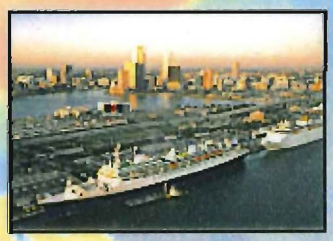
TRANSPORTATION SYSTEM HURRICANE EMERGENCY PREPAREDNESS STUDY

METRO-DADE

Dade County Metropolitan Planning Organization
Dade County Office of Emergency Management



Post, Buckley, Schuh & Jernigan, Inc.
The Gothard Group, Inc.
Herbert Saffir Consulting Engineers
Marlin Engineering, Inc.

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Technical Report No. 2

SYSTEM VULNERABILITY ANALYSIS

TECHNICAL REPORT 2:
SYSTEM VULNERABILITY ANALYSIS

DRAFT

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EXECUTIVE SUMMARY

The Dade County Metropolitan Planning Organization (MPO) undertook a study to review, and where appropriate, enhance hurricane emergency preparedness planning directed at the Dade County transportation system. The firm of Post, Buckley, Schuh & Jernigan, Inc. was retained by the MPO to lead the consulting team conducting the study, which was financed by US DOT Planning Emergency Relief (PLER) funds administered through the MPO. Project work was closely coordinated with the Dade County Office of Emergency Management (OEM), and integrated input from transportation planning, operating, and supporting agencies at local, state, and federal levels as well as incorporating recently updated information from the South Florida Water Management District and the National Hurricane Center.

The objectives of the study were to systematically identify principal physical, functional and personnel resources within the transportation system, to evaluate the system's ability and readiness to deal with hurricane events, and to review and assess procedures associated with transportation system hurricane preparedness and response. Principal tasks of the study were:

1. Inventory key transportation system components pertinent features of the transportation system, and key human resources of the system relevant to hurricane preparedness and response;

2. Assess susceptibility of the transportation system to hurricane occurrence by evaluating exposure, vulnerability, and survivability issues; and

3. Review transportation system preparedness procedures, identifying both effective and less effective points in them, and to develop and offer proposals for refinement.

Technical Report #2 documents an analysis of the susceptibility of the inventoried transportation system resources to wind and storm surge damage and the evaluation of the potential impact on the County's population and employment.

New storm surge atlases were prepared showing potential limits and inundation levels for three hurricane categories. The surge atlas, when combined with any previously developed facility or demographic maps within a GIS environment, allows analyses important for identifying where both people and transportation facilities may be exposed to storm effects, and for initiating *a priori*, remediative actions which may help lessen damage during hurricanes, and facilitate a more prompt response in post-storm situations. This atlas was the basis for redefining the 1995 Hurricane Evacuation Areas, as determined by the Dade County OEM.

In addition, a wind vulnerability analysis for key agency facilities was performed. Taking advantage of GIS capabilities, a series of hypothetical storm tracks hurricane were superimposed on graphical representation of the transportation system elements, population, and employment databases. It is during such storm track testing where the time analytic power of GIS can be most fully explored. Calculations were performed on each of the various physical elements and functional components by exposure category, and *a priori* estimates of systemic impact of the storm were developed far more efficiently than if manually executed. The analysis shows that the worst scenario will be a storm that will have a landfall near the downtown area and proceed northwesterly thereby threatening the most developed part of the county. Not surprisingly, a Category 5 storm scenario will be the most damaging, not only because of its higher core sustained wind speeds of 155 mph or more, but because Category 5 storms are generally larger in size than lesser strength storms. For example, the 75 mph wind bands associated with a Category 5 hurricane will extend out further than those of a Category 1 storm; the 110 mph bands will likewise inflict more damage than those of a Category 3 storm because they will affect a greater area. The impact of different hurricane categories, storm tracks and wind speed bands on the database elements were then analyzed for base year (1993) and future year (2000) conditions.

Also accompanying Technical Report #2 is a technical appendix documenting details of findings of the wind and surge vulnerability analyses.

1.0 INTRODUCTION

1.1 PURPOSE, SCOPE AND METHODOLOGY

The purpose of this report is to evaluate the susceptibility of transportation systems to hurricane storm occurrence. An analysis of the susceptibility of the inventoried transportation system resources to wind and storm surge damage and the evaluation of the potential impact on the county's population and employment was performed. These analyses are representative of those which emergency management planners may perform to assess the impacts of hypothetical storms upon the transportation system and related facilities for which an inventory database was developed.

In addition to transportation infrastructure data, a variety of demographic information is also presented in this report which is important for hurricane susceptibility and evaluation analyses. A series of maps showing the concentration of population and employment in Dade County by Traffic Analysis Zone for 1990 (census year), 1993 (the base year), and 2000 (future year projection) are included. These data can be used to identify levels of infrastructure storm impact, and were used in estimating evacuation clearance times as well.

As noted, all the preceding information was structured into the Geographic Information System (GIS) database. The GIS database files were used to assist in the evaluation of the susceptibility of the inventoried transportation system resources to both storm surge and wind exposures. The location and severity of hurricane storm surges for various strength storms is documented and a storm surge atlas was developed in GIS format. This atlas file, when combined with the physical and functional facilities or demographic databases within a GIS environment, can then be used in analyses to identify where both people and transportation facilities may be exposed to storm effects. With this type of information, planners can initiate remedial actions in advance which may help lessen damage during hurricanes and allow for quicker response in post-storm situations.

In order to analyze the vulnerability to hurricane storm surges, the storm surge limits of three different hurricane categories were translated into a GIS format. Through the use of the powerful GIS spatial overlay analysis technique, it was possible to efficiently and accurately compare storm surge limits to facility location to identify whether a facility is located in a hurricane storm surge impact-prone area; likewise, using demographic data files, an analysis can be done to evaluate how much the existing and projected future population and employment are located in storm surge affected areas. Taking advantage of GIS capabilities, hurricane wind impact tracks were superimposed on the transportation system, population, and employment databases to analyze the impact of different hypothetical hurricane categories, storm tracks and wind speeds. The level of potential wind damage was based on the Saffir-Simpson hurricane intensity scale and actual inspection of numerous transportation facilities by Mr. Saffir. Several hypothetical storms with varied tracks and strengths were analyzed for storm surge impact and wind impact. The results of these analyses were tabulated to summarize the extent of potential disruption to the urban area. From these analyses, recommendations and conclusions relative to transportation system preparedness were identified.

1.2 STORM SURGE EXPOSURE

The development of an updated hurricane storm surge atlas for Dade County was a major product of this study. The atlas was the result of a collaborative effort between the Dade County Office of Emergency Management (OEM); the National Hurricane Center (NHC); the U.S. Geological Survey; the South Florida Water Management District (SFWMD); and Post, Buckley, Schuh & Jernigan, Inc. (PBS&J). The results were utilized by the OEM to redefine hurricane evacuation areas for Dade County for 1995.

The SLOSH Model Hypothetical Storm Simulations

Storm surge is the abnormal rise in water level caused by the wind and pressure forces of a hurricane or tropical storm. Storm surge produces most of the flood damage associated with

storms that make landfall or that closely approach a coastline. The maps contained in the storm surge atlas summarize surge height estimates made using the computerized storm surge model, SLOSH (Sea, Lake, and Overland Surges from Hurricanes). The SLOSH model was developed by Chester Jeslesnianski of the National Oceanic and Atmospheric Administration, National Weather Service.

The storm surge computations and analyses were conducted by the Storm Surge Division of the National Hurricane Center headed by Mr. Brian Jarvinen. The purpose of the atlas is to provide maps of SLOSH-modeled heights of storm surge and extent of flood inundation, for various combinations of hurricane strength, forward speed of storm, and direction of storm motion (storm track). These surge calculations do not include rainfall; rainfall is categorically excluded from the SLOSH calculations.

Surge calculations resulting from the SLOSH model incorporate observed values (depth of water and heights of terrain and barriers) centered in the Biscayne Bay Basin area of Miami. The NHC performed estimates of surge elevation, for each hurricane category (1-5) using the SLOSH model prepared in 1988 for the Biscayne Bay Basin. This atlas illustrates a composite of the worst flooding that could occur for many different storm tracks and forward speed. Potential flooding is shown for Category 1, Category 2-3, and Category 4-5 hurricane intensities. Therefore, three intensity categories were developed.

The storm surge levels for worst case conditions, referred to as the "Maximums of the Maximums" (MOMS) for each of the Category 1, Category 3, and Category 5 hurricanes at a mapping scale of 1-inch = 4,000 feet were used. Since oncoming hurricanes often change category (intensity) as they approach, considering more than three intensity categories is not necessary or appropriate. These calculations were based on the fact that the South Florida Water Management District (SFWMD) indicated that they will maintain their flood gates in an open position for all hurricanes categories greater than Category 2. Gate operation for Category 2 and smaller hurricanes will be variable depending on antecedent rainfall conditions.

The proficiency of the SLOSH model has been evaluated (Jarvinen and Lawrence, 1985) through a comparative analysis of modeled and observed surges at 523 sites during 10 hurricanes. The mean absolute error in surge height calculations by SLOSH was 1.4 feet. Although the error range was from -7.1 feet to +8.8 feet, the standard deviation was only 2.0 feet and 79 percent of the errors lay within one standard deviation of the mean error, -0.2 feet (on the average, modeled values were slightly less than observed).

The SLOSH model was used to develop data for various combinations of hurricane strength, wind speed, and direction of movement. Storm strength was modeled by use of the central pressure, the size of the storm eye, and the radius of maximum winds using the five categories of hurricane intensity as depicted in the Saffir-Simpson Hurricane Scale.

The modeling for each tropical storm/hurricane category was conducted using the mid-range pressure difference (p, millibars) for that category. In addition, the model simulates the storm "filling" (weakening upon landfall) and RMW (radius of maximum winds) increase as summarized below.

To determine surge values, the SLOSH model uses a telescoping polar grid as its unit of analysis. Use of the grid configuration allows for individual calculations per grid square which is beneficial in two ways:

(1) It provided increased resolution of the storm surge at the coastline and inside harbors, bays and rivers, while decreasing the resolution in the deep water where detail is not as important; and

(2) It allows economy in computation.

Storm Scenarios

Once surge heights have been determined for the individual storm tracks, the maximum surge heights are plotted by storm track and tropical storm/hurricane category. These plots of maximum surge heights for a given storm category and track are referred to as Maximums Envelopes of Water (MEOWs). The surge inundation limits displayed on the maps in this Atlas reflect a further compositing of the MEOWs into Maximums of the Maximums (MOMs) regardless of the storm track or direction of the hurricane. The only variable is the intensity of the hurricane represented by category strength (Tropical Storm, and Hurricane Intensity Categories 1-5). The MOM surge heights were furnished by the National Hurricane Center. The depth of surge, for a given hurricane category at a given location, is determined by deducting the known ground elevation (using the local survey data, referenced to the National Geodetic Vertical Datum - NGVD) from the respective hurricane category surge elevation as depicted in the Reference Point Table at the end of the Atlas. United States Geological Survey (USGS) quadrangle sheets, or other appropriate topographic references which are based on the same datum, can also be used to determine ground elevation at specific locations, but the accuracy of these elevations will be limited to the precision and tolerance associated with that map.

In Dade County, recent construction in some areas has been erected upon ground elevated above the surrounding mean elevation, thereby decreasing the flood-prone status as solely represented by the surge maps.

In the Dade County region, topographic data from the USGS quadrangle sheets were used to determine the ultimate storm tide limits for each category. Note that the storm tide limits mapped in this atlas reflect the "raw" surge estimates, as computed using the SLOSH model, plus a foot upward adjustment to account for Mean High Tide. It should also be noted that within the inland extent of depicted surge inundation, water depths may be shallow, even for the Category 5 storms. Reference points have been included on the maps to indicate the relation between ground

elevation and total storm tide elevations at specific locations within the County. Similarly, spot elevations have been identified on the atlas to give the user additional points of reference.

Regarding the interpretation of the data, it is important to understand that the configuration and depth (bathymetry) of the ocean bottom will have a bearing on the surge and wave heights. Those regions which have a narrow shelf, or one that drops off steeply from the shoreline, with deep water in close proximity to the shoreline, tend to produce a lower surge but a higher and more powerful wave. Conversely, those shoreline regions of the County, which have a long, gently sloping shelf and shallower normal depths, can expect a higher surge but smaller waves. The reason this occurs is because surges in deeper water can be dispersed down and out, away from the hurricane, whereas surge builds and amplifies in shallower water. Once surge reaches shallow water, the energy can no longer be dispersed in a downward direction; consequently it piles up as it is driven ashore by the wind stresses of the hurricane. Because waves roll toward shore, their height is also a function of water depth.

A wave is cylindrical and rolls toward shore with its strength and size dependent on the velocity of the wind driving it, the length of time the wind has blown, and the distance the wind has driven the wave across the ocean surface. Once the wave approaches the shore, where the depth of water decreases, it is slowed by frictional drag against the bottom. As a result, the wave front steepens, becomes higher, leans forward and finally breaks. A wave will break when it reaches water which is only slightly deeper than the wave's own height. Where water maintains a depth of 10 to 20 feet close to shore, a wave will only break when it has almost reached land, thus expending its energy directly against the shore. The additional limits if inundation attributable to dynamic wave run-up action are not depicted in this atlas, nor is the added flooding attributed to rainfall accompanying a hurricane depicted, as noted below.

How the Maps Were Made

The maps prepared for this atlas consist of digital USGS planimetric base maps (1:100000) and digital topography from 1:24000 USGS 7-1/2 minute quadrangles. Dade County's planimetric files were also incorporated for road names, and recent roadway construction information. Detailed shoreline and storm tide limits for each category of storm were digitized onto the base maps using Microstation/Intergraph software. All information provided in this atlas is also available in digital form.

How to Use the Maps

The purpose of the maps contained in this atlas is to reflect a worst-possible scenario of hurricane storm inundation and to provide a basis for establishing the hurricane evacuation zones and conducting evacuation clearance time studies. The surge tide delineations are composite for all potential storm tracks for a given category of storm, and the extent of surge flooding across Dade County would not indeed be expected for a given storm. In Andrew, for example, the surges in North Dade, away from the storm's central section, were lower than those forecast by the atlas, because the storm had a particular path. Limits in meteorology associated with hurricane forecasting preclude estimating specific tracks far enough in advance with sufficient accuracy to estimate such specific surge inundation. The storm tide delineations reflect simulated conditions at high tide. This adjusted value includes the raw SLOSH-model surge value plus a one-foot allowance for high tide. However, it should be noted that these surge limits only reflect stillwater saltwater flooding. Local processes, such as waves, rainfall, and freshwater flooding from overflowing rivers, streams, canals, and ditches which are normally included in observations of storm surge height, are not storm surge and are not included in the calculated value of surge by the SLOSH model. It is incumbent upon local emergency management officials, planners and weather forecasters to estimate the degree and extent of rainfall freshwater flooding, as well as to assess the magnitude of the waves that will accompany the surge.

SLOSH model grid-squares are shown in black color. Three numerical values, also colored black, are annotated in each grid square. These values correspond to the Category 1, Category 3 and Category 5 surge elevations computed in that vicinity. A notation "NV" indicates that surge was not computed by the SLOSH model for the corresponding hurricane category. The surge atlas is contained in a separate document as Appendix 2A and copies are available for distribution to local officials for use in preparing their agencies for hurricane impacts.

1.3 WIND VULNERABILITY

Wind vulnerability evaluations were performed with respect to the current condition of facilities and their ability to structurally withstand hurricane wind loads. The study team performed an assessment of the buildings at the study sites, many supplemented by a cursory visual inspection. This assessment accounts for specific local conditions which are deemed to impact survivability, and are based primarily on a comparison of the building code upon which the design was performed to the current post-Andrew requirements of the South Florida Building Code.

The pre-Andrew code:

1) Used a design wind velocity without modification for structure importance, higher wind gusts and surrounding terrain effects,

2) Reduced design loads significantly and perhaps excessively for elevations 30 feet above grade,

3) Did not consider the higher negative pressure (suction) effects present at all corners, edges and ridges of a building, and

4) Allowed windows and glass areas within corners of a building to be designed without consideration of these higher negative pressures.

These items have been corrected in the current version of the South Florida Building Code. It should be noted that the majority of the structures included within this study were designed and constructed under the pre-Andrew code.

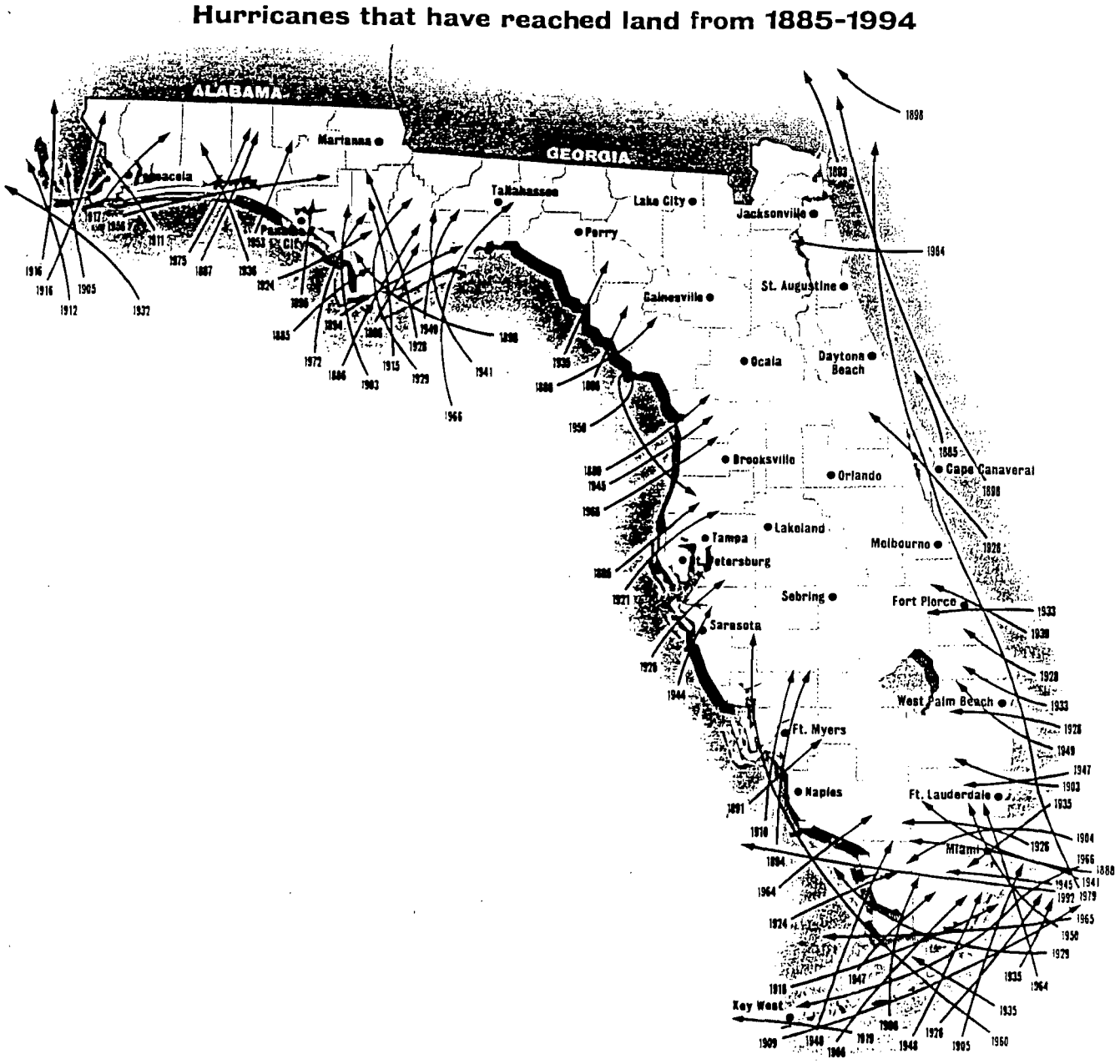
A detailed structural analysis of the buildings within the study sites was not performed. The survivability of individual buildings during a hurricane event is highly dependent upon the quality of construction, the factors of safety employed by the designer, and the criticality of the hurricane wind load case compared to other load cases. An evaluation of these parameters is beyond the scope of this report.

It should also be noted that a structure's survival of hurricane Andrew does not necessarily indicate that it can withstand a Category 4 hurricane. The direction of the wind to which the building was subjected may not have been in the critical direction for maximum stresses on the structure and its components. Also, the environment surrounding the structure may have changed significantly, removing certain shielding elements which may have protected the structure during hurricane Andrew. While the survival of hurricane Andrew does provide correlation of performance with certain methods and systems of construction, it does not necessarily guarantee empirically survival of another Category 4 hurricane.

The Florida peninsula is particularly vulnerable to hurricane storm events. Examples of the variety of storms that have hit the Dade County area in the years between 1885 and 1994 are shown in Figure 1-1.

For this study, maps were developed to define representative "design hurricane storms" that could strike Dade County. There is no assurance that future hurricanes would strike at the assumed angle; in fact, the worst possible storm could be a storm that might make landfall in the southern part of Dade County and take a northerly route, moving toward the north into Broward County with the eye along the coastline. This is similar to Hurricane Cleo which struck the Miami area

Figure 1-1


Hurricanes that have reached land from 1885-1994
ALABAMA
GEORGIA
Marianna
Pensacola
Tallahassee
Lake City
Jacksonville
Perry
Gainesville
St. Augustine
Ocala
Daytona Beach
Brooksville
Orlando
Cape Canaveral
Lakeland
Tampa
St. Petersburg
Melbourne
Sebring
Fort Pierce
Sarasota
West Palm Beach
Ft. Myers
Naples
Ft. Lauderdale
Miami
Key West

in August 1964 and moved up the peninsula almost paralleling the east coast. Cleo was only a Category 2 storm.

Figures 1-2 and 1-3 indicate the Saffir-Simpson Scale with the subjective definitions of general storm effects and typical damages for each of the categories. The Saffir/Simpson Scale was basically set up to show the average speeds in a hurricane measured over a one-minute period. Due to wind turbulence, additional effects are caused by gust speeds which are in excess of this average one-minute speed. These gusts may be 25 percent to 35 percent higher than the winds in a one-minute average speed.

For a historical review of previous tracks of storms that have hit Florida, the reader is referred to the National Oceanic and Atmospheric Administration (NOAA) publication "Tropical Cyclones in the North Atlantic Ocean, 1871-1986". The cumulative charts of tropical storms and hurricanes indicate that any magnitude of storm can occur from any direction in South Florida.

Characteristics of the Project Storms Used for this Study

Based on the Saffir-Simpson Hurricane Scale, key characteristics of project storms used for analysis purposes in this study include:

- Category 1 Project Storm

  Maximum sustained one-minute winds = 74-95 miles per hour and higher
  Maximum gust velocity = 93-119 miles per hour (for duration of 2-3 seconds)
  Probable estimated frequency of occurrence = 25 years (for any single location)

Figure 1-2

SAFFIR / SIMPSON HURRICANE INTENSITY CATEGORIES

Category	Central Pressure		Wind Speed	
	Millibars	Inches (Hg)	Miles Per Hour	Knots
1	≥ 980	≥ 28.94	74 - 95	64 - 83
2	965 - 979	28.50 - 28.91	96 - 110	84 - 96
3	945 - 964	27.91 - 28.47	111 - 130	97 - 113
4	920 - 944	27.17 - 27.88	131 - 155	114 - 135
5	< 920	< 27.17	> 155	> 135

The NHC uses the Saffir/Simpson Hurricane Scale which categorizes hurricanes based on intensity and damage potential. This scale also provides a range of windspeeds and central barometric pressures associated with the five defined categories of hurricanes.

Figure 1-3

THE SAFFIR/SIMPSON HURRICANE SCALE

SUBJECTIVE DEFINITIONS

Scale No. 1 - Sustained winds of 74 to 95 miles per hour. Damage primarily to shrubbery, trees, foliage, and unanchored mobile homes. No real structural 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. Evacuation of mobile homes is required.

Scale No. 2 - Sustained 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 2 to 4 hours before arrival of hurricane center. Considerable damage to piers. Marinas flooded. Small craft in unprotected anchorages torn from moorings. Evacuation of some shoreline residences and low-lying island areas required.

Scale No. 3 - Sustained 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; larger structures near coast damaged by battering waves and floating debris. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Evacuation of low-lying residences within several blocks of shoreline possibly required.

Scale No. 4 - Sustained winds of 131 to 155 miles per hour. Shrubs and trees blown down; most 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 3 to 5 hours before hurricane center arrives. Major erosion of beaches. Massive evacuation of all residences within 500 yards of shore possibly required, and of single-story residences on low ground within 2 miles of shore.

Scale No. 5 - Sustained winds greater than 155 miles per hour. Shrubs and trees blown down; considerable damage to roofs of buildings; virtually 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 3 to 5 hours before hurricane center arrives. Massive evacuation of residential areas on low ground within 5 to 10 miles of shore possible required.

- Category 3 Project Storm

  Maximum sustained one-minute winds = 111-130 miles per hour and higher
  Maximum gust velocity = 144-169 miles per hour (for duration of 2-3 seconds)
  Probable estimated frequency of occurrence = 50 years (for any single location)

- Category 5 Project Storm

  Maximum sustained one-minute winds = 155 miles per hour and higher
  Maximum gust velocity = 200 miles per hour (for duration of 2-3 seconds)
  Probable estimated frequency of occurrence = 300 years (for any single location)

Historical Data and Records Used

There is no typical or characteristic hurricane. All of the factors and characteristics can vary from hurricane to hurricane. One of the alarming features of a hurricane is that - occasionally - the storm may not move for several days. An example of this is Tropical Storm Alberto, which caused tremendous flooding in Georgia (1994) because it generally stopped its forward motion. Subsequent tropical storms induced rainfall, that struck Georgia, after Alberto, exacerbated the initial flooding.

Data on tropical storms in this hemisphere goes back to 1492. However, detailed studies of hurricanes and studies of hurricane disaster mitigation began after Hurricane Camille struck the Mississippi coast in 1969. Much of the increase in coastal area population still remains vulnerable to wind and storm surge in a Category 3 or higher hurricane. Loss of life in hurricanes far exceeds loss of life caused by earthquakes. The 1900 Galveston, Texas hurricane is now estimated to have caused up to 12,000 deaths (Rappaport and Fernandez-Partagas, January 1995).

For definition of the project storms and their characteristics depicted on the map, damage maps from the following storms were studied:

Storm	Location	Dates
Labor Day Hurricane	Florida	August 29 - September 10, 1935
Hurricane Donna	Florida	September 4-12, 1960
Hurricane Cleo	Florida	August 20 - September 5, 1964
Hurricane Camille	Mississippi	August 17-18, 1969
Hurricane Eloise	Florida	September 13-27, 1975
Hurricane Alicia	Texas	August 17-18, 1983
Hurricane Hugo	South Carolina	September 21-22, 1989
Hurricane Andrew	Florida	August 23-24, 1992

A list of storms striking Dade County, and their effects, is given in the attached Table 1-1.

1.4 VULNERABILITY ASSESSMENT FOR TRANSPORTATION FACILITIES

The main section of this report provide a more detailed assessment of the existing condition of existing transportation network elements and related facilities, relative to their vulnerability to storm surge and wind impacts from a hurricane event, and potential actions for improved readiness where appropriate.

For each network element, or structure, or facility that was considered, an assessment relative to storm surge exposure and wind damage exposure was made. For network elements, the assessment is necessarily more generalized, while the review of facilities or structures is more specific. Also, the assessment relative to storm surge impact is more evident since the surge atlas is geographically precise. In contrast, the wind vulnerability is less definitive because this impact vector is not as easily predicted and is more variable in its manifestation.

Table 1-1

CHRONOLOGICAL LIST OF HURRICANES STRIKING DADE COUNTY

Date	Name	Peak Winds (Miles per hour)	(Feet) Tidal Surge	Damage, Data**
August 1888	Unknown	Unknown	14	Reference NOAA
August 1891	Unknown	Unknown	Unknown	Reference NOAA
October 1906	Category 2 on * Saffir-Simpson Scale	Unknown	Unknown	$160,000 damage 164 deaths
September 1926	Category 4 on * Saffir-Simpson Scale YANKEE HURRICANE	138	13.2	1.4 billion dollars damage; 243 deaths
November 1935	Category 2 on * Saffir-Simpson Scale	75	6	5.5 billion dollars damage; 19 deaths
October 1941	Category 2 on * Saffir-Simpson Scale	123	8	$700,000 damage, 5 deaths; this hurricane looped in the Atlantic
September 1945	Category 3 on * Saffir-Simpson Scale	196	13.7	500 million dollars damage; 4 deaths
September 1947	Category 4 on * Saffir-Simpson Scale	155	21.6	704 million dollars damage; 51 deaths
October 1948	Category 3 on * Saffir-Simpson Scale	100	6.2	5.5 million dollars damage
October 1950	Category 3 on * Saffir-Simpson Scale KING	150	19.3	28 million dollars damage; 3 deaths

* Refers to Saffir-Simpson Hurricane Scale
** Not all in Dade County

Table 1-1 (Continued)

Date	Name	Peak Winds (Miles per hour)	(Feet) Tidal Surge	Damage, Data**
August 1964	Category 2 on * Saffir-Simpson Scale CLEO	138	6	600 million dollars damage; 3 deaths
September 1965	Category 3 on * Saffir-Simpson Scale BETSY	165	9	6.4 billion dollars damage; 75 deaths
September 1979	Category 4 on * Saffir-Simpson Scale DAVID	172	5	487 million dollars damage; 1,212 deaths
August 1992	Category 4 on * Saffir-Simpson Scale ANDREW	175	16.9	30 billion dollars damage; 48 deaths

* Refers to Saffir-Simpson Hurricane Scale
** Not all in Dade County

The specific facilities or structures included in the assessment were selected on the basis of their strategic importance, or because they are representative of numerous similar facilities. It was not feasible to consider all facilities or structures, nor all network segments on a detailed basis.

The purpose of this analysis is to provide a general appraisal of the vulnerability of various components of the transportation system to hurricane impact vectors. Based on this review, potential readiness actions can be identified, which would, if implemented, over time lead to improved preparation for, or response to, subsequent hurricane events.

2.0 HIGHWAY TRANSPORTATION SYSTEM VULNERABILITY ANALYSIS

2.1 STORM SURGE EXPOSURE

2.1.1 Traffic Signals

Dade County Public Works Department did not possess an extensive and encompassing inventory of the signal installation type prior to this study. The data was organized in a database, and even more, further embedded that database in a GIS environment which allows the geographical placement of the inventory, its depiction of the signals on a map, and differentiates the signals by installation type. Thus information is fully able to be integrated with existing DCPW GIS systems.

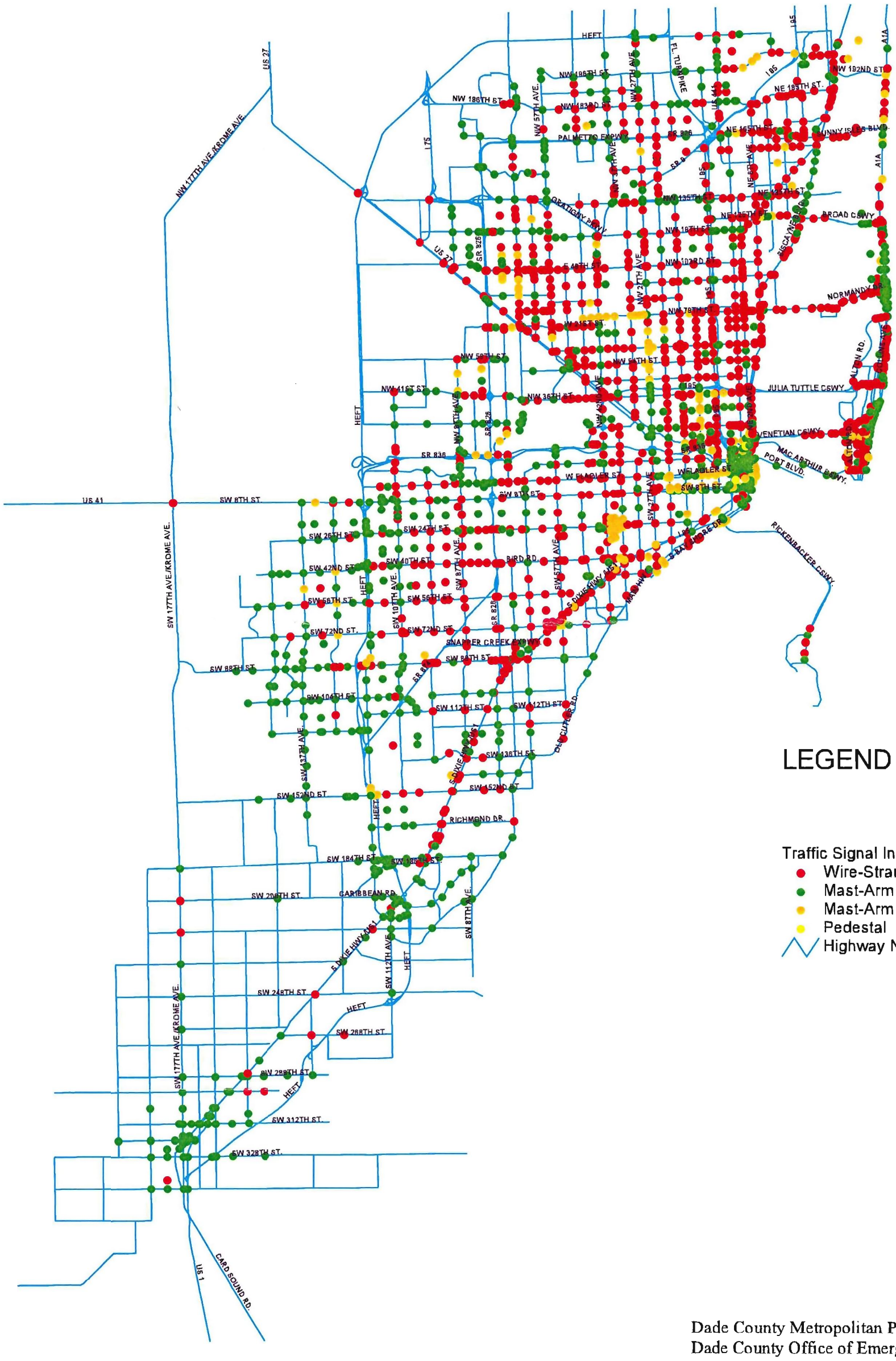
A map showing the traffic signals by installation types is shown in Figure 2-1.

The illuminated signs, flashing signs, school speed zone sign flashers, flashing signals, slaves, activated pre-empt signals and under construction signals were not inventoried as part of the study.

The inventory of existing traffic signals in Dade County included a total of more than 2,000 operating signals. These signals were located in GIS format and cross referenced by signal installation type, employing the analytic capabilities of the GIS system. Of these, 1,027 were identified as wire-strand (signal head suspended from wire extending across roadways or intersection), 826 mast-arm rigid (signal head fixed to arm), 197 mast-arm dangling (signal head suspended from arm) and 2 pedestal signal installation types. The definition for all the codes and headings shown on the following tables can be found in Appendix 1B.

The traffic signal heads may be subject to storm surge exposure, depending on the surge height generated by a storm. In addition, the controller cabinet and underground conduits will be

Traffic Signal Installation Types



LEGEND

Traffic Signal Installation Type
- Wire-Strand
- Mast-Arm Rigid
- Mast-Arm Dangling
- Pedestal
- Highway Network

Dade County Metropolitan Planning Organization
Dade County Office of Emergency Management
Figure 2-1

PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Dade County Transportation System
Hurricane Emergency Preparedness Study

METRO-DADE

subject to flooding. In low lying elevations, such as Miami Beach, Key Biscayne, and the shoreward portions of South Dade east of Old Cutler and South of Matheson Hammock, it is quite foreseeable that a Category 4 or 5 hurricane could generate sufficient surge to affect even signal head.

All signal locations were superimposed upon the storm surge-prone areas for the different hurricane categories. For a Category 1 hurricane, 69 signal's controller installations would be affected. This represents approximately 3 percent of the signals inventoried. Under a Category 3 hurricane, 557 controllers are located in the surge zone. This represents approximately 27 percent of the signals inventoried. Finally, in a Category 5 hurricane, up to 885 controllers were found to be exposed to surge. This represents approximately 43 percent of the signals inventoried as part of the study. In all these instances, it is likely that controller cabinets will be subjected to water damage for all scenarios analyzed.

Dade County Public Works Department implements a specific pre-storm policy for a hurricane emergency situations. Immediately before a hurricane, signal timings are adjusted to reflect pre-defined phasing to favor certain traffic movements, such as to clear the beaches and to increase vehicle flow rates and travel speed. Ninety percent of Dade County signals are controlled at the Traffic Control Center.

FDOT has pre-defined three priority roadway groups to clean up after a hurricane. The traffic signals located on the groups for each of the three priority groups were identified. The Priority 1 Group has 316 traffic signals as shown in Table 2-1 (pages 2-3 through 2-11). Out of 316 signals, 146 signals are wire-strand signals, 21 are mast-arm dangling, 148 signals are mast-arm rigid, and 1 is a pedestal installation type.

