

Shoreline Erosion on Guam:
A Position Paper

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PATRICK D. MCMAKIN

GUAM COASTAL MANAGEMENT PROGRAM, BUREAU OF PLANNING

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Introduction

In response to Section 305(b) (9), Rules and Regulations 902.19 of the Coastal Management Act of 1972, increased nationwide emphasis on the management of shoreline erosion problems is a major objective of many Coastal Zone Management programs. This paper addresses the extent of natural force and man-induced shoreline erosion on the island of Guam and represents the Guam Coastal Management Program's position concerning the amount of emphasis needed, locally, in relation to the unique factors that formulate our resource planning objectives.

Shoreline Classification

Comprised of 212 square miles of land area, the entire island of Guam is considered to be a coastal zone. There are 116.5 miles of shoreline circumventing the island. To address existing or potential shoreline erosion problems, the immediate coastline or ocean-land interface is classified into rock coastline, sandy beaches, mangrove mudflats and river estuaries.

Rocky Coastline

The rocky coastline constitutes 62% of Guam's shoreline, approximately 72.5 miles. It is characterized by steep slopes, cliffs, headlands, uplifted limestone terraces, benches cut into limestone or into volcanic rock slightly above sea level and low exposed beach rock. The cut benches are the most extensive type of rocky coastline on Guam and have been formed by erosion of the adjacent elevated rocky shores, often with secondary construction by marine worms and algae or rims forming pools on top of the benches. Indentations, called "nips", formed by extremely slow erosion of limestone rock by algae, limpets and chitons, are typically present at the existing and at previous sea levels. In some parts of the southwest coast volcanic lava formations occur at the shoreline adjacent to eroded flat lava benches at sea level, similar in shape to the coral reef flats. Small areas of low rocky shoreline, consisting of reef limestone and beach rock raised slightly above high tide level are scattered through certain beach areas in all parts of Guam. Noticeable shoreline change is practically non-existent along the rocky shore with the exception of slumping or fracturing of parts of steep slopes and cliffs due to solution, earthquakes, or storm waves. This occurrence is unpredictable and limited to areas that are not developed on the northeast and northwest coast and minor localities in the southeast of Guam. No serious, immediate or eminent problems exist in the rocky coastline areas.

Sandy Beaches

The sandy beaches of Guam comprise approximately 31% of the shoreline or 35.9 miles. They are sloping landforms composed of unconsolidated sand, gravel, broken shells, coral and foraminifera. They are characterized by high permeability and volcanic detrital or reef bioclastic composition, or a mixture of the two. They extend landward from the water's edge to a distinct break in the landform or to a point where terrestrial vegetation covers the substrate. They extend seaward as far as the sandy bottom is appreciably affected by tide, currents and wave movements. Most of the sandy beaches of Guam are protected from the erosive effects of average weather conditions by an expanse of shallow reef flat that extends seaward to a reef front or fringing reef that suppresses

the force of all but the largest of storm waves. During typhoons, an excess buildup of sand is lifted from the floor of the reef flat and a sandy beach may be expanded further inland. Erosion of beach areas during storms is minimal and limited to small areas where a channel or reef cut allows storm waves to penetrate the reef flat buffer zone. Post-typhoon redistribution of sand can naturally correct limited adverse effects.

The major potential for erosion of sandy beaches exists with the influence of man. The practice of sandmining for construction, landfill and golf course purposes has degraded several beach areas in terms of ecological complexity, aesthetic appearance and recreational potential. Increased enforcement and study of alternative sources of sand resources are current methods utilized to deter this activity. Since the inception of Guam's Coastal Management Program, and coordination of enforcement and public information programs--the incidence of sandmining has considerably diminished.

Until recently, Guam was free of the erosive effects of beach groins perpendicular to longshore currents. The past year has seen the construction of the first concreted groin on a sandy beach along Cocos Island--a southern offshore portion of a barrier reef lagoon with longshore currents affecting sand formation. The effects have been a noticeable sand buildup on one side of the groin with a subsequent sand loss on the opposite side. This groin, the base of a small boat pier, was constructed without the required federal and local permits. Improved field inspection, coordination of regulatory enforcement and ongoing research are seeking to modify this dock to encourage the retention of natural beach processes, inhibit shoreline erosion and discourage future proliferation of beach groins, seawalls or jetties. Public participation, federal and local enforcement, field inspection, the Guam Coastal Management Seashore Reserve Plan and Comprehensive Land-Use planning (including delineation of areas of particular concern) are the measures utilized in meeting this objective.

