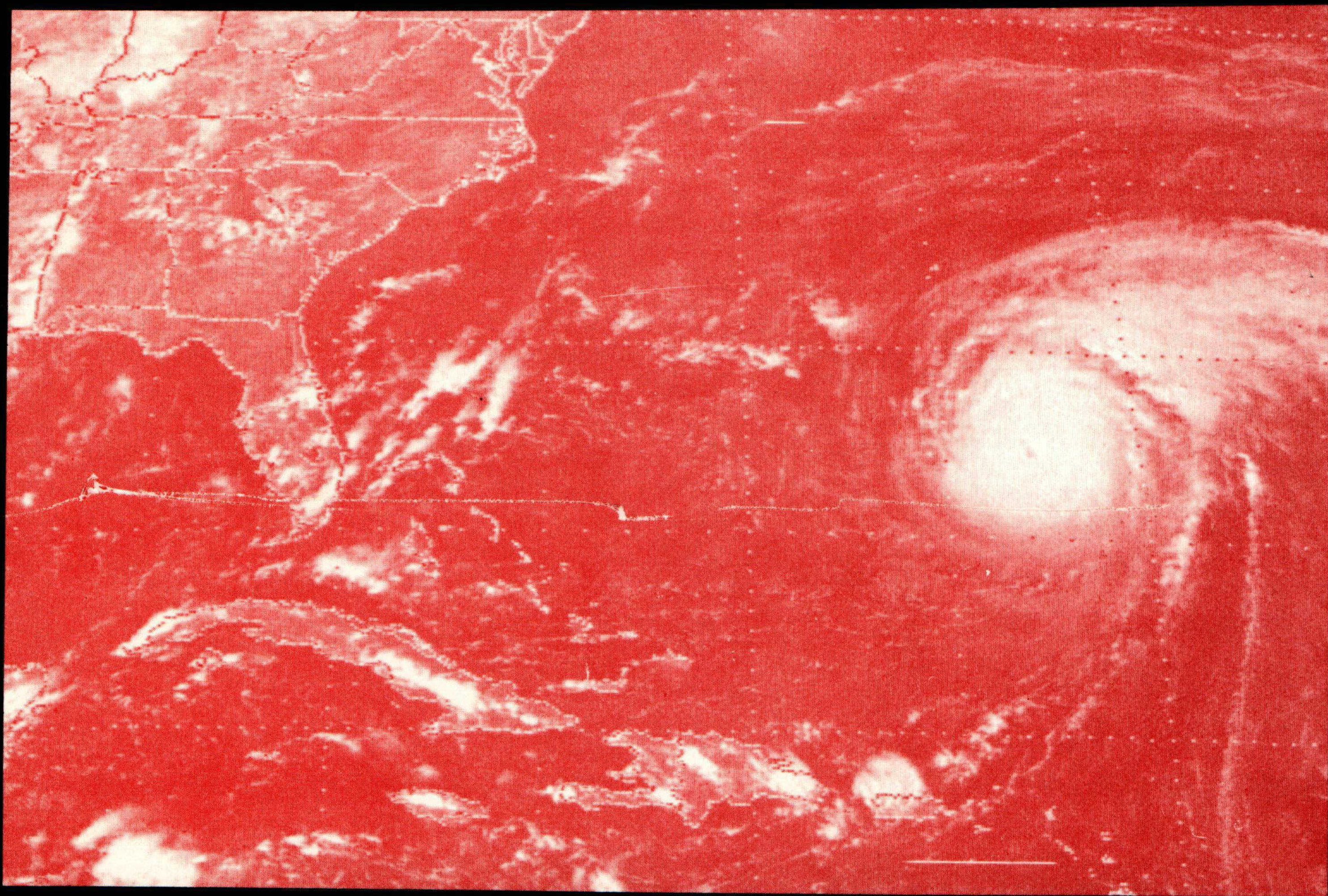

TECHNICAL DATA REPORT

LOWER SOUTHEAST FLORIDA HURRICANE EVACUATION STUDY

JUNE 1983

LOWER SOUTHEAST FLORIDA
HURRICANE EVACUATION STUDY

Technical Data Report

Prepared for:

Monroe, Dade, Broward and Palm Beach Counties

Prepared by:

Post, Buckley, Schuh & Jernigan, Inc.
217 South Adams Street
Tallahassee, Florida 32301

and

Department of the Army
Jacksonville District, Corps of Engineers
Jacksonville, Florida

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EXECUTIVE SUMMARY

BACKGROUND

The lower southeast Florida region, comprised of Monroe, Dade, Broward and Palm Beach Counties, has been identified by the National Oceanic and Atmospheric Administration as one of the most hurricane vulnerable areas of the United States. The U.S. Army Corps of Engineers, Jacksonville District, recognizing the need to identify and measure time components critical to the hurricane evacuation process, provided funding through its Flood Plain Management Services Program and leadership to accomplish this study. Funding assistance was also provided by the Federal Emergency Management Agency (FEMA). Detailed technical study results are provided through this Technical Data Report. Implementation Reports will be developed subsequently by county civil defense officials with the assistance of the Jacksonville District, Corps of Engineers to provide a decision making guide for local county officials. Public information materials will then be developed by the South Florida and Treasure Coast Regional Planning Councils. Major technical work tasks were performed by Post, Buckley, Schuh & Jernigan, Inc. under contract to and under the guidance of, the Jacksonville District, Corps of Engineers.

STUDY OBJECTIVE AND METHODOLOGY

The objective of this study is to provide a quantitative framework upon which each county in the lower southeast Florida study area can update and refine existing hurricane evacuation plans. To accomplish this objective, technical data were developed to identify and measure the critical time elements of a hurricane evacuation process. Extensive analysis was performed on the socioeconomic and shelter data, behavioral patterns, hurricane hazards and transportation movements related to hurricane evacuation.

Key elements of the methodology used in the Technical Data Report are summarized as follows:

- o **Hazards Analysis** - A comprehensive analysis of the potential hurricane hazards to the Lower Southeast Florida region.

- o **Vulnerability Analysis** - A detailed identification of the areas and population of the region vulnerable to specific hurricane hazards.

- o **Population Data** - A systematic enumeration of the dwelling units and population within the identified vulnerable areas.

- o **Behavioral Data** - A statistically significant investigation of the probable tendencies of potential future evacuees.

- o **Shelter Data** - A regionwide inventory of existing public shelter characteristics and shelter capacity analysis.

- o **Gale Force Winds** - A time history analysis of the expected time of arrival of gale force winds relative to hurricane landfall.

- o **Shelter Duration** - A time history analysis of the expected shelter stay duration throughout the life of the storm.

- o **Study Analysis Zones** - A regionwide delineation of the vulnerable areas into study analysis zones with common hazard vulnerability and common evacuation routes.

- o **Evacuation Routes** - The assignment of evacuation vehicle volumes from specific study analysis zones to specific routes to develop optimum intra- and inter-county routing strategies.

- o **Shelter Assignment** - The assignment of specific study analysis zones to specific shelters based on evacuation routing strategies and shelter capacities.

- o **Clearance Time** - The calculation of times associated with the movement of the enumerated vulnerable population from specific vulnerable study analysis zones to specific evacuation destinations.

- o **Evacuation Order Time** - The formulation of recommendations for the timing of issuing evacuation orders based on all components of evacuation time analyzed.

- o **Coordination** - The continuous participation and involvement in accomplishing the tasks by all concerned preparedness and response agencies.

STUDY AREA DESCRIPTION AND DATA BASE

Chapter 2, Study Area Description and Data Base, presents historical hurricane activity in southeast Florida, population and housing characteristics, and listings and maps of Red Cross shelters in the area.

Since 1900, storms of hurricane strength have affected the southeast Florida area an average of about once every 2.6 years. Of the 31 hurricanes which have affected the four counties in the Southeast Florida area since 1900, all have occurred between the months of June to November. The months of September and October have produced more study area hurricanes (14 and 10, respectively), than the other months.

The permanent population of the study area has increased from 2.3 million in 1970 to 3.3 million in 1980. The population also increases significantly during the hurricane season (June through November) due to tourists.

Lists of designated Red Cross shelters were provided by the local Red Cross Chapters. Following is the total number of Red Cross shelters available in each county in the study area:

	Monroe	Dade	Broward	Palm Beach
Number of Red Cross Shelters	17	53	24	36

HURRICANE FLOODING AND HAZARDS ANALYSIS

Chapter 3, Hurricane Flooding and Hazards Analysis, identifies and describes the hazards of a hurricane that would affect the southeast Florida area. The chapter includes a description of the simulated hurricanes, a description of the hurricane computer models, and a description of the hazards analysis. The three major hazards produced by a hurricane are:

- o Storm tide
- o High winds
- o Rainfall

The worst probable storm tide results for the Lower Southeast Florida area are as follows:

Saffir/Simpson Hurricane Scale Number	Elevation (Feet Above Mean Sea Level)			
	Monroe	Dade	Broward	Palm Beach
1	5	5	4	4
2	7	7	5	5
3	10	10	7	6
4	13	13	9	8
5	15+	15+	11+	9+

Pre-landfall hazards time is the time frame immediately before hurricane eye landfall within which evacuation should not be carried out due to the effects of the arrival of gale force winds. Also, during the pre-landfall hazards time, storm tides begin inundating roadways. Following are the maximum pre-landfall hazard times in hours before eye landfall for each county in the study area that were determined from the simulated hurricanes for the study:

	Maximum Pre-Landfall Hazards Time in Hours			
	Monroe	**Dade**	**Broward**	**Palm Beach**
Storm Tide	5.5	3.0	2.0	1.5
Sustained Gale Force Winds	14.0	11.5	11.5	11.5

Actual pre-landfall hazard times will vary from those predicted due to a differing forward speed, radius of maximum winds, and the pressure drop of an actual hurricane. The actual pre-landfall hazard times for a specific hurricane will be based on data provided to the county civil defense/disaster preparedness director by the forecasters at the National Hurricane Center.

There are approximately 170 hospitals and nursing homes located in the study area. Some of those hospitals and nursing homes may require evacuation due to flooding from storm tide. Following is the number of hospitals and nursing homes in each county that may experience storm tide flooding:

	Monroe	**Dade**	**Broward**	**Palm Beach**
Hospitals	4	7	2	0
Nursing Homes	1	12	3	0

BEHAVIORAL PATTERNS OF POPULATION-AT-RISK

Chapter 4, Behavioral Patterns of Population-at-Risk, discusses the current behavioral research, the behavioral surveys conducted for this study, the refinement of behavioral assumptions, and the behavioral response curves.

The following conclusions were drawn from the behavioral survey conducted for the study:

- A significant number of households contacted, approximately 25 percent, indicated that they do not intend to evacuate during a hurricane.

- Seventy (70) percent of the residential vehicles available for evacuation in the study area would be used during an evacuation.

- 20 to 25 percent of the households contacted that plan to evacuate indicated that they intend to use Red Cross shelters.

- The general public has a misperception about whether they have lived in an area that has experienced a major hurricane.

TRANSPORTATION ANALYSIS

Chapter 5, Transportation Analysis, discusses the evacuation travel patterns, the transportation analysis input assumptions, the transportation analysis methodology, the roadway system representation, the model application, and the clearance times.

Delineation of study analysis zones is an essential part of a hurricane evacuation plan. The study analysis zones were determined using the storm tide analysis results; the Urbanized Area Transportation Study Analysis Zones for Dade, Broward, and Palm Beach Counties; census divisions for Monroe County; and easily recognizable streets and topographic features (canals, waterways, railroads, etc.). Following are the number of study analysis zones determined for each county in the study area:

	Monroe	Dade	Broward	Palm Beach
Study Analysis Zones	5	47	30	54

EVACUATION PLANNING IMPLICATIONS

Chapter 6, Evacuation Planning Implications, provides a quantitative framework upon which each county in the study area can base an evacuation order. The chapter discusses county storm situations and regional storm scenarios, evacuation time requirements, Red Cross shelter considerations, evacuation routes, traffic control, and special evacuation considerations.

Two general levels of vulnerability were developed for the counties in the study area. Each level represents a distinct hurricane situation confronting the area and producing different intensities of storm tide, hurricane winds, and required evacuation. Storm situations were classified by an "A" for less intense storms and "B" for more intense storms and are summarized as follows:

County	Storm Situation	Saffir/Simpson Category	Worst Probable Storm Tide
Monroe	A	1-2	5-7
	B	3-5	10-15+
Dade	A	1-3	5-10
	B	4-5	13-15+
Broward	A	1-3	4-7
	B	4-5	9-11+
Palm Beach	A	1-3	3-6
	B	4-5	8-9+

The total population required to evacuate in each county was determined by comparing modelled flooding with occupied dwelling and population data in each traffic analysis zone. The resulting population-at-risk for each area by storm situation was as follows:

	Monroe					
Situation	**Lower Keys**	**Middle Keys**	**Upper Keys**	**Dade**	**Broward**	**Palm Beach**
A	29,200	9,800	15,200	261,700	191,700	111,300
B	32,100	9,800	15,200	385,400	217,100	120,900

The study analysis zones where evacuation from storm tide flooding and where evacuation of mobile home and travel trailer residents from only high winds is required is shown by county and storm situation as follows:

		Study Analysis Zones Requiring Evacuation	
County	**Storm Situation**	**Flooding**	**Winds**
Monroe	A	1-5	1-5
	B	1-5	1-5
Dade	A	1-17	18-47
	B	1-25	26-47
Broward	A	1-9	10-30
	B	1-15	16-30
Palm Beach	A	1-18	19-54
	B	1-23	24-54

Of key importance to hurricane preparedness is the foreknowledge of the estimated time it would take to evacuate threatened residents from an approaching hurricane. The evacuation order time is the time in hours before hurricane eye-landfall by which the evacuation order must be give to allow all evacuees to reach their chosen destinations. The evacuation order time includes the pre-landfall hazards time and post-evacuation order clearance time. Post-evacuation order clearance time includes the mobilization time, travel time, and queueing delay time required to clear evacuation vehicles from the road network. The ranges in county evacuation order times are as follows:

	Evacuation Order Times in Hours			
Storm Situation	**Monroe**	**Dade**	**Broward**	**Palm Beach**
A	13.5-31.5	16-20	13-16	12-16
B	18.0-31.5	18-22	19	17.5

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER STUDY

The Lower Southeast Florida area has a hurricane evacuation problem. The study sets forth a quantitative regional framework which will result in a comprehensive, realistic, and viable hurricane evacuation plan for the local governments of the Lower Southeast Florida area to assist in alleviating the hurricane evacuation problem. Chapter 7, Conclusions and Recommendations for Further Study, sets forth recommended future effects aimed at preventing the problem from growing even worse. The following are major study conclusions:

- The calculated time required for evacuation of vulnerable areas due to an approaching hurricane is much longer than the practical warning time available from the National Hurricane Center. While some of the highest evacuation order times in the study area ranged from 16 to 31.5 hours, the National Hurricane Center generally provides a hurricane warning 12 to 16 hours before hurricane eye landfall.

- The results of the sensitivity of clearance times to the rate of mobilization for evacuation indicates that there is a potential time saving for several counties in attempting to achieve a more rapid mobilization.

- There is a serious need for increased multi-jurisdictional coordination of evacuation planning. Although some inter-county coordination is already underway, this study emphasizes the need for coordinating the longer distance evacuation trips as well as the media information, shelter sharing and other hurricane evacuation procedural elements.

The following are recommendations for additional research and planning efforts:

- **Behavioral Studies** - Behavioral studies relating to hurricane evacuation have not reliably identified behavioral determinants leading to a decision to evacuate. Effective communication methods that optimize public response to evacuation orders must receive serious research attention in the near future. An effective research program for updating this study's behavioral survey and for taking post-evacuation experience surveys should be planned for immediately.

- **Inter-Regional Impacts** - Efforts to quantify inland shelter needs produced by evacuees who travel long distances is now underway. These planning studies should continue and be enhanced by potential post-evacuation surveys.

- **Vertical Refuge** - Within the hurricane discipline, there is a definite need to define the terms vertical refuge and vertical evacuation. Vertical refuge is being posed as an alternative to the very long evacuation order times resulting from current hurricane studies. After the terms are clearly defined, then the technical aspects of vertical refuge can be evaluated as a potential safe alternative for hurricane evacuees.

- o **Study Updates** - Since the socioeconomic, highway, shelter and other components of this study may change significantly over a two-year period, it is recommended that this hurricane study and others similar to it be revised every two years.

- o **Public Information/Hazard Awareness** - To supplement the public information effort of this study, future efforts should include a year-round public information program. This could be accomplished through the news media, school systems, and/or public information tabloid materials into local telephone directories or other locally distributed publications.

- o **Plan Exercises and Testing** - A program framework for mock hurricane exercises is included in the implementation documents. Such exercises to test inter-county preparedness and response capabilities should be conducted annually.

- o **Plan Updating** - The evacuation plan resulting from this study should be accurately maintained through periodic updating and revision to incorporate population changes, highway/bridge changes, shelter changes, and new hurricane hazard analysis techniques. Such updating should be conducted at least biannually.

Unlike other comprehensive plans formulated to guide development, it is hoped that the data presented in the Lower Southeast Florida Hurricane Evacuation Plan will have to be used infrequently. However, the future safety of the region's residents/tourists requires that a high level of preparedness to implement the plan must be maintained. Hopefully, the data presented and published by this study will assist in an orderly and coordinated hurricane evacuation, and reduce loss of life when a hurricane directly affects the Lower Southeast Florida area.

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ACKNOWLEDGEMENTS

This report documenting technical work tasks of the Lower Southeast Florida Hurricane Evacuation Study was prepared by Post, Buckley, Schuh & Jernigan, Inc. under contract to the U.S. Army Corps of Engineers, Jacksonville District. The following persons and agencies are thanked for their participation and direct contributions to the study:

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- o American Red Cross, which provided shelter data through local county offices.

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- o Mr. John Wilson of the State of Florida Bureau of Disaster Preparedness, who provided state review and support for all study elements.

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- o Study Review Committee members in each county, who attended meetings and provided local input necessary to the successful and worthwhile completion of the study.

- o Mr. Herbert Saffir, Dade County, Florida, Consulting Engineer, and Dr. Robert H. Simpson, Simpson Weather Associates, Charlottesville, Virginia, for use of the Saffir/Simpson Hurricane Scale.

Chapter 1
INTRODUCTION

The lower southeast Florida region, comprised of Monroe, Dade, Broward and Palm Beach Counties, is one of the most hurricane vulnerable areas of the United States. The potential for large scale loss of life is significant considering the historically high hurricane frequency and the large number of persons inhabiting the low-lying coast areas in the region. The 300-mile long, four county study area is shown in Figure 1.

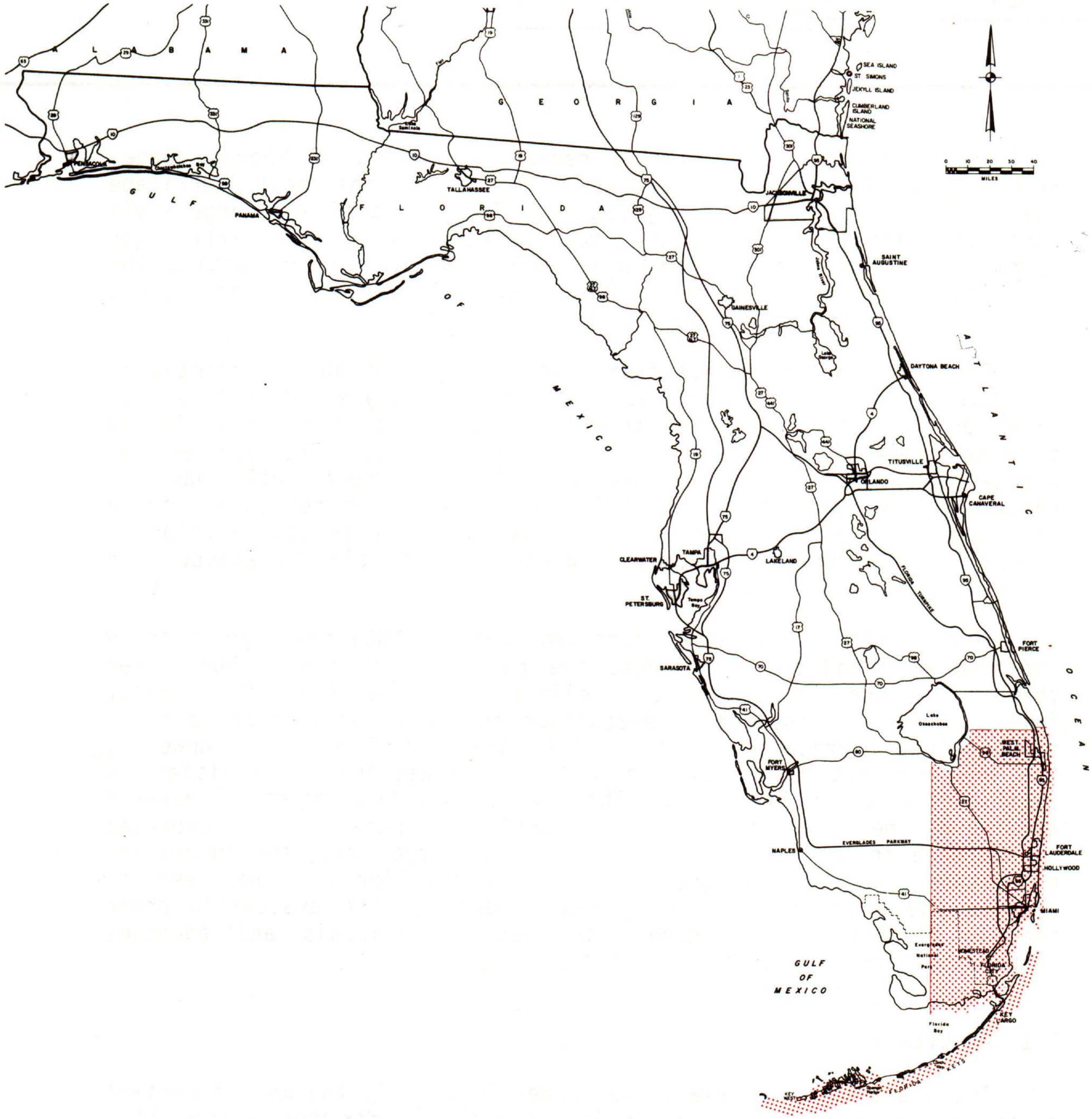
The focal point in avoiding loss of life during a hurricane is the determination of the time at which local or state authorities must order an evacuation to allow threatened residents in hazardous areas to reach safe shelter before a hurricane arrives. The earlier the evacuation order is issued, the more time residents will have to evacuate. However, if an evacuation order is issued too early, there is a strong likelihood that the hurricane may change course prior to landfall, rendering the evacuation unnecessary or placing evacuees in a more hazardous location.

Since 1950, the National Hurricane Center (NHC) has significantly improved its ability to forecast the path of approaching hurricanes through the use of computers, satellites and other scientific means. This allowed the issuance of evacuation orders at earlier and earlier times before hurricane landfall. Over the past five years, however, the NHC has not been able to improve forecasting capabilities as signficantly as in the past. This means that the amount of advance warning of the time and location of hurricane landfall is not expected to increase in the foreseeable future. Therefore, with the increasing population and tourist growth in Southeast Florida, the need to improve the accuracy and timing requirements of the evacuation order becomes of critical importance to those individuals and agencies responsible for public safety.

1.1 AN OVERVIEW

The issuance of an evacuation order is clearly the most important action required by a county commission acting under the advice of a County Civil Defense Director in a hurricane situation.

As shown in Figure 2, the official warning process for an approaching hurricane begins with notice of a hurricane watch issued by the National Hurricane Center. This alerts residents to the potential of the hurricane and suggests that they should immediately begin to monitor the approaching storm and begin to prepare for a possible evacuation.



LOWER SOUTHEAST FLORIDA
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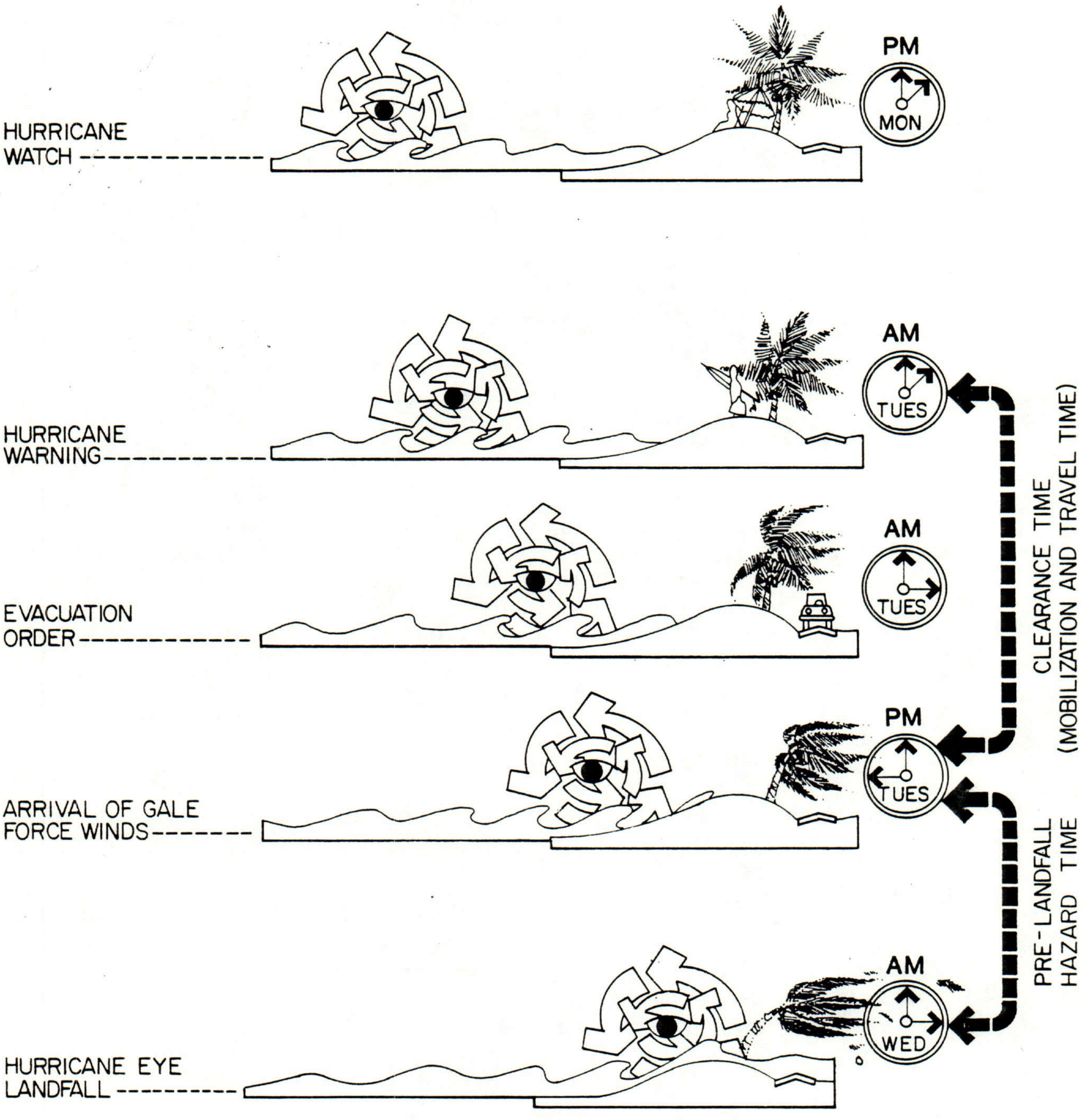
STUDY AREA

FIGURE 1



THE HURRICANE APPROACH
WARNING PHASES

FIGURE 2

The second phase of the warning process involves the issuance of a hurricane warning for a large geographical area. Some residents will leave at the announcement of a hurricane watch. The majority of residents, however, will begin evacuating during this hurricane warning phase. Early evacuation may result from media coverage or from previous experience with hurricane storm tide flooding and hurricane force winds.

The issuance of a local evacuation order is a key and critical element to safe evacuation. The order is issued a specified number of hours before the eye of the hurricane reaches land. A hurricane evacuation order must be issued in sufficient time to allow evacuees to reach their chosen destinations before the arrival of gale force winds and before roadways are inundated from storm tide and heavy rainfall. The critical components of the evacuation order time, therefore, are the clearance time required for individuals to leave their place of residence and reach safe shelter and the time of arrival of hurricane hazards prior to actual hurricane landfall.

Clearance time relates to the time required for mobilization and travel time from the vulnerable areas. The travel time involves normal travel time as well as the congestion that would occur based upon a heavy volume of travel on certain roadways. Clearance time begins when the first evacuating vehicle enters the road network and ends when the last evacuating vehicle reaches its destination.

Pre-landfall hazards time involves the time frame before the hurricane eye reaches land, in which gale force winds arrive and roadways begin to be flooded by storm surge and heavy rainfall. Generally gale force winds arrive several hours before the storm surge begins to affect an area. Since gale force winds make travel extremely hazardous, all evacuation movements need to be completed by this point in time.

The evacuation order time, therefore, is determined by identifying the time of hurricane eye landfall and then subtracting the amount of time required to clear all vehicles prior to the pre-landfall hazards time. The forecasting of these time components for different hurricane tracks and intensities is the critical and important element in hurricane evacuation planning and decision making.

1.2 STUDY OBJECTIVE AND SCOPE

The objective of this study is to provide a quantitative framework within which each county in the lower southeastern Florida study area can update and refine existing hurricane evacuation plans. Specifically, the overall purpose is to provide emergency management officials the evacuation order times, measured in hours before hurricane eye landfall, that allow vulnerable residents to reach their chosen destinations for unique storm tracks and intensities. Since hurricanes are a regional phenomenon, recognizing no county boundaries, all assumptions and calculation procedures used in producing evacuation order times must be based on multi-county vulnerability and response.

To accomplish the study objective, a comprehensive scope of services was developed. The scope of services was directed toward identifying and measuring the critical elements of an evacuation order. These critical elements involve the clearance time and pre-landfall hazards time.

Clearance Time - The critical tasks in the determination of clearance time included socio-economic and shelter data collection, behavioral response analysis, and transportation analysis. The specific work undertaken in these areas included the following:

Data Collection

- a compilation and listing of population/dwelling unit data within the identified vulnerable areas

- a regionwide inventory of existing public shelter characteristics and shelter capacity analysis

Behavioral Analysis

- a detailed look at current behavioral research in the area of evacuation response by population-at-risk

- a statistically valid investigation of the probable behavioral tendencies of potential evacuees

Transportation Analysis

- the assignment of evacuation vehicle volumes from the delineated traffic evacuation zones to specific evacuation routes

- the calculation of evacuation vehicle clearance and evacuation order times by storm scenario, by assumed high or low levels of evacuee participation, and by an assumed rate of evacuee mobilization

Pre-Landfall Hazards Time - The important task in the determination of pre-landfall hazards time involved hurricane flooding and hazards analysis. The following specific work was performed for this task:

Hurricane Flooding and Hazards Analysis

- a regionwide identification of roadways and residential areas that historically become heavily inundated due to rainfall flooding

- o a comprehensive analysis of the potential hurricane hazards (flooding and wind hazards) to the lower southeast Florida coast

- o a detailed identification of the areas and population of the region vulnerable to these hurricane hazards

- o a flooding analysis of existing Red Cross shelter structures and hospital/nursing home structures

- o a comparison of the expected time of inundation of critical evacuation route points versus the expected time of hurricane eye landfall

In addition to the technical tasks, continuous coordination among all concerned preparedness and response agencies was maintained.

The study is not intended to replace the detailed operations plan developed by each local government unit in the region. Detailed manpower, shelter, and equipment assignments are a local function of evacuation planning and are best handled at that level. Data developed and presented in this report are at a technical level which must be subsequently translated into a simplified decision making reference document (Implementation Reports) for each county. Also, it must be noted that in an emergency situation, data produced in this study would be only one of several tools available to the local civil defense authority. Prior to reaching any conclusions, the characteristics of a real storm situation must be carefully compared with those assumptions set forth in this study.

1.3 AUTHORIZATION AND LEGAL AUTHORITY

Technical work tasks reported in this report were accomplished by Post, Buckley, Schuh & Jernigan, Inc. under contract to the United States Army Corps of Engineers, Jacksonville District. Authority for the Corps of Engineers' funding and direction of this study is the Flood Plain Management Services Program set up under Section 206 of the 1960 Flood Control Act, as amended. The study was initiated by the Jacksonville District of the Corps of Engineers in response to requests from the Board of County Commissioners of Broward, Dade, Monroe, and Palm Beach Counties and by further endorsement of the Governor of the State of Florida. Appendix A provides letters of support from each county and the State of Florida.

Participation in the study by the Federal Emergency Management Agency (FEMA) has as its legal authority Section 201a of the Federal Disaster Relief Act of 1974 (P.L. 93-288). Federal legal authority for State disaster preparedness agencies involved in the study is set forth by the Federal Civil Defense Act of 1950 (P.L. 81-920) and the Federal Disaster Relief Act of 1974. Legal authority for the planning activities of local and state disaster preparedness organizations is established by the State Disaster Preparedness Act of 1974 (Chapter 252, Florida Statutes). The State Disaster Preparedness Act directs the creation of local organizations for disaster preparedness in each Florida county and authorizes such organizations in the municipalities of the State.

Of ultimate importance in hurricane evacuation planning is the recognition of the legal authority for ordering and coordinating evacuations. Authority to order evacuation from an approaching hurricane is conferred to the Governor by Chapter 252.36 of the Florida Statutes. Likewise, Executive Order 80-29 delegates the same power to the governing bodies of each city and county in the absence of the Governor's directive. In the event that the State of Florida or a county fails to order an evacuation as early as a city may feel is required by local conditions, the municipality may order evacuation within its legal boundaries. However, evacuation orders issued by higher levels of government are binding upon lower levels of government. Thus, a state declaration is binding upon counties and municipalities, and a county order is binding upon a municipality.

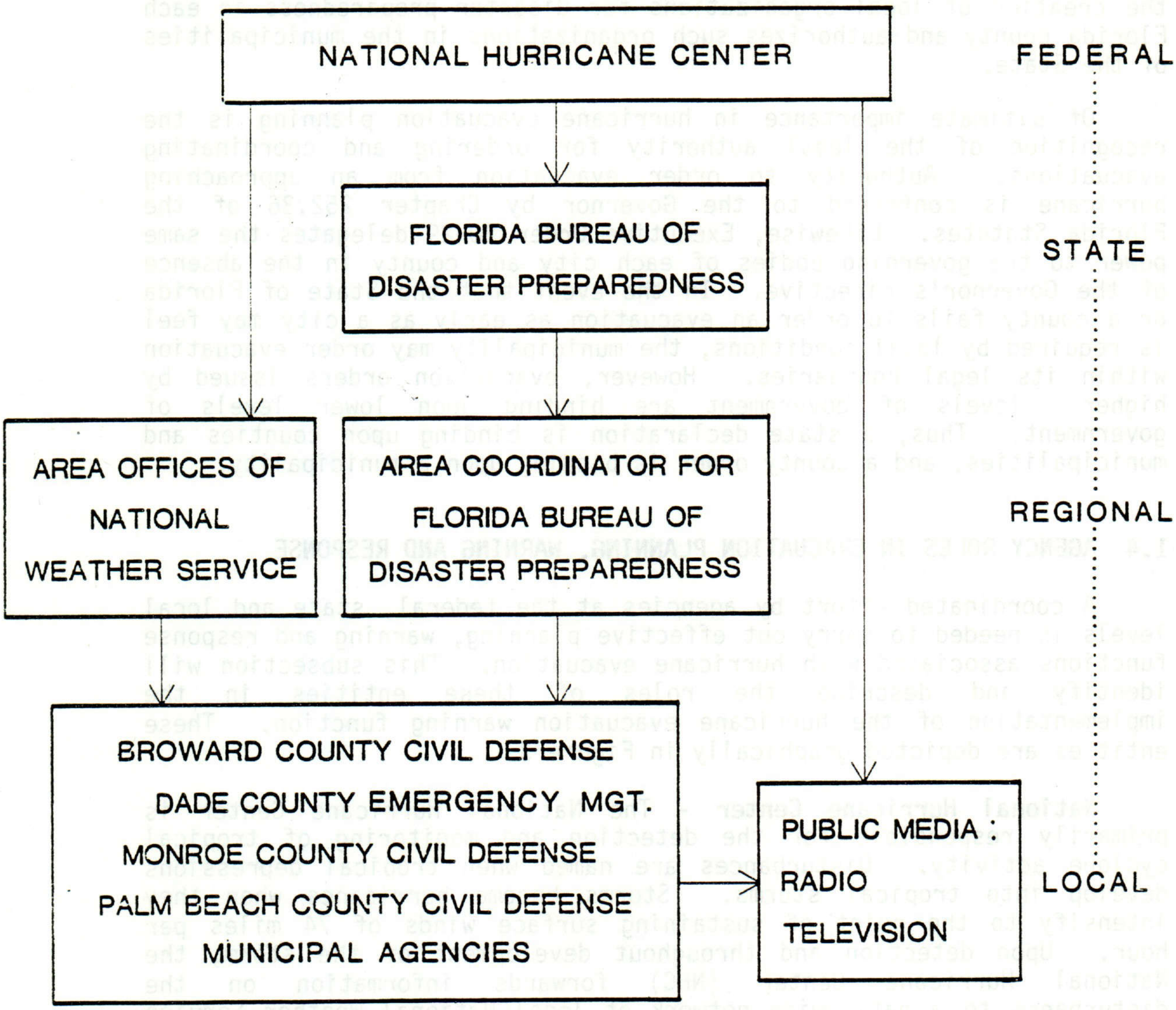
1.4 AGENCY ROLES IN EVACUATION PLANNING, WARNING AND RESPONSE

A coordinated effort by agencies at the federal, state and local levels is needed to carry out effective planning, warning and response functions associated with hurricane evacuation. This subsection will identify and describe the roles of these entities in the implementation of the hurricane evacuation warning function. These entities are depicted graphically in Figure 3.

National Hurricane Center - The National Hurricane Center is primarily responsible for the detection and monitoring of tropical cyclone activity. Disturbances are named when tropical depressions develop into tropical storms. Storms become hurricanes when they intensify to the point of sustaining surface winds of 74 miles per hour. Upon detection and throughout development of the storm, the National Hurricane Center (NHC) forwards information on the disturbance to a nationwide network of local National Weather Service Offices. Advisory bulletins containing current storm information are disseminated to these offices at 6-hour intervals. These bulletins include the location and characteristics of the storm, the direction of movement, and forecasts for the next 12 to 24 hours.

When the eye of the storm approaches landfall, the 6-hour reporting interval may be supplemented by bulletins every three hours, or less if needed. Also included in these advisories are recommendations concerning public evacuation. Information concerning the hazard potential of the hurricane as it moves to within 72 hours of projected landfall is channeled to local and state disaster preparedness agencies by the NHC. This information is channeled over the National Warning System (NAWAS), and categorizes the hurricane according to the Saffir/Simpson Scale of hazard potential.

Local Weather Service Offices - Local weather service offices within the study area are located in Key West, Miami, and West Palm Beach. Area weather service offices are responsible to areas not



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AGENCY RELATIONS IN THE HURRICANE WARNING SYSTEM

FIGURE 3

necessarily defined by one county's boundaries -- the Miami office provides information to Dade, Broward and Monroe (to Channel Five Bridge) Counties, the Key West Office covers south of the Channel Five Bridge, and the West Palm Beach office provides information for Palm Beach and counties north of the study area. Each office interprets information forwarded from the NHC regarding potential storm effects on each office's area of jurisdiction. In addition to the NHC reports, each office adds local weather statements to advisory bulletins. These are then forwarded via NAWAS and weather teletype to county disaster preparedness agencies. These local statements include recommended precautionary measures, response actions, and estimated times within which each should be completed. General areas recommended for evacuation are identified in these reports.

The Governor of the State of Florida - The Governor, through legislation in the Florida Statutes, Chapter 252.36(5)(e), has been granted the authority to order evacuation from an approaching hurricane if he deems this action as "necessary for the preservation of life or other disaster mitigation, response, or recovery."

State of Florida Bureau of Disaster Preparedness - The Bureau of Disaster Preparedness is located in the Division of Public Safety Planning and Assistance, within the Department of Community Affairs. It provides primary staff support to the Governor during potential disaster situations, and is responsible for making recommendations to the Governor regarding the nature, extent and timing of the evacuation order. The Bureau is also responsible for directing the coordination of disaster mitigation, preparedness, response and recovery activities within the state.

Communications between the Bureau, the NHC, and the local weather service office are maintained through several channels including NAWAS, and are also maintained through the four area coordination offices throughout the state.

Local Government Elected Officials - Elected officials, local disaster preparedness agencies, and other departments are all involved in the hurricane evacuation process at the local level. The chief elected official or chief executive officer of counties and municipalities (commission chairman and/or mayor) is delegated the authority to order the evacuation from an approaching hurricane by the same legislation authorizing the Governor to issue an evacuation order.

County and Municipal Disaster Preparedness Agencies - These agencies serve similar functions to the municipal and county officials as does the Bureau of Disaster Preparedness for the Governor. The chief elected official or chief executive officer of the municipality normally issues evacuation orders after recommendation by the county disaster preparedness department or disaster advisory committee. Local disaster preparedness agencies perform many of the detailed planning activities that must take place for a successful evacuation.

Local Government Departments - County and city departments such as fire, public works, law enforcement, traffic engineering, health services and utilities are all involved during the execution of an evacuation. Manpower and equipment of these departments is coordinated by the local disaster preparedness agencies upon issuance of a declaration of emergency conditions.

American Red Cross - Local chapters of the American Red Cross provide the service of overall management of public disaster shelters. This includes the provision of trained staff, food supplies, and registration procedures to the evacuated public during shelter stay.

1.5 STUDY COORDINATION ACTIVITIES

A major study objective was to coordinate closely with all interested local and state agencies. This coordination was critical to the technical and administrative success of each individual work element. Meetings were held with key study participants throughout the study effort. A Study Review Committee was set up in each county to make suggestions concerning each work task and to review the preliminary work task results. Appendix B presents a list of coordination meetings and Study Review Committee members.

Existing county hurricane evacuation planning documents were obtained from local civil defense directors and carefully reviewed. These documents included, but were not limited to the following:

1) Hurricane Evacuation Plan for Key West and Stock Island (1982) provided by the Port and Transit Authority of Key West, Florida

2) Structural Report on Hurricane Shelters (1982) provided by Monroe County Civil Defense

3) NASKWNOTE 3140 (Hurricane Shelters and Evacuation Traffic Flow for Naval Air Station Personnel, 1982) provided by Commanding Officer, Naval Air Station, Key West, Florida

4) Dade County Natural Disaster Plan (1979) provided by Office of Emergency Preparedness, Civil Defense Division, Dade County

5) Emergency Preparedness Plan (1982) provided by Broward County Division of Mass Transit and Broward County Civil Defense

6) Analysis of Hurricane Evacuation Time Requirements for the Coastal Areas of Broward County (1981) provided by Broward County Office of Planning

7) Hurricane Evacuation Plan (1981), provided by Palm Beach County Civil Defense

In addition to important state and local study participation, the Treasure Coast and South Florida Regional Planning Councils provided assistance and review at all meetings. Newsletters summarizing study progress were assembled and distributed by each regional planning council.

1.6 REPORT FRAMEWORK

Documentation of this study effort is presented in a chronological framework, describing work tasks as they were performed and as they built upon each previous task. The report begins with a description of the study area and data compiled for use as a base throughout the work effort. The hurricane flooding and hazards analysis is then presented detailing the technical tools used and conclusions drawn regarding pre-landfall hazards times. The report continues with an examination of the probable behavioral patterns of the population-at-risk and establishes the assumptions regarding how quickly people will evacuate and what types of destinations they will seek.

The transportation analysis is then described including assumptions and conclusions related to clearance times. Evacuation time requirements are also highlighted. The report concludes with a chapter concerning the planning implications of the measured time components and a chapter setting forth conclusions and recommendations for further study.

Chapter 2
STUDY AREA DESCRIPTION AND DATA BASE

The Lower Southeast coast of Florida has often been described as one of the most hurricane-prone regions in the United States. The area's historical tendency to hurricane strikes, along with its low-lying topography, densely populated urban centers, and sizeable tourist population, are all characteristics that contribute to its vulnerability.

An initial stage of the evacuation planning process involved gathering descriptive information on these and other related characteristics of the Southeast Florida region into a study data base. Data that were gathered by the study team were presented to the Study Review Committees established for each county. After a series of reviews and revisions with committee members, a data base consisting of the most accurate and reliable information available was assembled and utilized.

2.1 HISTORICAL HURRICANE ACTIVITY

During this century, Southeast Florida has been affected by more hurricanes than any area of comparable size in the United States. Southeast Florida also has been affected by more hurricanes of high intensity than any other comparable region. Since 1900, storms of hurricane strength have affected Southeast Florida (Monroe, Dade, Broward and Palm Beach Counties) on the average of approximately once every three years.

Tropical storms and hurricanes that affect Florida's southeastern coast typically form in the Atlantic cyclonic basin off the west coast of Africa or the western Caribbean. The release of heat from warmed ocean waters promotes the formation and strengthening of these storms during the summer months.

Studies by the National Hurricane Center have shown that there are periods during which hurricane tracks concentrate on Florida. Of the thirty-one hurricanes which have affected Southeast Florida since 1900, it is interesting to note that all came in the months June to November, with no hurricanes affecting the study area in December to May. In addition, the majority of hurricanes for each affected county evolved in the months of September or October. Monroe County has had the highest number (19 hurricanes) affect its area since 1900 with Broward County having had the lowest (7 hurricanes). The number of hurricanes since 1900 affecting each county by month of the year is summarized in Table 1.

TABLE 1

**NUMBER OF HURRICANES SINCE 1900
BY COUNTY BY MONTH**

Lower Southeast Florida
Hurricane Evacuation Study

MONTH	MONROE	DADE	BROWARD	PALM BEACH	REGION
June	0	0	0	1	1
July	0	0	0	1	1
August	1	1	1	3	3
September	8	5	2	6	14
October	9	7	4	2	10
November	1	1	0	0	2
December-May	0	0	0	0	0
TOTAL	19	14	7	13	31

Studies by the National Hurricane Center have also shown that certain intensities of hurricanes are more frequent in the Southeast Florida area. A common classification of hurricane intensity is the Saffir/Simpson Hurricane Scale, which has five categories detailing different degrees of expected winds, surge and damage potential. Category one is the least intense classification, with winds of 74 to 95 miles per hour, and category five is the most intense, with winds of greater than 155 miles per hour. Appendix C describes the Saffir/Simpson Scale in detail. Since 1900, most hurricanes in the Southeast Florida area have been a category two or three storm. Table 2 provides data concerning the number of hurricanes since 1900 affecting each county by Saffir/Simpson category number.

TABLE 2

**NUMBER OF HURRICANES SINCE 1900
BY COUNTY BY SAFFIR/SIMPSON SCALE NUMBER**

Lower Southeast Florida
Hurricane Evacuation Study

SAFFIR/SIMPSON CATEGORY	MONROE	DADE	BROWARD	PALM BEACH	REGION
1	2	1	0	1	3
2	6	6	4	7	12
3	8	6	1	3	11
4	2	1	2	2	4
5	1	0	0	0	1
TOTAL	19	14	7	13	31

Not only were hurricane frequency data important to examine, but also the hurricane tracks that have passed over, across and by the study area were critical to consider. Historical hurricane tracks provided guidance as to which hypothetical storm tracks would be modelled for the hazards analysis. Most hurricanes since 1900 have affected the study area by a southeast to northwest direction, making landfall at the coastline in an angular fashion. However, several hurricanes have approached the study area from the south or southwest and have paralleled the coastline or crossed over the southern tip of Florida. Figure 4 presents the study area with hurricane tracks recorded since 1900.

2.2 TOPOGRAPHY

South Florida is particularly exposed to the dangers presented by hurricanes because of its topography. The region is essentially a flat, low-lying limestone plain. Elevations are typically highest along the coastal ridge, which runs in a north-south direction several miles inland from the ocean. The highest point in the region is 53 feet above mean sea level, in the vicinity of Jupiter. To the west of the coastal ridge, elevations gradually decrease to just slightly above sea level in the Everglades Basin. To the east of the ridge, elevations decrease as well, sloping down gradually to the Intracoastal Waterway.

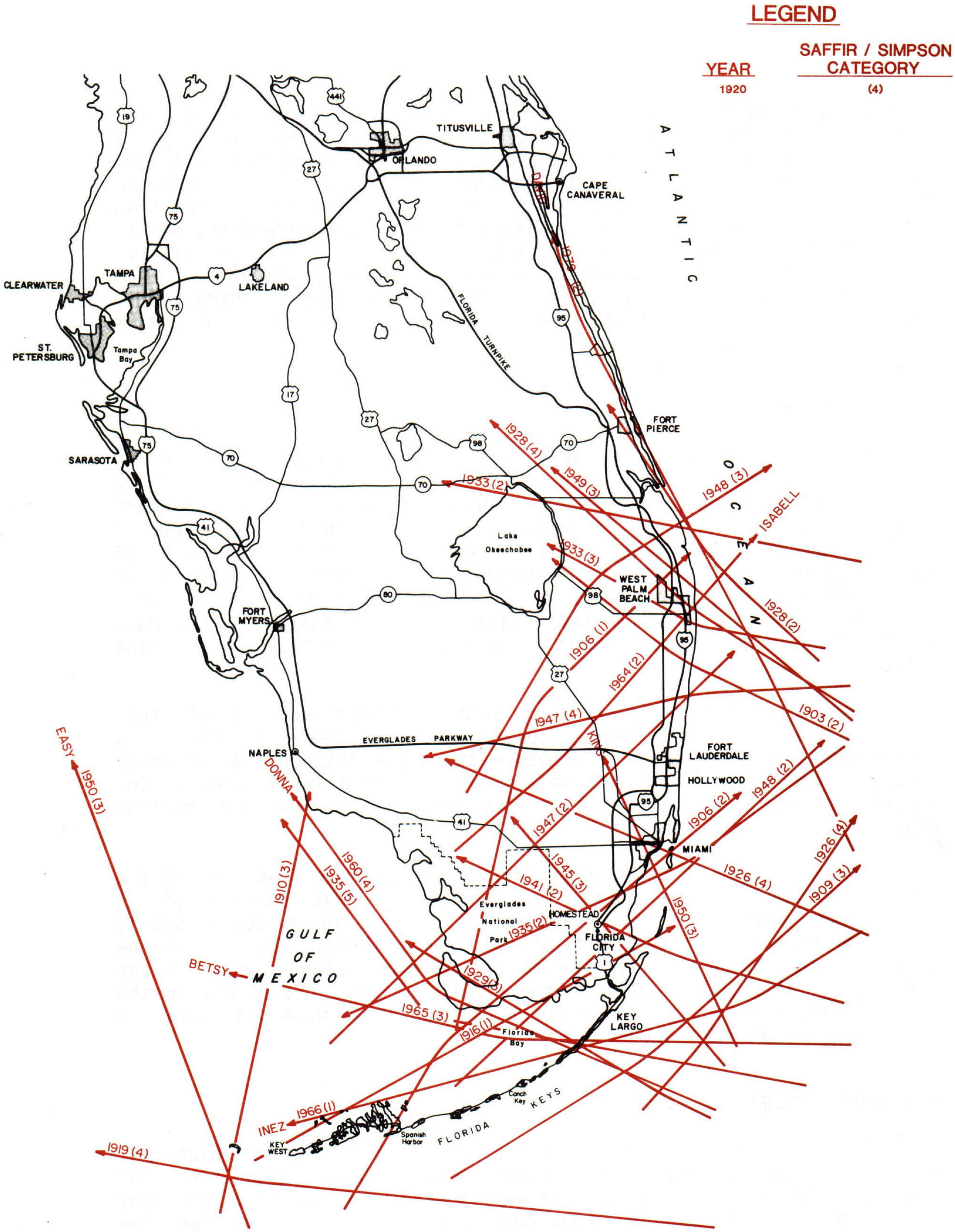
The Intracoastal Waterway is a series of bays and channels that traverses the length of Dade, Broward and Palm Beach Counties. A continuous series of barrier islands east of the Intracoastal Waterway separates much of the mainland peninsula from the Atlantic Ocean. The coastal barrier islands are typically long and narrow with minimal elevations.

The topography of Monroe County is very distinct from that of the three counties to the north. The Florida Keys consist of an archipelago that sweeps for almost 150 miles in a southwesterly direction from southeastern Dade County. The islands that compose the Keys are topographically similar to the barrier islands found to the north, typically being long, narrow and low-lying. Elevations in the Florida Keys are rarely greater than 10 feet above mean sea level and in most cases are much lower.

2.3 ROAD NETWORK

The study area is traversed by a complex system of highways, arterial roadways, and local streets that would convey vehicular traffic during an evacuation. Roadways providing westward access away from the exposed heavily populated coastal fringe comprise the system's critical component for the evacuating population. Figure 5 illustrates the region's major highway network.

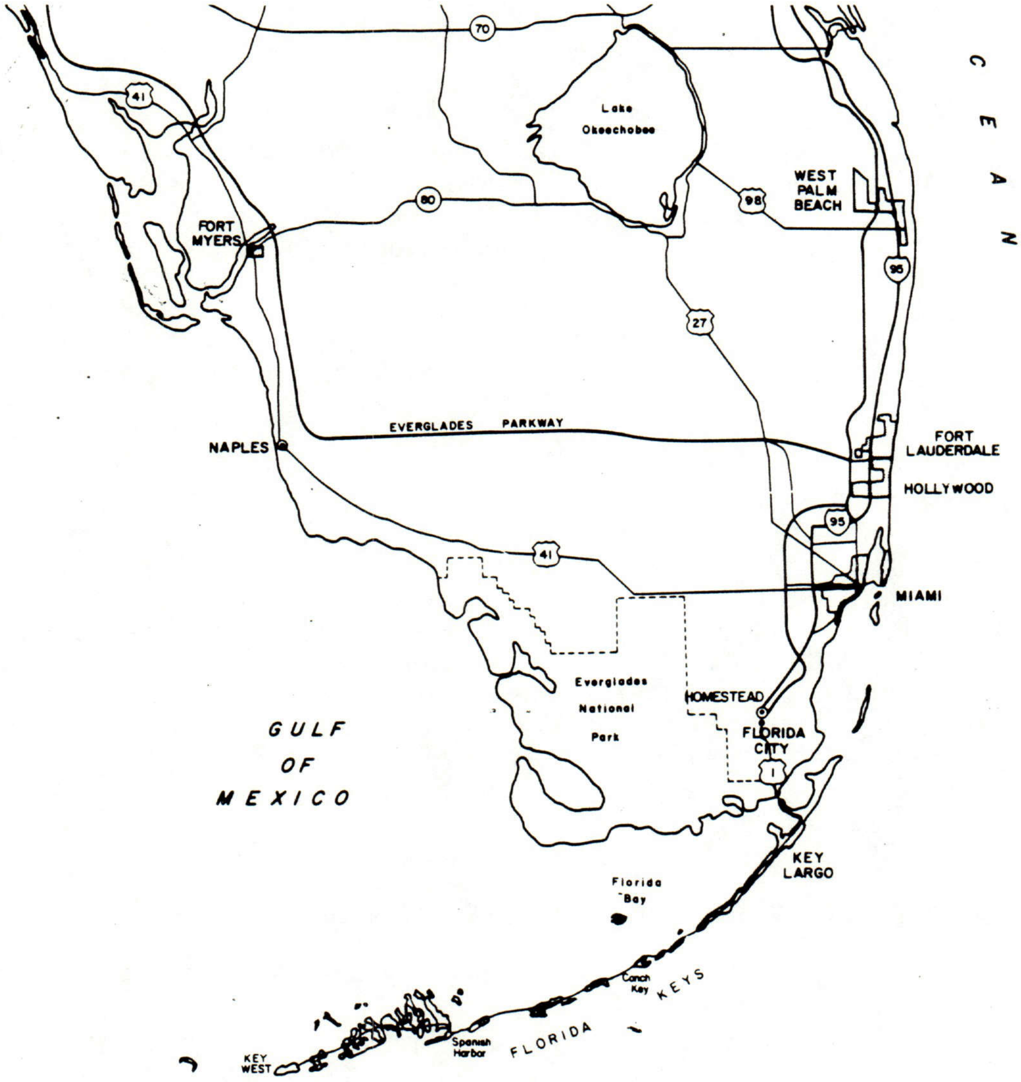
The coastal areas of Dade, Broward and Palm Beach Counties are served by a series of causeways that move traffic to and from the



LOWER SOUTHEAST FLORIDA HURRICANE EVACUATION STUDY

HURRICANE TRACKS SINCE 1900

FIGURE 4



LOWER SOUTHEAST FLORIDA
HURRICANE EVACUATION STUDY

EXISTING HIGHWAY NETWORK

FIGURE 5

barrier islands. These causeways would provide the sole means of evacuation for local residents and tourists, and are typically four-lane arterials. Most have movable span bridges that allow unimpeded movement of boats along the Intracoastal Waterway. Many of the causeway approaches are low and poorly drained, making them prone to flooding.

U.S. Route 1 and Card Sound Road (County Road 905) are the only access routes to the mainland from the Florida Keys. U.S. 1 spans the Keys to Key West with 40 fixed bridges and two bascule bridges. While the Monroe County bridge replacement program is decreasing the danger of mechanical bridge failure, U.S. 1 has several other conditions that present problems for a mass evacuation effort. Significant portions of the roadway have only two lanes, which severely limits traffic capacity. In addition, segments of the route are at very low elevation (less than five feet above mean sea level) and are easily flooded, particularly at the approach to south Dade County in the vicinity of Lake Surprise.

Individuals intending to exit the region entirely when a hurricane threatens would make use of a limited number of major north-south and east-west traffic movers. Florida's Turnpike and Interstate 95 are the major northbound highways serving the study area. Evacuees utilizing I-95 would have to use alternate routes from its terminus in north Palm Beach County for continued northbound travel. Routes A1A, U.S. 1 and U.S. 441 (State Road 7) are urban arterial roads which depart the study area that would also be major distributors for shorter evacuation trips within the region. Routes exiting westward toward the Naples/Ft. Myers urban areas include U.S. 27, U.S. 41 (Tamiami Trail), and State Route 84 (Alligator Alley), which are generally two-lane rural arterials.

2.4 POPULATION AND HOUSING CHARACTERISTICS

The past several decades have marked a period of dramatic growth in the region's resident population. All four counties have shown considerable rates of growth, with the region's population expanding by over 43 percent during the decade between 1970 and 1980. Both Broward and Palm Beach Counties experienced over 60 percent growth in population to arrive at a population of one million and one half million, respectively. Even with less than 30 percent population growth in the decade 1970 to 1980, Dade and Monroe Counties arrived at a population of 1.6 million and 63 thousand, respectively. Concurrently, housing units have also grown at an impressive rate of over 70 percent regionwide in the same ten year period. The fact that most of the population resides in the easternmost quarter of Dade, Broward and Palm Beach Counties means that as the local population increases, the magnitude of threat to life and injury due to the effects of a hurricane increases as well. Table 3 summarizes the growth in population and housing units between 1970 and 1980 for each study area county and for the region as a whole.

TABLE 3

GROWTH IN POPULATION AND HOUSING UNITS 1970-1980

Lower Southeast Florida
Hurricane Evacuation Study

	COUNTY				
	Monroe	Dade	Broward	Palm Beach	Entire Region
Total Population, 1970	52,586	1,267,792	620,100	348,993	2,298,471
Total Population, 1980	63,098	1,625,979	1,014,043	573,125	3,276,245
Percent Change	20.0	28.3	63.5	64.2	43.1
Total Housing Units, 1970	20,731	453,908	253,320	141,363	869,322
Total Housing Units, 1980	38,088	665,414	482,891	294,090	1,480,483
Percent Change	83.7	46.6	90.6	108.0	70.3

Source: 1980 Census of Population and Housing, summarized July 1982

Population, housing and other pertinent demographic data were collected for Dade, Broward and Palm Beach Counties utilizing Traffic Analysis Zones (TAZs) as the basic unit of measure. Traffic Analysis Zonal Data were employed to achieve the following:

- utilize existing traffic data from available Area Transportation Studies
- assemble a comprehensive data base for the transportation modelling portion of this study
- facilitate updating of the study results as new data become available

Data for Monroe County were gathered using Census Divisions as the basic geographic unit of measure. This was necessitated because traffic analysis zones are not established for transportation planning in the Florida Keys.

With 1980 established as the base year for the study, all information utilized was intended to depict 1980 conditions. When 1980 data were not available, projection methods were applied to generate updated information. Population and housing information that was gathered also included inventories of motor vehicle ownership as well as locations and numbers of mobile home dwelling units. Table 4 summarizes the sources of information for key data inputs from each county.

TABLE 4

DATA SOURCES BY COUNTY

Lower Southeast Florida
Hurricane Evacuation Study

	MONROE	DADE	BROWARD	PALM BEACH
POPULATION	1980 Census of Population by Census division	1980 traffic analysis zonal data from Dade County Planning Dept., Research Division	1980 traffic analysis zonal data from Broward County Planning Council, Regional Transportation Review Prog.	1979 zonal data from Area Planning Board of Palm Beach County, MPO staff; recommended by MPO staff as 1980 base data
HOUSING UNITS	1980 Census of Population by Census division	1980 traffic analysis zonal data from Dade County Planning Dept. Research Division	1980 traffic analysis zonal data from Broward County Planning Council, Regional Transportation Review Prog.	Projected from 1976 data, West Palm Beach Urban Area Transportation Study
MOTOR VEHICLES	Monroe County Behavioral Survey	1980 traffic analysis zonal data from Dade County Planning Dept. Research Division	1980 traffic analysis zonal data from Broward County Planning Council, Regional Transportation Review Prog.	Projected from 1976 data, West Palm Beach Urban Area Transportation Study
HOTEL/MOTEL UNITS	"The Florida Keys" inventory by Monroe County Civil Defense	1980 traffic analysis zonal data from Dade County Planning Dept. Research Division	1980 traffic analysis zonal data from Broward County Planning Council, Regional Transportation Review Prog.	1976 zonal data, West Palm Beach Urban Area Transportation Study
MOBILE HOME UNITS/ POPULATION	"The Florida Keys" inventory by Monroe County	Dade County Planning Dept.	Broward County Planning and Administrative Systems Div.	Area Planning Board of Palm Beach County, MPO Staff
RED CROSS SHELTERS/ CAPACITIES	Monroe County Civil Defense	American Red Cross, Dade County Chapter	American Red Cross, Broward County Chapter	American Red Cross, Palm Beach County Chapter
MEDICAL FACILITIES	Health Systems Agency (HSA) of South Florida	Dade County Planning Dept.	Health Planning and Development Council, Inc.	Area Planning Board of Palm Beach County, Palm Beach County Health Planning Council

Socioeconomic data gathered for each traffic analysis zone and census division were then stratified by traffic evacuation zone for use in the transportation analysis. Traffic evacuation zones were developed as an initial step of the transportation analysis and thus are detailed in Chapter 5, Transportation Analysis. The primary importance of establishing traffic evacuation zones was to create sub-county areas that could be used to state which people should evacuate for a particular storm intensity. Ultimately, the zones were used to model traffic movements from one geographic area of a county to another. Monroe, Dade, Broward and Palm Beach Counties were delineated into 5, 47, 33 and 54 traffic evacuation zones, respectively.

In addition to the population and housing unit data reported previously, socioeconomic data by traffic evacuation zone also revealed that a significant number of mobile home units exist in each county. Zonal data developed for Monroe, Dade, Broward and Palm Beach Counties included 2,296, 15,143, 22,541 and 14,818, mobile home units, respectively. These figures become important as all mobile home residents are strongly urged to evacuate for any hurricane intensity. Appendix D summarizes mobile home units by traffic evacuation zone as well as other data compiled for use in the study.

2.5 HOTEL/MOTEL UNITS

Inventories of existing transient accommodations were developed to include the tourist population and numbers of hotel/motel units in subsequent analysis. Seasonal hotel/motel occupancy rates were established using monthly surveys of local tourist establishments conducted by Laventhol & Horwath. Estimates of the tourist population were subsequently generated assuming an average of 1.5 persons per occupied hotel/motel unit, as agreed upon at local review committee meetings. Occupancy rates during the summer months of 1981 ranged from an average of 47.1 percent in the West Palm Beach area to 58.5 percent in the Miami Beach area. Since occupancy data were not available for Monroe County, the Miami Beach highest occupancy figure of approximately 70 percent was used. Table 5 presents the hotel/motel occupancy rates by several months of the hurricane season and an average monthly occupancy figure. For planning purposes, the highest monthly occupancy figure available for each area was used for the study.

TABLE 5

REGIONAL HOTEL/MOTEL OCCUPANCY RATES

Lower Southeast Florida
Hurricane Evacuation Study

	1981 OCCUPANCY RATES (%)				
AREAS	JUNE	JULY	AUGUST	SEPTEMBER	AVERAGE SUMMER OCCUPANCY
West Palm Beach (Palm Beach County)	48.8	47.5	43.6	48.5	47.1
Fort Lauderdale (Broward County)	60.8	62.6	53.9	41.8	54.8
Miami Beach (Dade County)	47.7	71.9	72.2	42.2	58.5

Source: Laventhol & Horvath, "South Florida Trend of Business in the Lodging Industry, Volume II," Numbers 6-9

Note: Laventhol & Horvath does not keep figures on Key West/Monroe County hotel and motel occupancy rates.

2.6 RED CROSS SHELTERS

Lists of designated Red Cross shelters were provided by local Red Cross Chapters. Based on minimum space per evacuee standards established by each Chapter, estimates of shelter capacities within each county were prepared. The total combined area in square feet of the usable sections of public shelters was compared with square footage per person standards to derive shelter capacity. In Monroe, Dade, and Palm Beach Counties, shelter capacities were developed based on 40 square feet per person. In Broward County, 10 square feet per person was used in developing shelter capacity. These figures were used as requested by Red Cross Chapter staff in each county. Resulting totals of Red Cross shelter capacity for Monroe, Dade, Broward and Palm Beach Counties were 6,863, 51,901, 42,950 and 24,349 evacuees. Tables 6 through 9 list designated Red Cross Shelters and their shelter capacities for the four counties; Figures 6 through 9, which are keyed to each preceding table, illustrate the locations of Red Cross shelters provided by Red Cross staff.

2.7 MEDICAL FACILITIES

In order to identify medical facilities that may be threatened during a future hurricane event, lists of hospitals, nursing homes and clinics within each county were compiled. These facilities were included in the regional analysis of flooding and related hazards that can be expected to occur under various projected storm situations. Medical facilities that are identified in Chapter 3 as being vulnerable are required to develop contingency plans for evacuation in conjunction with local hurricane preparedness agencies. Chapter 6 provides discussion related to medical facilities and their special importance in a hurricane evaucation.

In Monroe, Dade, Broward and Palm Beach Counties, 4, 83, 40 and 34 medical facilities, respectively, were identified. Medical facilities identified included community, children's and VA hospitals, as well as specialized nursing homes. Appendix E provides a listing by county of each identified medical facility.

