The Utilization of Seawalls in Response to Shoreline Erosion

Consequences, Socio-Economic, Political and Legal Forces, and Alternatives

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Executive Summary

When coastal buildings or roads are threatened, the typical response is to harden the coast with a seawall. Seawalls run parallel to the beach and can be built of concrete, wood, steel, or boulders. Seawalls are also called bulkheads or revetments; the distinction is mainly a matter of purpose. They are designed to halt shoreline erosion caused primarily by wave action. If seawalls are maintained, they may temporarily hold back the ocean from encroaching on shoreline development. In spite of their ability to hold back the ocean, when waves hit a seawall, the waves are reflected back out to sea, taking beach sand with them and eventually causing the beach to disappear. Moreover, seawalls can cause increased erosion at the ends of the seawall on an adjacent beach that is not walled. Alternatives to seawalls exist, such as beach nourishment and managed retreat. Making coastal land use decisions that ensure a seawall will not be needed in the future to protect structures, however, is the most prudent coastal management solution. This can be accomplished by establishing setback lines and conducting managed retreat of structures that are threatened by shoreline erosion before the situation worsens, or structures that have the potential for being threatened in the future. Regional case studies are presented to illustrate.

Prologue

I have an undergraduate education in Ocean Engineering that provided me with a basis for my technical background and technical interest in the ocean. My career to-date as an engineer has exposed me to a broad range of ocean engineering projects. As a result of this background and due to various influences, I have become aware of man's large negative impact on the ocean and acute lack of understanding of the ocean.

I am specifically interested by the relationship between engineering and science, particularly in the context of the ocean and the coastal zone. An excerpt from "The Corps and the Shore," by Orrin Pilkey and Katherine Dixon illustrates, "A generalized difference between scientists and engineers, at least in coastal studies, is that scientists are trained to observe natural systems and engineers are trained to manipulate them. Victor Baker, geologist at the University of Arizona, compares the disparate approaches of engineering and science as 'the practical problem-solving approach of engineering to the academic puzzle solving of science.' In many cases...a society in search of solutions chooses the seemingly straightforward 'can do' nature of engineering over the questioning, theoretical approach of science. But science, which studies the way nature works, is the necessary underpinning of engineering." I agree with these statements and recognize the issues from which they are born. Society needs oceanographers that are knowledgeable of modern engineering and engineers who understand the science of the oceans.

Numerous difficulties and downfalls have been acknowledged in the field of coastal engineering. Humankind's attempts at engineering in the dynamic coastal zone have often produced short term solutions with long term harmful impacts to the coastal environment. Many of man's efforts have been detrimental and have highlighted the weaknesses of engineering in the dynamic coastal zone with an ignorance or avoidance of ocean science. The science that would dictate the most prudent long term solution is bypassed in favor of a short term solution that is ultimately detrimental to man's use and enjoyment of this complex environment. Planning stages of coastal projects may fail and are followed by undesirable corrections; engineering solutions are being conceived to preserve structures that should never have been built in the coastal zone. I recognize the requirement for ocean engineering and building along coastlines, as man lives, works, and recreates adjacent to and in the ocean. Often though, ocean science is either not well understood or ignored.

While attending a California Shore and Beach Preservation Association's conference a few years ago, I was struck by a prevalent dichotomy. We as a society have an implementation wall: the inability to implement prudent coastal management. People with private interests sue and win the right to build on the beach. Individuals and cities illegally dump rocks to protect property. Even within the conference, one speaker talked about the problems of man's building along the coastline, and the next speaker talked about a seawall to protect homes, or a groin to block sand flow into harbors. We must effectively integrate environmental information with policy analysis and decision-making.

The Santa Barbara and Ventura Counties' coastal regions, with their harbors, submarine canyons, long straight beaches, points, rivers, bluffs, and artificially armored coastal areas provide significant opportunities for research and study on coastal management issues. Valuable lessons can be learned that will transfer to the national and international community.

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1.0 INTRODUCTION

Shoreline erosion presents a major problem in California and many other states. Sea level rise compounds the problem. While the shoreline has historically receded and advanced, erosion has become exacerbated by human's efforts to control California's rivers and to divert their waters for public and private use. Dams, highways, coastal structures, and other development in coastal watersheds prevent or retard the transportation of sand to the coast. This phenomenon only becomes recognized as a problem when valuable resources that have been placed near the shoreline become threatened by storms as their sand buffer erodes.

Seawalls are often the engineering tool that is employed to protect coastal structures that are threatened by shoreline erosion. This paper is going to attempt to illustrate that the effect of seawalls on beaches is primarily a negative one. A longstanding controversy has existed over the role of seawalls as a destructive force on beaches. Initially before the environmental revolution of recent decades, the coastal engineering community and the U.S. Army Corps of Engineers (the federal agency that controls federal monies and permitting, design, and construction of coastal and inland waterway public works) plainly ignored the environmental impact of seawalls under the assumption that protection of buildings was worth any price (Pilkey et. al., 1996). By the 1980s, the role of seawalls as a destructive force on beaches was recognized by most coastal scientists and residents but not by the coastal engineering community. Indeed, my coursework as a junior in university in the late 1980s included a coastal engineering class, and the harmful effects of seawalls were not a component of our education on the subject. Today, coastal planners and managers are becoming increasingly reluctant to consider seawalls for coastal defense applications (WES, 1992).

This report will offer national, state, and local perspectives with reference to local examples throughout. A couple of regional case studies are presented to illustrate and reinforce the issues surrounding seawalls. The state of California has very little recent information on the extent of shoreline armoring (the placing of seawalls). The last comprehensive study occurred in 1989-90, and while many counties have information on the extent of armoring along their coastline, no recent statewide assessment exists (Surfrider, 2000). Nevertheless, a drastic increase in shoreline armoring has occurred in recent decades, and, as this report will demonstrate, this is a cause for concern. By 1990, California's coastline had 130 miles of shoreline armoring, a 390% increase since 1971 (Surfrider Foundation, 2000). The two significant El Nino winters in the 1990s caused substantial erosion---the extent of shoreline armoring is now probably greater than 130 miles.

2.0 THE PROBLEM: COASTAL BUILDING AND SHORELINE EROSION

Shoreline erosion is the term used to describe the natural process of shoreline retreat where the beach changes its location but retains its shape. The problem arises when shoreline retreat meets human obstacles, such as houses, highways, and seawalls---the seawalls placed to protect those houses and highways. These obstacles block shoreline retreat; the beach is squeezed up against these objects, which causes it to narrow and leads to a reduction in sand supply to adjacent beaches.

