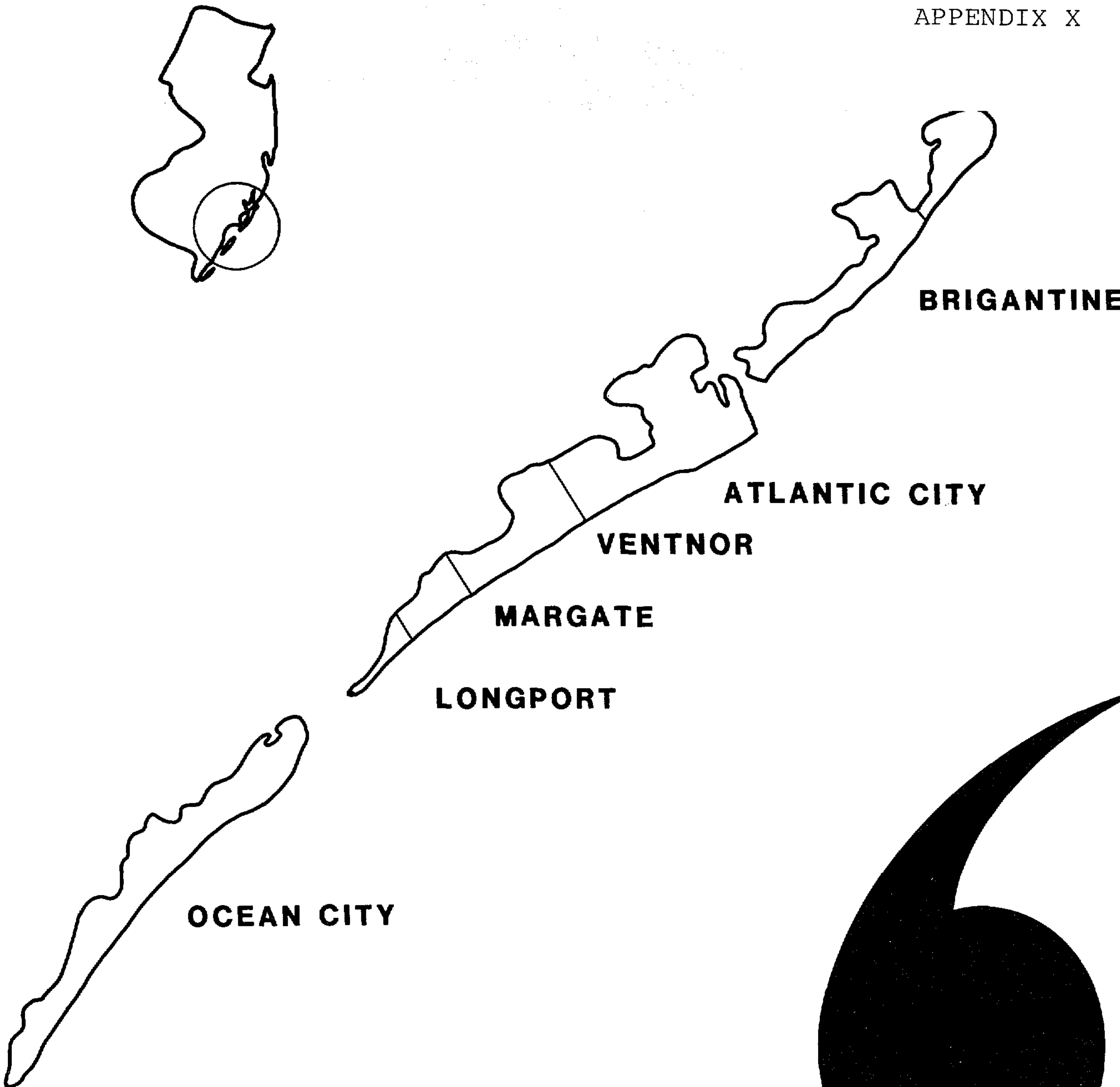
Coastal Storm Hazard Mitigation

Atlantic County Barrier Islands And Ocean City, New Jersey

APPENDIX X



New Jersey Department of Environmental Protection

COASTAL STORM HAZARD MITIGATION:

Atlantic County Barrier Islands And Ocean City, New Jersey

CITY OF BRIGANTINE

CITY OF ATLANTIC CITY

CITY OF VENTNOR

CITY OF MARGATE

BOROUGH OF LONGPORT

CITY OF OCEAN CITY

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EXECUTIVE SUMMARY

Coastal storms often result in loss of life and extensive damages to public and private property. The heavily developed nature of New Jersey barrier islands increases this vulnerability to hurricane and northeast storm hazards. The continued development of coastal areas, without consideration for the natural hazards present, will undoubtedly result in future storm damages, and an increased need for high cost shore protection projects and expenditure of public funds in post-storm clean-up and repair of storm damages.

In an attempt to address the ever increasing demand for shore protection and storm recovery funding, the Federal Emergency Management Agency (FEMA) has contracted with the New Jersey State Police and the New Jersey Department of Environmental Protection (NJDEP) to evaluate and recommend storm hazard mitigation strategies which could be implemented in six New Jersey muncipalities. The six municipalities studied are Brigantine, Atlantic City, Ventnor, Margate, Longport and Ocean City. Those areas which are most vulnerable to damages from coastal storms were identified in a separate report (Coastal Storm Vulnerability Analysis). Various hazard mitigation techniques were then evaluated and discussed with members of each of six local hazard mitigation steering committees appointed by the mayor of each of the six study area municipalities. These individual steering committees had several opportunities to suggest possible mitigation plans and comment on NJDEP recommendations. All NJDEP and local suggestions are included in this report.

The technique of hazard mitigation on barrier islands is a positive approach to minimizing the potential loss of life and property resulting from coastal storms. The general approaches to storm hazard mitigation are land use management, construction practices and shore protection. The land use management approach to hazard mitigation seeks to either avoid future storm losses through land management programs or to minimize the social and economic costs incurred by shorefront communities where erosion and storm damages occur. Improved land use management can be accomplished through land acquisition, zoning control, and wise expenditures of public funds for infrastructure siting and repair.

The purchase of property in high hazard areas for conservation and public safety purposes would decrease a municipality's vulnerability to storm damage while at the same time possibly increasing public access to the shore and recreational opportunities. However, the applicability of this approach is limited by the availability of funds.

Through zoning changes, the maximum number of people and amount of improved property exposed to storm hazards can be controlled. A conservation zone can be established through a dune and beach protection ordinance. The institution of a setback line would prevent most building in close proximity to the water or oceanfront bulkheads and seawalls, the area most vulnerable to wave damage.

The technique of transfer of development rights would establish preservation zones with attendant development rights and receiving zones where development rights must be purchased to exceed the zoned density. High hazard areas would be designated preservation zones and safer areas of the community would be designated as receiving zones, where higher density development would be allowed with purchased development rights. This technique is most suitable for islands which have not already exceeded evacuation capabilities or municipalities with mainland and barrier island components.

In a post-storm situation it may be possible to relocate heavily damaged utilities and roads outside of high hazard and erosion areas or to abandon the infrastructure entirely. In some cases, alternate existing routes can be used to service the same areas and the right of way can be used for dune creation and serve as a buffer between developed areas and the ocean while saving the cost of reconstruction and eliminating storm repairs.

Damages to structures can be decreased by requiring buildings in flood hazard areas to meet stringent standards. The floodplain management regulations established under the National Flood Insurance Program and the recent addition of floodproofing requirements to the BOCA Code (which is the uniform building code in New Jersey) are major steps in this direction. However, additional strengthening of these codes is advisable.

Shore protection can be accomplished using either non-structural or structural methods. The former includes dune creation and beach nourishment, the latter includes groins, bulkheads and seawalls. Because of the relatively high cost of structural shore protection, and the potential impacts of structures on recreational beaches, non-structural shore protection options should be considered and implemented if feasible, and shore protection should be implemented in association with other hazard mitigation strategies. This is a more cost effective long term strategy.

Although the concept of hazard mitigation is a relatively new one, its potential for reducing storm damages along the coast is very high. Many of the recommended hazard mitigation techniques, particularly downzoning, oceanfront setbacks and acquiring oceanfront property, dirctly contrast existing development practices along the New Jersey coast. It must be realized, however, that future coastal development should incorporate new ideas to mitigate coastal storm damages. The ideas as discussed in this report have been successfully applied at several coastal locations in the United States. Comprehensive development plans which incorporate coastal storm hazard mitigation are increasingly needed in New Jersey's densely developed coastal municipalites. Hopefully this report will serve as a catalyst for redefining planning objectives at the local level and realizing the inherent danger of increased development along the Atlantic Ocean.

The report makes the following major conclusions and recommendations.

1. Because of the densely developed nature of the study area, and the associated high property values, hazard mitigation techniques may have to be implemented primarily as a post storm program.

2. Coastal municipalities should reevaluate their master plans and zoning ordinances in light of coastal storm vulnerability.

3. Because funding for shore protection projects is very limited and shore protection costs are high, coastal municipalities that make a concerted effort to mitigate future storm damages should receive higher funding priority.

4. A public awareness/education program is needed for the public to learn why hazard mitigation is such an important planning element.

5. Each coastal municipality should request that FEMA include wave runup data on the Flood Insurance Rate Maps.

6. Coastal municipalities should initiate a structural inspection program to determine whether buildings are adequately anchored to foundations and provide guidelines for anchoring.

7. Each oceanfront municipality should adopt and enforce an effective beach and dune ordinance to protect the beach area and promote dune building, planting and maintenance.

8. Dune fields should be created where possible and enhanced where existing.

9. Each oceanfront municipality should establish oceanfront setbacks.

10. Oceanfront property should be acquired for conservation purposes where possible.

11. All oceanfront property presently in municipal ownership should be retained in municipal ownership, preferably for open space or recreational use.

12. Property owners should be advised to install protective shutters on windows and glass doors and minimize use of wide paned glass.

13. Municipalities should institute programs for inspection, repair and reinforcement of bulkheads and seawalls.

14. Each municipality should review its zoning in terms of maximum population at full build out and consider downzoning in light of evacuation capabilities. Studies should be made to consider the feasibility of increasing the capacity or raising the elevation of escape routes, considering costs, environmental constraints and accessibility due to flooding of approaches.

PART I: HAZARD MITIGATION AND RECOVERY PLANNING

A. INTRODUCTION

The New Jersey coast faces the constant threat of damage from hurricanes and northeast storms. While there has been a marked lull in the number of severe storms that have struck the Jersey shore in the past 20 years, coastal scientists and residents generally agree that another major storm is inevitable. At the same time, development along the coast has continued despite recent downturns in construction activity elsewhere. The population and property now at risk far exceed that which existed at the time of the most destructive storm in recent memory, the March 1962 northeast storm. Furthermore, due to the sometimes imperceptible retreat of the shoreline, accelerated by increasing sea level rise, the beaches afford less natural protection today than in the past.

Coastal erosion continually threatens the densely developed New Jersey barrier islands. This problem, first recognized in the mid-1800's, has required large capital expenditures to complete shore protection projects, including groins, jetties, bulkheads, seawalls and beachfill. The need for high cost shore protection has increased significantly over the past twenty years, primarily as a result of increased coastal development. With 45 municipalities fronting the Atlantic Ocean, the competition for shore protection funding in New Jersey can be expected to increase and therefore, spending in New Jersey can be expected to continue to increase accordingly. Brigantine, Absecon Island and Ocean City experience severe erosion problems, have limited access routes and high seasonal populations, and are experiencing rapid growth. Therefore, they were selected for this study of coastal storm preparedness. Table 1 and Figure 1 indicate that at least $17.4 million was spent for shore protection in the study area from 1960 through 1984.

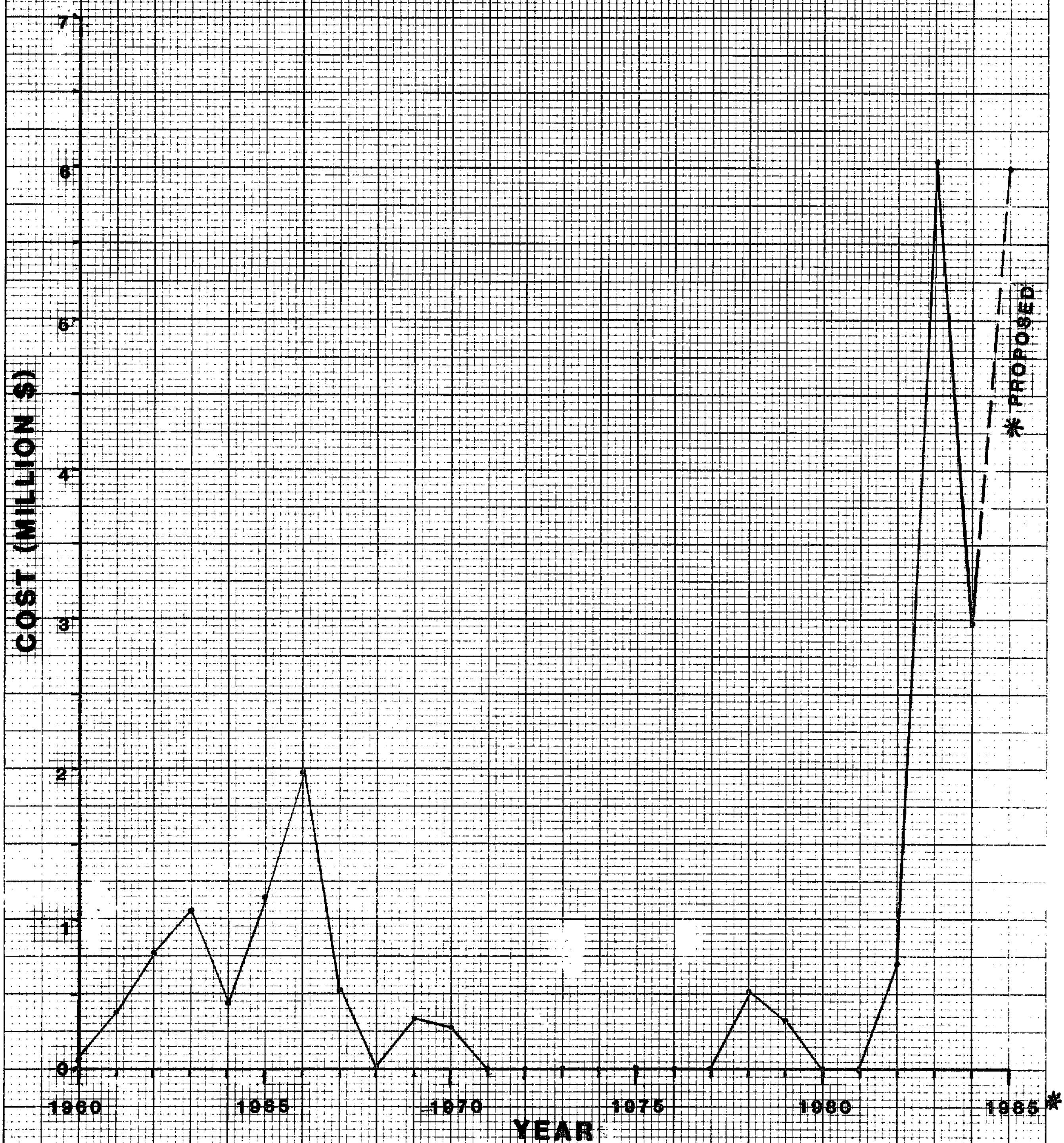


FIGURE 1 : SHORE PROTECTION SPENDING BY YEAR

TABLE 1: SHORE PROTECTION COSTS BY MUNICIPALITY 1960-1984*

MUNICIPALITY	STATE SHARE	LOCAL SHARE
Brigantine	$1,460,246	$418,989
Atlantic City	4,963,021	1,025,669
Ventnor	0	0
Margate	127,930	0
Longport	653,144	219,442
Ocean City	6,742,165	1,822,271
Totals	$13,946,506	$3,486,371

Ventnor received no oceanfront shore protection money from 1960-1984, and Margate spent less than $130,000 during the same time. Because of their downdrift location, these two cities were the recipients of much of the beachfill placed on the Atlantic City shore. The beaches of Ventnor and Margate, although not very high, were wide enough to maintain some degree of oceanfront protection.

Despite the downtrend in shore protection spending during the 1970's, increased expenditures are anticipated in the future. The relatively small amount of money directed to study area projects during this period was due primarily to a statewide financial crisis which reduced all shore protection funding.

With the prospect of continued erosion and increasing shore protection costs, the state and federal governments are examining various alternatives. One of these alternatives is hazard mitigation through land use controls. Because erosion cannot be completely controlled, the damaging effects of erosion should be mitigated to the maximum extent possible. The increasing cost of erosion control and shore protection can be moderated through comprehensive storm hazard mitigation techniques involving land management. Land management is a more cost effective long range solution to the erosion problem than many of the current structural shore protection methods.

*Although records of certain known projects were not found, this list represents nearly the total amount spent on shore protection. Shore protection projects include construction and maintenance of groins, bulkheads, seawalls, jetties, and the placement of beachfill.

It is realized that development cannot be prevented or eliminated, but the recreational, intrinsic and strategic worth of barrier islands is such that intensive and committed policies consistent with the preservation and enhancement of barrier islands are imperative (National Science Foundation, 1980). Traditional development patterns need to be modified at the local level in order to achieve sound development and resource protection goals.

The information contained in this and a companion Coastal Storm Vulnerability Analysis (NJDEP, 1984a) was assembled in response to the increasing threat of a major coastal storm, of which the March 1984 northeaster was merely a rude reminder. Comprehensive storm preparedness can be viewed as a series of six related activities as adapted from McElyea et al., 1982 and Haas et al., 1977 (see Figure 2).

1. Mitigation involves activities which reduce the potential damage and loss of life caused by a major storm; these activities are not tied to a specific disaster, but arise from a long-term concern for avoiding damage.

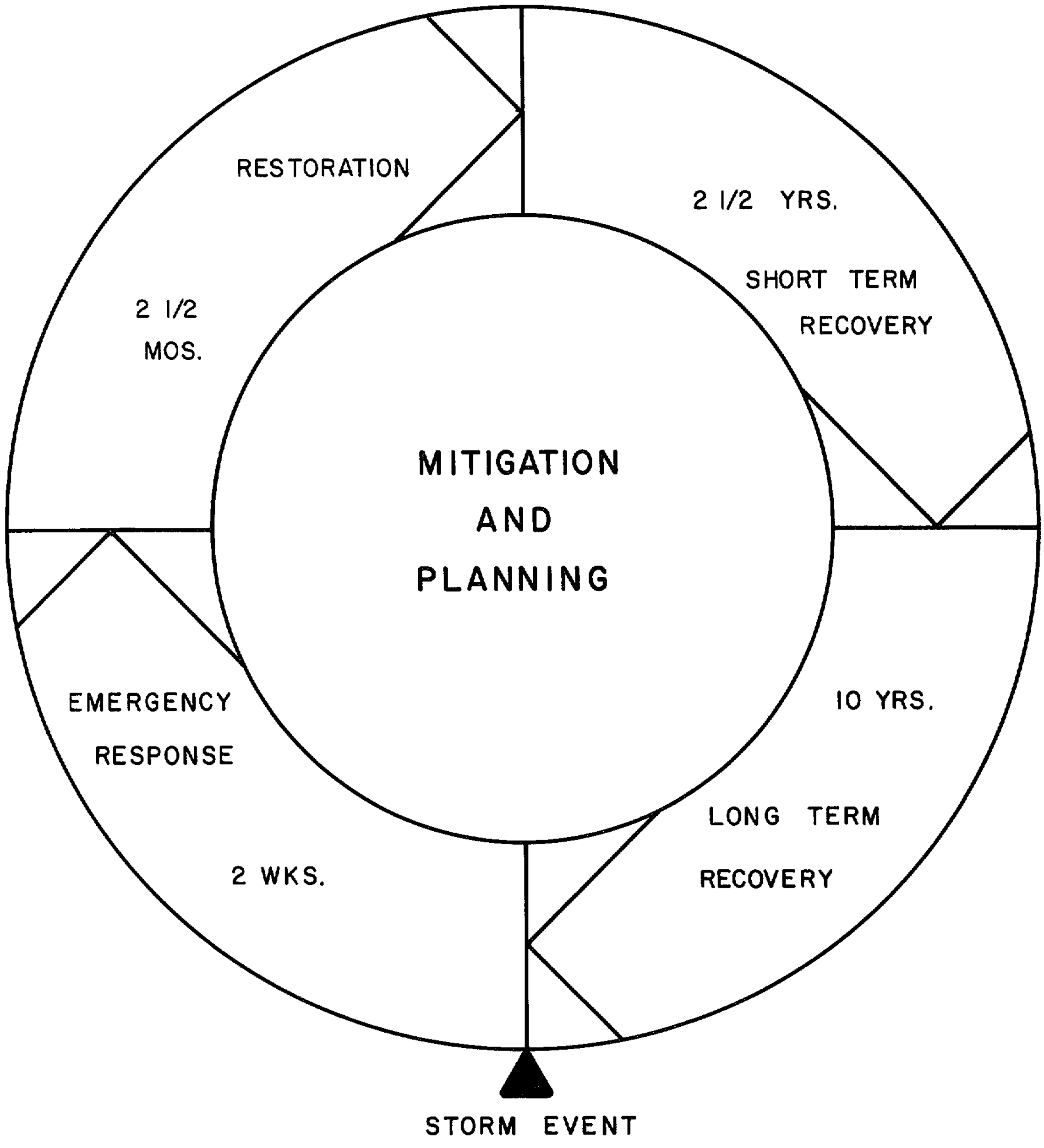
2. Planning, for each of the following post-storm activities, entails anticipating key problems and needs arising from a major storm, identifying methods and resources to ameliorate them and generally preparing, well in advance of a storm, for the quick and rational mobilization and deployment of available resources.

3. Emergency Response activities immediately precede a particular disaster in the form of evacuation and, following the disaster, include search and rescue operations and provision of emergency housing and medical care.

4. Restoration involves repairs to damaged infrastructure, debris removal and other quick remedies and improvements to essential services that enable the community to function, however marginally.

5. Short-term Recovery encompasses the period of several years after a storm during which the full range of repair and reconstruction activities are completed to return the community to pre-storm levels of social and economic vitality (i.e., "normalcy").

FIGURE 2: HAZARD MANAGEMENT ACTIVITIES



ADAPTED FROM RECONSTRUCTION FOLLOWING DISASTER (1977) AND BEFORE THE STORM : MANAGING DEVELOPMENT TO REDUCE HURRICANE DAMAGES (1982)

6. Long-term Recovery constitutes those projects that better the community often by commemorating the storm event, educating the public, and providing added protection from future storms.

The Coastal Storm Preparedness Study, of which this report is the third and final study phase, addresses the full range of problems and issues arising from the activities described above. The principal objectives of the study are to enhance New Jersey's capability to respond in an integrated, planned manner to major storms and, where possible, minimize the potential loss of life and property in the State's densely populated coastal zone. The study encompasses the three barrier islands in and around Atlantic City (see Figure 3). These islands contain the Atlantic County municipalities of Brigantine, Atlantic City, Ventnor, Margate and Longport, and Ocean City in Cape May County. These six municipalities have a total year round population of 84,600 (1980 census) and an estimated peak daily seasonal population of 425,000 (Mitchell, 1984). Each island is densely developed and is connected to the mainland by one or more causeways.

The Coastal Storm Preparedness Study was conducted in three parts:

Phase I -- Vulnerability Analysis identifies hazard areas and the degree of potential loss of life and property damage that may be incurred from a 100-year storm. Shore protection structures are mapped and their ability to withstand an onslaught of wind, water and waves is postulated. Seasonal and non-seasonal (year-round) populations on the barrier islands are estimated. The value of structures in particularly vulnerable portions of the study area is tabulated along with the amount of insurance in force.

Phase II -- Emergency Response Planning involves the preparation of a sample severe weather plan which describes activities and responsibilities during such an emergency and includes evacuation procedures which were presented and explained to local officials. The New Jersey State Police, Office of Emergency Management, and the local emergency management coordinators are continuing to work together to develop specific severe weather plans for each municipality.

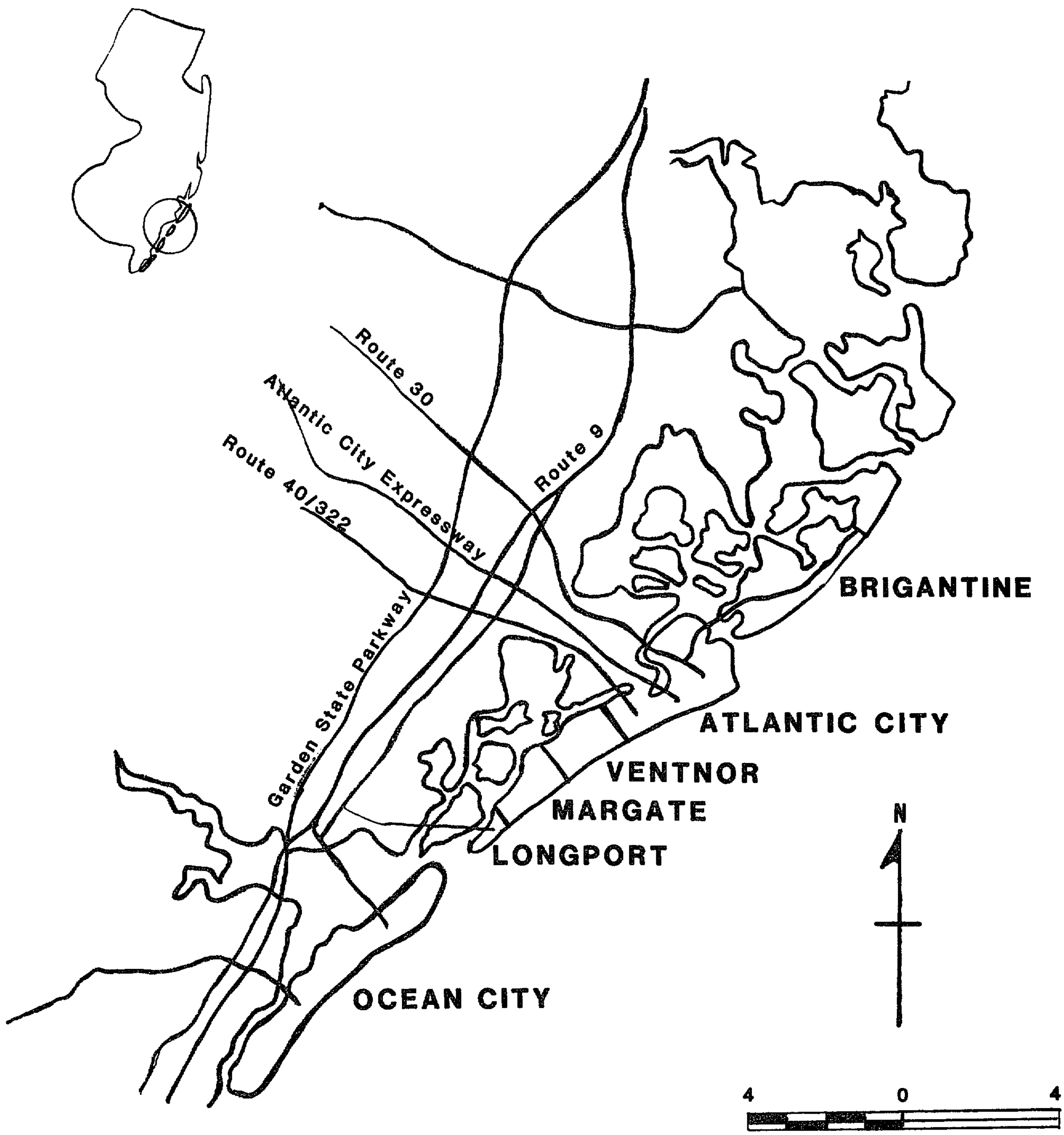


FIGURE 3 : STUDY AREA

Phase III -- Hazard Mitigation and Recovery Planning, the focus of this report, presents general strategies and site-specific recommendations to reduce the State's vulnerability to damage from coastal storms in the study area. The adoption of the recommended storm mitigation measures in the form of a post-storm redevelopment plan would enable a municipality to more quickly recover from a major coastal storm and incur less damages and costs in future storms. Furthermore, it would facilitate the response of various state and federal agencies to any disaster declaration, as well as assist the municipality to have greater input in the post-disaster recommendations of such agencies (e.g. the Interagency Hazard Mitigation Team).

At a minimum, it is hoped that the several volumes that constitute the Coastal Storm Preparedness Study will increase the awareness and understanding of both the destructive forces of coastal storms and the prospects for minimizing potential losses through sound development practices.

B. BARRIER ISLAND PROCESSES

Barrier islands are dynamic land forms subject to life threatening flooding and other storm related damages. Geologically, New Jersey's barrier islands are young and extremely mobile. Formed originally on high areas between old river valleys, New Jersey's barrier islands developed further offshore than where presently located (Halsey, 1979). Made of unconsolidated sands, silts and clays, these islands are easily moved by natural processes. Rising sea level has caused the barrier islands to slowly migrate landward and upward in space and time to their present position.

Major storm processes are also intricately linked to this migration. The energy associated with major storms accounts for most of the movement of sediment landward and upward on barrier islands.

Despite development and structural alterations, most beach and dune systems are maintained in balance by sediment restored back to the beaches during calm periods subsequent to erosion during storms. This usually takes days or weeks, and sometimes months, depending on the severity of the storm. Severe storms occur under low pressure atmospheric conditions which cause a local sea level rise to occur. This local sea level rise, combined with heightened wave formation, enables storm waves to strike and quickly erode the beach and dune system farther inland. Post-storm fair weather waves are less effective at picking up the sand from the nearshore and redepositing it back onto the beach.

The most important processes in shaping barrier islands are winds and waves combined with tidal movements. Winds and waves combine to produce longshore drift, which is defined as the movement of sediment in the nearshore zone. Major storms with winds from the northeast are responsible for moving the majority of sediment along our coast. This predominantly southerly sediment movement is opposed by prevailing lighter intensity winds whose waves move less sediment but occur more frequently in time. If there is a period of lower frequency and intensity of storms, most beach areas will appear to be in a state of equilibrium, because less sediment has been removed by storms.

On the northern end of drumstick shaped barriers such as Absecon Island and Peck Beach (Ocean City), there are two critical erosion areas: the inlet section and the nodal zone (see Vulnerability Analysis for complete discussion of geomorphology). Depending on the location of the main ebb channel or any welding shoals, these two sections may become one large erosion zone during storms. The inlet section of a drumstick barrier island is one of the most repetitively damaged and flooded areas on a barrier island, in part because it is usually the most seaward in location, is situated adjacent to the deepest portion of the inlet channel, and is usually oriented to directly receive the northeast storm waves. Because of this potential for damage, this area on developed barrier islands is usually the most structurally fortified section of the island, even though these structural measures are not altogether effective and quickly fall into disrepair.

1. Nodal Zones

The nodal zone is the area at which the predominant direction of littoral drift diverges (American Geological Institute, 1962). Along New Jersey's barrier islands, a nodal zone is often characterized by increased erosion due to a lack of sediment remaining in the area. Because the direction of longshore drift diverges in the nodal zone, sediment is moved out of the area. The narrow beaches within the nodal zones are then more susceptible to damage from coastal storm erosion and flooding. However, due to inlet channel changes, the position of a nodal zone can shift, and therefore, the hazard to the adjacent beach areas can also change. This shift can occur seasonally or can happen over a period of years, thus changing the erosion pattern of the area. Therefore, it is imperative that observations and measurements of the littoral environment be made to identify the location and movement of a nodal zone before shore protection projects or substantive changes to the oceanfront are contemplated.

2. <u>The "Ideal" Barrier Island</u>

Pilkey and Neal (1980) illustrated their concept of an ideally developed island as one which is both aesthetic and safe (Figure 4). The "ideal" island would allow dynamic coastal processes to go on relatively unhindered, without shorefront stabilization. This concept of development provides recreational benefits and safety at minimum cost. Although such an island does not exist in New Jersey, this view enables us to see clearly how past development practices have increased the potential hazard from coastal storms, and the cost of protecting barrier island residents and property.

3. <u>Storm Frequency</u>

The New Jersey coast is vulnerable to damage from both hurricanes and northeast storms. The risk of living on barrier islands has changed over time as a result of the historical variations in storm frequencies and because shoreline erosion constantly makes property that is close to the sea more exposed to the perils of high energy waves and storm surge (Dolan and Hayden, 1980). Figure 5 indicates the number of damaging coastal storms affecting the eastern United States between 1923 and 1984. There appears to be a cyclic pattern to the frequency of damaging coastal storms, with alternating periods of high and low frequency. As coastal development continues to increase and sea level continues to rise, an increase in the frequency of damaging storms can be expected.

4. <u>Hurricanes and Northeasters</u>

The storms which present the greatest hazard to New Jersey's coastal zone are hurricanes and northeast storms. These storms have historically caused significant shore erosion and associated property damage. Although these storms can be equally devastating, they are two very distinct storm systems.