TABLE 6

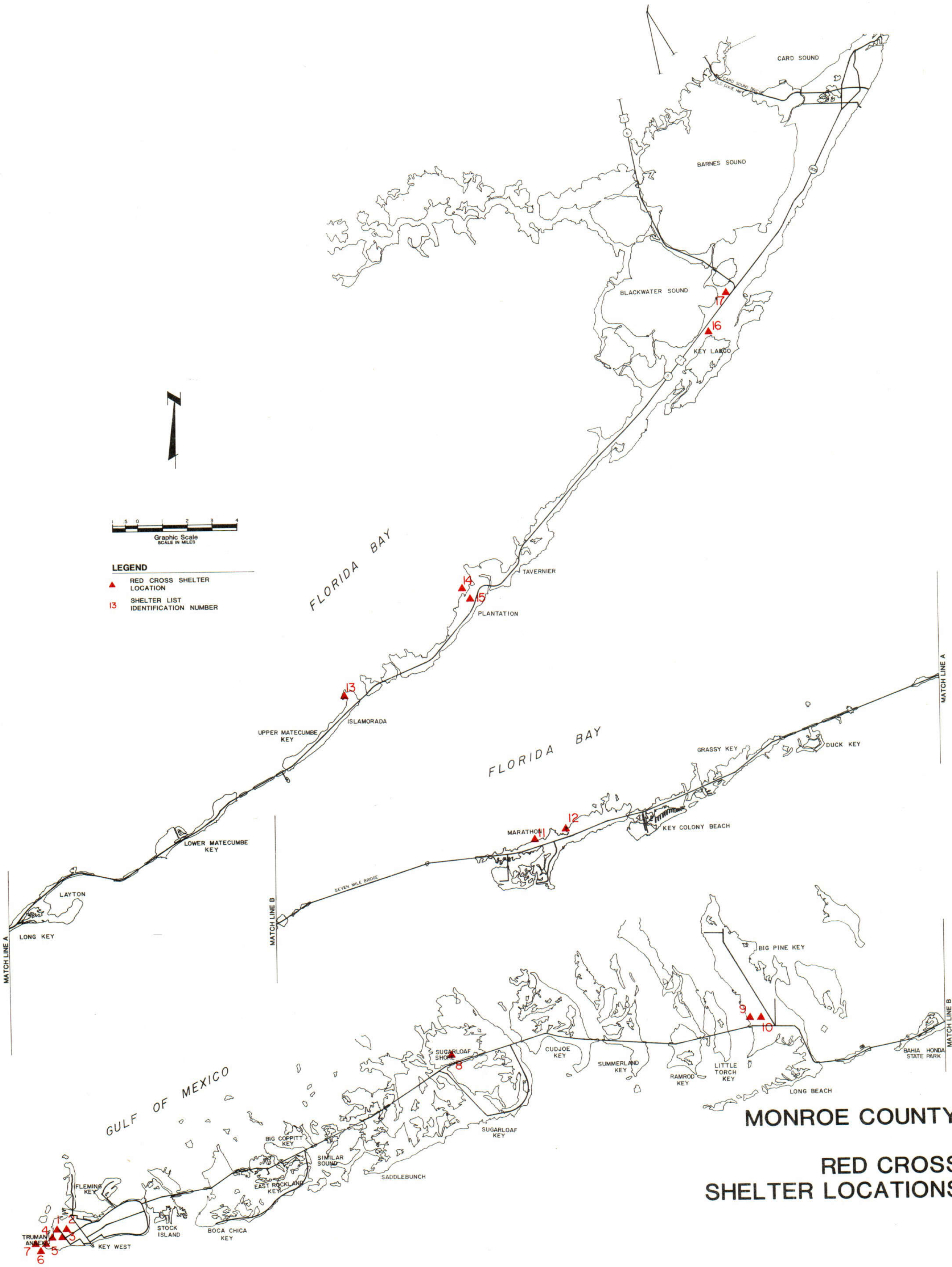
MONROE COUNTY RED CROSS SHELTERS

Lower Southeast Florida
Hurricane Evacuation Study

Shelter	Capacity at 40 Square Feet Per Evacuee
1. Mary Immaculate High School Truman Avenue, Key West	300
2. Harris Elementary School Southard and Margaret Street, Key West	300
3. Glynn Archer School White Street, Key West	700
4. Key West Main Post Office Simonton Street, Key West	500
5. Administration Building Truman Annex	690
6. Fleet Sonar School Truman Annex	874
7. Galley Building Truman Annex	204
8. Sugarloaf Volunteer Fire Department Sugarloaf Key, U.S. 1	100
9. Methodist Church Youth Center Key Deer Boulevard, Big Pine Key	110*
10. Methodist Church Key Deer Boulevard, Big Pine Key	110*
11. Stanley Switlick Elementary School Marathon	300
12. DAV Building Marathon	100
13. Island Christian School Islamorada	500
14. Plantation Elementary School Plantation - Tavenier	750
15. Coral Shores High School Plantation - Tavenier	1,000
16. Key Largo Elementary School Key Largo	1,000**
17. Key Largo Elementary School Cafeteria Key Largo	

*Estimated shelter capacity

**Combined capacity of Shelters 16 and 17



MONROE COUNTY

RED CROSS SHELTER LOCATIONS

FIGURE 6

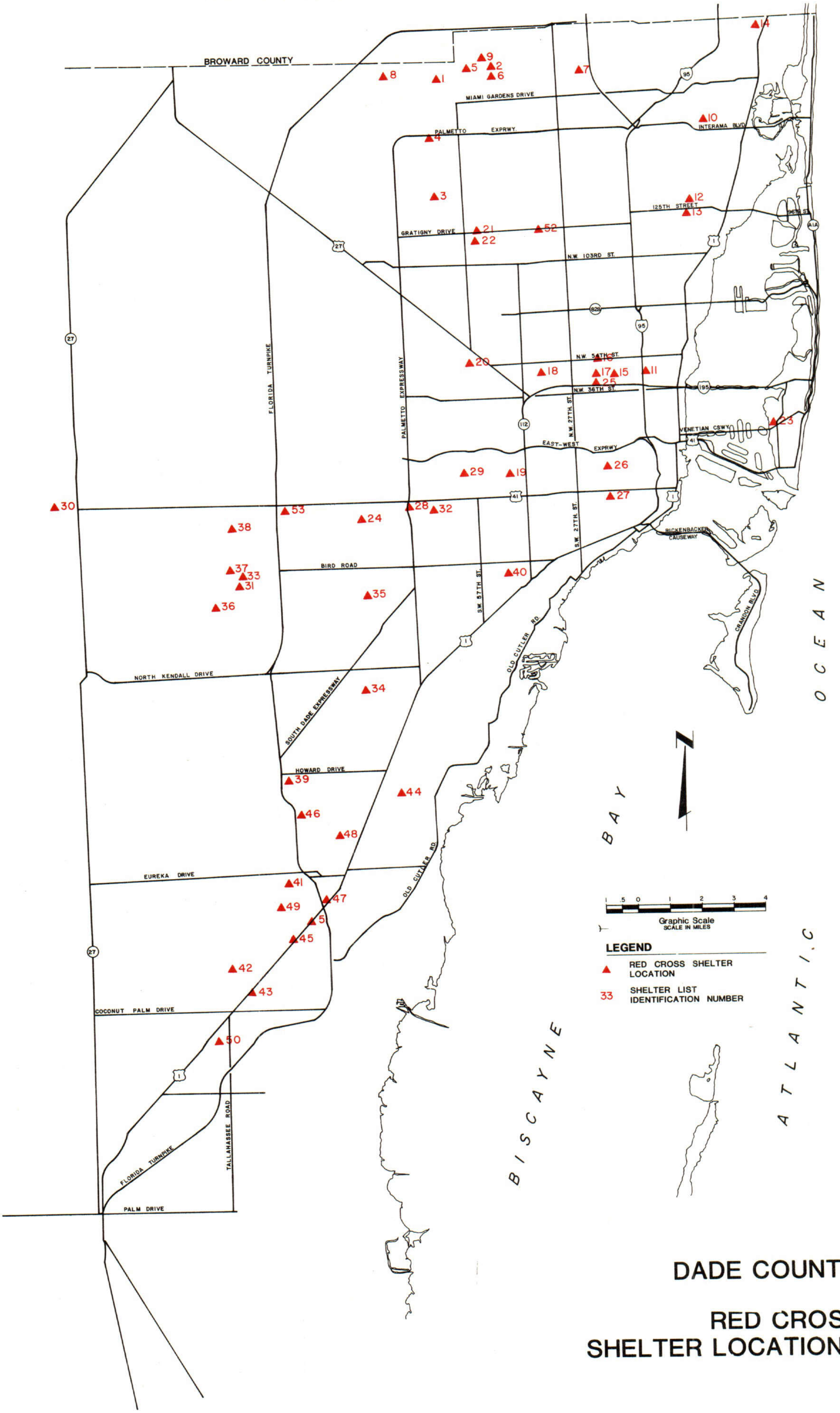
TABLE 7

DADE COUNTY RED CROSS SHELTERS

Lower Southeast Florida
Hurricane Evacuation Study

Shelter	Capacity at 40 Square Feet Per Evacuee
1. American Senior High 1830 NW 67th Ave.	2,000
2. Miami Carol City Senior High 3422 NW 187th Street	1,800
3. Hialeah-Miami Lakes Senior High 7977 W. 12th Ave.	2,000
4. Miami Lakes Junior High School 6425 Miami Lakeway Drive	800
5. Lake Stevens Junior High School 18484 NW 48th Place	800
6. Brentwood Elementary School 3101 NW 191st Street	1,000
7. Norwood Elementary School 19810 NW 14th Court	500
8. Palm Springs North Elementary 17615 NW 82nd Avenue	525
9. Skyway Elementary 4555 NW 206th Terrace	525
10. N. Miami Beach Senior High School 1247 NE 167th Street	2,000
11. Miami Edison Senior High School 6161 NW 5th Court	1,000
12. North Miami Senior High School 800 NE 137th Street	2,000
13. North Miami Junior High School 131105 NE 7th Avenue	420
14. Highland Oaks Junior High School 2325 NE 203rd Street	800
15. Allapattah Junior High School 1331 NW 46th Street	525
16. Drew Middle School 1801 NW 60th Street	500
17. Kelsey Pharr Elementary School 2000 NW 46th Street	550
18. Lorah Park Elementary School 5160 NW 31st Ave.	800
19. Kinlock Park Junior High School 4330 NW 3rd Street	800
20. Miami Springs Senior High School 751 Dove Avenue	900
21. Hialeah Junior High School 6027 E. 7th Avenue	1,000
22. Amelia Earhart Elementary School 5987 East 7th Avenue	1,000
23. Miami Beach Convention Center 1700 Washington Avenue	1,200
24. Miami Coral Park Senior High School 8865 SW 16th Street	2,000
25. Miami Jackson Senior High School 1751 NW 36th Street	1,200
26. Citrus Grove Junior High School 2153 NW 3rd Street	800
27. Shenandoah Elementary School 1023 SW 21st Avenue	676
28. Flagarine Elementary School 920 SW 76th Avenue	600

Shelter	Capacity at 40 Square Feet Per Evacuee
29. Temple Beth Tor 6438 SW 8th Street	200
30. Miccosukee Indian Reservation Tamiami Trail (U.S. 41)	500
31. Miami Sunset Senior High School 13125 SW 72nd Street	2,000
32. South Miami Senior High School 6856 SW 53rd Street	1,350
33. H.D. McMillan Junior High School 13100 SW 59th Street	800
34. Miami Killian Senior High School 10655 SW 97th Avenue	2,000
35. Glades Junior High School 9451 SW 64th Street	540
36. Kendale Lakes Elementary School 8000 SW 142nd Avenue	1,000
37. Royal Green Elementary School 13047 SW 47th Street	1,000
38. W.R. Thomas Junior High School 1301 SW 26th Street	800
39. Gloria Floyd Elementary School 12650 SW 109th Avenue	800
40. Coral Gales High School 450 Bird Road	1,100
41. Miami South Ridge Senior High School 19355 SW 114th Avenue	2,000
42. South Dade Senior High School 28401 SW 167th Avenue	1,400
43. Campbell Drive Junior High School 31110 SW 157th Avenue	800
44. Southwood Junior High School 16301 SW 80th Avenue	800
45. Mays Junior High School 11700 Hamlin Mill Drive	250
46. Pinelake Elementary School 16700 SW 109th Avenue	800
47. Bel Aire Elementary School 10205 SW 196th Street	425
48. R.R. Morton Elementary School 18050 Homestead Avenue	115
49. Caribbean Elementary School 11990 SW 200th Street	500
50. Chapman Elementary School 27190 SW 140th Avenue	250
51. South Dade Government Center 10710 Cutler Ridge Blvd.	500
52. Miami Dade Community College 113rd Street & 27th Avenue NW	2,400
53. Florida International University Tamiami Trail and Turnpike	850



DADE COUNTY

RED CROSS SHELTER LOCATIONS

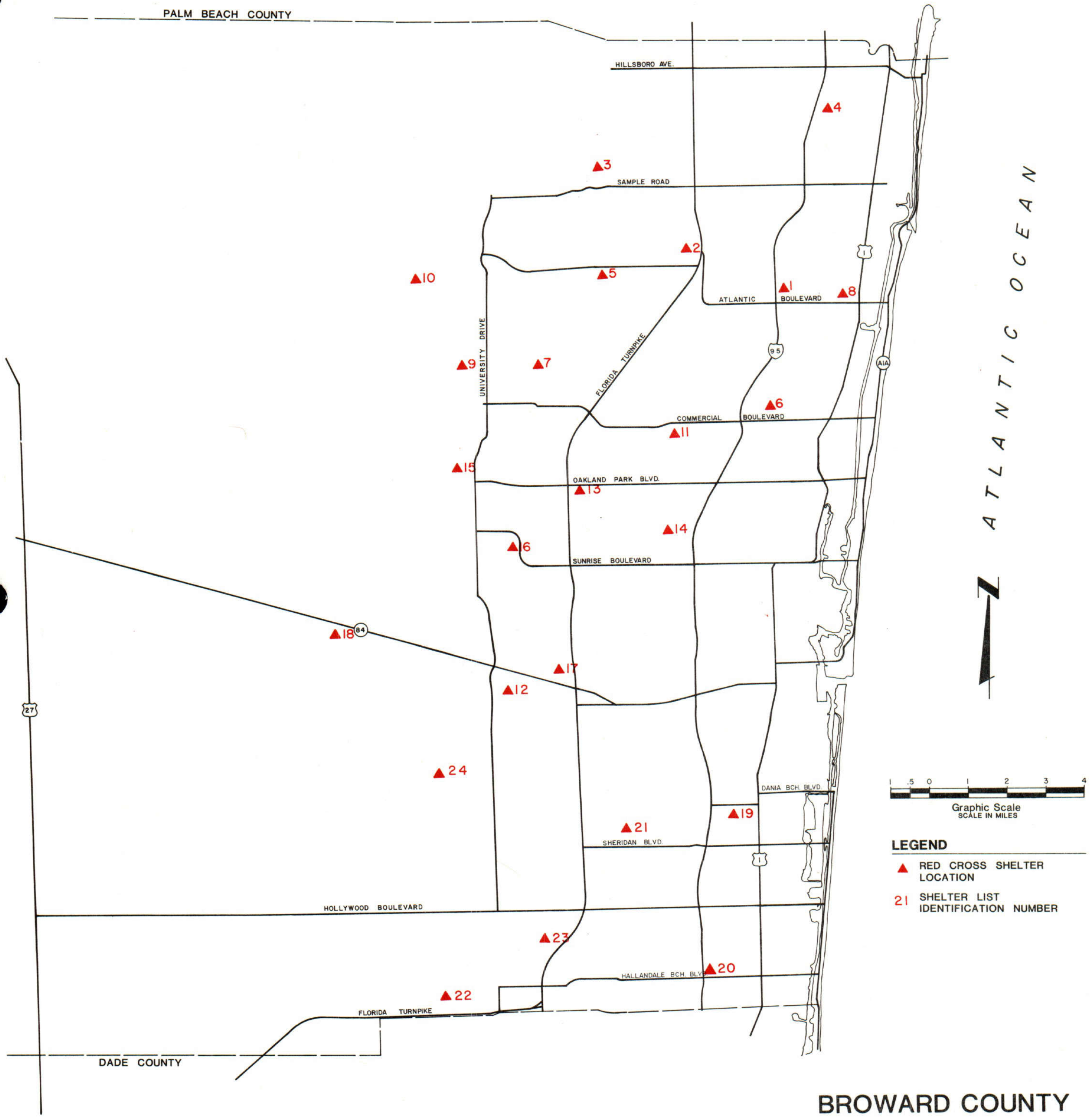
FIGURE 7

TABLE 8

BROWARD COUNTY RED CROSS SHELTERS

Lower Southeast Florida
Hurricane Evacuation Study

Shelter	Capacity at 10 Square Feet Per Evacuee
1. Ely High School 801 NE 10th St., Pompano Beach	2,000
2. Coconut Creek High School 1400 NW 44th Ave., Coconut Creek	2,000
3. Coral Springs High School 7201 Sample Rd., Coral Springs	2,500
4. Deerfield Beach High School 910 SW 15th St., Deerfield Beach	2,000
5. Margate Middle School 500 NW 65th Ave., Margate	(1,200)
6. Northeast High School 700 NE 56th St., Oakland Park	2,000
7. North Lauderdale Elementary 7500 Kimberly Blvd., N. Lauderdale	500
8. Pompano High School 1400 SE 6th St., Pompano Beach	1,000
9. Tamarac Elementary School 7601 N. University Dr., Tamarac	500
10. Taravella High School 10600 Riverside Dr., Coral Springs	1,500
11. Boyd Anderson High School 3050 NW 41st St., Lauderdale Lakes	2,000
12. Broward Community College 3501 SW Davie Rd., Davie	5,000
13. Castle Hill Elementary 2640 NW 46th Ave., Lauderhill	500
14. Dillard High School 2501 N.W. 11th St., Ft. Lauderdale	2,500
15. Piper High School 3000 NW 43rd Place, Sunrise	3,000
16. Plantation High School 6901 NW 16th St., Plantation	2,000
17. South Plantation High School 1300 SW 54th Ave., Plantation	(1,500)
18. Western High School 1200 SW 136th Ave., Ft. Lauderdale	(1,500)
19. Attucks Middle School 3500 NW 22nd Ave., Hollywood	1,500
20. Hallandale High School 720 NW 9th Ave., Hallandale	2,500
21. Hollywood Hills High School 5400 Sterling Rd., Hollywood	2,000
22. Miramar High School 3601 SW 89th Ave., Miramar	2,000
23. Pembroke Pines Elementary School 6700 SW 9th Street, Pembroke Pines	750
24. Pioneer Middle School 5350 SW 90th Avenue, Cooper City	1,000



BROWARD COUNTY

RED CROSS SHELTER LOCATIONS

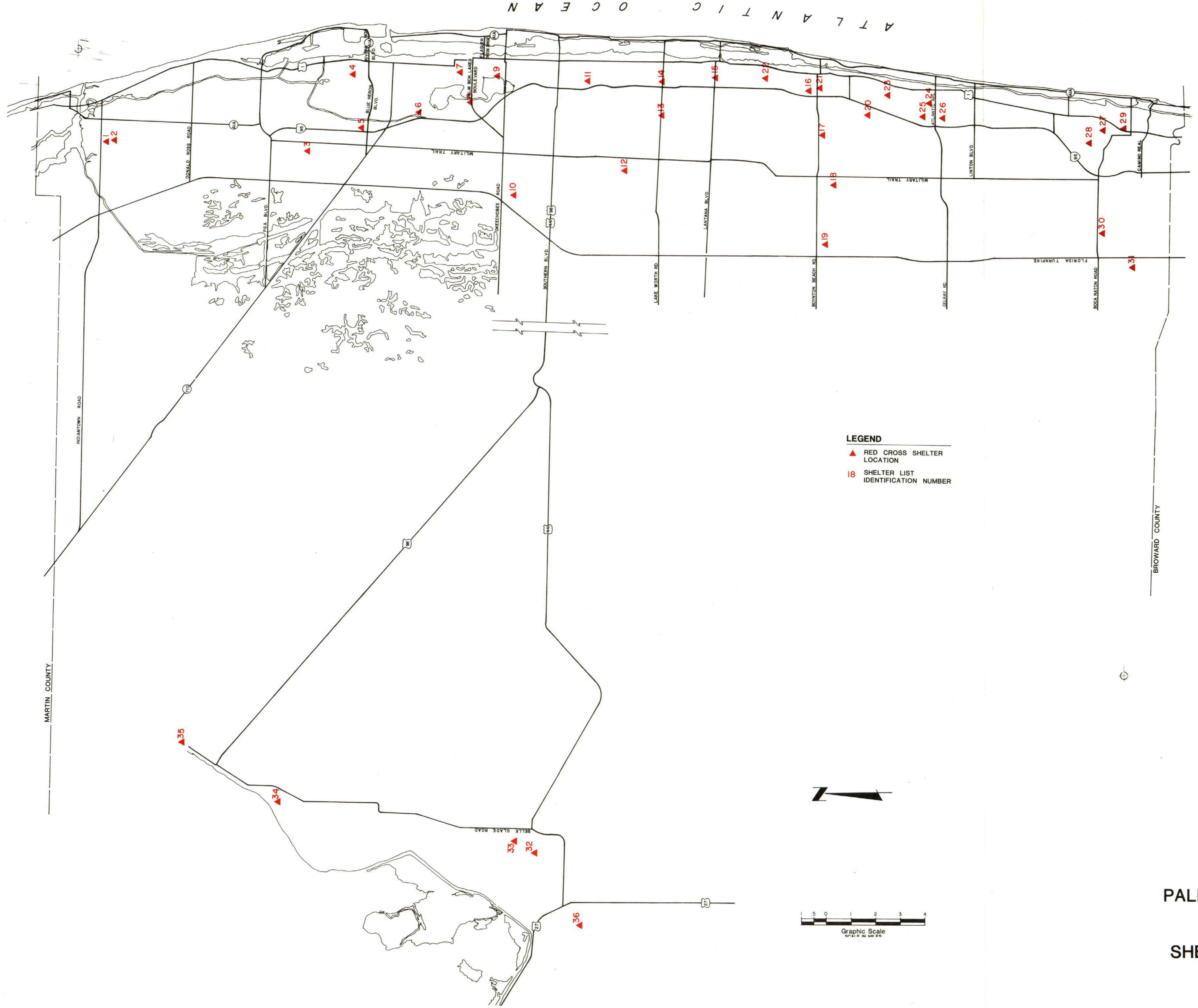
FIGURE 8

TABLE 9

PALM BEACH COUNTY RED CROSS SHELTERS

Lower Southeast Florida
Hurricane Evacuation Study

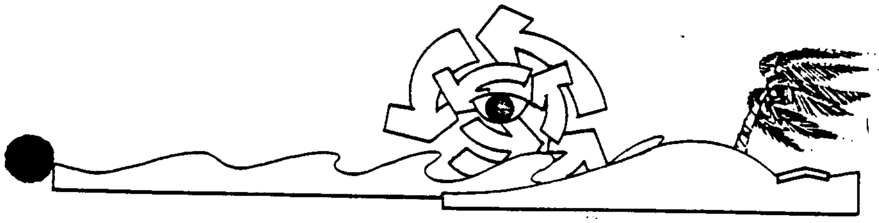
	Shelter	Capacity at 40 Square Feet Per Evacuee
1.	Jupiter High School 601 Toney Penna Dr., Jupiter	650
2.	Jerry Thomas Elementary School 800 Maplewood Dr., Jupiter	3,000
3.	Palm Gardens High School 4245 Holley Dr., Palm Beach Gardens	2,410
4.	Suncoast High School Charger Blvd., Riviera Beach	490
5.	North Tech Educational Center 7071 Garden Rd., Riviera Beach	366
6.	Northshore High School 3701 Northshore Dr., W. Palm Beach	400
7.	Roosevelt Jr. High School 1601 Tamarind, W. Palm Beach	190
8.	West Palm Beach Auditorium Palm Beach Lakes & Congress, W. Palm Beach	4,000
9.	Twin Lakes High School 501 Georgia, W. Palm Beach	350
10.	Wynnebrook Elementary School 1167 Drexel Rd., W. Palm Beach	378
11.	Forest Hill High School 6901 Parker Ave., W. Palm Beach	60
12.	John I. Leonard High School 4701 101th Ave. North, Lake Worth	665
13.	Palm Beach Junior College 4200 S. Congress, Lake Worth	1,440
14.	Lake Worth High School 1701 Lake Worth Rd., Lake Worth	385
15.	Lantana Elementary School 710 Ocean Ave., Lantana	240
16.	Poinciana Elementary School 1400 NW 1st ST., Boynton Beach	200
17.	Congress Community School 101 S. Congress, Boynton Beach	200
18.	St. Vincent de Paul Seminary S. Military 1/2 mi. south of Boynton Road	200
19.	Hagen Road School 10439 Hagen Road, Boynton Beach	670
20.	South Tech Training Center 1300 S.W. 30th Ave. Boynton Beach	270
21.	Boynton Civic Center 128 E. Ocean Ave., Boynton Beach	250
22.	Rolling Green Elementary School 550 Miner Rd., Boynton Beach	290
23.	Atlantic High School 2501 Seacrest Blvd., Delray Beach	405
24.	Delray Civic Center NW 1st Ave., Delray Beach	150
25.	Pompepy Park Recreation Center 240 NW 10th Ave., Delray Beach	220
26.	Carver Middle School 301 SW 14th Avenue, Delray Beach	365
27.	Bibletown Community Church 601 NW 4th Ave., Boca Raton	3,000
28.	Florida Atlantic University 500 NW 20th St., Boca Raton	485
29.	Boca Raton Recreation Center 150 NW Crawford Blvd., Boca Raton	250
30.	Boca Raton YMCA 6631 Palmetto Circle S., Boca Raton	150
31.	Our Lady of Lourdes Church 22094 SW 57th Ave., Boca Raton	250
32.	Palm Beach Junior College 1977 College Dr., Belle Glade	300
33.	Glades Central High School 425 W. Canal St. N., Belle Glade	785
34.	Pahokee High School 360 E. Main St., Pahokee	160
35.	Canal Point Elementary School 300 Everglades St., Canal Point	95
36.	Rosenwald Elementary School 1321 Palm Beach Rd. W., South Bay	630



PALM BEACH COUNTY

RED CROSS
SHELTER LOCATIONS

FIGURE 9



Chapter 3
HURRICANE FLOODING AND HAZARDS ANALYSIS

A key step in this regional hurricane evacuation planning effort involved clearly identifying the extent of flooding and related hazards that may be experienced during a hurricane event. The Lower Southeast Florida Hurricane Evacuation Study employed several computer modelling techniques to project flooding and other hazards caused by selected storm scenarios. Analyses focused on probable worst-case situations within general storm intensity categories. Results from the flooding and hazards analysis facilitate subsequent modelling of evacuation movements by determining two major parameters:

- geographic areas requiring evacuation and areas not requiring evacuation
- the time of arrival of hazards prior to hurricane eye landfall

3.1 DESCRIPTION OF SIMULATED HURRICANES

A total of 191 hypothetical hurricanes was selected by the staff of the National Hurricane Center (NHC) in Coral Gables for simulation within this planning study. These simulated hurricanes included 130 landfalling storms, 24 exiting storms, and 37 paralleling storms. The simulated hurricanes were composed of parameters determined to be meteorologically probable for storms approaching southeast Florida. The input parameters used to compose each simulated hurricane included the following:

- Saffir/Simpson Hurricane Scale Category Number
- barometric pressure drop (millibars)
- storm size (radius of maximum winds in statute miles)
- forward speed (miles per hour)

A listing of the simulated hurricanes and their associated input parameters is contained in Table 10.

The Saffir/Simpson Scale (fully defined in Appendix C) describes the degree of hazard and damage potential generally associated with the full range of hurricane intensities. The Saffir/Simpson Hurricane Scale is a universal scale adopted by the National Hurricane Center (NHC) to describe the expected hazards anywhere along the Gulf or Atlantic coasts. The surge height ranges listed for each

TABLE 10

HURRICANES SIMULATED BY SPLASH

Lower Southeast Florida Hurricane Evacuation Study

Storm Track	Storm Category	Landfall of Eye or Closest Approach	Area Receiving Maximum Surge	Pressure Prop (mb)	Radius Maximum Winds	Forward Speed
NOLS100	1	30 Miles west of Key West	Stock Island	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5		Key West	100	12	12
* NOLS090	1	10 Miles west of Key West	Saddlebunch Key	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5		Stock Island	100	12	12
NOLS080	1	Key West	Kemp Channel	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5		Saddlebunch Key	100	12	12
* NOLS070	1	East Rockland Key	Kemp Channel	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
NOLS060	1	Sugarloaf Key	Pigeon Key	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5		Bahia Honda	100	12	12
NOLS050	1	Big Pine Key	Pigeon Key	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5		Bahia Honda	100	12	12
NOLS040	1	Little Duck Key	Key Colony Beach	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
* NOLS030	1	Vaca Key	Craig Key/Conch Key	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
NOLS020	1	Duck Key	Matecumbe Key	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5		Craig Key	100	12	12
NOLS010	1	Layton	Plantation Key	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5		Matecumbe Key	100	12	12
NOON000	1	Upper Matecumbe Key	South Key Largo	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5		Plantation Key	100	12	12
NORS010	1	Tavernier	Pennekamp State Park	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
* NORS020	1	South Key Largo	North Barnes Sound	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
NORS030	1	Key Largo	North Key Largo	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
NORS040	1	Monroe/Dade County Line	Cutler Ridge	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12

TABLE 10 (continued)

HURRICANES SIMULATED BY SPLASH

Storm Track	Storm Category	Landfall of Eye or Closest Approach	Area Receiving Maximum Surge	Pressure Prop (mb)	Radius Maximum Winds	Forward Speed
NOLS040	1	Elliott Key	Key Biscayne	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
* NOLS030	1	Cutler Ridge	Miami Beach	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
NOLS020	1	Virginia Key	Haulover Beach	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
NOLS010	1	Surfside	Miami Beach Hollywood Beach	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
* NORC000	1	Hollywood Beach	Hillsboro Inlet	30	30	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
NORS010	1	Fort Lauderdale	Ft. Lauderdale Boca Raton	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
NORS020	1	Deerfield Beach	Hillsboro Inlet South Palm Beach	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
NORS030	1	Delray Beach	Boca Raton Palm Beach (north)	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
* NORS040	1	South Palm Beach	South Palm Beach North Lake Worth	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
NORS050	1	West Palm Beach	Palm Beach (North) Jupiter Inlet	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
NORS060	1	Juno Beach	North Lake Worth Martin County	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5			100	12	12
CRLS030	1	Lantana	Jupiter Inlet Jupiter Inlet	30	20	12
	2			40	20	12
	3			60	20	12
* CRLS020	1	West Palm Beach	North Lake Worth	30	20	12
	2			40	20	12
	3			60	20	12
CRLS010	1	Delray Beach	Boca Raton	30	20	12
	2			40	20	12
	3			60	20	12
* CRLN000	1	Pompano Beach	Hillsboro Inlet	30	20	12
	2			40	20	12
	3			60	20	12
CRRS010	1	Hallandale	Key Biscayne	30	20	12
	2			40	20	12
	3			60	20	12
* CRRS020	1	Miami Beach	Key Biscayne	30	20	12
	2			40	20	12
	3			60	20	12
CRRS030	1	Key Biscayne	Cutler Ridge	30	20	12
	2			40	20	12
	3			60	20	12

TABLE 10 (continued)

HURRICANES SIMULATED BY SPLASH

Storm Track	Storm Category	Landfall of Eye or Closest Approach	Area Receiving Maximum Surge	Pressure Prop (mb)	Radius Maximum Winds	Forward Speed
CRRS020	1	Cutler Ridge	Cutler Ridge	30	20	12
	2			40	20	12
	3			60	20	12
PARCIRS020	1	20 Mi. north of Ft. Lauderdale	Ft. Lauderdale	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5		Miami	100	12	12
PARCIRS010	1	10 Mi. north of Ft. Lauderdale	Miami	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5		Miami	100	12	12
PARCION000	1	Over Ft. Lauderdale	Miami	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5		Miami	100	12	12
PARCILS010	1	10 Mi. south of Ft. Lauderdale	Miami	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5		Miami	100	12	12
PARCILS020	1	20 Mi. south of Ft. Lauderdale	Miami	30	20	12
	2			40	20	12
	3			60	20	12
	4			80	20	12
	5		Miami	100	12	12
PARCILS010	1	10 Mi. south of Matecumbe Key	Long Key	30	20	12
	2			40	20	12
	3		Key Largo	60	20	12
PARCION000	1	Over Matecumbe Key	Matecumbe Key	30	20	12
	2			40	20	12
	3		Matecumbe Key	60	20	12
PARCIRS010	1	10 Mi. north of Matecumbe Key	Matecumbe Key	30	20	12
	2			40	20	12
	3		Molasses Reef	60	20	12
PARCIRS020	1	20 Mi. north of Matecumbe Key	Matecumbe Key	30	20	12
	2			40	20	12
	3		Matecumbe Key	60	20	12

Legend: NOR, NOL = Landfalling storm
CRR, CRL = Exiting or crossing storm
PAR = Paralleling storm

Saffir/Simpson storm category are those to be expected in a "standard basin" or average coastal region along the entire Gulf and Atlantic coasts. Therefore, any unique local land mass characteristics are not considered in determining the standard Saffir/Simpson scale surge height ranges. The height of the storm surge is determined not only by the parameters of the hurricane itself, but also the characteristics of the land mass that it approaches. Such characteristics include bathymetric configuration and slope, coastline configuration, and local astronomical tides.

Because of certain land mass characteristics of southeast Florida, surge heights obtained from the computer models for the simulated hurricanes did not fall within the standard ranges listed by the Saffir/Simpson Scale. The ranges also varied from county to county. Modelled surge heights were significantly lower for southeast Florida than those associated with standard Saffir/Simpson categories. Modelled surge heights were generally one to two feet less for the category 1 or 2 storm and 5 to 10 feet less for a category 3, 4, or 5 storm.

Since the determination of flood vulnerable areas is of vital importance in the hurricane evacuation planning process, a clear definition of hurricane flood levels and their components is essential. The total elevation of water causing the flooding is called storm tide. Storm tide consists of three major components: storm surge, astronomical high tide and breaking wave setup. Although the term storm surge has come into common use as equivalent to storm tide, in precise terms, storm surge is only one element of the storm tide elevations that cause flooding hazards during a hurricane. In Monroe County, storm tides were determined to range from 5 to over 15 feet above mean sea level. In Dade, Broward, and Palm Beach Counties the storm tide ranges from 4 to over 15 feet, 3 to over 11 feet, and 3 to over 9 feet, respectively. Table 11 summarizes the worst probable storm tide for each Saffir/Simpson category scale number.

TABLE 11

WORST PROBABLE STORM TIDE RANGES BY COUNTY

Lower Southeast Florida
Hurricane Evacuation Study

SAFFIR/SIMPSON SCALE NUMBER	ELEVATION (FEET ABOVE MEAN SEA LEVEL) MONROE	DADE	BROWARD	PALM BEACH
1	5	5	4	4
2	7	7	5	5
3	10	10	7	6
4	13	13	9	8
5	15+	15+	11+	9+

In addition to the parameters of the hurricane itself, the point of landfall, closest approach, and the angle of approach of the storm affect the location and height of the storm surge. Such characteristics define the track of the hurricane. It should be noted that storm tide elevations are determined for the normal landfalling hurricanes which represent the worst probable storm impacts for southeast Florida.

All of the exiting tracks and some of the paralleling tracks which travel over land, have not been simulated as Category 4 and 5 hurricanes. As hurricanes travel over land, they diminish in strength; therefore, the stronger Category 4 and 5 hurricanes are not likely to occur on these tracks.

3.2 DESCRIPTION OF HURRICANE COMPUTER MODELS

The computer modelling for the flooding analysis was done in three parts. The first part was performed by the National Hurricane Center and involved computing the open coast surge levels using the Special Program to List Amplitudes of Surges from Hurricanes (SPLASH).[1] The second part, performed by PBS&J, involved routing the hurricane surge and astronomical tide inland using the TTSURGE program.[2] The final program in the series, called NTRPL, added the breaking wave setup components to the surge and astronomical high tide components to yield total <u>storm tide</u>. In combination, these computer models are able to simulate the storm tide elevations resulting from hypothetical hurricanes with selected combinations of central pressure depression, forward speed, track and winds.

The first hurricane simulation model, SPLASH, was applied to calculate the height and duration of open coastline storm surge heights created by an approaching and landfalling hurricane. The model may be applied to any segment of Gulf or Atlantic coast; however, it assumes a generalized smooth coastline and does not consider the amplification of surge by a bay or estuary. The output of SPLASH provided data on the following effects of a simulated hurricane:

- peak surges along the coastline
- time histories of surges along the coastline
- computed wind speeds along the coast
- computed wind directions along the coast

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[1]Chester P. Jelesnianski, "SPLASH (Special Program to List the Amplitudes of Surges from Hurricanes), Part I-Landfall Storms," NOAA Technical Memorandum, NWS TDL-#46.

Chester P. Jelesnianski, "SPLASH" (Special Program to List the Amplitudes of Surges from Hurricanes), Part II-General Track and Variant Storm Conditions," NOAA Technical Memorandum, NWS TDL-#52.

[2]Tetra Tech, <u>Coastal Flooding Storms Surge Model</u>, Federal Emergency Management Agency, FIA, Washington, D.C., May 1980.

In the second analysis step, inputs to the inland routing model, TTSURGE, included the following: (1) all the SPLASH program inputs; (2) the SPLASH predicted surge heights at the coast; (3) the elevations and relief of the land; and (4) the bathymetry of the bays and rivers. TTSURGE uses well established mathematical equations describing a storm driven tidal surge. The generation and propagation of the storm surge are governed by the laws of continuity of mass and momentum, including driving forces of surface wind stress and atmospheric pressure gradients, the retarding force due to bottom friction, and inertia forces due to convective and Coriolis accelerations. TTSURGE also adds the astronomical high tide to the surges propagated inland.

The study area was approximated by a two-dimensional rectangular grid. The grid size was chosen to represent the shape and relief of the study area. Three separate grids were then designed for Dade, Broward and Palm Beach Counties. No inland routing of the surges was performed in Monroe County since the Keys are composed of a narrow string of small islands. It was assumed that the surge elevations computed by SPLASH propagate uniformly across each key. Since the grid systems are composed of 1 mile segments, the model is not suitable to handle differences in channel widths in the Keys.

The two-dimensional grid in TTSURGE employs a moving boundary inland, an embedded one-dimensional river model, and a special treatment for barriers such as offshore barrier islands and inland bridge embankments. The moving boundary allows the propagation of surges into the low lying coastal areas, with the limit of flooding being a part of the numerical solution. The surge was propagated over each grid rectangle step-by-step until a grid rectangle of sufficient elevation was encountered to block the flow.

The embedded one-dimensional model, which was used to represent inland rivers and the intracoastal waterway, allows water to be conveyed inland without the surrounding higher ground being flooded. TTSURGE simulates the propagation of storm surge and astronomical high tide into higher flood plains surrounding rivers and canals in the area.

A third special feature of the TTSURGE model is the handling of natural or man-made narrow barriers. Offshore barrier islands and inland road or bridge embankments can be modelled. Inlets can be specified and if the surge overtops the barrier, weir flow is computed.

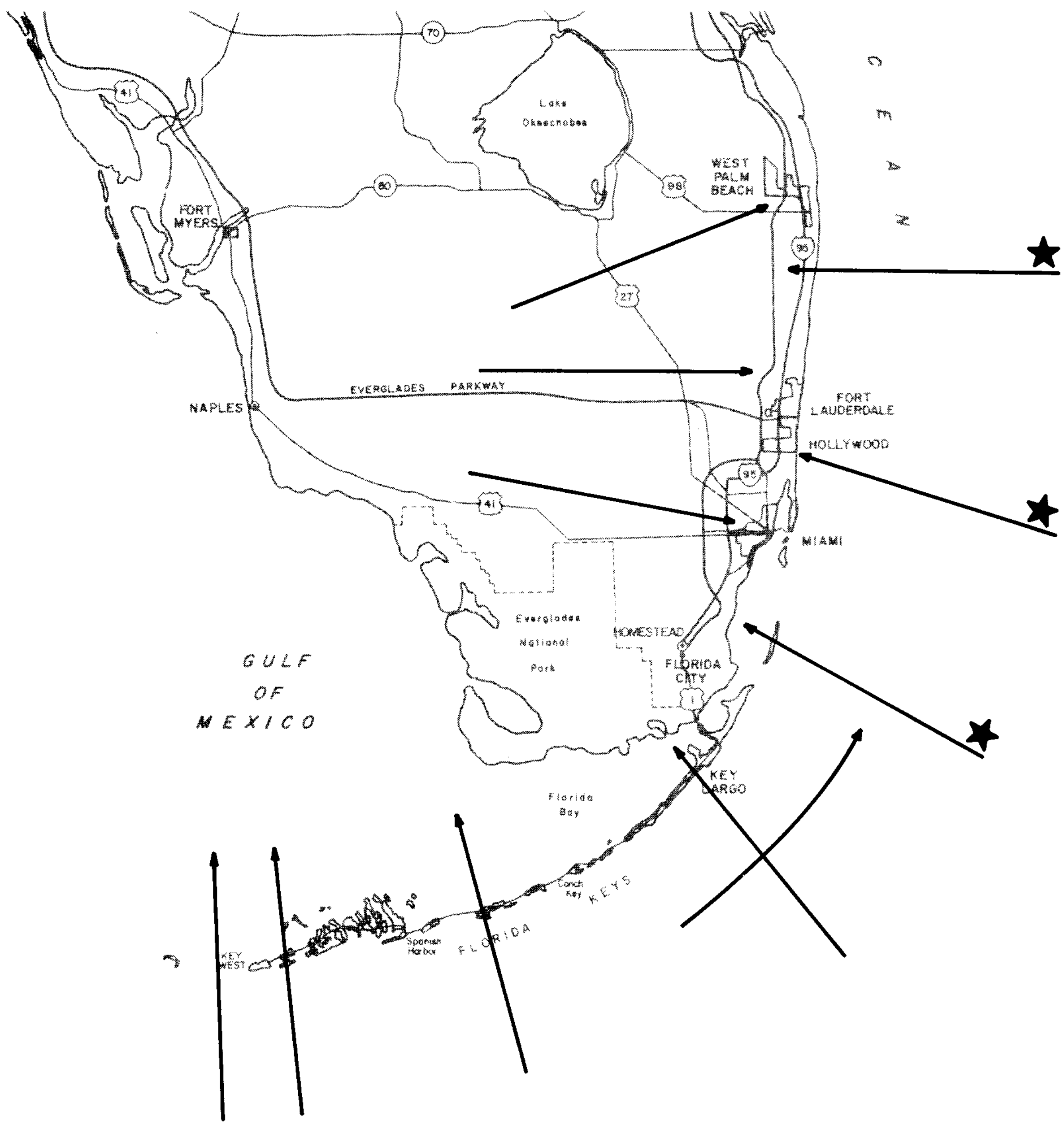
Since evacuation analysis was performed for the worst probable threat of each storm category, only one worst case landfalling hurricane track was run in each of the three counties where inland routing was performed. Along each track, the Category 1, 3 and 5 hurricanes were simulated. For Dade County, the reference hurricane was a landfalling storm at the Perrine Cutler Ridge area. Broward County's reference hurricane involved a landfalling storm at Hollywood. For Palm Beach County, the reference hurricane used was a landfalling storm at the Boynton Beach area. Due to the extreme length of Monroe County, several storm tracks were selected as reference hurricanes for quantification of storm tides and for transportation analysis. Figure 10 illustrates all reference hurricanes, including those for Dade, Broward, and Palm Beach Counties selected from the SPLASH runs for use in the inland routing by TTSURGE. Paralleling and exiting reference hurricanes are also provided.

These hurricanes were simulated to hit land during astronomical high tide. The hurricane surges by time history, obtained from SPLASH, were added to the astronomical tides and then input to TTSURGE. TTSURGE predicts water levels due to the combined effects of hurricane pressure surges and astronomical tides throughout the basin. The NTRPL program outputs storm tide. Storm tide is the set of peak water elevations throughout the entire study area, plus time histories of the water elevations at selected points throughout the study area.

During the third model application step, the water elevations and extent of flooding for the Category 2 and 4 hurricanes were interpolated from the 1, 3 and 5 hurricane results. The interpolation of these two events was performed by a computer program developed by PBS&J called NTRPL. This program used the output from TTSURGE for the peak elevations and computed interpolated values. The program also added the breaking wave setup to the surge and astronomical tide elevations. This breaking wave setup reflects a rise in the water levels due to the effects of breaking waves.

It should be noted that when the study was initiated, the National Hurricane Center (NHC) in Coral Gables, Florida was in the process of developing their SLOSH computer model for the area surrounding Biscayne Bay in Dade County, Florida. The SLOSH computer model performs functions and has capabilities similar to those of TTSURGE. Waiting for the NHC to complete this work to include in the report would have delayed the project considerably; therefore, inland routing of the hurricane surges was determined with the TTSURGE computer model. After the inland routing was complete, the National Hurricane Center provided preliminary SLOSH runs for the landfalling reference hurricanes in Dade, Broward and Palm Beach Counties for comparison purposes only.

The SLOSH and TTSURGE runs were compared to understand similarities and dissimilarities in modelled surge effects. There was general agreement in most areas. Where comparisions were performed, storm surges varied by a maximum of one to two feet. Future updates of the Lower Southeast Florida Hurricane Evacuation Study should incorporate the results of the SLOSH models developed for Biscayne Bay and Florida Bay. It must be noted that since model results compared favorably, the SPLASH and TTSURGE storm tide results were used exclusively for this study.



★ STORM TRACK USED IN INLAND ROUTING

LOWER SOUTHEAST FLORIDA HURRICANE EVACUATION STUDY

REFERENCE HURRICANES

FIGURE 10

3.3 HURRICANE HAZARDS

The three major hazards produced by a hurricane are the high winds, storm tide and rainfall. Of these, storm tide is by far the most dangerous, historically causing 9 out of 10 hurricane-related deaths. High winds of a hurricane can also have a devastating effect on persons outdoors or inside unsound structures during the passage of the storm. Finally, although rainfall usually does not directly cause death in a hurricane, it may inundate potential evacuation routes and prevent persons from evacuating areas vulnerable to the storm tide.

While storm tide has been demonstrated to be a hurricane's most life-threatening danger, the arrival of gale force winds as a storm approaches is the most significant hazard related to the timing of an evacuation order. Predictive analyses of the geographic extent of flooding identify that portion of the population most vulnerable to a hurricane's storm tide. The arrival of gale force winds before landfall, however, marks the time beyond which an evacuation should no longer continue. Dangerously high winds usually arrive at the coastline hours before the storm surge or the eye of the hurricane. Evacuation activities cannot be carried out safely after winds reach sustained gale force (39 mph). This study, therefore, maintains as a central assumption that all evacuation movements should be completed before winds increase to sustained gale force intensity.

3.3.1 High Winds

Tropical cyclones become hurricanes when their maximum sustained wind velocity exceeds 74 miles per hour (mph). Hurricane winds have been recorded as high as 190 mph. The fury of a hurricane's winds can be extremely hazardous to residents of structures unable to withstand potential wind loading and uplift forces that can occur. For this reason, it is recommended that all residents of mobile homes evacuate to more reliable shelter when threatened by the direct hit of a hurricane.

As part of this study, inventories of mobile home dwelling units and population were assembled for each of the four counties. Mobile home residents were included (along with those residing in areas vulnerable to storm tide) in calculations of the total population-at-risk. Both groups are treated as being equally vulnerable to the effects of a hurricane. As a hurricane approaches, the affected area will experience increasing wind velocities and rainfall intensities. As stated before, the point at which sustained gale force winds arrive is significant because evacuation procedures cannot be conducted safely thereafter. The SPLASH and SLOSH computer models provided data regarding the time of arrival and subsequent duration of gale force winds. This information, as well as the time of inundation (if flooding occurs), was then available for key roadway points throughout the study area. The SPLASH and SLOSH models were used to generate these data because the TTSURGE model does not print out the time histories of wind speeds.

Since the key forecast information provided to local entities by the NHC is the projected time of eye landfall, this point in time is used in the study for all evacuation time component analyses, including the prediction of the arrival of sustained gale force winds. The SPLASH and SLOSH models calculate the time of eye landfall of the hurricane based on model inputs and assigns an hour and date to this point in time. It then begins computing average wind speeds in ten minute intervals for the grid point approximately 18 hours before simulated eye landfall and continues the wind speed estimates until approximately 12 hours after simulated eye landfall. Since the SPLASH model computes wind speeds at the coastline, only the coordinate of the roadway point parallel to the coast is used to identify it. These wind speeds result in a conservative estimate of the arrival of gale force winds and represent the worst case for each situation.

Hazards data from the hurricane simulation models documented when gale force winds would arrive for each reference hurricane. As described in Chapter 6, Evacuation Planning Implications, each reference hurricane was used to develop 17 regional storm scenarios. Table 12 summarizes the highest gale force wind pre-landfall hazards time for each regional storm scenario. For each affected county or area, these gale force wind times were determined by reviewing computer printouts for all analyzed roadway points. For Monroe County, gale force winds pre-landfall hazards times ranged from 10 to 14 hours in the Lower Keys, 9 to 13 hours in the Middle Keys, and 7.5 to 11.5 hours in the Upper Keys. For Dade, Broward and Palm Beach Counties, gale force winds pre-landfall hazards times ranged from 6.5 to 11.5 hours in each county. Appendix F provides the listing of roadway points analyzed for gale force winds <u>and</u> surge pre-landfall hazards times.

3.3.2 Storm Surge and Storm Tide

As a hurricane crosses the continental shelf and moves close to the coast, mean water level may increase 15 feet (5 meters) or more. The advancing storm surge combines with the normal astronomical tide and breaking wave setup to create the hurricane storm tide at the open coast. In addition, wind driven waves five to ten feet high are superimposed on the storm tide. This buildup of water level can cause severe flooding in coastal areas, particularly when the storm surge coincides with normal high tides. A storm tide was recorded as high as 24 feet at the Mississippi coastline during Hurricane Camille in 1969. The higher the surge builds over the sea, the more land will be inundated by the propagation of its water over areas of low elevation. In addition, the devastating power of the storm tide increases with height. For a hurricane making landfall on the east coast of Florida, the maximum height of the storm tide will be experienced north of where the eye actually crosses the coast.

Many factors are involved in the formation and degree of propagation of the storm surge element of a storm tide. These include the intensity of the hurricane, size of the hurricane, forward speed of the hurricane, bottom conditions where the surge comes ashore, the

TABLE 12

GALE FORCE WINDS
PRE-LANDFALL HAZARDS TIME*

Lower Southeast Florida
Hurricane Evacuation Studv

Reaional Storm Number	Saffir/ Simpson Cateaory	Landfall at	Lower Kevs	Middle Kevs	Upper Kevs	Dade	Broward	Palm Beach
1	1-2	15 mi. west of Kev West	10.0	---	---	---	---	---
2	1-2	Boca Chica	11.5	9.5	---	---	---	---
3	3-5	Boca Chica	14.0	12.5	---	---	---	---
4	1-2	Marathon	---	9.0	7.5	---	---	---
5	3-5	Marathon	---	13.0	11.0	---	---	---
6	1-2	Kev Larao	---	---	7.5	6.5	---	---
7	3-5	Kev Larao	---	---	11.5	7.5	6.5	---
8	1-3	Perrine-Cutler Ridae	---	---	---	9.5	7.5	---
9	4-5	Perrine-Cutler Ridae	---	---	---	11.5	7.5	---
10	1-3	Hollvwood	---	---	---	---	9.5	6.5
11	4-5	Hollvwood	---	---	---	6.5	11.5	7.5
12	1-3	Bovnton Beach	---	---	---	---	---	10.0
13	4-5	Bovnton Beach	---	---	---	---	---	11.5
14	Paralleling Storm Reaionwide		11.5	9.0	7.5	9.5	9.5	10.0
15	1-3	Exitina at Miami Beach	---	---	---	10.5	7.5	---
16	1-3	Exitina at Pompano Beach	---	---	---	---	9.5	6.0
17	1-3	Exitina at West Palm Beach	---	---	---	---	---	8.0

Leaend:
UPPER KEYS = Channel Five Br. to Kev Larao
MIDDLE KEYS = Seven Mile Br. to Channel Five Br.
LOWER KEYS = Kev West to Seven Mile Br.

*In hours before hurricane eve landfall

position or angle of the hurricane's track as it crosses the coastline, and the physical configuration of the coastline where the surge comes ashore. Generally, shallow water located off a coast where the hurricane comes ashore increases the surge height. Also, the closer to perpendicular that the track of the hurricane follows in relation to the coastline, the higher the surge will be. Finally, the presence of a major bay, inlet, or river mouth where the surge comes ashore can greatly amplify the height of the storm tide as it moves from the bay or river mouth to the back of the bay or up the river. This is often referred to as the "funnelling effect."

3.3.2.1 Flooding of Urban Area Traffic Analysis Zones

The Lower Southeast Florida Hurricane Evacuation Study employed urban area traffic analysis zones as the smallest geographic unit of measure to target vulnerable population for evacuation. Combinations of zones to be evacuated varied based upon the category of storm and the extent of local flooding under a given storm scenario forecast by computer modelling. The extent of flooding in each scenario was computed by the TTSURGE model and the NTRPL program for Dade, Broward, and Palm Beach Counties and by SPLASH for Monroe County. The results of the computer modelling are included and used in Chapter 5, Transportation Modelling, to implement evacuation strategies for the four counties under each evacuation scenario.

The determination of the extent of evacuation required under each of the five category storm situations for each county is stated by using the results of the computer modelling to show which TTSURGE grid elements are flooded. The traffic analysis zones in each flooded grid element are assumed to be flooded with over one foot of storm tide. A key in the determination of the areal extent to be evacuated was the use of the traffic analysis zones (TAZs) as the units of geographic area clustered together to compose them. Thus, the detail of both the extent of evacuation for each scenario and the traffic-evacuation zones developed in the transportation analysis task is defined by the size of the traffic analysis zones.

Chapter 5, Section 5.2.2, outlines the assumptions made concerning population-at-risk and explains the development of traffic evacuation zones based on clusters of flooded urban area traffic analysis zones. Assumed flood limits based on two storm groupings for each county will also be presented in Chapter 5.

3.3.2.2 Flooding of Shelters and Medical Facilities

A major analysis that must be undertaken when determining the feasibility of utilizing a particular structure as a public shelter is the structure's geographic location and its elevation as it would be affected by storm tide flooding. This same type of analysis must be undertaken when determining whether special in-patient care facilities such as hospital and nursing homes must be evacuated from the effects of forecasted storm tide. The envelope of highest surges provided by the TTSURGE model made it possible to undertake the analysis for every designated public shelter, hospital, and nursing home throughout the region.

Red Cross shelters in Broward and Palm Beach Counties were found to be entirely out of the flood vulnerable areas. However, in Dade and Monroe Counties several shelters may experience some storm tide depending upon the ground floor elevation and category of storm. In Monroe County, 15 Red Cross shelters may experience storm tide flooding, particularly for the more intense storms. Dade County has 6 Red Cross shelters that may experience flooding. Table 13 presents Red Cross shelters that may experience storm tide by county.

Those hospitals and nursing homes in zones experiencing storm tide flooding in each county are listed in Table 14. Although Palm Beach County has no facilities in vulnerable areas, Monroe, Dade and Broward Counties have 5, 19 and 5 vulnerable facilities, respectively. Chapter 6, Evacuation Planning Implications, will explain special evacuation considerations for these facilities.

3.3.2.3 Roadway Flooding Locations and Times

Because of the characteristics of a hurricane, its approach usually creates a storm tide high enough to inundate and block potential evacuation routes hours before the eye of the storm actually reaches the coast (eye landfall). This is especially true in southeast Florida with very low-lying coastal roadways and low bridge approaches leading from the vulnerable barrier islands. Although wind hazards usually arrive before storm tide floods roadway links, it is important to review critical flooding points.

The time histories of storm tides at selected grid points provided by each simulation of a hurricane through the TTSURGE model were utilized to predict when certain critically low roadway points would become inundated. The grid points were chosen to represent over 200 roadway points located in Monroe, Dade, Broward and Palm Beach Counties. The elevations of these points were determined from storm evacuation maps obtained from NOAA. By comparing these elevations to the time histories of the surges obtained by the computer modelling the time that they are flooded was determined. Appendix F, as stated previously, provides storm tide inundation times by roadway point.

Inundation of roadway points was looked at further to determine storm tide pre-landfall hazards time by regional storm scenario. Inundation of roadways would occur in the Lower, Middle and Upper Keys areas of Monroe County from 4 to 5.5, 2.5 to 3.5, and 2.5 to 4 hours before eye landfall, respectively. In Dade, Broward and Palm Beach Counties, these times range from 1 to 3 hours before eye landfall. Table 15 presents the storm tide pre-landfall hazards times by regional storm scenario by county.

TABLE 13

RED CROSS SHELTERS EXPERIENCING STORM TIDE

Lower Southeast Florida
Hurricane Evacuation Study

(Numbers in parentheses are storm categories for which flooding occurs.)

Monroe County

Mary Immaculate High School (4-5)
Harris Elementary School (3-5)
Glynn Archer School (3-5)
Key West Main Post Office (4-5)
Truman Annex Administration Building (5)
Fleet Sonar School (5)
Truman Annex Galley Building (5)
Sugarloaf Volunteer Fire Department (4-5)
Methodist Church and Youth Center Big Pine Key (3-5)
Stanley Switlick Elementary School (4-5)
DAV Building, Marathon (4-5)
Island Christian School, Islamorada (5)
Plantation Elementary School (5)
Coral Shores High School (5)
Key Largo Elementary School and Cafeteria (5)

Dade County

Chapman Elementary (4-5)
Campbell Drive Junior High (4-5)
South Dade Government Center (4-5)
Mays Junior High (4-5)
Bel Aire Elementary (4-5)
Miami Beach Convention Center (1-5)

Broward County

None

Palm Beach County

None

TABLE 14

HOSPITALS AND NURSING HOMES EXPERIENCING STORM TIDE

Lower Southeast Florida
Hurricane Evacuation Study

(Numbers in parentheses are storm categories for which flooding occurs.)

Monroe County

Mariner's Hospital (5)
Fisherman's Hospital (4-5)
DePoo Hospital (4-5)
Florida Keys Memorial Hospital (3-5)
Florida Keys Memorial Nursing Home (3-5)

Dade County

Miami Heart Institute (2-5)
Mt. Sinai Hospital of Greater Miami (1-5)
Mercy Hospital Inc. (4-5)
North Miami General Hospital (3-5)
South Shore Hospital and Medical Center (1-5)
U.S. Air Force Hospital (3-5)
Victoria Hospital, Inc. (3-5)
East Ridge Lutheran Retirement Village (1-5)
Fountainhead Nursing Home (3-5)
Four Freedoms Manor (3-5)
Greynolds Park Manor Rehabilitation Center (4-5)
Lincoln Memorial Nursing Home (4-5)
Lutheran Medical Center (2-5)
Miami Beach Hebrew Home for Aged (3-5)
Palm Convalescent Home (5)
Royal Glades Convalescent Home (4-5)
Towne House for Convalescents (2-5)
Treasure Isle Convalescent Home (2-5)
Villa Maria Nursing and Rehabilitation Center (5)

Broward County

North Beach Medical Center (3-5)
Doctors Hospital of Hollywood (5)
Dania Nursing Home (3-5)
Golden Isles Convalescent Center (4-5)
Golferest Nursing Home (4-5)

Palm Beach County

None

TABLE 15

STORM TIDE
PRE-LANDFALL HAZARDS TIME*

Lower Southeast Florida
Hurricane Evacuation Study

Regional Storm Number	Saffir/ Simpson Category	Landfall at	Lower Keys	Middle Keys	Upper Keys	Dade	Broward	Palm Beach
1	1-2	15 mi. west of Key West	4.0	---	---	---	---	---
2	1-2	Boca Chica	4.0	2.5	---	---	---	---
3	3-5	Boca Chica	5.5	3.5	---	---	---	---
4	1-2	Marathon	---	2.5	2.5	---	---	---
5	3-5	Marathon	---	3.5	4.0	---	---	---
6	1-2	Key Largo	---	---	2.5	2.5	---	---
7	3-5	Key Largo	---	---	4.0	3.0	2.0	---
8	1-3	Perrine-Cutler Ridge	---	---	---	2.5	2.0	---
9	4-5	Perrine-Cutler Ridge	---	---	---	3.0	2.0	---
10	1-3	Hollywood	---	---	---	---	2.0	1.0
11	4-5	Hollywood	---	---	---	2.5	2.0	1.0
12	1-3	Boynton Beach	---	---	---	---	---	1.0
13	4-5	Boynton Beach	---	---	---	---	---	1.5
14	Paralleling Storm Regionwide		4.0	2.5	2.5	2.5	2.0	1.0
15	1-3	Exiting at Miami Beach	---	---	---	2.5	2.0	---
16	1-3	Exiting at Pompano Beach	---	---	---	---	2.0	1.0
17	1-3	Exiting at West Palm Beach	---	---	---	---	---	1.0

Legend:
UPPER KEYS = Channel Five Br. to Key Largo
MIDDLE KEYS = Seven Mile Br. to Channel Five Br.
LOWER KEYS = Key West to Seven Mile Br.

*In hours before hurricane eye landfall

3.3.3 Rainfall

No predictive tool is available for determining the rate and ultimate geographic distribution of the expected six to twelve inches of rainfall generally accompanying a hurricane. However, rainfall exerts only a minor influence on the transient water levels of a storm surge.[3] Rainfall in itself does not normally necessitate the emergency evacuation of large numbers of residents during the passage of a hurricane as does the storm tide. This evacuation study does include evacuation of several small pockets of study area population that historically experience severe flooding due to rainfall alone. Rainfall may, however, cause the early inundation of roadways sought as evacuation routes by persons attempting to escape from areas vulnerable to storm tide flooding.

Even though rainfall does not normally cause loss of life, such freshwater inundation of roadways preceding hurricane eye landfall could render particular evacuation routes unusable. This inundation could sever those evacuation routes, adding critical hours to the overall evacuation time. Potential isolation of certain areas is also of great concern, therefore, freshwater inundation of evacuation routes was addressed in the evacuation planning process. The procedure included an initial identification of roadway segments throughout the region historically inundated by rainfall. Coordination with municipal and county traffic engineering representatives allowed the identification of roadways particularly prone to rapid inundation from rainfall. In some cases it was determined that the vulnerability of specific transportation routes to early flooding rendered their use in an evacuation scenario unfeasible. These roadways were subsequently deleted from the networks of designated evacuation routes. Other roadways that are likely to experience lesser degrees of spot flooding due to rainfall have been retained in the evacuation route network because they frequently represent the only means of escape from vulnerable areas.

Rain bands from a hurricane generally arrive with gale force winds; however, previous hurricane experience in Palm Beach County has shown that substantial rain can arrive much earlier. Local civil defense staff must monitor rain intensity and timing to assess its importance in severing evacuation routes for a particular storm situation. Premature heavy rains could necessitate the issuance of an evacuation order earlier than would otherwise be issued.

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[3] Kenneth C. Crawford, Hurricane Surge Potentials Over Southeast Louisiana as Revealed by a Storm-Surge Forecast Model: A Preliminary Study, U.S. Department of Commerce, NOAA-NWS, August 1978, p. 5.

3.4 PRE-LANDFALL HAZARDS TIME ASSUMPTIONS

Pre-landfall hazards time is the time frame before actual hurricane eye landfall within which evacuation should not be carried out due to the effects of sustained gale force winds. As reported in this Hazards chapter, gale force winds (as well as storm tide inundation) arrive at different times for differing roadway points and storm categories. For developing evacuation order times, those gale force winds pre-landfall hazards times determined for each regional storm scenario were used since gale force winds arrive much earlier than storm tide inundation.

Actual pre-landfall hazards times will vary from those predicted due to differing forward speed, radius of maximum winds, and pressure drop of an actual storm. Thus it is important to understand that actual pre-landfall hazards time in a storm will be determined in discussions between the National Hurricane Center and county civil defense directors.

3.5 FLOOD INSURANCE STUDY CONCEPT

As noted previously, the specific hazard analysis findings of potential surge height and subsequent delineation of traffic-evacuation zones were the result of numerical simulations of probable hurricanes. The parameters of the hypothetical hurricanes were selected by NHC staff. The objective of this study effort made the assignment of specific quantitative probabilities to those parameters unnecessary.

Flood insurance programs, having a much different objective, include the measurement of storm tide height potential within the detailed analysis of the flood plain of an area. The flood insurance studies administered by the Federal Emergency Management Agency (FEMA) delineate flood hazard zones and assign actuarial rates under the National Flood Insurance Program (NFIP).

To arrive at these conclusions, coastal studies usually employ a joint probability method to determine coastal flood levels having recurrence intervals of 10-, 50-, 100- and 500-years. This method finds the quantitative probability of a particular flood level by joining the probabilities of each of the parameters selected to synthesize each storm. In essence, the flood levels represent a probability level resulting from many synthetic storms. No one particular storm could completely cause that flood level throughout the study area identified as the "base flood elevation" (BFE). This contrasts greatly with the surge height prediction method employed by this study. Each surge height envelope output from the hurricane surge models represents the results of a discrete hypothetical hurricane of given parameters as input to the model. Because of the differences between flood insurance studies and this evacuation study in terms of their objectives, methods, and what their results actually represent; any comparison of storm tide heights and subsequent traffic-evacuation zones to BFEs and flood hazard zones under the NFIP is inappropriate.

Chapter 4
BEHAVIORAL PATTERNS OF POPULATION AT RISK

Future evacuation of an endangered population due to a hurricane approaching Southeast Florida potentially involves the coordinated action of thousands of individuals. Therefore, information pertaining to the tendencies and intended choices of the evacuating population were gathered and analyzed. Specifically, the following behavioral aspects were addressed:

- o when the threatened population would leave their residences in relation to a given evacuation order
- o the number of vehicles that the threatened household would utilize for evacuation
- o the number of threatened households that would require transportation or other assistance if ordered to evacuate
- o the pre-planned destinations of the potentially threatened population
- o the general hurricane experience of the potentially threatened population

In addition, behavioral factors affecting the actual response of a threatened population significantly contribute to the dynamics of an evacuation. Studies of behavioral factors influencing public response to hurricane threats are valuable because they offer responsible officials insight into the attitudes and/or characteristics of the population-at-risk that may deter or elicit their response to an evacuation order.

4.1 CURRENT BEHAVIORAL RESEARCH

Behavioral research into public response to hurricane evacuation can generally be divided into two categories:

- o surveys generating data for input into evacuation/transportation analyses
- o studies of behavioral factors influencing public response to hurricane threats

The Behavioral Survey for this study is primarily a tool to gather data for the transportation modelling portion of the report. Behavioral surveys administered as part of other regional hurricane evacuation planning efforts were reviewed prior to developing the survey for the Lower Southeast Florida Study. The Tampa Bay Hurricane Evacuation Plan's behavioral survey was eventually selected as the prototype for this study. The basic design of the survey questionnaire and the sampling methodology had been demonstrated to be effective in gathering statistically reliable data for regional hurricane evacuation planning purposes. Modifications made to the Tampa Bay behavioral survey are discussed in Section 4.2.

Recent studies have been undertaken to determine and analyze the behavioral response factors related to hurricane evacuation. Although not all their conclusions are adopted for this study, several investigators have made substantial advances in the area. Dr. Earl J. Baker of Florida State University analyzed the results of four separate surveys to find behavioral predictors of response to hurricane warnings.[1] Responses of individuals impacted by Hurricanes Carla (1961), Camille (1969), and Eloise (1975) were compared and analyzed to identify variables that can be correlated to an individual's inclination to evacuate. Over 75 variables were tested to assess their ability to predict evacuation. The results determined that the four surveys failed to identify consistently strong predictors of evacuation. Although the findings of the study are based on admittedly marginal data in terms of statistical significance some of the conclusions are very interesting:

- "Knowledge about hurricanes and hurricane safety rules were consistently not found to be associated with evacuation behavior." This raises questions regarding the common belief that making the public generally more aware about hurricane dangers and proper response to governmental warnings enhances evacuation response.

- The "presence or absence of previous experience, per se, is unrelated to evacuation. The same is true with respect to the number of hurricanes experienced, recency of one's experience, and whether damages or injuries were suffered by one's household." This contention refutes the widespread belief that the public's real or perceived hurricane experience may have an effect on response to evacuation orders.

- "A better predictor of evacuation is how bad one expects the storm to be. Those who expected wind damage to be high in Camille were most likely to leave, as were those who expected winds to do damage in Eloise."

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[1]Earl J. Baker. Predicting Response to Hurricane Warnings: A Reanalysis of Data from Four Studies. Mass Emergencies 4, p. 9-24, 1979.

- "Elevation of the respondent's home above mean sea level exhibited one of the strongest associations with evacuation produced by any of the four studies," leading to the encouraging conclusion that individuals who are most threatened during a hurricane are most likely to evacuate.

- "One of the best predictors consistently identified is the extent of evacuation which took place in the respondent's neighborhood. People who lived in areas from which most of their neighbors evacuated were also likely to have evacuated."

Clark and Carter of the University of Minnesota have employed previous research of behavioral patterns to propose a formal model of individual and general response to hurricane warnings.[2] Their own model is based on the maximum utility model of decision-making, which asserts that under conditions of uncertainty individuals will choose actions which maximize their long-term benefit. The authors reach several conclusions about the behavior of an evacuating population that have implications for hurricane preparedness:

- Information regarding a hurricane threat will be gathered from sources dependent on "(1) the ease with which information can be obtained, and (2) the perceived reliability or credibility of the source." Since significant proportions of the population will utilize multiple sources of information, inconsistency in the information delivered through different media could cause confusion, create decision delays, and ultimately slow down an evacuation.

- "Significant delays will occur between hurricane warnings and recommendations to evacuate and peak evacuation periods (because) of the time involved in trying to confirm that evacuation is necessary and of the fact that officials generally recommend evacuation prior to the time environmental conditions make it clear that evacuation is necessary." This infers that the threatened population will delay action until it is clearly in their self-interest to do so, perhaps acting at that point without sufficient time to complete evacuation movements.

- "Problems with response to hurricane warnings (will increase in the future) because of the fact that hurricane warnings are issued for such large areas and any given hurricane will actually affect a much smaller area." Individuals who choose not to act when a storm approaches and are relatively unaffected have, therefore, reinforced the belief that remaining is a decision to their personal benefit.

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[2]Carter, T. Michael and Clark, John P., Response to Hurricane Warnings as a Process: Determinants of Household Behaviors. Report No. 33, Florida Sea Grant College, p. 19-24, 1980.

Research conducted by the Texas A & M University Sea Grant College under the Texas Hurricane Awareness Program has probed the effectiveness of different means of informing and preparing the public for a future hurricane evacuation.[3] During 1977 and 1978, 381 interviews were conducted in Galveston to assess the relative value of checklist/map brochures, television spots, and radio interviews as informational and motivational media. The results gained do not seem conclusive enough to establish guidelines for communicating hurricane evacuation information to the public. A follow-up study by the same group of researchers, however, aids in determining specific tactics and information that would encourage people to respond to warnings.[4] The methodology primarily used psychological experiments to develop a Hurricane Response Model which would promote the most thorough possible evacuation. The study also included a summary of supplemental guidelines that address the behavioral aspect of response to evacuation:

- The availability of evacuation plans increases the likelihood of evacuation.
- People who fail to confirm evacuation messages tend not to evacuate.
- Families tend to evacuate as units.
- People are more apt to leave if they feel their property will be safe.
- Knowledge of availability of public shelters will prompt more people to evacuate.
- People who anticipate greater storm damage are more likely to evacuate.
- People who believe weather reports are usually accurate are more likely to evacuate.
- An expectation of receiving more information can delay decisions.

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[3]Carlton Ruch, Awareness Program Component Assessment. Report No. 33, Florida Sea Grant College, p. 143-149, 1980.

[4]Christensen, Larry B. and Ruch, Carlton E., Hurricane Message Enhancement. College Station: Texas A&M University. Sea Grant College Program, 1981.

The research that has been cited here represents a small portion of a large body of information on the subject of the behavioral component of public response to hurricane warnings and requests to evacuate. Research to date has not provided the answers necessary to reliably implement hurricane preparedness and information programs in Southeast Florida that address the key issue of public attitudes to response. Efforts to determine more precisely what would best stimulate the population-at-risk in Southeast Florida to respond to hurricane warnings should continue as an outgrowth of this regional evacuation planning process.

4.2 BEHAVIORAL SURVEY

After reviewing current research and literature regarding community attitudes and response to hurricanes, a behavioral survey was developed and conducted for the four-county study area. The Behavioral Survey provided data and statistics that were required to complete other elements of the study, particularly the Transportation Analysis component.

A detailed discussion of the Behavioral Survey, including explanation of the survey's design, execution, data compilation, and results can be found in Appendix G. The results are presented and analyzed for each individual county to facilitate their use by Civil Defense and related agencies in updating local hurricane preparedness plans. The remainder of this section is a summary of the findings thoroughly presented in Appendix G.

A total of 3,000 households in Monroe, Dade, Broward, and Palm Beach Counties participated in the telephone survey. Respondents were asked a series of questions about their present attitudes and future intended actions regarding response to governmental evacuation orders, evacuation destinations, specialized transportation needs, previous hurricane experience, and related issues.

The prototype telephone questionnaire was based almost entirely from the questionnaire used for the Tampa Bay Regional Study. Preliminary revisions were then made in the prototype questionnaire by the U.S. Army Corps of Engineers and Post, Buckley, Schuh & Jernigan, Inc. The revisions were made to adapt the questionnaire to the specific information needs for performing a hurricane evacuation study in southeast Florida. This preliminary questionnaire was then presented and reviewed with members of the Regional Disaster Preparedness Committee and at workshops in each county. Included in the workshops were local officials, county officials, and the general public. Shown in Figure 11 is the final form of the questionnaire used for the telephone survey.

The survey study area for the region comprised those areas in each county which earlier hazards modelling indicated would be flooded under a Category 3 hurricane. After a total of 3,000 telephone interviews for the four-county region was decided upon, the distribution of surveys for each county was based on affected

1 2 3

Date of attempt ____________
Time of attempt ____________
Result of attempt ____________
Person & time to call back ____________

(INTERVIEWER: IF INITIAL RESPONDENT IS APPARENTLY AN ADULT AND, THEREFORE, POSSIBLY DESIRED RESPONDENT: THAT IS: HEAD OF HOUSEHOLD OR DECISION MAKER AS TO WHAT TO DO BEFORE A HURRICANE, CONTINUE: OTHERWISE, MAKE APPOINTMENT TO CALL BACK AT A TIME RESPONDENT CAN BE REACHED.)

INTRODUCTION: "Hello, my name is ____________. I am calling for the Civil Defense Director in (USE RESPONDENT'S HOME COUNTY) ____________. May I speak to the head of your home?" (INTERVIEWER, IF PERSON WITH WHOM YOU ARE SPEAKING IS DESIRED RESPONDENT, CONTINUE WITH . . . "We are conducting a survey to get reactions to what persons would do if a hurricane should strike. I hope you saw the announcement in the newspaper. The purpose of the survey is to gather data that will be used to prepare an evacuation plan. Your answers to the following questions will be an important part of that plan.

1. Do you live in an:

   a. Apartment or condominium building
      -4 or more floors high ( )
      -Less than 4 floors high ( )
   b. Mobile home ( )
   c. Single-family home ( )
   d. Other ____________ ( )

2. How many people live in your home including yourself?

   ____________ (Number)

3. How many motor vehicles do you have at home? ____________ (Number)
   (IF NONE, SKIP TO 5)

4. (IF THERE ARE VEHICLES, ASK) How many motor vehicles would you use should you be asked to evacuate? ____________ (Number)

   (SKIP QUESTION 5 - GO TO QUESTION 6)

5. How many people in your home would require transportation such as a bus or taxi should you be asked to evacuate?

   ____________ (Number)

6. If everyone is home and you were ordered by a governmental authority to evacuate due to an approaching hurricane, would you:

   a. Have left before the evacuation order was issued ( )
   b. Leave immediately after the evacuation order ( )
   c. Leave ( ) hours after the evacuation order
   d. Stay and not leave ( )

7. After leaving would you:

   a. Go to the home of a friend or relative ( ) Yes ( ) No
   b. Look for a hotel or motel room ( ) Yes ( ) No
   c. Go to a Red Cross Shelter ( ) Yes ( ) No
   d. Don't know where you would go? ( )
      (DON'T READ DON'T KNOW)

   (IF YES TO a. OR b. ABOVE, ASK FOR LOCATION)
   (MENTION RESPONDENT'S HOME COUNTY FIRST)

   Dade County ( ) Palm Beach County ( )
   Broward County ( ) Monroe County ( )
   Out of Region ( )

   (TRY TO GET A STREET ADDRESS, INCLUDING CITY OR COUNTY IF "DON'T KNOW ADDRESS", TRY TO GET A GENERAL ADDRESS SUCH AS NEARBY -- MAJOR INTERSECTION OR BLOCK)

   (IF MONROE COUNTY RESIDENT ANSWERS YES TO c. ABOVE , ASK FOR LOCATION)

   Monroe County ( ) Broward County ( )
   Dade County ( ) Palm Beach County ( )

8. Have you ever lived in South Florida during the direct hit of a major hurricane?

   Yes ( ) (IF "YES" ASK QUESTIONS 9, 10, AND 11)
   No ( )

9. What year was that, please ____________

10. What was the storm's name ____________

11. Did you evacuate? ( ) Yes ( ) No

12. Are you a seasonal or year-round resident at this address?
    ( )Seasonal ( ) Year-round

13. And I understand that your address is:

Thank you for your help!

INTERVIEWER'S INITIALS ____________

TELEPHONE INTERVIEW FORM

FIGURE 11

population and also on the goal of obtaining a 95 percent confidence level for the results in each county. The distribution of telephone surveys within each county was proportionately based on the affected population within a given area. The number of surveys allocated to each county is shown as follows:

Distribution of Sample

COUNTY	NUMBER OF COMPLETED INTERVIEWS
Monroe	600
Dade	1,200
Broward	800
Palm Beach	400
TOTAL	3,000

Prior to the initiation of the telephone survey, television stations and newspapers throughout the region were contacted and informed about the Hurricane Evacuation Study and the upcoming Behavioral Survey. To gain cooperation, the media were solicited to advise the public-at-large about the purpose and importance of the Behavioral Survey. The telephone calls were then made between November 11 and December 2, 1981 by Gulf Coast Research, an experienced public opinion research firm.

The required 3,000 telephone surveys were completed with no significant problems. Up to three call-backs were placed before the abandonment of a potential respondent. The call-back procedure was used to minimize bias in the results.

Upon completion of the 3,000 telephone surveys, the results were keypunched, verified, and compiled by Post, Buckley, Schuh & Jernigan, Inc. The primary reasons for using computer programs for the analysis were:

1. To increase the quality of analysis
2. To allow a more complete statistical analysis of the survey data
3. To facilitate any future data analysis

The survey was analyzed statistically using the computer program package, Statistical Package for the Social Sciences (SPSS). SPSS is a sophisticated software package with more than adequate statistical capabilities for the analysis required for this study. All 3,000 completed surveys were used in the analysis. Results were compiled on both a countywide and regionwide basis.

As stated previously, information provided by the Behavioral Survey is particularly critical to the transportation analysis component of the study. Statistically valid answers regarding household type, household characteristics, public response to evacuation orders, evacuation destinations and previous hurricane experience provide parameters for performing transportation analysis and consequently for estimating clearance times. Behavioral survey results are used primarily to generate traffic demand estimates from evacuation zones within each county to specific destination categories and to estimate public response to an approaching hurricane to define the time evacuees enter the transportation network.

Survey data reported in Appendix G centers around six general categories of data as discussed below:

1) **Question #1: Type of Housing Unit**

   Household type is a key variable used in understanding and predicting automobile ownership and use. Mobile home information is also important for the transportation analysis and in planning for public shelters, as all mobile homes must be evacuated during a hurricane evacuation. Finally, an inventory of households in flood-prone areas located in buildings four floors or higher provides information that is invaluable when looking at vertical refuge as a hurricane preparedness and evacuation alternative.

2) **Questions #2-5: Household Characteristics**

   In modelling travel behavior during an evacuation, it is critical to have a realistic estimate of the number of vehicles for households at risk that will actually enter the street network. Average household size figures aid in estimating the evacuating population from different dwelling unit types. Information regarding individuals needing public transportation provides planning data and highlights the significance of heightened public awareness and involvement in aiding elderly and handicapped individuals during an evacuation.

3) **Question #6: Evacuation Order Responses**

   Data gathered from responses to these questions are fundamental to regional transportation modelling and the establishment of ultimate clearance times required to evacuate the population-at-risk. Both the number and timing of vehicles entering streets relative to an evacuation order determine congestion along evacuation routes and, consequently, overall clearance times.

4) **Question #7: Evacuation Destinations**

   Evacuation destinations are significant for modelling the distance and period of time necessary to complete evacuation from generalized points of origin to generalized points of destination. By comparing existing public shelter capacities with demand for shelter space, shelter planning and implementation programs can be designed to meet realistic shelter needs when a hurricane threatens.

5) **Questions #8-11: Previous Hurricane Experience**

These questions were asked principally to determine whether the affected public has a true perception of its own previous experience with hurricanes and to interpret whether these experiences and perceptions will affect future hurricane preparedness and evacuation efforts.

The results show that area residents have a significant misperception about previous hurricane experience, frequently believing that they have encountered the direct hit of a major storm when they have not. One misperception is that David and Dennis, both of which affected south Florida in recent years, were storms of major hurricane intensity. This prevailing public misperception is significant because a sizeable portion of the people who would be vulnerable in the next hurricane believe that they have gone through a hurricane without evacuation and are now reluctant or complacent about evacuation in the future. These results prompt concern that prevailing public misperceptions about hurricane experience may diminish the ability of the affected population to respond at a time of risk, thereby unnecessarily increasing the threat to life and injury.

6) **Question #12: Year-Round Residency**

In designing the survey questionnaire, it was determined that it would be preferable to isolate year-round residents for sampling, because most seasonal residents are not in south Florida during the hurricane season and, therefore, are not subject to evacuation. The survey method proved successful in sampling a very high proportion of year-round residents.

Finally, an analysis of the responses to the Behavioral Survey questionnaire acquired throughout the region provides some general conclusions that warrant serious consideration in ongoing hurricane evacuation and disaster preparedness planning efforts:

1. While a great majority of households indicated they would respond either immediately or rather promptly to an evacuation order, approximately 25 percent of the households surveyed said they do not intend to evacuate.

2. Almost 30 percent of the vehicles owned by the respondents would not be used during an evacuation, thereby helping to reduce the traffic problem.

3. While the number of households stating a need for public transportation assistance represents a small segment of the total households sampled, this demand could become a logistical problem involving thousands of persons within an already strained situation. It is hoped that this potential problem can be successfully addressed through a combination of increased public education and citizen cooperation.

4. Of the respondents who stated that they would evacuate in a hurricane emergency, approximately 20 to 25 percent intend to seek public Red Cross shelters.

5. The general public clearly has a misperception about previous hurricane experience. This prevailing public misperception is significant because a sizeable portion of the people who would be vulnerable in the next hurricane believe they have experienced a major hurricane without evacuation and are now reluctant or complacent about evacuation in the future.

4.3 REFINEMENT OF BEHAVIORAL ASSUMPTIONS

A meeting series was held with each county's Study Review Committee to carefully review behavioral survey results for logic and clarity. These meetings were intended to present the results of the behavioral survey, but more importantly to refine behavioral assumptions for subsequent use in the transportation modelling task.

One of the most important assumptions agreed upon related to where evacuees would go. Committee members agreed that the best approach would be to use a sensitivity analysis, testing realistic parameters within which the true parameters might fall. Two values of an assumed non-evacuating population-at-risk were agreed upon to test a high or low participation in the evacuation. The assumed percentage of population-at-risk going to Red Cross shelters was then varied based on a high or low participation in the evacuation and an assumed storm intensity.

Tables 16 and 17 summarize the assumed evacuee percentages by destination type for the Lower Keys, and Middle and Upper Keys areas, respectively. To test a high level of participation in the evacuation, 100 percent of the vulnerable population was assumed to evacuate, resulting in zero percent not evacuating. Depending on the assumed storm intensity, levels of low participation varied from 20 to 50 percent not evacuating in the Lower Keys and from 15 to 40 percent not evacuating in the Middle and Upper Keys. A higher percentage of evacuees in the Lower Keys (15 to 25%) were expected to seek Red Cross shelter than in the Middle and Upper keys (5 to 10%). Of those evacuees seeking hotels/motels or the home of friends and relatives, the majority in each area were assumed to go to Dade County or out of the region.

TABLE 16

MONROE COUNTY - LOWER KEYS
ASSUMED EVACUEE PERCENTAGES BY DESTINATION TYPE

Lower Southeast Florida
Hurricane Evacuation Study

	Cat. 1-2 Storm		Cat. 3-5 Storm	
	High Participation	Low Participation	High Participation	Low Participation
Red Cross Shelter*	25%	15%	25%	25%
Friends**	50	25	50	35
Hotel/Motel**	25	10	25	20
Not Evacuating	0	50	0	20
	100%	100%	100%	100%

*Of those going to Red Cross Shelters, it is assumed approximately 95% would go to Monroe, 3% to Dade, 1% to Broward, and 1% to Palm Beach County.

**Of those going to the home of a friend or hotel/motel units, it is assumed approximately 26% would go to Monroe, 29% to Dade, 8% to Broward, 4% to Palm Beach County, and 33% would go out of the region.

TABLE 17

MONROE COUNTY - MIDDLE AND UPPER KEYS
ASSUMED EVACUEE PERCENTAGES BY DESTINATION TYPE

Lower Southeast Florida
Hurricane Evacuation Study

	Cat. 1-2 Storm		Cat. 3-5 Storm	
	High Participation	Low Participation	High Participation	Low Participation
Red Cross Shelter*	10%	5%	10%	5%
Friends**	60	35	60	50
Hotel/Motel**	30	20	30	30
Not Evacuating	0	40	0	15
	100%	100%	100%	100%

*Of those going to Red Cross Shelters, it is assumed approximately 80% would go to Monroe, 10% to Dade, 10% to Broward, and 0% to Palm Beach County.

**Of those going to the home of a friend or hotel/motel units, it is assumed approximately 11% would go to Monroe, 53% to Dade, 4% to Broward, 3% to Palm Beach County, and 29% would go out of the region.

In Dade County, a high participation by the population-at-risk was tested by assuming 100 percent evacuation, thus zero percent not evacuating. For the low participation case, 18 percent for the category 4-5 storm and 30 percent for the category 1-3 storm were assigned to the not evacuating destination category. The percentage of evacuees assumed to go to Red Cross shelters varied from 15 to 25 percent. Of those evacuees going to a hotel/motel or home of a friend, the majority were assumed to stay in Dade County, while 25 percent were taken out of the region. Table 18 summarizes the assumed evacuee percentages by destination type for Dade County.

TABLE 18

DADE COUNTY
ASSUMED EVACUEE PERCENTAGES BY DESTINATION TYPE

Lower Southeast Florida
Hurricane Evacuation Study

	Cat. 1-3 Storm		Cat. 4-5 Storm	
	High Participation	Low Participation	High Participation	Low Participation
Red Cross Shelters	20%	15%	25%	20%
Friends*	65	45	60	50
Hotel/Motel*	15	10	15	12
Not Evacuating	0	30	0	18
	100%	100%	100%	100%

*Of those going to the home of a friend or hotel/motel units it is assumed approximately 63% would go to Dade, 9% to Broward, 3% to Palm Beach County and 25% would go out of the region.

Table 19 presents the assumed evacuee percentages by destination type for Broward County. A high participation by the population-at-risk was tested by assigning zero percent to the not evacuating destination category. For the low participation case, 20 percent in the category 4-5 storm and 30 percent in the category 1-3 storm were assigned to the not evacuating destination category. The percentages of evacuees assumed to go to Red Cross shelters varied from 15 to 25 percent. Of those evacuees going to a hotel/motel or home of a friend, the majority were assumed to stay in Broward County, while 37 percent were taken out of the region.

TABLE 19

BROWARD COUNTY
ASSUMED EVACUEE PERCENTAGES BY DESTINATION TYPE

Lower Southeast Florida
Hurricane Evacuation Study

	Cat. 1-3 Storm		Cat. 4-5 Storm	
	High Participation	Low Participation	High Participation	Low Participation
Red Cross Shelter	20%	15%	25%	20%
Friends*	65	45	60	50
Hotel/Motel*	15	10	15	10
Not Evacuating	0	30	0	20
	100%	100%	100%	100%

*Of those going to the home of a friend or hotel/motel units, it is assumed approximately 2% would go to Dade, 58% to Broward, 3% to Palm Beach County, and 37% to out of the region.

In Palm Beach County, a high level of participation in the evacuation was also tested by assigning zero percent to the not evacuating destination category. For the low participation case, 25 percent were assigned to the not evacuating category for both storm intensity situations. The percentage of evacuees assumed to go to Red Cross shelters varied from 10 to 20 percent. Of those evacuees going to a hotel/motel or home of a friend, the majority were assumed to stay in Palm Beach County, while 44 percent were assumed to go out of the region. Table 20 summarizes the assumed evacuee percentages by destination type for Palm Beach County.

TABLE 20

PALM BEACH COUNTY
ASSUMED EVACUEE PERCENTAGES BY DESTINATION TYPE

Lower Southeast Florida
Hurricane Evacuation Study

	Cat. 1-3 Storm		Cat. 4-5 Storm	
	High Participation	Low Participation	High Participation	Low Participation
Red Cross Shelter	15%	10%	20%	15%
Friends*	55	45	55	40
Hotel/Motel*	30	20	25	20
Not Evacuating	0	25	0	25
	100%	100%	100%	100%

*Of those going to the home of a friend or hotel/motel units, it is assumed approximately 1% would go to Dade, 2% to Broward, 53% to Palm Beach County, and 44% would go out of the region.

