A MARINE ENVIRONMENTAL IMPACT SURVEY
FOR THE PROPOSED MERIZO PIER

April 13, 1972

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BY

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FINAL REPORT

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The Marine Laboratory

Environmental Survey Report

No. 1

INTRODUCTION

Background

Mr. Charles Hambley of Merizo, Guam is submitting a proposal to the Department of Land Management, Government of Guam and the U. S. Department of Interior to construct a pier and adjacent access channel on submerged lands. These lands are located seaward of lot nos. 6, 8, and 9 in the municipality of Merizo, Territory of Guam (Fig. 1). It is necessary for Mr. Hambley to file an environmental impact statement and obtain permission from the above governmental organizations. He contacted the authors of this report and requested a marine survey of the construction site. The results of our survey are contained herein

This report does not constitute a complete environmental impact statement. Instead it is an environmental impact survey from which Mr. Hambley may extract details for his final statement.

The report is based upon drawings by Juan C. Tenorio and Associates, entitled: Proposed Merizo Pier for Mr. & Mrs. C. Hambley. The drawing Number is 9-1 and is dated January 24, 1972.

The Proposal

The concrete pile supported pier will be approximately 127 feet long. It will be set on the lagoon reef flat facing Cocos Island (Fig. 1). The pier will be six feet wide and have a channel dredged alongside to a depth four feet below the present bottom. The proposed channel width is 40 feet. Dredge spoil from the channel will be used to backfill and level the existing shore slope. A seawall four feet high is planned as a retaining wall for the backfill and leveling. The seawall and a concrete boat launching ramp will stand approximately at the present intertidal zone.

Potential modification of the marine environment includes the following:

1. Seawall construction backfill, and boat ramp will completely cover the present intertidal habitat.

2. Dredging will physically remove the extant benthic habitat of the lagoon reef flat and possibly the upper channel slope.

3. Dredge silt may affect downstream benthic organisms.

4. Pier footings will cover benthic organisms of the reef flat.

5. The pier structure will shade part of the benthic habitat on the lagoon reef flat.

RESULTS

Description of Study Area

General Land Forms and Geology:

The study area is located on a narrow coastal plain, bordered on the shoreward side by steep rolling volcanic hills. The hills comprise the lower slopes of the steep mountain range of southern Guam. Geologically these mountains are part of the Umatac formation and consist of deeply weathered volcanic rock. The topsoil on these slopes is classified as the Asan clay. This material supports a growth of sawgrasses and other savannah type plants.

The narrow coastal plain borders the Cocos lagoon (Fig. 1) and consists of unconsolidated material. Part of this material is derived from erosion of the bordering mountain slopes and part from accumulation of bioclastic materials derived from carbonate secreting marine organisms of the adjacent lagoon.

The supratidal zone is crowded with high density residential and commercial dwellings using septic tanks for waste disposal. Vegetation consists of ornamental plants and lawn type grasses that lie between the above structures and the beach. The entire supratidal shore area has been greatly altered and reworked by man throughout the municipality. Very few endemic plants occur here.

Intertidal:

This zone (Fig. 2) consists of boulder rubble, sand, and gravel. The boulder rubble is encrusted with a pink coralline algae. Numerous small gastropods (Cerithium sp.), hermit crabs, and a few grapsid crabs are found here. The zone is rather barren biologically and shows signs of considerably past disturbance by man throughout the Merizo area.

Fringing Lagoon Reef Flat:

This zone is approximately 130 feet wide (Fig. 2). The substratum is composed of a mixture of silt and volcanic sands, washed down from the uplands, and bioclastic sands, and rubble composed of coral and mollusc fragments, foraminiferan tests, and calcium carbonated secreting algae (Halimeda). The zone supports a good stand of eelgrass (Enhalus). The outer part of the reef flat has some large living corals forming "microatolls" of Porites lutea. These structures (about 15) lie within the proposed channel and will be removed. They shelter such organisms as the Echinometra mathei, Diadema sp. and fishes of the families, Apogonidae, Holocentridae and Pomacentridae. None of these organisms are particulately abundant in the area. Evidence of a few burrowing organisms exists. The entire reef flat shows considerable influence of man's activity in the form of jettson. Except for the eelgrass community and the scattered "microatolls" the reef flat is a rather barren region. About 5,000 ft^2 of this habitat will be removed by dredging. The above mentioned communities are not evenly distributed and would make up less than 50% of the area to be dredged.

