CHAPTER 165

LOW-COST SHORELINE PROTECTION

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ABSTRACT

As the public interest in low-cost, self-installed solutions to shoreline erosion continues to grow, the involvement of private enterprise in developing solutions intensifies. Now that low-cost devices are identified as a salable commodity as goods or services, the number of inventors, creative engineers, agronomists, and foresighted planners producing potential designs are rapidly growing. Over two hundred devices, both proven and untested devices, have been cataloged as a part of the National Shoreline Erosion Demonstration Program. This program calls for the Corps of Engineers to plan, establish, and conduct for a period of five years a shoreline erosion control development and demonstration program including physical and vegetative devices.

INTRODUCTION

There is no need to recount the tales of the thousands of miles of eroding shoreline around the United States as well as throughout the world; the National Shoreline Study adequately covers the discouraging situation around the coastline of the United States. Little else needs to be said to emphasize that without adequate protection, in the broadest sense, a very significant part of our coastline falls prey to the ravages of the sea, and, of course, to man himself. Adequate protection against these forces comes normally by constructing monumental structures, such as the San Francisco seawall (O'Shaunessy), which render the land-sea-air interface permanent. It is definitely not in the best interest of the nation to provide this degree of protection at other than very valuable property at an extremely high wave energy site.

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At the opposite extreme of the cost scale is the institutional type of protection. Through appropriate legislation and other forms of institutional arrangements, loss of man-made structures along the shoreline is prevented. By restricting development to behind the third row of dunes (McHarg), man-made structures are protected from falling to the forces of the sea, at least for several years, and at the same time with adequate control the dune structure is maintained for the last line of defense. There is much to be said for this form of protection in an area that is not already fully or even overdeveloped. In the latter case it makes pitifully little sense to legislate shoreline protection. Rather, recognizing that there is little man can do to completely stop erosion, attention must be given to providing erosion protection in the form of a new beach equilibrium--a form which does not match the energy of the ocean against the inertia of a coastline but a form which enhances the resistance of the shore to erosion.

Within the context of the philosophy sketched here shoreline protection can be a reality and not a dream. Moreover, within the broad spectrum of solutions available, from laws to monuments, there is a place for low-cost protection.

Whenever major erosion threatens public property, astute elected officials generally call upon state or federal government to help solve the problem. On the other hand, when the property is private, help is seldom available and the owner is forced to provide his own defense. This requirement often results in many thousands of dollars being wasted by construction of ill-conceived projects. Sometimes the owner goes to a coastal engineer for help; but, more frequently, they design their own protection with the "good advice" of a brother-in-law, uncle, or helpful neighbor. Unfortunately, even if the private landowner does come to a coastal engineer, he seldom receives the kind of inexpensive advice for which he is looking. This is not necessarily the fault of the coastal engineer since the type of protection with which he is normally concerned is of the more glamorous, permanent, and expensive variety. So the home owner, dejected by the exorbitant costs of the traditional shore protection works, is faced with paying more than he can or is willing to afford, selling his property to an unsuspecting buyer, or developing his own solution.

More recently, significant interest has arisen in the governmental and industrial sectors to provide help for the private landowner with an eroding shoreline. Some research has been sponsored by state and federal government, although <u>not</u> at a level commensurate with the problem. A major demonstration and testing program has been undertaken by the Michigan Department of Natural Resources (Brater, Armstrong, and McGill, 1974, 1975). The demonstration projects are designed to provide data on various devices, methods of construction, and costs. Close evaluation of the results of this study will provide extremely useful information on effectiveness and durability of each of these shore protection devices.

Significant efforts have also been made to educate the public about not only devices suitable and available but more fundamentally about the basic phenomena that cause erosion problems (Brater). These publications range from brochures or "roadmaps" (Arno) to thorough treatments in the language of the intended user (Habel). This self-help literature has been distributed widely in the Great Lakes area and less completely in the Atlantic, Gulf, and Pacific areas with the hope of improving on the landowners self-design.