Most estimates indicate that eighty percent or more of the U.S. shoreline is eroding (Pilkey et. al, 1996). Areas where the shoreline is either stable or accreting are probably temporary states, and, for all practical purposes, the U.S. shoreline is eroding everywhere (Pilkey et. al, 1996). The causes of shoreline erosion are numerous and difficult to establish in a quantitative manner. The fundamental force behind shoreline erosion is the ocean "chewing" at the edges of the continent. The U.S. coastline is subject to a variety of coastal storm threats. Wind, waves, and currents from storms move material from the shoreline to the continental shelf. Compounding these forces are other factors, such as sea level rise and human activity. Human activity exacerbating the shoreline erosion problem includes the interruption of sediment supply to beaches, coastal engineering projects (seawalls, jetties, groins, breakwaters, navigation channel deepening, inlet formation), and sand mining. For example, seawalls are not only employed as a fix for shoreline erosion, but they are a cause of shoreline erosion. Local erosion occurs to a beach that is adjacent to a seawalled beach.

Sea level rise is a characteristic of global warming. The increased atmospheric temperature associated with global warming will melt portions of the ice caps, raising the sea level. Quantifying the exact contribution of sea level rise to shoreline erosion is not possible. In 1994, a joint French-American project utilizing the Topex/Poseidon satellite reported a tenth of an inch per year sea level rise worldwide---a one inch per decade rate (Pilkey et. al., 1996). The effects of sea level rise can be seen with absolute certainty on rapidly subsiding coasts such as the Mississippi delta (Pilkey et. al., 1996).

Sediment carried by local creeks and rivers to the ocean is intercepted by man-made structures such as debris basins and dams. Reducing sand supply to beaches by the damming of rivers is a significant problem contributing to increased erosion. In Ventura County, twenty miles up the Ventura River, more than 11 million cubic yards of sediment lie trapped behind Matilija Dam. The material represents the accumulation of almost half a century of sand that would be on the beaches in the absence of the dam. During the life of Matilija Dam, heavy siltation and structural defects have reduced the water storage capacity by more than 90%.[1] With Lake Casitas now serving as the area's primary reservoir, Matilija has been rendered obsolete for anything but flood control. The dam's removal, which has widespread support, would allow sand to flow freely to Ventura beaches. Obviously, important ecological remedies would be served, too, such as providing access for the endangered Steelhead Rainbow Trout (Oncorhynchus Mykiss), which has its historic breeding grounds in the upper reaches of the watershed.

In Santa Barbara County, sediments that would otherwise be transported to the ocean by creeks and rivers and would ultimately replenish the beaches are trapped in debris basins and frequently disposed of on land.[2] Debris basins are effective at reducing the debris loads associated with flood flows. The flood debris can plug bridges and culverts and fill channels, resulting in excessive flooding of urbanized areas. Hence the reason that debris basins are useful for flood control. Sediment trapped in debris basins could be taken to the beach and introduced into the littoral cell. This would replenish the littoral cell and would help facilitate larger beaches that protect coastal resources. This sediment would be deposited in the ocean by natural

[1] World Wide Web: http://www.beacon.dst.ca.us/building_the_beaches.htm

processes if it weren't intercepted by man-made structures. Other human activities that affect sediment supply to rivers, and ultimately the beach, are agricultural practices, urbanization, and forest and brush fires.

3.0 SEAWALLS DEFINED

Three categories of response are employed in response to a local shoreline erosion problem: 1) hard stabilization, such as seawalls, 2) soft stabilization, such as beach replenishment, and 3) relocation of threatened buildings. As implied, the hard stabilization alternative involves armoring the beach to stabilize it or hold it in place. The most common and widespread coastal engineering tool for hard stabilization is the seawall. A seawall is a structure built on the beach parallel to the shoreline. Seawalls can be large or small, high or low, and constructed of a range of materials including wood, plastic, concrete, rock, construction rubble, steel, old cars, aluminum, rubber tires, and sandbags (Pilkey et. al., 1996).

3.1 Seawalls Types

Several types of seawalls can be delineated. The term seawall is used to describe both the collective group of hard stabilization structures built parallel to the shoreline and a member within that group. The distinction between seawalls, bulkheads, and revetments is mainly matter of purpose (USACE, 1984). Design features are determined at the functional planning stage, and the structure is named to suit its intended purpose (USACE, 1984). In general, seawalls are massive structures, because they are designed to resist the full force of oncoming waves. Bulkheads are next in size; bulkheads are relatively low and small walls designed to hold land. They are built to keep land from eroding out from underneath them, rather than to protect buildings from severe waves. They must still resist erosion by the wave climate at the site.

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[2] Ibid.

Revetments are a common type of seawall built directly on a surface such as the seaward slope of a dune or an eroding bluff. Usually revetments are constructed of boulders. These large rocks have the advantage of providing ample interstitial cavities that collect some of the water from a breaking wave, reducing sand-removing wave reflection and backwash (Pilkey et. al., 1996). Revetments are generally the lightest because they are designed to protect shorelines against erosion by currents or light wave action (USACE, 1984). In many discussions, seawalls, revetments, and bulkheads are grouped together and referred to simply as seawalls. Specific design details are considered beyond the scope of this discussion.

3.2 Seawalls' Effectiveness

Seawalls, if properly engineered and constructed for a particular situation, are effective at saving beachfront property, provided the severe disadvantages they impose are acceptable (Pilkey et. al., 1996). They can be effective in protecting beachfront property from a retreating shoreline and, if high enough and strong enough, can protect a backshore area against the onslaught of storm waves. They may retain a low fill, but they are intended primarily to withstand and to deflect or dissipate wave energy. If a community's only priority is to preserve beachfront buildings then seawalls will effectively accomplish that goal. Seawalls protect only the land immediately behind them, offering no protection to fronting beaches. Scientists, coastal residents, and most coastal engineers (though not all) are in agreement that seawalls degrade beaches. This and other significant disadvantages that seawalls impose are discussed in the following section.

4.0 IMPACT OF SEAWALLS ON THE BEACH

4.1 Characterization of Beach Loss Due to Seawalls and Related Controversy

Seawalls destruction of beaches is categorized as three types of loss: placement loss, passive loss, and active loss (Pilkey et. al., 1996). Placement loss is the process by which a part of the beach is loss when the seawall is constructed out on the beach, seaward of the high tide line. Passive loss occurs over a time scale of decades; providing a stationary object against which a retreating beach narrows and eventually disappears causes the loss. A beach changes location through shoreline retreat but will maintain its width if left alone by humans. Seawalls may intensify surf-zone processes during storms; active loss is due to wave energy being intensified instead of dissipated, leading to more sand being swept offshore. Seawalls can be built to offset some of their negative effects. A seawall should have a sloped rather than vertical face. The face should be irregular with groves or pockets to dissipate wave energy; in this way, less energy is available for wave reflection.

