MARINE SURVEY FOR THE PROPOSED DREDGING

AT THE

CABRAS ISLAND TERMINAL OF MOBIL PETROLEUM COMPANY

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AUGUST 5, 1974

UNIVERSITY OF GUAM
THE MARINE LABORATORY
ENVIRONMENTAL SURVEY REPORT
NO. 16

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INTRODUCTION

Background

On February 7, 1974, Mobil Petroleum Company Operations Manager Hans A. Henricksen contacted University of Guam President Pedro C. Sanchez in connection with an environmental survey for dredging and deepening the existing pier facility at Cabras Island. A contract was negotiated and signed. To obtain the required permit to dredge in the subtidal waters of Apra Harbor it is necessary for Mobil Petroleum Company to file an environmental assessment with the U. S. Department of Interior, U. S. Army Corps of Engineers, and the Government of Guam. Through the Director of the Marine Laboratory the authors were asked to submit a proposal. The results of this environmental survey are contained within. The report is based upon drawings and information supplied by Mobil Petroleum Company. This report does not constitute a complete Environmental Impact Statement, instead it is an environmental assessment or survey from which Mobil Petroleum Company may extract details for their complete statement.

Scope of Work

The investigators agreed to perform the following:

1. Provide a catalog of the major marine organisms of the study area,
2. Evaluate the potential environmental impact of the facilities construction,

[1]This work and the opinions expressed herein are those of the authors and not necessarily those of the University of Guam, The Marine Laboratory, or the Government of Guam.

3. Conduct preliminary current studies (24-hour cycle) and correlate with environmental considerations.

RESULTS

Description of Study Area

General Setting:

The project site is located on the lagoon side of the Apra Harbor Glass Breakwater, Pier B. The breakwater and the associated facilities are artificial structures built upon the east end of the Luminao Barrier Reef (Figure 1) about 1300 feet from the west end of Cabras Island. The present pierhead extends lagoonward to the edge of the barrier reef shelf. Dolfins flank are either side of the existing pier at the edge of this shelf.

Physiographic and Biologic Description:

Shoreline and Intertidal

The shoreline is composed of limestone fill and rip-rap jutting lagoonward from the breakwater. A small inlet remains between the shoreside facility and the Coast Guard "sea plane ramp" filled area. To the west of the pier, the Kaiser cement-holding facility occupies a small amount of land surrounded lagoonward by limestone boulders. To the east, the small inlet is bordered with limestone. A considerable amount of rubble is present. Parallel to the breakwater road are boulders and a small fine-grain sand beach. The sea-plane ramp fill area is edged with boulders, and a partially broken concrete retaining wall is present along the lagoon. The filled areas are approximately six to eight feet above sea level.

The shoreline vascular plants include the beach morning glory (Ipomea pes-caprae), Seaevola frutescens, Pago (Hibiscus tilraceus), Tangantangan

(Leucena leucocephola), and daisies (Bidens sp.). Two sprouted mangrove seedlings were observed along the shore of the inlet. Occasional sedges were seen.

The predominant animals occurring here are molluscs. Scattered boulders hold citons in depressions. Numerous snails (Planaxis sulcatus) are found among the smaller boulders at the pier side of the inlet. The neritid snail Nerita plicata is occasionally seen among the high intertidal boulders. Small grapsid crabs are also present.

Lagoon Shelf and Slope Zones

The lagoon shelf is a relatively flat, shallow platform which extends lagoonward from the Glass Breakwater shoreline to the steep lagoon slope. The shelf itself most probably represents the original reef-flat surface of the Luminao Barrier Reef which has since been greatly altered; first by the construction of the breakwater and secondly by the subsequent construction of the Mobil Petroleum Company pier facilities and adjacent Kaiser cement-handling plant. The shelf grades gently downward from a depth of 1-3 feet along the rip-rap fill of the breakwater to a depth of 6-8 feet at the upper edge of the lagoon slope. The lagoon slope dips downward at about a 45° angle to depths of 90 to 100 feet where it grades into the relatively flat lagoon floor.

