

## Summary of Beach Nourishment Episodes on the U.S. East Coast Barrier Islands

Hugo R. Valverde§, Arthur C. Trembanis†, and Orrin H. Pilkey†

§Hampton Roads Planning  
District Commission  
Chesapeake, VA, U.S.A.

†Program for the Study of  
Developed Shorelines  
Duke University, Campus Box  
90228  
Durham, NC 27708, U.S.A.

### ABSTRACT

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This study documents that since 1923, approximately 350 million cubic yards of sand have been deposited on the US East Coast barrier island shoreline (from Long Island, New York to Fisher Island, Florida), by more than 573 beach nourishment episodes, at 154 locations. On East Coast barrier beaches, the use of beach nourishment to control coastal erosion has increased rapidly since the 1960's. Most of this volume (65%) has been placed by federally sponsored beach nourishment projects, either storm and erosion control projects or navigation projects with beach disposal of dredge spoil. However, the proportion of nourishment projects not involving federal funds (state/local and local/private nourishment projects) has been increasing.

**ADDITIONAL INDEX WORDS:** *Beach replenishment, East Coast erosion control, soft stabilization.*



### INTRODUCTION

Beach nourishment is our nation's most widely used response to shoreline erosion. Despite its popularity, information documenting the extent to which beach nourishment has been used is fragmented and incomplete. This study attempts to fill this void by creating a database that documents open-ocean beach nourishment episodes which have occurred on the US East Coast barrier island shoreline (from Long Island, New York to Fisher Island, Florida) (Figure 1). It is hoped that the information presented by this study will be useful as a baseline database to coastal managers at all levels in evaluating and formulating policies involving beach nourishment. For example, in the current debate of the appropriate federal role in beach nourishment, this study provides a starting point by documenting the past.

Two other studies have attempted to establish a beach nourishment database for the East coast. The first study was performed by PILKEY and CLAYTON (1989), which documented East Coast open-ocean beach nourishment episodes through 1986. The most recent was a study by the US ARMY CORPS OF ENGINEERS (1994). The Corps study, however, only considered federal projects and did not assess the federal role in the larger picture of US beach nourishment. Our study is rather broad in scope and includes data on both federal and non-federal projects. This study adds to Pilkey and Clayton's work by bringing it up-to-date, to 1996. Additionally, where possible, Pilkey and Clayton's study was corrected by adding missing projects and replacing inaccurate information.

### METHODS

PILKEY and CLAYTON (1989) note in their study that data on beach nourishment "is difficult to come by." While it seems that this situation has improved somewhat, it is still very hard to obtain records on some types of beach nourishment, especially small or non-federal projects.

For the purposes of this study, beach nourishment was defined as the introduction of new sand, placed on the beach by hydraulic or mechanical means, which had the immediate effect of increasing the dry beach width. Thus, both engineered and non-engineered nourishments (such as beach disposal of dredge spoil) are included. The term *episode* is used to describe an individual application of sand to a beach, which may be part of a larger beach nourishment project, consisting of several episodes over decades of time.

The following information was sought for each beach nourishment episode: location, year, funding type, volume, length, and cost. These data were obtained from a variety of sources including conference proceedings, journal articles, newspaper articles, consultant reports, Corps of Engineers' documents, and state reports and files. A large part of this information was also obtained by personally communicating with federal, state, and local government officials. The first draft of the data table was sent to many of these individuals for comments and verification. Presently, we are still receiving feedback on the data table (see Table 1) and we invite any additional corrections. Our data table is available for examination at our website, <http://www.geo.duke.edu/Research/psds>.

Establishing our data table was a difficult and somewhat arbitrary process. In the process of collecting the data, we sometimes found several versions of the costs, lengths, and

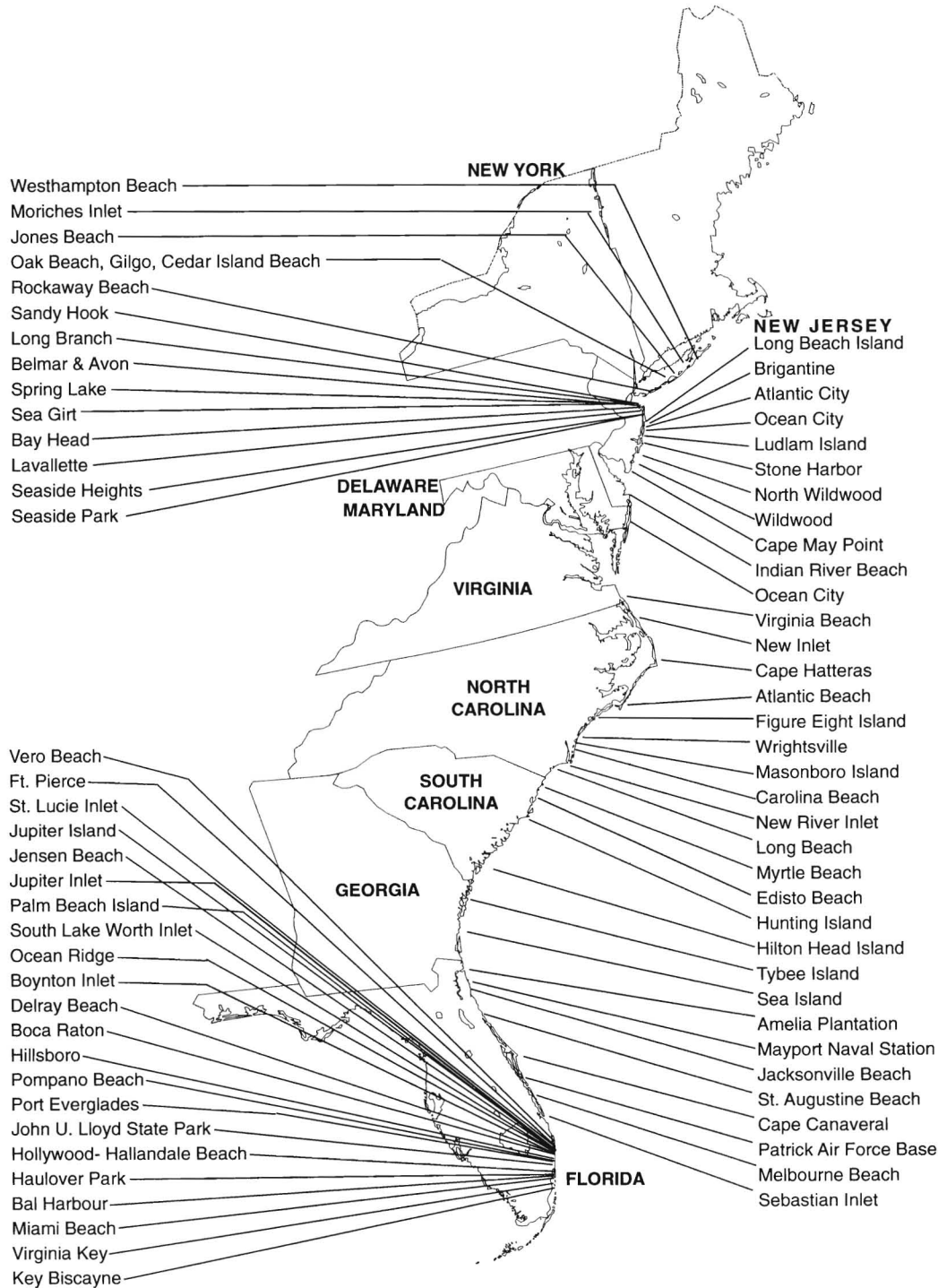


Figure 1. Index map showing the approximate location of 71 nourishment projects (for a complete list of projects see Table 1).

volumes for a single nourishment episode. For the table, we had to choose one source of information over another. However, in the reference list, we tried to include all the sources we found for an episode, not just the source that contained the figure we actually used in our table.

We are certain that the data presented by this study are not entirely complete or accurate. Out of 573, we found 62 (11%) episodes with no funding source information, 56 (10%) without information on volume, 299 (52%) without information on length, and 257 (45%) without cost information.

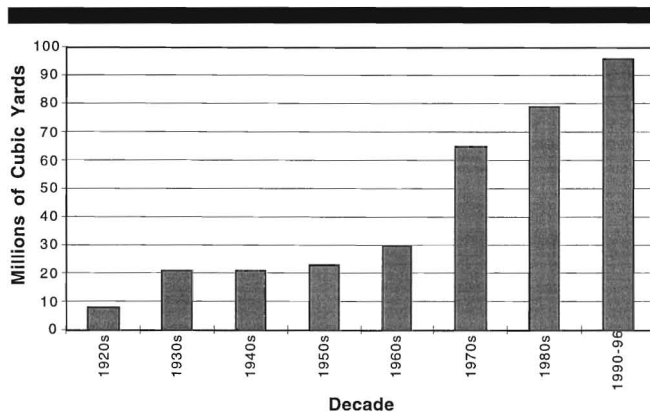


Figure 2. Total volume of nourishment sand placed on US East Coast barrier island beaches per decade.