Industry is responding to the need for low cost solutions through their own research and development which is providing the coastal engineer with many new and innovative ideas that "might" fall into the category of low cost.

Before going further, a few words of clarification are in order. It is not implied that a "low-cost" solution is acceptable or even available for most erosion situations; rather the emphasis of this paper is on eroding areas that are not necessarily amenable to the more-costly, traditional forms of control. Moreover, it must be pointed out that too often the inexpensive methods of protection are not "low-cost" at all.

To evaluate the new concepts and ideas for low-cost protection and to disseminate the results to the owners of eroding shorelines, the U.S. Congress created the National Shoreline Erosion Demonstration Program.

Section 54 of the "Shoreline Erosion Control Demonstration Act of 1974," directed the Secretary of the Army, acting through the Corps of Engineers to establish and conduct for a period of five years a national shoreline erosion control and demonstration program. The intent of the program is to develop and demonstrate to the public and technical community methods for "low-cost" shore protection. Specifically, these methods are to be developed and demonstrated in "sheltered waters." Sheltered waters are defined as those areas where the design breaking wave is less than six feet. In addition, the Act specifically calls for widespread dissemination of the results of this program.

In the following sections, proven methods and devices for low-cost protection is discussed. Next, several of the new and innovative and yet untried concepts are presented. The National Shoreline Erosion Demonstration Program is presented in terms of direction, accomplishments, and goals.

What constitutes low-cost shore protection? This question is addressed here to provide the framework needed for further discussion. Low-cost shore protection is shore protection for sheltered or inland areas which fulfills one of the following criteria:

a. Cost less than $50 per front foot for materials and can be constructed without the use of heavy construction equipment.

b. Cost less than $125 per front foot for materials plus placement using heavy construction equipment.

These cost figures are intended to provide a degree of protection to the shore for approximately a 10-year period with a minimum of maintenance assuming that a storm exceeding a 1 in 25 year severity is not encountered during the 10-year interval with the severity being measured in terms of a combination of violence and duration.

This definition now raises the question, what is a sheltered area? For the purpose of low-cost protection it is defined as follows. A "sheltered" or "inland" site is an area which falls under one or more of the following conditions:

Coastal shores. Those shores receiving wave attack from waves generated on the open or semi-open waters of the Atlantic, Gulf, Pacific, Bering Sea, or Arctic Ocean, but which waves are attenuated by refraction, diffraction or friction in such a manner that the significant wave height of waves breaking on these shores never exceeds six feet in height.

Tidewater shores. Those shores fronting on the inland tidal waters connected with the Atlantic, Gulf, Pacific, Bering Sea, or Arctic Ocean.

Great Lakes shores. All shores fronting on the Great Lakes plus the shores of all bays connected directly with one of the Great Lakes and standing at the same water levels as the parent Great Lake.

DEVICES AND METHODS WITH POTENTIAL FOR SUCCESS

This section is devoted to describing devices and methods which, if used in the field, would result with a high probability of success. This description is not intended to be all inclusive but rather to present those concepts and established devices which have a probable chance of success. Devices can be categorized as follows:

- Revetments
- Seawalls
- Bulkheads
- Breakwater
- Beach fills
- Groins
- Vegetation
- Institutional

There is one extremely important factor concerning the successful behavior of all gravity, and to some extent cantilevered, type structures in the above list. This factor involves an adequate foundation and toe (most seaward portion) protection for the structure. The successful behavior of any gravity structure whether it be semi-flexible or rigid is very much dependent on the adequacy of foundation materials on which the structure is placed. If the foundation is inadequate or under-designed, a high degree of movement of structural components can be expected with resultant failure of the integrity of the structure. A properly designed and constructed foundation for the overlying structure can result in a satisfactory performance equal to or greater than the desired life of the installation, assuming, of course, the structural components of the main element of the structure are properly designed.