The lagoon shelf consists primarily of a consolidated reef-rock platform with scattered shallow holes and depressions containing minor deposits of unconsolidated sediments. Living corals and various kinds of metal junk, rubber tires, bottles, cans, wire cables, wood, and concrete rubble are scattered over the surface of the shelf. Most conspicious of this junk is the presence of a considerable quantity of munitions adjacent to the west side of the pier head. The lagoon slope consists mostly of unconsolidated sediment and junk, as described above, but lacks scattered coral growth except for an

occasional colony growing on the pier-head structures or on the surface of the junk itself.

On the lagoon shelf the dominant community is a Porites--Pocillopora coral assemblage. The shelf is considerably wider on the east side of the pierhead, and the coral diversity (Table 1) there is greater (17 species) than that found on the west side (8 species). Although the width of the coral community on the west side of the pierhead (Transects 1 and 2) is narrower, the percentage of substrate coverage is higher there than on the east side (Transects 3 and 4, Table 2). Coral density is greater on the east side of the pierhead (Transects 3 and 4, Table 2) than on the east side (Transects 1 and 2, Table 2). In general the coral colony size is smaller on the east side than that on the west, which would tend to increase the density there. The distribution of corals on the shelf is not uniform. Greater development was found in the mid-section of the lagoon shelf on both sides of the pierhead. Coral colonies tended to be very small and scattered along the shallow shoreward part of the lagoon shelf, whereas growth on the outer lagoonward part of the shelf consists of a few larger but more widely scattered Porites and Pocillopora colonies.

On the lagoon slope, which is located within the area to be dredged, only three species of corals were observed (Table 1). Values for coral density and percentage of substrate covered by living coral growth were both less than 0.10 on all four transects. Most of the colonies observed there were growing on the hard surface of scattered pieces of junk. The lagoon slope itself consists of steeply sloping surface of unconsolidated sediments. Very few marine organisms were observed on the sand substrates. A few burrowing sea anemones were observed on the sandy slope of Transect 4. Other widely scattered organisms observed on the lagoon slope were the sea cucumbers Holothuria argus and Holothuria edulis; several purple and orange colored sponges, mostly growing

on the hard surfaces of scattered pieces of junk; small colonial hydroids; and several burrowing molluscs.

By far the most conspicuous coral present was the large subhemispherical, massive Porites colonies, all generally under 1 meter in diameter. This rather homogenous size distribution indicates a community which probably developed after the disturbance caused by breakwater construction. Associated with this conspicuous Porites community are the much smaller cespitose clumps of Pocillopora damicornis. These relatively fast growing colonies are also abundantly encrusting the pier and dolfin pilings. Although Table 1 lists eleven species of corals other than Porites and Pocillopora, these are represented by widely scattered colonies and, in some cases, by a single occurrence only. The only other conspicuous corals were small excrusting patches of Leptastrea purpurea located in the shallower habitats toward the breakwater. Associated with this coral assemblage are large aggregations of the sea urchin Diadema setosum. On the west side of the pierhead seven or eight large aggregations of more than two hundred individuals were observed. A few sea cucumbers (Holothuria atra and Bohadschia argus) were seen. Large polychaete annelid worms (Sabellastarte indica) were also observed among massive Porites colonies.

Toward the outer edge of the lagoon shelf conspicuous aggregations of the red lipped conch (Strombus luhuanus) were observed. A few Lambus lambus were seen here also. A few widely scattered soft corals (Sinularidae) were present.

Fishes

There are three distinct macro-habitats for fishes in the study area. The first is the harbor or lagoon margin and slope. This habitat begins slightly landward of the pierhead and the two dolphin structures and slopes rapidly off to the lagoon or harbor floor. The bottom lacks natural topographic relief

except for occasional sponges. It is basically a featureless floor of a sandsilt composition. In addition to the sponges, there are scattered pieces of debris which have been jettisoned from ships or from the pier itself. This debris consists of broken wood and metal frame structures, batteries, tires, 55-gallon drums, pipes, tangled cable, and other assorted pieces of jetsam. Most of this debris has small coral colonies, sponges, and other encrusting organisms growing upon it.

The second obvious fish habitat consists of piling and framing timbers which form the dolphins and pier. Although both the dolphins and pierhead lie within the first-mentioned habitat, their massive structure provides a significantly different habitat type. The shoreward section of the pier runs through the coral beds which the pier were either removed or destroyed during the original construction. Both of the dolphins, pier, and pierhead have accumulations of debris at their bases.

