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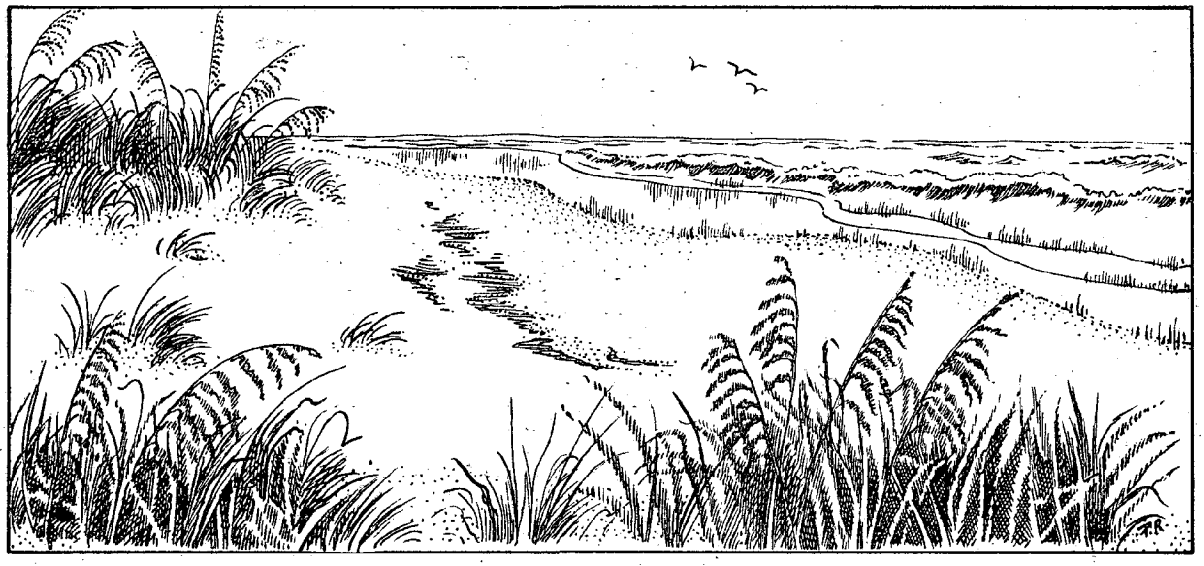
A PROPOSED COMPREHENSIVE BEACH MANAGEMENT PROGRAM FOR THE STATE OF FLORIDA



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STATE OF FLORIDA

DEPARTMENT OF NATURAL RESOURCES

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A PROPOSED COMPREHENSIVE BEACH MANAGEMENT PROGRAM FOR THE STATE OF FLORIDA

STATE OF FLORIDA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF BEACHES AND SHORES

Tallahassee, Florida

March, 1986

STATE OF FLORIDA

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INTRODUCTORY COMMENTS

The purpose of this report, which represents a refinement and update of that published in April 1985, is to continue the development of a Comprehensive Beach Management Program for the State of Florida. The April 1985 report was completed in a short time-frame and provided a description of past efforts and a preliminary identification of the eroding areas and the associated costs for their renourishment. Recommendations for improvement of the present program were also presented.

This report is the first of a two volume series and has benefitted from considerable public comments on the April 1985 report, and especially from the deliberations of a second convened Task Force to address this subject. The present volume (Volume I) provides general background and develops specific recommendations required to improve the effectiveness of the State's beach management program. Volume II will contain the results of a one year's planning effort and will develop a Comprehensive Beach Management Program for the State of Florida.

The main body of the present volume (Volume I) is organized in four chapters for easy reference. Chapter I describes the erosive forces acting on the shoreline, their consequences and magnitudes and the alternative responses to these forces. A brief description of the mechanics of beach nourishment is also provided. The second chapter reviews the significance of Florida's beach resource. The current beach erosion control program is described in Chapter III. The final chapter develops recommendations for a Comprehensive Beach Management Program to effectively address Florida's severe beach erosion problems.

The appendices contain background and supporting material to that presented in the text. The report of the Task Force is included as Appendix A. The remaining appendices contain technical details related to statements and results presented in the text.

EXECUTIVE SUMMARY

This report has examined the causes and extent of Florida's shoreline erosion and possible responses. Additionally, the value of the beaches to the State's economy has been reviewed. The history, effectiveness, and economic value of past beach nourishment projects has been evaluated, and a recommended change of the current Beach Erosion Control Program to a Comprehensive Beach Management Program has been given. A summary of the findings is:

1) Beaches play a significant role in attracting tourists to the State.
2) Beach restoration and renourishment are viable and essential responses to the erosion of certain Florida beaches and necessary if these beaches are to maintain their effectiveness in attracting tourists to the State and providing protection against storms.
3) Legislative changes should be made in 1986 to initiate a plan to implement a Comprehensive Beach Management Program for the State of Florida.
4) Provision should be made for effective transfer of sand around inlets at no cost to the State.
5) The existing program of financial partnership with the Federal government and local agencies for such erosion control measures as beach restoration, renourishment, dune protection and inlet sand transfer should be continued where such possibilities exist. The associated FY 86/87 financial needs, including $2,230,000 for implementation studies, are $35,932,000.
6) During FY 86/87, the framework should be developed for a uniform State-wide procedure for the identification of beach restoration priorities.
7) Specific major Legistative actions to implement the plan include:
   a) Provide a stable source of funding for a Florida Beach Management Program and discontinue the current line item appropriation funding in order to provide needed funding flexibility.
   b) Require all inlet districts, port authorities, etc. to place at no cost to the State all suitable sand material on adjacent beaches that is dredged as part of channel maintenance or sand material trapped as a result of inlet jetties. Additionally, initiate efforts to change Federal Law PL 94-587 (least cost method of inlet sand disposal).

c) Appropriate $2,230,000 for preparation of district beach management plans which include requisite research needs.

d) Allow greater flexibility in public access and parking while maintaining the intent of ready and equal utilization by all segments of the general public, including residents and tourists.

8) Specific major Departmental activities include:

a) Establish an interagency committee to provide a coordinated review of erosion control projects with an intent of expediting project implementation while safeguarding Florida's coastal environment.

b) Prepare district-wide beach management plans for submittal to the Legislature by April, 1987.

c) Develop specific recommendations for improving parking and beach access requirements.

d) Take actions necessary to amend the current Memorandum of Understanding between the Departments of Natural Resources and Environmental Regulation and the Board of Trustees to ensure that all compatible sand material dredged as a result of inlet maintenance dredging is placed on adjacent beaches.

e) Implement educational programs to inform Florida's citizens and tourists of the importance of Florida's beach resources. Provide for more detailed educational programs for Grades K through 12 of Florida's Public School System.

Chapter I

GENERAL EROSION CONDITION OF FLORIDA'S SHORELINE AND POSSIBLE REMEDIAL MEASURES

CHAPTER I

GENERAL EROSION CONDITION OF FLORIDA'S SHORELINE AND POSSIBLE REMEDIAL MEASURES

NATURAL FORCES, CAUSES OF EROSION AND GENERAL CONDITION OF FLORIDA'S BEACHES

General. Under natural conditions, Florida's beaches respond to the short- and long-term forces of nature. Rare hurricanes and winter storms cause rapid and dramatic erosion of the beach dune system. Even the winter season with its typical storms cause the beach to narrow, to be rebuilt with the onset of milder summer wave conditions. Storms recurring with consistent statistical frequencies cause fluctuations of the shoreline, but no net erosion. However, observations conducted over a long period of time reveal a slow erosional trend. This is due to the nearly imperceptible relative rise in sea level, which at present is about one foot per century along Florida's coastline. Although this rate of relative rise is not large, it translates (approximately) into 100 to 200 ft of horizontal shoreline recession per century.

The discovery of Florida's mild climate and abundant natural resources resulted in the development of coastal areas, causing significant modifications along the shoreline. Many structures were built without an understanding of the extreme shoreline fluctuations which will occur during a rare storm, or of the slow but persistent erosional trend. This construction included houses, hotels, roads, etc.; quite naturally, as the erosion threat became apparent, efforts were made to protect this property, usually through armoring or other coastal structures. A second significant effect of early Florida development was the interest in modifying the natural inlets and river entrances to be more conducive for commercial and recreational navigation. The natural entrances usually had a fairly shallow bar on the ocean side and if channels were present, their alignments were not straight and their locations shifted frequently, making navigation difficult. To improve navigational characteristics, the depth across the bar was increased by dredging and one or more jetties were constructed to reduce the rate of channel infilling, to provide protection against waves for vessels entering the channel, and to fix the channel position. These modifications performed admirably for navigation; however, the jetties which were frequently long,

interrupted the longshore transport processes, causing sand to accumulate on one side of the inlet and to erode on the other side. This effect is most noticeable along the east coast of Florida where the net transport is directed from north to south. Some inlet modifications caused hydraulic changes which exacerbated the downdrift sediment deficit. Additionally, past channel maintenance dredging has resulted in the disposal of substantial quantities of sand in locations such that it is effectively lost to the nearshore system. In many cases, inlet modifications have resulted in greatly accentuated erosion to the downdrift beaches.

In summary of the above discussion, Florida's beaches as well as those of the nation are experiencing an erosional trend due to (1) natural causes, and (2) human related causes. Although the relative proportions of these two effects are not known precisely on a site-by-site basis or even State-wide, it is believed that both are substantial and along Florida's east coast are of approximately equal magnitude.

With this general information as background, the descriptions below focus on the specific characteristics of the east and west coasts of Florida.

Florida's East Coast. The sandy shoreline of the east coast extends from the Georgia-Florida border at the St. Marys River to Cape Florida at the south end of Key Biscayne, a distance of approximately 330 miles. Sediment transport characteristics along this shoreline are much more consistent than along the west coast. The dominant sediment transport is from north to south with the greatest transport occurring near the Florida-Georgia border. The net longshore sediment transport represents the net volume of sand passing a point over an average one-year time period and is of considerable importance.

If a barrier to sediment transport is constructed, the updrift beaches will accrete (gain volume) at this rate and the downdrift beaches will erode at this rate. Figure I.1 presents an estimate of the net longshore sediment transport rates along the east coast of Florida. There are 19 inlets along the segment of the east coast identified above and 15 of these have been modified for navigational purposes. That these modifications have taken a toll on the downdrift beaches is clear by the concentration of high shoreline erosion rates south of the inlets as presented in Figure I.2.

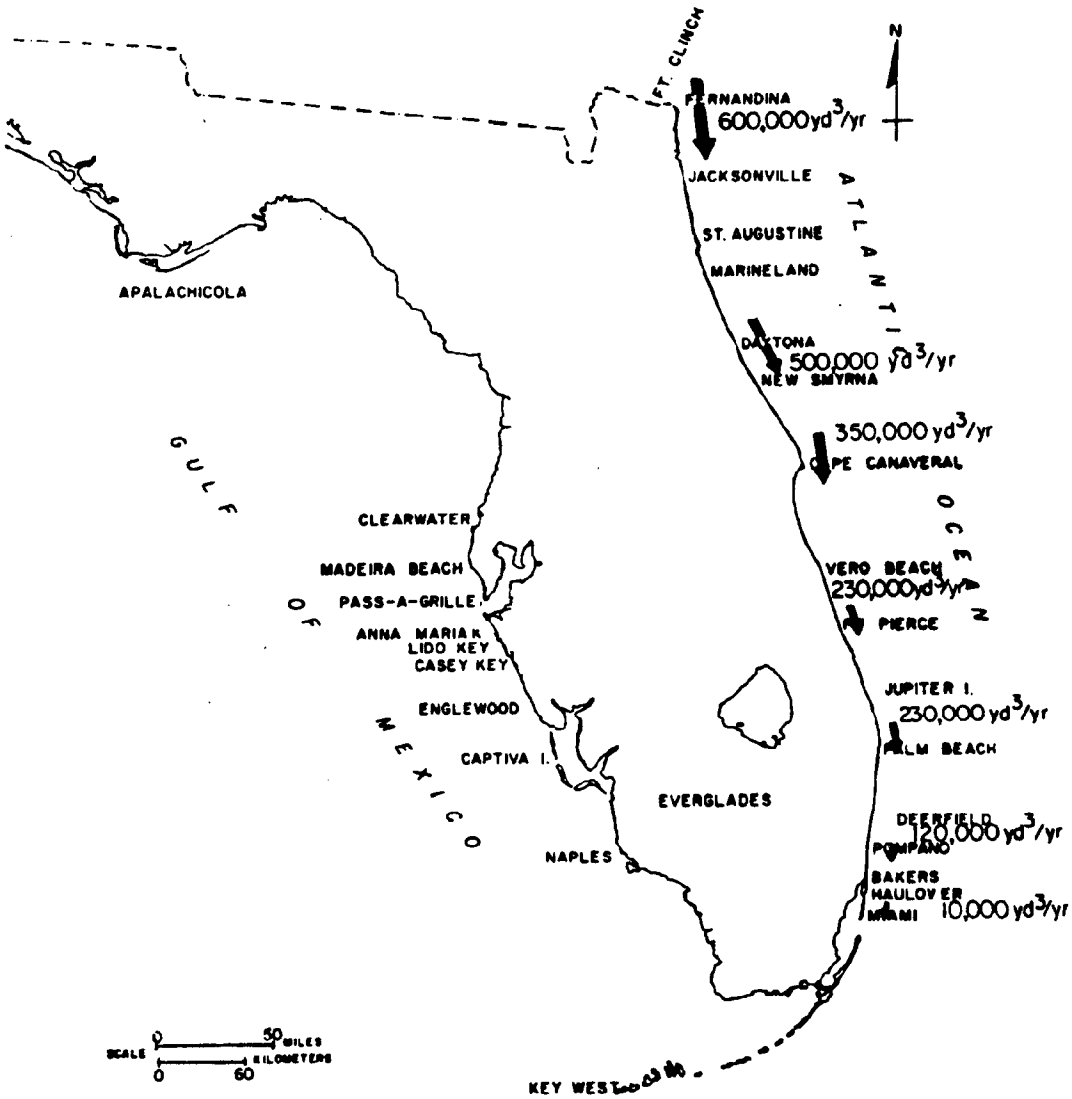

Figure I.1. Estimates of Net Annual Longshore Sediment Transport Along Florida's East Coast.

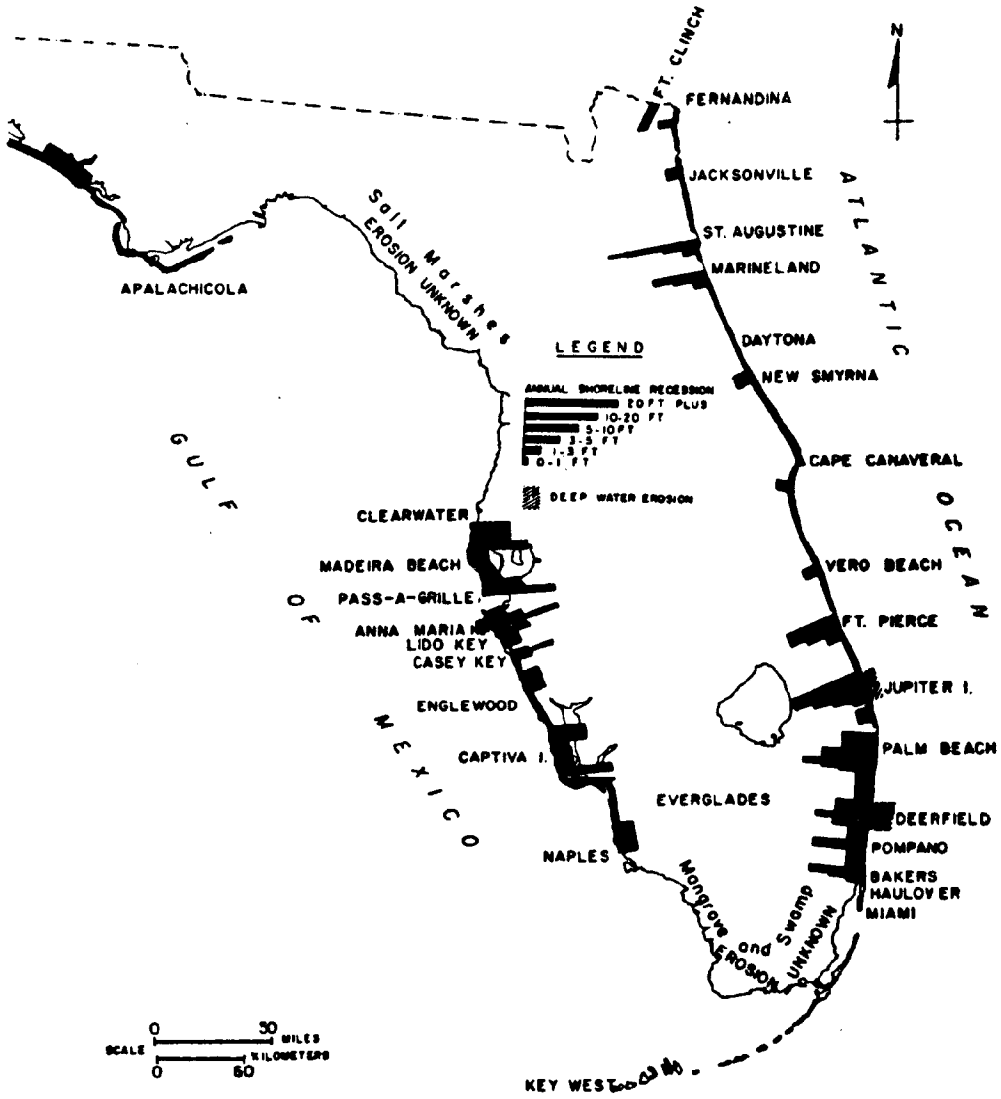

Figure I.2. Rates of Long-Term Erosion Along Florida's Coastline and Relationship to Inlets. (Bruun, 1962)

St. Lucie Inlet represents an example of the effects of such inlets. Cut in 1892, this inlet has caused an annual average erosion rate of 30 ft/yr on northern Jupiter Island over the period 1892-1976. An additional interesting example is St. Marys Entrance which was provided with jetties in 1902. The jetties altered the flow patterns of the tidal currents causing an additional 120 million cubic yards of sand to be jetted and stored offshore in the ebb tidal shoal (Olsen, 1977).