As a beach narrows in front of a seawall, reducing the available beach area, the amount of sand transported past the seawall in both directions is reduced because of the smaller area of the surf zone. This reduction leads to erosion on adjacent shorelines, termed flanking erosion. Refer to Figure 1 for a simple schematic depicting the evolution of a seawall and the beach, once a seawall has been constructed. The evolution begins with a seawall being emplaced as a response to shoreline erosion, the beach subsequently narrows and the offshore slope steepens, the beach eventually disappears, and the offshore slope steepens further. Higher, unimpeded waves now hit the seawall; the beach's wave buffering effect is lost, creating the need for a higher seawall and for continual seawall maintenance.

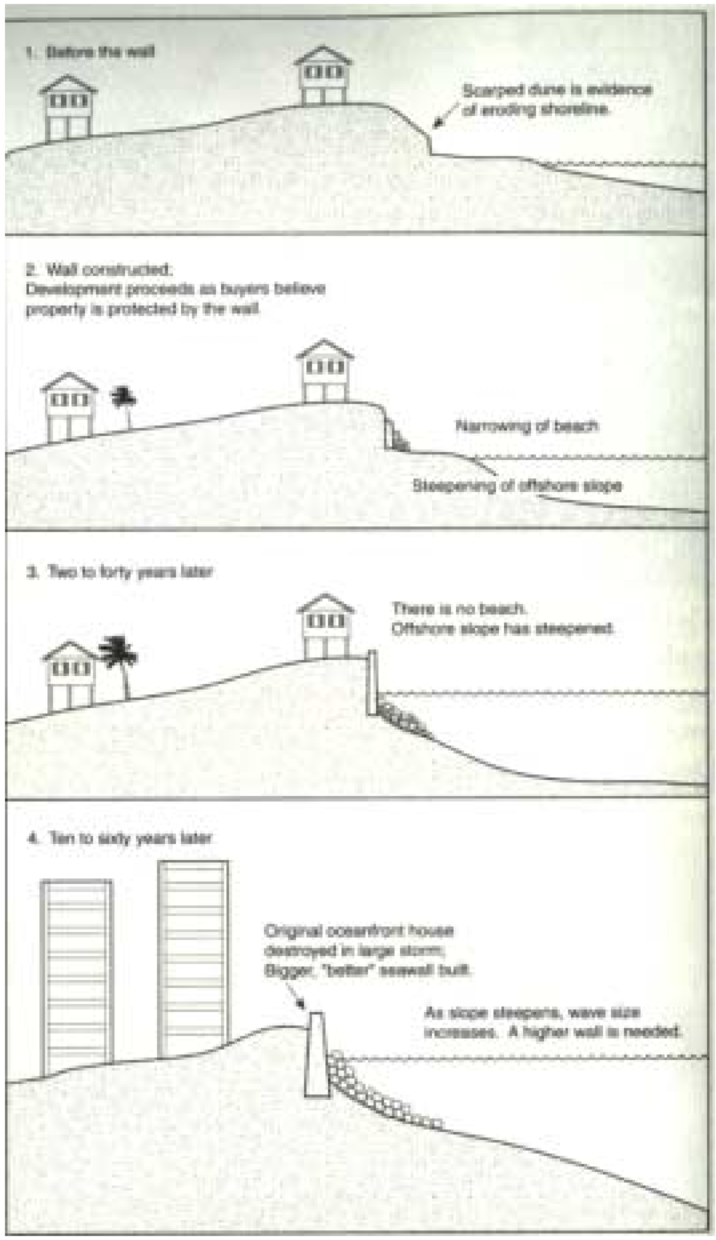

Figure 1. The Evolution of a Seawall and the Beach, Once a Seawall has been Constructed.
[from Pilkey et. al., 1996]

Before the environmental revolution of recent decades, the coastal engineering community and the Corps of Engineers ignored the environmental impact of seawalls under the assumption that the protection of buildings was worth any price. By the 1980's, the destructive role of seawalls was recognized by most coastal scientists and residents, but not by the engineering community. The long-standing controversy that has existed over the role of seawalls in the destruction of beaches continues to a degree today; a few coastal engineers maintain a pro-seawall stance. This report maintains that seawalls are ecologically destructive to the beach, present safety problems, loss of recreational use, and aesthetic degradation, and are costly to construct and maintain.

4.2 Consequences of Seawalls and Associated Beach Loss

When viewed over a period of decades, the cost of most efforts to stabilize an eroding shoreline with a seawall exceeds the value of the property to be saved (Pilkey et. al., 1996). When the cost of the eventual degradation of the public beach and the environment is added, the expense of maintaining that fixed point in the shoreline with a seawall is orders of magnitude greater than the value of the property (Pilkey et. al., 1996). Shoreline engineering structures are inevitably damaged or destroyed and are replaced with bigger ones. Often the reason a structure is damaged is because the waves have removed the protective beach; as the protective beach is diminished, the seawall must increase in size. See Figure 2.

Removal of seawalls and other hard stabilization structures almost never occurs (a rare case of a seawall removal is presented in the Case Study Section) and must be considered irreversible. Coastal engineering structures are often altered or replaced but seldom taken away---the impact to the beach is permanent. Furthermore, shoreline armoring leads to more shoreline armoring (Pilkey et. al., 1996). All structures eventually cause sand supply deficits on adjacent beaches; therefore, seawalls have a tendency to get longer. Hence, the impact of a seawall on a beach is significant, dynamic, and permanent, and a seawall in one location can cause seawalls to be placed on adjacent beaches. The bottom line is that a community can have shorefront structures OR beaches, but not both. To keep a beach on an eroding shoreline, the buildings must be "sacrificed" (or removed).

Figure 2. Seawall Repairs, including increasing the seawall height, at Point Mugu, California. Note the complete loss of beach on the seaward side of the seawall. [Photo: Shawn Kelly].

5.0 POLITICAL, LEGAL, AND SOCI-ECONOMIC FORCES

5.1 Seawalls within the Coastal Management Framework

Coastal management occurs in a fragmented framework, with responsibilities and authorities shared by federal, state, and local governmental bodies. Numerous stakeholders exist in the coastal zone, and these stakeholder groups have different perspectives on coastal management. This condition subsequently affects land use choices. Private land owners must cooperate with public entities to ensure goals for coastal management are met. Local governments have historically had the primary responsibility for land use planning and community land use decisions (Beatley et. al., 1994). Land use planning and management programs are at their weakest in the coastal zone.