Lagoon Margin and Upper Channel Slope:

This region (Fig. 2) is located at the seaward margin of the lagoon reef flat where it slopes steeply into Mamaon channel. This region supports the highest density of coral growth found either in the study area or in adjacent areas east and west of it. This coral community serves as an excellent fish habitat The area also supported a high standing crop of the algal genera Halimeda, Caulerpa, and Dictyota. It is the least disturbed zone within the study area and supports the most diverse reef community. Every effort should be made during construction to avoid damage to this zone. This should be no problem since the lagoon margin is located lagoonward of the proposed pier head and is in water of sufficient depth to avoid dredging. The majority of the coral species on the lagoon margin are resistent to siltation and should not be affected by work on the reef flat if physical destruction is avoided.

Lower Channel slope:

This region (Fig. 2) extends to the channel floor at an angle of 45-60°. It is interrupted by a narrow terrace (approx. 30 feet wide) in 50-60 feet of water. The slope and terrace are covered with mudsands. They are rich communities of alcyonarian corals and hydroids, particularly on the terrace. A conspicuous feature of the slope is the presence of large intact coral coralla that have broken off from the lagoon margin and rolled downslope. These corals are dead but form a habitat for a few fish species. The structures are not nearly as effective a habitat as the living corals of the lagoon margin. It is unlikely that the proposed construction will affect this zone if no large pieces of construction debris or dredged debris material is pushed down the slope.

Biological Studies

The major benthic faunal and floral components present in the study region consist of the following: 1) A community of "eelgrass", Enhalus acoroides, is found on the fringing lagoon reef flat. 2) A coral community consisting of scattered colonies, intermixed with the "eelgrass", occupies the outer half of the fringing lagoon reef flat. This coral community increases in species diversity and density along the channel margin and upper channel slope. If then decreases rapidly on the lower channel slope, and is represented by only a few widely scattered colonies on the channel floor. 3) The major components of the algal community consist of: Ectocarpus sp. and an encrusting Lithothamnion sp. in the intertidal zone; Padina boryana, Halimeda opuntia, Halimeda micronesica, Dictyota sp., Neomeris sp., Gracillaria sp., and Sargassum myriocystum, on the fringing lagoon reef flat Caulerpa racemosa, Caulerpa sertularioides, Halimeda micronesica, Halimeda opuntia, Porolithon gardineri, Neogoniolithon frutescens, Amphiroa fragilissima, Padina boryana, and Porolithon onkodes on the upper and lower channel slopes. and 4) Other benthic organisms observed were gastropods of the genus Cerithium in the intertidal zone; Holothuria atra, Stichopus chloronatus, Polyplectana sp., Echinometra mathei and Diadema sp. on the fringing reef flat; Diadema sp., among the corals of the upper channel slope; alcyonarian species, dendroid hydroids, and nudibranch molluscs on corals and coral rubble of the lower channel slope.

The coral community is the major benthic community present in the study area. Table 1 lists the coral species observed in the various zones and gives a relative index of abundance for each zone. The coral community will be least effected by the actual area of dredging and location of pier footings because living coral density and percentage of substratum covered is low in these regions. Highest coral density and substratum surface covered occurs on the upper channel and lower channel slopes. This region is generally below the level at which dredging is contemplated. It is recommended that the corals on the upper channel slope not be disturbed. No dredge spoil should be dumped over the edge of the channel margin where it would accumulate and damage corals in the deeper sections of the channel slope. The dredge spoil can best be utilized in making backfill along the shore as proposed in the construction plans and drawings.

Data on fishes observed are contained in Table 2. Very few fish species were observed on the lagoon reef flat. The largest aggregations were found associated with the coral concentrations on the upper channel slope. A fair number of species were present on the lower channel slope and channel floor. The reduced availability of cover in the latter two area may account for this difference.

Removal of the coral cover along the upper channel slope would result in a considerable reduction in the number of individuals and species in the area. There was a fairly large aggregation of fishes around the construction rubble and pier heads on adjacent property. To some degree, these structures have provided a form of replacement cover for coral that was dredged out. However, the highest species count was in the coral.

The fishes in the study area were primarily resident species. In all, we would estimate less than 20 lbs. of resident fish biomass would be affected if the entire coral area was removed. The fish-coral association combines to make this a pleasing area to snorklers. The developers would be well advised to preserve this association for the use by their guests.