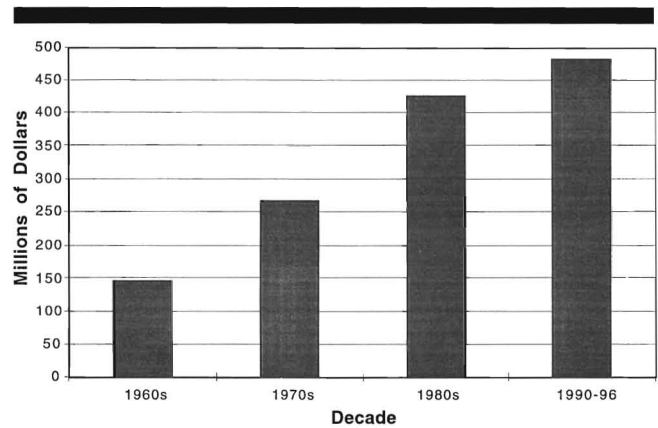


Figure 3. Total estimated cost of nourishing US East Coast barrier island beaches per decade. Costs are in 1996 dollars.

In order to arrive at an approximation of how much has been spent nourishing the East Coast barriers, we had to estimate missing costs. To do this, we first adjusted all documented costs for inflation and converted them to 1996 dollars, based upon cost update factors given by USACE (1996). Then, from those episodes with both a documented cost and volume, an average cost per cubic yard was calculated for each funding type. Finally, an episode's known volume was multiplied by the corresponding cost per cubic yard average for the appropriate funding type, in order to arrive at an estimated cost. If an episode's funding type was undocumented, then a median cost per cubic yard figure was used, such that 50% of the documented costs per cubic yard were higher and lower. If an episode had no volume (10% of the episodes had no volume), an estimated cost could not be obtained. Table 1 depicts only the documented costs expressed in project year dollars not including our estimated costs.

**FUNDING TYPES**

The beach nourishment episodes identified in this study were classified into one of six funding types, which are explained below. Some nourishment episodes, however, such as Wrightsville Beach, North Carolina were performed under a variety of funding categories for a single nourishment episode. For the purposes of simplifying the data table and analysis, we chose the dominant funding type. In some cases, to assign a funding type, we had to make assumptions or make an inference from available sources, where it was not explicitly available.

(1) Federal Storm and Erosion. These are nourishment episodes performed by federally sponsored beach erosion control, shore protection, or hurricane protection projects, where Congress authorizes up to 65 percent of the total cost. The remaining share is paid for by state and local governments. Of the six categories, these nourishments are the largest in cost and volume.

(2) Federal Navigation. These episodes involve federal navigation channel maintenance with beach disposal. Rather than dispose of dredged sand offshore or on an upland disposal area, sometimes it is less expensive and beneficial to

dispose of the sand on a neighboring beach, at no cost to the local community. If beach disposal is not cost effective, in some cases, the local community will pay to have the dredge spoil placed on their beach.

(3) Federal Emergency. These are federally-funded nourishment episodes, which usually occur in response to a large loss of beach caused by major storms. For example, on the East Coast, the most widespread use of federal emergency projects was in response to the 1962 Ash Wednesday storm and the severe winter storm season of 1992-93.

(4) State. These are nourishment episodes which are paid for entirely by the state government.

(5) State/Local. This classification encompasses those beach nourishment episodes which were sponsored under a state and local government cost sharing agreement.

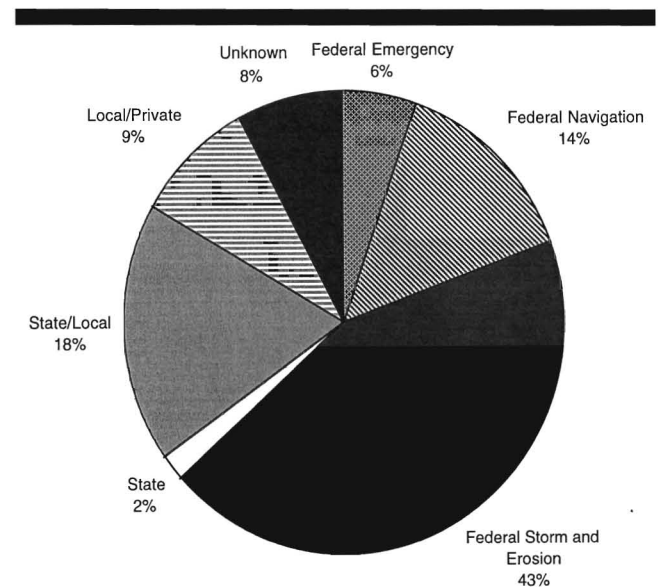


Figure 4. Funding sources of US East Coast barrier island nourishment episodes expressed as a percent of total sand volume (1923-1996).

Table 1. *East Coast barrier island beach nourishment episodes (1923–1996)*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented		References
						Cost (\$)		
<b>EAST COAST BARRIERS</b>								
<b>New York</b>								
1	Saganopack Pond area, NY	1962	Federal: Emergency	70,000	3,168	\$133,400		2
2	Mecox Bay area, NY	1962	Federal: Emergency	175,000	6,864	\$153,900		2
3	Southampton Beach, NY	1962	Federal: Emergency	200,000	5,280	\$96,600		2
4	Tiana Beach, NY	1993	Federal: Navigation	500,000	3,000	\$1,650,000		189
5	Westhampton Beach, NY	1962	Federal: Emergency	136,500	1,584	\$93,600		2
6	Westhampton Beach, NY	1969	Federal: Storm and Erosion	750,000				2
7	Westhampton Beach, NY	1970	Federal: Storm and Erosion	1,100,000				2
8	Westhampton Beach, NY	1984	Federal: Storm and Erosion			\$610,000		2
9	Westhampton Beach, NY	1993	Federal: Navigation	1,440,000		\$5,364,030		150
10	Westhampton Beach, NY	1996	Federal: Storm and Erosion	4,000,000	12,000	\$30,700,000		188
11	Moriches Inlet, NY	1966	Local/Private	677,900				189
12	Moriches Inlet, NY	1969	Local/Private	151,000				189
13	Moriches Inlet, NY	1973	Local/Private	135,000				189
14	Moriches Inlet, NY	1978	Local/Private	218,500				189
15	Great South Beach, NY	1962	Federal: Emergency	993,500	30,624	\$844,100		2
16	Great South Beach, NY	1967	Local/Private	135,300				189
17	Great South Beach, NY	1960s	Local/Private	265,900				189
18	Great South Beach, NY	1973	Local/Private	174,100				189
19	Great South Beach, NY	1983	Local/Private	10,000				189
20	Great South Beach, NY	1991	Local/Private	3,000				189
21	Great Gunn Beach, NY	1969	Local/Private	62,400				189
22	Great Gunn Beach, NY	1995	Local/Private	40,000				189
23	Smith Point County Park, NY	1996	Local/Private	600,000				189
24	Brookhaven & Islip, NY	1962	Federal: Emergency	715,000	37,000	\$528,600		2
25	Water Island, NY	1996	Local/Private	76,000	1,000	\$470,000		189
26	Fire Island Pines, NY	1994	Local/Private	150,000	6,300	\$900,000		189
27	Point o Woods, NY	1994	Local/Private	75,000	4,300	\$450,000		189
28	Ocean Bay Park, NY	1994	Local/Private	140,000	2,600	\$800,000		189
29	Seaview, NY	1994	Local/Private	55,000	3,000	\$330,000		189
30	Saltaire/Fairharbor/Dunewood, NY	1994	Local/Private	550,000	8,500	\$3,000,000		189
31	Oak Beach, NY	1946						60
32	Oak Beach, Gilgo Beach, Cedar Beach, NY	1946–1959		1,000,000				6
33	Hempstead Beach, NY	1990	Federal: Navigation	353,000	3,000	\$2,403,000		189
34	Hempstead Beach, NY	1994	Federal: Navigation	560,000	3,000	\$3,771,000		189
35	Hempstead Beach, NY	1995	Federal: Navigation	459,000	3,000	\$2,915,000		189
36	Gilgo Beach, NY	1960	Federal: Navigation					7
37	Gilgo Beach, NY	1974	Federal: Navigation	954,000		\$797,000		8,264
38	Gilgo Beach, NY	1975	Federal: Navigation	931,310	11,000	\$3,335,000		8,9,264
39	Gilgo Beach, NY	1977	Federal: Navigation	2,271,457	11,000	\$9,017,963		10,11,264
40	Gilgo Beach, NY	1987	Federal: Navigation					154
41	Gilgo Beach, NY	1989	Federal: Navigation	1,000,000	14,000	\$7,348,000		154,189,264
42	Gilgo Beach, NY	1990	Federal: Navigation	797,000	14,000	\$4,882,000		189,264
43	Gilgo Beach, NY	1992	Federal: Navigation	1,515,000	14,000	\$10,225,000		189,264
44	Gilgo Beach, NY	1994	Federal: Navigation	1,500,000	18,000	\$11,183,000		189
45	Jones Beach, NY	1927–1959	State/Local	40,000,000				5
46	Jones Beach, NY	1973	Federal: Navigation					151
47	Jones Beach, NY	1990	Federal: Navigation	388,000	1,000			189
48	Lido Beach, NY	1962	Federal: Emergency	200,000	4,224	\$249,500		2
49	Rockaway Beach, NY	1926–1930		5,200,000				12,13
50	Rockaway Beach, NY	1930–1936		5,200,000				12
51	Rockaway Beach, NY	1939	State/Local	400,000	4,752	\$60,000		12
52	Rockaway Beach, NY	1958		1,250,000				12
53	Rockaway Beach, NY	1962	Federal: Emergency	175,000	2,112	\$135,500		2,12,15
54	Rockaway Beach, NY	1967	State/Local	300,000	3,696			15
55	Rockaway Beach, NY	1975	Federal: Storm and Erosion	3,668,700	15,840	\$9,420,556		16,17,18,19
56	Rockaway Beach, NY	1976	Federal: Storm and Erosion	1,489,600	22,176	\$2,204,467		17
57	Rockaway Beach, NY	1977	Federal: Storm and Erosion	1,000,000	10,560	\$2,500,000		11,17
58	Rockaway Beach, NY	1978	Federal: Emergency	671,300	7,920	\$1,200,000		20,21
59	Rockaway Beach, NY	1980	Federal: Storm and Erosion	466,000	3,696	\$1,724,000		20,22,23
60	Rockaway Beach, NY	1982	Federal: Storm and Erosion	1,066,400	6,336	\$2,716,750		20,24
61	Rockaway Beach, NY	1982	Federal: Storm and Erosion	163,000	1,500	\$965,776		24
62	Rockaway Beach, NY	1984	Federal: Storm and Erosion	1,667,900	5,808	\$9,732,204		19
63	Rockaway Beach, NY	1986	Federal: Storm and Erosion	1,345,000	6,336	\$6,972,540		19,25

