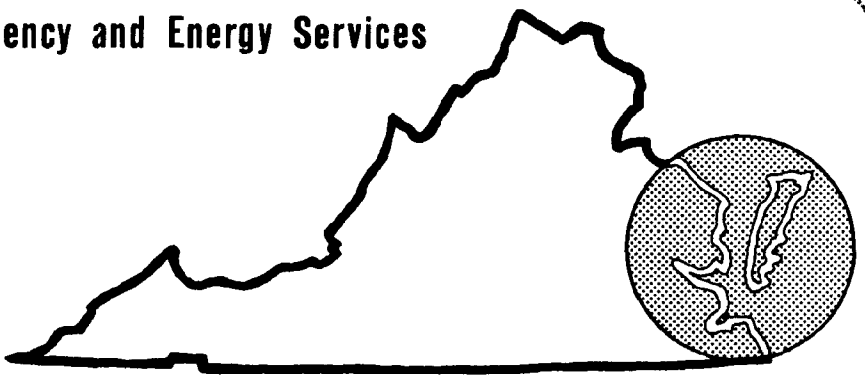
Disaster Preparedness Handbook

Hurricane Hazard Mitigation for Coastal Virginia

prepared by:
Commonwealth of Virginia
Office of Emergency and Energy Services



COMMONWEALTH OF VIRGINIA

OFFICE OF EMERGENCY AND ENERGY SERVICES

HURRICANE HAZARD MITIGATION

FOR

COASTAL VIRGINIA

JULY, 1980

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FOREWORD

Hurricanes--and the devastation they bring--are forceful reminders of how frail our advance technology can be in the face of these destructive Atlantic storms. Yet public officials have a statutory responsibility under the State Code to use whatever means are in their possession to reduce the consequences of natural hazards. Local officials, in particular, have a central role in hazard mitigation for their jurisdictions.

Through this publication, Hurricane Hazard Mitigation for Coastal Virginia, the State Office of Emergency and Energy Services seeks to acquaint local officials with the vulnerability of our coastal regions to the hazards posed by the "greatest storm on earth", and offers suggested guidelines for the development of effective hazard reduction measures. Our ultimate purpose, of course, is to save lives and reduce property loss should a major hurricane, for which we are long overdue, make landfall along Virginia's coast.

Richmond, Virginia
July, 1980

George L. Jones
State Coordinator of Emergency
and Energy Services

HURRICANE HAZARD MITIGATION FOR COASTAL VIRGINIA

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I. INTRODUCTION

HURRICANE HAZARD MITIGATION FOR COASTAL VIRGINIA

Introduction

> I am afraid that most Virginians have not learned from the past. As a result, a major hurricane could leave a death toll in Virginia alone far exceeding the 6,000 people who died in Galveston, Texas, in the Great Hurricane of 1900.

Dr. Neil Frank, Director of the National Hurricane Center, made this somber statement at a Hurricane Awareness Symposium for local government officials at Norfolk, Virginia, in June, 1979. We, in the State Office of Emergency and Energy Services who, under the Commonwealth of Virginia Emergency Services and Disaster Law, share with local government-elected officials the responsibility for the safety and welfare of our citizens, are in full agreement with Dr. Frank's assessment. Sometime in the future, a hurricane will kill hundreds, if not thousands, of Virginians and cause millions of dollars of property damage. We do not know precisely when or where, but it <u>will</u> happen.

Since 1900, 129 hurricanes have crossed our Atlantic and Gulf coasts. Fifty-three of these have been classified by NOAA's National Weather Service as "major" hurricanes--that is, hurricanes with peak winds in excess of 110 miles per hour and storm surges greater than eight feet.

The impacts of these storms can be staggering. The two deadliest U. S. hurricanes in this century killed over 6,000 people at Galveston, Texas, in 1900, and 1,800 people at Lake Okeechobee, Florida, in 1928. The two costliest landfalls were by Hurricane Agnes, a relatively weak storm which caused $2.1 billion in damage in the East and Northeast in 1972, and Hurricane Camille, which caused $1.4 billion in damage in 1969 in Mississippi and Louisiana, and Nelson County, Virginia.

We have been lucky, when compared to other areas of the world. Hurricane Tracy virtually wiped out the City of Darwin, Australia, on Christmas Day, 1974. About 300,000 people died when a hurricane struck Bangladesh in 1970--probably the largest fatality figure ever attributed to a single natural event.

In the 79 years since the Galveston disaster, the United States has put men on the moon, orbited satellites to forecast the weather, and developed computers that can solve the most complex problems. One might assume that our technological ingenuity has reduced or eliminated the risk of losing substantial numbers of lives in a hurricane. That is, however, not true.

In fact, the hurricane peril has significantly increased. More Americans are at risk today from a major hurricane than at the turn of the century.

- First, more people are potentially in the path of hurricanes. Our coastal populations are increasing at a rate more than three times the rate of national population growth. This is not primarily due to the high fertility of U. S. beach lovers--rather newcomers are moving into coastal areas in record numbers. By 1970, 48 million people lived within 50 miles of the Atlantic coast alone.

- Second, a large percentage of these coastal dwellers have no significant experience with hurricanes. In the last twenty years, only one hurricane with a substantial death toll has hit the East Coast of the United States. Much of the uninitiated population has little appreciation of the potential destructive power of these storms.

- Finally, the long periods of time between major hurricanes has lulled society into a false sense of complacency. Awards of water and sewer permits by local governmental authorities have allowed concentrated development in areas where people are in jeopardy during coastal storms. Building codes are lax--and sometimes poorly enforced. Evacuation plans are often out of date and are in need of revision. Summer tourists add yet another dimension. For example, during a summer weekend the number of visitors at Virginia Beach will increase the normal population by more than 75,000. It would be difficult to evacuate this popular resort area in the likely time available to cope with a major hurricane.

The question for state and local officials is: WHAT CAN BE DONE?

Three basic and complementary strategies are available to reduce the costs of killer hurricanes:

1. We can try to mitigate the intensity or impact of the hurricane.

2. We can better warn populations in areas threatened by an approaching hurricane and have appropriate responses to those warnings.

3. We can strive for prudent development in areas significantly threatened by hurricanes.

The purpose of this handbook is to address these strategies in terms of recommendations for local government officials and community leaders to lessen the impact of the greatest storm on earth--the Hurricane--should it strike Virginia's coastal jurisdictions.

II. THE HURRICANE THREAT

THE HURRICANE THREAT

Hurricane approach and landfall may drastically change the shoreline and damage or destroy man-made structures. Large, steep waves riding the crest of a storm surge erode beaches, dunes, and cliffed bay shores and destroy inadequately-designed buildings. The storm surge inundates low-lying areas along bay and mainland shorelines with salt water, and severe storm-surge flooding may destroy large areas of natural vegetation and agricultural crops. Freshwater flooding produced by torrential hurricane rainfall may be particularly destructive along natural drainage systems. Hurricane winds may damage or destroy man-made structures, with mobile homes particularly vulnerable to wind damage. Because of the direct and pervasive relationship of hurricanes and many natural coastal hazards, an understanding of hurricanes is important.

Characteristics of Hurricanes

Hurricanes develop from a variety of tropical weather disturbances and pass through several increasingly-intense phases, classified as tropical depressions (with winds less than 40 mph), tropical storms (with winds between 40 and 73 mph), and finally, hurricanes (with winds over 73 mph).

Hurricane size and intensity are not directly related. The most intense hurricanes are not necessarily the largest; for example, the diameter of cyclonic circulation tends to increase during the decaying stage (Colon, 1966). Low barometric pressure and relatively-high wind velocity are common to all tropical disturbances, and these parameters are more suitable for classifying hurricanes (Dunn and Miller, 1964).

Average life of a hurricane, determined by time and place of origin and rate of forward movement, is about nine days. Most hurricanes move forward at a rate of about 12 mph. The forward speed of hurricanes that have struck the Virginia coast in the past have averaged 8-12 mph.

Components of Hurricanes

WIND - Wind is the element most commonly associated with hurricanes by the public. Highest wind speeds occur in a narrow ring usually extending 20-30 miles from the center of the hurricane. The highest measured wind speed was 197 mph in Inez (Colon, 1966), but gusts of 220 mph have been estimated from damages and barometric pressure records. In a major hurricane, gusts between 73 and 120 mph may extend 40-100 miles from the center. Minor damages begin with winds of approximately 50 mph. Moderate damages, such as broken windows and displaced shingles, begin with winds of around 80 mph; and major structural destruction begins when wind speeds reach 100 mph (Friedman, 1971).

STORM SURGE - About 90 percent of the deaths near the coast which result from hurricanes are caused not by wind but by storm surge--the rise of water above mean sea level. The height of storm surge along the open coast depends on a number of factors which include wind speed, depth of water, storm trajectory, and speed of the storm. Coastal configuration can result in a funneling effect, and coincidence with normal astronomical tide will also affect surge height.

Although the maximum surge usually affects only a short length of coastline, combined storm surge and wave action may have damaging effects over 100 miles away in either direction.

RAINFALL - Some of the greatest rainfalls recorded in Virginia have resulted from hurricanes. Upon striking a land mass and moving inland, the forward movement of a hurricane is reduced, and the rate of rainfall increases. Maximum rainfall occurs in front of and along the right side of slowly-moving tropical storms. Rainfall is equally distributed in the front and rear halves of storms whose forward motion has stalled.

WAVES - Wind-driven waves on top of the storm surge pose a number of problems. First of all, the wave run-up can flood areas not reached by the surge itself. Second, the battering action of waves can transmit tremendous force. Third, the erosive power of waves is considerable.

TORNADOES - The hurricane system usually generates a number of tornadoes in the right front quadrant of the storm as it approaches landfall and moves inland. The average length and width of hurricane-induced tornado paths is only half that of non-hurricane tornadoes, although they are still powerful storms.

Factors Influencing Severity of Hurricane Impact

The severity of hurricanes can be expressed in various terms, such as damage to man-made structures, monetary losses, and loss of human life. The nature of the storm, population density, and shoreline characteristics determine the number of lives lost, the extent of shoreline erosion, and damage to or destruction of man-made structures. The nature of the storm dictates whether storm surge, fresh-water flooding, or wind will be the dominant destructive element. The loss of human life and the amount of property damage is directly affected by population density. Shoreline characteristics will either amplify or diminish some of the hurricane processes.

Hurricane Scale Ranges

Saffir and Simpson have devised a five-category scale of hurricane intensity which is being used increasingly to describe hurricanes. It gives a general indication of both wind speed and storm surge height. See table following:

SAFFIR/SIMPSON HURRICANE SCALE RANGES

Scale Number (Category)	Central Pressure		Winds (Mph)	Surge (Ft.)	Damage
	Millibars	Inches			
1	Z 980	Z 28.94	74 - 95	4 - 5	Minimal
2	965 - 979	28.50 - 28.91	96 - 110	6 - 8	Moderate
3	945 - 964	27.91 - 28.47	111 - 130	9 - 12	Extensive
4	920 - 944	27.17 - 27.88	131 - 155	13 - 18	Extreme
5	< 920	< 27.17	> 155	>18	Catastrophic

III. THE VIRGINIA COAST: POPULATION AND GEOGRAPHIC FACTORS

DESCRIPTION OF VIRGINIA'S COAST*

Virginia's coastal zone, including offshore islands, Chesapeake Bay and Atlantic Ocean shoreline, is 3,315 miles in length. Two hundred ninety-four miles of this is classified as beach. Seventy-seven percent of the coast is privately owned, and limited public access to the shore is a serious Statewide problem. All but 106 miles of coast is either undeveloped or in non-recreational low-density uses.

The Chesapeake Bay shore consists of erodible bluffs interspersed with tidal wetlands and scattered sandy beaches. Uninhabited barrier islands and wetlands occupy most of the Atlantic shores of Northampton and Accomack Counties. Much of this land is owned by the Nature Conservancy--an international, private, non-profit organization. Apart from the City of Virginia Beach and the small community of Sandbridge, the coast between Cape Henry and the North Carolina boundary is occupied by military reservations, state park land and nature reserves.

Virginia's Tidewater counties encompass 29 percent of the State's area and include 62 percent of the total population (i.e., 3,028,150). Population growth in this area is one and one-half times faster than the State average. Although woodland (59.1%) and agriculture (22.4%) are the dominant land uses, residential development (3.1%) and tourism are increasingly important components. Here tourism--most of it shore based--provides 16 percent of all private employment in Virginia.

Flooding and erosion are rated as high priority concerns by planners in coastal counties. Increasing urbanization along the southern shores of Chesapeake Bay, combined with the pending development of onshore Outer Continental Shelf (OCS) oil and gas support facilities, will exacerbate present flood and erosion problems. Storm surge flooding associated with hurricanes and slow-moving Northeasters is a major problem in Chesapeake Bay.

Erosion is a critical problem along 18 percent of the shorefront. The Virginia Institute of Marine Science has undertaken a comprehensive assessment of erosion and flood hazard in each coastal county.

Virginia's 1973 Erosion and Sediment Control Law requires comprehensive erosion control plans to be developed by coastal localities. The State's Wetlands Act (1972) provides coastal localities and the Virginia Marine Resources Commission with authority to issue permits for construction in flood-prone tidal wetlands and adjacent territory. Together with the flood hazard clauses of the Statewide building code, these are the primary management tools for coping with flood and erosion hazards throughout the State.