Four coliform samples were collected in the study area. Table 3 show the sample station locations. Analysis of these samples (Table 3) indicated that the minimum coliform pollution level of 200/100 ml, established by the Guam Water Pollution Control Commission, is exceeded for total coliform and is at a slightly polluted level (100/100 ml) for fecal coliform in the intertidal zone (sample 3). This coliform contamination of the intertidal zone may originate from septic tank seepage or overflow. The remainder of the coliform samples are within the water quality levels. Salinity and dissolved oxygen values were normal over the very short study period.

Current Studies

Currents were studied because of their role in the distribution of dredge silt to other areas. Damage of adjacent areas can occur during dredging operations. Current studies on the lagoon reef flat and the adjacent Mamaon Channel were conducted through one complete diurnal tide cycle. Current patterns on the lagoon reef flat were determined by using drift cross and underwater dye release techniques. In Mamaon Channel the current patterns were determined by making drift cross casts near the central part of the channel. A total of seven underwater dye releases and seven drift cross casts, each cast consisting of three drift crosses set at 10 cm were made from Station A (Fig. 3). Seven drift cross casts were made in the Mamaon Channel from Station B (Fig. 3). Each of these drift cross casts consisted of three drift crosses: a 1 m depth cross to determine currents in the upper surface layer of water and 5 m and 10 m depth crosses to determine currents in deeper water layers.

The axis of each dye plume and the drift cross tracts are plotted on Figure 3. Table 4 lists the magnetic bearing and velocity for each dye plume and drift cross tract. The current patterns on the lagoon reef flat and in the Mamaon Channel were found to be rather uniform with respect to current direction (Table 4) throughout the tidal cycle. During the entire study period there was a unidirectional seaward flowing current in the Mamaon Channel (Fig. 3). This unidirectional flow is probably due to the high volume transport of water across the barrier reef enclosing Cocos Lagoon (Fig. 1). During periods of calms and low wind velocity combined with lower low water neap tides, the transport of water across the barrier reef would be at a minimum. During these times the current direction in Mamaon Channel could conceivably be in a lagoonward direction. According to Emery (1962) there may be either a weak inward or outward flow in the channel at flood tide. It was found that the mass transport of water flowing seaward in the Mamaon Channel was rather uniform for the upper 10 m layer of water because, the 1 m, 5 m, and 10 m drift crosses all moved at about the same velocity (Table 4). It is strongly suspected that the mass transport of water in the entire water column of the Mamaon Channel is uniform. During a SCUBA dive to the channel floor at 100 feet, a current similar to that measured in the upper 10 m layer of water was encountered.

Several small streams discharge into Cocos Lagoon along the coastal lagoon reef flat. During a heavy rain squall, which occurred between 11:45 A. M. and 12:00 A. M. several muddy plumes appeared at the mouths of these small streams. The river plumes moved out into Mamaon Channel and then into Bile Bay. The muddy plume from the nearest stream moved across the outer half of the study area during this rain squall. Most organisms which are found within the various zones (Fig. 2) of study area and along the Mamaon Channel are probably fairly well adapted to the above periodic discharge of silt laden fresh water from the coastal streams. Secchi disk readings near Station B (Fig. 3 Table 4) prior to the rain squall were 40 feet. About 15 minutes after the rain squall the secchi disk reading was reduced to 2.5 feet. due to the muddy river discharge from nearby streams. Secchi disk readings two hours after the rain squall had increased to 20 feet and by four hours later it had increased to 30 feet. The major difference between fresh water plumes originating from coastal rivers and those generated by dredging operations is that the plume from the former tends to float as a lens on top of the more dense seawater, whereas the plumes from dredging operations tend to have a greater vertical distribution in the water mass. This vertical distribution of silt in the water column suggests that there is a greater probability of damage to organisms living on the deeper parts of the upper channel slope, lower channel slope, and channel floor. Analysis of sediment samples in the Mamaon Channel by Emery (1962) show that a considerable fraction consists of non-bioclastic materials. This indicates that eventhough some of the river sediment is carried off in the silt loaded plume, some silt does accumulate naturally as sediments in the study area.

Considering the small amount of dredging to be conducted in the study area, and the probability that the organisms found in nearby areas are already subjected to periodic river siltation from the coastal streams, it is though by the authors that dredging is unlikely to cause severe damage to adjacent regions.

