REPORT OF THE

COASTAL EROSION ABATEMENT COMMISSION

TO

THE GOVERNOR

AND

THE GENERAL ASSEMBLY OF VIRGINIA

SENATE DOCUMENT NO. 4

COMMONWEALTH OF VIRGINIA
DIVISION OF PURCHASES AND SUPPLY
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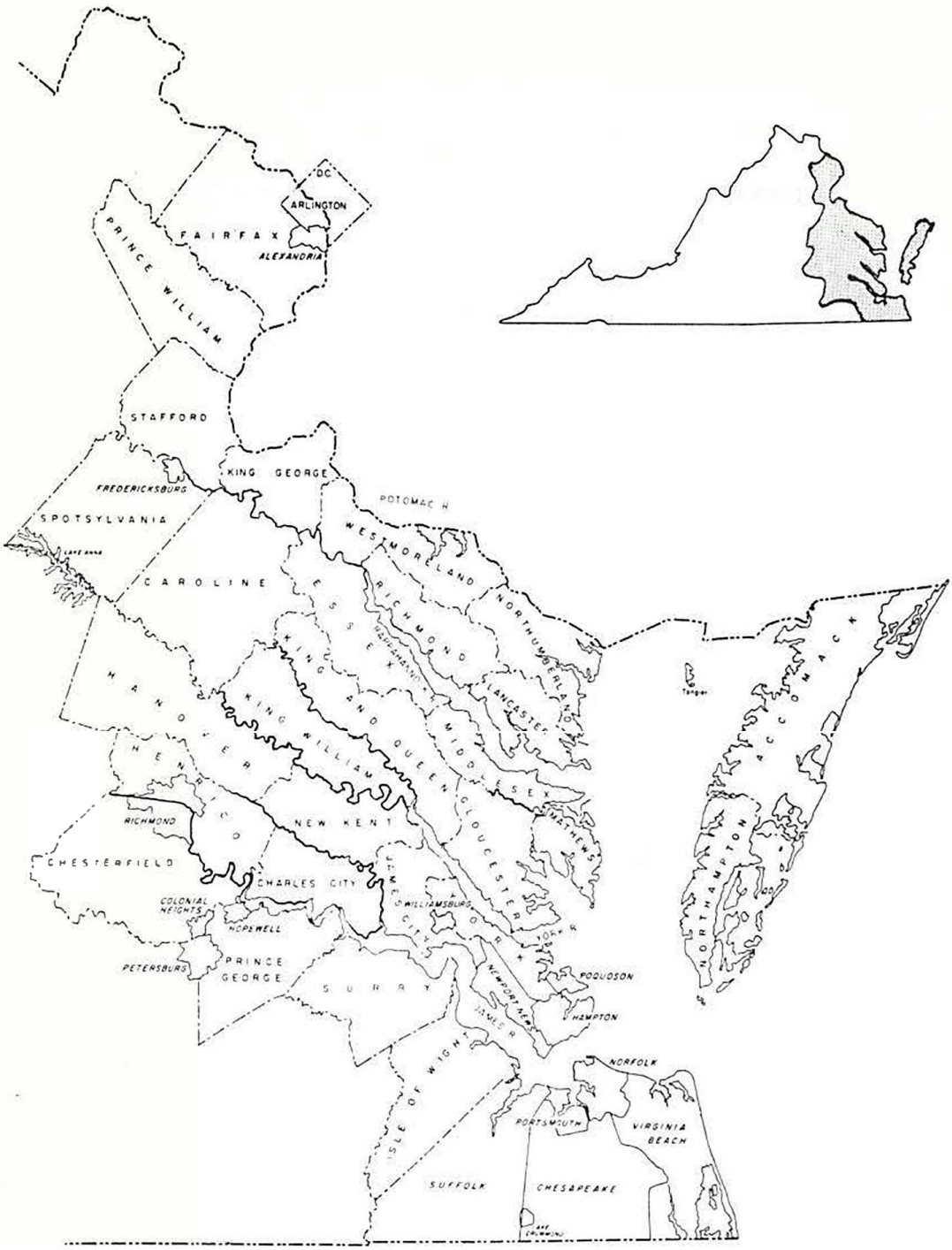

LOCATION MAP
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II. ACKNOWLEDGEMENTS

During the course of its study, the Commission conducted site visits, solicited and received extensive public testimony, reviewed relevant reports and obtained the advice of both property owners and technical experts in evaluating the effects of erosion on the tidal shoreline of the Commonwealth.

The Commission wishes to express its appreciation to Governor John N. Dalton for his interest in the Commission's work and in the shoreline erosion problem.

The Commission is indebted to those citizens, many of whom are shoreline property owners, who willingly gave their time and first-hand knowledge to the Commission. The Commission also expresses its gratitude to the many local officials who provided the Commission with their own observations and expert advice.

The Commission relied upon several executive branch agencies for assistance during the course of its work and would like to express its appreciation in particular to Secretary of Commerce and Resources Maurice B. Rowe; Dr. Robert J. Byrne, Carl H. Hobbs, III, and N. Bartlett Theberge, Jr., J. D., L. L. M., of the Virginia Institute of Marine Science; Don Budlong and Lynn C. Goodwin of the Office of the Secretary of Commerce and Resources; Joseph B. Willson, Jr., Director of the Soil and Water Conservation Commission; Fred W. Walker, Director, Department of Conservation and Economic Development; and Neal Barber of the Department of Housing and Community Development. The Commission also expresses its appreciation to James Melchor and Curtis W. Baskette of the U. S. Army Corps of Engineers, Norfolk District. Todd LePage and Susan T. Gill of the Division of Legislative Services assisted as legislative staff to the Commission.

The Commission would also like to thank Joseph Hoggard of Norfolk and David Grochmal, Assistant City Manager, Virginia Beach, as well as David N. Grimwood and Peter J. Vanderstappen, Soil Conservation Service of the U.S. Department of Agriculture; W. C. Garrett, Shoreline Committee, Virginia Association of Soil and Water Conservation Districts; and P. W. Davis, Eastern Shore Soil and Water Conservation District.

The Commission wishes to make special note of the report, **Shoreline Erosion in the Commonwealth of Virginia: Problems, Practices, and Possibilities (Special Report in Applied Marine Science and Ocean Engineering, No. 220, 1979, Virginia Institute of Marine Science). Shoreline Erosion** was prepared by an interdisciplinary group representing the Virginia Institute of Marine Science, Virginia Polytechnic Institute and State University, and the Middle Peninsula Planning District Commission for the Office of the Secretary of Commerce and Resources as part of the Commonwealth's coastal resources management planning effort. The report assesses the causes and effects of shoreline erosion along the Commonwealth's tidal waters and the alternative legal, economic, institutional and structural methods of addressing the problems. The Commission utilized many of the findings of **Shoreline Erosion** and extracted various sections for inclusion in this report.

III. INTRODUCTION

Pursuant to Senate Joint Resolution 22, the 1978 General Assembly created the Coastal Erosion Abatement Commission to study the effects of erosion on beaches, islands and inlets of the Commonwealth and to make such recommendations as deemed necessary to prevent the further destruction of those resources. (See Appendix A.) The Commission held an organizational meeting in May, 1978 and a two-day, combined instructional meeting and public meeting in June, 1978. Commission members conducted various site visits in 1978 and 1979.

The Commonwealth's tidal shoreline, which exceeds 5,000 miles in length, comprises a wide diversity of shores. These include the low-lying barrier islands of the Eastern Shore; the ocean front headland-barrier spit of southeastern Virginia; and the shores of Chesapeake Bay and its tributaries, which range from huge bluffs to tidal marshes. All of these shore types are affected by the natural process of erosion. Problems and issues arise when shoreline use itself causes erosion which adversely affects adjacent shoreline areas. Thus, individuals may be agents as well as victims of shoreline erosion. The extent and variety of tidal shoreline erosion in Virginia is a pernicious problem. Mitigation of its impact is by no means a simple matter technically, legally, economically or institutionally.

Tidal shoreline erosion in Virginia poses difficult challenges to the State, to the localities, and to private citizens. Erosion can result in a loss of fastland property and improvements thereon and a loss of taxable lands. It may result in an influx of sediment into the estuarine system and smaller tidal creek entrances, endangering marine resources, disrupting recreational and commercial navigation, and requiring costly dredging. Severe erosion may require substantial public and private investment to protect property and structures. Shoreline erosion does supply sand to beaches fringing the Bay system and the ocean shoreline. All but the latter impact may be perceived as distinct problems.

Management of shoreline erosion involves one or a combination of two basic strategies: (1) physical measures to inhibit the natural erosion process, such as groin fields, revetments, bulkheads, or vegetation; and (2) institutional measures to prevent or reduce victimization, such as setback lines. This report does not address the technical aspects of these shoreline erosion management strategies. (The reader is referred to the previously cited report **Shoreline Erosion** for this information.)

Shoreline erosion is viewed herein from the perspective of ownership. This report focuses on the role of state government on matters of public beach erosion and advisory assistance to property owners. The report includes a discussion of the Commission's findings at its site visits, a discussion of the causes and effects of shoreline erosion, and detailed recommendations for the conservation and development of public beaches and the need for advisory assistance to private property owners. The report also includes a summary of the legal issues involved in addressing shoreline erosion, and specific legislative recommendations.

The Commission recognizes that coastal erosion is a long-standing problem of major proportions in Virginia. The Commission likewise recognizes that there is no easy solution to the erosion problem. Accordingly, the Commission does not offer this report as a final solution to the coastal erosion problem, but rather offers this report as a starting point in an attempt to control the serious effects of coastal erosion.

IV. FINDINGS AND RECOMMENDATIONS

A. CONSERVATION, DEVELOPMENT AND USE OF PUBLIC BEACHES

1. State Aid for Local Public Beaches

THE COMMISSION FINDS THAT: Local public beaches along tidal shorelines are important recreational and economic assets to the Commonwealth. 1978 tourist travel in Norfolk and Virginia Beach amounted to expenditures of $197 million and $118 million, respectively. Part of these expenditures can be attributed to the availability of public beaches. Travel expenditures in these two cities alone provided 11,700 jobs, $12.9 million in state tax revenues, and $8.4 million in local tax revenues. Local public beaches are in short supply in relation to the demand and the total number of miles of tidal shoreline. Such public beaches are subject to severe erosion, threatening their recreational and economic value. There is a need for their continual conservation, protection, improvement, development, and maintenance to sustain their recreational and economic value. There is a further need for the State Government to aid Local Governments in conserving, protecting, improving, developing, and maintaining these public beaches.

THE COMMISSION RECOMMENDS THAT: There be established a State matching fund to assist Local Governments in conserving, protecting, improving, developing, and maintaining local public beaches for recreational use by the general public. There shall be appropriated from the General Fund the amount of $1 million annually for this purpose, such fund to be administered by the Department of Conservation and Economic Development.

The Commission further recommends that such funds as may be unexpended from the State matching fund at the end of the biennium for which they were appropriated be retained in a Special Emergency Assistance Fund for public beaches to be used at the discretion of the Governor.

2. Establishment of Commission on Public Beaches

THE COMMISSION FINDS THAT: There is a need for establishment of a body whose

membership is experienced in matters of tidal shoreline erosion and that such body should determine the allocation of State matching funds to Local Governments. There is a need for such body to obtain continual technical advice in reviewing the circumstances of public beach erosion and in determining the allocation of State matching funds.

THE COMMISSION RECOMMENDS THAT: There be established a Commission on Conservation and Development of Public Beaches to determine the allocation of State matching funds to Local Governments. Technical assistance to the Commission on Conservation and Development of Public Beaches shall be provided by the School of Marine Science, Virginia Institute of Marine Science, College of William and Mary. There shall be appropriated from the General Fund the sum of $32,200 for the first year of the 1980-82 Biennium and $32,900 for the second year of the Biennium for this purpose.

3. Sand Supply for Public Beaches

THE COMMISSION FINDS THAT: There is a need to locate sources of sand supplies for rebuilding public beaches. Certain bottom areas in the lower Chesapeake Bay should be studied as possible sources of sand supply for public beaches.

THE COMMISSION RECOMMENDS THAT: The School of Marine Science, Virginia Institute of Marine Science, College of William and Mary, study and analyze possible sources of sand supply in the lower Chesapeake Bay and vicinity for rebuilding public beaches. There shall be appropriated from the General Fund the sum of $136,600 for the first year of the 1980-1982 Biennium and $127,000 for the second year of the Biennium for such purpose.

B. EROSION MANAGEMENT FOR SHORELINE OTHER THAN PUBLIC BEACHES

1. Establishment of a Shoreline Erosion Advisory Service

THE COMMISSION FINDS THAT: Property along the tidal shoreline is subject to severe erosion, which causes a loss of property value and taxable assets. Private citizens and localities owning such shoreline property could benefit from state and local advisory services to assist them in selecting the appropriate measures to address the shoreline erosion problems. Current federal and State advisory services are insufficient to meet this need.

THE COMMISSION RECOMMENDS THAT: There be established a Shoreline Erosion Advisory Service to advise shoreline property owners of alternative methods of addressing shoreline erosion problems. Such Advisory Service shall be the responsibility of the Soil and Water Conservation Commission. The Soil and Water Conservation Commission shall seek the advice and assistance of the School of Marine Science, Virginia Institute of Marine Science, College of William and Mary, in carrying out such responsibilities. There shall be appropriated from the General Fund the sum of $114,600 for the first year of the 1980-1982 Biennium and $109,700 for the second year of the Biennium, for this purpose.

In order for the Advisory Service of the Soil and Water Conservation Commission to provide continuing advice to shoreline property owners and to have the support of an adequate resource base in areas of low cost erosion control techniques and training in coastal processes, there shall be appropriated to the Virginia Institute of Marine Science, College of William and Mary, from the General Fund a sum of $25,800 for the first year of the 1980-82 Biennium and $26,800 for the second year of the Biennium for this purpose.

2. Research for Most Economical Erosion Control Measures

THE COMMISSION FINDS THAT: The cost of constructing erosion control devices is becoming prohibitive for many private property owners. While conventional structures, such as bulkheads or groins, may be required for shorelines experiencing high rates of erosion, less costly methods of erosion control may be appropriate and workable on shorelines with lesser erosion rates. The use of vegetation to stabilize shoreline erosion has been successful in some areas, and is especially worthy of further testing and evaluation.

THE COMMISSION RECOMMENDS THAT: Additional research and evaluation be conducted on the use of vegetation to stabilize eroding shorelines. Such research and evaluation shall determine

the appropriate type of vegetation to be used under varying physical, biological, and chemical conditions of the shoreline. There shall be appropriated from the General Fund the sum of $50,700 for the first year of the 1980-1982 Biennium and $67,900 for the second year of the Biennium for this purpose. Such sum shall be appropriated to the Soil and Water Conservation Commission.

C. INTEGRATED APPROACH TO TIDAL SHORELINE EROSION

THE COMMISSION FINDS THAT: Current efforts in addressing tidal shoreline erosion problems differ along adjacent shoreline properties. Approaches on a piecemeal basis frequently exacerbate erosion, cause economic hardship, and do not account for the dynamics of erosion and accretion within a shoreline system. Shoreline erosion must be addressed on a **"REACH"** basis, a reach being a shoreline segment wherein there is mutual interaction of the forces of erosion, sediment transport, and accretion.

THE COMMISSION RECOMMENDS THAT: Tidal shoreline erosion be addressed on a "REACH" basis as fundamental State policy.

D. CONTINUED STUDY OF ALTERNATIVE MEANS TO ADDRESS SHORELINE EROSION

THE COMMISSION FINDS THAT: Extensive study and numerous site visits have revealed tidal shoreline erosion to be an issue of significant magnitude throughout tidal Virginia, affecting many property owners, the recreational opportunities of the general public, and the economic interests of private enterprise. The importance of tidal shoreline erosion to extensive areas of the Commonwealth requires further investigation by the Legislative and the Executive Branches into alternative means of addressing the problem. As a consequence, there is a need for further study of tidal shoreline erosion by the Coastal Erosion Abatement Commission.

