



**US Army Corps
of Engineers**

Engineer Institute for
Water Resources

Study of Public Use of Jetties, Groins and Breakwaters for Recreational Activities

STUDY OF PUBLIC USE OF
JETTIES, GROINS AND BREAKWATERS
FOR RECREATIONAL ACTIVITIES

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PREFACE

This report was prepared by James J. Comiskey, under the supervision of Kyle E. Schilling, Chief, Policy Studies Division, Institute for Water Resources (IWR), in coordination with Dr. William Burris, Office of Policy, Office of the Chief of Engineers. Janet Wright of the IWR staff was largely responsible for the preparation of the questionnaire utilized in the development of this study. Additional review, comment and guidance were provided by the following:

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CHAPTER I EXECUTIVE SUMMARY

This report discusses the public use of U.S. Army Corps of Engineers coastal and navigation structures (groins, jetties and shore-connected breakwaters) for fishing and other recreational activities. Topic elements contained in this report include:

- o Number and type of coastal and navigation structures in the United States.
- o Legal and administrative authority of the U.S. Army Corps of Engineers over public use of its jetties, groins and breakwaters.
- o Overviews, visitation statistics, accidents and benefits associated with public use of jetties, groins and breakwaters.
- o Design modifications and improvements for safe public use of coastal and navigation structures.
- o Issues and alternatives for policy decisions on public use of U.S. Army Corps of Engineers jetties, groins and shore-connected breakwaters.

Responses of Corps districts and divisions from an IWR questionnaire provided the basis for most of the data analyzed in this report. Information presented in this study is comprehensive in that all 21 Corps coastal and Great Lakes districts completed the questionnaire. Also, a number of opinions and professional observations on the public use of coastal and navigation structures was secured from state marine safety officers and safety councils as well as other applicable Federal agencies.

Findings and conclusions of this study effort include the following:

- o The 21 U.S. Army Corps of Engineers districts comprising the coastal and Great Lakes regions of the United States contain approximately 4500 navigation and shore protection structures, including 480 jetties, 328 shore-connected breakwaters and 3684 groins.
- o About 51 percent of all coastal and navigation structures in the United States were constructed using sheet pile while an estimated 43 percent contain rubble-stone. Other smaller numbers of these structures include crib-type construction (two percent) and combinations of wooden cribs with concrete caps and steel cells (four percent).
- o The legal authority of the U.S. Army Corps of Engineers to construct and maintain jetties, groins and breakwaters derives historically from a number of river and harbor acts.
- o The U.S. Army Corps of Engineers has legal authority to fund, install and maintain any minimum safety feature to protect the public engaged in recreational activities at any Corps jetty, groin or breakwater.

However, response data from a number of Corps districts indicate no clear consensus on the applicability of certain Federal laws or mandates whose implementation may result in the addition of a handrail, cap or other measure to provide safer access for use of Corps jetties, etc.

- o To date, only six Corps districts have actually entered into formal cooperative agreements with state or local entities to increase recreational opportunities at jetties, groins and breakwaters. Such formal agreements could include applicable cost-sharing provisions of PL 89-72 and written agreements for payment for any local costs as stated in Section 221 of the River and Harbor and Flood Control Act.
- o Although marine safety officers in several states contacted during the course of this study indicated that their respective state coastal authorities gave "silent consent" to the recreational use of jetties and shore-connected breakwaters, these same officials recognized the existence of potentially hazardous conditions at these same structures.
- o Members of two metropolitan lifeguard units interviewed by telephone stressed the apparent lack of public awareness of potential dangers associated with public use of jetties, etc. While conceding that the total ban was unrealistic, they urged implementation of safety measures to warn of hazards (signs).
- o Approximately 12 percent (547) of all coastal and navigation structures are used by the public for fishing and related recreational activities.
- o While the U.S. Army Corps of Engineers maintains only seven percent of all jetties, groins and shore-connected breakwaters, on a percentage utilization basis, recreational use of these structures accounts for about 58 percent of all such recreation. Recreational use at Corps jetties accounts for 86 percent of all fishing and sightseeing activities on this type of navigation structure. However, for groins and shore-connected breakwaters, the recreational use factor is higher for facilities maintained by non-Corps parties (68 and 51 percent, respectively).
- o At present, very little factual data is available concerning intensity of use of jetties, groins and breakwaters for recreational purposes.
- o The liability of the U.S. Army Corps of Engineers for accidents resulting from public use of its jetties, groins and breakwaters can only be decided on an individual basis, given the wide variation in state laws determining liability and the potentially enormous number of case-specific situations, as well as the possibility of numerous interpretations of statutes by different judges and juries.

- o At over 35 percent of its estimated 667 coastal and navigation structures, the U.S. Army Corps of Engineers has taken measures (signs and barricades) to discourage recreational use of these facilities. On less than one percent of all non-Corps-maintained jetties, etc., have any signs been erected by state or local governments.
- o An estimated 30 percent of all Corps of Engineers maintained structures have been modified for greater access and public use. The installation of safe handrails on the structure was the most frequently cited improvement by district personnel, followed by the construction of safe walkways.
- o Excluding the approximately 3500 private smaller groins, less than four percent of the approximately 1000 coastal and navigation structures nationwide have actually been designed for public use.
- o Although there are presently nearly 400 coastal and navigation structures considered unsafe or unsuitable for public use due to design characteristics, an estimated 74 percent or 296 of these structures are capable of some public use with implementation of safety or engineering features.

During the course of this study effort, five issues and related policy considerations emerged that must be considered in the development and implementation of future decisions by the U.S. Army Corps of engineers affecting public use of its jetties, groins and shore-connected breakwaters. These include: (1) applicability and/or development of engineering measures and other physical design modifications for safe use of these structures; (2) Corps-wide evaluation of the rationale, benefits and negative impacts associated with public use of jetties, etc.; (3) Corps of Engineers liability stemming from recreational use of its coastal and navigation structures; (4) need for an information system (computerized file) for management of Corps shore structures; and (5) cost-sharing requirements for the installation of recreation and/or safety features.

It is anticipated that resolution of some of these issues will contribute to the development of greater safety measures for members of the public choosing to use jetties, groins and breakwaters for recreational activities.

CHAPTER II

INTRODUCTION

At the request of the Office of Policy, Office of the Chief of Engineers (OCE), the Policy Studies Division of the Institute for Water Resources was asked to prepare a report on the public use of U.S. Army Corps of Engineers jetties, groins and breakwaters. The meanings of the terms jetty, groin and breakwater used in this report are based on definitions for these structures contained in Volume III of the Shore Protection Manual.

Jetty - A structure, on open seacoasts, extending into a body of water, and designed to prevent shoaling of a channel by littoral materials and to direct and confine the stream or tidal flow. Jetties are built at the mouth of a river or tidal inlet to help deepen and stabilize a channel.

Groin - A shore protection structure built (usually perpendicular to the shoreline) to trap littoral drift or retard erosion of the shore.

Breakwater - A structure protecting a shore area, harbor, anchorage or basin from waves.

The principal objectives of this study are: (1) to determine the number of navigation (jetties and breakwaters) and shore protection (groins) structures, improved or unimproved, for recreational activities and the extent of public use of these structures; (2) to ascertain attitudes and methods of the 21 Corps of Engineers coastal and Great lakes districts to accommodate or to discourage public use of jetties, groins and breakwaters, as well as the effectiveness of these methods; (3) to evaluate the need for "minimum facilities" for public health and safety under the provisions of PL 89-72 (Federal Water Project Recreation Act) at those Corps structures not specifically improved for public use; (4) to suggest some guidelines for evaluating both hazardous and "safe" characteristics of jetties, etc., unimproved for public use during times of storms and adverse weather conditions; and (5) to present alternative policies available to the U.S. Army Corps of Engineers in the public use of coastal (shore protection) and navigation structures, including implementation assessments and consideration of associated benefits.

Questionnaire data from all 21 Corps coastal and Great Lakes districts provided most of the information contained in this document. Where questions existed concerning district responses, appropriate Corps personnel were contacted by telephone to resolve ambiguous data entries. In addition, a number of opinions and professional observations on the public use of coastal and navigation structures was secured from state marine safety officers and national safety councils, as well as other applicable Federal agencies.

Chapter III discusses the number and type (rubble-mound, crib, etc.) of coastal and navigation structures in the United States. In Chapter IV the legal and administrative authority of the U.S. Army Corps of Engineers over public use of these structures is presented. While Chapter V contains overviews, visitation statistics, accidents and benefits related to this same

use for recreational activities (fishing, etc.), Chapter VI summarizes major types of design modifications (concrete caps, handrails, etc.) and improvements for safe use of jetties, groins and shore-connected breakwaters. Issues and alternatives for policy decisions on public use of jetties, etc., are the topical areas discussed in Chapter VII. The final chapter (VIII) presents overall study findings and conclusions.

CHAPTER III

NUMBER AND TYPE OF COASTAL AND NAVIGATION STRUCTURES IN THE UNITED STATES

Number of Structures

The 21 U.S. Army Corps of Engineers districts comprising the coastal and Great Lakes regions of the United States contain approximately 4500 navigation and shore protection structures (Table 1). Based on questionnaire data provided to the U.S. Army Engineer Institute for Water Resources, it is estimated that there are 480 jetties, 328 shore-connected breakwaters and 3684 groins in these districts. The number of existing groins in actuality may be considerably higher due to the large number of smaller structures of this sort (<20 feet), owned and maintained by private individuals and not included in district inventories.

About 74 percent of all jetties nationwide are presently maintained by the U.S. Army Corps of Engineers. Non-Federal parties (state and local governments) have constructed 121 jetties and have sole maintenance responsibilities for these structures and for five other jetties built by the Corps of Engineers. The Detroit District maintains the largest number of jetties (80), followed by the Jacksonville District with 48; New England, 36; Buffalo, 28; and Baltimore, 23. There are no Corps-maintained jetties in the Chicago and Norfolk Districts or in the Pacific Ocean Division.

Of the 192 groins constructed by the U.S. Army Corps of Engineers, a large percentage (66 percent) or 127 groins are maintained by non-Federal parties. Maintenance of such shore erosion control structures is generally a non-Federal responsibility. However, in the case of multipurpose projects providing for navigation as well as shore protection in the Galveston and Los Angeles areas, maintenance responsibility is vested in the Federal government. These districts presently provide normal maintenance and perform necessary repairs to a number of such groins, 23 and 11, respectively. Although a total of 3619 other (non-Corps and private) groins were reported, this estimate is considered rather low by Corps district personnel since it may not include the hundreds of smaller groins abutting private, residential shorefront properties.

Similar to maintenance responsibilities with jetties., the Corps of Engineers performs most of these functions on breakwaters. In 1981, this agency maintained 76 percent or 248 structures nationwide. The New England Division with 52, and the Detroit District with 60, contained the largest number of Corps-maintained breakwaters. Other Corps offices with sizeable numbers of these structures include the Alaska District and the Pacific Ocean Division, both with 26. In addition to another 14 breakwaters constructed by the Corps but maintained by non-Federal parties, there are 66 other such structures entirely built and maintained by state and local funding. Over 81 percent of these breakwaters are located in the Galveston and Chicago Districts as well as in the Pacific Ocean Division.

TABLE 1

NUMBER OF JETTIES, GROINS AND SHORE-CONNECTED BREAKWATERS BY U.S. ARMY CORPS OF ENGINEERS DISTRICT⁷

District or Division	JETTIES ⁴			GROINS ⁴			BREAKWATERS ⁴			District/ Division Totals
	Constructed by Corps of Engineers		Other Structures ³	Constructed by Corps of Engineers		Other Structures ³	Constructed by Corps of Engineers		Other Structures ³	
	Corps Maintenance	Non-Fed ² Maintenance		Corps Maintenance	Non-Fed ² Maintenance		Corps Maintenance	Non-Fed ² Maintenance		
1. New England	36	0	NA ⁵	2	0	NA	52	0	NA	88
2. New York	15	0	73 ⁸	0	20	1142	9	0	3	1262
3. Philadelphia	12	2	0	0	31	369	2	0	5	421
4. Baltimore	23	0	0	0	0	456	3	0	1	483
5. Norfolk	0	0	2	0	0	NA ^{5,6}	0	5	NA	5
6. Wilmington	2	0	2	0	5	8 ⁶	4	0	0	21
7. Charleston	6	0	6	1	0	75	0	0	0	88
8. Savannah	4	0	0	1	0	0	0	0	0	5
9. Jacksonville	48	0	7	0	16	2	0	0	0	73
10. Mobile	8	0	0	0	0	1	2	0	0	11
11. New Orleans	15	0	0	0	0	0	0	0	0	15
12. Galveston	14	0	2	11	0	4	7	2	12	52
13. Los Angeles	17	0	14	23	23	11	8	0	0	96
14. San Francisco	8	2	1	0	0	1	7	4	4	27
15. Portland	22	0	0	5	0	NA ⁵	4	0	1	32
16. Seattle	9	0	0	6	0	1	12	3	3	34
17. Alaska	7	0	NA ⁵	8	0	NA ⁵	26	0	NA	41
18. Pacific Ocean	0	1	11	7	0	48	26	0	24	117
19. Chicago	0	0	3	0	8	374	11	0	13	409
20. Detroit	80	0	0	0	0	1000	60	0	0	1140
21. Buffalo	28	0	0	1	24	0	15	0	0	68
Subtotals	354	5	121	65	127	3492	248	14	66	4492
Totals		(480)			(3684)			(328)		

Notes and References

- Coastal or navigation structures maintained entirely by U.S. Army Corps of Engineers.
- Jetties, groins and breakwaters constructed by U.S. Army Corps of Engineers, but presently maintained by non-Federal entities as a result of cost sharing or similar agreements.
- All other jetties, groins or breakwaters in district.
- The meanings of the terms jetty, groin and breakwater used in this questionnaire are based on definitions for these structures contained in Volume III of the Shore Protection Manual.