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented	References
						Cost (\$)	
64	Rockaway Beach, NY	1988	Federal: Storm and Erosion	1,166,000	6,336	\$3,406,906	199
65	Rockaway Beach, NY	1994	Federal: Navigation	153,000	3,000	\$1,373,000	199
66	Rockaway Beach, NY	1996	Federal: Navigation	340,000	4,000	\$2,400,000	199
67	Breezy Point/Roxbury beaches, NY	1994	Federal: Navigation	199,000	7,500	\$1,288,000	189
68	Plumb Beach and Belt Parkway, NY	1992	Federal: Navigation	145,000	1,000	\$1,329,000	189
69	Coney Island, NY	1923	Local/Private	1,700,000	8,750		152,153
70	Coney Island, NY	1926	Local/Private	850,000	2,500		152,153
71	Coney Island, NY	1941	Local/Private	500,000	12,500		152,153
72	Coney Island, NY	1961	State/Local	750,000	7,000		152,153
73	Coney Island, NY	1995	Federal: Storm and Erosion	2,800,000	18,340	\$9,000,000	187,200
New Jersey							
74	Sandy Hook, NJ	1975	Federal: Storm and Erosion	191,447			26
75	Sandy Hook, NJ	1976	Federal: Storm and Erosion	198,276	3,168	\$480,150	26,28
76	Sandy Hook, NJ	1977	Federal: Storm and Erosion	200,000	1,056	\$770,500	27,28
77	Sandy Hook, NJ	1979	Federal: Storm and Erosion				28
78	Sandy Hook, NJ	1983	Federal: Storm and Erosion	2,370,766		\$10,236,161	30,197
79	Sandy Hook, NJ	1984	Federal: Storm and Erosion	800,000		\$3,968,965	31,197
80	Sandy Hook, NJ	1990	Federal: Storm and Erosion	3,302,273		\$1,350,000	159,197
81	SeaBright-Monmouth Beach, NJ	1963	Federal: Emergency	1,433,000	26,928	\$1,418,400	2
82	Sandy Hook-Deal, NJ	1995	Federal: Storm and Erosion	4,400,000	16,368	\$19,100,000	149
83	Sandy Hook-Deal, NJ	1996	Federal: Storm and Erosion	4,100,000	12,672	\$16,300,000	149
84	Shark River Inlet						6
85	Avon by the Sea, NJ	1950	Federal: Navigation	22,000			158
86	Avon by the Sea, NJ	1960		250,000			158
87	Avon by the Sea, NJ	1971	Federal: Navigation	120,000			158
88	Avon by the Sea, NJ	1982	Federal: Navigation	136,000		\$352,240	158,197
89	Avon & Belmar, NJ	1958	State/Local			\$226,544	32
90	Spring Lake, NJ	1969	State/Local			\$112,728	32
91	Spring Lake/Belmar, NJ	1994	State/Local	70,000	1,180	\$347,199	193,197
92	Sea Girt, NJ	1962	Federal: Emergency			\$25,751	32
93	Sea Girt, NJ	1966	Federal: Storm and Erosion	425,211		\$552,774	33
94	Bay Head, NJ	1963	Federal: Emergency			\$217,551	32
95	Lavalette, NJ	1963	Federal: Emergency			\$186,225	32
96	Seaside Heights, NJ	1963	Federal: Emergency			\$154,498	32
97	Seaside Park, NJ	1963	Federal: Emergency			\$99,443	32
98	Berkely Township, NJ	1962	Federal: Emergency			\$12,628	32
99	Berkely Township, NJ	1968	State/Local			\$71,566	32
100	South Seaside Park, NJ	1978	State/Local				34
101	Barnegat Light, NJ	1963	Federal: Emergency			\$67,309	32
102	Barnegat Light, NJ	1966	State/Local			\$65,481	32
103	Barnegat Light, NJ	1991	Federal: Navigation	75,000			197
104	Long Beach Island, NJ	pre-1963	Federal: Storm and Erosion	60,000			35
105	Long Beach Island, NJ	post-1972	Federal: Navigation				36
106	Long Beach Island, NJ	1979	Federal: Emergency	1,000,000	14,784	\$4,600,000	37
107	Harvey Cedars, NJ	1962	Federal: Emergency	715,000	19,008	\$759,700	2
108	Harvey Cedars, NJ	1963	Federal: Emergency			\$282,770	32
109	Harvey Cedars, NJ	1967	State/Local			\$39,484	32
110	Harvey Cedars, NJ	1990		27,300		\$34,957	197
111	Harvey Cedars, NJ	1992		110,000			197
112	Harvey Cedars & Long Beach Town- ship, NJ	1994	State/Local	660,000		\$3,700,000	194,197
113	Surf City, NJ	1963	State/Local				32
114	Ship Bottom, NJ	1956	State/Local	182,000			38
115	Ship Bottom, NJ	1963	Federal: Emergency			\$161,659	32
116	Brant Beach, NJ	1956	State/Local	115,000			38
117	Union Township, NJ	1966	State/Local			\$12,142	32
118	Island Heights, NJ	1962	Federal: Emergency			\$18,300	32
119	Long Beach, NJ	1959	State/Local			\$72,025	32
120	Long Beach, NJ	1962	Federal: Emergency			\$28,690	32
121	Long Beach, NJ	1963	Federal: Emergency			\$1,008,050	32
122	Brigantine, NJ	1962	Federal: Emergency			\$70,589	2
123	Brigantine, NJ	1963	Federal: Emergency	392,500	17,952	\$503,700	39
124	Brigantine, NJ	1996	State/Local	1,200,000			195
125	Atlantic City, NJ	1936		792,000			14
126	Atlantic City, NJ	1937		900,000			14