The Priority 2 group has 215 traffic signals as shown in Table 2-2 (pages 2-12 through 2-19). Of these, 117 are wire-strand signals, 13 are mast-arm dangling, and 85 are mast-arm rigid installations. *(text continues on page 2-31)*

TABLE 2-1

Traffic Signals
in FDOT Disaster Response Priority Group 1

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
I-95	Broward County Line	Golden Glades Interchange	3387	I-95 (NB)	MIAMI GARDENS DR		1	SA	12
			3238	I-95 (SB),	MIAMI GARDENS DR		1	SA	12
			3809	NE 6 AVE	NE 177 ST		1	SA	1-
			3215	NW 2 AVE	NW 7 AVE EXT	NW 17400 BLK	1	SA	12
			2020	SR 826	NW 2 AVE		1	SA	12
			3768	HIGHLAND LAKES	NE 203 ST		2	SA	12
			4110	NW 4 AVE	NW 7 AVE EXT	NW 171 ST	2	SA	12
			3693	I-95 (SB)	IVES DAIRY RD		3	SA	12
	Golden Glades Interchange	SR 112	2495	I-95 (NB OFF)	NW 79 ST	NW 6 AVE	1	SA	12
			3574	I-95 (NB ON)	NW 81 ST	NW 6 AVE	1	SA	12
			3102	I-95 (NB ON)	OPA LOCKA BLVD	NW 6 AVE	1	SL	--
			3633	I-95 (NB)	NW 103 ST	NW 6 AVE	1	SA	12
			3670	I-95 (SB OFF)	OPA LOCKA BLVD	NW 6 CT	1	SA	12
			3634	I-95 (SB ON)	NW 79 ST	NW 6 CT	1	SL	--
			3861	I-95 (SB)	N MIAMI BLVD		1	SA	12
			4519	I-95 (SB)	NW 103 ST		1	SA	12
			4001	NW 7 AVE	GOLDEN GLADES	PARKING LOT	1	SA	1-
			3733	NW 7 AVE	NW 151 ST		1	SA	12
			3100	I-95 (NB OFF)	NW 135 ST	NW 6 AVE	2	SA	12
			3160	I-95 (NB OFF)	NW 151 ST	NW 6 AVE	2	SA	12
			3083	I-95 (NB)	N MIAMI BLVD	NW 6 AVE	2	SA	12
			4199	I-95 (NB)	NW 62 ST	NW 5 CT	2	SA	12
			2503	I-95 (NB)	NW 95 ST	NW 6 AVE	2	SA	12
			3055	I-95 (NB)	NW 119 ST	NW 6 AVE	2	SA	12
			3268	I-95 (SB ON)	NW 135 ST		2	SL	--
			5327	I-95 (SB)	NW 54 ST	NW 6 CT	2	SA	12
			4200	I-95 (SB)	NW 62 ST	NW 5 PL	2	SA	12
	SR 112	US 1	2347	NW 3 AVE	NW 10 ST		1	SA	12
			2373	NW 3 AVE	NW 14 ST		1	NA	12
			3428	NW 3 CT	NW 8 ST	I-95 SB OFF	1	NA	12
			2375	NW 7 AVE	NW 14 ST		1	SA	12
			2194	FLAGLER ST (W)	W 2 AVE		2	NA	12
			4786	I-95 RAMPS	SW 25 RD		2	SA	12
			2302	NW 2 AVE	NW 1 ST		2	NA	12
			3379	NW 2 AVE	NW 2 ST		2	NA	12
			3380	NW 2 AVE	NW 3 ST		2	NA	12
			2323	NW 2 AVE	NW 5 ST		2	NA	12

TABLE 2-1

Traffic Signals
in FDOT Disaster Response Priority Group 1

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			3288	NW 2 AVE	NW 6 ST		2	NA	12
			2338	NW 2 AVE	NW 8 ST		2	NA	12
			5323	NW 3 AVE	NW 1 ST		2	NA	12
			3400	NW 3 AVE	NW 2 ST	I-95 NB OFF	2	NA	12
			3423	NW 3 AVE	NW 3 ST		2	NA	12
			4479	NW 3 AVE	NW 4 ST		2	SA	12
			3427	NW 3 AVE	NW 6 ST		2	NA	12
			3429	NW 3 AVE	NW 8 ST		2	NA	12
			2355	NW 3 AVE	NW 11 ST		2	SA	12
			3418	NW 3 CT	NW 2 ST	I-95 SB ON	2	NA	12
			3424	NW 3 CT	NW 5 ST		2	NA	12
			2217	SW 2 AVE	SW 1 ST		2	NA	12
			3326	SW 3 AVE	SW 8 ST		2	SA	12
			5213	SW 4 AVE	SW 6 ST		2	SA	--
			3327	SW 4 AVE	SW 8 ST		2	NA	12
			3425	NW 3 AVE	NW 5 ST		3	NA	12
			3399	NW 3 CT	NW 3 ST		3	NA	12
			3426	NW 3 CT	NW 6 ST		3	NA	12
			4620	NW 5 AVE	NW 36 ST		3	SA	12
			3450	SW 3 AVE	SW 7 ST		3	SA	12
			3381	SW 4 AVE	SW 7 ST	I-95 OFF RAMP	3	SA	12
SR 836	I-95	SR 826	2373	NW 3 AVE	NW 14 ST		1	NA	12
			2375	NW 7 AVE	NW 14 ST		1	SA	12
			3085	NW 72 AVE	NW 12 ST		1	SA	12
			3397	DOUGLAS RD	NW 14 ST		1	SA	12
			3483	SR 836	NW 72 AVE N		1	SA	12
			3616	NW 22 AVE	NW 11 ST		1	SA	12
			4129	LEJEUNE RD	NW 11 ST		1	SA	12
			4577	MILAM DAIRY RD	NW 7 ST (W)		1	SA	12
			4585	NW 30 AVE	NW 11 ST		1	SA	12
			5183	MILAM DAIRY RD	NW 7 ST (E)		1	SA	12
			2143	LEJEUNE RD	NW 14 ST		2	SA	12
			2359	NW 12 AVE	NW 11 ST		2	SA	12
			3402	NW 12 AVE	NW 12 ST		2	SA	12
			3746	NW 27 AVE	NW 11 ST		2	SA	12
			3957	PERIMETER RD	RED RD		2	SA	1-

TABLE 2-1

Traffic Signals
in FDOT Disaster Response Priority Group 1

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			4614	RED RD	NW 11 ST	BLUE LAGOON	2	SA	12
			4899	RED RD	SR 836		2	SA	12
			5175	SR 836	NW 72 AVE S	FRONTAGE RD	2	SA	1-
			2372	NW 1 PL	NW 14 ST		3	SA	12
	SR 826	HEFT	4338	GALLOWAY RD	NW 12 ST		1	SA	12
			4562	GALLOWAY RD	SR 836 (S)		1	SA	12
			4608	SR 836	NW 107 AVE		1	SA	12
			5115	NW 12 ST	NW 8600 BLK	SR 836 EXIT	2	SA	1-
			4659	NW 78 AVE	NW 12 ST		3	SA	1-
SR 826	Golden Glades Interchange	I-75	3164	SR 826	NW 27 AVE N		1	SL	--
			3573	SR 826	NW 17 AVE N		1	SL	--
			3631	SR 826	NW 22 AVE S		1	SA	12
			3642	SR 826	NW 22 AVE N		1	SL	--
			3657	SR 826	NW 17 AVE		1	SA	1-
			4056	SR 826	NW 27 AVE S		1	SA	12
			3068	RED RD	SR 826 (N)		2	SA	12
			3586	SR 826	NW 13 AVE N		2	SA	12
			3587	SR 826	NW 13 AVE		2	SA	12
			3783	LUDLAM RD	SR 826 (N)		2	SL	--
			3784	LUDLAM RD	SR 826 (S)		2	SA	12
			3845	RED RD	SR 826 (S)		2	SA	12
			4157	SR 826	NW 47 AVE N		2	SA	12
			4158	SR 826	NW 47 AVE S		2	SL	--
			4165	DOUGLAS RD	SR 826 (S)		2	SL	--
			4166	DOUGLAS RD	SR 826 (N)		2	SA	1-
			4391	SR 826	NW 32 AVE N		2	SA	12
			4392	SR 826	NW 32 AVE S		2	SL	--
			4625	LUDLAM RD	WINDMILL GATE DR		2	SA	12
			4987	RED RD	NW 165 TER		2	SA	12
			5014	LEJEUNE RD	SR 826 (N)		2	SL	--
			5015	LEJEUNE RD	SR 826 (S)		2	SA	12
			5016	MIA LAKES DR W	SR 826 (E)	NW 154 ST	2	SA	12
			5017	MIA LAKES DR W	SR 826 (W)	NW 154 ST	2	SA	12
			5212	MIA LAKES DR W	NW 77 CT	NW 154 ST	2	SA	12
	I-75	Flagler Street	3614	OKEECHOBEE RD	SR 826 (E)		1	SA	12
			3683	SR 826	NW 103 ST E		1	SA	12

TABLE 2-1

Traffic Signals
in FDOT Disaster Response Priority Group 1

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			3917	SR 826	NW 103 ST W		1	SL	--
			3954	NW 79 AVE	NW 36 ST EXT		1	SA	1-
			4176	NW 79 AVE	NW 58 ST		1	SA	12
			4405	OKEECHOBEE RD	SR 826 (W)		1	SA	12
			4489	MILAM DAIRY RD	NW 12 ST		1	SA	12
			4502	SR 826	NW 58 ST W		1	SA	12
			4533	SR 826	NW 74 ST E		1	SA	12
			4534	SR 826	NW 74 ST W		1	SA	12
			4575	NW 79 AVE	NW 41 ST		1	SA	12
			5359	W 68 ST	W 1800 BLK	FRONTAGE RD	1	SA	12
			3547	FLAGLER ST (W)	W 79 AVE		2	SA	12
			3620	FLAGLER ST (W)	SR 826 (E)	W 76 CT	2	SA	12
			3621	FLAGLER ST (W)	SR 826 (W)	W 78 AVE	2	SA	12
			4501	SR 826	NW 58 ST E		2	SA	12
			4665	W 21 CT	W 68 ST		2	SA	12
			4666	SR 826	W 68 ST E	W 19 CT	2	SA	12
			4699	SR 826	W 68 ST W	W 20 AVE	2	SA	12
			4750	NW 79 AVE	NW 103 ST		2	SA	1-
			4753	SOUTH RIVER DR	SR 826 (E)		2	SA	12
			4856	NW 79 AVE	NW 48 ST		2	SA	12
			4895	NW 80 AVE	NW 103 ST		2	SA	12
			5028	SOUTH RIVER DR	SR 826 (W)		2	SA	12
			5109	NW 79 AVE	NW 2 ST		2	SA	--
			5111	NW 79 AVE	NW 25 ST		2	SA	12
			5200	NW 75 AVE	NW 25 ST		2	SA	12
			4621	MILAM DAIRY RD	NW 16 ST		3	SA	1-
			4659	NW 78 AVE	NW 12 ST		3	SA	1-
			4734	NW 79 AVE	NW 53 ST		3	SA	12
	Flagler Street	US 1	2634	SW 74 AVE	SW 8 ST		1	SA	12
			2960	CORAL WAY	SW 75 AVE		1	SA	12
			3523	BIRD RD	SR 826 (W)		1	SA	12
			3623	CORAL WAY	SR 826 (E)		1	SA	12
			3624	CORAL WAY	SR 826 (W)		1	SA	12
			3668	KENDALL DR	SR 826 (E)		1	SA	12
			3777	MILLER DR	SR 826 (E)		1	SL	--
			3778	MILLER DR	SR 826 (W)		1	SA	12
			3781	SR 826	SUNSET DR E		1	SL	--

TABLE 2-1

Traffic Signals
in FDOT Disaster Response Priority Group 1

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			3782	SR 826	SUNSET DR W		1	SA	12
			3972	KENDALL DR	SW 77 AVE		1	SA	12
			4062	BIRD RD	SR 826 (E)		1	SA	12
			4137	KENDALL DR	SW 7500 BLK	MALL	1	SA	12
			4195	US 1	SW 98 ST		1	SA	12
			4283	SUNSET DR	SW 77 CT		1	SA	12
			4374	BIRD RD	SW 74 CT	SW 75 AVE	1	SA	12
			4681	DATRAN DR	US 1		1	SA	12
			4682	DADELAND BLVD	S DADELAND BLVD		1	SA	12
			5322	DATRAN DR	DADELAND MDTA STA		1	FA	12
			3997	DADELAND BLVD	KENDALL DR		2	SA	12
			5114	CORAL WAY	SW 74 AVE		2	SA	12
SR 112	NW 42nd Avenue	I-95	3048	NORTH RIVER DR	NW 36 ST		1	SA	12
			3575	NW 32 AVE	NW 41 ST		1	SA	12
			3959	SR 112	NW 22 AVE S		1	SA	12
			2478	NW 27 AVE	NW 38 ST	SR 112 EB	2	SA	12
			2480	NW 27 AVE	NW 41 ST		2	SA	12
			3604	DOUGLAS RD	NORTH RIVER DR	NW 33 ST	2	SA	12
			5039	NW 12 AVE	NW 39 ST	SR112 EB OFF	2	SA	12
			5041	NW 12 AVE	NW 40 ST	I-95 SB OFF	2	SA	12
I-195	I-95	Alton Road	2649	ALTON RD	CHASE AVE	N BAY RD	1	SA	12
Julia Tuttle			2650	ALTON RD	ART GODFREY RD		1	SA	12
Expr.									
I-395	I-95	A1A	2361	BAYSHORE DR (N)	NE 13 ST		1	SA	12
MacArthur			2373	NW 3 AVE	NW 14 ST		1	NA	12
Cswy.			2640	ALTON RD	5 ST		1	SA	12
			2728	JEFFERSON AVE	5 ST		1	SA	12
			2734	LENOX AVE	5 ST		1	SA	12
			2740	MERIDIAN AVE	5 ST		1	SA	12
			2752	MICHIGAN AVE	5 ST		1	SA	12
			2794	WASHINGTON AV	5 ST		1	SA	12
			3645	US 1	NE 11 TERR		1	SA	12
			2658	COLLINS AVE	5 ST		2	SA	12
			2736	MAC ARTHUR CS	TERMINAL ISLE		2	SA	12

TABLE 2-1

Traffic Signals
in FDOT Disaster Response Priority Group 1

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			2737	MAC ARTHUR CS	PALM & HIB. ISLE	FOUNTAIN ST	2	SA	12
			2738	MAC ARTHUR CS	STAR ISLE	BRIDGE ST	2	SA	12
			3685	NE 2 AVE	NE 12 ST	SR836 EB EXIT	2	NA	12
			2372	NW 1 PL	NW 14 ST		3	SA	12
			3684	NE 1 AVE	NE 12 ST	SR 836 WB EN	4	NA	12
SR 826	Golden Glades Interchange	A1A	2003	SR 826	NE 10 AVE		1	SA	12
Sunny			2010	SR 826	US 1		1	SA	12
Isles Cswy.			2012	SR 826	NE 12 AVE		1	SA	12
			2013	SR 826	NE 19 AVE		1	SA	12
			2014	SR 826	NE 15 AVE		1	SA	12
			2017	SR 826	NE 8 AVE		1	SA	12
			2018	SR 826	NE 6 AVE		1	SA	12
			2019	SR 826	WEST DIXIE HWY		1	SA	12
			2020	SR 826	NW 2 AVE		1	SA	12
			3179	NE 15 AVE	NE 164 ST		1	SA	12
			3647	WEST DIXIE HWY	NE 164 ST		1	SA	12
			3671	SR 826	NE 35 AVE		1	SA	12
			3737	SR 826	NE 3 CT		1	SA	12
			3915	SR 826	NE 18 AVE		1	SA	12
			4352	SR 826	NE 9 AVE	NE 167 ST (MID	1	SA	12
			4710	SR 826	NE 26 AVE		1	SA	12
			4800	SR 826	NE 28 AVE		1	SA	12
			4801	SR 826	NE 2900 BLK	INTERAMA EN	1	SA	12
			4802	INTERAMA BLVD	SR 826		1	SA	12
			2995	COLLINS AVE	SR 826 (S)		2	SA	12
			3383	MIAMI AVE (N)	SR 826		2	SA	12
			5206	NW 2 AVE	NW 165 ST		2	SA	12
			5253	COLLINS AVE	SR 826 (N)		2	SA	12
			4767	SR 826	NE 2 AVE		3	SA	12
A1A	MacArthur Cswy.	Julia Tuttle Expr.	2658	COLLINS AVE	5 ST		2	SA	12
			2659	COLLINS AVE	8 ST		2	NA	12
			2660	COLLINS AVE	10 ST		2	NA	12
			2661	COLLINS AVE	11 ST		2	NA	12
			2662	COLLINS AVE	14 ST		2	NA	12
			2663	COLLINS AVE	ESPA-OLA WAY		2	NA	12

TABLE 2-1

Traffic Signals
in FDOT Disaster Response Priority Group 1

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			2664	COLLINS AVE	LINCOLN RD		2	SA	12
			2665	COLLINS AVE	17 ST		2	NA	12
			2666	COLLINS AVE	18 ST		2	NA	12
			2667	COLLINS AVE	20 ST		2	NA	12
			2668	COLLINS AVE	21 ST		2	NA	12
			2669	COLLINS AVE	22 ST		2	NA	12
			2670	COLLINS AVE	23 ST		2	SA	12
			2671	COLLINS AVE	24 ST		2	SA	12
			2672	COLLINS AVE	26 ST (INDIAN CREEK DR)		2	SA	12
			2673	COLLINS AVE	27 ST		2	SA	12
			2674	COLLINS AVE	29 ST		2	SA	12
			2675	COLLINS AVE	30 ST		2	SA	12
			2677	ART GODFREY RD	COLLINS AVE		2	NA	12
			3888	COLLINS AVE	15 ST		2	SA	12
			4649	OCEAN DR	5 ST		2	SA	12
			4424	OCEAN DR	10 ST		3	SA	--
	Julia Tuttle Expr.	Normandy Drive	2681	COLLINS AVE	45.25 ENT	EDEN ROCK	1	SA	12
			2682	COLLINS AVE	46.00 BLK	PARKING LOT	1	SA	12
			2683	COLLINS AVE	47.47 ENT	MIMOSA APTS	1	SA	12
			2721	INDIAN CREEK DR	63 ST		1	SA	12
			3283	COLLINS AVE	53.00 BLK	N OF IMPERIAL	1	SA	12
			3432	COLLINS AVE	53.33 ENT	OLIVER HOUS	1	SA	12
			3433	COLLINS AVE	55.55 BLK		1	SA	12
			3438	COLLINS AVE	54.45 EXIT	CASTLE	1	SA	12
			3439	COLLINS AVE	54.45 ENT	CASTLE	1	SA	12
			3690	COLLINS AVE	50.55 ENT	CRYSTAL HOU	1	SA	12
			3702	COLLINS AVE	52.25 ENT	ALEXANDER H	1	SA	12
			3866	COLLINS AVE	49.25 ENT	EXECUTIVE HS	1	SA	12
			3923	COLLINS AVE	58.75 BLK		1	SA	12
			2677	ART GODFREY RD	COLLINS AVE		2	NA	12
			2678	COLLINS AVE	43 ST		2	PT	12
			2679	COLLINS AVE	INDIAN CREEK (44 ST)		2	SA	12
			2689	COLLINS AVE	63 ST		2	SA	12
			2690	COLLINS AVE	67 ST		2	SA	12
			2691	COLLINS AVE	69 ST		2	SA	12
			2692	COLLINS AVE	71 ST		2	PT	12
			3434	COLLINS AVE	56.01 ENT	OCEANSIDE P	2	SA	12

TABLE 2-1

Traffic Signals
in FDOT Disaster Response Priority Group 1

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			3538	COLLINS AVE	44.41 ENT	FOUNTAINBLE	2	SA	12
			3770	COLLINS AVE	65 ST		2	SA	12
			3880	COLLINS AVE	72 ST		2	PT	12
			3922	COLLINS AVE	44.41 EXIT	FOUNTAINBLE	2	SL	--
	Normandy Drive	SR 826 Sunny Isles Cswy.	2916	HARDING AVE	91 ST		1	PT	12
			3390	COLLINS AVE	96 ST & 97 ST		1	SL	--
			3548	COLLINS AVE	97.01 ENT		1	SA	12
			3628	COLLINS AVE	HARBOUR WAY (WB)		1	SL	--
			3629	COLLINS AVE	HARBOUR WAY (EB)		1	SA	1-
			4179	COLLINS AVE	HAULOVER FIRE S		1	PE	--
			2693	COLLINS AVE	73 ST		2	PT	12
			2694	COLLINS AVE	74 ST		2	NA	12
			2695	COLLINS AVE	75 ST		2	PT	12
			2696	COLLINS AVE	81 ST		2	NA	12
			2697	COLLINS AVE	85 ST		2	PT	12
			2713	HARDING AVE	77 ST		2	NA	12
			2911	COLLINS AVE	93 ST		2	PT	12
			2912	COLLINS AVE	94 ST		2	PT	12
			2919	HARDING AVE	96 ST		2	PT	12
			2995	COLLINS AVE	SR 826 (S)		2	SA	12
			3005	COLLINS AVE	96 ST		2	PT	12
			3319	COLLINS AVE	95 ST		2	PT	12
			3880	COLLINS AVE	72 ST		2	PT	12
			3993	BAYVIEW DR	OCEAN BLVD		2	SA	12
			4231	COLLINS AVE	90 ST		2	PT	12
			4310	COLLINS AVE	88 ST		2	SA	12
			4900	ATLANTIC AVE	OCEAN BLVD COLLI	OCEANIA DEV	2	SA	1-
			5253	COLLINS AVE	SR 826 (N)		2	SA	12
			3490	COLLINS AVE	159 ST		3	SA	12
			4736	COLLINS AVE	HAULOVER PK		3	SA	12
	Sunny Isles Cswy.	Broward County Line	3459	COLLINS AVE	185 ST		1	SA	12
			3501	COLLINS AVE	172 ST		1	SA	12
			3881	COLLINS AVE	174 ST		1	SA	12
			4549	COLLINS AVE	178 ST		1	SA	1-
			4605	COLLINS AVE	189 ST		1	SA	1-
			5591	COLLINS AVE	TERRACINA AVE		1	SA	FC
			3320	COLLINS AVE	THE STRAND		2	SA	1-

TABLE 2-1

Traffic Signals
in FDOT Disaster Response Priority Group 1

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			5182	GALLOWAY RD	SW 94 ST		2	SA	12
			4142	GALLAHAD DADE	OCEAN BLVD		3	SA	12
			4606	COLLINS AVE	SR 856	Wm Lehman Cs	3	SA	1-
			4733	COLLINS AVE	170 ST		3	SA	1-
			4735	COLLINS AVE	183 ST		3	SA	1-
US 1	Broward County Line	SR 826	2010	SR 826	US 1		1	SA	12
			2023	WEST DIXIE HWY	NE 172 ST		1	SA	12
			3454	US 1	NE 187 ST		1	SA	12
			3456	US 1	NE 203 ST		1	SA	12
			3469	MIAMI GARDENS	US 1		1	SA	12
			3638	US 1	NE 172 ST		1	SA	12
			3639	US 1	NE 178 ST	POINT EAST	1	SA	12
			3644	US 1	NE 183 ST	WILLIAMS IS	1	SA	12
			3841	AVENTURA BLVD	US 1	NW 199 ST	1	SA	12
			4280	US 1	NE 180 ST	DEL PRADO	1	SA	12
			4301	US 1	NE 209 ST		1	SA	12
			4587	US 1	NE 18200 BLK		1	SA	12
			4603	NE 26 AVE	NE 203 ST		1	SA	12
			4655	SR 856	US 1		1	SA	12
			4669	US 1	NE 195 ST	MALL	1	SA	12
			4670	US 1	NE 196 ST	MALL	1	SA	12
			5267	US 1	NE 208 ST	WATERWAY B	2	SA	1-
			5269	US 1	NE 191 ST		2	SA	12
SR 874	HEFT	SR 826	3581	KENDALL DR	SW 97 AVE		1	SA	12
			4139	KENDALL DR	SR 874 (NB OFF)		1	SA	12
			4140	KENDALL DR	SR 874 (SB)		1	SA	12
US 1	HEFT	Monroe County Line	4339	US 1	SW 344 ST		2	SA	12

TABLE 2-2

Traffic Signals in FDOT Disaster Response Priority Group 2

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
I-75	HEFT	SR 826	5080	HIA-HIA GDN BLV	I-75		1	SA	--
			5331	W 16 AVE	W 84 ST		2	SA	--
US 1	HEFT	Cutler Ridge	3649	US 1	SW 112 AVE		1	SA	12
			5261	US 1	SW 157 AVE		1	SA	12
			3502	US 1	SW 216 ST		1	SA	12
			3465	US 1	SW 248 ST		1	SA	12
			4246	CARIBBEAN BLVD	SW 10900 BLK		2	SA	12
			2993	CARIBBEAN BLVD	US 1		2	SA	12
			4704	FLAGLER AVE	SW 308 ST	NE 11 ST HMST	2	SA	12
			4394	OLD DIXIE HWY	SW 288 ST		2	SA	12
			3646	OLD DIXIE HWY	SW 296 ST		2	SA	12
			4120	OLD DIXIE HWY	SW 304 ST		2	SA	12
			4497	SW 112 AVE	SW 20900 BLK		2	SA	1-
			4493	SW 157 AVE	SW 288 ST		2	SA	12
			4252	US 1	SW 117 AVE	SW 211 ST	2	SA	12
			5049	US 1	SW 127 AVE	SW 232 ST	2	SA	12
			3533	US 1	SW 167 AVE	SW 304 ST	2	SA	12
			3652	US 1	SW 20400 BLK		2	SA	12
			3627	US 1	SW 220 ST		2	SA	12
			3741	US 1	SW 268 ST		2	SA	1-
			5262	US 1	SW 280 ST		2	SA	1-
			3046	US 1	SW 288 ST		2	SA	12
			3610	US 1	SW 296 ST		2	SA	12
			3024	US 1	SW 308 ST		2	SA	12
			3025	US 1	SW 312 ST		2	SA	12
			3570	US 1	SW 320 ST		2	SA	12
			3026	US 1	SW 328 ST		2	SA	12
SR 878	SR 874	US 1	4483	GALLOWAY RD	SR 878 (N)		1	SA	12
			4422	GALLOWAY RD	SR 878 (S)		1	SL	--

TABLE 2-2

Traffic Signals in FDOT Disaster Response Priority Group 2

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			3921	GALLOWAY RD	SW 82 ST		1	SA	12
			4518	SR 878	SW 72 AVE S		1	SA	12
			4481	SR 878	US 1		2	SA	12
			3941	SW 72 AVE	SW 80 ST		2	SA	12
SR 934	I-95	A1A	3014	ADVENTURE AVE	J KENNEDY BLVD		1	SA	12
79th St Cswy.			2759	BAY DRIVE (E)	NORMANDY DR	71 ST	1	SA	12
			2764	BAY DRIVE (W)	NORMANDY DR	71 ST	1	SA	12
			2763	BIARRITZ DR	NORMANDY DR		1	SA	12
			3013	HISPANOLA AVE	J KENNEDY BLVD		1	SA	12
			2725	INDIAN CREEK DR	71 ST	DICKENS AVE	1	SA	1-
			3874	J KENNEDY BLVD	18.00 BLK		1	SA	12
			3919	J KENNEDY BLVD	HARBOR ISLAND	FIRE STA	1	PE	--
			3785	J KENNEDY BLVD	PELICAN HARBOR		1	SA	12
			3016	J KENNEDY BLVD	TREASURE DR (E)		1	SA	12
			2093	MIAMI AVE (N)	N 79 ST		1	SA	12
			2123	NE 2 AVE	NE 79 ST		1	SA	12
			2122	NE 4 AVE	NE 79 ST		1	SA	12
			2121	NE 4 CT	NE 79 ST		1	SA	12
			2120	NE 5 AVE	NE 79 ST		1	SA	12
			2117	NE 10 AVE	NE 79 ST		1	NA	12
			3516	NE 10 AVE	NE 82 ST		1	NA	12
			2760	NORMANDY DR	RUE VERSAILLES		1	SA	12
			2761	NORMANDY DR	TROUVILLE ESP		1	SA	12
			2094	NW 2 AVE	NW 79 ST		1	SA	12
			2756	RUE NOTRE DAME	71 ST		1	SA	12
			2765	RUE VENDOME	71 ST		1	SA	12
			2757	TROUVILLE ESP	71 ST		1	SA	12
			2115	US 1	NE 78 ST		1	SA	12
			2119	US 1	NE 79 ST		1	SA	12
			3015	HARBOR DR	J KENNEDY BLVD		2	SA	12

TABLE 2-2

Traffic Signals in FDOT Disaster Response Priority Group 2

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			3544	HARDING AVE	71 ST		2	PT	12
			2118	NE 7 AVE	NE 79 ST		2	NA	12
			2637	ABBOTT AVE	71 ST		3	PT	12
			2638	ABBOTT AVE	72 ST		3	NA	12
NW 27th Av.	Broward County Line	SR 922	2977	ALI BABA AVE	NW 27 AVE		1	SA	12
		Broad Cswy.	3829	NW 27 AVE	CALDER TRACK		1	SA	12
			3840	NW 27 AVE	NW 115 ST		1	SA	12
			2520	NW 27 AVE	NW 119 ST		1	SA	12
			4545	NW 27 AVE	NW 132 ST		1	SA	12
			3559	NW 27 AVE	NW 151 ST		1	SA	12
			3589	NW 27 AVE	NW 175 ST		1	SA	12
			4290	NW 27 AVE	NW 18700 BLK	FIRE STA	1	PE	--
			4871	SW 127 AVE	SW 96 ST		1	SA	FC
			3865	EAST RD (MDCC)	NW 119 ST		2	SA	12
			2908	MIAMI GARDENS D	NW 27 AVE		2	SA	12
			3576	NW 27 AVE	NW 135 ST		2	SA	12
			5319	NW 27 AVE	NW 137 ST	SUPERIOR ST	2	SA	12
			4281	NW 27 AVE	NW 191 ST		2	SA	12
			4619	NW 27 AVE	NW 199 ST		2	SA	12
			5239	NW 27 AVE	NW 203 ST		2	SA	12
			3403	NW 27 AVE	NW 207 ST		2	SA	12
			2980	OPA-LOCKA BLVD	NW 27 AVE		2	SA	12
			3817	SR 9 (SWB)	NW 27 AVE (NB)		2	SA	12
			5242	SR 821	NW 27 AVE N		2	SA	12
			5241	SR 821	NW 27 AVE S	NW 215 ST	2	SA	12
			3251	NW 27 AVE	NW 160 ST		3	SA	12
	SR 922	MacArthur Cswy.	4235	NW 26 AVE	NW 103 ST		1	SA	12
	Broad Cswy.		2494	NW 27 AVE	NW 75 ST		1	SA	12
			3385	NW 27 AVE	NW 84 ST		1	SA	12
			2502	NW 27 AVE	NW 87 ST		1	SA	12

TABLE 2-2

Traffic Signals in FDOT Disaster Response Priority Group 2

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			2512	NW 27 AVE	NW 103 ST		1	SA	12
			3689	NW 27 AVE	NW 110 ST		1	SA	12
			3220	NW 27 AVE	NW 113 ST		1	SA	12
			2404	NORTH RIVER DR	NW 27 AVE	NW 20 ST	2	SA	12
			2378	NW 27 AVE	NW 14 ST		2	SA	12
			2388	NW 27 AVE	NW 17 ST		2	SA	12
			2479	NW 27 AVE	NW 28 ST		2	SA	12
			3819	NW 27 AVE	NW 34 ST		2	SA	12
			2056	NW 27 AVE	NW 36 ST		2	SA	12
			3835	NW 27 AVE	NW 43 TERR		2	SA	12
			2499	NW 27 AVE	NW 79 ST		2	SA	12
			2507	NW 27 AVE	NW 95 ST		2	SA	12
			2483	NW 27 AVE	NW 46 ST		3	SA	12
			3836	NW 27 AVE	NW 50 ST		3	SA	12
			2486	NW 27 AVE	NW 54 ST		3	SA	12
			4300	NW 27 AVE	NW 60 ST		3	SA	12
			2489	NW 27 AVE	NW 62 ST		3	SA	12
			3837	NW 27 AVE	NW 65 ST		3	SA	12
			3588	NW 27 AVE	NW 71 ST		3	SA	12
	MacArthur Cswy.	US 1	2182	US 1	SW 27 AVE		1	SA	12
			2204	FLAGLER ST (W)	W 27 AVE		1	SA	12
			2239	SW 27 AVE	SW 6 ST		1	SA	12
			2253	SW 27 AVE	SW 8 ST		1	SA	12
			2259	SW 27 AVE	SW 16 ST		1	SA	12
			2265	CORAL WAY	SW 27 AVE		1	SA	12
			2333	NW 27 AVE	NW 7 ST		1	SA	12
			3447	SW 27 AVE	SW 7 ST		1	SA	12
			4679	SW 27 AVE	SW 27 TERR		3	SA	12
NW 36th St.	SR 826	SR 112	3143	EAST DRIVE	NW 36 ST		1	SA	12
			3156	LEE DR	NW 36 ST		1	SA	12

TABLE 2-2

Traffic Signals in FDOT Disaster Response Priority Group 2

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			3023	LEJEUNE RD	NW 36 ST	SR112 EB ON	1	NA	12
			4853	LUDLAM RD	PERIMETER RD	OLD	1	SA	--
			3163	MILAM DAIRY RD	NW 36 ST EXT		1	SA	12
			3233	NW 36 ST	NW 4900 BLK		1	SA	12
			3234	NW 36 ST	NW 5300 BLK		1	SA	12
			3142	PALMETTO DR	NW 36 ST		1	SA	12
			4503	PERIMETER RD	NW 62 AVE		1	FA	--
			3022	ROYAL POINCIANA	NW 36 ST		1	SA	12
			2900	SHERIDAN DR	NW 36 ST		1	SA	12
			2901	SOUTH DR	NW 36 ST		1	SA	12
			2902	CURTISS PKWY	NW 36 ST		2	SA	12
			5333	LUDLAM RD	NW 36 ST		2	SA	12
			3830	NW 36 ST EXT	NW 7100 BLK		2	SA	12
			3903	NW 66 AVE	NW 36 ST		2	SA	12
NW 42nd Ave.	SR 944	SW 8th Street	2136	FLAGLER ST (W)	LEJEUNE RD		1	SA	12
			3811	LEJEUNE RD	NW 18 ST		1	SA	12
			3125	LEJEUNE RD	NW 3100 BLK	EAL DRIVEWAY	1	SA	12
			3023	LEJEUNE RD	NW 36 ST	SR112 EB ON	1	NA	12
			2843	LEJEUNE RD	OKEECHOBEE RD		1	NA	12
			3019	LEJEUNE RD	ROYAL POINCIANA		1	SA	12
			2144	LEJEUNE RD	SW 8 ST		1	SA	12
			2854	HIALEAH DR	LEJEUNE RD		2	SA	12
			2141	LEJEUNE RD	NW 7 ST		2	SA	12
			3124	LEJEUNE RD	NW 25 ST		2	SA	12
			2849	LEJEUNE RD	SE 8 ST	HIALEAH	2	SA	12
	SW 8th Street	US 1	2587	ALHAMBRA CIR	LEJEUNE RD	SW 42 Ave	1	SA	12
			2584	ANDALUSIA AVE	LEJEUNE RD	SW 42 Ave	1	SA	12
			2592	ARAGON AVE	LEJEUNE RD		1	SA	12
			2595	BIRD RD	LEJEUNE RD	SW 42 Ave	1	SA	12
			2604	CORAL WAY	LEJEUNE RD		1	SA	12

TABLE 2-2

Traffic Signals in FDOT Disaster Response Priority Group 2

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			2617	GRAND AVE	LEJEUNE RD	PONCE DE LEO	1	SA	12
			3786	LEJEUNE RD	MINORCA AVE		1	SA	12
			2627	LEJEUNE RD	UNIVERSITY DR		1	SA	12
			2621	LEJEUNE RD	US 1		1	SA	12
			3117	LEJEUNE RD	VALENCIA AVE		1	SA	12
			3272	ALTARA AVE	LEJEUNE RD	SW 42 Ave	2	SA	12
SR 959	SR 826	Ockeechobee Rd	3198	OKEECHOBEE RD	RED RD	W 9 ST	1	SA	12
			3168	RED RD	W 18 ST		1	SA	12
			3978	RED RD	W 21 ST		1	SA	12
			3139	RED RD	W 23 ST		1	SA	12
			2872	RED RD	W 29 ST		1	SA	12
			3813	RED RD	W 32 ST		1	SA	12
			5219	RED RD	W 37 ST		1	SA	FC
			3752	RED RD	W 40 PL		1	SA	12
			4116	RED RD	W 44 PL		1	SA	12
			2882	RED RD	W 49 ST		1	SA	12
			4410	RED RD	W 53 ST		1	SA	12
			4375	RED RD	W 60 ST		1	SA	12
			2884	RED RD	W 65 ST		1	SA	12
			3970	RED RD	W 71 PL		1	SA	12
			3983	RED RD	W 75 PL		1	SA	12
			4851	GRATIGNY PKWY	RED RD (N)		2	SA	12
			4852	GRATIGNY PKWY	RED RD (S)		2	SA	12
			3838	MIA LAKES DR E	RED RD		2	SA	12
			3344	RED RD	NW 138 ST		2	SA	12
			3961	RED RD	NW 142 ST		2	SA	12
			4111	RED RD	NW 158 ST		2	SA	12
			3974	RED RD	NW 159 ST		2	SA	12
			4643	RED RD	NW 163 ST		2	SA	12
			3753	RED RD	W 68 ST		2	SA	12