Jetty - A structure, on open seacoasts, extending into a body of water, and designed to prevent shoaling of a channel by littoral materials, and to direct and confine the stream or tidal flow. Jetties are built at the mouth of a river or tidal inlet to help deepen and stabilize a channel.

Groin - A shore protection structure built (usually perpendicular to the shoreline) to trap littoral drift or retard erosion of the shore.

Breakwater - A structure protecting a shore area, harbor, anchorage or basin from waves.
- Approximate number is not available (NA).
- Does not include possible several hundred smaller groins owned and maintained by private individuals.
- Source of Data: Responses from Institute for Water Resources questionnaire to applicable Corps districts (divisions).
- According to the Chief, Coastal Engineering Branch, New York District, this figure also includes smaller jetty-like structures on minor waterways.

Type of Structure/Construction Material Utilized

Approximately 51 percent of all coastal and navigation structures in the United States were constructed using sheet pile while an estimated 43 percent contain rubble stone (Table 2). Other smaller numbers of these structures include crib-type construction (two percent) and combinations of wooden cribs with concrete caps and steel cells (four percent).

Sheet pile types include timber, steel and concrete sheet piling structures. Groins, constructed and maintained entirely without Federal funds, account for 90 percent of all coastal structures utilizing sheet piling. By far, the vast majority (over 80 percent) of all such structures are located in the New York District, the only Corps region reporting sizeable numbers of such structures. A few jetties and shore-connected breakwaters have also been constructed using a sheet piling design. A common type of sheet pile timber groins (heavily used in coastal areas around New York) is usually supported by wales and round piles. Some permeable timber groins have also been built by leaving space between the sheetings. Sheet piles are supported in a vertical position between the wales and secured to them with nails. All timber and piles used for marine construction should be given the maximum recommended pressure treatment with creosote coating.

Groins constructed of steel sheet piling (used extensively in Chicago and other Great Lakes regions) have been constructed with web and arch-web designs. Some have been made permeable by cutting openings in the piles. The interlock type of steel sheet piles provides a sand-tight connection. Steel sheet piling is also used in groin structures such as a single row of piling formation with or without buttresses, and is formed-filled with suitable material. The life expectancy of steel piling depends upon water conditions at the site.

The coastal areas around New York and Jacksonville are the only regions with any significant number of structures utilizing concrete in conjunction with sheet piling. There are 44 such groins in the New York District constructed and maintained by non-Federal parties. The Jacksonville District contains 16 breakwaters using this type of construction material.

Rubble-mound coastal structures in the United States include 328 jetties, 634 groins and 230 shore-connected breakwaters, or 43 percent of all structures. The popularity of this construction material for these structures is due to a variety of factors. Unlike the rigid, vertical wall type, a rubble-mound structure, when subjected to severe wave action, is not prone to complete failure. Rubble structures, not being monolithic, will follow more of a process of disintegration; that is, wearing away or dislodging stone by stone, rather than total collapse. The damaged structures, if anything, will offer a more stable base for any repairs. This repairable feature makes a decision necessary between the relative costs of initial construction and maintenance in designing a rubble-mound breakwater.

At present, 62 percent of all Corps-maintained jetties, 80 percent of the groins and 76 percent of the breakwaters have been constructed using a variety of rubble-mound construction designs. It is interesting to note that out of a

TABLE 2

NUMBER OF JETTIES, GROINS AND SHORE-CONNECTED BREAKWATERS BY TYPE OF CONSTRUCTION MATERIAL

District or Division	JETTIES			GROINS			BREAKWATERS			Totals
	Constructed by Corps of Engineers		Other Structures ³	Constructed by Corps of Engineers		Other Structures ³	Constructed by Corps of Engineers		Other Structures ³	
	Corps ¹ Maintenance	Non-Fed ² Maintenance		Corps ¹ Maintenance	Non-Fed ² Maintenance		Corps ¹ Maintenance	Non-Fed ² Maintenance		
Rubble Mound	220	48	60	52	91	491	178	10	42	1192
<u>Sheet Pile</u>										
Timber	1	--	28	3	7	837	4	2	2	884
Steel	33	--	2	--	25	377	13	--	9	459
Concrete	2	--	--	2	1	45	2	16	1	69
<u>Crib</u>										
Timber	19	--	--	1	--	8	9	--	--	37
Steel-Concrete	14	--	2	1	--	--	8	--	6	31
Sand Asphalt	--	--	--	--	--	--	--	--	--	--
Other	39	--	--	3	5	6	40	--	2	95
TOTALS	328	48	92	62	29	1764	254	28	62	2767

1. Coastal or navigation structures maintained entirely by U.S. Army Corps of Engineers.

2. Jetties, groins and breakwaters constructed by U.S. Army Corps of Engineers, but maintained by non-Federal entities as a result of cost sharing or similar agreements.

3. All other jetties, groins and breakwaters reported in questionnaire.

total of 80 jetties maintained by the Detroit District, only six were built with rubble-mound. Costs and unavailability of suitable material may have precluded widespread usage of rubble-mound in the construction of jetties in the district.

In terms of numbers of coastal and navigation structures, lesser utilized construction design techniques and material include timber and steel concrete crib types, concrete dolosse and tetrapods. Wooden crib types are built of timber and some of the compartments are flooded. The structure is then capped with a timber superstructure which is usually replaced by concrete when the timber decays. Timber structures are not suitable for saltwater where marine borers can occur. However, in freshwater, timber crib structures give long and satisfactory service, and steel concrete cribs require little maintenance and are suitable for construction in depths up to 40 feet and in various types of sedimentary foundations. Steel concrete structures of the crib variety are vulnerable to storm damage during construction. In addition, erosion can seriously affect steel structures in water.

CHAPTER IV

LEGAL AND ADMINISTRATIVE AUTHORITY OF THE U.S. ARMY CORPS OF ENGINEERS OVER PUBLIC USE OF ITS JETTIES, GROINS AND BREAKWATERS

In order to provide a better understanding of Federal legislative mandates affecting the public use of Corps of Engineers jetties, groins and breakwaters, a review was undertaken of key statutes identified in Corps publications as the legal basis for Corps construction, operation and safe management of these structures. In addition, as part of this review, a short analysis of major engineering regulations and internal Corps directives was made to ascertain their applicability for Corps installation of safety features on coastal or navigation structures with heavy public use.

General Legal Background

The legal authority of the U.S. Army Corps of Engineers to construct and maintain jetties, groins and breakwaters derives historically from a series of river and harbor acts and the U.S. Constitution that grants this agency navigation power or Federal jurisdiction over the "navigable waters" of the United States. The commerce clause from which this navigation power is derived was not invoked in the early history of the United States on behalf of water resources management or use. However, Justice John Marshall in 1824 in Gibbons vs. Ogden declared that the commerce power of Congress (Article I, Section 8) "comprehends navigation within the limits of every state in the Union," so far as navigation may be in any manner connected with "commerce with foreign nations, or among the several states or with the Indian tribes." The Army Corps of Engineers became almost exclusively responsible for navigation and has retained that function ever since 1824 as the Federal government has devoted increasing attention to navigation improvements under rivers and harbors legislation.

Federal investigations and improvements of rivers, harbors and other waterways are under the jurisdiction of and are prosecuted by the Department of the Army under the direction of the Secretary of the Army and supervision of the Chief of Engineers (33 USC 540). In most cases, these investigations and construction of navigation (jetties and breakwaters) and coastal (groins) structures are generally carried out pursuant to a specific directive of Congress and approval of the Chief of Engineers. The common practice is for the House and Senate Public Works Committees to report an omnibus bill authorizing various surveys. Once a survey report reaches Congress, the next step is congressional authorization of the project. Favorable surveys usually recommend authorization of a certain improvement or modification as the Chief of Engineers may deem advisable. Although the above general provisions and most other Federal laws relating to works of improvements to navigation (jetties and breakwaters) apply equally to coastal or shore protection structures (groins), for purposes of analysis, Federal laws dealing with the shore protection structures will be treated separately in this study since certain important sections of these laws, particularly relating to operation and maintenance (O&M) of these structures, vary substantially from similar

mandates applicable to navigation structures. The following short discussion presents only those specific portions of Federal laws potentially related to policy options for public use of these structures.

Specific Federal Laws Relating to Navigation Structures (Jetties and Breakwaters)

As specified in 33 USC 540, the Federal government bears all costs for the construction of commercial navigation structures such as jetties and breakwaters due to the widespread benefits associated with these structures. Section 5 of the River and Harbor Appropriations Act of 1844, as amended, provides for the economical operation and maintenance of these structures at Federal expense. This same O&M authority can be used for essential repairs, rehabilitation, replacement or reconstruction of existing jetties and breakwaters that are required for continued use of the project for authorized purposes which do not change the project in scope, scale and location.

Under provisions contained in Section 107 of the River and Harbor and Flood Control Act of 1960, PL 86-545, the Corps of Engineers can allot up to \$25 million per year to construct jetties and breakwaters and related improvements for smaller navigation projects not specifically authorized by Congress. Each project for which money is allocated must be a complete project and the allotment must be adequate to complete the project. No more than \$2 million can be allocated for construction of a project at one locality under provisions of PS 94-587, as amended (33 USC 577).

The Federal government also assumes one-half of the cost for the construction of any jetty or breakwater associated with recreational navigation. Non-Federal interests bear the other half of construction costs as well as providing necessary policing and other services. However, the costs of operations and maintenance of the general navigation features of a small boat harbor are a Federal responsibility as established by Section 6 of PL 93-251 (Water Resources Development Act of 1974).

Federal Role in the Development of Shore Protection Measure (Groins)

Under existing beach erosion general laws (River and Harbor Act of July 1930, PL 520, 33 USC 426; River and Harbor and Flood Control Act of July 1960, PL 727, 33 USC 566; Act of July 28, 1950, PL 826, 33 USC 426e; River and Harbor Act of 1962, PL 87-874; Act of November 1, 1963, PL 88-172, 33 USC 4263), Congress has authorized Federal participation in the cost of restoring and protecting the shores of property on the Atlantic and Pacific Oceans, the Gulf of Mexico, the Great Lakes, and lakes, estuaries and bays directly connected to these water bodies through a variety of measures including the construction of groins. The intent of this legislation is to prevent or control shore erosion caused by wind and tidal-generated waves and currents along the nation's coasts and shores.

While Section 103 of the River and Harbor Act of 1962 authorized the Secretary of the Army to undertake construction of small beach and shore protection projects, an act of August 13, 1946, as amended (33 USC 426e-426h),

authorizes Federal technical and financial assistance by the Corps on the construction but not the maintenance of shore and beach erosion control and restoration projects specifically authorized by Congress. The Corps is further authorized to construct without specific authorization small shore and beach protection projects with total Federal share of costs not to exceed \$1 million including allowance for maintenance.

Provisions for some Corps maintenance over groins is contained in other Federal authorities, both in general laws and in specific authorization acts. Congress has authorized in various river and harbor acts the emplacement of some shore erosion protection structures, including groins, as part of an overall navigation facilities project, and, as a consequence, all maintenance and operation costs of the entire project are borne by the Federal government. An example of specific authority for Corps-sponsored maintenance on beach erosion structures can be found in PL 84-99 (33 USC 701m). This law permits emergency protection of federally authorized and constructed hurricane and shore protection works and the repair or restoration of federally authorized and constructed hurricane or shore protection structures damaged or destroyed by wind, wave or water actions of other than an ordinary nature.