Study Review Committee members suggested that where possible auto ownership assumptions be tied to sub-county data and not directly to survey answers. This was suggested due to the wide variance in auto ownership, particularly in Dade County, where so many elderly reside in sub-county pockets. Of those vehicles available for evacuation at the residential end, it was assumed that 70 percent would be used as indicated in the behavioral survey.

Survey data indicated that 20 to 35 percent of those choosing to evacuate would leave before the evacuation order. Another 30 to 50 percent would leave immediately after the evacuation order. Based upon local discussion in each county, it was recognized that these percentages could vary considerably depending upon the intensity of the storm, time of day of projected landfall, quick or slow response by the population-at-risk, and short or long lead time available from the warning system.

4.4 BEHAVIORAL RESPONSE CURVES

The time distribution of the percent of evacuees leaving vulnerable areas is a critical assumption which affects all subsequent time analysis for the hurricane evacuation event. Research into the public response to hurricane evacuation has only recently been studied in a regional context. Empirical data provided in an analysis performed by T. M. Carter, J. E. Clark, and R. K. Leik, University of Minnesota, provided the only recent experience that is applicable to hurricane evacuation response times in the southeast Florida coastal area. This study did document the cumulative percent of evacuees who had left home during each hourly period of the hurricane evacuation event. From this information it was determined that approximately 44 percent of the evacuees had mobilized by the time the evacuation order was issued for Hurricane David approaching Miami on September 2, 1979. Approximately 25 percent of the population had evacuated vulnerable areas in Mobile during Hurricane Frederick on September 12, 1979.

The cumulative response distributions to these two hurricane evacuation events are valid as a beginning point in attempting to understand the patterns of public response during evacuation. The generalized shapes of these two empirical response curves were referenced within the Tampa Bay Regional Hurricane Evacuation Plan development. However, a shorter, more rapid response curve was used, with approximately 20 percent of evacuating population mobilizing before the evacuation order is given.

Due to the lack of empirical data necessary to further define the slope of the behavioral response curve and the location of the evacuation order time relative to each time interval, three separate response curves were developed for the Lower Keys area, the Middle and Upper Keys area, Dade, Broward and Palm Beach Counties. As with other assumptions resulting from the behavioral survey, the percentage of total evacuees assumed to have left before the evacuation order was discussed with Study Review Committee members from each county.

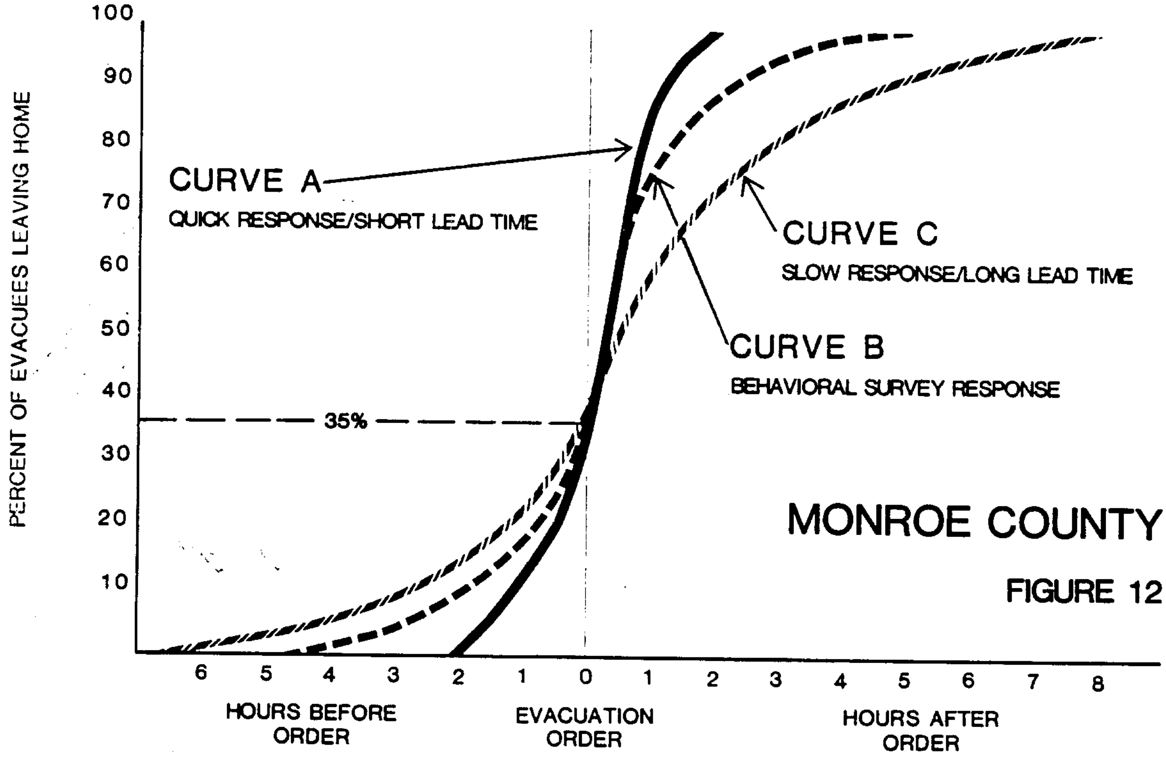
Figures 12 through 15 present the curves developed for each county. Curves for the different sections of the Keys are combined and illustrated by Figure 12, showing Monroe County behavioral response curves. The assumed percentage of evacuees who have left before the evacuation order varies for each county, but is held constant for the set of curves. These constants are 35 percent for Monroe, 25 for Dade, 20 for Broward and 30 percent for Palm Beach County. The curves provide an estimate of the rate at which evacuation vehicles load onto the street network at hourly intervals during the evacuation response. Thus, the development of three curves provides three assumed mobilization rates for input into the transportation analysis task.

Curve A - A quick response by evaucees is caused by a more urgent situation arising from a short warning time.

Curve <u>**B**</u> - The stated responses by individuals surveyed in the Behavioral Survey were used to develop curve B.

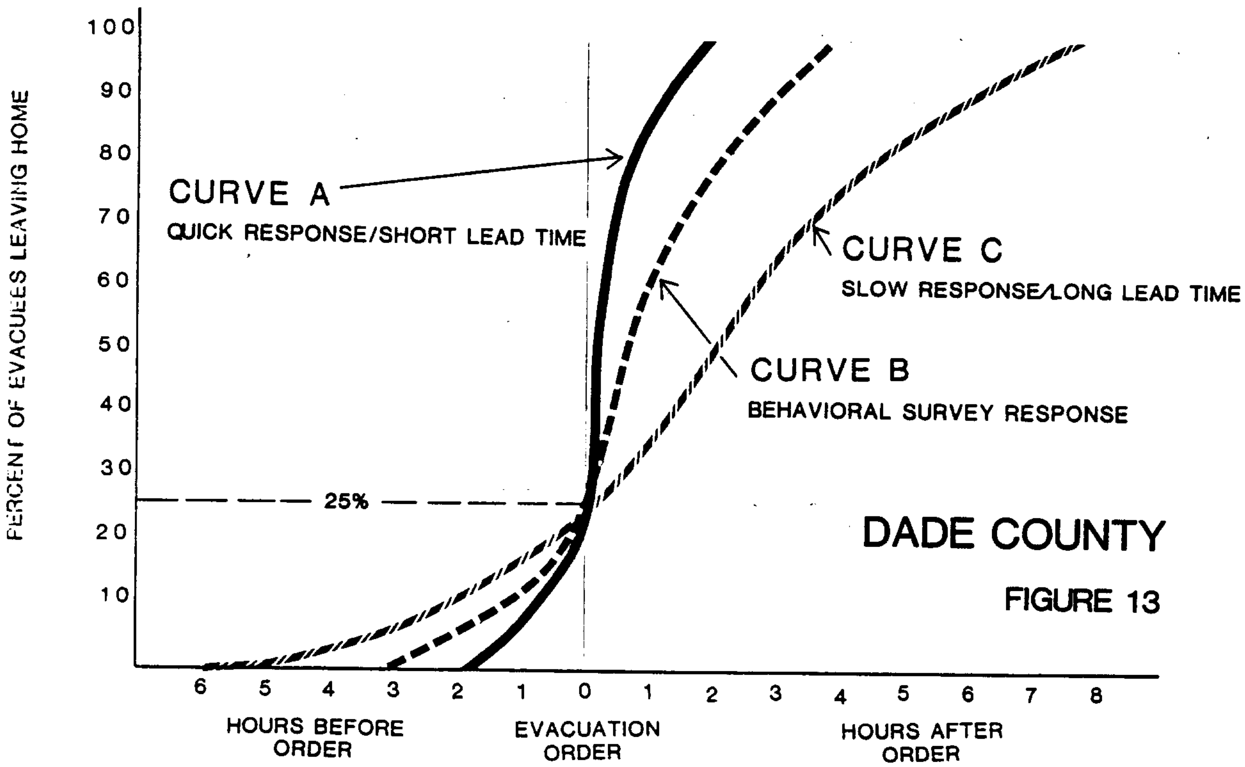
Curve <u>**C**</u> - Represents a more lengthy and slower response which more closely represents the empirical data obtained from Hurricanes Frederick and David.

The development and application of three separate response curves was undertaken to facilitate a sensitivity analysis showing the effect of varying behavioral response on transportation clearance times and thus evacuation order times. A complete description of sensitivity results is provided at the conclusion of Chapter 5.0.



MONROE COUNTY

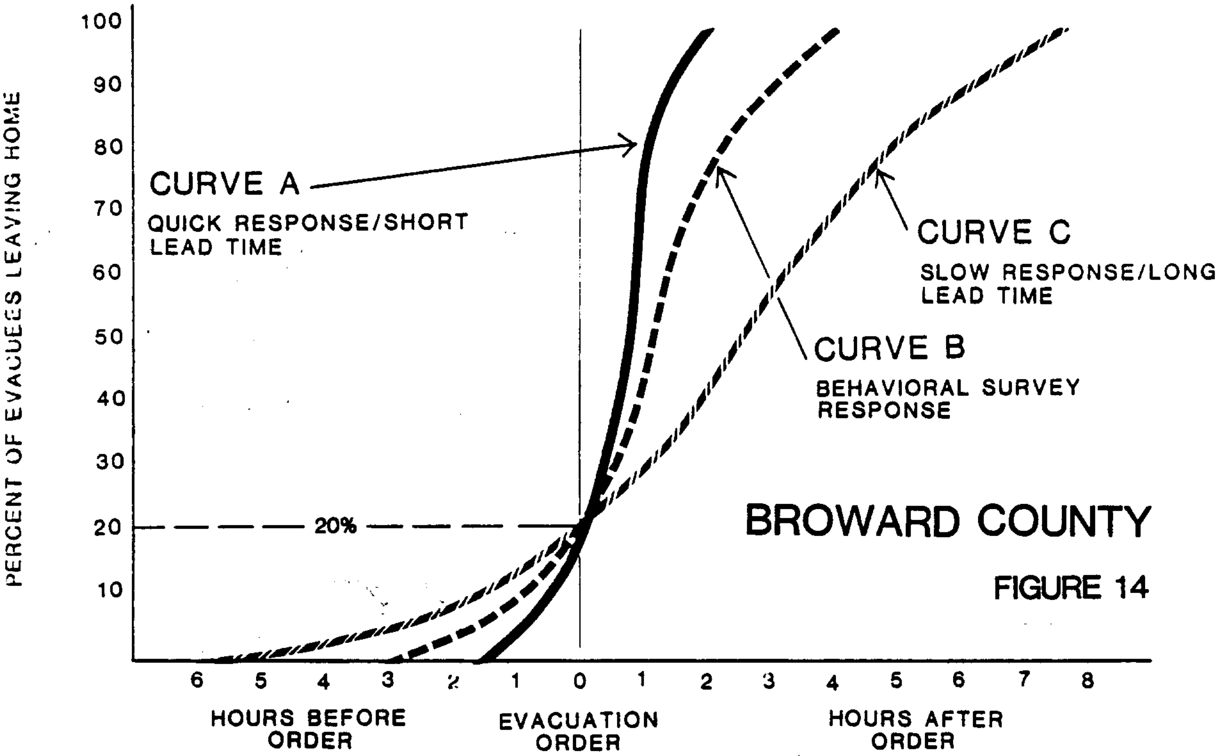
FIGURE 12

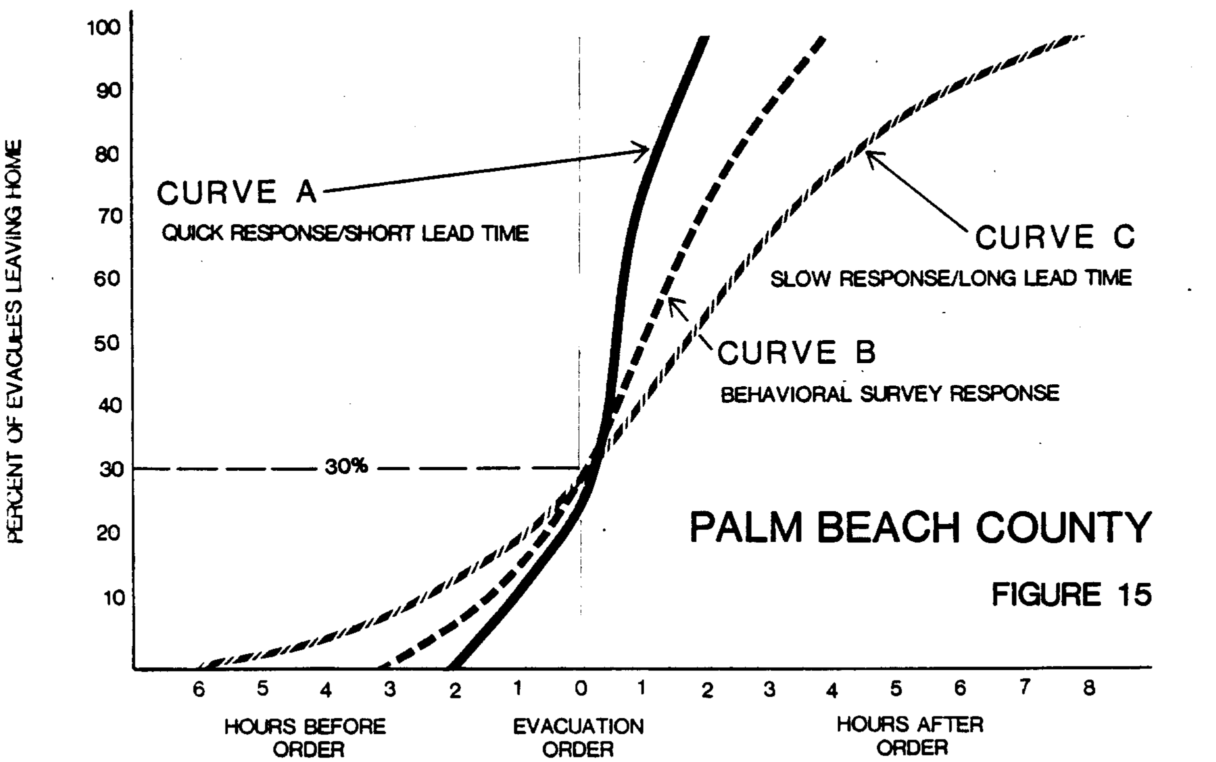


DADE COUNTY

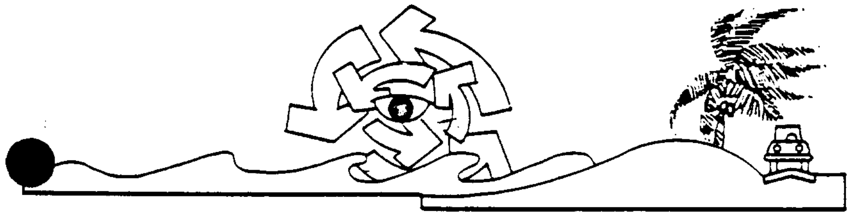
FIGURE 13

HURRICANE EVACUATION
RESPONSE CURVES





HURRICANE EVACUATION
RESPONSE CURVES



Chapter 5
TRANSPORTATION ANALYSIS

When a hurricane evacuation is required for a major urban area, a large number of vehicles must be moved across a road network in a relatively short period of time. The number of evacuees becomes significant for an area as densely populated as the lower southeast Florida coast, and varies depending on the storm intensity and direction of approach. Vehicles enter the road network at different times depending on the evacuees' response relative to the time of the evacuation order. Conversely, vehicles leave the road network depending on both the planned destinations of evacuees and the availability of acceptable destinations such as Red Cross shelters, hotel/motel units and friends or relatives in non-flooded areas. Vehicles move across the road network from trip origin to destination at a speed dependent on the traffic loadings on various roadway segments and the ability of the segments to handle a certain volume of vehicles each hour.

The overall goal of the transportation analysis task was to calculate clearance times (the time it takes to clear a county's roadways of all evacuating vehicles) and to translate that clearance time into an evacuation order time. Evacuation order time is the time before hurricane eye-landfall at which the evacuation order must be given to allow all evacuees to reach appropriate destinations. While clearance time is a technical value resulting from planning and engineering analysis, evacuation order time becomes an administrative element of grave importance to civil defense directors and county commissioners. Factors that influence evacuation order time must be studied intensively to determine which factors have a strong influence and to what degree. Within this study, a sensitivity analysis was performed and 72 clearance and evacuation order times were calculated by varying three major input parameters.

The transportation analysis task initially identified the kinds of traffic movements associated with a hurricane evacuation that must be considered in the development of clearance times. Basic assumptions in the transportation analysis task relate to regional storm scenarios, population-at-risk, behavioral and socio-economic characteristics, and roadway system and traffic control. The transportation modelling methodology and a roadway system representation were developed for each county in the study area to facilitate model application and development of clearance and evacuation order times.

5.1 EVACUATION TRAVEL PATTERNS

Traffic movements associated with hurricane evacuation have been identified for the purposes of this analysis by five general patterns:

(1) **In-County Origins to In-County Destinations**

Trips made from storm tide vulnerable areas, mobile home units, and historically heavy rain flooded areas in an individual county to destinations within the same county, such as Red Cross shelters, hotel and motel units, and friends outside the storm tide vulnerable areas.

(2) **In-County Origins to Out-of-County Destinations**

Trips made as in category (1) that originate in an individual county, but have destinations in other counties of the region or outside the region entirely.

(3) **Out-of-County Origins to In-County Destinations**

Trips made as in category (1) that enter an individual county from other counties in the region.

(4) **Out-of-County Origins to Out-of-County Destinations**

Trips passing through an individual county while travelling from another county in the region to either another county or outside the region entirely.

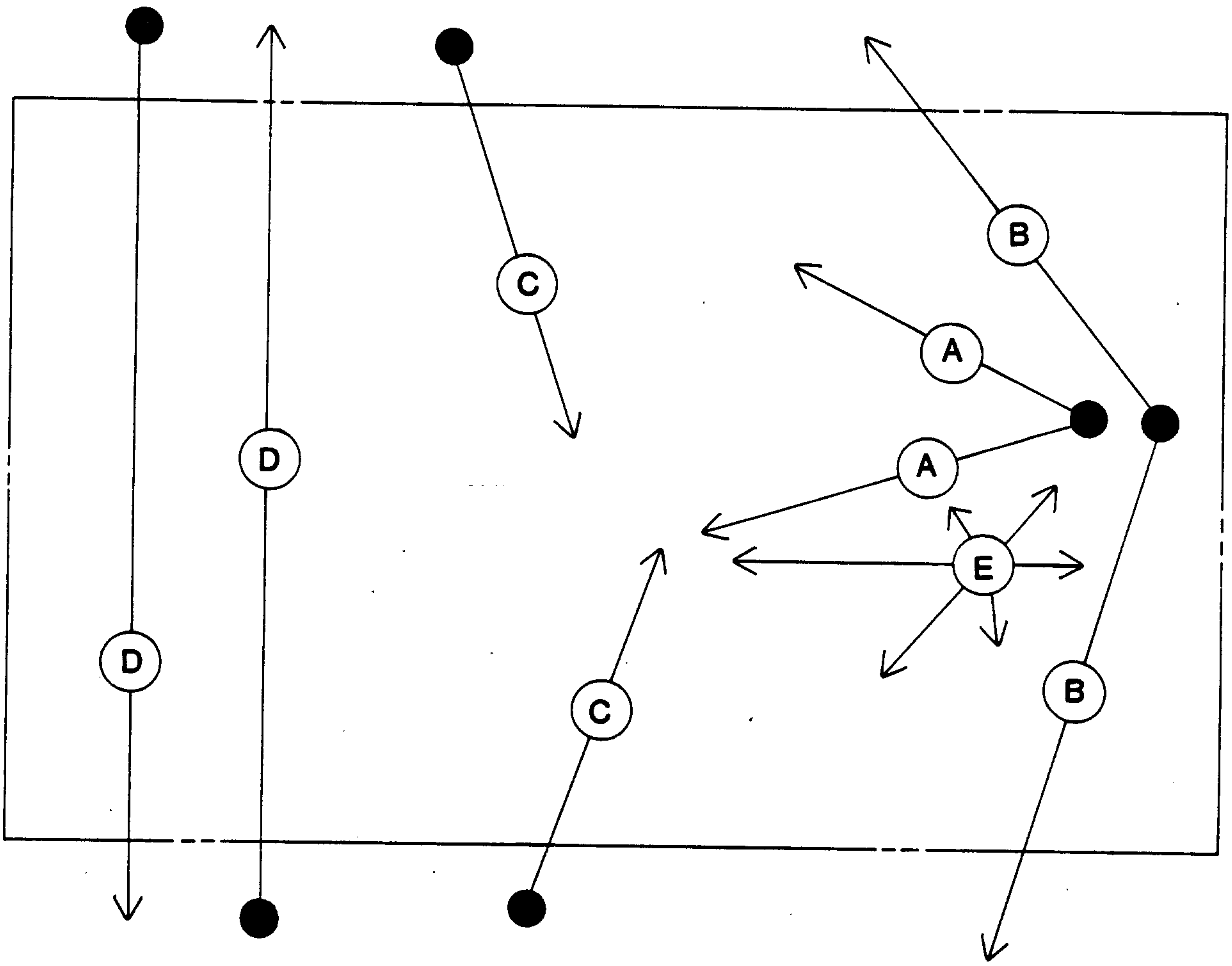
(5) **Background Traffic**

Trips made by persons preparing for the arrival of hurricane conditions; these trips may be shopping trips to gather supplies and/or trips from work to home to assist the family in evacuation. This traffic also includes transit vehicles (buses) used to pick up evacuees without personal transportation.

Figure 16 graphically depicts these traffic movement patterns associated with hurricane evacuation situations. It is important to recognize that three of the five defined patterns involve traffic movement patterns generated by counties outside of one county's boundaries. It is evident that, depending on the assumed storm track, these inter-county movements result in a number of regional traffic impacts. During the transportation analysis task, these movements were quantified to facilitate estimation of demand for roadway segments and their resulting clearance times.

5.2 TRANSPORTATION ANALYSIS INPUT ASSUMPTIONS

Since all hurricanes differ from one another in some respect, it becomes necessary to set forth clear assumptions about storm characteristics before transportation modelling can begin. Not only does a storm vary in its track, intensity, and size, but also the way in which it is perceived by residents in potentially vulnerable areas. This causes a wide variance in behavior of people who should evacuate.



A IN-COUNTY ORIGINS TO IN-COUNTY DESTINATIONS

B IN-COUNTY ORIGINS TO OUT-OF-COUNTY DESTINATIONS

C OUT-OF-COUNTY ORIGINS TO IN-COUNTY DESTINATIONS

D OUT-OF-COUNTY ORIGINS TO OUT-OF-COUNTY DESTINATIONS

E BACKGROUND TRAFFIC

EVACUATION TRAVEL PATTERNS

FIGURE 16

Even the time of day at which a storm makes landfall influences the time parameters of an evacuation response.

The transportation analysis task results in clearance and evacuation order times based on a set of assumed conditions and behavioral responses. It is not only likely, but almost certain that an actual storm will differ from a simulated storm for which clearance times are calculated in this report. Therefore, a sensitivity analysis was performed during the transportation modelling task. Those variables having the greatest influence on clearance time were identified and then varied to establish the logical range within which the actual input assumption values might fall. The input assumptions listed below were included in the sensitivity analysis:

- Intensity of Regional Storms

  Storm Situation A - Less Intense Storms
  Storm Situation B - More Intense Storms

- Behavioral Response/Mobilization Time

  Curve A - Quick Response/Short Lead Time
  Curve B - Behavioral Survey Responses
  Curve C - Slow Response/Long Lead Time

- Level of Evacuation Participation

  High Participation by Population-at-Risk
  Low Participation by Population-at-Risk

Key assumptions guiding the transportation analysis are grouped into four areas:

1. Regional Storm Scenarios
2. Population-at-Risk
3. Behavioral Assumptions
4. Roadway System and Traffic Control Assumptions

These four areas and their detailed assumed values are described in the following paragraphs.

5.2.1 Refinement of Regional Storm Scenarios

It was necessary to evaluate a large number of hypothetical hurricanes and select those storms which would cause the worst possible impact on storm vulnerable areas. A total of 191 hypothetical hurricanes, varying by landfall point and intensity, were simulated using the SPLASH hurricane computer models. Calculation of clearance times for all 191 simulated storms would be cumbersome and unusable by local emergency preparedness officials and it would be inappropriate given the relative level of accuracy of hurricane storm forecasting and storm surge simulation. Storm forecasting for the period 12 to 24 hours prior to eye landfall is not precise enough to allow for more than 3 or 4 worst-case evacuation plans per county.

Given these considerations, seventeen regional storms were carefully selected as regional storm scenarios for use in the transportation modelling analysis. Tables 21 and 22 provide the regional storm number, the counties affected, and a brief description of each selected storm. Table 21 contains only those storms landfalling in Monroe County. Table 22 contains those storms landfalling in Dade, Broward and Palm Beach Counties. These storms were chosen and described in the Hurricane Flooding and Hazards Analysis Chapter by selecting the storm tracks causing the greatest surge or worst probable impacts on various portions of individual counties. A paralleling storm was included to address the regional traffic impacts resulting from a progressive evacuation of each county in the region. Three storms crossing from west to east, or exiting storms were also included.

It is important to note that the five Saffir-Simpson categories of storms have been collapsed into two storm intensity ranges for each county. This was done recognizing the similarities in surge heights for different storm intensities and realizing the manner in which hurricanes change intensity over a short period of time due to certain meteorological conditions. For Monroe County (Lower, Middle, and Upper Keys) storm categories were grouped into Category 1-2 for storm situation "A" and Category 3-5 for storm situation "B." For Dade, Broward and Palm Beach Counties storm categories were grouped into Category 1-3 for siutation "A" and Category 4-5 for situation "B."

5.2.2 Population-at-Risk and Traffic Evacuation Zones

Through the hazards analysis, those areas subject to hurricane storm tide flooding and gale force winds were identified. This information became one of the key inputs to the transportation analysis task. Those residents who must evacuate as well as those residents who <u>should not</u> evacuate were also clearly defined. The transportation analysis then produces clearance times reflecting only needed evacuation movements.

Within the transportation analysis task it was assumed that all persons living in areas flooded by storm tide must be evacuated. This evacuee group included residents living in single family, multi-family, or mobile home units, as well as tourists staying in hotel/motel units located in storm tide vulnerable areas. In addition, all mobile home residents living outside the hurricane flooded areas of each county were evacuated due to high wind vulnerability. A final group of residents included in the evacuating population of each county consisted of persons living in areas that historically flood due to heavy rainfall. These areas of concern were identified by local county officials and were included as areas with population-at-risk.

TABLE 21

TRANSPORTATION ANALYSIS REGIONAL STORM SCENARIOS

MONROE COUNTY LANDFALLING STORMS

Lower Southeast Florida
Hurricane Evacuation Study

Regional Storm Number	Storm Description	PB	BR	DA	UPPER KEYS	MIDDLE KEYS	LOWER KEYS
1	Category 1-2 Storm at 15 miles west of Key West	X	X	X	X	X	A
2	Category 1-2 Storm at Boca Chica	X	X	X	X	A	A
3	Category 3-5 Storm at Boca Chica	X	X	X	X	B	B
4	Category 1-2 Storm at Marathon	X	X	X	A	A	X
5	Category 3-5 Storm at Marathon	X	X	X	B	B	X
6	Category 1-2 Storm at Key Largo	X	X	A	A	X	X
7	Category 3-5 Storm at Key Largo	X	A	B	B	X	X

Legend:

PB = Palm Beach County
BR = Broward County
DA = Dade County
UPPER KEYS = Channel Five Bridge to Key Largo
MIDDLE KEYS = Seven Mile Bridge to Channel Five Bridge
LOWER KEYS = Key West to Seven Mile Bridge

X = Little to no evacuation required, no storm surge
A = Category 1-2 storm situation
B = Category 3-5 storm situation

TABLE 22

TRANSPORTATION ANALYSIS REGIONAL STORM SCENARIOS

PARALLELING, CROSSING AND DADE, BROWARD AND PALM BEACH COUNTY LANDFALLING STORMS

Lower Southeast Florida
Hurricane Evacuation Study

Regional Storm Number	Storm Description	PB	BR	DA	UPPER KEYS	MIDDLE KEYS	LOWER KEYS
8	Category 1-3 Storm at Perrine-Cutler Ridge	X	A	A	X	X	X
9	Category 4-5 Storm at Perrine-Cutler Ridge	X	A	B	X	X	X
10	Category 1-3 Storm at Hollywood	A	A	X	X	X	X
11	Category 4-5 Storm at Hollywood	A	B	A	X	X	X
12	Category 1-3 Storm at Boynton Beach	A	X	X	X	X	X
13	Category 4-5 Storm at Boynton Beach	B	X	X	X	X	X
14	Paralleling Storm Regionwide	A	A	A	A	A	A
15	Category 1-3 Storm Exiting at Miami Beach	X	A	A	X	X	X
16	Category 1-3 Storm Exiting at Pompano Beach	A	A	X	X	X	X
17	Category 1-3 Storm Exiting at West Palm Beach	A	X	X	X	X	X

Legend:

PB = Palm Beach County
BR = Broward County
DA = Dade County
UPPER KEYS = Channel Five Bridge to Key Largo
MIDDLE KEYS = Seven Mile Bridge to Channel Five Bridge
LOWER KEYS = Key West to Seven Mile Bridge

X = Little or no storm surge
A = Category 1-2 storm situation
B = Category 3-5 storm situation

Having established those persons who should evacuate during a particular storm situation, it was then necessary to develop a series of zones (called traffic evacuation zones) to geographically locate this vulnerable population. Traffic zones also make it possible to model traffic movements from one geographic area to another. A series of zones was established for each county based on the following factors:

(1) coincidence with flooding limits for the two major storm category ranges

(2) direct relation to Urbanized Area Transportation Study Traffic Analysis Zones, or in the case of Monroe County, census divisions for an established population base

(3) use of easily recognizable streets and topographic features (Atlantic Ocean, Seaboard Coastline Railroad, etc.) for identification of zonal boundaries

(4) consideration of population densities and locations in terms of major east-west arterial streets

Table 23 provides a listing of traffic evacuation zones for Dade, Broward and Palm Beach Counties and their corresponding urban area traffic analysis zones. Although one goal in establishing the traffic evacuation zones was to include entire traffic analysis zones, this was not always possible due to major differences in the simulated flood limits and zonal boundaries. A traffic analysis zone, therefore, may be listed beside two or three traffic evacuation zone numbers, indicating a split traffic analysis zone.

Figures 17 through 20 illustrate the traffic evacuation zones established for the transportation analysis task for Monroe, Dade, Broward and Palm Beach Counties, respectively. Monroe, Dade, Broward and Palm Beach Counties have 5, 47, 30 and 54 traffic evacuation zones. Flood limits are also shown on the Dade, Broward, and Palm Beach zonal maps identifying those zones vulnerable due to a Category 1-3 storm tide (light shaded zones) and those zones vulnerable due to a Category 4-5 storm tide (heavily shaded zones). In general, flood limits do not go beyond U.S. 1 in Dade, Broward and Palm Beach Counties. In Monroe County, simulated storm tides cover much of the land area at risk for all categories of storms. Again, mobile home residents in all zones were assumed vulnerable to gale force winds. Tables 24 to 27 precede each graphic and give the geographic limits of each traffic evacuation zone for Dade, Broward, Palm Beach and Monroe Counties, respectively. These limits generally followed widely recognizable streets, highways or unique geographic features.

Using the assumed regional storm scenarios presented previously, the assumed types of vulnerable housing for a hurricane situation, and the zonal data compiled for each delineated traffic evacuation zone, the assumed population-at-risk for each storm scenario was quantified. Table 28 gives the population-at-risk for each county by regional

TABLE 23

TRAFFIC-EVACUATION ZONE - TRAFFIC ANALYSIS ZONE EQUIVALENCY CHARTS

Lower Southeast Florida Hurricane Evacuation Study

Dade County
Traffic-Evacuation Zone - Traffic Analysis Zone Equivalency Chart

TRAFFIC EVACUATION ZONE	URBAN AREA TRAFFIC ANALYSIS ZONES
1	1-7, 487
2	8-23, 26, 27, 486
3	24, 483, 485, 492
4	25, 28-33, 35p
5	34, 35p, 36-42
6	43-49
7	50-55
8	65-69, 72-76
9	1027, 1028p, 1029, 1030, 1043p, 1044p, 1049-1054, 1064-1085
10	58-64
11	288-292, 466-468
12	470p, 472, 473, 484
13	488-491, 710-712, 715, 716
14	717, 729-731, 750-751, 912p
15	913-914, 928, 929
16	931p, 932, 959-960, 965-970
17	1055p, 1056, 1057p, 1061-1063
18	77
19	1017, 1018, 1020p, 1021p, 1022p, 1023-1026, 1028p, 1031-1032, 1086-1089
20	1037-1042, 1043p, 1044p, 1045-1048
21	971-979, 1055p, 1057p, 1058-1060
22	931p, 933-934, 935p, 937, 939, 940, 941p, 955-958, 961-964, 980
23	701p, 704-709, 713-714, 720
24	470p, 471, 474, 482, 493-534, 539-542
25	56, 57, 286-287, 293p, 294, 465, 469
26	70, 71, 78-88, 245-248, 250-272, 281-285, 295-296
27	89-106, 249
28	107-138, 186-189, 196-207, 214-225
29	139-142, 167-185
30	143-166, 387-388, 391-395, 582-587
31	600-626
32	190-195, 347-385, 413-422
33	208-213, 226-244, 312, 313, 319-322, 333-346
34	273-280, 293p, 297-311, 450-464
35	314-318, 323-332, 412, 423-449, 475-481, 535-538, 543-569
36	386, 389, 390, 396-411, 570-575, 579-581, 674, 675 683-684, 691, 692, 700
37	588-592, 596-599, 627-647
38	576-578, 594, 595, 648-673, 676-678, 767-770
39	679-682, 685-690, 693-699, 701p, 702-703, 718-719, 721-727, 733-745, 756-766
40	810-836, 850-861
41	795-809, 870, 874-884
42	728, 732, 746-749, 752-755, 771-773, 775-794, 902, 912p
43	774, 896, 897, 903-911, 915-927, 930, 931p, 941p 942-944
44	871-873, 885-895, 898-901, 945-948
45	837-841, 843-849, 862-864, 868-869, 998-999, 1010-1012
46	842, 865-867, 935p, 936, 938, 949-954, 981-990, 996, 997, 1000
47	991-995, 1001-1009, 1013-1016, 1019, 1020p, 1021p, 1022p, 1033-1036

Broward County
Traffic-Evacuation Zone - Traffic Analysis Zone Equivalency Chart

TRAFFIC EVACUATION ZONE	URBAN AREA TRAFFIC ANALYSIS ZONES
1	1-6, 9p, 82
2	10p, 77-79, 158, 217p, 221
3	211, 216p, 218, 220, 222, 223p, 224, 225p
4	223p, 225p, 226-229, 239, 243-246, 248
5	247, 249p, 311-317
6	296, 308-310
7	318, 325-327, 378, 380, 628-633, 669-671, 883
8	634-637, 672-676
9	677-684, 687-688, 757, 760-763, 766-774
10	686, 689, 758, 759, 764, 765, 775, 776
11	240p, 242, 249p, 250, 252
12	230, 238
13	212, 216p, 219
14	80, 159, 160, 217p
15	7, 8, 9p, 10p
16	685, 690-696, 713-731, 738-756, 777-795, 801, 802, 875-878, 885
17	613, 614, 709-712, 732-737, 796-800, 803-807, 815-874
18	364-366, 373-375, 379, 548, 549, 553, 554, 638-649, 652-668, 697-702
19	550-552, 555-612, 615-627, 703-708, 808-814, 884, 886-892
20	269, 270, 273-288, 292-295, 297-307, 319-324, 328-363, 367-372, 376, 377, 533-536, 547, 650, 651
21	462, 474-499, 507-532, 537-546
22	251, 253-268, 271, 272, 289-291, 408, 410, 411, 428, 429, 437-451, 501-506
23	129-137, 149-157, 196, 197, 202-206, 382, 383, 386-407, 409, 412-415, 452-461, 463, 464, 500
24	198-201, 207-210, 215, 231-237, 240p, 241, 381, 384, 385, 416-427, 430-436, 881, 882
25	110-128, 138-148, 465-473
26	81, 83-101, 187-195, 880
27	161-186, 213-214
28	11-24, 27-31, 34-35, 66-76, 879
29	25, 26, 32, 33, 36-39, 45-51, 60-65, 102, 103
30	40-44, 52-59, 104-109

Palm Beach County
Traffic-Evacuation Zone - Traffic Analysis Zone Equivalency Chart

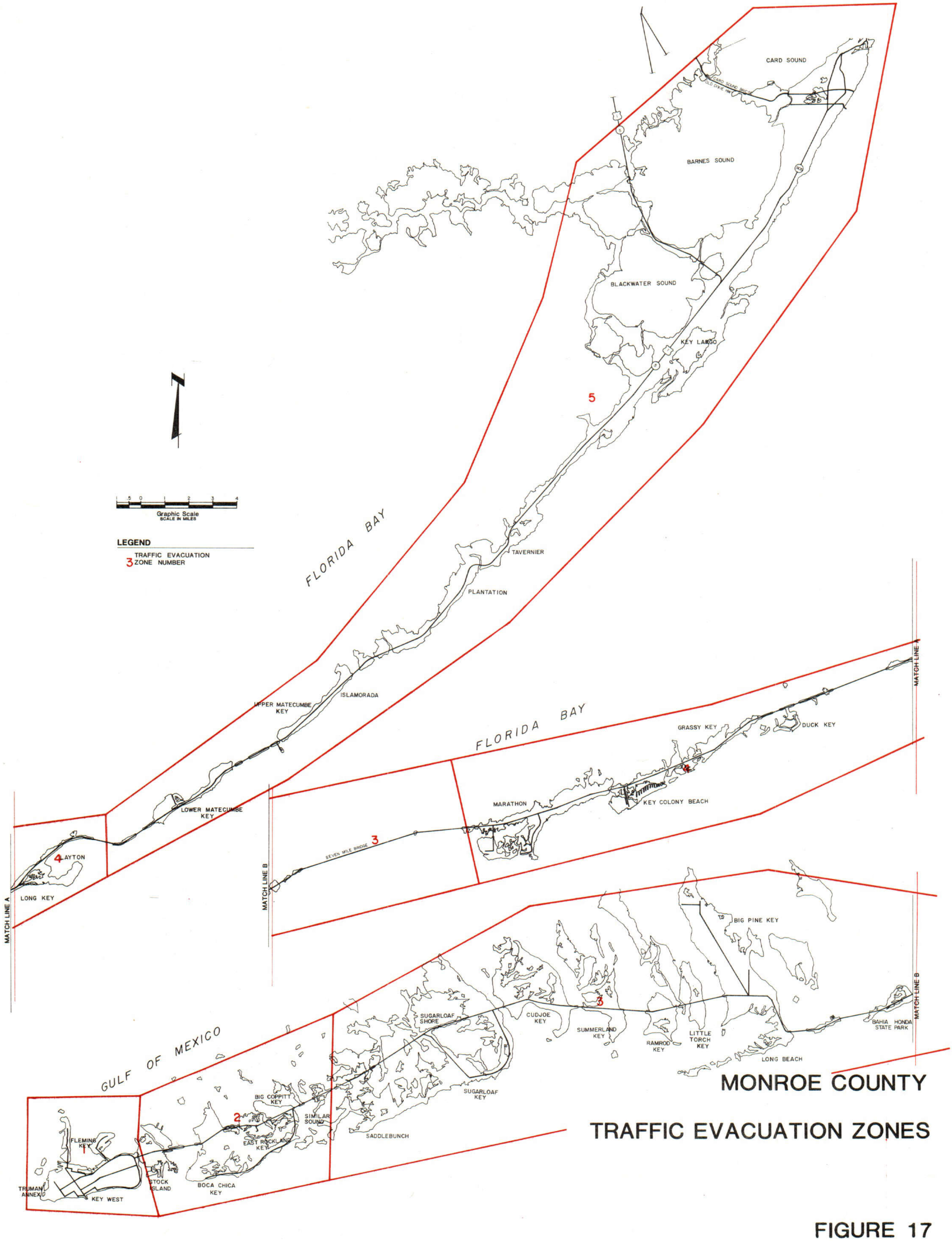
TRAFFIC EVACUATION ZONE	URBAN AREA TRAFFIC ANALYSIS ZONES
1	9, 14, 17, 21, 22
2	5, 6, 7, 8, 13p, 384
3	4p, 11p, 12, 15, 16, 100
4	31, 36, 41p
5	13p, 43p, 49, 50, 54, 59, 60, 65
6	77, 78, 83p, 84, 90p, 91
7	96p, 99p, 105p, 115p, 122p, 130p, 351-353, 381, 389p
8	132p, 144p, 354-358, 396p, 432p, 433p, 434p, 435, 436
9	169p, 178p, 188p, 194p, 359-362, 400p
10	204p, 215p, 363, 364
11	224p, 226p, 234p, 241, 365-367
12	251, 258, 350p, 368, 369
13	268p, 273p, 275p, 291p, 350p, 370, 371, 439
14	283p, 291p, 292, 372, 373, 440
15	301p, 305p, 374, 375, 376p, 408p
16	310p, 316p, 323, 330, 376p, 377, 409, 423
17	340, 347, 378, 379, 415p, 416
18	348p, 349p, 380
19	224p, 226p, 234p
20	204p, 215p
21	169p, 178p, 188p, 194p, 400p
22	130p, 132p, 133p, 144p, 396p, 432p, 433p, 434p
23	83p, 90p, 96p, 99p, 115p, 122p, 389p
24	10, 11p
25	18-20, 27-30, 32
26	33-35, 37, 38, 44, 45
27	13p, 39, 40, 41p, 42, 43p, 46-48, 385
28	55, 56, 61, 70-76, 80-82, 387
29	51-53, 57, 58, 62-64, 66, 67, 386
30	87-89, 92-95, 97, 98, 99p, 102-104, 105p, 111-114 115p, 119-121, 388, 389p, 390, 391
31	79, 85, 86, 101, 108-110, 116-118, 123-125
32	136, 137, 145, 146
33	126, 138-141, 147-151, 152p, 399, 401-402, 426-428
34	127-129, 131, 142, 143, 152p, 153-155, 382, 392-395 397, 398, 429, 430-431
35	159-161, 170-172, 180-182, 196-198
36	162-168, 169p, 173-177, 178p, 184-187, 188p
37	183, 189-193, 194p, 199-203, 205, 210-214, 403-405
38	207-209, 217-219, 228-230
39	220-223, 224p, 225, 231-233, 238-240, 437
40	235-237, 243-245, 252, 253
41	246-250, 254-257, 350p, 406
42	260-262, 277-279, 284-285
43	263-266, 269-271, 280, 281, 286, 287, 293, 438
44	267, 268p, 272, 273p, 274, 275p, 282, 283p, 288, 289 290p, 294, 350p, 407p
45	296-298, 302, 303, 306-308, 312-314, 317-320, 324, 325, 441
46	290p, 291p, 299, 300, 301p, 304, 305p, 309, 310p, 407p 408p
47	315, 316p, 321, 322, 326-329, 333p, 334-338, 411-414, 415p, 422, 442
48	331, 332, 333p, 339, 341-346, 348p, 349p, 417-419, 443
49	2, 3, 25, 26, 424, 425
50	1, 23, 24, 68, 69, 106, 107, 133-135, 383, 420, 421
51	156-158, 179, 195, 206, 216
52	227, 242, 259, 276
53	295, 311, 410
54	Western rural portion of county

TABLE 24

MONROE COUNTY TRAFFIC EVACUATION ZONAL BOUNDARIES

Lower Southeast Florida
Hurricane Evacuation Study

Traffic-Evacuation Zone	Zone Description
1	Key West
2	Stock Island to and including Shark Key
3	Saddlebunch Key to Seven Mile Bridge
4	Marathon to Channel 5 Bridge
5	Channel 5 Bridge to and including Key Largo



MONROE COUNTY

TRAFFIC EVACUATION ZONES

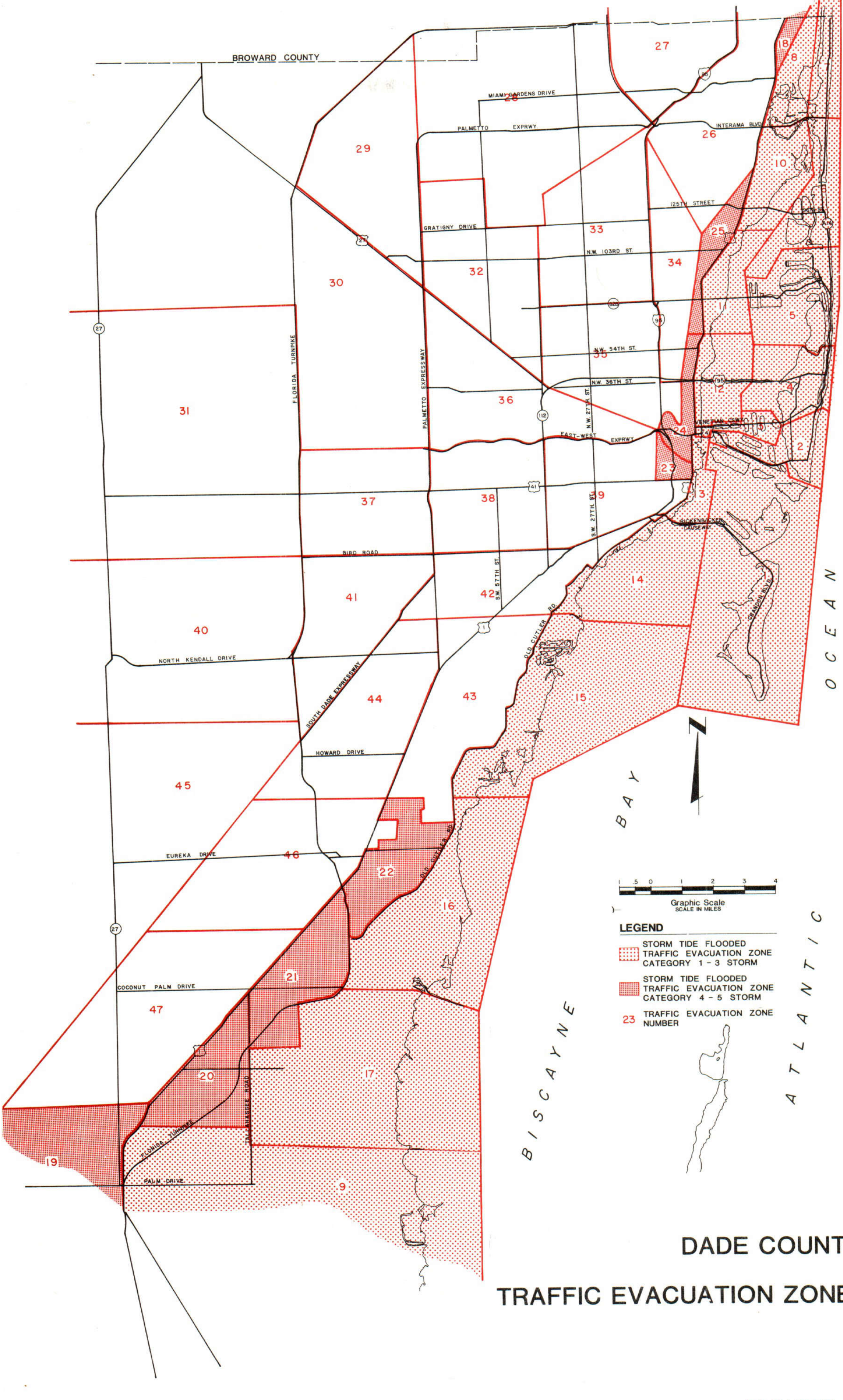
FIGURE 17

TABLE 25

DADE COUNTY TRAFFIC-EVACUATION ZONAL BOUNDARIES

Lower Southeast Florida
Hurricane Evacuation Study

Traffic-Evac Zone	Zone Description
1	Port of Miami, Fisher Island, Virginia Key, Key Biscayne
2	Watson Island, Palm Island, Star Island, Hibiscus Island, Miami Beach south of Dade Boulevard
3	Venetian Islands
4	Sunset Islands, Miami Beach north of Dade Boulevard, south of 47th Street
5	Treasure Island, Miami Beach north of 47th Street, south of Miami Beach city limits
6	Surfside, Bay Harbor Islands, Bal Harbor, Sunny Isles north to Sunny Isles Causeway
7	North of Sunny Isles Causeway, south of Dade County line, east of Intracoastal Waterway
8	South of Dade County line, east of Biscayne Blvd., north of Sunny Isles Causeway, west of Intra-Coastal Waterway
9	South of Mowry Drive and Canal Drive on the east, east of U.S. 1
10	South of Sunny Isles Causeway, east of Biscayne Blvd., north of Broad Causeway, west of Intracoastal Waterway
11	South of Broad Causeway, east of Biscayne Blvd., north of NW 62nd Street, West of Intracoastal Waterway
12	South of NW 62nd Street, east of Biscayne Blvd., north of Venetian Causeway, west of Intracoastal Waterway
13	South of MacArthur Causeway, east of U.S. 1, north of Rickenbacker Causeway, west of Intracoastal Waterway
14	South of Rickenbacker Causeway, east of Bayshore Drive, north of Sunset Drive, west of Intracoastal Waterway
15	South of Sunset Drive, east of Old Cutler Road, north of Coral Reef Drive, west of Bay (ocean)
16	South of Coral Reef Drive, east of Old Cutler Road and Florida Turnpike Extension, north of Coconut Palm Drive, west of Bay
17	South of Coconut Palm Drive, east of Turnpike Extension and SW 137th Avenue (including Homestead Air Force Base), north of Canal Drive, west of Bay
18	South of Dade County line, east of Dixie Highway, north of Ives Dairy Road
19	South of 304th Street, west of U.S. 1
20	East of South Dixie Highway, north of 304th Street, west of 137th Avenue
21	Southeast of South Dixie Highway, east of 137th Avenue, north of Waldin Drive and northwest of Turnpike Extension
22	South of Coral Reef Drive, east of South Dixie Highway, northwest of Old Cutler Road
23	South of Miami River, east of SE 12th Avenue, north of SW 8th Street, west of Bay
24	South of NW 62nd Street, east of Florida East Coast Railroad, and northeast of Miami Drive, west of U.S. 1
25	Southeast of Florida East Coast Railroad, north of NW 62nd Street, west of U.S. 1
26	South of Dade County line, east of I-95 and N. Glades Drive, northwest of U.S. 1, and west of Dixie Highway
27	South of Dade County line, east of Turnpike, west of I-95
28	South of Dade County line, east of Palmetto Expressway, north of NW 84th Street and Gratigny Road, northwest of Road 9, west of the Turnpike
29	South of County line, southeast of Turnpike Extension, northeast of Okeechobee Road, west of Palmetto Expressway
30	South and east of County line, north of NW 74th Street, and East/West Extension, west of Palmetto Expressway, and southwest of Okeechobee Road
31	South of NW 74th Street, north of SW 22nd Street, west of Turnpike-Homestead Extension
32	South of NW 84th Street and Gratigny Road, east of Palmetto Expressway, north of Okeechobee Road, west of LeJuene Road
33	South of S.R. 9, east of LeJuene Road, north of NW 79th Street, west of North-South Expressway (Miami Ave.)
34	Southwest of Biscayne River Memorial Highway, east of North-South Expressway, north of NW 36th Street (27), west of Dixie Highway
35	South of NW 79th Street, east of LeJuene Road, north of Okeechobee Road and 836, west of Dixie Highway
36	Southwest of Okeechobee Road, east of Palmetto Expressway, north of East-West Expressway
37	South of East-West Expressway, east of Turnpike-Homestead Extension, north of Bird Road, west of Palmetto Expressway
38	South of East-West Expressway, east of Palmetto Expressway, north of Bird Road, west of LeJuene Road.
39	South of East-West Expressway, east of LeJuene Road, north and west of Dixie Highway, west of SW 12th Avenue (northern section)
40	South of Bird Road Extension, north of SW 120th Street, west of Turnpike-Homestead Extension
41	South of Bird Road, east of Turnpike-Homestead Extension, north of South Dade Expressway and Sunset Drive to the east, west of Palmetto Expressway
42	South of Bird Road and Dixie Highway, east of Palmetto Expressway, north of Sunset Drive, west of Old Cutler Road
43	South of Sunset Drive, east of Palmetto Expressway and Florida East Coast Railroad, north of Coral Reef Drive and Richmond Drive at SW 77th Avenue
44	South of Sunset Drive, east of South Dade Expressway and Florida Turnpike, north of Coral Reef drive, west of South Dixie Highway
45	South of SW 120th Street, north of Hainlin Mill Drive, west of Seaboard Coastline Railroad and Florida Turnpike
46	South of Coral Reef Drive, east of Seaboard Coastline Railroad, north of Hainlin Mill Drive, west of South Dixie Highway
47	South of Hainlin Mill Drive, north of SW 304th Street, west of South Dixie Highway



DADE COUNTY

TRAFFIC EVACUATION ZONES

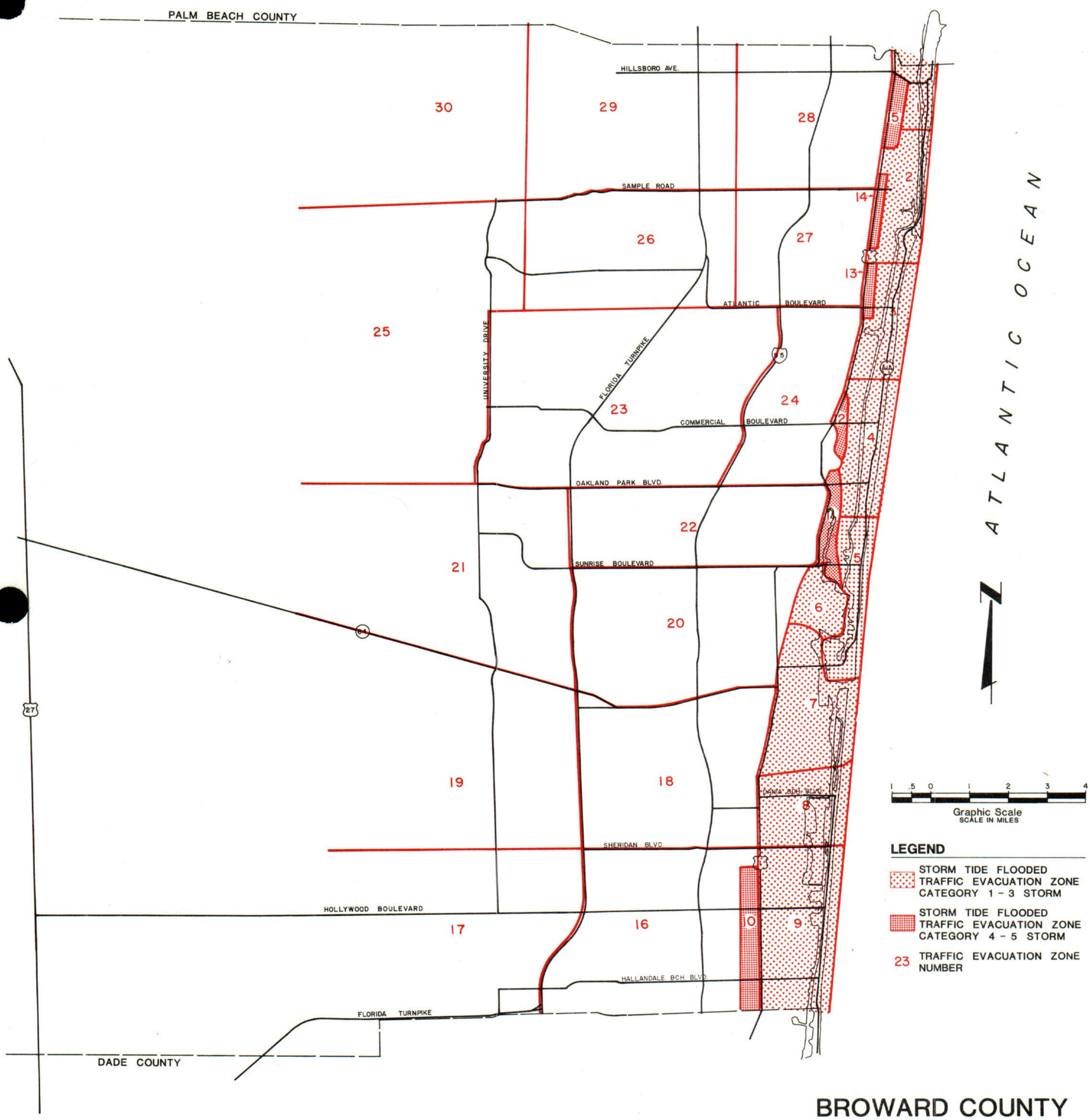
FIGURE 18

TABLE 26

BROWARD COUNTY TRAFFIC EVACUATION ZONAL BOUNDARIES

Lower Southeast Florida
Hurricane Evacuation Study

Traffic-Evac Zone	Zone Description
1	Southeast of U.S. 1, northwest of SE 12th Avenue, north of SE 15th Street, west of the ocean, south of Broward County line
2	South of SE 15th Street, east of NE 23rd Avenue, north of NE 14th Street to the ocean
3	South of NE 14th Street, east of NE 26th Avenue and U.S. 1 on southwest border, north of SE 15th Street to the ocean
4	South of SE 15th Street, east of NE 30th Avenue (Bayview Drive), north of NE 19th Street to the ocean
5	South of NE 19th Street, east of Bayview Drive on the northern section, east of Intracoastal Waterway, north of Port Everglades to the ocean
6	South of Middle River, east of Victory Park Road, north of the New River, west of the Intracoastal Waterway
7	South of New River, west of Stranahan River to Port Everglades, east of U.S. 1, north of Danis Cutoff Canal to the ocean
8	South of Danis Cutoff Canal, east of U.S. 1, north of Sheridan Street to the ocean
9	South of Sheridan Street, east of U.S. 1, north of County line to the ocean
10	South of Taft Street, east of Dixie Highway, north of County line, west of U.S. 1
11	South of NE 37th Drive, east of U.S. 1, north of Middle River, west of Bayview Drive (NE 30th Avenue)
12	South of NE 62nd Street, east of U.S. 1 and Coral Ridge Country Club, west of NE 30th Avenue (Bayview Drive)
13	South of NE 14th Street, east of U.S. 1, north of SE 5th Street, west of NE 26th Avenue
14	South of NE 39th Street, east of U.S. 1, north of NE 18th Street, west of NE 23rd Avenue
15	South of Hillsboro Blvd., east of U.S. 1, north of NE 49th Street, west of SE 12th Avenue
16	South of Sheridan Street, east of Florida Turnpike, north of County line, west of Dixie Highway
17	South of Sheridan Street, north of County line, west of Turnpike
18	South of S.R. 84, east of Turnpike, north of Sheridan Street, west of U.S. 1
19	South of S.R. 84, north of Sheridan Street, west of Turnpike
20	South of Sunrise Boulevard, east of the Turnpike north of S.R. 84, west of Cordoba and Victory Park Roads
21	South of Oakland Park Blvd., north of S.R. 84, west of Turnpike
22	South of Oakland Park Blvd. east of Turnpike, north of Sunrise Blvd., west of U.S. 1
23	South of Pompano Canal and Southgate Blvd., east of University Drive, north of Oakland Park Blvd., west of I-95
24	South of Atlantic Blvd., east of I-95, north of Oakland Park Blvd., west of U.S. 1
25	South of Sample Road, north of Oakland Park Blvd., west of University Drive (southern portion), west of NW 80th Avenue (northern portion) above Southgate Blvd.
26	South of Sample Road, east of NW 80th Avenue, north of Pompano Canal and Southgate Blvd., west of Powerline Road
27	South of Sample Road, east of Powerline Road, north of Atlantic Blvd., west of U.S. 1
28	South of County line, east of Powerline Road, north of Sample Road, west of U.S. 1
29	South of County line, east of NW 80th Avenue, north of Sample Road, west of Powerline Road
30	South of County line, north of Sample Road, west of NW 80th Avenue



BROWARD COUNTY

TRAFFIC EVACUATION ZONES

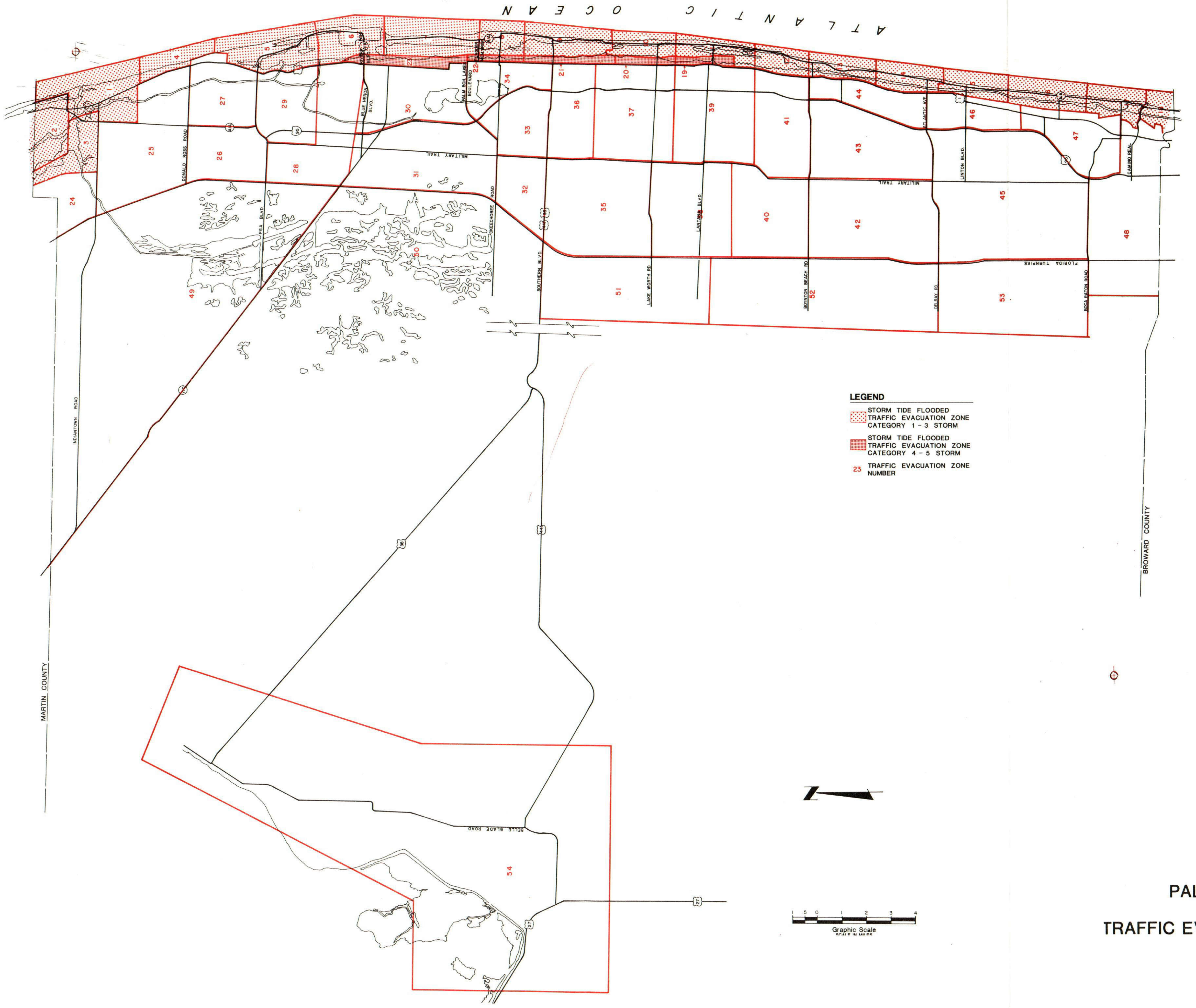
FIGURE 19

TABLE 27

PALM BEACH COUNTY TRAFFIC EVACUATION ZONAL BOUNDARIES

Lower Southeast Florida Hurricane Evacuation Study

Traffic-Evacuation Zone	Zone Description
1	South of Martin County line, east of Intracoastal Waterway to Loxahatchee River, east of U.S. 1 to Indiantown Road, east of AIA Alt. (Old Dixie Highway), north of Frederick Small Road, and west of Atlantic Ocean/Jupiter Inlet Beach Colony
2	Eastern section is South of Martin County line east of U.S. 1, north of Jupiter Inlet and east of the Intracoastal Waterway. Western section is south of Martin County, east of Loxahatchee River, north of Loxahatchee River, west of Old Dixie Highway/Tequesta
3	South of Loxahatchee River and Martin County line, east of Loxahatchee Road to Indiantown Road, north of Indiantown Road, west of Intracoastal Waterway
4	Twenty-miles south of Olympus Way, east of Intracoastal Waterway, north of Donald Ross Road, west of Atlantic Ocean
5	South of Seminole Road, east of U.S. 1, north of Earman River Canal, west of Ocean Blvd.
6	South of Earman River Canal, east of U.S. 1, north of Lake Worth Inlet, west of Atlantic Ocean
7	South of Lake Worth Inlet, east of Intracoastal Waterway, north of Flagler Memorial Bridge, west of Atlantic Ocean
8	South of Flagler Memorial Bridge, east of Intracoastal Waterway, north of Fisherman's Island, west of Atlantic Ocean
9	South of Southern Blvd. Bridge, east of Intracoastal Waterway, and Palm Beach Golf Course north, west of the Atlantic Ocean
10	South of Palm Beach Golf Course, east of Intracoastal Waterway, north of North Atlantic Drive, west of Atlantic Ocean
11	South of North Atlantic Drive and 18th Avenue, east of Intracoastal Waterway, north of Boynton Inlet, west of Atlantic Ocean
12	South of Boynton Inlet, east of Old Dixie Highway, north of Ocean Avenue, west of Atlantic Ocean
13	South of Ocean Avenue, east of U.S. 1, north of Gulf Stream Golf Course, West of Atlantic Ocean
14	South of Golf View Drive, east of U.S. 1 and 7th Avenue, north of Casuarina, west of Atlantic Ocean
15	South of Casuarina, east of Dixie Highway, north of Pelican Way, west of Atlantic Ocean
16	South of C15 Canal, east of Dixie Highway, north of NE 20th Street, west of Atlantic Ocean
17	South of NE 20th Street, east of NE 4th Street to Palmetto Park Road, then east of U.S. 1, north of Camino Real Road, west of Atlantic Ocean
18	South of Camino Real Road, east of Old Dixie Highway, north of Broward County line, west of Atlantic Ocean
19	South of 12th Avenue, east of U.S. 1, north of Sterns Street, west of Intracoastal Waterway
20	South of 13th Street, east of U.S. 1, north of 12th Avenue, west of Intracoastal Waterway
21	South of Belvedere, east of U.S. 1, north of 13th Avenue, west of Intracoastal Waterway
22	South of 12th Street, east of Old Dixie Highway, north of Belvedere, west of Intracoastal Waterway
23	South of Silver Beach Road, east of Broadway to 59th Street, then east of Spruce to 36th , then east of old Dixie Highway, north of 12th Street, west of Intracoastal Waterway
24	South of Martin County line, east of Florida Turnpike, north of Indiantown Road, west of Loxahatchee Road
25	South of Indiantown Road, east of Florida Turnpike, north of Donald Ross Road, west of Alt. AIA to Frederick Small Road, then west of Intracoastal Waterway
26	South of Donald Ross Road, east of Florida Turnpike, north of PGA Blvd., west of Florida East Coast Railroad
27	South of Donald Ross Road, east of Florida East Coast Railroad, north of PGA Blvd, west of Intracoastal Waterway to Seminole Road, then west of U.S. 1
28	South of PGA Boulevard east of Florida Turnpike, north of Blue Heron Blvd., west of U.S. 1, south of North Lake Blvd., west of Interstate 95
29	South of PGA Blvd., east of I-95, north of North Lake Blvd., west of U.S. 1
30	South of Blue Heron Blvd., east of I-95, north of Palm Beach Lakes, west of U.S. 1
31	South of Blue Heron Boulevard, east of Florida Turnpike, north of Okeechobee Rd., west of I-95
32	South of Okeechobee, east of Florida Turnpike, north of Southern Blvd. west of Military Trail
33	South of Okeechobee and Palm Beach Lakes Blvd., east of Military Trail, north of Southern Blvd., west of I-95
34	South of Palm Beach Lakes Blvd., east of I-95, north of Southern Blvd., west of U.S. 1
35	South of Southern Blvd., east of Florida Turnpike, north of Lake Worth Road, west of Military Trail
36	South of Southern Blvd., east of Military Trail, north of the Palm Beach Canal, west of U.S. 1
37	South of the Palm Beach Canal, east of Military Trail, north of Waterway Drive, west of U.S. 1
38	South of Lake Worth Road, east of Florida Turnpike, north of Hypoluxo Road, west of Military Trail
39	South of Waterway Drive, east of Military Trail, north of Knollwood Road, west of Florida Turnpike
40	South of Hypoluxo Road, east of Florida Turnpike, north of Boynton West Road, west of Military Trail
41	South of Knollwood Road and Miner Road, east of Military Trail, north of Boynton Road, west of U.S. 1
42	South of Boynton Road, east of Florida Turnpike, north of Delray West Road, west of Military Trail
43	South of Boynton Road, east of Military Road, north of Atlantic Avenue, west of I-95
44	South of Boynton Road, east of I-95, north of Atlantic Avenue, west of U.S. 1
45	South of Delray West Road and Atlantic Avenue, east of Florida Turnpike, north of Glades Road, west of I-95
46	South of Atlantic Avenue, east of I-95, north of Moore Road, west of Dixie Highway
47	South of Moore Road, east of I-95, north of Palmetto Park Road, west of Dixie Highway and U.S. 1
48	South of Palmetto Road and Glades Road, east of U.S. 441, north of Broward County line, west of Old Dixie Highway, U.S. 1, and I-95
49	South of Martin County line, east of the Everglades, north of Bee Line Highway, west of Florida Turnpike
50	South of Bee Line Highway, East of the Everglades north of West Palm Beach Canal, west of Florida Turnpike
51	South of West Palm Beach Canal, east of the Everglades, north of Lantana Avenue, west of Florida Turnpike
52	South of Lantana Avenue, east of the Everglades, north of Delray West Road, west of Florida Turnpike
53	South of Delray West Road, east of the Everglades, north of Broward County line, west of U.S. 441, north of Glades Road, west of Florida Turnpike
54	South Bay, Belle Glade, Pahokee, Canal Point Avenue



PALM BEACH COUNTY

TRAFFIC EVACUATION ZONES

FIGURE 20

storm scenario. Depending on the storm track and intensity, the total regional population-at-risk can vary from 29,200 to 619,000 people. It is important to note that the figures reported in Table 28 refer to the assumed population that should evacuate their homes or hotel/motel units and does not reflect who will evacuate or where they will go (to destinations either in or out of the county of interest). In addition, the population-at-risk is calculated using only dwelling units and hotel/motel units expected to be occupied during the June to November hurricane season, not the total annual resident population of the storm tide vulnerable zones.

TABLE 28

POPULATION AT RISK BY REGIONAL STORM SCENARIOS

Lower Southeast Florida
Hurricane Evacuation Study

Regional Storm Number	Population-at-Risk by County: Monroe	Dade	Broward	Palm Beach	Total Regional Population at Risk
1	29,200	---	---	---	29,200
2	39,000	---	---	---	39,000
3	41,900	---	---	---	41,900
4	25,000	---	---	---	25,000
5	25,000	---	---	---	25,000
6	15,200	261,700	---	---	276,900
7	15,200	385,400	191,700	---	592,300
8	---	261,700	191,700	---	453,400
9	---	385,400	191,700	---	577,100
10	---	---	191,700	111,300	303,000
11	---	261,700	217,100	111,300	590,100
12	---	---	---	111,300	111,300
13	---	---	---	120,900	120,900
14	54,300	261,700	191,700	111,300	619,000
15	---	261,700	191,700	---	453,400
16	---	---	191,700	111,300	303,000
17	---	---	---	111,300	111,300

Other zonal data assumptions were made after consultation with local planning officials regarding occupancy and number of persons and vehicles per mobile home unit and hotel/motel unit. An average dwelling unit occupancy for Dade, Broward and Palm Beach Counties was assumed to be 85 percent, with 80 percent being the assumed occupancy for Monroe County. For hotel/motel units in the region, the occupancy figures varied from 49 percent to 72 percent, depending on the individual county and data obtained from Lowenthal and Horvath. Two persons per occupied mobile home unit and 1.5 people per occupied hotel/motel unit were assumed for each county.

Although total residential auto information was available and compiled for each traffic-evacuation zone, the data were not stratified by type of dwelling unit. Therefore, in the zones affected by wind only, one evacuating vehicle per occupied mobile home unit was assumed. One vehicle per storm vulnerable occupied hotel/motel unit was also assumed. Approximately 70 percent of the vehicles available at the home origin were assumed to be used for evacuation. This percentage varied slightly depending on the county or subcounty area being analyzed.

5.2.3 Behavioral Assumptions

The two major behavioral assumptions required for the transportation analysis were the mobilization time for households in vulnerable areas and the level of participation by vulnerable residents in the evacuation event. As stated in Chapter 4.0, little empirical information is available regarding the behavioral response of persons in vulnerable areas. It is therefore necessary to both perform the behavioral survey to collect attitudinal information and to vary the behavioral assumptions within a sensitivity analysis to determine their effect on evacuation times.

The behavioral response curves A, B and C described in Chapter 4, Section 4.4, are intended to include the most probable range of possible mobilization times that might be experienced in a future hurricane evacuation situation. Curve A is intended to depict the quickest mobilization response by vulnerable households. For analysis purposes, response Curve A includes two hours of mobilization occurring before the evacuation order and only two hours of mobilization time occurring after the evacuation order for a total of four hours of total mobilization time. For Curve B, the Monroe County mobilization time is five hours before the evacuation order, and five hours after the evacuation order, for a total of 10 hours of mobilization time. For Dade, Broward and Palm Beach Counties, mobilization is assumed to occur three hours before the evacuation order time and four hours after, resulting in a total of seven hours of mobilization time. Curve C includes six hours of mobilization before the evacuation order and eight hours of mobilization after the evacuation order, for a total of 14 hours of mobilization time for all counties in the study area. For the sensitivity analysis, therefore, the mobilization time was varied between four hours for Curve A and 14 hours for Curve C.

These behavioral response curves describing mobilization by the vulnerable population define the rate at which evacuation vehicles load onto the evacuation street network for each hourly interval. The percentage of evacuees leaving each evacuation zone is then available for the calculations relating to traffic loadings at critical links along the evacuation network. These behavioral response curves, then, produce the arrival rate for the queuing and delay analysis performed for each regional storm scenario.

The second key behavioral assumption relates to the level of evacuation participation by residents of storm vulnerable areas. As discussed in Chapter 4, Section 4.3, a high level and a low level of participation by the population-at-risk was tested to determine the impact on evaucation times. Tables 16 through 20 summarize the ranges of percent of population assumed to not evacuate from vulnerable areas for storm level intensities A and B. In all cases, a high participation level was assumed with 100 percent of the storm vulnerable population participating in the evacuation. The low participation levels varied from 50 percent not evacuating in the Lower Keys for a Category 1 or 2 storm, to a low of 15% not evacuating the Middle and Upper Keys for a Category 3 through 5 storm.

The sensitivity analysis, therefore, was structured to display the difference in clearance times resulting from 100% participation by the vulnerable population as compared to a low participation varying from 50% to 85% of the vulnerable population participating in the evacuation process. By varying the level of absolute participation in the evacuation, the percentage of evacuees going to specific destinations also was forced to change. The percentages of evacuees assumed to go to Red Cross shelters, hotel/motel units, and friends' homes were also adjusted based on varying not evacuating percentages. These values are also depicted on Tables 16 through 20.

After discussions with the study coordinating committees, it was determined that these sensitivity ranges were reasonable and logical and could be expected to account for the outer ranges of an envelope of behavioral response to be encountered in the event of a hurricane approaching the southeast Florida coast.

5.2.4 Roadway System and Traffic Control Assumptions

A final group of assumptions used for input to the transportation modelling task included assumptions regarding the roadway system chosen for the evacuation network and traffic control measures selected for traffic movement. Although these assumptions developed for the transportation analysis task are general, the efforts at the county and municipal levels regarding traffic control and roadway selection were quite detailed. The detailed manpower allocations to major arterials involve extensive coordination among local officials. This study does not presume to replace those efforts, but seeks to quantify the time elements within which such manpower would operate.

In choosing roadways to be used for the evacuation network, an effort was made to include only street facilities with sufficient elevations, little or no adjacent tree coverage, substantial shoulder width and surface, and roadways already contained in existing county hurricane evacuation plans. Another objective was to provide east-west arterials and bridge combinations that would provide the smoothest (least disjointed) possible traffic flow. In selecting major north-south arterials, A1A, Military Trail, I-95, and the Florida Turnpike were incorporated as major regional movers of traffic. Major portions of U.S. 1 were omitted from the evacuation network in Dade, Broward and Palm Beach Counties to discourage lengthy north-south movements which may interfere with traffic coming off the barrier islands. It should be noted that clearance times were based on having all evacuation vehicles off the roadways before hazardous conditions arrive.