THE COMMISSION RECOMMENDS THAT: The Coastal Erosion Abatement Commission be continued and make further findings and recommendations to the Governor and the General Assembly. (See Appendix B.)

V. COMMISSION SITE VISITS AND PUBLIC TESTIMONY

The Commission conducted numerous site visits in 1978 and 1979 to view first hand tidal shoreline erosion problems. The Commission met with local officials and conducted public meetings during these site visits. Field observations made by the Commission and the advice of local officials and private citizens are the basis for much that the Commission is recommending.

Commission members and the public were instructed by staff from the Virginia Institute of Marine Science and local officials on the causes and effects of shoreline erosion, the techniques of erosion control and their effects on adjacent properties, the effect of wave action on dunes and beaches, the Commonwealth's existing policies and programs, and the distribution and magnitude of shoreline erosion on ocean beaches and within the Chesapeake Bay and its tributaries.

Testimony from the public hearing and site visits identified severe erosion problems which have resulted from development close to the water's edge; on or seaward of a dune; improper construction of structural controls; and lack of funding sources for erosion control efforts. Testimony and site visits also demonstrated the natural protection and beach nourishment offered by dunes, the need for their proper reinforcement and protection, and the proper exercise of control techniques and construction of structural devices. An obvious need for a more informed public was demonstrated regarding the risks of development close to the water's edge and the proper methods of control. The rising costs of the various structural methods of control and the limited advisory services presently available clearly demonstrated the need for funding sources and increased advisory services relating to erosion control. Both are extremely limited at present.

The Shoreline Committee of the Virginia Association of Soil and Water Conservation Districts invited the Commission to observe riverine erosion problems and control methods utilized in the Northern Neck. The Commission was shown control methods such as vegetative plantings, riprap, rock revetments, jetties, and bulkheads and advised of the cost of each method.

The Committee advised the Commission of the need for research of vegetative means of

inhibiting shoreline erosion. The purpose of such research is to investigate and collect data for determining the conditions under which vegetative measures can be used for erosion control, by themselves or in combination with structural controls. The site visits confirmed that the application and maintenance of proper controls will protect eroding banks and beaches. The public hearing indicated widespread concern with shoreline erosion in the Northern Neck and Middle Peninsula areas and an interest in State-sponsored advisory services to assist private citizens.

Colonial Beach officials requested the Commission to investigate the severe erosion (in some areas, 50 feet or more) being experienced by the former resort town of 2,600. The Commission visited the most severely affected areas of the town, on the Potomac side of the peninsula. Town officials pointed out the loss of 75 feet of beach, now a ragged bluff, ineffectively reinforced by concrete fill or gabions. Approximately $10,000 of the town's highway money has been redirected to reinforce the bluff along with a public road which is in danger of collapsing. An Army Corps of Engineers' study suggests restoring the central town beach and the Castlewood Park beach (at the southernmost tip of the peninsula) at a cost of $250,000, $125,000 of which would be federal funds. The Corps project would only build up the beach at either end. The need for funding was obvious. Town officials have sought help from other state and federal sources to no avail. A minimum of $50,000 was estimated necessary to effectively stabilize the bank along the public road, Irving Avenue .

The Commission reviewed erosion problems in public areas and on private property along the Bay side of the Eastern Shore. The Commission found uncoordinated and inappropriate control techniques, often resulting in the destruction of adjacent private waterfront property.

Erosion threatens the embankment fill along the road at the North end of the Chesapeake Bay Bridge Tunnel. If the erosion continues at its present rate and force, part of the riprapped embankment supporting the foundation of the bridge will come under direct wave attack, subjecting the Eastern Shore end of the bridge to collapse. Although this property is presently the responsibility of the federal government, it will soon be transferred to the Chesapeake Bay Bridge Tunnel Authority.

Testimony from the public hearing following the site visits articulated a need for additional technical advisory assistance on the Shore, the use of local expertise regarding control methods, clear state policy on erosion accretion, and funding assistance for erosion control efforts.

A Subcommittee consisting of Senator Gartlan, Delegate Fickett and Mr. Anderson met with Mr. Larese Casanova of Maryland's Shore Erosion Control Program. The Subcommittee discussed Maryland's loan program for the construction of shoreline erosion abatement devices, the formation of Shore Erosion Control Districts, and the sand replenishment program. The Subcommittee also toured boat areas adjacent to Annapolis where the district approach had been utilized.

A second subcommittee consisting of Senators Fitzpatrick, Willey, and Boucher, and Mr. Anderson and Mr. Humphreys visited Wrightsville Beach, Masonboro Inlet, Carolina Beach, and Ft. Fisher in North Carolina. These localities have all utilized different approaches to the erosion problem and have employed State assistance in their endeavors.

Under the North Carolina Coastal Area Management Act (CAMA), "ocean hazard areas" are designated "areas of environmental concern." These hazard areas are highly susceptible to erosion and physical changes. Development is allowed only by permit granted under the provisions of CAMA. The permitting system in ocean hazard areas is designed to protect dunes as natural protective barriers, to assist local governments in planning and managing their coastal resources, and to inform property owners of the risks of development.

Set back provisions are also utilized as part of the CAMA provisions as are General and Specific Use Standards. The permit is multi-purpose, and is used to streamline the process for obtaining clearance for: 1) water quality certification; 2) major development permitted under CAMA; and 3) excavation and/or fill easements in lands covered by water.

VI. CONSERVATION, DEVELOPMENT, AND USE OF PUBLIC BEACHES

A. STATUS OF PUBLIC BEACHES

Site visits, public testimony and technical assistance confirmed that nearly 54 percent of all the easily accessible public beaches in Virginia have experienced severe erosion (Table 1).

TABLE 1

PUBLIC BEACHES IN VIRGINIA

LOCALITY	TOTAL MILEAGE	SEVERELY ERODED
Virginia Beach City	7.3	3.5
Norfolk City	7.4	2.5
Hampton City	3.5	3.0
Yorktown	.3	0.0
Colonial Beach Town	2.5	2.0
Cape Charles Town	.5	.5
Gloucester County	.1	0.0
Stafford County	.3	.3
Miles	21.9	11.8

Virginia Beach

The principal public beach is located on the oceanfront between Rudee Inlet and 89th Street, the boundary with Fort Story at Cape Henry. A beach nourishment program has been used since 1953 to maintain a protective beach in front of the boardwalk between the vicinity of Rudee Inlet and 49th Street. Because the net littoral drift is northward, the program, in effect, nourishes the entire beach to Cape Henry. Between 1964 and 1977, in excess of 3.3 million cubic yards of sand was placed on the beach at a total program cost of about $6.2 million.

In addition to the ongoing federal project noted above, the Corps of Engineers is initiating the Phase I stage of Advanced Engineering and Design studies of additional beach erosion control and hurricane protection between Rudee Inlet and 89th Street. Implementation of this plan would cost $37,000,000 (Phase I). Protection would include installation of a new sheetpile wall somewhat seaward of the existing bulkhead between Rudee Inlet and 57th Street. Between 57th and 89th Streets, the existing dunes would be raised and strengthened. For the entire 6-mile reach, the beach elevation would be raised to 10 feet above mean sea level by placement of sand. Navigation studies of Rudee Inlet will also be included.

Aside from cost burden of the nourishment program, a major problem is locating and getting access to sand sources for the continual demand. In the past, materials have been taken from dredging within Rudee Inlet and from a stockpile at Fort Story emplaced as a result of widening the Thimble Shoals Channel. Sand is also pumped through a by-pass pipe at Rudee Inlet to the beach. Lynnhaven Inlet maintenance dredging has recently served as another sand supply. Approximately 120,000 cubic yards will be supplied from the Fort Story stockpile in 1979. Because this stockpile is being diminished, the City is evaluating alternate sites, especially subaqueous sources near the Lynnhaven Inlet. The continuing requirement for annual sand replenishment has forced the City to use limited upland sources.

In an effort to stabilize the oceanfront beach and encourage tourism, the city, State and local governments have funded the sand replenishment programs. The amounts are presented below. (Figures are rounded to the neareast hundred dollars.)

	FY 1975	FY 1976	FY 1977	FY 1978	FY 1979
Federal	$110,800	$ 79,800	$126,300	$126,300	$130,000
State	50,000	50,000	50,000	50,000	150,000
City	409,800	469,800	539,200	470,700	881,200
Total	$570,600	$599,600	$715,500	$647,000	$1,161,200

The City of Virginia Beach has contributed between 72 and 79 percent of the replenishment cost over these five fiscal years. State contributions have ranged from 7 percent to 15 percent, while the federal share has been between 11 and 20 percent.

Norfolk

The public beach at Norfolk, 7.3 miles in length, fronts the Chesapeake Bay between a point a few hundred feet west of the entrance to Little Creek and the tip of Willoughby Spit. This shoreline section is exposed to wave attack from both the mouth of Chesapeake Bay and from the extensive fetch within Chesapaeake Bay. The net littoral drift is from east to the west. Two independent published studies have concluded that the jettied entrance to Little Creek constitutes a blockage to sand passage from the shoreline to the east.(1)(2) Recent preliminary studies by the Commission and the Virginia Institute of Marine Science indicate that a coast-parallel trench excavated in 1953 along the beach at the Naval Amphibious Base would also interrupt the natural littoral drift.

In some areas of East Ocean View and Willoughby Spit, the erosion situtation has become critical. The northeast storm of April, 1978, inflicted severe damage to homes and businesses in East Ocean View. Homes were also damaged near the tip of Willoughby Spit. Within the one-mile section west of Little Creek (East Ocean View), erosion rates range up to 9 feet per year. The April, 1978, storm left the beach in a depleted condition with total or severe damage to many of the erosion protection structures and millions of dollars in damage to shorefront tourist facilities. If a nearly comparable storm strikes soon, the damage costs will be much more severe.

In addition to an extensive series of groins installed by the City in the 1930's, various private landowners have installed bulkheads and revetments in an effort to control erosion. While the groin field has been partially successful, additional treatment will be necessary to provide protection against severe northeast storms. In 1978 the Virginia General Assembly appropriated $90,000 to the City of Norfolk for use on the public beach, in addition to the City of Norfolk's appropriation of $88,000. These funds are being used for some emergency sand replenishment and for an evaluation of the feasiblity of a pump-bypass system to transfer sand from the east side of Little Creek entrance to the Ocean View/Willoughby Spit beaches.

In 1977 the Norfolk District of Corps of Engineers initiated a five-year Plan of Study for hurricane protection and beach erosion control of East Ocean View/Willoughby Spit. The study will examine various alternative approaches to meet the objective and the costs and benefits of these strategies. If the benefits justify the costs, the District can recommend authorization of the selected approach. While the outcome of the study cannot be predicted, there is a strong likelihood that a beach fill and nourishment program will be the selected strategy. This would enhance the recreational value of the beach as well as protect the fastland from erosion. About 2.5 million cubic yards of sand would be needed to supply the initial fill and surcharge. Following the initial fill, about 50,000 cubic yards of sand per year would be required to maintain the width of the improved beach.

Hampton

The City of Hampton has 3.5 miles of public beach, which includes a natural park area with beach frontage in the Grand View section of Hampton. The principal public beach in the City of Hampton is Buckroe Beach, located on the Chesapeake Bay, facing eastward. This section of Hampton is hammerhead-shaped with spits at the north and the south, totaling a length of approximately 3.5 miles. The public beach area is located about two miles north of Fort Monroe. The shoreline along these two miles is hardened or stabilized with groins. Thus, the shoreline to the south supplies very little sand. The three-mile shoreline reach to the north is the principal natural

source of sand, a relatively weak source. During 1966-67, a beachfront recreational area was constructed behind a steel sheetpile bulkhead. In addition, six 200-foot groins were installed with a spacing of 600 feet. Although plans initially called for placement of sand fill within the groins, the sand was not placed due to budget limitations. During the period 1967 to 1975, the sand volumes within the groins became so seriously depleted that little dry sand was available and unimpeded wave attack was undermining the bulkhead at several locations. In the 1975-77 period, sandbag sills were installed and 31,000 cubic yards of sand were placed in the system. The total cost of the project was about $52,000. This nourishment action has helped provide a viable recreational beach and protection for the bulkhead. Additional nourishment is needed.

Cape Charles

The town beach at Cape Charles, about 3,000 feet in length, is located on the north side of the entrance to Cape Charles harbor. The harbor entrance jetty acts to trap sand, forming the basis of the beach. At present the beach area is narrow and low. As such, it offers little protection to the bulkhead which acts as a retaining wall for the road foundation which fringes the shoreline. The groins are in poor condition and the bulkhead needs repair. In 1977-78, the United States Department of Agriculture submitted a Resource Conservation and Development project proposal to replace the groins and repair the bulkhead. In addition, some vegetative controls were planned to inhibit the action of the wind from blowing sand off the beach onto the roadway. The RC&D projects were dropped due to budget constraints. A funding level of $85,000 is needed to complete the work.

Yorktown

The Yorktown public beach, 1,500 feet in length, is on the south side of the York River just east of the Coleman Bridge. The beach has a high visitation rate. While the shoreline has been relatively stable, the area is highly susceptible to overwash during storms. In 1977-1978 the county undertook a beachfront improvement plan which included toilet facilities, paved parking, landscaped promenade and a backshore riprap revetment to protect these improvements from storm conditions. The cost of the project was $450,000.

Gloucester Point

The public beach at Gloucester Point, about 500 feet in length, is located directly across the York River from the Yorktown beach. Visitations to this beach have increased dramatically in response to the county's expenditures for increased parking and grounds keeping. In addition, a new public boat ramp with enlarged trailer parking capability is being completed by the Commission of Game and Inland Fisheries. Although low in elevation, the beach itself is relatively stable.

Colonial Beach

Colonial Beach, in Westmoreland County, is located on the Potomac River. The town occupies a low peninsula between the Potomac River and Monroe Creek with a frontage on the river of about 2.5 miles. At one time Colonial Beach was the most popular summer tourist area on the Potomac. In recent times, tourism has seriously declined. A significant contributing factor is the high erosion of the shoreline. The river frontage has been seriously eroded due to the exposure to wave action from the east and the northwest.

Approximately two miles of the shoreline are open to the public. Two public beach areas, which are connected by a shoreline drive (Irving Avenue), exist within the two-mile reach. The central town beach, about 600 feet in length, is to the north, while Castlewood Park, with a beachfront of 1,000 feet, is at the extreme southern tip of the spit. Irving Avenue also provides the access to the large marina complexes at the mouth of Monroe Bay.

Three shore erosion problems exist. The central public beach is suffering from sand depletion. The southerly net movement of sand is bypassing the Castlewood park spit and shoaling the entrance to Monroe Creek. These two aspects of the problem are under study by the Corps of Engineers. Their preliminary studies propose beach fill and a modest breakwater at the central beach, and beach fill and a terminal groin at Castlewood Park to intercept the sand tending to shoal the entrance to Monroe Bay. Estimated total first costs are about $250,000, with nonfederal cost at about $125,000. The third problem, one of extreme urgency, is the protection of those segments of Irving

Avenue not protected and undergoing severe erosion. About 550 feet of public roadway is in immediate danger of being washed out.

B. DETAILED RECOMMENDATIONS FOR PUBLIC BEACHES

1. Matching Funds

The Commission recommends that the State establish a matching fund to assist local governments in conserving, protecting, improving, developing and maintaining their public beaches. State assistance is essential for ensuring recreational opportunities, tourism, economic benefits for local business, and an important tax base for local and State revenues. To provide such assistance, there should be appropriated from the General Fund $1 million annually for this purpose.

State assistance should be provided on a 50 percent matching basis. Local governments may match State funds only with locally-derived revenues. The amount of State matching funds for which a locality may be eligible during any one fiscal year shall be limited to 30 percent of the total appropriation to the State matching fund for that fiscal year. The purpose of these stipulations is to encourage local participation with the State in addressing the problem of shoreline erosion and to provide an opportunity for all eligible localities to acquire a portion of the funds.

