SAVING THE AMERICAN BEACH: A POSITION PAPER BY

CONCERNED COASTAL GEOLOGISTS

Results of the Skidaway Institute of Oceanography Conference on America's Eroding Shoreline: The need for geologic input into shoreline management, decisions and strategy

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SUMMARY

New approaches to the management of the American shoreline are urgently needed to preserve our recreational beaches for future generations. Approximately half of the 10,000 miles of the "lower 48" American shoreline facing the open ocean is under development pressure. Well over 2,000 miles are considered by the U. S. Army Corps of Engineers to be in a state of critical erosion. Erosion is occurring along almost all of the U.S. coast and when shoreline retreat collides with shoreline development, a state of "critical erosion" is achieved. Shoreline retreat is due to many causes but a major one is rising sea level and indications are that the rise will continue for the foreseeable future.

The usual response to critical erosion on America's shore is stabilization; halting of shoreline retreat by engineering means. Such stabilization of America's shore has been successful in increasing the length of life of buildings built adjacent to the beach. However, stabilization in the long run (50 years ±) and sometimes in a much shorter time frame has resulted in severe degradation of the recreational beach area. Dollar costs of halting shoreline retreat by stabilization is very high. Replacement of the beach by pumping in new sand costs about 1 million dollars or more per shoreline mile each time it is done and it must be carried out repeatedly; commonly in 3 to 10 year intervals. Another approach, the building of seawalls, costs between $100 to $600 per linear open ocean shoreline foot. Combining these cost figures with the 2,000 mile figure of critically eroding shoreline gives some idea of the magnitude of the potential economic crisis on the American shoreline if we continue to stabilize.

American taxpayers are paying huge sums of money to temporarily protect the private property of a relative few. Furthermore this practice commonly leads to the ultimate destruction of a highly valued public recreational area.

Stabilization costs can be justified for major coastal cities or harbor entraces (Chicago, Galveston, Miami Beach, Coney Island, the Columbia River entrance, for example), but stabilization of most American shores is not justifiable in the broader scope of national interests. Numerous projects, involving public and private money along virtually all developed coastal and lake shores presently threaten most of America's recreational shoreline.

The following summarizes our views on stabilization of America's open ocean shorelines.

1. People are directly responsible for the "erosion problem" by constructing buildings near the beach. For practical purposes, there is no erosion problem where there are no buildings or farms.
2. Fixed shoreline structures (breakwaters, groins, seawalls, etc.) can be successful in prolonging the life of beach buildings. However, they almost always accelerate the natural rate of beach erosion. Resulting degradation of the beach may occur in the immediate vicinity of structures or it may occur along adjacent shorelines sometimes miles away.
3. Most shoreline stabilization projects protect property, not beaches. The protected property belongs to a few individuals relative to the number of Americans who use beaches. If left alone, beaches will always be present, even if they are moving landward.
4. The cost of saving beach property by stabilization is very high. Often it is greater than the value of the property to be saved especially if long range costs are considered.
5. Shoreline stabilization in the long run (10 to 100 years) usually results

in severe degradation or total loss of a valuable natural resource, the open ocean beach.

6. Historical data show that shoreline stabilization is irreversible. Once a beach has been stabilized, it will almost always remain in a stabilized state at increasing cost to the taxpayer.

The consequences of responding to rising sea level by shoreline stabilization are so serious that we urge immediate measures to explore totally new approachs to shoreline management. Such approaches may even involve drastic and unpopular measures such as assuming that buildings adjacent to the beach are temporary or expendable. Equally important, the new approach to shoreline management must incorporate the very significant advances in geologic understanding of shoreline processes that have occurred during the last decades. In the past the American public has been largely unappraised and unaware of the long range environmental and dollar costs of shoreline stabilization. There is a critical and immediate need for the public to know the direction in which American shoreline management is leading.

I. STATUS OF THE AMERICAN SHORELINE

1. We Are Losing Our Beaches

Widespread erosion is occurring on the U.S. shoreline and in some areas the rate of erosion has significantly increased in the past two decades. Many factors are responsible for coastal erosion but it is so widespread that sea level rise appears to be a primary cause. Specific evidence of sea level rise is indicated by tide gauge records not only in American waters but throughout the world. Sea level rise is probably due to melting of ice in high latitudes and it must be assumed that the rise will continue for decades to come. The National Academy of Science recently has warned of continued or even accelerated melting of the ice due to climatic changes related to increasing atmospheric carbon dioxide from consumption of fossil fuels.

