KEEP

AMERICAN SAMOA WATER RESOURCES STUDY

BASELINE WATER QUALITY SURVEY [redacted]
AMERICAN SAMOA

UNITED STATES ARMY ENGINEER DISTRICT, HONOLULU

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BASELINE WATER QUALITY SURVEY

IN

AMERICAN SAMOA

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Prepared for:

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Pacific Ocean
Fort Shafter, Hawaii

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SYNOPSIS

This study of the baseline water quality in American Samoa covered the effects of wet and dry seasons and a variety of tide and weather conditions on the water quality and exchange characteristics of several water classifications. To accommodate federal and local environmental planning requirements, this study had three basic objectives: (1) to statistically describe water quality characteristics and recommend standards, (2) to describe the dynamic processes of Pago Pago Harbor and recommend control measures, and (3) to evaluate the Tafuna outfall area and recommend a general location for an expanded outfall.

The water quality measurements were statistically analyzed and found to generally conform well to log-normal distributions. These water quality test results were used to develop suggested statistical water quality standards for TP, TN, and turbidity for both saline and fresh water categories; chlorophyll-a and compensation depth values for saline waters; and suspended solids and fecal coliform for streams. Suggested water categories were ocean, open coastal nearshore, embayment, streams, and a special category for Pago Pago Harbor.

Estimates based on measured concentrations and estimated flows from the stream, canneries, and sewage discharge into Pago Pago Harbor showed that three-fourths of the TP and TN inputs were from the wastewaters of the canneries. The results of the study of the Pago Pago Harbor system also showed that a two-layer structure of water quality and movement exists in the harbor. The upper layer is primarily influenced by the wind, while the lower layer responds to the tide.

Current measurements in the Tafuna area showed a reversing tide-related longshore current with net transport toward the southwest. Mixing measurements showed good mixing energy in the area; therefore, good dispersion after initial dilution can be expected. Current measurements also showed a significant shoreward component within the Vai Cove area. These observations led to the recommendation to locate any future outfall diffusers outside of the cove on the southwest side.

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CHAPTER I

INTRODUCTION

Water quality has become an important factor in the decision-making processes of governmental agencies and private enterprise. With the institutionalization of environmental quality considerations, it is now legally necessary to examine the consequences of human activities on the natural environment and on human health.

American Samoa (Figure I-1), as a territory of the United States, is required to meet the provisions of the Federal Water Pollution Control Act amendments of 1972 (Public Law 92-500) and the Clean Water Act of 1977 (Public Law 95-217). The general need for water pollution control has grown with the territory's economy and population. To satisfy this need and to comply with institutional requirements, the American Samoa Government (ASG) has been pursuing various programs. These include pollution control regulations and their enforcement, water quality monitoring, the formulation of initial water quality standards, and the preparation of a Wastewater Facilities Plan for American Samoa (CH2M Hill, 1976).

As part of the American Samoa Water Resources Study, the U.S. Army Corps of Engineers (Honolulu District) is providing technical assistance to the ASG in the preparation of an areawide waste treatment management plan for the territory, in compliance with Section 208 of PL 92-500 (as amended by PL 95-217).

The Corps initiated its 208 assistance to American Samoa in 1978 by conducting the Wastewater Management Data Evaluation Study for American Samoa (M&E Pacific, Inc., 1978). The overall purpose of that study was to review the adequacy of existing water quality data and related programs in the context of 208 planning and to identify specific needs. Among its principal findings, the 1978 study cited the general lack of water quality data representative of American Samoa waters, the need for water quality standards, and the need to quantify

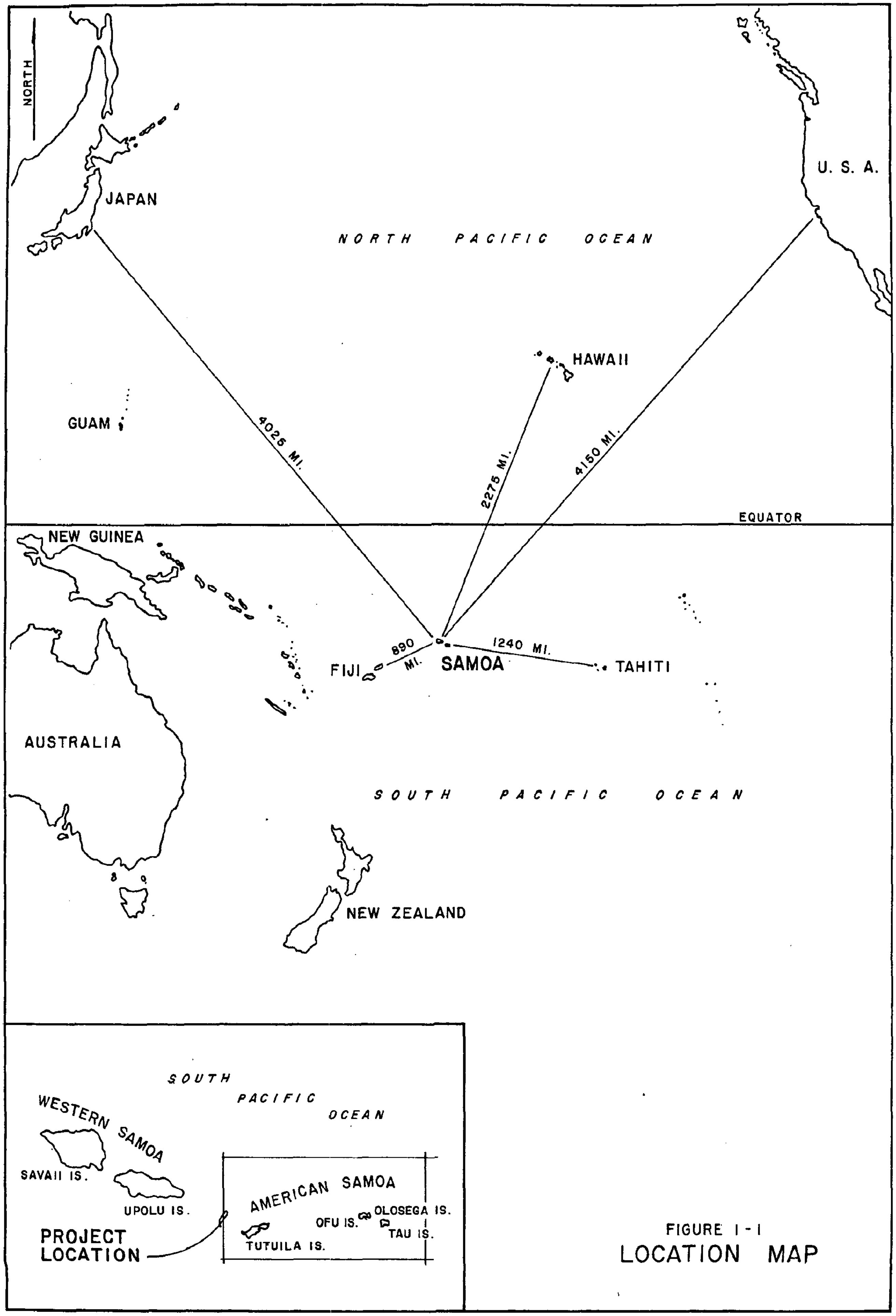


FIGURE I-1
LOCATION MAP

the effects of present and proposed discharges in Pago Pago Harbor and the Tafuna sewage treatment plant ocean outfall area.

The need for water quality information and data in American Samoa is particularly necessary for two current ASG projects. The first of these is the revision of existing water qualilty standards by the ASG Environmental Quality Commission (EQC), where additional data would provide a sound basis for numerical standards and improve their enforceability. The second project is the revision of the 1976 Wastewater Facilities (201) Plan recently initiated by the ASG Department of Public Works. Additional information on background water quality and exchange characteristics as well as an evaluation of the effects of the present discharges would assist in the formulation and selection of planned improvements that confront governmental agencies and private enterprise.

STUDY PURPOSE AND OBJECTIVES

The purpose of the Baseline Water Quality Survey, American Samoa, contracted to the firm of M&E Pacific, Inc. of Honolulu (Contract No. DACW84-78-C-0015), is to gather and analyze receiving water quality data for the Territory of American Samoa. These data will serve as a basis for developing technical recommendations for specific wastewater management needs.

The primary objectives of the study are defined as follows:

1. To statistically describe the background water quality characteristics of the ocean, embayment, and stream waters of American Samoa and to recommend changes in the existing receiving water quality standards.
2. To estimate the mass emissions into Pago Pago Harbor (Figure I-2) and describe the dynamic processes of the harbor and to evaluate the effects of existing discharges on the natural ecosystem and the beneficial uses of this important water body.

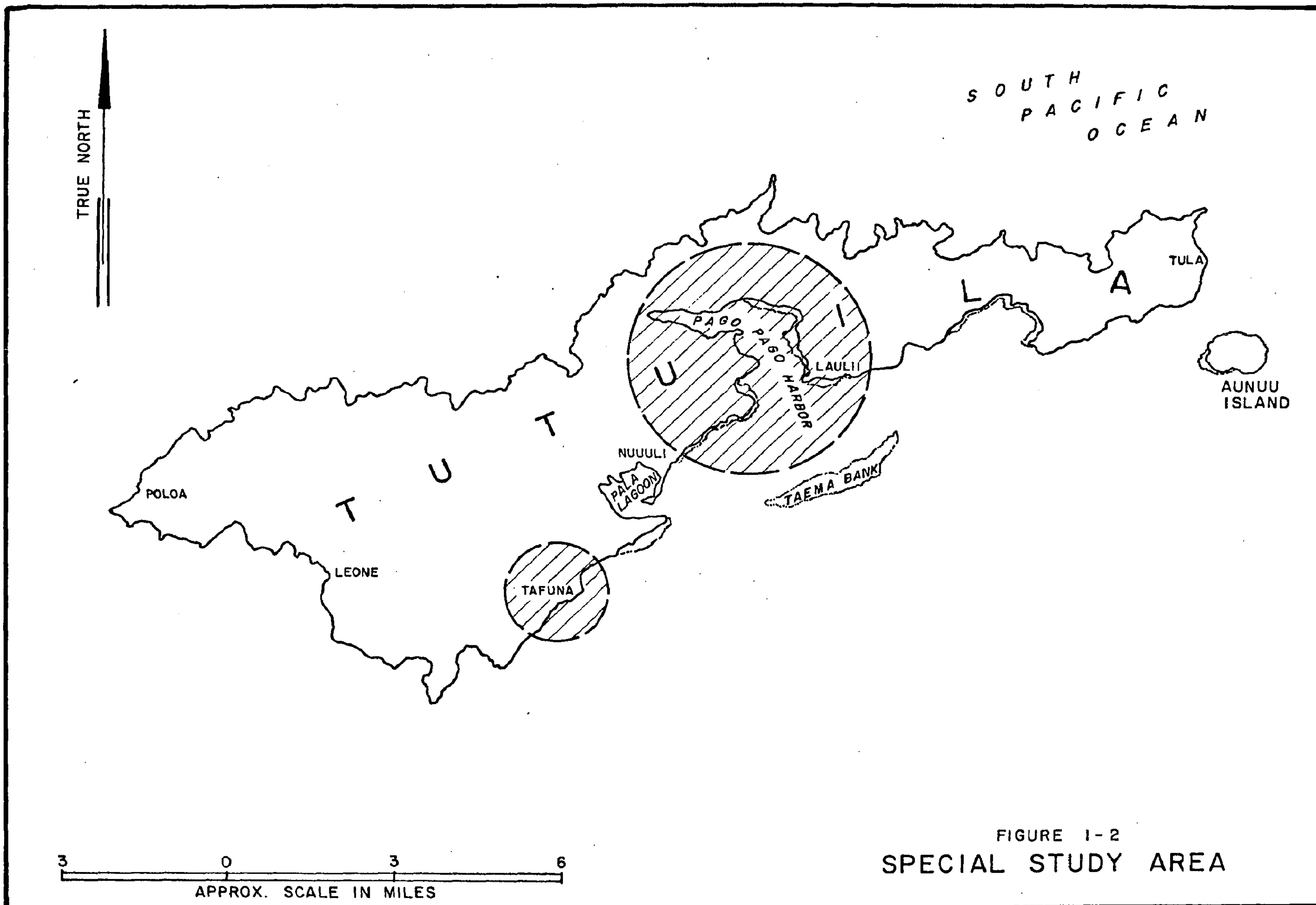


FIGURE I-2
SPECIAL STUDY AREA

3. To describe the water quality and transport characteristics of the nearshore area in the vicinity of the existing Tafuna sewage treatment plant outfall (Figure I-2) in sufficient detail to recommend the general location for the planned outfall expansion.

SCOPE

The scope of this study involves a territorywide water quality sampling survey designed to collect representative sets of data and to conduct special studies in Pago Pago Harbor and near the Tafuna outfall.

The reliability of the water quality data collected was primarily based on three criteria.

1. Statistical validity. Sufficient data points were collected for each water body classification investigated to allow reliable statistical descriptions for each parameter.
2. Temporal representation. Sampling trips were scheduled to take into account tidal, weather, and seasonal variations in American Samoa.
3. Spatial representation. Sampling locations were selected to represent the horizontal and vertical water quality variations of the different types of water bodies found in American Samoa.

It should also be mentioned that the data collected are intended to serve as a "baseline" for the ASG water quality monitoring program. As more data are collected, the reliability of the results will improve.

Two field trips were undertaken to gather most of the required data. The "wet" season characteristics were measured during February and March 1979. The "dry" season measurements were made during July 1979. In addition to the samples taken by M&E Pacific, Inc., two sets of samples from stream and Pago Pago Harbor surface stations were taken by the staff of the ASG Environmental Quality Laboratory.

Besides in-situ and laboratory water quality measurements, the study involved the use of current meters, drogues, dye, and aerial photographs to describe the current structure and mixing characteristics at Tafuna and in Pago Pago Harbor. The combination of transport and water quality constitutes the dynamic description necessary to evaluate the cause and effect relationships of present conditions and to predict the probable consequences of future actions.

ACKNOWLEDGMENT

The investigators wish to acknowledge the generous cooperation and assistance of the following people without whom this study would have been much more difficult and, indeed, impossible:

1. Mr. Pati Faiai, Special Assistant to the Governor for the Environment
2. Mr. Joseph Pereira and Dr. Paul Templet, ASG Development Planning Office
3. Mr. Tau Vaivai and Staff, ASG Environmental Quality Laboratory
4. Mr. Henry Sesepasara and Dr. Richard Wass, ASG Office of Marine Resources
5. Lt. Mason Stober, U.S. Coast Guard
6. Boat owner-operators: Messrs. Faatauvaa Kitiona, Joe Misaalafua, Mel Makaiwi, Andy Nesheim, John Fiu, Wally Thompson, and Frank McCoy

We especially thank Mr. Frank McCoy for recovering a current meter that had broken loose during high seas.

CHAPTER II

SUMMARY AND CONCLUSIONS

This study had three general objectives. The first objective was to statistically describe the baseline water quality characteristics of the several water classifications in American Samoa in order to develop suggested numerical values for revising and adding to the water quality standards being proposed by the ASG Environmental Quality Commission (Appendix E). The second objective was to describe the water quality, material input, and exchange characteristics of Pago Pago Harbor in order to define effective measures to improve environmental conditions. The third objective was to evaluate the vicinity of the existing outfall in the Tafuna area with respect to mixing, transport, and water quality in order to suggest a general location for a new outfall and to provide measurements that can be used to calculate initial dilution and a zone of mixing once the expected effluent flow, the diffuser depth, and the water quality standards have been defined.

BASELINE WATER QUALITY

The results of the water quality measurements in open ocean, nearshore open coastal, embayment, Pago Pago Harbor, and stream waters were statistically analyzed and found to generally conform to log-normal distributions. The ocean water classifications have been defined in the proposed standards given in Appendix E. A discussion of the statistical approach used in this study is included in the methodology chapter.

The in-situ measurements of temperature, salinity, dissolved oxygen, irradiance, and fecal coliform showed that ocean and nearshore open coastal waters were well mixed to at least 100 feet, while there was, under regular tradewind conditions, a slight but persistent stratification at 10 to 30 feet indicated in Pago Pago Harbor. This stratification tends to break down with sustained wind stress from the northwest or north. Irradiance energy measurements showed that the

1 percent incident light depth (an approximation of the photic zone, which defines the depth below which there is insufficient light for plant life) decreased from a geometric mean of 167 feet at the ocean stations to a geometric mean of 26 feet at the three stations inside Pago Pago Harbor. The dissolved oxygen (DO) levels in the open ocean were below saturation, as is normal for nutrient poor tropical waters, with higher values near the surface. DO levels increased in the near-shore area and especially in the surface layer of Pago Pago Harbor due to increased chlorophyll-a levels. However, DO levels remained generally low in the lower layer of Pago Pago Harbor and occasionally showed very low values near the bottom in the inner harbor, even during late afternoon, which is the time when DO levels are highest. Streams draining primarily undisturbed areas had DO levels near saturation while those with urban and agricultural influence occasionally had DO levels around 50 percent of saturation. Since low and fluctuating DO levels indicate a stressed condition, it is likely that these streams and the inner Pago Pago Harbor area cannot presently support a diverse biological community and may occasionally cause fish kills.

Fecal coliform were virtually absent at saline water stations. Background streams showed low fecal coliform levels while urban influenced streams frequently showed concentrations of fecal coliform far in excess of the proposed standards.

Laboratory measurements conducted at the environmental quality laboratory in American Samoa included pH, turbidity, and suspended solids. As expected, the well-buffered saline water pH levels were consistent, with geometric mean values between 8.2 and 8.3. Streams showed lower pH levels, with geometric means between 7.4 and 7.5. It is expected that other fresh water areas, such as lakes or marshes, would have lower pH levels. Turbidity levels increased from around 0.18 NTU at open ocean stations to 1.06 NTU in the upper layer of the inner harbor. The lower layer of the harbor was consistently low in turbidity with levels of 0.25 NTU generally being maintained at least halfway into the inner harbor. Suspended solids did not show as pronounced a trend as turbidity, presumably because the turbidity-causing material is generally low density organic material. The turbidity and suspended solids levels are in line with the observed photic zone depth and indicate a stressed condition in Pago Pago Harbor not conducive to a coral based ecosystem.

Measurements made on preserved samples at a laboratory in Honolulu included total phosphorus, total Kjeldahl nitrogen, nitrate plus nitrite nitrogen, and chlorophyll-a. The total phosphorus (TP) levels were low in ocean and nearshore waters, with geometric mean levels around 8 ug/l. These levels increased by a factor of two in the surface layer of outer Pago Pago Harbor and by a factor of four in the surface layer of the inner harbor. The lower layers had only slightly lower but more variable levels of TP than the upper layers presumably because TP is associated with suspended solids which sink, such as clay, silt, and sand.

Total Kjeldahl nitrogen (TKN) levels had a similar pattern as TP, except that the lower layer of Pago Pago Harbor did not exhibit any significant increase from background open ocean levels. Possibly this is because TKN is usually associated with organic material that does not sink readily. The nitrate plus nitrite nitrogen (NO_3+NO_2,N) results appeared to be somewhat inconsistent between the February and July samples and showed unusually high variations in the normally constant ocean samples. The potential effect of this uncertainty of the nitrate plus nitrite nitrogen levels on the total nitrogen is on the order of 10 percent, which is acceptably low since it is within the statistical uncertainty of about 20 percent. Future monitoring will resolve the doubt in this measurement.

The chlorophyll-a levels were low for ocean and nearshore areas but showed a high increase in the surface layers of Pago Pago Harbor. The lower layer of the harbor also showed an increase but at a markedly lower level. The chlorophyll-a levels in the upper layer of Pago Pago

Harbor show high variability which is due to fluctuations in the residence time. With the ready supply of nutrients, it is probable that, under calm wind conditions, the plankton population can increase to the point where night time DO levels are too low to support fish life.

The urban and agriculturally influenced stream results showed a definite increase in TP, TKN, and especially NO_3+NO_2,N levels above the levels in background streams. Of special note was the effect of road construction activities on the turbidity and suspended solids, TP, and TKN levels of the stream draining the "top mile" area. Effective erosion control is necessary for road construction projects if damage to reef areas and water quality are to be prevented.

The water quality test results were used to develop suggested statistical water quality standards for TP, TN, and turbidity, for both saline and fresh water categories, chlorophyll-a and compensation depth values for saline waters, and suspended solids and fecal coliform for streams. The suggested water categories were ocean, open coastal nearshore, embayment, streams, and a special category for Pago Pago Harbor. It should be noted that adoption of the suggested Pago Pago Harbor standards would require the relocation of the Utulei outfall and cannery discharges outside of the harbor before compliance could be achieved.

It may be appropriate in future revisions of the standards to make additional fresh water classifications for urban streams and marsh areas as well as to include benthic biological standards for embayment and nearshore open coastal areas.

PAGO PAGO HARBOR SYSTEM

The results of the study of the Pago Pago Harbor system showed that there is a two-layer structure of water movement corresponding to the two-layer water quality characteristics. The upper layer moves primarily as a result of wind forces, while the lower layer responds to the in and out movement of the tide. Exchange at the mouth of the harbor is influenced by the direction of the tide-related reversing longshore current which possibly changes seasonally.

Stream, tuna cannery, and sewage input of total phosphorus and total nitrogen to the harbor were estimated using measured concentrations and estimated flows. Runoff could only be approximately estimated because of the dearth of specific hydrologic information in the Pago Pago Harbor drainage basin. The results of these estimates showed that approximately three-fourths of the total TP and TN inputs to the harbor from the land are from the tuna canneries' effluents. The remaining 25 percent of the input is split approximately evenly between the Utulei outfall and nonpoint stream flow.

Residence time estimates based on estimated wind- and tide-related transport agreed reasonably closely with those based on TP and TN input rates. The overall average harbor residence time with respect to the transition zone with the ocean is estimated to be in the range of 12.9 to 19.5 days.

Using the estimated residence times of the inner and outer harbor upper and lower layers, it was possible to estimate the net phytoplankton growth rates for the various areas. The results showed that the lower layer was very likely primarily light limited, while the upper layer exhibited high growth rates especially in the inner harbor. Considering the virtual uncontrollability of the residence time, it would be necessary to significantly reduce the nutrient input if the detrimental effects of excessive planktonic growth are to be controlled. These detrimental effects include a reduction in the photic depth, fluctuations in the DO level, and increased organic loading on the bottom. The proposed criteria for acceptable nutrient concentrations are included in the proposed standards. Since the majority of the nutrient input is from the canneries, compliance with the proposed standards means relocation of the nutrient containing cannery discharges outside of the harbor.

TAFUNA OUTFALL STUDY

The current structure in the Tafuna area consists of a reversing tide-related longshore current with net transport toward the southwest of around 5.5 cm/second. Reversal was noted in the directions of the ebb- and flood-related flows between the February and July measurement periods. Possibly, this reversal is seasonal.

The drogue, dye, and current meter measurements showed a significant shoreward component within the Vai Cove area. There also appeared to be an enhanced longshore flow around the southern point of that cove. These observations led to the recommendation to locate any future outfall diffusers outside of the cove on the southwest side.

Dye dispersion measurements showed good mixing characteristics in the area, which was, as expected, significantly higher than inside Pago Pago Harbor. Because of partial confinement, the dispersion coefficient increase with scale was not quite as theoretically predicted for open ocean conditions. Good dispersion after initial dilution can be expected in this area.

The fecal coliform disappearance rate, T_{90}, as measured at the Utulei outfall inside Pago Pago Harbor was around one hour. It is possible that a shorter T_{90} exists in the clearer waters off Tafuna; however, chlorination facilities should be provided for any new discharges in the area.

RELEVANCE TO THE 208 PLANNING PROCESS

The results of this study are directly applicable to the Section 208 planning process being conducted by the ASG Development Planning Office. The proposed water quality standards, as based on the measurements made during this study, are in line with the approach outlined in the Wastewater Management Data Evaluation Study for American Samoa (M&E Pacific, Inc., 1978). The results of the Pago Pago Harbor study included in this report support the evaluation in the 1978 study of the importance of erosion control and the need to limit nutrient input to embayments.

The Tafuna outfall area evaluation expands on the Section 201 study by CH2M Hill and ties into the general wastewater management plan for American Samoa being refined by the Development Planning Office.

Support is given by the fecal coliform and other stream measurements made in this study to the recommendations in the 1978 report that nonpoint sources be controlled so as to minimize detrimental effects on stream waters.

The continuing monitoring program recommended in the 1978 report remains generally applicable, except that the initial monthly sampling schedule is no longer necessary because of the baseline water quality data developed in this study. Because of the changes in the proposed water quality standards, the parameters of the proposed monitoring program would be changed by the deletion of total coliform and the addition of chlorophyll-a if the standards are adopted. Consideration should also be given to revising the sampling locations of the monitoring program to those established in this study.

CHAPTER III

METHODOLOGY

The field and laboratory measurements as well as the calculation techniques employed in this study have been developed and utilized over a period of several years for similar studies on several Pacific islands (Hawaii Kai outfall, 1972; Kauai water quality, 1973; Kaneohe Bay, 1976; Hilo Bay, 1977; Ponape, 1978; Palau, 1978; Majuro, 1979, and Saipan, 1979). The general approach consists of the use of standard laboratory analyses combined with field adapted sampling and measurements techniques. The calculations were performed by statistical computer programs and other techniques appropriate to each investigation.

Where applicable, Standard Methods (14th Edition) methods or EPA methods were employed for the chemical analyses. Since some of these methods were not designed for sea water, however, it was necessary to adapt the appropriate sea water methods reported by Strickland and Parsons (1968) for routine use.

The field methods used in this study have evolved to fulfill the data gathering and calculation requirements in the context of relatively remote areas and for use on small boats. Of necessity these methods must be flexible enough to accommodate local limitations and adverse weather conditions while still being reliable. It is generally necessary to transport a considerable amount of equipment to the study area to fulfill these requirements. Fortunately, the ASG environmental quality laboratory in American Samoa was available for use during this study, thereby adding greater versatility and increasing the number of analyses that could be performed without delay.

The water quality data were statistically analyzed primarily on the basis of log-normal distributions (discussed later in this chapter) since this type of distribution has been noted to generally match the natural variation of many water quality parameters. Practical calculations using dye data were developed to describe mixing coefficients as based on Fick's Law (A. Fick, 1855).

The dry and wet season water quality data were grouped for similar stations in order to provide a statistical description over both time and space. The station locations are shown on Figures III-1 through III-4, and the categories selected and station numbers are summarized in Table III-1.

The specific methods used during this study are described in the remainder of this chapter.

WATER QUALITY MEASUREMENTS

Measurements of various water quality parameters for American Samoa waters were generally made twice during each of wet and dry season trips at each of the ocean, embayment and stream stations. Some parameters were measured directly in the field, others were measured on water samples brought from the field to the public health water laboratory in the LBJ medical center in American Samoa, and some were measured on preserved samples sent to Honolulu for analysis. In order to increase the statistical base, two additional sets of samples were taken at the stream stations and at the surface of the Pago Pago Harbor stations in May 1979 by the staff of the environmental quality laboratory. Due to boat breakdowns, three, rather than four, sets of samples were taken from Stations 14, 15, 16, and 17.

Sampling Procedures

Sampling of ocean and embayment waters using a Van Dorn sampler was performed at 19 stations as shown on Figures III-1 to III-4. One-gallon samples were taken at depths of 3 and 60 feet, except at Station 13, where the bottom sample was from 30 feet due to the shallow depth. Separate samples for oil and grease analysis were taken at Stations 8 through 13 by skimming 500 ml from the surface.

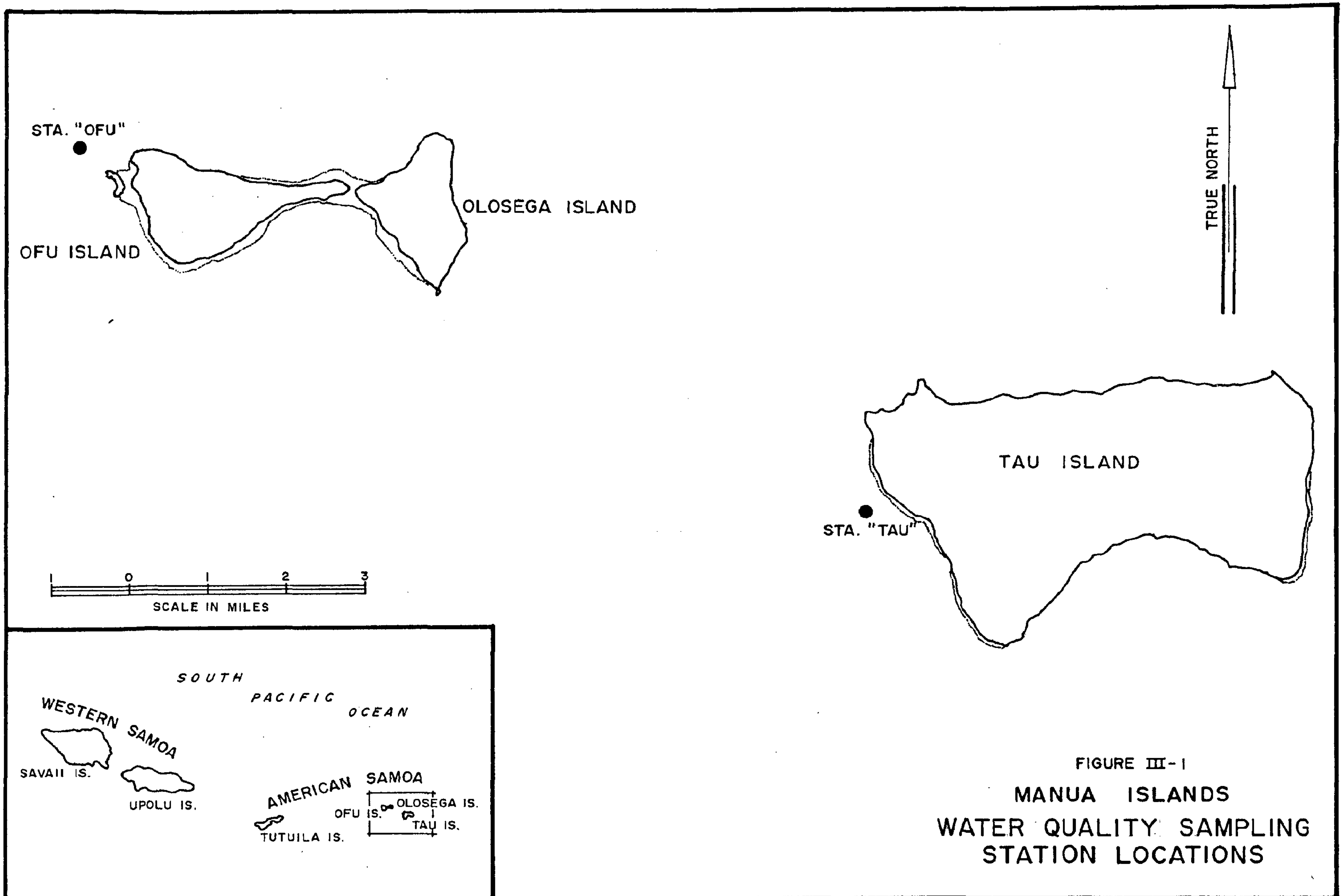


FIGURE III-1
MANUA ISLANDS
WATER QUALITY SAMPLING
STATION LOCATIONS

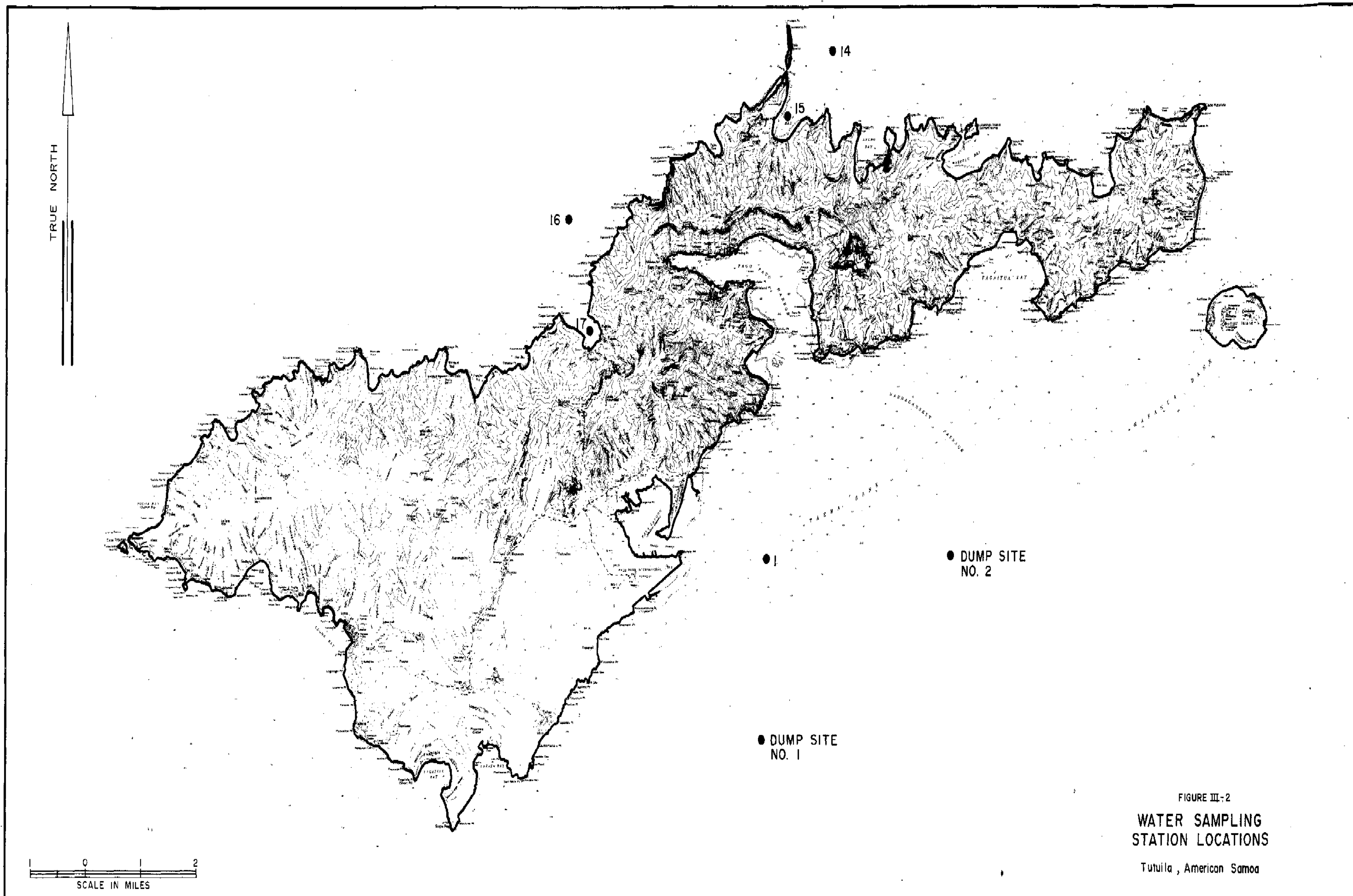
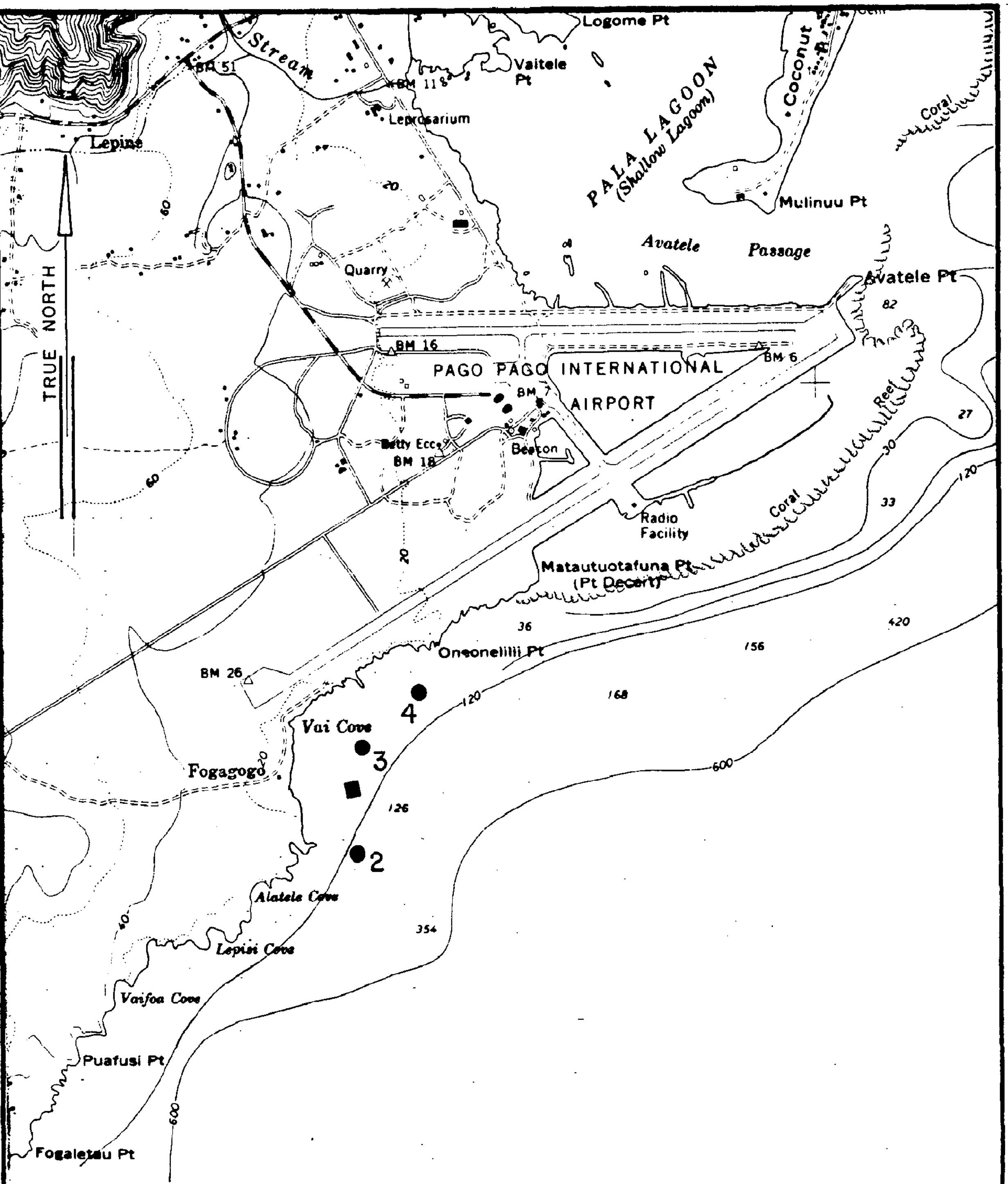


FIGURE III-2
WATER SAMPLING
STATION LOCATIONS
Tutuila, American Samoa



LEGEND

● WATER QUALITY SAMPLING STATION

■ CURRENT METER STATIONS

2000 0 2000
SCALE IN FEET

FIGURE III-3

TAFUNA WATER QUALITY SAMPLING AND CURRENT METER STATION LOCATIONS

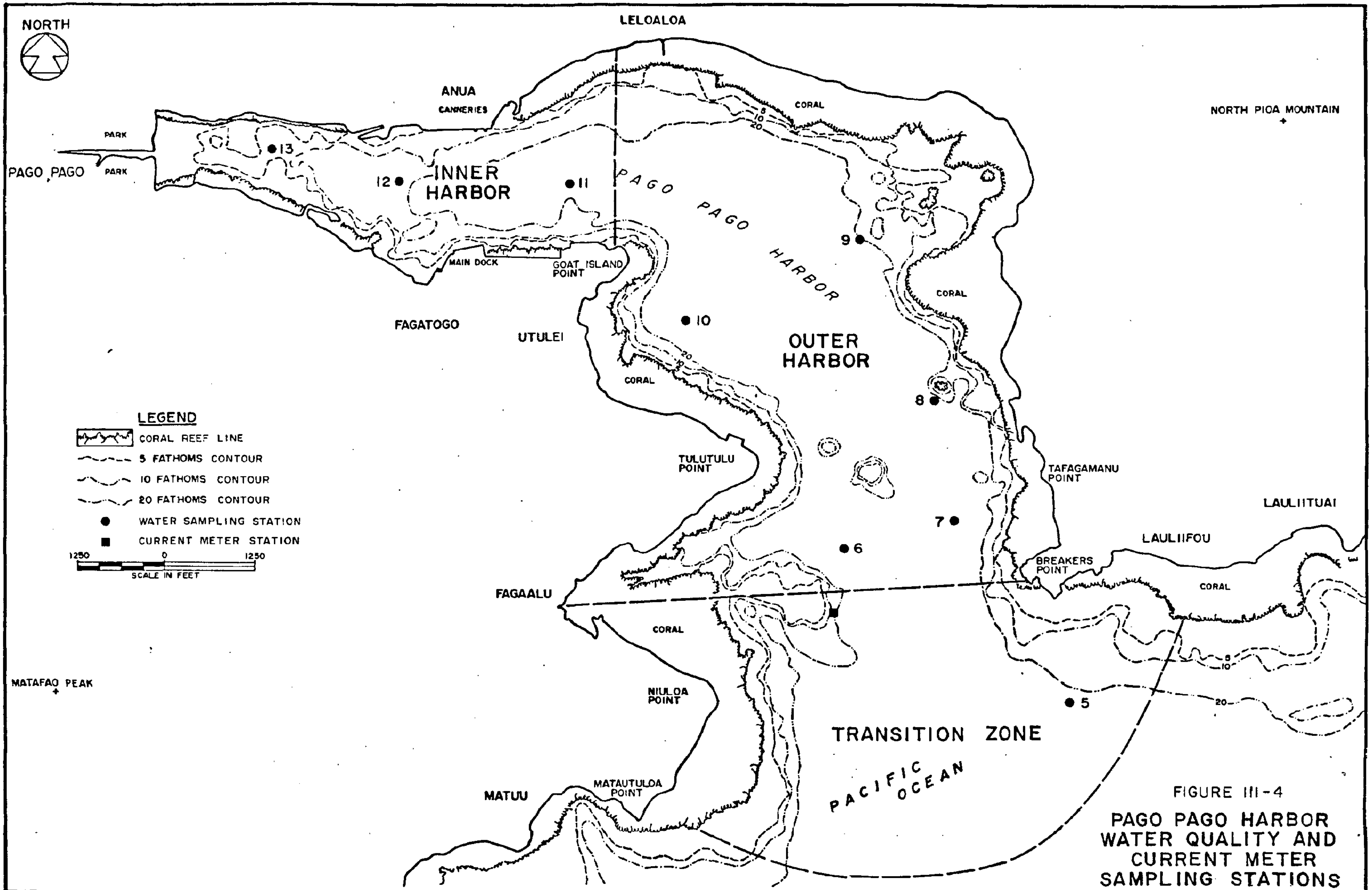


FIGURE III-4

PAGO PAGO HARBOR WATER QUALITY AND CURRENT METER SAMPLING STATIONS

TABLE III-1

STATION LOCATIONS

Category	Station Number
Saline	
Open Ocean	1, 14, 16, Tau, Ofu and Dumpsite 1
Open Coastal Nearshore	2, 3, 4
Embayment	15, 17
Transition Zone	5
Outer Pago Pago Harbor	6, 7, 8, 9, 10
Inner Pago Pago Harbor	11, 12, 13
Streams	
Background	Maloata (1), Leone Falls (4), Upper Vaitele (5)
Urban and Agricultural Influence	Poloa (2), Asili (3), Auasi (6), Leloaloa (8), Pago Pago No. 1 (9), Pago Pago No. 2 (10), Fagatogo (11), Fagaalu (12)
Road Construction Effects	Aua (7)

Fresh water samples were taken at 12 streams on Tutuila (Figure III-5). The streams were selected to represent undeveloped, urban land use and road construction effects as well as to serve as a data base for mass emission into Pago Pago Harbor. Stream samples were taken above the tidal influence. No stream sampling was conducted in Manu'a because there are no perennial streams.

Field Measurements

Salinity was measured using a Kahlsico Salinometer with a 100-foot probe. In order to detect any stratification, measurements were taken at the surface, 5 feet, 10 feet, then at every 10-foot interval to a depth of 100 feet or, if shallow, to the bottom.

Temperature readings for seawater stations were taken simultaneously with salinity measurements using the same instrument. For stream waters, temperatures were obtained using the dissolved oxygen meter or a mercury thermometer.

Dissolved oxygen concentrations were measured using a Yellow Springs Instruments Co., Inc. (YSI) Model 57 oxygen meter calibrated with oxygen saturated fresh water. Measurements were made at depths of 3 and 60 feet for sea water stations.

Irradiance measurements were made using a Hydro Products Model 620 A irradiance meter. The percentage of incident light at various depths was determined by comparison of the readings of a surface and a subsurface photometer. Measurements were made at regular intervals (usually every 10 feet) until the one percent incident light energy level was reached. This level is usually considered as the depth of the compensation level below which no significant photosynthetic activity occurs.

Fecal coliform counts were obtained using Millipore filter field kits and a Millipore portable water bath incubator. Cultures were innoculated in the field, with subsequent incubation in the laboratory. The T_{90} test (time required for an expected 90 percent die-off of fecal

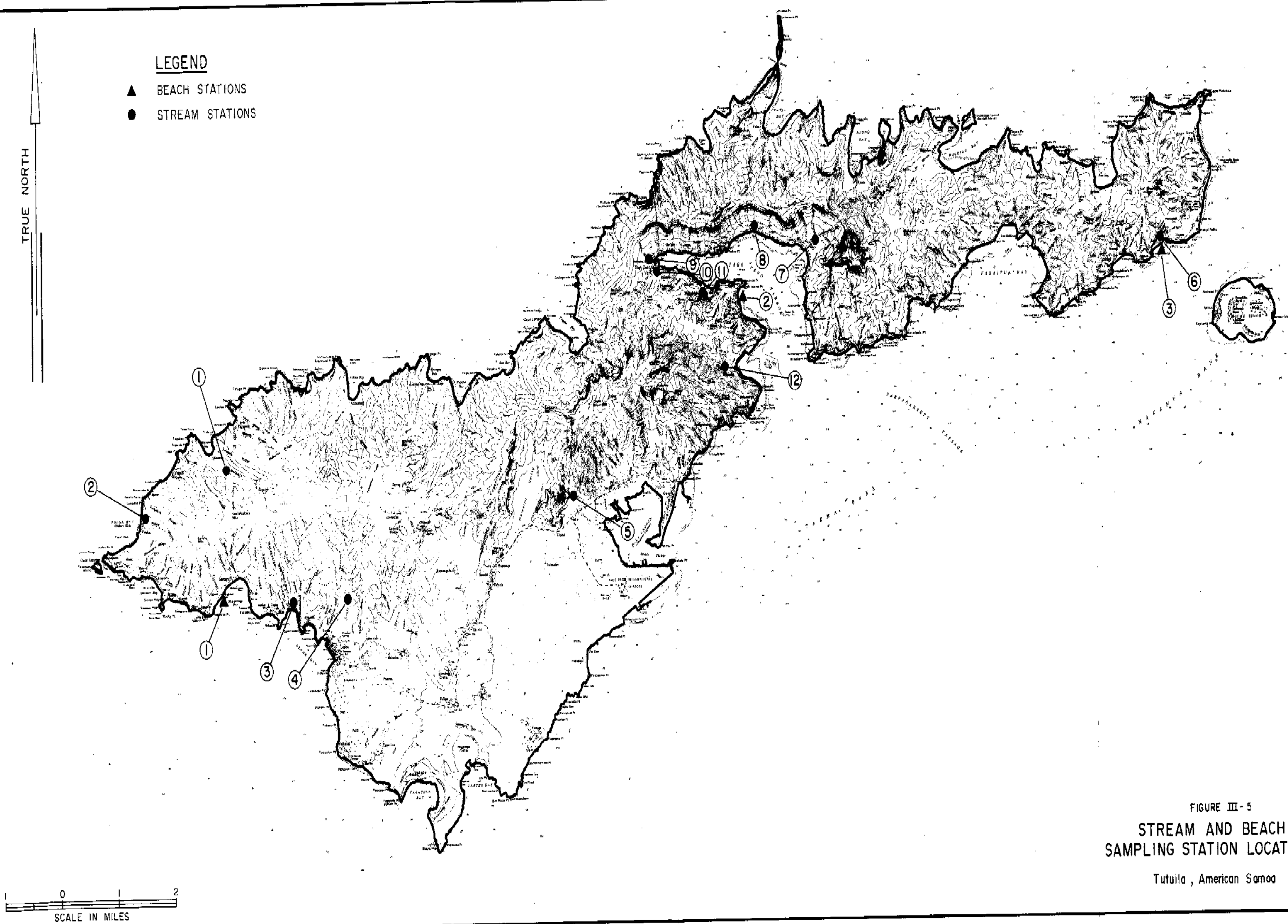


FIGURE III-5
STREAM AND BEACH
SAMPLING STATION LOCATIONS
Tutuila, American Samoa

coliform) was performed using serial dilutions of the timed samples from the Utulei outfall plume. The "Membrane Filter Method" as described in Standard Methods for the Examination of Water and Wastewater was used. Sea water samples were diluted with sterilized tap water to minimize any excess salt effects.

Laboratory Measurements Conducted in American Samoa

pH was measured at the American Samoa environmental quality laboratory using an Orion Research Ionalyzer Model 407A specific ion meter calibrated with appropriate pH buffer solutions.

Turbidity was measured using a Hach Chemical Co. Model 2100 A Turbidimeter with turbidity standards relative to the Nephelometric Turbidity Unit (NTU).

Suspended solids tests were conducted according to Standard Methods, 14th edition. In addition, the filters were thoroughly rinsed with distilled water to remove any residual salt after the salt water sample was filtered.

Chlorophyll-a was determined according to the method described by Strickland and Parsons in A Practical Handbook of Seawater Analysis (1968). Two thousand ml portions of sample were filtered through GF/C glass fiber filters and the filters placed in 100-ml nalgene bottles containing 50 ml of 90 percent acetone. The nalgene bottles were packed in ice and air freighted to Honolulu in styrofoam containers where they were analyzed using a centrifuge and spectrophotometer. The chlorophyll-a content was calculated according to the Strickland and Parsons formula.

LABORATORY MEASUREMENTS CONDUCTED AT THE M&E PACIFIC LABORATORY IN HONOLULU

With the exception of the analyses for chlorophyll-a and oil and grease, all analyses were conducted in duplicate. Demineralized tap water was used for all distilled water needs.

The samples for the analyses of TKN, NO_2+NO_3, TP, Cl^-, and oil and grease were preserved with sulfuric acid to a pH under two in 500 ml nalgene wide-mouth bottles. These sample bottles were packed with ice in styrofoam ice-coolers then shipped to the laboratory in Honolulu via air freight. Chlorophyll-a samples were also packed in these styrofoam coolers. Once transported to the laboratory, samples were immediately stored in a refrigerator maintained at a temperature of 4°C.

Total Kjeldahl Nitrogen

The method described by Strickland and Parsons in A Practical Handbook of Seawater Analysis was followed with the following modifications. Digestion of samples was complete after all "smoke" cleared in the 125 ml erlenmeyer flasks. The addition of 11-ml of the developing solution for seawater samples consisted of this ratio; 100 ml NaOH (330g/ 2,000 ml), 10 ml KBr (1.5g/250 ml), and 0.75 ml of 1.5 N hyperchlorite. The developing period was 3.5 hours. For the fresh water samples, the developing solution consisted of this ratio; 100 ml NaOH, 10 ml KBr, and 1.5 ml of 1.5 N hyperchlorite. The developing period was 1.5 hours.

Nitrate Plus Nitrite Nitrogen

The cadmium reduction column method of Strickland and Parsons was used. To maximize the reducing power of cadmium, samples were filtered through GF/C glass fiber filter papers, which retain particles in the semi-colloidal range, before passage through the reduction columns. Duplicate blanks and triplicate standards were passed through each of the two columns used for each day on which the columns were used. Experience has shown that the concentration of nitrite-nitrogen in offshore waters was low compared to nitrate-nitrogen. Hence, the nitrite-nitrogen was not measured separately.

Total Phosphorus

The "Single Reagent Method" as described in the Manual of Methods for Chemical Analysis of Water and Wastes, Environmental Protection Agency, 1974, was used for total phosphorus determinations for seawater and estuarine waters. Boiling glass beads were used to prevent bumping and to make evaporation of samples smoother.

Chlorides

The "Mercuric Nitrate Method" as described in Standard Methods for the Examination of Water and Wastewater, 14th edition, 1975, was used to determine the chloride concentrations in water samples.

Oil and Grease

The "Separatory Funnel Extraction Method" as described in the EPA Manual of Methods for Chemical Analysis of Water and Wastes was used.

Chlorophyll-a

The pigments were allowed to extract at 4°C in a refrigerator for at least two days instead of about 20 hours as described by Strickland and Parsons. The longer extraction period was designed to compensate for the fact that filters were not ground up for more efficient extraction. Magnesium carbonate was not added to the samples before filtering because work on samples for chlorophyll-a was started at the earliest possible time and was therefore not required. Instead of using 10 ml extract, 50 ml was used because of the use of 10 cm cells, which hold about 25 ml of sample. To correct for evaporation during extraction, the volume of the extract was measured just prior to 10-minute centrifugation and measurement on the spectrophotometer.

CURRENT MEASUREMENTS

Currents were measured by the use of current meters and drogues.

Current Meters

Endeco Type 105 current meters were installed at the division line between outer Pago Pago Harbor and the transition zone during both the wet and dry season sampling trips (Figure III-4). The meter depth at this location was 30 to 35 feet. A typical installation configuration for this type of meter is shown on Figure III-6. The anchor for the mooring line was placed by divers at a depth of 75 feet. This meter is an axial flow, ducted impeller recording meter designed for continental shelf and estuarine environmental monitoring. It was specifically selected because it is capable of measuring very low current velocities. In addition, this type of meter is not overly sensitive to surge. The meter was set to record the current speed and direction at 30-minute intervals and was in place for 21 days during the wet season monitoring period and 17 days during the dry season period. The speed and direction data were recorded on 16 mm film for subsequent data retrieval. Possible interference with the sensitive rotor by the growth of attached marine organisms was effectively eliminated by antifouling paint. The shorter period of record during the dry season was the result of heavy wave action breaking the anchor chain.

The same type of Endeco meter was installed at the Tafuna study area during the dry season (Figure III-3). The meter depth was about 30 feet, with the anchor placed at a depth of 65 feet. The period of record at this location was 20 days.

Drogues

The type of drogues used to track currents in both Pago Pago Harbor and the Tafuna STP outfall site are shown on Figure III-7. The general procedure was to release drogues at three depths. Tracking was accomplished using a small boat and a sextant and measuring two angles among three landmarks. These data would then be used to plot drogue vectors. A wind correction factor was applied for all subsurface drogues.

In inner Pago Pago Harbor, three sets of drogues, set at the surface, 10-foot, and 100-foot depths, were released along an imaginary line between Goat Island Point and Lepua Light to describe the exchange between the inner and outer harbor.

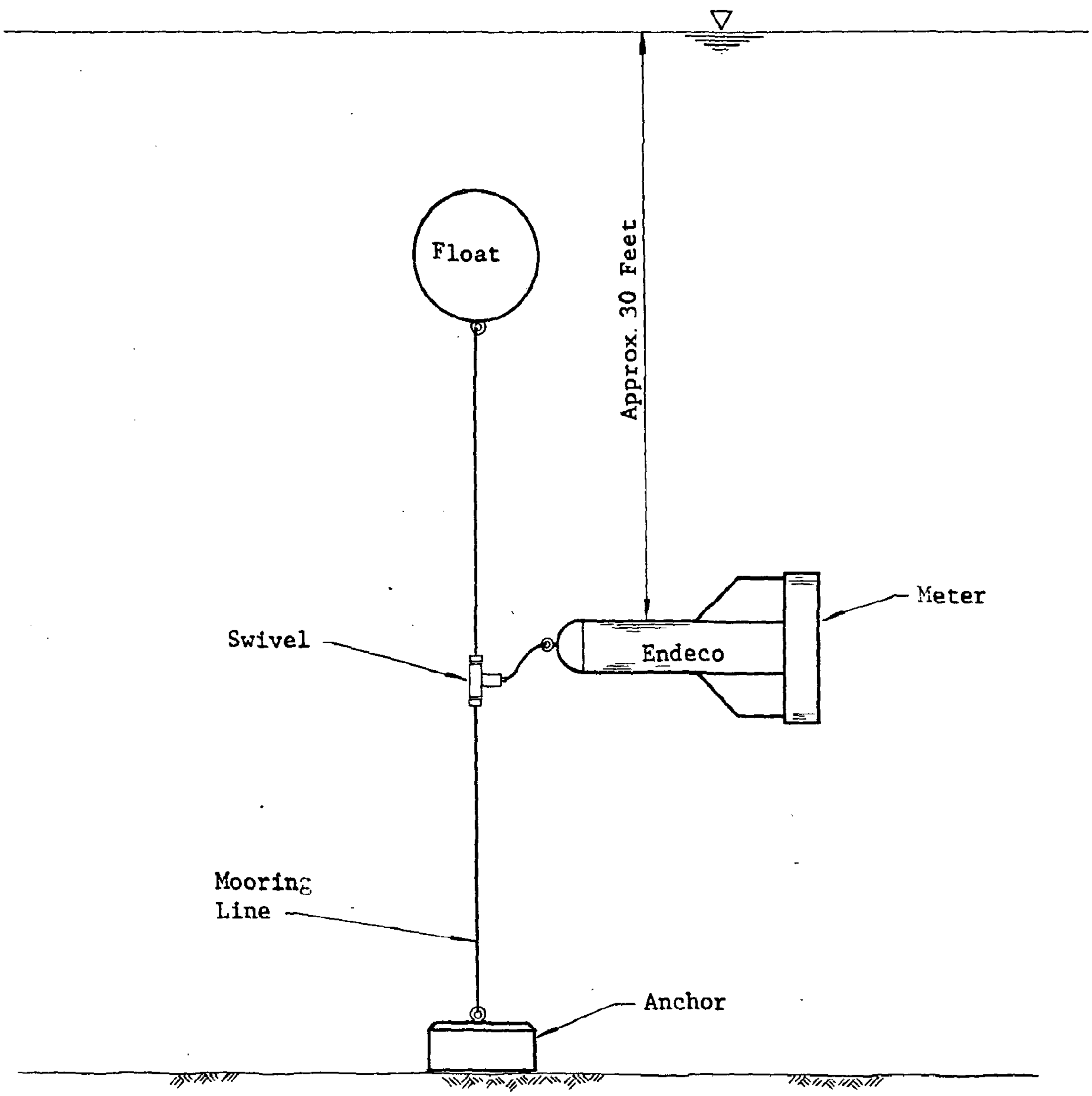


FIGURE III-6

TYPICAL CURRENT METER INSTALLATION

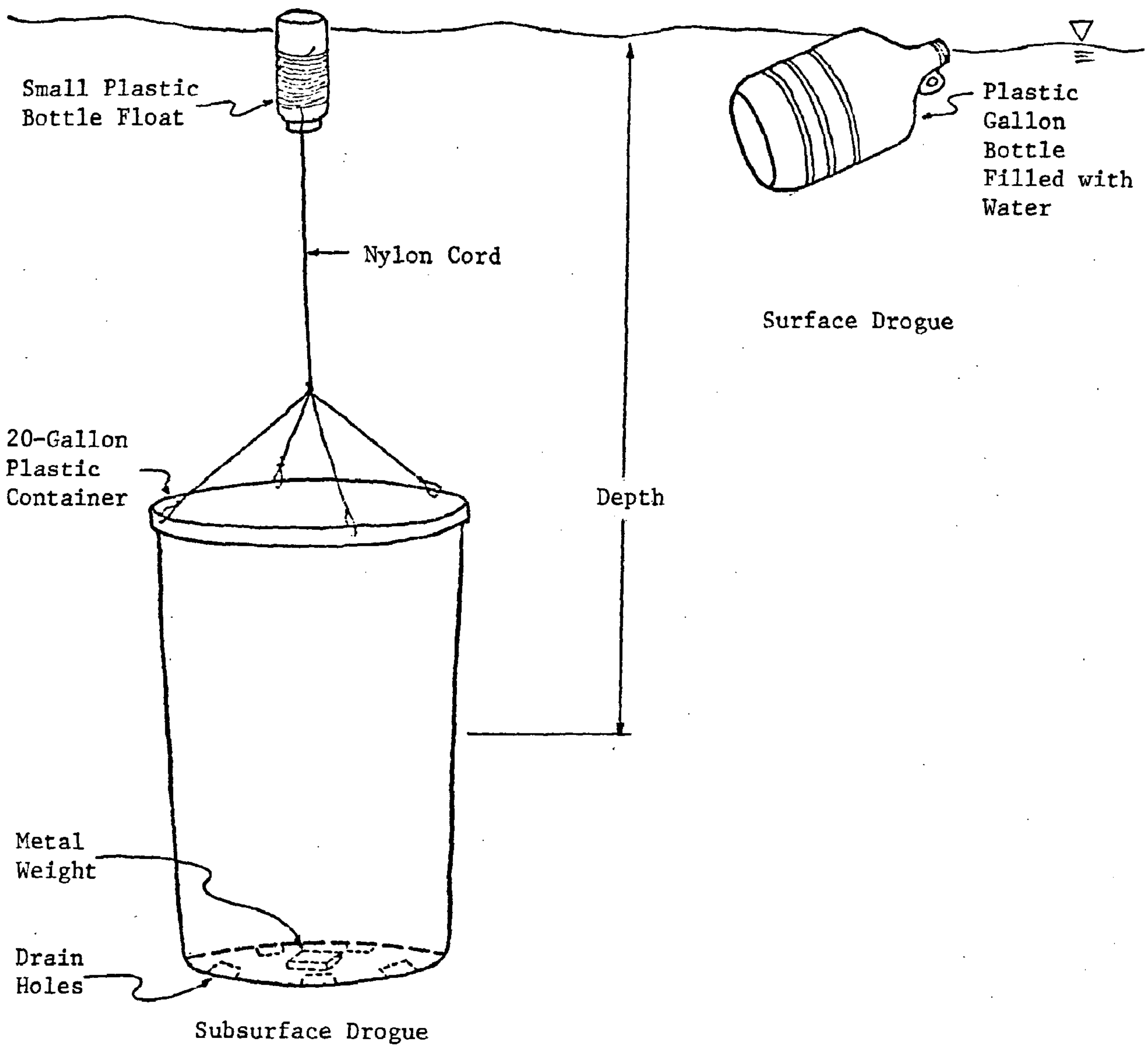


FIGURE III-7

SURFACE AND SUBSURFACE DROGUES

The same was done for the outer harbor along a line connecting Breakers Point and Niuloa Point. This procedure was repeated on four separate occasions in order to measure currents under both flood and ebb tides and varying wind conditions.

For the Tafuna STP outfall site, three drogues were released (at the surface, at 15 feet, and at 30 feet) on four occasions in order to estimate the transport of an effluent plume.

MIXING MEASUREMENTS

Dye studies were conducted on two occasions during the wet season trip and once during the dry season directly below the tramway in Pago Pago Harbor to determine the dispersion and mixing characteristics of the inner harbor area. The tramway runs directly over the canneries. One set of dye measurements was also made at each of the current meter locations in outer Pago Pago Harbor and at Tafuna.

The general procedure involves the release of two pounds of Rhodamine-B dye from a boat. Vertical aerial photographs (slides) are then taken of the expanding dye patch with the time after dye release noted. The scale of the photographs is given by the dimensions of the boat or by markers placed a known distance apart.

The resulting slides are then projected on a sheet of paper and the outline of the dye patch traced. The area of the patch for each timed photograph is then determined using a planimeter.

The horizontal dispersion coefficient is then calculated using the definition developed by Brooks (1960) based on Fick's First Law:

$$k = \frac{1}{2}\frac{d\sigma^2}{dt}$$

Where k = dispersion coefficient

t = time

σ = standard deviation of the tracer concentration distribution

Using the assumption that 4σ is approximately equal to the average horizontal dimension of the patch and using the Brooks (1960) definition of scale, $L = 2\sqrt{3}\sigma$, Fick's First Law can be integrated to give a working definition of the dispersion coefficient;

$$k = \frac{0.04(A_A - A_1)}{T_2 - T_1}$$

where k = dispersion coefficient (ft^2/sec)

A_2 = area of dye patch at time = T_2

A_1 = area of dye patch at time = T_1

The corresponding scale is given by L, which is approximated by the square root of the average dye patch area for the period in question; i.e.:

$$L = \sqrt{\frac{A_2 + A_1}{2}}$$

The resulting relationship between scale and dispersion coefficient can then be plotted on log-log paper and compared to Richardson's law (L.F. Richardson, 1926) for an infinite ocean; i.e.:

$$k = a\,L^{4/3}$$

It should be noted that the use of aerial photographs for this determination is only valid for 30 to 35 minutes after the dye is released. After that time the edges of the dye patch become too indefinite to be readily identifiable.

STATISTICAL DATA EVALUATION

Statistical descriptions are necessary when the data exhibit a wide range of values that cannot be reliably described by a single value. The statistical calculations used in this study to describe the water quality characteristics of the several water classifications were based on the log-normal cumulative distribution. This type of distribution has been observed by numerous investigators to satisfactorily describe environmental water quality data.