The allocation of State matching funds will be determined by the Commission on Conservation and Development of Public Beaches. In allocating the State matching funds, the Commission shall consider whether or not the erosion was caused by public navigational works, the intensity of use of the affected public beaches for which the funds shall be used, the availability of public beaches in the vicinity, the rates of erosion, and evidence of the applicant locality's willingness and ability to address shoreline erosion. The Commission shall allocate grants from the State matching fund for the conservation, protection, improvement, development, and maintenance of beaches in public ownership only. The State matching fund shall be administered by the Department of Conservation and Economic Development.

2. Commission on Conservation and Development of Public Beaches.

It is recommended that a Commission on Conservation and Development of Public Beaches be established to review the financial needs of localities for implementation of the recommended Public Beach Conservation and Development Act; determine successful applicants and the equitable allocation of funds among participating localitites; and oversee local implementation of approved projects. The Director of the Department of Conservation and Economic Development should administer the allocation of funds to localities in accordance with the Commission's determinations.

The Commission should be composed of 9 members. There should be four ex officio members, selected by the directors of the Soil and Water Conservation Commission, the Marine Resources Commission, the Department of Conservation and Economic Development, and the Commission on Outdoor Recreation. It is recommended that 5 members be appointed by the Governor and be subject to confirmation by the General Assembly.

The Commission should meet once prior to the beginning of each fiscal year to receive applications for grants from localities and to determine the allocation of such grants, and as often throughout the year as necessary. The Department of Conservation and Economic Development should provide staff assistance to the Commission from time to time, if required. At-large members of the Commission shall receive such compensation as provided in § 14.1-18 of the Code of Virginia. Other expenses necessary to the Commission's work shall be incurred against the State matching fund.

3. Shoreline Advisor

The Commission for Conservation and Development of Public Beaches shall be assisted in its technical assessment of applications from the localities for matching grant funds by staff at the Virginia Institute of Marine Science, College of William and Mary. For this purpose, the Coastal Erosion Abatement Commission reccommends the establishment of a position of technical advisor on public beaches at the Virginia Insitute of Marine Science, College of William and Mary. In order to serve the Commission for Conservation and Development of Public Beaches, the advisor will maintain under constant review all ongoing research at the Virginia Institute of Marine Science and

that of other institutions relevant to the public beaches. The advisor will also maintain periodically updated files and archives of necessary reports, charts, photography, and maps documenting the status of the public beaches of the Commonwealth. Furthermore, the advisor will maintain liaison with the appropriate personnel of the localities, and he may serve as an advisor to the localities on matters pertaining to the public beaches. There shall be appropriated from the General Fund the sum of $32,200 for the first year of the 1980-82 Biennium and $32,900 for the second year of the Biennium for this purpose.

4. Analysis of Sand Resources in the Chesapeake Bay

The public beaches at Virginia Beach, Norfolk and Hampton rely upon beach nourishment to maintain their recreational capability and to provide a buffering beach width as protection for the fastland and shoreside facilities. The beaches at Colonial Beach also require nourishment. In all cases, locating suitable and economical marine sand sources which can be extracted at acceptable environmental risk is a serious problem. Implementation of the Corps of Engineer's plans at Virginia Beach would require initial sand volume of 2.5 million cubic yards. If nourishment is the recommended strategy at East Ocean View and Willoughby Spit in Norfolk, about 2.5 million cubic yards will be required. Combined annual maintenance requirements would be about 250,000 cubic yards.

Studies of the Corps of Engineers (1972) disclosed the existence of a very promising deposit in the Thimble Shoals Channel area, (3) estimated to be about 12 to 19 million cubic yards of coarse sand and gravel. In 1974 about 452,000 cubic yards of material were stockpiled at Fort Story for later use. The extraction was part of an enlargement of the Thimble Shoal Navigation Channel. While it is encouraging to have such a deposit available, the extraction is only economical if very large volumes are dredged. Consequently, a large sand storage area would be required. The Corps of Engineers study included reconnaissance work in the zone offshore of oceanfront Virginia Beach. Materials comparable to the Thimble Shoals deposit were not found.

With the exception of about 20,000 cubic yards of sand placed from an upland site in 1979 just west of the Little Creek jetties, all of the prior nourishment sand placed on the East Ocean View-Willoughby Spit area in Norfolk has been derived from dredging operations in the Little Creek entrance and forebay area. In 1975 a channel enlargement was made but the material (about 800,000 cubic yards) was placed on the beaches of the U.S. Navy Amphibious Base at Little Creek. If the Corps of Engineers study, to be completed in 1982, justifies a nourishment program, approximately 2.5 million cubic yards of sand will be needed. Even without the federal project, the City of Norfolk needs to maintain a sand supply for the East Little Creek-Willoughby Spit area. While sand bypassing from the updrift side of Little Creek remains a possibility, the determination of the feasibility awaits the completion of the sand budget analysis by the Corps of Engineers.

Alternate sources must be evaluated. Willoughby Bank is a source worthy of investigation. During the construction of the second Hampton Roads tunnel, a borrow area on Willoughby Bank adjacent to Fort Wool was utilized to provide foundation sand for the tunnel tube and surcharge for a tunnel island. Subsequent to that, the surcharge material was successfully used as beach nourishment sands at Buckroe Beach in Hampton.

Given the need for beach nourishment sands for the public beaches of Virginia Beach, Norfolk and Hampton, additional investigations of the extractable subaqueous sand resources are required. These investigations would augment the earlier studies by the Corps of Engineers east of the Chesapeake Bay Bridge tunnel by extending the assessment to the inner approaches to Hampton Roads, and those areas fronting Hampton and Lynnhaven Inlet.

The Commission recommends funding studies by the Virginia Institute of Marine Science to assess the extent and quality of the sands for beach nourishment within the inner approaches to Hampton Roads which would include the entrance to Lynnhaven Inlet, Willoughby Bank, Horseshoe Shoal fronting Hampton, Hampton Flats and other areas in the environs deemed appropriate. This study, to be completed in a period of three to four years, would include:

a. Determination of the extent and quality of sands for beach nourishment purposes in the aforementioned areas;

b. Study of the most economical means of recovery and transportation of potential sands to the

target areas; and

c. Assessment of the environmental risk of extraction to the associated marine ecosystem.

Tasks (a) and (b) above will be completed within two years. Initiation of Task (c), scheduled for the third and fourth years, would be contingent upon the findings of Tasks (a) and (b). To the extent possible, the goal of the program will be to delineate areas with sands suitable and economical for beach nourishment which may be dedicated to that purpose.

VII. EROSION MANAGEMENT FOR SHORELINE OTHER THAN PUBLIC BEACHES

A. DETAILED RECOMMENDATIONS

1. Shoreline Erosion Advisory Service

Although there are not at present comprehensive management strategies to mitigate the impacts of shoreline erosion, there are limited technical advisory services available to assist the owners of tidal shoreline property in the selection of methods to control erosion.

Advisory services are offered through the Marine Advisory Service of the Virginia Institute of Marine Science at Gloucester Point, and the Soil Conservation Service (U.S. Department of Agriculture) at Warsaw. Each of these agencies devotes one person per year in an attempt to satisfy the growing demand for advice and education in shoreline erosion. While most of the service rendered is focused on the problems of the individual landowner, their clients also include localities. During 1978 the two agencies provided advice on shoreline erosion problems for approximately 350 cases wherein the problem involved shoreline lengths of 75 to 9,000 feet.

An expanded advisory service, available to private property owners and localities, should be the forefront of State level actions to alleviate the impacts of erosion. In addition to consultation on specific problems, this program should include public education regarding the nature of the erosion problem. Such activity could, for example, save large private landowner residences. The State advisory service would provide 3 technical advisors to work with private property owners and localities. Of approximately 350 cases per year, the current advisors with the Virginia Institute of Marine Science and the Soil Conservation Service indicate that successful implementation of control measures on the shoreline covers approximately 2 to 2.5 miles per year. With the additional advisors available, it could be anticipated the successful implementation rate would increase to approximately 6 miles per year. Even though the implementation rate seems extremely low, this level of service will realistically protect an additional 125 to 175 real estate properties per year.

Equally valuable to the citizens of the Commonwealth would be the educational program whereby shoreline landowners can learn of inadequate techniques which have failed to reduce erosion on other sites. The scope of this service will be difficult, if not impossible, to measure but has been a most important work of the present advisors.

A Shoreline Erosion Advisory Service Office should be created within the Virginia Soil and Water Conservation Commission. This is consistent with the Agency's Land Management Program responsibilities, including erosion and sediment control, and its statutory authority for shore erosion control programs outlined in Section 21-11.18 of the Code of Virginia. The costs of establishing this office to provide additional advisory services, including a chief engineer, 2 assistants, a secretary and expanded educational efforts, are projected to be $114,600 for the first year of the 1980-82 Biennium and $109,700 for the second year. Upon establishment of the advisory service, meetings with private coastal engineering and coastal consulting firms will be held. The purpose of these meetings is to establish the consulting limits of State-supported advisory service.

a. Support of the Erosion Advisory Services by the Virginia Institute of Marine Science

The Erosion Advisory Services of the Soil and Water Conservation Commission will be supported by the research and training program at the Virginia Institute of Marine Science. This support will include research on alternate forms of low-cost erosion control structures, training in coastal processes, and assistance in advisory matters.

In recent years VIMS has initiated, with the assistance of the National Sea Grant Program and the Coastal Plains Regional Commisssion, the development of some low-cost erosion control structures. These demonstration projects have shown some success and additional work on these and alternate methods could yield dividends to the citizens of the Commonwealth. It is anticipated that future solicitations for funding from the federal government to cover the non-personnel research costs will also be successful.

The costs of maintaining this support, including a marine scientist, part-time secretary, supplies and travel, are projected to be $25,800 for the first year of the 1980-82 Biennium and $26,800 for the second year of the Biennium.

In addition, the Erosion Advisory Service should provide local officials with a convenient, ready source of informative material to help them choose among alternative courses of action for coping with shoreline erosion. An information center should be located at the Virginia Institute of Marine Science. The Institute currently houses a "Marine Environmental and Resources Research and Management System" (MERRMS), which produces and stores microfiche copies of various reports, studies, and research findings and maintains equipment and facilities for visual displays. MERRMS should be the repository for information helpful to local officials, such as aerial photos, erosion studies, maps, and monitoring reports. This repository would also serve the Shoreline Advisor to the Commission on Conservation and Development of Public Beaches. These materials could be made available to local officials at cost.

2. Vegetative Stabilization Project for Shoreline Erosion

The vegetative stabilization project will concentrate on eroding sites where property values do not warrant expensive engineering solutions. In addition to lower cost, the vegetative technique enhances the total ecological value of the shoreline by supplying nutrients to the food chain and by offering an improved aquatic habitat.

Previous work with vegetative treatment has shown that certain shorelines may have the potential to be effectively stabilized by introducing selected vegetation with or without engineering structures (Figure 1).

FIGURE 1 - Successful vegetative controls in the Northern Neck.

The principal factor limiting the use of such a procedure is the present lack of an evaluation system for identifying sites. Previous experience indicates that vegetative treatment will work in highly protected areas. Implementation of this proposal will expand the range of environmental conditions which are adapted to vegetative treatment.

The objectives of the project are:

1. Determine how eroding tidal estuaries can be stablized using vegetation;

2. Select and propagate superior species of native vegetation for site evaluation; and

3. Develop a criteria for classification of sites.

The project is scheduled to last 5 years and the work would be carried out by the personnel of the Shoreline Erosion Advisory Service under the Virginia Soil and Water Conservation Commission. The cost of the project is projected to be $50,700 for the first year of the Biennium and $67,900 for the second year. The remaining costs for the following three years are expected to be $50,000 a year, for a total of $150,000.

During the first year, the project group will select representative shoreline sites and conduct the analysis of the littoral and biological environment of those sites. In addition, the pretreatment monitoring will be initiated. The group will collect smooth and saltmeadow cordgrass and other species from native stands and establish evaluation plantings under selected conditions. Seedlings of smooth cordgrass and saltmeadow cordgrass will be grown using different methods of propagation.

During the second project year, site surveying will be continued and evaluation criteria will be improved by new observations. Smooth and saltmeadow cordgrass will be planted on selected tidal sites using a variety of established techniques. The strains of collected smooth cordgrass, saltmeadow cordgrass and other species will be evaluated for superior characteristics under controlled conditions.

In the third year, those slopes treated for stability during the second year will be evaluated. Site surveying will continue to provide further refinement of evaluation criteria. Seedlings from superior strains will be transplanted to enlarge the selected sites. This approach will thus allow comparison between the plantings of native stocks against the superior strains. More smooth cordgrass and saltmeadow cordgrass seedlings will be grown using the best propagation technique. Establishment procedures will continue to be evaluated and refined.

During the fourth year, those slopes treated in the second and third year will be evaluated. Additional sites will be treated using the up-dated evaluation criteria for site selection. The superior strains of smooth cordgrass and saltmeadow cordgrass plus any other selected species will be increased. Additional seedings of smooth cordgrass and saltmeadow cordgrass will be grown. These will be transplanted using techniques refined by an evaluation of those planted on tidal riverbanks in the first year.

Evaluation of previously treated sites will be completed in the fifth year and evaluation criteria will be refined based on these results. An evaluation of propagation and establishment techniques will be completed based on earlier plantings. Plants of superior strains of smooth cordgrass, saltmeadow cordgrass and other species will be evaluated. If sufficient superiority is evident, selections will be made for commercial production. A final report will be prepared by the end of the fifth project year.

VIII. LEGISLATION RECOMMENDED

The Commission recommends that legislation similar to the drafts attached in Appendix C be enacted during the 1980 Session of the General Assembly.

IX. GENERAL FINDINGS

A. CAUSES

The Commonwealth, having a tidal shoreline exceeding 5,000 miles in length, is graced with a wide diversity of shore types which include the low-lying barrier islands of the Eastern Shore, the ocean front headland-barrier spit of southeastern Virginia, and the shores of Chesapeake Bay and other estuaries which range from high bluffs to tidal marshes. The principal natural processes responsible for erosion are the long-term changes in the level of the sea, the waves generated by local or distant winds and the short-term water level fluctuations occurring during storms.

1. Sea Level Rise

About 18,000 years ago the polar ice caps, formed indirectly from water of the world's oceans, were extensive, and sea level was about 300 feet lower than its present elevation. The ocean shorelines off of what is now Virginia were then located near the edge of the continental shelf, about 60 nautical miles from the entrance to Chesapeake Bay. Of course, the Bay and its rivers were not estuaries at that time, but rather were an upland drainage network leading to the sea. The gorges of the rivers were deeper because the fluvial action tended to scour channels as the rivers flowed down to the sea. As the ice caps began to melt and recede, the elevation of the sea started to rise.

Although there are local variations due to local land subsidence or uplift, an average value for sea level rise in the Chesapeake Bay area is about 0.01 feet per year or 1 foot per century (4). This average includes shorter term variations of several years duration which may be appreciably larger or smaller. Although this rate of sea level rise is small, its effect is dramatic. Because the fringes of the ocean and the Bay are generally gently sloping, each decade brings constant encroachment against the fastland. Of course, the gentle action of sea level rise does not by itself erode the fastland but constantly elevates the point of application of the erosive forces of the waves. An analogy with a sawmill is fitting. Sea level rise represents the belt advancing the saw blade while wave action represents the cutting teeth.

Another important aspect of sea level rise is its effect on the sedimentation characteristics of the Chesapeake Bay and its tributary rivers. When sea level was lower, the fluvial action of the freshwater rivers tended to carry sand and silt to the edge of the sea. Today, however, the coarse-grained materials, sand and gravel, are deposited in the tributary reaches near the fall line which separates the Piedmont from the Coastal Plain. The fall line extends approximately along the Route I-95 corridor through Richmond, Fredericksburg, and Washington. Moreover, saline oceanic waters now enter the Bay and tributaries. The net effect of the circulation between the entering oceanic water and freshwater introduced from the rivers (James, York, etc.) is to trap the fine grained sediments, the silt and clays, within the estuaries. Thus, very little of the sediment delivered to the estruary system, either from the tributary freshwater rivers or from shoreline erosion, escapes from the mouth of the Chesapeake Bay into the ocean.