It is recommended that dredging operations be carried out during periods when a strong seaward flowing current is present in Mamaon Channel. We believe that a minimum amount of damage, due to dredge silt, would occur during this time as the current pattern from Figure 3 shows that it would be carried out to sea via the Mamaon Channel.

REFERENCES CITED

Emery, K. O. 1962. Marine geology of Guam. U. S. Geol. Surv. Prof. Pap. 403-B:1-76.

Table 1. Coral species list showing their relative abundance by reef zones. D = dominant species, A = abundant species, C = common species, O = occasional species, and R = rare species.

REEF ZONES

Lagoon Reef Flat		Upper Channel Slope		Lower Channel Slope		Channel Floor	
Goniastrea pectinata	R	*Acrhelia horrescens*	O	*Anomastrea* sp.	O	*Goniopora* sp.	O
Leptastrea purpurea	O	*Acropora formosa*	R	*Echinophyllia aspera*	R	*Plerogyra sinuosa*	R
Montipora hoffmeisteri	O	*Echinopora lamellosa*	R	*Goniopora gracilis*	O		
Montipora lobulata	O	*Leptastrea purpurea*	C	*Leptastrea purpurea*	C		
Montipora verrilli	O	*Montipora lobulata*	C	*Leptoseris hawaiiensis*	R		
Pavona (P.) obtusata	O	*Montipora tuberculosa*	O	*Montipora lobulata*	O		
Pocillopora damicornis	O	*Montipora verrilli*	C	*Montipora subtilis*	R		
Porites lobata	R	*Montipora verrucosa*	C	*Montipora tuberculosa*	O		
Porites lutea	D	*Platygyra rustica*	R	*Montipora verrucosa*	O		
Psammocora contigua	O	*Pocillopora damicornis*	O	*Montipora* sp.	O		
		Porites andrewsi	D	*Pachyseris speciosa*	C		
		Porites australiensis	C	*Pavona gardineri*	R		
		Porites cocosensis	A	*Plerogyra sinuosa*	C		
		Porites (S.) convexa	C	*Porites australiensis*	O		
		Porites (S.) iwayamaensis	A	*Porites andrewsi*	D		
		Porites (S.) horizontalata	O	*Porites cocosensis*	C		
		Psammocora contigua	O	*Porites (S.) horizontalata*	C		
		Stylocoeniella armata	C	*Porites lobata*	O		
				Porites lutea	O		
				Psammocora nierstrazi	R		
				Stylocoeniella armata	A		

Table 2. Fish species list showing their relative abundance. D = dominant species, A = abundant species, C = common species, O = occasional species, and R = rare species.

Acanthuridae	
Acanthurus nigrofuscus	C
Acanthurus pyroferus	R
Ctenochaetus striatus	D
Zebrasoma flavescens	O
Zebrasoma veliferum	O
Apogonidae	
Apogon sp.	R
Paramia quinquelineata	O
Balistidae	
Sufflamen chrysoptera	R
Blenniidae	
Meiacanthus atrodorsalis	R
Bothidae	
Bothus mancus	R
Canthigasteridae	
Canthigaster solandri	O
Canthigaster cinctus	R
Chaetodontidae	
Chaetodon auriga	R
Chaetodon citrinellus	R
Chaetodon ephippium	R
Chaetodon falcula	R
Chaetodon lunula	R
Chaetodon melannotus	R
Chaetodon mertensii	O
Chaetodon unimaculatus	R
Chaetodon trifasciatus	O
Heniochus varius	R
Holocentridae	
Holocentrus sammara	R
Myripristis kuntee	O
Myripristis multiradiatus	O
Myripristis sp.	O
Kyphosidae	
Kyphosus vaigiensis	R
Labridae	
Cheilinus oxycephalus	R
Labroides bicolor	R
Labroides dimidiatus	O
Stethojulis sp.	R
Lutjanidae	
Lethrinus sp.	O
Lutjanus vaigiensis	O
Scolopsis cancellatus	R
Mullidae	
Mulloidichthys auriflamma	C (school)
Mulloidichthys samoensis	D (school)
Parupeneus bifasciatus	O
Ostraciontidae	
Ostracion cubicus	R
Pomacentridae	
Abudefduf curacao	C
Chromis caeruleus	C
Dascyllus aruanus	C
Pomacentrus albofasciatus	R
Pomacentrus pavo	O
Pomacentrus tracyi	O
Pomacentrus vaiuli	R
Sacridae	
Scarus sordidus	C
Serranidae	
Epinephelus merra	R
Sygnathidae	
Corythoichthys intestinalis	O
Zanclidae	
Zanclus canescens	O

Table 3. Chemical and Coliform Data.

