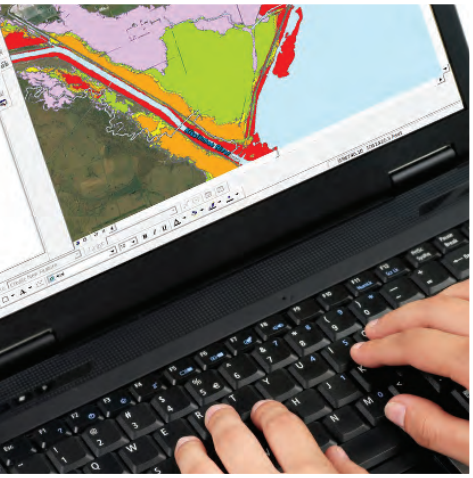
Florida Statewide Regional Evacuation Study Program



Evacuation Transportation Analysis

Volume 4-7

Florida Division of Emergency Management

Central Florida Regional Planning Council

Central Florida Region

Includes Hurricane Evacuation Study

Statewide Regional Evacuation Study Program

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EVACUATION TRANSPORTATION ANALYSIS

VOLUME 4-7

CENTRAL FLORIDA REGION

Prepared for:

Central Florida Regional Planning Council
Florida Division of Emergency Management

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September 2010

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EXECUTIVE SUMMARY

The evacuation transportation analysis discussed in this volume documents the methodology, analysis, and results of the transportation component of the Statewide Regional Evacuation Study Program (SRESP). Among the many analyses required for the SRESP study, transportation analysis is probably one of the most important components in the process. By bringing together storm intensity, transportation network, shelters, and evacuation population, transportation analysis explicitly links people's behavioral responses to the regional evacuation infrastructure and helps formulate effective and responsive evacuation policy options. Due to the complex calculations involved and numerous evacuation scenarios that need to be evaluated, the best way to conduct the transportation analysis is through the use of computerized transportation simulation programs, or transportation models.

A. Background and Purpose

Over the years, different planning agencies have used different modeling approaches with varying degrees of complexity and mixed success. Some have used full-blown conventional transportation models such as the standard Florida model FSUTMS; others have used a combination of a simplified conventional model and a spreadsheet program, such as the Abbreviated Transportation Model (ATM). These models have different data requirements, use different behavioral assumptions, employ different traffic assignment algorithms, and produce traffic analysis results with different levels of detail and accuracy. These differences make it difficult for planning agencies to share information and data with each other. They also may produce undesirable conditions for staff training and knowledge sharing.

One of the objectives of the SRESP is to create consistent and integrated regional evacuation data and mapping, and by doing so, to facilitate knowledge sharing between state, regional, county, and local partners. To achieve this objective, it is important for all Regional Planning Councils to adopt the same data format and to use the same modeling methodologies for their transportation analyses. The primary purpose of the transportation component of the SRESP is to develop a unified evacuation transportation modeling framework that can be implemented with the data collected by the Regional Planning Councils.

B. Study Area

The study area for this analysis includes the five county Central Florida Regional Planning Council area. The transportation modeling methodology includes some processes that are performed at the statewide level, in order to determine the impacts of evacuations from other regions impacting the evacuation clearance times in the Central Florida region. While the impact of other regions is included in the Central Florida analysis, it is important to note that the results of the transportation analysis presented in this document are only reported for the five counties included in the Central Florida RPC. Transportation analysis results for other regions and counties are reported in the corresponding Volume 4 report for those regions.

C. Input and Coordination

The development of the transportation methodology and framework required coordination and input from all eleven regional planning councils in Florida, along with the Division of Emergency Management, Department of Transportation, Department of Community Affairs, and local county emergency management teams. At the statewide level, the transportation consultant, Wilbur Smith Associates, participated in SRESP Work Group Meetings which were typically held on a monthly basis to discuss the development of the transportation methodology and receive feedback and input from the State agencies and RPCs.

At the local and regional level, Wilbur Smith Associates conducted a series of four regional meetings to coordinate with and receive input from local county emergency management, the regional planning council, local transportation planning agencies and groups, as well as other interested agencies.

D. Evacuation Modeling Methodology and Framework

The evacuation modeling methodology and framework was developed during 2008 and 2009 in coordination with all eleven Regional Planning Councils and the Division of Emergency Management. The methodology used in the Central Florida RPC Evacuation Transportation Analysis is identical to the methodology used for all eleven Regional Planning Councils and includes the following components:

- **Behavioral Assumptions** – In 2008, the Statewide Regional Evacuation Study Program (SRESP) commissioned a survey of Florida residents. The purpose of this survey was to develop an understanding of the behavior of individuals when faced with the prospect of an impending evacuation. These data were used to develop a set of "planning assumptions" that describe the way people respond to an order to evacuate and are an important input to the SRESP Evacuation Model. The behavioral data provides insights into how people respond to the changing conditions leading up to and during an evacuation. The primary application of the survey data was to help anticipate how people would respond with respect to five behaviors:

    - How many people would evacuate?
    - When they would leave?
    - What type of refuge they would seek?
    - Where they would travel for refuge?
    - How many vehicles would they use?

    These evacuation behaviors are distinguished based on several descriptive variables as listed below:

    - Type of dwelling unit (site-built home versus mobile home);
    - The evacuation zone in which the evacuee reside; and,
    - The intensity of the evacuation that has been ordered.

- **Zone System and Highway Network** - The SRESP evacuation model relies upon data that covers the entire State of Florida as well as areas covering the States of Georgia, Alabama, Mississippi, South Carolina, North Carolina, and Tennessee. While the primary

focus of the model is with evacuation behavior within Florida, areas outside of the state had to be considered in order to allow a more precise routing of evacuation traffic. This allows the model to measure the flow of traffic across the state line if needed.

The data included in this system contain the demographic information crucial to modeling evacuation traffic. The demographic information is labeled as "small area data". These data provide population and dwelling unit information that will identify where the individuals in the region reside. The planning assumptions developed from the behavioral analysis conducted for this study were applied to these demographic data. The result is a set of evacuation trips generated by the evacuation model. The number of these trips will vary depending on the hazard conditions that prompt the evacuation. Small area data geographies were aggregated into larger units known as Traffic Evacuation Zones (TEZ). These TEZ form the basic unit of analysis in the evacuation model. The final TEZ system for the State of Florida has 17,328 zones. This number provides sufficient detail to accurately accommodate the assignment of evacuation trips onto an evacuation network.

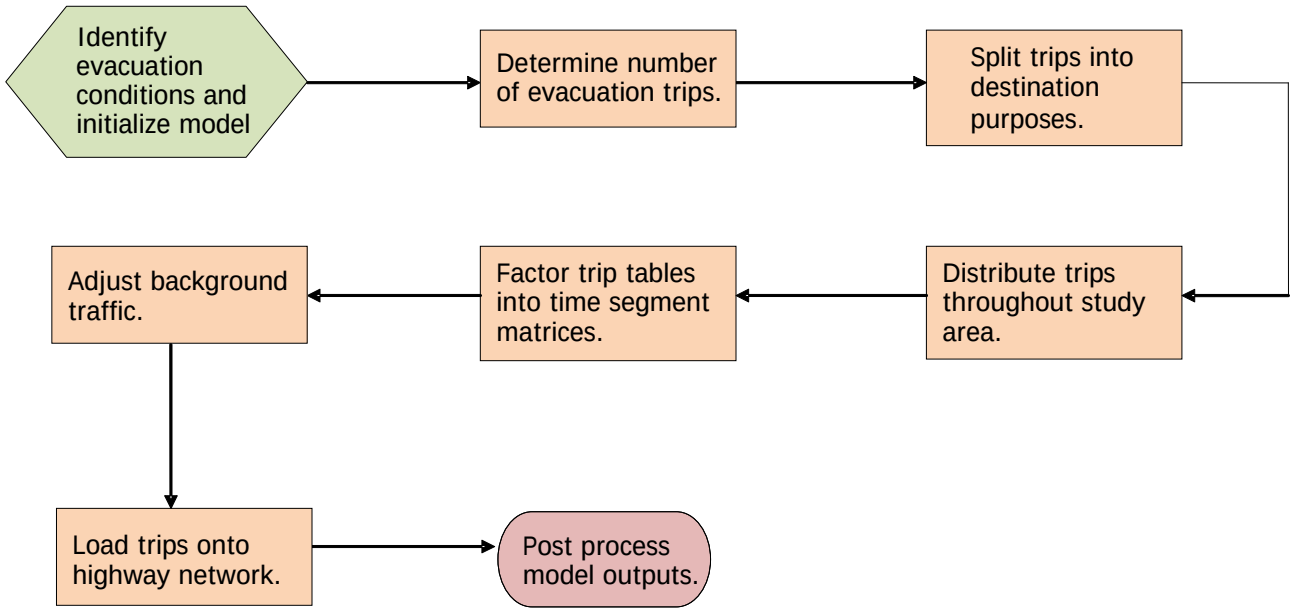
- **Background Traffic** - The traffic that consumes the roadway capacity of a transportation system during an evacuation can be divided into two groups. The first group is the evacuation traffic itself. Once the evacuation demand is determined, this information is converted into a number of vehicles evacuating over time. These evacuation trips are then placed on a representation of the highway network by a model. The model determines the speed at which these trips can move and proceeds to move the evacuation trips accordingly. The result is a set of clearance times.

  The second group of traffic is known as background traffic. Background traffic, as its name implies, is not the primary focus of an evacuation transportation analysis and is accounted for primarily to impede the movement of evacuation trips through the network. These trips represent individuals going about their daily business mostly unconcerned with the evacuation event. For the most part, background traffic represents trips that are relatively insensitive to an order to evacuate and are thus said to be occurring in the "background." Even though background traffic is relatively insensitive to evacuation orders, it is important to account for background traffic since it can have a dramatic impact on available roadway capacity. This in turn can severely affect evacuation clearance times.

- **Evacuation Traffic** - The model flow for the evacuation model is divided into a total of eight modeling steps. The following eight steps are represented graphically in the flowchart in Figure ES-1:

  1. Identify evacuation conditions and initialize model;
  2. Determine number of evacuation trips;
  3. Split trips into destination purposes;
  4. Distribute trips throughout study area;
  5. Factor trip tables into time segment matrices;
  6. Adjust background traffic;
  7. Load trips onto highway network; and,
  8. Post process model outputs.

Figure ES-1 - General Model Flow



- **Dynamic Traffic Assignment** - Dynamic traffic assignment (DTA) was utilized in the evacuation methodology because it is sensitive to individual time increments. DTA works by assigning a certain number of vehicles to the highway network in a given interval of time. The model then tracks the progress of these trips through the network over the interval. Another set of vehicles is assigned during the following time interval. The model then tracks the progress of these trips through the network along with the progress of the trips loaded in the previous time interval. As vehicles begin to arrive at the same segments of roadway, they interact with one another to create congestion. When vehicles that were loaded to the network in subsequent intervals of time arrive at the congested links, they contribute to the congestion as well. This results in a slowing down of the traffic and eventually spill-backs and queuing delays. It is this time dependent feature of DTA that makes it well suited to evacuation modeling. By dynamically adjusting the travel times and speeds of the vehicles moving through the network as they respond to congestion the model is able to do the following:

    - The evacuation model is able to estimate the critical clearance time statistics needed for this study;
    - The model takes into account the impact of compounded congestion from multiple congestion points;
    - The model is able to adjust the routing of traffic throughout the network as a function of congestion as it occurs throughout the evacuation; and,
    - The model is capable of adjusting its capacities from time segment to time segment, making it possible to represent such phenomena as reverse lane operations and background traffic.

- **Prototype Model Development** - Wilbur Smith Associates developed a prototype model to test the modeling methodology used to calculate evacuation clearance times.

The prototype model demonstrated the viability of the methodology developed for this study. This included the use of dynamic traffic assignment, background traffic curves, regional sub-area trip balancing, the use of survey rates, the use of 100% participation rates, response curves, and county-by-county phasing of evacuations. The prototype model served as the backbone for all regional evacuation models that have been developed for this study. The models implemented for each RPC use a structure similar to the prototype with identical methodology.

E. Regional Model Implementation

The regional model developed for the Central Florida Region used a series of input data provided by the RPC, including the following:

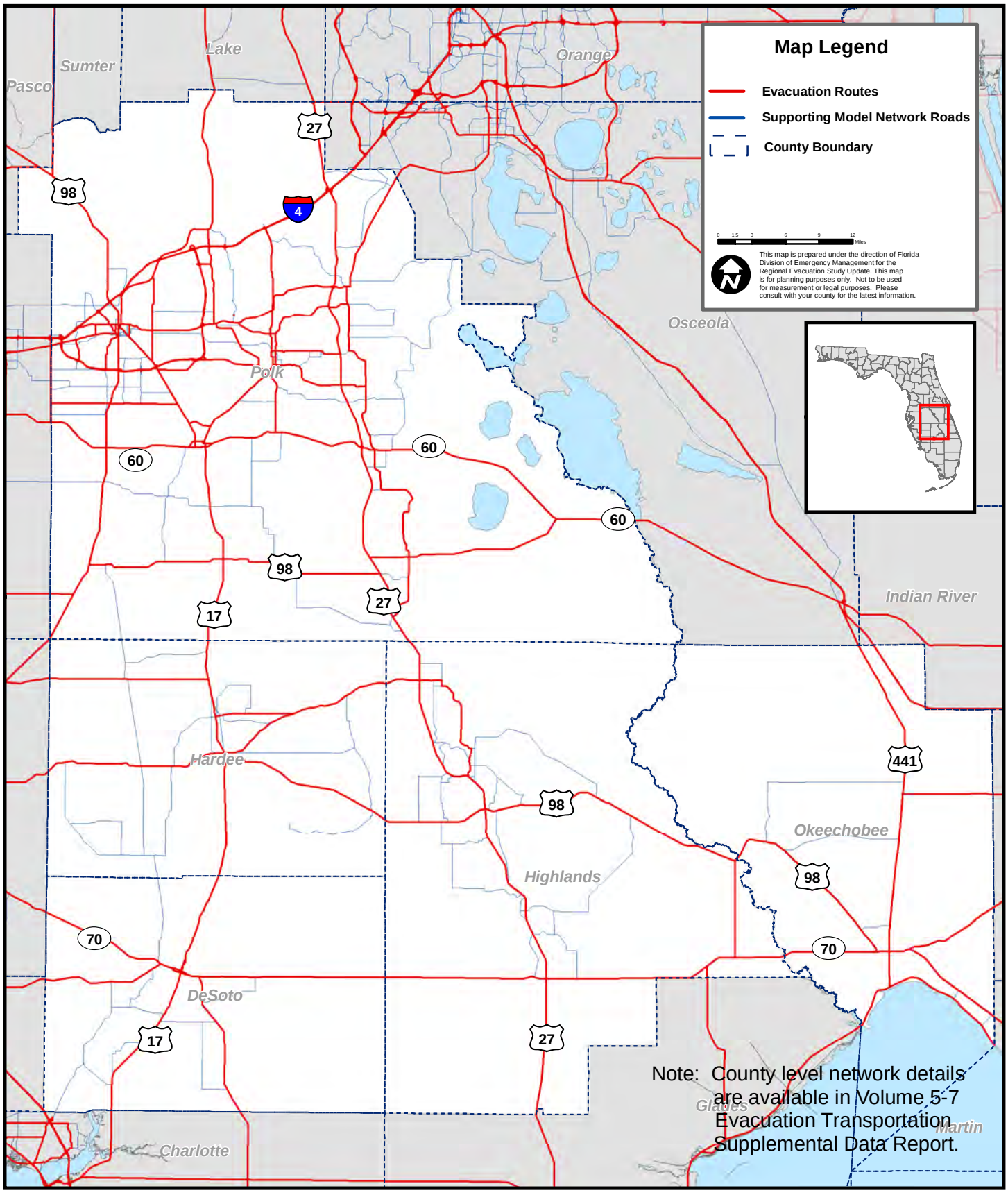
- **Regional Model Network** - The regional model network consists of the RPC designated evacuation routes as well as a supporting roadway network that facilitates movement of evacuation traffic. The 2005 Florida Department of Transportation (FDOT) Statewide Model Network was used as a basis for developing the regional model network, while the evacuation routes were obtained from the Central Florida RPC. The RPC relied on the emergency managers of its constituent counties to provide it with information on which roads were to be included as evacuation routes. The resulting model network was updated to 2006 conditions and is referred to as the base model network. **Figure ES-2** identifies the model network and evacuation routes for the CFRPC. County level details of the regional model network are provided in the Volume 5-7 report. The regional model network for the Central Florida region includes key roadways within the five county region, including I-4, Florida's Turnpike, US 92, US 27, US 98, US 17, US 441, SR 60, SR 70, and SR 78, SR 37, SR 64, and SR 62.

- **Regional Zone System** - The regional zone system is based on Traffic Evacuation Zones (TEZ) and contains the regional demographic information, which includes housing and population data that is essential to modeling evacuation traffic. There are 351 zones located within the five county Central Florida region, as illustrated in **Figure ES-3**. In the Central Florida region, Polk County has the largest number of TEZs with 263, and Highlands County follows with 39 TEZs. Okeechobee County has 22 TEZs while Hardee and DeSoto Counties have the lowest number of TEZs in the RPC with 15 and 12 zones, respectively. The larger number of TEZs generally reflects counties with denser urban structure and/or higher population densities.

- **Regional Demographic Characteristics** - Demographic data were developed for the following years: 2006, 2010, and 2015. A snapshot of the key demographic data for each county in the Central Florida RPC for 2006, 2010 and 2015 is summarized in **Table ES-1**. The tables list the number of occupied dwelling units for site built homes, the permanent population in site-built homes, as well as the number of occupied dwelling units for mobile homes and the permanent population in mobile homes. The mobile home category includes RVs and boats and the permanent population in those housing options. The demographic characteristics summary also includes hotels and motels because a number of these units are in or near vulnerable areas, and the proportion of seasonal units and hotel/motel units that are occupied at any point in time will have an important impact on the total population that may participate in an evacuation.

Figure ES-2

Central Florida Regional Model Network



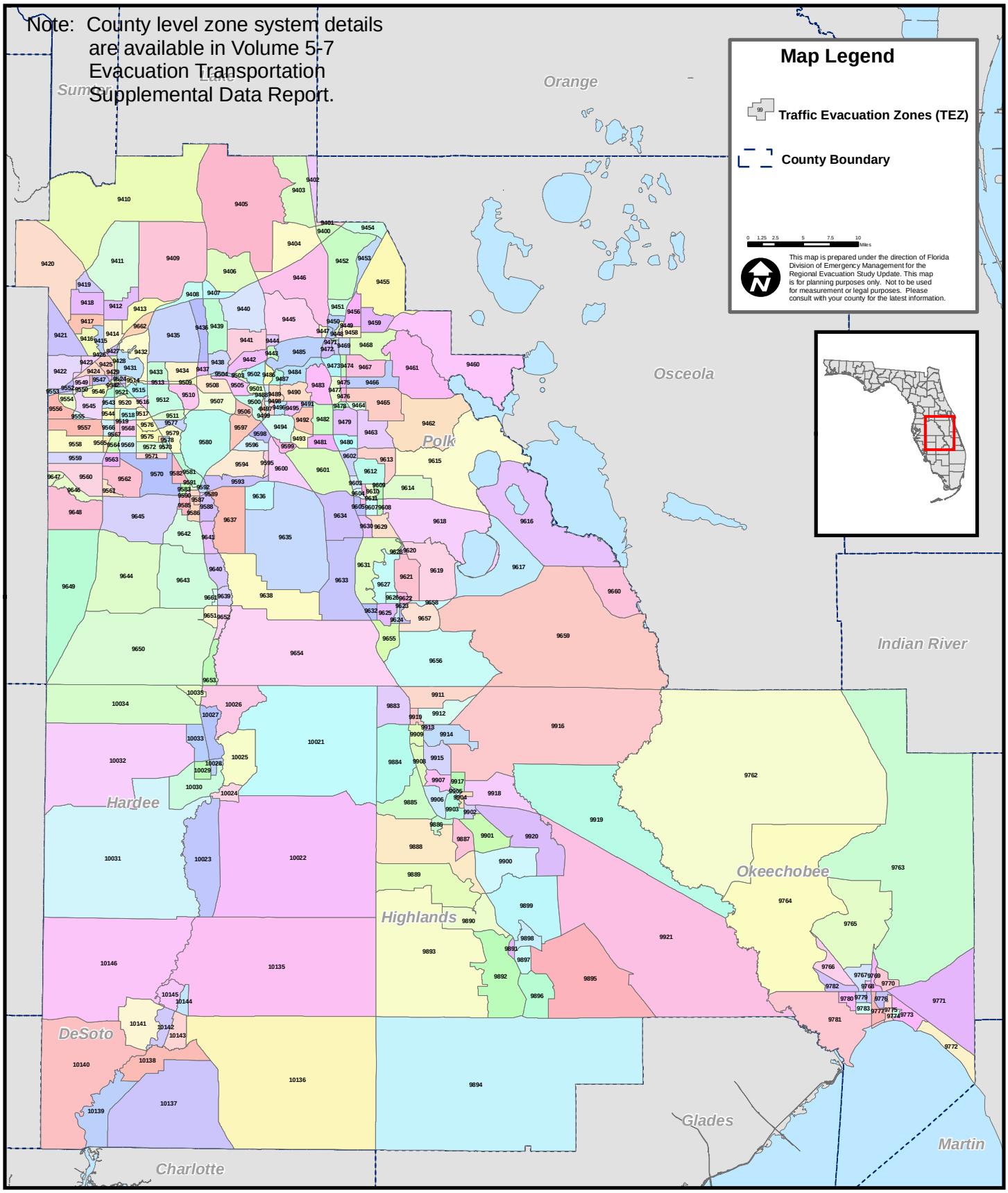
Note: County level network details are available in Volume 5-7 Evacuation Transportation Supplemental Data Report.

Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: June, 2010

Figure ES- 3

Central Florida Regional Model (TEZ) Zone System



Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August, 2010

Polk County has the largest population in the region during all three time periods. The county is expected to reach more than 570,000 people by 2015. Highlands County has the second largest population in the region and is forecasted to have more than 100,000 people by 2015. Okeechobee is predicted to grow to over 42,000 by 2015, while DeSoto and Hardee Counties, the counties with smallest populations, both are expected to reach more than 35,000. Although Polk County shows the largest absolute growth between 2006 and 2015, the county that will experience the largest percentage of change is Hardee County at 31%.

Table ES-1 – Central Florida Demographic Characteristic Summary

County	Characteristic	Year		
		2006	2010	2015
DeSoto	Occupied site-built homes	6,683	7,495	8,791
	Population in site-built homes	19,036	20,311	23,823
	Occupied mobile homes	3,835	3,873	4,027
	Population in mobile home	13,173	13,305	13,832
	Hotel/motel units	200	200	200
Hardee	Occupied site-built homes	5,833	6,110	8,424
	Population in site-built homes	17,652	18,505	25,723
	Occupied mobile homes	2,272	2,333	2,333
	Population in mobile home	9,286	9,604	9,604
	Hotel/motel units	112	112	112
Highlands	Occupied site-built homes	29,695	30,865	36,042
	Population in site-built homes	68,907	71,593	83,663
	Occupied mobile homes	8,900	8,900	8,900
	Population in mobile home	19,660	19,660	19,660
	Hotel/motel units	1,207	1,207	1,207
Okeechobee	Occupied site-built homes	6,804	7,576	8,532
	Population in site-built homes	19,243	21,531	24,538
	Occupied mobile homes	5,659	5,699	5,860
	Population in mobile home	16,667	16,762	17,559
	Hotel/motel units	425	425	425
Polk	Occupied site-built homes	176,913	198,435	227,450
	Population in site-built homes	427,956	445,567	502,460
	Occupied mobile homes	30,352	30,352	30,352
	Population in mobile home	58,401	68,763	68,082
	Hotel/motel units	11,580	12,556	14,024

Source: Central Florida Regional Planning Council

- **Planned Roadway Improvements** - To correspond to the three different sets of demographic data, three model networks were ultimately developed. The base 2006 network and two future year networks to correspond to the 2010 demographic data and the 2015 demographic data. The 2006 base model network was updated to reflect roadway capacity improvement projects completed between 2006 and 2010 to create the 2010 network. The 2010 network was then updated to reflect planned roadway capacity improvement projects expected to be implemented between 2011 and 2015 to create the 2015 network.

  The planned roadway improvements that were added to the network generally include only capacity improvement projects such as additional through lanes. **Table ES-2** identifies capacity improvement projects completed between 2006 and 2010 that were included in the 2010 network. Likewise, **Table ES-3** identifies capacity improvement projects planned for implementation between 2011 and 2015. The tables identify each roadway that will be improved as well as the extent of the improvement. For example, by the end of 2015 in DeSoto County, US 17 (SR 35) from Peace River Shores to SW Collins St will be widened to 6 lanes.

  It is important to note that Tables ES-2 and ES-3 are not intended to be all inclusive of every transportation improvement project completed within the region. The tables only identify key capacity improvement projects that impact the evacuation model network and are anticipated to have an impact on evacuation clearance times.

- **Behavioral Assumptions** - For the Central Florida Region, three counties, DeSoto, Highlands, and Okeechobee Counties have evacuation zones corresponding to different categories of storm surge. Evacuation rates for site-built homes and mobile/manufactured homes are provided by county and summarized in **Figure ES-4** through **Figure ES-9**. Other rates, such as out of county trip rates, vehicle use rates, public shelter use rates, friend/relative refuge use rates, hotel/motel refuge use rates, and other refuge use rates, are detailed by county, storm threat, and evacuation zone in Volume 5-7.

  Please note that the original behavioral response rates provided by SRESP in Volume 2-7 were modified to fit the evacuation zones created for DeSoto, Highlands, and Okeechobee Counties. The original rates were based on the assumption that DeSoto, Highlands, and Okeechobee were inland areas with no evacuation zones; however, DeSoto utilizes five zones, Highlands, three, and Okeechobee, three zones. The evacuation zone systems for those counties are listed below:

  - DeSoto – 5 zones: Zone A, Zone B, Zone C, Zone D, Zone E;
  - Highlands – 3 zones: Zone C, Zone D, Zone E;
  - Okeechobee – 3 zones: Zone A, Zone B, Zone C/D/E.

- **Shelters** - In order for the transportation model to accurately assign public shelter trips to the correct location, a complete list of available public shelters needs to be available. The shelters were categorized as either primary or other, with primary indicating that the shelter is compliant with American Red Cross standards for a shelter and other indicating all other shelters. In the five county region there are a total of 90 shelters,

including 36 in Highlands County, 29 in Polk County, 14 in Okeechobee County, 8 in Hardee County, and 3 in DeSoto County. All together, the 90 shelters located within the five county region can host more than 34,000 persons during an evacuation event. Detailed lists of the available public shelters by county are included in Volume 5-7.

Table ES-2 – Central Florida Roadway Improvements, 2006 – 2010

County	Roadway	From	To	Number of Lanes
Hardee	US 17	N of Iguana Ln	S of Stenstorm Rd	6
Polk	SR 570 (Polk Pkwy)	Pace Rd	I-4	4
	CR 655 (Berkley Rd)	CR 546	Pace Rd	4
	CR 540A	SR 37	US 98	4
	CR 582	CR 35A	US 98	4
	US 27	SR 542	I-4	6
	US 27	SR 60	SR 540	6
	CR 54 (Ronald Reagan Pkwy)	US 27	Lake Wilson Rd	4

Sources: FDOT SIS First Five Year Plan, FDOT SIS Second Five Year Plan, Central Florida Regional Planning Council
Note: Projects included in this table are roadway improvement projects completed between 2006 and 2010 on roadways that are included in the regional transportation model network. Only projects which added roadway capacity, such as additional through lanes, were included. The list is not intended to be all inclusive of every transportation improvement project completed within the region. A list of historical projects completed during the last five years was included in this report because the base regional network developed for the study, along with the base demographic data, is for the year 2006.

Table ES-3 - Central Florida Planned Roadway Improvements, 2011–2015

County	Roadway	From	To	Number of Lanes
DeSoto	US 17 (SR 35)	Peace River Shores	SW Collins St	6
Okeechobee	SR 70	80th Ave	St Lucie County line	4
Polk	County Line Rd	SR 60	W Pipkin Rd	4
	CR 37B	CR 540A	SR 570 (Polk Pkwy)	4
	Bartow Northern Connector	US 98	US 17	4
	W Pipkin Rd	End of 4-lanes	Old Hwy 37	4
	CR 35A	Galloway Rd	Duff Rd	4
	US 27	SR 540	SR 542	6

Sources: FDOT SIS First Five Year Plan, FDOT SIS Second Five Year Plan, Central Florida Regional Planning Council
Note: Projects included in this table are roadway improvement projects planned for completion between 2011 and 2015 on roadways that are included in the regional transportation model network. Only projects which are planned to add roadway capacity, such as additional through lanes, were included. The list is not intended to be all inclusive of every transportation improvement project planned for completion within the region.

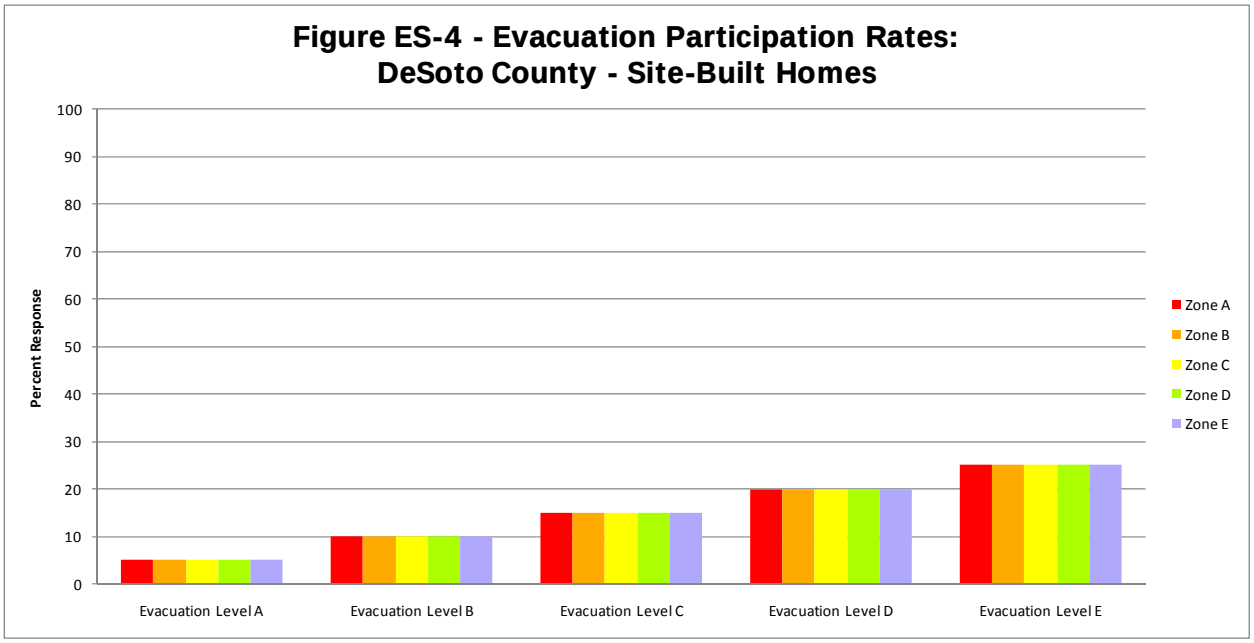


Figure ES-4 - Evacuation Participation Rates:
DeSoto County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

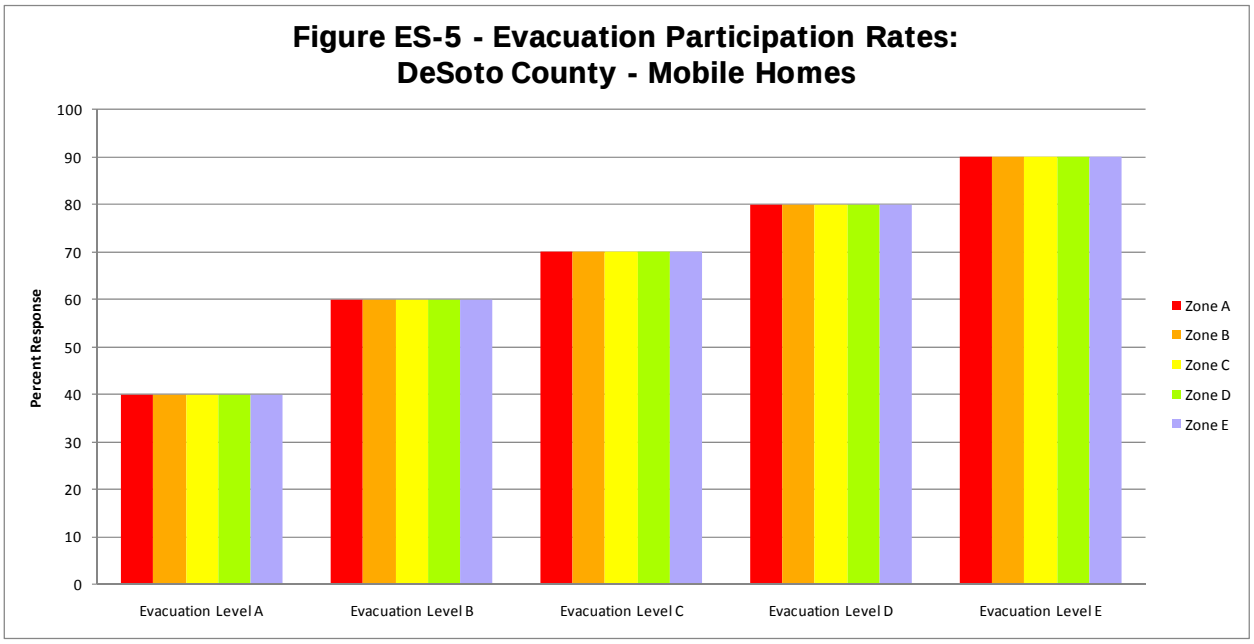


Figure ES-5 - Evacuation Participation Rates:
DeSoto County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

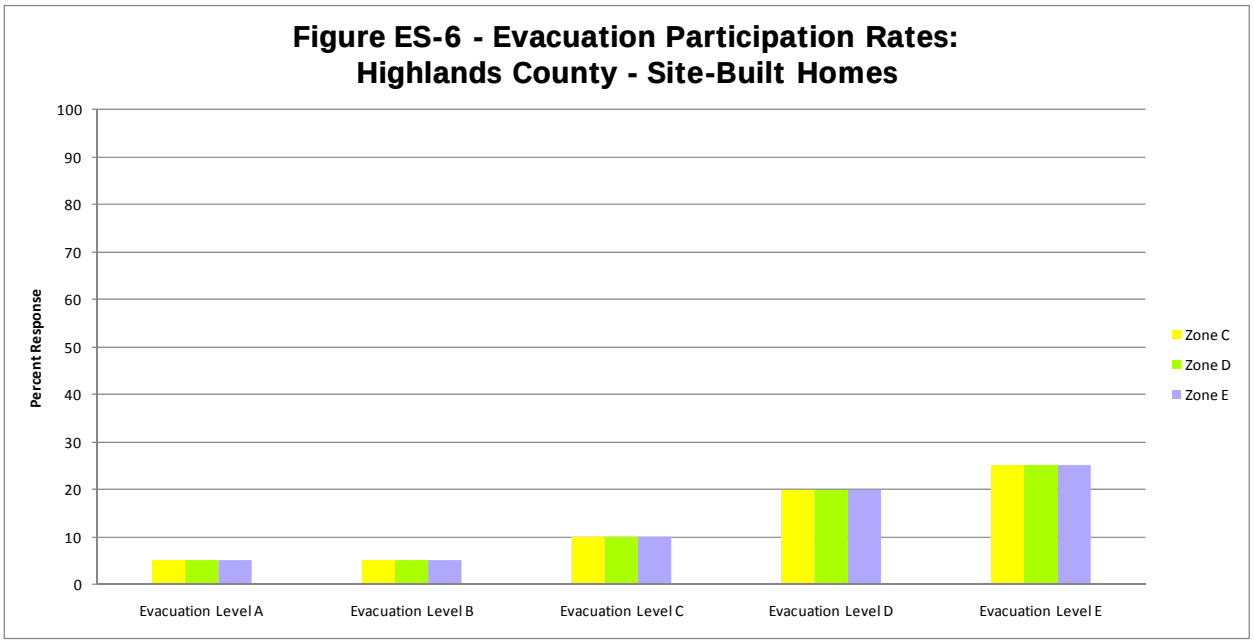


Figure ES-6 - Evacuation Participation Rates:
Highlands County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone C
Zone D
Zone E