The use of a normal distribution (the familiar bell-shaped curve) is applicable, among other things, to describing the results of repetitive trial measurements on a single sample. Such a distribution is characterized by being unbounded on both sides and symmetrical about the arithmetic mean. The log-normal distribution, which is used for environmental data, is a normal distribution of the logarithms of the data points rather than their direct numerical values. A log-normal distribution is characterized by being bounded by zero on one side and by being skewed toward the lower values. The arithmetic mean of such a distribution is always larger than the median, which is always larger than the modal value. The arithmetic mean is, of course, what is commonly called the "average," which is determined by adding up all of the data and dividing by the number of data points. Half of the data points are less than the median value and half are larger. For a log-normal distribution, the median is equal to the geometric mean, which is calculated by finding the average of the logarithms of all of the data points. The modal value is the single most common value of the data set.

A cumulative distribution of a data set of n numbers is determined by ordering that set from the smallest to the largest values and then numbering the ordered values in sequence from 1 to n. The cumulative distribution function, F(i), is then calculated for each number by using the formula

$$F(i) = \frac{i - 1/2}{n}$$

where i is the sequence number. The cumulative distribution can then be obtained by plotting F(i) versus the data values. If such a plot forms a straight line on log-probability paper, then the data set is log-normally distributed and the central tendency is best described by the geometric mean value. The slope of the line of such a plot is indicative of the variability of that data set. That variability in the log-normal distribution is numerically expressed by the geometric standard deviation which, unlike the more familiar plus and minus value of the arithmetic standard deviation, is a unitless factor that is used to multiply or divide the geometric mean value to define the one standard deviation range around the geometric mean.

The confidence that can be placed in the reliability of a data set increases with the square root of the number of data points. Since all of the data points in a set go into defining the geometric mean, that confidence is greatest for the geometric mean value and progressively less on either side. The confidence is also dependent on the variability of the data. With the conservative assumption that the measured values of the distribution of environmental water quality data are log-normally distributed around the "true" values, the following formula can be used to calculate the confidence interval at any point in the distribution:

$$\text{Confidence interval at } F_{(c)} = \exp\left[\ln C_{F(c)} \pm \frac{(u)\ (\sigma_m)}{\sqrt{n\left(1 - \frac{F(c) - 50}{50}\right)}}\right]$$

Where: $F(c)$ = cumulative distribution function percent frequency

$C_{F(c)}$ = "true" concentration at $F_{(c)}$

σm = standard deviation of the normal distribution of lnC n = number of samples

u = normal distribution factor from statistical tables related to the desired confidence interval (1.96 for 95 percent and 1.04 for 70 percent)

The use of this formula with the characteristics of the observed data in American Samoa leads to the general recommendation that it takes about 24 data points randomly taken over both time and space to be 95 percent confident of being within about 20 percent of the true geometric mean value for nutrient, turbidity, and chlorophyll-a measurements. More points are needed for more variable parameters such as fecal coliform in the streams, while fewer would suffice for such relatively constant parameters as pH and dissolved oxygen.

The theoretical random sampling requirement over both time and space is difficult to comply with in a strict sense but can be reasonably approximated by designing a sampling program that covers the main temporal factors of season, tide, and weather and the horizontal and vertical spatial distribution of sampling stations. This means that a regular time and space sampling pattern is imposed on the assumed generally random condition of the real world. The results of this study appear to support this approach in that the statistical evaluation of the data generally showed well-defined log-normal distributions for almost all parameters for each of the water classifications.

CHAPTER IV

BASELINE WATER QUALITY

The rationale for baseline water quality data gathering and evaluation in American Samoa is to statistically describe the ecologically important parameters for representative areas at representative times. With this approach in mind, water quality stations were selected, parameters were chosen, and a sampling and measurement program was designed.

The spatial distribution of water quality stations, as shown in Chapter III, was designed to provide data for the major classifications of waters in American Samoa, open ocean, nearshore, embayments, outer and inner Pago Pago Harbor, and streams. The ocean classifications conform to the descriptions in Appendix E (Draft Water Quality Standards for American Samoa). Emphasis was placed on Pago Pago Harbor because this is a special study area with the most apparent water quality problems. The stream sampling stations were selected to give information on background stream water quality (Maloata, Leone Falls, and Upper Vaitele), the effect of road construction (Aua), as well as urban and agricultural influence (the remaining eight stream stations). The sampling locations for each of the urban-agricultural influence streams were just above the areas of tidal influence.

The temporal sampling and measurement schedule of the water quality parameters was designed to generally cover what are believed to be the major influences on water quality, the wet and dry season, ebb and flood tide, and a variety of wind conditions.

The sampling program, although not strictly conforming to randomness as called for by statistical theory, yielded results that can be confidently described by log-normal distributions as shown in the methodology chapter. Since log-normal distributions of environmental measurements have been observed by numerous investigators using much larger data bases, such conformance by the water quality data for

American Samoa is an indication that a valid description of the baseline water quality characteristics has generally been achieved.

PARAMETER SELECTION

The selection of parameters to describe environmental water quality should take into account the factors of health, aesthetics, ecological importance, and measurability. The number of parameters should be the minimum necessary to describe the water quality. In addition, the types of possible control measures that might be applied to alleviate a stressed condition should be taken into account when selecting the types of parameters to be included in the standards.

Human health concerns have traditionally been measured by using coliform bacteria as indicator organisms. Because the fecal coliform test is more closely correlated with enteric disease-causing organisms and has little interference from common soil bacteria, it is preferred over the total coliform test for stream and ocean waters. Although other indicator organisms, notably fecal streptococci, have been suggested, they do not have as extensive a data base as fecal coliform and, consequently, would be less useful in detecting historical trends.

Aesthetic considerations in water quality include water clarity, floatables, color, odor, and a healthy, diverse biological community. Water clarity is indicated by turbidity, suspended solids, and irradiance. Unfortunately, no consistent, routine test is available for floatables. In part, color is indicated by the chlorophyll-a concentration. The dissolved oxygen concentration is a reasonably good indicator of the odor-causing potential of a body of water. The balance of an aquatic biological community is partly indicated by the dissolved oxygen and chlorophyll-a content.

Parameters that measure ecologically important aspects of water quality can be grouped into three general categories. The first group are those that define physical and chemical boundary conditions such as temperature, salinity, pH, dissolved oxygen, light penetration, and turbidity. Except for turbidity, these parameters generally do not exhibit a large variation and can be described by a narrow range of values. The second group consists of toxic substances such as heavy metals and pesticides, which do not occur at high concentrations under natural conditions and which are generally associated with industrial effluents and large drainage areas. Unless there is an active source of such toxic substances, there is little need for routine measurements.

The third general category is comprised of biostimulants that might act at any level in the trophic pyramid. The rate of photosynthesis can be stimulated by the addition of the rate limiting nutrient, which might be nitrate or ammonia nitrogen, orthophosphate, silica, or any number of such micronutrients as some metals or vitamins. Tropical sea waters such as those found around American Samoa are generally nutrient limited (primarily nitrogen and phosphorus) and consequently have very low phytoplankton concentrations. The addition of these nutrients from point or nonpoint sources increases both the rate of phytoplankton growth and the concentration that can be sustained. Because such selective stimulation results in a greater production of organic material than is being used up by respiration, the result is an accumulation of organic material; a process that is called eutrophication. Other trophic levels can also be stimulated selectively, such as the stimulation of bacterial decomposition by high organic loading (BOD), or the stimulation of certain fish species by the discharge of particulate organic material. Such stimulation is generally undesirable since it usually serves to unbalance an ecosystem that has achieved equilibrium within the local boundary conditions.

The effect of nutrient addition is not manifested immediately since growth requires time. The longer residence time in embayments provides such an opportunity for the phytoplankton (indicated by chlorophyll-a) to respond to discharges of nutrients. The same discharges in an open coastal area will generally have no discernible effect because the exposure time, before dilution and transport have reduced the nutrient concentration, is too short for any significant growth response.

The variability with time also enters into the selection of total nitrogen (i.e., total Kjeldahl nitrogen plus nitrate and nitrite nitrogen) and total phosphorus (orthophosphate plus organic and reduced phosphorus) as the nutrient parameters for the proposed standards. There is sufficient time for biological action to change one form of nitrogen or phosphorus to another. Several studies in lakes have confirmed this condition by noting that there is a much better correlation between total nitrogen or total phosphorus and chlorophyll-a than between nitrate or orthophosphorus and chlorophyll-a.

The approach of using total nitrogen and total phosphorus is supported by the consideration of a practical control strategy. It would be very ineffective to only limit the discharge of ammonia, nitrate, and orthophosphate while allowing the discharge of organic nitrogen and organic phosphorus.

It is undesirable for maintaining a balanced ecosystem and continuing the nursery function as well as when considering the traditional reef fishing and gathering practices in Samoa, for eutrophication to occur in embayments. The results of excess planktonic growth include a reduction in the photic zone, an increase in the organic loading on the bottom, and a large daily fluctuation in the dissolved oxygen. These conditions contribute to the decrease of a healthy reef community and can cause fish kills. Other contributing factors to the decrease of the reef community include high sediment loading from erosion and reef flat filling operations.

EXISTING WATER QUALITY

The quality of the ocean and stream waters in American Samoa is very high in those areas away from direct urban, agricultural, and industrial influences. Urban stream waters and the dilution zones of point discharges show the greatest influence of human activities on water quality. Some of these areas can be identified as being in undesirable conditions from health, aesthetic, and/or ecological considerations. The sampling and measurement program used in this study was designed to describe both the background water quality away from significant human influence and the effect of human activities on stream and embayment water quality.

All of the water quality data gathered during this study are given in Appendix A. The results of statistical analyses of the various water categories are presented in Appendix B, including the cumulative distribution function for each. Summaries of the statistics of each parameter are discussed in this chapter.

Fecal Coliform

The statistical summary of the fecal coliform data is given in Table IV-1. As expected, these results show that fecal coliform are generally absent in sea water environments. This is due primarily to the bacteriocidal effect of the sea water environment and secondarily to the dilution and transport characteristics. Background streams show a moderate number of fecal coliform that might be primarily attributable to bird and animal effects. The streams with urban and agricultural influence, however, show significant fecal coliform concentrations. This is illustrated on Figure IV-1 on a log-normal probability plot. It might be noted that even though there is a variation of more than four orders of magnitude there is reasonably good conformance to a log-normal distribution. The results indicate that presently the urban influenced streams far exceed the proposed fecal coliform standard (Appendix E) of a geometric mean of 100 per 100 ml and consequently may constitute a health hazard. Further efforts to repair or replace faulty sewage disposal systems and eliminate human and animal sanitary waste disposal into streams are necessary to reduce the fecal coliform levels.

pH

The pH level (Table IV-2) of sea water changes very little because of the naturally high buffering capacity. Hence, the sea water standards should reflect this narrow range; 7.9 to 8.6 is suggested for both the embayment and ocean waters. The pH of fresh water is lower and

TABLE IV-1

STATISTICAL SUMMARY OF FECAL COLIFORM

Location	Number of Data Points	Mean #/100 ml	Standard Deviation #/100 ml	Median #/100 ml	Geometric Mean #/100 ml	Geometric Standard Deviation
Ocean Stations						
Surface	9	<1	0	<1	<1	1.00
Open Coastal Nearshore						
Surface	9	<1	0.2	<1	<1	1.36
Embayment						
Surface	4	6	9.5	1	2	5.70
Transition Zone	4	<1	0	<1	<1	1.00
Outer Harbor	20	<1	0.8	<1	<1	1.7
Inner Harbor						
Surface	11	3.1	8.3	<1	<1	3.33
Background Streams	9	60	79	18	12	10.5
Urban Influence	20	3460	4340	2100	1090	9.83
Road Construction	3	4500	4030	3900	3020	3.39

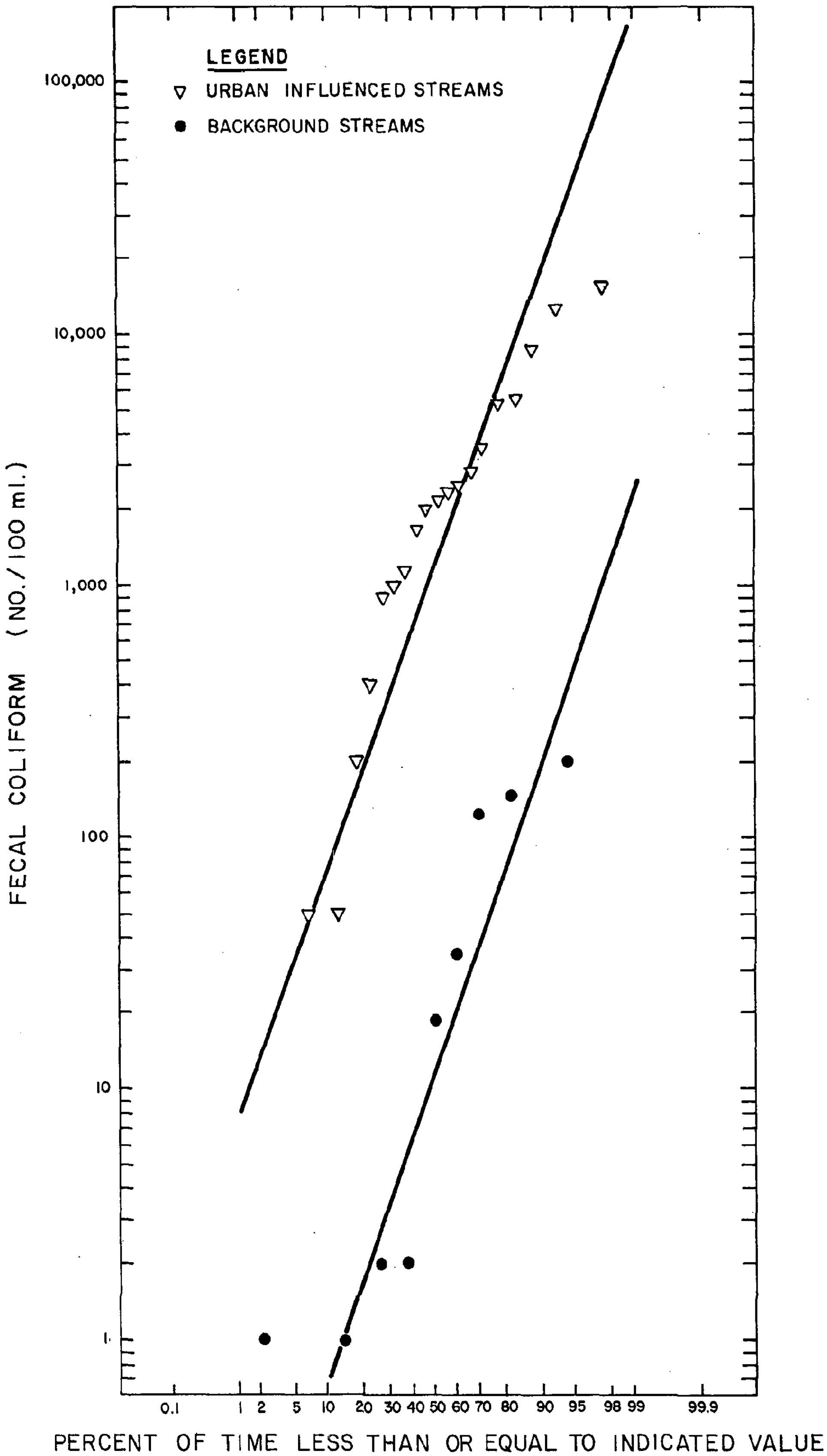


FIGURE IV-1

FECAL COLIFORM CUMULATIVE DISTRIBUTIONS FOR STREAMS

TABLE IV-2

STATISTICAL SUMMARY OF PH

Location	Number of Data Points	Mean	Standard Deviation	Median	Geometric Mean	Geometric Standard Deviation
Ocean Stations						
Surface	16	8.26	.057	8.30	8.26	1.01
60-ft depth	16	8.26	.059	8.28	8.26	1.01
Open Coastal Nearshore						
Surface	12	8.27	.056	8.27	8.27	1.01
60-ft depth	12	8.27	.058	8.28	8.27	1.01
Embayment						
Surface	6	8.27	.048	8.28	8.27	1.01
60-ft depth	6	8.28	.039	8.28	8.28	1.00
Transition Zone						
Surface	4	8.23	.150	8.30	8.22	1.02
60-ft depth	4	8.25	.164	8.32	8.24	1.02
Outer Harbor						
Surface	20	8.26	.110	8.29	8.26	1.01
60-ft depth	20	8.28	.079	8.32	8.28	1.01
Inner Harbor						
Surface	12	8.30	.134	8.34	8.30	1.02
60-ft depth	12	8.24	.098	8.29	8.24	1.01
Background Streams	12	7.46	.181	7.45	7.46	1.02
Urban Influence	28	7.42	.227	7.42	7.42	1.03
Road Construction	4	7.52	.024	7.51	7.52	1.00

more variable than that of sea water because of the lower buffering capacity. The range proposed by the ASG of 6.0 to 8.0 appears appropriate.

Dissolved Oxygen

The DO levels for the various water categories are given in Table IV-3. The proposed ASG standard of at least 80 percent saturation is exceeded a significant percentage of the time in the bottom layer of inner Pago Pago Harbor and in urban influenced stream waters. These conditions are due to excessive organic loading into the streams and harbor. The situation is exacerbated by the stratification in Pago Pago Harbor and the generally low exchange rate. Alleviation of low DO conditions involves the reduction in direct organic loading from point and nonpoint sources as well as a reduction in the addition of nutrients to Pago Pago Harbor. The nutrients increase the growth rate of phytoplankton which are then able to achieve excessive concentrations because of the long residence time in the harbor.

Turbidity

The statistical summary of the turbidity measurements is given in Table IV-4 and the ocean, outer Pago Pago Harbor, and inner Pago Pago surface data are illustrated on Figure IV-2. The geometric mean values reflect the high clarity of the nutrient poor ocean waters off American Samoa as well as the lack of stratification (at least down to a depth of 100 feet) of ocean, nearshore, and embayment waters. However, stratification is indicated for Pago Pago Harbor, with the more turbid surface layer (down to a depth of 10 to 30 feet) distinctly different from the clearer lower layer. The generally greater variability in water clarity as one approaches closer to shore is illustrated by the corresponding increasing slopes of the log-normal distributions on Figure IV-2. It should be noted that, when the wind direction is from the west or north, the surface layer in Pago Pago Harbor is transported out, upwelling occurs at the upwind shoreline, and the stratification tends to break down. The resulting greater surface clarity allows

TABLE IV-3

STATISTICAL SUMMARY OF DISSOLVED OXYGEN

Location	Number of Data Points	Mean mg/1	Standard Deviation mg/1	Median mg/1	Geometric Mean mg/1	Geometric Standard Deviation
Ocean Stations						
Surface	16	6.11	.171	6.10	6.11	1.03
50-ft depth	16	5.98	.163	6.00	5.98	1.03
Open Coastal Nearshore						
Surface	12	6.22	.154	6.25	6.21	1.03
50-ft depth	12	5.99	.146	5.95	5.99	1.02
Embayment						
Surface	6	6.22	1.00	6.55	6.14	1.20
50-ft depth	6	5.93	.175	6	5.93	1.03
Transition Zone						
Surface	4	6.06	.17	6.03	6.06	1.03
50-ft depth	4	5.89	.246	5.88	5.88	1.04
Outer Harbor						
Surface	20	6.35	.54	6.23	6.33	1.09
50-ft depth	20	5.86	.21	5.80	5.86	1.04
Inner Harbor						
Surface	12	6.37	1.20	6.05	6.27	1.20
50-ft depth	12	5.25	.586	5.48	5.21	1.12
Background Streams	12	8.09	.320	8.1	8.09	1.04
Urban Influence	28	6.96	1.24	7.4	6.83	1.23
Road Construction	4	7.78	.299	7.8	7.77	1.04

TABLE IV-4

STATISTICAL SUMMARY OF TURBIDITY

Location	Number of Data Points	Mean NTU	Standard Deviation NTU	Median NTU	Geometric Mean NTU	Geometric Standard Deviation
Ocean Stations						
Surface	16	.182	.046	0.18	.176	1.33
60-ft depth	16	.199	.092	0.17	.185	1.47
Open Coastal Nearshore						
Surface	12	.2	.058	.18	.193	1.31
60-ft depth	12	.179	.046	.175	.174	1.28
Embayment						
Surface	6	.298	.182	.185	.260	1.74
60-ft depth	6	.290	.170	.2	.258	1.65
Transition Zone						
Surface	5	.26	.05	.25	.26	1.24
60-ft depth	5	.30	.21	.21	.25	1.84
Outer Harbor						
Surface	25	.47	.26	.42	.43	1.47
60-ft depth	25	.25	.08	.23	.24	1.34
Inner Harbor						
Surface	15	1.23	.811	.910	1.06	1.73
60-ft depth	15	1.04	1.20	.620	.655	2.56
Background Streams	12	3.22	1.38	2.85	2.96	1.53
Urban Influence	28	8.15	8.14	5.3	6.07	2.05
Road Construction	4	40.4	19.5	39.5	36.5	1.73

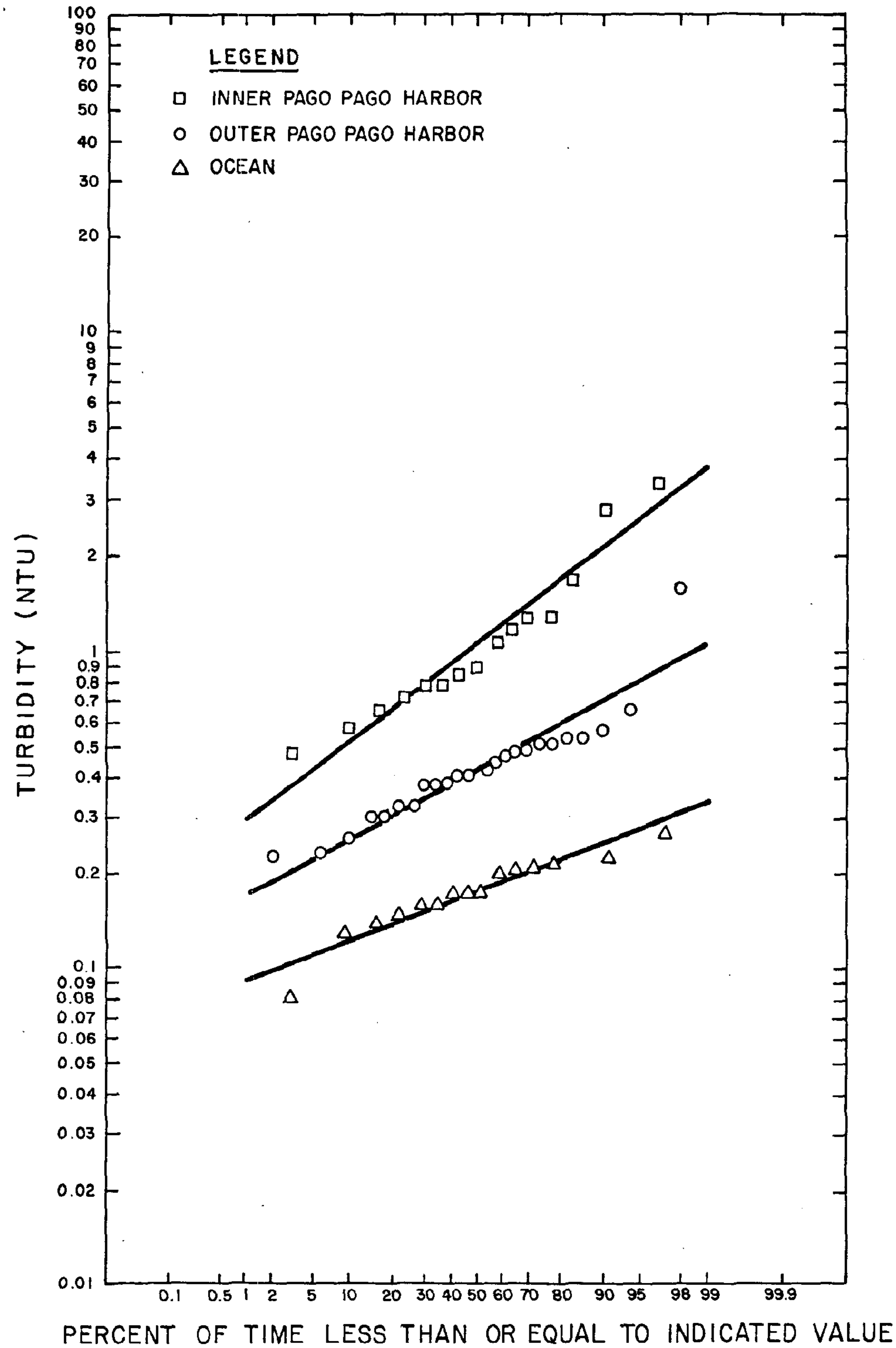


FIGURE IV-2

TURBIDITY CUMULATIVE DISTRIBUTIONS FOR SURFACE WATERS deeper light penetration and increased phytoplankton growth at lower levels. This condition resulted in most of the higher turbidity values in the lower layer of the inner harbor as well as the high variability. Under regular tradewind conditions the lower layer remained very clear at least to station 12.

The stream turbidity values show the influence of urban and agricultural activity by a doubling of the turbidity above background stream values. Of particular note is the factor of 12 increase in turbidity due to road construction. These data confirm the observations made during the Wastewater Management Data Evaluation Study for American Samoa, 1978, that road construction is the single greatest source of nonpoint erosion and that more effective controls are required.

Suspended Solids

The suspended solids levels for sea water appear to be fairly constant with geometric mean values between 1 and 2 mg/1 as shown in Table IV-5. It is noteworthy that, as in the case of turbidity, the suspended solids are higher in the surface layer than in the bottom layer of Pago Pago Harbor but that station 5 in the transition zone shows more uniformity and perhaps more suspended material in the lower layer. Possibly because of salinity interference, the suspended solids test appears not to be as sensitive as the turbidity test in sea water. Table IV-5 also clearly shows the effect of urban influence and especially road construction on the suspended solids content of streams.

Irradiance

The summary of irradiance data given in Table IV-6 and illustrated on Figure IV-3 shows the decreasing depth of the photic zone as one moves closer to shore and into Pago Pago Harbor. In addition, the greater variability of the photic zone depth is indicated by the geometric standard deviation. These results show that in inner Pago Pago Harbor photosynthesis is largely confined to the upper layer, while in the outer harbor photosynthesis and coral growth can occur some distance into the lower layer. The dissolved oxygen, turbidity and chlorophyll-a measurements correspond well with the irradiance results.

TABLE IV-5

STATISTICAL SUMMARY OF SUSPENDED SOLIDS

Location	Number of Data Points	Mean mg/1	Standard Deviation mg/1	Median mg/1	Geometric Mean mg/1	Geometric Standard Deviation
Ocean Stations						
Surface	11	1.51	.485	1.40	1.44	1.37
60-ft depth	11	1.28	.549	1.33	1.16	1.65
Open Coastal Nearshore						
Surface	9	1.64	.905	2	1.28	2.42
60-ft depth	9	1.86	1.26	2.1	1.48	2.15
Embayment						
Surface	4	1.37	.608	1.44	1.25	1.70
60-ft depth	4	1.85	.887	1.62	1.71	1.58
Transition Zone						
Surface	4	1.80	1.13	1.65	1.53	1.98
60-ft depth	4	2.98	2.93	1.75	2.17	2.39
Outer Harbor						
Surface	19	2.15	.857	1.80	1.99	1.51
60-ft depth	20	1.85	.767	1.55	1.70	1.50
Inner Harbor						
Surface	11	4.98	2.35	4	4.48	1.64
60-ft depth	12	4.60	5.05	3.2	3.22	2.32
Background Streams	12	1.75	.955	1.35	1.56	1.62
Urban Influence	28	5.49	2.87	5.25	4.83	1.69
Road Construction	4	33.1	18.9	36.8	27.6	2.14

TABLE IV-6

STATISTICAL SUMMARY OF IRRADIANCE, DEPTH TO 1% INCIDENCE LIGHT

Location	Number of Data Points	Mean ft	Standard Deviation ft	Median ft	Geometric Mean ft	Geometric Standard Deviation
Ocean Stations	11	168	15	170	167	1.10
Open Coastal Nearshore	4	153	19	145	152	1.13
Transition Zone	4	110	18	110	109	1.18
Outer Harbor	15	74	19	80	72	1.34
Inner Harbor	9	30	17	21	26	1.84

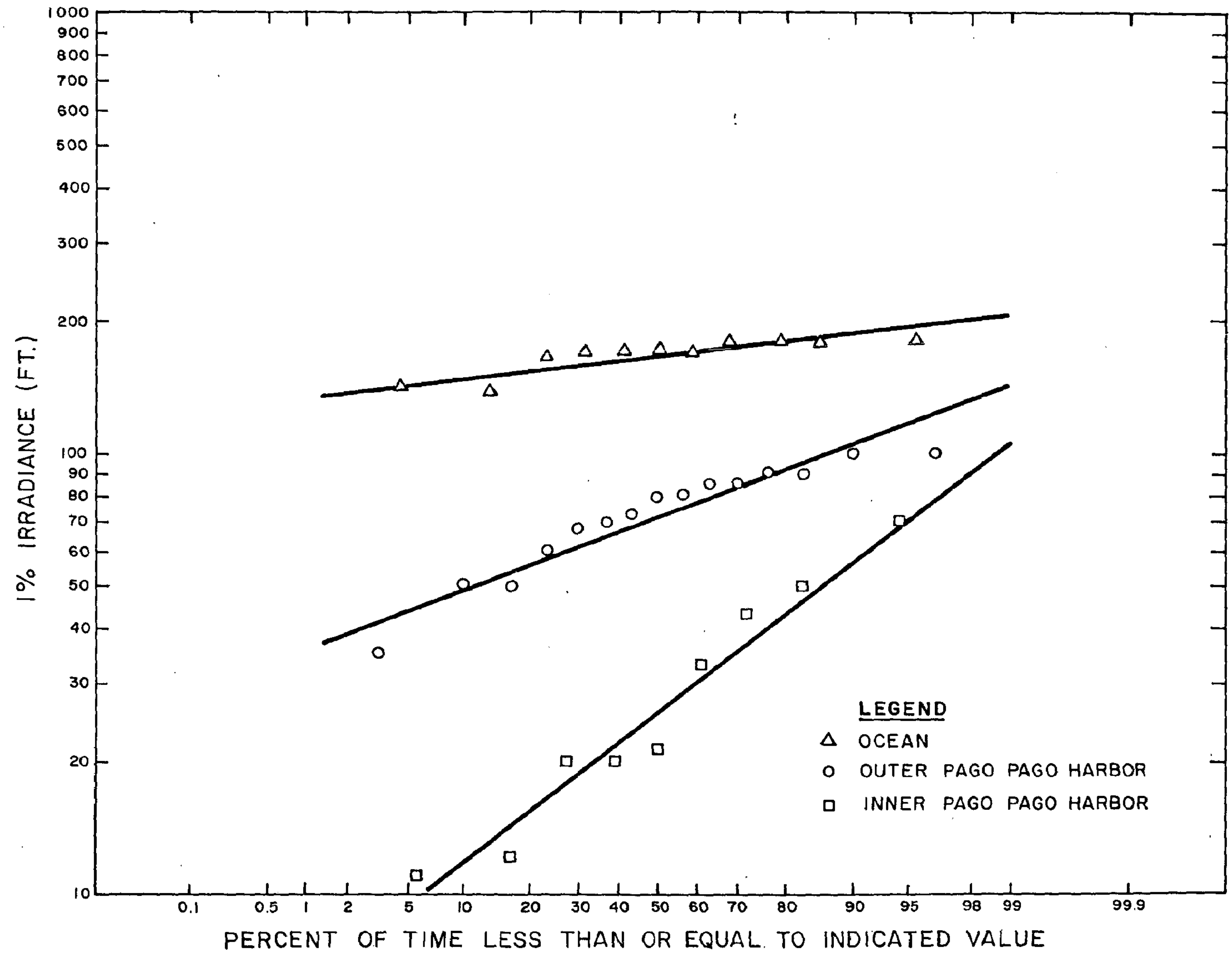


FIGURE IV-3

CUMULATIVE DISTRIBUTION OF DEPTHS OF 1% INCIDENT LIGHT

Total Kjeldahl Nitrogen

The statistical summary of the organic plus ammonia nitrogen (or TKN) concentrations in saline and stream waters of American Samoa is given in Table IV-7. The cumulative distributions of TKN in ocean and Pago Pago surface waters are shown on Figure IV-4, while background and urban influence stream levels are illustrated on Figure IV-5. The geometric mean TKN values for ocean, nearshore, embayment and lower layer Pago Pago Harbor waters are very similar. Nitrogen addition to the harbor appears to be concentrated in the upper layer, presumably because point and nonpoint sources have low salinities. The effect of urban and agricultural activities increases the TKN of stream waters a relatively modest 19 percent, and the increase due to road construction is about 46 percent above background stream levels. A note of caution should be made concerning the low number of points used in some of these statistical analysis and the corresponding wide confidence interval. With this in mind, the results given for the transition zone and road construction streams should not be given as much weight as the other categories. The degree of confidence is proportional to the square root of the number of samples.

Nitrate Plus Nitrite Nitrogen

The results of the NO_3+NO_2 nitrogen analysis (Table IV-8) show an unusually high amount of variation for saline water, as illustrated by the high and variable geometric standard deviations. In addition, the concentrations of NO_3+NO_2 nitrogen in saline waters appear to be significantly higher than expected from experience in Hawaii and other Pacific Islands. Whether this is the actual condition or the result of possible sample contamination, some unknown preservation error or analytical difficulty is not known at this time. The possible degree of uncertainty that the nitrate plus nitrite values may have on the total nitrogen values in saline waters is relatively small, around 10 percent, compared to the general statistical variability of the total nitrogen measurement. A continued monitoring program will resolve any questions regarding the nitrate plus nitrite values in

TABLE IV-7

STATISTICAL SUMMARY OF TOTAL KJELDAHL NITROGEN

Location	Number of Data Points	Mean ug/1-N	Standard Deviation ug/1-N	Median ug/1-N	Geometric Mean ug/1-N	Geometric Standard Deviation
Ocean Stations						
Surface	17	103	51.6	87	92.7	1.59
60-ft depth	18	106	32.3	103	101	1.34
Open Coastal Nearshore						
Surface	9	101	21.0	107	99.4	1.23
60-ft depth	9	95	30.5	100	87.9	1.62
Embayment						
Surface	6	72	8.89	74.5	71.4	1.14
60-ft depth	6	120	43.0	105	113	1.44
Transition Zone						
Surface	4	178	65.8	170	169	1.45
60-ft depth	3	104	31	110	101	1.38
Outer Harbor						
Surface	26	143	68.5	128	128	1.64
60-ft depth	19	114	63.0	103	101	1.65
Inner Harbor						
Surface	19	240	137	234	200	1.96
60-ft depth	12	131	82.6	102	111	1.83
Background Streams	17	275	120	259	241	1.82
Urban Influence	44	329	157	320	287	1.77
Road Construction	6	394	178	377	351	1.79

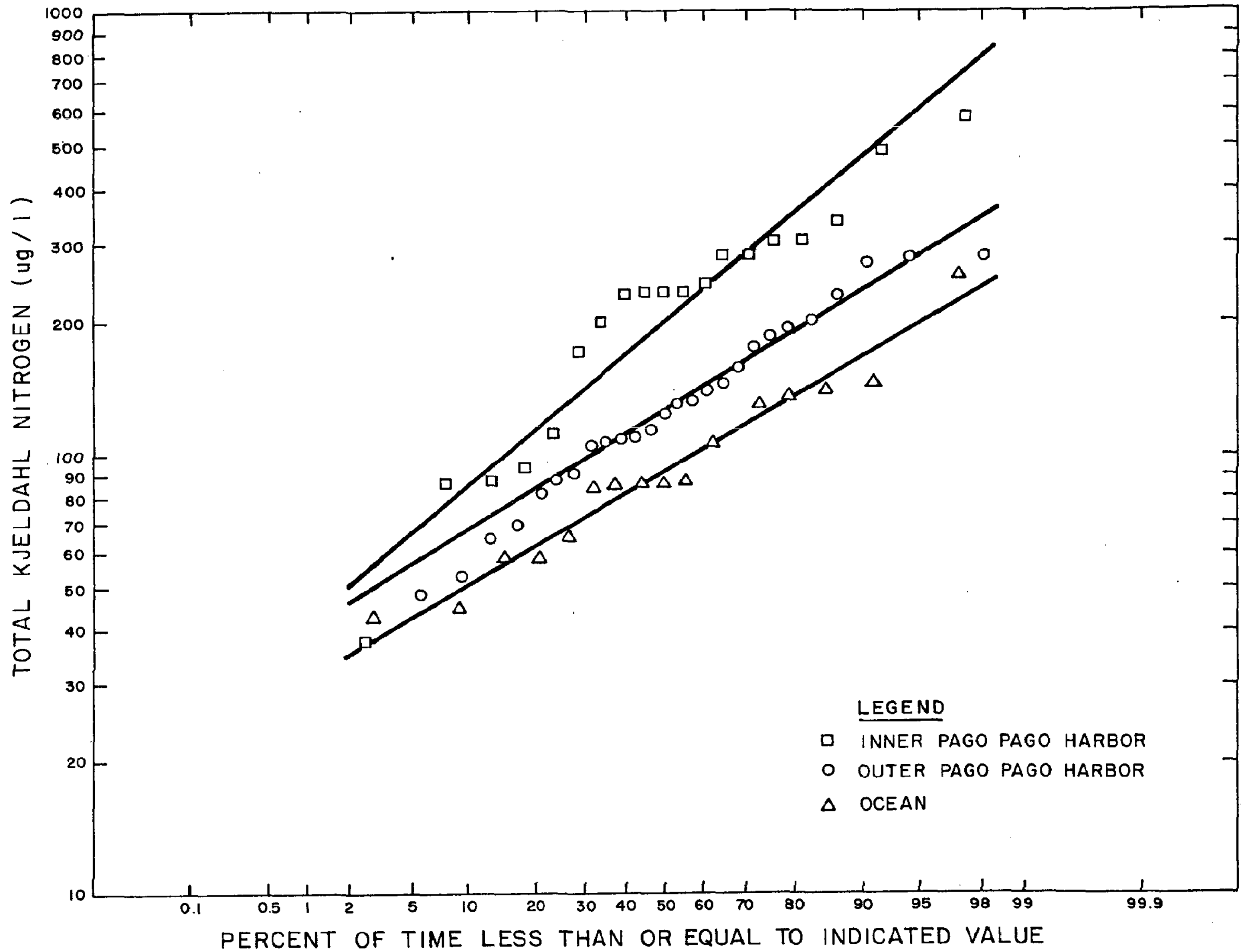


FIGURE IV-4

TOTAL KJELDAHL NITROGEN CUMULATIVE DISTRIBUTION FOR SALINE SURFACE WATERS

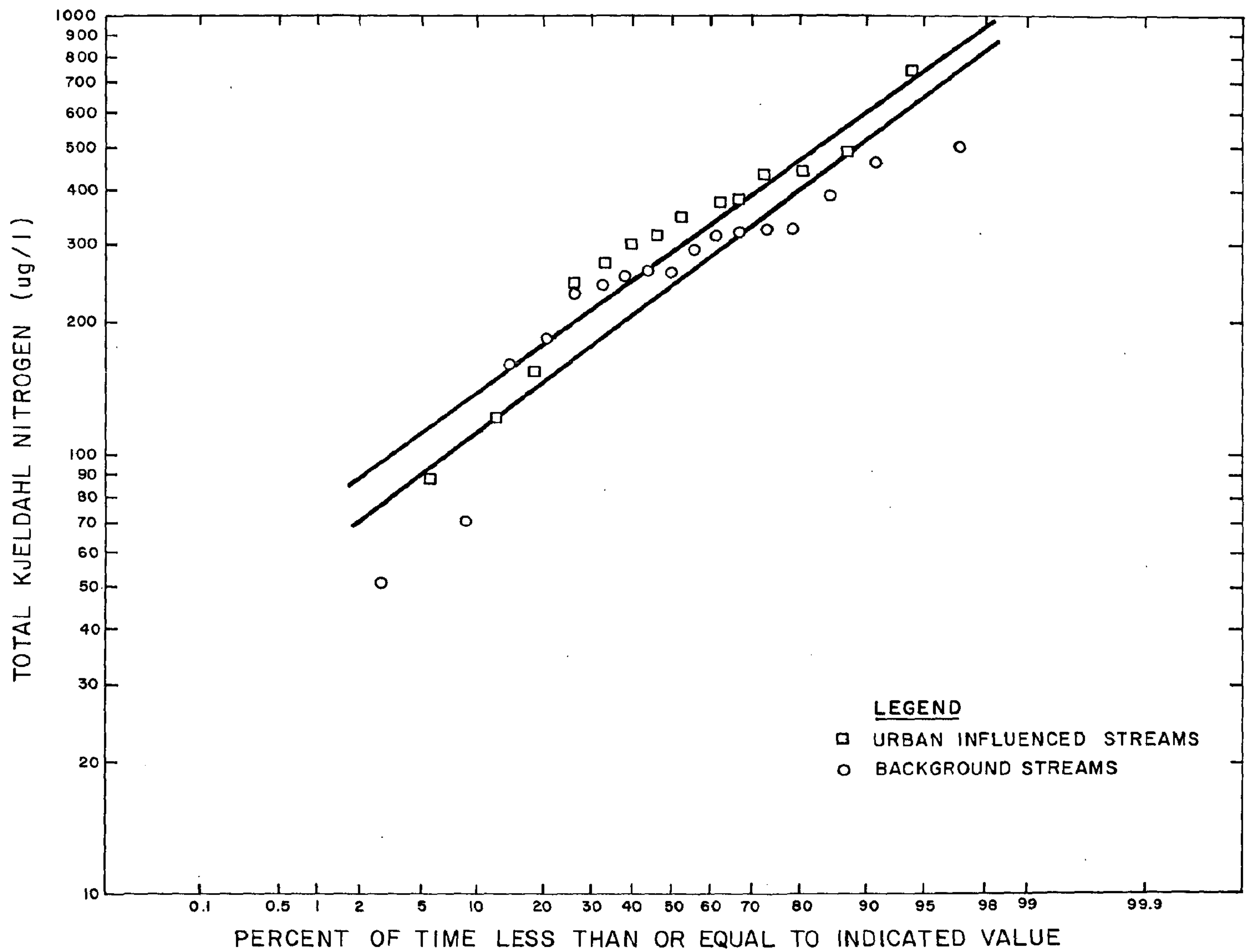


FIGURE IV-5

TOTAL KJELDAHL NITROGEN CUMULATIVE DISTRIBUTIONS FOR STREAMS

TABLE IV-8

STATISTICAL SUMMARY OF NITRATE + NITRITE

Location	Number of Data Points	Mean ug/1-N	Standard Deviation ug/1-N	Median ug/1-N	Geometric Mean ug/1-N	Geometric Standard Deviation
Ocean Stations						
Surface	18	18.1	19.9	14.3	7.75	6.35
60-ft depth	18	15.6	16.8	11.1	6.38	6.88
Open Coastal Nearshore						
Surface	12	46.9	33.1	39.2	36.3	2.24
60-ft depth	12	35.7	32.9	26.5	24.0	2.74
Embayment						
Surface	6	23.8	6.76	25.5	22.8	1.40
60-ft depth	6	15.5	11.8	14.9	10.4	3.08
Transition Zone						
Surface	5	33.6	22.9	26	28.9	1.80
60-ft depth	4	25.7	24.8	22	9.3	10.6
Outer Harbor						
Surface	26	46.7	27.6	43.8	37.1	2.17
60-ft depth	20	35.9	32.0	23.9	23.6	2.77
Inner Harbor						
Surface	17	58.9	75.4	34.8	39.6	2.23
60-ft depth	12	33.6	22.3	32.7	23.1	3.18
Background Streams	18	51.9	33.6	43.6	45.0	1.69
Urban Influence	42	233	227	188	128	3.59
Road Construction	6	142	51.7	130	135	1.39

saline waters. It is believed, however, that the fresh water samples (stream and effluent) gave reliable results. As expected, the urban and agricultural influence streams showed a greater variation in NO_3+NO_2 nitrogen than the background streams, probably due to waste disposal and agricultural drainage. The geometric mean values show an increase by about a factor of three for urban, agricultural and road construction effects above background stream levels.

Total Phosphorus

The statistical summary of total phosphorus (TP) data is given in Table IV-9 and illustrated for ocean and surface harbor waters as well as background and urban streams on Figure IV-6. The high geometric standard deviation for ocean surface waters is believed to be an artifact of the chemical analysis. Some of the ocean TP concentrations which are close to the limit of detection and in the vicinity of the distilled and deionized water blanks give results that tend to be in error on the low side. This condition is illustrated on Figure IV-6 by the group of five low points for the ocean samples. The TP levels for Pago Pago Harbor waters are a factor of two to four times those of ocean waters. This factor is much higher than for total nitrogen because the background TP levels are much lower. It should also be noted that, since TP is associated with suspended solids and sedimentary material which can travel downward, there is less difference between the upper and lower levels than with total nitrogen which is mostly dissolved or associated with less dense organic material. The TP values for streams show that approximately half of the time there is significant phosphorus addition to urban and agricultural influence streams, possibly from detergents or eroded material. The association of TP with soil is also illustrated by the higher concentrations in Aua Stream which is influenced by erosion due to road construction.

Chlorophyll-a

The effects of nutrient addition to nutrient poor tropical ocean waters are shown by the statistical summary of chlorophyll-a data given

TABLE IV-9

STATISTICAL SUMMARY OF TOTAL PHOSPHORUS

Location	Number of Data Points	Mean ug/l-P	Standard Deviation ug/l-P	Median ug/l-P	Geometric Mean ug/l-P	Geometric Standard Deviation
Ocean Stations						
Surface	17	12.8	9.69	12	8.13	3.18
60-ft depth	17	11.2	6.18	9.9	9.45	1.91
Open Coastal Nearshore						
Surface	12	11.5	8.47	7.45	8.67	2.37
60-ft depth	12	6.54	3.26	5.8	5.57	1.96
Embayment						
Surface	6	21.6	16.6	16.2	18.2	1.78
60-ft depth	6	13.6	8.97	16.1	9.80	2.86
Transition Zone						
Surface	5	19.7	15.9	13.6	15.6	2.09
60-ft depth	4	25.7	26.3	15.7	18.1	2.55
Outer Harbor						
Surface	26	21.3	17.2	15.5	16.6	2.00
60-ft depth	20	25.8	30.2	7.8	13.6	3.26
Inner Harbor						
Surface	18	42.8	35.3	28.9	32.2	2.20
60-ft depth	12	42.2	47.1	20.6	28.3	2.37
Background Streams	16	106	74.5	102	86.7	1.97
Urban Influence	38	157	127	106	103	2.89
Road Construction	5	157	76.9	131	144	1.57

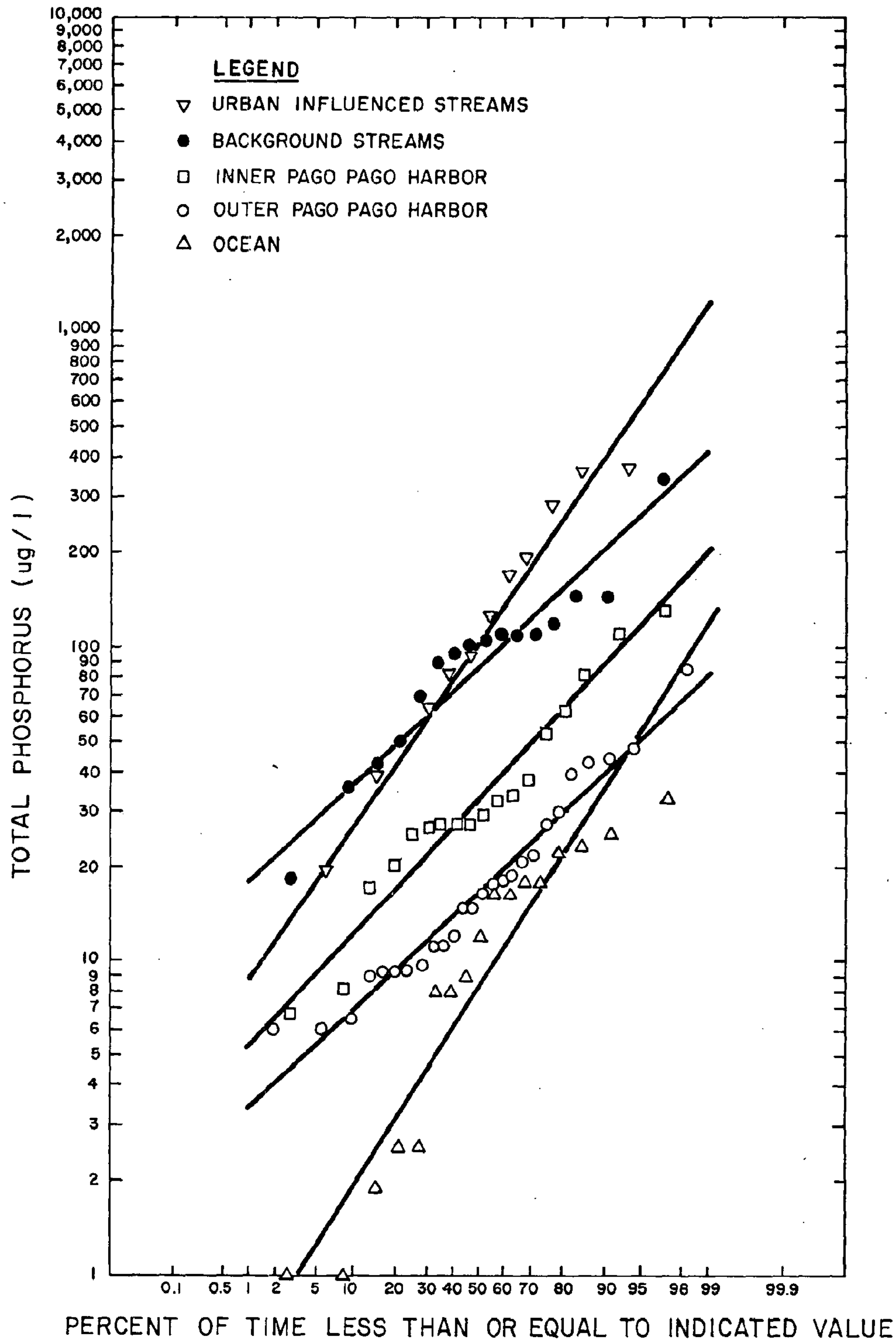


FIGURE IV-6

TOTAL PHOSPHORUS CUMULATIVE DISTRIBUTIONS FOR SURFACE WATERS in Table IV-10 and illustrated on Figure IV-7 for surface waters. Chlorophyll-a was measured to gauge the effect of nutrient discharges and residence time on the basic component of the water column biological community, the phytoplankton. There are progressively increasing levels of chlorophyll-a from ocean, to nearshore, and to embayment corresponding to the increasing residence time and availability of nutrients. This trend is pronounced when considering the surface waters of the transition zone, outer Pago Pago Harbor and inner Pago Pago Harbor. The significantly lower levels (though still increasing shoreward) of chlorophyll-a in the lower level of Pago Pago Harbor is undoubtedly due primarily to light limitation and partly to lower nutrient levels. The exponential effect of residence time on phytoplankton levels is shown by the fact that while the geometric mean values for nutrients (TN and TP) were higher by factors of two to four above background ocean water levels the geometric mean of the chlorophyll-a levels in inner Pago Pago Harbor surface waters are higher by a factor of about 30. The sensitivity to the fluctuating in residence times is also illustrated by the large geometeric standard deviations.

The relatively large percentage of time that high levels of chlorophyll-a occur in inner Pago Pago Harbor and even in the outer harbor indicates that there are occasions where there is excessive oxygen depletion during early morning hours which restricts the development of a balanced ecosystem in these areas. Improvement of this situation involves a reduction in the input of nutrients and possibly in the input of oxygen demanding material. There is no reasonable way to significantly increase the exchange rate of Pago Pago Harbor with the ocean, consequently the residence time becomes a constant of the system and the significant control factor is the phytoplankton net growth rate which is primarily dependent on the nutrient concentration.

SUGGESTED ALTERATIONS AND ADDITIONS TO THE PROPOSED WATER QUALITY STANDARDS FOR AMERICAN SAMOA

The Environmental Quality Commission of American Samoa is currently in the process of updating water quality standards. During a

TABLE IV-10

STATISTICAL SUMMARY OF CHLOROPHYLL-A

Location	Number of Data Points	Mean ug/1	Standard Deviation ug/1	Median ug/1	Geometric Mean ug/1	Geometric Standard Deviation
Ocean Stations						
Surface	14	.211	.154	.203	.163	2.16
60-ft depth	15	.174	.103	.146	.146	1.94
Open Coastal Nearshore						
Surface	12	.277	.225	.215	.185	2.94
60-ft depth	12	.233	.153	.177	.190	1.98
Embayment						
Surface	6	.304	.108	.315	.284	1.53
60-ft depth	5	.315	.050	.331	.312	1.18
Transition Zone						
Surface	4	1.03	1.02	.686	.713	2.72
60-ft depth	4	.526	.315	.505	.450	1.93
Outer Harbor						
Surface	24	3.18	3.16	1.93	1.80	3.15
60-ft depth	20	.709	.443	.659	.598	1.83
Inner Harbor						
Surface	17	10.5	13.0	6.59	4.73	4.58
60-ft depth	11	1.20	1.46	0.617	.801	2.36

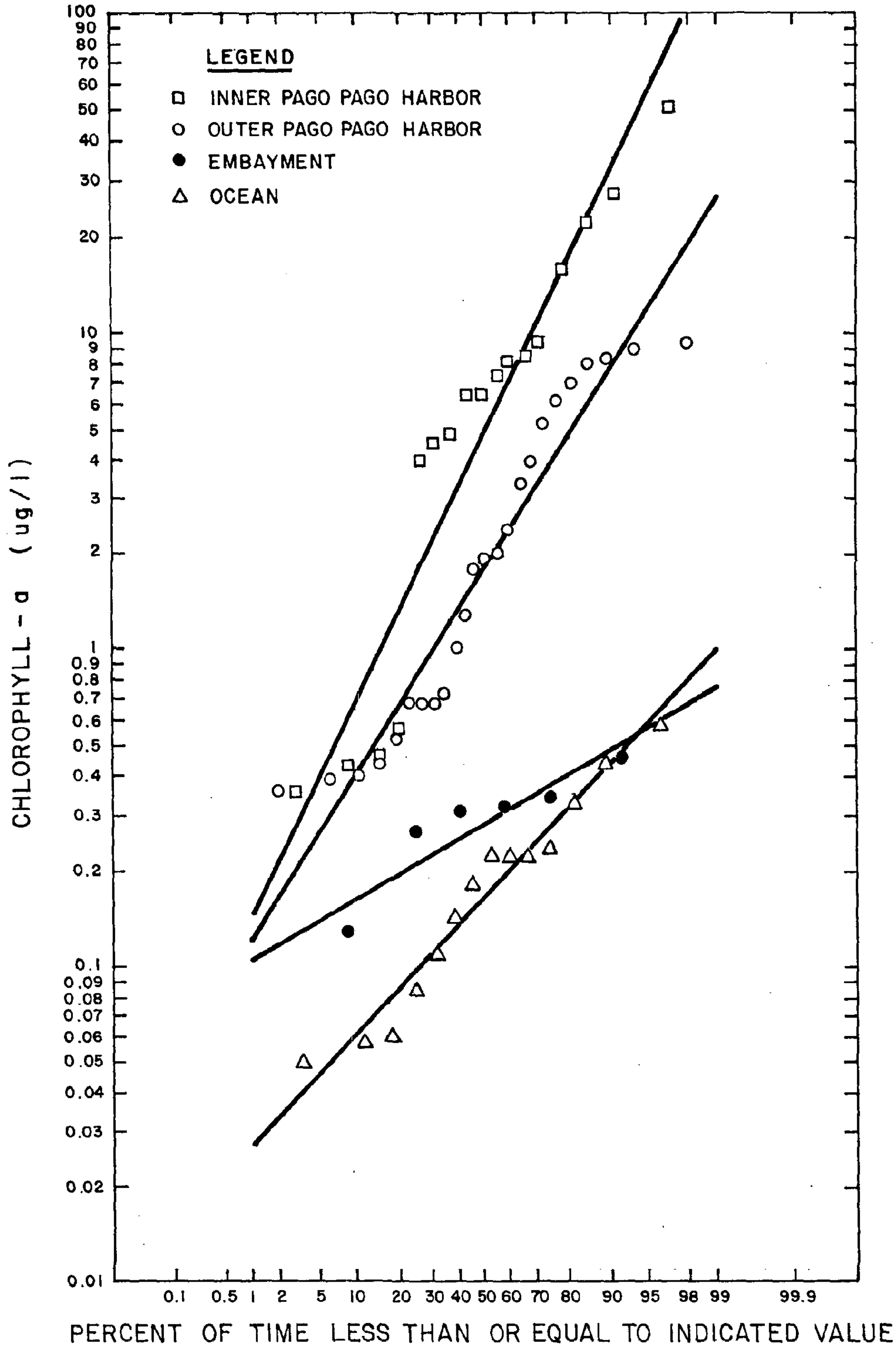


FIGURE IV-7

CHLOROPHYLL-A CUMULATIVE DISTRIBUTIONS FOR SURFACE WATERS public hearing in June 1979 regarding the May 1979 version of the proposed standards it was decided that the results of this study be used to suggest possible further revisions of the May 1979 document (Appendix E). This section is written in the context of the May 1979 revision of the standards.

Rationale

The primary contribution of this study to the effort to promulgate water quality standards for American Samoa is the measurement and statistical descriptions of some of the parameters for various categories of water. Consequently, the suggestions for revisions are limited to the numerical values for some of the parameters studied.

The basic approach to defining suggested numerical values for standards for significantly variable parameters was to select a representative area in a desirable condition for each water classification and use the measured log-normal distributions plus the expected confidence interval (5 to 20 percent, depending on the geometric standard deviation) at the geometric mean to define the standard. The suggested standards for ocean and open coastal waters also included some provisions for the addition of nutrients so as to accommodate point discharges in defined zones of mixing in areas which are limited by time and, consequently, would not respond by undesirable plankton growth to the nutrient addition.

For parameters with little variation, such as pH, it is not necessary to make a statistical description and the standard would consist of an acceptable range of values.

In some cases there are too few data to confidently describe the actual existing distribution and the suggested standard is based on reasonable interpolations from surrounding data sets (e.g. the chlorophyll-a levels in embayments as shown on Figure IV-7).

Because of its unique exchange characteristics it is suggested that Pago Pago Harbor be made a separate water category.

The saline water standard parameters that should be defined statistically are: turbidity, compensation depth (1 percent incident light engery), total phosphorus, total nitrogen, and chlorophyll-a. Stream waters have statistical standards on fecal coliform, turbidity, suspended solids, total phosphorus, and total nitrogen.

Suggested Standards

Tables IV-11 through IV-14 give the suggested standards for the four categories of saline waters, while Table IV-15 covers fresh surface waters. The "not to exceed more than 2 percent of the time" level is a straight line projection on log-probability paper of the geometric mean (i.e., 50 percent level) and the 10 percent level. The 2 percent value is suggested to control short-term discharges.

As discussed earlier in this chapter, the parameters with little variation that define biological boundary conditions can be expressed by acceptable ranges of values based on natural variability. On this basis, the pH and DO ranges were determined. The suggested pH range for all saline waters is 7.9 to 8.6. Stream water pH values should be in the range of 6.0 to 8.0. All waters should maintain dissolved oxygen levels at greater than 80 percent of saturation.

The suggested statistical standards include both time and space variations in the water body in question and a sampling program to test compliance would involve taking samples and measurements at several stations, at two depths and covering any significant seasonal variations. Considering the magnitude of the geometric standard deviation, a minimum of about 24 samples would be required to test compliance for most of the suggested statistical standards. For example, sampling in Pago Pago Harbor would include samples from both the surface and lower layer at stations in the inner and outer harbor taken during both the wet and dry season. A statistical analysis of all of the data would then be compared to the standard.

Presently, the ASG Environmental Quality Laboratory is not equipped to conduct, in house, all of the sampling and analyses that would

TABLE IV-11

SUGGESTED STATISTICAL STANDARDS FOR OCEAN WATERS

Parameter	Units	Geometric Mean Not to exceed the given talue	Not to exceed the given value more than 10% of the time	Not to exceed the given value more than 2% of the time
Turbidity	NTU	0.20	0.29	0.36
Total Phosphorus	ug/l	11	23	35
Total Nitrogen	ug/l	115	180	230
Chlorophyll-a	ug/l	0.18	0.40	0.65
Compensation Depth (1% Incident Light)	feet	150*	132*	120*

* To exceed given values 50, 90, and 98% of the time respectively.

TABLE IV-12

SUGGESTED STATISTICAL STANDARDS FOR OPEN COASTAL NEARSHORE WATERS

Parameter	Units	Geometric Mean Not to exceed the given value	Not to exceed the given value more than 10% of the time	Not to exceed the given value more than 2% of the time
Turbidity	NTU	0.22	0.34	0.44
Total Phosphorus	ug/l	14	30	50
Total Nitrogen	ug/l	130	210	280
Chlorophyll-a	ug/l	0.22	0.47	0.75
Compensation Depth (1% Incident Light)	feet	130*	107*	95*

* To exceed given values 50, 90, and 98% of the time respectively.

TABLE IV-13

SUGGESTED STATISTICAL STANDARDS FOR EMBAYMENT WATERS

Parameter	Units	Geometric Mean Not to exceed the given value	Not to exceed the given value more than 10% of the time	Not to exceed the given value more than 2% of the time
Turbidity	NTU	0.27	0.44	0.60
Total Phosphorus	ug/1	15	36	60
Total Nitrogen	ug/1	135	220	300
Chlorophyll-a	ug/1	0.31	0.70	1.10
Compensation Depth (1% Incident Light)	feet	100*	77*	66*

* To exceed given values 50, 90, and 98% of the time respectively.

TABLE IV-14

SUGGESTED STATISTICAL STANDARDS FOR PAGO PAGO HARBOR

Parameter	Units	Geometric Mean Not to exceed the given value	Not to exceed the given value more than 10% of the time	Not to exceed the given value more than 2% of the time
Turbidity	NTU	0.34	0.66	1.00
Total Phosphorus	ug/1	16	44	80
Total Nitrogen	ug/1	145	245	330
Chlorophyll-a	ug/1	0.80	2.00	3.50
Compensation Depth (1% Incident Light)	feet	75*	50*	40*

* To exceed given values 50, 90, and 98% of the time respectively.

TABLE IV-15

SUGGESTED STATISTICAL STANDARDS FOR STREAM WATER

Parameter	Units	Geometric Mean Not to exceed the given value	Not to exceed the given value more than 10% of the time	Not to exceed the given value more than 2% of the time
Turbidity	NTU	3.6	7.2	10.8
Suspended Solids	mg/l	2.0	4.0	6.0
Total Phosphorus	ug/l	95	210	350
Total Nitrogen	ug/l	300	640	1000
Fecal Coliform	#/100 ml	100	300	600

be called for in a sampling program along the lines of the suggested standards. The tests that would have to be conducted elsewhere on preserved samples include total phosphorus, total Kjeldahl nitrogen, nitrite plus nitrite nitrogen, and chlorophyll-a. The staff of that laboratory, however, have been instructed in and have conducted sample preservation and shipping procedures. Consequently, it is believed that sampling and analyses for the suggested standards are within the extended capabilities of the ASG laboratory.

The standards being proposed by the EQC have provisions for periodic revisions and updating. It is suggested that future updating include considerations for the development of additional standards on benthic conditions and biological parameters as well as additional fresh water categories for marsh areas and possibly urban streams.

CHAPTER V

PAGO PAGO HARBOR SYSTEM

The waters and biological communities of Pago Pago Harbor are subjected to a variety of stresses as a result of human activities. These include: reef flat filling; reef dredging, discharge of domestic wastewater; discharges of cannery wastewaters; stream transport of eroded material from road construction, building construction, and agriculture; stream transport of solid waste and sanitary waste; and various direct discharges from vessels. Since this study is concerned primarily with the water quality effects, emphasis will be placed on those discharges that have the greatest effect on the water column.

PHYSICAL CHARACTERISTICS AND TIDAL EXCHANGE

Pago Pago Harbor is a deep natural harbor presumably formed by stream erosion during periods when the sea level was much lower than at present. Fringing reefs of varying widths are found around the entire perimeter of the harbor. In many areas the reef flats have been filled to provide level land for urban, commercial, and industrial construction or for the disposal of solid wastes. A comparison with an 1839 map of Pago Pago Harbor indicates that by 1973 about 23 percent of the reef flat area had been filled. This reduction in the water surface area has resulted in a reduction in tidal exchange by about 8.5 percent and a corresponding increase in tide-related residence time (Sunn, Low, Tom & Hara, Inc., 1975).

Seaward of the reef edge the depth increases sharply to a relatively flat bottom. The bottom slope at the centerline of the harbor is fairly uniform at between one and two percent to a depth of around 200 feet at the mouth of the harbor. The calculations made in this report use the 1971 soundings of the harbor which indicate somewhat shallower depths than previously published maps. This difference may be due to different measuring techniques or it may indicate sediment accumulation or infilling. The determination of a rate of accumulation would be the subject of a separate study of sediments and is not covered in this report.

The Pago Pago Harbor area was divided for evaluation purposes into inner harbor, outer harbor, and transition areas as shown on Figure V-1. The division line between the outer harbor and the transition zone was located at the section with the smallest cross-sectional area, which therefore is likely to act as a hydraulic control section to limit exchange. The division line between the inner and outer harbor was somewhat more arbitrary but approximately divides the more sheltered inner area from the area with greater wind and wave exposure. The transition zone boundary is located at approximately the distance outside of the outer harbor mouth that can be traversed between times of tidal reversal by the average outer harbor current speed (about 6 cm/sec).