Federal Water Project Recreation Act (PL 89-72)

PL 89-72 specifies that full consideration shall be given to outdoor recreation opportunities in the investigation and planning of any Federal navigation,* flood control, reclamation, hydroelectric or multiple-purpose water resource project. PL 89-72 further specifies that benefits of a project that can be attributed to outdoor recreation as well as the costs shall be taken into account in determining the economic benefits of the project. In 1965, PL 89-72 thus firmly established that outdoor recreation may be considered an authorized purpose at large Corps projects, subject to economic justification of such enhancement and two further notable requirements.

First, project allocations to recreation cannot exceed project allocations to navigation, flood control and other project purposes (i.e., obviously a requirement that Corps projects not be constructed primarily for outdoor recreation).

Second, the full potential of those Federal projects serving these purposes will be developed only upon an agreement by a non-Federal body that it will administer the area for either or both of these purposes, and that it will advance or repay a prescribed share of the costs of the project allocated to these purposes. Under the 1965 law, the non-Federal body was required to bear not less than one-half of the separable costs of the project allocated to recreation and all the costs of the operation, maintenance and replacement.

* Within the purview of this study, provisions of PL 89-72 may only apply to jetties and breakwaters since Federal navigation projects are covered by its provisions. Groins, being shore protection structures, may be exempt from these same provisions. However, it is possible that a groin located at a multiple-purpose water resource project may be covered by this act.

Any modifications (installation of a cap or additional structural support, for example) to a jetty or breakwater to accommodate recreational use must be cost shared on a 50-50 basis between the U.S. Army Corps of Engineers and a non-Federal cost-sharing partner.

However, in recognition that the recreational use of a project may occur even without recreation facilities, Section 3a of this act provides for construction of certain "minimum facilities" for public health and safety without cost-sharing provisions. The legislative history of the Federal Water Project Recreation Act specifies that these facilities would include guardrails, turnarounds at the ends of roads and minimum sanitary facilities. It would appear that minimum facilities for public health and safety could be provided at Federal costs at navigation structures in the absence of cost sharing for recreation.

Applicability of U.S. Army Engineer Regulations (ER) to Public Use of Corps Coastal and Navigation Structures

Current policy for cost sharing of nonreservoir fishing piers, walkways and guardrails to be included in preauthorization studies is contained in ER 1120-2-400, "Recreation Resources Planning," dated 1 November 1971, and ER 1120-2-404, "Federal Participation in Recreational Development," dated 14 August 1970. Policy for inclusion of similar facilities on authorized projects and as operation and maintenance measures is contained in ER 1130-2-400, "Project Operations: Recreation-Resource Management of Civil Works Water Resource Projects," dated 28 May 1971. While contributions and user fees are discussed in ER 1130-2-400, cost sharing of basic facilities is not mentioned.

Although Section 6e of PL 89-72 excluded most jetties, breakwaters and groins from cost-sharing provisions of this act since these were usually part of projects for small boat harbors, beach erosion or hurricane protection, comparable cost-sharing principles have been applied where possible.

From analysis of these engineering regulations, there is no indication that cost-sharing policy for adding recreation facilities to completed nonreservoir projects would be different from that stated above. In addition, if the recreation facilities to be provided in a completed project are for the sole purpose of reducing a current hazard to health and safety, local cost sharing may not be mandatory. However, if there is a potential recreation resource that would be enhanced by the development, local participation should be sought. If local interests refuse to participate, the facilities provided at Federal expense should be limited to those necessary to eliminate the current hazard.

Although other general Army (AR) and engineering regulations contain directives for providing a "safe" environment for the public and minimization of hazards, no such specific regulations or guidelines exist for evaluations of hazards on jetties, breakwaters or groins. In general, the safety of each structure is subjectively evaluated during required inspection and action deemed appropriate is taken. The diversity of corrective action is indicative of the individual hazards presented by each structure and the subjective

nature of the evaluations. Although inspections and corrective actions are the primary means to achieve the policy of minimum hazards rather than by specific engineering regulations, the following paragraphs will discuss two engineering regulations applicable in a generic way to overall Corps of Engineers responsibility for safety at these structures.

ER 385-1-85 (Safety Management Evaluation) establishes policy and programs for surveying, analyzing and evaluating Field Operating Activities' (FOA) management effort and effectiveness toward the Corps of Engineers' safety program. This regulation is directly applicable to safety measures over public use of Corps jetties and breakwaters in that it specifies that all Corps field commanders will provide a safe and healthful environment for not only government employees but for members of the public visiting Corps-administered facilities.

Provisions for the development and implementation of safety operating guidelines is contained in ER 385-1-88 (Operating Procedures). This regulation states that Corps safety programs will minimize the potential for personal injury, loss of life, occupational illness and property damage. Thus, all district safety programs must include guidelines for the safe operation and management of all its coastal and navigation structures.

Besides Army and engineering regulations, the Corps of Engineers is required to provide minimum safety features at applicable jetties and breakwaters by internal OCE guidance. According to the Safety and Occupational Health Office, OCE, the Chief of Engineers has sent letters to all Corps district engineers on an annual basis directing them to minimize all hazards to the public at Corps recreation facilities through whatever measures deemed necessary.

A brief review of Federal mandates and engineering regulations indicates that the U.S. Army Corps of Engineers has legal authority to fund, install and maintain any minimum safety feature to protect the public engaged in recreation activity at any Corps jetty, groin or breakwater. Authority for such unilateral Corps action is provided in Section 3(a) of PL 89-72 and in Federal safety (DOD) directives. However, the addition of any large-scale modification to an existing structure (cap, new engineering design) to accommodate public use requires a 50-50 cost-sharing agreement between the Corps of Engineers and a non-Federal partner.

Corps Districts' Views on Applicability of Federal Laws and Local Cooperative Agreements Relating to Improvements of Navigation and Coastal Structures for Public Use

Table 3 contains a list of applicable Federal laws and mandates and local cooperative agreements for improving and modifying coastal structures for public recreational use as well as various Corps district rationales for implementing these mandates and agreements. Actual response language concerning these modifications is presented in a more detailed format in Table 4. Analysis of Corps district responses indicates no clear consensus on the applicability of certain Federal laws or mandates whose implementation may result in the addition of a handrail, cap or other measure to provide safer

TABLE 3

APPLICATION OF FEDERAL LAWS AND MANDATES, LOCAL COOPERATIVE AGREEMENTS AND RATIONALE FOR IMPROVEMENTS TO
U.S. ARMY CORPS OF ENGINEERS JETTIES, GROINS AND BREAKWATERS BY CORPS DISTRICT (GENERALIZED FORMAT)

Corps District/ Division	Federal Laws and Mandates ¹					Local Cooperative Agreements ²			Reasons/Rationale For Improvements ³		No Improvements ¹¹	
	PL-89-72 ⁴	Gen. O&M Auth.	Cont. ⁵ Cong. Auth.	New Cong. Auth.	Unknown	None Applic- able	Formal Agree- ments ⁶	Informal Agree- ments ⁷	None Applic- able	Local Cost- sharing ⁹		Excessive Local Demand ¹⁰
1. New England						X		X				X
2. New York	X								X	X		
3. Philadelphia		X							X		X	
4. Baltimore					X				X			X
5. Norfolk				X			X				X	
6. Wilmington						X			X			X
7. Charleston					X		X					X
8. Savannah					X				X		X	
9. Jacksonville	X									X		
10. Mobile		X							X			X
11. New Orleans				X					X			X
12. Galveston						X			X			X
13. Los Angeles						X	X					X
14. San Francisco						X	X				X	
15. Portland						X	X		X			X
16. Seattle	X						X				X	
17. Alaska			X ¹²						X	X		
18. Pacific Ocean						X			X			X
19. Chicago	X								X		X	
20. Detroit		X						X ⁸			X	
21. Buffalo	X								X		X	
TOTALS	5	3	1	2	3	7	6	2	13	3	8	10

1. Federal legal bases/authorities for district improvements of structures for public use.
2. Number of Corps districts having formal or informal arrangements in relation to cost of construction and O&M associated with structure.
3. Principal justification for Corps additions or improvements to structure for recreational use.
4. Federal Water Project Recreation Act includes accounts/funding under Code 710 Passpack.
5. These resolutions provide Chief of Engineers with authority to spend funds for emergency repair of Corps facilities should need arise.
6. Includes cost-sharing provisions under PL 89-72 and written agreement as required by Section 221 of 1970 Flood Control Act.
7. Includes agreements between Corps and local officials for periodic policing of structure, trash removal, etc.
8. Past informal agreements are no longer in effect.
9. Corps districts will only fund improvements to structures if cost-sharing agreements are executed.
10. Corps may fund improvements if high risk factor is present due to heavy use by local citizenry.
11. Also included here is fact that improvement cannot be made due to location of structure as in some cases in New Orleans and Charleston Districts and that some Corps Divisions publicly discourage use of coastal and navigation structures (Pacific Ocean and North Pacific Divisions.)
12. Section 107 of River and Harbor Act of 1960.

TABLE 4

APPLICATION OF FEDERAL LAWS, LOCAL COOPERATIVE AGREEMENTS AND RATIONALES FOR IMPROVEMENTS TO U.S. ARMY CORPS OF ENGINEERS JETTIES, GROINS AND BREAKWATERS BY CORPS DISTRICT (DETAILED FORMAT)

Corps District/ Division	Federal Laws/Mandate ¹	Local Cooperative Agreements ²	Reason/Rationale for Improvements ³
1. New England	None applicable	Informally, local publics are responsible for policing activities in and around structures	None
2. New York	PL 89-22 (Federal Water Project Recreation Act)	None	If project authorizations were made for that purpose and if required local cooperation were available
3. Philadelphia	Authorizations for operation and maintenance	None	Excessive demand
4. Baltimore	Unknown	None	None
5. Norfolk	Initial project authorization retrofitting local responsibility	Generally, formal 221 agreements insuring public use of protected shoreline	Large demand for walkways and handrails
6. Wilmington	None applicable	None	None
7. Charleston	Unknown	Walkway at Murrells Inlet required 50 percent local sponsor cost sharing for construction and 100 percent for maintenance ⁴	Improvements are not appropriate for all jetties due to lack of highland access
8. Savannah	Unknown	None	Public demand or political pressure
9. Jacksonville	PL 89-72	Two structures have been constructed under PL 89-72 through a formal agreement	Public need is present but not being met, if even sufficient authority and some of Code 710 restriction
10. Mobile	O&M general authority	None	Walkways have been considered but none constructed by Corps.
11. New Orleans	Congressional authorization	None	None practical
12. Galveston	None applicable	None	None
13. Los Angeles	None exist	On two jetties and on one breakwater there were cooperative agreements	Crest elevations are such that improvements and not feasible
14. San Francisco	None applicable	Locals sponsor maintenance of public use facilities	If required by sponsor during design.
15. Portland	None applicable	None	None
16. Seattle	PL 89-72, Code 710 account	Washington State Park and Recreation Commission agreed to maintain 710 constructions including interpretive signs.	Local demands
17. Alaska	Congressional authorizations	No known outgrants - local agreements specifies definite task	Upon request from local government; however, such additions are usually made during initial construction
18. Pacific Ocean	None applicable	Informal agreement that no public use will be permitted on Corps projects	None. It is against our policy to encourage public use of structure
19. Chicago	Improvement of access authorities	None	Need, budget, public requests
20. Detroit	O&M general authority	Originally, several groups agreed to close fences and gates of structures during storms.	In extreme public use, surfaces are repaired and rails installed
21. Buffalo	Code 710 - Cost-sharing with non-Corps party	Agreement is no longer in effect	Improvements are made to structure if significant danger to public exists

Notes:

1. Federal legal bases/authorities for district improvement of structures of public use.
2. Number of Corps districts having formal or informal arrangements relating to costs of construction and O&M associated with structure.
3. Principal justification for Corps additives or improvements of structure for recreational use.
4. An agreement with the South Carolina Park, Recreation and Tourism Department and Georgetown County effectively transfers liability for accidents at the Murrells Inlet project to these entities.

access or use of Corps jetties or groins. One-third of all Corps districts stated that such modifications were not covered by present Federal mandates affecting Corps of Engineers activities. Uncertainty over the whole issue has been reported by three districts. However, another five districts (New York, Buffalo, Chicago, Seattle and Jacksonville) have interpreted provisions of PL 89-72 as allowing individual Corps districts to fund recreational modifications to a structure only if a non-Federal cost-sharing partner can be secured. Project modifications in two of these five districts (Seattle and Jacksonville) have resulted from the development of cost-sharing agreements as stated in PL 89-72. Other areas of Federal authority under which improvements for public use of structures can be made and cited by other Corps districts include: general operation and maintenance authorities and new project authorization as well as continuing authorities.