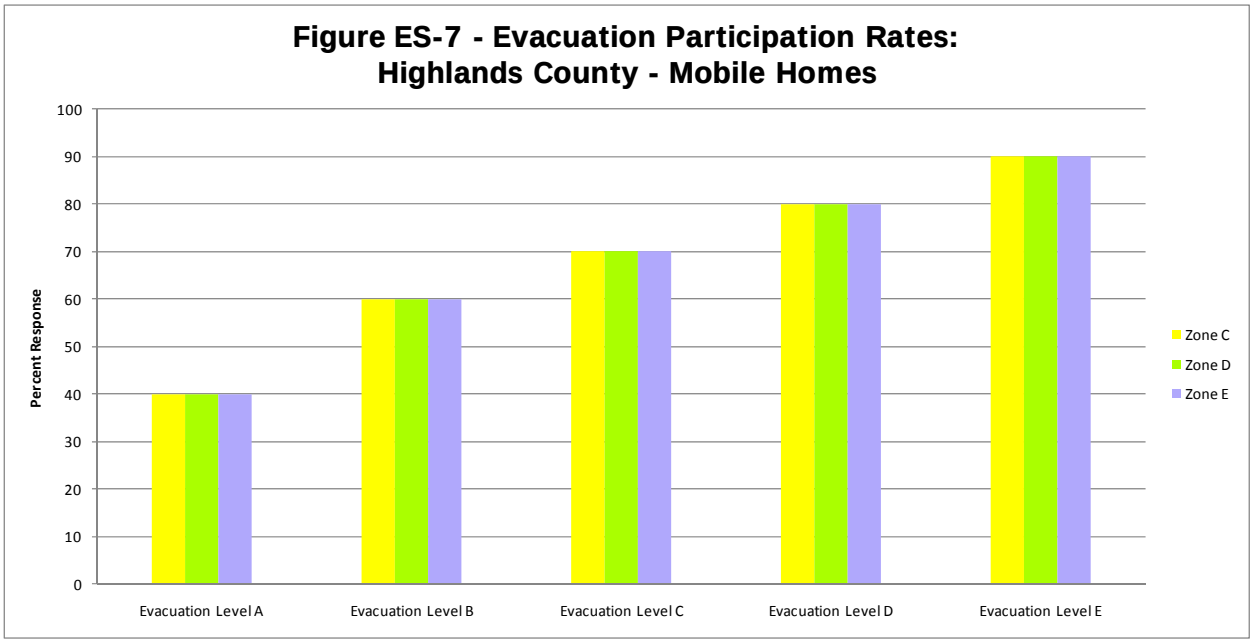


Figure ES-7 - Evacuation Participation Rates:
Highlands County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone C
Zone D
Zone E

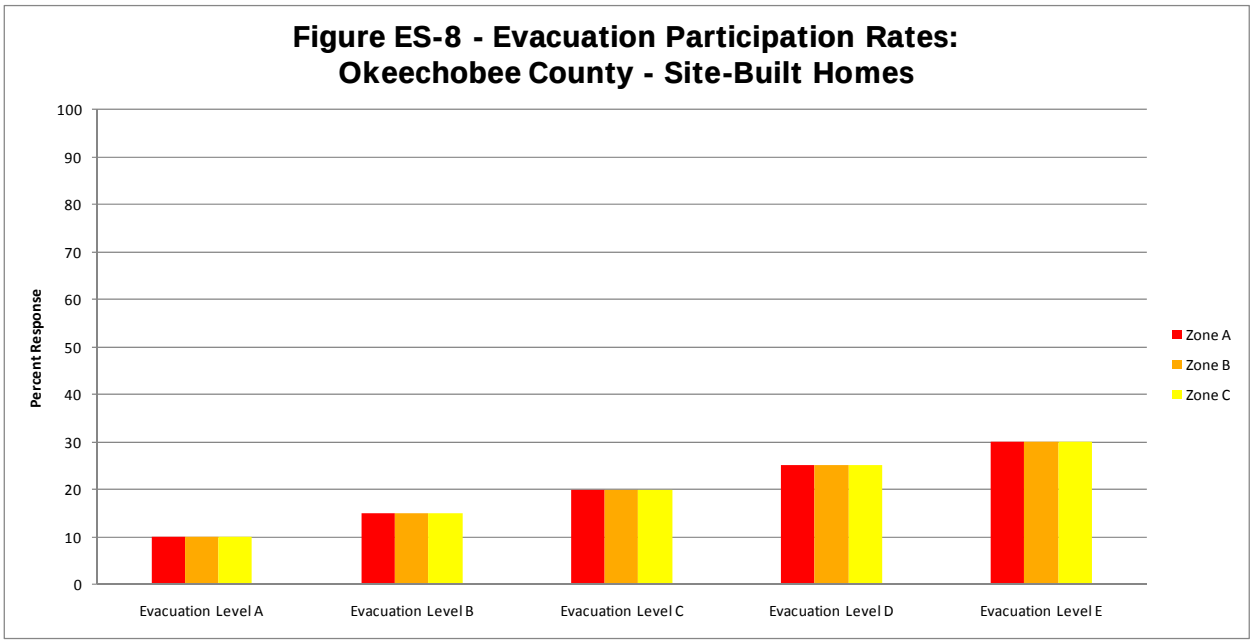


Figure ES-8 - Evacuation Participation Rates:
Okeechobee County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C

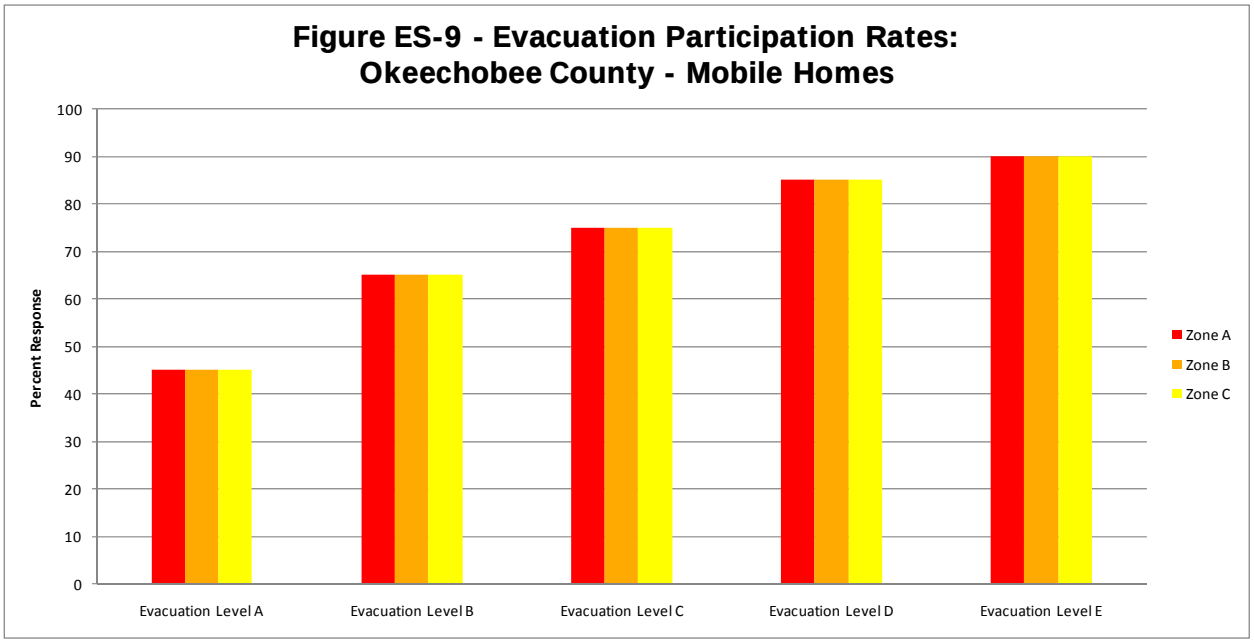


Figure ES-9 - Evacuation Participation Rates:
Okeechobee County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C

- **Evacuation Zones** - The final input variable that is needed to complete the transportation evacuation model is the delineation of evacuation zones for all coastal counties. Local county emergency managers have the responsibility of identifying and defining evacuation zones for their county. Within the Central Florida region, DeSoto, Highlands, and Okeechobee Counties have updated and established their evacuation zones based on the results of the new data and information collected as part of the SRESP. County level evacuation zones are included in Volume 5-7.

F. TIME User Interface

Wilbur Smith Associates developed the Transportation Interface for Modeling Evacuations (TIME) to make it easier for RPC staff and transportation planners to use the model and implement the evacuation methodology. The TIME interface is based on an ArcGIS platform and is essentially a condensed transportation model, which provides a user friendly means of modifying input variables that would change the clearance times for various evacuation scenarios.

The evacuation model variables include a set of distinguishing characteristics that could apply to evacuation scenarios as selection criteria. These following variables may be selected using the TIME interface and allow the user to retrieve the best results from various evacuation alternatives:

- Analysis time period;
- Highway network;
- Behavioral response;
- One-way evacuation operations;
- University population;
- Tourist occupancy rates;
- Shelters;
- Counties evacuating;
- Evacuation level;
- Response curve hours; and,
- Evacuation Phasing.

G. Vulnerable Population

Using a combination of the demographic data, behavioral assumptions, and evacuation zones, the vulnerable population in each county could be determined by evacuation level. For the purposes of the transportation analysis, the vulnerable population, or population-at-risk, is defined as the total population living within the county designated evacuation zones for each evacuation level. This population is living in an area that is at risk for severe flooding during a storm event. The vulnerable population for the Central Florida Region for 2010 is identified in **Table ES-4**, summarized by evacuation zone and split between site-built homes and mobile/manufactured homes. Vulnerable population for 2015 is summarized in **Table ES-5**.

Table ES-4 – Vulnerable Population in the Central Florida Region for 2010

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
DeSoto County					
Site-built Homes	994	227	947	1,589	0
Mobile/Manuf. Homes	665	90	339	580	0
TOTAL	1659	317	1286	2169	0
Highlands County					
Site-built Homes	0	0	0	4	11
Mobile/Manuf. Homes	0	0	0	8	25
TOTAL	0	0	0	12	36
Okeechobee County					
Site-built Homes	5,233	5,202	11,097	0	0
Mobile/Manuf. Homes	7,548	2,398	6,816	0	0
TOTAL	12,781	7,600	17,913	0	0

Note: Vulnerable population determined using SRESP small area data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

Table ES-5 – Vulnerable Population in the Central Florida Region for 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
DeSoto County					
Site-built Homes	1,432	305	1,189	2,021	0
Mobile/Manuf. Homes	691	94	352	603	0
TOTAL	2,123	399	1,541	2,624	0
Highlands County					
Site-built Homes	0	0	0	5	14
Mobile/Manuf. Homes	0	0	0	8	25
TOTAL	0	0	0	13	39
Okeechobee County					
Site-built Homes	5,579	5,587	13,372	0	0
Mobile/Manuf. Homes	7,548	2,398	7,613	0	0
TOTAL	13,127	7,985	20,985	0	0

Note: Vulnerable population determined using SRESP small area data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

In addition, based again on the demographic data, behavioral assumptions, and evacuation zones, the planned destinations of vulnerable population in each county could be determined by evacuation level. Destinations include friends and family, hotel/motel, public shelter, and other locations. Vulnerable population destinations for the Central Florida Region are identified in **Table ES-6** for 2010 and in **Table ES-7** for 2015.

The vulnerable shadow population is provided in **Table ES-8** for both 2010 and 2015. The vulnerable shadow population was determined using the behavioral assumptions for evacuating shadow population and is based on evacuation level (storm category), not evacuation zone.

Table ES-6 – Vulnerable Population by Destination for 2010

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
DeSoto County					
To Friends and Family	929	181	738	1,243	0
To Hotel/ Motel	116	20	81	137	0
To Public Shelter	398	72	291	492	0
To Other Destination	216	43	176	296	0
Highlands County					
To Friends and Family	0	0	0	6	19
To Hotel/ Motel	0	0	0	1	4
To Public Shelter	0	0	0	3	10
To Other Destination	0	0	0	1	4
Okeechobee County					
To Friends and Family	7,291	4,440	10,407	0	0
To Hotel/ Motel	1,016	500	1,236	0	0
To Public Shelter	2,818	1,780	4,137	0	0
To Other Destination	1,655	880	2,132	0	0

Note: Vulnerable population destinations determined using SRESP behavioral data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

Table ES-7 – Vulnerable Population by Destination for 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
DeSoto County					
To Friends and Family	1,205	230	889	1,514	0
To Hotel/ Motel	141	25	95	161	0
To Public Shelter	494	89	343	585	0
To Other Destination	284	55	214	363	0
Highlands County					
To Friends and Family	0	0	0	7	20
To Hotel/ Motel	0	0	0	1	4
To Public Shelter	0	0	0	3	10
To Other Destination	0	0	0	2	5
Okeechobee County					
To Friends and Family	7,499	4,671	12,211	0	0
To Hotel/ Motel	1,034	519	1,430	0	0
To Public Shelter	2,904	1,876	4,866	0	0
To Other Destination	1,690	918	2,479	0	0

Note: Vulnerable population destinations determined using SRESP behavioral data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

Table ES-8 – Vulnerable Shadow Evacuation Population

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
2010					
DeSoto County	13,570	14,422	14,893	14,898	15,725
Hardee County	11,442	11,442	12,367	13,292	14,217
Highlands County	23,236	23,236	26,816	33,967	37,519
Okeechobee County	10,976	8,662	0	0	0
Polk County	90,925	113,173	135,420	157,668	179,915
2015					
DeSoto County	14,218	15,212	15,783	15,816	16,759
Hardee County	12,163	12,163	13,448	14,733	16,019
Highlands County	23,840	23,840	28,024	36,382	40,537
Okeechobee County	12,060	9,819	0	0	0
Polk County	93,243	118,376	143,508	168,641	193,773

Note: Vulnerable shadow population determined using SRESP behavioral data and county provided evacuation zones.

H. Evacuation Model Scenarios

There are literally thousands of possible combinations of variables that can be applied using the evacuation transportation model, which will result in thousands of possible outcomes. For the purposes of this analysis, two distinct sets of analyses were conducted using the SRESP evacuation transportation model, including one set of analysis for growth management purposes and one set of analysis for emergency management purposes. The two sets of analysis include the following:

- **Base Scenarios** – The base scenarios were developed to estimate a series of worst case scenarios and are identical for all eleven RPCs across the State. These scenarios assume 100 percent of the vulnerable population evacuates and includes impacts from counties outside of the RPC area. These scenarios are generally designed for growth management purposes, in order to ensure that all residents that choose to evacuate during an event are able to do so. The base scenarios for the Central Florida region are identified in **Table ES-9**; and,

- **Operational Scenarios** – The operational scenarios were developed by the RPCs in coordination with local county emergency managers and are designed to provide important information to emergency management personnel to plan for different storm events. These scenarios are different from region to region and vary for each evacuation level. The operational scenarios for the Central Florida region are identified in **Table ES-10**.

Because of the numerous possible combinations of variables that can be applied in the model, the evacuation transportation model is available for use through the Central Florida RPC to continue testing combinations of options and provide additional information to emergency managers.

I. Clearance Time Results

Each of the ten base scenarios and ten operational scenarios were modeled for the Central Florida Region using the regional evacuation model. Results were derived from the model to summarize the evacuating population, evacuating vehicles, clearance times, and critical congested roadways. Detailed results are discussed in Chapter IV. Clearance times are presented in this executive summary since the determination of clearance time is one of the most important outcomes from the evacuation transportation analysis.

Calculated clearance times are used by county emergency managers as one input to determine when to recommend an evacuation order. This calculation can include the population-at-risk, shadow evacuees, as well as evacuees from other counties anticipated to pass through the county. Clearance time is developed to include the time required for evacuees to secure their homes and prepare to leave, the time spent by all vehicles traveling along the evacuation route network, and the additional time spent on the road caused by traffic and road congestion. Clearance time does not relate to the time any one vehicle spends traveling along the evacuation route network, nor does it guarantee vehicles will safely reach their destination once outside the County. The four clearance times that are calculated as part of the evacuation transportation analysis include the following:

Table ES-9 – Base Scenarios

	Scenario 1 Level A 2010	Scenario 2 Level B 2010	Scenario 3 Level C 2010	Scenario 4 Level D 2010	Scenario 5 Level E 2010
Demographic Data	2010	2010	2010	2010	2010
Highway Network	2010	2010	2010	2010	2010
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	12-hour	12-hour	12-hour	12-hour	12-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	100%	100%	100%	100%	100%
Evacuation Zone	A	B	C	D	E
Counties Evacuating	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas
	Scenario 6 Level A 2015	**Scenario 7 Level B 2015**	**Scenario 8 Level C 2015**	**Scenario 9 Level D 2015**	**Scenario 10 Level E 2015**
Demographic Data	2015	2015	2015	2015	2015
Highway Network	2015	2015	2015	2015	2015
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	12-hour	12-hour	12-hour	12-hour	12-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	100%	100%	100%	100%	100%
Evacuation Zone	A	B	C	D	E
Counties Evacuating	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas

Table ES-10 – Operational Scenarios

	Scenario 1 Level A 2010	Scenario 2 Level B 2010	Scenario 3 Level C 2010	Scenario 4 Level D 2010	Scenario 5 Level E 2010
Demographic Data	2010	2010	2010	2010	2010
Highway Network	2010	2010	2010	2010	2010
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	9-hour	12-hour	9-hour	12-hour	12-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	Planning	Planning	Planning	Planning	Planning
Evacuation Level	A	B except as noted below	C except as noted below	D except as noted below	E except as noted below
Counties Evacuating	Manatee Hillsborough Pinellas Hardee Polk Osceola Orange Lake	St. Lucie (C) Indian River (C) Osceola Highlands Hardee Polk Manatee (A) Hillsborough (A)	Palm Beach (D) Martin (D) St. Lucie Okeechobee Highlands Glades Hendry Polk (B) Hardee (B)	Lee Charlotte Sarasota DeSoto Hardee Highlands Polk (C) Manatee (C) Osceoloa (B) Orange (B)	Martin St. Lucie Indian River Okeechobee (D) Highlands (D) Polk (C) Osceola (D) Orange (C) Lake (C) Sumter (C)
	Scenario 6 Level A 2015	**Scenario 7 Level B 2015**	**Scenario 8 Level C 2015**	**Scenario 9 Level D 2015**	**Scenario 10 Level E 2015**
Demographic Data	2015	2015	2015	2015	2015
Highway Network	2015	2015	2015	2015	2015
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	9-hour	12-hour	12-hour	9-hour	12-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	Planning	Planning	Planning	Planning	Planning
Evacuation Level	A except as noted below	B except as noted below	C except as noted below	D except as noted below	E except as noted below
Counties Evacuating	Lee (B) Charlotte (B) Sarasota (B) DeSoto (B) Hardee Highlands Polk Manatee Osceoloa Orange	Martin (C) St. Lucie (C) Indian River (C) Okeechobee Highlands Polk Osceola Orange Lake Sumter	Manatee (D) Hillsborough (D) Pinellas (D) Hardee Polk Osceola Orange Lake	Palm Beach (E) Martin (E) St. Lucie Okeechobee Highlands Glades Hendry Polk (C) Hardee (C)	St. Lucie Indian River Okeechobee Osceola Highlands (D) Hardee (C) Polk (C) Manatee (B) Hillsborough (B)

- **Clearance Time to Shelter** - The time necessary to safely evacuate vulnerable residents and visitors to a "point of safety" within the county based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from the point in time when the evacuation order is given to the point in time when the last vehicle reaches a point of safety within the county. Key points to remember for clearance time to shelter include:
  - All in-county trips reach their destination within the county; and,
  - This definition does not include any out of county trips.

- **In-County Clearance Time** - The time required from the point an evacuation order is given until the last evacuee can either leave the evacuation zone or arrive at safe shelter within the county. This does not include those evacuees leaving the county on their own. Key points to remember for in-county clearance time include:
  - All in-county trips reach their destination within the county;
  - All out of county trips exit the evacuation zone, but may still be located in the county; and,
  - This definition does not include out-of-county pass-through trips from adjacent counties, unless they evacuate through an evacuation zone.

- **Out of County Clearance Time** - The time necessary to safely evacuate vulnerable residents and visitors to a "point of safety" within the county based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from the point an evacuation order is given to the point in time when the last vehicle assigned an external destination exits the county. Key points to remember for out of county clearance time include:
  - The roadway network within the county is clear;
  - All out of county trips exit the county, including out of county pass-through trips from adjacent counties; and,
  - All in-county trips reach their destination.

- **Regional Clearance Time** - The time necessary to safely evacuate vulnerable residents and visitors to a "point of safety" within the (RPC) region based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from last vehicle assigned an external destination exits the region. Key points to remember for regional clearance time include:
  - The roadway network within the RPC is clear;
  - All out of county trips exit the RPC, including out of county pass-through trips from adjacent counties;
  - All in-county trips reach their destination; and,
  - Regional clearance time is equal to the largest out of county clearance time for a given scenario for any of the counties within the RPC, since the out of county clearance time includes out of county pass through trips from adjacent counties.

Calculated clearance times are used by county emergency managers as one input to determine when to recommend an evacuation order. Clearance times for each of the base scenarios are summarized in **Table ES-11** and **ES-12**, while clearance times for each of the operational scenarios are summarized in **Table ES-13** and **Table ES-14.** Clearance time includes several components, including the mobilization time for the evacuating population to prepare for an evacuation (pack supplies and personal belongs, load their vehicle, etc.), the actual time spent traveling on the roadway network, and the delay time caused by traffic congestion.

Base Scenarios

In-county clearance times for the base scenarios range from 12.5 hours for the evacuation level A scenarios to 35.5 hours for Okeechobee County for evacuation level E scenario in 2010. Clearance Time to Shelter shows a similar pattern, with clearance times for the base scenarios ranging from 10 hours for the evacuation level A scenarios to 30 hours for DeSoto County for evacuation level E scenario in 2010.

In 2015, in-county clearance times for the base scenarios increase slightly to between 12.5 hours for the evacuation level A scenarios and 40.5 hours for Okeechobee County for the evacuation level E scenario. Clearance Time to Shelter shows a similar pattern, with clearance times for the base scenarios ranging from 10 hours for the evacuation level A scenarios to 38.5 hours for DeSoto County for evacuation level E scenario in 2015.

Out of county clearance times for the base scenarios range from 13.5 hours for the base evacuation level A scenario to 44.5 hours in Polk County for the evacuation level E scenario. Out of county clearance times increase slightly in 2015, with Polk County at 48.5 hours for evacuation level E. Regional clearance time for the five county CFRPC region ranges from 15 hours to 44.5 hours in 2010 and from 16 to 48.5 hours in 2015.

Operational Scenarios

In-county clearance times for the 2010 operational scenarios range from 0 hours to 27 hours depending upon the scenario. Counties that were not included in the evacuation scenario will have an in-county clearance time of 0 since no one within the county is evacuating. Clearance Time to Shelter shows a similar pattern, with clearance times for the operational scenarios ranging from 0 hours to 20.5 hours depending upon the county and the scenario.

In 2015, in-county clearance times for the operational scenarios vary from 0 hours to 18.5 hours for the level D evacuation in Okeechobee County. Clearance Time to Shelter shows a similar pattern that depends upon the scenario, with clearance times for the base scenarios ranging from 0 hours to 14.5 hours.

Out of county clearance times for the 2010 operational scenarios range from 9 hours to 33.5 hours for the evacuation level D scenario. Out of county clearance times for all counties in 2015 range from 12.5 to 23.5 hours depending upon the scenario. Regional clearance time for the five county CFRPC region ranges from 11 hours to 33.5 hours in 2010 and between 15 and 23.5 hours in 2015.

Table ES-11 – 2010 Clearance Times for Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Clearance Time to Shelter					
DeSoto County	12.5	13.0	16.5	22.0	30.0
Hardee County	10.0	10.5	10.5	9.5	11.0
Highlands County	12.5	12.5	12.5	12.5	12.5
Okeechobee Co.	12.5	12.5	0.0	0.0	0.0
Polk County	13.0	15.0	16.5	16.0	20.5
In-County Clearance Time					
DeSoto County	13.5	13.5	17.5	24.0	32.0
Hardee County	12.5	12.5	12.5	12.0	12.5
Highlands County	13.0	13.0	13.0	13.0	13.0
Okeechobee Co.	15.0	15.5	20.0	26.0	35.5
Polk County	13.5	15.5	17.0	16.5	21.0
Out of County Clearance Time					
DeSoto County	13.5	14.0	18.0	24.0	32.0
Hardee County	13.5	13.5	18.0	25.0	33.5
Highlands County	14.5	14.5	19.0	25.0	34.5
Okeechobee Co.	15.0	16.0	19.5	25.5	35.0
Polk County	14.5	21.0	24.0	36.5	44.5
Regional Clearance Time					
Central Florida	15.0	21.0	24.0	36.5	44.5

Table ES-12 – 2015 Clearance Times for Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Clearance Time to Shelter					
DeSoto County	12.5	13.5	14.5	29.5	38.5
Hardee County	10.0	10.5	11.0	11.0	38.0
Highlands County	12.5	12.5	12.5	12.5	12.5
Okeechobee Co.	12.5	12.5	0.0	0.0	0.0
Polk County	13.0	16.0	17.5	30.5	20.5
In-County Clearance Time					
DeSoto County	13.5	14.0	22.0	30.5	38.5
Hardee County	12.5	12.5	12.5	12.5	39.5
Highlands County	13.0	13.0	13.0	13.0	13.0
Okeechobee Co.	15.0	16.0	24.5	33.0	40.5
Polk County	13.5	16.5	18.0	31.0	21.0
Out of County Clearance Time					
DeSoto County	13.5	14.5	22.0	31.0	41.0
Hardee County	13.0	14.5	22.0	31.5	41.5
Highlands County	14.5	15.0	22.5	32.0	39.5
Okeechobee Co.	15.0	16.0	24.0	32.5	40.0
Polk County	16.0	18.5	32.0	35.0	48.5
Regional Clearance Time					
Central Florida	16.0	18.5	32.0	35.0	48.5

Table ES-13 – 2010 Clearance Times for Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Clearance Time to Shelter					
DeSoto County	0.0	0.0	0.0	20.5	0.0
Hardee County	5.0	6.5	5.5	10.5	0.0
Highlands County	0.0	12.5	9.5	12.5	12.5
Okeechobee Co.	0.0	0.0	0.0	0.0	0.0
Polk County	10.0	13.0	10.0	13.0	13.0
In-County Clearance Time					
DeSoto County	0.0	0.0	0.0	27.0	0.0
Hardee County	8.5	10.5	8.5	12.5	0.0
Highlands County	0.0	13.0	10.0	13.0	13.0
Okeechobee Co.	0.0	0.0	14.5	0.0	14.5
Polk County	10.5	13.5	10.5	13.5	13.5
Out of County Clearance Time					
DeSoto County	10.0	12.5	14.0	27.5	13.5
Hardee County	10.0	11.5	15.0	27.5	13.5
Highlands County	9.0	13.0	15.0	27.0	15.0
Okeechobee Co.	9.0	13.5	14.0	26.0	14.0
Polk County	11.0	15.0	19.0	33.5	17.0
Regional Clearance Time					
Central Florida	11.0	15.0	19.0	33.5	17.0

Table ES-14 – 2015 Clearance Times for Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Clearance Time to Shelter					
DeSoto County	11.5	0.0	0.0	0.0	0.0
Hardee County	6.0	0.0	9.0	9.0	9.5
Highlands County	9.5	12.5	0.0	9.5	12.5
Okeechobee Co.	0.0	12.5	0.0	3.0	0.5
Polk County	10.0	13.0	14.5	10.0	13.0
In-County Clearance Time					
DeSoto County	14.5	0.0	0.0	0.0	0.0
Hardee County	8.5	0.0	11.5	9.5	12.0
Highlands County	10.0	13.0	0.0	10.0	13.0
Okeechobee Co.	0.0	13.5	0.0	18.5	15.0
Polk County	10.5	13.5	15.0	10.5	13.5
Out of County Clearance Time					
DeSoto County	14.5	12.5	13.0	19.0	13.5
Hardee County	14.5	12.0	14.0	20.5	14.0
Highlands County	14.0	14.0	13.5	20.0	14.0
Okeechobee Co.	12.5	14.0	18.0	18.5	14.5
Polk County	16.5	15.0	23.5	23.5	15.5
Regional Clearance Time					
Central Florida	16.5	15.0	23.5	23.5	15.5

J. Maximum Evacuating Population Clearances

From an emergency management standpoint, it is important to get an understanding of the maximum proportion of the evacuating population that can be expected to evacuate at various time intervals during an evacuation. Should storm conditions change during an evacuation, emergency managers will need to be able to estimate what portion of the evacuating population is estimated to still remain within the county trying to evacuate.

Using the base scenarios, which assume 100% of the vulnerable population is evacuating, along with shadow evacuations and evacuations from adjacent counties, an estimate was made of the evacuating population actually able to evacuate out of each county by the time intervals of 12, 18, 24, and 36 hours. The estimated maximum evacuating population by time interval for 2010 is identified in **Table ES-15** and for 2015 in **Table ES-16**.

It is important to note that these estimates take into account many variables, including roadway capacity, in-county evacuating trips, out of county evacuating trips, evacuating trips from other counties, and background traffic that is impeding the evacuation trips. For this reason, the maximum evacuation population by time interval will vary slightly between evacuation level and either increase or decrease from one evacuation level to the next.

K. Sensitivity Analysis

As discussed previously, there are literally thousands of possible combinations of variables that can be applied using the evacuation transportation model, which will result in thousands of possible outcomes. As part of the analysis process, a sensitivity analysis was conducted using the prototype model to evaluate the effect of different response curves on the calculated evacuation clearance times. Calculated clearance times will never be lower than the designated response time, since some evacuating residents will wait to evacuate until near the end of the response time window. For example, using a 12-hour response curve in the analysis means that all residents will begin their evacuation process within 12-hours, and some residents will choose to wait and begin evacuating more than 11.5 hours from when the evacuation was ordered. This will generate a clearance time of more than 12 hours.

The sensitivity analysis identified that clearance times will vary by scenario and by any of the numerous parameters that can be chosen in a particular scenario model run (demographics, student population, tourist population, different counties that are evacuating, response curve, phasing, shadow evacuations, etc.). A few general rules of thumb did emerge from the sensitivity analysis that can provide some guidance to the region regarding the sensitivity of the response curve to the calculated clearance times:

- For low evacuation levels A and B, clearance time will vary by as much as 40 percent depending on the response curve. Low evacuation levels A and B have fewer evacuating vehicles that can be accommodated more easily on the transportation network. In most cases, clearance times typically exceed the response curve by one to two hours. Thus, a 12 hour response curve may yield a clearance time of 13 or 14 hours while an 18 hour response curve may yield a clearance time of 19 or 20 hours. This leads to a higher level of variability than larger evacuations;

Table ES-15 – Maximum Evacuating Population by Time Interval for 2010

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Estimated Evacuating Population Clearing DeSoto County					
12-Hour	13,537	14,055	12,103	10,165	7,934
18-Hour	15,229	16,398	18,155	15,247	11,900
24-Hour				20,329	15,867
36-Hour					21,156
Estimated Evacuating Population Clearing Hardee County					
12-Hour	10,171	10,171	8,245	6,380	5,093
18-Hour	11,442	11,442	12,367	9,570	7,639
24-Hour				12,760	10,185
36-Hour				13,292	14,217
Estimated Evacuating Population Clearing Highlands County					
12-Hour	19,230	19,230	16,936	16,310	13,067
18-Hour	23,236	23,236	25,405	24,465	19,600
24-Hour			26,816	32,620	26,134
36-Hour				33,979	37,567
Estimated Evacuating Population Clearing Okeechobee County					
12-Hour	19,006	21,782	23,705	18,127	13,207
18-Hour	23,757	29,043	35,557	27,191	19,810
24-Hour			38,520	36,254	26,414
36-Hour				38,520	38,520
Estimated Evacuating Population Clearing Polk County					
12-Hour	75,248	64,670	67,710	51,836	48,516
18-Hour	90,925	97,005	101,565	77,754	72,775
24-Hour		113,173	135,420	103,672	97,033
36-Hour				155,508	145,549

Note: These estimates take into account many variables, including roadway capacity, in-county evacuating trips, out of county evacuating trips, evacuating trips from other counties, and background traffic that is impeding the evacuation trips. For this reason, the maximum evacuation population by time interval will vary between evacuation level and either increase or decrease from one evacuation level to the next.

Table ES-16 – Maximum Evacuating Population by Time Interval for 2010

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Estimated Evacuating Population Clearing DeSoto County					
12-Hour	14,525	14,676	10,825	8,711	6,862
18-Hour	16,341	17,734	16,238	13,066	10,293
24-Hour			19,846	17,422	13,724
36-Hour				22,503	20,587
Estimated Evacuating Population Clearing Hardee County					
12-Hour	11,227	10,066	7,335	5,613	4,632
18-Hour	12,163	12,163	11,003	8,419	6,948
24-Hour			13,448	11,225	9,264
36-Hour				14,733	13,896
Estimated Evacuating Population Clearing Highlands County					
12-Hour	19,730	19,072	14,946	13,648	12,331
18-Hour	23,840	23,840	22,419	20,472	18,496
24-Hour			28,024	27,296	24,662
36-Hour				36,395	36,993
Estimated Evacuating Population Clearing Okeechobee County					
12-Hour	20,150	23,198	21,177	15,638	12,706
18-Hour	25,187	30,931	31,765	23,457	19,059
24-Hour			42,353	31,276	25,412
36-Hour				42,353	38,118
Estimated Evacuating Population Clearing Polk County					
12-Hour	69,932	76,784	53,816	57,820	47,944
18-Hour	93,243	115,177	80,723	86,730	71,916
24-Hour		118,376	107,631	115,640	95,888
36-Hour			143,508	168,641	143,832

Note: These estimates take into account many variables, including roadway capacity, in-county evacuating trips, out of county evacuating trips, evacuating trips from other counties, and background traffic that is impeding the evacuation trips. For this reason, the maximum evacuation population by time interval will vary between evacuation level and either increase or decrease from one evacuation level to the next.

- For mid-level evacuations such as C and sometimes D, clearance time varied by as much as 25 percent during the sensitivity analysis. The number of evacuating vehicles is considerably higher than for levels A and B, and lower response curves tend to load the transportation network faster than longer response curves. The variability in clearance times is less in these cases than for low evacuation levels; and,

- For high-level evacuations such as some level D evacuations and all E evacuations, clearance time variability is reduced to about 10 to 15 percent. Large evacuations involve large numbers of evacuating vehicles, and the sensitivity test identified that clearance times are not as dependent on the response curve as lower level evacuations since it takes a significant amount of time to evacuate a large number of vehicles.

The counties within the Central Florida Region are encouraged to test additional scenarios beyond what has been provided in this study. Each model run will provide additional information for the region to use in determining when to order an evacuation. Due to advancements in computer technology and the nature of the developed transportation evacuation methodology, this study includes a more detailed and time consuming analysis process than used in previous years studies. Counties interested in testing various response curves for each scenario can easily do so using the TIME interface to calculate clearance times for different response curves.

L. Summary and Conclusions

Through a review of the results of the 20 different scenarios (10 base and 10 operational), several conclusions could be reached regarding the transportation analysis, including the following:

- Critical transportation facilities within the CFRPC region include I-4, US 17, SR 64, SR 70, SR 62, US 98, US 27, US 441, US 92, and US 17. For large storm events, such as level D and E evacuations, other State facilities also play an important role in evacuations;

- During the level A and B evacuation scenarios, the roadway segments with the highest vehicle queues are primarily concentrated along the major Interstate and State Highway system. During these levels of evacuation, State and County officials should coordinate personnel resources to provide sufficient traffic control at interchanges and major intersections along these routes;

- In contrast, for the higher level C, D, and E evacuation scenarios, many other roadway facilities, both within and outside of the region, will require personnel resources for sufficient traffic control at interchanges and major intersections;

- CFRPC counties play a major role even when evacuations occur in other parts of the State, as seen in operational scenarios that assumed either Gulf Coast area storm events or East Coast area storm events. For example, evacuation traffic from the Treasure Coast area travels through Okeechobee and Highlands Counties, while evacuation traffic from the Southwest area greatly impacts Hardee, DeSoto, and Polk Counties. CFRPC counties should continue their coordination efforts with the State and provide assistance for a variety of storm events;

- The Florida Department of Transportation should continue to work with local counties on

implementing intelligent transportation system (ITS) technology, which will provide enhanced monitoring and notification systems to provide evacuating traffic with up to date information regarding expected travel times and alternate routes;

- The State can use the data and information provided in this report (specifically the evacuating vehicle maps in Volume 5-7) to estimate fuel and supply requirements along major evacuation routes to aid motorists during the evacuation process;

- For major evacuation routes that have signalized traffic control at major intersections, traffic signal timing patterns should be adjusted during the evacuation process to provide maximum green time for evacuating vehicles in the predominate north and east directions; and,

- The counties within the Central Florida Region are encouraged to test additional transportation scenarios beyond what has been provided in this study. Each model run will provide additional information for the region to use in planning for an evacuation. Counties interested in testing various response curves for each scenario can easily do so using the TIME interface to calculate clearance times for different evacuation conditions, such as different evacuation levels, different behavioral response assumptions, and different response curves.

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CHAPTER I
INTRODUCTION

The evacuation transportation analysis discussed in this volume documents the methodology, analysis, and results of the transportation component of the Statewide Regional Evacuation Study Program (SRESP). Among the many analyses required for the SRESP study, transportation analysis is probably one of the most important components in the process. By bringing together storm intensity, transportation network, shelters, and evacuation population, transportation analysis explicitly links people's behavioral responses to the regional evacuation infrastructure and helps formulate effective and responsive evacuation policy options. Due to the complex calculations involved and numerous evacuation scenarios that need to be evaluated, the best way to conduct the transportation analysis is through the use of computerized transportation simulation programs, or transportation models.

A. Background and Purpose

Over the years, different planning agencies have used different modeling approaches with varying degrees of complexity and mixed success. Some have used full-blown conventional transportation models such as the standard Florida model FSUTMS; others have used a combination of a simplified conventional model and a spreadsheet program, such as the Abbreviated Transportation Model (ATM). These models have different data requirements, use different behavioral assumptions, employ different traffic assignment algorithms, and produce traffic analysis results with different levels of detail and accuracy. These differences make it difficult for planning agencies to share information and data with each other. They also may produce undesirable conditions for staff training and knowledge sharing.