The cross-sections for the inner-outer harbor and the outer harbor-transition zone division lines are shown on Figure V-2. The cumulative cross-sectional areas as a function of depth are given on Figure V-3. The cumulative volumes of the inner and outer harbor areas are shown on Figure V-4 as a function of depth. These figures were drawn using the contour lines of the 1971 bathymetric survey. Figure V-3 is used to give the cross-sectional area above and below any depth at the boundaries between the harbor sectors. Figure V-4 is used to give the volume of water above and below any depth in the total harbor or in either the inner or outer sectors.

The average surface area of the inner harbor is about 12.6×10^6 sq ft, while that of the outer harbor is about 41.4×10^6 sq ft. Considering the total volumes, this means that the average depth at mean low water is 71.3 feet for the inner harbor and 100.8 feet for the outer harbor. The overall average depth for Pago Pago Harbor is 94.0 feet. According to the NOAA tide tables, the average tidal range for Pago Pago is 2.5 feet, or approximately 4.8 feet on a 24-hour basis

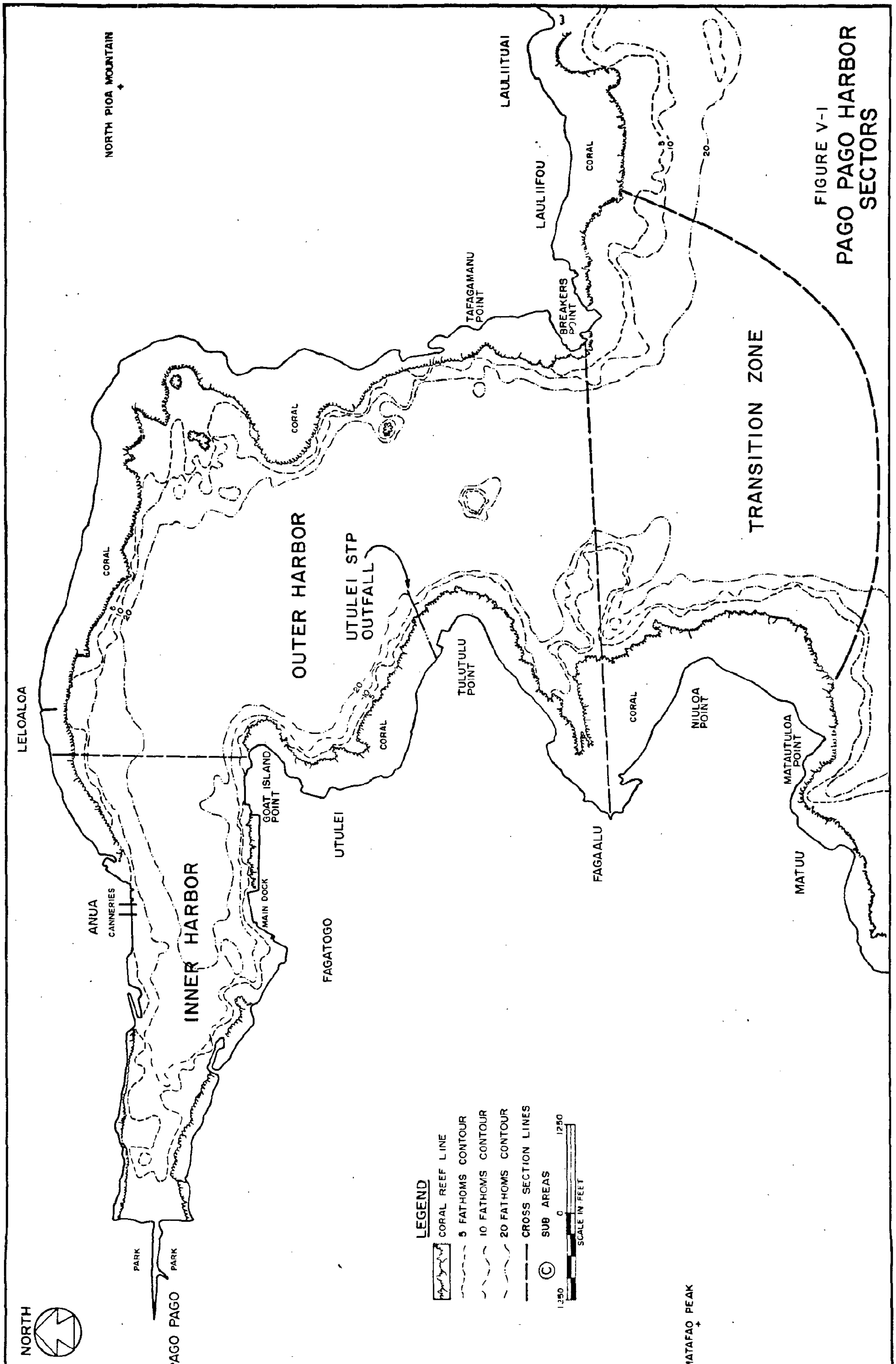
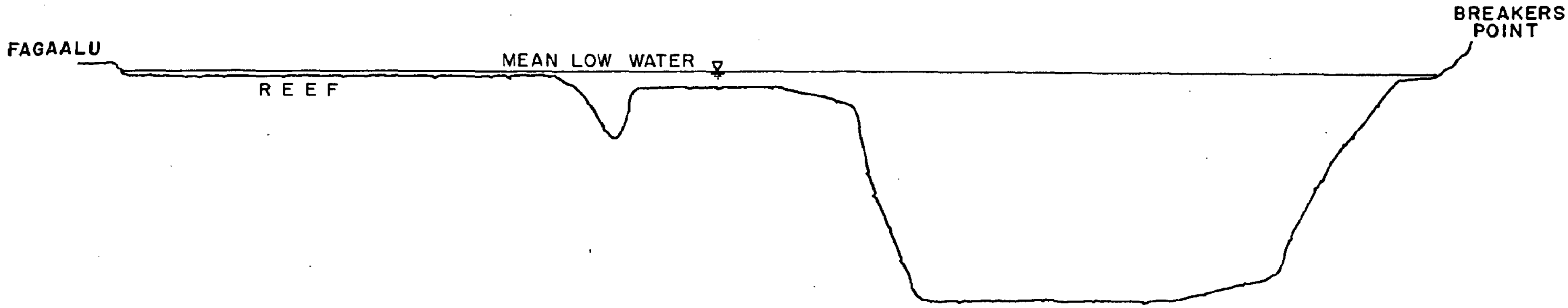
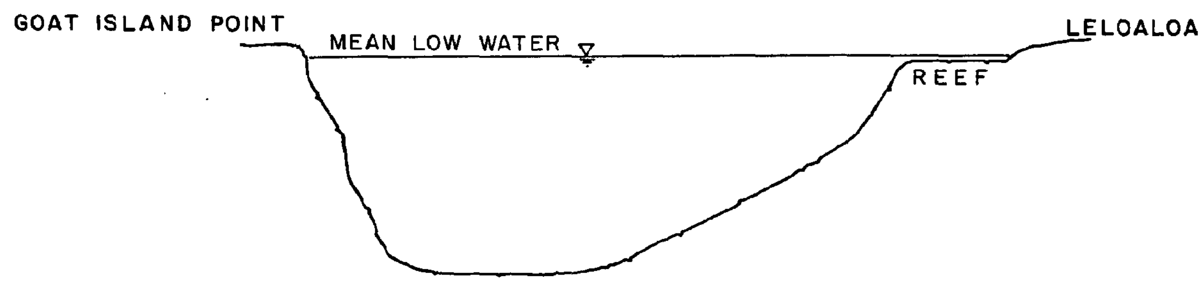


FIGURE V-1
PAGO PAGO HARBOR SECTORS
NORTH
NORTH PIOA MOUNTAIN
LAULIITUAI
LAULIIFOU
CORAL
TAFAGAMANU POINT
BREAKERS POINT
TRANSITION ZONE
OUTER HARBOR
UTULEI STP OUTFALL
TULUTULU POINT
CORAL
NIULOA POINT
MATAUTULOA POINT
LELOALOA
GOAT ISLAND POINT
UTULEI
FAGAALU
MATUU
ANUA
CANNERIES
INNER HARBOR
MAIN DOCK
FAGATOGO
PARK
PARK
PAGO PAGO
MATAFAO PEAK
LEGEND
CORAL REEF LINE
5 FATHOMS CONTOUR
10 FATHOMS CONTOUR
20 FATHOMS CONTOUR
CROSS SECTION LINES
SUB AREAS
1250
0
1250
SCALE IN FEET



CROSS SECTION - OUTER PAGO PAGO HARBOR / TRANSITION ZONE

SCALE: HORIZ. 1" = 810'
VERT. 1" = 135'



CROSS SECTION - INNER PAGO PAGO HARBOR / OUTER PAGO PAGO HARBOR

SCALE: HORIZ. 1" = 810'
VERT. 1" = 135'

FIGURE V-2

CROSS-SECTIONS AT PAGO PAGO HARBOR DIVISION LINES

SOURCE: EDAT

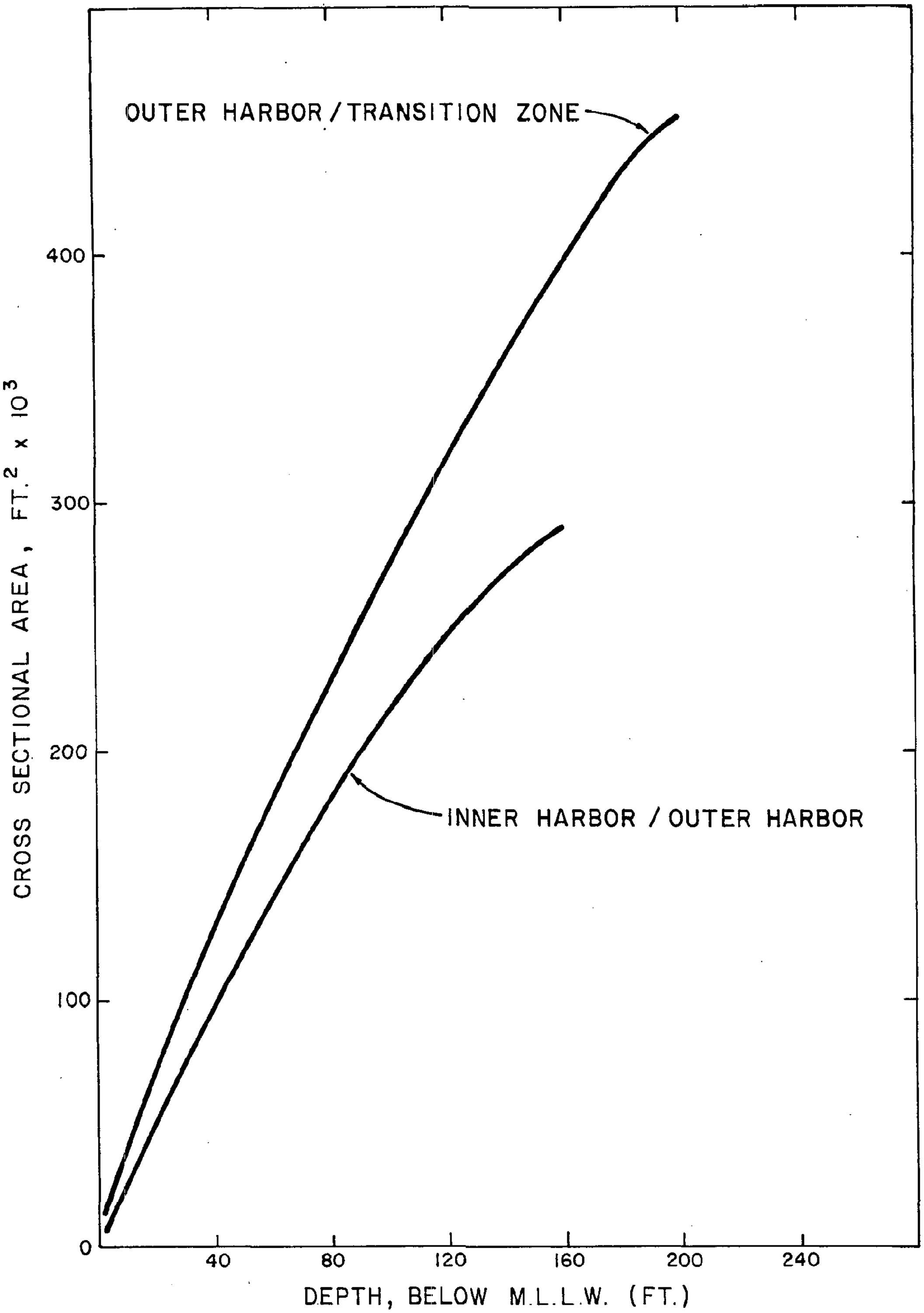


FIGURE V-3

CROSS-SECTION AREAS BETWEEN PORTIONS OF PAGO PAGO HARBOR

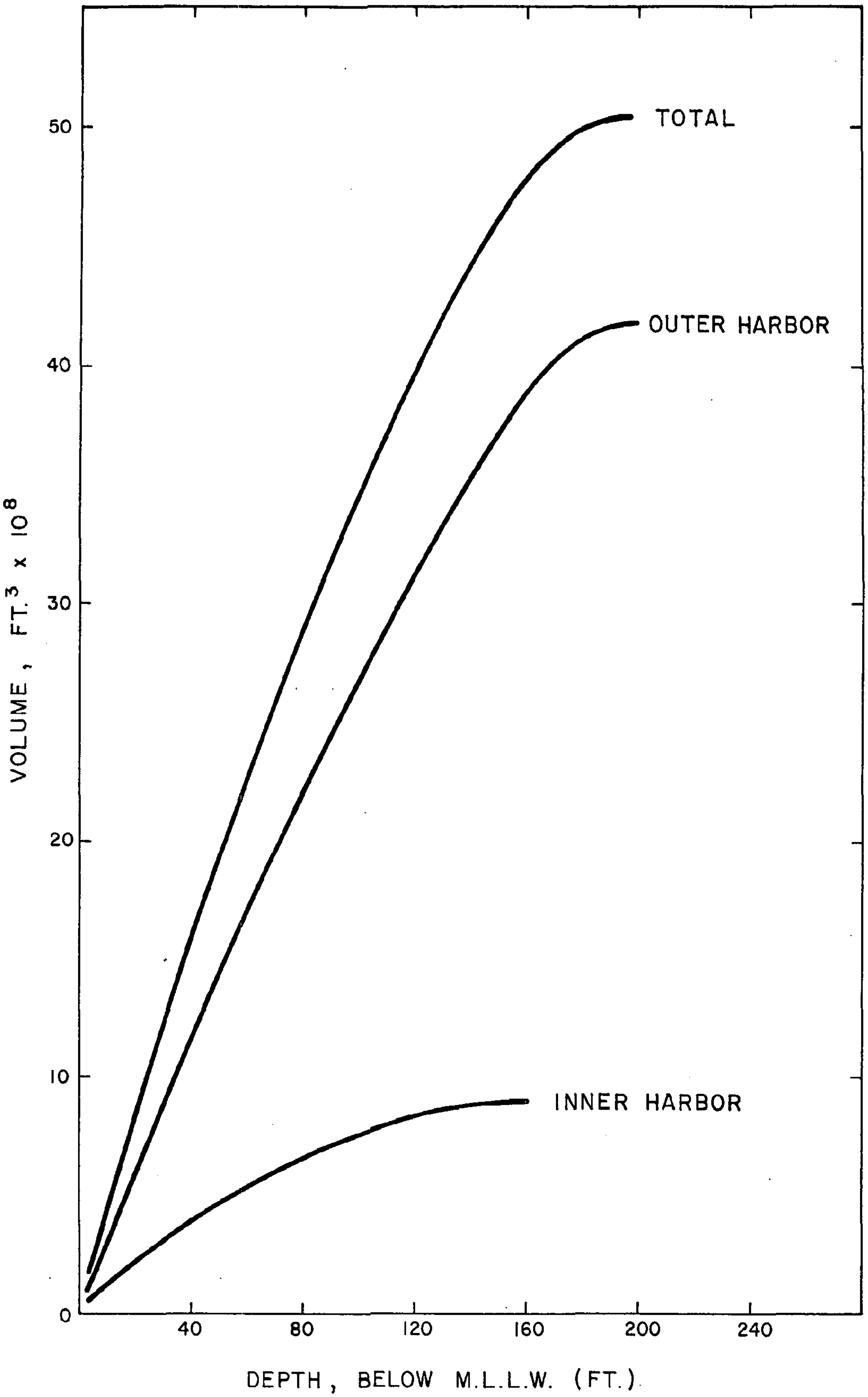


FIGURE V-4

VOLUMES OF INNER AND OUTER PAGO PAGO HARBOR VS. DEPTH (using an average tidal cycle time of 12.4 hours). This means that the average outer harbor residence time (volume/daily exchange) when considering tidal exchange only is 19.5 days with respect to the transition zone. Similarly, the average inner harbor residence time with respect to the outer harbor is 14.8 days or 34.3 days with respect to the transition zone. Since these calculations do not take into account wind-induced transport or stratification effects, they should be regarded as overall maximum values.

CURRENT STRUCTURE AND WIND-RELATED EXCHANGE

Salinity and temperature profiles taken at the eight Pago Pago Harbor stations showed that slightly higher temperature and slightly lower salinity in the surface layer resulted in a small but persistent density stratification throughout the harbor at a depth of 10 to 30 feet. The upper layer was also characterized by higher levels of turbidity, chlorophyll-a, total phosphorus, and total nitrogen than the lower layer. This layer is clearly definable by diver observations. Drogue measurements showed that the current structure of the upper layer was primarily wind related with the surface drogues generally moving directly downwind and the 10-foot deep drogue often indicating a counter current.

The results of drogue measurements along the inner harbor-outer harbor division line are shown in Appendix D, covering flood and ebb tides under several wind conditions during February and July, 1979. The 100-foot deep drogue movements generally responded to tidal currents and indicate the slower and more irregular movements in the deeper protected portions of the harbor. Since the cross-sectional area is large relative to the tidal change, the resulting slow tidal current (less than 1 cm/sec) is often masked by the movement due to eddies. It should be noted that the subsurface drogue vectors shown in the figures in this report have been corrected for wind-related effects on the surface floats and hence do not generally form a continuous path.

Drogue measurements at the boundary between the outer harbor and the transition zone are also shown in Appendix D. Again, the surface layer exhibits the direct influence of the wind with some return flow shown at the 10-foot level. The drogue speeds are generally higher here than inside the harbor because the wind exposure is more direct and the tidal exchange per unit cross-sectional area is greater. There is also evidence that a tide-related longshore current across the mouth of the harbor influences the exchange characteristics of the lower layer. During February, measurements at the Tafuna Outfall site showed that the longshore current moved easterly during ebb tide and westerly during flood. (Similar observations were made by CH2M Hill in October 1975.) At the mouth of Pago Pago, the easterly ebb current tended to retard the outward flow along the west side of the harbor mouth and enhance the outward flow next to Breakers Point. During flood tide the westerly setting longshore current enhanced the inflow along Breakers Point and tended to counteract inflow along the west side of the harbor mouth.

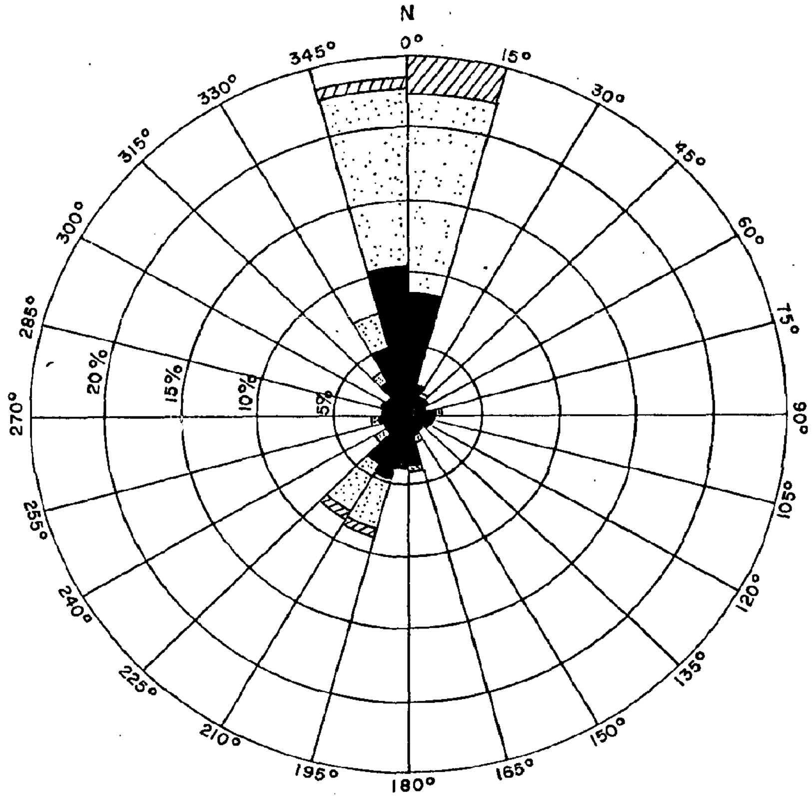
During the dry season study in July 1979, the measurements at Tafuna showed that the longshore current structure was reversed from the situation in February. In July the ebb flow was westerly and the flood flow was easterly. (This is discussed further in Chapter VI and is shown schematically on Figure VI-8.) The response at the harbor mouth was enhanced inflow during flood and enhanced outflow during ebb along the western side, while both types of flow were retarded on the Breakers Point side. This change was particularly evident from a comparison between the current meter records of February and July (discussed later). It is not known what months of the year each of the two longshore current patterns predominates or even if the phenomenon is seasonal.

One of the reasons that there is concern about the current structure across the mouth of Pago Pago Harbor is the possibility of placing an outfall in the vicinity of Breakers Point to discharge treated wastewater from the tuna canneries. This possibility is being considered since it would be less expensive than the significantly longer pipeline that would be required if the discharge occurred in the Tafuna area. The evaluation of the effects of such an outfall would require additional current measurements before reasonably reliable estimates of the potential for inflow of waste material to Pago Pago Harbor can be made.

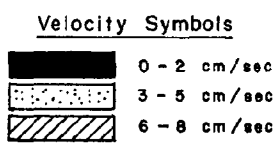
A current meter installation (Figure III-3) was made at a depth of 30 to 35 feet along the west side of the outer harbor-transition zone boundary line in order to measure the temporal distribution of current direction and speed in the upper portion of the lower layer. A statistical summary of the results for both the February and July, 1979 installations is given in the appendix. The data are presented in direction and speed frequency of occurrence matrices for flood and ebb tides and overall. Current roses and speed frequency diagrams for the February and July installations are shown on Figures V-5 through V-10.

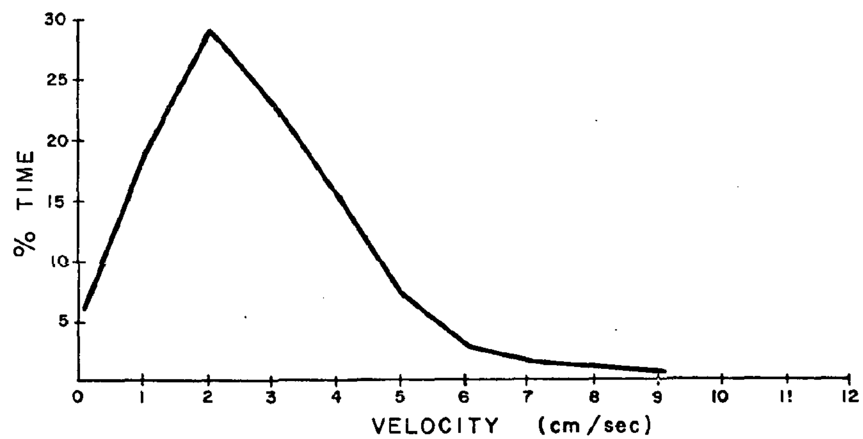
The effects of the easterly longshore ebb flow and the westerly longshore flood flow in February are evident at the current meter location by the inflow during ebb tide and the retarded inflow during flood tide. During July the reversal of the longshore current pattern resulted in net outflow during ebb tide and inflow during flood. The variations from the dominant pattern can be attributed to the location of the meter near the boundary between the upper and lower layer as well as to the effects of the nearby reef. The higher current speeds recorded by the meter during July when compared to February support the description of the effect of the longshore current pattern on the spatial and temporal exchange pattern of the lower layer at the mouth of Pago Pago Harbor.

The average current speed as a function of depth and location is shown on Figure V-11, which includes data from inside and outside Pago Pago Harbor as well as results from Tafuna and measurements made outside of Taema Banks in the open ocean (Dump Site No. 1). This comparison shows the lesser effects of wind on the surface in sheltered areas



OVERALL TIDE CURRENT ROSE

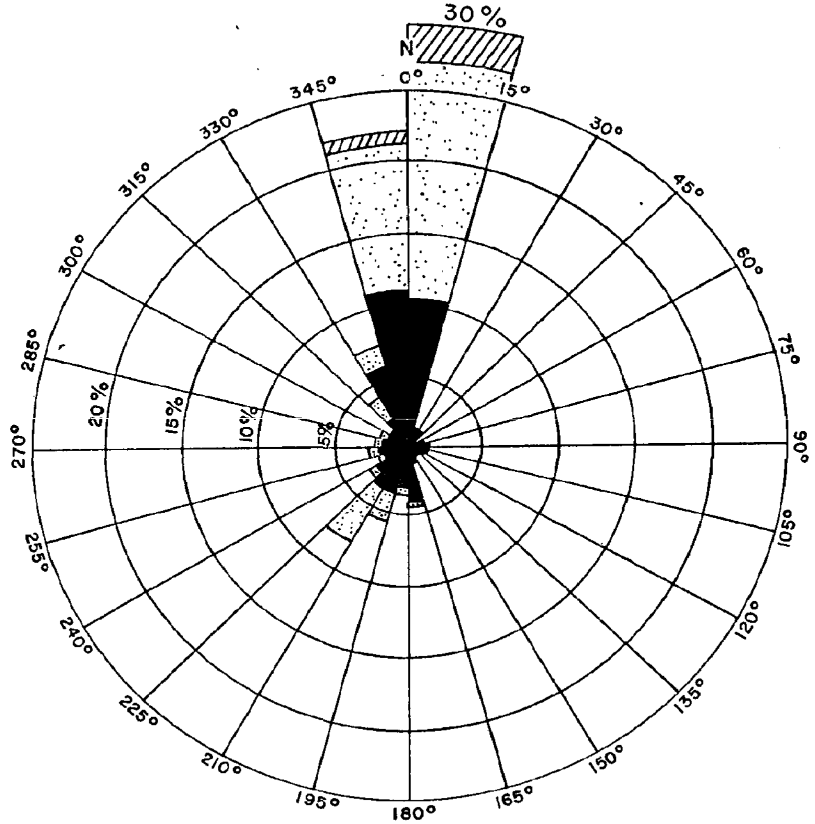




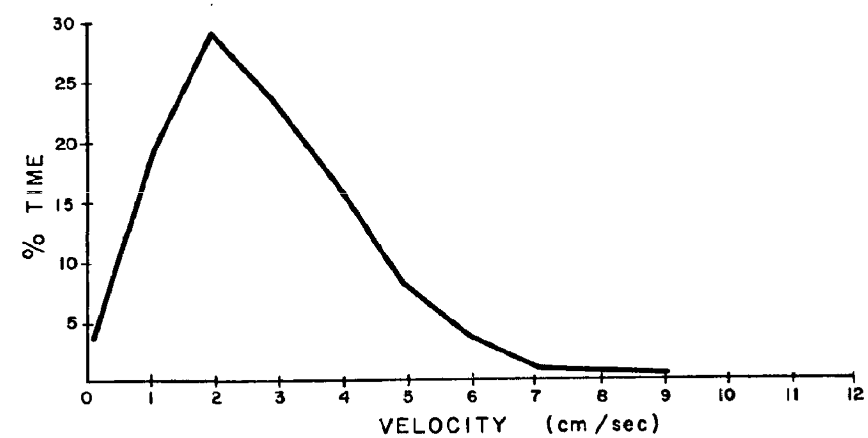
VELOCITY PROFILE

FIGURE V-5

CURRENT ROSE AND VELOCITY PROFILES
PAGO PAGO HARBOR 2-12-79 / 3-4-79



EBB TIDE CURRENT ROSE



VELOCITY PROFILE

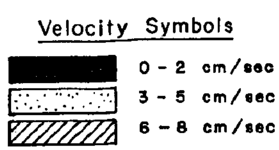
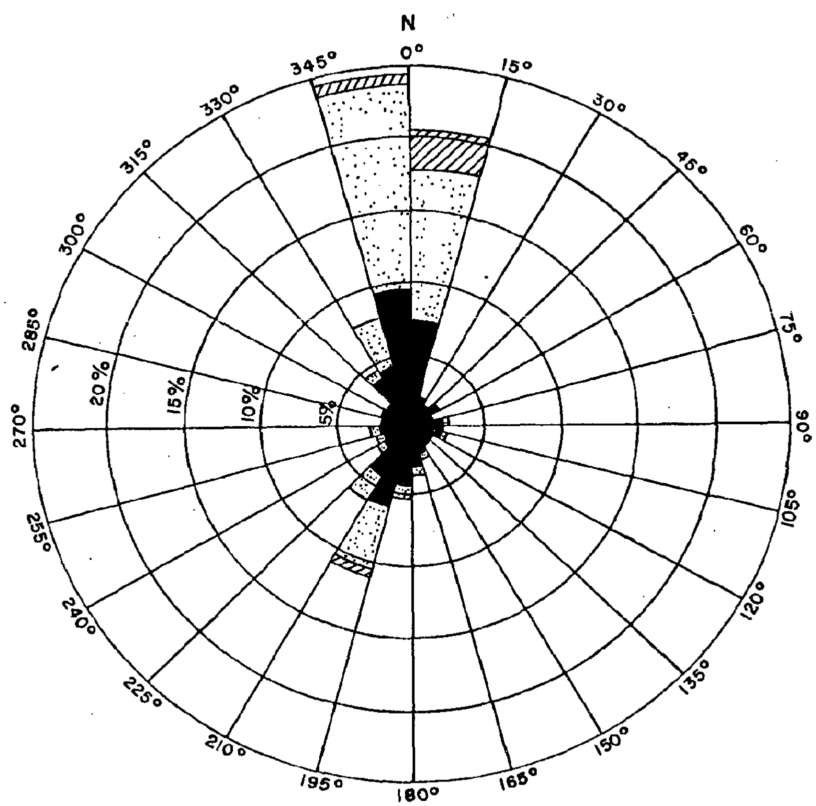


FIGURE V-6

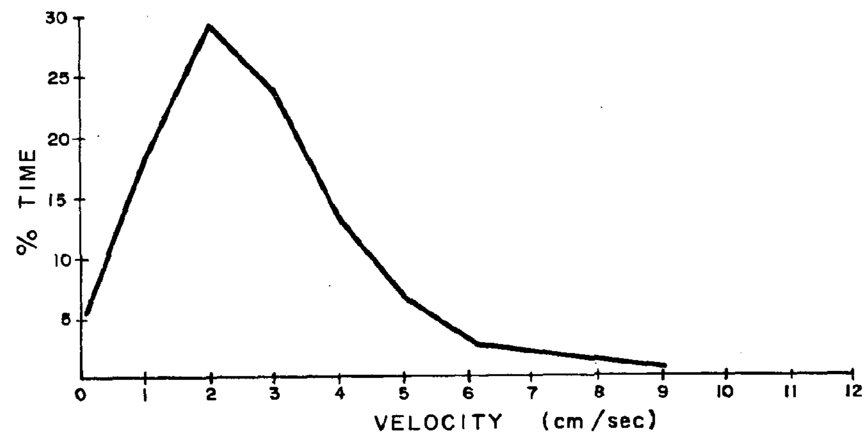
CURRENT ROSE AND VELOCITY PROFILES
PAGO PAGO HARBOR 2-12-79 / 3-4-79



FLOOD TIDE CURRENT ROSE

Velocity Symbols

- 0 - 2 cm/sec
- 3 - 5 cm/sec
- 6 - 8 cm/sec



VELOCITY PROFILE

FIGURE V-7

CURRENT ROSE AND VELOCITY PROFILES
PAGO PAGO HARBOR 2-12-79 / 3-4-79

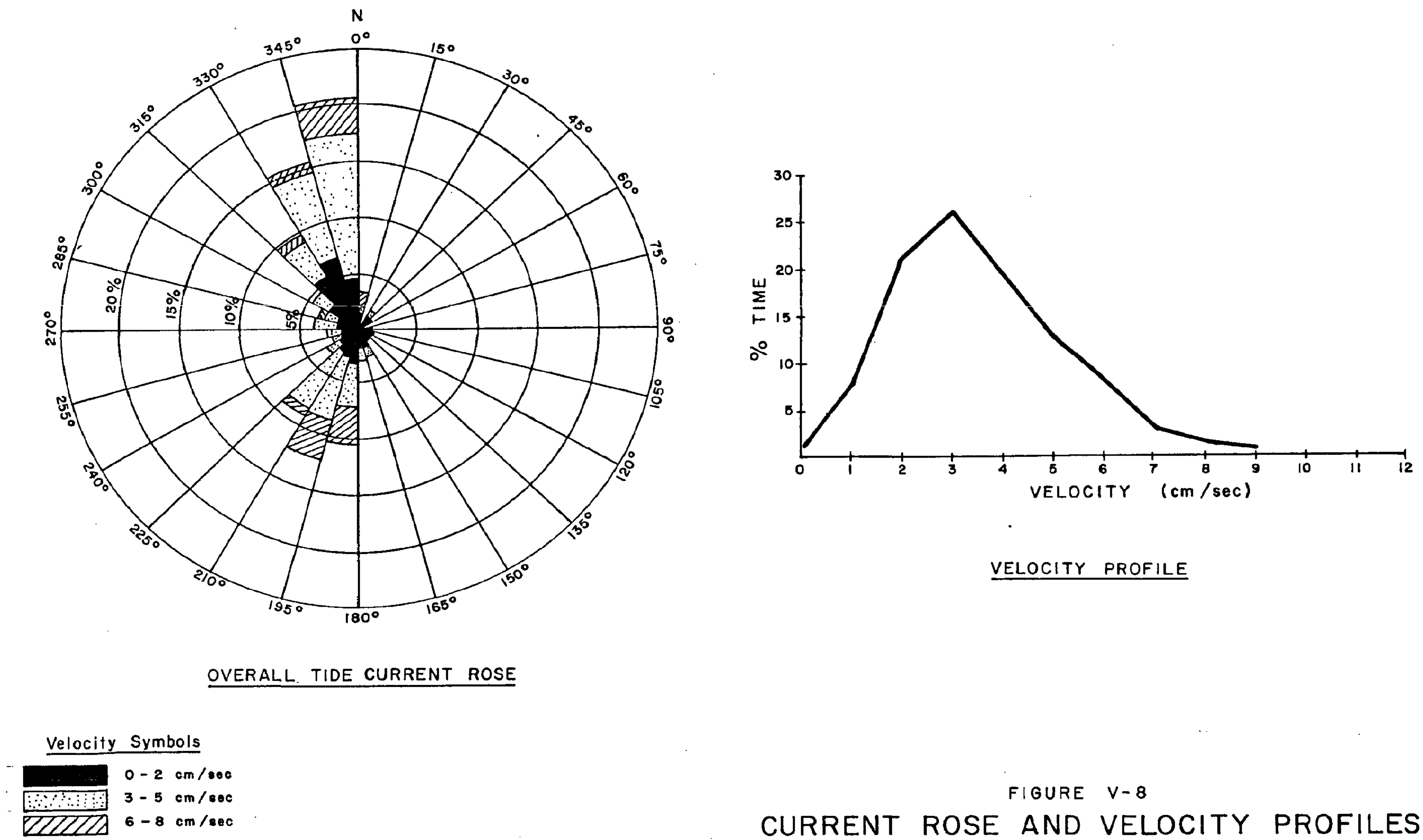
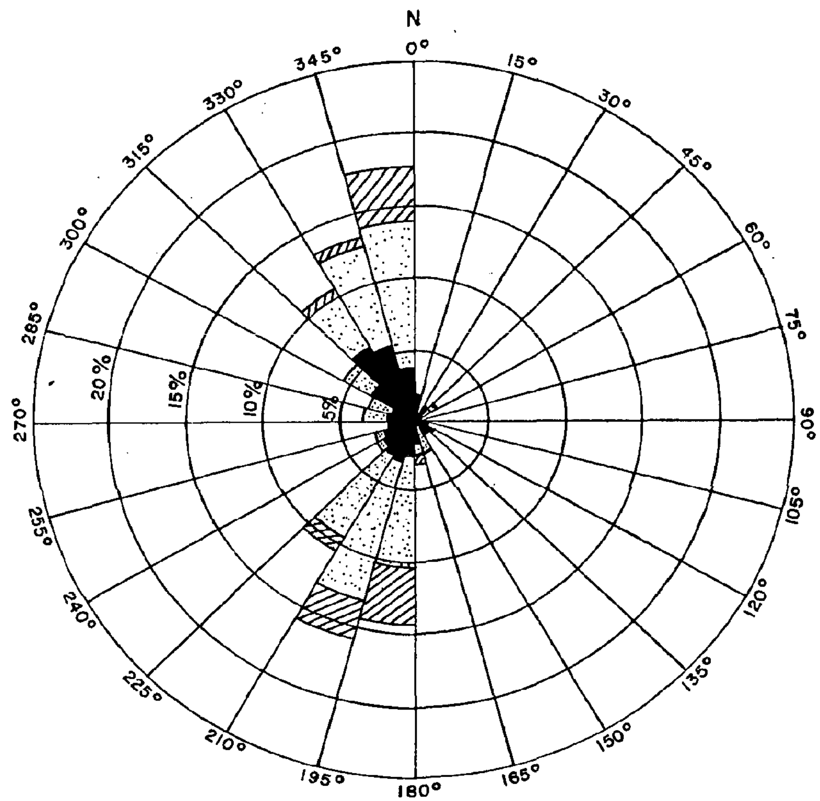
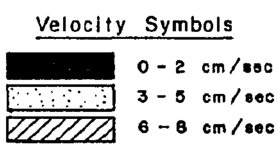


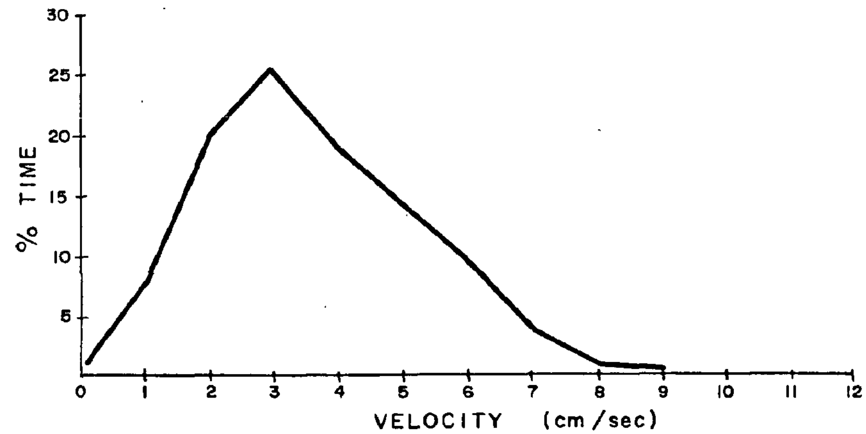
FIGURE V-8

CURRENT ROSE AND VELOCITY PROFILES
PAGO PAGO HARBOR 7-3-79 / 7-19-79



EBB TIDE CURRENT ROSE

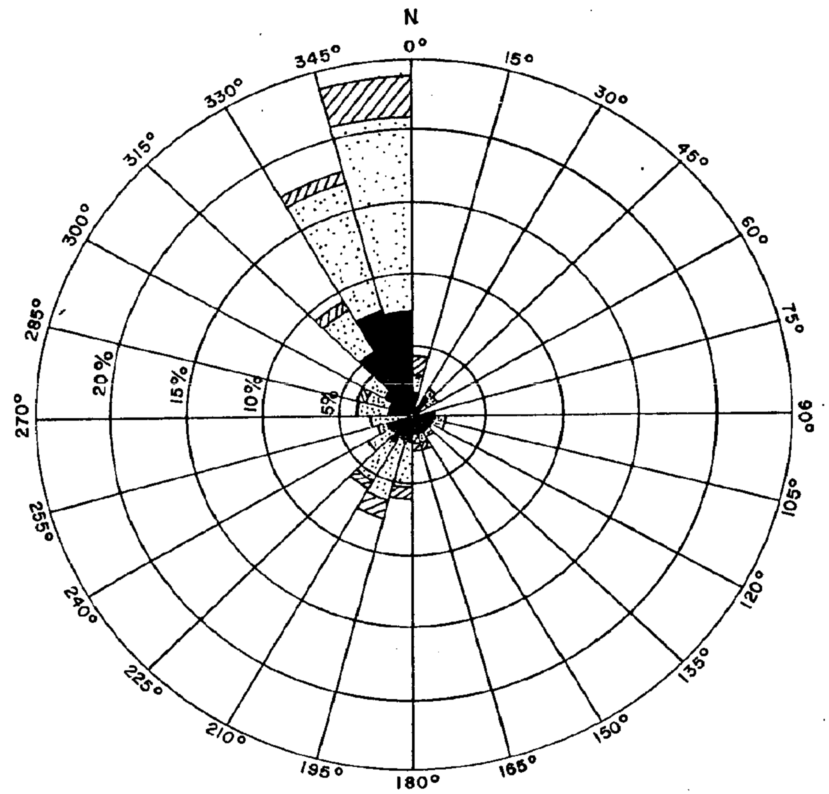




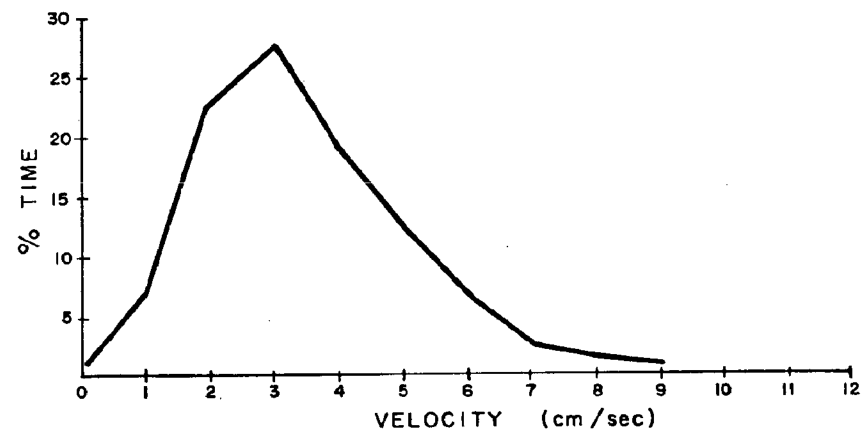
VELOCITY PROFILE

FIGURE V-9

CURRENT ROSE AND VELOCITY PROFILES
PAGO PAGO HARBOR 7-3-79 / 7-19-79



FLOOD TIDE CURRENT ROSE



VELOCITY PROFILE

Velocity Symbols

- 0 - 2 cm/sec
- 3 - 5 cm/sec
- 6 - 8 cm/sec

FIGURE V-10

CURRENT ROSE AND VELOCITY PROFILES
PAGO PAGO HARBOR 7-3-79 / 7-19-79

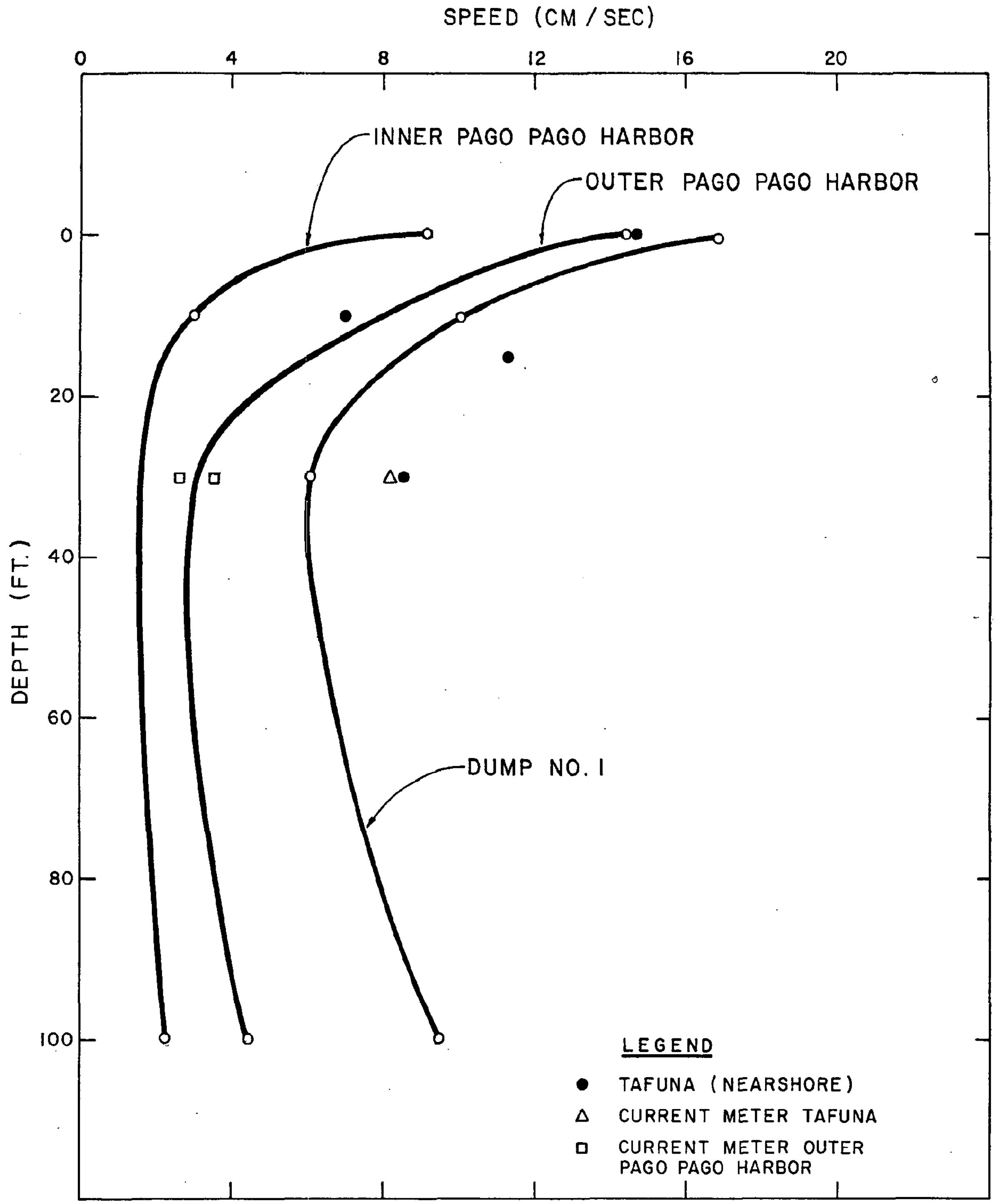


FIGURE V-11

AVERAGE CURRENT SPEED VARIATION WITH DEPTH AND LOCATION as well as the effects of stratification and the restriction on larger scale subsurface currents in confined areas. The lowest current speeds are observed in the area of interference between the wind-driven surface current and the tide-related nearshore or large scale open ocean current. The average current speed at the 100-foot depth is highest in the open ocean, where large-scale currents develop in response to latitudinal effects and hemispherical weather patterns. The longshore tide-related current is generally slower than the open ocean current, while the deep currents in embayments with hydraulically restrictive mouths respond primarily to the relatively small-scale effects of the in and out tidal flow.

Using the observed wind-driven surface current, the observed depth range of the stratification, as well as the predominant wind direction, it is possible to estimate the wind-related exchange between the transition zone and outer harbor as well as between the outer and inner harbor. The formulation developed by Banks (1975) for wind-driven transport in shallow lakes or above a shallow thermocline is based on a velocity profile very similar to that observed within the upper layer of Pago Pago Harbor.

$$q_1 = q_2 = \frac{4q_o D}{27}$$

Where: q_1 = per unit width transport in the wind direction

q_2 = per unit width counterflow

D = depth

q_o = water velocity at the surface

For the predominant wind conditions at the outer harbor-transition zone dividing line, q_o = 14 cm/sec or 1,654 ft/hour and D = 30 feet. Therefore, the average transport per foot width per hour is estimated to be above 7,350 cubic feet. Considering the approach angle of the wind, the available width is about 1,000 feet. These conditions result in an estimated wind-induced flux of about 1.8×10^8 cubic feet per day to the surface layer.

A similar calculation for the inner-outer harbor wind-induced flux using q_o = 9 cm/sec, D = 30 feet, and an effective width of 1,000 feet yields a value of about 1.1×10^8 cubic feet per day.

The drogue vectors indicate that the predominant transport factor in the surface layer is the wind. Using the volume-depth relationship presented earlier yields an estimated average surface layer residence time for the outer harbor of about 6.8 days with respect to the transition zone. The inner harbor has an estimated average surface layer residence time with respect to the outer harbor of about 2.7 days or 9.5 days with respect to the transition zone.

If the tidal exchange occurs primarily in the lower layer, as appears to be the case from the drogue pattern, then the average residence time of the lower layer of the outer harbor would be 14.9 days with respect to the transition zone. The lower layer of the inner harbor would have an average residence time of 9.7 days with respect to the lower outer harbor or 24.6 days with respect to the transition zone.

A summary of the estimated overall residence times of the inner and outer harbor areas with respect to the transition zone is given in Table V-1 for the conservative condition of tidal exchange only and the more liberal condition of tidal and average wind exchange.

TABLE V-1

ESTIMATED OVERALL RESIDENCE TIMES IN PAGO PAGO HARBOR WITH RESPECT TO THE TRANSITION ZONE

Area	Residence Time with Average Tidal Exchange Only (days)	Residence Time with Average Tide and Average Wind Exchange (days)
Outer Harbor	19.5	12.9
Inner Harbor	34.3	18.1

When stratification is considered, then the average estimated residence times given in Table V-2 are applicable.

TABLE V-2

ESTIMATED AVERAGE RESIDENCE TIMES WITH RESPECT TO THE TRANSITION ZONE OF THE UPPER AND LOWER LAYERS OF PAGO PAGO HARBOR

Area	Residence Time with Average Tidal and Wind Exchange (days)
Outer Harbor Upper Layer	6.8
Outer Harbor Lower Layer	14.9
Inner Harbor Upper Layer	9.5
Inner Harbor Lower Layer	24.6

DISPERSION COEFFICIENTS

Horizontal dye dispersion measurements were made on three occasions in the inner harbor and once in the outer harbor. The results calculated according to the procedure described in the methodology chapter are shown on Figures V-12 and V-13. The variation inherent in this type of measurement is evident on these figures. The eddies, which are the subject of this measurement, are of the same scale as the measuring device, the dye patch. The dye may or may not come under the influence of another eddy before the next photograph is taken; hence, there is an inherent variability in the short-term dispersion. The average of a number of these short-term measurements, however, constitutes a valid basis for calculation and comparison with other areas.

The inner harbor dispersion coefficient magnitude and relationship to scale is typical for a semi-confined water body in that the overall rate of increase with scale is slow and the smaller scale values are somewhat higher than has been theoretically calculated for open ocean conditions with no boundary effects. This might be explained by noting that mixing energy that would have gone into the formation of large-scale eddies in an unconfined space is perforce limited to smaller-scale eddies in a confined area.

The few data points obtained for the outer harbor are insufficient to define the effect of scale on the dispersion coefficient.

This information on the dispersion coefficients in Pago Pago Harbor is useful in making dispersion calculations after initial dilution for wastewater discharges. It would also be necessary if a computer model of the harbor would be designed to calculate exchange characteristics on a finer scale than is being attempted in this study. The dispersion coefficient is one of the primary variables in the equations describing exchange among the grid points of a computer model.

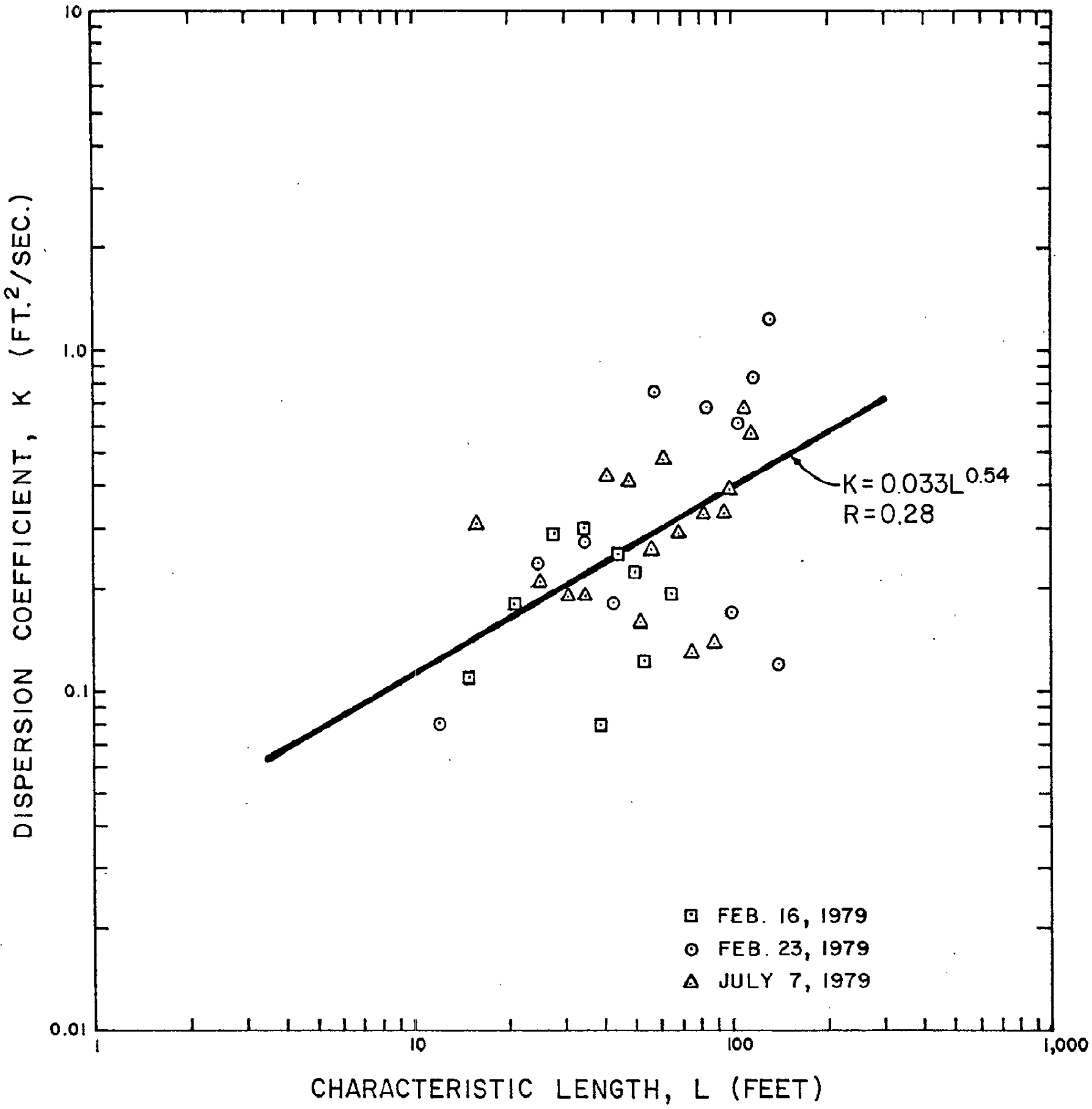


FIGURE V-12

DISPERSION COEFFICIENT VS. CHARACTERISTIC LENGTH FOR INNER PAGO PAGO HARBOR

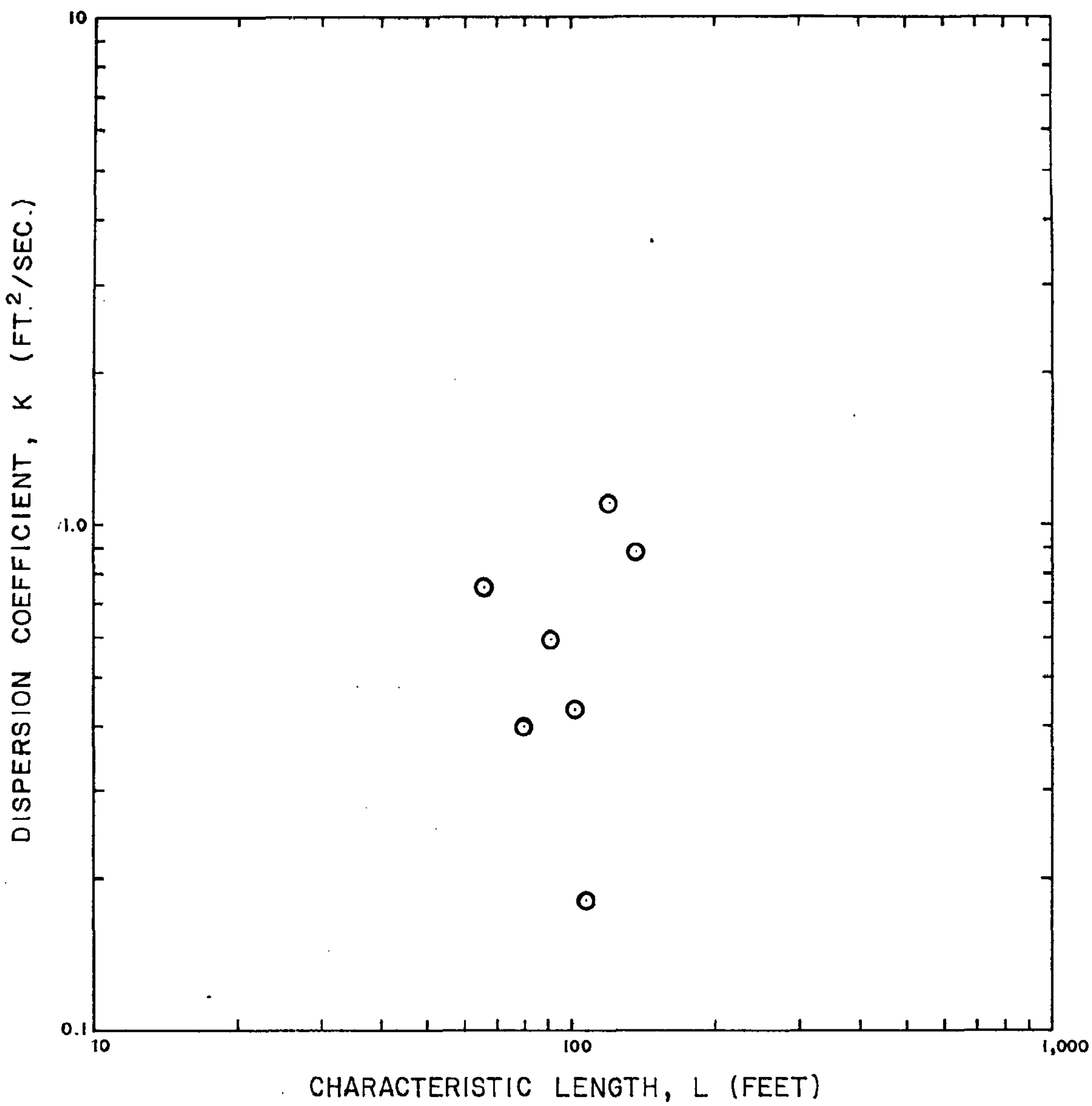


FIGURE V-13

DISPERSION COEFFICIENT VS. CHARACTERISTIC LENGTH FOR OUTER PAGO PAGO HARBOR

MASS EMISSIONS OF NITROGEN AND PHOSPHORUS

Three general sources add nutrients to Pago Pago Harbor waters: surface runoff, the Utulei wastewater treatment plant, and the tuna canneries.

Samples were taken from eight streams around Tutuila judged to have urban influence on their quality characteristics. Five of these streams discharge into Pago Pago Harbor. The average concentration of nitrogen and phosphorus in the urban influenced streams should be a valid number to estimate the mass emission rate from nonpoint sources. Three to five samples were obtained of the effluents of each of the two canneries and of the Utulei treatment plant.

In addition to concentrations, it is necessary to estimate average discharge rates before mass emissions can be obtained. For the case of the point discharges, this is not too difficult even though there is some question as to the exact figures. For the nonpoint sources, however, the problem is the lack of basic data regarding rainfall, infiltration, and evapotranspiration rates. The rainfall data at the airport indicating an annual average of 125 inches are the most extensive and should be representative of the rainfall near the windward shoreline of Tutuila. There are some rainfall data for the top of Mount Alava at the 1,800-foot elevation that indicate an annual average of 250 inches. In order to estimate the total rainfall on the Pago Pago Harbor watershed, it was necessary to make the assumption that the rainfall was entirely orographic so that the isohyets were defined by the contour lines.

As shown on Figure V-14, the Pago Pago Harbor drainage basin was divided into nine sectors containing the individual streams measured in this study and the areas not directly measured. Table V-3 shows the surface areas of the nine sectors along with the average estimated daily rain volumes for all sectors. From the total values an average estimated rainfall for the basin of about 158 inches per year was calculated.

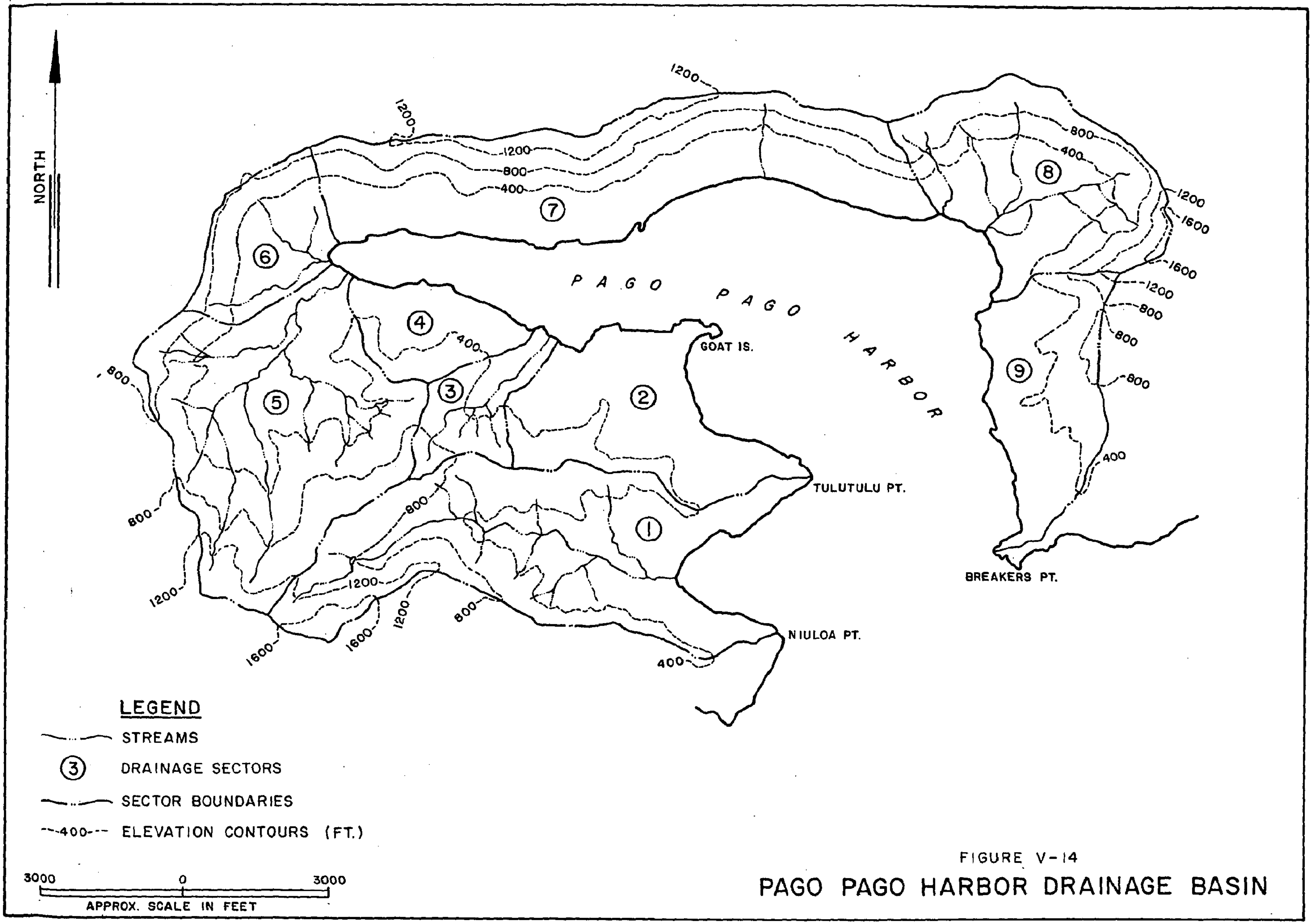


FIGURE V-14

PAGO PAGO HARBOR DRAINAGE BASIN

TABLE V-3

ESTIMATED PAGO PAGO HARBOR DRAINAGE BASIN

DAILY RAINFALL VOLUME

Sector	Surface Area x 10^6 Square Feet	Estimated Rainfall Volume (mgd)
1	25.6	7.0
2	13.0	3.3
3	4.6	1.2
4	5.5	1.4
5	25.0	6.7
6	6.6	1.7
7	25.4	7.0
8	17.0	4.9
9	11.1	2.9
Totals	133.8	36.1

The stream flow measurements, which were made at the time samples were taken, combined with the ratio of the recorded rainfall at the airport to the average daily rainfall were used to calculate an estimate for the fraction the runoff is of total rainfall. The range obtained was from 27 to 67 percent, with an overall average of 40.2 percent. This indicates an average total runoff of 14.5 MGD into Pago Pago Harbor, with 6.5 MGD to the inner harbor and 8.0 MGD to the outer harbor. This is an average of about 3 MGD per square mile. This is somewhat greater than the 2.3 MGD per square mile noted for the Kaneohe Bay drainage basin on Oahu, Hawaii (Sunn, Low, Tom & Hara, Inc., 1976).