Revetments

Substantial data are available to verify that a graded rip-rap type revetment can be very successful as a shore stabilization structure. Of course, the stone size distribution in the revetment, including the foundation material, must be commensurable with expected wave forces on the structure.

In geographic areas where the cost of placing suitable rip-rap material (stone) exceeds acceptable limits, consideration could be given to the placement of precast concrete armor units on a proper foundation. Most all of the presently used precast armor units are described in the CERC Shore Protection Manual. The use of precast concrete units is generally associated with large coastal structures subjected to very large wave forces. However, there are no apparent technical reasons why small precast concrete armor units, would not be equally effective in a low wave energy environment.

There are other alternative materials and approaches for construction of revetments which exhibit potential success; however, presently available performance data in regard to upper limit of stability are meager and this lack of information is influential in establishing the relative probability of success if the structure is tested in the demonstration program. These alternatives include the precast concrete interlocking and semi-interlocking units placed on a proper foundation and appropriate toe protection provided. Also, included is a step-type revetment consisting of cribbing units which are interlocking and filled with proper graded stones, all placed on an adequate foundation with toe protection provided in front of the first step. However, one factor of concern for the crib type revetment involves a prediction of the durability of the cribbing units if low-cost constraints are adhered to for its structural make-up.

Seawalls and Bulkheads

The primary function of a seawall is to protect the area behind it from direct wave attack and the structure may or may not be subjected to backfill pressures. Bulkheads' functions are to retain backfill and are subjected to direct wave attack. The functional difference between a seawall and a bulkhead is, therefore, sometimes difficult to delineate, but for purposes of application in moderate to low wave energy environments, they may be considered to serve the same function with seawalls and, therefore, would generally be more massive than bulkheads.

There are a number of existing designs of precast concrete type seawalls, if placed on an adequate foundation, that would be promising for success. Most of these designs would require heavy equipment to handle and place the concrete segments. Promising results could also be obtained for a seawall constructed of cribbing filled with stones with the structure placed on a proper foundation and toe protection provided. However, the factor concerning structural durability of the cribbing for the seawall would be similar to that cited for the cribbed type revetment mentioned earlier.

The presently available technical guidance on bulkhead design is somewhat substantial, therefore, installation of a standard steel, concrete, or timber sheetpile bulkhead as a low-cost structure would most likely be successful. Appropriate measures to prevent excessive wave induced bottom scour in front of the sheetpile is necessary or desirable for most installations. There are alternative sheetpiling materials that would be considered for the bulkheading and depending on local environmental conditions (mainly physical). These may prove to be cost effective and exhibit a high probability of success. Examples of such materials are aluminum, asbestos, fiberglass, and many variations of synthetics. The use of lightweight steel or special additives to concrete to reduce weight but maintain strength, and thus reduce material costs of the sheetpiling, would also seem appropriate to consider.

Breakwaters

There has been limited use of breakwaters in the United States for strictly shore protection purposes. Since these structures are located offshore at depths commensurable with desired beach and shore responses, they are subjected to greater wave forces and structural components must be stronger or larger than for those structures located in the foreshore or beach zone. An offshore breakwater of proper design will dissipate incident wave energy, thus, the shores within the "lea or shadow" of the breakwater will be protected, and in this context the overall functional behavior of the structure could be considered as promising with regard to success. There are two basic or standard techniques to constructing offshore breakwaters, both of which could be considered as resulting in a high probability of success if constructed in the demonstration programs. The first involves the use of rubble with an armor layer of stone or precast concrete units, depending on economics; and, the second involving the use of semi-interlocking precast concrete segments. Each technique requires provision for an appropriate foundation to support the super-structure, including toe protection which will remain stable under design wave forces. Relatively heavy-duty equipment and possible certain marine plants are required for most breakwater construction and since the structure is located offshore, it is apparent that construction practices and procedures are more difficult and involved as compared to construction of a similar structure on the shore zone. This is particularly important to keep the project within the low-cost category.