An important assumption for the transportation modelling was that all bridges from the barrier islands to the mainland would remain down during a Hurricane Warning period. U.S. Coast Guard regulation 33-117.1(c) and Florida DOT procedure 571-004 (6.p.15) may give civil defense authorities the ability to implement this procedure. At the present time, request for closure prior to a major disaster occurring (and prior to the warning period) must be directed to the Coast Guard. The Coast Guard, however, has the capability of acting on these requests immediately. The request should be directed to the Coast Guard Duty Officer, 7th Coast Guard District, Miami, Florida. It is essential that appropriate bridge regulations be researched and implemented to allow for immediate response to an evacuation order. All boats should be moved to safe harbor prior to or during a Hurricane Watch period. The lives of citizens evacuating in vehicles could be at great risk if bridges are not allowed to operate at full capacity during a Hurricane Warning. Bridge openings obviously result in less than full hourly capacity for vehicular movement.

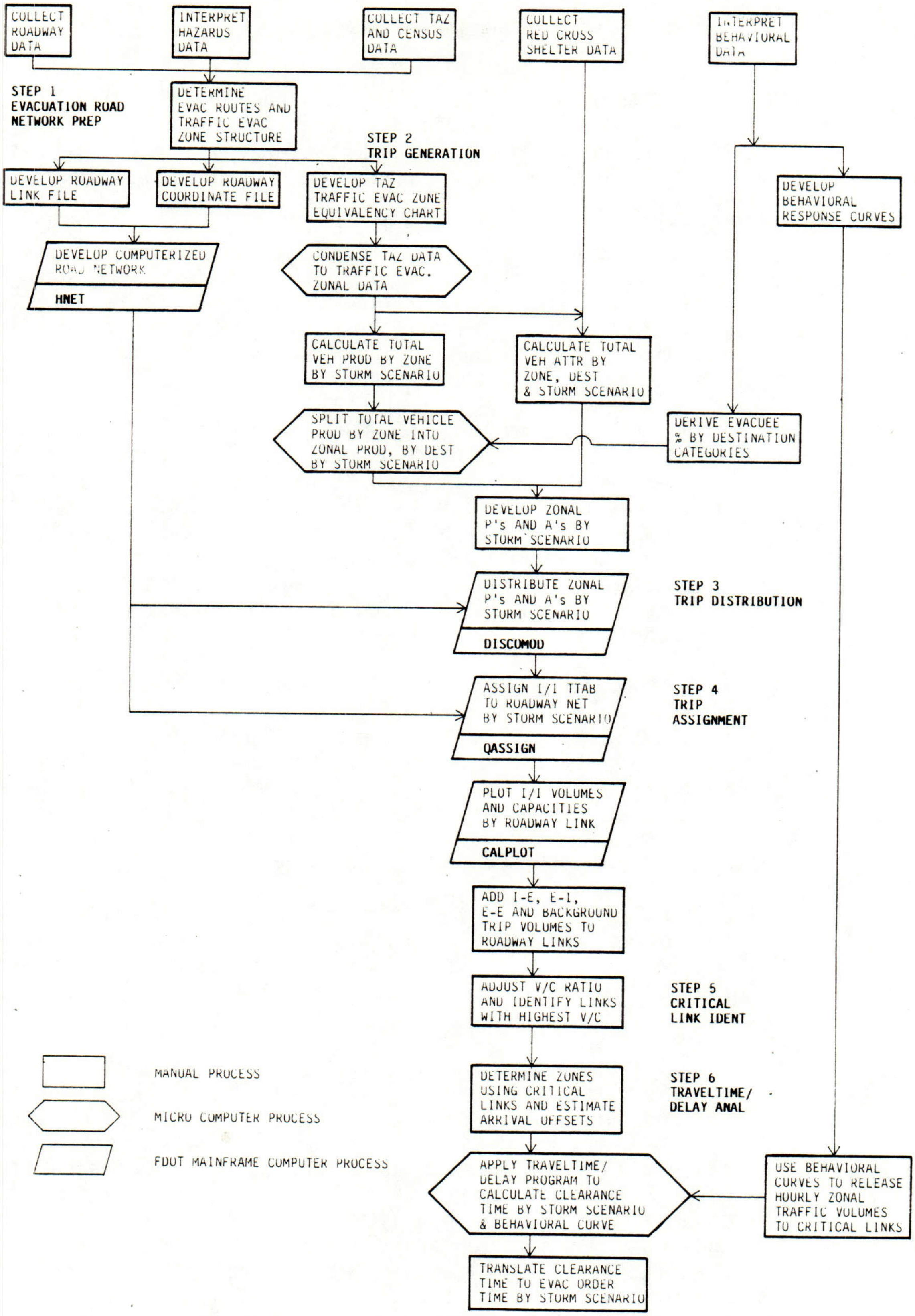
It was assumed that special manpower (local policemen, sheriffs, highway patrollmen) will be assigned to critical intersections in the study area. This would allow for smoother traffic flow and would allow east-west traffic movements more intersection "green time." The transportation modelling task also assumes that provisions would be made for removal of vehicles in distress during the evacuation.

5.3 TRANSPORTATION MODELLING METHODOLOGY

The transportation modelling methodology developed and employed for Monroe, Dade, Broward and Palm Beach Counties involved a number of manual, microcomputer, and Florida DOT mainframe computer activities. The methodology, while very technical, was designed to be consistent with the accuracy level of the modelling inputs and assumptions. The methodology is unique in that it is sensitive to the behavioral response of evacuees relative to an evacuation order, and low or high participation in the evacuation by the population-at-risk.

Appendix H specifies and explains the steps carried out in the transportation modelling task at a detailed technical level. In summary, the modelling methodology shown in Figure 21 involved six major steps. These steps are briefly described below:

(1) **Evacuation Road Network Preparation** - This step involved developing information for those roadways selected for inclusion in the evacuation road network. Information was coded into a "link file" and "coordinate file" for use by the Florida Department of Transportation computer. The end product of the step was a computerized representation of the roadway system.



TRANSPORTATION MODELLING METHODOLOGY

FIGURE 21

(2) **Trip Generation** - This step included compilation of traffic analysis zonal data into a traffic-evacuation zonal data file using a TAZ to traffic-evacuation zone equivalency chart. Specific socioeconomic variables were used in the trip generation calculations to produce total evacuating vehicles originating from each traffic evacuation zone. These originating vehicles were stratified by destination type based on interpretation of the behavioral survey and local input. Other socioeconomic variables coupled with Red Cross Shelter capacity information were used to develop estimates of the number of evacuating vehicles that would find acceptable destinations in each zone.

(3) **Trip Distribution** - This step concentrated only on those trips originating in a county and finding acceptable destinations within the same county. Productions from each zone were matched with available attractions in all zones. The end product of the step was a trip table showing trips between each zone and all other zones for each evacuation destination. A unique trip table was developed for each regional storm scenario, and for each assumed low or high participation in the evacuation by the population-at-risk.

(4) **Trip Assignment** - This step included the use of another Florida DOT computer module to place trips from a particular trip table on the road segments included in the computerized roadway system. All other categories of evacuation travel patterns (in county to out of county, out of county to in county, out of county to out of county, and background) were then manually assigned to the plots to arrive at total evacuation vehicles per roadway segment.

(5) **Critical Link Identification** - This step developed a series of volume to capacity ratios to determine which roadway segments would be most congested by evacuation vehicles. Those links with the highest volume to capacity ratio were identified for each county.

(6) **Travel Time/Queuing Delay Analysis** - This step involved a detailed look at the critical links identified for the four counties of the study area. Initially, traffic evacuation zones using the critical link of interest were identified. Evacuation vehicles from each zone were then released to the network in accordance with a behavioral response curve. Based on an assumed hourly capacity for the critical link, the hourly volume desiring to use the link could then be translated into a queuing delay time at the link and an evacuation travel time. The end product of this major step was a set of clearance and evacuation order times for each regional storm scenario.

5.4 ROADWAY SYSTEM REPRESENTATION

In order to determine the routing of evacuation traffic a representation of the roadway system was developed. A traditional "link-node" system was developed to identify roadway sections. Nodes are used to identify the intersection of two roadways or changes in roadway characteristics, and to provide points along curved sections of the roadway to assist in computer plotting. Links are the roadway segments as defined by the nodes when connected. Each link is identified by a pair of node numbers.

Once the links and nodes for the evacuation routes were identified, roadway characteristics were specified for each link. The characteristics of each link were defined by the following features.

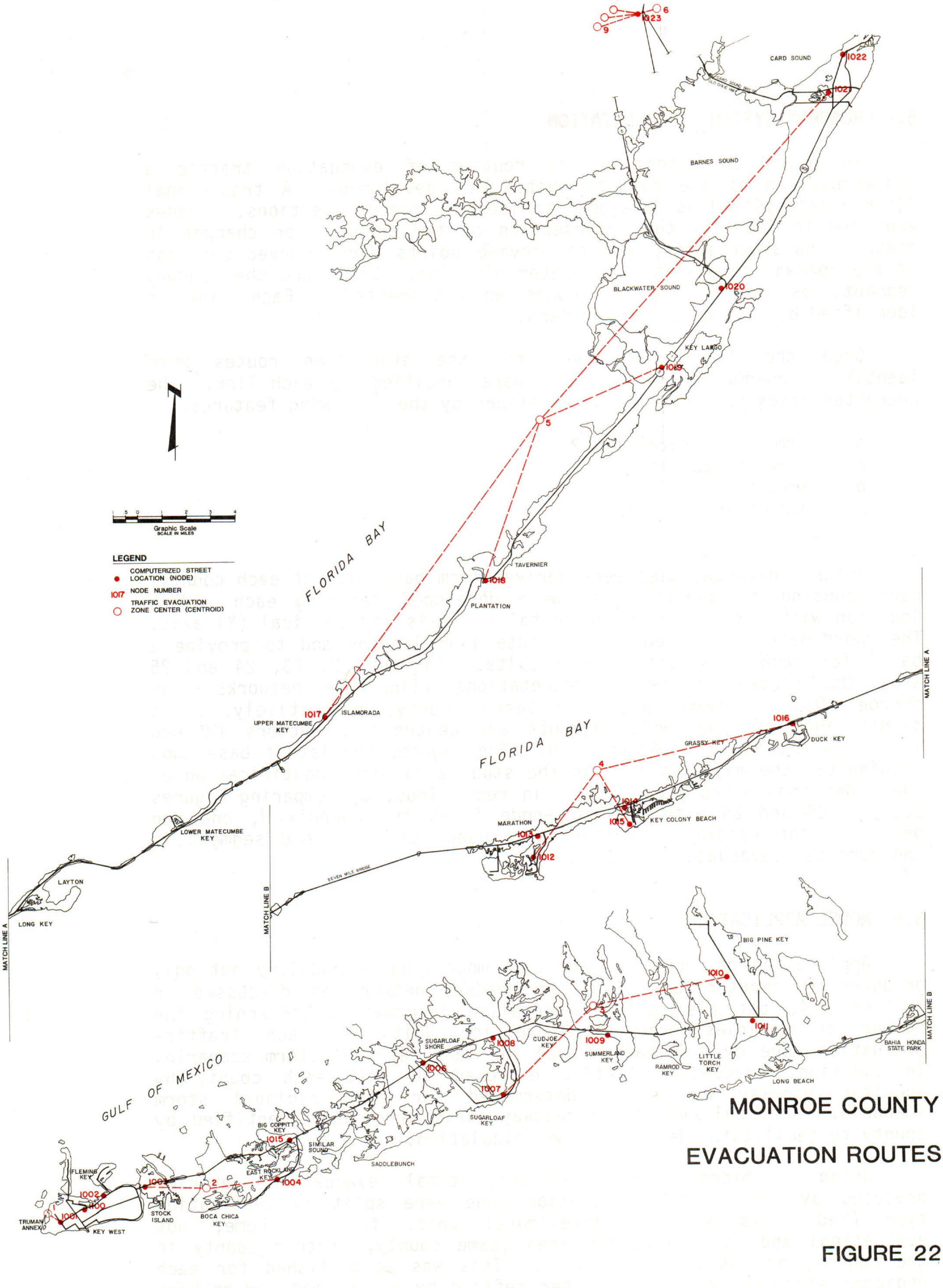
- o Number of travel lanes
- o Type of facility
- o Area type
- o Direction of travel

After link-node files were derived from base maps of each county, corresponding coordinate files were developed defining each node's location with respect to a horizontal (X) axis and vertical (Y) axis. The coordinates were used to calculate link lengths and to provide a basis for computer plotting of results. Figures 22, 23, 24 and 25 show the roadway system representations (link-node networks) for Monroe, Dade, Broward and Palm Beach County, respectively. The significance of link node segments and centroid connectors (dashed lines) is explained in Appendix H. The figures consist of base maps showing all the major streets in the study area with identification of the nodes and centroid connectors in red. Thus, by comparing Figures 22, 23, 24 and 25 with the link-node files in Appendix H, one can determine the roadway characteristics used for each road segment in the hurricane evacuation network.

5.5 MODEL APPLICATION

Application of the transportation modelling methodology not only produced a computerized evacuation roadway network as discussed in Section 5.4, but also produced detailed information concerning the number of vehicles evacuating dwelling units in each traffic-evacuation zone by destination type for each regional storm scenario. In addition, evacuation traffic expected to exit each county by specific highway route was determined for each regional storm scenario. Critical evacuation roadway links were then identified by county to facilitate clearance time calculation.

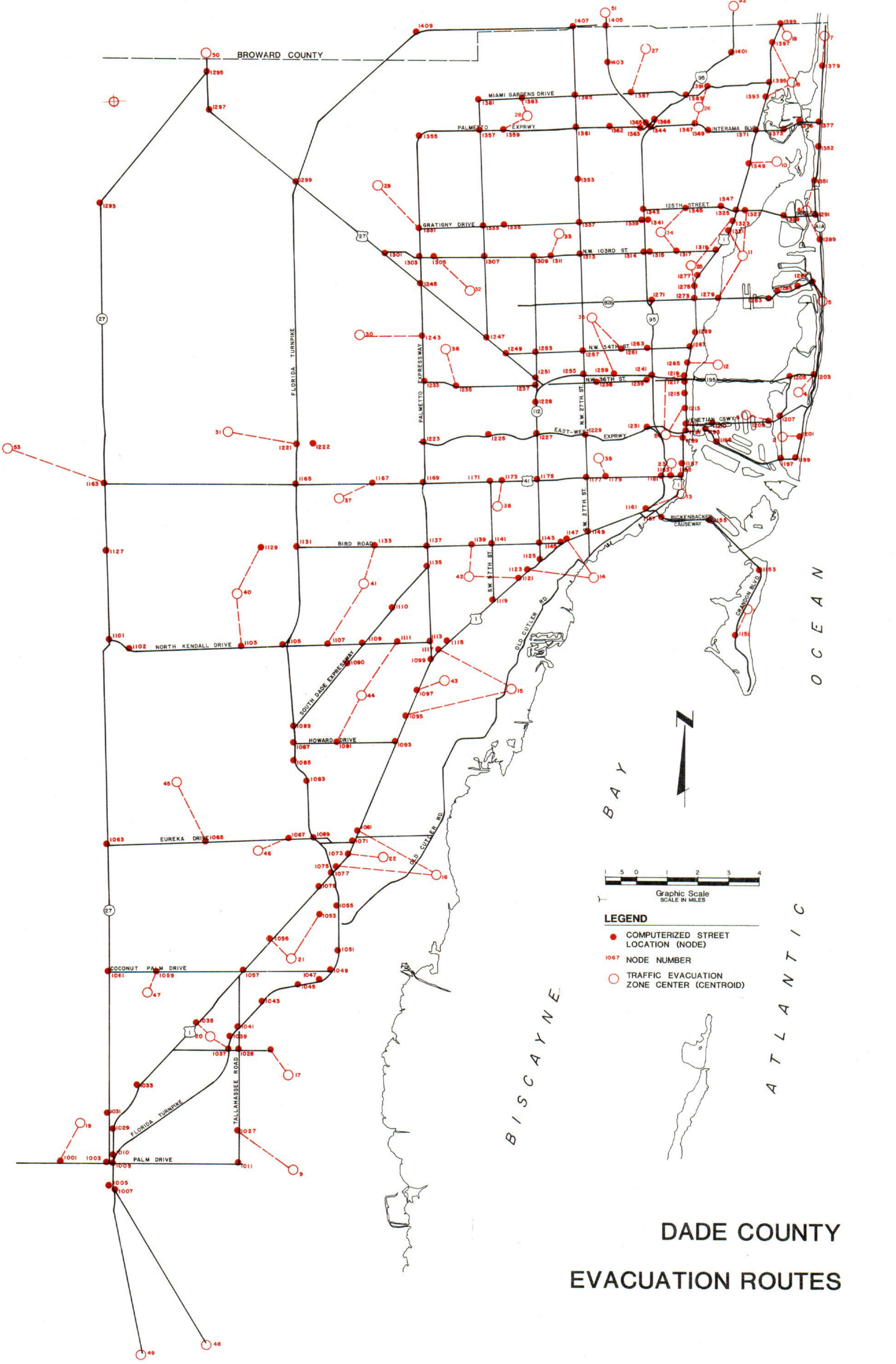
Using a micro-computer process, total evacuation vehicles produced by each traffic-evacuation zone were split by destination type (Red Cross shelter, hotel/motel unit, friend's home, not evacuating) and by destination area (same county, another county in the region, or out of the region). This was accomplished for each regional storm scenario and further refined by an assumed low or high participation in the evacuation by the population-at-risk. Appendix H provides this data by county.



MONROE COUNTY

EVACUATION ROUTES

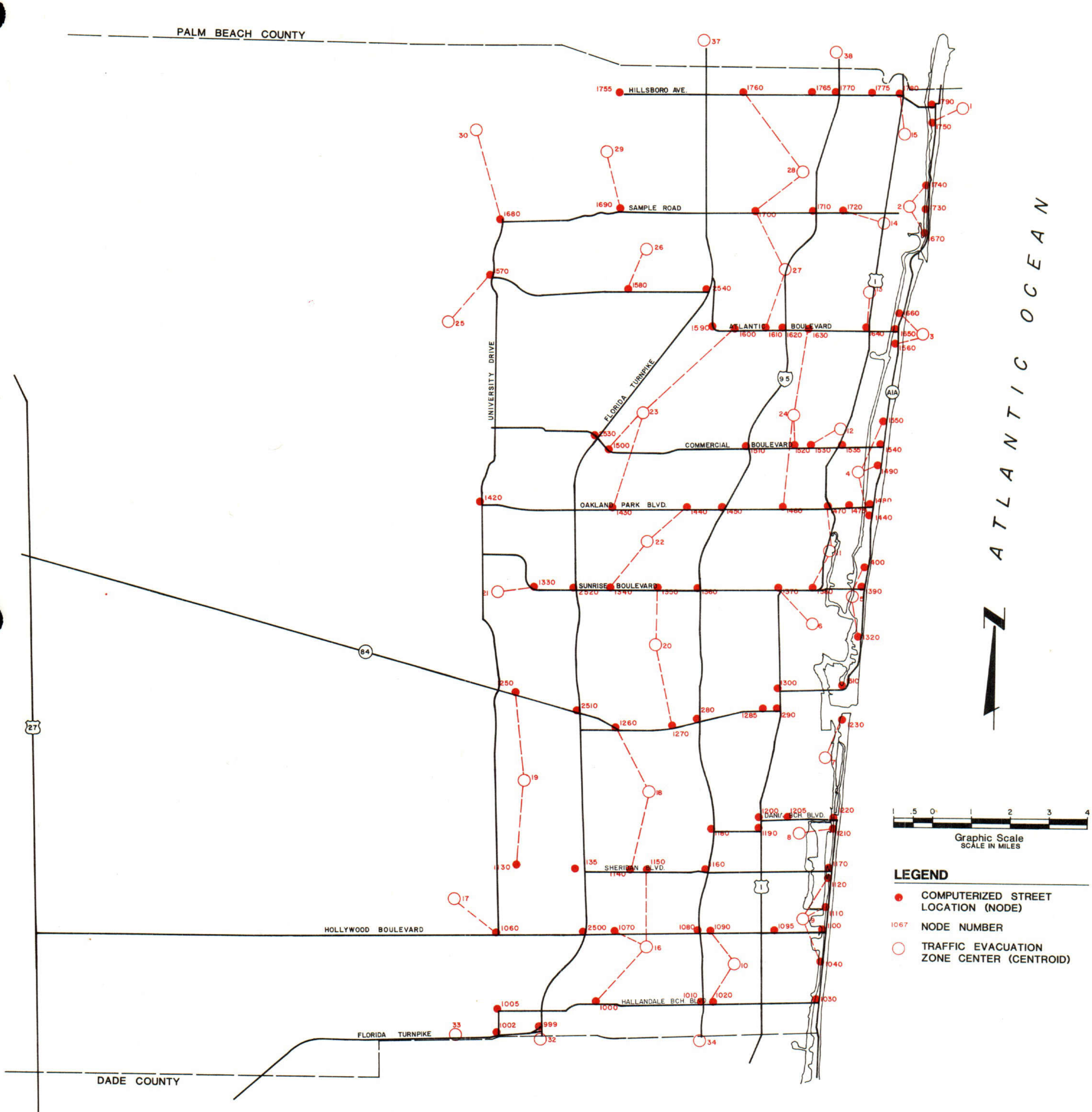
FIGURE 22



DADE COUNTY

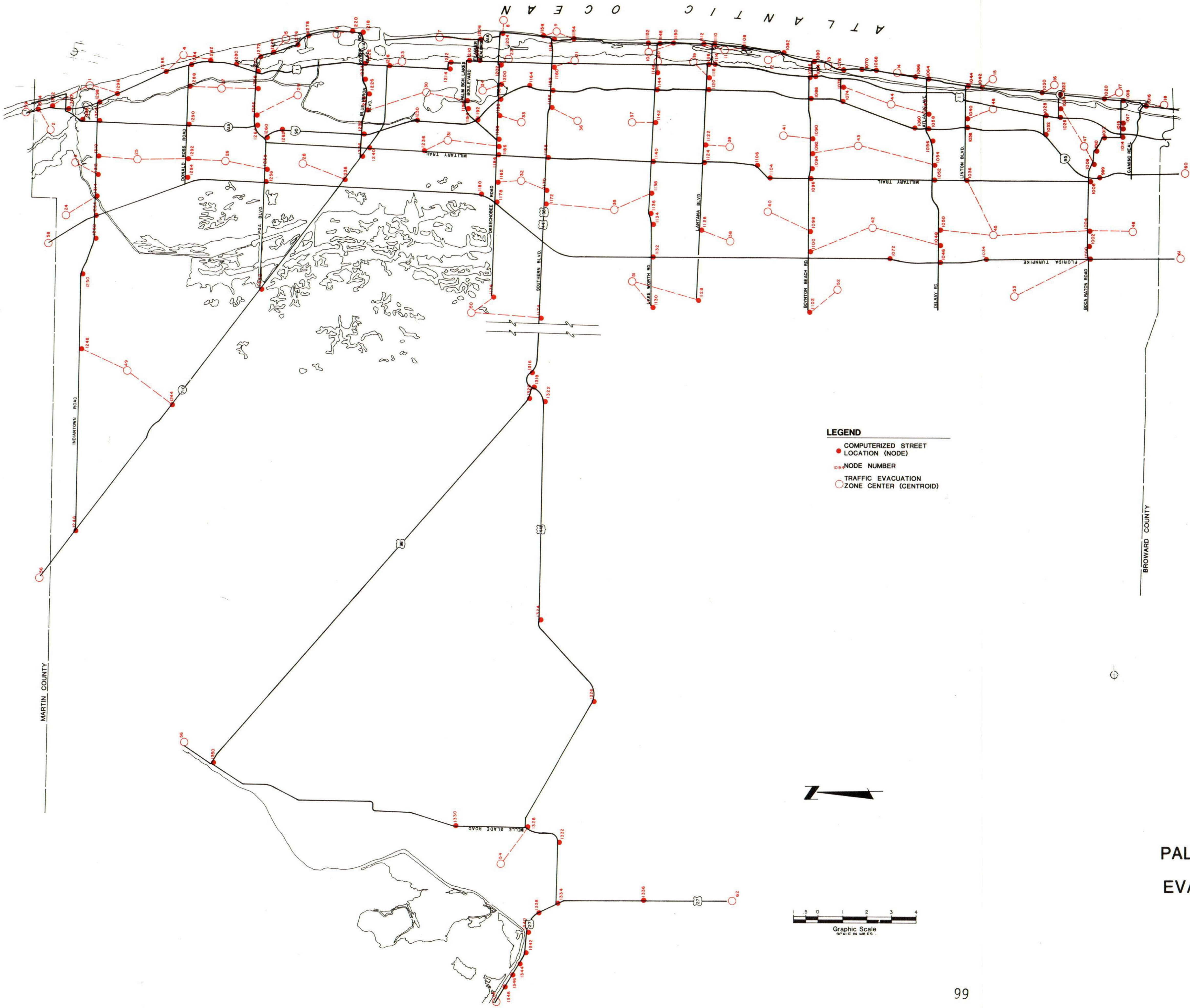
EVACUATION ROUTES

FIGURE 23



BROWARD COUNTY EVACUATION ROUTES

FIGURE 24



PALM BEACH COUNTY

EVACUATION ROUTES

FIGURE 25

regional storm scenario and further refined by an assumed low or high participation in the evacuation by the population-at-risk. Appendix H provides this data by county.

While the data presented in Appendix H are extremely important and useful, the data reflect where vehicles would go assuming enough safe destinations were available to satisfy peoples' perceived idea of where they would go. In the case of hotel/motel units, a deficit of available units exists for those individuals desiring a hotel/motel unit within the county of residence. In Dade, Broward, and Palm Beach Counties, 25, 30 and 60 percent, respectively, of the evacuees desiring an in-county hotel/motel unit could not be placed within their county of residence. Therefore, for transportation modelling purposes, these individuals were assumed to find hotel/motel shelter outside of their county.

A Red Cross shelter capacity deficit occurred only in the Middle Keys area and in the rural western area of Palm Beach County. An assumption was made for modelling purposes that the Middle Keys Red Cross shelter evacuees not able to be handled there would find safe refuge in Upper Keys and Dade County shelters. The Belle Glade area of Palm Beach County possibly would need to find additional shelter space depending upon the number of people evacuating from sub-standard housing in a real hurricane situation.

Appendix H provides traffic figures for evacuation vehicles expected to exit each county of the study area by regional storm scenario. These traffic volumes include in-county to out-of-county, as well as through movements. It should be noted that these traffic figures do not include background traffic that would otherwise be on the roadway and do not indicate at what time during the evacuation a certain portion of the reported traffic would arrive. These figures are useful, particularly for counties outside the study area who must plan for inter-regional traffic during a hurricane evacuation process.

An additional product of model application was a listing of those roadway segments identified as most critical during a hurricane evacuation. These roadway segments were identified as having the greatest travel demand during a hurricane evacuation relative to the segments' ability to handle a certain number of vehicles per hour. Critical links identified by county are as follows:

Monroe County

Channel Five Bridge
U.S. 1 over Barnes Sound

Dade County

41st Street at I-195
Eureka Drive at Florida Turnpike
Sunny Isles Blvd/163rd Street at U.S. 1
Tamiami Trail/U.S. 41 at State Road 9/Grapeland Blvd.
Florida Turnpike between U.S. 1 and South Dade Expressway
Northeast 125th Street between U.S. 1 and I-95

Broward County

Atlantic Blvd. east of I-95
Hollywood Blvd. east of I-95
U.S. 27 north of S.R. 84
Hallandale Beach Blvd. east of I-95
Sheridan Street east of I-95
Commercial Blvd. west of U.S. 1

Palm Beach County

AIA north of Blue Heron Blvd./Riviera Bridge
AIA/PGA Blvd.
Royal Park Bridge/Okeechobee Road
S.R. 710 between Florida Turnpike and Military Trail
Linton Blvd. between AIA and I-95
AIA north of N.E. Spanish River Blvd.

5.6 CLEARANCE AND EVACUATION ORDER TIMES

Just as the Hazards Analysis provided data necessary for deriving pre-landfall hazards times, the transportation analysis produced clearance and evacuation order times based on the outlined assumptions. Twelve times were produced for each sub-area of Monroe County and for Dade, Broward and Palm Beach Counties. A sensitivity test was performed on clearance and evacuation order times for three behavioral response curves, for two storm intensity levels, and for two levels of participation in the evacuation (thus, twelve times per county or sub-county unit).

A series of tables providing the above clearance time information was developed and presented to each county's Study Review Committee. Tables H-19 through H-24 in Appendix H provide detailed clearance time data developed for further use in determining evacuation order times.

The sensitivity analysis performed during the transportation modeling task resulted in 72 different evacuation order times for the study area. These evacuation order times are shown on Tables 29 through 31 for storm landfall in the Lower, Middle and Upper Keys, respectively. Tables 32 through 34 show the evacuation order times for Dade, Broward and Palm Beach Counties.

TABLE 29

MONROE COUNTY EVACUATION ORDER TIMES

Lower Southeast Florida
Hurricane Evacuation Study

Storm Landfall Point: Boca Chica

REGIONAL STORM SCENARIO	STORM CATEGORY	PERCENTAGE RESPONDING TO EVAC. ORDER	PRE-EVAC. ORDER CLEARANCE TIME	POST-EVAC. ORDER CLEARANCE TIME	PRE-LANDFALL HAZARDS TIME	EVACUATION ORDER TIME
RESPONSE CURVE A - QUICK RESPONSE/SHORT LEAD TIME						
2	1-2	Low	2	9.0	11.5	20.5
2	1-2	High	2	17.0	11.5	28.5
3	3-5	Low	2	16.0	14.0	30.0
3	3-5	High	2	20.0	14.0	34.0
RESPONSE CURVE B - BEHAVIORAL SURVEY RESPONSE						
2	1-2	Low	5	9.0	11.5	20.5
2	1-2	High	5	16.5	11.5	28.0
3	3-5	Low	5	15.5	14.0	29.5
3	3-5	High	5	19.0	14.0	33.0
RESPONSE CURVE C - SLOW RESPONSE/LONG LEAD TIME						
2	1-2	Low	7	11.0	11.5	22.5
2	1-2	High	7	14.0	11.5	25.5
3	3-5	Low	7	13.5	14.0	27.5
3	3-5	High	7	17.0	14.0	31.0

TABLE 30

MONROE COUNTY EVACUATION ORDER TIMES

Lower Southeast Florida
Hurricane Evacuation Study

Storm Landfall Point: Marathon

REGIONAL STORM SCENARIO	STORM CATEGORY	PERCENTAGE RESPONDING TO EVAC. ORDER	PRE-EVAC. ORDER CLEARANCE TIME	POST-EVAC. ORDER CLEARANCE TIME	PRE-LANDFALL HAZARDS TIME	EVACUATION ORDER TIME
RESPONSE CURVE A - QUICK RESPONSE/SHORT LEAD TIME						
4	1-2	Low	2	6.5	9.0	15.5
4	1-2	High	2	11.5	9.0	20.5
5	3-5	Low	2	12.0	13.0	25.0
5	3-5	High	2	14.5	13.0	27.0
RESPONSE CURVE B - BEHAVIORAL SURVEY RESPONSE						
4	1-2	Low	5	7.0	9.0	16.0
4	1-2	High	5	11.0	9.0	20.0
5	3-5	Low	5	11.0	13.0	24.0
5	3-5	High	5	13.0	13.0	26.0
RESPONSE CURVE C - SLOW RESPONSE/LONG LEAD TIME						
4	1-2	Low	7	9.0	9.0	18.0
4	1-2	High	7	9.0	9.0	18.0
5	3-5	Low	7	9.0	13.0	22.0
5	3-5	High	7	11.0	13.0	24.0

TABLE 31

MONROE COUNTY EVACUATION ORDER TIMES

Lower Southeast Florida
Hurricane Evacuation Study

Storm Landfall Point: Key Largo

REGIONAL STORM SCENARIO	STORM CATEGORY	PERCENTAGE RESPONDING TO EVAC. ORDER	PRE-EVAC. ORDER CLEARANCE TIME	POST-EVAC. ORDER CLEARANCE TIME	PRE-LANDFALL HAZARDS TIME	EVACUATION ORDER TIME
RESPONSE CURVE A - QUICK RESPONSE/SHORT LEAD TIME						
6	1-2	Low	2	3.0	7.5	10.5
6	1-2	High	2	5.5	7.5	13.0
7	3-5	Low	2	5.5	11.5	17.0
7	3-5	High	2	7.0	11.5	18.5
RESPONSE CURVE B - BEHAVIORAL SURVEY RESPONSE						
6	1-2	Low	5	6.0	7.5	13.5
6	1-2	High	5	6.0	7.5	13.5
7	3-5	Low	5	6.0	11.5	17.5
7	3-5	High	5	6.5	11.5	18.0
RESPONSE CURVE C - SLOW RESPONSE/LONG LEAD TIME						
6	1-2	Low	7	8.0	7.5	15.5
6	1-2	High	7	8.0	7.5	15.5
7	3-5	Low	7	8.0	11.5	19.5
7	3-5	High	7	8.0	11.5	19.5

TABLE 32

DADE COUNTY EVACUATION ORDER TIMES

Lower Southeast Florida
Hurricane Evacuation Study

Storm Landfall Point: Perrine-Cutler Ridge

REGIONAL STORM SCENARIO	STORM CATEGORY	PERCENTAGE RESPONDING TO EVAC. ORDER	PRE-EVAC. ORDER CLEARANCE TIME	POST EVAC. ORDER CLEARANCE TIME	PRE-LANDFALL HAZARDS TIME	EVACUATION ORDER TIME
RESPONSE CURVE A - QUICK RESPONSE/SHORT LEAD TIME						
8	1-3	Low	2	7.5	9.5	17.0
8	1-3	High	2	10.0	9.5	19.5
9	4-5	Low	2	9.0	11.5	20.5
9	4-5	High	2	11.0	11.5	22.5
RESPONSE CURVE B - BEHAVIORAL SURVEY RESPONSE						
8	1-3	Low	3	8.0	9.5	17.5
8	1-3	High	3	10.5	9.5	20.0
9	4-5	Low	3	9.5	11.5	21.0
9	4-5	High	3	11.5	11.5	22.5
RESPONSE CURVE C - SLOW RESPONSE/LONG LEAD TIME						
8	1-3	Low	6	10.0	9.5	19.5
8	1-3	High	6	12.0	9.5	21.5
9	4-5	Low	6	11.5	11.5	23.0
9	4-5	High	6	13.0	11.5	24.5

TABLE 33

BROWARD COUNTY EVACUATION ORDER TIMES

Lower Southeast Florida
Hurricane Evacuation Study

Storm Landfall Point: Hollywood

REGIONAL STORM SCENARIO	STORM CATEGORY	PERCENTAGE RESPONDING TO EVAC. ORDER	PRE-EVAC. ORDER CLEARANCE TIME	POST-EVAC. ORDER CLEARANCE TIME	PRE-LANDFALL HAZARDS TIME	EVACUATION ORDER TIME
RESPONSE CURVE A - QUICK RESPONSE/SHORT LEAD TIME						
10	1-3	Low	2	5.0	9.5	14.5
10	1-3	High	2	6.0	9.5	15.5
11	4-5	Low	2	5.5	11.5	17.0
11	4-5	High	2	6.5	11.5	18.0
RESPONSE CURVE B - BEHAVIORAL SURVEY RESPONSE						
10	1-3	Low	3	6.5	9.5	16.0
10	1-3	High	3	7.0	9.5	16.5
11	4-5	Low	3	7.0	11.5	18.5
11	4-5	High	3	7.0	11.5	18.5
RESPONSE CURVE C - SLOW RESPONSE/LONG LEAD TIME						
10	1-3	Low	6	10.5	9.5	20.0
10	1-3	High	6	10.5	9.5	20.0
11	4-5	Low	6	10.5	11.5	22.0
11	4-5	High	6	10.5	11.5	22.0

TABLE 34

PALM BEACH COUNTY EVACUATION ORDER TIMES

Lower Southeast Florida
Hurricane Evacuation Study

Storm Landfall Point: Boynton Beach

REGIONAL STORM SCENARIO	STORM CATEGORY	PERCENTAGE RESPONDING TO EVAC. ORDER	PRE-EVAC. ORDER CLEARANCE TIME	POST-EVAC. ORDER CLEARANCE TIME	PRE-LANDFALL HAZARDS TIME	EVACUATION ORDER TIME
RESPONSE CURVE A - QUICK RESPONSE/SHORT LEAD TIME						
12	1-3	Low	2	4.0	9.5	13.5
12	1-3	High	2	5.0	9.5	15.0
13	4-5	Low	2	4.0	11.5	15.5
13	4-5	High	2	5.0	11.5	16.5
RESPONSE CURVE B - BEHAVIORAL SURVEY RESPONSE						
12	1-3	Low	3	5.5	9.5	15.0
12	1-3	High	3	6.5	9.5	16.0
13	4-5	Low	3	5.5	11.5	17.0
13	4-5	High	3	6.5	11.5	18.0
RESPONSE CURVE C - SLOW RESPONSE/LONG LEAD TIME						
12	1-3	Low	6	9.5	9.5	19.0
12	1-3	High	6	9.5	9.5	19.0
13	4-5	Low	6	9.5	11.5	21.0
13	4-5	High	6	9.5	11.5	21.0

5.6.1 Intensity of Regional Storms

The relatively good evacuation highway networks for Broward and Palm Beach Counties are able to handle the higher evacuation population levels of a high-intensity storm with only an average of two hours added to the total required evacuation time. For Dade County, there is an average three hour difference between the evacuation order times for storm situation A (Cateory 1-3) and storm situation B (Category 4-5), all other conditions remaining constant.

The Monroe County evacuation order times experience an average five hour increase between storm situations A and B for the Upper Keys, and a six to ten hour increase between storm situations A and B for the Lower Keys. This dramatic increase in Monroe County is due mainly to the extremely high pre-landfall hazards times of 12 to 14 hours and the requirement to move a greater number of evacuees across the vulnerable evacuation route of U.S. 1.

5.6.2 Behavioral Response/Mobilization Times

The most alarming evacuation order times occur within Monroe County, since U.S. 1 is the only evacuation route available for evacuation from the Florida Keys. It is interesting to note that on Tables 30 and 31 most of the evacuation order times actually decrease as longer behavioral response assumptions are tested. This occurs mainly because response curve C represents an early release of vehicles before the evacuation order time. The congestion experienced under response curve A varies the post-evacuation order clearance time beyond that experienced with response curve C. In the Upper Keys of Monroe County, and for Dade, Broward and Palm Beach Counties, there is a more normal increase in total evacuation time as the sensitivity test moves from curve A to curve C.

This suggests a possible optimal behavioral response distribution that could be determined for each county or sub-area given its particular evacuation network. Broward and Palm Beach Counties appear to have an optimum behavioral response distribution somewhere near response curve B. The optimum response curve for Dade County would perhaps lie between response curve B and response curve C since the less congested situation with response curve C yields only a slightly higher evacuation time. The extensive congestion calculated for the Lower and Middle Keys areas is a clear sign that a quick response mobilization would be impossible to plan for in this area.

5.6.3 Level of Evacuation Participation

The third variable in the sensitivity analysis was the high and low percentage of persons responding to the evacuation order. Again, for Palm Beach and Broward Counties, there was either no increase or only one hour increase in evacuation times due to the low or high percentage of evacuation participation. Dade County experienced an average two hour difference if 20 to 30 percent of the population remains in vulnerable areas. The Upper Keys experienced no time savings under response curve C and only one or two hours of time savings under response curves A or B.

With storm landfall in the Marathon area, there was a substantial savings experienced under response curves A and B of approximately five and four hours, respectively. This indicates some potential for reducing the extensive Middle Keys evacuation times if significant numbers of residents leave early. For a storm landfall at Boca Chica in the Lower Keys, there is also some potential for significant savings of seven to eight hours under response curves A and B if significant numbers of residents leave early. The unacceptable situation of 50 percent of the Lower Keys residents remaining would only become acceptable if those residents could somehow be appropriately sheltered.

The strongest results of the sensitivity analysis suggest that there may be great potential for more efficient evacuation plans for Palm Beach and Broward Counties by attempting to achieve the quickest possible mobilization of persons residing in vulnerable areas. In Dade County, the greatest savings may be in encouraging large numbers of persons in vulnerable areas to evacuate early. For the Monroe County evacuation situation, planning efforts should concentrate on the earliest possible evacuation response.

Chapter 6
EVACUATION PLANNING IMPLICATIONS

The technical data developed for the Lower Southeast Florida Hurricane Evacuation Study were prepared to identify and measure the critical time elements of an evacuation order. These critical elements included the clearance time and pre-landfall hazards time. Extensive efforts in the areas of socioeconomic and shelter data collection, behavior analysis, hurricane hazards analysis, and transportation analysis were performed to measure these elements. Therefore, evacuation timing data reflect the ultimate need to allow all vulnerable residents time to reach their chosen destinations for unique storm tracks and intensities.

This chapter provides a quantitative framework within which each county in the lower southeast Florida study area can base an evacuation order. The planning implications of evacuation data inputs and outputs reported previously are structured for use in evacuation decision making. Specifically, county storm situations representing varying levels of threat and response are summarized and then incorporated into regional storm scenarios. Evacuation timing requirements are then presented for each county by regional storm scenario. Planning recommendations concerning Red Cross shelters, evacuation routes, traffic control and special evacuation considerations are discussed.

6.1 COUNTY STORM SITUATIONS AND REGIONAL STORM SCENARIOS

Two general levels of vulnerability were developed for Dade, Broward and Palm Beach Counties and for each of the Lower, Middle and Upper Keys areas of Monroe County. Each level represents a distinct storm situation confronting the area and producing different intensities of storm tide, hurricane winds and required evacuation. Classification of storm situations into "A" for less intense storms and "B" for more intense storms allows counties to gear evacuation efforts to an expected hurricane intensity.

6.1.1 Monroe County Storm Situations

In Monroe County, an "A" situation will occur when a Saffir/Simpson category one or two hurricane approaches with storm tides five to seven feet above mean sea level and winds ranging from 74 to 110 miles per hour. A "B" storm situation exists when the county faces a Saffir/Simpson category three to five hurricane intensity, with storm tides ten to over fifteen feet above mean sea level and winds ranging from 111 to over 155 miles per hour. Depending upon which area of the Keys is confronted by a hurricane, 15,200 to 41,900 people were assumed to leave their residences to seek safe shelter. Of the five traffic evacuation zones established for

Monroe County, one or more could be required to evacuate, depending upon which area of the Keys is confronted by the approaching hurricane.

6.1.2 Dade County Storm Situations

In Dade County, an "A" storm situation will result from a Saffir/Simpson Category one to three hurricane intensity with storm tides five to ten feet above mean sea level and winds ranging from 74 to 130 miles per hour. All residents in traffic evacuation zones 1 through 17, as well as mobile home residents in 18 through 47, are assumed to evacuate. This translates to an assumed evacuation population of 261,700 persons.

A "B" storm situation will occur in Dade County if a Saffir/Simpson category four or five hurricane approaches with tides ten to over fifteen feet above mean sea level and winds ranging from 131 to over 155 miles per hour. Zones 1 through 25 should evacuate, as well as mobile home residents in zones 26 through 47. This evacuation level produces an assumed evacuating population of 385,400 persons .

6.1.3 Broward County Storm Situations

In Broward County, an "A" storm situation will occur if a Saffir/Simpson category one to three hurricane approaches with storm tides four to seven feet above mean sea level and winds ranging from 74 to 130 miles per hour. All residents in traffic evacuation zones 1 through 9, as well as mobile home residents in zones 10 through 30, should evacuate. This results in an assumed evacuating population of 191,700 persons.

A "B" storm situation will exist in Broward County if a Saffir/Simpson category four or five hurricane threatens with storm tides seven to over eleven feet above mean sea level and winds ranging from 131 to over 155 miles per hour. Zones 1 through 15 should evacuate, as well as mobile home residents in zones 16 through 30. This produces an assumed evacuating population of 217,100 persons.

6.1.4 Palm Beach County Storm Situations

In Palm Beach County, an "A" storm situation will occur if a Saffir/Simpson category one to three hurricane approaches with storm tides three to six feet above mean sea level and winds ranging from 74 to 130 miles per hour. All residents in traffic evacuation zones 1 through 18, as well as mobile home residents in zones 19 through 54, should evacuate. This produces an assumed evacuating population of 111,300 persons.

A "B" storm situation presents Palm Beach County with a Saffir/Simpson category four or five hurricane intensity, with storm tides eight to over nine feet above mean sea level, and winds ranging from 131 to over 155 miles per hour. Zones 1 through 23 should evacuate, as well as mobile home residents in zones 24 through 54. This produces an assumed evacuating population of 120,900 persons.

Table 35 summarizes the "A" and "B" storm situations developed for Dade, Broward and Palm Beach Counties and each sub-county area of Monroe County. Data are presented to facilitate quick reference of expected storm tides, hurricane winds, and required extent of evacuation, as described previously for each county and storm situation.

6.1.5 Regional Storm Scenarios

A hurricane is a storm that recognizes no county's boundaries and whose impact can affect many counties upon approach. Therefore, analysis of clearance times and pre-landfall hazards times had to consider evacuation movements and storm vulnerability as an interrelated regional phenomenon. Seventeen regional storm scenarios were developed as reference hurricanes. Each regional storm scenario was based on a combination of a unique storm track and storm intensity. Regional storm scenarios affect each county in one of three ways:

1. An "A" storm situation as previously described for each county

2. A "B" storm situation, also described for each county

3. A storm situation requiring little to no evacuation for a county

Of the seventeen regional storm scenarios, thirteen involve landfalling storms, three involve exiting storms, and one presents a paralleling storm. Each regional storm creates a different total population-at-risk as identified by compared results of the hazards analysis and collected socioeconomic data.

Table 36 presents a summary of the 17 regional storm scenarios developed and used in the study. County storm situations that would confront Dade, Broward, and Palm Beach Counties and each of the Lower, Middle and Upper Keys areas of Monroe County were identified for each regional storm scenario. The total regional population-at-risk is also provided on Table 36 for each regional storm.

The number of different storm tracks and varying degrees of storm intensity that could confront a county in an actual hurricane situation are limitless. The seventeen regional storm scenarios with resulting county storm situations developed in this study provide alternative storm tracks and intensities with which an approaching hurricane should be compared. By deciding which regional storm tracks and intensity levels are most likely for an approaching hurricane, local emergency preparedness officials in each county can identify who must evacuate and decide whether an evacuation is necessary.

TABLE 35

COUNTY STORM SITUATIONS

Lower Southeast Florida
Hurricane Evacuation Study

County	Storm Situation	Saffir/Simpson Category	Storm Tide at Shoreline (Feet above MSL)	Velocity of Hurricane Winds (MPH)	County Traffic Evacuation Zones Assumed to Evacuate: Residents in Zones:	County Traffic Evacuation Zones Assumed to Evacuate: Mobile Home Residents in Zones:	Population Assumed to Evacuate
Monroe-Lower Keys	A	1-2	5-7	74-110	1-4	1-4	29,200
	B	3-5	10-15+	111-155+	1-4	1-4	32,100
Monroe-Middle Keys	A	1-2	5-7	74-110	4-5	4-5	9,800
	B	3-5	10-15+	111-155+	4-5	4-5	9,800
Monroe-Upper Keys	A	1-2	5-7	74-110	5	5	15,200
	B	3-5	10-15+	111-155+	5	5	15,200
Dade	A	1-3	5-10	74-130	1-17	18-47	261,700
	B	4-5	13-15+	131-155+	1-25	26-47	385,400
Broward	A	1-3	4-7	74-130	1-9	10-30	191,700
	B	4-5	9-11+	131-155+	1-15	16-30	217,100
Palm Beach	A	1-3	3-6	74-130	1-18	19-54	111,300
	B	4-5	8-9+	131-155+	1-23	24-54	120,900

TABLE 36

REGIONAL STORM SCENARIOS

Lower Southeast Florida
Hurricane Evacuation Study

Regional Storm Number	Saffir/ Simpson Category	Landfall at	PB	BR	DA	UPPER KEYS	MIDDLE KEYS	LOWER KEYS	Total Regional Population-at-Risk
1	1-2	15 mi. west of Key West	X	X	X	X	X	A	29,200
2	1-2	Boca Chica	X	X	X	X	A	A	39,000
3	3-5	Boca Chica	X	X	X	X	B	B	41,900
4	1-2	Marathon	X	X	X	A	A	X	25,000
5	3-5	Marathon	X	X	X	B	B	X	25,000
6	1-2	Key Largo	X	X	A	A	X	X	276,900
7	3-5	Key Largo	X	A	B	B	X	X	592,300
8	1-3	Perrine-Cutler Ridge	X	A	A	X	X	X	453,400
9	4-5	Perrine-Cutler Ridge	X	A	B	X	X	X	577,100
10	1-3	Hollywood	A	A	X	X	X	X	303,000
11	4-5	Hollywood	A	B	A	X	X	X	590,100
12	1-3	Boynton Beach	A	X	X	X	X	X	111,300
13	4-5	Boynton Beach	B	X	X	X	X	X	120,900
14	Paralleling Storm Regionwide		A	A	A	A	A	A	619,000
15	1-3	Exiting at Miami Beach	X	A	A	X	X	X	453,400
16	1-3	Exiting at Pompano Beach	A	A	X	X	X	X	303,000
17	1-3	Exiting at West Palm Beach	A	X	X	X	X	X	111,300

Legend:

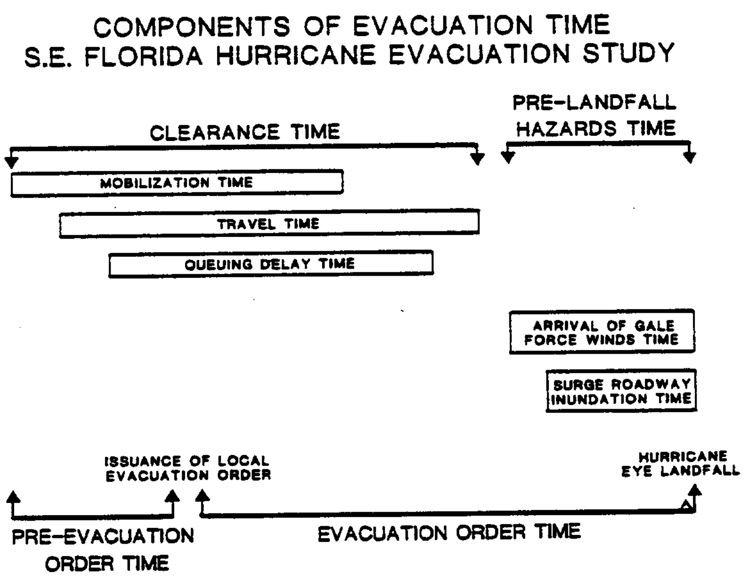
PB = Palm Beach County
BR = Broward County
DA = Dade County
X = Little or no storm surge

UPPER KEYS = Channel Five Br. to Key Largo
MIDDLE KEYS = Seven Mile Br. to Channel Five Br.
LOWER KEYS = Key West to Seven Mile Br.
A = Low Intensity Storm Situation
B = High Intensity Storm Situation

6.2 EVACUATION TIME REQUIREMENTS

Regional storm scenarios not only allow the determination of who should evacuate in each county, but also facilitate the calculation of how long an evacuation will take for unique hurricane tracks and storm intensities. Pre-landfall hazards times and post-evacuation order clearance times are developed in the study to allow the calculation of evacuation order times. The evacuation time concepts represented pictorially in Figure 2 of the introductory chapter are presented below in Figure 26 as a bar chart.

FIGURE 26
EVACUATION TIME COMPONENTS



Terms presented in Figure 26 are defined as follows:

Clearance Time is the time required to clear all vehicles evacuating in response to a hurricane situation from the roadways. Clearance time begins when the first evacuating vehicle enters the road network (as defined by a hurricane evacuation behavioral response curve) and ends when the last evacuating vehicle reaches its destination. Clearance time includes the time required by evacuees to secure their homes and prepare to leave (referred to as mobilization time), the time spent by evacuees travelling along the road network (referred to as travel time), and the time spent by evacuees waiting along the road network due to traffic congestion (referred to as queuing delay time). Clearance time does not relate to the time any one vehicle spends traveling on the road network.

Pre-Landfall Hazards Time is the time frame immediately before hurricane eye landfall within which evacuation should not be carried out due to the effects of the arrival of sustained gale force winds (39 mph).

Post-Evacuation Order Clearance Time is the clearance time remaining after the evacuation order is issued. This time component added to the pre-landfall hazards time results in evacuation order time.

Pre-Evacuation Order Time refers to a period of time prior to issuance of the evacuation order in which a certain percent of evacuees have already left home and have entered the road network.

Evacuation Order Time is the time in hours before hurricane eye-landfall by which the evacuation order must be given to allow all evacuees time to reach their chosen destinations.

The determination of evacuation order time requirements focuses on developing evacuation order times by county for each regional storm scenario using pre-landfall hazards times and clearance times determined for each regional storm scenario. Time adjustment considerations for evacuation order times are then discussed based on actual hurricane characteristics and behavioral responses of the population-at-risk. The section concludes with a framework for evacuation decision making discussing a procedure for using technical data in emergency decision making.

6.2.1 Pre-Landfall Hazards Times

The evacuation of vulnerable areas must be accomplished before arrival of the hazards preceding hurricane eye landfall. The hazards analysis of the Lower Southeast Florida Hurricane Evacuation Study identified that time component before hurricane eye landfall during which gale force winds arrive and during which roadways would be inundated due to storm tide.

The hazards analysis revealed that pre-landfall hazards times would be greatest for Monroe County, ranging from 7.5 hours to 14 hours before hurricane eye landfall. In Dade, Broward, and Palm Beach Counties, pre-landfall hazards times ranged from 6 hours to a maximum of 11.5 hours before hurricane eye landfall. The variation in times reflects different hurricane tracks and levels of hurricane intensity for each regional storm scenario. Pre-landfall hazards times also assume that the hurricane will have a forward speed of twelve miles per hour and a radius of maximum winds of twenty miles for a category 1 to 4 storm. A forward speed of 12 miles per hour and a radius of maximum winds of 12 miles was assumed for a category 5 hurricane.

In all regional storms, the arrival of gale force winds preceded the storm tide inundation of roadways according to the storm tide modeling. Roadways in the storm tide vulnerable areas of each county generally will be flooded one to five and one-half hours before hurricane eye-landfall. Therefore, in planning for the worst probable case situation, gale force winds were chosen to represent the pre-landfall hazards time frame. Rainfall is expected to arrive with the advent of gale force winds; however, rainfall and related roadway flooding must be carefully monitored prior to landfall of a hurricane.

6.2.2 Clearance Times

The transportation analysis revealed that clearance times were affected more by the rate at which people responded (evacuated) to a hurricane situation than any other assumed parameter. The second most important factor influencing clearance times was the storm intensity (Categories 1-2 and 3-5 in Monroe County and Categories 1-3 and 4-5 in Dade, Broward and Palm Beach Counties). A third influencing factor was the level of participation in the evacuation by the population-at-risk.

For the purpose of developing evacuation order times, clearance times reflecting the B behavioral response curve (rate of evacuees' response based on the behavioral survey) were used. An average clearance time representing a figure between a high and low level of participation were used, but were weighted more heavily to the high participation figure for conservative planning purposes. Depending upon the "A" or "B" storm situation confronting the county, the clearance time reflecting the proper storm intensity was used.

Although one county's traffic movements exert more or less influence on another county's roadway system depending on the assumed regional storm scenario, these movements have a relatively minor effect on clearance times. This rather surprising result of the transportation analysis was due to the extremely heavy vehicle demand on certain roadway links connecting the barrier islands to the mainland. This is not to say that heavy traffic congestion would not occur on such roadway facilities as I-95 and the Florida Turnpike. More relative congestion would occur on identified critical links near the storm tide vulnerable areas.

Clearance time generally begins before an evacuation order is issued due to the assumption based on the behavioral survey that twenty to thirty percent of the evacuating population will mobilize and begin leaving prior to the official issuance of an evacuation order. Therefore, total clearance time must be thought of as a pre-evacuation order clearance time and a post-evacuation order clearance time combination. Decision makers must be able to identify the post-evacuation order clearance time required so that by adding the pre-landfall hazards time, the time at which the evacuation order must be issued can be identified.

Due to the limited road network and long travel distances involved, Monroe County had the lengthiest post-evacuation order clearance times. These time elements ranged from six hours for a regional storm striking the Upper Keys to 20 hours for a paralleling storm affecting all of the Keys. If thirty to forty percent of the people are not expected to begin to evacuate prior to the evacuation order, up to five hours must be added to these post-evacuation order clearance times.

In Dade County, post evacuation order clearance times range from 9.5 to 10.5 hours. In Broward County, times range from 6.5 hours to 7.5 hours. In Palm Beach County, for every regional storm affecting the county, six hours of post-evacuation order clearance time is required. If twenty to thirty percent of the people are not expected to begin to evacuate prior to the evacuation order, up to three hours must be added to the post-evacuation order clearance times.

6.2.3 Evacuation Order Times

Evacuation order times are determined for each regional storm scenario for each county by adding the pre-landfall hazards time and post-evacuation order clearance time developed for each regional storm scenario for each county. The post evacuation order clearance times are based on the Survey Behavioral Response Curve (Curve B) and are the numerical average of times calculated for high and low percentage response to the evacuation order. Table 37 presents a summary of those critical time elements for each regional storm scenario and county.

Evacuation order times provide the number of hours before hurricane eye landfall at which time the evacuation order should be issued. In Monroe County the evacuation order time ranges from 13.5 hours for a category one or two storm striking the Upper Keys to 31.5 hours for either a paralleling storm or a category four or five storm striking the Lower Keys. In Dade County, evacuation order times range from 16 hours for a category one or two storm striking the Upper Keys to 22 hours for a landfalling category four or five storm at the Perrine-Cutler Ridge area.

Evacuation order times in Broward County range from 13 hours for a category three to five hurricane striking the Upper Keys to 19 hours for a category four or five hurricane landfalling at Hollywood. In Palm Beach County, evacuation order times range from 12 hours for a category one to three storm exiting at Pompano Beach to 17.5 hours for a category four or five hurricane landfalling at Boynton Beach.

6.2.4 Evacuation Time Adjustments

Evacuation time requirements presented above define the amount of time before projected eye-landfall that the official evacuation order should be issued to allow residents time to reach safe shelter. The assumptions related to hurricane storm characteristics as well as behavioral responses of evacuees may or may not hold true in a real storm situation. Emergency preparedness officials and decision makers must be prepared to make time adjustments based on local knowledge of actual behavioral tendencies and actual storm characteristic information provided by the National Hurricane Center.

Actual storm characteristics affect both pre-landfall hazards times and clearance times. If the approaching hurricane is moving at a forward speed of faster than 12 miles per hour and/or has a radius of maximum winds greater than 20 miles, <u>pre-landfall hazards times must be increased</u>. Conversely, if such conditions are less than those parameters, <u>pre-landfall hazards times can be decreased</u>. Adjustments

TABLE 37

EVACUATION TIME REQUIREMENTS
BY COUNTY BY REGIONAL STORM SCENARIO

Regional Storm Scenario	MONROE COUNTY Pre-Landfall Hazards Time	MONROE COUNTY Post-Evac. Order Clearance Time	MONROE COUNTY Evacuation Order Time	DADE COUNTY Pre-Landfall Hazards Time	DADE COUNTY Post-Evac. Order Clearance Time	DADE COUNTY Evacuation Order Time	BROWARD COUNTY Pre-Landfall Hazards Time	BROWARD COUNTY Post-Evac. Order Clearance Time	BROWARD COUNTY Evacuation Order Time	PALM BEACH COUNTY Pre-Landfall Hazards Time	PALM BEACH COUNTY Post-Evac. Order Clearance Time	PALM BEACH COUNTY Evacuation Order Time
	Hours**			Hours**			Hours**			Hours**		
1	10	13	23	*	*	*	*	*	*	*	*	*
2	11.5	13	24.5	*	*	*	*	*	*	*	*	*
3	14	17.5	31.5	*	*	*	*	*	*	*	*	*
4	9	9	18	*	*	*	*	*	*	*	*	*
5	13	12	25	*	*	*	*	*	*	*	*	*
6	7.5	6	13.5	6.5	9.5	16	*	*	*	*	*	*
7	11.5	6.5	18.0	7.5	10.5	18	6.5	6.5	13	*	*	*
8	*	*	*	9.5	9.5	19	7.5	6.5	14	*	*	*
9	*	*	*	11.5	10.5	22	7.5	6.5	14	*	*	*
10	*	*	*	*	*	*	9.5	6.5	16	6.5	6	12.5
11	*	*	*	6.5	9.5	16	11.5	7.5	19	7.5	6	13.5
12	*	*	*	*	*	*	*	*	*	10	6	16
13	*	*	*	*	*	*	*	*	*	11.5	6	17.5
14	11.5	20	31.5	9.5	9.5	19	9.5	6.5	16	10	6	16
15	*	*	*	10.5	9.5	20	7.5	6.5	14	*	*	*
16	*	*	*	*	*	*	9.5	6.5	16	6	6	12
17	*	*	*	*	*	*	*	*	*	8	6	14

*Storm track warrants little or no evacuation.

**Post-Evacuation Order Clearance Times shown here are based on Behavioral Response Curve B and are average times between high and low evacuation participation levels.

should be made in consultation with the National Hurricane Center and area National Weather Service offices during the Hurricane Watch period.

Projected time of day of hurricane eye landfall will influence clearance times in that if evacuation must be carried out during night time hours, clearance times will increase. Clearance times should be increased in this situation by two to three hours in each county.

Behavioral tendencies of the evacuating population have their primary effect on clearance times. In addition to the adjustments discussed previously concerning whether twenty to forty percent of the population-at-risk has begun to mobilize and leave prior to the evacuation order, the rate at which the evacuating population is leaving must be considered. If the evacuating population is generally unresponsive, clearance times must be increased by two to four hours. If the storm has received frightening publicity and the evacuating population is responding rapidly, clearance times can be reduced by two to four hours.

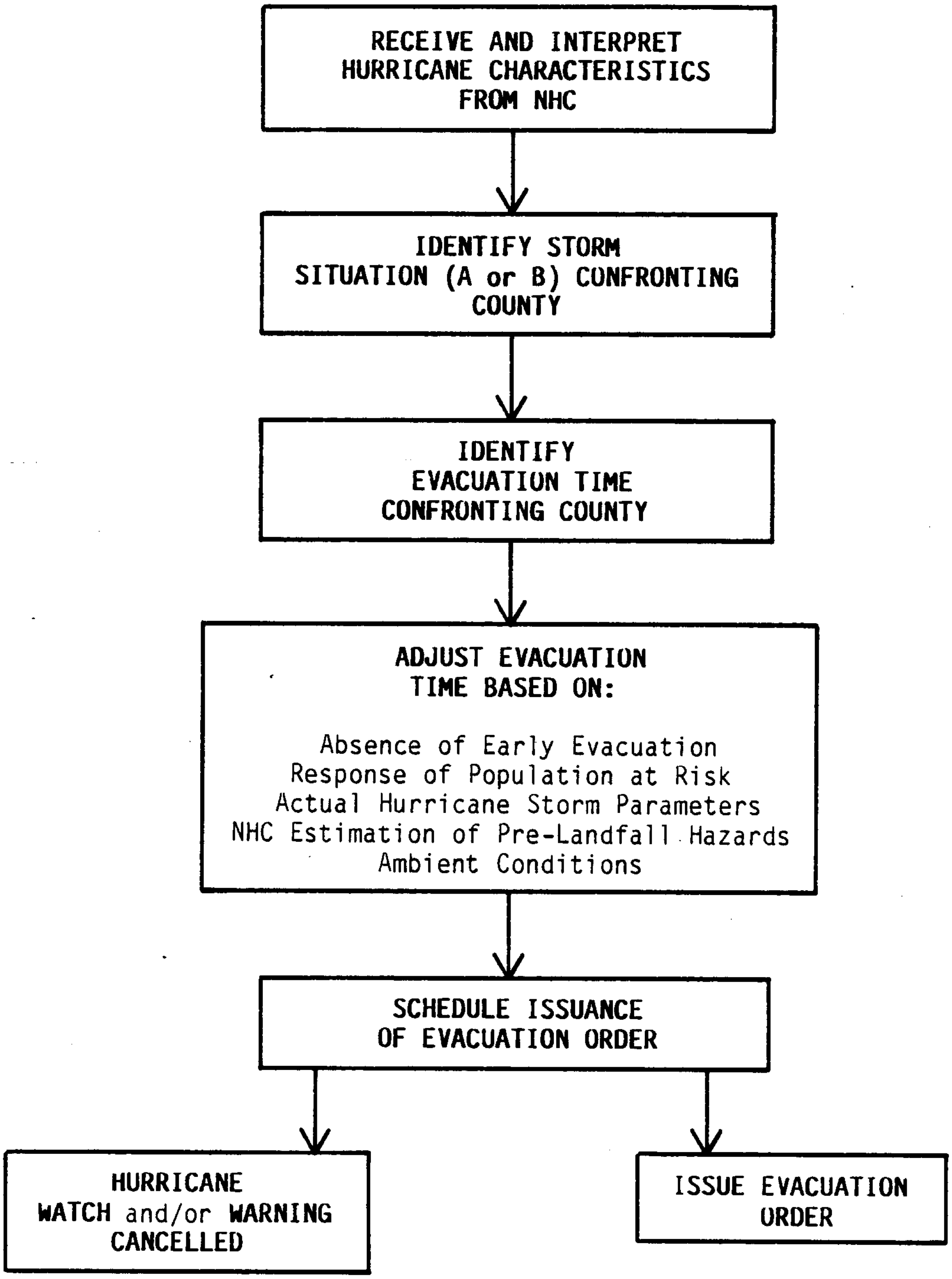
6.2.5 Framework for Evacuation Decision Making

The use of evacuation timing data in an actual hurricane situation demands constant coordination with the National Hurricane Center in the form of local statements and a systematic interpretation of all available storm information. In the Tampa Bay Region, Hurricane Evacuation Plan, Technical Data Report (1981), a local evacuation decision making system was devised. For the Lower Southeast Florida Hurricane Evacuation Study, that system has been modified and adopted and is discussed below.

The implementation of a framework for evacuation decision making assumes that all agencies involved in hurricane preparedness and warning retain and utilize the data base presented in this report for the interpretation and communication of evacuation decision during hurricane approach. It is also assumed that the National Hurricane Center will supplement the data base with timely information during the approach of an actual hurricane.

Figure 27 presents the framework for evacuation decision making. The first step in the process involves each county receiving and interpreting hurricane characteristics from the National Hurricane Center. The purpose of this step is to focus on or eliminate certain regional storm scenarios as storms that are likely to strike the county of interest. However, since a hurricane's characteristics can change dramatically during an approach, the elimination or focus of regional storm scenarios must be considered tentative.

When the National Hurricane Center assigns a Saffir/Simpson category number to a hurricane, decision makers can begin this focus or elimination of certain regional storm scenarios. If the storm has been identified as a category four or five storm, weaker intensity storms may be tentatively eliminated.



FRAMEWORK FOR EVACUATION DECISION-MAKING

FIGURE 27

Likewise, information received from the National Hurricane Center concerning the storm's track will allow the focusing on either a landfall, paralleling or exiting regional storm scenario. As the storm moves closer to land, a certain range of coastline can be considered as the area the storm will strike. However, any assumptions regarding where and how the storm will likely make landfall involves clear and constant communication with the National Hurricane Center.

The second step of the process involves identifying the storm situation confronting a county. After determining which regional storm scenarios are likely to affect the county of interest, the possible storm situations (A, B or little to no storm tide) can be determined. By focusing on a particular storm situation that is likely to confront the area, each county can discern expected storm tide heights, wind speeds and level of evacuation (number of people/areas to be evacuated) needed.

The third step, identifying evacuation times confronting each county, involves determining the evacuation order times required for each regional storm scenario still considered as a possible threat. By looking at Table 37, evacuation order times can be identified for each regional storm scenario for each county. In addition, pre-landfall hazards times and clearance times used in calculating evacuation order times are provided so that required adjustments can be made.

Since evacuation order times are quite long for many regional storm scenarios, many types of storm behavior may still be possible at the time the order needs to be given. The longest evacuation order time of those regional storm scenarios still considered probable should be used.

The fourth step involves adjusting evacuation times. Information leading to pre-landfall hazards time evaluation for an actual hurricane will be derived directly from the National Hurricane Center in the form of local statements. Clearance times must then be adjusted based on actual behavioral responses of the evacuating population. These adjustments have been discussed previously and relate to absence or presence of early evacuation, the rate at which evacuees are mobilizing and evacuating, and ambient roadway conditions.

Upon estimating the actual evacuation order time, the issuance of the evacuation order should be scheduled. As conditions warrant, the evacuation order should then be issued on time, or the hurricane watch and/or warning should be cancelled.

As an example of how this framework for evacuation decision making might be applied to a real life hurricane approach, the following hypothetical situation is narrated:

> A category 2 hurricane is moving northwest through the Bahamas at 12 miles per hour and has a radius of maximum winds of

20 statute miles. The hurricane's current track indicates that it will probably make landfall on the east coast of Florida. Storm and meteorological conditions indicate that the storm will probably not intensify to more than a category 3 hurricane. The hurricane is 300 miles from the United States mainland and current conditions indicate that it will make landfall 20 hours from now.

Storm information received from the National Hurricane Center indicates that regional storm scenarios 6, 8, 10 and 12 are most probable (Table 36). County storm situations created by these regional storm scenarios involve an "A" situation in the Upper Keys and in Dade, Broward, and Palm Beach Counties. Table 35 is referred to to ascertain expected storm tide, wind velocities, and levels of evacuation required for an "A" storm situation in each predicted affected area.

By consulting Table 37 and National Hurricane Center staff, local emergency preparedness officials in each county are able to determine the evacuation time requirements facing the county of interest. Monroe County staff identifies a clearance time of 6 hours, calculates a pre-landfall hazards time of 8.5 hours based on information from the National Hurricane Center, and then has a required evacuation order time of 14.5 hours. Dade, Broward, and Palm Beach Counties, through the same exercise, determine required evacuation order times of 19, 16 and 16 hours, respectively. Where two different evacuation order times are still possible, the longest time is assumed.

Since it is now 6:00 P.M. on a Tuesday, the storm is expected to make landfall on Wednesday at 2:00 P.M. The evacuation order should be given by 11:30 P.M. Tuesday in the Upper Keys area of Monroe County, by 7:00 P.M. Tuesday in Dade County, and by 10:00 P.M. Tuesday in Broward and Palm Beach Counties. Since evacuation wil have to take place to a large extent at night, the evacuation order generally should be moved up even further. However, the population has responded quickly due to the loss of life that occurred in Puerto Rico due to the storm and thus this would seem to balance out any needed additional evacuation time.

The above hypothetical hurricane is obviously an oversimplification of a real storm situation. Actual conditions may require more adjustments and storm characteristics are very tentative at 20 hours before hurricane eye landfall. The hypothetical hurricane points out the framework for decision making as an important guide to emergency preparedness.

Of critical importance in the event of a hurricane approach such as the one described above, is the reaction to the situation on a regional basis. Ideally, the evacuation order would be given by the times described above. However, problems with information received by the public in one county from media in another county make the situation very difficult.

6.3 RED CROSS SHELTER CONSIDERATIONS

An important element of the transportation analysis involved the distribution of Red Cross shelter evacuees to available Red Cross shelters. Each zone generally produced a number of people in vehicles seeking Red Cross shelters and attracted a certain number of these people in vehicles based upon Red Cross shelter locations and square footage estimates.

6.3.1 Shelter Assignments

To facilitate the development of Implementation Reports for each county, an assignment of traffic evacuation zones to specific shelters was determined based on the transportation analysis. The basic criteria used to make the assignment included matching the closest available shelter to each zone, and where additional shelter space was needed, assigning zones to shelters along minimum time paths to a common area. A common area of shelters was assigned to facilitate making instructions as simple and easy to follow as possible by a certain vulnerable zone.

Appendix I provides a table for each study area county and lists each shelter by street address and traffic evacuation zone. In addition, the shelter capacity and traffic evacuation zones assigned to the shelter are provided. A final element of the tables is the usability of each shelter for each hurricane intensity. Red Cross shelters that are vulnerable to storm tide (as determined in the Hazard Analysis) were not assigned evacuees for those storm situations causing flooding at the shelters.

6.3.2 Shelter Capacity

An important element of hurricane evacuation prepardness is the provision of adequate Red Cross shelter capacity for those evacuees desiring public shelter. A comparison of existing Red Cross shelter capacity in each county with expected public shelter demand revealed that with few exceptions the lower southeast Florida study area has adequate shelter capacity. Recent efforts have been made in each county by Red Cross staff to update shelter capacities and seek inter-county agreements where necessary to supplement in county shelter capacity. Monroe County and Dade County hurricane preparedness staff have worked together to provide a central destination for Monroe County evacuees seeking Red Cross shelter in Dade County.

Shelter assignments revealed that several Red Cross shelter capacity problems result in sub-county areas. In Monroe County, for less intense storms the Middle Keys experience a shortage of shelter space. For more intense storms, many Red Cross shelters become unusable due to stormtide, causing a shelter deficit in the Lower and Middle Keys. Although much of the shelter deficit can be offset by shelter availability in Dade County, the evacuation travel necessary to reach such shelter involves long evacuation trips and increased clearance times.

Another shelter capacity problem involves the Belle Glade-western Palm Beach County area. Due to the large amount of sub-standard housing coupled with the area's extreme vulnerability to rainfall flooding, a larger percentage of evacuees would need Red Cross shelters than those evacuees leaving the eastern coastal area of the county. This large shelter demand cannot be accommodated with the existing Red Cross shelter space now existing in the western part of the County. Therefore, it is anticipated that some of the vulnerable residents will need to be transported to excess shelter space in the nonvulnerable areas of eastern Palm Beach County.

A minor Red Cross shelter deficit occurs in lower Dade County due to the extensive storm tide flooding caused by a "B" storm situation. Several shelters usable in a category one to three storm become unusable in a category four to five storm, leaving an unmet demand for shelter space for the more intense storm. Excess Red Cross shelter space in the western part of the Dade County urban area is available to meet this shelter demand from the Homestead and south Dade County area.

As population increases in the study area, and as the technical data report is updated, careful attention must be paid to the increasing divergence between available Red Cross shelter capacity and public shelter demand. The standard shelter planning figure of 40 square feet per person now being achieved in portions of the study area may be compromised in the future due to the increased population and increased shelter demand. Red Cross staff should continue its excellent work in identifying additional acceptable shelter space as needs arise.

6.3.3 Shelter Duration

An important element of shelter preparedness is the knowledge of how long evacuees must stay in a Red Cross shelter through the duration of a passing hurricane. Such information allows shelter staff to plan the food and supply needs of evacuees as well as to prevent evacuees leaving shelter before hazardous conditions have passed.

The hazards analysis produced time histories of computed wind speeds allowing the determination of minimum shelter durations for each county for each of the seventeen regional storm scenarios. Table 38 provides the number of hours from the arrival of sustained gale force winds to the departure of sustained gale force winds. Minimum shelter duration ranges from 13.5 to 22.5 hours in Monroe County, 12.5 to 21 hours in Dade County, 13.5 to 20 hours in Broward County and 12.5 to 20 hours in Palm Beach County. These planning figures do not include additional time for evacuees arriving early at shelter and therefore, should be interpreted as the minimum amount of time evacuees will be kept in Red Cross shelters. Actual shelter duration would be longer than those figures contained in Table 38 depending upon when the evacuation order is issued.

TABLE 38

MINIMUM SHELTER DURATIONS (in hours)

Lower Southeast Florida
Hurricane Evacuation Study

Regional Storm Number	Lower Keys	Middle Keys	Upper Keys	Dade	Broward	Palm Beach
1	16.5	*	*	*	*	*
2	18.0	15.0	*	*	*	*
3	22.5	20.5	*	*	*	*
4	*	15.5	13.5	*	*	*
5	*	21.5	19.0	*	*	*
6	*	*	15.5	13.5	*	*
7	*	*	22.0	15.5	13.5	*
8	*	*	*	18.0	14.0	*
9	*	*	*	20.5	14.0	*
10	*	*	*	*	18.0	12.5
11	*	*	*	12.5	19.5	14.5
12	*	*	*	*	*	18.5
13	*	*	*	*	*	20.0
14	18.0	15.5	15.5	18.0	18.0	18.5
15	*	*	*	21.0	15.0	*
16	*	*	*	*	20.0	13.0
17	*	*	*	*	*	18.0

*Little to no evacuation required.

Note: These shelter duration times are based on the arrival and departure of gale force winds.

6.4 EVACUATION ROUTES

The assignment of evacuating vehicles to the evacuation road network was a critical output of the transportation analysis. Since the transportation analysis simulates the evacuation travel patterns expected in a hurricane evacuation, the evacuation routes used by a particular traffic evacuation zone become of ultimate importance in identifying critical links and their clearance times. The effect that one zone's set of evacuation routes has on all other zones route usage is thus an important element within the transportation analysis.

It must be understood that the transportation methodology assigned vehicles to the evacuation road network using optimum time paths from each vulnerable zone to safe attractions in each other zone. Optimum time paths were determined in an iterative modeling process involving consideration of volume to capacity relationships throughout the network. Evacuation travel patterns were then modeled on a zone to zone basis. Since zones are quite large, particularly outside the storm tide vulnerable areas, the actual roadways used to get to a particular shelter location in a zone could vary depending upon the direction of approach to the zone.

To facilitate the development of Implementation Reports for each county, evacuation route assignments were developed from each storm tide vulnerable zone to an assigned Red Cross shelter(s) for that zone. Generally, zones outside the vulnerable areas were assigned to a Red Cross shelter within that same zone; thus specific route assignments were inappropriate for non-vulnerable zones since evacuating vehicles would not use the main evacuation road network. Specific route assignments were not made for hotel/motel, friends, and out of the region destinations because of the infinite number of possible routing that would be taken to get to these general destinations. The transportation modeling analysis used a gravity model to handle evacuee's movements to these broader categories of destinations.

Evacuation route assignments from storm tide vulnerable areas to Red Cross shelters are provided in Appendix J. Evacuees from vulnerable zones should use the specified corridor(s) to leave the area at risk regardless of whether going to a Red Cross shelter or some other destination. This structuring of traffic movement will ensure the use of manually controllable intersections and reduce traffic conflict at the passages from the Barrier Islands to the Mainland.

6.5 TRAFFIC CONTROL

The movement of evacuating vehicles during a hurricane evacuation requires extensive traffic control efforts to make maximum use of roadway capacity and to expedite safe escape from hurricane hazards. Although detailed manpower planning and assignments are best made at the local level, a general discussion of traffic control measures is provided related to traffic control points, roadway modifications and emergency response to traffic accidents and vehicle breakdowns.