An example of one such continuing authority is Section 107 of PL 86-654 (River and Harbor and Flood Control Act of 1960) granting power to the Chief of Engineers to construct small navigation projects without enactment of new legislation for these projects.

To date, only six Corps districts have actually entered into formal cooperative agreements with state or local entities to increase recreational opportunities at jetties, groins and breakwaters. Such formal agreements could include applicable cost-sharing provisions of PL 89-72 and written agreements for payment of any local costs as stated in Section 221 of the 1970 River and Harbor and Flood control Act. The New England Division and Detroit District have developed informal agreements with local governmental units requiring them to perform minor management functions to these structures (policing areas periodically, etc.), but requiring no expenditure of local funds either for construction or maintenance. However, no such local agreements, either formal or informal, have been implemented in the majority of U.S. Army Corps of Engineers coastal and Great Lakes districts.

Among the justifications for improving jetties, etc., for public use cited by Corps personnel were sponsorship of certain required expenditures by non-Federal cost-sharing partners and the existence of hazardous conditions (excessively slippery surfaces, frequent overtopping) on structures heavily used by local fishermen and sightseers. The latter reason in response to public pressures may necessitate Corps funding of improvements to a locally popular jetty or breakwater. On the other hand, almost one-half (10) of all Corps respondents indicated a negative preference for Corps funding and involvement in modifications to coastal structures to accommodate public use. The Pacific Ocen and North Pacific Divisions, for example, presently discourage any public use of these structures due to the generally dangerous conditions of wave actions present at these areas.

CHAPTER V

PUBLIC USE OF U.S. ARMY CORPS OF ENGINEERS JETTIES, GROINS AND BREAKWATERS: OVERVIEWS, VISITATION STATISTICS, ACCIDENTS AND BENEFITS

Overview of Issue of Public Use of Jetties, Groins and Breakwaters by Non-Corps Officials

In order to solicit a wide variety of views on the issue of public use of coastal and navigation structures, several officials outside the U.S. Army Corps of Engineers were contacted by telephone. They represent such diverse groups as the U.S. Coast guard, state marine safety officers, national and private safety councils, university sea grant programs, and lifeguard units in a few major cities (Table 5).

Most of the individuals contacted reported that, although the issue has at best only been casually addressed, and that although few, if any, meaningful statistics have been collected on accidents/fatalities associated with recreational use of groins, breakwaters and jetties, there appear to be no major problems with public use of these structures. However, conversations with members of metropolitan lifeguard staffs indicated gross underestimation of the safety hazards accompanying the use of these structures by the recreating public. These safety hazards include presence of rip currents near structures and slippery surfaces and the possibility of frequent overtopping.

Marine safety officers in Michigan, California, Florida, New York and New Jersey indicated that their respective state coastal authorities gave "silent consent" to the recreational use of jetties and shore-connected breakwaters. Although these same officials recognized the existence of potentially hazardous conditions during storms, all but one were in agreement about the benefits provided by these structures. Individuals especially benefiting from recreational opportunities afforded by jetties, etc., include members of society (poor, senior citizens) who without some type of public access would not have any occasion to engage in marine-related recreation. In several coastal areas of the United States with large amounts of shoreline privately owned, these coastal and navigation structures sometimes provide the only form of public access to the water.

Although representatives of the U.S. Coast Guard, university sea grant programs and organizations concerned with water safety indicated interest in the issue of public use of groins, jetties and breakwaters, due to the limited scope of their program areas and issue concerns, these officials were unable to provide much detailed information on the subject. The Search and Rescue Office of the U.S. coast Guard maintains files only on boating accidents and would not normally include jetty-related accidents unless collisions involving watercraft occurred on or near this structure. Organizations relating to water safety contacted in this study generally reported that public use of coastal and navigation structures is not considered a program priority. Texas A&M University was the only sea grant center reporting any data on this issue.

During telephone interviews, members of two metropolitan lifeguard units stressed the apparent lack of public awareness of potential dangers associated with public use of jetties, etc. While conceding that a total ban on

TABLE 5

OVERVIEWS BY NON-CORPS PARTIES ON PUBLIC USE OF COASTAL AND NAVIGATION STRUCTURES FOR RECREATION

Agency/ Organization Contacted	Little/No Accident Dates Available	Few/No Major Problems With Use	Usage Permitted By State	Adequate ² Precautions By Users	Problem Not Adequately Addressed	Safety Hazards With Use Of Structures	Recommendations For Use
1. U.S. Coast Guard							
Search & Rescue Office ³	X				X	X	
Boating Ed. Div.	X				X	X	
2. States							
Michigan ⁵	X	X	X	X			
California ⁶	X	X			X		
Florida ⁷	X	X					
New York ⁸	X	X	X				
New Jersey ⁹	X	X	X		X		
3. Organizations							
National Safety Council ¹⁰	X				X	X	
Council on National Cooperation in Aquatic Sports ¹¹	X				X	X	
American Association of Port Authorities ¹²	X				X		
National Water Safety Congress ²⁰	X	X			X	X	
4. Sea Grant Research Centers							
Texas A&M ¹³	X		X		X	X	
University of Rhode Island ¹⁴	X				X		
Univ. of Southern California ¹⁵	X				X		
5. Metropolitan Lifeguard Units							
U.S. Lifeguard Association ¹⁶	X				X	X	x ²¹
City of Fort Lauderdale, Florida ¹⁷	X		X		X	X	x ¹⁸
City of Long Beach, California	X		X		X		

Notes and References

- Assumes most members of recreation public will vacate structure if unsafe conditions develop (storms, slippery surfaces, etc.)
- Includes suggestions for capping structures, installation of handrails, need for posting of signs, etc.
- Source: LT. J. Walton, Search and Rescue Operations Division, U.S. Coast Guard, Washington, D.C., telephone conversation, July 27, 1981.
- Source: John Bernhartsen, Office of Boating Education and Water Safety, U.S. Coast Guard, Washington, D.C., telephone conversation, July 28, 1981.
- Source: James Rubbens, Coastal Zone Management Program, Michigan Department of National Resources, telephone conversation, July 22, 1981.
- Source: William Satou, California Division of Boating and Waterways, telephone conversation, July 22, 1981.
- Source: Charles Futch, Assistant Director, Department of Marine Resources, State of Florida, telephone conversation, July 22, 1981.
- Source: Alex Gronball, Safety Officer, New York Division of Boating and Marine Safety, telephone conversation, July 27, 1981.
- Source: Sergeant J. Planer, Division of Marine Police, State of New Jersey, July 27, 1981.
- Source: Peggy Brock, National Safety Council, Chicago, Illinois, telephone conversation July 21, 1981.
John Fleming, National Safety Council Washington, D.C., telephone conversation, July 27, 1981.
- Source: Louis Priest, President, Council on National Cooperation in Aquatic Sports, Manassas, Virginia, telephone conversation July 17, 1981.
- Source: Rex Sherman, American Association of Port Authorities, telephone conversation, September 3, 1981.
- Source: James McCoy, Director of Center for Marine Safety, Coastal Zone Laboratory, Texas A&M University, Galveston, Texas, telephone conversation, July 27, 1981.
- Source: J. Farrell, Sea Grant Program, University of Rhode Island, Kingston, Rhode Island, telephone conversation, September 1, 1981.
- Source: Stewart Ross, Sea Grant Program, University of Southern California, Los Angeles, telephone conversation, September 10, 1981.
- Joseph DeVinney, Department of Sanitary Engineering, University of Southern California, September 10, 1981.
- A formal letter with specific concerns about public use of jetties and breakwaters is expected from U.S. Lifeguard Association.
- Source: Eugene Bergman, Head of Lifeguards, City of Fort Lauderdale, Florida, telephone conversation, July 28, 1981.
- Suggestions include installation of smooth (preferably concrete) caps, handrails, proper caution signs, gate structure where possible.
- Source: Richard Miller, Lifeguard, City of Long Beach, California, telephone conversation, July 28, 1981.
- Source: Carl Bishop, Executive Secretary, National Water Safety Congress, telephone conversation, October 8, 1981.

recreational use of these structures is unrealistic and that the total number of accidents associated with these same structures is probably no greater than any other form of marine recreation, they nevertheless urged implementation of measures to prevent loss of life and injury to the public. Adequate signs and warning posters should be installed and frequently inspected to assure their continued emplacement. In this respect, both local as well as Corps responsibility should be upgraded. One of the lifeguards was of the opinion that the addition of handrails would encourage rather than discourage public use of these facilities. Further discussion of the recreational use of these facilities is expected to be included on the agenda at a national meeting of the U.S. Lifeguards Association.

Extent of Public Use of Jetties, Groins and
Breakwaters for Recreational Purposes

Approximately 12 percent (547) of all coastal and navigation structures are presently used by the public for fishing and related recreational activities (Tables 6 and 7). Over one-half of all shore-connected breakwaters (both Corps and non-Corps-maintained) as well as 44 percent (211) of all jetties serve as sites for seasonal recreation opportunities. However, since nearly all (95 percent) of the estimated 3700 groins are privately maintained, few are utilized by the general recreating public.

Table 8 presents a percentage breakdown of recreational use at both Corps-maintained and non-Corps-maintained jetties, groins and breakwaters. While the Corps of Engineers maintains only seven percent of all jetties, groins and shore-connected breakwaters, on a percentage utilization basis, recreational use of these structures accounts for about 58 percent of all such recreation (318 172), respectively.

TABLE 6

RECREATIONAL USE OF COASTAL AND NAVIGATION
STRUCTURES BY TYPE OF STRUCTURE¹

Type of Structure	Total Number	Number utilized	Percent Utilized
1. Jetties	4802	211	44
2. Groins	3684	164	4
3. Shore-connected Breakwaters	328	172	52
Totals	4492	547	12

1. Includes both Corps and non-Corps structures.
2. Total number of structures is derived from Table 1.

TABLE 7

NUMBER OF UNIMPROVED AND IMPROVED* COASTAL AND NAVIGATION STRUCTURES UTILIZED
FOR PUBLIC RECREATION BY CORPS DISTRICT

District/Division	JETTIES				GROINS				BREAKWATERS				TOTALS
	Improved		Unimproved		Improved		Unimproved		Improved		Unimproved		
	Corps Maint	Non-Fed Maint											
1. New England	20	--	--	--	--	--	--	--	30	--	--	--	50
2. New York	--	--	--	--	--	1	--	--	--	1	--	--	2
3. Philadelphia	--	--	8	--	--	--	--	--	24	--	--	--	32
4. Baltimore	1	--	--	--	--	--	--	--	--	--	--	--	1
5. Norfolk	--	--	--	--	--	--	--	--	--	2	--	3	5
6. Wilmington	--	--	--	--	--	--	--	--	--	--	--	--	0
7. Charleston	1	--	4	--	--	--	--	--	25	--	--	--	30
8. Savannah	--	--	--	4	--	--	--	--	1	--	--	--	5
9. Jacksonville	1	3	--	--	--	--	--	--	--	--	--	--	4
10. Mobile	--	--	3	--	--	--	--	--	1	--	--	--	4
11. New Orleans	--	--	--	--	--	--	--	--	--	--	--	--	0
12. Galveston	--	--	9	2	--	4	11	--	1	2	2	6	37
13. Los Angeles	2	--	10	--	--	--	23	--	1	--	7	--	43
14. San Francisco	1	1	--	--	--	--	--	--	1	2	--	--	5
15. Portland	11	--	11	--	1	--	--	--	3	--	--	--	26
16. Seattle	4	4	2	--	--	--	6	--	1	--	4	1	22
17. Alaska	--	--	4	--	--	--	1	--	9	--	10	--	24
18. Pacific Ocean	--	--	--	7	--	--	1	40	--	--	1	10	59
19. Chicago	--	--	--	--	--	--	--	--	--	--	7	--	7
20. Detroit	71	--	--	8	--	--	--	--	--	32	--	28	139
21. Buffalo	10	--	9	--	9	--	--	16	5	--	2	--	51
TOTALS	122	8	60	21	10	5	42	107	51	39	33	49	546

Notes: *Modified for safer public access (handrails, ladders, etc.)

Source: Questionnaire response data from Corps district offices.

TABLE 8

RECREATIONAL USE OF CORPS OF ENGINEERS AND
NON-CORPS OF ENGINEERS COASTAL AND NAVIGATION STRUCTURES

Type of Structure	Total Number	Number Utilized (Corps- Maintained)	Percentage of Total (Utilized)	Number Utilized (Non-Corps Maintained)	Percentage of Total (Utilized)
1. Jetties	480	182	38%	29	6%
2. Groins	3684	52	1%	112	3%
3. Shore-connected Breakwaters	328	84	26%	88	27%
Totals	4492	318	7%	229	5%

Source: U.S. Army Engineer Institute for Water Resources, questionnaire to Corps districts, April 1981.