Considerable attention has been given to the use of portable or floating breakwaters to attenuate wave energy. There are currently no devices of this type that do not become less efficient in wave energy attenuation as the wave length of the incident wave increases. The fact that low-cost solutions generally will be confined to sheltered waters does introduce an attraction to utilize floating breakwater devices as short wave periods would normally prevail.

Beach Fill

The use of beach fill as a low-cost structure would result in a probable chance of success provided the placed fill was of suitable size characteristics. Periodic nourishment for the initially placed fill would be required or should be anticipated. The predominance of short period waves breaking on the beach fill means that direct offshore transport will dominate. No beach recovery can be expected by onshore transport since, in general, there would be no, or minimal, occurrences of long period waves; thus, periodic nourishment to balance the losses to the offshore zone would be necessary to maintain desired project dimensions in the study area. Depending on local conditions, terminal structures (groins) may be needed at one or both ends of the eroding segment, as well as, artificial headlands.

Groins

An accurate determination of the littoral material movement of the site specific is essential to the use of groins as a low-cost structure. A moderate amount of alongshore transport of littoral materials must prevail in the area or a groin or groin system will not function properly. Assuming the prevailing littoral material transport conditions are favorable for the functional aspects of a groin system, there are several materials from which the groins can be constructed and successful results expected. Constructing the groin of rubble has several desirable features in regard to wave energy dissipation and retention of the impounded sand. This assumes the structure has a proper foundation and distribution of stone throughout the groin cross-section. The use of steel, concrete or timber sheetpiling with stone protection around the outer end is also a well-proven and acceptable method for groin construction. Pre-fabricated segments (concrete) which have an interlocking or semi-interlocking design and founded on a proper foundation can also be structurally effective. If the material components of a crib type structure (crib units filled with stone) will be durable for the life of the structure, there is no reason to believe this type of groin would not also be effective.

If the site conditions are favorable for testing of a groin system, the most effective structure would be a rubble design. The performance of a sheetpile design with rubble placed around the outer end of the groin should be comparable to a prefabricated segmented design (interlocking or semi-interlocking) placed on proper foundation materials.

Vegetation

Very little information and guidance are presently available in regard to the effectiveness of vegetation to directly dissipate incident wave energy. Its effectiveness in a high wave energy environment is probably very limited. On the other hand, the use of vegetation to impound or retain aeolian sand in the foredune area of the coastal zone is well proven and these stabilized or created foredunes are of tremendous value in terms of shore protection.

Fairly adequate data are available on species adaptation and on establishment and maintenance on the Atlantic and Gulf Coasts. On the Great Lakes, Pacific and Alaskan coasts, considerably less is known. Although vegetation is the only generally accepted method to feasibly stablize dunes, few quantitative estimates are available on the degree of protection provided. Dahl et al. gives a very complete literature review. Recent successes using panic grass (*Panicum amarum*) along the North Carolina Coast in dune stabilization is given by Seneca, Woodhouse and Broome. In addition to panic grass, American beachgrass, europian beachgrass, and sea oats are some of the more successful vegetation used in dune building and stabilization.

The intertidal zone has not yet received the same degree of success. However, vegetation appears to offer considerable promise for the more protected site. Considering that many thousands of miles of shoreline are now well protected by natural marsh grass, it is obvious that the most likely technique for stablizing the shoreline in a sheltered area is to simulate the protection provided by nature. With some assistance by man through planting sufficient numbers of plants or seeds, at the proper time, the invasion of natural marsh species can be hastened. Most of the work done in the intertidal zone has been with smooth cordgrass (*Spartina alternaflora*). This plant thrives well in the intertidal salt marshes of the Atlantic and Gulf Coasts. In the more brackish waters the following grasses are being considered: three-square (*Scirpus Americanus*), needle rush grass (*Juncus roemeriannus*), and saltmeadow cordgrass (*Spartina patens*). Very little has been written on the degree of protection that this method can provide although there is much current research in this area. Webb and Dodd show how smooth cordgrass has been used in Galveston Bay. It appears though that marsh vegetation in conjunction with some form of physical temporary protection, such as a floating breakwater, offer much opportunity for low-cost shoreline protection at a very attractive cost.