Due to its generally rocky character, the shoreline of Monroe County is of substantialy different character than that of the remainder of Florida. However, the limited beach areas in Monroe County serve a valuable recreational function and are subject to the same erosional causes discussed.

The annual erosion rate along Florida's east coast ranges, on the average, between 1 to 3 ft/yr, with the long-term extreme rate of 30 ft/yr as noted earlier.

Florida's West Coast. The "Big Bend" area separates the two segments of sandy beaches along Florida's west coast. The lower segment extends from Collier County through Pinellas County, a length of some 170 miles. The upper segment extends from Franklin County to Escambia County, a length of 133 miles.

Along the lower segment of Florida's west coastline, the longshore sediment transport is fairly weak and variable, but is generally directed to the south. The magnitude of this net transport is typically less than 50,000 cubic yards per year. The sand along this section of shoreline tends to be finer than along the east coast and consequently the beaches are of milder slope. Although the littoral processes along the northern segment of the west coast are dominated by winds and waves from the east, there is a location slightly to the west of the Bay-Gulf County line southeast of which the net longshore sediment transport is toward the southeast. Due to the highly variable shoreline features in Gulf and Franklin Counties, the directions of net longshore sediment transport patterns are quite irregular. For example on the north-south leg of Cape San Blas, the transport is toward the north at the north end and to the south at the south end. To the west of Panama City, the net transport is consistently to the west and increasing westerly to an estimated value of approximately 200,000 cubic yards per year at the entrance to Pensacola Bay. The highest long-term erosion rate on the west coast is on

St. Joseph Spit and has averaged 28 ft/yr over the past 136 years (Stapor, 1973).

AN ATTEMPT TO PUT THE CAUSES OF BEACH EROSION INTO PERSPECTIVE

A great deal has been written regarding beach erosion and to some extent there has been substantial misinformation and confusion relating to causes of and responses to the erosion. Therefore it may be helpful to try to put the causes of beach erosion into perspective.

Natural Causes. As described earlier, the greatest natural overall cause of net beach erosion is the slow but pervasive rise in sea level which induces an offshore sediment transport to reestablish an equilibrium beach profile. This offshore sediment transport results in an erosion which in terms of horizontal recession amounts to approximately 100 to 200 times the vertical rise.

In addition to the erosional trend due to sea level rise, long- and short-term natural fluctuations occur. Extreme storms cause severe, generally widespread erosion in a period of less than a day but require several years to recover. Additionally, the long-term processes near inlets result in substantial oscillations of the adjacent shorelines and in some cases, inlet migration causes long-term shoreline instabilities.

In terms of erosional trends, it is estimated that along the Florida east coast, the natural effects account for approximately one-half of the total erosional trend and along the west coast from one-third to one-half of the total.

Human-Related Causes. With regard to human-related causes of beach erosion, along the east coast of Florida, the dominant cause has clearly been due to inlets which have resulted in the impoundment of sediment at the updrift jetties and also storage of huge quantities of material in the ebb and flood tidal shoals. Additionally, early dredging practices too frequently included disposal of large quantities of beach-quality sand at sea, resulting in a loss of this valuable resource to the nearshore system.

The example of St. Marys Entrance modifications has already been noted to have caused storage of very large quantities of sand in the ebb tidal shoals. The construction of the jetties resulted in hydraulic peculiarities which

caused the ebb tidal shoals to increase in volume by an additional 120 million cubic yards of sand. Although it may not be economically feasible to place all of this sand on the beach, this volume is enough to build a beach 17 feet thick, 120 feet wide and 300 miles long! Thus it is clear that compared to other possible causes, the modification of inlets on the east coast has resulted in very, very large amounts of beach erosion. Although the St. Marys example is clearly unusual, the volume increases in the ebb tidal shoals at both St. Johns River and St. Augustine Inlet are of similar magnitudes.

Other possible human-related causes of beach erosion are construction of groin fields and seawalls. Groins act to trap longshore sediment transport on the updrift sides and thereby starve the shorelines downdrift of the groin fields. In the early 1930's and 1940's, groins were regarded as a preferred method of solution for beach erosion. Of course, groins simply redistribute the sand from a beach that usually already has a deficit rather than adding more needed sand to the system. Seawalls and other shore parallel structures are somewhat more benign than groins in the sense that they do not remove sand from the longshore sediment transport. However seawalls and revetments prevent sand from being supplied to the littoral transport system by arresting erosion of the upland (the purpose for which these structures were designed); they are believed to cause a small increase in beach erosion. For example, it is estimated that less than five percent of the east coast of Florida has such coastal structures which reduce the sediment supply to the littoral system. Many of these revetments have been constructed in response to the proximity of inlets and the associated erosional stress. As a rough estimate, if a total of 20 miles (or one hundred thousand lineal feet) of east coast shoreline is revetted and each foot of revetment prevents two cubic yards per year from entering the littoral stream, then the one hundred thousand lineal feet would prevent, on an annual basis, a total of two hundred thousand cubic yards of material from entering the littoral stream. By comparison, the 120 million cubic yards of additional material stored in the ebb tidal shoals at St. Marys Entrance thus amounts to an equivalent of 600 years of material that is prevented from entering the littoral stream by the presence of 20 miles of revetment. Thus in our ranking of the dominant causes of beach erosion along the east coast of Florida, clearly the modifications to inlets must be considered as the greatest cause. Moreover, the specific cause of the erosion is due to the removal of sand from the nearshore system and the remedy thus indicated must be the replacement of sand to the system.

ALTERNATIVE RESPONSES TO BEACH EROSION

Given the present era of sea level rise and slow but persistent erosional trend and the fluctuating storm-induced erosion, the problem arises of identifying the proper response to this erosion. The proper choice will depend on a number of factors including, but not limited to: rate of erosion, existing marine habitats, degree of development, effectiveness of nourishment, availability of a suitable sand source, etc. Somewhat surprisingly there are only three possible responses: (1) retreat, (2) armor and (3) nourish, and of course, combinations of these three. In the following subsections, these various alternatives will be discussed in an attempt to identify and establish the factors that could guide the selection of a proper response.

Prior to discussing the three alternatives, it is important to identify commonly accepted ground rules. It is clear that if we had the opportunity to step back in time, say, one hundred years and plan the development of Florida's beaches with today's knowledge and will, we would chart a different course than was done in the past. However, much of Florida's shoreline has been developed to a moderate to heavy degree. In many locations, State and County highways are located in close proximity to the shoreline. The degree and pattern of present development should be regarded as a common basis for selecting appropriate response strategies to beach erosion. In lightly developed areas, the need for remedial measures can be avoided or delayed through proper siting and construction.

Retreat Response. The retreat response represents the passive approach in which the erosional trend is allowed to occur as it would under completely natural conditions. Figure I.3-a illustrates the variation of the shoreline position with time under this alternative. In analyzing the effects of the retreat alternatives, two types of upland structures are recognized, depending on their foundations. Some structural foundations, in particular piling, are designed to function even though the erosion progresses beneath the structure. In such cases, the structural integrity may be maintained even though the beach migrates, due to erosion, past the structure, leaving it on the active beach. The second type of foundation, such as "slab on grade", is not designed to withstand erosion--beach retreat under this foundation will cause loss of structural integrity. Of this type, those structures which can

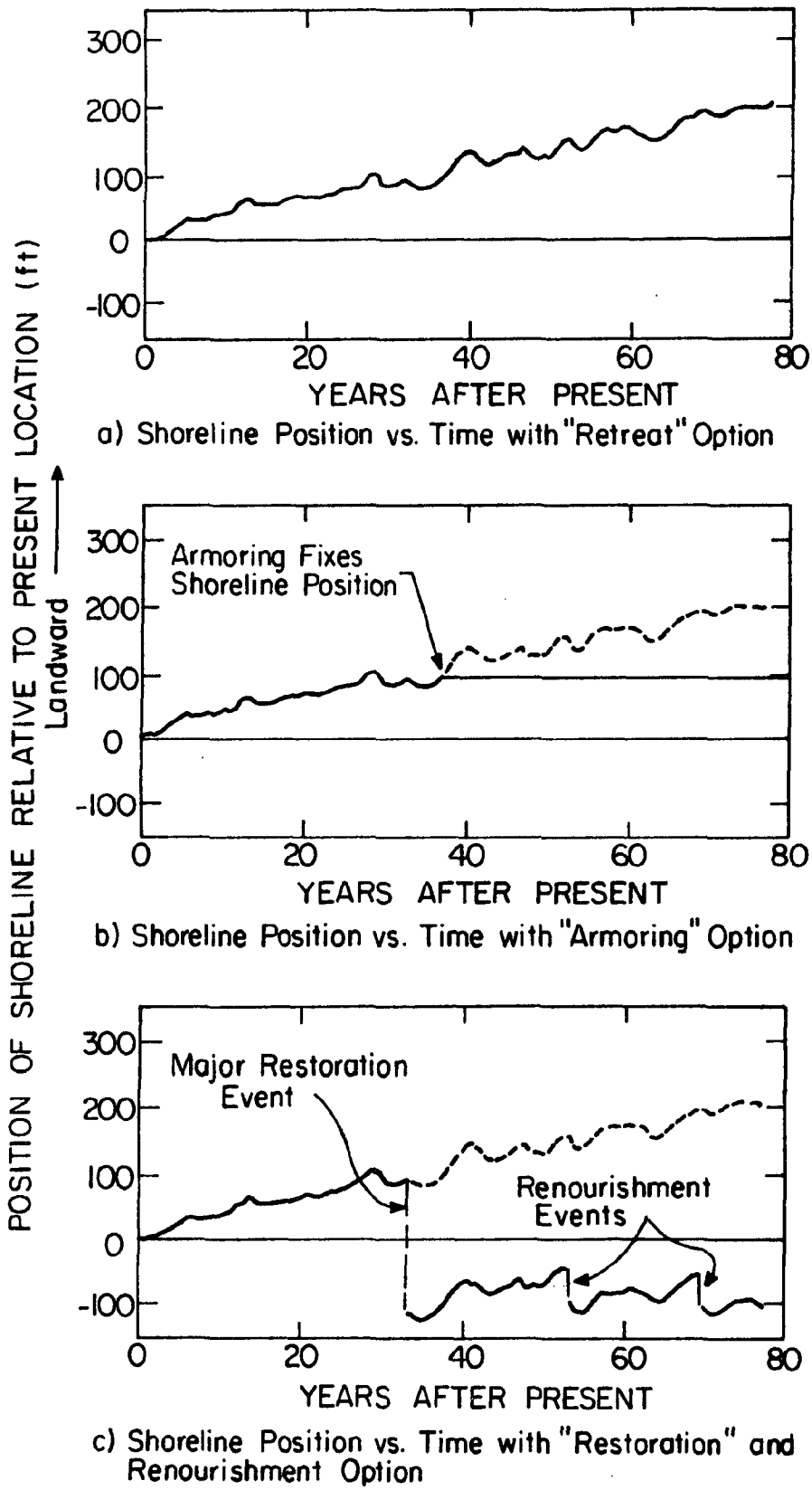

Figure I.3. Shoreline Positions Under Three Options.

be moved economically could be relocated inland. Those structures and facilities which cannot be moved, including roads and some utilities, must be demolished or will succumb to the forces of the sea, usually during storms.

In the above sceanario, it is clear that the factors favoring the "retreat alternative" would be: (1) low density development, and (2) high erosion rates, making nourishment and to a lesser extent, armoring, relatively ineffective and uneconomical choices.

An advance State management policy appropriate for the retreat alternative includes : (1) designating areas as those in which, for the foreseeable future, the retreat mechanisms will be followed, and (2) siting structures as far from the shoreline as possible.

Armoring Response. The armoring response is a decision to "hold the coast" in place to prevent further encroachment of the sea. This leads to a deepening of water adjacent to the structure (loss of the beach) and also, primarily through the prevention of sand being fed into the system through erosion, leads to some additional erosional pressure on the adjacent shorelines. Factors which may favor the armoring response are: (1) upland development and/or facilities which warrant protection, (2) where for lack of a suitable sand source or other reasons, nourishment is not a viable alternative, and (3) as a temporary measure until nourishment can be accomplished. If decisions are made to allow armoring without nourishment, it is suggested that this be on a littoral segment basis such as on a barrier island. One combination of approaches would be to allow armoring but to require the installer to mitigate the effects of the revetment through the annual addition of a quantity of sand into the system which is equal to or greater than the amount prevented by the armoring installation. Again, as in the case of the retreat response, it is recommended that the State develop a clear policy toward armoring in order that shorefront property owners and coastal communities can plan accordingly. Less impact to adjacent shorelines will occur if this is done. The variation of the shoreline position with time under the armoring option is presented in Figure I.3-b.

Beach Restoration and Renourishment Response. Beach nourishment encompasses both restoration and renourishment and is the process of placing sufficient

quantities of beach quality sand into the system to reverse and/or offset the effects of erosion. Restoration refers to the placement of sufficient quantities of sand to widen the beach to a near-natural condition whereas beach renourishment refers to the addition of smaller quantities of sand to maintain the beach in this near-natural condition. These two elements of the nourishment responses are illustrated in Figure I.3-c. Factors which favor the beach nourishment alternative include: (1) high recreational and/or upland property values, (2) low erosion rates, and (3) availability of high-quality sand sources. Again, proper shoreline planning would be assisted by designating those areas where nourishment is the selected alternative.

Beach nourishment is most effective where the beach is slightly out of balance such that only a small remedial effort will be effective in restoring the balance.

THE BEACH RESTORATION ALTERNATIVE

General. Past projects have been implemented to mitigate beach erosion in a specific area and the nourishment sand was placed on the beach fronting this segment of the shoreline. The effectiveness of such projects was based on the retention of sand in the area placed, even though it is recognized that placed material of beach quality remained in the system and benefitted the adjacent beaches. As the objective of the proposed program will be to benefit long segments of the beaches of the State, sand remaining in the system will be considered in evaluating the effectiveness of the program. In fact, where natural conditions are appropriate, the use of "feeder beaches" will be explored which constitutes placing high-quality material in the system in a localized area and allowing this material to be transported downdrift by natural forces to benefit these beaches. The following subsections will describe the feeder beach concept and will discuss the behavior of beach restoration and renourishment projects.