Dames & Moore conducted a study of the potential for water supply and hydropower on Tutuila (Dames & Moore, 1978) using primarily six gaged streams (outside of the Pago Pago Harbor drainage area), with long stream flow records to estimate an average annual runoff of about 6 cfs (3.88 MGD) per square mile of drainage basin. The runoff estimate developed in this study, which is about 25 percent lower than the Dames & Moore estimate, is somewhat less principally because the gage locations are at higher elevations than the sea level flow measurement locations used in this study and were consequently subject to a higher average rainfall. In any case, the basic conclusions of this study are not very sensitive to such relatively small differences in the estimated runoff. Consequently, the estimate developed in this study on direct measurements within the Pago Pago Harbor drainage basin will be used for further calculations since there is a reasonable explanation for the difference from the estimate given by Dames & Moore for other areas on Tutuila as derived from a large data base.

If an evapotranspiration rate of 75 inches per year is assumed and the rainfall and runoff estimates are reasonable, then the average infiltration rate would be about 19.5 inches per year, or 12 percent of the total rainfall. Dames & Moore estimated a 10 percent infiltration rate, which is in reasonable agreement.

With this runoff estimate, along with the results of the chemical analysis, a nutrient mass emission estimate can be made as shown in Table V-4. It is clear from these results that any significant reduction in nutrient loading to Pago Pago Harbor must include the removal of the effluents from the tuna canneries. The uncertainty in the runoff estimate does not change this conclusion. Similarly, the relocation of the Utulei STP outside of the Pago Pago Harbor area, although a step in the right direction, would not result in a major reduction in the nutrient load without a similar relocation of the effluents from the canneries.

The mass of total phosphorus (TP) and total nitrogen (TN) in the inner and outer harbor can be used along with the rate of input to make further estimates of the residence time. Although TP and TN can be considered to approximate conservative substances, these estimates must be considered approximate since they do not include exchange with the bottom sediment nor possible losses to denitrification or diffusion of ammonia nitrogen.

Table V-5 gives the mass of TP and TN in the upper and lower layers of the inner and outer harbor.

The masses of TP and TN due to the background concentrations are about 1,220 kilograms total phosphorus and about 16,950 kilograms total nitrogen. Subtracting these values from the totals yields 1,214 kilograms TP and 3,097 kilograms TN as the result of additions to the harbor by runoff, the Utulei STP, and the canneries. Dividing the rates of input into the masses of TN and TP due to the input yields estimates of residence times of 17.4 days for nitrogen and 13.5 days for phosphorus for the whole harbor relative to the transition zone. These numbers fall in the range of residence time values for the whole harbor as calculated from water transport characteristics. This range was 19.5 days when considering tide exchange only and 12.9 days when estimates of predominant wind related transport are included.

TABLE V-4

APPROXIMATE NUTRIENT MASS EMISSION TO PAGO PAGO HARBOR

Source	Estimated Discharge Flow Rate (mgd)	Total Nitrogen Concentration (mg/1-N)	Total Phosphorus Concentration (mg/1-P)	Mass Discharge (kilograms/day)	
				N	P
Runoff	14.5	0.42	0.10	23.1	5.5
Utulei STP	0.8	7.06	4.60	21.4	13.9
Canneries	0.8	44.10	23.3	133.5	70.6
TOTALS	16.1			178.0	90.0

TABLE V-5

TOTAL NITROGEN AND PHOSPHORUS IN PAGO PAGO HARBOR

Location		Kilograms Total Nitrogen	Kilograms Total Phosphorus
Inner Harbor	Upper Layer	2,054	276
	Lower Layer	2,245	474
Outer Harbor	Upper Layer	4,163	419
	Lower Layer	11,585	1,265
Totals		20,047	2,434

Considering the number of assumptions and estimates that were independently made, there is reasonable agreement among these values. The tide only residence time estimate is high since it does not take into account the wind exchange. The estimate with the predominant wind exchange is likely to be too low for an overall average because the predominant wind condition does not occur all of the time. The estimate based on total phosphorus may be somewhat low because some of the phosphorus is associated with sedimentary material and hence would settle out of the system. Finally, the estimate using total nitrogen might be too high or too low depending on what the net effect is of nitrogen fixing, resolubilization from sediment, denitrification, and ammonia outgassing. In any case, the residence time will vary due to weather conditions very likely within the range defined by the results given.

PHYTOPLANKTON GROWTH RATE

The net growth rate of phytoplankton is dependent on the availability of nutrients, light availability, and the predation and settling rates. Under equilibrium conditions, such as in the open ocean, the net growth rate is zero in that the predation plus settling rates are equal to the growth rate within the nutrient and light limitations. When oceanic plankton are exposed to higher nutrient concentrations, there is an increase in the rate of growth and hence an increase in the average concentration. The rate of growth with excess nutrients and adequate light has been observed by numerous investigators to be exponential with time. Consequently, the longer the exposure time to the higher concentration of nutrients the greater the phytoplankton concentration. Predation pressure on the phytoplankton also increases exponentially due to zooplankton response to the greater availability of food, but this exponential increase is less than the one for phytoplankton since it is in response to the phytoplankton concentration.

This growth condition exists in Pago Pago Harbor due to the excess nutrient input. The results of the chlorophyll-a vs. estimated residence time relationship are shown on Figure V-15 for both the upper and lower layers. The geometric mean values were used for the chlorophyll-a values while the residence time estimates included the predominant wind related exchange. The significantly lower net growth rate in the lower layer can be attributed primarily to light limitations and secondarily to lower nutrient availability. The apparent upper layer growth rate is significantly higher in the inner harbor than the outer harbor. This is likely due to the greater availability of nutrients. From Figure V-15, the net doubling times for phytoplankton for the lower layer, upper outer harbor, and upper inner harbor are 30, 5.2, and 2.1 days respectively. These values correspond to growth rate constants of 0.02, 0.13, and 0.33 per day respectively. For comparison, it has been estimated that the growth rate constant for Kaneohe Bay, Oahu, before extensive development or sewage discharge was 0.09 per day, which increased to 0.12 per day with sewage addition (Sunn, Low, Tom & Hara, Inc., 1976). Hawaii Kai marina, which is shallow and surrounded by development, had an estimated growth rate of 0.25 per day (Sunn, Low, Tom & Hara, Inc., 1973). On this basis, it is apparent that the growth rate in the upper layer of Pago Pago Harbor is very high, especially in the inner harbor, and it is not surprising that the inner harbor is subject to algal blooms and low dissolved oxygen episodes, especially during times of low wind exchange when the chlorophyll-a levels can easily rise an order of magnitude if the residence time increases by just 7 days.

Since little control can be achieved over the residence time, the only control available is to limit the nutrient input. Considering the relative contributions of the canneries, runoff, and sewage effluent, it is apparent that, if water quality is to be improved, the cannery effluent discharge points will have to be relocated outside of the Pago Pago Harbor area to an area with good transport where residence times are short. This decision, however, has to be made in the context of all other considerations, including economics and the establishment of priorities.

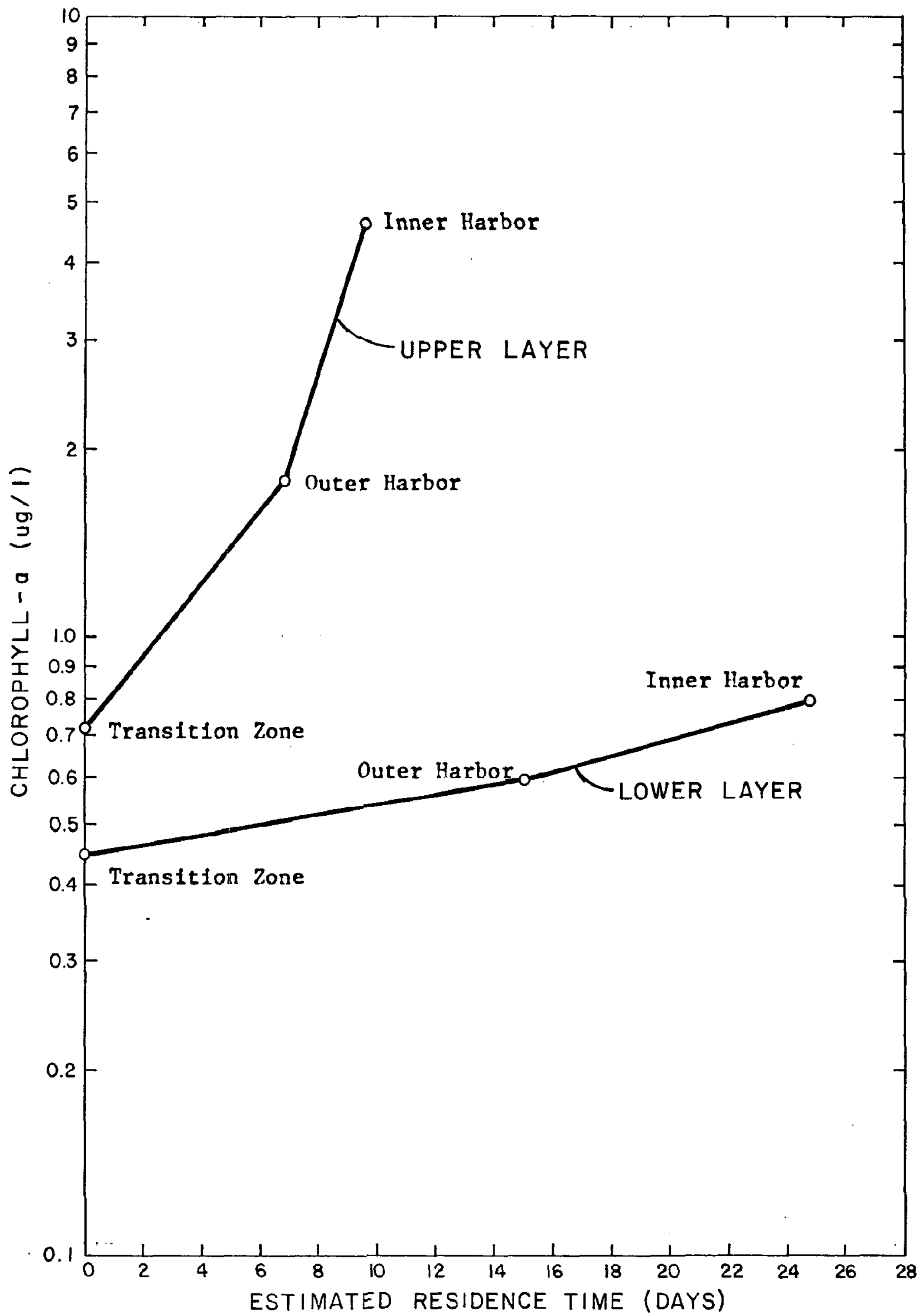


FIGURE V-15

CHLOROPHYLL-A VS. ESTIMATED

RESIDENCE TIMES IN LOWER AND UPPER LAYERS

CHAPTER VI

TAFUNA SEWAGE TREATMENT PLANT OUTFALL SITE

The existing outfall at Tafuna discharges about 0.03 mgd of effluent at a depth of about 70 feet within Vai Cove located near the west end of the runway in the vicinity of Fogagogo. Because of plans to increase the amount of treated sewage to be disposed of by ocean outfall in this general area (CH2M Hill, 1976), additional information was required regarding mixing and transport characteristics, as well as water quality. The general purpose of this information is to determine the general location for the planned outfall and to provide information required for outfall design.

WATER QUALITY

Three water quality stations were established in this area, as shown on Figure III-3, and the data were grouped to indicate nearshore conditions in an open coastal area. No evidence of the existing discharge was detected at the water quality stations undoubtedly because of the very small discharge volume and the good mixing and transport characteristics of the area. In general, the water quality was very similar to that of the open ocean with slight increases in chlorophyll-a and turbidity and a slight decrease in the photic zone depth. These changes are as expected for nearshore waters with no substantial fresh water discharges. The higher than expected nitrate plus nitrite nitrogen levels in the dry season samples were similar to the higher levels generally noted for the dry season samples for other locations including the open ocean. The values may be valid or there may be an unknown contamination or preservation error involved. In any case, since the important parameter is total nitrogen, of which NO_3 plus NO_2 nitrogen is but a small part, the possible error is something less than 10 percent, which is within the statistical reliability range of total nitrogen. The continuing monitoring program should clarify any discrepancies in the data base.

The salinity and temperature profiles of the Tafuna outfall area showed no significant or consistent stratification, which is not surprising considering the direct wind and wave exposure of the area. These profiles can be used to calculate sea water density for use with any of the several computer programs (such as PLUME, OUTPLM, and OKHPLM specified by EPA) that calculate initial dilution for various alternative diffuser configurations and discharge depths.

CURRENT STRUCTURE

Drogue and current meter measurements were conducted during both the February and July field trips. The type of current meter used during the February trip, however, was particularly sensitive to surge, as confirmed by diver observation, with the result that much of the data indicated high velocities directly onshore and offshore. When these were excluded from the data the remainder was sufficient to indicate a southwesterly flow during flood tide and a northerly flow during ebb with the net flow likely to be southwesterly. However, too much uncertainty remained in the speed to be used in any definitive calculations. To remedy this situation, a different type of meter (Endeco 105) not as sensitive to surge was installed during the July sampling trip at the same location and additional drogue studies were conducted.

The drogue measurements during February, as shown on Figures VI-1 and VI-2, confirmed the general tide related reversing current pattern gleaned from the current meter record. A similar pattern was noted by CH2M Hill in October 1975.

The drogue vector results for July are shown on Figures VI-3 and VI-4. The drogue measurements were taken at high slack and low slack tidal conditions. The high slack measurement (Figure VI-3) shows the predominent effect of the wind on the surface drogue with very low speeds and variable direction being evident with the subsurface drogues possibly related to the time of current reversal. The low slack measurement was made under light trade wind conditions and shows shoreward

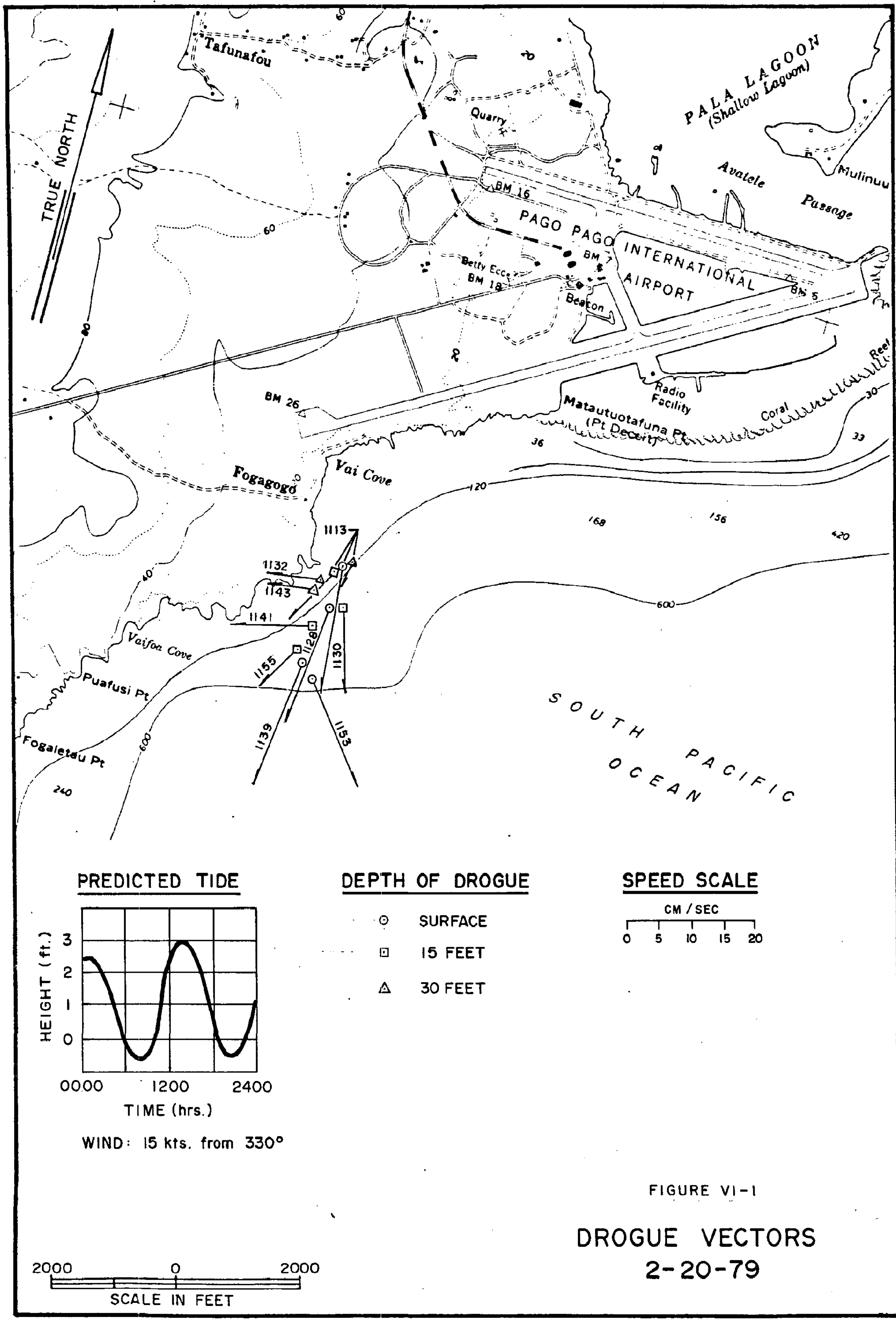


FIGURE VI-1

DROGUE VECTORS
2-20-79

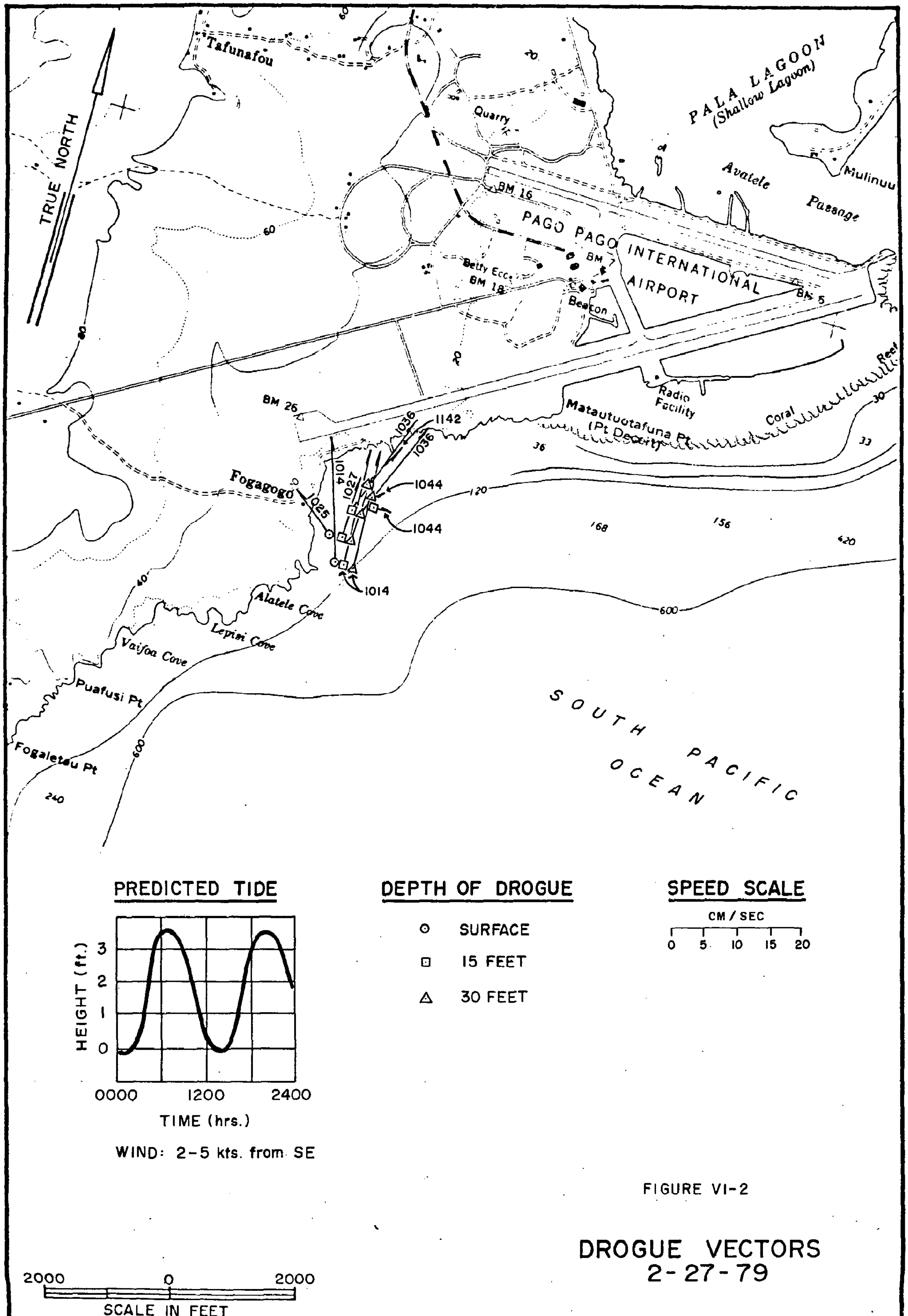


FIGURE VI-2

DROGUE VECTORS
2-27-79

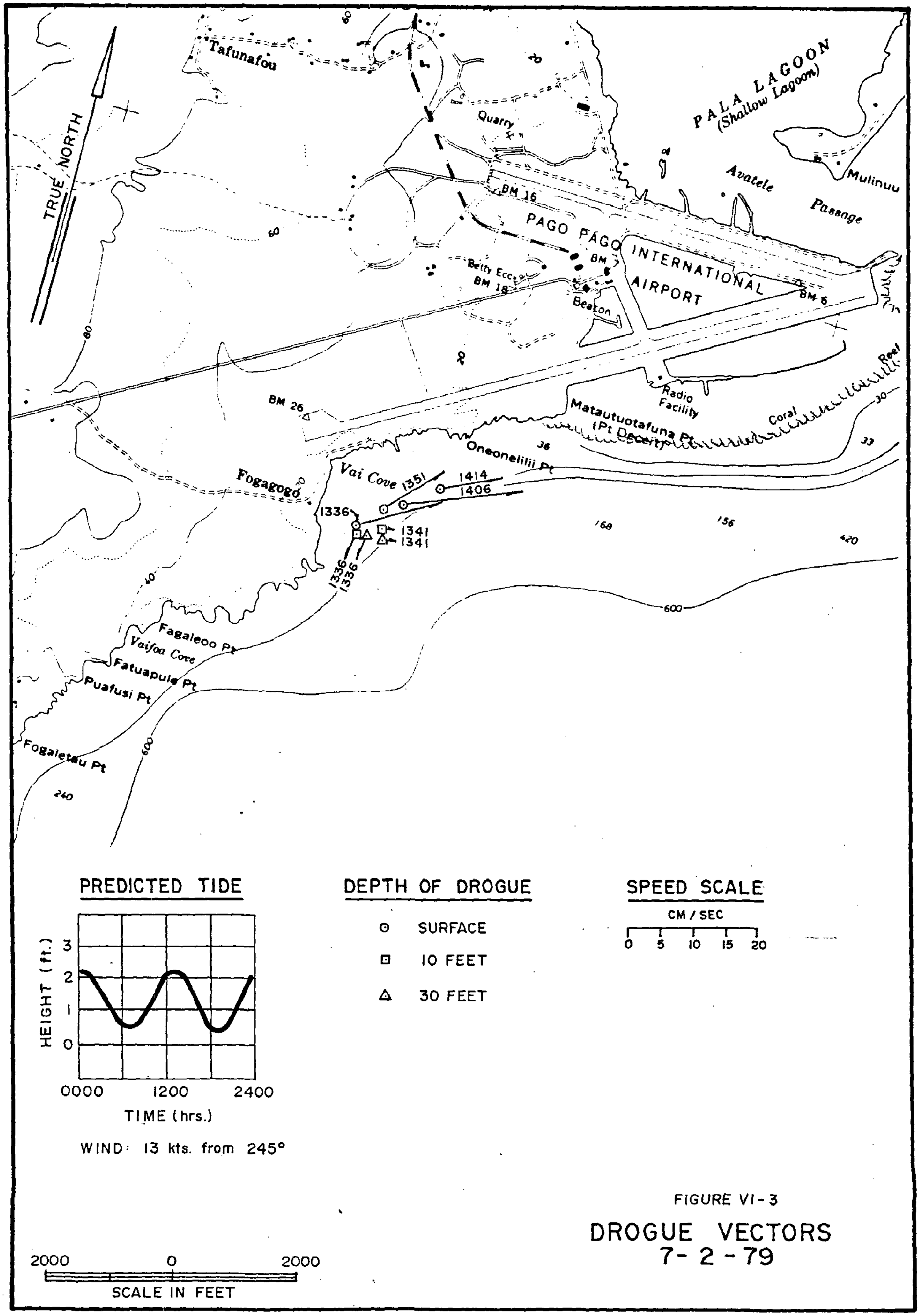


FIGURE VI-3

DROGUE VECTORS
7-2-79

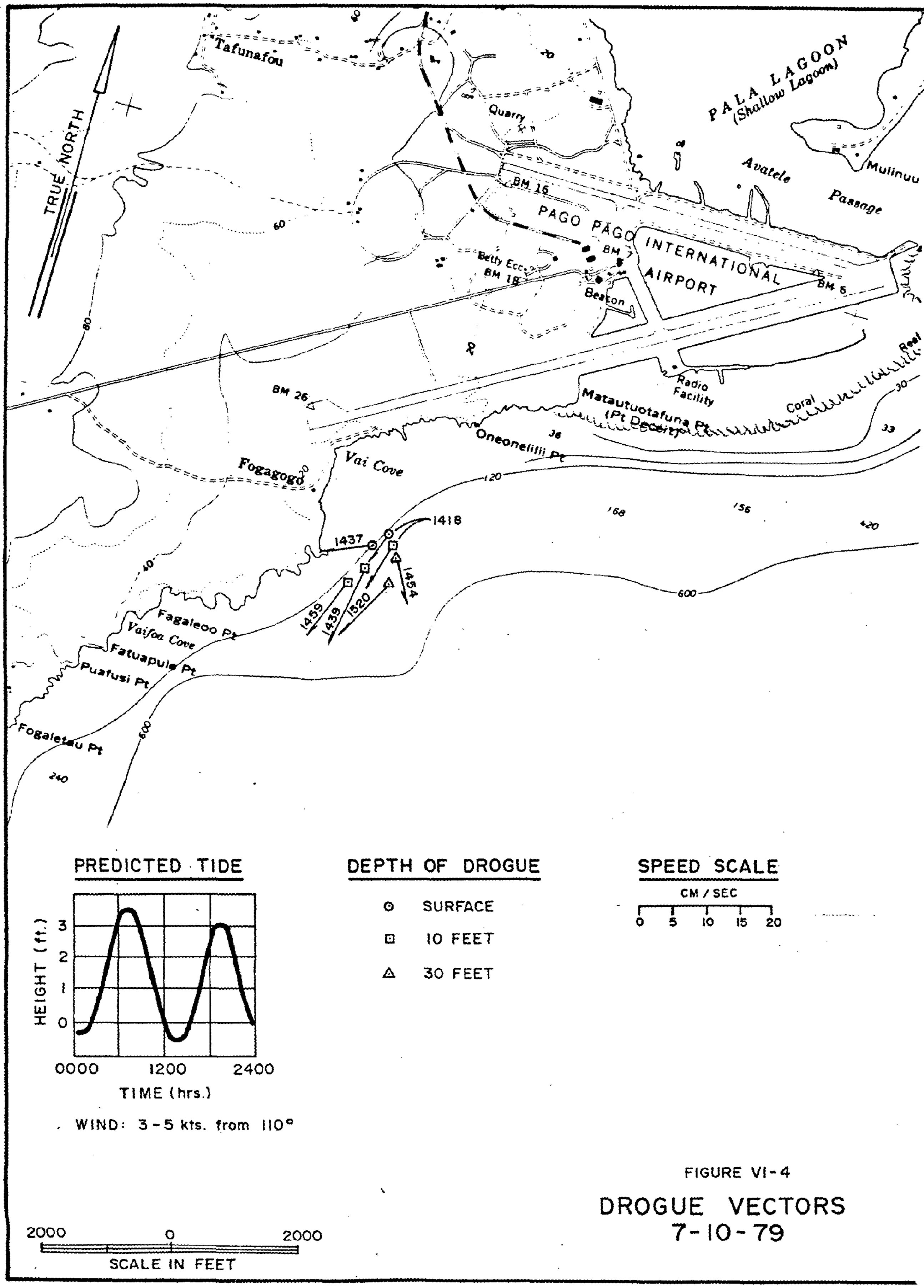


FIGURE VI-4

DROGUE VECTORS
7-10-79

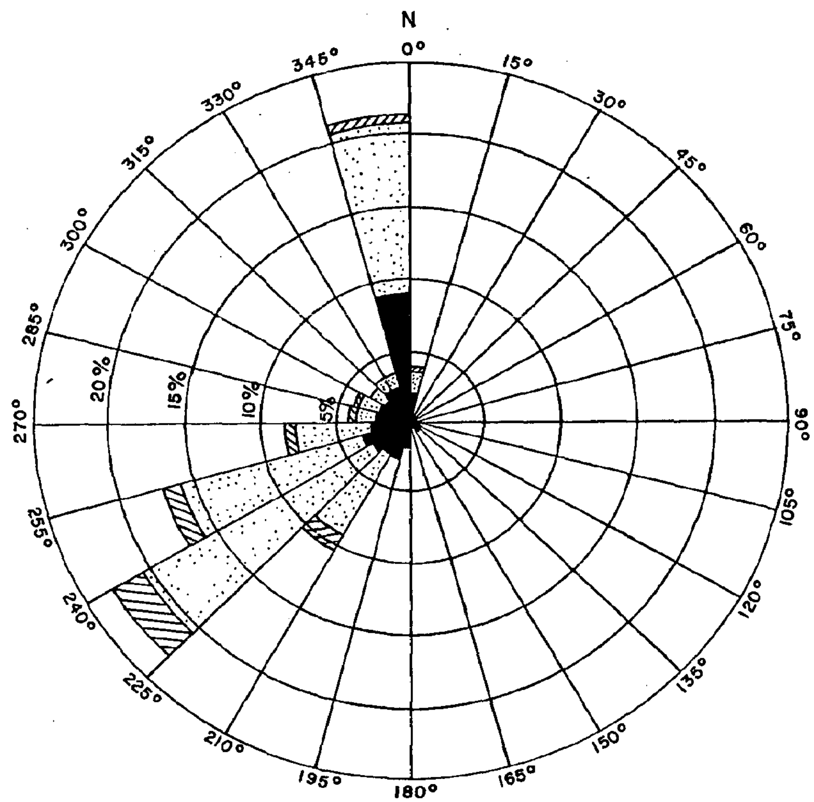
surface transport with strong subsurface transport toward the southwest. It might be noted that the current meter record for this time recorded exactly the same speed and direction as the 30-foot drogue.

The current roses for the July period are shown on Figures VI-5, VI-6, and VI-7 for overall, flood, and ebb tides respectively. The net transport is toward the southwest at 5.5 cm/second (0.1 knots) primarily because of the generally higher velocities during ebb tide. Another significant observation is that the July record shows a reversal of the general current pattern observed during February and October in that ebb tidal flow is toward the southwest while flood related flow is northerly. These observations are illustrated in general terms on Figure VI-8. Possibly there is a seasonal shift in the approach directions of the ebb and flood waves that are sufficient to result in this switch in the longshore current direction in this coastal sector. The duration or cause of this switch is not known and may not be a significant concern regarding discharge possibilities in this area as long as there is significant net transport away from the discharge area.

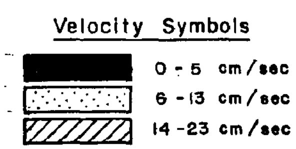
The current meter record and drogue observations as well as the dye study for mixing determination showed that under regular tradewind conditions there is significant shoreward transport within Vai Cove. This is especially the case during moderate to high wave conditions (which are not that infrequent). If this problem is to be avoided the proposed outfall diffuser will have to be located off the southern point of the cove (Fatuasina Point) in order to take advantage of the enhanced current velocity around the point and to minimize shoreward transport. Unfortunately, this area becomes deep quickly so that the diffuser will still be relatively close to shore even if located at a depth somewhere between 100 and 150 feet.

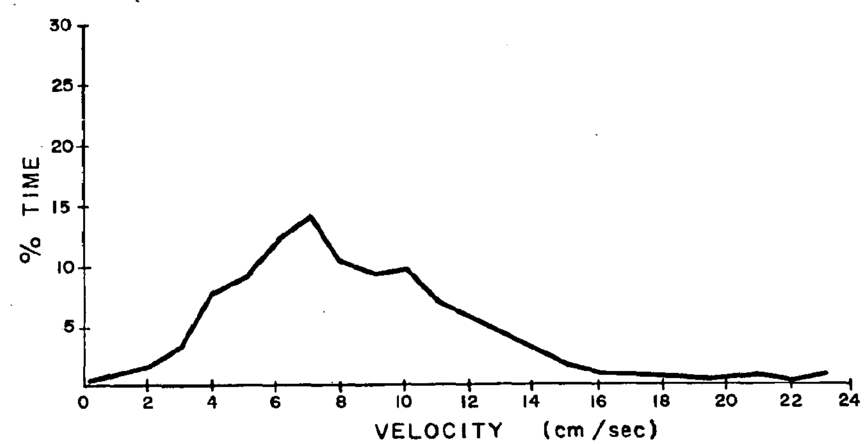
MIXING MEASUREMENTS

Dye dispersion measurements were conducted on August 1, 1979 during moderate wind and sea conditions (8- to 10-foot seas). The results are shown on Figure VI-9, which gives the relationship between



OVERALL TIDE CURRENT ROSE





VELOCITY PROFILE

FIGURE VI-5

CURRENT ROSE AND VELOCITY PROFILES
TAFUNA 7-3-79 / 7-23-79

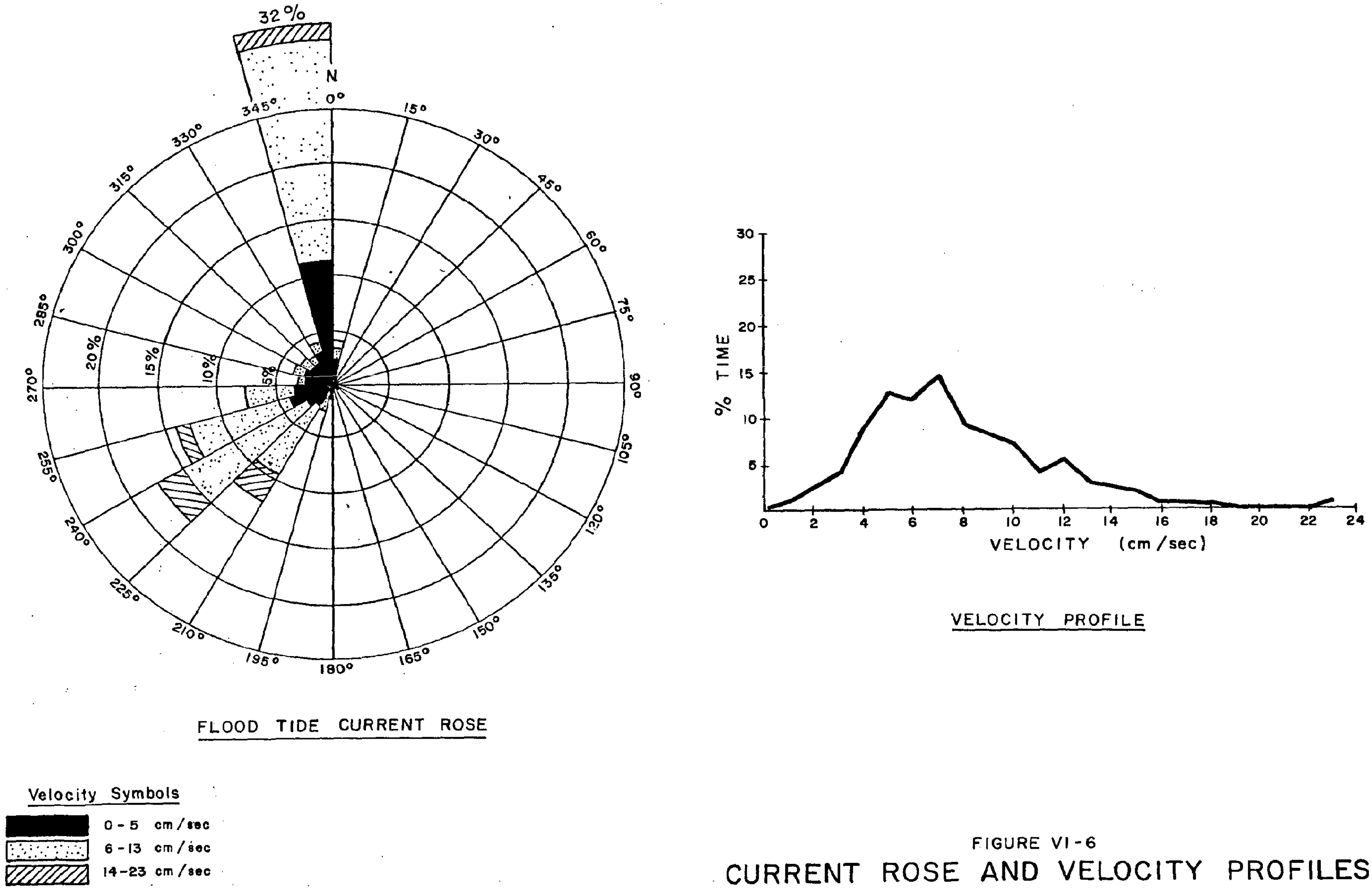
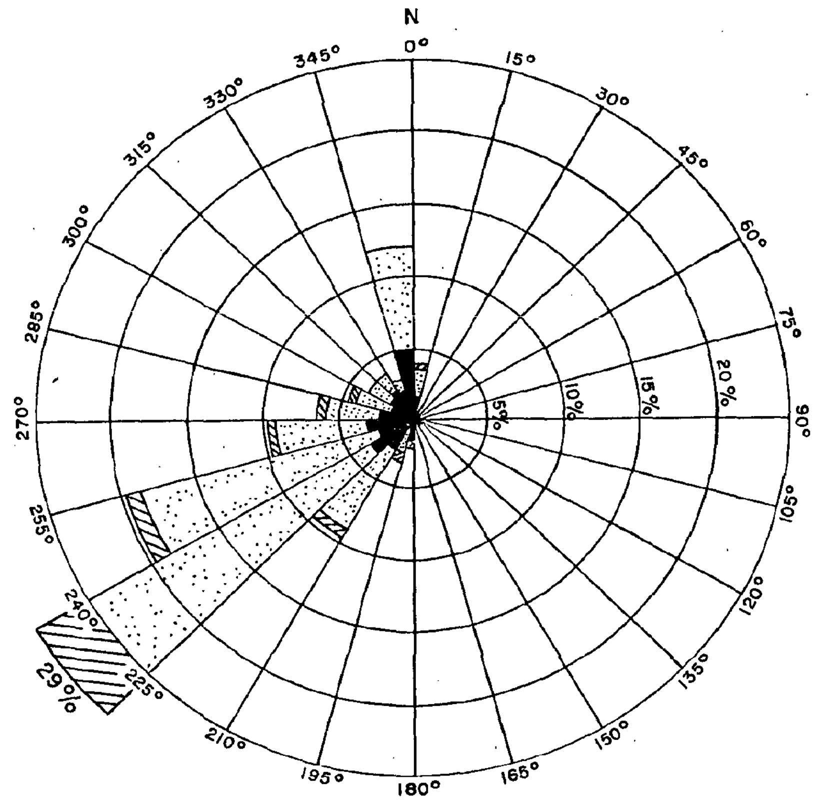
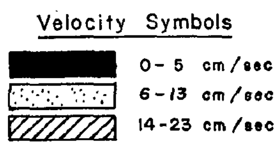
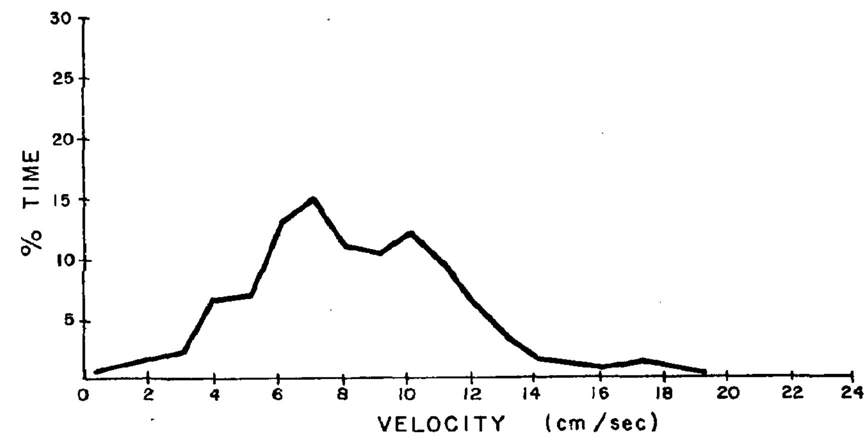


FIGURE VI-6
CURRENT ROSE AND VELOCITY PROFILES
TAFUNA 7-3-79 / 7-23-79



EBB TIDE CURRENT ROSE





VELOCITY PROFILE

FIGURE VI-7

CURRENT ROSE AND VELOCITY PROFILES

TAFUNA 7-3-79 / 7-23-79

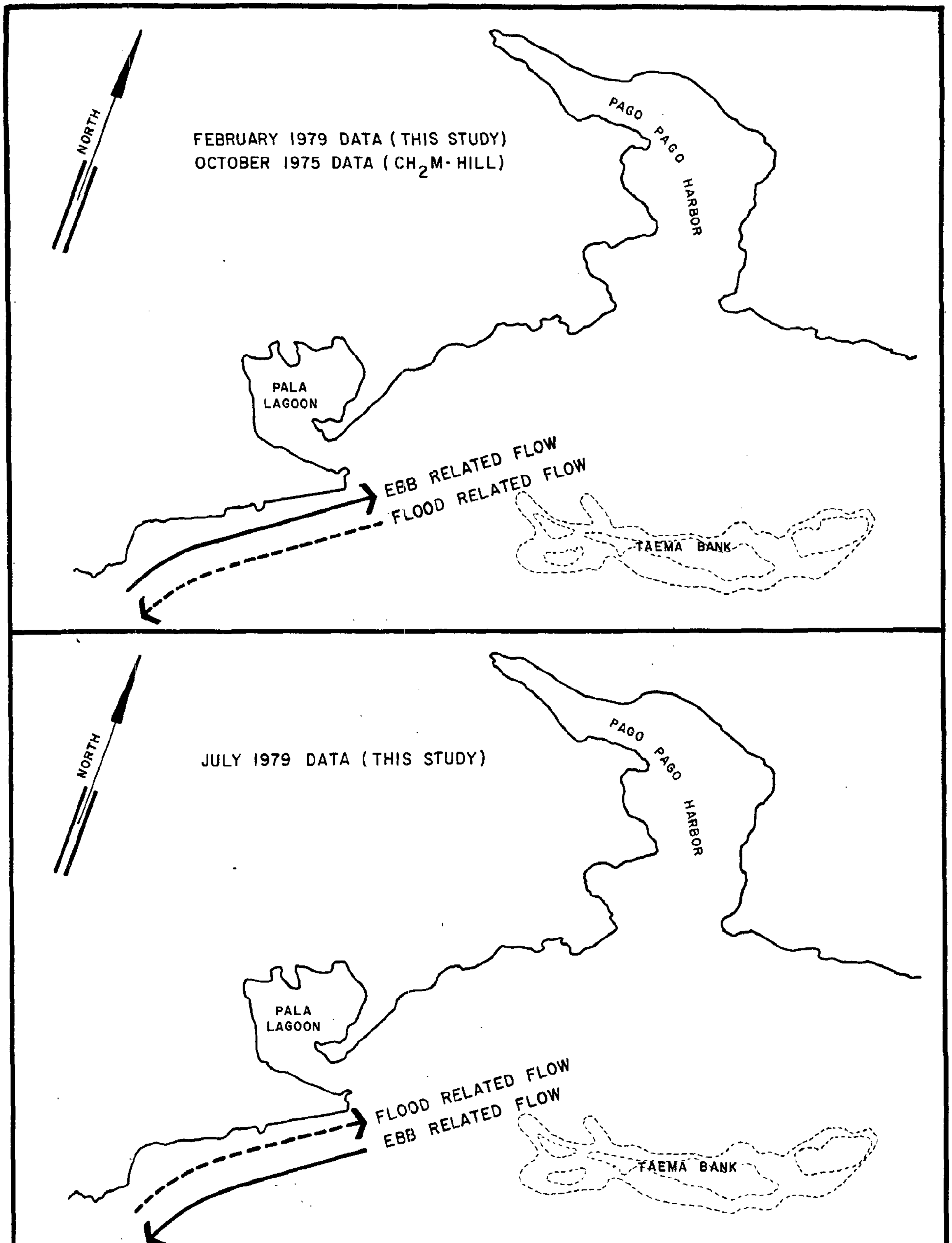


FIGURE VI-8

GENERAL TIDE RELATED LONG-SHORE
CURRENT PATTERN IN THE TAFUNA OUTFALL AREA

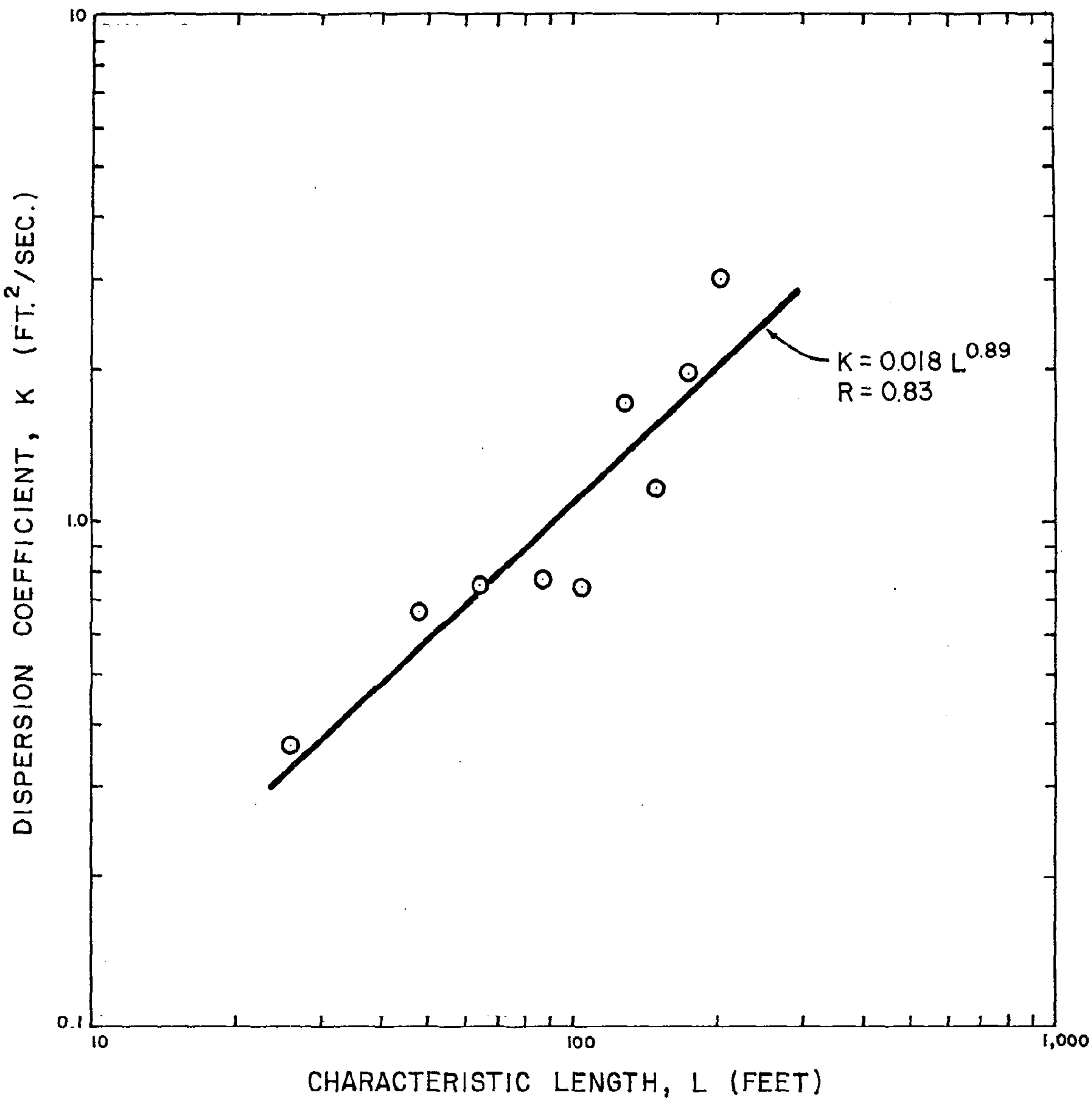


FIGURE VI-9

DISPERSION COEFFICIENT VS. CHARACTERISTIC LENGTH FOR THE TAFUNA OUTFALL AREA the dispersion coefficient and the characteristic length. As would be expected for this more exposed area, the data indicate more mixing energy than inside Pago Pago Harbor and a higher rate of increase of the dispersion coefficient with scale. These results appear to be typical for open coastal nearshore areas but do not quite show the 4/3 power increase with scale theoretically predicted for open ocean conditions (L.F. Richardson, 1926). This is presumably because of the confining influence of the shoreline and relatively shallow bottom on the eddy size distribution. The results of the measured relationship can be used in calculating the dispersion of the effluent plume subsequent to initial dilution.

COLIFORM DISAPPEARANCE RATE

The initial plan was to measure the T_{90} (the time for 90 percent of the coliform to disappear) at the existing Tafuna outfall. The Tafuna discharge, however, was too small and too intermittent due to wave surges to form a plume and could not be used for this type of test. Consequently, the test was conducted using the more than adequate plume at the Utulei outfall in Pago Pago Harbor. The results of these tests are given on Figures VI-10 and VI-11, and both indicate a T_{90} time of about one hour.

The results of the two tests agree with each other and are therefore believed to describe the disappearance rate in Pago Pago Harbor under the conditions of the tests. Similar measurements at other tropical and subtropical locations, however, have shown much shorter T_{90} values ranging from 15 to 30 minutes. Possibly the high turbidity in Pago Pago Harbor along with the generally overcast conditions that prevail during the field tests may have served to shield the fecal coliform from the bacteriacidal effects of direct sunlight as well as protect them from marine bacteria. It is possible that under the open coastal conditions found in the vicinity of the Tafuna outfall, the T_{90} time would be significantly shorter. Until this is determined, however, it would be necessary to plan to chlorinate any increased discharges in the nearshore areas at Tafuna.

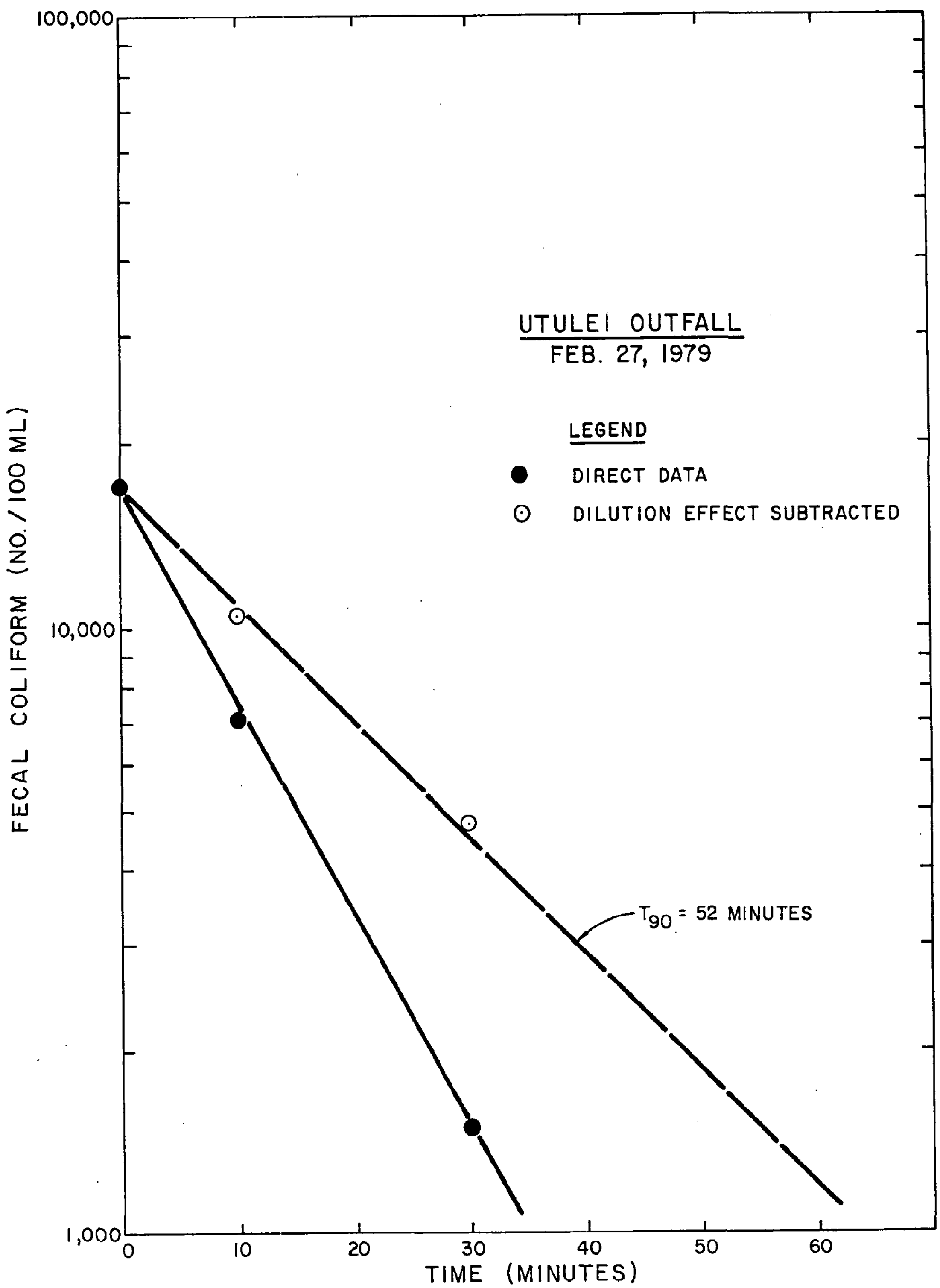


FIGURE VI-10

T_{90} DETERMINATION FOR FECAL COLIFORM (WET SEASON)

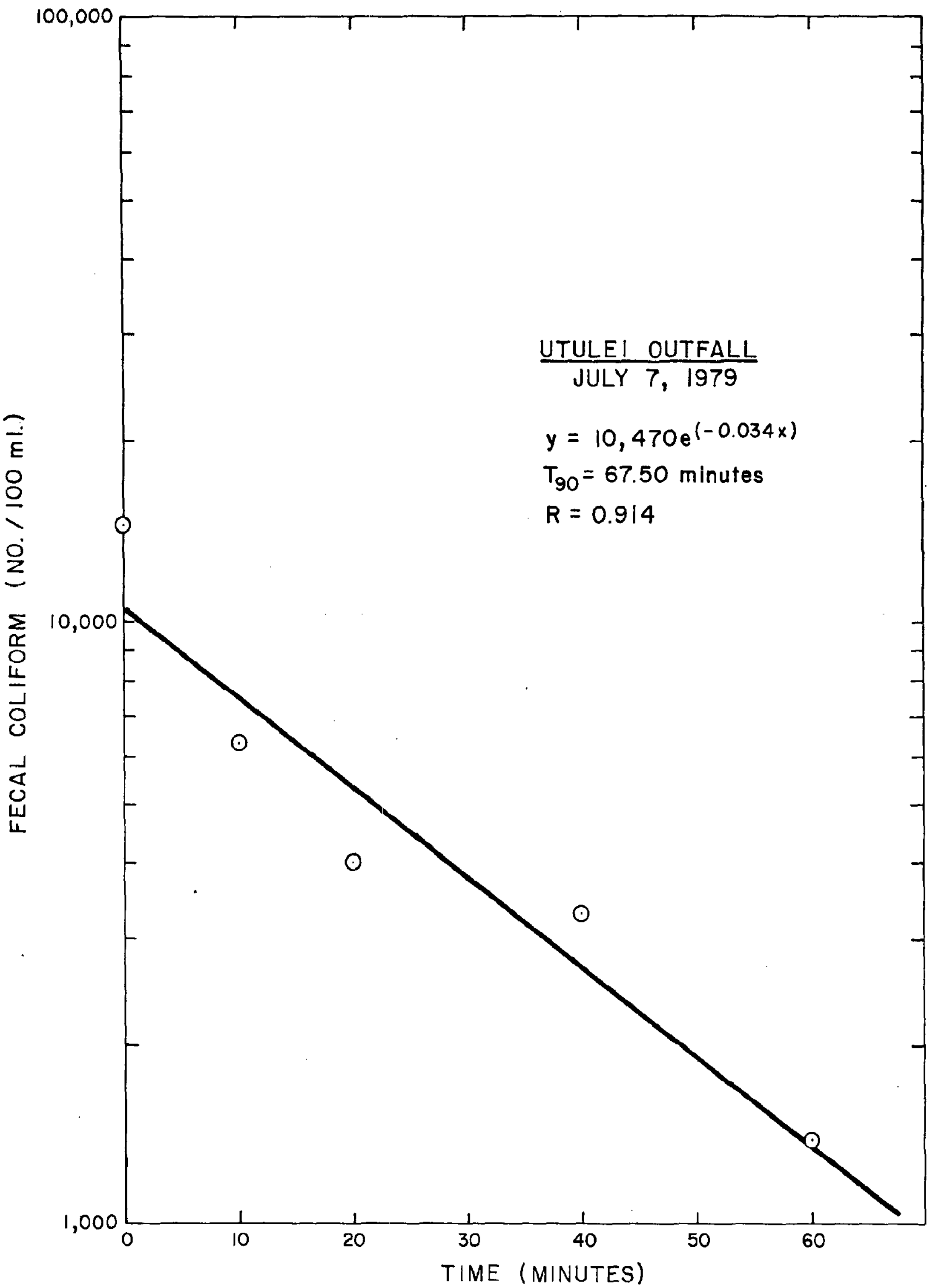


FIGURE VI-11

T_{90} DETERMINATION FOR FECAL COLIFORM (DRY SEASON)

The results of the T_{90} test along with the wind-related transport can be used to estimate the coliform concentration near the shoreline when no disinfecton is being applied.

CONCLUSION

The Tafuna area is a viable location for an expanded outfall if the diffuser is adequately sized to achieve good initial dilution and is located outside of the confines of the Vai Cove area. Care should be taken to adequately remove floatables and settleables and moderate chlorination should be practiced to control pathogens.