Institutional Devices

Intangible devices are much more difficult to identify except in a generic sense. Moreover, the actual cost of institutional devices are ill defined. Conceptually, the ideas that can be considered in this category include zoning, permitting, taxing and such other regulatory powers that government - local, state, and federal - can use. The institutions in themselves are indeed low-cost; however, the cost of implementing the regulation to the property owner can be quite costly. For example, if a land owner were experiencing a rapid rate of erosion he would want to quickly install some device to slow or stop the process. However, if a coastal zone authority does not permit the use of structures within fifty feet of the mean high water line then the land owner will not be allowed to protect his property and thus his cost will in no way be low. Yet, the cost to the coastal zone authority is minimal. In brief, there are few, if any, institutional devices that could qualify, to the individual homeowner, as low-cost shoreline protection.

INNOVATIVE DEVICES

As the public interest in low-cost, self-installed solutions to shoreline erosion continues to grow, the involvement of private enterprise in developing solutions intensifies. Now that low-cost devices are identified as a salable commodity as goods or services, the number of inventors, creative engineers, agronomists, and foresighted planners producing potential designs are rapidly growing. This energy has and continues to lead to very innovative designs that may be functionally and structurally successful and may be low-cost. As a part of the National Shoreline Erosion Demonstration Program, known devices and methods which have been used or tested in various degrees, or just proposed, have been tabulated. The list is limited to just those items which might be classified as low-cost. A page from that list is included as Figure 1. The devices have been categorized as shown below along with the number of devices in each category.

Revetments	37
Bulkheads and seawalls	35
Groins	39
Offshore breakwaters	24
Floating breakwaters	18
Beach fills	9
Coastal vegetation	27
Other	8

From this compilation of devices, the Shoreline Erosion Advisory Panel (which will be described later in this paper) has recommended that from this list of devices at least the following should be field tested.

Aluminum bulkheads
Bins or cribs (concrete, steel, aluminum, or wood)
Gabions (rusting of mesh container a problem)
Longard tubes (sand-filled plastic tubes)
Nami rings (upright concrete culvert pipe)
Interlocking concrete block (with filter cloth)
Stone rip-rap (with gravel or plastic filters or mastic binder)
Plastic bags (sand filled or concrete filled)
Precast concrete sheet piling (possibly pre-stressed)
Rubble mound groins and breakwaters
Concrete pipe groins
Z-wall offshore breakwaters (steel or concrete)
Scrap tire floating breakwater
Tethered floating mat plastic breakwaters

It was further recommended that existing installations of the following devices should be monitored.

Sand-grabber (cinder blocks)
Shore-protector (slat breakwater)
Beach-builder (flap valve breakwater)

Figures 2-9 show examples of several forms of low-cost structures that have been proposed or used in the field. Some of these devices hold great promise while others do not appear as attractive.