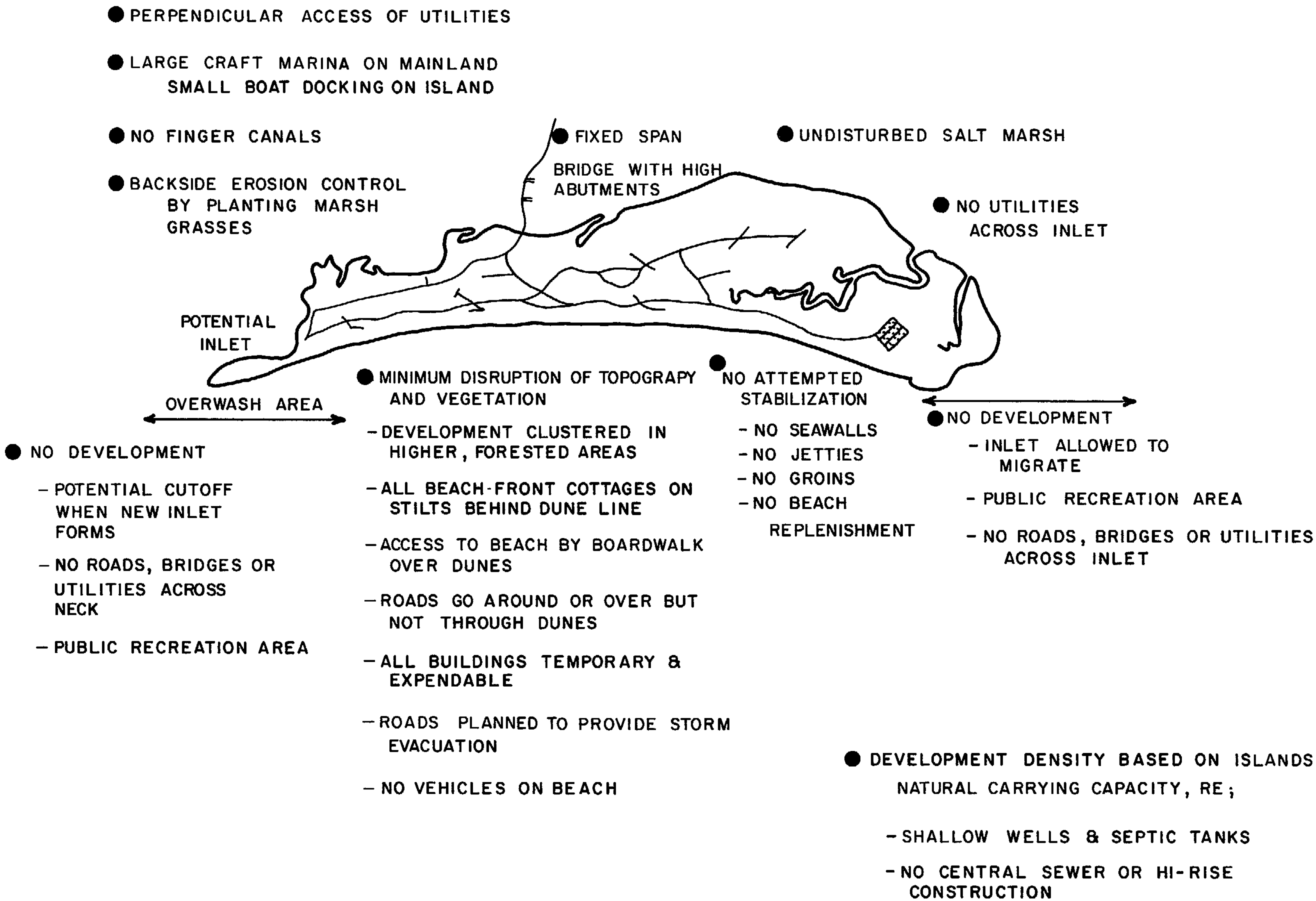


FIGURE 4 : THE IDEAL ISLAND

SOURCE: PILKEY AND NEAL, 1980

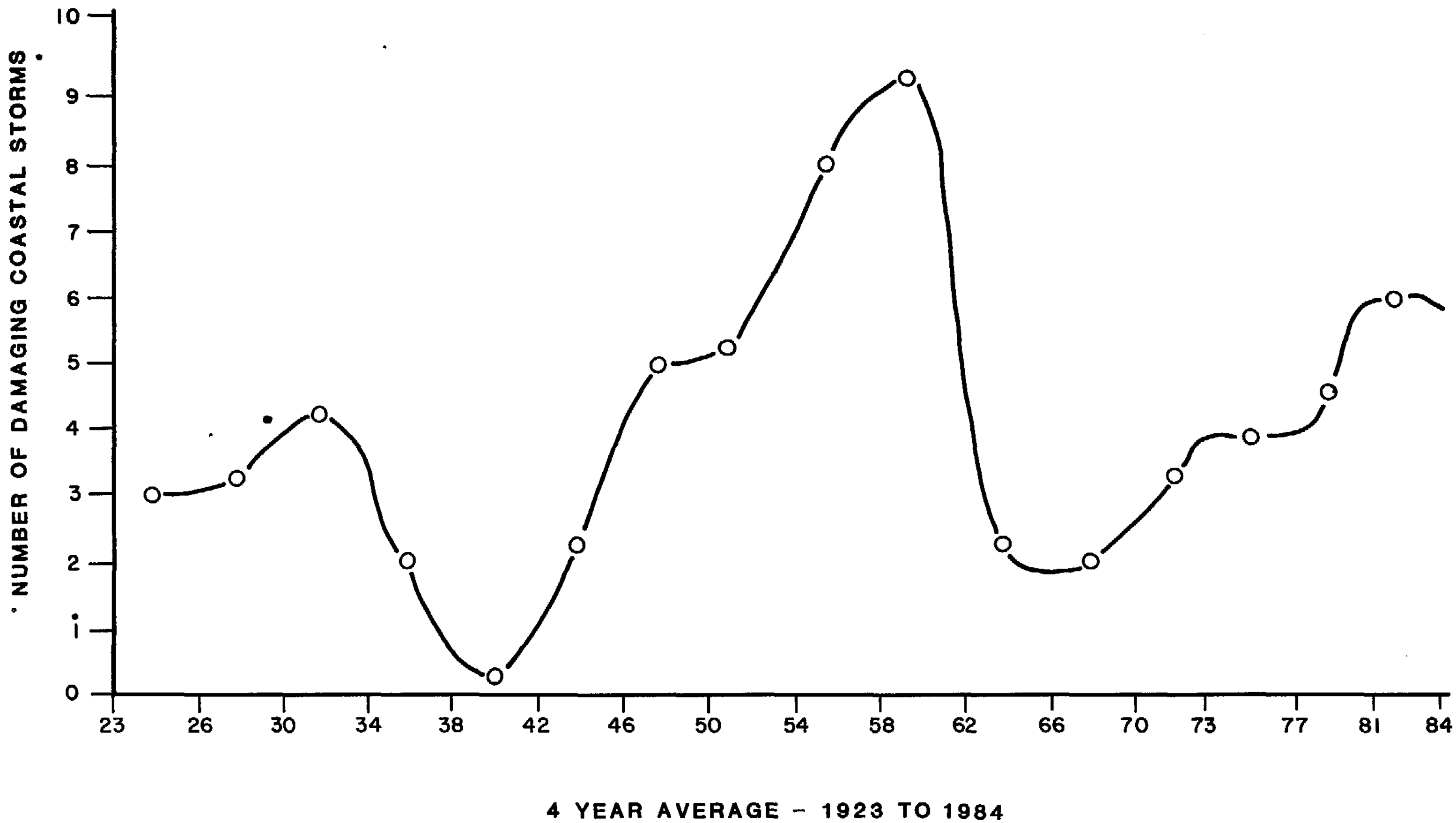


FIGURE 5 : NUMBER OF DAMAGING COASTAL STORMS - EASTERN UNITED STATES

SOURCE:

1923-1962 MATHER ET AL. (1964)

1962-1973 RICHARDSON (1977)

1973-1984 NJDEP (1981, 1984)

NOTE: 1981-1984 IS A 3 YEAR AVERAGE

Hurricanes are formed over the warm waters of the Gulf of Mexico, Caribbean Sea or Atlantic Ocean, and are classified as having winds of 74 m.p.h. or higher. Although the duration of a hurricane is relatively short, the intensity of hurricane wind, waves and associated storm surge produces the greatest hazard to coastal residents in New Jersey. In addition, because hurricanes require warm ocean water to maintain the storm's intensity, they occur in summer and early fall, the period when the coast is most heavily populated.

Extratropical storms, better known as northeasters, usually develop as low pressure systems that slowly move offshore. Accompanying winds, although not usually of hurricane force, blow onshore from an east-northeasterly direction for sustained periods of time. Because of the often slower moving nature of these storms, their duration may be longer (up to several days), and the resulting damage may ultimately exceed the destruction from a hurricane.

Perhaps the biggest difference between the two types of storms is that northeasters are usually more predictable than hurricanes in track and intensity. Due to more accurate forecasting, better pre-storm evacuation and preparation measures can be initiated. It should also be recognized that astronomically high tides can significantly increase the potential for coastal erosion, flooding and property damage during either type of storm.

5. <u>Destructive Components of Storms</u>

Coastal storms present a significant hazard along the New Jersey shore in several ways. The large number of barrier island inhabitants, the density and type of development, the low island elevations and the low elevation and limited number of barrier island access/egress routes combine to create a potentially dangerous storm scenario.

Storms acting on barrier islands often modify them by two important processes: overwash and inlet formation. Overwash occurs when the combined effects of erosion, wave runup, and storm surge cause the water to overtop the barrier beach, channeling water and sand toward the bay. Tidal inlet breakthroughs can be formed on barrier beaches during storms, often as a result of overwash events (Aubrey, 1980). The individual destructive components of coastal storms are described below.

Wind - The strong winds which accompany coastal storms and hurricanes can be very damaging in several ways. Sustained winds, over 74 m.p.h. (and upward of 150 m.p.h. for a Category 5 hurricane) for a hurricane, exert tremendous pressure on buildings and threaten their basic structural integrity.

Roofs, siding, decorative edgings, and windows are especially vulnerable to wind damage. Strong winds also transfer energy to the sea surface, resulting in increased wave heights, periods and energy.

Storm Surge - During storms, reduced atmospheric pressure and strong winds pile up water along the coast, causing a temporary local rise in sea level known as storm surge. The surge associated with coastal storms and hurricanes usually consists of three parts (Gross, 1972): 1. a slow, gradual rise in water level beginning several hours before the storm's arrival, 2. a sharp rise in water level as the storm center passes (surge), and 3. a rise and fall of sea level as the resurgences or oscillations set up by the storm pass. Combined with high energy storm waves and astronomically high tides, storm surges can be extremely destructive.

Waves - Storm waves increase the hazard to coastal areas because a) the wave height is increased, and b) the wave period is increased. The resulting high energy waves reach the shore in quicker succession, thereby speeding up the process of beach erosion and coastal flooding. As more beach is eroded, more property is exposed to storm waves, and the risk of damage greatly increases. As storm waves destroy beachfront structures, the wreckage creates another serious hazard. This debris can be propelled by waves and currents, battering other structures along the way.

Sediment transport in the offshore direction on the beach face is a result of high energy storm wave action. Short period high energy waves tend to flatten the beach profile, eroding the dune-berm and forming a scarp (cliff). The formation of a scarp is intensified by oblique wave approach and alongshore swash movement. Wave swash moving alongshore hastens erosion at the base of the scarp by undercutting the dune-berm and transporting the eroded sediment downdrift and offshore.

Tidal Flooding - Coastal flooding in New Jersey is due primarily to landward flows caused by high tides, waves from strong winds and storm surge. Tidal floods can also be caused by the combination of waves generated by hurricane winds and runoff resulting from the heavy rains that accompany hurricanes. Most severe tidal floods are caused by tidal inundation generated by high winds superimposed on the regular or spring cyclic tides. Hurricanes are the primary source of the extreme winds. In the case of tidal floods associated with hurricanes, the high velocities of hurricane winds often produce storm surges of four to five feet above normal for a category 1 hurricane, and greater than eighteen feet for a category 5 hurricane (Neumann et al., 1981). Both types of storms often cause water to build up in the bays and creeks behind barrier islands. As the tide ebbs, the winds prevent water from draining out through the inlets and the next flood tide causes even higher tidal levels.

Sea Level Rise - The damaging effects of coastal erosion are amplified by the continued and gradual rise in sea level which has been occurring since the melting of the Pleistocene glaciers approximately 15,000 years ago. The change in sea level along the New Jersey coast is dependent largely on this change in the polar ice mass, which in turn depends on numerous climatic and atmospheric variables. A tectonic component, which may also affect the local rate of sea level rise, is difficult to quantify and, therefore, scientists use the term "relative" in describing sea level change.

Measurement of tidal levels in Atlantic City from 1940-1970 indicates that local relative sea level is rising at a rate of approximately one foot per century (NJDEP, 1981). Because of the low elevation and gentle slope of most New Jersey barrier islands, a slight vertical rise in sea level can result in a significant horizontal displacement of the shoreline. This results in more land being subjected to erosive forces of the ocean. In a natural state, a barrier island will tend to migrate landward and upward in response to rising sea level. However, when barrier islands are extensively stabilized, movement of sand from the ocean beach landward to the bayshore is prevented, and the island may drown in place. This seems to be happening on many New Jersey barrier islands.

C. PEOPLE AND PROPERTY AT RISK

The potential for loss of life and damage to property from a severe coastal storm or hurricane is high, though not uniformly high, throughout the study area. For example, a beachfront block in the casino district of Atlantic City has been assessed at over 170 million dollars (1982 dollars) while many interior blocks carry assessments of less than one million dollars. Likewise, a wide disparity in property values occurs along the beachfront of the study area.

The variation in property values, and the corresponding population densities, provide a basis for determining the benefits of alternative mitigating techniques as well as their likely costs. But whatever the potential loss in any particular section of a community at this time, the area becomes increasingly vulnerable as population grows and land values escalate. For the same reason that the risk of loss will increase with time, opportunities for hazard mitigation will decrease.

1. Population Trends

Over the last two decades the six municipalities in the study area experienced a net decline in year-round residents of 7%. This statistic conceals the fact that 4 of the 6 communities grew substantially during this time frame (see Figure 6 -- Margate changed little). Only Atlantic City experienced a sharp decrease in year-round residents between 1960 and 1980. A resurgence, owed largely to the introduction of casino gambling in 1976, is anticipated to continue through the end of the century. Based on both economic and demographic factors, a 31% population increase is projected between the years 1980 and 2000 for the study area communities (N.J. Department of Environmental Protection, Division of Water Resources, Bureau of Planning and Standards).

The State does not have a clear handle on the number of people on the barrier islands at peak times. The New Jersey Shore Protection Master Plan (NJDEP, 1981) includes population statistics and seasonal population ratios by municipality. A more recent study of tourism in New Jersey (NJDEP, 1984c) includes estimates of shorefront visitors by municipality and by type of accommodation. Each of these sets of figures was used by James K. Mitchell (1984) to estimate peak summer populations in New Jersey's coastal municipalities and thus derive high and low peak population estimates (Table 2). No seasonal population ratios were available for Absecon Island, so the high peak population was estimated as twice the low peak.

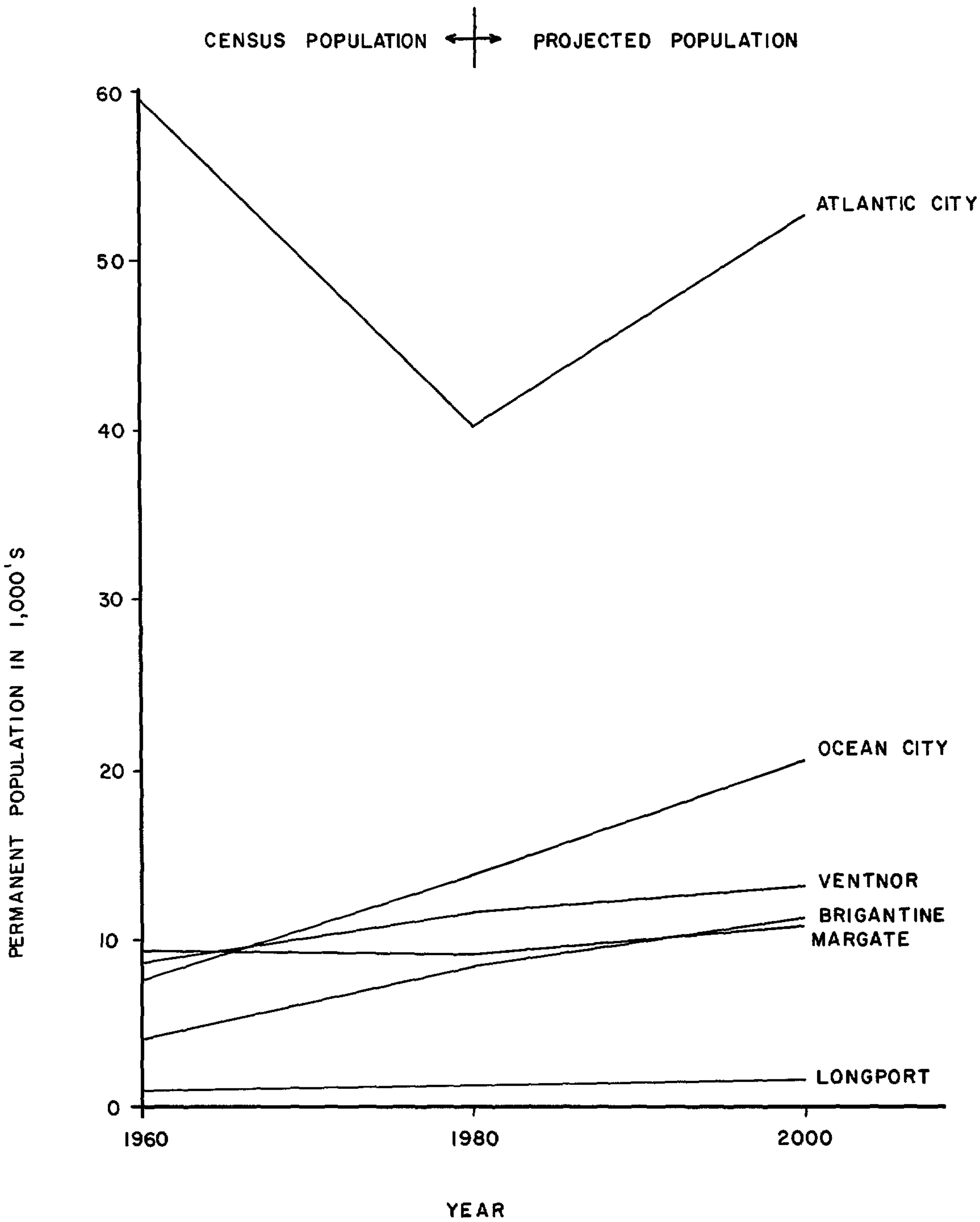


FIGURE 6: POPULATION STATISTICS

SOURCE: U.S. CENSUS, 1980

TABLE 2: PEAK SUMMER POPULATIONS

Municipality	High Peak Population Estimate[1]	Low Peak Population Estimate[2]
Brigantine	22,445	14,691
Atlantic City	683,596	341,798
Ventnor	34,050	17,025
Margate	29,830	14,915
Longport	6,162	3,081
Ocean City	136,700	34,631

[1]Estimates from NJDEP (1981)
[2]Estimates from NJDEP (1984c)

Since the number of visitors to these barrier islands during the tourist season already greatly exceeds the number of year-round residents, the difficulty of safely carrying out a full-scale evacuation becomes evident. Should an increase in visitors approaching that of permanent residents occur over the next two decades, an already questionable evacuation capability will become clearly inadequate.

Evacuation times were estimated by Mitchell (1984) using both of the peak summer population estimates shown in Table 2 and assuming different traffic volumes (Table 3). The traffic volume is assumed to be either at capacity or at what is defined as the 30th peak hour volume. The latter is a frequently used figure in roadway design representing the 30th highest hourly volume measured over a long period (e.g. a month or a year) and is described by Mitchell as "typical rush hour traffic on a normal summer day".

TABLE 3: LOCAL EVACUATION TIMES IN HOURS[1]

Community	High Peak Population Estimate			Low Peak Population Estimate		
	Number of People	30th Peak Hour Traffic Flow	Capacity Traffic Flow	Number of People	30th Peak Hour Traffic Flow	Capacity Traffic Flow
Absecon Island	783,020	16.4	12.4	391,510	9.0	7.1
Ocean City	136,700	14.0	10.4	34,631	5.0	4.1

[1]Taken from Mitchell (1984)

These evacuation times are based on the following assumptions: (1) populations at risk are as shown in Table 2; (2) all evacuation is carried out by road; (3) no persons remain in communities at risk after evacuation is complete; (4) evacuation vehicles carry an average of 4 passengers; (5) two lane evacuation routes carry only outbound traffic while one lane of four lane routes remains open for inbound and emergency vehicles; (6) there is a uniform reaction of 1.0 hour in all communities at risk; (7) non-delayed travel time to safe locations varies from 1.0 hour (Long Beach Island to Absecon Island) to 2.0 hours (Cape May County); and (8) evacuees follow optimal routing and scheduling plans (Mitchell, 1984).

Mitchell's work indicates that the evacuation time for Absecon Island is on the order 7.1 to 16.4 hours. This includes Brigantine City which shares its evacuation route with Absecon Island. For Ocean City, evacuation time estimates are 4.1 to 14.0 hours. Note that these estimates are for evacuation of the barrier islands only, not for an evacuation of all low lying areas. A larger scale evacuation would affect Cape May County and increase the evacuation times for Ocean City.

Both Mitchell and the Division of Coastal Resources recognize the difficulty in accurately estimating peak summer populations, particularly for day visitors. The Division feels that the estimates derived from the tourism study (NJDEP, 1984c) are more accurate, as population studies were a major focus of the study and figures were carefully validated. Thus the evacuation times of 7.1 to 9 hours to evacuate Absecon Island and 4.1 to 5 hours to evacuate Ocean City are felt to be more realistic.

The National Hurricane Center has indicated that it is unlikely to be able to issue a Hurricane Warning for the New Jersey coast more than 12 hours before hurricane conditions occur. Furthermore, the Coastal Storm Vulnerability Analysis (NJDEP, 1984a) indicated that most available escape routes will be inundated 2 to 3 hours before the center of the storm passes. Mitchell noted that his evacuation time estimates do not take into account the closure of roads due to high winds or water. When all of this information is taken into account, it is apparent that if the high peak population estimates are correct, the evacuation times for Brigantine, Absecon Island and Ocean City already exceed the time period likely to be available between issuance of a Hurricane Warning and closure of evacuation routes. If the low peak population estimates are correct, the evacuation time approximately equals available time for Brigantine/Absecon Island and is about one half of the available time for Ocean City. In either case, a large number of people are at risk on these islands and may be unable to escape should a hurricane strike.

2. Assessed Values

The value of structures in the first block along the beachfront is placed at over 1½ billion dollars for the six municipalities (see Table 4). This figure represents 37% of the total value of structures in the municipalities although the beachfront block constitutes only 8% of the total land area. Thus, the most vulnerable property is also the most valuable, owing both to the oceanfront vantage. The low value per acre in Brigantine reflects its less developed, more residential character.

TABLE 4: MARKET VALUE OF PROPERTY IMPROVEMENTS IN $1000's*

Municipality	BEACHFRONT BLOCK Total	BEACHFRONT BLOCK Per Acre	% of Total	ENTIRE MUNICIPALITY Total	ENTIRE MUNICIPALITY Per Acre
Brigantine	$ 99,724	$237	29	$347,400	$85
Atlantic City	1,076,184	2,131	49	2,195,316	290
Ventnor	122,916	1,217	31	395,225	294
Margate	112,558	1,237	23	496,462	554
Longport	46,200	1,050	45	103,258	538
Ocean City	184,514	549	21	893,844	240
TOTAL	$1,642,096			$4,431,505	
AVERAGE		$1,097			$249

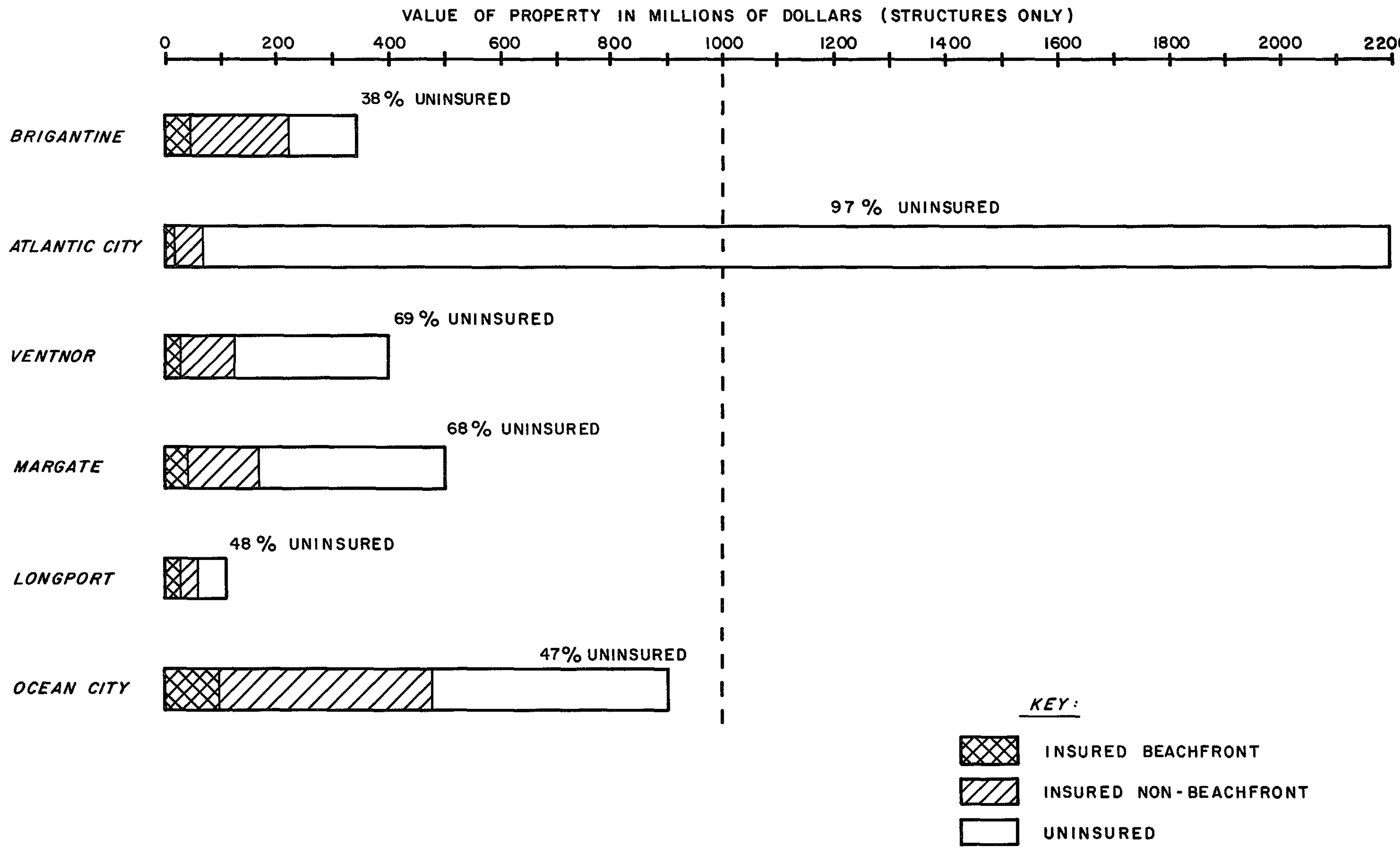
* Based on 1982 Tax Books with 1983 equalization ratios applied to assessed value of improvements; excludes value of land and contents of structures.

3. Insurance in Force

Nearly three-fourths (71%) of the federal flood insurance coverage in New Jersey insures structures in coastal municipalities, 25% in the study area alone. While sizeable, the 25%, which equates to over 1.2 billion dollars, covers only about one fourth of the 4.4 billion dollar total value of improvements in the six municipalities. The percentage of exposed risk, that is, the percentage of the total value of property that is not covered by flood insurance, ranges from 38% in Brigantine to 97% in Atlantic City (see Figure 7).

D. STORM HAZARD MITIGATION STRATEGIES

Storm hazard mitigation strategies are means by which loss of life, injuries to people and damages to property caused by coastal storms can be decreased. This section addresses general strategies which have been used to reduce property damage due to storms in various parts of the country, with examples from a number of states. Not all strategies would be feasible in each municipality in the study area. The mitigation strategies fall into five categories: land acquisition, land use controls, shore protection, construction standards and control of infrastructure construction, which are discussed in detail.



SOURCE: NJDEP , 1984a

FIGURE 7 : FLOOD INSURANCE COVERAGE

Each of these can be implemented either prior to a storm or to guide reconstruction and redevelopment after a storm has caused significant damages.

1. <u>Land Acquisition</u>

Acquisition of land in high hazard areas for conservation, shore protection (e.g. dune creation) and public safety purposes is one strategy available for storm hazard mitigation. In addition to decreasing a municipality's vulnerability to storms, the public acquisition of lands increases public access to the shore and recreational opportunities, although access to dune areas would be restricted to preserve the dunes as protective features. There are several drawbacks to the approach, primarily the high cost of acquiring developed waterfront properties and the loss of tax ratables to the community. If the acquired property provides public access for recreation, the lost property tax revenue may be offset by increases in recreational income from beach fees or recreation related expenditures and the resulting tax revenue. In some cases, businesses and residences could be relocated within the municipality, thereby minimizing the revenue loss to the municipality. In addition, the reduction in storm damages would save the municipality in the cost of post storm clean up and repairs.

Funding for land acquisition is the critical and most important aspect of the program. The high level of development in New Jersey's coastal zone has caused property values to soar, making acquisition a very expensive option.

In addition to the funding methods discussed in the funding section (Part I, Section G), municipalities may be able to exchange public properties located outside of high hazard areas for target hazard prone properties, either with or without monetary consideration. Local governments may also acquire land through condemnation (police powers) with compensation.

The acquisition of target area properties can be accomplished either in fee-simple or less than fee simple (i.e. easements) purchases. Fee simple purchase would transfer the property rights and ownership completely. The purchase of easements would transfer some but not all of the property rights, while not transferring ownership. Easements may be either positive (allowing some use of the property) or negative (prohibiting some use of the property). Although easements cost less than fee simple purchase, they do not provide as much control over the property. Acquisition of development rights is discussed in Part I, Section D2.

Target acquisition areas should be identified and ranked prior to storm damage, based on the following natural and man-made physical factors as well as social factors.

a. Physical Factors

Erosion Rate and Beach Stability: Erosion hazard areas have been delineated using factors such as beach width and height, presence of dunes, sediment budget and density of development (Nordstrom et al., 1977; NJDEP, 1981). The presence of shoreline engineering structures has caused accelerated erosion, usually of adjacent, down-drift shorelines. Previous dune removal or encroachment has destroyed natural storm buffers and depleted large sand reservoirs. In addition, removal of beach vegetation has increased the potential for sediment transport and erosion. A high erosion rate would be heavily weighed in setting priorities for land acquisition.

Inlet Proximity: Inlets are by nature highly dynamic and, therefore, adjacent areas are subject to cyclic patterns of erosion and accretion which may change suddenly. Historical coastal charts provide a chronology of inlet migration and associated shoreline changes. Tidal inlet history can be examined to predict future movement and effects on the adjacent shoreline. For this reason, the New Jersey Shore Protection Master Plan has identified barrier island tips as primary acquisition targets and the State has purchased several of these areas (e.g. Corson Inlet State Park, Townsend's Inlet Waterfront Park, Barnegat Light State Park, Strathmere State Natural Area).

Island Breaching: By looking at historical records, areas of barrier island breaching and locations of former inlets can be identified. These areas are especially vulnerable to breaching during severe storms. Lagoonal development on the bay side of a barrier island reduces the width of the island by bringing water closer to the center of the island. This increases the susceptibility to breaching during a storm, usually from the back side of a barrier island, due to storm elevated water levels.

Overwash Areas: Previous overwash areas can be identified by examining storm damage records and aerial photographs. In addition, the system of roads in highly developed areas can act as a network of overwash passes during storms. Many roads perpendicular to the shore which provide access to the beach also provide flood channels for sand and stormwater.

Density of Development: Undeveloped sites should be prime acquisition targets because they serve as buffers to developed areas. Conversely, areas which have a history of high property damage and thus high hazard are also prime acquisition sites, though more likely to be available only in a post-storm setting.

b. Social Factors

Sites which have the potential for increasing the recreational use of and public access to the shore should be given high priority for acquisition.

Coastal land acquisition can be implemented as either a pre-storm or post-storm program. Pre-storm acquisition is preferable as it minimizes exposure of people and property to coastal hazards although it is more expensive. The level of coastal development and the associated property values create an economic obstacle for acquisition in much of the coastal zone. Because the value of structures in developed coastal areas is about equal to the value of the land, post-storm acquisition may be a more realistic approach (NJDEP, 1981) since the expected damage to structures during a severe storm will reduce the cost of post-storm acquisition.

Ideally, an acquisition plan identifying target acquisition sites would be developed prior to a major storm, consider the physical, social and economic factors discussed above and include an evaluation of potential funding sources. The acquisition plan could then be implemented immediately following a severe storm with accompanying damages.

2. Land Use Controls

Each municipality in New Jersey is required under the Municipal Land Use Law (N.J.S.A. 40:55D-1) to adopt master plans and zoning ordinances, by approval of the governing body. These plans and ordinances can designate and regulate areas subject to flooding and thus incorporate storm hazard mitigation. Among the mitigation measures which could be incorporated in zoning ordinances are the establishment of preservation/conservation zones, maximum development densities, and waterfront setbacks. A program can also be instituted for transferring development rights out of storm hazard areas.

If zoning ordinances were changed in a community to accomplish storm hazard mitigation, some existing uses would become non-conforming uses. The Municipal Land Use Law states that a non-conforming use may be repaired or restored in the event of partial destruction. This is generally taken to be less than 50% loss, although it may be otherwise defined by a municipality. In order for a storm mitigation plan to be effective, once a non-conforming dwelling unit or structure is damaged 50% or more, it should be permitted to be rebuilt only if it would comply with existing ordinances.

a. Density, Land Use and Setbacks: In order to reduce the danger to life and property from storms, the oceanfront area can be zoned at a lower density than areas further inland (e.g. single family homes, rather than multi-family and highrise structures), thus effectively setting limits to population and property exposed to storm hazards. Multi-family residences should be located on safer, interior portions of an island. The planned overall density (i.e. full build out under the Master Plan) should be closely related to the carrying capacity of the island. Carrying capacity includes such factors as realistic evacuation capabilities, water supply, sewerage and road capacities, and land area. Sanibel, Florida has been zoned using this approach to establish maximum allowable density (Butler et al., 1980). Ideally, the maximum allowable density would not exceed the ability of the population to be evacuated between storm warning and storm arrival. As noted previously, estimates indicate that two of the three barrier islands in the study area already exceed this density and Ocean City may exceed it, depending on which population estimates are accurate and whether a general or local (i.e. barrier islands only) evacuation is ordered. Therefore, it is essential for these municipalities to reexamine their zoning, and seriously consider downzoning, particularly in areas where full build out has not yet occurred.