2. Wind and Wave Action

When visiting the ocean shores of Virginia an observer may notice wave conditions ranging from "fair weather" to those of a storm. Fair weather waves are characterized by generally well-defined gentle undulations which break on the beach face with apparent regularity. These waves are generated by wind fields relatively far offshore and then travel to distant shores. During a storm, however, strong local winds generate waves which mix with those generated offshore. The result is an apparent maelstrom with waves of all sizes and shapes. Generally speaking, "fair weather" waves (swells) carry sand from the immediate nearshore bottom and deposit it on the beach. Storm waves, on the other hand, tend to remove sand from the beach itself and to deposit it in nearshore waters in accumulations called bars. When the fair weather swell waves return, the material stored in the bars is driven back to the beach face. Thus, there is a periodic shift of sand between the beach and

the nearshore.

Another very important aspect of wave behavior on beaches is that waves drive sand along the shore. This occurs when, as is usually the case, the breaking wave crests approach at an angle to the shoreline. This action of the waves provides the principal supply of sand which works along the shore and is deposited in the entrances to inlets and creeks.

An observer visiting the shore of the Chesapeake Bay and the wider parts of the tributary estuaries would witness the same wave behavior except the wave heights would be smaller and the time between successive waves shorter. This is due to the fact that the degree of wave development is strongly dependent on fetch, the "over the water" distance the wind blows. Of course the distances across the Bay are much smaller than those found on our ocean coast.

The beaches fringing our coastline are natural formations created by wave action as the waves expend their energy. Beaches are, in fact, recognized as the most efficient dissipators of wave energy. Thus, aside from their intrinsic attractiveness to man, beaches are protective structures which inhibit erosion of the fastland.

During storms (northeasters) and hurricanes, the strong winds push additional water against the ocean coast and into the Bay. As a result, the normal rise and fall of tide oscillates around an elevated mean water level. While the storm surge generally ranges between one and two feet, it may be several feet in magnitude. For example, the extremely severe northeast storm of March, 1962, resulted in water elevations at Norfolk of 6.1 feet higher than predicted.

A listing of major storms (when the storm surge exceeds two feet) between 1956-1978 is cited in Table 2. Within the 22 year period, Virginia had 64 major storms with high storm surges and large waves. The frequency and severity of coastal storms have increased in recent decades.(5)

3. Hurricanes

In recent years, Virginia has been blessed with the absence of serious hurricanes. During the period 1899-1977, Virginia has been directly affected by land-falling hurricanes only three times; August 1933, September 1944, and August 1955.(6) These were respectively categorized as scale 2, 3, and 1 hurricanes. The scale of the hurricane combines wind strength (and therefore local wave action) and storm surge elevation. A scale 3 to 5 is considered a major hurricane. It is sobering to realize that North Carolina, in the same period, has experienced 21 hurricanes, 8 of which were equal to or greater than scale 3. The above description does not imply that damages have not been experienced from other tropical cyclones as the figures allude simply to direct landfalls. The occupants of the shoreline must realize that should a major storm landfall the Virginia coast, the damages would be enormous.

Aside from the obvious hazard of flooding low-lying areas, the storm surge permits the erosive action of the waves to attack the fastland directly above the usual buffer provided by the beach. The effect is further acentuated if the storm occurs in conjunction with the higher, or spring, tides of the lunar month.

4. Tidal Currents

Tidal currents, the water movements resulting from the rise and fall of the tide, play a secondary role in shoreline erosion since the current speeds are small except near inlets, such as Lynnhaven Inlet, where their influence is a dominant force. Away from inlets the tidal currents tend to move the sand stirred up by waves slowly along the coast.

5. Interaction of Erosive Elements

It is of interest to see how these elements interact during the passage of a typical northeast storm. With the onset of the storm the northeast or easterly winds generate large waves which impinge on the open coast beaches. Because of the large, steep waves and accompanying storm surge, large volumes of sand are removed from the ocean beaches. Some of this material will be moved offshore for temporary storage in sand bars and some will be driven along shore to storage in inlets or to beach areas on the fringe of the storm's influence. Within the Bay and tributary rivers the intensity of erosion will depend on the path and strength of the storm. When the local

TABLE 2

Occurrence of Major Storms in Virginia Beach
From 1956-1978

Storm	Date	Storm Surge (ft)	Wind Speed (kn)	Direction
	11 Jan. 1956	3.4	33	NE.
	11 Apr. 1956	4.3	62	N.
	3 Nov. 1956	2.0	29	NE.
	28 Feb. 1957	2.4	33	NE.
	8 Mar. 1957	2.2	27	NE.
	1 Nov. 1957	2.7	28	NE.
	25 Jan. 1958	2.3	44	E.
	1 Feb. 1958	2.2	30	W.
	19 Mar. 1958	2.2	21	NE.
	27 Mar. 1958	2.6	20	N.
	11 Dec. 1958	2.1	27	NE.
	29 Dec. 1958	2.3	38	E.
	12 Apr. 1959	2.5	45	NE.
	19 Dec. 1959	2.1	29	N.
	31 Jan. 1960	3.0	42	NE.
	13 Feb. 1960	2.3	49	NE.
	3 Mar. 1960	2.4	52	E.
	12 Dec. 1960	2.0	40	W.
	16 Jan. 1961	2.0	13	W.
	8 Feb. 1961	2.4	27	NE.
	22 Mar. 1961	2.2	33	E.
	28 Nov. 1961	2.0	23	NW.
	28 Jan. 1962	2.2	37	NE.
Ash Wed	7 Mar. 1962	5.6	41	NE.
	22 Mar. 1962	2.4	20	N.
	3 Nov. 1962	2.5	33	N.
	26 Nov. 1962	3.3	41	N.
	8 Feb. 1963	2.3	30	NE.
	6 Nov. 1963	2.4	38	E.
	4 Jan. 1964	2.0	28	W.
	12 Jan. 1964	2.6	42	E.
	12 Feb. 1964	2.0	32	E.
Cleo	1 Sept. 1964	1.0	42	ESE.
Dora	13 Sept. 1964	0.3	61	NE.
Gladys	23 Sept. 1964	2.3	44	N.
Isabell	16 Oct. 1964	2.6	50	NE.

(W.S. Richardson, U. S. Weather Service, personal communication, 1979)

TABLE 2 (Continued)

Occurrence of Major Storms in Virginia Beach From 1956-1978

Storm	Date	Storm Surge (ft)	Wind Speed (kn)	Direction
	16 Jan. 1965	3.9	35	NE.
	22 Jan. 1965	3.0	36	E.
	29 Jan. 1966	3.6	37	E.
	24 Dec. 1966	2.3	31	NE.
Alma	13 June 1966	1.0	40	N.
	7 Feb. 1967	2.6	33	NE.
	12 Dec. 1967	2.0	30	E.
	29 Dec. 1967	2.0	31	W.
Doria	16 Sept. 1967	3.4	55	N.
	14 Jan. 1968	2.3	33	E.
	8 Feb. 1968	2.6	30	NE.
Gladys	20 Oct. 1968	1.3	46	NE.
	10 Nov. 1968	4.3	34	N.
	12 Nov. 1968	2.6	47	NE.
	2 Mar. 1969	5.9	40	N.
	2 Nov. 1969	2.6	36	NE.
	10 Nov. 1970	2.6	22	SE.
	16 Dec. 1970	2.0	31	E.
	27 Mar. 1971	2.8	45	NE.
	6 Apr. 1971	4.0	44	NE.
	19 Oct. 1972	-	34	N.
	11 Feb. 1973	3.5	44	N.
	21 Mar. 1973	3.1	28	N.
	2 Mar. 1975	2.2	22	S-SE.
	14 Oct. 1977	2.6	29	NE.
	30 Oct. 1977	2.3	24	NE.
	20 Dec. 1977	-	-	-
	28 Apr. 1978	4.6	39	NE.

(W.S. Richardson, U. S. Weather Service, personal communication, 1979)

easterly winds in the Bay are sustained at 20 mph or greater the waves become quite large and the attack is focused on the western side of Chesapeake Bay and the lower reaches of the tributary estuaries. After the storm center has passed offshore or to the north, the winds shift to the northwest quadrant. These winds, accompanied by a clear sky, are frequently stronger and of longer duration than those experienced during the "storm". Now the ocean front beaches tend to recover some of the sand from the offshore bar. But in the Bay the focus of wave attack simply shifts. Now the eastern side of the Bay receives wave attack. Because the major tributary estuaries have a northwest-southeast orientation, their banks also receive substantial wave attack during northwest winds.

B. THE MAGNITUDE OF EROSION

To gain an insight of the magnitude of shoreline changes within the Bay System, the earliest reliable maps (1850's) were compared with a series of 1940-1960 maps and charts for 2,365 miles of the Bay system.(7) Similar studies were made of the barrier islands and the coastline between Cape Henry and the Virginia - North Carolina border. (8)(9) The summarized results (Table 3) show that over 28,000 acres (about 44 square miles) of land were lost during the recent past century (1850-1950).

Table 3

ACREAGE LOSSES DUE TO EROSION CIRCA 1850-1950

Atlantic Coast		
SE Virginia	27 miles	-40 acres
Atlantic Coast		
Eastern Shore	84 miles	-7,228 acres
Virginia Chesapeake Bay		
and Tributaries	2,365 miles	-21,079 acres
TOTAL	2,476 miles	-28,347 acres

The ocean coastline segments show characteristically different erosion responses than the Bay system. The barrier islands are, for the most part, sand-starved islands segmented by tidal inlets. The net littoral drift is directed to the south. The northernmost islands (Wallops, Assawoman, Metomkin, and Cedar) have retreated in a fashion so that the new shoreline parallels the older. The erosion rates on Metomkin and Cedar Islands are greater than the other two. The central Parramore, Hog and Cobb Islands, are flanked by deep inlets which strongly influence their gross behavior. Over recent times these islands have accreted on the northern ends due to local trapping of sand which bypasses the adjacent inlet. The retreat of the southern portions of the islands has been dramatic (up to 50 feet per year on Hog Island). The southern section of chain, ending with Smith Island, has retreated in a nearly parallel fashion, Smith Island at about 25 feet per year. Meanwhile, Fishermans Island, which is at the toe of the peninsula, has accreted to a four-fold increase in area during the century studied.

The ocean coastline of Virginia south of Cape Henry is characterized by zones of alternating shoreline advancement and recession. If the erosion history of total shoreline length between Cape Henry and the North Carolina border (27.5 miles) is averaged over the long term, the annual recession rate is about 0.7 feet. Although the average erosion rate is relatively small, the entire ocean shore front is subject to severe erosion during northeast storms and hurricanes. The shoreline is highly dynamic and development is taken at great risk. Experience in the past has demonstrated high property damage.

The Lower Chesapeake Bay shoreline and that of its tributary estuaries, the James, York, Piankatank, Rappahannock, and Potomac Rivers, is highly dissected by entrances to creeks so that

there is a high degree of variability in shoreline response within and between adjacent segments. Again, referring to gross average, the eastern and western shores of the Chesapeake Bay lost about 12 acres per mile per century. The southern sides of the tributaries have experienced somewhat greater erosion due to the more direct attack from northwesterly winds. Although individual segments of the shoreline have experienced erosion rates exceeding 7 feet per year, one or two feet per year is more common. For the 2,365 miles of Bay system shoreline measured, the average erosion rate was 0.7 feet per year. The Chesapeake Bay has been estimated to have one of the nation's highest rates of erosion for tidewater areas. (10)

The products of shoreline erosion (sand, silt and clay) contribute a significant fraction of the total sediment load trapped in the Bay System. Estimates are that a total amount of over 270,000,000 cubic yards of material was eroded from the Virginia portion of the Chesapeake Bay system between 1850 and 1950.(11) This volume is about one third the volume of water in the entire York River estuary. The sand fraction derived from erosion is the principal source of beach materials. The silt and clay fractions, however, contribute to the general sedimentation of the channels and smaller tidal creeks. Although the volume of suspended sediment entering the Virginia estuary system has not been determined precisely, interpretation of available records indicates that deposition from the upland drainage basins of the Potomac, Rappahannock, York and James River is about 4 million tons per year. If we assume that 30 percent of the material derived from shore erosion is silt and clay, then it appears that about 1 million tons per year are injected into the system via shoreline erosion. Thus, the total silt/clay deposition is about 5 million tons per year, of which 20 percent is derived from shore erosion.

C. THE EFFECTS OF EROSION

Tidal shoreline erosion is a problem only because it challenges occupation of the shore zone and use of contiguous waters and subaqueous bottoms. The attractions to the shores are manifold and the pressures for occupation are growing. The principal effects of tidal shore erosion in Virginia are, without rank of position:

(1) Loss of fastland property and improvements thereon;

(2) Loss of taxable lands within localities;

(3) Influx of eroded sediments into the estuarine system and its smaller tidal creek entrances; and

(4) Principal supply of sand to beaches fringing the Bay system and ocean shoreline.

The first two effects are generally perceived as adverse impacts. The third effect, while a natural consequence of shore erosion, may not be perceived as beneficial since the fine grained sediments contribute to the shoaling of navigational waterways and the silting of oyster rocks. The sand size materials deposited in the entrances to feeder creeks reduces navigability. The fourth effect, the supply of sand to the fringing beaches, is decidedly a beneficial aspect of shore erosion.

1. Property and tax losses.

Within the Chesapeake Bay System and along the ocean shoreline the principal source of beach material is sand derived from fastland erosion. This fact complicates strategies to alleviate the impacts of erosion because reduction of the sediment sources by shoreline protection structures diminishes the sand supply available to adjacent beaches.

In viewing the problem of shore erosion, it is necessary to contrast the oceanic segments of the shoreline with those of the Bay System. For the most part, the barrier islands of the Eastern Shore, aside from Wallops Island which is owned by the Federal Government and used by NASA, are held by either private, State, or Federal concerns as a natural preserve. While light recreational use of the islands is likely, erosion per se will not be a problem as far as hazards to property improvements are concerned. In a sense the barrier islands may be viewed as a protective barrier to the mainland spine of the Eastern Shore. While still susceptible to flooding during extreme storms and hurricanes, the eastern edge of the spine is protected from significant erosion. A possible exception to this is the region adjacent to Metomkin Bay where the protective spit has been breached and wave penetration into the Bay is increasing.

The coastline between Cape Henry and the North Carolina border is varied. The beach-tourism/residential zone of Virginia Beach, between Cape Henry and Rudee Inlet, is established and the management goal is obvious: To maintain the beach as the economic base of the tourist industry. Thus far, and in spite of trials, this goal has been met. The cost of the maintenance will continue to rise. There is an increasing acceptance of the fact that the ocean shoreline is dynamic and frontal losses are expected. Development, nonetheless, proceeds perilously close to the beach and within the dunes. South of Sandbridge, the shoreline is a natural preserve under State or Federal auspices.

The southern end of Chesapeake Bay from Cape Henry to Willoughby Spit and the Bay frontage of the City of Hampton experience partial oceanic conditions because they are gated by the mouth of Bay and the long fetch to the north. Because of the moderate to high residential and tourist-oriented development, these shorelines are subject to high erosion risks during storms. A significant fraction of these are also subject to the risk of tidal flooding.

While occupancy of the ocean shore zone is an accepted hazard, within the Chesapeake Bay System erosion is perceived in a different way; the inevitability of loss is not assumed. Erosion of the shoreline is perceived as a highly personal battle.

Before assessing the magnitude of critical erosion (defined herein as greater than 2 feet per year with endangered property improvements), it is of interest to examine the occupation of the Bay System shoreline. Housing density per shoreline mile was approximated by tabulating the structures within 200 feet of the shoreline, as shown on 1968 U.S.G.S. Topographic maps.

Although these data were from dated source material, the current conclusion remains that most of the rural shoreline is sparsely settled. The density class 26-30 houses per mile represents an averaged individual frontage of 200 feet or less. If one considers areas with this or greater housing densities (including "cities") as "developed" areas, the total mileage of "developed" shoreline is 158 miles.