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APPENDIX A

TABLE A-1

"WET SEASON" WATER QUALITY SAMPLING RESULTS IN AMERICAN SAMOA

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temperature (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
2/13/79	1 (Taema Bank)	SUR	50	34.38	28.90	6.1	0.23	8.30	-	< 1	< 1
		5	-	-	-						
		10	20	34.35	-						
		15	-	-	28.64						
		20	10	-	-						
		30	10	-	-						
		40	10	-	-						
		50	5	34.40	28.60	5.8					
		60	5	-	-		0.24	8.30	-		
		70	4	-	-						
		80	4	-	-						
		90	4	-	-						
		100	4	34.40	28.70						
		110	4								
		120	3								
		150	2								
		170	1								
2/13/79	2 (Tafuna)	SUR	50	34.20	29.20	6.2	0.32	8.30	-	< 1	< 1
		10	20	34.30	29.10						
		20	10	34.40	29.00						
		30	10	34.40	28.90						
		40	9	34.40	28.90						
		50	5	34.40	28.80	5.8					
		60	5	34.40	28.80		0.18	8.30			
		70	5	34.40	28.80						
		80	5	34.45	28.75						
		90	-	34.45	28.75						
		100	4	34.50	28.70						
		110	3								
		120	2								
		140	1								

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temperature (^oC)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/l)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
2/13/79	3 (Tafuna)	SUR	50	33.80	29.40	6.4	0.26	8.33	-	<2	<2
		5	-	34.00	29.40						
		10	20	34.30	29.10						
		20	20	34.40	28.90						
		30	20	34.40	28.90						
		40	15	34.40	28.90						
		50	15	34.40	28.80	6.0					
		60	10	34.40	28.75		0.22	8.33	-		
		70	10	34.40	28.70						
2/13/79	4 (Tafuna)	SUR	50	33.80	29.40	6.3	0.27	8.32	-	<2	<2
		10	30	34.40	29.00						
		20	30	34.40	20.00						
		30	25	34.40	28.90						
		40	25	34.40	28.90						
		50	15	34.40	28.90	6.0					
		60	15	34.40	28.90		0.29	8.33	-		
2/14/79	5 (Pago)	SUR	50	34.40	29.10	5.9	0.33	8.30	-	<1	<1
		10	30	34.40	29.00						
		20	20	34.42	28.90						
		30	20	34.50	28.80						
		40	20	34.50	28.75						
		50	20	34.50	28.70	5.6					
		60	10	34.50	28.70		0.65	8.32	-		
		70	6	34.50	28.65						
		80	5	34.50	28.65						
		90	-	34.50	28.60						
		100	3	34.58	28.60						
		120	1								

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temperature (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
2/14/79	6	SUR	60	33.90	29.30	6.5	0.58	8.37	-	2	<1
	(Pago)	5	40	34.20	29.20						
		10	35	34.40	29.00						
		20	30	34.40	28.90						
		30	25	34.45	28.80						
		40	20	34.45	28.80						
		50	10	34.48	28.75	5.8					
		60	5	34.50	28.75		0.21	8.34	-		
		70	2	34.50	28.75						
		80	1	34.50	28.70						
		90		34.50	28.70						
		100		34.50	28.70						
2/14/79	7	SUR	50	34.00	29.20	6.2	0.33	8.37	-	<1	<1
	(Pago)	5	30	34.20	29.20						
		10	30	34.40	29.00						
		20	25	34.50	28.80						
		30	20	34.50	28.80						
		40	13	34.50	28.70						
		50	7	34.50	28.70	5.8					
		60	4	34.50	28.70		0.22	8.34	-		
		70	2.5	34.60	28.70						
		80	1.5	34.60	28.66						
		90	1	34.60	28.64						
		100		34.60	28.64						
2/14/79	8	SUR	50	33.90	29.40	6.2	0.54	8.33	-	<1	<1.
	(Pago)	5	30	34.30	29.10						
		10	20	34.55	29.00						
		20	20	34.55	28.90						
		30	15	34.60	28.80						
		40	12	34.60	28.75						
		50	10	34.65	28.75	5.9					
		60	8	34.65	28.70		0.18	8.33	-		
		70	2	34.65	28.70						
		80	1	34.65	28.70						
		90		34.65	28.70						
		100		34.65	28.65						

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temperature (^{o}C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
2/14/79	9 (Pago)	SUR	50	33.50	29.40	6.15	0.41	8.34	-	<1	<1
		5	30	34.30	29.10						
		10	25	34.40	29.10						
		20	10	34.50	28.90						
		30	15	34.50	28.80						
		40	8	34.55	28.70						
		50	4	34.55	28.70	5.9					
		60	2	34.60	28.70		0.18	8.33	-		
		70	1	34.60	28.70						
		80		34.60	28.65						
		90		34.60	28.65						
		100		34.60	28.65						
2/14/79	10 (Pago)	SUR	40	33.90	29.70	6.3	0.66	8.36	-	<1	<1
		5	20	34.00	29.60						
		10	13	34.00	29.10						
		20	9	34.55	28.90						
		30	6	34.55	28.80						
		40	4	34.60	28.80						
		50	2.5	34.60	28.80	5.8					
		60	1	34.60	28.80		0.21	8.33	-		
		70		34.60	28.80						
		80		34.60	28.75						
		90		34.60	28.75						
		100		34.60	28.70						
2/14/79	11 (Pago)	SUR	60	34.00	29.80	6.55	0.77	8.38	-	<1	<1
		5	20	34.10	29.75						
		10	8	34.30	29.35						
		20	6	34.50	29.00						
		30	5	34.55	28.90						
		40	4	34.55	28.85						
		50	2.5	34.60	28.80	5.85					
		60	1	34.60	28.75		0.25	8.33			
		70		34.60	28.75						
		80		34.60	28.70						
		90		34.60	28.70						
		100		34.60	28.70						

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temperature (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
2/14/79	12 (Pago)	SUR	60	33.80	30.00	6.0	0.73	8.34	-	< 1	<1
		5	35	34.00	30.00						
		10	25	34.30	29.50						
		20	10	34.45	29.10						
		30	5	34.55	28.90						
		40	2	34.60	28.90						
		50	1	34.60	28.70	5.6					
		60		34.60	28.70		0.25	8.31	-		
		70		34.60	28.70						
		80		34.60	28.70						
		90		34.60	28.70						
		100		34.60	28.70						
2/14/79	13 (Pago)	SUR	40	33.90	29.90	6.25	1.3	8.35	-	<1	<1
		5	13	33.90	29.90						
		10	3.5	33.90	29.90						
		15	-	34.40	29.30						
		20	1	34.50	29.00						
		30		34.60	28.90		0.62	8.25	-		
		40		34.60	28.80						
		50		34.60	28.80	4.6					
2/15/79	14 (Vatia off-shore)	SUR	50	34.40	29.00	6.3	0.21	8.25	-	4	<1
		10	30	34.40	29.00						
		20	30	34.45	29.00						
		30	20	34.45	28.95						
		40	15	34.45	28.90						
		50	15	34.45	28.90	6.1					
		60	5	34.50	28.90		0.17	8.25	-		
		70	5	34.50	28.80						
		80	4	34.50	28.80						
		90	4	34.50	28.80						
		100	4	34.50	28.80						
		110	2								
		120	1.5								
		130	1.5								
		140	1								

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temperature (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/l)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
2/15/79	15	SUR	40	34.40	29.20	6.3	0.18	8.24	-	< 1	< 1
	(Vatia Bay)	10	30	34.40	29.10						
		20	20	34.45	29.00						
		30	15	34.50	29.00						
		40	10	34.50	29.00						
		50	8	34.50	29.00	6.0					
		60	6	34.50	29.00		0.19	8.25	-		
		70	3	34.50	28.90						
2/15/79	16	SUR	50	34.50	29.20	6.3	0.18	8.30	-	< 1	< 1
	(Fagasa	10	30	34.50	29.10						
	Offshore)	20	20	34.60	29.00						
		30	10	34.60	29.00						
		40	10	34.60	28.90						
		50	10	34.60	28.90	6.1					
		60	10	34.60	28.90		0.16	8.30	-		
		70	10	34.60	28.90						
		80	10	34.60	28.80						
		90	9	34.60	28.80						
		100	8	34.60	28.80						
		110	6								
		120	5								
		130	3.5								
		140	3								
		150	2								
		160	2								
		170	2								
		180	1								
2/15/79	17	SUR	40	34.50	29.50	6.8	0.19	8.30	-	< 1	< 1
	(Fagasa	10	25	34.60	29.00						
	Bay)	20	15	34.60	28.90						
		30	10	34.60	28.90						
		40	10	34.60	28.90						
		50	10	34.60	28.90	6.0					
		60	9	34.60	28.90		0.21	8.30	-		
		70	[illegible]	34.60	[illegible]						

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temperature (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
2/19/79	5	SUR	60	34.50	28.70	6.0	0.25	8.00	3.2	<1	<1
	(Pago)	10	20	34.50	28.60						
		20	20	34.60	28.50						
		30	15	34.60	28.50						
		40	10	34.60	28.50						
		50	8	34.60	28.50	5.9					
		60	6	34.60	28.50		0.21	8.00	7.3		
		70	4	34.60	28.50						
		80	3	34.64	28.50						
		90	2.5	34.64	28.50						
		100	2	34.64	28.50						
		110	1.75								
		120	1.50								
		130	1.0								
2/19/79	6	SUR	-	32.60	28.05	6.4	0.30	8.07	1.5	<2	<2
	(Pago)	5		34.50	28.50						
		10		34.50	28.50						
		20		34.50	28.50						
		30		34.60	28.60						
		40		34.60	28.70						
		50		34.60	28.70	5.6					
		60		34.60	28.60		0.21	8.10	2.5		
		70		34.60	28.60						
		80		34.63	28.60						
2/19/79	7	SUR	-	34.30	28.50	6.0	0.42	8.13	3.0	<2	<2
	(Pago)	10		34.30	28.50						
		20		34.30	28.50						
		30		34.60	28.80						
		40		34.60	28.70						
		50		34.60	28.60	5.7					
		60		34.60	28.60		0.15	8.13	2.3		
		70		34.62	28.60						
		80		34.66	28.60						
		90		34.63	28.60						
		100		34.64	28.60						

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temperature (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/l)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
2/19/79	8	SUR	-	33.00	28.00	6.1	0.49	8.13	2.8	< 2	< 2
	(Pago)	5		33.90	28.50						
		10		34.60	28.60						
		20		34.60	28.60						
		30		34.60	28.70						
		40		34.60	28.65						
		50		34.60	28.60	5.8					
		60		34.60	28.60		0.25	8.17	1.9		
		70		34.60	28.60						
		80		34.60	28.60						
		90		34.60	28.60						
		100		34.60	28.60						
2/19/79	9	SUR	-	28.70	26.90	5.6	1.60	8.00	3.1	< 2	< 2
	(Pago)	5		29.60	27.10						
		10		34.60	28.70						
		20		34.60	28.70						
		30		34.60	28.65						
		40		34.60	28.65						
		50		34.65	28.60	5.9					
		60		34.65	28.60		0.20	8.17	1.6		
		70		34.65	28.65						
		80		34.65	28.65						
		90		34.65	28.65						
		100		34.65	28.65						
2/19/79	10	SUR	-	32.40	27.90	5.9	0.55	8.12	2.2	<2	<2
	(Pago)	5		34.00	28.40						
		10		34.60	28.70						
		20		34.60	28.70						
		30		34.60	28.70						
		40		34.60	28.70						
		50		34.64	28.70	5.7					
		60		34.65	28.70		0.43	8.17	3.5		
		70		34.66	28.70						
		80		34.66	28.70						
		90		34.66	28.70						
		100		34.66	28.70						

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temperature (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
2/19/79	11 (Pago)	SUR	-	31.40	27.80	5.8	0.66	8.12	6.1	<2	<2
		5		32.00	28.00						
		10		34.60	28.70						
		20		34.60	28.70						
		30		34.60	28.70						
		40		34.60	28.60						
		50		34.65	28.60	5.8					
		60		34.65	28.60		0.21	8.18	3.5		
		70		34.65	28.65						
		80		34.65	28.65						
		90		34.65	28.65						
		100		34.65	28.65						
2/19/79	12 (Pago)	SUR	-	32.30	28.10	5.5	1.10	8.12	3.6	<2	<2
		5		33.80	28.40						
		10		34.60	28.70						
		20		34.62	28.70						
		30		34.64	28.80						
		40		34.64	28.70						
		50		34.65	28.70	5.3					
		60		34.65	28.70		0.29	8.12	0.7		
		70		34.65	28.70						
		80		34.65	28.65						
		90		34.65	28.65						
		100		34.65	28.65						
2/19/79	13 (Pago)	SUR	-	32.00	28.20	5.0	3.30	8.08	8.2	-	-
		5		34.40	28.70						
		10		34.60	28.70						
		20		34.65	28.70						
		30		34.65	28.70						
		40		34.65	28.70	4.5	1.00	8.00	3.2		

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temperature (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
2/21/79	14 (Vàtia Off Shore)	SUR	-	34.30	28.80	6.2	0.22	8.30	1.07	-	-
		10		34.30	28.80						
		20		34.35	28.60						
		30		34.40	28.60						
		40		34.45	28.60						
		50		34.45	28.50	6.1					
		60		34.45	28.50		0.33	8.31	1.33		
		70		34.45	28.50						
		80		34.45	28.50						
		90		34.46	28.50						
		100		34.45	28.50						
2/21/79	15 (Vàtia Bay)	SUR	-	32.00	29.70	7.0	0.58	8.30	1.67	-	-
		10		34.00	28.70						
		20		34.40	28.70						
		30		34.45	28.70						
		40		34.45	28.70	6.1	0.60	8.30	3.07		
2/21/79	16 (Fagasa Off Shore)	SUR	-	34.40	29.00	6.1	0.22	8.31	1.27	-	-
		10		34.40	28.90						
		20		34.50	28.80						
		30		34.50	28.70						
		40		34.50	28.50						
		50		34.50	28.50	6.0					
		60		34.50	28.50		0.47	8.32	1.60		
		70		34.50	28.50						
		80		34.54	28.50						
		90		34.55	28.50						
		100		34.55	28.50						
2/21/79	17 (Fagasa Bay)	SUR	-	33.20	29.20	7.0	0.48	8.33	2.00	-	-
		10		34.20	28.70						
		20		34.50	28.60						
		30		34.55	28.60						
		40		34.54	28.50						
		50		34.55	28.50	6.0					
		60		34.55	28.50		0.38	8.33	1.93		

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temperature (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
2/22/79	1	SUR	-	34.60	28.80	6.03	0.20	8.29	1.47	-	-
	(Taema Bank)	10		34.60	28.75						
		20		34.65	28.70						
		30		34.65	28.75						
		40		34.65	28.70						
		50		34.65	28.60	6.00					
		60		34.65	28.60		0.15	8.29	1.73		
		70		34.65	28.60						
		80		34.65	28.60						
		90		34.65	28.60						
		100		34.65	28.60						
2/22/79	Dump Site No. 1	SUR	-	34.60	28.70	6.0	0.15	8.31	2.13	-	-
		10		34.60	28.60						
		20		34.60	28.60						
		30		34.60	28.60						
		40		34.64	28.60						
		50		34.65	28.56	5.9					
		60		34.65	28.55		0.24	8.32	1.87		
		70		34.65	28.50						
		80		34.65	28.50						
		90		34.65	28.50						
		100		34.65	28.50						
2/22/79	Dump Site No. 2	SUR	-	34.50	28.80	6.0	0.17	8.33	2.27	-	-
		10		34.60	28.80						
		20		34.55	28.70						
		30		34.60	28.70						
		40		34.60	28.65						
		50		34.62	28.60	5.9					
		60		34.64	28.60		0.15	8.32	1.47		
		70		34.64	28.60						
		80		34.65	28.60						
		90		34.65	28.60						
		100		34.65	28.60						

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temperature (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
2/22/79	4 (Tauna)	SUR	-	34.42	28.90	6.1	0.17	8.32	2.00	-	-
		10		34.46	28.90						
		20		34.46	28.90						
		30		34.50	28.80						
		40		34.50	28.80						
		50		34.50	28.68	5.9	0.21	8.33	2.33	-	-
		60		34.50	28.65						
		70		34.50	28.60						
		80		34.55	28.60						
		90		34.57	28.60						
		100		34.57	28.60						
2/22/79	3 (Tafuna)	SUR	-	34.40	29.00	6.1	0.15	8.33	2.67	-	-
		10		34.38	29.00						
		20		34.45	28.70						
		30		34.45	28.70						
		40		34.48	28.60						
		50		34.52	28.60	5.95					
		60		34.52	28.60		0.16	8.33	2.33		
2/22/79	2 (Tafuna)	SUR	-	34.40	28.90	5.95	0.19	8.30	2.47	-	-
		10		34.50	28.85						
		20		34.54	28.70						
		30		34.60	28.60						
		40		34.60	28.64						
		50		34.60	28.60	5.90	0.17	8.33	2.60		
		60		34.60	28.60						
		70		34.60	28.60						
		80		34.60	28.60						
		90		34.60	28.60						
		100		34.60	28.60						

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temperature (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
3/1/79	"Tau" (Manua)	SUR	-	34.60	28.80	6.3	0.27	8.30	-	-	-
		10		34.60	28.70						
		20		34.62	28.70						
		30		34.62	28.70						
		40		34.63	28.70						
		50		34.63	28.70	6.0					
		60		34.63	28.70		0.24	8.27			
		70		34.62	28.68						
		80		34.62	28.68						
		90		34.63	28.65						
		100		34.63	28.65						
3/1/79	"Ofu" (Manua)	SUR	-	34.60	29.30	6.2	0.21	8.30	-	-	-
		10		34.60	29.10						
		20		34.60	29.00						
		30		34.60	28.90						
		40		34.60	28.90						
		50		34.60	28.80	6.1					
		60		34.60	28.80		0.18	8.30			
		70		34.62	28.80						
		80		34.63	28.80						
		90		34.63	28.80						
		100		34.63	28.80						
3/3/79	5 (Pago)	SUR	-	-	-	-	0.30	-	2.2		
		60					0.30		2.3		
	6 (Pago)	SUR	-	-	-	-	0.39	-	3.0	-	-
		60					0.28		2.7		
	7 (Pago)	SUR	-	-	-	-	0.33	-	2.6	-	-
		60					0.21		2.5		
	8 (Pago)	SUR	-	-	-	-	0.45	-	9.4*	-	-
		60					0.27		2.4		
	9 (Pago)	SUR	-	-	-	-	0.51	-	3.6	-	-
		60					0.33		2.4		

* "Salt spots on drying dish".

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temperature (^oC)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)
	10	SUR	-	-	-	-	0.51	-	3.8	-	-
	(Pago)	60					0.47		3.1		
	11	SUR	-	-	-	-	0.87	-	15.0*		
	(Pago)	60					0.28		3.2		
	12	SUR	-	-	-	-	1.30	-	6.4		
	(Pago)	60					0.40		4.4		
	13	SUR	-	-	-	-	2.80	-	9.1		
	(Pago)	60					1.30		19.6		

* "Salt spots on drying dish".

TABLE A-2

"DRY SEASON" WATER QUALITY SAMPLING RESULTS IN AMERICAN SAMOA

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
7/3/79	Dump Site No. 1	Sur	50	33.37	28.10	5.75	0.16	8.19	2.2	<1
		5	40	33.42	28.10					
		10	30	33.42	28.10					
		20	30	33.42	28.10					
		30	30	33.42	28.10					
		40	20	33.42	28.10					
		50	20	33.47	28.10	5.75				
		60	20	33.47	28.05		0.12	8.20	2.2	
		70	15	33.47	28.05					
		80	10	33.47	28.05					
		90	7	33.47	28.05					
		100	7	33.47	28.05					
		110	7							
		120	7							
		130	6							
		140	5							
		150	4							
		160	3							
		170	1							
		300	-				0.13	8.22	2.5	
7/3/79	1 (Taema Bank)	Sur	60	33.42	28.20	5.85	0.08	8.23	1.0	<1
		5	50	33.45	28.20					
		10	40	33.42	28.20					
		20	40	33.42	28.20					
		30	40	33.42	28.20					
		40	30	33.42	28.15					
		50	25	33.42	28.15	5.75				
		60	17	33.47	28.10		0.13	8.23	0.9	

Table A-2, Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
	1 Cont.	70	12	33.47	28.10					
		80	9	33.47	28.10					
		90	7	33.47	28.10					
		100	5	33.47	28.10					
		110	3							
		120	2.5							
		130	2.0							
		140	1.0							
7/3/79	2	Sur	50	33.37	28.20	6.20	0.13	8.23	1.7	<1
	(Tafuna)	5	40	33.42	28.15					
		10	40	33.42	28.15					
		20	30	33.42	28.15					
		30	30	33.42	28.15					
		40	25	33.42	28.15					
		50	20	33.42	28.00	5.90				
		60	15	33.42	28.01		0.11	8.24	0.8	
		70	13	33.42	28.00					
		80	10	33.42	28.05					
		90	8	33.42	28.00					
		100	7	33.42	28.00					
		110	5	33.42						
		120	3	33.42						
		130	3	33.42						
		140	1	33.42						
7/3/79	3	Sur	50	33.27	28.20	6.45	0.23	8.24	2.2	<1
	(Tafuna)	5	40	33.37	28.20					
		10	40	33.37	28.15					
		20	30	33.42	28.15					

Table A-2 Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
	3 Cont.	30	25	33.42	28.15					
		40	20	33.40	28.15					
		50	15	33.47	28.00	5.95	0.16	8.23	4.4	
		60	Bottom							
7/3/79	4	Sur	50	33.37	28.20	6.00	0.18	8.22	2.2	<1
	(Tafuna)	5	40	33.42	28.20					
		10	30	33.42	28.20					
		20	25	33.42	28.20					
		30	20	33.42	28.15					
		40	20	33.42	28.15					
		50	16	33.42	28.10	5.85				
		60	14	33.42	28.10		0.18	8.25	2.1	
		70	11	33.42	28.10					
		80	9	33.42	28.10					
		90	7	33.42	28.10					
		100	5	33.42	28.10					
		110	4							
		120	3							
		130	3							
		140	3							
		150	1							
7/5/79	5	Sur	50	33.49	28.20	6.05	0.23	8.30	1.1	<1
	(Pago)	5	40	33.47	28.20					
		10	30	33.47	28.15					
		20	20	33.47	28.15					
		30	20	33.47	28.15					
		40	15	33.47	28.10					
		50	7	33.47	28.10	5.85				

Table A-2, Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
	5 Cont.	60	7	33.47	28.10		0.13	8.35	1.1	
		70	5	33.47	28.10					
		80	3	33.47	28.10					
		90	2	33.47	28.10					
		100	1	33.47	28.10					
7/5/79	6	Sur	60	33.27	28.20	5.90	0.23	8.23	0.8	<1
	(Pago)	5	50	33.27	28.20					
		10	50	33.37	28.20					
		20	35	33.47	28.15					
		30	15	33.47	28.15					
		40	10	33.47	28.15					
		50	7	33.47	28.15	5.75				
		60	7	33.47	28.10		0.16	8.32	1.3	
		70	4	33.47	28.10					
		80	2	33.47	28.10					
		90	2	33.47	28.10					
		100	1	33.47	28.10					
7/5/79	7	Sur	60	33.27	28.20	6.25	0.26	8.28	1.2	6
	(Pago)	5	50	33.27	28.20					
		10	40	33.37	28.20					
		20	28	33.47	28.20					
		30	19	33.47	28.15					
		40	13	33.47	28.15					
		50	8	33.47	28.13	5.80				
		60	5	33.52	28.13		0.23	8.33	1.3	
		70	3	33.47	28.10					
		80	2	33.47	28.10					
		90	1.5	33.47	28.10					
		100	1	33.47	28.10					

Table A-2, Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
7/5/79	8	Sur	60	33.27	28.20	6.35	0.38	8.28	1.5	<1
	(Pago)	5	30	33.37	28.15					
		10	22	33.37	28.15					
		20	16	33.47	28.10					
		30	10	33.47	28.10					
		40	7	33.47	28.10					
		50	4.5	33.47	28.10	5.85				
		60	3	33.47	28.10		0.23	8.30	1.0	
		70	2	33.47	28.10					
		80	1.4	33.47	28.05					
		90	1	33.47	28.05					
		100	-	33.47	28.05					
7/5/79	9	Sur	70	33.27	28.20	5.85	0.38	8.26	1.6	<1
	(Pago)	5	40	33.27	28.20					
		10	35	33.37	28.15					
		20	25	33.37	28.10					
		30	15	33.47	28.10					
		40	8	33.47	28.10					
		50	4.5	33.47	28.10	5.75				
		60	2.2	33.47	28.10		0.40	8.33	1.5	
		70	1 @ 73'	33.47	28.10					
		80	-	33.47	28.10					
		90	-	33.47	28.10					
		100	-	33.47	28.10					

Table A-2, Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
7/5/79	10 (Pago)	Sur	60	33.27	28.20	5.75	0.31	8.30	1.8	<1
		5	30	33.32	28.15					
		10	25	33.37	28.15					
		20	20	33.37	28.15					
		30	13	33.47	28.15					
		40	7.5	33.47	28.15					
		50	4.5	33.47	28.15	5.45				
		60	3	33.47	28.10		0.23	8.30	1.3	
		70	2	33.47	28.10					
		80	1@85'	33.47	28.10					
		90	–	33.47	28.10					
		100	–	33.47	28.10					
7/5/79	11 (Pago)	Sur	60	33.37	28.20	6.10	0.48	8.33	2.1	<1
		5	35	33.37	28.20					
		10	20	33.37	28.20					
		20	7.5	33.42	28.20					
		30	3	33.42	28.18					
		40	1.3	33.47	28.15					
		50	1@43'	33.47	28.10	5.50				
		60	–	33.47	28.10		0.53	8.30	1.5	
		70	–	33.47	28.10					
		80	–	33.47	28.10					
		90	–	33.47	28.10					
		100	–	33.47	28.10					

Table A-2, Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
7/5/79	12 (Pago)	Sur	60	33.17	28.20	5.80	0.58	8.28	2.2	<1
		5	40	33.27	28.20					
		10	25	33.47	28.20					
		20	4.5	33.47	28.15					
		30	1.5	33.47	28.15					
		40	1 @ 33'	33.47	28.15					
		50	–	33.47	28.15	5.45				
		60	–	33.47	28.15		0.68	8.30	2.0	
		70	–	33.47	28.10					
		80	–	33.47	28.10					
		90	–	33.47	28.10					
		100	–	33.47	28.10					
7/5/79	13 (Pago)	Sur	50	33.27	28.30	5.00	0.78	8.25	3.4	28
		5	30	33.37	28.30					
		10	13	33.37	28.30					
		20	1.5	33.37	28.20					
		30	1 @ 21'	33.47	28.20	4.45	3.70	8.28	5.2	
7/6/79	14 (Vatia – Offshore)	Sur	40	33.37	28.30	6.20	0.13	8.25	1.4	<1
		5	20	33.47	28.30					
		10	20	33.47	28.25					
		20	20	33.47	28.20					
		30	20	33.47	28.20					
		40	18	33.47	28.20					
		50	15	33.51	28.20	5.90				
		60	10	33.51	28.20		0.11	8.25	1.0	
		70	9	33.52	28.20					
		80	7	33.52	28.20					
		90	5	33.57	28.20					

Table A-2 Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
	14 Cont.	100	4.5	33.57	28.20					
		110	3.5							
		120	3							
		130	2.5							
		140	2							
		150	1.5							
		160	1.3							
		170	1							
7/6/79	15 (Vatia Bay)	Sur	45	33.17	28.40	5.80	0.18	8.20	0.6	2
		5	30	33.37	28.30					
		10	30	33.47	28.30					
		20	25	33.47	28.30					
		30	20	33.47	28.20					
		40	15	33.47	28.20					
		50	9	33.47	28.20	5.60				
		60	6	33.47	28.15		0.17	8.23	1.3	
		70	4	33.47	28.15					
		80	2	33.47	28.10					
		90	2	33.47	28.10					
		100	Bottom							
7/6/79	16 (Fagasa - Offshore)	Sur	60	33.27	28.10	6.00	0.16	8.25	1.5	<1
		5	50	33.47	28.20					
		10	35	33.52	28.20					
		20	30	33.57	28.15					
		30	20	33.57	28.10					
		40	15	33.57	28.10					
		50	15	33.57	28.10	5.80				
		60	9	33.57	28.10		0.14	8.23	0.9	

Table A-2, Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/l)	Fecal Coliform (#/100 ml)
	16 Cont.	70	7	33.62	28.10					
		80	6	33.62	28.10					
		90	3	33.62	28.10					
		100	2	33.62	28.10					
		110	2							
		120	1.5							
		130	1.5							
		140	1.5							
		150	1.5							
		160	1.5							
		170	1.5							
		180	1.0							
7/6/79	17	Sur	50	33.16	28.10	4.40	0.18	8.25	1.2	20
	(Fagasa Bay)	5	30	33.47	28.30					
		10	30	33.47	28.30					
		20	25	33.47	28.25					
		30	20	33.47	28.20					
		40	18	33.47	28.20					
		50	15	33.47	28.18	5.90				
		60	10	33.47	28.18		0.19	8.25	1.1	
		70	Bottom							
7/10/79	Dump Site No. 1	Sur	60	33.47	28.10	6.30	0.14	8.13	1.4	<1
		5	50	33.47	28.10					
		10	40	33.47	28.10					
		20	35	33.47	28.05					
		30	30	33.47	28.05					
		40	25	33.47	28.05					
		50	20	33.47	28.05	6.20				

Table A-2, Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
	Dump Site No. 1	60	15	33.47	28.00		0.17	8.11	0.7	
	Cont.	70	13	33.47	28.00					
		80	8.5	33.47	28.00					
		90	7	33.47	28.00					
		100	5.5	33.47	28.00					
		110	4.5							
		120	3.8							
		130	3							
		140	2.5							
		150	2							
		160	1.8							
		170	1.5							
		180	1							
		300	-				0.13	8.10	1.1	
7/10/79	1	Sur	70	33.47	28.10	6.30	0.18	8.18	0.9	<1
	(Taema Bank)	5	50	33.47	28.10					
		10	50	33.47	28.10					
		20	40	33.52	28.10					
		30	35	33.52	28.00					
		40	30	33.52	28.00					
		50	25	33.52	28.00	6.30				
		60	19	33.47	28.00		0.19	8.19	0.4	
		70	15	33.47	28.00					
		80	13	33.47	28.00					
		90	10	33.47	28.00					
		100	8.5	33.47	28.00					
		110	7							
		120	5.5							
		130	4.5							

Table A-2, Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
	1 Cont.	140	4							
		150	3							
		160	2							
		170	1							
7/10/79	2 (Tafuna)	Sur	50	33.32	28.15	6.30	0.17	8.19	0.6	<1
		5	35	33.47	28.15					
		10	30	33.47	28.10					
		20	25	33.47	28.10					
		30	17	33.47	28.05					
		40	17	33.47	28.05					
		50	15	33.47	28.05	6.20				
		60	12	33.47	28.05		0.16	8.19	1.0	
		70	9.5	33.47	28.05					
		80	7.5	33.47	28.00					
		90	6	33.47	28.00					
		100	5	33.47	28.00					
		110	4							
		120	3							
		130	2.5							
		140	2							
		150	1.8							
		160	1.5							
		170	1.3							
		180	1							

Table A-2, Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
7/10/79	3 (Tafuna)	Sur	50	32.97	28.15	6.30	0.18	8.19	0.2	<1
		5	35	33.27	28.10					
		10	25	33.47	28.10					
		20	20	33.47	28.10					
		30	14	33.47	28.10					
		40	10	33.47	28.10					
		50	9	33.47	28.05	6.30	0.18	8.19	0.8	
		55	Bottom							
7/10/79	4 (Tafuna)	Sur	55	32.97	28.20	6.30	0.15	8.22	0.7	<1
		5	50	33.47	28.20					
		10	35	33.47	28.20					
		20	30	33.47	28.15					
		30	22	33.47	28.10					
		40	18	33.47	28.10					
		50	10	33.47	28.10	6.10				
		60	12	33.47	28.05		0.13	8.22	0.4	
		70	12	33.47	28.05					
		80	9	33.47	28.05					
		90	7	33.47	28.05					
		100	5	33.47	28.05					
		110	4							
7/11/79	5 (Pago)	Sur	60	33.30	28.10	6.30	0.19	8.30	0.7	<1
		5	40	33.42	28.05					
		10	25	33.47	28.05					
		20	20	33.47	28.05					
		30	12	33.47	28.00					
		40	8	33.47	28.00					
		50	5	33.47	28.00	6.20				

Table A-2, Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
	5 Cont.	60	3.2	33.47	28.00					
		70	2	33.47	27.98					
		80	1.5	33.47	27.98					
		90	1	33.47	27.98					
		100	-	33.47	27.98					
7/11/79	6 (Pago)	Sur	80	33.37	28.05	6.40	0.24	8.28	1.5	<1
		5	40	33.37	28.05					
		10	36	33.47	28.00					
		20	28	33.47	28.00					
		30	20	33.47	28.00					
		40	14	33.47	28.00					
		50	9	33.47	28.00	6.30				
		60	5.5	33.47	28.00		0.18	8.32	1.1	
		70	3.6	33.47	28.00					
		80	1.6	33.47	28.00					
		90	1@86'	33.47	28.00					
		100	-	33.47	28.00					
7/11/79	7 (Pago)	Sur	55	33.07	27.90	7.00	0.42	8.32	1.4	<1
		5	40	33.27	27.90					
		10	35	33.41	28.00					
		20	13	33.41	28.00					
		30	6	33.47	28.00					
		40	3	33.47	28.00					
		50	4	33.45	28.00	6.25				
		60	2.5	33.47	28.00		0.28	8.30	1.3	
		70	1@68'	33.47	28.00					
		80	-	33.47	28.00					
		90	-	33.47	28.00					
		100	-	33.47	28.00					

Table A-2, Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
7/11/79	8	Sur	45	33.27	28.00	7.35	0.43	8.35	2.0	<1
	(Pago)	5	25	33.27	27.90					
		10	22	33.27	27.90					
		20	7	33.37	28.00					
		30	5	33.45	28.00					
		40	1.9	33.47	28.00					
		50	1	33.47	27.98	6.25				
		60	-	33.47	28.00		0.28	8.30	1.1	
		70	-	33.47	28.00					
		80	-	33.47	28.00					
		90	-	33.47	28.00					
		100	-	33.47	28.00					
7/11/79	9	Sur	55	33.07	28.20	7.35	0.47	8.32	1.7	<1
	(Pago)	5	35	33.07	28.20					
		10	25	33.15	28.10					
		20	4	33.22	28.00					
		30	1.8	33.47	28.10					
		40	1@35'	33.47	28.10					
		50	-	33.47	28.08	5.90				
		60	-	33.45	28.10		0.32	8.32	1.0	
		70	-	33.47	28.00					
		80	-	33.47	28.00					
		90	-	33.47	28.00					
		100	-	33.47	28.00					

Table A-2, Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
7/11/79	10 (Pago)	Sur	55	33.16	28.20	7.50	0.48	8.36	1.7	<1
		5	30	33.27	28.20					
		10	18	33.37	28.10					
		20	8.5	33.42	28.00					
		30	3.8	33.47	28.00					
		40	1.9	33.47	28.00					
		50	1	33.47	28.05	6.00				
		60	-	33.47	28.00		0.23	8.32	1.1	
		70	-	33.47	28.00					
		80	-	33.47	28.00					
		90	-	33.47	28.00					
		100	-	33.47	28.00					
7/11/79	11 (Pago)	Sur	60	33.01	28.30	7.60	0.91	8.38	3.6	<1
		5	18	33.07	28.20					
		10	3	33.07	28.20					
		20	1	33.27	28.10					
		30	-	33.37	28.10					
		40	-	33.45	28.04					
		50	-	33.47	28.00	5.90				
		60	-	33.47	28.00		0.69	8.30	1.8	
		70	-	33.47	28.03					
		80	-	33.47	27.98					
		90	-	33.47	28.00					
		100	-	33.47	28.02					

Table A-2, Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
7/11/79	12	Sur	55	32.97	28.50	7.80	1.20	8.40	4.0	<1
	(Pago)	5	13	33.07	28.40					
		10	1.7	33.16	28.10					
		20	1@12'	33.27	28.10					
		30	–	33.37	28.08					
		40	–	33.47	28.10					
		50	–	33.47	28.10	5.60				
		60	–	33.47	28.05		1.40	8.30	2.8	
		70	–	33.47	28.00					
		80	–	33.47	27.95					
		90	–	33.47	28.00					
		100	–	33.47	28.00					
7/11/79	13	Sur	50	31.39	28.80	9.00	1.70	8.53	6.1	<1
	(Pago)	5	7.5	32.76	28.45					
		10	1.7	33.27	28.20					
		20	1@11'	33.27	28.10					
		30	–	33.37	28.10	4.40	4.00	8.23	7.3	
7/12	"Tau"	Sur	45	33.37	28.50	6.30	0.14	8.30	0.4	–
		5	30	33.47	28.50					
		10	25	33.47	28.50					
		20	20	33.47	28.50					
		30	15	33.47	28.50					
		40	10	33.47	28.45					
		50	10	33.47	28.45	6.00				
		60	9	33.47	28.40		0.13	8.28	0.3	
		70	8	33.47	28.40					
		80	6	33.47	28.40					
		90	5	33.47	28.40					

Table A-2, Cont.

Date	Station No. (Location)	Depth (ft)	Relative Irradiance (%)	Salinity (o/oo)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/1)	Fecal Coliform (#/100 ml)
	"Tau" Cont.	100	4	33.47	28.40					
		110	3							
		120	2.5							
		130	2							
		140	1.7							
		150	1.5							
		160	1.3							
		165	1							
7/12/79	"Ofu"	Sur	45	33.47	28.60	6.40	0.11	8.32	0.1	-
		5	25	33.47	28.60					
		10	20	33.47	28.55					
		20	20	33.52	28.50					
		30	15	33.52	28.50					
		40	10	33.47	28.50					
		50	10	33.47	28.50	6.10	0.14	8.30	0.6	
		60	10	33.47	28.50					
		70	8	33.47	28.45					
		80	7	33.52	28.45					
		90	6	33.52	28.45					
		100	5	33.52	28.45					
		110	4							
		120	3.5							
		130	3							
		140	2.5							
		150	2							
		160	2							
		170	1.5							
		180	1							

TABLE A-3

NUTRIENT, CHLOROPHYLL-A, AND OIL AND GREASE RESULTS FOR AMERICAN SAMOA WET SEASON SAMPLING

Station No. (Location)	Depth (ft)	Date Sampled	Total Kjeldahl Nitrogen (ug/1-N)	Total Phosphorus (ug/1-P)	NO_2+NO_3 (ug/1-N)	Chlorophyll-a (mg/m^3)	Oil and Grease (mg/1)
1	Surface	2/13	141.5	1.9	24.4	0.444	--
(Taema Bank)	60 ft		107.7	9.6	26.0	0.221	
2	Surface	2/13	133.1	8.9	20.9	0.508	--
(Tafuna)	60 ft		105.8	16.9	14.3	0.556	
3	Surface	2/13	76.4	16.9	34.0	0.790	--
(Tafuna)	60 ft		105.8	3.8	26.1	0.141	
4	Surface	2/13	74.6	13.6	125.9	0.441	--
(Tafuna)	60 ft		25.8	4.2	15.1	0.442	
5	Surface	2/14	135.5	13.6	15.6	2.527	--
(Pago)	60 ft		110.3	64.7	14.4	0.739	
6	Surface	2/14	131.3	9.1	17.4	8.336	--
(Pago)	60 ft		93.5	35.1	16.4	0.352	
7	Surface	2/14	110.3	79.9	29.4	1.998	--
(Pago)	60 ft		138.6	61.4	18.6	0.454	
8	Surface	2/14	141.8	14.7	18.2	8.094	1.1*
(Pago)	60 ft		284.6	77.5	17.0	1.134	
9	Surface	2/14	108.2	17.8	25.9	3.920	0.6*
(Pago)	60 ft		78.8	99.8	19.9	0.818	

* Samples taken 3/3

Station No. (Location)	Depth (ft)	Date Sampled	Total Kjeldahl Nitrogen (ug/1-N)	Total Phosphorus (ug/1-P)	NO_2+NO_3 (ug/1-N)	Chlorophyll-a (mg/m^3)	Oil and Grease (mg/1)
10 (Pago)	Surface	2/14	157.5	22.7	13.9	9.268	0.7*
	60 ft		86.1	2	13.8	0.782	
11 (Pago)	Surface	2/14	339.2	64.2	20.0	8.476	0.6*
	60 ft		99.8	88.5	12.0	1.294	
12 (Pago)	Surface	2/14	305.6	133.0	47.3	6.386	—
	60 ft		152.3	21.5	32.2	0.577	
13 (Pago)	Surface	2/14	488.3	83.4	53.1	7.228	0.7*
	30 ft		278.3	172.6	61.7	5.433	
14 (Vatia-Offshore)	Surface	2/15	137.6	12.0	17.9	0.109	—
	60 ft		97.7	5.4	15.4	0.242	
15 (Vatia Bay)	Surface	2/15	64.9	18.9	28.0	0.460	—
	60 ft		109.8	1.6	13.4	0.372	
16 (Fagasa-Offshore)	Surface	2/15	86.3	2	12.9	0.239	—
	60 ft		80.2	7.5	13.7	0.204	
17 (Fagasa Bay)	Surface	2/15	82.7	10.7	23.0	0.323	—
	60 ft		100.4	4.9	16.3	0.331	
1 (Taema Bank)	Surface	2/22	123.9	48.0	4.4	0.227	—
	60 ft		110.3	26.0	1.9	0.457	
2 (Tafuna)	Surface	2/22	147.0	17.2	11.5	ND	
	60 ft		128.1	3.8	2.8	0.340	
3 (Tafuna)	Surface	2/22	85.1	22.2	47.6	0.228	—
	60 ft		112.4	10.4	7.8	0.277	
4 (Tafuna)	Surface	2/22	143.9	29.9	7.1	0.267	—
	60 ft		99.8	2	21.1	0.290	

* Samples taken 3/3

Station No. (Location)	Depth (ft)	Date Sampled	Total Kjeldahl Nitrogen (ug/1-N)	Total Phosphorus (ug/1-P)	NO_2+NO_3 (ug/1-N)	Chlorophyll-a (mg/m^3)	Oil and Grease (mg/1)
5	Surface	2/19	203.7	46.5	20.6	0.218	—
(Pago)	60 ft		70.4	14.7	0.3	0.270	
6	Surface	2/19	53.6	11.2	12.3	0.451	—
(Pago)	60 ft		49.4	24.9	3.9	0.334	
7	Surface	2/19	88.2	18.5	12.3	0.366	—
(Pago)	60 ft		84.0	7.6	15.0	0.320	
8	Surface	2/19	123.9	43.8	62.9	0.680	6.0
(Pago)	60 ft		87.2	4.3	3.2	0.434	
9	Surface	2/19	101.9	16.2	4.5	0.409	4.4
(Pago)	60 ft		107.1	79.7	120.9	1.268	
10	Surface	2/19	106.1	43.6	43.4	0.738	3.1
(Pago)	60 ft		139.7	44.1	4.6	0.409	
11	Surface	2/19	209.0	29.7	19.3	0.460	9.4
(Pago)	60 ft		89.3	15.2	1.1	0.381	
12	Surface	2/19	73.5	27.6	24.4	0.423	7.6
(Pago)	60 ft		82.9	13.0	7.9	0.252	
13	Surface	2/19	122.9	52.5	34.8	0.338	1.0
(Pago)	30 ft		83.0	56.7	33.1		
14	Surface	2/21	81.9	32.5	2.5	0.334	—
(Vatia-Offshore)	60 ft		104.0	98.2	1.6	0.146	
15	Surface	2/21	94.5	54.8	19.9	0.130	—
(Vatia Bay)	60 ft		212.1	16.0	3.44		
16	Surface	2/21	43.1	22.2	0.04		-
(Fagasa -Offshore)	60 ft		149.1	17.2	ND	0.088	

Station No. (Location)	Depth (ft)	Date Sampled	Total Kjeldahl Nitrogen (ug/1-N)	Total Phosphorus (ug/1-P)	NO_2+NO_3 (ug/1-N)	Chlorophyll-a (mg/m^3)	Oil and Grease (mg/1)
17 (Fagasa Bay)	Surface	2/21	111.3	12.5	12.5	0.344	--
	60 ft		133.4	26.3	2.0	0.250	
Ta'u (Manua)	Surface	3/1	165.0	16.5	3.1	-	--
	60 ft		120.8	8.3	2.7	-	
Ofu (Manua)	Surface	3/1	95.6	18.2	0.4		
	60 ft		153.3	7.9	0.5		
Dump Site #1	Surface	2/22	141.6	25.5	25.2	0.050	
	60 ft		181.7	12.5	8.4	0.025	
Dump Site #2	Surface	2/22	143.9	2	1.6	0.077	
	60 ft		158.6	17.9	2.4	0.066	
Utulei STP Eff (Composite)		2/28	7277.1	6421	255.6		
Utulei STP Eff (Grab)		3/2	6766.7	7407	54.9		
Utulei STP Eff (Grab)		3/2	7495.8	2826	49.2		
Van Camp (Grab)		3/1	47,381.3	15,434	401.0		
Van Camp (Grab)		3/1	48,511.5	24,926	31.4		
Poloa Stream		2/17	87.7	23.0	44.4		
Leone Stream		2/17	111.0	35.1	43.8		
Nuuuli Stream		2/17	69.8	42.6	43.4		
Asili Stream		2/17	81.6	4.9	46.6		
Maloata Stream		2/17	50.9	18.5	36.1		

Station No. (Location)	Depth (ft)	Date Sampled	Total Kjeldahl Nitrogen (ug/1-N)	Total Phosphorus (ug/1-P)	NO_2+NO_3 (ug/1-N)	Chlorophyll-a (mg/m^3)	Oil and Grease (mg/1)
Pago Stream #1		2/20	136.5		161.4		
Pago Stream #2		2/20	220.5		223.1		
Fagatogo Stream		2/20	651.0		632.8		
Auasi Stream		2/20	105.0	207.0	23.7		
Fagaalu Stream		2/20	246.8	66.2	119.2		
Aua Stream		2/20	120.8		145.6		
Leloaloa Stream		2/20	273.0	84.0	118.8		
Pago Stream #1		2/24	672.0	64.0	177.4		
Pago Stream #2		2/24	152.3	366.0	12.3		
Auasi Stream		2/24	89.3	139.0	48.7		
Nuuuli Stream		2/24	183.8		22.5		
Leone Stream		2/24	162.8	348.0	33.8		
Malota Stream		2/24	236.3		16.1		
Asili Stream		2/24	120.8		20.4		
Poloa Stream		2/24	94.5	47.0	39.1		
Fagatogo Stream		2/24	220.5	46.3	681.6		
Aua Stream		2/24	640.5	281.0	87.3		
Fagaalu Stream		2/24	126.0	171.0	170.5		

TABLE A-4

NUTRIENT, CHLOROPHYLL-A, OIL AND GREASE

RESULTS FOR AMERICAN SAMOA - DRY SEASON SAMPLING

Date	Station (Stream Name)	Depth (ft)	Total Kjeldahl Nitrogen (ug/1-N)	Total Phosphorus (ug/1-P)	NO_2+NO_3 (ug/1-N)	Chlorophyll-a (mg/m^3)	Oil and Grease (mg/1)
7/3/79	1	Surface		8.0	28.9	0.085	
	(Taema Bank)	60		6.7	24.0	0.141	
	2	Surface		6.4	40.0	0.161	
	(Tafuna)	60		5.8	26.8	0.056	
	3	Surface		4.9	38.4	0.202	
	(Tafuna)	60		5.8	37.0	0.212	
	4	Surface		5.5	31.9	0.035	
	(Tafuna)	60		4.9	30.5	0.141	
7/5/79	5	Surface		6.7	32.9	0.720	
	(Pago)	60		16.6	29.6	0.242	
	6	Surface	81	14.7	37.1	0.527	
	(Pago)	60	92	6.7	27.9	0.285	
	7	Surface	91	12.0	44.2	1.024	
	(Pago)	60	104	7.7	40.4	0.857	
	8	Surface	105	6.1	29.5	1.296	
	(Pago)	60	60	7.7	35.4	0.161	
	9	Surface	109	8.9	60.5	1.870	
	(Pago)	60	71	7.7	45.4	0.849	
	10	Surface	133	9.2	34.3	2.371	
	(Pago)	60	103	10.7	30.3	0.740	

Table A-4, cont.

Date	Station (Stream Name)	Depth (ft)	Total Kjeldahl Nitrogen (ug/1-N)	Total Phosphorus (ug/1-P)	NO_2+NO_3 (ug/1-N)	Chlorophyll-a (mg/m^3)	Oil and Grease (mg/1)
	11	Surface	88	6.7	37.4	4.460	
	(Pago)	60	145	15.3	48.6	1.250	
	12	Surface	113	8.0	33.2	4.814	
	(Pago)	60	61	19.6	36.6	0.335	
	13	Surface	94	25.5	63.8	3.912	
	(Pago)	35	87	32.5	77.5	1.454	
7/6/79	14	Surface	59	18.1	28.8	0.142	
	(Vatia Offshore)	60	79	16.6	25.4	0.270	
	15	Surface	75	17.1	29.8	0.260	
	(Vatia Bay)	60	169	16.2	28.7	0.345	
	16	Surface	87	16.6	29.0	0.224	
	(Fagasa Offshore)	60	85	16.9	26.4	0.119	
	17	Surface	76	15.3	29.4	0.306	
	(Fagasa Bay)	60	67	16.6	29.3	0.277	
7/10/78	1	Surface	130	8.8	85.5	0.182	
	(Taema Bank)	60	110	9.9	68.8	0.093	
	2	Surface	88	7.8	62.9	0.146	
	(Tafuna)	60	117	11.9	76.3	0.111	
	3	Surface	120	7.1	85.4	0.106	
	(Tafuna)	60	134	8.5	118.4	0.092	
	4	Surface	118	6.1	57.5	0.416	
	(Tafuna)	60	99	9.5	52.6	0.139	

Table A-4, cont.

Date	Station (Stream Name)	Depth (ft)	Total Kjeldahl Nitrogen (ug/1-N)	Total Phosphorus (ug/1-P)	NO_2+NO_3 (ug/1-N)	Chlorophyll-a (mg/m^3)	Oil and Grease (mg/1)
7/11/79	5	Surface	114	10.5	73.0	0.652	
	(Pago)	60	132	6.8	58.3	0.852	
	6	Surface	115	9.2	93.5	1.991	
	(Pago)	60	137	9.9	62.6	0.747	
	7	Surface	168	9.5	64.9	5.318	
	(Pago)	60	146	7.1	66.0	2.082	
	8	Surface	48	6.5	75.0	7.241	
	(Pago)	60	10	7.5	96.2	1.049	
	9	Surface	10	10.9	100.6	9.053	2.3
	(Pago)	60	176	7.8	13.9	0.523	
	10	Surface	189	6.1	63.2	6.195	0.4
	(Pago)	60	238	7.8	66.6	0.578	
	11	Surface	304	17.0	127.6	15.959	N.D.
	(Pago)	60	296	12.2	25.2	0.611	
	12	Surface	234	34.0	54.2	22.796	0.4
	(Pago)	60	103	13.3	22.1	0.617	
	13	Surface	234	33.3	18.1	27.515	0.6
	(Pago)	30	169	45.6	44.9	0.977	
7/12/79	Ofu	Surface	66	5	15.7	0.057	
		60	91	5	22.7	0.115	
	Tau	Surface	86	5	8.6	0.060	
		60	126	5	7.6	0.106	

Table A-4, cont.

Date	Station (Stream Name)	Depth (ft)	Total Kjeldahl Nitrogen (ug/1-N)	Total Phosphorus (ug/1-P)	NO_2+NO_3 (ug/1-N)	Chlorophyll-a (mg/m^3)	Oil and Grease (mg/1)
7/3/79	Dump Site No. 1	Surface	85	23.0	23.9	0.227	
		60	117	12.0	26.5	0.219	
		300	94	14.1	29.7	0.143	
7/10/79	Dump Site No. 1	Surface	107	7.8	12.3	0.578	
		60	148	10.5	6.6	0.163	
		300	214	5	12.5	0.245	
5/25/79	5 (Pago)	Surface	258.3	21	26		
	6 (Pago)	Surface	203.7	21	58	0.191	
	7 (Pago)	Surface	231.0	27	77		
	8 (Pago)	Surface	274.1	39	78	0.675	
	9 (Pago)	Surface	280.4	48	83	0.674	
	10 (Pago)	Surface	282.5	30	53	0.386	
	11 (Pago)	Surface	585.9	38	32		
	12 (Pago)	Surface	232.1	117	11	51.1	
	13 (Pago)	Surface	236.4	28	22	0.555	

Table A-4, cont.

Date	Station (Stream Name)	Depth (ft)	Total Kjeldahl Nitrogen (ug/1-N)	Total Phosphorus (ug/1-P)	NO_2+NO_3 (ug/1-N)	Chlorophyll-a (mg/m^3)	Oil and Grease (mg/1)
6/1/79	9 (Pago)	Surface	196.4	18	23	3.375	
	11 (Pago)	Surface	242.6	27	330	6.59	
	12 (Pago)	Surface	285.6	26	29	8.97	
	13	Surface	283.5	20	76	8.30	
5/24/79	1 (Maloata Stream)	Surface	507.5	96	34		
	2 (Poloa Stream)	Surface	479.6	89	5		
	3 (Asili Stream)	Surface	387.8	72	10		
	4 (Leone Falls)	Surface2	253.9	101	41		
	5 (Nuuuli Stream)	Surface	319.5	144	58		
	6 (Auasi Stream)	Surface	297.5	366	222		
	7 (Aua Stream)	Surface	412.4	95	126		
	9 (Pago No. 1 Stream)	Surface	283.3	98	263		
	10 (Pago No. 2 Stream)	Surface	300.6	183	266		

Table A-4, cont.

Date	Station (Stream Name)	Depth (ft)	Total Kjeldahl Nitrogen (ug/1-N)	Total Phosphorus (ug/1-P)	NO_2+NO_3 (ug/1-N)	Chlorophyll-a (mg/m^3)	Oil and Grease (mg/1)
	11 (Fagatogo Drain)	Surface	442.9	425	520		
	12 (Fagaalu Stream)		301.1	223	431		
5/30/79	1 (Maloata Stream)	Surface	293.8	111	58		
	2 (Poloa Stream)	Surface	270.2	83	40		
	3 (Asili Stream)	Surface	269.6	73	41		
	4 (Leone Falls)	Surface	313.7	103	29		
	5 (Nuuuli Stream)	Surface	351.5	363	57		
	6 (Auasi Stream)	Surface	351.5	363	305		
	7 (Aua Stream)	Surface	340.5	131	119		
	9 (Pago No. 1 Stream)	Surface	313.2	111	371		
	10 (Pago No. 2 Stream)	Surface	326.3	128	209		
	11 (Fagatogo Drain)	Surface	460.2	335	731		
	12 (Fagaalu Stream)	Surface	312.2	198	239		

Table A-4, cont.

Date	Station (Stream Name)	Depth (ft)	Total Kjeldahl Nitrogen (ug/1-N)	Total Phosphorus (ug/1-P)	NO_2+NO_3 ug/1-N)	Chlorophyll-a (mg/m^3)	Oil and Grease (mg/1)
7/9/79	1 (Maloata Stream)	Surface	391	50	47.6		
7/14/79	2 (Poloa Stream)	Surface	293	60	35.1		
	3 (Asili Stream)	Surface	456	20	62.6		
	4 (Leone Falls)	Surface	259	110	56.5		
	5 (Nuuuli Stream)	Surface	259	120	109.5		
	6 (Auasi Stream)	Surface	352	360	139.4		
	7 (Aua Stream)	Surface	330	100	134.3		
	9 (Pago No. 1 Stream)	Surface	488	40	371.3		
	10 (Pago No. 2 Stream)	Surface	440	90	264.7		
	11 (Fagatogo Drain)	Surface	744	360	698.6		
	12 (Fagaalu Stream)	Surface	504	190	208.0		

Table A-4, cont.

Date	Station (Stream Name)	Depth (ft)	Total Kjeldahl Nitrogen (ug/1-N)	Total Phosphorus (ug/1-P)	NO_2+NO_3 (ug/1-N)	Chlorophyll-a (mg/m^3)	Oil and Grease (mg/1)
7/17/79	1 (Maloata Stream)	Surface	246	70	33.5		
	2 (Poloa Stream)	Surface	444	120	35.5		
	3 (Asili Stream)	Surface	349	50	71.7		
	4 (Leone Falls)	Surface	326	90	55.3		
	5 (Nuuuli Stream)	Surface	467	110	159.6		
	6 (Auasi Stream)	Surface	357	360	100.0		
	7 (Aua Stream)	Surface	521	180	239.6		
	8 (Leloaloa Stream)	Surface	381	110	119.5		
	9 (Pago No. 1 Stream)	Surface	383	210	395.7		
	10 (Pago No. 2 Stream)	Surface	373	100	262.4		
	11 (Fagatogo Drain)	Surface	439	280	904.6		
	12 (Fagaalu Stream)	Surface	397	130	199.3		

TABLE A-5

"WET SEASON" WATER QUALITY SAMPLING RESULTS FOR STREAMS IN AMERICAN SAMOA

Date	Station (Stream Name)	Salinity (o/oo)	Temperature (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/l)	Total Coliform (#/100 ml)	Fecal Coliform (#/100 ml)	Velocity (kts)	Flow (cfm)
2/17/79	1 (Maloata)	0	25.84	8.20	2.0	7.50	1.00	-	2	1.5	255
	2 (Vaitele [Poloa])	0.30	26.28	8.10	9.2	7.75	2.70	-	2,400	0.7	79
	3 (Asili)	0	27.09	8.25	5.0	6.90	2.00	-	2	1.3	305
	4 (Leone)	0	25.62	8.10	4.0	7.40	3.00	-	200	1.4	227
	5 (Nuuuli)	0	25.87	7.85	3.8	7.30	1.40	-	2	0.2	33
2/20/79	6 (Auasi)	-	26.40	7.90	39.0	7.83	5.56	2	1,200	1.8	301
	7 (Aua)	-	26.20	8.10	37.0	7.50	25.70	-	3,900	1.5	328
	8 (Leloaloa)	-	26.30	5.40	6.7	7.40	9.85	-	-	-	2*
	9 (Pago Pago #1)	-	27.20	6.50	9.8	7.28	4.10	-	200	0.7	133
	10 (Pago Pago #2)	-	27.20	7.70	7.8	7.40	12.74	-	5,200	2.5	886
	11 (Pago Drainage [Fagatogo])	-	26.80	6.80	8.7	7.29	5.80	100	100	1.4	71
	12 (Fagaalu)	-	27.20	7.90	6.9	7.50	4.80	100	100	1.4	612
2/24/79	1 (Maloata)	0	25.80	8.40	2.3	7.30	1.10	-	-	2.9	734
	2 (Vaitele [Poloa])	0	27.90	8.30	10.0	7.65	6.60	-	-	0.9	114
	3 (Asili)	0	27.10	8.30	4.3	7.65	2.25	-	-	1.2	421
	4 (Leone)	0	27.40	8.50	2.9	7.80	2.20	-	-	1.1	780
	5 (Nuuuli)	0	28.10	8.50	2.8	7.65	1.15	-	-	0.7	118
	6 (Auasi)	0	29.00	7.80	7.3	7.75	2.85	-	-	0.2	14
	7 (Aua)	0	29.40	7.90	65.0	7.55	47.80	-	-	0.1	12
	8 (Leloaloa)		NO FLOW								
	9 (Pago Pago #1)	0	29.20	4.10	5.2	7.30	6.21	-	-	1.7	96
	10 (Pago Pago #2)	0	29.60	7.80	3.6	7.50	5.65	-	-	1.7	387
	11 (Pago Drainage [Fagatogo])	0	27.38	6.10	3.3	7.45	3.60	-	-	-	0.4*
	12 (Fagaalu)	0	28.30	7.50	2.4	7.65	1.90	-	-	2.0	365

* Estimated flow

TABLE A-6

"DRY SEASON" WATER QUALITY SAMPLING RESULTS FOR STREAMS IN AMERICAN SAMOA

Date	Station (Stream Name)	Temp. (°C)	D.O. (ppm)	Turbidity (NTU)	pH	Suspended Solids (mg/l)	Fecal Coliform (#/100 ml)	Velocity (kts)	Flow (cfm)
7/9/79	1 (Maloata)	25.8	8.25	1.5	7.20	0.8	1	0.6	149
	2 (Vaitele [Poloa])	24.5	7.70	2.3	7.42	2.2	2,000	0.3	16
	3 (Asili)	24.8	7.50	3.3	7.40	3.2	2,900	1.1	200
	4 (Leone)	23.8	8.10	2.6	7.52	2.3	2	1.0	243
	5 (Nuuuli)	24.5	7.60	1.8	7.30	1.3	134	0.5	30
	6 (Auasi)	26.0	6.50	3.1	7.42	6.1	-	No Flow	
	7 (Aua)	27.0	7.70	17.5	7.52	9.7	800	1.7	21
	8 (Leloaloa)	No Flow							
	9 (Pago Pago #1)	28.0	4.00	5.2	7.05	4.9	12,700	0.8	61
	10 (Pago Pago #2)	28.0	6.70	1.9	7.30	3.4	2,500	0.8	89
	11 (Pago Drainage [Fagatogo])	26.5	4.60	5.2	7.25	8.9	8,700		19
	12 (Fagaalu)	28.0	6.80	3.3	7.60	5.9	2,500	0.8	89
7/17/79	1 (Maloata)	25.8	8.10	3.7	7.55	1.6	18	1.4	369
	2 (Vaitele [Poloa])	27.0	7.30	22.0	7.45	7.6	1,700	0.5	29
	3 (Asili)	26.8	7.80	11.0	7.55	5.3	900	1.8	342
	4 (Leone)	25.2	8.00	6.1	7.65	4.0	34	1.0	291
	5 (Nuuuli)	26.0	7.50	5.1	7.35	1.2	152	0.7	64
	6 (Auasi)	26.0	7.70	26.0	7.55	9.8	3,600	0.6	33
	7 (Aua)	26.0	7.40	42.0	7.50	49.0	8,800	1.2	73
	8 (Leloaloa)	26.3	4.30	6.2	7.37	5.5	600		3 gal/mi
	9 (Pago Pago #1)	26.5	5.20	7.6	6.97	7.5	15,900	1.2	182
	10 (Pago Pago #2)	26.7	7.20	3.8	7.27	4.3	5,600	2.3	931
	11 (Pago Drainage [Fagatogo])	27.2	5.60	5.4	7.23	12.6	400	1.9	55
	12 (Fagaalu)	27.2	7.30	5.7	7.37	5.2	1,000	1.6	340

TABLE A-7

CLIMATOLOGICAL DATA FOR AMERICAN SAMOA

(February 1979)

Day	Average Temperature (°F)	Total Precipitation (inches)	Wind Average Speed (mph)	Wind Direction	Percent of Possible Sunshine	Sky Cover Sunrise to Sunset (tenths)
1	83	0	13.8	NE	61	6
2	82	0.01	9.2	NE	52	8
3	81	0.52	7.3	NE	60	7
4	81	1.73	6.4	E	18	10
5	77	1.75	6.7	N	0	10
6	77	2.30	13.9	E	0	10
7	83	0.02	16.6	NE	23	10
8	84	0.01	18.2	E	31	8
9	83	T	17.3	E	73	4
10	82	0.15	12.5	NE	59	6
11	84	0	11.3	E	68	5
12	84	T	12.9	E	73	4
13	82	0.11	12.0	E	58	5
14	81	0.19	8.9	E	56	7
15	82	0	10.4	E	54	8
16	83	0.18	13.8	E	37	7
17	79	1.06	7.1	E	0	10
18	78	3.73	13.1	N	2	10
19	79	1.37	15.9	N	3	10
20	81	0.23	17.0	N	3	10
21	84	0.06	10.4	N	25	9
22	81	0.04	13.0	NE	74	3
23	83	T	16.4	NE	55	6
24	84	T	15.2	E	52	7
25	84	T	16.2	E	55	5
26	81	0.14	14.3	NE	49	6
27	81	0.43	8.1	E	4	9

TABLE A-8

CLIMATOLOGICAL DATA FOR AMERICAN SAMOA

(July 1979)

Day	Average Temperature (°F)	Total Precipitation (inches)	Wind Average Speed (mph)	Wind Direction	Percent of Possible Sunshine	Sky Cover Sunrise to Sunset (tenths)
1	81	T	7.5	S	9	5
2	78	0	10.2	S	10	3
3	77	0	7.5	SE	0	10
4	78	0.16	6.7	N	10	8
5	80	0	6.3	NW	29	5
6	78	0.28	10.0	SE	1	9
7	79	0.06	16.9	E	0	10
8	81	0	12.9	E	18	5
9	77	0	9.3	E	26	7
10	76	0.03	7.8	NE	58	9
11	80	0.26	9.7	N	68	7
12	79	0	5.4	NE	80	4
13	78	0	6.4	S	77	6
14	79	0.60	8.9	E	79	6
15	82	T	15.9	NE	75	5
16	81	1.43	10.0	N	48	8
17	79	T	6.5	N	85	6
18	78	0	6.0	NE	82	3
19	79	T	11.9	N	81	7
20	81	0	12.5	NE	93	6
21	81	0.13	14.3	E	73	9
22	78	2.56	18.0	E	35	10
23	77	2.82	20.1	E	2	10
24	77	0.38	22.9	E	2	10
25	79	T	19.2	E	2	9
26	78	0.02	19.1	E	44	6
27	78	T	21.9	E	29	7
28	78	0	21.5	E	45	8
29	77	0.04	18.8	NE	18	9
30	76	0.04	17.7	E	36	8
31	79	0.02	15.1	E	37	9
Aug. 1	80	0	15.6	E	37	8

APPENDIX B

STUDY AREA	AMERICAN SAMOA
LOCATION	EMBAYMENT, SURFACE
PARAMETER	FECAL COLIFORM (NO./100ML)

NUMBER OF DATA POINTS	4
MEDIAN	1.25
SMALLEST NUMBER	.5
LARGEST NUMBER	20
MEAN	5.75
STANDARD DEVIATION	9.52628
COEF. OF VARIANCE	1.65674
GEOMETRIC MEAN	1.77828
GEOMETRIC STANDARD DEVIATION	5.70142
84.1% FREQUENCY VE	10.1387
15.9% FREQUENCY VE	.311901

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.500	.125
2	.500	.375
3	2.000	.625
4	20.000	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	OUTER PAGO PAGO HARBOR, SURFACE
PARAMETER	FECAL COLIFORM (NO./100ML)

NUMBER OF DATA POINTS	12
MEDIAN	.5
SMALLEST NUMBER	.5
LARGEST NUMBER	6
MEAN	1.04167
STANDARD DEVIATION	1.57333
COEF. OF VARIANCE	1.5104
GEOMETRIC MEAN	.690357
GEOMETRIC STANDARD DEVIATION	2.0783
84.1% FREQUENCY VE	1.43477
15.9% FREQUENCY VE	.332174

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.500	.042
2	.500	.125
3	.500	.208
4	.500	.292
5	.500	.375
6	.500	.458
7	.500	.542
8	.500	.625
9	.500	.708
10	1.000	.792
11	1.000	.875
12	6.000	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	OCEAN STATIONS, SURFACE
PARAMETER	FECAL COLIFORM (NO./100 ML)

NUMBER OF DATA POINTS	9
MEDIAN	.5
SMALLEST NUMBER	.5
LARGEST NUMBER	.5
MEAN	.5
STANDARD DEVIATION	0
COEF. OF VARIANCE	0
GEOMETRIC MEAN	.500001
GEOMETRIC STANDARD DEVIATION	1.
84.1% FREQUENCY VE	.500001
15.9% FREQUENCY VE	.5

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.500	.056
2	.500	.167
3	.500	.278
4	.500	.389
5	.500	.500
6	.500	.611
7	.500	.722
8	.500	.833
9	.500	.944

STUDY AREA	AMERICAN SAMOA
LOCATION	OPEN COASTAL NEARSHORE, SURFACE
PARAMETER	FECAL COLIFORM (NO./100ML)

NUMBER OF DATA POINTS	9
MEDIAN	.5
SMALLEST NUMBER	.5
LARGEST NUMBER	1
MEAN	.611111
STANDARD DEVIATION	.220479
COEF. OF VARIANCE	.360784
GEOMETRIC MEAN	.583265
GEOMETRIC STANDARD DEVIATION	1.35751
84.1% FREQUENCY VE	.791786
15.9% FREQUENCY VE	.429659

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.500	.056
2	.500	.167
3	.500	.278
4	.500	.389
5	.500	.500
6	.500	.611
7	.500	.722
8	1.000	.833
9	1.000	.944

STUDY AREA	AMERICAN SAMOA
LOCATION	BACKGROUND STREAMS
PARAMETER	FECAL COLIFORM (NO./100ML)

NUMBER OF DATA POINTS	9
MEDIAN	18
SMALLEST NUMBER	.5
LARGEST NUMBER	200
MEAN	60.3889
STANDARD DEVIATION	78.8415
COEF. OF VARIANCE	1.30556
GEOMETRIC MEAN	11.9544
GEOMETRIC STANDARD DEVIATION	10.4711
84.1% FREQUENCY VE	125.176
15.9% FREQUENCY VE	1.14165

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.500	.056
2	1.000	.167
3	2.000	.278
4	2.000	.389
5	18.000	.500
6	34.000	.611
7	134.000	.722
8	152.000	.833
9	200.000	.944

STUDY AREA AMERICAN SAMOA
LOCATION INNER PAGO PAGO HARBOR, SURFACE
PARAMETER FECAL COLIFORM (NO./100ML)

NUMBER OF DATA POINTS	11
MEDIAN	.5
SMALLEST NUMBER	.5
LARGEST NUMBER	28
MEAN	3.09091
STANDARD DEVIATION	8.26383
COEF. OF VARIANCE	2.67359
GEOMETRIC MEAN	.817766
GEOMETRIC STANDARD DEVIATION	3.33423
84.1% FREQUENCY VE	2.72662
15.9% FREQUENCY VE	.245264

NO. POINTS	INDIVIDUAL POINTS	F(I)
1 $	.500	.045
2	.500	.136
3	.500	.227
4	.500	.318
5	.500	.409
6	.500	.500
7	.500	.591
8	.500	.682
9	1.000	.773
10	1.000	.864
11	28.000	.955

STUDY AREA	AMERICAN SAMOA
LOCATION	URBAN INFLUENCE
PARAMETER	FECAL COLIFORM (NO./100ML)

NUMBER OF DATA POINTS	20
MEDIAN	2100
SMALLEST NUMBER	1
LARGEST NUMBER	15900
MEAN	3460.05
STANDARD DEVIATION	4336.61
COEF. OF VARIANCE	1.25334
GEOMETRIC MEAN	1085.68
GEOMETRIC STANDARD DEVIATION	9.83063
84.1% FREQUENCY VE	10672.9
15.9% FREQUENCY VE	110.438