Sea level rise along the American coast is believed to be approximately 1 foot per century. On coastal plain coasts, this is accompanied by lateral shoreline retreat orders of magnitude greater than the vertical rise in sea level because of the gentle slope of the coastal plain surface. The present rate of sea level rise should be expected to cause between 500 to 1500 ft of shoreline retreat per 100 years over broad stretches of U.S. coast. Measured rates of shoreline retreat are highly variable ranging from zero to dozens of feet per year. Even though some areas near rivers or deltas are growing seaward, such conditions are unusual, generally local, and considered geologically ephemeral. Shoreline retreat along Mid Atlantic, Southeast Atlantic and Gulf sandy barrier coasts tends to be fairly regular and continuous. Retreat of West Coast, New England and the Great Lakes shores often is more sporadic. Cliffed shorelines occasionally retreat in catastrophic "jumps."

The epitome of the U.S. beach crisis is Cape May, New Jersey. Once America's foremost beach resort, swimmers in Cape May today have difficulty finding any sand to stand on. Cape May City is lined with massive seawalls.

The overall trend of erosion is perhaps most spectacularly illustrated by the present underwater location of old village sites; villages that existed before massive shoreline stabilization was considered an appropriate solution. Examples of such are Cove Point, Washington, Bay Ocean, Oregon, Balize, Louisiana, Edingsville Beach, South Carolina, and Hog Island, Virginia.

Retreat of the American shores does not threaten our recreational beaches. Beaches will essentially remain as they are but will move landward. Shoreline retreat does, however, pose a serious threat to buildings along the shore.

2. Crowding the Shore

Urbanization and construction on barrier islands, cliffed coasts, beaches, and coastal floodplains of the United States have increased markedly in recent years. NOAA (National Oceanographic and Atmospheric Administration) recently estimated that approximately 80% of the U.S. population will reside within easy driving distance of the coast by the year 1990. Mass migration of people to these areas poses immediate and unanticipated problems. Development of barrier islands on the Atlantic and Gulf coasts has brought about the installation of numerous stabilization structures (seawalls, revetments, groins, etc.) to protect coastal property. Development on cliffed coasts creates a distinctly different set of problems.

Between 1948 and 1978, California experienced a benign and quiescent climatic period characterized by few storms capable of generating large storm swell or heavy surface runoff. During this time extensive urbanization occurred along the coast. Studies of tree rings in Southern California show that this was the longest drought period since the 1520's. With urbanization, the ground-water table level has risen along the coast due to extensive watering of non-native vegetation, agricultural irrigation, septic tanks, leach lines and cess-pools; the equivalent of approximately 50 to 60 inches of precipitation per year. This has added weight to cliff material and contributes to landslides and cliff failures. These failures result in immediate and costly stabilization measures which in turn may greatly accelerate beach erosion.

3. Stabilization

Development of the American coastline has led to an endless program to protect investments whether they be individual homes or commercial enterprises. Property owners, because they have built in a dynamic and destructive environment, in many cases at great cost, demand stabilization structures to try and protect their homes and businesses. Many stabilization structures have been used but the most common are seawalls, rip rap revetements, groins and offshore breakwaters: These structures are fixed in space and represent considerable effort and expense to construct and maintain. They are designed for as long a life as possible and hence are not easily moved or replaced. They become permanent fixtures in our coastal scenery but their performance is poor in protecting communities and municipalities from beach retreat and destruction. Even more damaging is the fact that these shoreline defense structures frequently enhance erosion by reducing beach width, steepening offshore gradients, and increasing wave heights. As a result, they seriously degrade the environment and eventually help to destroy the areas they were designed to protect.

Some outstanding case histories prove these points:

1. The Galveston Seawall, America's mightiest, was built in response to the 1900 Hurricane which killed 6,000 people. As recently as 1965, a wide sand beach existed seaward of the wall. The beach has now essentially disappeared from in front of the wall and is being replaced by rows of rip-rap protecting the foot of the seawall. Beyond the west end of the seawall, the natural shoreline is now retreating at 15 feet per year due to the loss of its source of sand in front of the seawall.