A total of 184 of these 547 structures have been improved by the Corps of Engineers (addition of handrails, etc.) to provide safer or easier access. By comparing the total number of structures improved by the Corps or non-Corps agencies (Table 9) with the number of modified structures currently utilized by the public for recreation (Table 8), public preference for use of Corps modified structures is evident. Corps districts report some public usage at 182 of the 184 Corps structures (99 percent) that have been improved. According to these same Corps officials, only about 21 percent of all non-Corps improved jetties, etc., are used for recreational purposes.

The Alaska, Buffalo and Detroit Districts along with the Pacific Ocean Division account for over 90 percent of all structures improved for public use. The Detroit District alone contains 66 percent of all these structures. Many of the non-Corps groins, jetties and breakwaters presently utilized for a variety of recreation activities are situated in the Pacific Ocean Division and in the Charleston and Philadelphia Districts.

Although no statistics were available on actual number of users (fishermen, etc.) on a structure-by-structure basis, Corps personnel, on the whole, reported that there appeared to be no one single structure in their respective districts more heavily utilized by the public than others. These districts, however, were able to ascertain that fishing from jetties and groins as well as walking/sightseeing were the most popular recreation activities occurring on these structures (Table 10). Fishing and walking accounted for about 70 percent of all activities associated with both improved and unimproved jetties, breakwaters, etc.

TABLE 9

STRUCTURE MODIFICATIONS OR IMPROVEMENTS TO PROVIDE SAFER OR EASIER PUBLIC ACCESS TO
JETTIES, GROINS AND BREAKWATERS BY U.S. ARMY CORPS OF ENGINEERS¹ AND NON-CORPS PARTIES²

Structure Modification/Improvement	Corps Sponsored		Non-Corps Sponsored	
	Number	Percent	Number	Percent
1. Construction of access roads	18	10	40	16
2. Maintenance of access roads	5	3	38	16
3. Construction of turnaround at road end	2	1	10	4
4. Maintenance of turnaround	0	0	10	4
5. Construction of parking area	7	4	45	19
6. Maintenance of parking area	4	2	46	19
7. Installation of guardrails	5	3	2	1
8. Construction of safe walkways to structure	24	13	14	6
9. Construction of safe walkway on structure	35	19	8	3
10. Installation of handrails or safe ladder on or near the structure	48	26	2	1
11. Provision of sanitary facilities	4	2	10	4
12. Provision of camping, picnicking or swimming areas on or near structure	4	2	5	2
13. Installation of concrete cap on structure	19	10	2	3
14. Provision of special facilities or parking for the handicapped	7	4	0	0
15. Construction of fishing piers	2	1	3	1
16. Other	<u>0</u>	<u>0</u>	<u>2</u>	<u>1</u>
TOTAL	184	100	243	100

¹On a total of 225 structures: 170 jetties, 10 groins and 45 shore-connected breakwaters.

²On a total of 94 structures: 46 jetties, 7 groins and 41 shore-connected breakwaters.

TABLE 10

NUMBER OF COASTAL AND NAVIGATION STRUCTURES ¹
USED BY TYPE OF RECREATIONAL ACTIVITY

Type of Activity	Number of Structures		Percent of All Activities
	Improved	Unimproved	
1. Walking on structure	215	169	33
2. Fishing	270	152	37
3. Swimming/diving near/from structure	186	14	17
4. Recreational boat anchoring	141	6	13
5. Other	—	—	—
TOTALS	812	341	1000

¹ Includes all Corps and non-Corps jetties, groins and breakwaters.

Visitation Statistics/Intensity of Public Use at
Corps and Non-Corps-Maintained Jetties, Groins and Breakwaters

At present, very little factual data is available concerning intensity of use of jetties, groins and breakwaters located in the coastal and Great Lakes areas of the United States. Only six Corps districts and one division (Baltimore, Buffalo, Seattle, Jacksonville, Mobile, Los Angeles and Pacific Ocean Division) out of a total of 21 districts responding to the questionnaire submitted any estimates of public visitation to these structures. Of the estimate of visitor days supplied by these districts, all but one were based on professional judgments rather than on official statistics. To date, only one study actually reporting usable visitation statistics at a navigation structure is available. A study prepared by scientists at the University of Southern California reported use intensity of .7 to 21.1 persons/100 meters of structure on jetties and breakwaters in the vicinity of Paolos Verdes, California (Ghazanshaishi, et al.). Since this usage coefficient was derived using data observed in one of the less popular recreation seasons of the year (November) and only using a "grab sample," its applicability to other coastal structures may be of dubious value. The most popular recreation season reported was summer, accounting for 58 percent of all activities on these structures, followed by fall (22 percent) and spring (20 percent).

Accidents and Injuries Resulting from Public Use
of Coastal and Navigation Structures

From our analysis of response data supplied to IWR by Corps districts on accidents and injuries resulting from use of jetties, etc., few, if any, generalized statements can be made concerning this issue. Few Corps districts actually maintain files on personal injuries at these structures. Local or state marine safety officials generally provide such information to appropriate Corps personnel. The following short discussion summarizes the limited (and perhaps somewhat ambiguous) data on the subject submitted by various Corps districts.

Over 80 percent of all Corps districts reported no information on number of injuries or accidents at jetties, groins or breakwaters in their districts. The largest number of accidents (4) occurred in the Detroit District, while files in the New Orleans and Seattle Districts and the Pacific Ocean Division offices indicate only one accident for each of these districts. Types of accidents included cuts (5), broken bones (2), drowning (3), and other (2). The majority of Corps respondents concluded that generally no single structure or type of structures have a higher incidence of accidents. In addition, combinations of factors rather than one single factor are usually responsible for injuries to the recreating public using local jetties and breakwaters. Severe weather conditions, in combination with certain types of structures and particular types of materials used in its construction, represent the most hazardous condition (slippery surfaces) for individuals engaged in recreation in these areas. The actions of waves on coastal structures can contribute significantly to the development of conditions potentially hazardous for members of the recreating public. Waves along with weather conditions are responsible for not only slippery surfaces but also for periodic drownings during storm surges or during other times of overtopping waters. Few

generalized statements can be made about wave conditions and overtopping from an analysis of data from Corps district offices. Only partial or incomplete responses were received from these offices on questions relating to overtopping of structure by waves, etc. Detailed information of these questions could be secured only through a very thorough analysis of project files on each groin and jetty to determine actual recorded data on existing wave conditions prior to engineering design of the structure. Such a task was clearly not possible given time and financial constraints of most coastal and navigation units of Corps district offices.

Overtopping at most Corps structures occurs during times of high storm surges. Given average conditions, most Corps jetties, groins and breakwaters are generally subject only to these storm surges and, consequently, overtopped about 10 percent of the time. From the point of view of engineering, although about one-half of all Corps structures have been designed to be overtopped, such design may not include public safety features for recreation use during storm surges. Personal opinions and general observations of corps officials familiar with public use, rather than statistically supported data, were the basis for most of this accident-related information.

The only official record of accident statistics relevant to this topic and maintained by the Office of Safety and Occupational health, U.S. Army Corps of Engineers, is contained in Code 0706 (accidents occurring from individuals fishing from rocks, piers, banks, etc.). A total of 37 such accidents has occurred since 1977: 1977, 0; 1978, 12; 1979, 7; and 1980, 18. This account code provides no breakdown of those accidents that took place on jetties, groins and breakwaters.

In an analysis of 305 tort claims resulting from accidents at Corps projects during 1979-1980 prepared by the Office of Safety and Occupational Health, OCE, the absence of proper signs warning the public of dangerous conditions was the most frequently cited reason for these accidents. Claims, involving 39 fatalities of which 70 percent were drownings and each in excess of \$9 million, all alleged that: (a) there were no warnings of water condition changes creating hazardous situations for recreationists, or (b) there were no clear warning signs posted, or both a and b. On a percentage basis, at the time of accident, 18 percent and 49 percent, respectively, of all negligence suits against the Corps for these fatalities alleged: (1) failure to post sign and (2) failure to warn. Similar reasons for negligence were cited for bodily injury.

Corps safety officers interviewed during the course of this study voiced concern over Corps liability for both type if its warning signs as well as their periodic maintenance and replacement. Although there are at present no clear cut guidelines as to what elements comprise an "adequate" or "effective" warning sign, many safety officials are of the opinion that these signs should be: (1) short -- a few words, indicating type of risk/hazard; (2) painted in a bright and easily legible script; and (3) most importantly, periodically inspected and replaced when necessary. In the interest of small boat navigation and safety, any groin, breakwater, etc., which may become inundated during high flood tides should also have signs or markers indicating the extent of the submerged structure. The sheer absence of a warning sign rather

than any particular wording may indicate greater negligence and, consequently, liability on the part of the Federal, state or local agency responsible for the structures.

A study conducted a few years ago in the British Isles on the effectiveness of warning signs to prevent accidents suggests that signs be: (1) frequently changed -- at least every five years, (2) visually meaningful -- capable of attracting immediate attention, (3) short in form so that messages and warnings can be read as a person is passing by. As a rule, people will not heed a warning if they are required to stop and read it.

Government Liability Associated with Public Use of Corps Coastal and Navigation Structures

The liability of the U.S. Army Corps of Engineers for accidents resulting from public use of its jetties, groins or breakwaters can only be decided on an individual basis, given the wide variation in state laws determining liability, the potentially enormous number of case-specific situations, as well as the possibility of numerous interpretations of statutes by different judges and juries. The following short discussion will, therefore, only highlight some important legal considerations associated with this issue.

The Federal Tort Claims Act, 28 USC 1346(B), 2674, is the principal Federal law permitting an individual involved in an accident at a Corps-maintained coastal or navigation structure to bring suit against the U.S. government. Under provisions of this act, the United States is liable for claims for money damages for injury or loss of property, personal injury or death to the same extent and in the same manner as a private individual under like circumstances in accordance with the law of the place where the negligent or wrongful act or omission occurred. The above sections are effective unless the act in question falls within the enumerated exception of the Federal tort Claims Act, 28 USC S2680. The maintenance of a Federal structure such as a jetty, groin and breakwater does not come within an enumerated exception. Therefore, state laws in which the structure is located controls as to the liability of the United States for the death or injury of a trespasser on these structures.

If recreation is included as a project purpose for a jetty, groin or breakwater, the U.S. government has a legal responsibility to maintain and operate this structure in a safe manner and may be even required to install handrails and warning signs if local wave conditions are considered hazardous to recreation users. Although failure to install such modifications may increase liability of the U.S. government, some states have enacted laws that may reduce or negate these liability claims. For example, the state of New Jersey has enacted a Landowner's Liability Act that grants to an owner or occupant of certain premises immunity from liability to trespassers or licensees using the premises for recreational activities (fishing, swimming, etc.).

When Corps of Engineers district offices permit public use of Corps-maintained coastal and navigation structures, this district has a duty to provide reasonably adequate warning should potential hazardous water

conditions exist in the vicinity of these facilities. In determining whether reasonable care has been used, the burden of giving a warning sufficient to prevent injury is weighed against the gravity of the harm and the likelihood that it will occur absent warning. Serious bodily harm or death might result if a fisherman slips or falls, although the chance that this will occur is considerably less for an adult than a child. On the other hand, the government faces a heavy burden if it is to give a warning adequate to prevent harm. It is economically and probably physically infeasible to keep out a determined fisherman. A sign will be ignored, a fence will be climbed or cut through and a 24-hour a day guard is expensive, to say the least. It must be emphasized that the standard of care is not an absolute duty to warn but one of reasonable care. Balancing the risk of harm to an adult against the burden of giving adequate warning, it seems that posting a guard is unreasonable and that the emplacement of a fence may be difficult to maintain. Although warning signs may not be as strong a physical deterrent to entry into jetties, etc., as guards and fences, they nevertheless provide the Corps of Engineers with some mechanism of informing fishermen and other members of the public of their potential involvement in accidents by recreating on these structures.

Discouraging Public Use of Jetties, Groins and Shore-Connected Breakwaters

At over 35 percent of its estimated 667 coastal and navigation structures (Corps-maintained), the U.S. Army Corps of Engineers has taken measures (signs and barricades) to discourage recreational use of the facilities. Less than one percent of all non-Corps-maintained jetties, etc., have any signs or barricades erected by local governments or other non-Corps parties.* In addition, these same non-Corps parties have installed few (14) signs on Corps-maintained structures to dissuade local publics from using these facilities.