The length of critical shoreline erosion as estimated from the Virginia Institute of Marine Science's Shoreline Situation Reports indicates that approximately 12 miles of shoreline within the Bay System show historical (1850-1950) erosion rates greater than 2 feet per year plus endangered property improvements.

The comparison between "critically" eroding shoreline and the housing density distribution indicates that most development has occurred along shorefronts experiencing low or moderate erosion rates. Aerial observation of the Virginia shoreline corroborates that most development occurs within fringing embayments and large creek systems.

2. Erosion As A Hazard

While tidal shoreline erosion in Virginia has not been a direct cause of loss of life, significant property losses have occurred along many segments of the shoreline. The "Ash Wednesday" storm of March, 1962 caused widespread damage along the coastline of Virginia, as have several recent hurricanes. As recently as April, 1978 a northeast storm caused such substantial damage to the Ocean View - Willoughby Spit section of Norfolk and to other coastal reaches of Virginia, that the area was declared a disaster area.

During major storms lower lying areas generally experience the joint hazards of erosion and flooding. In such cases the damage levels may be extreme.

An erosion rate of greater than 2 feet per year was selected as the criterion for designation as "highly eroding shorelines" because it significantly exceeds the average erosion rate for the Bay System shoreline, which is determined to be approximately 0.7 feet per year.(12) Therefore, selection of shoreline erosion rates greater than 2 feet per year represents those shoreline segments which have experienced erosion rates significantly greater than the average erosion rate. Table 4 indicates the erosion rate versus affected mileage for the various counties within the Chesapeake Bay System.(13) Within the Chesapeake Bay System, some 243 miles of shoreline are so affected. Of these, about 60 miles are marsh shoreline. With the inclusion of the ocean shorefront, the total increases to about 330 miles, of which about 120 miles is marsh or low barrier island.

TABLE 4

SHORELINE EROSION RATES FOR TIDEWATER VIRGINIA CHESAPEAKE BAY SYSTEM

		Erosion Rates (Ft./Yr.)					Erosion Rates >5 Ft./Yr.	
		0-1	1-2	2-3	3-4	4-5		
Locality	Total Shore Miles	Miles of Shoreline in Each Category					(Ft./Yr.)	(Miles)
*Accomack	490	0.3	18.5	10.6	6.6	6.1 22.0	32.6 3.0	0.3
Caroline	43	3.5	3.5					
Charles City	121	6.1	11.6	1.1				
Chesterfield	45	3.6	5.1	0.5			20.7	3.9
Essex	151	1.7	11.5	13.4	9.1	0.9		
Gloucester	296	24.9	21.8	8.5	1.4	0.7		
Hampton	64	1.9	3.1	2.4	0.9	1.9	6.4	2.5
Henrico	35	0.6	1.7				6.1	0.2
*Isle of Wight	80	3.9	12.9	1.4	7.0			
James City	152	2.7	17.0					
*King George	131		7.0	1.7				
King and Queen	71	1.8	2.2					
King William	119	0.8						
Lancaster	277	1.7	12.1	7.2	0.4	1.7 5.6 6.0 8.6 5.1	7.9 0.8 0.5 1.0 0.7	4.1
Mathews	215	1.9	15.1	12.7	2.1	3.5 8.0 7.1	30.9 0.5 3.6	0.1
Middlesex	187	1.6	16.8	4.1	3.7	0.6 6.1	6.5 1.8	0.9
New Kent	83	1.1	4.6					
Newport News	47	2.6	6.3	0.5				
*Norfolk	146		3.0	0.7				
*Northampton	261	1.1	4.5	8.3	3.1	2.4 7.0	5.7 1.3	1.8
*Northumberland	438	1.6	6.8	10.3	5.7	8.0 7.1 6.1 10.6 5.7	5.2 0.4 3.3 0.6 1.3	2.4
Prince George	93	6.8	16.4	2.9				
*Richmond	142	0.5	8.5	9.7	2.0			
*Suffolk	113		1.6	1.3				
Spotsylvania	7	0.5	1.9					
Surry	66	0.3	15.8	2.5			11.8	3.8
*Virginia Beach	378					6.0		
*Westmoreland	252	2.3	5.0	11.3	7.1	1.5		
York	195	9.1	21.8	5.0	8.0		7.4	0.6
Total	4698	82.9	258.1	115.2	55.1	33.3		39.4

CUMULATIVE MILES OF EROSION

Erosion Rates (Ft./Yr.)	>0	>1	>2	>3	>4	>5
Miles of Shoreline	584.0	501.1	243.0	127.8	72.7	39.4

Data from: "Shoreline Erosion in Tidewater Virginia," Byrne and Anderson, 1977

+ Does not include Fairfax, Prince William, and Stafford Counties.

* Includes only a portion of the locality.

It is very important to note that this delineation is based upon a comparison of mean high water line positions designated on map series generated in the 1850's and a series surveyed between 1950-1968. It does not identify areas which were stabilized in the interim or subsequent period. In addition, a more appropriate delineation would be that of the retreat rate of the bluff line or fastland boundary of upland vegetation in non-bluff areas. This is the case because the water line can fluctuate markedly due to seasonal or long term modulations of sand on the beach.

3. Coping With Erosion - The Present

At the present time the Commonwealth does not have a coherent program to alleviate the impacts of erosion for private property owners. Mitigation of the erosion impact has been the responsibility of the individual, shorefront-property owner. In some cases, the property owners have moved their residences back from the shore. However, by far most have installed shorefront structures to reduce or stop erosion. Several problems arise from this piecemeal approach.

(1) In many cases the actions of an individual may exacerbate the erosion problem of adjacent property owners by trapping the littoral drift supply and/or by localized effects at the ends of structures.

(2) Because various shorefront property owners may treat their individual lots at different times, interaction among adjacent or nearby structures may result in less effective erosion control.

(3) Because individual property owners may select the structural approach for their property on the basis of intuition, their own observations, or on outside advice from people with varying degrees of expertise, many reaches represent a smorgasbord of structural methods. Frequently the mixed methods do not interact favorably for uniform protection.

(4) Because shoreline protection is expensive, some property owners accept the lowest cost proposals only to find later that poor quality construction has resulted in loss of their total investment. At present there are no minimum standards for erosion abatement construction. Furthermore, while many of these structures require State or Federal permits, the permitting agencies do not, at present, formally examine the adequacy of design or construction details of the proposed structures.

(5) Once installed, virtually all structures require maintenance for long term effectiveness. As individual lot owners change, maintenance is not kept up, leading to premature loss or replacement of the structure.

Rather than the chaotic approach illustrated above, shoreline erosion needs to be addressed on a reach basis with full consideration for the net effectiveness of the structural or other methods employed. A reach is a shoreline unit wherein there is mutual interaction along the shore in response to the forces of erosion, sediment transport, and accretion. The methods employed within a reach should be selected to meet the shoreline management strategy for that reach.

For example, consider a segment of shoreline which has wide creek mouths flanking it on both sides. Since there is likely little sand bypassing across the creek mouths, that shoreline segment may be considered an entity to itself with respect to erosion processes. A hypothetical case will illustrate further. Assume that half of the shoreline reach is a high bluff of sandy material and that erosion of the bluff results in a sand supply to the other half of the reach. As conditions of individual management now stand, we might find that a land owner downdrift of the bluffed region would install groins (colloquially called jetties) to trap some of the sand, thereby widening his beach and inhibiting fastland erosion. At some later date the owner(s) of the bluffed region might decide to construct a revetment or bulkheads to inhibit or stop erosion of their property. In doing so, the local supply of sand to the groin field would be diminished leading to failure of such a protection strategy. The downdrift property owner would then have to make a larger investment in an alternate strategy which was independent of reliance on an updrift sediment supply.

This example clearly illustrates a circumstance wherein a coordinated community response to the erosion problem within an affected reach would be advantageous. Real case examples are abundant in the Chesapeake Bay System. The case for coordinated strategies along entire reaches is so strong that every effort toward such response should be endorsed. Such coordinated response will require expert analysis of the shoreline condition and design of appropriate structures. This

requirement will necessitate enhanced advisory or engineering services, be they private or public.

While the hypothetical case illustrates the nuances of effects within reaches within the Chesapeake Bay and tributary estuarine systems, more dramatic examples of interference with coastal processes can be illustrated on the oceanic or near-oceanic shoreline. In these cases, rather major interruptions occur when major navigational waterways intersect the shoreline. Two of the most outstanding examples in Virginia are the entrance to Little Creek on the Norfolk shoreline and the entrance at Rudee Inlet on the ocean coastline of Virginia Beach.

In the case of Little Creek, long jetties placed to protect the channel block the westerly littoral drift. In this case, the updrift (easterly) jetty prevents the littoral drift from passing to the adjacent downdrift beach (Figure 2).

FIGURE 2 - View, looking West, of Jetties at Little Creek. The net sand drift is to the West. Note the offset in beach width caused by the trapping action of the long east Jetty with resulting starvation of the beaches to the west.

At Rudee Inlet (Figure 3) the southerly jetty also inhibits sand bypassing but, in that case, a mechanical bypassing system was incorporated into the plan so that the downdrift beaches would be nourished.

FIGURE 3 - View, looking north, of the jettied entrance to Rudee Inlet in Virginia Beach. The net drift of sand is to the north. Note the fillet of sand trapped by the jetty. The City pumps some of the trapped sand to the downdrift beaches.

An additional example of the problem of shoreline management is illustrated by the construction of the seawall/boardwalk in Virginia Beach. In this case, shoreside facilities were constructed within the long term hazard zone of coastal retreat and storm damage. By virtue of the development, tourist activity was enhanced; on the other hand, maintenance costs must be accepted since perserving a wide beach provides the recreational base which maintains the tax base of the locality and, to a degree, that of the Commonwealth. At the same time, the beach, widened by artificial means, also protects the seawall. The nourishment of the beach fronting the seawall also benefits the downdrift shoreline to the north where manipulated and natural sand dunes protect the fastland development (Figure 4).

FIGURE 4 - View, looking South from 89th Street in Virginia Beach. Note the increased beach width in the foreground and center compared to the narrow beach fronting the Boardwalk area (far background). This is caused by natural accretion near Cape Henry augmented by the sand nourishment program along the Boardwalk.

While the longer (1850-1950) data shows an accretionary trend of 300 feet in 100 years, the shorter term accretion since beach nourishment has been enacted is even more dramatic. Shoreline studies of the area, graphically illustrated in Figure 5, show an advance of the shoreline of 120 feet between 1969 and 1974 at 89th Street in Virginia Beach.(14)

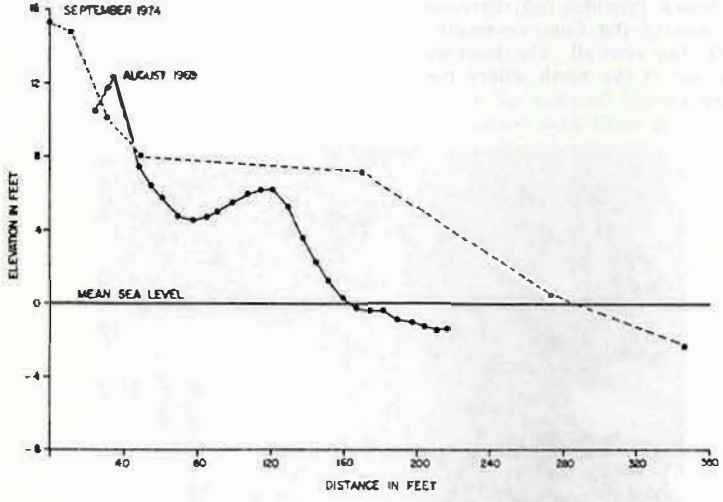

FIGURE 5 - Comparative beach profiles taken in 1969 and 1964 at 89th Street in Virginia Beach. Beach width at mean sea level has increased by 120 feet.

Similarly, at 61st Street, approximately 2 miles from the Boardwalk, the shoreline had advanced about 40 feet.

In contrast to the case at Virginia Beach where beach nourishment has been a continuous process, the replenishment program at East Ocean View has been performed in "slugs" depending upon the requirements for dredging the navigational waterway at Little Creek. Nourishment of beaches to west of the entrance was performed in 1953 and again 1960. Development along the shoreline has continued during those years and, with the continuing retreat of the beach, the shorefront properties now have no protective beach (Figure 6).

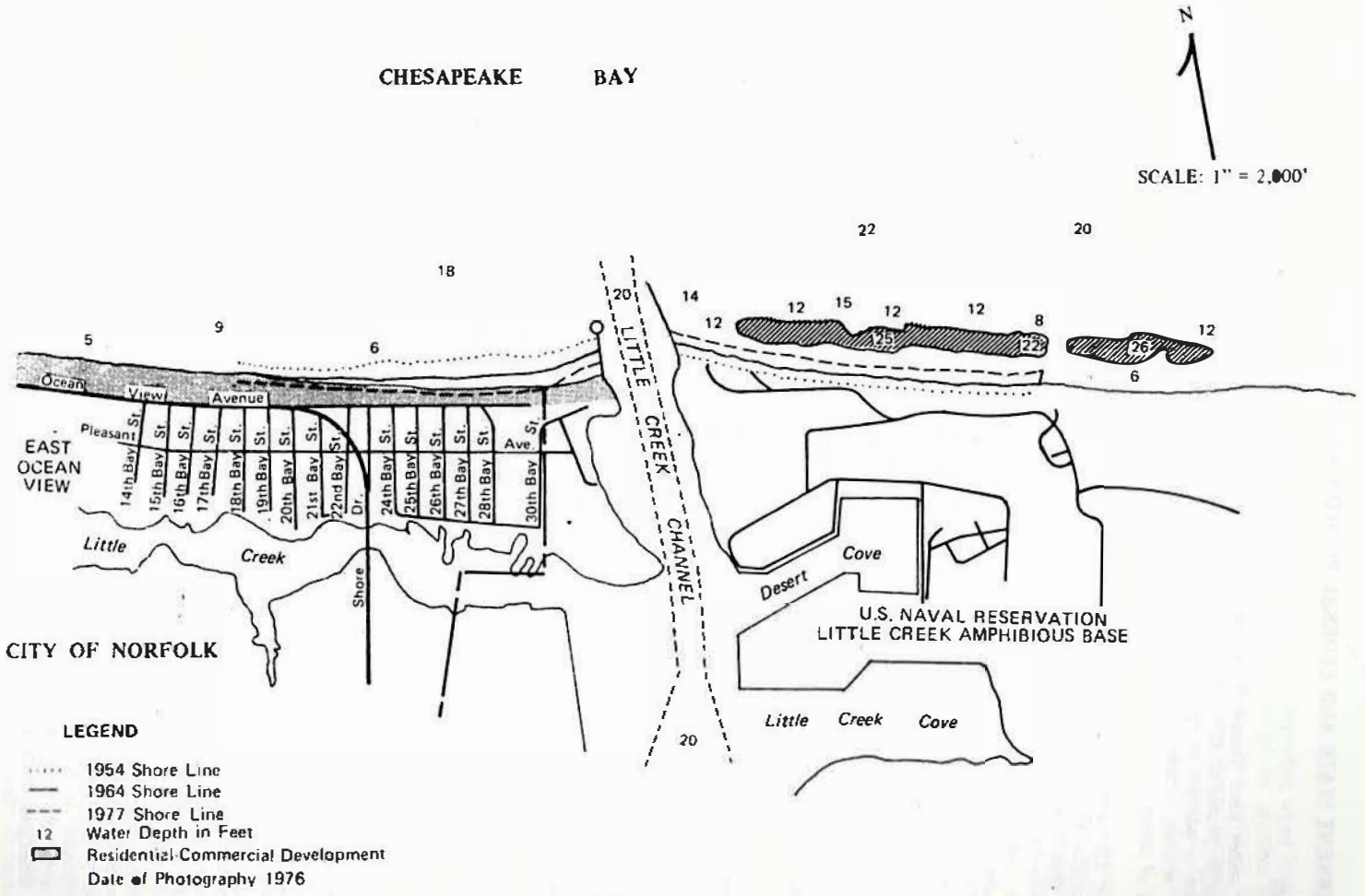

FIGURE 6 - Map, showing retreat of shoreline and beach at East Ocean View, 1954-1977, and accretion east of Little Creek jetty during same period. Note the relative positions of the shorelines in 1977 east and west of the channel.