A number of federal programs and policies, not specifically coastal in nature, indirectly exercise a major influence on the coastal zone (Beatley et. al., 1994). For example, federal funds for interstate highway construction have opened coastal areas in many cases for significant development pressures. Tax code subsidies allow for interest and property tax deductions on second homes and for accelerated depreciation on seasonal rental properties. A high proportion of these property types are present in the coastal zone; therefore, the shaping and influencing of development patterns by these programs and policies are ultimately increasing pressure on the coastal zone. This may lead to irresponsible development whereby structures are built that may one day need to be protected by a seawall. Millions of taxpayer dollars are wasted subsidizing beachfront building. For example, Federal flood insurance and expensive Army Corps of Engineer projects have done very little to make oceanfront building safe.

5.2 Socio-Economic Pressure and Political Influence in the Coastal Zone

Compounding the shoreline erosion problem is the fact that the number of people owning and occupying beachfront buildings is small relative to the number who would like to use the beach for recreation. The beaches belonging to all and enjoyed by many thousands are being threatened with destruction in order to save the properties belonging to hundreds (Pilkey et. al., 1996). One of the significant policy dilemmas in coastal management is determining the balance between government regulations of coastal lands to protect and promote the public interest and, on the other hand, the sanctity of private property (Beatley et. al., 1994). The developed coastal zone faces intense conflict between private-property operations in shorelands and public activities in tidelands and coastal waters (Clark, 1998). To deal with the significant threats to biodiversity in coastal and marine ecosystems and the coastal ecosystem destruction that is occurring, policy and scientific communities must focus greater attention on the preservation of species' communities, distinctive ecosystems, and diversity of gene pools within species (Beatley, 1991).

Shoreline armoring is politically difficult because of its long-term environmental impact and because no compromise is possible (Pilkey et. al., 1996). In the face of eroding beaches, owners of beachfront property will use political influence to demand, “something be done.” What is typically done is armor the shoreline with rocks, concrete, and/or steel in the form of a seawall. The more intelligent action would be to move the building away from the ocean---this approach will be discussed in a later section. It would be a rare politician who could withstand the complaints of beachfront homeowners and developers seeking seawalls and who could adopt a long-term approach, thinking ahead decades to the beach destruction that a seawall will cause. Seawalls allow for no compromise, since they lead to longer and higher structures---placing a seawall on a short stretch of coastline and walking away is not possible.

5.3 Environmental Law and Permitting

Before any coastal structure is built, the local community must be informed of all environmental impacts, unless an emergency permit is issued. Under Federal Law, the National Environmental Protection Act (NEPA) of 1974 provides that before a coastal structure is built, an Environmental Impact Statement (EIS) or an Environmental Impact Report (EIR) must be written. These documents detail the environmental effects that the new construction will have on the surrounding area. The public comment phase of this process is when the public may have the strongest influence on the course of the project (see Appendix A for an example of public comment on a draft environmental assessment: Comments on the Draft Environmental Assessment of a Seawall Repair at the Naval Air Weapons Station Point Mugu, California). The developers must address any and all legitimate environmental concerns that are raised during the public comment period. If environmental questions are not raised during this period, they may not be addressed in the final report or the project.

California state law requires homeowners to obtain a Coastal Development permit from either their local government or the Coastal Commission (depending on whether the local government has a Local Coastal Plan). Permits generally require the applicant to submit site plans for the protective device and a wave uprush study that details the beach profile of the site and potential impacts of the device to the surrounding environment. The problem is that many times homeowners or local governments place a seawall without a permit and enforcement action is never taken; that is, the seawalls are not ordered to be removed and they stay in place, albeit illegally.

6.0 SEAWALL ALTERNATIVES AND AVOIDANCE

Alternatives exist to constructing seawalls when confronted with shoreline erosion. In contrast to engineering methods for erosion management, public policy strategies are available for a less direct approach. These methods entail controlling development in erosion hazard areas, promotion of pubic awareness of coastal hazards, and providing economic relief from erosion-related losses of public property. The different strategies may be classified as land use management alternatives, warning systems, and relief, rehabilitation, and insurance techniques. Short-term and long-term strategies are appropriate; a short-term strategy should produce information necessary for the specification of a large-scale regional program (Noble Consultants, 1989).

Bringing new sand to an eroding beach, termed beach replenishment, has been growing in popularity since the 1960's as the solution to shoreline erosion (Pilkey et. al., 1996). Beach replenishment, however, is still a reactionary measure and is not without its problems. Other measures more effectively deal with the source of the problem, such as managed retreat and coastal setback lines. Setback lines are a land use planning mechanism that address coastal development in the planning stages and hopefully avoid the scenario of a building or roadway requiring protection from shoreline erosion at some point in the future. The following sections address these options more fully.

6.1 Beach Replenishment

Beach replenishment or [re]nourishment is an increasingly popular "middle ground" solution for an eroding beach. Typically offshore sand deposits or sand from a navigational channel-deepening project are dredged and pumped onto an eroding beach (Figure 3). This replenishment can restore the recreational beach in the short-term and to some extent protect shoreline structures from erosion and storm forces (Beatley et. al., 1994). Beach replenishment is generally accepted as more aesthetically pleasing and less environmentally damaging than a hard stabilization structure, such as a seawall. Beach replenishment projects, however, are very expensive, short-lived, and the replenishing cycle is never-ending. If the sand grain size of the imported sand is not the same size as the existing beach sand, the nourished beach may erode faster than a natural beach. A beach nourishment project can cause bottom organisms to be smothered by turbid water that has sand and mud suspended in it. Beach replenishment is only a temporary solution. While beach nourishment is problematic, this *soft* approach usually will have less of an environmental impact than a seawall.

To replenish or not to replenish is a critical decision in the face of rising sea levels and the expected acceleration in that rise (Pilkey et. al., 1996). Relocation of buildings may ultimately be the best or only way to preserve beaches in developed coastal areas. This concept of "managed retreat" should be coupled with the establishment and successful implementation of meaningful setback lines.

Figure 3. Two views of the dredge outfall and construction zone at a beach replenishment project at Silver Stand Beach, Oxnard, California. Silver Strand Beach benefits from the dredging associated with Corps maintenance of Channel Islands Harbor; many beaches benefit from the maintenance of navigation channels and harbors [Photos: Shawn Kelly].