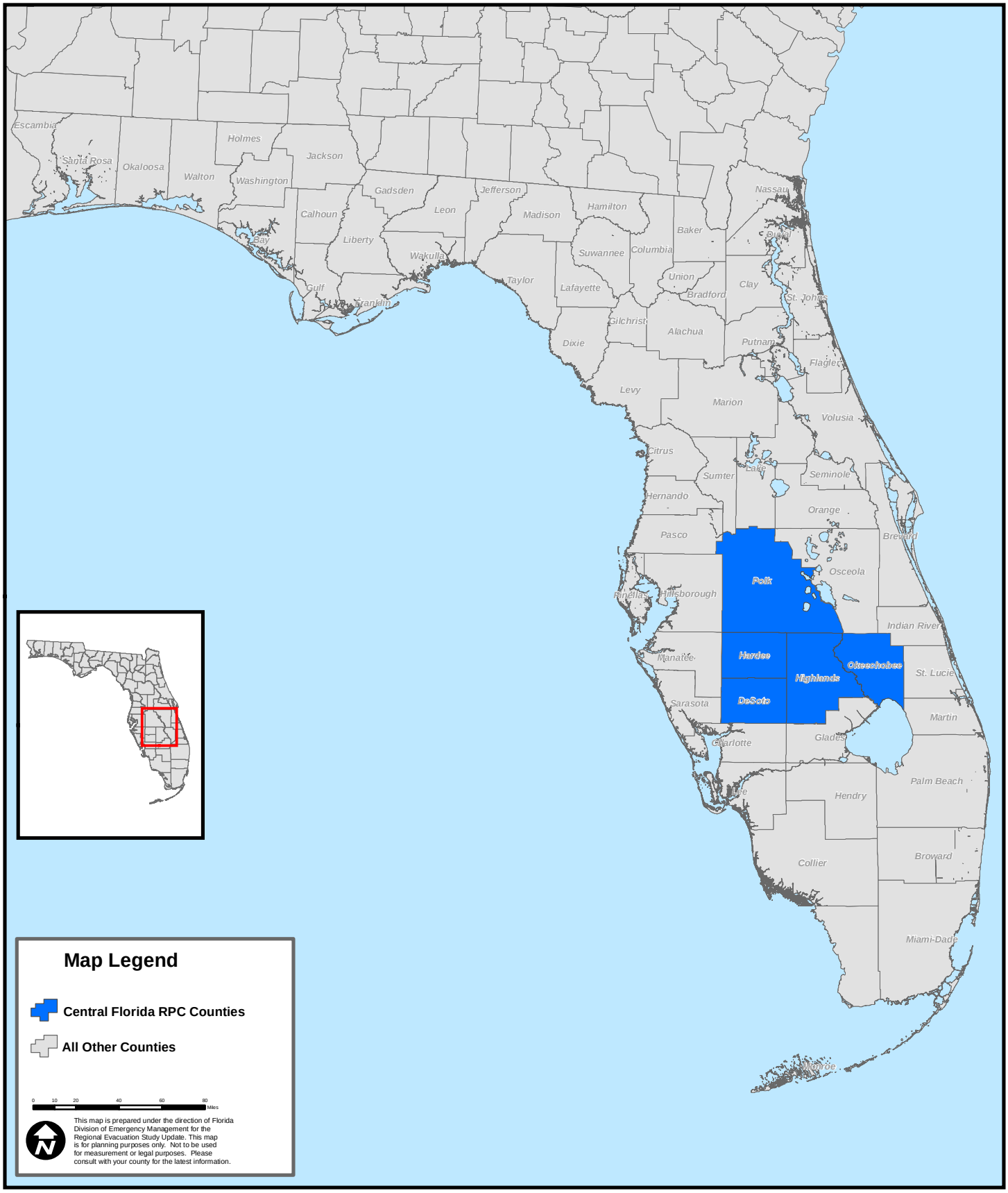
One of the objectives of the SRESP is to create consistent and integrated regional evacuation data and mapping, and by doing so, to facilitate knowledge sharing between state, regional, county, and local partners. To achieve this objective, it is important for all Regional Planning Councils to adopt the same data format and to use the same modeling methodologies for their transportation analyses. The primary purpose of the transportation component of the SRESP is to develop a unified evacuation transportation modeling framework that can be implemented with the data collected by the Regional Planning Councils.

B. Study Area

The study area for this analysis includes the five county Central Florida Regional Planning Council area, as illustrated in **Figure I-1**. The transportation modeling methodology includes some processes that are performed at the statewide level, in order to determine the impacts of evacuations from other regions impacting the evacuation clearance times in the Central Florida region. While the impact of other regions is included in the Central Florida analysis, it is important to note that the results of the transportation analysis presented in this document are only reported for the five counties included in the Central Florida RPC. Transportation analysis results for other regions and counties are reported in the corresponding Volume 4 report for those regions.

Figure I-1

Central Florida Regional Planning Council



Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: July, 2010

C. Input and Coordination

The development of the transportation methodology and framework required coordination and input from all eleven regional planning councils in Florida, along with the Division of Emergency Management, Department of Transportation, Department of Community Affairs, and local county emergency management teams. At the statewide level, the transportation consultant, Wilbur Smith Associates, participated in SRESP Work Group Meetings which were typically held on a monthly basis to discuss the development of the transportation methodology and receive feedback and input from the State agencies and RPCs.

At the local and regional level, Wilbur Smith Associates conducted a series of four regional meetings to coordinate with and receive input from local county emergency management, the regional planning council, local transportation planning agencies and groups, as well as other interested agencies. The four meetings held in the Central Florida region included the following:

Regional Meeting No. 1 – Model Development Meeting

The first regional meeting for the Central Florida region was held on September 23, 2008 at 1:30 PM. The purpose of the model development meeting was to introduce the transportation model development process. Feedback received through this process was used and incorporated into the development of the evacuation transportation methodology and framework.

Regional Meeting No. 2 – Model Implementation Meeting

The second regional meeting for the Central Florida region was held on March 23, 2009 at 1:30 PM. The purpose of the model implementation meeting was to discuss the evacuation modeling methodology, present the evacuation networks and small area data summaries, and obtain input from local county emergency management staff regarding county level traffic management plans, model input assumptions, and the geographic extents of the regional model. Feedback received through this process was used and incorporated into the development of the Central Florida regional model.

Regional Meeting No. 3 – Scenario Development Meeting

The third regional meeting for the Central Florida region was held on October 6, 2009 at 10:00 AM. The purpose of the scenario development meeting was to discuss the final evacuation methodology and framework, review the Central Florida regional model network, discuss the base scenarios for the region for growth management purposes, and discuss and receive input on the operational scenarios to be evaluated for emergency management purposes.

Regional Meeting No. 4 – Transportation Analysis Meeting

The fourth and final regional meeting for the Central Florida region was held on September xx, 2010 at x:00 PM. The purpose of the transportation analysis meeting was to review the draft results of the transportation analysis and receive feedback on the draft final report.

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CHAPTER II
EVACUATION MODELING METHODOLOGY AND FRAMEWORK

The evacuation modeling methodology and framework was developed during 2008 and 2009 in coordination with all eleven Regional Planning Councils and the Division of Emergency Management. The methodology used in the Central Florida RPC Evacuation Transportation Analysis is identical to the methodology used for all eleven Regional Planning Councils and is summarized in the following sections.

A. Behavioral Assumptions

In 2008, the Statewide Regional Evacuation Study Program (SRESP) commissioned a survey of Florida residents. The purpose of this survey was to develop an understanding of the behavior of individuals when faced with the prospect of an impending evacuation. These data were used to develop a set of "planning assumptions" that describe the way people respond to an order to evacuate and are an important input to the SRESP Evacuation Model. The behavioral data provides insights into how people respond to the changing conditions leading up to and during an evacuation.

The primary application of the survey data was to help anticipate how people would respond with respect to five behaviors:

- How many people would evacuate?
- When they would leave?
- What type of refuge they would seek?
- Where they would travel for refuge?
- How many vehicles would they use?

These evacuation behaviors are distinguished based on several descriptive variables as listed below:

- Type of dwelling unit (site-built home versus mobile home);
- The evacuation zone in which the evacuee reside; and,
- The intensity of the evacuation that has been ordered.

How many people?

The evacuation rate indicates the percent of residents who will leave their homes to go some place safer in each storm threat scenario. The evacuation rates are based on the following assumptions: that the storm track passes very close to the area being evacuated; and officials order evacuation for surge evacuation zones corresponding to storm category. Under the 100 percent response scenario, this rate will default to 100 percent.

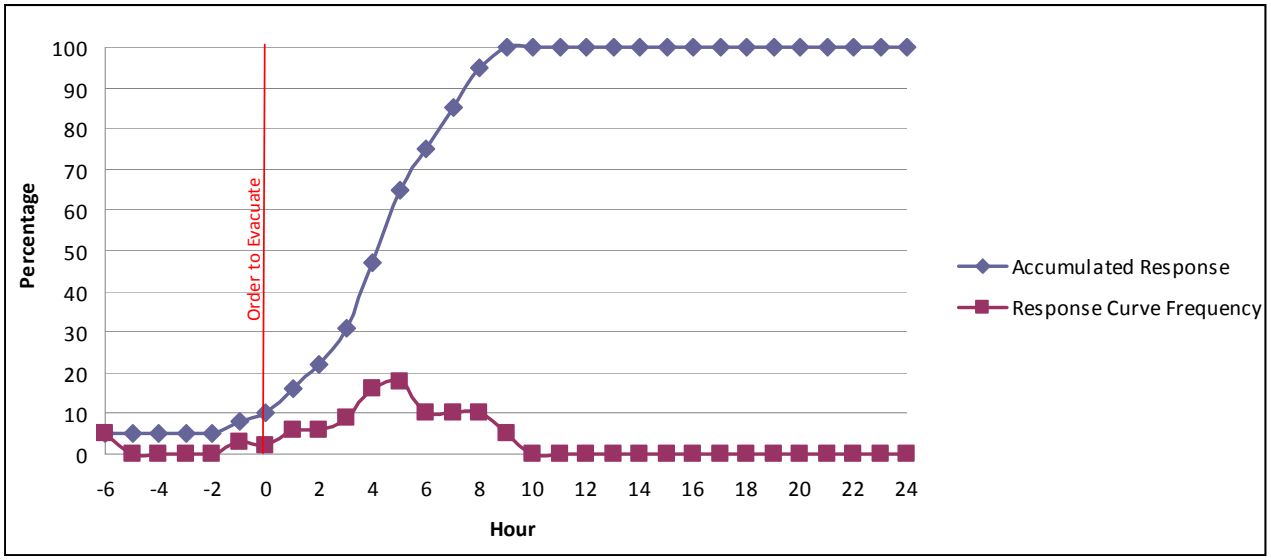
When will they leave?

Consistent with behavior observed in past evacuations, evacuees do not begin their journey toward safety all at the same time. Rather, evacuees each begin their trips at different times

based on their unique characteristics and constraints. Some individuals will prefer to evacuate soon after an order is given. Others may need to spend time securing personal property or seeing to the welfare of their relatives before they feel comfortable evacuating. Yet others will underestimate the threat posed to them by an oncoming storm and may not evacuate until very late. A set of evacuation response curves show the proportion of evacuation by increment of time for evacuation orders that were issued.

Each curve represents a different assumption on the amount of time it will take for an evacuating population to fully mobilize. The curves reflect the sense of urgency with which the population perceives the impending evacuation. Faster curves represent more urgent circumstances and slower curves represent less urgent circumstances. These curves are used by the model to divide the total number of evacuating trips into segments representing each hour that evacuating trips begin their journey. For example, a nine hour curve will place a certain number of evacuating trips in the first segment. These trips will represent those evacuees leaving in the first hour of an evacuation. The curve will then place another number of trips in the second segment representing the number of people leaving in the second hour of an evacuation. This process continues until all evacuees have begun their journey, which in a nine hour curve occurs during the ninth segment. All of the curves developed for the SRESP assume that some portion of the evacuating population leave before an order to evacuate is given. Typically, this is ten percent of the evacuating population. The nine hour response curve used in the model is depicted in **Figure II-1**. Response curves are available in the model to evaluate six, nine, twelve, eighteen, twenty-four, and thirty-six hour responses.

Figure II-1 – Nine Hour Response Curve



What type of refuge would be sought?
The survey data identified four types of refuge sought by evacuees. Specific rates were developed that identified the number of evacuees seeking shelter at each of these following different types of refuge:

- Friends and family;
- Hotel or motel;
- Public shelter; and,
- Other types of refuge not covered elsewhere in the list including, but not limited to, office space, churches, civic organization halls, and club houses.

Where will they travel?
The behavior survey distinguishes between trips that leave the county where an evacuation journey begins and trips that stay within the county. The out-of-county trip rate indicates the percent of evacuees who will seek refuge outside their county of residence. The in-county trip rate will determine how many of the evacuating trips are destined to remain within the county.

How many vehicles are used?
The vehicle use rate indicates the percentage of vehicles available to the evacuating household(s) that will be used in evacuation in each storm threat scenario. This rate ultimately determines the number of vehicles on the highways during an evacuation.

B. Zone System and Highway Network

The SRESP evacuation model relies upon data that covers the entire State of Florida as well as areas covering the States of Georgia, Alabama, Mississippi, South Carolina, North Carolina, and Tennessee. While the primary focus of the model is with evacuation behavior within Florida, areas outside of the state had to be considered in order to allow a more precise routing of evacuation traffic. This allows the model to measure the flow of traffic across the state line if needed.

Zone System
The data included in this system contain the demographic information crucial to modeling evacuation traffic. The demographic information is labeled as “small area data”. These data provide population and dwelling unit information that will identify where the individuals in the region reside. The planning assumptions developed from the behavioral analysis conducted for this study were applied to these demographic data. The result is a set of evacuation trips generated by the evacuation model. The number of these trips will vary depending on the hazard conditions that prompt the evacuation.

The RPC developed their small area data by consulting either MPO or FDOT model Traffic Analysis Zone (TAZ) data or Census 2000 geography. In some cases, demographic data were developed at the parcel level. Data were developed for the following years: 2006, 2010, and 2015.

Traffic Evacuation Zones (TEZ)
Small area data geographies were aggregated into larger units known as Traffic Evacuation Zones (TEZ). These TEZ form the basic unit of analysis in the evacuation model similar to how traffic analysis zones form the basic unit of analysis in a standard travel demand model. The

TEZ system was developed so that the small area geographies will nest completely within one TEZ or another. This eliminates any potential for split data and will ensure that data in the TEZ system can always be updated with relative ease.

The final TEZ system for the State of Florida has 17,328 zones. This number provides sufficient detail to accurately accommodate the assignment of evacuation trips onto an evacuation network. Furthermore, additional roadway segments have been included in the model's highway network to facilitate the movement of evacuation trips onto and off of the evacuation network. Each TEZ has a unique identification number that will be used by the model to connect evacuation trip generation to the evacuation highway network.

Highway Network

A highway network is used to represent the roads that evacuees travel along as they journey toward safety. Various datasets were used to develop the highway network database as follows:

- Florida Statewide Model Network – The 2005 base year statewide model was used as a basis for developing the evacuation model. The statewide model was obtained from the Florida Department of Transportation (FDOT) Systems Planning Office;

- Evacuation Routes – Evacuation routes in each Regional Planning Council (RPC) area were obtained from the RPCs themselves. The RPCs relied on their constituent counties to provide them with information on which roads were to be included as evacuation routes;

- Florida Highway Data Software (FHD) – The 2006 Florida Highway Data software was obtained from FDOT. This software was used to view and query data extracted from the Roadway Characteristics Inventory (RCI) which includes number of lanes, facility types, speed limits, etc.;

- FDOT Quality/Level of Service Handbook – The 2002 FDOT Quality/Level of Service Handbook (QLOS) and the 2007 LOS Issue Papers (2002 FDOT QLOS addendum) were obtained from the FDOT Systems Planning Office website. The QLOS handbook and the LOS tables were used to establish roadway capacities for evacuation purposes; and,

- Microsoft and Google aerials and maps – These aerial maps were used to identify and clarify roadway alignments. Whenever questions concerning the existence of particular facilities, their characteristics, or their alignments arose, aerials were referenced.

Changes to the Florida Statewide Model Network

Some modifications to the Florida Statewide Model network were necessary in order to make the data usable for evacuation modeling purposes:

- The original database, which was coded for a 2005 base year, was updated to 2006 conditions to correspond to the SRESP base year;
- Additional facilities had to be added to the network to accommodate evacuation traffic behavior;
- Many attributes from the original data set were removed and new ones were added

specifically tailored for trip activity for evacuation modeling purposes;
- Based on RPC input, any missing facilities instrumental for evacuations were coded into the highway network database;
- The highway network database was extensively reviewed for the correct coding of one-way links;
- The 2006 FHD software was used to verify the highway network database number of lanes for the state roads, US highways, and major county roads. For other roads Microsoft and Google aerial maps were used;
- The area type and facility type attributes for each roadway segment were verified for their consistency with existing conditions; and,
- The network attributes were modified to the specific needs of evacuation modeling and reporting purposes. The evacuation routes designated by the RPC were flagged for reporting purposes. The County name attribute and the RPC number attributes were checked and modified accordingly.

Capacities

Network capacities for the evacuation model are based on facility type and area type. The network facility type classification and the area type classification were retained from the existing Florida Statewide Model highway network database.

FDOT's 2002 Quality/Level of Service (QLOS) generalized level of service volume tables were used for estimating the link capacity for each combination of functional class and area type. The generalized level of service volume tables were generated from conceptual planning software which is based on the 2000 edition of the Highway Capacity Manual (HCM). Using statewide default values for each of these roadway characteristics, the generalized LOS volume tables were developed from the conceptual planning software.

The peak hour volume represents the most critical period for traffic operations and has the highest capacity requirements. Many urban routes are filled to capacity during each peak hour, and variation is therefore severely constrained. The peak hour directional volumes at LOS E, closely represent the maximum volume (capacity) that can be accommodated through a given roadway. In some cases the Peak Hour Two-Way LOS tables do not show the maximum services volumes at the LOS E. For example, the four-lane Class I arterial service volumes are only shown from LOS A to LOS D, This indicates that the maximum volume thresholds (capacity) are reached at LOS D and these volumes represent the capacity of the roadway.

A lookup table was created with facility type, area type, number of lanes, and capacities by comparing model network characteristics to the roadway characteristics in the QLOS manual. The lookup table is shown in **the Transportation Supplemental Data Report**. The capacity attribute in the network was automatically assigned for any given link with a specific facility type, area type and number of lanes during the network preparation process.

Speeds

The existing highway network database link speeds were verified for their reasonableness and their suitability for evacuation modeling purpose. The speed values of the existing statewide model database were reasonable and therefore retained in for evacuation modeling.

Roadway Attributes

The roadway attributes contain the highway characteristics for each link in the highway network. Some of the attributes like DISTANCE, FTYPE, ATYPE, etc., were retained from the highway network database and other attributes like DENSITY and EVAC_RTE are specific to the evacuation modeling and were included in the network.

Reverse Lane Operations

Additional changes were also made in order to accommodate reverse lane operations in an evacuation scenario. Most of the facilities that would be subject to a reverse lane operations scenario were coded as a pair of one-way links. Additional attributes were added to the network in order to allow for the correct calculation of capacity in the reverse lane direction. The configurations of reverse lane facilities reflect the reverse lane operations plans established by the State.

C. Background Traffic

The traffic that consumes the roadway capacity of a transportation system during an evacuation can be divided into two groups. The first group is the evacuation traffic itself. Once the evacuation demand is determined, this information is converted into a number of vehicles evacuating over time. These evacuation trips are then placed on a representation of the highway network by a model. The model determines the speed at which these trips can move and proceeds to move the evacuation trips accordingly. The result is a set of clearance times.

The second group of traffic is known as background traffic. Background traffic, as its name implies, is not the primary focus of an evacuation transportation analysis and is accounted for primarily to impede the movement of evacuation trips through the network. These trips represent individuals going about their daily business mostly unconcerned with the evacuation event. For the most part, background traffic represents trips that are relatively insensitive to an order to evacuate and are thus said to be occurring in the "background." Even though background traffic is relatively insensitive to evacuation orders, it is important to account for background traffic since it can have a dramatic impact on available roadway capacity. This in turn can severely affect evacuation clearance times.

Methodology used to Account for Background Traffic

There are two dynamics at work when evacuation traffic and background traffic interact with one another. The first is the effect of background traffic displacing evacuation traffic as background traffic attempts to use the same roads as the evacuation traffic. The second is the effect of evacuation traffic displacing background traffic. As vehicles move along the network and try to get onto certain roads they leave less room for other vehicles to use those same roads. As background traffic builds up there is less room for evacuation traffic to move, and vice versa. While the effect that evacuation traffic has on background traffic may be of some interest to those who are concerned with disruptions in daily trip making behavior during an evacuation event, for the purposes of this study we are much more interested in the effect that background traffic has on evacuation clearance times.

The effect that background traffic has on evacuation traffic can be stated in terms of available capacity. The more background traffic there is on a segment of road, the less capacity is available for evacuation traffic to use. Following this logic, it becomes apparent that by causing the available capacity to fluctuate throughout the evacuation event, one is able to sufficiently

account for the impact of background traffic. FDOT's Florida Traffic Information DVD was used to develop average peaking characteristics for various functional classes of roadways throughout the state. These characteristics were analyzed to determine how much capacity is available throughout a given day during an evacuation.

Two sets of curves were developed, one for coastal evacuating counties that represent lower background traffic and one for all other counties representing greater background traffic. The model then adjusts capacities up and down consistent with these curves as it simulates the evacuation.

Figure II-2 illustrates the set of curves showing the percentage of available capacity throughout a 24 hour period for a coastal evacuating county after the model accounts for background traffic. **Figure II-3** illustrates the set of curves showing the percentage of available capacity throughout a 24 hour period for all other counties after the model accounts for background traffic.

Figure II-2 – Percent of Available Capacity for Coastal Counties

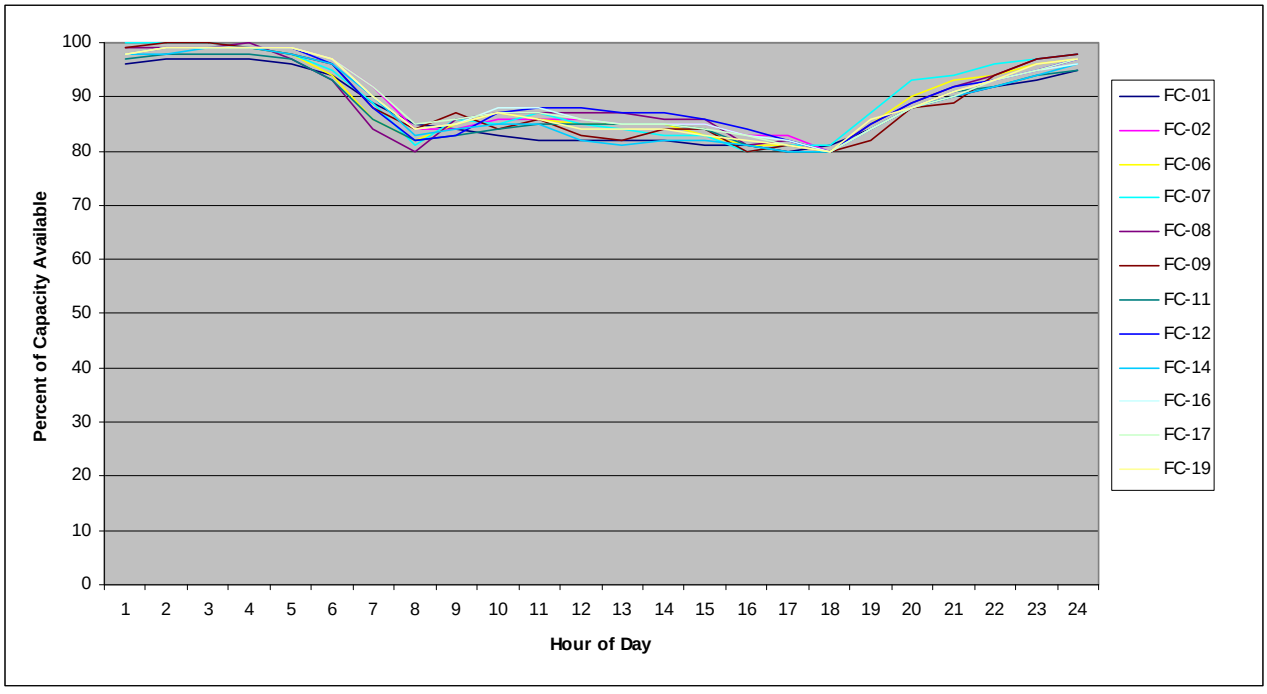
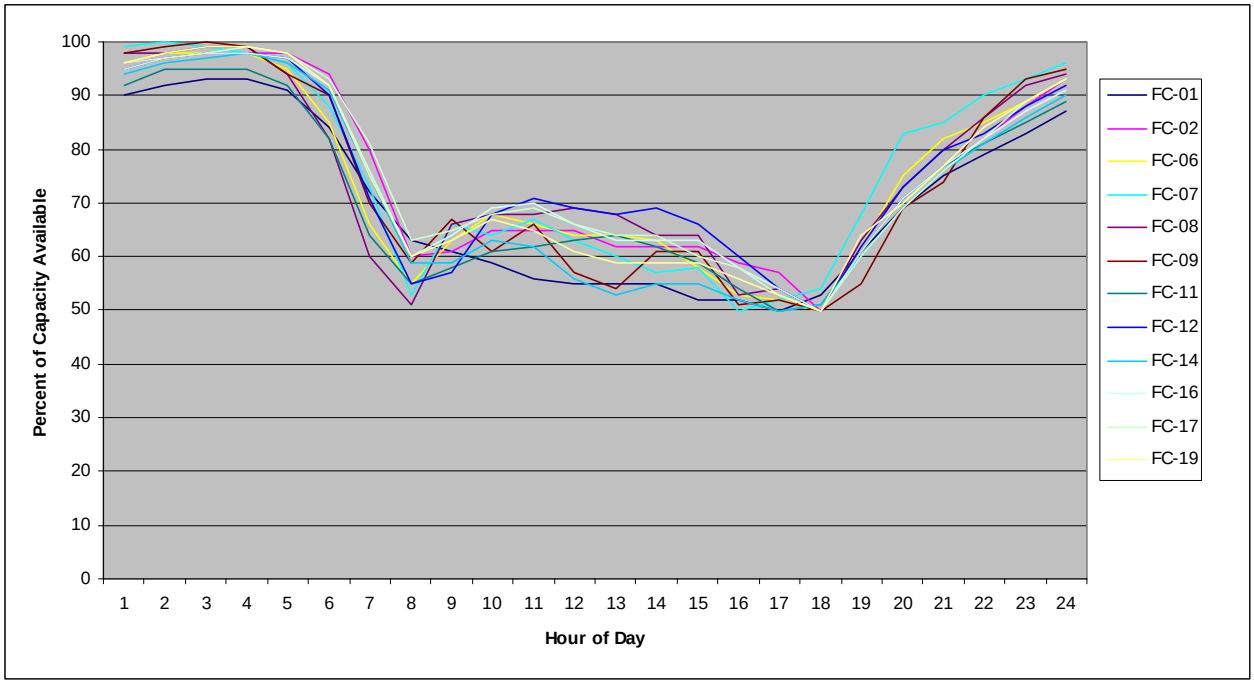


Figure II-3 – Percent of Available Capacity for Other Counties

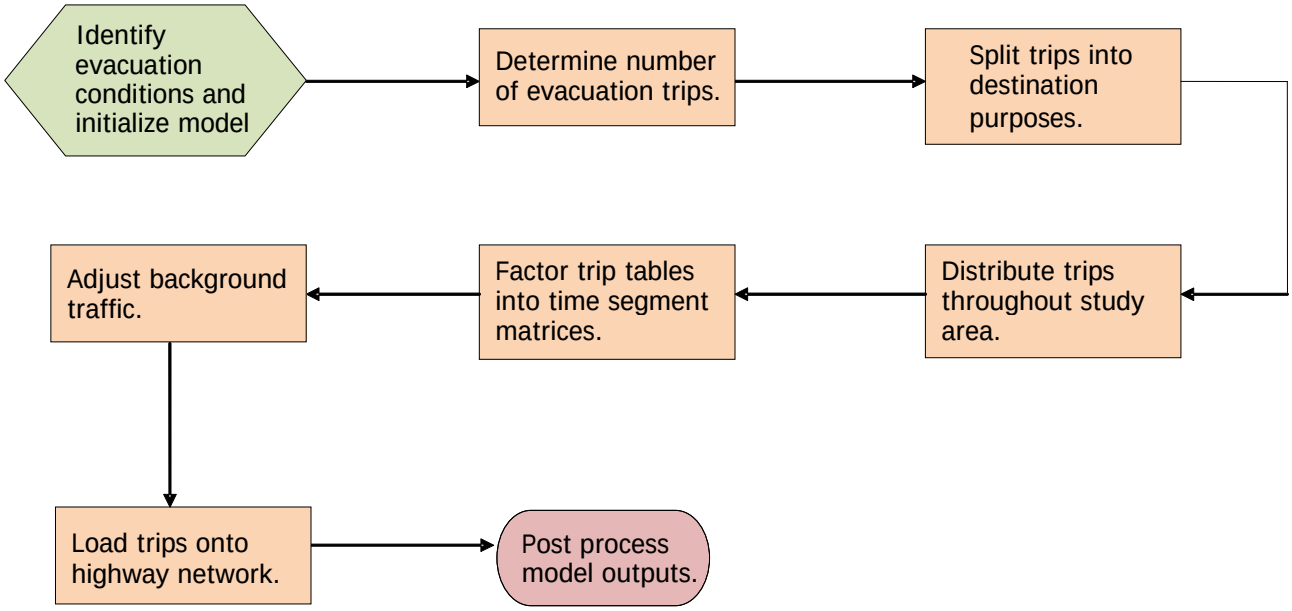


D. Evacuation Traffic

The model flow for the evacuation model is divided into a total of eight modeling steps. The following eight steps are represented graphically in the flowchart in **Figure II-4**:

1. Identify evacuation conditions and initialize model;
2. Determine number of evacuation trips;
3. Split trips into destination purposes;
4. Distribute trips throughout study area;
5. Factor trip tables into time segment matrices;
6. Adjust background traffic;
7. Load trips onto highway network; and,
8. Post process model outputs.

Figure II-4 - General Model Flow



Initializing the Model

At the beginning of the model flow, the model will need to determine the hazard conditions representing the particular scenario that will be analyzed. This will allow the model to accurately identify the areas that will be subject to evacuation and to determine the intensity of the evacuation event. This process will then establish the appropriate rates that will be used to determine the number of evacuation trips that will be generated.

Number of Evacuating Trips

After the model has finished initializing it will begin to calculate the number of evacuation trips that are generated. Estimating an appropriate number of trips is essential to ensuring that the behavior expressed on the highway network during trip assignment is reflective of likely conditions during a real world evacuation event.

The planning assumptions developed by the behavioral analysis were translated into a master rates file that can be referenced by the model in order to determine the number of evacuation trips that a particular scenario can be expected to generate.

Production Ends

Every trip has two ends. One end represents where a trip begins its journey and is typically referred to as the production end. The other end represents where a trip finishes its journey and is typically referred to as the attraction end. The calculation of the production end of each evacuation trip in the model is driven by the master rates file mentioned above.

Attraction Ends

The other end of an evacuation trip, the attraction end, is calculated using a much more simplified methodology. Public shelters have clearly defined capacities. For hotels and motels,

each room will be designated as an attraction. Trips destined to shelter with friends and family or in other unspecified destinations will have an attraction generated at each non-evacuating household in the model. This will ensure that these trips are evenly distributed around the area with some clumping occurring in highly residential areas.

Splitting Trips into Destination Purposes

Once the number of evacuation trips has been determined it will be necessary to divide the trips into various trip purposes. These purposes are based on the type of destination that an evacuee is headed to and the relative location of that destination. There are four types of destinations and two relative locations for a total of eight trip purposes, as identified below:

- Friends & Family – In County;
- Public Shelter – In County;
- Hotel/Motel – In County;
- Other – In County;
- Friends & Family – Out of County;
- Public Shelter – Out of County;
- Hotel/Motel – Out of County; and,
- Other – Out of County.

The same behavioral analysis that establishes the evacuation and vehicle use rates used to determine the number of evacuation trips that are being generated by the model is also a source of data for determining the various destinations where these evacuation trips are heading.

Trip End Balancing

Once the model has finished splitting the trip ends into their respective purposes, it will commence the process of balancing trip ends. The balancing of trip ends is critical so that the trip distribution process which is to follow this step will be able to tie every trip production to every trip attraction. A surplus or deficit of one trip end or the other may cause complications in the evacuation model that can lead to overestimating the model, underestimating the model, or aborting the model process.

In County Balancing - The trip balancing procedure begins by considering each purpose individually. If the trip purpose under consideration is an In County purpose the model compares the number of productions to the number of attractions. If the number of attractions is greater than the number of productions, the model will simply apply a universal adjustment of all attraction trip ends in the county down to the number of productions. The end result should be an equal number of In County productions and attractions.

If, on the other hand, the productions should exceed attractions the excess productions are shifted over to the corresponding Out of County purposes. For example, if the model estimates using the behavioral planning assumptions that there will be 3,000 evacuees destined In County to Hotel/Motel destinations, but there are only 2,500 Hotel/Motel attraction ends available in the county, the excess 500 trips will become Out of County Hotel/Motel trips.

Out of County Balancing - If the purpose under consideration is an Out of County purpose the model will balance the attractions regionally. Using data derived from the behavioral study, a

certain percentage of each out of county trip will be destined to a particular region. If a particular region is prohibited by the model from receiving evacuation trips, the model will reallocate the portion of evacuation trips originally destined for that regional equally among all other regions. **Table II-1** identifies the percentages of out of county trips destined from each region and to each region. When the model has finished balancing the evacuation productions and attractions, the model will then proceed with trip distribution.

Table II-1 – Out of County Trip Destinations by Region

From \ To	Apalachee	Central	East Central	North Central	Northeast	South	Southwest	Tampa Bay	Treasure Coast	West	Withla-coochie	Out-of-State
Apalachee	31.2%	0.1%	1.1%	2.3%	2.1%	0.0%	0.1%	0.7%	0.3%	3.5%	0.8%	57.8%
Central	5.9%	9.8%	13.0%	4.4%	4.7%	0.0%	4.2%	5.9%	5.4%	0.7%	1.7%	44.2%
East Central	2.5%	1.7%	27.1%	5.4%	5.9%	1.5%	2.6%	6.7%	0.8%	1.4%	3.1%	41.2%
North Central	5.2%	0.7%	3.6%	15.2%	6.3%	0.3%	0.3%	3.1%	0.2%	1.3%	2.0%	61.8%
Northeast	3.7%	0.7%	4.2%	6.6%	10.3%	0.6%	0.6%	1.8%	0.2%	1.9%	2.0%	67.4%
South	2.0%	3.4%	20.9%	2.1%	3.4%	24.5%	5.7%	2.1%	9.0%	0.5%	3.1%	23.4%
Southwest	1.4%	5.2%	15.9%	3.9%	3.3%	4.6%	11.0%	8.4%	3.2%	0.8%	5.4%	37.0%
Tampa Bay	3.2%	3.7%	14.1%	2.8%	4.5%	2.2%	1.3%	15.7%	2.0%	0.5%	7.3%	42.6%
Treasure Coast	2.8%	1.5%	22.8%	3.0%	4.4%	4.5%	4.0%	9.4%	11.5%	0.2%	2.0%	34.0%
West	6.3%	0.2%	2.1%	0.9%	3.5%	0.4%	0.1%	0.3%	0.3%	8.7%	0.8%	76.4%
Withla-coochee	2.4%	1.7%	12.4%	7.4%	3.3%	1.0%	0.7%	6.5%	0.5%	1.2%	15.0%	48.0%

Source: Derived from SRESP Behavioral Data and Planning Assumptions

Trip Distribution

After the model has determined how many evacuation trips there will be in a given scenario, split those trips into purposes, and balanced the trip ends for those purposes, it will be necessary for the model to perform a trip distribution. The trip distribution step in the model connects each production end to a unique attraction end. The end result is a trip table containing origins and destinations for each trip in the model. Typically, origin zones are referred to by the letter I and destination zones are referred to by the letter J. An Origin-Destination matrix, also known as an OD matrix, is one of the principal inputs into trip assignment. This matrix tells the model where each trip is coming from and where it is going to.

The trip distribution process begins by looping through each trip purpose and determining whether the purpose is In County or Out of County. In County trips are restricted to destination TEZs within the same county as the trip origin. Out of County trips are restricted to TEZs not in the same county as the trip origin. The trip distribution is conducted using a gravity model that relies on distances as the chief measure of impedance.

Time Segmentation

The final step of the model prior to initiating the trip assignment sequence is to segment the trip table into discreet time periods. This segmentation determines at what point in time each trip begins its evacuation. The model is set up to process a set of evacuation response curves with a period resolution of one-half hour. The model uses a set of factors developed from the behavioral response curves to divide the evacuation trip tables into the different segments.

The model makes the following assumptions. Due to limitations in the model, these assumptions cannot be adjusted. The analyst should keep these assumptions in mind when using results developed by the model:

- All evacuations begin when an order to evacuate has been issued;
- All evacuations begin during the first hour of daylight, approximately 7:00 AM;
- All evacuations begin during an average weekday;
- Some portion of evacuation trips, typically ten percent, leaves prior to the beginning of an evacuation; and,
- Those evacuation trips that leave prior to the beginning of an evacuation leave no later than the previous evening and have already cleared the network by the time an evacuation order is given.

E. Dynamic Traffic Assignment

Dynamic traffic assignment (DTA) was utilized because it is sensitive to individual time increments. DTA works by assigning a certain number of vehicles to the highway network in a given interval of time. The model then tracks the progress of these trips through the network over the interval. Another set of vehicles is assigned during the following time interval. The model then tracks the progress of these trips through the network along with the progress of the trips loaded in the previous time interval. As vehicles begin to arrive at the same segments of roadway, they interact with one another to create congestion. When vehicles that were loaded to the network in subsequent intervals of time arrive at the congested links, they contribute to the congestion as well. This results in a slowing down of the traffic and eventually spill-backs and queuing delays.