Another means of decreasing the vulnerability to storms is to establish a conservation zone along the oceanfront. Only limited development would be permitted in this zone, and only if the development was designed to promote recreational use (for example walkways and gazebos over dunes for physical and visual beach access) or shore protection. The conservation zone may be defined to include only the beach, the beach and dunes, or extend further inland in high hazard areas. Protection of the beach alone is not adequate storm protection, and protection of beach, dunes and inland areas is ideal.

The definition of a dune is critical to determine the effectiveness and enforcement of any dune protection ordinance, and must at least include all dunes in existence at the time of enactment. Ideally, such ordinances should take into account the dynamic nature of dunes and protect them as they migrate. The definition of a dune may include areas which would under natural conditions have dunes, even if there is no dune at a given time. In some ordinances, the landward slope is not recognized as a part of the dune and has been weakened by heavy encroachment. Lastly, protection of secondary and tertiary dunes should also be incorporated in ordinances.

The establishment of setback lines beyond which no new development or redevelopment may occur is an extremely effective storm hazard mitigation technique. Setbacks can be established at either the state or the local level, through legislation or zoning regulations respectively. No development other than water dependent uses or support facilities for public recreational use would be allowed seaward of the setback line in the area of extreme high hazard. Setback lines may be established on the basis of erosion rate, distance from the shoreline, elevation, wave runup, existing shore protection structures and their anticipated useful life, limits of vegetation, presence of dunes, as well as other factors, or any combination of these. In order to be effective, the location of the setback line at a given site should change as conditions change rather than be stationary over time. Ordinances may incorporate language that provides for review and redesignation over time, usually a 2-10 year period.

Some states prohibit most development seaward of the setback, while others require special construction practices. The setback program and permitting authority reside with the state in some instances, and with county or local government in others. In any case, the local governments may establish more stringent setbacks.

In addition to the establishment of strict oceanfront setbacks, municipalities could provide for the relaxation of setbacks on the landward side of a property to enable development to occur further inland. In other words, a municipal ordinance may state that a project located on an oceanfront lot is not required to meet the standard side or rear yard setback. Such a provision would be particularly useful in rebuilding after a storm, to allow damaged buildings on previously developed lots to be rebuilt further inland.

Examples of land use legislation at the state level are discussed below.

Texas

The Texas Open Beaches Act (Section E, Chapter 61) defines beaches and affirms the rights of the public for access to and use of public beaches. In effect, this establishes a conservation zone on the beach. The Act defines public beaches as "any beach area, whether publicly or privately owned, extending from the line of mean low tide to the line of vegetation bordering on the Gulf of Mexico to which the public has acquired the right of use or easement to or over the area by prescription, dedication, presumption..." (61.001(5)). The Act prohibits creation, erection or construction of "any obstruction, barrier or restraint that will interfere with the free and unrestricted right of the public" to access the beach or use property abutting a state-owned beach. The attorney general or any county or district attorney may file suit to obtain court order to remove any obstruction or to prohibit interference with access and use.

As the vegetation line has retreated with storm erosion, in particular as a result of Hurricane Alicia in 1983, the State of Texas has condemned properties which were seaward of the new vegetation line and prohibited rebuilding of those more than 50% destroyed. This action is now the subject of law suits filed by the property owners involved. In two cases, the Texas District Court has ruled that the beach area to which the public has access changes as the vegetation line moves. One case involved a specific home which was not permitted to be rebuilt. The second ruling does not involve particular houses, merely the question of whether, after the hurricane, the beach is public up to the vegetation line. This decision may be appealed (Moran and Smith, 1984).

The Texas Natural Resources Code provides for county establishment of a dune protection line on barrier islands and peninsulas in order to preserve "sand dunes that offer a defense against storm water and erosion of the shoreline" (Chapter 63). The line may not extend more than 1000 feet inland of the mean high tide line. Permits are required for certain activities within such areas, and may be issued only where it is demonstrated that the activity "will not materially weaken the dune or reduce its effectiveness as a means of protection from the effects of high wind and water".

North Carolina

Pursuant to North Carolina's Coastal Area Management Act of 1974, the State Coastal Resources Commission has identified ocean hazard areas of particular environmental concern. Three categories of ocean hazard areas have been identified: Ocean Erodible Areas, High Hazard Flood Areas and Inlet Hazard Areas. State permits are required for major development in these areas.

In essence, the Ocean Erodible Area defines a setback line. This area is the shoreline which has "a substantial possibility of excessive erosion and significant shoreline fluctuation." The area extends from the mean low water line landward to a point determined by the vegetation line and the 100 year storm recession line. The setback line from the first line of vegetation is calculated by multiplying the average annual rate of erosion by 30, with a minimum setback of 60 feet. The Ocean Erodible Area also extends landward to "the recession line that would be generated by a storm having a one percent chance of being equalled or exceeded in any given year" (a 100 year storm) (N.C.A.C. 15:07H.0304(1)(b)). North Carolina's High Hazard Flood Area is the V-zone (coastal high hazard area) delineated on Federal Flood Insurance Rate Maps. Lastly, the Inlet Hazard Areas are high erosion shorelines located along inlets.

Standards have been developed by the North Carolina Coastal Resources Commission to guide permit decisions in Ocean Hazard Areas. These standards are of four types: erosion control, construction standards, setback requirements and regulation of public facilities. The erosion control standards require development to occur inland of the crest of the primary dune or the long term erosion setback line, whichever is furthest from the first line of stable vegetation. If this precludes any practical use of a lot existing as of June 1, 1979 the development may be seaward of the primary dune if it is located behind the long-term erosion setback line and it is not located on or in front of a frontal dune. Where no primary dune is present, the development shall be set behind the frontal dune or the long-term erosion setback line, whichever is furthest landward.

Certain uses may be permitted seaward of the oceanfront setback line, including sand parking lots, beach accessways, elevated decks, gazebos, storage sheds, temporary amusement stands and campgrounds that do not involve substantial permanent structures. These uses are permitted if they are inland of the vegetation line, involve no significant alteration or removal of primary or frontal dunes or dune vegetation, and have overwalks to protect dunes. In Ocean Erodible Areas, lots recorded prior to June 1, 1979 are not subject to strict setback requirements where that would preclude placement of permanent structures on the lot, although structures built on these lots must still be at least 60 feet landward of the vegetation line, entirely behind the landward toe of the frontal dune and setback on the lot the maximum feasible distance from the ocean (McElyea et al., 1982). The lowest habitable floor of the structure shall be no more than 1000 square feet or 10% of the lot size, whichever is greater.

In the Inlet Hazard Area only single family and duplex units and readily movable non-residential structures are permitted and setbacks are required.

Massachusetts

Massachusetts, through Executive Order No. 181 (1980), ordered State agencies to adopt policies for barrier beaches, including the policy that" no development shall be permitted in the velocity zones or primary dune areas of barrier beaches."

Massachusetts also regulates barrier islands, beaches and dunes under its Coastal Wetlands Restriction Act (c. 131, S.105) and Wetlands Protection Act (c. 131, S.40). The Protection Act is implemented at the local level through a permit program which ensures that an activity will not have an adverse effect on the important characteristics of identified resources (e.g. beaches, dunes) such as their ability to respond to wave action, their volume, and vegetative cover. Barrier islands are mapped under the Wetlands Restriction Act, which is implemented at the State level. On altered (developed) barriers, beaches and dunes are generally mapped as barrier beach resources and a field determination made as to the appropriate restriction line, depending on the extent of existing alteration of the resource (e.g. number of groins, bulkheads).

Rhode Island

The Rhode Island Coastal Management Program has categorized barrier beaches as either developed or undeveloped. Development is only allowed on developed barrier beaches, and is subject to construction regulations. The regulations prohibit building on dunes, prohibit additional structural shoreline protection, and require new structures to be elevated an additional six feet in velocity zones. Structures on dunes which are damaged 50% or more by storm floods, waves or wind may not be rebuilt.

Rhode Island has measured erosion rates on barrier beaches and requires a construction setback of 50 feet from the shoreline. Where erosion rates have been determined to be critical, the setback is calculated by multiplying the average annual erosion rate by 30 (anticipated life span of a structure).

Georgia

As another example, Georgia's Shore Assistance Act of 1979 established a permit system for structures on sand dunes, and submerged lands. The dynamic dune field is defined as the ocean facing area of beach and sand dunes extending from ordinary high water inland to trees 20 feet high, coastal marshes or a structure existing on April 25, 1979, the effective date of the Act. Criteria are set forth for structures in the dynamic dune field. Among the requirements are that the structure be placed at the landward part of the site, that the project retain and restore vegetation and topography as best possible, that the structure be built to hurricane resistant standards, and that normal functions of sand transport be maintained. In beach areas, eroding sand dune areas and areas without dunes, no permits are to be issued except for shoreline engineering structures, boardwalks or crosswalks. Georgia does not require a permit for repair of a house damaged less than 80%.

Glynn County, Georgia, which includes St. Simons Island and Sea Island, has adopted regulations more stringent than Georgia's Shore Assistance Act (Butler et al., 1980). A Beach and Dune Protection District was established in 1974 which includes both a primary and a secondary dune district. Only fencing and elevated boardwalks are permitted in the primary dune district, which extends 40 feet inland from the landward toe of the primary dune. This definition provides the benefit of a boundary which varies with conditions and over time. Buildings on pilings are allowed in the secondary dune district.

New York

On August 2, 1981 the New York legislature amended the State's Environmental Conservation Law by passing the Coastal Erosion Hazard Areas Act (N.Y.S.A. 841:34-0101 et seq.). The Act states that parts of the coastline of New York are prone to erosion which can cause extensive losses to property, natural resources, and human lives. In addition, the Act states that such losses often result in large expenditures of public funds and that construction practices often contribute to the potential for damage. Its purpose is to minimize such damages and expenses.

Coastal erosion hazard areas likely to be subject to erosion within 40 years are to be identified and mapped based on analysis of shoreline recession. Natural protective features are also to be mapped. Erosion hazard areas of two types are defined: natural protective feature areas and structural hazard areas. The landward boundary of the erosion hazard area is located either 25 feet from the landward edge of a natural protective feature (i.e. dune, bluff or beach where no dune or bluff exists) or at a distance from the bluff equal to 40 times the average annual recession rate plus 25 feet in structural hazard areas along bluffs which are receding one foot or more per year. The erosion hazard boundaries established are subject to review and adjustment every ten years and after major coastal storms. Further, the Act states that "any activities, development or other actions in such erosion hazard areas should be undertaken in such manner as to minimize damage to property and to prevent the exacerbation of erosion hazards. Such actions may be restricted or prohibited if necessary to protect natural protective features or to prevent or reduce erosion impacts".

The Coastal Erosion Hazard Areas Act calls on local governments to encourage the achievements of these aims through preparation of an erosion hazard area ordinance or law which sets minimum standards and criteria to be used to approve or deny development in the erosion hazard areas. Standards and criteria which are considered include alternatives to and need for the activity, setbacks, effects on erosion, placement of erosion protection structures or use of non-structural measures, and effects on natural protective features and natural resources. Standards for erosion protection structures would also be included. The Act includes provisions for the granting of variances and requires permits for development in hazardous areas. Lastly, the Act states that public actions which would encourage new development in coastal erosion hazard areas should not occur unless protective measures are first taken.

The State of New York has prepared draft maps and held public hearings for the south shore of Long Island and is in the process of preparing draft maps for New York City. Ordinances have not yet been adopted as they are not required until six months after adoption of final maps. Thus, it is still too early to evaluate the effectiveness of the Act.

Florida

Florida has adopted construction setback or control lines under its Beach and Shore Preservation Act (Chapter 161, F.S.). The law requires the establishment of a construction control line which marks the landward limit of the impact zone of a 100 year storm surge. The control line is established by county governments and is based on ground elevations relative to historic storm tides, wave uprush, shoreline erosion , dune lines, vegetation lines, beach and offshore contours and existing upland development. Until county lines were established throughout the State, the control line was taken as 50 feet from the mean high water line. All counties subject to the Act (i.e. having sandy beaches) have established control lines, which are marked by monuments. The designated control lines are subject to review when the State finds a need for review (previously a five year review period was established). The Act specifically provides that the line does not define a seaward limit for structures, but simply defines an area in which special structural and siting considerations are required to insure protection of the beach and dune system. Permits are required for construction, excavation and alteration seaward of the control lines. Structures in existence prior to establishment of the control line are exempt from the law.

The effectiveness of the coastal control line was studied after Hurricane Eloise hit Florida in 1975. The study showed that average losses increased for structures located nearer the shoreline and were higher for those seaward of the control line than for those landward (Shows, 1978). Shows noted that "the spatial distribution of losses demonstrates the importance of small absolute distances from the setback line".

Florida's control line also delineates the landward extent of State claims to tidelands. This line is used in conjunction with beach restoration and shorefront protection projects as well as public access.

Lastly, Chapter 161 of the Florida law provides for the creation of Beach and Shore Preservation Districts in Florida at the county level. The District authorities can establish shore preservation programs and have the power to acquire lands, exercise eminent domain, construct facilities and make rules and regulations.

New Jersey

Gares et al. (1980) have suggested the establishment of Dune Management Districts for New Jersey. A Dune Management District would have a dynamic boundary subject to periodic review and would be based on a storm of given frequency. Gares et al. recommended using a 50 year storm and a 10 year planning period. In delineating the district, the shoreline erosion rate, dune formation and migration, the length of the planning period and the frequency of overwash would be considered to determine the recommended ideal dune height and width based on the amount of protection desired while still allowing dune migration. New construction would be prohibited in the Dune Management District, and overwashed sand would not be removed. Rebuilding of damaged structures would be examined on a case by case basis. Public acquisition of vacant land is also recommended.

The National Flood Insurance Program (NFIP) Regulations (44 CFR 60.3) include design, performance and elevation standards for building in flood hazard areas. The regulations are to be enforced at the local level, which has been a weakness of the program in some areas, and must be incorporated into the ordinances of municipalities which participate in the NFIP. All of New Jersey's shorefront municipalities are in the NFIP. In addition to identifying flood prone areas, FEMA has identified coastal high hazard areas in oceanfront communities. Coastal high hazard areas, or V-zones, are areas subject to high velocity waves of at least 3 feet in height.

Section 60.3 of the NFIP Regulations states that sand dunes function as natural barriers that mitigate the effects of coastal flooding and that alteration of dunes in coastal high hazard areas (V zones) must be prohibited if potential flood damage would be increased. The Federal Insurance Administration (1978) developed model ordinances for review of building permit applications which require review of development proposed in a Coastal High Hazard Area to determine if it would alter sand dunes so as to increase potential flood damage, and prohibit alteration of sand dunes which would increase potential flood damage. Such an ordinance has been adopted in all of the shorefront municipalities in New Jersey. However, the NFIP regulations and consequently a number of ordinances do not protect dunes outside of the V zone, nor clearly protect dunes in the V zone. Developers have often argued successfully that the replacement of a dune by a shore protection structure such as a bulkhead, revetment or seawall, provides better protection than a dune, regardless of impacts such a structure might have on the beach.

A recently completed assessment of dune ordinances in New Jersey (NJDEP, 1984b) indicates that most dune ordinances describe a fixed and static legally defined line, such as a building line or dune area, that does not recognize future beach erosion or past processes that may have caused the dunes to migrate landward past the building line since the ordinance was adopted. The consequence is that the ordinance does not prevent building in natural dune areas which are landward of the building line. A second problem is that municipalities often grant variances to their dune ordinances and allow building in dune areas out of fear that they would otherwise have to buy the lot. Dune ordinances seldom provide clear guidance for building new dunes, repairing damaged dunes, improving existing dunes, or for placing structures in a dune zone (e.g. walkways to the beach).

b. <u>Transfer of Development Rights</u>

The technique of transfer of development rights (TDR) involves the establishment of preservation/conservation zones with attendant development rights or credits and the establishment of receiving zones where development rights can be purchased to exceed the zoned density. Unsold development rights would be taxable just as property is taxable. Once development rights to a property were sold, the land would remain in ownership of the seller but would not be subject to development and would decrease in value accordingly.

In the context of storm hazard mitigation, high hazard/high erosion areas would be designated preservation zones and the development rights for the property within these zones would be calculated and allocated based on property ownership. Safer areas of the community would be designated as receiving zones, where higher density development would be allowed with purchased development rights. In municipalities which are already developed, this technique would come into effect as redevelopment occurred and, in some cases, might be associated with an overall downzoning of the municipality.

Development rights can be purchased in either a pre- or post-storm setting to prevent rebuilding of structures significantly damaged by a storm. In order to be most effective as a mitigation technique, the TDR program should be mandatory, although a voluntary program would also be worthwhile. In a mandatory program, the marketability of development rights would have to be guaranteed, perhaps through creation of a development rights bank by the municipality or the state. The bank would buy development rights and sell them to developers in the receiving zone when they became marketable.

The attractiveness of the TDR approach is that it would phase out and eventually eliminate development in areas of high hazard while monetarily compensating property owners for not developing or redeveloping their property, without spending tax dollars.

TDR has been used in Collier County, Florida, on the Gulf coast, where 40,000 acres have been designated as a special treatment zone which can generate development credits and thus serve as a preservation area. The special treatment zone consists mainly of barrier islands, mangroves, salt marshes and beaches. The receiving zones for development rights are those areas in the County zoned multi-family, and housing can be built at a higher density in the receiving zones with the purchase of development rights. Areas from which development rights are transferred must be preserved either by a restrictive covenant or by donation to the County or a non-profit conservation organization. In one example of the use of TDR in Collier County, two development rights (one right per two acres) were purchased for $6000 each and used to build additional condominium units which were marketed for $150,000 to $200,000 each (Bentz, 1983).

There has been a moratorium on the program since 1982 due to the increased density being placed on only one island, Marco Island, which has received all of the excess development to date and due to the perceived inequitability in receiving $3000 per acre of land assessed for tax purposes at $50 per acre.

TDR is presently being used in New Jersey in areas covered by the Pinelands Act. The enabling legislation establishing the Pinelands Commission gave the Commission land use powers which are relied upon for this program. Burlington County is actively using funds from a revenue bond to buy transfer development credits which it plans to sell to developers in the future.

Elsewhere in New Jersey, the Superior and Appellate Courts recently ruled on East Windsor Township's use of TDR to preserve farmland. The Superior Court found that in the absence of specific regulations in the Municipal Land Use Law, municipalities do not have the authority to engage in TDR. The Appellate Court upheld this decision. The case had been appealed to the New Jersey Supreme Court but was recently settled prior to that court making a ruling. The courts did not rule on the constitutionality of TDR. Enabling legislation has been introduced in the New Jersey Senate and Assembly which would specifically give municipalities the authority to engage in TDR.

A TDR program to reduce storm-related losses may soon be explored in a municipality in Cape May County under funding from the New Jersey Department of Environmental Protection. The project will determine the viability of the program for one municipality and its applicability to other coastal communities. The project involves documentation of the risk and economic cost of past storms, analyzing existing land use and calculating the existing development potential of the island. Transfer sites are to be identified and their development capacity evaluated. Preservation and transfer districts will be delineated and a market analysis of development rights undertaken.

c. Land Exchange

Where publicly owned vacant land is available within a reasonable distance and outside of a flood hazard area, that land may be traded for privately owned land in a high flood hazard area. As an example, Arizona law provides for a governing body to petition the State to designate an area as eligible for flood relocation assistance and exchange for State land. The program is voluntary (a majority of people within the area must have signed a petition requesting relocation) and a suitable parcel of land owned by the State or other governmental entity must be located within 25 miles. A floodplain land exchange fund may be used by the State either to purchase land to support the relocation, or for condemnation of private lands within a floodplain which is not exchanged, or to compensate the State trust for exchanges involving private land valued lower than the State land for which it has been exchanged (Sections 26-322 and 37-610-01, Arizona Revised Statutes).

3. Construction Standards

Requiring that builders build to minimum hurricane or storm resistant building standards is a means of reducing storm damage. Building codes can take the form of performance standards or specifications. The floodproofing requirements of BOCA and the Southern Standard Building Code are, for the most part, performance standards. The Southern Building Code Congress is now completing a deemed compliance manual for one and two family buildings with specifications and drawings. In other words, design according to the manual specifications will be deemed to comply with the Southern Standard Building Code. In areas governed by the code, this should provide some engineering involvement in design of homes, which have been found more vulnerable to storm damages than either fully or partially engineered buildings.

The Federal Emergency Management Agency's 1981 publication entitled Design and Construction Manual for Residential Buildings in Coastal High Hazard Areas provides technical information on construction materials and design details to withstand storm winds and waters. These guidelines are not binding upon builders and are not considered to be stringent standards. Other publications provide design standards as well, including Elevated Residential Structures (FEMA, 1984) and Coastal Design: A Guide for Builders, Planners and Homeowners (Pilkey et al., 1983). These guidelines cover such information as materials, anchoring, fastenings, foundations, bracing, shape of house, wind and water loads, etc. A general discussion of construction standards for hurricane resistance in Texas, North Carolina, South Carolina, Rhode Island and New Jersey follows.

Texas

The Texas Coastal and Marine Council, in 1981, published Model Minimum Hurricane Resistant Building Standards for the Texas Gulf Coast, in response to legislation mandating the development of standards. The adoption and implementation of these standards is up to each municipality. The standards describe hazard zones, based on potential exposure to wave and scour, battering by debris, flooding, wind and design parameters. Specific requirements for structural integrity of foundations, masonry, steel and iron, wood, concrete, cladding and glazing, and roofing construction are established for each zone. A study by Hix (1976) of 5 types of structures ranging from single family houses to condominiums to 10 story high rises, indicated that designing to these standards would increase the structural cost of construction by 3-8% and the overall finished cost by 1-3% compared to building only to the Southern Standard Building Code.

South Carolina

The South Carolina Coastal Council sponsored a study by the Department of Civil Engineering at Clemson University of coastal construction codes for coastal high hazard areas (V zones). The study included a review of regulations now in use and designation of hurricane design criteria for South Carolina. As a result, A Supplement to the Southern Building Code for Hurricane Protection was prepared in January 1984 to be used as a guide for local communities. The supplement deals primarily with woodframe, multi-story residences on pilings but can be adapted to commercial, utility or high-rise buildings. The design storm on which the supplement is based is a 100 year flood, with the associated wind speed and storm surge height. The model code contains performance standards for battering loads, water loads, wind loads, scour, and wood connections. Shutters would be required for all glasswork below the Base Flood Elevation plus Wave Height. Breakaway walls are prohibited as they would generate battering material in a storm.

The South Carolina model code uses more recent wind load design (American National Standards Institute) than does the Texas model code because the Model Code authors find it more suitable for coastal conditions. The standards assume that scour will equal the predicted wave height and that scour around piles shall be taken as twice the pile diameter or twice the greatest dimension for non-round piles. This is more detailed than the Texas model code, which makes no specific requirement.

North Carolina

North Carolina has a State Building Code and a Residential Building Code which apply throughout the State. The former applies to new residential and commercial construction, and the latter to construction, alteration, repair and removal of one and two family dwellings only.

The Residential Building Code includes standards for wind resistance in coastal areas experiencing winds greater than 75 mph. The State Building Code provides standards for areas subject to winds greater than 80 mph. In addition, the North Carolina Coastal Resource Commission has established standards for Ocean Hazard Areas pertaining to piling size, embedment and resistance to decay, insects and corrosion, foundation stability and minimum floor elevations (N.C.A.C. 15:7H. 0308(d)) and requires that exposed structural connections be either enclosed or rust proofed. The rapid rusting of non-galvanized fasteners in coastal areas has been responsible for structural failures in coastal storms. Cantilevered decks and walkways must be designed to be stable in wave forces of a 100 year storm or be designed to break away without structural damage to the main structure.

A report prepared for the North Carolina Office of Coastal Zone Management (McElyea et al., 1982) finds that the North Carolina State Building Code may need amendments to protect structures against a 100 year coastal storm. In particular, McElyea et al. (1982) reference a 1981 study by Sheaffer and Roland recommending new standards which relate to "(1) wind, waves, flooding, erosion and scour, soils, structural stability and related conditions, and (2) special fire and structural hazards associated with multi-story, multi-family modular wood frame buildings".

Since the construction standards were implemented and the report was written by McElyea et al. (1982), the North Carolina coast was struck by Hurricane Diana in September 1984. A study of damages by Spencer Rogers (1985) indicated that inadequately anchored porches and balconies resulted in major damages and that most damages were to buildings built before the code went into effect. Rogers' comparison of damages caused by Hurricane Alicia in Texas and Hurricane Diana in North Carolina showed that although the type of development and the wind speeds (100 mph) were similar, Diana caused significantly less damage than Alicia, showing the success of the construction standards. Rogers noted that the wind speeds were well below the design wind speed (120 mph) and that the force of the wind increases with the square of the velocity, so the standards have yet to be completely tested.

Rhode Island

Rhode Island requires construction in high flood hazard areas to exceed the State building code. Pilings must penetrate 10 feet below mean sea level; floors, roofs and walls must be fastened to floor beams with metal straps or "hurricane clips"; the roof pitch must be more than 40° to reduce lift during high winds; glass windows must withstand 100 mph loads; houses must be elevated an additional 6 feet (Lee and Olsen, 1983).

New Jersey

In New Jersey, the Basic Building Code of the Building Officials and Code Administrators International, Inc. (BOCA) has been adopted as a Uniform Construction Code (N.J.S.A. 52:27D-1 et seq.) and must be used by all municipalities. It is administered by the New Jersey Department of Community Affairs and enforced at the local level. Flood proofing requirements were not made part of the code until January, 1984 nationally and August, 1984 in New Jersey. The flood proofing section of the code (Section 1313) applies to all new structures located in flood prone areas, and to structures undergoing substantial changes (greater than 50%), using the 100 year flood as the minimum criterion for determining flood prone areas and establishing the base flood level. The code requires that all buildings and structures located within a flood prone area have the lowest structural member, except pilings and columns, at or above the base flood level. Buildings and structures which are not in Use Group R (i.e. which are not single-family residences) may alternatively comply with water tight construction provisions of the code. The flood proofing requirements of the code in coastal high hazard areas pertain to anchoring of buildings and structures to piles and columns, fastening of building components, and placement of obstructions below the lowest floor. A registered professional architect or engineer must certify that all applicable flood proofing requirements are met before a Certificate of Occupancy can be issued.

Although the addition of these flood proofing requirements to the BOCA Basic Building Code has strengthened the code and incorporated the construction standards of the National Flood Insurance Program, it is still considered by many to be somewhat inadequate. Because Flood Insurance Rate Maps do not recognize wave runup in delineating coastal high hazard areas and, therefore, there are no specific construction standards for development in wave runup zones, there is the potential for major storm damage. In addition, standards are felt to be inadequate with regard to design wind speeds and anchoring of walls and roofs. Lastly, the performance standards are too general, which makes interpretation and enforcement difficult. More specific guidelines are needed (e.g. to interpret the regulations for breakaway walls).

Municipalities in New Jersey are required to use the BOCA Basic Building Code as the construction standard and may not supplement the code with more stringent standards, either as a building code or under a zoning or special ordinace. Therefore, in order for adequate standards to be adopted in coastal communities, the standard must first be incorporated into the BOCA Building Code at the national level and then the amended code adopted by the State. Alternatively, legislation could be passed at the State level establishing stronger flood proofing controls.

4. Floodproofing Existing Structures

Modifications can be made to existing structures to decrease the likelihood of flood damage. Houses can be jacked up and elevated on piles, although this is less practical for structures with a slab-on-grade foundation, attached units and large brick or masonry structures (Illinois DOT, 1984). In Elevated Residential Structures, a FEMA publication (1984), the following four criteria characterize structures for which raising is generally feasible:

1. accessible below the first floor for placement of jacks and beams,

2. light enough to be jacked with conventional house moving equipment,

3. small enough to be raised in one piece, and

4. strong enough to withstand the stress of the raising process.

Particularly suitable are wood frame homes and light commercial buildings which are raised above the ground, although brick and masonry structures can be raised. The publication also includes a comparison of the costs of elevated foundations over conventional foundations and design and construction guidelines for new construction.

Structures which are located in flood zones and are not anchored (i.e. only anchored by gravity), or are poorly anchored, can be anchored to prevent flotation. The means of anchoring depends on the design of the house. Some alternatives are driving piles at house corners to which the house is then fastened, use of ground anchors, and use of diagonal struts under the house (Pilkey et al., 1983). Additional fastenings can be added to existing houses which are not adequately tied together (e.g. fastening of roof to wall) and interior walls reinforced (Pilkey et al., 1983).

Gordon (1981) notes an additional method of preventing flotation: reducing hydrostactic pressure by providing trap doors in first floor rooms. Small openings can also be made in walls of crawl spaces, basements and garages to allow floodwaters to more easily enter these areas. This is a wet floodproofing technique and will allow hydrostatic pressure to equalize on each side of the structure walls and minimize the likelihood of wall and foundation failure. If wet floodproofing is done it should be accompanied by raising the contents within the house where feasible (e.g. furnace, hot water heater, electrical service) (Illinois DOT, 1984). Raising utilities may also be beneficial where the house floods only a few feet. Tax incentives, such as credits, deductions and rebates are all means of encouraging property owners to take floodproofing measures.

E. SHORE PROTECTION

Several steps can be taken to combat the erosion problem on barrier island beaches. The options range from "no action" to "corrective measures". The various corrective shore protection measures, including structural engineering and non-structural solutions, are listed in Table 5. These include measures which armor the shoreline, decrease offshore wave energy, or increase sedimentation. The majority of these solutions are high cost options and require large expenditures, usually from passage of federal and/or state legislative appropriations or, in New Jersey's recent experience, bond issues.

TABLE 5: CATALOG OF SHORE EROSION CONTROL METHODS

METHODS	OBJECTIVE	REQUIREMENTS	PROBLEMS
Structural			
Groins	To impede longshore transport and induce sedimentation	Sufficient longshore transport or artificial nourishment	Can cause downdrift erosion. Aesthetically unpleasing. Hazard to swimmers.
Bulkheads	To retain soil and protect eroding shorelines	Sufficient soil foundation to withstand forces	Can cause erosion in front of and adjacent to structures. Impedes beach access.
Seawalls	To protect shorelines from moderate - heavy wave action	Supply of suitable stone	Causes erosion in front of and adjacent to the structure. Impedes beach access and is aesthetically unpleasing.
Revetments	To protect eroding shorelines from wave and current scour	Availability of suitable stone and protection from toe scour	Can cause erosion in front of and adjacent to structure. Subject to scour and settlement damage.
Breakwaters	To diminish wave energy and induce sedimentation	Suitable supply of stone and supply of sediment in longshore system	Swimming and navigation hazard. Can cause shoaling and completely block longshore drift causing adjacent erosion.

Non-Structural

Beach Nourishment	To increase beach width and height and provide sedimentation to the long-shore system	Large quantity of suitable sand nearby	Temporary - has to be done on a periodic basis. May require structures to hold sand in place.
Dune Building & Maintenance	To create and maintain a dune line or zone	Space for dunes, supply of sand, vegetation and fences to stabilize	Easily disturbed. Requires regular maintenance.
Artifical Seaweed	To reduce current velocity and induce sedimentation	Purchase of "seaweed" and anchoring materials	Does not significantly attenuate wave action. Can be dislodged and carried away. Preliminary research by NJDEP found this method to by ineffective.

The problem of beach erosion is affected primarily by wave action, size and supply of littoral sediment, predominant winds, and proximity to tidal inlets. Therefore, each solution must be "customized" to each specific problem site, taking into account all possible variables. The physical processes acting in certain areas must be examined to determine the probable response to different shore protection solutions. The cost of a project must also be weighed against the value of the property being protected and the expected benefit, both economic and recreational, from such a project.

Due to the problems often associated with shore protection structures, North Carolina does not allow the construction of seawalls, bulkheads and other shoreline erosion control structures except beach nourishment or berm projects if their purpose is to protect property. In emergency situations, which are defined by the State as when the erosion scarp is within 20 feet of the foundation of a building, the placement of sand bags for protection is allowed. The sand bag structure may be up to 3 bags (15 feet) wide. This restriction applies regardless of when a structure was built.

1. New Jersey Shore Protection Master Plan

The New Jersey Shore Protection Master Plan (NJSPMP) (NJDEP, 1981) provides a plan for all future shore protection work. It represents 1) a review of past and present erosion and shore protection trends, 2) an evaluation of impacts and implementation of alternative approaches to shore protection (engineering and land management) and 3) a comprehensive shore protection plan which is consistent with State coastal management policies and objectives. The geographical area studied in the Shore Protection Master Plan includes the Raritan Bay shore from Perth Amboy to Sandy Hook, south along the Atlantic Ocean shore to Cape May, and north along the Delaware Bay and River to Crosswicks Creek.

2. The Reach Concept

Where appropriate, development of the engineering plans for New Jersey is based on a regional (reach) approach, rather than stop-gap piecemeal solutions. Along ocean shores, piecemeal solutions often tend to aggravate the erosion problem in adjacent shore areas. The "reach concept" is the method whereby consistent shore protection engineering plans are developed within areas affected by similar coastal processes. The reach concept attempts to reduce the potential for any one shore erosion control program to produce adverse effects in adjacent shore areas. Shore protection is thereby provided for an entire coastal section, irrespective of political subdivision boundaries, rather than for only local erosion problem areas as has been the traditional practice in New Jersey. The reaches that have been developed for the New Jersey Shore Protection Master Plan (NJSPMP) are shown on Figure 8, together with the affected counties and political subdivisions within each reach.