2. The Sea Bright, Monmouth Beach, New Jersey shore section has little remaining beach even at low tide. The shoreline is fronted with a massive seawall extending to an elevation of 20 ft above M.L.W. with a cap width of 8 feet. The

wall was built in 1954 replacing an earlier seawall built in 1945. State officials now fear that due to the lack of beach and the much steepened offshore gradient, the seawall may fail completely in a storm. Even now, 25 knot sustained winds produce seawall-topping waves at Sea Bright. Steepening is to be expected in front of all open ocean structures; leading ultimately to the destruction of the seawall itself.

3. During the decade of the 70's and for a good part of the 60's there was no beach at Miami Beach. The seawalls and groins protecting the hotels had destroyed the original "raison d'etre" for this, the most famous of America's beach resorts. TV shows emanating from Miami Beach beaches managed to take advantage of occasional pocket remnant beaches. At a cost of $64,000,000 fifteen miles of Miami Beach were recently replenished. The economic justification for this expenditure of tax money is an assumed income generating 10 times the cost of sand pumping. This may be true for Miami Beach but if the total mileage of critically-threatened American shoreline is considered, the absurdity of the future economic picture of the American Beach becomes clear. Furthermore replenishment is akin to painting a house. It will have to be done repeatedly and probably at ever-shorter intervals.

4. The jetties at Indian River Inlet, Delaware have successfully protected navigable waters for over 50 years. The shoreline here has been receding at a steady 3 feet per year rate. When a replacement bridge was recently built it was placed closer to the sea than its predecessor. This was done for good engineering reasons and also because it was the cheapest construction alternative. Soon after construction the beach retreated to the northside bridge abutments and $715,000 was needed to pump in new sand. We can be assured that every few years from now on a millon dollar replenishment job will be needed to save the bridge. If the bridge had been built on the backside of the barrier island, the problem would not have arisen for 50 years. At what point should the state abandon the bridge? They will soon spend more money protecting the bridge than constructing it.

5. There are other detrimental byproducts of stabilization that must be considered. For example replenishment of Waikiki beach involved replacement of coarse calareous sand by softer muddier calcareous sand. Destruction of the soft beach sand by breaking waves increased the turbidity of the water and killed offshore coral reefs. The replacement of quartz sand by calcareous sand on Miami Beach has resulted in increased water turbidity and is damaging local coral communities.

Frequently, the response to continued beach loss is to begin bigger and more expensive "stabilization" endeavors, which continue to aggravate the problem. Finally, we become locked into a dilemma of costly counter-productive measures - wherein the more we do, the worse the problem becomes. We can, unfortunately, look back on a sad history of small coastal communities originating small "stabilization" projects that attracted and caused an increase in development. This increase brought with it an expanded economic and political base which, when next threatened by beach erosion, demanded even larger coastal defenses. This set in motion a long and needless commitment to defend the development: a commitment doomed for ultimate failure.

In a rational and well-educated society, it is alarming to realize that few if any alternatives to stabilization methods have been seriously proposed or tried. It is time for imaginative, creative, and bold ideas. New ideas and approaches have surfaced from time to time. For example, bypassing of sand past jetties at harbor entrances has allowed beaches to persist where they would have completely disappeared otherwise. It seems clear that we cannot proceed with the "bigger is better" coastal defense scenarios. We know that coastal communities will exist for some time in the future, just as they have been in the past. Yet the "bigger is better" thinking does not provide for intelligent long-range planning. We must

consider the "fate" of beaches based on scientific data and interpretation and set in motion a rational policy for living with nature. Our crisis approach to coastal management must come to an end.

4. The Price We Pay for Coastal Stabilization

The price we pay for the installation and maintenance of a "stabilized" shoreline whether it be in esthetic or fiscal terms, is enormous and it is accelerating. Although there are some examples of private sources paying for "beach protection" most commonly it is the taxpayers of the continental hinterlands that pay for shoreline stabilization. It is ironic that many people unwittingly and unknowingly pay for projects that degrade a public resource. Furthermore, this resource frequently becomes increasingly more inaccessible in the areas that receive the greatest infusion of funds. Too often the cost of stabilization is significantly higher than the value of the structure to be protected. The following examples dramatically illustrate the cost of shoreline stabilization:

1. The U.S. Park Service claims that 15 million dollars have been spent on various shoreline stabilization schemes in the vicinity of the Cape Hatteras Lighthouse. Additional plans are in the works to build more massive stabilization structures to save the lighthouse. The cheaper alternative, moving the lighthouse, has not been seriously considered. This in spite of the fact that the shoreline has moved landward almost 3,000 feet in front of the present lighthouse site since the mid 1850's.