It is this time dependent feature of DTA that makes it well suited to evacuation modeling. By dynamically adjusting the travel times and speeds of the vehicles moving through the network as they respond to congestion the model is able to do the following:

- The evacuation model is able to estimate the critical clearance time statistics needed for this study;
- The model takes into account the impact of compounded congestion from multiple congestion points;
- The model is able to adjust the routing of traffic throughout the network as a function of congestion as it occurs throughout the evacuation; and,
- The model is capable of adjusting its capacities from time segment to time segment, making it possible to represent such phenomena as reverse lane operations and background traffic.

Parameters of the Evacuation Assignment

The DTA for the evacuation model makes use of certain parameters which dictate how the assignment will function. The parameters that were established are:

- **Capacity -** The SRESP evacuation model uses hourly lane capacities derived from the Florida Department of Transportation Quality/Level-of-Service Handbook. These capacities are initially set to represent Level-of-Service E conditions. These capacities are then further increased by an additional 20 percent for freeway links and 10 percent for non-freeway links. These increases in capacity are meant to reflect high volume usage typically found during an evacuation, optimal green timing of traffic signals and traffic control typically controlled during an evacuation by law enforcement personnel, and the use of shoulder and emergency lanes;

- **Storage -** Storage determines how many vehicles can remain standing on a length of roadway at any moment in time. The evacuation model assumes that storage is set to 250 vehicles per lane per mile. This assumes approximately 21 feet of space are "occupied" by any given vehicle. Given the mix of vehicles on a roadway network (including compacts, SUVs, trailers, and trucks) this spacing appears to be reasonable for stand-still traffic;

- **Time Intervals -** In order to properly implement a DTA model, the assignment process needs to be segmented according to a set of time intervals. Half-hour intervals provide sufficient detail to satisfy the planning needs of both emergency management and growth management concerns. The model calculates vehicle assignments over 192 such intervals for a 96 hour model period. This is sufficient to capture all evacuation activity during an event and allows sufficient time for the evacuation traffic to clear at both the county and regional level; and,

- **One-Way Evacuation Operation -** The State of Florida has recently published a series of one-way evacuation operation plans for major corridors throughout the state. The intention of these plans is to fully maximize the available capacity on a freeway by using all lanes to move evacuees away from danger. The model will emulate one-way operations by simultaneously increasing the capacity of links headed away from the threatened area and eliminating the capacity of links headed toward the threatened area. The capacity of links headed away from the threatened area will increase by 66 percent, which is consistent with capacity increases used by Florida's Turnpike Enterprise. Past experience of reverse lane operations have shown that capacities do not double, as is commonly assumed, but increase by a lower percentage of about two thirds.

F. Prototype Model Development

Wilbur Smith Associates developed the prototype model to test the modeling methodology used to calculate evacuation clearance times. The prototype model demonstrated the viability of the methodology developed for this study. This included the use of dynamic traffic assignment, background traffic curves, regional sub-area trip balancing, the use of survey rates, the use of 100% participation rates, response curves, and county-by-county phasing of evacuations.

The prototype model served as the backbone for all regional evacuation models that have been developed for this study. The models implemented for each RPC use a structure similar to the prototype with identical methodology.

The SRESP evacuation model relies upon data that covers the entire State of Florida as well as areas covering the States of Georgia, Alabama, Mississippi, South Carolina, North Carolina, and Tennessee. While the primary focus of the model is with evacuation behavior within Florida, areas outside of the state had to be considered in order to allow a more precise routing of evacuation traffic. This allows the model to measure the flow of traffic across the state line if needed.

CHAPTER III
REGIONAL MODEL IMPLEMENTATION

The evacuation transportation model discussed in Chapter II includes several components that are completed using a statewide dataset (determine number of evacuation trips, split trips into destination purposes, and distribute trips throughout state) and several components that can only be completed at the regional level (factor trip tables into time segment matrices, adjust background traffic, and load trips onto the highway network) due to computer run time limitations with the model software. Thus, for the regional level steps, each RPC throughout the State needed to decide on a regional model network to complete the analysis in their region. For the Central Florida Region, the regional model network includes the five counties within the RPC plus nineteen other counties surrounding the region, as illustrated in **Figure III-1**.

This chapter discusses the input data used in evaluating evacuation transportation conditions for the Central Florida Region. It is important to note that the input data discussed in this chapter is included only for the counties within the Central Florida RPC, as these are the counties that the Central Florida RPC has direct responsibility for the data. Data for the adjacent counties included in the Central Florida Regional model were provided by the corresponding RPC in which the counties belong. The model data for these counties is discussed in the corresponding Volume 4 report for those respective RPCs.

A. Regional Model Network

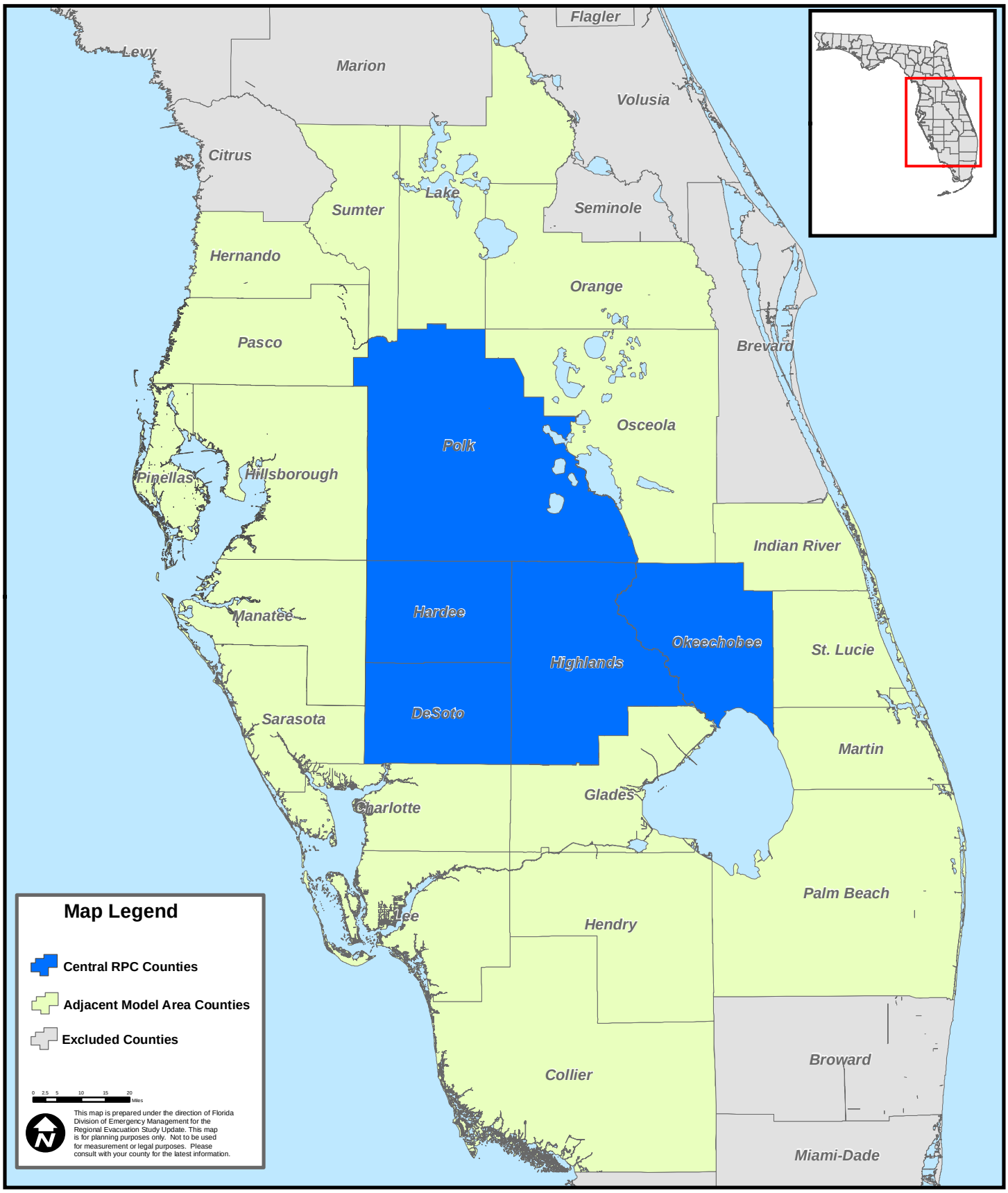
The road network is a key component of the evacuation model. The roadway variables in the network include area type, functional class, number of through lanes, capacity, speed, and several others. The regional model network consists of the RPC designated evacuation routes as well as a supporting roadway network that facilitates movement of evacuation traffic. The 2005 Florida Department of Transportation (FDOT) Statewide Model Network was used as a basis for developing the regional model network, while the evacuation routes were obtained from the Central Florida RPC. The RPC relied on the emergency managers of its constituent counties to provide it with information on which roads were to be included as evacuation routes. The resulting model network was updated to 2006 conditions and is referred to as the base model network. **Figure III-2** identifies the model network and evacuation routes for the CFRPC. County level details of the regional model network are provided in the Volume 5 report. The regional model network for the Central Florida region includes key roadways within the five county region, including I-4, Florida's Turnpike, US 92, US 27, US 98, US 17, US 441, SR 60, SR 70, and SR 78, SR 37, SR 64, and SR 62.

B. Regional Zone System

The regional zone system is based on Traffic Evacuation Zones (TEZ) and contains the regional demographic information, which includes housing and population data that is essential to modeling evacuation traffic, as discussed in Chapter II. The regional demographic characteristics identify where the individuals in the region reside, as well as where the vulnerable populations are located. The TEZs are aggregations of the smaller small area data geographies provided by the RPC. Each traffic evacuation zone has a unique identification

Figure III-1

Central Florida Regional Model Area

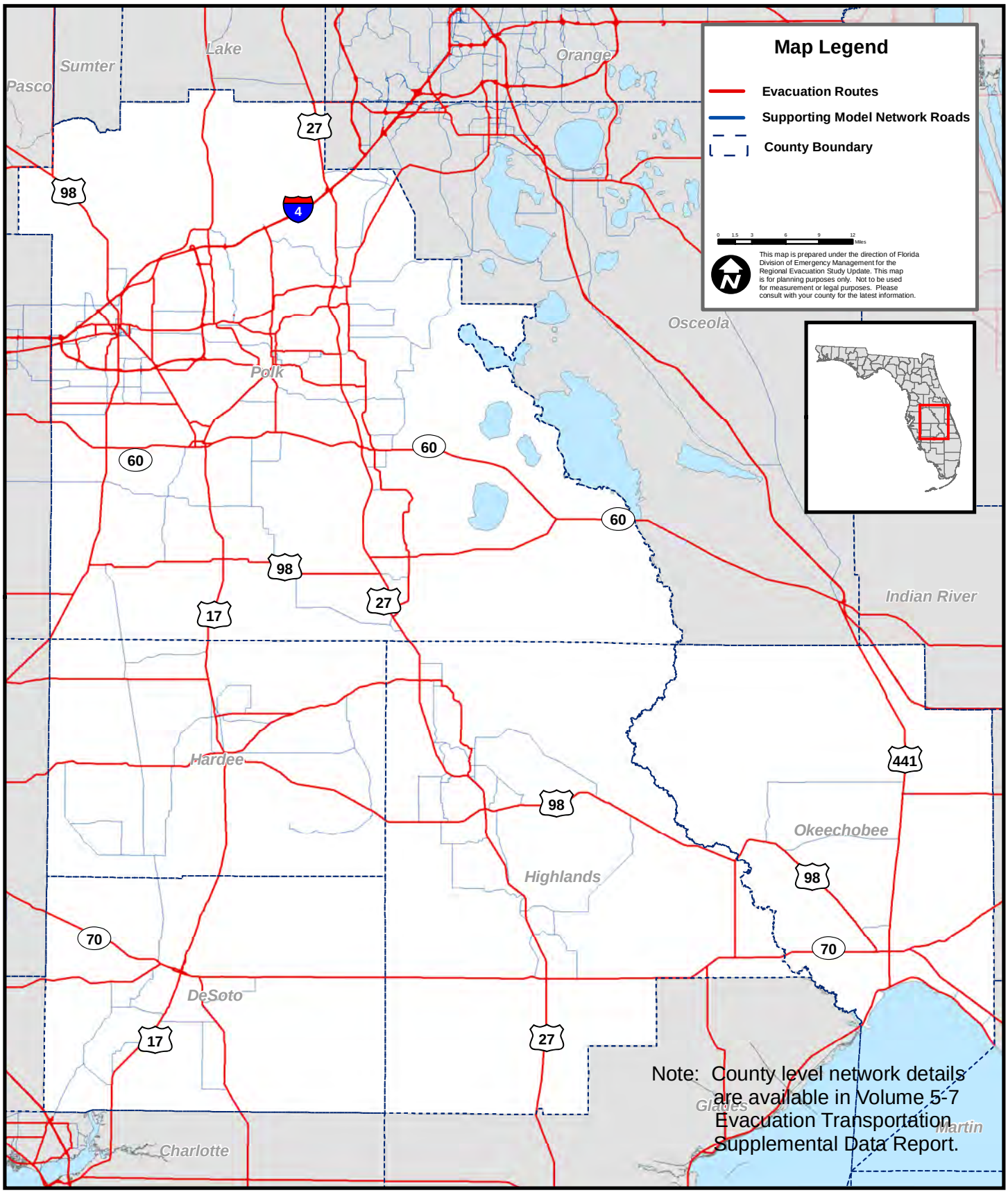


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: May, 2010

Figure III-2

Central Florida Regional Model Network



Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: June, 2010

number that is used by the model to connect evacuation trip generation to the evacuation highway network. There is a buffer in zone numbering between counties to allow for future growth in each county.

The final TEZ system for the State of Florida has 17,328 zones. Of the total number of zones in Florida, 351 of the zones are located within the five county Central Florida region, as illustrated in **Figure III-3**. In the Central Florida region, Polk County has the largest number of TEZs with 263, and Highlands County follows with 39 TEZs. Okeechobee County has 22 TEZs while Hardee and DeSoto Counties have the lowest number of TEZs in the RPC with 15 and 12 zones, respectively. The larger number of TEZs generally reflects counties with denser urban structure and/or higher population densities.

C. Regional Demographic Characteristics

As discussed in Chapter II, the evacuation model uses the demographic information as input for generating a set of evacuation trips. The demographic data were developed for the following years: 2006, 2010, and 2015.

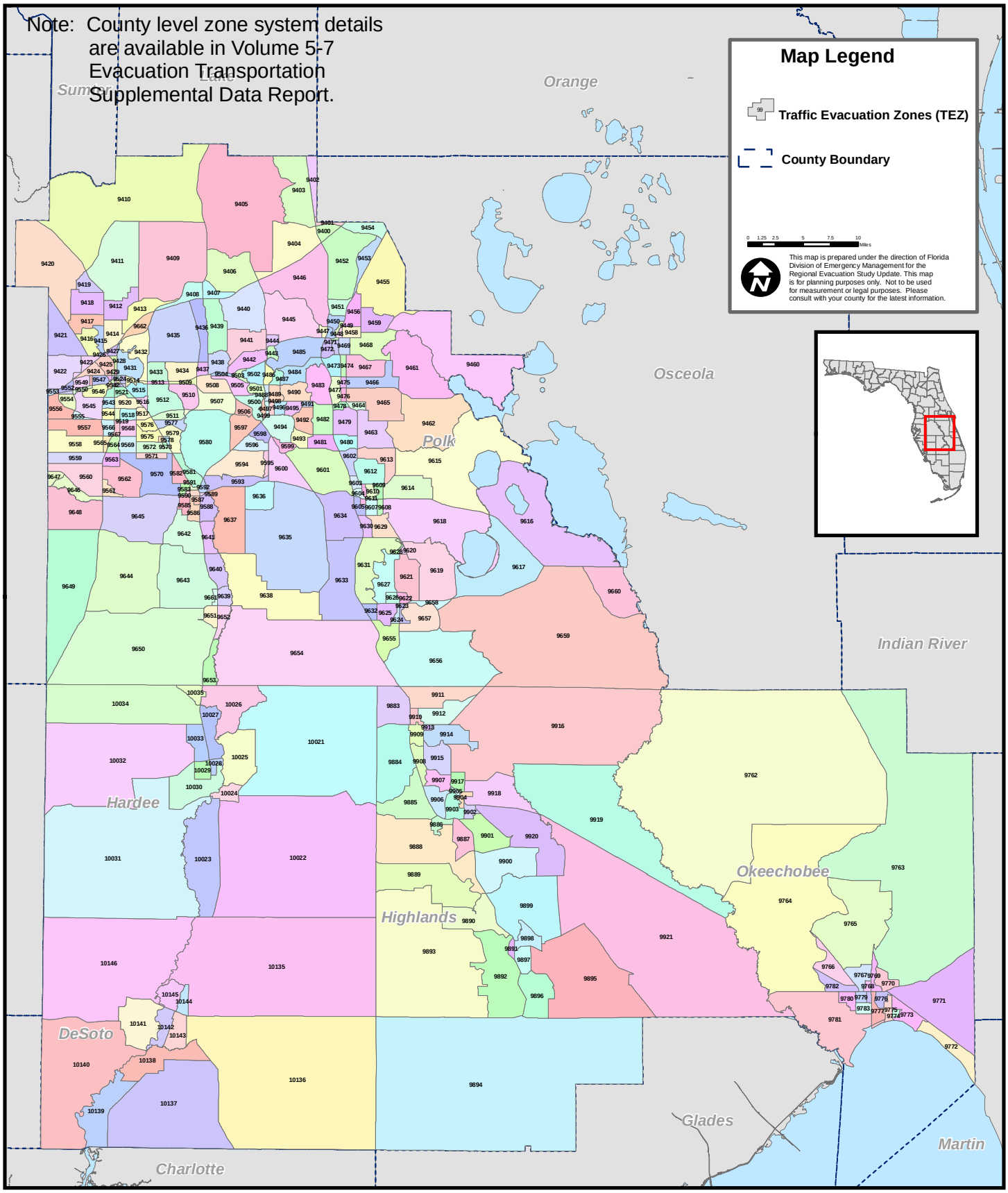
A snapshot of the key demographic data for each county in the Central Florida RPC for 2006, 2010 and 2015 is summarized in **Table III-1**. The tables list the number of occupied dwelling units for site built homes, the permanent population in site-built homes, as well as the number of occupied dwelling units for mobile homes and the permanent population in mobile homes. The mobile home category includes RVs and boats and the permanent population in those housing options. The demographic characteristics summary also includes hotels and motels because a number of these units are in or are near vulnerable areas, and the proportion of seasonal units and hotel/motel units that are occupied at any point in time will have an important impact on the total population that may participate in an evacuation. Detailed demographic data for each individual TEZ within the region is included in Volume 5.

Polk County has the largest population in the region during all three time periods. The county is expected to reach more than 570,000 people by 2015. Highlands County has the second largest population in the region and is forecasted to have more than 100,000 people by 2015. Okeechobee is predicted to grow to over 42,000 by 2015, while DeSoto and Hardee Counties, the counties with smallest populations, both are expected to reach more than 35,000. Although Polk County shows the largest absolute growth between 2006 and 2015, the county that will experience the largest percentage of change is Hardee County at 31%.

Within the Central Florida region, for each year, Polk County has the highest number of mobile homes followed by Highlands County. Hardee County has the lowest number of mobile homes with for all three time periods. Notably, mobile homes comprise about 40% of all occupied homes in Okeechobee County. For the entire region, mobile homes make up about 15% of all occupied homes.

Figure III- 3

Central Florida Regional Model (TEZ) Zone System



Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: August, 2010

Table III-1 - Central Florida Demographic Characteristic Summary

County	Characteristic	Year		
		2006	2010	2015
DeSoto	Occupied site-built homes	6,683	7,495	8,791
	Population in site-built homes	19,036	20,311	23,823
	Occupied mobile homes	3,835	3,873	4,027
	Population in mobile home	13,173	13,305	13,832
	Hotel/motel units	200	200	200
Hardee	Occupied site-built homes	5,833	6,110	8,424
	Population in site-built homes	17,652	18,505	25,723
	Occupied mobile homes	2,272	2,333	2,333
	Population in mobile home	9,286	9,604	9,604
	Hotel/motel units	112	112	112
Highlands	Occupied site-built homes	29,695	30,865	36,042
	Population in site-built homes	68,907	71,593	83,663
	Occupied mobile homes	8,900	8,900	8,900
	Population in mobile home	19,660	19,660	19,660
	Hotel/motel units	1,207	1,207	1,207
Okeechobee	Occupied site-built homes	6,804	7,576	8,532
	Population in site-built homes	19,243	21,531	24,538
	Occupied mobile homes	5,659	5,699	5,860
	Population in mobile home	16,667	16,762	17,559
	Hotel/motel units	425	425	425
Polk	Occupied site-built homes	176,913	198,435	227,450
	Population in site-built homes	427,956	445,567	502,460
	Occupied mobile homes	30,352	30,352	30,352
	Population in mobile home	58,401	68,763	68,082
	Hotel/motel units	11,580	12,556	14,024

Source: Central Florida Regional Planning Council

D. Planned Roadway Improvements

To correspond to the three different sets of demographic data, three model networks were ultimately developed. The base 2006 network, discussed in section A, and two future year networks to correspond to the 2010 demographic data and the 2015 demographic data. The 2006 base model network was updated to reflect roadway capacity improvement projects completed between 2006 and 2010 to create the 2010 network. The 2010 network was then updated to reflect planned roadway capacity improvement projects expected to be implemented between 2011 and 2015 to create the 2015 network.

The planned roadway improvements that were added to the network generally include only capacity improvement projects such as additional through lanes. **Table III-2** identifies capacity improvement projects completed between 2006 and 2010 that were included in the 2010 network. Likewise, **Table III-3** identifies capacity improvement projects planned for implementation between 2011 and 2015. The tables identify each roadway that will be improved as well as the extent of the improvement. For example, by the end of 2015 in DeSoto County, US 17 (SR 35) from Peace River Shores to SW Collins St will be widened to 6 lanes.

It is important to note that Tables III-2 and III-3 are not intended to be all inclusive of every transportation improvement project completed within the region. The tables only identify key capacity improvement projects that impact the evacuation model network and are anticipated to have an impact on evacuation clearance times.

Table III-2 - Central Florida Region Roadway Improvements, 2006 – 2010

County	Roadway	From	To	Number of Lanes
Hardee	US 17	N of Iguana Ln	S of Stenstorm Rd	6
Polk	SR 570 (Polk Pkwy)	Pace Rd	I-4	4
	CR 655 (Berkley Rd)	CR 546	Pace Rd	4
	CR 540A	SR 37	US 98	4
	CR 582	CR 35A	US 98	4
	US 27	SR 542	I-4	6
	US 27	SR 60	SR 540	6
	CR 54 (Ronald Reagan Pkwy)	US 27	Lake Wilson Rd	4

Sources: FDOT SIS First Five Year Plan, FDOT SIS Second Five Year Plan, Central Florida Regional Planning Council
Note: Projects included in this table are roadway improvement projects completed between 2006 and 2010 on roadways that are included in the regional transportation model network. Only projects which added roadway capacity, such as additional through lanes, were included. The list is not intended to be all inclusive of every transportation improvement project completed within the region. A list of historical projects completed during the last five years was included in this report because the base regional network developed for the study, along with the base demographic data, is for the year 2006.

Table III-3 - Central Florida Planned Roadway Improvements, 2011–2015

County	Roadway	From	To	Number of Lanes
DeSoto	US 17 (SR 35)	Peace River Shores	SW Collins St	6
Okeechobee	SR 70	80th Ave	St Lucie County line	4
Polk	County Line Rd	SR 60	W Pipkin Rd	4
	CR 37B	CR 540A	SR 570 (Polk Pkwy)	4
	Bartow Northern Connector	US 98	US 17	4
	W Pipkin Rd	End of 4-lanes	Old Hwy 37	4
	CR 35A	Galloway Rd	Duff Rd	4
	US 27	SR 540	SR 542	6

Sources: FDOT SIS First Five Year Plan, FDOT SIS Second Five Year Plan, Central Florida Regional Planning Council
Note: Projects included in this table are roadway improvement projects planned for completion between 2011 and 2015 on roadways that are included in the regional transportation model network. Only projects which are planned to add roadway capacity, such as additional through lanes, were included. The list is not intended to be all inclusive of every transportation improvement project planned for completion within the region.

E. Behavioral Assumptions

The behavioral assumptions provide important information on the way people respond to an evacuation order and are an important input to the SRESP transportation evacuation model. For the Central Florida Region, three counties, DeSoto, Highlands, and Okeechobee Counties, have evacuation zones corresponding to different categories of storm surge. Evacuation rates for site-built homes and mobile/manufactured homes are provided by county and summarized in **Figure III-4** through **Figure III-9**. Other rates, such as out of county trip rates, vehicle use rates, public shelter use rates, friend/relative refuge use rates, hotel/motel refuge use rates, and other refuge use rates, are detailed by county, storm threat, and evacuation zone in Volume 5-7.

A review of the evacuation rates for the Central Florida region illustrates that evacuation participation rates increase as the evacuation level increases, and participation rates for persons living in mobile/manufactured homes are generally higher than for persons living in site-built homes. It should be noted that a certain percentage of the population evacuates, even when they are not living in an area that is ordered to evacuate. These people are commonly referred to as shadow evacuees. Shadow evacuation rates are also included in Figure III-4 through Figure III-9.

For example, if an evacuation order was issued for DeSoto County for persons living in evacuation zone A, the county could expect a 5 percent participation rate from persons living in site-built homes in evacuation zone A (Figure III-4) and a 40 percent participation rate from persons living in mobile/manufactured homes in evacuation zone A (Figure III-5). In addition, DeSoto County can expect shadow evacuations to occur for persons living in site-built homes at a rate of 5 percent from evacuation zones B, C, D, and E (Figure III-4). Likewise, for persons living in mobile/manufactured homes, DeSoto County can expect shadow evacuations to occur at a rate of 40 percent from evacuation zones B through E (Figure III-5).

Please note that the original behavioral response rates provided by SRESP in Volume 2-7 were modified to fit the evacuation zones created for DeSoto, Highlands, and Okeechobee Counties. The original rates were based on the assumption that DeSoto, Highlands, and Okeechobee were inland areas with no evacuation zones; however, DeSoto utilizes five zones, Highlands three zones, and Okeechobee three zones. The evacuation zone systems for those counties are listed below:

- DeSoto County – 5 zones: Zone A, Zone B, Zone C, Zone D, Zone E;
- Highlands County – 3 zones: Zone C, Zone D, Zone E; and,
- Okeechobee County – 3 zones: Zone A, Zone B, Zone C/D/E.

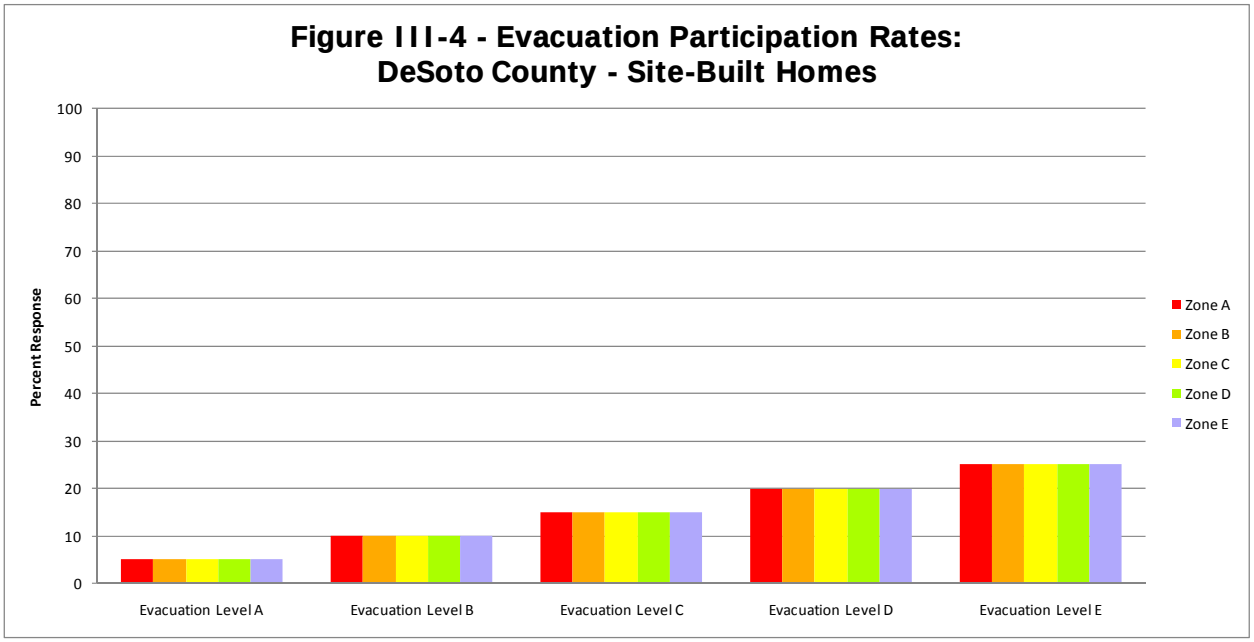


Figure III-4 - Evacuation Participation Rates:
DeSoto County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

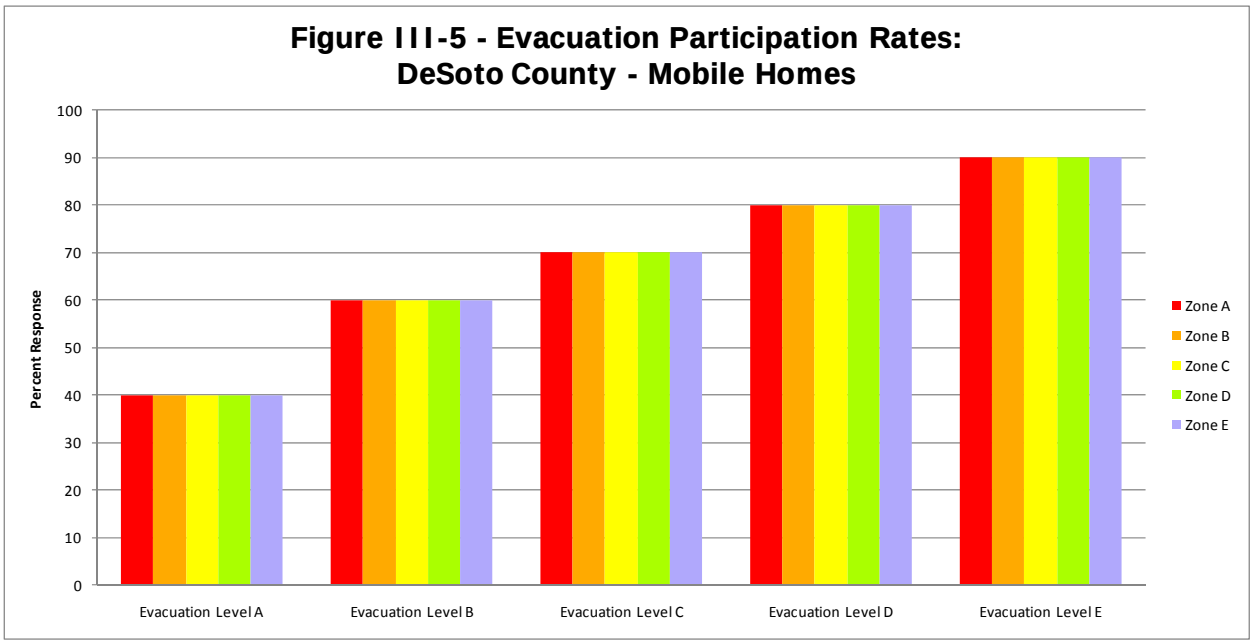


Figure III-5 - Evacuation Participation Rates:
DeSoto County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C
Zone D
Zone E

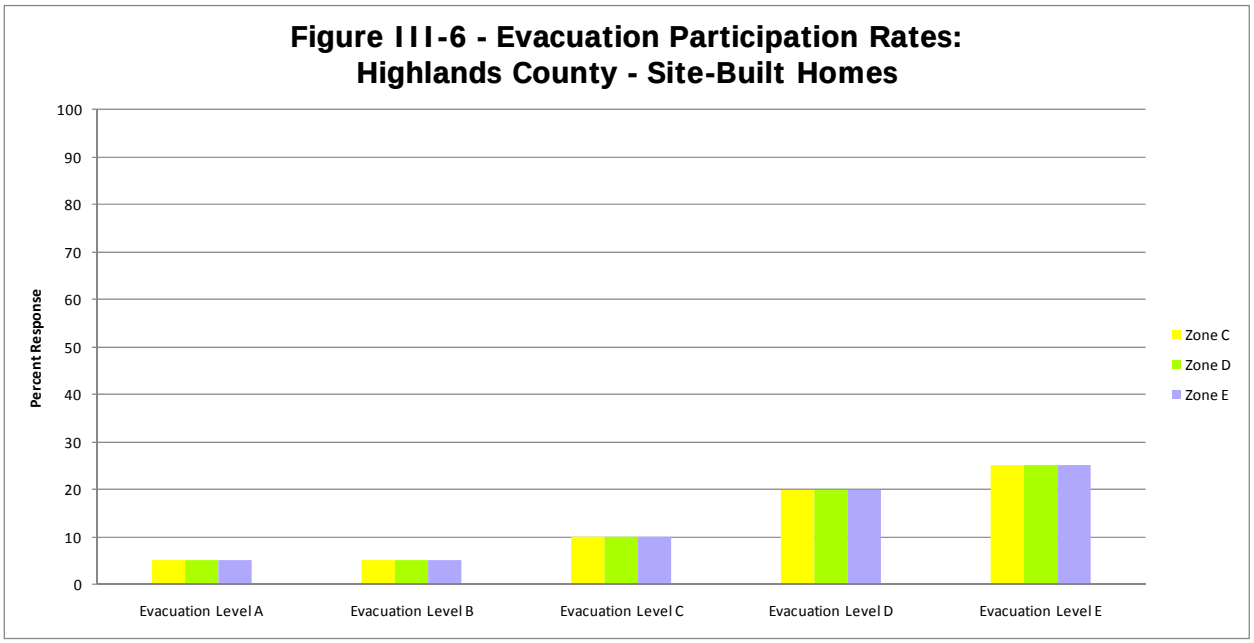


Figure III-6 - Evacuation Participation Rates:
Highlands County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone C
Zone D
Zone E

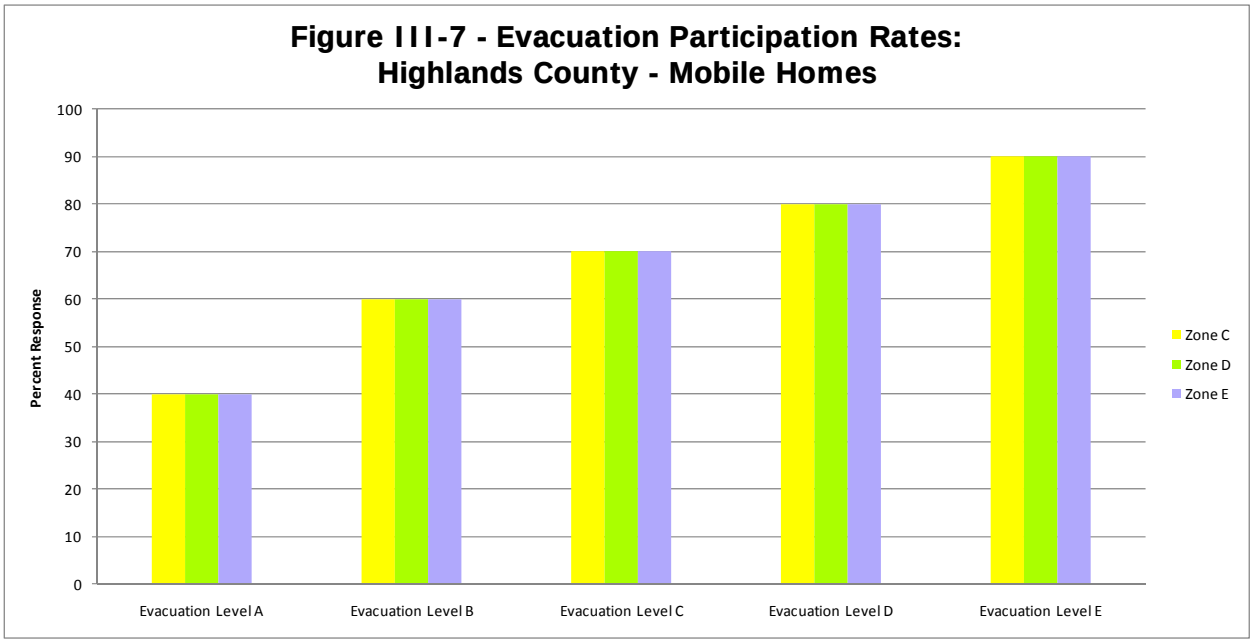


Figure III-7 - Evacuation Participation Rates:
Highlands County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone C
Zone D
Zone E

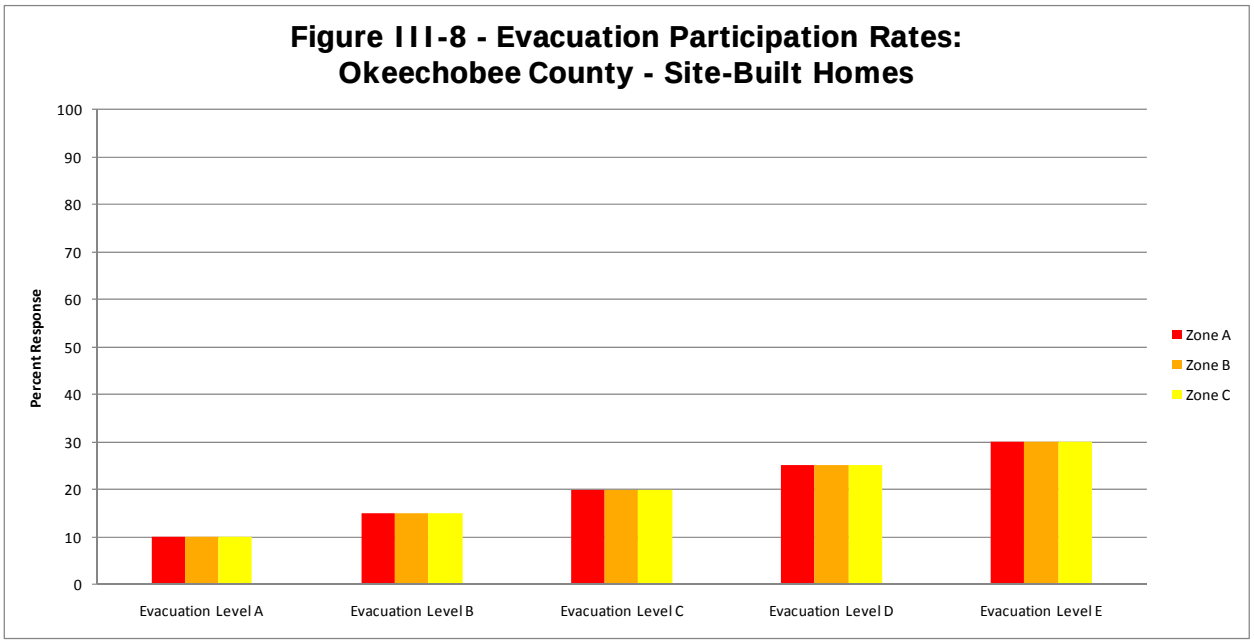


Figure III-8 - Evacuation Participation Rates:
Okeechobee County - Site-Built Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C

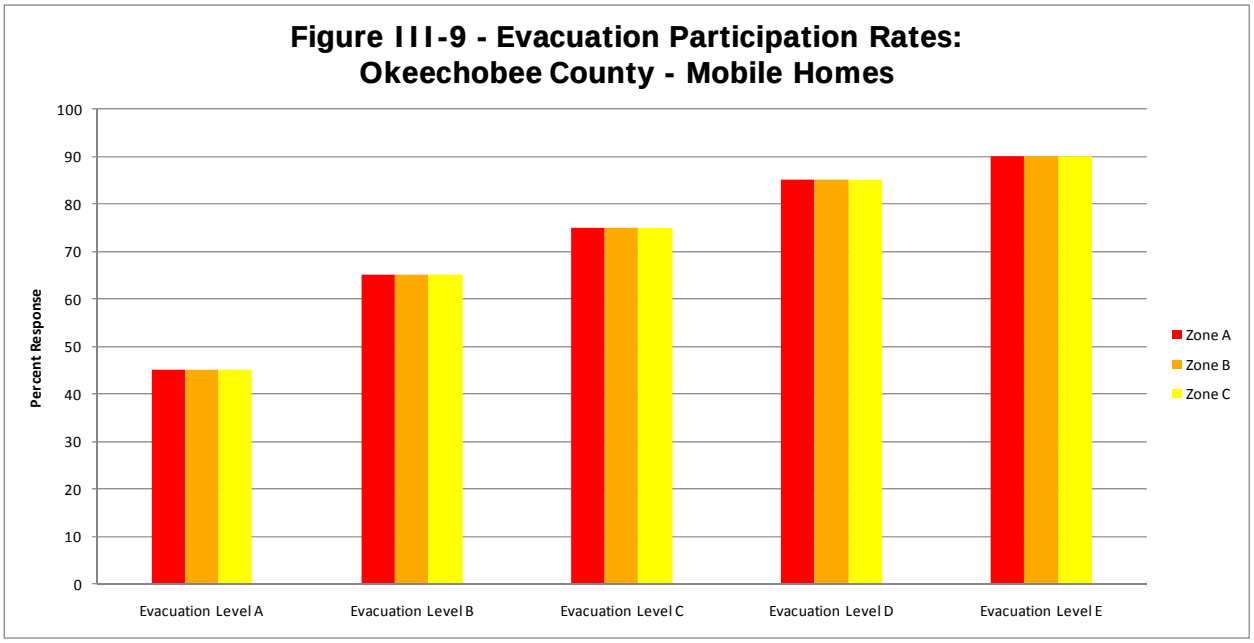


Figure III-9 - Evacuation Participation Rates:
Okeechobee County - Mobile Homes
Percent Response
100
90
80
70
60
50
40
30
20
10
0
Evacuation Level A
Evacuation Level B
Evacuation Level C
Evacuation Level D
Evacuation Level E
Zone A
Zone B
Zone C

F. Shelters

In order for the transportation model to accurately assign public shelter trips to the correct location, a complete list of available public shelters needs to be available. The Central Florida RPC compiled the list of available public shelters using information provided by the local county emergency managers. The shelters were categorized as either primary or other, with primary indicating that the shelter is compliant with American Red Cross standards for a shelter and other indicating all other shelters.