*Source: Natural Hazard Management in Coastal Areas, NOAA, Office of Coastal Zone Management, Washington, D.C., November, 1976.

IV. VIRGINIA HURRICANE PREPAREDNESS PROGRAM

VIRGINIA'S HURRICANE PREPAREDNESS PROGRAM

Program Description

Recognizing the vulnerability of our coastal area and the potential for a major disaster should a major storm strike our coast, in 1978 the State Office of Emergency and Energy Services, in cooperation with the affected local governments, embarked on a three-phased hurricane disaster preparedness program for the Eastern Shore and Tidewater regions of the State.

The phases consist of (1) identifying the hurricane hazards in our coastal areas; (2) assisting local governments in developing hurricane emergency response plans; and (3) developing hurricane hazard mitigation programs for the high-risk coastal jurisdictions. We felt the undertaking of this project was vital, inasmuch as the population in our coastal areas has grown so swiftly that most residents have never felt the full impact of these great storms and are largely unaware of the dangers inherent in the storm surge. Many have experienced only the fringe effects of the hurricane and have developed a false sense of security.

Program Status

PHASE I - The identification of hurricane hazards for each Eastern Shore and coastal Tidewater jurisdiction. This was accomplished in CY 1978 through the development of hazard analysis maps showing high-risk areas and the compilation of an accompanying hurricane survival checklist. In accordance with a joint State-National Ocean Survey agreement, if funding is made available, hazard identification maps for the remaining Northern Neck jurisdictions will be prepared in CY 1981. This will complete the mapping program for the State's entire Atlantic Ocean and Chesapeake Bay coastline.

PHASE II - The preparation of hurricane response plans. Plans which establish emergency procedures and responsibilities, delineate control measures, designate shelters and identify evacuation routes were completed for the Eastern Shore and coastal Tidewater jurisdictions in CY 1979.

PHASE III - The development and recommendation of hurricane hazard mitigation measures for Virginia's coastal jurisdictions. This handbook is designed to fulfill the requirements of Phase III. Recommendations for hazard reduction through improved building standards, land use management, natural hazard disclosure, erosion abatement, and community and individual protective measures are presented to local government officials for their consideration in developing effective local hurricane preparedness and mitigation programs.

V. HAZARD REDUCTION THROUGH IMPROVED BUILDING STANDARDS

HURRICANE HAZARD REDUCTION THROUGH IMPROVED BUILDING STANDARDS

Virginia's coast has not suffered catastrophic loss of life and property since Hurricane DONNA, with her 138-miles-per-hour winds, struck the coastal jurisdictions on September 12, 1960; however, conditions are now developing which lead officials to fear another major storm. In fact, Hurricane DAVID, which devastated Puerto Rico and battered the North and South Carolina coasts on September 5, 1979, was a near miss. Factors which contribute to the fear of a future destructive hurricane include the following:

- Rapidly-increasing development in low-lying coastal areas, many of which are reachable only over stretches of exposed low roads.
- Influx of persons from non-coastal areas who fail to appreciate how devastating a major hurricane can be. This problem is compounded by the fact that many persons have experienced a near miss or only a minor storm and thus have a casual attitude toward these storms.
- Warning systems have improved much in recent years, contributing to complacency among both officials and the public. However, a plateau has been reached; and additional significant improvements are not anticipated.

The best way--from a technical, political, and economic standpoint--to significantly reduce hurricane damage on a wide scale is through the use of hurricane-resistant building practices.

If proper standards are developed and thoughtfully applied in a manner consistent with the exposure to hurricane dangers, damage can be greatly reduced at a modest cost. Since a substantial portion of the population inevitably refuses to evacuate during a warning, the use of stronger structures will obviously result in lower loss of life during the storms.

Currently, all political subdivisions in the Commonwealth of Virginia are governed in their construction practices by a Unified Statewide Building Code. The Virginia Uniform Statewide Building Code was enacted by the 1972 Virginia General Assembly, effective September 1, 1973. The current edition was adopted June 19, 1978, becoming effective August 1, 1978, and is comprised of the following texts:

The BOCA Basic Building Code/1978
The BOCA Basic Plumbing Code/1978
The BOCA Basic Mechanical Code/1978
The One and Two Family Dwelling Code/1975
The National Electrical Code/1978
The Virginia Administrative Amendments/1978

The Unified Statewide Building Code protects many people living in the coastal zone to some degree because of requirements for continued eligibility for the State in the Federal Flood Insurance Program. The National Flood Insurance Program regulates those buildings in the coastal zone in designated "flood hazard" areas, ensuring that such buildings shall maintain some degree of protection against flood waters.

The Flood Insurance Program is similar in nature to other zoning concepts, only it is on a national level. Essentially the program requires local communities to adopt flood plain zoning as a requirement to obtaining federal mortgage loan funds. One typical requirement of the program is that the first habitable floor level of all new buildings is to be above the 100-year flood level (or storm surge level on the coast) to qualify for federally-subsidized flood insurance. All construction in flood-prone zones will be required to have flood insurance to obtain a mortgage loan from any federally-subsidized or insured savings and loan institution. Conformance with the specified requirements of the National Flood Insurance Program will qualify a homebuilder for "federally-subsidized" insurance, whereas those not in compliance will have to purchase more expensive unsubsidized insurance to obtain a house loan. Local communities may also have additional restrictive flood zoning measures, depending on the area.

While the Statewide Code does provide some degree of flood protection, it does not give, for all localities, a level of protection by assurance that the 100-year wind loadings are considered in designs which would permit structures to withstand hurricane forces--wind, as well as storm surge and flooding.

A wide variety of dwellings have been constructed along Virginia's coastline ranging from high-rise condominiums and resort hotels to small cottages. Most of the larger structures are designed by professionals; and since Virginia lies in a hurricane-prone region, these expensive buildings are usually designed to withstand hurricane forces. By contrast, builders of less-expensive single-family homes may not feel they can afford the services of a design professional. Consequently, when hurricane conditions do occur, these smaller structures usually suffer most. Much of the storm damage to these buildings is attributable to vulnerable location, too low in elevation, or a structural design not adequate for hurricane forces.

Local governing bodies are encouraged to review the Unified Statewide Building Code to ensure that the standards prescribed therein provide sufficient protection for their particular geographic locations with respect to hurricane-force winds* and storm surge. The National Weather Service, Norfolk International Airport, Norfolk, Virginia, can provide historical data on Atlantic coast storms which can assist local officials in determining the wind load forces and storm surge heights that should be considered in establishing adequate hurricane protective standards.

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*BOCA Basic Building Code/1978, Section 712.2.1, Increased Loads: For structures located in flat, open country, open flat coastal belts, grassland, unusually exposed positions or in geographical regions where local records indicate higher wind loads than established in Section 712.1, the higher wind load shall be used.

If local governments determine to be more conservative than is minimally necessary to comply with the Unified Statewide Building Code, they should require the building official to designate standards applicable to the special hurricane threat to their jurisdiction. Should it be necessary to seek amendment to the Code in order to achieve the desired protective standards of construction, local governing bodies should follow the procedures prescribed in Section 36-100, 1978 Accumulative Supplement to the Unified Statewide Building Code.**

To assist builders, owners, potential buyers of coastal homes and local building officials, suggested guidelines for hurricane-proof construction are set forth below. The guidelines are part of a Florida Sea Grant Study, "Hurricane-Resistant Construction for Homes", by Todd L. Walton, Jr., University of Florida. While the guidelines were developed primarily for Florida's coastal areas, it is believed the construction standards and techniques discussed therein are equally applicable for Virginia's coastal areas.

**Section 36-98, Code of Virginia, mandates the State Board of Housing and Community Development to adopt all Code provisions and regulations.

SUGGESTED GUIDELINES FOR "HURRICANE-PROOF" CONSTRUCTION***

From the observations of various engineering specialists, it appears that any type of construction (i.e., wood, brick, or masonry) can be designed to withstand hurricane-force winds if designed properly and in accordance with good engineering practices (3, 14). This section is aimed at providing some specific guidelines and information as to where additional guidelines can be obtained for good high-hazard residential construction.

Much of the information within this section can be obtained in two excellent publications: "Houses Can Resist Hurricanes" FPL 33 by the Forest Products Laboratory (15), and "How to Build Storm-Resistant Structures" by the Southern Pine Association (16). References (15) and (16) can be obtained by writing to the respective issuing agencies.

Wood Frame Construction

Wood is an excellent building material for use in the hazardous coastal zone provided it is properly treated. Specific construction practices which can make the difference in a normal wood frame house and a hurricane-proof house are the uses of good anchorage and fasteners. To be structurally sound, a building should be rigidly fastened and have its components properly held together. Proper fastenings throughout the entire building are the key to good construction here. This process begins at the foundation where the wood sill is anchored to the concrete or concrete block foundation wall (see Figure 8). From there fastening should continue from the sill to the wall studs (see Figure 9). Commercial framing anchors and fastenings are available for this type construction which consists of punched metal straps. These type of connectors or variations thereof are used in both the South Florida Building Code and the Southern Standard Building Code and are available at building suppliers in counties utilizing those codes.

At the top of the walls, other type metal connectors can be used (Figures 10, 11) to provide a rigid connection between the wall studs, plate, and the roof trusses.

Poor nailing practices are a cause of numerous building failures due to high winds. Reference (15) provides a table of recommended nailing practices to be used for sound construction. This table (Table 2, page 18, Reference 15) should be included in your building plans for the contractor to comply with.

Due to the severe racking forces encountered in high winds, it is recommended that wood frame homes use either plywood sheathing or wood sheathing on all

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Note: Numbers in parentheses (1) refer to references at end of this section.

***Extracted from Hurricane-Resistant Construction for Homes, by Todd L. Walton, Jr., Coastal Engineering Specialist, Coastal Engineering Laboratory, University of Florida, Marine Advisory Program Publication SUSF-SG-76-005.

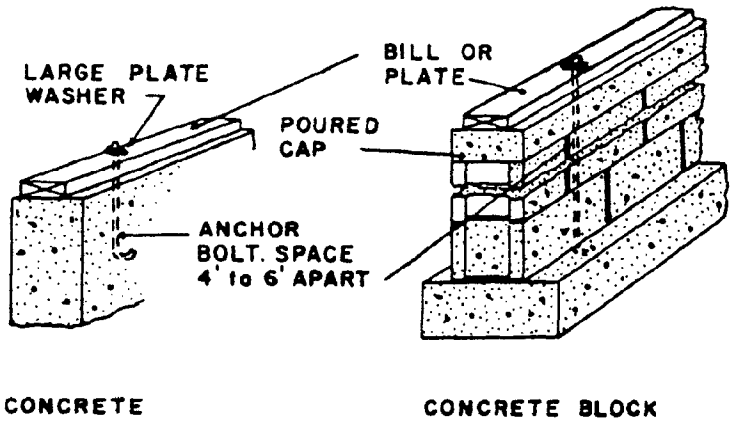


Figure 8. Anchoring wood sill or plate to foundation. From Reference (15).

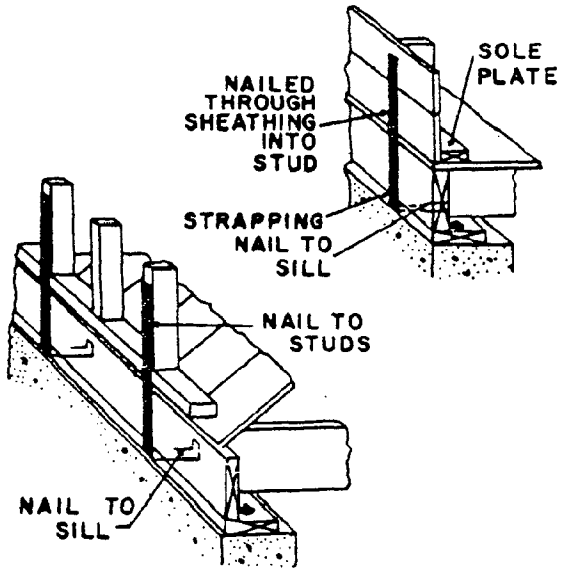


Figure 9. Foundation-to-wall connections: A, straps nailed directly to studs; B, straps nailed through sheathing into studs. From reference (15).

walls of the house to provide good lateral resistance. Additionally, plywood sub-flooring and attic flooring should be used to provide good tortional resistance in the horizontal plane of the house. Reference (15) covers both types of sheathing and shows recommended nailing and connection practices for sheathing. Figure 12 shows a timber frame house which failed in the winds of Cyclone "Tracy" in Darwin, Australia in December of 1974. This house would not have collapsed had the walls been sheathed to provide lateral rigidity. Plywood sheathing also provides good insulation for the energy-conscious homeowner. Numerous other good timber construction practices are provided in Reference (15). Rather than repeat this information it is best for the homeowner desiring a timber frame home to request a copy of this reference from the source listed.