Table 11 contains a list of measurements or actions taken by the Corps and other public bodies aimed at curtailing public use of coastal structures. Almost all districts reported some use of barricades. The Jacksonville District has installed 75 percent of all no trespassing signs erected by the Corps to curtail use of groins, etc. Non-Corps parties in the Buffalo area have also erected a total of nine such barricades - all on Corps-maintained jetties and breakwaters. Most of the signs forbidding swimming and diving were reported located near a series of groins in the Galveston area, well-known for its dangerous rip currents and swimming conditions. Of the 193 other measures (almost all signs indicating caution or hazardous risk), the Detroit District was responsible for the erection of at least 53 percent of such signs. The Portland and Seattle Districts and the Pacific Ocean Division have also installed several (about 13 each) of these signs on Corps-maintained structures.

Response data was insufficient to determine overall effectiveness of these measures to discourage recreational activities from jetties, groins and breakwaters.

* This figure may be deceptively low in that it also includes a few thousand residential shorefront groins that are used only by property owners for recreational purposes.

TABLE 11

TYPE AND NUMBER OF MEASURES USED TO DISCOURAGE
PUBLIC USE OF JETTIES, GROINS AND SHORE-CONNECTED BREAKWATERS
BY U.S. ARMY CORPS OF ENGINEERS AND BY NON-CORPS PARTIES
(STATE OR LOCAL GOVERNMENTS)

Type of Measure	Number of Measures	
	Corps of Engineers	Non-Corps
1. Barricades	46	9
2. <u>Signs</u>		
a. No Trespassing	60	6
b. No Fishing	--	2
c. No Swimming/Diving	1	17
d. No Picnicking/Camping	--	--
e. Fishing at Own Risk	8	--
f. No Entrance After Dark	8	5
g. Access or Use by Corps Permit Only	2	--
h. Other	<u>193</u> ¹	<u>1</u>
TOTAL	3182	39

1 Most of these "Other" measures refer to signs denoting caution or hazardous area or use structure at own risk.

2 At 237 Corps-maintained groins, jetties and breakwaters.

Benefits/Problems and Examples of Public Use of
Jetties, Groins and Breakwaters

Public use of groins, jetties and breakwaters in nearly all Corps coastal and Great Lakes districts present no reported major problems for Corps resource personnel. Only the Jacksonville District reported any substantial conflicts from use of coastal and navigation structures by recreationists. Corps officials attributed the absence of major problems to a variety of factors. First of all, in many districts, structures heavily used by the public have been turned over to local government for general maintenance and operation under previous cost-sharing agreements. As a result, the Corps of

Engineers' liability for these structures may be limited. Secondly, extensive use of signs indicating potentially hazardous conditions, and fencing and other barriers limiting access to Corps structures, has reduced, to a certain extent, Corps liability for accidents occurring on these structures and has successfully discouraged public use. Finally, the remoteness of some structures from major population centers, as in the New Orleans District, has reduced their potential for fishing and recreation.

Although few major problems were cited by Corps officials (Table 12), some minor problems have been encountered at the district level due to public use of these facilities. Adverse weather conditions have created some potentially dangerous situations for the recreating public using local jetties and breakwaters. Some complaints have been received in district offices by property owners whose lands adjacent to these structures are often traversed by members of the public trying to gain access to them. Complaints have also been filed in these same district offices over periodic conflicts between fishermen and divers using the same structures.

In addition to the general absence of major difficulties, public use of jetties, etc., may be considered a positive benefit to the taxpayer. According to a majority of Corps district questionnaire respondents, recreational opportunities afforded by these structures can enhance the public image of the U.S. Army Corps of Engineers if the local population is aware of Corps involvement in the construction and yearly maintenance of the structures.

Examples of various Corps jetties, groins and breakwaters presently utilized for fishing and other recreational activities are presented in Table 12. According to data submitted to Corps districts, jetties are the most popular single type of structure (vs. groins and breakwaters) for public use. Fishermen make up the largest group of recreational enthusiasts using these structures. Few districts reported any other overall problems with public use of these structures other than such items as cracks in some caps and periodic vandalism.

TABLE 12

EXAMPLES OF PUBLIC USE OF U.S. ARMY CORPS OF ENGINEERS COASTAL AND NAVIGATION
STRUCTURES BY CORPS DISTRICT

Corps District/ Division	Name/Location of Structure	Type of Use	Benefits, Problems, Comments
1. New England			No specific information available
2. New York			No specific information available
3. Philadelphia	Manasquan Inlet and Indian River Inlet Jetties**		
4. Baltimore	North Jetty, Ocean City, MD	Fishing, walking activities	
5. Norfolk	Shoreline, Hampton Institute, Norfolk, VA	Fishing/sightseeing	Structure has concrete facing
6. Wilmington	No such structure		
7. Charleston	South Jetty, Murrells Inlet, SC	Fishing and walking	
8. Savannah	Groin, North End of Tybee Island Beach, GA	Fishing	Good public access to structure
9. Jacksonville	Pier at Miami Beach and Fernandina Beach, FL	Fishing Fishing	Problem of vandalism; Facility is new and all operational problems have not surfaced yet.
10. Mobile	West Jetty, Panama City, FL	Fishing	No problems up to date
11. New Orleans			Remoteness of structures prevents any recreational use.
12. Galveston	Groin field (11) Galveston, TX	Fishing/sightseeing	These unimproved structures were constructed with rubble mound; swift currents--make swimming and surfing near them hazardous.
13. Los Angeles	Jetty at Ventura Harbor, CA, East Breakwater, Dana Point Harbor, CA	Fishing	
14. San Francisco	West Jetty, Santa Cruz Harbor, CA	Fishing/walking.	Problems associated with wave over- topping and slippery surface.
15. Portland	South jetty, Columbia River, Oregon	Fishing	No particular problems
16. Seattle	Breakwater adjacent to under- water park, Seattle, WA	Fishing	Fear by divers of ecological damage due to beach nourishment.
17. Alaska	Douglas, Haines, Homer, Kodiak Old Matakalta, Pelican, Alastia	Docking and mooring of boats, fishing	There are some access roads on portions of breakwaters and other structures.
18. Pacific Ocean	None		
19. Chicago	Southwest Pier, Waukegan Harbor IL	Fishing	
20. Detroit	Most all Great Lakes jetties, groins and breakwaters	Fishing	Use of Corps structures provides positive image of this organization.
21. Buffalo	Breakwater, Barcelona Harbor, NY		Filled structure with cracked cap, poor access.

*Based on questionnaire response data submitted to U.S. Army Engineer Institute for Water Resources.

**Also, Absecon Inlet North and South Jetties and Cold Spring Inlet North and South Jetties.

CHAPTER VI

DESIGN MODIFICATIONS AND IMPROVEMENTS FOR SAFE PUBLIC USE OF COASTAL AND NAVIGATION STRUCTURES

This chapter presents a brief survey of the types of modifications or improvements (handrails, better access, etc.) to coastal and navigation structures sponsored by the U.S. Army Corps of Engineers and by other non-Federal parties. Included here also is a discussion of the number of such structures originally designed for public use as well as those deemed unsafe due to design characteristics. In addition, some consideration is given to the number of structures capable of being retrofitted to accommodate safe public use and costs related to these retrofitting activities.

Corps of Engineers and Non-Corps-Sponsored Improvements to Coastal and Navigation Structures

Thirty percent of all Corps-maintained structures have been modified for greater access and public use. Four Corps districts together (Alaska, Buffalo, Chicago and Detroit) have financed the greatest percentage (65) of the improvements, with the Detroit District alone accounting for almost 45 percent of all such Corps-sponsored improvements nationwide.

According to an analyses of questionnaire response data (Table 9) installation of handrails or safe ladders was the most frequently cited (26 percent) improvement sponsored by the U.S. Army Corps of Engineers, followed by construction of safe walkways on structure (19 percent). Other important structural additions to jetties, groins and breakwaters funded by Corps districts included construction of safe walkways to these structures, as well as access roads and installation of concrete caps. Only four percent of all Corps-sponsored feature modifications were designed to accommodate the recreational opportunities for the handicapped.

Of a total of 94 structures improved by one or more modifications by non-Corps parties, 83 percent of these structures are presently maintained by the Corps of Engineers. This study did not attempt to ascertain the extent of cost sharing for modifications at these facilities.

Non-Corps-sponsored improvements to jetties, groins and shore-connected breakwaters differ somewhat from Corps-financed modifications in that the former, for the most part, are not directly associated with safety features on or to these structures. While 68 percent of all Corps improvements were specifically aimed at public safety measures for public fishing or recreating from these structures (safe walkways, handrails, concrete caps, etc.), 70 percent of all non-Corps modifications consisted of measures largely concerned with vehicular access to these structures (construction and maintenance of access roads and parking areas). Non-Corps parties may prefer to fund roadways and access areas to these jetties, etc., since overall costs associated with these types of feature modifications may be lower (access areas may have been previously purchased as parkland and require only seasonal maintenance).

Structures Originally Designed for Public Use

Excluding an estimated 2500 private smaller groins, less than four percent of the other 1000 coastal and navigation structures nationwide have actually been designed to accommodate public use (Table 13). In the opinion of district respondents, approximately 30 percent of all these structures are presently unsafe or unsuitable for use by the recreating public due to design characteristics of these structures (voids in structure, slippery surfaces, etc.). However, 296 (presently unimproved) jetties, groins and shore-connected breakwaters could be utilized for some recreational activities if certain features were added (handrails, concrete caps, etc.) (Table 14).

With regard to Corps-maintained structures, only three percent of the jetties and six percent of its breakwaters were constructed with original design features permitting safe public usage. The Buffalo District with six jetties and the Alaska District with nine breakwaters maintain the largest number of such coastal structures. The only two regions in the country with any sizeable number of structures with safety features developed and maintained by non-Corps parties are in northwest Florida (five jetties) and in the Galveston area (four groins).

The largest number of structures considered unsafe or unsuitable for public use due to design characteristics are located in the Hawaiian Islands (Pacific Ocean Divisions, Table 15). Both the Great Lakes regions (Buffalo, Chicago and Detroit areas) as well as the Pacific Northwest (Alaska, Seattle and Portland) also contain large numbers (82 and 92, respectively) of these coastal structures deemed unsuitable for fishing and associated activities. On the other hand, the New England Division and Corps districts in the North Atlantic region reported that only two jetties and three breakwaters in these areas should not be used by the public for recreation due to inadequate engineering design for this purpose.

There are at present over 230 Corps structures, many of which require upgrading and/or installation of safety features if these same structures are to be used by recreational enthusiasts. According to data provided by Corps district personnel, the Corps districts with the greatest numbers of such substandard structures (from point of view of public use) include Los Angeles and Detroit, both with 45, Pacific Ocean Division (33), Portland (24) and Alaska (17).

Non-Corps parties (local and state governments) also maintain a large group of structures unsafe or unsuitable for public safety (16 jetties, 83 groins and 40 breakwaters) with potential liability problems for local or state governments. Most of these structures are located in the Buffalo, New York, area, and on the Hawaiian Islands.

No information has been collected on the popularity of any Corps or non-Corps-maintained structure potentially representing a hazardous condition for public users. Neither has any extensive data been compiled on the reason why certain districts have determined a number of structures unsafe. Some of these reasons cited in district responses to the questionnaire included: (1) large voids in structures (mostly of rubble-mound type), (2) slippery

TABLE 13

SOME DESIGN CHARACTERISTICS OF COASTAL AND NAVIGATION STRUCTURES

Structure Characteristics	Structure Maintained by U.S. Army Corps of Engineers			Structures Built by Corps but Maintained by Other Parties			Other Coastal and Navigation Structures		
	Jetties	Groins	Shore-Connected	Jetties	Groins	Shore-Connected	Jetties	Groins	Shore-Connected
			Breakwaters			Breakwaters			Breakwaters
1. Specific design to accommodate public use	12	0	15	1	0	5	5	5	0
2. Structure unsafe or unsuitable for public use due to design characteristics	92	44	96	1	32	7	15	51	33
3. Possibility of public use of unimproved structures with installation of suitable and safe design characteristics	137	16	80	2	39	2	2	4	10
4. Total number of coastal and navigation structures	354	65	248	5	127	14	121	3,492	66

1. Includes state, local governments and some quasi-public groups.

2. Number may be considerably higher due to the fact that some Corps districts made no estimates of all smaller groins (< 20 feet).

Source: Response questionnaire data prepared by Institute for Water Resources, U.S. Army Corps of Engineers.