Tests Run	Sample #	Test Results		Sample Station Location
Dissolved Oxygen	25	5.9 mg/l		Intertidal
	29	6.1 mg/l		Channel Slope (Surface)
	48	7.1 mg/l		Fringing Lagoon Reef Flat
	57	6.2 mg/l		Channel Slope (25 feet depth)
	72	6.0 mg/l		Fringing Lagoon Reef Flat
	101	7.2 mg/l		Channel Slope (Surface)
	171	7.1 mg/l		Intertidal
	172	7.1 mg/l		Channel Slope (25 feet depth)
		Total	Fecal	
Coliform	2	35/100 ml	10/100 ml	Channel Slope (Surface)
	3	310/100 ml	100/100 ml	Intertidal
	4	155/100 ml	40/100 ml	Fringing Lagoon Reef Flat
	5	55/100 ml	10/100 ml	Channel Slope (25 feet depth)
		S ‰		
Salinities	4	34.380		Intertidal
	5	34.287		Channel Slope (Surface)
	6	34.254		Fringing Lagoon Reef Flat
	7	34.106		Intertidal
	8	34.448		Channel Slope (25 feet depth)
	9	34.286		Channel Slope (Surface)

Table 4. Current, wind, water temperature, and Secchi disk data.

	Time	Magnetic Bearing	Velocity in knots/hr.	Water Temp. in °C	Wind Direction	Wind Velocity in knots	Secchi Disk Reading in Ft.	Tide Condition
STATION A								
Drift Cross Cast #1	1007	283°	.211	---	102°	2-3,gusts 5-2	---	Ebb
Dye Release #1	1007	283°	.164	---	102°	2-3,gusts 5-7	---	Ebb
Drift Cross Cast #2	1216	288°	.185	---	90°	2-3,no. gusts	---	Ebb
Dye Release #2	1216	288°	.135	---	90°	2-3,gusts 5-6	---	Flood
Drift Cross Cast #3	1354	283°	.135	---	90°	2-3,gusts 5-6	---	Flood
Dye Release #3	1354	283°	.114	---	90°	2-3,gusts 5-6	---	Flood
Drift Cross Cast #4	1601	282°	.099	27.8	90°	2-3,gusts 5-6	---	Flood
Dye Release #4	1601	282°	.087	27.8	90°	2-3,gusts 5-6	---	Flood
Drift Cross Cast #5	1800	285°	.114	27.8	90°	2-3,gusts 5-6	---	Flood
Dye Release #5	1800	285°	.106	27.8	90°	2-3,gusts 5-6	---	Flood
Drift Cross Cast #6	2010	295°	.211	---	90°	1-2,gusts 3-4		Ebb
Dye Release #6	(No dye release)		---	---	---	---	---	---
Drift Cross Cast #7	0625	296°	.135	26.3	---	---	---	Flood
Dye Release #7	0625	296°	.135	26.3	---	---	---	Flood
STATION B								
Drift Cross Cast #1								
1 meter	1004	295°	.411		102°	2-3,gusts 5-7	40	Ebb
5 meter	1004	300°	.352	---	102°	2-3,gusts 5-7	40	Ebb
10 meter	1004	300°	.330	---	102°	2-3,gusts 5-7	40	Ebb
Drift Cross Cast #2								
1 meter	1216	300°	.617	---	90°	2-3,no gusts	2.5	Ebb
5 meter	1216	300°	.548	---	90°	2-3,no gusts	2.5	Ebb
10 meter	1216	300°	.352	---	90°	2-3,no gusts	2.5	Ebb
Drift Cross Cast #3								
1 meter	1355	300°	.411	---	90°	2-3,gusts 5-6	20	Flood
5 meter	1355	300°	.411	---	90°	2-3,gusts 5-6	20	Flood
10 meter	1355	300°	.411	---	90°	2-3,gusts 5-6	20	Flood
Drift Cross Cast #4								
1 meter	1559	300°	.380	---	90°	2-3,gusts 5-6	30	Flood
5 meter	1559	300°	.449	---	90°	2-3,gusts 5-6	30	Flood
10 meter	1559	300°	.411	---	90°	2-3,gusts 5-6	30	Flood