Feeder Beach Concept. An ideal location for the feeder beach concept would be near a source of high-quality beach sand at the updrift end of a littoral subsystem. The updrift end of a barrier island might be an ideal location for a feeder beach with the ebb tidal shoals providing a large quantity of high-quality sand (Figure I.4). Typically these barrier islands on the east coast

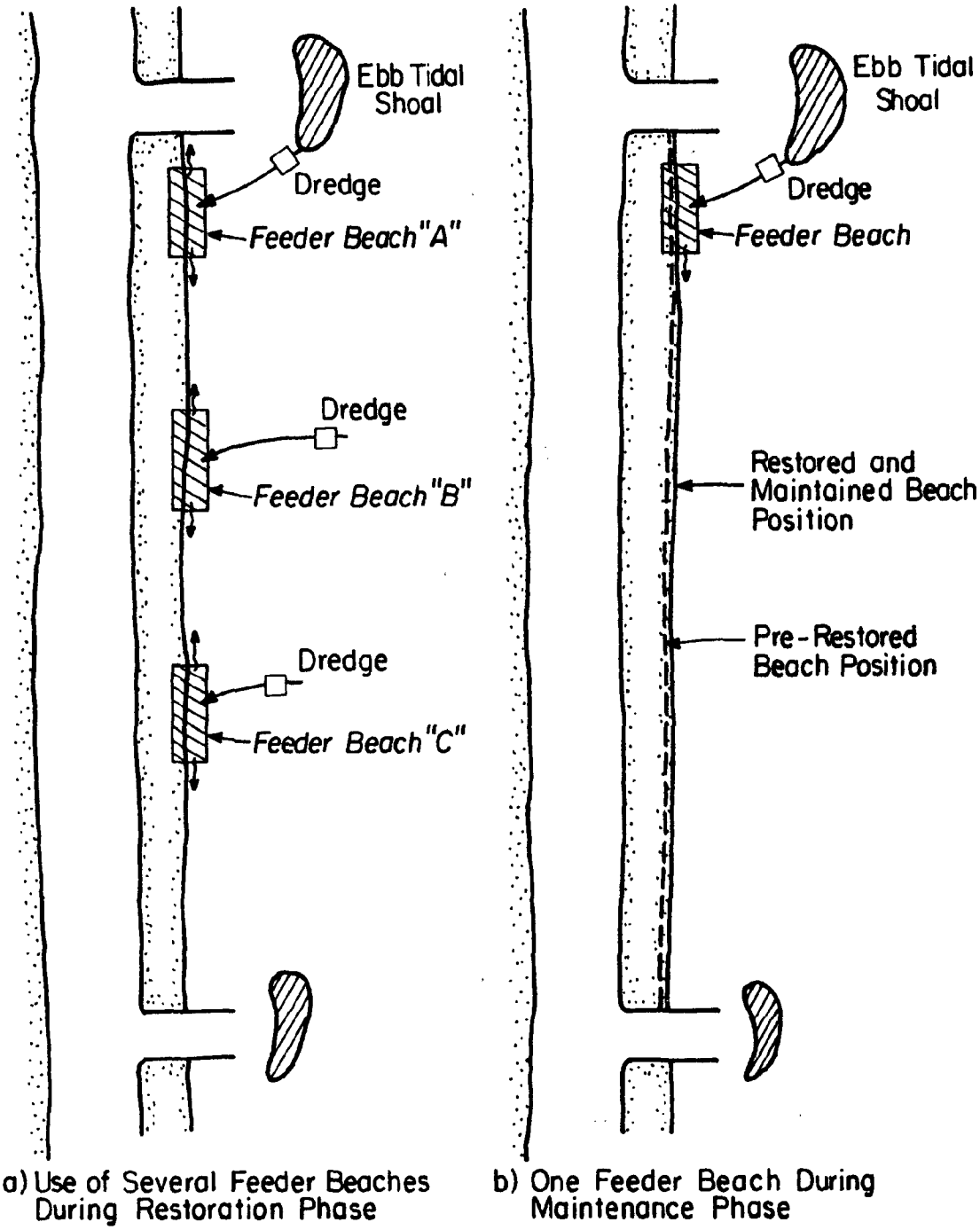

Figure I.4. Feeder Beach Concept in Restoration and Maintenance Phases.

of Florida are on the order of 10 to 30 miles in length. With the natural longshore sediment transport from north to south, the material would be placed in the "feeder beach" which could be two miles in length. The sand would spread out to the south and except for the blocking effect of the south jetty at the inlet would also move to the north. The single feeder beach concept at the updrift end of a littoral cell is ideally suited for maintenance of a restored beach and will be useful but probably will require additional "feeder beach" locations for the initial restoration. Figure I.4-a presents an illustration where, during restoration, "feeder beaches" are located every 5 miles or so and are approximately one mile in length. Sand placed in these feeder beaches will spread out laterally, gradually widening the entire beach. Figure I.4-b represents the maintenance phase with one feeder beach at the updrift end of the littoral cell.

It is clear that any nourishment project on an uninterrupted beach will act as a feeder beach providing sand to the downdrift beaches and thus reduce the erosional trend and the need for nourishment downdrift of the project.

Mechanics of Beach Nourishment. Sand placed on the beach may move both parallel and perpendicular to the shoreline. Although our ability to predict the behavior of nourishment projects is not complete, it may be helpful to discuss the general knowledge of this subject.

Profile Adjustment. For a particular sand size there is a so-called "equilibrium beach profile". Although the actual beach profile varies with wave climate somewhat around the equilibrium, the concept of an equilibrium profile will serve adequately for our purposes. The equilibrium beach profiles for coarse and fine sand are relatively steep and mild, respectively. Generally, as shown in Figure I.5, when a beach is nourished, the sand is placed on a slope which is steeper than the equilibrium. Over the ensuing months and perhaps years, as larger and larger waves occur, the beach profile will equilibrate, gradually transporting material seaward, until the equilibrium profile occurs (approximately). Associated with this equilibration is a reduction in the width of the above-water beach, thus lending the impression that sand is being lost from the area, although the sand is merely being transported seaward where it performs a vital storm protection function in reducing the height and energy of storm waves. Thus

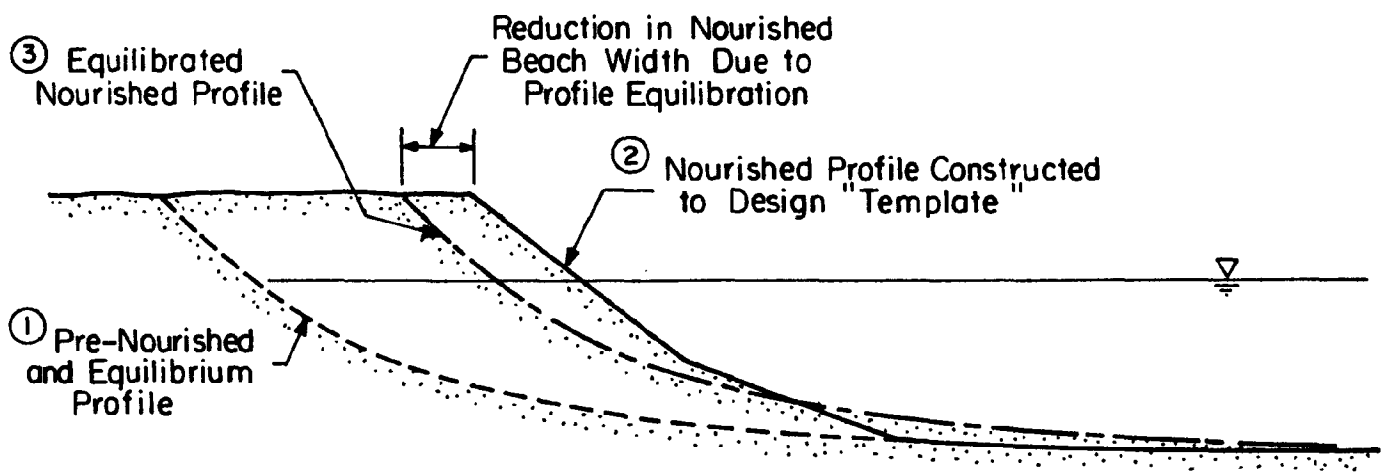

Figure I.5. Reduction in Beach Width Due to Profile Equilibration from Construction Template.

sand which is tranferred from the "dry beach" offshore is not lost from the system and this reduction in beach width should be expected and regarded in the light of equilibration of the beach profile rather than as an indication of the ineffectivenss of the project.

Longshore Transport. In addition to the offshore transport, sand placed on the beach results in an anomalous planform bulge which will be smoothed by natural forces in an alongshore direction, Figure I.6. To illustrate the concepts of beach nourishment and loss of material in the region placed due to longshore transport, two idealized cases are discussed in Appendix B. The first case pertains to the situation where a beach fill is placed on a long straight uninterrupted coastline and material "lost" is due to the fill "spreading out" and benefitting the adjacent beaches. The second case is that where a fill is placed immediately downdrift of a complete interruption in the longshore sediment transport. As an example of the first case, a project of four miles length where the effective waves are one foot in height would be expected to "lose" 15 percent of its volume in a period of 20 years. The longevity of beach fills is treated in greater detail in Appendix B.

Effects of Sea Level Rise on Future Nourishment Requirements. Some recent studies have suggested that, due to the "green house" effect, the rate of sea level rise will increase in the future. A recent (1984) study by the Environmental Protection Agency (EPA) projects a world-wide sea level increase by the year 2100 ranging from 1.8 to 11.3 ft. Other studies have suggested a substantially more moderate range. For example the National Academy Study (NAS), "The Changing Climate", predicts a rise over the next century of 2.3 ft.

Appendix C presents a detailed evaluation of the increased beach nourishment requirements due to increased sea level rise. The results show, that if a beach nourishment program is successful in effectively bypassing sand at inlets thereby eliminating this present erosional component due to alongshore sediment transport, the average annual renourishment requirement over the next 50 years would be the same as the present rate. Over the next century, the average increase would be 50%.

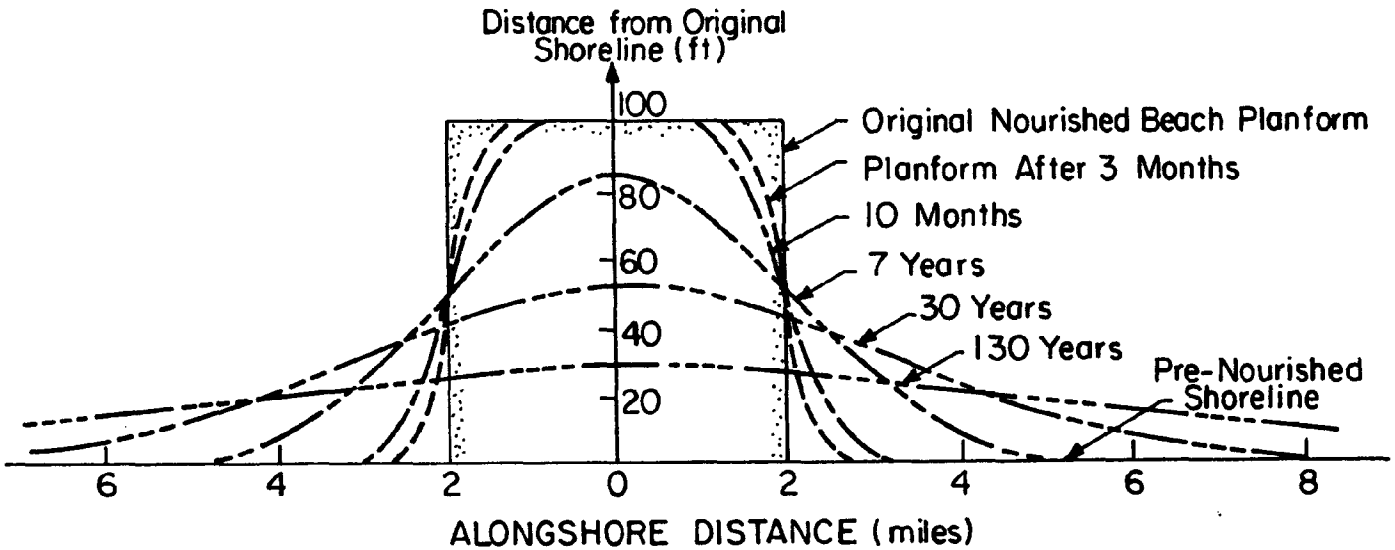

Figure I.6. Example of Evolution of Initially Rectangular Nourished Beach Planform. Example for Project Length, ℓ, of 4 Miles and Effective Wave Height, H, of 2 Feet and Initial Nourished Beach Width of 100 Feet.

Comments on the Performance of Miami Beach Project. The Miami Beach Project was commenced in 1974 with the Bal Harbour section (at the north end). In conjunction with this project, the south jetty at Bakers Haulover was extended and recurved toward the south. Prior to construction of this stabilization structure, sand placed on this beach was eroded rapidly, primarily by the flood tidal currents into Bakers Haulover Inlet, with associated deposition as a flood tidal shoal inside Biscayne Bay. For a large portion of the time, the waterline at Bal Harbour was at the seawalls. Due to the lack of sediment transport from the north as prevented by the high currents at Bakers Haulover and the net southerly longshore transport, this is clearly the most highly erosion-stressed segment of the project. Therefore it is of interest to examine its performance at this location.

The construction of this northerly section of the Miami Beach project advanced the beach seaward by approximately 300 ft. Measurements based on 1981 and 1985 photographs show that approximately 8 1/2 years after placement, the beach had receded only some 40 ft. Moreover, in the period 1981 to 1985, the beach was essentially stable with any changes discernible being less than ±10 ft. Thus it is interpreted that the 40 ft. "recession" from 1976 to 1981 was in part the previously discussed "profile equilibration". The Miami Beach Project is a clear example of a successful beach restoration program, providing a wide recreational and storm protection beach with only minimal shoreline changes in the initial ten year period after construction.

Chapter II

THE IMPORTANCE OF FLORIDA'S BEACH RESOURCES

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THE IMPORTANCE OF FLORIDA'S BEACH RESOURCES

ECONOMIC CONSIDERATIONS

Florida's beaches are a resource which attract and are enjoyed by residents and tourists. In combination with Florida's favorable climate, beaches have become the State's most important asset for attracting tourists.

The worth or value of Florida's beaches to the State's economy has been both of significant interest and difficult to quantify with precision. Difficulty in precise identification of Florida beach value stems from the fact that State revenue originates from sales tax rather than the more accountable income tax. Hence, it is not possible to know how many times the dollar experiences a taxable transaction (called the multiplier). Even so, studies funded during the past several years have developed clarifying information to more nearly quantify beach value.

As a general first indication, beach value should increase as population increases. It is apparent from Figure II.1 that relative to population growth of the world and North America, Florida's population growth has been significant; a continuation of the trend appears likely.

A study recently completed by Bell and Leeworthy (1985, 1986) has resulted in elucidating information. The following is a summary.

In a twelve month period from January through December of 1984, an estimated 34 percent of Florida's visitors came to Florida because of its beaches. Note, however, that the State of Florida (annual reports of the Florida Department of Commerce) reports that 77 percent of auto tourists and 44 percent of air tourists enjoy Florida because of the beaches, the former contributing twice as many tourists as the latter. Curtis, Moss and Shows (1985) state "approximately 70 percent of Florida's tourists report that sand beaches are an important determinant in their decision to vacation in Florida". These tourists spent over 69 million days at the beaches and generated beach related direct sales of $1.15 billion supporting an estimated 47,546 jobs with an annual payroll of nearly $287 million. The tourist dollar has a multiplier impact on the Florida economy which produces induced sales, employment, wages and taxes. Using a conservative multiplier of 3, it is

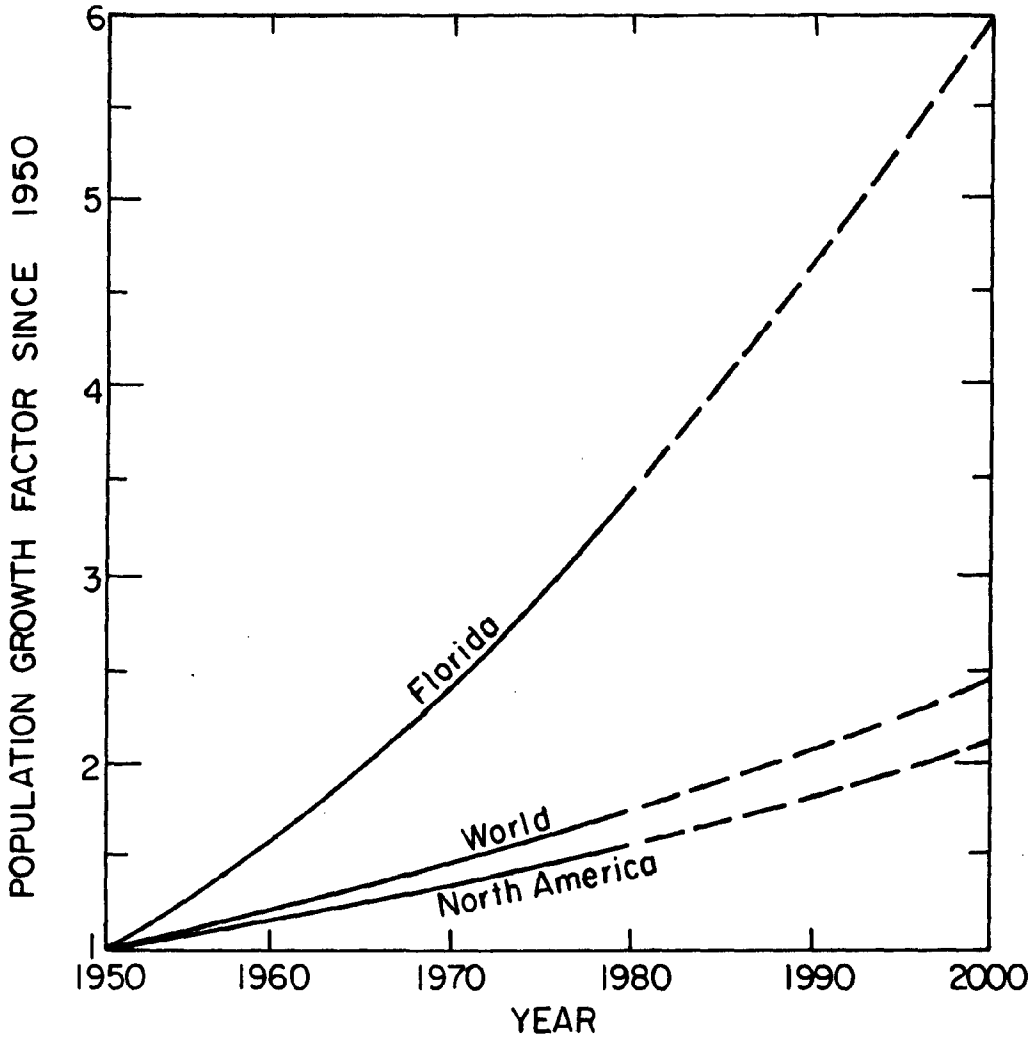

Figure II.1. Measured and Projected Relative Population Growth since 1950 for the World, North America and Florida.

estimated that $2.3 billion in induced sales generated over 95,000 jobs during the period, with an annual payroll of nearly $574 million. Induced State taxes are estimated at about $41 million. Total beach related tourism, using the multiplier for the study period, created over $3.4 billion in sales, supporting 142,638 jobs with an annual payroll of over $860 million; total estimated sales taxes generated thereto amounted to nearly $99 million.