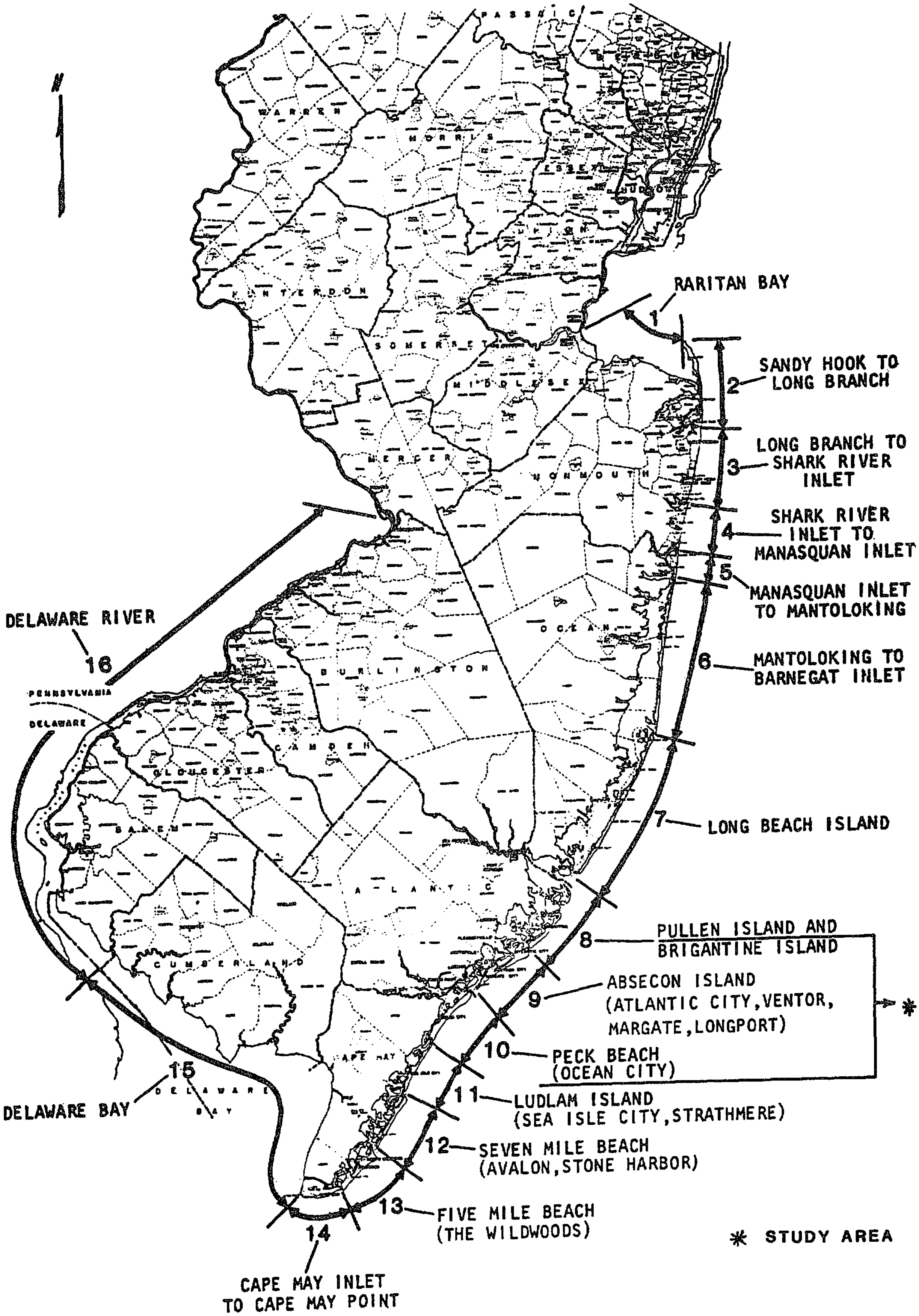


FIGURE 8 : SHORELINE REACHES

SOURCE: NJDEP, 1981

3. Erosion Classification

Four erosion categories for New Jersey barrier island reaches were presented in the Shore Protection Master Plan (NJDEP, 1981). Criteria for these erosion classifications include beach width, presence of dunes, sediment budget, presence and functional performance of shore protection structures, proximity to development, and wave climate. The erosion categories are defined as follows: Critical Erosion (I) - areas having the least suitable natural and man-made protection from the operating erosion forces, while receiving significant erosive attack and damage to protective features; Significant Erosion (II) - areas where a low to moderate level of protection exists, but where erosive forces are expected to reduce this level in time; Moderate Erosion (III) - areas with a moderate to high degree of protection for the level of erosive processes that are operative; Non-Eroding (IV) - non-eroding or stable. The erosion categories for Brigantine, Absecon Island and Ocean City are identified in Figure 9. Most of the shoreline on the three barrier islands is classified as critical or significant erosion areas.

4. Recommended Shore Protection Plans

The New Jersey Shore Protection Master Plan ranks different engineering alternatives in order of benefit-cost ratio. This analysis was based on four parameters: engineering costs, public service costs, recreational benefits, and property protection benefits. The engineering alternatives and benefit-cost ratios are listed on Table 6 for Brigantine, Absecon Island and Ocean City (Peck Beach). Note that only 9 of the 15 alternative plans have a benefit-cost ratio greater than 1.0 These projects have a higher funding priority. As of January 1985, the status of implementation for the various engineering alternatives by reach is as follows:

Reach 8, Brigantine - No action on alternatives.
Dune maintenance/repair: Scheduled within 5 years.
Estimated Cost: $75,000

Reach 9, Absecon Island - Alternative 3.
Maintenance of structures: completed spring 1984.
Cost: $3,000,000.
Beachfill: Scheduled for spring 1985.
Estimated Cost: $7,500,000.

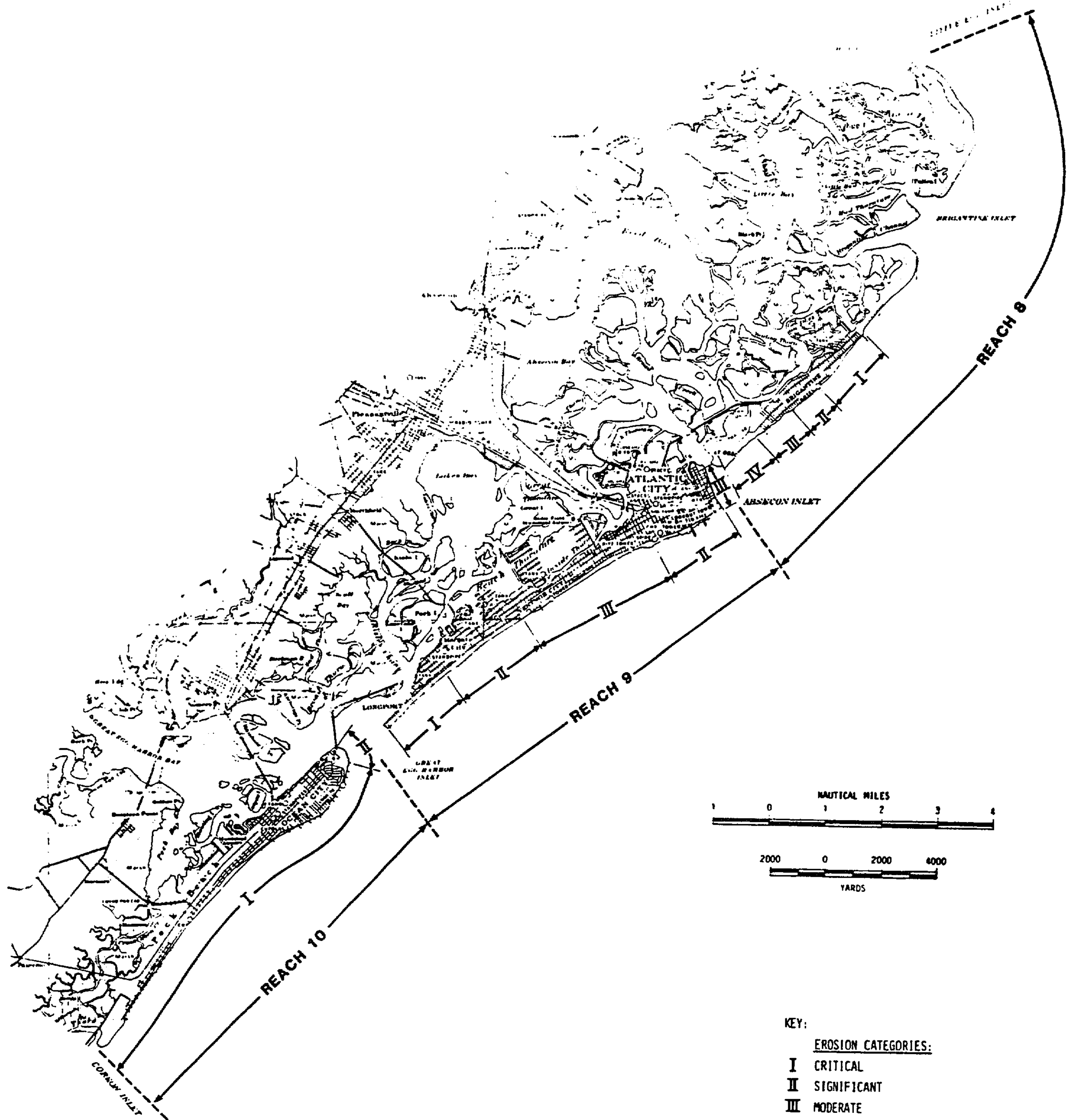


FIGURE 9 : EROSION CLASSIFICATION

SOURCE: NJDEP, 1981

	Storm Erosion Protection	Recreational Development	Combination Program	Limited Restoration	Maintenance
BRIGANTINE ISLAND	o 75' berm along the developed northern groin protected area and 100' berm for the southern portion of the reach o Beach nourishment at 10 year intervals o Dune maintenance BCR*=0.06	o Existing beach if maintained will satisfy the recreational demand through the entire planning period o Maintenance of existing functional structures o Dune maintenance BCR=0.17	o Initial fill for storm erosion protection. This berm width more than satisfies recreational demand to 2030 o Beach nourishment at 10 year intervals o Maintenance of existing functional structures o Dune maintenance BCR=0.06	o Beach fill to 75' berm width at northern half of developed section o Beach nourishment at 10 year intervals o Maintenance of existing functional structures o Dune maintenance BCR=0.07	o Maintenance of existing functional structures o Dune maintenance o Post storm berm repair BCR=0.04
ABSECON ISLAND	o 75' berm in groin field at northern end of island, 100' berm elsewhere o Beach nourishment at 3 year intervals o Maintenance of existing functional structures BCR=1.36	o Initial fill to 400' recreational berm width in Atlantic City; tapered to 150' at Jackson Street; 150' elsewhere o Beach nourishment at 3 year intervals o Maintenance of existing functional structures BCR=1.45	o Recreational development alternative design applies here BCR=1.45	o Beach fill to 100' berm width at Longport o Beach nourishment at 3 year interval o Maintenance of existing functional structures BCR=1.12	o Maintenance of existing functional structures o Post storm berm repair BCR=0
PECK BEACH	o Initial fill to 75' width in northern groin field, 100' width elsewhere o Beach nourishment at 5 year intervals o Maintenance of existing functional structures o Dune maintenance o Groin construction/modification BCR=1.41	o Initial fill for recreational beach at northern end of island o Periodic berm expansion o Beach nourishment at 5 year intervals o Maintenance of existing functional structures o Dune maintenance BCR=1.70	o Initial fill for storm protection design o Periodic beach expansions for recreation at northern public access area o Beach nourishment at 5 year intervals o Maintenance of existing functional structures o Dune maintenance BCR=1.42	o Initial fill to storm berm design at northern portion of island o Beach nourishment at 5 year intervals o Maintenance of existing functional structures o Dune maintenance BCR=1.60	o Maintenance of existing functional structures o Dune maintenance o Post storm berm repair BCR=1.18

TABLE 6 : SUMMARY OF ALTERNATIVE ENGINEERING PLANS

SOURCE: NJDEP, 1981

*** BCR - BENEFIT/COST RATIO**

Reach 10, Peck Beach - Alternative 2.

Beachfill: Completed fall 1982.
Cost: $5,000,000.

Under the New Jersey Shore Protection Program Rules and Regulations (N.J.A.C. 7:7F), shore protection grants and loans will be conditioned on compliance with the Department of Environmental Protection Coastal Resource and Development Policies (N.J.A.C. 7:7E-1.1 et seq.) pertaining to dunes, beaches and coastal erosion hazard areas.

F. CONSTRUCTION AND RECONSTRUCTION OF INFRASTRUCTURE

Proximity to infrastructure is an important determinant of where development occurs because access to roads, sanitary sewer lines and potable water is essential. Thus by not extending infrastructure to particularly hazard prone or sensitive areas, development of these areas can be discouraged. This technique is used in Pennsylvania and Florida. In Massachusetts, Executive Order #181 (1980) prohibits use of state and federal funds for construction projects which encourage growth and development in hazard prone barrier beach areas. In North Carolina, the "General Use Standards for Ocean Hazard Areas" (N.C.A.C. 15:07H.0306) state that public funds shall be used to construct growth inducing public facilities in ocean hazard areas only when 1) there is an overriding public interest and benefit, 2) existing hazards will not be increased or buffers lost, 3) the facilities will be reasonably safe from flood and erosion related damage, and 4) the facilities will not promote growth and development in ocean hazard areas. Infrastructure is included in this regulation.

The federal government recently took steps to limit the use of federal funds to construct or expand infrastructure on barrier islands. In 1982, Congress passed the Coastal Barrier Resources Act which prohibits expenditure of federal funds to construct or expand infrastructure, structures or facilities or to provide flood insurance or other aid to designated undeveloped barrier islands. Certain types of expenditures are exempt from the Act. The Act does not pertain to reconstruction of storm damaged infrastructure on developed barrier islands. To date, the federal government has not designated any undeveloped barrier islands in New Jersey. However, revisions to the maps are being considered this year with more than 1000 areas under review as potential designated undeveloped barriers. Fourteen of these areas are in New Jersey.

On barrier islands which are already developed, as in New Jersey, this approach would only be useful in guiding post-storm redevelopment of damaged utilities and roads where existing homes and businesses have been largely destroyed. Utilities and roads could then be relocated outside of high hazard/erosion areas. Control could be exerted at either the federal, state, or local level, depending on the funding source for repairs. If a Presidential Disaster were declared, public assistance might be available for infrastructure repair and replacement under the Disaster Relief Act of 1974. The Regional Director of the Federal Emergency Management Agency could condition funding for utility and road repairs in high hazard areas upon protection of the structures from future damages. The state could also attach such conditions to its post storm aid. At the state level, legislation, executive order, or departmental policy or regulations could be used to implement this policy.

Construction of new utilities (sewer and water lines) may be funded by federal, state or municipal government. Once constructed, repair and maintenance costs are usually borne by the utility company and paid out of user fees.

The relocation of roads and utilities would require purchasing new rights-of-way. The purchase of rights-of-way is not eligible for federal disaster relief funds, although the construction itself would be eligible. Repair of public facilities is funded at 75% of costs by FEMA, but this percentage can be increased by up to 10% for mitigation measures. A portion of shore protection funds could be made available for relocation of infrastructure in areas with continued, severe erosion (Baker, 1980).

G. IMPLEMENTATION OF STORM HAZARD MITIGATION STRATEGIES

1. Public Education

In order for storm hazard mitigation strategies to be accepted and implemented at the local level, the public must be made aware of their vulnerability to storms, potential costs of storms and means of reducing storm damage. In particular, local officials must be convinced of storm hazards and evacuation problems in order to better serve, advise and educate their constituents. Public awareness programs can involve a variety of media and techniques including radio and TV spots, newspaper article series and supplements, publication and distribution of brochures and pamphlets, public meetings and slide shows, and educational programs in schools and Scout groups.

Newspapers are an effective means of reaching the public. They are most effective in educating people about storms when technical information is integrated with stories of more personal and local interest. An effective approach is to combine a local/human interest story, photos, a description of historical events, and interviews with discussion of vulnerability to future storms and mitigation strategies. Newspaper supplements or inserts which can be removed as a whole and saved have also been used to educate people about storm hazards and response. In addition to including mapping of escape routes and hazardous areas, means of reducing hazards and the high cost of storms may be introduced as well as means of implementing these hazard reduction strategies.

Radio and television spots are another means of educating the public about their vulnerability to storms and hazard mitigation. Radio reaches a more limited audience than the more costly TV spots, but can focus on the local audience. In contrast, television can reach a broader audienced encompassing seasonal coast dwellers throughout the State and the New York and Philadelphia metropolitan areas. An example of this approach is the three part special report on Long Island's coastal hazards recently aired on a New York news program. Commercials, documentaries and interviews are all formats which might be used with these media and on cable television.

Pamphlets or brochures on storm hazards and hazard mitigation may be prepared and distributed by mailings, with utility bills, door-to-door, or in public areas or stores frequented by year round and seasonal residents.

A study of the effectiveness of three different public education techniques was conducted in Texas (Ruch, 1980). The public awareness program included the mailing of a survival checklist and map brochure, broadcasting radio interviews on hurricane preparedness and survival, and broadcasting television spots showing hurricane force and destructiveness. Groups exposed to only one of these techniques were compared to a group exposed to none. The study revealed a significant increase in hurricane knowledge of those exposed only to the brochure compared to those with no exposure, but a lower perception of danger and hurricane impact. Those exposed only to television differed only in increased perception of danger during later hurricane advisories and those exposed only to radio only differed in decreased danger perception at early advisory stages.

Community outreach programs are another way of educating the public. These include school curricula in coastal storm hazard mitigation as well as public meetings, slide shows and presentations at civic or club meetings. All can be used to educate and attempt to gather support for implementation of hazard mitigation strategies at the local level.

Community awareness can also be increased by techniques such as marking historical flood levels in conspicuous locations, or requiring notification in deeds, mortgages, real estate sales that a particular property is subject to flood hazards (Hildreth, 1980; U.S. Water Resources Council, 1981). Such hazard notification not only involves home buyers and developers, but has the added benefit of involving realtors, financial institutions (lenders) and title companies.

At the New Jersey shore, many homes are seasonally occupied and owners live in northern New Jersey or the Philadelphia area. Thus, educational efforts should be focused on the summer months in an attempt to reach these people.

Funding for informational and educational programs may be available at the federal level (Federal Emergency Management Agency, National Oceanic and Atmospheric Administration, U.S. Geological Survey, U.S. Army Corps of Engineers), as well as the state and local levels.

2. Building Moratorium

Enactment of a post-storm building moratorium prohibiting reconstruction and repair of storm damaged structures may be useful to enable a state or municipality to evaluate damages and more wisely accommodate post-storm development so as to incur less damages and costs from future storms. During the moratorium period, damages would be assessed, reconstruction plans made and changes in high hazard area designations accomplished. Effectiveness of building codes, acquisition priorities and funding sources would be evaluated. A moratorium could be imposed at either the state or local level and could be restricted to structures receiving a specified amount of damage (e.g. 50% damage or higher). A municipality could be divided into districts, with a moratorium imposed on those areas which received heavy damage and where redevelopment should be questioned.

Sanibel, Florida proposes three such districts, a Redevelopment District, a Restoration District and an Impacted District, with criteria for defining the districts established prior to such damage. A moratorium would be applied to the first, permits required in the second, and repairs allowed without permits in the third (Rogers, Golden & Halpern, 1981).

Rosenthal (1980) proposes the formation of a "Recovery Task Force" within two weeks of a disaster, during which time damages and hazard mitigation options would be assessed, vital community facilities restored and temporary reconstruction plans prepared. In the following ten weeks, a moratorium would be placed on heavily damaged and hazardous areas, local legislation enacted to revise zoning and building codes, a reconstruction Master Plan adopted, a reconstruction agency formed, and funding sources investigated (including disaster aid, acquisition funds, private investment). Under this scenario, as in Sanibel, zones would be established in the municipality for (1) immediate rebuilding (2) rebuilding with some changes, and (3) no rebuilding prior to reassessment (high damage, high hazard areas). During the time period of the moratorium (perhaps 60-90 days), development controls could be put into effect to guide redevelopment. This time period could also be used to identify the methods for implementing post-storm reconstruction plans, which might include establishment of a governmental body with condemnation powers. The length of the moratorium would have to accommodate the pressure to rebuild for the summer season, particularly if the storm occurred in the late winter or spring.

The adoption of post-storm development plans by both local and state government prior to the next major storm would minimize the need for and duration of a post-storm building moratorium, and provide for a speedier recovery.

3. Funding

A number of the hazard mitigation strategies require funding for implementation. The highest cost strategies are land acquisition and shore protection measures. Funding may be available at the federal, state and local level. A number of funding sources are discussed below, as well as their use in several states.

a. National Flood Insurance Act (1968): Section 1362 of this act provides for federal purchase of high hazard properties which have federal flood insurance and are damaged substantially beyond repair by flooding. Furthermore, properties in flood hazard areas which are covered by flood insurance and have sustained damage as a result of a single casualty of any nature under such circumstances that a statute, ordinance or regulation precludes repair or restoration, or permits repair or restoration only at a significantly increased construction cost, may also be purchased. Lastly, structures which incur significant flood damage three times in five years equal to 25% of the value of the structure each time are eligible for purchase. This voluntary program pays the pre-flood value of the property less the insurance payment, but does not pay relocation costs.

FEMA evaluates the anticipated savings through property acquisition, the community's commitment to hazard mitigation (e.g. floodplain management regulations, matching funds) and the community's proposed use of the acquired property (which must be recreational or open space) in evaluating the request for Section 1362 funds. The major problem with the program is that its funding by Congress has been significantly lower than the applications for funds. These funds were used to acquire storm-damaged property in Scituate, Massachusetts following a major northeaster in 1978 and are presently being used to acquire properties in Baytown, Texas following damage due to Hurricane Alicia in 1983.

b. Congressional Appropriations and Initiatives: As part of the fiscal 1985 Appropriations Act for the Departments of State, Commerce and Justice (P.L. 98-411), funding may be available for specific beach and dune restoration projects, and for the continuation of New Jersey's Coastal Management Program. Other appropriations may be made in the future. In addition, each year Congress may appropriate funds for the US Army Corps of Engineers to implement authorized navigation and shore protection projects.

Outer Continental Shelf Revenue Sharing legislation and the reauthorization of the Federal Coastal Zone Management Act which would provide funding for the state Coastal Management Programs will be considered by Congress this year.

c. Bond Issues: The voters at the state, county or municipal level could decide to fund an acquisition or shore protection program by authorizing a bond. In 1983, New Jersey passed a $135 million bond issue for Green Acres, $28 million of which was for open space or park acquisition. In 1977, the State passed a $30 million bond issue, $20 million of which was for shore protection, and a second shore protection bond issue for $50 million was passed in 1983.

d. Green Acres: The State, through its Green Acres Program, could provide partial funding for land acquisition. Newly acquired sites could be added to the State Park System.

The Green Acres priority ranking system considers various characteristics in determining prime acquisition target areas. These characteristics include water frontage, other water resources features, outstanding or unique natural features, endangered species habitats, native wildlife and plant species habitats, historic and cultural resources, acquisition costs, alternative preservation techniques, alternative sites, development threats, statewide and immediate service area recreation needs, critical recreation access sites and connectors, accessibility, special needs, integrity of purposes, public use potential, public support, and relationship to planning. This priority system favors larger parcels of land because of the greater potential for public use.

e. Legislative Appropriation: The State could enact legislation which would appropriate funds to purchase high hazard coastal property. Such legislation may be more likely in the wake of a severe storm for purchase of damaged property.

As an example, in 1981, the North Carolina General Assembly enacted a beach access statute and appropriated $1 million for initial implementation. It has appropriated $1.2 million for the program in each of the past three years. The statute requires that land which is in a high hazard area, and thus unsuitable for development, but is useful for access be given high acquisition priority.

f. Taxes and User Fees: A surcharge, similar to a luxury tax, could be added to the cost of tourist-related products, housing, and services provided in coastal towns, or a tax could be placed on property or non-tourist activities or uses.

For example, in North Carolina, a 1983 Act authorizes a transient occupancy tax at the county level, with requirements for use of the revenues varying by county. In Mecklenburg County, North Carolina, a designated portion of the tax must be used for activities and programs aiding and encouraging convention and visitor promotion. Remaining revenues can be used for acquiring, constructing, financing, maintaining and operating various tourist or visitor related facilities. Three other counties are authorized to spend funds only to further development of travel, tourism and conventions in the county through state, national and international advertising and promotion. A fifth county (Hanover County) must use 80% of the revenue to control beach erosion and 20% to promote travel and tourism (excluding planning, constructing, operating, etc., a civic or convention center). Several city occupancy taxes were also authorized for tourist-related expenditures including public facilities and control and repair of waterfront erosion.

A municipal services taxing unit may be created under Florida law to collect a special tax for provision of services the county does not provide, including beach erosion control projects. On Captiva Island, Florida, a private resort community known as South Seas Plantation, which comprises the northern third of the island, privately funded a beach nourishment and beach vegetation project. A special tax was assessed to property owners within the resort community, based on the benefit which the property owner would receive from the project, which was in turn based on location of property and beach frontage. About 87% of costs were assessed to beachfront owners and 13% to non-beachfront owners, with payment permissible in a lump sum or over an eight year period with 10% interest (Gooderham and Workman, 1983).

Florida also places an excise tax on deeds and other instruments which convey lands, tenements, or other realty, or interest therein (Chapter 81-33). 7.2% of the taxes collected are paid to a Water Management Lands Trust Fund, to be used to acquire lands for water management, water supply and conservation and protection of water resources. An additional 13.3% is paid into a Land Acquisition Trust Fund.

Florida law also provides for the creation of Beach and Shore Preservation Districts at the county level. The Districts may levy a special benefits tax for capital, operation and maintenance costs of the beach and shore preservation program. The tax can be levied on each taxable property in proportion to the benefits the property will receive. Martin County, Florida adopted a Beach Impact Fee based on household size and beach acquisition costs in order to acquire beachfront property for recreational use. The fee is required as a condition for approving planned unit developments (Florida Department of Community Affairs, 1984). Bonds may also be issued to cover these costs.

Similarly, a small sales tax (e.g. ½ percent) could be levied at the county level, and distributed to municipalities for uses including land acquisition.

In 1983, North Carolina enacted a State income tax credit (maximum $5000) for donation of lands useful for beach access or fish and wildlife conservation. A similar approach could be used for oceanfront high hazard zones. Another alternative would be a reduction in property taxes on undeveloped properties in high hazard areas which agree to remain undeveloped, or generally a tax structure which encourages appropriate use of high hazard areas and discourages inappropriate use, for example by placing a special assessment on building in high hazard areas to partially cover public costs of building there. Tax incentives such as deductions, credits and rebates can also be used to encourage relocation out of flood hazard areas.

Several methods of imposing taxes or user fees to fund shore protection are currently under consideration in New Jersey. A bill proposing a one percent tax on hotels, motels, campgrounds and seasonal homes to fund shore protection was introduced to the State legislature in 1985. A bill which would require that each coastal municipality pay a certain percentage of the collected beach fees into a fund for shore protection is also being considered.

g. Conservation Organizations: Such groups purchase high hazard property land and retain it as open space.

h. Corporate Donations: Large companies and businesses in the shore area, especially those which benefit most from summer tourists, could be encouraged to make tax deductible contributions to an acquisition program.

i. Private Donations: Donations of land or money for an acquisition program can be made as outright conveyances (fee simple) which provides the greatest tax benefits, bargain sales (selling at less than full market value), life estates, or donations in trust. The granting of conservation or scenic easements is another possibility. In New Jersey, lands can be transferred to the State Natural Lands Trust or other qualified recipients including federal, state, county and municipal government agencies and conservation groups. The State Natural Lands Trust was created by the legislature in 1968 and is an arm of state government formed to seek donations of land to hold as permanent open space and to assist potential donors of such lands.

PART II:. SITE SPECIFIC RECOMMENDATIONS

A. INTRODUCTION

Each of the six municipalities in the study area was analyzed individually with regard to current zoning and building practices, existing ordinances and patterns of development. The vulnerability of each municipality was reviewed in terms of current land uses and specific hazardous areas were identified. Although these communities are already densely developed, there is considerable development pressure and the remaining vacant land is rapidly being built upon and existing structures are being razed and replaced by denser development.

Members of the New Jersey Department of Environmental Protection, Division of Coastal Resources, met with representatives of each of the six coastal municipalities being studied. The purpose of the meetings was to discuss specific problems and storm vulnerability of each city, as well as storm hazard mitigation strategies which would be suitable to address these problems. Each mayor appointed a steering committee to meet periodically with members of the Division of Coastal Resources. The committees varied by municipality but generally included planning and zoning board members, the emergency management coordinators, construction officials, and municipal engineers and planners. The county planner, county emergency management coordinator and a member of the county environmental commission were also invited. A list of committee members is found in Appendix I.

Three meetings were held with each steering committee over a four month period (see Appendix I). The first meeting was an introductory session which outlined the purpose of the Coastal Storm Preparedness Study. The local steering committee members were presented with draft copies of the Vulnerability Analysis, vulnerability maps, shoreline change maps, aerial photographs of previous storms and potential hazard mitigation strategies, and were asked to evaluate these in terms of local problems and needs.

The second meeting served as a forum for the steering committee to discuss specific hazard mitigation techniques within each municipality. Prior to the meeting, the steering committee members were presented with worksheets outlining the different areas of vulnerability within each municipality, and asked for their recommendations regarding hazard mitigation techniques. Division of Coastal Resources representatives presented their mitigation strategies and discussed them along with those of the local steering committee. The various ideas were evaluated in terms of existing development and land use patterns, storm vulnerability, and implementation potential.

The recommendations made by the Division of Coastal Resources and the local steering committees are listed in Tables 7-12 and are followed by discussions of the strategies for each municipality.

The purpose of the third meeting was to review a final draft of the hazard mitigation report with the local steering committee.

As expected, there were a few meetings at which the DEP's specific hazard mitigation recommendations were not well received by some members of the local steering committees. There were several types of adverse reactions: 1) a general apprehension of the State's intention to help, 2) a question of whether any of the recommendations would be feasible in terms of implementation and cost, 3) a fear of losing ratables by increasing oceanfront setbacks, establishing conservation zones, and limiting post-storm reconstruction, and 4) a feeling that no government agency should determine where people live or how they should use or develop private property. In contrast, the local steering committees were generally supportive of dune building and enhancement, post-storm acquisition of oceanfront properties, elevating escape routes, and inspection programs and anchoring of existing structures, provided funding was available.

Many of the hazard mitigation techniques presented have never been used in the study area. Because the concept of hazard mitigation is relatively new, any recommendations will have to be developed cooperatively between appropriate state and local groups over a period of time. The Municipal Land Use Law requires that a municipality reexamine its master plan and development regulations every six years and prepare a report of findings, including any recommended changes. This would be an appropriate time for discussion and implementation of hazard mitigation plans. This process will require education of local planners, government officials, and the general public. It is important for all people to realize that (1) the long term safety of the towns and their inhabitants is of primary importance, and (2) the availability of future shore protection and post-storm recovery funds will be limited and may be contingent on local efforts to reduce or mitigate storm damages.

At present, post-storm recovery funds in the form of federal disaster assistance are available upon Presidential declaration of a disaster pursuant to the Federal Disaster Relief Act. Disasters were declared in New Jersey coastal areas following storms in 1971, 1976 and 1984. In addition, large amounts of federal assistance were provided following the 1962 northeast storm, prior to passage of the Federal Disaster Relief Act. Assistance is available in many forms and under many programs (National Governors Association, 1979), for both public assistance and individual and family assistance.

In December, 1980, an Executive Order established procedures for activation of an Interagency Hazard Mitigation Team in response to a Presidential disaster declaration. Each team would include members from the primary federal agencies involved in assistance. The Team is responsible for evaluating the damages and preparing a report which recommends a comprehensive approach to mitigating future flood damages during the post-flood recovery period. Federal agencies are to conform to the report recommendations to the fullest extent practicable. The mitigation recommendations are required to emphasize non-structural measures.

In addition to the report of the Interagency Hazard Mitigation Team, a state which receives federal disaster assistance is required under Section 406 of the Disaster Relief Act, to prepare a Long Range Recovery Plan.

The Long Range Recovery Plan, often referred to as the 406 Plan, is designed to elaborate on the report of the Interagency Hazard Mitigation Team and to develop hazard mitigation plans and a framework for implementing these plans. The Plan must be prepared within six months of the disaster declaration.

FEMA can require various mitigation measures as a condition of disaster assistance. In accepting disaster assistance the state agrees to take action to mitigate future flood hazards. Thus it is apparent that the implementation of hazard mitigation plans is an important aspect of the federal disaster assistance program and the granting of disaster aid in the future may depend on the progress the state and municipalities have made in implementing these plans.

Lastly, the issue of storm hazard mitigation is an economic issue and the availability of federal, state and local funds (presently a 75% federal: 25% state or local share) is not guaranteed.

B. BRIGANTINE

1. Description* and Present Land Use Regulations

Brigantine (Figure 10) is approximately 6.3 square miles in size (4,038 acres). Approximately half of the City consists of State regulated wetlands and most of the remaining land is developed. The 1980 population was 8,318 or approximately 4 people per acre of upland. Sixteen percent of the population consists of senior citizens and the mean family income is relatively high at $23,935. The total market value of real property is $282.3 million. Brigantine Boulevard provides the only access to the mainland, via Atlantic City and Route 30.

Land use in Brigantine is primarily residential, and single family dwellings predominate, with the mean value of residental property per acre of upland equal to $182,910. Only 33.6% of the housing is seasonal. Much of the City is zoned for single family dwellings, particularly the northeastern section around the golf course, the central portion of the island between 8th and 31st Streets South, and some areas near Absecon Inlet.