In the five county region there are a total of 90 shelters, including 36 in Highlands County, 29 in Polk County, 14 in Okeechobee County, 8 in Hardee County, and 3 in DeSoto County. All together, the 90 shelters located within the five county region can host more than 34,000 persons during an evacuation event. Detailed lists of the available public shelters by county are included in Volume 5-7.

G. Evacuation Zones

The final input variable that is needed to complete the transportation evacuation model is the delineation of evacuation zones for all coastal counties. Local county emergency managers have the responsibility of identifying and defining evacuation zones for their county. Within the Central Florida region, DeSoto, Highlands, and Okeechobee Counties have updated and established their evacuation zones based on the results of the new data and information collected as part of the SRESP. Evacuation zones for the Central Florida Region are illustrated in **Figure III-10**. County level evacuation zones are included in Volume 5-7.

H. TIME User Interface

Wilbur Smith Associates developed the Transportation Interface for Modeling Evacuations (TIME) to make it easier for RPC staff and transportation planners to use the model and implement the evacuation methodology. The TIME interface is based on an ArcGIS platform and is essentially a condensed transportation model, which provides a user friendly means of modifying input variables that would change the clearance times for various evacuation scenarios.

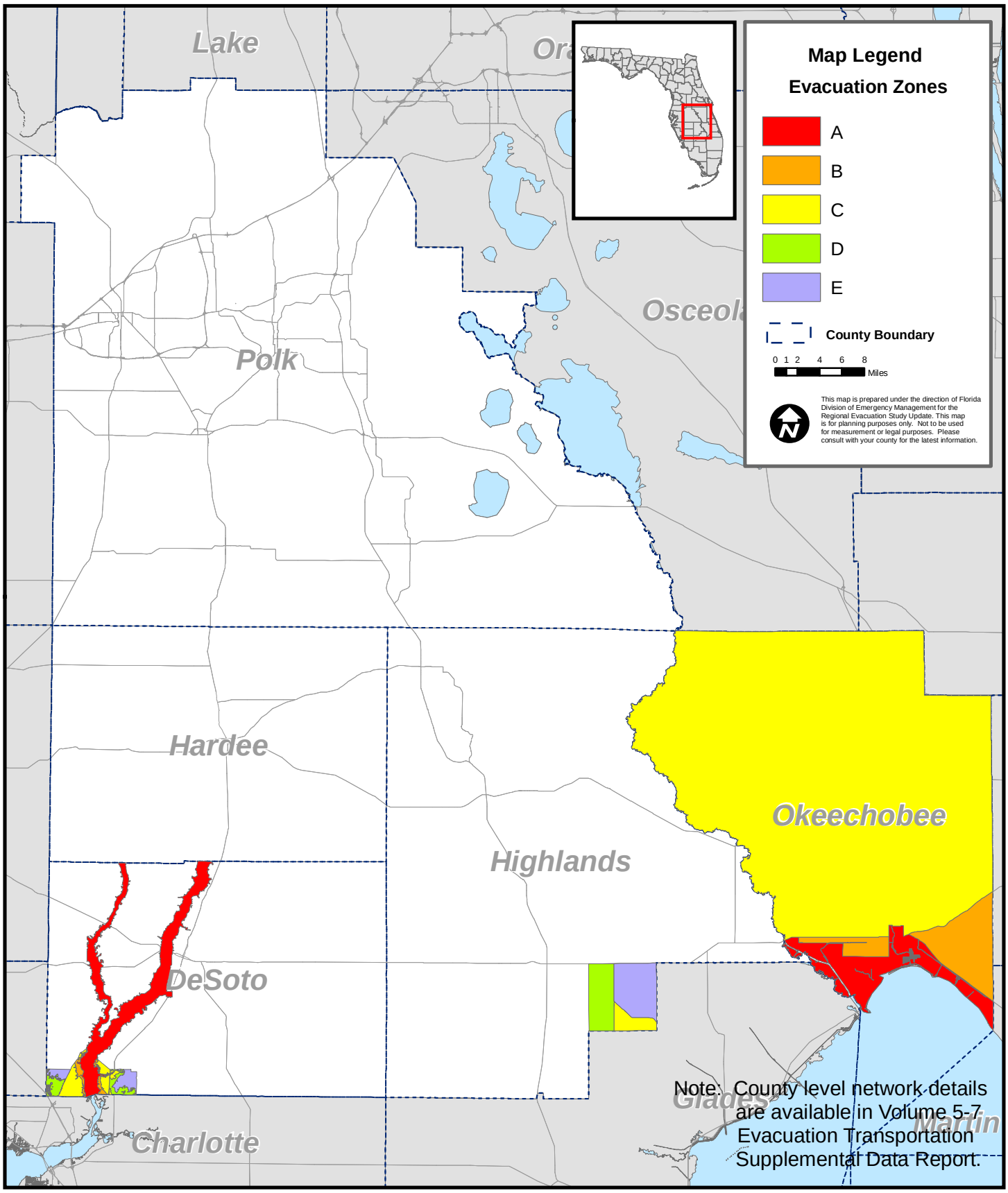
The evacuation model variables include a set of distinguishing characteristics that could apply to evacuation scenarios as selection criteria. These following variables may be selected using the TIME interface and allow the user to retrieve the best results from various evacuation alternatives:

- **Analysis time period -** The first input variable is the evacuation analysis time period. The time period selections include 2006, 2010 and 2015. The time period determines which set of demographic data and which version of the model network will be used.

- **Highway network -** Once the time period is selected, the user must pick either the default highway network or a modified network. The default includes the network corresponding to the selected time period and also incorporates planned highway improvement projects from the Florida Department of Transportation Work Program. In the case that there are any new projects or changes need to be taken into account, the

Figure III-10

Central Florida Regional Evacuation Zones



Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: June, 2010

modified network would be chosen. These changes could include possible road or bridge closures because of storm conditions or any managed traffic diversions or traffic control measures.

- **Behavioral response -** The next variable is behavioral response, which is a set of "planning assumptions" that describe the way people respond to an order to evacuate and are an important input to the SRESP Evacuation Model. A user may choose 100% or the survey response. The 100% response indicates that 100% of people in evacuation zones will evacuate, while the survey response uses the percentage of people from the behavioral planning assumptions corresponding to the evacuation level for each county.

- **One-way evacuation operations -** Another variable for consideration is whether to allow one-way evacuation operations or not. One-way evacuation operations allow take into account the FDOT one-way evacuation operations plans for major facilities, including I-4, I-75, and Florida's Turnpike.

- **University population -** The model permits the user to incorporate the population in university housing since this data is not included in the regular population numbers. The default assumption is that the region's universities are at the maximum housing capacity housing during the Fall/Spring semester. The other options available are the summer university population, which is generally much less than the fall or spring, and an option for no school in session.

- **Tourist occupancy rates -** The RPC has the option to choose the default rates or to modify those rates based on any special circumstance they may have for tourist rates since there are different tourist seasons, sectors and special events. If modified rates are desired, then the user may select no tourist occupancy or modify the rates on a county by county basis.

- **Shelters -** When choosing which shelters are open to the public during an evacuation event, the user may select either primary shelters or other shelters, both primary and other shelters, and/or modified. In many situations, the shelters category may need to be modified because of availability or capacity changes.

- **Counties evacuating -** The evacuating counties are the counties within the geographic extent of Central Florida's model network and include both coastal and inland counties. The coastal counties include Indian River, St. Lucie, Martin, Palm Beach, Hernando, Pasco, Pinellas, Hillsborough, Manatee, Sarasota, Charlotte, Lee, and Collier Counties. The inland counties are Polk, Hardee, DeSoto, Highlands, Okeechobee, Glades, Hendry, Sumter, Lake, Orange, and Osceola Counties. The user has the opportunity to pick which of the counties in the network actually evacuate.

- **Evacuation level -** Once the evacuating counties are chosen, the evacuation level is designated. The evacuation levels range from A to E and represent the evacuation zones that are ordered to evacuate. The user may also select "none", which assumes that no evacuations are made within the selected county; only regular background traffic will occur.

- **Response curve hours –** The user must define which evacuation response curve will be applied to each evacuating county in the area. The evacuation response curves show the proportion of evacuation by increment of time for evacuation orders that were issued. There are six different curves to from which to choose: a 6-hour curve, 9-hour curve, 12-hour curve, 18-hour curve, 24-hour curve, and a 36-hour curve. The faster curves represent more urgent circumstances and slower curves represent less urgent circumstances.

- **Evacuation Phasing –** The phase selection indicates when an evacuation would begin in a given county. There are ten different options beginning in hour 1 and extending to hour 27. After hour 3, the other phasing options follow in 3 hour increments.

CHAPTER IV
TRANSPORTATION ANALYSIS

The transportation analysis brings together key factors such as evacuation level, transportation network, shelters, and evacuation population, and explicitly links people's behavioral responses to the regional evacuation infrastructure. The results of this analysis help to formulate effective and responsive evacuation policy options. Two distinct sets of analyses were conducted using the SRESP evacuation transportation model, including one set of analysis for growth management purposes and one set of analysis for emergency management purposes. The results of this analysis are discussed in this chapter.

A. Vulnerable Population

Using a combination of the demographic data, behavioral assumptions, and evacuation zones, the vulnerable population in each county could be determined by evacuation level. For the purposes of the transportation analysis, the vulnerable population, or population-at-risk, is defined as the total population living within the county designated evacuation zones for each evacuation level. This population is living in an area that is at risk for severe flooding during a storm event. The vulnerable population for the Central Florida Region for 2010 is identified in **Table IV-1**, summarized by evacuation zone and split between site-built homes and mobile/manufactured homes. Vulnerable population for 2015 is summarized in **Table IV-2**.

The vulnerable population in the Central Florida Region includes population from three counties in the region and varies by evacuation zone. Okeechobee County, for example, has nearly 12,800 vulnerable residents in evacuation zone A and only 7,600 vulnerable residents in evacuation zone B in 2010. The vulnerable population living in site-built homes verses mobile/manufactured homes varies by county and evacuation zone.

In addition, based again on the demographic data, behavioral assumptions, and evacuation zones, the planned destinations of vulnerable population in each county could be determined by evacuation level. Destinations include friends and family, hotel/motel, public shelter, and other locations. Vulnerable population destinations for the Central Florida Region are identified in **Table IV-3** for 2010 and in **Table IV-4** for 2015.

In all cases in the Central Florida Region, the vulnerable population is far more likely to stay with friends and family during an evacuation. This is followed by public shelter destinations and then hotel/motel and other locations.

The vulnerable shadow population is provided in **Table IV-5** for both 2010 and 2015. The vulnerable shadow population was determined using the behavioral assumptions for evacuating shadow population and is based on evacuation level (storm category), not evacuation zone. Vulnerable shadow population for the five county region ranges from 150,000 to more than 247,000 persons for 2010, depending upon the evacuation level. For 2015, the range increases to between 155,000 and 267,000 persons.

Table IV-1 – Vulnerable Population in the Central Florida Region for 2010

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
DeSoto County					
Site-built Homes	994	227	947	1,589	0
Mobile/Manuf. Homes	665	90	339	580	0
TOTAL	1659	317	1286	2169	0
Highlands County					
Site-built Homes	0	0	0	4	11
Mobile/Manuf. Homes	0	0	0	8	25
TOTAL	0	0	0	12	36
Okeechobee County					
Site-built Homes	5,233	5,202	11,097	0	0
Mobile/Manuf. Homes	7,548	2,398	6,816	0	0
TOTAL	12,781	7,600	17,913	0	0

Note: Vulnerable population determined using SRESP small area data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

Table IV-2 – Vulnerable Population in the Central Florida Region for 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
DeSoto County					
Site-built Homes	1,432	305	1,189	2,021	0
Mobile/Manuf. Homes	691	94	352	603	0
TOTAL	2,123	399	1,541	2,624	0
Highlands County					
Site-built Homes	0	0	0	5	14
Mobile/Manuf. Homes	0	0	0	8	25
TOTAL	0	0	0	13	39
Okeechobee County					
Site-built Homes	5,579	5,587	13,372	0	0
Mobile/Manuf. Homes	7,548	2,398	7,613	0	0
TOTAL	13,127	7,985	20,985	0	0

Note: Vulnerable population determined using SRESP small area data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

Table IV-3 – Vulnerable Population by Destination for 2010

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
DeSoto County					
To Friends and Family	929	181	738	1,243	0
To Hotel/ Motel	116	20	81	137	0
To Public Shelter	398	72	291	492	0
To Other Destination	216	43	176	296	0
Highlands County					
To Friends and Family	0	0	0	6	19
To Hotel/ Motel	0	0	0	1	4
To Public Shelter	0	0	0	3	10
To Other Destination	0	0	0	1	4
Okeechobee County					
To Friends and Family	7,291	4,440	10,407	0	0
To Hotel/ Motel	1,016	500	1,236	0	0
To Public Shelter	2,818	1,780	4,137	0	0
To Other Destination	1,655	880	2,132	0	0

Note: Vulnerable population destinations determined using SRESP behavioral data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

Table IV-4 – Vulnerable Population by Destination for 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
DeSoto County					
To Friends and Family	1,205	230	889	1,514	0
To Hotel/ Motel	141	25	95	161	0
To Public Shelter	494	89	343	585	0
To Other Destination	284	55	214	363	0
Highlands County					
To Friends and Family	0	0	0	7	20
To Hotel/ Motel	0	0	0	1	4
To Public Shelter	0	0	0	3	10
To Other Destination	0	0	0	2	5
Okeechobee County					
To Friends and Family	7,499	4,671	12,211	0	0
To Hotel/ Motel	1,034	519	1,430	0	0
To Public Shelter	2,904	1,876	4,866	0	0
To Other Destination	1,690	918	2,479	0	0

Note: Vulnerable population destinations determined using SRESP behavioral data and county provided evacuation zones. Vulnerable population numbers are not inclusive, meaning population numbers listed for a higher zone are not included in the lower zone. For example, vulnerable population listed for Evacuation Zone B does not include vulnerable population listed for Evacuation Zone A.

Table IV-5 – Vulnerable Shadow Evacuation Population

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
2010					
DeSoto County	13,570	14,422	14,893	14,898	15,725
Hardee County	11,442	11,442	12,367	13,292	14,217
Highlands County	23,236	23,236	26,816	33,967	37,519
Okeechobee County	10,976	8,662	0	0	0
Polk County	90,925	113,173	135,420	157,668	179,915
2015					
DeSoto County	14,218	15,212	15,783	15,816	16,759
Hardee County	12,163	12,163	13,448	14,733	16,019
Highlands County	23,840	23,840	28,024	36,382	40,537
Okeechobee County	12,060	9,819	0	0	0
Polk County	93,243	118,376	143,508	168,641	193,773

Note: Vulnerable shadow population determined using SRESP behavioral data and county provided evacuation zones.

B. Clearance Time Definitions

The determination of clearance time is one of the most important outcomes from the evacuation transportation analysis. Calculated clearance times are used by county emergency managers as one input to determine when to recommend an evacuation order. This calculation can include the population-at-risk, shadow evacuees, as well as evacuees from other counties anticipated to pass through the county. Clearance time is developed to include the time required for evacuees to secure their homes and prepare to leave, the time spent by all vehicles traveling along the evacuation route network, and the additional time spent on the road caused by traffic and road congestion. Clearance time does not relate to the time any one vehicle spends traveling along the evacuation route network, nor does it guarantee vehicles will safely reach their destination once outside the County. The four clearance times that are calculated as part of the evacuation transportation analysis include the following:

- **Clearance Time to Shelter** - The time necessary to safely evacuate vulnerable residents and visitors to a "point of safety" within the county based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from the point in time when the evacuation order is given to the point in time when the last vehicle reaches a point of safety within the county. Key points to remember for clearance time to shelter include:
  - All in-county trips reach their destination within the county; and,
  - This definition does not include any out of county trips.

- **In-County Clearance Time** - The time required from the point an evacuation order is given until the last evacuee can either leave the evacuation zone or arrive at safe shelter within the county. This does not include those evacuees leaving the county on their own. Key points to remember for in-county clearance time include:
  - All in-county trips reach their destination within the county;
  - All out of county trips exit the evacuation zone, but may still be located in the county; and,
  - This definition does not include out-of-county pass-through trips from adjacent counties, unless they evacuate through an evacuation zone.

- **Out of County Clearance Time** - The time necessary to safely evacuate vulnerable residents and visitors to a "point of safety" within the county based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from the point an evacuation order is given to the point in time when the last vehicle assigned an external destination exits the county. Key points to remember for out of county clearance time include:
  - The roadway network within the county is clear;
  - All out of county trips exit the county, including out of county pass-through trips from adjacent counties; and,
  - All in-county trips reach their destination.

- **Regional Clearance Time** - The time necessary to safely evacuate vulnerable residents and visitors to a "point of safety" within the (RPC) region based on a specific hazard, behavioral assumptions and evacuation scenario. Calculated from last vehicle assigned an external destination exits the region. Key points to remember for regional clearance time include:

- The roadway network within the RPC is clear;
- All out of county trips exit the RPC, including out of county pass-through trips from adjacent counties;
- All in-county trips reach their destination; and,
- Regional clearance time is equal to the largest out of county clearance time for a given scenario for any of the counties within the RPC, since the out of county clearance time includes out of county pass through trips from adjacent counties.

C. Evacuation Model Scenarios

There are literally thousands of possible combinations of variables that can be applied using the evacuation transportation model, which will result in thousands of possible outcomes. For the purposes of this analysis, two distinct sets of analyses were conducted using the SRESP evacuation transportation model, including one set of analysis for growth management purposes and one set of analysis for emergency management purposes. The two sets of analysis include the following:

- **Base Scenarios** – The base scenarios were developed to estimate a series of worst case scenarios and are identical for all eleven RPCs across the State. These scenarios assume 100 percent of the vulnerable population evacuates and includes impacts from counties outside of the RPC area. These scenarios are generally designed for growth management purposes, in order to ensure that all residents that choose to evacuate during an event are able to do so; and,

- **Operational Scenarios** – The operational scenarios were developed by the RPCs in coordination with local county emergency managers and are designed to provide important information to emergency management personnel to plan for different storm events. These scenarios are different from region to region and vary for each evacuation level.

Because of the numerous possible combinations of variables that can be applied in the model, the evacuation transportation model is available for use through the Central Florida RPC to continue testing combinations of options and provide additional information to emergency managers.

D. Base Scenarios

A total of ten base scenarios were developed through discussions with the SRESP Statewide Work Group and are identical for all eleven RPCs. The SRESP requires a consistent set of base scenarios that will be used by all regions across the State to provide a consistent background between regions. The base scenarios also allow the results to be used consistently from region to region for other purposes, such as growth management. The ten base scenarios were developed to include the following assumptions:

- **Analysis Time Period** – Five scenarios for the 2010 time period and five scenarios for the 2015 time period. The five scenarios for each time period include one for each of the five evacuation levels, A, B, C, D, and E;

- **Highway Network** – The five 2010 scenarios use the 2010 network and the five 2015 scenarios use the 2015 network, which includes planned roadway capacity improvement

projects expected to be implemented by 2015;

- **One-Way Evacuation Operations** – The base scenarios do not include implementation of any one-way evacuation operations;

- **University Population** – The base scenarios use the fall/spring semester data to estimate evacuation trips by the student population. This data was provided by each RPC as part of the demographic small area data;

- **Tourist Occupancy Rates** – The base scenarios use the default hotel/motel occupancy rates to estimate tourist evacuation trips. This data was provided by each RPC as part of the demographic small area data;

- **Shelters** – The base scenarios assume all designated primary shelters within each county in the model network are open. The base scenarios do not include shelters that are designated as other shelters, only primary shelters;

- **Response Curve** – The 12-hour response curve is used for all ten base scenarios;

- **Evacuation Phasing** - All counties that are evacuating begin at same time, within 1 hour of the evacuation order being given;

- **Behavioral Response** - For all five evacuation levels (A, B, C, D, or E) in both the 2010 and 2015 time periods, the behavioral response for the base scenarios includes the following:
  - 100% response in evacuation zones for both mobile homes and site built homes for the counties in the RPC, plus one coastal county on either side of the region. Because the Central Florida region does not include any coastal counties, the Central Florida base scenarios include Gulf Coast counties in their base scenarios. These counties include DeSoto, Hardee, Highlands, Okeechobee, Polk, Charlotte, Sarasota, Hillsborough, Manatee, and Pinellas Counties;
  - 100% response for mobile homes in inland areas for the counties in the RPC, plus Gulf Coast counties west of the region (DeSoto, Hardee, Highlands, Okeechobee, Polk, Charlotte, Sarasota, Hillsborough, Manatee, and Pinellas Counties);
  - Planning Assumption response (shadow evacuation) for site built homes in inland areas for the counties in the RPC plus Gulf Coast counties west of the region (includes DeSoto, Hardee, Highlands, Okeechobee, Polk, Charlotte, Sarasota,
  - Hillsborough, Manatee, and Pinellas); and,
  - For the remaining counties in the Central Florida model network, no evacuations are assumed, including shadow evacuations.

The ten base scenarios are summarized in **Table IV-6**.

Table IV-6 – Base Scenarios

	Scenario 1 Level A 2010	Scenario 2 Level B 2010	Scenario 3 Level C 2010	Scenario 4 Level D 2010	Scenario 5 Level E 2010
Demographic Data	2010	2010	2010	2010	2010
Highway Network	2010	2010	2010	2010	2010
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	12-hour	12-hour	12-hour	12-hour	12-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	100%	100%	100%	100%	100%
Evacuation Zone	A	B	C	D	E
Counties Evacuating	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas
	Scenario 6 Level A 2015	**Scenario 7 Level B 2015**	**Scenario 8 Level C 2015**	**Scenario 9 Level D 2015**	**Scenario 10 Level E 2015**
Demographic Data	2015	2015	2015	2015	2015
Highway Network	2015	2015	2015	2015	2015
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	12-hour	12-hour	12-hour	12-hour	12-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	100%	100%	100%	100%	100%
Evacuation Zone	A	B	C	D	E
Counties Evacuating	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas	DeSoto Hardee Highlands Okeechobee Polk Charlotte Sarasota Hillsborough Manatee Pinellas

E. Base Scenario Results

Each of the ten base scenarios were modeled for the Central Florida Region using the regional evacuation model. Results were derived from the model to summarize the evacuating population, evacuating vehicles, clearance times, and critical congested roadways. Each of these results are discussed in the following sections.

Evacuating Population

It is important to determine the evacuating population for each of the base scenarios in order to understand the magnitude of the evacuation effort, including estimated population that is evacuating and the county level shelter demand. Evacuating population for the base scenarios is summarized by county for 2010 in **Table IV-7** and for 2015 in **Table IV-8**.

Within the five county region, total evacuating population ranges from more than 164,500 persons for a base scenario level A evacuation to more than 291,300 persons for a base scenario level E evacuation in 2010. By 2015, this range increases within the five counties to more than 170,700 persons for a base scenario level A evacuation and more than 316,000 persons for a base scenario level E evacuation.

Evacuating Vehicles

From a transportation standpoint, the number of evacuating vehicles is more important than the evacuating population. Evacuating vehicles for the base scenarios is summarized by county for 2010 in **Table IV-9** and for 2015 in **Table IV-10**.

The total number of evacuating vehicles within the five county region for the base scenarios also varies by evacuation level. A total of nearly 72,600 vehicles evacuate from the five county RPC for a base scenario level A evacuation in 2010, and this number increases to more than 136,900 evacuating vehicles from the five county region for a base scenario level E evacuation in 2010. By 2015, the number of evacuating vehicles is expected to increase to nearly 75,300 vehicles for a base scenario level A evacuation and more than 148,600 evacuating vehicles for a base scenario level E evacuation.

Shelter Demand

Shelter demand is another critical piece of the evacuating population, and shelter demand estimates by county are summarized for each of the base scenarios in **Table IV-11**. Shelter demand is the population in each county who will seek public shelter during their evacuation, either at an in-county shelter or an out of county shelter.

Public shelter demand in the five county region ranges from nearly 29,200 persons for the base scenario level A evacuation in 2010 to more than 50,000 persons for the base scenario level E evacuation. By 2015, the public shelter demand is expected to increase to nearly 30,150 persons for the level A evacuation and nearly 53,700 persons for the level E evacuation.

Table IV-7 – Evacuating Population by Base Scenario for 2010

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
DeSoto County					
Site-built Homes	1,959	3,128	4,885	7,059	7,886
Mobile/Manuf. Homes	13,270	13,270	13,270	13,270	13,270
Tourists	0	0	0	0	0
TOTAL	15,229	16,398	18,155	20,329	21,156
Hardee County					
Site-built Homes	1,850	1,850	2,775	3,700	4,625
Mobile/Manuf. Homes	9,592	9,592	9,592	9,592	9,592
Tourists	0	0	0	0	0
TOTAL	11,442	11,442	12,367	13,292	14,217
Highlands County					
Site-built Homes	3,580	3,580	7,160	14,323	17,911
Mobile/Manuf. Homes	19,656	19,656	19,656	19,656	19,656
Tourists	0	0	0	0	0
TOTAL	23,236	23,236	26,816	33,979	37,567
Okeechobee County					
Site-built Homes	6,863	12,105	21,557	21,557	21,557
Mobile/Manuf. Homes	16,761	16,761	16,761	16,761	16,761
Tourists	133	177	202	202	202
TOTAL	23,757	29,043	38,520	38,520	38,520
Polk County					
Site-built Homes	22,247	44,495	66,742	88,990	111,237
Mobile/Manuf. Homes	68,678	68,678	68,678	68,678	68,678
Tourists	0	0	0	0	0
TOTAL	90,925	113,173	135,420	157,668	179,915

Table IV-8 – Evacuating Population by Base Scenario for 2015

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
DeSoto County					
Site-built Homes	2,549	3,942	6,054	8,711	9,654
Mobile/Manuf. Homes	13,792	13,792	13,792	13,792	13,792
Tourists	0	0	0	0	0
TOTAL	16,341	17,734	19,846	22,503	23,446
Hardee County					
Site-built Homes	2,571	2,571	3,856	5,141	6,427
Mobile/Manuf. Homes	9,592	9,592	9,592	9,592	9,592
Tourists	0	0	0	0	0
TOTAL	12,163	12,163	13,448	14,733	16,019
Highlands County					
Site-built Homes	4,184	4,184	8,368	16,739	20,933
Mobile/Manuf. Homes	19,656	19,656	19,656	19,656	19,656
Tourists	0	0	0	0	0
TOTAL	23,840	23,840	28,024	36,395	40,589
Okeechobee County					
Site-built Homes	7,491	13,191	24,588	24,588	24,588
Mobile/Manuf. Homes	17,563	17,563	17,563	17,563	17,563
Tourists	133	177	202	202	202
TOTAL	25,187	30,931	42,353	42,353	42,353
Polk County					
Site-built Homes	25,132	50,265	75,397	100,530	125,662
Mobile/Manuf. Homes	68,111	68,111	68,111	68,111	68,111
Tourists	0	0	0	0	0
TOTAL	93,243	118,376	143,508	168,641	193,773

Table IV-9 – Evacuating Vehicles by Base Scenario for 2010

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
DeSoto County					
Site-built Homes	729	1,163	1,817	2,813	3,143
Mobile/Manuf. Homes	4,110	4,110	4,110	4,624	4,624
Tourists	0	0	0	0	0
TOTAL	4,839	5,273	5,927	7,437	7,767
Hardee County					
Site-built Homes	667	667	1,000	1,429	1,787
Mobile/Manuf. Homes	2,744	2,744	2,744	2,744	2,927
Tourists	0	0	0	0	0
TOTAL	3,411	3,411	3,744	4,173	4,714
Highlands County					
Site-built Homes	1,415	1,415	2,830	6,065	7,586
Mobile/Manuf. Homes	8,903	8,903	8,903	10,016	10,016
Tourists	0	0	0	0	0
TOTAL	10,318	10,318	11,733	16,081	17,602
Okeechobee County					
Site-built Homes	3,090	5,088	8,120	8,120	8,700
Mobile/Manuf. Homes	6,427	6,427	6,427	6,829	6,829
Tourists	107	142	162	162	162
TOTAL	9,624	11,657	14,709	15,111	15,691
Polk County					
Site-built Homes	9,674	19,347	29,021	38,695	52,089
Mobile/Manuf. Homes	34,723	34,723	34,723	39,063	39,063
Tourists	0	0	0	0	0
TOTAL	44,397	54,070	63,744	77,758	91,152

Table IV-10 – Evacuating Vehicles by Base Scenario for 2015

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
DeSoto County					
Site-built Homes	948	1,466	2,252	3,471	3,847
Mobile/Manuf. Homes	4,272	4,272	4,272	4,806	4,806
Tourists	0	0	0	0	0
TOTAL	5,220	5,738	6,524	8,277	8,653
Hardee County					
Site-built Homes	919	919	1,379	1,970	2,463
Mobile/Manuf. Homes	2,744	2,744	2,744	2,744	2,927
Tourists	0	0	0	0	0
TOTAL	3,663	3,663	4,123	4,714	5,390
Highlands County					
Site-built Homes	1,653	1,653	3,306	7,086	8,863
Mobile/Manuf. Homes	8,903	8,903	8,903	10,016	10,016
Tourists	0	0	0	0	0
TOTAL	10,556	10,556	12,209	17,102	18,879
Okeechobee County					
Site-built Homes	3,337	5,507	9,155	9,155	9,809
Mobile/Manuf. Homes	6,610	6,610	6,610	7,023	7,023
Tourists	107	142	162	162	162
TOTAL	10,054	12,259	15,927	16,340	16,994
Polk County					
Site-built Homes	11,088	22,176	33,265	44,353	59,706
Mobile/Manuf. Homes	34,723	34,723	34,723	39,063	39,063
Tourists	0	0	0	0	0
TOTAL	45,811	56,899	67,988	83,416	98,769

Table IV-11 – Shelter Demand by Base Scenario

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
2010					
DeSoto County	2,551	2,710	2,953	3,608	3,730
Hardee County	1,832	1,832	1,985	2,183	2,451
Highlands County	5,465	5,465	5,988	7,803	8,366
Okeechobee County	3,818	4,745	6,149	6,297	6,566
Polk County	15,533	18,217	20,901	25,191	28,908
2015					
DeSoto County	2,721	2,914	3,204	3,952	4,090
Hardee County	1,948	1,948	2,161	2,435	2,764
Highlands County	5,554	5,554	6,164	8,181	8,837
Okeechobee County	4,000	5,006	6,695	6,849	7,150
Polk County	15,925	19,001	22,080	26,762	31,021

Note: Shelter demand is the population in each county who will seek public shelter during their evacuation, either at an in-county shelter or an out of county shelter.

Congested Roadways

Another important component of the transportation analysis is the identification of critical roadway segments for evacuation traffic. This analysis includes a review of vehicle flows during the evacuation period, along with excessive vehicle queues. A summary of the total number of evacuating vehicles for each of the base scenarios is presented in **Table IV-12**. It is important to note that the total number of evacuating vehicles in the table below includes vehicles evacuating from all of the counties included in the base scenarios (DeSoto, Hardee, Highlands, Okeechobee, Polk, Charlotte, Sarasota, Hillsborough, Manatee, and Pinellas Counties) for a total of ten evacuating counties.

Table IV-12 – Total Evacuating Vehicles for Base Scenarios

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
2010	548,550	725,373	940,941	1,103,282	1,244,154
2015	572,993	752,647	987,171	1,161,859	1,306,962

The identification of critical roadways in the evacuation network is also important to assist emergency managers with identifying roadways that have the greatest impact on clearance times. Critical roadways were identified by reviewing roadways in the model network that have the highest vehicle queues for extended periods of time during an evacuation. Due to the nature of a major evacuation in general, nearly all roadway facilities will have extended vehicle queues at some point during the evacuation process. The point of this analysis is to identify those roadway facilities that have vehicle queues for the longest time periods during each of the evacuation scenarios. Critical roadway segments for the Central Florida Region are identified in **Figures IV-1** through **IV-10** for each of the base scenarios for 2010 and 2015.