6.2 Coastal Setback Lines

Shoreline erosion can be countered by keeping structures back a safe distance from the shoreline using setbacks. A setback line is delineated at a calculated distance inland from the beach, and all construction is required to be located landward of this line (Clark, 1998). The setback distance is calculated using a methodology that predicts how far back the beach will erode in the future. A setback line keeps future structures from locating close to an eroding beach and restricts any expansion or rebuilding of existing structures seaward of the setback. This places erosion management in the realm of land use management. Non-structural approaches like setbacks, instead of a seawall that is expensive, aesthetically unpleasing, and ultimately self-defeating, are intuitively a better approach to managing shoreline erosion. This approach goes to the core of the problem: by preventing development of land on or immediately behind the beach, the likelihood that a building or roadway will need to be protected with a seawall at some point in the future is avoided. Continued beach recession is certain and predictable along much of the coastline. A setback not only protects beachfront structures from erosion and storm waves, but it conserves the natural defenses of the shoreline, i.e. sand dunes that would be bulldozed, cleared, and/or filled for development.

6.3 Managed Retreat

Hard stabilization may be the best way to save buildings, but retreating from the problem by removing buildings is the best way to save beaches (Pilkey et. al., 1996). Hence, managed retreat is a coastal land use strategy whereby structural development is withdrawn from the coast to a designated setback line farther inland. Managed retreat allows nature to take its course. Unfortunately, coastal communities and beachfront property owners often do not take managed retreat as a serious option. Perhaps, though, the day will come when taxpayers refuse to continue paying the millions of dollars needed to maintain artificial beaches and to armor beaches with seawalls, with their accompanying environmental, recreational, and aesthetic consequences. Due to political apathy among many citizens, however, the majority probably doesn't realize the extent to which their tax money is applied to never-ending short-term solutions to shoreline erosion. A relatively small number of people create the need for shoreline armoring. In a typical beachfront community, a few hundred property owners front the beaches used by thousands. If threatened shorefront buildings were relocated, demolished, or allowed to fall in, rather than having a seawall built to protect them, erosion problems would disappear and the community would keep its beaches (Pilkey et. al., 1996).

7.0 REGIONAL CASE STUDIES

Following are two cases studies that both illustrate examples of short-term, reactive solutions to coastal erosion problems---specifically, (illegal) construction of seawalls to save poorly located shoreline public facilities, that is, facilities placed to close to the eroding shoreline. Due to increasing public awareness, however, both situations are in the process of being reversed and mark a shift from the coastal engineering practice of placing seawalls to more environmentally sound coastal management solutions. Hence, they are noteworthy.

7.1 Placing and Removing a Seawall at Goleta Beach, Santa Barbara

On March 3, 2000, the last portion of a 1000-foot seawall was put into place at Goleta Beach County Park in Santa Barbara County (Figures 4 and 5). The seawall was constructed under an emergency permit issued by Santa Barbara County and cost approximately $130,000 to construct. The director of the County Parks and Recreation Department requested the permit. The days leading up to the seawall construction were characterized by high tides and storm surges that were causing erosion of the lawn at the Beach Park. The Parks Department staff apparently panicked and thought the entire park might wash away (Murillo, 2000). At a Board of Supervisor's meeting, the County Parks Director defended her action amid heavy criticism from members of the scientific and environmental communities (Murillo, 2000). None of the supervisors expressed enthusiasm for the boulder buttress; even as they praised the assets the park offers the public (Murillo, 2000).

Initially it looked as if the Coastal Commission might order county officials to remove the Goleta Beach seawall. At least two of the agency's twelve commissioners, Pedro Nava and Sara Wan, wanted the wall removed. They filed an appeal with their own commission, attacking the emergency permit County Parks secured from the County Planning and Development Department. Nava and Wan argued that the boulder revetment is not consistent with the County's Local Coastal Program Master Plan governing shoreline development. They contended—and many of the speakers at the supervisors' meeting concurred—that the seawall interferes with coastal access and negatively affects the environmentally sensitive habitat of protected birds (Murillo, 2000). Moreover, the seawall is aesthetically unpleasing.

Figure 4. Sketch of Goleta Beach County Park (the seawall extends approximately from the jet ski ramp to the Beachside Grill).
[from: http://www.sbparks.com/Scripts/Parks.idc?ParkID=4]

Figure 5. Seawall in front of Goleta Beach County Park, looking west.
[Photo: Shawn Kelly, November 30]

The supervisors heard testimony from only one member of the public who supported the seawall. The rest of the comments echoed the sentiments of a beach erosion expert and a UCSB biologist, both of whom discussed alternatives that are nature-friendly and more effective than “buttressing the turf.” But the board wasn’t ready to order the wall taken down. Questions that the staff considered were: How much would it cost to remove the wall? Where would the boulders be put once removed? What’s the plan for next winter? At a later hearing the board planned to decide whether to include the seawall project in a long-term planning study already underway for the Goleta Beach area (Murillo, 2000). While it made sense to examine the ecological consequences of the seawall against the backdrop of the surrounding environment, board members recognized the extreme scrutiny they were under and seemed to be leaning toward dealing with the controversial seawall as quickly as possible.

Another question that the Board had was whether or not the Coastal Commission actually had jurisdiction over an emergency permit issued by the county. What happened in the end was the Board of Supervisors voted to apply to the Coastal Commission for a Coastal Development

Permit to remove the seawall (Lund, 2000). Such a permit approval is legally required in any case, even to remove a wall that nobody wants. This effectively sidestepped the questions of jurisdiction and the legality of the emergency permit. The California Coastal Commission staff apparently went along with this end result.

As of this writing, the seawall at Goleta Beach is being removed, and a sand berm built in its place (Figure 6). The rocks are being taken to a County Flood Control storage area for potential use on other projects. The sand being used to construct the sand berm is being borrowed from the delta at the mouth of the Goleta Slough to the west of the beach park. In conjunction with this project, a dredging project inside the Slough will commence soon, and the dredge spoils will be placed at the west end, or the upcoast end, of the Park (Figure 7). In the past, the dredge spoils have been placed adjacent to the Slough mouth at the east end, or downcoast, of the Park. The dredging project is a flood control measure being conducted by County Flood Control.

Figure 6. Seawall being removed at in front of Goleta Beach County Park, looking west. [Photo: Shawn Kelly, November 30]

Figure 7. Dredge pipe on beach in front of Goleta Beach County Park.
Note large dump truck in the background with sand for the sand berm.
[Photo: Shawn Kelly, November 30]

In addition to these projects, a Park study has been completed and another is in the funding stage. The County Parks Department is seeking funding under the AB1431 grant program administered by the State to conduct a study on how to retain the sand in front of the Park once it is replenished. Another Park-related study has been recently completed and is undergoing review; this is a carrying capacity study that addresses the long-term impacts on and uses of the Park and looks at such projects as interpretive education and promoting native vegetation.