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	1.00	.025
2	50.00	.075
3	50.00	.125
4	200.00	.175
5	400.00	.225
6	900.00	.275
7	1000.00	.325
8	1200.00	.375
9	1700.00	.425
10	2000.00	.475
11	2200.00	.525
12	2400.00	.575
13	2500.00	.625
14	2900.00	.675
15	3600.00	.725
16	5200.00	.775
17	5600.00	.825
18	8700.00	.875
19	12700.00	.925
20	15900.00	.975

STUDY AREA	AMERICAN SAMOA
LOCATION	ROAD CONSTRUCTION
PARAMETER	FECAL COLIFORM (NO./100ML)

NUMBER OF DATA POINTS	3
MEDIAN	3900
SMALLEST NUMBER	800
LARGEST NUMBER	8800
MEAN	4500
STANDARD DEVIATION	4033.61
COEF. OF VARIANCE	.896359
GEOMETRIC MEAN	3016.75
GEOMETRIC STANDARD DEVIATION	3.38514
84.1% FREQUENCY VE	10212.1
15.9% FREQUENCY VE	891.176

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	800.00	.167
2	3900.00	.500
3	8800.00	.833

STUDY AREA　　AMERICAN SAMOA
LOCATION　　OCEAN STATIONS, SURFACE
PARAMETER　　PH

NUMBER OF DATA POINTS	16
MEDIAN	8.295
SMALLEST NUMBER	8.13
LARGEST NUMBER	8.33
MEAN	8.26375
STANDARD DEVIATION	5.65537E-Ø2
COEF. OF VARIANCE	6.84358E-Ø3
GEOMETRIC MEAN	8.26354
GEOMETRIC STANDARD DEVIATION	1.ØØ689
84.1% FREQUENCY VE	8.32Ø48
15.9% FREQUENCY VE	8.2Ø699

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	8.13Ø	.Ø31
2	8.18Ø	.Ø94
3	8.19Ø	.156
4	8.23Ø	.219
5	8.25Ø	.281
6	8.25Ø	.344
7	8.25Ø	.4Ø6
8	8.29Ø	.469
9	8.3ØØ	.531
1Ø	8.3ØØ	.594
11	8.3ØØ	.656
12	8.3ØØ	.719
13	8.3ØØ	.781
14	8.31Ø	.844
15	8.31Ø	.9Ø6
16	8.33Ø	.969

STUDY AREA AMERICAN SAMOA
LOCATION OCEAN STATIONS, 60 FT DEPTH
PARAMETER PH

NUMBER OF DATA POINTS	16
MEDIAN	8.28
SMALLEST NUMBER	8.11
LARGEST NUMBER	8.32
MEAN	8.26188
STANDARD DEVIATION	5.89029E-02
COEF. OF VARIANCE	7.12948E-03
GEOMETRIC MEAN	8.26165
GEOMETRIC STANDARD DEVIATION	1.00718
84.1% FREQUENCY VE	8.32099
15.9% FREQUENCY VE	8.20273

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	8.110	.031
2	8.190	.094
3	8.200	.156
4	8.230	.219
5	8.230	.281
6	8.250	.344
7	8.250	.406
8	8.270	.469
9	8.290	.531
10	8.300	.594
11	8.300	.656
12	8.300	.719
13	8.310	.781
14	8.320	.844
15	8.320	.906
16	8.320	.969

STUDY AREA AMERICAN SAMOA
LOCATION OPEN COASTAL NEARSHORE, SURFACE
PARAMETER PH

NUMBER OF DATA POINTS	12
MEDIAN	8.27
SMALLEST NUMBER	8.19
LARGEST NUMBER	8.33
MEAN	8.26583
STANDARD DEVIATION	5.56707E-02
COEF. OF VARIANCE	6.73504E-03
GEOMETRIC MEAN	8.26563
GEOMETRIC STANDARD DEVIATION	1.00676
84.1% FREQUENCY VE	8.32151
15.9% FREQUENCY VE	8.21013

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	8.190	.042
2	8.190	.125
3	8.220	.208
4	8.220	.292
5	8.230	.375
6	8.240	.458
7	8.300	.542
8	8.300	.625
9	8.320	.708
10	8.320	.792
11	8.330	.875
12	8.330	.958

STUDY AREA AMERICAN SAMOA
LOCATION OPEN COASTAL NEARSHORE, 60 FT DEPTH
PARAMETER PH

NUMBER OF DATA POINTS	12
MEDIAN	8.275
SMALLEST NUMBER	8.19
LARGEST NUMBER	8.33
MEAN	8.2725
STANDARD DEVIATION	5.80163E-02
COEF. OF VARIANCE	7.01316E-03
GEOMETRIC MEAN	8.27229
GEOMETRIC STANDARD DEVIATION	1.00704
84.1% FREQUENCY VE	8.33055
15.9% FREQUENCY VE	8.21443

NO. POINTS	--INDIVIDUAL POINTS	F(I)
1	8.190	.042
2	8.190	.125
3	8.220	.208
4	8.230	.292
5	8.240	.375
6	8.250	.458
7	8.300	.542
8	8.330	.625
9	8.330	.708
10	8.330	.792
11	8.330	.875
12	8.330	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	EMBAYMENT, SURFACE
PARAMETER	PH

NUMBER OF DATA POINTS	6
MEDIAN	8.275
SMALLEST NUMBER	8.2
LARGEST NUMBER	8.33
MEAN	8.27
STANDARD DEVIATION	.048166
COEF. OF VARIANCE	5.82418E-03
GEOMETRIC MEAN	8.26985
GEOMETRIC STANDARD DEVIATION	1.00584
84.1% FREQUENCY VE	8.31818
15.9% FREQUENCY VE	8.2218

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	8.200	.083
2	8.240	.250
3	8.250	.417
4	8.300	.583
5	8.300	.750
6	8.330	.917

STUDY AREA	AMERICAN SAMOA
LOCATION	EMBAYMENT, 60 FT DEPTH
PARAMETER	PH

NUMBER OF DATA POINTS	6
MEDIAN	8.275
SMALLEST NUMBER	8.23
LARGEST NUMBER	8.33
MEAN	8.27667
STANDARD DEVIATION	3.88157E-02
COEF. OF VARIANCE	4.68977E-03
GEOMETRIC MEAN	8.27653
GEOMETRIC STANDARD DEVIATION	1.0047
84.1% FREQUENCY VE	8.31545
15.9% FREQUENCY VE	8.23784

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	8.230	.083
2	8.250	.250
3	8.250	.417
4	8.300	.583
5	8.300	.750
6	8.330	.917

STUDY AREA	AMERICAN SAMOA
LOCATION	TRANSITION ZONE, SURFACE
PARAMETER	PH

NUMBER OF DATA POINTS	4
MEDIAN	8.3
SMALLEST NUMBER	8
LARGEST NUMBER	8.3
MEAN	8.225
STANDARD DEVIATION	.15
COEF. OF VARIANCE	.018237
GEOMETRIC MEAN	8.22393
GEOMETRIC STANDARD DEVIATION	1.01858
84.1% FREQUENCY VE	8.37671
15.9% FREQUENCY VE	8.07393

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	8.000	.125
2	8.300	.375
3	8.300	.625
4	8.300	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	TRANSITION ZONE, 60 FT. DEPTH
PARAMETER	PH

NUMBER OF DATA POINTS	4
MEDIAN	8.315
SMALLEST NUMBER	8
LARGEST NUMBER	8.35
MEAN	8.245
STANDARD DEVIATION	.164215
COEF. OF VARIANCE	1.99169E-02
GEOMETRIC MEAN	8.24372
GEOMETRIC STANDARD DEVIATION	1.02032
84.1% FREQUENCY VE	8.41121
15.9% FREQUENCY VE	8.07957

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	8.000	.125
2	8.310	.375
3	8.320	.625
4	8.350	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	OUTER PAGO PAGO HARBOR, SURFACE
PARAMETER	PH

NUMBER OF DATA POINTS	2Ø
MEDIAN	8.29
SMALLEST NUMBER	8
LARGEST NUMBER	8.37
MEAN	8.2575
STANDARD DEVIATION	.11Ø496
COEF. OF VARIANCE	1.33812E-Ø2
GEOMETRIC MEAN	8.25676
GEOMETRIC STANDARD DEVIATION	1.Ø1356
84.1% FREQUENCY VE	8.36868
15.9% FREQUENCY VE	8.14634

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	8.ØØØ	.Ø25
2	8.Ø7Ø	.Ø75
3	8.12Ø	.125
4	8.13Ø	.175
5	8.13Ø	.225
6	8.23Ø	.275
7	8.23Ø	.325
8	8.26Ø	.375
9	8.28Ø	.425
1Ø	8.28Ø	.475
11	8.3ØØ	.525
12	8.32Ø	.575
13	8.32Ø	.625
14	8.33Ø	.675
15	8.34Ø	.725
16	8.35Ø	.775
17	8.36Ø	.825
18	8.36Ø	.875
19	8.37Ø	.925
2Ø	8.37Ø	.975

STUDY AREA AMERICAN SAMOA
LOCATION OUTER PAGO PAGO HARBOR, 60 FT DEPTH
PARAMETER PH

NUMBER OF DATA POINTS	20
MEDIAN	8.32
SMALLEST NUMBER	8.1
LARGEST NUMBER	8.34
MEAN	8.2775
STANDARD DEVIATION	7.90652E-02
COEF. OF VARIANCE	9.55182E-03
GEOMETRIC MEAN	8.27711
GEOMETRIC STANDARD DEVIATION	1.00965
84.1% FREQUENCY VE	8.357
15.9% FREQUENCY VE	8.19798

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	8.100	.025
2	8.130	.075
3	8.170	.125
4	8.170	.175
5	8.170	.225
6	8.300	.275
7	8.300	.325
8	8.300	.375
9	8.300	.425
10	8.320	.475
11	8.320	.525
12	8.320	.575
13	8.320	.625
14	8.330	.675
15	8.330	.725
16	8.330	.775
17	8.330	.825
18	8.330	.875
19	8.340	.925
20	8.340	.975

STUDY AREA AMERICAN SAMOA
LOCATION INNER PAGO PAGO HARBOR, SURFACE
PARAMETER PH

NUMBER OF DATA POINTS 12
MEDIAN 8.335
SMALLEST NUMBER 8.08
LARGEST NUMBER 8.53

MEAN 8.29667
STANDARD DEVIATION .133711
COEF.,OF VARIANCE 1.61160E-02

GEOMETRIC MEAN 8.29564
GEOMETRIC STANDARD DEVIATION 1.01628
84.1% FREQUENCY VE 8.4307
15.9% FREQUENCY VE 8.16275

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	8.080	.042
2	8.120	.125
3	8.120	.208
4	8.250	.292
5	8.280	.375
6	8.330	.458
7	8.340	.542
8	8.350	.625
9	8.380	.708
10	8.380	.792
11	8.400	.875
12	8.530	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	INNER PAGO PAGO HARBOR, 6Ø FT DEPTH
PARAMETER	PH

NUMBER OF DATA POINTS	12
MEDIAN	8.29
SMALLEST NUMBER	8
LARGEST NUMBER	8.33
MEAN	8.24167
STANDARD DEVIATION	9.75919E-Ø2
COEF. OF VARIANCE	1.18413E-Ø2
GEOMETRIC MEAN	8.2411
GEOMETRIC STANDARD DEVIATION	1.Ø12Ø1
84.1% FREQUENCY VE	8.34Ø1
15.9% FREQUENCY VE	8.14327

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	8.ØØØ	.Ø42
2	8.12Ø	.125
3	8.18Ø	.2Ø8
4	8.23Ø	.292
5	8.25Ø	.375
6	8.28Ø	.458
7	8.3ØØ	.542
8	8.3ØØ	.625
9	8.3ØØ	.7Ø8
1Ø	8.3ØØ	.792
11	8.31Ø	.875
12	8.33Ø	.958

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STUDY AREA	AMERICAN SAMOA
LOCATION	BACKGROUND STREAMS
PARAMETER	PH

NUMBER OF DATA POINTS	12
MEDIAN	7.45
SMALLEST NUMBER	7.2
LARGEST NUMBER	7.8
MEAN	7.46
STANDARD DEVIATION	.181208
COEF. OF VARIANCE	2.42906E-02
GEOMETRIC MEAN	7.45796
GEOMETRIC STANDARD DEVIATION	1.02449
84.1% FREQUENCY VE	7.64064
15.9% FREQUENCY VE	7.27965

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	7.200	.042
2	7.300	.125
3	7.300	.208
4	7.300	.292
5	7.350	.375
6	7.400	.458
7	7.500	.542
8	7.520	.625
9	7.550	.708
10	7.650	.792
11	7.650	.875
12	7.800	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	URBAN INFLUENCE
PARAMETER	PH

NUMBER OF DATA POINTS	28
MEDIAN	7.42
SMALLEST NUMBER	6.9
LARGEST NUMBER	7.83
MEAN	7.41693
STANDARD DEVIATION	.226999
COEF. OF VARIANCE	3.05972E-02
GEOMETRIC MEAN	7.41552
GEOMETRIC STANDARD DEVIATION	1.03128
84.1% FREQUENCY VE	7.64745
15.9% FREQUENCY VE	7.19062

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	6.900	.018
2	6.970	.054
3	7.050	.089
4	7.230	.125
5	7.250	.161
6	7.270	.196
7	7.280	.232
8	7.290	.268
9	7.300	.304
10	7.300	.339
11	7.370	.375
12	7.400	.411
13	7.400	.446
14	7.420	.482
15	7.420	.518
16	7.450	.554
17	7.450	.589
18	7.500	.625
19	7.500	.661
20	7.550	.696
21	7.550	.732
22	7.600	.768
23	7.650	.804
24	7.650	.839
25	7.650	.875
26	7.750	.911
27	7.750	.946
28	7.830	.982

STUDY AREA	AMERICAN SAMOA
LOCATION	ROAD CONSTRUCTION
PARAMETER	PH

NUMBER OF DATA POINTS	4
MEDIAN	7.51
SMALLEST NUMBER	7.5
LARGEST NUMBER	7.55
MEAN	7.5175
STANDARD DEVIATION	2.36292E-02
COEF. OF VARIANCE	3.14322E-03
GEOMETRIC MEAN	7.51744
GEOMETRIC STANDARD DEVIATION	1.00315
84.1% FREQUENCY VE	7.54109
15.9% FREQUENCY VE	7.49387

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	7.500	.125
2	7.500	.375
3	7.520	.625
4	7.550	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	OCEAN STATIONS, SURFACE
PARAMETER	DISSOLVED OXYGEN (MG/L)

NUMBER OF DATA POINTS	16
MEDIAN	6.1
SMALLEST NUMBER	5.75
LARGEST NUMBER	6.3
MEAN	6.11438
STANDARD DEVIATION	.170605
COEF. OF VARIANCE	2.79024E-02
GEOMETRIC MEAN	6.1121
GEOMETRIC STANDARD DEVIATION	1.02852
84.1% FREQUENCY VE	6.28644
15.9% FREQUENCY VE	5.94259

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	5.750	.031
2	5.850	.094
3	6.000	.156
4	6.000	.219
5	6.000	.281
6	6.030	.344
7	6.100	.406
8	6.100	.469
9	6.100	.531
10	6.200	.594
11	6.200	.656
12	6.300	.719
13	6.300	.781
14	6.300	.844
15	6.300	.906
16	6.300	.969

STUDY AREA	AMERICAN SAMOA
LOCATION	OCEAN STATIONS, 60 FT DEPTH
PARAMETER	DISSOLVED OXYGEN (MG/L)

NUMBER OF DATA POINTS	16
MEDIAN	6
SMALLEST NUMBER	5.75
LARGEST NUMBER	6.3
MEAN	5.98125
STANDARD DEVIATION	.163172
COEF. OF VARIANCE	2.72805E-02
GEOMETRIC MEAN	5.97715
GEOMETRIC STANDARD DEVIATION	1.02761
84.1% FREQUENCY VE	6.14421
15.9% FREQUENCY VE	5.81852

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	5.750	.031
2	5.750	.094
3	5.800	.156
4	5.800	.219
5	5.900	.281
6	5.900	.344
7	5.900	.406
8	6.000	.469
9	6.000	.531
10	6.000	.594
11	6.100	.656
12	6.100	.719
13	6.100	.781
14	6.100	.844
15	6.200	.906
16	6.300	.969

STUDY AREA AMERICAN SAMOA
LOCATION OPEN COASTAL NEARSHORE, SURFACE
PARAMETER DISSOLVED OXYGEN (MG/L)

NUMBER OF DATA POINTS	12
MEDIAN	6.25
SMALLEST NUMBER	5.95
LARGEST NUMBER	6.45
MEAN	6.21667
STANDARD DEVIATION	.154233
COEF. OF VARIANCE	2.48096E-02
GEOMETRIC MEAN	6.21488
GEOMETRIC STANDARD DEVIATION	1.02522
84.1% FREQUENCY VE	6.37161
15.9% FREQUENCY VE	6.062

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	5.950	.042
2	6.000	.125
3	6.100	.208
4	6.100	.292
5	6.200	.375
6	6.200	.458
7	6.300	.542
8	6.300	.625
9	6.300	.708
10	6.300	.792
11	6.400	.875
12	6.450	.958

STUDY AREA   AMERICAN SAMOA
LOCATION   OPEN COASTAL NEARSHORE, 50 FT DEPTH
PARAMETER   DISSOLVED OXYGEN   (MG/L)

NUMBER OF DATA POINTS	12
MEDIAN	5.95
SMALLEST NUMBER	5.8
LARGEST NUMBER	6.3
MEAN	5.9875
STANDARD DEVIATION	.146357
COEF. OF VARIANCE	2.44438E-02
GEOMETRIC MEAN	5.98586
GEOMETRIC STANDARD DEVIATION	1.02449
84.1% FREQUENCY VE	6.13247
15.9% FREQUENCY VE	5.84277

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	5.800	.042
2	5.850	.125
3	5.900	.208
4	5.900	.292
5	5.900	.375
6	5.950	.458
7	5.950	.542
8	6.000	.625
9	6.000	.708
10	6.100	.792
11	6.200	.875
12	6.300	.958

STUDY AREA   AMERICAN SAMOA
LOCATION   EMBAYMENT, SURFACE
PARAMETER   DISSOLVED OXYGEN   (MG/L)

NUMBER OF DATA POINTS	6
MEDIAN	6.55
SMALLEST NUMBER	4.4
LARGEST NUMBER	7
MEAN	6.21667
STANDARD DEVIATION	1.00482
COEF. OF VARIANCE	.161634
GEOMETRIC MEAN	6.13978
GEOMETRIC STANDARD DEVIATION	1.19571
84.1% FREQUENCY VE	7.34137
15.9% FREQUENCY VE	5.13486

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	4.400	.083
2	5.800	.250
3	6.300	.417
4	6.800	.583
5	7.000	.750
6	7.000	.917

STUDY AREA   AMERICAN SAMOA
LOCATION   EMBAYMENT, 50 FT DEPTH
PARAMETER   DISSOLVED OXYGEN (MG/L)

NUMBER OF DATA POINTS	6
MEDIAN	6
SMALLEST NUMBER	5.6
LARGEST NUMBER	6.1
MEAN	5.93333
STANDARD DEVIATION	.175119
COEF. OF VARIANCE	2.95144E-02
GEOMETRIC MEAN	5.93111
GEOMETRIC STANDARD DEVIATION	1.03051
84.1% FREQUENCY VE	6.11206
15.9% FREQUENCY VE	5.75551

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	5.600	.083
2	5.900	.250
3	6.000	.417
4	6.000	.583
5	6.000	.750
6	6.100	.917

STUDY AREA   AMERICAN SAMOA
LOCATION   TRANSITION ZONE, SURFACE
PARAMETER   DISSOLVED OXYGEN (MG/L)

NUMBER OF DATA POINTS	4
MEDIAN	6.025
SMALLEST NUMBER	5.9
LARGEST NUMBER	6.3
MEAN	6.0625
STANDARD DEVIATION	.170172
COEF. OF VARIANCE	2.80696E-02
GEOMETRIC MEAN	6.06071
GEOMETRIC STANDARD DEVIATION	1.02824
84.1% FREQUENCY VE	6.23184
15.9% FREQUENCY VE	5.89427

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	5.900	.125
2	6.000	.375
3	6.050	.625
4	6.300	.875

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STUDY AREA          AMERICAN SAMOA
LOCATION            TRANSITION ZONE, 6Ø FT. DEPTH
PARAMETER           DISSOLVED OXYGEN   (MG/L)

NUMBER OF DATA POINTS                                  4
MEDIAN                                                 5.875
SMALLEST NUMBER                                        5.6
LARGEST NUMBER                                         6.2

MEAN                                                   5.8875
STANDARD DEVIATION                                     .246221
COEF. OF VARIANCE                                      .Ø41821

GEOMETRIC MEAN                                         5.88363
GEOMETRIC STANDARD DEVIATION                           1.Ø4262
84.1% FREQUENCY VE                                     6.13437
15.9% FREQUENCY VE                                     5.64314

     NO. POINTS          INDIVIDUAL POINTS          F(I)

         1                     5.6ØØ                .125
         2                     5.85Ø                .375
         3                     5.9ØØ                .625
         4                     6.2ØØ                .875
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STUDY AREA AMERICAN SAMOA
LOCATION OUTER PAGO PAGO HARBOR, SURFACE
PARAMETER DISSOLVED OXYGEN, (MG/L)

NUMBER OF DATA POINTS	20
MEDIAN	6.225
SMALLEST NUMBER	5.6
LARGEST NUMBER	7.5
MEAN	6.3525
STANDARD DEVIATION	.544464
COEF. OF VARIANCE	8.57086E-02
GEOMETRIC MEAN	6.33128
GEOMETRIC STANDARD DEVIATION	1.08657
84.1% FREQUENCY VE	6.87935
15.9% FREQUENCY VE	5.82687

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	5.600	.025
2	5.750	.075
3	5.850	.125
4	5.900	.175
5	5.900	.225
6	6.000	.275
7	6.100	.325
8	6.150	.375
9	6.200	.425
10	6.200	.475
11	6.250	.525
12	6.300	.575
13	6.350	.625
14	6.400	.675
15	6.400	.725
16	6.500	.775
17	7.000	.825
18	7.350	.875
19	7.350	.925
20	7.500	.975

STUDY AREA AMERICAN SAMOA
LOCATION OUTER PAGO PAGO HARBOR, 60 FT. DEPTH
PARAMETER DISSOLVED OXYGEN (MG/L)

NUMBER OF DATA POINTS	20
MEDIAN	5.8
SMALLEST NUMBER	5.45
LARGEST NUMBER	6.3
MEAN	5.86
STANDARD DEVIATION	.211884
COEF. OF VARIANCE	3.61576E-02
GEOMETRIC MEAN	5.85639
GEOMETRIC STANDARD DEVIATION	1.03647
84.1% FREQUENCY VE	6.06999
15.9% FREQUENCY VE	5.6503

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	5.450	.025
2	5.600	.075
3	5.700	.125
4	5.700	.175
5	5.750	.225
6	5.750	.275
7	5.800	.325
8	5.800	.375
9	5.800	.425
10	5.800	.475
11	5.800	.525
12	5.850	.575
13	5.900	.625
14	5.900	.675
15	5.900	.725
16	5.900	.775
17	6.000	.825
18	6.250	.875
19	6.250	.925
20	6.300	.975

STUDY AREA AMERICAN SAMOA
LOCATION INNER PAGO PAGO HARBOR, SURFACE
PARAMETER DISSOLVED OXYGEN (MG/L)

NUMBER OF DATA POINTS	12
MEDIAN	6.05
SMALLEST NUMBER	5
LARGEST NUMBER	9
MEAN	6.36667
STANDARD DEVIATION	1.20196
COEF. OF VARIANCE	.188789
GEOMETRIC MEAN	6.27082
GEOMETRIC STANDARD DEVIATION	1.19579
84.1% FREQUENCY VE	7.49861
15.9% FREQUENCY VE	5.24406

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	5.000	.042
2	5.000	.125
3	5.500	.208
4	5.800	.292
5	5.800	.375
6	6.000	.458
7	6.100	.542
8	6.250	.625
9	6.350	.708
10	7.600	.792
11	7.800	.875
12	9.000	.958

STUDY AREA AMERICAN SAMOA
LOCATION INNER PAGO PAGO HARBOR, 50 FT DEPTH
PARAMETER DISSOLVED OXYGEN (MG/L)

NUMBER OF DATA POINTS	12
MEDIAN	5.475
SMALLEST NUMBER	4.4
LARGEST NUMBER	5.9
MEAN	5.24583
STANDARD DEVIATION	.586383
COEF. OF VARIANCE	.111781
GEOMETRIC MEAN	5.21456
GEOMETRIC STANDARD DEVIATION	1.12231
84.1% FREQUENCY VE	5.85233
15.9% FREQUENCY VE	4.64629

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	4.400	.042
2	4.450	.125
3	4.500	.208
4	4.600	.292
5	5.300	.375
6	5.450	.458
7	5.500	.542
8	5.600	.625
9	5.600	.708
10	5.800	.792
11	5.850	.875
12	5.900	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	BACKGROUND STREAMS
PARAMETER	DISSOLVED OXYGEN (MG/L)

NUMBER OF DATA POINTS	12
MEDIAN	8.1
SMALLEST NUMBER	7.5
LARGEST NUMBER	8.5
MEAN	8.09167
STANDARD DEVIATION	.319683
COEF. OF VARIANCE	3.95076E-02
GEOMETRIC MEAN	8.08576
GEOMETRIC STANDARD DEVIATION	1.04074
84.1% FREQUENCY VE	8.41517
15.9% FREQUENCY VE	7.76925

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	7.500	.042
2	7.600	.125
3	7.850	.208
4	8.000	.292
5	8.100	.375
6	8.100	.458
7	8.100	.542
8	8.200	.625
9	8.250	.708
10	8.400	.792
11	8.500	.875
12	8.500	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	URBAN INFLUENCE
PARAMETER	DISSOLVED OXYGEN (MG/L)

NUMBER OF DATA POINTS	28
MEDIAN	7.4
SMALLEST NUMBER	4.
LARGEST NUMBER	8.3
MEAN	6.9625
STANDARD DEVIATION	1.24265
COEF. OF VARIANCE	.178478
GEOMETRIC MEAN	6.83473
GEOMETRIC STANDARD DEVIATION	1.22846
84.1% FREQUENCY VE	8.39618
15.9% FREQUENCY VE	5.56367

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	4.000	.018
2	4.100	.054
3	4.600	.089
4	5.200	.125
5	5.600	.161
6	6.100	.196
7	6.300	.232
8	6.500	.268
9	6.700	.304
10	6.800	.339
11	6.800	.375
12	7.200	.411
13	7.300	.446
14	7.300	.482
15	7.500	.518
16	7.500	.554
17	7.700	.589
18	7.700	.625
19	7.700	.661
20	7.800	.696
21	7.800	.732
22	7.800	.768
23	7.900	.804
24	7.900	.839
25	8.100	.875
26	8.250	.911
27	8.300	.946
28	8.300	.982

STUDY AREA	AMERICAN SAMOA
LOCATION	ROAD CONSTRUCTION
PARAMETER	DISSOLVED OXYGEN (MG/L)

NUMBER OF DATA POINTS	4
MEDIAN	7.8
SMALLEST NUMBER	7.4
LARGEST NUMBER	8.1
MEAN	7.775
STANDARD DEVIATION	.298608
COEF. OF VARIANCE	3.84062E-02
GEOMETRIC MEAN	7.77064
GEOMETRIC STANDARD DEVIATION	1.03934
84.1% FREQUENCY VE	8.07638
15.9% FREQUENCY VE	7.47648

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	7.400	.125
2	7.700	.375
3	7.900	.625
4	8.100	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	OCEAN STATIONS, SURFACE
PARAMETER	TURBIDITY (NTU)

NUMBER OF DATA POINTS	16
MEDIAN	.18
SMALLEST NUMBER	.08
LARGEST NUMBER	.27
MEAN	.181875
STANDARD DEVIATION	4.60751E-02
COEF. OF VARIANCE	.253334
GEOMETRIC MEAN	.175588
GEOMETRIC STANDARD DEVIATION	1.33384
84.1% FREQUENCY VE	.234207
15.9% FREQUENCY VE	.131641

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.080	.031
2	.130	.094
3	.140	.156
4	.150	.219
5	.160	.281
6	.160	.344
7	.170	.406
8	.180	.469
9	.180	.531
10	.200	.594
11	.210	.656
12	.210	.719
13	.220	.781
14	.220	.844
15	.230	.906
16	.270	.969

STUDY AREA AMERICAN SAMOA
LOCATION OCEAN STATIONS, 60 FT DEPTH
PARAMETER TURBIDITY (NTU)

NUMBER OF DATA POINTS	16
MEDIAN	.17
SMALLEST NUMBER	.11
LARGEST NUMBER	.47
MEAN	.199375
STANDARD DEVIATION	9.18309E-02
COEF. OF VARIANCE	.460594
GEOMETRIC MEAN	.184691
GEOMETRIC STANDARD DEVIATION	1.46562
84.1% FREQUENCY VE	.270687
15.9% FREQUENCY VE	.126016

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.110	.031
2	.120	.094
3	.130	.156
4	.140	.219
5	.150	.281
6	.150	.344
7	.160	.406
8	.170	.469
9	.170	.531
10	.180	.594
11	.190	.656
12	.240	.719
13	.240	.781
14	.240	.844
15	.330	.906
16	.470	.969

LOCATION	OPEN COASTAL NEARSHORE, SURFACE
PARAMETER	TURBIDITY (NTU)

NUMBER OF DATA POINTS	12
MEDIAN	.18
SMALLEST NUMBER	.13
LARGEST NUMBER	.32
MEAN	.2
STANDARD DEVIATION	5.75247E-Ø2
COEF. OF VARIANCE	.287623
GEOMETRIC MEAN	.1931Ø6
GEOMETRIC STANDARD DEVIATION	1.31246
84.1% FREQUENCY VE	.253447
15.9% FREQUENCY VE	.147131

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.13Ø	.Ø42
2	.15Ø	.125
3	.15Ø	.2Ø8
4	.17Ø	.292
5	.17Ø	.375
6	.18Ø	.458
7	.18Ø	.542
8	.19Ø	.625
9	.23Ø	.7Ø8
1Ø	.26Ø	.792
11	.27Ø	.875
12	.32Ø	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	OPEN COASTAL NEARSHORE, 6Ø FT DEPTH
PARAMETER	TURBIDITY (NTU)

NUMBER OF DATA POINTS	12
MEDIAN	.175
SMALLEST NUMBER	.11
LARGEST NUMBER	.29
MEAN	.179167
STANDARD DEVIATION	4.6Ø154E-Ø2
COEF. OF VARIANCE	.25683
GEOMETRIC MEAN	.174148
GEOMETRIC STANDARD DEVIATION	1.28Ø32
84.1% FREQUENCY VE	.222965
15.9% FREQUENCY VE	.136Ø17

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.11Ø	.Ø42
2	.13Ø	.125
3	.16Ø	.2Ø8
4	.16Ø	.292
5	.16Ø	.375
6	.17Ø	.458
7	.18Ø	.542
8	.18Ø	.625
9	.18Ø	.7Ø8
1Ø	.21Ø	.792
11	.22Ø	.875
12	.29Ø	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	EMBAYMENT, SURFACE
PARAMETER	TURBIDITY (NTU)

NUMBER OF DATA POINTS	6
MEDIAN	.185
SMALLEST NUMBER	.18
LARGEST NUMBER	.58
MEAN	.298333
STANDARD DEVIATION	.182234
COEF. OF VARIANCE	.610708
GEOMETRIC MEAN	.259941
GEOMETRIC STANDARD DEVIATION	1.73678
84.1% FREQUENCY VE	.451459
15.9% FREQUENCY VE	.149668

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.180	.083
2	.180	.250
3	.180	.417
4	.190	.583
5	.480	.750
6	.580	.917

STUDY AREA	AMERICAN SAMOA
LOCATION	EMBAYMENT, 60 FT DEPTH
PARAMETER	TURBIDITY (NTU)

NUMBER OF DATA POINTS	6
MEDIAN	.2
SMALLEST NUMBER	.17
LARGEST NUMBER	.6
MEAN	.29
STANDARD DEVIATION	.170294
COEF. OF VARIANCE	.58722
GEOMETRIC MEAN	.257841
GEOMETRIC STANDARD DEVIATION	1.65392
84.1% FREQUENCY VE	.42645
15.9% FREQUENCY VE	.155897

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.170	.083
2	.190	.250
3	.190	.417
4	.210	.583
5	.380	.750
6	.600	.917

STUDY AREA	AMERICAN SAMOA
LOCATION	TRANSITION ZONE, SURFACE
PARAMETER	TURBIDITY (NTU)

NUMBER OF DATA POINTS	5
MEDIAN	.25
SMALLEST NUMBER	.19
LARGEST NUMBER	.33
MEAN	.26
STANDARD DEVIATION	5.56776E-02
COEF. OF VARIANCE	.214145
GEOMETRIC MEAN	.25516
GEOMETRIC STANDARD DEVIATION	1.24388
84.1% FREQUENCY VE	.317387
15.9% FREQUENCY VE	.205133

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.190	.100
2	.230	.300
3	.250	.500
4	.300	.700
5	.330	.900

STUDY AREA	AMERICAN SAMOA
LOCATION	TRANSITION ZONE , 60 FT. DEPTH
PARAMETER	TURBIDITY (NTU)

NUMBER OF DATA POINTS	5
MEDIAN	.21
SMALLEST NUMBER	.13
LARGEST NUMBER	.65
MEAN	.296
STANDARD DEVIATION	.207075
COEF. OF VARIANCE	.699577
GEOMETRIC MEAN	.251763
GEOMETRIC STANDARD DEVIATION	1.83701
84.1% FREQUENCY VE	.46249
15.9% FREQUENCY VE	.137051

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.130	.100
2	.190	.300
3	.210	.500
4	.300	.700
5	.650	.900

STUDY AREA	AMERICAN SAMOA	
LOCATION	OUTER PAGO PAGO HARBOR, SURFACE	
PARAMETER	TURBIDITY, (NTU)	

NUMBER OF DATA POINTS	25
MEDIAN	.42
SMALLEST NUMBER	.23
LARGEST NUMBER	1.6
MEAN	.4668
STANDARD DEVIATION	.259915
COEF. OF VARIANCE	.556802
GEOMETRIC MEAN	.427664
GEOMETRIC STANDARD DEVIATION	1.47408
84.1% FREQUENCY VE	.63041
15.9% FREQUENCY VE	.290123

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.230	.020
2	.240	.060
3	.260	.100
4	.300	.140
5	.310	.180
6	.330	.220
7	.330	.260
8	.380	.300
9	.380	.340
10	.390	.380
11	.410	.420
12	.420	.460
13	.420	.500
14	.430	.540
15	.450	.580
16	.470	.620
17	.480	.660
18	.490	.700
19	.510	.740
20	.510	.780
21	.540	.820
22	.550	.860
23	.580	.900
24	.660	.940
25	1.600	.980

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STUDY AREA AMERICAN SAMOA
LOCATION OUTER PAGO PAGO HARBOR, 60 FT. DEPTH
PARAMETER TURBIDITY (NTU)

NUMBER OF DATA POINTS	25
MEDIAN	.23
SMALLEST NUMBER	.15
LARGEST NUMBER	.47
MEAN	.2536
STANDARD DEVIATION	8.20508E-02
COEF. OF VARIANCE	.323544
GEOMETRIC MEAN	.242714
GEOMETRIC STANDARD DEVIATION	1.34169
84.1% FREQUENCY VE	.325648
15.9% FREQUENCY VE	.180901

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.150	.020
2	.160	.060
3	.180	.100
4	.180	.140
5	.180	.180
6	.200	.220
7	.210	.260
8	.210	.300
9	.210	.340
10	.210	.380
11	.220	.420
12	.230	.460
13	.230	.500
14	.230	.540
15	.230	.580
16	.250	.620
17	.270	.660
18	.280	.700
19	.280	.740
20	.280	.780
21	.320	.820
22	.330	.860
23	.400	.900
24	.400	.940
25	.470	.980

STUDY AREA AMERICAN SAMOA
LOCATION INNER PAGO PAGO HARBOR, SURFACE
PARAMETER TURBIDITY (NTU)

NUMBER OF DATA POINTS	15
MEDIAN	.91
SMALLEST NUMBER	.48
LARGEST NUMBER	3.3
MEAN	1.232
STANDARD DEVIATION	.81Ø83
COEF. OF VARIANCE	.658142
GEOMETRIC MEAN	1.Ø55Ø8
GEOMETRIC STANDARD DEVIATION	1.72586
84.1% FREQUENCY VE	1.82Ø92
15.9% FREQUENCY VE	.611332

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.48Ø	.Ø33
2	.58Ø	.1ØØ
3	.66Ø	.167
4	.73Ø	.233
5	.77Ø	.3ØØ
6	.78Ø	.367
7	.87Ø	.433
8	.91Ø	.5ØØ
9	1.1ØØ	.567
1Ø	1.2ØØ	.633
11	1.3ØØ	.7ØØ
12	1.3ØØ	.767
13	1.7ØØ	.833
14	2.8ØØ	.9ØØ
15	3.3ØØ	.967

STUDY AREA	AMERICAN SAMOA
LOCATION	INNER PAGO PAGO HARBOR, 60 FT DEPTH
PARAMETER	TURBIDITY (NTU)

NUMBER OF DATA POINTS	15
MEDIAN	.62
SMALLEST NUMBER	.21
LARGEST NUMBER	4
MEAN	1.04
STANDARD DEVIATION	1.20153
COEF. OF VARIANCE	1.15532
GEOMETRIC MEAN	.655448
GEOMETRIC STANDARD DEVIATION	2.55589
84.1% FREQUENCY VE	1.67526
15.9% FREQUENCY VE	.256446

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.210	.033
2	.250	.100
3	.250	.167
4	.280	.233
5	.290	.300
6	.400	.367
7	.530	.433
8	.620	.500
9	.680	.567
10	.690	.633
11	1.000	.700
12	1.300	.767
13	1.400	.833
14	3.700	.900
15	4.000	.967

STUDY AREA AMERICAN SAMOA
LOCATION BACKGROUND STREAMS
PARAMETER TURBIDITY (NTU)

NUMBER OF DATA POINTS	12
MEDIAN	2.85
SMALLEST NUMBER	1.5
LARGEST NUMBER	6.1
MEAN	3.21667
STANDARD DEVIATION	1.38093
COEF. OF VARIANCE	.429305
GEOMETRIC MEAN	2.96346
GEOMETRIC STANDARD DEVIATION	1.52663
84.1% FREQUENCY VE	4.52411
15.9% FREQUENCY VE	1.94118

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	1.500	.042
2	1.800	.125
3	2.000	.208
4	2.300	.292
5	2.600	.375
6	2.800	.458
7	2.900	.542
8	3.700	.625
9	3.800	.708
10	4.200	.792
11	5.100	.875
12	6.100	.958

STUDY AREA AMERICAN SAMOA
LOCATION URBAN INFLUENCE
PARAMETER TURBIDITY (NTU)

NUMBER OF DATA POINTS	28
MEDIAN	5.3
SMALLEST NUMBER	1.9
LARGEST NUMBER	39
MEAN	8.15357
STANDARD DEVIATION	8.13545
COEF. OF VARIANCE	.997777
GEOMETRIC MEAN	6.07127
GEOMETRIC STANDARD DEVIATION	2.05402
84.1% FREQUENCY VE	12.4705
15.9% FREQUENCY VE	2.95579

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	1.900	.018
2	2.300	.054
3	2.400	.089
4	3.100	.125
5	3.300	.161
6	3.300	.196
7	3.300	.232
8	3.600	.268
9	3.800	.304
10	4.300	.339
11	5.000	.375
12	5.200	.411
13	5.200	.446
14	5.200	.482
15	5.400	.518
16	5.700	.554
17	6.900	.589
18	7.300	.625
19	7.600	.661
20	7.800	.696
21	8.700	.732
22	9.200	.768
23	9.800	.804
24	10.000	.839
25	11.000	.875
26	22.000	.911
27	26.000	.946
28	39.000	.982

STUDY AREA	AMERICAN SAMOA
LOCATION	ROAD CONSTRUCTION
PARAMETER	TURBIDITY (NTU)

NUMBER OF DATA POINTS	4
MEDIAN	39.5
SMALLEST NUMBER	17.5
LARGEST NUMBER	65
MEAN	40.375
STANDARD DEVIATION	19.5251
COEF. OF VARIANCE	.483594
GEOMETRIC MEAN	36.4626
GEOMETRIC STANDARD DEVIATION	1.72577
84.1% FREQUENCY VE	62.9261
15.9% FREQUENCY VE	21.1283

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	17.500	.125
2	37.000	.375
3	42.000	.625
4	65.000	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	OCEAN STATIONS
PARAMETER	IRRADIANCE (FT)

NUMBER OF DATA POINTS	11
MEDIAN	170
SMALLEST NUMBER	140
LARGEST NUMBER	180
MEAN	167.727
STANDARD DEVIATION	14.7247
COEF. OF VARIANCE	8.77898E-02
GEOMETRIC MEAN	167.094
GEOMETRIC STANDARD DEVIATION	1.09722
84.1% FREQUENCY VE	183.34
15.9% FREQUENCY VE	152.288

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	140.000	.045
2	140.000	.136
3	165.000	.227
4	170.000	.318
5	170.000	.409
6	170.000	.500
7	170.000	.591
8	180.000	.682
9	180.000	.773
10	180.000	.864
11	180.000	.955

STUDY AREA	AMERICAN SAMOA
LOCATION	OPEN COASTAL NEARSHORE
PARAMETER	IRRADIANCE (FT)

NUMBER OF DATA POINTS	4
MEDIAN	145
SMALLEST NUMBER	140
LARGEST NUMBER	180
MEAN	152.5
STANDARD DEVIATION	18.9297
COEF. OF VARIANCE	.124129
GEOMETRIC MEAN	151.67
GEOMETRIC STANDARD DEVIATION	1.12603
84.1% FREQUENCY VE	170.786
15.9% FREQUENCY VE	134.694

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	140.000	.125
2	140.000	.375
3	150.000	.625
4	180.000	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	INNER PAGO PAGO HARBOR
PARAMETER	IRRADIANCE (FT)

NUMBER OF DATA POINTS	9
MEDIAN	21
SMALLEST NUMBER	11
LARGEST NUMBER	60
MEAN	30
STANDARD DEVIATION	17.4786
COEF. OF VARIANCE	.582619
GEOMETRIC MEAN	25.5985
GEOMETRIC STANDARD DEVIATION	1.83646
84.1% FREQUENCY VE	47.0106
15.9% FREQUENCY VE	13.9391

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	11.000	.056
2	12.000	.167
3	20.000	.278
4	20.000	.389
5	21.000	.500
6	33.000	.611
7	43.000	.722
8	53.000	.833
9	60.000	.944

STUDY AREA	AMERICAN SAMOA
LOCATION	TRANSITION ZONE
PARAMETER	IRRADIANCE (FT)

NUMBER OF DATA POINTS	4
MEDIAN	110
SMALLEST NUMBER	90
LARGEST NUMBER	130
MEAN	110
STANDARD DEVIATION	18.2574
COEF. OF VARIANCE	.165977
GEOMETRIC MEAN	108.852
GEOMETRIC STANDARD DEVIATION	1.18261
84.1% FREQUENCY VE	128.73
15.9% FREQUENCY VE	92.0444

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	90.000	.125
2	100.000	.375
3	120.000	.625
4	130.000	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	OUTER PAGO PAGO HARBOR
PARAMETER	IRRADIANCE (FT)

NUMBER OF DATA POINTS	15
MEDIAN	80
SMALLEST NUMBER	35
LARGEST NUMBER	100
MEAN	74.4667
STANDARD DEVIATION	19.1232
COEF. OF VARIANCE	.256802
GEOMETRIC MEAN	71.7751
GEOMETRIC STANDARD DEVIATION	1.34344
84.1% FREQUENCY VE	96.4239
15.9% FREQUENCY VE	53.4262

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	35.000	.033
2	50.000	.100
3	50.000	.167
4	60.000	.233
5	68.000	.300
6	70.000	.367
7	73.000	.433
8	80.000	.500
9	80.000	.567
10	85.000	.633
11	86.000	.700
12	90.000	.767
13	90.000	.833
14	100.000	.900
15	100.000	.967

STUDY AREA AMERICAN SAMOA
LOCATION OCEAN STATIONS, SURFACE
PARAMETER SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	11
MEDIAN	1.4
SMALLEST NUMBER	.9
LARGEST NUMBER	2.27
MEAN	1.51
STANDARD DEVIATION	.4843
COEF. OF VARIANCE	.320861
GEOMETRIC MEAN	1.44239
GEOMETRIC STANDARD DEVIATION	1.37227
84.1% FREQUENCY VE	1.97935
15.9% FREQUENCY VE	1.0511

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.900	.045
2	1.000	.136
3	1.070	.227
4	1.270	.318
5	1.400	.409
6	1.400	.500
7	1.470	.591
8	1.500	.682
9	2.130	.773
10	2.200	.864
11	2.270	.955

STUDY AREA AMERICAN SAMOA
LOCATION OCEAN STATIONS, 60 FT DEPTH
PARAMETER SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	11
MEDIAN	1.33
SMALLEST NUMBER	.4
LARGEST NUMBER	2.2
MEAN	1.28182
STANDARD DEVIATION	.549178
COEF. OF VARIANCE	.428436
GEOMETRIC MEAN	1.15859
GEOMETRIC STANDARD DEVIATION	1.65122
84.1% FREQUENCY VE	1.9131
15.9% FREQUENCY VE	.701657

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.400	.045
2	.700	.136
3	.900	.227
4	.900	.318
5	1.000	.409
6	1.330	.500
7	1.470	.591
8	1.600	.682
9	1.730	.773
10	1.870	.864
11	2.200	.955

STUDY AREA	AMERICAN SAMOA
LOCATION	OPEN COASTAL NEARSHORE, SURFACE
PARAMETER	SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	9
MEDIAN	2
SMALLEST NUMBER	.2
LARGEST NUMBER	2.67
MEAN	1.63778
STANDARD DEVIATION	.904776
COEF. OF VARIANCE	.552441
GEOMETRIC MEAN	1.27834
GEOMETRIC STANDARD DEVIATION	2.41569
84.1% FREQUENCY VE	3.08806
15.9% FREQUENCY VE	.529182

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.200	.056
2	.600	.167
3	.700	.278
4	1.700	.389
5	2.000	.500
6	2.200	.611
7	2.200	.722
8	2.470	.833
9	2.670	.944

STUDY AREA	AMERICAN SAMOA
LOCATION	OPEN COASTAL NEARSHORE, 60 FT DEPTH
PARAMETER	SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	9
MEDIAN	2.1
SMALLEST NUMBER	.4
LARGEST NUMBER	4.4
MEAN	1.86222
STANDARD DEVIATION	1.25588
COEF. OF VARIANCE	.674374
GEOMETRIC MEAN	1.47669
GEOMETRIC STANDARD DEVIATION	2.14539
84.1% FREQUENCY VE	3.16807
15.9% FREQUENCY VE	.688308

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.400	.056
2	.800	.167
3	.800	.278
4	1.000	.389
5	2.100	.500
6	2.300	.611
7	2.300	.722
8	2.600	.833
9	4.400	.944

STUDY AREA	AMERICAN SAMOA
LOCATION	EMBAYMENT, SURFACE
PARAMETER	SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	4
MEDIAN	1.435
SMALLEST NUMBER	.6
LARGEST NUMBER	2
MEAN	1.3675
STANDARD DEVIATION	.607913
COEF. OF VARIANCE	.444543
GEOMETRIC MEAN	1.24529
GEOMETRIC STANDARD DEVIATION	1.70023
84.1% FREQUENCY VE	2.11728
15.9% FREQUENCY VE	.732422

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.600	.125
2	1.200	.375
3	1.670	.625
4	2.000	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	EMBAYMENT, 60 FT DEPTH
PARAMETER	SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	4
MEDIAN	1.615
SMALLEST NUMBER	1.1
LARGEST NUMBER	3.07
MEAN	1.85
STANDARD DEVIATION	.886905
COEF. OF VARIANCE	.479408
GEOMETRIC MEAN	1.70611
GEOMETRIC STANDARD DEVIATION	1.57751
84.1% FREQUENCY VE	2.69481
15.9% FREQUENCY VE	1.08016

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	1.100	.125
2	1.300	.375
3	1.930	.625
4	3.070	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	TRANSITION ZONE, SURFACE
PARAMETER	SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	4
MEDIAN	1.65
SMALLEST NUMBER	.7
LARGEST NUMBER	3.2
MEAN	1.8
STANDARD DEVIATION	1.12842
COEF. OF VARIANCE	.6269
GEOMETRIC MEAN	1.52586
GEOMETRIC STANDARD DEVIATION	1.97845
84.1% FREQUENCY VE	3.01884
15.9% FREQUENCY VE	.771242

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.700	.125
2	1.100	.375
3	2.200	.625
4	3.200	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	TRANSITION ZONE, 60 FT. DEPTH
PARAMETER	SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	4
MEDIAN	1.75
SMALLEST NUMBER	1.1
LARGEST NUMBER	7.3
MEAN	2.975
STANDARD DEVIATION	2.93414
COEF. OF VARIANCE	.986265
GEOMETRIC MEAN	2.16973
GEOMETRIC STANDARD DEVIATION	2.39466
84.1% FREQUENCY VE	5.19577
15.9% FREQUENCY VE	.906069

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	1.100	.125
2	1.200	.375
3	2.300	.625
4	7.300	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	OUTER PAGO PAGO HARBOR, SURFACE
PARAMETER	SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	19
MEDIAN	1.8
SMALLEST NUMBER	.8
LARGEST NUMBER	3.8
MEAN	2.14737
STANDARD DEVIATION	.856588
COEF. OF VARIANCE	.398701
GEOMETRIC MEAN	1.98663
GEOMETRIC STANDARD DEVIATION	1.51Ø14
84.1% FREQUENCY VE	3.ØØØØ9
15.9% FREQUENCY VE	1.31553

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.8ØØ	.Ø26
2	1.2ØØ	.Ø79
3	1.4ØØ	.132
4	1.5ØØ	.184
5	1.5ØØ	.237
6	1.5ØØ	.289
7	1.6ØØ	.342
8	1.7ØØ	.395
9	1.7ØØ	.447
1Ø	1.8ØØ	.5ØØ
11	2.ØØØ	.553
12	2.2ØØ	.6Ø5
13	2.6ØØ	.658
14	2.8ØØ	.711
15	3.ØØØ	.763
16	3.ØØØ	.816
17	3.1ØØ	.868
18	3.6ØØ	.921
19	3.8ØØ	.974

STUDY AREA AMERICAN SAMOA
LOCATION OUTER PAGO PAGO HARBOR, 60 FT. DEPTH
PARAMETER SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	20
MEDIAN	1.55
SMALLEST NUMBER	1
LARGEST NUMBER	3.5
MEAN	1.845
STANDARD DEVIATION	.767412
COEF. OF VARIANCE	.415941
GEOMETRIC MEAN	1.70289
GEOMETRIC STANDARD DEVIATION	1.50492
84.1% FREQUENCY VE.	2.56271
15.9% FREQUENCY VE	1.13155

NO. POINTS	INDIVIDUAL POINTS	E(I)
1	1.000	.025
2	1.000	.075
3	1.100	.125
4	1.100	.175
5	1.100	.225
6	1.300	.275
7	1.300	.325
8	1.300	.375
9	1.300	.425
10	1.500	.475
11	1.600	.525
12	1.900	.575
13	2.300	.625
14	2.400	.675
15	2.400	.725
16	2.500	.775
17	2.500	.825
18	2.700	.875
19	3.100	.925
20	3.500	.975

STUDY AREA   AMERICAN SAMOA
LOCATION   INNER PAGO PAGO HARBOR, SURFACE
PARAMETER   SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	11
MEDIAN	4
SMALLEST NUMBER	2.1
LARGEST NUMBER	9.1
MEAN	4.98182
STANDARD DEVIATION	2.34854
COEF. OF VARIANCE	.471422
GEOMETRIC MEAN	4.47663
GEOMETRIC STANDARD DEVIATION	1.64042
84.1% FREQUENCY VE	7.34357
15.9% FREQUENCY VE	2.72895

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	2.100	.045
2	2.200	.136
3	3.400	.227
4	3.600	.318
5	3.600	.409
6	4.000	.500
7	6.100	.591
8	6.100	.682
9	6.400	.773
10	8.200	.864
11	9.100	.955

STUDY AREA — AMERICAN SAMOA
LOCATION — INNER PAGO PAGO HARBOR, 60 FT DEPTH
PARAMETER — SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	12
MEDIAN	3.2
SMALLEST NUMBER	.7
LARGEST NUMBER	19.6
MEAN	4.6
STANDARD DEVIATION	5.04957
COEF. OF VARIANCE	1.09773
GEOMETRIC MEAN	3.21986
GEOMETRIC STANDARD DEVIATION	2.31658
84.1% FREQUENCY VE	7.45906
15.9% FREQUENCY VE	1.38992

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.700	.042
2	1.500	.125
3	1.800	.208
4	2.000	.292
5	2.800	.375
6	3.200	.458
7	3.200	.542
8	3.500	.625
9	4.400	.708
10	5.200	.792
11	7.300	.875
12	19.600	.958

STUDY AREA AMERICAN SAMOA
LOCATION BACKGROUND STREAMS
PARAMETER SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	12
MEDIAN	1.35
SMALLEST NUMBER	.8
LARGEST NUMBER	4
MEAN	1.75417
STANDARD DEVIATION	.954763
COEF. OF VARIANCE	.544283
GEOMETRIC MEAN	1.56431
GEOMETRIC STANDARD DEVIATION	1.61941
84.1% FREQUENCY VE	2.53327
15.9% FREQUENCY VE	.965974

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.800	.042
2	1.000	.125
3	1.100	.208
4	1.150	.292
5	1.200	.375
6	1.300	.458
7	1.400	.542
8	1.600	.625
9	2.200	.708
10	2.300	.792
11	3.000	.875
12	4.000	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	URBAN INFLUENCE
PARAMETER	SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	28
MEDIAN	5.25
SMALLEST NUMBER	1.9
LARGEST NUMBER	12.74
MEAN	5.48786
STANDARD DEVIATION	2.87292
COEF. OF VARIANCE	.523505
GEOMETRIC MEAN	4.82695
GEOMETRIC STANDARD DEVIATION	1.68597
84.1% FREQUENCY VE	8.13809
15.9% FREQUENCY VE	2.86302

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	1.900	.018
2	2.000	.054
3	2.200	.089
4	2.250	.125
5	2.700	.161
6	2.850	.196
7	3.200	.232
8	3.400	.268
9	3.600	.304
10	4.100	.339
11	4.300	.375
12	4.800	.411
13	4.900	.446
14	5.200	.482
15	5.300	.518
16	5.560	.554
17	5.650	.589
18	5.800	.625
19	5.900	.661
20	6.100	.696
21	6.210	.732
22	6.600	.768
23	7.500	.804
24	7.600	.839
25	8.900	.875
26	9.800	.911
27	12.600	.946
28	12.740	.982

STUDY AREA	AMERICAN SAMOA
LOCATION	ROAD CONSTRUCTION
PARAMETER	SUSPENDED SOLIDS (MG/L)

NUMBER OF DATA POINTS	4
MEDIAN	36.75
SMALLEST NUMBER	9.7
LARGEST NUMBER	49
MEAN	33.05
STANDARD DEVIATION	18.8963
COEF. OF VARIANCE	.571748
GEOMETRIC MEAN	27.6426
GEOMETRIC STANDARD DEVIATION	2.1368
84.1% FREQUENCY VE	59.0668
15.9% FREQUENCY VE	12.9365

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	9.700	.125
2	25.700	.375
3	47.800	.625
4	49.000	.875

STUDY AREA	AMERICAN SAMOA	
LOCATION	OCEAN STATIONS, SURFACE	
PARAMETER	TOTAL PHOSPHORUS (UG/L)	

NUMBER OF DATA POINTS	17
MEDIAN	12
SMALLEST NUMBER	1
LARGEST NUMBER	32.5
MEAN	12.8294
STANDARD DEVIATION	9.68664
COEF. OF VARIANCE	.755034
GEOMETRIC MEAN	8.13414
GEOMETRIC STANDARD DEVIATION	3.18353
84.1% FREQUENCY VE	25.8953
15.9% FREQUENCY VE	2.55507

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	1.000	.029
2	1.000	.088
3	1.900	.147
4	2.500	.206
5	2.500	.265
6	7.800	.324
7	8.000	.382
8	8.800	.441
9	12.000	.500
10	16.500	.559
11	16.600	.618
12	18.100	.676
13	18.200	.735
14	22.200	.794
15	23.000	.853
16	25.500	.912
17	32.500	.971

STUDY AREA AMERICAN SAMOA
LOCATION OCEAN STATIONS, 60 FT DEPTH
PARAMETER TOTAL PHOSPHORUS (UG/L)

NUMBER OF DATA POINTS	17
MEDIAN	9.9
SMALLEST NUMBER	2.5
LARGEST NUMBER	26
MEAN	11.1882
STANDARD DEVIATION	6.17757
COEF. OF VARIANCE	.552149
GEOMETRIC MEAN	9.44717
GEOMETRIC STANDARD DEVIATION	1.90875
84.1% FREQUENCY VE	18.0322
15.9% FREQUENCY VE	4.94941

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	2.500	.029
2	2.500	.088
3	5.400	.147
4	6.700	.206
5	7.500	.265
6	7.900	.324
7	8.300	.382
8	9.600	.441
9	9.900	.500
10	10.500	.559
11	12.000	.618
12	12.300	.676
13	16.600	.735
14	16.900	.794
15	17.500	.853
16	17.900	.912
17	26.000	.971

STUDY AREA AMERICAN SAMOA
LOCATION OPEN COASTAL NEARSHORE, SURFACE
PARAMETER TOTAL PHOSPHORUS (UG/L)

NUMBER OF DATA POINTS	12
MEDIAN	7.45
SMALLEST NUMBER	1.2
LARGEST NUMBER	29.9
MEAN	11.5417
STANDARD DEVIATION	8.47237
COEF. OF VARIANCE	.734086
GEOMETRIC MEAN	8.66948
GEOMETRIC STANDARD DEVIATION	2.37377
84.1% FREQUENCY VE	20.5793
15.9% FREQUENCY VE	3.6522

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	1.200	.042
2	4.900	.125
3	5.500	.208
4	6.100	.292
5	6.400	.375
6	7.100	.458
7	7.800	.542
8	13.600	.625
9	16.900	.708
10	16.900	.792
11	22.200	.875
12	29.900	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	OPEN COASTAL NEARSHORE, 60 FT DEPTH
PARAMETER	TOTAL PHOSPHORUS (UG/L)

NUMBER OF DATA POINTS	12
MEDIAN	5.8
SMALLEST NUMBER	1
LARGEST NUMBER	11.9
MEAN	6.54167
STANDARD DEVIATION	3.25812
COEF. OF VARIANCE	.498057
GEOMETRIC MEAN	5.56861
GEOMETRIC STANDARD DEVIATION	1.96124
84.1% FREQUENCY VE	10.9214
15.9% FREQUENCY VE	2.83933

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	1.000	.042
2	3.800	.125
3	3.800	.208
4	4.200	.292
5	4.900	.375
6	5.800	.458
7	5.800	.542
8	8.500	.625
9	8.700	.708
10	9.500	.792
11	10.400	.875
12	11.900	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	EMBAYMENT, SURFACE
PARAMETER	TOTAL PHOSPHORUS (UG/L)

NUMBER OF DATA POINTS	6
MEDIAN	16.2
SMALLEST NUMBER	10.7
LARGEST NUMBER	54.8
MEAN	21.55
STANDARD DEVIATION	16.5594
COEF. OF VARIANCE	.768419
GEOMETRIC MEAN	18.1915
GEOMETRIC STANDARD DEVIATION	1.78349
84.1% FREQUENCY VE	32.4443
15.9% FREQUENCY VE	10.2

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	10.700	.083
2	12.500	.250
3	15.300	.417
4	17.100	.583
5	18.900	.750
6	54.800	.917

STUDY AREA	AMERICAN SAMOA
LOCATION	EMBAYMENT, 60 FT DEPTH
PARAMETER	TOTAL PHOSPHORUS (UG/L)

NUMBER OF DATA POINTS	6
MEDIAN	16.1
SMALLEST NUMBER	1.6
LARGEST NUMBER	26.3
MEAN	13.6
STANDARD DEVIATION	8.97218
COEF. OF VARIANCE	.659719
GEOMETRIC MEAN	9.80243
GEOMETRIC STANDARD DEVIATION	2.85707
84.1% FREQUENCY VE	28.0063
15.9% FREQUENCY VE	3.43094

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	1.600	.083
2	4.900	.250
3	16.000	.417
4	16.200	.583
5	16.600	.750
6	26.300	.917

STUDY AREA	AMERICAN SAMOA	
LOCATION	TRANSITION ZONE SURFACE	
PARAMETER	TOTAL PHOSPHORUS UG/L	

NUMBER OF DATA POINTS	5
MEDIAN	13.6
SMALLEST NUMBER	6.7
LARGEST NUMBER	46.5
MEAN	19.66
STANDARD DEVIATION	15.8963
COEF. OF VARIANCE	.808562
GEOMETRIC MEAN	15.6348
GEOMETRIC STANDARD DEVIATION	2.08908
84.1% FREQUENCY VE	32.6624
15.9% FREQUENCY VE	7.48407

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	6.700	.100
2	10.500	.300
3	13.600	.500
4	21.000	.700
5	46.500	.900

STUDY AREA	AMERICAN SAMOA
LOCATION	TRANSITION ZONE, 60 FT. DEPTH
PARAMETER	TOTAL PHOSPHORUS (UG/L)

NUMBER OF DATA POINTS	4
MEDIAN	15.65
SMALLEST NUMBER	6.8
LARGEST NUMBER	64.7
MEAN	25.7
STANDARD DEVIATION	26.344
COEF. OF VARIANCE	1.02506
GEOMETRIC-MEAN	18.1012
GEOMETRIC STANDARD DEVIATION	2.55137
84.1% FREQUENCY VE	46.1832
15.9% FREQUENCY VE	7.09464

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	6.800	.125
2	14.700	.375
3	16.600	.625
4	64.700	.875

STUDY AREA	AMERICAN SAMOA	
LOCATION	OUTER PAGO PAGO HARBOR, SURFACE	
PARAMETER	TOTAL PHOSPHORUS (UG/L)	

NUMBER OF DATA POINTS	26
MEDIAN	15.45
SMALLEST NUMBER	6.1
LARGEST NUMBER	79.9
MEAN	21.2923
STANDARD DEVIATION	17.24
COEF. OF VARIANCE	.809683
GEOMETRIC MEAN	16.5997
GEOMETRIC STANDARD DEVIATION	2.00351
84.1% FREQUENCY VE	33.2577
15.9% FREQUENCY VE	8.28535

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	6.100	.019
2	6.100	.058
3	6.500	.096
4	8.900	.135
5	9.100	.173
6	9.200	.212
7	9.200	.250
8	9.500	.288
9	10.900	.327
10	11.200	.365
11	12.000	.404
12	14.700	.442
13	14.700	.481
14	16.200	.519
15	17.800	.558
16	18.000	.596
17	18.500	.635
18	21.000	.673
19	22.700	.712
20	27.000	.750
21	30.000	.788
22	39.000	.827
23	43.600	.865
24	43.800	.904
25	48.000	.942
26	79.900	.981

STUDY AREA	AMERICAN SAMOA
LOCATION	OUTER PAGO PAGO HARBOR, 60 FT. DEPTH
PARAMETER	TOTAL PHOSPHORUS (UG/L)

NUMBER OF DATA POINTS	20
MEDIAN	7.8
SMALLEST NUMBER	1
LARGEST NUMBER	99.8
MEAN	25.8
STANDARD DEVIATION	30.1865
COEF. OF VARIANCE	1.17002
GEOMETRIC MEAN	13.6448
GEOMETRIC STANDARD DEVIATION	3.26121
84.1% FREQUENCY VE	44.4984
15.9% FREQUENCY VE	4.18395

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	1.000	.025
2	4.300	.075
3	6.700	.125
4	7.100	.175
5	7.500	.225
6	7.600	.275
7	7.700	.325
8	7.700	.375
9	7.700	.425
10	7.800	.475
11	7.800	.525
12	9.900	.575
13	10.700	.625
14	24.900	.675
15	35.100	.725
16	44.100	.775
17	61.400	.825
18	77.500	.875
19	79.700	.925
20	99.800	.975

STUDY AREA AMERICAN SAMOA
LOCATION INNER PAGO PAGO HARBOR, SURFACE
PARAMETER TOTAL PHOSPHORUS (UG/L)

NUMBER OF DATA POINTS	18
MEDIAN	28.85
SMALLEST NUMBER	6.7
LARGEST NUMBER	133
MEAN	42.8278
STANDARD DEVIATION	35.3016
COEF. OF VARIANCE	.824268
GEOMETRIC MEAN	32.2309
GEOMETRIC STANDARD DEVIATION	2.19834
84.1% FREQUENCY VE	70.8545
15.9% FREQUENCY VE	14.6614

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	6.700	.028
2	8.000	.083
3	17.000	.139
4	20.000	.194
5	25.500	.250
6	26.000	.306
7	27.000	.361
8	27.600	.417
9	28.000	.472
10	29.700	.528
11	33.300	.583
12	34.000	.639
13	38.000	.694
14	52.500	.750
15	64.200	.806
16	83.400	.861
17	117.000	.917
18	133.000	.972