During the study period, combined resident and tourist use of Florida's beaches accounted for an estimated 146 million beach recreational days and generated direct and indirect beach related sales of $4.581 billion, while sales generated thereto created an estimated 179,256 jobs and $164 million in State taxes.

Tourist related economic activities include a diversity of business related revenue including hotels, restaurants, automobile repair and fuel establishments, gift shops, supermarkets, to name only a few. These business establishments not only provide for direct and induced sales, employment and wages but also contribute a sizeable portion of county Ad Valorem taxes. The percentage of business activities related, either directly or indirectly, to the beach resources of Florida is not known. However, the total value of real property within beach resource counties certainly indicates the relative worth of not only business related property but other beach front property as well. The just value of real property in the 26 coastal counties with sandy beaches for calendar year 1984, amounted to over $252 billion, or about 74 percent of all just value of real property in Florida. Ad Valorem taxes levied by beach resource counties on real property value in 1984 was approximately $3.5 billion.

Assuming that a favorable beach related economy continues, some $45.81 billion in direct and indirect sales will occur in Florida during the next decade as a result of Florida's beaches. Additionally, some $1.64 billion in direct beach related State taxes will be collected (this does not include local taxes).

Tourism, population and State budget statistics compiled by the Florida Department of Commerce are listed in Table II.1 from which the importance of tourism is punctuated. Curtis and Shows (1984) report that in recent years tourist expenditures comprise about 19 percent of the Gross State Product. The relative importance of tourism is illustrated by comparison with other categories of Florida business in Table II.2.

Table II.1. Florida Fiscal Statistics - Tourism

Year	Tourist Arrivals (Millions)	Tourist Expenditure ($ Billions)	Florida Population (Millions)	State Budget ($ Billions)
1974	24.500	6.690	7.900	4.359
1975	26.260	8.844	8.200	4.569
1976	29.502	10.372	8.400	4.900
1977	29.674	11.479	8.650	5.390
1978	34.020	12.935	9.000	5.951
1979	35.664	15.993	9.400	7.749
1980	35.923	17.081	9.740	7.891
1981	35.905	18.594	10.100	8.560
1982	37.445	20.785	10.350	9.547
1983	38.907	22.820	10.750	10.547

Table II.2. Florida Department of Commerce Five Year Summary

	TOURISM	INDUSTRY NEW*	EXPANDED* (Compilations begun Jan. 1981)	NEW & EXPANDED INDUSTRY SUMMARY	TRADE	MOTION PICTURE & TV
1979	35.6 Mil. visitors $16 Bil. expenditures	*125 industries (includes foreign) 25,583 jobs $722.3 Mil. capital investment	———	———	$7.6 Bil. exports $5.9 Bil. imports $13.5 Bil. total trade	23 films and TV $42.9 Mil. budget $40 Mil. commercials (approx.)
1980	35.9 Mil. visitors $17 Bil. expenditures	*62 industries (includes foreign) 19,886 jobs $981.1 Mil. capital investment	———	———	$10.3 Bil. exports $6.5 Bil. imports $16.8 Bil total trade.	19 films and TV $78.5 Mil. budget $50 Mil. commercials (approx.)
1981	35.9 Mil. visitors $18.6 Bil. expenditures	*138 industries 23,431 jobs $943.3 Mil. capital investment	*123 industries 33,685 jobs $669.7 Mil. capital investment	261 industries 57,106 jobs $1.6 Bil. capital investment	$11.2 Bil. exports $7.4 Bil. imports $18.6 Bil. total trade	13 films and TV $50.3 Mil. budget $40 Mil. commercials (approx.)
1982	**37.4 Mil. visitors **$20.7 Bil. expenditures	*111 industries 19,544 jobs $943.3 Mil. capital investment	*110 industries 16,619 jobs $1.8 Bil. capital investment	221 industries 36,163 jobs $2.2 Bil. capital investment	$9.9 Bil. exports $7.1 Bil. imports $17.0 Bil. total trade	32 films and TV $78.2 Mil. budget $63.8 Mil. commercials
1983	38.9 Mil. visitors $22.8 Bil. expenditures	*93 industries 11,327 jobs $339.7 Mil. capital investment	*48 industries 4,788 jobs $1.9 Bil. capital investment	141 industries 16,095 jobs $2.2 Bil. capital investment	$7.6 Bil. exports $7.9 Bil. imports $15.5 Bil. total trade	27 films and TV $68 Mil. budget $76.9 Mil. commercials ***$2.5 Mil. recordings
5 Year Total	183.7 Mil. visitors $95.1 Bil. expenditures	*529 industries 99,760 jobs $3.4 Bil. capital investment	*281 industries 55,072 jobs $4.4 Bil. capital investment	810 industries 154,832 jobs $7.8 Bil. investment	$46.6 Bil. exports $34.6 Bil. imports $81.2 Bil. total trade	114 films & TV $318 Mil. budget $291 Mil. commercials

*FDC-assisted industries only. Statistics for all state locations and expansions unavailable.

**Final adjusted 1982 data

***First-year on recording activity in Florida

Another way to measure the value of Florida's sandy beaches is to examine recent costs of beach nourishment projects. These serve to illustrate the benefits of beach protection to the extent that such costs or expenditures are not required when the beaches are preserved by other means. During the past several years Curtis, Shows and Spence (1980) and Curtis and Shows (1982, 1984) have conducted a number of benefit/cost studies regarding beach nourishment projects. Table II.3 provides estimates of annual costs for the Delray and Jacksonville Beach nourishment projects. The table lists current costs, assuming different interest rates. They also break out the cost per mile and cost per foot of beachfront. Data for the Delray Beach restoration project suggests a beachfront value of from $606 to $747 per alongshore foot of beach. However, since these data were obtained almost three years ago, inflation adjustment yields a current value of from $689 to $849 per alongshore foot of beach. Jacksonville Beach has a value of from $530 to $740 per alongshore foot of beach. Although the value of beachfront land varies significantly along coastal Florida, it is probably true, particularly for urban coastal areas, that the cost of artificial beach nourishment is small compared to the real value of coastal property.

While we now have an idea of the importance of beaches to the State of Florida, it is also important to know how the State is maintaining this highly valuable economic source. This task is the responsibility of the Department of Natural Resources, headed by the Florida Governor and Cabinet, through the Division of Beaches and Shores. Historical funding levels of the Division are listed in Table II.4. These data are further simplified and listed in Table II.5 according to each of the four basic functions of the Division described in Table II.4. Table II.5 also presents the State budget and compares Division funding levels to the State Budget on an annual basis. Average funding levels for resource protection, maintenance and preservation is approximately 0.06 percent of the annual State budget.

BEACHES AS STORM PROTECTION

The Shore Protection Manual (U.S. Army, 1977) states "beaches of suitable dimensions are effective in dissipating wave energy, and, when they can be maintained to proper dimensions, afford protection for the adjacent upland, and are classed as shore-protection structures". Using artificial nourishment

Table II.3. Estimated Beach Nourishment Costs

Interest Rate	Present Value	Project Length	Cost/Mile	Cost/Foot
	DELRAY BEACH PROJECT (Sept. 1982)			
7%	$11,948,092	3.03	$3,943,265	$747
9%	10,646,538	3.03	3,513,708	665
11%	9,694,454	3.03	3,199,489	606
	JACKSONVILLE BEACH PROJECT (July 1984)			
5%	39,097,000	10.0	3,909,700	740
7%	32,596,000	10.0	3,259,600	617
9%	28,116,000	10.0	2,811,600	532

Sources: Curtis and Shows (1982, 1984).

Table II.4. Division of Beaches and Shores Historical Expenditures in Thousands of Approximate Dollars

	OFFICE OF BEACH EROSION CONTROL						BUREAU OF COASTAL DATA ACQUISITION			BUREAU OF C E & REGU	DIV EXEC OFFICE
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Fiscal Year	Beach Nourishment	Sand Transfer	Dune Protection	Structural Solution	Research and Other	ECA Admin	Line Establish-ment	Data Collection Analysis, & Admin	CCCL Total	Permit-ting Admin	Exec Admin
65-66	0	25	0	131	0	NA	--	--	--	--	NA
66-67	147	0	0	25	106	NA	--	--	--	--	NA
67-68	24	46	0	9	15	NA	--	--	--	--	NA
68-69	0	160	0	0	115	NA	--	--	--	--	NA
69-70	88	0	0	0	2	9	--	--	--	26	9
70-71	678	122	0	0	15	5	--	--	--	14	5
71-72	125	119	0	53	37	9	166	*	166	28	9
72-73	326	27	0	0	0	31	500	*	500	84	31
73-74	1660	0	0	150	30	42	132	*	132	110	42
74-75	1454	255	5	50	90	73	476	*	476	145	73
75-76	1298	0	0	57	64	70	241	360	601	139	70
76-77	2313	68	32	0	21	80	57	495	552	160	80
77-78	2562	45	47	0	32	121	306	329	635	355	69
78-79	382	0	18	0	68	157	299	425	724	459	89
79-80	6696	1523	196	0	151	205	348	520	868	581	85
80-81	3963	0	203	0	159	65	316	529	745	566	124
81-82	5613	1211	59	0	0	234	427	645	1072	720	105
82-83	125	1036	181	13	74	106	258	1177	1435	548	147
83-84	1558	411	90	216	18	254	440	1149	1589	600	158

NOTES: NA - data not available.
* Numbers included in tally of column (8) when program was at University of Florida, COEL.
Column (8) is for outside contracted coastal engineering, DOT survey work and aerial photography.

Table II.5. State Budget and Division of Beaches and Shores Budget by Category and as a Percent

Fiscal Year	State Budget ($ billions)	Expenditures by Category (Division of Beaches and Shores)				Total Expenditures (DBS)* $	DBS Budget as a Percent of State Budget
		Beach Erosion Control $	Coastal Data Acquisition $	Engineering and Regulation $	Executive Division Office $		
74-75	4.359	1,927,000	476,000	145,000	73,000	2,621,000	0.067
75-76	4.569	1,489,000	601,000	139,000	70,000	2,299,000	0.050
76-77	4.900	2,514,000	552,000	160,000	80,000	3,306,000	0.067
77-78	5.390	2,807,000	635,000	355,000	69,000	3,866,000	0.072
78-79	5.951	625,000	724,000	459,000	89,000	1,897,000	0.032
79-80	7.749	8,771,000	868,000	581,000	85,000	10,304,000	0.133
80-81	7.891	4,390,000	745,000	560,000	124,000	5,819,000	0.074
81-82	8.569	7,117,000	1,072,000	720,000	105,000	9,014,000	0.105
82-83	9.547	1,535,000	1,435,000	548,000	147,000	3,665,000	0.038
83-84	10.547	2,547,000	1,149,000	600,000	158,000	4,454,000	0.042

*DBS = Division of Beaches and Shores

methodology, long reaches of beach may be protected at a cost relatively low compared to costs of other adequate protective structures. It is significant that artificial nourishment directly remedies the basic cause of most erosion problems - a deficiency in natural sand supply - and benefits rather than damages the shore beyond the immediate problem area. That is, the beach is replaced with a beach which supplies sand to the adjacent beaches rather than a shore-hardening structure which can damage the adjacent beaches. In addition, a widened beach has the basic characteristic of increasing beach value because of its recreational benefits.

In Florida, beach nourishment projects are encouraged to have artifical dunes constructed on the landward side of the project. These dunes, in addition to the nourished beach, provide additional storm protection.

VALUE OF PUBLIC BEACHFRONT PROPERTY

Of the approximately 800 miles of Florida's sandy beaches fronting the Atlantic Ocean, Gulf of Mexico or Straits of Florida, approximately 390 miles are owned by Federal, State, or local governments. Although without an appraisal, there is no way to arrive at an accurate value of the publicly-owned beachfront property in Florida, an estimate of the minimum value of the property is in excess of $11.4 billion. Of the 390 miles of publicly-owned beach, an estimated 71 miles, or about 18 percent, are considered to be severely eroding. The value of that publicly-owned, severely eroding, beach property is estimated to be some $2.0 billion.

The State of Florida and some local governments have prided themselves, and rightfully so, in implementing beachfront acquisition programs. Similar emphasis should be placed on protecting those acquired public beach resources from erosion losses. Already, over $2.03 billion worth of publicly-owned beachfront property is threatened by erosion. If the problem of erosion is not resolved, Florida stands to lose a valuable resource that has taken years and many millions of dollars to acquire. The acquisition of public beachfront property by all levels of government is effectively addressing concerns that such property would be developed, which would result in the loss of the property to the public and indeed possibly the loss of the beach itself. Similar attention should be given to protecting, enhancing and possibly restoring certain eroding public beach property already purchased to address fears that the property will be lost, not by development but by erosion.

In April 1985, the Department of Natural Resources, with the assistance of the Restore Our Coast Task Force, published a document entitled "Beach Restoration: A State Initiative". In that report an estimate of the cost of restoring approximately 140 miles of critically eroded beach was set at some $472 million. Based on an estimate of the restoration needs in park areas, approximately $239 million would be required for the 71 miles of severely eroded public beach, the value of which is over $2.0 billion. As can be seen the cost associated with restoring a portion or all of the State's publicly-owned eroded beach is considerable. However, for comparative purposes, one may wish to consider other public works projects. Presented below are several capital-intensive projects in Florida--projects considered to be in the public interest.

Public Works Projects	Approximate Cost
High Speed Train - Tampa to Miami	$ 3.00 Billion
Miami Metrorail System	1.05 Billion
Interstate Highway (Alligator Alley)	380.00 Million
Skyway Bridge	200.00 Million
Key's Bridge	179.00 Million
I-595 Port Everglades Loop	1.20 Billion
Miami Dolphins Football Stadium	125.00 Million

If the public is willing and able to expend the funds to construct such public interest projects as noted above, it appears that the same interest should apply to restoring eroding public beachfront property.

Chapter III

FLORIDA'S CURRENT

BEACH EROSION CONTROL PROGRAM

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FLORIDA'S CURRENT BEACH EROSION CONTROL PROGRAM

BACKGROUND

Florida's Beach Erosion Control Program is administered by the Department of Natural Resources pursuant to ss. 161.091 Florida Statutes as a grant-in-aid to local governments program with program initiative resting almost exclusively with local governments.

A local government identifying a beach erosion problem may apply to the Department for funding. Applications are received, on a biennial basis coincident with the Legislative biennial budget process. Projects are evaluated by the Department after which eligible project applications are submitted as part of the Department's Legislative budget request.

Local governments receiving an appropriation for specific projects are required to submit to the Department certain data necessary for project implementation, i.e., environmental permits, plans and specifications, etc. Upon receipt and review of all required data by the Department the application is submitted to the Florida Governor and Cabinet with a staff recommendation. Upon approval of a project contract, actual implementation of the project may begin.

Eligible project types under the program include, but are not necessarily limited to, beach restoration, renourishment, dune enhancement and protection measures, inlet sand transfer projects, special shoreline studies, and certain structural activities including terminal groins, offshore breakwaters, etc.

