (NTU)	TSS (mg/1)	DO (mg/1)	NO_2+NO_3-N (µg/1 N)	TKN (µg/1 N)	Total N (µg/1 N)	Total P (µg/1 P)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)	Chl. a (mg/m³)
1T (5')	8.2	22.9	32.9	-	7	7.0	2	318	320	25	6	2	1.30
1B (30')	8.1	22.6	34.9	-	5	-	2	350	352	14			1.34
2T (5')	8.3	22.6	32.9	-	4	6.9	2	324	326	16	2	2	1.31
2B (30')	8.3	22.8	35.0	-	10	-	2	286	288	16			1.31
3T (5')	8.3	23.8	32.7	-	4	7.3	2	197	199	22	2	2	2.07
3B (30')	8.3	23.1	34.8	-	6	-	1	267	268	25			1.41
4T (5')	8.1	23.0	28.7	-	10	7.2	3	203	205	24	100	2	2.45
4B (30')	8.3	22.8	34.9	-	8	-	4	274	278	14			1.15
5T (5')	8.3	23.1	32.6	-	3	7.0	4	178	182	14	6	2	1.50
5B (30')	8.3	23.1	34.9	-	3	-	4	235	239	15			1.18
6T (5')	8.2	23.4	32.7	-	5	7.2	4	159	163	17	70	2	1.34
6B (30')	8.3	23.0	34.9	-	7	-	3	178	181	14			1.15
7T (5')	-	-	-	-	-	-	-	-	-	-	-	-	-
7B (30')	-	-	-	-	-	-	-	-	-	-	-	-	-
8T (5')	8.2	23.6	32.7	-	4	7.2	2	140	142	14	18	2	1.51
8B (30')	8.1	22.8	34.9	-	4	-	2	249	251	26			2.36
9T (5')	8.2	22.8	32.9	-	4	6.8	2	44	46	14	16	2	1.56
9B (30')	8.2	22.9	34.9	-	9	-	1	153	154	11			0.88
10T (5')	8.1	23.5	32.6	-	5	6.5	1	108	109	20	220	2	1.48
10B (30')	8.3	22.9	34.9	-	13	-	1	293	294	19			1.46
11T (5')	8.1	23.5	32.7	-	21	7.0	1	83	84	20	170	2	1.58
11B (30')	8.2	22.9	34.9	-	8	-	1	248	249	35			1.56
12T (5')	8.1	23.5	33.0	-	14	6.8	1	204	205	36	1,400	2	1.27
12B (30')	8.2	22.9	34.9	-	4	-	1	216	217	12			0.89

Note: Bacteriological (TC and FC) analyses for top samples only.
No turbidity data for this day.
Outfall repair work in progress. No samples or measurements taken at Sta. 7 (discharge site) on this date.

HILO SEWAGE TREATMENT PLANT FACILITIES PLAN

WATER QUALITY MONITORING RESULTS: DECEMBER 14, 1976

Station (Depth, Ft)	pH	Temp (°C)	Salinity (°/oo)	Turbidity (NTU)	TSS (mg/l)	DO (mg/l)	NO_2+NO_3-N (µg/l N)	TKN (µg/l N)	Total N (µg/l N)	Total P (µg/l P)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)	Chl.a (mg/m^3)
1T (5')	8.2	25.9	33.8	0.40	-	6.5	9	171	180	13	3	1	0.89
1B (30')	8.2	24.9	34.1	0.45	-	-	2	171	173	12			0.91
2T (5')	8.3	25.5	33.5	0.40	-	6.5	10	112	122	13	42	1	0.37
2B (30')	8.3	25.3	34.2	0.35	-	-	11	107	118	20			0.22
3T (5')	8.4	26.6	34.0	0.45	-	7.0	13	96	109	17	1	1	0.83
3B (30')	8.4	25.4	34.2	0.65	-	-	18	144	162	28			0.40
4T (5')	8.4	27.0	31.9	0.65	-	6.3	7	128	135	19	1	1	0.83
4B (30')	8.4	25.4	34.2	0.53	-	-	13	146	159	31			0.29
5T (5')	8.5	25.0	32.4	0.40	-	6.6	10	92	102	19	1	1	0.97
5B (15')	8.5	25.7	34.0	-	-	-	-	-	-	-			-
6T (5')	8.4	25.8	33.1	0.53	-	6.2	9	160	169	16	1	1	3.04
6B (30')	8.4	25.6	34.2	0.30	-	-	12	102	114	19			0.21
7T (5')	8.4	25.7	33.7	0.38	-	6.1	8	83	91	21	100	1	0.52
7B (30')	8.4	25.2	34.2	0.68	-	-	3	107	110	16	410	1	0.37
8T (5')	7.8	26.0	33.9	1.80	-	7.5	10	197	207	20	1,600	60	0.21
8B (30')	8.2	25.3	34.3	0.43	-	-	12	96	108	17	500	20	0.61
9T (5')	8.3	26.2	33.6	0.30	-	6.4	9	70	79	12	1	1	1.00
9B (30')	8.3	25.7	34.3	0.35	-	-	7	86	93	10			0.82
10T (5')	8.4	26.3	33.2	0.30	-	6.4	12	80	92	10	1	1	0.91
10B (30')	8.4	25.7	34.2	0.50		-	9	101	110	11			0.44
11T (5')	8.4	26.0	33.7	0.35	-	6.4	11	117	128	10	1	1	0.54
11B (30')	8.4	25.6	34.1	0.33	-	-	20	115	135	14			0.62
12T (5')	8.4	26.0	33.6	0.48	-	6.3	13	102	115	8	1	1	0.24
12B (30')	8.4	25.5	34.2	0.88	-	-	12	96	108	13			0.21

Note: Bacteriological (TC and FC) analyses for top samples only.
No suspended solids (TSS) for this day.

HILO SEWAGE TREATMENT PLANT FACILITIES PLAN

WATER QUALITY MONITORING RESULTS: SEPTEMBER 16, 1976

Station (Depth, Ft)	pH	Temp (°C)	Salinity (°/oo)	Turbidity (NTU)	TSS (mg/1)	DO (mg/1)	NO_2+NO_3-N (µg/1 N)	TKN (µg/1 N)	Total N (µg/1 N)	Total P (µg/1 P)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)	Chl.a (mg/m³)
1T (5')	8.0	25.9	32.8	0.95	12	6.6	1	114	115	11	10	8	0.43
1B (30')	8.0	24.9	34.2	0.55	6	-	10	337	347	21			1.57
2T (5')	8.0	25.5	31.9	0.80	56	6.9	2	224	226	15	1	1	1.10
2B (30')	8.0	25.3	34.3	0.42	13	-	1	296	297	23			2.90
3T (5')	8.0	26.6	32.7	0.85	10	6.4	1	331	332	27	20	4	1.52
3B (30')	8.0	25.4	33.9	1.00	16	-	1	276	277	29			1.83
4T (5')	8.2	27.0	30.2	0.85	12	-	6	494	500	25	1	1	2.43
4B (30')	7.9	25.4	34.0	0.95	12	-	2	499	501	25			5.49
5T (5')	8.0	25.0	28.8	0.82	10	6.7	47	443	490	30	1	1	2.67
5B (15')	-	25.7	32.3	-	-	-	-	-	-	-			-
6T (5')	8.0	25.8	29.9	1.20	10	6.8	7	600	607	26	1	1	2.70
6B (30')	8.0	25.6	34.0	0.45	9	-	8	236	244	22			0.89
7T (5')	8.0	25.7	32.0	0.55	7	5.2	7	326	333	21	12	4	1.47
7B (30')	8.0	25.2	34.0	0.40	9	-	7	230	237	13			1.74
8T (5')	8.0	26.0	31.9	0.72	8	7.2	3	332	335	9	1	1	2.50
8B (30')	8.0	25.3	34.1	0.35	4	-	1	296	297	12			0.64
9T (5')	8.0	26.2	32.1	0.90	9	6.4	6	387	393	22	1	1	1.80
9B (30')	8.0	25.7	34.1	0.50	10	-	3	281	284	9			0.44
10T (5')	8.0	26.3	32.2	0.80	7	6.9	1	244	245	15	1	1	1.60
10B (30')	7.9	25.7	34.0	0.48	15	-	6	225	231	10			1.74
11T (5')	8.0	26.0	32.2	0.85	12	6.1	1	246	247	15	1	1	0.61
11B (30')	8.0	25.6	34.2	0.35	11	-	21	308	329	11			0.75
12T (5')	8.0	26.0	32.2	0.70	9	5.9	2	423	425	13	1	1	1.60
12B (30')	8.0	25.5	34.0	0.42	11	-	1	279	280	37			1.94

Note: Bacteriological (TC and FC) analyses for top samples only.

A P P E N D I X F

Marine Biology: Reports

by Dr. Ralph Bowers

Plankton Samples - Hilo Outfall (12/13/76)

Submitted to: Sunn, Low, Tom and Hara, Inc.

By: Ralph L. Bowers, Ph.D.

A comparison of the December 13, 1976, zooplankton data (Tables 1 and 2) with that collected on September 17, 1976, indicates that there has been a sharp decrease in the numbers of copepods, Nauplii, and short chain colonial diatoms at each station.

The observed decreases in numbers of planktonic organisms could be attributed to a number of environmental factors. The most important factors include light and nutrient availability and the length of time planktonic organisms remain in areas with specific light and nutrient conditions.

Zooplankton diversity remains lowest at station 1-Z, has increased at station 2-Z and decreased at station 4-Z when compared with the September 17, 1976, data. Such changes in zooplankton diversity most probably represent sampling and counting errors rather than actual changes in the zooplankton populations.

TABLE 1. The density (numbers of organisms/ft^3) of most common types of zooplankton collected from the surface waters of station 1-Z, 2-Z and 4-Z near the Hilo Ourfall. Based on the multiple subsample method.

<u>Organism</u>	Station 1-Z	Station 2-Z	Station 4-Z
Copepods	2.5	4.8	15.7
Nauplii (all species)	0.6	0.7	0.7
Lucifer	-	0.4	0.3
Lucifer Protozoea	-	0.1	1.3
Tunicates (all species)	-	-	0.1
Fish Larvae	-	-	-
Fish Eggs	0.2	1.2	0.9
Polychaetes	0.5	0.2	0.9
Gastropods	0.3	0.2	0.8
Bivalves	-	0.2	0.5
Hyperiids	0.1	-	0.4
Mysids	-	-	-
Chaetognaths	0.4	-	0.1
Medusae	-	-	-
Barnacle Cypris	-	0.1	-
Echinoderms	-	-	-
Ostracods	-	-	-
Oikopleura	3.3	1.1	3.0
Nemertean Larvae	-	-	-
Galatheid Larvae	-	0.1	-
Foraminifera	-	0.6	0.3

Phytoplankton- Short chain colonial diatoms rarely seen in the 3 station samples.

TABLE 2. The total number of zooplankton types collected at three stations near the Hilo Outfall. Based on the sample scanning method.

Station	Total Zooplankton Types
1-Z	9
2-Z	15
4-Z	13

Plankton Samples - Hilo Outfall (4/11/77)

Submitted to: Sunn, Low, Tom and Hara, Inc.

By: Ralph L. Bowers, Ph.D.

Based on the numbers of zooplankton types present (Tables 1 and 2), station 1-Z has shown a steady increase over the past 3 sampling periods (Sept., 1976, Dec., 1976 and April, 1977). Numbers of zooplankton types collected at station 1-Z are 9, 13 and 16. Station 2-Z has remained nearly constant with respect to zooplankton types collected (14, 15 and 15 for the 3 sampling periods). No comparative data exists for station 3-Z (first collection). Station 4-Z has shown a decrease in zooplankton types between the Sept. and Dec.,1976 collections (17 and 13 respectively) and has remained at 13 types for the April, 1977 collection.

With respect to the densities of individual zooplankton types, copepods have increased in number and the densities are similar to those of Sept., 1976. Nauplii densities remain low when compared with those of Sept., 1976.

The presence of phytoplankton (short chain colonial diatoms) may be responsible for the increased copepod densities observed for the April, 1977, collections. It is difficult to explain why the Nauplii densities remain low.

Station 3-Z did not contain significant numbers of phytoplankton and this may have resulted in the few organisms observed in the subsamples (for density determination).

TABLE 1. The densities (numbers/ ft^3) of the most common types of zooplankton collected from the surface waters of stations 1-Z, 2-Z, 3-Z and 4-Z near the Hilo Outfall. Based on the multiple subsample method.

Organism	Station 1-Z	Station 2-Z	Station 3-Z	Station 4-Z
Copepods (all species)	67.3	71.0	16.8	45.4
Nauplii (all species)	0.1	1.9	0.2	0.2
Lucifer	-	0.6	-	-
Tunicates (all species)	0.1	-	-	-
Fish Eggs	0.1	1.3	0.3	1.1
Polychaetes	0.1	-	-	0.2
Gastropods	0.6	3.0	-	-
Bivalves	0.7	0.4	0.3	0.2
Chaetognaths	1.2	0.2	1.2	0.3
Medusae	0.5	0.1	0.1	0.2
Barnacle Cypris	-	0.1	-	0.2
Oikopleura	-	-	-	0.1
Pteropod	0.1	0.1	-	-
Crab Zoea	0.1	-	-	0.1
Cladocerans	-	0.2	-	0.1
Doliolum	-	-	-	0.2
Phytoplankton (short chain colonial diatoms)	3,500	4,500	-	3,000

TABLE 2. The total number of zooplankton types collected at 4 stations near the Hilo Ourfall. Based on the sample scanning method.