6.5.1 Traffic Control Points

Safe evacuation of residents at risk must involve the near-continuous movement of vehicles through critical intersections and convergence points along critical links of the evacuation road network. Typically, traffic signals along east-west evacuation routes do not provide the necessary "green time" required in an evacuation situation. An underlying assumption of the transportation analysis was that manpower would be available at key intersections and thus clearance times reflect the use of manpower. Therefore, it is recommended that specific assignment of emergency traffic control manpower to intersections along east-west corridors and other critical traffic control points within the evacuation road network be incorporated into each county's hurricane emergency operations plans. Although critical links identified in the transportation analysis will need special manpower control many other traffic control points will require assistance from state, county and local police and emergency personnel. Using the "nodes" identified in each county's evacuation route structure as a base, local officials should identify specific traffic control points where detailed manpower assignments will be made.

6.5.2 Roadway Modifications

Traffic control, draw/swing bridge positioning and lane usage modifications should be used as necessary in a hurricane evacuation situation. Efforts should be made to control bridge access from the barrier islands to the mainland, channeling traffic and preventing unnecessary turning conflicts.

All draw/swing bridges needed for evacuation should be locked in the "down" position during a hurricane warning. Boat owners in each county must be made aware of existing flotilla plans and understand that vessels must be secured in safe harbor prior to or during the hurricane watch. Critical links identified for the study area would be severely impacted by bridge openings during a hurricane warning, increasing clearance times significantly. Therefore, it is strongly recommended that appropriate U.S. Coast Guard Regulations and Florida Department of Transportation procedure (see p. 92 for further clarification) be researched and implemented to allow each county emergency management/civil defense director to assume authority to modify normal bridge openings during hurricane evacuation.

Lane usage modifications must involve close coordination between civil defense staff and local agencies involved in traffic control. Generally, because of the complex and intricate inter-relation of each roadway contained in the evacuation network, it is difficult to realize a savings in clearance time by changing flow direction on roadway lanes. This lack of savings in clearance times is due to traffic operations problems, the need for additional manpower that is already scarce,and the need to allow emergency vehicles to travel against the main flow of traffic. However, in Monroe County, recognizing the long clearance times and limited road network, it may become necessary at some point during the hurricane warning to allow traffic to flow north on both lanes of US 1 from Monroe County to Dade County. Two way traffic flow would still be allowed on the Card Sound Road. Based on traffic congestion and expected arrival of gale force winds, Monroe County Civil Defense should monitor the need for this action during an evacuation effort.

A final roadway modification should include alleviating the payment of tolls by evacuation traffic on toll roads. This could be accomplished by the Governor of Florida ordering all toll attendants to leave their work facilities or issuing an executive order under advisement by the Florida Department of Transportation.

6.5.3 Emergency Response to Accidents/Breakdowns

The magnitude and intensity of traffic during a hurricane evacuation will always be accompanied by a certain number of traffic accidents and breakdowns. Although parking lanes and roadway shoulders are available for vehicles in distress, the movement of such vehicles to these areas is often difficult and disruptive. It is recommended that at least two traffic control personnel be positioned at each key intersection so that one can assist disabled vehicles as needed. A tow vehicle should also be positioned at each critical link to facilitate the removal of immobilized vehicles. These critical links are listed in Chapter 5, Section 5.5. Roadways that historically experience flooding due to rainfall alone should be monitored for vehicle distress and help. In addition, identifications of other key locations should be made and prohibitions on house trailers and boat trailers should be considered, particularly in Monroe County where a disabled trailer could tie up the only escape route.

6.6 SPECIAL EVACUATION CONSIDERATIONS

Hurricane preparedness and evacuation present special problems for medical facilities and nursing homes as well as elderly and disabled residents. Special planning efforts and warning procedures must be developed in each localized area for these groups. Given the location of many medical facilities in flood vulnerable areas, coupled with a larger elderly population, these specialized evacuation considerations become extremely important in the lower southeast Florida area.

6.6.1 Medical Facilities and Nursing Homes

The hazards analysis revealed that 19 medical facilities (hospitals and nursing homes) in Dade County alone are in zones that may experience hurricane storm flooding. Five medical facilities in Monroe County and five in Broward County may also be subject to hurricane flooding. Palm Beach County medical facilities were determined to be outside the flood vulnerable areas.

Medical facilities are responsible for developing individual hurricane contingency plans. Generally, a similar medical facility outside the flood vulnerable area is better equipped to host patient evacuees than a standard Red Cross shelter. Thus, medical facilities should be encouraged to evacuate when necessary to similar facilities.

6.6.2 Elderly and Disabled Residents

The large elderly and disabled population residing in areas of the region present special problems in attempting to safely evacuate all population subject to hurricane hazards. Such residents often do not receive general preparedness or evacuation instructions by way of the public media due to hearing difficulties. In addition, due to physical limitations, elderly and disabled residents are not able to carry out hurricane evacuation in the required amount of time.

In June 1980, the Florida Legislature enacted Florida Statutes, section 252.355, directing local disaster prepardness agencies to provide for a voluntary registration of disabled citizens. This registration, along with any updating since 1980, becomes the inventory of persons with the need for specialized evacuation assistance in each county.

It is recommended that listings of these disabled persons be updated as necessary to plan for the mobilization required to safely evacuate this important element of the population. Each county should coordinate its mass transit capabilities so that vehicles can be dispensed to "pick-up" locations early in the evacuation process. Even with civil defense efforts to provide transportation for and make individual contact with disabled and elderly residents, the need for neighborly assistance will be critical to the safe evacuation of such residents. Many elderly, upon leaving home, will fear vandals taking everything they own, even when faced with the possibility of losing life due to the storm tide or structural failure of the building in which they reside. Disabled and elderly persons should be made aware of evacuation procedures during the off-hurricane season and should be made aware that local law enforcement officers will be involved in any hurricane evacuation.

Chapter 7
CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER STUDY

The quantification of evacuation order times, as well as the coordination with local study area officials, revealed the need to specify some general conclusions and recommendations for further study. These conclusions and recommendations concern evacuation timing coordination, and local plan refinement. In addition, a discussion of inter-regional impacts, vertical refuges, and study updates is provided.

7.1 EVACUATION TIMING DILEMMAS

Evacuation order times were identified ranging from a minimum of 12 hours to a maximum of 31.5 hours. Times varied based on assumptions regarding the rate at which people evacuate, the category storm and a low or high participation in the evacuation by the population-at-risk.

The difficulty in dealing with these times is best understood by local civil defense directors who must advise their local elected body to order an evacuation. A hurricane warning will generally not be posted by the National Hurricane Center for an area until 12 to 16 hours before eye landfall (depending upon projected time of day of landfall). If the civil defense director advises that the evacuation order be given 20 hours before eye landfall (most likely during a hurricane watch), the chances are very high that the storm could miss the area. Thus the evacuation could prove to be unnecessary in the eyes of the public, if the storm does miss. However, if the evacuation order is not issued until 12 hours before eye landfall and the storm directly hits the area being evacuated, great loss of life could occur because of too little time available for population-at-risk to escape hurricane hazards.

These dangerous and difficult situations face local, regional and state decision makers due to several incompatible factors:

- an extremely dense population located in the most vulnerable and hazardous areas of the region
- a limited road network comprised of low elevated bridges and very few highways with a great deal of capacity exiting the study area
- a hurricane forecasting system whose accuracy is not expected to greatly increase over the foreseeable future
- high evacuation dollar costs which must be paid by some level of government even if the storm does miss the area

- a population who has had very little experience with a major hurricane and who perceives safe in-county hotel/motel destinations that may or may not exist in an evacuation situation

- extensive coordination which must be achieved among all levels of government

The answers to the timing dilemmas created by these incompatible factors is, unfortunately, not readily at hand. The State of Florida has initiated looking at a probabilistic warning system which potentially could help decision makers during the watch period. The project is being funded by a grant from the Federal Emergency Management Agency. It employs a system which analyzes the strength, speed, and direction of an approaching hurricane viewed from a point on the shore. It uses data from the National Hurricane Center in a mathematical procedure which generates the levels of risk of the hurricane striking a particular area. These risk levels are figured for time windows (successive twelve- or nine- hour periods, starting at 72 hours before the closest point of approach); and hurricane preparedness actions are assigned to each time window in a manner that promotes phased evacuation and minimizes the problem of potential false alarms. A distinct feature of the procedure is that for each time window a miss-to-strike ratio is calculated. For example, if the miss-to-strike ratio is five to one, one would expect that for every five times action is taken at this point, one could expect a hurricane to strike once.

7.2 BEHAVIORAL STUDIES

The Behavioral Survey conducted as part of this study gathered valuable and previously unavailable data concerning the intended response of the affected population to a hurricane threat. The critical significance of survey data to the regionwide evacuation simulation coupled with the real concern that the <u>intended</u> and <u>actual</u> response of the public may vary widely highlights the importance of confirming the Behavioral Survey findings with followup studies. Central assumptions to this study derived from the Behavioral Survey, including vehicle usage, shelter demand and travel destinations should be verified or modified with additional quantitative analyses. Should a governmental evacuation order be issued in the future, the opportunity subsequently exists to retest survey respondents to compare intended and actual public response.

Public awareness programs administered by hurricane preparedness officials establish the comprehensiveness of responses to evacuation orders as one of their ultimate goals. Research up to the present, however, has been unable to reliably identify behavioral determinants leading to the decision to evacuate as well as communication methods that optimize public evacuation response. The diverse demographic character of the region's population and the widespread reluctance to evacuate exhibited in the Behavioral Survey compound the problems faced by local officials. A highly desirable continuation of the study effort, then, would involve additional research which ultimately provides officials with guidelines to structure their use of information and media to heighten public responsiveness to hurricane evacuation warnings. This may include a study of public awareness of risks in areas that are not coastal.

7.3 MULTI-JURISDICTIONAL COORDINATION

A great deal of multi-jurisdictional coordination must occur to enable a successful evacuation to take place. This coordination should address evacuation routes, traffic control, and public shelters. Due to the extreme vulnerability of the Florida Keys (Monroe County) to an approaching hurricane, Dade County acts as a logical refuge to many Keys citizens. Commendable coordination continues to take place between Dade and Monroe County emergency management departments as evidenced by a recent agreement to send Monroe County evacuees seeking public shelter in Dade County to one central location. Evacuees would then be sent to more specific shelters based on shelter loadings and logical traffic routing. Such coordination should be encouraged not only between other counties in the study area, but also between counties immediately outside the study area who will receive evacuation traffic and demands on public facilities.

7.4 LOCAL PLAN REFINEMENT

The planning effort undertaken by the U.S. Army Corps of Engineers for this study was intended to provide officials in Monroe, Dade, Broward and Palm Beach Counties with quantitative data on which evacuation decisions could be based. In no way is any of the material intended to replace each county's detailed local evacuation/emergency detailed operations plans. It is hoped that local governments will use the material to better understand who should be evacuated and when the evacuation should occur.

A joint effort by the Jacksonville District Corps of Engineers and local civil defense/disaster preparedness officials will produce Implementation Reports for each county. These documents will include information from this technical data report which is specific to a given county and which can be used as an additional tool in making evacuation decisions.

7.5 INTER-REGIONAL IMPACTS

Study area counties participating in an evacuation generate impacts that affect other counties in the study area. In addition, these impacts extend into counties of other Florida regions. Specifically, evacuation traffic will be produced by vulnerable counties in the study area and a portion of this traffic will either pass through or find acceptable shelter in other surrounding counties such as Glades, Hendry, Collier and Martin Counties. Some traffic will continue to urban areas such as Orlando, Tampa, and Ft. Myers. It is important that these impacts be recognized in terms of traffic control, gasoline supplies and shelter capacities.

The State of Florida, Bureau of Disaster Preparedness, is now leading an effort to quantify inland shelter needs produced by inter-regional impacts of evacuation. The Central Florida, East Central Florida, and Withlacoochee Regional Planning Councils have analyzed and produced reports on inland sheltering facilities in their respective regions which conclude Phase I of the Inland Shelter Study. The study aims at coordinating the evacuation and sheltering of threatened residents in both inland counties and west Florida coastal areas.

7.6 VERTICAL REFUGE

Vertical refuge has been set forth as a possible alternative to the approach of evacuating the population-at-risk inland to more traditional public shelter. Vertical refuge refers to the movement of population-at-risk to upper floors in multi-level buildings. Considering the long evacuation order times calculated in the transportation analysis and recognizing the limitations of state-of-the-art hurricane forecasting, vertical refuge has to be more closely looked at as an alternative.

Sensitivity analysis used in the transportation modelling and related to a high or low participation in the evacuation by the population-at-risk shed some light on the usefulness of vertical refuge in reducing overall evacuation order times. By assuming that 20 to 30 percent of the people who should evacuate would not evacuate, clearance times, and thus evacuation order times, were one to three hours less in Dade, Broward and Palm Beach Counties. Clearance times in Monroe County were two to eight hours less. However, in Monroe County, there are fewer buildings that could be considered for vertical refuges. Reducing evacuation order times by one to three hours is helpful, but still leaves times incompatible with forecasting capabilities.

Vertical refuge raises a number of other legal and social questions. Structural integrity of high rise buildings must be addressed, not only for withstanding high winds but also for resisting the scouring effects of storm tide. Legal issues involving security and liability in utilizing such buildings must be addressed. The ability of such facilities to accommodate large numbers of people for 15 to 20 hours at a time must certainly be considered.

It is recommended that future efforts involve a close examination of vertical refuge as an evacuation alternative for the lower southeast Florida coast. A clear definition of vertical refuge and vertical evacuation must be developed so that counties can form policies related to their acceptance or rejection of this evacuation alternative.

7.7 STUDY UPDATES

It is recommended that this evacuation study be updated every two years to incorporate population changes, highway/bridge improvements, shelter modifications, and changes in hurricane hazard analysis and forecast techniques. Updates should be closely coordinated with all concerned federal, state and local officials.

GLOSSARY

Arrival of gale force winds time - The predicted amount of time in hours before projected hurricane eye landfall that sustained gale force winds will arrive, preventing safe vehicular evacuation.

Astronomical tide - The periodic rising and falling of the water once or twice a day that results from gravitational attraction of the moon and sun and other astronomical bodies acting upon the rotating earth.

Breaking wave setup - The superimposed elevation of the water surface over normal surge elevation due to onshore mass transport of the water by breaking wave action alone.

Clearance time - Clearance time is the time required to clear all vehicles evacuating in response to a hurricane situation from the roadways. Clearance time begins when the first evacuating vehicle enters the road network (as defined by a hurricane evacuation behavioral response curve) and ends when the last evacuating vehicle reaches its destination. Clearance time includes the time required by evacuees to secure their homes and prepare to leave (referred to as mobilization time), the time spent by evacuees traveling along the road network (referred to as travel time), and the time spent by evacuees waiting along the road network due to traffic congestion (referred to as queuing delay time). Clearance time does not relate to the time any one vehicle spends traveling on the road network.

County storm situation - A level of vulnerability to a hurricane confronting one of the four counties of the Lower Southeast Florida region based on a predicted range of open coast sotrm surge height and predicted level of wind velocity on the Saffir-Simpson Hurricane Sale which requires a certain level of evacuation of that county.

Evacuation order time - The time in hours before hurricane eye landfall by which the evacuation order must be given to allow all evacuees time to reach their chosen destinations.

Eye landfall - The point in time when the eye, or physical center of the hurricane reaches the coastline from the hurricane's approach over water.

Funneling effect - The amplification in the height of a potential open coast hurricane storm surge by a bay or estuary as the surge travels into or up the bay or estuary.

Hurricane Warning - An advisory issued by the National Hurricane Center when winds of at least 74 mph, high water, and storm surge are expected to reach a specific area within a period of 24 hours.

Hurricane Watch - An advisory issued when hurricane conditions are a possible threat to a certain area, usually given 24 to 48 hours before hurricane eye landfall.

Mobilization time - The time required by evacuees to secure their homes and prepare to leave.

Pre-evacuation order time - A period of time prior to issuance of the evacuatin order in which a certain percentage of evacuees have already left home and have entered the road network. The percent having left as well as the number of hours is defined directly by the hurricane evacuation behavioral response curve used.

Pre-landfall hazards time - The time frame occurring before hurricane eye landfall within which evacuation should not be carried out due to the arrival of sustained gale force winds (39 mph).

Queuing delay time - The time spent by evacuees significantly slowed from normal travel speeds or stopped on the road network due to traffic congestion.

Reference hurricanes - The hypothetical hurricane simulations selected to represent a full range of hurricane scenarios and evacuation times expected to confront a county from an approaching hurricane. Reference to the expected scenarios and evacuation times from these hurricanes form the framework for the decision-making guide formulated by this study.

Regional storm scenario - A combination of the different county storm situations created by a single hypothetical hurricane approaching the Lower Southeast Florida region used in this study to realistically model the vehicle movements of an evacuation by simulating the inter-county traffic impacts that would occur.

Saffir/Simpson Scale - A scale which assigns a number from 1 to 5 to a hurricane based on wind speed and barometric pressure (see Appendix C).

SLOSH - Acronym for Sea, Lake, and Overland Surges from Hurricanes storm surge prediction model. SLOSH is able to simulate the overland tidal surge heights and winds that result from hypothetical hurricanes with selected characteristics in pressure, size, forward speed, track and winds.

SPLASH - Acronym for Special Program to List Amplitudes of Surges from Hurricanes model. SPLASH predicts surge heights at the open coastline for a given area.

Storm Tide - The expected still water elevation in flooded areas due to the components of astronomical high tide, storm surge and breaking wave setup.

Surge roadway inundation time - The predicted amount of time in hours before projected hurricane eye landfall that local low-lying coastal roadways will become inundated and consequently impassable by evacuating vehicles.

Travel time - The amount of time required for vehicles from an evacuation zone to traverse the evacuation route to their shelter destinations based on the attainable operating speed, specific distance of the route, assumping no congestion delays.

TTSURGE - A coastal flooding storm surge model developed by Tetra Tech, Inc. which uses output from SPLASH to predict inland storm surge.

Worst-probable - Term used in this study to describe the hypothetical hurricanes selected for the basis of the evacuation plan. Localized tracks predicted to create the worst hazard for each of the four counties of the region, yet limited to those meteorologically and historically probable hurricanes to approach the Lower Southeast Florida region.

APPENDIX A

County and State of Florida
Letters of Support

STATE OF FLORIDA

Office of the Governor

THE CAPITOL

TALLAHASSEE 32301

BOB GRAHAM
GOVERNOR

June 2, 1981

Colonel James W. R. Adams
U.S. Army Corps of Engineer
Post Office Box 4970
Jacksonville, Florida 32232

Dear Colonel Adams:

Florida's vulnerability to disaster from hurricanes and the need for mitigation of the threat that they pose to life and property have been of priority concern to my administration. The need for preparedness efforts that ensure effective emergency response is essential if we are to protect those who live and visit our shores.

I would like to thank the Jacksonville District Corps of Engineers for its efforts to ensure that Florida is prepared to handle the hurricane contingency. The Lee County and Tampa Bay Regional Hurricane Evacuation Planning studies funded and administered by your agency represent pioneering achievements in addressing the complex issues of hurricane preparedness planning. Florida has been very fortunate to have participated in these projects.

It is my understanding that your agency is prepared to fund a study similar to the one done for the Tampa Bay area for the lower Southeast Coast region of Florida (to include Broward, Dade, Monroe and Palm Beach Counties). Extensive development and population growth in the Southeast Florida area, coupled with the extreme physical vulnerability and complex problems of providing effective response capabilities in the Florida Keys, point out the crucial need for an effective tool to guide decision-makers in responding to hurricane emergencies.

Therefore, I heartily endorse and support your efforts to conduct such a study and offer the full cooperation of the Florida Bureau of Disaster Preparedness in the development of this regional plan.

With kind regards,

Sincerely,

Bob Graham

Governor

BG/rcd

cc: Mr. John Wilson
Bureau of Disaster Preparedness

ANNE L. KOLB, CHAIRMAN
BOARD OF COUNTY COMMISSIONERS
765-5133

February 12, 1981

Colonel James W. R. Adams
District Engineer
U.S. Army Corps of Engineers
Jacksonville District
P. O. Box 4970
Jacksonville, FL 32232

Dear Colonel Adams:

Broward County government recognizes the need for a comprehensive plan addressing the response to and the evacuation of segments of Broward County as a result of a major disaster. We are aware that this need has been recognized by the Jacksonville District, U.S. Army Corps of Engineers and the Florida Bureau of Disaster Preparedness.

I would like to assure you that an evacuation plan of the scope you are about to study will be well received and will make a major contribution to improving disaster planning in Broward County. There is a definite need for improved coordination of disaster preparedness at the local government level and between contiguous counties.

It is my understanding that the suggested study will be funded by your office. Such an effort is in agreement with the overall goals and policies of the County and the results would produce a resource valuable to our Division of Emergency Preparedness. In disaster planning, time is always a critical factor; therefore, we urge that your office proceed with the planning as expeditiously as possible and insure that Broward County is included in the study area.

Sincerely,

Anne Kolb

Anne L. Kolb, Chairman
Board of County Commissioners

ALK:ASA:d

cc: Graham W. Watt, County Administrator
Arthur St. Amand, Director, Emergency Preparedness Division

Office of the Mayor
METROPOLITAN DADE COUNTY-FLORIDA
242 DADE COUNTY COURTHOUSE
MIAMI, FLORIDA 33130
579-5305

STEPHEN P. CLARK
Mayor

April 7, 1981

Colonel James W. R. Adams
District Engineer
U.S. Army Corps of Engineers
Jacksonville District
P. O. Box 4970
Jacksonville, FL 32232

Dear Colonel Adams:

It is my understanding that the Jacksonville District, U.S. Army Corps of Engineers, is prepared to conduct a Gold Coast Hurricane Evacuation Study involving Palm Beach, Broward, Dade and Monroe Counties similar to the study made of the Tampa Bay Region. I also understand that the Corps of Engineers is prepared to fund the proposed study.

The extensive development and population growth in the Southeast Florida area very graphically points out the need for a comprehensive evacuation plan for our low-lying coastal regions in the event of a major storm. We are concerned, however, that the inclusion of Palm Beach County in the study will prove counter-productive simply because Palm Beach is far removed from our boundaries and does not share in the problems of our southeast region or in the solutions to those problems. We respectfully request your reconsideration of this issue. Nevertheless, we wholeheartedly agree that the proposed study is needed and hereby request that Dade County be included within the study area.

Sincerely,

Steve Clark

Stephen P. Clark
Mayor

County Administrator

BOARD OF COUNTY COMMISSIONERS
Wilhelmina Harvey, District 1
Curt Blair, District 2
Mayor Protem Jerry Hernandez, Jr., District 3
MAYOR George E. Dolezal, District 4
Ken Sorensen, District 5

OFFICE OF:

P.O. BOX

COUNTY of MONROE
KEY WEST, FLORIDA 33040
(305) 294-4641

March 25, 1981

Col. James W.R. Adams
District Engineer
U.S. Army Corps of Engineers
Jacksonville District
P.O. Box 4970
Jacksonville, Fla. 32232

Dear Col. Adams:

We wholeheartedly request that Monroe County be included in your Hurricane Evacuation Plan as described by Ron Hilton of your Staff.

The problem of evacuation in Monroe County is monumental, therefore, we welcome all the help that we can get.

We offer the full cooperation of our local Disaster Preparedness Office in the development of the Plan.

Please keep us advised of your progress.

Sincerely yours,

George E. Dolezal

George E. Dolezal, MAYOR
MONROE County
Florida

L:lr

February 23, 1981

Colonel James W.R. Adams
District Engineer
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232

Dear Col. Adams:

This letter is to request a hurricane evacuation study for Palm Beach County and is in response to information received from Mr. Ron Hilton at the Dade County meeting convened on February 6, 1981.

Palm Beach County is extremely interested in acquiring all possible updated technical data concerning hazard analysis to include surge/splash, coastal and inland flooding; wind damage estimates at various force levels; and the possible hazards at Lake Okeechobee in event of levee failure. We would also appreciate the technical information available from a transportation modeling exercise to determine traffic flows and time required for evacuation.

In the past, Palm Beach County Civil Defense has worked very closely with the Palm Beach County Area Planning Board and the local Weather bureau in developing hazard analysis and evacuation planning. Based upon this information, the County plan has been developed through coordination with the appropriate task organization to include:

1. Police, Sheriff's Department
2. Fire Departments, County districts
3. Medical, HRS, Social Services
4. Resources (Engineering, Road & Bridges, Building Services, Transportation, etc.)
5. Municipalities (37). Each municipality has its own individual plan in support of the County plan.

BOX 1989 . WEST PALM BEACH, FLORIDA 33401

During the Dade meeting, there was discussion as to who should be included on the regional advisory group. Approximately five years ago, the Board of County Commissioners made the decision to leave the South Florida Planning Council and form the Treasure Coast Regional Planning Council. Palm Beach County Civil Defense will continue to work with and through the County's Area Planning Board and the Treasure Coast Regional Planning Council. In the process of developing the plan, our planning agencies will coordinate with our contiguous counties (Broward and Martin Counties).

We look forward to working with your agency in the development of this plan.

Sincerely,

Frank

Frank Foster, Chairman

VJB/rlb

cc: Vince Bonvento
Robert Owen

APPENDIX B

Study Coordination Meeting List
and Study Review Committee Membership

LOWER SOUTHEAST FLORIDA
HURRICANE EVACUATION STUDY
COORDINATION MEETINGS

1981

January 4	Meeting between State of Florida and Corps of Engineers in Tallahassee
January 27	Meeting with all county officials in Miami
February 6	Meeting with all county civil defense directors in Miami
February 7	Special meeting with Monroe County officials and Governor Graham and other State of Florida officials in Key West
March 18	Meeting with Monroe and Dade County officials in Key West and Miami
March 19	Meetings with Broward and Palm Beach County officials in Ft. Lauderdale and West Palm Beach
May 27 and 28	Meetings with all county civil defense and Red Cross directors to coordinate shelters
October 8	Initial Disaster Preparedness Committee meeting in Miami (for all counties).
October 26-29	Meetings at Key West, Key Colony Beach and Plantation Key to discuss study and behavioral survey
December 3	Meeting with Dade County civil defense officials to discuss initial behavioral survey results

1982

March 18	Meeting with all county civil defense directors in Miami to discuss behavioral survey results
April 20-22	Meetings with Disaster Preparedness Committee members in all counties to discuss behavioral survey results
May 18	Meeting with Palm Beach County officials to identify special areas of flooding and areas especially vulnerable to high winds
June 8-10	Meetings with Disaster Preparedness Committee members in all counties to discuss inputs and assumptions for transportation modeling

September 2	Meeting with Monroe County civil defense officials and others to discuss transportation modeling results and study progress and schedule
September 3	Meeting with Monroe County Disaster Preparedness Committee members to discuss transportation modeling results and study progress and schedule
November 3-4	Meetings with civil defense directors in Broward, Dade, and Palm Beach Counties to discuss transportation modeling and study progress and schedule
November 8-10	Meetings with Disaster Preparedness Committee members in Broward, Dade and Palm Beach Counties to discuss transportation modeling results and study progress and schedule.

1983

March 23, 24	Meeting in Miami with Civil Defense Directors, Bureau of Disaster Preparedness officials, South Florida and Treasure Coast Regional Planning Council officials and FEMA and NOAA officials to review the draft technical data report.
April 18-22	Meetings in Key West, Miami, West Palm Beach and Ft. Lauderdale to initiate and discuss development of implementation guides in four counties.

REGIONAL
DISASTER PREPAREDNESS
COMMITTEE MEMBERS

BROWARD COUNTY

Mr. Edward Bailey
Assistant Public Works Director
City of Oakland Park

Chief Gerald Berkowitz, F.D.
Civil Defense Director
City of Cooper City

Mr. Bill Berthune, P.D.
City of Deerfield Beach

Mr. Stephen C. Biats
Town of Hacienda Village

Mayor Neal Bidwill
Civil Defense Director
Village of Sea Ranch Lakes

Ms. Sally Billie
Seminole Tribe of Florida

Mr. William Bodenhamer
Chamber of Commerce

Chief Robert Bollia, F.D.
Civil Defense Coordinator
City of Lauderdale Lakes

Mr. C. Thomas Bonner
American Red Cross

Dr. Jess Boytell
Civil Defense Director
City of North Lauderdale

Mr. Roy Brown
American Red Cross

Capt. Ben Butler, P.D.
City of Plantation

Mr. Ronald J. Butler
North Broward Hospital

Mr. George A. Brescher
County Sheriff

Lt. Bernard Buzzo, P.D.
City of Miramar

Ms. Ellen Click
Seminole Tribe of Florida

Mayor Bruce Connolly
Civil Defense Director
Village of Lazy Lake

Lt. Ramon Coven, F.D.
City of Hallandale

Mr. John Coyne
City Fire Chief

Captain William Crabson
Salvation Army

Mayor Sherman Crise
Civil Defense Director
Town of Hacienda Village

Mr. Nate Daniels
Civil Defense Coorndinator
City of Fort Lauderdale

Chief William A. Davis, Jr., P.D.
Civil Defense Coordinator
City of Parkland

Lt. John Dixon, P.D.
Village of Sea Ranch Lakes

Chief Ralph Dunn, P.D.
Civil Defense Coordinator
Town of Hillsboro Beach

Mr. Al Ford
Broward County Health &
Public Safety Department

Mayor John R. Forrest
Civil Defense Director
Town of Lauderdale-by-the-Sea

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City Police Chief

Lt. Gilbert Frazier, P.D.
Civil Defense Coordinator
City of Hollywood

Chief Ben Galante, P.D.
Civil Defense Coordinator
City of Miramar

Mr. Steve Galligan
Administrative Services
Civil Defense Coordinator
City of Fort Lauderdale

Chief Warren S. Gilbert, P.D.
Civil Defense Coordinator
City of Coral Springs

Mr. Kenneth Graulich
Director, Public Works
Town of Lauderdale-By-The-Sea

Ms. Vi Hagemeister
Salvation Army

Mr. Eugene Hedges
City Fire Chief
P.O. Box 1300
Pompano Beach

Chief Neil Henderson, F.D.
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Civil Defense Coordinator
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Ms. Erni Hirsch
Seminole Indian Reservation

Ms. Judith A. Hunt
School Board of Broward County

Mr. Lawrence Ingwell
National Safety Council

R. L. Jenner
Port Everglades Authority

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Civil Defense Coordinator
City of Dania

Mr. Robert P. Kelley, Director
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Public Safety Department

Mr. Bob Kennedy
Chairman of Disaster Committee
North Broward Hospital

Lt. Edward Knapp, P.D.
City of Pembroke Pines

Mr. Bill Knickerson
Broward County Fire Control Board
Fire Protection Division

Chief Robert Lindley, F.D.
Civil Defense Coordinator
City of Margate

Mayor John Lomelo
Civil Defense Director
City of Sunrise

Mr. Charles E. Malone
City Fire Chief
Lighthouse Point

Chief Paul Mannino, P.D.
City of Lighthouse Point

Mr. Samuel Martin
City Police Chief
Hollywood

Mayor James E. Maurer
Civil Defense Director
City of Wilton Manors

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Town of Davie

Mr. James McDonald, P.D.
City of Parkland

Mayor Frank McDonough
Civil Defense Director
City of Lighthouse Point

Mr. John McElilgott
City Fire Chief
Hallendale

Dr. William T. McFatter
Broward School Board

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City of Tamarac

Chief Morris C. Meek, P.D.
Civil Defense Coordinator
City of Plantation

Mr. John S. Miller
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John Moore, Executive Director
National Safety Council

Dr. Sherwood Moore
Village of Lazy Lake

Capt. Albert Mortimer, P.D.
City of Tamarac

Mr. Gary Morton
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Pompano Beach

Chief William Neal, P.D.
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Chief Eugene O'Sullivan, P.D.
Emergency Preparedness Disaster
Director
Town of Pembroke Park

Mr. Ron Pagano, P.D.
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Mr. Lou Perrotti, Public Works
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City of Cooper City

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Civil Defense Coordinator
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Lauderdale-by-the-Sea

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Lieutenant Paul Shaffer
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Fire Marshal Bob Shelley
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City of Lauderhill

Mr. Carl Soderlin
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City of Lauderhill

Mr. Arthur St. Amand
Broward County Division of
Disaster Preparedness

Mr. Ray Summers
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Lauderdale-by-the-Sea

Chief John Tighe, P.D.
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City of Pembroke Pines

Mr. Edward Turner, Public Safety
Civil Defense Coordinator
City of Oakland Park

Mr. David Vlazny
Murray, Martin, and Olsen

Sgt. Robert Weatherholt, P.D.
Town of Davie

Chief John Whalen, Public Safety
Civil Defense Coordinator
Cooper City

Chief Leonard White, F.D.
City of Lauderdale Lakes

Lt. William Wilson, P.D.
City of Deerfield Beach

REGIONAL
DISASTER PREPAREDNESS
COMMITTEE MEMBERS

DADE COUNTY

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Management Analysis Bureau
Metro-Dade Police Department

Mr. Ernest Bayford
Ambu-car of Dade County, Inc.

Mr. Tom Bennett
7th Coast Guard District

Mr. Martin Bishop, Director
Metro-Dade Emergency Management

Chief Stan Blair
North Bay Village Police Dept.

Chief Dale P. Bowlin, Police Division
Metro-Dade Police Department

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Coral Gables

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Miami Beach

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Assistant Gen. Superintendent of Transportation, MTA

Mr. Walt Cronise
Meteorologist
WPLG Channel 10

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Town Police Chief
Town of Surfside

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Metro-Dade Fire Department

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Mr. A. C. Fischer
Dade County Civil Defense

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General Services Administration

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Meteorologist
WCIX Channel 6

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Dade County Department of
Public Health

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Dade County League of Cities

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Metro-Dade Public Works Department

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Islandia Police

Captain William Saunderson
Florida Marine Patrol

Mr. Jack Serig
Safety Supervisor
Dade County Schools

Pat Sheridan
Director of Disaster Services
American Red Cross

Mr. Eugene L. Simm, Director
Metro-Dade Traffic and
Transportation Dept.

Mr. Phillip F. Sistik
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Coral Gables

Chief Emmett Snider
Homestead Police

Mr. Bob Sofer
Meteorologist
WCKT Channel 7

Mr. Charles E. Sowers
Emergency Medical Services
Metro-Dade Fire Department

Mr. Steve Spratt
Director of Human Resources

Chief Norman Staubesand
Bal Harbour Police

Mr. Glenn Suddeth
Citizen's Safety Council

Mr. Ramon Torres
Supervisor of Transportation
Dade County Schools

Neville Turner
Civil Defense Coordinator
City of Homestead

Mr. Bob Weaver
Meteorologist
WTVJ Channel 4

Isaac A. Withers, Director
Metro-Dade Community Action Agency

REGIONAL
DISASTER PREPAREDNESS
COMMITTEE MEMBERS

MONROE COUNTY

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Key Colony Beach

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Planning and Zoning Dept.

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Monroe County Civil Defense

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American Red Cross

Mr. Robert C. Ernst
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Monore County Commissioner
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Key Colony Beach

Mr. Jeff Fischer
University of Florida
Sea Grant and Cooperative
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Key West

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Weather Specialist
National Weather Service
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NAS Boca Chica

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Emergency Services Coordinator

Mr. Billy Pinder
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Key West

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Fire Chief, Marathon VFD
Civil Defense
Mid-Keys Coordinator

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News Director WFFG/WMUM

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Monroe County Sheriff's Dept.
Key West

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Mayor Pro-Tem
Monroe County

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Public Works Director

Ms. Jan Terry
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Key Colony Beach

Dean Turney
West Palm Beach

Mr. Richard Urbanak
Chief Meterologist
National Weather Service
Key West

Mr. Kevin Wadlow
The Keynoter

Mr. Billy Wagner
Civil Defense Director
Key West

Mr. William A. Wagner III
Fire Chief
Conch Key

Honorable Dennis Wardlow
Mayor of Key West

Mr. Peter Weber
Monroe County

Mr. W. H. Westray, Chairman
Lower Keys American Red Cross
Shelter Coordinator
Key West

Lt. Robert Wilkinson
MOnroe County Sheriff's Dept.
Plantation Sub-Station

Mr. James Winston
City Police Chief
Key West

478th Civil Affairs Company
Coral Gables

Mr. R. L. Blazevic
Key West

REGIONAL
DISASTER PREPAREDNESS
COMMITTEE MEMBERS

PALM BEACH COUNTY

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Civil Defense Director
City of Lake Worth

Mr. Vince Bonvento
Administrative Office
Palm Beach County

Mr. Frank W. Brutt
Executive Director
Area Planning Board
Palm Beach County

Mr. Peter L. Cheney
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City of Boynton Beach

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Police Chief Robert J. DiSavino
Civil Defense Director
Town of Juno Beach

Police Chief Franklin Flannery
Civil Defense Director
Village of Tequesta

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Board of County Commissioners

Mr. George Frost
Civil Defense Director

Police Chief John Jamason
Civil Defense Director
City of West Palm Beach

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Palm Beach County Civil Defense

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Mayor of Gulf Stream
Civil Defense Director
Town of Gulf Stream

Mr. Jerry Krinn
Palm Beach County Chapter
American Red Cross

Mr. Stephen M. Letro
Meteorologist in Charge
National Weather Service Office

Mr. Dennis M. Smith
Police Department
Delray Beach

Mr. Gordon Tiffany
Civil Defense Director
City of Delray Beach

Mr. Rolfe H. Wagner
Civil Defense Director
City of Belle Glade

Chief Jack Withrow
Civil Defense Director
City of Boca Raton

REGIONAL
DISASTER PREPAREDNESS
COMMITTEE MEMBERS

STATE, FEDERAL, AND OTHER AGENCIES

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South Florida Area Coordinator
Florida Bureau of Disaster
Preparedness

Commander R. N. Roussel
Captain of the Port
Port of Miami, USCG

Mr. James J. Connoly
Port Director
Port Everglades Authority

Mr. David H. Dickey
U.S. Coast Guard
Key West

Mr. Frank J. DeLuca
Florida Department of Transportation

Captain A. C. Dempsey
Commander
Seventh Coast Guard District

Mr. Jerry Faris, Administrator
Data and Model Support
Florida Department of Transportation

Dr. Neil Frank, Director
National Hurricane Center

Mr. S. L. Fuller
Florida Department of Transportation

Mr. John C. Goodknight
District Engineer
Florida Department of
Transportation

Mr. Mike Grundy
Corps of Engineers

Ms. Sandy Barrett
South Florida Regional
Planning Council

Mr. R. G. Harris, Director
Glades County Civil Defense

Ms. Judy Kennington
Hendry County Civil Defense

Mr. J. R. Maloy, Executive Director
South Florida Water Management District

William G. Massey
Natural and Technological Hazards
Division
Federal Emergency Management Agency

Mr. Barry Peterson
South Florida Regional
Planning Council

Mr. Sam Shannon
Treasure Coast Regional
Planning Council

Mr. Dan Trescott
Florida Bureau of Disaster Preparedness

United States Coast Guard Auxiliary
Miami

MSCA Capt. Vaughan
State of Florida
Department of Military Affairs

Mr. Bob Wilkerson, Director
Division of Public Safety and
Assistance
Department of Veteran and
Community Affairs

Mr. John Wilson
Florida Bureau of Disaster
Preparedness

Mr. Judson Wood, Disaster Director
Florida Division
American Red Cross

STATE, FEDERAL, AND OTHER AGENCIES (Con'd)

Mr. Rudy Marchese
Treasure Coast Regional
Planning Council

Mr. Miles Lawrence
National Hurricane Center

Mr. Brian Jarvinen
National Hurricane Center

APPENDIX C

Saffir/Simpson Scale

THE SAFFIR/SIMPSON HURRICANE SCALE

The Saffir/Simpson Hurricane Scale is used by the National Weather Service to give public safety officials a continuing assessment of the potential for wind and storm-surge damage from a hurricane in progress. Scale numbers are made available to public-safety officials when a hurricane is within 72 hours of landfall. Scale assessments are revised regularly as new observations are made, and public-safety organizations are kept informed of new estimates of the hurricane's disaster potential.

Scale numbers range from 1 to 5. Scale No. 1 begins with hurricanes in which the maximum sustained winds are at least 74 miles per hour, while Scale No. 5 applies to those in which the maximum sustained winds are 155 miles per hour or more.

The scale was developed by Herbert Saffir, Dade County, Florida, consulting engineer, and Dr. Robert H. Simpson, former National Hurricane Center Director, and projects scale assessment categories as follows:

<u>Category No. 1</u> - Winds of 74 to 95 miles per hour. Damage primarily to shrubbery, trees, and unanchored mobile homes. No real damage to other structures. Some damage to poorly-constructed signs. Low-lying coastal roads inundated, minor pier damage, some small craft in exposed anchorage torn from moorings.

<u>Category No. 2</u> - Winds of 96 to 110 miles per hour. Considerable damage to shrubbery and tree foliage; some trees blown down. Major damage to exposed mobile homes. Extensive damage to poorly constructed signs. Some damage to roofing materials of buildings; some window and door damage. No major damage to buildings. Coastal roads and low-lying escape routes inland cut by rising water two to four hours before arrival of hurricane center. Considerable damage to piers. Marinas flooded. Small craft in unprotected anchorages torn from moorings.

<u>Category No. 3</u> - Winds of 111 to 130 miles per hour. Foliage torn from trees; large trees blown down. Practically all poorly-constructed signs blown down. Some damage to roofing materials of buildings; some window and door damage. Some structural damage to small buildings. Mobile homes destroyed. Serious flooding at coast and many smaller structures near coast destroyed; large structures near coast damaged by battering waves and floating debris. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives.

<u>Category No. 4</u> - Winds of 131 to 155 miles per hour. Shrubs and trees blown down; all signs down. Extensive damage to roofing materials, windows and doors. Complete failure of roofs on many small residences. Complete destruction of mobile homes. Major damage to lower floors of structures near shore due to flooding and battering by waves and floating debris. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives. Major erosion of beaches.

Category No. 5 - Winds greater than 155 miles per hour. Shrubs and trees blown down; considerable damage to roofs of buildings; all signs down. Very severe and extensive damage to windows and doors. Complete failure of roofs on many residences and industrial buildings. Extensive shattering of glass in windows and doors. Some complete building failures. Small buildings overturned or blown away. Complete destruction of mobile homes. Low-lying escape routes inland cut by rising water three to five hours before hurricane center arrives.

Dr. Neil Frank, present National Hurricane Center Director, has adapted atmospheric pressure ranges to the Saffir/Simpson Scale. These pressure ranges, along with a numerical break-down of wind ranges, are listed below:

NUMBER	MILLIBARS	INCHES	(MPH)	DAMAGE
1	> 980	> 28.94	74-95	Minimal
2	965-979	28.5-28.91	96-110	Moderate
3	945-964	27.91-28.47	111-130	Extensive
4	920-944	27.17-27.88	131-155	Extreme
5	< 920	< 27.17	155+	Catastrophic

APPENDIX D

Traffic-Evacuation Zonal Data

MONROE COUNTY TRAFFIC EVACUATION ZONAL DATA

Lower Southeast Florida
Hurricane Evacuation Study

EVACUATION TRAFFIC ZONE	DESCRIPTION	STUDY AREA DESIGNATION	POPULATION 1980	TOTAL DWELLING UNITS	HOTEL* MOTEL UNITS	MOBILE HOME SPACES	RV* SPACES
1	Key West	Lower Keys	24,292	11,535	1,680	581	317
2	Stock Island -> Shark Key	Lower Keys	7,345	2,976	434	176	96
3	Saddle Bunch Key -> 7 Mile Bridge	Lower Keys	6,353	4,514	184	133	750
[illegible]	Marathon -> Channel 5 Bridge	Middle Keys	10,221	7,193	1,445	289	571
5	Channels 5 Bridge -> Key Largo	Upper Keys	14,887	11,870	1,753	1,117	1,331
	TOTALS		**63,098**	**38,088**	**5,496**	**2,296**	**3,065**

*Zones 1 & 2 Estimated

DADE COUNTY TRAFFIC-EVACUATION ZONAL DATA

Lower Southeast Florida
Hurricane Evacuation Study

ZONE	TPOP	MHU	TDU	HU	AUTO	MHP	HP
1	6481	0	4645	1251	3504	0	1877
2	46180	0	32318	14949	9936	0	22426
3	4341	0	2485	694	1979	0	1042
4	17360	0	11045	9396	5850	0	14097
5	35376	0	22889	5904	14004	0	9458
6	14958	0	10446	4595	5782	0	6894
7	9975	0	6725	5900	2555	0	8851
8	14981	0	9720	128	6909	0	193
9	6822	1113	2667	288	3200	2226	433
10	5308	579	3131	220	3131	1158	331
11	16951	0	9231	234	7285	0	352
12	7749	0	4299	394	3920	0	669
13	3606	0	3931	620	2161	0	931
14	5284	0	2683	222	3158	0	333
15	2163	0	839	57	1127	0	86
16	2624	0	883	0	1383	0	0
17	2258	0	549	0	765	0	0
18	210	0	14	95	84	0	143
19	21963	1079	8072	211	9552	2158	318
20	25757	901	9456	483	11631	1802	726
21	19773	72	5271	9	7056	144	14
22	34927	0	9779	100	17210	0	150
23	19531	0	8801	398	9399	0	599
24	10410	0	6565	4469	4419	0	6728
25	9625	712	5341	1131	6425	1425	1696
26	76493	546	---	440	---	1092	---
27	31940	0	---	40	---	0	---
28	99592	600	---	533	---	1200	---
29	8298	331	---	102	---	662	---
30	2906	0	---	654	---	0	---
31	11359	1215	---	0	---	2430	---
32	127986	540	---	745	---	1080	---
33	52974	801	---	0	---	1602	---
34	55531	703	---	344	---	1405	---
35	110262	1500	---	323	---	3000	---
36	20437	801	---	2861	---	1602	---
37	58812	1056	---	0	---	2112	---
38	75945	697	---	550	---	1394	---
39	113693	386	---	1280	---	772	---
40	46974	0	---	0	---	0	---
41	63337	0	---	0	---	0	---
42	42406	0	---	393	---	0	---
43	37434	93	---	150	---	186	---
44	46822	0	---	100	---	0	---
45	836	1293	---	0	---	2586	---
46	49358	0	---	0	---	0	---
47	15877	125	---	61	---	250	---

TPOP = Total Population
MHU = # of Mobile Home Units
TDU = # of Total Dwelling Units
HU = # of Hotel/Motel Units

AUTO = # of Residential Vehicles
MHP = Mobile Home Population
HP = Hotel/Motel Population
--- = Data not used in calculations

BROWARD COUNTY ZONAL DATA

Lower Southeast Florida
Hurricane Evacuation Study

ZONE	TPOP	MHU	TDU	HU	AUTO	MHP	HP
1	10,058	0	5,129	915	5,911	0	1,373
2	14,861	152	6,826	313	9,678	305	470
3	19,541	0	9,899	998	13,025	0	1,499
4	35,606	0	18,047	3,108	22,450	0	4,664
5	8,644	0	5,248	5,576	6,017	0	8,365
6	5,575	0	2,938	400	3,903	0	601
7	2,547	103	1,343	177	1,768	206	266
8	6,560	151	3,007	426	3,831	302	640
9	55,737	37	28,123	4,609	31,083	74	6,916
10	12,211	647	5,952	743	7,031	1,294	981
11	7,045	0	3,066	79	4,789	0	96
12	3,702	0	2,037	0	2,702	0	0
13	2,616	0	1,209	0	1,731	0	0
14	2,955	31	1,302	0	1,911	62	0
15	1,902	0	826	0	1,131	0	0
16	104,926	1,068	---	616	---	6,940	---
17	74,906	1,112	---	250	---	2,224	---
18	36,884	3,445	---	761	---	5,970	---
19	66,310	6,649	---	188	---	13,298	---
20	103,926	1,068	---	1,810	---	2,136	---
21	88,902	479	---	0	---	958	---
22	79,632	759	---	1,130	---	1,518	---
23	105,151	1,452	---	779	---	2,904	---
24	63,259	719	---	495	---	1,438	---
25	40,192	1	---	0	---	2	---
26	40,627	1,144	---	294	---	2,288	---
27	29,017	426	---	67	---	852	---
28	49,743	1,988	---	517	---	3,976	---
29	7,495	1,107	---	0	---	2,214	---
30	11,133	3	---	0	---	6	---

TPOP = Total Population
MHU = # of Mobile Home Units
TDU = # of Total Dwelling Units
HU = # of Hotel/Motel Units

AUTO = # of Residential Vehicles
MHP = Mobile Home Population
HP = Hotel/Motel Population
--- = Data not used in calculations

PALM BEACH COUNTY TRAFFIC-EVACUATION ZONAL DATA

Lower Southeast Florida
Hurricane Evacuation Study

ZONE	TPOP	MHU	TDU	HU	AUTO	MHP	HP
1	3700	113	1965	226	1459	226	339
2	5589	0	2396	41	3308	0	31
3	4427	66	1753	0	2462	133	0
4	571	184	342	98	503	368	147
5	4801	0	2453	35	3675	0	53
6	11198	124	6934	1213	3964	248	1820
7	7017	41	4085	590	4403	83	885
8	4913	0	3733	1426	3953	0	2140
9	4365	0	2384	107	2513	0	162
10	4233	0	3099	751	1486	0	1127
11	5052	373	3649	285	3183	711	419
12	1490	113	908	80	755	226	121
13	6180	644	3776	231	2788	1236	348
14	4312	86	2750	480	1347	173	721
15	5550	91	3175	170	2475	182	256
16	5918	61	3858	311	4597	122	468
17	2978	0	1875	629	1520	0	945
18	4147	0	2944	0	2217	0	0
19	681	0	389	34	302	0	49
20	1278	0	757	94	599	0	141
21	3687	0	1766	85	2139	0	129
22	1948	0	949	64	748	0	96
23	3391	0	1777	87	1363	0	132
24	274	0	---	0	---	0	---
25	855	94	---	0	---	188	---
26	2560	0	---	126	---	0	---
27	6523	289	---	196	---	578	---
28	21350	1567	---	0	---	3134	---
29	15530	317	---	179	---	634	---
30	26824	142	---	400	---	284	---
31	2330	1007	---	0	---	2014	---
32	1257	554	---	0	---	1108	---
33	8552	501	---	64	---	1001	---
34	23938	40	---	703	---	80	---
35	9190	1873	---	0	---	3746	---
36	11641	139	---	107	---	278	---
37	40255	1204	---	251	---	2408	---
38	2695	1629	---	20	---	3258	---
39	12869	1537	---	60	---	3074	---
40	425	0	---	0	---	0	---
41	9550	1428	---	0	---	2856	---
42	4780	248	---	0	---	496	---
43	16290	0	---	0	---	0	---
44	17256	22	---	253	---	44	---
45	20220	0	---	0	---	0	---

TPOP = Total Population
MHU = # of Mobile Home Units
TDU = # of Total Dwelling Units
HU = # of Hotel/Motel Units
AUTO = # of Residential Vehicles
MHP = Mobile Home Population
HP = Hotel/Motel Population
--- = Data not used in calculations

PALM BEACH COUNTY TRAFFIC-EVACUATION ZONAL DATA

Lower Southeast Florida
Hurricane Evacuation Study

ZONE	TPOP	MHU	TDU	HU	AUTO	MHP	HP
46	12325	15	---	27	---	29	---
47	22191	0	---	324	---	0	---
48	28612	178	---	126	---	356	---
49	1325	0	---	0	---	0	---
50	7545	138	---	32	---	276	---
51	4340 *	---	---	0	---	---	---
52	460 *	---	---	0	---	---	---
53	3825 *	---	---	0	---	---	---
54	26767 *	---	---	0	---	---	---

TPOP = Total Population
MHU = # of Mobile Home Units
TDU = # of Total Dwelling Units
HU = # of Hotel/Motel Units

AUTO = # of Residential Vehicles
MHP = Mobile Home Population
HP = Hotel/Motel Population

* 1/3 assumed to be in substandard housing

--- Due to lack of census data on dwelling units. The vulnerable population was calculated on a percentage basis for mobile homes and substandard housing.

APPENDIX E

Medical Facilities Listings

APPENDIX E

MEDICAL FACILITIES IN MONROE, DADE, BROWARD AND PALM BEACH COUNTIES

Lower Southeast Florida
Hurricane Evacuation Study

Monroe County

Mariner's Hospital at Plantation Key
Fisherman's Hospital at Marathon
De Poo Hospital at Key West
Florida Keys Memorial Hospital at Stock Island

Dade County

Abbey Hospital and Medical Center
American Hospital, Inc.
Baptist Hospital of Miami, Inc.
Biscayne Medical Center
Cedars of Lebanon Hospital
Christian Hospital, Inc.
Coral Gables Hospital
Doctors' Hospital
P. O. Dodge Memorial Hospital
Douglas Gardens Hospital
Hialeah Hospital
Highland Park General Hospital
Jackson Memorial Hospital
Larkin General Hospital
Mercy Hospital, Inc.
Miami Dade General Hospital
Miami Heart Institute
Miami International Hospital
Mt. Sinai Hospital of Greater Miami
North Dade Hospital & Medical Center
North Miami General Hospital
North Shore Hospital
Northwest Hospital
Osteopathic General Hospital
Palm Springs General Hospital of Hialeah, Inc.
Palmetto General Hospital
Pan American Hospital Corporation
Parkway General Hospital, Inc.
St. Francis Hospital, Inc.
James Archer Smith Hospital
South Miami Hospital

Dade County (continued)

South Shore Hospital & Medical Center
U.S. Air Force Hospital
University of Miami Hospitals & Diagnostic Clinic
University of Miami Health Center Hospital
Variety Children's Hospital
Veterans Administration Hospital
Victoria Hospital, Inc.
Westchester General Hospital
Anna E. Anderson Health Center
Arch Creek Nursing & Convalescent Home
Asthmatic Children's Foundation Residential
  Treatment Center
Coral Gables Convalescent Home
Dade County (Metro) Human Resources Health Center
East Ridge Lutheran Retirement Village
Fair Havens Nursing Home
Floridean Rest Home
Fountainhead Nursing Home
Four Freedoms Manor
Green Briar Nursing Center
Greynolds Park Manor Rehabilitation Center
Heritage House Convarlium
Hialeah Convalescent Home
Homestead Manor
Jackson Heights Nursing Home
Jackson Manor Nursing Home
Krest View Nursing Home
LaPosada Convalescent Home
Lincoln Memorial Nursing Home
Lutheran Medical Center
Miami Beach Hebrew Home for Aged
Miami Jewish Home & Hospital for the Aged, Inc.
Miami Convalescent Home
New Riviera Health Resort
North Miami Convalescent Home
North Shore Nursing Home
Palmetto Extended Care Center
Palm Convalescent Home
Pinecrest Nursing Home
Pines Nursing Home
Ramsey Nursing Home
Royal Glades Convalescent Home
Snapper Creek Nursing Home
Towne House for Convalescents
Treasure Isle Convalescent Home
Villa Maria Nursing & Rehabilitation Center
Dade County Health Department
Family Health Center
South Miami Health Center

Dade County (continued)

Homestead Center
North Miami Center
Miami Beach Center
46 Street Center

Broward County

Bennett Community Hospital
Broward General Medical Center
Community Hospital of South Broard
Coral Ridge Psychiatric Hospital
Cypress Community Hospital
Doctors General Hospital
Doctors Hospital of Hollywood
Florida Medical Center
Ft. Lauderdale Mental Health Institute
Hollywood Medicla Center
Hollywood Pavilion Psychiatric Hospital
Holy Cross Hospital
Imperial Point Hospital
Las Olas General Hospital
Margate General Hospital
Memorial Hospital
North Beach Medical Center
North Broward Hospital
North Ridge General Hospital
Pembroke Pines General Hospital
Plantation General Hospital
University Community Hospital
West Broward Hospital
Alden House
Aviva Manor Nursing Home
Broward Convalescent Home
The Center for Living
Colonial Palms Nursing Home
Colonial Palms Nursing Home - East
Covenant Care Center
Dania Nursing Home
Daystar, Inc.
Golden Isles Convalescent Center
Golfcrest Nursing Home
Harbor Beach Convalescent Home
Hollywood Hills Nursing Home
John Knox Medical Center
Manor Pines Convalescent Center
Monticello Manor Nursing Home
Mt. Vernon Manor Nursing Home
Pinehurst Convalescent

Broward County (continued)

Plantation Nursing Home
Sheffield Convalarium
St. John's Nursing & Rehabilitation
Sweeting Nursing Home
Tamarac Convalescent Center
Washington Manor
Manor Oaks Nursing Home

Palm Beach County

Bethesda Memorial Hospital
Boca Raton Community Hospital
Community Hospital of the Palm Beaches, Inc.
Doctor's Hospital of Lake Worth
Everglades Memorial Hospital
The Hospital (Palm Beach-Martin County Medical
  Center, Inc.
Glades General Hospital
Good Samaritan Hospital
John F. Kennedy Memorial Hospital
Palm Beach Gardens Community Hospital
St. Mary's Hospital
Abbey Delray
Atlantis Convalescent Center
Boca Raton Convalescent Center
Boulevard Manor
Clemmons Convalescent Pavillion
Convalescent Center of the Palm Beaches
Crest Manor Nursing Home
Darcy Hall
Eason's Nursing Home
Finnish-American Rest Home
The Fountains
Helen Wilkes Residence
Lakeside Adult Care Center
Lake View Manor
Mason's Rehabilitation Center, Inc.
Medicana Nursing Center
Medic-Home Health Center of Lake Worth
Noreen McKeen Residence for Geriatric Care
Open Door Estates
Palm Beach Care
Palm Beach County Home and General Care Facilities
Palmview Manor Convalescent Center
Sunset Heights

APPENDIX F

Roadway Point Pre-Landfall Hazards Times

MONROE COUNTY
ROADWAY POINT PRE-LANDFALL HAZARDS TIMES

Lower Southeast Florida
Hurricane Evacuation Study

POINT NO.	LOCATION OF POINT	TIME OF ARRIVAL (**IN HOURS BEFORE EYE LANDFALL**) OF Gale Force Winds CAT. 1-2	Gale Force Winds CAT. 3-5	Surge Inundation CAT. 1-2	Surge Inundation CAT. 3-5
1	East Int. of Old Dixie Highway and Rt. 905 (north Key Largo)	5.5-7.0	9.0-10.5	1.0	2.5
2	West Int. of Old Dixie Highway and Rt. 905 (north Key Largo)	5.5-7.0	9.0-10.5	2.5	4.0
3	Old Dixie Highway between Steamboat Creek & Rt. 905 (North Key Largo)	5.5-7.0	9.0-10.5	2.5	4.0
4	Int. of Rt. 905 and U.S. 1 (near Lake Surprise in Key Largo)	6.0-7.5	9.5-11.0	1.5	3.0
5	U.S. 1 approx. 2 mi. south of Newport (South Key Largo)	6.5-7.5	9.5-11.5	---	.5
6	U.S.1 near Thompson (Tavernier)	6.5-7.5	9.5-11.5	---	1.5
7	U.S. 1 near Community Harbor (Tavernier)	6.5-7.5	9.5-11.5	1.0	2.5
8	U.S. 1 at North End of Islamorada (Upper Matecumbe Key)	6.5-8.0	10.0-11.5	2.0	3.0
9	U.S. 1 approximately 1 mi. north of Lake Surprise (near Key Largo)	6.0-7.5	9.5-11.0	1.5	3.0
10	U.S. 1 at Teatable Key (Upper Matecumbe Key)	6.5-8.0	10.0-11.5	---	2.0
11	U.S. 1 approx. 5 mi. south of Islamorada	6.5-8.0	10.0-11.5	2.0	3.0
12	U.S. 1 near Long Key (Layton)	7.0-8.5	10.5-12.0	1.5	2.5
13	U.S. 1 at Grassy Key (2 mi. south of Duck Key)	7.5-9.0	11.5-13.0	1.5	3.5
14	U.S. 1 at Key Colony (north of Marathon)	7.5-9.0	11.5-13.0	---	2.5
15	Int. of U.S. 1 and S.R. 931 (Marathon)	7.5-9.0	11.5-13.0	---	2.5
16	S.R. 931 south end at Vaca Key (Marathon)	7.5-9.0	11.5-13.0	1.5	3.5
17	S.R. 931 south end at Boot Key (Marathon)	7.5-9.0	11.5-13.0	2.5	3.5
18	U.S. 1 at Bahia Honda State Park	7.5-9.0	11.5-13.0	---	2.5
19	Int. of U.S. 1 and S.R. 940 at Big Pine Key	7.5-9.0	11.5-13.0	1.0	3.0
20	North end of S.R. 940 at Big Pine Key	7.5-9.0	11.5-13.0	2.5	3.5
21	U.S. 1 at Little Torch Key	7.5-9.0	11.5-13.0	---	2.5
22	U.S. 1 at Ramrod Key	7.5-9.0	11.5-13.0	1.0	3.0
23	U.S. 1 at Summerland Key	7.5-9.0	11.5-13.0	1.0	3.0

MONROE COUNTY
ROADWAY POINT PRE-LANDFALL HAZARDS TIMES

POINT NO.	LOCATION OF POINT	TIME OF ARRIVAL (**IN HOURS BEFORE EYE LANDFALL**) OF Gale Force Winds CAT. 1-2	Gale Force Winds CAT. 3-5	Surge Inundation CAT. 1-2	Surge Inundation CAT. 3-5
24	Unnamed Road at Little Torch Key	7.5-9.0	11.5-13.0	2.0	3.5
25	Unnamed Road at Ramrod Key	7.5-9.0	11.5-13.0	2.0	3.5
26	Unnamed Road at Summerland Key	8.0-9.5	12.0-13.5	1.5	3.0
27	U.S. 1 at Cudjoe Key	8.0-9.5	12.0-13.5	1.0	3.0
28	Int. of U.S. 1 and S.R. 939 (Sugarloaf Key)	8.0-9.5	12.0-13.5	---	3.0
29	U.S. 1 at Big Coppitt Key	9.5-11.5	12.0-14.0	2.0	3.5
30	S.R. 941 at Berger Key (U.S. Naval Air Station)	9.5-11.5	12.0-14.0	3.0	4.5
31	Int. of U.S. 1 and AIA (Key West)	8.5-10.0	12.5-14.0	---	3.0
32	Unnamed Road at Dredgers Key (near Key West)	8.5-10.0	12.5-14.0	3.5	4.0
33	Int. of Atlantic Blvd. & White St. (Key West)	8.5-10.0	12.5-14.0	4.0	5.5
34	Int. of Flagler Ave. & White St. Key West)	8.5-10.0	12.5-14.0	2.5	4.0
35	Int. of Truman Ave. & Duval St. (Key West)	8.5-10.0	12.5-14.0	---	2.5

DADE COUNTY
ROADWAY POINT PRE-LANDFALL HAZARDS TIMES

Lower Southeast Florida
Hurricane Evacuation Study

		TIME OF ARRIVAL (**IN HOURS BEFORE EYE LANDFALL**) OF			
		Gale Force Winds		Surge Inundation	
POINT NO.	LOCATION OF POINT	CAT. 1-3	CAT. 4-5	CAT. 1-3	CAT. 4-5
1	Ocean Blvd. in Golden Isles	6.5-10.0	+11.0-11.5	1.5	1.5
2	Int. of Ocean Blvd. and Interama Rd.	6.5-9.5	10.5-11.5	0.5-1.0	0.5-1.0
3	Int. of Collins Ave. & 96th St.	6.5-9.5	10.5-11.5	1.5	1.0-1.5
4	Collins Ave. near Allison Island	6.5-9.5	10.5-11.5	0.5	0.5
5	Collins Ave. just south of Rt. 195	6.5-9.5	10.5-11.5	2.0	1.0-1.5
6	Int. of Collins Ave and MacArthur Causeway	6.5-9.5	10.5-11.5	1.0	0.5-1.0
7	Int. of Alton Rd. and Dade Blvd.	6.5-9.5	10.5-11.5	1.5	1.5
8	Alton Rd. near Indian Creek	6.5-9.5	10.5-11.5	1.5	1.5
9	Broad Causeway at Bay Harbor Islands	6.5-9.5	10.5-11.5	2.0	2.0-1.5
10	North Bay Causeway east of Treasure Island	6.5-9.5	10.5-11.5	1.5	1.5
11	Julia Tuttle Causeway	6.5-10.0	10.5-11.5	NF-0.5	0.0-0.5
12	Venetian Causeway at Biscayne Island	6.5-10.0	10.5-11.5	0.0-0.5	0.5
13	MacArthur Causeway at Palm Island	6.5-10.0	10.5-11.5	1.5	1.0-1.5
14	Port Blvd. near U.S. 1	6.5-10.0	10.5-11.5	0.0-0.5	0.0-0.5
15	Rickenbacker Causeway near Marine Stadium	6.5-10.0	10.5-11.5	0.5	0.5
16	Rickenbacker Causeway near Bear Cut	6.5-10.0	10.5-11.5	2.5	1.0-1.5
17	Interama Blvd. near Biscayne Creek	6.5-10.0	10.5-11.5	1.5	0.5-1.0
18	Int. of Miami Gardens Dr. & Biscayne Blvd.				
19	Int. of Biscayne Blvd. and N.E. 125th St.	6.5-9.5	10.5-11.5		
20	Biscayne Blvd. just north of Venetian Causeway	6.5-10.0	10.5-11.5	1.0	0.5-1.5
21	Brickell Ave. just north of Rickenbacker Causeway	6.5-10.0	10.5-11.5	0.0-0.5	0.5
22	South Bay Shore Dr. just north of Dinner Key	6.5-10.0	10.5-11.5	1.0-1.5	1.5
23	Int. of S. Bay Shore Dr. and S.W. 27th Ave.	6.5-10.0	10.5-11.5	1.0	1.0
24	Int. of Sunset Dr. & Granada Blvd.	6.5-10.0	10.5-11.5	NF	-0.5
25	S.W. 57th Ave. just north of Killian Dr.	6.5-9.5	10.5-11.5	NF	NF-0.5

NF = No flooding at this road point

DADE COUNTY
ROADWAY POINT PRE-LANDFALL HAZARDS TIMES

POINT NO.	LOCATION OF POINT	TIME OF ARRIVAL (**IN HOURS BEFORE EYE LANDFALL**) OF Gale Force Winds CAT. 1-3	Gale Force Winds CAT. 4-5	Surge Inundation CAT. 1-3	Surge Inundation CAT. 4-5
26	Int. of S. Dixie Hwy. and Red Rd. (S.W. 57th Ave.)	6.5-9.5	10.5-11.5	NF	NF- 1.5
27	Int. of S. Dixie Hwy & S.W. 27th Ave.	6.5-10.0	10.5-11.5	NF	NF
28	Int. of Coral Way & S.W. 27th Ave.	6.5-10.0	10.5-11.5	NF	NF
29	Int. of Flagler St. & 12th St.	6.5-10.0	10.5-11.5	1.0-1.5	0.5-1.0
30	Int. of S.W. 8th St. & S.W. 12th St.	6.5-10.0	10.5-11.5	NF- 1.0	0.0-.0.5
31	I-95 just noroth of Rt. 836	6.5-10.0	10.5-11.5	NF	NF
32	I-95 at N.W. 125th St.	6.5-9.5	10.5-11.5	NF	NF
33	I-95 at Ives Estates	6.5-9.5	10.5-11.5	NF	NF
34	W. Dixie Hwy. in North Miami	6.5-9.5	10.5-11.5	NF	0.5
35	N.E. 2nd Ave. in Miami Shores	6.5-9.5	10.5-11.5	NF- 0.5	0.5
36	Miami Gardens Dr. near [?†	6.5-9.5	10.5-11.5	NF-0.0	0.0
37	Florida Turnpike near Carol City	6.5-9.5	10.5-11.5	NF	NF
38	Int. of N.W. 27th Ave. and the Palmetto Expressway	6.5-9.5	10.5-11.5	NF	NF
39	Int. of N.W. 27th Ave. & N.W. 103rd St.	6.5-9.5	10.5-11.5	NF	NF
40	Int. of N.W. 79th St. & N.W. 22nd Ave.	6.5-9.5	10.5-11.5	NF	NF
41	N.W. .27th Ave near Miami River	6.5-10.0	10.5-11.5	NF	NF
42	Rt. 836 just east of LeJune Rd.	6.5-10.0	10.5-11.5	NF	NF
43	Airport Expwy. near N.W. 17th Ave.	6.5-10.0	10.5-11.5	NF	NF
44	N.W. 36th St. just east of Airport	6.5-10.0	10.5-11.5	NF	NF
45	Int. of Red Rd. and S. River Dr.	6.5-10.0	10.5-11.5	NF	NF
46	Int. of Red Rd. and Miami Gardens	6.5-9.5	10.5-11.5	NF	NF
47	Palmetto Expwy. near Medley	6.5-10.0	10.5-11.5	NF	NF
48	Palmetto Expwy just north of Rt. 836	6.5-10.0	10.5-11.5	NF	NF
49	Florida Turnpike near Flagler St.	6.5-10.0	10.5-11.5	NF	NF
50	Int. of W. Flagler St. & Milam Dairy Rd.	6.5-10.0	10.5-11.5	NF	NF
51	Palmetto Expwy. just north of Bird Rd.	6.5-10.0	10.5-11.5	NF	NF
52	Coral Way near Westchester	6.5-10.0	10.5-11.5	NF	NF-(0.5)
53	Int. of Bird Rd. & Galloway Rd.	6.5-10.0	10.5-11.5	NF	NF

NF = No flooding at this road point

DADE COUNTY
ROADWAY POINT PRE-LANDFALL HAZARDS TIMES

POINT NO.	LOCATION OF POINT	TIME OF ARRIVAL (**IN HOURS BEFORE EYE LANDFALL**) OF Gale Force Winds CAT. 1-3	Gale Force Winds CAT. 4-5	Surge Inundation CAT. 1-3	Surge Inundation CAT. 4-5
54	Int. of Sunset Dr. & Galloway Rd.	6.5-10.0	10.5-11.5	NF	NF
55	N. Kendall Dr. near S.W. 62nd Ave.	6.5-10.0	10.5-11.5	NF	NF-0.5
56	S. Dade Expressway just south of N. Kendall Dr.	6.5-9.5	10.5-11.5	NF	NF
57	Killian Dr. near S.W. 72nd Ave.	6.5-9.5	10.5-11.5	NF-0.0	0.0
58	Int. of Sunset Dr. & S.W. 117th Ave.	6.5-9.5	10.5-11.5	NF	NF
59	Int. of N. Kendall Dr. & Lindgren Rd.	6.5-9.5	10.5-11.5	NF	NF
60	Int. of Tamiami Trail and Krome Ave.	6.5-9.5	10.5-11.5	NF	NF
61	Tamiami Trail just west of the Palmetto Expressway	6.5-10.0	10.5-11.5	NF	NF
62	Int. of Ludlum Rd. and Chapman Field Dr.	6.5-9.5	10.5-11.5	NF-(1.5)	(0.5-1.0
63	Int of U.S. 1 and S.W. 128th St.	6.5-9.5	10.5-11.5	NF	NF
64	Int. of Coral Reef Dr. & Palmetto Rd.	6.5-9.5	10.5-11.5	NF-0.0	0.0
65	Int. of Eureka Dr. & Caribbean Dr.	6.5-9.5	10.5-11.5	NF-(0.0)	0.0
66	Old Cutler Rd. near Black Crrek	6.5-9.5	10.5-11.5	NF-(2.5)	(1.0-2.0
67	W. Dade Expwy. near Eureka Dr.	6.5-9.5	10.5-11.5	NF	(1.5-2.0
68	W. Dade Expwy. near S. Allapattah Rd.	6.5-9.5	10.5-11.5	NF	(2.0
69	Coral Reef Dr. near U.S. Naval Air Station	6.5-9.5	10.5-11.5	NF	(2.0
70	Int. of Eureka Dr. & Lindgren Rd.	6.5-9.5	10.5-11.5	NF	NF-(1.5
71	Int. of Quail Roost Dr. & Burr Rd.	6.5-9.5	10.5-11.5	NF	(1.5-2.0
72	Int. of U.S. 1 and Caribbean Dr.	6.5-9.5	10.5-11.5	NF	(2.0-4.0
73	Int. of U.S. 1 and S.W. 216th St.	6.5-9.5	10.5-11.5	NF	NF-(2.5
74	Silver Palm Dr. just west of U.S. 1	6.5-9.5	10.5-11.5	NF	(2.0-3.0
75	Int. of Krome Ave. & S.W. 216th St.	6.5-9.5	10.5-11.5	NF	NF
76	Int. of Krome Ave. a& Coconut Palm Dr.	6.5-9.5	10.5-11.5	NF	NF-(1.5)
77	Int. of S.W. 264th St. & Redland Rd.	6.5-9.5	10.0-11.5	NF	NF
78	Int. of U.S. 1 and Moody Dr.	6.5-9.5	10.0-11.5	NF	(3.0-4.0)
79	Floridas Turnpike near Campbell Dr.	6.5-9.5	10.0-11.5	(2.5)	(2.0-2.5)
80	Int. of U.S. 1 and Campbell Dr.	6.5-9.5	10.0-11.5	NF	NF
81	Avocado Dr. just west of Country Club Dr.	6.5-9.5	10.0-11.5	NF	NF
82	Int. of Loveland Rd. and Waldin Dr.	6.5-9.5	10.0-11.5	NF	NF

NF = No flooding at this road point

DADE COUNTY
ROADWAY POINT PRE-LANDFALL HAZARDS TIMES

POINT NO.	LOCATION OF POINT	TIME OF ARRIVAL (IN HOURS BEFORE EYE LANDFALL) OF Gale Force Winds CAT. 1-3	CAT. 4-5	Surge Inundation CAT. 1-3	CAT. 4-5
83	Int. of Mowry Dr. & Tower Rd.	6.5-9.5	10.0-11.5	NF	NF
84	Int. of U.S. 1 and Floridas Turnpike	6.5-9.5	10.0-11.5	NF-(4.0)	(2.0-3.0)
85	Int. of S. Canal Dr & Tallahassee Rd.	6.5-9.5	10.0-11.5	NF-(2.0)	(0.0-1.0)
86	Palm Dr. just east of U.S. 1	6.5-9.5	10.0-11.5	NF-(2.0)	-2.0
87	Int. of Rt. 27 & Loveland Rd.	6.5-9.5	10.0-11.5	NF	NF
88	U.S. 1 just south of Card Sound Rd.	5.5-9.0	9.5-10.0	1.0	1.0
89	Card Sound Road	5.5-9.0	9.5-10.0	1.0	1.0

NF = No flooding at this road point

BROWARD COUNTY
ROADWAY POINT PRE-LANDFALL HAZARDS TIME

Lower Southeast Florida
Hurricane Evacuation Study

POINT NO.	LOCATION OF POINT	TIME OF ARRIVAL (**IN HOURS BEFORE EYE LANDFALL**) OF Gale Force Winds CAT. 1-3	Gale Force Winds CAT. 4-5	Surge Inundation CAT. 1-3	Surge Inundation CAT. 4-5
1	Int. of Rt. 810 & Ocean Blvd.	6.5-10.0	10.5-11.5	NF	NF
2	North Ocean Blvd. just south of Hillsboro Inlet	6.5-10.0	10.5-11.5	1.5-2.0	2.0
3	Int. of North Ocean Blvd. & Atlantic Blvd.	6.5-10.0	10.5-11.5	NF	NF
4	North Ocean Dr. & Oakland Park Blvd.	6.5-10.0	10.5-11.5	1.5-2.0	NF-0.5
5	Int. of North Ocean Dr. & Sunrise Blvd.	6.5-10.0	10.5-11.5	NF-0.0	0.0
6	Int. of Int. of North Ocean Dr. & Las Olas Blvd.	6.5-10.0	10.5-11.5	NF	NF
7	North Ocean Dr. near Mayan Lake	6.5-10.0	10.5-11.5	NF	NF-0.0
8	North Ocean Dr. & Sheridan St.	6.5-10.0	11.0-11.5	1.0-1.5	2.0
9	North Ocean Dr. near Hollywood Beach	6.5-10.0	11.0-11.5	1.0-1.5	1.5
10	Int. of Ocean Dr. & Hollywood Blvd	6.5-10.0	11.0-11.5	NF-1.5	2.0
11	Int. of South Ocean Dr. & Hallandale Beach Blvd.	6.5-10.0	11.0-11.5	NF	NF-0.5
12	Rt. U.S.1 just south of Hillsboro Canal	6.5-10.0	10.5-11.5	NF	NF
13	Rt. U.S.1 near Deerfield Beach	6.5-10.0	10.5-11.5	NF	NF
14	Rt. U.S.1 just north of Atlantic Blvd.	6.5-10.0	10.5-11.5	NF	NF
15	Rt. U.S.1 north of Imperial Point	6.5-10.0	10.5-11.5	NF	NF
16	Int. of Rt. U.S.7 & Sunrise Blvd.	6.5-10.0	10.5-11.5	NF	NF
17	Int. of Oakland Park Blvd. & Bayview Dr.	6.5-10.0	10.5-11.5	NF	NF
18	Int. of Dixie Highway & Sample Rd.	6.5-10.0	10.5-11.5	NF	NF
19	Int. of Dixie Highway & Coconut Creek Parkway	6.5-10.0	10.5-11.5	NF	NF
20	Int. Dixie Highway & N.E. 50th St.	6.5-10.0	10.5-11.5	NF	NF
21	Wilton Dr. near south fork Middle River	6.5-10.0	10.5-11.5	NF	NF
22	Int. of South Andrews Ave. & Davie Blvd.	6.5-10.0	10.5-11.5	NF	NF-0.5
23	Int. of Rt. U.S.1 & Griffin Rd.	6.5-10.0	11.0-11.5	NF	NF
24	Rt. U.S.1 just south of Hollywood Blvd.	6.5-10.0	11.0-11.5	NF	NF- -0.5
25	Int. of Rt. U.S.1 & Pembroke Rd.	6.5-10.0	11.0-11.5	NF	0.0
26	Cypress Rd. just south of Atlantic Blvd.	6.5-10.0	10.5-11.5	NF	NF
27	Int. of Rt. I-95 & Rt. 810	6.5-10.0	10.5-11.5	NF	NF

NF = No flooding at this road point

BROWARD COUNTY
ROADWAY POINT PRE-LANDFALL HAZARDS TIME

POINT NO.	LOCATION OF POINT	TIME OF ARRIVAL (IN HOURS BEFORE EYE LANDFALL) OF Gale Force Winds CAT. 1-3	Gale Force Winds CAT. 4-5	Surge Inundation CAT. 1-3	Surge Inundation CAT. 4-5
28	Rt. I-95 just south of Copans Rd.	6.5-10.0	10.5-11.5	NF	NF
29	Int. of Rt. I-95 & Oakland Park Blvd.	6.5-10.0	10.5-11.5	NF	NF
30	Int. of Rt. I-95 & Davie Blvd.	6.5-10.0	11.0-11.5	NF	NF
31	Int. of Rt. I-95 & Hollywood Blvd.	6.5-10.0	10.5-11.5	NF	NF
32	Int. of Rt. 810 & Powerline Rd.	6.5-10.0	10.5-11.5	NF	NF
33	Int. of Coconut Creek Parkway & Powerline Rd.	6.5-10.0	10.5-11.5	NF	NF
34	Powerline Rd. north of 52nd St.	6.5-10.0	10.5-11.5	NF	NF
35	Int. of Commercial Blvd. & Prospect Rd.	6.5-10.0	10.5-11.5	NF	NF
36	Int. of Floridas Turnpike & Sample Rd.	6.5-10.0	10.5-11.5	NF	NF
37	Floridas Turnpike near Margate Estates	6.5-10.5	10.5-11.5	NF	NF
38	Int. of Oakland Park Blvd. & N.W. 31st Ave.	6.5-10.5	10.5-11.5	NF	NF
39	Int. of Rt. 441 & Commercial Blvd.	6.5-10.5	10.5-11.5	NF	NF
40	Oakland Park Blvd. near Lauderdale Lakes	6.5-10.5	10.5-11.5	NF	NF
41	Int. of Floridas Turnpike & Sunrise Blvd.	6.5-10.5	10.5-11.5	NF	NF
42	Int. of Rt. 441 & Broward Blvd.	6.5-10.5	10.5-11.5	NF	NF
43	Int. of Rt. 441 & Orange Dr.	6.5-10.0	11.0-11.5	NF	NF
44	Int. of Rt. 441 & Sheridan St.	6.5-10.0	11.0-11.5	NF	NF
45	Int. of Pembroke Rd. & Rt. 441	6.5-10.0	11.0-11.5	NF	NF
46	Int. of Floridas Turnpike & Sterling Rd.	6.5-10.0	11.0-11.5	NF	NF
47	Int. of Floridas Turnpike & Rt. 84	6.5-10.5	10.5-11.5	NF	NF

NF = No flooding at this road point

PALM BEACH COUNTY
ROADWAY POINT PRE-LANDFALL HAZARDS TIMES

Lower Southeast Florida
Hurricane Evacuation Study

POINT NO.	LOCATION OF POINT	TIME OF ARRIVAL (**IN HOURS BEFORE EYE LANDFALL**) OF Gale Force Winds CAT. 1-3	Gale Force Winds CAT. 4-5	Surge Inundation CAT. 1-3	Surge Inundation CAT. 4-5
1	Int. of Rt. 1 & Rt. AIA just north of Little Lake Worth	5.5-9.0	10.5	NF	NF
2	Int. of PGA Blvd. & Rt. 1	5.5-9.0	10.5	NF	NF
3	Ocean Blvd. near Little Munyon Island	5.5-9.0	10.5	NF	NF
4	Ocean Blvd. just south of Lake Worth Inlet	6.5-9.5	10.5-11.5	NF	NF
5	Int. of County Rd. & Ocean Blvd.	6.5-9.5	10.5-11.5	NF	NF
6	Rt. 1 south of RCA Blvd.	5.5-9.0	10.5	NF	NF
7	Rt. 1 near Lake Park	5.5-9.0	10.5	NF	NF
8	Int. of Rt. 1 & Blue Heron Blvd. (near Riviera Beach)	5.5-9.0	10.5	NF	NF
9	Broadway Ave. just north of 45th St.	6.5-9.5	10.5-11.5	NF	NF
10	Prosperity Farms Rd. just north of PGA Blvd.	5.5-9.0	10.5	NF	NF
11	Int. of Prosperity Farms Rd. & PGA Blvd.	5.5-9.0	10.5	NF	NF
12	Int. of Prosperity Farms Rd. & RCA Blvd.	5.5-9.0	10.5	NF	NF
13	Int. of Lake Park Rd. & Prosperity Farms Rd.	5.5-9.0	10.5	NF	NF
14	Alt. Rt. A1A near Hood Rd.	5.5-9.0	10.5	NF	NF
15	Int. of Alt Rt. A1A & PGA Blvd.	5.5-9.0	10.5	NF	NF
16	Int. RCA Blvd. & Alt. Rt. A1A	5.5-9.0	10.5	NF	NF
17	Int. of Park Ave. & Florida East Coast Railroad	5.5-9.0	10.5	NF	NF
18	Int. of Blue Heron Blvd. & Florida East Coast Railroad	6.5-9.5	10.5-11.5	NF	NF
19	Int. of 8th St. & Florida East Coast Railroad	6.5-9.5	10.5-11.5	NF	NF
20	Int. of 45th St. & Florida East Coast Railroad (near Magnolia Park)	6.5-9.5	10.5-11.5	NF	NF
21	Rt. I-95 near Palm Beach Gardens	5.5-9.0	10.5	NF	NF
22	Rt. I-95 near 8th St.	6.5-9.5	10.5-11.5	NF	NF
23	Int. of Floridas Turnpike & Hood Rd.	5.5-9.0	10.5	NF	NF
24	Int. of Floridas Turnpike & Lake Park Rd.	5.5-9.0	10.5	NF	NF

NF = No flooding at this road point

PALM BEACH COUNTY
ROADWAY POINT PRE-LANDFALL HAZARDS TIMES

POINT NO.	LOCATION OF POINT	TIME OF ARRIVAL (**IN HOURS BEFORE EYE LANDFALL**) OF Gale Force Winds CAT. 1-3	Gale Force Winds CAT. 4-5	Surge Inundation CAT. 1-3	Surge Inundation CAT. 4-5
25	Floridas Turnpike near Military Park	6.5-9.5	10.5-11.5	NF	NF
26	Military Trail south of PGA Blvd.	5.5-9.0	10.5	NF	NF
27	Int. of 45th St. & Military Trail	6.5-9.5	10.5-11.5	NF	NF
28	Int. of 45th St. & Seaboard Coast Line Railroad	6.5-9.5	10.5-11.5	NF	NF
29	Ocean Blvd. near Palm Beach	6.5-9.5	10.5-11.5	NF	NF
30	Ocean Blvd. near Pinner Island	6.5-9.5	10.5-11.5	NF	NF
31	Int. of Ocean Blvd. & Okeechobee Rd.	6.5-9.5	10.5-11.5	NF	NF
32	Int. of Ocean Blvd. & Lake Worth Rd.	6.5-9.5	10.5-11.5	NF	NF
33	Ocean Blvd. near South Palm Beach	6.5-9.5	10.5-11.5	NF	1.0-1.5
34	Ocean Blvd. at Ocean Ridge	6.5-9.5	10.5-1.5	NF	NF
35	Int. Broadway Ave. & Dixie Highway	6.5-9.5	10.5-11.5	NF	NF
36	Int. of Dixie Highway & Okeechobee Rd.	6.5-9.5	10.5-11.5	NF	NF
37	Int. of Dixie Highway & Southern Blvd.	6.5-9.5	10.5-11.5	NF	NF
38	Int. of Lake Worth Rd. & Dixie Highway	6.5-9.5	10.5-11.5	NF	NF
39	Int. of Dixie Highway & Lantana Rd.	6.5-9.5	10.5-11.5	NF	NF
40	Int. Dixie Highway & Boyton Beach Rd.	6.5-9.5	10.5-11.5	NF	NF
41	Int. of Olive Ave. & Southern Blvd.	6.5-9.5	10.5-11.5	NF	NF
42	Int. of Palm Beach Lakes Blvd. & Seaboard Coast Line Railroad	6.5-9.5	10.5-11.5	NF	NF
43	Int. of Rt. I-95 & Palm Beach Lakes Blvd.	6.5-9.5	10.5-11.5	NF	NF
44	Int. of Ft. I-95 & Southern Blvd.	6.5-9.5	10.5-11.5	NF	NF
45	Int. of Rt. I-95 & Hypoluxo Rd.	6.5-9.5	10.5-11.5	NF	NF
46	Congress Ave. near Glenridge	6.5-9.5	10.5-11.5	NF	NF
47	Int. of Congress Ave & Lake Worth Rd.	6.5-9.5	10.5-11.5	NF	NF
48	Int. of Congress Ave. & Boynton Beach Rd.	6.5-9.5	10.5-11.5	NF	NF
49	Int. of Military Trail & Southern Blvd.	6.5-9.5	10.5-11.5	NF	NF
50	Int. of Military Trail & Lake Worth Rd.	6.5-9.5	10.5-11.5	NF	NF
51	Int. of Military Trail & Hypoluxo Rd.	6.5-9.5	10.5-11.5	NF	NF
52	Floridas Turnpike crossing over Belvedere Rd.	6.5-9.5	10.5-11.5	NF	NF

NF = No flooding at this road point

PALM BEACH COUNTY
ROADWAY POINT PRE-LANDFALL HAZARDS TIMES

POINT NO.	LOCATION OF POINT	TIME OF ARRIVAL (**IN HOURS BEFORE EYE LANDFALL**) OF Gale Force Winds CAT. 1-3	Gale Force Winds CAT. 4-5	Surge Inundation CAT. 1-3	Surge Inundation CAT. 4-5
53	Int. of Military Trail & Okeechobee Rd.	6.5-9.5	10.5-11.5	NF	NF
54	Int. of Lantana Rd. & Congress Ave.	6.5-9.5	10.5-11.5	NF	NF
55	Int. of Military Trail & Lowson Blvd.	6.5-10.0	10.5-11.5	NF	NF
56	Int. of Military Trail & Yamato Rd. (near University Park)	6.5-10.0	10.5-11.5	NF	NF
57	W. Atlantic Blvd. near Ocean Blvd.	6.5-10.0	10.5-11.5	NF	NF
58	Ocean Blvd. at Highland Beach	6.5-10.0	10.5-11.5	NF	NF
59	Int. Ocean Blvd. & Palmetto Park Rd.	6.5-10.0	10.5-11.5	NF	NF
60	Int. of Dixie Highway & Yamato Rd. (near Boca Raton)	6.5-10.0	10.5-11.5	NF	NF
61	Int. of Dixie Highway & Camino Real Rd.	6.5-10.0	10.5-11.5	NF	NF
62	Int. of N.E. 80th St. & Rt. 1	6.5-10.0	10.5-11.5	NF	NF
63	Rt. I-95 near Lake Ida	6.5-10.0	10.5-11.5	NF	NF
64	Int. Congress Ave. & West Atlantic Ave.	6.5-10.0	10.5-11.5	NF	NF
65	Boca Raton Rd. at Floridas Turnpike	6.5-10.0	10.5-11.5	NF	NF
66	Camino Real Rd. at Rt. I-95 (near Royal Oak Hills)	6.5-10.0	10.5-11.5	NF	NF

NF = No flooding at this road point

APPENDIX G

Hurricane Evacuation Plan
Behavioral Survey

APPENDIX G

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APPENDIX G

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INTRODUCTION

The Behavioral Survey Task is a key portion of the Southeast Florida Hurricane Evacuation Plan. This survey provides data to other plan elements, particularly the Transportation Analysis.