D. CURRENT STATE AND FEDERAL POLICIES AND PROGRAMS:

1. State

Many states have passed State legislation and invested large sums of money to deal with the shore erosion problem. Although it is a serious problem in Virginia, the Commonwealth has taken little action to address shoreline erosion. There are four sections of the Code of Virginia which deal with the erosion problem. The Shore Erosion Control Act (15), presented below is basically a statement of policy.

> Article 2.2, Section 21-11.16 of the Code of Virginia, states the policy:
> Declaration of policy. The shores of the Commonwealth of Virginia are a most valuable resource that should be protected from erosion which reduces the tax base, decreases recreational opportunities, decreases the amount of open space and agricultural lands, damages or destroys roads and produces sediment that damages marine resources, fills navigational channels, degrades water quality and, in general, adversely affects the environmental quality; therefore, the General Assembly hereby recognizes shore erosion as a problem which directly or indirectly affects all of the citizens of this State and declares it the policy of the State to bring to bear the State's resources in effectuating effective practical solutions thereto.

The act also gives the Virginia Soil and Water Conservation Commission responsibility to coordinate shore erosion control programs and authorizes the Commission to hire one shore erosion engineer to assist in carrying out these programs. However, the act is simply a statement of policy; it contains neither organizational nor enforcement provisions. Further, no funds have been appropriated since its passage in 1972 to hire the shore erosion engineer.

One year later another Virginia statute, the Erosion and Sediment Control Law (16), delegated responsibility to the Virginia Soil and Water Conservation Commission to create an erosion and sediment control program. The act calls for the Commission to cooperate with soil and water districts and local governments in developing a statewide coordinated erosion and sedimentation program. The statute, however, specifically excludes tidal shore erosion control projects approved by the Marine Resources Commission from coverage. A review of this legislation and the guidelines promulgated by the Soil and Water Conservation Commission indicates that the law is primarily intended to address the problem of upland erosion and sedimentation rather than the particular problem of shoreline erosion in coastal areas. Thus, Virginia is still without a comprehensive statewide approach to the coastal erosion problem.

Considerably prior to the passage of the erosion related acts of 1972 and 1973, the Code of Virginia authorized the creation of the Virginia Beach Erosion Commission to deal with shoreline problems in the Virginia Beach oceanfront area.(17) The Commission has addressed the beach stability problem by implementation of an extensive beach nourishment program. In 1977 approximately 304,030 cubic yards of sand were used to stabilize the Virginia Beach shoreline. 160,000 cubic yards of this sand were pumped from Rudee Inlet, and the remainder was trucked in from Fort Story. This massive beach nourishment program was carried out on a budget of $715,272. Of this money, $50,000 was a direct appropriation from the General Assembly, and $126,300 was provided by the Army Corps of Engineers.(18) The remainder of the funds came from the "sand tax" which is levied by the city on the resort (hotel/motel) shoreline owners. Under this special tax scheme, the monetary burden of financing shoreline protection is placed on those who benefit most from the program. The money collected is not spent solely on shoreline nourishment, however. Other programs funded by the Virginia Beach Erosion Commission include offshore surveys and channel maintenance. One significant problem looms on the horizon for Virginia Beach; the sand stockpile at Fort Story is virtually depleted and an alternative sand source must be found if the nourishment program is to continue as in the past.

Norfolk has received a $90,000 appropriation from the General Assembly. The Community Improvement Department of the City of Norfolk is charged with resonsibility for these funds and for development of an effective erosion plan. Current plans include a channel bypass feasiblity demonstration to be conducted at the Little Creek Channel, beach nourishment (similar to the Virginia Beach Program), an analysis of long range sources of sand, and the development of long range strategies to deal with the overall shoreline erosion problem in Norfolk. (19)

2. Federal

A survey of applicable Federal law pertaining to shoreline erosion is important when considering development of a State erosion plan. Several Federal agencies have addressed the problem and are currently involved with the shoreline erosion problem on a national scale. These agencies include: The Office of Coastal Zone Management in the National Oceanic and Atmospheric Administration (NOAA), as administrators of the Coastal Zone Management Act of 1972, as amended in 1976 (20); the United States Army Corps of Engineers (21) ; the National Flood Insurance Administration (NFIA); and, to a limited extent, the Small Business Administration.

To participate in the federal Coastal Zone Management Program, states must address such coastal issues as recreational access to the shoreline, energy development, use of tidal waters and adjacent lands, and shoreline erosion. To meet the statutory requirements in terms of addressing shoreline erosion, states must set forth a planning process for: (1) assessing the effects of shoreline erosion; and (2) evaluating ways to control or lessen its impact.

A state's shoreline erosion planning process must consider the causes and effects of shoreline erosion, its extent and location, the impacts of control and mitigation devices on adjacent properties, structural and non-structural strategies for addressing erosion problems, and the costs of alternative solutions. In addition, the state program must identify the legal authority and the enforceable policies by which the state can implement a program for managing the effects of shoreline erosion.

States may also choose to designate areas with high rates of erosion as "areas of particular concern." In such case, erosion-prone areas must be identified, designated, planned for, and managed in accord with state legal authorities and policies which address shoreline erosion. The state must establish priorities for uses of shoreline erosion "areas of particular concern."

The U. S. Army Corps of Engineers maintains a Beach Erosion Control Program. The purpose of the program, as defined in the Flood Control Act of 1962 (PL 87-874), is to prevent damage to shorelines, and to encourage recreational opportunities. It allows the Corps "to assist in the construction, but not the maintenance, of works for the restoration and protection against erosion by waves and currents...." Construction is defined to include the artificial supply of sand when periodic beach nourishment would be the most suitable and economical remedial measure.

The federal contribution under this program may not exceed one half of the project cost. However, in cases of restoration and protection of public parks and conservation areas, the federal contribution may be as high as 70 percent of the total costs (excluding land costs) if these areas:

(1) Include a zone which excludes permanent human habitation;

(2) Include, but are not limited to, recreational beaches;

(3) Satisfy adequate criteria for conservation and development of natural resources;

(4) Extend landward to include protective dunes, bluffs, or other natural protective features where appropriate; and

(5) Provide essentially full park facilities for public use.

In addition, federal participation may be as high as 70 percent in projects providing hurricane protection.

Federal assistance is also available under the Corps program for shores other than public shores if a project has benefits such as those arising from public use or protection of nearby public property. The federal contribution in these cases is adjusted according to the degree of such benefits. The Corps has developed considerable expertise in this particular area of coastal zone management. In addition, the Corps is authorized under the Water Resources Act of 1974 to provide technical advisory services to any duly authorized agency of any State, county, city or subdivision thereof. While these services do not include funding of structural or non-structural controls, the Corps will provide technical advice and comment on engineering design. If the costs of technical services by a Corps District exceed $3,000, approval must first come from the Corps Division offices.

The Federal Insurance Administration (FIA) is involved, although to a more limited extent, with the erosion problem. FIA construction criteria applicable in flood prone areas can mitigate erosion effects. In addition, compliance with the requirements of the Flood Disaster Protection Act of 1973 must be considered. This Act amended Section 1302 of the National Flood Insurance Act of 1968 to extend flood insurance coverage to "damage and loss resulting from the erosion and undermining of shorelines by waves or currents intakes and other bodies of water exceeding anticipated cyclical levels". This language has caused technicians difficulty in that it is difficult to determine what constitutes "anticipated cyclical levels." This difficulty has in fact hampered development of practical regulatory and insurance policies. (23)

Section 1910.5 of the National Flood Insurance Program proposed a set-back requirement for lands designated as type E zones by the Administrator of FIA. The FIA has been unable to develop useful guidelines for determining when erosion damage is covered, and therefore this section has not achieved any of the goals which Congress had intended in the legislation amending the Flood Disaster Protection Act of 1973. This standstill in development is confusing and difficult for both technicians and communities seeking the protection that the FIA was mandated to provide.

Recent discussion with FIA officials indicates a desire to repeal the V zone (coastal high hazard area) and the E zone (special flood-related hazard area) provisions of the Flood Disaster Protection Act of 1973, as amended.(24) Officials indicated a desire to place the erosion provision in another program, possibly the Coastal Zone Management Program. It is significant that to date no E zones have been designated by the administrator.

A study was completed in June, 1978 by the Great Lakes Basin Commission Standing Committee on Coastal Zone Management.(25) Because of the difficulties in implementation the FIA has been experiencing, the study recommends repeal of the erosion coverage sections of the Flood Disaster Protection Act. The study also recommends that a national program be established to provide financial assistance for State level implementation of erosion plans developed pursuant to Sec. 305(b)(9) of the Coastal Zone Management Act.

The Small Business Administration makes low or no-interest loans available following storm-related damage. In order to be eligible for this relief a designation as disaster area must be declared. An assessment of damage by the Governor and, in some cases, a follow-up by the President is necessary, but the potential availability of such funds should not be overlooked.

E. MANAGEMENT STRATEGIES - POSSIBILITIES AND CONSTRAINTS

(The Commission is presenting these alternative management strategies for information only. They are not to be construed as official Commission recommendations.)

A number of considerations are required before any particular management strategy can reasonably be selected for any reach of coastline under consideration. The factors in that planning process are:

(1) A statement of the erosion induced problem;

(2) A clear statement of the management goal(s) for that reach;

(3) A complete technical assessment of the options for structural and non-structural treatment and a statement of the trade-offs within and among options;

(4) An assessment of the costs and benefits of the various technical options in light of current and projected or planned land use characteristics;

(5) An assessment of possible institutional mechanisms to implement the mitigation program. These institutional considerations include the distribution of costs between private and public sectors; and

(6) The resolution of legal issues.

The remainder of this section discusses these elements.

1. Statement of the Erosion Induced Problem

The erosion induced problem may differ appreciably for different reaches within the same region. The underlying cause of the problem, however, is an erosion rate which is perceived as intolerable for one reason or another. In one reach, the erosion rate may be so high that regulation of building activity in that hazard zone is deemed necessary. In another reach, shoreside tourist facilities or the beach itself, the keystone of the tourist attraction, may be eroding.

2. Management Goals for a Reach

The management goal (s) may be framed in terms of the principal effects of erosion:

(1) To reduce, eliminate, or prevent the victimization of existing or future property owners by the loss of property, property improvements, and productive use of property due to erosion;

(2) To reduce the loss of taxable lands within localities;

(3) To reduce the influx of erosion products into the estuarine system and its flanking tidal entrances; and

(4) To maintain a supply of sand to beaches within the reach.

Certainly other management goals may be stated; however, the above goals (individually and in combination) must be viewed as the principal choices for the program within the reach. Not all goals will have equal weight for any given reach. In fact, satisfaction of all of the goals for any reach is not likely because some are mutually exclusive.

3. Technical Assessment of Options

The technical assessment for options within a reach involves five principal elements.

(1) Determination of the limits of the reach. A reach is a segment of shoreline wherein there is a mutual interaction of the forces of erosion, sediment transport, and accretion. Appreciable littoral sand supply, for example, would not pass the boundaries of the reach. A reach may also be defined as a shoreline segment wherein mainipulation of the shoreline within that segment would not directly influence adjacent segments;

(2) Determination of the rates and patterns of erosion and accretion within the reach;

(3) Determination within the reach of the sites of erosion induced sand supply and the volumes of that sand supply for incremental erosion distances (also determination of the sand volumes lost from the reach);

(4) Determination of the direction of net littoral drift, and, if possible, estimation of the magnitude of gross and net drift rates; and

(5) Estimation of erosion causing factors other than wave induced, such as ground water or surface runoff.

The importance of these five elements can be illustrated by considering an example. Assume (a) a shoreline reach, one-half of which is an eroding bluff containing a high percentage of sand and (b) a strong net littoral drift such that as erosion of the bluff proceeds, the sand supplied by erosion acts to supply beach materials to the downdrift beaches which may also be eroding. This case nicely illustrates the interactive nature of processes within a reach because the erosion of the bluff supplies sand to the beach fronting the bluffs as well as the downdrift beaches in the same reach. The sand supply, in turn, retards the erosion rate by at least partially maintaining the beach.

Elements such as these are cornerstones in the evaluation of various options. For example, if the decision were made to stop erosion of the bluff with the installation of a riprap revetment, that action would influence the options remaining for the remainder of the reach. For example, the installation of a groin field in the downdrift portions of the reach would be a marginally effective action because the sand supply required for their proper function would be starved by preventing

continued erosion of the sandy bluffs. It is this type of interaction among components of the reach which must be considered in the formulations of options.

4. Economic Assessment of Costs and Benefits: An Economic Decision Framework

The objectives of the economic assessment methodology are to estimate those costs and benefits which are necessary for a comparison of alternative erosion control strategies. Alternative strategies include both structural and non-structual measures as well as a no-action strategy. The methodology provides for an assessment of benefits and costs on the basis of a shoreline reach.

Control measures may have an impact on benefits and costs in three different shore areas: the shore zone, nearshore zone, and fastland zone.

The shore zone is a buffer between the water body and the fastland. The seaward limit is essentially the mean low water line which generally separates the steeper slope of the foreshore from the low tide terrace of lesser slope. The landward limit is the fastland which is generally discernable by a topographic feature such as a bluff face or upland vegetation.

The nearshore zone extends waterward from the shore zone to the 12-foot contour.

The fastland zone extends from the landward limit of the shore zone is termed the fastland. Fastland is relatively stable and is the site of most material development and construction.

Calculations of costs and benefits should include the impact of controls on each of these areas. Either private or public entities may incur costs and accrue benefits. Therefore, total costs and benefits are calculated with a secondary breakdown between private and public entities.

A full discussion of the economic assessment methodology or decision framework is given, with a case example, in **Shoreline Erosion.**

5. Institutional Alternatives

A variety of public and semi-public tools exist for dealing with shore erosion specifically and shoreland use generally. These tools, some of which are described in the following section, can be grouped in several broad catergories: direct ownership and control, use regulation, incentive measures, and educational/advisory services. In the case of public actions, other standards become relevant in assessing appropriateness. These include principles of: 1) equity in the distribution of public costs and benefits, 2) maximized administrative efficiency and coordination, and 3) maximized return on investment except where superceded by the public need.

A number of institutional alternatives are available for applying structural and non-structural solutions to shoreline erosion problems. They can be employed by local, state and federal governments alone or in combination with private interests. An outline of the alternatives follows.

a. Full or Partial Public Ownership of Land

Full or partial public ownership of land (and/or structures) offers the most direct means of managing erosion-prone shorelines. Outright ownership of erodable property would basically insure full control of development, plus proper construction and maintenance of shoreline structures in these areas. But this is a limited approach. In the case of property acquisition, major limiting factors include purchase costs of the property and selection of a party to be responsible for the property.

Funds for selective acquisition of shoreland areas could be raised either through an earmarked appropriation from the State's general fund, or through solicitation of funding from foundations. In the case of appropriation, a State funding priority scheme favoring shoreline preservation would need to be developed.

A related approach in developing shoreline areas is that of mandatory and/or voluntary dedication of public easements or property. Local governments are already empowered to require land dedication for public use as a condition of subdivision plat approval. Under Delaware's erosion control program, for example, the State will fund a shoreline stabilizing project if the property

owners agree to allow access to the once private beach.(26)

Voluntary dedication of easements or property would also be solicited for acceptance by third parties as gifts to be held in public trust, in combination with some of the regulatory and tax incentive tools discussed later in this section. It should also be noted that Corps of Engineers assistance for erosion control is only available for projects which benefit public use of shore property. Appropriate holding bodies for such properties could include special purpose federal, State, or regional authorities, local or regional special districts, quasi-public organizations or public trusts, and State agencies. Authorization for cooperation among local governments in such activity is provided by the "joint exercise of powers" provision of the Intergovernmental Cooperation Act of 1972. Federal Title V commissions such as the Coastal Plains Regional Commission provide a model for interstate cooperation.

b. Regulation and Use Restriction

Regulation of shoreline uses could take the form of several existing land/water use management models. It is important, however, to avoid new regulatory machinery where possible. Regulatory approaches hold greater promise in special cases of particularly hazardous shorelines which, for example, could be designated as "areas of particular concern" under a state's coastal program.