Mangrove Mudflats

The appendix to the Atlas of the Reef and Beaches of Guam contains maps and description of mangrove areas. The U. S. Army Corps of Engineers has also conducted studies to define the nature of the mangrove communities. Presently, mangrove mudflats are represented in only two locations on Guam. An extensive stand of several mangrove species has been increasing in size along 4.5 miles of the inner shore of Apra Harbor along the central western coast. Apra Harbor is the island's major deep-water port and is characterized by a breakwater that was built upon the barrier reef of a natural lagoon. The expanse of mangroves has noticeably increased in the past ten years because increased sedimentation from inland erosion, carried by the Laguas, Agueda and Atantano Rivers, has increased the mudflat area. The mangroves themselves further assist in the buildup of shoreline area. The Apra mangroves are rarely frequented by man, except to catch mangrove crabs. They are encompassed by federally-owned property, restricted areas and are classified as wetlands. Shoreline erosion is non-existent in this area, rather shoreline buildup is in effect.

The other area of mangrove shoreline is along the extreme southern coastline between Merizo and Inarajan along the inner area of the Cocos Lagoon. The strand of mangroves fringes 3.5 miles of shoreline and assists in shoreline stabilization. These mangroves have proved extremely resistant to typhoon

winds and waves and represent a unique ecological community. The only potential for shoreline degradation would occur if the mangroves were removed to enhance visual and public access. Due to their limited occurrence on Guam and ecological importance, the Coastal Management Seashore Reserve Plan discourages this possibility. The U. S. Army Corps of Engineers may also protect mangroves through their permit system controlling development in wetlands.

River Estuaries

Approximately forty rivers constitute the surface drainage pattern that covers the southern half of the island. Thirty-three of these have mouths at the seashore and nine of these have extensive estuarine areas. Major rivers flow into shoreline embayments that are most often the site of urban village centers because of the relatively flat terrain that borders the coastline river mouths. Inland erosion is a persistent problem and clouds many estuaries with pollution. However, shoreline erosion is only a problem at Talofofo Bay along the southeast coast of Guam. In a detailed project report entitled, Talofofo Beach, Territory of Guam, published in June, 1974, the COE defined the nature of shoreline erosion in this area and outlined a plan for shore protection. The plan has never been implemented. The following description is adapted from their report.

Talofofo Bay

The shoreline at Talofofo Beach changes with the wet and dry season. During the dry season, the river flow is relatively low and a sandbar develops at the northern side of the river mouth. The sandbar diverts a great deal of riverine material to the beach area. In addition, sand from offshore deposits is carried by waves, through the reef opening in the bay, onto the shore. During the wet season, the river flow increases and increased deposit of riverine material occurs, however, since the tradewinds are low, a smaller amount of sand is transported by wave action. During the wet seasons, the incidence of typhoons or tropical storms is the erosive factor at Talofofo Bay. Shoreline above five feet which is eroded by stormwave action does not build back. Since the early 1940's 1.6 acres of land have been claimed by shoreline erosion. A revetment, at an initial (1974) cost of \$525,000 with an annual charge of \$29,900 for interest, amortization and maintenance would be required to implement the selected plan. Based on the extent of the problem, the economic feasibility and existence of higher priority needs, the plan will most likely never be implemented.

Additional Considerations

In addition to Federal Coastal Zone Management interest in shoreline erosion, the U. S. Congress passed the Shore Erosion Control Demonstration Act (Public Law 93-251, Section 54) in 1974. This act gave the COE authorization to initiate a shore erosion control demonstration program, and created the Shore Erosion Advisory Panel. The Advisory Panel, through the COE District Engineer, Hawaii Office, invited Guam to submit site location proposals. The Bureau of Planning, in consultation with the University of Guam Marine Laboratory, and the Guam Environmental Protection Agency concluded that no existing sites on Guam warrant study for demonstration projects.

Conclusion

Numerous shoreline studies by the Guam Coastal Management Program, COE, University of Guam Marine Laboratory, and Guam Environmental Protection Agency have defined the nature of shoreline resources and extent of shoreline erosion. Only one problem area has warranted study for consideration of shore stabilization, primarily as a result of the unique characteristics of Guam's shoreline, further emphasis, funding, and study is of low priority. On an island the size of Guam, future problems concerning shoreline erosion can easily be recognized and considered for study. Currently, shoreline erosion areas are not a geographic area of particular concern on Guam.

References

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