If the Federal Government is participating financially in a project the Legislature may appropriate up to 75 percent of the non-Federal share of eligible project costs with local government project sponsors required to contribute 25 percent of the non-Federal project cost. If Federal participation is not available the Legislature may appropriate up to 75 percent of the total eligible project activity cost. The State pays 100 percent of all sand source studies as well as all costs for erosion control projects of which the State is the upland riparian owner.

PROGRAM ACCOMPLISHMENTS

The State of Florida under the Florida Beach Erosion Control Program, with the financial and technical assistance of local governments and Federal agencies, has restored or renourished 67.3 miles of beach during the period 1965 to 1984 at a cost to the State of $34.4 million with the total cost being over $115.5 million.

The Program has been most successful in certain areas of the State. All but a few miles of the entire east coast shorelines of Dade and Broward Counties have been restored. Although not of the same magnitude, other projects in Duval, Pinellas, Palm Beach and Brevard Counties have proven quite successful.

It is important to note that the vast majority of restoration projects implemented in Florida are performing as designed or in some cases are exceeding design standards in terms of performance.

PROBLEM AREAS WITH FLORIDA'S CURRENT PROGRAM

As previously mentioned, Florida's Beach Erosion Control Program has been extremely effective for a number of years. However, changing conditions of Florida's coastal areas have rendered the current program inadequate. Increased development pressure, sea level rise, inlet modifications, extreme storm events and increased demand for shore armoring without mitigation have changed the complexion of Florida's beach erosion problem. As the State erosion control program has always depended on local government initiative, it is not surprising that areas such as Dade and Broward Counties were primarily the forerunners of comprehensive solutions to beach erosion problems. With so many different coastal areas now experiencing similar severe erosion problems at the same point in time, competition for available Federal and State financial and technical assistance has increased dramatically.

Under the current system, the Department does not and cannot select erosion control projects based on State-wide needs. In areas of the State with severe erosion problems, the Department is powerless to initiate a remedy unless a local government submits an application for funding. The State cannot continue to provide this limited ministerial role in the identification of a proper response to Florida's erosion problem..

Program emphasis must be modified with the State taking the lead role in identifying, prioritizing and sponsoring erosion control projects on a State-wide basis. The critical beach erosion problems facing Florida must now be viewed as a State problem of significant proportion and dealt with by comprehensive efforts at the State level. Other factors that have also led to a general decline in the effectiveness of the program are discussed in the following paragraphs.

Lack of Comprehensive Planning. A program designed to preserve, protect, and enhance Florida's beach resources must invariably depend on a comprehensive planning effort. Such a program must possess a systematic and realistic approach to resolving Florida's beach erosion problems. Essential to such a program is the development of a more complete knowledge of beach conditions on a State-wide basis in order that erosion control measures can be identified in terms of the type of measures to be utilized in the most critical areas.

Florida has not embarked on a truly comprehensive beach erosion control planning effort, but rather has deferred that responsibility to a multitude of agencies at the Federal, State, and local levels of government. This has resulted in beach erosion control planning and implementation efforts that have been largely sporadic in nature and at best fragmented with very little central control. A more sophisticated and comprehensive approach to resolving Florida's beach erosion problems is now required.

Lack of Funding Flexibility. Certain changes in the funding mechanism used in the existing program are required to bridge the gap between an outdated program and a truly comprehensive endeavor. First a stable source of funding must be identified which will ensure funding for the program on a financially predictable basis. Beach erosion control projects are very complex, expensive, and time consuming to plan and prepare. Project preparation is a must under the current program as a project cannot be submitted to the Legislature for funding without certain information being available. Conversely, if funds are expended for project preparation, history has proven that only a slight hope exists that the project will be funded in a timely manner, if at all. Therefore a conflict exists between project preparation and funding. Additionally, certain aspects of project preparation, i.e., shoreline changes etc., quickly become outdated requiring a

costly restudy to update the project design. Thus, if funds are not made available in a timely fashion, the cost of implementing a project increases dramatically.

Secondly, fixed capital outlay line-item funding currently used is not a workable system. Under this system monies appropriated for a project found not to be viable cannot be transferred to viable projects that may have been underestimated with respect to total project cost. For example, during fiscal year 1985-86, the Corps of Engineers had no alternative but to dispose of beach compatable sand offshore rather than placing the material on the Anastasia State Park beach as would have occurred if the Department had the capability to transfer funds from project to project.

Most construction programs in state government rely on fixed capital outlay as a more suitable type of appropriation. However, with respect to Beach Erosion Control Program funding, flexibility must be available.

Federal Participation. Over 42 million cubic yards of sand have been placed on Florida's beaches as a direct result of Federal participation. The severe erosion problems of Dade and Broward Counties could not have been virtually resolved without that participation. Federal assistance has also resulted in project construction in Duval, Pinellas, and Palm Beach Counties. Federal participation has been significant in these five counties as, under Federal criteria, projects within these highly urbanized areas were readily justifiable. It is probable that future erosion control projects within these areas will continue to benefit from Federal participation. In addition, Federal projects implemented elsewhere in the State should continue to receive Federal assistance on at least a maintenance basis.

Much of the remainder of the State may not qualify for Federal financial assistance, and erosion problems may have to be resolved with State and local funding capabilities. This should not lead to the conclusion that additional Federal funds for new projects cannot be obtained. State and local governments, using all the efforts, support, and power at their disposal, should continue to pursue Federal funds.

Obtaining additional Federal, technical, and financial assistance is one of the two identified problem areas with respect to Federal participation. The second is the manner in which Federal law requires the Corps of Engineers

to, in a few cases, dispose of beach suitable material dredged from Federal inlet navigation channels in offshore disposal areas pursuant to PL 94-587 (least cost method of inlet sand disposal). Clearly, to remove such a valuable nonrenewable resource and essentially destroy that resource by offshore disposal is an inexcusable waste.

Administrative Procedural Problems. Dredge and fill operations, such as beach restoration which are conducted on sovereignty lands of Florida must be authorized by various regulatory agencies including the Department of Natural Resources, Department of Environmental Regulation, Department of State, Board of Trustees of the Internal Improvement Trust Fund and the U.S. Army Corps of Engineers.

The process of obtaining all the various approvals and providing the necessary information to obtain these approvals is time-consuming. The need for a streamlining process came to light in 1979 and 1982 with the Corps of Engineers' maintenance dredging of Federally-authorized navigation channels. In 1979, the Departments of Natural Resources, Environmental Regulation, and the Board of Trustees entered into a Memorandum of Understanding with the Corps of Engineers that a sole permitting agency would act on behalf of the State in issuance of permits to the Corps for inlet dredging. This has proven somewhat successful in streamlining a cumbersome process, however, the Memorandum of Understanding has been less effective in ensuring that all beach compatable sand material dredged from inlets is placed on the beach. The Memorandum of Understanding must be revised to ensure that all dredged material is placed on adjacent beaches.

In 1982, the Florida Legislature amended Chapters 161 and 253, Florida Statutes, which eliminated the requirement for establishment of erosion control lines for placement of inlet-dredged sand on adjacent beaches. This improved coordination with the Corps of Engineers in placing inlet sand on adjacent eroded beaches by reducing approval delays.

Although some success has been made in reducing unnecessary delays for inlet sand transfer projects, costly delays continue for restoration, renourishment and other erosion control projects most notably in the establishment of erosion control lines and environmental permitting.

Cost Sharing. Current statutory funding formulas need to be revised to resolve inequities in erosion control program funding. There now exist various funding percentage allowances for different levels of government and for various types of erosion control projects. For example, the State currently pays 100 percent of sand search studies required for beach restoration projects even though local governments benefit equally from such studies. Also, while project activities such as monitoring costs and maintenance costs are eligible for State funding, others, such as project engineering, supervision and inspection are not. These inequities should and can be resolved by establishing an overall State, and local cost sharing percentage for all project activities.

Beach Access. Under the current law, beach access sites must be made available at approximately one-half mile intervals along a beach restoration project. Adequate public parking spaces, as determined by the Department of Natural Resources, must exist within the project area. Each access site and all public parking spaces must be available to Florida residents and tourists on an equal basis. Although beach restoration projects implemented to date have generally been in compliance with requirements of the law, it is felt that some beach access sites provided fall short of that which should be made available.

The problem of beach access for restoration projects is not necessarily a problem of quantity, but of quality. All too often beach access sites are small with very few parking spaces, or even worse, a five or six foot easement between buildings with no parking spaces available.

If Florida is to embark on a comprehensive beach restoration program, quality beach access must be assured. Minimum parking standards must be adopted, as well as a minimum area for access sites. Although minimum standards should be rigid, overall beach access requirements should be flexible without jeopardizing the objective of providing beach access for the general public.

Chapter IV

ESTABLISHING A COMPREHENSIVE BEACH MANAGEMENT PROGRAM

CHAPTER IV
ESTABLISHING A COMPREHENSIVE BEACH MANAGEMENT PROGRAM

RECOMMENDATIONS

In Chapter III, a discussion of Florida's current Beach Erosion Control Program was provided as well as a summary of the significant accomplishments to date. The lack of optimal effectiveness of Florida's current program was also discussed along with an identification of the most significant problem areas. In this chapter, each of the identified problem areas will be discussed with respect to how these problems can be resolved. This chapter, however, is not limited to recommendations for resolving current programmatic problems; rather, it is a guideline for establishing a new and comprehensive beach management program.

PROGRAM TRANSITION

Continuing Program Responsibilities. Although a more sophisticated and comprehensive beach management program should be operative by the first of the 1987-88 fiscal year, the State must continue its current responsibilities regarding maintenance of previously restored beaches. Without a continuing beach maintenance program, Florida could lose a sizeable investment, i.e. the restoration projects in Miami Beach, Jacksonville Beach, etc.

Additionally, the State has a continuing responsibility for completing beach restoration projects already started but not completed due to State financial constraints. Of particular importance are those restoration or renourishment projects for which Federal funds are available. Many of these projects such as the Jacksonville renourishment project are implemented in phases requiring State and Federal funding on an annual basis. If the State does not provide its share of the annual costs, the project must be delayed for a year or more resulting in a significant increase in total project costs. For example, the second phase of the Jacksonville renourishment project was delayed until 1986 due to lack of State funding. The delay resulted in an estimated additional cost of over $1,000,000 as the contractor had to demobilize equipment upon depletion of funding in 1985. Once the project continues, hopefully in the summer of 1986, the State will have to pay its share of a second equipment mobilization by the contractor.

Several projects have been identified in the Department's FY 1986-87 Legislative budget request that deserve further emphasis as a means of punctuating the importance of State funding for these projects and are presented below in order of priority. It is important to note that the total amount of funds requested is requested as a lump sum appropriation and not as a line item project-by-project appropriation. Additional projects identified after the Department submitted its Legislative budget request are also presented.

INLET SAND TRANSFER PROJECTS

Hurricane Pass - Pinellas County	$ 500,000
St. Lucie Inlet - Martin County	1,000,000
St. Marys Entrance Channel - Nassau County	9,500,000
Other Projects (Now Unforeseen)	1,000,000
Sub Total	$12,000,000

BEACH MAINTENANCE PROJECTS

Jacksonville Renourishment Project	$ 5,500,000
Dade County Beach Renourishment Project (Miami Beach)	$ 1,725,379
John U. Lloyd State Park Renourishment	$ 1,601,000
Sand Key Renourishment	$ 1,215,000
Pass-A-Grille Renourishment	$ 187,500
Sub Total	$10,228,879

BEACH RESTORATION AND DUNE PROTECTION

	1986-87	
	Restoration	Dune Protection
North of Haulover	$ 5,250,000	
North Boca Raton	$ 2,223,250	
John U. Lloyd State Park	*	$ 500,000
Jacksonville	*	$ 550,000
Key Biscayne	*	$ 1,200,000
Pompano Beach	*	$ 1,500,000
Boca Raton South	*	$ 250,000
Sub Total	$ 7,473,250	$ 4,000,000

SPECIAL STUDIES

Preparation of District Beach Management Plans and the State-wide Comprehensive Beach Management Plan includes the following:

Sand Search, Monitoring, Data Collection and Other Research Needs	$ 1,600,000
Historical Shoreline Changes (Growth Management Requirement)	$ 300,000
Public Educational Programs (includes K through 12)	$ 80,000
Storm Effects Study (Matching Share for Federal Funds)	$ 250,000
Sub Total	$ 2,230,000
TOTAL TRANSITIONAL PROGRAM NEEDS	$35,932,129

Implementation of a Comprehensive Planning Program. As mentioned, a program designed to enhance Florida's beach resources must depend on comprehensive planning. Such efforts should be the responsibility of a single state agency and include any and all required actions necessary to attain a complete knowledge of beach conditions.

A logical approach to such a planning effort is to establish planning districts possessing similar geomorphic characteristics. Such districts will, in some cases, transcend political boundaries, however, unlike other district or regional planning efforts, coastal management must be in accordance with the natural beach-dune processes. Consideration has been given to identification of geomorphic districts resulting in a recommendation for establishing seven beach management planning districts as follows:

Northeast District	- Nassau County to Cape Canaveral
Southeast District	- Cape Canaveral through Dade County
Monroe Co. District	- Monroe County
Southwest District	- Collier County through Manatee County
Pinellas Co. District	- Pinellas County
East Panhandle District	- Franklin and Gulf Counties
West Panhandle District	- Bay through Escambia Counties

The Department of Natural Resources, Division of Beaches and Shores will be responsible for developing a beach management plan for each of the seven planning districts and for maintaining each management plan by updating on an annual basis. Each management plan would be used as a basis for a comprehensive State-wide plan that would identify the critical needs of each district, compare those needs on a relative basis and identify State-wide priorities. Once State-wide priorities are identified the Department would then make an annual report to the Legislature together with recommended funding priorities. The estimated cost for preparation of the several district plans and the follow-up State-wide plan is $2,230,000. The State-wide management plan will be presented to the Legislature in its 1987 session together with a request for funds to implement the plan. Types of studies and research necessary may include but are not necessarily limited to the following:

1) identify causes of shoreline erosion and change, erosion rates, and project long-term erosion for all major beach and dune systems by surveys and profiles;

2) identify shoreline development, degree of density, and assess impacts of development and shoreline protective structures on shoreline change and erosion;

3) identify and assess effects of inlets, jetties, inlet sand transfer and beach renourishment projects on shoreline change and erosion;

4) identify economic value of beaches including recreational value, tax base, and revenues generated;

5) conduct sand source and suitability analyses;

6) study dune and vegetation conditions;

7) conduct marine habitat inventories for areas where beach restoration may be most suitable;

8) identify alternative management responses to erosion; to preserve undeveloped beach and dune systems; to restore damaged beach and dune systems; and to prevent inappropriate development and redevelopment on migrating beaches. Consider: beach restoration and renourishment; armoring; shoreline setback, relocation, abondonment; dune and vegetation restoration; and acquisition;

9) establish criteria, including costs and specific implementation actions, for alternative management techniques;

10) select and recommend appropriate management measures for all of Florida's sandy beaches in a Beach Management Program to be submitted to the Governor, Cabinet and the Legislature by April 1987;

11) provide beach management data and recommendations generated by this study to all local governments for their use in preparing and implementing the coastal management element of their comprehensive plan.

STATUTORIAL AND ADMINISTRATIVE CHANGES DURING THE TRANSITION PERIOD

In addition to the preparation of district management plans and ultimately the State-wide beach management plan there are several changes to the current program that should be accomplished during the FY 1986-87 program transitional period. The following is a list of recommendations for addressing identified problems in the current program. It is important that these changes be made by the 1986 Legislature.

Legislative Action.

1) Provide a stable source of revenue for the Erosion Control Trust Fund.

2) Request Congress, (legislative resolution) to initiate changes in PL 94-587 (least cost method of inlet sand disposal).

3) Discontinue the current line item appropriation funding.

4) Revise Chapter 161.091 Florida Statutes, to include, as eligible for State funding, all activities associated with erosion control projects excluding beach access site acquisition and development.

5) Change the current 75% - 25% state/local share of project cost to a 50% - 50% split. The 50% cost sharing between State and local governments would be used for either Federal or non-Federal projects. Continue full State responsibility for costs associated with erosion control projects of which the State is the upland riparian owner.

6) Appropriate funds in the amount of $2,230,000 for preparation of district beach management plans and a State-wide comprehensive plan.

7) Amend Chapter 161 and 253, Florida Statutes, to eliminate the requirement for establishing erosion control lines for beach restoration. In lieu of establishing erosion control lines, the use of mean high water line surveys in accordance with Chapter 177 Florida Statutes, currently the basis for establishing an erosion control line, can be the demarcation between public and private ownership. Provide specific restrictions on the use of land created seaward of the pre-project mean high water line. Additionally, provide restrictions against using beach restoration as justification for increased density or advancing the line of construction. Also, require that 30 year erosion projection be referenced to the pre-project seasonal high water line.