7.2 Solutions to Shoreline Erosion at Surfer's Point, Ventura

Significant shoreline erosion at Surfer's Point at the mouth of the Ventura River in Ventura demonstrates the consequences of the sand deficit due to the reduced sediment loads in the Ventura River and poor planning by developers and city government. The siting of public improvements at the Point shows a lack of consideration of prudent coastal science when planning shoreline public *improvements*. At the center of the issue is a bike path that traverses along the length of Surfer's Point immediately landward of the beach. The bike path is poorly located at the back of the beach in the midst of the active shoreline. The bike path was initially constructed in 1981 despite warnings that the section adjacent to the Ventura River Estuary (northern tip of the Point) was close to the active shoreline and adjacent to sensitive dunes. The bike path was destroyed during storms in 1982-83. After seven years of planning, the bike path was reconstructed in 1989, remarkably along essentially the same alignment---again despite warnings from numerous sources, including those familiar with the fate of the previous bike path. The empirical and scientific evidence was ignored, and the City of Ventura paid for a new bike path and parking lot immediately adjacent to the shoreline in the interest of recreation and tourism, albeit misguided.

Because of the strong likelihood of erosion, the California Coastal Commission designated the path and parking lot “temporary.” The bike path and parking lot’s life spans were projected at five to 20 years (Jenkin, 1997). Similar to the initial bike path, however, the bike path again suffered damage within just two winters. Inundated with requests to fix and protect this popular feature, the city applied for an emergency permit to deposit rock boulders along the shore. The Coastal Commission denied the request as both environmentally unsound and as being in conflict with the terms of the San Buenaventura Coastal Plan. In November 1992, the city dumped large granite boulders on the downshore side of the Ventura River (City of Ventura, 1996) (Figure 8). For the last five years, the top of Surfer’s Point has been an eyesore conglomeration of broken asphalt, chain link fence, and concrete blocks (Figures 9 and 10). This scenario is a familiar picture of the results of man’s infringement on the dynamic coastal zone.

The public has wanted the bike path repaired for a number of years now. The City of Ventura and the Ventura County Fairgrounds control the area. A study funded by the City of Ventura in 1995 evaluated several projects aimed at solving erosion problems at Surfers' Point. One was a return to 1989 conditions, which would require filling the eroded areas and protecting the immediate shoreline with a cobble berm, a rock revetment, or a stepped seawall. Costs for these barriers, not including permits and future maintenance, were estimated at $1.2 million for the berm, $2.2 million for the revetment, and $3.6 million for the seawall. Another option, demolishing the fractured bike path and relocating it to Shoreline Drive (the access road for Surfer’s Point), would cost $119,000 (Ventura County Fairgrounds: Seaside Park, 1996).

Figure 8. Unpermitted Emergency Revetment at Surfer's Point.
[from: http://www.rain.org/~pjenkin/point/point.htm]

Figure 9. Shoreline Erosion at Surfer's Point, December 1996.
[from http://www.rain.org/~pjenkin/point/point.htm]

The hired consultant proposed a revetment as being the most technically effective methodology to arrest erosion and preserve existing uplands. "District and City Staff propose to their respective Boards that the preferred alternative for EIR study be a hybrid version of the rock revetment, with concrete stairways placed periodically for the length of the revetment for safe public access to the beach (Ventura County Fairgrounds: Seaside Park, 1996). As has been illustrated in earlier discussion, that decision would be a poor one in terms of aesthetics and environmental impact concerns, not to mention a gross error in priorities to allow this short term and high impact fix to occur to save a bike path. This action would potentially be enormously destructive to the beach.

My assessment in an essay written on the issue in 1995 was:

> The option that comes closest to an appropriate solution is the proposal to demolish immediate upland infrastructure and retreat. This option, with the addition of sand replenishment and restoration of the natural dune and vegetation environment, is the most environmentally sensible solution. Furthermore, a small groin that is located directly above the eroded area should be removed. This groin was built years earlier by the Army Corps of Engineers to protect the toe of the levee on the Ventura River's east bank and may have been the catalyst for the erosion and a significant contribution to the eroded state of the Point. If executed properly, this option, coupled with sand replenishment, would be far more desirable than an asphalt, concrete, and/or bolder beachfront. The bike path doesn't have to be removed entirely, merely rerouted to a more inland course.

During an initial public hearing in Ventura to discuss the issue, members of the public said, "Just fix it; dump the rocks..." Public apathy of this type is dangerous. The public seemed willing to ignore the potential ramifications of the proposed revetment. The beach in front of a hard structure, such as a revetment, would eventually entirely erode. Subsequent to severe erosion, the surfing resource could be drastically affected with backwash from the seawall entering the lineup from the shoreward direction. The originally proposed dumping of rocks would in no way enhance the recreational resource, the environment immediately landward of the shoreline, or the aesthetic beauty of this landmark California point.

When faced with a coastal management decision such as this, priorities must be carefully assessed. Approximately 2 miles North of the Fairgrounds and Surfer's Point exists 6 miles of ocean front biking opportunities, behind, sadly enough, a largely seawalled coastline. The Fairgrounds has a total of 3,000 parking spaces, 1,700 located directly in front of the facility. Why chose to dump rocks to the potential detriment of an important California surfing area and important recreational resource to save something as inconsequential and poorly located as the bike path and approximately 250 parking spaces, representing only 8 % of the available parking spaces for the Fairgrounds? The community must not be short sighted and must ensure that the "end justifies the means."

The California Department of Parks and Recreation has a Statewide Coastal Erosion Policy of planned retreat and recognition of natural shoreline processes. The State's coastal erosion policy states, "Structural protection and reprotection of developments shall be allowed only when the cost of protection is commensurate with the value (physical and intrinsic) of the development to be protected, and when it can be shown that the protection will not negatively affect the beach or the near shore environment."[3] Those were two significant strikes for the proposed project. City Hall is not being protected; rather, a bike path and parking spaces. Furthermore, any type of "hard" solution would definitely negatively affect the nearshore environment.

The State said in direct comments, "the bikeway was constructed in its present alignment despite our request for a greater setback, due to the threat of inevitable erosion. For the record, State Parks did not request, participate in or consent placement of rock rip rap along the bikeway...We have consistently advised the Fairgrounds and City that based on this policy, we cannot maintain the bikeway where undermined by erosion in its present location." The California Coastal Act requires "that new, non-coastal dependent developments not be built if it is known that the development will require a protective structure in the future."[4] A bike path and parking spaces are not coastal dependent structures. Neither are the Fairgrounds.

In 1998, the Ventura City Council voted unanimously to enter an Engineering Services Agreement with Noble Consultants coastal engineers to provide preliminary engineering services at a cost of $138,338. Fortunately for the future of Surfer's Point, a managed retreat plan has been selected. This includes relocating the bike path back from its current location to a location adjacent to Shoreline Drive and restoration of the area seaward of Shoreline Drive to a "natural" beach habitat (Coastal Resources Grant Program Assistance Application for Part A Grant-Energy Assistance, 1998).