As noted above, the third habitat type is the relatively, dense bed of coral (Porites spp.) lying in a band from a point about midway out on the lagoon terrace to the shore.

Table 3 is a checklist of sixty-four species of fishes which occur in the study area. These species represent fairly ubiquitous fishes which are easily observable. It is quite likely that there are other species that are nocturnal or otherwise cryptic and may not have been observed. Of the sixty-four species listed, twenty-six are popular sport or commercial fishes. Some line fishing is done from the pier and from decks of ships when alongside. Spearfishermen occasionally fish around the pier and dolphin structures but concentrate mostly in the Porites zone.

Table 3 clearly indicates that lagoon slope and margin at the proposed dredge site has the poorest fish community. The list shows that of sixteen

species found in this habitat, nine require some type of natural or man-made cover, six are burrowing forms which normally inhabit such sand silt bottoms, and one species (Caranx melampygus) is highly transient in nature. Thus, without the scattered debris in this habitat, only the six burrowing forms would normally occur here.

The same Table shows that some thirty-two species occur around the man-made pier and dolphin structures and accumulated debris at their bases. These structures are essentially acting as artificial reefs. This is especially true of the dolphins and pierhead which are emplaced in the generally barren sand/silt habitat. The shoreward part of the pier replaces the natural reef structure of the Porites beds but in this case is not as effective a fish habitat as the natural reed. The aggregated long-spined sea urchins (Diadema) form a protective micro-habitat for numerous juvenile fishes.

The richest ichthyofauna is by far to be that associated with the natural Porites coral community. Some fifty-five species occur in this area, and there are doubtlessly more cryptic species.

It would therefore appear, from the available data, that the dredging contemplated on the lagoon margin and slope, seaward of the dolphins and pierhead, and the proposed driving of additional piles around the pierhead will result in very little damage to the fish community and no permanent damage. Sediments from the dredging operation may drive some of the fishes now inhabiting the dolphin and pierhead structures away until construction is completed. Again, this result would be temporary and the fishes could be expected to rapidly re-enter the area. Sediment might also encroach somewhat upon the Porites zone and temporarily drive the nonsilt-adapted species from the area. Moreover, even though these corals are themselves normally silt adapted, care should be taken to avoid damage to the Porites species from sedimentation. Their loss

would definitely inhibit the return of the fish community. Similarly, care should be taken to insure that no other form of physical damage occurs in the Porites zone. The dredging apparatus and pile driver will, presumably, be barge mounted and as such should be placed and anchored in such a way that no damage to the coral occurs.

In general, if the above recommendations are followed, it seems likely that the proposed construction and dredging will not cause significant ireparable damage to the fish community immediate area.

Currents

A twenty-four hour current study was conducted on July 6-7, 1974. The general current patterns were mapped and tracked by releasing 1-meter and 5-meter drogues at the pierhead which is located more or less in the center of the region to be dredged. A total of thirteen drogue casts were conducted during the current-study period. The drogue tracts are shown on Figure 3 and summarized in Table 4. The actual tracts were determined by plotting their course on a general area map at periodic intervals.

Results

During this twenty-four hour current study the wind generally had an unusual southerly bearing over the long sweep of the lagoon width. This wind generated a small chop about 1.0-1.5 feet high which abated during the early hours of the second day. Rain occurred during the early hours of the study, and scattered showers and overcast skies remained during much of the remainder of the study. Of all the drift casts, most drifted to the east of the pier and shoreward over the lagoon shelf (see Fig. 3). During ebb tide, casts 1 through 4 drifted eastward from the pier, then shoreward between the dolphin B and the pierhead. The wind was generally from the south or southeast. Drift

cast 5, during ebb-flood tide stage, drifted west of the pier, curving shoreward between the pierhead and dolphin A. There was no change in wind direction; however, there was a redirection in velocity and a change in tide from ebb to flood which is probably responsible for tract of this drogue. Drift casts 7 and 9 occurred during flood tide stage and had a pattern similar to those described for casts 1 through 4. With drift casts 9 and 10, the 5-m drogue curved shoreward between dolphin B and the pierhead to the east, whereas the 1-m drogue moved westward past dolphin A before curving toward the shore. Cast 11, on an ebb tide, differed, moving westward and curving shoreward as in drift cast 5. With cast 12 and no measurable wind, the 1-m drogue drifted westward and seaward of dolphin A, while the 5-m drogue drifted past dolphin B. Again without wind both 1-m and 5-m drogues drifted eastward during drogue cast 13.