Station	Total Zooplankton Types
1-Z	16
2-Z	15
3-Z	13
4-Z	13

Plankton Sampling - Hilo Outfall (9/76 - 6/77)

Submitted to: Sunn, Low, Tom and Hara, Inc.

By: Ralph L. Bowers, Ph.D.

The previous Hilo Outfall Plankton Sample Report (4/11/77) contained an error for the zooplankton types collected at station 1-Z for the Sept., 1976, Dec., 1976 and April,1977, sampling periods. It was reported that numbers of zooplankton types had shown a steady increase over the 3 sampling periods. The total zooplankton types collected during the Sept., 1976, and Dec., 1976, sampling periods were inadvertently switched giving the impression that the zooplankton types increased from 9 to 13 to 16. In actuality the zooplankton types varied from 13 to 9 to 16.

A comparison of the present zooplankton data (6/6/77) with that collected previously does not indicate any general trends with respect to the zooplankton populations.

The numbers of copepods/ft^3 (Table 1) have decreased at all 4 stations when compared with the April, 1977, data. Nauplii densities remain low when compared with those of Sept., 1976. The number of zooplankton types (Table 2) collected at each station has decreased at stations 1-Z (16 - 15), 2-Z (15 - 13) and 3-Z (13 - 10) and increased at station 4-Z (13 - 15). The number of zooplankton types collected at each station for each sampling period (Table 3) appear to vary irregularly rather than show any general trends. Zooplankton data collected quarterly for 3 years, from an area seaward of the Reef Runway in Honolulu, did not reveal general trends in either the densities of copepods or the number of zooplankton types collected.

Table 4 lists the numbers of copepods/ft^3 collected at each station during each sampling period. With the exception of station 3-Z, copepods were more abundant in Sept., 1976, and April, 1977. It is interesting to note that short chain colonial diatoms were extremely abundant in the Sept., 1976, and April, 1977, plankton samples (up to 22,500 colonies/ft^3). The short chain colonial diatoms were either absent or few in number in the Dec., 1976, and June, 1977, plankton samples.

The short chain colonial diatoms are a probable nutrient source for copepods and, given sufficient time, increased diatom densities should result in greater copepod densities.

The causes of the increased diatom densities for Sept., 1976, and April, 1977, are difficult to ascertain without additional data on water quality (nutrients, temperature, clarity, etc.) current systems (length of time a specific body of water remains in a given area), storm discharges (or lack of same) and increased or decreased sewage discharge.

Table 5 lists the numbers of copepods/ft^3 and numbers of zooplankton types collected from several areas in the State of Hawaii. The data presented in Table 5 allows a basic comparison between zooplankton data collected near the Hilo Outfall and zooplankton data collected at various other areas in Hawaii. The Hilo Outfall zooplankton data falls within the range of data from other areas suggesting that zooplankton populations near the Hilo Outfall are not significantly different from zooplankton populations sampled elsewhere in the State.

The variations in zooplankton densities and numbers of zooplankton types, observed during the present study, are most likely the result of "patchy" distributions caused by the influences of current patterns, prevailing winds and groundwater flows rather than influences (both positive and/or negative) of the Hilo Outfall.

TABLE 1. The densities (numbers/ ft^3) of the most common types of zooplankton collected from the surface waters of stations 1-Z, 2-Z, 3-Z and 4-Z near the Hilo Outfall. Based on the multiple subsample method.

Organism	Station 1-Z	Station 2-Z	Station 3-Z	Station 4-Z
Copepods (all species)	1.1	41.8	15.5	20.7
Nauplii (all species)	2.5	3.9	0.6	1.0
Lucifer	-	1.9	2.7	1.0
Lucifer Protozoea	-	0.1	-	-
Fish Eggs	3.3	0.6	0.5	0.7
Polychaetes	0.1	0.2	-	-
Gastropods	0.2	0.4	0.4	0.4
Bivalves	0.3	0.4	0.9	0.6
Chaetognaths	-	1.0	0.3	1.8
Oikopleura	6.4	0.7	0.4	0.5
Pteropods	-	-	-	0.1
Crab Zoea	0.1	-	-	-
Hyperiids	0.5	0.6	0.4	0.5
Mysids	-	-	-	0.1

Phytoplankton - Short chain colonial diatoms present but very few in number.

TABLE 2. The total number of zooplankton types collected at 4 stations near the Hilo Outfall. Based on the sample scanning method.

Station	Total Zooplankton Types
1-Z	15
2-Z	13
3-Z	10
4-Z	15

TABLE 3. Comparisons between the total numbers of zooplankton types, collected during each sampling period, at each of the 4 stations near the Hilo Outfall. Based on the sample scanning method

	Total Zooplankton Types			
Station	Sept. 1976	Dec. 1976	April, 1977	June 1977
1-Z	13	9	16	15
2-Z	14	15	15	13
3-Z	-	-	13	10
4-Z	17	13	13	15

TABLE 4. Numbers of copepods per ft^3 collected at each station during each sampling period.

	Numbers of Copepods/ ft^3			
Station	Sept. 1976	Dec. 1976	April, 1977	June, 1977
1-Z	183.4	2.5	67.3	1.1
2-Z	84.4	4.8	71.0	41.8
3-Z	-	-	16.8	15.5
4-Z	56.8	15.7	45.4	20.7

TABLE 5. Numbers of Copepods/ ft^3 and total number of zooplankton types collected from various areas in Hawaii.

Location	Date/Time	No./ft^3(Range)	Zooplankton Types (Range)
Haleiwa Harbor	1/72- 10:00AM - 3:00PM	0.3 - 4.1	2 - 6
Hawaii Kai Marina	9/73- 9:00AM - 8:30PM	65.1 - 991.5	7 - 13
Seaward of Hawaii Kai Marina	9/73- 9:45AM - 7:05PM	14.2 - 24.3	11 - 13
Kiikii Stream, Waialua	5/72- 10:00AM - 8:00PM	30.8 - 1415.0	5 - 6
Nawailiwili Harbor, Kauai	12/71- 10:00AM - 9:50PM	24.0 - 243.0	6 - 8
Seaward of Reef Runway	9/73- 9/76- 10:00 AM	1.0 - 38.0	12 - 23

Brief Biological Reconnaissance of Eleven Dive Sites Located to the East and West of the Existing Hilo STP Outfall

Presented to: Sunn,Low, Tom and Hara, Inc.

By: Ralph L. Bowers, Ph.D.

INTRODUCTION

The present study is an attempt to determine existing marine biological conditions at several locations that do not now appear to be affected by the Hilo STP outfall.

METHODS

During January 10-11, 1977, eleven diving stations were established (see navigation chart) where biological observations were carried out.

Poor water clarity at stations 1 and 4-7 did not permit the use of transect / quadrat methods for biological measurements and relatively short "bounce" dives were made at these locations.

Station 7A resulted from an attempt to swim from a known point (seaward end of the outfall diffuser) toward station 7. Brief visual observations were noted as the divers swam to a depth of 85 feet where low air supply terminated the dive.

At stations 2, 3, and 8-10 standard transect/quadrat methods and fish counts were completed. The methods utilized are identical to those presented in the May, 1975, Hilo STP biological report, with one exception. That is, transect line length, at each station, was reduced to 40 meters (as opposed to 80 meters).

PRESENTATION OF RESULTS

Estimates of the Percent Substratum Coverage

Table 1 lists the percent cover and frequency estimated for the various living and non-living aspects of the substratum at stations 2, 3 and 8-10. Table 2 lists the comparisons, between stations, for the four major types of coverages estimated (live corals, coralline alga, green alga and non-living aspects).

Estimates of the Invertebrate Densities (Other than Coral)

Table 3 lists the types, numbers observed, densities and frequencies for the macroscopic invertebrates that fell within the 16 one meter square areas of stations 2, 3 and 8-10.

Relative Abundance of Fishes

Table 4 lists the number of fishes and number of species of fishes observed within 3 meters on either side of the 40 meter length of the transect line at stations 2, 3 and 8-10.

STATION DESCRIPTIONS

Station 1 (Depth Range 12-15 ft)

The substratum consists of large, dead coral boulders with a heavy covering of silt. Deeper areas between the boulders consists of a layer of fine silt approximately 0.5 meter in thickness. A total of 8 species of live corals were observed in the area. Generally the coral colonies were very small with siltation damage evident (portions of colony dead with heavy silt covering and small areas of live polyps covered with thin layer of silt). Total live coral coverage was visually estimated at less than 2%.

TABLE 1. The percent coverage of the substratum by various organisms and materials. Also listed are the frequencies of occurrence, along each transect line, for each organism and each physical aspect of the substratum.

Station #	Sand	Rubble	Dead Coral	Porolithon	*Porites lobata*	*Porites compressa*	*Porites irregularis*	*Montipora verrucosa*	*Montipora patula*	*Montipora flabellata*	*Pavona varians*	*Leptastrea purpurea*
2	-	-	26.6	39.1	4.7	4.7	-	7.8	3.1	-	6.2	-
2	-	-	.62	.87	.18	.18	-	.31	.06	-	.18	-
3	-	26.6	25.0	3.1	3.1	7.8	4.7	3.1	-	-	1.6	-
3	-	.50	.69	.12	.06	.31	.18	.12	-	-	.06	-
8	1.6	1.6	23.4	3.1	39.1	10.9	-	4.7	3.1	3.1	-	-
8	.06	.06	.69	.12	.94	.31	-	.19	.12	.12	-	-
9	-	14.1	15.6	-	31.2	9.4	-	14.1	7.8	-	-	3.1
9	-	.44	.44	-	.75	.31	-	.44	.25	-	-	.12
10	6.2	-	53.1	-	18.7	-	-	3.1	3.1	1.6	-	3.1
10	.12	-	.94	-	.56	-	-	.12	.12	.06	-	.12

TABLE 1. Cont.

Pocillopora meandrina	*Pocillopora damicornis*	*Cyphastrea ocellina*	*Fungia scutaria*	*Palythoa tuberculosa*	*Halimeda* (Green Alga)	
-	1.6	1.6	4.7	-	-	Percent Cover
-	.06	.06	.12	-	-	Frequency
-	-	-	-	-	25.0	Percent Cover
-	-	-	-	-	.69	Frequency
4.7	-	-	1.6	3.1	-	Percent Cover
.19	-	-	.06	.06	-	Frequency
3.1	-	-	1.6	-	-	Percent Cover
.12	-	-	.06	-	-	Frequency
7.8	-	-	-	3.1	-	Percent Cover
.31	-	-	-	.12	-	Frequency

TABLE 2. Total estimated percent coverage of the substratum by live corals, coralline alga, the green alga, *Halimeda*, and non-living aspects (sand, rubble, etc.).

Station	Live Corals	Coralline Alga	Green Alga (*Halimeda*)	Non-Living Aspects
2	34.4	39.1	---	26.6
3	19.5	3.1	25.0	51.6
8	70.3	3.1	---	26.6
9	70.3	---	---	29.7
10	40.5	---	---	59.3

TABLE 3. Macroscopic invertebrates, other than corals, observed within the five transect areas.

Station #	Class of Invertebrate	# Observed	Density (#/m^2)	Frequency
2	---	---	---	---
3	Sea Urchin (*E. calamaris*)	3	.19	.06
3	Sea Urchin (*T. gratilla*)	2	.13	.06
8	Sea Urchin (*E. mathaei*)	17	1.06	.37
8	Sea Urchin (*T. gratilla*)	2	.13	.13
8	Sea Urchin (*E. aciculatum*)	3	.19	.19
8	Sea Urchin (*E. calamaris*)	1	.06	.06
9	---	---	---	---
10	Sea Urchin (*E. Mathaei*)	9	.56	.25
10	Sea Urchin (*E. calamaris*)	1	.06	.06

TABLE 4. Numbers of fishes and fish species observed within five transect areas.

Station #	Total Number of Fishes	Total Number of Fish Species
2	339	31
3	52	13
8	543	39
9	172	26
10	217	27

Very little algae was present. Encrusting, filter feeding organisms such as sponges, bryozoans and tunicates were well represented in this area.

Station 2 (Depth Range 14-25ft)

This area is characterized by an eroded reef structure that protrudes 10-12 ft above thick silt deposits. The irregular reef formations and apparent relative freedom from heavy silt loads has produced a varied habitat suitable for many species of organisms (particularly fishes - see Table 4). Although the reef top has a thin layer of silt present, no silt - damaged coral colonies were observed. Some encrusting corals (ie, *Leptastrea purpurea*) had formed large colonies up to $3m^2$.

Station 3 (Depth Range 12-15 ft)

The substratum is relatively smooth when compared with station 2. Depth differences of only 2-3 ft and few irregularities have produced a habitat suitable to fewer organisms (see Tables 1, 2 and 4). This area is characterized by shallow depressions filled with sand, rubble and silt and upon which are gorwing many thalli of *Halimeda*, a type of green alga capable of adding significant amounts of calcified material to reef deposits. The protruding hard portions of the reef top support coral growth but at a reduced level from that observed at station 2. No areas of deep silt were observed nor were silt damaged corals observed.