Most of the City's oceanfront is zoned to allow higher density development. Along the City's northern oceanfront, garden apartments, hotels and motels are permitted uses, and current land use reflects the zoning for the most part. Garden apartments are permitted along Steelman's Bay. The area behind the dune conservation zone at the southern end of Brigantine and along St. Georges Thorofare is zoned for garden apartments, townhouses, and/or motels. Several condominium developments have recently been constructed in these areas. Most remaining portions of the City are zoned for one to four family homes.

The major commercial development in the City is located along Brigantine Boulevard and in the vicinity of the

* All demographic data in the following sections is taken from 1980 Census and NJDEP (1984c). Population densities and property value per acre were calculated by the Division of Coastal Resources to reflect developable land only.

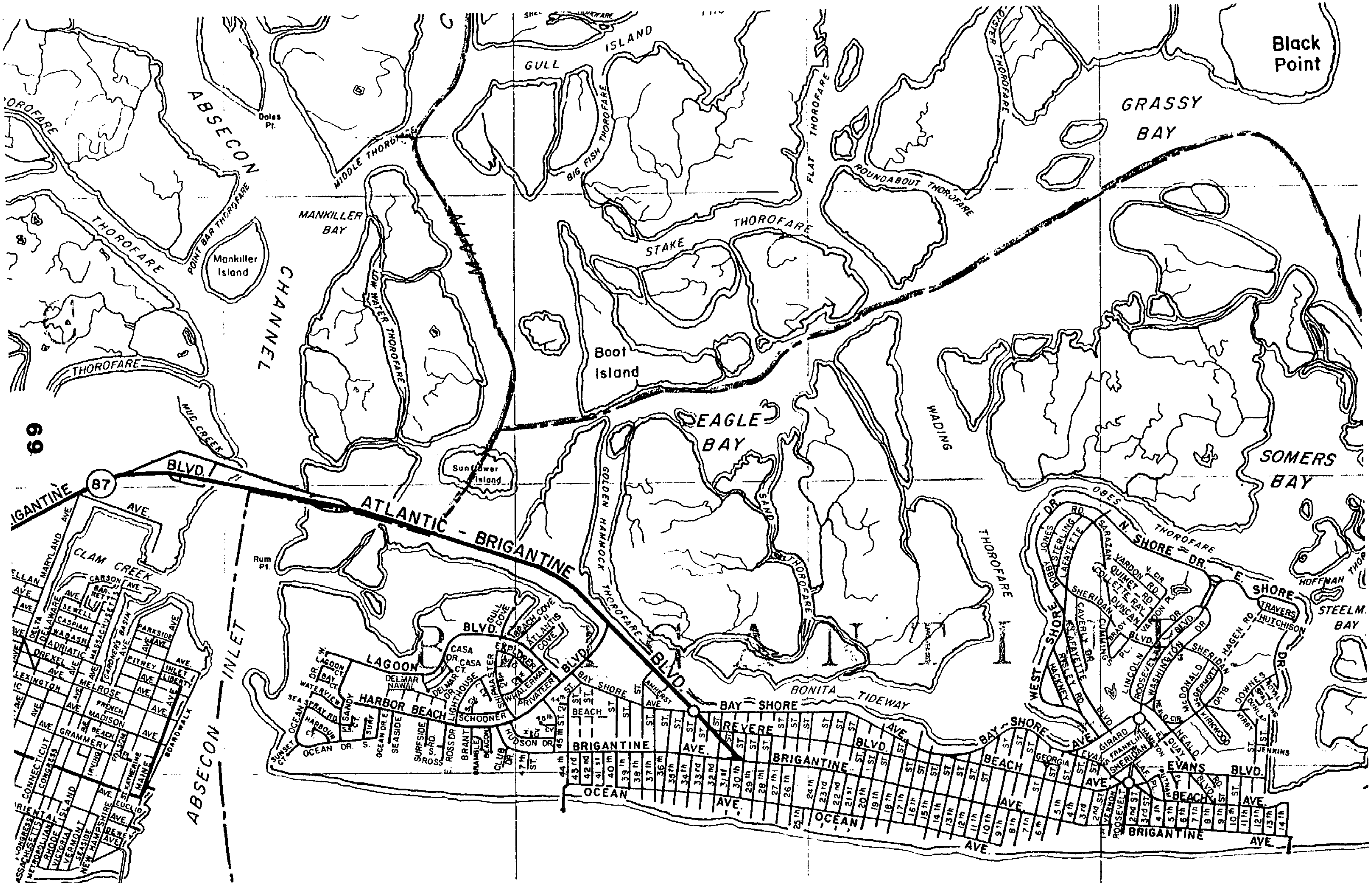


FIGURE 10: Road Map Of Brigantine

Alfred B. Patton, 1980

traffic circle, although an additional area along the ocean and at the northern tip of Brigantine is zoned commercial. Marinas, boatyards and related commercial activities are found along the back bay shores.

In Brigantine, no non-conforming building may be enlarged, extended or increased, if such enlargement, extension or increase will increase the degree of non-conformity. Any such addition or improvement shall not exceed the present bulk requirements nor encroach upon any existing yard or setback requirements. Any non-conforming building destroyed by windstorm, fire, explosion or other act of God to an extent of more than 60% of the recorded true value as appraised in the records of the tax assessor shall be deemed completely destroyed. Such structures may not be rebuilt, repaired, or restored except in conformity with the Municipal Land Use Ordinance. Undersized lots in existence as of January 1, 1967 may be built upon subject to certain conditions.

The Municipal Land Use Ordinance of the City of Brigantine includes among its many purposes "to secure safety from fire, flood, panic and other natural and man-made disasters" and "to encourage the control of surface water runoff, and to encourage the control of soil erosion and sedimentation and to prevent flooding and other damage to land." Accordingly, in 1962 after the storm of March 6-8, the City adopted an ordinance protecting beaches, sand dunes and the dune line (referring to that established by the U.S. Army Corps of Engineers) and any other artificial or natural protective barriers. The ordinances prohibited removal, alteration, interference with or destruction of any part of these features or any act which tended to lessen the protection afforded by these features.

This action was greatly strengthened by the 1982 adoption of an ordinance to define, delineate and regulate beach and dune areas. A Dune and Shoreline Management Plan was prepared by Pennoni Associates, Inc. for the City Commission of Brigantine in 1981. The Plan assessed the characteristics and conditions of existing dunes, mapped regulated dunes, and established a development restriction line, a Dune Maintenance District, a Dune Restoration District and a Dune Reconstruction District which were incorporated into the Land Use Ordinance. The dune and beach areas are designated a Conservation Zone. The ordinance requires permits for movement or displacement of sand within these districts, sets forth conditions for issuance of permits and prohibits all construction activities other than shore protection projects and dune management programs seaward of the dune restriction line. The City acquired and condemned property in order to implement the ordinance. Although this is one of the strongest dune protection ordinances in New Jersey, it does not protect all existing dunes in Brigantine, as it only applies to dunes seaward of the development restriction line.

In addition to its Dune ordinance, Brigantine has also instituted an ordinance pertaining to construction, reconstruction or repair of bulkheads. The ordinance requires that the top of oceanfront bulkheads be a minimum of 11 feet above mean sea level and all other bulkheads be at least 9 feet above mean sea level. The ordinance also contains specifications on materials used and construction methods.

2. Vulnerability

In order to define the coastal storm vulnerability of Brigantine City, different areas were examined in terms of beach width and height, erosion rate, presence of dunes, types of shorefront structures, and land use patterns. The primary vulnerability results from the narrow, low beaches and close proximity of development to the oceanfront, especially north of South 8th Street (see Vulnerability Analysis, Plate No. 1). The erosion rate for northern Brigantine (from about 40th Street South to 14th Street North) is 3.1 feet/year (Nordstrom et al., 1977), as measured from aerial photographs for 1952 and 1971. No shoreline change rate is available for the southern portion of Brigantine but it continues to accrete as a result of lengthening of the jetty. Post-storm photographs taken in March 1962 also served as indicators of the most vulnerable areas by showing the different levels of storm damage in the City (Figure 11).

Development patterns on Brigantine Island, like most seaside resorts, encouraged the building of residential and commercial structures as close to the beach as possible. This has commonly resulted in high density development in the most hazardous part of the barrier island, adjacent to the narrow beach. As the erosional forces of the ocean gradually reduce beach width, the developed areas become more susceptible to storm wave attack. Wave runup analyses can be found in the Vulnerability Analysis, Part I-C.

FIGURE 11: Brigantine: 4th Street North - 20th Street South, March 10, 1962. Note extensive beach erosion and washover between 2nd Street North and 7th Street South.

Some oceanfront sections of Brigantine are fortified with shore parallel bulkheads which act as breakwaters during storms. North of 2nd Street North, only a low timber bulkhead and a narrow beach separate the ocean from developed areas (Figure 12). Such structures tend to instill a false sense of security in adjacent landowners who believe the structure will safeguard their homes. Therefore, construction directly behind oceanfront bulkheads continues despite the fact that beaches are eroding. This construction is then vulnerable to damage from storm wave runup and overwash.

There is a wide dune field at the southern end of the island from 45th Street South to the Absecon Inlet jetty. This southern section of the City is able to support a dune field because of the positive sediment budget in the area. This is enforced by the blocking of the southerly moving longshore sediment by the Brigantine jetty at Absecon Inlet.

Tidal flooding also presents a serious danger because of the low elevation of the island and the manner in which many of the older homes were constructed (slab/block foundation, not raised above base flood elevation). This hazard is greatest in the golf course area of Brigantine where the elevations are lowest and many homes were built before base flood elevations were established by FEMA. This flotation zone is delineated on plate number 1, Vulnerability Analysis.

3. Recommendations

The City of Brigantine had mixed reactions to some of the specific hazard mitigation strategies suggested by members of the Division of Coastal Resources. The City's and Division's recommendations are listed in Table 7. All steering committee members agreed that the dunes along the beachfront need to be better maintained. The floodproofing and buffering effect of dunes is recognized and future improvements are planned such as better planting and fertilizing, reorienting of pathways, building of dune walkover structures, and closing street end gaps. The idea of inspecting homes in the flotation zones for proper anchoring was also approved.

One of the primary problems pointed out by the Brigantine committee members is that the City is already fully developed and land use changes are, therefore, difficult to achieve. Some committee members believe that

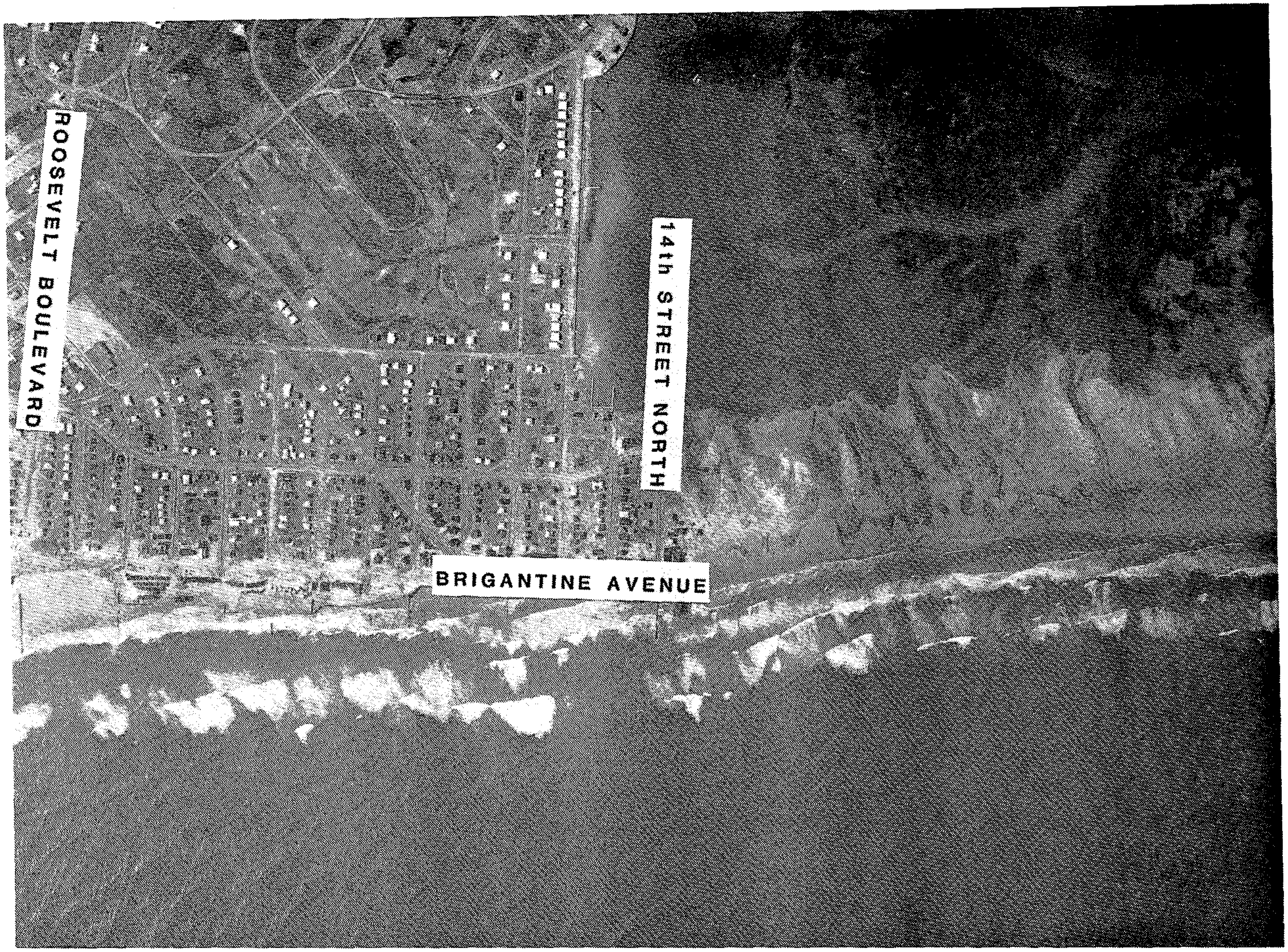


FIGURE 12: Brigantine: 14th Street North - Roosevelt Boulevard, March 10, 1962. Note damage to structures along oceanfront and washover penetration landward of Brigantine Avenue. Undeveloped area north of 14th Street North exhibits a typical response of a natural beach to severe storm event.

all oceanfront structures (homes) destroyed by storm should be rebuilt on the same site using improved construction methods and standards. However, the consensus of the Committee is that all possible efforts should be made to acquire heavily damaged properties in the most vulnerable areas. The Division of Coastal Resources feels that the proposed zoning changes should be implemented now so that orderly and well thought out post-storm redevelopment will take place.

The Brigantine representatives also disagree with the suggested land use/zoning changes because of the potential loss of ratables. If acquisition, increased oceanfront setbacks and downzoning techniques are utilized in Brigantine, many homes located in the coastal high hazard area and wave runup zone might not be rebuilt following a damaging storm. This would obviously result in a decrease of ratables, a generally unpopular idea. The Division of Coastal Resources recommends land use changes, in particular downzoning and increased setbacks, and suggests ways in which lost ratables can be offset. Although some of these areas are presently developed, the northern end of the City is being redeveloped at a higher density as motel units, including the Brigantine Motor Lodge, are replaced by condominiums. First, if homes are set back further or not rebuilt in the high hazard areas following a storm, future storm damages and costs to the City will automatically be reduced. The use of acquired or setback buffer areas will also limit damage to structures outside of the high hazard area by reducing overwash and battering by oceanfront debris. The loss of ratables can also be offset by a slight increase in the beach user fees, which are relatively inexpensive at seven dollars per season.

Lastly, the Brigantine Steering Committee strongly believes that much of the City's coastal storm vulnerability could be reduced by the continued use of shore protection structures. In particular, the City recommends the construction of two new groins along the northern beaches, at 7th and 14th Streets North, and raising of the oceanfront bulkhead north of Roosevelt Boulevard. In spite of their high cost, these proposals do not necessarily guarantee positive results. A new engineering study would be required to determine the probable effects on adjacent beaches from any new shore protection project. A higher bulkhead could result in increased scouring of the beach in front of the structure and increased downdrift erosion and undercutting of dunes. Because of the high cost of structural shore protection measures, as well as the limited availability of these funds at the state and federal level, the implementation of lower cost land management techniques may ultimately be accomplished at the local level.

TABLE 7: BRIGANTINE HAZARD MITIGATION RECOMMENDATIONS

AREA OF VULNERABILITY:	D.E.P. RECOMMENDED HAZARD MITIGATION TECHNIQUES	LOCAL RECOMMENDED HAZARD MITIGATION TECHNIQUES
Oceanfront: North 9th-14th St. 1. Beach width ±50 feet; no dunes; erosion rate of -3.1 ft/yr; structures in wave runup zone.	1. Change zoning to incorporate future setbacks landward of Brigantine Ave. right-of-way; try to build up dunes seaward of bulkhead; don't allow post-storm reconstruction within V-Zone or wave runup zone; Change B-1 zone to zone permitting only recreational/service uses (i.e., restaurant/snack bar; parking; shops) at low density.	1. Rebuild bulkhead to higher elevation; build new groin at North 14th Street; beach fill; look to purchase or swap high hazard oceanfront land if funds are available.
Oceanfront: Roosevelt Blvd.-North 9th Street 2. Narrow beach with no dunes; erosion rate of -3.1 ft/yr; hotel/motel development seaward of Brigantine Ave., within the V-zone and wave runup zone.	2. Rezone to conservation all beach area seaward of Brigantine Ave.; incorporate future setbacks landward of Brigantine Ave.; reestablish and maintain dunes.	2. Rebuild bulkhead to higher elevation; build new groin at 7th Street; beachfill; Purchase or swap properties substantially damaged if funds are available.
Oceanfront: South 8th St.-Roosevelt Blvd. 3. Narrow beach; low dunes with many paths; over-wash area; erosion rate of -3.1 ft/yr; V-zone boundary landward of some structures.	3. Dunes need to be repaired and paths closed or reoriented; dune walkover structures need to be built; structures should not be rebuilt seaward of Brigantine Ave. if substantially damaged in storms; extend conservation zone to Brigantine Ave.	3. Dunes should be repaired; purchase or swap properties substantially damaged if funds are available.

TABLE 7 (continued)

AREA OF VULNERABILITY:	D.E.P. RECOMMENDED HAZARD MITIGATION TECHNIQUES	LOCAL RECOMMENDED HAZARD MITIGATION TECHNIQUES
Golf Course Area - north of Roosevelt Blvd. 4. Very low elevation; flotation zone.	4. Older homes should be inspected for adequacy of anchoring; homeowners should be encouraged to anchor or raise homes properly in order to reduce potential for flotation; if city cannot complete the survey, an information sheet should be provided to homeowners to aid them in conducting their own inspection.	4. Homes should be surveyed but city may not have resources to complete; advise homeowners to purchase Federal Flood Insurance and also to raise or anchor structures properly
Oceanfront: South 17th-8th 5. Low dunes with many paths; structures along V-zone boundary.	5. Dunes should be enhanced; dune paths should be closed or reoriented; increase landward setbacks from Ocean Avenue for post-storm reconstruction and new construction. Between south 16th and 13th streets, rezone R-4 district to conservation zone. Abandon Ocean Avenue if destroyed and incorporate in dune system	5. Repair and enhance dunes.
Oceanfront: South 27th-17th 6. Low dunes with many paths; V-zone boundary landward of homes.	6. Dunes need to be enhanced, paths closed and walkover structures built; don't allow new structures or rebuilt structures in V-zone. V-zone.	6. Repair and enhance dunes; build walkover structures at streetends; close paths in dunes.

TABLE 7 (continued)

AREA OF VULNERABILITY:	D.E.P. RECOMMENDED HAZARD MITIGATION TECHNIQUES	LOCAL RECOMMENDED HAZARD MITIGATION TECHNIQUES
Oceanfront: South 27th-36th 7. Low dunes with paths.	7. Dunes need to be enhanced; close paths; build walkover structures.	7. Repair and enhance dunes; build walkover structures at street ends; close paths in dunes.
Oceanfront: South 44th-36th 8. Low dunes with many paths; V-zone boundary landward of Ocean Avenue and structures.	8. Improve dune district; don't allow new or rebuilt structures in V-zone, by increasing setbacks landward of Ocean Avenue and re-zoning to conservation district; eliminate high density (R-4) zone landward of Ocean Avenue.	8. Improve dune district.
South 44th St. - Absecon Inlet 9. Low dunes with many paths.	9. Improve dune district by fencing, planting, eliminating gaps.	9. Improve dune district.
Foot of Bridge - Brigantine Boulevard and Absecon Inlet 10. V-zone; Located on escape route; undeveloped.	10. Rezone to preclude residential use (including hotels, motels); consider water dependent uses or park and ride lot; require waterfront setbacks for structures.	

C. ATLANTIC CITY

1. Description and Present Land Use Regulations

Atlantic City is not typical of New Jersey's barrier island communities due to the presence of casino gambling and its long history as an urban area. It is the largest urban center in the New Jersey coastal zone. The City is 11.94 square miles in size, about one third of which is upland (Figure 13). The ocean and inlet beach are 4.3 miles long. Three roads provide direct access from the mainland to Atlantic City, these being the White Horse and Black Horse Pikes (Routes 30 and 40 respectively) and the Atlantic City Expressway. The population of 40,199 is nearly as high as the other five cities in the study area combined. Twenty-three percent of these people are senior citizens. The mean family income is $16,848. The population density of Atlantic City is the highest in the study area, about sixteen people per acre of upland. If Atlantic City rebuilds according to present zoning, densities will increase greatly.

Unlike the other five municipalities in the study area, residential property value in Atlantic City is a small portion of the total real property value of $847.8 million. Sixty-one percent of real property is classified as commercial, valued at $519.8 million. Residential development is valued at $285,969 per acre, very little (11.5%) of which is seasonal.

High-rise casino-hotels, commercial buildings and multi-family residential structures characterize Atlantic City's development. Atlantic City's Boardwalk extends from the City of Ventnor, along the entire oceanfront around into Absecon Inlet. New Jersey voters passed a constitutional referendum to legalize gambling in 1976, which was followed by passage of the Casino Control Act in 1977. The City was subsequently rezoned and redevelopment has occurred in limited portions of the City, the bulk of this work centering on the beachfront blocks.

The oceanfront blocks from Roosevelt Avenue to Virginia Avenue and from Connecticut Avenue to Absecon Inlet at Atlantic Avenue are zoned resort commercial, with a 56 acre urban renewal tract between the two districts. A second resort commercial zone is located along the Inlet, at the end of Maine and New Hampshire Avenues near Gardner's Basin and a third is located in the marina area. The purpose of the resort commercial districts is to provide for transient

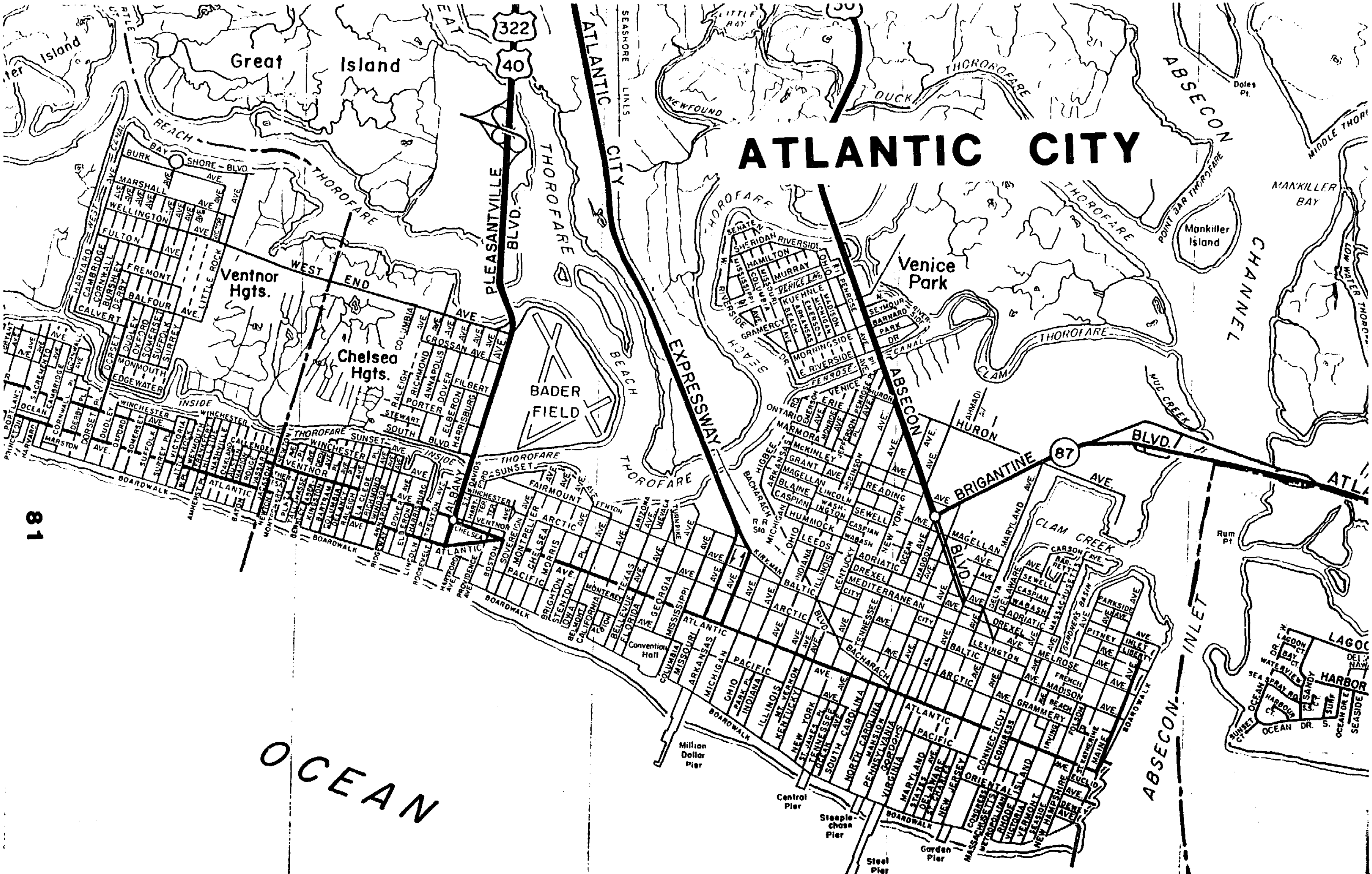


FIGURE 13: Road Map Of Atlantic City

Alfred B. Patton, 1980

and tourist-oriented uses, while encouraging residential development as well. Permitted uses include casino-hotels, multi-family housing, restaurants, retail shops and offices. Buildings may be 385 feet high in this zone.

The Atlantic City Land Use Ordinance stipulates that buildings abutting the Boardwalk may not be set back. However, the planning board may authorize a setback if the setback will be developed in a manner designed to promote the continuity, unity and functionality of the Boardwalk as an active pedestrian way. This also applies in the residential zones abutting the Boardwalk.

At present, nine casinos are operating on the oceanfront and several casino expansions, a new casino, and high-rise condominiums are under construction. One additional casino is operating in the marina area (with an expansion underway) and a new casino is scheduled to open there in May 1985. Redevelopment has yet to begin near Gardner's Basin. A Master Plan was prepared by Resorts International for the Atlantic City Housing Authority in April 1983 for the Urban Renewal Tract. The plan provides for five casino hotels along the oceanfront and mixed residential and commercial use across Pacific Avenue. A new hotel casino and a hotel casino expansion are under construction on the oceanfront in the urban renewal tract, while most of the tract remains vacant.

Seaward of the Boardwalk is the Beach District. Presently there are five recreational piers extending into the ocean in this district, some of which are now closed to the public. The remaining oceanfront is zoned for multi-family high rises and hotels between Roosevelt Place and Elberon Avenue and single family dwellings between Elberon Avenue and the City of Ventnor. Current uses on the oceanfront in the single family district do, however, include a pediatric hospital for children and three high-rise condominium/apartment buildings.

Inland of the oceanfront resort commercial district, a strip of the City several blocks wide, centered on Atlantic Avenue, is zoned as the central business district and for mixed commercial-residential use. This reflects the present land use, although the potential exists for denser development. Smaller neighborhoods and heavy commercial districts are located throughout the City.

The southwesterly end of Atlantic City, between the City of Ventnor and Albany Avenue, is zoned for and is developed as one and two family dwellings and townhouses. Multi-family dwellings are also permitted along and within three blocks of Beach Thorofare between Albany and Missouri Avenues. Building height in these areas may not exceed 35 to 40 feet. Chelsea Heights, located across Beach Thorofare from the main portion of Atlantic City, is developed with single family detached units, which reflects current zoning.

South of Route 30 and north of Bacharach Boulevard is the residential area known as Venice Park, which extends down to Mediterranean Avenue. It is now and will, under current zoning, remain single family. However, across both Route 30 and Mediterranean Avenue, higher density, multi-family housing is permitted. A large portion of this area is vacant, and townhouses exist in much of the area.

The North Inlet section of Atlantic City is a blighted, low rise, residential area between Maryland Avenue and the Absecon Inlet where little redevelopment has occurred. Much of the housing has been abandoned and/or neglected. The Inlet is bulkheaded from Caspian Avenue to Euclid Avenue, with a gap near the abandoned Hackney's Restaurant. The North Inlet section is primarily zoned for high density, multi-family use, including high rises around Gardner's Basin (including hotels). In 1981, an ordinance was passed creating two high-rise overlay districts between Connecticut Avenue and the Inlet. High rises up to 250 feet in height are permitted along Atlantic Avenue and up to 385 feet high on Maine Avenue and the waterfront.

In 1983 a plan for redevelopment of the North Inlet was prepared by American City Corporation for the New Jersey Casino Control Commission. The plan would generally conform with existing zoning, with the exception of maritime use areas along Clam Creek, Delta Basin and Gardner's Basin and two proposed commercial and service centers (Inlet Center near Lighthouse Park and Upland Center at the inland end of Gardner's Basin). The plan is designed to "create a balanced residential community..., create economic value..., conserve and enhance the Inlet's natural features..., implement adequate prevention and protection techniques to control flooding in the Inlet, preserve sound residential and historically significant structures..., improve public access to the Inlet's waterfront..., create neighborhoods that offer a full range of housing choices..., preserve and assess the maritime industries in the area..." and provide access to commercial uses (American City Corp., 1983). In order to meet these goals, neighborhood commercial centers are proposed, as are housing development plans for each

Inlet neighborhood, parks, and roadway modifications and closures. Of particular relevance to this study is the proposal to 1) realign Maine Avenue to continue around the Inlet beyond Caspian Avenue, 2) create a tree lined median for the street to serve as a major collector street, while 3) Vermont and New Hampshire become one-way streets for local traffic and 4) Rhode Island Avenue is closed to traffic and becomes a bike path and walkway. Also pertinent are the retention of the Gardner's Basin Maritime Park, realignment of the Boardwalk north of Melrose Avenue along Maine Avenue, maintenance of views of the Absecon Lighthouse from the Boardwalk, and the proposal to redevelop both Hackney's Restaurant on the Boardwalk and Starn's Restaurant at Maine and Caspian Avenues, as restaurants.

The Division of Coastal Resources regulates much of the development in Atlantic City under the Coastal Area Facility Review Act. Developments of 25 or more dwelling units or hotel rooms, parking areas two acres or more in size, and roads and sewers which are at least 1200 feet in length are regulated under the Act. The Division has guidelines for use in regulating development in the North Inlet section of Atlantic City which presently have a basic conflict with the City's zoning provisions. The City zoning provides for the tallest buildings along the waterfront (385 feet in the resort commercial zone and along the Absecon Inlet and 220 feet around Gardner's Basin), with lower height limits further inland. However, the Division guidelines provide for a transition from low heights on the waterfront to higher buildings further inland on both the Inlet and the oceanfront east of Virginia Avenue. Only low to medium rise buildings (transitioning up to 9 stories) north of Melrose Avenue are acceptable under these guidelines, which are based on the State's Coastal Resource and Development Policies (N.J.A.C. 7:7E-1.1 et seq.).

The City permits non-conforming buildings and uses to continue indefinitely, but does not allow them to be altered or enlarged, extended, placed on a different portion of a lot, or re-established after the physical operation has ceased or has been discontinued. A building which houses a non-conforming use and is damaged may be repaired or restored within 12 months. However, if the non-conforming structure or non-conforming portion of the structure is destroyed by any means to an extent of more than 80% of its replacement value, it may only be reconstructed in conformity with the zoning ordinance. A building which houses a conforming use, but which does not conform to other land use regulations (e.g. setbacks, lot size) may be rebuilt. In districts where single family dwellings are permitted, non-conforming lots of record on the effective date of the ordinance may be built upon notwithstanding ordinance limitations, subject to certain conditions.

2. Vulnerability

The most critically eroding area of Atlantic City is adjacent to Absecon Inlet, where there is literally no beach (Figure 14). A deteriorating timber bulkhead and several stone groins provide only minimal protection for the Inlet shoreline of Atlantic City. (A discussion of the effectiveness of the shore protection structures can be found in Vulnerability Analysis, Part I,C.) Overtopping of this bulkhead by storm waves and high tides occurs frequently, in part because of the deep channel located approximately 300 feet offshore. The vulnerability of this section of the City is evidenced by the repeated damage to the stretch of Boardwalk between Oriental and Arctic Avenues. The jetty on the Brigantine side of Absecon Inlet only minimally protects the Inlet shoreline of Atlantic City, which is subjected to the direct force of northeast storm winds and waves.

The vulnerability to damage from storm waves is high for the entire oceanfront of Atlantic City. The flat, gently sloping beaches provide very little protection to shorefront development. Although the Boardwalk is the first beachfront structure, oceanfront bulkheads and building foundations constitute the first substantial barriers to storm waves. Because of the nature of the City's Resort Commercial zone, high density casino hotel development lies directly on the inland side of the Boardwalk, which is also the A-zone/V-zone boundary as mapped by FEMA (Federal Emergency Management Agency, 1983). The potential for oceanfront damages may change when the beach is artificially filled in 1985, although it would not affect the V-zone boundary.