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[3] World Wide Web: http://www.picosearch.com/cgi-bin/ts.pl
[4] World Wide Web: http://ceres.ca.gov/wetlands/permitting/cca.html

The managed shoreline retreat plan constitutes a unique departure from traditional methods for erosion planning in an urbanized environment. The plan calls for removal of all existing improvements seaward of Shoreline Drive (beyond which retreat will not be accepted and erosion will be halted by whatever means necessary), armoring of the beach with a natural cobble mattress to stabilize the nearshore beach profile, placement of feeder dune material from inland sources, and construction of a buried cutoff wall with toe stone that will provide “a silent sentinel to protect inland areas during times of severe beach erosion.” See Figures 11 and 12. The visible portion above grade will be architecturally finished for aesthetics. So, while the plan is a step in the right direction, an obvious lack of full commitment to retreat and to complete natural restoration is evident. The plan now must also have a commitment to a long-term beach replenishment program and restocking/maintenance of the feeder dune to ensure the “buried seawall” remains buried. The clear concern is that once the buried seawall is in place, the incentive to maintain the beach and dune environment is lessened.

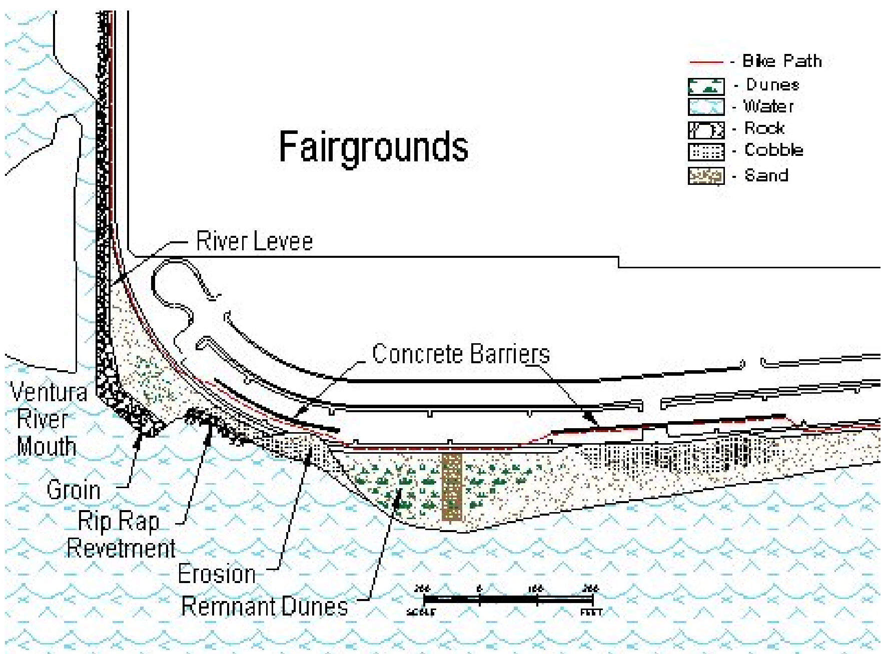

Figure 10. Sketch of Current Condition at Surfer’s Point.
[from http://www.rain.org/~pjenkin/point/point.htm]

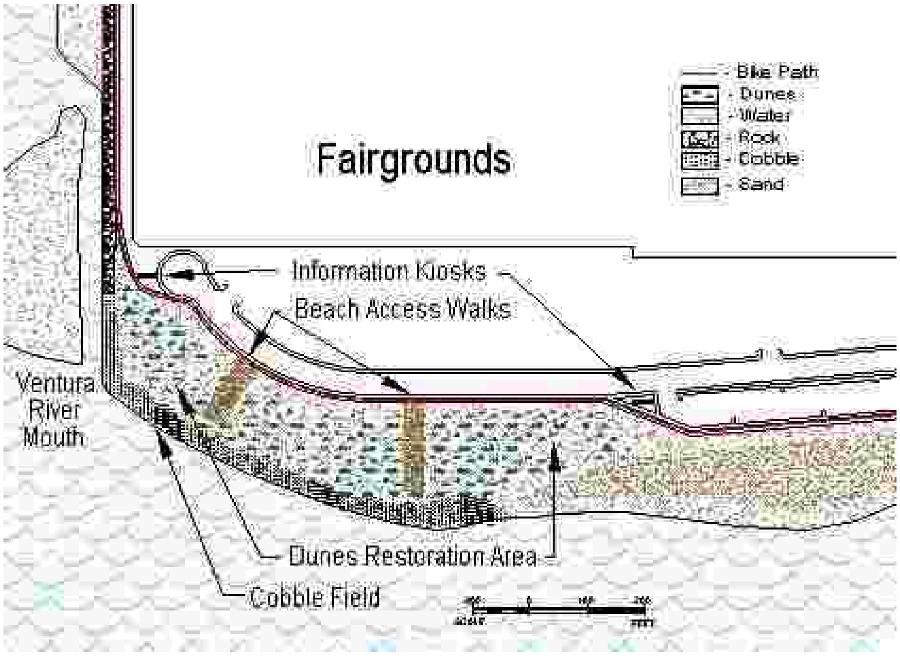

Figure 11. Managed Retreat and Restoration Plan for Surfer's Point.
[from http://www.rain.org/~pjenkin/point/point.htm]

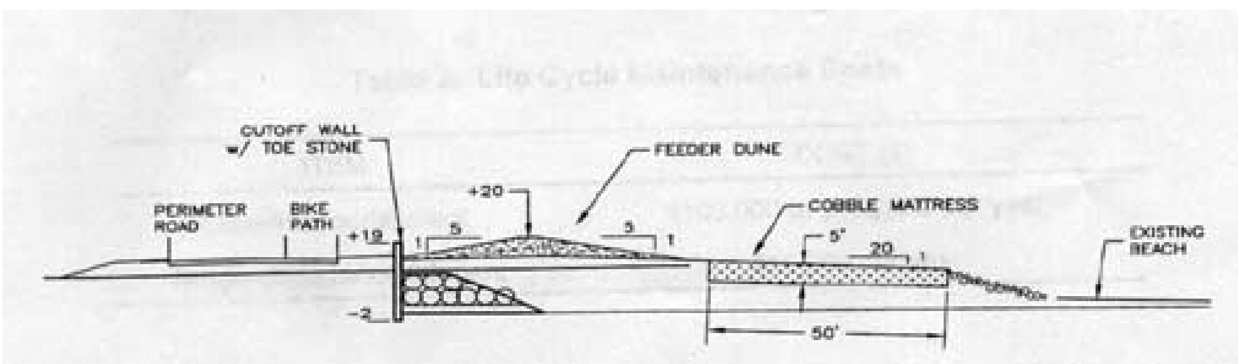

Figure 12. Plan View of Restoration Plan for Surfer's Point.
[from http://www.rain.org/~pjenkin/point/point.htm]

The cobble nourishment component of the project is underway. In September of this year, the Ventura County Flood Control District began a project to clear a channel under the Santa Ana Bridge near Oak View, less than 10 miles up from the mouth of the Ventura River. In a precedent setting effort, the City of Ventura coordinated with the County to have approximately

3,000 cubic yards of sand and cobble from the river delivered to the beach at Surfers Point. This project required cooperation with the Ventura County Fairgrounds, funding from the California Coastal Conservancy and permits from the California Coastal Commission. The result is an increased awareness of coastal sediment supplies among these government agencies. And in the process the community benefits from the temporary improvements of the eroded section of Surfers' Point. Tons of dangerous rebar and rip-rap have been removed and replaced with cobble from the river, making the beach a much safer place.