2. The previously mentioned Galveston seawall has successfully protected the city over the past 80 years. At the same time, the beach in front of the wall has disappeared, the shoreface has steepened, and wave energy has increased. It is hard to deny the ultimate usefulness of the Galveston seawall. But was destruction of the beach by stabilization of Sea Bright and Monmouth Beach and Long Branch, New Jersey, also worth the cost? In order to save relatively small numbers of buildings, mostly vacation homes, the beach environment in these New Jersey communities has essentially disappeared at great financial cost.

5. Scientific Input into Shoreline Management

Most of our shoreline stabilization has been and is being carried out without consideration or understanding of fundamental principles of shoreline processes. Prediction of economic and environmental impact of shoreline stabilization is frequently done in the context of poor or no understanding of the coastal system in spite of our increased understanding of shoreline processes in the last two decades. Frequently, political considerations override scientific facts. Failure to consider scientific principles leads to increased shoreline damage and increased cost of stabilization.

To stop East Timbalier Island's continued landward migration, and the eventual exposure of Timbalier bay (Louisiana) oil-field installations to waves of the Gulf of Mexico, the oil field owners have "stabilized" the shore with two seawalls, built in the late 1960's. Only the eastern part of the island, the part immediately adjacent to the installations, was stabilized; the western half (downdrift) was left in its natural state. The consequences of this stabilization scheme follow an all too familiar pattern. The eastern half became fixed in space while the western part continued to migrate with rapidly diminished sediment supply. The result as been a segmentation of the island; a deep and wide tidal inlet now separates the two halves. This result should not have surprised anyone; it could easily have been predicted prior to construction of the seawall.

A major shortcoming of design and planning for shoreline stabilization has

been the short design-life consideration. Commonly a shoreline erosion problem is considered in a 15 to 35 years context. Yet we have a number of shorelines that have been stabilized for 50 years, where beaches have been essentially destroyed at great cost. Shoreline stabilization schemes that do not preserve the environment for future generations should not be carried out. The public-at-large and not just the few people with threatened buildings, should be clearly informed of the long range consequence of action being taken at the shore.

A second major shortcoming of shoreline stabilization solutions is the failure to understand the shoreline system in a regional context. We now know that beaches may exist in equilibrium with an entire shoreline for many miles. An action that halts the flow of sand at one location may well cause increased shoreline retreat at other locations. On coastal plain coasts, the beach exists in equilibrium with the inner continental shelf. Obtaining sand for beach nourishment from the shoreface or anywhere else within the dynamic system inevitably affects this equilibrium and enhances rates of shoreline retreat.

On cliffed coasts, erosion is episodic. It occurs catastrophically at widely spaced intervals of time. Failure to take the long range view of cliff failure continues to lead to economic and ecologic disasters. Complicating the situation further is the fact that along the Pacific shore, particularly of Southern California, a major source of sand has been cut off by dam construction on rivers.

Plans are in the mill to replenish some of the southshore Long Island barrier beaches (Westhampton Beach) with sand from offshore. Geologic studies indicate that removal of offshore sand (from a depth of less than 10 meters) will simply cause sand to move offshore more rapidly. In other words, the replenishment project bears with it the seeds of its own destruction.

Tybee Island, Georgia is an example of a beach system presently being stabilized on a relatively small scale. Over a period of 100 years more than 75 groins have been constructed at Tybee Island. Today only one of these, the most recent one built in 1974, has any significant effect. The recent history of stabilization projects on this island is fraught with large underestimates of sand volume and dollars required. At one point removal of sand from a nearby inlet to the south actually hastened the erosion of the new beach. Probably much of the long range erosion problem on Tybee is due to dredging of the Savannah River channel to the north, thus removing a natural supply of sand. Channel dredging and beach replenishment are funded from separate bureaucratic pots. Hence, as in many cases along the American shore, potentially good beach sand is removed from a channel and dumped at sea rather than on the adjacent beach.

Scientific input is needed both in long-range, large-scale planning and in community beach-management planning. Simple approaches such as bulldozing sand from the lower beach to the upper beach after storms has proven to be unwise. Such a procedure steepens the beach and increases the rate of shoreline retreat. Beach community officials apparently find this impossible to believe and, despite geological advice to the contrary, continually employ this technique.