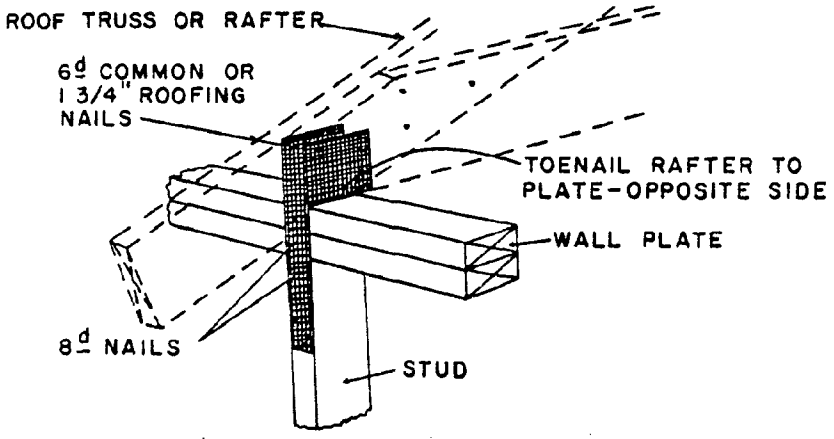


Figure 10. Single member plate connectors. From Reference (15).

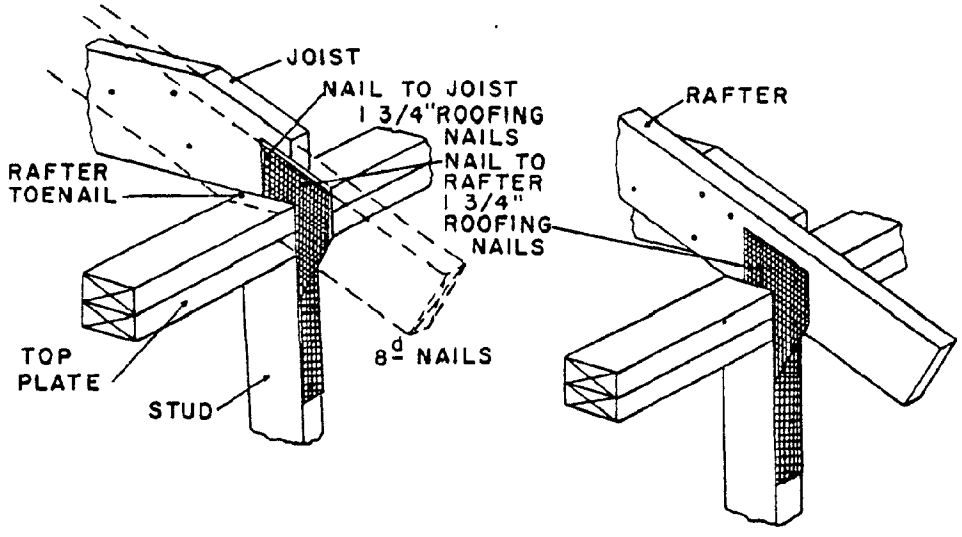


Figure 11. Rafter-to-stud plate connector for: A, ceiling joist over stud, and B, rafter over stud. From Reference (15).

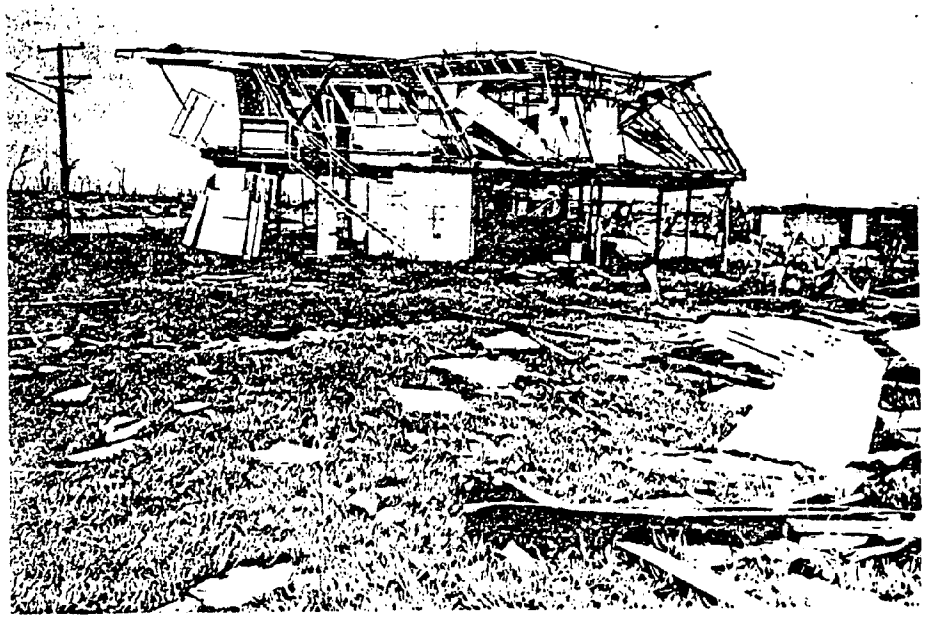


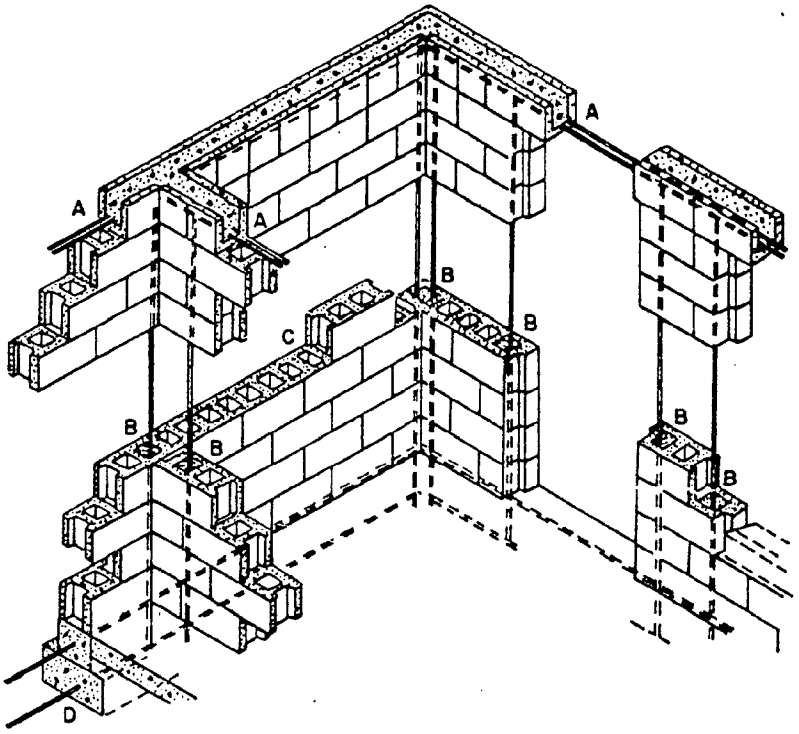
Figure 12. House destroyed by racking force in Cyclone Tracy.

Masonry and Brick Construction

Unsupported masonry walls of typical residential type construction with a height of 8-9 feet per floor are adequate to withstand typical hurricane wind forces, provided they are constructed in accordance with regulations of either the South Florida Building Code or the Southern Standard Building Code. This would include reinforcement bars internally through the blocks from foundation to ceiling in interior and exterior corners of the house and at all framed doors or large windows for the case of masonry block walls (see Figure 13). A continuous reinforced concrete bond beam completes the top layer and should be adequately tied into the roofing system by metal fastenings (hurricane clips) or some method of bolting.

The exterior surface of concrete block walls should be stuccoed or water proofed in some manner to resist rain penetration (3,21). The interior of concrete block walls should have furrings strips and then interior cladding to reduce any through-the-wall moisture penetration. Condensation may occur within uninsulated masonry block and can be controlled by installing a vapor barrier on the warm side of the wall. A water emulsion asphalt paint applied to the wall surface as it is constructed is one method used to provide a moisture barrier. Moisture penetration through masonry foundation walls below grade is controlled by parging the outer face with portland cement plaster or mortar.

Cavity type brick walls with inner cavities not greater than 2 feet have withstood the strongest winds of Cyclone "Tracy" in Darwin, Australia (150 mph) (14). This type of wall is shown in Figure (14) and should have metal ties not less than one per two square feet of wall bonded into the mortar between walls. Cavity walls are very good for severe exposure because the cavity acts as a barrier to moisture. Rain penetration to the interior wall is practically impossible if proper flashing and weep holes are installed. To be effective certain precautions must be observed during construction.



A. Continuous reinforced concrete bond beam. Lap bars at corners

B. Reinforced concrete studs tied to footing

C. Reinforcement in horizontal mortar joints

D. Reinforced concrete footing

Figure 13. Typical methods of reinforcing concrete masonry walls. From Reference (21).

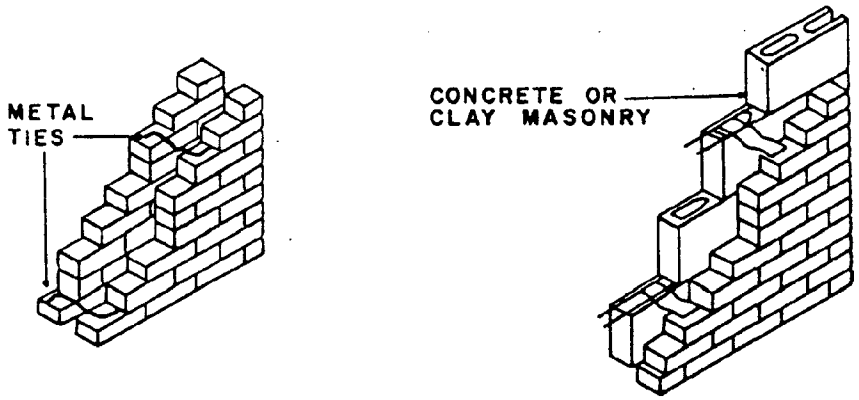


Figure 14. Cavity type walls.

The cavity must be kept free of mortar droppings and weep holes must be provided in conjunction with flashing to properly drain the cavity of any water which enters the outer wall and collects on the flashing. A vapor barrier is not required in a cavity wall where the cavity is insulated with fill materials such as water-repellent vermiculite or silicon-treated perlite which will not retain excessive moisture, or with rigid board materials such as glass tubes, framed glass, or foamed plastics that are at least 1" less in thickness than the cavity and are installed next to the inner wall.

Solid brick walls bonded with masonry headers are considerably less resistant to rain penetration than the metal-tied cavity type walls and should not be used in this severe exposure area.

If veneer brick walls are to be used (see Figure 15), wood or plywood sheathing should be used behind it to provide protection against water penetration and also to provide additional racking resistance. Corrosion-resistant metal ties should be used to tie in the brick work to the sheathing and studs to act structurally with the load-bearing backup material. One metal tie should be provided for each 2 feet of wall area.

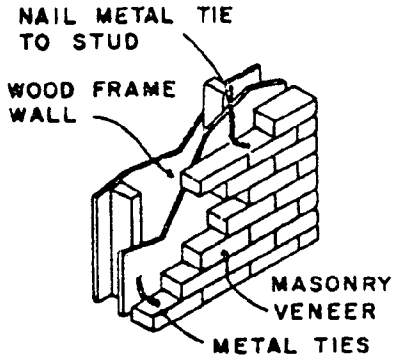


Figure 15. Veneer Brick Wall

Pole Houses

Due to the recent enactment of the National Flood Insurance Program and the requirement that the first habitable floor level of the building be above the 100-year storm tide, a considerable number of future residential structures built in the coastal zone will be required to be on poles (i.e., pole houses or "stilt" houses). Pole houses are a special type of wood house using pressure-treated timber poles to provide elevation and structural rigidity.

In areas where erosion due to wave forces or deflation due to wind forces can cause a loss of foundation material, it is wise to use pole-type construction regardless. Figure 16 is of a pole house which was sitting on an 18-foot-high dune system prior to September, 1975. Hurricane "Eloise" with winds of over 100 mph and an 11-foot storm tide eroded the dunes in this area some 60 feet. Other houses in the area were not built on poles and were completely destroyed while the house shown suffered only very minor damage.

Two basic types of pole house construction exist. One type, as in Figure 16, has its poles cut off at the first floor level and is tied into the first floor. A better type of construction from a structural standpoint is to have the pole system run integrally through the structure and rigidly tied into the house frame at the first floor level and the rafters (15) as illustrated in Figure 17.

Considerable literature exists on the design of pole house type construction, along with some basic structural framing plans for these types of homes in References (15), (17), (18), (19), and (20). Structure details on the various aspects of constructing these types of buildings as well as discussing the aspect of pole embedment are given in References (15), (18), and (20). The depth of pole embedment for a given house is dependent on both the house shape, exposed surfaces to the wind, wind speed and height of structure above ground. If the structure is built too close to water or is built in an area of loose sand (i.e., no vegetative cover to prevent deflation) then consideration should be given to possible loss of pole embedment cover due to erosion by wind or water. Determining pole embedment in the design of a pole house is the job of a professional engineer or architect and should not be attempted by unqualified persons. Lateral and diagonal bracing between poles to provide for wind or water forces is also a job for professional engineers or architects. Where diagonal structural bracing is to be used between poles (in areas where design flood level is above grade), it is suggested that cable-type cross bracing be used to minimize water or wave forces on the structural framing. Additional good building practice in such situations is to use plywood sheathing on the underside of the house. Some examples of this type of practice are given in Reference (15).