It appears that the winds influence the movement of the drogues, especially the upper layers (e.g., 1-meter) of water which tended to carry them shoreward. Under conditions of no measurable wind the drogues, as is true with all the tracts when the wind was not blowing, almost paralleled the lagoon shelf margin. In all cases the 1-m drogue moved much faster than the 5-m one.

ENVIRONMENTAL IMPACT OF THE PROPOSED PROJECT

1. The proposed dredging will remove approximately 8,000 sq. ft. marine substrate. Approximately 14,537 cu. ft. of sediments will be removed during the dredging process. Although the surface habitat will be removed, the new substrate slightly deeper will probably become colonized by the same communities which are presently found. The actual area to be dredged has the least well-developed community of the entire project study site (see Tables 1 and 3).

2. During the dredging process a dredge plume will be generated which could damage the adjacent lagoon shelf communities if the currents during the dredging carry it to the shelf.

3. The increased size of the pierhead will increase the amount of shade directly under it. According to the fish study, the shadow areas attracted more fish than the surrounding areas. Some of the most diverse habitats are present on the pier pilings themselves. It is possible that the increased structures will create a habitat which will attract more fish and provide a habitat for coral and other encrusting animals as the present piling support a considerable amount of attached marine life.

RECOMMENDATIONS

The most serious potential impact of this project is the movement of sediment-charged waters (dredge plume) on to the adjacent, rich, lagoon-shelf community. It is our recommendation based on the 24-hour current study that dredging operations be conducted during times when there is an offshore wind blowing. Our current study showed that with onshore winds there was a tendency for the current to move on to the lagoon shelf. When this onshore wind abated somewhat, the general current patterns more or less paralleled the shore. Dredging during these conditions would allow sediments from the dredge plume to settle out on the rather barren lagoon slope and floor rather than be carried onto the coral-rich lagoon shelf. Also dredging during times of ebb tides would have a tendency to carry the dredge spoil away from the lagoon shelf.

During the dredging operation all precautions should be taken not to spill or otherwise foul the area with fuel, oil, or other contaminants.

Table 1. List of corals observed on the lagoon shelf and lagoon slope (see Figure 2 for transect locations).

	1		2		3		4	
	Lagoon Shelf	Lagoon Slope	Lagoon Shelf	Lagoon Slope	Lagoon Shelf	Lagoon Slope	Lagoon Shelf	Lagoo Slope
Psammocora contigva					X			
Psammocora (Stephanaria) togianensis					X			
Pocillopora damicornis	X	X	X	X	X	X	X	X
Pocillopora danae							X	
Pocillopora verrucosa								
Stylocoeniella armata	X		X		X		X	
Montipora tuberculosa					X		X	
Pavona decussata	X				X		X	
Pavona (Polyastra) obtusata					X			
Porites cocosensis					X		X	
Porites lobata	X		X	X	X		X	
Porites lutea	X		X	X	X		X	
Porites (Synaraea) convexa	X				X		X	
Porites (Synaraea) iwayamaensis	X				X		X	
Platygyora sinensis					X		X	
Leptastrea bottae					X		X	
Leptastrea purpurea	X				X		X	
Lobophyllia corymbosa					X			
Heliopora coerulea					X			
Total for transect zones	8	1	4	3	17	1	13	1
Total for transects	8		4		17		13	
Total species for entire project site	19							

Table 2. Percentage of substrate covered by living corals and coral density for transects 1 through 4. (See Figure 2 for location of transects).