Station 4 (Depth 40 ft)

Station 5 (Depth 28 ft)

Station 6 (Depth 60 ft)

Stations 4-6 are all characterized by uniform thick silt and mud deposits. In all cases visibility was one foot or less. In general, visibility decreased sharply as one approached to within 3-10 ft of the bottom.

Probing the silt with an aluminum pole indicated an average soft silt depth of approximately 0.5 meter. Many holes in the silt (created by infaunal organisms) were observed at station 4. Station 5 had very few holes in the silt and none were observed at station 6. Station 6 contained much sugar cane waste material, and, black mud with a strong hydrogen sulfide odor was clinging to the anchor when it was brought into the boat.

Station 7 (Depth 105 ft)

Extreme water turbidity prevented observations except for coral rubble where the anchor was resting.

Station 7A (Depth 85 ft)

Observations made while swimming toward station 7 from the diffuser indicate little, if any, biological or topographic change in the reef when compared to descriptions presented in the May, 1975, report. At a depth of 85 ft, the general reef formation consists of a series of ridges and channels. The ridges support live corals shile the channels contain sand and rubble. No thick silt deposits were seen although most areas did have a "dusty" appearance due to a very thin layer of silt present.

Station 8 (Depth 30 ft)

Station 9 (Depth 60 ft)

Stations 8 and 9 were established as control stations where water quality hopefully would not be affected by river and stream runoff, sugar cane waste, breakwater construction, dredging activities and sewage effluent.

The site chosen was directly seaward of Richardsons Park (the parking area) at the 30 ft depth (station 8) and 60 ft depth (station 9).

Station 8 is characterized by a basalt boulder slope supporting an abundant coral and fish population (see Tables 2 and 4). The boulder slope extends seaward and terminates on a flat, hard coral substratum at the 50-

60 ft depth.

Station 9 is characterized by a relatively flat, hard substratum that contains patches of coral rubble and sand. Many large colonies of coral (dominant forms are Porites lobata and Montipora verrucosa) arise from the flat areas. No evidence of silt deposition at either station 8 or 9 was observed.

Station 10 (Depth 30 ft)

Station 10 was located directly seaward of Onekahakaha Park. This area is characterized by a very shallow slope with large basalt boulders present. When compared to stations 8 and 9, station 10 had increased water turbidity, evidence of silt deposition ("dusty" appearance) and reduced coral coverage.

GENERAL CONCLUSIONS

The brief biological reconnaissance carried out at several stations both to the East and West of the existing Hilo STP outfall has indicated that observed biological consitions are generally poorer to the West of the Hilo STP outfall. These poor biological conditions appear to be the result of many factors including; increased surface runoff from rivers and streams, increased sediment loads resulting from strom runoff and human activities (agriculture, urbanization, dredging, etc.) reduced circulation due to breakwater construction, and finally, increased water borne loads of organic debris resulting from the processing of sugar cane.

Station 10 appeared to be somewaht influenced by the above mentioned detrimental factors. Stations 8 and 9 do not appear to be influenced by factors detrimental to marine life (either natural or human induced). It is the author's opinion that the marine environment, from Honolii Cove, on the West, to at least Keokea Point, on the East (see navigation chart), is negatively influenced by both natural and man induced factors as mentioned above.

Previous studies (May, 1975) have shown that biological conditions adjacent to the Hilo STP outfall are not as depressed as stations 1-6 and 10 observed during the present study.

Again, as previously mentioned in the May, 1975, study, it seems that natural, and man induced, conditions have a far greater negative impact on marine life than the present effluent levels of the Hilo STP.

Biological Reconnaissance of the Hilo STP Outfall

Submitted to: Sunn, Low, Tom and Hara, Inc.

By: Ralph L. Bowers, Ph.D.

I. INTRODUCTION

The present study is a reexamination of 5 stations (4 stations adjacent to the outfall pipe and 1 control station) initially studied May 19 - 23, 1975, and 6 stations (3 stations in Hilo Bay and 3 stations to the East of the outfall area) initially studied January 10 - 11, 1977.

Stations Locations (see Map 1)

1* - at major break in outfall, West side (45 - 55ft).

2* - at outfall diffuser, West side (48 - 55ft).

3* - at major break in outfall, East side (45 - 60ft)

4* - at outfall diffuser, East side (48 - 60ft)

5* - control site, seaward and East of first bend in Hilo Breakwater from STP (40ft)

1** - Eastern area of Blonde Reef (12 - 15ft)

2** - Central area of Blonde Reef (12 - 20ft)

3** - Western area of Blonde Reef (17 - 20ft)

4** - Control site seaward of Richardsons Beach Park (30ft).

5** - Control site seaward of Richardsons Beach Park (60ft).

6** - Control site seaward of Onekahakaha Beach Park (40ft).

The methods used to collect the data were the same as presented in the reports for the May, 1975, and January, 1977, studies with the exception that no photograhs were taken. Station descriptions can be found in the May, 1975, and January, 1977, reports.

* Indicates stations studied May, 1975, and June, 1977.

** Indicates stations studied January, 1977, and June, 1977.

II. RESULTS

Estimates of the Percent Substratum Coverage

Table 1 lists the percent cover and frequency estimated for the various living and non-living aspects of the substratum. Table 2 lists the total percent coverage of the substratum by live corals, coralline alga, the green alga, *Halimeda* and non-living aspects for each station and each study period.

Estimates of the Invertebrate Densities (Other than Coral)

Table 3 lists the types, numbers observed, densities and frequencies for the macroscopic invertebrates that fell within the 16 - 32 $1m^2$ areas of each station. Table 4 lists the total numbers, densities and numbers of species for the macroscopic invertebrates recorded at each station and each study period. All species at each station are lumped together.

Relative Abundance of Fishes

Table 5 lists the number of fishes and number of species of fishes observed within 3m on either side of the 40 - 80m transect line at each station. Table 6 lists the number of fishes, number of fish species and diversities for each station and each study period.

III. DISCUSSION

Specific data, collected during the June, 1977, study period is presented in Tables 1, 3 and 5. Comparative data, collected during all 3 study periods (May, 1975, January, 1977, and June, 1977) in presented in Tables 2, 4 and 6.

Throughout the 3 study periods, variations in the substratum coverage, numbers of invertebrates present (other than corals) and the numbers and species of fishes present is evident. In general, these variations do not appear to illustrate any specific trends which may indicate either a positive or negative

TABLE 1. The percent coverage of the substratum by various organisms and materials. Also listed are the frequencies of occurrence, along each transect line, for each organism and each physical aspect of the substratum.

Station	Silt	Sand	Rubble	Dead Coral	Porolithon	Porites lobata	Porites compressa	Porites irregularis	Montipora verrucosa	Montipora patula	Montipora flabellata	Montipora stellata	Pocillopora meandrina	Pocillopora damicornis	Leptastrea purpurea	Leptastrea bottae	Fungia scutaria	Pavona varians	Cyphastrea ocellina
1*	-	10.9	4.7	21.9	14.8	15.6	6.3	2.3	6.3	.8	-	-	-	-	6.3	-	2.3	3.1	4.7
1*	-	.13	.13	.53	.41	.44	.22	.09	.19	.03	-	-	-	-	.25	-	.09	.13	.19
2*	-	-	7.0	28.9	10.2	24.2	3.9	-	13.9	1.6	.8	-	.8	-	5.6	-	.8	2.3	.8
2*	-	-	.16	.56	.28	.59	.16	-	.44	.06	.03	-	.03	-	.19	-	.03	.09	.03
3*	-	3.9	6.3	32.0	10.9	13.3	2.3	-	16.4	3.9	-	-	-	-	3.1	-	.8	7.0	-
3*	-	.03	.06	.27	.31	.34	.06	-	.47	.16	-	-	-	-	.13	-	.03	.28	-
4*	-	3.1	2.3	31.3	7.8	14.1	10.9	-	8.6	4.7	-	-	.8	-	5.5	.8	2.3	7.8	-
4*	-	.06	.09	.81	.19	.50	.28	-	.31	.19	-	-	.03	-	.16	.03	.09	.22	-
5*	-	-	-	35.2	10.2	17.2	9.4	-	12.5	6.3	-	-	-	-	.8	-	2.3	3.1	3.1
5*	-	-	-	.84	.31	.56	.31	-	.44	.22	-	-	-	-	.03	-	.09	.13	.13
1**	27.3	-	13.3	50.0	-	-	-	2.3	3.1	-	-	-	-	-	.8	-	.8	2.3	-
1**	.53	-	.34	.81	-	-	-	.09	.13	-	-	-	-	-	.03	-	.03	.09	-
2**	-	-	6.3	28.1	21.1	4.7	7.0	4.7	7.0	.8	.8	1.6	-	2.3	4.7	-	2.3	6.3	1.6
2**	-	-	.16	.78	.59	.19	.28	.19	.28	.03	.03	.06	-	.09	.13	-	.09	.25	.06
3**	-	4.7	6.3	34.4	7.8	1.6	1.6	4.7	9.4	4.7	-	-	-	1.6	6.3	-	-	1.6	1.6
3**	-	.19	.19	.81	.25	.06	.06	.19	.38	.19	-	-	-	.06	.19	-	-	.06	.06
4**	-	2.3	-	18.8	7.0	39.8	17.2	-	6.3	3.1	-	-	3.9	-	.8	-	-	.8	-
4**	-	.06	-	.59	.25	.81	.50	-	.22	.13	-	-	.16	-	.03	-	-	.03	-
5**	-	-	35.2	18.2	4.5	26.5	3.8	-	18.2	7.6	-	-	4.5	-	.8	-	-	-	.8
5**	-	-	.30	.55	.15	.73	.15	-	.48	.27	-	-	.18	-	.03	-	-	-	.03
6**	-	-	-	43.8	3.1	28.1	-	-	1.6	3.1	-	-	12.5	-	3.1	-	-	-	-
6**	-	-	-	.88	.06	.75	-	-	.06	.13	-	-	.50	-	.13	-	-	-	-

TABLE 1, Cont.

	Palythoa tuberculosa	*Halimeda* (Green Alga)	
1*	-	-	Percent Cover
1*	-	-	Frequency
2*	-	-	Percent Cover
2*	-	-	Frequency
3*	-	-	Percent Cover
3*	-	-	Frequency
4*	-	-	Percent Cover
4*	-	-	Frequency
5*	-	-	Percent Cover
5*	-	-	Frequency
1**	-	-	Percent Cover
1**	-	-	Frequency
2**	-	-	Percent Cover
2**	-	-	Frequency
3**	-	14.1	Percent Cover
3**	-	.44	Frequency
4**	-	-	Percent Cover
4**	-	-	Frequency
5**	-	-	Percent Cover
5**	-	-	Frequency
6**	4.7	-	Percent Cover
6**	.19	-	Frequency

TABLE 2. The total percent coverage of the substratum by live corals, coralline alga, *Halimeda* and non-living aspects. The data covers each station and each study period.

	May, 1975				January, 1977				June, 1977			
Station	Live Corals	Coralline Alga	*Halimeda*	Non-Living Aspects	Live Corals	Coralline Alga	*Halimeda*	Non-Living Aspects	Live Corals	Coralline Alga	*Halimeda*	Non-Living Aspects
1*	45.2	10.1	-	44.5					47.7	14.8	-	37.5
2*	41.5	8.6	-	50.0					35.9	10.2	-	54.1
3*	42.8	18.0	-	39.0					46.8	10.9	-	42.2
4*	50.8	.8	-	48.4					55.5	7.8	-	36.7
5*	47.6	6.2	-	46.0					54.7	10.2	-	35.2
1**					-	-	-	-	9.3	-	-	90.6
2**					34.4	39.1		26.6	43.8	21.1	-	34.4
3**					19.5	3.1	25.0	51.6	33.1	7.8	14.1	45.4
4**					70.3	3.1	-	26.6	71.9	7.0	-	21.1
5**					70.3	-	-	29.7	62.2	4.5	-	33.4
6**					40.5	-	-	59.3	53.1	3.1	-	43.8

TABLE 3. Macroscopic invertebrates, other than corals, observed within the 16 - 32 $1m^2$ areas of each station

Station	Class of Invertebrate	No. Observed	Density	Frequency
1*	Sea Urchin (E. calamaris)	10	.31	.31
2*	Sea Urchin (E. calamaris)	7	.22	.22
3*	Sea Urchin (E. calamaris)	7	.22	.22
3*	Sea Cucumber (H. atra)	1	.03	.03
4*	Sea Urchin (E. calamaris)	10	.31	.25
5*	---	-	-	-
1**		-	-	-
2**	Sea Urchin (E. calamaris)	1	.03	.03
2**	Sea Urchin (T. gratilla)	3	.09	.09
3**	Sea Urchin (E. calamaris)	2	.13	.13
3**	Sea Urchin (T. gratilla)	2	.13	.13
4**	Sea Urchin (E. calamaris)	6	.19	.16
4**	Sea Urchin (T. gratilla)	2	.06	.06
4**	Sea Urchin (E. mathaei)	27	.84	.50
4**	Sea Urchin (E. aciculatum)	4	.13	.13
5**	Sea Urchin (H. mammillatus)	1	.03	.03
5**	Sea Urchin (C. gigantea)	1	.03	.03
5**	Sea Cucumber (H. atra)	1	.03	.03
6**	Sea Urchin (E. calamaris)	5	.31	.25
6**	Sea Urchin (E. mathaei)	9	.56	.19
6**	Sea Urchin (E. aciculatum)	1	.06	.06

TABLE 4. The total numbers, densities and numbers of species of macroscopic invertebrates, other than corals, recorded at each station during each study period.