TABLE 14

NUMBER OF UNIMPROVED STRUCTURES CAPABLE OF SOME PUBLIC USE WITH
IMPLEMENTATION OF SAFETY OR ENGINEERING FEATURES (BY CORPS DISTRICT)

District/Division	JETTIES			GROINS			BREAKWATERS			District Totals
	Constructed by Corps of Engineers		Other Structures	Constructed by Corps of Engineers		Other Structures	Constructed by Corps of Engineers		Other Structures	
	Corps Maintenance	Non-Fed Maintenance		Corps Maintenance	Non-Fed Maintenance		Corps Maintenance	Non-Fed Maintenance		
1. New England	1	--	--	--	--	--	1	--	--	2
2. New York	--	--	--	--	--	--	--	--	--	0
3. Philadelphia	12	2	--	--	29	--	--	--	--	43
4. Baltimore	21	--	--	--	--	--	--	--	1	22
5. Norfolk	--	--	--	--	--	--	--	2	--	2
6. Wilmington	--	--	--	--	--	--	--	--	--	0
7. Charleston	1	--	--	--	--	--	--	--	--	1
8. Savannah	--	--	--	--	--	--	--	--	--	0
9. Jacksonville	1	--	--	--	--	--	--	--	--	0
10. Mobile	--	--	--	--	--	--	--	--	--	0
11. New Orleans	--	--	--	--	--	--	--	--	--	0
12. Galveston	14	--	2	11	--	4	6	2	8	47
13. Los Angeles	2	--	--	--	--	--	1	--	--	3
14. San Francisco	2	--	--	--	--	--	2	--	--	4
15. Portland	--	--	--	5	--	--	3	--	1	9
16. Seattle	--	--	--	--	--	--	--	--	--	0
17. Alaska	2	--	--	--	--	--	12	--	--	14
18. Pacific Ocean	--	--	--	--	--	--	--	--	--	0
19. Chicago	--	--	--	--	8	--	9	--	--	17
20. Detroit	58	--	--	--	--	--	37	--	--	95
21. Buffalo	23	--	--	--	2	--	11	--	--	36
TOTALS	137	2	2	16	39	4	80	4	10	296

Source: Institute for Water Resources Questionnaire, 1981

TABLE 15

NUMBER OF JETTIES, GROINS AND SHORE-CONNECTED BREAKWATERS CONSIDERED UNSAFE OR UNSUITABLE
FOR PUBLIC USE DUE TO DESIGN CHARACTERISTICS (BY CORPS DISTRICT)

District/Division	JETTIES			GROINS			BREAKWATERS			District Totals
	Constructed by Corps of Engineers		Other Structures	Constructed by Corps of Engineers		Other Structures	Constructed by Corps of Engineers		Other Structures	
	Corps Mainte- nance	Non-Fed Mainte- nance		Corps Mainte- nance	Non-Fed Mainte- nance		Corps Mainte- nance	Non-Fed Mainte- nance		
1. New England	--	--	--	--	--	--	--	--	--	0
2. New York	--	--	--	--	--	--	--	--	--	0
3. Philadelphia	--	--	--	--	9	--	--	--	--	9
4. Baltimore	2	--	--	--	--	--	--	--	--	2
5. Norfolk	--	--	--	--	--	--	--	3	--	3
6. Wilmington	--	--	--	--	--	--	--	--	--	0
7. Charleston	5	--	--	--	--	--	--	--	--	5
8. Savannah	--	--	4	--	--	--	--	--	--	0
9. Jacksonville	6	--	--	--	--	--	--	--	--	6
10. Mobile	--	--	--	--	--	--	--	--	--	0
11. New Orleans	15	--	--	--	--	--	--	--	--	15
12. Galveston	--	--	--	--	--	1	--	--	4	5
13. Los Angeles	15	--	--	23	--	--	--	--	--	45
14. San Francisco	3	--	--	--	1	1	3	1	2	11
15. Portland	22	--	--	2	--	--	--	--	--	22
16. Seattle	9	--	--	8	--	--	1	12	3	34
17. Alaska	10	--	--	8	--	--	17	--	--	35
18. Pacific Ocean	--	1	11	7	--	48	26	--	24	117
19. Chicago	--	--	--	--	--	--	2	--	--	2
20. Detroit	22	--	--	--	--	--	23	--	--	45
21. Buffalo	5	--	--	--	23	--	4	--	--	32
TOTALS	92	1	15	44	32	51	96	7	33	394

Source: Institute for Water Resources Questionnaire, 1981

surfaces, (3) rip currents near structure, (4) no access, (5) submersion of structure during high tide, and (6) crest width too narrow for pedestrian use.

Upgrading and Improving Design Characteristics of Jetties, Groins and Breakwaters for Public Use

Corps officials in 11 districts cited 141 jetties, 59 groins and 94 breakwaters capable of public use if some additional safe or engineering features are implemented at these structures (Table 14). While some districts reported a number of presently Corps-maintained structures as unsafe or unsuitable for public use, these same Corps districts (Pacific Ocean, for example) list few, if any, of these same structures as requiring modifications to accommodate public use. Such a policy may indicate a strong decision on the part of district officials to discourage any public use of local jetties or breakwaters for fishing, etc. On the other hand, response from such Corps districts as Buffalo, Detroit, Baltimore and Galveston reported a greater number of structures they reported as being unsafe or unsuitable for total public use (Table 15). These Corps districts, while perhaps not encouraging use of these structures as a matter of policy, are merely stating that they are presently being used by the public despite the fact that they may be unsafe for such use.

It is interesting to note that by comparing Table 14 with Table 6, should the Army Corps of Engineers wish to upgrade the recreational potential of its coastal and navigation structures through the implementation of safety or engineering features, such modifications could result in a 76 percent increase over the number of jetties presently being utilized for these purposes. For groins and shore-connected breakwaters such increases would be 31 percent and 95 percent, respectively.

Suggested methods to improve overall safety of these structures for public use include: (1) installation of concrete caps to counteract voids in structures, (2) widening of crest of structure, (3) raising top of jetty above tide line, (4) installation of handrails, and (5) addition of steps and other safe walkways to structure.

Some Costs and Engineering Options for Structure Modifications for Public Use

Costs associated with the addition of an improvement of a jetty or breakwater to accommodate recreational use vary depending upon the type of design and amount of construction materials utilized in its construction. At present, only one Corps district (San Francisco) could provide any current (1981) costs for such improvements. Table 16 presents a breakdown of costs for capping a jetty structure and for the installation of a handrail.

Based on cost coefficients contained in Table 16, the installation of a three-inch galvanized 500-foot handrail with riser pipe every 15-20 feet would total about \$18,500. This amount assumes no costly structural modifications

TABLE 16

COSTS ASSOCIATED WITH INSTALLATION OF CAP AND HANDRAIL ON JETTY
FOR RECREATION FISHING AND OTHER USES¹

Construction Material Item of Cost ²	Unit Price	Cost
1. Precast Concrete Cap 6" deep (27,450 sq. feet)	\$3.44 per square foot	\$ 94,000
2. Concrete fill (360,000 lbs.)	\$.43 per lb.	\$154,800
3. Structural Support	1.5 X price of cap	\$141,600
4. Handrail (3" galvanized steel) (5,510 feet)	\$36.40 per foot	\$200,600
5. Powerline for Light (5,510 feet)	\$3.00 per foot	\$ 16,500
6. Vapor Lamps	\$300 per lamp	\$ 5,500
Total Cost		\$613,400

Source: U.S. Army Engineer District, San Francisco (July, 1981).

¹ Cost derived from planning analysis of proposed jetty to be situated near south end of Golden Gate Bridge, San Francisco, CA.

² Source: Douglas Pirie, Chief, Hydraulics and Hydrology Section, San Francisco District, U.S. Army Corps of Engineers.

(concrete capping, structural support, etc.) to the jetty. Such modifications could add several hundred thousand dollars to the original project cost.

Given the rather small amount of money required for the addition of a safety handrail and the potentially large reduction in risk for the general public from its installation, Corps expenditure for this modification may be justified under various safety mandates applicable to all Federal agencies. However, Corps funding of these additional structural modifications for recreational purposes alone to a jetty or breakwater or groin would be contrary to the recreation cost-sharing agreements provided by PL 89-72.

Some large-scale structural design features of these coastal structures by the U.S. Army Corps of Engineers may result in secondary benefits to local recreationists without any cost sharing on their part. First, during the planning stages, design of these structures may include certain features that render the structure itself useful for recreational purposes. For example, engineering considerations may dictate a relatively flat top for certain groins, breakwaters, etc., or may specify acquisition of land directly adjacent to the structure to insure areas for repair and maintenance of the structure. Secondly, during the redesign of structures to accommodate changes in shoreline conditions (filling in of permeable areas to trap sediment, etc.), Corps district personnel may elect to employ retrofit designs that while similar in cost and in structural stability to other design characteristics may also provide some auxiliary or secondary recreational benefits. In all stages of the planning and construction of jetties, groins, etc., Corps officials in coastal engineering branches should coordinate closely with local recreation officials to determine the likelihood of any future recreation use of these structures.

CHAPTER VII

ISSUES AND ALTERNATIVES FOR POLICY DECISIONS ON PUBLIC USE OF U.S. ARMY CORPS OF ENGINEERS JETTIES, GROINS AND SHORE-CONNECTED BREAKWATERS

Throughout the development of this report several issues emerged that must be fully addressed before the adoption of any Corps-wide policy on the public use of its coastal and navigation structures. For purposes of discussion, these issues can be grouped into five topical categories: (1) applicability and/or development of engineering measures and other physical design modifications for safe public use of groins, jetties and breakwaters; (2) rationale and benefits, as well as negative impacts, etc., associated with public use of its coastal and navigation structures; (3) Corps of Engineers liability stemming from recreational use of its coastal and navigation structures; (4) need for a centralized data base for management of Corps-maintained jetties, groins, etc.; and (5) cost-sharing requirement for public safety and recreation facilities at Corps coastal and navigation structures.

Of central concern to Corps planners evaluating a jetty, groin or breakwater to determine its recreational potential is a consideration of the safety aspects of the physical design of a particular structure for this use. While the addition of a concrete cap or steel handrail may provide for safer pedestrian traffic use, certain features of design inherent in a structure or combinations of both structural design as well as type of material utilized may result in periodically dangerous conditions for fishermen and other recreational enthusiasts. For example, experience in the South Atlantic Division of the U.S. Army Corps of Engineers indicates that rubble-mound structures tend to shift under wave attack. While this flexibility is usually desirable, caps and handrails rigidly anchored to rock elements may be subject to frequent and expensive maintenance. Without such maintenance, jetties or breakwaters using this type of construction material may pose serious hazards for public use of these structures.

In addition to this type of material and engineering design of the structure, other critical physical factors affecting the potential recreational use of jetties include: tidal range (wave height and frequency of occurrence); frequency and severity of storms (hurricanes, northeasters); height of structure above water; location of structure (near urban center vs. remote area); likelihood and occurrence of slippery surface on cap; and availability of a suitable fish resource.

With regard to advantages and disadvantages of permitting public use on Corps of Engineers maintained structures, responses from nine coastal and Great Lakes division offices indicated no clear consensus. Many comments centered on the need for flexibility on any policy decision to be made on this issue. The South Atlantic Division is of the opinion that only one of two options is available to the Corps resource managers:

- o Public use of all Corps-maintained structures should be discouraged by installation of no trespassing signs on those structures and by barricading any land access; or

- o The structures should be improved by the addition of applicable minimum safety features. Adequate signs and warning posters should be installed and frequently inspected to assure continued emplacement so that the public is constantly made aware of potential dangers.

On the other hand, the North Central Division, the Corps division with the largest number of such structures, stated that the Corps should participate in enhancing its breakwaters to make them safer for public fishing and sightseeing for the following reasons: (1) people are already using the structures even though some of them are in dangerous or poor condition; (2) participation would enhance the image of the Corps in the minds of the public; and (3) taxpayers could see some direct benefit to them. A Corps district (Buffalo) within this division has also suggested that a study of recreational use of detached structures be performed.

Two Corps divisions (North Pacific and Pacific Ocean) presently discourage any recreational use of their structures. Both divisions have stated that jetties, groins and breakwaters in these areas of the country are simply too hazardous for general recreational use by the public. Conversations with individuals generally opposed to public use of these structures stated that the very nature of navigation structures presents immediate dangers to the recreating public fishing from them.

A large portion of corps breakwaters and jetties subject to heavy seas are constructed of large stone with rough surfaces, relatively large voids between stones, and sharp edges on the stone, which is generally unsafe for pedestrian traffic. Wave splash results in organic growths, which make the stone very slippery and, on falling, a person may be severely cut by the rough edges of the stone. Due to the side slopes of the structures, people generally cannot fish from the crest due to the horizontal distance to the water. As a result, they climb down the side of the structures near the water line where they may be in danger from the action of wind waves or waves generated by fast moving vessels.