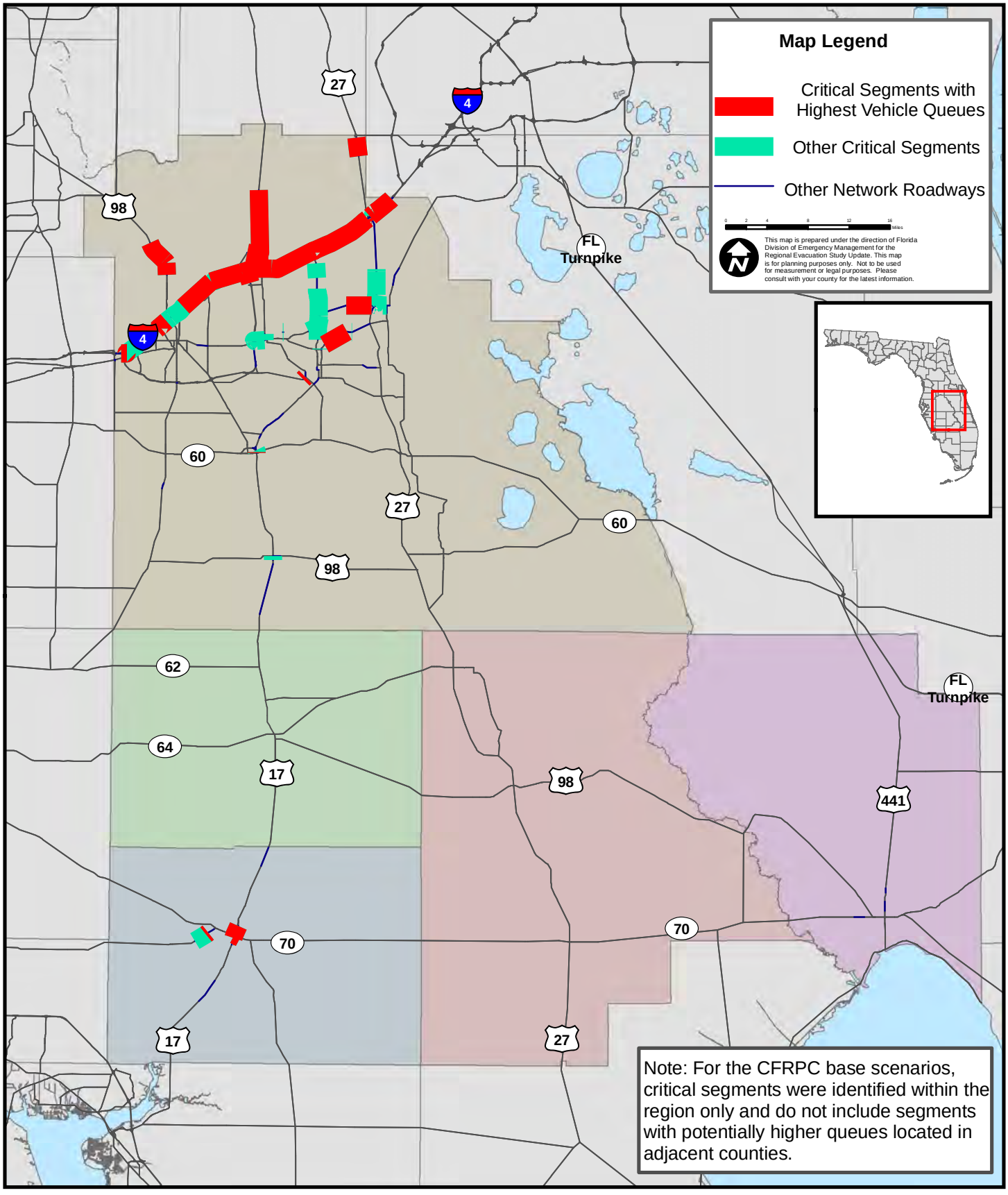
Through a review of the critical roadway segment figures, it is clear that I-4, US 17, SR 64, SR 70, SR 62, US 98, US 27, US 441, US 92, and US 17 are critical facilities for all evacuation scenarios. During the level A evacuation scenarios, the roadway segments with the highest vehicle queues are primarily concentrated along the major Interstate and State Highway system. In contrast, for the level E evacuation scenarios, the roadway segments with the highest vehicle queues include other roadways within the region.

In addition to the identification of critical roadway segments, the total number of evacuating vehicles entering and exiting each county by evacuation scenario was also determined. Evacuating vehicles exiting each county by major evacuation route are identified in **Table IV-13** for 2010 and **Table IV-14** for 2015. In addition, evacuating vehicles entering each county by major evacuation route are identified in **Table IV-15** for 2010 and **Table IV-16** for 2015. Detailed volume figures for all evacuation routes in the Central Florida Region for each base scenario are included in Volume 5-7.

The number of vehicles entering and exiting each county during an evacuation varies widely depending upon the scenario, roadway, and county. As expected, major interstates and state highways generally carry larger volumes of evacuating traffic. The vehicle flows into and out of each county also generally follow the same pattern as the critical segment figures, as locations with higher queues and congestion generally have higher traffic volumes.

Figure IV-1

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Base Scenario Evacuation Level A

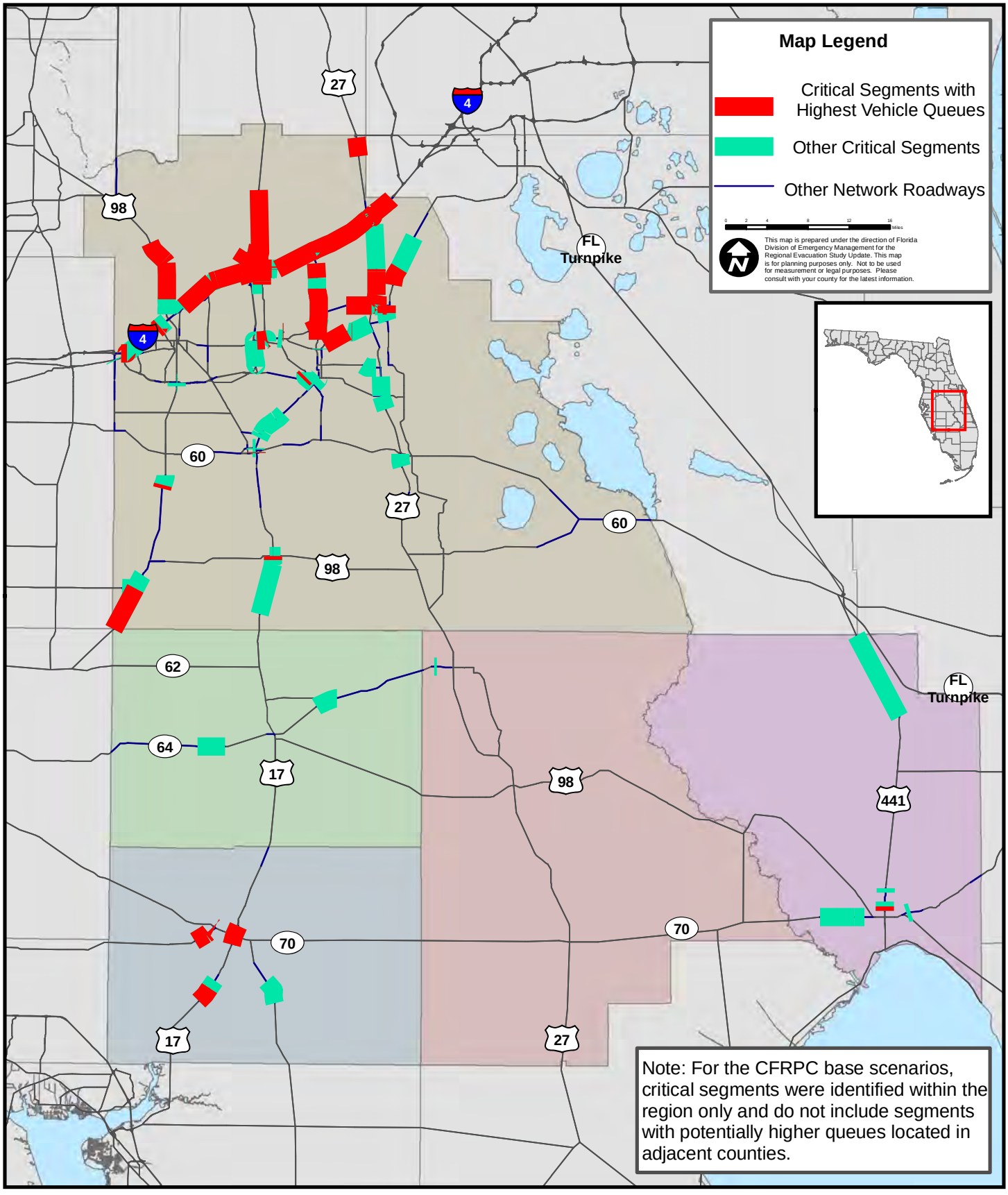


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-2

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Base Scenario Evacuation Level B

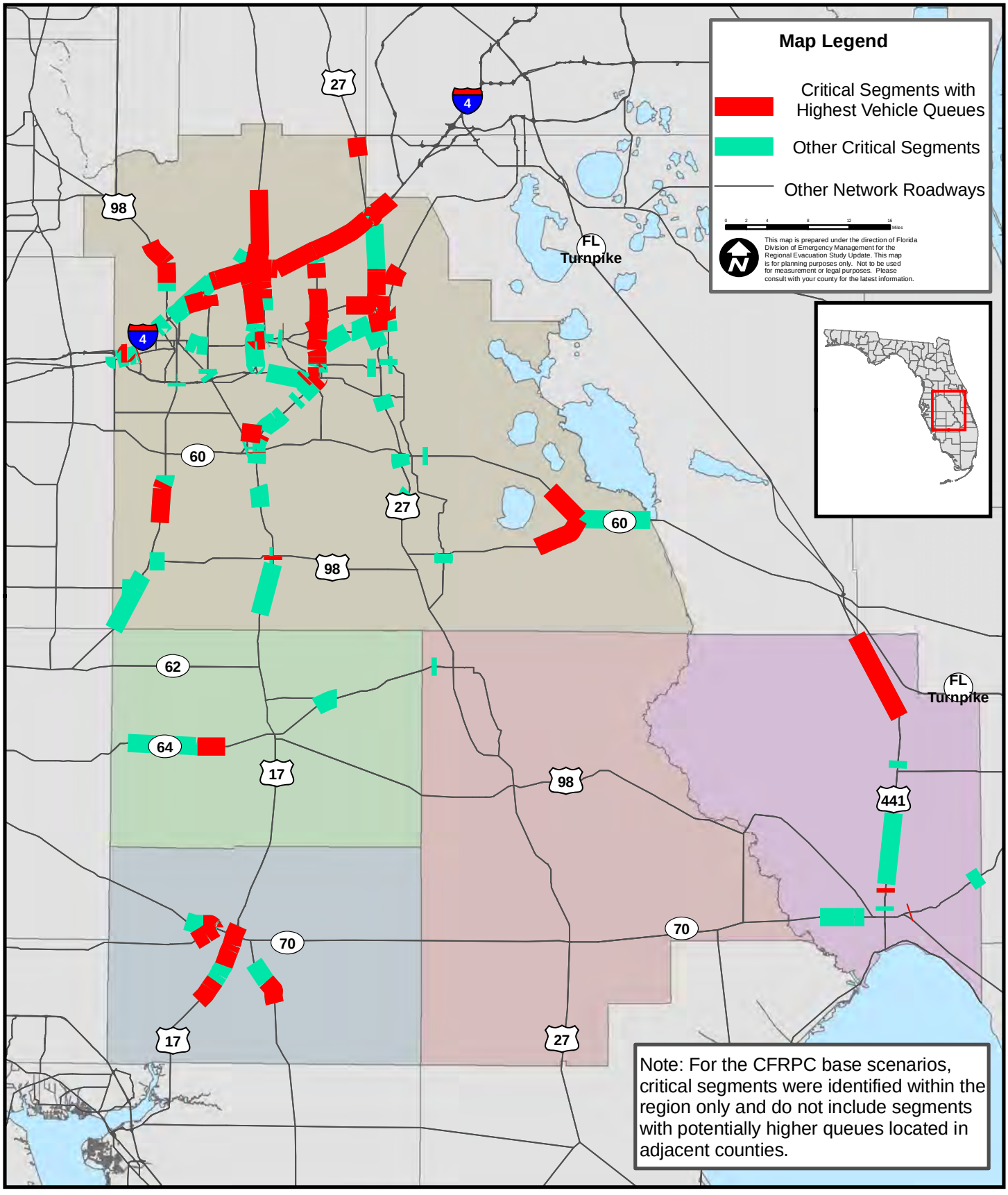


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-3

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Base Scenario Evacuation Level C

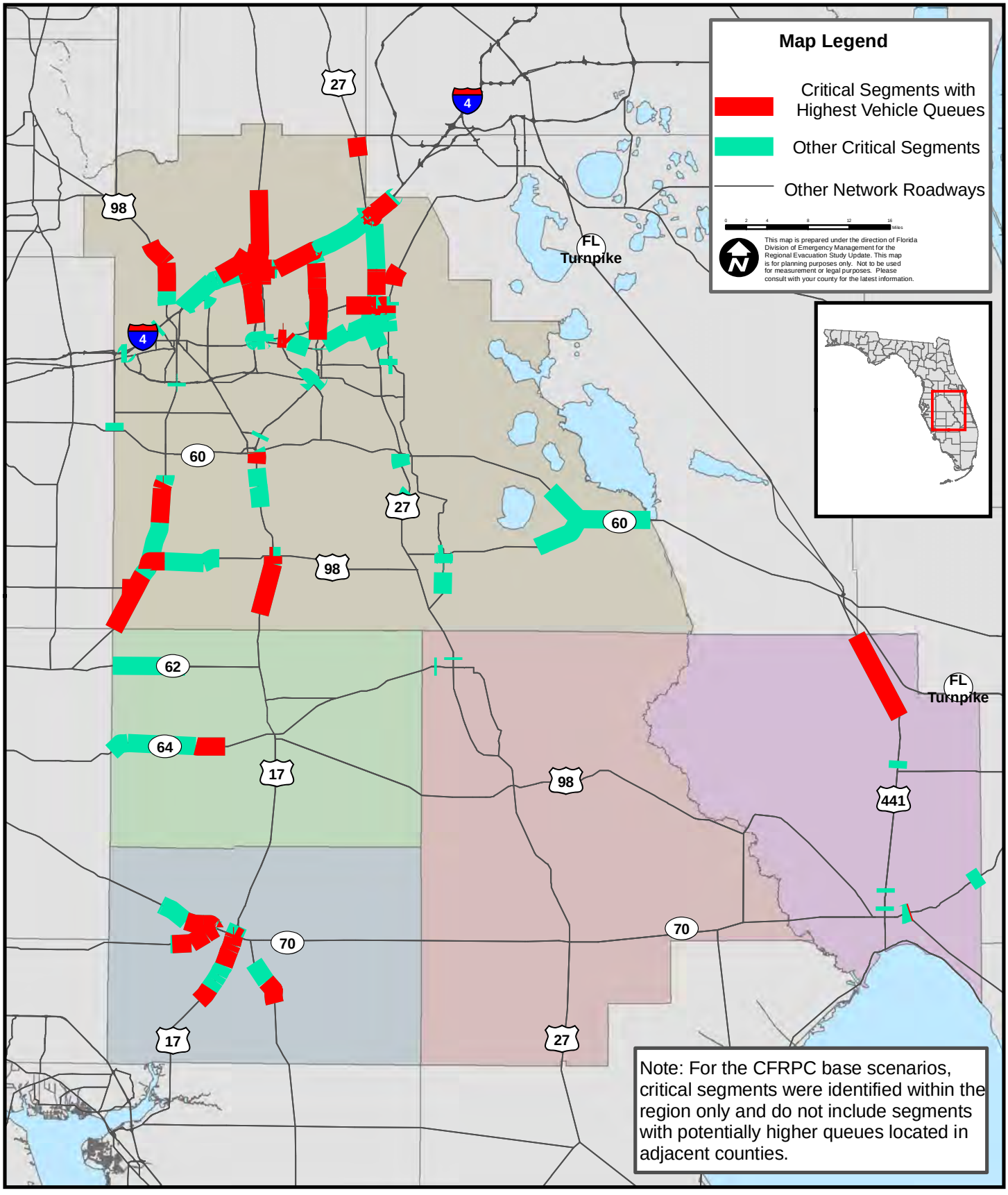


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-4

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Base Scenario Evacuation Level D

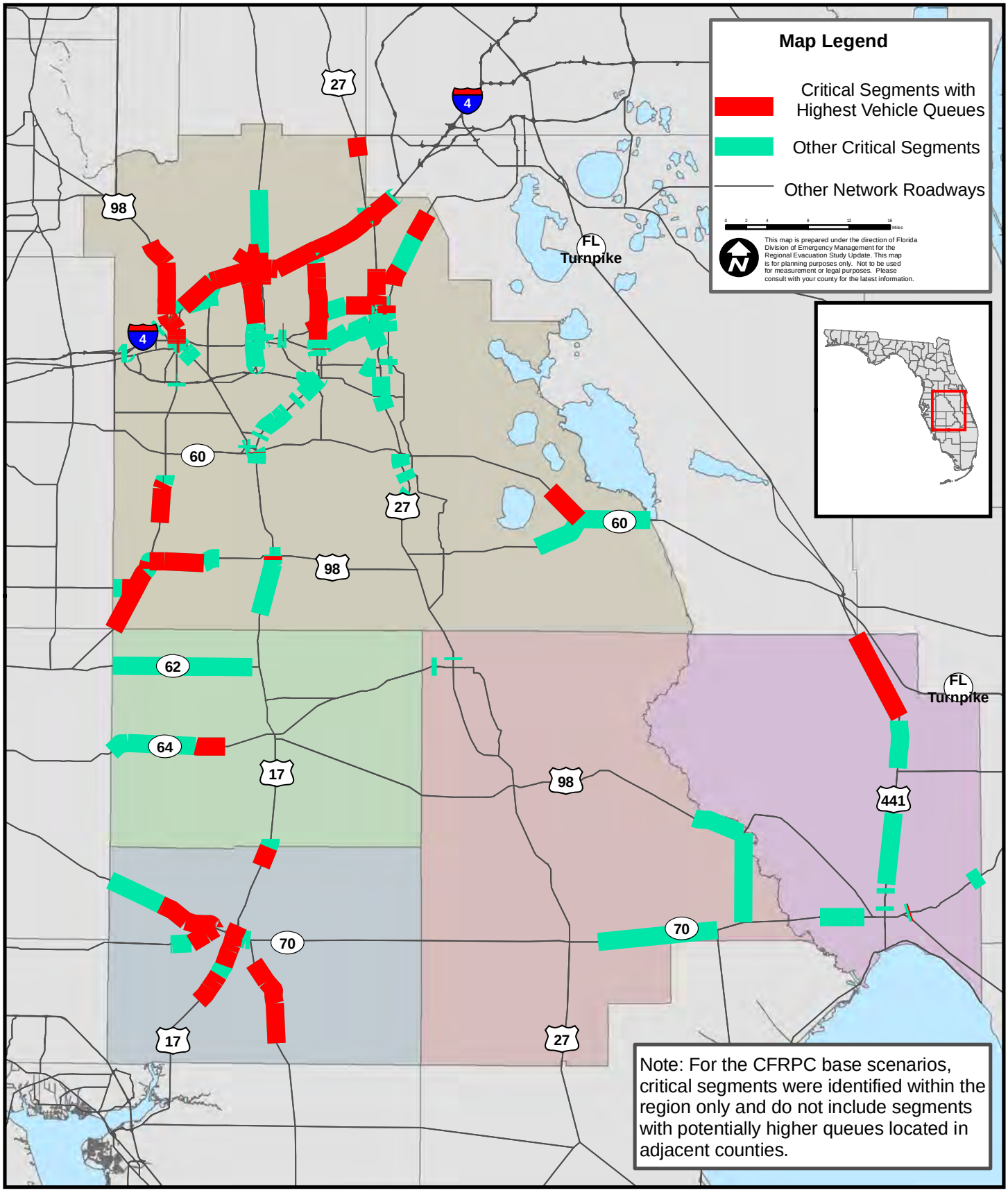


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-5

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Base Scenario Evacuation Level E

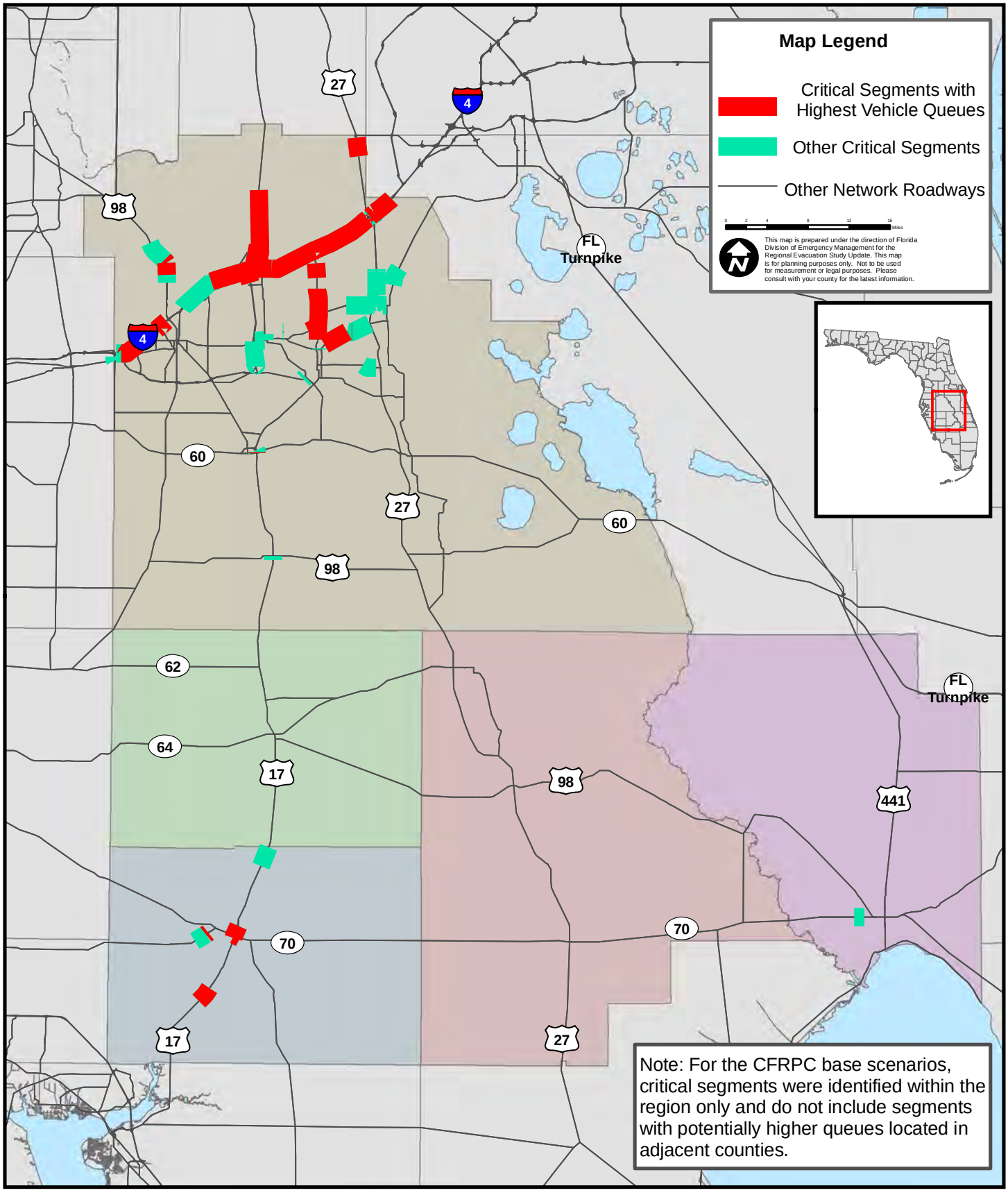


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-6

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Base Scenario Evacuation Level A

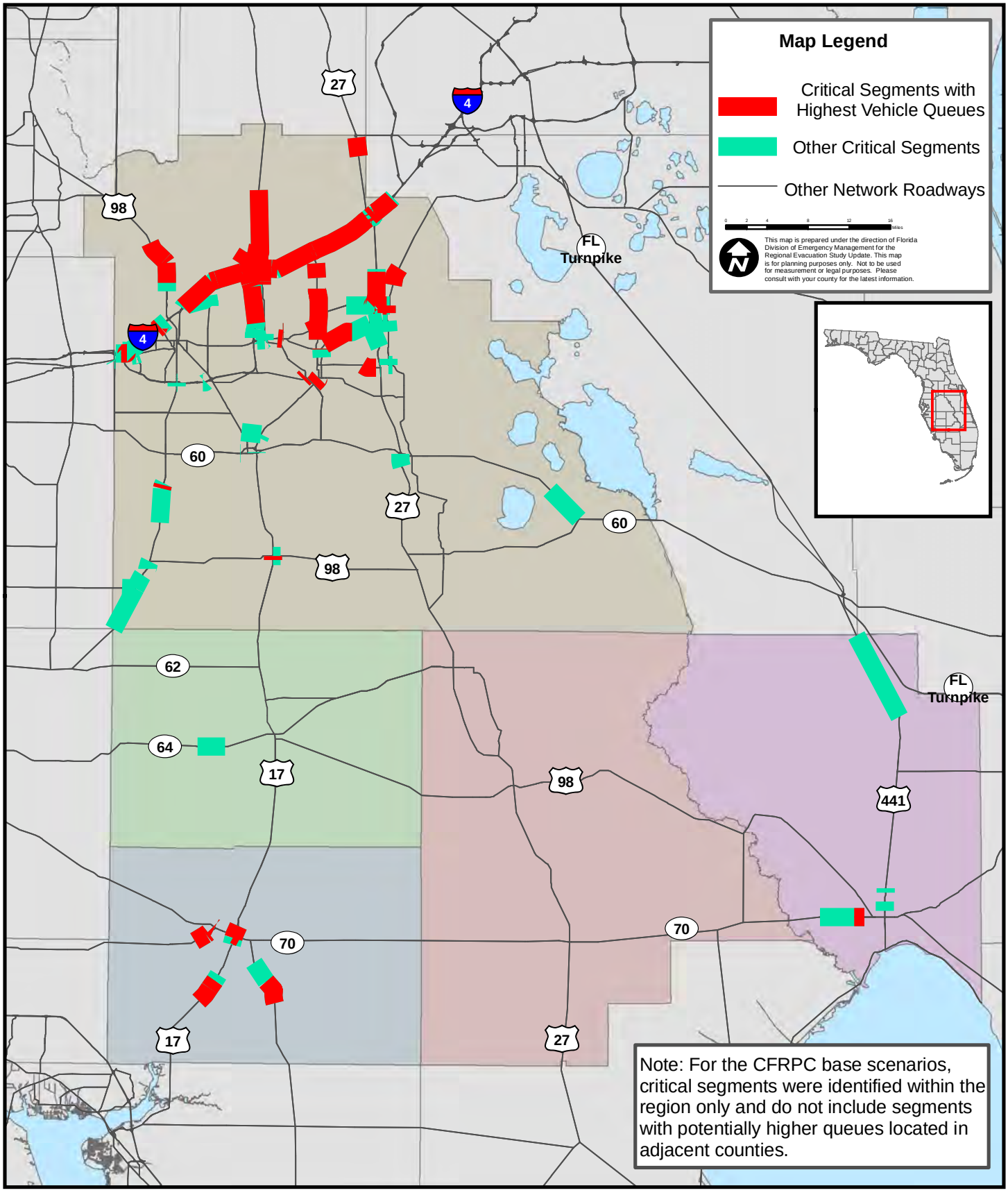


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-7

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Base Scenario Evacuation Level B

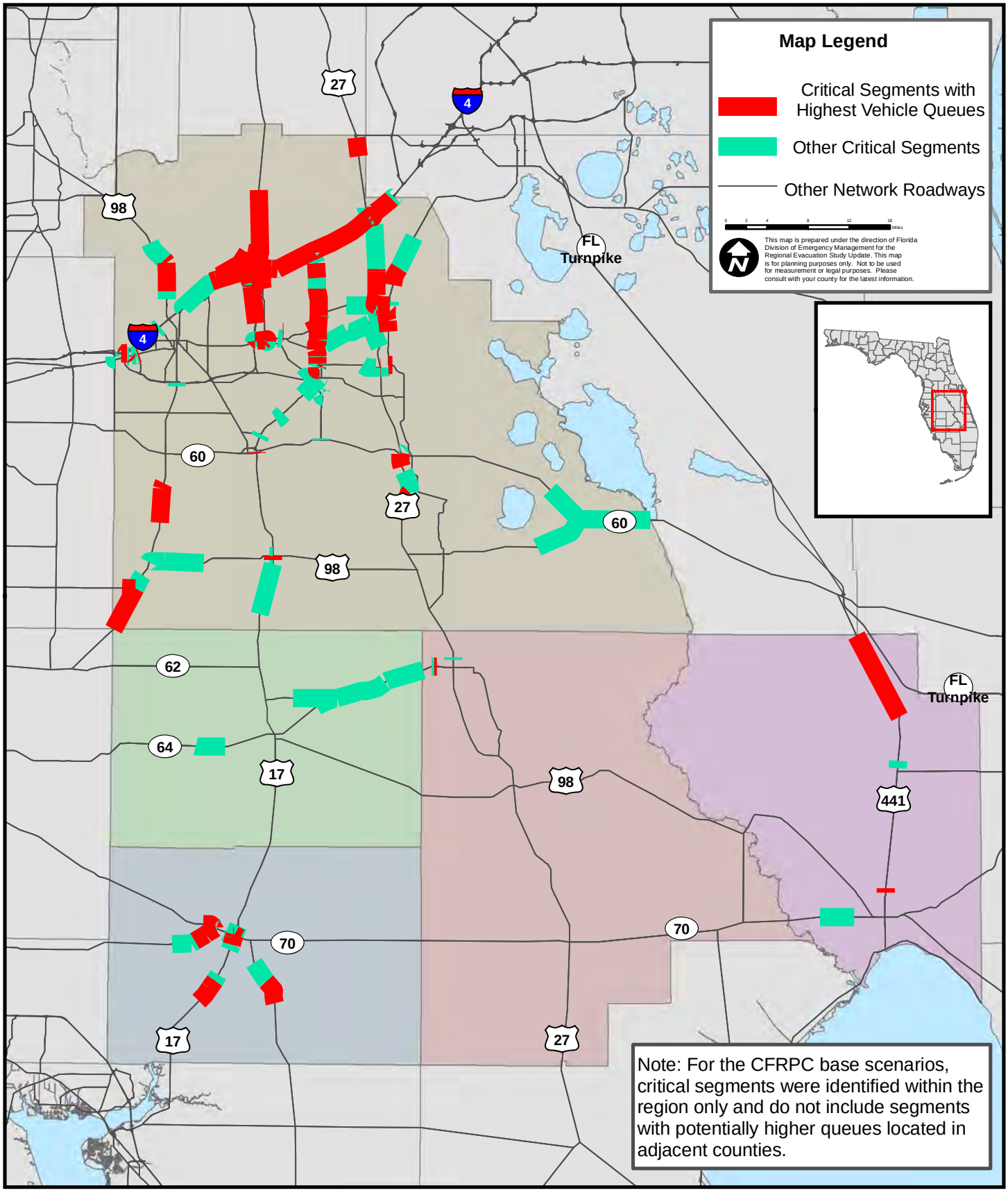


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-8

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Base Scenario Evacuation Level C

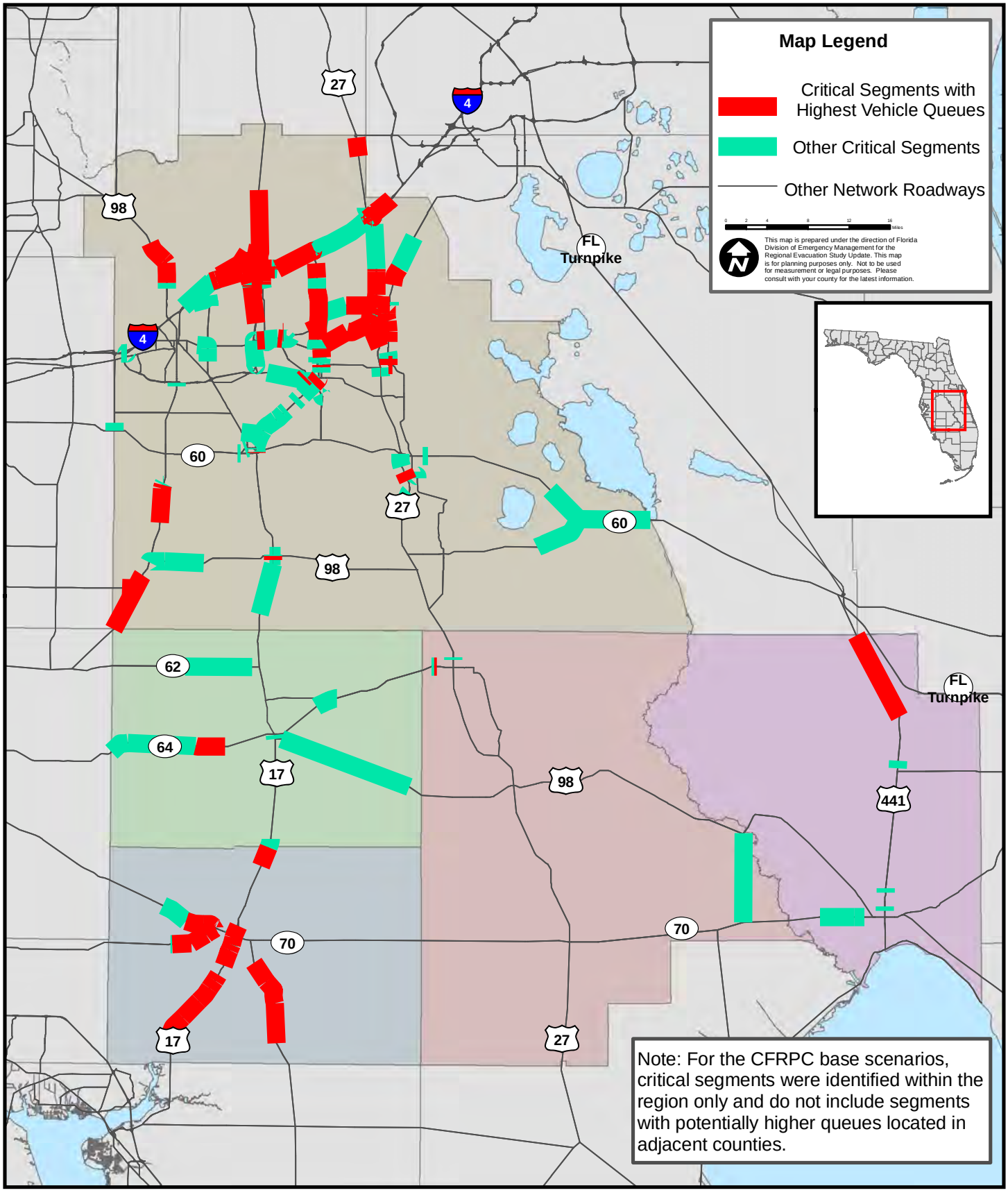


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-9

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Base Scenario Evacuation Level D

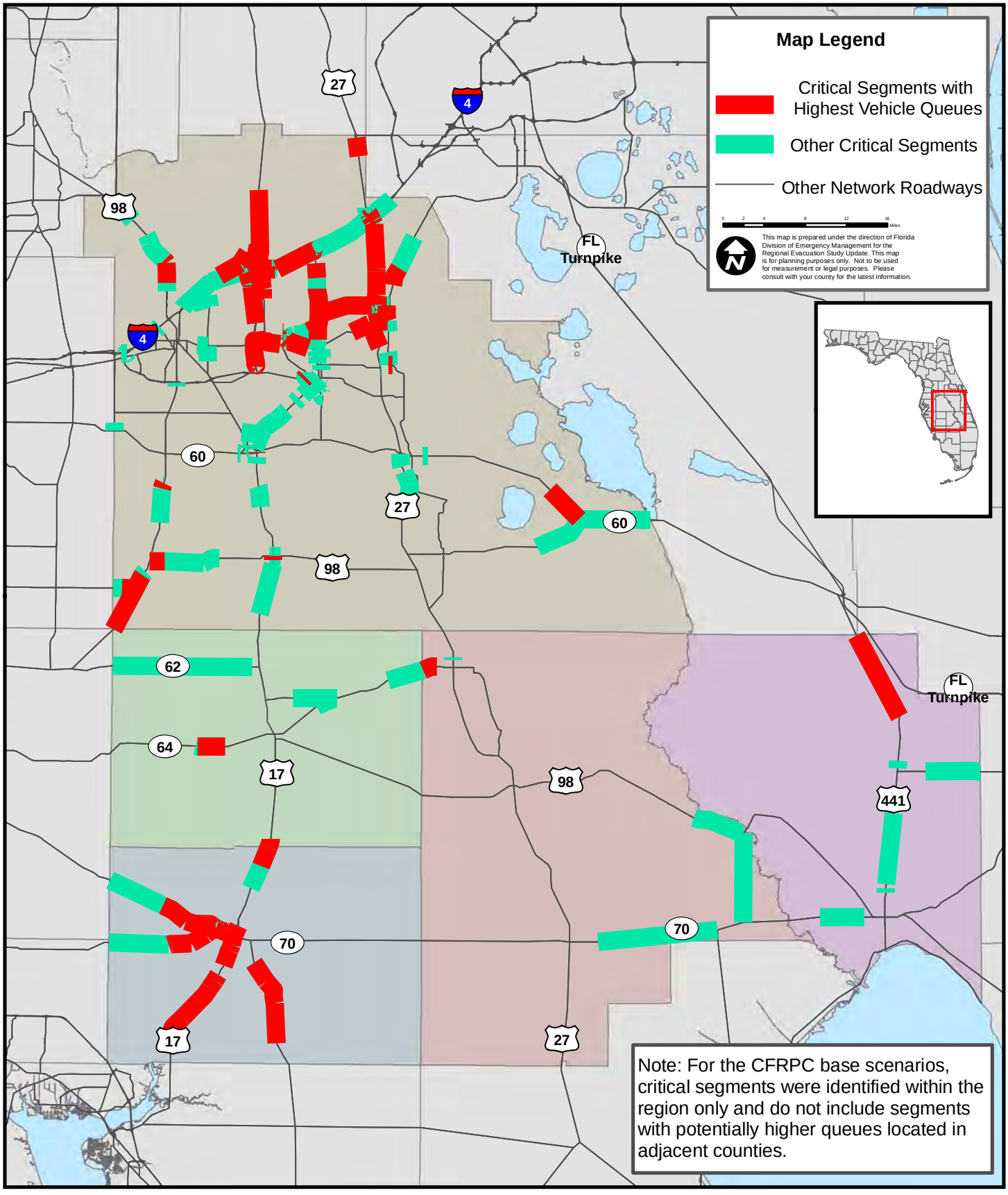


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-10

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Base Scenario Evacuation Level E



Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Table IV-13 – Evacuating Vehicles Leaving Each County by Evacuation Route for the 2010 Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
DeSoto County					
US 17 Southbound	0	100	700	4,800	9,400
SR 31 Southbound	300	400	700	2,000	3,800
SR 70 Eastbound	2,100	3,500	5,600	7,400	7,600
US 17 Northbound	4,400	6,200	9,800	13,200	20,000
SR 70 Westbound	100	100	100	200	200
SR 72 Westbound	0	100	200	200	200
Hardee County					
US 17 Southbound	300	500	700	1,200	2,200
SR 64 Westbound	100	100	200	100	100
SR 62 Westbound	100	200	400	1,400	4,100
US 17 Northbound	5,800	9,100	14,700	21,200	29,200
SR 64 Eastbound	1,000	3,500	5,500	6,300	8,300
SR 66 Eastbound	500	800	2,800	5,700	7,400
Highlands County					
SR 70 Westbound	200	100	100	0	0
SR 66 Westbound	200	500	800	900	2,700
US 27 Southbound	200	300	1,200	3,600	5,800
SR 70 Eastbound	2,100	4,400	5,400	6,700	9,700
US 98 Eastbound	200	700	3,900	5,700	8,100
US 27 Northbound	2,000	5,600	12,000	19,700	26,300
SR 64 Westbound	0	100	100	100	200
Okeechobee County					
US 98 Westbound	300	800	2,200	2,200	2,300
SR 70 Westbound	400	500	600	600	600
SR 78 Southbound	200	300	500	600	700
US 98 Southbound	100	100	200	300	400
SR 710 Eastbound	800	1,300	2,600	4,300	5,600
SR 70 Eastbound	1,800	4,900	8,100	11,200	13,800
FL Turnpike SB	2,200	2,900	3,500	4,600	4,900
FL Turnpike NB	0	0	1,400	3,200	6,500
US 441 Northbound	2,800	4,800	8,800	10,200	11,300
Polk County					
US 17 Southbound	300	500	800	1,400	2,500
US 27 Southbound	400	600	700	1,900	4,000
SR 60 Eastbound	1,800	3,500	6,500	8,300	9,600
US 17 Northbound	700	3,600	5,500	5,700	8,200
I-4 Eastbound	35,600	47,400	67,800	88,000	83,000
US 27 Northbound	7,100	10,700	18,000	30,200	31,200
SR 33 Northbound	3,400	7,800	10,600	16,500	10,800
SR 471 Northbound	5,200	10,500	10,800	15,400	19,500
US 98 Northbound	900	1,300	1,300	3,000	6,300
I-4 Westbound	300	700	1,800	3,600	7,000
SR 60 Westbound	100	100	100	200	600

Table IV-14 – Evacuating Vehicles Leaving Each County by Evacuation Route for the 2015 Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
DeSoto County					
US 17 Southbound	2,700	100	3,500	4,100	2,100
SR 31 Southbound	300	400	800	2,600	4,700
SR 70 Eastbound	2,600	3,700	6,200	9,300	8,400
US 17 Northbound	4,500	6,400	8,700	19,900	25,100
SR 70 Westbound	200	100	100	200	300
SR 72 Westbound	100	100	300	300	600
Hardee County					
US 17 Southbound	400	500	700	1,800	3,100
SR 64 Westbound	100	100	200	200	300
SR 62 Westbound	100	200	500	2,100	3,900
US 17 Northbound	6,100	9,200	14,800	27,100	32,400
SR 64 Eastbound	1,300	3,600	6,900	7,900	12,400
SR 66 Eastbound	600	900	2,900	6,300	8,100
Highlands County					
SR 70 Westbound	200	200	100	100	100
SR 66 Westbound	300	500	800	1,000	1,200
US 27 Southbound	200	300	1,400	4,700	6,800
SR 70 Eastbound	2,500	4,600	6,100	9,200	10,600
US 98 Eastbound	300	1,000	3,500	7,200	9,000
US 27 Northbound	2,300	5,500	14,900	20,300	31,300
SR 64 Westbound	100	100	100	200	100
Okeechobee County					
US 98 Westbound	300	800	2,500	2,500	2,100
SR 70 Westbound	400	500	700	700	600
SR 78 Southbound	100	1,400	600	700	800
US 98 Southbound	100	100	200	300	1,000
SR 710 Eastbound	800	1,100	2,500	4,700	6,300
SR 70 Eastbound	2,200	5,500	9,800	13,600	13,900
FL Turnpike SB	2,400	3,200	3,800	4,800	6,200
FL Turnpike NB	0	0	1,500	5,400	10,200
US 441 Northbound	2,900	4,900	8,800	10,600	13,200
Polk County					
US 17 Southbound	400	600	900	1,800	3,500
US 27 Southbound	400	600	800	3,100	4,200
SR 60 Eastbound	2,000	3,900	6,600	8,700	13,700
US 17 Northbound	1,000	3,200	4,700	8,000	8,100
I-4 Eastbound	37,400	51,500	77,200	76,400	89,400
US 27 Northbound	7,800	13,800	24,500	25,700	36,600
SR 33 Northbound	3,500	6,800	14,400	15,800	15,300
SR 471 Northbound	4,900	7,200	11,200	11,400	17,400
US 98 Northbound	1,700	2,400	1,800	6,300	4,000
I-4 Westbound	300	900	2,000	6,900	7,300
SR 60 Westbound	100	100	200	400	600

Table IV-15 – Evacuating Vehicles Entering Each County by Evacuation Route for the 2010 Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
DeSoto County					
US 17 Southbound	300	500	700	1,200	2,200
SR 70 Westbound	200	100	100	0	0
US 17 Northbound	3,000	5,100	7,300	7,000	6,100
SR 31 Northbound	0	1,000	1,500	3,900	10,800
Hardee County					
US 17 Northbound	4,400	6,200	9,800	13,200	20,000
SR 66 Westbound	200	500	800	900	2,700
SR 64 Westbound	0	100	100	100	200
US 17 Southbound	300	500	800	1,400	2,500
US 27 Southbound	400	600	700	1,900	4,000
Highlands County					
SR 70 Eastbound	2,100	3,500	5,600	7,400	7,600
SR 64 Eastbound	1,000	3,500	5,500	6,300	8,300
SR 66 Eastbound	500	800	2,800	5,700	7,400
US 98 Westbound	300	800	2,200	2,200	2,300
SR 70 Westbound	400	500	600	600	600
US 27 Southbound	400	600	700	1,900	4,000
Okeechobee County					
SR 70 Eastbound	2,100	4,400	5,400	6,700	9,700
US 98 Eastbound	200	700	3,900	5,700	8,100
SR 710 Westbound	0	0	0	0	0
FL Turnpike SB	2,200	2,900	3,500	4,600	4,900
FL Turnpike NB	0	0	1,400	3,200	6,500
Polk County					
US 17 Northbound	5,800	9,100	14,700	21,200	29,200
US 27 Northbound	2,000	5,600	12,000	19,700	26,300
SR 60 Eastbound	800	4,300	6,500	11,200	9,900
I-4 Eastbound	40,400	52,200	63,300	80,600	75,200
I-4 Westbound	900	1,200	1,300	1,400	1,700
SR 60 Westbound	400	300	200	200	300

Table IV-16 – Evacuating Vehicles Entering Each County by Evacuation Route for the 2015 Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
DeSoto County					
US 17 Southbound	400	500	700	1,800	3,100
SR 70 Westbound	200	200	100	100	100
US 17 Northbound	0	100	1,700	8,200	18,700
SR 31 Northbound	0	800	1,700	6,900	12,300
Hardee County					
US 17 Northbound	4,500	6,400	8,700	19,900	25,100
SR 66 Westbound	300	500	800	1,000	1,200
SR 64 Westbound	100	100	100	200	100
US 17 Southbound	400	600	900	1,800	3,500
US 27 Southbound	400	600	800	3,100	4,200
Highlands County					
SR 70 Eastbound	2,600	3,700	6,200	9,300	8,400
SR 64 Eastbound	1,300	3,600	6,900	7,900	12,400
SR 66 Eastbound	600	900	2,900	6,300	8,100
US 98 Westbound	300	800	2,500	2,500	2,100
SR 70 Westbound	400	500	700	700	600
US 27 Southbound	400	600	800	3,100	4,200
Okeechobee County					
SR 70 Eastbound	2,500	4,600	6,100	9,200	10,600
US 98 Eastbound	300	1,000	3,500	7,200	9,000
SR 710 Westbound	0	0	0	0	0
FL Turnpike SB	0	0	1,500	5,400	10,200
FL Turnpike NB	2,400	3,200	3,800	4,800	6,200
Polk County					
US 17 Northbound	6,100	9,200	14,800	27,100	32,400
US 27 Northbound	2,300	5,500	14,900	20,300	31,300
SR 60 Eastbound	800	100	11,000	15,100	18,300
I-4 Eastbound	42,900	55,400	68,400	75,400	86,900
I-4 Westbound	900	1,200	1,300	1,500	1,700
SR 60 Westbound	400	300	200	200	300

Clearance Times

Calculated clearance times are used by county emergency managers as one input to determine when to recommend an evacuation order. Clearance times for each of the base scenarios are summarized in **Table IV-17** and **IV-18**, as well as **Figures IV-11, IV-12,** and **IV-13**. Clearance time includes several components, including the mobilization time for the evacuating population to prepare for an evacuation (pack supplies and personal belongs, load their vehicle, etc.), the actual time spent traveling on the roadway network, and the delay time caused by traffic congestion.

In-county clearance times for the base scenarios range from 12.5 hours for the evacuation level A scenarios to 35.5 hours for Okeechobee County for evacuation level E scenario in 2010. Clearance Time to Shelter shows a similar pattern, with clearance times for the base scenarios ranging from 10 hours for the evacuation level A scenarios to 30 hours for DeSoto County for evacuation level E scenario in 2010.

In 2015, in-county clearance times for the base scenarios increase slightly to between 12.5 hours for the evacuation level A scenarios and 40.5 hours for Okeechobee County for the evacuation level E scenario. Clearance Time to Shelter shows a similar pattern, with clearance times for the base scenarios ranging from 10 hours for the evacuation level A scenarios to 38.5 hours for DeSoto County for evacuation level E scenario in 2015.

Out of county clearance times for the base scenarios range from 13.5 hours for the base evacuation level A scenario to 44.5 hours in Polk County for the evacuation level E scenario. Out of county clearance times increase slightly in 2015, with Polk County at 48.5 hours for evacuation level E.

Regional clearance time for the five county CFRPC region ranges from 15 hours to 44.5 hours in 2010 and from 16 to 48.5 hours in 2015.

Table IV-17 – 2010 Clearance Times for Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Clearance Time to Shelter					
DeSoto County	12.5	13.0	16.5	22.0	30.0
Hardee County	10.0	10.5	10.5	9.5	11.0
Highlands County	12.5	12.5	12.5	12.5	12.5
Okeechobee Co.	12.5	12.5	0.0	0.0	0.0
Polk County	13.0	15.0	16.5	16.0	20.5
In-County Clearance Time					
DeSoto County	13.5	13.5	17.5	24.0	32.0
Hardee County	12.5	12.5	12.5	12.0	12.5
Highlands County	13.0	13.0	13.0	13.0	13.0
Okeechobee Co.	15.0	15.5	20.0	26.0	35.5
Polk County	13.5	15.5	17.0	16.5	21.0
Out of County Clearance Time					
DeSoto County	13.5	14.0	18.0	24.0	32.0
Hardee County	13.5	13.5	18.0	25.0	33.5
Highlands County	14.5	14.5	19.0	25.0	34.5
Okeechobee Co.	15.0	16.0	19.5	25.5	35.0
Polk County	14.5	21.0	24.0	36.5	44.5
Regional Clearance Time					
Central Florida	15.0	21.0	24.0	36.5	44.5

Table IV-18 – 2015 Clearance Times for Base Scenario

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
Clearance Time to Shelter					
DeSoto County	12.5	13.5	14.5	29.5	38.5
Hardee County	10.0	10.5	11.0	11.0	38.0
Highlands County	12.5	12.5	12.5	12.5	12.5
Okeechobee Co.	12.5	12.5	0.0	0.0	0.0
Polk County	13.0	16.0	17.5	30.5	20.5
In-County Clearance Time					
DeSoto County	13.5	14.0	22.0	30.5	38.5
Hardee County	12.5	12.5	12.5	12.5	39.5
Highlands County	13.0	13.0	13.0	13.0	13.0
Okeechobee Co.	15.0	16.0	24.5	33.0	40.5
Polk County	13.5	16.5	18.0	31.0	21.0
Out of County Clearance Time					
DeSoto County	13.5	14.5	22.0	31.0	41.0
Hardee County	13.0	14.5	22.0	31.5	41.5
Highlands County	14.5	15.0	22.5	32.0	39.5
Okeechobee Co.	15.0	16.0	24.0	32.5	40.0
Polk County	16.0	18.5	32.0	35.0	48.5
Regional Clearance Time					
Central Florida	16.0	18.5	32.0	35.0	48.5

Figure IV-11 - Clearance Time to Shelter Base Scenarios

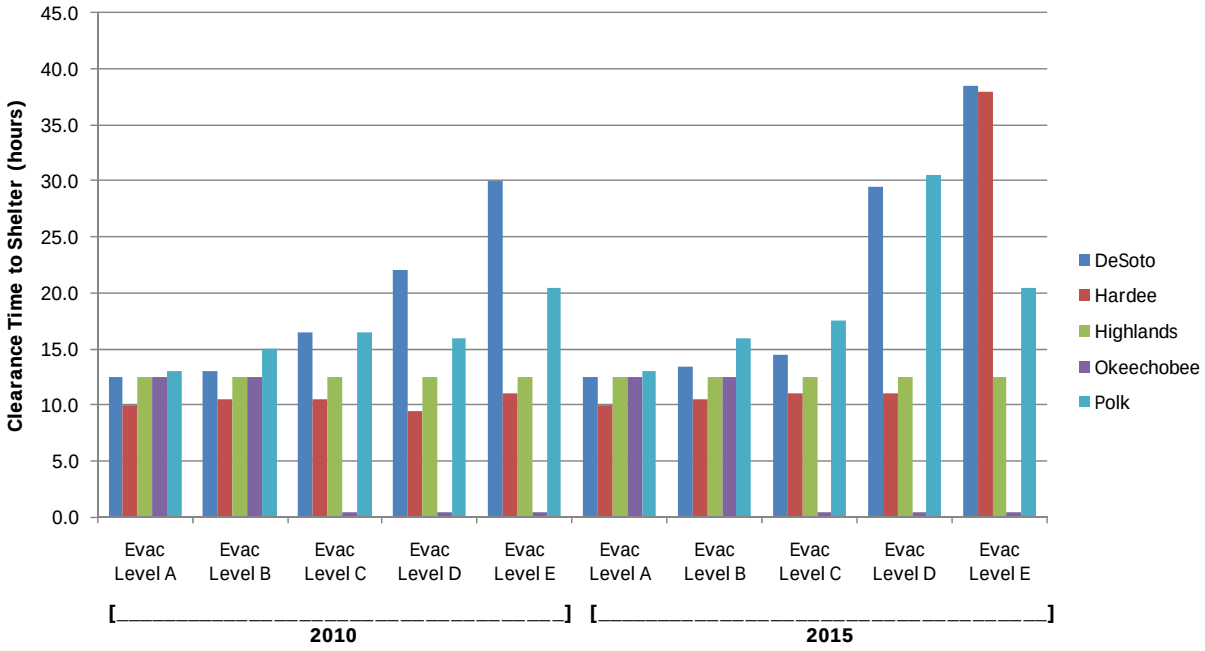


Figure IV-12 - In-County Clearance Times Base Scenarios

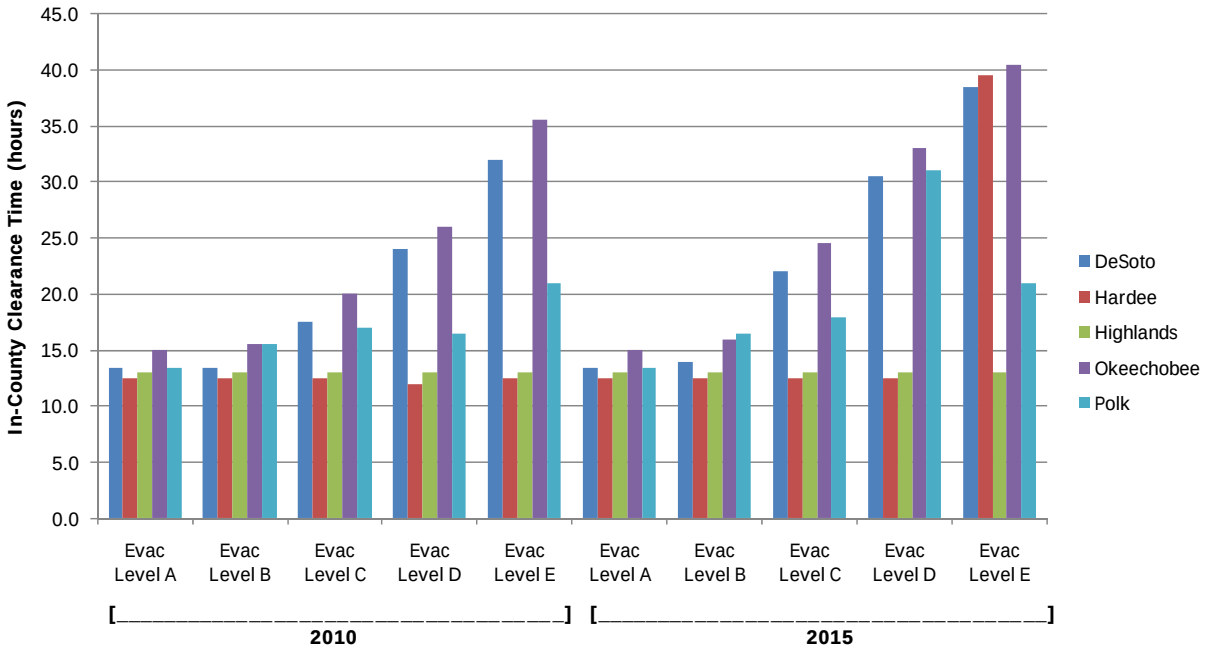
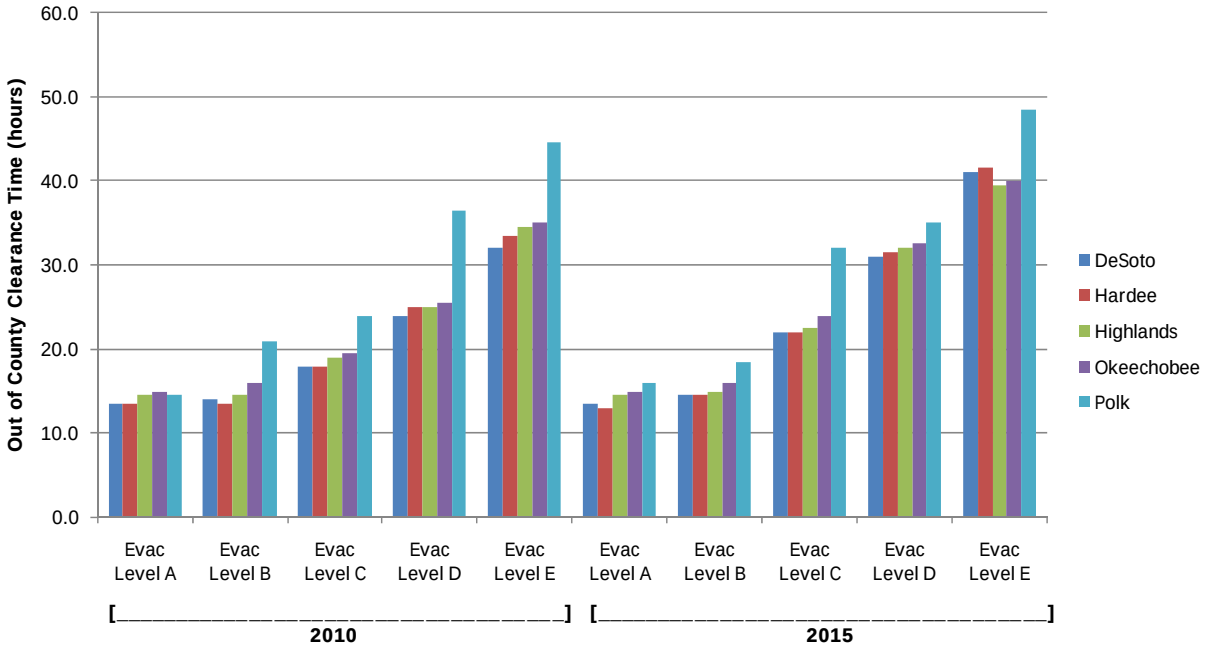


Figure IV-13 - Out of County Clearance Times Base Scenarios



F. Operational Scenarios

The transportation analysis also included ten region wide operational scenarios selected by the county emergency managers and RPC staff for the Central Florida Region. While the base scenarios required that the basic assumptions were consistent between scenarios except for the year and the evacuation level, this is not the case for the operational scenarios. The only requirement for each region is that two operational scenarios are developed for each evacuation level (two for Level A, two for Level B, etc.). Otherwise, the assumptions and characteristics between the ten operational scenarios can be different for each scenario.

The ten operational scenarios selected for analysis in the Central Florida Region are illustrated in **Table IV-19.** The ten operational scenarios were developed to estimate response and evacuation conditions for a variety of both east coast and Gulf of Mexico storms and include the following:

- 2010 Level A – west to east track along the I-4 corridor;
- 2010 Level B – east to west track south of the SR 60 corridor;
- 2010 Level C – southeast to northwest track west of Okeechobee City;
- 2010 Level D – southwest to northeast track similar to Hurricane Charlie;
- 2010 Level E – southeast to northwest track east of Okeechobee City;
- 2015 Level A – southwest to northeast track similar to Hurricane Charlie;
- 2015 Level B – southeast to northwest track east of Okeechobee City;
- 2015 Level C – west to east track along the I-4 corridor;
- 2015 Level D – southeast to northwest track west of Okeechobee City; and,
- 2015 Level E – east to west track south of the SR 60 corridor.

Table IV-19 – Operational Scenarios

	Scenario 1 Level A 2010	Scenario 2 Level B 2010	Scenario 3 Level C 2010	Scenario 4 Level D 2010	Scenario 5 Level E 2010
Demographic Data	2010	2010	2010	2010	2010
Highway Network	2010	2010	2010	2010	2010
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	9-hour	12-hour	9-hour	12-hour	12-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	Planning	Planning	Planning	Planning	Planning
Evacuation Level	A	B except as noted below	C except as noted below	D except as noted below	E except as noted below
Counties Evacuating	Manatee Hillsborough Pinellas Hardee Polk Osceola Orange Lake	St. Lucie (C) Indian River (C) Osceola Highlands Hardee Polk Manatee (A) Hillsborough (A)	Palm Beach (D) Martin (D) St. Lucie Okeechobee Highlands Glades Hendry Polk (B) Hardee (B)	Lee Charlotte Sarasota DeSoto Hardee Highlands Polk (C) Manatee (C) Osceoloa (B) Orange (B)	Martin St. Lucie Indian River Okeechobee (D) Highlands (D) Polk (C) Osceola (D) Orange (C) Lake (C) Sumter (C)
	Scenario 6 Level A 2015	**Scenario 7 Level B 2015**	**Scenario 8 Level C 2015**	**Scenario 9 Level D 2015**	**Scenario 10 Level E 2015**
Demographic Data	2015	2015	2015	2015	2015
Highway Network	2015	2015	2015	2015	2015
One-Way Operations	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary
Response Curve	9-hour	12-hour	12-hour	9-hour	12-hour
Evacuation Phasing	None	None	None	None	None
Behavioral Response	Planning	Planning	Planning	Planning	Planning
Evacuation Level	A except as noted below	B except as noted below	C except as noted below	D except as noted below	E except as noted below
Counties Evacuating	Lee (B) Charlotte (B) Sarasota (B) DeSoto (B) Hardee Highlands Polk Manatee Osceoloa Orange	Martin (C) St. Lucie (C) Indian River (C) Okeechobee Highlands Polk Osceola Orange Lake Sumter	Manatee (D) Hillsborough (D) Pinellas (D) Hardee Polk Osceola Orange Lake	Palm Beach (E) Martin (E) St. Lucie Okeechobee Highlands Glades Hendry Polk (C) Hardee (C)	St. Lucie Indian River Okeechobee Osceola Highlands (D) Hardee (C) Polk (C) Manatee (B) Hillsborough (B)

G. Operational Scenario Results

Each of the ten operational scenarios were modeled for the Central Florida Region using the regional evacuation model. Results were derived from the model to summarize the evacuating population, evacuating vehicles, clearance times, and critical congested roadways. The results are discussed in the following sections.

Evacuating Population

Similar to the base scenarios, the evacuating population was estimated for the five county region. Evacuating population for the operational scenarios is summarized by county for 2010 in **Table IV-20** and for 2015 in **Table IV-21**.

Within the five county region, total evacuating population ranges from 55,400 persons for the operational scenario level A evacuation to 170,900 persons for the operational scenario level D evacuation in 2010. By 2015, this range increases within the five counties to more than 81,400 persons for the operational scenario level A evacuation and nearly 189,500 persons for the operational scenario level E evacuation.

Evacuating Vehicles

From a transportation standpoint, the number of evacuating vehicles is more important than the evacuating population. Evacuating vehicles for the operational scenarios are summarized by county for 2010 in **Table IV-22** and for 2015 in **Table IV-23**.

The total number of evacuating vehicles within the five county region for the operational scenarios also varies by evacuation level. A total of more than 25,300 vehicles evacuate from the five county RPC for the operational scenario level A evacuation in 2010, and this number increases to 75,400 evacuating vehicles from the five county region for the operational scenario level E evacuation in 2010. By 2015, the number of evacuating vehicles is expected to increase to slightly more than 35,600 vehicles for the operational scenario level A evacuation and nearly 85,400 evacuating vehicles for the operational scenario level E evacuation.

Shelter Demand

Shelter demand estimates by county are summarized for each of the operational scenarios in **Table IV-24**. Shelter demand is the population in each county who will seek public shelter during their evacuation, either at an in-county shelter or an out of county shelter.

Public shelter demand in the five county region ranges from only 8,700 persons for the operational scenario level A evacuation in 2010 to more than 28,200 persons for the operational scenario level D evacuation. By 2015, the public shelter demand is expected to increase to more than 13,500 persons for the level A evacuation and more than 30,700 persons for the level E evacuation.

Table IV-20 – Evacuating Population by Operational Scenario for 2010

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
DeSoto County					
Site-built Homes	0	0	0	4,060	0
Mobile/Manuf. Homes	0	0	0	10,616	0
Tourists	0	0	0	0	0
TOTAL	0	0	0	14,676	0
Hardee County					
Site-built Homes	1,850	1,850	1,850	3,700	0
Mobile/Manuf. Homes	3,837	5,755	5,755	7,673	0
Tourists	0	0	0	0	0
TOTAL	5,687	7,605	7,605	11,373	0
Highlands County					
Site-built Homes	0	3,580	7,160	14,320	14,320
Mobile/Manuf. Homes	0	11,793	13,759	15,725	15,725
Tourists	0	0	0	0	0
TOTAL	0	15,373	20,919	30,045	30,045
Okeechobee County					
Site-built Homes	0	0	4,311	0	5,389
Mobile/Manuf. Homes	0	0	12,570	0	14,247
Tourists	0	0	202	0	202
TOTAL	0	0	17,083	0	19,838
Polk County					
Site-built Homes	22,247	44,495	44,495	66,742	66,742
Mobile/Manuf. Homes	27,471	41,207	41,207	48,075	48,075
Tourists	0	0	0	0	0
TOTAL	49,718	85,702	85,702	114,817	114,817

Table IV-21 – Evacuating Population by Operational Scenario for 2015

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
DeSoto County					
Site-built Homes	2,380	0	0	0	0
Mobile/Manuf. Homes	8,275	0	0	0	0
Tourists	0	0	0	0	0
TOTAL	10,655	0	0	0	0
Hardee County					
Site-built Homes	2,571	0	3,856	3,856	3,856
Mobile/Manuf. Homes	3,837	0	6,714	6,714	6,714
Tourists	0	0	0	0	0
TOTAL	6,408	0	10,570	10,570	10,570
Highlands County					
Site-built Homes	4,184	4,184	0	16,736	16,736
Mobile/Manuf. Homes	7,862	11,793	0	15,725	15,725
Tourists	0	0	0	0	0
TOTAL	12,046	15,977	0	32,461	32,461
Okeechobee County					
Site-built Homes	0	3,688	0	6,147	7,377
Mobile/Manuf. Homes	0	11,416	0	14,928	15,806
Tourists	0	177	0	202	202
TOTAL	0	15,281	0	21,277	23,385
Polk County					
Site-built Homes	25,132	50,265	75,397	75,397	75,397
Mobile/Manuf. Homes	27,244	40,867	47,678	47,678	47,678
Tourists	0	0	0	0	0
TOTAL	52,376	91,132	123,075	123,075	123,075

Table IV-22 – Evacuating Vehicles by Operational Scenario for 2010

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
DeSoto County					
Site-built Homes	0	0	0	1,618	0
Mobile/Manuf. Homes	0	0	0	3,699	0
Tourists	0	0	0	0	0
TOTAL	0	0	0	5,317	0
Hardee County					
Site-built Homes	667	667	667	1,429	0
Mobile/Manuf. Homes	1,098	1,646	1,646	2,195	0
Tourists	0	0	0	0	0
TOTAL	1,765	2,313	2,313	3,624	0
Highlands County					
Site-built Homes	0	1,415	2,830	6,063	6,063
Mobile/Manuf. Homes	0	5,342	6,232	8,013	8,013
Tourists	0	0	0	0	0
TOTAL	0	6,757	9,062	14,076	14,076
Okeechobee County					
Site-built Homes	0	0	1,624	0	2,030
Mobile/Manuf. Homes	0	0	4,821	0	5,805
Tourists	0	0	162	0	162
TOTAL	0	0	6,607	0	7,997
Polk County					
Site-built Homes	9,674	19,347	19,347	29,021	29,021
Mobile/Manuf. Homes	13,889	20,834	20,834	24,306	24,306
Tourists	0	0	0	0	0
TOTAL	23,563	40,181	40,181	53,327	53,327

Table IV-23 – Evacuating Vehicles by Operational Scenario for 2015

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
DeSoto County					
Site-built Homes	885	0	0	0	0
Mobile/Manuf. Homes	2,563	0	0	0	0
Tourists	0	0	0	0	0
TOTAL	3,448	0	0	0	0
Hardee County					
Site-built Homes	919	0	1,379	1,379	1,379
Mobile/Manuf. Homes	1,098	0	1,921	1,921	1,921
Tourists	0	0	0	0	0
TOTAL	2,017	0	3,300	3,300	3,300
Highlands County					
Site-built Homes	1,653	1,653	0	7,084	7,084
Mobile/Manuf. Homes	3,561	5,342	0	8,013	8,013
Tourists	0	0	0	0	0
TOTAL	5,214	6,995	0	15,097	15,097
Okeechobee County					
Site-built Homes	0	1,373	0	2,289	2,943
Mobile/Manuf. Homes	0	4,297	0	5,970	6,321
Tourists	0	142	0	162	162
TOTAL	0	5,812	0	8,421	9,426
Polk County					
Site-built Homes	11,088	22,176	33,265	33,265	33,265
Mobile/Manuf. Homes	13,889	20,834	24,306	24,306	24,306
Tourists	0	0	0	0	0
TOTAL	24,977	43,010	57,571	57,571	57,571

Table IV-24 – Shelter Demand by Operational Scenario

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
2010					
DeSoto County	0	0	0	2,651	0
Hardee County	918	1,223	1,223	1,880	0
Highlands County	0	3,489	4,505	6,690	6,690
Okeechobee County	0	0	2,551	0	3,102
Polk County	7,824	13,078	13,078	17,046	17,046
2015					
DeSoto County	1,750	0	0	0	0
Hardee County	1,034	0	1,704	1,704	1,704
Highlands County	2,588	3,576	0	7,067	7,067
Okeechobee County	0	2,239	0	3,284	3,715
Polk County	8,216	13,862	18,224	18,224	18,224

Note: Shelter demand is the population in each county who will seek public shelter during their evacuation, either at an in-county shelter or an out of county shelter.

Congested Roadways

A summary of the total number of evacuating vehicles for each of the operational scenarios is presented in **Table IV-25**. It is important to note that the total number of evacuating vehicles in the table below includes vehicles evacuating from all of the counties included in the operational scenario, as identified in Table IV-19. The number of counties varies by scenario, with four of the scenarios including 10 counties stretching from Collier County to Sumter County.

Table IV-25 – Total Evacuating Vehicles for Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
2010	386,000	236,914	283,276	621,822	371,482
2015	366,801	270,276	880,514	396,546	380,628

Similar to the base scenarios, critical roadways were identified by reviewing roadways in the model network that have the highest vehicle queues for extended periods of time during an evacuation. Due to the nature of a major evacuation in general, nearly all roadway facilities will have extended vehicle queues at some point during the evacuation process. The point of this analysis is to identify those roadway facilities that have vehicle queues for the longest time periods during each of the evacuation scenarios. Critical roadway segments for the Central Florida region are identified in **Figures IV-14** through **IV-23** for each of the operational scenarios for 2010 and 2015.

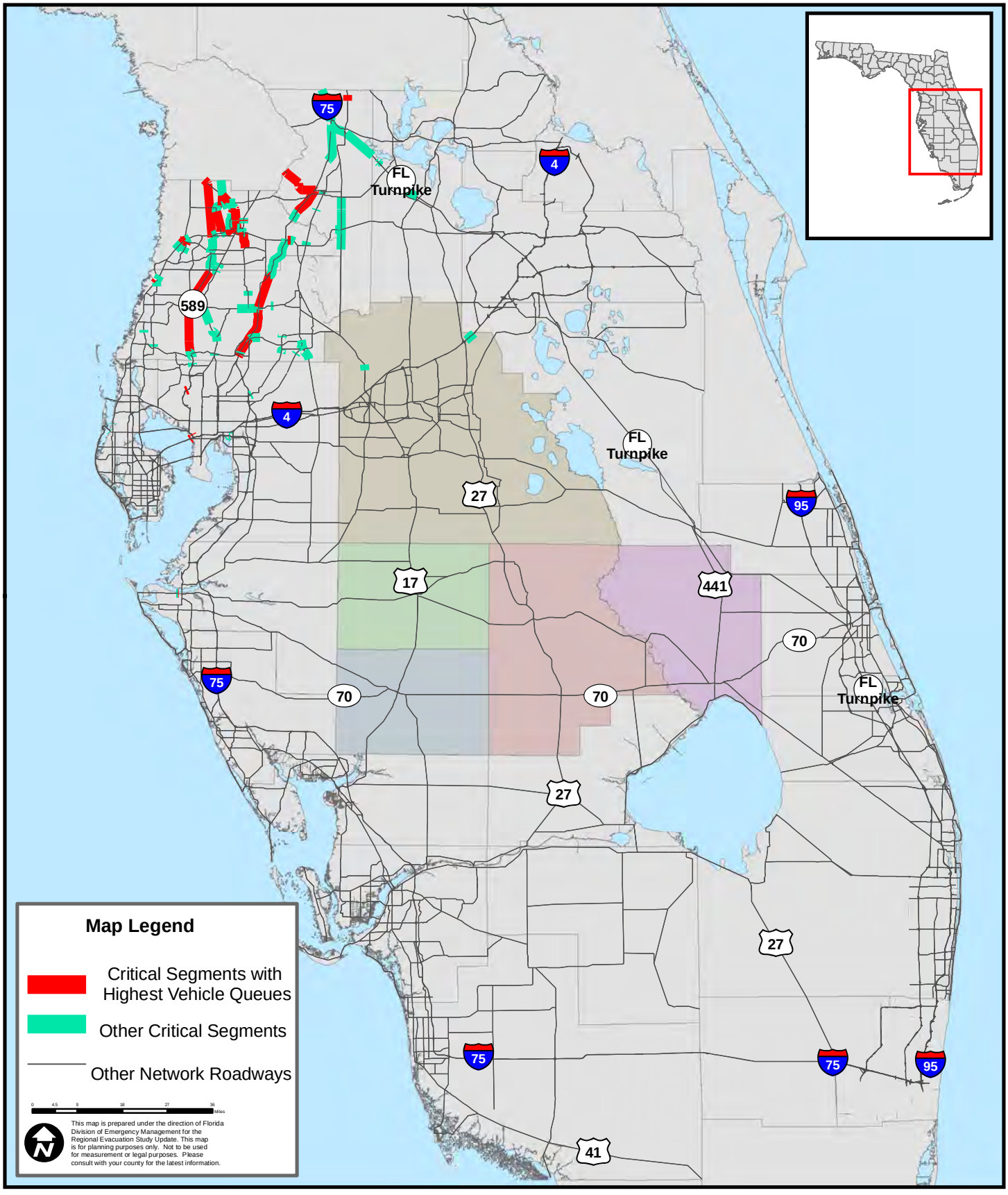
Critical facilities for the operational scenarios vary greatly depending upon the scenario, as illustrated in the figures. For example, for the 2015 level D operational scenario, which assumes a southeast to northwest storm track west of Okeechobee City, critical facilities include US 441 and SR 70 in Okeechobee County and SR 70, US 27, and US 98 in Highlands County. In contrast, for the 2015 level C operational scenario, which assumes a west to east storm track along the I-4 corridor, the critical facilities within the Central Florida region are concentrated in Polk County.