II. SOLUTIONS TO AMERICAN SHORELINE PROBLEMS:

ALTERNATIVES FOR CONSIDERATION

Principles common to all immediate solutions are (1) sea level rise and coastal erosion are inevitable, (2) most stabilization and nourishment projects are untenable and indefensible in terms of physical realities, cost-benefit ratios, and escalating budgets, (3) increased public awareness through education is becoming paramount, not only of coastal residents but also regulatory agencies, legislators, and the general American public, and (4) new and in many cases, sweeping, legislation is required to

reverse the trend of costly shoreline management practices.

Ultimate solutions to the problem will not be simple. They will involve political, sociological, economic, as well as scientific and engineering considerations. Solutions for the barrier island coasts of the Atlantic and Gulf will differ from the solutions for the cliffed Pacific coast. The solution for a developed New Jersey barrier island will differ from that of a pristine Texas barrier island. Complexity of the "solution" is clearly illustrated by the following alternative approaches to halting the accelerating loss of American recreational beaches.

1. Public Education

Inform all relevant interested parties of long-range and long-distance ramifications of proposed development-stabilization projects --

At present, the general public is unaware of the fact that sea level is rising or that most of the nation's beaches are retreating, whether cliff or barrier island and that this process is inevitable. For example, few people realize that over the past 150 years, rates of erosion on the Atlantic coast have ranged from 1-3 feet per year to more than 100 feet per year, as documented by such federal agencies as the U.S. Geological Survey, National Oceanographic and Atmospheric Administration, Corps of Engineers, etc. Warning of the likelihood of continued sea level rise by the National Academy of Science must be communicated immediately to the public. Equally important, few people seem to realize that actions taken in one place on the shore may have a profound, direct, and adverse effect on adjacent beaches.

Not only should all interested or involved parties be notified of the attendant physical problems involved, they should also be apprised of the prospective long term financial burden. Economic estimates are that the long-term debt borne by the nation -- especially in view of the federal flood control act, which is stimulating acceleration of building activities in the coastal zone -- will lead to costs on the order of many billions of dollars during the next several decades.

In 1967, the federal government proposed a protection plan for Delaware's shoreline. Long range cost was estimated to be 25 million dollars plus annual maintenance costs. An independent estimate by University of Delaware economists indicated a cost approaching 3/4 of a billion dollars over a 50 year time span. Commonly long range estimates, by the federal government, of beach stabilization costs, fall far short of the mark.

The fate of the American recreational beaches must be determined by a broad segment of an informed populace. In most cases, the monies for coastal management are derived from public rather than private funds. If the American public were aware of its role in funding such projects, i.e., that a Nebraska farmer is helping protect an Atlantic beach house with a private beach, then public support for these projects would quickly diminish.

2. Science

Obtain competent scientific input into shoreline planning --

This is a major principle; failure to do so in the past has resulted in large scale losses of recreational, commercial, and residential property representing both public and private resources. Generally coastal management agencies and the Corps of Engineers have not adequately developed or fully utilized scientific data. In numerous other cases, political considerations have negated sound scientific observations.

Open oceans groins built on Westhampton Beach, N.Y. were constructed against the advice of all involved engineers and geologists. The groins caused severe and

immediate erosion to the west. A 40 million dollar federal beach replenishment project is now proposed to save threatened private homes.

3. Alternatives to Structural Stabilization

Halt all stabilization projects immediately whether funded privately or publicly --

In most cases, current efforts at stabilization should cease. Obvious exceptions include certain (1) military reservations, (2) industrial complexes, (3) harbor entrances, (4) densely populated urban areas, and (5) selected resort communities with high economic value with which the general public is not willing to part. Justification for cessation of these efforts hinges on the inevitability of beach erosion problems, uneconomical cost-benefit ratios, and projected exponential increases in coastal management budgets, especially on a long-term basis.

Spend the money slated for stabilization projects to move threatened buildings --

A fundamentally important but often overlooked aspect of expenditures on coastal management projects is that the buildings to be saved are frequently worth considerably less than the amount of money spent in their protection. Costs for removing these structures would be much less than costs for preserving them and would simultaneously remove the basic problem -- artificial perturbations in a naturally dynamic system. "Better to move than to protect."