Several sections of Atlantic City are especially vulnerable to damages resulting from tidal flooding. These areas include Gardner's Basin, Venice Park and Chelsea Heights. All are low lying residential districts surrounded by tidal waterways on at least two sides (see: plates 5 and 6, Vulnerability Analysis). The homes typical of these areas are timber frame structures set on concrete slab or block foundations, which are more susceptible to flotation than newer homes built on pilings above the base flood

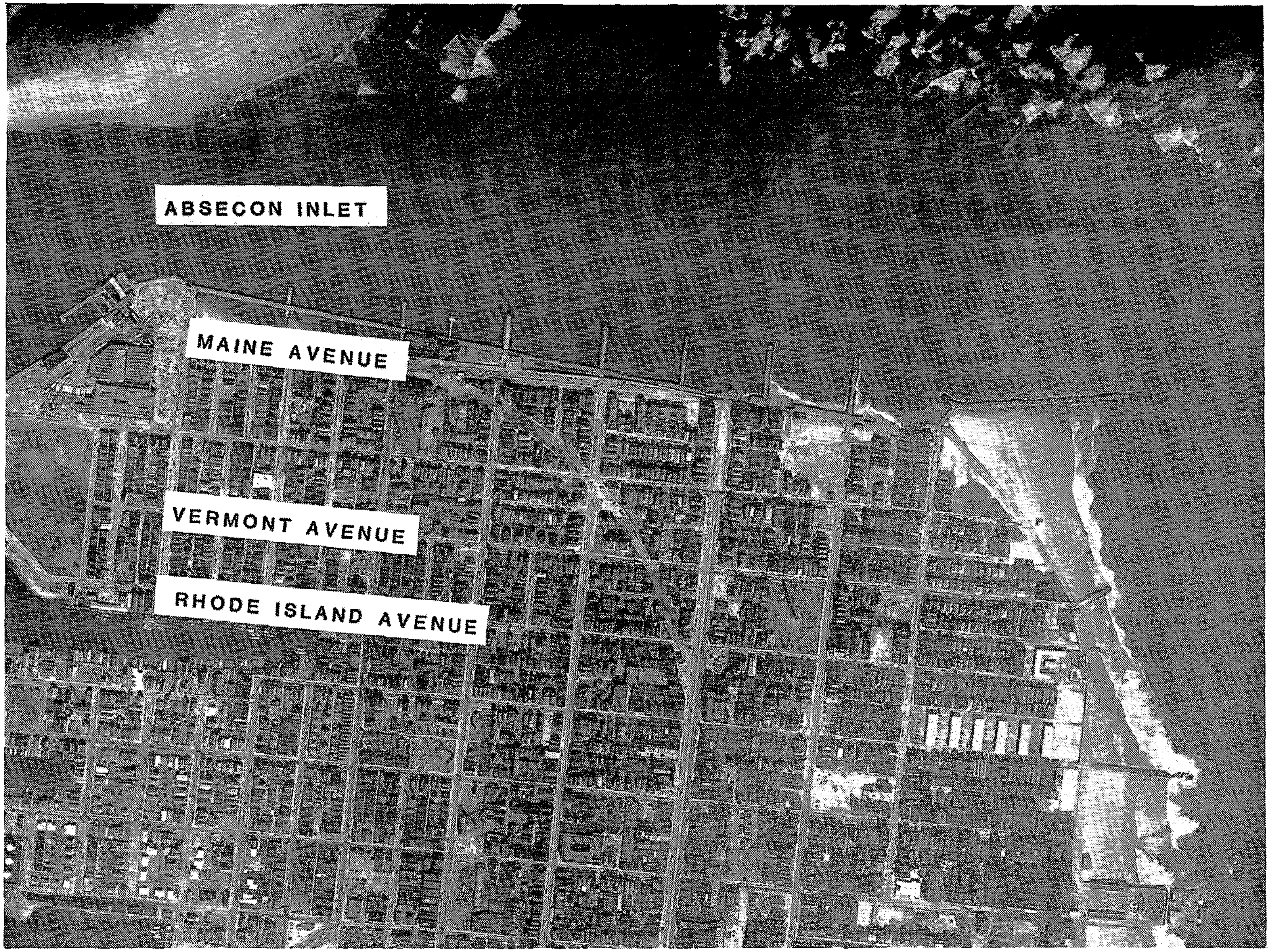


FIGURE 14: Atlantic City: Absecon Inlet Shoreline, March 10, 1962. Note damage to boardwalk and bulkhead along Maine Avenue, and on the oceanfront between Vermont and Rhode Island Avenues.

elevation. Flood damage in these low lying areas was evident in the March 1984 storm.

3. Recommendations

As was the case with most municipalities in the study area, Atlantic City representatives were only partially receptive to the hazard mitigation techniques recommended by the Division of Coastal Resources. In Atlantic City, the extremely high value of oceanfront property, particularly the resort commercial (casino) zones, makes land use changes very unpopular and acquisition almost impossible. The resort commercial zone which extends from Roosevelt Avenue all the way around Absecon Inlet, encourages casinos to be built abutting the Boardwalk. Because no setbacks are required, the high cost casinos and accompanying hotels and high rise condominiums are constructed in an area which is the most vulnerable to storm wave, wind and flood damage. The Atlantic City Planning Board can, however, authorize setbacks if the development is designed to promote "continuity, unity and functionality of the boardwalk." There are two significantly sized areas that have yet to be redeveloped and in which the Division believes setbacks from the Boardwalk should be incorporated. These areas are the Uptown Urban Renewal Tract (along the Boardwalk between Virginia and Connecticut Avenues) and the Absecon Inlet area. Setbacks would not preclude commercial use of the space but would prevent permanent structures other than the Boardwalk to be located there. The land management techniques recommended by the Division of Coastal Resources would most easily be implemented in these two areas simply because they are currently vacant. Even so, the high value of this land will cause many developers and property owners to oppose any restrictions whatsoever and the City feels that it would impose an economic hardship on any casino which is required to set back from the Boardwalk.

Due to the concentration of resort commercial development adjacent to the City's narrow beach, both State and City Committee members agree that a major beach nourishment project is needed soon. It was also agreed that sand dunes serve an important function as storm wave and flood buffers. There is, however, some doubt as to whether the City's beaches are wide enough to maintain dunes. The City used to place snow fences on the back of the beach in the winter and build up a small dune, then bulldoze it away in the spring. It is strongly recommended that the City resume the installation of sand fences to increase deposition of sand on the beaches, at least in the southwestern end of the City where existing beaches are wider. These newly formed dunes should then be permanently maintained and a dune ordinance adopted. The Division of Coastal Resources is available to provide technical assistance regarding dune building.

A program of acquiring high hazard waterfront property, particularly along the Inlet, to serve as a storm buffer is recommended, but may be economically unfeasible. One possible funding source for acquisition is the New Jersey Green Acres Program. Because of the high public use, accessibility, and sound planning relationship, acquisition of high hazard property along Absecon Inlet scores relatively high on the Green Acres Priority System Rating.

One hazard mitigation recommendation has recently been approved. This specific recommendation is to raise the road surface of Arkansas Avenue from Baltic Avenue to the Atlantic City Expressway entrance. Department of Environmental Protection and Atlantic City Office of Emergency Management representatives met with Clyde Fear, Executive Director of the Expressway Authority, who indicated the Authority's willingness to finance the project. The increased street elevation will reduce the degree of flooding on this critical route, allowing more time for storm evacuation. Topographic data is now being collected for use in roadway design.

TABLE 8: ATLANTIC CITY HAZARD MITIGATION RECOMMENDATIONS

AREA OF VULNERABILITY:	D.E.P. RECOMMENDED HAZARD MITIGATION TECHNIQUES	LOCAL RECOMMENDED HAZARD MITIGATION TECHNIQUES
Absecon Inlet Shoreline 1. No beach; V-zone boundary along Maine Avenue; bulkhead in poor condition; Boardwalk susceptible to storm damage between Oriental and Arctic; area adjacent to Inlet is zoned Resort-Commercial and High Density Residential.	1. Repair bulkheads; rezone and require setbacks to preserve open space in wave runup zone landward of Maine Avenue; setbacks should be greater between Euclid and Oriental Avenues; do not rebuild boardwalk if damaged; consider using Maine Avenue as a promenade to avoid repeat cost of replacing storm damaged Boardwalk; don't allow construction waterward of Maine Avenue; where possible relocate infrastructure away from Maine Avenue; downzone first block on Maine Avenue (between Atlantic and Baltic) to RM-1.	1. Beach nourishment; reconstruct and repair groins, bulkheads, jetties; extend inlet jetty on Brigantine side.
Gardner's Basin 2. Very low (6'NGVD) elevations; entire area subject to frequent flooding, especially along Baltic Avenue.	2. Repair/rebuild bulkheads; inspect and properly anchor structures in flotation zone.	2. Reconstruct bulkhead and seawall.
Oriental Avenue (Inlet)-Connecticut Avenue 3. Narrow, low beach; overwash area; V-zone boundary at Boardwalk; two senior citizen homes adjacent to Boardwalk, bulkhead in poor condition.	3. Beach nourishment; incorporate setbacks from Boardwalk for new construction and rebuilding; reconstruct damaged Boardwalk within setback area; repair bulkhead; don't run utility lines under the Boardwalk.	3. Beach nourishment.

TABLE 8 (continued)

AREA OF VULNERABILITY:	D.E.P. RECOMMENDED HAZARD MITIGATION TECHNIQUES	LOCAL RECOMMENDED HAZARD MITIGATION TECHNIQUES
Urban Renewal Tract (Connecticut Avenue to Virginia Avenue 4. Narrow, low beach; V-zone boundary at Boardwalk.	4. Beach nourishment; since presently undeveloped, setbacks (50') from the present Boardwalk would provide a buffer for new construction, moving it away from the area of storm wave impact; rebuild damaged Boardwalk directly in front of structures; don't allow utility lines to run under the Boardwalk-run them up the side streets from Pacific Avenue.	4. Beach nourishment; build groins; dune development.
Virginia Avenue-Morris Avenue 5. Narrow, low beach; V-zone at Boardwalk; zoned Resort-commercial.	5. Beach nourishment; create dunes where feasible.	5. Beach nourishment.
Morris Avenue-Roosevelt Place 6. Low beach; V-Zone at Boardwalk; zoned Resort-commercial.	6. Install fencing to create dunes.	
Roosevelt Place-Jackson Avenue: Oceanfront 7. Low beach; erosion rate 5.6 ft/yr; V-zone boundary at Boardwalk; zoned residential highrise.	7. Install fencing to effectively maintain and expand dunes on both sides of the Boardwalk; incorporate setback from Boardwalk for new and rebuilt development.	7. Dune development and maintenance.

TABLE 8 (continued)

AREA OF VULNERABILITY:	D.E.P. RECOMMENDED HAZARD MITIGATION TECHNIQUES	LOCAL RECOMMENDED HAZARD MITIGATION TECHNIQUES
Arkansas & Missouri Avenues - Access to Expressway		
8. Area from Arctic Avenue to Expressway entrance subject to early flooding; elevation 6'-8' NGVD.	8. Raise elevation of Arkansas and Missouri Avenues to at least 8' in order to tie into Atlantic Avenue escape route (+8'); investigate cause of flooding at Atlantic City Expressway toll plaza for possible correction.	8. Raise roadways and improve drainage.
Albany & So. Blvd; West End Avenue		
9. Much of roadway elevation 6' NGVD; frequent flooding restricts evacuation route.	9. Raise low parts of roadway to at least 7'NGVD; build dike along West End Avenue to hold back tidal floods; repair/rebuild bulkheads; install flap gates in storm sewers to prevent tidal flooding.	9. Recondition older bulkheads.
Chelsea Heights & Venice Park		
10. Low elevation; surrounded on 3 sides by water; older, low lying structures subject to flooding and flotation.	10. Repair bulkheads; inspect and properly anchor structures.	10. Reconstruct bulkheads where needed; provide informational sheet on anchoring homes.
Brigantine Blvd., across Brigantine Bridge		
11. Vacant property; on major evacuation route; subject to storm wave action.	11. Don't allow residential development; consider commercial or transportation zone.	

TABLE 8 (continued)

AREA OF VULNERABILITY:	D.E.P. RECOMMENDED HAZARD MITIGATION TECHNIQUES	LOCAL RECOMMENDED HAZARD MITIGATION TECHNIQUES
Entire oceanfront 12. Extensive use of wide pane glass; structures (restrooms, storage areas, sitting pavilions, cabanas, etc.) located on or over beach, seaward of Boardwalk.	12. Try to design buildings to minimize exposure of wide pane glass to highest energy storm winds; do not place non-water dependent structures seaward of Boardwalk.	11. Reduce amount of glass coverage facing ocean.

D. VENTNOR

1. Description and Present Land Use Regulations

Ventnor (Figure 15) is a suburban community, two square miles (128 acres) in size and 1.7 miles long. Approximately 130 acres are wetlands. The 1980 population was 11,704, which is about 10.2 people per acre of upland. Twenty-two percent of the population is senior citizens. The mean family income is $25,072. There are no roads connecting Ventnor directly to the mainland. Access is via the bridges and causeways which terminate in Atlantic City and Margate.

Ventnor is primarily a residential community, with high-rise development along some of the oceanfront and low-rise in the rest of the City. The City is almost entirely developed with the exception of the area known as Ventnor West. Total market value of all real property is $200.2 million. The median value per upland acre of residential property is $329,968 and only 25% of the residences are seasonal.

Most of Ventnor is zoned for one and two family houses, and existing uses reflect this zoning. A portion of Ventnor Heights is zoned for and developed as garden apartments and townhouses. West of Monmouth Avenue, one and two family homes exist in the area zoned for single and two family dwellings and townhouses. Further west, along Beach Thorofare, the City owns a 175 acre parcel of land, of which about 85 acres are wetlands and 90 acres upland. This area, called Ventnor West, is zoned Planned Residential. A conceptual plan was prepared for Ventnor West in 1979 by R.E. Hughey Associates which calls for 865 units, including single family detached homes, townhouses and condominium apartments. At present, Ventnor is pursuing resolution of Tidelands claims on the property and has no immediate plans to develop. The City has several commercial districts along Ventnor Avenue, Dorset Avenue and West End Avenue.

There are presently six high-rise apartment/condominium buildings on the oceanfront, three of which are non-conforming uses. The zoning ordinance does allow for additional high rises in the oceanfront block between Surrey Place and the Atlantic City border. Ventnor does not permit extension or enlargement of non-conforming uses. If a non-conforming use or structure ceases operations for more than one year, any subsequent use must conform with regulations. Whenever a non-conforming structure has been damaged by fire or other causes to the extent of 75% of its

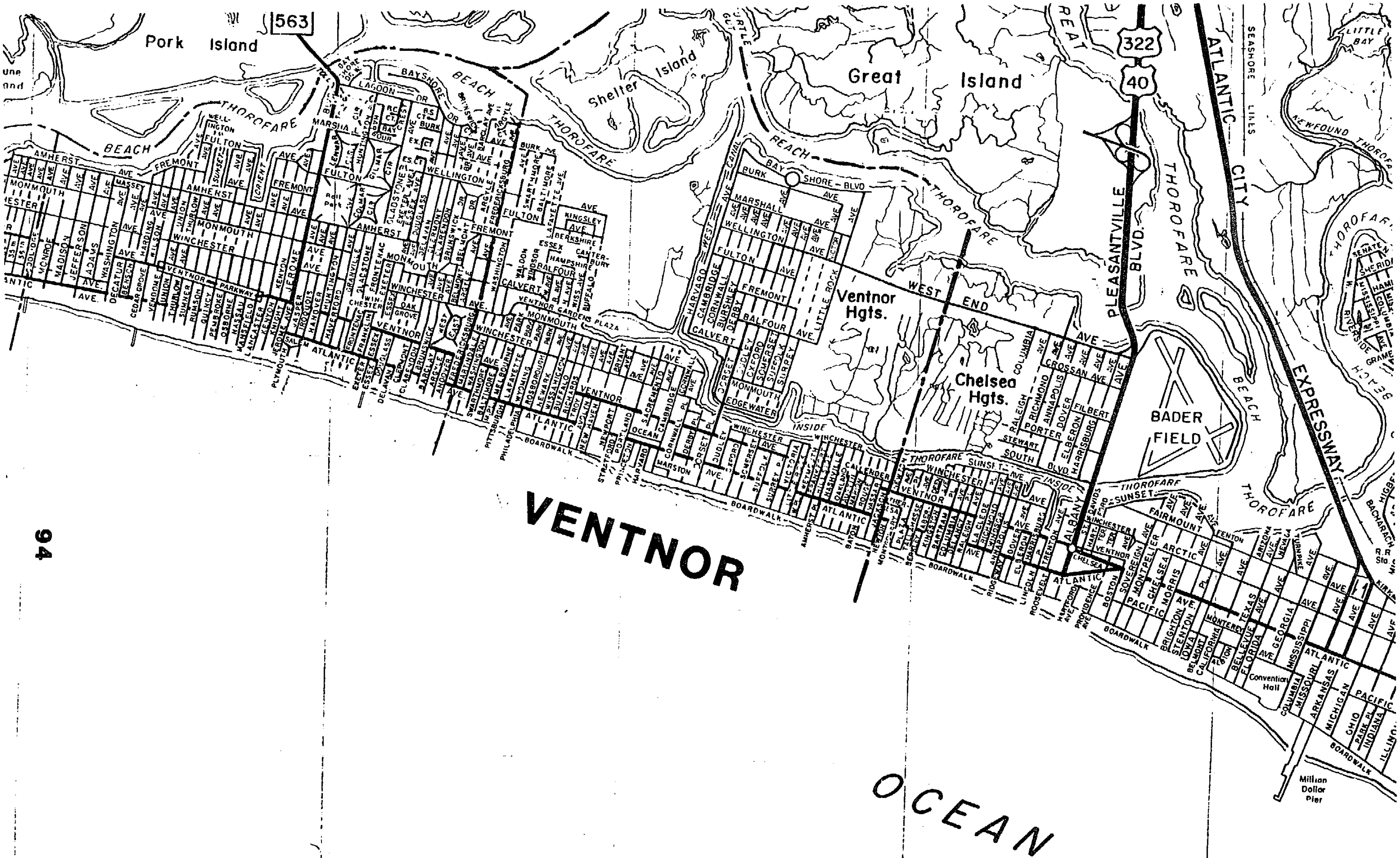


FIGURE 15: Road Map Of Ventnor

Alfred B. Patton, 1980

market value, it may be rebuilt or repaired only in conformity with zoning regulations.

2. Vulnerability

The oceanfront property is protected by a series of bulkheads and seawalls of varying heights (see: Vulnerability Analysis, Part I, B and C). This oceanfront area is most vulnerable to damage from storm waves and overwash, as is the case with the majority of coastal cities. The erosion rate for Ventnor is 5.6 feet/year based on aerial photographs for 1952 and 1971 (Nordstrom et al., 1977) and the beach width ranges from 50 feet at the Margate boundary to 200 feet at the Atlantic City boundary. Being located downdrift of Atlantic City, Ventnor's beaches ultimately receive some benefit from beachfill placed on Atlantic City's beaches. Major storm damage is usually limited to the block seaward of Atlantic Avenue and is concentrated at street ends where the roads have been lowered to allow ramped access to the boardwalk (Figure 16). The flat, gently sloping beach in Ventnor has no dunes, which increases the potential for flooding and storm damage. A boardwalk extends from Atlantic City to Margate, located seaward of the bulkheads.

The greatest storm hazard results from the location of residential structures directly behind the oceanfront bulkheads and seawalls. These structures are situated in the wave runup zone, which is the area most heavily impacted by storm waves and debris breaking over oceanfront structures (see Vulnerability Analysis, Plate 7).

Another serious hazard presents itself in the part of the City known as Ventnor Heights. More than half of this area is subject to tidal flooding from Inside Thorofare and Beach Thorofare due to the low elevation of this section of the City. The flooding problem is exacerbated by the fact that many of the homes were built too low and not adequately anchored. The area of Ventnor Heights most affected by flooding is delineated as the flotation zone on Plate 7, Vulnerability Analysis.

3. Recommendations

Members of the Ventnor Steering Committee were receptive to discussing hazard mitigation, but were not convinced that Ventnor is particularly susceptible to storm damages and, therefore, that extensive mitigation and zoning changes are required. This is primarily the result of

FIGURE 16 : Ventnor: Suffolk Avenue - Washington Avenue, March 10, 1962. Most damage was limited to the boardwalk and street end bulkheads. Washover was concentrated at street ends, due to bulkhead failure.

minimal damages caused by both the March 1962 and March 1984 northeasters. These storms produced severe damages in other coastal towns, but relatively minor damages in Ventnor.

The first and simplest hazard mitigation technique is dune building on the municipal beach. Unfortunately, the beach in parts of Ventnor, especially at the southern end, may not be wide enough to maintain a dune line. It is possible that the northern beach has sufficient width to permit the building and maintenance of a dune. The Division of Coastal Resources plans to provide technical assistance to the City of Ventnor regarding dune building, despite the fact that certain oceanfront property owners are opposed to dunes because they believe dunes will obstruct their ocean view. Decks could be built to allow oceanfront property owners the same vista.

The idea of increasing oceanfront setbacks in order to create a wider buffer zone was not well received by many of the Steering Committee members. They argue that increasing setbacks will not allow the building or rebuilding of the large, spacious homes typical of Ventnor's oceanfront, and that homes should be rebuilt but elevated. However, homes of different architectural design could be built on these relatively deep lots.

In the area of land acquisition, the Ventnor representatives do not see the need to purchase high hazard oceanfront property. One reason for this is the extremely high cost of such a purchase. Another reason is that the city already owns several oceanfront properties, including a playground, community building and a fishing pier. Members of the Division of Coastal Resources still encourage the acquisition of all possible oceanfront property for inclusion in the City's conservation/recreation zone. One possible technique for accomplishing this is by transfer of development rights. This is possible because the large (80 acres) City owned tract of land known as Ventnor West could serve as a receiving zone. This concept is described in Part I, Section D2.

The downzoning of the northern oceanfront area from high density to medium density was also recommended to the Ventnor Steering Committee. The purpose of this was to limit the number of high-rise/high density residences in that part of the City with the greatest storm vulnerability, the oceanfront. This area presently contains low-rise buildings, which should make the rezoning more palatable. Local Committee members disagreed, claiming that the present zoning lends continuity to the Ventnor-Atlantic City border. They also feared losing ratables. However, as no high-rises have yet been built here, it is really a question of not gaining ratables.

It was mutually agreed that the City's bulkheads should be inspected and repaired if necessary.

TABLE 9: VENTNOR HAZARD MITIGATION RECOMMENDATIONS

AREA OF VULNERABILITY	D.E.P. RECOMMENDED HAZARD MITIGATION TECHNIQUES	LOCAL RECOMMENDED HAZARD MITIGATION TECHNIQUES
Suffolk-Fredericksburg Avenue Oceanfront 1. Very narrow beach; erosion rate 5.6 feet/year; overwash area; medium density residential zone directly behind oceanfront bulkhead (V-zone boundary); homes in wave runup zone.	1. Build dunes on both sides of oceanfront bulkhead, if possible; rezone to low density the block seaward of Atlantic Avenue; increase setbacks from the bulkhead; consider Transfer of Development Rights (TDR) between oceanfront block (Transfer) and Ventnor West (Receive).	1. Repair and strengthen oceanfront bulkheads; rebuild damaged buildings at higher elevation.
Jackson to Surrey Avenue: Oceanfront 2. Low beach; no dunes; high density residential development directly behind oceanfront bulkhead, in wave runup zone.	2. Rezone from high density high rise (zone 9) to medium (zone 3) or moderate (zone 1,2); increase setbacks from bulkhead; create dune seaward of bulkhead; consider TDR to Ventnor West.	2. Build dunes in areas of beach which can accommodate them; repair and strengthen oceanfront bulkheads; retain highrise zone.
Dorsett & Monmouth Avenues: West End Avenue 3. Evacuation route is very low at this point (6') and subject to frequent flooding.	3. Repair bulkheads along Inside Thorofare; construct berm along West End Avenue or raise road; install flap gates to prevent tidal flooding via storm sewers.	3. Repair bulkheads along Inside Thorofare; investigate and experiment with flap gate use on West End Avenue.

TABLE 9 (continued)

AREA OF VULNERABILITY	D.E.P. RECOMMENDED HAZARD MITIGATION TECHNIQUES	LOCAL RECOMMENDED HAZARD MITIGATION TECHNIQUES
Ventnor West 4. Undeveloped, low lying area; evacuation routes subject to early flooding.	4. Develop at low to moderate density; consider designation as receiving area for transfer of development rights; include wetlands in conservation zone.	
Ventnor Heights 5. Very low area; flotation zone.	5. Inspect structures for proper anchoring and anchor as needed.	5. Inspect structures for proper anchoring.

E. MARGATE

1. Description and Present Land Use Regulations

Margate City (Figure 17) is 1.5 square miles in size and has very few wetland areas. In 1980, 9,179 people lived in this community, a density of 10.2 people per acre, and twenty-one percent of the population is senior citizens. The mean family income was $34,636. The Margate-Northfield Boulevard (Route 563) provides direct access to and from the mainland.

Margate is predominantly developed in single family dwellings, with a residential development value of $533,409 per acre. The total value of all real property in Margate is $290.6 million, 4.6% of which is commercial. The commercial uses are found in three areas, one at each end of the city along Ventnor Avenue and a third at the southern end of the city on Beach Thorofare. Apartments and townhouses are permitted in these zones.

Exclusive of the small commercial zone, the entire city east of Vendome Avenue is zoned single family and this is the current land use. Twenty-five percent of the residences are seasonal. Multi-family residential districts are located west of Vendome Avenue, both in the two oceanfront blocks and between Ventnor and Monmouth Avenues. Single and two family houses, apartments and townhouses are permitted in these areas, although most of the area presently consists of single family dwellings. There are three high rises on the oceanfront in this zone at present, but the current height restriction is 35 feet.

2. Vulnerability

Margate is protected by a series of bulkheads and seawalls on the oceanfront, placed at varying distances from Atlantic Avenue. Most were constructed and are owned and maintained by the City. As is the case in most coastal municipalities, primary storm vulnerability results from the proximity of residential development to the oceanfront and the small beach height and width. The erosion rate is 5.6 feet/year based on aerial photographs for 1952 and 1971 (Nordstrom et al., 1977), which explains the low, narrow beach and, therefore, the storm vulnerability. Post-storm photographs indicate that the majority of storm damage is limited to the area seaward of Atlantic Avenue (Figure 18). This area is impacted chiefly by wave runup and overwash of the oceanfront bulkheads and seawalls (see: Vulnerability

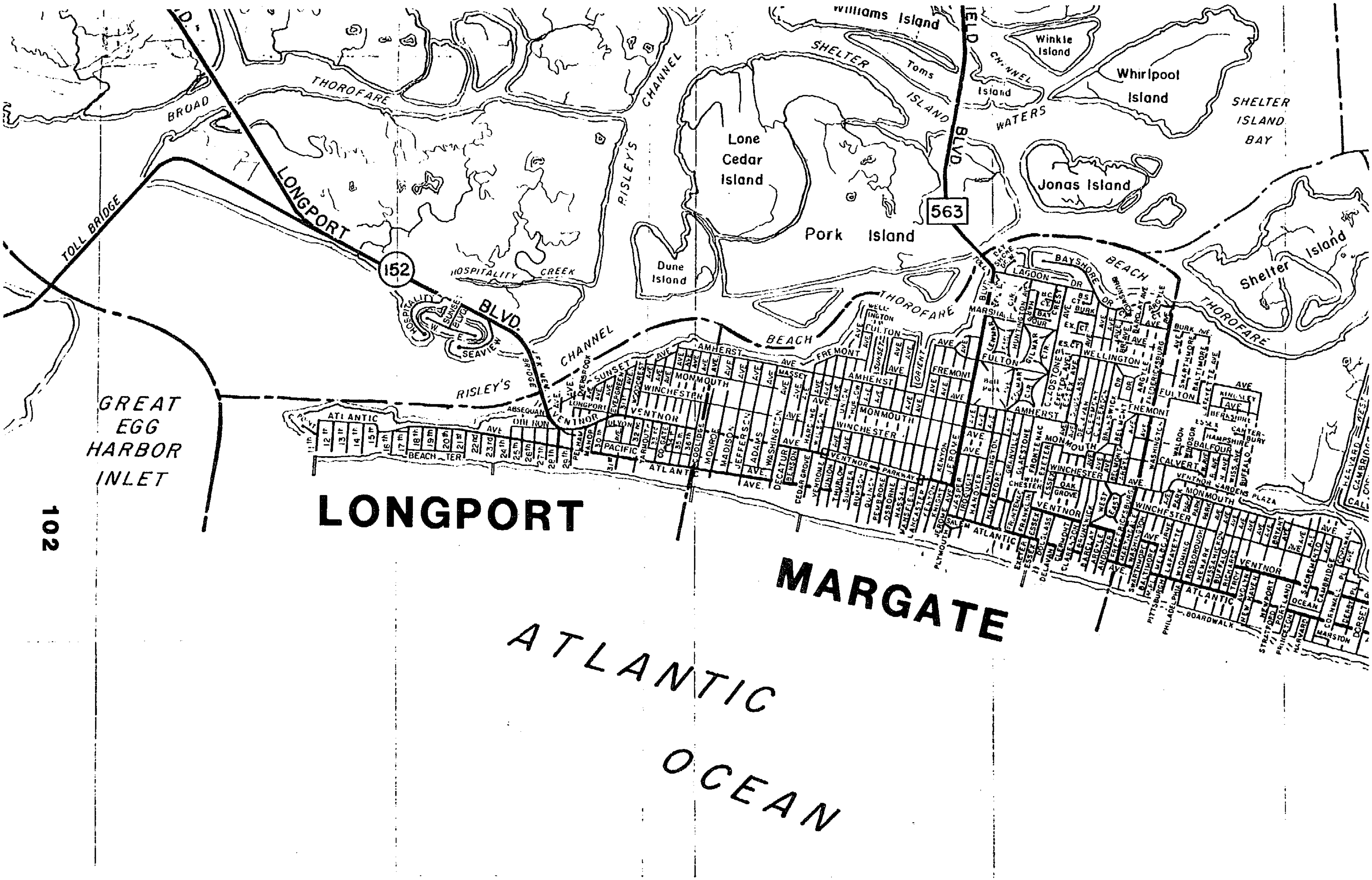


FIGURE 17: Road Map Of Margate

Alfred B. Patton, 1980

FIGURE 18: Margate: Essex Avenue - Madison Avenue, March 10, 1962. Note extensive washover, especially in the southern end of the City.

Analysis, Part I-C). Because of the high density residential development landward of the bulkheads and seawalls, many homes are located in the wave runup zone where storm damage is greatest.

The southwest section of Margate is also vulnerable to damage as the result of tidal flood inundation from Beach Thorofare and Longport (see Vulnerability Analysis, Plate No. 8). This flooding is a consequence of the City's low elevation (6 feet NGVD) landward of Ventnor Parkway as well as the low bulkheads along Beach Thorofare.

3. Recommendations

Several hazard mitigation techniques were discussed with members of Margate's Steering Committee. Dune building was considered but may be infeasible due to the narrowness of the beach. Less importantly, concern was expressed by some local committee members that dunes would block the ocean view and also cause sand to blow onto private lawns along the oceanfront. From a hazard mitigation standpoint, these two reasons are trivial and indefensible.

The idea of incorporating greater oceanfront setbacks into the local zoning ordinance was not well received. Because many oceanfront lots are only 40 feet deep, there is no room for much of a setback while still allowing reconstruction of homes on these lots. However, the Division of Coastal Resources encourages any increase in setbacks, no matter how small. The reason for this is simple: the greater the landward distance between residences and the oceanfront seawall or bulkhead, the less damage is likely to occur, especially as a result of low frequency storms.

Another Division recommendation is to downzone the southern oceanfront area from Residential Multi-Family to a lower density. Again, the purpose of this zoning change is to reduce the level of high density development in the vulnerable oceanfront block. Most of the existing oceanfront zoning in Margate is single family, and most of the multi-family zone presently contains single family dwellings.

The representatives of Margate's Steering Committee agreed with the Division of Coastal Resources that a city-wide bulkhead inspection and maintenance program would be an important step in reducing tidal flooding during storms. It was also suggested by a Margate Committee member that storm shutters be used to cover glass windows and doors exposed to the direction of the highest storm winds to minimize damage.

TABLE 10: MARGATE HAZARD MITIGATION RECOMMENDATIONS

AREA OF VULNERABILITY:	D.E.P. RECOMMENDED HAZARD MITIGATION TECHNIQUES	LOCAL RECOMMENDED HAZARD MITIGATION TECHNIQUES
Brunswick to Essex Avenue: Oceanfront 1. Indentation of bulkheads focuses wave energy in small area; erosion rate 5.6 ft/yr; homes built directly behind bulkheads in wave runup zone.	1. Develop dunes where feasible; change zoning to incorporate greater setbacks from bulkheads to establish a buffer area; repair bulkheads.	1. Beach nourishment; repair bulkheads.
South of Cedar Grove Avenue, Landward of Ventnor Pkwy. 2. Very low elevation (6'NGVD); old ineffective bulkhead along Beach Thorofare; flotation zone.	2. Repair bulkheads; inspect structures to ensure proper anchoring to foundation; anchor if needed.	2. Repair bulkheads; inspect homes for proper anchoring.
Cedar Grove to Coolidge Avenue: Oceanfront 3. Very narrow beach; erosion rate 5.6 ft/yr; no dunes; multi-family development located right up to bulkhead/ seawall and in wave runup zone.	3. Rezone to a lower density (R-25, R-40) in high hazard oceanfront area; increase setbacks from bulkhead/ seawall to establish buffer.	3. Repair and raise bulkheads; consider setbacks for multi-family development.