TABLE 2-2

Traffic Signals in FDOT Disaster Response Priority Group 2

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			4661	RED RD	W 16 ST		3	SA	12
Kendall Drive	Krome Avenue	HEFT	4898	KENDALL DR	SW 123 CT		1	SA	1-
			4334	KENDALL DR	SW 127 AVE		1	SA	12
			4863	KENDALL DR	SW 122 AVE		2	SA	12
			4286	KENDALL DR	SW 12500 BLK		2	SA	12
			3964	KENDALL DR	SW 132 AVE		2	SA	12
			4598	KENDALL DR	SW 133 AVE		2	SA	12
			3842	KENDALL DR	SW 137 AVE		2	SA	12
			4604	KENDALL DR	SW 13800 BLK		2	SA	12
			4652	KENDALL DR	SW 142 AVE		2	SA	12
			5218	KENDALL DR	SW 147 AVE		2	SA	12
			4820	KENDALL DR	SW 152 AVE		2	SA	12
			5224	KENDALL DR	SW 157 AVE		2	SA	UC
	HEFT	US 1	3237	GALLOWAY RD	KENDALL DR		1	SA	12
			4715	KENDALL DR	MILLS DR		1	SA	12
			4401	KENDALL DR	SR 821 (NB OFF)		1	SA	12
			4141	KENDALL DR	SR 878 (EB ON)		1	SA	12
			3322	KENDALL DR	SW 7300 BLK	MALL	1	SA	12
			3774	KENDALL DR	SW 79 AVE		1	SA	12
			3831	KENDALL DR	SW 99 CT		1	SA	12
			4760	KENDALL DR	SW 112 AVE		1	SA	12
			3994	KENDALL DR	SW 117 AVE RD		1	SA	12
			2953	KENDALL DR	US 1		1	SA	12
			5571	KENDALL DR	SW 9100 BLK		2	SA	UC
			3535	KENDALL DR	SW 107 AVE		2	SA	12
			3995	KENDALL DR	SW 117 AVE		2	SA	12
			5153	SW 122 AVE	SW 8800 BLK		2	SA	12
Tamiami Trail	Collier County Line	HEFT	4198	KROME AVE	SW 8 ST		1	FA	--
			3730	SW 122 AVE	SW 8 ST		1	SA	12

TABLE 2-2

Traffic Signals in FDOT Disaster Response Priority Group 2

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			5130	SW 127 AVE	SW 8 ST		1	SA	12
			4239	SR 821	SW 8 ST W		2	SA	12
			5406	SW 127 AVE	SW 6 ST		2	SA	UC
			4869	SW 137 AVE	SW 8 ST		2	SA	12
			4758	SW 132 AVE	SW 8 ST		3	SA	12
Port Blvd.	US 1	North America Wy	4922	PORT BLVD	SOUTH AMERICA WAY		2	SA	--
			5268	PORT BLVD (NEW)	BAYSIDE EXIT		2	SA	12

TABLE 2-3

Traffic Signals in FDOT Disaster Response Priority Group 3

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
Tamiami Trail	HEFT	SR 826	3362	GALLOWAY RD	SW 8 ST		1	SA	12
			3743	SW 97 AVE	SW 8 ST		1	SA	12
			4238	SR 821	SW 8 ST E		2	SA	12
			4565	SW 82 AVE	SW 8 ST		2	SA	12
			5164	SW 92 AVE	SW 8 ST		2	SA	1-
			4563	SW 94 AVE	SW 8 ST		2	SA	12
			4510	SW 102 AVE	SW 8 ST		2	SA	12
			3709	SW 107 AVE	SW 8 ST		2	SA	12
			3879	SW 112 AVE	SW 8 ST		2	SA	12
			4974	SW 117 AVE	SW 8 ST		2	SA	12
			4910						
	SR 826	NW 27th Avenue	2631	DOUGLAS RD	SW 8 ST		1	SA	12
			4335	GALIANO ST	SW 8 ST		1	SA	12
			2626	GRANADA BLVD	SW 8 ST		1	SA	12
			2625	PONCE DE LEON	SW 8 ST		1	SA	12
			2145	RED RD	SW 8 ST		1	SA	12
			2254	SW 32 AVE	SW 8 ST		1	SA	12
			4378	SW 47 AVE	SW 8 ST		1	SA	12
			2632	SW 62 AVE	SW 8 ST		1	SA	12
			2633	LUDLAM RD	SW 8 ST		2	SA	12
	NW 27th Avenue	US 1	4799	BAYSHORE DR (S)	SE 8 ST		2	SA	12
			2244	MIAMI AVE (S)	S 8 ST		2	NA	12
			2245	SW 1 AVE (E)	SW 8 ST		2	NA	12
			2246	SW 2 AVE	SW 8 ST		2	NA	12
			4388	SW 5 AVE	SW 8 ST		2	NA	12
			2247	SW 8 AVE	SW 8 ST		2	NA	12
			4385	SW 11 AVE	SW 8 ST		2	NA	12
			2248	SW 12 AVE	SW 8 ST		2	NA	12
			4384	SW 15 AVE	SW 8 ST		2	NA	12
			2249	SW 17 AVE	SW 8 ST		2	SA	12
			2250	SW 19 AVE	SW 8 ST		2	PT	12
			3249	SW 21 AVE	SW 8 ST		2	NA	12
			2251	SW 22 AVE	SW 8 ST		2	SA	12
			2243	US 1	SE 8 ST		2	SA	12
Krome Avenue	SR 25	SR 994	4784	KROME AVE	SW 200 ST		1	SA	12
			4783	KROME AVE	SW 184 ST		2	SA	12

TABLE 2-3

Traffic Signals in FDOT Disaster Response Priority Group 3

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
	SR 994	US 1	4787	KROME AVE	SW 216 ST		1	SA	12
			3038	FLAGLER AVE	KROME AVE		2	SA	12
			3039	FLAGLER AVE	MOWRY DR		2	SA	12
			3031	KROME AVE	MOWRY DR		2	SA	12
			3032	KROME AVE	N 2 ST		2	NA	12
			3034	KROME AVE	N 8 ST		2	SA	12
			4788	KROME AVE	SW 232 ST		2	SA	12
			4785	KROME AVE	SW 248 ST		2	SA	12
			4789	KROME AVE	SW 264 ST		2	SA	12
			4790	KROME AVE	SW 288 ST		2	SA	12
			4328	KROME AVE	SW 296 ST		2	SA	12
			3036	KROME AVE	SW 304 ST	N 15 ST HMST	2	SA	1-
			3027	KROME AVE	SW 328 ST	S 8 ST HMSTD	2	SA	12
			3759	KROME AVE	SW 344 ST		2	SA	--
			3760	NW 1 AVE	NW 8 ST	HOMESTEAD	2	SA	12
Flagler Street	NW 87th Avenue	NW 27th Avenue	2206	DOUGLAS RD	FLAGLER ST (W)		1	SA	12
			2139	FLAGLER ST (W)	LUDLAM RD		1	SA	12
			3618	FLAGLER ST (W)	MILAM DAIRY RD		1	SA	12
			2138	FLAGLER ST (W)	RED RD		1	SA	12
			2205	FLAGLER ST (W)	W 32 AVE		1	SA	12
			3617	FLAGLER ST (W)	W 43 AVE		1	SA	12
			2137	FLAGLER ST (W)	W 47 AVE		1	SA	12
			4782	FLAGLER ST (W)	W 49 AVE		1	SA	12
			3153	FLAGLER ST (W)	W 59.00 BLK		1	PE	--
			3952	FLAGLER ST (W)	W 62 AVE		1	SA	12
			4296	FLAGLER ST (W)	W 69 AVE		1	SA	12
			4421	FLAGLER ST (W)	W 74 AVE	FLORIDA BLVD	1	SA	12
			3622	TAMIAMI CNL RD	SW 72 AVE		1	SA	12
			3747	FLAGLER ST (W)	GALLOWAY RD		2	SA	12
			4859	FLAGLER ST (W)	W 82 AVE		2	SA	12
			4860	FLAGLER ST (W)	W 84 AVE		2	SA	12
	NW 27th Avenue	I-95	4641	FLAGLER ST (W)	W 3 CT		2	NA	12
			2200	FLAGLER ST (W)	W 16 AVE		2	SA	12
			2201	FLAGLER ST (W)	W 17 AVE		2	SA	12
			2203	FLAGLER ST (W)	W 24 AVE		2	SA	12
			3823	FLAGLER ST (W)	W 25 AVE		2	SA	12

TABLE 2-3

Traffic Signals in FDOT Disaster Response Priority Group 3

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			5214	NW 77 CT	NW 74 ST		2	SA	12
			5007	SW 1 ST	MIAMI RIVER BR		2	PE	--
			2221	SW 16 AVE	SW 1 ST		2	NA	12
			2222	SW 17 AVE	SW 1 ST		2	SA	12
			3658	BEACOM BLVD	SW 1 ST		3	SA	12
			5008	FLAGLER ST (W)	MIAMI RIVER	BRIDGE	3	PE	--
			3487	FLAGLER ST (W)	W 6 AVE		3	SA	12
			2197	FLAGLER ST (W)	W 8 AVE		3	NA	12
			3745	FLAGLER ST (W)	W 10 AVE		3	SA	12
			2198	FLAGLER ST (W)	W 12 AVE		3	NA	12
			2199	FLAGLER ST (W)	W 13 AVE		3	SA	12
			2202	FLAGLER ST (W)	W 22 AVE		3	SA	12
			2219	SW 8 AVE	SW 1 ST		3	NA	12
			3461	SW 10 AVE	SW 1 ST		3	NA	12
			2220	SW 12 AVE	SW 1 ST		3	NA	12
			3803	SW 13 AVE	SW 1 ST		3	NA	12
			2223	SW 22 AVE	SW 1 ST		3	SA	12
NW/SW 12th Avenue	SR 112	SR 972	2262	CORAL WAY	SW 12 AVE		1	SA	1-
			2328	NW 12 AVE	NW 7 ST		1	SA	12
			5010	NW 12 AVE	MIAMI RIVER BR		2	PE	--
			3541	NW 12 AVE	NW 2 ST		2	SA	12
			2317	NW 12 AVE	NW 4 ST		2	SA	12
			4774	NW 12 AVE	NW 1500 BLK		2	SA	12
			2248	SW 12 AVE	SW 8 ST		2	NA	12
			2198	FLAGLER ST (W)	W 12 AVE		3	NA	12
			2377	NW 12 AVE	NW 14 ST		3	SA	12
			3152	NW 12 AVE	NW 16 ST		3	SA	12
			2401	NW 12 AVE	NW 20 ST		3	SA	12
			2409	NW 12 AVE	NW 22 ST		3	SA	12
			2414	NW 12 AVE	NW 28 ST		3	SA	12
			2424	NW 12 AVE	NW 29 ST		3	SA	12
			4722	NW 12 AVE	NW 33 ST		3	SA	12
			2051	NW 12 AVE	NW 36 ST		3	SA	12
			4695	NW 20 ST	NW 1200 BLK	FIRE STA	3	PE	--
			2220	SW 12 AVE	SW 1 ST		3	NA	12
			2235	SW 12 AVE	SW 6 ST		3	PT	12

TABLE 2-3

Traffic Signals in FDOT Disaster Response Priority Group 3

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			3407	SW 12 AVE	SW 7 ST		3	NA	12
SR 989	SR 821	SR 5	3351	OLD CUTLER RD	SW 112 AVE	SW 220 ST	2	SA	1-
Allapattah Drive			4126	SW 112 AVE	SW 211 ST		2	FA	1-
			3937	SW 112 AVE	SW 216 ST		2	SA	1-
			4824	SW 112 AVE	SW 248 ST		2	SA	--
NW/SW 107th Avenue	SR 836	SR 874	3894	FLAGLER ST (W)	W 107 AVE		1	SA	12
			4554	FONT'BLEAU BLVD	NW 107 AVE	NW 7 ST	1	SA	1-
			4795	SNAPPER CRK RD	SW 107 AVE		1	SA	12
			3966	SUNSET DR	SW 107 AVE		1	SA	12
			4560	SW 107 AVE	SW 4 ST		1	SA	12
			3990	SW 107 AVE	SW 1400 BLK	FIU 'A,B' DR	1	SA	12
			3991	SW 107 AVE	SW 1700 BLK	FIU 'D,E' DR	1	SA	12
			4796	SW 107 AVE	SW 64 ST		1	SA	12
			2966	BIRD RD	SW 107 AVE		2	SA	12
			3822	CORAL WAY	SW 107 AVE		2	SA	12
			4003	KILLIAN PKWY	SW 107 AVE	SW 104 ST	2	FA	1-
			3527	MILLER DR	SW 107 AVE		2	SA	12
			3709	SW 107 AVE	SW 8 ST		2	SA	12
			4757	SW 107 AVE	SW 1100 BLK	FIU DORMS	2	SA	12
			5334	SW 107 AVE	SW 16 ST		2	SA	12
			4590	SW 107 AVE	SW 32 ST		2	SA	1-
			4118	SW 107 AVE	SW 48 ST		2	SA	12
			4600	SW 107 AVE	SW 84 ST		2	SA	12
			5051	SW 107 AVE	SW 9100 BLK		2	SA	12
			4122	SW 107 AVE	SW 93 ST		2	SA	12
			4311	SW 107 AVE	SW 100 ST		2	SA	1-
Sunset Drive	SW 117th Avenue	SR 959	2885	GALLOWAY RD	SUNSET DR		1	SA	12
			3004	LUDLAM RD	SUNSET DR		1	SA	12
			3956	SNAPPER CRK RD	SUNSET DR		1	SA	12
			4687	SUNSET DR	SW 59 PL		1	SA	--
			3003	SUNSET DR	SW 62 AVE		1	SA	12
			3590	SUNSET DR	SW 72 AVE		1	SA	12
			3560	SUNSET DR	SW 92 AVE		1	SA	12
			3738	SUNSET DR	SW 97 AVE		1	SA	12

TABLE 2-3

Traffic Signals in FDOT Disaster Response Priority Group 3

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			4412	SUNSET DR	SW 102 AVE		1	SA	12
			3966	SUNSET DR	SW 107 AVE		1	SA	12
			5167	SUNSET DR	SW 113 PL		1	SA	12
			5384	SUNSET DR	SW 52 AVE	TRIONFO ST	2	SA	12
			4568	SUNSET DR	SW 117 AVE		2	SA	12
Coral Way	SR 5	SR 953	2262	CORAL WAY	SW 12 AVE		1	SA	1-
			2264	CORAL WAY	SW 22 AVE		1	SA	12
			2266	CORAL WAY	SW 32 AVE		1	SA	12
			4897	CORAL WAY	SW 33 AVE		1	SA	12
			3181	CORAL WAY	SW 36 AVE		1	SA	12
			2263	CORAL WAY	SW 17 AVE		2	SA	12
			2635	CORAL WAY	DOUGLAS RD		3	SA	12
			2613	CORAL WAY	GALIANO ST		3	NA	12
			2614	CORAL WAY	PONCE DE LEON		3	NA	12
			2615	CORAL WAY	SALZEDO ST		3	NA	12
NW/SW 87th Avenue	SR 836	SR 5	2964	BIRD RD	GALLOWAY RD	SW 87 Ave	1	SA	12
			2962	CORAL WAY	GALLOWAY RD		1	SA	12
			2970	GALLOWAY RD	MILLER RD		1	SA	12
			4269	GALLOWAY RD	NW 800 BLK		1	SL	--
			2885	GALLOWAY RD	SUNSET DR		1	SA	12
			3362	GALLOWAY RD	SW 8 ST		1	SA	12
			3231	GALLOWAY RD	SW 16 ST		1	SA	12
			4248	GALLOWAY RD	SW 22.00 BLK		1	SA	12
			4602	GALLOWAY RD	SW 25 ST		1	SA	12
			3864	GALLOWAY RD	SW 32 ST		1	SA	12
			3955	GALLOWAY RD	SW 48 ST		1	SA	12
			4478	GALLOWAY RD	SW 60.00 BLK		1	SA	12
			3747	FLAGLER ST (W)	GALLOWAY RD		2	SA	12
			4850	GALLOWAY RD	NW 7 ST		2	SA	12
			4818	GALLOWAY RD	NW 8 ST		2	SA	12
			4187	GALLOWAY RD	PARK BLVD		2	SA	12
			4346	GALLOWAY RD	SW 104 ST		2	FA	1-
			4307	GALLOWAY RD	SW 124 ST		2	SA	1-
			4702	GALLOWAY RD	SW 128 ST		2	SA	12

TABLE 2-3

Traffic Signals in FDOT Disaster Response Priority Group 3

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
Red Road	SR 836	SR 5	2599	BIRD RD	RED RD		1	SA	12
			3742	BLUE RD	RED RD		1	SA	12
			2958	CORAL WAY	RED RD		1	SA	12
			2138	FLAGLER ST (W)	RED RD		1	SA	12
			4498	LEVANTE AVE	RED RD		1	SA	1-
			2967	MILLER DR	RED RD		1	SA	12
			3252	RED RD	NW 7 ST		1	SA	12
			2887	RED RD	SEVILLA AVE		1	SA	12
			2145	RED RD	SW 8 ST		1	SA	12
			3744	RED RD	SW 16 ST		1	SA	1-
Quail Roost Drive	SR 997	SR 5	3641	HOMESTEAD AVE	QUAIL ROOST DR		1	SA	1-
			5026	LEJEUNE RD	NW 27 ST		2	SA	12
			4325	QUAIL ROOST DR	SR 821 (E)		2	SA	12
			4324	QUAIL ROOST DR	SR 821 (W)		2	SA	12
			4495	QUAIL ROOST DR	SW 107 AVE		2	SA	12
			4642	QUAIL ROOST DR	SW 113 AVE		2	SA	12
			4823	QUAIL ROOST DR	SW 115 AVE		2	SA	12
			3725	QUAIL ROOST DR	SW 117 AVE		2	SA	1-
			2994	QUAIL ROOST DR	US 1		2	SA	12
SW 152nd Street	SR 5	SR 821	4535	CORAL REEF DR	SW 92.00 BLK	FIRE STA	1	PE	--
			3878	CORAL REEF DR	SW 102 AVE		1	SA	12
			4500	CORAL REEF DR	SW 107 AVE		1	SA	12
			3796	CORAL REEF DR	SW 112 AVE		1	SA	12
			4764	CORAL REEF DR	SW 117 AVE		2	SA	12
			2955	CORAL REEF DR	US 1		2	SA	12
			4395	CORAL REEF DR	SR 821 (E)		3	SA	1-
			4396	CORAL REEF DR	SR 821 (W)		3	SA	1-
SW 112th Street	SR 5	SW 107th Avenue	3349	GALLOWAY RD	KILLIAN DR		1	FA	1-
			3495	KILLIAN DR	SW 97 AVE		1	SA	12
			3728	SW 102 AVE	SW 112 ST		2	SA	--
			5123	SW 107 AVE	SW 112 ST		2	SA	--
Milam Dairy Road	SR 968	SR 944	3618	FLAGLER ST (W)	MILAM DAIRY RD		1	SA	12
			4350	MILAM DAIRY RD	NW 22 ST		1	SA	1-

TABLE 2-3

Traffic Signals in FDOT Disaster Response Priority Group 3

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			4528	MILAM DAIRY RD	NW 74 ST		1	SA	12
			3975	MILAM DAIRY RD	NW 74 ST CONN		1	SA	12
			3622	TAMIAMI CNL RD	SW 72 AVE		1	SA	12
			2897	MILAM DAIRY RD	NW 25 ST		2	SA	12
			4315	MILAM DAIRY RD	NW 58 ST		2	SA	12
			4708	MILAM DAIRY RD	NW 19 ST		3	SA	12
1st Street	I-95	SR 5	2191	FLAGLER ST	MIAMI AVE	HOMESTEAD	2	NA	1-
NW, NE, SW, SE			2190	FLAGLER ST (E)	E 1 AVE		2	NA	1-
			2189	FLAGLER ST (E)	E 2 AVE		2	NA	1-
			2188	FLAGLER ST (E)	E 3 AVE		2	NA	1-
			2192	FLAGLER ST (W)	W 1 AVE		2	NA	12
			2215	MIAMI AVE (S)	S 1 ST		2	NA	1-
			2228	MIAMI AVE (S)	S 2 ST	I-95 ENT	2	NA	12
			2214	SE 1 AVE	SE 1 ST		2	NA	1-
			2213	SE 2 AVE	SE 1 ST		2	NA	1-
			2212	SE 3 AVE	SE 1 ST		2	NA	1-
			2216	SW 1 AVE	SW 1 ST		2	NA	12
			2187	FLAGLER ST (E)	US 1		3	NA	12
			2211	US 1	SE 1 ST		3	NA	12
Okeechobee Road	SR 826	SR 112	2847	HIALEAH DR	OKEECHOBEE RD		1	SA	12
			3520	LUDLAM RD	OKEECHOBEE RD		1	SA	12
			2845	OKEECHOBEE RD	E 1 AVE		1	SA	12
			2844	OKEECHOBEE RD	E 4 AVE		1	SA	12
			2846	OKEECHOBEE RD	PALM AVE		1	SA	12
			3886	OKEECHOBEE RD	SE 8 CT	HIALEAH	1	SA	12
			4411	OKEECHOBEE RD	W 8 AVE		1	SA	12
			3608	OKEECHOBEE RD	W 16 AVE	W 29 ST	1	SA	12
			4728	OKEECHOBEE RD	W 19 ST		1	SA	12
			4731	OKEECHOBEE RD	W 1900 BLK		1	SA	12
			4531	SOUTH RIVER DR	NW 74 ST		1	SA	12
			3976	OKEECHOBEE RD	W 21 ST (EB ON		2	SA	12
	SR 112	SR 5	2058	DOUGLAS RD	NW 36 ST		1	SA	12
			2098	FEDERAL HWY	NE 2 AVE	NE 36 ST	1	SA	12
			2047	MIAMI AVE (N)	N 36 ST		1	NA	12
			2049	NW 7 AVE	NW 36 ST		1	SA	12

TABLE 2-3

Traffic Signals in FDOT Disaster Response Priority Group 3

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			4805	NW 14 AVE	NW 36 ST		1	SA	12
			2053	NW 17 AVE	NW 36 ST		1	SA	12
			2054	NW 18 AVE	NW 36 ST		1	SA	12
			2055	NW 22 AVE	NW 36 ST		1	SA	12
			2057	NW 32 AVE	NW 36 ST		1	SA	12
			2050	NW 10 AVE	NW 36 ST		2	SA	12
			2051	NW 12 AVE	NW 36 ST		3	SA	12
			4676	NW 36 ST	NW 700 BLK	FIRE STA	3	PE	--
US 1	NW 54th Street	I-95	3298	FEDERAL HWY	NE 38 ST	NE 39 ST	1	SA	12
			2105	FEDERAL HWY	NE 54 ST		1	NA	12
			3241	US 1	NE 6 ST		1	SA	12
			2342	US 1	NE 10 ST		1	SA	12
			2350	US 1	NE 11 ST		1	SA	12
			2362	US 1	NE 13 ST		1	SA	12
			2367	US 1	NE 14 ST		1	SA	12
			4288	US 1	NE 17 ST		1	SA	12
			4136	US 1	NE 17 TERR		1	SA	12
			2390	US 1	NE 19 ST		1	SA	12
			3596	US 1	NE 22 ST		1	SA	12
			3597	US 1	NE 26 ST		1	SA	12
			2417	US 1	NE 29 ST		1	SA	12
			3598	US 1	NE 33 ST		1	SA	12
			2097	US 1	NE 36 ST	SR 112 EB ON	1	SA	12
			2099	US 1	NE 38 ST	SR 112 WB	1	SA	12
			4397	US 1	NE 50 TERR		1	SA	12
			2103	US 1	NE 54 ST		1	SA	12
			2261	US 1	SE 15 ST RD		1	SA	12
			4799	BAYSHORE DR (S)	SE 8 ST		2	SA	12
			2255	CORAL WAY	US 1		2	SA	12
			2318	US 1	NE 5 ST		2	SA	12
			2381	US 1	NE 15 ST		2	SA	12
			4836	US 1	NE 21 ST		2	SA	12
			4579	US 1	SE 5 ST		2	SA	12
			3448	US 1	SE 7 ST		2	SA	12
			2243	US 1	SE 8 ST		2	SA	12
			3493	CHOPIN PLAZA	US 1		3	NA	12

TABLE 2-3

Traffic Signals in FDOT Disaster Response Priority Group 3

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			2178	MIAMI AVE (S)	US 1		3	SA	12
			2232	SE 3 AVE	SE 4 ST	US 1 NB	3	NA	12
			2304	US 1	NE 2 ST		3	NA	12
			2308	US 1	NE 3 ST		3	NA	12
			2312	US 1	NE 4 ST		3	NA	12
			2211	US 1	SE 1 ST		3	NA	12
			4321	US 1	SE 2451	2333 BLK	3	SA	12
			2267	US 1	SE 26 RD		3	SA	12
			2296	US 1 (SB)	NE 1 ST		3	NA	12
			2224	US 1 (SB)	SE 2 ST		3	NA	12
	I-95	SW 57th Avenue	3669	ALHAMBRA CIR(S)	US 1		1	SA	12
			2624	AUGUSTO ST	US 1		1	SA	12
			2185	BIRD RD	US 1		1	SA	12
			2186	DOUGLAS RD	US 1		1	SA	12
			2623	GRANADA BLVD	US 1		1	SA	12
			2620	GRAND AVE	US 1		1	SA	12
			3735	MARIPOSA CT	US 1		1	SA	12
			4389	PONCE DE LEON	SAN AMARO DR		1	SA	12
			3625	PONCE EXTENSION	US 1		1	SA	12
			2998	RED RD	US 1		1	SA	12
			2622	RIVIERA DR	US 1		1	SA	12
			2180	US 1	SW 17 AVE		1	SA	12
			2181	US 1	SW 22 AVE		1	SA	12
			2184	US 1	SW 32 AVE		1	SA	12
			5223	US 1	SW 5700 BLK	BAKERY CENT	1	SA	1-
			2618	GRANADA BLVD	PONCE DE LEON		2	SA	1-
			3414	PONCE DE LEON	RIVIERA DR		2	SA	1-
			2611	PONCE DE LEON	STANFORD DR		2	SA	1-
			4680	US 1	SW 16 AVE		2	SA	12
			4491	US 1	SW 58 AVE	SW 70 ST	2	SA	12
			4413	ALHAMBRA CIR(S)	PONCE DE LEON		3	SA	12
			4688	PONCE DE LEON	GRECO AVE, RUI	PONCE EXT	3	SA	12
	SW 57th Avenue	SW 87th Avenue	4341	DADELAND BLVD	US 1		1	SA	12
			3531	HOWARD DR	US 1		1	SA	12
			2954	KILLIAN DR	US 1		1	SA	12
			3790	LUDLAM RD	SW 80 ST		1	SA	12
			3650	LUDLAM RD	US 1		1	SA	12

TABLE 2-3

Traffic Signals in FDOT Disaster Response Priority Group 3

ROAD	From	To	SIGNALS_ID	NAME1	NAME2	NAME3	INTYPE	COTYPE	STATUS
			3002	SUNSET DR	US 1		1	SA	12
			2999	US 1	SW 62 AVE		1	SA	12
			4683	US 1	SW 70 AVE		1	SA	12
			4804	US 1	SW 73 ST		1	SA	12
			3626	US 1	SW 80 ST		1	SA	12
			3147	US 1	SW 104 ST		1	SA	12
			3090	US 1	SW 124 ST		1	SA	12
			4278	US 1	SW 128 ST		1	SA	12
			5442	GALLOWAY RD	SW 132 ST		2	SA	12
			5385	SW 70 AVE	SW 85 ST		2	SA	--
			4291	SW 104 ST	SW 7800 BLK	FIRE STA	2	PE	--
			3651	US 1	SW 132 ST		2	SA	12
	SW 87t Avenue	HEFT	3566	BANYAN ST	US 1(SB)		1	SA	12
			3236	COLONIAL DR	US 1		1	SA	12
			4535	CORAL REEF DR	SW 92.00 BLK	FIRE STA	1	PE	--
			3224	FRANJO RD	US 1 (NB)	EVERGREEN S	1	SA	12
			3557	HIBISCUS ST	US 1 (SB)		1	SA	12
			3656	MITCHELL DR	US 1		1	SA	12
			2956	RICHMOND DR	US 1 (NB)		1	SA	12
			3916	RICHMOND DR	US 1 (SB)		1	SL	--
			4530	US 1	SW 14601		1	SA	12
			3891	US 1	SW 15900 BLK		1	SA	12
			4712	US 1	SW 184 ST		1	SA	12
			3556	US 1 (NB)	SW 174 ST		1	SA	12
			2955	CORAL REEF DR	US 1		2	SA	12
			3558	HIBISCUS ST	US 1 (NB)		2	SA	12
			3872	MARLIN RD	US 1		2	SA	12
			2994	QUAIL ROOST DR	US 1		2	SA	12

The Priority 3 group has 344 traffic signals as shown in Table 2-3 (pages 2-20 through 2-29), of which 344 traffic signals, 164 signals are wire-strand, 50 are mast-arm dangling and 130 are mast-arm rigid.

The number of traffic signals located on FDOT priority routes totals 876 traffic signals, which represents 42% of all signals inventoried in this study.

It is strongly recommended that 511 signals (427 wire-strand and 84 mast-arm dangling) out of the 876 on the pre-defined priority routes should continue to be replaced to better withstand a Category 3 hurricane. The mast-arm rigid is the preferred installation type; Dade County Public Works retrofitting and reconstruction activities should be accelerated as funds permit.

2.1.2 Sign Structures

Large guide signs for the major state roads such as overhead trusses, overhead cantilevers and butterflies located in the medians will not normally be expected to be subject to storm surge exposure. Footings for cantilever signs located on the Florida Turnpike will be exposed to surge for a Category 3 or higher as an example; on SR 826, the supported loads for the signs located between N.W. 36th and SR 874 will be exposed to surge for a Category 3 or higher storm. Also, overhead and sign mounted signs (footings) located on SR 874, between S.W. 88th Street, and S.W. 104th Street will be exposed to surges for a Category 3 and higher storm. On the other hand, street signs such as stop signs, speed limit signs, etc. will certainly be exposed to surge.

2.1.3 Power Poles

The power poles will not be affected by storm surge.

2.1.4 Causeways

2.1.4.1 Venetian Causeway

The problems with Venetian Causeway are due to:

(1) The low elevations of the structures,
(2) The age of the structures, and
(3) The 2-lane wide bridges.

Most of the structures will be below the elevation of possible tidal surge even in a Category 2 hurricane with landfall immediately south of the Causeway or at the Causeway.

2.1.4.2 Rickenbacker Causeway

This causeway connects Key Biscayne and the City of Miami on the mainland.

The filled causeways are very low and can flood in a Category 2 hurricane. (The fill sections connect the fixed bridges and the approach roadways.) Because of the low elevation of the filled sections, it is doubtful if the Causeway could be used in a hurricane (if the angle of incidence of hurricane was such that it caused flooding, with landfall at Key Biscayne or immediately south). Some of the filled causeway sections are only 6 or 7 feet above mean sea level.

Bridges have adequate structural design, and are high enough to be out of Category 1-3 surges, except for the main span of the William B. Powell Bridge, which could rise above even a strong Category 5 storm surge.

2.1.5 Roadside Foliage

Foliage and tree damage will not be severely affected by surge exposure.

2.2 WIND VULNERABILITY

2.2.1 Traffic Signals

The interaction between power systems and failed communication lines will have a tremendous effect on the transportation system. Most of the electrical service furnished to the signal system is not underground and will not insure that operations can be resumed immediately after a storm. Damage to power systems and communication systems will, in general, make the traffic signals impossible to operate; furthermore, it will delay repairs and recovery of the system. As evidenced by the lack of signalization in South Dade County after Hurricane Andrew, traffic movements through virtually all major intersections were at best cautious for several days after the storm. Eventually, in the case of Andrew, National Guardsmen and government employees directed traffic at most South Dade intersections with great traffic delays, and exposure to dangerous situations for these untrained personnel.

The wire-strand supported systems used in many areas of Dade County are inadequate for any type of hurricane, from a Category 1 hurricane (75 mph) and up. Even the mast-arm rigid signals will have a considerable amount of damage with a Category 3 hurricane (131 mph and up) or greater. The mast arm dangling signal type was obviously inadequate for anything over a Category 1 hurricane.

Generally, most traffic signals in Dade County have not been designed to resist the full hurricane wind loads of a Category 3 or greater hurricane.

In the urgency to replace systems that were damaged by Hurricane Andrew in Dade County, after Andrew, most of the systems were replaced to the same design. Very little attention to retrofitting was possible because of time constraints. The mast arm systems were generally inadequate in a Category 3 hurricane or greater.

The Florida Department of Transportation and Dade County are currently in the process of replacing the mast-arm dangling and span wire installation types to the mast-arm rigid type. The goal of the DOT is to have all the traffic signals with a mast-arm rigid installation in order to withstand at least a Category 2 hurricane.

A Category 4 or Category 5 hurricane on the Saffir-Simpson Hurricane Scale with velocities of 131 mph to 155 mph, and greater than 155 mph, respectively, will result in virtually a complete cessation of all traffic signal functioning in Dade County. The reasons for this are:

(a) the type of design and construction of the individual signal systems;

(b) the fact that after Hurricane Andrew, a Category 4 storm, only 77 of the 2,378 Dade County traffic signals were still functioning; and

(c) loss of power.

2.2.2 Sign Structures

In considering guide sign structures, the general philosophy of the American Association of State Highway and Transportation Officials (AASHTO) recommends a 25-year recurrence interval for design which corresponds to 110 miles per hour.

The Florida Department of Transportation design criteria for the guide signs structures is to design for 110 miles per hour wind speed to conform to the requirements of AASHTO Standard

Specifications for Structural Supports for Highway Signs. Therefore, the three types of signs inventoried, overhead truss, overhead cantilever (sometimes called "sign bridges"), and butterfly mount in median, will withstand a Category 1 or 2 hurricane but are expected to fail during a Category 3 hurricane or stronger storm.

During Hurricane Andrew, the guide signs on major highways such as the Florida Turnpike Extension were knocked down and severe damage was experienced. The overhead truss structures failed and fell on the roadways below. Major facilities such as the Palmetto Expressway or I-95 may be blocked, thus retarding response and recovery effort as relief supplies may be forced to be routed on surface arterials or local streets.

2.2.3 Power Poles

The Florida Power & Light Company has used a basic storm of 110 miles per hour for design of its transmission system. Florida Power & Light Company relies generally upon above-ground transmission lines, except for those lines in the central urban area. With the occurrence of Hurricane Andrew (a Category 4 hurricane), most of Dade County was without power. In the south end of the county, where the hurricane exhibited its most powerful effects, there were 12,000 failed transformers, 3,500 miles of downed conductors and 21,500 failed poles.

In general, even the critical nuclear power plant system at Turkey Point was knocked out in Hurricane Andrew, not because of damage to the reactors and the steam generators but because of the damage to all of the appurtenant buildings at the Turkey Point Plant, because of lack of communication with Turkey Point, and because of failures in the power distribution system.

It is educating to note that twenty-eight (28) tall transmission poles were installed in 1989, for the City of Homestead municipally owned power plant, to support a 138 kilowatt transmission line. The poles were designed for 212 miles per hour winds, with rigorous and exacting

foundation design and construction observed. All twenty-eight poles were intact and upright after Hurricane Andrew.

Although some engineering reports addressing Florida Power and Light Company prestressed concrete transmission poles, indicated that the poles survived Andrew, the reports were incorrect. Several prestressed concrete poles suffered complete flexural failure and literally snapped. This caused a number of complete failures of main transmission line systems, and contributed greatly to the long delays in restoring power to several sections of the county.

2.2.4 Causeways

2.2.4.1 Venetian Causeway

The structures are not modern structures; the low level bascules and the reinforced concrete bridge structures have required considerable maintenance in the past few years. Scour has occurred at the supporting piers of the bascule bridges; corrosion to the reinforcing steel with progressive concrete spalling has occurred to the fixed bridge spans. Recently, a section of concrete railing gave way, spilling a number of people into the bay, after they had leaned on it, further evidence of the causeway's structural deterioration. FDOT is now initiating reconstruction and rehabilitation of the causeway; work is scheduled to begin in fiscal year 1995-1996.