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented		References
						Cost (\$)		
127	Atlantic City, NJ	1938		500,000				14
128	Atlantic City, NJ	1942	Federal: Storm and Erosion	1,362,000				14
129	Atlantic City, NJ	1948	Federal: Storm and Erosion	1,073,684	5,808			14,40
130	Atlantic City, NJ	1963	Federal: Storm and Erosion	580,000	3,696			41,42,43
131	Atlantic City, NJ	1970	Federal: Emergency	830,000	4,752			41,43,44
132	Atlantic City, NJ	1979	State/Local	48,158				39,40
133	Atlantic City, NJ	1983		75,000		\$358,250		197
134	Atlantic City, NJ	1986	State/Local	1,000,000		\$7,000,000		45,46,47
135	Longport, NJ	1990	Federal: Navigation	250,000		\$949,000		197
136	Ocean City, NJ	1952	Federal: Storm and Erosion	2,550,000	9,504	\$1,912,500		48
137	Ocean City, NJ	1959	Federal: Storm and Erosion	1,618,000		\$469,008		48,49
138	Ocean City, NJ	1962	Federal: Emergency					49
139	Ocean City, NJ	1966	State/Local					50
140	Ocean City, NJ	1970	State/Local	475,270				49
141	Ocean City, NJ	1971	State/Local	237,900				49
142	Ocean City, NJ	1972	State/Local	543,650				49
143	Ocean City, NJ	1973	State/Local	347,341				49
144	Ocean City, NJ	1974	State/Local	167,549				49
145	Ocean City, NJ	1975	State/Local	166,799				49
146	Ocean City, NJ	1976	State/Local	81,656				49
147	Ocean City, NJ	1977	State/Local	169,949				49
148	Ocean City, NJ	1978	State/Local	121,686				49
149	Ocean City, NJ	1979	State/Local	124,702				49
150	Ocean City, NJ	1980	State/Local	150,015		\$647,147		49
151	Ocean City, NJ	1982	State/Local	1,200,000		\$5,200,000		49,51
152	Ocean City, NJ	1992	Federal: Storm and Erosion	2,600,000	9,500	\$10,915,970		196
153	Ocean City, NJ	1993	Federal: Storm and Erosion	2,800,000	9,500	\$14,571,909		196
154	Ocean City, NJ	1993	Federal: Emergency	846,000		\$2,915,131		196
155	Ocean City, NJ	1994	Federal: Storm and Erosion	606,000	6,336	\$3,217,825		196
156	Ocean City, NJ	1995	Federal: Storm and Erosion	1,411,000	24,816	\$5,749,776		196
157	Ocean City, NJ	1995	State/Local	360,000	10,560	\$1,232,572		196
158	Ludlum Beach Island, NJ	1962	Federal: Emergency	905,082	35,376	\$809,300		2
159	Upper Township, NJ	1966	State/Local					50
160	Upper Township, NJ	1981		36,000		\$93,240		197
161	Upper Township, NJ	1984	State/Local	1,600,000				52,197
162	Upper Township, NJ	1984		120,000		\$2,453,600		197
163	Upper Township, NJ	1992		23,000				197
164	Strathmere, NJ	1982	Local/Private	45,000		\$90,000		53,197
165	Strathmere, NJ	1984		450,000		\$2,986,679		197
166	Strathmere, NJ	1984		592,000		\$3,929,142		197
167	Sea Isle City, NJ	1965	State/Local			\$63,845		50
168	Sea Isle City, NJ	1981		20,880		\$54,080		197
169	Sea Isle City, NJ	1983	State/Local	45,000		\$194,294		197
170	Sea Isle City, NJ	1984	State/Local	800,000		\$3,652,500		197
171	Sea Isle City, NJ	1987		158,000		\$528,244		136,197
172	Avalon, NJ	1987	State/Local	1,305,000	6,000	\$2,873,940	61,157,	192,197
173	Avalon, NJ	1990	Local/Private	404,000	2,500	\$600,000		157,192
174	Avalon, NJ	1992	Local/Private	410,000	3,000	\$1,188,000		192
175	Avalon, NJ	1993	Federal: Emergency	239,000	2,800	\$1,777,193		192
176	Stone Harbor, NJ	1968	State/Local			\$255,464		50
177	North Wildwood, NJ	1966	State/Local			\$5,698		50
178	North Wildwood, NJ	1989	State/Local	190,000		\$875,000		157,197
179	Wildwood, NJ	1963	Federal: Emergency			\$24,298		50
180	Wildwood, NJ	1991	Federal: Navigation	100,000				157
181	Lower Township, NJ	1969	State/Local			\$89,455		50
182	Lower Township, NJ	1986	State/Local	87,000				197
183	Cape May, NJ	1962	Federal: Emergency	156,656	8,448	\$358,600		2
184	Cape May, NJ	1967	State/Local			\$2,427		50
185	Cape May, NJ	1969	State/Local			\$256,495		50
186	Cape May, NJ	1981		36,000		\$93,000		197
187	Cape May, NJ	1989	Federal: Storm and Erosion	465,000	3,600	\$3,158,000		198
188	Cape May, NJ	1991	Federal: Storm and Erosion	900,000	8,000	\$4,380,000		198
189	Cape May, NJ	1992		500,000				197
190	Cape May, NJ	1993	Federal: Storm and Erosion	415,000	4,800	\$4,561,000		198
191	Cape May, NJ	1993	Federal: Emergency	300,000		\$2,135,000		198
192	Cape May, NJ	1995	Federal: Storm and Erosion	330,000	4,800	\$2,605,000		198

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented		References
						Cost (\$)		
193	Cape May Point, NJ	1992	State/Local	42,000				197
194	Cape May State Park, NJ	1986		15,000		\$272,618		197
195	Cape May State Park, NJ	1992		200,000		\$261,905		197
Delaware								
196	Fort Miles, DE	1962	Federal: Emergency	95,400	8,400	\$46,300		271
197	North Shores, DE	1962	Federal: Emergency	69,400	4,900	\$36,100		271
198	Rehoboth Beach, DE	1962	Federal: Emergency	216,200	5,000	\$318,900		271
199	Dewey Beach, DE	1962	Federal: Emergency	82,000	3,550	\$132,500		190
200	Dewey Beach, DE	1993	State/Local	5,755	1,900	\$30,210		190
201	Dewey Beach, DE	1994	State/Local	578,874	6,000	\$2,342,230		185,190
202	Dewey Beach, DE	1994	Federal: Storm and Erosion	14,004	1,385	\$60,000		190
203	North Indian Beach, DE	1994	Private	21,000	403	\$61,400		190
204	Indian Beach, DE	1962	Federal: Emergency	148,700	18,500	\$94,700		271
205	Indian Beach, DE		Private	4,800	154	\$20,435		271
206	North Indian River Inlet, DE	1957	Federal: Storm and Erosion	512,400		\$316,500		271
207	North Indian River Inlet, DE	1961	Federal: Navigation	48,000				190
208	North Indian River Inlet, DE	1962	Federal: Emergency	290,000	8,400	\$182,600		190
209	North Indian River Inlet, DE	1963	Federal: Storm and Erosion	590,300		\$374,900		190
210	North Indian River Inlet, DE	1965	Federal: Navigation	90,000				190
211	North Indian River Inlet, DE	1972	Federal: Storm and Erosion	774,300	5,000	\$637,200		190,201
212	North Indian River Inlet, DE	1974	Federal: Emergency					190
213	North Indian River Inlet, DE	1975	Federal: Storm and Erosion	142,500	5,000	\$276,600		190,201
214	North Indian River Inlet, DE	1978	Federal: Emergency	535,400	5,000	\$714,600		190,201
215	North Indian River Inlet, DE	1982	State	223,900				190
216	North Indian River Inlet, DE	1984	Federal: Emergency	540,000				190,201
217	North Indian River Inlet, DE	1990	State	175,000				190,200
218	North Indian River Inlet, DE	1991	State	68,900				200
219	North Indian River Inlet, DE	1992	State	40,000				190,200
220	Beach Cove-Bethany Beach, DE	1962	Federal: Emergency	37,100	9,504	\$32,900		2
221	Bethany Beach, DE	1961	Federal: Storm and Erosion	100,000				190
222	Bethany Beach, DE	1962	Federal: Emergency	69,700		\$138,400		190
223	Bethany Beach, DE	1989	State	284,500	5,138	\$1,630,241		190
224	Bethany Beach, DE	1992	State	219,735	5,138	\$1,037,303		190
225	Bethany Beach, DE	1994	State/Local	184,452	4,150	\$838,953		190
226	South Bethany-York Beaches, DE	1962	Federal: Emergency	65,000	24,816	\$119,000		2
227	South Bethany, DE	1989	State	231,600	4,158	\$1,307,849		190
228	South Bethany, DE	1992	State	192,749	4,850	\$905,786		190
229	South Bethany, DE	1994	State/Local	98,419	2,550	\$452,165		190
230	York Beach-Fenwick Island, DE	1962	Federal: Emergency	297,700	15,200	\$454,900		190
231	Fenwick Island, DE	1962	Federal: Emergency	67,600		\$121,900		190
232	Fenwick Island, DE	1988	State	333,500	6,000	\$1,572,993		190
233	Fenwick Island, DE	1991	Federal: Storm and Erosion	126,800	1,600	\$443,603		190
234	Fenwick Island, DE	1992	Federal: Storm and Erosion	37,000	1,690	\$269,234		190
235	Fenwick Island, DE	1992	State	144,900	4,150	\$716,916		190
236	Fenwick Island, DE	1994	Federal: Emergency	68,236	2,300	\$369,809		190
Maryland								
237	Ocean City, MD	1963	Federal: Emergency	1,050,000	42,240	\$1,517,600		2
238	Ocean City, MD	1988	State/Local	2,700,000	36,960	\$14,200,000		182
239	Ocean City, MD	1991	Federal: Storm and Erosion	3,800,000	36,960	\$15,003,269		182
240	Ocean City, MD	1992	Federal: Emergency	1,221,388		\$10,800,000		164,182
241	Ocean City, MD	1993	Federal: Emergency	223,515		\$960,000		182
242	Ocean City, MD	1994	Federal: Emergency	1,300,000		\$8,800,000		182
Virginia								
243	Virginia Beach, VA	1951	Federal: Storm and Erosion	20,000				59,175,178
244	Virginia Beach, VA	1952	Federal: Storm and Erosion	1,320,000				59,175,178
245	Virginia Beach, VA	1953	Federal: Storm and Erosion	94,000		\$722,163		59,175,178,179
246	Virginia Beach, VA	1954	Local/Private	17,500				175,178
247	Virginia Beach, VA	1955	Local/Private	115,100				56,175,178
248	Virginia Beach, VA	1956	Local/Private	115,100				56,175,178
249	Virginia Beach, VA	1957	Local/Private	115,100				56,175,178
250	Virginia Beach, VA	1958	Local/Private	115,100				56,178
251	Virginia Beach, VA	1959	Local/Private	115,100				56,178
252	Virginia Beach, VA	1960	Local/Private	115,100				56,178
253	Virginia Beach, VA	1961	Local/Private	115,100				56,178
254	Virginia Beach, VA	1962	Federal: Emergency	472,000				59,178