F. LONGPORT

1. Description and Present Land Use Regulations

Longport (Figure 19) is much smaller than the other five municipalities in the study area, both in acreage (0.44 square miles) and population. There are no wetland areas in Longport. A greater proportion (38%) of the population of 1,249 consists of senior citizens. Median family income is $27,370. Longport Boulevard, also known as the Longport-Somers Point Road (Route 152), is a bridge causeway system to the mainland.

Residential land use predominates in Longport, with residential development valued at $835,372 per acre and a density of 6.5 people per acre. Total property value is $94.2 million. The majority (54%) of the housing is seasonal and consists of single family dwellings for which most of the city is zoned. There are a few multi-family residential and commercial motel/hotel districts within Longport where townhouses and motels have been built, primarily between 15th and 17th Streets between the ocean and bay, and on either side of Longport-Somers Point Road. Although high rises are no longer permitted, there are two on the oceanfront. There are a few blocks devoted to commercial uses.

The zoning code for the Borough of Longport provides that a non-conforming use terminate upon abandonment for more than one year. A non-conforming use may not be enlarged, extended, moved on the lot or structurally altered in any way except as required for normal maintenance or to modernize or redecorate existing bath, kitchen, utility or living areas or to prevent damage or injury. A non-conforming structure may not be enlarged or altered so as to increase its non-conformity. A non-conforming structure or use may be restored or reconstructed if damaged or destroyed by fire or other accidental cause, subject to the above. An undersized lot (area, width or depth) in existence at the time of enactment of the code, may be used for a permitted use, subject to certain conditions.

2. Vulnerability

The Borough of Longport is extremely vulnerable to storm damage because of several factors, including absence of a measurable beach, proximity to Great Egg Inlet, low elevation and narrowness of the Longport section of Absecon Island. This part of Absecon Island has experienced severe

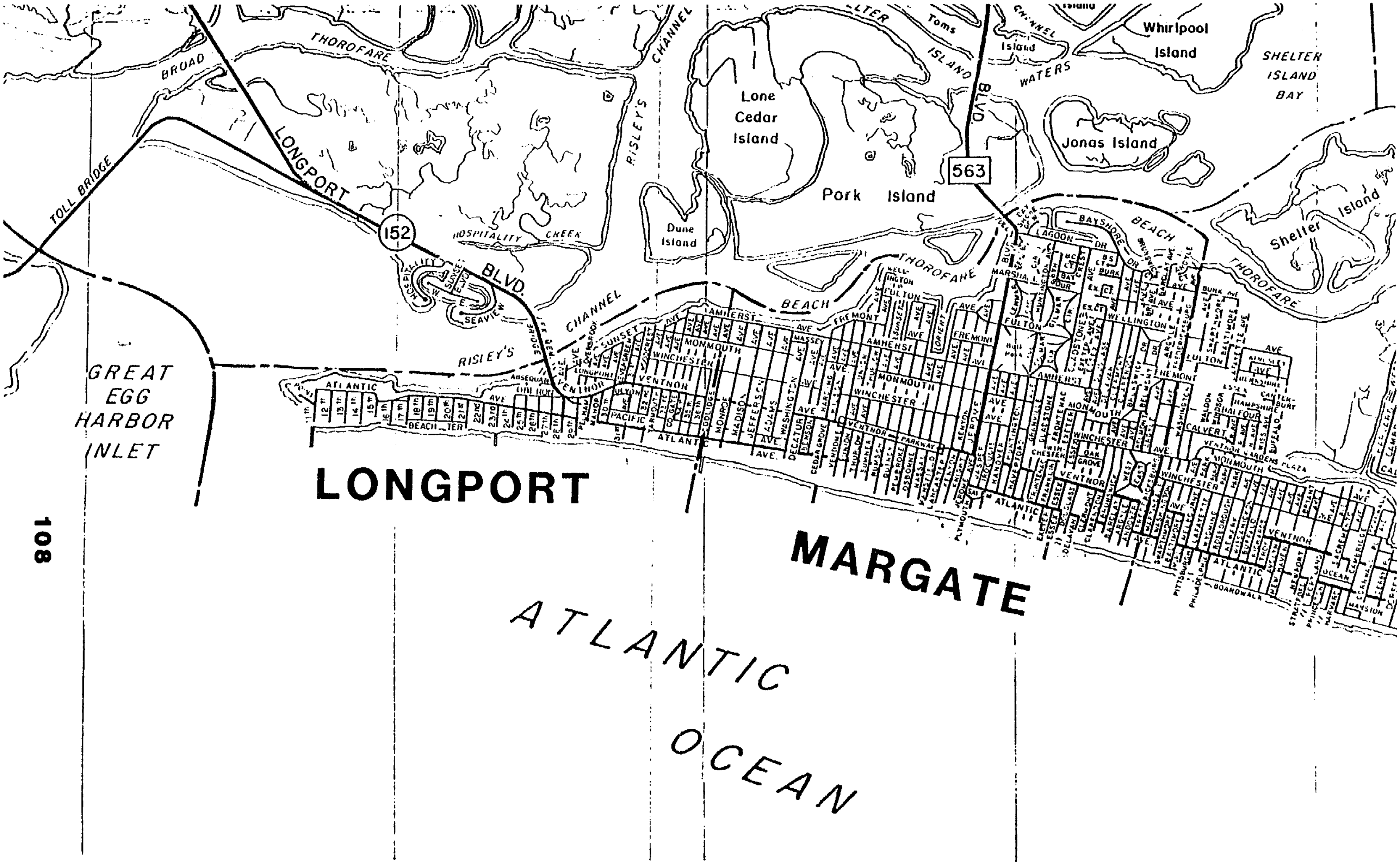


FIGURE 19: Road Map Of Longport

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erosion since the late 1800's when approximately 184 acres of beach was lost from the lower end of Longport (Board of Commerce and Navigation, 1922). The oceanfront is now protected by bulkheads, a massive seawall, and a terminal groin. The oceanfront block is most vulnerable to damage from wave runup and overtopping of the bulkheads and seawall. Details of the wave runup analysis are found in the Coastal Storm Vulnerability Analysis, Part I-C.

Post-storm photographs (March, 1962) have shown the most severe damage from storm waves to occur within 100 feet of the seawall (Figure 20). Overwash sediment, transported by storm waves and surge, was deposited as far as 1,000 feet inland, blocking all the major evacuation routes. The section of Longport south of 27th Street was completely overwashed during the March, 1962 northeaster, a 34-year event (Figure 21).

Along with the hazard from storm waves, Longport is also vulnerable to severe tidal flooding due to the low elevation and narrowness of the spit. The Longport spit is only 450 feet wide at 21st Street. This fact, combined with the spit's proximity to Risley's Channel, causes Longport to be especially susceptible to breaching during severe storms. The part of the Borough landward of Ventnor Avenue becomes flooded during even moderate storms, with frequencies of as little as six years (U.S.G.S., 1962).

3. Recommendations

Due to their similar development patterns, and because they have the same engineering consultant and construction official, the Longport Steering Committee meetings were combined with those of neighboring Margate. Unfortunately, the only actual representatives of Longport in attendance were the building inspector, city engineer and emergency management coordinator (one meeting). Members of the Division of Coastal Resources did receive a completed hazard mitigation work sheet from Longport Mayor Howard Kupperman. The Mayor indicated that improvements were needed to the stone groins and jetties, and that better drainage is required for the central part of the Borough. The other Division of Coastal Resources recommendations, including acquisition, zoning changes, anchoring surveys and increased setbacks were not commented on.

FIGURE 20: Longport: Southern Margate - Northern Longport, March 8, 1962. Note severe beach erosion and extensive washover as far inland as Ventnor Avenue.

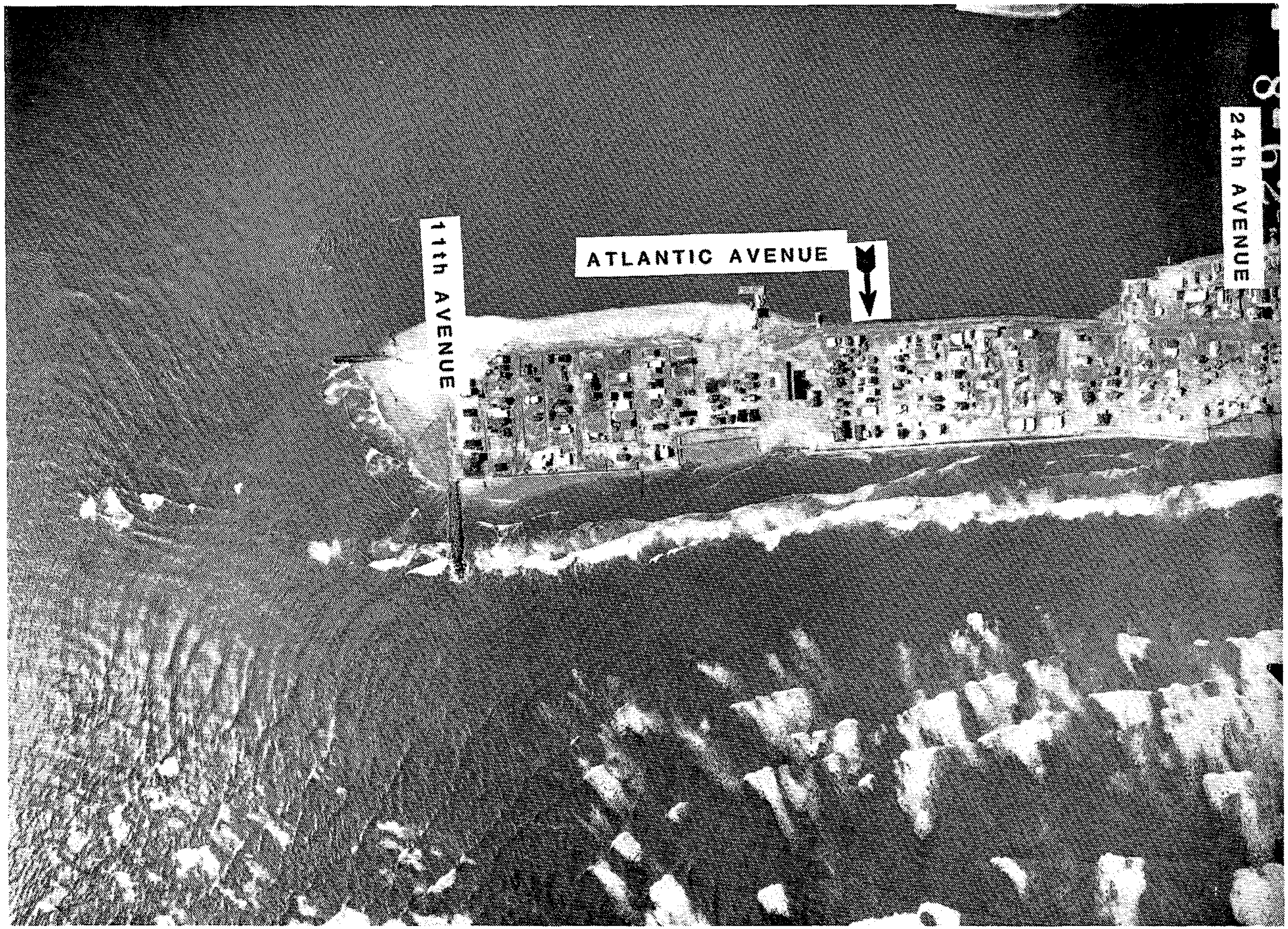

FIGURE 21: Longport: 24th Avenue - 11th Avenue, March 8, 1962. Note damage to oceanfront boardwalk, complete washover back to Atlantic Avenue and loss of beach. The narrowness of this spit increases the potential for breaching during sever storms.

TABLE 11: LONGPORT HAZARD MITIGATION RECOMMENDATIONS

AREA OF VULNERABILITY:	D.E.P. RECOMMENDED HAZARD MITIGATION TECHNIQUES	LOCAL RECOMMENDED HAZARD MITIGATION TECHNIQUES
Entire Boro: Oceanfront 1. Very little beach; no dunes; erosion rate 5.6 ft/yr; overwash area; residential development in wave runup zone, directly up to seawall (V-zone boundary).	1. Change zoning to incorporate greater setbacks from oceanfront seawall and bulkheads; establish a dune line in existing right of way (20') between seawall and first homes.	1. Improve groins and jetty.
Oceanfront South of 11th Avenue-tip of Island 2. Narrow, low beach; overwash area; residential development in wave runup zone; located along unstable inlet.	2. Investigate for acquisition; prevent rebuilding of storm damaged structures.	
Entire Boro: Inland of Ventnor Avenue 3. Very low elevation (6'NGVD); frequent flooding; flotation zone.	3. Inspect and repair bulkheads along Risley's Channel; inspect structures and ensure proper anchoring.	

G. OCEAN CITY

1. Description and Present Land Use Regulations

Ocean City occupies the entire island of Peck Beach (Figure 22). The City is 5.83 square miles (3731 acres) in area with about 8 miles of oceanfront. Approximately 770 acres of Ocean City are wetlands. The City is not as densely populated as Absecon Island. Ocean City's density is 4.7 people per acre of upland. The total population is 13,949 of whom 26% are senior citizens. Mean family income is $24,609. The median value of residential property per acre of upland is $97,938. Amusements are concentrated on the boardwalk. Two bridge-causeway systems provide access to the island from the mainland (Roosevelt Boulevard (Route 623) and Route 52), and a bridge-causeway system crosses each inlet to the adjacent barrier islands. Ocean City is strongly oriented toward resort-recreational activities, with 59% of all housing seasonal and a relatively high number of motel rooms for the study area.

Ocean City's zoning ordinances are now being revised. Presently, most of Ocean City is developed with one and two family houses, which reflects the existing zoning. The oceanfront at the northern end of Ocean City (5th Street to 1st Street) is zoned for 3 or more family residences, hotels and business. Presently, much of the area is smaller 1-2 family houses, with the exception of a high-rise apartment/condominium building and some low-rise condominiums.

That portion of the island three blocks north and six blocks south of the Route 52 bridge is zoned for higher densities than much of the rest of the island. The boardwalk is found in this area and extends from Saint James Street about 2.4 miles down to 23rd Street. The oceanfront block from 6th Street to 14th Street is in the Boardwalk Zone. Permitted and existing uses in the zone are retail, amusements, entertainment, parking and restaurants on and within 200 feet of the boardwalk. From a line 200 feet west of the boardwalk and within this zone, retail, restaurant, parking, hotel/motel, amusement and entertainment are permitted uses. Inland of the Boardwalk Zone is the Hotel/Motel Zone which also allows guest houses and single to multi-family houses, offices, retail and parking. Much of this zone still consists of smaller 1-4 family residences. Further inland is the Central Business Zone, and nearer the back side of the island are multi-family, motel, business and industrial zones.

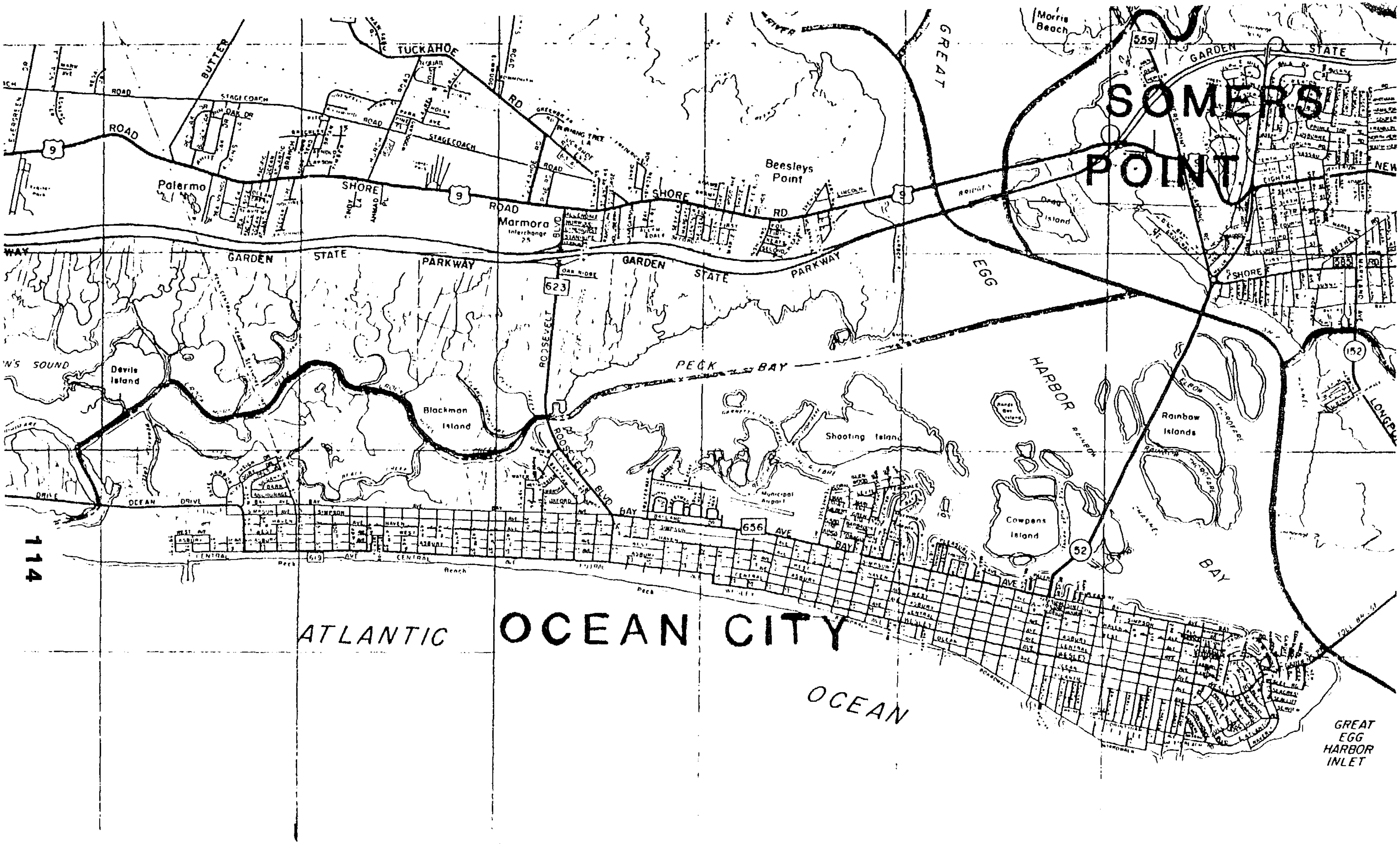

FIGURE 22: Road Map Of Ocean City

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The second major area zoned for business and light industry is located along and at the foot of the Roosevelt Boulevard Bridge. A recreation zone is located along the bay north of the Roosevelt Boulevard Bridge, which is occupied in part by an airport. Inland of this is an undeveloped transportation zone, along the abandoned railroad right-of-way.

Most of the oceanfront in Ocean City is bulkheaded, although the bulkheads are irregular and there are gaps, sometimes several blocks long, which are not bulkheaded. North of 15th Street there is little to no beach in front of the bulkheads. From 18th Street to 57th Street, residences have been built very close to the bulkheads. From 29th to 34th Street, there is a wider beach with dunes in front of the bulkhead and further south the bulkhead is buried beneath the sand in some areas, with intermittent dunes.

Ocean City first adopted a dune ordinance in October, 1971. The ordinance defined an "Atlantic Ocean Coastal Beach Zone" in which no building could be erected or used except for recreation, access, public safety and shore protection uses. In addition, non-conforming uses which were destroyed by more than 50% could not be rebuilt. The ordinance also set construction standards for waterfront buildings and an oceanfront bulkhead setback.

In November 1971 the ordinance was amended to (1) permit restoration or repair of partially destroyed non-conforming uses, (2) repeal the oceanfront bulkhead setback and (3) specify that wood pilings and bulkheads be treated with creosote to prevent decay. Subsequently, in 1974 an ordinance was passed to permit single family dwellings in the Atlantic Ocean Coastal Beach Zone if such use would neither threaten the public health, safety and welfare, nor lead to damage or loss of property, and would meet design criteria. The amendment arose out of a claim that the building prohibition in this zone amounted to a taking of property and the failure of Ocean City voters to approve a referendum for a bond issue to secure funds to purchase the affected lands.

A flood damage prevention ordinance adopted in 1978 established a permit requirement for development or construction within the 100 year floodplain. Basically the ordinance requires that federal floodplain management regulations be met for new construction and substantial improvements, and states that there shall be no alteration of sand dunes within the V-zone which would increase potential flood damage.

At present, non conforming uses which are 50% destroyed can only be rebuilt as conforming uses. This figure may be changed to 75% with the new ordinance.

2. Vulnerability

With a developed oceanfront approximately 8 miles long, Ocean City is highly vulnerable to damage from coastal storms. The shore is fortified with a wide range of engineering structures designed to protect the beach and adjacent development. These structures include timber and stone groins, bulkheads and revetments. Although these structures do offer some protection, they do not treat the basic problem, which is a negative sediment budget. The historical erosion rate along the Ocean City shoreline ranges from 6 to 12 feet/year (Nordstrom et al., 1977) as measured from vertical aerial photographs for 1952 and 1971.

Analysis of post-storm photographs indicates different levels and types of damage in different parts of Ocean City. The northern end of the City, from 30th Street to Great Egg Inlet, generally suffers storm damage to beaches, oceanfront bulkheads and structures within the wave runup zone (Figures 23 and 24). Overwash penetration in this area is limited primarily to the first or second shore parallel road. South of 39th Street, overwash penetration can be expected to be much greater, reaching as far back as Bay Avenue, largely because of the narrowness and low elevation of this part of the island (Figures 25 and 26). Again, however, much of the problem of vulnerability is due to the fact that high density (7 homes/acre) residential development lies directly on the landward side of the oceanfront bulkheads in the wave runup zone. Part I-C of the Vulnerability Analysis explains the effect of wave runup on bulkheads and adjacent structures. Devoid of protective dunes, the low, narrow beaches provide very little protection to inland development, while allowing storm waves to break directly at the bulkhead.

3. Recommendations

The Ocean City Hazard Mitigation Steering Committee was generally receptive to most of the mitigation techniques described by the Division. As a matter of fact, several of the hazard mitigation recommendations, including zoning changes and increased setbacks, are being incorporated into

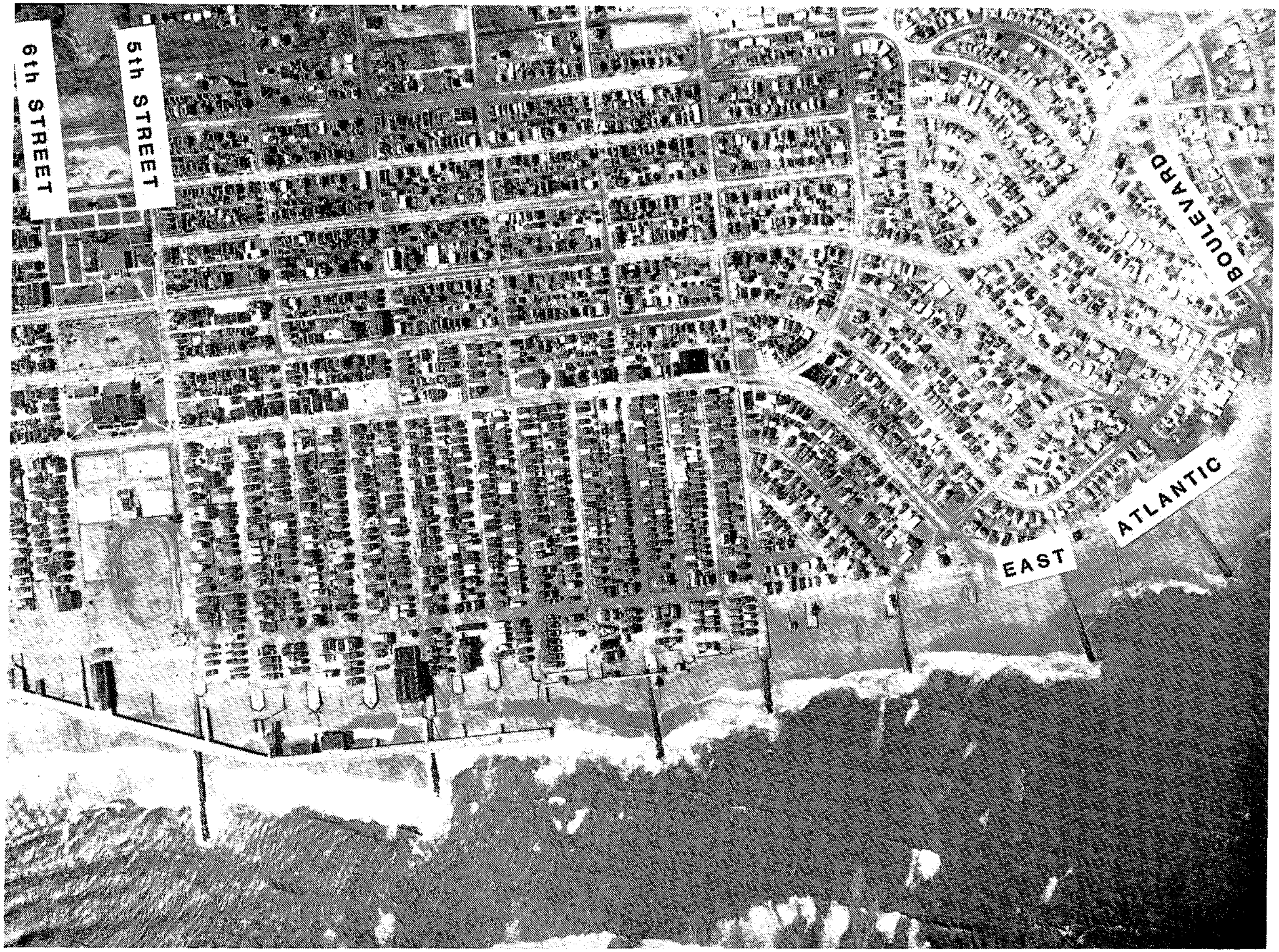

FIGURE 23: Ocean City: East Atlantic Boulevard - 6th Street, March 8, 1962. Damage to the northern end of the City was relatively minor, but increased markedly south of 5th Street.

FIGURE 24: Ocean City: 5th Street - 15th Street, March 8, 1962. Note extensive washover and boardwalk damage, particularly south of 11th Street.

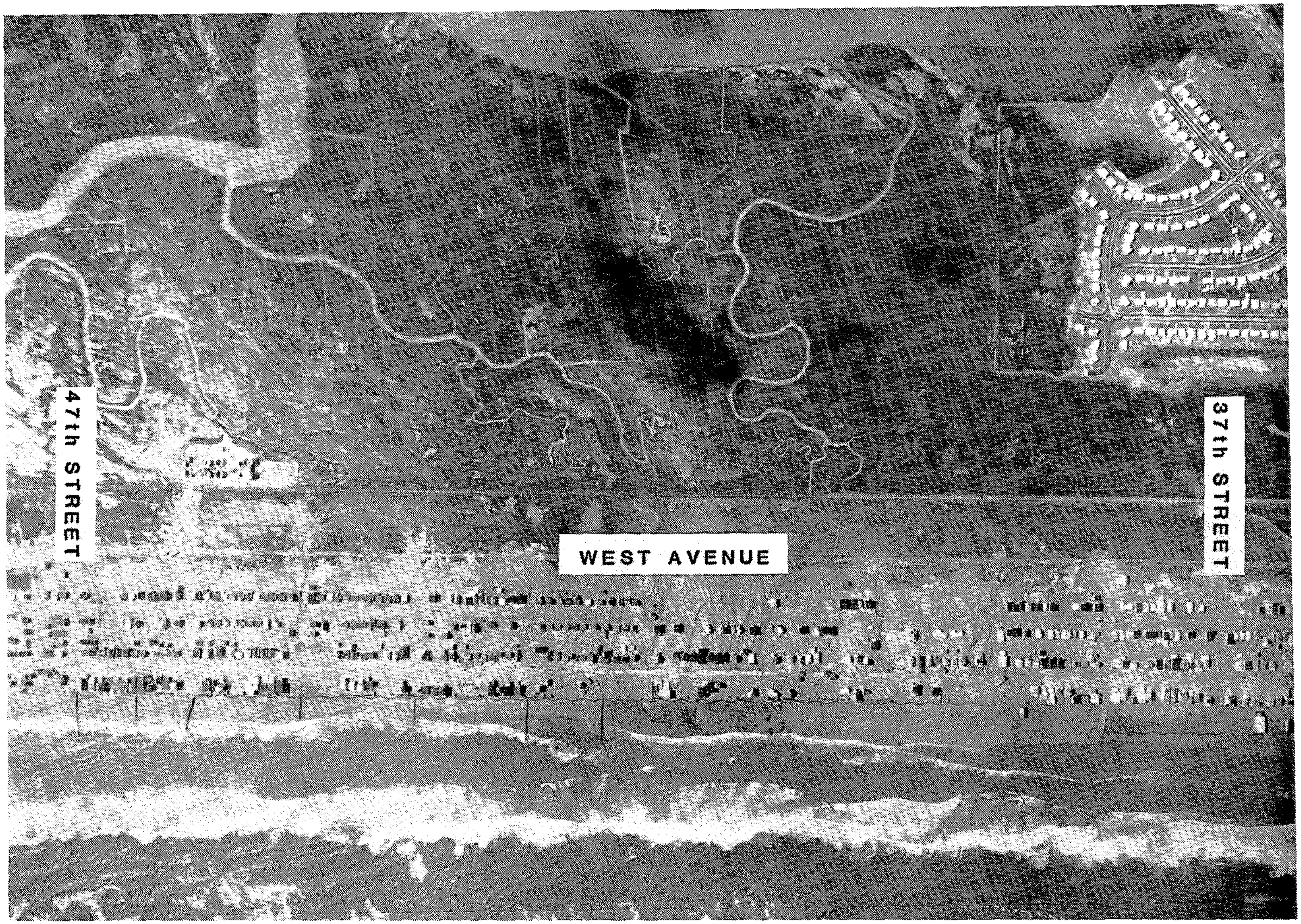

FIGURE 25: Ocean City: 37th Street - 47th Street, March 8, 1962. Note severe damage to oceanfront bulkheads and adjacent homes in the wave runup zone. Washover area extends inland to West Avenue.

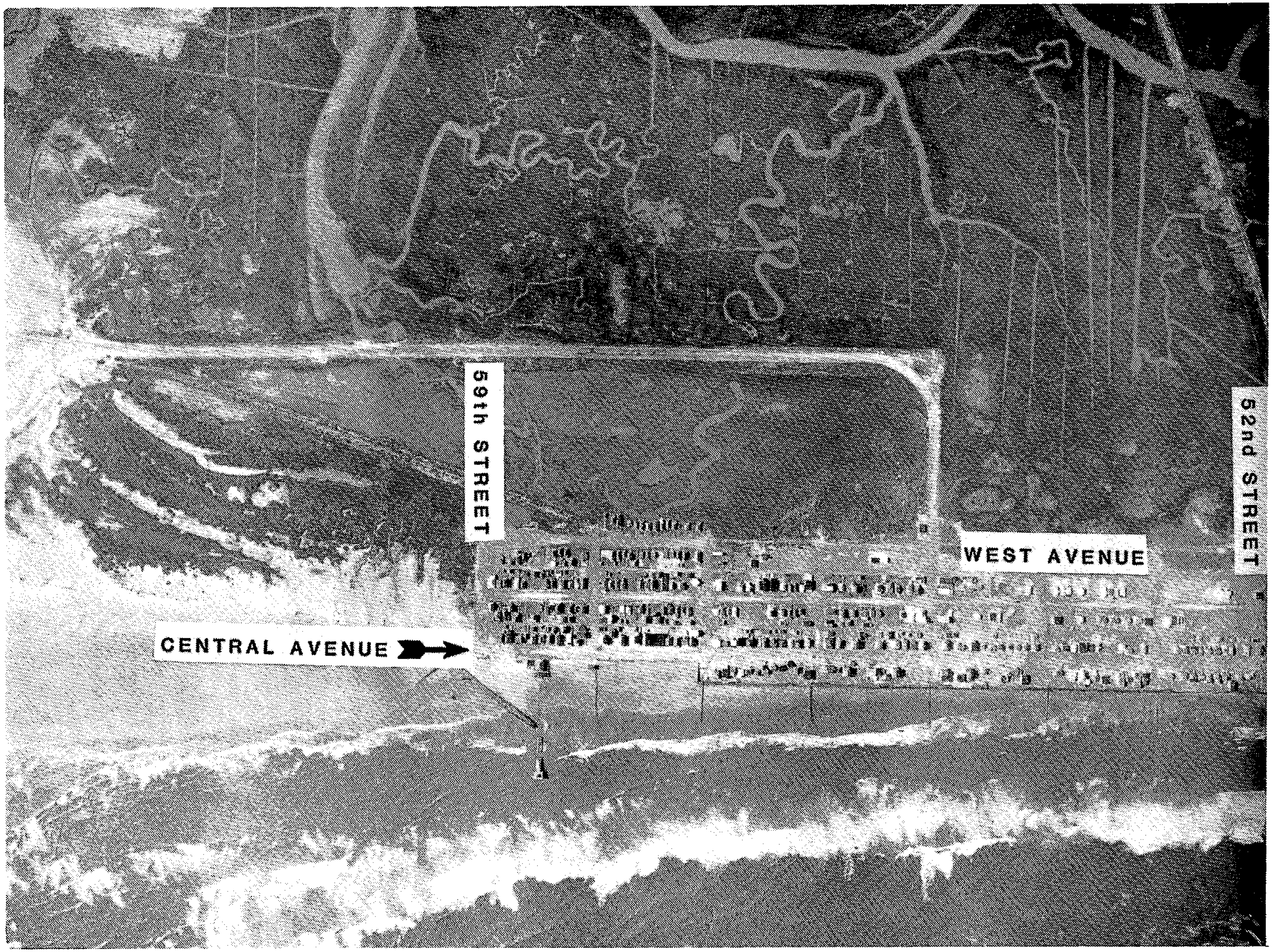

FIGURE 26: Ocean City: 52nd Street - 59th Street, March 8, 1962. Note damage to homes in the wave runup zone, seaward of Central Avenue. Washover extends inland to West Avenue.

the current master plan revisions. Ocean City plans to conduct surveys of structures in flotation zones and to recommend methods of proper anchorage. The City is also in the process of replacing older bulkheads, and is interested in establishing bulkhead standards as well as making oceanfront bulkheads mandatory inland of any dunes.