STUDY AREA AMERICAN SAMOA
LOCATION INNER PAGO PAGO HARBOR, 60 FT DEPTH
PARAMETER TOTAL PHOSPHORUS (UG/L)

NUMBER OF DATA POINTS	12
MEDIAN	28.55
SMALLEST NUMBER	12.2
LARGEST NUMBER	172.6
MEAN	42.1667
STANDARD DEVIATION	47.1395
COEF. OF VARIANCE	1.11793
GEOMETRIC MEAN	28.3126
GEOMETRIC STANDARD DEVIATION	2.36585
84.1% FREQUENCY VE	66.9835
15.9% FREQUENCY VE	11.9672

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	12.200	.042
2	13.000	.125
3	13.300	.208
4	15.200	.292
5	15.300	.375
6	19.600	.458
7	21.500	.542
8	32.500	.625
9	45.600	.708
10	56.700	.792
11	88.300	.875
12	172.600	.958

STUDY AREA AMERICAN SAMOA
LOCATION BACKGROUND STREAMS
PARAMETER TOTAL PHOSPHORUS (UG/L)

NUMBER OF DATA POINTS	16
MEDIAN	102
SMALLEST NUMBER	18.5
LARGEST NUMBER	348
MEAN	105.825
STANDARD DEVIATION	74.489
COEF. OF VARIANCE	.703888
GEOMETRIC MEAN	86.6608
GEOMETRIC STANDARD DEVIATION	1.96539
84.1% FREQUENCY VE	170.322
15.9% FREQUENCY VE	44.0934

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	18.500	.031
2	35.100	.094
3	42.600	.156
4	50.000	.219
5	70.000	.281
6	90.000	.344
7	96.000	.406
8	101.000	.469
9	103.000	.531
10	110.000	.594
11	110.000	.656
12	111.000	.719
13	120.000	.781
14	144.000	.844
15	144.000	.906
16	348.000	.969

STUDY AREA AMERICAN SAMOA
LOCATION URBAN INFLUENCE
PARAMETER TOTAL PHOSPHORUS (UG/L)

NUMBER OF DATA POINTS	38
MEDIAN	1Ø5.3
SMALLEST NUMBER	4.9
LARGEST NUMBER	425
MEAN	156.662
STANDARD DEVIATION	127.Ø71
COEF. OF VARIANCE	.811Ø17
GEOMETRIC MEAN	1Ø2.637
GEOMETRIC STANDARD DEVIATION	2.88971
84.1% FREQUENCY VE	296.59
15.9% FREQUENCY VE	35.5181

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	4.9ØØ	.Ø13
2	12.ØØØ	.Ø39
3	2Ø.ØØØ	.Ø66
4	21.ØØØ	.Ø92
5	23.ØØØ	.118
6	4Ø.ØØØ	.145
7	46.ØØØ	.171
8	47.ØØØ	.197
9	52.ØØØ	.224
1Ø	6Ø.ØØØ	.25Ø
11	64.ØØØ	.276
12	66.ØØØ	.3Ø3
13	72.ØØØ	.329
14	73.ØØØ	.355
15	83.ØØØ	.382
16	89.ØØØ	.4Ø8
17	9Ø.ØØØ	.434
18	98.ØØØ	.461
19	1ØØ.ØØØ	.487
2Ø	111.ØØØ	.513
21	128.ØØØ	.539
22	13Ø.ØØØ	.566
23	139.ØØØ	.592
24	171.ØØØ	.618
25	183.ØØØ	.645
26	19Ø.ØØØ	.671
27	198.ØØØ	.697
28	2Ø7.ØØØ	.724
29	223.ØØØ	.75Ø
3Ø	28Ø.ØØØ	.776
31	335.ØØØ	.8Ø3
32	36Ø.ØØØ	.829
33	36Ø.ØØØ	.855
34	36Ø.ØØØ	.882
35	363.ØØØ	.9Ø8
36	366.ØØØ	.934
37	366.ØØØ	.961
38	425.ØØØ	.987

STUDY AREA	AMERICAN SAMOA
LOCATION	ROAD CONSTRUCTION
PARAMETER	TOTAL PHOSPHORUS (UG/L)

NUMBER OF DATA POINTS	5
MEDIAN	131
SMALLEST NUMBER	95
LARGEST NUMBER	281
MEAN	157.4
STANDARD DEVIATION	76.9305
COEF. OF VARIANCE	.488758
GEOMETRIC MEAN	144.474
GEOMETRIC STANDARD DEVIATION	1.56901
84.1% FREQUENCY VE	226.682
15.9% FREQUENCY VE	92.0799

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	95.000	.100
2	100.000	.300
3	131.000	.500
4	180.000	.700
5	281.000	.900

STUDY AREA	AMERICAN SAMOA	
LOCATION	OCEAN STATIONS, SURFACE	
PARAMETER	TOTAL KJELDAHL NITROGEN	(UG/L)

NUMBER OF DATA POINTS	17
MEDIAN	87
SMALLEST NUMBER	43
LARGEST NUMBER	255
MEAN	1Ø2.941
STANDARD DEVIATION	51.6472
COEF. OF VARIANCE	.5Ø1716
GEOMETRIC MEAN	92.7332
GEOMETRIC STANDARD DEVIATION	1.59372
84.1% FREQUENCY VE	147.791
15.9% FREQUENCY VE	58.1866

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	43.ØØØ	.Ø29
2	45.ØØØ	.Ø88
3	59.ØØØ	.147
4	59.ØØØ	.2Ø6
5	66.ØØØ	.265
6	85.ØØØ	.324
7	86.ØØØ	.382
8	86.ØØØ	.441
9	87.ØØØ	.5ØØ
1Ø	87.ØØØ	.559
11	1Ø7.ØØØ	.618
12	13Ø.ØØØ	.676
13	131.ØØØ	.735
14	138.ØØØ	.794
15	142.ØØØ	.853
16	144.ØØØ	.912
17	255.ØØØ	.971

STUDY AREA AMERICAN SAMOA
LOCATION OCEAN STATIONS, 6Ø FT DEPTH
PARAMETER TOTAL KJELDAHL NITROGEN (UG/L)

NUMBER OF DATA POINTS	18
MEDIAN	1Ø3
SMALLEST NUMBER	65
LARGEST NUMBER	181
MEAN	1Ø5.611
STANDARD DEVIATION	32.3Ø22
COEF. OF VARIANCE	.3Ø5857
GEOMETRIC MEAN	1Ø1.326
GEOMETRIC STANDARD DEVIATION	1.34ØØ2
84.1% FREQUENCY VE	135.779
15.9% FREQUENCY VE	75.6149

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	65.ØØØ	.Ø28
2	67.ØØØ	.Ø83
3	74.ØØØ	.139
4	79.ØØØ	.194
5	8Ø.ØØØ	.25Ø
6	84.ØØØ	.3Ø6
7	85.ØØØ	.361
8	91.ØØØ	.417
9	98.ØØØ	.472
1Ø	1Ø8.ØØØ	.528
11	11Ø.ØØØ	.583
12	112.ØØØ	.639
13	117.ØØØ	.694
14	117.ØØØ	.75Ø
15	126.ØØØ	.8Ø6
16	148.ØØØ	.861
17	159.ØØØ	.917
18	181.ØØØ	.972

STUDY AREA	AMERICAN SAMOA
LOCATION	OPEN COASTAL NEARSHORE, SURFACE
PARAMETER	TOTAL KJELDAHL NITROGEN (UG/L)

NUMBER OF DATA POINTS	9
MEDIAN	107
SMALLEST NUMBER	75
LARGEST NUMBER	133
MEAN	101.333
STANDARD DEVIATION	20.9643
COEF. OF VARIANCE	.206884
GEOMETRIC MEAN	99.3733
GEOMETRIC STANDARD DEVIATION	1.23489
84.1% FREQUENCY VE	122.715
15.9% FREQUENCY VE	80.4716

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	75.000	.056
2	76.000	.167
3	85.000	.278
4	88.000	.389
5	107.000	.500
6	110.000	.611
7	118.000	.722
8	120.000	.833
9	133.000	.944

STUDY AREA	AMERICAN SAMOA
LOCATION	OPEN COASTAL NEARSHORE, 60 FT DEPTH
PARAMETER	TOTAL KJELDAHL NITROGEN (UG/L)

NUMBER OF DATA POINTS	9
MEDIAN	100
SMALLEST NUMBER	26
LARGEST NUMBER	134
MEAN	95
STANDARD DEVIATION	30.4672
COEF. OF VARIANCE	.320708
GEOMETRIC MEAN	87.9098
GEOMETRIC STANDARD DEVIATION	1.62099
84.1% FREQUENCY VE	142.501
15.9% FREQUENCY VE	54.2322

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	26.000	.056
2	76.000	.167
3	91.000	.278
4	99.000	.389
5	100.000	.500
6	106.000	.611
7	106.000	.722
8	117.000	.833
9	134.000	.944

STUDY AREA	AMERICAN SAMOA	
LOCATION	EMBAYMENT, SURFACE	
PARAMETER	TOTAL KJELDAHL NITROGEN	(UG/L)

NUMBER OF DATA POINTS	6
MEDIAN	74.5
SMALLEST NUMBER	58
LARGEST NUMBER	83
MEAN	71.8333
STANDARD DEVIATION	8.88632
COEF. OF VARIANCE	.123708
GEOMETRIC MEAN	71.3539
GEOMETRIC STANDARD DEVIATION	1.13687
84.1% FREQUENCY VE	81.1203
15.9% FREQUENCY VE	62.7633

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	58.000	.083
2	65.000	.250
3	74.000	.417
4	75.000	.583
5	76.000	.750
6	83.000	.917

STUDY AREA	AMERICAN SAMOA	
LOCATION	EMBAYMENT, 60 FT DEPTH	
PARAMETER	TOTAL KJELDAHL NITROGEN	(UG/L)

NUMBER OF DATA POINTS	6
MEDIAN	105
SMALLEST NUMBER	67
LARGEST NUMBER	175
MEAN	119.667
STANDARD DEVIATION	43.0426
COEF. OF VARIANCE	.359687
GEOMETRIC MEAN	113.29
GEOMETRIC STANDARD DEVIATION	1.44026
84.1% FREQUENCY VE	163.166
15.9% FREQUENCY VE	78.6594

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	67.000	.083
2	97.000	.250
3	100.000	.417
4	110.000	.583
5	169.000	.750
6	175.000	.917

STUDY AREA	AMERICAN SAMOA
LOCATION	TRANSITION ZONE SURFACE
PARAMETER	TOTAL KJELDAHL NITROGEN (UG/L)

NUMBER OF DATA POINTS	4
MEDIAN	170
SMALLEST NUMBER	114
LARGEST NUMBER	258.3
MEAN	178.075
STANDARD DEVIATION	65.7877
COEF. OF VARIANCE	.369433
GEOMETRIC MEAN	169.062
GEOMETRIC STANDARD DEVIATION	1.45221
84.1% FREQUENCY VE	245.513
15.9% FREQUENCY VE	116.417

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	114.000	.125
2	136.000	.375
3	204.000	.625
4	258.300	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	TRANSITION ZONE, 60 FT DEPTH
PARAMETER	TOTAL KJELDAHL NITROGEN (UG/L)

NUMBER OF DATA POINTS	3
MEDIAN	110
SMALLEST NUMBER	70.35
LARGEST NUMBER	132
MEAN	104.117
STANDARD DEVIATION	31.2432
COEF. OF VARIANCE	.300079
GEOMETRIC MEAN	100.71
GEOMETRIC STANDARD DEVIATION	1.38237
84.1% FREQUENCY VE	139.217
15.9% FREQUENCY VE	72.853

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	70.350	.167
2	110.000	.500
3	132.000	.833

STUDY ARZA	AMERICAN SAMOA
LOCATION	OUTER PAGO PAGO HARDOR, SURFACE
PARAMETER	TOTAL KJELDAHL NITROGEN (UG/L)

NUMBER OF DATA POINTS	26
MEDIAN	127.5
SMALLEST NUMBER	48
LARGEST NUMBER	282.5
MEAN	142.725
STANDARD DEVIATION	68.5144
COEF. OF VARIANCE	.48ØØ45
GEOMETRIC MEAN	127.563
GEOMETRIC STANDARD DEVIATION	1.63513
84.1% FREQUENCY VE	2Ø8.581
15.9% FREQUENCY VE	78.Ø14

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	48.ØØØ	.Ø19
2	53.55Ø	.Ø58
3	65.ØØØ	.Ø96
4	69.ØØØ	.135
5	81.ØØØ	.173
6	88.2ØØ	.212
7	91.ØØØ	.25Ø
8	1Ø5.ØØØ	.288
9	1Ø8.ØØØ	.327
1Ø	1Ø9.ØØØ	.365
11	11Ø.ØØØ	.4Ø4
12	115.ØØØ	.442
13	124.ØØØ	.481
14	131.ØØØ	.519
15	133.ØØØ	.558
16	142.ØØØ	.596
17	155.ØØØ	.635
18	158.ØØØ	.673
19	168.ØØØ	.712
2Ø	189.ØØØ	.75Ø
21	196.4ØØ	.788
22	2Ø3.7ØØ	.827
23	231.ØØØ	.865
24	274.1ØØ	.9Ø4
25	28Ø.4ØØ	.942
26	282.5ØØ	.981

STUDY AREA	AMERICAN SAMOA
LOCATION	OUTER PAGO PAGO HARBOR, 60 FT. DEPTH
PARAMETER	TOTAL KJELDAHL NITROGEN (UG/L)

NUMBER OF DATA POINTS	19
MEDIAN	103
SMALLEST NUMBER	47
LARGEST NUMBER	285
MEAN	114.224
STANDARD DEVIATION	63.0041
COEF. OF VARIANCE	.552533
GEOMETRIC MEAN	100.684
GEOMETRIC STANDARD DEVIATION	1.65264
84.1% FREQUENCY VE	166.394
15.9% FREQUENCY VE	60.9235

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	47.000	.026
2	49.350	.079
3	50.000	.132
4	60.000	.184
5	71.000	.237
6	79.000	.289
7	86.000	.342
8	92.000	.395
9	94.000	.447
10	103.000	.500
11	103.000	.553
12	104.000	.605
13	107.100	.658
14	137.000	.711
15	139.000	.763
16	146.000	.816
17	176.000	.868
18	238.000	.921
19	285.000	.974

STUDY AREA	AMERICAN SAMOA
LOCATION	INNER PAGO PAGO HARBOR, SURFACE
PARAMETER	TOTAL KJELDAHL NITROGEN (UG/L)

NUMBER OF DATA POINTS	19
MEDIAN	234
SMALLEST NUMBER	37
LARGEST NUMBER	586
MEAN	240.105
STANDARD DEVIATION	136.501
COEF. OF VARIANCE	.568504
GEOMETRIC MEAN	200.425
GEOMETRIC STANDARD DEVIATION	1.95792
84.1% FREQUENCY VE	392.417
15.9% FREQUENCY VE	102.366

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	37.000	.026
2	86.000	.079
3	88.000	.132
4	94.000	.184
5	113.000	.237
6	172.000	.289
7	200.000	.342
8	232.000	.375
9	234.000	.447
10	234.000	.500
11	236.000	.553
12	243.000	.605
13	284.000	.658
14	286.000	.711
15	304.000	.763
16	306.000	.816
17	339.000	.868
18	488.000	.921
19	586.000	.974

STUDY AREA AMERICAN SAMOA
LOCATION INNER PAGO PAGO HARBOR, 6Ø FT DEPTH
PARAMETER TOTAL KJELDAHL NITROGEN (UG/L)

NUMBER OF DATA POINTS	12
MEDIAN	1Ø1.5
SMALLEST NUMBER	46
LARGEST NUMBER	296
MEAN	131.Ø83
STANDARD DEVIATION	82.6322
COEF. OF VARIANCE	.63Ø379
GEOMETRIC MEAN	11Ø.7Ø9
GEOMETRIC STANDARD DEVIATION	1.82666
84.1% FREQUENCY VE	2Ø2.227
15.9% FREQUENCY VE	6Ø.6Ø73

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	46.ØØØ	.Ø42
2	53.ØØØ	.125
3	61.ØØØ	.2Ø8
4	83.ØØØ	.292
5	87.ØØØ	.375
6	1ØØ.ØØØ	.458
7	1Ø3.ØØØ	.542
8	145.ØØØ	.625
9	152.ØØØ	.7Ø8
1Ø	169.ØØØ	.792
11	273.ØØØ	.875
12	296.ØØØ	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	BACKGROUND STREAMS
PARAMETER	TOTAL KJELDAHL NITROGEN (UG/L)

NUMBER OF DATA POINTS	17
MEDIAN	259
SMALLEST NUMBER	51
LARGEST NUMBER	5Ø8
MEAN	274.647
STANDARD DEVIATION	119.937
COEF. OF VARIANCE	.436697
GEOMETRIC MEAN	24Ø.874
GEOMETRIC STANDARD DEVIATION	1.82421
84.1% FREQUENCY VE	439.4Ø3
15.9% FREQUENCY VE	132.Ø43

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	51.ØØØ	.Ø29
2	7Ø.ØØØ	.Ø88
3	163.ØØØ	.147
4	184.ØØØ	.2Ø6
5	236.ØØØ	.265
6	246.ØØØ	.324
7	254.ØØØ	.382
8	259.ØØØ	.441
9	259.ØØØ	.5ØØ
1Ø	294.ØØØ	.559
11	314.ØØØ	.618
12	32Ø.ØØØ	.676
13	326.ØØØ	.735
14	327.ØØØ	.794
15	391.ØØØ	.853
16	467.ØØØ	.912
17	5Ø8.ØØØ	.971

STUDY AREA	AMERICAN SAMOA
LOCATION	ROAD CONSTRUCTION
PARAMETER	TOTAL KJELDAHL NITROGEN (UG/L)

NUMBER OF DATA POINTS	6
MEDIAN	376.5
SMALLEST NUMBER	121
LARGEST NUMBER	641
MEAN	394.333
STANDARD DEVIATION	178.267
COEF. OF VARIANCE	.452072
GEOMETRIC MEAN	351.104
GEOMETRIC STANDARD DEVIATION	1.78641
84.1% FREQUENCY VE	627.217
15.9% FREQUENCY VE	196.541

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	121.000	.083
2	330.000	.250
3	341.000	.417
4	412.000	.583
5	521.000	.750
6	641.000	.917

STUDY AREA AMERICAN SAMOA
LOCATION URBAN INFLUENCE
PARAMETER TOTAL KJELDAHL NITROGEN (UG/L)

NUMBER OF DATA POINTS	44
MEDIAN	319.5
SMALLEST NUMBER	82
LARGEST NUMBER	744
MEAN	329.023
STANDARD DEVIATION	156.937
COEF. OF VARIANCE	.476973
GEOMETRIC MEAN	286.889
GEOMETRIC STANDARD DEVIATION	1.77271
84.1% FREQUENCY VE	508.571
15.9% FREQUENCY VE	161.837

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	82.000	.011
2	88.000	.034
3	89.000	.057
4	95.000	.080
5	105.000	.102
6	121.000	.125
7	126.000	.148
8	137.000	.170
9	152.000	.193
10	221.000	.216
11	221.000	.239
12	247.000	.261
13	270.000	.284
14	270.000	.307
15	273.000	.330
16	283.000	.352
17	293.000	.375
18	298.000	.398
19	301.000	.420
20	301.000	.443
21	312.000	.466
22	313.000	.489
23	326.000	.511
24	349.000	.534
25	352.000	.557
26	352.000	.580
27	357.000	.602
28	373.000	.625
29	381.000	.648
30	383.000	.670
31	388.000	.693
32	397.000	.716
33	439.000	.739
34	440.000	.761
35	443.000	.784
36	444.000	.807
37	456.000	.830
38	460.000	.852
39	480.000	.875
40	488.000	.898
41	504.000	.920
42	651.000	.943
43	672.000	.966
44	744.000	.989

STUDY AREA AMERICAN SAMOA
LOCATION OCEAN STATIONS, SURFACE
PARAMETER NITRATE + NITRITE (UG/L)

NUMBER OF DATA POINTS	18
MEDIAN	14.3
SMALLEST NUMBER	.Ø4
LARGEST NUMBER	85.5
MEAN	18.Ø633
STANDARD DEVIATION	19.9127
COEF. OF VARIANCE	1.1Ø239
GEOMETRIC MEAN	7.74913
GEOMETRIC STANDARD DEVIATION	6.34831
84.1% FREQUENCY VE	49.1939
15.9% FREQUENCY VE	1.22Ø66

NO. POINTS	INDIVIDUAL POINTS	F(I)
1.	.Ø4Ø	.Ø28
2	.4ØØ	.Ø83
3	1.6ØØ	.139
4	2.5ØØ	.194
5	3.1ØØ	.25Ø
6	4.4ØØ	.3Ø6
7	8.6ØØ	.361
8	12.3ØØ	.417
9	12.9ØØ	.472
1Ø	15.7ØØ	.528
11	17.9ØØ	.583
12	23.9ØØ	.639
13	24.4ØØ	.694
14	25.2ØØ	.75Ø
15	28.8ØØ	.8Ø6
16	28.9ØØ	.861
17	29.ØØØ	.917
18	85.5ØØ	.972

STUDY AREA AMERICAN SAMOA
LOCATION OCEAN STATIONS, 60 FT DEPTH
PARAMETER NITRATE + NITRITE (UG/L)

NUMBER OF DATA POINTS	18
MEDIAN	11.05
SMALLEST NUMBER	.02
LARGEST NUMBER	68.8
MEAN	15.59
STANDARD DEVIATION	16.7796
COEF. OF VARIANCE	1.07631
GEOMETRIC MEAN	6.37593
GEOMETRIC STANDARD DEVIATION	6.87795
84.1% FREQUENCY VE	43.8533
15.9% FREQUENCY VE	.92701

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.020	.028
2	.500	.083
3	1.600	.139
4	1.900	.194
5	2.400	.250
6	2.700	.306
7	6.600	.361
8	7.600	.417
9	8.400	.472
10	13.700	.528
11	15.400	.583
12	22.700	.639
13	24.000	.694
14	25.400	.750
15	26.000	.806
16	26.400	.861
17	26.500	.917
18	68.800	.972

STUDY AREA AMERICAN SAMOA
LOCATION OPEN COASTAL NEARSHORE, SURFACE
PARAMETER NITRATE + NITRITE (UG/L)

NUMBER OF DATA POINTS	12
MEDIAN	39.2
SMALLEST NUMBER	7.1
LARGEST NUMBER	125.9
MEAN	46.925
STANDARD DEVIATION	33.1889
COEF. OF VARIANCE	.707276
GEOMETRIC MEAN	36.3157
GEOMETRIC STANDARD DEVIATION	2.24423
84.1% FREQUENCY VE	81.501
15.9% FREQUENCY VE	16.1818

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	7.100	.042
2	11.500	.125
3	20.900	.208
4	31.900	.292
5	34.000	.375
6	38.400	.458
7	40.000	.542
8	47.600	.625
9	57.500	.708
10	62.900	.792
11	85.400	.875
12	125.900	.958

STUDY AREA AMERICAN SAMOA
LOCATION OPEN COASTAL NEARSHORE, 60 FT DEPTH
PARAMETER NITRATE + NITRITE (UG/L)

NUMBER OF DATA POINTS	12
MEDIAN	26.45
SMALLEST NUMBER	2.8
LARGEST NUMBER	118.4
MEAN	35.7333
STANDARD DEVIATION	32.932
COEF. OF VARIANCE	.921603
GEOMETRIC MEAN	24.0434
GEOMETRIC STANDARD DEVIATION	2.73596
84.1% FREQUENCY VE	65.7818
15.9% FREQUENCY VE	8.78794

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	2.800	.042
2	7.800	.125
3	14.300	.208
4	15.100	.292
5	21.100	.375
6	26.100	.458
7	26.800	.542
8	30.500	.625
9	37.000	.708
10	52.600	.792
11	76.300	.875
12	118.400	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	EMBAYMENT, SURFACE
PARAMETER	NITRATE + NITRITE (UG/L)

NUMBER OF DATA POINTS	6
MEDIAN	25.5
SMALLEST NUMBER	12.5
LARGEST NUMBER	29.8
MEAN	23.7667
STANDARD DEVIATION	6.76Ø67
COEF. OF VARIANCE	.28446
GEOMETRIC MEAN	22.7964
GEOMETRIC STANDARD DEVIATION	1.39678
84.1% FREQUENCY VE	31.8416
15.9% FREQUENCY VE	16.32Ø6

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	12.5ØØ	.Ø83
2	19.9ØØ	.25Ø
3	23.ØØØ	.417
4	28.ØØØ	.583
5	29.4ØØ	.75Ø
6	29.8ØØ	.917

STUDY AREA	AMERICAN SAMOA
LOCATION	EMBAYMENT, 6Ø FT DEPTH
PARAMETER	NITRATE + NITRITE (UG/L)

NUMBER OF DATA POINTS	6
MEDIAN	14.85
SMALLEST NUMBER	2
LARGEST NUMBER	29.3
MEAN	15.5233
STANDARD DEVIATION	11.81Ø3
COEF. OF VARIANCE	.76Ø812
GEOMETRIC MEAN	1Ø.3977
GEOMETRIC STANDARD DEVIATION	3.Ø7565
84.1% FREQUENCY VE	31.9796
15.9% FREQUENCY VE	3.38Ø64

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	2.ØØØ	.Ø83
2	3.44Ø	.25Ø
3	13.4ØØ	.417
4	16.3ØØ	.583
5	28.7ØØ	.75Ø
6	29.3ØØ	.917

STUDY AREA	AMERICAN SAMOA
LOCATION	TRANSITION ZONE, SURFACE
PARAMETER	NITRITE-NITRATE (UG/L-N)

NUMBER OF DATA POINTS	5
MEDIAN	26
SMALLEST NUMBER	15.6
LARGEST NUMBER	73
MEAN	34.78
STANDARD DEVIATION	22.2326
COEF. OF VARIANCE	.63921
GEOMETRIC MEAN	28.8731
GEOMETRIC STANDARD DEVIATION	1.79977
84.1% FREQUENCY VE	51.765
15.9% FREQUENCY VE	16.0427

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	15.600	.100
2	26.600	.300
3	26.000	.500
4	32.700	.700
5	73.000	.900

STUDY AREA	AMERICAN SAMOA
LOCATION	TRANSITION ZONE, 60 FT. DEPTH
PARAMETER	NITRITE-NITRATE (UG/L-N)

NUMBER OF DATA POINTS	4
MEDIAN	22
SMALLEST NUMBER	.3
LARGEST NUMBER	58.3
MEAN	25.62
STANDARD DEVIATION	24.8082
COEF. OF VARIANCE	.968351
GEOMETRIC MEAN	9.192
GEOMETRIC STANDARD DEVIATION	10.5793
84.1% FREQUENCY VE	98.3214
15.9% FREQUENCY VE	.878323

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.300	.125
2	4.400	.375
3	29.600	.625
4	58.300	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	OUTER PAGO PAGO HARBOR, SURFACE
PARAMETER	NITRITE-NITRATE (UG/L-N)

NUMBER OF DATA POINTS	26
MEDIAN	43.8
SMALLEST NUMBER	4.5
LARGEST NUMBER	100.6
MEAN	46.7300
STANDARD DEVIATION	27.6277
COEF. OF VARIANCE	.59121
GEOMETRIC MEAN	37.1028
GEOMETRIC STANDARD DEVIATION	2.16847
84.1% FREQUENCY VE	80.4564
15.9% FREQUENCY VE	17.1101

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	4.500	.019
2	12.300	.058
3	12.300	.096
4	13.900	.135
5	17.400	.173
6	18.200	.212
7	23.000	.250
8	25.900	.288
9	29.400	.327
10	29.500	.365
11	34.300	.404
12	37.100	.442
13	43.400	.481
14	44.200	.519
15	53.000	.558
16	58.000	.596
17	60.500	.635
18	62.900	.673
19	63.200	.712
20	64.900	.750
21	75.200	.788
22	77.000	.837
23	78.000	.865
24	88.000	.904
25	93.500	.942
26	100.600	.981

STUDY AREA	AMERICAN SAMIA
LOCATION	OUTER PAGO PAGC HARBOR, 60 FT. DEPTH
PARAMETER	NITRITE-NITRATE (UG/L)

NUMBER OF DATA POINTS	20
MEDIAN	23.9
SMALLEST NUMBER	3.2
LARGEST NUMBER	120.9
MEAN	35.9
STANDARD DEVIATION	31.9568
COEF. OF VARIANCE	.890163
GEOMETRIC MEAN	23.649
GEOMETRIC STANDARD DEVIATION	2.76889
84.1% FREQUENCY VE	65.4815
15.9% FREQUENCY VE	8.54095

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	3.200	.025
2	3.900	.075
3	4.600	.125
4	13.800	.175
5	13.900	.225
6	15.000	.275
7	16.400	.325
8	17.000	.375
9	18.600	.425
10	19.900	.475
11	27.900	.525
12	30.300	.575
13	35.400	.625
14	40.400	.675
15	45.400	.725
16	62.600	.775
17	66.000	.825
18	66.600	.875
19	96.200	.925
20	120.900	.975

STUDY AREA AMERICAN SAMOA
LOCATION INNER PAGO PAGO HARBOR, SURFACE
PARAMETER NITRATE + NITRITE (UG/L)

NUMBER OF DATA POINTS	17
MEDIAN	34.8
SMALLEST NUMBER	11
LARGEST NUMBER	330
MEAN	58.8941
STANDARD DEVIATION	75.3789
COEF. OF VARIANCE	1.27991
GEOMETRIC MEAN	39.5814
GEOMETRIC STANDARD DEVIATION	2.26528
84.1% FREQUENCY VE	89.6631
15.9% FREQUENCY VE	17.4731

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	11.000	.029
2	18.100	.088
3	19.300	.147
4	20.000	.206
5	22.000	.265
6	24.400	.324
7	29.000	.382
8	33.200	.441
9	34.800	.500
10	37.400	.559
11	47.300	.618
12	53.100	.676
13	54.200	.735
14	63.800	.794
15	76.000	.853
16	127.600	.912
17	330.000	.971

STUDY AREA	AMERICAN SAMOA
LOCATION	INNER PAGO PAGO HARBOR, 60 FT DEPTH
PARAMETER	NITRATE + NITRITE (UG/L)

NUMBER OF DATA POINTS	12
MEDIAN	32.65
SMALLEST NUMBER	1.1
LARGEST NUMBER	77.5
MEAN	33.575
STANDARD DEVIATION	22.2931
COEF. OF VARIANCE	.66398
GEOMETRIC MEAN	23.1455
GEOMETRIC STANDARD DEVIATION	3.18168
84.1% FREQUENCY VE	73.6416
15.9% FREQUENCY VE	7.27462

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	1.100	.042
2	7.900	.125
3	12.000	.208
4	22.100	.292
5	25.200	.375
6	32.200	.458
7	33.100	.542
8	36.600	.625
9	44.900	.708
10	48.600	.792
11	61.700	.875
12	77.500	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	BACKGROUND STREAMS
PARAMETER	NITRATE + NITRITE (UG/L)

NUMBER OF DATA POINTS	18
MEDIAN	43.6
SMALLEST NUMBER	16.1
LARGEST NUMBER	159.6
MEAN	51.9278
STANDARD DEVIATION	33.6347
COEF. OF VARIANCE	.647721
GEOMETRIC MEAN	44.9737
GEOMETRIC STANDARD DEVIATION	1.693
84.1% FREQUENCY VE	76.1438
15.9% FREQUENCY VE	26.5657

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	16.100	.028
2	22.500	.083
3	29.000	.139
4	33.500	.194
5	33.800	.250
6	34.000	.306
7	36.100	.361
8	41.000	.417
9	43.400	.472
10	43.800	.528
11	47.600	.583
12	55.300	.639
13	56.500	.694
14	57.000	.750
15	58.000	.806
16	58.000	.861
17	107.500	.917
18	159.600	.972

STUDY AREA AMERICAN SAMOA
LOCATION URBAN INFLUENCE
PARAMETER NITRATE + NITRITE (UG/L)

NUMBER OF DATA POINTS	42
MEDIAN	188.35
SMALLEST NUMBER	5
LARGEST NUMBER	904.6
MEAN	233.327
STANDARD DEVIATION	227.121
COEF. OF VARIANCE	.973395
GEOMETRIC MEAN	127.995
GEOMETRIC STANDARD DEVIATION	3.58756
84.1% FREQUENCY VE	459.19
15.9% FREQUENCY VE	35.6774

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	5.000	.012
2	10.000	.036
3	12.300	.060
4	20.400	.083
5	23.700	.107
6	35.100	.131
7	35.500	.155
8	39.100	.179
9	40.000	.202
10	41.000	.226
11	44.400	.250
12	46.600	.274
13	48.700	.298
14	62.600	.321
15	71.700	.345
16	100.000	.369
17	119.200	.393
18	139.400	.417
19	161.400	.440
20	170.200	.464
21	177.400	.488
22	199.300	.512
23	208.000	.536
24	209.000	.560
25	222.000	.583
26	223.100	.607
27	236.000	.631
28	262.400	.655
29	263.000	.679
30	264.700	.702
31	266.000	.726
32	305.000	.750
33	371.000	.774
34	371.300	.798
35	395.700	.821
36	431.000	.845
37	528.000	.869
38	632.800	.893
39	681.600	.917
40	698.600	.940
41	731.000	.964
42	904.600	.988

STUDY AREA AMERICAN SAMOA
LOCATION ROAD CONSTRUCTION
PARAMETER NITRATE + NITRITE (UG/L)

NUMBER OF DATA POINTS	6
MEDIAN	130.15
SMALLEST NUMBER	87.3
LARGEST NUMBER	239.6
MEAN	141.967
STANDARD DEVIATION	51.7206
COEF. OF VARIANCE	.364313
GEOMETRIC MEAN	135.292
GEOMETRIC STANDARD DEVIATION	1.39141
84.1% FREQUENCY VE	188.246
15.9% FREQUENCY VE	97.2338

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	87.300	.083
2	119.000	.250
3	126.000	.417
4	134.300	.583
5	145.300	.750
6	239.600	.917

STUDY AREA AMERICAN SAMOA
LOCATION OCEAN STATIONS, SURFACE
PARAMETER CHLOROPHYLL-A (UG/L)

NUMBER OF DATA POINTS	14
MEDIAN	.203
SMALLEST NUMBER	.05
LARGEST NUMBER	.578
MEAN	.211286
STANDARD DEVIATION	.154395
COEF. OF VARIANCE	.730739
GEOMETRIC MEAN	.163412
GEOMETRIC STANDARD DEVIATION	2.15939
84.1% FREQUENCY VE	.35287
15.9% FREQUENCY VE	7.56751E-02

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.050	.036
2	.057	.107
3	.060	.179
4	.085	.250
5	.109	.321
6	.142	.393
7	.182	.464
8	.224	.536
9	.227	.607
10	.227	.679
11	.239	.750
12	.334	.821
13	.444	.893
14	.578	.964

STUDY AREA	AMERICAN SAMOA
LOCATION	OCEAN STATIONS, 60 FT DEPTH
PARAMETER	CHLOROPHYLL-A (UG/L)

NUMBER OF DATA POINTS	15
MEDIAN	.146
SMALLEST NUMBER	.025
LARGEST NUMBER	.457
MEAN	.173933
STANDARD DEVIATION	.102937
COEF. OF VARIANCE	.59182
GEOMETRIC MEAN	.146056
GEOMETRIC STANDARD DEVIATION	1.94251
84.1% FREQUENCY VE	.283715
15.9% FREQUENCY VE	7.51895E-02

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.025	.033
2	.088	.100
3	.093	.167
4	.106	.233
5	.115	.300
6	.119	.367
7	.141	.433
8	.146	.500
9	.163	.567
10	.204	.633
11	.219	.700
12	.221	.767
13	.242	.833
14	.270	.900
15	.457	.967

STUDY AREA	AMERICAN SAMOA	
LOCATION	OPEN COASTAL NEARSHORE, SURFACE	
PARAMETER	CHLOROPHYLL-A (UG/L)	
NUMBER OF DATA POINTS		12
MEDIAN		.215
SMALLEST NUMBER		.Ø2
LARGEST NUMBER		.79
MEAN		.276667
STANDARD DEVIATION		.22469
COEF. OF VARIANCE		.812133
GEOMETRIC MEAN		.184729
GEOMETRIC STANDARD DEVIATION		2.94483
84.1% FREQUENCY VE		.543996
15.9% FREQUENCY VE		6.27299E-Ø2

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.Ø2Ø	.Ø42
2	.Ø35	.125
3	.1Ø6	.2Ø8
4	.146	.292
5	.161	.375
6	.2Ø2	.458
7	.228	.542
8	.267	.625
9	.416	.7Ø8
1Ø	.441	.792
11	.5Ø8	.875
12	.79Ø	.958

STUDY AREA	AMERICAN SAMOA	
LOCATION	OPEN COASTAL NEARSHORE, 6Ø FT DEPTH	
PARAMETER	CHLOROPHYLL-A (UG/L)	
NUMBER OF DATA POINTS		12
MEDIAN		.1765
SMALLEST NUMBER		.Ø56
LARGEST NUMBER		.556
MEAN		.233Ø83
STANDARD DEVIATION		.152835
COEF. OF VARIANCE		.6557Ø8
GEOMETRIC MEAN		.19Ø252
GEOMETRIC STANDARD DEVIATION		1.97834
84.1% FREQUENCY VE		.376383
15.9% FREQUENCY VE		9.61677E-Ø2

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.Ø56	.Ø42
2	.Ø92	.125
3	.111	.2Ø8
4	.139	.292
5	.141	.375
6	.141	.458
7	.212	.542
8	.277	.625
9	.29Ø	.7Ø8
1Ø	.34Ø	.792
11	.442	.875
12	.556	.958

STUDY AREA	AMERICAN SAMOA
LOCATION	EMBAYMENT, SURFACE
PARAMETER	CHLOROPHYLL-A (UG/L)

NUMBER OF DATA POINTS	6
MEDIAN	.3145
SMALLEST NUMBER	.13
LARGEST NUMBER	.46
MEAN	.3Ø3833
STANDARD DEVIATION	.1Ø8178
COEF. OF VARIANCE	.356Ø45
GEOMETRIC MEAN	.284355
GEOMETRIC STANDARD DEVIATION	1.532Ø1
84.1% FREQUENCY VE	.435635
15.9% FREQUENCY VE	.1856Ø9

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.13Ø	.Ø83
2	.26Ø	.25Ø
3	.3Ø6	.417
4	.323	.583
5	.344	.75Ø
6	.46Ø	.917

STUDY AREA	AMERICAN SAMOA
LOCATION	EMBAYMENT, 6Ø FT DEPTH
PARAMETER	CHLOROPHYLL-A (UG/L)

NUMBER OF DATA POINTS	5
MEDIAN	.331
SMALLEST NUMBER	.25
LARGEST NUMBER	.372
MEAN	.315
STANDARD DEVIATION	5.Ø1846E-Ø2
COEF. OF VARIANCE	.159316
GEOMETRIC MEAN	.31169
GEOMETRIC STANDARD DEVIATION	1.17838
84.1% FREQUENCY VE	.367291
15.9% FREQUENCY VE	.2645Ø6

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.25Ø	.1ØØ
2	.277	.3ØØ
3	.331	.5ØØ
4	.345	.7ØØ
5	.372	.9ØØ

STUDY AREA	AMERICAN SAMOA
LOCATION	TRANSITON ZONE , SURFACE
PARAMETER	CHLOROPHYLL-A (UG/L)

NUMBER OF DATA POINTS	4
MEDIAN	.686
SMALLEST NUMBER	.218
LARGEST NUMBER	2.527
MEAN	1.02925
STANDARD DEVIATION	1.02296
COEF. OF VARIANCE	.993888
GEOMETRIC MEAN	.713117
GEOMETRIC STANDARD DEVIATION	2.7243
84.1% FREQUENCY VE	1.94274
15.9% FREQUENCY VE	.261762

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.218	.125
2	.652	.375
3	.720	.625
4	2.527	.875

STUDY AREA	AMERICAN SAMOA
LOCATION	TRANSITION ZONE, 60 FT. DEPTH
PARAMETER	CHLOROPHYLL-A (UG/L)

NUMBER OF DATA POINTS	4
MEDIAN	.5045
SMALLEST NUMBER	.242
LARGEST NUMBER	.852
MEAN	.52575
STANDARD DEVIATION	.315086
COEF. OF VARIANCE	.599307
GEOMETRIC MEAN	.450367
GEOMETRIC STANDARD DEVIATION	1.93111
84.1% FREQUENCY VE	.869707
15.9% FREQUENCY VE	.233217

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.242	.125
2	.270	.375
3	.739	.625
4	.852	.875

STUDY AREA AMERICAN SAMOA
LOCATION OUTER PAGO PAGO HARBOR, SURFACE
PARAMETER CHLOROPHYLL-A, (UG/L)

NUMBER OF DATA POINTS	24
MEDIAN	1.9305
SMALLEST NUMBER	.366
LARGEST NUMBER	9.268
MEAN	3.17733
STANDARD DEVIATION	3.15583
COEF. OF VARIANCE	.993232
GEOMETRIC MEAN	1.79847
GEOMETRIC STANDARD DEVIATION	3.14916
84.1% FREQUENCY VE	5.66368
15.9% FREQUENCY VE	.571095

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.366	.021
2	.386	.063
3	.409	.104
4	.451	.146
5	.527	.188
6	.674	.229
7	.675	.271
8	.680	.313
9	.738	.354
10	1.024	.396
11	1.296	.438
12	1.870	.479
13	1.991	.521
14	1.998	.563
15	2.371	.604
16	3.375	.646
17	3.920	.688
18	5.318	.729
19	6.195	.771
20	7.241	.813
21	8.094	.854
22	8.336	.896
23	9.053	.938
24	9.268	.979

STUDY AREA	AMERICAN SAMOA
LOCATION	OUTER PAGO PAGO HARBOR, 60 FT. DEPTH
PARAMETER	CHLOROPHYLL-A (UG/L)

NUMBER OF DATA POINTS	20
MEDIAN	.659
SMALLEST NUMBER	.161
LARGEST NUMBER	2.082
MEAN	.7088
STANDARD DEVIATION	.443481
COEF. OF VARIANCE	.625679
GEOMETRIC MEAN	.597806
GEOMETRIC STANDARD DEVIATION	1.83392
84.1% FREQUENCY VE	1.09633
15.9% FREQUENCY VE	.325972

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.161	.025
2	.283	.075
3	.320	.125
4	.334	.175
5	.352	.225
6	.409	.275
7	.434	.325
8	.454	.375
9	.523	.425
10	.578	.475
11	.740	.525
12	.747	.575
13	.782	.625
14	.818	.675
15	.849	.725
16	.857	.775
17	1.049	.825
18	1.134	.875
19	1.266	.925
20	2.082	.975

STUDY AREA AMERICAN SAMOA
LOCATION INNER PAGO PAGO HARBOR, SURFACE
PARAMETER CHLOROPHYLL-A (UG/L)

NUMBER OF DATA POINTS	17
MEDIAN	6.59
SMALLEST NUMBER	.338
LARGEST NUMBER	51.1
MEAN	10.4872
STANDARD DEVIATION	12.9658
COEF. OF VARIANCE	1.23635
GEOMETRIC MEAN	4.7338
GEOMETRIC STANDARD DEVIATION	4.57683
84.1% FREQUENCY VE	21.6658
15.9% FREQUENCY VE	1.0343

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.338	.029
2	.423	.088
3	.460	.147
4	.553	.206
5	3.912	.265
6	4.460	.324
7	4.814	.382
8	6.386	.441
9	6.590	.500
10	7.228	.559
11	8.300	.618
12	8.476	.676
13	8.970	.735
14	15.959	.794
15	22.796	.853
16	27.515	.912
17	51.100	.971

STUDY AREA — AMERICAN SAMOA
LOCATION — INNER PAGO PAGO HARBOR, 60 FT DEPTH
PARAMETER — CHLOROPHYLL-A (UG/L)

NUMBER OF DATA POINTS — 11
MEDIAN — .617
SMALLEST NUMBER — .252
LARGEST NUMBER — 5.433

MEAN — 1.19827
STANDARD DEVIATION — 1.46412
COEF. OF VARIANCE — 1.22186

GEOMETRIC MEAN — .801211
GEOMETRIC STANDARD DEVIATION — 2.36103
84.1% FREQUENCY VE — 1.89232
15.9% FREQUENCY VE — .339234

NO. POINTS	INDIVIDUAL POINTS	F(I)
1	.252	.045
2	.335	.136
3	.381	.227
4	.577	.318
5	.611	.409
6	.617	.500
7	.977	.591
8	1.250	.682
9	1.294	.773
10	1.454	.864
11	5.433	.955

APPENDIX C

FAGO FAGO (WET SEASON)

SAMPLE SIZE = 490

THIS IS A EBB SORT

X =-.311797 Y = 1.32596 RESULTANT = 1.36213 ANGLE =-76.7672

% OF TIME

SEC	0CM	1CM	2CM	3CM	4CM	5CM	6CM	7CM	8CM	9CM	SUBT	VSUM
1	.4	2.9	7.3	6.9	5.9	4.5	1.6	.4	.2	.0	30.2	.98776
2	.0	.0	.2	.0	.2	.0	.0	.0	.0	.0	.4	.01224
3	.0	.0	.0	.0	.0	.2	.0	.0	.2	.0	.4	.02653
4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
5	.0	.2	.2	.0	.2	.0	.0	.0	.0	.0	.6	.01429
6	.2	.0	.4	.4	.2	.0	.0	.0	.0	.0	1.2	.02857
7	.0	.2	.2	.0	.0	.0	.0	.0	.0	.0	.4	.00612
8	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0	.2	.00612
9	.0	.2	.2	.0	.0	.0	.0	.0	.0	.0	.4	.00612
10	.0	.0	.4	.2	.0	.0	.0	.0	.0	.0	.6	.01429
11	.0	.4	.0	.2	.2	.0	.0	.0	.0	.0	.8	.01837
12	.2	1.0	1.8	.8	.2	.0	.0	.0	.0	.0	4.1	.07959
13	.4	.8	1.4	.6	.4	.2	.0	.0	.0	.0	3.9	.08163
14	.0	1.4	1.4	1.2	.8	.6	.2	.0	.0	.0	5.7	.15510
15	.2	.2	2.4	2.7	1.4	.0	.2	.2	.0	.0	7.3	.21429
16	.2	.4	.8	.4	.4	.0	.0	.0	.0	.0	2.2	.04898
17	.0	.2	.2	.2	.0	.0	.0	.0	.0	.0	.6	.01224
18	.0	1.0	.6	.8	.2	.0	.0	.0	.0	.0	2.7	.05510
19	.0	.4	.4	.2	.2	.0	.0	.0	.0	.0	1.2	.02653
20	.2	.0	.4	.2	.2	.0	.0	.0	.0	.0	1.0	.02245
21	.0	.0	.6	.0	.0	.0	.0	.0	.0	.0	.6	.01224
22	.2	.6	1.0	1.4	.2	.0	.0	.0	.0	.0	3.5	.07755
23	.6	3.1	2.4	1.2	.4	.0	.0	.0	.0	.0	7.8	.13265
24	.4	5.3	5.9	5.1	4.5	1.8	1.0	.0	.0	.0	24.1	.65714
25	3.1	18.4	28.6	22.9	15.7	7.3	3.1	.6	.4	.0	.0	.00000

PAGO PAGO (WET SEASON)
SAMPLE SIZE = 458

THIS IS A FLOOD SORT

X =-.366424 Y = 1.07355 RESULTANT = 1.13436 ANGLE =-71.1539

% OF TIME

SEC	0CM	1CM	2CM	3CM	4CM	5CM	6CM	7CM	8CM	9CM	SUBT	VSUM
1	.9	1.7	4.1	4.4	3.7	3.1	.9	.9	.7	.2	20.5	.71834
2	.0	.0	.0	.0	.0	.2	.2	.0	.0	.0	.4	.02402
3	.0	.0	.0	.0	.0	.2	.0	.0	.0	.0	.2	.01092
4	.0	.0	.0	.2	.0	.2	.0	.0	.0	.0	.4	.01747
5	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0	.2	.00873
6	.0	.0	.4	.0	.4	.0	.0	.0	.0	.0	.9	.02620
7	.0	.0	.7	.0	.0	.0	.0	.0	.0	.0	.7	.01310
8	.0	.0	.7	.0	.2	.0	.0	.0	.0	.0	.9	.02183
9	.0	.2	.2	.2	.0	.0	.0	.0	.0	.0	.7	.01310
10	.2	.4	.4	.0	.0	.0	.0	.0	.0	.0	1.1	.01310
11	.0	.7	.7	.2	.0	.0	.0	.0	.0	.0	1.5	.02620
12	.2	1.1	1.5	.4	.0	.0	.0	.0	.0	.0	3.3	.05459
13	.7	1.5	2.0	.7	.4	.0	.0	.0	.0	.0	5.2	.09170
14	.2	2.4	3.7	3.5	.7	.7	.2	.2	.0	.0	11.6	.29039
15	.2	1.7	2.0	1.5	.9	.4	.0	.0	.0	.0	6.8	.15939
16	.4	.2	.2	1.1	.2	.0	.0	.0	.0	.0	2.2	.04803
17	.2	.4	.7	.4	.2	.0	.0	.0	.0	.0	2.0	.03930
18	.2	.7	.9	.2	.0	.0	.2	.0	.0	.0	2.2	.04367
19	.2	.7	.4	.2	.0	.0	.0	.0	.0	.0	1.5	.02183
20	.0	.2	.9	.0	.0	.0	.0	.0	.0	.0	1.1	.01965
21	.0	.2	.4	.0	.2	.0	.0	.0	.0	.0	.9	.01965
22	.2	1.3	1.7	.0	.2	.0	.0	.0	.0	.0	3.5	.05677
23	.4	1.5	2.0	2.2	1.3	.2	.0	.0	.0	.0	7.6	.18341
24	.7	3.3	5.0	8.3	4.8	1.5	.4	.4	.2	.0	24.7	.72489
25	4.8	18.3	28.6	23.6	13.5	6.6	2.0	1.5	.9	.2	.0	.00000

PAGO PAGO (WET SEASON)

SAMPLE SIZE = 948

THIS IS A OVERALL SORT

X =-.338189 Y = 1.20401 RESULTANT = 1.25061 ANGLE =-74.3106

% OF TIME

SEC	0CM	1CM	2CM	3CM	4CM	5CM	6CM	7CM	8CM	9CM	SUBT	VSUM
1	.6	2.3	5.8	5.7	4.9	3.8	1.3	.6	.4	.1	25.5	.85760
2	.0	.0	.1	.0	.1	.1	.1	.0	.0	.0	.4	.01793
3	.0	.0	.0	.0	.0	.2	.0	.0	.1	.0	.3	.01899
4	.0	.0	.0	.1	.0	.1	.0	.0	.0	.0	.2	.00844
5	.0	.1	.1	.0	.2	.0	.0	.0	.0	.0	.4	.01160
6	.1	.0	.4	.2	.3	.0	.0	.0	.0	.0	1.1	.02743
7	.0	.1	.4	.0	.0	.0	.0	.0	.0	.0	.5	.00949
8	.0	.0	.3	.1	.1	.0	.0	.0	.0	.0	.5	.01371
9	.0	.2	.2	.1	.0	.0	.0	.0	.0	.0	.5	.00949
10	.1	.2	.4	.1	.0	.0	.0	.0	.0	.0	.8	.01371
11	.0	.5	.3	.2	.1	.0	.0	.0	.0	.0	1.2	.02215
12	.2	1.1	1.7	.6	.1	.0	.0	.0	.0	.0	3.7	.06751
13	.5	1.2	1.7	.6	.4	.1	.0	.0	.0	.0	4.5	.08650
14	.1	1.9	2.5	2.3	.7	.6	.2	.1	.0	.0	8.5	.22046
15	.2	.9	2.2	2.1	1.2	.2	.1	.1	.0	.0	7.1	.18776
16	.3	.3	.5	.7	.3	.0	.0	.0	.0	.0	2.2	.04852
17	.1	.3	.4	.3	.1	.0	.0	.0	.0	.0	1.3	.02532
18	.1	.8	.7	.5	.1	.0	.1	.0	.0	.0	2.4	.04958
19	.1	.5	.4	.2	.1	.0	.0	.0	.0	.0	1.4	.02426
20	.1	.1	.6	.1	.1	.0	.0	.0	.0	.0	1.1	.02110
21	.0	.1	.5	.0	.1	.0	.0	.0	.0	.0	.7	.01582
22	.2	.9	1.4	.7	.2	.0	.0	.0	.0	.0	3.5	.06751
23	.5	2.3	2.2	1.7	.8	.1	.0	.0	.0	.0	7.7	.15717
24	.5	4.3	5.5	6.6	4.6	1.7	.7	.2	.1	.0	24.4	.68987
25	3.9	18.4	28.6	23.2	14.7	7.0	2.5	1.1	.6	.1	.0	.00000

PAGO PAGO (DRY SEASON)

SAMPLE SIZE = 396

THIS IS A EBB SORT

X =-1.21054 Y =-.342471 RESULTANT = 1.25805 ANGLE = 15.7966

% OF TIME

SEC	0CM	1CM	2CM	3CM	4CM	5CM	6CM	7CM	8CM	9CM	SUBT	VSUM
1	.0	.0	.0	.0	.0	.0	.3	.3	.0	.0	.5	.03283
2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
3	.0	.0	.0	.0	.3	.0	.0	.0	.0	.0	.3	.01010
4	.0	.0	.0	.5	.0	.0	.0	.0	.0	.0	.5	.01515
5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
6	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
8	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
9	.0	.0	.0	.3	.0	.0	.0	.0	.0	.0	.3	.00758
10	.0	.0	.0	.0	.3	.0	.0	.0	.0	.0	.3	.01010
11	.0	.0	.0	1.0	.3	.5	.0	.0	.0	.0	1.8	.06566
12	.3	.0	.0	.8	.8	.0	.3	.0	.0	.0	2.0	.06818
13	.0	.0	1.8	2.0	4.3	2.0	2.3	.8	.5	.3	13.9	.62121
14	.0	.5	2.0	1.8	4.0	4.0	2.3	1.0	.0	.0	15.7	.66919
15	.3	.0	1.3	2.5	2.5	2.0	.8	.8	.0	.0	10.1	.40152
16	.0	.0	.8	.3	.3	.0	.0	.0	.0	.0	1.3	.03283
17	.0	.0	.5	.8	.0	.0	.0	.0	.0	.0	1.3	.03283
18	.0	.0	.3	.3	.3	.5	.0	.0	.0	.0	1.3	.04798
19	.0	.3	.5	1.8	.3	.0	.0	.0	.0	.0	2.8	.07576
20	.0	.0	.8	.5	.5	.0	.0	.0	.0	.0	1.8	.05051
21	.0	.5	2.5	1.8	.3	.3	.0	.0	.0	.0	5.3	.13131
22	.0	3.3	3.3	3.3	.3	.0	.0	.3	.0	.0	10.4	.22475
23	.0	2.5	3.5	4.8	1.5	.8	.3	.0	.0	.0	13.4	.35354
24	.0	.3	2.8	3.0	3.0	4.3	3.5	.5	.0	.0	17.4	.73232
25	.5	7.3	19.9	25.3	18.7	14.4	9.6	3.5	.5	.3	.0	.00000

PAGO PAGO (DRY SEASON)

SAMPLE SIZE = 371

THIS IS A FLOOD SORT

X =-.951138 Y = .847832 RESULTANT = 1.27416 ANGLE =-41.7133

% OF TIME

SEC	0CM	1CM	2CM	3CM	4CM	5CM	6CM	7CM	8CM	9CM	SUBT	VSUM
1	.0	.3	.0	.5	.3	1.1	1.1	.0	.5	.5	4.3	.23989
2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
3	.0	.0	.0	.0	.5	.3	.5	.0	.0	.0	1.3	.06739
4	.0	.0	.0	1.1	.3	.0	.0	.0	.0	.0	1.3	.04313
5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
6	.0	.0	.3	.0	.0	.0	.0	.0	.0	.0	.3	.00539
7	.0	.0	.3	.0	.0	.0	.3	.0	.0	.0	.5	.02156
8	.0	.0	.3	.3	.3	.0	.0	.0	.0	.0	.8	.02426
9	.0	.0	.0	.0	.0	.3	.0	.0	.0	.0	.3	.01348
10	.0	.0	.5	.3	.3	.0	.0	.0	.0	.0	1.1	.02965
11	.0	.0	.5	1.1	.3	.0	.3	.0	.0	.0	2.2	.07008
12	.0	.0	.5	.3	.8	.3	.5	.0	.0	.0	2.4	.09704
13	.0	1.1	.3	1.1	1.1	1.9	.5	.3	.0	.3	6.5	.26146
14	.0	.0	1.1	1.3	1.6	1.9	1.3	.3	.0	.0	7.5	.32075
15	.0	.0	1.1	.8	2.4	1.1	.5	.0	.0	.0	5.9	.22911
16	.0	.0	.5	.8	.8	.8	.0	.0	.0	.0	3.0	.10782
17	.0	.0	.3	.5	.0	.0	.0	.0	.0	.0	.8	.02156
18	.0	.0	.0	1.1	1.1	.0	.0	.0	.0	.0	2.2	.07547
19	.0	.0	.8	1.6	.5	.3	.0	.0	.0	.0	3.2	.09973
20	.0	.3	.5	1.3	.8	.0	.0	.3	.0	.0	3.2	.10512
21	.0	.8	.8	1.1	.5	.5	.0	.0	.0	.0	3.8	.10512
22	.0	1.1	4.0	1.9	1.3	.0	.0	.3	.0	.0	8.6	.22102
23	.0	1.9	5.9	6.2	2.4	.3	.0	.3	.0	.0	17.0	.45283
24	.3	1.6	4.9	6.2	4.0	3.5	1.6	1.1	.5	.0	23.7	.85175
25	.3	7.0	22.6	27.5	19.4	12.1	6.7	2.4	1.1	.8	.0	.00000

PAGO PAGO (DRY SEASON)

SAMPLE SIZE = 767

THIS IS A OVERALL SORT

X =-1.08507 Y = .233282 RESULTANT = 1.10986 ANGLE =-12.1335

% OF TIME

SEC	0CM	1CM	2CM	3CM	4CM	5CM	6CM	7CM	8CM	9CM	SUBT	VSUM
1	.0	.1	.0	.3	.1	.5	.7	.1	.3	.3	2.3	.13299
2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
3	.0	.0	.0	.0	.4	.1	.3	.0	.0	.0	.8	.03781
4	.0	.0	.0	.8	.1	.0	.0	.0	.0	.0	.9	.02868
5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
6	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.1	.00261
7	.0	.0	.1	.0	.0	.0	.1	.0	.0	.0	.3	.01043
8	.0	.0	.1	.1	.1	.0	.0	.0	.0	.0	.4	.01173
9	.0	.0	.0	.1	.0	.1	.0	.0	.0	.0	.3	.01043
10	.0	.0	.3	.1	.3	.0	.0	.0	.0	.0	.7	.01956
11	.0	.0	.3	1.0	.3	.3	.1	.0	.0	.0	2.0	.06780
12	.1	.0	.3	.5	.8	.1	.4	.0	.0	.0	2.2	.08214
13	.0	.5	1.0	1.6	2.7	2.0	1.4	.5	.3	.3	10.3	.44720
14	.0	.3	1.6	1.6	2.9	3.0	1.8	.7	.0	.0	11.7	.50065
15	.1	.0	1.2	1.7	2.5	1.6	.7	.4	.0	.0	8.1	.31812
16	.0	.0	.7	.5	.5	.4	.0	.0	.0	.0	2.1	.06910
17	.0	.0	.4	.7	.0	.0	.0	.0	.0	.0	1.0	.02738
18	.0	.0	.1	.7	.7	.3	.0	.0	.0	.0	1.7	.06128
19	.0	.1	.7	1.7	.4	.1	.0	.0	.0	.0	3.0	.08735
20	.0	.1	.7	.9	.7	.0	.0	.1	.0	.0	2.5	.07692
21	.0	.7	1.7	1.4	.4	.4	.0	.0	.0	.0	4.6	.11864
22	.0	2.2	3.7	2.6	.8	.0	.0	.3	.0	.0	9.5	.22295
23	.0	2.2	4.7	5.5	2.0	.5	.1	.1	.0	.0	15.1	.40156
24	.1	.9	3.8	4.6	3.5	3.9	2.6	.8	.3	.0	20.5	.79009
25	.4	7.2	21.3	26.3	19.0	13.3	8.2	3.0	.8	.5	.0	.00000

TAFUNA (DRY SEASON)

SAMPLE SIZE = 513

THIS IS A EBB SORT

X =-6.33453 Y =-1.81726 RESULTANT = 6.59004 ANGLE = 16.0072

% OF TIME

SEC	0CM	1CM	2CM	3CM	4CM	5CM	6CM	7CM	8CM	9CM	10CM	11CM	12CM	13CM	14CM	15CM	16CM	17CM	18CM	19CM	20CM	21CM	22CM	23CM	24CM	25CM	26CM	VSUM
1	.0	.0	.0	.0	.2	.4	.2	.0	.2	.4	1.0	.2	.4	.2	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.31189
2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
6	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
8	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
9	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
10	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
11	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
12	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
13	.0	.0	.0	.0	.0	.2	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.02339
14	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.4	.6	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.13060
15	.0	.0	.0	.0	.4	.4	.8	.2	1.4	1.0	1.8	1.4	.6	.8	.0	.2	.0	.2	.0	.0	.0	.2	.0	.0	.0	.0	.0	.89279
16	.0	.0	.0	.0	.6	1.6	1.9	3.5	2.1	3.7	4.5	3.5	1.9	2.3	1.0	.8	.6	.0	.6	.0	.0	.0	.0	.0	.0	.0	.0	2.79337
17	.0	.0	.0	.0	.4	.4	2.3	3.1	2.7	2.5	2.1	1.9	1.4	1.6	.6	.2	.2	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.81092
18	.0	.2	.0	.0	.8	.4	2.5	2.3	1.2	.4	.0	1.0	.2	.2	.4	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.73879
19	.0	.0	.0	.0	.6	.6	1.0	.8	.4	.4	.8	.4	.2	.6	.2	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.50877
20	.0	.0	.0	.2	.2	.0	1.4	.6	.6	.2	.4	.0	.2	.4	.2	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.37232
21	.0	.0	.4	.0	.4	.0	.4	.6	.2	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.12671
22	.0	.0	.2	.2	.4	.0	.2	.2	.2	.2	.2	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.12865
23	.0	.0	.0	.2	.2	.0	.0	.2	.4	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.07992
24	.0	.0	.0	1.0	1.8	2.1	1.8	2.3	.8	1.4	.8	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.76023
25	.0	.2	.6	1.6	5.8	6.0	12.5	14.0	10.1	10.1	11.9	9.4	5.1	6.2	2.5	1.4	1.4	.4	.6	.0	.0	.2	.0	.0	.0	.0	.0	.00000

TAFUNA (DRY SEASON)

SAMPLE SIZE = 466

THIS IS A FLOOD SORT

X =-4.37705   Y = .40516   RESULTANT = 4.39576   ANGLE =-5.28847

% OF TIME

SEC	0CM	1CM	2CM	3CM	4CM	5CM	6CM	7CM	8CM	9CM	10CM	11CM	12CM	13CM	14CM	15CM	16CM	17CM	18CM	19CM	20CM	21CM	22CM	23CM	24CM	25CM	26CM	VSUM
1	.0	.0	.2	.2	.4	.0	.9	.6	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0	.19313
2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
6	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
8	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
9	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
10	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
11	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
12	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
13	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00429
14	.0	.0	.0	.0	.0	.0	.2	.6	.0	.2	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.10086
15	.0	.0	.6	.0	.4	.2	.9	.9	1.9	.6	2.1	.2	1.3	.4	.9	.6	.2	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.10086
16	.0	.0	.0	.2	.4	1.1	1.3	1.7	1.9	3.0	2.4	.6	1.1	.6	1.1	.9	.0	.2	.2	.0	.0	.0	.0	.0	.0	.0	.0	1.57296
17	.0	.0	.6	.2	1.1	1.7	1.1	2.8	.9	1.7	.6	.6	1.3	.2	.9	.2	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.13519
18	.0	.0	.0	.2	.6	.9	1.5	.4	.9	.9	.9	.2	.4	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.53004
19	.0	.0	.0	.2	.4	1.1	.2	.0	.4	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.14378
20	.0	.0	.0	.2	.2	1.3	.0	.4	.4	.2	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.18455
21	.0	.0	.2	.0	.2	.6	.0	.9	.2	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.14592
22	.0	.0	.0	.4	.4	.4	.2	.4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.09442
23	.0	.0	.0	.6	.6	.6	.4	.6	.0	.2	.0	.4	.4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.26609
24	.0	.4	.6	1.7	4.3	4.9	5.2	5.2	3.2	1.5	1.5	1.1	.9	.9	.2	.2	.2	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.16524
25	.0	.4	2.6	4.1	9.2	12.9	11.8	14.6	9.9	8.8	7.7	3.6	5.4	2.4	3.0	1.9	.6	.6	.2	.0	.0	.0	.0	.2	.0	.0	.0	.00000

TAFUNA (DRY SEASON)