8) Provide that all inlet districts, inland navigation districts and port authorities be required to place all suitable sand material on adjacent beaches that is dredged as part of channel maintenance including sand material trapped as a result of inlet jetties or in the ebb tidal shoals. Additionally, provide that all such activities be the financial responsibility of said districts or authorities.

9) Provide that public access and public parking spaces be in accordance with Department recommendations identified later in this section.

Department Action.

1) Establish, at the discretion of the Governor and Cabinet, an interagency committee comprised of representatives from affected agencies, to provide a coordinated effort in the review of erosion control projects, without relinquishing the permitting authority of any agency. The coordinated effort would provide for all designated representatives to meet in the preliminary planning and review stages of a project and establish the necessary information to conduct a review. Various agencies' concerns related to the project would be reviewed and discussed at the preliminary review stage. Follow-up meetings to present the requested information and to respond to all agencies' concerns would be requisite. Attempts should be made by all regulatory agencies in the permitting of erosion control projects, to establish long-term permits in which periodic maintenance could be allowed without the sponsor being subjected again to the entire permitting process.

2) Prepare district-wide beach management plans in accordance with recommended planning districts followed by the preparation of a State-wide beach management plan for submittal to the Legislature by April of 1987. The State-wide plan should possess specific recommendations and project priorities for review by the Legislature. The preparation of the district plans is dependent upon a legislative appropriation of $1,000,000 for fiscal year 1986-87, as previously mentioned.

3) Amend the rules governing the Beach Erosion Control Program regarding beach access sites and public parking spaces to require the following minimum standards:

   a. In areas where large city, county, or state beach parks exist with 100 or more parking spaces, those larger access sites should be sufficient to accommodate beach users for one-half mile in either direction of the boundaries of the subject site. Such a criterion is considered appropriate, as larger beach parks generally possess more than 100 parking spaces and also provide other facilities, including restrooms, picnic facilities, etc.

   b. In areas void of large beach parks, a minimum of four beach access sites per mile should be required. Each of the four sites should have a land area of approximately 10,000 square feet and must be capable of accommodating at least 25 public parking spaces.

   c. In areas void of access sites having a land area of 10,000 square feet or more, a minimum of six access sites per mile should be required. The minimum number of public parking spaces per site should be at least 12 spaces, and the minimum area for each site should be approximately 5,000 square feet.

   d. In areas totally void of beach access sites, local governments should be required to make every effort to acquire beach access sites within the project area by purchase or by other means including use of eminent domain. If after diligent efforts have been made by a local government to purchase access sites it is found that there is no possibility of acquiring such sites within the project area, local funds should be required to mitigate the lack of access by providing for the purchase of the number of

access sites normally required for a particular project generally in the same area of the State. Under no circumstances should a restoration project be implemented until all required access sites and public parking spaces are available or until mitigation has been accomplished.

e. Other mitigation efforts may be considered if such mitigation is considered by the Department as being in the public interest. Examples of different types of mitigation are payment of a project by private upland property owners, provisions for turtle nesting programs, especially in areas where an abundance of turtle nesting is known to exist. Also the construction of artificial reefs may be considered as mitigation for both beach access and habitat loss occurring as a result of beach restoration. Any special requirements associated with mitigation should be approved by the Department. These criteria should be considered minimal; however, in addition to minimum access requirements, the Department should take into account other existing access points and public parking spaces that may not be located directly on the beach, but should not consider any public access site or any public parking spaces existing further than two-thousand feet landward of a beach restoration project. In addition, motels, hotels, and private parking lots or garages serve to accommodate a certain segment of the tourist and resident population. The Department should take into account the amount of beach access and parking spaces afforded by private resorts, camping grounds, hotels, motels, and private parking lots and garages. Any public beach access site existing within a beach restoration project area should be open and available to the general public on an equal basis and should be clearly marked and identified as a public beach access site.

4) Take necessary action to amend the current Memorandum of Understanding between the Departments of Natural Resources and Environmental Regulation and the Board of Trustees to ensure that all compatible sand material dredged as a result of inlet maintenance dredging be placed on adjacent beaches.

PROGRAM IMPLEMENTATION

By the end of the 1987 Legislative session the recommended Legislative and Department actions, as previously outlined, hopefully will be accomplished. Preparation of beach management plans will have been completed and reviewed by the Legislature with required funding available for implementation of identified priority projects. If these actions have been accomplished the Department will then be in a position to, in concert with a particular local government as a project participant, define, by contract, the responsibilities required of both the Department and the participant, including, but not necessarily limited to, the following:

Project Participant Responsibilities

1) Provision of matching funds on a 50-50 percent basis for all activities associated with an erosion control project.

2) Identification of public beach access sites and public beach parking spaces in accordance with Department criteria.

3) Provision of easements or rights of way as necessary.

4) Any other responsibilities agreed upon between the participant and the Department.

Project Sponsor (State) Responsibilities

1) Initiate actions required to implement a particular erosion control project such as biological monitoring, shoreline changes, project engineering and design, supervision and inspection, post project monitoring, mean high water line surveys, etc.

2) Obtain, as the project sponsor, all required permits for erosion control projects.

APPENDICES

Appendix A

REPORT OF "RESTORE OUR COAST TASK FORCE"

FINAL REPORT

RESTORE OUR COAST TASK FORCE

January 13, 1986

I. INTRODUCTION

The purpose of these recommendations is to expand and "flesh out" the recommendations contained in the April, 1985 report of this task force and the Department of Natural Resources entitled "Beach Restoration: A State Initiative."

It should be emphasized that the following recommendations are the product of the task force, not the Department of Natural Resources.

To differentiate the task force recommendations from the explanatory text, the recommendations are indented and underlined.

II. THE ECONOMIC IMPACT OF OUR BEACHES

This task force recognizes and reemphasizes that Florida's beaches are of tremendous importance to the economy of this state.

We think this is evident in light of the following facts:

* Tourism is the #1 industry in Florida. Each year, some 32 million tourists visit our state. They spend some $17 billion annually in Florida.

* Next only to our weather, beaches are the #1 attraction cited by tourists coming to Florida. Forty-seven percent of all tourists say they use our beaches during their stay, based on Department of Commerce surveys.

* Residents and tourists generate $4.6 billion in beach-related sales annually, according to a recent Sea Grant study.

* Beach-related sales create 180,000 jobs with an annual payroll of $1.1 billion.

* Beach-related sales generate $164 million in tax revenue for the State of Florida annually.

Despite the importance of beaches to Florida's economy and despite the fact that beach-related sales contribute $164 million annually to the state treasury, the State of Florida has invested only $33 million in beach restoration projects over the past 20 years.

III. WHY WE NEED A NEW APPROACH TO BEACH PRESERVATION

The initial DNR task force report made a convincing case for the need to reorganize Florida's approach to beach preservation.

We think it is appropriate to begin our final report by restating some of the major shortcomings in the present system:

* Beaches, like water, are a statewide resource. Yet there is no statewide system of managing our beaches. Instead, "management" of our beaches is left up to some 200 individual municipal and county governmental entities. In the past 20 years, only a dozen communities have undertaken beach restoration programs. The rest have done nothing. And this neglect has aggravated a growing erosion problem statewide. With exception of a few areas such as Dade and Broward, we are losing ground to erosion in many areas of the state.

* Under current law, there is no system of priorities for erosion control.

* There is no organized program to address the erosion caused by the many navigation inlets on both coasts -- one of the major causes of beach erosion.

* Present procedures are so complex that it takes from five to fifteen years to get a restoration project built. The average time from project inception to completion is eight years.

* The current approach to erosion control is built on the risky assumption that there will always be 50% federal matching funds available.

The earlier DNR task force report identified 140 miles of critically eroded beaches in this state and estimated a $362 million price tag to restore those beaches. Yet state funding for beach projects is averaging less than $2 million per year and has been declining.

It should be noted that the DNR figures on critical erosion did not include Monroe County. Nor did the April, 1985 report take into consideration the severe damage to the beaches of Pinellas County that occurred later in the year.

We do not want to leave the impression that the current program has been a total failure. To the contrary, it has accomplished a great deal. Florida leads the nation in beach restoration. Beaches have been successfully restored in some of the most critically eroded areas, such as Miami Beach.

But the situation has changed since Florida's beach law was enacted 20 years ago. The current approach is no longer adequate to meet our needs in the 1980's and 1990's.

In short, it is time to reorganize Florida's beach preservation program.

The task force wishes to express its support for the concept of the coastal construction control line, recognizing the vulnerablilty of buildings and other structures seaward of this line and the high monetary and environmental costs of protecting such buildings. It is the opinion of the task force that conscientious and conservative application of restrictions on construction seaward of the control line will progressively reduce the state's necessary expenditures on beach restoration measures in the future.

However, it is clear that coastal permitting policies, no matter how carefully applied, are not enough to save Florida's eroding beaches.

The task force believes it is imperative that we establish a new approach to manage our beach resources in Florida -- perhaps the most endangered of all our major natural resources.

The key word is management.

The scope of the program we envision would go far beyond the initial concept of simply restoring 140 miles of critically eroded beaches.

The following recommendations constitute our vision of how Florida can most effectively manage her precious beach resources.

IV. ROLE OF THE STATE

Up to now, the role of the state in beach preservation has essentially been limited to:

* Establishing the coastal construction control line.

* Regulating construction within the coastal construction control line.

* Regulating construction of locally-sponsored erosion control projects such as beach restoration.

* Providing state matching funds to locally-sponsored projects.

If Florida is ever to have a sound program of beach preservation, this passive role on the part of the state must change.

Indeed, the task force strongly recommends that the state must assume the primary responsibility for beach nourishment and beach restoration.

There are logical reasons for the state to assume primary responsibility for beach preservation in Florida:

* Geomorphic Considerations -- Our beaches, like our rivers, know no political boundaries. They cross many jurisdictions. Loss of sand from the state beach system as a result of human intervention at inlets at Jacksonville and St. Augustine depletes sand that otherwise would feed the beaches at Daytona Beach. Hence, to be effective, beach restoration must be undertaken on the basis of natural geographic reaches of the coastline, not on the basis of arbitrary county or municipal lines. Some 200 local governmental entities, acting independently, cannot solve the problem. It can only be solved on a statewide basis.

* Ownership Considerations -- The State of Florida claims ownership of all beaches seaward of the mean high water line or, in cases of beach restoration projects, of all the dry, sandy beach created as a result of such projects. If the state has the ownership of the beaches, it should have the primary responsibility to protect and maintain them.

* Stewardship Considerations -- The state profits handsomely from its beaches. It should be willing to plow back some of its profits to maintain this valuable resource -- just as the prudent owner of a hotel will reinvest a portion of his or her profits to refurbish the hotel. Despite the enormous "profits" from its beaches, the State of Florida has invested only $33 million in state money for beach nourishment or restoration over the past 20 years. The inadequacy of the state's financial support for erosion control is emphasized by the fact that the DNR has identified the need for spending at least $362 million to restore critically eroded beaches in Florida resort areas. That is ten times more than the state has spent for beach restoration in its history.

Accordingly, the task force recommends that Chapter 161, Florida, Statutes be amended to provide the following:

1. The State of Florida shall be responsible for the over-all management of the beaches of Florida. This beach management program shall include the following elements:

   * To reinstate the natural net longshore sediment transport at all coastal inlets in the state in order to restore equilibrium to the beach system.

   * To restore critically eroded beaches of Florida on a priority basis.

   * To provide for a program of periodic renourishment of priority beaches in recognition of the principle that beaches, like highways, need to be periodically maintained.

   * To improve and increase public access to our beaches to make them more usable by tourists and residents.

   * To implement a statewide erosion prevention program by rebuilding damaged dunes, constructing dune and beach crosswalks where necessary and systematically revegetating beaches and dunes.

2. The state agency designated to administer the state beach program shall be the Division of Beaches and Shores of the Department of Natural Resources.

3. The Department of Natural Resources shall act as project sponsor of erosion control projects. This responsibility shall include:

   * Setting project priorities on a benefit-cost basis.

   * Issuing and administering contracts for design, engineering and construction.

   * Supervising construction.

   * Monitoring of project engineering.

   * Research.

   * Obtaining necessary permits.

4. Pre-project studies of every erosion control project shall include, but not be limited to a comparative analysis of the alternatives, including restoration, acquisition, acquiesence, retreat or structural solutions.

5. Restoration projects shall be ranked on a benefit to cost basis using such factors as:

   * Environment

   * Storm protection

   * Navigation

   * Recreation

   * Tourism

   * Protection of the tax base

   * Downdrift benefits

6. Project priorities shall be reviewed and reassessed at least on an annual basis.

7. In the first year of implementation of the statewide beach restoration program, the Division of Beaches and Shores shall be directed to:

   * Prepare a detailed statewide erosion analysis on a county-by-county basis to refine the data in the April 1985 report and to consider erosion that has taken place since then as a result of storms and other causes.

   * Prepare a methodology of establishing priorities for erosion projects.

   * Come up with an initial set of priorities to be commenced in FY 1987-88.

   * Initiate a program of study focused on improvement of beach restoration technology.

8. As a general rule, beach restoration projects should be constructed to provide protection for a 25-year storm event. However, the Department of Natural Resources should be given latitude, on a site-by-site basis, to vary the width of the restored beach.

9. Engineering design and construction of beach restoration projects shall be done by private enterprise rather than creating a state-employed work force on the grounds that this is the most efficient and cost-effective method of construction for this program.

10. Legislative intent should be clarified and strengthened to assure that beach restoration is not used as justification for increasing upland land usage or densities, relocating the coastal construction control line or siting construction further seaward.

11. The DNR shall undertake a continuing program of public awareness and education about Florida's beaches.

12. To insure success of the proposed beach management program, it is vital that the Legislature provide a stable source of funding for beach management. The current line item, fixed capital outlay method of appropriating funds for erosion control must be discontinued. Instead, the Legislature should return to the system of placing funds directly into the beach erosion control trust fund. This is necessary to give flexibility to the beach construction program and avoid situations in which funds remain idle because a specific line item project has been delayed in construction or, in the case of projects which, after closer analysis, turn out to be non-viable.

V. LOCAL PARTICIPATION

Under present law, the initiative for beach erosion control is in the hands of local government. If there is to be a beach restoration project, it must first be sponsored by a municipality or county. The state's role is primarily to serve as an agency for providing matching funds.

Generally, funding for beach projects is based on the following matching fund premise:

Federal government	--	50%
State government	--	37.5%
Local government	--	12.5%

In recent years, the amount of federal money for beach restoration projects has been declining, and indications are that this decline will continue. In projects where no federal money is available, the state provides 75% of the construction cost and local governments provide 25%.

The current system has a number of built-in deficiencies that discourage a sound program of beach restoration in Florida:

* It makes it difficult if not impossible to have any rational system of statewide priorities in beach restoration. That's because the state has no real voice in project selection. The decision to implement restoration projects is entirely up to the discretion of the some 200 individual municipal and county governments.

* Under the current system, projects are built more on the basis of local desire and initiative than comparative need. The ability to obtain federal and state matching funds is the key determinant. Since 1965, some 87% of all state money for beach restoration has gone to only four counties -- Dade, Broward, Pinellas and Duval. No restoration has taken place in the past 20 years in 16 beach-front counties.

* The current system sometimes violates principles of good engineering design of beach restoration. That's because nearly all restoration projects today are built on the basis of arbitrary political boundaries -- not on the geomorphic reality of the coast. The result is that some projects are built in shorter lengths than is desirable. Thus they are less stable and more vulnerable to erosion. Excluding the big projects in Dade, Broward and Duval Counties, the average length of a restoration project is 1.5 miles. One of the reasons for the long-term stability of the Miami Beach project is that it was built in a natural geographic reach of 10.5 miles.

* The current system of restoring beaches on a scattergun basis is needlessly expensive and wasteful. At least 20% of the cost of beach restoration involves the setting up and breaking down of the dredging equipment. By restoring our beaches on the basis of natural geographic reaches -- instead of one or two mile increments -- we could save a great deal of money.

To remedy these deficiencies, we recommend a new approach to local participation based on geomorphic considerations rather than arbitrary political boundaries. This is based on the reality that our beach systems, like our fresh water systems, know no political boundaries.

Our proposed solution is based on establishing a series of beach management districts similar to the concept of water management districts. In fact, the task force explored the idea of utilizing the existing structure and administrative staffs of Florida's water management districts for the beach program. But the idea was rejected for two reasons. First is the fact that the water management districts include many inland counties, and we felt it would be unfair to burden these inland counties with cost-sharing of beach projects. Second, the task force concluded that the expertise required for the beach-related program was substantially different than that for water management. We also explored the idea of using the existing inland navigation districts as the administrative vehicle. But we concluded that they were too large to provide meaningful local input.