Station	May, 1975 Total Number	May, 1975 Density	May, 1975 Number of Species	January, 1977 Total Number	January, 1977 Density	January, 1977 Number of Species	June, 1977 Total Number	June, 1977 Density	June, 1977 Number of Species
1*	10	.31	3				10	.31	1
2*	6	.19	1				7	.22	1
3*	-	-	-				8	.24	2
4*	1	.03	1				10	.31	1
5*	-	-	-				-	-	-
1**				-	-	-	-	-	-
2**				-	-	-	4	.12	2
3**				5	.31	2	4	.26	2
4**				23	1.44	4	39	1.22	4
5**				-	-	-	3	.09	3
6**				10	.62	2	15	.94	3

TABLE 5. The number of fishes and number of fish species observed within 3m on either sides of the 40 - 80m transect line at each station.

Station	Total Number of Fishes	Total Number of Fish Species
1*	377	31
2*	449	34
3*	221	28
4*	506	37
5*	157	24
1**	4	3
2**	488	21
3**	93	14
4**	424	45
5**	293	35
6**	244	21

TABLE 6. The number of fishes, number of fish species and diversities for each station and each study period.

Station	May, 1975			January, 1977			June, 1977		
	Number of Fishes	Number of Species	Diversity	Number of Fishes	Number of Species	Diversity	Number of Fishes	Number of Species	Diversity
1*	306	36	.118				377	31	.082
2*	151	28	.185				449	34	.076
3*	193	30	.155				221	28	.127
4*	160	26	.163				506	37	.073
5*	181	24	.133				157	24	.153
1**				-	-	-	4	3	.750
2**				339	31	.091	388	21	.043
3**				52	13	.250	93	14	.151
4**				543	39	.072	424	45	.106
5**				172	26	.151	293	35	.119
6**				217	27	.124	244	21	.086

influence, as a result of the Hilo STP ocean outfall, on the marine biological environment adjacent to the Hilo STP ocean outfall. The apparent increases and decreases in coral coverage, invertebrate densities and numbers of species and numbers and species of fishes can be explained on the basis of different transect line placement within the station area and the motility of macroscopic invertebrates (sea urchins and sea cucumbers) and fishes.

The June, 1977, sampling period was conducted after repairs to the broken portions of the outfall pipe had been completed. Although species motility may be a more"correct" explanation of the observations, it is interesting to note the increase in numbers and species of fishes observed at the diffuser stations and the relative stability of the fish populations observed at the (now repaired) break area. At the 2 diffuser stations (2* and 4*) numbers of fishes increased from 151 and 160 (in May, 1975) to 449 and 506 (in June, 1977) respectively. It is the author's opinion that the observed increases in numbers of fishes and fish species at the 2 diffuser stations, is the result of increased diffuser effluent flows following repairs to the outfall pipe. Additional periodic sampling is required to support the opinion that increased sewage effluent, at the diffuser, has had a positive effect (increased numbers and species) on the adjacent fish populations.

Visual observations, made during the June, 1977, study period, revealed no obvious positive or negative changes with respect to siltation, coral coverage and invertebrate densities when compared with the previous 2 study periods (May, 1975, and January, 1977, reports) except for a relatively small area of reef top damage by construction activities during repairs to the outfall pipe.

Biological data, as well as, visual observations generally indicate that the marine environment steadily improves from the poorest conditions found inside Hilo Bay to the best conditions seaward of Richardsons Beach Park (eastern most control stations). In relation to this spectrum of marine biological conditions, the Hilo STP outfall discharges into an environment that has been previously exposed to natural and man made detrimental factors such as freshwater surface runoff from rivers and streams, increased sediment loads resulting from storm runoff and human activities (agriculture, dredging, etc.) and increased water borne loads of organic debris resulting from the processing of sugar cane.

It is the author's opinion that the biological conditions presently existing, adjacent to the Hilo STP outfall, are the result of many years of natural and man induced influences that appear to overshadow any negative environmental influences of the relatively small point discharge of sewage effluent. Visual observations, noted during the substratum coverage measurements, did not reveal the presence of any sewage sludge near the outfall diffuser. The fine particulate matter, discharged from the diffuser heads, was carried up in the effluent plume and apparently dispersed over a large area. Underwater visibility, adjacent to the diffuser, was a minimum of 60ft. throughout the June, 1977, study period indicating that the present rate of effluent discharge has little, if any, negative influence on the adjacent marine environment. Based on the numbers and species of fishes present, near the diffuser, the Hilo STP ocean outfall appears to be a positive influence on the adjacent marine environment.

A P P E N D I X   G

Comments and Replies to
Environmental Impact Statement

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

March 31, 1980

Mr. Edward Harada
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

RE: EIS Preparation Hilo
District Sewerage System,
South Hilo, Hawaii

Dear Sir:

We have reviewed the referenced environmental impact statement (EIS) preparation notice and have the following comments to offer.

In general, the information provided for review appears to cover many of our concerns, assuming that it will be detailed and referenced in the EIS. We are most concerned about the destruction of wetlands and possible degradation of aquatic habitat at the sewage outfall. Therefore, please carefully consider avoidance of critical areas, and delineate any wetlands that may be impacted by the treatment plant or sewage trunk lines.

With reference to the ocean outfall, please provide adequate physical oceanographic data in the EIS to evaluate dilution and transport of sewage effluent. If circulation is inadequate, the project would only accomplish a transfer of major pollution from a dispersed system to a concentrated point source in coastal waters. You might also consider recycling schemes as an alternative to an ocean outfall such as brown water irrigation.

We noticed throughout the briefing document provided for our review that the decision on degree of treatment has not been made. Since this will ultimately change the degree of project impact on the coastal environment, we suggest that this determination be made prior to submitting the EIS for reviews.

The document also suggested that industrial wastes would be also treated within the planned system although the effluent will be predominantly from domestic sources. We suggest that you consider selective treatment for industrial wastewater, because the composition of such effluent is typically different from that of domestic sewage, and treatment of the two types may differ significantly.

These are our concerns for the protection of fish and wildlife resources in the Hilo area. If we can be of any additional assistance, please let us know.

Thank you for the opportunity to comment on this preparation notice.

Sincerely yours,

Maurice H. Taylor

Maurice H. Taylor
Field Supervisor
Division of Ecological Services

M&E Pacific, Inc.

Environmental Engineers

Pacific Trade Center, Suite 600
190 South King Street
Honolulu, Hawaii 96813
(808) 521-3051 Cable: MEPAC

May 12, 1980

Mr. Maurice H. Taylor, Field Supervisor
U.S. Department of Agriculture
Fish and Wildlife Service
Division of Ecological Services
300 Ala Moana Boulevard
P. O. Box 50167
Honolulu, Hawaii 96850

SUBJECT: Environmental Impact Assessment
Hilo District Sewerage System

I would like to thank you for your review and comments on the subject report. The following are in response to your comments dated March 31, 1980.

1. Your concern about the destruction of wetlands will be addressed and a map delineating such areas will be incorporated.

2. An extensive evaluation of the coastal water environment of the Hilo area was done in the preparation of the Section 201 Hilo Facilities Plan and will be incorporated into the EIS. Similarly, an evaluation of the alternatives to the ocean outfall was done and will be addressed.

3. The determination of the degree of treatment is dependent upon the approval by EPA of the Hawaii County's application for a waiver from secondary treatment requirements. Unfortunately, the timetable of which this determination is expected to be made is not in accordance with either the Hilo Facilities Plan nor its EIS. Therefore, the EIA was written to specifically address the impacts of the effluent with the various alternative degrees of treatment (see "EEFLUENT DISCHARGE INTO OCEAN REGIME"). It was determined that the ambient marine water quality can be expected (as a minimum impact) to remain at present levels due to the large dilution and dispersion afforded by the ocean currents. Therefore, it is felt that delaying the approval of the Facilities Plan and the EIS is not strongly justified.

P. O. Box 309 CK, [illegible] CM 96950
Branch Office. ~~[illegible]~~

4. In order to identify, assess and document possible dischargers of heavy metals and organic toxicants, a survey of commercial/industrial establishments was conducted in conjunction with the secondary treatment waiver application. In that survey, four establishments were identified which include:

    a. Hilo Dental Associates, Inc.
    b. Hilo Medical Lab, Inc.
    c. State Department of Health, Waikea Health Center
    d. Hilo Quality Cleaners, Ltd.

    It was found that the heavy metal and toxicant concentration in the wastewater sampled at the existing treatment facility are similar to the background levels in domestic wastewater. Therefore, selective treatment for industrial wastewater would not be a practical recommendation. More importantly, it should be noted that the existing commercial/industrial discharges after dilution and dispersion through the outfall system would not impose any severe impact upon the marine environment. Attached for your information are the results of the heavy metal and toxicant concentrations of the Hilo wastewater as reported in the supporting documents for the secondary treatment waiver application. These tables and a similar discussion in relation to industrial discharges as described above will be addressed in the revised EIS.

We trust that these replies meet with your satisfaction. Should you have any questions, please call Ken Ishizaki at 521-3051.

JAMES S. KUMAGAI, Ph.D.
Vice President

BM/ep

Attach.

TABLE 1

ORGANIC TOXICANT CONCENTRATIONS IN THE EFFLUENT OF THE HILO WWTP*

Organic Toxicant	Concentration in ug/l
Bromodichloromethane**	<10
Bromoform	<10
Carbon Tetrachloride	<10
Chloroform	<10
Dichloromethane	<10
Dimethyldisulfide**	<10
1-1-1 Trichloroethane**	<10
1-1-2-2 Tetrachlorothene	<10
Toluene	<10
Trichloroethylene	<10
2-Propynol**	<10

* All organic toxicants listed in Table 1, Federal Register, Volume 44, Number 117, Friday, June 15, 1979, page 34831, were analyzed. Only those toxicants identified in the analyses are noted in this table.

** Compounds are not listed in Table 1, Federal Register, Volume 44, Number 117, Friday, June 15, 1979, page 34831.

TABLE 2

ESTIMATED HEAVY METALS CONCENTRATION AFTER INITIAL DILUTION FOR THE HILO DISCHARGE

	Water Quality Criteria* (ug/l)		Concentration (ug/l)	
Constituent	Average Over 24-Hr Period	Maximum Allowable	Wastewater	After Initial Dilution
Antimony	**		<100	< 2.0
Arsenic	29	67	< 5	< 0.1
Beryllium	**		< 5	< 0.1
Cadmium	1	16	< 5	< 0.1
Chromium	**		10	0.20
Copper	0.79	18	40	0.78
Cyanide	**		< 10	< 0.20
Lead	**		14	0.27
Mercury	**		<1.0	< 0.02
Nickel	**		< 50	< 1.0
Selenium	4.4	10	<0.5	< 0.01
Silver	0.26	0.58	< 20	< 0.4
Thallium	**		<100	<2.00
Zinc	**		110	2.20
Asbestos				

* Unless otherwise noted, water quality criteria are based on the proposed criteria developed by the EPA as set forth in the Federal Register, Volume 44, No. 52, Thursday, March 15, 1979, and Volume 44, No. 144, Wednesday, July 25, 1979. The criteria listed reflect the allowable concentration to protect the salt water aquatic life.

** The proposed criteria are not available or none have been established for the protection of the salt water aquatic life.

TABLE 3

CONCENTRATION OF TOXIC POLLUTANTS IN DOMESTIC WASTEWATER

Constituent	Concentration (mg/1)
Arsenic	0.014
Cadmium	0.005
Chromium	0.020
Copper	0.119
Cyanide	0.029
Lead	0.051
Mercury	0.0005
Nickel	0.031
Zinc	0.490

Source: Eason, J.E., Kremer, J.G., Dryden, "Industrial Waste Control in Los Angeles County," JWPCF, Vol. 50, April 1978.

TABLE 4

CONCENTRATIONS OF HEAVY METALS IN WASTEWATER AT THE HILO FACILITY

Metal	Concentration in mg/l Influent	Effluent[a]	Limits of Detection*
Manganese	0.015	0.015	0.002
Chromium	0.004	0.04	0.002
Copper	0.020	0.020	0.001
Nickel	0.007	0.007	0.002
Silver	0.004	0.004	0.002
Zinc	0.052	0.052	0.001
Mercury	0.00006	0.00004	0.00001
Arsenic	0.05	0.05	0.05
Selenium	0.01	0.01	0.01
Lead	0.06	0.05	0.01
Cyanide	0.07	0.06	—

* Test performed in 1978 by C. Brewer Laboratory, Honolulu, Hawaii.