Among the land use changes, the City intends to incorporate residential setbacks from the oceanfront bulkhead in the Boardwalk Zone extending from 6th to 15th Street. This setback requirement would apply only to residential structures and not boardwalk related commercial structures.

In terms of general development policies, the City is in the process of revising its master plan and zoning ordinance. These revisions are expected to reduce the population at maximum build out by 20%, from 26,000 to 21,000.

One of Ocean City's primary concerns is the continued development of vacant oceanfront property. The City has tried several times to prevent such development using the existing dune ordinance, but has been unsuccessful. The City, however, did not take advantage of expert witnesses available through the State Department of Environmental Protection and Federal Emergency Management Agency. Professionals working for these two groups often provide technical assistance and court testimony to reinforce established coastal development policies, including hazard mitigation strategies.

The Ocean City Planning Board has already approved one hazard mitigation recommendation regarding land use. The Board adopted a 25 foot residential setback from the oceanfront bulkhead line. This increased setback, based on wave runup calculations, will reduce the number of structures, and associated storm damage in this high hazard area.

The <u>Vulnerability Analysis</u> indicated that the topographic mapping used to prepare the Flood Insurance Rate Maps for Ocean City was inaccurate. The true elevations are lower than those shown on the maps, resulting in incorrect designation of flood zones. It is recommended that the Federal Emergency Management Agency obtain accurate topographic maps of Ocean City and revise the Flood Insurance Rate Maps accordingly.

TABLE 12: OCEAN CITY HAZARD MITIGATION RECOMMENDATIONS

AREA OF VULNERABILITY:	D.E.P. RECOMMENDED HAZARD MITIGATION TECHNIQUES	LOCAL RECOMMENDED HAZARD MITIGATION TECHNIQUES
North Street-Great Egg Inlet: Oceanfront 1. Narrow beach with low dunes; V-zone boundary at front row of beach homes; erosion rate -8 ft/yr.	1. Improve/expand existing dunes; acquire, when possible, all property seaward of Beach Road and East Atlantic and incorporate property and portion of road into dune zone (road can be narrowed as one way street).	1. Beach nourishment using dredged material from Great Egg Inlet; improve dunes; city acquires oceanfront property whenever possible.
North Street-5th Street Oceanfront 2. Narrow beach; no dunes; overwash area; erosion rate -12 ft/yr; high density residential development seaward of Corinthian Ave.; structures built in wave runup zone.	2. Rezone high density residential to Boardwalk commercial and/or lower density; incorporate setbacks from oceanfront bulkhead or Boardwalk; consider abandoning Boardwalk where it is frequently damaged.	2. Residential setbacks from bulkheads.
5th-15th Streets: Oceanfront 3. Very low, narrow beach; overwash area; nodal zone; erosion rate -12 ft/yr; V-zone boundary landward of many structures.	3. Incorporate setbacks from Boardwalk line into zoning plan; rebuild Boardwalk inshore of Bulkhead; rezone from residential to commercial along Boardwalk; don't allow multi-family development in Boardwalk zone; repair/replace older bulkheads; modify groins to allow more sand movement over the tops.	3. Institute residential setbacks from bulkheads; repair old bulkheads; consider relocating damaged infrastructure.

TABLE 12 (continued)

AREA OF VULNERABILITY:	D.E.P. RECOMMENDED HAZARD MITIGATION TECHNIQUES	LOCAL RECOMMENDED HAZARD MITIGATION TECHNIQUES
15th-25th Streets: Oceanfront 4. Very little/no beach; overwash zone; erosion rate -6.1 ft/yr; structures in wave runup zone.	4. Incorporate setbacks from bulkhead to create buffer; build dunes where feasible; rezone all lots seaward of Wesley Avenue to zone 1 or 2; repair/replace old bulkheads.	4. Institute residential setbacks from oceanfront bulkhead; repair old bulkheads; build dunes where possible; consider mandatory bulkhead ordinance for oceanfront lots behind dunes.
25th-29th Street: Oceanfront 5. Low dunes with many paths; erosion rate -6.1 ft/yr; houses in wave runup zone; overwash zone.	5. Repair and enhance dunes by refencing, planting and closing gaps; construct dune walkover structures; incorporate setbacks from bulkhead; consider acquisition of storm damaged property seaward of Wesley Avenue; downzone oceanfront block between 28th and 29th from zone 3 to zone 2 or 1.	5. Improve dunes; consider residential setbacks from oceanfront bulkhead; consider mandatory bulkhead ordinance for oceanfront lots behind dunes.
29th-36th Streets: Oceanfront 6. Dunes are wide but too low, with many paths; structures built in wave runup zone; overwash zone.	6. Repair dunes primarily by closing gaps; incorporate setbacks from oceanfront bulkheads; build walkover structures.	6. Repair dunes; consider residential setbacks from oceanfront bulkheads; consider mandatory bulkhead ordinance for oceanfront lots behind dunes.

TABLE 12 (continued)

AREA OF VULNERABILITY:	D.E.P. RECOMMENDED HAZARD MITIGATION TECHNIQUES	LOCAL RECOMMENDED HAZARD MITIGATION TECHNIQUES
36th-47th Streets: Oceanfront		
7. Low, narrow beach; erosion rate -6.1 ft/yr; homes located in wave runup zone; V-zone boundary right at residential area; overwash zone.	7. Dune building and repair, especially at street ends; develop setbacks from oceanfront bulkhead; consider acquisition of storm damaged property seaward of Central Avenue for incorproation into dune zone.	7. Dune building; residential setbacks from bulkhead; land acquisition where possible; consider mandatory bulkhead for oceanfront lots behind dunes.
47th-59th Streets: Oceanfront		
8. Narrow beach; overwash area; erosion rate -6.1 ft/yr; homes built right up to oceanfront bulkhead (V-zone boundary) in wave runup zone; overwash zone.	8. Dune building and repair, especially at street ends; develop setbacks from oceanfront bulkhead; consider acquisition of storm damaged property seaward of Central Ave.	8. Dune building; residential setbacks from bulkhead; land acquisition where possible; consider mandatory bulkhead for oceanfront lots behind dunes.
East Atlantic to Fifth Street between Bay and West Avenues		
9. Low elevation; wood frame structures susceptible to flotation.	9. Inspect structures and anchor or elevate as required.	9. Inspect and anchor structures as needed.

H. General Recommendations

1. Construction Standards

The municipal steering committees generally agreed that more stringent construction standards are an essential ingredient to storm hazard mitigation in New Jersey. The possible levels of implementation are at the state level and at the level of BOCA International Inc.

At the state level, legislation would be required to either permit municipalities to enact more stringent construction standards than BOCA standards in areas prone to coastal flooding or require the Department of Community Affairs (or other Departments) to develop such standards for the coastal communities.

Because BOCA has been adopted as a uniform construction code in New Jersey, no municipality may adopt more restrictive construction standards, nor standards for construction practices not covered by BOCA. However, through participation in the National Flood Insurance Program, municipalities are required to adopt floodplain management regulations.

BOCA International, Inc. provides for annual submission of proposed code revisions. A New Jersey committee consisting of local construction officials, State officials and a FEMA representative developed a revised section on flood resistant construction. The proposed revisions were submitted to BOCA on August 1, 1984 by Robert Williams, the construction official of Atlantic City, for consideration for incorporation in the 1985 edition of BOCA. The major changes proposed are:

a. All basement floor surfaces in flood hazard zones shall be located at or above the base flood elevations.

b. In flood hazard zones, enclosed spaces below the base flood elevation shall not be used for human occupancy with the exception of structure egress, entrance foyers, stairways and incidental storage. Fully enclosed spaces shall be provided with vents, valves or other openings which will automatically equalize the lateral pressure of flood waters acting on the exterior wall surfaces. The bottom of the openings shall be no lower than 12 inches and no higher than 24 inches above finished grade. A minimum of two openings per building, or one opening for each understructure space, whichever is greater, shall be required.

c. In flood hazard zones, where water resistant construction is used in non-residential buildings in lieu of elevating the buildings, requirements are set forth for openings below the base flood elevation, for floor and wall penetrations, for utilities, and for shutoff valves in sanitary and storm sewer systems.

d. High hazard zones are defined as areas of tidal influence subject to three foot waves or higher, high velocity wave runup or wave induced erosion.

e. Unacceptable materials for breakaway walls in high hazard zones are specified.

f. Piling embedment standards for high hazard zones require consideration of combined wave and wind loads and scour.

g. New or replacement mechanical and electrical systems must be placed above the base flood elevation or protected to prevent water from entering or accumulating within the system components during floods up to the base flood elevation.

h. Requirements are set for mobile units.

i. Alterations and repairs of buildings, and increases in building height or floor area are addressed.

j. Submission by a registered professional architect or engineer of plans and specifications as well as a signed statement by same that the design meets the flood resistant construction standards is required.

In addition to these proposed revisions to BOCA, which would be a significant improvement to standards for coastal hazard areas, the following should also be considered:

a. Standards for protection of buildings and structures from damage due to winds anticipated from a 100 year storm (about 100 mph in New Jersey). The failure of windward walls or windows has resulted in heavy structural damages as internal pressures are increased and roofs and leeward walls lost. It has been suggested that in hurricane prone areas, buildings must be designed to withstand greater internal pressure due to the likelihood that windows will break (Joseph Minor, personal communication, 1984). Presently, the design wind is that of a 50 year storm, which is 80 mph for New Jersey.

b. Standards for withstanding battering loads.
c. The elimination of all breakaway walls for new construction in coastal high hazard areas.
d. More specific guidelines for how the required flood proofing can be implemented (i.e. more specific standards).

2. Anchoring Existing Structures

The Vulnerability Analysis pointed out the susceptibility of houses in each municipality to flotation in the design storm. This possibility would not only cause serious damage to the floating structure but also to nearby structures with which it comes in contact. The houses in each identified flotation zone should be surveyed to determine whether they are sufficiently anchored to prevent flotation. Owners of inadequately anchored homes should be notified and made aware of the potential damages they face as well as methods by which their home could be anchored. In addition, owners who renovate their homes should seriously consider elevating or anchoring them.

A surveying and anchoring program would be eligible for a Community Development Block Grant from the U.S. Department of Housing and Urban Development. Alternatively, local construction officials may be able to conduct such a survey. As a minimum, the mailing of an information sheet to homeowners in flotation zones describing the problem, hazard and possible solutions should be undertaken.

3. Flood Insurance Rate Maps

The Federal Emergency Management Agency has prepared Flood Insurance Rate Maps for each municipality to identify flood hazard zones. In the six municipalities in question, velocity (V) zones (coastal high hazard areas) and areas inundated by the 100 year flood (A zones) have been identified. Only Atlantic City, Margate and Ventor have areas which are above the 100 year base flood elevation (i.e. B zones). In a few areas of the country, notably in New England following the Blizzard of 1978, the Flood Insurance Rate Maps were drawn to include areas prone to damage from wave runup on bulkheads and seawalls within the coastal high hazard zone. This designation clearly identifies the extreme danger in building in close proximity to these structures, and requires development in the area to build to higher construction standards.

Wave runup should be used in defining the high hazard area on the Flood Insurance Rate Maps for each municipality. A municipality may petition the Federal Emergency Management Agency to revise the maps to include wave runup, and should do so in all cases.

CONCLUSIONS AND RECOMMENDATIONS

1. Because of the densely developed nature of the study area, and the associated high property values, hazard mitigation techniques may have to be implemented primarily as a post-storm program. It is important that coastal municipalities develop and implement specific hazard mitigation plans in order for rational post-storm recovery and redevelopment to take place.

2. Coastal municipalities should reevaluate their master plans and zoning ordinances in light of coastal storm vulnerability. The implementation of hazard mitigation strategies should be accomplished as part of the periodic master plan review and revision required under the Municipal Land Use Law.

3. Because funding for shore protection projects is very limited and shore protection costs are high, coastal municipalities that make a concerted effort to mitigate future storm damages should receive higher funding priority. Shore protection funding and post-storm recovery assistance may be contingent on local efforts to implement hazard mitigation strategies.

4. Members of the New Jersey Department of Environmental Protection are available to assist local municipalities in developing and implementing hazard mitigation techniques and educational programs. This support might consist of technical assistance (scientific and planning), expert witness testimony, and references on a wide range of subjects. In order for an effective hazard mitigation plan to be accepted and implemented, local residents must understand the concept. A public awareness/education program is needed for the public to learn why hazard mitigation is such an important planning element. Because politicians are generally responsive to local majority opinion, the benefit of increased public awareness can be quite far reaching.

5. Each coastal municipality should request that FEMA include wave runup data on the Flood Insurance Rate Maps. This data will more accurately determine coastal high hazard areas.

6. Coastal municipalities should initiate a structural inspection program to determine whether buildings are adequately anchored to foundations. Guidelines for the inspections, as well as remedial measures, should be

developed by the local building officials and the New Jersey Department of Environmental Protection. A sample building construction checklist can be found in Appendix 2 (Texas Coastal and Marine Council, 1981).

7. Each oceanfront municipality should adopt and enforce an effective beach and dune ordinance to protect the beach area and promote dune building, planting and maintenance. The building restriction line should be subject to periodic review, particularly after major storms. A thorough, well written dune ordinance can be a very effective barrier island management tool.

8. Dune fields should be created where possible using standard fencing and planting techniques, thus providing additional protection for landward development. Where dunes already exist, maintenance and enhancement through fencing, planting and closing gaps will improve the protective capacity of the dune system. Wooden walkovers or angled walkways should be used to gain beach access.

9. Each oceanfront municipality should establish oceanfront setbacks. Setback lines can be measured from bulkheads, seawalls or boardwalks, and should be at least 25-50 feet landward of these structures, depending on beach and nearshore profiles.

10. Acquisition of oceanfront property for conservation purposes is recommended. The acquisition and conservation should not be limited to the beachfront but should also include any building lots adjacent to the beachfront. The New Jersey Green Acres Program often purchases property, especially along the beachfront, for conservation and recreation use.

11. All oceanfront property presently in municipal ownership should be retained in municipal ownership, preferably for open space or recreational use.

12. Property owners should be advised to install protective shutters on windows and glass doors and minimize use of wide paned glass.

13. Municipalities should institute programs for inspection, repair and reinforcement of bulkheads and seawalls.

14. The peak population on each of the three barrier islands is estimated to approach or exceed that which can be

evacuated within the anticipated warning time of a hurricane strike. Each municipality should review its zoning in terms of maximum population at full build out and consider downzoning. Studies should be made to consider the feasibility of increasing the capacity or raising the elevation of escape routes, considering costs, environmental constraints and accessibility due to flooding of approaches. The NJDEP should also make this consideration a factor in their review of coastal development applications.

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APPENDIX I

HAZARD MITIGATION
STEERING COMMITTEE MEMBERS

AND

MEETING SCHEDULE

BRIGANTINE STEERING COMMITTEE

NAME	AFFILIATION	MEETING ATTENDANCE 6/6/84	7/11/84	9/27/84
Carmen D. Benedetto	Brigantine Police Department	x		
Matthew Doran	Brigantine Building Department	x	x	x
Pat Doran	Brigantine City Engineer		x	x
Charles Fetter	Brigantine City Administrator	x	x	
Joseph Greco	Brigantine Commissioner	x	x	x
J. Edward Kline	Brigantine Mayor	x		x
Jack O'Connor	Brigantine Police Department		x	x
Robert Shipley	Brigantine Commissioner	x		x
George McDermott	Brigantine City Administrator			x
James Eden	Atlantic County Emergency Management Deputy Coordinator		x	
Brian Lefke	Atlantic County Division of Planning	x		
Robert Reynolds	Federal Emergency Management Agency		x	
Ruth Ehinger	New Jersey Department of Environmental Protection	x	x	x
Mark Mauriello	New Jersey Department of Environmental Protection	x	x	x

ATLANTIC CITY STEERING COMMITTEE

NAME	AFFILIATION	MEETING ATTENDANCE 6/20/84	7/11/84	9/25/84
Robert Badger	Atlantic City Engineering Department	x	x	x
Harvey Burns	Atlantic City Department of Public Works	x		
John DeFrancesco	Atlantic City Department of Public Works	x		
Jody Schaaf Loen	Atlantic City Division of Planning	x	x	x
Jackie McBride	Atlantic City Office of Emergency Management	x	x	
Jim Masland	Atlantic City Office of Emergency Management	x	x	
Allyn Seel	Atlantic City Office of Emergency Management	x	x	x
Amy Lempert	Casino Control Commission		x	
Richard Ross	Casino Control Commission		x	
James Eden	Atlantic County Office of Emergency Management	x		
Frank Siracusa	Atlantic County Office of Emergency Management	x		
Ruth Ehinger	New Jersey Department of Environmental Protection	x	x	x
Mark Mauriello	New Jersey Department of Environmental Protection	x	x	x
Robert Reynolds	Federal Emergency Management Agency		x	

VENTNOR STEERING COMMITTEE

NAME	AFFILIATION	MEETING ATTENDANCE 6/20/84	7/11/84	9/27/84
William Dombrosky	Ventnor Construction Official		x	
Thomas Klein	Ventnor Water & Sewer Superintendent		x	x
William Melfi	Ventnor Emergency Management Coordinator		x	x
Marilyn Tees	Ventnor Zoning and Planning Boards Secretary		x	
Joseph Verruni	Ventnor City Administrator	x	x	x
Ed Winkleman	Ventnor Zoning Board		x	
Brian Lefke	Atlantic County Division of Planning	x		
Ruth Ehinger	New Jersey Department of Environmental Protection	x	x	x
Mark Mauriello	New Jersey Department of Environmental Protection	x	x	x
Robert Reynolds	Federal Emergency Management Agency		x	

MARGATE STEERING COMMITTEE

NAME	AFFILIATION	MEETING ATTENDANCE 6/20/84	7/18/84	9/25/84
Russell Roney	Margate City Commissioner	x		
Roger Rubin	Margate Planning Consultant	x	x	
Raymond Schulze	Margate Coordinator Emergency Management	x	x	x
Donald Sullivan	Margate Construction Official	x	x	
J. Thomas Woods	Margate City Engineer		x	x
James R. Eden	Atlantic County Office of Emergency Management		x	
Ruth Ehinger	New Jersey Department of Environmental Protection	x	x	x
Mark Mauriello	New Jersey Department of Environmental Protection	x	x	x

LONGPORT STEERING COMMITTEE

NAME	AFFILIATION	MEETING ATTENDANCE 6/20/84	7/18/84	9/25/84
David Buzby	Longport, Emergency Management Coordinator		x	
Howard Kupperman	Longport Mayor			
George Portscher	Longport Public Works	x		
Donald Sullivan	Longport Construction Official	x	x	
J. Thomas Wood	Longport Borough Engineer		x	x
James R. Eden	Atlantic County Office of Emergency Management		x	
Ruth Ehinger	New Jersey Department of Environmental Protection	x	x	x
Mark Mauriello	New Jersey Department of Environmental Protection	x	x	x

OCEAN CITY STEERING COMMITTEE

NAME	AFFILIATION	MEETING ATTENDANCE 6/7/84	7/10/84	9/25/84
Jeanne Clunn	Ocean City Councilwoman Cape May County Environmental Commission	x	x	x
Joseph Kane	Ocean City Administrator	x	x	x
Henry Knight	Ocean City Councilman Ocean City Planning Board	x	x	x
George Morgan	Ocean City Emergency Management Coordinator	x	x	x
John Murphy	Ocean City, Deputy Coordinator Emergency Management		x	
Richard Snyder	Ocean City Division of Public Works	x	x	x
Woody Jarmer	Cape May County Planning Board		x	
David Rutherford	Cape May County Planning Board	x		
Ruth Ehinger	New Jersey Department of Environmental Protection	x	x	x
Mark Mauriello	New Jersey Department of Environmental Protection	x	x	x
Robert Reynolds	Federal Emergency Management Agency		x	

Appendix 2: Building Construction Checklist

FOR THE TEXAS COAST AND SHORELINE

Building construction on the Gulf Coast presents many special problems unique to shoreline construction. Problems which can arise from the great degree of exposure to high winds, flood waters, erosion, subsidence and highly corrosive environments must be considered by owners and prospective owners of shoreline properties.

This checklist is intended as a guide for persons investing in shoreline properties. Although it brings to light the most frequently encountered problems, it is recommended that a registered professional engineer be retained who is experienced and qualified in the field of shoreline building design.

I. LOCATION

YES NO

☐ ☐ A. BEACH ACCESS. Does the structure block access to public beaches? Does the structure violate open beach provisions of Texas State Law? (Contact the Texas Attorney General's office or the General Land Office of Texas (GLO).)

☐ ☐ B. DUNE PROTECTION. Has care been taken to protect any dunes and their vegetation? Have the requirements of State Sand Dune Protection legislation been met? If the structure is a multiple unit dwelling, motel, or subdivision, has a single joint access route or walkway to the beaches been planned? (Contact the GLO for further information.)

☐ ☐ C. ZONING REGULATIONS. Does the building and building site plan conform to city and county zoning regulations regarding type of structure, location with respect to dunes and water, and other provisions of applicable zoning laws? (Check with your contractor or local building officer to be certain.)

☐ ☐ D. BUILDING PERMITS. Have the necessary city or county building permits been obtained? Have requirements of local utility districts, if any, been met? Does the structure involve construction in wetland or in navigable waters and require a permit from the U.S. Army Corps of Engineers or the GLO?

☐ ☐ E. EVACUATION ROUTE. Does the building site have an adequate means of evacuation in the event of a hurricane? Is the elevation of the evacuation route higher than the expected storm tide elevations? Road elevation information is available from city, county and State Department of Highways and Public Transportation.

☐ ☐ F. INSURABILITY. Have the requirements and recommendations of insurance companies been checked pertaining to minimum floor elevation and structural requirements to assure insurability?

☐ ☐ G. OWNERSHIP. Has particular attention been paid to boundaries between State owned and privately owned lands, especially on waterfront structures? If in doubt, check with local government or the GLO.

II. ELEVATION, EROSION & SUBSIDENCE

YES NO

☐ ☐ A. CONSTRUCTION WITHIN FLOOD PLAIN. Is the building within a designated flood plain area? Have city, county, and other applicable flood levels been checked? Have requirements and recommendations of applicable flood plain code requirements been met? (Consult your local city or county engineer.)

☐ ☐ B. FLOOR ELEVATION. Is the minimum floor elevation of the structure above flood levels established by applicable codes and requirements?

☐ ☐ C. BREAK-AWAY CONSTRUCTION. Do city or county building codes require construction below flood level to be "break-away" construction?

☐ ☐ D. LOCAL EROSION RATES. If the structure is located near bay or Gulf waters, have local erosion rates been determined? (Contact the Bureau of Economic Geology, the Texas Coastal and Marine Council (TCMC) and the GLO.)

☐ ☐ E. EROSION PREVENTION. Have measures been taken to prevent erosion due to wind and flood water runoff, including provision for adequate natural or planted vegetation?

☐ ☐ F. WHEN EROSION OCCURS. Should storm scour or erosion occur, is the foundation still adequate to support gravity and wind loads on the structure? (See Section IV, Foundation Design.)

☐ ☐ G. SUBSIDENCE. Does the location have a history of ground subsidence or sinking? If so, has this been taken into account in design, access, and hurricane evacuation routes? Have measures been taken to prevent subsidence in likely areas? (Contact the TCMC or the Bureau of Economic Geology.)

III. WIND LOAD DESIGN

YES NO

☐ ☐ A. DESIGN WIND VELOCITIES. Has the design wind velocity been determined on the basis of governing building code requirements or higher possible wind velocities? Has the effect of negative (suction) pressure been considered in all wind load design? (Check with city or county building department officials to determine minimum design wind velocities and pressures for which the structure must be designed.)

☐ ☐ B. BUILDING FRAME DESIGN. Has the structural frame been designed to withstand pressures and suction forces due to required design or possible higher wind velocities? Have shape factors and the effect of roof slope been taken into account in calculating design wind pressure?

☐ ☐ C. GENERAL BUILDING DESIGN. Have all building elements (doors, siding, railing, etc.) been designed to withstand forces due to required design or possible stronger occurring wind or velocities?

☐ ☐ E. ADEQUACY OF DESIGN. Has the structure been designed by a registered professional engineer, qualified to do work in this field? Do building drawings have the seal and signature of a registered professional engineer?

IV. FOUNDATION DESIGN

YES NO

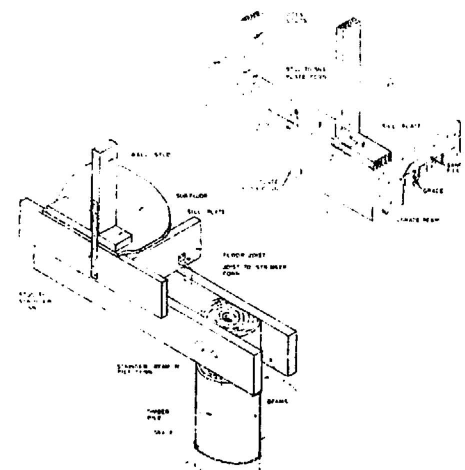
☐ ☐ A. WAVE FORCES. If the building is located within a flood plain, has the foundation been designed to withstand wave forces and battering action from floating debris?

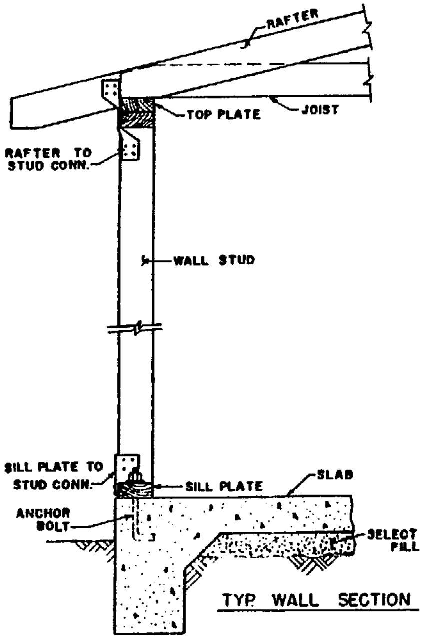
☐ ☐ B. EROSION. Has the foundation been designed to adequately withstand the effect of erosion or scour due to wind and water runoff? A structure built on pilings and properly anchored is generally much less susceptible to severe storm damage than a structure built on a slab foundation.

☐ ☐ C. PILE FOUNDATION. If a pile foundation is used, are pilings driven deep enough below the scour zone to resist forces due to design or possible higher occurring wind pressures and wave forces after scouring has taken place? Knowledge of the nature and character of the soil under the structure is necessary to make this determination.

☐ ☐ D. PILE SPACING. Are the piles or other foundations spaced widely enough apart to allow free flow of flood water runoff and withstand the effects of storm scour and erosion?

☐ ☐ E. CORROSION RESISTANCE. Have pilings been properly treated to prevent damage due to constant moisture, salt water, marine borers and rot?





V. WOOD FRAME BUILDING CONSTRUCTION

YES NO

☐ ☐ A. SILL PLATE. Are sill plates securely attached to foundation by means of anchor bolts (or metal straps in the case of pile foundations) to resist uplift and lateral forces caused by design wind pressures?

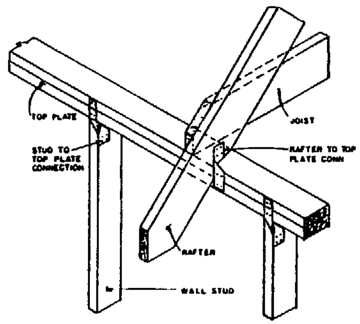
☐ ☐ B. WALL CONNECTIONS. Are wall studs securely attached to sill plates and top plates?

☐ ☐ C. ROOF. Are rafters and joists securely attached to top plates?

☐ ☐ D. HURRICANE STRAPS. Are metal hurricane straps required by governing building codes? These straps are highly recommended on all coastal construction.

☐ ☐ E. CONTINUOUS CONNECTION. Have metal straps been provided to insure a positive, continuous connection from the foundation to the structural members of the roof?

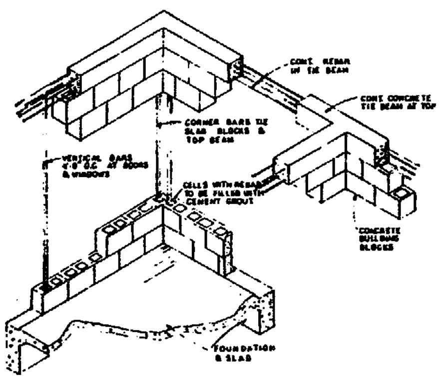
☐ ☐ F. MEMBER DESIGN. Have floor, roof and wall members been designed to carry additional loads due to higher design wind pressures?



☐ ☐ G. CONNECTION DESIGN. Are member connections and fasteners adequate to carry loads from high design wind velocities established for the area?

☐ ☐ H. WALL BRACING. Is diagonal wall bracing or properly attached plywood wall sheathing provided to resist high lateral loads on the structure?

☐ ☐ I. CORROSION. Are bolts, straps, plates, nails, and all other metal fasteners hot dip galvanized or otherwise protected from corrosion?



VI. CONCRETE BLOCK BUILDING CONSTRUCTION

YES NO

☐ ☐ A. DESIGN. Has the structure been designed by a registered professional engineer to resist pressures and suction forces due to design wind velocities established by the city or county, or possible higher storm velocities?

☐ ☐ B. VERTICAL WALL REINFORCEMENT. Has vertical reinforcing steel and concrete been provided at corners, openings, and at regular intervals along walls without openings?

☐ ☐ C. BOND BEAM. Has a properly designed reinforced concrete bond beam, which will resist uplift forces, been provided at the top of the wall, continuously around the structure?

☐ ☐ D. ROOF ANCHORS. Has the roof system been securely anchored to the bond beam to resist uplift forces due to design wind velocities?

☐ ☐ E. TIE TO FOUNDATION. Has vertical wall reinforcement been adequately tied to the foundation and to the bond beam to form a continuous tie from the foundation to the roof?

VII. ROOFING, SIDING & TRIM

YES NO

☐ ☐ A. ROOFING SYSTEM. Can you determine if the roofing system which is being used has been adequate in previous high wind situations?

☐ ☐ B. BUILT-UP ROOF. Are all layers properly adhered to previous layers and to the structural roof itself? Has loose gravel been eliminated from the roofing system to avoid damage to windows and other structures during high wind?

☐ ☐ C. SHINGLES. Has shingle exposure been decreased and fasteners added to reduce high uplift pressure on roofs?

☐ ☐ D. SECURELY ATTACH CORNERS & EDGES. Have the corners and edges of shingles, roofing material, siding, and any other building elements been securely attached to prevent loosening during high winds?

☐ ☐ E. ROOF PANELS. If roof panels are used, have they been securely attached to the structural frame to resist design uplift pressures?

☐ ☐ F. WALL SIDING. Has a type of wall siding been used which can be affixed to provide enough strength to withstand design wind velocities?

☐ ☐ G. SHUTTERS. Have shutters been provided for all glass openings and any other opening which may need protection from high winds? Are shutters such a type that can be installed quickly and easily?

VIII. UTILITIES

YES NO

☐ ☐ A. TELEPHONE & ELECTRICAL. Has all wiring been encased in a non-corrosive, watertight conduit? Are all conduits placed in such a manner as to avoid damage due to flooding, erosion, and floating debris? Have junction boxes and breaker boxes been located above flood level and in a place not subjected to driving rain?

☐ ☐ B. WATER & SEWERAGE. Are all water and sewerage lines constructed of a non-corrosive material and located to avoid damage and contamination due to flooding, erosion, and floating debris?

IX. QUALITY ASSURANCE

YES NO

☐ ☐ A. PLANS & SPECIFICATIONS. Does the contractor have a complete set of detailed construction drawings and specifications which cover all aspects of construction?

☐ ☐ B. CONTRACTOR. Is the contractor qualified and experienced in coastal construction?

☐ ☐ C. INSPECTION. Have arrangements been made to have a qualified registered professional engineer inspect the construction of the building? Have local building code regulations been checked for the necessity of required building inspections?

REFERENCES FOR ADDITIONAL SHORELINE CONSTRUCTION INFORMATION

Bureau of Economic Geology
University of Texas at Austin
University Station, Box X
Austin, Texas 78712

Federal Disaster Assistance Admin.
Department of Housing and Urban Development (HUD)
1100 Commerce Street
Dallas, Texas 75242

Federal Insurance Administration and Hazard Mitigation
1100 Commerce Street
Dallas, Texas 75242

Insurance Information Institute
1011 Congress Avenue, Suite #501
Austin, Texas 78701

National Flood Insurance Program
P.O. Box 34294
Bethesda, Maryland 20034

Texas Attorney General's Office
Supreme Court Building
P.O. Box 12548
Austin, Texas 78711

Texas Catastrophe Property Insurance Assn.
P.O. Box 2930
Austin, Texas 78769

Texas Coastal and Marine Council
P.O. Box 13407
Austin, Texas 78711

Texas General Land Office
1700 Congress Avenue
Austin, Texas 78701

Texas State Department of Highways and Public Transportation
11th and Brazos Streets
Austin, Texas 78701

U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, Texas 77550

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Texas Catastrophe Property Insurance Association

This brochure was developed by the Texas Coastal and Marine Council in cooperation with Goldston Engineering, Inc., Corpus Christi, Texas, and represents a continuing effort by the sponsors of the Hurricane Awareness Program to educate the public on how best to protect their lives and property in hurricane-prone areas.

A special set of Model Minimum Hurricane Resistant Building Standards have been developed for the Texas Coast. For further information on these standards or additional copies of this brochure, contact your local building officials or the Texas Coastal and Marine Council, P.O. Box 13407, Austin, Texas 78711, phone 512/475-5849.

Source: Texas Coastal And Marine Council, 1981