Accordingly, we recommend the following system of local participation:

1. Create seven local beach management districts based on geomorphology and population:

   a) District One: Escambia, Santa Rosa, Okaloosa, Walton, Bay, Gulf and Franklin.

   b) District Two: Pinellas.

   c) District Three: Manatee, Sarasota, Charlotte, Lee, Collier and Monroe.

   d) District Four: Dade.

   e) District Five: Broward.

   f) District Six: Palm Beach, Martin, St. Lucie, Indian River, and Brevard.

   g) District Seven: Volusia, Flagler, St. Johns, Duval and Nassau.

2. Administration: A board of governors appointed by the Governor. Each district would have an administrator appointed by the local board and a small staff.

3. Funding Share: Districts would be responsible for paying 25% of the total cost of beach restoration projects undertaken within their districts. The state would pay 75% of the total project cost.

4. Taxing: Districts would be authorized to levy ad valorem taxes up to a ceiling set by the Legislature. In addition, they would have authority to levy special assessments on upland property owners where beach restoration projects take place. These assessments would be based on the same rationale of the assessments levied by municipalities when constructing sidewalks or sewer lines adjacent to private property.

5. Responsibilities:

   * Providing the local share of funds for erosion control projects.

   * Obtaining public access to beaches.

   * Providing parking at beach access points.

VI. FUNDING

Who should pay the cost of restoring and preserving Florida's beaches?

The Restore Our Coast Task Force unanimously agrees on this principle:

Insofar as possible, the beneficiaries of beach restoration should pay for the costs of beach restoration.

We find that the primary beneficiaries of our beaches are:

a. The users -- residents and tourists alike.

b. The riparian property owner -- whose valuable property is saved from being eaten away by erosion and thus benefits most financially.

c. Residents of coastal counties -- whose economies benefit the most from beaches.

d. The people of Florida -- regardless of where they live -- who derive $164 million in annual sales tax revenue from beach-related activities to help pay the cost of state government.

We believe all of these beneficiaries should share in the cost of beach restoration and maintenance and recommend the following:

1. The 75% state share of the beach management program shall be paid by a tourism promotion sales charge applied to taxable sales of the following: places where alcoholic beverages are served, restaurants, hotels, auto rentals and admissions. The amount of the surcharge shall be sufficient to generate $35 million per year or the estimated 75% state matching share of the beach management and restoration program.

2. The 25% local share of the beach management program, which shall be collected by the various beach management districts, shall come from the following sources:

   * Ad valorem assessment of property owners in the district, similar to assessments for water management districts.

   * Special assessments of beachfront property owners adjacent to restoration/renourishment projects, similar to special assessments for sewers and sidewalks.

VI. INLETS

Inlets, especially navigation inlets, are one of the major causes of beach erosion in Florida. Inlets cause erosion by interrupting the natural flow of sand down the coast. Substantial segments of Florida's east coast beaches are, in effect, a slow moving "river of sand." Years ago, prior to the construction of navigation inlets, the adjacent shorelines had reached a state of equilibrium, and the river of sand was continuous down the coast. As inlets have been dredged and jettied over the years, this equilibrium has been changed. Hundreds of millions of cubic yards of beach sand have been diverted to offshore shoals instead of moving down the coast. This has contributed significantly to beach erosion downstream.

The task force recognizes the importance of ports and navigation inlets to the state's economy. However, we also recognize the importance of replacing sand into the beach system that is being lost to these inlets.

In recent years, the Corps of Engineers and the Department of Natural Resources have strived to recapture sand that is dredged during inlet channel maintenance and to place this sand back in the beach system through the periodic construction of "feeder beaches" on the downdrift side of the inlet. In the case of federally-maintained inlets, federal law requires the Corps to use the "least cost method" for disposing of sand dredged for navigation. In some cases, this has resulted in the sand being dumped offshore, beyond the beach system, thus losing it from the system. The Legislature has tried to compensate for this by allocating funds to the Department of Natural Resources to pay the difference in cost in dredging projects so that the dredged sand can be pumped back on the beach. Even so, there have been times when the DNR did not have the money to pay the difference in cost to put the sand back on the beach.

In an effort to assure that sand lost at inlets is put back into the beach system, the task force recommends:

1. Require the Department of Natural Resources to design and implement a state- wide program to reinstate natural net longshore sediment transport at all coastal inlets in the state. This could include sand by-passing across inlets or, in cases where long distances make such by-passing impractical, obtaining a similar budget of sand from other sources such as offshore shoals. However, at the discretion of DNR, certain natural inlets may be exempted from these sediment transfer requirements.

2. Provide that all inlet navigation districts and port authorities shall be financially responsible for reinstating the natural net longshore sediment transport at their facilities. This could be accomplished by placing all suitable sand on beaches during channel maintenance and/or by extracting sand trapped in the ebb tidal shoals and/or by reimbursing the Department of Natural Resources to recapture the lost sand.

3. Request the Governor's office and the DNR to work with Florida's Congressional delegation and other coastal states to seek to amend Section III of the federal Rivers and Harbors Act, to raise the ceiling of federal expenditures on inlet-related projects from $1 million to $2 million. At the same time they should seek to change PL 94-587 which now only allows the least cost method of inlet sand disposal which sometimes results in dumping sand out at sea and losing it from the system.

VII. RESEARCH

While Florida has considerable practical experience in coastal engineering and beach restoration, we recognize that there is still a great deal that is not known about the natural coastal processes and the most effective design of erosion control projects. We recognize also that there is inadequate knowledge about the environmental effects of these projects. Accordingly, we recommend that research into these fields should be a basic component of the state's erosion control program. Indeed, the task force suggests that such research will prove to be a cost-effective activity for the program on the grounds that the lessons learned will assist in improving project design and thus save money in the long term. Such research will also help minimize damage to the environment. Therefore, we recommend the following:

1. Build in a research compenent as an integral part of the state's beach management program, allocating approximately 5% of the total program cost for this purpose.

2. Require the Division of Beaches and Shores to put together a five-year plan of essential research projects on a priority basis, just as the work plan for the statewide beach restoration program is to be undertaken on a priority basis. The first five-year research plan should be completed for review by the governor and cabinet no later than December 31, 1986. This plan should be reviewed and readjusted on an annual basis.

3. Appoint an advisory committee of recognized experts in the fields of coastal engineering and the environment to assist the DNR in coming up with its research priorities. The committee would function in a manner similar to the advisory committeefor the Florida Sea Grant college program.

VIII. ENVIRONMENT

There was considerable debate among members of the task force on the impact of beach nourishment projects on the coastal environment.

While environmental monitoring has been required of all beach nourishment/beach restoration projects for a number of years, environmental representatives contend that these studies are still not giving enough information on the long-term impact of these projects on the environment.

There were two main areas of disagreement between environmental representatives and coastal engineers: The allowable range of turbidity in beach nourishment projects and whether or not rock and worm formed reef, which have been recently exposed as a result of erosion, should be allowed to be covered with sand. The primary concern of the environmental representatives is the long-term effects of beach nourishment, which they feel has not been adequately studied.

The task force concludes that if such disagreements are not resolved on the basis of scientific fact, it may be impossible for the State of Florida to undertake a comprehensive beach restoration program.

Accordingly, the task force makes the following recommendations:

1. Require the Department of Natural Resources, in cooperation with the Department of Environmental Regulation, to make a detailed analysis of all project monitoring studies that have been made to date to determine, insofar as possible, the short-term and long-term effects of beach nourishment on the coastal environment.

2. Convene immediately an inter-agency task force to formulate new standards and criteria for environmental monitoring of erosion control projects. This task force should consist of representatives of the Department of Environmental Regulation and the Department of Natural Resources. This report is due July 1, 1986.

3. The Department of Environmental Regulation and the Department of Natural Resources will implement the new environmental monitoring criteria on all beach nourishment and beach restoration projects effective July 1, 1986. Monitoring should continue for a period of five years after the completion of the project.

4. The Department of Environmental Regulation is encouraged to approve water quality mixing zone variances for the first year's projects (FY 1986-87) to allow for their implementation and to allow field-testing to evaluate the environmental effects of the projects. In these tests, turbidity should be monitored within the mixing zone during construction to establish the pattern of turbidity movement near the shore. The results of this monitoring will be used to evaluate future renourishment efforts.

In addition, the task force recommends that current environmental laws be amended to provide for the following:

5. In the case of beach restoration and inlet sand transfer projects, nearshore features including those artificial, man-made, or created through coastal processes such as erosion shall not be preserved in lieu of restoring the beach. Such features include, but are not limited to, jetties, groins, breakwaters, man-made structures, exposed bedrock and rock outcrops. The task force recognizes the uncertainty concerning the biological significance of these features and therefore recommends an emphasis on monitoring and analysis to resolve the issue.

6. Where worm formed reefs in the high turbidity zone have been exposed by erosion, they may be covered by beach renourishment. It is suggested that these rocky sub strates are exposed and covered as a normal part of coastal processes. Covering a worm reef could be mitigated by the placement of sub strates suitable for worm attachment. Another form of mitigation could be the establishment of offshore reefs. The task force recognizes the uncertainty concerning the biological significance of these features and therefore recommends an emphasis on monitoring and analysis to resolve the issue.

7. Mechanical beach cleaning should be restricted during the turtle nesting season. Cleaning activities during this period should be limited to labor intensive practices designed to reduce impact on turtle nesting habitat. Required practices shall include hand-cleaning, use of light weight equipment with low pressure low profile tires, eg., ATV vehicles, and rakes which penetrate the beach no more than two inches. Sponsors of beach cleaning shall be required to make nesting surveys and investigate hatch success, using DNR approved personnel. In areas where there is a high density of human use of the beaches, local government entities shall be required to make nesting surveys, investigate hatch success and provide for nest relocation as needed, using DNR approved personnel.

8. In areas which have turtle nesting and where no alternative exists to beach renourishment during the sea turtle nesting season, such projects must include a DNR approved sea turtle hatchling success plan.

9. To prevent disorientation of sea turtle hatchlings by artificial lights, all buildings, parking lots, recreation facilities, dune crossovers and other structures within the direct line of sight of the beach shall utilize low profile, low intensity lighting or shall shield such lighting so that the source of light is not visible from the beach. In any situation where lighting cannot be altered to meet the lighting standards, eg., public roads or highways adjacent to the beach, a DNR approved nest and hatchling protection plan must be implemented. This could include automatic timers to turn lights off no later than 11 p.m. and relocating of nests to protected sites. Where possible, vehicular lighting shall be shielded from the beach.

10. Sand for beach renourishment shall be suitable for sea turtle nesting.

11. Dune and beach vegetation shall be restored in any beach restoration project. To protect such vegetation, crosswalks shall be constructed.

IX. BEACH ACCESS

Under current law, beach access sites must be made available at approximately every one-half mile of a beach restoration project. Additionally, adequate public parking spaces, as determined by the Department of Natural Resources, must exist within the project area. Each access site and all public parking spaces must be available to all Florida residents and tourists on an equal basis. Although beach restoration projects implemented to date have generally been in compliance with requirements of law, it is felt that some beach access sites provided fall short of that which should be made available.

The problem of beach access for restoration projects is not necessarily a problem of quantity, but of quality. All too often beach access sites are small with very few parking spaces, or even worse, a five or six foot easement between buildings with no parking spaces available. If Florida is to embark on a comprehensive beach restoration program, quality beach access must be assured, minimum parking standards must be adopted, as well as a minimum area for access sites. Although minimum standards should be rigid, overall beach access requirements can be flexible without jeopardizing the objective of providing beach access for the general public.

Accordingly, the task force recommends the following requirements for beach access and parking in connection with future beach restoration projects:

1. In areas where large city, county, or state beach parks exist with 100 available parking spaces or more, those larger access sites should be sufficient to accomodate beach users for one-half mile in either direction of the boundaries of the subject site. Such a criterion is considered appropriate, as larger beach parks generally possess much more than 100 parking spaces and also provide other facilities, including restrooms, picnic facilities, etc.

2. In areas void of large beach parks, a minimum of four beach access sites per mile should be required. Each of the four sites should have a land area of approximately 10,000 square feet and must be capable of accommodating at least 25 public parking spaces.

3. In areas void of access sites having a land area of 10,000 square feet or more, a minimum of six access sites per mile should be required. The minimum number of public parking spaces per site must be at least 16 spaces and the minimum area for each site must be approximately 5,000 square feet.

4. In areas totally void of beach access sites, local funds should be required to mitigate the lack of access by providing for the purchase of the number of access sites normally required for a particular project area in some other portion of the state. Under no circumstances should a restoration project be implemented until all required access sites and public parking spaces are available or until mitigation has been accomplished.

5. Mitigation of parking and access requirements may be considered if it is considered by the Department as being significantly in the public good. Examples of different types of mitigation are provisions for turtle nesting, especially in areas where an abundance of turtle nesting is known to exist. Additionally, the construction of artificial reefs may be considered as mitigation for both beach access and minimal habitat loss occurring as a result of beach restoration. Any special requirements associated with mitigation, such as a turtle nesting program, shall be approved by the Department. These criteria should be considered minimal; however, the Department should take into account other existing access points and public parking spaces that may not be located directly on the beach, but should not consider any public access site or any public parking spaces existing further than one-thousand feet landward of a beach restoration project. In addition, it is recognized thatmotels, hotels, and private parking lots or garages serve to accommodate a certain segment of the population, both tourists and residents. The Department should take into account the amount of beach access and parking spaces afforded by private resorts, camping grounds, hotels, motels, and private parking lots and garages. Any beach access site existing within a beach restoration project area must be open and available to the general public on an equal basis and must be clearly marked and identified as a public beach access site.

X. PRIVATE RESTORATION/NOURISHMENT PROJECTS

A majority of Florida's beaches are on and adjacent to privately owned property. Most of these private beaches will not be eligible for the proposed state beach restoration program. However, it is recognized that they are an important part of Florida's total beach system, and therfore, it is in the public interest to encourage private property owners to undertake beach restoration/beach nourishment programs because this new sand will add to the total sand budget of the beach system and will provide other public benefits.

Accordingly, the task force recommends:

1. That Chapter 161 be amended to specifically encourage private beach restoration/beach nourishment projects that are approved, supervised and monitored by the Department of Natural Resources.

2. That as an incentive to encourage such state-approved beach restoration/beach nourishment projects, the state or the regional beach management district shall be authorized to share in the total cost of such projects with the state share to be commensurate with state benefits. Such benefits shall be established on a case-by-case basis and may include: enhancement of turtle nesting areas; functioning as a sand "feeder" to public beaches; public use from access points other than immediately upland of the project; providing new public access in areas in which communities charge differential fees for beach use, eg., charging non-residents more than residents for beach access and parking.

XI. LEGISLATIVE RECOMMENDATIONS FOR FISCAL YEAR 1986-87

The task force recognizes that because of the startup time involved in implementing the proposed statewide program of beach restoration, a large appropriation for this purpose will not be necessary in fiscal year 1986-87.

However, the task force strongly recommends that the Legislature, during the 1986 session, enact statutorily the beach management program proposed in this report. We recognize that this will require a major rewriting of Chapter 161, Florida Statutes. We feel this should be done now to avoid delays in implementing this program.

If the Legislature approves the program in concept, we estimate that it will take a year of planning and design before construction can begin on the highest priority projects.

However, this does not mean that there cannot be major progress in 1986-87 toward implementation of a comprehensive beach preservation program in the coming year.

This will require a substantial financial commitment to the state's beach program in fiscal year 1986-87. However, by acting quickly, the Legislature can reap a $2 for $1 match in available federal funds, thereby reducing future costs to the program by Florida taxpayers.

Accordingly, the task force recommends the Legislature take the following actions in the 1986 session:

1. Provide statutorily for a statewide beach management program as outlined herein.

2. Appropriate $1 million to the Department of Natural Resources for the development of the beach management plan for the seven beach management districts. This activity would include, during FY 1986-87, the following activities to get the program moving:

   * Prepare a detailed statewide erosion analysis on a county-by-county basis to refine the data on critical erosion contained in the DNR's April, 1985 report, and to consider erosion that has taken place since then as a result of storms.

   * Prepare a methodology for establishing statewide priorities for erosion projects.

* Come up with an initial set of project priorities to be commenced in FY 1987-88.

* Initiate a program of research focused on improvements of beach restoration technology.

* Make a coastal habitat inventory.

3. Commence a program of study, as formulated by the proposed DNR/DER task force, focusing on the physical and environmental aspects of erosion control projects. A first year budget of $680,000, which includes a sand search and beach monitoring study, is recommended.

In addition, the task force recommends that the 1986 Legislature give priority to two important elements of the state's current beach preservation program. These recommendations do not require new statutory language:

Matching All Available Federal Funds on Pending Projects in Fiscal Year 1986-87.

The most cost-efficient way to restore Florida's critically eroded beaches is to take maximum advantage of available federal funds. Failure to do so could cost Florida taxpayers many millions of dollars over the next decade.