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented		References
						Cost (\$)		
255	Virginia Beach, VA	1963	Federal: Storm and Erosion	181,100	18,480	\$168,000		56,175,178
256	Virginia Beach, VA	1964	Federal: Storm and Erosion	181,100	18,480	\$166,000		56,175,178
257	Virginia Beach, VA	1965	Federal: Storm and Erosion	181,100	18,480	\$176,439		56,175,178
258	Virginia Beach, VA	1966	Federal: Storm and Erosion	181,100	18,480	\$178,256		56,57,178,180
259	Virginia Beach, VA	1967	Federal: Storm and Erosion	181,100	18,480	\$205,664		56,57,178,180
260	Virginia Beach, VA	1968	Federal: Storm and Erosion	147,400	18,480	\$209,030		56,57,178,180
261	Virginia Beach, VA	1969	Federal: Storm and Erosion	100,500	18,480	\$232,757		56,178,180
262	Virginia Beach, VA	1970	Federal: Storm and Erosion	283,800	18,480	\$211,951		56,178,180
263	Virginia Beach, VA	1971	Federal: Storm and Erosion	230,600	18,480	\$363,892		56,178,180
264	Virginia Beach, VA	1972	Federal: Storm and Erosion	489,800	18,480	\$427,097		56,58,178,180
265	Virginia Beach, VA	1973	Federal: Storm and Erosion	358,600	18,480			56,58,178,180
266	Virginia Beach, VA	1974	Federal: Storm and Erosion	165,500	18,480			56,178,180
267	Virginia Beach, VA	1975	Federal: Storm and Erosion	273,430	18,480	\$1,979,376		56,178,180
268	Virginia Beach, VA	1976	Federal: Storm and Erosion	241,210	18,480			56,178,180
269	Virginia Beach, VA	1977	Federal: Storm and Erosion	289,488	18,480			59,178,180
270	Virginia Beach, VA	1978	Federal: Storm and Erosion	259,992	18,480			59,178,180
271	Virginia Beach, VA	1979	Federal: Storm and Erosion	295,040	18,480			59,178,180
272	Virginia Beach, VA	1980	Federal: Storm and Erosion	266,150	18,480	\$1,866,140		59,178,180
273	Virginia Beach, VA	1981	Federal: Storm and Erosion	332,494	18,480			59,178,180
274	Virginia Beach, VA	1982	Federal: Storm and Erosion	319,578	18,480			59,178,180
275	Virginia Beach, VA	1983	Federal: Storm and Erosion	317,395	18,480			59,178,180
276	Virginia Beach, VA	1984	Federal: Storm and Erosion	351,399	18,480	\$2,889,770		59,178,180
277	Virginia Beach, VA	1985	Federal: Storm and Erosion	384,453	18,480			59,178
278	Virginia Beach, VA	1986	Federal: Storm and Erosion	396,066	18,480			59,178
279	Virginia Beach, VA	1987	Local/Private	306,682	18,480	\$1,271,000		178
280	Virginia Beach, VA	1988	Local/Private	160,071	18,480			178
281	Virginia Beach, VA	1989	Federal: Navigation	1,200,000	18,480			178
282	Virginia Beach, VA	1990	Local/Private	94,586	18,480			178
283	Virginia Beach, VA	1991	Local/Private	195,419	18,480			178
284	Virginia Beach, VA	1992	Local/Private	265,659	18,480			178
285	Virginia Beach, VA	1993	Local/Private	311,790	18,480			178
286	Virginia Beach, VA	1994	Local/Private	303,318	18,480	\$800,000		178
287	Virginia Beach, VA	1995	Federal: Storm and Erosion	289,450	18,480	\$962,000		176
288	Virginia Beach, VA	1996	Federal: Storm and Erosion	300,000	18,480	\$1,100,000		177,178
289	Dam Neck Naval Base, VA	1996	Federal: Storm and Erosion	808,000	9,200	\$3,800,000		184
290	Sandbridge, VA	1962	Federal: Emergency	262,000	11,088	\$508,700		2
North Carolina								
291	Pea Island, NC	1990	Federal: Navigation	254,955	2,000			183
292	Pea Island, NC	1991	Federal: Navigation	282,600	2,500			183
293	Pea Island, NC	1992	Federal: Navigation	184,300	4,000			183
294	Pea Island, NC	1992	Federal: Navigation	1,078,000	5,400			183
295	Pea Island, NC	1993	Federal: Navigation	433,235	2,500			183
296	Pea Island, NC	1995	Federal: Navigation	250,000	2,000	\$1,674,992		183
297	Hatteras Island, NC	1974	Federal: Navigation	135,293	1,353	\$164,818		183
298	Hatteras Island, NC	1977	Federal: Navigation	97,029	970	\$248,521		183
299	Hatteras Island, NC	1984	Federal: Navigation	29,972	300	\$155,625		183
300	Hatteras Island, NC	1986	Federal: Navigation	90,114	901	\$303,195		183
301	Hatteras Island, NC	1988	Federal: Navigation	74,646	746	\$359,861		183
302	Hatteras Island, NC	1992	Federal: Navigation	18,147	1 81	\$184,840		183
303	Cape Hatteras, NC	1966	Federal: Storm and Erosion	312,000				63
304	Cape Hatteras, NC	1972	Federal: Storm and Erosion	200,000				63
305	Cape Hatteras, NC	1973	Federal: Storm and Erosion	1,300,000	7,920	\$4,000,000		64,65
306	Ocracoke Island, NC	1986	Federal: Navigation	167,755	1,678	\$471,410		207
307	Ocracoke Island, NC	1988	Federal: Navigation	90,773	908	\$420,821		207
308	Ocracoke Island, NC	1989	Federal: Navigation	113,229	1,132	\$557,830		183
309	Ocracoke Island, NC	1992	Federal: Navigation	100,000	1,000	\$653,748		183
310	Ocracoke Island, NC	1995	Federal: Navigation	44,305		\$145,135		183
311	Fort Macon/Atlantic Beach, NC	1973	Federal: Navigation	504,266	5,043	\$414,807		183
312	Fort Macon/Atlantic Beach, NC	1978	Federal: Navigation	1,179,739	11,797	\$1,565,177		66
313	Fort Macon/Atlantic Beach, NC	1986	Federal: Navigation	1,912,894	39,129	\$5,316,038		67
314	Fort Macon/Atlantic Beach, NC	1990	Federal: Navigation	312,522	4,000	\$1,663,911		183
315	Fort Macon/Atlantic Beach, NC	1994	Federal: Navigation	2,473,727	24,737	\$3,794,727		183
316	Emerald Isle, NC	1989	Federal: Navigation	45,399				207
317	West Onslow Beach, NC	1990	Federal: Navigation	101,653	4,000	\$417,984		207
318	Topsail Island, NC	1982	Federal: Navigation	51,715				207
319	Topsail Island, NC	1988	Federal: Navigation	151,017		\$423,256		207



Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented		References
						Cost (\$)		
320	Topsail Island, NC	1992	Federal: Navigation	75,519	755	\$177,830		183
321	Topsail Island, NC	1993	Federal: Navigation	80,162	802	\$269,659		183
322	Topsail Island, NC	1995	Federal: Navigation	38,883	389	\$269,659		183
323	Figure Eight Island, NC	1979	Federal: Navigation					207
324	Figure Eight Island, NC	1985	Local/Private	46,300	2,000			68
325	Figure Eight Island, NC	1986	Local/Private	250,000	2,000			69
326	Figure Eight Island, NC	1993	Local/Private	275,000	3,000			205,208
327	Wrightsville Beach, NC	1939		700,000	13,728	\$98,000		14,70
328	Wrightsville Beach, NC	1955		38,000				71
329	Wrightsville Beach, NC	1956	State/Local	35,000				71
330	Wrightsville Beach, NC	1957		304,000				71
331	Wrightsville Beach, NC	1959		100,000	7,920			71
332	Wrightsville Beach, NC	1965	Federal: Storm and Erosion	2,993,100	14,000	\$739,339		36,72,73
333	Wrightsville Beach, NC	1966	Federal: Storm and Erosion	362,108	12,000	\$255,941		72,74,75
334	Wrightsville Beach, NC	1970	Federal: Storm and Erosion	1,436,533	8,000	\$578,545		76,77
335	Wrightsville Beach, NC	1980	Federal: Emergency	540,715	8,000	\$1,030,736		78
336	Wrightsville Beach, NC	1980	Federal: Navigation	36,108				207
337	Wrightsville Beach, NC	1981	Federal: Storm and Erosion	1,249,699	8,000	\$4,427,792		78
338	Wrightsville Beach, NC	1982	Federal: Navigation	124,533				207
339	Wrightsville Beach, NC	1983	Federal: Navigation	93,755				207
340	Wrightsville Beach, NC	1985	Federal: Navigation	19,399				207
341	Wrightsville Beach, NC	1986	Federal: Navigation	898,593	6,864	\$1,331,715		79,80
342	Wrightsville Beach, NC	1987	Federal: Navigation	76,556				207
343	Wrightsville Beach, NC	1989	Federal: Navigation	96,771				207
344	Wrightsville Beach, NC	1991	Federal: Storm and Erosion	1,016,684	6,864	\$2,682,412		183
345	Wrightsville Beach, NC	1994	Federal: Storm and Erosion	619,031	6,400	\$1,973,591		183
346	Masonboro Island, NC	1986	Federal: Navigation	1,997,521	5,000			79
347	Masonboro Island, NC	1994	Federal: Navigation	362,009	2,400			208
348	Carolina Beach, NC	1955	Federal: Storm and Erosion	252,000		\$50,000		81,82
349	Carolina Beach, NC	1956	State/Local	200,000				81,82
350	Carolina Beach, NC	1965	Federal: Storm and Erosion	3,597,362	10,032	\$925,506		35
351	Carolina Beach, NC	1967	Federal: Storm and Erosion	389,959	4,224	\$186,308		183
352	Carolina Beach, NC	1967	Federal: Navigation	115,000				207
353	Carolina Beach, NC	1968	Federal: Navigation	97,000				75
354	Carolina Beach, NC	1970	Federal: Emergency	282,423	4,224	\$291,159		75,76,83
355	Carolina Beach, NC	1971	Federal: Storm and Erosion	734,140	11,600	\$517,897		75,85
356	Carolina Beach, NC	1972	Federal: Navigation	18,816	182			207
357	Carolina Beach, NC	1973	Federal: Navigation	30,547				207
358	Carolina Beach, NC	1974	Federal: Navigation	66,687				207
359	Carolina Beach, NC	1975	Federal: Navigation	40,804				207
360	Carolina Beach, NC	1976	Federal: Navigation	119,971				207
361	Carolina Beach, NC	1977	Federal: Navigation	62,066				207
362	Carolina Beach, NC	1979	Federal: Navigation	230,866				207
363	Carolina Beach, NC	1980	Federal: Navigation	38,075				207
364	Carolina Beach, NC	1981	Federal: Navigation	109,176		\$174,002		207
365	Carolina Beach, NC	1981	Federal: Emergency	406,352		\$1,051,774		22,81
366	Carolina Beach, NC	1982	Federal: Storm and Erosion	3,662,181	14,256	\$8,384,406		86,87
367	Carolina Beach, NC	1983	Federal: Navigation	119,244				207
368	Carolina Beach, NC	1985	Federal: Navigation	28,267				207
369	Carolina Beach, NC	1985	Federal: Storm and Erosion	764,162	6,000	\$1,652,004		88
370	Carolina Beach, NC	1988	Federal: Storm and Erosion	950,913	5,700	\$1,890,535		183
371	Carolina Beach, NC	1989	Federal: Navigation	98,843				208
372	Carolina Beach, NC	1991	Federal: Storm and Erosion	1,008,736	11,600	\$2,450,286		183
373	Carolina Beach, NC	1995	Federal: Storm and Erosion	1,157,742	11,600	\$3,185,642		183
374	Bald Head Island, NC	1992	Federal: Navigation	800,000	12,300	\$900,000		203
375	Bald Head Island, NC	1996	Local/Private	715,000	13,000	\$2,860,000		204,208
376	Long Beach, NC	1986	Federal: Navigation	130,000		\$215,000		89,90,91
377	Long Beach, NC	1989	Federal: Navigation	104,803				208
378	Long Beach, NC	1993	Federal: Navigation	160,091	1,601	\$1,389,987		208
379	Holden Beach, NC	1971	Federal: Navigation	108,802	1,088	\$70,259		207
380	Holden Beach, NC	1973	Federal: Navigation	108,627				207
381	Holden Beach, NC	1974	Federal: Navigation	92,774				207
382	Holden Beach, NC	1975	Federal: Navigation	62,303				207
383	Holden Beach, NC	1977	Federal: Navigation	76,149				207
384	Holden Beach, NC	1984	Federal: Navigation	76,867				207
385	Holden Beach, NC	1986	Federal: Navigation	95,927				207

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented		References
						Cost (\$)		
386	Holden Beach, NC	1987	Federal: Navigation	173,963				207
387	Ocean Isle, NC	1974	Federal: Navigation	82,831				207
388	Ocean Isle, NC	1976	Federal: Navigation	20,925				207
389	Ocean Isle, NC	1980	Federal: Navigation	37,325				207
390	Ocean Isle, NC	1983	Federal: Navigation	54,905				207
391	Ocean Isle, NC	1984	Federal: Navigation	38,880				207
392	Ocean Isle, NC	1986	Federal: Navigation	30,630				207
393	Ocean Isle, NC	1989	Federal: Navigation	48,614				207
South Carolina								
394	North Myrtle Beach, SC	1990	Federal: Emergency	377,200		\$1,950,000	167,211,212,213,214	
395	Myrtle Beach, SC	1987	State/Local	850,000	31,680	\$4,500,000		92,214,215
396	Myrtle Beach, SC	1990	Federal: Emergency	380,000		\$2,600,000	167,211,212,213,214	
397	Huntington Beach, SC	1988	Federal: Navigation	450,000	10,000	\$900,000		214,215
398	Surfside, SC	1990	Federal: Emergency	70,000	5,000	\$581,250	167,211,212,213,214	
399	Garden City, SC	1990	Federal: Emergency	163,500	13,500	\$1,640,000		211,212,213,214
400	Pawleys Island, SC	1988	State/Local	60,000				211,212,213,214
401	Pawleys Island, SC	1990	Federal: Emergency	220,000	16,200	\$612,000	167,211,212,213,214	
402	Debidue Island, SC	1990		180,000	8,000	\$900,000		215
403	Edisto Beach, SC	1954	State/Local	830,000	4,752			214,215
404	Edisto Beach, SC	1995	State/Local			\$1,500,000		214,215
405	Isle of Palms, SC	1983	Local/Private	175,000	4,000	\$175,000		214,215
406	Isle of Palms, SC	1984	Local/Private	350,000	5,000	\$1,000,000		167,212,213
407	Folly Beach, SC	1982-1988	Federal: Storm and Erosion	305,560	1,000	\$500,000		168
408	Folly Beach, SC	1990	Federal: Emergency			\$350,000		214,215
409	Folly Beach, SC	1993	Federal: Storm and Erosion	2,641,818	28,215	\$7,184,000		214,215
410	Seabrook Island, SC	1982	Local/Private	75,000	3,000			214,215
411	Seabrook Island, SC	1983	Local/Private	1,230,000	16,500			93
412	Seabrook Island, SC	1990	Local/Private	700,000	6,000	\$1,500,000		209
413	Hunting Island, SC	1968	Federal: Storm and Erosion	750,000	9,850	\$609,000		94,95,216
414	Hunting Island, SC	1971	Federal: Storm and Erosion	761,324	9,850	\$534,000		95,216
415	Hunting Island, SC	1975	Federal: Storm and Erosion	613,000	8,860	\$872,000		94,95,216
416	Hunting Island, SC	1980	Federal: Storm and Erosion	1,400,000	20,000	\$2,107,053	96,97,214,215,216	
417	Hunting Island, SC	1991	State/Local	757,644	7,800	\$2,876,250		165,166
418	Hilton Head Island, SC	pre-1973	Local/Private	2,107,053				218
419	Hilton Head Island, SC	1980	Local/Private	550,000	15,000	\$1,100,000		214,215
420	Hilton Head Island, SC	1982	Local/Private	800,000				98
421	Hilton Head Island, SC	1990	State/Local	2,340,000	35,000	\$9,700,000		215,217,218
Georgia								
422	Tybee Island, GA	1976	Federal: Storm and Erosion	2,300,000	18,480	\$3,600,000	99,100,101,219,220	
423	Tybee Island, GA	1987	Federal: Storm and Erosion	1,360,000	14,500	\$3,700,000		102,219,220
424	Tybee Island, GA	1994	Federal: Navigation	2,000,000				222
425	Tybee Island, GA	1995	Federal: Storm and Erosion	300,000		\$1,860,000		221,222
426	Sea Island, GA	1964	Federal: Storm and Erosion	150,000	4,224	\$175,000		103
427	Sea Island, GA	1977	Local/Private	100,000	400			223,224
428	Sea Island, GA	1986	Local/Private	250,000	2,640			223,224
429	Sea Island, GA	1990	Local/Private	2,000,000	10,560	\$6,000,000		223,224
Florida								
430	Fernandina Beach, FL	1979	Federal: Navigation	1,000,000	9,000			174,228
431	Fernandina Beach, FL	1982	Federal: Navigation	395,000				174,231
432	Fernandina Beach, FL	1990	Federal: Navigation	147,693				231
433	Fernandina Beach, FL	1993	Federal: Navigation	654,000		\$3,905,230		230,236
434	Fernandina Beach, FL	1996	Federal: Navigation	84,446				236
435	Amelia Island, FL	1983		76,000				229
436	Amelia Island, FL	1987	Federal: Navigation	1,000,000				174
437	Amelia Island, FL	1989	Federal: Navigation	750,000				229
438	Amelia Island, FL	1994	Local/Private	2,159,096	1,700	\$3,500,000		225,226
439	Mayport/Kathryn Abby Hanna Park, FL	1966						227
440	Mayport/Kathryn Abby Hanna Park, FL	1972	Federal: Navigation	1,600,000				105,227
441	Mayport/Kathryn Abby Hanna Park, FL	1974	Federal: Navigation	400,000	7,920			105,227,233
442	Mayport/Kathryn Abby Hanna Park, FL	1980	Federal: Navigation	823,000				174