[a] Supernatant of settled sample

HILO DENTAL ASSOCIATES, INC.
475 KINOOLE STREET
HILO, HAWAII 96720
TELEPHONE: 935-1149

September 5, 1978

Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720
ATTN: Edward Harada
Chief Engineer

Dear Sir,

In response to your letter of August 25, 1978 the following information is submitted:

Hilo Dental Associates, Inc. has installed in its facility a catchment system to retrieve the heavy metals, i.e. mercury and silver, that is used in our business. This is done so that these metals can be refined and reused by our Corporation.

We discharge a sterilization solution, Benzeconium Chloride, and some solutions used in developing X-rays, but we cannot identify them from the list that was sent to us.

Sincerly,

Walt L R Serrao

WALTER L R SERRAO
Business Manager

HILO MEDICAL LAB, INC.

Ponahawai Professional Center, Suite 104
275 Ponahawai Street • Hilo, Hawaii 96720
Phone: 935-4814

E. W. BEST, M.D., F.C.A.P.
A. S. WOO, JR., M.D., F.C.A.P.
M. S. PARK, M.D., F.C.A.P.

September 1, 1978

Mr. Harold Sugiyama
Bureau of Sewers and Sanitation
Department of Public Works
25 Aupuni Street
Hilo, Hawaii 96720

SUBJECT: Listing of Toxic Pollutants & Quantity

The only pollutants that we use in our laboratory are:

1. Aqueous solution of 0.05% potassium cyanide. Approximately 500 ml of this solution is flushed into the drain weekly with lots of water.

2. Aqueous solution of 0.025% potassium cyanide. Approximately 400 ml of this solution is being discharged weekly into the drain.

If there is any question, please call Juan Macanas at 935 4814.

Juan Macanas
Chief Technologist
Hilo Medical Lab, Inc.

GEORGE R. ARIYOSHI
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 916
HILO, HAWAII 96720

GEORGE A. L. YUEN
DIRECTOR OF HEALTH

AUDREY W. MERTZ, M.D., M.P.H.
DEPUTY DIRECTOR OF HEALTH

HENRY N. THOMPSON, M.A.
DEPUTY DIRECTOR OF HEALTH

JAMES S. KUMAGAI, PH.D., P.E.
DEPUTY DIRECTOR OF HEALTH

September 15, 1978

Chief Engineer
County of Hawaii
Department of Public Works
Hilo, HI 96720

LISTING OF TOXIC POLLUTANTS DISCHARGED TO THE SEWER SYSTEM

The Department of Health, Waiakea Health Center, located at 191 Kuawa Street, discharges the following pollutants:

Potassium Cyanide
Approximately 60 g/year is used for the detection of isoniazid (INH) metabolites. Due to the chemical reaction during the testing procedure, very little is discharged into the sewer system.

Phenol
Approximately 200 g/year is used in carbofuchsin stains.

3 gallons/year of Lysol is used as a disinfectant.

Silver
An estimated 1,200 feet of 70 mm film and 3,000 x-ray films, 14 x 17 inches, are processed during the year. The silver is currently not extracted before discharging into the sewer system.

Marie M. Shimizu
(Mrs.) MARIE M. SHIMIZU
Laboratory Administrator, Hawaii

js

cc: District Health Officer, Hawaii
Chief Sanitarian, Hawaii

Hilo Quality Cleaners, Ltd.

DRYCLEANING · LAUNDERING · RENTAL SERVICE · LINENS · UNIFORMS · MOPS

September 19, 1978

Mr. Harold Sugiyama
Bureau of Sewers and Sanitation
Dept. of Public Works, County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

In Re: Letter dated August 28, 1978

Dear Mr. Sugiyama:

We are enclosing a copy of the letter received from our supplier regarding laundry washroom supplies.

In the dry cleaning department, I have gone through the list of chemicals concerned and feel that there is a very minimal discharge into the sewer system since we have a filtration system which filters the solvent constantly while the dry cleaning machines are in operation. Also, we distill the solvent once every other week for the purpose of recycling it and not discharge or waste it.

If there are any questions, please contact me.

Sincerely yours,

Masao Ochi

Masao Ochi, President and
General Manager

MO:mot

Encl. 1

[illegible]NOVA CO
INCORPORATED
982 TERMINAL WAY • SAN CARLOS • CALIFORNIA 94070
AREA CODE 415 • 591-9643

September 14, 1978

Mr. Masao Ochi
Hilo Quality Laundry
865 Kinoale Street
Hilo, Hawaii 96720

Dear Mr. Ochi:

Warren Lampshire contacted me regarding the possibilty of the presence of Arsnic in your laundry soap. In turn, I contacted the soap manufacturers and was assured that there is no arsnic in the soap. The soap is composed of caustic soda and rendered tallow fat only.

In addition, please be advised that all the laundry chemicals you purchase through Lampco are bio-degradable and contain no arsnic.

It's time again for me to make my service visit to you. I'llbe in Hilo--Monday and Tuesday, October 2nd. and 3rd., to work in your plant for two days to check out the washroom. At that time, we can further discuss the sewage situation.

See you in October.....

Sincerely,

Matt Musante

MM:jb

c.c. Warren Lampshire
Lampco

DEPARTMENT OF PLANNING
AND ECONOMIC DEVELOPMENT

GEORGE R. ARIYOSHI
Governor
HIDETO KONO
Director
FRANK SKRIVANEK
Deputy Director

Kamamalu Building, 250 South King St., Honolulu, Hawaii • Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

April 7, 1980

Ref. No. 0967

Mr. Edward Harada
Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Harada:

Subject: Environmental Impact Assessment for the Hilo District Sewerage System

We have reviewed the subject environmental impact assessment and have the following comments to offer for your consideration in the preparation of an environmental impact statement.

1. There is an apparent lack of site-specific detail in the discussions of both the existing and proposed sewage treatment plant (STP) facility. The location map is not of sufficient scale nor is the accompanying discussion detailed enough to provide a clear description of the proposed development.

2. A more thorough discussion on the land uses surrounding the new STP facility appears warranted, particularly with regard to the proximity, character, and density of residential areas relevant to the proposal.

3. With respect to potential impacts, there should be some discussion on the existing or potential recreational value of the shoreline area, and the impact of the new STP on any historic sites on the property.

4. With respect to alternatives to the proposed action, there is no consideration of alternative sites for the new STP beyond the existing site.

Thank you for the opportunity to comment on the subject assessment. If there should be any questions, please feel free to contact us at any time.

Sincerely,

Hideto Kono

M&E Pacific, Inc.

Environmental Engineers

Pacific Trade Center, Suite 600
190 South King Street
Honolulu, Hawaii 96813
(808) 521-3051 Cable: MEPAC

May 12, 1980

Mr. Hideto Kono, Director
Department of Planning and Economic Development
Kamamalu Building
250 South King Street
Honolulu, Hawaii 96813

SUBJECT: Environmental Impact Assessment
Hilo District Sewerage System

I would like to thank you for your review and comments on the subject report. The following are in response to your comments dated April 7, 1980.

1. A larger scale map will be incorporated into the EIS along with a discussion on the priority schedule to provide a clearer description of the proposed developments.

2. A discussion on land uses surrounding the new STP facility will be addressed in the revised EIS. Attached for your information are the State land use map and the City's zoning map for the concerned area. Similar maps of this nature will be incorporated in the final EIS report.

3. The potential recreational value of the shoreline area and the impacts of the project will be addressed in the revised EIS. Attached is the requested discussion on the recreational value of the shoreline area. Historic sites of the Hilo District as designated by the Hilo Community Development Plan and the State Historic Preservation Officer will be addressed in the first draft of the EIS.

4. Alternatives for site selection have been evaluated in the preparation of the Section 201 Hilo Facilities Plan. These alternatives with the justification of the proposed site will be addressed.

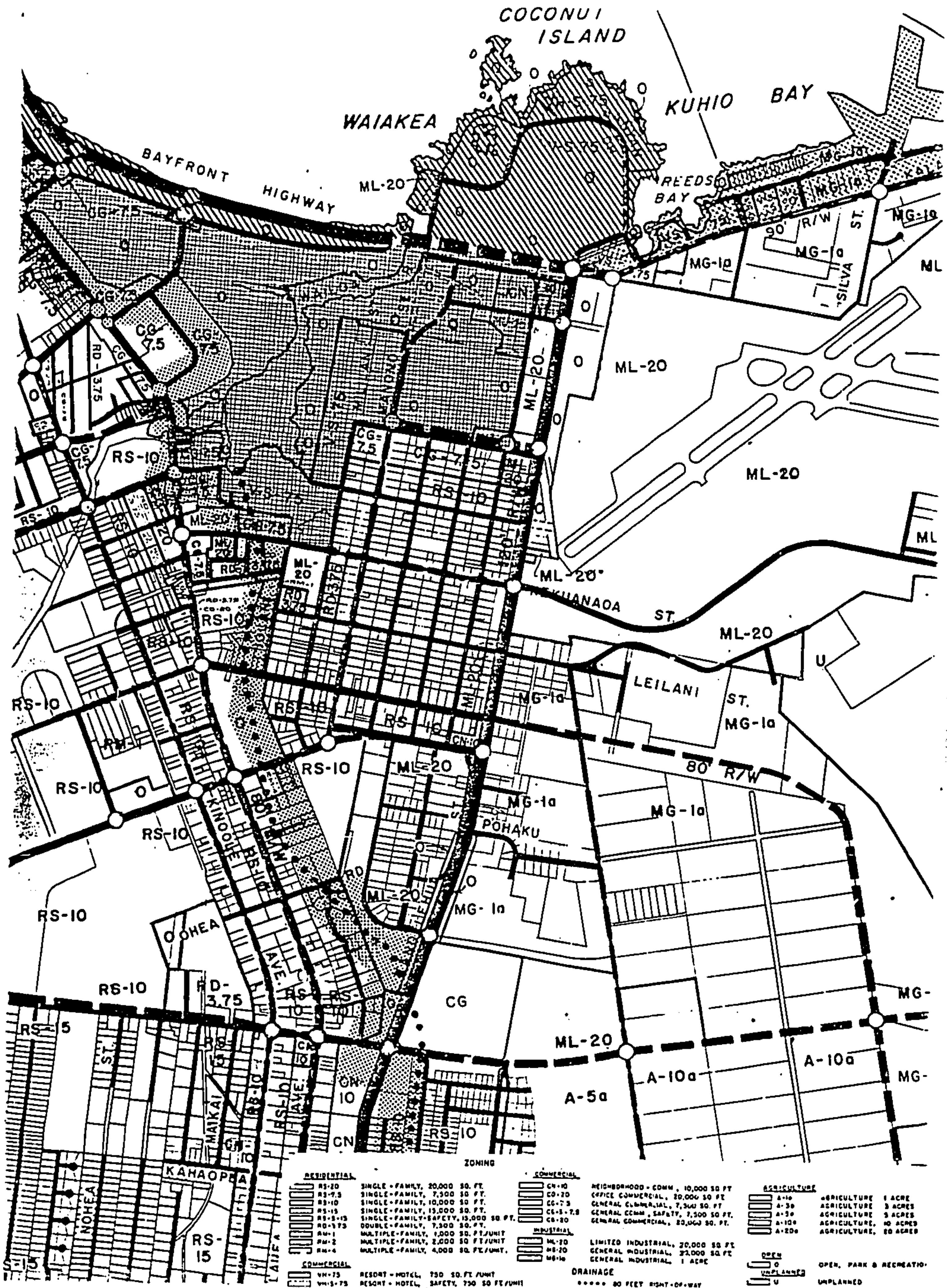
We trust these actions and replies meet with your satisfaction. Should you have any questions, please call Ken Ishizaki at 521-3051.

JAMES S. KUMAGAI, Ph.D.
Vice President

BM/ep
Attach.