SAMPLE SIZE = 979

THIS IS A OVERALL SORT

X =-5.40278 Y =-.759397 RESULTANT = 5.45588 ANGLE = 8.00088

% OF TIME

SEC	0CM	1CM	2CM	3CM	4CM	5CM	6CM	7CM	8CM	9CM	10CM	11CM	12CM	13CM	14CM	15CM	16CM	17CM	18CM	19CM	20CM	21CM	22CM	23CM	24CM	25CM	26CM	VSUM
1	.0	.0	.1	.1	.3	.2	.5	.3	.1	.3	.5	.1	.2	.1	.0	.0	.1	.0	.0	.0	.0	.0	.0	.1	.0	.0	.0	.25536
2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
6	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
8	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.00000
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16	.0	.0	.0	.1	.5	1.3	1.6	2.7	2.0	3.4	3.5	2.1	1.5	1.5	1.0	.8	.3	.1	.4	.0	.0	.0	.0	.0	.0	.0	.0	2.21246
17	.0	.0	.3	.1	.7	1.0	1.7	3.0	1.8	2.1	1.4	1.3	1.3	.9	.7	.2	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.48928
18	.0	.1	.0	.1	.7	.6	2.0	1.4	1.0	.6	.4	.6	.3	.2	.2	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.63943
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25	.0	.3	1.5	2.8	7.5	9.3	12.2	14.3	10.0	9.5	9.9	6.6	5.2	4.4	2.8	1.6	1.0	.5	.4	.0	.0	.1	.0	.1	.0	.0	.0	.00000

APPENDIX D

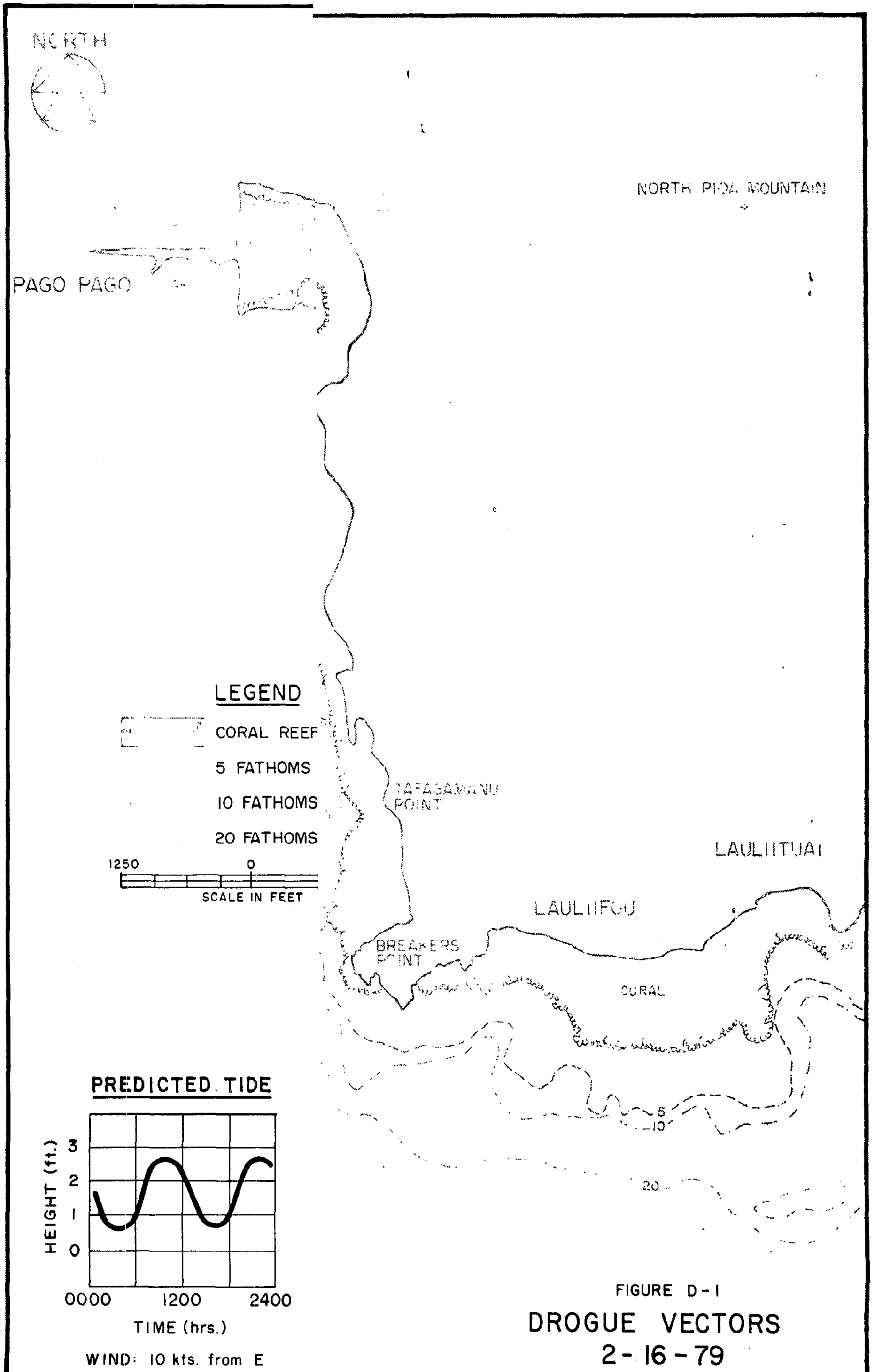

FIGURE D-1

DROGUE VECTORS

2-16-79

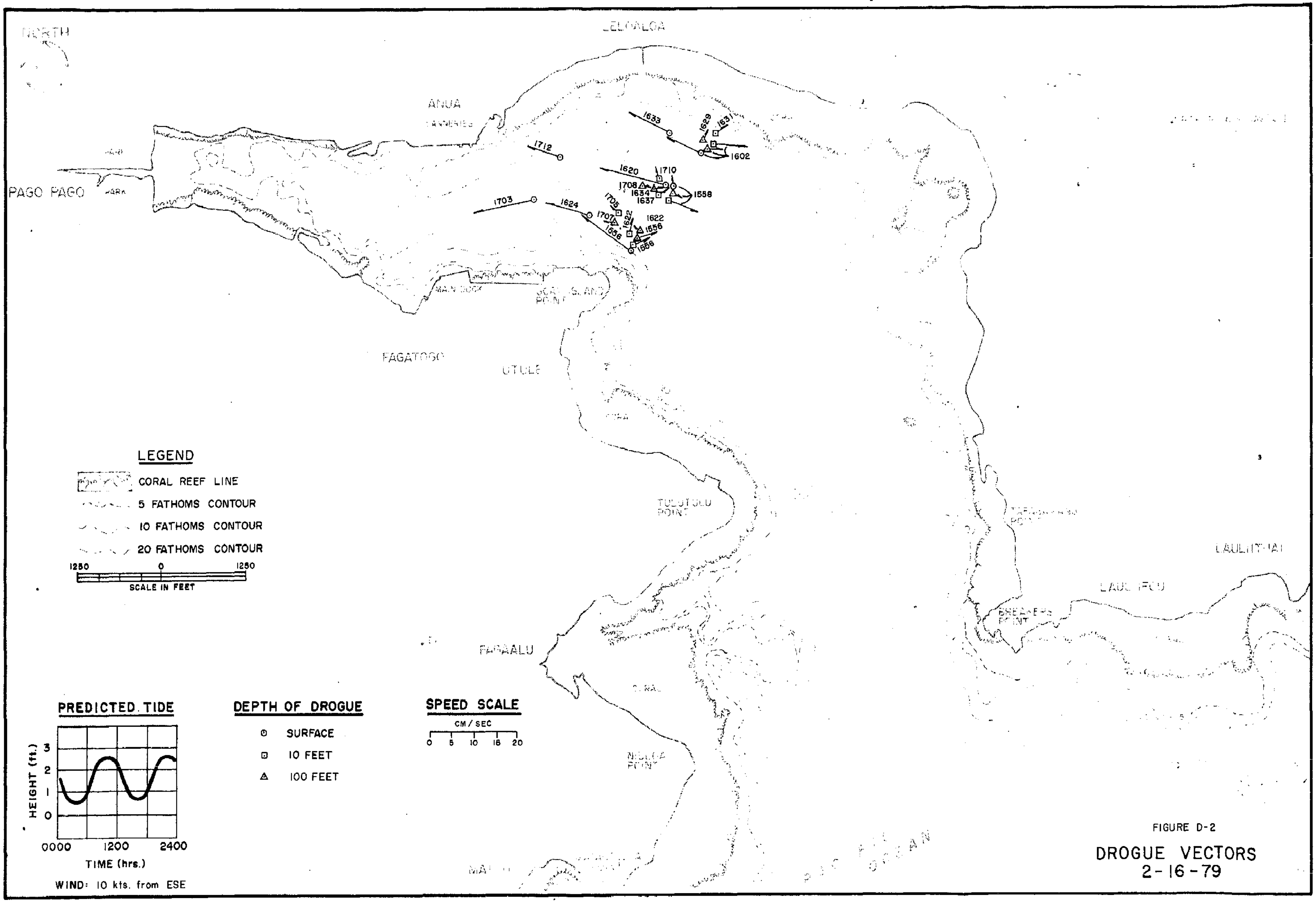

FIGURE D-2

DROGUE VECTORS
2-16-79

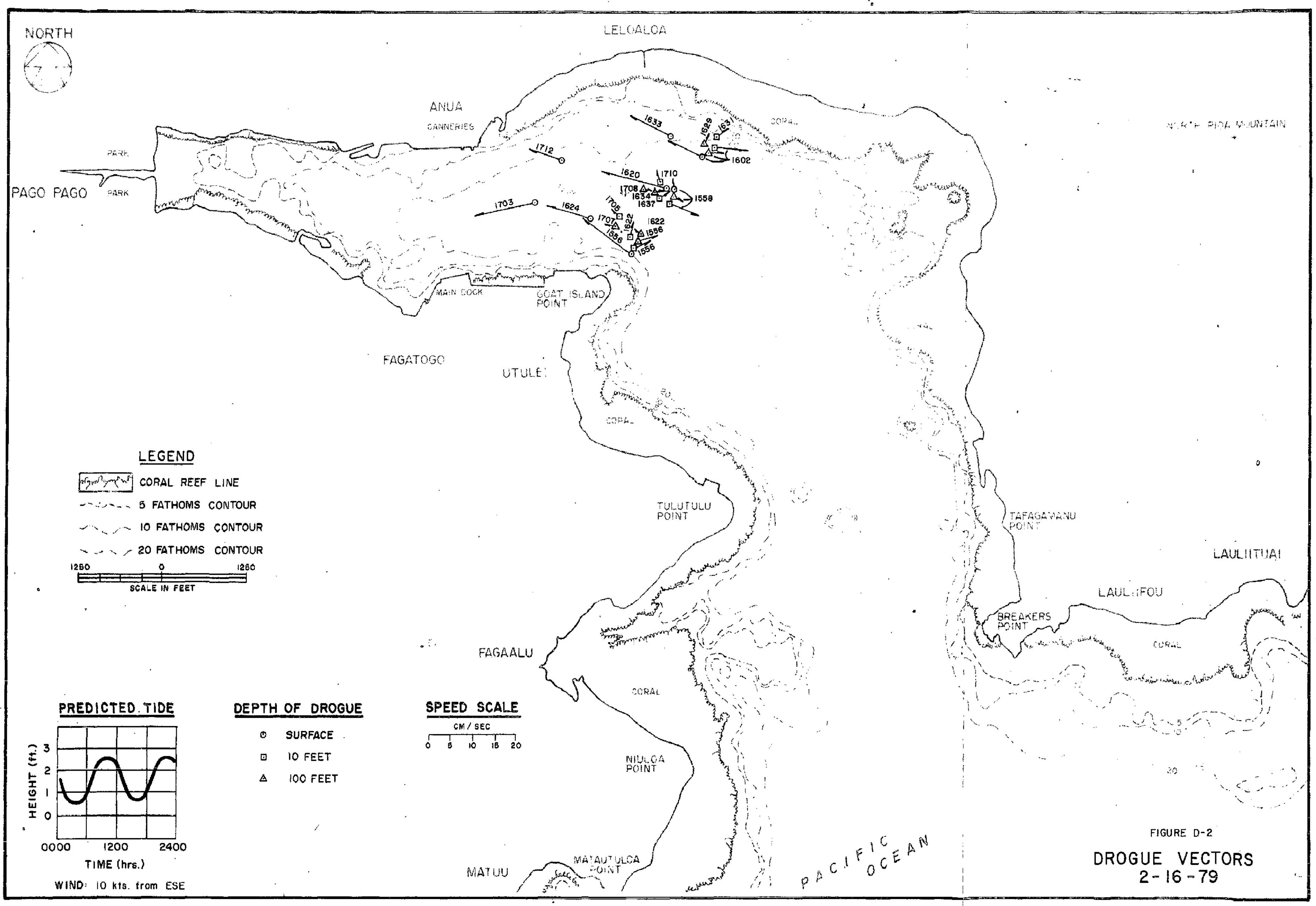

FIGURE D-2

DROGUE VECTORS
2-16-79

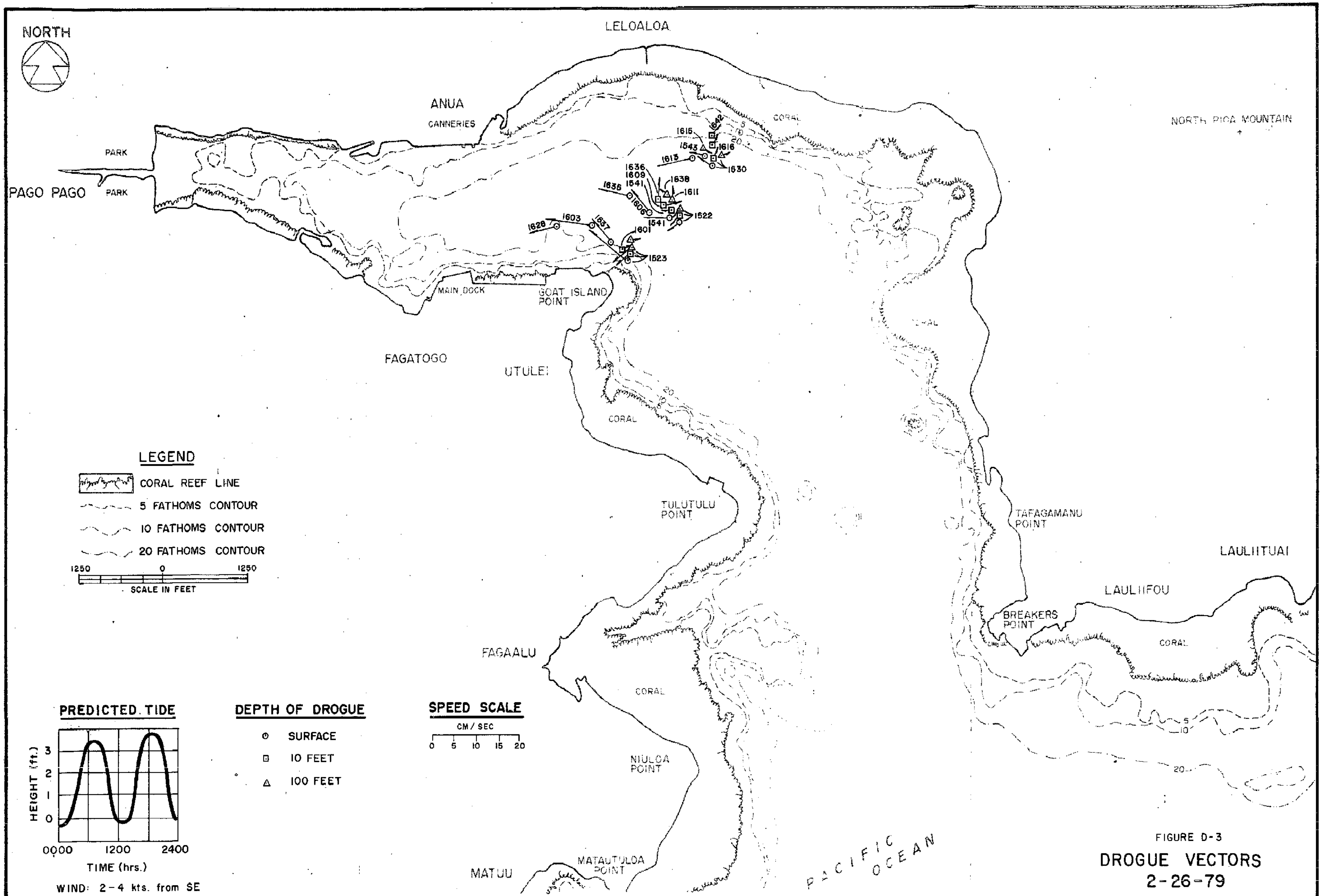

FIGURE D-3

DROGUE VECTORS
2-26-79

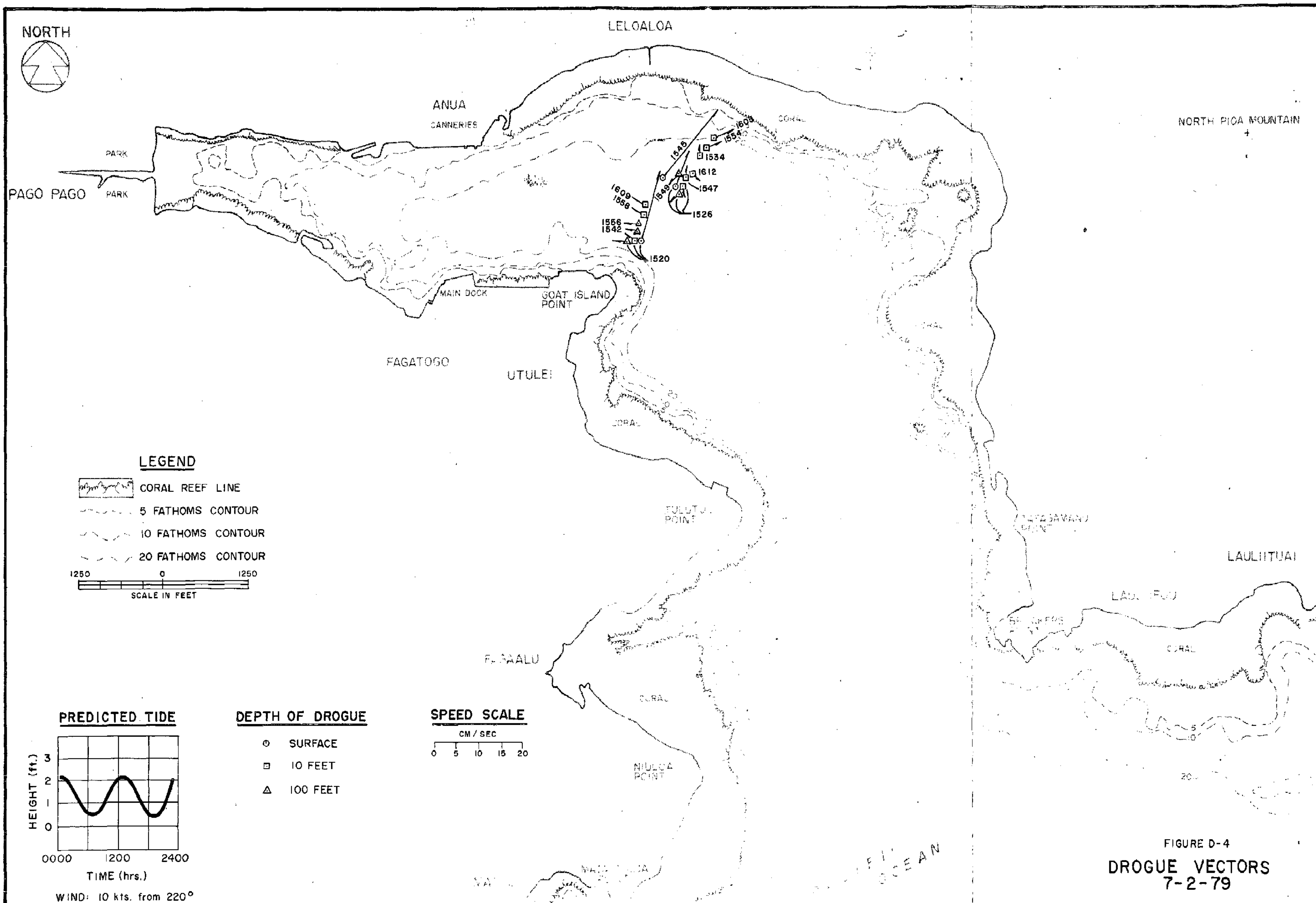

FIGURE D-4
DROGUE VECTORS
7-2-79

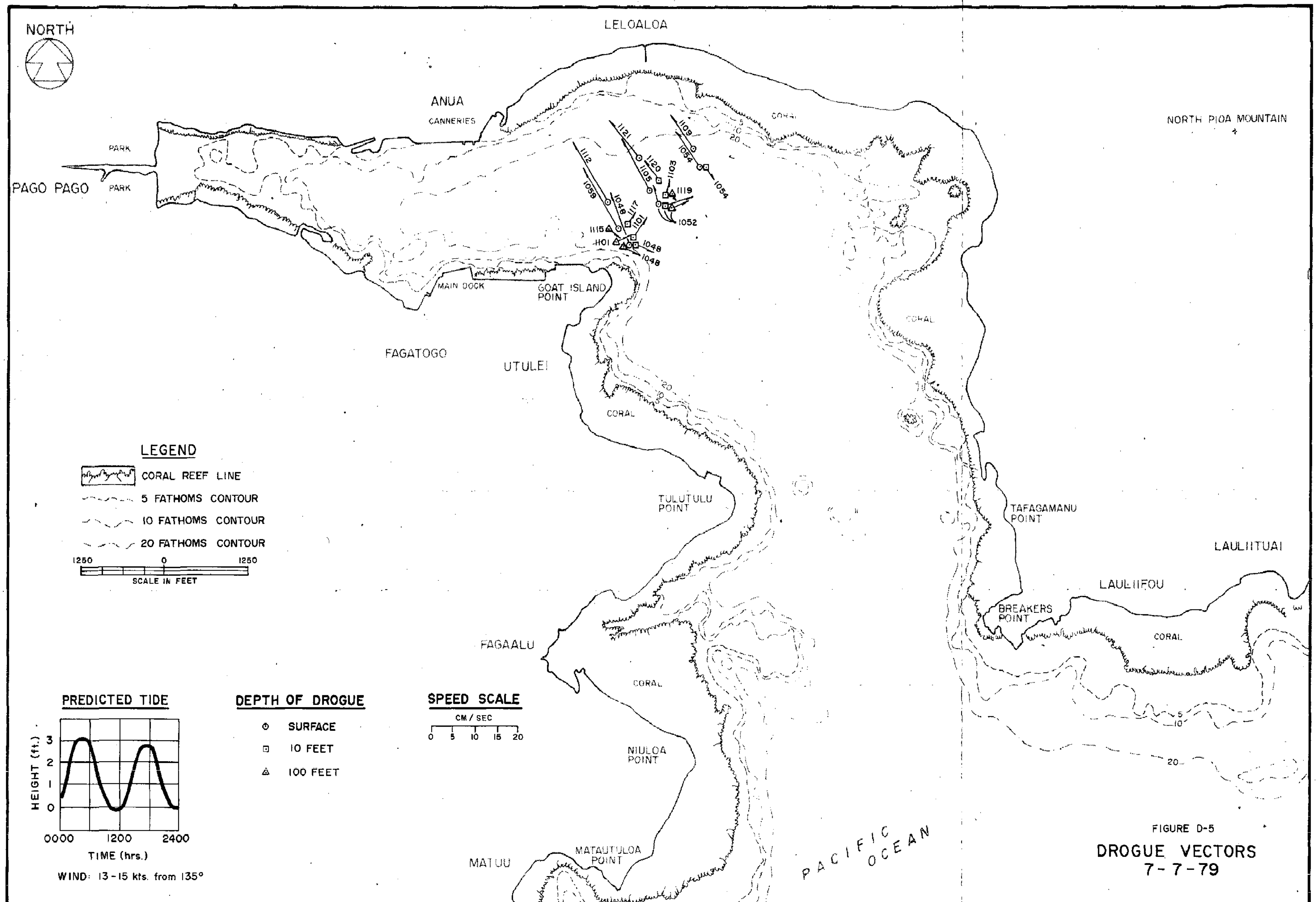

FIGURE D-5

DROGUE VECTORS
7-7-79

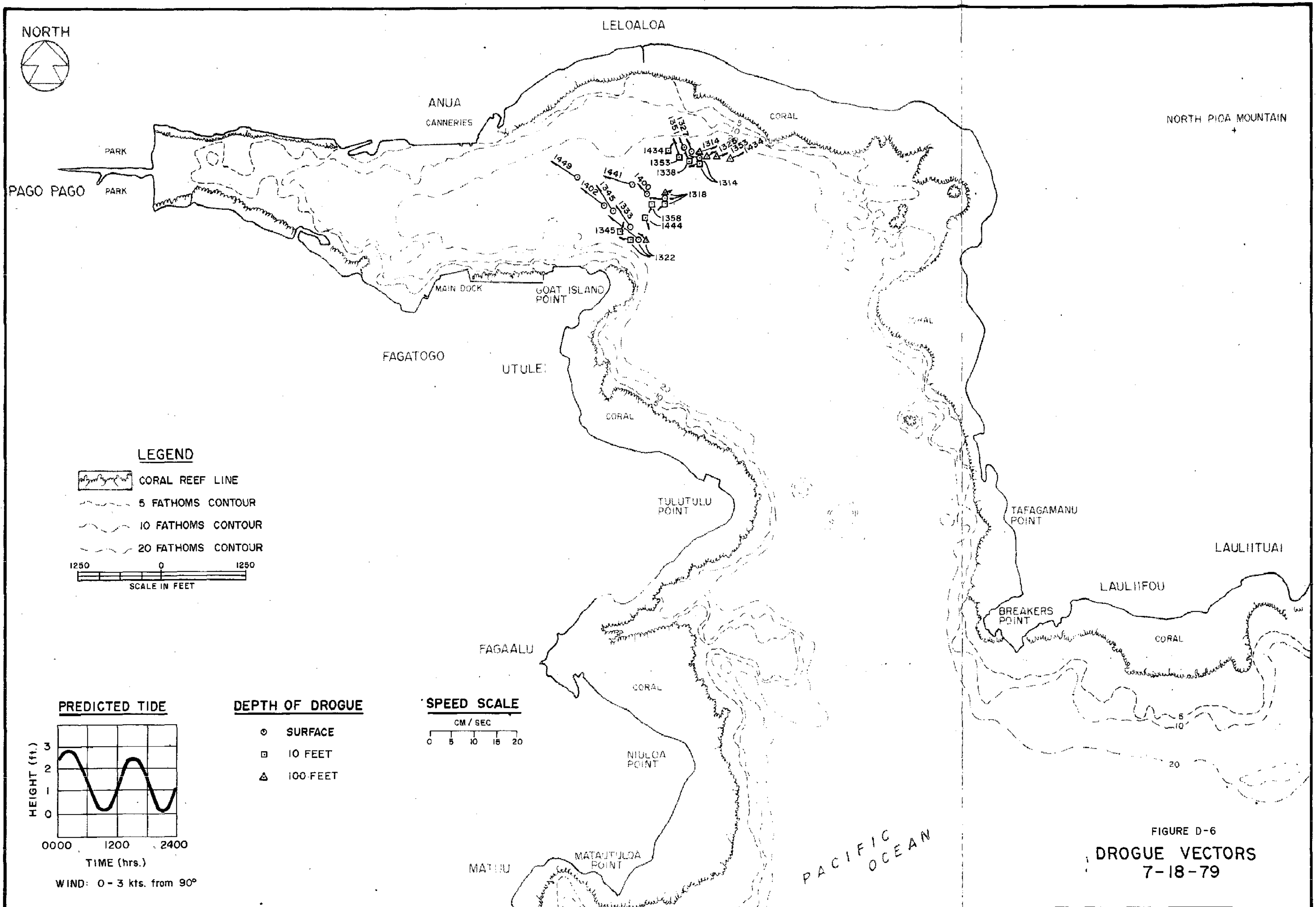

FIGURE D-6

DROGUE VECTORS
7-18-79

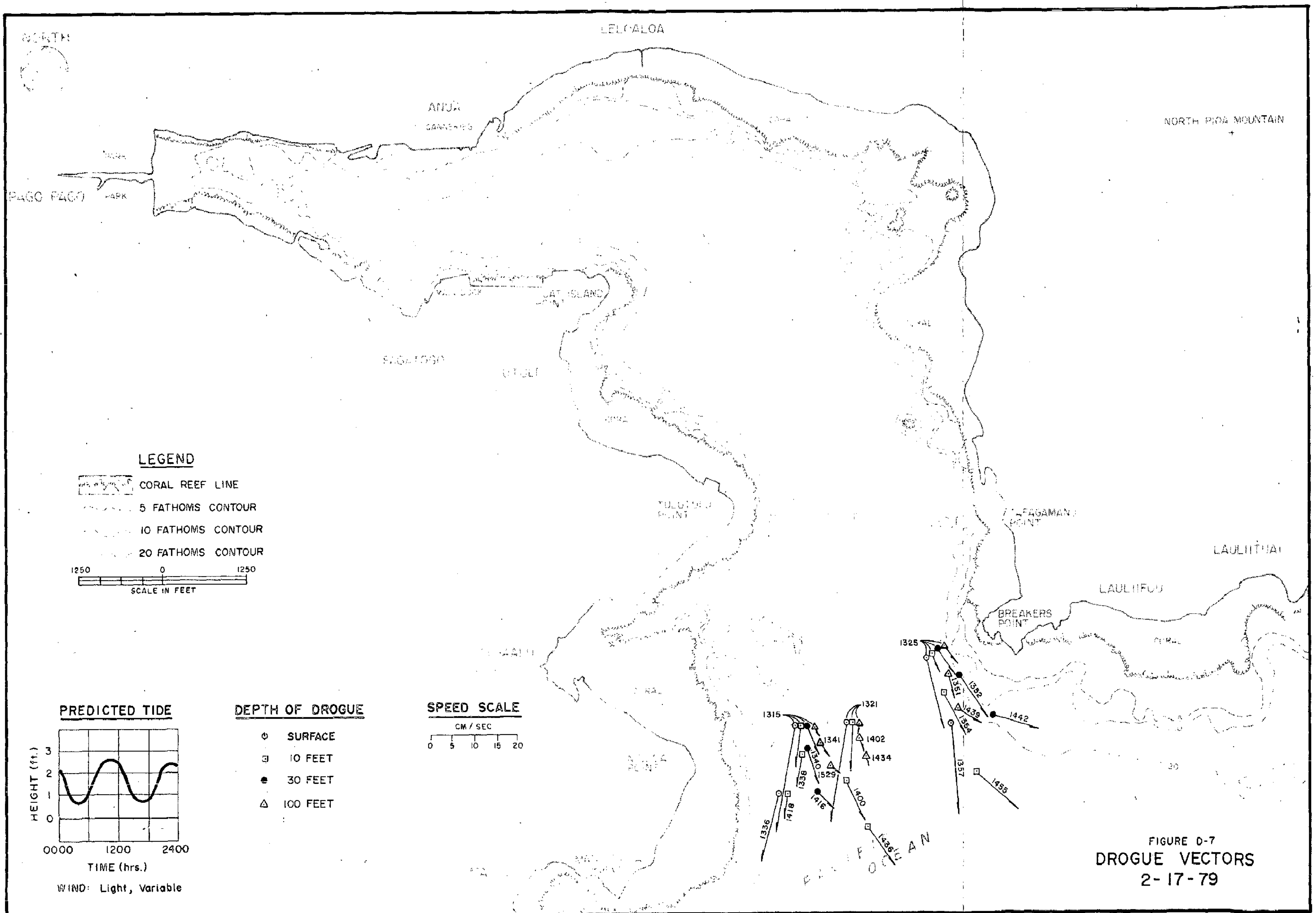

FIGURE D-7
DROGUE VECTORS
2-17-79

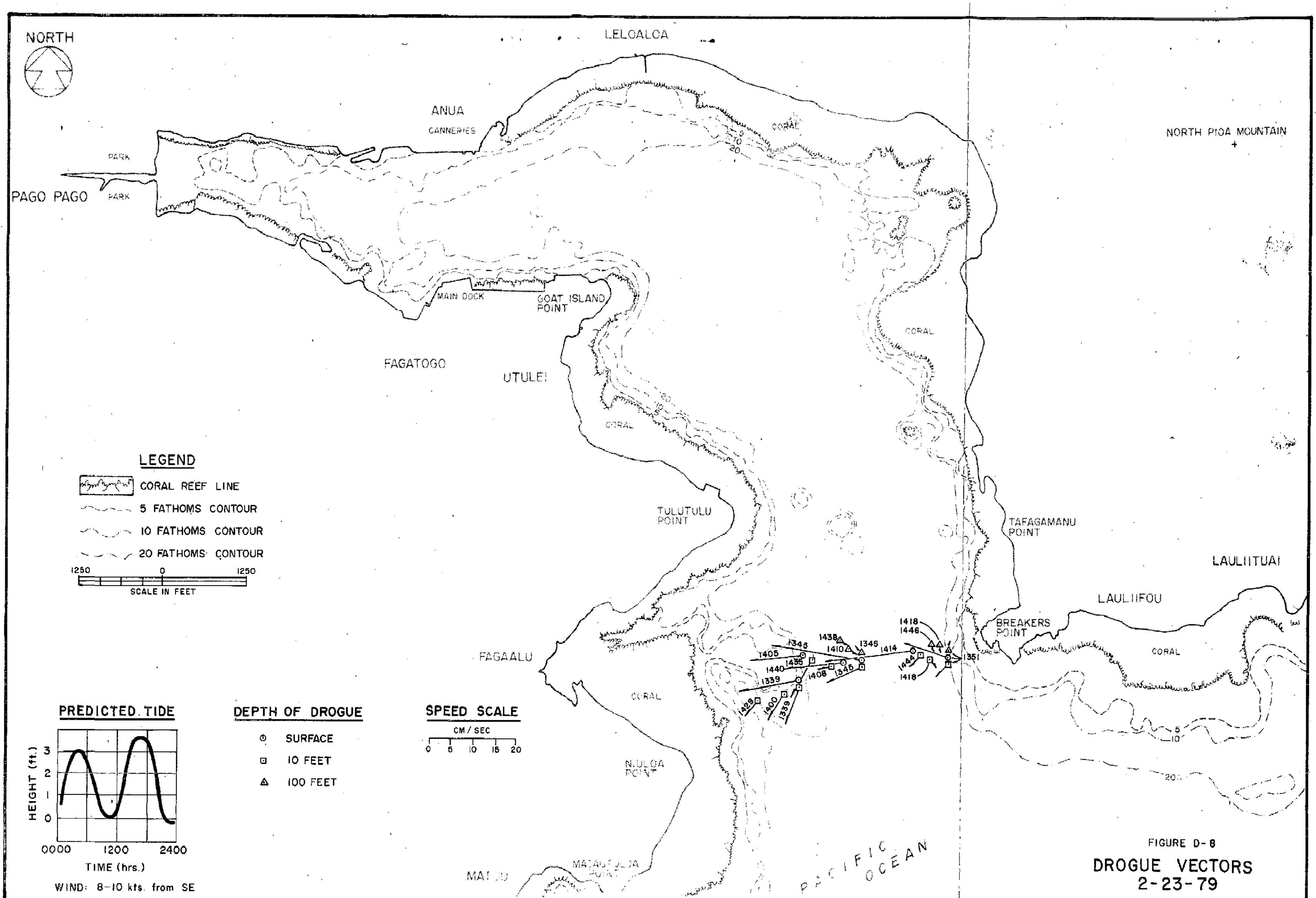

FIGURE D-8

DROGUE VECTORS
2-23-79

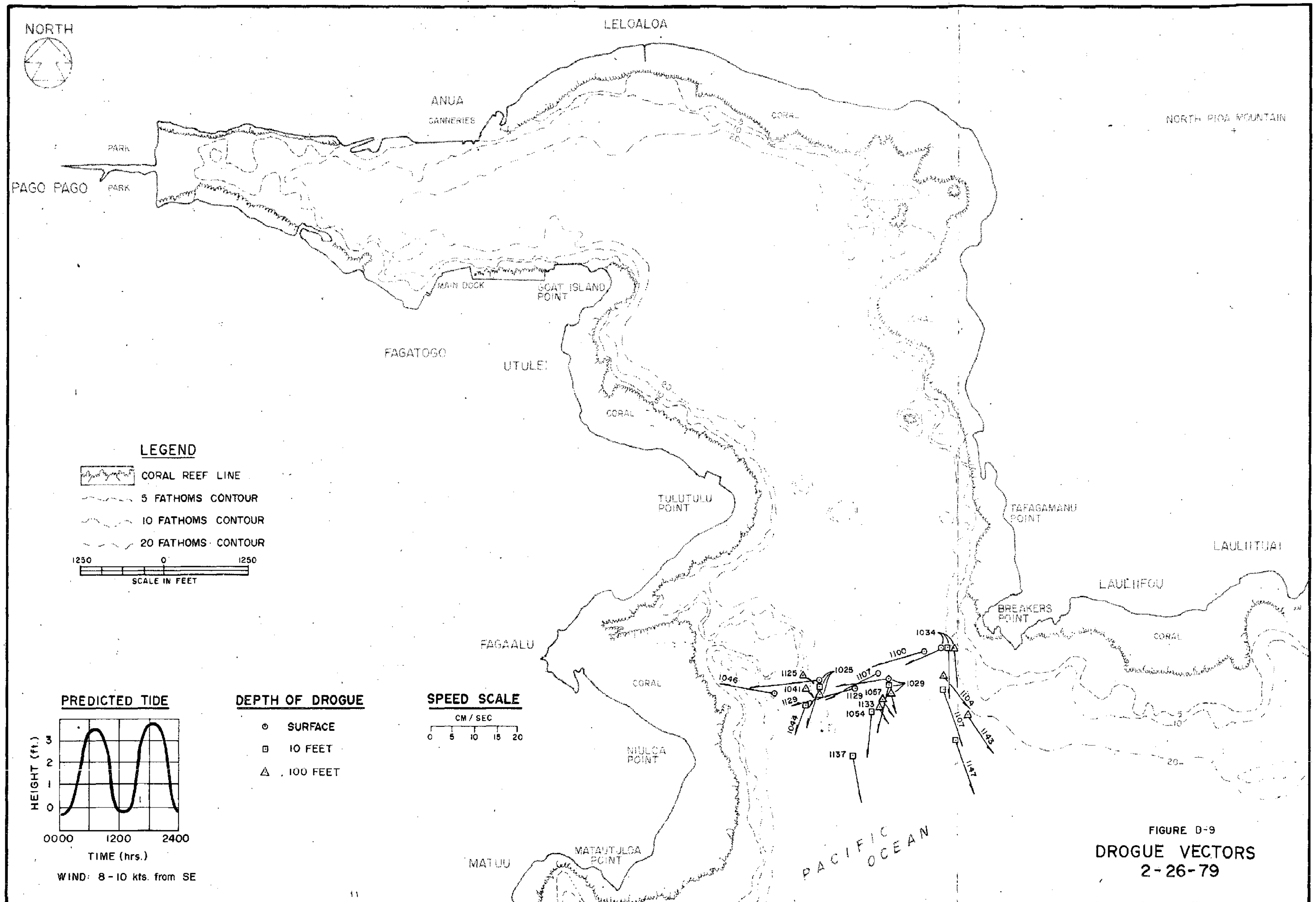

FIGURE D-9

DROGUE VECTORS
2-26-79

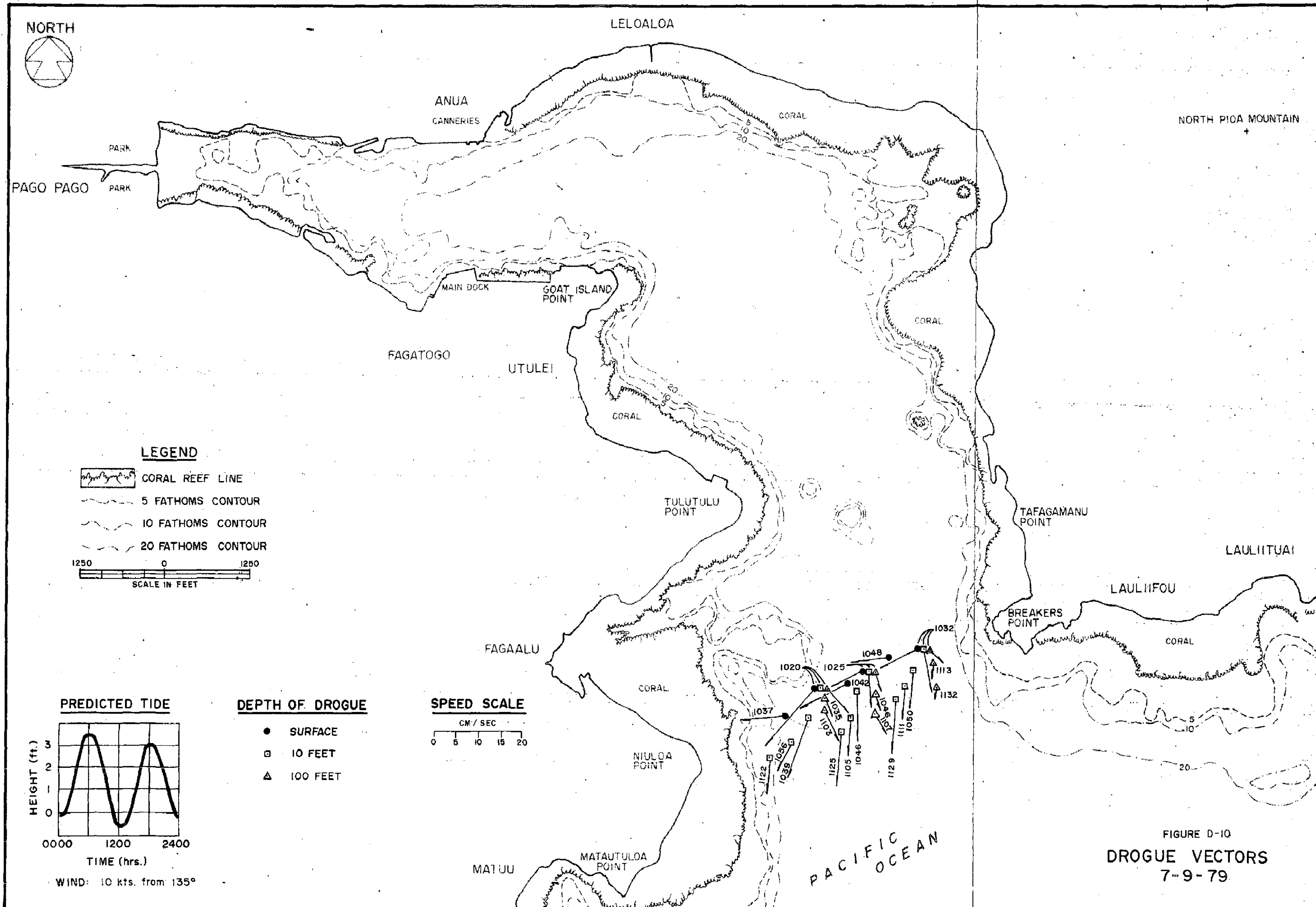

FIGURE D-10
DROGUE VECTORS
7-9-79

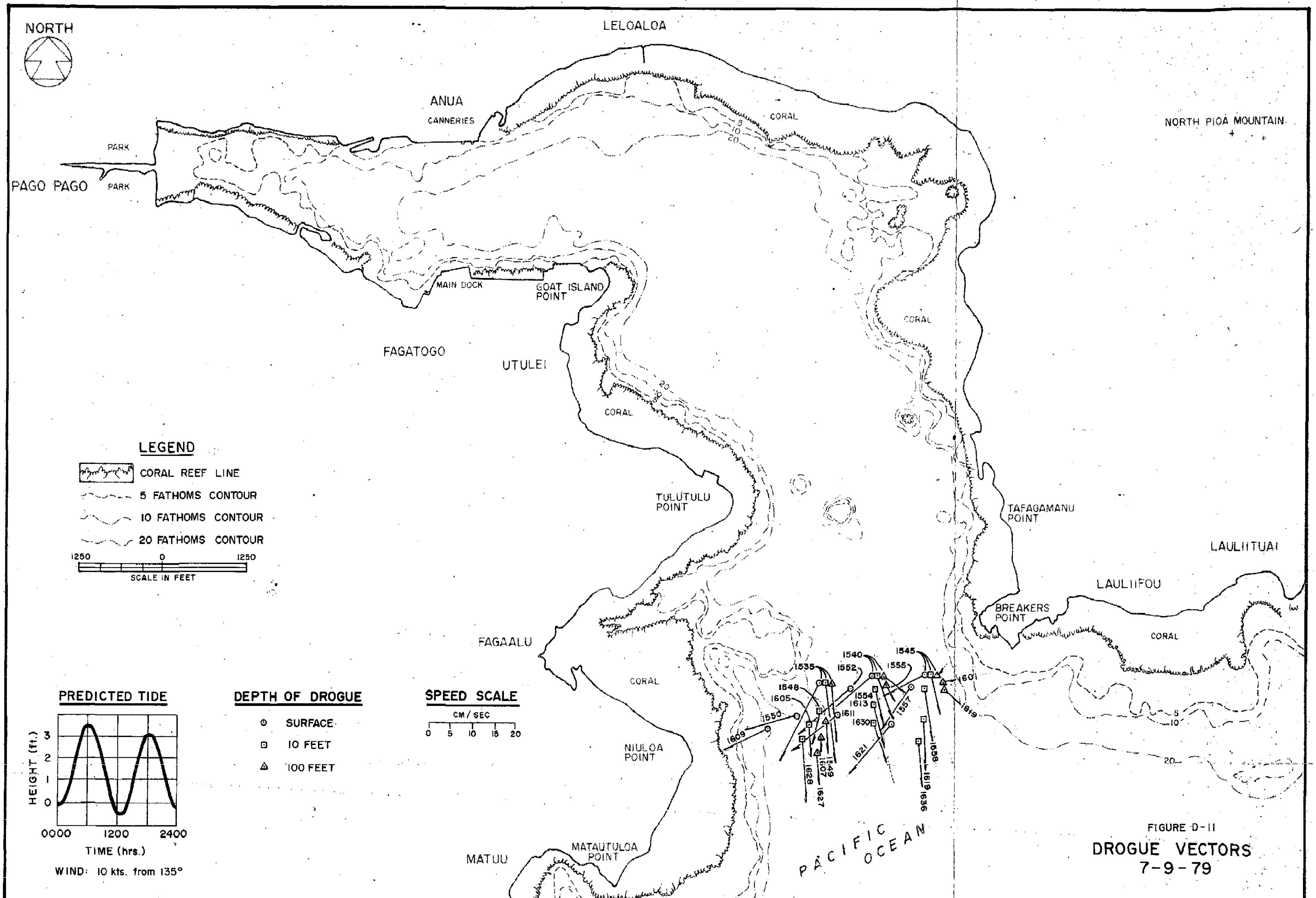

FIGURE D-11
DROGUE VECTORS
7-9-79

A P P E N D I X   E

WATER QUALITY STANDARDS FOR AMERICAN SAMOA

Revised May, 1979

I. Introduction

These standards of water quality and the classification of the waters of the Territory of American Samoa, according to their present and future beneficial uses, have been prepared as required by the Federal Water Pollution Control Act of 1972, as amended, and in accordance with the Territorial Environmental Quality Act, 13 ASC 1-324.

II. Policies

A. Waters whose existing quality is better than the established standards become effective will be maintained at their existing high quality. These and other waters of the Territory will not be lowered in quality unless it has been affirmately demonstrated to the Environmental Quality Commission that such change is justifiable as a result of necessary economic or social development, and will not interfere with or become injurious to any assigned uses made of, or presently possible in such waters. Any public or private development, which would constitute a new source of pollution to high quality waters, is required, as part of the initial project design, to provide the degree of waste treatment necessary to preserve this high quality.

B. Village septic tanks and cesspool construction and operation shall be governed by Public Health regulations, Water Quality standards, Building codes, and Sewer System use regulations.

C. The American Samoa Government may revise these standards or develop additional Water Quality Standards based upon measurements of selected physical, biological and chemical indicators for the waters of the Territory.

1. The Environmental Quality Commission will review existing standards, at least, once every three years.

2. The Department of Health, Public Health Office, in cooperation with the Environmental Quality Commission, will develop and carry out an ongoing Water Quality monitoring program for fresh-water impoundments and streams, embayments, and the nearshore and off-shore open coastal waters of American Samoa.

3. The Department of Health, Public Health Office will annually (a) analyze all available water quality data (b) assess the natural, statistical variation of selected water quality indicators for fresh-water impoundments and streams, embayments, nearshore and offshore coastal waters, and oceanic waters of American Samoa; and (c) recommend to the Environmental Quality Commission any necessary revisions to existing water quality criteria, standards, or policies for fresh-water impoundments and streams, embayments, nearshore and offshore open coastal waters and oceanic waters of American Samoa.

III. Definitions

As used in these standards:

A. "Discharge of Pollutant" means the releasing, expelling or dumping of water pollutants into the waters of American Samoa.

B. "Environmental Quality Commission" means the Environmental Quality Commission of the American Samoa Government.

C. "Natural" means free of substances or conditions, or a combination of both, at a specific time and place, which are attributable to the activities of man.

D. "Person" means any individual, partnership, firm, association, municipality, public or private corporation, subdivision or agency of the Territory, trust, estate or any other legal entity.

E. "Point Source" means any discernable confined and discrete conveyance including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, vessel, or other floating craft from which pollutants may be discharged.

F. "Pollutant" means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, excavator material and industrial, municipal and agricultural waste discharged into water.

G. "Pollution" means the man-made or man-induced alteration of the physical, chemical and biological, and radiological intergrity of Territorial waters.

H. "Receiving Water" means any water body receiving a pollutant.

I. "Zone of Mixing" means a defined area around a point source within which specific water quality limits may be revised in accordance with Section V of these standards. In other words, a zone of mixing is the volume of polluted water near the point of discharge within which the waste mixes with ocean water due to the momentum of the waste discharge, the difference in density between the waste and the receiving water, and velocity of the receiving water through the mixing zone.

IV. Classification of Waters and Allowable Uses

A. Fresh Surface Waters

1. Description

Fresh surface waters include all perennial and intermittent fresh water streams, all natural and artificial impoundments, springs, seeps and wetlands, including coastal wetlands not surface connected to the ocean.

2. Objective

All fresh surface waters are to remain in as nearly their natural state as possible. However, they may be partially degraded by uses which are controlled to prevent significant modifications to natural water quality characteristics.

Fresh surface and ground waters designated for public or domestic water supply shall be protected and preserved so that they will meet the National Interim Primary Drinking Water Regulations (NIPDWR) and those standards in the Public Health Service Drinking Water Standards which are not superseded by the NIPDWR. Consequently, there shall be no discharges of treated or untreated sewage, industrial wastes, or other material attributable to the activities of man into waters designated for public or domestic water supply.

3. Allowable Uses

a. Recreational and subsistence fishing;
b. Boat launching ramps and designated mooring areas;
c. Subsistence food gathering, e.g. shellfish harvesting;
d. Aesthetic enjoyment;
e. Whole and limited body contact recreation, e.g. bathing, swimming, snorkeling, surfing, and SCUBA diving;
f. Support and propagation of marine life, e.g. mari-culture development;
g. Scientific research; and
h. Other uses not specified in this regulation which may be considered by the Environmental Quality Commission if such uses are compatible with the objectives defined for embayments.

b. Non-Allowable Uses

a. Point source discharges;
b. Zones of mixing;
c. Dumping of solid and industrial waste material;
d. Animal pens over or adjacent to any shoreline (21 ASC, 1904);
e. Boat harbors (excluding existing harbors at Pago Pago, Auasi, Ofu, and Ta'u);
f. Dredging and filling activities, except as allowed under a permit issued by the Corps of Engineers.

C. Open Coastal Waters

1. Description

Open coastal waters begin at the shoreline and extend seawardto the 100 fathom (600 feet or 183 meter) depth contour. This category includes small bays with good water movement which do not qualify as embayments. This classification is divided into two divisions which are determined by distance from shore and water depth.

"Nearshore" open coastal waters are those waters within 1,500 feet of the shore. If the water depth at the 1,500 feet distance from the shore is less than 20 fathoms (120 feet) the Nearshore waters extend to the 20 fathom (120 feet) depth contour.

"Offshore" open coastal waters are those waters seaward of the limit defined for "Nearshore" waters to the 100 fathom (600 feet or 183 meters) depth contour.

3. Allowable Uses

a. Portable water supply;
b. The support and propagation of aquatic life and wildlife;
c. Aesthetic enjoyment;
d. Compatible recreation in and on the water, e.g. fishing and swimming; and
e. Other uses not specified in this regulation which may be considered by the Environmental Quality Commission if such uses are compatible with the objectives defined for fresh waters.

4. Non-Allowable Uses

a. Bathing, as well as washing family clothes and dishes;
b. Point-source discharges, e.g. cesspool or septic tank effluent;
c. Zones of mixing
d. Animal pens over or adjacent to any impoundment or stream .(21 ASC, Section 1921).
e. Dead animal disposal (21 ASC, Section 1906); and
f. dredging and filling activities

B. Embayments

1. Description

Any embayment is a body of water subject to tidal action and bounded by headlands which restrict the exchange of water with the open ocean. A bay or lagoon is an embayment if the ratio of the volume of water in the bay is more than 700 times the cross-sectional area of the bay at the entrance.* Consequently, the residence time of water in embayments, as opposed to open coastal areas, allows for the accumulation of land drainage materials which influence water quality and marine ecosystems.

2. Objective

All embayments are to remain in as nearly their natural state as possible. However, they may be partially degraded through uses which are controlled to prevent excessive modification to natural water quality characteristics.

* Volumes and cross sectional areas are in units of feet.

2. Objectives

a. "Nearshore": All nearshore waters are to remain in or nearly their natural state as possible. However, they may be partially degraded through uses which are controlled to prevent excessive modification or degradation.

b. "Offshore": All offshore waters are presently close their natural state. It is the intent of these standards to sustain this high quality. However, limited volumes of these waters may be partially degraded at designated receiving sites with acceptable wastewater discharges.

3. Allowable Uses

a. Commercial, subsistence and recreational fishing;
b. Scientific research;
c. Whole and limited body contact recreation e.g., swimming snorkeling, surfing, and SCUBA diving;
d. Harbors and boat launching ramps;
e. Commercial and recreational boating;
f. The support and propagation of marine life;
g. Zones of Mixing (by permit only in designated "offshore" waters);
h. Other uses not specified in this regulation which may be considered by the Environmental Quality Commission if such uses are compatible with the objectives defined for open coastal waters.

4. Non-Allowable Uses

a. Offshore oil recovery;
b. Point source discharges to "Nearshore" waters;
c. Dumping of solid and industrial waste material; and
d. Discharge of oil sludge, oil refuse, fuel oil, or bilge waters from any vessel (20 ASC, Section 1412);
e. Animal pens over or except as allowed adjacent to the shoreline (20 ASC, 1904); and
f. Dredging and filling activities, except as allowed under a permit issued by the Corps of Engineers.

D. Oceanic Waters

1. Description

Open ocean waters extend from the 100 fathom (600 feet or 183 meters) depth contour seaward to the twelve (12) mile limit.

2. Objectives

All oceanic waters are presently close to their natural state. It is the intent of these standards to sustain this high quality. When necessary, these waters may be partially degraded at designated ocean dumping sites (by permit only) for the disposal of dredged materials and industrial wastes.

3. Allowable Uses

a. Commercial, subsistence and recreational fishing;
b. Scientific research;
c. Commercial and recreational boating;
d. The support and propagation of marine life;
e. Power generation and acceptable thermal discharges;
f. Ocean dumping at designated sites under permits issued by U.S. Environmental Protection Agency; and
g. Other uses not specified in this regulation which may be considered by the Environmental Quality Commission if such uses are compatible with the objectives defined for oceanic waters.

4. Non-Allowable Uses

a. Discharge of oil sludge, oil refuse, fuel oil, or bilge waters from any vessel.
b. Dumping of solid or industrial waste materials without an EPA ocean dumping permit.

V. Zones of Mixing

A zone of mixing may be established according to the following criteria and procedures:

A. Criteria

A zone of mixing can only be granted by the Environmental Quality Commission if the application and the supporting information clearly shows that:

1. The beginning or continuation of the function or operation involved in a discharge by the granting of the Zone of Mixing is in the public interest;

2. The proposed discharge does not substantially endanger human health or safety;

3. Compliance with the existing Water Quality Standards, from which a zone of mixing is sought, would produce serious hardships without equal or greater benefits to the public;

4. Significant alterations generated by a proposed discharge do not measurably affect the marine ecology of the receiving waters; and

5. The proposed discharge does not (a) violate the Water Quality Standards set forth in Section VI, A1 through A3 and B; (b) will not unreasonably interfere with any actual or probable use of the water areas for which it is classified and; (c) has received a degree of treatment or control required to meet the Water Quality Standards for the receiving waters adjacent to the Zone of Mixing.

B. <u>Procedures to apply for Zone of Mixing</u>

1. Every application for a Zone of Mixing shall be made on forms furnished by the Environmental Quality Commission and shall be accompanied by a complete and detailed description of present conditions, how present conditions compare to standards, and such other information as the Chairman may prescribe by rules and regulations.

2. Each application for a Zone of Mixing shall be reviewed in light of the descriptions, statements, plans, histories, and other supporting information as may be submitted upon the request of the Environmental Quality Commission and the effect or probable effect on the Water Quality Standards established in Section VI of these standards.

3. A Zone of Mixing, or a renewal, shall be granted within the requirements of this section for the following time periods and conditions:

a. If a Zone of Mixing is granted on the ground that there is no practicable means known, or available, for the adequate prevention, control, or abatement of the discharge involved, it shall be only until the necessary means for prevention, control, or abatement becomes practicable and subject to the taking of any substitute or alternative measures that the Environmental Quality Commission may prescribe. No renewal of a Zone of Mixing granted under this section shall be allowed without a thorough review of known and available means of preventing, controlling or abating the discharge involved.

b. The Environmental Quality Commission may issue a Zone of Mixing for a period not exceeding five years.

c. Every Zone of Mixing granted under this section shall include, but not be limited, to grantee requirements to perform effluent and receiving water sampling and testing and to report the results of each test to the Environmental Quality Commission. A program of research to develop practicable alternatives to the methods of treatment or control in use by the grantee shall be required if such research is deemed prudent by the Environmental Quality Commission.

d. Any Zone of Mixing granted pursuant to this section may be renewed from time to time on terms and conditions (for periods not exceeding five years) which would be appropriate for the initial granting of a Zone of Mixing, provided that:

    (1) the applicant for renewal has met all of the conditions specified in the immediately preceding Zone of Mixing;

    (2) Zone of Mixing established in pursuance thereof, shall provide for discharge not greater in quantity of mass emissions than that attained pursuant to the terms of the immediately preceding Zone of Mixing at its espiration; and

    (3) No renewal shall be granted except on application therefore. Any such application shall be made at least 60 days prior to the expiration of the current Zone of Mixing.

e. The Environmental Quality Commission on its own motion, or upon the application of any person, shall terminate a Zone of Mixing, if, after a hearing, it shall determine:

(1) that the water area does not meet the basic standards (Section VI, A1 thru A3 and B) applicable to all water areas:

(2) that the Zone of Mixing granted will unreasonably interfere with any actual or probable use of the water area;

(3) that the discharge does not receive the degree of treatment or control specified in the permit.

Such termination shall be made only after a hearing held by the Environmental Quality Commission in accordance with the Administrative Procedures Act of the American Samoa Code. Upon such termination, the standards of Water Quality applicable thereto shall be those established for the Water as otherwise classified.

f. Upon expiration of the period stated in the Zone of Mixing, the Zone of Mixing shall automatically terminate and no rights shall be vested to the designee.

g. Whenever an application is approved the Zone of Mixing shall be established using the simple computer program "PLUME" to calculate the initial dilution. The Zone of Mixing will include an additional volume of receiving water surrounding the initial dilution plumes in which mixing occurs by coastal circulation processes from continuously supplied dilution waters. The "PLUME" model is based on the widely accepted principle of bouyant plume dispersion employed in many mathematical models.

Further, the following shall be taken into account in the establishment of a Zone of Mixing:

(1) protected uses of the body of water
(2) existing natural conditions of the receiving water;
(3) character of the effluent,
(4) the adequacy of the design of the outfall and diffuser system to achieve the desired dispersion and assimilation in the receiving water.

VI. Standards for Water Quality

A. The following standards apply to all fresh surface water, embayments, open coastal waters and oceanic waters of the Territory:

1. They shall be free from materials attributable to sewage, industrial wastes, or other activities of man that will produce color, odor, or taste, either of itself or in combination, or in the biota.

2. They shall be free from substances and conditions or combinations thereof attributable to sewage, industrial wastes, or other activities of man that will induce objectionable aquatic growths or degrade indigenous biota.

3. They shall be free from substances and conditions or combinations thereof attributable to sewage, industrial wastes, or other activities of man which may be toxic or cause irritation to humans, other animals, plants, and aquatic life.

4. The number of fecal coliform bacteria shall not exceed a geometric mean of 100 per 100 milliliters nor exceed 200/100 milliliters in more than 10% of samples. In areas where shellfish are collected, coliform concentrations shall comply with U.S. Public Health Service Shellfish Standards, in its latest revision.

5. The temperature shall not deviate more than 1.5^{o}F from condition which would occur naturally and shall not hourly fluctuate more than 1.0 degrees Fahrenheit not exceed 85 degrees Fahrenheit due to the influence of other than natural causes.

6. The concentration of dissolved oxygen shall not be less than 80% of saturation.

7. Radioactivity:

   a. Since human exposure to any ionizing radiation is undersirable, the concentration of radioactivity in natural waters will be maintained at the lowest practicable level.

   b. No radioactive materials shall be present in natural waters as a consequence of the failure of an installation to exercise appropriate controls to eliminate releases.

c. The concentration of radioactivity shall not:

1) result in accummulations of radioactivity in edible palnts and animals that present a hazard to consumers or are harmful to aquatic life, as recommended by the Federal Radiation Council in the Radiation Protection Guides;

2) exceed 1/30 of the MPC values given for continuance occupational exposure in the National Bureau of Standards Handbook No. 69, as revised; or

3) exceed the current National Interim Public Drinking Water regulations for waters used for public or domestic supplies.

8. Substances of unknown toxicity

a. All effluents containing foreign materials shall be considered harmful and not permissible until acceptable bioassay tests have shown otherwise. It is the obligation of the person producing the effluent to demonstrate that it is harmless, at the request of the Environmental Quality Commission.

b. Compliance with Section VI, A-3 of these Standards will be determined by use of indicator organisms, analysis of species diversity, population density, growth anomalies, bioassays of appropriate duration or other appropriate methods as specified by the Environmental Quality Commission.

c. The survival of aquatic life in surface waters shall not be less than that for the same water body in areas unaffected by sewage, industrial wastes or other activities of man, or, when necessary, for other control water that is consistent with the requirements for "Experimental water" as described in <u>Standard Methods for the Examination of Water and Wastewater</u> (latest available edition).

d. In addition, effluent limits based upon acute bioassays of effluents will be prescribed where appropriate, additional numerical receiving water limits including the water quality criteria used to support toxic effluent standards identified under Section 307 (a) of the federal Water Pollution Control Act of 1972, as amended, (40 FR 6532, 40 FR 258) will apply; further, numerical receiving water limits for specific toxicants will be established as sufficient data becomes available; and source control of toxic substances will be encouraged.

9. Maximum allowable pesticides: concentrations shall conform to national guidelines as stated in the National Technical Advisory Commission Report, Water Quality Criteria, or in subsequent national guideline publications.

10. Currents are important for transporting nutrients, larvae, and sedimentary materials for flushing and purifying wastes, and for maintaining patterns of scour and fill. To protect these functions, there shall be no changes in basin geometry or fresh water inflow that will alter current patterns in such a way as to adversely affect existing biological and sedimentological situations.

11. The concentration of total nitrogen and total phosphorous shall not exceed the respective concentrations which would occur naturally by more than 20%. Further numerical standards for nitrogen, phosphorus and possibly chlorophyll-a are likely to be established as sufficient data becomes available as a result of studies presently in progress.

B. The following standards apply to all fresh surface waters, embayments, and open coastal waters.

1. They shall be free from visible floating materials, grease, scum, foam, and other floating matter attributable to sewage, industrial wastes, or other activities of man.

2. They shall be free from materials attributable to sewage, industrial wastes, or other activities of man that will produce visible turbidity or settle to form deposits.

C. The following standards apply specifically to all fresh surface waters of the Territory.

1. The PH range shall be 6.0 to 8.0, and be within 0.5 pH units of that which would occur naturally.

2. Turbidity shall not exceed 10 NTU (Nephelometric Turbidity Units.)

D. The following standards apply to all embayment waters of the territory.

1. The pH range shall be 7.0 to 8.6 and be within 0.5 pH units of that which would occur naturally.

2. Turbidity shall not exceed 1.0 NTU (Nephelometric Turbidity Units).

E. The following standards apply to all open coastal waters of the territory.

1. The pH range shall be 7.6 to 8.6 and be within 0.5 pH units of that which would occur naturally.

2. Turbidity shall not exceed 0.5 NTU (Nephelometric Turbidity Units).

F. It is specifically recognized that the establisment of additional, or revised, numerical standards is likely as sufficient supporting data becomes available.

VII. Permits

No direct or non-point source discharges, or treated/untreated sewage or wastes from other than natural causes, shall be allowed into fresh waters, embayments, open coastal waters, oceanic waters or ground water of the Territory without application to, review by, and written permission from the Environmental Quality Commission.

VIII. Enforcement

Enforcement of these Water Quality Standards shall be in accordance with the applicable provisions of the Territorial Environmental Quality Act, 13 ASC 1-324.

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