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented Cost (\$)	References
443	Mayport/Kathryn Abby Hanna Park, FL	1985	Federal: Navigation	1,284,000		\$2,022,000	227,233,264
444	Mayport/Kathryn Abby Hanna Park, FL	1990	Federal: Navigation	422,000			233
445	Mayport/Kathryn Abby Hanna Park, FL	1994	Federal: Navigation	700,000			233
446	Jacksonville Beach, FL	1963	Federal: Emergency	320,000			93
447	Jacksonville Beach, FL	1974	Federal: Navigation				33
448	Jacksonville Beach, FL	1978	Federal: Storm and Erosion	1,268,000		\$4,311,000	105,106,233,234
449	Jacksonville Beach, FL	1980	Federal: Storm and Erosion	1,218,000		\$2,120,000	105,106,233,234
450	Jacksonville Beach, FL	1986	Federal: Storm and Erosion	309,000	26,400	\$1,493,000	233,264
451	Jacksonville Beach, FL	1987	Federal: Storm and Erosion	850,000		\$2,427,000	233,234,264
452	Jacksonville Beach, FL	1992	Federal: Storm and Erosion	370,000	8,800	\$2,070,000	233,264
453	Jacksonville Beach, FL	1996	Federal: Storm and Erosion	1,240,000	39,600	\$7,400,000	233
454	Anastasia State Park/ St Augustine, FL	1963	Federal: Emergency	50,000		\$95,000	93
455	Anastasia State Park/ St Augustine, FL	1996	Federal: Storm and Erosion	292,000		\$3,584,360	235
456	Ponce Inlet (North Beach), FL	1974	Federal: Storm and Erosion	89,167			236
457	Ponce Inlet (North Beach), FL	1978	Federal: Storm and Erosion	434,558			236
458	Ponce Inlet (North Beach), FL	1984	Federal: Storm and Erosion	82,212			236
459	Ponce Inlet (North Beach), FL	1985	Federal: Storm and Erosion	899,996			236
460	Ponce Inlet (North Beach), FL	1989	Federal: Storm and Erosion	868,967			236
461	Ponce Inlet (North Beach), FL	1996	Federal: Storm and Erosion				236
462	Cape Canaveral/Cocoa Beach, FL	1966	Federal: Navigation	120,000			265
463	Cape Canaveral/Cocoa Beach, FL	1972	Federal: Storm and Erosion	200,000			94
464	Cape Canaveral/Cocoa Beach, FL	1975	Federal: Navigation	2,715,000	11,088	\$1,050,000	108,109,237
465	Cape Canaveral/Cocoa Beach, FL	1994	Federal: Storm and Erosion	100,000	5,100	\$190,000	269
466	Cape Canaveral/Cocoa Beach, FL	1995	Federal: Navigation	742,000			238
467	Cocoa Beach, FL	1996	Federal: Storm and Erosion	40,000	2,500	\$341,000	269
468	Patrick Air Force Base, FL	1985	Federal: Storm and Erosion	180,000	21,120		237
469	Patrick Air Force Base, FL	1996	Federal: Storm and Erosion	100,000	18,000	\$1,300,000	269
470	Indialantic/Melbourne Beach, FL	1981	Federal: Storm and Erosion	540,000	11,088	\$3,582,000	110,111
471	Indialantic/Melbourne Beach, FL	1985		180,000			237
472	Sebastian Inlet (South Beach), FL	1972	State/Local	423,684		\$195,998	111,239
473	Sebastian Inlet (South Beach), FL	1978	State/Local	187,600		\$599,900	239
474	Sebastian Inlet (South Beach), FL	1986	State/Local	110,038	3,168	\$287,779	112,239
475	Sebastian Inlet (South Beach), FL	1989	State/Local	100,000		\$174,500	239
476	Sebastian Inlet (South Beach), FL	1990	State/Local	235,000		\$735,450	239
477	Sebastian Inlet (South Beach), FL	1993	State/Local	116,520		\$675,093	239
478	Vero Beach, FL	1979	State/Local				114
479	Vero Beach, FL	1984	State/Local				115
480	Ft Pierce (South Beach), FL	1971	Federal: Storm and Erosion	718,000	6,864	\$621,288	94,108
481	Ft Pierce (South Beach), FL	1974	Federal: Navigation	36,000			264
482	Ft Pierce (South Beach), FL	1978	Federal: Navigation	49,800	6,864	\$315,591	240
483	Ft Pierce (South Beach), FL	1980	Federal: Storm and Erosion	426,000		\$1,428,000	264
484	Ft Pierce (South Beach), FL	1983	Federal: Storm and Erosion	346,000	6,864	\$1,559,431	267
485	Ft Pierce (South Beach), FL	1987	Federal: Navigation	29,800	6,864	\$259,561	240
486	Ft Pierce (South Beach), FL	1989	Federal: Navigation	47,800	6,864	\$394,400	240
487	Ft Pierce (South Beach), FL	1990	Federal: Navigation	55,700	6,864		240
488	Ft Pierce (South Beach), FL	1994	Federal: Navigation	7,190			236
489	Ft Pierce (South Beach), FL	1995	Federal: Navigation	166,650			236
490	Hutchinson Island, FL	1996	Federal: Storm and Erosion	1,340,000	21,648	\$11,168,529	266
491	St Lucie Inlet, FL	1980					174
492	St Lucie Inlet, FL	1985					174
493	St Lucie Inlet, FL	1989					174
494	Jupiter Island, FL	1957	State/Local	250,000			93,173
495	Jupiter Island, FL	1961	Federal: Navigation	366,000			173
496	Jupiter Island, FL	1963		64,644	2,112		94,173
497	Jupiter Island, FL	1964		118,312			94,173
498	Jupiter Island, FL	1967		60,000		\$30,000	94,117,173
499	Jupiter Island, FL	1970-72	Federal: Navigation	280,000			173
500	Jupiter Island, FL	1974	Local/Private	3,488,759	25,872	\$4,046,960	117,118,173,249
501	Jupiter Island, FL	1978	Local/Private	1,327,289	26,400		118,119,120,173,249
502	Jupiter Island, FL	1983	Local/Private	1,000,000	26,400	\$2,400,000	119,121,173,249
503	Jupiter Island, FL	1987	Local/Private	2,230,000	17,500	\$3,500,000	147,148,249