Where through house type pole construction (Figure 17) is not used, it becomes necessary to properly anchor the house to the poles. Again, a professional engineer or architect should either design or certify the design of such structures to withstand the required structural loadings of the house.

It is common practice in pole house construction to have a contractor who specializes in pole type construction build the pole and beam framing for the house, while a second contractor (homebuilder) builds the house to design specifications on this framing system.

Figure 16. Pole house which survived Hurricane Eloise.

Figure 17. Pole house with integral pole - rigid frame construction.

As a final testament to the structural soundness of well-designed pole houses, Reference (19) discusses types of pole houses which have survived the worst winds and water forces of Hurricane Camille with only minor damage to the structure. One family moved back into their pole house one day after Camille made its landfall.

SPECIAL CONSIDERATIONS

Roofs

By far, the greatest damage to homes in hurricane-prone zones is due to roof losses and consequent water damage. Although any roof can be properly designed to withstand hurricane-force loads, it is apparent through experience that some roof types are considerably better than others. Shapewise, it appears, hip roofs are better than gable roofs while at the same time more steeply pitched roofs fare better than low-pitched roofs (3, 14). Low-pitched roofs act as airfoils and have higher uplift pressures exerted on their windward sides. Resisting uplift pressures becomes of more importance in design of low-pitched roofs.

It appears from research on wind pressure on roofs that roofs having a pitch angle of over 40^{o} should prevent negative (suction) pressures from developing on the windward side of roofs (2).

The majority of roofs today are framed with prefabricated roof trusses which have tension-compression web members in them. These provide a very good framing system with good structural rigidity in the plain or the trusses, although the designer should require that the trusses be sufficiently strong to withstand design wind loads.

A need for structural rigidity in the ridge framing direction is also of importance though, as has been found by the recent disastrous effects of Cyclone "Tracy", which hit Darwin, Australia in 1974 (14). An example of a building which lacked good bracing in the ridge frame direction and in the corresponding walls is shown in Figure (12). This type of failure could have been prevented by diagonal wall bracing and adequately-designed structural purlines, roof sheathing (15), or a ceiling designed as a diaphragm (22, 23), all of which should be adequately fastened to the wall framing.

It appears that the longitudinal bracing provided for in hip roofs may be a contributing factor to the apparent successful performance of hip roofs over the more common gable-type roof systems.

Roof coverings for roofs should be selected so that high winds do not cause a loss of water-shedding ability. Both wood shingles and wood shakes have resisted storm damage better than most roofing materials (15). Asphalt shingles have performed poorly in most instances, although much of this is believed due to a lack of good fastening techniques used. Information on a variety of types of covers and what constitutes good fastening for the roof covering is detailed in Reference (15). In both the U. S. and Australia, experience has shown that metal roof cladding has proved to be least acceptable and has failed in numerous instances. Again, though, the probable cause was the lack of proper fastening procedures of the metal roofing to the roof system.

Should a metal roof be used, Reference (14) can provide criteria for fastening the roof in place. Proper roof cover fastening for timber roof systems is covered in Reference (15).

Large overhangs (eaves) are a major cause of roof failures also. Eaves should extend out from the building a minimum distance necessary to provide drainage. Proper shading from the sun can be provided by shutters or awnings designed to be bolted down during storms.

Doors, Garage Doors

Any doors to be used in hurricane-prone zones should be structurally checked for adequacy to withstand design loading by a professional engineer or architect, or be certified by the seller as to strength under a given design wind load. This is especially true of garage doors, as experience has noted numerous failures of typical metal and wood overhead sliding doors. A typical mode of failure noted in overhead garage doors is that the wind causes the inadequately-braced door to buckle, thereby allowing the garage door rollers to come out of their tracks with a consequent total failure of the system. Projected missiles are also of considerable danger in a hurricane. Both doors and garage doors should be of adequate strength to prevent damage due to flying objects such as 2"X4"s or tree limbs.

Additional failures to both garage and normal doors occur due to poor attachment to the framing. Usually a door is connected by two hinges and a lock. Additional fixtures such as dead bolts can be fastened onto the framing for use during hurricanes, thereby providing additional rigid connection to the house framing. Note that these should be emplaced on the outside of the house since the owners of the house will usually leave the home during a severe hurricane warning.

Garage doors can have similar connections made depending on the type of door to be used. Again, due to the importance of doors in providing both protection to the interior and preventing wind-blown water damage, it is desirable to have these features checked for their structural adequacy by a professional engineer or architect where building codes are lacking.

Windows, Glass, Glazing, and Hurricane Shutters

Due to numerous window failures in past hurricanes, the South Florida Building Code (SFBC) adopted regulations concerning the fastening of windows to wall frames to ensure against the windows pulling out. This code similarly limits both the size and spacing of windows in structures and the type of glass to be used. The Metropolitan Dade County Building and Zoning Department specifies that such products must be tested by a testing laboratory to SFBC design loads as a code requirement. The Building Department maintains a listing of approved products which meet SFBC specifications and will withstand high winds (120 mph, according to SFBC) provided the window systems are framed and fastened in accordance with the SFBC.

No window is safe from projected missiles such as tree limbs or similar storm debris. For this reason, it is suggested that storm shutters of adequate strength to prevent missile damage be used with all window systems. Reference (3) notes the following:

"Storm shutters, particularly where constructed according to established standards, can be of definite value in minimizing glass breakage. For dwellings, the combination awning pull-down type offers ease of operation with reasonable possibilities of protection. . .The development of pull-down, roll-down, or curtain-type shutters for smaller openings appears worthy of careful consideration."

Additional damage due to wind-blown water during hurricanes can be prevented by insuring that good caulking practice is used around the window system.

The South Florida Building Code provides a very good guide in the area of windows and glazing to be used. Information on properly-tested products can be obtained from the Dade County Building and Zoning Department.

Landscaping and Siting

Proper landscaping and siting of a home can be of great value to a homeowner as a protective measure.

Shelterbelts of trees provide some protection against the wind if planted dense enough to break the wind force. In some studies (14, 24) it has been found that tree cover can provide 10-20 percent reduction in wind speeds. Trees though, can also be detrimental if not sufficiently strong to withstand wind forces or if not pruned adequately to get rid of weak or dead limbs. Dead tree limbs projected by the wind are found to be a significant cause of home damage. Therefore, it is best to do a pruning prior to hurricane season. Also it is a good idea to tie down any trees with shallow root systems by using cables tied to the tree trunk and staked to the ground. If planting trees for a shelterbelt, use those trees with deep root systems.

Likewise, the more exposed the house, the higher the winds it will experience. Siting a house behind a sand dune on a pole-type frame is preferable to building on the dune, even if the final floor elevation is at the same height. This is because the dune will deflect the winds upward and also reduce wind speeds somewhat.

The home closest to the coast or bay may provide the best scenic view, but from a protection standpoint, has the worst exposure to severe weather. Usually the greatest damage from winds is found in the first row (most exposed) of homes. Of course, this is self evident for water and wave damage also. As wind speeds are significantly reduced when wind passes over land, as opposed to water, it pays to construct as far away from the water as is reasonable.

Vegetation prevents sand from blowing and therefore causing either wind-blown sand abrasion damage, loss of foundation material (scour), or a buildup of sand against a wall causing additional structural loading that the house was not designed for. Providing good vegetation to hold sand in place during high winds should be on a coastal homeowner's checklist.

As mentioned earlier, exposure to higher winds increases with height. It is, therefore, good to keep as low a profile as possible and yet be above storm tide design level.

VI. SUMMARY

The following items provide a checklist for home builder or home buyer considerations when building in the high-hazard coastal area:

1. Check to see if your area is covered by adequate building codes. Find out what important provisions have been put into the code to protect you from wind or water damage due to poor construction practices.

2. Find out what design flood levels are for your area. You must again decide whether you wish to be more conservative than the local regulations provide for.

3. Find out what design wind loads are for your area. You must again decide whether you wish to be more conservative than the local regulations provide for.

4. Consider the details! The large majority of homes experience minor hurricane damage due to some small overlooked portion of design. With the material and references provided in this report, you should be able to check over many of these details yourself and either change the plans if you are building a home, or modify the existing structure in case you are buying an existing home.

5. Have a design professional check out your home plans and certify them as adequate to withstand your specified hazard designs or his recommended designs. If you are buying a home, have him check out the home for possible modifications to make it structurally sound against wind or water.

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MOBILE HOME CONSTRUCTION AND SAFETY

In the Commonwealth of Virginia, mobile home construction and safety standards are governed by the "Virginia Industrialized Building Unit and Mobile Home Safety Regulations - Part One". These regulations contain mandatory mobile home tie-down provisions.

The American Red Cross estimates that an average of 1,165 mobile homes are destroyed and an additional 1,000 are damaged each year due to winds. Especially vulnerable are mobile homes which have not been anchored. A recent study concluded that considerably less than 50 percent of the occupied mobile homes throughout the country have been tied down, notwithstanding mandatory State and local tie-down ordinances.

Disaster assistance can help repair or replace damaged units; insurance can compensate for incurred losses. Neither assistance nor insurance, however, can save lives or actually protect the unit from damage or destruction. Only effective enforcement of the State-enacted tie-down law can do that.

General ranges of windspeed at which different types of mobile home damage typically occur are as follows:*

- At windspeeds below 50 mph, only minor damage to weak attachments and loose elements (especially at the eaves), and minor damage due to roof peeling, small debris, or sliding off the piers should occur.

- At windspeeds between 50 and 70 mph, minor damage is more likely and major damage can occur, including complete loss of the roof, attendant wall damage or collapse, and over-turning of the home. In this windspeed range, tie-downs are very effective in preventing damage, and injuries are rarely serious.

- At windspeeds between 70 and 100 mph, severe damage and destruction of mobile homes is common. Destruction occurs most often by overturning, vaulting, or tossing of homes that are not properly tied down. Thus, tie-downs are very important in preventing damage and injuries. Mobile homes that are tied down can fail also, however, either by giving way of the tie-down system or failure of a major portion of the superstructure, such as a wall or roof. In fact, if only the underframe is tied down, the entire superstructure may be torn away.

- At windspeeds in excess of 100 mph, it is unlikely that a mobile home will survive without serious damage unless it is tied down well and has a favorable combination of the factors mentioned earlier, such as heavy, strong construction, a rough surrounding terrain, and effective shielding from nearby trees or buildings. Mobile homes are simply not designed to resist windspeeds in this range, either structurally or in terms of tie-downs, so survival

of such winds is highly uncertain. In fact, the hurricane-resistant design pressures of current standards correspond only to 88 mph windspeeds (at 30 feet in open terrain).

Based on the above information, it is recommended that local governments take the following actions on a continuing basis:

- Rigorously enforce current design and construction standards for mobile homes.
- Frequent inspection of mobile home parks and individual mobile home sites to ensure compliance with mandatory mobile home tie-down regulations.
- All occupants of mobile homes, even with tie-downs, should be prepared to evacuate their homes in favor of a more substantial structure or shelter anytime a severe thunderstorm, hurricane, or tornado warning is issued for their immediate vicinity. These storms are all capable of producing windspeeds that can cause major damage and severe injury or death (above 70 mph). Of course, hurricanes and tornadoes are more likely to bring such extreme winds, but severe thunderstorms can also produce these winds.
- Each mobile home park should be required to have a severe windstorm warning signal and a shelter or other structure usable as a shelter within easy reach (2-3 blocks) of every mobile home. These shelters can normally be designed as functional spaces, such as recreation or laundry rooms.

*Source: An Engineering Analysis: Mobile Homes in Windstorms by W. Pennington Vann and James R. McDonald, February 1978, Institute for Disaster Research, Texas Tech University.

BUILDING CONSTRUCTION CHECKLIST FOR THE VIRGINIA COAST AND SHORELINE*

Prospective buyers or current owners of shore property naturally are concerned about the specialized problems involved in shore area construction. This checklist summarizes a number of items of importance in evaluating the effects of predictable storm forces and long-term erosion. The list includes most major concerns but is not exhaustive. Before becoming committed to any major expenditures, a competent professional engineer experienced in shore area design and construction should be retained and requested to supply satisfactory answers to the following questions.

I. LOCATION

Yes	No	
☐	☐	A. BEACH ACCESS. Does the structure block access to public beaches? Does the structure violate open beach provisions of Virginia law?
☐	☐	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?
☐	☐	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 inspector to be sure.)
☐	☐	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 Virginia Marine Resources Commission?
☐	☐	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 Transportation.
☐	☐	F. INSURABILITY. Have the requirements and recommendations of insurance companies been checked pertaining to minimum floor elevation and structural requirements to assure insurability?

Yes	No	
☐	☐	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.

II. ELEVATION, EROSION AND SUBSIDENCE

☐	☐	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 building inspector.)
☐	☐	B. STORM TIDE ELEVATION. Has the elevation of the 100-year storm tide (or flood plain) been determined and compared with the existing ground elevation at this building site? Contact local building inspector.
☐	☐	C. FLOOR ELEVATION. If this location is subject to flooding during the 100-year storm, is the lowest habitable floor raised above the top of the highest storm wave cresting on the 100-year storm tide?
☐	☐	D. EROSION PREVENTION. Have measures been taken to prevent erosion due to wind and flood water runoff, including provision for adequate natural or planted vegetation?
☐	☐	E. 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.)
☐	☐	F. 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?