In general, for almost any type of hurricane, evacuation will be needed for the islands adjacent to the Causeway.

The Causeway should be used only for evacuation for residents of the islands located along the facility prior to a hurricane and not be relied upon as an access route following a hurricane.

2.2.4.2 Rickenbacker Causeways

Bridges have adequate structural design. All main structures are fixed (no movable bridges)

2.2.5 Roadside Foliage

Foliage and tree damage will be a decided factor in recovery efforts after a hurricane. Experience after Hurricane Andrew - even 25 miles north of the eye of the storm - indicated that an entire community could be closed off from roads and highways. This was the situation in Coral Gables for several days after Hurricane Andrew. Some of the residential streets were virtually impassable to vehicular traffic as much as 10 days after the passage of Andrew.

In the descriptive definition of Category 1, it is stated that with wind velocities of from 75 to 95 miles per hour, damage would occur to shrubbery, trees, and foliage. There would be damage to poorly constructed signs. Even a Category 1 hurricane on the Saffir-Simpson Hurricane Scale would cause damage to old growth trees.

Note that failure of trees, branches, trees blowing down, etc. are important considerations in this study. They will have a decided effect on the transportation system and its ability to operate immediately after a hurricane, hampering or preventing vehicle movements, and slowing the flow of aid and relief supplies to the more affected areas. And, as was the case in Andrew, roadside vegetation debris may escalate poor traffic circulation indirectly by requiring trash hauling trucks to remove post-event debris and contribute to post-storm congestion.

In a Category 3 hurricane or greater, with winds of 111 to 155 miles per hour, experience in Hurricane Andrew showed that in streets with considerable tree growth, all streets in Coral Gables, for instance, were literally impassable until crews had cleared away fallen trees and tree limbs.

Density of trees will be an important point to consider. Without any recent hurricanes to reduce the density, the areas south of Flagler and the areas of North Dade which remained relatively tree-canopied, tree damage will be an important factor in the functioning of the Dade County transportation system after a hurricane.

3.0 TRANSIT TRANSPORTATION SYSTEM VULNERABILITY ANALYSIS

3:1 STORM SURGE EXPOSURE

It should be noted that most of the Metrorail and Metromover stations and system would not be flooded. The analysis shows that the following Metrorail stations will be located in the storm surge prone areas for Category 3 and 5 hurricanes:

- Dadeland South
- Dadeland North
- South Miami
- Douglas Road
- Brickell
- Culmer.

These stations will be subject to floated-in debris, standing water, and potentially flooded power traction substations, perhaps the most onerous and potentially dangerous of the possible results of surge inundation. The Riverwalk Metromover Station was identified to be located in a Category 5 surge zone.

Of the 21 Metromover stations, 13 stations were identified as being located in storm surge-prone areas. The following stations are located in a Category 3 surge-prone area: Bayfront Park, Knight Center, Miami Avenue, Fort Dallas Park, Government Center, Omni Station, Bicentennial Tower, Fifth Street, and Final District. In addition to the stations already mentioned, the Eleventh Street, the Eighth Street and the Tenth Street/Promenade are located in a Category 5 storm surge-prone area. These facilities cannot be expected to provide shelter, regardless of their elevation. The columns and foundations will be exposed to surge and surge-borne debris.

Only the Tri-Rail station located near Miami International Airport (MIA) will be located in the storm surge-prone area; it is sited in the Category 3 surge zone.

3.2 WIND VULNERABILITY

The Metrorail and Metromover guideway and stations were evaluated with respect to their current condition and their ability to structurally withstand hurricane wind. The following paragraphs detail the evaluation of these facilities.

3.2.1 Metrorail Guideway

The Metrorail guideway is designed to carry fully loaded trains under normal operating conditions and is also designed to resist the overturning, including uplift, due to a catastrophic derailment. The resulting structure is massive, with a very large dead load to wind load ratio. By virtue of this design, the Metrorail guideway structure is not very sensitive to hurricane effects, with minimal damage to the structural system as a result of a Category 3 or 4 hurricane.

Typically, wind loading was not the critical load case for the design. The Compendium of Design Criteria, Volume III, Guideway Design Criteria presents wind pressures based on a sustained wind velocity of 120 miles per hour (75 psf lateral wind pressure up to 40 feet). This wind pressure is applied to the exposed area of the superstructure including the guideway girders, acoustical barriers and deck appurtenances. All girders were assumed to carry acoustical barriers. It should be noted that the guideway and acoustical barriers behaved well when subjected to Andrew's Category 2 winds in the area of Dadeland North and Dadeland South Stations.

While the structural guideway system exhibits limited wind vulnerability, certain appurtenances appear vulnerable and require further investigation. These elements include the following:

1) The cover boards for the contact rail system are vulnerable to wind from a Category 1 storm. This vulnerability was demonstrated during Hurricane Andrew, where many sections of cover board were separated from the contact rail assembly. Cover boards were not vulnerable when they were shielded by adjacent acoustical barriers.

2) The contact rail is continuous over 1500 feet and anchored at one location within this length. The contact rail is supported every 10 feet by a fiberglass support which restrains the rail transversely while allowing for significant expansion and contraction due to temperature changes. No uplift restraint is provided. The contact rail without cover boards should be stable for up to a Category 2 hurricane, however, as demonstrated during Hurricane Andrew, is not stable for a Category 2 event when the wind surface provided by the cover boards is added.

3.2.2 Metrorail Stations

The Metrorail stations were designed in accordance with the pre-Andrew SFBC. These stations are open structures and should be able to withstand at least a Category 1 hurricane. Dadeland North and Dadeland South Stations successfully withstood Category 2 hurricane wind loads during Hurricane Andrew without significant damage.

The roof of the stations have no uplift restraints, with uplift wind loads resisted by roof gravity loads only. A detailed engineering evaluation of the existing roofs and supports should be performed to assess the critical wind speeds which will result in uplift of the roof, and remedial measures taken as necessary.

The traction power substations consist of windowless CBS construction. Louvers are provided within the walls for ventilation. These structures should survive at least a Category 2 hurricane event.

3.2.3 Metrorail Vehicle Storage

The Metrorail system has 136 vehicles. During a hurricane event, these vehicles are stored in the open yard at the William Lehman Operations and Maintenance Center. Up to 14 Metrorail vehicles can be stored in the maintenance building. (Refer to Section 2.5 for the evaluation of the Operations and Maintenance Building). The exposed vehicles will be subject to damage from flying debris for all categories of hurricanes.

3.2.4 Metromover Guideway

The Metromover guideway is designed to carry fully loaded vehicles under normal operating conditions. The Basis for Design for the Miami Metromover system presents wind pressures based on a sustained wind velocity of 120 miles per hour (72 psf lateral wind pressure up to 40 feet with a concurrent 29 psf uplift pressure). This wind pressure is applied to the exposed area of the superstructure including the guideway girders, wireway/walkways and appurtenances. It should be noted that the guideway behaved well when subjected to Andrew's Category 1 winds. Typically, wind loading was not the critical load case for the design of the superstructure. The substructure is fairly massive and designed with auger-cast piles capable of resisting significant uplift. By virtue of this design, the Metromover guideway structure should survive at least a Category 2 hurricane event.

3.2.5 Metromover Stations

The Metromover stations were designed in accordance with the pre-Andrew SFBC. These stations are open structures and should be able to withstand at least a Category 2 hurricane. The Metromover stations successfully withstood Category 1 hurricane wind loads during Hurricane Andrew without significant damage. The roofs of the typical stations are cast integrally with the station framing system and are therefore not susceptible to uplift.

3.2.6 Metromover Vehicle Storage

The Metromover system has 29 vehicles. During a hurricane event, 19 of these vehicles are stored at the Metromover maintenance building and yard. (Refer to Section 2.5 for the evaluation of the Metromover maintenance building). The remaining vehicles are stored on the guideway at Government Center Station, School Board Station and the tail track at 15th Street. These sections of guideway are designed specifically for this purpose. The exposed vehicles will be subject to damage from flying debris for all categories of hurricanes.

The stability of the exposed Metromover vehicles can be expected through a Category 2 hurricane. Overturning is prevented by the guide wheels surrounding the guide beam on the superstructure.

4.0 TRANSPORTATION-SUPPORTING FACILITIES VULNERABILITY ANALYSIS

4.1 AGENCY FACILITIES SURVEY

A survey was mailed to selected municipalities, state agencies and county agencies to collect information on their building/facilities. The survey was mailed to the following municipalities and to other non-city agencies:

County Agencies Transportation
Dade County Public Works Department
Metro-Dade Transit Agency
Miami International Airport
Port of Miami

County Agencies - Non-Transportation
Dade County Offices of
Emergency Management
Metro-Dade Fire Rescue
Metro-Dade Police Department

Municipalities
City of Coral Gables
City of Homestead
City of Hialeah
City of North Miami
City of Miami
City of Miami Beach

State Agencies
Florida Department of Transportation
(District 6)
Florida Highway Patrol

As previously cited in the Technical Report #1, the Transportation System Inventory, several transportation agencies, as well as county and city agencies were contacted. As part of the study, an analysis was performed and the agencies located in storm surge prone areas for different hurricane intensity were identified.

The agencies that were geocoded from the survey results are the following: DCPW, MDTA, FDOT, Port of Miami, City of Coral Gables, City of North Miami and City of Homestead. A

total of 49 facilities were identified and a tabular format developed showing the survey results. For the Port of Miami, only three of the office buildings located on Port Boulevard were included in the database.

The 49 facilities were evaluated from storm surge exposure and wind vulnerability. The analysis shows that under a Category 1 hurricane none of the facilities were located in the storm surge prone area. Under a Category 3 hurricane, fifteen facilities out of the 49 were identified in the storm surge prone area. This represents 30 percent of the total. For a Category 5 hurricane, twenty-one facilities out of the 49 were located in the storm surge prone area which represents 42 percent of the total.

The findings are illustrated in Table 4-1.

Some general comments can be made regarding the characteristics of a building relevant to hurricane damage potential and are as follows:

- Roof type such as flat, gable ends, and slope will not withstand a Category 1 storm
- Roof construction such as metal will not withstand a Category 1 storm
- Roofing material such as shingle, gravel, wood or bold-up will not withstand a Category 1 storm
- Window types such as skylight, awning and jalousies will not withstand a Category 1 storm
- Most common door types such as hollow metal, metal overhead roll-up, glass, wood, bay and french will withstand up to a Category 3 storm.

These comments can be used as a general base to determine the damage that will be expected on different structures.

Section 4.4 discusses the wind vulnerability for the transportation agency facilities.

4.2 AIRPORTS

General aviation airports located in Dade County include Opa-locka, which serves many corporate aircraft, Kendall-Tamiami Executive and Homestead General. Both the Tamiami and Homestead facilities have been rebuilt since they were damaged by Hurricane Andrew in 1992.

Homestead Air Reserve Base refers to the site which previously functioned as Homestead Air Force Base. As a result of Hurricane Andrew and Air Force "right sizing", the base was realigned. The base is to become a dual use military/civilian airport with the area no longer needed by the Air Force to be conveyed to Dade County, and redeveloped in accordance with a base reuse master plan.

The most important airport located in Dade County is Miami International Airport (MIA). MIA employs 30,000 (DCAD staff, airline employees, airline services, etc.) full-time employees which operate the bustling airport that handles 100,000 passengers a day during peak travel seasons. The following analysis shows the susceptibility of storm occurrence for the airports.

The storm surge limits map shows the following:

- The east side of MIA will be subject to storm surge for a Category 3 and higher hurricane
- Opa-locka airport will not be subject to storm surge
- Kendall-Tamiami Executive Airport is located in a surge prone area for a Category 5 hurricane
- Homestead Air Reserve Base is located in an area that will be subject to storm surge for a Category 1 hurricane to the north and Category 3 hurricane to the west, of the airport.

No information was received from the Aviation Department for MIA for facility buildings. Data such as first floor elevations would have been used to determine how much the surge impact would be for given structures such as the terminals and concourses.

Although one of the most vital portions of the Transportation System of Dade County, airports and airport facilities have not been adequately addressed in the past.

Hurricane Andrew played havoc with all of the buildings at Kendall-Tamiami Executive Airport, Homestead General and the Homestead Air Reserve Base. In general, design criteria for construction of buildings at both Miami International Airport and the outlying airports have met the minimum requirements of the previous South Florida Building Code. For buildings of such vital importance during and after hurricanes, the design criteria should have exceeded the minimum code requirements. Based on the new South Florida Building Code, buildings at Opa-locka Airport and other airports, including Miami International Airport, can now be considered as non-conforming, and in some cases not safe, for occupancy during certain category hurricanes. Even those new buildings at the Homestead Air Reserve Base presumably designed in accordance with the new building code were inadequate for a Category 4 hurricane. (The new code does not require buildings to be designed for this category or above).

Miami International Airport

In general, the parking garages may be usable for interior car storage away from the perimeter of the building during a Category 1 or Category 2 hurricane. For a hurricane of greater intensity, the parking garages should not be used as car shelter areas, and certainly not as personnel shelters. The Police District Office located on the ground floor of the Central Parking Garage is away from the exterior of the complex and appears adequate for hurricane shelter purposes.

The Sky Ride and Sky Port with moving sidewalks are vulnerable in any hurricane. The exterior louvers and exterior glass facades do not appear adequate to sustain even Category 1 hurricane wind loads and debris impact.

The Miami International Airport Hotel appears to be safe for use as a hurricane shelter area. Exterior windows on the east elevation of the buildings are few, while the remainder of the building elevation presents a solid surface, with few openings. The roof restaurant appears very susceptible to wind damage and should not be used for shelter purposes in any category hurricane.

The second floor of the Main Terminal appears to be a safe area during a Category 2 hurricane. Occupants, however, must keep away from the large glass expanses on the east side and west side which would sustain the wind loads generated by lower category hurricanes.

The International Terminal area appears unsuitable for use as a hurricane shelter because of the great expanses of glass in the terminal area. The glass walls were probably not designed to meet the impact requirements, or wind load requirements of the new South Florida Building Code, because the recent code revisions were not in effect at the time.

The new Terminal Area A, located to the north of the existing Terminal (just opened to operations), is safe as a hurricane refuge area away from the glass. The glass and windows have the same disadvantages at the International Terminal areas: they have not been designed for the new wind and impact loads given in the revised South Florida Building Code.

Jetways servicing aircraft must be securely "tied down" prior to a hurricane, and where practical must be reduced in length so as to reduce their "sail" areas exposed to the wind. Permanent tie-down anchorages should be utilized where available.

Some consideration should be given to replacing the glass in certain key areas with laminated glass, meeting the wind load and impact requirements of the new South Florida Building Code.

There is a great variety and number of service vehicles, luggage vehicles and other miscellaneous equipment which would need to be secured to prevent damage, both to the equipment itself, and to other equipment and structures.

4.3 PORT OF MIAMI

The Port of Miami is one of the premier transportation facilities within Dade County. The port is among the busiest passenger and cargo facilities in the world. Miami is considered the "cruise capital of the world" and it reigns as the world's leading port-of-call for cruise ships. In 1993, the seaport handled 3.2 million cruise passengers.

On the cargo side, the seaport ranks as the nation's eighth busiest cargo port. The seaport is well established as a load center for the major steamship lines and is the only Florida port with direct service to the Far East. Information of all the buildings/facilities was received from the Seaport Department.

In order to minimize the database, only three buildings were geocoded. The analyses addressed the susceptibility of hurricane occurrence for the Port of Miami on these three buildings.

The analysis shows that all the facilities at the Port of Miami will be subject to storm surge for Category 3 hurricane and above. The storm surge height is expected to vary between 7.4 to 11.1 for the two intensities of hurricane reviewed. The first floor elevation of the office buildings varies between 11 to 14 feet. The newest building was constructed in 1994 with a first floor elevation of 14 feet.

The passenger terminal buildings first floor elevation varies between 6.5 to 14 feet. Therefore, these facilities will be impacted by storm surge with the exception of Passenger Terminal 12, which has a first floor elevation of 14 feet. However, wave action could also affect this structure.

Ground elevations on the islands (Dodge and Lummus) constituting the seaport are relatively low; the islands will be partially submerged during Category 3 hurricane or greater, making everything inaccessible.

Office Buildings

Buildings in the office complex immediately east of the port access bridge (over the Intracoastal Waterway) have finished floor elevations subject to coastal flooding and in addition their exterior cladding were probably not designed in accordance with wind load and impact load requirements of the new South Florida Building Code. With extensive glass and curtain wall facades, these buildings do not appear to be designed with Category 4 or 5 hurricane wind loads in mind and probably are susceptible to a Category 1 to Category 3 wind actions.

Terminal Buildings

The older masonry and concrete terminal buildings appear to be designed with due consideration for hurricane wind loads. These terminal building generally exhibit an industrial building type architecture or configuration. At the east end of the port, these buildings have low pitched roofs, which are subject to significant damage from wind loads generated in a Category 3 hurricane or greater. These buildings were designed under the previous South Florida Building Code. In general, the terminal buildings would be expected to sustain structural damage if subjected to a Category 3 hurricane or above.

Cargo Containers at the East End of the Port

Cargo containers would be subject to movement during a hurricane, depending on the inside dead weight and the container location. Also, these containers are stacked up to three high, which will be subject to wind damage. The lifting cranes should be "tied-down" in case of an approaching hurricane. The exposed area of the cranes presents a considerable surface area for wind loadings.

Obviously, the seaport buildings, cranes and cargo, by virtue of their elevation and exposure, are in a precarious position with landfall of a hurricane, at or immediately south of, the seaport.

Ships

In the event of an approaching hurricane, it is anticipated that ships would not remain at their docks, unless there was not sufficient warning time for them to go to sea and/or evacuate from the port. It is expected that all large ships would be able to vacate thus avoiding structural damage to the port waterfront structures due to ship impact.

Hurricane Camille, with three ocean-going freighters beached on land, and the 1926 Hurricane with various ocean-going ships beached in what is now Bayfront Park, demonstrate the consequences a hurricane can have large vessels left at port.

4.4 MAIN ADMINISTRATIVE CENTERS

The main local administrative centers at municipal, county and state levels were identified. At the county level, the characteristics of representative buildings for the transportation sectors were collected, such as those associated with the MPO, MDTA and the Public Works Department offices. The respective mayors' and/or managers' office locations and public works department offices for major municipalities were also identified. At the state level, two significant locations for FDOT activities were identified.

The local government administrative center facilities were identified and located, and evaluated for storm exposure. The facility locations were identified with respect to whether they were located in a surge tide inundation area, and the category of storm which would potentially subject the facility to flooding. In addition, an assessment was made relative to wind vulnerability based on professional engineering site evaluations of the facilities.

The main administrative centers that are located in storm surge prone areas were identified as shown in Table 4-2. The actual offices themselves might or, indeed, might not be affected by storm surge, depending upon the location within a particular building or structure. The building could expect to be subject to surge tide inundation, perhaps three to five feet deep on the first floor, but if the offices were located on one of the upper floors, they would not be flooded. However, access to upper floor offices may be denied due to flooding or by power outage. The definition of the headings that appear on all the tables of this report can be found in Appendix 1B.

For Category 1 hurricanes, there are four administrative centers that would be impacted and all are offices located in the more northerly beach municipalities.

All facilities that will be affected by a Category 1 storm will also be affected by Category 3 and 5 storms; it is cumulative.

For Category 3 hurricanes, an additional 16 administrative centers would be impacted. These include structures housing the MPO, MDTA and DCPW, which offices are located at the same address in the main county administration building downtown, but on upper floors. As well as FDOT and a number of city manager offices are located in this surge category's zone of flooding, including those of two of the county's largest municipalities, Miami and Miami Beach, as well as the remainder of Beach community city hall facilities.

For Category 5, an additional four facilities that were inventoried would be affected. The five additional facilities are city manager offices.

The same main administrative centers were evaluated with respect to their current condition and their ability to structurally withstand hurricane wind. The following paragraphs detail the assessment of the facilities for the principal transportation agencies.

- FDOT District 6 Headquarters

The FDOT district headquarters main office building is a two-story structure located at 1000 N.W. 111th Avenue. The existing shutters appear insufficient for the two-story entrance height and probably do not conform with the new building code. The building is vulnerable because of a glass curtainwall at the entrance. The existing shutters should be evaluated and replaced with adequate shutters to conform to the new building code if necessary. The building as is will probably withstand a Category 2 hurricane.

- FDOT District 6 Planning Office

The FDOT Planning Office is located at 602 South Miami Avenue. This building is a two-story structure, and the general condition of the building is good. The building is inadequate for occupancy in any category hurricane, because of low finished floor elevation, its proximity to the Miami River near its mouth at Biscayne Bay and its site in a Category 1 flood zone.

- Stephen P. Clark Center

The Stephen P. Clark Center is located at 111 N.W. 1st Street. All the county offices such as MPO, MDTA and DCPW are located in the building on different floors. A few windows broke during Andrew, and the results were that the contents of one MPO office were strewn over a surprising wide area of the floor, with wind and water intrusion in adjacent offices.

- MDTA

The offices of MDTA are located in the 9th floor of the Stephen P. Clark Government Center in downtown Miami. Also, vital agency functions are located on the 3rd, 4th and 5th floors, including Metrorail and Metromover control offices and equipment, as well as agency communication equipment, and the MDTA agency-wide computer installation. These floors are basically windowless and therefore safe as far as wind impacts are concerned, and they are elevated, probably above even Category 5 surge heights. The center office facility is a 30-floor building with a flat roof. Some radio equipment is located on the roof. The general condition of the building is excellent. The windows, however, were designed and installed under the previous South Florida Building Code. It is recommended that a study be made of the existing windows to assess their condition and strength, and to evaluate their compliance with the new building code.

If necessary, some of the windows could be replaced, thus strengthening the building and improving its capabilities for hurricane resistance. The building as is, should be able to withstand a Category 1 hurricane.

- MPO

The offices of MPO are also located on the 9th floor of the Stephen P. Clark Government Center. The building condition is described above. The Stephen P. Clark Center was designed to the criteria set-forth in the previous South Florida Building Code and this vulnerable to wind and impact damage generated by a Category 3 hurricane and above.

- DCPW

Dade County Public Works Department has its offices on the 14th, 15th and 16th floors of the Stephen B. Clark Government Center. Wind velocities, even in a Category 1 hurricane, will be higher at this elevation than at ground level. These offices should not be considered safe for occupancy in any category hurricane, until an evaluation is made to determine the adequacy of the existing windows.

- DCPW/Traffic Signals and Signs Division

The DCPW/Traffic Signals and Signs Division is located at 7100 N.W. 36th Street. There are three separate one-story structures: an administrative office building, a traffic control center building, and a sign shop building to the south. The general condition of these buildings appears good and all three should withstand a Category 2 hurricane. Immediately to the east of the Traffic Control Center building, there is a free-standing radio tower, which would present a hazard in a Category 2 hurricane.

4.5 MAJOR DEPOTS

A listing of the locations of the major maintenance yards and shops, and storage facilities, for the state and county transportation agencies were identified. These facilities can be used as storage sites for pre-storm preparedness activities and for post-hurricane or recovery period.

In a Category 1 hurricane, the major depots will not be affected by storm surges. The MDTA Metrobus and Metromover storage sites will be affected under Category 3 hurricane for saltwater flooding as shown in Table 4-3. For a Category 5 hurricane, the Metrorail and FDOT maintenance yard will be affected as an addition to those identified in Category 3 as shown in Table 4-3. These findings represent the susceptibility of the major state and county transportation depots due to storm surge flooding.

The three MDTA Metrobus garages, the William Lehman Operations and Maintenance Center and the Metromover maintenance building, were evaluated with respect to their condition and their ability to structurally withstand hurricane winds.

- Metrobus Central Garage

The central bus garage complex consists of an administration building, bus maintenance garages, a "drivers building", smaller ancillary structures scattered around the property, and the large asphalt bus parking lot. This oldest and largest Metrobus facility complex is located between N.W. 32nd and N.W. 35th Avenues, between 32nd and 33rd Streets, about two blocks east of the Miami River, just over four miles northwest of the Miami CBD. The Central Administration Building (CAB) is a three-story structure, the drivers building is two stories in height, and the garage structure is an average, one-story structure.

The CAB is located at 3201 N.W. 33rd Street. The general condition of the main office building is good, with the exception of the steel louvers protecting the windows in the main office building. The inspection shows that the buildings should not be considered for occupancy in a Category 2 or higher hurricane. Some remedial work on exteriors and further investigative work should be conducted to determine action required to strengthen the facilities to withstand a storm.

- Metrobus Coral Way Garage

The Coral Way facility is located at 2775 S.W. 72nd Avenue, and like Metrobus Central, is a complex comprised of maintenance structures, an office building, several smaller structures, and a surface lot. The office building is two stories tall, the garage facility is an oversized one-story structure and the lubrication facility has two-story high appurtenant structures.

The general condition of the Coral Way office structure is good, and it should be able to withstand a Category 1 hurricane. Extensive glass windows in walls of the building, however, increases its vulnerability to damages from winds and wind-driven debris.

The bus garage appears to be safe for a Category 1 hurricane.

The lubrication facility, however, does not appear adequate to withstand a Category 1 storm impact. This structure and the Coral Way facility associated small sheds should be evaluated for structural integrity and adhesion to their foundations to make certain they do not contribute to or become destructive elements (wind-born debris missiles) in a hurricane.

- Metrobus Northeast Garage

The Northeast Garage is located at 360 N.E. 185th Street. Like both preceding Metrobus facilities, it is a mixed complex of structures catering to transit bus storage, maintenance, and dispatching functions. The general condition of the Northeast Garage's structure is good. The Northeast Garage's one-story office building is in good condition, and will most probably withstand a Category 2 hurricane. The first floor is windowless and the second story has fixed windows.

The garage facilities should be safe for a Category 1 hurricane. These facilities are not rated as highly as the office building because steel roll-up doors are extensively used along two opposing sides of buildings.

- William Lehman Yards and Shops

The William Lehman Operations and Maintenance Center servicing Metrorail consists of a two story operations and maintenance building, a traction power substation, and a vehicle wash

facility, all of CBS construction and three ancillary one story pre-engineered metal structures. The control tower on the operations and maintenance building extends to four stories.

The general condition of the buildings is good. These facilities should withstand a Category 1 hurricane. These facilities are not rated higher due to the extensive use of steel roll-up doors, particularly at the corners of the operations and maintenance building.

- Metromover Maintenance Facility

The Metromover Maintenance Facility consists of a two story building of CBS construction. The general condition of the building is good. This facility should withstand a Category 1 hurricane. This facilities is not rated higher due to the extensive use of steel roll-up doors, particularly at the corners of the building.

4.6 INTERMODAL CENTERS

The major access and transfer points were identified such as the parking facilities for the Port of Miami, Miami International Airport and the transit system.

A total of 31 intermodal centers were identified. Out of 31, 11 are located in the surge prone area for a Category 3 hurricane as shown in Table 4-4. A total of 14 were identified to be located in the surge prone area for a Category 5 hurricane.

The wind vulnerability analysis for these facilities can be found in Sections 3.2, 4.2 and 4.3. The park-and-ride lots would not be directly damaged by wind; they would probably be exposed to becoming resting places for wind-blown debris, which could render them inoperable in a post-storm response situation. These locations may be used as marshalling points for supplies and volunteers, as was the case in Andrew. As an interim measure, the wind-blown debris may be pushed to one side.

4.7 MAJOR FIRE STATIONS

The extensive use of steel roll-up doors within these facilities, particularly near corners of buildings, presents major vulnerability of these structures. These facilities should withstand a Category 1 hurricane.

A total of 64 fire stations were identified for select major governments within Dade County, including the Metro-Dade Fire Rescue Department. Out of the 64, 3 fire stations are located in storm surge-prone areas for a Category 1 hurricane as shown in Table 4-5. An additional 11 fire stations are located in the Category 3 hurricane's surge flooding area, and additional 12 fire stations are located in the surge zone of a Category 5 hurricane. A total of 26 fire stations were identified as being located in the storm surge-prone areas. This represents 40 percent of the total fire stations inventoried.

However, the first floor elevation information for the fire stations identified as located in the storm surge-prone area for a Category 1 hurricane is not available. Therefore, it cannot be determined if flooding of the actual structure may indeed occur. The existing database can be updated to include this information should it become available.

For the Category 3 hurricane, the first floor elevation information for three of the 14 stations located in the storm surge-prone areas was inventoried. Out of the three, two fire stations would be subjected to flooding. Twenty-six fire stations were identified to be in the storm surge prone area for a Category 5 hurricane. First floor elevation information was collected for 5 stations out of the 26 stations. It was found that all of them will be flooded during a hurricane.

A wind vulnerability analysis was not performed for the fire station because it was outside the scope of work. Generally, it can be assumed that any pre-Andrew constructed facility should withstand a Category 1 storm, while post-Andrew constructed facilities should be able to

withstand a Category 2 storm. Some general information concerning the structure of the facilities to withstand wind exposure is addressed in Section 4.1.

4.8 MAJOR POLICE STATIONS

A total of ten major police stations for select cities within Dade County and the Metro-Dade Police Department were inventoried. For a Category 1 hurricane, no police stations were identified to be in the storm surge-prone area. Four police stations were determined to be in the storm surge-prone areas for a Category 3 hurricane as shown in Table 4-6. First floor elevation information was collected for these four police stations; three out of the four stations will be subject to flooding. An additional four police stations were identified to be in the storm surge-prone area for a Category 5 hurricane. Therefore, there will be a total of eight police stations located in the storm-surge prone areas for a Category 5 hurricane. Out of the eight police stations, six will be subjected to flooding.

It was determined that 61 percent of the inventoried police stations in Dade County will be located in the storm surge prone areas for the different hurricane intensities. Forty-six percent of the police stations will be subjected to flooding in a Category 5 hurricane. The first floor elevations for all the police stations were not available. Therefore, a complete analysis could not be performed at this time.

These facilities, if pre-Andrew constructed, should withstand a Category 1 storm, while a post-Andrew constructed facility should be able to withstand a Category 2 storm. Section 4.1 provides basic information of some features of the facilities such as door type, window types, etc., to wind damage.

5.0 NON-TRANSPORTATION FACILITIES VULNERABILITY ANALYSIS

5.1 PUBLIC HURRICANE SHELTERS

There are 78 hurricane shelters in Dade County. Out of the 78, one shelter is located on the storm surge-prone area for a Category 1 hurricane as shown in Table 5-1. Two additional shelters would be located for a Category 3 hurricane and an additional 14 shelters were identified to be in the storm surge area for a Category 5 hurricane. A total of 17 shelters were identified to potentially be subject to surge flooding; this represents twenty-one percent of all the shelters in Dade County (at the time this report was written). The use of shelters in potential storm surge areas has been eliminated.

The fact that the shelters were identified in the storm surge prone areas does not mean that they all will be flooded. The first floor elevation of the building will determine if flooding will occur.

While the shelter facility may remain a viable surge refuge if the ground floor is sufficiently elevated, these remain concerns regarding post-storm egress if parking facilities associated with the shelter are prone to surge. If shelter residents' vehicles flood, they may have no capability to leave the shelter after the storm, impeding potential personal household level response and recovery efforts. Because of vehicle unavailability, the shelter support system such as food and water for those staff and evacuees forced to remain in the shelter present a concern.

The existing database can and should be expanded at a later date to include the first floor elevation of shelters. This would permit a more realistic representation of what to expect during a hurricane.

New efforts must be developed to look at potential wind problems The analysis does not include the wind vulnerability since information on shelter buildings/facilities was not collected as part of this study.

5.2 OFFICES OF EMERGENCY MANAGEMENT

The Offices of Emergency Management in Dade County were located relative to the storm surge prone areas for different hurricane intensity. A total of 7 offices were inventoried. Up to three out of seven would be affected by flooding in a Category 3 and 5 hurricane as shown in Table 5-2. This represents 42 percent of the total EOC offices in Dade County.

Even though the facility will not be subject to flooding, there may be equipment located in the first floor of the structure that could be damaged. Also, the parking lot area, point of access/egress may be prone to flooding, creating a problem for post-hurricane conditions.

A wind vulnerability analysis was not performed for the OEM because it was not part of the study.

5.3 MOBILE HOME PARKS

A total of 62 mobile home parks were inventoried in Dade County. The mobile home parks will not be affected due to storm surge in the Category 1 hurricane. Of the 62 mobile home parks identified, 22 will be located in the surge prone areas for the Category 3 hurricane as shown in Table 5-3 and 32 will be located in the Category 5 hurricane surge areas. This represents 35 percent of the total for the Category 3 areas and 52 percent of the total for the Category 5 areas that will be subjected to flooding.

These structures are extraordinarily wind vulnerable. In the event of even a perspective Category 1 storm, these facilities will be advised/ordered to evacuate by the OEM office.

5.4 HEALTH CARE FACILITIES

5.4.1 Hospitals

A total of 35 hospitals were identified in Dade County. The analysis shows that three hospitals (9%) are located in the surge prone areas for Category 1 hurricanes; nine hospitals (26%) for Category 3 hurricanes, and 16 (45%) for Category 5 hurricanes. The first floor elevation of each hospital will determine if the hospitals are subjected to flooding; such information was not available in this study. The findings are illustrated in Table 5-4.

While the hospital facility may not be subject to inundation, the access/egress may be subject to flooding during the post-storm situation, and emergency vehicles associated with hospitals may be subject to flooding as well, and may contribute to chaos in operation of the facility.

5.4.2 Nursing Homes and Adult Congregate Living Facilities

The nursing homes and Adult Congregate Living Facilities (ACLF) were inventoried as part of this study. A total of 162 were identified in Dade County. The analysis shows the following:

- 6 nursing homes and ACLF's are located in the surge prone area for a Category 1 hurricane;
- 40 nursing homes and ACLF's are located in the surge prone area for a Category 3 hurricane;
- 60 nursing homes and ACLF's are located in the surge prone area for a Category 5 hurricane.

This indicates that up to 3.7 percent would be affected by a Category 1 hurricane, up to 25 percent in a Category 3 hurricane, and up to 37 percent by a Category 5 hurricane. Because no facility elevation data was collected, an estimate of the number of facilities that will be actually significantly affected by flooding cannot be determined. The results are illustrated in Table 5-5. The existing database can be expended to include such vital information for emergency management in the future.

5.5 POWER SUBSTATIONS

An inventory of the power substations was performed and it was found that there are 116 in Dade County. Out of 116 power substations, 7 were located in the surge prone area for a Category 1 hurricane as shown in Table 5-6. For a Category 3 hurricane, 33 power substations were identified and 54 power substations were identified for a Category 5 hurricane. The analyses show that 6 percent will be in Category 1, 28 percent in a Category 3 and 47 percent in a Category 5. These power substations are all susceptible to flooding.

5.6 TELEVISION STUDIOS

The television stations were inventoried and it was found that there are 34 television stations in Dade County. Out of the 34 television stations, one was located in the surge prone area for a Category 1 hurricane as shown in Table 5-7, five were located in a Category 3 hurricane and finally 8 were located in a Category 5 hurricane.

This represents 2 percent for Category 1, 15 percent for Category 3 and 24 percent for Category 5.