SHORE EROSION ADVISORY PANEL
INFORMATION ON EROSION CONTROL DEVICES-METHODS
CATEGORY D.-OFFSHORE BREAKWATERS

Ref. No.	Designation and Description of Device or Method	Results of Laboratory Tests: Test Locations–Test Dates	Results of Laboratory Tests: Test Waves, Scale of Tests, and Results	Lab Data	Results of Field Installations: Test Location and Sponsor	Estimated Waves: Max Feet	Estimated Waves: Significant (ft)	Yrs Obs	Field Data	Degree of Success (a): Exc	Good	Fair	Poor	Product Data: Patent	Manufacturer or Patent Holder	Cost per Foot (b): 3 ft Waves	6 ft Waves	Comments (Corps or SEAP Reviewer)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)				(12)	(13)	(14)		(15)
D-14	Rubble Mound (impermeable)	WES-Vicksburg, MS (1966-67) CERC-BEB-Large Wave Tank ('67)	Waves up to 1-ft in actual ht. Waves up to 6-ft actual ht. design criteria defined	D14-L	Numerous field installations in USA eg. Winthrop Bch. MS Haleiwa, HI 1-5' depth Santa Monica, CA		Large (up to 30') 2.4' (MA) 17' at Haleiwa, HI	Many 5 yrs Haleiwa	D14-F	F,S				No	Information contained in CERC's "Shore Protection Manual" Vol 2		Varies - was $330/l.f. at Haleiwa, HI (1966)	From "CERC" SPM. Model studies (Hudson '59) indicate that the required crest elevation of rubble type breakwater depends on wave height, wave period, wave length, face slope of the structure, and permeability of the structure. Cost varies with design wave height and depth of water
D-15	Shore Attached Breakwaters				Many locations in U.S. eg. Crescent City, CA (1957)		Large (up to 30')	0	D15-F	F,S					Many contractors in U.S.		very expensive	Cost varies with design wave height and depth of water. Usually constructed of stone and sometimes combined with tetrapods, tribars, dolos, etc. See SPM, fig. 6-90 & 6-91
D-16	Stone Asphalt Breakwaters				Ijmuiden, The Netherlands (1964)				D16-F	S	F				Many contractors in U.S.		very expensive	Cost varies with design wave height and depth of water. Design of stone asphalt breakwater in SPM, Fig 6-92
D-17	Submerged Breakwaters	BEB-TM No. 1 (1940) A Model study of the effect of submerged breakwaters on Wave Action	CERC Library V.F. 1346 Submerged Barriers for Shore Protection	D17-L	Artificial offshore Reef (1973) Possible test of reef in Florida				D17-F		F,S			Yes	Possible U.S. Army Corps Project Patent 1973		very expensive	Cost varies with design wave height and depth of water Laboratory test demonstrates that submerged breakwaters will reduce wave height, but the effect is dependent on the degree of submergence and the crest width of the submerged breakwater
D-18	Underwater Fence Device (Plywood device with trap doors)				Constructed 40ft of this device at unknown site on sand bar in Lake Michigan ('72) Mr. Fred Clinton, WRC, State of Michigan			1-2	D18-F			S	F		Mr. Fred Clinton, Inventor John R. Sheil Engrs Inc Lansing, MI	$6 (E) 1'72		Planned a 2000' installation of this device on second sand bar in Lake Michigan if funds become available
D-19	Wave Filters (Fibrous Screens): Aluminum Wool, Rubberized Hair and Plastic Foam Filters	Waterways Exp. Station Vicksburg, MS. (1972) Research Rpt H-72-2 by G.H.Keulegan	Results in reference material. Wave Damping Effects of Fibrous Screens by G.H.Keulegan (1972)	D19-L													$50-$100 (E) (1971)	
D-20	Worm Reefs (Sabellariid Reefs)				Worm reefs as related to beach stabilization (1967) by D.W. Kirtley Florida State Univ. Study: Various Florida Reefs		2.1' (Lake Worth, FL)		D20-F			F,S					$25-$50 (E) (1967)	With worm reefs we might be able to control and manipulate the shape & size of the reefs artificially to the end that the beaches might be better protected from erosion and our valuable nearshore natural resources conserved
D-21	Wilson Breakwater				Lauderdale-by-the-sea Fl (1966) Offshore in Atlantic Ocean		Large (up to 30') 2.1		D21-F				F,S	Yes	Inventor: Mr. A.B. Wilson, Lauderdale, FL		$100 + (E) (1966)	Failed & removed in Feb 1967 $20,000 experiments. Design must be stronger and cost of structure would be unrealistic
D-22	"Z" Wall Concrete (Precast Concrete Panels)				Port Marquette Twp. MI (Lake Michigan) State of Michigans Dept of Natural Resources	84 (8M)	15 ft.	2	D22-F			S	F	Yes	Speidel Foundation & Marine Inc. Box 34 Benton Harbor, MI		$67 (A) (1974)	Major storm of Jan 1975 caused extensive settlement and tipping of sections Waves 6' to 10' high
D-23	Triple-Bulkhead Type of Floating Breakwater	BEB Research Tanks, Wash. DC (1957)	Scale 1 to 24 Results - reducing wave hts drops off rapidly with increase in wave period. Forces required to hold breakwater against larger waves (9-10 ft. prototype) exceed 200,000lbs anchor chain Results - will reduce hts of waves 75-90% if their wave lgt is less wdt across bkwtr	D23-L										No	test for U.S. Navy Bureau of Yards and Docks, Wash. DC		$50-$100 (E) (1957)	Reference: TM No. 99 (BEB) by C.W. Ross (1957) High Cost may exceed SEAP limits "Model tests on a Triple-Bulkhead Type of Floating Breakwater"