III. WIND LOAD DESIGN

☐	☐	A. 100-YEAR WIND SPEED. Has the wind velocity for a 100-year storm been found for this building site?
☐	☐	B. FRAME DESIGN. Is the structural frame designed to withstand at least a 100-year storm wind with an adequate safety factor?
☐	☐	C. ELEMENT DESIGN. Is each element of the building designed to withstand both pressure and suction forces associated with at least a 100-year storm wind while remaining attached to the building?

Yes	No	
☐	☐	D. SHAPE FACTOR. Has the effect of shape factors and roof slope been accounted for when calculating wind pressure and suction?

IV. FOUNDATION DESIGN

☐	☐	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 run-off and withstand the effects of storm scour and erosion?
☐	☐	E. CORRISION RESISTANCE. Have pilings been properly treated to prevent damage due to constant moisture, salt water, marine borers and rot?

V. WOOD-FRAME BUILDING CONSTRUCTION

☐	☐	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 used? 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?

Yes	No		
☐	☐	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
☐	☐	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.	ROOF, SIDING AND TRIM
☐	☐	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?

Yes	No		
☐	☐	D.	SECURELY ATTACH CORNERS AND 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

☐	☐	A.	TELEPHONE AND 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

☐	☐	A.	PLANS AND 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 building code regulations been checked for the necessity of required building inspections?

*SOURCE: In the compilation of this Check List, material was extracted from the following documents:

1. "Building Construction on Shoreline Property - A Check List", by C. A. Collier, Marine Advisory Program, Florida Cooperative Extension Service, University of Florida, Gainsville, Florida.
2. "Building Construction Check List for the Texas Coast and Shoreline", Texas Coastal and Marine Council, Austin, Texas, in cooperation with Goldston Engineering, Inc., Corpus Christi, Texas.

VI. LAND-USE MANAGEMENT

LAND-USE MANAGEMENT

The concept of land-use management is to utilize hazardous areas in ways which will minimize unecomomic risk of losses to property and life. Land-use management can be accomplished through governmental regulation, the most common being natural protection and zoning ordinances.

Protection of Sand Dunes

Sand dunes and beaches serve as buffers against coastal storms. In some places dunes and beaches have been built artificially. In others, the natural protection has been supplemented with additional sand, and in still other cases, steps have been taken simply to stabilize and protect the natural features.

The Virginia General Assembly recognized the importance of coastal primary sand dunes with their unique physiographic features which, in their natural state, serve as protective barriers from the effects of flooding and erosion caused by coastal storms, thereby protecting life and property; that such dunes provide an essential source of natural sand replenishment for beaches and an important natural habitat for coastal fauna, and are important to the overall scenic and recreational attractiveness of Virginia's coastal area.

The General Assembly recognized further that inappropriate development on coastal primary sand dunes can destroy vegetation which stabilizes such features, alter the natural contour of these sand dunes, impede their natural formation and migration and interrupt wind and water currents which replenish the sand supply of beaches. Such alterations to coastal primary sand dunes may lead to increased shoreline erosion, coastal flooding, damage to fixed structures near the shore, loss of public and private open space, loss of wildlife habitat and increased expenditure of public funds.

In view of the above findings, the 1980 General Assembly passed the Coastal Primary Sand Dune Protection Act (Sections 62.1-13.20:1 through 62.1-13.20:8, Code of Virginia). The principal features of the Act are as follows:

- Empowers certain localities (Accomack, Lancaster, Mathews, Northampton and Northumberland counties and cities of Hampton, Norfolk and Virginia Beach) to adopt the Coastal Primary Sand Dune Model Ordinance that is set out in the statute.

- Requires disturbance of primary sand dunes (those contiguous to mean high water) to be approved at the local and/or State level, after public hearings and in accordance with guidelines promulgated by the Virginia Marine Resources Commission (VMRC), under an application and permit system.

- Specifies activities that would still be allowed without a permit (e.g., planting beach grasses and building sand fences).

- Gives localities the option to exercise permitting authority over uses through existing wetlands boards, or to leave the permitting decision with the VMRC.

- Authorizes the VMRC to review and approve, disapprove or remand the decisions of local wetlands boards.

- Provides exemption for any project or development for which a valid building permit or final site plan approval had been issued prior to July 1, 1980.

- Became effective July 1, 1980.

Protection of Wetlands

The State's Wetlands Act (Section 62.1-13.1 through 62.1-13.20, Code of Virginia), which was passed in 1972, provides coastal jurisdictions and the Virginia Marine Resources Commission with authority to issue permits to control development in tidal wetlands where certain vegetation is present.

The Act:

- Defines wetlands as that vegetated land lying between and contiguous to mean low water and an elevation above mean low water equal to the factor 1.5 times the mean tide range at the site of the proposed project in the county, city or town in question, and specifies the vegetation by type.

- Requires disruption of wetlands to be approved at the local and/or State level, after public hearings and in accordance with guidelines promulgated by VMRC, under an application and permit system.

- Provides a model wetlands zoning ordinance for adoption by authorized counties, cities or towns.

- Directs the creation of local wetlands boards in those jurisdictions which have enacted a wetlands zoning ordinance pursuant to the Act.

- Gives localities the option to exercise permitting authority over wetlands uses through existing wetlands boards, or to leave the permitting decision with the VMRC.

- Authorizes the VMRC to review and approve, disapprove or remand the decisions of the local wetlands boards.

Protection of Public Beaches

Public beaches are a rare and valuable resource; however, beaches are eroding, thereby diminishing recreational, aesthetic and economic benefits associated with these areas. In an effort to conserve and protect public beaches, the General Assembly enacted the Public Beach Conservation and Development Act in the 1980 legislative session (adds Sections 10-215 through 10-222, Code of Virginia). This Act:

- Creates a Commission on Conservation and Development of Public Beaches with nine members (five at large, four from State agencies).

- Permits establishment of a fund to make grants to localities for up to half the cost of erosion control on public beaches. The other half of the cost must come from local funds, not federal. Only 30 percent of the funds could go to any one locality in a single year.

- Requires localities to establish local Erosion Advisory Commissions before they are eligible for any State funds.

Erosion Abatement

Other legislative actions taken in 1980 to control erosion of coastal property are outlined below:

A. Amend and reenact Section 15.1-31, Code of Virginia, pertaining to the construction of dams, levees and seawalls:

   - Allows the State to build dams and seawalls or to dredge to prevent erosion.

   - Declares the design, construction, performance, maintenance and operation of any such works to be a proper governmental function for a public purpose.

   - Provides that erosion due to a State activity may be a "taking" of private land requiring compensation.

B. Amends Sections 21-11.18 and 21-11.19 and adds Section 21-11.20, Code of Virginia, concerning the responsibilities of the Soil and Water Conservation Commission:

   - Establishes a Shoreline Erosion Advisory Service within the Soil and Water Conservation Commission to assist private property owners in addressing tidal shoreline erosion problems.

   - Directs the Commission to cooperate with Virginia Institute of Marine Science (VIMS) in providing shoreline erosion advisory services.

   - Deletes the Commission's authority over public beaches.

C. Amend and reenact Section 28.1-195, Code of Virginia, setting out the responsibilities of the Virginia Institute of Marine Sciences (VIMS):

   - Directs VIMS to engage in research and provide training, technical assistance and advice to the Commission on Conservation and Development of Public Beaches on erosion along tidal shorelines, the Soil and Water Conservation Commission on matters relating to tidal shoreline erosion, and to other agencies upon request.

The organizational relationships for the Commonwealth of Virginia Shoreline Erosion Program are shown in Figure 1.*

Coastal Set-Back Lines

A zone at the shoreline can be delineated based on several variables such as a one percent (1%) probability of storm surge, specific contour levels, etc. Construction within a zone can be controlled or prohibited by establishing set-back lines. A unique aspect of this measure is that it often combines ecological as well as natural hazard considerations.

In the event local zoning regulations do not establish coastal set-back lines, governing bodies of coastal jurisdictions should explore the practical and legal feasibility of establishing such lines.

Recommendations

Inasmuch as all of the legislative actions discussed in this section contribute to the maintenance of the shoreline, they are extremely important as hazard mitigation measures. The following recommendations, therefore, are offered to the governing bodies of coastal zone jurisdictions:

A. In order to reasonably protect the public interest and private and public property from erosion and flooding, and to protect the natural environment, if not already enacted, the adoption of local ordinances authorized by the Coastal Primary Sand Dune Protection Act and the Wetlands Act should be expedited.

B. Conscientiously enforce the protective provisions of the ordinances.

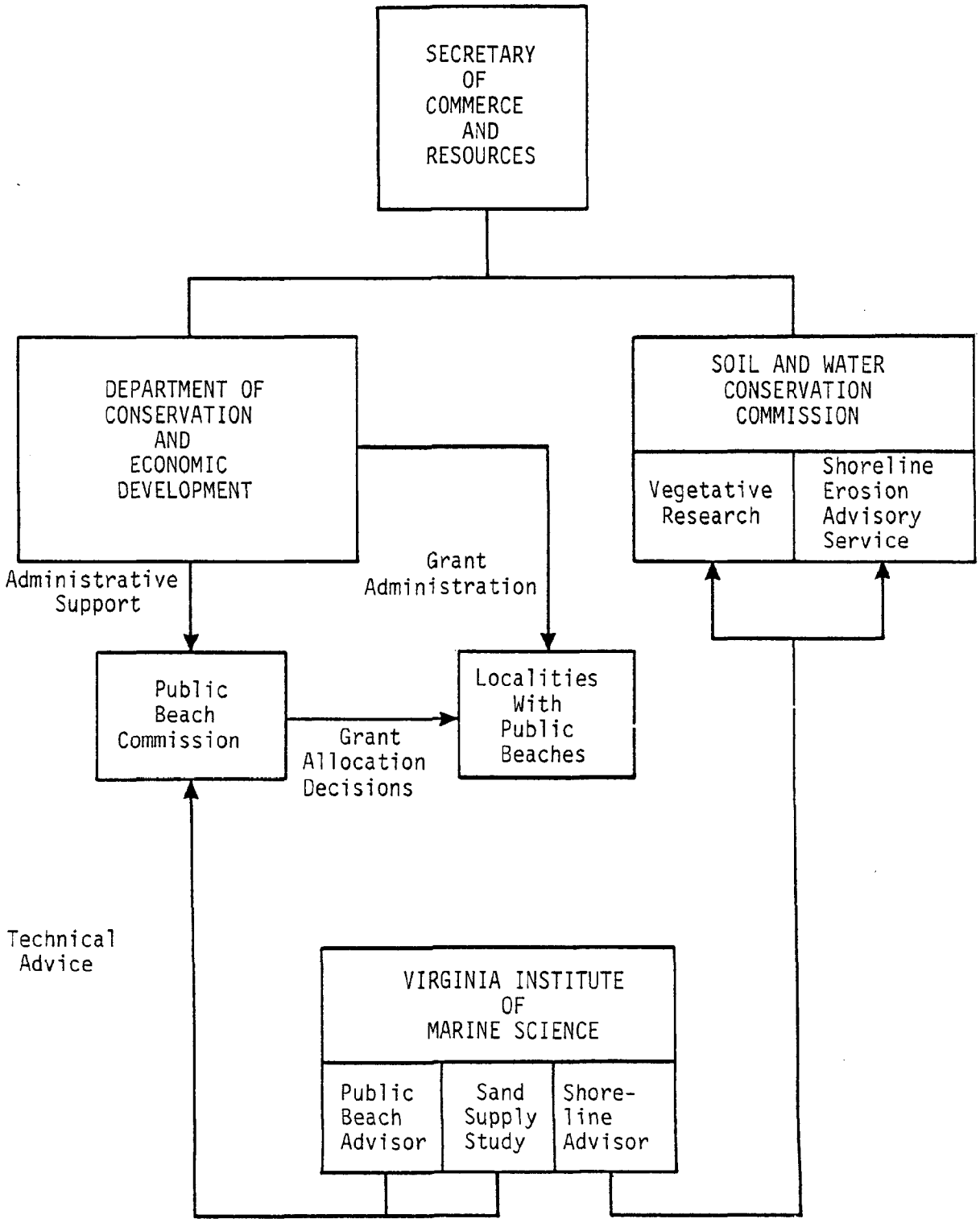
C. For coastal localities with public beaches on tidal shorelines, establish, on a priority basis, local Erosion Advisory Commissions in order to be eligible for State funds to assist in erosion control, under the provisions of the Public Beach Conservation and Development Act.

D. Where non-existent, determine the feasibility of establishing coastal set-back lines to limit construction or other development which would increase the vulnerability of the shoreline to hurricanes.

*Chart provided by the Office of the Secretary of Commerce and Resources, Richmond, Virginia.

Figure 1

EROSION ABATEMENT



VII. COMMUNITY ACTION AND INDIVIDUAL PROTECTIVE MEASURES

COMMUNITY ACTION AND INDIVIDUAL PROTECTIVE MEASURES

Authority and Responsibility of Local Governing Bodies

The General Assembly has recognized the possibility of the occurrence of disasters resulting from either man-made or natural causes and has made provision for the State and its political subdivisions to deal with such emergencies by assigning in the State Disaster Law certain emergency powers and duties to the Governor and the elected officials of each political subdivision, by establishing a State Office of Emergency Services and by authorizing the creation of local Emergency Services organizations in the political subdivisions of the State.