		Density Corals/m^2	Percentage of Cover
TRANSECT 1	(Lagoon Shelf)	1.52	2.02
	(Lagoon Slope)	0.10	0.10
TRANSECT 2	(Lagoon Shelf)	1.60	3.18
	(Lagoon Slope)	0.10	0.10
TRANSECT 3	(Lagoon Shelf)	2.27	1.39
	(Lagoon Slope)	0.10	0.10
TRANSECT 4	(Lagoon Shelf)	1.81	1.44
	(Lagoon Slope)	0.10	0.10

Table 3. (continued)

Family/species	Habitats A	B	C	
Mullidae				
Mulloidichthys samoensis			c	1
Parupeneus barberinus		r		1
P. porphyreus			p	1
P. multifasciatus			p	1
Ostracionfidae				
Ostracion cubicus		r	r	
Lactoria cornutus			r	
Pomacentridae				
Abudefduf curacao			p	
A. sexfasciatus			p	
Chromis caeruleus	c	a	a	
Dascyllus aruanus	c	d	a	
D. trimaculatus		p	p	
Pomacentrus amboinensis	c	a	a	
P. nigricans			c	
P. pavo	p	c	c	
P. tracyei			r	
Scaridae				
Scarus dubius		r	p	1
S. sordidus			p	1
Serranidae				
Epinephelus merra			p	1
Tetraodontidae				
Arothron nigropunctatus		r		1
Zanclidae				
Zanclus cornutus	p	p	c	
Totals	16	32	55	

Total spp = 64

Total relative abundance	r=	0	10	14	24
	p=	9	14	24	47
	c=	5	4	8	17
	a=	1	3	3	7
	d=	0	1	1	2

Table 3. (continued)

Family/species	Habitats A	B	C		
Chaetodontidae					
Chaetodon auriga		p	p		
C. bennetti		r	p		
C. ephippium		p	p		
C. falcula	p	c	c		
C. lunula		p	p		
C. melannotus		r			
C. trifasciatus		r	p		
Heniochus acuminatus		c	p		
Gobiidae					
Amblygobius albimaculatus	c		p		2
Asterropteryx semipunctatus	p				2
Gnatholepis sp.	p				2
Ptereleotris sp.	a				2
Obtortiophagus sp.	p				2
Holocentridae					
Adioryx spinifer			r	1	
Flammeo sammara			p	1	
F. sp.			r	1	
Myripristis berndti			p	1	
Labridae					
Cheilinus chlorurus					
C. fasciatus		p	p	1	
Halichoeres marginatus			r		
H. trimaculatus		p	p		
Hemigymnus melapterus			p	1	
Hemipteronotus sp.			r		2
Labroides dimidiatus		p	p		
Stethojulis strigiventer			r		
Lutjanidae					
Lethrinus sp.		p	p	1	
Lutjanus vaigiensis	p	p	p	1	
Monotaxis grandoculis			r	1	

Table 3. Checklist of fishes. A=Sand/silt bottom south of pierhead, only cover here is debris. B=Pier and dolphinstructures along with debris. C=Porites spp. coral bed. r=rare 1-2 observed; p=present 3-10 observed; c=common 10's observed; a=abundant 100's observed; d=dominant 1000's observed. 1=Popular commercial or sport species. 2=Burrowing forms not requiring rock cover or debris.

	Habitats			
Family/species	A	B	C	
Acanthuridae				
Acanthurus lineatus			r	1
A. nigrofuscus			p	1
A. triostegus			p	1
A. xanthopterus	p	c	c	1
Ctenochaetus striatus		p	c	1
Naso lituratus			r	1
N. unicornis			p	1
Zebrasoma flavescens			p	
Z. veliferum		r	r	
Apogonidae				
Cheilodipterus quinquelineatta	c	a	d	
Aulostomidae				
Aulostomus chinensis		r	r	
Balistidae				
Pseudobalistes sp.			r	
Sufflamen chrysoptera		p	p	
Blenniidae				
M. atrodorsalis	p	p	c	
Canthigasteridue				
Canthigaster solandri		p	p	
Carangidae				
Caranx melampygus	p			1

Table 4. Summary of current data, July 6-7, 1974

Cast No.	Time- 1 m In	Time- 1 m Out	Time- 5 m In	Time- 5 m Out	Wind Speed (m/sec)	Wind Direction	Tide
1.	1120	1150	1120	1150 1145 (aground)	7.5	152	ebb
2.	1155	1240	1155	1240	7.2	172	ebb
3.	1244	1320 1300 (aground)	1244	1320 1255 (aground)	8.6	184	ebb
4.	1320	1420 1400 (aground)	1320	1420 1340 (aground)	10.6	185	ebb
5.	1420	1520	1420	1420	5.3	184	ebb/flood
6.	1505	1630 1545 (aground)	1525	1630 1545 (aground)	7.2	201	flood
7.	1630	1730 (aground)	1630	1730 (aground)	6.7	196	flood
8.	1730	1830	1730	1830	5.2	220	flood
9.	2015	2115	2015	2115	4.1	170	flood
10.	2130	2300	2130	2300	2.2	114	flood/ebb
11.	0100	0200	0100	0200	4.2	179	ebb
12.	0500	0600	0500	0600	0	-	flood
13.	0715	0815	0715	0815	0	-	flood