(a) Degree of Success (11)
This is a judgement by the reviewer
F = Functional
S = Structural

(b) Cost per Foot (14)
A = Actual cost (include year)
E = Estimated cost

Figure 1. An excerpt from the tabulation of devices and methods for low-cost shoreline protection prepared for the National Shoreline Erosion Demonstration Program.

Figure 2. The "Sandgrabber" in Lake Erie

Figure 3. Campbell's precast breakwater units

Figure 4. Gobi blocks in the large wave tank at CERC

Figure 5. "Goodyear" type floating breakwater, Cranston, Rhode Island

Figure 6. Sand filled bags as a revetment in conjunction with an asbestos bulkhead and dune vegetation at Seabrook Island, South Carolina

Figure 7. Institutional low-cost measures

Figure 8. Bolsaroca, large, reinforced, synthetic bags filled with mortar or concrete in sites

Figure 9. The Shoreprotector, at Virginia Beach, Virginia

SHORELINE EROSION CONTROL DEMONSTRATION PROGRAM

> The Congress finds that because of the importance and increasing interest in the coastal and estuarine zone of the United States, the deterioration of the shoreline within this zone due to erosion, the harm to water quality and marine life from shoreline erosion, the loss of recreational potential due to such erosion, the financial loss to private and public landowners resulting from shoreline erosion, and the inability of such landowners to obtain satisfactory financial and technical assistance to combat such erosion, it is essential to develop, demonstrate, and disseminate information about low-cost means to prevent and control shoreline erosion. It is therefore the purpose of this section to authorize a program to develop and demonstrate such means to combat shoreline erosion.

Thus on March 7, 1974, the President signed into law Section 54, Public Law 251, 93rd Congress -- the Shoreline Erosion Control Demonstration Act of 1974. The Act calls for the Chief, U.S. Army Corps of Engineers, to plan, establish, and conduct for a period of five years a national shoreline erosion control demonstration and development program. The program consists of planning, constructing, maintaining, evaluating and demonstrating prototype shoreline erosion control devices, both physical and vegetative. The Act is silent on institutional devices and these are, therefore, omitted from the program.

Although the Corps of Engineers is administering the project, they are cooperating with the Department of Agriculture, vis-a-vis the Soil Conservation Service, particularly with respect to vegetative means of preventing and controlling shoreline erosion.

The actual demonstration projects developed under this program emphasize the development of low-cost erosion control devices on sheltered or inland waters. These demonstration projects are being constructed with at least two sites each on the shorelines of the Atlantic, Gulf, and Pacific Coasts, the Great Lakes, and the State of Alaska, and with six sites at serious erosion sites in the State of Delaware along Delaware Bay. These demonstration projects can be built on private or public lands as long as a non-federal sponsor can pay at least 25 percent of the construction costs and assume operation and maintenance costs upon completion of the project.