A total of 3,000 households in Monroe, Dade, Broward, and Palm Beach Counties participated in the telephone survey. Respondents were asked a series of questions about their present attitudes and future intended actions regarding response to governmental evacuation orders, evacuation destinations, specialized transportation needs, previous hurricane experience, and related issues. The results of the survey were then coded and analyzed by computer. The results of the computer analysis will assist the implementing agencies in planning shelter needs and capacities, the timing of evacuation orders, educational programs, and other measures.

The Behavioral Survey consisted of the following six steps:

1. Survey questionnaire design
2. Determination of sample characteristics
3. Survey execution
4. Computer compilation
5. Analysis of results
6. Preparation of report.

SURVEY QUESTIONNAIRE DESIGN

The questionnaire for the telephone survey was developed in four steps:

1. Prototype questionnaire design
2. Preliminary revisions
3. Review with workshops
4. Final revisions.

The prototype questionnaire was based almost entirely from the questionnaire used for the Tampa Bay Region Study. Preliminary revisions were then made in the prototype questionnaire by the U.S. Army Corps of Engineers and Post, Buckley, Schuh & Jernigan, Inc. The revisions were made to adapt the questionnaire to the specific information needs for developing a hurricane evacuation plan in southeast Florida. This preliminary questionnaire was then presented and reviewed with members of the Regional Disaster Preparedness Committee and at workshops in Monroe County. Included in the workshops were local officials, county officials, and the general public. The purpose of the workshops was to determine if any special issues or concerns needed to be addressed in the telephone survey. Based on the workshops and data analysis requirements, final revisions were made in the questionnaire. Shown in Figure D-1 is the final form of the questionnaire used for the telephone survey.

DETERMINATION OF SAMPLE CHARACTERISTICS

The survey study area for the region comprised those areas in each county which earlier modeling in this study indicated would be flooded under a Category 3 hurricane. A total of 3,000 telephone interviews for the four-county region was decided upon. The distribution was based on affected population and also on the goal of obtaining a 95 percent confidence level for the results in each county. The number of surveys for each county is shown in Table G-1.

Table G-1

DISTRIBUTION OF SAMPLE

County	Number of Completed Interviews
Monroe	600
Dade	1,200
Broward	800
Palm Beach	400
Total	3,000

Within each county, the surveys were also proportionately distributed based on affected population. The procedure in each county differed slightly for various reasons, as explained in the following sections.

Monroe County

For the purposes of the Behavioral Survey, Monroe County was divided into two sections:

TELEPHONE INTERVIEW FORM
FOR
HURRICANE EVACUATION BEHAVIORAL SURVEY

1 2 3

Date of attempt ______________________
Time of attempt ______________________
Result of attempt ______________________
Person & time to call back ______________________

(INTERVIEWER: IF INITIAL RESPONDENT IS APPARENTLY AN ADULT AND, THEREFORE, POSSIBLY DESIRED RESPONDENT: THAT IS: HEAD OF HOUSEHOLD OR DECISION MAKER AS TO WHAT TO DO BEFORE A HURRICANE, CONTINUE: OTHERWISE, MAKE APPOINTMENT TO CALL BACK AT A TIME RESPONDENT CAN BE REACHED.)

INTRODUCTION: "Hello, my name is ____________________. I am calling for the Civil Defense Director in (USE RESPONDENT'S HOME COUNTY) ______________. May I speak to the head of your home?" (INTERVIEWER, IF PERSON WITH WHOM YOU ARE SPEAKING IS DESIRED RESPONDENT, CONTINUE WITH . . . "We are conducting a survey to get reactions to what persons would do if a hurricane should strike. I hope you saw the announcement in the newspaper. The purpose of the survey is to gather data that will be used to prepare an evacuation plan. Your answers to the following questions will be an important part of that plan.

1. Do you live in an:

   a. Apartment or condominium building
      -4 or more floors high ( )
      -Less than 4 floors high ( )
   b. Mobile home ( )
   c. Single-family home ( )
   d. Other ______________ ( )

2. How many people live in your home including yourself?

   ____
   (Number)

3. How many motor vehicles do you have at home? ________
   (IF NONE, SKIP TO 5) (Number)

4. (IF THERE ARE VEHICLES, ASK) How many motor vehicles would you use should you be asked to evacuate? ________
   (Number)

   (SKIP QUESTION 5 - GO TO QUESTION 6)

5. How many people in your home would require transportation such as a bus or taxi should you be asked to evacuate?

   ____
   (Number)

Figure G-1

6. If everyone is home and you were ordered by a governmental authority to evacuate due to an approaching hurricane, would you:

a. Have left before the evacuation order was issued ( )
b. Leave immediately after the evacuation order ( )
c. Leave ( ) hours after the evacuation order
d. Stay and not leave ( )

7. After leaving would you:

a. Go to the home of a friend or relative ( ) Yes ( ) No
b. Look for a hotel or motel room ( ) Yes ( ) No
c. Go to a Red Cross Shelter ( ) Yes ( ) No
d. Don't know where you would go? ( )
(DON'T READ DON'T KNOW)

(IF YES TO a. OR b. ABOVE, ASK FOR LOCATION)
(MENTION RESPONDENT'S HOME COUNTY FIRST)

Dade County ( ) Palm Beach County ( )
Broward County ( ) Monroe County ( )
Out of Region ( )

(TRY TO GET A STREET ADDRESS, INCLUDING CITY OR COUNTY
IF "DON'T KNOW ADDRESS", TRY TO GET A GENERAL ADDRESS
SUCH AS NEARBY -- MAJOR INTERSECTION OR BLOCK)

(IF MONROE COUNTY RESIDENT ANSWERS YES TO c. ABOVE , ASK FOR LOCATION)

Monroe County ( ) Broward County ( )
Dade County ( ) Palm Beach County ( )

8. Have you ever lived in South Florida during the direct hit of a major hurricane?

Yes ( ) (IF "YES" ASK QUESTIONS 9, 10, AND 11)
No ( )

9. What year was that, please __________

10. What was the storm's name ________________

11. Did you evacuate? ( ) Yes ( ) No

12. Are you a seasonal or year-round resident at this address?
( )Seasonal ( ) Year-round

13. And I understand that your address is:

Thank you for your help!

INTERVIEWER'S INTITIALS _________

1. Lower Keys
2. Upper Keys.

The Lower Keys consist of those Keys west of and including Big Pine Key. The Upper Keys are those located east of Big Pine Key. The 600 surveys allotted to Monroe County were divided equally between the two sections. This allocation was not exactly proportional to population, since the Lower Keys have 60 percent of the population. The reason for using this procedure was to obtain a statistically significant sample for the Upper Keys.

The 300 surveys in each section were divided among telephone exchanges based on the relative populations in each exchange area. For each telephone exchange, the required number of surveys was obtained by scanning through the Monroe County Telephone Directory and marking every tenth number for calling.

Dade County

In Dade County the 1,200 telephone interviews were distributed among telephone districts flooded in a Category 3 hurricane based on the populations in each district. The basic procedure was as follows:

1. Determine which telephone exchange districts would have more then 50 percent of their surface area flooded in a Category 3 storm (for survey planning purposes, these districts were considered totally flooded).

2. Determine estimated 1980 population of each of the telephone exchange districts flooded in a Category 3 hurricane.

3. Distribute 1,200 interviews among the telephone exchange districts using the following formula:

$$TCi = \frac{1200 \times Pi}{Pt}$$

where,

TC_i = Number of surveys to be made in telephone exchange district i

P_i = Population of telephone exchange district i

P_t = Total population of telephone exchange districts flooded in a Category 3 hurricane

4. Draw desired sample from each telephone exchange by dialing telephone numbers obtained from cross-reference telephone directories which list telephone numbers by exchange at random interval.

Broward County

In Broward County, the 800 interviews were distributed among the telephone exchange districts that contained traffic analysis zones flooded in a Category 3 hurricane. This modification of the procedure used in Dade County was necessary because the extent of flooding in Broward would be much less than in Dade during a Category 3 hurricane. The basic procedure was as follows:

1. Determine which telephone exchange districts had traffic analysis zones flooded in a Category 3 hurricane.

2. Aggregate the 1980 population of the traffic analysis zones flooded in a Category 3 hurricane in each telephone exchange district.

3. Determine the number of surveys for each telephone exchange district using the following formula:

$$TC_i = \frac{800 \times Si}{S_t}$$

where,

TC_i = Number of surveys to be made in telephone exchange district i

S_i = Sum of population of flooded traffic analysis zones in telephone exchange district i.

S_t = Sum of population of flooded traffic analysis zones in Broward County

4. For each telephone exchange district, determine which telephone exchanges are prevalent in the areas flooded in a Category 3 hurricane and use only those telephone exchanges for the survey.

5. Draw desired sample from each telephone exchange by dialing telephone numbers obtained from cross-reference telephone directories at random interval.

Palm Beach County

In Palm Beach County, the 400 interviews were distributed among traffic analysis zones flooded in a Category 3 hurricane based on population. Because the extent of flooding was the most geographically limited of all four counties, in Palm Beach County the procedure was as follows:

1. Determine which traffic analysis zones would be flooded in a Category 3 hurricane.

2. Determine the 1980 estimated population for each flooded traffic analysis zone flooded in a Category 3 hurricane.

3. Distribute the 400 surveys among traffic analysis zones flooded in a Category 3 hurricane using the following formula:

$$TC_i = \underline{400 \times Pi} \qquad P_t$$

where,

TC_i = number of surveys to be made in flooded traffic analysis zone i,

P_i = Population of traffic analysis zone

P_t = Total population of all flooded traffic analysis zones in Palm Beach County.

4. Distribute the surveys for each traffic analysis zone among the flooded streets in that zone.

5. For any street assigned more than one-third the total number of telephone numbers listed for that street, reassign the appropriate number of calls to a neighboring flooded street using the cross-reference telephone directory. The cross-reference telephone directory for Palm Beach County is cross-referenced by street and name.

6. Use a skip-interval method to select the telephone numbers to call from each street. The skip-interval is based on the ratio of numbers to be called to the total telephone numbers on the street.

SURVEY EXECUTION

Prior to the initiation of the telephone survey, television stations and newspapers throughout the region were contacted and informed about the Hurricane Evacuation Plan and the upcoming Behavioral Survey. To gain cooperation, the media were solicited to advise the public-at-large about the purpose and importance of the Behavioral Survey. The telephone calls were then made from Tampa, Florida between November 11 and December 2, 1981 by Gulf Coast Research, an experienced public opinion research firm.

The required 3,000 telephone surveys were completed with no significant problems. Up to three call-backs were placed before the abandonment of a potential respondent. The call-back procedure was used to minimize bias in

1. Do you live in an:

a. Apartment or condominium building -4 or more floors high ( ) -less than 4 floors high ( ) b. Mobile home ( ) c. Single-family home ( ) d. Other ________________ ( )

Responses to this question provide data that are applied in varying ways throughout the study. Household type is a key variable used in understanding and predicting automobile ownership and use, both of which are important elements in the transportation and evacuation planning portions of the Hurricane Evacuation Plan. Mobile home information is also important for the transportation analysis and in planning for public shelters, as all mobile homes must be evacuated during a hurricane evacuation. Finally, an inventory of households in flood-prone areas located in buildings four floors or higher provides information that is invaluable when analyzing vertical evacuation as a hurricane preparedness and evacuation alternative.

As shown in Table G-2, the predominant type of dwelling unit in the survey area is the single-family home. The second most common type of dwelling unit is apartments and condominiums (35.6 percent), over half of which are four or more stories high.

Table G-2

DWELLING UNIT CHARACTERISTICS

REGIONWIDE

Type of Dwelling Unit	Percent	Confidence Interval
Apartment or Condominium:		
Four or more stories high	18.9	17.5 - 20.3
Less than four stories high	16.7	15.4 - 18.0
Mobile Home	7.5	6.5 - 8.5
Single Family Home	53.2	51.4 - 55.0
Other 1/	3.7	3.0 - 4.3

1/ Boathouses, boatels, etc.

Questions 2 through 5 obtain information about other household characteristics including the number of people within the household unit, the availability and use of personal transportation, and the need for transportation assistance:

2. How many people live in your home, including yourself? ____________

(Number)

3. How many motor vehicles do you have at home? ____________ (IF NONE, SKIP TO 5) (Number)

4. (IF THERE ARE VEHICLES, ASK) How many motor vehicles would you use should you be asked to evacuate? ____________ (Number)

5. How many people in your home would require transportation such as a bus or taxi should you be asked to evacuate? ____________ (Number)

In modeling travel behavior during an evacuation, it is critical to have a realistic estimate of the number of vehicles that will actually enter the street network. Average household size figures aid in estimating the evacuating population and in programming public shelter capacities. Information regarding individuals needing public transportation provides planning data and highlights the significance of heightened public awareness and involvement in aiding elderly and handicapped individuals during an evacuation.

As shown in Table G-3, the average number of people per household in the region is 2.57 and each household has an average of 1.41 motor vehicles. In a hurricane evacuation, the average number of motor vehicles used per household is .99, meaning that 70.2 percent of the vehicles in the evacuation area would be used. The results of the survey also show that 18.1 percent of the households surveyed in the region include people needing public transportation at a time of evacuation. This portion of the population includes those households that do not have an automobile (10.8 percent) as well as those households containing individuals requiring public transportation assistance due to ill health and other circumstances. The average number of people needing public transportation in those households that require assistance is 1.89, while the average among all households sampled is 0.34. These numbers are derived by comparing the total number of people needing public transportation first with the number of households requiring assistance and, second, with the total number of households sampled. These numbers provide a basis from which local Disaster Preparedness and Civil Defense officials can project the need for public transportation assistance in the event of a hurricane evacuation.

Table G-3

HOUSEHOLD CHARACTERISTICS

REGIONWIDE

Characteristic	Average	Confidence Interval
Number of People	2.57	2.52 - 2.62
Number of Motor Vehicles	1.41	1.38 - 1.44
Number of Motor Vehicles used in an Evacuation	0.99	.94 - 1.04
Number of Households with People Needing Public Transportation	542	
Percent of Households Sampled	18.1	17.9 - 18.4
Number of People Needing Public Transportation	1,023	
Average per Household Only in Households Needing Public Transportation	1.89	1.78 - 1.99
Number of People Needing Public Transportation by Household, Areawide	0.34	.31 - .37

Questions 6 and 7 study how those surveyed intend to respond to an evacuation order and their destinations, should an evacuation occur:

6. If everyone is home and you were ordered by a governmental authority to evacuate due to an approaching hurricane, would you:

   a. Have left before the evacuation order was issued ( ) b. Leave immediately after the evacuation order ( ) c. Leave ( ) hours after the evacuation order d. Stay and not leave ( )

7. After leaving would you:

   a. Go to the home of a friend or relative ( ) Yes ( ) No b. Look for a hotel or motel room ( ) Yes ( ) No c. Go to a Red Cross shelter ( ) Yes ( ) No d. Don't know where you would go ( )

   (DON'T READ DON'T KNOW)

   (IF YES TO a. OR b. ABOVE, ASK FOR LOCATION) (MENTION RESPONDENT'S HOME COUNTY FIRST)

Dade County ( ) Palm Beach County ( ) Broward County ( ) Monroe County ( ) Out of Region ( )

(TRY TO GET A STREET ADDRESS, INCLUDING CITY OR COUNTY IF "DON'T KNOW ADDRESS", TRY TO GET A GENERAL ADDRESS SUCH AS NEARBY -- MAJOR INTERSECTION OR BLOCK)

(IF MONROE COUNTY RESIDENT ANSWERS YES TO c. ABOVE, ASK FOR LOCATION)

Monroe County ( ) Broward County ( ) Dade County ( ) Palm Beach County ( )

Data gathered from responses to these questions are fundamental to regional transportation modeling and the establishment of ultimate clearance times required to safely evacuate the population-at-risk. Both the number and timing of vehicles entering streets relative to an evacuation order determine congestion along evacuation routes and, consequently, overall clearance times.

Evacuation destinations are significant for modeling the distance and period of time necessary to complete evacuation from generalized points of origin to generalized points of destination. By comparing existing public shelter capacities with questionnaire results that project demand for shelter space, shelter planning and implementation programs can be designed to realistically meet shelter needs should a hurricane evacuation become necessary.

Table G-4 shows that, if an evacuation order were given, 48.6 percent of the households would evacuate immediately and 20.6 percent would have left before the order were given. For the 4.5 percent who would wait a certain number of hours, the average time before leaving would be 2.3 hours. The survey also showed that 26.3 percent of the households would not leave, despite the evacuation order. Table G-5 shows that 23.1 percent of the households would go to a Red Cross shelter when they evacuated and 38.9 percent would go either to the home of a friend, to a motel, or to a hotel.

Table G-4

EVACUATION ORDER RESPONSES

REGIONWIDE

Response	Percent	Confidence Interval
Before Order	20.6	19.1 - 31.2
Immediately After	48.6	46.8 - 50.4
Certain Number of Hours	4.5	3.8 - 5.2
Stay and Not Leave	26.3	24.7 - 27.9

Table G-5

EVACUATION DESTINATION

REGIONWIDE

Destination	Percent	Confidence Interval
Home of a Friend	28.7	27.1 - 30.3
Hotel or Motel	10.2	9.1 - 11.3
Red Cross Shelter	23.1	21.6 - 24.6
Don't Know	11.2	10.0 - 12.4
Not Evacuating	26.8	25.4 - 28.2

Because the results were not meant to be utilized directly in other elements of the Hurricane Evacuation Plan, this group of questions serves a different purpose than those preceding it in the Behavioral Survey. These questions were asked principally to determine whether the affected public has a true perception of its own previous experience with hurricanes and to interpret whether these experiences and perceptions will affect future hurricane preparedness and evacuation efforts.

The results show that area residents have a significant misperception about previous hurricane experience, frequently believing that they have encountered the direct hit of a major storm when they have not. This is largely attributable to the widespread belief that tropical storms David and Dennis, both of which affected south Florida in recent years, were storms of hurricane intensity. This prevailing public misperception is significant because a sizable portion of the people who would be vulnerable in the next hurricane believe that they have gone through a hurricane without evacuation and are now reluctant or complacent about evacuation in the future. The Behavioral Survey also shows that more respondents who believe that they had experienced a hurricane would evacuate during a future hurricane threat than had actually done so during past threats.

These results prompt concern that prevailing public misperceptions about hurricane experience may diminish the ability of the affected population to respond at a time of risk, thereby unnecessarily increasing the threat to life and injury. Public education programs should be directed toward reversing these misunderstandings and impressing upon the public the importance of preparedness and organized response during hurricane emergencies.

Table D-6 shows that 50.7 percent of the households surveyed believe they have been in the direct hit of a hurricane in south Florida. Cross-checking with other responses showed that only 33.4 percent of the population had actually been in a direct hit. Table G -6 also shows that only 24.0 percent of those who believe they were in a hurricane actually evacuated.

Table G-6

PREVIOUS HURRICANE EXPERIENCE

REGIONWIDE

Question	Percent
Lived in south Florida during direct hit of hurricane?	50.7
If yes, did you evacuate?	24.0
Actually experienced direct hit of a hurricane	33.4

Question 12 inquires into the respondent's tenure of residency:

12. Are you a seasonal or year-round resident at this address?
( ) Seasonal ( ) Year-round

Thank you for your help!

In designing the survey questionnaire, it was determined that it would be preferable to isolate year-round residents for sampling because most seasonal residents are not in south Florida during hurricanes and, therefore, are not subject to evacuation. The survey method proved successful in sampling a very high proportion of year-round residents. On a regionwide basis, 91.1 percent of the 3,000 respondents maintain year-round local residency.

Monroe County

Question 1 on the Telephone Interview Form sought information regarding the proportionate mix of housing types occupied in the study area:

1. Do you live in an:

a. Apartment or condominium building -4 or more floors high ( ) -less than 4 floors high ( ) b. Mobile home ( ) c. Single-family home ( ) d. Other ________________ ( )

Responses to this question provide data that are applied in varying ways throughout the study. Household type is a key variable used in understanding and predicting automobile ownership and use, both of which are important elements in the transportation and evacuation planning portions of the Hurricane Evacuation Plan. Mobile home information is also important for the transportation analysis and in planning for public shelters, as all mobile homes must be evacuated during a hurricane evacuation. Finally, an inventory of households in flood-prone areas located in buildings four floors or higher provides information that is invaluable when analyzing vertical evacuation as a hurricane preparedness and evacuation alternative.

Table G-7 shows that the predominant type of housing is the single family home. The second most common type of dwelling unit is the mobile home. The percentage of mobile homes is much higher than in any other county in the region. There are also fewer apartments and condominiums than in the other counties.

Table G-7

DWELLING UNIT CHARACTERISTICS

MONROE COUNTY

	Percent					
Type of Dwelling Unit	County	Confidence Interval	Lower Keys	Confidence Interval	Upper Keys	Confidence Interval
Apartment or Condominium						
Four or more stories high	5.0	(3.2- 6.8)	5.7	(2.9- 8.5)	4.3	(1.8- 6.8)
Less than four stories high	9.7	(7.3-12.1)	7.3	(4.2-10.4)	12.0	(8.2-15.8)
Mobile Home	25.5	(21.9-29.1)	20.0	(15.3-24.7)	31.0	(25.6-36.4)
Single Family Home	53.8	(49.7-57.9)	62.7	(57.1-68.3)	45.0	(39.2-50.8)
Other 1/	6.0	(4.0- 8.0)	4.3	(1.8- 6.8)	7.7	(4.5-10.9)

1/ Boathouse, boatels, etc.

Questions 2 through 5 obtain information about other household characteristics, including the number of people within the household unit, the availability and use of personal transportation, and the need for transportation assistance:

2. How many people live in your home, including yourself? ________

(Number)

3. How many motor vehicles do you have at home? ________
(IF NONE, SKIP TO 5) (Number)

4. (IF THERE ARE VEHICLES, ASK) How many motor vehicles would you use should you be asked to evacuate? ________
(Number)

5. How many people in your home would require transportation such as a bus or taxi should you be asked to evacuate? ________
(Number)

In modeling travel behavior during an evacuation, it is critical to have a realistic estimate of the number of vehicles that will actually enter the street network. Average household size figures aid in estimating the evacuating population and in programming public shelter capacities. Information regarding individuals needing public transportation provides planning data and highlights the significance of heightened public awareness and involvement in aiding elderly and handicapped individuals during an evacuation.

As shown in Table G-8, the average number of people per household in the county is 2.46 and each household has an average of 1.59 motor vehicles. In a hurricane evacuation, the average number of motor vehicles used per household is 1.05, meaning that 66.0 percent of the vehicles in the evacuation area would be used. The results of the survey also show that 12.5 percent of the households surveyed in Monroe County include people needing public transportation at a time of evacuation. This portion of the population includes those households that do not have an automobile (4.3 percent) as well as those households containing individuals requiring public transportation assistance due to ill health and other circumstances. The average number of people needing public transportation in those households that require assistance is 1.97 while the average among all households sampled is 0.25. These numbers are derived by comparing the total number of people needing public transportation first with the number of households requiring assistance and, next, with the total number of households sampled. These numbers provide a basis from which local Disaster Preparedness and Civil Defense Officials can project the need for public transportation assistance in the event of a hurricane evacuation.

Table G-8

HOUSEHOLD CHARACTERISTICS

MONROE COUNTY

Characteristic	Average County	Confidence Interval	Average Lower Keys	Confidence Interval	Average Upper Keys	Confidence Interval
Number of People	2.46	(2.36-2.56)	2.62	(2.46-2.78)	2.30	(2.19-2.41)
Number of Motor Vehicles	1.59	(1.51-1.67)	1.53	(1.42-1.64)	1.64	(1.53-1.75)
Number of Motor Vehicles used in an Evacuation	1.05	(1.00-1.10)	0.96	(0.89-1.03)	1.14	(0.97-1.31)
Number of Households with People Needing Public Transportation	75		53		22	
Percent of Households Sampled	12.5	(12.1-12.8)	17.7	(16.9-18.4)	7.3	(7.1-7.5)
Number of People Needing Public Transportation	148		111		37	
Average per Household only in Households Needing Public Transportation	1.97	(1.70-2.24)	2.09	(1.74-2.44)	1.68	(1.30-2.06)
Number of People Needing Public Transportation by Household, Areawide	0.25	(0.19-0.31)	0.37	(0.26-0.48)	0.12	(0.06-0.18)

Questions 6 and 7 study how those surveyed intend to respond to an evacuation order and their destinations, should an evacuation occur:

6. If everyone is home and you were ordered by a governmental authority to evacuate due to an approaching hurricane, would you:

a. Have left before the evacuation order was issued ( ) b. Leave immediately after the evacuation order ( ) c. Leave ( ) hours after the evacuation order d. Stay and not leave ( )

7. After leaving would you:

a. Go to the home of a friend or relative ( ) Yes ( ) No b. Look for a hotel or motel room ( ) Yes ( ) No c. Go to a Red Cross shelter ( ) Yes ( ) No d. Don't know where you would go ( )

(DON'T READ DON'T KNOW)

(IF YES TO a. OR b. ABOVE, ASK FOR LOCATION) (MENTION RESPONDENT'S HOME COUNTY FIRST)

Dade County ( ) Palm Beach County ( ) Broward County ( ) Monroe County ( ) Out of Region ( )

(TRY TO GET A STREET ADDRESS, INCLUDING CITY OR COUNTY IF "DON'T KNOW ADDRESS", TRY TO GET A GENERAL ADDRESS SUCH AS NEARBY -- MAJOR INTERSECTION OR BLOCK)

(IF MONROE COUNTY RESIDENT ANSWERS YES TO c. ABOVE, ASK FOR LOCATION)

Monroe County ( ) Broward County ( ) Dade County ( ) Palm Beach County ( )

Data gathered from responses to these questions are fundamental to regional transportation modeling and the establishment of ultimate clearance times required to safely evacuate the population-at-risk. Both the number and timing of vehicles entering streets relative to an evacuation order determine congestion along evacuation routes and, consequently, overall clearance times. Evacuation destinations are significant for modeling the distance and period of time necessary to complete evacuation from generalized points of origin to generalized points of destination. By comparing existing public shelter capacities to questionnaire results that project demand for shelter space, shelter planning and implementation programs can be designed to realistically meet shelter needs should a hurricane evacuation become necessary.

Table G-9 shows the responses to an evacuation order for the entire county, Lower and Upper Keys. The major difference between the two sections is that 30.7 percent of the households in the Lower Keys would not evacuate, as compared to only 20.7 percent in the Upper Keys. For the 8.8 percent of the households waiting a certain number of hours before evacuating, the average time was 2.7 hours.

Table G-9

EVACUATION ORDER RESPONSES

MONROE COUNTY

	Percent					
Response	County	Confidence Interval	Lower Keys	Confidence Interval	Upper Keys	Confidence Interval
Before Order	29.0	(25.3-32.7)	21.0	(16.2-25.8)	37.0	(31.4-42.6)
Immediately After	36.5	(32.6-40.4)	41.0	(35.3-46.7)	32.0	(26.5-37.5)
Certain Number of Hours	8.8	(6.5-11.1)	7.3	(4.2-10.4)	10.3	(6.7-13.9)
Stay and Not Leave	25.7	(22.1-29.3)	30.7	(25.3-36.1)	20.7	(15.9-25.5)

As shown in Table G-10, 15.8 percent of the households would evacuate to a Red Cross Shelter and 52.4 percent would go to either the home of a friend, to a motel, or to a hotel. The responses in every category are significantly different for the Upper and Lower Keys. Table G -11 shows that, of the households evacuating to the home of a friend, to a motel, or to a hotel, 74 percent would commonly go to Dade County or out of the region. The relative percentages vary between the Lower and Upper Keys.

Table G-10

EVACUATION DESTINATION

MONROE COUNTY

	Percent					
Destination	County	Confidence Interval	Lower Keys	Confidence Interval	Upper Keys	Confidence Interval
Home of a Friend	35.7	(31.8-39.6)	27.3	(22.1-32.5)	44.0	(38.2-49.8)
Hotel or Motel	16.7	(13.6-19.8)	12.3	(8.4-16.2)	21.0	(16.2-25.8)
Red Cross Shelter	15.8	(12.8-18.8)	25.0	(19.9-30.1)	6.7	(3.7- 9.7)
Don't Know	8.3	(6.0-10.6)	6.0	(3.1- 8.9)	10.7	(7.0-14.4)
Not Evacuating	23.5		29.4		17.6	

Table G-11

DESTINATION LOCATIONS

MONROE COUNTY

Destination	Location (Percent)				
Red Cross Shelter	Dade	Broward	Palm Beach	Monroe	Out of Region
County	4.2	--	3.2	91.6	--
Lower Keys	2.7	--	1.3	94.7	--
Upper Keys	10.0	--	10.0	80.0	--
Friend's Home, Motel, or Hotel					
County	43.3	5.4	3.2	16.6	30.6
Lower Keys	28.6	7.6	4.2	26.1	32.8
Upper Keys	52.3	4.1	2.6	10.8	29.2

Questions 8 through 11 on the elephone Interview Form examine the affected population's real or perceived previous hurricane experience while also asking if the respondents had evacuated from their homes during past hurricanes:

8. Have you ever lived in South Florida during the direct hit of a major hurricane?

    Yes (   )   (IF "YES" ASK QUESTIONS 9, 10, AND 11)   No (   )

9. What year was that, please? ______________

10. What was the storm's name? ______________

11. Did you evacuate? (   ) Yes   (   ) No

Because the results were not meant to be utilized directly in other elements of the Hurricane Evacuation Plan, this group of questions serves a different purpose than those preceding it in the Behavioral Survey. These questions were asked principally to determine whether the affected public has a true perception of its own previous experience with hurricanes and to interpret whether these experiences and perceptions will affect future hurricane preparedness and evacuation efforts.

The results show that area residents have a significant misperception about previous hurricane experience, frequently believing that they have encountered the direct hit of a major storm when they have not. This is largely attributable to the widespread belief that tropical storms David and Dennis, both of which affected South Florida in recent years, were storms of hurricane intensity. This prevailing public misperception is significant because a sizable portion of the population that would be vulnerable in the next hurricane believe that they have gone through a hurricane without evacuation and are now reluctant or complacent about evacuation in the future. The Behavioral Survey also shows that more respondents who believe that they had experienced a hurricane would evacuate during a future hurricane threat than had actually done so during past threats.

These results prompt concern that prevailing public misperceptions about hurricane experience may diminish the ability of the affected population to respond at a time of risk, thereby unnecessarily increasing the threat to life and injury. Public education programs should be directed toward reversing these misunderstandings and impressing upon the public the importance of preparedness and organized response during hurricane emergencies.

Table G-12 shows that 50.5 percent of households surveyed in Monroe County believe they had been through the direct hit of a hurricane. Cross-checking with other responses showed that only 36.5 percent had actually experienced a hurricane. Table G -12 also shows that 26.4 percent of the households who believe they were in the direct hit of a hurricane evacuated at the time.

Table G-12

PREVIOUS HURRICANE EXPERIENCE

MONROE COUNTY

Question	Percent County	Percent Lower Keys	Percent Upper Keys
Lived in south Florida during hit of hurricane?	50.5	49.7	51.3
If yes, did you evacuate?	26.4	16.1	36.4
Actually experienced direct hit of a hurricane	36.5	35.6	37.4

Question 12 inquires into the respondent's tenure of residency:

12.
( ) Seasonal ( ) Year-round

Thank you for your help!

In designing the survey questionnaire, it was determined that it would be preferable to isolate year-round residents for sampling because most seasonal residents are not in south Florida during hurricanes and, therefore, are not subject to evacuation. The survey method proved successful in sampling a very high proportion of year-round residents. In Monroe County, 89.3 percent of the 600 respondents maintain year-round local residency.

Monroe County: Summary

From the outset of work on the Southeast Florida Hurricane Evacuation Plan it was understood that Monroe County, because of its geography, is uniquely vulnerable to hurricanes. Flood studies conducted in conjunction with the plan indicated that the entire county population of 64,000 people would be vulnerable in a Category 3 hurricane. In public workshops, residents and government officials of Monroe County indicated that the Upper and Lower Keys should be analyzed separately because of apparent socio-economic differences. The results of the Behavioral Survey did, in fact, show wide differences in the responses of Upper and Lower Keys residents in almost every category analyzed. The average Upper Keys household is likely to contain fewer individuals and more motor vehicles than a given Lower Keys household. Upper Keys residents would use more cars per household in an evacuation effort and more frequently stated their intent to respond before an official governmental request to evacuate has been given. Data gathered from Lower Keys respondents shows a significantly higher need for public transportation assistance, public shelter space, and a greater intention to wait for a governmental order before evacuating or not to evacuate at all. Finally, the survey shows that Upper Keys residents are more likely to evacuate to other counties in the region, particularly Dade County, one of many factors that are considered in the transportation modeling and evacuation planning portions of the plan.

Dade County

Question 1 on the Telephone Interview Form, sought information regarding the proportionate mix of housing types occupied in the study area:

1. Do you live in an:

a. Apartment or condominium building -4 or more floors high ( ) -less than 4 floors high ( ) b. Mobile home ( ) c. Single-family home ( ) d. Other ______________ ( )

Responses to this question provide data that are applied in varying ways throughout the study. Household type is a key variable used in understanding and predicting automobile ownership and use, both of which are important elements in the transportation and evacuation planning portions of the Hurricane Evacuation Plan. Mobile home information is also important for the transportation analysis and in planning for public shelters, as all mobile homes must be evacuated during a hurricane evacuation. Finally, an inventory of households in flood-prone areas located in buildings four floors or higher provides information that is invaluable when analyzing vertical evacuation as a hurricane preparedness and evacuation alternative.

As shown in Table G-13, the predominant type of dwelling unit in the survey area is the single-family home (53.8 percent). The second most common type of dwelling unit is apartments or condominiums. (40.3 percent) These figures are very similar to the regionwide averages. Only 3.5 percent of the households surveyed live in a mobile home.

Table G-13

DWELLING UNIT CHARACTERISTICS
DADE COUNTY

Type of Dwelling Unit	Percent	Confidence Interval
Apartment or Condominium		
Four or more stories high	22.2	19.8 - 24.6
Less than four stories high	18.1	15.9 - 20.3
Mobile Home	3.5	2.4 - 4.6
Single Family Home	53.8	50.9 - 56.7
Other 1/	2.3	1.4 - 3.2

1/ Houseboats, boatels, etc.

Questions 2 through 5 obtain information about other household characteristics, including the number of people within the household unit, the availability and use of personal transportation and the need for transportation assistance:

2. How many people live in your home, including yourself? ________

(Number)

3. How many motor vehicles do you have at home? ________
(IF NONE, SKIP TO 5) (Number)

4. (IF THERE ARE VEHICLES, ASK) How many motor vehicles would you use should you be asked to evacuate? ________
(Number)

5. How many people in your home would require transportation such as a bus or taxi should you be asked to evacuate? ________ (Number)

In modeling travel behavior during an evacuation, it is critical to have a realistic estimate of the number of vehicles that will actually enter the street network. Average household size figures aid in estimating the evacuating population and in programming public shelter capacities. Information regarding individuals needing public transportation provides planning data and highlights the significance of heightened public awareness and involvement in aiding elderly and handicapped individuals during an evacuation.

As shown in Table G-14, the average number of people per household in the county is 2.81 and each household has an average of 1.37 motor vehicles. In a hurricane evacuation, the average number of motor vehicles used per household is .96, meaning that 70.1 percent of the vehicles in the evacuation area would be used. The results of the survey also show that 21.7 percent of the households surveyed in Dade County include people needing public transportation at a time of evacuation. This portion of the population includes those households that do not have an automobile (16.1 percent) as well as those households containing individuals requiring public transportation assistance due to ill health and other circumstances. The average number of people needing public transportation in those households that require assistance is 1.87, while the average among all households sampled is 0.41. These numbers are derived by comparing the total number of people needing public transportation first with the number of households requiring assistance and, second, with the total number of households sampled. These numbers provide a basis from which local Disaster Preparedness and Civil Defense Officials can project the need for public transportation assistance in the event of a hurricane evacuation.

Table G-14

HOUSEHOLD CHARACTERISTICS

DADE COUNTY

Characteristic	Average	Confidence Interval
Number of People	2.81	2.72 - 2.90
Number of Motor Vehicles	1.37	1.31 - 1.43
Number of Motor Vehicles used in an Evacuation	0.96	0.92 - 1.00
Number of Households with People Needing Public Transportation	260	
Percent of Households Sampled	21.7	21.2 - 22.2
Number of People Needing Public Transportation	487	
Average per Household Only in Households Needing Public Transportation	1.87	1.74 - 2.00
Number of People Needing Public Transportation by Household, Areawide	0.41	0.36 - 0.46

Questions 6 and 7 study how those surveyed intend to respond to an evacuation order and their destinations, should an evacuation occur:

6. If everyone is home and you were ordered by a governmental authority to evacuate due to an approaching hurricane, would you:

a. Have left before the evacuation order was issued ( ) b. Leave immediately after the evacuation order ( ) c. Leave ( ) hours after the evacuation order d. Stay and not leave ( )

7. After leaving would you:

a. Go to the home of a friend or relative ( ) Yes ( ) No b. Look for a hotel or motel room ( ) Yes ( ) No c. Go to a Red Cross shelter ( ) Yes ( ) No d. Don't know where you would go ( )

(DON'T READ DON'T KNOW)

(IF YES TO a. OR b. ABOVE, ASK FOR LOCATION) (MENTION RESPONDENT'S HOME COUNTY FIRST)

Dade County ( ) Palm Beach County ( ) Broward County ( ) Monroe County ( ) Out of Region ( )

(TRY TO GET A STREET ADDRESS, INCLUDING CITY OR COUNTY IF "DON'T KNOW ADDRESS", TRY TO GET A GENERAL ADDRESS SUCH AS NEARBY -- MAJOR INTERSECTION OR BLOCK)

(IF MONROE COUNTY RESIDENT ANSWERS YES TO c. ABOVE, ASK FOR LOCATION)

Monroe County ( ) Broward County ( ) Dade County ( ) Palm Beach County ( )

Data gathered from responses to these questions are fundamental to regional transportation modeling and the establishment of ultimate clearance times required to safely evacuate the population-at-risk. Both the number and timing of vehicles entering streets relative to an evacuation order determine congestion along evacuation routes and, consequently, overall clearance times. Evacuation destinations are significant for modeling the distance and period of time necessary to complete evacuation from generalized points of origin to generalized points of destination. By comparing existing public shelter capacities with questionnaire results that project demand for shelter space, shelter planning and implementation programs can be designed to realistically meet shelter needs should a hurricane evacuation become necessary.

Table G15 shows that, if an evacuation order were given, 51.1 percent of the households would evacuate immediately and 18.5 percent would have already left before the order were given. For the 4.5 percent of the households leaving a certain number of hours after the order, the average time is 2.2 hours. The percentage of households that would not leave is 25.9.

Table G-15

EVACUATION ORDER RESPONSES

DADE COUNTY

Response	Percent	Confidence Interval
Before Order	18.5	16.3 - 20.7
Immediately After	51.1	48.2 - 54.0
Certain Number of Hours	4.5	3.3 - 5.7
Stay and Not Leave	25.9	23.4 - 28.4

As shown in Table G 16, 28.2 percent of the households would go to a Red Cross shelter when they evacuated and 34.4 percent would go either to the home of a friend, to a motel, or to a hotel. Table G-17 shows that, of this 34.4 percent, 63.4 percent would remain in Dade County while most of the rest would leave the region. Over 3 percent of the households do not know where they would go when they evacuated.

Table G-16

EVACUATION BY DESTINATION CATEGORY

DADE COUNTY

Destination	Percent	Confidence Interval
Home of a Friend	26.7	24.2 - 29.2
Hotel or Motel	7.7	6.2 - 9.2
Red Cross Shelter	28.2	25.6 - 30.8
Don't Know	10.8	9.0 - 12.6
Not Evacuating	26.6	

Table G-17

DESTINATION LOCATION

EVACUATING TO HOME OF A FRIEND, HOTEL OR MOTEL

DADE COUNTY

Destination Location	Percent	Confidence Interval
Dade	63.4	58.6 - 68.2
Broward	9.0	6.1 - 11.9
Palm Beach	2.7	1.0 - 4.4
Out of Region	21.5	17.3 - 25.7
Don't Know	3.4	

Questions 8 through 11 on the Telephone Interview Form examine the affected population's real or perceived previous hurricane experience while also asking if the respondents had evacuated from their homes during past hurricanes:

8. Have you ever lived in South Florida during the direct hit of a major hurricane?

   Yes ( ) (IF "YES" ASK QUESTIONS 9, 10, AND 11) No ( )

9. What year was that, please? ______________

10. What was the storm's name? ______________

11. Did you evacuate? ( ) Yes ( ) No

Because the results were not meant to be utilized directly in other elements of the Hurricane Evacuation Plan, this group of questions serves a different purpose than those preceding it in the Behavioral Survey. These questions were asked principally to determine whether the affected public has a true perception of its own previous experience with hurricanes and to interpret whether these experiences and perceptions will affect future hurricane preparedness and evacuation efforts.

The results show that area residents have a significant misperception about previous hurricane experience, frequently believing that they have encountered the direct hit of a major storm when they have not. This is largely attributable to the widespread belief that tropical storms David and Dennis, both of which affected south Florida in recent years, were storms of hurricane intensity. This prevailing public misperception is significant because a sizable portion of the people who would be vulnerable in the next hurricane believe that they have gone through a hurricane without evacuation and are now reluctant or complacent about evacuation in the future. The Behavioral Survey also shows that more respondents who believe that they had experienced a hurricane would evacuate during a future hurricane threat than had actually done so during past threats.

These results prompt concern that prevailing public misperceptions about hurricane experience may diminish the ability of the affected population to respond at a time of risk, thereby unnecessarily increasing the threat to life and injury. Public education programs should be directed toward reversing these misunderstandings and impressing upon the public the importance of preparedness and organized response during hurricane emergencies.

Table G-18 shows that 51.5 percent of the households surveyed in Dade County believe they have been through the direct hit of a hurricane in south Florida. Cross-checking with other responses showed that only 32.0

percent had actually been through the direct hit of a hurricane. Table D-18 also shows that, of the 51.5 percent who believe they were in a hurricane, only 18.1 percent evacuated.

Table G-18

PREVIOUS HURRICANE EXPERIENCE

DADE COUNTY

Question	Percent
Lived in south Florida during direct hit of hurricane?	51.5
If yes, did you evacuate?	18.1
Actually experienced direct hit of a hurricane	32.0

Question 12 inquires into the respondent's tenure of residency:

12. Are you a seasonal or year-round resident at this address?
( ) Seasonal ( ) Year-round

Thank you for your help!

In designing the survey questionnaire, it was determined that it would be preferable to isolate year-round residents for sampling because most seasonal residents are not in south Florida during hurricanes and, therefore, are not subject to evacuation. The survey method proved successful in sampling a very high proportion of year-round residents. In Dade County, 95.4 percent of the 1,200 respondents maintain year-round local residency.

Dade County: Summary

In a Category 3 hurricane, there is extensive flooding in Dade County which affects a population of about 600,000. Dade County has a high percentage of apartment dwellers and the highest average household size, which combine to mean that a large number of people would have to be evacuated in a hurricane. Also, in Dade County, the highest percent of vehicles would be used. Adding to the evacuation problems is the large number of households without vehicles and needing public transportation, the result of pockets of elderly persons in the flooded areas. Also of significance, a large percentage of those evacuating would remain in Dade County, creating a high demand for public shelters.

Broward County

Question 1 on the Telephone Interview Form, sought information regarding the proportionate mix of housing types occupied in the study area:

1. Do you live in an:

a. Apartment or condominium building -4 or more floors high ( ) -less than 4 floors high ( ) b. Mobile home ( ) c. Single-family home ( ) d. Other ____________ ( )

Responses to this question provide data that are applied in varying ways throughout the study. Household type is a key variable used in understanding and predicting automobile ownership and use, both of which are important elements in the transportation and evacuation planning portions of the Hurricane Evacuation Plan. Mobile home information is also important for the transportation analysis and in planning for public shelters, as all mobile homes must be evacuated during a hurricane evacuation. Finally, an inventory of households in flood-prone areas located in buildings four floors or higher provides information that is invaluable when analyzing vertical evacuation as a hurricane preparedness and evacuation alternative.

As shown in Table G-19, the predominant type of dwelling unit in the Broward County survey area is apartments or condominiums (50.7 percent). The 50.7 percent is more than 15 percent higher than the regionwide average of 35.6 percent. Approximately 60 percent of the apartments are four or more stories high. The second most prevalent type of dwelling unit is the single-family home (41.3 percent).

Table G-19

DWELLING UNIT CHARACTERISTICS

BROWARD COUNTY

Type of Dwelling Unit	Percent	Confidence Interval
Apartment or Condominium:		
Four or more stories high	30.4	27.1 - 33.7
Less than four stories high	20.2	17.4 - 23.0
Mobile Home	2.8	1.0 - 6.6
Single Family Home	41.3	37.8 - 44.8
Other 1/	5.3	3.7 - 6.9

1/ Houseboats, boatels, etc.

Questions 2 through 5 obtain information about other household characteristics, including the number of people within the household unit, the availability and use of personal transportation, and the need for transportation assistance:

2. How many people live in your home, including yourself? ___________

(Number)

3. How many motor vehicles do you have at home (IF NONE, SKIP TO 5) (Number)

4. (IF THERE ARE VEHICLES, ASK) How many motor vehicles would you use should you be asked to evacuate? ___________ (Number)

5. How many people in your home would require transportation such as a bus or taxi should you be asked to evacuate? ___________ (Number)

In modeling travel behavior during an evacuation, it is critical to have a realistic estimate of the number of vehicles that will actually enter the street network. Average household size figures aid in estimating the evacuating population and in programming public shelter capacities. Information regarding individuals needing public transportation provides planning data and highlights the significance of heightened public awareness and involvement in aiding elderly and handicapped individuals during an evacuation.

As shown in Table G-20, the average number of people per household in the county is 2.37 and each household has an average of 1.24 motor vehicles. In a hurricane evacuation, the average number of motor vehicles used per household is .89, meaning that 71.8 percent of the vehicles in the evacuation area would be used. The results of the survey also show that 21.8 percent of the households surveyed in Broward County include people needing public transportation at a time of evacuation. This portion of the population includes those households that do not have an automobile (11.5 percent) as well as those households containing individuals requiring public transportation assistance due to ill health and other circumstances. The average number of people needing public transportation in those households that require assistance is 1.91, while the average among all households sampled is 0.42. These numbers are derived by comparing the total number of people needing public transportation first with the number of households requiring assistance and, next, with the total number of households sampled. These numbers provide a basis from which local Disaster Preparedness and Civil Defense Officials can project the need for public transportation assistance in the event of a hurricane evacuation.

Table G-20

HOUSEHOLD AVERAGES

BROWARD COUNTY

Characteristic	Average	Confidence Interval
Number of People	2.37	2.27 - 2.47
Number of Motor Vehicles	1.24	1.18 - 1.30
Number of Vehicles Used in an Evacuation	0.89	0.85 - 0.93
Number of Households with People Needing Public Transportation	174	
Percent of Households Sampled	21.8	21.2 - 22.4
Number of People Needing Public Transportation	332	
Average per Household Only in Households Needing Public Transportation	1.91	1.74 - 2.09
Number of People needing Public Transportation by Household, Areawide	0.42	0.35 - 0.48

Questions 6 and 7 study how those surveyed intend to respond to an evacuation order and their destinations, should an evacuation occur:

6. If everyone is home and you were ordered by a governmental authority to evacuate due to an approaching hurricane, would you:

   a. Have left before the evacuation order was issued ( ) b. Leave immediately after the evacuation order ( ) c. Leave ( ) hours after the evacuation order d. Stay and not leave ( )

7. After leaving would you:

a. Go to the home of a friend or relative ( ) Yes ( ) No b. Look for a hotel or motel room ( ) Yes ( ) No c. Go to a Red Cross shelter ( ) Yes ( ) No d. Don't know where you would go ( )

(DON'T READ DON'T KNOW)

(IF YES TO a. OR b. ABOVE, ASK FOR LOCATION) (MENTION RESPONDENT'S HOME COUNTY FIRST)

Dade County ( ) Palm Beach County ( ) Broward County ( ) Monroe County ( ) Out of Region ( )

(TRY TO GET A STREET ADDRESS, INCLUDING CITY OR COUNTY IF "DON'T KNOW ADDRESS", TRY TO GET A GENERAL ADDRESS SUCH AS NEARBY -- MAJOR INTERSECTION OR BLOCK)

(IF MONROE COUNTY RESIDENT ANSWERS YES TO c. ABOVE, ASK FOR LOCATION)

Monroe County ( ) Broward County ( ) Dade County ( ) Palm Beach County ( )

Data gathered from responses to these questions are fundamental to regional transportation modeling and to the establishment of ultimate clearance times required to safely evacuate the population-at-risk. Both the number and timing of vehicles entering streets relative to an evacuation order determine congestion along evacuation routes and, consequently, overall clearance times. Evacuation destinations are significant for modeling the distance and period of time necessary to complete evacuation from generalized points of origin to generalized points of destination. By comparing existing public shelter capacities with questionnaire results that project demand for shelter space, shelter planning and implementation programs can be designed to realistically meet shelter needs should a hurricane evacuation become necessary.

Table G-21 shows that, if an evacuation order were given, over half (54.9 percent) of the households would evacuate immediately, 16.0 percent would have left before the order were given, and 26.7 percent would not evacuate. For the 2.4 percent of the population who would leave a certain number of hours after the order, the average time before leaving would be 2.1 hours. The evacuation order responses for Broward County were similar to the regionwide averages, with a less than 7 percent difference in all categories.

Table G-21

EVACUATION ORDER RESPONSES

BROWARD COUNTY

Response	Percent	Confidence Interval
Before Order	16.0	13.4 - 18.6
Immediately	54.9	51.4 - 58.4
Certain Number of Hours	2.4	1.30 - 3.5
Stay and Not Leave	26.7	23.6 - 29.8

As shown in Table G-22, 22.9 percent of the households would go to a Red Cross shelter when they evacuate and 36.1 percent of the households would go either to the home of a friend, to a motel, or to a hotel. Table G -23 shows that, of the 36.1 percent, 56.7 percent would not leave Broward County, 35.6 percent would leave the region, and the remainder would go to either Palm Beach or Dade County.

Table G-22

EVACUATION BY DESTINATION CATEGORY

BROWARD COUNTY

Destination	Percent	Confidence Interval
Home of a Friend	29.5	26.3 - 32.7
Hotel or Motel	6.6	4.8 - 8.4
Red Cross Shelter	22.9	20.0 - 26.0
Don't Know	12.9	10.5 - 15.3
Not Evacuating	28.0	

Table G-23

DESTINATION LOCATION

EVACUATING TO HOME OF A FRIEND, HOTEL OR MOTEL

BROWARD COUNTY

Destination Location	Percent	Confidence Interval
Dade	4.8	2.2 - 7.4
Broward	56.7	50.8 - 62.6
Palm Beach	2.1	0.3 - 3.9
Out of Region	35.6	29.9 - 41.3

Questions 8 through 11 on the Telephone Interview Form examine the affected population's real or perceived previous hurricane experience while also asking if the respondents had evacuated from their homes during past hurricanes:

8. Have you ever lived in South Florida during the direct hit of a major hurricane?

Yes ( ) (IF "YES" ASK QUESTIONS 9, 10, AND 11) No ( )

9. What year was that, please?

10. What was the storm's name? _______________

11. Did you evacuate? ( ) Yes ( ) No

Because the results were not meant to be utilized directly in other elements of the Hurricane Evacuation Plan, this group of questions serves a different purpose than those preceding it in the Behavioral Survey. These questions were asked principally to determine whether the affected public has a true perception of its own previous experience with hurricanes and to interpret whether these experiences and perceptions will affect future hurricane preparedness and evacuation efforts.

The results show that area residents have a significant misperception about previous hurricane experience, frequently believing that they have encountered the direct hit of a major storm when they have not. This is largely attributable to the widespread belief that tropical storms David and Dennis, both of which affected south Florida in recent years, were storms of hurricane intensity. This prevailing public misperception is significant because a sizable portion of the people who would be vulnerable in the next hurricane believe that they have gone through a hurricane without evacuation and are now reluctant or complacent about evacuation in the future. The Behavioral Survey also shows that more respondents who believe that they had experienced a hurricane would evacuate during a future hurricane threat than had actually done so during past threats.

These results prompt concern that prevailing public misperceptions about hurricane experience may diminish the ability of the affected population to respond at a time of risk, thereby unnecessarily increasing the threat to life and injury. Public education programs should be directed toward reversing these misunderstandings and impressing upon the public the importance of preparedness and organized response during hurricane emergencies.

Table G-24 shows that 48.4 percent of the households surveyed in Broward County believe they had lived in south Florida during the direct hit of a hurricane. Cross-checking with other responses showed that only 28.4 percent of the households had experienced the direct hit of a hurricane in south Florida. Table G-24 also shows that only 26.2 percent of the households who believe they were in the direct hit of a hurricane evacuated in that hurricane.

Table G-24

PREVIOUS HURRICANE EXPERIENCE

BROWARD COUNTY

Question	Percent
Lived in south Florida during direct hit of hurricane?	48.4
If yes, did you evacuate?	26.2
Actually experienced direct hit of a hurricane	28.4

Question 12 inquires into the respondent's tenure of residency:

12. Are you a seasonal or year-round resident at this address?
( ) Seasonal ( ) Year-round

Thank you for your help!

In designing the survey questionnaire, it was determined that it would be preferable to isolate year-round residents for sampling because most seasonal residents are not in south Florida during hurricanes and, therefore, are not subject to evacuation. The survey method proved successful in sampling a very high proportion of year-round residents. In Broward County, 88.6 percent of the 800 respondents maintain year-round local residency.

Broward County: Summary

The affected population in Broward County in a Category 3 hurricane is about 100,000. Broward County is similar to Dade in many respects. There is a high percentage of apartment dwellers, almost one-third of whom live in apartment buildings four or more stories high. As with Dade County, a significant percent of households are without a vehicle and would require public transportation. The primary difference between Dade and Broward is the higher number of households intending to leave the region, which would add to highway congestion. A significant number of households would go to a Red Cross shelter in Dade County.

Palm Beach County

Question 1 on the Telephone Interview Form, sought information regarding the proportionate mix of housing types occupied in the study area:

1. Do you live in an:

a. Apartment or condominium building -4 or more floors high ( ) -less than 4 floors high ( ) b. Mobile home ( ) c. Single-family home ( ) d. Other ______________ ( )

Responses to this question provide data that are applied in varying ways throughout the study. Household type is a key variable used in understanding and predicting automobile ownership and use, both of which are important elements in the transportation and evacuation planning portions of the Hurricane Evacuation Plan. Mobile home information is also important for the transportation analysis and in planning for public shelters, as all mobile homes must be evacuated during a hurricane evacuation. Finally, an inventory of households in flood-prone areas located in buildings four floors or higher provides information that is invaluable when analyzing vertical evacuation as a hurricane preparedness and evacuation alternative.

As shown in Table G-25, the predominant type of dwelling unit in the Palm Beach County survey area is the single-family home (73.7 percent). The second most common type of dwelling unit is the apartment or condominium (22.8 percent). These figures are significantly different than the regionwide averages of 53.2 percent for single-family homes and 35.6 percent for apartments and condominiums.

Table G-25

DWELLING UNIT CHARACTERISTICS

PALM BEACH COUNTY

Type of Dwelling Unit	Percent	Confidence Interval
Apartment or Condominium:		
Four or more stories high	7.0	4.4 - 9.6
Less than four stories high	15.8	12.1 - 19.5
Mobile Home	2.3	0.6 - 4.0
Single Family Home	73.7	72.5 - 74.9
Other 1/	1.2	0.0 - 2.4

1/ Houseboats, boatels, etc.

Questions 2 through 5 obtain information about other household characteristics, including the number of people within the household unit, the availability and use of personal transportation and the need for transportation assistance:

2. How many people live in your home, including yourself?

____

(Number)

3. How many motor vehicles do you have at home? ____________
(IF NONE, SKIP TO 5) (Number)

4. (IF THERE ARE VEHICLES, ASK) How many motor vehicles would you use should you be asked to evacuate? ____________
(Number)

5. How many people in your home would require transportation such as a bus or taxi should you be asked to evacuate? ____________
(Number)

In modeling travel behavior during an evacuation, it is critical to have a realistic estimate of the number of vehicles that will actually enter the street network. Average household size figures aid in estimating the evacuating population and in programming public shelter capacities. Information regarding individuals needing public transportation provides planning data and highlights the significance of heightened public awareness and involvement in aiding elderly and handicapped individuals during an evacuation.

As shown in Table G-26, the average number of people per household in the county is 2.42 and each household has an average of 1.61 motor vehicles. In a hurricane evacuation, the average number of motor vehicles used per household is 1.17, meaning that 72.7 percent of the vehicles in the evacuation area would be used. The results of the survey also show that 8.3 percent of the households surveyed in Palm Beach County include people needing public transportation at a time of evacuation. This portion of the population includes those households that do not have an automobile (3.5 percent) as well as those households containing individuals requiring public transportation assistance due to ill health and other circumstances. The average number of people needing public transportation in those households that require assistance is 1.70, while the average among all households sampled is 0.14. These numbers are derived by comparing the total number of people needing public transportation first with the number of households requiring assistance and, second, with the total number of households sampled. These numbers provide a basis from which local Disaster Preparedness and Civil Defense Officials can project the need for public transportation assistance in the event of a hurricane evacuation.

Table G-26

HOUSEHOLD CHARACTERISTICS

PALM BEACH COUNTY

Characteristics	Average	Confidence Interval
Number of People	2.42	2.30 - 2.54
Number of Motor Vehicles	1.61	1.53 - 1.69
Number of Vehicles Used in an Evacuation	1.17	1.11 - 1.23
Number of Households with People Needing Public Transportation	33	
Percent of Households Sampled	8.3	8.1 - 8.5
Number of People Needing Public Transportation	56	
Average per Household Only in Households Needing Public Transportation	1.70	1.31 - 2.09
Number of People needing Public Transportation by Household, Areawide	0.14	0.08 - 0.20

Questions 6 and 7 study how those surveyed intend to respond to an evacuation order and their destinations, should an evacuation occur:

6. If everyone is home and you were ordered by a governmental authority to evacuate due to an approaching hurricane, would you:

   a. Have left before the evacuation order was issued ( ) b. Leave immediately after the evacuation order ( ) c. Leave

( ) hours after the evacuation order d. Stay and not leave ( )

7. After leaving would you:

a. Go to the home of a friend or relative ( ) Yes ( ) No b. Look for a hotel or motel room ( ) Yes ( ) No c. Go to a Red Cross shelter ( ) Yes ( ) No d. Don't know where you would go ( )

(DON'T READ DON'T KNOW)

(IF YES TO a. OR b. ABOVE, ASK FOR LOCATION) (MENTION RESPONDENT'S HOME COUNTY FIRST)

Dade County ( ) Palm Beach County ( ) Broward County ( ) Monroe County ( ) Out of Region ( )

(TRY TO GET A STREET ADDRESS, INCLUDING CITY OR COUNTY IF "DON'T KNOW ADDRESS", TRY TO GET A GENERAL ADDRESS SUCH AS NEARBY -- MAJOR INTERSECTION OR BLOCK)

(IF MONROE COUNTY RESIDENT ANSWERS YES TO c. ABOVE, ASK FOR LOCATION)

Monroe County ( ) Broward County ( ) Dade County ( ) Palm Beach County ( )

Data gathered from responses to these questions are fundamental to regional transportation modeling and to the establishment of ultimate clearance times required to safely evacuate the population-at-risk. Both the number and the timing of vehicles entering streets relative to an evacuation order determine congestion along evacuation routes and, consequently, overall clearance times. Evacuation destinations are significant for modeling the distance and period of time necessary to complete evacuation from generalized points of origin to generalized points of destination. By comparing existing public shelter capacities with questionnaire results that project demand for shelter space, shelter planning and implementation programs can be designed to realistically meet shelter needs should a hurricane evacuation become necessary.

Table G-27 shows that, if an evacuation order were given, 47.0 percent of the households would evacuate immediately and 23.3 percent would have already left before the order were given; 27.2 percent of the households would not evacuate if the order were given. For the 2.5 percent of the population who would leave a certain number of hours after the order, the average time before leaving would be 2.0 hours. The evacuation order responses were very similar, with less than 3 percent differences in each category from the regionwide averages.

Table G-27

EVACUATION ORDER RESPONSES

PALM BEACH COUNTY

Response	Percent	Confidence Interval
Before Order	23.3	19.0 - 27.6
Immediately	47.0	42.0 - 52.0
Certain Number of Hours	2.5	0.8 - 4.2
Stay and Not Leave	27.2	22.7 - 31.7

As shown in Table G-28, 19.3 percent of the households would go to a Red Cross shelter when they evacuated and 38.0 percent of the households would go either to the home of a friend, to a motel, or to a hotel. Table G-29 shows that, of this 38.0 percent, 53.3 percent would go somewhere in Palm Beach County and 42.8 percent would leave the region.

Table G-28

EVACUATION BY DESTINATION CATEGORY

PALM BEACH COUNTY

Destination	Percent	Confidence Interval
Home of a Friend	22.7	18.5 - 26.9
Hotel or Motel	15.3	11.7 - 19.1
Red Cross Shelter	19.3	15.3 - 23.3
Don't Know	13.2	9.8 - 16.6
Not Evacuating	29.5	

Table G-29

DESTINATION LOCATION

EVACUATING TO HOME OF FRIEND, HOTEL OR MOTEL

PALM BEACH COUNTY

Destination Location	Percent	Confidence Interval
Dade	0.7	0.0 - 2.4
Broward	2.0	0.0 - 4.6
Palm Beach	53.3	45.0 - 61.6
Out of Region	42.8	34.6 - 51.0
Don't Know	1.2	0.0 - 3.3

Questions 8 through 11 on the Telephone Interview Form examine the affected population's real or perceived previous hurricane experience while also asking if the respondents had evacuated from their homes during past hurricanes:

8. Have you ever lived in South Florida during the direct hit of a major hurricane?

   Yes ( ) (IF "YES" ASK QUESTIONS 9, 10, AND 11) No ( )

9. What year was that, please? ____________

10. What was the storm's name? ____________

11. Did you evacuate? ( ) Yes ( ) No

Because the results were not meant to be utilized directly in other elements of the Hurricane Evacuation Plan, this group of questions serves a different purpose than those preceding it in the Behavioral Survey. These questions were asked principally to determine whether the affected public has a true perception of its own previous experience with hurricanes and to interpret whether these experiences and perceptions will affect future hurricane preparedness and evacuation efforts.

The results show that area residents have a significant misperception about previous hurricane experience, frequently believing that they have encountered the direct hit of a major storm when they have not. This is largely attributable to the widespread belief that tropical storms David and Dennis, both of which affected south Florida in recent years, were storms of hurricane intensity. This prevailing public misperception is significant because a sizable portion of the people who would be vulnerable in the next hurricane believe that they have gone through a hurricane without evacuation and are now reluctant or complacent about evacuation in the future. The Behavioral Survey also shows that more respondents who believe that they had experienced a hurricane would evacuate during a future hurricane threat than had actually done so during past threats.

These results prompt concern that prevailing public misperceptions about hurricane experience may diminish the ability of the affected population to respond at a time of risk, thereby unnecessarily increasing the threat to life and injury. Public education programs should be directed toward reversing these misunderstandings and impressing upon the public the importance of preparedness and organized response during hurricane emergencies.

Table G-30 shows that 53.5 percent of the households surveyed in Palm Beach County believe they had lived in south Florida during the direct hit of a hurricane. Cross-checking with other responses showed that only 42.6 percent of the households had experienced the direct hit of a hurricane.

Table D-30 also shows that only 33.6 percent of the households who believe they were in the direct hit of a hurricane evacuated in that hurricane.

Table G-30

PREVIOUS HURRICANE EXPERIENCE

PALM BEACH COUNTY

Question	Percent
Lived in south Florida during direct hit of hurricane?	53.5
If yes, did you evacuate?	33.6
Actually lived in south Florida during direct hit of a hurricane?	42.6

Question 12 inquires into the respondent's tenure of residency:

12. Are you a seasonal or year-round resident at this address?
( ) Seasonal ( ) Year-round

Thank you for your help!

In designing the Survey Questionnaire, it was determined that it would be preferable to isolate year-round residents for sampling because most seasonal residents are not in south Florida during hurricanes and, therefore, are not subject to evacuation. The survey method proved successful in sampling a very high proportion of year-round residents. In Palm Beach, 85.5 percent of the 400 respondents maintain year-round local residency.

Palm Beach County: Summary

The affected population in Palm Beach County is only about 8,000, many fewer persons than in the other counties. Palm Beach County has the highest percentage of single family homes and lowest percentage of apartments. In addition, the county has the highest number of vehicles per household and the lowest percentage of households without a vehicle. These findings indicate that, in an evacuation, there would be many cars on the highway network and a light demand for public transportation in Palm Beach County. Palm Beach County has a large percentage of persons who would either leave the region when they evacuate or not evacuate at all, creating a relatively low demand for public shelters.

CONCLUSIONS

The primary purpose of the Behavioral Survey is to provide baseline statistics for the individual elements of the evacuation plan. Additionally, the Behavioral Survey supplies data for each county of the region which can be directly utilized by local Civil Defense and Disaster Preparedness agencies in the development of Hurricane Evacuation Implementation Plans. The data obtained from the Behavioral Survey provides reliable information that, in many cases, was not previously available.

Information provided by the Behavioral Survey is particularly critical to the transportation modeling component of the study. Statistically valid answers regarding household type, household characteristics, public response to evacuation orders, evacuation destinations and previous hurricane experience provide parameters for performing transportation modeling and consequently for estimating clearance times. Specifically, each of the following transportation modeling major tasks rely on the Behavioral Survey results.

1. Generation of traffic demand estimates from evacuation zones within each county to specific destination categories.

2. Development of a computer-coded transportation network including evacuation routes most likely to be used during an evacuation.

3. Estimate of the public response to an approaching hurricane to define the time evacuees enter the transportation network.

4. Application of a computer model to estimate the time required for all evacuees to leave the transportation networks and reach their destinations.

Finally, an analysis of the responses to the Behavioral Survey questionnaire acquired throughout the region provides some general conclusions that warrant serious consideration in ongoing hurricane evacuation and disaster preparedness planning efforts:

1. While the vast majority of households would respond either immediately or rather promptly to an evacuation situation, a significant group of the households contacted, 26.3 percent, does not intend to evacuate.

APPENDIX H

TRANSPORTATION ANALYSIS METHODOLOGY
TECHNICAL NOTES

APPENDIX H

TABLE OF CONTENTS

APPENDIX H

LIST OF TABLES

Introduction

This appendix provides a series of technical notes regarding the transportation modelling methodology summarized in Section 5.3. As noted, six major steps were carried out for the transportation modelling and are listed below:

(1) Evacuation Road Network Preparation
(2) Trip Generation
(3) Trip Distribution
(4) Trip Assignment
(5) Critical Link Identification
(6) Travel Time/Queuing Delay Analysis

Technical notes will be presented by major modelling step.

Evacuation Road Network Preparation

This step involved developing facility type, area type, and number of lanes information for those roadways selected for inclusion in the evacuation road network. Information was coded into a "link file" and "coordinate file" for use by the Florida Department of Transportation mainframe computer. The end product of this step was a computerized representation of the roadway system.

A traditional "link-node" system was developed to identify roadway sections. Nodes are used to identify the intersection of two roadways or changes in roadway characteristics, and to provide points along curved sections of the roadway to assist in computer plotting. Two basic types of node designations were utilized. First, nodes identifying geographic centers of activity within evacuation zones, referred to as centroids, were shown by open circles. External centroids, centroids located outside the county under consideration, were also designated by open circles. The external centroids represent trips originating either outside the study area or within other counties in the study area that are loaded onto the roadway network. A second type of node, shown as solid dots, was used to identify points (usually intersections) along the roadways. Links are the roadway segments as defined by the nodes when connected. Each link is identified by a pair of node numbers.