P. O. Box 309 CK, Saipan, CM 96950
Branch Office P. O. Box 3519, Agana, Guam 96910

HILO BAY
Kuhio Bay
Keaukaha
Kaulainahee Island
Cocoanut Island
Hilo Radio Tower
Mokaoku
Liliuokalani Gardens
Reeds Bay
Naval Electronic Facility
Waiakea
Hoakimau Pond
Wailoa River
Ivy Sch
Hoolulu Park
Pumping Sta
GENERAL LYMAN FIELD
Hawaii Army National Guard
Pumping Station
Quarry
Shopping Center
Hawaii Technical Sch
Waiakea-Kai Sch
Camp Two
Waiakea Waena Sch
KAWAILANI STREET
KEKUANAOA ST
LEILANI ST
PUAINAKO
KINOOLE
KILAUEA
Hilo South Base
DISTRICTS
U = URBAN
R = RURAL
A = AGRICULTURAL
C = CONSERVATION


COCONUT ISLAND
WAIAKEA
KUHIO BAY
REEDS BAY
BAYFRONT HIGHWAY
KANOELEHUA AVE.
KAHAOPEA
KINOOLE
NOHEA
MAIKAI
OHEA
POHAKU
LEILANI ST.
KEKUANAOA ST.
SILVA ST.
80' R/W
90' R/W
ML-20
MG-1a
RS-10
RS-15
RD-3.75
CG-7.5
CG
CN-10
A-5a
A-10a
ZONING
RESIDENTIAL
RS-20 SINGLE-FAMILY, 20,000 SQ. FT.
RS-7.5 SINGLE-FAMILY, 7,500 SQ FT.
RS-10 SINGLE-FAMILY, 10,000 SQ FT.
RS-15 SINGLE-FAMILY, 15,000 SQ. FT.
RS-S-15 SINGLE-FAMILY-SAFETY, 15,000 SQ. FT.
RD-3.75 DOUBLE-FAMILY, 7,500 SQ. FT.
RM-1 MULTIPLE-FAMILY, 1,000 SQ. FT./UNIT
RM-2 MULTIPLE-FAMILY, 2,000 SQ FT/UNIT
RM-4 MULTIPLE-FAMILY, 4,000 SQ. FT./UNIT.
COMMERCIAL
VH-75 RESORT-HOTEL, 750 SQ. FT./UNIT
VH-S-75 RESORT-HOTEL, SAFETY, 750 SQ FT/UNIT
V-S-75 RESORT-HOTEL, SAFETY, 750 SQ FT./UNIT
COMMERCIAL
CN-10 NEIGHBORHOOD-COMM, 10,000 SQ FT
CO-20 OFFICE COMMERCIAL, 20,000 SQ FT
CG-7.5 GENERAL COMMERCIAL, 7,500 SQ. FT
CG-S-7.5 GENERAL COMM, SAFETY, 7,500 SQ FT.
CG-20 GENERAL COMMERCIAL, 20,000 SQ. FT.
INDUSTRIAL
ML-20 LIMITED INDUSTRIAL, 20,000 SQ FT
MG-20 GENERAL INDUSTRIAL, 20,000 SQ FT
MG-1a GENERAL INDUSTRIAL, 1 ACRE
DRAINAGE
80 FEET RIGHT-OF-WAY
60 FEET RIGHT-OF-WAY
AGRICULTURE
A-1a AGRICULTURE 1 ACRE
A-3a AGRICULTURE 3 ACRES
A-5a AGRICULTURE 5 ACRES
A-10a AGRICULTURE, 10 ACRES
A-20a AGRICULTURE, 20 ACRES
OPEN
O OPEN, PARK & RECREATIO
UNPLANNED
U UNPLANNED

The following is to be incorporated to Chapter III - THE RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS, POLICIES, AND CONTROLS.

Recreation

According to the State Comprehensive Recreational Plan, there is a high participation in swimming, jogging, and outdoor events among the residents of the Hilo area. However, natural features presently constrain shoreline recreation in the Hilo area because of the small acreage of sandy beaches and the inclement weather. Of the County's 305.5 miles of shoreline, only 1.2 miles are considered prime sand beach which are generally favorable for swimming and other water-oriented activities.

There are approximately 60 acres of neighborhood recreational facilities in the Hilo area. However, according to the Hilo Community Development Plan, approximately 80 more acres are required. By 1980-85, an additional 35 acres will be required. It should be noted that the possibility exists such that the existing treatment plant site may be converted to a recreational park when the new treatment plant is in operation.

MEMORANDUM:

PLANNING DEPARTMENT — County of Hawaii, Hilo, Hawaii 96720

To: Ed Harada, Chief Engineer Date: March 24, 1980

From: PLANNING DIRECTOR

Subject: EIA (EIS Preparation Notice) - Hilo District Sewerage System South Hilo, Hawaii - February 1980

Thank you for sending the subject EIA to us for review. We have found the text to be rather comprehensive, in that all major potentially significant environmental impacts have been identified.

However, the subject text is somewhat unclear as to the exact proposed location of the new treatment plant facility, and the proposed scheduling of the three (3) specific implementation actions (Proposed Actions).

We have previously reviewed the subject project's Facilities Plan of February 1979, and have submitted our comments to you in a memorandum dated April 20, 1979. At that time, we indicated that an EIA should contain an environmental impact determination as a part of the text.

It was noted in the transmittal letter (March 6, 1980) that an EIS is currently being prepared for the subject Hilo Sewerage System. The subject document is therefore in essence an EIS Preparation Notice. However, this determination is not reflected within the EIA text.

Should you have any questions on the above, please contact us. Mahalo.

BS:wkm

M&E Pacific, Inc.

Environmental Engineers

Pacific Trade Center, Suite 600
190 South King Street
Honolulu, Hawaii 96813
(808) 521-3051 Cable: MEPAC

May 12, 1980

Mr. Sidney Fuke, Director
County of Hawaii
Planning Department
25 Aupuni Street
Hilo, Hawaii 96720

SUBJECT: Environmental Impact Assessment
Hilo District Sewerage System

I would like to thank you for your review and comments on the subject report. In response to your comment on the location of the new treatment plant and the proposed scheduling of the proposed actions, a large scale map in conjunction with a discussion on the priority schedule of the proposed developments will be incoporated into the EIS.

Should you have any questions on the above, please call Ken Ishizaki at 521-3051.

JAMES S. KUMAGAI, Ph.D.
Vice President

BM/ep

P.O. Box 309 CK, Saipan CM 96950
Branch Office ~~[illegible]~~

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWA
P. O. BOX 1820 • HILO, HAWAII 96720 • 25 AUPUNI STRE

April 8, 1980

TO: Department of Public Works

FROM: Manager

SUBJECT: ENVIRONMENTAL IMPACT ASSESSMENT
HILO DISTRICT SEWERAGE SYSTEM

We reviewed the Environmental Impact Assessment for the proposed project and have no comments to offer.

H. William Sewake
Manager

CS

...Water brings progress...

M&E Pacific, Inc.

Environmental Engineers

Pacific Trade Center, Suite 600
190 South King Street
Honolulu, Hawaii 96813
(808) 521-3051 Cable: MEPAC

May 12, 1980

Mr. H. William Sewake, Manager
County of Hawaii
Department of Water Supply
P. O. Box 1820
Hilo, Hawaii 96720

SUBJECT: Environmental Impact Assessment (EIA)
Hilo Ditrict Sewerage System
South Hilo, Hawaii

I would like to thank you for reviewing the EIA and EIS preparation notice for the subject project.

An EIS has been compiled containing an expanded and more detailed discussion on the various topics touched upon in the EIA. Within the near future, the Environmental Quality Commission will be forwarding you a copy of this document soliciting any further comments you may have.

JAMES S. KUMAGAI, Ph.D.
Vice President

BM/ep

P. O. Box 309 CK, Saipan, CM 96950
Branch Office [illegible]

Department of Parks and Recreation
COUNTY OF HAWAII
HILO, HAWAII

MEMORANDUM

Date: March 17, 1980

To: Ed Harada, Chief Engineer

From: Parks & Recreation

Subject: Hilo District Sewerage System
EIS Preparation Notice

We have reviewed the subject report and have no adverse comments to offer.

Milton T. Hakoda
Director

M&E Pacific, Inc.

Environmental Engineers

Pacific Trade Center, Suite 600
190 South King Street
Honolulu, Hawaii 96813
(808) 521-3051 Cable: MEPAC

May 12, 1980

Mr. Milton T. Hakoda, Director
County of Hawaii
Department of Parks and Recreation
25 Aupuni Street
Hilo, Hawaii 96720

SUBJECT: Environmental Impact Assessment (EIA)
Hilo Ditrict Sewerage System
South Hilo, Hawaii

I would like to thank you for reviewing the EIA and EIS preparation notice for the subject project.

An EIS has been compiled containing an expanded and more detailed discussion on the various topics touched upon in the EIA. Within the near future, the Environmental Quality Commission will be forwarding you a copy of this document soliciting any further comments you may have.

JAMES S. KUMAGAI, Ph.D.
Vice President

BM/ep

[illegible], GA 96950
Branch Office [illegible]

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

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

GEORGE A. L. YUEN
DIRECTOR OF HEALTH

VERNE C. WAITE, M.D.
DEPUTY DIRECTOR OF HEALTH

HENRY N. THOMPSON, M.A.
DEPUTY DIRECTOR OF HEALTH

JAMES S. KUMAGAI, PH.D., P.E.
DEPUTY DIRECTOR OF HEALTH

TADAO BEPPU
DEPUTY DIRECTOR OF HEALTH

March 27, 1980

In reply, please refer to:
File: EPHS-SS

Mr. Edward Harada
Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni St.
Hilo, Hawaii 96720

Dear Mr. Harada:

Subject: Request for Comments on Proposed Environmental Impact Statement (EIS) for Hilo District Sewerage System, South Hilo

Thank you for allowing us to review and comment on the subject proposed EIS. Please be informed that we do not have any comments or objections to this project at this time.

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.

Sincerely,

Brian J. J. Choy
for MELVIN K. KOIZUMI
Deputy Director for
Environmental Health

M&E Pacific, Inc.

Environmental Engineers

Pacific Trade Center, Suite 600
190 South King Street
Honolulu, Hawaii 96813
(808) 521-3051 Cable: MEPAC

May 12, 1980

Mr. Melvin Koizumi, Deputy Director
State of Hawaii
Department of Health
P. O. Box 3378
Honolulu, Hawaii 96801

SUBJECT: Environmental Impact Assessment (EIA)
Hilo Ditrict Sewerage System
South Hilo, Hawaii

I would like to thank you for reviewing the EIA and EIS preparation notice for the subject project.

An EIS has been compiled containing an expanded and more detailed discussion on the various topics touched upon in the EIA. Within the near future, the Environmental Quality Commission will be forwarding you a copy of this document soliciting any further comments you may have.

JAMES S. KUMAGAI, Ph.D.
Vice President

BM/ep

P. O. Box 3[illegible], CA 94[illegible]
Branch Office ~~[illegible]~~

GEORGE R. ARIYOSHI
GOVERNOR

RYOKICHI HIGASHIONNA, PH.D.
DIRECTOR

DEPUTY DIRECTORS
JAMES R. CARRAS
JAMES B. McCORMICK
DOUGLAS S. SAKAMOTO
JACK K. SUWA
JONATHAN K. SHIMADA, PH.D.

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

IN REPLY REFER TO

April 2, 1980

STP 8.6147

Mr. Edward Harada
Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Harada:

Subject: Hilo District Sewerage System
South Hilo, Hawaii

Thank you for giving us the opportunity to be consulted on the above-captioned action. We have no substantive comments to offer other than to advise you that any construction within our highway rights-of-way must require a permit from our Highways Division.

Very truly yours,

for Ryokichi Higashionna
Director of Transportation

M&E Pacific, Inc.

Environmental Engineers

Pacific Trade Center, Suite 600
190 South King Street
Honolulu, Hawaii 96813
(808) 521-3051 Cable: MEPAC

May 12, 1980

Dr. Ryokichi Higashionna, Director
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813

SUBJECT: Environmental Impact Assessment (EIA)
Hilo District Sewerage System
South Hilo, Hawaii

I would like to thank you for reviewing the EIA and EIS preparation notice for the subject project.

An EIS has been compiled containing an expanded and more detailed discussion on the various topics touched upon in the EIA. Within the near future, the Environmental Quality Commission will be forwarding you a copy of this document soliciting any further comments you may have.

JAMES S. KUMAGAI, Ph.D.
Vice President

BM/ep

P. O. Box [illegible]
Branch Office [illegible]

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. Box 1361, Hilo, HI 96720

March 19, 1980

Mr. Ed Harada, Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, HI 96720

Dear Ed:

We have no comments on the Environmental Impact Assessment for the Hilo District Sewerage System.

Sincerely,

Larry R. Soenen
District Conservationist

cc Jack P. Kanalz
State Conservationist

M&E Pacific, Inc.

Environmental Engineers

Pacific Trade Center, Suite 600
190 South King Street
Honolulu, Hawaii 96813
(808) 521-3051 Cable: MEPAC

May 12, 1980

U.S. Department of Agriculture
Soil Conservation Service
P. O. Box 1361
Hilo, Hawaii 96720

ATTENTION: Mr. Larry R. Soenen
District Conservationist

SUBJECT: Environmental Impact Assessment (EIA)
Hilo Ditrict Sewerage System
South Hilo, Hawaii

I would like to thank you for reviewing the EIA and EIS preparation notice for the subject project.

An EIS has been compiled containing an expanded and more detailed discussion on the various topics touched upon in the EIA. Within the near future, the Environmental Quality Commission will be forwarding you a copy of this document soliciting any further comments you may have.

JAMES S. KUMAGAI, Ph.D.
Vice President

BM/ep

[illegible] CM 96950
Branch Office [illegible]

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

COMMANDER (dpl)
Fourteenth Coast Guard District
Prince Kalanianaole Federal Bldg.
300 Ala Moana Blvd.
Honolulu, Hawaii 96850

16450
13 May 1980

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Gentlemen:

The Coast Guard has reviewed the Environmental Impact Statement on the Hilo District Sewerage System and has no objection to the plan or constructive comments to offer at the present time.

Sincerely,

J. F. OTRANTO
Commander, U. S. Coast Guard
District Planning Officer
Fourteenth Coast Guard District
By Direction of the District Commander

Copy to: County of Hawaii, Dept. of Public Works
COMDT (G-WEP/7)

DEPARTMENT OF PARKS & RECREATION
COUNTY OF HAWAII

Herbert Matayoshi, Mayor
Milton Hakoda, Director

May 12, 1980

Office of Environmental Quality Control
550 Halekauwila St., Room 301
Honolulu, Hawaii 96813

Subject: Hilo District Sewerage System - EIS

We have reviewed the subject report and have no adverse comments to offer.