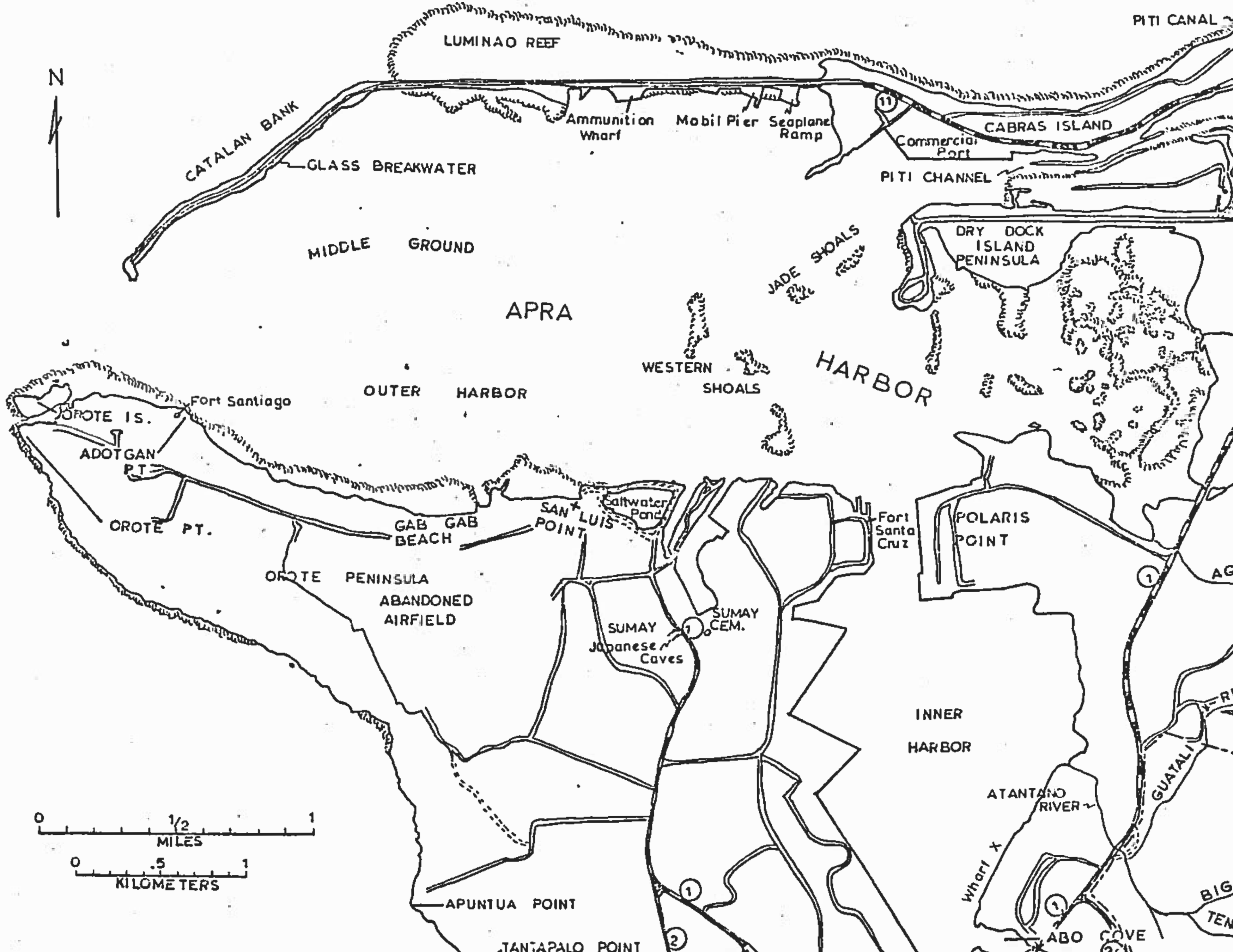

Figure 1. Map showing location of project site, labelled Mobil Pier, in Apra Harbor.