TABLE 5-6
(Continued)

FPL Power Substations

Category 5 Hurricane

FPLSUBST_I	FEDNO	SUBSTA	SUBNO	PHONE	ADDRESS	SURGE_INUN
3	9	40TH STREET	55	531-7727	4008 SHERIDAN AVE, MIA. BCH	Y
4	17	62ND AVE.	84	266-3792	1680 SW 62 AVE, MIAMI	Y
5	66	8ST TERM	527	261-2807	6767 SW 8 ST, MIAMI	Y
8	90	AVENTURA	428	932-7620	2625 NE 206 ST, N. MIAMI BEACH	Y
9	100	AVOCADO	324		197 AVE & SW 216 ST, MIAMI	Y
12	104	BLUE LAGOON	664	262-1329	5590 NW 6ST, MIAMI	Y
13	87	BOULEVARD	391	893-0512	11130 NE 14 AVE, N. MIAMI	Y
17	58	CORAL REEF	91	235-0521	10625 SW 152 ST, MIAMI	Y
20	96	COURT	542	233-7347	12590 SW 136 ST, MIAMI	Y
24	75	DADELAND	341	667-6064	6890 SW 81 ST, MIAMI	Y
25		DAVIS	262	238-3331	12701 SW 136 ST, MIAMI	Y
26	19	DEAUVILLE	94	866-5290	6873 HARDING AVE, MIA. BCH.	Y
29	98	DUMFOUNDLING	367	931-4561	NE 187 ST& 29 AVE	Y
30		EUREKA			150 AVE & 184 ST, MIAMI	Y
32	31	FLORIDA CITY	143	247-3435	16100 PALM DR (344 ST), MIAMI	Y
33	11	FRONTON	58	635-6181	3795 NW 38 AVE, MIAMI	Y
39	73	GOULDS	105	233-6553	21200 SW 112 AVE, MIAMI	Y
44	25	GREYNOLDS	302	947-6268	2485 SUNNY ISL. BLVD, MIA. BCH.	Y
45	64	HAINLIN	322	258-1839	147 AVE & 216 ST, MIAMI	Y
48	32	HOMESTEAD	88	257-5509	28250 SW 122 AVE, MIAMI	Y
49	62	INDIAN CREEK	330	865-3977	5800 COLLINS AVE, MIA. BCH.	Y
54	43	KENDALL	193	271-4783	8175 SW 102 ST, MIAMI	Y
55	53	KEY BISCAYNE	278	3615145	W/O CIRCLE ON CRANDON BLVD	Y
56	76	KILLIAN	333	232-1232	11775 SW 99 AVE, MIAMI	Y
58	51	LAWRENCE	204	642-1412	1951 NW 11 ST, MIAMI	Y
59	40	LE JUENE	109	871-4678	NW 20 ST W/O LEJUENE	Y
60	77	LEMON CITY	335	751-8322	7645 NE 3 PL, MIAMI	Y
62	82	LINDGREN	384	385-6222	8121 SW 137 AVE, MIAMI	Y
64		LUCY	488	248-7732	SW 328 ST & LUCY ST (162 AVE)	Y
65	27	MARION	64	271-1331	8045 SW 117 AVE, MIAMI	Y
68	107	MCGREGOR	675	245-8563	9205 SW 360 ST, MIAMI	Y
69	72	MERCHANDISE	106	261-0891	7255 NW 7 ST, MIAMI	Y
70	1	MIAMI	1	371-4798	122 SW 3 CT, MIAMI	Y
71	2	MIAMI BEACH	5	672-2311	EAST END MCARTHUR CSWY	Y
77	92	MITCHELL	444	253-5672	13607 SW 92 AVE, MIAMI	Y
78	106	MONTGOMERY	680	252-1386	SW 117 AVE & 120 ST, MIAMI	Y
81	10	NORMANDY	305	866-1012	8670 HARDING AVE, MIA. BCH.	Y
82	49	OJUS	219	931-1212	19301 NE 28 AVE, N. MIA. BCH.	Y
86		PERIMETER N.	535	592-4160	NW 16 ST & 72 AVE, MIAMI	Y
88	42	PERRINE	174	235-7373	10700 EUREKA DR (184 ST)	Y
89	16	PRINCETON	86	258-3382	13089 COCONUT PLM DR (248 ST)	Y
92	5	RIVERSIDE	223	444-4126	4645 NW 4 ST, MIAMI	Y
93	93	RONEY	435	532-1632	LIBERTY AVE N/O 23 ST, MIA. BCH.	Y
95	94	SAGA	520	258-2388	8800 SW 232 ST, MIAMI	Y
99	99	SIMPSON	588	856-0762	199 SW 8 CT, MIAMI	Y
101	88	SNAPPER CREEK	398	661-8034	10700 SW 57 AVE, MIAMI	Y
102	24	SOUTH MIAMI	97	667-5193	5797 SW 68 ST, MIAMI	Y
103	65	SUNILAND	318	233-1132	12250 SW 82 AVE, MIAMI	Y

TABLE 5-6
(Continued)

FPL Power Substations

FPLSUBST_I	FEDNO	SUBSTA	SUBNO	PHONE	ADDRESS	SURGE_INUN
108		TURKEY POINT	264	248-0041	87 AVE & SW 360 ST, MIAMI	Y
110	50	UNIVERSITY	244	661-5935	5235 PONCE DE LEON, C. GABLES	Y
111	44	VENETIAN	179	532-3024	1925 WEST AVE, MIA. BCH.	Y
112	74	VILLAGE GREEN	276	223-8081	11800 SW 43 ST, MIAMI	Y
113	95	VIRGINIA KEY	533	361-6713	W/S SEWER TREATMENT PLANT	Y
116	83	WHISPR. PINES	412	251-6064	8501 SW 198 ST, MIAMI	Y

5.7 RADIO STUDIOS

An inventory of the radio stations shows that 38 radio stations are located in the study area. For a Category 1 hurricane it was found that three radio stations were located in the storm surge prone area as shown in Table 5-8. For a Category 3, nine radio stations were located in the storm surge area. Finally, 11 radio stations were located in the surge prone areas for a Category 5 hurricane. The analysis shows that 28 percent of the radio stations are located in the storm surge area for a Category 5 hurricane.

5.8 ARMORIES

An inventory of the armory locations shows that four armories are located in the study area. It was found that two locations were located in the storm surge prone area for a Category 5 hurricane as shown in Table 5-9.

TABLE 5-9

Armories

Category 5 Hurricane

ARMORY_ID	LOCATION	ADDRESS	SURGE_INUN
4	ARMED FORCES RESOURCES CENTER	13601 SW 116TH STREET	Y
2	NAT'L GUARD OF N. MIAMI	13250 NE 8TH AVENUE	Y

6.0 DEMOGRAPHIC VULNERABILITY ANALYSIS

This section describes an analysis of population and employment data with respect to potential impact by future hurricane events affecting Dade County. This demographic evaluation is structured to provide detailed information on the changes in population and employment in four levels of aggregation that are the following:

- Countywide
- Surge Prone Area
- Original/Existing Evacuation Zones
- Expanded Evacuation Zones

The countywide information presents an overview of the development of the population and employment GIS database for Dade County. The surge-prone area level of information is used to identify the population and employment that lives or works in the three categories of storm surge-prone areas. The demographic tabulations by evacuation zone provide detailed information for analyzing the population and employment change within each evacuation zone. The existing and expanded evacuation zones, when applied to the evacuation model discussed in detail in Technical Report #3, provide results for the evacuation zones as defined for the 1994 season versus anticipated expanded 1995 season evacuation zones based on identification of additional areas impacted by hurricane storm surge. At the time of the analysis, official 1995 evacuation zones had not yet been defined. As a point of information, evacuation zones used for analysis are very close to the anticipated and later OEM refined official 1995 evacuation zones.

6.1 POPULATION AND EMPLOYMENT CHANGE AT COUNTY-WIDE LEVEL

It is important to identify the areas of growth in both population and employment, but especially population, and to link to surge inundation areas that are for residential growth to avoid further spread in Category 1 areas which will put additional stress on the road system during evacuations when even greater people will be subject to evacuation notices.

On the employment side, the development of business in surge areas will put them at risk of saltwater flooding with concomitant exposure of whatever goods or services they supply to the community as well.

Population

A comparison of county-wide population totals for Dade County for the years 1990 (pre-Hurricane Andrew), 1993 (post-Hurricane Andrew) and the year 2000 (the design year) is provided in Table 6-1.

Between 1990 and 1993, total population in Dade County increased by 15,258 from 1,937,097 to 1,952,355. By the year 2000, total population will increase to 2,221,337 at an average 1.9 percent compounded rate of increase per year from 1993, a net increase of 14 percent from 1993. Of growth of 268,982 forecast between 1993 and 2000, 3 percent is projected to occur in Category 1 surge-prone areas, 28 percent is expected to occur in Category 3 storm surge areas and 52 percent is projected to occur in Category 5 storm surge areas.

Employment

Employment data can be used to identify those areas of the county which attract trips, that is, which are the destination of trips, especially home-based work trips.

Recently, total employment in Dade County has decreased by 72,977 from 1,105,351 in 1990 to 1,032,374 in 1993. The parentheses shown on Table 6-1 represents a negative value. Projections indicate that Dade County's total employment will increase by 31,210 to 1,136,561 by the year 2000. This represents a 3 percent compounded rate of increase over a 10-year period at an average 1.38 percent compounded increase per year from 1993 to 2000, a net increase of 10 percent from 1993. Of the 104,187, 1 percent is expected to occur in Category 1 storm surge areas, 36 percent in Category 3 storm surge areas and 61 percent in Category 5 storm surge areas.

6.2 POPULATION AND EMPLOYMENT BY SURGE-PRONE AREAS

Population

Table 6-2 shows the population by surge-prone areas for Category 1, 3 and 5 hurricanes. Between 1990 and 1993, the population decreased by 2,966 in Category 1 surge-prone areas. Projections indicate that the total population will increase by 4,667 to 42,100 by the year 2000 for areas subject to saltwater flooding by a Category 1 storm. This represents a 12.47 percent compounded rate of increase over a 10-year period and at an average 2.90 percent compounded increase per year from 1993 to 2000, a net increase of 7,633 people.

For a Category 3 storm, the population decreased by 50,179 between 1990 and 1993. For year 2000, an increase of 25,346 is projected, which represents a 5.4 percent compounded rate of increase over a 10-year period, and a 2.4 percent average percent compounded increase per year from 1993 to 2000, or a net increase of 18 percent over seven years, totalling 75,525 people.

In the Category 5 storm surge impact area, between 1990 and 1993, Dade County experienced a loss in population of 40,972. This represents a 2.00 percent average percent compounded decrease per year from 1990 and 1993. The future year projection shows an increase of 92,555 from 829,369 in 1990 to 921,924 in 2000. This represents a 2.4 percent compounded rate of increase per year from 1993 to 2000, a net increase of 18 percent over seven years.

TABLE 6-1

Change in County-Wide Population and Employment

Change in County-Wide Population

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	1,937,097			
1993	1,952,355	15,258	0.8	0.3[1]
2000	2,221,337	284,240	15.0	1.9[2]

Change in County-Wide Employment

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	1,105,351			
1993	1,032,374	(72,977)	-6.6	-2.3[1]
2000	1,136,561	31,210	2.8	1.4[2]

[1] Average percent change per year, 1990-1993

[2] Average percent change per year, 1993-2000

TABLE 6-2

Population by Surge-Prone Areas

Category 1 Hurricane

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	37,433			
1993	34,467	(2,966)	7.9	2.7[1]
2000	42,100	4,667	12.5	2.9[2]

Category 3 Hurricane[3]

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	467,644			
1993	417,465	(50,179)	-10.7	-3.7[1]
2000	492,990	25,346	5.4	2.4[2]

Category 5 Hurricane[4]

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	829,369			
1993	780,397	(48,972)	-5.9	-2.0[1]
2000	921,924	92,555	11.2	2.4[2]

[1] Average percent change per year, 1990-1993
[2] Average percent change per year, 1993-2000
[3] Includes population in Category 1 hurricane surge-prone areas as well
[4] Includes population in Category 1 and Category 3 hurricane surge-prone areas as well

The loss in population from 90 to 93 in the surge zone was caused by Andrew. From 1993 to 2000 it is projected that population will increase, which will indicate both that residents are rebuilding their homes after Andrew and that new residential construction will continue.

The projected increase in population in the surge zones will increase evacuation needs in terms of both public and private sectors, and increase clearance time as these residents move to either shelters or other locations in or out of Dade County.

Employment

The employment data by surge-prone areas is shown in Table 6-3. For a Category 1 storm, the county employment decreased by 875 between 1990 and 1993. By year 2000, total employment will increase to 11,071 at an average 1.5 percent compounded rate of increase from 1993, a net increase of 1,110 employees.

For surge-prone areas in a Category 3 storm, the employment data shows a decrease for the three studied years. Between 1990 and 1993, Dade County employment experienced a low of 41,129 and between 1990 and 2000 a low of 3,436, or a net increase of 20 percent over seven years, totalling 37,693 employees.

The surge-prone areas for a Category 5 storm experienced a decrease in employment between 1990 and 1993. By year 2000, total employment will increase to 466,793 at an average 2.1 percent compounded rate of increase from 1993, a net increase of 16 percent over seven years.

Population

A comparison of the total countywide population by surge-prone areas for the years 1990 (pre-Hurricane Andrew), 1993 (post-Hurricane Andrew) and the year 2000 (the future year) is provided.

TABLE 6-3

Employment by Surge-Prone Areas

Category 1 Hurricane

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	10,836			
1993	9,961	(875)	8.1	2.8[1]
2000	11,071	235	2.2	1.5[2]

Category 3 Hurricane[3]

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	228,575			
1993	187,446	(41,129)	-18.0	-6.4[1]
2000	225,139	(3,436)	-1.5	-2.7[2]

Category 5 Hurricane[4]

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	463,237			
1993	403,303	(59,934)	-12.9	-4.5[1]
2000	466,793	3,556	0.8	2.1[2]

[1] Average percent change per year, 1990-1993
[2] Average percent change per year, 1993-2000
[3] Includes population in Category 1 hurricane surge-prone areas as well
[4] Includes population in Category 1 and Category 3 hurricane surge-prone areas as well

Population within the storm surge area for a Category 1 storm represented 1.9 percent of the total population for year 1990. For year 1993, it represented a 1.8 percent of the total population. Population for year 2000 in the surge area for Category 1 is forecast to represent 1.90 percent of the total population. Table 6-4 represents the findings.

For the year 1990 under a Category 3 storm, the population in the surge-prone area represented 24 percent of the total countywide population. In 1993, it represented 21 percent and in the year 2000, 22 percent of the total population is projected to reside in Category 3 areas.

The Category 5 storm surge-prone areas are more populated than the Category 3 and Category 1 situations; 43 percent of the total population resides on this Category 5 storm for 1990. For 1993, this represented 40 percent of the total population. Finally, by the year 2000, the population will represent 42 percent of the countywide population.

Employment

The total employment data shows that 0.98 percent will lie in a Category 1 surge-prone area for year 1990. A decrease was experienced through 1993. By the year 2000, 0.9 percent of the total employment will be located in the Category 1 surge-prone area.

For a Category 3 storm, the employment in the surge-prone areas represent 21 percent of the total for year 1990, 18.2 percent for year 1993 and 19.8 percent for year 2000.

For a Category 5 storm, the employment located in the surge-prone areas represented 42 percent of the total county wide employment for 1990; 39 percent of the total employment for 1993 and 41 percent of the total employment for the year 2000. The results are shown in Table 6-5.

TABLE 6-4

Percent of County-Wide Population by Surge-Prone Areas

Category 1 Hurricane

Year	Total Population County-Wide	Total Population Category 1	Percent
1990	1,937,097	37,433	1.9
1993	1,952,355	34,467	1.8
2000	2,221,337	42,100	1.9

Category 3 Hurricane

Year	Total Population County-Wide	Total Population Category 3	Percent
1990	1,937,097	467,644	24
1993	1,952,355	417,465	21
2000	2,221,337	492,990	22

Category 5 Hurricane

Year	Total Population County-Wide	Total Population Category 5	Percent
1990	1,937,097	829,369	43
1993	1,952,355	780,397	40
2000	2,221,337	921,924	42

TABLE 6-5

Percent of County-Wide Employment by Surge-Prone Areas

Category 1 Hurricane

Year	Total Population County-Wide	Total Population Category 1	Percent
1990	1,105,351	10,836	0.9
1993	1,032,374	9,961	0.9
2000	1,136,561	11,071	0.9

Category 3 Hurricane

Year	Total Population County-Wide	Total Population Category 3	Percent
1990	1,105,351	228,575	21
1993	1,032,374	187,446	18.2
2000	1,136,561	225,139	20

Category 5 Hurricane

Year	Total Population County-Wide	Total Population Category 5	Percent
1990	1,105,351	463,237	42
1993	1,032,374	403,303	39
2000	1,136,561	466,793	41

6.3 POPULATION AND EMPLOYMENT BY ORIGINAL CLEARANCE TIME MODELING EVACUATION ZONES

Evacuation zones were developed for the clearance time analysis based on the existing original pre-Emergency Preparedness Study evacuation zone structure. While the evacuation zones have since been revised based on surge analyses performance in the Emergency Preparedness Study, at the point when the analyses were conducted, they had not been amended; therefore, initial evacuation modeling work concentrated on using the previous, existing evacuation zone structure as the basis of specifying zones to use in the model.

Population

An analysis of population residing in the existing evacuation zones that will be affected by different storm intensities was performed and the results are shown in Table 6-6. The analysis shows that in the Category 1 storm surge zones, between 1990 and 1993, a net increase in population of 8.1 percent was experienced. This represents a 2.6 percent compounded increase per year from 1990 to 1993. Projections indicate that fewer people will live in the existing Category 1 evacuation zones by a figure of 5,447 from 1993 to 2000. Over a 10-year period, from 1990 to 2000, an increase of 4.1 percent in persons affected in Category 1 evacuation zones are forecast.

The population living in the existing evacuation zones for Category 3 storms experienced a decrease of 1,656 from 1990 to 1993. For year 2000, a 7.3 percent compounded rate of increase over a 10-year period is expected and at an average 7.7 percent compounded increase per year for the 1993 to 2000 forecast period.

The analysis shows that for a Category 5 storm's surge area, the affected population decreased by 40,638 from 491,404 in 1990 to 450,766 in 1993. This decline in population is due to the direct impact that Hurricane Andrew had in those areas. By the year 2000, an increase to

TABLE 6-6

Population by Original Clearance Time Modeling Evacuation Zones

Category 1 Hurricane

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	133,015			
1993	143,842	10,827	8.1	2.6[1]
2000	138,462	5,447	4.1	0.5[2]

Category 3 Hurricane[3]

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	276,459			
1993	274,803	(1,656)	-0.6	-0.2[1]
2000	296,567	20,108	7.3	1.1[2]

Category 5 Hurricane[4]

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	491,404			
1993	450,766	(40,638)	-8.3	-2.8[1]
2000	519,100	27,696	5.6	2.2[2]

[1] Average percent change per year, 1990-1993
[2] Average percent change per year, 1993-2000
[3] Includes population in Category 1 hurricane surge-prone areas as well
[4] Includes population in Category 1 and Category 3 hurricane surge-prone areas as well

519,100 at an average 2.04 percent compounded rate of increase per year from 1993 is expected. A net increase of 68,334 persons, or 15 percent, is projected for the seven-year span.

A comparison of the people living in the existing evacuation zones with respect to the total county-wide population was performed. The results are shown in Table 6-7.

Population living in the existing evacuation zones under a Category 1 storm represented 6.9 percent of the total population for 1990. For 1993, the population represents 7.3 percent while in 2000 it is projected to be 6.2 percent.

The analysis shows that for a Category 3 storm, 14.3 percent of the total population resided in the evacuation zones for 1990. For 1993, the population represented 14.1 percent of the total population. By the year 2000, the total population that resides in the existing Category 3 evacuation zones is anticipated to be 13.4 percent.

For a Category 5 storm, the percentage of the total population that lives in the existing evacuation zones was 25 percent for year 1990. Based on the Dade County Planning Department's (DCPD) projections, population for the entire county will increase and people living in the existing Category 5 evacuation areas will represent 23 percent of the total population for the year 2000.

Employment

Table 6-8 shows the results of the analysis of the total employment that will be located in the existing time clearance modeling evacuation zones for different storm intensities. Between 1990 and 1993, employment decreased for Category 1 storm surge-prone areas by 2.30 percent. Projections indicate that employment will increase from 1990 to 2000 in the Category 1 storm pre-study evacuation zones.

TABLE 6-7

Percent of County-Wide Population by Original Clearance Time Modeling Evacuation Zones

Category 1 Hurricane

Year	Total Population County-Wide	Total Population Category 1	Percent
1990	1,937,097	133,015	6.9
1993	1,952,355	143,842	7.4
2000	2,221,337	138,462	6.2

Category 3 Hurricane

Year	Total Population County-Wide	Total Population Category 3	Percent
1990	1,937,097	276,459	14.3
1993	1,952,355	274,803	14.1
2000	2,221,337	296,567	13.4

Category 5 Hurricane

Year	Total Population County-Wide	Total Population Category 5	Percent
1990	1,937,097	491,404	25
1993	1,952,355	450,766	23
2000	2,221,337	519,100	23

TABLE 6-8

Employment by Existing Clearance Time Modeling Evacuation Zones

Category 1 Hurricane

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	86,049			
1993	84,071	(1,978)	-2.3	-0.8[1]
2000	89,811	3,762	4.4	0.9[2]

Category 3 Hurricane[3]

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	240,547			
1993	220,066	(20,481)	-8.5	-2.9[1]
2000	245,314	4,767	1.9	1.6[2]

Category 5 Hurricane[4]

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	353,468			
1993	313,463	(40,005)	-11.3	-3.9[1]
2000	355,794	2,326	0.7	1.8[2]

[1] Average percent change per year, 1990-1993
[2] Average percent change per year, 1993-2000
[3] Includes population in Category 1 hurricane surge-prone areas as well
[4] Includes population in Category 1 and Category 3 hurricane surge-prone areas as well

For a Category 3 storm, the employment that will be located in the existing evacuation zones decreased by 20,481 from 1990 to 1993. By year 2000, Dade County's total employment will increase by 4,767 to 245,314. This represents a 1.9 percent compounded rate of increase over a 10-year period and an average 1.6 percent compounded increase per year from 1993 to 2000. The net growth total represents 25,248 jobs, an 11 percent increase.

Within the Category 5 storm evacuation zone areas, the total employment that was located in the existing evacuation zones decreased from 1990 to 1993. Projection on Dade County total employment shows an increase of 0.7 percent compounded rate between 1990 and 2000.

Table 6-9 illustrates the comparison between the total employment and the existing evacuation areas for the years 1990 (pre-Hurricane Andrew), 1993 (post-Hurricane Andrew) and the year 2000 (the future year).

Employment in the existing evacuation areas under a Category 1 storm represent 7.8 percent of the total employment for year 1990. For year 1993, the population represents 8.1 percent of the Dade County employment and 7.9 percent for the year 2000.

The employment located in the existing evacuation zones for a Category 3 storm represents 22 percent of the entire Dade County employment for year 1990. In 1993 it represented 21 percent and by the year 2000 it will represent 22 percent.

For a Category 5 storm, the employment located in the existing evacuation zones represents 32 percent of the total employment for 1990. In 1993 it represented 30 percent. Projections show that employment in the Category 5 evacuation zones will represent 31 percent of the total employment.

TABLE 6-9

Percent of County-Wide Employment by Existing Clearance Time Modeling Evacuation Zones

Category 1 Hurricane

Year	Total Population County-Wide	Total Population Category 1	Percent
1990	1,105,351	86,049	7.8
1993	1,032,374	84,071	8.1
2000	1,136,561	89,811	7.9

Category 3 Hurricane

Year	Total Population County-Wide	Total Population Category 3	Percent
1990	1,105,351	240,547	22
1993	1,032,374	220,066	21
2000	1,136,561	245,314	22

Category 5 Hurricane

Year	Total Population County-Wide	Total Population Category 5	Percent
1990	1,105,351	353,468	32
1993	1,032,374	313,463	30
2000	1,136,561	355,794	31

6.4 POPULATION AND EMPLOYMENT BY EXPANDED CLEARANCE TIME MODELING EVACUATION ZONES

Due to the new information discovered which led to the revised storm surge atlas produced in the study effort, certain areas of the county may be subject to storm surges for certain storm tracks that previously were shown to be "dry." For purposes of the evacuation clearance time analysis, the additional inland areas that look like candidates for some degree of life-threatening storm surge were taken into account and expanded evacuation zones were defined.

Population

Under the study analysis, no expanded evacuation zones for a Category 1 storm was assumed. The existing evacuation zones will be adequate.

Table 6-10 shows the population distribution comparisons by expanded time clearance modeling evacuation zones for Category 3 and 5 hurricanes for 1990, 1993 and 2000. For 1990 population residing in the expanded evacuation zones for a Category 3 storm was 317,067. The 1993 population decreased by 6.5 percent from 1990 to 1993. This decrease is due to the impact Hurricane Andrew had on those areas. Projections show that a 1.4 percent compounded rate of increase is expected between 1993 and 2000.

For a Category 5 hurricane, the population residing in the expanded evacuation zones was found to be 464,144 for 1990. Between 1990 and 1993, population remained the same. For year 2000, a percent change of 22 between 1990 and year 2000 is expected.

Table 6-11 shows the comparison between total county-wide population and expanded evacuation zones.

TABLE 6-10

Population by Expanded Clearance Time Modeling Evacuation Zones

Category 3 Hurricane

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	317,067			
1993	296,632	(20,435)	-6.5	-2.2[1]
2000	326,159	9,092	2.9	1.4[2]

Category 5 Hurricane[3]

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	464,144			
1993	464,822	678	0.2	0.1[1]
2000	565,509	101,365	22	2.8[2]

[1] Average percent change per year, 1990-1993
[2] Average percent change per year, 1993-2000
[3] Includes population in Category 3 hurricane surge-prone areas as well

TABLE 6-11

Percent of County-Wide Population by Expanded Clearance Time Modeling Evacuation Zones

Category 3 Hurricane

Year	Total Population County-Wide	Total Population Category 1	Percent
1990	1,937,097	317,067	16.4
1993	1,952,355	296,632	15.2
2000	2,221,337	326,159	14.7

Category 5 Hurricane

Year	Total Population County-Wide	Total Population Category 3	Percent
1990	1,937,097	464,144	24
1993	1,952,355	464,822	24
2000	2,221,337	565,509	25

Under a Category 3 storm scenario, population in the expanded evacuation zones represented 16.4 percent of the total county-wide population for 1990, 15.2 percent for 1993 and 14.7 percent for 2000.

For a Category 5 storm, the population residing in the expanded evacuation zones represented 24 percent of the total county-wide population for 1990. For 1993 it represented 24 percent. Finally, for 2000 it will represent 25 percent.

Employment

For a Category 3 storm the total employment that will reside in the expanded evacuation zones is the following as shown in Table 6-12:

- Between 1990 to 1993, the data shows a decrease in total affected employment by 22,406;

- Between 1993 and 2000, the data shows an increase in total employment by 2993; this represents a 1.1 percent change between 1990 and 2000.

For a Category 5 storm, there is a decrease in total employment between 1990 and 1993. This decrease is due to the impact that Hurricane Andrew had on those areas. Between 1993 and 2000, a 3.3 percent increase is anticipated.

Table 6-13 illustrates the percent of county-wide employment by expanded evacuation zones.

Under a Category 3 storm, total employment residing in the expanded evacuation zones represents 14.4 percent of the total county-wide employment for 1990; 13.3 percent for 1993 and 14.3 for year 2000.

TABLE 6-12

Employment by Expanded Clearance Time Modeling Evacuation Zones

Category 3 Hurricane

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	159,485			
1993	137,079	(22,406)	-14.1	-4.9[1]
2000	162,478	2,993	1.9	2.5[2]

Category 5 Hurricane[3]

Year	Total Population	Change From 1990	Percent Change	Average Percent Change Per Year
1990	218,541			
1993	196,911	(21,630)	-9.9	-3.4[1]
2000	225,163	6,622	3.0	1.9[2]

[1] Average percent change per year, 1990-1993
[2] Average percent change per year, 1993-2000
[3] Includes population in Category 3 hurricane surge-prone areas as well

TABLE 6-13

Percent of County-Wide Employment by Expanded Clearance Time Modeling Evacuation Zones

Category 3 Hurricane

Year	Total Population County-Wide	Total Population Category 1	Percent
1990	1,105,351	159,485	14.4
1993	1,032,374	137,079	13.3
2000	1,136,561	162,478	14.3

Category 5 Hurricane

Year	Total Population County-Wide	Total Population Category 3	Percent
1990	1,105,351	218,541	19.8
1993	1,032,374	196,911	19.1
2000	1,136,561	225,163	19.8

For a Category 5 storm, 19.8 percent of the total county-wide employment was located in the expanded evacuation zones for 1990. For 1993, it represented 19.1 percent. Finally for the year 2000, it is anticipated to be 19.8 percent of the total county-wide employment.

6.5 POPULATION DENSITY BY TRAFFIC ANALYSIS ZONE

An analysis of the population density by Traffic Analysis Zone (TAZ) for the census year 1990, 1993 (post-Andrew) and 2000 future year scenario was performed. The analysis shows that the more densely populated areas are the following:

- City of Hialeah
- City of Sweetwater
- City of Miami (Downtown)
- City of Miami Beach
- City of North Miami Beach
- West Kendall
- Area west of the Palmetto Expressway between SR 836 and W. Flagler Street

High-rise buildings are predominant in the Miami Beach area, the area west of the Palmetto between SR 836 and W. Flagler Street, downtown Miami and the City of Sweetwater. The City of Miami Beach and North Miami Beach are coastal areas and they are in Category 1 evacuation zones. The West Kendall area is located in a Category 5 evacuation zone. Therefore, special attention should be given to these areas during evacuation efforts. Because these identified areas are higher density areas, they will contribute commensurably more to evacuation flows, and to the congestion they generate. Figures 6-1, 6-2 and 6-3 illustrate the findings.

1990 Population Density By Traffic Analysis Zone

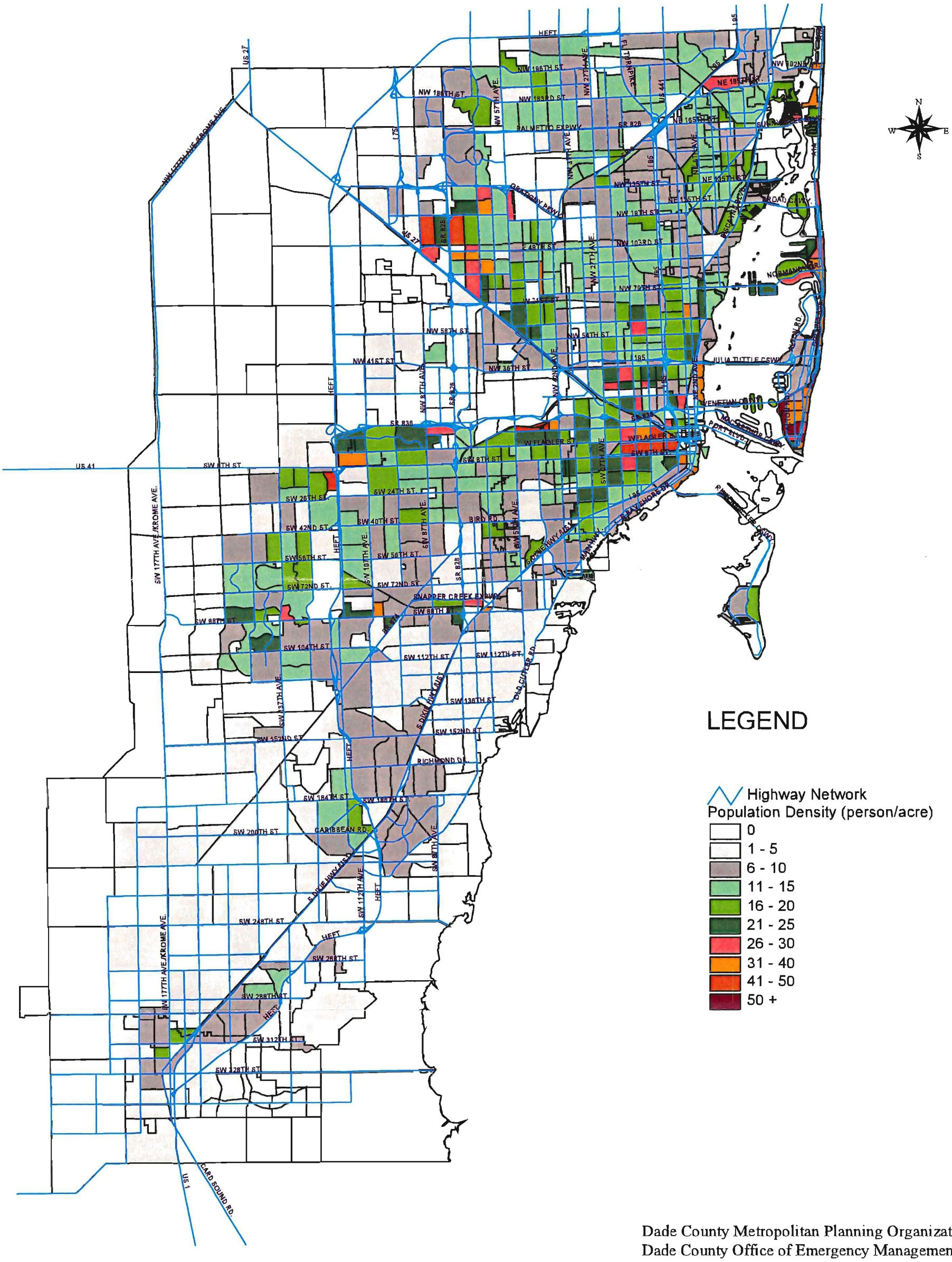


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Figure 6-1

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1993 Population Density By Traffic Analysis Zone

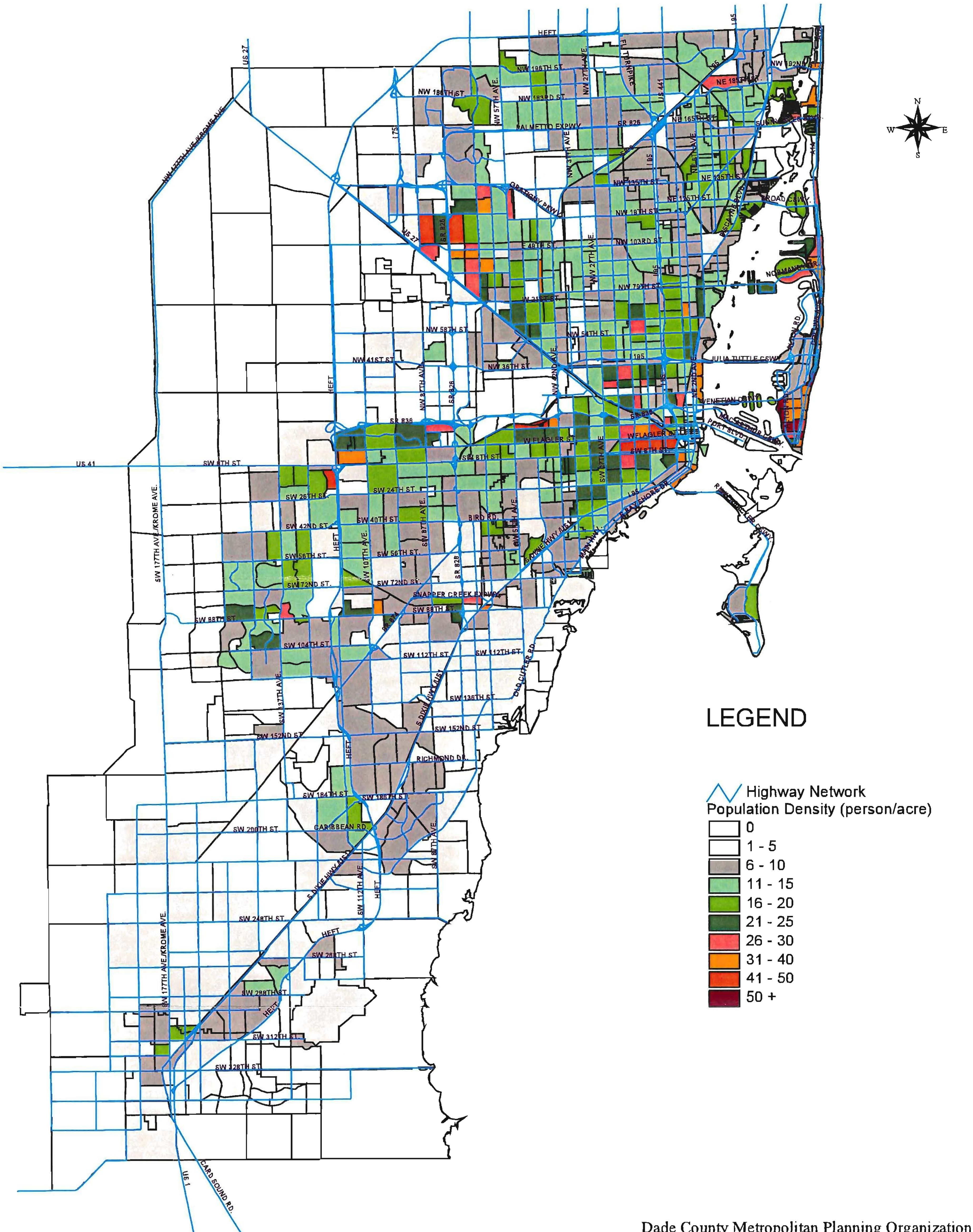

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Figure 6-2

2000 Population Density By Traffic Analysis Zone

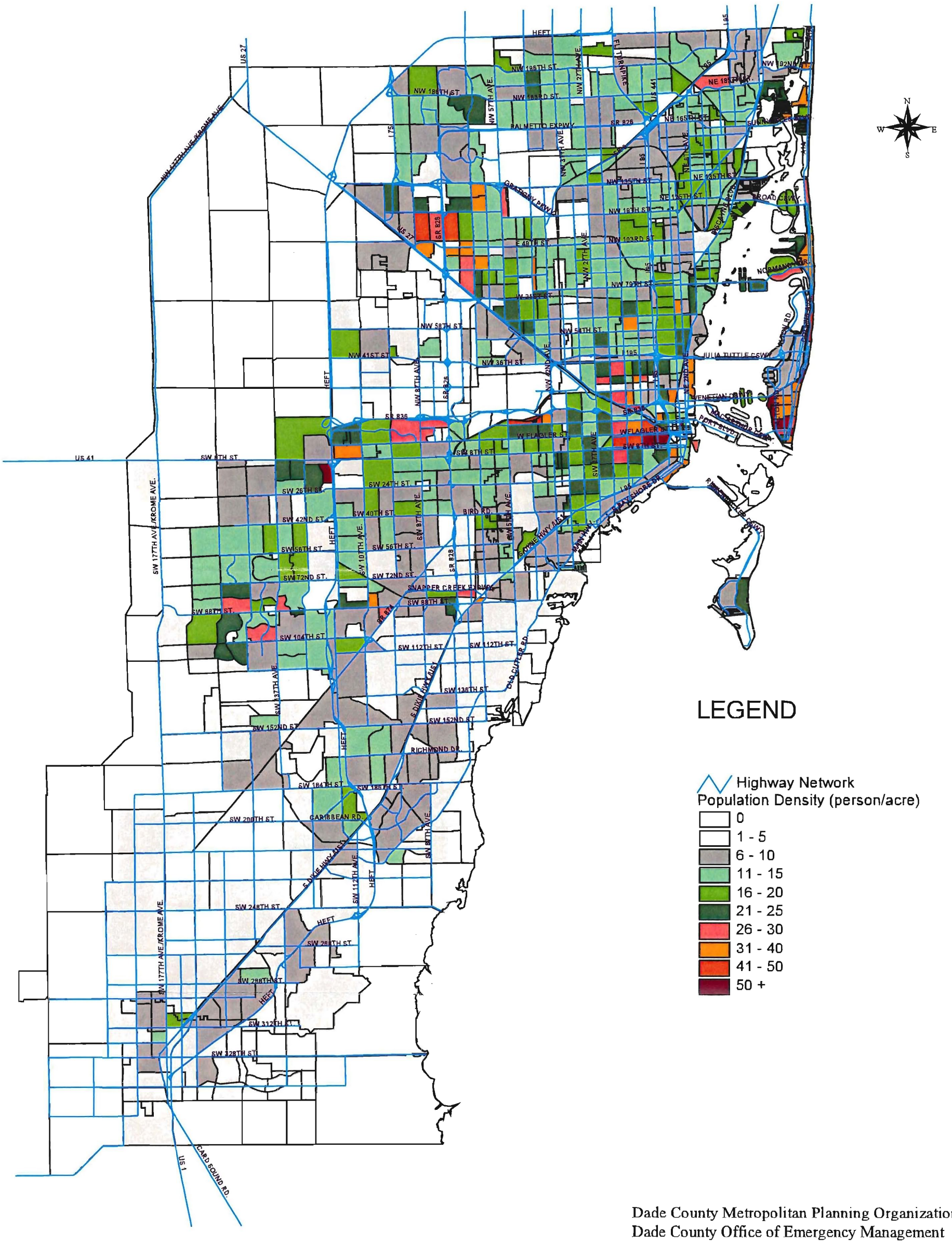

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Figure 6-3

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6.6 EMPLOYMENT DENSITY BY TRAFFIC ANALYSIS ZONE

The employment density is concentrated in downtown Miami, West Dade, the airport area and the Miami Beach area. In the downtown area, all the government offices, as well as a major hospital are located, exhibiting a large volume of employment. The West Dade area is in the process of development and major corporations have their headquarters located in this area as well as several large business parks, which create a large source of employment. Another large employer is the Miami International Airport (MIA) and the surrounding areas of the airport. In the Miami Beach area, a major hospital is located, creating a large number of jobs. The downtown and Miami Beach areas were identified to be located in the Category 1 evacuation zones. Congestion can be expected in those areas as workers attempt to secure places of employment and then return home, perhaps to a Category 1 high density area, before evacuating. Figures 6-4, 6-5 and 6-6 illustrate the findings.