Once the links and nodes for the evacuation routes were identified, roadway characteristics were specified for each link. The characteristics of each link were defined by the following features:

- Number of travel lanes
- Type of facility
- Area type
- Direction of travel

Roadway characteristics for the chosen evacuation network were obtained from official 1980 approved urban area roadway networks maintained by FDOT. As noted, information centered around number of travel lanes, facility type, area type and direction of travel.

The number of travel lanes has the greatest effect on the ability of the roadway segment to handle a certain number of vehicles per hour. The type of facility refers to a link's designation as a one-way street, collector (undivided or divided), arterial, freeway, or centroid connector (local street). Area type designates the major land use characteristic surrounding the link and includes central business district, outlying business district, fringe area, residential area and rural area. Direction of travel designates whether the link allows two-way travel or only one-way travel. Definitions of the facility type and area types are provided in Tables H1 and H2, respectively. Tables H3-H6 provide the link node file, developed for Monroe, Dade, Broward and Palm Beach Counties.

The significance of the link characteristics is defined by their use as indicators of roadway speed and capacity. Travel speeds provide indications of travel time in that as average speeds increase travel times decrease. Average speeds vary with the type of facility in question, the number of lanes, and the environment or area surrounding the roadway. Link capacities determine the ability of a link to efficiently serve travel demands.

Corresponding coordinate files defining each node's location with respect to a horizontal (X) axis and vertical (Y) axis were developed. The coordinates were used in FDOT's computer module HNET to calculate link lengths and to provide a basis for computer plotting of results. HNET was also used to prepare county evacuation networks on which traffic could be assigned by the FDOT computer. The UTPS program HR is employed by HNET to build a binary-coded network file (historical record) for use by subsequent modelling steps. These evacuation road networks are maintained by the FDOT computer for future study updating and incorporation of roadway improvements.

TABLE H-1

UTPS FACILITY TYPE DEFINITIONS

Facility Type 1.

Freeway - a facility with full control of access to give preference to through traffic, i.e., Interstate and Turnpike.

Facility Type 2.

Divided Arterial and Expressway - a facility 1) with a painted area or physical barrier separating opposing traffic flows; 2) carrying a majority of the longer trips within and through the urban area; 3) emphasizing traffic movement over land access; and 4) carrying higher volumes than any facility except Freeways. Expressways have some grade separate intersections, fewer signals per mile than arterials, and some frontage roads.

Facility Type 3.

Undivided Arterials - similar to Facility Type 2 except no painted area or physical barrier separates opposing traffic flows. Undivided arterials generally have more signals per mile, few frontage roads, serve fewer through trips, and serve more land access than divided arterials.

Facility Type 4.

Collector - streets collecting traffic from local streets in the neighborhoods, and channeling it into the arterial systems. A minor amount of through traffic may be carried on collector streets, but the system primarily provides land access service by carrying local traffic movements between or within residential neighborhoods, commercial, and residential areas, or to higher type facilities.

Facility 5.

Local Street or Centroid Connector - streets not classified in a higher system, primarily providing direct access to abutting land and access to the higher systems. They offer the lowest level of mobility and usually carry no bus routes. Service to through traffic is deliberately discouraged. In the systems planning networks a number of these facilities are generally represented by a single zone centroid connector, thus an artificially high hourly capacity is assigned by the capacity tables. Each zone should have two or more centroid connectors to increase the accuracy of the assignment process.

Facility Type 6.

One Way Streets - any facility where traffic is confined to one direction of flow.

TABLE H-2

UTPS AREA TYPE DEFINITIONS

<u>Area Type 1.</u>

Central Business District - an area where the dominant land use comprises intense business activity. These areas are characterized by large numbers of pedestrians, commercial vehicles, loadings of goods and people, a heavy demand for parking space, and high parking turnover (usage).

<u>Area Type 2.</u>

Fringe Area - the portion of a municipality immediately outside the Central Business District having a wide range in type of business activity but which includes small businesses, light industry, warehousing, automobile service activities, and intermediate strip development with some concentrated residential areas. Traffic in these areas generally involves trips that do not have an origin or destination within the area. Moderate pedestrian traffic and lower parking turnover than is found in the Central Business District are implied in this category. However, large parking areas serving the Central Business District might be present.

<u>Area Type 3.</u>

Residential Area - areas within the influence of a municipality in which the dominant land use is residential development. Small businesses may be included, but the area is characterized by few pedestrians and low parking turnover.

<u>Area Type 4.</u>

Outlying Business District - an area within the influence of a municipality which is normally separated geographically by some distance from the Central Business District and its fringe area but which has intense activity characteristic of a central area. The principal land use is for business, and there may be heavy traffic circulation or through movements involved with the area causing lower operating speeds than fringe areas. Another characteristic is high parking demand and turnover with moderate pedestrian traffic. This category does not include off-street shopping development entirely on one side of the street. Moderate to heavy strip development on both sides of facility should be coded OBD.

<u>Area Type 5.</u>

Rural Area - an area within the influence of a municipality in which predominant land use is other than those described in Items 1 through 4 above.

TABLE H-3

MONROE COUNTY LINK-NODE FILE

```
**** TSO FOREGROUND HARDCOPY ****
*** PRINTOFF, 07 DEC 82, 16:16:47, TUESDAY   ***
DSNAME=KN931HS.LINKS.YMON.DATA
```

ANODE	BNODE		# OF LANES IN BOTH DIRECTIONS		FACILITY TYPE	AREA TYPE
1	1001	S	2	X	5	1
2	1003	S	2	X	5	2
2	1004	S	2	X	5	2
3	1007	S	2	X	5	2
3	1009	S	2	X	5	2
3	1010	S	2	X	5	2
4	1012	S	2	X	5	2
4	1015	S	2	X	5	2
4	1016	S	2	X	5	2
5	1017	S	2	X	5	2
5	1018	S	2	X	5	2
5	1019	S	2	X	5	2
6	1024	S	2	X	5	2
7	1025	S	2	X	5	2
8	1026	S	2	X	5	2
9	1027	S	2	X	5	2
1001	1100	S	4	X	3	4
1002	1003	S	4	X	3	4
1002	1100	S	4	X	3	4
1003	1005	S	4	X	2	5
1004	1005	S	2	X	4	5
1005	1006	S	2	X	3	5
1006	1007	S	2	X	4	5
1006	1008	S	2	X	3	5
1008	1009	S	2	X	3	5
1007	1008	S	2	X	4	5
1009	1011	S	2	X	3	5
1010	1011	S	2	X	4	5
1011	1013	S	2	X	3	5
1012	1013	S	2	X	4	5
1013	1014	S	2	X	3	5
1014	1015	S	2	X	4	5
1014	1016	S	2	X	3	5
1016	1017	S	2	X	3	5
1017	1018	S	2	X	3	5
1018	1019	S	4	X	3	5
1019	1020	S	4	X	3	5
1020	1021	S	2	X	3	5
1020	1023	S	2	X	3	5
1021	1022	S	2	X	3	5
1021	1023	S	2	X	3	5
1023	1024	S	4	X	2	5
1024	1025	S	4	X	2	5
1025	1026	S	4	X	2	5
1026	1027	S	4	X	2	5

TABLE H-4

DADE COUNTY LINK-NODE FILE

```
**** TSO FOREGROUND HARDCOPY ****
*** PRINTOFF, 06 DEC 82, 16:58:19, MONDAY    ***
DSNAME=KN931HS.LINKS.Y80DA.DATA
```

1	1151	S	2	X	5	3
2	1201	S	2	X	5	3
3	1209	S	2	X	5	3
4	1203	S	2	X	5	3
5	1287	S	2	X	5	3
6	1289	S	2	X	5	3
6	1351	S	2	X	5	3
7	1379	S	2	X	5	3
8	1393	S	2	X	5	3
8	1397	S	2	X	5	3
9	1027	S	2	X	5	3
10	1349	S	2	X	5	3
11	1279	S	2	X	5	3
11	1321	S	2	X	5	3
11	1327	S	2	X	5	3
12	1215	S	2	X	5	3
12	1265	S	2	X	5	3
13	1161	S	2	X	5	3
13	1185	S	2	X	5	3
14	1123	S	2	X	5	3
14	1147	S	2	X	5	3
15	1095	S	2	X	5	3
15	1117	S	2	X	5	3
16	1075	S	2	X	5	3
16	1081	S	2	X	5	3
17	1026	S	2	X	5	3
18	1399	S	2	X	5	3
19	1001	S	2	X	5	3
20	1035	S	2	X	5	3
20	1037	S	2	X	5	3
21	1053	S	2	X	5	3
22	1073	S	2	X	5	3
23	1183	S	2	X	5	3
23	1187	S	2	X	5	3
24	1189	S	2	X	5	3
24	1213	S	2	X	5	3
24	1265	S	2	X	5	3
25	1275	S	2	X	5	3
25	1323	S	2	X	5	3
26	1367	S	2	X	5	3
26	1391	S	2	X	5	3
27	1387	S	2	X	5	3
28	1359	S	2	X	5	3
28	1383	S	2	X	5	3
29	1331	S	2	X	5	3
30	1243	S	2	X	5	3
31	1221	S	2	X	5	3
32	1305	S	2	X	5	3
33	1311	S	2	X	5	3
34	1317	S	2	X	5	3
34	1345	S	2	X	5	3
35	1259	S	2	X	5	3
35	1261	S	2	X	5	3
36	1235	S	2	X	5	3
37	1167	S	2	X	5	3
38	1173	S	2	X	5	3
39	1179	S	2	X	5	3
40	1103	S	2	X	5	3
40	1129	S	2	X	5	3
41	1107	S	2	X	5	3
41	1133	S	2	X	5	3

42	1121	S	2	X	5	3
42	1139	S	2	X	5	3
43	1097	S	2	X	5	3
44	1091	S	2	X	5	3
44	1111	S	2	X	5	3
45	1065	S	2	X	5	3
46	1067	S	2	X	5	3
47	1059	S	2	X	5	3
48	1007	S	2	X	3	5
49	1007	S	2	X	3	5
50	1295	S	2	X	3	5
51	1405	S	4	X	1	3
52	1401	S	6	X	1	3
1001	1003	S	2	X	3	3
1003	1005	S	2	X	3	5
1003	1009	S	2	X	3	2
1003	1031	S	2	X	3	5
1007	1009	S	4	X	3	2
1009	1010	S	4	X	3	2
1009	1011	S	2	X	3	3
1010	1029	S	4	X	3	2
1010	1037	S	4	X	1	3
1011	1013	S	2	X	4	5
1011	1027	S	2	X	3	3
1013	1015	S	2	X	3	5
1015	1017	S	2	X	3	5
1017	1019	S	2	X	3	5
1019	1021	S	2	X	3	5
1021	1023	S	2	X	3	5
1023	1025	S	2	X	3	5
1025	1047	S	2	X	3	5
1026	1028	S	2	X	4	3
1027	1028	S	2	X	3	3
1028	1037	S	4	X	3	3
1028	1041	S	2	X	3	3
1029	1033	S	4	X	3	2
1031	1033	S	2	X	3	2
1031	1061	S	2	X	3	3
1033	1035	S	4	X	3	3
1035	1057	S	4	X	3	3
1037	1039	S	4	X	1	3
1039	1041	S	4	X	1	3
1041	1043	S	4	X	1	3
1043	1045	S	4	X	1	3
1045	1047	S	4	X	1	5
1047	1049	S	4	X	1	3
1047	1053	S	2	X	3	5
1049	1051	S	4	X	1	3
1051	1055	S	4	X	1	3
1053	1079	S	2	X	3	5
1055	1077	S	4	X	1	3
1056	1057	S	4	X	3	3
1056	1079	S	4	X	3	3
1057	1059	S	2	X	3	5
1059	1061	S	2	X	3	5
1061	1063	S	2	X	3	5
1063	1065	S	2	X	3	5
1063	1101	S	2	X	3	5
1065	1067	S	2	X	3	5
1067	1069	S	2	X	3	5
1069	1071	S	2	X	3	3
1069	1077	S	4	X	1	4
1069	1083	S	4	X	1	4
1071	1073	S	6	X	3	3
1071	1081	S	6	X	3	3
1071	1075	S	6	X	3	3

TABLE H-4 (continued)

DADE COUNTY LINK-NODE FILE

1075	1077	S	6	X	3	3
1077	1079	S	4	X	3	3
1081	1093	S	6	X	3	3
1083	1085	S	4	X	1	4
1085	1087	S	6	X	1	3
1087	1089	S	6	X	1	3
1087	1091	S	2	X	3	3
1089	1105	S	4	X	1	3
1089	1090	S	4	X	1	3
1091	1093	S	4	X	3	4
1093	1095	S	6	X	3	3
1095	1097	S	6	X	3	3
1097	1099	S	8	X	3	3
1099	1113	S	4	X	1	3
1099	1117	S	8	X	3	4
1101	1102	S	4	X	3	5
1101	1127	S	2	X	3	5
1102	1103	S	4	X	3	5
1103	1105	S	4	X	3	3
1105	1107	S	6	X	3	3
1105	1131	S	4	X	1	3
1107	1109	S	6	X	3	3
1109	1110	S	8	X	1	3
1109	1111	S	6	X	3	3
1110	1135	S	4	X	1	3
1111	1113	S	6	X	3	3
1113	1115	S	6	X	3	4
1113	1135	S	4	X	1	4
1115	1117	S	8	X	3	4
1115	1119	S	6	X	3	4
1119	1121	S	6	X	3	3
1119	1141	S	2	X	3	3
1121	1123	S	6	X	3	3
1123	1125	S	6	X	3	3
1125	1143	S	4	X	3	3
1125	1145	S	6	X	3	3
1127	1129	S	2	X	4	3
1127	1163	S	2	X	3	5
1129	1131	S	4	X	3	3
1131	1133	S	4	X	3	4
1131	1165	S	4	X	1	3
1133	1137	S	6	X	3	3
1135	1137	S	8	X	1	3
1137	1139	S	6	X	3	3
1137	1169	S	8	X	1	3
1139	1141	S	6	X	3	3
1141	1143	S	6	X	3	3
1143	1145	S	4	X	3	3
1143	1175	S	4	X	3	3
1145	1147	S	6	X	3	3
1147	1149	S	6	X	3	3
1149	1161	S	6	X	3	3
1149	1177	S	4	X	3	3
1151	1153	S	4	X	2	3
1153	1155	S	4	X	2	3
1155	1157	S	4	X	2	3
1157	1161	S	4	X	2	3
1161	1181	S	6	X	1	3
1163	1165	S	4	X	3	3
1163	1293	S	2	X	3	5
1165	1167	S	4	X	3	3
1165	1221	S	4	X	1	5
1167	1169	S	4	X	3	3
1169	1171	S	4	X	3	3
1169	1223	S	8	X	1	4
1171	1173	S	4	X	3	3
1171	1225	S	2	X	3	3
1173	1175	S	4	X	3	3
1175	1177	S	4	X	3	3
1175	1227	S	6	X	3	3
1177	1179	S	4	X	3	4
1177	1229	S	4	X	3	3
1179	1181	S	4	X	3	4
1181	1183	S	4	X	2	3
1181	1231	S	8	X	1	3
1183	1185	S	4	X	2	1
1185	1187	S	4	X	3	1
1187	1189	S	8	X	3	2
1189	1191	S	8	X	3	1
1189	1211	S	4	X	3	2
1090	1109	S	8	X	1	3
1191	1193	S	6	X	2	3
1191	1231	S	8	X	1	2
1193	1195	S	6	X	2	3
1195	1197	S	6	X	2	3
1197	1199	S	6	X	3	2
1197	1207	S	4	X	3	2
1199	1201	S	4	X	3	2
1201	1203	S	4	X	3	3
1203	1205	S	4	X	3	4
1203	1287	S	6	X	3	3
1205	1207	S	4	X	3	3
1205	1219	S	6	X	1	3
1207	1209	S	4	X	3	2
1209	1210	S	2	X	3	3
1210	1211	S	4	X	3	3
1211	1213	S	4	X	3	2
1213	1215	S	4	X	3	3
1215	1217	S	4	X	3	3
1217	1219	S	4	X	3	3
1217	1239	S	4	X	3	3
1219	1241	S	6	X	1	3
1221	1222	S	4	X	1	3
1221	1299	S	4	X	1	5
1222	1223	S	4	X	1	3
1223	1225	S	6	X	1	3
1223	1233	S	8	X	1	4
1225	1227	S	6	X	1	3
1227	1228	S	6	X	3	3
1227	1229	S	6	X	1	3
1228	1237	S	8	X	3	4
1229	1231	S	8	X	1	2
1229	1255	S	4	X	3	3
1231	1241	S	10	X	1	3
1233	1235	S	6	X	3	4
1233	1243	S	8	X	1	4
1235	1237	S	4	X	3	3
1237	1238	S	4	X	3	4
1237	1251	S	6	X	3	3
1238	1239	S	2	X	3	3
1239	1263	S	4	X	3	3
1241	1259	S	6	X	1	3
1241	1271	S	10	X	1	3
1243	1245	S	8	X	1	4
1245	1247	S	4	X	3	4
1245	1301	S	6	X	3	4
1245	1303	S	8	X	1	4
1247	1249	S	4	X	3	4
1247	1307	S	4	X	3	4
1249	1251	S	4	X	3	4
1249	1253	S	4	X	3	3
1251	1253	S	4	X	3	3

TABLE H-4 (continued)

DADE COUNTY LINK-NODE FILE

1251	1255	S	6	X	1	3
1253	1257	S	4	X	3	3
1253	1309	S	4	X	3	4
1255	1257	S	4	X	3	3
1255	1259	S	6	X	1	3
1257	1261	S	4	X	3	3
1257	1313	S	4	X	3	3
1261	1263	S	4	X	3	3
1263	1267	S	4	X	3	3
1263	1314	S	4	X	3	3
1265	1219	S	4	X	3	3
1265	1267	S	4	X	3	3
1267	1269	S	4	X	3	3
1269	1273	S	4	X	3	3
1271	1273	S	4	X	3	3
1271	1315	S	10	X	1	3
1273	1275	S	4	X	3	3
1273	1279	S	4	X	3	3
1275	1277	S	4	X	3	3
1277	1319	S	4	X	3	3
1279	1281	S	6	X	3	3
1281	1283	S	6	X	3	3
1283	1285	S	6	X	3	3
1285	1287	S	6	X	3	3
1287	1289	S	6	X	3	3
1289	1291	S	6	X	3	4
1291	1329	S	4	X	3	4
1291	1351	S	6	X	3	4
1293	1295	S	2	X	3	5
1295	1297	S	2	X	3	5
1297	1299	S	2	X	3	5
1299	1301	S	6	X	3	4
1299	1409	S	4	X	1	5
1301	1303	S	4	X	3	3
1303	1305	S	6	X	3	4
1303	1331	S	6	X	1	3
1305	1307	S	6	X	3	4
1307	1309	S	4	X	3	4
1307	1333	S	4	X	3	4
1309	1311	S	4	X	3	4
1311	1313	S	4	X	3	4
1313	1314	S	6	X	3	4
1313	1337	S	6	X	3	4
1314	1315	S	6	X	3	3
1314	1339	S	6	X	3	3
1315	1317	S	6	X	3	3
1315	1341	S	10	X	1	3
1319	1321	S	4	X	3	3
1321	1323	S	4	X	3	3
1323	1325	S	4	X	2	4
1325	1327	S	4	X	3	4
1325	1347	S	4	X	3	3
1325	1349	S	4	X	2	4
1327	1329	S	4	X	3	4
1331	1333	S	2	X	3	3
1331	1355	S	6	X	1	3
1333	1335	S	2	X	3	3
1333	1357	S	4	X	3	4
1335	1337	S	4	X	3	4
1337	1339	S	6	X	3	3
1337	1353	S	6	X	3	4
1339	1341	S	6	X	3	3
1339	1363	S	6	X	3	4
1341	1343	S	10	X	1	3
1343	1344	S	8	X	1	3
1343	1345	S	4	X	3	3
1344	1363	S	4	X	2	3
1344	1365	S	8	X	1	3
1345	1347	S	4	X	3	3
1349	1371	S	4	X	2	4
1351	1352	S	4	X	3	4
1352	1377	S	6	X	3	3
1353	1361	S	6	X	3	3
1353	1363	S	4	X	2	3
1355	1357	S	6	X	1	4
1357	1359	S	6	X	1	4
1357	1381	S	4	X	3	3
1359	1361	S	6	X	1	4
1361	1362	S.	6	X	1	3
1361	1385	S	6	X	3	3
1362	1365	S	4	X	1	3
1365	1366	S	6	X	1	3
1365	1403	S	4	X	1	3
1366	1367	S	4	X	1	4
1366	1389	S	6	X	1	3
1367	1369	S	6	X	3	4
1369	1371	S	6	X	3	4
1371	1373	S	4	X	3	4
1371	1393	S	4	X	2	4
1373	1375	S	4	X	3	4
1375	1377	S	4	X	3	4
1377	1379	S	6	X	2	3
1381	1383	S	4	X	3	3
1383	1385	S	4	X	3	3
1385	1387	S	4	X	3	3
1385	1407	S	6	X	3	3
1387	1389	S	4	X	3	3
1389	1391	S	4	X	3	3
1389	1401	S	6	X	1	3
1391	1395	S	4	X	3	3
1393	1395	S	4	X	2	4
1395	1397	S	4	X	2	3
1397	1399	S	4	X	2	3
1403	1405	S	4	X	1	3
1405	1407	S	4	X	1	5
1407	1409	S	4	X	1	5

TABLE H-5

BROWARD COUNTY LINK-NODE FILE

**** ISO FOREGROUND HARDCOPY ****
*** PRINTOFF, 06 DEC 82, 16:53:48, MONDAY ***
DSNAME=KN931HS.LINKS.Y80BR.DATA

1

1	1750	S	2	X	5	4
2	1670	S	2	X	5	3
2	1740	S	2	X	5	3
3	1560	S	2	X	5	3
3	1660	S	2	X	5	3
4	1410	S	2	X	5	3
4	1490	S	2	X	5	3
4	1550	S	2	X	5	3
5	1320	S	2	X	5	3
5	1400	S	2	X	5	3
6	1370	S	2	X	5	3
7	1230	S	2	X	5	3
8	1210	S	2	X	5	3
9	1040	S	2	X	5	3
9	1110	S	2	X	5	3
9	1120	S	2	X	5	3
10	1020	S	2	X	5	3
10	1090	S	4	X	5	3
11	1380	S	4	X	5	3
11	1470	S	4	X	5	3
12	1530	S	2	X	5	3
13	1640	S	2	X	5	3
14	1720	S	2	X	5	3
15	1780	S	2	X	5	3
16	1000	S	2	X	5	3
16	1070	S	2	X	5	3
16	1150	S	2	X	5	3
17	1060	S	2	X	5	3
18	1140	S	2	X	5	3
18	1260	S	2	X	5	3
19	1130	S	2	X	5	4
19	1250	S	2	X	5	4
20	1270	S	2	X	5	3
20	1350	S	2	X	5	3
21	1330	S	2	X	5	3
22	1340	S	4	X	5	3
22	1440	S	4	X	5	3
23	1430	S	2	X	5	4
23	1500	S	2	X	5	4
23	1600	S	2	X	5	4
24	1460	S	2	X	5	3
24	1520	S	2	X	5	3
24	1630	S	2	X	5	3
25	1570	S	2	X	5	3
26	1580	S	2	X	5	3
27	1610	S	2	X	5	3
27	1700	S	2	X	5	3
28	1700	S	2	X	5	3
28	1760	S	2	X	5	5
29	1690	S	2	X	5	5
30	1680	S	2	X	5	5
31	1050	S	2	X	3	5
32	999	S	4	X	1	5
33	999	S	4	X	1	5
33	1002	S	4	X	2	3
34	1010	S	6	X	1	3
35	1240	S	4	X	2	5
36	1800	S	2	X	3	5
37	2540	S	4	X	1	5
38	1770	S	6	X	1	4
999	1002	S	4	X	1	3
999	2500	S	4	X	1	3
1000	1005	S	4	X	2	3
1000	1010	S	4	X	2	3
1002	1005	S	4	X	2	3
1010	1020	S	4	X	2	3
1010	1080	S	6	X	1	2
1020	1030	S	6	X	2	4
1030	1040	S	6	X	2	3
1040	1100	S	6	X	2	3
1050	1060	S	2	X	3	5
1050	1240	S	2	X	3	5
1060	2500	S	4	X	2	3
1070	2500	S	6	X	2	4
1070	1080	S	6	X	2	4
1080	1090	S	4	X	3	4
1080	1160	S	8	X	1	2
1090	1095	S	6	X	2	3
1095	1100	S	4	X	3	3
1100	1110	S	4	X	2	3
1110	1120	S	4	X	2	3
1120	1170	S	4	X	2	3
1130	1135	S	2	X	3	3
1135	1140	S	6	X	2	3
1140	1150	S	6	X	2	3
1150	1160	S	6	X	2	3
1160	1170	S	4	X	2	3
1160	1180	S	6	X	2	3
1170	1210	S	2	X	3	3
1180	1190	S	2	X	3	4
1180	1280	S	6	X	1	2
1190	1200	S	4	X	3	2
1200	1205	S	6	X	2	4
1205	1220	S	4	X	2	3
1210	1220	S	2	X	3	3
1220	1230	S	2	X	4	5
1240	1250	S	4	X	2	5
1240	1800	S	2	X	3	5
1250	2510	S	4	X	2	3
1260	1270	S	4	X	2	3
1260	2510	S	4	X	2	3
1270	1280	S	4	X	2	4
1280	1285	S	8	X	2	4
1280	1360	S	6	X	1	2
1285	1290	S	6	X	2	4
1290	1300	S	4	X	2	3
1300	1310	S	4	X	2	4
1310	1320	S	4	X	3	4
1320	1390	S	4	X	3	4
1330	2520	S	6	X	2	4
1340	2520	S	6	X	2	4
1340	1350	S	6	X	2	4
1350	1360	S	6	X	2	4
1360	1370	S	6	X	2	4
1360	1450	S	6	X	1	2
1370	1380	S	6	X	2	4
1380	1390	S	4	X	2	4
1390	1400	S	4	X	2	3
1400	1410	S	4	X	2	3
1410	1480	S	4	X	2	3
1420	1430	S	6	X	2	4
1430	1440	S	6	X	2	4
1440	1450	S	6	X	2	4
1450	1460	S	6	X	2	4
1450	1510	S	6	X	1	2
1460	1470	S	6	X	2	4
1470	1475	S	6	X	2	4

TABLE H-5 (continued)

BROWARD COUNTY LINK-NODE FILE

1475	1480	S	4	X	2	4
1480	1490	S	6	X	2	3
1490	1540	S	2	X	3	4
1500	1510	S	6	X	2	4
1500	2530	S	4	X	2	4
1510	1520	S	6	X	2	4
1510	1620	S	6	X	1	4
1520	1530	S	6	X	2	4
1530	1535	S	6	X	2	4
1535	1540	S	4	X	2	4
1540	1550	S	2	X	3	3
1550	1560	S	2	X	3	3
1560	1650	S	2	X	3	3
1570	1580	S	4	X	2	4
1580	2540	S	4	X	2	3
1590	1600	S	4	X	2	3
1590	2540	S	4	X	2	3
1600	1610	S	4	X	3	4
1610	1620	S	4	X	3	4
1620	1630	S	4	X	3	4
1620	1710	S	6	X	1	4
1630	1640	S	4	X	2	4
1640	1650	S	4	X	2	4
1650	1660	S	4	X	2	4
1660	1670	S	2	X	3	3
1670	1730	S	2	X	3	3
1680	1690	S	4	X	2	5
1690	1700	S	4	X	2	4
1700	1710	S	6	X	2	4
1710	1720	S	6	X	2	4
1710	1770	S	6	X	1	4
1730	1740	S	2	X	3	3
1740	1750	S	2	X	3	3
1750	1790	S	2	X	3	3
1755	1760	S	2	X	3	3
1760	1765	S	4	X	2	4
1765	1770	S	6	X	2	4
1770	1775	S	6	X	2	3
1775	1780	S	4	X	2	3
1780	1790	S	4	X	3	4
2500	2510	S	4	X	1	4
2510	2520	S	4	X	1	3
2520	2530	S	4	X	1	3
2530	2540	S	4	X	1	3

TABLE H-6

PALM BEACH COUNTY LINK-NODE FILE

```
**** TSO FOREGROUND HARDCOPY ****
*** PRINTOFF, 06 DEC 82, 16:55:47, MONDAY     ***
DSNAME-KN931HS.LINKS.Y80PB.DATA
```

1	1	1296	S	2	X	5	5
	1	1302	S	2	X	5	5
	2	1304	S	2	X	5	5
	3	1312	S	2	X	5	5
	4	1282	S	2	X	5	5
	4	1286	S	2	X	5	5
	5	1274	S	2	X	5	5
	6	1220	S	2	X	5	5
	7	1206	S	2	X	5	5
	8	1204	S	2	X	5	5
	9	1154	S	2	X	5	5
	9	1158	S	2	X	5	5
	10	1150	S	2	X	5	5
	10	1152	S	2	X	5	5
	11	1108	S	2	X	5	5
	11	1112	S	2	X	5	5
	12	1082	S	2	X	5	5
	13	1078	S	2	X	5	5
	14	1066	S	4	X	5	5
	15	1042	S	4	X	5	5
	16	1030	S	4	X	5	5
	17	1020	S	2	X	5	5
	18	1016	S	2	X	5	5
	19	1118	S	2	X	5	5
	20	1146	S	2	X	5	5
	21	1160	S	2	X	5	5
	22	1202	S	2	X	5	5
	23	1216	S	2	X	5	5
	24	1314	S	2	X	5	5
	25	1292	S	2	X	5	5
	25	1310	S	2	X	5	5
	26	1258	S	2	X	5	5
	26	1292	S	2	X	5	5
	27	1268	S	2	X	5	5
	27	1288	S	2	X	5	5
	28	1238	S	2	X	5	5
	29	1266	S	4	X	5	5
	30	1196	S	4	X	5	5
	30	1228	S	2	X	5	5
	31	1186	S	2	X	5	5
	31	1236	S	2	X	5	5
	32	1170	S	2	X	5	5
	32	1182	S	2	X	5	5
	33	1190	S	2	X	5	5
	34	1200	S	2	X	5	5
	35	1138	S	2	X	5	5
	35	1172	S	2	X	5	5
	36	1166	S	2	X	5	5
	37	1142	S	2	X	5	5
	38	1126	S	2	X	5	5
	39	1122	S	2	X	5	5
	40	1098	S	2	X	5	5
	41	1090	S	2	X	5	5
	42	1048	S	2	X	5	5
	43	1054	S	2	X	5	5
	43	1092	S	2	X	5	5
	44	1062	S	2	X	5	5
	44	1076	S	2	X	5	5
	45	1002	S	2	X	5	5
	45	1036	S	2	X	5	5
	46	1040	S	2	X	5	5
	47	1008	S	2	X	5	5
	47	1024	S	2	X	5	5
	48	1004	S	2	X	5	5
	49	1244	S	2	X	5	5
	49	1248	S	2	X	5	5
	50	1174	S	2	X	5	5
	50	1176	S	2	X	5	5
	51	1128	S	2	X	5	5
	51	1130	S	2	X	5	5
	52	1102	S	2	X	5	5
	53	1000	S	2	X	5	5
	54	1328	S	2	X	3	5
	55	1348	S	2	X	3	5
	56	1354	S	2	X	3	5
	57	1246	S	2	X	3	5
	58	1254	S	4	X	1	5
	59	1304	S	6	X	2	5
	60	999	S	4	X	1	5
	61	1000	S	4	X	1	5
	62	1336	S	2	X	3	5
	999	1006	S	6	X	1	5
	999	1004	S	6	X	2	5
	999	1008	S	6	X	2	5
	1000	1002	S	4	X	2	3
	1000	1034	S	4	X	1	5
	1002	1004	S	4	X	2	3
	1006	1032	S	6	X	1	5
	1006	1036	S	2	X	3	3
	1008	1010	S	6	X	2	3
	1010	1012	S	6	X	2	4
	1012	1014	S	4	X	2	4
	1014	1015	S	4	X	2	1
	1015	1017	S	2	X	3	3
	1016	1018	S	2	X	3	3
	1017	1018	S	4	X	3	3
	1018	1020	S	2	X	3	3
	1020	1022	S	2	X	3	3
	1022	1024	S	4	X	3	5
	1022	1030	S	2	X	3	3
	1024	1026	S	4	X	3	5
	1026	1028	S	4	X	3	5
	1028	1032	S	6	X	2	3
	1030	1042	S	2	X	3	5
	1032	1038	S	6	X	1	5
	1034	1046	S	4	X	1	5
	1036	1038	S	2	X	3	5
	1036	1052	S	2	X	3	5
	1038	1040	S	4	X	3	4
	1038	1058	S	6	X	1	5
	1040	1044	S	2	X	3	5
	1042	1044	S	2	X	3	5
	1044	1064	S	2	X	3	5
	1046	1048	S	4	X	2	5
	1046	1072	S	4	X	1	5
	1048	1050	S	4	X	2	5
	1050	1052	S	4	X	2	5
	1052	1054	S	4	X	2	5
	1052	1096	S	2	X	3	5
	1054	1056	S	4	X	2	3
	1056	1058	S	4	X	2	4
	1058	1060	S	6	X	1	5
	1058	1062	S	4	X	2	2
	1060	1074	S	6	X	1	5
	1062	1064	S	4	X	3	4
	1064	1066	S	2	X	3	3
	1066	1068	S	2	X	3	3

TABLE H-6 (continued)

PALM BEACH COUNTY LINK-NODE FILE

1068	1070	S	2		3	3
1070	1078	S	2		3	3
1072	1132	S	4	X	1	5
1074	1076	S	4	X	4	3
1074	1088	S	6	X	1	5
1076	1078	S	2	X	4	3
1078	1080	S	2	X	3	3
1080	1082	S	2	X	3	3
1080	1084	S	2	X	3	5
1082	1108	S	2	X	3	3
1084	1086	S	4	X	2	4
1086	1088	S	4	X	2	3
1088	1090	S	6	X	2	3
1088	1120	S	6	X	1	5
1090	1092	S	2	X	3	5
1092	1094	S	2	X	3	5
1094	1096	S	2	X	3	5
1096	1098	S	2	X	3	5
1096	1104	S	2	X	3	5
1098	1100	S	2	X	3	5
1100	1102	S	2	X	3	5
1104	1106	S	2	X	3	5
1106	1124	S	2	X	3	5
1108	1110	S	2	X	3	3
1110	1112	S	2	X	3	3
1110	1114	S	2	X	3	5
1112	1150	S	2	X	3	3
1114	1116	S	4	X	3	4
1116	1118	S	4	X	2	4
1118	1120	S	4	X	2	4
1120	1122	S	2	X	3	5
1120	1144	S	6	X	1	5
1122	1124	S	2	X	3	5
1124	1126	S	2	X	3	5
1124	1140	S	2	X	3	5
1126	1128	S	2	X	3	5
1130	1132	S	2	X	3	5
1132	1134	S	4	X	2	4
1132	1178	S	4	X	1	5
1134	1136	S	4	X	2	4
1136	1138	S	4	X	2	3
1138	1140	S	4	X	2	3
1140	1142	S	4	X	2	3
1140	1168	S	6	X	2	4
1142	1146	S	4	X	2	4
1144	1162	S	6	X	1	5
1146	1148	S	4	X	2	1
1148	1150	S	2	X	3	3
1148	1152	S	2	X	3	3
1152	1154	S	2	X	3	3
1154	1156	S	2	X	3	3
1156	1158	S	2	X	3	3
1156	1160	S	2	X	3	5
1158	1204	S	4	X	3	3
1160	1162	S	4	X	3	4
1162	1164	S	6	X	1	5
1162	1166	S	4	X	2	5
1164	1198	S	6	X	1	5
1166	1168	S	4	X	2	4
1168	1170	S	2	X	3	4
1168	1184	S	6	X	2	4
1170	1172	S	2	X	3	5
1172	1174	S	2	X	3	5
1174	1316	S	2	X	3	5
1176	1178	S	2	X	3	5
1178	1180	S	4	X	1	5
1178	1182	S	4	X	2	4
1180	1256	S	4	X	1	5
1182	1184	S	4	X	2	4
1184	1186	S	4	X	2	4
1184	1236	S	4	X	2	4
1186	1188	S	4	X	2	4
1188	1190	S	4	X	2	4
1188	1192	S	6	X	2	4
1190	1198	S	4	X	2	4
1192	1194	S	6	X	2	4
1192	1198	S	6	X	1	5
1192	1230	S	6	X	1	5
1194	1196	S	6	X	2	4
1196	1210	S	4	X	3	3
1198	1200	S	6	X	2	3

1200	1202	S	6	X	2	2
1202	1204	S	4	X	3	4
1204	1206	S	4	X	3	4
1206	1208	S	4	X	3	5
1208	1210	S	4	X	3	3
1210	1212	S	4	X	3	3
1212	1214	S	4	X	3	3
1214	1216	S	4	X	3	4
1216	1222	S	4	X	3	4
1218	1220	S	2	X	4	3
1218	1222	S	4	X	4	5
1220	1278	S	2	X	4	3
1222	1224	S	4	X	3	4
1224	1226	S	6	X	2	4
1226	1228	S	6	X	2	3
1228	1232	S	6	X	2	3
1230	1232	S	6	X	1	5
1232	1234	S	6	X	2	4
1232	1262	S	6	X	1	5
1234	1238	S	2	X	3	5
1234	1240	S	2	X	2	3
1236	1240	S	2	X	2	5
1238	1242	S	2	X	3	5
1242	1244	S	2	X	3	5
1242	1256	S	2	X	3	5
1244	1246	S	2	X	3	5
1246	1248	S	2	X	3	5
1248	1250	S	2	X	3	5
1250	1252	S	2	X	3	5
1252	1254	S	2	X	3	5
1254	1256	S	4	X	1	5
1254	1314	S	2	X	3	5
1256	1258	S	4	X	2	5
1258	1260	S	4	X	2	5
1260	1262	S	6	X	1	5
1260	1264	S	6	X	2	5
1264	1266	S	4	X	2	5
1264	1290	S	2	X	3	5
1266	1270	S	4	X	2	4
1268	1270	S	4	X	2	4
1270	1272	S	2	X	4	5
1270	1280	S	2	X	4	3
1272	1274	S	2	X	4	5
1274	1276	S	2	X	4	3
1276	1278	S	2	X	4	3
1280	1282	S	2	X	4	3
1282	1284	S	2	X	4	3
1284	1286	S	2	X	4	5
1284	1288	S	2	X	4	5
1286	1296	S	2	X	4	5
1288	1290	S	2	X	4	5
1290	1292	S	2	X	4	5
1290	1308	S	2	X	3	5
1292	1294	S	2	X	4	5
1296	1298	S	2	X	4	5
1298	1300	S	2	X	4	3
1298	1308	S	2	X	3	5
1300	1302	S	6	X	2	4
1300	1306	S	4	X	2	4
1302	1304	S	6	X	2	5
1306	1308	S	2	X	3	4
1308	1310	S	2	X	3	4
1310	1312	S	2	X	3	4
1312	1314	S	2	X	3	5
1316	1318	S	2	X	3	5
1318	1320	S	2	X	3	5
1320	1322	S	2	X	3	5
1320	1350	S	2	X	3	5
1322	1324	S	2	X	3	5
1324	1326	S	2	X	3	5
1326	1328	S	2	X	3	5
1328	1330	S	2	X	3	5
1328	1332	S	2	X	3	5
1332	1334	S	2	X	3	5
1334	1336	S	2	X	3	5
1334	1338	S	2	X	3	5
1338	1340	S	2	X	3	5
1340	1342	S	2	X	3	5
1342	1344	S	2	X	3	5
1344	1346	S	2	X	3	5
1346	1348	S	2	X	3	5

Trip Generation

This step included compilation of traffic analysis zonal data into a traffic-evacuation zonal data file using a TAZ-traffic-evacuation zone equivalency chart. Specific socioeconomic variables were then manipulated to produce total evacuation vehicles originating in each traffic-evacuation zone. For Dade, Broward, and Palm Beach counties, vehicle productions by traffic-evacuation zone were calculated using the following formulas:

For Surge Areas:

(zonal residential autos) X (assumed D.U. occupancy) X (assumed % of residential autos to be used in an evacuation) + (zonal hotel/motel units) X (assumed occupancy) X (1 evacuation vehicle per unit)

For Wind Only:

(mobile home units) X (assumed mobile home occupancy) X (1 evacuation vehicle per unit)

In Monroe County, since residential auto information was not available, vehicle productions by traffic-evacuation zone were calculated using the following formulas:

Lower Keys:

(total dwelling units - naval air station units) X (.96 assumed evacuation vehicles per unit) X (assumed occupancy) + (hotel/motel units + recreational vehicle units) X (1 evacuation vehicle per unit) X (assumed occupancy)

Middle and Upper Keys:

(total dwelling units) X (1.14 evacuation vehicles per unit) X (assumed occupancy) + (hotel/motel units + recreational vehicle units) x (1 evacuation vehicle per unit) X (assumed occupancy)

These originating vehicles by zone were stratified by destination category, for each storm situation, and for an assumed high or low participation in the evacuation by the population-at-risk. Tables H7-10 provide a continuous listing of the vehicle productions for each county resulting from differing storm situations and low or high participation in the evacuation. Hotel/motel unit and Red Cross shelter data were used to develop estimates of the number of evacuation vehicles that would find acceptable destinations in each zone for those destination types. For the home of a friend destination type, relative population totals for each traffic evacuation zone were used to derive a weighted estimate of the attractions available for total numbers of evacuees desiring the home of a friend.

In this transportation modelling effort, originating vehicles are called "productions," while acceptable destinations for vehicles are called

TABLE H-7

MONROE COUNTY VEHICLE PRODUCTIONS

CAT 1-2 STORM SITUATION - LOWER KEYS
HIGH EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	9093	2273	2153	61	30	30	0	4547	1187	1300	346	191	1523	2273	593	650	173	95	761	0
ZONE # 2	1915	479	454	13	6	6	0	958	250	274	73	40	321	479	125	137	36	20	160	0
ZONE # 3	4139	1035	980	28	13	13	0	2070	540	592	157	87	693	1035	270	296	79	43	347	0
ZONE # 4	8011	801	641	80	80	0	0	4807	519	2514	197	125	1404	2403	260	1257	99	62	702	0
ZONE # 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CAT 1-2 STORM SITUATION - LOWER KEYS
LOW EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	9093	1364	1292	37	18	18	0	2273	593	650	173	95	761	909	237	260	69	38	305	4547
ZONE # 2	1915	287	272	8	4	4	0	479	125	137	36	20	160	192	50	55	15	8	64	958
ZONE # 3	4139	621	588	17	8	8	0	1035	270	296	79	43	347	414	108	118	31	17	139	2070
ZONE # 4	8011	401	321	40	40	0	0	2804	303	1466	115	73	819	1602	173	838	66	42	468	3204
ZONE # 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CAT 3-5 STORM SITUATION - LOWER KEYS
HIGH EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	9093	2273	2153	61	30	30	0	4547	1187	1300	346	191	1523	2273	593	650	173	95	761	0
ZONE # 2	1915	479	454	13	6	6	0	958	250	274	73	40	321	479	125	137	36	20	160	0
ZONE # 3	4139	1035	980	28	13	13	0	2070	540	592	157	87	693	1035	270	296	79	43	347	0
ZONE # 4	8011	801	641	80	80	0	0	4807	519	2514	197	125	1404	2403	260	1257	99	62	702	0
ZONE # 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CAT 3-5 STORM SITUATION - LOWER KEYS
LOW EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	9093	2273	2153	61	30	30	0	3183	831	910	242	134	1066	1819	475	520	138	76	609	1819
ZONE # 2	1915	479	454	13	6	6	0	670	175	192	51	28	224	383	100	110	29	16	128	383
ZONE # 3	4139	1035	980	28	13	13	0	1449	378	414	110	61	485	828	216	237	63	35	277	828
ZONE # 4	8011	401	321	40	40	0	0	4006	433	2095	164	104	1170	2403	260	1257	99	62	702	1202
ZONE # 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe County
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-7 (continued)

MONROE COUNTY VEHICLE PRODUCTIONS

CAT 1-2 STORM SITUATION - MIDDLE KEYS
HIGH EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 4	8011	801	641	80	80	0	0	4807	519	2514	197	125	1404	2403	260	1257	99	62	702	0
ZONE # 5	13045	1305	1044	131	131	0	0	7827	845	4094	321	204	2285	3914	423	2047	160	102	1143	0

CAT 1-2 STORM SITUATION - MIDDLE KEYS
LOW EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 4	8011	401	321	40	40	0	0	2804	303	1466	115	73	819	1602	173	838	66	42	468	3204
ZONE # 5	13045	652	522	65	65	0	0	4566	493	2388	187	119	1333	2609	282	1365	107	68	762	5218

CAT 3-5 STORM SITUATION - MIDDLE KEYS
HIGH EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 4	8011	801	641	80	80	0	0	4807	519	2514	197	125	1404	2403	260	1257	99	62	702	0
ZONE # 5	13045	1305	1044	131	131	0	0	7827	845	4094	321	204	2285	3914	423	2047	160	102	1143	0

CAT 3-5 STORM SITUATION - MIDDLE KEYS
LOW EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 4	8011	401	321	40	40	0	0	4006	433	2095	164	104	1170	2403	260	1257	99	62	702	1202
ZONE # 5	13045	652	522	65	65	0	0	6523	704	3412	267	170	1905	3914	423	2047	160	102	1143	1957

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe County
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-7 (continued)

MONROE COUNTY VEHICLE PRODUCTIONS

CAT 1-2 STORM SITUATION - UPPER KEYS
HIGH EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 5	13045	1305	1044	131	131	0	0	7827	845	4094	321	204	2285	3914	423	2047	160	102	1143	0

CAT 1-2 STORM SITUATION - UPPER KEYS
LOW EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 5	13045	652	522	65	65	0	0	4566	493	2388	187	119	1333	2609	282	1365	107	68	762	5218

CAT 3-5 STORM SITUATION - UPPER KEYS
HIGH EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 5	13045	1305	1044	131	131	0	0	7827	845	4094	321	204	2285	3914	423	2047	160	102	1143	0

CAT 3-5 STORM SITUATION - UPPER KEYS
LOW EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 5	13045	652	522	65	65	0	0	6523	704	3412	267	170	1905	3914	423	2047	160	102	1143	1957

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe County
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-8

DADE COUNTY VEHICLE PRODUCTIONS

CAT 1-3 STORM SITUATION
HIGH EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	2986	597	0	0	0	0	0	1941	0	1231	175	52	483	448	0	284	40	12	112	0
ZONE # 2	16675	3335	0	0	0	0	0	10839	0	6872	976	293	2699	2501	0	1586	225	68	623	0
ZONE # 3	1677	335	0	0	0	0	0	1090	0	691	98	29	271	252	0	160	23	7	63	0
ZONE # 4	10246	2049	0	0	0	0	0	6660	0	4222	599	180	1658	1537	0	974	138	41	383	0
ZONE # 5	12583	2517	0	0	0	0	0	8179	0	5185	736	221	2037	1887	0	1196	170	51	470	0
ZONE # 6	6749	1350	0	0	0	0	0	4387	0	2781	395	118	1092	1012	0	642	91	27	252	0
ZONE # 7	5768	1154	0	0	0	0	0	3749	0	2377	337	101	934	865	0	548	78	23	215	0
ZONE # 8	4203	841	0	0	0	0	0	2732	0	1732	246	74	680	630	0	399	57	17	157	0
ZONE # 9	2111	422	0	0	0	0	0	1372	0	870	123	37	342	317	0	201	29	9	79	0
ZONE # 10	2021	404	0	0	0	0	0	1314	0	833	118	35	327	303	0	192	27	8	75	0
ZONE # 11	4503	901	0	0	0	0	0	2927	0	1856	263	79	729	675	0	428	61	18	168	0
ZONE # 12	2616	523	0	0	0	0	0	1700	0	1078	153	46	423	392	0	249	35	11	98	0
ZONE # 13	1732	346	0	0	0	0	0	1126	0	714	101	30	280	260	0	165	23	7	65	0
ZONE # 14	2039	408	0	0	0	0	0	1325	0	840	119	36	330	306	0	194	28	8	76	0
ZONE # 15	712	142	0	0	0	0	0	463	0	294	42	13	115	107	0	68	10	3	27	0
ZONE # 16	823	165	0	0	0	0	0	535	0	339	48	14	133	123	0	78	11	3	31	0
ZONE # 17	455	91	0	0	0	0	0	296	0	188	27	8	74	68	0	43	6	2	17	0
ZONE # 18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 19	1277	255	0	0	0	0	0	830	0	526	75	22	207	192	0	122	17	5	48	0
ZONE # 20	1108	222	0	0	0	0	0	720	0	456	65	19	179	166	0	105	15	4	41	0
ZONE # 21	96	19	0	0	0	0	0	62	0	39	6	2	15	14	0	9	1	0	3	0
ZONE # 22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 25	857	171	0	0	0	0	0	557	0	353	50	15	139	129	0	82	12	3	32	0
ZONE # 26	325	65	0	0	0	0	0	211	0	134	19	6	53	49	0	31	4	1	12	0
ZONE # 27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 28	357	71	0	0	0	0	0	232	0	147	21	6	58	54	0	34	5	1	13	0
ZONE # 29	197	39	0	0	0	0	0	128	0	81	12	3	32	30	0	19	3	1	7	0
ZONE # 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 31	723	145	0	0	0	0	0	470	0	298	42	13	117	108	0	68	10	3	27	0
ZONE # 32	321	64	0	0	0	0	0	209	0	133	19	6	52	48	0	30	4	1	12	0
ZONE # 33	477	95	0	0	0	0	0	310	0	197	28	8	77	72	0	46	6	2	18	0
ZONE # 34	418	84	0	0	0	0	0	272	0	172	24	7	68	63	0	40	6	2	16	0
ZONE # 35	893	179	0	0	0	0	0	580	0	368	52	16	144	134	0	85	12	4	33	0
ZONE # 36	477	95	0	0	0	0	0	310	0	197	28	8	77	72	0	46	6	2	18	0
ZONE # 37	628	126	0	0	0	0	0	408	0	259	37	11	102	94	0	60	8	3	23	

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe Country
d = Dade County
b = Broward County
p = Palm Beach County
o = Out of Region

TABLE H-8 (continued)

DADE COUNTY VEHICLE PRODUCTIONS

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 38	3672	734	0	0	0	0	0	2387	0	1513	215	64	594	551	0	349	50	15	137	0
ZONE # 39	230	46	0	0	0	0	0	150	0	95	14	4	37	35	0	22	3	1	9	0
ZONE # 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 43	55	11	0	0	0	0	0	36	0	23	3	1	9	8	0	5	1	0	2	0
ZONE # 44	3438	688	0	0	0	0	0	2235	0	1417	201	60	557	516	0	327	46	14	128	0
ZONE # 45	769	154	0	0	0	0	0	500	0	317	45	14	125	115	0	73	10	3	29	0
ZONE # 46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 47	74	15	0	0	0	0	0	48	0	30	4	1	12	11	0	7	1	0	3	0

CAT 1-3 STORM SITUATION
LOW EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	2986	448	0	0	0	0	0	1344	0	852	121	36	335	299	0	190	27	8	74	0
ZONE # 2	16675	2501	0	0	0	0	0	7504	0	4758	675	203	1868	1668	0	1058	150	45	415	0
ZONE # 3	1677	252	0	0	0	0	0	755	0	479	68	20	188	168	0	107	15	5	42	0
ZONE # 4	10246	1537	0	0	0	0	0	4611	0	2923	415	124	1148	1025	0	650	92	28	255	0
ZONE # 5	12583	1887	0	0	0	0	0	5662	0	3590	510	153	1410	1258	0	798	113	34	313	0
ZONE # 6	6749	1012	0	0	0	0	0	3037	0	1925	273	82	756	675	0	428	61	18	168	0
ZONE # 7	5768	865	0	0	0	0	0	2596	0	1646	234	70	646	577	0	366	52	16	144	0
ZONE # 8	4203	630	0	0	0	0	0	1891	0	1199	170	51	471	420	0	266	38	11	105	0
ZONE # 9	2111	317	0	0	0	0	0	950	0	602	86	26	237	211	0	134	19	6	53	0
ZONE # 10	2021	303	0	0	0	0	0	909	0	576	82	25	226	202	0	128	18	5	50	0
ZONE # 11	4503	675	0	0	0	0	0	2026	0	1284	182	55	504	450	0	285	41	12	112	0
ZONE # 12	2616	392	0	0	0	0	0	1177	0	746	106	32	293	262	0	166	24	7	65	0
ZONE # 13	1732	260	0	0	0	0	0	779	0	494	70	21	194	173	0	110	16	5	43	0
ZONE # 14	2039	306	0	0	0	0	0	918	0	582	83	25	229	204	0	129	18	6	51	0
ZONE # 15	712	107	0	0	0	0	0	320	0	203	29	9	80	71	0	45	6	2	18	0
ZONE # 16	823	123	0	0	0	0	0	370	0	235	33	10	92	82	0	52	7	2	20	0
ZONE # 17	455	68	0	0	0	0	0	205	0	130	18	6	51	46	0	29	4	1	11	0
ZONE # 18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 19	1277	192	0	0	0	0	0	575	0	365	52	16	143	128	0	81	12	3	32	0
ZONE # 20	1108	166	0	0	0	0	0	499	0	316	45	13	124	111	0	70	10	3	28	0
ZONE # 21	96	14	0	0	0	0	0	43	0	27	4	1	11	10	0	6	1	0	2	0
ZONE # 22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe Country
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-8 (continued)

DADE COUNTY VEHICLE PRODUCTIONS

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 25	857	129	0	0	0	0	0	386	0	245	35	10	96	86	0	55	8	2	21	0
ZONE # 26	325	49	0	0	0	0	0	146	0	93	13	4	36	33	0	21	3	1	8	0
ZONE # 27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 28	357	54	0	0	0	0	0	161	0	102	14	4	40	36	0	23	3	1	9	0
ZONE # 29	197	30	0	0	0	0	0	89	0	56	8	2	22	20	0	13	2	1	5	0
ZONE # 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 31	723	108	0	0	0	0	0	325	0	206	29	9	81	72	0	46	6	2	18	0
ZONE # 32	321	48	0	0	0	0	0	144	0	91	13	4	36	32	0	20	3	1	8	0
ZONE # 33	477	72	0	0	0	0	0	215	0	136	19	6	54	48	0	30	4	1	12	0
ZONE # 34	418	63	0	0	0	0	0	188	0	119	17	5	47	42	0	27	4	1	10	0
ZONE # 35	893	134	0	0	0	0	0	402	0	255	36	11	100	89	0	56	8	2	22	0
ZONE # 36	477	72	0	0	0	0	0	215	0	136	19	6	54	48	0	30	4	1	12	0
ZONE # 37	628	94	0	0	0	0	0	283	0	179	25	8	70	63	0	40	6	2	16	0
ZONE # 38	3672	551	0	0	0	0	0	1652	0	1047	149	45	411	367	0	233	33	10	91	0
ZONE # 39	230	35	0	0	0	0	0	104	0	66	9	3	26	23	0	15	2	1	6	0
ZONE # 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 43	55	8	0	0	0	0	0	25	0	16	2	1	6	6	0	4	1	0	1	0
ZONE # 44	3438	516	0	0	0	0	0	1547	0	981	139	42	385	344	0	218	31	9	86	0
ZONE # 45	769	115	0	0	0	0	0	346	0	219	31	9	86	77	0	49	7	2	19	0
ZONE # 46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 47	74	11	0	0	0	0	0	33	0	21	3	1	8	7	0	4	1	0	2	0

CAT 4-5 STORM SITUATION
HIGH EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	2986	747	0	0	0	0	0	1792	0	1136	161	48	446	448	0	284	40	12	112	0
ZONE # 2	16675	4169	0	0	0	0	0	10005	0	6343	900	270	2491	2501	0	1586	225	68	623	0
ZONE # 3	1677	419	0	0	0	0	0	1006	0	638	91	27	250	252	0	160	23	7	63	0
ZONE # 4	10246	2562	0	0	0	0	0	6148	0	3898	553	166	1531	1537	0	974	138	41	383	0
ZONE # 5	12583	3146	0	0	0	0	0	7550	0	4787	680	204	1880	1887	0	1196	170	51	470	0
ZONE # 6	6749	1687	0	0	0	0	0	4049	0	2567	364	109	1008	1012	0	642	91	27	252	0
ZONE # 7	5768	1442	0	0	0	0	0	3461	0	2194	311	93	862	865	0	548	78	23	215	0
ZONE # 8	4203	1051	0	0	0	0	0	2522	0	1599	227	68	628	630	0	399	57	17	157	0
ZONE # 9	2111	528	0	0	0	0	0	1267	0	803	114	34	315	317	0	201	29	9	79	0
ZONE # 10	2021	505	0	0	0	0	0	1213	0	769	109	33	302	303	0	192	27	8	75	0
ZONE # 11	4503	1126	0	0	0	0	0	2702	0	1713	243	73	673	675	0	428	61	18	168	0

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe Country
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-8 (continued)

DADE COUNTY VEHICLE PRODUCTIONS

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 12	2616	654	0	0	0	0	0	1570	0	995	141	42	391	392	0	249	35	11	98	0
ZONE # 13	1732	433	0	0	0	0	0	1039	0	659	94	28	259	260	0	165	23	7	65	0
ZONE # 14	2039	510	0	0	0	0	0	1223	0	775	110	33	305	306	0	194	28	8	76	0
ZONE # 15	712	178	0	0	0	0	0	427	0	271	38	12	106	107	0	68	10	3	27	0
ZONE # 16	823	206	0	0	0	0	0	494	0	313	44	13	123	123	0	78	11	3	31	0
ZONE # 17	455	114	0	0	0	0	0	273	0	173	25	7	68	68	0	43	6	2	17	0
ZONE # 18	118	30	0	0	0	0	0	71	0	45	6	2	18	18	0	11	2	0	4	0
ZONE # 19	5835	1459	0	0	0	0	0	3501	0	2220	315	95	872	875	0	555	79	24	218	0
ZONE # 20	7268	1817	0	0	0	0	0	4361	0	2765	392	118	1086	1090	0	691	98	29	271	0
ZONE # 21	4205	1051	0	0	0	0	0	2523	0	1600	227	68	628	631	0	400	57	17	157	0
ZONE # 22	10312	2578	0	0	0	0	0	6187	0	3923	557	167	1541	1547	0	981	139	42	385	0
ZONE # 23	5879	1470	0	0	0	0	0	3527	0	2236	317	95	878	882	0	559	79	24	220	0
ZONE # 24	5847	1462	0	0	0	0	0	3508	0	2224	316	95	873	877	0	556	79	24	218	0
ZONE # 25	4637	1159	0	0	0	0	0	2782	0	1764	250	75	693	696	0	441	63	19	173	0
ZONE # 26	325	81	0	0	0	0	0	195	0	124	18	5	49	49	0	31	4	1	12	0
ZONE # 27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 28	357	89	0	0	0	0	0	214	0	136	19	6	53	54	0	34	5	1	13	0
ZONE # 29	197	49	0	0	0	0	0	118	0	75	11	3	29	30	0	19	3	1	7	0
ZONE # 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 31	723	181	0	0	0	0	0	434	0	275	39	12	108	108	0	68	10	3	27	0
ZONE # 32	321	80	0	0	0	0	0	193	0	122	17	5	48	48	0	30	4	1	12	0
ZONE # 33	477	119	0	0	0	0	0	286	0	181	26	8	71	72	0	46	6	2	18	0
ZONE # 34	418	105	0	0	0	0	0	251	0	159	23	7	62	63	0	40	6	2	16	0
ZONE # 35	893	223	0	0	0	0	0	536	0	340	48	14	133	134	0	85	12	4	33	0
ZONE # 36	477	119	0	0	0	0	0	286	0	181	26	8	71	72	0	46	6	2	18	0
ZONE # 37	628	157	0	0	0	0	0	377	0	239	34	10	94	94	0	60	8	3	23	0
ZONE # 38	3672	918	0	0	0	0	0	2203	0	1397	198	59	549	551	0	349	50	15	137	0
ZONE # 39	230	58	0	0	0	0	0	138	0	87	12	4	34	35	0	22	3	1	9	0
ZONE # 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 43	55	14	0	0	0	0	0	33	0	21	3	1	8	8	0	5	1	0	2	0
ZONE # 44	3438	860	0	0	0	0	0	2063	0	1308	186	56	514	516	0	327	46	14	128	0
ZONE # 45	769	192	0	0	0	0	0	461	0	292	41	12	115	115	0	73	10	3	29	0
ZONE # 46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 47	74	19	0	0	0	0	0	44	0	28	4	1	11	11	0	7	1	0	3	0

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe Country
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-8 (continued)

DADE COUNTY VEHICLE PRODUCTIONS

CAT 4-5 STORM SITUATION
LOW EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	2986	597	0	0	0	0	0	1493	0	947	134	40	372	358	0	227	32	10	89	0
ZONE # 2	16675	3335	0	0	0	0	0	8338	0	5286	750	225	2076	2001	0	1269	180	54	498	0
ZONE # 3	1677	335	0	0	0	0	0	839	0	532	76	23	209	201	0	127	18	5	50	0
ZONE # 4	10246	2049	0	0	0	0	0	5123	0	3248	461	138	1276	1230	0	780	111	33	306	0
ZONE # 5	12583	2517	0	0	0	0	0	6292	0	3989	566	170	1567	1510	0	957	136	41	376	0
ZONE # 6	6749	1350	0	0	0	0	0	3375	0	2140	304	91	840	810	0	514	73	22	202	0
ZONE # 7	5768	1154	0	0	0	0	0	2884	0	1828	260	78	718	692	0	439	62	19	172	0
ZONE # 8	4203	841	0	0	0	0	0	2102	0	1333	189	57	523	504	0	320	45	14	125	0
ZONE # 9	2111	422	0	0	0	0	0	1056	0	670	95	29	263	253	0	160	23	7	63	0
ZONE # 10	2021	404	0	0	0	0	0	1011	0	641	91	27	252	243	0	154	22	7	61	0
ZONE # 11	4503	901	0	0	0	0	0	2252	0	1428	203	61	561	540	0	342	49	15	134	0
ZONE # 12	2616	523	0	0	0	0	0	1308	0	829	118	35	326	314	0	199	28	8	78	0
ZONE # 13	1732	346	0	0	0	0	0	866	0	549	78	23	216	208	0	132	19	6	52	0
ZONE # 14	2039	408	0	0	0	0	0	1020	0	647	92	28	254	245	0	155	22	7	61	0
ZONE # 15	712	142	0	0	0	0	0	356	0	226	32	10	89	85	0	54	8	2	21	0
ZONE # 16	823	165	0	0	0	0	0	412	0	261	37	11	103	99	0	63	9	3	25	0
ZONE # 17	455	91	0	0	0	0	0	228	0	145	21	6	57	55	0	35	5	1	14	0
ZONE # 18	118	24	0	0	0	0	0	59	0	37	5	2	15	14	0	9	1	0	3	0
ZONE # 19	5835	1167	0	0	0	0	0	2918	0	1850	263	79	727	700	0	444	63	19	174	0
ZONE # 20	7268	1454	0	0	0	0	0	3634	0	2304	327	98	905	872	0	553	78	24	217	0
ZONE # 21	4205	841	0	0	0	0	0	2103	0	1333	189	57	524	505	0	320	45	14	126	0
ZONE # 22	10312	2062	0	0	0	0	0	5156	0	3269	464	139	1284	1237	0	784	111	33	308	0
ZONE # 23	5879	1176	0	0	0	0	0	2940	0	1864	265	79	732	705	0	447	63	19	176	0
ZONE # 24	5847	1169	0	0	0	0	0	2924	0	1854	263	79	728	702	0	445	63	19	175	0
ZONE # 25	4637	927	0	0	0	0	0	2319	0	1470	209	63	577	556	0	353	50	15	138	0
ZONE # 26	325	65	0	0	0	0	0	163	0	103	15	4	41	39	0	25	4	1	10	0
ZONE # 27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 28	357	71	0	0	0	0	0	179	0	113	16	5	45	43	0	27	4	1	11	0
ZONE # 29	197	39	0	0	0	0	0	99	0	63	9	3	25	24	0	15	2	1	6	0
ZONE # 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 31	723	145	0	0	0	0	0	362	0	230	33	10	90	87	0	55	8	2	22	0
ZONE # 32	321	64	0	0	0	0	0	161	0	102	14	4	40	39	0	25	4	1	10	0
ZONE # 33	477	95	0	0	0	0	0	239	0	152	22	6	60	57	0	36	5	2	14	0
ZONE # 34	418	84	0	0	0	0	0	209	0	133	19	6	52	50	0	32	5	1	12	0
ZONE # 35	893	179	0	0	0	0	0	447	0	283	40	12	111	107	0	68	10	3	27	0
ZONE # 36	477	95	0	0	0	0	0	239	0	152	22	6	60	57	0	36	5	2	14	0
ZONE # 37	628	126	0	0	0	0	0	314	0	199	28	8	78	75	0	48	7	2	19	0

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe Country
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-8 (continued)

DADE COUNTY VEHICLE PRODUCTIONS

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 38	3672	734	0	0	0	0	0	1836	0	1164	165	50	457	441	0	280	40	12	110	0
ZONE # 39	230	46	0	0	0	0	0	115	0	73	10	3	29	28	0	18	3	1	7	0
ZONE # 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 43	55	11	0	0	0	0	0	28	0	18	3	1	7	7	0	4	1	0	2	0
ZONE # 44	3438	688	0	0	0	0	0	1719	0	1090	155	46	428	413	0	262	37	11	103	0
ZONE # 45	769	154	0	0	0	0	0	385	0	244	35	10	96	92	0	58	8	2	23	0
ZONE # 46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 47	74	15	0	0	0	0	0	37	0	23	3	1	9	9	0	6	1	0	2	0

TABLE H-9

BROWARD COUNTY VEHICLE PRODUCTIONS

CAT 1-3 STORM SITUATION
HIGH EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	4190	838	0	0	0	0	0	2724	0	131	1545	57	992	629	0	30	357	13	229	0
ZONE # 2	6119	1224	0	0	0	0	0	3977	0	191	2255	84	1448	918	0	44	521	19	334	0
ZONE # 3	8596	1719	0	0	0	0	0	5587	0	268	3168	117	2034	1289	0	62	731	27	469	0
ZONE # 4	15685	3137	0	0	0	0	0	10195	0	489	5781	214	3711	2353	0	113	1334	49	856	0
ZONE # 5	7173	1435	0	0	0	0	0	4662	0	224	2643	98	1697	1076	0	52	610	23	392	0
ZONE # 6	2639	528	0	0	0	0	0	1715	0	82	972	36	624	396	0	19	225	8	144	0
ZONE # 7	1193	239	0	0	0	0	0	775	0	37	439	16	282	179	0	9	101	4	65	0
ZONE # 8	2611	522	0	0	0	0	0	1697	0	81	962	36	618	392	0	19	222	8	143	0
ZONE # 9	21908	4382	0	0	0	0	0	14240	0	684	8074	299	5183	3286	0	158	1863	69	1196	0
ZONE # 10	468	94	0	0	0	0	0	304	0	15	172	6	111	70	0	3	40	1	25	0
ZONE # 11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 14	28	6	0	0	0	0	0	18	0	1	10	0	7	4	0	0	2	0	1	0
ZONE # 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 16	2124	425	0	0	0	0	0	1381	0	66	783	29	503	319	0	15	181	7	116	0
ZONE # 17	681	136	0	0	0	0	0	443	0	21	251	9	161	102	0	5	58	2	37	0
ZONE # 18	2108	422	0	0	0	0	0	1370	0	66	777	29	499	316	0	15	179	7	115	0
ZONE # 19	4069	814	0	0	0	0	0	2645	0	127	1500	56	963	610	0	29	346	13	222	0
ZONE # 20	654	131	0	0	0	0	0	425	0	20	241	9	155	98	0	5	56	2	36	0
ZONE # 21	293	59	0	0	0	0	0	190	0	9	108	4	69	44	0	2	25	1	16	0
ZONE # 22	465	93	0	0	0	0	0	302	0	14	171	6	110	70	0	3	40	1	25	0
ZONE # 23	889	178	0	0	0	0	0	578	0	28	328	12	210	133	0	6	75	3	48	0
ZONE # 24	440	88	0	0	0	0	0	286	0	14	162	6	104	66	0	3	37	1	24	0
ZONE # 25	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
ZONE # 26	700	140	0	0	0	0	0	455	0	22	258	10	166	105	0	5	60	2	38	0
ZONE # 27	261	52	0	0	0	0	0	170	0	8	96	4	62	39	0	2	22	1	14	0
ZONE # 28	1217	243	0	0	0	0	0	791	0	38	448	17	288	183	0	9	104	4	67	0
ZONE # 29	677	135	0	0	0	0	0	440	0	21	249	9	160	102	0	5	58	2	37	0
ZONE # 30	2	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0

CAT 1-3 STORM SITUATION
LOW EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	4190	629	0	0	0	0	0	1886	0	91	1069	40	687	419	0	20	238	9	153	0
ZONE # 2	6119	918	0	0	0	0	0	2754	0	132	1562	58	1002	612	0	29	347	13	223	0
ZONE # 3	8596	1289	0	0	0	0	0	3868	0	186	2193	81	1408	860	0	41	488	18	313	0
ZONE # 4	15685	2353	0	0	0	0	0	7058	0	339	4002	148	2569	1569	0	75	890	33	571	0

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe County
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-9 (continued)

BROWARD COUNTY VEHICLE PRODUCTIONS

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 5	7173	1076	0	0	0	0	0	3228	0	155	1830	68	1175	717	0	34	407	15	261	0
ZONE # 6	2639	396	0	0	0	0	0	1188	0	57	674	25	432	264	0	13	150	6	96	0
ZONE # 7	1193	179	0	0	0	0	0	537	0	26	304	11	195	119	0	6	67	2	43	0
ZONE # 8	2611	392	0	0	0	0	0	1175	0	56	666	25	428	261	0	13	148	5	95	0
ZONE # 9	21908	3286	0	0	0	0	0	9859	0	473	5590	207	3589	2191	0	105	1242	46	798	0
ZONE # 10	468	70	0	0	0	0	0	211	0	10	120	4	77	47	0	2	27	1	17	0
ZONE # 11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 14	28	4	0	0	0	0	0	13	0	1	7	0	5	3	0	0	2	0	1	0
ZONE # 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 16	2124	319	0	0	0	0	0	956	0	46	542	20	348	212	0	10	120	4	77	0
ZONE # 17	681	102	0	0	0	0	0	306	0	15	174	6	111	68	0	3	39	1	25	0
ZONE # 18	2108	316	0	0	0	0	0	949	0	46	538	20	345	211	0	10	120	4	77	0
ZONE # 19	4069	610	0	0	0	0	0	1831	0	88	1038	38	666	407	0	20	231	9	148	0
ZONE # 20	654	98	0	0	0	0	0	294	0	14	167	6	107	65	0	3	37	1	24	0
ZONE # 21	293	44	0	0	0	0	0	132	0	6	75	3	48	29	0	1	16	1	11	0
ZONE # 22	465	70	0	0	0	0	0	209	0	10	119	4	76	47	0	2	27	1	17	0
ZONE # 23	889	133	0	0	0	0	0	400	0	19	227	8	146	89	0	4	50	2	32	0
ZONE # 24	440	66	0	0	0	0	0	198	0	10	112	4	72	44	0	2	25	1	16	0
ZONE # 25	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 26	700	105	0	0	0	0	0	315	0	15	179	7	115	70	0	3	40	1	25	0
ZONE # 27	261	39	0	0	0	0	0	117	0	6	66	2	43	26	0	1	15	1	9	0
ZONE # 28	1217	183	0	0	0	0	0	548	0	26	311	12	199	122	0	6	69	3	44	0
ZONE # 29	677	102	0	0	0	0	0	305	0	15	173	6	111	68	0	3	39	1	25	0
ZONE # 30	2	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0

CAT 4-5 STORM SITUATION
HIGH EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	4190	1048	0	0	0	0	0	2514	0	121	1425	53	915	629	0	30	357	13	229	0
ZONE # 2	6119	1530	0	0	0	0	0	3671	0	176	2081	77	1336	918	0	44	521	19	334	0
ZONE # 3	8596	2149	0	0	0	0	0	5158	0	248	2925	108	1878	1289	0	62	731	27	469	0
ZONE # 4	15685	3921	0	0	0	0	0	9411	0	452	5336	198	3426	2353	0	113	1334	49	856	0
ZONE # 5	7173	1793	0	0	0	0	0	4304	0	207	2440	90	1567	1076	0	52	610	23	392	0
ZONE # 6	2639	660	0	0	0	0	0	1583	0	76	898	33	576	396	0	19	225	8	144	0
ZONE # 7	1193	298	0	0	0	0	0	716	0	34	406	15	261	179	0	9	101	4	65	0
ZONE # 8	2611	653	0	0	0	0	0	1567	0	75	888	33	570	392	0	19	222	8	143	0
ZONE # 9	21908	5477	0	0	0	0	0	13145	0	631	7453	276	4785	3286	0	158	1863	69	1196	0

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe Country
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-9 (continued)

BROWARD COUNTY VEHICLE PRODUCTIONS

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 10	4768	1192	0	0	0	0	0	2861	0	137	1622	60	1041	715	0	34	405	15	260	0
ZONE # 11	2980	745	0	0	0	0	0	1788	0	86	1014	38	651	447	0	21	253	9	163	0
ZONE # 12	1654	414	0	0	0	0	0	992	0	48	562	21	361	248	0	12	141	5	90	0
ZONE # 13	1059	265	0	0	0	0	0	635	0	30	360	13	231	159	0	8	90	3	58	0
ZONE # 14	1170	293	0	0	0	0	0	702	0	34	398	15	256	176	0	8	100	4	64	0
ZONE # 15	692	173	0	0	0	0	0	415	0	20	235	9	151	104	0	5	59	2	38	0
ZONE # 16	2124	531	0	0	0	0	0	1274	0	61	722	27	464	319	0	15	181	7	116	0
ZONE # 17	681	170	0	0	0	0	0	409	0	20	232	9	149	102	0	5	58	2	37	0
ZONE # 18	2108	527	0	0	0	0	0	1265	0	61	717	27	460	316	0	15	179	7	115	0
ZONE # 19	4069	1017	0	0	0	0	0	2441	0	117	1384	51	889	610	0	29	346	13	222	0
ZONE # 20	654	164	0	0	0	0	0	392	0	19	222	8	143	98	0	5	56	2	36	0
ZONE # 21	293	73	0	0	0	0	0	176	0	8	100	4	64	44	0	2	25	1	16	0
ZONE # 22	465	116	0	0	0	0	0	279	0	13	158	6	102	70	0	3	40	1	25	0
ZONE # 23	889	222	0	0	0	0	0	533	0	26	302	11	194	133	0	6	75	3	48	0
ZONE # 24	440	110	0	0	0	0	0	264	0	13	150	6	96	66	0	3	37	1	24	0
ZONE # 25	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
ZONE # 26	700	175	0	0	0	0	0	420	0	20	238	9	153	105	0	5	60	2	38	0
ZONE # 27	261	65	0	0	0	0	0	157	0	8	89	3	57	39	0	2	22	1	14	0
ZONE # 28	1217	304	0	0	0	0	0	730	0	35	414	15	266	183	0	9	104	4	67	0
ZONE # 29	677	169	0	0	0	0	0	406	0	19	230	9	148	102	0	5	58	2	37	0
ZONE # 30	2	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0

CAT 4-5 STORM SITUATION
LOW EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	4190	838	0	0	0	0	0	2095	0	101	1188	44	763	419	0	20	238	9	153	0
ZONE # 2	6119	1224	0	0	0	0	0	3060	0	147	1735	64	1114	612	0	29	347	13	223	0
ZONE # 3	8596	1719	0	0	0	0	0	4298	0	206	2437	90	1564	860	0	41	488	18	313	0
ZONE # 4	15685	3137	0	0	0	0	0	7843	0	376	4447	165	2855	1569	0	75	890	33	571	0
ZONE # 5	7173	1435	0	0	0	0	0	3587	0	172	2034	75	1306	717	0	34	407	15	261	0
ZONE # 6	2639	528	0	0	0	0	0	1320	0	63	748	28	480	264	0	13	150	6	96	0
ZONE # 7	1193	239	0	0	0	0	0	597	0	29	338	13	217	119	0	6	67	2	43	0
ZONE # 8	2611	522	0	0	0	0	0	1306	0	63	741	27	475	261	0	13	148	5	95	0
ZONE # 9	21908	4382	0	0	0	0	0	10954	0	526	6211	230	3987	2191	0	105	1242	46	798	0
ZONE # 10	4768	954	0	0	0	0	0	2384	0	114	1352	50	868	477	0	23	270	10	174	0
ZONE # 11	2980	596	0	0	0	0	0	1490	0	72	845	31	542	298	0	14	169	6	108	0
ZONE # 12	1654	331	0	0	0	0	0	827	0	40	469	17	301	165	0	8	94	3	60	0
ZONE # 13	1059	212	0	0	0	0	0	530	0	25	301	11	193	106	0	5	60	2	39	0
ZONE # 14	1170	234	0	0	0	0	0	585	0	28	332	12	213	117	0	6	66	2	43	0

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe Country
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-9 (continued)

BROWARD COUNTY VEHICLE PRODUCTIONS

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 15	692	138	0	0	0	0	0	346	0	17	196	7	126	69	0	3	39	1	25	0
ZONE # 16	2124	425	0	0	0	0	0	1062	0	51	602	22	387	212	0	10	120	4	77	0
ZONE # 17	681	136	0	0	0	0	0	341	0	16	193	7	124	68	0	3	39	1	25	0
ZONE # 18	2108	422	0	0	0	0	0	1054	0	51	598	22	384	211	0	10	120	4	77	0
ZONE # 19	4069	814	0	0	0	0	0	2035	0	98	1154	43	741	407	0	20	231	9	148	0
ZONE # 20	654	131	0	0	0	0	0	327	0	16	185	7	119	65	0	3	37	1	24	0
ZONE # 21	293	59	0	0	0	0	0	147	0	7	83	3	54	29	0	1	16	1	11	0
ZONE # 22	465	93	0	0	0	0	0	233	0	11	132	5	85	47	0	2	27	1	17	0
ZONE # 23	889	178	0	0	0	0	0	445	0	21	252	9	162	89	0	4	50	2	32	0
ZONE # 24	440	88	0	0	0	0	0	220	0	11	125	5	80	44	0	2	25	1	16	0
ZONE # 25	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
ZONE # 26	700	140	0	0	0	0	0	350	0	17	198	7	127	70	0	3	40	1	25	0
ZONE # 27	261	52	0	0	0	0	0	131	0	6	74	3	48	26	0	1	15	1	9	0
ZONE # 28	1217	243	0	0	0	0	0	609	0	29	345	13	222	122	0	6	69	3	44	0
ZONE # 29	677	135	0	0	0	0	0	339	0	16	192	7	123	68	0	3	39	1	25	0
ZONE # 30	2	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0