Thank you for the opportunity to review the report, which is being returned for your further use.

Milton T. Hakoda
Director

encl.

cc: Dept. of Public Works

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

COPY

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII

P. O. BOX 1820 • HILO, HAWAII 96720 • 25 AUPUNI STREET

May 22, 1980

Office of Environment Quality Control
550 Halekauwila Street, Room 301
Honolulu, HI 96813

ENVIRONMENTAL IMPACT STATEMENT
HILO DISTRICT SEWERAGE SYSTEM

We have no comments to the subject document. The document is being returned to your office.

H. William Sewake
Manager

QA

Enc.

cc - County Department of Public Works

...Water brings progress...

(P)1538.0

MAY 19 1980

Office of Environmental
Quality Control
550 Halekauwila Street
Room 301
Honolulu, Hawaii 96813

Gentlemen:

Subject: Environmental Impact Statement for Hilo District Sewerage System

Thank you for this opportunity to review and comment on the subject project.

The project will not have any adverse environmental effect on any existing or planned facilities serviced by our department.

Very truly yours,

RIKIO NISHIOKA
State Public Works Engineer

MI:jm

cc: Department of Public Works
County of Hawaii

DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY SUPPORT COMMAND, HAWAII
FORT SHAFTER, HAWAII 96858

RECEIVED

16 MAY 1980

APZV-EHE-E

'80 MAY 19 P3:21

Office of Environmental Quality Control
State of Hawaii
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Gentlemen:

The Environmental Impact Statement (EIS) for the Hilo District Sewerage System, South Hilo, Hawaii has been reviewed and we have the following comments to offer:

a. The US Army Reserve Center, Hilo is located within the study area. We would appreciate receiving the plans for the Reserve Center tie-in when this information becomes available or any other information that relates to this Army installation.

b. A Department of the Army permit from the Corps of Engineers will be required for work in the navigable waters of Hilo Bay.

Sincerely,

Original signed by

PETER D. STEARNS
COL, EN
Director of Engineering and Housing

Copy Furnished:
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

HEADQUARTERS
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860

IN REPLY REFER TO:

002A:amn
Ser 1040

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80 MAY 16 P 2: 49

COUNTY OF HAWAII
DEPT. OF PUBLIC WORKS

15 MAY 1980

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Gentlemen:

Environmental Impact Statement for the
Hilo Wastewater Management Plan

The Environmental Impact Statement for the Hilo District Sewerage System has been reviewed and the Navy has no comments to offer. The EIS will be retained by this Command for reference purposes.

The opportunity to review the subject EIS is appreciated.

Sincerely,

R. D. EBER
CDR, CEC, USN
FACILITIES ENGINEER
BY DIRECTION OF THE COMMANDER

Copy to:
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, HI 96720

COPY — PLANNING DEPARTMENT
25 AUPUNI STREET
COUNTY OF HAWAII
HILO, HAWAII 96720

May 19, 1980

Mr. Richard O'Connell
Office of Environmental Quality Commission
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. O'Connell:

We have recently reviewed the subject EIS and have found the text to be rather comprehensive in identifying and addressing anticipated environmental impacts. As such, we have no overall major adverse comments to offer.

We would like to point out, however, that all maps within the text (especially Figure I-3) should reflect the latest possible development of Hilo (i.e. streets, major subdivisions, etc.). It was noted within the text that Figure I-3 (Priority Schedule) is an outdated map which does not incorporate major developments such as the Airport Terminal and Komohana Street Extension, etc. that were completed some time ago.

Thank you for this opportunity to provide comments on the subject EIS.

Should you have any questions on the above, please contact us. Mahalo.

Sincerely,

SIDNEY FUKE
Director

BS:y

cc: Department of Public Works ✓

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

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

GEORGE A. L. YUEN
DIRECTOR OF HEALTH

~~VERNE S. WAITE, M.D.~~
DEPUTY DIRECTOR OF HEALTH

HENRY N. THOMPSON, M.A.
DEPUTY DIRECTOR OF HEALTH

~~JAMES S. KUMAGAI, PH.D., P.E.~~
DEPUTY DIRECTOR OF HEALTH

~~TADAO BEPPU~~
DEPUTY DIRECTOR OF HEALTH

May 16, 1980

In reply, please refer to:
File: EPHS-SS

MEMORANDUM

To: Mr. Edward Harada, Chief Engineer
Department of Public Works, County of Hawaii

From: Deputy Director for Environmental Health

Subject: Environmental Impact Statement (EIS) for Hilo District Sewerage System, S. 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 Public Health Regulations, 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.

for Brian J.J. Choy
MELVIN K. KOIZUMI

cc: Office of Environmental Quality Control

HERBERT T. MATAYOSHI, MAYOR
A. DUANE BLACK, DIRECTOR

DEPARTMENT OF RESEARCH AND DEVELOPMENT

COUNTY OF HAWAII • 25 AUPUNI STREET • HILO, HAWAII 96720 • TELEPHONE (808) 961-8366

May 19, 1980

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, HI 96813

SUBJECT: Environmental Impact Statement
Hilo District Sewerage System

Thank you for the opportunity to review the above titled document. We have no comments.

A. DUANE BLACK
DIRECTOR

cc: Department of Public Works/County of Hawaii

800-3266

STATE OF HAWAII
DEPARTMENT OF PLANNING AND ECONOMIC DEVELOPMENT
P. O. Box 2359
Honolulu, Hawaii 96804

RECEIVED
DEPT. OF PUBLIC WORKS
JUN 9 9 15 AM '80
TO ________

June 4, 1980

Ref. No. 1424

Mr. Richard L. O'Connell
Director
Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. O'Connell:

SUBJECT: Environmental Impact Statement for the Hilo Wastewater Management Plan of the Hilo District, South Hilo, Hawaii

We have reviewed the subject EIS and find that it has adequately assessed the major environmental impacts which can be anticipated from the implementation of this project.

Thank you for the opportunity to review and comment on this document.

Sincerely,

Hideto Kono

cc: Dept. of Public Works
~~City and County of Honolulu~~
County of Hawaii

June 3, 1980 STP 8.6291

Dr. Richard O'Connell
Director
Office of Environmental
Quality Control
550 Halekauwila St., Room 301
Honolulu, Hawaii 96813

Dear Dr. O'Connell:

Environmental Impact Statement
Hilo District Sewerage System
South Hilo, Hawaii

Thank you for the opportunity to review and comment on the subject EIS. We have no substantive comments to offer which could improve the document.

The proposing party should be advised that any work done within the State highway rights-of-way must require a permit from the State Department of Transportation, Highways Division.

Very truly yours,

Ryokichi Higashionna

ALK:jk

cc: HWY-P
Hawaii Dept. of Public Works

June 16, 1980 STP 8.6318

MEMORANDUM

TO: DR. RICHARD O'CONNELL, DIRECTOR
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

FROM: DIRECTOR OF TRANSPORTATION

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT
HILO DISTRICT SEWERAGE SYSTEM
SOUTH HILO, HAWAII

The following supplements our comments of June 3, 1980 (STP 8.6291) on the subject EIS.

1. We request that the proposed sewer improvements accommodate the General Lyman Field sewer system with a tie in at force main "M".

2. Any portion of the work done within the right-of-way of the General Lyman Field must require the approval of the Department of Transportation, Airports Division.

Ryokichi Higashionna
Ryokichi Higashionna

ALK:jk

cc: HWY-P
AIR
Hawaii Dept. of Public Works

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

PODED-PV

28 May 1980

Mr. Edward Harada, Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Harada:

We have reviewed your Environmental Impact Statement for the Hilo District Sewerage System, South Hilo, Hawaii, dated 28 April 1980. The extension of the outfall and the stream crossing in the Wailuku and Wailoa Rivers will require a Department of the Army (DA) permit. To avoid bioassay and bio-accumulation testing requirements under Section 404 of the Clean Water Act, we suggest that the fill used to anchor, cover, or cushion the sewer lines meet the following criteria:

a. The material be composed predominantly of sand, gravel, or any other naturally occurring sedimentary material with particle size larger than silt, characteristic of, and generally found in areas of high current or wave energy such as streams with large bed loads or coastal areas with shifting bars and channels; or

b. Material be substantially the same as the substrate at the construction site, its source sufficiently removed from sources of pollution to provide reasonable assurance that such material has not been contaminated by pollution and adequate terms and conditions be imposed to provide reasonable assurance that the material will not be moved by currents or other means that would be damaging to the environment outside the construction site.

When submitting the DA permit application, we suggest that you identify the fill material and provide data to substantiate that the fill meets the exclusion criteria provided. The environmental impact statement should address potential impacts, if any, on recreational activities, particularly surfing, resulting from extension of the sewer line. If the environmental

PODED-PV
Mr. Edward Harada

28 May 1980

statement is being prepared to satisfy the U.S. Environmental Protection Agency (EPA) or to obtain an EPA grant, we suggest that you provide us a letter from EPA accepting or adopting the environmental statement, when submitting the DA permit application. More details on how you intend to construct the sewer outfall extension and stream crossing are needed when applying for the DA permit.

Sincerely,

B. R. SCHLAPAK
Colonel, Corps of Engineers
District Engineer

[illegible]
LTC, Corps of Engineers
Deputy District Engineer

G-44

M&E Pacific, Inc.

Environmental Engineers

Pacific Trade Center, Suite 600
190 South King Street
Honolulu, Hawaii 96813
(808) 521-3051 Telex: 7430065

August 27, 1980

Colonel B. R. Schlapak, District Engineer
Department of the Army
Corps of Engineers
Building 230
Fort Shafter, Hawaii 96858

SUBJECT: Environmental Impact Statement
Hilo Wastewater Management Plan

Thank you for your review and comments on the subject report. The long-term impact on recreation due to the effects of the effluent discharge into the coastal waters will be addressed. Shoreline parks located within the study area include the Bayfront, Cocoanut Island, Onekahakaha, James Kealoha, and Leleiwi Beach Parks. The shoreline activities are generally associated with picnicking. Water contact activities include swimming, diving, surfing and nearshore fishing.

Review of available data on water quality parameters of the receiving waters indicate that the water quality is not being discernibly altered by the discharge. No adverse effects on the recreational activities is expected from the chemical components of the discharge since (1) plans call for a higher degree of treatment of the discharge effluent than now, and (2) the extension of the outfall of another 2,000 feet to a depth of 60 to 90 feet of water. The intended design will provide these additional safeguards to water quality and to public health.

In addition, the impacts on the microbiological quality of the receiving waters are expected to be minimal due to (1) the initial dilution obtained through the design of the outfall diffuser, (2) dispersion obtained through the ocean currents, and (3) the high coliform die-off rate (T-90).

Should you have any questions on the above, please call Ken Ishizaki at 521-3051.

JAMES S. KUMAGAI, Ph.D.
Vice President

BM/ep

GEORGE R. ARIYOSHI
GOVERNOR

RICHARD O'CONNELL
DIRECTOR

TELEPHONE NO.
548-6915

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
OFFICE OF THE GOVERNOR
550 HALEKAUWILA ST.
ROOM 301
HONOLULU, HAWAII 96813

June 9, 1980

Mr. Edward Harada
Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

SUBJECT: Environmental Impact Statement for Hilo Wastewater Management Plan

Dear Mr. Harada,

We have reviewed the subject EIS and offer the following comments for your consideration:

P. I-5,6

The description of the proposed action should be expanded. How much land is required for the proposed treatment plant? A description of the surrounding land uses should be included. How far is the proposed treatment site from residential or commercial activities? What are the anticipated sewage volumes for the Hilo service area? Is the proposed system designed to meet existing residential/commercial demands? Future demands? What percentage of Hilo's current residential/commercial units will be served by this system? Will all future developments utilize the proposed treatment plant instead of private systems? Why is the design capacity of the proposed treatment plant (5.0 mgd) less than the design capacity of the existing plant (7.0 mgd)? Will future needs be adequately met with this smaller system? What is the relationship of the proposed project to the 208 Water Quality Plan?

P. I-9

When will the new facility be operational? What is the timing for various stages of development?

P. II-15

Any endangered flora in the study area should be identified in the EIS.

P. IV-1

A discussion of increased energy use due to increased pumping of sewage should be included in the EIS.

P. IV-2

The discussion of construction impacts on endangered flora and fauna should be expanded. What impact will construction of sewer lines have on Waiakea, Kionakapahu and Lokoaka ponds? Have any mitigative measures been considered to minimized adverse effects on endangered species?

What noise levels are anticipated during construction?

P. IV-3

The impact of erosion from construction activities should be discussed in greater detail. What impact will erosion and sedimentation have on water quality? Marine organisms? Wet lands?

P. IV-4

Where is the municipal landfill? How will sludge be transported to this site? A discussion of methods and impacts of this disposal operation should be included in the EIS.

P. IV-9

Will existing hotels, apartments and commercial developments be hooked up to this system or will private facilities still be used?

As stated in the EIS, "adequate sewer facilities serve to create a more favorable climate for residential and commercial development." Therefore, an improved sewer system may be considered to induce growth. The secondary impact of increased growth should be more fully discussed in the EIS.