The Act directed the Chief of Engineers to establish the Shoreline Erosion Advisory Panel. The Panel is charged with providing general guidance and expert technical advice to the Chief on the establishment, conduct, and evaluation of results of the program. The Panel consists of 15 members, selected as individuals who are knowledgeable with respect to various aspects of shoreline erosion problems. Representatives from various geographical areas, institutions of higher education, professional organizations, state and local government and private organizations serve on the Panel. Specifically, the Panel is to:

(a) advise the Chief of Engineers generally in carrying out provisions of this Act;
(b) recommend criteria for the selection of development and demonstration sites;
(c) recommend alternative institutional, legal, and financial arrangements necessary to effect agreements with non-Federal sponsors of project sites;
(d) make periodic reviews of the progress of the program pursuant to this section;
(e) recommend means by which the knowledge obtained from the project may be made readily available to the public; and
(f) perform such functions as the Chief of Engineers may designate.

To carry out this program, Congress has authorized appropriations, over the five-year life of the program, not to exceed $8,000,000.

A demonstration site is a shore frontage occupied by shore protection works consisting of one or more installations or devices to be monitored and evaluated under the SEAP program. The site shall include the area containing the installation or installations, plus adjacent shore fronts likely to be significantly affected by them within ten years of the date of installation. It is further recognized that three types of sites may be used.

(a) SEAP Site - A site on which installation of protective works are initiated under the SEAP program.
(b) Joint Site - A site bearing existing shore protection works constructed by others but which are repaired, modified, or supplemented under the SEAP program.
(c) Existing Site - A site containing existing shore protection works or devices installed by others, but selected for study and evaluation under the SEAP program.

The Panel has developed and adopted a set of criteria for site selection evaluation which considers legal criteria, social and public relations criteria, environmental criteria, and economic criteria. The Panel has also developed and adopted a procedure for site selection; this procedure involves identifying candidate sites and ranking them in order of value as regional demonstration sites, and then matching these sites with a priority listing of methods and devices which the Panel believes worthy of testing. The result is a program of test installations scheduled as to costs and year of installation; the recommended program has been sent by the Panel to the Chief of Engineers with recommendations for construction.

The enabling Act requires that when a demonstration project is installed on non-Federal property, that part of the expense be borne by an agency or individual other than the Federal government. The Panel has prepared a set of recommendations on institutional arrangements which will be forwarded to the Chief of Engineers in October 1976. Among the questions considered in the institutional arrangements are: access to demonstration site by the interested public; liability of Federal government and landowners for damage to other persons or other property; duration of demonstration testing at the particular site; removal of unsuccessful devices at the end of demonstration period.

The Panel has also addressed the question of monitoring the demonstration sites once the devices have been installed. As a result of its deliberations, the Panel has a draft of guidelines for use in monitoring test installations. The draft guidelines include coverage of such subjects as the proper balance between the number and type of monitoring observations against the expense of the monitoring program, and whether or not a device will be repaired or modified, and to what extent, if it is found to be failing in its intended protective action.

In accordance with the Act, the Chief of Engineers has announced the following sixteen sites (including six in Delaware Bay) where demonstration projects will be constructed.

- Kotzabue, Alaska
- Unalaklett, Alaska
- Alameda, California
- Bowers, Delaware
- Broadkill Beach, Delaware
- Kitts Hummock, Delaware
- Lewes, Delaware
- Pickering Beach, Delaware
- Slaughter Beach, Delaware
- Basin Bayou State Park, Florida
- Stuart-Jensen Causeways, Florida
- Geneva State Park, Ohio
- Bulls Island, South Carolina
- Sand Point, Texas
- Oak Harbor, Washington
- Port Wing, Wisconsin

This list includes private, local, state, and federal lands. Moreover, it includes sandy, clay, and cobble beaches, coasts with bluffs and those with dunes, beaches with moderate wave energy and beaches with low wave energy, and beaches frequented by ice. These sites are representative of the U.S. coastline.

The success of this program will do much to bring realistic, workable, low-cost shoreline protection solutions into the hands of local government and most importantly the private landowner.

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