1990 Employment Density By Traffic Analysis Zone

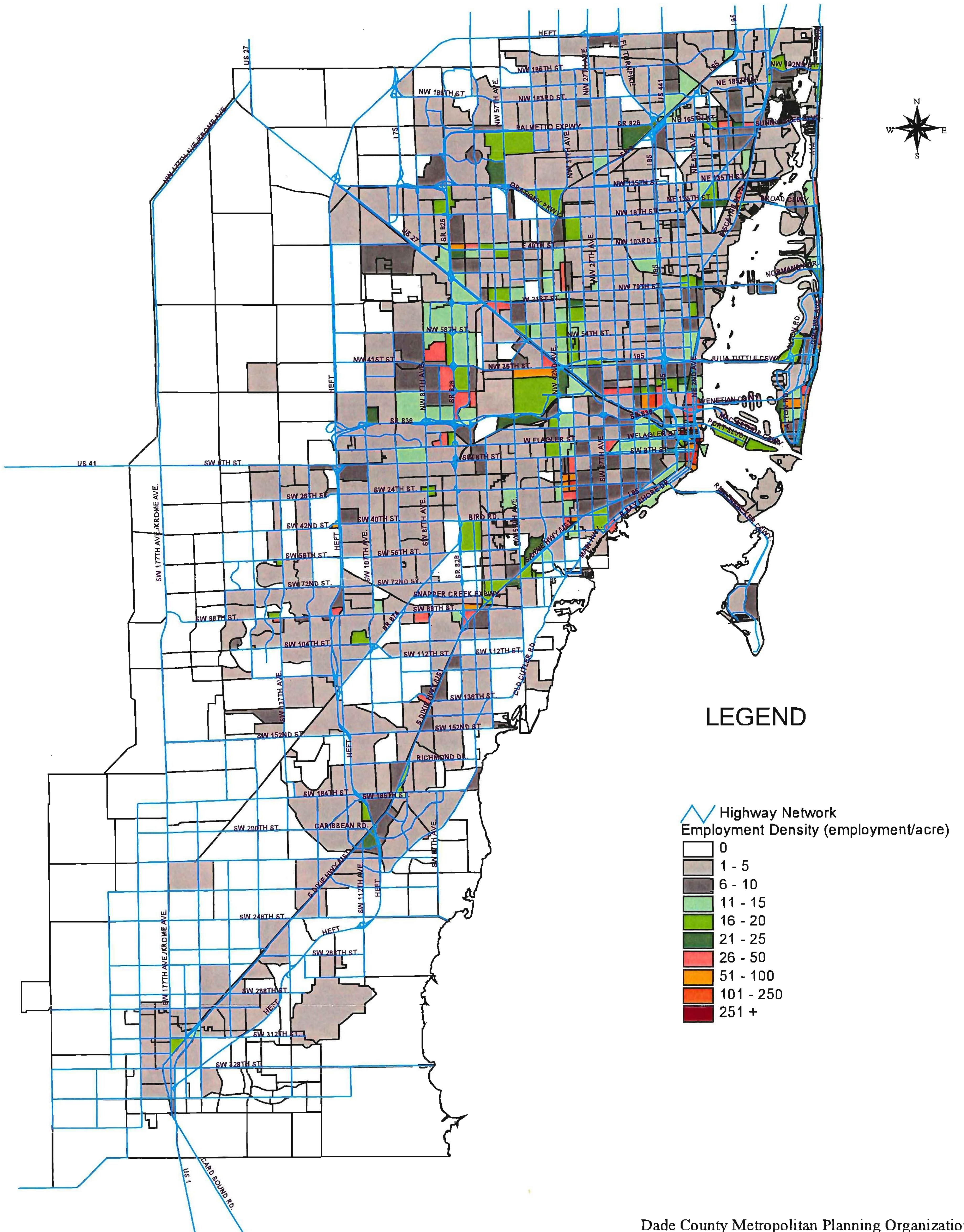

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Figure 6-4

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1993 Employment Density By Traffic Analysis Zone

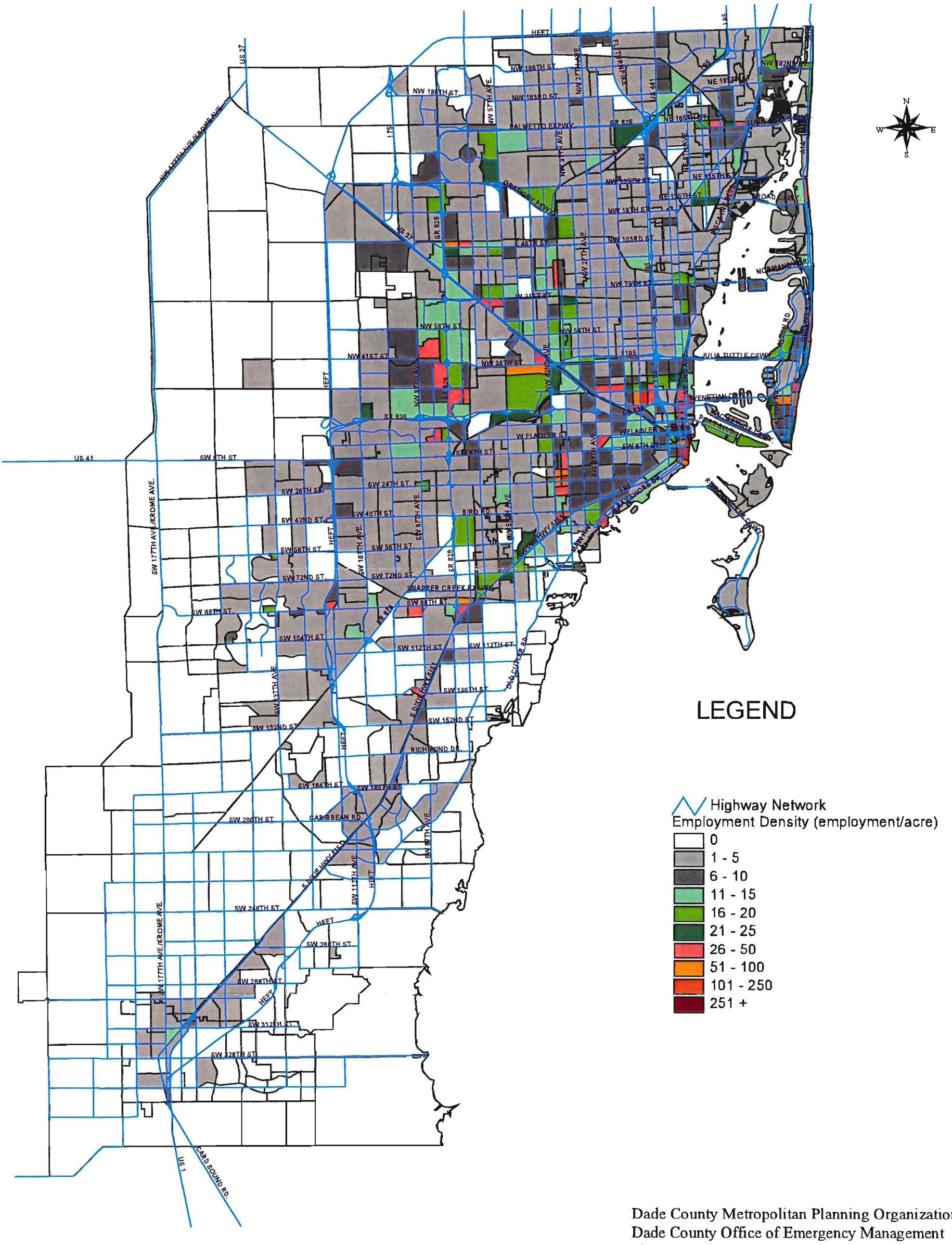

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Figure 6-5

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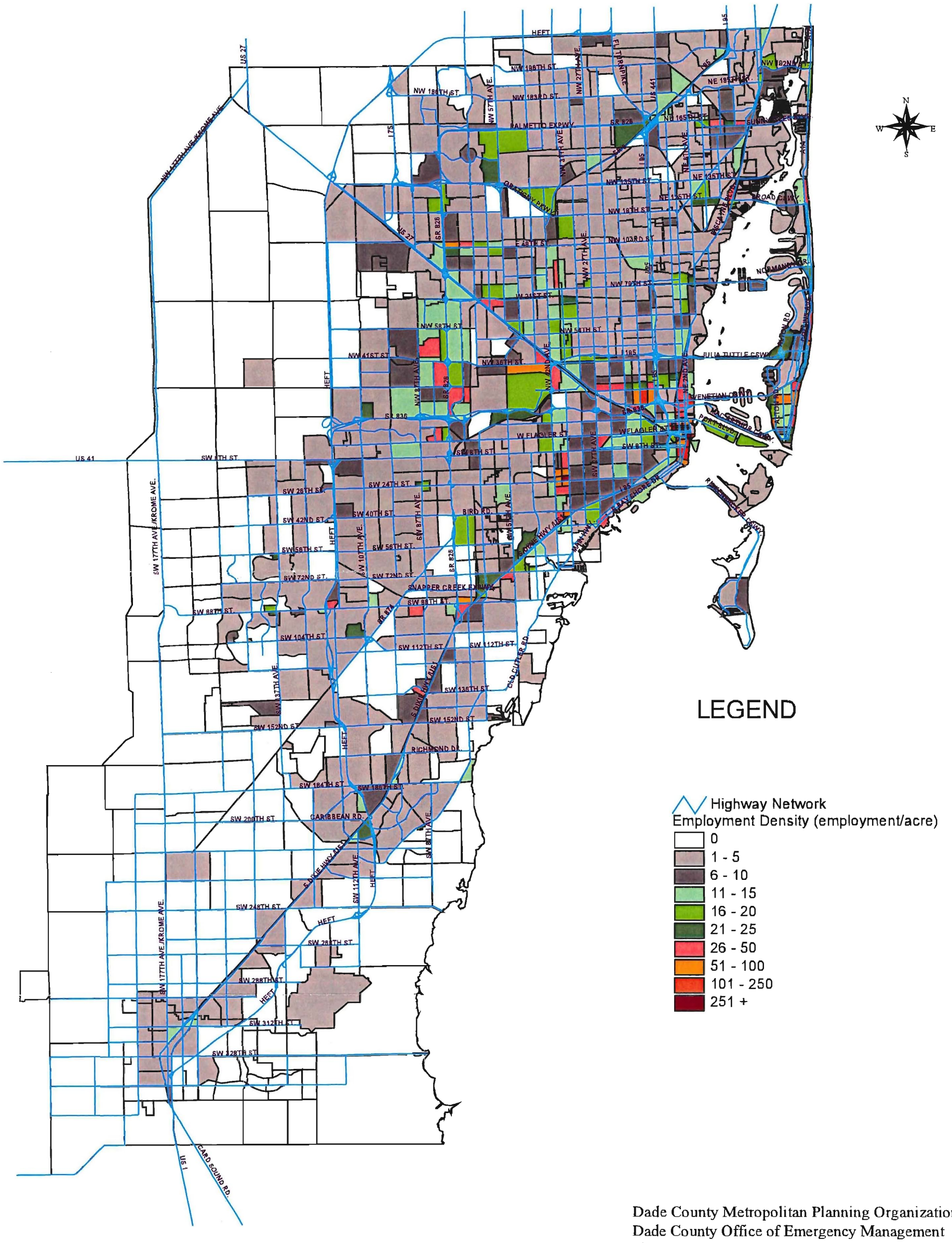
2000 Employment Density By Traffic Analysis Zone



LEGEND

Highway Network

Employment Density (employment/acre)

- 0
- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 50
- 51 - 100
- 101 - 250
- 251 +

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Figure 6-6

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7.0 EXAMPLE STORM IMPACT ANALYSES

To demonstrate the applications of the GIS database prepared in this study to emergency planning, several different hypothetical storm track scenarios covering different storm intensities were synthesized and analyzed. For a Category 1 storm, two model track storms were assumed. The two storm tracks are almost perpendicular the coastline, with the hurricane traveling westward across the county, and are presented in Figure 7-1. One track was defined for a storm passing through the southern part of Dade County, while the second track was positioned more toward the north, using the Broward County line as the north limit of the analysis.

The Category 1 storm will experience sustained winds of 75 mph and is defined as the minimum threshold of significant damage. The bandwidth of sustained hurricane-force winds is estimated to be 12 miles.

For Category 3 strength hurricane analysis, two different storm track scenarios were assumed. The first scenario is a storm that strikes Dade County at a 10 degree angle to the coastline with a track passing through the Central Business District (CBD) and more generally affecting the central and the north portions of the county. The second scenario assumes a storm track parallel to the coastline, with the track just offshore of the Ragged Keys and the Beaches. These are illustrated in Figures 7-2 and 7-3.

In a Category 3 storm, the maximum sustained wind is 130 mph. The analysis shows three lines or bands of sustained winds: 75 mph, 110 mph and 130 mph. The 75 mph bandwidth is defined to be 28 miles. The bandwidth for the 110 mph winds is defined to be 19 miles, and the bandwidth for the maximum wind speed of 130 mph is defined to be 13 miles. These bandwidths represent the thresholds of damage for the different wind speeds for the areas on either side of the storm track swept by the characteristically weaker winds occurring away from the eye.

Two theoretical scenarios were postulated for the Category 5 hurricane impact evaluation with both defined similarly to the storm tracks developed for the Category 3 analyses. Only two were developed because Category 5 storms are generally (though not always) larger, and additional track assessments would tend to repeat largely similar results as each track analyzed would cover a significant portion of the county due to the size of the storm. The first scenario is set with a track which lies over Virginia Key and proceeds inland across the most heavily developed parts of the county, directly over the mid-Brickell area of downtown, Flagami in Central Dade, and the Airport West area and International Mall in West Dade. The second scenario assumes a coastline-paralleling course to the northeast, just offshore of Elliott Key, Key Biscayne, and Miami Beach. The storm tracks and wind bandwidth cross sections are illustrated in Figures 7-4 and 7-5.

The most dangerous of Saffir-Simpson hurricane categories is postulated to possess 155 mph maximum sustained winds extending approximately 7.5 miles out from the storm center, a bandwidth of 15 miles overall. This bandwidth was excluded from Figures 7-4 and 7-5 because a comparison of the common windspeeds between a Category 3 and 5 storm (75, 110, 130) were evaluated for hurricane damages; the greater 155 mph winds exceed virtually all construction/installation standards and systems failing at 130 mph would certainly not be expected to survive the higher core winds of a Category 5 storm. The 110 mph winds ring extends out an additional three miles for a bandwidth of 21 miles, followed by a third ring of supra-hurricane winds of 110 mph about 26 miles wide, or a 13-mile radius. Finally, a fourth ring of winds extending out some 17.5 miles from the center of the storm, completes the cross-section of hurricane force or greater wind bands of the hypothetical Category 5 storm analyzed in this exercise.

Each band of wind intensity for each of the three storm categories analyzed represents strongest sustained winds for that band, and for that storm. For the exercises, each storm is assumed to be circular and symmetric in shape and cross-section, and the hurricane is assumed to hold together uniformly as it proceeds across the landscape on its inland track scenarios. In actual

occurrence, hurricanes are rarely perfect circles with uniform distribution of wind bands about the central eye, and with such tidy discrimination of wind speeds from band to band. Instead they are more usually characterized by sustained winds lasting for periods of a minute or so, frequently longer, punctuated by occasional relative lulls in which wind speeds may drop 25 percent or more; but they also quite often even more intensely gust to more than 30 percent above the sustained maxima for the given storm category. Wind bands do not segregate themselves so neatly into rings of different speeds; there is a continuum of speeds associated with actual hurricanes, and they are frequently much more haphazardly arrayed about the eye than is portrayed in the scenario and models presented. Finally, micro-scale sub-storm events of devastating intensity are hypothesized to occur within the stronger parts of the storm, things such as small turbulence effects resembling mini-tornadoes, which can wreck havoc on buildings and infrastructure, and which may in part account for the condensed damage locales witnessed during Andrew, are not specifically addressed because they cannot be validly assigned to a given storm, or to any part of a storm.

A hurricane, while an organized general system, is internally chaotic and a very dangerous storm event, which cannot be entirely captured by the analyses developed during this study. This is the major caveat associated with the analyses performed: that the hurricanes, as presented in the analysis scenario, are a neat package of symmetric, concentric, segregated bands of stepwise decreasing wind intensities, with maximum winds as reported for the storm category. For the purposes of exploring the potential ramifications of storm impacts upon the transportation system and its infrastructure, however, the characterizations of the hypothetical storms and their proposed tracks is both appropriate and instructive.

The findings for the Category 3 north track scenario are contained in Appendix 2B (a tabular summary) as a more exhaustive example analysis; its analytic detail is too great to allow treatment in this narrative.

7.1 CATEGORY 1 STORM

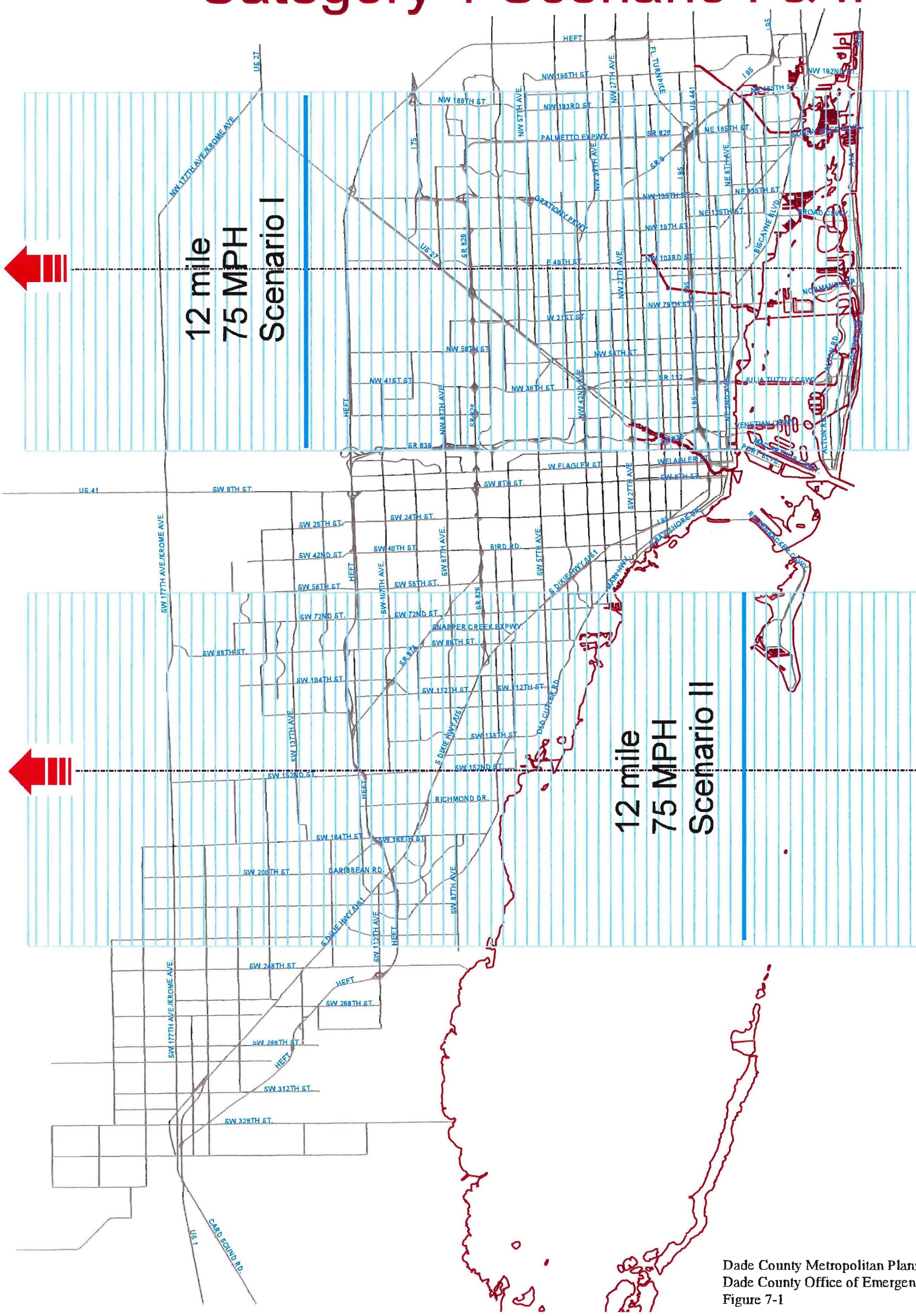
7.1.1 Scenario 1 - Storm Track Across North Dade

A trans-north Dade storm track scenario was considered in this analysis. The maximum band extent for a hypothetical Category 1 storm with sustained wind speed of 75 mph was estimated at 12 miles. The 75 mph represents the threshold of damage. The Broward County line was taken as the northern limit of the storm track. Figure 7-1 illustrates the design storm.

The analysis shows that the storm will directly impact the following elements of the transportation systems, support services, other infrastructure elements potentially contributing to evacuation flows, and other significant elements.

- 222 centerline miles of streets with heavy vegetation
- 244 centerline miles of streets with light vegetation
- 3,442 power poles
- 178 guide sign structures
- 1,178 traffic signals
- 12 Metrorail stations
- 9 Metromover stations
- 7 Transportation Depots
- 23 Intermodal centers
- 3 Offices of Emergency Management
- 25 Administrative centers
- 20 Hospitals
- 13 Nursing home and adult congregate living facilities (ACLF)
- 30 Mobile home parks
- 43 Hurricane shelters
- 58 Florida Power & Light power substations

Hurricane Impact Analysis - Category 1 Scenario I & II



Dade County Metropolitan Planning Organization
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Figure 7-1

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- 36 Fire stations
- 7 Police stations
- 17 Radio stations
- 24 TV stations
- 3 Armories
- 18 Agency facilities

The number of miles of streets with heavy vegetation being affected is an important factor because it is expected at least some segments will be debris strewn with downed trees and limbs, and traffic detours may need to be observed to move around the potential blockage sites, thus hampering possible rescue, and probable response and recovery efforts for the area(s), neighborhoods, or communities around the blockages. Some examples of facilities with heavy vegetation being affected are: N.W. 87th Avenue, Julia Tuttle Causeway, Sunny Isles Causeway, N.W. 67th Avenue/Ludlam Road and some sections of Biscayne Boulevard near North Bay Causeway.

The guide signs on structures impacted represent 72 percent of all the guide signs inventoried in the study. Three types of structures were identified: overhead truss, overhead cantilever and butterfly mount in median. Out of 178, 109 are overhead trusses, 48 are overhead cantilevers and 21 are butterfly mount signs located in medians of divided arterials or expressways. The removal of the downed guide signs will represent problems for the crew because of the power shortage that will be experienced. Because of the damage, traffic detours may be needed.

The traffic signals represent 57 percent of the total traffic signals inventoried in the study. Out of 1,178 affected, 704 are wire strand installations, 381 are mast-arm rigid installations, 92 are mast-arm dangling installations and one is a pedestal type signal installation. Wind damages for the wire-strand installations will probably be quite high, with damaged or destroyed signal heads. Even with restoration of power, it is likely that intersections controlled by wire-strand signals will remain uncontrolled, possibly manually-controlled, or more probably, controlled by temporary

stop signs. In addition, taking intersections from the computerized system may also percolate through neighboring streets and intersections and further exacerbate the poor traffic control/flow management system as well.

The population and employment data that are affected under this scenario were also analyzed. The analysis shows the following:

- For 1990, 1,017,791 were impacted, which represents 53 percent of the county-wide population
- For 1993, 1,080,721 people were impacted, which represents 55 percent of the county-wide population
- For 2000, 1,153,500 people will be impacted under this scenario and represents 52 percent of the county-wide population
- For 1990, the affected employment was 679,131, which represents 61 percent of the total county-wide employment
- For 1993, the affected employment was 665,046, which represents 64 percent of the total county-wide employment
- For the year 2000, the employment that will be affected is found to be 708,082, which represents 62 percent of the total county-side employment

The results of the population and employment analysis are illustrated in Table 7-1. The impacts of the storm on population and employment can be enormous and will impact the roadway systems as people seek to put their homes and businesses back together.

TABLE 7-1

Category 1 Hurricane
Storm Track Across North Dade
Affected Population and Employment

75 MPH
Population

Year	Total Population County-Wide	Total Population Category 1	Percent
1990	1,937,097	1,017,791	53%
1993	1,952,355	1,080,721	55%
2000	2,221,337	1,153,500	52%

75 MPH
Employment

Year	Total Employment County-Wide	Total Population Category 1	Percent
1990	1,105,351	679,131	61%
1993	1,032,374	665,046	64%
2000	1,136,561	708,082	62%

The personnel information for three major transportation agencies was analyzed under this scenario. It was found that 716 MDTA employees will be located in the storm track and represent 61 percent of the total emergency personnel. Out of the 716, 10 are managers, 20 are essential employees, 358 are bus drivers assigned to the Central garage, 59 are bus drivers assigned to the Coral Way garage and 269 are bus drivers assigned to the Northeast garage. These jobs are directly related to the provision of public transportation services and the implementation of post-storm resumption of the service and the availability of drivers and vehicles can be assessed. Depending on the storm path, the determination of what service will be effective, and which routes might be more easily restored, and which part of the county could have public transportation mobility can be evaluated.

For the FDOT personnel information, it was found that one person in a manager position will be affected under this scenario. This represents 9 percent of the FDOT's emergency personnel.

The analysis shows that 26 key people that work for Dade County Public Works (DCPW) Department will be affected under this scenario. Out of the 26, 7 are managers and 19 are essential employees.

The Metrorail stations affected represent 57 percent of the total inventoried. Affected Metromover stations represent 43 percent of the total.

The administrative centers subject to this Category 1 storm represent 63 percent of the total. The intermodal centers represent 72 percent of the total.

The hurricane shelters represent 55 percent of the total in Dade County. The mobile home parks represent 48 percent of the totals. The Offices of Emergency Management represent 43 percent of the total.

The debris-clearing and removal efforts for the affected facilities will be enormous and will affect the cleanup and response time.

The hospitals represent 57 percent of all the hospitals in Dade County. Almost all nursing homes and Adult Congregate Living Facilities will be affected; they represent 98 percent of the total.

7.1.2 Scenario 2 - Storm Track Across - South Dade

A trans-South Dade scenario track was evaluated for a hypothetical Category 1 storm (see Figure 7-1). The 75 mph bandwidth was assumed to be 12 miles. This scenario assumes a perpendicular orientation to the coastline for the path of the storm. Under this scenario, the following transportation system, support services, other infrastructure elements potentially contributing to evacuation flows, and other significant elements will be affected.

- 92 centerline miles of streets with heavy vegetation
- 124 centerline miles of streets with light vegetation
- 907 power poles
- 21 guide sign on structures
- 308 traffic signals
- 3 Metrorail stations
- 2 Transportation Depots
- 3 Intermodal centers
- 2 Administrative centers
- 5 Hospitals
- 22 Nursing home and adult congregate living facilities
- 7 Mobile home parks
- 15 Hurricane shelters
- 14 Florida Power & Light power substations
- 13 Fire stations

- 3 Police stations
- 1 TV station
- 1 Armory
- 6 Agency facilities

Some of the roads with heavy vegetation being affected are: S.W. 56th Street/Miller Road, S.W. 177th Avenue or Krome Avenue, S.W. 57th Avenue and Old Cutler Road. These facilities could expect extensive debris with downed power lines and tree limbs, and traffic detours may be needed to move around the potential blockage sites.

The guide signs on structures that will be impacted under this scenario represent 8.5 percent of the total. Out of 21, 16 are overhead trusses and 5 overhead cantilevers. The guide signs obstructions creates a problem to crews because these signs cannot be cleared as easily as downed trees. Traffic detours will probably be needed to avoid the potential blockage sites.

Traffic signals impacted under this scenario represent 15 percent of the total. Of 308 affected signals, 113 are wire-strand installations, 182 are mast-arm rigid installations, 13 are mast-arm dangling installation types. No pedestal type was located in the impact area. The installation type that is most affected by wind is the wire-strand installation, which will cause damage or destroyed signal heads. Even with restoration of power, the wire-strand signals will remain unoperational, causing major traffic chaos. All these locations will need to be manually controlled by personnel or police stationed at the intersection.

The administrative centers that will be in the storm track represent 5 percent of the total inventory. The intermodal centers represent 9 percent of the total.

The three Metrorail stations represent 14 percent of the total stations. No Metromover stations were located in the storm scenario analyzed.

The hospitals represent 14 percent of all the Dade County hospitals. The nursing homes and ACLF, represent 14 percent of all this data inventoried.

The hurricane shelters affected by a Category 1 hurricane on this track represent 19 percent of all the shelters in the county. The mobile home parks represent 11 percent of all the data collected. The Florida Power & Light power substations that will be located in the impact area represent 22 percent of all the substations in Dade County.

The analysis shows that the population for 1990 represented 21 percent of the total county-wide population. For 1993, it represented 19 percent of the total. For the year 2000, 23 percent of the total population is expected to live in the storm impact area.

The employment analysis shows that 13 percent of all the employment were located in the area for 1990. For 1993, 10 percent were located in the area of impact. For the year 2000, 12 percent of the county-wide employment is expected to be located in the storm impact areas under this scenario.

The results of the employment and population analysis are illustrated in Table 7-2. The impacts of the storm on population and employment will be seen in the entire system such as transportation, support services, and other elements, as people seek to put their homes and businesses back together after a storm.

The analysis of emergency personnel shows that 12 percent of the personnel assigned for emergency use for MDTA will reside in the storm area. Of 139 personnel for MDTA, 29 are managers, 10 are essential employees, 10 are bus drivers working out of the central garage, 88 are bus drivers working out of the Coral Way garage and 2 were bus drivers working out of the southeast garage. The effects of which routes will be unoperational and which routes might be more easily restored can be determined by adding the bus route information to the database. This information was not available on a GIS environment at the time of the study.

TABLE 7-2

Category 1 Hurricane
Storm Track Across South Dade
Affected Population and Employment

75 MPH
Population

Year	Total Population County-Wide	Total Population Category 1	Percent
1990	1,937,097	400,027	21%
1993	1,952,355	371,884	19%
2000	2,221,337	502,155	23%

75 MPH
Employment

Year	Total Employment County-Wide	Total Population Category 1	Percent
1990	1,105,351	143,153	13%
1993	1,032,374	105,303	10%
2000	1,136,561	140,872	12%

For FDOT, 45 percent of all the emergency personnel would live in the impact area. Finally, 27 percent of the DCPW Department personnel would live in the area.

The FDOT personnel impact was found to be five persons. Out of the five, four are managers and 1 is an essential employee.

The Dade County Public Works (DCPW) Department will have 13 managers and 16 essential employees that reside in the impact area for the scenario analyzed.

The differences between the two scenarios are that a storm track across North Dade will affect and cause more damage than the one across South Dade because the most populated areas are in the northern part of the county. Therefore, the transportation systems and support services are more dense in order to serve these areas. Also, the street system in the northern part of the county is more heavily vegetated than the south because the southern part was already leveled by Andrew.

7.2 CATEGORY 3 STORM

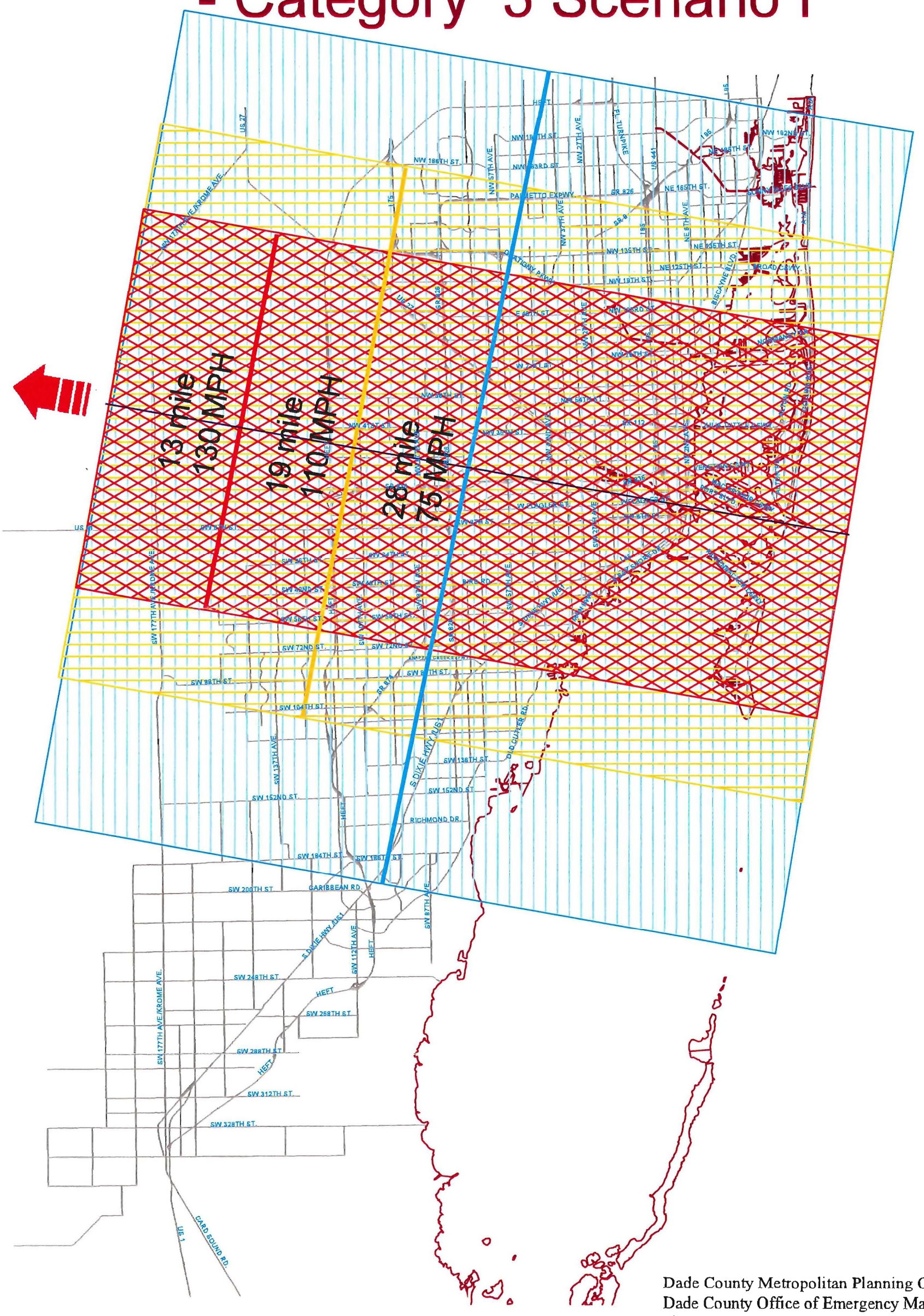
7.2.1 Scenario 1 - Storm Track Across Central Dade

Figure 7-2 illustrates the design storm that was assumed for this case and gives a graphic representation of the possible Category 3 hurricanes that could hit Dade County.