Zoning is the basic tool provided to local governments for regulation of land uses. Enabling legislation currently allows local governments to establish shoreland zones within which minimum setbacks may be required, and also to establish special conditions for the development and use of environmentally-sensitive lands. The limiting factor in the shoreland zoning approach is the degree of dependence on state agencies created for information about local erosion rates and the likely inland extent of the problem. The federal Flood Insurance Administration has recently suggested several variations of the shoreland hazard zones. These boundaries would be determined by multiplying average useful lives of shoreline structures by the predicted local shoreline erosion rate. Within the zone, (a) future uses would be limited to open space, or else (b) specified "no-construction" setbacks would be created, inside of which new structures would either be prohibited or allowed only if capable of being relocated. The City of Virginia Beach has adopted specific building regulations applicable to areas subject to coastal storm flooding and wave action.

Subdivision and/or site plan review ordinances represent companion tools to local zoning ordinances more directly focused on construction standards. Subdivision regulations (now required of all Virginia localities) apply to land division and transfer, and allow localities to: 1) review plats for consistency with established standards for erosion, drainage, and flood control; 2) require dedication of rights-of-way or land for public use as a condition of plat approval; and 3) reserve lands for future public acquisition on the basis of approved plans for public facilities. Recent authorization by the General Assembly to extend power of contract zoning (conditional rezoning) to all local governments is an important supporting measure. It allows these governments to negotiate with developers and produce binding agreements on specific uses to be permitted in particular districts. Assistance in assessing possible impacts of (or hazards to) various uses would need to be provided by the State or other sources, however.

Public acquistion of development rights allows the imposition of various forms of use restriction. One of the more frequent applications of the principle has been in the case of historic or scenic easements, where property owners agree to transfer certain development rights to the public while retaining ownership of the property.

Virginia's wetlands legislation provides another regulatory model generally relevant to the erosion problem. Under the legislation, all local governments in Tidewater Virginia are authorized to adopt wetlands zoning regulations for specified wetlands areas and to establish local wetlands boards with permit issuance authority over uses (less certain exempted uses) within these areas. Permit decisions of local wetlands boards are subject to review and override by the Virginia Marine Resources Commission (VMRC), and, in areas where local wetlands ordinances are not adopted, the VMRC retains direct control of wetlands uses. Variances for demonstrated hardships are permitted, as in the case of conventional zoning.

The regulatory jurisdiction of the VMRC also extends to activities upon subaqueous land, and provides still another regulatory framework. Under the State Code, the VMRC administers a permitting/leasing program for all uses of state-owned subaqueous land not specifically exempted,

with provision for limited environmental impact assessment of proposed actions in coordination with the Virginia Institute of Marine Science and other advisory agencies.

c. Incentives

Incentive measures for managing erosion-prone shorelines could include various combinations of grants, cost-sharing, and preferential tax, loan, and insurance policies closely tied to the regulatory and advisory approaches described elsewhere in this section. Maryland's Shore Erosion Control construction fund, which offers long-term, interest-free loans for construction of control structures, is one example of the direct incentive approach. However, such programs might foster the individual piecemeal approach.

Incentives should be designed to encourage nonconflicting uses of the shoreline, as well as the replenishment (where feasible and necessary) of eroding shorelines, and the proper installation and maintenance of control structures. One major problem area is the present system of property taxation, which in effect tends to encourage transfer and development of shorefront property rather than retention in low-intensity use or improvement in the form of flood-proofing or erosion defense. Local assessment of low-intensity shorefront land as commercial property, for example, now has the effect of forcing conversion to that use, because the carrying costs of holding the land in any lower use become prohibitive. Property tax exemptions and/or income tax credits for improvements to property in hazard areas could be offered, although these measures alone would probably not be sufficient to offset the true "costs" of improvements to property owners (or even retention in nonproductive use) because such improvements would seldom enhance the property's market value. This problem might be attacked more directly through broadening of the present land use assessment law or changing the assessment criteria to take into consideration raw land and use of structures as well as productivity of land.

X. LEGAL PERSPECTIVE

A. GENERAL LEGAL PERSPECTIVE

Any attempt to understand present law concerning accretion and erosion would be futile without first examining the common law which is the historical foundation of current law and policies. The following common law definitions are useful as a starting point:

Erosion - The gradual eating away of the soil by the operation of currents or tides.(27)

Alluvion - That increase of the earth, on a shore or bank of a stream or the sea, by the force of water, as by a current or waves, which is so gradual that no one can judge how much is added at each moment in time.(28)

Accretion - The act of growing to a thing; usually applied to the gradual and imperceptible accumulation of land by natural causes, as out of the sea or a river.(29)

Avulsion - The removal of considerable quantities of soil from the land of one man, and its deposit or annxation to the land of another, suddenly, and by the perceptible action of water.(30)

Reliction - The gradual and imperceptible recession of water.(31)

One authority states the general rule of accretion as follows:

Under both the common law and civil law, when a river occupies land by erosion, the landowner loses title. He gains if the river recedes. The law of accretion was adopted with the common law of England...passed by Congress.(32) This states the general rule quite well. A riparian owner generally loses title when his land is eroded and gains when alluvion is deposited by accretion.(33) An important distinction came to be made between avulsion and accretion or erosion. The English courts set the stage for a distinction between gradual changes and significant or avulsive changes. The U.S. Supreme Court addressed this issue and they set forth the following judicial test for distinguishing gradual from avulsive changes in the shoreline.

The test as to what is gradual and imperceptible, in the sense of the rule is, that though

witnesses may see from time to time that progress has been made, they could not perceive it while the process was going on.(34)

The distinction between avulsive action and gradual or imperceptible accretion or erosion is of critical importance. If accretion or erosion occurs, title changes; title does not change if avulsion occurs.(35) Although the doctrine of avulsion has been largely overlooked in Virginia, it has not been neglected in other states. As applied in a recent New York case, the court held that the doctrine permitted the "owner of land abutting a navigable bay...to reclaim land lost through sudden submergence, but not that part of the land lost through erosion."(36) The key principle on which a landowner could rely is that when the change is sudden or avulsive, title does not change. The Commonwealth would not own subaqueous lands created by avulsive action and would not have jurisdiction under §§ 62.1-2 and 62.1-3 of the Code of Virginia over these newly created bottom lands. When, however, the loss of property is due to erosion, the gradual eating away of the shoreline, the state gains title and the landowner loses title.

The Supreme Court of Virginia has held that:

> The increase of land adjacent to the seashore, derived from alluvial deposits, happening so gradually that the increase could not be observed while actually going on, although a visible increase took place from year to year, belongs to the owner of the land bounded upon the sea. The riparian owner gains accretion, whether by reliction; the gradual and imperceptible recession of the water, or by alluvion; the gradual and imperceptible accretion from the water.(37)

The court reasoned that access to water was one of the values of riparian land and adoption of any other rule would deny the riparian owner access and destroy the riparian nature of the land. The court went on to hold:

> Section 3574 of the Code of 1819, (Section 62.1-2 of the current Code), in terms extends the rights of riparian owners of lands on bays, rivers, creeks and shores of the sea to low water mark, however, as this line may change either for the advantage or disadvantage of the riparian owner, low water mark remains his true boundary under the Virginia statute. The title of the Commonwealth to public waters likewise shifts with the shifting sands. (38; 39)

Virginia has adopted the general rules of erosion and accretion as inherited from the common law of England. Virginia courts have yet to come to grips with the doctrine of avulsion, but the majority rule seems likely to prevail.

One additional doctrine merits discussion in relation to [before advancing to specific laws regarding] Virginia's erosion problem. This is the doctrine of reemergence. An explanation follows:

> Where a landowner loses acreage to a navigable river by erosion, title to this acreage is transferred by law from him to the state or owner of the bed. If the river were to move in the other direction and replace the same acreage with accreted land, the landowner would obtain title by the doctrine of accretion. If the river were moved by an avulsive shift rather than by slow and imperceptible accretive movements, some jurisdictions recognize the "doctrine of reemergence," and hold that title to such land revests in its former owner.(40)

This rule is therefore the exception to the normal rule regarding avulsion. Normally, title does not change as the result of an avulsive action, but when an avulsive action recreates a former estate, title revests in the original owner. Although no instance of the application of this doctrine has been found in Virginia law, its existence should nevertheless be noted.

B. PRIVATE LIABILITY

The most important point to remember is that the law regarding liability for downdrift impacts is at the evolutionary or developmental stage. For this reason there have been few cases litigated on this point. Obviously, in situations where there is no statutory law and very few cases, it is difficult to make a judgment.

The right of an owner to protect his property from damage by the sea is widely recognized. This right is most commonly expressed as the Common Enemy Doctrine. An expression of this

doctrine follows:

> Every proprietor of land exposed to the inroads of the sea may erect on his land groins, or other reasonable defenses, for the protection of his land against the inroads of the sea, although, by doing so, he may cause the sea to flow with greater violence against the land of his neighbor, and render it necessary for the latter to protect himself, by the erection of similar sea defenses. "Each landowner has a right to protect himself, but not be protected by others, against the common enemy." But a man has no right to do more than is necessary for his defense and to make improvements at the expense of his neighbor.(41)

In Jubilee Yacht Club v. Gulf Refining Company (42), the rule cited above was followed. In this case the court held, " The erection of fences, walls, or other structures, or the making of excavations on his own land, is ordinarily within the absolute right of the owner, without reference to the incidental injury which thereby be caused to his neighbor."

One case, Katen Kamp v. Union Realty Company (43), has been discovered in which a riparian owner has been held liable for downdrift impacts created by the erection of an effective groin. In Katen Kamp, the landowner was not attempting to protect his shoreline, which was rocky, and not in need of protection. The groin erected by the landowner was not to protect property as expressly sanctioned in the common enemy doctrine, but to improve the land. The owner was quite successful in that he turned his rocky point into a sandy beach, but activities of this sort are improvement schemes and not protective measures. Katen Kamp can be distinguished from the normal protection situation because the owner was attempting to change and improve his land, not merely to protect it.

In a Virginia Case, Burwell v. Hobson (44), an injuction against construction of a dike was upheld to prevent damage to lands behind a previously constructed dike on the opposite side of the creek. The applicability of the case to erosion liability is not as clear as Katen Kamp since this case involves flooding damage rather than downstream erosion damage. It also appears to have been decided more on principles of easement and rights running with the land. Under the common enemy doctrine, the building of a dike, absent unreasonableness of construction or a scheme to improve and not protect property, should have been permissible in Burwell. This case may be interpreted to establish in Virginia a rule as to liability between private parties based on priority in time that contravenes the generally accepted common enemy doctrine.

In summary, the question of individual liability for downstream impacts appears unsettled at this time.

C. STATE AND LOCAL LIABILITY IN EROSION CONTROL

Several cases have been discovered in which a city, state, or the federal government has been held free of liability for actions causing erosion. In Paty v. Town of Palm Beach (45), the Florida Supreme Court held that the town was not liable for downdrift impacts of a town erected groin. In Pitman v. U.S. (46), the Federal Court of Claims held that the plaintiff's damage claim from erosion resulting from a Federal project was non-compensable. The U.S. Supreme Court held in Bedford v. U.S. (47), that:

> Damages to land by flooding as the result of revetments erected by the United States along the banks of the Mississippi River to prevent erosion of the banks from natural causes are consequential and do not constitute a taking of the lands flooded within the meaning of the Fifth Amendment to the Federal Constitution.

No Virginia cases dealing with the issue of State or local liability for downstream erosion impacts have been found. Such liability for downstream impacts may occur in the protection of public beaches from erosion, or, as a result of State actions to control erosion on private lands.

The Commonwealth of Virginia like many other states enjoys the protection offered by the doctrine of sovereign immunity. As a general rule the Commonwealth cannot be sued without its permission.(48) The State's immunity from suit also extends to its agents and employees acting in their official capacity.(49) This immunity was extended to the Elizabeth River Tunnel District in Tunnel District v. Beecher .(50) If, however, State agents exceed their authority and go beyond the sphere of their employment, or if they step aside from it, they do not enjoy such immunity when

they are sued by a party who has suffered injury by their negligence. An agent or employee of the State can incur no liability for negligence or any other tort so long as the act is within the scope of his employment and not performed in such a grossly negligent fashion as to take him outside of the protection his employment offers. Only if the agent were grossly negligent or acting outside the scope of his employment could a successful action be maintained. In such a situation the suit would be against the agent as an individual and the State would incur no liability.(51)

James A. Eichner, in A Century of Tort Immunities in Virginia, (52) states:

Thus, the doctrine of a state's absolute immunity from suit in tort has become case hardened. Absolute immunity in negligence has been similarly extended to state-created authorities, despite the fact that such authorities have been held absolutely liable, without negligence, for property damage on state constitutional grounds.

Section 15.1-31 of the Code of Virginia is of interest in terms of local liability for actions taken to control erosion. According to this section:

(a) Any county, city or town may construct a dam, levee, seawall or other structure or device...the purpose of which is to prevent the flooding or inundation of such county, city, or town, or part thereof.

(b) The General Assembly withdraws the right to bring...any action at law or suit in equity against any county, city, or town because of, or arising out of the design, maintenance, performance, operation or existence of such works...but this provision shall not be construed to authorize the taking of private property without just compensation...(53)

Although erosion is not specifically cited as a rationale for this section, erosion can cause flooding and inundation and action taken to control erosion may arguably fall within the purview of this provision. Any ambiguities regarding this section may be resolved by the simple addition of the word "erosion" to the enumerated hazards of flooding and inundation. Freedom from tort liability related to erosion control could be made available to the political subdivisions of the state by simple amendment. Any changes to or interpretations of this section must be consonant with Article I, section II of the Virginia Constitution prohibiting taking or damaging of private property for public use without just compensation.

Article I, Section 11 of the Constitution of Virginia states:

That no person shall be deprived of his life, liberty, or property without due process of law; that the General Assembly shall not pass any law impairing the obligation of contracts, nor any law whereby private property shall be taken or damaged for public uses, without just compensation, the term "public uses to be defined by the Assembly."

This provision has been held to be self-executing.(54) The Virginia Supreme Court has also held that regardless of tort liability, self-executing provisions of the Virginia Constitution require compensation when private property is taken or damaged for public use.(55)

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Appendix A

SENATE JOINT RESOLUTION NO. 22

WHEREAS, the beaches, islands and inlets of the Commonwealth lying along or near the Atlantic Ocean and Chesapeake Bay are major assets to the economy of the entire State; and

WHEREAS, the aesthetic beauty of Virginia's beaches, islands and inlets is unparalleled anywhere; and

WHEREAS these areas are a source of great enjoyment and recreational activity for all Virginians; and

WHEREAS, due to a variety of social and environmental factors, these areas are subject to a constant state of erosion and destruction; and

WHEREAS the beaches, islands and inlets of this Commonwealth constitute a great natural resource which is in extreme danger and needs preservation and protection; now, therefore, be it

RESOLVED by the Senate of Virginia, the House of Delegates concurring, That there is hereby established the Coastal Erosion Abatement Commission. The Commission shall be composed of eight legislative members, three of whom shall be appointed by the Committee on Privileges and Elections of the Senate from the membership of the Senate and five of whom shall be appointed by the Speaker of the House of Delegates from the membership thereof. Such additional citizen members may be added to the membership of the Commission as the Commission shall find necessary, provided that the total membership of the Commission shall not exceed thirteen members.

The Commission shall conduct a study on the effects of erosion on the beaches, islands and inlets of the Commonwealth and shall make such recommendations as are deemed necessary to prevent the further destruction of these valued natural resources. The Commission shall coordinate its efforts with the Virginia Institute of Marine Science and with all interested persons and agencies, including the federal government and neighboring states. All officers and agencies of the Commonwealth and its subdivisions shall assist the Commission in its work upon request.