Some Corps coastal resource specialists are of the opinion that even if a stone structure is to be modified to encourage pedestrian traffic, it generally is not feasible, from a stability standpoint when there is severe wave exposure, to use a concrete or other impervious type of cap. A rubble-mound structure functions by absorbing wave energy through its porosity. When a cap is placed on its crest, wave energy is reflected back and causes a loss of stone. Capped structures on the west and southwest coast have adequately demonstrated this action. A concrete cap is generally used with the highly interlocking, highly porous concrete armor components where the sublayers are closely fitted and the reflected energy can escape around the units. To make such structures amenable to fishing, a platform might be constructed on the protected side for use of the fishermen. During severe storms however, such platforms may be heavily damaged.

Even if adequate measures were taken to permit selective public usage (warning signs, handrails, caps, etc.), under present constraints, no manpower is available to staff an office to administer recreation on coastal structures or to assign rangers to monitor use. This may imply that a local sponsor would, of necessity, assume full operations and maintenance responsibility.

With public use of its jetties, groins and shore-connected breakwaters, Corps of Engineers liability associated with the management of these structures may increase. Based on opinions and reviews of pertinent case law, the North Atlantic division has concluded that under the Federal Tort Claims Act, the government can be held liable for money damages unless certain precautions such as erecting and enforcing "no trespassing" and "danger" signs and installing a fence are taken. Even if liability for accidents at these facilities has been transferred to other state or local entities, the U.S. government can still be sued should accidents occur on these Corps-maintained jetties or breakwaters. In a recent decision, the court held that an indemnification agreement between the U.S. and a local sponsor was of no value if the government was guilty of negligent activity.

Proper management of U.S. Army Corps of Engineers coastal and navigation structures as well as the implementation of any future policy guidance regarding this management necessitates the maintenance of an adequate data base containing the number and type of structures as well as any statistical information about their public use. To date, no such centralized reporting system has been developed. Concern about the apparent lack of this system was voiced in comments on the draft report of this study by the Engineering Division, Directorate of Civil Works, OCE. Besides information on Corps-maintained jetties, groins, etc., this computerized file could also include data on other non-Corps structures used for fishing and related recreational activities. Without an adequate inventory on accidents and on recreational use of its breakwaters, jetties, etc., in a central system, Corps decision makers may be unable to assess impacts of a quantitative nature from the implementation of any new engineering regulation.

Certain aspects of cost-sharing requirements as specified in PL 89-72 for installation of features for recreation and for public health and safety are still subject to some interpretation by different Corps districts. While Corps participation in the installation of such project features should be accomplished on a cost/responsibility basis with a non-Federal entity, questions remain concerning the particular type of facility (walkway, handrail, etc.) that needs to be cost shared. The Corps of Engineers may be able to fund walkways, lights, handrails and restroom facilities if such features are considered necessary for public safety. If recreation facilities are provided at a completed project for the purpose of reducing hazards to health and safety, cost sharing with a non-Federal partner may not be required. On the other hand, participation should be sought if a local recreation opportunity would be enhanced by the addition of recreation-related facilities. Should no local or state governmental entity be willing to cost share in the development of recreation resources at Corps of Engineers jetties, groins and shore-connected breakwaters, these facilities provided at Federal expense should be limited to those necessary to eliminate hazards at these structures.

CHAPTER VIII

STUDY FINDINGS AND CONCLUSIONS

Number and Type of Coastal and Navigation Structures in the United States

The 21 U.S. Army Corps of Engineers districts comprising the coastal and Great Lakes regions of the United States contain approximately 4500 coastal (shore-protection) and navigation structures. It is estimated that there are 480 jetties, 328 shore-connected breakwaters and 3684 groins in these districts. The number of groins reported may be considerably higher due to the large number of smaller types of these structures (<20 feet) owned and maintained by private individuals and not included in district inventories.

About 74 percent of all jetties nationwide are presently maintained by the U.S. Army Corps of Engineers. Of the 192 groins constructed by the same agency to prevent erosion in coastal areas, most of these structures (66 percent) are maintained by non-Federal parties. Similar to maintenance responsibilities with jetties, the Corps of engineers performs most of these functions on breakwaters. In 1981, this agency maintained 76 percent or 248 such structures nationwide. Federal law permits expenditure of Corps funds for maintenance of both types of navigation structures (jetties and breakwaters). Maintenance of shore erosion control structures is generally a non-Federal responsibility. However, in the case of multipurpose projects involving both navigation and shore protection as in the Galveston and Los Angeles areas, maintenance responsibility is vested in the Federal government.

About 51 percent of all coastal and navigation structures in the United States were constructed using sheet pile while an estimated 43 percent of these same structures consist of rubble stone. Other smaller number structures include crib-type (two percent) and combinations of wooden with concrete caps and steel cells (four percent).

Legal and Administrative Authority of U.S. Army Corps of Engineers Over Management and Public Use of Its Coastal and Navigation Structures

The legal authority of the U.S. Army Corps of Engineers to construct and maintain jetties, groins and breakwaters derives historically from a series of river and harbor acts.

As specified in the U.S. Code, the Federal government bears all costs for the construction of commercial navigation structures such as jetties and breakwaters because of the general or widespread nature of the benefits. An 1884 river and harbor act also provides for the economical operation and maintenance of these structures at Federal expense. For structures associated with recreational navigation, the Federal government assumes all maintenance costs but only one-half of the construction costs.

Under existing beach erosion control laws, Congress has authorized Federal participation in the cost of restoring and protecting the shores of property on the Atlantic, Pacific and Gulf coastal areas of the United States. An act

of August, 1946, authorizes Federal technical and financial assistance by the Corps on the construction, but not for the maintenance, of these structures.

A brief review of Federal mandates and engineering regulations indicates that the U.S. Army Corps of Engineers has legal authority to fund, install and maintain any minimum safety feature to protect the public engaged in recreation activity at any Corps jetty, groin and breakwater. Authority for such Corps action is provided in Section 3(a) of PL 89-72 and in Federal safety (DOD) directives. However, the addition of any large-scale modification to an existing structure (cap, new engineering design) to accommodate public use requires a 50-50 cost-sharing agreement between the Corps of Engineers and a non-Federal partner.

Response data from a number of corps districts indicate no clear consensus on the applicability of certain Federal laws or mandates whose implementation may result in the addition of a handrail, cap or other measure to provide safer access or use of Corps jetties or groins. One-third of all Corps districts stated that such modifications were not covered at present by Federal mandates affecting Corps of Engineers activities.

To date, only six Corps districts have actually entered into formal cooperative agreements with state or local entities to increase recreational opportunities at jetties, groins and breakwaters. Such formal agreements could include applicable cost-sharing provisions of PL 89-72 and written agreements for payment for any local costs as stated in Section 221 of the 1970 River and Harbor and Flood Control Act.

Public Use of Corps of Engineers Jetties, Groins and Breakwaters

In order to solicit a wide variety of views on the issue of public use of coastal and navigation structures, several individuals outside the Corps of Engineers were contacted. Most of these people reported that, although the issue has at best been only casually addressed and that although few, if any, meaningful statistics had been collected on accidents/fatalities associated with recreational use of these structures, there appears to be no major problem with their use at fishing and sightseeing piers.

On the other hand, members of the metropolitan lifeguard units stressed the apparent lack of public awareness of potential dangers associated with public use of jetties. They urged implementation of safety measures to prevent loss of life and injury to the public including installation of and frequent maintenance of warning signs. One of the lifeguards was also of the opinion that the addition of handrails would encourage rather than discourage public use of these facilities.

Approximately 318 or 48 percent of all Corps coastal and navigation structures are presently used by the public for fishing and related recreational activities. While the Corps maintains only seven percent of all jetties, groins and shore-connected breakwaters, on a percentage utilization basis, recreational use of these structures accounts for about 58 percent of

all such recreation. On this same basis, recreational use at Corps-maintained jetties accounts for 86 percent of the fishing and sightseeing activities on this type of navigation structure. However, for groins and shore-connected breakwaters, this recreational use factor is higher for these facilities maintained by non-Corps parties, 68 percent and 51 percent, respectively. A total of 319 of these structures has been improved (addition of handrails, etc.) to provide safer or easier access. Corps districts report some public usage at 99 percent of all facilities that have been improved for recreational use. On the other hand, only about 21 percent of all non-Corps improved jetties, etc., are used for fishing and related activities.

At present, very little factual data is available concerning visitation rates/intensity or use of jetties, groins and breakwaters located in the coastal and Great Lakes areas of the United States. Only six Corps districts and one division out of a total of 21 responding to a questionnaire submitted any estimates of public visitation to these structures. All but one of these estimates were based on professional judgment rather than on official statistics.

Few, if any, generalized statements can be made regarding accidents or injuries arising from public use of coastal structures. Only one or perhaps two Corps districts actually maintain files on personal injuries at these structures. Local or state marine safety officials generally provide such information to Corps personnel when it becomes available. Absence of signs providing adequate warning of dangers associated with the public use of jetties, groins and breakwaters as well as their improper maintenance and replacement can result in tort claims against the U.S. Army Corps of Engineers.

Although response data were insufficient to determine overall effectiveness of measures to discourage public use of coastal and navigation structures, the U.S. Army Corps of Engineers has taken such measures (installation of signs and some barricades) at over 35 percent of the estimated 667 structures it maintains. On less than one percent of all non-Corps-maintained jetties have any signs or barricades been erected by local governments or other parties.

In general, public use of groins, jetties and breakwaters for fishing and sightseeing in nearly all Corps coastal and Great Lakes districts present no apparent major problems for Corps resource personnel. In response to questions on this issue, 18 out of 19 districts also reported no substantial conflicts with local public officials from use of coastal structures by recreationists. However, some districts cautioned about any public use of these structures due to potentially dangerous conditions during times of storms, etc.

Public use of jetties, etc., overall, is also considered a positive benefit to the taxpayer in the opinions of several Corps district offices. Recreational opportunities afforded by these structures can enhance the public image of the U.S. Army Corps of Engineers if the local population is aware of Corps involvement in the construction and yearly maintenance of the structures.

Design Modification and Improvements for Safe Public Use of Coastal and Navigation Structures

Thirty percent of all Corps-maintained structures have been modified for greater access and public use. Four Corps districts (Alaska, Buffalo, Chicago and Detroit) have financed the greatest percentage (65) of these improvements, with the Detroit District accounting for almost 45 percent of all such Corps-sponsored improvements nationwide.

The installation of safe handrails was the most frequently cited improvement by district personnel, followed by construction of safe walkways on structure. Only four percent of all reported Corps-sponsored modifications were designed to accommodate recreational opportunities for the handicapped.

Of a total of 94 structures improved by one or more modifications by non-Corps parties, 83 percent of these structures are presently maintained by the Corps of Engineers. While 68 percent of all Corps improvements were specifically aimed at public safety measures for fishing, etc., from these structures (installation of concrete caps, handrails, etc.), 70 percent of all non-Corps modifications consisted of measures largely concerned with vehicular access to these structures (construction and maintenance of access roads and parking areas).

Excluding an estimated 3500 private smaller groins, less than four percent of the other 1000 coastal and navigation structures nationwide have actually been designed for public use. In the opinion of corps coastal engineering specialists, approximately 40 percent of these 1000 structures are presently unsafe or unsuitable for use by the recreationing public due to design characteristics (voids in structure, slippery surfaces, etc.). However, 296 presently unimproved jetties, groins and breakwaters could be utilized for some recreational activities if certain features were added(handrails, etc.).

Costs associated with the addition of an improvement of a jetty, etc., for recreational use vary depending upon the type of design and amount of construction material utilized. Based upon costs supplied by San Francisco District, the installation of 500 feet of handrail would cost about \$18,500. This assumes no major structural modifications for its installation.

Issues and Alternatives for Policy Development

Five major issues or alternatives must be considered before the implementation of any Corps-wide policy on the public use of its jetties, groins and shore-connected breakwaters. These include: (1) applicability and/or development of engineering modifications for safe public use of coastal and navigation structures; (2) rationale and benefits as well as negative impacts associated with public use of these structures; (3) U.S. Army Corps of Engineers liability from recreational use of jetties, etc.; (4) need for a centralized data base for management of Corps-maintained coastal and navigation structures; and (5) cost-sharing requirements for public safety and recreation facilities at jetties, groins and breakwaters constructed and

maintained by the Corps of Engineers. Resolution of some of these issues as well as the incorporation of other policy alternatives into the Corps decision-making process will contribute to development of overall effective management for public use of jetties, groins and breakwaters.

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