- 75 mph Band

The maximum band extent for a hypothetical Category 3 storm with sustained wind speed of 75 mph was estimated at 28 miles. A 10-degree angle was assumed to the coastline with a track passing through the central business district and more generally, affecting the central and northern

Hurricane Impact Analysis - Category 3 Scenario I



Dade County Metropolitan Planning Organization
Dade County Office of Emergency Management
Figure 7-2

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Dade County Transportation System
Hurricane Emergency Preparedness Study

METRO-DADE

portions of the county. The 75 mph track is the widest diameter and will show the largest area of impact.

The analysis shows that the following transportation systems, support services, other infrastructure elements potentially contributing to evacuation flows, and other significant elements will be affected:

- 389 centerline miles of streets with heavy vegetation
- 423 centerline miles of streets with light vegetation
- 5,314 power poles
- 237 guide signs on structures
- 1,955 traffic signals
- 21 Metrorail stations
- 21 Metromover stations
- 12 Transportation Depots
- 32 Intermodal centers
- 6 Office of Emergency Management
- 38 Administrative centers
- 32 Hospitals
- 151 Nursing home and adult congregate living facilities
- 46 Mobile home parks
- 77 Hurricane shelters
- 106 Florida Power & Light power substations
- 60 Fire stations
- 10 Police stations
- 38 Radio stations
- 34 TV stations
- 4 Armories
- 45 Agency facilities

The analysis shows that some of the streets that are heavily vegetated are: South Dixie Highway between Kendall Drive and I-95, S.W. 67th Avenue, and Miami Beach areas such as Collins Avenue and Alton Road. These areas will need more attention for cleanup response priority. Also, traffic detours may be implemented to avoid these sites.

The traffic signals that will be affected in this storm scenario represent 95 percent of the total signals in Dade County. Out of the 1,955, 1,015 are wire-strand installations, 742 are mast-arm rigid installations, 196 are mast-arm dangling installations and 2 are pedestal type signal installations. A great percentage of the signals will be affected by this scenario. Most of them will not be operational because the wind damages to the wire-strand installation will destroy the signal heads. All these locations will be uncontrolled, creating a traffic chaos.

The guide signs on structures that will be affected represent 95 percent of the total guide signs inventoried. Out of 237, 146 are overhead trusses, 65 are overhead cantilevers and 26 are butterfly mount signs located in medians of divided highways. The overhead trusses impacted represent 59 percent of the total guide sign structures. The overhead cantilevers represent 26 percent of the total, and the butterfly mount signs located in the median represent 11 percent of the total guide sign structures inventoried. The cleanup or debris removal associated with these impacts will require personnel which may not be available or be ready to go back to work. This may create chaos to the highway system. Different alternatives/detours may need to be implemented to keep traffic moving.

Population that would have been affected in 1990 was 1,812,117 residents. This represents 94 percent of the total county-wide population. For year 1993, 1,878,951 which represents 96 percent of the total county-wide population would have resided in affected areas. For year 2000, population expected to endure impacts is estimated to be 2,089,904, which represents 94 percent of the total county-wide population. Table 7-3 illustrates the findings.

TABLE 7-3

Category 3 Hurricane
Storm Track Across Central Dade
Affected Population

75 MPH

Year	Total Population County-Wide	Total Population Category 3	Percent
1990	1,937,097	1,812,117	94%
1993	1,952,355	1,878,951	96%
2000	2,221,337	2,089,904	94%

110 MPH

Year	Total Population County-Wide	Total Population Category 3	Percent
1990	1,937,097	1,491,456	77%
1993	1,952,355	1,573,620	81%
2000	2,221,337	1,714,585	77%

130 MPH

Year	Total Population County-Wide	Total Population Category 3	Percent
1990	1,937,097	1,128,841	58%
1993	1,952,355	1,191,623	61%
2000	2,221,337	1,261,624	57%

The employment data that will be affected under this scenario was found to be:

- 1,059,373 for 1990. This would have represented 95 percent of the total county-wide employment in 1990;
- 1,015,137 for 1993. This represented 98 percent of that year's total; and
- 1,100,837 for the year 2000. This represents 97 percent of the projected total future year employment.

Population and employment will be severely impacted during such a hypothetical storm, making the response effort and post-storm resumption of service difficult. Table 7-4 illustrates the employment analysis results.

The transportation personnel that will be affected under this scenario was identified and is as follows:

- 1,101 MDTA employees. This represents 94 percent of the total personnel assigned for emergency operation. Out of 1,101, 51 are managers, 39 are essential employees, 406 are bus drivers assigned to the Central garage, 269 are bus drivers working out of the Coral Way garage, and 336 are bus drivers that work in the Northeast garage
- 10 FDOT employees. This represents 90 percent of the personnel for emergency use. Out of 10, 8 are managers and 2 are essential employees.
- 95 DCPW Department employees. This represents 90 percent of the total inventoried personnel. Out of the 95, 25 are managers and 70 are essential employees.

TABLE 7-4

Category 3 Hurricane
Storm Track Across Central Dade
Affected Employment

75 MPH

Year	Total Employment County-Wide	Total Employment Category 3	Percent
1990	1,105,351	1,053,973	95%
1993	1,032,374	1,015,137	98%
2000	1,136,561	1,100,837	97%

110 MPH

Year	Total Employment County-Wide	Total Employment Category 3	Percent
1990	1,105,351	949,612	86%
1993	1,032,374	922,234	89%
2000	1,136,561	991,042	87%

130 MPH

Year	Total Employment County-Wide	Total Employment Category 3	Percent
1990	1,105,351	795,259	72%
1993	1,032,374	781,025	76%
2000	1,136,561	829,682	73%

The recovery effort to make the public transit service operational will be affected because a great percentage of MDTA employees will be affected by this scenario.

The hospitals affected in this scenario represent 91 percent of all the hospitals in Dade County. The nursing home and adult congregate living facilities represent 93 percent of the total.

Fifty-six percent of the mobile home parks will be affected in this scenario. Ninety-eight percent of the hurricane shelters will be impacted in this scenario.

One hundred percent of the inventoried intermodal centers will be impacted in this scenario. Ninety-five percent of the administrative centers will be affected. Ninety-one percent of the FP&L power substations will be impacted in this scenario.

In other words, Dade County will be severely affected if a hurricane hits Dade County as assumed in this scenario. Power loss is assumed and debris on the roadway system can be expected. Personnel inventory that will be affected represents 90 percent of the emergency personnel.

- 110 mph Band

The diameter that was assumed for a 110 mph sustained wind speed intensity is 19 miles. All the coverages inventoried were included in the analysis. The analysis shows the impact to be as follows:

- 327 centerline miles of streets with heavy vegetation
- 341 centerline miles of streets with light vegetation
- 4,469 power poles
- 202 guide signs on structures
- 1,645 traffic signals

- 21 Metrorail stations
- 21 Metromover stations
- 30 Intermodal center
- 9 Transportation Depots
- 5 Office of Emergency Management
- 35 Administrative centers
- 29 Hospitals
- 125 Nursing home and adult congregate living facilities
- 38 Mobile home parks
- 62 Hurricane shelters
- 83 FP&L power substations
- 48 Fire stations
- 9 Police stations
- 30 Radio stations
- 30 TV stations
- 2 Armories
- 41 Agency facility

Some major streets that will be affected in this scenario due to roads side trees and foliage are: South Dixie Highway, SR 874 between 87th Avenue and SR 826 and Krome Avenue. These roadway segments were identified to have heavy vegetation. The effects that the storm will have on those streets will be seen by extensive debris clearing and removal efforts and traffic detours will need to be implemented to move around the potential street/highway blockage.

A total of 248 guide signs on structures were inventoried. The total guide sign structures that will be impacted under this scenario is 202. Out of 202, 134 are overhead trusses, 48 are overhead cantilevers and 20 are butterfly mounts. Fifty-four percent of the affected guide signs will be overhead trusses. Nineteen percent of the signs will be overhead cantilevers. Finally, 8 percent will be butterfly mounts.

The total traffic signals affected in this scenario represent 80 percent of all the traffic signals in Dade County. Out of the 1,645, 859 are wire-strand installations. This represents 42 percent of the total traffic signals. Twenty-nine percent of the signals will be mast-arm rigid installation, which represents 609 traffic signals and 8½ percent will be mast-arm dangling installations, which represents 175 traffic signals. Two pedestal type signal installation will be located in the storm impact area. Poor traffic control will be experienced in the intersections because of the wind damage to signal heads, especially on the wire-strand installation type.

An analysis of the population and employment that may be affected on this model storm was performed (see Tables 7-3 and 7-4). The findings are the following:

- 1,491,456 population for 1990 would have resided in the storm model area of impact. This represents 77 percent of the total county-wide population;

- 1,573,620 population for 1993 would have resided in the impact area. This represents 19 percent of the total; and

- 1,714,585 population is projected for year 2000. This represents 77 percent of the total county-wide population.

The analysis on employment data is the following:

- 949,612 employment for 1990 were located in the model storm 110 mph band. This represents 86 percent of the county-wide employment;

- 922,234 employment for 1993. This represents 89 percent of the total; and

- 991,042 employment for year 2000 will be located in the impact area for the model storm. This represents 87 percent of the total county-wide employment.

The analysis shows that 83 percent of the hospitals will be located in the impact area. The nursing homes represent 77 percent of the total inventory.

Forty-six percent of the mobile home parks will be affected in this scenario. Seventy-nine percent of the hurricane shelters will be impacted in this scenario.

Eighty-seven percent of the administrative centers are located in the impact area. Ninety-four percent of the intermodal centers are located in the scenario.

Seventy-two percent of the FP&L power substations will be in the impact area.

Sixty percent of the MDTA emergency personnel will reside in the impact area. The number of employees that will be affected is 711 persons. Out of the 711, 34 are managers, 26 are essential employees, 321 are bus drivers assigned to the Central garage, 224 are bus drivers working out of the Coral Way garage and 106 are bus drivers working out of the Northeast garage.

Sixty-three percent of FDOT personnel will reside in the model storm 110 mph band path. This represents 7 persons; 5 are managers and 2 are essential employees.

Finally, seventy-five percent of the DCPW Department emergency personnel will be affected under this scenario. This represents 79 persons which will be divided into 19 managers and 60 essential employees.

- 130 mph Band

The diameter assumed for the maximum sustained wind speed of 130 mph is 13 miles. Under this area, the analysis shows the impact on the following elements of the transportation systems, support services, other infrastructure elements potentially contributing to evacuation flows, and other significant elements.

- 249 centerline miles of streets with heavy vegetation
- 239 centerline miles of streets with light vegetation
- 3,566 power poles
- 162 guide signs on structure
- 1,289 traffic signals
- 19 Metrorail stations
- 21 Metromover stations
- 8 Transportation Depots
- 28 Intermodal center
- 5 Office of Emergency Management
- 26 Administrative centers
- 27 Hospitals
- 105 Nursing home and adult congregate living facilities
- 34 Mobile home parks
- 41 Hurricane shelters
- 64 FP&L power substations
- 36 Fire stations
- 6 Police stations
- 28 Radio stations
- 27 TV stations
- 1 Armory
- 32 Agency facilities

The mileage of streets that are heavily vegetated and probably affected were calculated. Some examples of facilities which may be expected to be affected are the following: S.W. 56th Street or Miller Drive, N.W. 107th Avenue, some sections of Okeechobee Road and the areas surrounded by Miami Lakes.

Sixty-five percent of the guide signs on structure that are affected are overhead trusses, which represent 108 overhead truss guide signs. Seventeen percent are overhead cantilevers, which represents 41 overhead cantilever guide signs. Finally, 5 percent will be butterfly mount signs located in median, which represents 13 butterfly guide signs.

A total of 63 percent of all the traffic signals will be impacted in this scenario. Out of the 1,289, 702 are wire-strand installations, 421 are mast-arm rigid installations, 164 are mast-arm dangling installations and 2 are pedestal type signal installation. It can be expected that 702 intersections will remain uncontrolled due to the damage to the signal heads on the wire-strand installation types. This will imply that temporary stop signs will be needed at this location or that the signal will need to be controlled manually by personnel stationed at the intersection.

The analysis shows that population that will reside in the 130 mph band of this model storm is the following (see Table 7-3):

- For year 1990, 1,128,841, which represents 58 percent of the total county-wide population;
- For year 1993, 1,191,623, which represents 61 percent of the total county-wide population; and
- For year 2000, 1,261,624, which represents 57 percent of the total county-wide population.

A similar analysis was performed using the employment information and the results are (see Table 7-4):

- For year 1990, 795,259 employments were located in the model storm area and represents 72 percent of the total county-wide employment;
- For year 1993, 781,025, which represents 76 percent of the total county-wide employment; and
- For year 2000, 829,682, which represents 73 percent of the total county-wide employment.

Sixty-five percent of the administrative centers are located within the impact area. Eighty-eight percent of the intermodal center will be located in the area.

Seventy-seven percent of hospitals will be located in the impact area. Sixty-five percent of the nursing homes will be located in the track area.

Fifty-five percent of the FP&L power substations will be in the impact area.

Fifty-five percent of the mobile home parks will reside in the impact area.

Fifty-three percent of the shelters will be impacted by the assumed storm track's 130 mph band.

The emergency personnel information was evaluated. It was found that 45 percent of the MDTA personnel will reside in the impact area. This represents a total of 524 employees. Out of the 524, 15 are managers, 21 are essential employees, 257 are bus drivers working out of the Central garage, 191 are bus drivers working out of the Coral Way garage and 40 are bus drivers assigned to the Northeast garage.

Six FDOT emergency services personnel will reside in the impact area. Out of the 6, 5 are managers and 1 is an essential employee.

Fifty-eight percent of DCPW Department employees will be located within the impact area. This represents 61 employees. Out of 61, 12 are managers and 49 are essential employees.

Between the three bandwidths for damaging winds in a Category 3 storm that will cross central Dade County, the largest affected area will be that of the 75 mph band. This band is 29 miles wide and will affect a great portion of the county, even if the sustained winds are not as severe.

It can be expected that severe damages will be produced at a windspeed higher than 110 mph because the South Florida Building Code is based on a 110 mph wind load.

7.2.2 Scenario 2 - Parallel Storm Track

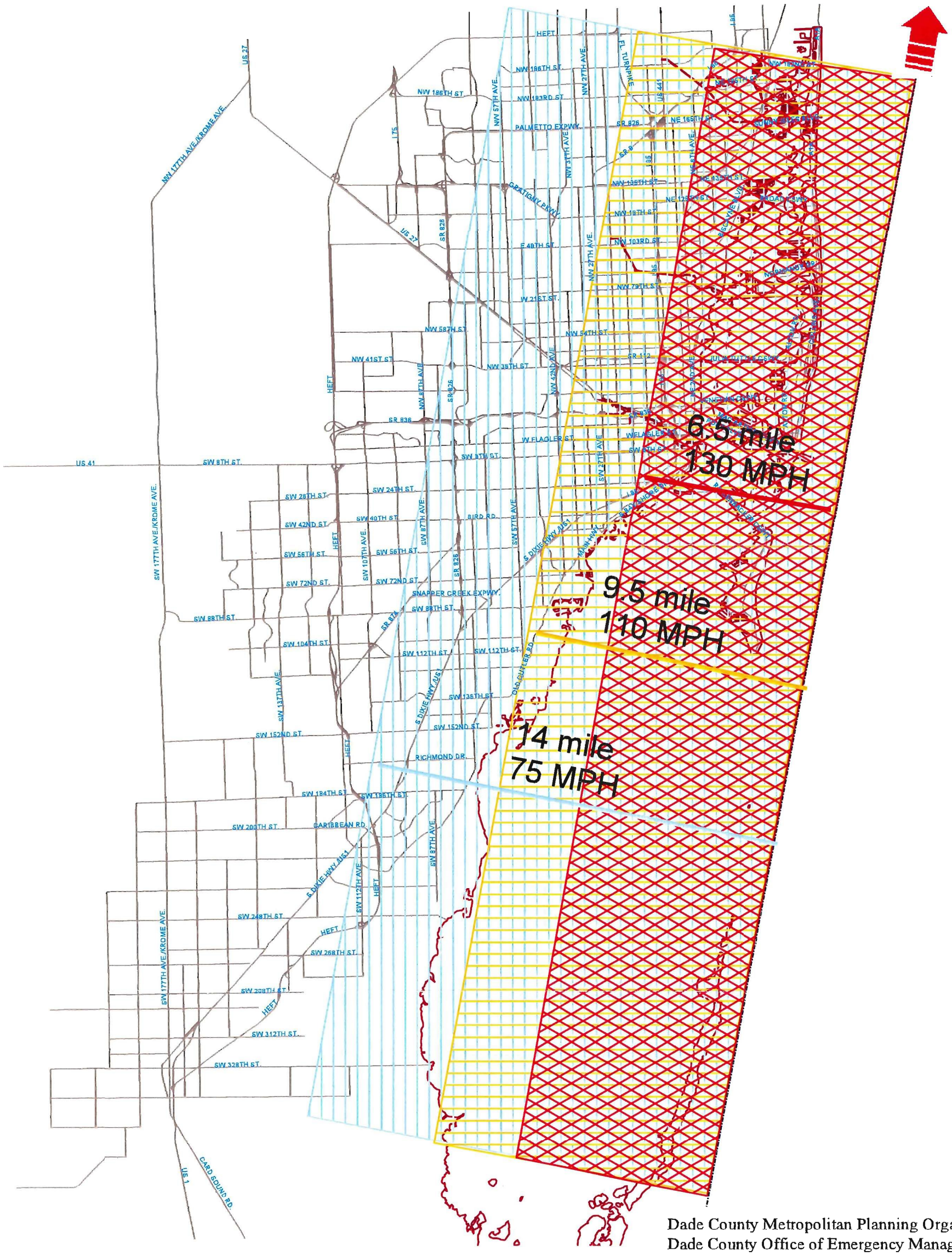
A parallel storm track was analyzed for a hypothetical Category 3 storm. The storm assumes a coastline-paralleling course to the northeast, just offshore of Elliott Key, Key Biscayne and Miami Beach. The path of the center of the storm is assumed to be 6.5 miles offshore from the coast. Three wind speed intensity susceptibilities were evaluated and the impact that this scenario will have is explained in detail in the next paragraph.

Figure 7-3 illustrates the storm track.

- 75 mph Band

The distance from the centerline of the eye wall for a 75 mph band is estimated to be 17.5 miles. The transportation components and human resources were evaluated under this scenario. The findings are as follows:

Hurricane Impact Analysis - Category 3 Scenario II



Dade County Metropolitan Planning Organization
Dade County Office of Emergency Management
Figure 7-3

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- 263 centerline miles of streets with heavy vegetation
- 344 centerline miles of streets with light vegetation
- 4,504 power poles
- 194 guide signs on structures
- 1,638 traffic signals
- 21 Metrorail stations
- 32 Intermodal centers
- 21 Metromover stations
- 9 Transportation Depots
- 6 Offices of Emergency Management
- 35 Administrative centers
- 29 Hospitals
- 133 Nursing home and adult congregate living facilities
- 38 Mobile home parks
- 47 Hurricane shelters
- 87 Florida Power & Light power substations
- 51 Fire stations
- 8 Police stations
- 37 Radio stations
- 28 TV stations
- 3 Armories
- 40 Agency facilities

The roadway debris will cause roadway blockage and traffic detours may be needed to clear the sites. Some of the roads that will be affected because of heavy vegetation are: Old Cutler Road, South Dixie Highway, Miller Drive/S.W. 56th Street, and roads in the Miami Beach area.

The guide signs on structures impacted represent 78 percent of the total. Out of 194, 123 are overhead trusses, 51 are overhead cantilevers and 20 are butterfly mount signs located in the

median of divided expressways. The impact that the downed signs will have on the roadway network will create lane closures decreasing the capacity of the roads.

The traffic signals that will be affected in this scenario represent 80 percent of all the traffic signals inventoried as part of this study. Out of 1,638, 915 are wire strand installations, 542 are mast-arm rigid installations, 179 are mast-arm dangling installations and 2 are pedestal type signal installations. As previously mentioned, the wire-strand installations will not withstand a Category 1 storm because the signal heads will be destroyed, making the intersections inoperable even with restoration of power. These locations will be uncontrolled, adding to traffic chaos.

The administrative centers that will be located in the 75 mph band path represent 88 percent of the total. All the intermodal centers inventoried in this study will be affected under this scenario.

The Metrorail station structures that will be impacted represent 100 percent of all the structures in Dade County. The Metromover stations represent 100 percent of the total.

Eighty-three percent of the hospitals will be located in the impact area. Eighty-two percent of the nursing homes and ACLF will be located in the storm area.

The mobile home parks that are situated in the storm track represent 61 percent of all the mobile home parks in Dade County. The hurricane shelters represent 60 percent of the inventory data.

Seventy-five percent of the power substations will be impacted in this scenario.

The human resources impact can be expressed as follows:

- Seventy-four percent of the county-wide population for year 1990 resided in the storm track's 75 mph band path's scenario.

- Seventy-four percent of the county-wide population for year 1993 were situated in the 75 mph wind impact area.

- Sixty-seven percent of the county-wide population for year 2000 is anticipated to live in the impact area.

- Eighty-six percent of the county employment for year 1990 located in the area.

- Eighty-eight percent of the county-wide employment for year 1993 was established in the impact area.

- Eighty-seven percent of the county-wide employment for year 2000 is estimated to be located in the storm impact area.

Tables 7-5 and 7-6 illustrate the population and employment analysis results.

Seventy-eight percent of the MDTA emergency personnel is found to be located in the impact area. Out of 917, 28 are managers, 27 are essential employees, 388 are bus drivers assigned to the Central garage, 147 are bus drivers assigned to the Coral Way garage and 327 are assigned to the Northeast garage. MDTA is one of the largest county departments which provides transportation services to the communities. The impacts that a storm will have on the county personnel will affect the restoration of transportation mobility in a post-storm situation.

Forty-five percent of the FDOT personnel assigned for emergency operation will be affected under this scenario. All the five persons are managers. This impact may affect the restoration of the state highway system during the post-storm efforts.

Fifty-three percent of DCPW Department personnel will be impacted in this storm scenario. Of the 56, 20 are managers and 236 are essential employees. The DCPW department controls and

TABLE 7-5

Category 3 Hurricane
Parallel Scenario
Affected Population

75 MPH

Year	Total Population County-Wide	Total Population Category 3	Percent
1990	1,937,097	1,423,925	74%
1993	1,952,355	1,448,523	74%
2000	2,221,337	1,494,381	67%

110 MPH

Year	Total Population County-Wide	Total Population Category 3	Percent
1990	1,937,097	816,687	42%
1993	1,952,355	858,450	44%
2000	2,221,337	863,493	39%

130 MPH

Year	Total Population County-Wide	Total Population Category 3	Percent
1990	1,937,097	440,979	23%
1993	1,952,355	470,078	24%
2000	2,221,337	469,839	21%

TABLE 7-6

Category 3 Hurricane
Parallel Scenario
Affected Employment

75 MPH

Year	Total Employment County-Wide	Total Employment Category 3	Percent
1990	1,105,351	955,573	86%
1993	1,032,374	905,734	88%
2000	1,136,561	989,216	87%

110 MPH

Year	Total Employment County-Wide	Total Employment Category 3	Percent
1990	1,105,351	550,120	50%
1993	1,032,374	541,056	52%
2000	1,136,561	575,292	51%

130 MPH

Year	Total Employment County-Wide	Total Employment Category 3	Percent
1990	1,105,351	350,690	32%
1993	1,032,374	345,860	34%
2000	1,136,561	366,922	32%

maintains the traffic signals in Dade County. The lack of personnel to restore the traffic signals will impact the post-storm resumption of services.

- 110 mph Band

A parallel storm track to the coastline was evaluated for a Category 3 storm. This band was assumed to extend 9.5 miles from the centerline path of the storm.

The analysis shows that the following transportation elements will be impacted under this scenario:

- 159 centerline miles of streets with heavy vegetation
- 173 centerline miles of streets with light vegetation
- 2,583 power poles
- 117 guide signs on structures
- 1,051 traffic signals
- 17 Intermodal centers
- 4 Transportation Depots
- 4 Offices of Emergency Management
- 225 Administrative centers

The guide signs on structures represent 47 percent of the total inventory. Out of 117, 73 are overhead trusses, 34 are overhead cantilevers and 10 are butterfly mount signs.

The traffic signals represent 51 percent of the signals inventoried as part of this study. Out of 1,051, 573 are wire-strand installations, 326 are mast-arm rigid installations, 150 are mast-arm dangling installations and 2 are pedestal type signal installations.

Fourteen Metrorail stations will be impacted in this 110 mph band scenario. This represents 66 percent of the total.

Twenty-one Metromover stations will be located in the storm scenario which represent all of the stations.

Sixty-three percent of the administrative centers are located in the impact area. Fifty-three percent of the intermodal centers are placed in the storm 110 mph band area.

Forty-five percent of the fire stations are situated in the impact area. Twenty-three percent of the police stations are located in the 110 mph band for this scenario.

Fifty-seven percent of the agency facilities surveyed are located in the area of impact. Seventy-five percent of the armories are located in the impact area.

Thirty-five percent of the hurricane shelters are located in the 110 mph band area. Thirty-four percent of the mobile home parks are located in the impact area.

Fifty-seven percent of the Offices of Emergency Management are located in this scenario.

Fifty-two percent of the hospitals will be impacted under this scenario. Thirty-eight percent of the nursing homes and ACLF are located in the path of 110 mph winds for this storm.

Thirty-seven percent of the Florida Power & Light power substations are located in the band.

The analysis shows that 42 percent of the county-wide population for year 1990 was located in the 110 mph impact area. Forty-four percent of the county-wide population for year 1993 resided in the impact area. Thirty-nine percent of the county-wide population will be living in the storm track area (see Table 7-5).

The employment for year 1990 represented 50 percent of the county-wide employment. For year 1993, the employment represented 52 percent of the county-wide employment. For year 2000, the employment that will be impacted under this scenario represents 51 percent of the county-wide employment (see Table 7-6).

The personnel assigned for emergency operation for MDTA, FDOT and DCPW Department was analyzed for impact under this scenario.

The personnel from MDTA that will be affected represent 43 percent of the emergency work force. Out of the 505, 9 are managers, 7 are essential employees, 260 are bus drivers working out of the Central garage, 52 working out of the Coral Way garage and 177 working out of the Northeast garage.

The FDOT will have two of their personnel impacted under this scenario, representing 18 percent of the emergency personnel. These two persons are categorized as managers.

The DCPW Department will have 22 percent of the emergency personnel affected by this scenario. Out of the 23, 6 are managers and 17 are essential employees.

- 130 mph Band

The bandwidth assumed for 130 mph wind is 6.5 miles from the centerline of the storm path.

Under this parallel storm track scenario, the analysis shows that the following components of the transportation system will be impacted:

- 97 centerline miles of streets with heavy vegetation
- 72.9 centerline miles of streets with light vegetation
- 1,426 power poles

- 55 guide signs on structures
- 637 traffic signals
- 5 Metrorail stations
- 21 Metromover stations
- 2 Transportation Depots
- 6 Intermodal centers
- 3 Office of Emergency Management
- 22 Administrative centers
- 8 Hospitals
- 38 Nursing home and adult congregate living facilities
- 9 Mobile home parks
- 5 Hurricane shelters
- 25 Florida Power & Light power substations
- 19 Fire stations
- 2 Police stations
- 9 Radio stations
- 16 TV stations
- 2 Armories
- 14 Agency facilities

At 130 mph, it can be expected that roadside foliage will be severely impacted. Some of the roadways that were inventoried as high vegetation areas are the following: Old Cutler Road, South Dixie Highway and the Miami Beach areas. These segments are examples of roadways that will be affected by debris. Locations such as these will need special attention in the recovery effort for cleanup.

Guide signs on structures impacted under this scenario represent 22 percent of the total inventoried guide signs for this study. Out of 55, 36 are overhead trusses, 17 are overhead cantilevers and 2 are butterfly mount signs located in the median.

The traffic signals affected under this storm track represent 31 percent of the traffic signals inventoried in the study. Out of 637, 342 are wire strand installations, 217 are mast-arm rigid installations, 76 are mast-arm dangling installations and 2 are pedestal type signal installations.

Five Metrorail stations are located in the scenario. This represents 24 percent of the stations in Dade County. All 21 Metromover stations are located in the impact area.

Fifty-five percent of the administrative centers are located in the scenario analyzed. Eighteen percent of the intermodal centers, and 17 percent of the depots are located in the impact area.

Six percent of the hurricane shelters will be affected in this scenario. Fifteen percent of the mobile home parks will be impacted. Forty-three percent of the Offices of Emergency Management are located in the storm track's 130 mph wind band.

Twenty-three percent of the hospitals and twenty-four percent of the nursing homes and ACLF will be affected under this scenario.

Twenty-two percent of the Florida Power & Light power substations are located in the 130 mph band's path.

Thirty percent of the fire stations and fifteen percent of the police stations are situated in the impact zone.

Twenty-nine percent of the agency facilities surveyed are located in the scenario.

The radio stations affected represent twenty-four percent of all the stations in Dade County. The TV stations represent forty-seven percent of all the stations in the county.

Population and employment data by traffic analysis zones considered in the analysis show that twenty-three percent of the county-wide population resided in the 130 mph impact area for year 1990. For year 1993, it represented twenty-four percent. Finally, for projection year 2000, it is estimated that twenty-one percent of the county-wide population will reside in the impact area for the parallel scenario analyzed (see Table 7-5).

The employment data shows that thirty-two percent of the county-wide employment for year 1990 would have been located in the impact area. For year 1993, it represented thirty-four percent. For year 2000, the employment residing in the impact area represents thirty-two percent of the county-wide employment. (see Table 7-6).

The personnel assigned to emergency operation for MDTA that will be impacted in the scenario represents 9 percent of all the assigned personnel. Out of 109, 2 are managers, 2 are essential employees, 52 are bus drivers assigned to the Central garage, 10 are bus drivers assigned to the Coral Way garage and 43 are bus drivers working out of the Northeast garage.

One person (9 percent) from FDOT emergency personnel will be impacted under this scenario; the person is classified as a manager.

Seven percent of DCPW Department emergency personnel will be affected under this scenario. Of these 8, 3 are managers and 5 are essential employees.

Under this scenario the transportation work force number will not be impacted as severely as the 75 mph sustained winds. At 110 mph, most of the structures may be affected because the old South Florida Building Code is based on this wind load limit for the design criteria. At 130 mph it can be expected that most of the structures will be damaged or destroyed.

The analysis shows that the most devastating scenario will be a storm oriented through the central part of the county versus the parallel scenario.

The parallel scenario will affect the coastal areas. The storm across central Dade County will impact not only the coastal area but the inland area, making this scenario a worse-case scenario.

7.3 CATEGORY 5 STORM

7.3.1 Scenario 1 - Storm Track Across Central Dade

This scenario assumes a 10-degree angle orientation for a hypothetical Category 5 storm. The bandwidth for 75 mph winds is estimated to be 35 miles, which represents most of Dade County. Impact will occur from NW. 196th Street to S.W. 268th Street as shown in Figure 7-4. This is the worst-case scenario: Category 5, central track.

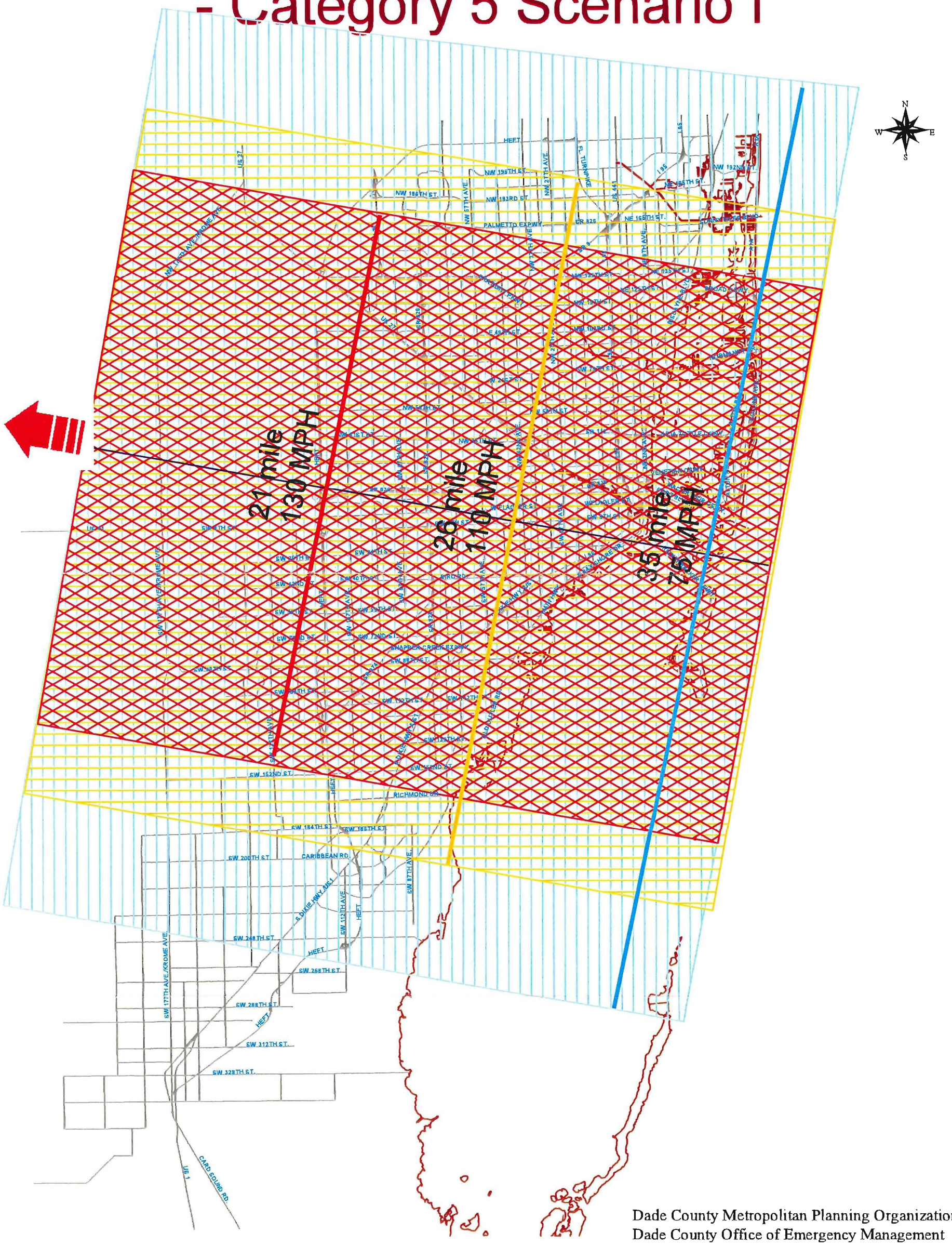
The bandwidth for 110 mph is estimated to be 26 miles and the bandwidth for 130 mph is calculated to be 21 miles. The transportation elements that will be affected under this scenario were evaluated for 110 mph and 130 mph wind speed. It is considered that at 155 mph, most of Dade County infrastructure will be unoperational; therefore, an analysis was not produced.

- 110 mph Band

The analysis shows that the following elements of the transportation systems, support services, other infrastructure elements potentially contributing to evacuation flows, and other significant elements will be affected under this scenario and are as follows:

- 375 centerline miles of streets with heavy vegetation
- 399 centerline miles of streets with light vegetation
- 5,111 power poles
- 225 guide signs on structures
- 1,871 traffic signals
- 21 Metrorail stations

Hurricane Impact Analysis - Category 5 Scenario I



Dade County Metropolitan Planning Organization
Dade County Office of Emergency Management
Figure 7-4

Dade County Transportation System
Hurricane Emergency Preparedness Study

PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.

METRO-DADE

- 21 Metromover stations
- 10 Transportation Depots
- 32 Intermodal centers
- 6 Office of Emergency Management
- 37 Administrative centers
- 32 Hospitals
- 145 Nursing home and adult congregate living facilities
- 43 Mobile home parks
- 73 Hurricane shelters
- 99 Florida Power & Light power substations
- 56 Fire stations
- 10 Police stations
- 32 Radio stations
- 34 TV stations
- 4 Armories
- 44 Agency facilities

Some of the major roads that will be blocked because of downed trees and debris are: S.W. 177th Avenue/Krome Avenue, Old Cutler Road, HEFT (between N.S. 58th Street and N.W. 108th Street) and roads in the Miami Beach areas.