Table 4 (Continued)

	Time	Magnetic Bearing	Velocity in knots/hr	Water Temp. in °C	Wind Direction	Wind Velocity in knots	Secchi Disk Reading in Ft.	Tide Condition
STATION B (Continued)								
Drift Cross Cast #5								
1 meter	1756	302°	.449	--	90°	2-3, gusts 5-6	--	Flood
5 meter	1756	302°	.380	--	90°	2-3, gusts 5-6	--	Flood
10 meter	1756	302°	.411	--	90°	2-3, gusts 5-6	-	Flood
Drift Cross Cast #6								
1 meter	1958	296°	.493	--	90°	2-3, gusts 5-6	--	Ebb
5 meter	1958	296°	.617	--	90°	2-3, gusts 5-6	--	Ebb
10 meter	1958	296°	.548	--	90°	2-3, gusts 5-6	--	Ebb
Drift Cross Cast #7								
1 meter	0636	300°	.617	--	-	--	-	Flood
5 meter	0636	300°	.617		-	--	-	Flood
10 meter	0636	300°	.617	--	-	-	-	Flood

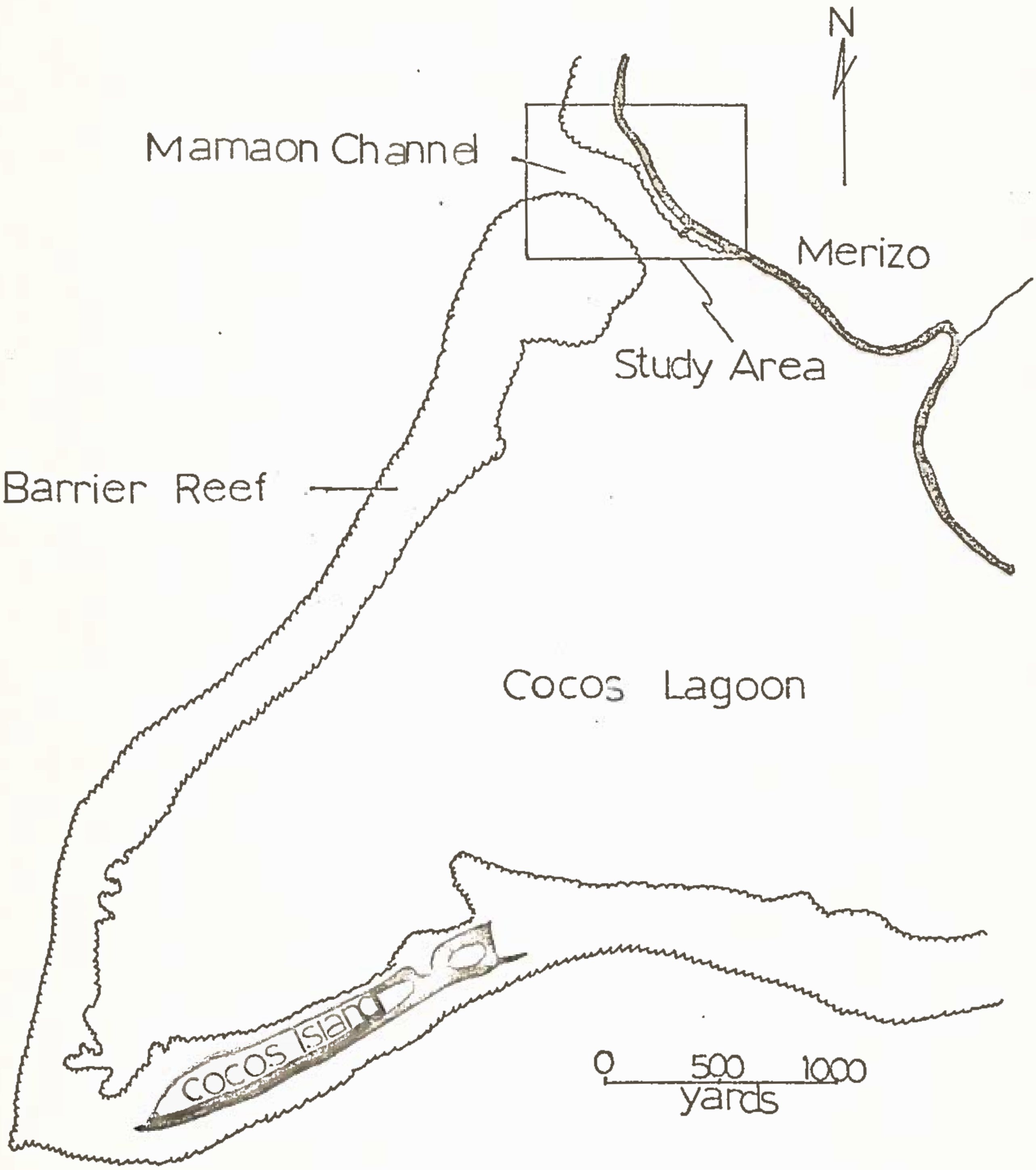

Figure 1. Cocos Lagoon showing the location of the study area.

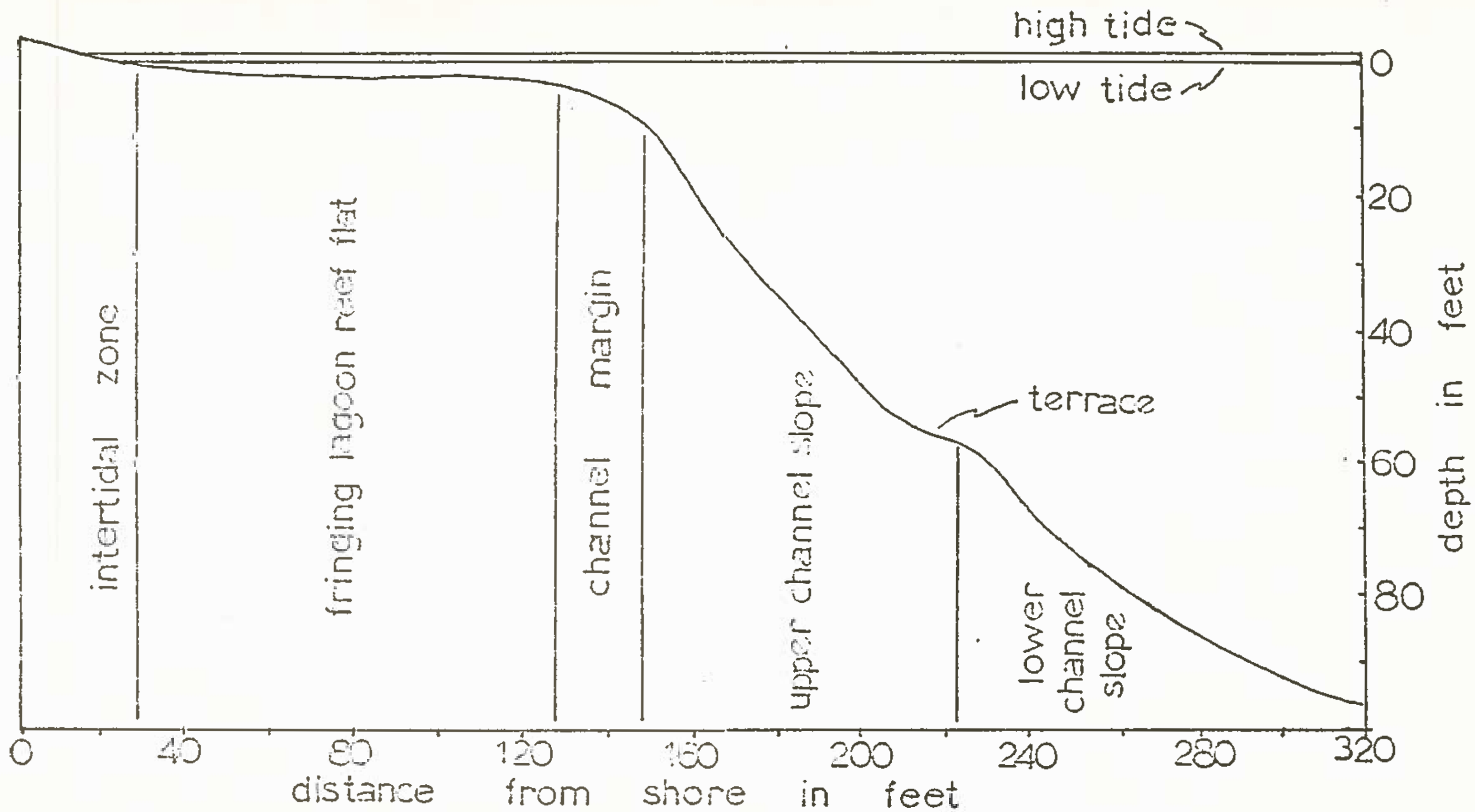

Figure 2. Vertical profile and zonation along the proposed pier site. Vertical exaggeration is 1.6X.