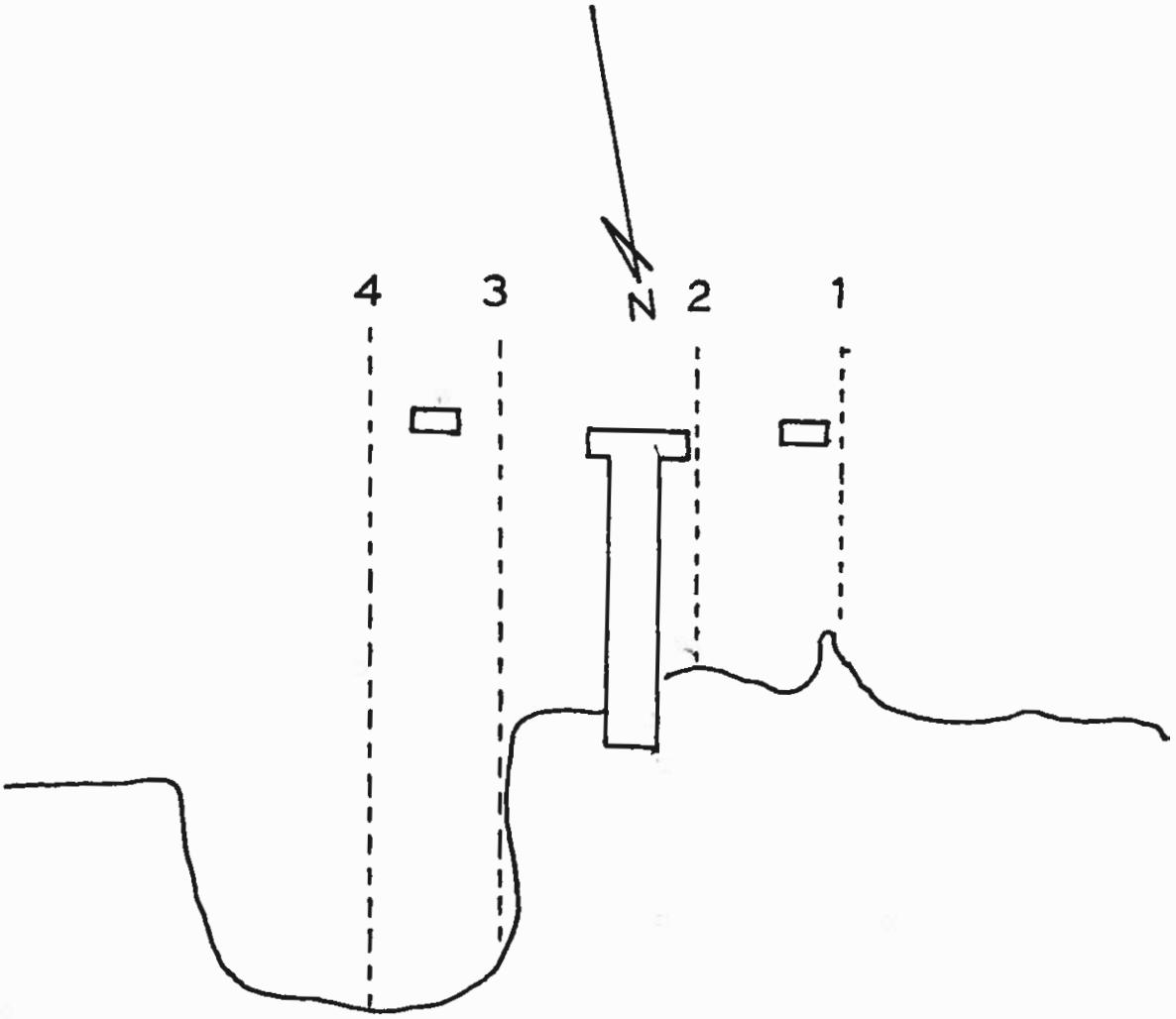

Figure 2. Map showing location of transects.