The guide signs on structures that will be damaged under this scenario represent 90 percent of the total guide signs inventoried. Out of 225, 143 are overhead trusses, 58 are overhead cantilevers and 9 are butterfly mount signs.

Ninety-one percent of the traffic signals will be impacted under this scenario. Out of 1,871, 967 are wire strand installations, 715 are mast-arm rigid installations, 187 are mast-arm dangling installations and 2 are pedestal type signal installations. As previously mentioned, severe damage can be expected and in some cases, destruction to the signal heads. The wire strand design

cannot withstand not even a Category 1 hurricane. At 110 mph, it can be expected that most of the signals will be unoperational. Power losses will be experienced, making intersections uncontrolled, contributing to post-storm traffic jams, hampering response.

All Metrorail and Metromover stations will be impacted under this scenario.

Ninety-three percent of the administrative centers will suffer damage under this scenario. One hundred percent of the intermodal centers are located in the impact area. Eighty-six percent of the Offices of Emergency Management will be affected under this case. Eighty-three percent of the transportation depots will be located in the impact area.

The impact on the hurricane shelters will represent 94 percent of the total. The mobile home parks will represent 69 percent of all the mobile home parks inventoried in the study.

Eighty-five percent of the power substations will be impacted, causing power loss. This implies that most of Dade County will be without power.

No television stations will be operational since all of them reside in the storm path. Eighty-four percent of the radio stations will be impacted under this scenario.

Ninety-one percent of the hospitals are located in the impact area. Ninety percent of the nursing home facilities are located in the damage area.

Eighty-eight percent of the fire stations and seventy-seven percent of the police stations are located in the area analyzed.

The population and employment impact was evaluated for this scenario. It was found that 90 percent of the county-wide population for year 1990 resided in the impact area. For year 1993,

92 percent were located in the storm track's impact coverage. Finally, for year 2000, 90 percent of the county-wide population will live in the impact area. The results are shown in Table 7-7.

The employment data shows that 94 percent of the county-wide employment for year 1990 was located in the storm area. For year 1993, 96 percent were situated within the impact area. For year 2000, it is expected that 95 percent of all the county employment will be located in the impacted area. The results are shown in Table 7-8.

If a hurricane hits Dade County, as simulated under this scenario, 90 percent of the population and 95 percent of the employment will be impacted.

The impact on the transportation personnel assigned to emergency use is very important. It was found that 84 percent of the MDTA emergency personnel will be affected under this scenario. Out of the 993, 48 are managers, 39 are essential employees, 385 are bus drivers assigned to the central garage, 268 are bus drivers working out of the Coral Way garage and 253 are bus drivers using the northeast garage. It is estimated that 75 percent of the bus drivers will be affected under this scenario.

The FDOT will have 81 percent of the emergency personnel affected by the storm under analysis. Out of the 9, 7 are managers and 2 are essential employees.

DCPW Department will have 88 percent of the emergency people impacted during this scenario. Out of the 92, 25 will be managers and 67 will be essential employees.

- 130 mph Band

The analysis shows that the following transportation system elements will be affected under this scenario:

TABLE 7-7

Category 5 Hurricane
Storm Track Across Central Dade
Affected Population

110 MPH

Year	Total Population County-Wide	Total Population Category 5	Percent
1990	1,937,097	1,739,351	90%
1993	1,952,355	1,799,461	92%
2000	2,221,337	2,007,059	90%

130 MPH

Year	Total Population County-Wide	Total Population Category 5	Percent
1990	1,937,097	1,500,165	77%
1993	1,952,355	1,571,263	80%
2000	2,221,337	1,725,479	78%

TABLE 7-8

Category 5 Hurricane
Storm Track Across Central Dade
Affected Employment

110 MPH

Year	Total Employment County-Wide	Total Employment Category 5	Percent
1990	1,105,351	1,033,732	94%
1993	1,032,374	989,823	96%
2000	1,136,561	1,073,846	94%

130 MPH

Year	Total Employment County-Wide	Total Employment Category 5	Percent
1990	1,105,351	550,120	86%
1993	1,032,374	541,056	89%
2000	1,136,561	575,292	87%

- 323 centerline miles of streets with heavy vegetation
- 356 centerline miles of streets with light vegetation
- 4,486 power poles
- 201 guide signs on structures
- 1,658 traffic signals
- 21 Metrorail stations
- 21 Metromover stations
- 10 Transportation Depots
- 30 Intermodal centers
- 5 Office of Emergency Management
- 35 Administrative centers
- 30 Hospitals
- 125 Nursing home and adult congregate living facilities
- 62 Hurricane shelters
- 38 Mobile home parks
- 87 Florida Power & Light power substations
- 50 Fire stations
- 9 Police stations
- 29 Radio stations
- 29 TV stations
- 3 Armories
- 42 Agency facilities

Under this scenario it is expected that most of the roads in Dade County that are heavily vegetated will be impacted with downed trees and debris. As an example, some of the roads are: sections of Okeechobee Road, South Dixie Highway, N.E. 185th Street and areas north of Miami Beach. These roads are expected to create traffic chaos because they will be closed to traffic.

The guide signs on structures represent 81 percent of the total guide signs inventoried. Out of 201, 136 are overhead trusses, 47 are overhead cantilevers and 18 are butterfly mount signs.

The traffic signals that will be impacted under this scenario represent 80 percent of the traffic signals inventoried in the study. Out of 1,658, 865 are wire strand installations, 613 are mast-arm rigid installations, 178 are mast-arm dangling installations and 2 are pedestal type signal installation. At 130 mph, virtually all signals will be damaged or destroyed, making the street system a traffic chaos because of the uncontrolled operation. Traffic detours will be implemented to avoid these areas.

All existing Metromover and Metrorail stations will be located in the impact area.

Eighty-eight percent of the administrative centers located within the study area will be impacted under this scenario. Ninety-four percent of the intermodal centers, and 71 percent of the Offices of Emergency Management will be affected under a storm track like this one. Eighty-three percent of the transportation depots will be impacted.

The hospitals located in the impact area represent eighty-six percent of all Dade County hospitals. The nursing homes affected represent seventy-seven percent of the total.

Seventy-five percent of the power substations will be located in the impact area. This implies that seventy-five percent of the power stations will not be operational.

The fire stations that will be impacted under this scenario represent seventy-eight percent of the fire stations inventoried in the study.

Sixty-nine percent of the police stations are situated in the 130 mph storm impact area.

The employment and population data was evaluated and it was found that (see Tables 7-7 and 7-8):

- 77 percent of the county-wide population for year 1990 resided in the impact area.
- 80 percent of the county-wide population for year 1993 were located in the storm area.
- 78 percent of the county-wide population for year 2000 will live in the storm area.
- 86 percent of the county-wide employment for year 1990 were located in the impact area.
- 89 percent of the county-wide employment for year 1993 were located in the storm track area.
- 87 percent of the county-wide employment for year 2000 will be located in the impact area.

The emergency personnel of the transportation sector were analyzed. It was found that 60 percent of MDTA emergency personnel live in the impact area. Out of 703, 37 are managers, 27 are essential employees, 316 are bus drivers working out of the Central garage, 238 are bus drivers working out of the Coral Way garage and 85 are bus drivers assigned to the Northeast garage.

Eight employees of FDOT assigned for emergency response will be impacted under this scenario. This represents 73 percent of emergency personnel. Out of the 8, 6 are managers and 2 are essential employees.

The DCPW Department will have 77 percent of the emergency personnel affected by the storm. Out of the 81, 20 are managers and 61 are essential employees.

7.3.2 Scenario 2 - Parallel Storm Track

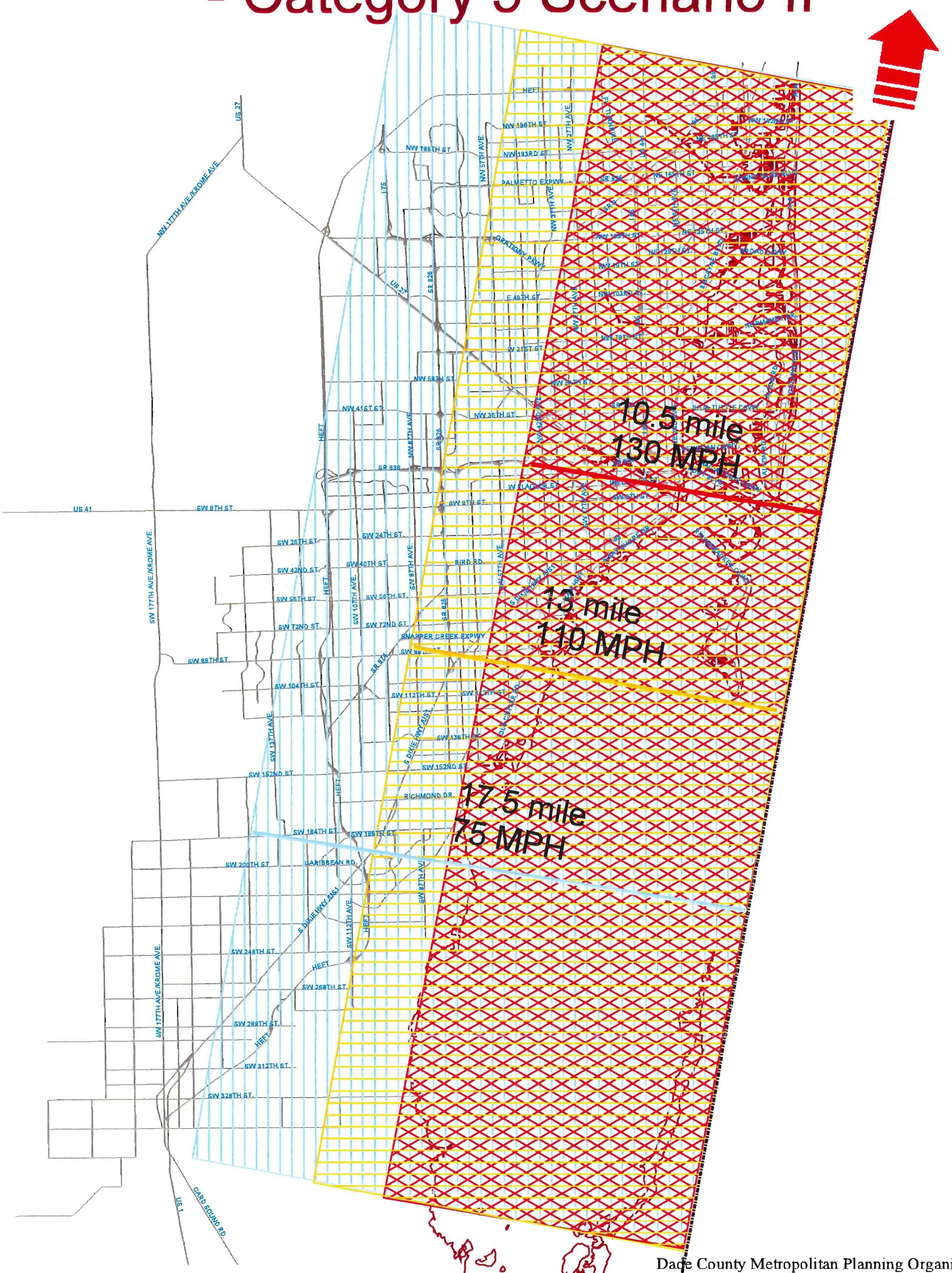
Under this scenario it is assumed that the storm is paralleling the coastline and moving to the northeast, just offshore of Elliott Key, key Biscayne and Miami Beach. Figure 7-5 illustrates the storm track and wind bandwidth cross-sections.

- 110 mph Band

The analysis shows that the following elements will be impacted under this scenario and are the following:

- 241 centerline miles of streets with heavy vegetation
- 308 centerline miles of streets with light vegetation
- 3,950 power poles
- 163 guide signs on structures
- 1,508 traffic signals
- 21 Metrorail stations
- 21 Metromover stations
- 6 Transportation Depots
- 32 Intermodal centers
- 5 Office of Emergency Management
- 35 Administrative centers
- 27 Hospitals
- 125 Nursing home and adult congregate living facilities
- 31 Mobile home parks
- 43 Hurricane shelters

Hurricane Impact Analysis - Category 5 Scenario II



Dade County Metropolitan Planning Organization
Dade County Office of Emergency Management
Figure 7-5

PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Dade County Transportation System
Hurricane Emergency Preparedness Study

METRO-DADE

- 76 Florida Power & Light power substations
- 6 Police stations
- 46 Fire stations
- 34 Radio stations
- 26 TV stations
- 3 Armories
- 31 Agency facilities

The analysis shows that in this scenario the following roads can be expected to have downed trees and a large amount of roadside foliage: Old Cutler Road, South Dixie Highway, MacArthur Causeway, Biscayne Boulevard, N.W. 37th Avenue and S.W. 57th Avenue. These are some examples of which roads can be expected to need detours in order to circumvent the blockage sites.

Guide signs on structure represent 65 percent of the inventory. Of 163 affected, 104 are overhead trusses, 42 are overhead cantilevers and 17 are butterfly mount signs.

Traffic signals affected represent 73 percent of all the traffic signals inventoried in the study. Out of 1,508, 861 are wire strand installations, 476 are mast-arm rigid installations, 169 are mast-arm dangling installations and 2 are pedestal type signal installations. This information will enable transportation and emergency management planners to estimate potential damage and the number of downed signals that will be destroyed and need repair or replacement. In addition, the number of uncontrolled intersections can be forecast and precautions can be made such as manually controlling key intersections to help alleviate traffic chaos.

All the Metromover and Metrorail stations are located in the impact area.

Eighty-three percent of the administrative centers will be impacted with this scenario. All the intermodal centers were located in the area of impact. Fifty percent of the depots are situated in the area swept by 110 mph winds.

The Offices of Emergency Management located in the 110 mph bandwidth area represent 72 percent of all such offices in Dade County.

The hospitals and nursing homes that will be affected under this scenario represent 77 percent of the inventory in Dade County.

Fifty-five percent of the hurricane shelters and fifty percent of the mobile home parks are located in the 110 mph impact area.

The power substations that will be located in the impact area represent 66 percent of all the stations in Dade County.

Table 7-9 shows the results on the population impact under this scenario. It was found that 65 percent of the 1990 population were affected; 66 percent of the 1993 population were living in the storm area and 60 percent will be residing in the impact area.

Table 7-10 shows the impact that employment will have under this scenario. It was found that 76 percent of the county-wide employment for 1990 was located in the area. For 1993, 77 percent of the employment was affected. Projection shows that for year 2000 it is estimated that 76 percent of the county-wide employment will be located in the 110 mph bandwidth.

The personnel assigned for emergency operation for MDTA, FDOT and DCPW Department were evaluated. It was found that 73 percent of MDTA personnel will live in the storm area. Out of the 853, 27 are managers, 23 are essential employees, 368 are bus drivers working out of the

TABLE 7-9

Category 5 Hurricane
Parallel Scenario
Affected Population

110 MPH

Year	Total Population County-Wide	Total Population Category 5	Percent
1990	1,937,097	1,262,234	65%
1993	1,952,355	1,290,164	66%
2000	2,221,337	1,324,171	60%

130 MPH

Year	Total Population County-Wide	Total Population Category 5	Percent
1990	1,937,097	925,159	48%
1993	1,952,355	966,320	50%
2000	2,221,337	975,251	44%

TABLE 7-10

Category 5 Hurricane
Parallel Scenario
Affected Employment

110 MPH

Year	Total Employment County-Wide	Total Employment Category 5	Percent
1990	1,105,351	838,382	76%
1993	1,032,374	799,632	77%
2000	1,136,561	869,063	76%

130 MPH

Year	Total Employment County-Wide	Total Employment Category 5	Percent
1990	1,105,351	660,089	60%
1993	1,032,374	647,164	63%
2000	1,136,561	689,691	61%

Central garage, 115 are bus drivers working out of the Coral Way garage and 320 are assigned to the Northeast garage.

Five persons from FDOT will be affected. All of them have a manager position. This represents 45 percent of the emergency personnel.

DCPW Department will have 49 people situated in the impact area. Out of these, 17 are managers and 32 are essential employees. This represents 46 percent of the emergency personnel.

- 130 mph Band

The analysis for the 130 mph wind bandwidth was evaluated. The analysis shows that the following transportation systems, support services, other infrastructure elements potentially contributing to evacuation flows, and other significant elements will be affected:

- 177 centerline miles of streets with heavy vegetation
- 211 centerline miles of streets with light vegetation
- 3,014 power poles
- 125 guide signs on structures
- 1,180 traffic signals
- 17 Metrorail stations
- 21 Metromover stations
- 4 Transportation Depots
- 21 Intermodal centers
- 4 Office of Emergency Management
- 25 Administrative centers
- 19 Hospitals
- 69 Nursing home and adult congregate living facilities
- 27 Mobile home parks

- 31 Hurricane shelters
- 54 Florida Power & Light power substations
- 4 Police stations
- 32 Fire stations
- 30 Radio stations
- 22 TV stations
- 3 Armories
- 31 Agency facilities

The guide signs on structures that will be impacted in this scenario represent 50 percent of the total guide signs inventoried as part of the study. Out of 125, 77 are overhead trusses, 37 are overhead cantilevers and 11 are butterfly mount signs located in median. The cleanup and removal of downed signs will be substantial, creating lane closure. In addition, personnel assigned to this operation may be impacted and may not be able to go back to work as soon as expected.

At 130 mph it can be expected that most of the signs will be damaged or destroyed because they are designed to withstand only 110 mph winds.

The traffic signals affected by the storm represent 58 percent of all the traffic signals inventoried as part of the study. Out of 1,180, 658 are wire-strand installations, 361 are mast-arm rigid installations, 159 are mast-arm dangling installations and 2 are pedestal type signal installations. This information is very helpful when inventorying the damage to the signal system. The location is identified in the GIS environment, making it easier for emergency planners to react and find solutions such as manually controlling key/principal intersections.

Eighty-one percent of the Metrorail stations are located in the storm track. All of the Metromover stations will be located in this storm track area.

The administrative centers that will be affected represent 63 percent of all centers inventories as part of this study. Sixty-six percent of the intermodal centers will be located in the impact area. Thirty-three percent of the transportation depots will be affected under this scenario.

The Offices of Emergency Management that are located in the storm path represent 57 percent of all the offices in Dade County.

Fifty-four percent of the hospitals will be located in the storm area. Forty-three percent of the nursing homes are located in this scenario.

The mobile home parks situated in the storm track represent 43 percent of the parks inventoried. The hurricane shelters in the impact area account for 40 percent of the shelters in the study area.

Forty-seven percent of the power substations are located in the storm path.

The analysis for the impact in population was found to be (see Table 7-9):

- For year 1990, 48 percent of the county-wide population lived in the area.
- For year 1993, 50 percent of the total population resided in the storm area.
- For year 2000, it is estimated that 44 percent of the county-wide population will live in the storm area.

The analysis for employment (see Table 7-10) shows the following:

- In year 1990, 60 percent of the county-wide employment was located in the area.
- In year 1993, 63 percent of the total employment was located in the storm path.

- In year 2000, it is estimated that 61 percent of the county-wide employment will be located in the storm impact area.

The analysis shows that 52 percent of MDTA, 18 percent of FDOT and 26 percent of DCPW Department personnel assigned for emergency operation will be affected under this scenario.

Six hundred and six people from MDTA will reside in the storm area. Out of these, 12 are managers, 11 are essential employees, 298 are bus drivers assigned to the Central garage, 63 are bus drivers working out of the Coral Way garage and 222 are bus drivers from the Northeast garage.

Two persons from FDOT will be affected and are categorized as managers.

Twenty-seven people from DCPW Department will be impacted. Out of these, 7 are managers and 20 are essential employees.

The Category 5 storm scenario will damage or destroy a great portion of Dade County. The analysis shows that for 110 mph the damage is abundant, but even though the 110 mph is not as wide as the 130 mph, it can be expected that the damages will be severe. The South Florida Building Code assumes a 110 mph wind load for design. Winds above this can expect to destroy or badly damage virtually all transportation system and general infrastructure elements.

Between the two scenarios, it can be said that a storm across central Dade County will cause more damage than one parallel to the coastline.

8.0 CONCLUSIONS

The GIS database developed during the inventory phase of this study was used to assist in the evaluation of the susceptibility of the inventoried transportation system resources to both storm surge and wind exposures. For each network element or facility that was considered, an assessment relative to storm surge exposure and wind damage exposure was made. For network elements, the assessment is necessarily more generalized, while the review of facilities or structures is more specific. Also, the assessment relative to storm surge impact is more evident because the surge atlas is relatively geographically precise. In contrast, the wind vulnerability is less definitive because this impact vector is not as easily predicted, and it is far more variable in its manifestation.

The development of a new hurricane storm surge atlas for Dade County was a major product of the Dade County Transportation System Hurricane Emergency Preparedness Study. This atlas illustrates a composite of the worst flooding that could occur for many different storm tracks and forward speeds. Potential flooding is shown for a Category 1, Category 3 and Category 5 hurricane intensities. Local officials should be reminded that any single hurricane will not produce the inland extent of flooding shown in the atlases; the area of maximum surge effect will be a function of a given storm's size, point of landfall and forward speed. The composite storm surge map is contained in Appendix 2A.

The analyses shows that the Miami International Airport (MIA) and the Kendall-Tamiami Executive Airport would be subject to storm surges for Category 3 and 5 hurricanes. It is recommended that the Aviation Department verify the first floor elevation of the buildings to determine if flooding will occur at these sites. The surge atlas shows that the runway at MIA will remain open because no storm surge is expected. However, the ability of the airport to maintain or restart operations will be a function of the specific conditions stipulated by Federal Aviation Administration Regulations, such as security fencing, extent of flooding, air traffic

control tower operations, condition of airfield lighting and signing, and condition of air traffic control equipment and navigation aid systems.

The wind vulnerability analysis shows that the buildings for the Miami International Airport meet the minimum requirements of the previous South Florida Building Code. It is recommended that during a hurricane the building/facilities not be occupied due to the extensive glass facades which do not appear to be adequate to withstand a Category 1 hurricane's wind forces. Of course, shuttering should be pursued where feasible to upgrade storm resistance.

The storm surge analysis shows that most of the facilities at the Port of Miami will be subject to flooding with the exception of the newest buildings constructed in 1994 in which the first floor elevation has been raised to conform with the new South Florida Building Code. Most of the buildings were designed under the previous South Florida Building Code. In general, the terminal buildings would sustain structural damage if subjected to a Category 3 hurricane or above. A significant concern at the port are the containers. Containers would be subject to movement during a hurricane, depending on the container's weight and location. In lieu of a specific plan, it can be expected that the containers will be a hazard to the other structures; they should be moved to other locations or tied down if feasible.

Many main administrative centers of the major transportation agencies and of government buildings were identified to be in surge-prone area. The specific facilities were selected on the basis of their strategic importance and their relationship to the transportation sector. For a Category 3 hurricane, buildings housing the MPO, FDOT and MDTA as well as several city manager's offices were located in areas expected to be subject to storm surge. An evaluation with respect to their condition and their ability to structural withstand hurricane wind was performed. The buildings were designed under the old South Florida Building Code and may be adequate for a Category 1 or 2 hurricane. It is recommended that existing shutters be replaced at the FDOT (District 6.0) headquarters. It is recommended that further study be made of the existing windows at the Government Center in which the offices of MPO, Public Works

Department and MDTA are located, to assess their condition and strength under the new South Florida Building Code. Disruption of some government services until damages can be overcome or repaired can be expected. If the roof or nearby windows fail and the records are not properly protected, it can be expected that these records will be lost, damaged or destroyed which will affect the community. Also, if personnel records of employees are lost, this may in turn affect future provision of personnel services to some workers. The County should consider designating several special shelters for the dependents of county workers who are critical to evacuation response and post-storm recovery.

The location of the major vehicle storage facilities for the transportation sector were identified and an analysis was performed to assess their vulnerability to storm surge and wind exposure. The storm surge exposure analysis shows that these facilities will be located on surge prone areas for a Category 3 hurricane or stronger storm. It is recommended that each agency review the first floor elevation of its buildings to determine if flooding may occur. If this is so, the agencies should have a backup site which can be used for storage during the post-hurricane or recovery period. The garage facilities and the office building will not probably withstand a Category 2 hurricane. It is recommended that some remedial work on exterior and further investigation work should be conducted to determine action required to strengthen the facilities.

The storm surge analysis for major fire stations shows that a total of 26 fire stations, which represents 40% of the total fire stations inventoried, will be located in a surge prone area for a Category 5 hurricane. The fire department is a primary source of immediate health care for emergency situations. It is recommended that first floor elevation of each station be determined and compared to the values shown on the new atlases to determine if flooding may occur.

The storm surge analysis for major police station shows that eight police stations will be located in the storm surge prone areas for a Category 5 hurricane. Based on information on the first floor elevation for these facilities that was received, it is concluded that six out of eight stations may be subject to flooding. These agencies should take precautions in moving all of the

equipment and files that can be damaged due to flooding. Police play a major role prior to, during, and following a storm because they are used for traffic control and to maintain security in devastated areas. It is recommended that all the first floor elevation information be collected to determine if the facilities will be operational during a storm. It may be necessary to find an alternative site for the offices that may be subject to flooding.

It was not possible to consider these facilities for wind vulnerability analysis. It is recommended that a separate study be made to determine the strengths of the facilities to wind damage since the police and fire departments play an important role during a hurricane. A number of mobile units for the police and fire department should be researched. This information will help determine how many cars will be available to respond to emergency situations and to manage the distribution of emergency response operations.

The inventory of existing traffic signals in Dade County included a total of more than 2,000 operating signals. For a Category 1 hurricane, it was estimated that 69 signals will be affected. Under a Category 3 hurricane, up to 557 signals will be affected. Finally under a Category 5 hurricane, up to 885 signals will be affected. The controller at each location may be subject to flooding and if this occurs, or if power is lost, the intersection will be unoperational. Failure of areawide traffic signals due to flooding impacts will cause post-hurricane traffic chaos, as amply witnessed following Hurricane Andrew.

Generally, most traffic signals in Dade county have not been designed to resist the full hurricane wind loads of a Category 3 or greater hurricane. It is recommended that the mast-arm installation type be used on the new signal design, and if resources allow, all the wire-strand and mast-arm dangling be replaced with the mast-arm rigid which may sustain wind for at least a Category 2 hurricane. If traffic signals are out of service, it can be fully expected that traffic, at least on the major arterials after the first day or so, when people and businesses start moving out into the community at large once again, will become extremely congested at major intersections.

It was found that typical expressway sign structures are designed for 110 miles/hour wind speed which correspond to a Category 2 hurricane. The agencies in charge of the design of the sign structures should reinforce the design to withstand at least a Category 3 hurricane. During Andrew, a number of guide signs on major highways, including a massive overhead sign bridge spanning I-95, fell onto roadways. Major facilities may be blocked due to knocked down guide signs, thus retarding response and recovery efforts as relief supplies may be forced to be routed on surface arterials or local streets.

Street blockages due to windblown debris from trees or branches are also important considerations in this study. This condition will have a decided effect on the transportation system and its ability to operate immediately after a hurricane, hampering or preventing vehicle movements and slowing the flow and relief supplied to the more affected areas.

The data collection shows that there is a demand for public shelters and increases in shelter availability and capacity are needed. These increases might result through school construction projects or other local resources. All school renovation and new building projects should be built to withstand some level of hurricane hazards and should be designed with mass sheltering as a design criteria. An intense public information campaign should be focused on areas outside potential threatened storm surge evacuation areas to discourage unnecessary evacuation movements and to teach residents how to retrofit an interior room of the house for hurricane survival. Some shelters were identified in the surge prone areas but because no information on the first floor elevation was collected, it cannot be determined if flooding may occur. While the shelter facility may remain a viable surge refuge if the ground floor is sufficiently elevated, there remain concerns regarding post-storm egress if parking facilities associated with the shelter are prone to surge. If shelter residents' vehicles flood, they may have no capability to leave the shelter after the storm, both impeding potential personal household level response and recovery efforts. Because of vehicle unavailability, the shelter support system such as food and water for those staff and evacuees forced to remain in shelter present a concern. Public shelters may

experience potable water problems, and pressure problems creating situations where no toilets will work; loss of power may also be experienced.

Even though many mobile home parks were found to be in surge prone areas, mobile home residents will be asked to evacuate in any hurricane situation, even in a lesser Category 1 storm. An important piece of information is knowing the capacity of the parks, which was not collected, but which will give the Office of Emergency Management (OEM) a better estimate of how many people may be expected to be evacuated. It is recommended that this information be surveyed and provide to the OEM office. The number of mobile homes should be researched in detail during further updates.

The study shows that while some health care facilities such as hospitals and nursing homes may not be subject to inundation, access/egress areas may be subject to flooding; emergency vehicles associated with these facilities may be subject to flooding as well, and may add to chaos in operation of the facilities. A main problem in managing spatially distributed emergency response operations such as ambulances is to determine the number of units that would be available to respond to emergency situations, the service territories, and the dispatching strategies of the emergency response units. Further work may be needed to include such information to provide better information to deal with the problems.

The analysis of the demographic information shows that 42,100 people will reside in the surge prone area for a Category 1 hurricane for the year 2000. For a Category 3 hurricane, 492,990 will reside in the surge prone areas. The total population that will be located in a Category 5 hurricane was found to be 921,924 people for the year 2000. It is recommended that the Planning Department take into account the new surge atlas to accommodate future growth in non-surge prone areas and retard growth in coastal high hazard areas.

The employment information shows that for a Category 1 hurricane, 11,000 employees are forecast to be located in a storm surge prone area for the year 2000. The total employment

affected in a Category 3 hurricane is projected to be 225,100. For a Category 5 hurricane, the total anticipated employment that will be located in the storm surge prone area is 466,800 for the year 2000.

The original and expanded evacuation zones provide results for the evacuation zones as defined for the 1994 season versus anticipated expanded 1995 season evacuation zones based on identification of additional areas impacted by hurricane storm surge. The difference between surge zone and evacuation zone is that OEM has determined that although flooding may occur,not all in the surge zone will be notified to evacuate because some of the area won't encounter potentially life threatening flooding.

The new storm surge limits show that the surge area is expanded compared to previous maps. Therefore, expanded clearance time modeling evacuation zones have been assumed for Category 3 and 5 hurricanes. The existing evacuation zones for a Category 1 hurricane will remain adequate with new surge limits.

The analysis shows that 138,462 people will live in the existing clearance modeling evacuation zones for a Category 1 hurricane for the year 2000. Under a Category 3 hurricane, 296,567 will reside in those zones for the year 2000. Finally, for a Category 5 hurricane, it is expected that 519,100 people will reside in the existing clearance time modeling evacuation zones for the year 2000.

The analysis shows that 139,460 people are projected to live in the coastal areas of Dade County, which will include the barrier islands of Miami Beach and Key Biscayne for year 2000. This represents 6.2 percent of the total county-wide population. These people are located in the Category 1 evacuation areas and are expected to be notified to evacuate in advance of a Category 1 or stronger hurricane landfall. The Miami Beach population represents 68 percent of the countywide total expected to be notified to evacuate. The current public shelter information shows that only 50,000 spaces are available. If, in a worst-case scenario, these evacuees were

all to seek public shelter space in Dade County, there would not be enough room to house even this relatively small group. The implications of the worst-case scenarios are very serious and thought should be given to public education campaigns to inform the public about not only the need for additional public shelter capacity in the county, but for residents to be made aware that alternative shelter arrangements should be developed well in advance of hurricane season as well, and that these other arrangements should not rely on out-of-county flight, but on alternative local shelter arrangements as well.

Arrangements made through civic organizations, community groups, neighborhood associations, and religious organizations should be pursued by emergency planners and individuals to help create an additional pool of alternative home shelter capacity, and individual households should be strongly encouraged to make arrangements to stay with local (Dade County, or perhaps Broward County) friends or family, to help alleviate the shelter shortage and to reduce traffic volumes and subsequent pre-storm congestion on the expressways which would be the primary routes for evacuation out of Dade County.

The evacuation clearance time findings and report indicate that major arterials and existing causeway facilities are principal choke points. Traffic control personnel should look at the feasibility of placing cones on the existing pavement on the northbound on-ramp of the Julia Tuttle Causeway to I-95 to form two travel lanes for evacuation off Miami Beach. The expected number of evacuees who will make this movement warrants this important action. A similar traffic control strategy should be accomplished for the northbound on-ramp from I-395 to I-95. Available traffic control personnel should be stationed at those routes which serve exiting traffic from the beach areas and on ramps to I-95.

These recommendations would lessen evacuation roadway congestion. Apparently, there were some problems with evacuating senior citizens and low income/no auto households from the beaches prior to Andrew; therefore, it is recommended that Metrobus evacuation procedures be implemented and that residents be made much more aware of these services.

The employment data shows that it is projected that by the year 2000, 89,811 employees will be located in the existing clearance time modeling evacuation zones for a Category 1 storm. For a Category 3 hurricane, 245,314 employees are expected to be located in those zones. For a Category 5 hurricane, 355,794 employees will work in those zones.

For a Category 3 hurricane, the analysis shows that 326,200 people will reside in the expanded evacuation zones for the year 2000. This represents an increase of 14.7 percent over the existing time clearance modeling evacuation zones.

The expanded zones will have 565,500 people for a Category 5 hurricane for the year 2000. This represents an increase of 25 percent compared to the existing evacuation zones.

The projections for year 2000 show that 162,500 people will work and be located in the expanded clearance time modeling evacuation zones. This represents an increase of 14.3 percent over the existing evacuation zones. For a Category 5 hurricane, it is expected that 225,200 people will work in the expanded clearance time modeling evacuation zones for the year 2000. This represents a 19.8 percent increase.

Taking advantage of the GIS capabilities, hurricane wind impact tracks were superimposed on transportation system and population employment database to analyze the impact of different hurricane categories, storm tracks and wind speeds. Several hurricane wind impact tracks were evaluated to address the ability of the various networks to function, and, perhaps most importantly, the status of the personnel after a storm and their potential status or availability to work.

Six scenarios were tested to illustrate what might be expected should such strong storms achieve landfall. Each scenario has a track and a storm intensity associated with it and the assessment of potential damages to the transportation system, its infrastructure, its functions and some of the system's agencies key personnel were evaluated. It is during such scenario testing where the true

analytic power of GIS can be most fully explored. By employing its overlay, comparison, and segregation functions to separate areas subject to the bands of lesser, moderately strong, and more intense winds, evaluation of the various transportation system elements and components exposed to the different strength wind was performed. Then, calculations were performed on each of the various physical elements and functional components by exposure category, and *a priori* estimate of systemic impact of the storm were developed which is far more efficient than if manually performed. Figure 8-1 represents the typical windspeed variability by band for Category 1, 3 and 5 hurricanes.

The analysis of the storm track scenarios shows that a theoretical track with a landfall near the downtown area and proceeding northerly will be the worst scenario because it will threaten the most intensely developed part of the county. The northern part of the county is where the majority of the traffic signals are located. The analysis for 75 mph for a Category 5 storm was not conducted for this storm category and track because it would involve the whole county. A comparison of the same windspeeds for different category storms was performed and it was found that at 110 mph for a Category 5 storm, the damages would be more severe than for a Category 3 storm. Table 8-1 shows that for a Category 5 storm with a north orientation, for the band with a wind speed of 110 mph, 91% of the total signals inventoried in this study will be affected. This information will enable transportation and emergency planners to forecast the severity of damages expected and will give them the number of downed signals to be repaired as an example. The Metrorail and Metromover stations will be affected in such a theoretical storm because most of these stations are located in the downtown area and North Dade.

Additionally, many health care facilities such as hospitals and nursing homes are located in the path of such a storm and the number of facilities affected would comprise 90% of the total inventoried. These numbers may encourage local medical officials to either seek the use of other hospitals or related facilities, or to more seriously considered stronger storm protection and emergency power supply measure.

As previously mentioned, the northerly area of the county is the most populated and population and employment would be affected as much as 90% to 95% for the projected year 2000. The emergency personnel for the transportation sector will be affected at between 80% to 90% of the work force if a storm were to strike the central part of the county. Transportation managers can forecast the number of people that will be affected during the storm and arrangements for backup staff may be made prior to the storm.

The public shelters that are located in the path of this storm track represent 95% of the total. Almost all public hurricane shelters are located to the north of the County.

The communication sector will be extremely affected if the storm takes this path. The analysis shows that all the TV and radio studios will be affected during the storm which will make mass communication with the public very problematic. The radio stations that would be impacted represent 84% of the total inventory.

Using GIS allows the emergency and transportation planning communities to more rapidly propose, analyze and estimate potential storm impacts before hurricane occurrence, thus facilitating pre-storm preparedness and post hurricane response action for a variety of potential storm situations. By quantifying potential impacts, the community will be able to target its response and enhance its ability to deal with the effects.

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