In fiscal year 1986-87, an estimated $44 million in federal matching funds will be available for beach restoration and beach renourishment projects. This $44 million can be obtained for a state match of $25 million -- nearly a $2 for $1 match.

Florida can ill afford not to take advantage of this opportunity now, especially since it is expected that there may be a sharp decline in federal funds for erosion control in the near future.

In fiscal year 1986-87, federal matching money (in millions of dollars) is expected to be available for the following projects:

	Federal	State
Miami Beach beach maintenance	5.0	1.7
John U. Lloyd State Park renourishment	3.7	1.6
Sand Key renourishment (Pinellas)	15.0	9.5
North Haulover Beach restoration (Dade)	8.0	5.0
North Boca Raton restoration (Palm Beach)	2.7	2.2
Duval County Beach renourishment	9.5	5.5
Totals	$43.9	$25.5

4. The task force recommends that the 1986 Legislature appropriate sufficient funds to match all available federal money for beach preservation projects.

Recapturing Sand from Inlet Dredging in FY 1986-87

As we have noted earlier in this report, one of the major causes of beach erosion in Florida is loss of sand at navigation inlets. Florida law requires that beach-quality sand from navigation projects be placed on adjacent beaches. However, federal law requires that such sand be disposed of by the "least cost" method which sometimes results in good quality beach sand being dumped offshore outside of the beach system. When this happens, it results in a major loss to Florida of a valuable natural resource. Transferring such sand to adjacent beaches as "feeder beaches" for beaches downstream is much more cost effective than placing sand on beaches by traditional beach restoration methods.

To place sand on beaches via traditional beach restoration methods costs two to three times per cubic yard of sand.

The Department of Natural Resources estimates that $1.5 million will be needed in FY 1986-87 to place sand on adjacent beaches in channel dredging at Honeymoon Island and St. Lucie Inlet.

5. Therefore, the task force recommends that the Legislature appropriate $1.5 million in fiscal year 1986-87 to insure that this large quantity of valuable sand is saved from possible loss by placing that sand as "feeder beaches" adjacent to the inlets.

Appendix B

LONGEVITY OF BEACH FILLS

APPENDIX B

LONGEVITY OF BEACH FILLS

INTRODUCTION

This appendix presents the results of simple analyses of the longevity of the volume of material placed on beaches for two idealized cases. The first case pertains to the situation where a beach fill is placed on a long straight uninterrupted coastline and material "lost" is due to the fill "spreading out" and benefitting adjacent beaches. The conditions considered are an initially rectangular (approximately) beach fill on a long, uninterrupted shoreline. The results are presented in terms of the percentage of material remaining in front of the location placed as a function of time, wave height and fill length. The second case is that where a fill is placed immediately downdrift of a complete interruption in the longshore sediment transport, such as a jettied inlet.

RESULTS

Case 1 - Material Placed on a Long Uninterrupted Shoreline

The analysis below considers the longevity of the volume of material placed on a long uninterrupted beach. Designating the longshore dimension over which the material is placed as ℓ, the effect of ℓ on the percentage of material retained in the region placed is interesting. It can be shown that the time associated with retention of a certain percentage of material varies as the square of the length, i.e.

$$\frac{t_2}{t_1} = \left(\frac{\ell_2}{\ell_1}\right)^2 \qquad \text{(B-1)}$$

As an example, if a project of one mile length retains 60% of its material in the region placed after one year, a project of three miles length subjected to the same wave climate would retain the same percentage (60%) after 9 years. Thus the ineffectiveness of isolated short projects is quite evident. The above example illustrates graphically the economies of long beach restoration projects.

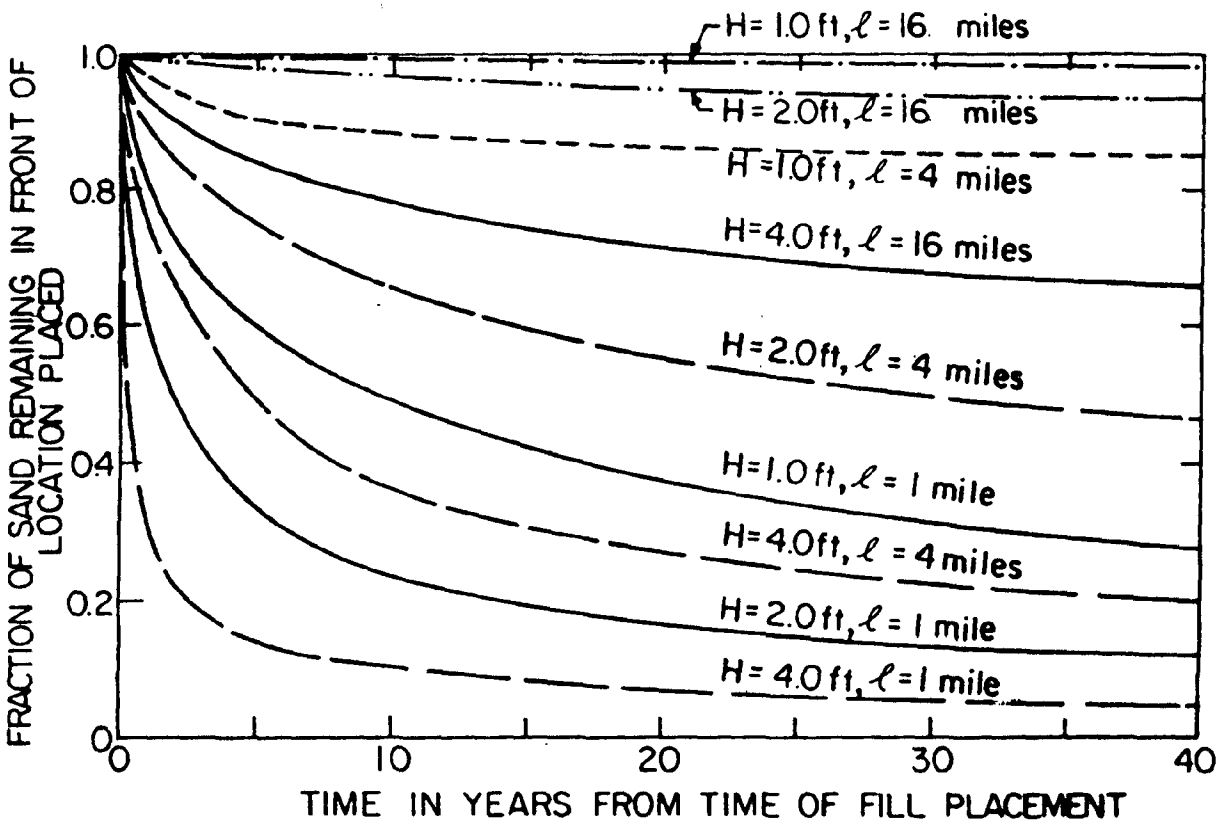

Figure B.1. Fraction of Material Remaining in Front of Location Placed for Several Wave Heights, H, and Project Lengths, ℓ. Effect of Longshore Sediment Transport.

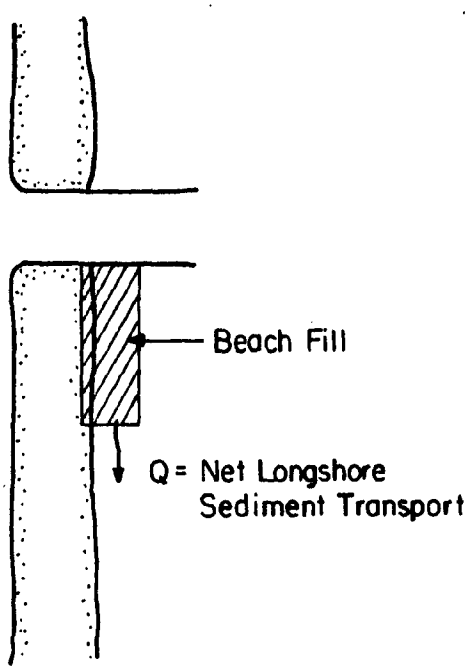

Figure B.2. Losses at a Littoral Barrier Due to Interruption of Net Longshore Sediment Transport.

A somewhat more complete version of Eq. (B-1) accounts for the different effective wave heights at the two sites and can be written as

$$\frac{t_2}{t_1} = \left(\frac{\ell_2}{\ell_1}\right)^2 \left(\frac{H_1}{H_2}\right)^{5/2} \tag{B-2}$$

which can be interpreted as follows. If, as an example at two sites of interest, the project lengths and effective wave heights are

ℓ_1 = 1 mile

ℓ_2 = 4 miles

H_1 = 4 ft

H_2 = 1 ft

and

$t_1(60\%)$ = time to "lose" 60% of fill from Project 1 = 1 year

$$t_2(60\%) = (1)\left(\frac{4}{1}\right)^2 \left(\frac{4}{1}\right)^{5/2} = 512 \text{ years.}$$

which is a sizable difference!

Figure B.1 presents several examples of the fraction of sand remaining in front of the location placed versus time from placement for various combinations of project length, ℓ, and wave height, H. As an example, a project of four miles length and one foot wave height would be expected to "lose" 15 percent of its volume in a period of 20 years.

Case 2 - Material Placed Immediately Downdrift of a Longshore Barrier

As noted, Case 1 pertained to the situation of an isolated fill placed on a long uninterrupted beach. The remaining case to be considered is where the fill is placed immediately downdrift of a complete littoral barrier such as might be the case downdrift of a deep navigational channel around which no bypassing occurs, see Figure B.2 This case is very simple. The volume, $\forall$, of material lost from the region placed in time, t, is simply

$$\forall = \bar{Q}_N t \tag{B-3}$$

in which $\bar{Q}_N$ is the net longshore sediment transport rate over the time period, t.

Appendix C

EVALUATION OF EFFECTS OF SEA LEVEL RISE ON FUTURE NOURISHMENT REQUIREMENTS

APPENDIX C

EVALUATION OF EFFECTS OF SEA LEVEL RISE ON FUTURE NOURISHMENT REQUIREMENTS

This appendix provides a detailed evaluation of the effects of increased rates of sea level rise on future nourishment requirements. In this evaluation, the following will be considered as representative:

(1) the present total rate of sea level rise in Florida is 1 ft/century of which 1/3 is the world-wide component and 2/3 is due to subsidence,

(2) the present average erosion rate is 1 ft/yr of which 1/2 is due to sea level rise and 1/2 due to human effects, primarily inlet modifications,

(3) the present renourishment requirements are 1 $yd^3/ft/yr$, and

(4) the projected sea level rise rate is 2.3 ft over the next century and the form is as shown by the EPA projections in Figure C.1 and can be presented by

$$S(t) = 3.3 \times 10^{-3} t + 2.0 \times 10^{-4} t^2 \qquad \text{(C-1)}$$

where S(t) is the sea level in the English system of units at time, t, and t is the time in years. (The second term in Eq. (C-1) is due to the increase.)

From the above considerations, the average renourishment requirement, r, due to sea level rise at any future time, t, will be

$$r(t) = 50 \frac{dS}{dt} \qquad \text{(C-2)}$$

in which r(t) is in units of $yd^3/ft/yr$ and dS/dt is in ft/yr. The associated average annual nourishment requirement over an N year interval, $\bar{r}_N$, will be

$$\bar{r}_N = \frac{50}{t_N} \int_0^{t_N} r(t)dt = 50 \frac{1}{t_N} \int_0^{t_N} \frac{dS}{dt} dt = [0.167 + 0.01\ t_N] \qquad \text{(C-3)}$$

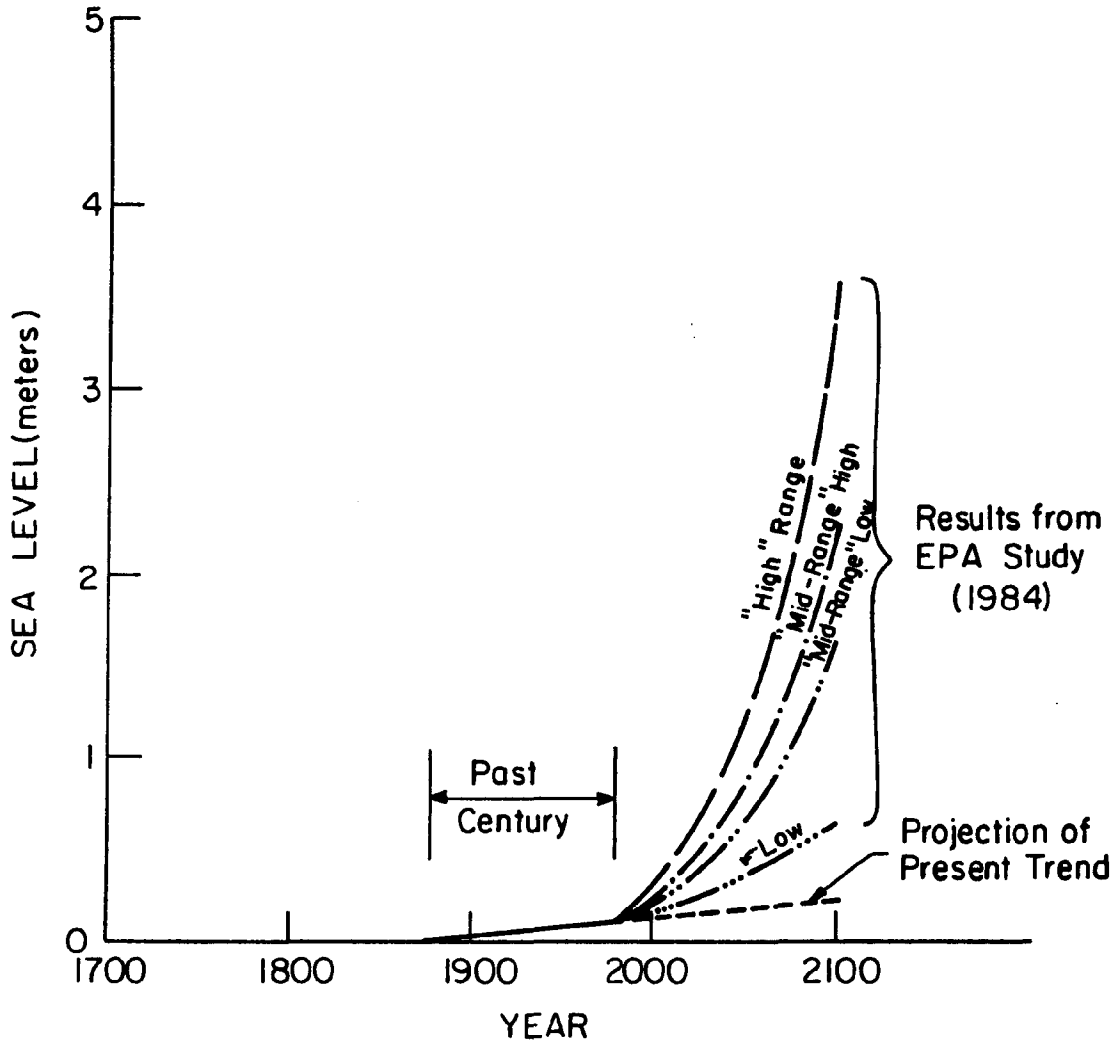

Figure C.1. Eustatic Sea Level Rise over the Past Century and Projections Developed in the EPA Study.

The total renourishment rate, R(t), is then that due to cross-shore transport and that due to alongshore transport,

$$R(t) = r(t) + \frac{1}{3} + \frac{1}{2} \cdot F \qquad \text{(C-4)}$$

in which the fractions $\frac{1}{3}$ and $\frac{1}{2}$ represent the contributions due to subsidence and longshore sediment transport and the factor, F, represents the degree to which the region is stressed by the longshore sediment transport deficit.

By definition, the present average value of F on the east coast of Florida is unity. The average total average nourishment rate $\bar{R}_N$ over the next N years is

$$\bar{R}_N = \frac{1}{t_N} \int_0^{t_N} R(t)dt = 0.5 + 0.01\ t_N + \frac{1}{2} F \qquad \text{(C-5)}$$

Based on Eq. (C-5), the average values of renourishment rates $\bar{R}_N$ over the next N years are presented in Table C.1 for N = 10, 25, 50 and 100 years.

TABLE C.1

AVERAGE ANNUAL RENOURISHMENT REQUIREMENTS,

$\bar{R}_N$ PER LINEAL FOOT OF BEACH FOR THE NEXT N YEARS

N (years)	$\bar{R}_N$ ($yd^3/ft/yr$)	
	F = 0.0	F = 1.0
10	0.60	1.10
25	0.75	1.25
50	1.00	1.50
100	1.50	2.00

If a beach nourishment program is successful in effectively bypassing sand at inlets thereby eliminating this present erosional component due to alongshore sediment transport (i.e. F=0), then it is seen that the average renourishment requirement over the next 50 years would be the same as the present rate. Over the next century, the average increase would be 50%.

Appendix D

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APPENDIX D

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