All legislative and citizen members, other than salaried State employees, shall receive such compensation as is provided for in § 14.1-18 of the Code of Virginia, and all members shall be reimbursed for their actual and necessary expenses incurred in the course of their official duties, for which there is hereby allocated from the general appropriation to the General Assembly the sum of fifteen thousand dollars.

The Commission shall complete its study and report its findings and recommendations to the Governor and the General Assembly no later than December one, nineteen hundred seventy-nine.

Appendix B

Senate Joint Resolution No.

Continuing the commission to study erosion abatement.

Whereas, Senate Joint Resolution No. 22 of the 1978 Session of the General Assembly created a commission to study the effects of erosion on the Commonwealth and make such recommendations as are deemed necessary to prevent the further destruction of valuable resources; and

Whereas, the report of the Erosion Abatement Commission recommends, based on thorough study, the enactment of legislative programs for public beach conservation and development; and

Whereas, the report finds that most of the shores of the Commonwealth are in private ownership and are eroding; and

Whereas, the report finds that erosion of private land is a serious problem of potential concern and detriment to all citizens of the Commonwealth; and

Whereas, the report finds that questions related to private and public rights in regard to possible state action to combat erosion are complex and deserving of further study; and

Whereas, the report of the aforementioned Commission finds that erosion programs of other states designed to combat erosion of private land have created hitherto unforseen problems; and

Whereas, erosion of private lands is of serious concern to the Commonwealth causing a loss of fastland, decreasing the tax base, decreasing water quality and filling navigable channels;

Now, therefore, be it

Resolved by the Senate of Virginia, the House of Delegates concurring, That the Erosion Abatement Commission created by Senate Joint Resolution No. 22 of the 1978 Session of the General Assembly be, and the same is hereby, continued so that the members of the Commission may complete the Commission's study of erosion by focusing on the effects of, and proper governmental responses to, the erosion of tidal shoreline. The Commission shall report its recommendations and findings after adequate investigation into the matter. The agencies directed to cooperate with the Commission shall continue to do so.

APPENDIX C

Legislation Recommended

§ 15.1-31. Construction of dams, levees, seawalls, etc.; certain proceedings prohibited.–(a) Any county, city or town may construct a dam, levee, seawall or other structure or device, or perform dredging operations hereinafter referred to as "works," the purpose of which is to prevent the *erosion*, flooding or inundation of such county, city or town, or part thereof. The design, construction, performance, maintenance and operation of any of such works is hereby declared to be a proper governmental function for a public purpose.

(b) The General Assembly hereby withdraws the right of any person, firm, corporation, association or political subdivision to bring, and prohibits the bringing of, any action at law or suit in equity against any county, city or town because of, or arising out of, the design, maintenance, performance, operation or existence of such works but nothing herein shall prevent any such action or suit based upon a written contract, but this provision shall not be construed to authorize the taking of private property without just compensation therefor and provided further that the flooding or inundation of any lands of any other person by the construction of a dam or levee to impound or control fresh water shall be a taking of such land within the meaning of the foregoing provision.

§ 21-11.18. Responsibility of Soil and Water Conservation Commission.–In addition to the other duties and responsibilities conferred by this chapter, the Virginia Soil and Water Conservation Commission shall have the duty and responsibility to make the necessary coordination of shore erosion control programs of all State agencies and institutions *other than those affecting public beaches*, and to secure the cooperation and assistance of the United States and any of its agencies to protect waterfront property from destructive erosion; to evaluate the effectiveness and practicability of current programs; and to explore all facets of the problems and alternative solutions to determine if other practical and economical methods and practices may be devised to control shore erosion. Such coordination shall not restrict the statutory authority of the individual agencies having responsibilities relating to shore erosion control.

§ 21-11.19. Shore erosion staff.–The Virginia Soil and Water Conservation Commission is authorized to employ ~~one shore erosion engineer~~ *personnel* to assist in carrying out the coordination responsibility of shore erosion control programs as herein assigned to ~~the Commission. This shore erosion engineer may also provide technical assistance to soil and water conservation districts having shore erosion problems~~ *and to establish a Shoreline Erosion Advisory Service Office*.

§ 21-11.20. Cooperation and coordination with the Virginia Institute of Marine Science.–The Soil and Water Conservation Commission shall rely on the Virginia Institute of Marine Science of the College of William and Mary for research, training and technical advice on erosion related problems.

§ 23.1-195. Virginia Institute of Marine Science continued; duties.–The Virginia Institute of Marine Science, hereafter referred to as Institute, is continued within the College of William and Mary as provided in chapter 5 (§ 23-39 et seq.) of Title 23 of this Code. All references in this Code to the Virginia Institute of Marine Science hereafter shall be deemed references to the Virginia Institute of Marine Science within the College of William and Mary.

It shall be the duty of the Institute:

(a) To conduct studies and investigations of all phases of the seafood and commercial fishing and sport fishing industries;

(b) To consider means by which fisheries resources may be conserved, developed and replenished and to advise the Marine Resources Commission and other agencies and private groups on these matters;

(c) To conduct studies and investigations of problems pertaining to the other segments of the maritime economy;

(d) To conduct studies and investigations of marine pollution in cooperation with the State Water

Control Board and the Department of Health and make the resulting data and possible corrective recommendations available to the appropriate agencies;

(e) To conduct hydrographic and biological studies of the Chesapeake Bay and the tributaries thereof and all the tidal waters of the Commonwealth and the contiguous waters of the Atlantic Ocean;

(f) To engage in research in the marine sciences;

(g) To engage in research and provide training, technical assistance and advice to the Commission on Conservation and Development of Public Beaches on erosion along tidal shorelines, the Soil and Water Conservation Commission on matters relating to tidal shoreline erosion, and to other agencies upon request;

~~(g)~~ *(h)* To make such special studies and investigations concerning the foregoing as it may be requested to do by the Governor.

The above studies shall include consideration of the seafood and other marine resources including the waters, bottoms, shore lines, tidal wetlands, beaches and all phenomena and problems related to marine waters and the means by which these marine resources might be conserved, developed and replenished.

Chapter 21

PUBLIC BEACH CONSERVATION AND DEVELOPMENT ACT

§ 10-215. Findings of the General Assembly.—The General Assembly of Virginia finds the following:

(1) The Constitution of Virginia sets forth that it shall be the policy of the Commonwealth to protect its atmosphere, lands and waters from pollution, impairment or destruction, for the benefit, enjoyment, and general welfare of the people of the Commonwealth.

(2) The shores of the Commonwealth of Virginia constitute a resource of inestimable value to all persons of the State.

(3) Public beaches provide important recreational and esthetic opportunities to the general public as well as contributing significantly to the economic welfare of the Commonwealth and its localities.

(4) Public beaches are a rare and valuable resource and should be conserved and developed.

(5) Public beaches are eroding thereby diminishing important recreational, esthetic and economic benefits associated with such areas.

(6) Public awareness of the values of shore areas, the causes and effects of erosion and techniques to control erosion is low.

(7) The level of research and development activities in the area of new erosion control methods and new sources of sand for public beach conservation and development is inadequate to satisfactorily address the magnitude of the problem.

§ 10-216. Declaration of policy.—In consideration of the findings in § 10-215, the General Assembly hereby declares that it is the policy of the Commonwealth:

(1) to conserve and develop public beaches for the benefit, use and enjoyment of the citizens of the Commonwealth;

(2) to promote understanding of the value of public beaches and the causes and effects of erosion;

(3) to make available technical advice on combating erosion of public beaches;

(4) to encourage research and development of new erosion control techniques and new sources of sand for public beach enhancement;

(5) to provide training and advice to the Soil and Water Conservation Commission in its program of private erosion control;

(6) to provide a program by which localities can apply for funding of conservation and development of public beaches; and

(7) To address erosion on a reach basis where possible.

§ 10-217. Definitions.–(1) "Agency of this State" includes the government of this State and any subdivision, agency, or instrumentality, corporate or otherwise, of the government of this State.

(2) "Commission" means the Public Beach Conservation and Development Commission created by § 10-218.

(3) "Director" means the Director of the Department of Conservation and Economic Development.

(4) "Erosion" means the process of destruction by the action of wind, water, or ice of the land bordering the tidal waters of the Commonwealth of Virginia.

(5) "Government" or "governmental" includes the government of this State, the government of the United States, and any subdivision, agency, or instrumentality, corporate or otherwise, of either of them.

(6) "Locality" means a city, county or town.

(7) "Program" means the provisions of the Public Beach Conservation and Development Act.

(8) "Public beach" means a sandy beach located on a tidal shoreline suitable for bathing in a city, county or town and open to indefinite public use.

(9) "Reach" means a shoreline segment wherein there is mutual interaction of the forces of erosion, sediment transport and accretion.

(10) "State" or "Commonwealth" means the Commonwealth of Virginia.

(11) "United States" or "agencies of the United States" includes the United States of America, the United States Department of Agriculture, and any other agency or instrumentality, corporate or otherwise, of the United States of America.

§ 10-218. Commission created, duties, meetings, etc.; compensation; allocation of funds.–There is hereby created a Commission on Conservation and Development of Public Beaches. The Commission shall: review the financial needs of localities for implementation of the Public Beach Conservation and Development Act; determine successful applicants and the equitable allocation of funds among participating localities; and oversee local implementation of approved projects. The Director of the Department of Conservation and Economic Development shall allocate funds to localities in accordance with Commission determinations and maintain such financial records of activities as are necessary.

(B) The Commission shall be composed of nine members as follows: one member ex officio shall be selected by the Directors of the Soil and Water Conservation Commission, the Virginia Marine Resources Commission, the Department of Conservation and Economic Development, and the Commission of Outdoor Recreation; and five members shall be appointed by the Governor subject to confirmation by the General Assembly. Initially the five members-at-large shall be appointed for the following terms: two for a term of four years; two for a term of three years; and one for a term of two years. Thereafter, successors to members-at-large whose terms expire shall be appointed for terms of four years. Members-at-large are ineligible for reappointment after two terms

until four years have elapsed since their last appointment. All terms shall begin July one, and appointments to fill vavancies occurring shall be for the unexpired term. A chairman shall be selected from among the members-at-large.

(C) The Commission shall meet once prior to the beginning of each fiscal year to receive applications for grants from localities and to determine the allocation of such grants, as often throughout the year as necessary.

(D) Commission members shall be compensated at the rate and manner provided by § 14.1-18 for members of the General Assembly.

(E) The Department of Conservation and Economic Development may provide staff assistance from time to time if required.

§ 10-219. Relationship of commission and director; regulations.–The Commission shall be responsible for the administration and allocation of the grant fund established in § 10-220. The Commission shall submit the names of recipient localities for allocation to the Director of the Department of Conservation and Economic Development for implementation and the Director shall disburse funds to designated localities. The Commission may promulgate regulations governing application procedures, allocation guidelines or implementation standards.

§ 10-220. Establishment of fund; unexpended money.–A fund shall be established to provide grants to local governments covering up to one half of the costs of erosion abatement measures designed to conserve and develop public beaches. No grants to any locality shall exceed thirty per centum of the money appropriated to such fund for that year. Money appropriated from such fund shall be matched by local funds. Federal funds shall not be used by localities to match money given from such fund. Localities may, however, combine state and local funds to match federal funds for purposes of securing federal grants.

In the event the money in such fund is insufficient to satisfy all applications for grants from such fund, the Commission shall maintain the applications in chronological order and grants shall be made accordingly when the money in such fund is sufficient to satisfy such applications for grants.

Money which remains unexpended from such fund at the end of the biennium for which it was appropriated shall be retained and shall become a Special Emergency Assistance Fund to be used at the discretion of the Governor for the conservation and development of public beaches.

§ 10-221. Guidelines for allocation of grant funds.–The Commission shall weigh the following when selecting localities for program participation and in determining grant allocations:

(1) present and future beach ownership;

(2) erosion caused by public navigational works;

(3) intensity of use;

(4) availability of public beaches in the vicinity;

(5) evidence of a locality's ability and willingness to develop a long term capacity to combat erosion;

(6) rate of erosion; and

(7) such other matters as the Commission shall deem sufficient for consideration.

§ 10-222. Local erosion advisory commissions.–In order to qualify for the program, localities must agree to establish local Erosion Advisory Commissions which shall determine local erosion problems and suggest erosion control strategies for the future, and assess program implementation.

Separate Statement of Senator Frederick C. Boucher

I fully concur in the Commission recommendation that there be established a Shoreline Erosion Advisory Service to advise private property owners of appropriate erosion control techniques, that further research be conducted concerning the possible use of vegetation to stabilize eroding shorelines and that shoreline erosion control should be addressed in terms of shoreline segments wherein there is mutual interaction of the forces of erosion, sediment transport and accretion.

I believe that the Commonwealth has a vital interest in the protection of its public beaches, and I therefore concur in the recommendations of the Commission for sand supply research and for the provision of State aid to localities on a matching basis for beach nourishment programs. Since I am of the opinion that the only practical long term approach to shoreline erosion abatement lies in the implementation of appropriate setback requirements and other developmental restrictions contained in the report of the Virginia Coastal Study Commission (Senate Document No. 30, 1978 House and Senate Documents, Vol. 1), I think it is important to state that the recommendations of this Commission concerning beach nourishment and sand supply program should not be viewed as alternatives to the recommendations of the Virginia Coastal Study Commission.

Senator Frederick C. Boucher

Separate Statement of Senator Jospeh V. Gartlan, Jr.

I have signed the report and concur in its findings and recommendations. I have reservations about the provisions of the proposed Public Beach Conservation and Development Act. I agree with the purpose of the proposed act but with the following reservations:

1. Composition of the Public Beach Conservation and Development Commission.

   The membership should include members of the General Assembly who together with agency designees, should number more than the gubernatorial appointees.

2. Proposed guidelines for fund allocation.

   These should be rewritten as standards which the Commission is required to follow. Standards and the method of their application should be more clearly stated and Commission regulations written thereunder should be subject to review and veto by the General Assembly.

Senator Joseph V. Gartlan, Jr.

Separate Statement of Delegate Raymond E. Vickery, Jr.

Enclosed is my dissenting comment to the Report of the Coastal Erosion Abatement Commission.

I congratulate Senator Joseph T. Fitzpatrick and my fellow members of the Commission on the excellent job done in studying coastal erosion abatement.

However, I must dissent from those portions of the report which recommend a program of "beach nourishment" or "sand replenishment" for all of the public beaches of Virginia. I am aware that the State has contributed in the past to certain programs in regard to protecting the investment in the most heavily developed part of Virginia Beach. Perhaps such an expenditure on a case by case basis may be necessary even though I believe it clear that a mistake was made in allowing such intensive development that close to the shoreline.

As I understand the report, it basically recommends an extension of the "sand replenishment" or "beach nourishment" program to all of the "public beaches" of Virginia. This I believe to be a serious mistake for the following reasons:

1. In the long run, such an effort is doomed to failure in those areas where sea and wind factors dictate that a beach will be removed.

2. There simply is not enough money in the Virginia treasury to sustain a full-scale beach nourishment or sand replenishment program which has a hope of success within the next twenty to thirty years.

3. I do not approve of taking control over funding of the projects of sand replenishment away from the legislature and placing it with a commission, the majority of which is appointed by the Governor.

4. The beaches themselves are a product of erosion. Where a beach is taken away in one place it will be built up in another. Our public policy should be to accomodate development to this process through a coastal zone management program such as that contained in SB 403, rather than to enter into an impossible attempt to maintain the status quo to benefit those who wish to place intensive development on the edge of the water.

5. Instead of investing money in a doomed program of sand replenishment and beach nourishment, this money should go into the purchase of access to to public beaches and the purchase of additional water front parks for the enjoyment of all the people.

I would hasten to add that I endorse the additional funding for public advisory programs and research into vegetation and other low-cost erosion techniques.

Raymond E. Vickery, Jr.