In recognizing that elected and appointed officials have an inherent responsibility for the safety and welfare of citizens in their communities, the General Assembly directed in the Law that each political subdivision have a Director of Emergency Services who, in the case of a city, would be the mayor or the city manager; and, in the case of a county, would be a member of the board of supervisors selected by the board or the chief administrative officer. In each instance, the Director is authorized to appoint a Coordinator of Emergency Services with consent of the governing body. A Coordinator of Emergency Services may also be appointed by the council of any town to insure integration of its organizations into the county Emergency Services organization.

The Law authorizes the Director of each local Emergency Services organization to work jointly with the public and private agencies within the State to develop mutual aid arrangements for reciprocal assistance in case of a disaster too great to be dealt with unassisted.

- Basic Philosophy -
Responsibility Goes With Authority

- *Elected officials have legal responsibility for the safety and welfare of their constituents.*
- *Emergency preparedness programs and response plans should be maintained by every political subdivision. These plans should be periodically tested, evaluated and updated.*
- *Local jurisdictions have the primary responsibility for initial disaster response and must fully commit available forces and resources before requesting assistance.*
- *When disaster assistance is required by local jurisdictions, such assistance should be requested through the State Coordinator of Emergency Services. He is responsible for coordinating State and Federal assistance. He will also assist with the development of local disaster preparedness plans and training programs upon request.*

The following sections of this chapter contain recommended guidelines and checklists for use by both local government officials and individual citizens in lessening the impact of a major disaster, with emphasis on hurricane mitigation actions:

- Public Awareness - Increased awareness of natural hazards on the part of local citizens is essential if property losses and human suffering from natural disasters are to be reduced. The guidelines presented will assist those officials who are involved in planning programs to improve the public awareness of the hurricane threat in their localities.

- Local Officials and Citizens Guide to Evaluating Hurricane Preparedness Plans - This self-survey will assist in evaluating and strengthening the ability of political subdivisions to defend themselves against a hurricane or other major coastal storm.

- Action Checklist - This survival checklist sets forth the many things to consider before, during and after a hurricane to save lives and protect property.

PUBLIC AWARENESS*

The Virginia coast is one of the fastest-growing parts of the State. As mentioned in an earlier section, the population growth in this area is one and one-half times faster than the State average.

The Virginia coast is an enjoyable and desirable place to live, work and relax. While natural hazards do exist that can cause major loss of life and property, it is possible to take responsible action to counter most of them. Preventive steps can lower risks to a level at which most people believe the benefits outweigh the risks.

Many Virginia coastal residents have never experienced a hurricane and are often either totally unaware of the dangers or have no knowledge of the necessary preparedness measures. The last major hurricane to hit Virginia's coast was DONNA in 1960. Since then, many thousands of new residents have moved into the area. Population in the particularly-exposed areas such as Sandbridge in Virginia Beach has increased several-fold in recent years. These residents, whose lives and property are most susceptible to destruction, are often the least knowledgeable of potential hazards and of what preventive steps should be taken. Experts contend that a basic awareness of the possible dangers of hurricanes and even minimal individual precautions can significantly reduce losses of property and human life.

Experience with the Virginia Hurricane Preparedness Program in 1978-79 has demonstrated that responsible local government officials and the general public are very interested in obtaining useful, simple information on hurricanes. This program, initiated by the State Office of Emergency and Energy Services (OEES), under a matching fund disaster preparedness grant from the Federal Emergency Management Agency (FEMA), has received wide recognition not only within the State but also with a number of Federal agencies, as well as other coastal states.** The risk-area identification maps and survival checklists originally developed in 1978 and reprinted in 1979 are again being requested by local government officials for the 1980 hurricane season.

While the State program was aimed primarily at State and local government response to hurricane disasters, it must be recognized that a community can never be better prepared than its individual citizens. The high hurricane consciousness of the people along the Mississippi-Louisiana coast is believed to have been the major factor in saving an estimated 50,000 lives from hurricane Camille. Since public awareness and education is a keystone to preparedness, a follow-on local awareness program to inform both present and future coastal residents of the potential of hurricanes--and how to responsibly cope with them--would substantially lessen future losses of both life and property.

Following are recommended guidelines for use by local emergency services directors/coordinators and other responsible local government officials in the development and implementation of a hurricane awareness program. The guidelines are applicable not only to a hurricane awareness program, but also can be used for all natural hazards to which a community may be exposed.

LOCAL HURRICANE AWARENESS PROGRAM

Getting Started

Who starts a hurricane awareness program? Who should get involved in the initial planning efforts? Any individual or organization which identifies the need for such a program and can garner the necessary support provides the spark.

Often the initial spark comes from a dynamic, concerned individual who is willing to devote time and energy to getting a hazard awareness program off the ground.

The legal question of liability for failure to notify those susceptible to hurricane hazards can be the very spark with which to initiate an awareness program. Try to find a sympathetic, concerned legislator or high local governing official to lend aid in initiating the awareness program.

Look around for other groups which might have an interest in a public safety program and may have resources to assist you. Inform such groups of your proposed education efforts; and these groups, in turn, could provide support and ignite further interest.

DOS AND DON'TS

DO - Look for a dynamic and concerned individual, in the private or public sector, who has the knowledge, drive, and connections to get an awareness program off the ground.

DO - Try to gain the support and involvement of all concerned parties early in the program formulation.

DON'T - Forget to check local, state or federal legislation which could give impetus to initiating an awareness program.

Setting Goals

As you begin to define the aims of your program, you must decide what response you want to achieve through your program. Your goals might be:

- Familiarization with the local government organization for hurricane disaster operations and recovery.
- Familiarization with, and increased response to, local warning systems.
- Familiarization with survival checklists.
- Familiarization with local government hurricane response plan, to include emergency evacuation procedures, evacuation routes, location of shelters, emergency supplies and provisions, etc.

- Importance of, and source for obtaining, special hazard insurance.
- Construction techniques to hurricane-proof homes and businesses.
- Familiarization with disaster recovery assistance programs--local, state, federal.

DOS AND DON'TS

DO - Define the communities or areas of your jurisdiction which are at risk to hurricane hazards.

DO - Determine what measures are available to lessen the risk and what responses you wish to encourage through your program.

DO - Define your target audiences (social, economic, locational, etc.) and tailor your messages to them.

DO - Be realistic in setting your initial goals.

DON'T - Assume that distributing information will by itself change people's actions.

Gathering Resources

Once you have decided to begin a hurricane awareness program, where do you obtain money and resources to get started?

Funding

Federal, state and local government entities may have funds for awareness programs. On the federal level, the Federal Emergency Management Agency (FEMA), National Oceanic and Atmospheric Administration (NOAA), United States Geological Survey (USGS), and the United States Army Corps of Engineers (USCE) are among those which have assisted in the past.

On the state level check with your Regional Planning District, Office of the Secretary of Commerce and Resources, and the State Office of Emergency and Energy Services.

On the local level check city or county planning agencies, universities, public utilities, and any special water, urban drainage or special districts as sources of possible funding assistance.

Support Services

There are resources which can be tapped to contribute time, skill or service, as well as money to your awareness program.

Federal and state governmental agencies listed under Funding, above, can furnish data, maps, slides, photographs and specialists to provide technical assistance.

In addition to government resources, there are private and community resources.

- Insurance agents can be approached to use their contacts to distribute information about hazards and possible protection.
- Banks and savings and loans can encourage hazard mitigation activities to protect their mortgages and loans.
- Owners of local businesses and industrial plants may be interested in helping financially with warning systems or in distributing information which would protect their customers and alleviate potential liabilities.

Take advantage of the special skills of concerned citizens. Do not forget to involve and mobilize existing volunteer groups. If they are given accurate information and appropriate roles, volunteer groups or individuals can play a large part in generating hazard awareness. The organizations which might become involved are varied:

4-H Clubs
Amateur Radio Clubs (RACES - Radio Amateur Civil Emergency Service)
American Association of Retired Persons
Girl Scouts
Boy Scouts
Sierra Club
Volunteer Action Centers
League of Women Voters
Civic and Business Clubs
Agricultural and Marine Extension Agents
Community Colleges and Universities
Structural Engineering Societies
Religious Organizations

The Red Cross, although a volunteer agency, plays an official role in disaster preparedness and relief and should also be contacted as a resource and for coordination of efforts.

DOS AND DON'TS

DO - Check with all relevant government entities when attempting to find funding and other support for hazard awareness programs.

DO - Approach local businesses and industry to gain their support. They have an interest in safeguarding the lives and property of their employees and citizens.

DON'T - Forget to include volunteer organizations when seeking resources for your program. Carefully match the skills of each potential contributor to appropriate roles in the program.

Getting the Program Across

What techniques or approaches can be used to disseminate the information developed for the awareness program to the citizens?

A hurricane awareness program is necessary, because most people do not perceive the threat of danger from hurricanes as a real problem, especially new residents on the coast or those who have never felt the effects of a major hurricane.

Research has shown that for issues in which an individual feels little real involvement, the message is best communicated by using primarily visual media which require minimal attention and effort to be understood. For this reason, your efforts will probably have a better effect through television and newspaper exposure than if presented on the radio. Ultimately, if one form of media is resistant or seems not to produce the desired results, go to other forms. When your program begins to get attention of the public, other media forms will usually pick it up.

Options for getting the word to the people include:

Television
Radio
Newspapers
Slide Shows
Films
Speakers Bureaus
Local Magazines (Chamber of Commerce, real estate, etc.)
Brochures
Billboards
Interpersonal Contacts
Public School Education

In the event of a hurricane threat, it will be important for all media to be familiar with the community's hurricane response plans. A briefing for the media should be arranged by the local emergency services coordinator. This would provide a unique opportunity to educate the media not only about their crucial role during times of hurricane emergency, but also about the potential role they could play in informing the people of actions that could be taken to lessen the effects of future disasters.

Newspapers. If you can convince newspapers to use your materials, they can be a very effective means of reaching the citizen at risk. Provision of camera-ready preparedness checklists or ads giving an address on how to obtain further information are usually well received by newspaper editors. Pictures (8X10 black and white glossies) showing past hurricanes with a brief descriptive text might be used, especially if they are keyed to the local area.

At the beginning of hurricane season newspapers should be requested to run a full-page reproduction of the Hurricane Risk Area Maps and Checklist developed for your jurisdiction under the State Hurricane Preparedness Program. Some newspapers will do this as a community service at no charge.

A series of articles could also be developed concentrating on various aspects of the hurricane--its general characteristics and means of destruction, areas most vulnerable, increased population and development in these areas, current construction practices, effects of the hazard on state or local industry or tourist business, warning techniques and preparedness steps.

Television. Studies have shown that television (especially 10, 30, or 60 second spots) may be the way to change people's opinions on the dangers of various hazards. In addition, spots can give an address where further information (maps, brochures) can be obtained. If recorded spots are to be distributed to TV or radio stations, a written script should accompany each one. Another option existing for TV includes the use of longer documentary films. Permission can usually be obtained from appropriate government or volunteer agencies (Red Cross) to use film clips from their products. For TV use, any message should be especially simple and easily understood. Remember that if used at all, spots and films released for public-service TV time will more than likely be aired during non-prime time hours (early in the morning or late at night). In the case of weather-related hazards, your local TV weatherperson can be a valuable contact for dissemination of information.

Live or taped interviews also provide a good means of presenting hazard information to the public. Again, personal contact is more likely to get your representative on local talk shows. In doing interviews with the news media, whether printed or broadcast, be sure that your spokesperson has all the necessary facts regarding preparedness and hazard characteristics. An information sheet should be provided to the reporter or interviewer in advance to aid them in asking relevant questions.

Provision of camera-ready material, including slides to local TV weather-persons for use during their regular weathercasts, has proven to be a successful approach. A script or descriptive text should always accompany each slide.

Radio. Even though radio may not be the most effective way to reach all sectors of the population, there may be some people for whom it is a useful method, e.g., teenagers or for populations in remote areas. Your options for radio include spots of varying lengths, one-shot interviews with knowledgeable people, or a continuing taped series providing information on hurricane hazards. These approaches can be ends in themselves or they can act as stimulants to get people to write or call a specific place for further information.

Alternative Approaches

Brochure. A single, simple, but attractive "preparedness and awareness" brochure may be the best first step in increasing the awareness of your citizens. A brochure is usually the least expensive type of material to develop and produce, especially if you are attempting to reach a very large audience and have limited funds.

Display Booths. Display booths that could be easily set up in shopping areas or civic centers could be used as a relatively cheap tool for communicating hurricane awareness information. The displays could use video cassette players, slides or photographs. Simple, graphic messages are most effective. You should include handouts that contain specific suggestions for constructive personal actions.

Public Meetings. Attendance at public meetings to discuss hurricane hazards will, of course, be difficult to encourage in the early part of your program. A useful approach is to work through civic or volunteer groups that might allow you to take advantage of their regular meetings and present your message. Perhaps a parent/teacher organization of a school in a vulnerable location would welcome a speaker at their monthly meeting. The Chamber of Commerce might be interested in a discussion of possible liabilities that business might face if customers were exposed to a hazard while on their property. Civic and study clubs are always on the lookout for interesting programs. It would be useful to develop a list of knowledgeable people in each location who would be willing and competent to speak about the hurricane hazard at public gatherings. It is very important that the speakers chosen be regarded by the community as having good credibility on the subject of the hazard.