Summary of unresolved issues

A major unresolved issue is whether the plant will provide advanced primary or secondary treatment. This should be stated in this section in addition to any information on the status of the application to EPA for waiver of secondary treatment requirements.

We appreciate the opportunity to review the subject EIS and look forward to the revised statement.

Sincerely,

Richard L. O'Connell
Director

cc: M & E Pacific, Attn: Ken Ishizaki

M&E Pacific, Inc.

Environmental Engineers

Pacific Trade Center, Suite 600
190 South King Street
Honolulu, Hawaii 96813
(808) 521-3051 Telex: 7430065

August 27, 1980

Mr. Richard L. O'Connell, Director
Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

SUBJECT: Environmental Impact Statement
Hilo Wastewater Management Plan

Thank you for your review and comments on the subject document. The following are in response to your comments dated June 9, 1980.

1. Reference Item: Pages I-5, 6. The description of the proposed action will be expanded to answer the pertinent inquiries made to this particular reference item.

   a. The land area required for the treatment plant is approximated at 14 to 20 acres.

   b. A description of the land uses of the surrounding area will be included in Chapter III: The Relationship of the Proposed Action to Land Use Plans, Policies, and Controls. Included will be a State Land Use Map and the Hilo Zoning Map.

   c. The location of the treatment plant in relation to residential and commercial activities can be obtained through an inspection of the Hilo Zoning Map and will not be specifically addressed in the EIS.

   d. Anticipated average sewage volumes for the Hilo area for the years 1995, 2025, and the ultimate are 5.6, 9.9 and 22.0 mgd respectively. A detailed description of the flows along with its derivation will be incorporated in the EIS.

   e. The proposed system is designed to meet both the existing and future demands according to standard design practice. The interceptor system is designed on a 40-year design period and the treatment plant is based on a 20-year design period.

f. The proposed system will have the capability to serve the entire Hilo area which includes the residential, commercial, industrial and resort users. Excluded are a few rural agricultural residences in the outlying fringes of Hilo which will continue to utilize cesspools or other onsite systems.

g. Future developments will utilize the proposed treatment plant as described in items (e) and (f) above. The priority schedule gives the anticipated timing for accommodating the future developments.

h. The design capacity of the proposed treatment plant (5.0 mgd) is the most current sewage flow projection based on revised population growth of the Hilo area. As stated in item (d), a detailed description of the sewage flow projection will be incorporated into the EIS. The design capacity of the existing plant (7.0 mgd) is outdated because of new zoning and population projections.

i. The guidelines of EPA require that the cost-effectiveness analysis for pollution abatement facilties be based on a 20-year design flow.

However, when considering the 50-year design flows (design flow of 10 mgd for the Hilo area) which is generally considered to be the useful life of structures and pipes, it would be prudent to construct the facility in two stages, the first being 5.0 mgd (one-half of the "ultimate" design flow), which is near the theoretical design flow of 5.6 mgd. Further, sewer construction and lateral hookup normally lag source generation, especially in areas where sewer construction program is in its early stages of development. For these reasons, the design flow of 5.0 mgd was used. This discussion will be incorporated in the EIS.

j. The Wastewater Facilities Plan for the Hilo District is consistent with the State's 208 Water Quality Plan. All federally funded sewer construction projects must be consistent with the 208 Plan.

2. Reference Item: I-9. The tentative implementation schedule for the proposed project as shown below will be included in the revised EIS.

TENTATIVE IMPLEMENTATION SCHEDULE*

Project	Initiate Construction
Interceptors A and B	FY 1980-81
Sewer Line C	FY 1981-82
Sewer Line D	FY 1982-83
Sewer Line E	FY 1982-85
Sewer Line F	FY 1982-85
Sewer Line H	FY 1982-85
Force Main I	FY 1984-85
Force Main K	FY 1984-85
SPS/Force Main M	FY 1985-86
Effluent Line	FY 1986-87
Sewage Treatment Plant	FY 1986
Outfall Extension	FY 1988

*This schedule is subject to revision, depending upon funding from both federal (EPA) and local (state and CIP) sources.

3. Reference Item: II-15. Refer to item no. 5 as described below.

4. Reference Item: IV-1. We will comply.

5. Reference Item: IV-2. The total areas affected by the proposed project is limited to existing right-of-ways for roads and utilities for which improvements were already made. Also, the proposed site for the treatment facility is located on the site of an abandoned quarry. Therefore, the effects of construction is not likely to present any adverse impacts on endangered flora or fauna.

   Sewer line "F" which fronts the Lokoaka and Kionakapahu Ponds have already been constructed. Work along sewer line "F" will consist mainly of collection lines and hookups. Hence, the construction-related impacts of the proposed project in the area will not be severe.

   The sewer line which fronts Waiakea Pond and crossing Wailoa River, likewise, has already been installed.

   Construction of sewer lines which includes excavation, installation of the sewer and backfill, usually proceeds in a manner in which short segments are installed at any one time. This practice will minimize the effects of erosion on Waiakea Pond for sewer lines "C" and "D".

The anticipated noise levels for construction equipment will be between 90 to 100 dBA measured at 50 feet. These levels are for short-term periods depending upon the construction schedule. Moreover, noise generated by vehicles or on that order of magnitude considering that the sewer lines lie within the right-of-ways of public roads. Also, the proximity of the treatment facility located near the airport is another factor in the background noise levels. Therefore, noise from construction is not a new occurrence and it is subject to control by DOH regulation.

6. Reference Item: IV-3. The resultant impacts of erosion and sedimentation upon the coastal water quality and marine organisms is not significant problem when compared to the order of magnitude of 2,600 tons of sediment which is discharged by the Wailuku and Wailoa Rivers each year.

7. Reference Item: IV-4. The municipal landfill is located approximately half of a mile mauka of the proposed site of the treatment plant. The landfill location will be delineated in the EIS.

   The disposal operation will not present a significant or adverse impact since the landfill and the access to the landfill from the treatment plant is located within the industrially zoned area.

8. Reference Item: IV-9. As described in item (f), the proposed system is intended to serve all residential, commercial, industrial and resort users with the exclusion of the rural agricultural residences in the outlying areas of the Hilo district.

   The phrase of a "more favorable climate" is being misinterpreted in relation to the secondary impact of population growth. The wastewater management plan and facilities is intended to provide for a more planned and orderly development rather than to serve as a stimulus for uncontrolled development. The relationship between development and the existence of sewers does not exist in Hawaii in the same way as in some mainland regions. Hawaii's regulations and program are structured differently.

9. Reference Item: Summary of Unresolved Issues. The application for the secondary treatment waiver was submitted on September 7, 1979. The review of the application by EPA is currently being conducted and a decision is expected sometime after 1981.

M&E Pacific, Inc.

A chapter summarizing the unresolved issues will be added to the revised EIS along with the description of its current status as described above.

Should you have any questions on the above, please call Ken Ishizaki at 521-3051.

JAMES S. KUMAGAI, Ph.D.
Vice President

BM/ep

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. Box 1361, Hilo, HI 96720

June 2, 1980

Mr. Edward Harada, Chief Engineer
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, HI 96720

Dear Mr. Harada:

Herewith are the comments of the USDA Soil Conservation Service on the Environmental Impact Statement prepared for the Hilo Wastewater Management Plan:

1. Page II-3. The EIS states, "Presently, lava formations rarely outcrop, except possibly in gulches and cliffs..." Outcrop of pahoehoe lava is very common in the study area. Many of the cesspools are blasted through pahoehoe or dense Aa lava outcrop.

2. Page II-7. The EIS states, "...an overlying Pahala ash layer (up to 25 feet thick) and its derivative soil make the surface far less permeable than normal for exposed basalts." The soils north of the Wailuku River are in fact among the most permeable soils in the state. They may be less permeable than loose Aa lava, but definitely more permeable than pahoehoe or dense Aa lava.

3. Page II-16. Paragraph 4 states, "A flood plain map (Figure II-7) has recently been prepared for the U. S. Soil Conservation Service (SCS) for a 100-year storm in Hilo. Results of this study will replace the flood hazard map developed earlier (March 1970) by the SCS that delineated flood-vulnerable areas, using historical data (Figure II-8)."

    a. The flood plain map (Figure II-7) was prepared for the Wailuku-Alenaio PL-566 Watershed Project and shows only the 100-year flood plain for Alenaio Stream. This map was not prepared to replace the March 1970 map as the document indicates.

b. The flood hazard area shown as Figure II-8 is actually the tsunami inundation area taken from the March 1970 map and not a flood hazard area map as identified.

Thank you for the opportunity to comment on this document. If there are any questions, please contact me at any time.

Sincerely,

Larry R. Soenen
District Conservationist

cc Jack Kanalz
State Conservationist

M&E Pacific, Inc.

Environmental Engineers

Pacific Trade Center, Suite 600
190 South King Street
Honolulu, Hawaii 96813
(808) 521-3051 Telex: 7430065

August 27, 1980

Mr. Larry R. Soenen
District Conservationist
U.S. Department of Agriculture
P. O. Box 1361
Hilo, Hawaii 96720

SUBJECT: Environmental Impact Statement
Hilo Wastewater Management Plan

Thank you for your review and comments on the subject document. The following replies are in response to your comments:

1. Reference Item: 1, Page II-3. The text will be revised to state that outcrop of pahoehoe lava is common in the study area.

2. Reference Item: 2, Page II-7. The text will be revised to note that, while the soils north of the Wailuku River are less permeable relative to the surrounding areas, these soils are among the most permeable within the state.

3. Reference Item: 3a, Page II-16. The text will be revised to correct the description of Figure II-7, Flood Plain Map.

4. Reference Item: 3b, Page II-16. The text will be revised by deleting the subject figure since this figure is shown on Figure II-10.

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

JAMES S. KUMAGAI
Vice President

BM/bs

RECEIVED

State of Hawaii
DEPARTMENT OF DEFENSE
OFFICE OF THE ADJUTANT GENERAL
3949 Diamond Head Road
Honolulu, Hawaii 96816

8 JUN 1980

HIENG

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Gentlemen:

Hilo District Sewerage System

Upon our review of the subject EIS, we have summarized the following comments:

1. Page I-10, 1st Paragraph - "The first priority is directed at minimizing the odor problems at the existing treatment facility."

   We anticipate that the odor problem will be generated at the proposed sewage treatment plant. An evaluation should be conducted on the area of odor impact, the frequency of the prevailing winds, etc., and its relationship to the Hawaii National Guard at Keaukaha Military Reservation.

2. Figure I-3 should be upgraded to reflect the proper roadway network to the airport and the general area.

3. Page IV-4, Item 4.

   As stated in Item 1 above, please evaluate the odor impact to the Hawaii National Guard at Keaukaha Military Reservation.

4. Page V-1, 3rd Paragraph.

   We understand that the treatment plant is located away from the highway area, however, close to our reservation.

3 JUN 1980

5. Page V-2, Odor - Temporary.

We question that the odor problem will be temporary. We do not feel assured that the implementation of the odor control facilities will totally eliminate the odor problem.

Your evaluation of our comments is appreciated.

Yours truly,

JERRY M. MATSUDA
Captain, HANG
Contr & Engr Officer

cc:
Dept of Public Works
County of Hawaii/Hilo
EIS returned to Commission
LTC Henry Hara
LTC David Howard
COL Kiyoshi Goya

M&E Pacific, Inc.

Environmental Engineers

Pacific Trade Center, Suite 600
190 South King Street
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(808) 521-3051 Telex: 7430065

August 27, 1980

Jerry M. Matsuda
Department of Defense
Office of the Adjutant General
3949 Diamond Head Road
Honolulu, Hawaii 96816

SUBJECT: Environmental Impact Statement
Hilo Wastewater Management Plan

Thank you for your review and comments on the subject document. The following are in response to your comments dated June 9, 1980.

1. Reference Item: 1, Page I-10, first paragraph. Currently, odor abatement procedures being undertaken by the Department of Public Works at the existing sewage treatment plant is (1) the controlled, deliberate inflow into the sewer system, and (2) covering of treatment units at the headworks. As stated, the sources of the odors have been attributed to the long detention times in the sewers and primary treatment tanks, and to the introduction of supernatant from the anaerobic digester into the major waste stream.

   The design of the proposed treatment facility will incorporate odor abatement facilities which include enclosing the preliminary treatment units and scrubbing the exhaust gases prior to discharge to the atmosphere.

   Also, provisions to treat supernatant from the anaerobic digesters prior to discharge in the main flow stream will also serve to mitigate potential odor problems as stated on page IV-4.

2. Reference Item: 2, Figure I-3. The figure will be updated to reflect the proper roadway network to the airport and general area.

3. Reference Item: Page IV-4, Item 4. Reference is made to the response as described in item (1) above.

4. Reference Item: Page V-1, third paragraph. The location of the treatment plant site as stated is correct.

M&E Pacific, Inc.

5. Reference Item: Page V-2, Odor - Temporary. As discussed in item (1) above, odor abatement measures will be designed as an integral part of the treatment faciliy. However, there will be times when major maintenance activities or plant upset will occur which may result in odors for short periods of time. During the normal operation of the treatment facility, the odor control measures will take care of any odor problems.

Should you have any questions on the above, please call Ken Ishizaki at 521-3051.

JAMES S. KUMAGAI, Ph.D.
Vice President

BM/ep