Surfer's Point has been a stable coastal landmark for decades, receiving the benefit of its natural cobblestone protection and constant sediment replenishment from the upcoast Ventura River; the community should work to return the Point to that condition. The politicians must learn to recognize beaches and coastlines as important natural resources and surfing and windsurfing as important recreational resources along California's coastal areas, more *unique* to this State than recreational biking, particularly when a myriad of options already exist for cyclists.

8.0 CONCLUSIONS

As knowledge of coastal dynamics and shoreline erosion has grown, approaches to coastal management have changed. Through the federal Coastal Zone Management Act, NOAA now bases their policies on a philosophy of siting buildings away from eroding shores (Pilkey et. al., 1996). This philosophy must be nurtured at the state and local level. The need to preserve beaches and preserve irresponsible shoreline development at the same time fails to recognize the uncompromising nature of building seawalls (Pilkey et. al., 1996). The potential for beach degradation associated with seawalls and other erosion control structures is consistently understated. Concern for buildings is still much greater than beaches. Prudent coastal management depends on adopting a long-term view, taking into account global warming and rising sea level, and recognizing the profound value of the beach to society as a whole.

Long-term objectives for the shoreline must call for the enhancement of beaches, reduction in storm damage losses, and establishment of policy and programs that control shoreline erosion without the proliferation of seawalls and other types of shoreline fortification. Although protection of property may be achieved through construction of seawalls and revetments to stop beach and bluff erosion, the cumulative fortification of the shoreline will reduce natural delivery of sand to the beach to the detriment of downcoast beaches. Furthermore, the ecological health, safety, aesthetics, recreational use, and accessibility of the beach are sacrificed when a seawall is constructed.

Considering the negative impact of seawalls on the beach, the decision to engage in beach replenishment or not is a critical decision in the face or rising sea levels and the expected acceleration in that rise (Pilkey et. al., 1996). Furthermore, while more desirable than the decision to front a beach with a seawall, beach replenishment has proven to be costly, temporary, and unpredictable. What needs to begin in earnest is the analysis of the managed retreat alternative to shoreline erosion problems. Relocation of buildings may ultimately be the way to preserve beaches in developed areas. The concept of managed retreat should be coupled with the establishment and successful implementation of meaningful setback lines. California should begin to identify non-coastal dependent structures and establish a plan of managed retreat for these structures. This must coincide with setback lines so that no new structures are built too close to the dynamic shoreline; if structures are built too close to the shoreline, they will certainly be jeopardized in the future by erosion and require seawall protection or need to be relocated.

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APPENDIX A

October 31, 1995

Comments on the *Draft Environmental Assessment* of a

Seawall Repair at the Naval Air Weapons Station

Point Mugu, California

By Shawn Kelly

General Comments

The first comment I have is that the "Prepared for:" and "Prepared by:" on the cover page of the draft environmental assessment (DEA) is the same entity, the U.S. Navy. This presents an obvious conflict of interest. A similar conflict of interest applies to all coastal projects. The Army Corps of Engineers is the Government organization in charge of designing and constructing coastal works in the United States, these include, most significantly, harbors, seawalls, jetties, and breakwaters. A significant and critical conflict of interest may exist in resolving shoreline erosion issues. The Army Corps of Engineers is the agency in charge of issuing environmental permits for new coastal construction. The Corps oversees the project's design and engineering, and they eventually permit their own design. The process should require a third party review with the authority to overrule decisions made by the Corps. This Navy project has obvious parallel problems. Furthermore, the Army Corps is a co-author of the DEA with the Navy on the Navy's project.

Detailed Comments

The public comment period for the DEA of the above stated project was officially closed on October 12. The EA is now being finalized. A phone conversation (1640 hours, October 31) with Jim Danza, an engineering technician associated with the project, presented a willingness by the Navy to discuss any problems with the EA and any design issues. A potential for the incorporation of new insights into the project exists. This is positive.

The work that is proposed in the DEA is storm damage related. My understanding is that the proposed work is not extensive, in that, the majority of the work is to recover from storm damage rather than build new manmade structures that would present an unfamiliar environmental impact to the area. The project seeks to remove a section of seawall and *repair existing sections* of seawall. The most significant new structure will be a "rock revetment return." Additional coastal construction related to the seawall will be forthcoming in fiscal years 1996 and 1997 and these works will be described in a subsequent environmental assessment. The extent of that work is unknown at this time.

Under Section 2.1 Project Purpose and Need first paragraph, the statement, “The purpose of the proposed project is to: ... (c) improve littoral sand transport in the project area,” is not an accurate statement. None of the proposed seawall changes will *improve* littoral transport.

The proposed seawall removal described in Section 2.3.2 is positive in that it represents the “un-hardening” of a section of coastline. This is offset, however, by the construction of the Rock Revetment Return described in Section 2.3.4, which is the most significant construction facet of the project.

Under the Seawall Removal Section 2.3.2, first paragraph, the statement, “ It is expected that removing the seawall in this location will encourage down-coast transportation of sand ...” is not substantiated. The driving force for this decision making process actually appears to be the lack of funding for the study, redesign, or repair of the entire seawall, stated in Section 2.4A, not necessarily the serious expectation that this will *enhance* down-coast transport, which seems unlikely.

The seawall removal described in Section 2.3.2 is attributed to the encroachment of the head of the Mugu submarine canyon. The same swell energy that damaged the seawall and destroyed the facilities behind the seawall will now cross the deep canyon, maintaining its energy without the benefit of bathymetric weakening and will hit the beach unobstructed. Is the Navy prepared to accept and deal with the potential for the ocean to break through to the lagoon at this section of beach between the two seawalls? Nor do I see any serious interruption of existing coastal dynamics.