Local publications, Chamber of Commerce magazines, or real estate publications may also be glad to use your printed materials, especially if straight information rather than scare tactics is used. However, personal contacts are usually needed to explain the purpose of your awareness program and the materials which are available for use.

Other Approaches. Some awareness programs have found rather unique sources of free distribution of their information. Paper bag companies have been willing to print information about hurricane and tornado safety at no additional cost on bags distributed to grocery stores along the Gulf Coast and in inland tornado-prone areas. The phone company in some parts of the United States has printed safety tips in the front pages of phone books, including earthquake preparedness in California and tsunami precautions in Hawaii. The City of Boulder, Colorado, has included messages about the flood plain in its monthly water bills. Remember, whatever approaches you try, always be open for new ideas and new interests.

Materials to Assist in Hurricane Awareness Program

The State Office of Emergency and Energy Services (OEES) Training Officer, phone (804) 272-1441, can provide assistance in obtaining hurricane preparedness brochures, publications, films and other audio-visual materials which have been prepared by NOAA, FEMA, and other federal agencies.

The OEES Information Officer, phone (804) 745-3305, can provide copies of brochures, maps and related materials developed under the State Hurricane Preparedness Program.

DOS AND DON'TS

DO - Try to determine the most effective means of reaching your citizens, but do not rely on only one form of media or approach to reach them.

DO - Keep and update a file of all organizations, publications and individuals who should regularly receive awareness materials.

DO - Use newspapers for long-term education of an audience concerning the nature of an area's susceptibility to hurricane hazards and to encourage readers to write for further information.

DO - Use short (10, 30, or 60 second) TV spots to alert or change your audience's perception of the dangers of, or their susceptibility to, the hurricane hazard.

DO - Consider the use of a simple, inexpensive but attractive brochure or poster if you wish to maintain a sustained effort and reach broad segments of the population.

DON'T - Expect material developed for radio to have the same impact as visual presentations, but do use it to reach appropriate audiences.

Evaluating Your Program

Once your program is underway, it is imperative that you evaluate it. Are you reaching your goals? Are all aspects of the program accomplishing what you intended?

Assessment of a program can be obtained by using several different methods such as:

- Telephone or mail surveys.
- Person-to-person interviews determining sight recognition of materials.

- Utilization of volunteers for testing various approaches and types of materials used in your program (TV spots vs. longer films, fear approach vs. simple listing of preparedness steps).

Samples of evaluation questionnaires for a multi-approach hurricane awareness program and a slide show presentation are given in Appendix B.

DOS AND DON'TS

DO - Determine which program elements are most effective.

DO - Determine if your information is actually changing attitudes and actions.

DO - Use several different approaches in determining your program's effectiveness.

DO - Make your evaluation a continuing, regular part of your program.

DON'T - Assume that your target audience has necessarily altered their behavior or attitudes as a result of your program.

*Source: A significant part of the information contained in the Section was extracted from "Hazard Awareness Guidebook: Planning for What Comes Naturally" by Sally S. Davenport, Texas Coastal and Marine Council, Austin, Texas; and Penny Waterstone, Natural Hazard Research Application and Information Center, Institute of Behavioral Science, University of Colorado, Boulder, Colorado; October, 1979.

**See Section I for a description of the State Hurricane Preparedness Program.

SAMPLE PUBLIC QUESTIONNAIRE PRECEDING
INSTIGATION OF
HURRICANE AWARENESS PROGRAM

Name: Address:
Age: Occupation/Education Level:

1. How long have you lived on the coast?
2. Have you ever experienced a hurricane?
   a) Where?
   b) When?
   c) Outcome?
3. Did you consider the possibilities of hurricanes before you moved here?
4. What are the first two or three things you would do to prepare for a hurricane?
5. Do you feel your home is the best place to 'weather' the storm?
   a) Why?
   b) How would you (do you) evaluate its structural soundness?
   c) How do you estimate its elevation above sea level?
6. When you were looking at your home, did anyone discuss these things with you?
7. If you wanted to know what winds your home was built to withstand, how would you find out?
8. If the Weather Service predicted twelve foot tides for your area, what would that mean to you personally?
9. Do you know where the nearest public shelter is? Can you get there if the streets are under two or three feet of water?
10. How many feet of water (flood level) does it take to close the causeway to your town?
11. Where would you go if you evacuated your town?
12. Where would you go for more information on hurricane protection?

HURRICANE INFORMATION QUESTIONNAIRE

Name_____ Age_____ Sex_____
Current Address_____ Phone_____
Have you ever experienced a hurricane? Yes_____ No_____
If yes, was your residence damaged? Yes_____ No_____
did you or a member of your family sustain injuries? Yes_____ No_____
did you evacuate? Yes_____ No_____
Have you had any special training in hurricanes? Yes_____ No_____
If yes, where? _____
If yes, where? _____
Did you obtain a copy of a Hurricane Survival Checklist and Map? Yes_____ No_____. If yes, do you still have it? Yes_____ No_____. Did you read it? Yes_____ No_____. How did you obtain it? _____
Do you remember seeing any "Hurricane Awareness" television spots? Yes_____ No_____.
Do you remember hearing any "Hurricane Awareness" radio spots? Yes_____ No_____.

SECTION ONE

Please indicate your sources of Hurricane Information. Check each of the following which apply:

1. _____School Classes
2. _____Hurricane Survival Checklists and Maps
3. _____Local Civil Defense
4. _____Local Red Cross
5. _____Educational Television Programs
6. _____Public Meetings
7. _____Radio Announcements and/or Interviews
8. _____Television Presentations
9. _____Newspapers
10. _____Other People
11. _____Mayor
12. _____County Judge
13. _____Other. Please Identify:_____

SECTION TWO

Please *briefly* indicate what the words "Storm Surge" mean to you (if you have no idea, put "Don't Know"): _____
How many feet of rising water do you believe a hurricane can produce? _____
What do you estimate the land elevation is at your residence? _____
Out of every ten persons killed by a hurricane, how many do you estimate are killed by the rising water? _____
Approximately how many miles of a coastline can suffer severe damage from a hurricane? _____
When a hurricane hits the coast, where do you think the most destruction will take place?
Near the center of the area hit_____ Near the edge_____ The same throughout_____
How many miles do you live from the nearest salt water bay or coastline? _____
If you needed additional information on a hurricane, how would you obtain that information? _____

SECTION THREE

For each of the following questions, place a *check mark* on the line under each question at the point which you feel most closely corresponds to your own opinion.

1. How necessary is it to purchase flood insurance?
   Is Not Necessary _____ Is Definitely Necessary
2. How necessary is it to have building codes which incorporate hurricane standards?
   Is Not Necessary _____ Is Definitely Necessary
3. If a hurricane struck one of the barrier islands on the coast, how certain is it that:
   a. the homes on that island in the path of the hurricane would be destroyed?
      Certain to Withstand the Hurricane _____ Certain to Be Destroyed by the Hurricane
   b. commercial buildings such as motels would be destroyed?
      Certain to Withstand the Hurricane _____ Certain to Be Destroyed by the Hurricane
4. If a hurricane struck one of the Texas coastal cities, how certain is it that the homes in the path of the hurricane would be destroyed?
   Certain to Withstand the Hurricane _____ Certain to Be Destroyed by the Hurricane
5. If you were informed that you were in the path of a hurricane and a notice had been issued to evacuate, would you do so?
   Would Not Evacuate _____ Definitely Would Evacuate
6. How destructive is the wind generated by a hurricane?
   Is Not Destructive _____ Is Extremely Destructive
7. How destructive is the rising water (storm surge; rising tide) generated by a hurricane?
   Is Not Destructive _____ Is Extremely Destructive

SECTION FOUR

In the event you were to evacuate, do you have a pre-planned evacuation route? Yes_____ No_____
If yes, please describe the route you would take: _____

_____

In the event you must leave your home due to a hurricane threat, do you know how to learn the location of your nearest Civil Defense or Red Cross shelter? Yes_____ No_____
If yes, how would you obtain that information? _____

_____

When a hurricane *watch** is issued, check *one* of the following which would most closely describe the action you would most likely take:

_____ A. I would wait for further bulletins.
_____ B. I would do nothing but remain inside the house.
_____ C. I would board up the windows and remain inside the house.
_____ D. I would board up the windows, tie down loose objects, collect a supply of food and water, and wait for further bulletins.
_____ E. I would board up the windows, tie down loose objects, collect a supply of food and water, and prepare to ride it out.
_____ F. I would board up the windows, tie down loose objects, and move a short distance away from the beach area.
_____ G. I would board up the windows, tie down loose objects, and move to a Civil Defense or Red Cross shelter.
_____ H. I would board up the windows, tie down loose objects, and evacuate.
_____ I. I would evacuate immediately.
_____ J. Other type of response: _____

_____

When a hurricane *warning*** is issued, check *one* of the following which would most closely describe the action you would most likely take:

_____ A. I would wait for further bulletins.
_____ B. I would do nothing but remain inside the house.
_____ C. I would board up the windows and remain inside the house.
_____ D. I would board up the windows, tie down loose objects, collect a supply of food and water, and wait for further bulletins.
_____ E. I would board up the windows, tie down loose objects, collect a supply of food and water, and prepare to ride it out.
_____ F. I would board up the windows, tie down loose objects, and move a short distance away from the beach area.
_____ G. I would board up the windows, tie down loose objects, and move to a Civil Defense or Red Cross shelter.
_____ H. I would board up the windows, tie down loose objects, and evacuate.
_____ I. I would evacuate immediately.
_____ J. Other type of response: _____

_____

* Watch means that there is a real possibility of a hurricane striking an area.
** Warning means that a hurricane is expected to hit an area within 24 hours.

Comments: _____

HURRICANE AWARENESS SLIDE SHOW QUESTIONNAIRE

1. **Was the material presented in an understandable manner?** yes_____ no_____

2. **Will the material just presented help you prepare yourselves and your property for a hurricane?** yes_____ no_____

3. **Did you learn anything *new* about hurricanes and how to prepare for them?** yes_____ no_____

4. (a) **Did the speaker talk loud enough?** yes_____ no_____
   (b) **Would you suggest another program on this subject next year?** yes_____ no_____

5. (a) **Have you ever experienced a hurricane?** yes_____ no_____
   (b) **If so, when and where?**_____
   (c) **Did you suffer any loss of property?** yes_____ no_____

6. **Additional comments (please be candid).**

_____

_____

_____

_____

_____

_____

Signature not necessary, but would be appreciated. _____

LOCAL OFFICIALS AND CITIZENS
GUIDE TO EVALUATING HURRICANE PREPAREDNESS PLANS

INTRODUCTION

It is human nature to assume hurricanes are disasters which strike somewhere else. Yet, the reality is that any community along Virginia's coast is a potential hurricane target.

After every hurricane or severe coastal storm there is a recurring theme: If only we had done more to prepare in advance. . . .Therefore, you might find useful this self-survey which is intended to encourage coastal jurisdictions to evaluate their own hurricane preparedness and response plans.

Hopefully, this self-survey will assist you in evaluating and strengthening the ability of your community to defend itself against a hurricane or other major coastal storm.

SURVEY*

Yes	No		
		I.	BASIC AUTHORITY
☐	☐	1.	Does the city or county have a disaster preparedness ordinance or other legal authority for local officials to conduct emergency operations, to include authority to order evacuation?
☐	☐	2.	Has the county or city executed an agreement or other written understanding with the American Red Cross, Salvation Army or other disaster relief organization, setting forth the responsibilities for shelters and other disaster-related activities?
☐	☐	3.	Has the overall director/leader for each shelter, whether Red Cross volunteers, local Emergency Services volunteers, city personnel, etc., been designated?
☐	☐	4.	Are the ordinances, regulations and/or plans of the county or city consistent with the state disaster preparedness plan?
☐	☐	5.	Is there a coordinated and integrated regional or area-wide evacuation and shelter plan? Have necessary intergovernmental agreements for assistance in hurricane evacuation and shelter been executed?
		II.	PRE-DISASTER MITIGATION
☐	☐	1.	Are zoning requirements and limitations consistent with anticipated storm surge?

Yes	No		
☐	☐	2.	Are building standards and codes in areas vulnerable to hurricanes adequate to withstand the effects of high wind and storm surge? Are these standards and codes enforced?
☐	☐	3.	Is state and/or local mobile home tie-down legislation adequate? Is the legislation enforced?
☐	☐	4.	Have communities vulnerable to flooding and storm surge qualified for flood insurance by adopting required flood plain management ordinances?
☐	☐	5.	Are designated evacuation shelters above storm-surge levels or outside storm surge areas?
☐	☐	6.	Has special consideration in the development of evacuation plans been given to the needs of the aged, the handicapped and for families living in mobile homes?
☐	☐	7.	Have key local agencies developed supplementary plans for their own operations in the case of an evacuation and are these plans integrated and consistent with the overall evacuation plan?
☐	☐	8.	Are notification rosters of each agency for use to warn of an approaching hurricane current and complete?
☐	☐	9.	Are citizens being educated adequately on how to prepare for and what steps to take in the event of a hurricane?
☐	☐	10.	If vertical evacuation into high-rise buildings is anticipated, have the selected structures been checked as to soundness of construction to withstand hurricane-force wind and storm surge? In the case of private structures, have agreements been executed with building owners?
☐	☐	11.	Have provisions been made for cots, blankets, food and sanitary facilities in the event that disaster victims may need to be kept in high-rise structures for an extended period until flood waters subside?
☐	☐	12.	Have evacuation route maps been published in the local newspapers or widely distributed to citizens?
☐	☐	13.	Are there any local plans for disclosing the extent and existence of natural hazards to the public, especially prospective new property owners?