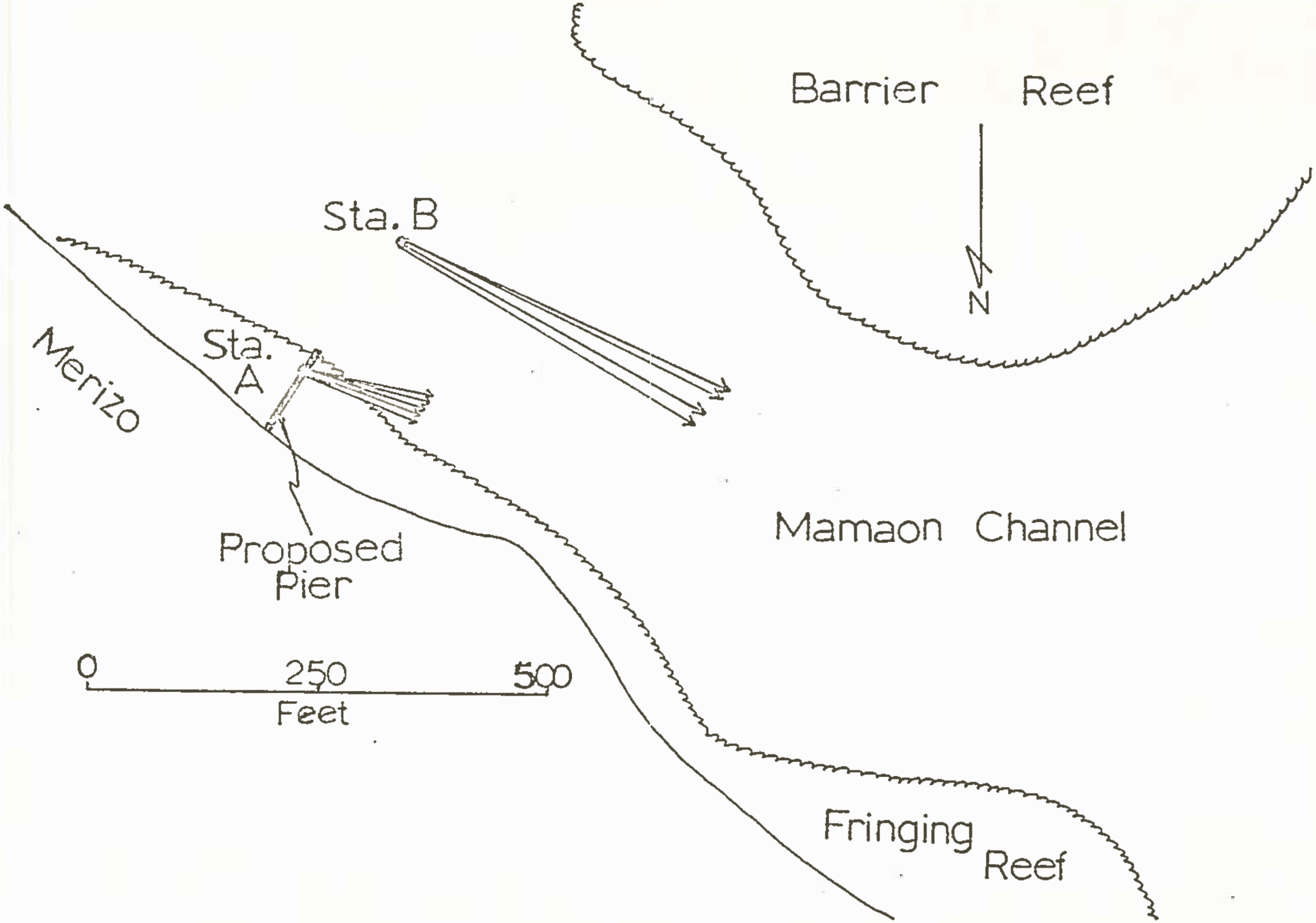

Figure 3. Study area showing the drift cross and dye plume tracts at Station A and the drift cross tracts at Station B.