1 = Red Cross Shelter
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m = Monroe Country
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-10

PALM BEACH COUNTY VEHICLE PRODUCTIONS

CAT 1-3 STORM SITUATION
HIGH EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	1016	152	0	0	0	0	0	559	0	4	11	298	246	305	0	2	6	163	134	0
ZONE # 2	2073	311	0	0	0	0	0	1140	0	8	23	608	502	622	0	4	12	332	274	0
ZONE # 3	1528	229	0	0	0	0	0	840	0	6	17	448	370	458	0	3	9	244	202	0
ZONE # 4	360	54	0	0	0	0	0	198	0	1	4	106	87	108	0	1	2	58	48	0
ZONE # 5	2297	345	0	0	0	0	0	1263	0	9	25	673	556	689	0	5	14	367	303	0
ZONE # 6	3052	458	0	0	0	0	0	1679	0	12	34	895	739	916	0	6	18	488	403	0
ZONE # 7	3020	453	0	0	0	0	0	1661	0	12	33	885	731	906	0	6	18	483	399	0
ZONE # 8	3149	472	0	0	0	0	0	1732	0	12	35	923	762	945	0	7	19	504	416	0
ZONE # 9	1612	242	0	0	0	0	0	887	0	6	18	473	390	484	0	3	10	258	213	0
ZONE # 10	1289	193	0	0	0	0	0	709	0	5	14	378	312	387	0	3	8	206	170	0
ZONE # 11	2114	317	0	0	0	0	0	1163	0	8	23	620	512	634	0	4	13	338	279	0
ZONE # 12	508	76	0	0	0	0	0	279	0	2	6	149	123	152	0	1	3	81	67	0
ZONE # 13	1843	276	0	0	0	0	0	1014	0	7	20	540	446	553	0	4	11	295	243	0
ZONE # 14	1070	161	0	0	0	0	0	589	0	4	12	314	259	321	0	2	6	171	141	0
ZONE # 15	1619	243	0	0	0	0	0	890	0	6	18	474	392	486	0	3	10	259	214	0
ZONE # 16	3004	451	0	0	0	0	0	1652	0	12	33	881	727	901	0	6	18	480	396	0
ZONE # 17	1250	188	0	0	0	0	0	688	0	5	14	367	303	375	0	3	8	200	165	0
ZONE # 18	1376	206	0	0	0	0	0	757	0	5	15	403	333	413	0	3	8	220	182	0
ZONE # 19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 25	58	9	0	0	0	0	0	32	0	0	1	17	14	17	0	0	0	9	7	0
ZONE # 26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 27	493	74	0	0	0	0	0	271	0	2	5	144	119	148	0	1	3	79	65	0
ZONE # 28	972	146	0	0	0	0	0	535	0	4	11	285	235	292	0	2	6	156	128	0
ZONE # 29	229	34	0	0	0	0	0	126	0	1	3	67	55	69	0	0	1	37	30	0
ZONE # 30	88	13	0	0	0	0	0	48	0	0	1	26	21	26	0	0	1	14	11	0
ZONE # 31	625	94	0	0	0	0	0	344	0	2	7	183	151	188	0	1	4	100	83	0
ZONE # 32	344	52	0	0	0	0	0	189	0	1	4	101	83	103	0	1	2	55	45	0
ZONE # 33	503	75	0	0	0	0	0	277	0	2	6	148	122	151	0	1	3	80	66	0
ZONE # 34	305	46	0	0	0	0	0	168	0	1	3	90	74	92	0	1	2	49	40	0
ZONE # 35	1162	174	0	0	0	0	0	639	0	4	13	341	281	349	0	2	7	186	154	0
ZONE # 36	86	13	0	0	0	0	0	47	0	0	1	25	21	26	0	0	1	14	11	0
ZONE # 37	816	122	0	0	0	0	0	449	0	3	9	239	198	245	0	2	5	131	108	0

1 = Red Cross Shelter
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m = Monroe Country
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-10 (continued)

PALM BEACH COUNTY VEHICLE PRODUCTIONS

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 38	1011	152	0	0	0	0	0	556	0	4	11	296	245	303	0	2	6	161	133	0
ZONE # 39	954	143	0	0	0	0	0	525	0	4	11	280	231	286	0	2	6	152	126	0
ZONE # 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 41	1726	259	0	0	0	0	0	949	0	7	19	506	418	518	0	4	10	276	228	0
ZONE # 42	154	23	0	0	0	0	0	85	0	1	2	45	37	46	0	0	1	25	20	0
ZONE # 43	65	10	0	0	0	0	0	36	0	0	1	19	16	20	0	0	0	11	9	0
ZONE # 44	650	98	0	0	0	0	0	358	0	3	7	191	158	195	0	1	4	104	86	0
ZONE # 45	183	27	0	0	0	0	0	101	0	1	2	54	44	55	0	0	1	29	24	0
ZONE # 46	1792	269	0	0	0	0	0	986	0	7	20	526	434	538	0	4	11	287	237	0
ZONE # 47	183	27	0	0	0	0	0	101	0	1	2	54	44	55	0	0	1	29	24	0
ZONE # 48	445	67	0	0	0	0	0	245	0	2	5	131	108	134	0	1	3	71	59	0
ZONE # 49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 50	86	13	0	0	0	0	0	47	0	0	1	25	21	26	0	0	1	14	11	0
ZONE # 51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 54	6693	1004	0	0	0	0	0	3681	0	26	74	1962	1620	2008	0	14	40	1070	884	0

CAT 1-3 STORM SITUATION
LOW EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	1016	102	0	0	0	0	0	457	0	3	9	244	201	203	0	1	4	108	89	0
ZONE # 2	2073	207	0	0	0	0	0	933	0	7	19	497	411	415	0	3	8	221	183	0
ZONE # 3	1528	153	0	0	0	0	0	688	0	5	14	367	303	306	0	2	6	163	135	0
ZONE # 4	360	36	0	0	0	0	0	162	0	1	3	86	71	72	0	1	1	38	32	0
ZONE # 5	2297	230	0	0	0	0	0	1034	0	7	21	551	455	459	0	3	9	245	202	0
ZONE # 6	3052	305	0	0	0	0	0	1373	0	10	27	732	604	610	0	4	12	325	268	0
ZONE # 7	3020	302	0	0	0	0	0	1359	0	10	27	724	598	604	0	4	12	322	266	0
ZONE # 8	3149	315	0	0	0	0	0	1417	0	10	28	755	623	630	0	4	13	336	277	0
ZONE # 9	1612	161	0	0	0	0	0	725	0	5	15	386	319	322	0	2	6	172	142	0
ZONE # 10	1289	129	0	0	0	0	0	580	0	4	12	309	255	258	0	2	5	138	114	0
ZONE # 11	2114	211	0	0	0	0	0	951	0	7	19	507	418	423	0	3	8	225	186	0
ZONE # 12	508	51	0	0	0	0	0	229	0	2	5	122	101	102	0	1	2	54	45	0
ZONE # 13	1843	184	0	0	0	0	0	829	0	6	17	442	365	369	0	3	7	197	162	0
ZONE # 14	1070	107	0	0	0	0	0	482	0	3	10	257	212	214	0	1	4	114	94	0
ZONE # 15	1619	162	0	0	0	0	0	729	0	5	15	389	321	324	0	2	6	173	143	0
ZONE # 16	3004	300	0	0	0	0	0	1352	0	9	27	721	595	601	0	4	12	320	264	0
ZONE # 17	1250	125	0	0	0	0	0	563	0	4	11	300	248	250	0	2	5	133	110	0
ZONE # 18	1376	138	0	0	0	0	0	619	0	4	12	330	272	275	0	2	6	147	121	0

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe Country
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-10 (continued)

PALM BEACH COUNTY VEHICLE PRODUCTIONS

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 25	58	6	0	0	0	0	0	26	0	0	1	14	11	12	0	0	0	6	5	0
ZONE # 26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 27	493	49	0	0	0	0	0	222	0	2	4	118	98	99	0	1	2	53	44	0
ZONE # 28	972	97	0	0	0	0	0	437	0	3	9	233	192	194	0	1	4	103	85	0
ZONE # 29	229	23	0	0	0	0	0	103	0	1	2	55	45	46	0	0	1	25	20	0
ZONE # 30	88	9	0	0	0	0	0	40	0	0	1	21	18	18	0	0	0	10	8	0
ZONE # 31	625	63	0	0	0	0	0	281	0	2	6	150	124	125	0	1	3	67	55	0
ZONE # 32	344	34	0	0	0	0	0	155	0	1	3	83	68	69	0	0	1	37	30	0
ZONE # 33	503	50	0	0	0	0	0	226	0	2	5	120	99	101	0	1	2	54	44	0
ZONE # 34	305	31	0	0	0	0	0	137	0	1	3	73	60	61	0	0	1	33	27	0
ZONE # 35	1162	116	0	0	0	0	0	523	0	4	10	279	230	232	0	2	5	124	102	0
ZONE # 36	86	9	0	0	0	0	0	39	0	0	1	21	17	17	0	0	0	9	7	0
ZONE # 37	816	82	0	0	0	0	0	367	0	3	7	196	161	163	0	1	3	87	72	0
ZONE # 38	1011	101	0	0	0	0	0	455	0	3	9	243	200	202	0	1	4	108	89	0
ZONE # 39	954	95	0	0	0	0	0	429	0	3	9	229	189	191	0	1	4	102	84	0
ZONE # 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 41	1726	173	0	0	0	0	0	777	0	5	16	414	342	345	0	2	7	184	152	0
ZONE # 42	154	15	0	0	0	0	0	69	0	0	1	37	30	31	0	0	1	17	14	0
ZONE # 43	65	7	0	0	0	0	0	29	0	0	1	15	13	13	0	0	0	7	6	0
ZONE # 44	650	65	0	0	0	0	0	293	0	2	6	156	129	130	0	1	3	69	57	0
ZONE # 45	183	18	0	0	0	0	0	82	0	1	2	44	36	37	0	0	1	20	16	0
ZONE # 46	1792	179	0	0	0	0	0	806	0	6	16	430	355	358	0	3	7	191	158	0
ZONE # 47	183	18	0	0	0	0	0	82	0	1	2	44	36	37	0	0	1	20	16	0
ZONE # 48	445	45	0	0	0	0	0	200	0	1	4	107	88	89	0	1	2	47	39	0
ZONE # 49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 50	86	9	0	0	0	0	0	39	0	0	1	21	17	17	0	0	0	9	7	0
ZONE # 51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 54	6693	669	0	0	0	0	0	3012	0	21	60	1605	1325	1339	0	9	27	714	589	0

CAT 4-5 STORM SITUATION
HIGH EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	1016	203	0	0	0	0	0	559	0	4	11	298	246	254	0	2	5	135	112	0
ZONE # 2	2073	415	0	0	0	0	0	1140	0	8	23	608	502	518	0	4	10	276	228	0

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe Country
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-10 (continued)

PALM BEACH COUNTY VEHICLE PRODUCTIONS

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 3	1528	306	0	0	0	0	0	840	0	6	17	448	370	382	0	3	8	204	168	0
ZONE # 4	360	72	0	0	0	0	0	198	0	1	4	106	87	90	0	1	2	48	40	0
ZONE # 5	2297	459	0	0	0	0	0	1263	0	9	25	673	556	574	0	4	11	306	253	0
ZONE # 6	3052	610	0	0	0	0	0	1679	0	12	34	895	739	763	0	5	15	407	336	0
ZONE # 7	3020	604	0	0	0	0	0	1661	0	12	33	885	731	755	0	5	15	402	332	0
ZONE # 8	3149	630	0	0	0	0	0	1732	0	12	35	923	762	787	0	6	16	419	346	0
ZONE # 9	1612	322	0	0	0	0	0	887	0	6	18	473	390	403	0	3	8	215	177	0
ZONE # 10	1289	258	0	0	0	0	0	709	0	5	14	378	312	322	0	2	6	172	142	0
ZONE # 11	2114	423	0	0	0	0	0	1163	0	8	23	620	512	529	0	4	11	282	233	0
ZONE # 12	508	102	0	0	0	0	0	279	0	2	6	149	123	127	0	1	3	68	56	0
ZONE # 13	1843	369	0	0	0	0	0	1014	0	7	20	540	446	461	0	3	9	246	203	0
ZONE # 14	1070	214	0	0	0	0	0	589	0	4	12	314	259	268	0	2	5	143	118	0
ZONE # 15	1619	324	0	0	0	0	0	890	0	6	18	474	392	405	0	3	8	216	178	0
ZONE # 16	3004	601	0	0	0	0	0	1652	0	12	33	881	727	751	0	5	15	400	330	0
ZONE # 17	1250	250	0	0	0	0	0	688	0	5	14	367	303	313	0	2	6	167	138	0
ZONE # 18	1376	275	0	0	0	0	0	757	0	5	15	403	333	344	0	2	7	183	151	0
ZONE # 19	204	41	0	0	0	0	0	112	0	1	2	60	49	51	0	0	1	27	22	0
ZONE # 20	418	84	0	0	0	0	0	230	0	2	5	123	101	105	0	1	2	56	46	0
ZONE # 21	1369	274	0	0	0	0	0	753	0	5	15	401	331	342	0	2	7	182	150	0
ZONE # 22	495	99	0	0	0	0	0	272	0	2	5	145	120	124	0	1	2	66	55	0
ZONE # 23	888	178	0	0	0	0	0	488	0	3	10	260	215	222	0	2	4	118	98	0
ZONE # 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 25	58	12	0	0	0	0	0	32	0	0	1	17	14	15	0	0	0	8	7	0
ZONE # 26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 27	493	99	0	0	0	0	0	271	0	2	5	144	119	123	0	1	2	66	54	0
ZONE # 28	972	194	0	0	0	0	0	535	0	4	11	285	235	243	0	2	5	130	107	0
ZONE # 29	229	46	0	0	0	0	0	126	0	1	3	67	55	57	0	0	1	30	25	0
ZONE # 30	88	18	0	0	0	0	0	48	0	0	1	26	21	22	0	0	0	12	10	0
ZONE # 31	625	125	0	0	0	0	0	344	0	2	7	183	151	156	0	1	3	83	69	0
ZONE # 32	344	69	0	0	0	0	0	189	0	1	4	101	83	86	0	1	2	46	38	0
ZONE # 33	503	101	0	0	0	0	0	277	0	2	6	148	122	126	0	1	3	67	55	0
ZONE # 34	305	61	0	0	0	0	0	168	0	1	3	90	74	76	0	1	2	41	33	0
ZONE # 35	1162	232	0	0	0	0	0	639	0	4	13	341	281	291	0	2	6	155	128	0
ZONE # 36	86	17	0	0	0	0	0	47	0	0	1	25	21	22	0	0	0	12	10	0
ZONE # 37	816	163	0	0	0	0	0	449	0	3	9	239	198	204	0	1	4	109	90	0
ZONE # 38	1011	202	0	0	0	0	0	556	0	4	11	296	245	253	0	2	5	135	111	0
ZONE # 39	954	191	0	0	0	0	0	525	0	4	11	280	231	239	0	2	5	127	105	0
ZONE # 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 41	1726	345	0	0	0	0	0	949	0	7	19	506	418	432	0	3	9	230	190	0

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe County
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

TABLE H-10 (continued)

PALM BEACH COUNTY VEHICLE PRODUCTIONS

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 42	154	31	0	0	0	0	0	85	0	1	2	45	37	39	0	0	1	21	17	0
ZONE # 43	65	13	0	0	0	0	0	36	0	0	1	19	16	16	0	0	0	9	7	0
ZONE # 44	650	130	0	0	0	0	0	358	0	3	7	191	158	163	0	1	3	87	72	0
ZONE # 45	183	37	0	0	0	0	0	101	0	1	2	54	44	46	0	0	1	25	20	0
ZONE # 46	1792	358	0	0	0	0	0	986	0	7	20	526	434	448	0	3	9	239	197	0
ZONE # 47	183	37	0	0	0	0	0	101	0	1	2	54	44	46	0	0	1	25	20	0
ZONE # 48	445	89	0	0	0	0	0	245	0	2	5	131	108	111	0	1	2	59	49	0
ZONE # 49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 50	86	17	0	0	0	0	0	47	0	0	1	25	21	22	0	0	0	12	10	0
ZONE # 51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 54	6693	1339	0	0	0	0	0	3681	0	26	74	1962	1620	1673	0	12	33	892	736	0

CAT 4-5 STORM SITUATION
LOW EVACUATION PARTICIPATION BY POPULATION AT RISK

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 1	1016	152	0	0	0	0	0	406	0	3	8	216	179	203	0	1	4	108	89	0
ZONE # 2	2073	311	0	0	0	.0	0	829	0	6	17	442	365	415	0	3	8	221	183	0
ZONE # 3	1528	229	0	0	0	0	0	611	0	4	12	326	269	306	0	2	6	163	135	0
ZONE # 4	360	54	0	0	0	0	0	144	0	1	3	77	63	72	0	1	1	38	32	0
ZONE # 5	2297	345	0	0	0	0	0	919	0	6	18	490	404	459	0	3	9	245	202	0
ZONE # 6	3052	458	0	0	0	0	0	1221	0	9	24	651	537	610	0	4	12	325	268	0
ZONE # 7	3020	453	0	0	0	0	0	1208	0	8	24	644	532	604	0	4	12	322	266	0
ZONE # 8	3149	472	0	0	0	0	0	1260	0	9	25	672	554	630	0	4	13	336	277	0
ZONE # 9	1612	242	0	0	0	0	0	645	0	5	13	344	284	322	0	2	6	172	142	0
ZONE # 10	1289	193	0	0	0	0	0	516	0	4	10	275	227	258	0	2	5	138	114	0
ZONE # 11	2114	317	0	0	0	0	0	846	0	6	17	451	372	423	0	3	8	225	186	0
ZONE # 12	508	76	0	0	0	0	0	203	0	1	4	108	89	102	0	1	2	54	45	0
ZONE # 13	1843	276	0	0	0	0	0	737	0	5	15	393	324	369	0	3	7	197	162	0
ZONE # 14	1070	161	0	0	0	0	0	428	0	3	9	228	188	214	0	1	4	114	94	0
ZONE # 15	1619	243	0	0	0	0	0	648	0	5	13	345	285	324	0	2	6	173	143	0
ZONE # 16	3004	451	0	0	0	0	0	1202	0	8	24	641	529	601	0	4	12	320	264	0
ZONE # 17	1250	188	0	0	0	0	0	500	0	4	10	267	220	250	0	2	5	133	110	0
ZONE # 18	1376	206	0	0	0	0	0	550	0	4	11	293	242	275	0	2	6	147	121	0
ZONE # 19	204	31	0	0	0	0	0	82	0	1	2	44	36	41	0	0	1	22	18	0
ZONE # 20	418	63	0	0	0	0	0	167	0	1	3	89	73	84	0	1	2	45	37	0
ZONE # 21	1369	205	0	0	0	0	0	548	0	4	11	292	241	274	0	2	5	146	121	0

1 = Red Cross Shelter
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TABLE H-10 (continued)

PALM BEACH COUNTY VEHICLE PRODUCTIONS

	Total Veh Prod	1	1m	1d	1b	1p	1o	2	2m	2d	2b	2p	2o	3	3m	3d	3b	3p	3o	4
ZONE # 22	495	74	0	0	0	0	0	198	0	1	4	106	87	99	0	1	2	53	44	0
ZONE # 23	888	133	0	0	0	0	0	355	0	2	7	189	156	178	0	1	4	95	78	0
ZONE # 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 25	58	9	0	0	0	0	0	23	0	0	0	12	10	12	0	0	0	6	5	0
ZONE # 26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 27	493	74	0	0	0	0	0	197	0	1	4	105	87	99	0	1	2	53	44	0
ZONE # 28	972	146	0	0	0	0	0	389	0	3	8	207	171	194	0	1	4	103	85	0
ZONE # 29	229	34	0	0	0	0	0	92	0	1	2	49	40	46	0	0	1	25	20	0
ZONE # 30	88	13	0	0	0	0	0	35	0	0	1	19	15	18	0	0	0	10	8	0
ZONE # 31	625	94	0	0	0	0	0	250	0	2	5	133	110	125	0	1	3	67	55	0
ZONE # 32	344	52	0	0	0	0	0	138	0	1	3	74	61	69	0	0	1	37	30	0
ZONE # 33	503	75	0	0	0	0	0	201	0	1	4	107	88	101	0	1	2	54	44	0
ZONE # 34	305	46	0	0	0	0	0	122	0	1	2	65	54	61	0	0	1	33	27	0
ZONE # 35	1162	174	0	0	0	0	0	465	0	3	9	248	205	232	0	2	5	124	102	0
ZONE # 36	86	13	0	0	0	0	0	34	0	0	1	18	15	17	0	0	0	9	7	0
ZONE # 37	816	122	0	0	0	0	0	326	0	2	7	174	143	163	0	1	3	87	72	0
ZONE # 38	1011	152	0	0	0	0	0	404	0	3	8	215	178	202	0	1	4	108	89	0
ZONE # 39	954	143	0	0	0	0	0	382	0	3	8	204	168	191	0	1	4	102	84	0
ZONE # 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 41	1726	259	0	0	0	0	0	690	0	5	14	368	304	345	0	2	7	184	152	0
ZONE # 42	154	23	0	0	0	0	0	62	0	0	1	33	27	31	0	0	1	17	14	0
ZONE # 43	65	10	0	0	0	0	0	26	0	0	1	14	11	13	0	0	0	7	6	0
ZONE # 44	650	98	0	0	0	0	0	260	0	2	5	139	114	130	0	1	3	69	57	0
ZONE # 45	183	27	0	0	0	0	0	73	0	1	1	39	32	37	0	0	1	20	16	0
ZONE # 46	1792	269	0	0	0	0	0	717	0	5	14	382	315	358	0	3	7	191	158	0
ZONE # 47	183	27	0	0	0	0	0	73	0	1	1	39	32	37	0	0	1	20	16	0
ZONE # 48	445	67	0	0	0	0	0	178	0	1	4	95	78	89	0	1	2	47	39	0
ZONE # 49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 50	86	13	0	0	0	0	0	34	0	0	1	18	15	17	0	0	0	9	7	0
ZONE # 51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ZONE # 54	6693	1004	0	0	0	0	0	2677	0	19	54	1427	1178	1339	0	9	27	714	589	0

1 = Red Cross Shelter
2 = Friends Home
3 = Hotel/Motel
4 = Not Evacuating

m = Monroe Country
d = Dade County
b = Broward County
p = Palm Beach County

o = Out of Region

attractions. For each storm situation, production and attraction data files were established. These "P" and "A" files only included vehicles making the in-county origin to in-county destination evaucation travel pattern.

Trip Distribution

This step concentrated only on those trips originating in a county and finding acceptable destinations in the same county. The FDOT trip distribution module, DISCOMOD, using "P" and "A" files from trip generation, matched productions from each zone with available attractions in all zones. For each destination type, DISCOMOD matched P's and A's based on the relative attractiveness of each zone (measured in terms of the total number of vehicle attractions by destination type) and impedence between origin and destination zones (measured in travel time between zones). A trip table showing trips between each zone and all other zones for each evacuation destination type was produced. DISCOMOD then adds the three trip tables produced for the Red Cross shelter, hotel/motel, and home of a friend destination types into one trip table. This resulting trip table contained all evacuation vehicular trips made between zones in a particular county.

Trip Assignment

This step involved the use of another Florida DOT computer module, QASSIGN, to place trips contained in a trip table for a particular storm situation on the road segments included in the computerized representation of the evacuation roadway system. As in standard UTPS highway assignments, some vehicle trip diversion occurs to alternative roadway combinations connecting traffic evacuation zones. However, due to the coarseness of the evacuation network, most zonal traffic uses an east-west arterial closest to the zone of interest. This phenomenon emphasizes the importance of choosing roadways for the evacuation network that result in the smoothest traffic flow and that have the best ability to handle a large number of vehicles per hour.

An intermediate product of this assignment step was a plot (using the FDOT computer module CALPLOT) of the in-county evacuation vehicles using each roadway segment and the assumed capacity of each roadway segment. Plots were produced for each county storm situation. All other evacuation travel patterns (in-county origin to out-of-county destination, out-of-county origin to in-county destination, out-of-county origin to out-of-county destination, and background) were then manually assigned to the plots to arrive at total evacuation related vehicles per roadway segment. Tables H-11 - H-14 provide the evacuating vehicles exiting each county at each route for the seventeen assumed regional storm scenarios.

It is important to note that background traffic as defined as an evaucation travel pattern, was hypothesized to be similar to peak period traffic volumes. FDOT's Urbanized Area System Planning Section provided peak hour factor data for various locations throughout Dade, Broward, and Palm Beach Counties. Average peak hour factors for Dade, Broward, and Palm

TABLE H-11

MAXIMUM EVACUATING VEHICLES EXITING MONROE COUNTY AT:

Regional Storm	U.S. 1
1	8,834
2	15,423
3	17,869
4	17,502
5	20,870
6	10,618
7	12,930
8	0
9	0
10	0
11	0
12	0
13	0
14	26,041
15	0
16	0
17	0

TABLE H-12

MAXIMUM EVACUATING VEHICLES EXITING DADE COUNTY AT:

Regional Storm	U.S. 27	U.S. 41	I-95	Florida Turnpike
1	1,310	1,310	1,311	1,311
2	1,978	1,978	1,978	1,978
3	1,978	1,978	1,978	1,978
4	1,753	1,753	1,754	1,754
5	1,753	1,753	1,754	1,754
6	9,110	7,011	9,111	9,111
7	11,672	9,778	11,673	11,673
8	9,024	5,924	8,024	8,024
9	10,586	8,691	10,586	10,586
10	0	0	0	0
11	8,024	5,924	8,024	8,024
12	0	0	0	0
13	0	0	0	0
14	11,088	8,989	11,089	11,589
15	0	0	15,498	15,498
16	0	0	0	0
17	0	0	0	0

TABLE H-13

MAXIMUM EVACUATING VEHICLES EXITING BROWARD COUNTY AT:

Regional Storm	I-95 (north)	Florida Turnpike (north)	U.S. 27 (north)	S.R. 84	U.S. 27 (south)	Florida Turnpike (south)	I-95 (south)
1	845	845	844	844	0	0	0
2	1,287	1,287	1,286	1,286	0	0	0
3	1,287	1,287	1,288	1,286	0	0	0
4	1,161	1,161	1,160	1,160	0	0	0
5	1,161	1,161	1,160	1,160	0	0	0
6	2,726	2,726	1,722	1,722	0	0	0
7	11,775	11,755	5,342	5,592	483	1,346	1,351
8	11,055	11,055	4,625	4,873	483	1,346	1,351
9	11,696	11,696	4,943	5,193	403	1,346	1,351
10	9,049	9,049	3,620	3,870	483	1,346	1,351
11	9,498	9,498	4,120	4,355	537	1,669	1,673
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	13,060	13,060	6,630	6,878	403	1,346	1,351
15	15,804	15,805	0	0	483	1,346	1,351
16	12,794	12,794	0	0	483	1,346	1,351
17	0	0	0	0	0	0	0

TABLE H-14

MAXIMUM EVACUATING VEHICLES EXITING PALM BEACH COUNTY AT:

Regional Storm	U.S.27 (north)	U.S. 441/ U.S. 98 (north)	S.R. 710 (north)	Florida Turnpike (north)	U.S. 1 (north)	I-95 (south)	Florida Turnpike (south)
1	475	0	0	475	0	0	0
2	739	0	0	739	0	0	0
3	739	0	0	739	0	0	0
4	692	0	0	692	0	0	0
5	692	0	0	692	0	0	0
6	1,085	503	503	1,085	503	0	0
7	4,999	2,417	2,758	7,417	4,758	0	0
8	4,417	2,417	2,758	6,835	4,758	0	0
9	5,353	3,353	3,856	9,708	4,856	0	0
10	7,922	4,422	7,682	12,124	10,182	637	637
11	8,340	6,340	9,103	13,955	11,103	637	637
12	2,987	2,987	5,247	5,247	5,247	637	637
13	3,047	3,047	5,309	5,309	5,309	653	653
14	10,690	6,690	8,952	15,394	6,643	637	637
15	0	2,417	2,758	9,043	6,966	0	0
16	0	4,422	7,682	16,085	14,143	637	637
17	0	2,987	5,247	6,747	6,747	637	637

Beach County were 10%, 8% and 11%, respectively. Peak periods were assumed to be 2 hours for Dade and Broward Counties, and 1½ hours for Palm Beach County. Another important assumption was that 24-Hour Average Daily Traffic for any given roadway link would be 100% of Level of Service D daily service volume at that link. Thus, for a link in each county having a Level of Service D daily service volume of 20,000 vehicles, the background traffic at the link would be calculated as follows:

Dade County

(20,000 vehicles)(10% peak hour factor)(2 hours) = 4,000 vehicles

Broward County

(20,000 vehicles)(8% peak hour factor)(2 hours) = 3,200 vehicles

Palm Beach County

(20,000 vehicles)(11% peak hour factor)(1½ hours) = 3,300 vehicles

In Monroe County, background traffic was not quantified as a separate volume by link due to the small trip lengths involved and small vehicle volumes expected by such incidental traffic movements.

The handling of background traffic in clearance time calculation will be discussed subsquently in this appendix.

Critical Link Identification

A series of volume to capacity ratio plots using FDOT's computer module CALPLOT, developed during Trip Assignment, were used to determine which roadway segments would be most congested with evacuating vehicles. The in-county to in-county evacuation travel volumes and the other evacuation travel pattern volumes were added during Trip Assignment and link volume to capacity ratios were adjusted to reflect all evacuation travel patterns. Those links with the highest volume to capacity ratio were then identified as the critical links for each county.

Travel Time/Queuing Delay Analysis

The critical links identified for the four counties of the study area were then reviewed in detail. Initially, traffic evacuation zones using the critical link of interest were identified for each storm situation (Category 1-3 or Category 4-5). Evacuation vehicles from each zone were then released to the network in accordance with a behavioral response curve. Based on an assumed hourly capacity for the critical link, the hourly volume desiring to use the link was then translated into a number of hours to clear the link. This number of hours to clear the link included time required by zonal vehicles to get to the link based on an assumed arrival time offset for each zone. To this time to clear the link was added the estimated time for the last vehicle using the link to reach the county line (assuming an average speed). Travel time to the farthest county line was added to the critical link clearance time, since out of county trips would be the last to clear the county network. The sum was considered to be the clearance time for that particular storm situation.

As an illustration of the above analysis, the most congested evacuation roadway segment for Broward County was Atlantic Blvd. east of I-95 and west of U.S. 1 (as defined by link 1630-1640 in the computerized evacuation road network). Traffic evacuation zones 2, 3, and 13 were identified as using the link. For regional storm scenario 10, a category 1-3 storm landfalling at Hollywood, evacuation traffic expected to use the link would consist of 4271 vehicles from zone 2, 7452 vehicles from zone 3, zero vehicles from zone 13, 65 vehicles from Palm Beach County, and background traffic of 3920 vehicles.

Tables H-15 - H17 provide the analysis data sheets for the three assumed behavioral response curves A, B and C. The vehicle volumes noted above appear under each appropriate origin heading. In each exhibit, the horizontal lines of data represent hourly intervals at the critical link. The portion of vehicles from each origin expected to be at the link during a particular hourly interval is shown in parenthesis as a decimal fraction. These portions are taken from the particular behavioral response curve being used. Since the background traffic is assumed to be inversely related to the evacuating traffic, background traffic portions (or fractions) are the inverse of the assumed behavioral response curve. Thus, the totals provided at the right hand side of each table represent the total evacuation vehicle demand for the critical link at each hourly interval.

To calculate how quickly vehicles would move through each critical evacuation link and to understand what traffic queues would develop, a detailed capacity figure was calculated for Atlantic Blvd. between I-95 and U.S. 1. Since intersections are the most restrictive points of an evacuation road network, a westbound intersection approach capacity at Level of Service D was calculated and used to meter traffic across the critical link. Table H-18 provides the analysis performed using a microcomputer program based on the 1965 Highway Capacity Manual.

TABLE H-15

Critical Link: ATLANTIC BLVD EAST OF I-95

TRAVEL TIME/DELAY ANALYSIS
BROWARD COUNTY
REGIONAL SCENARIO #10

Response Curve: A

ZONE 2	ZONE 3	ZONE 13	P.B.	DADE	MONROE	B.G.		TOTALS
4271*(.00) +	7452*(.05) +	0*(.05) +	65*(.00) +	0*(.05) +	0*(.05) +	3920*(.74)	=	3274
4271*(.05) +	7452*(.15) +	0*(.15) +	65*(.05) +	0*(.15) +	0*(.15) +	3920*(.20)	=	2119
4271*(.15) +	7452*(.54) +	0*(.54) +	65*(.15) +	0*(.54) +	0*(.54) +	3920*(.05)	=	4871
4271*(.54) +	7452*(.26) +	0*(.26) +	65*(.54) +	0*(.26) +	0*(.26) +	3920*(.00)	=	4279
4271*(.26) +	7452*(.00) +	0*(.00) +	65*(.26) +	0*(.00) +	0*(.00) +	3920*(.00)	=	1127
								15670

Carryover Analysis

Hour	Queue	Hour	Queue
1	824	2	493
3	2914	4	4743
5	3420	6	970
7	0	8	0

6.39 hours to clear link
\+ 1.5 hours to go from ATLANTIC BLVD EAST OF I-95 to Broward County line
\------
7.89 hours clearance time

TABLE H-16

Critical Link: ATLANTIC BLVD EAST OF I-95

Response Curve: B

TRAVEL TIME/DELAY ANALYSIS
BROWARD COUNTY
REGIONAL SCENARIO #10

ZONE 2	ZONE 3	ZONE 13	P.B.	DADE	MONROE	B.G.	TOTALS
4271*(.00) +	7452*(.04) +	0*(.04) +	65*(.00) +	0*(.04) +	0*(.04) +	3920*(.91) =	3865
4271*(.04) +	7452*(.06) +	0*(.06) +	65*(.04) +	0*(.06) +	0*(.06) +	3920*(.77) =	3639
4271*(.06) +	7452*(.10) +	0*(.10) +	65*(.06) +	0*(.10) +	0*(.10) +	3920*(.43) =	2691
4271*(.10) +	7452*(.23) +	0*(.23) +	65*(.10) +	0*(.23) +	0*(.23) +	3920*(.20) =	2932
4271*(.23) +	7452*(.34) +	0*(.34) +	65*(.23) +	0*(.34) +	0*(.34) +	3920*(.10) =	3923
4271*(.34) +	7452*(.14) +	0*(.14) +	65*(.34) +	0*(.14) +	0*(.14) +	3920*(.04) =	2674
4271*(.14) +	7452*(.09) +	0*(.09) +	65*(.14) +	0*(.09) +	0*(.09) +	3920*(.00) =	1278
4271*(.09) +	7452*(.00) +	0*(.00) +	65*(.09) +	0*(.00) +	0*(.00) +	3920*(.00) =	390
							21392

Carryover Analysis

Hour	Queue	Hour	Queue
1	1415	2	2604
3	2845	4	3327
5	4800	6	5024
7	3852	8	1792
9	0	10	0

8.73 hours to clear link
\+ 1.5 hours to go from ATLANTIC BLVD EAST OF I-95 to Broward County line
------
10.23 hours clearance time

TABLE H-17

Critical Link: ATLANTIC BLVD EAST OF I-95

Response Curve: C

TRAVEL TIME/DELAY ANALYSIS
BROWARD COUNTY
REGIONAL SCENARIO #10

ZONE 2	ZONE 3	ZONE 13	P.B.	DADE	MONROE	B.G.	TOTALS
4271*(.00) +	7452*(.01) +	0*(.01) +	65*(.00) +	0*(.01) +	0*(.01) +	3920*(.96) =	3838
4271*(.01) +	7452*(.02) +	0*(.02) +	65*(.01) +	0*(.02) +	0*(.02) +	3920*(.90) =	3721
4271*(.02) +	7452*(.03) +	0*(.03) +	65*(.02) +	0*(.03) +	0*(.03) +	3920*(.82) =	3524
4271*(.03) +	7452*(.03) +	0*(.03) +	65*(.03) +	0*(.03) +	0*(.03) +	3920*(.72) =	3176
4271*(.03) +	7452*(.05) +	0*(.05) +	65*(.03) +	0*(.05) +	0*(.05) +	3920*(.60) =	2855
4271*(.05) +	7452*(.06) +	0*(.06) +	65*(.05) +	0*(.06) +	0*(.06) +	3920*(.43) =	2350
4271*(.06) +	7452*(.10) +	0*(.10) +	65*(.06) +	0*(.10) +	0*(.10) +	3920*(.30) =	2181
4271*(.10) +	7452*(.13) +	0*(.13) +	65*(.10) +	0*(.13) +	0*(.13) +	3920*(.20) =	2187
4271*(.13) +	7452*(.17) +	0*(.17) +	65*(.13) +	0*(.17) +	0*(.17) +	3920*(.14) =	2379
4271*(.17) +	7452*(.12) +	0*(.12) +	65*(.17) +	0*(.12) +	0*(.12) +	3920*(.09) =	1984
4271*(.12) +	7452*(.10) +	0*(.10) +	65*(.12) +	0*(.10) +	0*(.10) +	3920*(.06) =	1501
4271*(.10) +	7452*(.08) +	0*(.08) +	65*(.10) +	0*(.08) +	0*(.08) +	3920*(.03) =	1148
4271*(.08) +	7452*(.06) +	0*(.06) +	65*(.08) +	0*(.06) +	0*(.06) +	3920*(.01) =	833
4271*(.06) +	7452*(.04) +	0*(.04) +	65*(.06) +	0*(.04) +	0*(.04) +	3920*(.00) =	558
4271*(.04) +	7452*(.00) +	0*(.00) +	65*(.04) +	0*(.00) +	0*(.00) +	3920*(.00) =	174

							32409

Carryover Analysis

Hour	Queue	Hour	Queue
1	1388	2	2659
3	3733	4	4459
5	4864	6	4764
7	4495	8	4232
9	4161	10	3695
11	2746	12	1444
13	0	14	0
15	0	16	0

15 hours to clear link
+ 1.5 hours to go from ATLANTIC BLVD EAST OF I-95 to Broward County line
------
16.5 hours clearance time

TABLE H-18

INTERSECTION ANALYSIS
Atlantic Blvd. and Dixie Highway
Broward County, Florida

GIVEN

1.	Two-way street with no parking (Urban)	
2.	Metropolitan Population	= 300,000
3.	Peak Hour Factor	= .99
4.	Location of the Intersection	= CBD
5.	Level of Service	= D
6.	% Left Turns	= 3%
7.	% Right Turns	= 3%
8.	% Cycle Length	= 0%
9.	Cycle Length	= 100 sec.
10.	Green Time	= 70 sec.
11.	Width of Approach	= 35 sec.

CALCULATED

1.	Vehicles per Hour of Green	= 2846
2.	Left Turn Factor	= 1.035
3.	Right Turn Factor	= 1.015
4.	Metropolitan Area Type Factor	= 1
5.	Population Adjustment Factor	= 1.106

WESTBOUND APPROACH VOLUME (THROUGH TRAFFIC) = 2430 vph

Green time was assumed to be a minimum of 70% of total cycle length due to the use of police manpower to control the intersection during an evacuation. The resulting westbound approach volume was rounded to 2450 vehicles per hour.

Data in Tables H15-H17, under the heading "Carryover Analysis," presented the resulting queues by hourly interval. These figures resulted from comparing hourly vehicle demand for the critical link with calculated hourly capacity for the link. Carryover analysis then allowed the calculation of a number of hours to clear the critical link. For response curves A, B and C, the resulting number of hours was calculated to be 6.39, 8.73 and 15 hours, respectively. These numbers were rounded and an estimate of the number of hours it would take the last vehicle crossing the link to reach the western county line was added to arrive at total clearance time. An average speed for this last vehicle was assumed to be 30 mph. Vehicle speeds in an evacuation have been observed to range from 25 to 45 mph with an average speed of 35 mph. These observations were reported in the June 1974 EPA publication, Evacuation Risks - An Evaluation, by J. M. Hans and T. C. Sell.

Clearance Times

Twelve clearance times were developed for each of the Lower, Middle, and Upper Keys areas of Monroe County and for Dade, Broward and Palm Beach Counties:

3	Response Curve Assumptions (A, B and C)
x 2	Storm Category Groupings
6	
x 2	Levels of Participation in the Evacuation
12	Clearance Times

Tables H-19 through H-24 provide the resulting clearance times for each area or county. Total clearance times for each area had the following ranges of values:

Lower Keys	11	to	24	hours
Middle Keys	8.5	to	18	hours
Upper Keys	5	to	15	hours
Dade County	9.5	to	19	hours
Broward County	7	to	16.5	hours
Palm Beach County	6	to	15.5	hours

That portion of clearance time critical to developing evacuation order times (post-evacuation order clearance time). These times were determined and extracted for each regional storm scenario.

TABLE H-19

MONROE COUNTY CLEARANCE TIMES

Lower Southeast Florida
Hurricane Evacuation Study

Storm Landfall Point: Boca Chica

STORM CATEGORY	PERCENTAGE RESPONDING TO EVAC. ORDER	PRE-EVAC. ORDER CLEARANCE TIME	POST EVAC. ORDER CLEARANCE TIME	TOTAL CLEARANCE TIME
RESPONSE CURVE A - QUICK RESPONSE/SHORT LEAD TIME				
1-2	LOW	2	9	11
1-2	HIGH	2	17	19
3-5	LOW	2	16	18
3-5	HIGH	2	20	22
RESPONSE CURVE B - BEHAVIORAL SURVEY RESPONSE				
1-2	LOW	5	9	14
1-2	HIGH	5	16.5	21.5
3-5	LOW	5	15.5	20.5
3-5	HIGH	5	19	24
RESPONSE CURVE C - SLOW RESPONSE/LONG LEAD TIME				
1-2	LOW	7	11	18
1-2	HIGH	7	14	21
3-5	LOW	7	13.5	20.5
3-5	HIGH	7	17	24

TABLE H-20

MONROE COUNTY CLEARANCE TIMES

Lower Southeast Florida
Hurricane Evacuation Study

Storm Landfall Point: Marathon

STORM CATEGORY	PERCENTAGE RESPONDING TO EVAC. ORDER	PRE-EVAC. ORDER CLEARANCE TIME	POST EVAC. ORDER CLEARANCE TIME	TOTAL CLEARANCE TIME
RESPONSE CURVE A - QUICK RESPONSE/SHORT LEAD TIME				
1-2	LOW	2	6.5	8.5
1-2	HIGH	2	11.5	13.5
3-5	LOW	2	12	14
3-5	HIGH	2	14.5	16.5
RESPONSE CURVE B - BEHAVIORAL SURVEY RESPONSE				
1-2	LOW	5	7	12
1-2	HIGH	5	11	16
3-5	LOW	5	11	16
3-5	HIGH	5	13	18
RESPONSE CURVE C - SLOW RESPONSE/LONG LEAD TIME				
1-2	LOW	7	9	16
1-2	HIGH	7	9	16
3-5	LOW	7	9	16
3-5	HIGH	7	11	18

TABLE H-21

MONROE COUNTY CLEARANCE TIMES

Lower Southeast Florida
Hurricane Evacuation Study

Storm Landfall Point: Key Largo

STORM CATEGORY	PERCENTAGE RESPONDING TO EVAC. ORDER	PRE-EVAC. ORDER CLEARANCE TIME	POST EVAC. ORDER CLEARANCE TIME	TOTAL CLEARANCE TIME
RESPONSE CURVE A - QUICK RESPONSE/SHORT LEAD TIME				
1-2	LOW	2	3	5
1-2	HIGH	2	5.5	7.5
3-5	LOW	2	5.5	7.5
3-5	HIGH	2	7	9
RESPONSE CURVE B - BEHAVIORAL SURVEY RESPONSE				
1-2	LOW	5	6	11
1-2	HIGH	5	6	11
3-5	LOW	5	6	11
3-5	HIGH	5	6.5	11.5
RESPONSE CURVE C - SLOW RESPONSE/LONG LEAD TIME				
1-2	LOW	7	8	15
1-2	HIGH	7	8	15
3-5	LOW	7	8	15
3-5	HIGH	7	8	15

TABLE H-22

DADE COUNTY CLEARANCE TIMES

Lower Southeast Florida
Hurricane Evacuation Study

STORM CATEGORY	PERCENTAGE RESPONDING TO EVAC. ORDER	PRE-EVAC. ORDER CLEARANCE TIME	POST EVAC. ORDER CLEARANCE TIME	TOTAL CLEARANCE TIME
RESPONSE CURVE A - QUICK RESPONSE/SHORT LEAD TIME				
1-3	LOW	2	7.5	9.5
1-3	HIGH	2	10	12
4-5	LOW	2	9	11
4-5	HIGH	2	11	13
RESPONSE CURVE B - BEHAVIORAL SURVEY RESPONSE				
1-3	LOW	3	8	11
1-3	HIGH	3	10.5	13.5
4-5	LOW	3	9.5	12.5
4-5	HIGH	3	11.5	14.5
RESPONSE CURVE C - SLOW RESPONSE/LONG LEAD TIME				
1-3	LOW	6	10	16
1-3	HIGH	6	12	18
4-5	LOW	6	11.5	17.5
4-5	HIGH	6	13	19

TABLE H-23

BROWARD COUNTY CLEARANCE TIMES

Lower Southeast Florida
Hurricane Evacuation Study

STORM CATEGORY	PERCENTAGE RESPONDING TO EVAC. ORDER	PRE-EVAC. ORDER CLEARANCE TIME	POST EVAC. ORDER CLEARANCE TIME	TOTAL CLEARANCE TIME
RESPONSE CURVE A - QUICK RESPONSE/SHORT LEAD TIME				
1-3	LOW	2	5	7
1-3	HIGH	2	6	8
4-5	LOW	2	5.5	7.5
4-5	HIGH	2	6.5	8.5
RESPONSE CURVE B - BEHAVIORAL SURVEY RESPONSE				
1-3	LOW	3	6.5	9.5
1-3	HIGH	3	7	10
4-5	LOW	3	7	10
4-5	HIGH	3	8	11
RESPONSE CURVE C - SLOW RESPONSE/LONG LEAD TIME				
1-3	LOW	6	10.5	16.5
1-3	HIGH	6	10.5	16.5
4-5	LOW	6	10.5	16.5
4-5	HIGH	6	10.5	16.5

TABLE H-24

PALM BEACH COUNTY CLEARANCE TIMES

Lower Southeast Florida
Hurricane Evacuation Study

STORM CATEGORY	PERCENTAGE RESPONDING TO EVAC. ORDER	PRE-EVAC. ORDER CLEARANCE TIME	POST EVAC. ORDER CLEARANCE TIME	TOTAL CLEARANCE TIME
RESPONSE CURVE A - QUICK RESPONSE/SHORT LEAD TIME				
1-3	LOW	2	4	6
1-3	HIGH	2	5	7
4-5	LOW	2	4	6
4-5	HIGH	2	5	7
RESPONSE CURVE B - BEHAVIORAL SURVEY RESPONSE				
1-3	LOW	3	5.5	8.5
1-3	HIGH	3	6.5	9.5
4-5	LOW	3	5.5	8.5
4-5	HIGH	3	6.5	9.5
RESPONSE CURVE C - SLOW RESPONSE/LONG LEAD TIME				
1-3	LOW	6	9.5	15.5
1-3	HIGH	6	9.5	15.5
4-5	LOW	6	9.5	15.5
4-5	HIGH	6	9.5	15.5

APPENDIX I

Red Cross Shelter Assignments

MONROE COUNTY SHELTER ASSIGNMENTS

Shelter	Shelter Location by Street Address and Traffic Evacuation Zone		Shelter Capacity	Traffic-Evacuation Zones Assigned to Shelter	Shelter Surge Feasibility
Mary Immaculate High School	Truman Avenue Key West	Zone 1	300	2	*****
Harris Elementary School	Southard & Margaret St. Key West	Zone 1	300	2	***
Glynn Archer School	White Street Key West	Zone 1	700	1	***
Key West Main Post Office	Simonton St. Key West	Zone 1	500	1	****
Administration Building	Truman Annex	Zone 1	690	1	*****
Fleet Sonar School	Truman Annex	Zone 1	874	1	*****
Truman Annex Galley Building	Truman Annex	Zone 1	204	1	*****
Sugarloaf Volunteer Fire Dept.	Sugarloaf Key U.S. 1	Zone 3	100	3	****
Methodist Church Youth Center	Key Deer Blvd. Big Pine Key	Zone 3	110	3	***
Methodist Church	Key Deer Blvd. Big Pine Key	Zone 3	110	3	***
Stanley Switlick Elementary School	Marathon	Zone 4	300	4	****
D.A.V. Building	Marathon	Zone 4	100	4	****
Island Christian School	Islamorada	Zone 5	500	3	*****
Plantation Elementary School	Plantation Tavernier	Zone 5	75	4	*****
Coral Shores High School	Plantation Tavernier	Zone 5	1,000	1, 5	*****
Key Largo Elem. School & Cafeteria	Key Largo	Zone 5	1,000	5	*****

* - Flooded in a Category 1 through 5 storm
** - Flooded in a Category 2 through 5 storm
*** - Flooded in a Category 3 through 5 storm
**** - Flooded in a Category 4 through 5 storm
***** - Flooded in a Category 5 storm

DADE COUNTY SHELTER ASSIGNMENTS

Shelter	Shelter Location by Street Address and Traffic Evacuation Zone		Shelter Capacity	Traffic-Evacuation Zones Assigned to Shelter	Shelter Surge Feasibility
American Senior High School	18350 N.W. 67th Ave.	Zone 28	2,000	5	
Miami Carol City Sr. High School	3422 N.W. 187th St.	Zone 18	1,800	8	
Hialeah-Miami Lakes Sr. High School	7977 W. 12th Ave.	Zone 32	2,000	25	
Miami Lakes Jr. High School	6425 Miami Lakeway Dr.	Zone 28	800	25	
Lake Stevens Jr. High	18484 N.W. 48th Pl.	Zone 28	800	5	
Brentwood Elementary School	3101 N.W. 191st. St.	Zone 28	1,000	28, 4	
Norwood Elementary School	19810 N.W. 14th Ct.	Zone 27	500	27	
Palm Springs North Elementary School	17615 N.W. 82nd Ave.	Zone 29	525	29	
Skyway Elementary	4555 N.W. 206 Terrace	Zone 28	525	4	
North Miami Beach Sr. High School	1247 N.E. 167th St.	Zone 26	2,000	7, 26	
Miami Edison Sr. High School	6161 N.W. 5th Ct.	Zone 34	1,000	12, 34	
North Miami Sr. High School	800 N.E. 137th St.	Zone 26	2,000	6, 26	
North Miami Jr. High School	13105 N.E. 7th Ave.	Zone 26	420	6	
Highland Oaks Jr. High School	2325 N.E. 203rd St.	Zone 26	800	18	
Allapattah Jr. High School	1331 N.W. 46th St.	Zone 35	525	3	
Drew Middle School	1801 N.W. 60th St.	Zone 35	500	2	
Kelsey Pharr Elementary School	2000 N.W. 46th St.	Zone 35	550	2, 35	
Lorah Park Elementary School	5160 N.W. 31st Ave.	Zone 35	800	2	
Kinlock Park Jr. High School	4330 N.W. 3rd St.	Zone 38	800	2	
Miami Springs Sr. High School	751 Dove Ave.	Zone 36	900	24, 36	
Hialeah Junior High School	6027 E. 7th Ave.	Zone 32	1,000	5, 32	
Amelia Earhart Elementary School	5987 E. 7th Ave.	Zone 32	1,000	24	
Miami Beach Convention Center	1700 Washington Ave.	Zone 2	1,200		
Miami Coral Park Sr. High School	8865 S.W. 16th St.	Zone 37	2,000	23	

DADE COUNTY SHELTER ASSIGNMENTS (continued)

Shelter	Shelter Location by Street Address and Traffic Evacuation Zone		Shelter Capacity	Traffic-Evacuation Zones Assigned to Shelter	Shelter Surge Feasibility
Miami Jackson Sr. High School	1751 N.W. 36th Street	Zone 35	1,200	2	
Citrus Grove Jr. High School	2153 N.W. 3rd Street	Zone 39	800	2, 39	
Shenandoah Elementary School	1023 S.W. 21st Avenue	Zone 39	676	2	
Flagami Elementary School	920 S.W. 76th Avenue	Zone 38	600	13	
Temple Beth Torah	6438 S.W. 8th Street	Zone 38	200	2	
Micccosukee Indian Reservation	Tamiami Trail/U.S. 41	Zone 31	500	30, 31	
Miami Sunset Sr. High School	13125 S.W. 72nd St.	Zone 40	2,000	22	
South Miami Sr. High School	6856 S.W. 53rd St.	Zone 42	1,350	38	
H.D. McMillan Jr. High School	13100 S.W. 59th St.	Zone 40	800	40, 41, 45	
Miami Killian Sr. High School	10655, S.W. 97th Ave.	Zone 44	2,000	44	
Glades Junior High School	9451 S.W. 64th St.	Zone 41	540	14	
Kendale Lakes Elementary School	8000 S.W. 142nd Ave.	Zone 40	1,000	19	
Royal Green Elementary School	13047 S.W. 47th St.	Zone 40	1,000	19	
W.R. Thomas Mr. High School	13001 S.W. 26th St.	Zone 31	800	19	
Gloria Floyd Elementary School	12650 S.W. 109th Ave.	Zone 44	800	22	
Coral Gables High School	450 Bird Road	Zone 42	1,100	1	
South Ridge Sr. High School	19355 S.W. 114th Ave.	Zone 46	2,000	20, 21	
South Dade Sr. High School	28401 S.W. 167th Ae.	Zone 47	1,400	9, 20, 47	
Campbell Drive Jr. High School	31110 S.W. 157th Ave.	Zone 21	800	9	****
Southwood Junior High School	16301 S.W. 80th Ave.	Zone 43	800	15, 43, 44	
Mayo Junior High School	11700 Hainlin Mill Dr.	Zone 21	250	21	****
Pinelake Elementary School	16700 S.W. 109 Ave.	Zone 46	800	21	
Belair Elementary School	10205 S.W. 196th St.	Zone 22	425	16	****
R.R. Moton Elementary School	18050 Homestead Avenue	Zone 46	115	46	

DADE COUNTY SHELTER ASSIGNMENTS (continued)

Shelter	Shelter Location by Street Address and Traffic Evacuation Zone		Shelter Capacity	Traffic-Evacuation Zones Assigned to Shelter	Shelter Surge Feasibility
Caribbean Elementary School	11990 S.W. 200th St.	Zone 46	500	20	
Chapman Elementary School	27190 S.W. 140th Ave.	Zone 20	250	17	****
South Dade Government Center	10710 Butler Ridge Blvd.	Zone 33	500	22	****
Miami Dade Community College	113 St. & 27th Ave. N.W.	Zone 33	2,400	10, 11, 33	
Florida International University	Tamiami Trail & Turnpike	Zone 37	850	37	

BROWARD COUNTY SHELTER ASSIGNMENTS

Shelter	Shelter Location by Street Address and Traffic Evacuation Zone		Shelter Capacity	Traffic-Evacuation Zones Assigned to Shelter	Shelter Surge Feasibility
Eli High School	801 NW 10th Street Pompano Beach	Zone 27	2,000	2	
Coconut Creek High School	1406 NW 44th Ave. Coconut Creek	Zone 26	2,000	3	
Coral Springs High School	7201 Sample Road Coral Springs	Zone 29	2,500	29, 30	
Deerfield Beach High School	910 S.W. 15th St. Deerfield Beach	Zone 28	2,000	1, 15, 28	
Margate Middle School	500 N.W. 65th Ave. Margate	Zone 26	1,200	3, 26	
Northeast High School	700 N.E. 56th St. Oakland Park	Zone 24	2,000	12, 24	
North Lauderdale Elementary	7500 Kimberly Blvd. North Lauderdale	Zone 23	500	23	
Pompano High School	1400 N.E. 6th St. Pompano Beach	Zone 27	1,000	13, 14, 27	
Tamarac Elementary	7601 N. University Dr. Tamarac	Zone 25	500	25	
Taravella High School	10600 Riverside Dr. Coral Springs	Zone 25	1,500		
Boyd Anderson High School	3050 N.W. 41st St. Lauderdale Lakes	Zone 23	3,000	4	
Broward Community Coll.	3501 S.W. Davie Rd. Davie	Zone 19	5,000	19	
Castle Hill Elementary	2640 N.W. 46th Ave. Lauderhill	Zone 22	500	22	
Dillard High School	2501 N.W. 11th St. Ft. Lauderdale	Zone 22	3,000	5	
Piper High School	3000 N.W. 43rd Place Sunrise	Zone 25	3,000	4	
Plantation High School	6901 N.W. 16th St. Plantation	Zone 21	2,000	6, 11	
South Plantation High School	1300 S.W. 54th Ave. Plantation	Zone 21	1,500	20, 21	
Western High School	1200 S.W. 136th Ave. St. Lauderdale	Zone 19	1,500		
Attucks Middle School	3500 N.W. 22nd Ave. Hollywood	Zone 18	1,500	7, 8	
Hallandale High School	720 N.W. 9th Ave. Hallandale	Zone 16	2,500	9, 10	
Hollywood Hills High School	5400 Stirling Rd. Hollywood	Zone 18	2,000	9, 18	
Miramar High School	3601 S.W. 89th Ave. Miramar	Zone 17	2,000	9	
Pembroke Pines Elementary School	6700 S.W. 9th St. Pembroke Pines	Zone 17	750	16, 17	
Pioneer Middle School	5350 90th Ave. Cooper City	Zone 19	1,000		

PALM BEACH COUNTY SHELTER ASSIGNMENTS

Shelter	Shelter Location by Street Address and Traffic Evacuation Zone		Shelter Capacity	Traffic-Evacuation Zones Assigned to Shelter	Shelter Surge Feasibility
Jupiter High School	601 Toney Penna Rd. Jupiter	Zone 25	650	3, 24, 25, 49	
Jerry Thomas Elementary School	800 Maplewood Drive Jupiter	Zone 25	3,000	1, 2, 4, 26, 27	
Palm Beach Gardens High School	4245 Holly Drive Palm Beach Gardens	Zone 28	2,410	5, 6, 29, 50	
Suncoast High School	Charger Boulevard Riviera Beach	Zone 28	490	23, 28	
North Tech Educational Center	7071 Garden Road Riviera Beach	Zone 30	366	7	
Northshore High School	3701 Northshore Dr. West Palm Beach	Zone 30	400	7, 30	
Roosevelt Junior High School	1601 Tamarind West Palm Beach	Zone 30	190	7	
West Palm Beach Auditorium	Palm Beach Lakes & Congress West Palm Beach	Zone 34	4,000	8, 9, 21, 33	
Twin Lakes High School	501 Georgia West Palm Beach	Zone 34	350	22, 34	
Wynnebrook Elementary School	1167 Drexel Rd. West Palm Beach	Zone 32	378	31, 32	
Forrest Hill High School	6901 Parber Avenue West Palm Beach	Zone *	60	36	
John I. Leonard High School	4701 10th Ave. North Lake Worth	Zone 35	665	35, 38, 51	
Palm Beach Junior College	4200 S. Congress Lake Worth	Zone 37	1,440	11, 20, 37, 39	
Lake Worth High School	1701 Lake Worth Rd. Lake Worth	Zone 37	385	10	
Lantana Elementary School	710 Ocean Avenue Lantana	Zone 29	240	19, 39	
Poinciana Elementary School	1400 N.W. 1st St. Goynton Beach	Zone 41	200	12	
Congress Community School	101 S. Congress Boynton Beach	Zone 43	200	41	
Saint Vincent De Paul Seminary	S. Military ½ mi. south of Boynton Road	Zone 42	200	41	
Hagen Road School	10439 Hagen Road Boynton Beach	Zone 42	670	40, 43, 45, 52, 53	
South Tech Training Center	1300 S.W. 30th Ave. Boynton Beach	Zone 43	270	43	
Boynton Civic Center	128 E. Ocean Ave. Boynton Beach	Zone 44	250	44	
Rolling Green Elementary School	550 Miner Road Boynton Beach	Zone 41	290	41	
Atlantic High School	2501 Seacrest Blvd. Delray Beach	Zone 44	405	13	
Delray Civic Center	N.W. 1st Ave. Delray Beach	Zone 44	150	14	

PALM BEACH COUNTY SHELTER ASSIGNMENTS (continued)

Shelter	Shelter Location by Street Address and Traffic Evacuation Zone		Shelter Capacity	Traffic-Evacuation Zones Assigned to Shelter	Shelter Surge Feasibility
Pompey Park Recreation Center	240 N.W. 10th Ave. Delray Beach	Zone 44	220	13, 14	
Carver Middle School	301 S.W. 14th Ave. Delray Beach	Zone 46	365	46	
Bibletown Community Church	601 N.W. 4th Ave. Boca Raton	Zone 47	3,000	15, 16, 17, 18	
Florida Atlantic University	500 N.W. 20th St. Boca Raton	Zone 47	485	47	
Boca Raton Recreation Center	150 N.W. Crawford Blvd. Boca Raton	Zone 47	250	18	
Boca Raton YMCA	6631 Palmetto Circle S. Boca Raton	Zone 48	150	48	
Our Lady of Lourdes Church	22094 S.W. 57th Ave. Boca Raton	Zone 48	250	48	
Palm Beach Junior College	1977 College Dr. Belle Glade	Zone 54	300	54	
Glades Central High School	425 W. Canal St. North Belle Glade	Zone 54	785	54	
Pahokee High School	360 E. Main St. Pahokee	Zone 54	160	54	
Canal Point Elementary School	300 Everglades St. Canal Point	Zone 54	95	54	
Rosenwald Elementary School	1321 Palm Beach Rd. West South Bay	Zone 54	630	54	

APPENDIX J

Route Assignments for Dade, Broward and Palm Beach Counties

DADE COUNTY ROUTE ASSIGNMENTS

Evacuation Zone	Shelter	Route Assignments
1	40 - Coral Gables High School	Crandon Blvd. north to Rickenbacker Causeway; west Grapeland Blvd. south to Bird Road; west to shelter
2	16 - Drew Middle School	Alton Rd. north to Dade Blvd.; west to Venetian Causeway; west to U.S. 1; south to I-395; west to I-95; north to 54th St.; north to 60th St.; west to shelter. Or, Alton Rd. south to MacArthur Causeway; west to I-395; west to I-95; north to 54th St.; north to 60th St.; west to shelter.
	18 - Lorah Park Elementary School	Alton Rd. north to Dade Blvd.; west to Venetian Causeway; west to U.S. 1, South to East West Expressway; west to I-95; north to 54th St.; west to 31st Ave.; south to shelter on 51st St. Or, Alton Rd. south to MacArthur Expressway; west to I-395; west to I-95; north to 54th St.; west to 31st Ave.; south to shelter on 51st St.
	19 - Kinlock Park Junior High School	Alton Rd. south to MacArthur Causeway; west to East-West Expressway; west to Lejune Rd. (112); south to 3rd St., west to shelter.
	25 - Miami Jackson Senior High School	Alton Rd. north to Dade Blvd.; west to Venetian Causeway; west to U.S. 1; north to 35th St.; west to shelter on 17th Ave. Or, Alton Rd. south to MacArthur Causeway; west to U.S. 1; north to 36th St.; west to shelter on 17th Ave.
	26 - Citrus Grove Junior High School	Alton Rd. north to Dade Blvd.; west to Venetian Causeway; West to U.S. 1; south to U.S. 41; west to Main St.; north to 3rd St.; east to Shelter on 21st Ave. Or, Alton Rd. south to MacArthur Causeway; west to U.S. 1; south to U.S. 41; west to Main St.; north to 3rd St.; east to shelter on 21st Ave.

DADE COUNTY ROUTE ASSIGNMENTS (continued)

Evacuation Zone	Shelter	Route Assignments
2	17 - Kelsey Pharr Elementary School	Venetian Causeway west to U.S. 1; north to U.S. 27; west to 19th Ave.; north to 176th St.; west to shelter
	27 - Shenandoah Elementary School	Alton Rd. north to Dade Blvd..; west to Venetian Causeway; west to U.S. 1; south to U.S. 41; west to Main St.; north to 10th St.; east to shelter on 21st Ave.
	29 - Temple Beth Tora	Alton Rd. north to Dade; west to Venetian Causeway; west to U.S. 1; south to U.S. 41; west to 64th Ave. Or, Alton Rd.; south to MacArthur Causeway; west to U.S. 1; south to U.S. 41; west to 64th Ave.
3	15 - Allapatlah Junior High School	Venetian Causeway west to U.S. 1; north to 54th St.; west to 13th Ave.; south to 46th St.
4	Brentwood Elementary	
	Skyway Elementary	
5	1 - American Senior High School	North Bay Causeway west to I-95; north to Golden Glades Expressway; west to 68th Ave.; north to 183rd St.
	5 - Lake Stevens Junior High School	North Bay Causeway west to U.S. 1; north to 183rd St.; west to 48th Pl.; north to shelter
	21 - Hialeah Junior High School	North Bay Causeway west to U.S. 1; north to 6th Ave.; north to 103rd St.; west to 7th Ave.; north to shelter

DADE COUNTY ROUTE ASSIGNMENTS (continued)

Evacuation Zone	Shelter	Route Assignments
6	12 - North Miami Senior High School	96th St. west to 123rd St.; west to 125th St.; west to 7th Ave.; north to shelter
	13 - North Miami Junior High School	96th St. west to 123rd St.; west to 125th St.; west to 7th Ave.; north to shelter
7	10 - North Miami Beach Sr. High	Ocean Beach Blvd. west to 163rd St.; west to 12th Ave.; north to 167th St.; west to shelter
8	2 - Miami Carol Senior High School	Miami Gardens Dr. west to 34th Ct.; north to shelter
9	42 - South Dade Senior High School	Tallahassee Rd. north to Biscayne Rd.; west to 167th Ave.; north to shelter
	43 - Campbell Dr. Junior High School	Tallahassee Rd. north to 157th Ave.; north to shelter
10	52 - Miami Dade Comm. College	125th St. west to U.S. 1; south to 103rd St.; west to 27th St.; north to shelter
11	52 - Miami Dade Comm. College	103rd St. west to 27th St.; north to shelter
12	11 - Miami Edison Senior High School	I-95 west to U.S. 1; north to 62nd St.; west to 5th Ct. to shelter
13	28 - Flagami Elementary School	U.S. 41 west to 76th Ave; south to shelter
14	35 - Glades Junior High School	27th St. north to U.S. 1; southwest to 40th St.; west to 97th Ave.; south to 64th St.; east to shelter
15	44 - Southwood Junior High School	Old Cutler Rd. south to 168th St.; west to 80th Ave.; north to shelter
16	47 - Belair Elementary School	168th St. west to U.S. 1; south to Broad Channel Rd.; southeast to Belair Dr.; south to shelter

DADE COUNTY ROUTE ASSIGNMENTS (continued)

Evacuation Zone	Shelter	Route Assignments
17	50 - Chapman Elementary School	268th St. west tto 140th Ave.; south to shelter. Or, Tallahassee Rd. north to 268th St.; west to 140th Ave.; south to shelter
18	14 - Highland Oak Junior High School	Biscayne Blvd. south to 203rd St.; west to 23rd Ave. to shelter
19	36 - Kendale Lakes Elementary School	27 north to N. Kendall Dr.; east to SW 142nd Ave.; north to shelter
	37 - Royal Green Elementary School	27 north to 42nd St.; east to 130th Ave.; south to shelter
	38 - W.R. Thomas Junior High School	27 north to 42nd St.; east to 130th Ave.; north to shelter on 26th St.
20	41 - South Ridge Senior High School	U.S. 1 north to Caribbean Blvd.; west to 110th Ct.; north to 197th Terrace; west to shelter. Or, Floridas Turnpike north to Caribbean Blvd.; west to 110th Ct.; north to 197th Terrace; west to shelter
	42 - South Dade Senior High School	U.S. 1 to 288th St.; west to 164th Ave.; north to shelter
	49 - Caribbean Elementary School	U.S. 1 north to 115th Ave.; north to 200th St.; west to shelter. Or, Floridas Turnpike north to Caribbean Blvd.; west to shelter
21	41 - South Ridge Senior High School	U.S. 1 north to Caribbean Blvd.; west to 110th Ct.; north to 197th Terrace; west to shelter. Or, Floridas Turnpike north to Caribbean Blvd.; west to 200th St.; west to 110th Ct.; north to 197th Terrace; west to shelter
	43 - Mays Junior High School	U.S. 1 north to Cutler Rd.; east to 113th Ave.; north to shelter
	46 - Pinelake Elementary School	U.S. 1 north to Floridas Turnpike; north to 168th St.; east to 109th Ave.; north to shelter

DADE COUNTY ROUTE ASSIGNMENTS (continued)

Evacuation Zone	Shelter	Route Assignments
22	31 - Miami Sunset Senior High School	Eureka west to Floridas Turnpike; north to 72nd St.; west to 132nd Ave.; north to shelter
	39 - Gloria Floyd Elementary School	Eureka west to Floridas Turnpike; north to 128th St.; east to 109th Ave.; north to shelter
	51 - South Dade Government Center	Eureka west to U.S. 1; south to Floridas Turnpike; south to Butler Ridge Blvd. to shelter
23	24 - Miami Coral Park Sr. High	I-95 south to U.S. 41; west to 89th Ave.; south to 16th St.; east to shelter
24	20 - Miami Springs Senior High School	East-West Expressway west to 37th Ave., north to U.S. 27; northwest to Seneca St.; west to shelter
	22 - Amelia Earhart Elementary School	East-West Expressway west to 37th Ave., north to U.S. 27; northwest to 7th Ave.; north to 59th St.; east to shelter
25	3 - Hialeah-Miami Lakes Sr. High	103rd St. west to 12th St.; north to 79th St.; east to shelter. Or, 79th St. west to 27th St.; north to 103rd St.; west to 12th St.; north to 79th St.; east to shelter
	4 - Miami Lakes Junior High School	103rd St. west to 12th St.; north to Miami Lakeway; east to shelter. Or, 79th St. west to 27th St.; north to 103rd St.; west to 12th St.; north to Miami Lakeway; east to shelter

BROWARD COUNTY ROUTE ASSIGNMENTS

Evacuation Zone	Shelter	Route Assignments
1	4 - Deerfield Beach High School	Hillsboro Blvd. west to Dixie Hwy.; south on Dixie Hwy. to SW 15th St.; west to shelter. 910 SW 15th St.
2	1 - Eli High School	Sample Rd. west to Dixie Hwy.; south to NW 10th St.; west to shelter. 801 NW 10th St.
3	2 - Coconut Circle High School and 5 - Margate Middle School	Atlantic Blvd. west to NW 31st Ave. merger; north to Coconut Creek Pkwy.; west to NW 44th Ave; north to shelter. Or, Atlantic Blvd. west to NW 31st Ave. merger; north to Coconut Creek Pkwy.; west to 441 (S.R. 7); south to Atlantic Blvd.; west to shelter. 500 NW 65th Ave.
4	11 - Boyd Henderson High School	Commercial Blvd. west to NW 31st Ave.; south to shelter. 3050 NW 41st St.
	15 - Piper High School	Oakland Park Blvd. west to University Dr.; north to NW 44th St.; west to shelter. 3000 NW 43rd Pl.
5	14 - Dillard High School	Sunrise Blvd. west to NW 27th Ave.; north to NW 11th St.; east to shelter. 2501 NW 11th St.
6	16 - Plantation High School	Sunrise Blvd. west to NW 68th Ave.; north to shelter. 6901 NW 16th St.
7	19 - Attucks Middle School	U.S. 1 south to Stirling Rd.; west to NW 22nd Ave.; south to shelter. 3500 NW 22nd Ave.
8	19 - Attucks Middle School	Davis Beach Blvd. west to U.S. 1; south to Stirling Rd.; west to NW 22nd Ave.; south to shelter. 3500 NW 22nd Ave.

BROWARD COUNTY ROUTE ASSIGNMENTS (continued)

Evacuation Zone	Shelter	Route Assignments
9	20 - Hallandale High School	Hollywood Blvd. west to 28th Ave.; south to NW 11th St.; east to NW 9th Ave.; south to shelter. 720 NW 9th Ave. Or,
	21 - Hollywood Hills High School	Sheridan St. west to I-95, north to Stirling Rd.; west to shelter. 5400 Stirling Rd.
	22 - Miramar High School	Hallandale Beach Blvd. west to SW 89th Ave.; south to shelter. 3601 SW 89th Ave.
10	20 - Hallandale High School	Hollywood Blvd. west to 28th Ave.; south to NW 11th St.; east to NW 9th Ave.; south to shelter. 720 NW 9th Ave.
11	16 - Plantation High School	Sunrise Blvd. west to NW 68th Ave.; north to shelter. 6901 NW 16th St.
12	6 - Northeast High School	Commercial Blvd. west to Dixie Hwy.; north to NE 56th St.; west to shelter. 700 NE 56th St.
13	8 - Pompano High School	Altantic Blvd. west to U.S. 1; north to NE 6th St.; west to shelter. 1400 NE 6th St.
14	8 - Pompano High School	U.S. 1 south to NE 6th St., west to shelter. 1400 NE 6th St.
15	4 - Deerfield Beach High Sch.	U.S. 1 south to SE 15th St.; west to shelter. 910 SW 15th St.

PALM BEACH COUNTY ROUTE ASSIGNMENTS

Evacuation Zone	Shelter	Route Assignments
1	2 - Jerry Thomas Elementary School	Indiantown Rd. west to Loxahatchee Dr.; south to shelter. 800 Maplewood Dr.
2	2 - Jerry Thomas Elementary School	U.S. 1 south to Indiantown Rd.; west to Loxahatchee Dr.; south to shelter. 800 Maplewood Dr.
3	1 - Jupiter High School	Indiantown Rd. west to Perry Ave.; south to Toney Penna Rd.; west to shelter. 601 Toney Penna Rd.
4	2 - Jerry Thomas Elementary School	U.S. 1 north to Indiantown Rd.; west to Loxahatchee Dr.; south to shelter. 800 Maplewood Dr.
5	3 - Palm Beach Gardens High Sch.	PGA Blvd. west to Military Trail (809); south to Holly Dr.; east to shelter. 4245 Holly Dr.
6	3 - Palm Beach Gardens High Sch.	Blue Heron Blvd. west to Military Trail (809); north to Holly Dr.; east to shelter. 4245 Holly Dr.
7	5 - North Tech. Educational Ctr.	Inlet Ave. (8th St.) west to Garden Rd.; north to shelter. 7071 Garden Rd. Or,
	6 - North Shore High School	Palm Beach Lakes Blvd. west to Congress Ave.; north to Pinehurst Dr.; southeast to North Shore Dr.; south to shelter. Or, 15th St. Extension west to North Shore Dr.; south to shelter. 3701 North Shore Dr. Or,
	7 - Roosevelt Jr. High School	Palm Beach Lakes Blvd. west to Tamarind Ave.; north to shelter. 1601 Tamarind Ave.
8	8 - West Palm Beach Auditorium	Royal Palm Hwy. west to U.S. 1; north to Palm Beach Lakes Blvd.; west to shelter. Palm Beach Lakes Blvd. & Congress Ave.
9	8 - West Palm Beach Auditorium	Southern Blvd. to I-95; north to Palm Beach Lakes Blvd.; east to shelter. Palm Beach Lakes Blvd. & Congress Ave.

PALM BEACH COUNTY ROUTE ASSIGNMENTS (continued)

Evacuation Zone	Shelter	Route Assignments
10	14 - Lake Worth High School	Lake or Lucerne Ave. west to Lake Worth Rd.; west to shelter. 1701 Lake Worth Rd.
11	13 - Palm Beach Junior College	Ocean Ave. (812) west to U.S. 1; north to Lake Ave.; west to Lake Worth Rd.; west to Congress Ave.; south to shelter. 4200 S. Congress
12	16 - Poinciana Elementary School	Boynton Rd./NW 2nd Ave. west to Seacrest Blvd; north to shelter. 1400 NW 1st St.
13	23 - Atlantic High School	S.E. 15th Ave. west to Seacrest Blvd.; south to shelter. 2501 Seacrest Blvd. Or,
	25 - Pompey Park Recreation Ctr.	SE 15th Ave. west to I-95; south to Atlantic Ave.; east to NW 10th Ave.; north to shelter. 240 NW 10th Ave.
14	25 - Pompey Park Recreation Ctr.	Atlantic Ave. west to NW 10th Ave.; north to shelter. 240 NW 10th Ave.
15	27 - Bibletown Community Church	U.S. 1 south to NE 12th St.; west to NW 4th Ave; south to shelter. 601 NW 4th Ave.
16	27 - Bibletown Community Church	NE Spanish River Blvd. west to U.S. 1; south to NE 12th St.; west to NW 4th Ave.; south to shelter. 601 NW 4th Ave.
17	27 - Bibletown Community Church	Palmetto Park Rd. west to NW 4th Ave.; north to shelter. 601 NW 4th Ave.
18	27 - Bibletown Community Church	Camino Real west to U.S. 1; north to Palmetto Park Rd.; west to NW 4th Ave.; north to shelter. 601 NW 4th Ave.
	29 - Boca Raton Recreation Ctr.	Camino Real west to U.S. 1; north to Palmetto Park Rd., west to Crawford Blvd.; north to shelter. 150 NW Crawford Blvd.

PALM BEACH COUNTY ROUTE ASSIGNMENTS (continued)

Evacuation Zone	Shelter	Route Assignments
19	15 - Lantana Elementary School	Lantana Rd. west to Arnold Ave.; south to shelter. 710 Ocean Ave.
20	13 - Palm Beach Junior College	Lake/Lucerne Ave. west to Lake Worth Rd.; west to Congress; south to shelter. 4200 S. Congress
21	8 - West Palm Beach Auditorium	Southern Blvd. west to I-95; north to Palm Beach Lakes Blvd.; east to shelter. Palm Beach Lakes Blvd. & Congress Ave.
22	9 - Twin Lakes High School	Okeechobee Blvd. west to Georgia Ave.; north to shelter. 501 Georgia
23	4 - Suncoast High School	Blue Heron Blvd. west to Ave. "H"; north to shelter. Charger Blvd.