III. POLICY DEVELOPMENT

☐	☐	1.	Have "lines of succession" been developed for key officials in the event some officials become casualties or are otherwise unavailable?

Yes	No	
☐	☐	2. Has a "support group" or committee headed by the county or city Emergency Services Director been organized with sufficient responsibility, authority and resources to provide personnel and materials for the implementation of pre-planned actions, to provide coordination and direction to personnel engaged in operations and to provide information, data and recommendations to the local governing body?

IV. OPERATIONS

☐	☐	1. Are procedures spelled out for officials of concerned agencies and citizens of affected areas to be alerted on a timely basis in the event of an approaching hurricane?
☐	☐	2. Are warning systems for citizens adequate and are citizens advised of the meaning of a warning by a siren?
☐	☐	3. Have evacuation plans been keyed to hurricane forecasting? Upon what condition will evacuation be implemented, by whom, and with what authority? What priorities have been established?
☐	☐	4. Do plans indicate which sectors of the population will be directed to which shelters?
☐	☐	5. Are there special provisions for handling the elderly and handicapped?
☐	☐	6. Are key communication facilities above flood level, have their emergency roles been defined, have they been "exercised" and do backup facilities exist for use in the event primary facilities are not operating?
☐	☐	7. Has coordination been effected with commercial radio and television stations?
☐	☐	8. Will amateur radio resources be employed to assist in evacuation before the hurricane strikes?
☐	☐	9. Has a traffic analysis been made to be sure that evacuation routes can handle anticipated traffic volume?
☐	☐	10. Do all shelters have adequate sanitary facilities and drinking water as well as available cots and blankets?
☐	☐	11. Are alternate evacuation plans available in the event that key evacuation routes are blocked by debris or stalled vehicles?
☐	☐	12. Is the hurricane evacuation plan "exercised" periodically?

Yes	No	
☐	☐	13. Have amphibious vehicles and 4-wheel drive vehicles been acquired, or arrangements made for use of those located in the community owned by private citizens or businesses?

*SOURCE: Many of the questions in this check list are based on material found in "A Public Officials and Citizens Guide to Evaluating Local Hurricane Evacuation Plans" prepared by the Federal Disaster Assistance Administration, in consultation with Dr. Neil Frank, Director, National Hurricane Center, in Miami, and Bryce J. Torrence, National Director, Disaster Services, the American Red Cross.

ACTION CHECKLIST

The following Hurricane Survival Checklist has been designed for individuals and families. It is recommended that this list, or one devised by local government, be run in the local newspaper each year just prior to the start of hurricane season. To ensure widest dissemination, a Survival Checklist Brochure should be prepared for distribution at schools, shopping centers, and other public meeting places.

HURRICANE SURVIVAL CHECKLIST*

Here is a list of the many things to consider before, during and after a hurricane. Some of the safety rules will make things easier for you during a hurricane. All are important and could help save your life and the lives of others.

TERMS YOU SHOULD KNOW

SMALL CRAFT CAUTIONARY STATEMENTS. When a tropical cyclone threatens a coastal area, small craft operators are advised to remain in port or not to venture into the open sea.

GALE WARNINGS may be issued when winds of 39-54 miles an hour (34-47 knots) are expected.

STORM WARNINGS may be issued when winds of 55-73 miles an hour (48-63 knots) are expected. If a hurricane is expected to strike a coastal area, gale or storm warnings will not usually precede hurricane warnings.

A HURRICANE WATCH is issued for a coastal area when there is a threat of hurricane conditions within 24-36 hours.

A HURRICANE WARNING is issued when hurricane conditions are expected in a specified coastal area in 24 hours or less. Hurricane conditions include winds of 74 miles an hour (64 knots) and/or dangerously high tides and waves. Actions for protection of life and property should begin immediately when the warning is issued.

BEFORE A HURRICANE HITS . . .

- You have the responsibility to prepare in advance.
- Know your elevation.
- Know how to escape.
- Follow the survival check list.
- Get information from sources that can help you.

Local Emergency Services Director/Coordinator Phone:_____

Fire, Rescue, or Police Emergency Phone:_____

American Red Cross Phone:_____

Utilities (gas, water, electric) Phone:_____

Other:_____

BEFORE A HURRICANE YOU SHOULD KNOW:

ELEVATION OF YOUR HOME ABOVE SEA LEVEL. Get this information from local Emergency Services officials. Your nearest Weather Service office can supply floodstage data for area streams and bayous.

MAXIMUM STORM SURGE WHICH MIGHT OCCUR. Information about the potential for inland flooding and storm surge is available through the nearest Weather Service office.

ROUTE TO SAFETY IF YOU HAVE TO LEAVE. Plan your escape route early. Check with local Emergency Services for low points and flooding history of your route.

LOCATION OF NEAREST OFFICIAL SHELTER. Local Emergency Services or Red Cross can locate the shelter nearest your home and explain what you should bring with you.

HOW SAFE YOUR HOME IS. Near the seashore, plan to relocate during a hurricane emergency unless you live in a high-rise above the third floor level. If you live in a mobile home, always plan to relocate.

THE INVENTORY OF YOUR PROPERTY. A complete inventory of personal property will help in obtaining insurance settlements and/or tax deductions for losses. Inventory checklists can be obtained from many sources, including your insurance representative. Don't trust your memory. List descriptions and take pictures. Store these and other important insurance papers in waterproof containers or in your safety deposit box.

WHAT YOUR INSURANCE WILL COVER. Review your insurance policies to avoid misunderstanding later. Take advantage of flood insurance. Separate policies are needed for protection against wind and water damage, which people frequently don't realize until too late.

IMPORTANT: Do not wait until a hurricane is near shore--by then it's too late. When a storm is heading to shore, officials are too busy preparing for the emergency and won't be able to respond to individual requests; and insurance can't be obtained.

WHEN A WATCH IS ISSUED, CHECK SUPPLIES:

TRANSISTOR RADIO WITH FRESH BATTERIES. Radio will be your most useful information source. Have enough batteries to last several days. There may be no electricity.

FLASHLIGHTS, CANDLES OR LAMPS, MATCHES. Store matches in waterproof container. Have lantern fuel for several days. Know how to use safely.

FULL TANK OF GASOLINE. Never let your vehicle gas tank be less than half-full during hurricane season--fill up as soon as a hurricane watch is posted. Remember, when there is no electricity, gas pumps won't work.

CANNED GOODS AND NON-PERISHABLE FOODS. Store packaged foods which can be prepared without cooking and need no refrigeration. There may be no electricity or gas.

CONTAINERS FOR DRINKING WATER. Have clean, air-tight containers to store sufficient drinking water for several days. The city supply will probably be interrupted or contaminated.

MATERIALS FOR PROTECTING GLASS OPENINGS. Have shutters or lumber for protecting large windows and doors and masking tape for use on small windows.

MATERIALS FOR EMERGENCY REPAIRS. Your insurance policy may cover cost of materials used in temporary repairs, so keep all receipts. These will also be helpful for any income tax deductions.

WHEN A WARNING IS ISSUED, ACT PROMPTLY:

LISTEN CONSTANTLY TO RADIO OR TV. Keep a log of hurricane position, intensity and expected landfall. Discount rumors. Use telephone sparingly.

IF YOU LIVE IN A MOBILE HOME, check tie-downs and leave immediately for a safer place.

PREPARE FOR HIGH WINDS. Brace your garage door. Lower antennas. Be prepared to make repairs.

ANCHOR OBJECTS OUTSIDE. Garbage cans, awnings, loose garden tools, toys and other loose objects can be deadly missiles. Anchor securely or bring indoors.

PROTECT WINDOWS AND OTHER GLASS. Board up or shutter large windows securely. Tape exposed glass to reduce shattering. Draw drapes across windows and doors to protect against flying glass if shattering does occur.

MOVE BOATS ON TRAILERS CLOSE TO HOUSE. Fill boats with water to weight them down. Lash securely to trailer and use tie-downs to anchor trailer to the ground or house.

CHECK MOORING LINES OR BOATS IN WATER, then leave them.

STORE VALUABLES AND PERSONAL PAPERS. Put irreplaceable documents in water-proof containers and store in highest possible spot.

PREPARE FOR TORNADOES AND FLOODS. Tornadoes and flash floods are the worst killers associated with a hurricane. In a tornado warning, seek inside shelter below ground level. If outside, move away at right angles from tornado. If escape is impossible, lie flat in a ditch or low spot. The surge of ocean water plus flash flooding of streams and rivers due to torrential rains combine to make drowning the greatest cause of hurricane deaths.

CHECK YOUR SURVIVAL SUPPLIES ONCE AGAIN.

IF YOU REMAIN AT HOME:

STAY INDOORS. Don't go out in the brief calm during passage of the eye of the storm. The lull sometimes ends suddenly as winds return from the opposite direction. Winds can increase in seconds to 75 m.p.h. or more.

PROTECT PROPERTY. Without taking any unnecessary risks, protect your property from damage. Temporary repairs can reduce your losses.

STAY AWAY FROM WINDOWS AND GLASS DOORS. Move furniture away from exposed doors and windows.

STAY ON LEEWARD OR DOWNWIND SIDE OF HOUSE. As wind direction changes, move to another room. If your home has an "inside" room, stay there during the height of the hurricane.

KEEP A CONTINUOUS COMMUNICATIONS WATCH. Keep radio or television tuned for information from official sources. Unexpected changes can sometimes call for last minute relocations.

REMAIN CALM. Your ability to meet emergencies will help others.

IF YOU MUST RELOCATE:

BE CERTAIN THERE IS A SAFE REFUGE TO ACCOMMODATE YOU--LEAVE EARLY IN DAYLIGHT IF POSSIBLE. Dangerous winds and tides may arrive three to five hours before the hurricane.

DON'T TRAVEL FARTHER THAN NECESSARY. Roads may be jammed. A stranded auto may become a coffin.

LOCK WINDOWS AND DOORS. Check to see that you have done everything to protect your property from damage and loss.

CARRY ALONG SURVIVAL SUPPLIES --

- First aid kit
- Canned or dried provisions, can opener, spoons, etc.
- Bottled water
- Extra family medication
- Spare eyeglasses, hearing aid and batteries, if required

KEEP IMPORTANT PAPERS WITH YOU AT ALL TIMES --

- Driver's license and other identification
- Insurance policies
- Property inventory
- Medic-alert or device to convey special medical information

TAKE WARM, PROTECTIVE CLOTHING.

AFTER THE HURRICANE, DANGERS REMAIN:

BEWARE OF OUTDOOR HAZARDS. Watch out for loose or dangling power lines, and report them immediately to proper authority. Many lives are lost by electrocution.

WALK OR DRIVE CAUTIOUSLY. Debris-filled streets are dangerous. Snakes and poisonous insects will be a hazard. Washouts may weaken road and bridge structures which could collapse under vehicle weight.

GUARD AGAINST SPOILED FOOD. Food may spoil if refrigerator power is off more than a few hours. Freezers will keep food several days if doors are not opened after power failure, but do not refreeze food once it begins to thaw.

DO NOT USE WATER UNTIL SAFE. Use your emergency supply or boil water before drinking until official word that the water is safe. Report broken sewer or water mains to proper authority.

TAKE EXTRA PRECAUTIONS TO PREVENT FIRE. Lowered water pressure in city mains and the interruption of other services may make firefighting extremely difficult after a hurricane.

NOW, THE CLEAN-UP:

NOTIFY YOUR INSURANCE REPRESENTATIVE. Insurance representatives will be on the scene immediately following a major disaster to speed up the handling of claims. Notify your insurance representative of any losses, and leave word where you can be contacted.

TAKE STEPS TO PROTECT PROPERTY. Make temporary repairs to protect property from further damage or looting. Use only reputable contractors (sometimes in the chaotic days following a disaster, unscrupulous operators will prey on the unsuspecting)--check the Better Business Bureau. Keep all receipts for materials used.

BE PATIENT. Hardship cases will be settled first by insurance representatives. Don't assume your settlement will be the same as your neighbor's. Policy forms differ and storm damage is often erratic. In a major catastrophe, the insurance industry will have emergency offices and extra manpower to expedite claim settlements and to speed recovery.

IT TAKES A TEAM EFFORT. Responsibility for the clean-up falls to numerous local, state and federal agencies. A local Emergency Services coordinator/ director will be on hand to help residents in this effort.

*SOURCE: This checklist has been compiled from material found in:

1. Survival Checklist/Flooding Map Brochures, Texas Hurricane Awareness Program, Texas Coastal and Marine Council, Austin, Texas, 1977.

2. Hurricane Survival Checklist, Virginia Hurricane Preparedness Program, State Office of Emergency and Energy Services, Richmond, Virginia, 1978.