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented		References
						Cost (\$)		
504	Jupiter Island, FL	1991		414,812				246
505	Jupiter Island, FL	1993		203,736				246
506	Jupiter Island, FL	1996	Local/Private	1,800,000	17,600			246
507	Jupiter Inlet (South Beach), FL		Federal: Storm and Erosion	60,000				249
508	Jupiter/Carlin Beach, FL	1995	Federal: Storm and Erosion	603,000	5,702	\$2,274,400		243,249,256
509	Juno Beach, FL	1996	Federal: Navigation	135,000	30,096	\$1,455,000		235,249
510	Lake Worth Inlet (South Beach), FL	1944		280,000				241,246
511	Lake Worth Inlet (South Beach), FL	1948		2,335,300				241,246
512	Lake Worth Inlet (South Beach), FL	1949		480,000				241,246
513	Lake Worth Inlet (South Beach), FL	1953		463,000				241,246
514	Lake Worth Inlet (South Beach), FL	1970		61,949				241,246
515	Lake Worth Inlet (South Beach), FL	1972		131,538				241,246
516	Lake Worth Inlet (South Beach), FL	1973		145,498				241,246
517	Lake Worth Inlet (South Beach), FL	1975		68,090				241,246
518	Lake Worth Inlet (South Beach), FL	1978		43,559				241,246
519	Lake Worth Inlet (South Beach), FL	1984		110,799				241,246
520	Lake Worth Inlet (South Beach), FL	1985		130,803				241,246
521	Lake Worth Inlet (South Beach), FL	1987	Federal: Navigation	191,000				241,246
522	Lake Worth Inlet (South Beach), FL	1989	Federal: Navigation	105,756				241,246
523	Lake Worth Inlet (South Beach), FL	1990	Federal: Navigation	75,351				241,246
524	Lake Worth Inlet (South Beach), FL	1991	Federal: Navigation	87,335				241,246
525	Lake Worth Inlet (South Beach), FL	1994	Federal: Navigation	178,000				241
526	Lake Worth Inlet (South Beach), FL							246
527	Palm Beach, FL	1944	State/Local	300,000		\$105,000		14
528	Palm Beach, FL	1948	State/Local	2,335,930		\$478,659		14
529	Palm Beach, FL	1949	State/Local	480,000				14
530	Palm Beach, FL	1953		463,000				93
531	Palm Beach, FL	1975	State/Local		6,336			122
532	Palm Beach, FL	1976		100,000				250
533	Palm Beach, FL	1977		86,000				250
534	Palm Beach, FL	1987		34,000				250
535	Midtown Beach, FL	1996	Local/Private	800,000	5,400			241,242,251
536	Boynton Inlet, FL	1961-1973		1,366,229				268,249
537	Boynton Inlet, FL		State/Local					
538	Delray Beach, FL	1973	Federal: Storm and Erosion	1,634,513	14,256	\$3,015,383		94,108,123,252
539	Delray Beach, FL	1978	Federal: Storm and Erosion	701,266	8,976	\$1,660,584		116,124,125,252
540	Delray Beach, FL	1984	Federal: Storm and Erosion	821,551	13,728	\$3,949,117		107,108,121,253
541	Delray Beach, FL	1992	Federal: Storm and Erosion	1,196,500	8,976	\$4,862,000		254,255,264
542	Delray Beach, FL	1996	Federal: Storm and Erosion	1,020,000	14,260			244
543	Boca Raton North, FL	1988	Federal: Storm and Erosion	1,102,000	8,500	\$3,547,000		257,258,264
544	Boca Raton South, FL	1985	State/Local	297,000	3,200			259
545	Boca Raton South, FL	1996	State/Local	252,000	4,170			249
546	Hillsboro Beach, FL	1972	Federal: Storm and Erosion	500,000	5,280			128,262
547	Hillsboro Inlet, FL		Local/Private					248
548	Pompano Beach/Lauderdale by the Sea, FL	1964	State/Local			\$3,677		127
549	Pompano Beach/Lauderdale by the Sea, FL	1970	Federal: Storm and Erosion	1,076,000	16,896	\$1,873,437		262
550	Pompano Beach/Lauderdale by the Sea, FL	1983	Federal: Storm and Erosion	1,909,000				262,264
551	John U Lloyd State Park, FL	1977	Federal: Storm and Erosion	1,090,000	7,920	\$2,945,262	108,116,261,262,263	
552	John U Lloyd State Park, FL	1989	Federal: Storm and Erosion	603,000	7,920	\$2,945,262	260,262,263,264	
553	Hallandale, FL	1971	Federal: Storm and Erosion	370,000	4,224	\$779,977	108,128,262,263	
554	Hollywood/Hallandale, FL	1979	Federal: Storm and Erosion	1,980,000	27,984	\$7,743,376	108,129,262,263	
555	Hollywood/Hallandale, FL	1991	Federal: Storm and Erosion	1,050,000		\$9,186,444		169,263
556	Sunny Isles, FL	1988	Federal: Storm and Erosion	1,500,000		\$15,600,000		170,263,264
557	Sunny Isles, FL	1990		30,000				263
558	Haulover Park, FL	1960	State/Local	180,000				93,263
559	Haulover Park, FL	1978	Federal: Storm and Erosion	300,000				130,263
560	Haulover Park, FL	1980	Federal: Navigation	80,000				131
561	Haulover Park, FL	1987		235,000				263
562	Bal Harbour, FL	1960	State/Local	86,000				93
563	Bal Harbour, FL	1961	State/Local	25,000				132
564	Bal Harbour, FL	1963-1973	State/Local	305,000				93
565	Bal Harbour, FL	1975	Federal: Storm and Erosion	1,700,000	4,224	\$5,047,000		94
566	Bal Harbour, FL	1990	Federal: Storm and Erosion	230,000	4,488	\$4,600,000		170

Table 1. *Continued.*

#	Beach Location	Date	Funding Type	Volume (cu. yds)	Length (feet)	Documented Cost (\$)	References
567	Miami Beach, FL	1978–1982	Federal: Storm and Erosion	12,000,000	55,440	\$55,000,000	133,134
568	Miami Beach, FL	1987	Federal: Storm and Erosion	350,000		\$5,000,000	170
569	Va. Key-Key Biscayne	1969	Federal: Storm and Erosion	373,000	13,200		94,108
570	Virginia Key, FL	1974	Federal: Storm and Erosion	500,000	6,864		116
571	Key Biscayne, FL	1987		360,000	12,672	\$1,428,571	107,133,137
572	Fisher Island, FL	1991		30,263		\$131,578	171
573	Key West, Smathers Beach, FL	1960		30,000		\$23,697	172

(6) Local/Private. These are nourishments carried out at the local level, either by a municipality or local homeowners.

### FINDINGS

Table 1 presents beach nourishment episodes, progressing from north to south geographically, which have occurred on the U.S. East Coast barrier island shoreline. In total, 573 beach nourishment episodes have occurred, at 154 locations (Figure 1). Three-hundred and fifty million cubic yards of sand have been placed, making the U.S. East Coast the most nourished shoreline in the country. Figure 2 indicates that since the 1960s, the sand placed on the East Coast barriers through beach nourishment has been increasing with time, especially in recent decades. Over 50% of the total sand used to nourish the East Coast has been placed within the last 16 years.

A dramatic increase in nourishment was found to have occurred in the 1970s (see Figure 2). This can be attributed in part to three factors: 1) legislation adopted around the 1970s, which increased the federal role in beach nourishment; 2) an increasing trend for federal navigation projects with beach disposal of dredged material, beginning in the 1970s; and 3) a shift in shore protection expenditures from hard stabilization to soft stabilization (USACE, 1994). These factors have continued to cause an increase in the use of beach nourishment in the 1980s and 1990s. In the 1990s, an increased number of relatively large nourishment projects were performed. Because of such projects, almost 30% of the total sand used to nourish the East Coast has been placed from 1990–96.

Figure 3 shows the estimated total amount (in 1996 dollars) that has been spent on nourishing the East Coast barriers since the 1960s. Because we are trying to establish a comprehensive view of beach nourishment, the costs presented include both federal and non-federal nourishment episodes. Since 1960, approximately \$1.3 billion has been spent. In recent years, from 1990–96, we estimate that over \$480 million dollars were spent on nourishing the East Coast. When this amount is distributed over the seven year time period, about \$68 million a year is being spent. This amount has increased 62% from the previous decade, when an estimated \$42 million a year was spent.

Figure 4 shows the distribution of funding expressed as percent of total sand volume placed on East Coast barrier island beaches. It is important to note that beaches listed in the Federal Storm and Erosion category will have been par-

tially funded by state and local sources. Approximately, 65% of the sand placed on the East Coast has been through federal sponsorship. Forty-four percent has been placed by Federal Storm and Erosion projects, 14% by Federal Navigation projects, and 6% by Federal Emergency. Although most nourishment has occurred as a result of federal involvement, our data (Table 1) indicate that the frequency of non-federal nourishment episodes has been increasing in recent years.

### CONCLUDING REMARKS

Our study finds a marked increase in the use of beach nourishment on the East Coast barrier island shoreline, especially in recent decades. A major factor contributing to this widespread use of beach nourishment has been the availability of federal funding. Recently, however, the availability of federal funds for beach nourishment projects has been reduced and threatened by the current administration. Additionally, in some areas, such as south Florida, suitable sand has become scarce, and legal disputes have arisen over the ownership of sand. Also in Florida, concern over the environmental impacts of beach nourishment has been increasing. For some communities, these factors may make the beach nourishment alternative less attractive or even unavailable in the future. In turn, this could cause an increased demand for non-federally funded nourishment episodes, importation of sand from outside areas (e.g. southeast Florida), and hard structures.

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