The Federal flood insurance program moved a number of houses back in 1979 from the shores edge in South Nags Head, North Carolina. One house cost $36,000 to move. The impetus behind this was not to prevent stabilization but to save the Federal government's flood zone insurance program from paying the entire cost of the house when it was consumed by the surf.

Remove threatened buildings next to the beach --

In general, structures of low commerical, residential, or aesthetic value might well be sacrificed. A major impetus for this might be the possibility, otherwise, for damage to adjacent property or the obstruction of recreational beach area. Most important, building removal by whatever means, removes the need for shoreline stabilization.

Destabilize islands and beaches --

The fundamental problem is, as the sea level continues to rise, an artifically stabilized beach becomes more and more "out of equilibrium" with the sea level. This means that more and more "heroic" efforts (bigger seawalls) will be needed.

Can we move seawalls and let nature roll on? Will a natural equilibrium beach be reestablished? Should nature simply be allowed to do the job for us, or should we initiate remedial action? Related questions include, if action is taken to reverse stabilization, who should bear the cost and will these activities create additional, perhaps more costly, coastal problems? Finally, the solution should include the promise that no more development be allowed in the same area in the future.

Exceptions to this general neutralization of structures in the coastal zone include designated areas in which the national interest is affected, such as the preservation of national treasures, and the cases specified previously.

Establish setback lines and conservation easements --

In defining and establishing a buffer zone between stable areas and the shoreline, setback lines and conservation easements should be considered, as well as the "permanence" of the "stable" sites. A setback line is the necessary first step toward resolution of problems and principles addressed in points above. With the certainity of erosion and landward retreat of coasts, of course, a static or permanently defined line cannot be considered as a long-range solution; development and utilization of coastal resources must retreat with the shoreline.

North Carolina is experimenting with a setback line of 30 times the average annual erosion rate. Some islands are so narrow, that this will totally prevent the possibility of development. One solution to this aspect of the problem is the concept of a "rolling" setback line; one that by definition and law would periodically shift landward, or away from the onslaught of erosion. For example, a given oceanward site could be designated as the lifetime possession (30-40 years) of the current landowner, after which time the property would be condemned and vacated.

Inherent in this concept is the prospect of tremendous benefit to the general citizenry through (1) increased access to the nation's shorelines, (2) aesthetic enhancement of a "buffer" area, via parks and other types of open space, provided that condemned structures are removed satisfactorily and (3) a dramatic reduction in public funds otherwise diverted into stabilization schemes.

Establishment of such methods would require that (1) they be adhered to in perpetuity, i.e., no subsequent changes in rules or stipulations except in dire circumstances, that (2) a time frame be instituted, such as the "life expentancy" of buildings involved, and that (3) responsibility for removal and funding be designated.

4. Economic and Political Alternatives

Prevent the use of public funds for redevelopment after the "next" storm --

Destruction of shoreline development by a storm is essentially the only way that artificial stabilization can be halted or reversed. Thus storms on the one hand sow tragedy and destruction but on the other hand, they offer a golden opportunity to reverse beach management strategies that have failed.

Dauphin Island, Alabama has been affected by 20 hurricanes during this century. Three (1916, 1947, 1979) produced maximum damage at the same place, a location controlled by nearshore bathymetry which focuses storm wave energy. The taxpayer paid millions of dollars in Flood Insurance payments for Dauphin Island buildings that were destroyed by Hurricane Frederic in 1979. We taxpayers have just commited well over 50 million dollars to build a new bridge and to reestablish the major development of Dauphin Island at this most senseless of all locations.

There is immediate need for measures to prevent redevelopment after storms. No longer should local, state, and federal governments expend public funds in redevelopment; on the contrary, these governments should assume responsibility for the protection of the public (as opposed to the private) interest, not to recreate an untenable situation or to guarantee recurrent destruction of such properties.

Carefully review all federal expenditures in beach communities regarding their long range impact on natural systems --

The federal government not only is responsible for bearing much of the cost of shoreline stabilization construction, but also the costs of water and sewer systems and flood insurance programs.

A water line was recently laid from Buxton to Avon on North Carolina's Outer Banks. The line, which will support increased density of development in Avon, goes through an area of the Hatteras National Seashore which is highly susceptible to inlet formation during storms. Placement of the pipe in such a danger zone assures the need for large future expenditures of federal funds for stabilization. It is an example of federal expenditure leading to density of development far beyond the natural carrying capacity of the island. Experience tells us the dense development will ultimately lead to stabilization of the shoreline with all of the attendant economic and environmental problems.

Require deeds to state hazards and/or require home purchasers to sign "hazard documents" --

Deeds to shoreline property should clearly state all natural flood and erosion hazards known at the time of validation of the deed. Descriptions of hazardous conditions may change as new data accumulate and/or as scientific knowledge and technology advances with refinements.

III. FUTURE NEEDS

It is readily apparent from the numerous examples of submerged and stranded jetties, multiple seawalls, and groins now detached from the shoreline that many stabilization projects have been failures. It is further shown by the need to continually repeat renourishment programs that were initially supposed to "solve the problem" once and for all. Too often these expensive attempts at stabilization occurred because (1) the engineering solution to problems created by natural processes were undertaken without consideration of the magnitude and significance of the process itself, (2) failure to consider how artificial structures affect the environment, (3) failure to measure, describe and accurately interpret processes that occur in the vicinity of the stabilization project, (4) lack of appreciation of the fact that coastlines are systems, not components, and (5) completely ignoring the solid evidence for sea level rise.

We are clearly at a point today when decisions relating to coastal erosion can call upon a vast reserve of research results and capabilities as well as innovative technology. The fact that we continually fail to do so is absurd. The responsibility rests on the shoulders of shortsighted politicians, developers and coastal engineers among others who, through ignorance, haste, or in response to political pressure, fail to utilize the results of available research reports, the tools and techniques developed from coastal research and the talents of numerous highly qualified research scientists. Federal engineering organizations counter this argument by saying they have invested millions of dollars in coastal research and indeed they have. But time and again we find they have asked inadequate or inappropriate questions.

Another major blunder that stands out clearly in assessing what has gone awry is the failure to look at the short and long term economic realities of attempts at shoreline stabilization and beach renourishment. These include direct and indirect costs involved and cost-benefit ratios in light of the long term significance of causes and effects of coastal erosion. Many attempts at artificial stabilization should never have been undertaken in the first place. Many others should be stopped immediately and no new projects should be initiated until a solid, unbiased economic study is made and it is clearly determined who will benefit and who will suffer, what it will cost and who will initially and eventually pay for the project.

Coastal research has made tremendous strides in terms of shoreline dynamics and processes. There is much that remains to be done but the accumulation of knowledge in the past 20 years is remarkable. During this same period of time our coasts have undergone extensive economic development until at the present time there is extreme human-induced stress being applied to the coastal zone. This is obvious in many coastal areas and is reflected in the concern expressed by various environmental groups and by the numerous task forces, workshops and meetings dedicated to coastal urbanization.

Traditionally, problems of shoreline erosion are "solved" by the quickest and cheapest methods. But there are no quick and cheap solutions to "problems" that are the result of long term processes. Managers have failed to consider the long term costs and the cost/benefit ratios involved. Past, present and future coastal programs must be evaluated by using a combined scientific-economic yardstick. In most examples we have been able to ferret out there is a predictable scenario that occurs in dealing with beach erosion on a "developed" coast:

A. Buildings are constructed along the shore, erosion occurs and threatens the building, short term remedies are given to slow or "stop" erosion.
B. Temporary success encourages new building, however ongoing erosion occurs and it is now accelerated because (1) the artificial structures accelerates the rates of erosion by steepening the beach profile and/or (2) the structures were poorly designed or improperly placed, and (3) the sea level rises and makes the beach "out of equilibrium."
C. At this point there has been an increased tax base and accompanying increased hue and cry to again stop erosion, etc.

This is a seemingly endless cycle of events which, due to a compounding of errors and poorly-thought-out decisions, becomes increasingly more expensive. By the time someone is willing to admit it wasn't worth the initial expense even if it had worked, the shoreline has been so highly developed that engineers, planners, politicians are totally locked into a program of continued commitment.

An immediate need exists to determine realistic costs and cost-benefit of shoreline management. In retrospect many such projects should never have occurred to begin with. Granted we are tied to certain existing programs, but it is not too late to blow the whistle on some and to refuse to initiate others. Future cost/benefit studies must include experienced geologists, economists, and engineers who have no vested interest, and who can (1) dig out the subtle realities of hidden costs, (2) put into their estimate the role of sea level rise and (3) apply state-of-the-art knowledge of coastal processes.

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