In addition to the identification of critical roadway segments, the total number of evacuating vehicles entering and exiting each county by evacuation scenario was also determined. Evacuating vehicles exiting each county by major evacuation route are identified in **Table IV-26** for 2010 and **Table IV-27** for 2015. In addition, evacuating vehicles entering each county by major evacuation route are identified in **Table IV-28** for 2010 and **Table IV-29** for 2015. Detailed volume figures for all evacuation routes in the Central Florida Region for each operational scenario are included in Volume 5-7.

The number of vehicles entering and exiting each county during an evacuation varies widely depending upon the scenario, roadway, and county. As expected, major interstates and state highways generally carry larger volumes of evacuating traffic. The vehicle flows into and out of each county also generally follow the same pattern as the critical segment figures, as locations with higher queues and congestion generally have higher traffic volumes.

Figure IV-14

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Operational Scenario Evacuation Level A

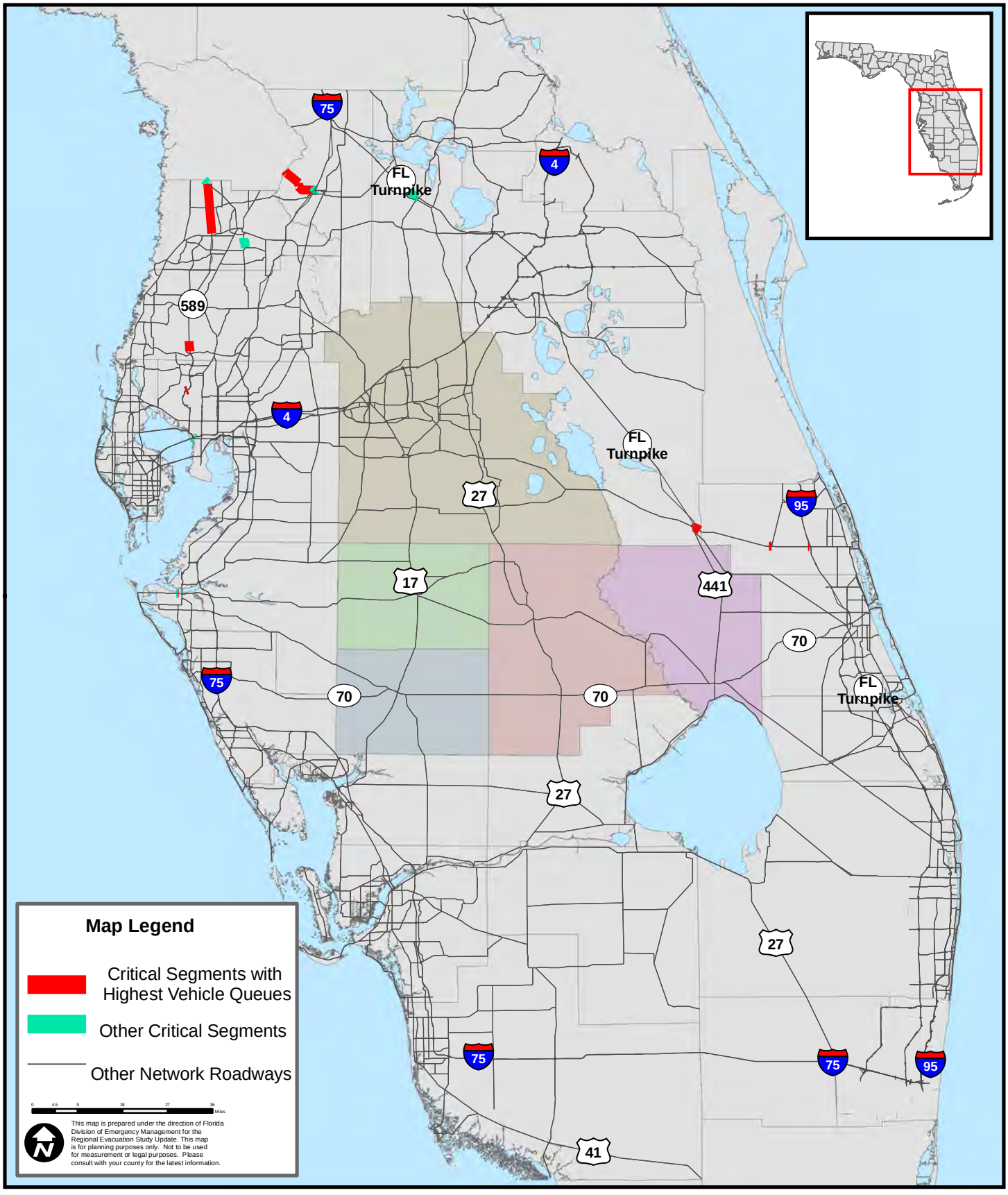


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-15

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Operational Scenario Evacuation Level B

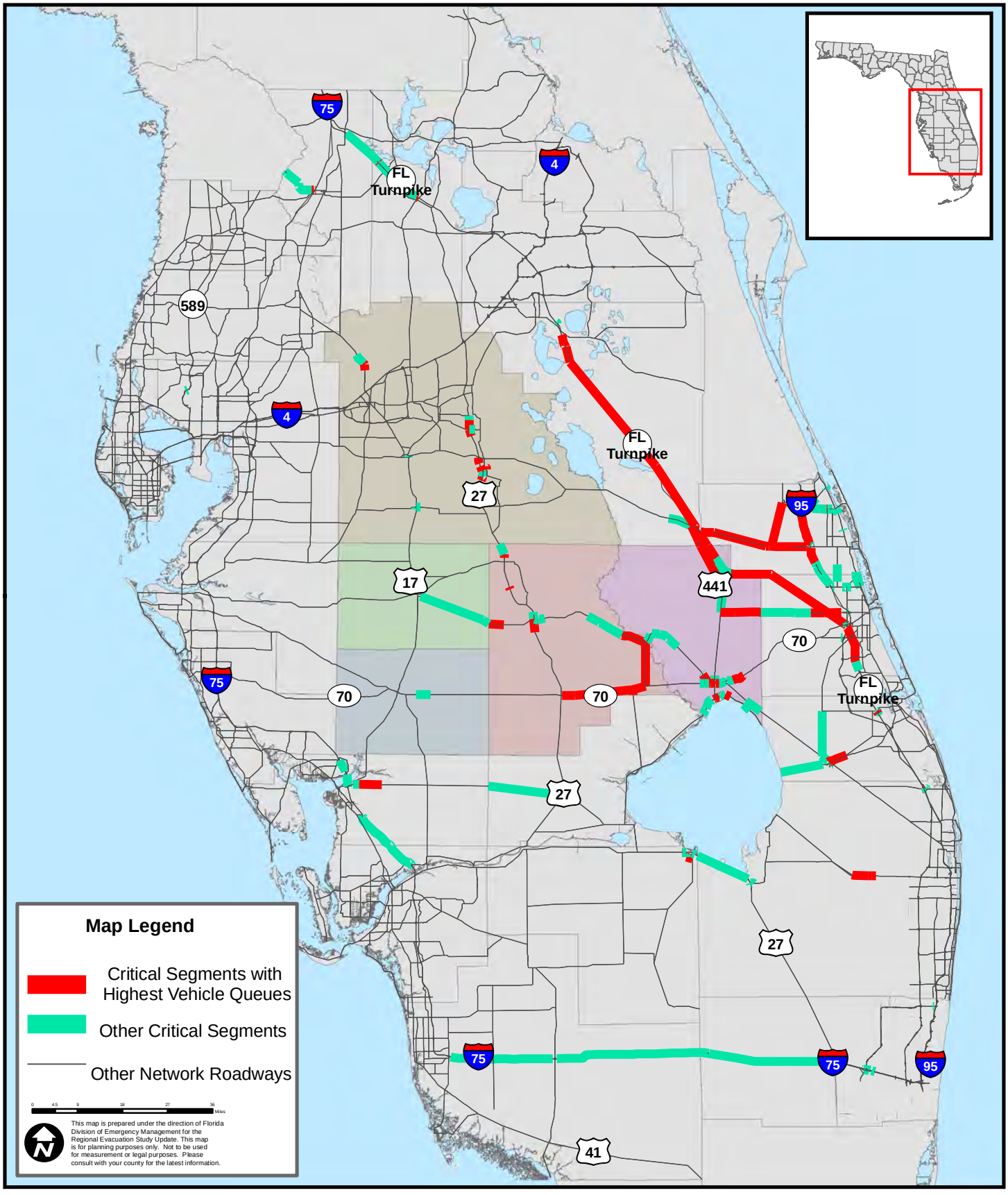


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-16

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Operational Scenario Evacuation Level C

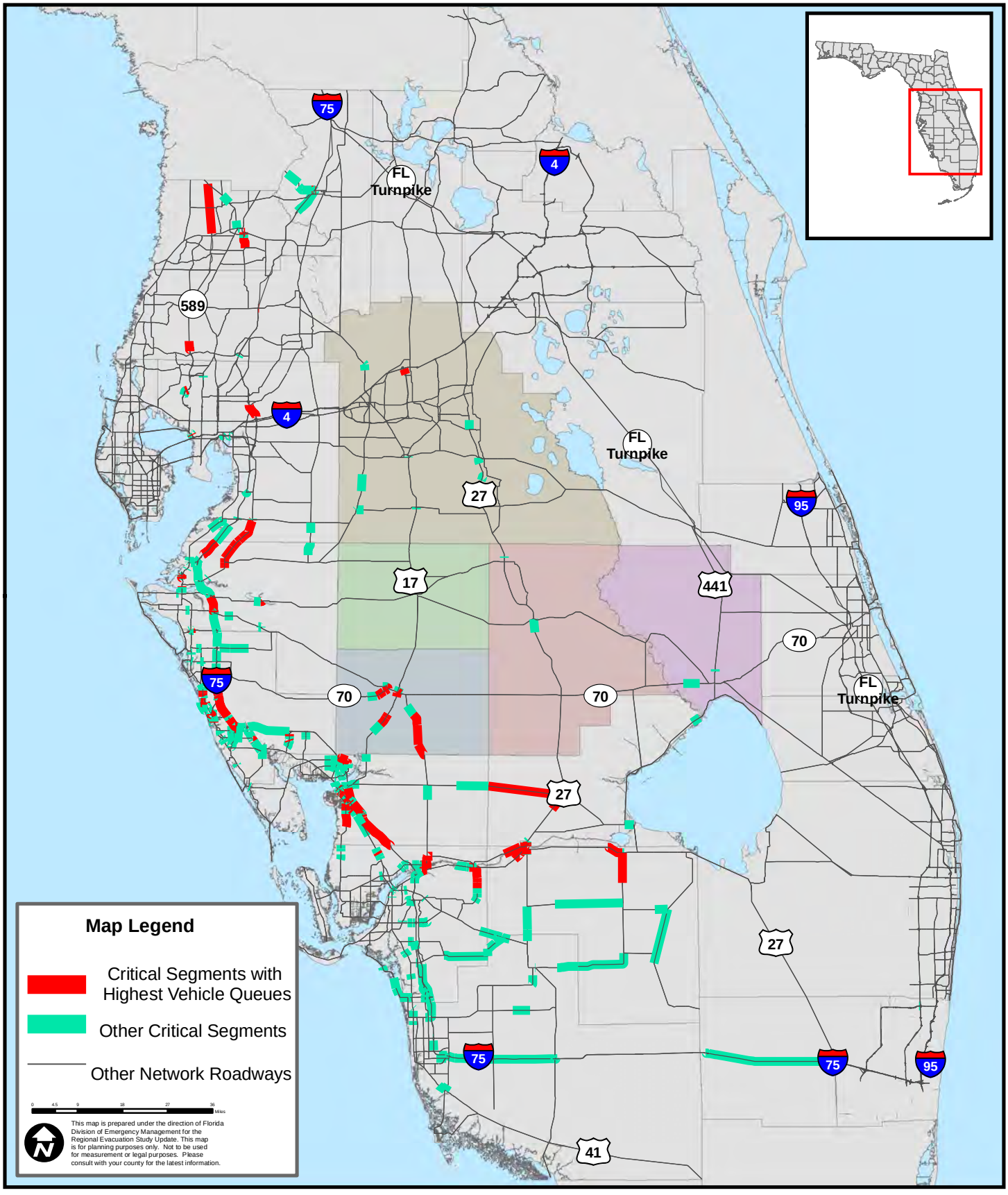


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-17

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Operational Scenario Evacuation Level D

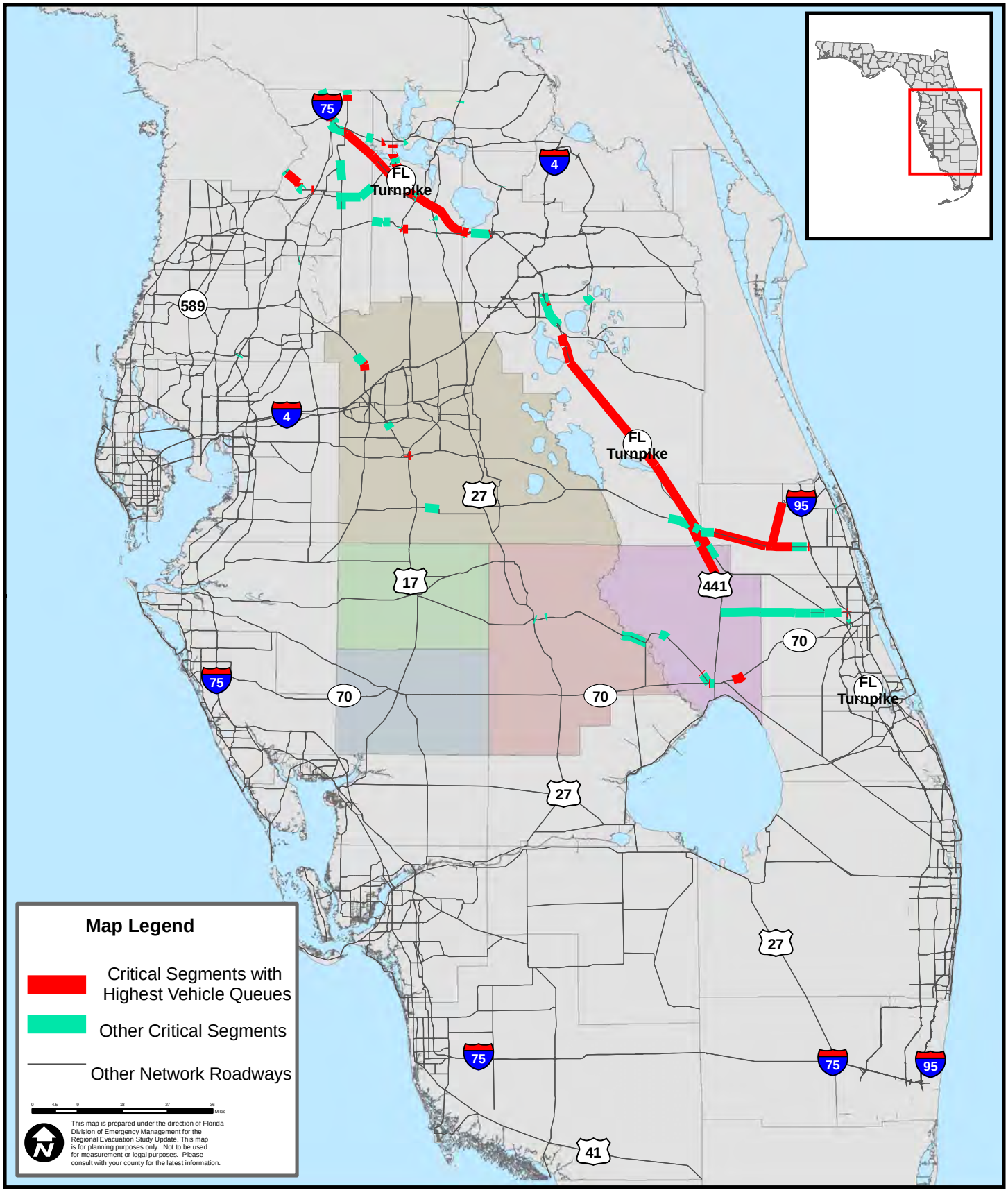


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-18

Critical Roadway Segments with Excessive Vehicle Queues for 2010 Operational Scenario Evacuation Level E

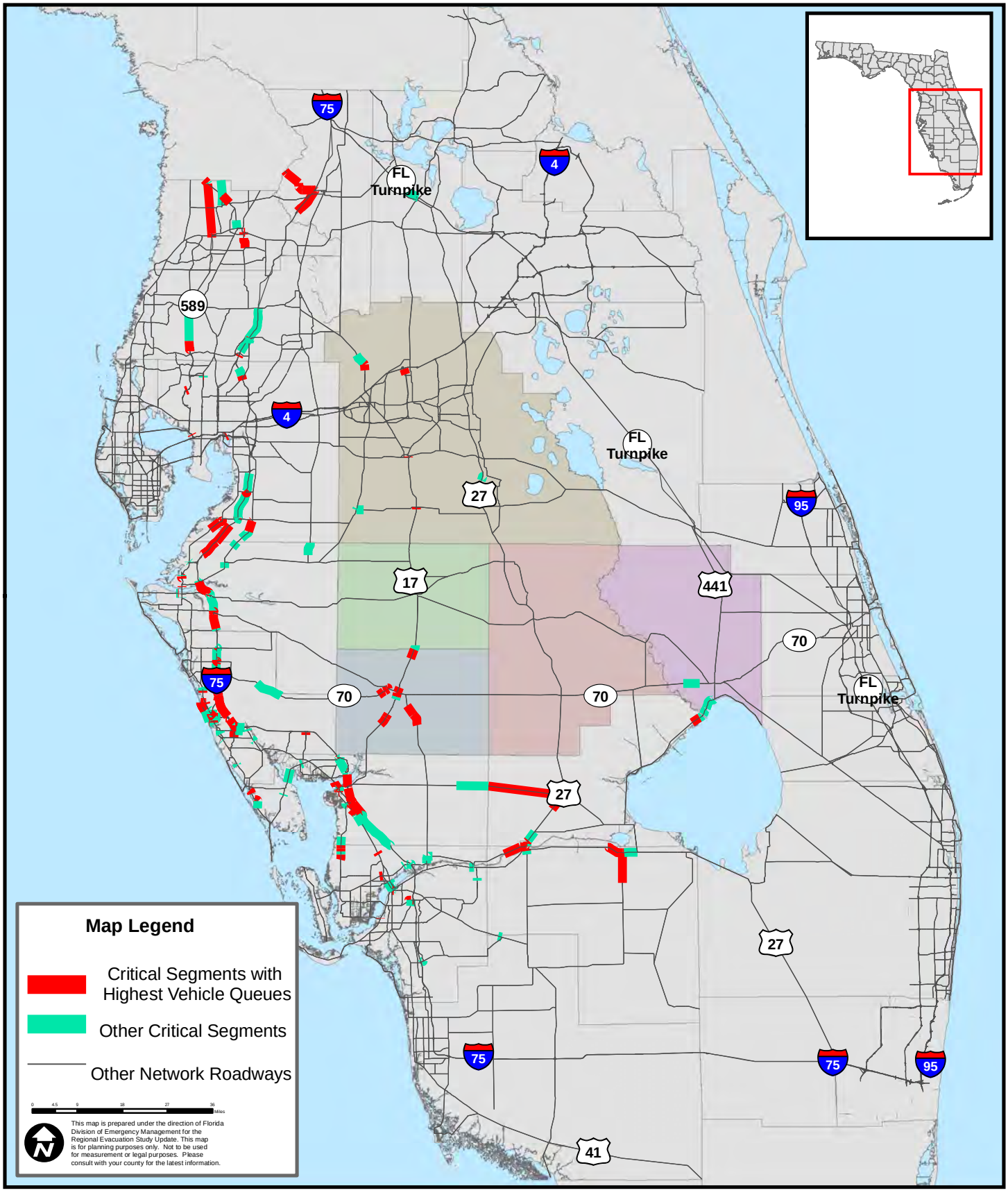


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-19

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Operational Scenario Evacuation Level A

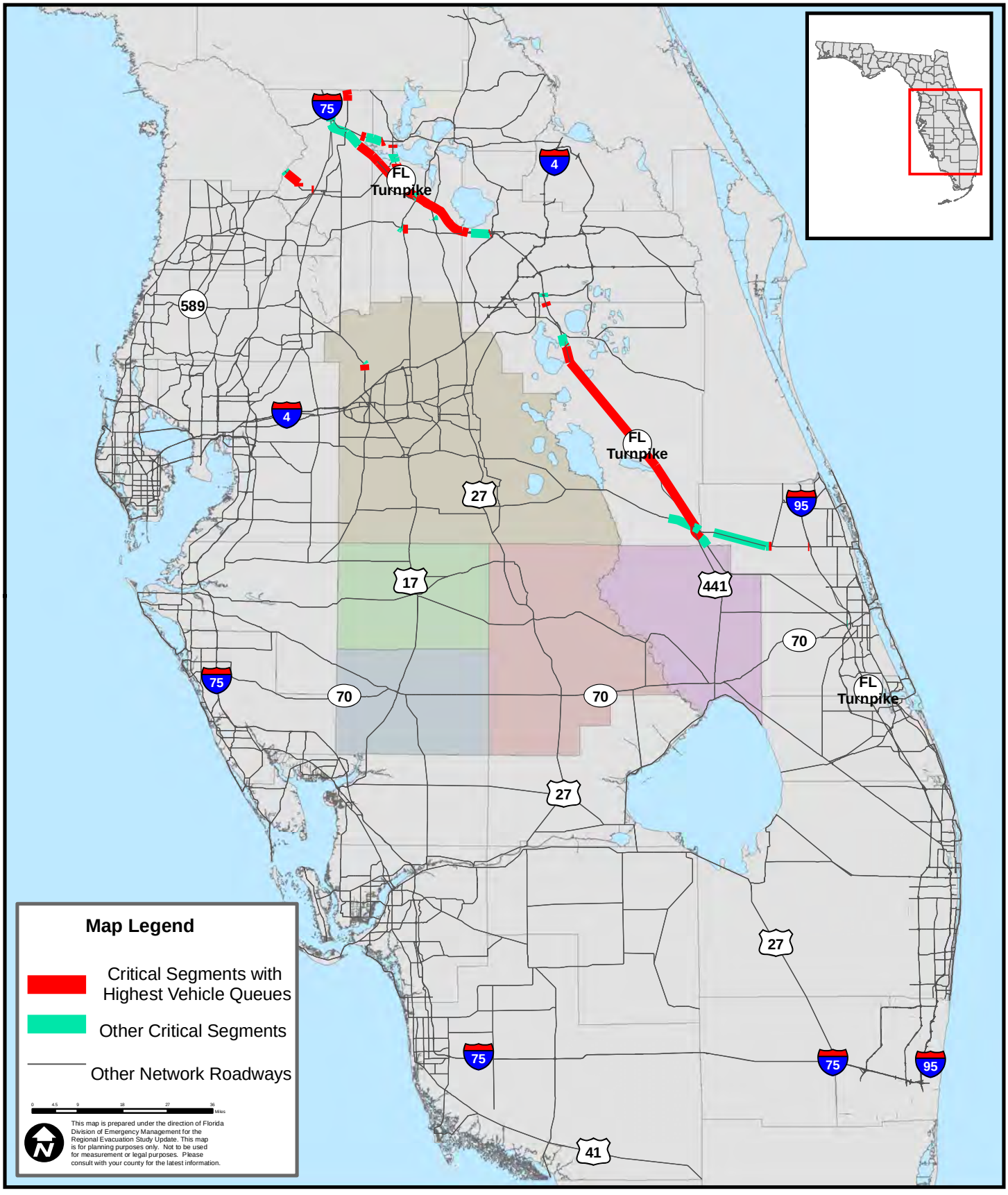


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-20

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Operational Scenario Evacuation Level B

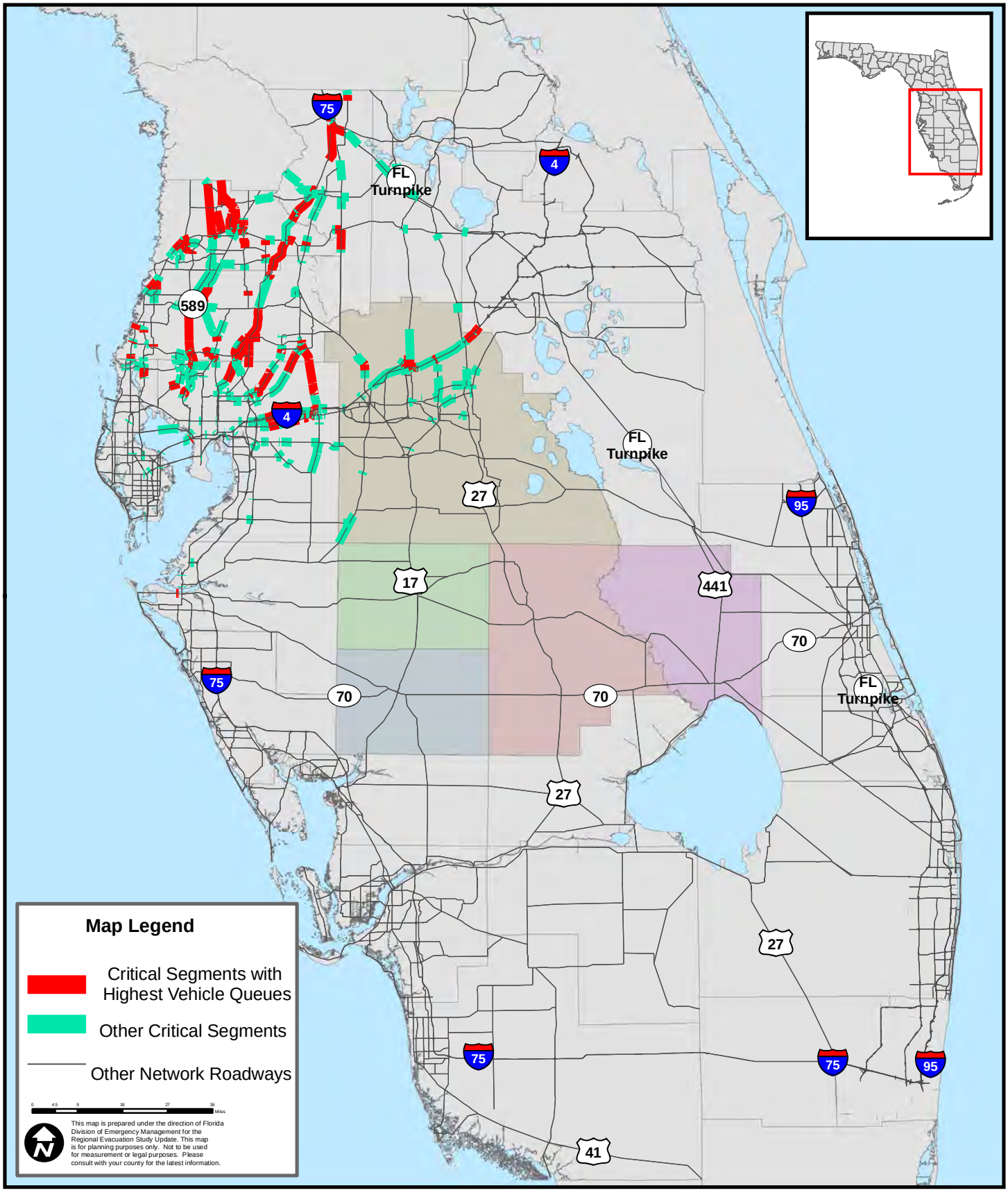


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-21

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Operational Scenario Evacuation Level C

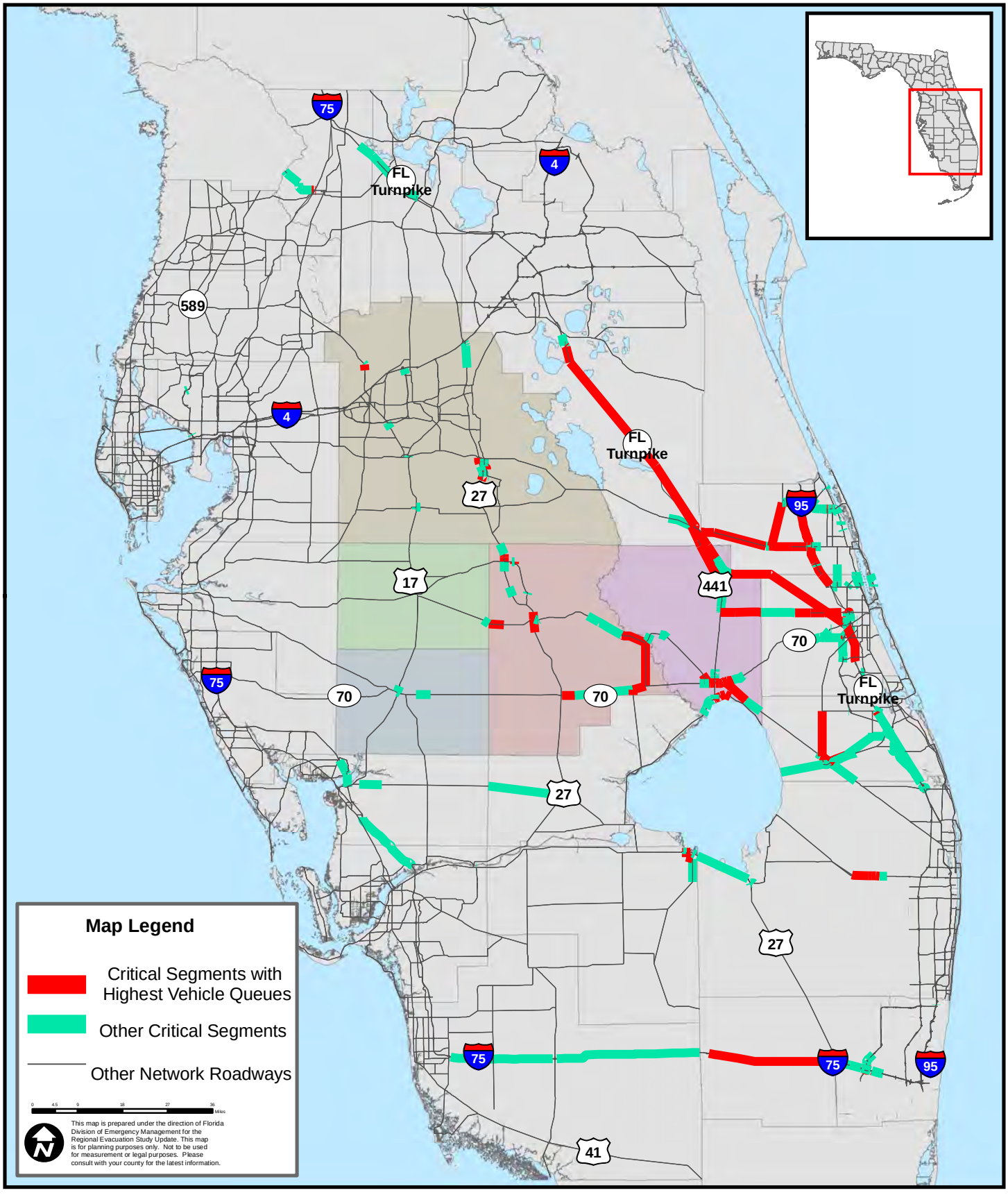


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-22

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Operational Scenario Evacuation Level D

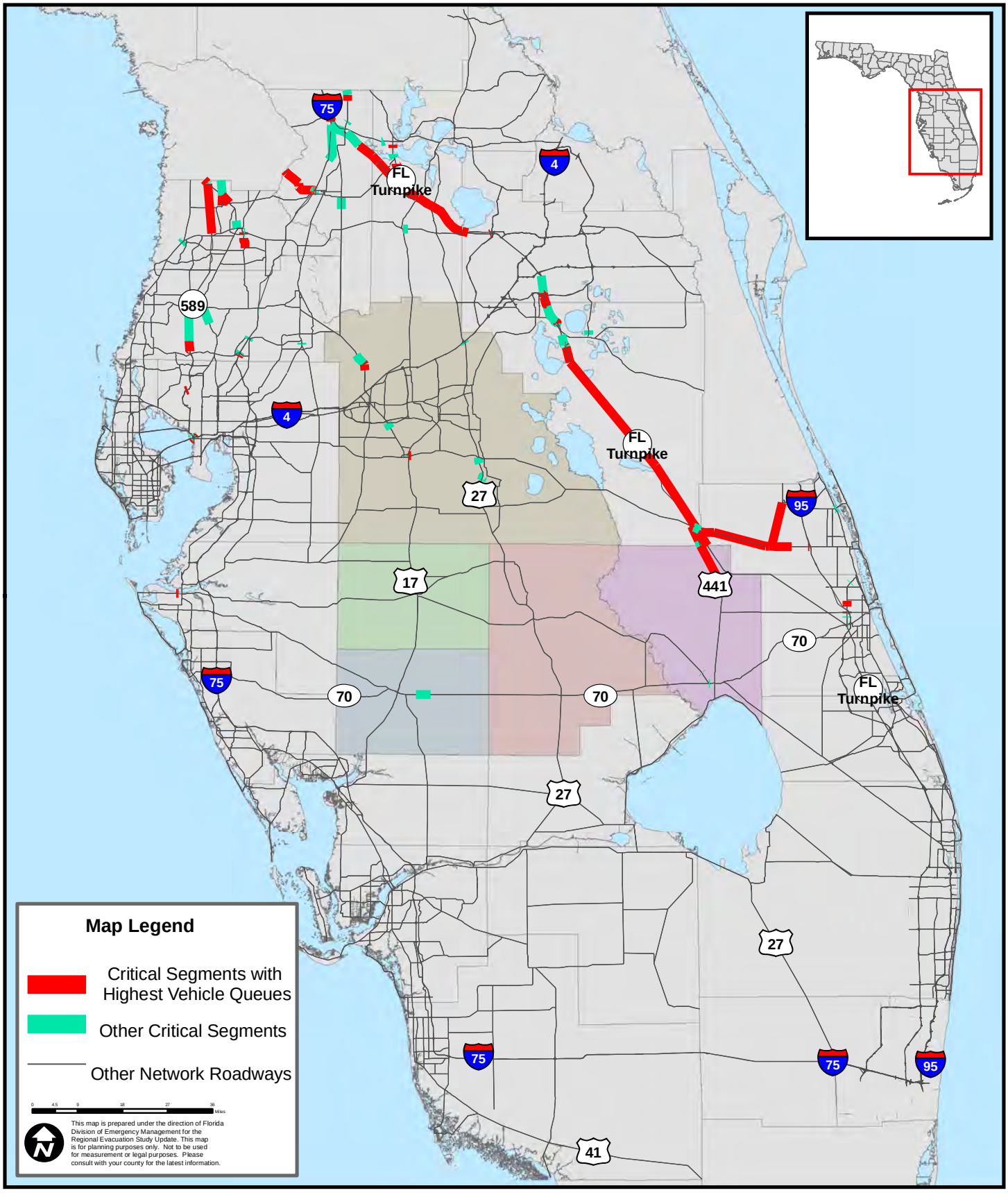


Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Figure IV-23

Critical Roadway Segments with Excessive Vehicle Queues for 2015 Operational Scenario Evacuation Level E



Sources: Central Florida Regional Planning Council, Wilbur Smith Associates

Map Printed: September , 2010

Table IV-26 – Evacuating Vehicles Leaving Each County by Evacuation Route for the 2010 Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
DeSoto County					
US 17 Southbound	0	0	0	900	0
SR 31 Southbound	200	200	200	600	700
SR 70 Eastbound	200	100	0	7,000	0
US 17 Northbound	0	0	0	16,300	0
SR 70 Westbound	0	200	2,400	1,100	1,500
SR 72 Westbound	0	200	300	5,700	600
Hardee County					
US 17 Southbound	400	300	300	500	1,300
SR 64 Westbound	0	100	100	100	100
SR 62 Westbound	0	0	1,000	1,900	500
US 17 Northbound	500	600	7,200	22,700	3,000
SR 64 Eastbound	200	100	100	1,100	0
SR 66 Eastbound	300	200	100	900	100
Highlands County					
SR 70 Westbound	0	500	2,600	100	2,700
SR 66 Westbound	0	100	5,800	2,700	3,700
US 27 Southbound	100	100	100	1,800	400
SR 70 Eastbound	200	100	100	7,200	100
US 98 Eastbound	100	100	100	2,800	200
US 27 Northbound	100	1,000	16,900	28,300	7,000
SR 64 Westbound	0	0	2,300	0	100
Okeechobee County					
US 98 Westbound	0	100	7,100	0	5,600
SR 70 Westbound	0	500	6,900	0	4,600
SR 78 Southbound	0	0	500	7,900	0
US 98 Southbound	0	0	100	100	100
SR 710 Eastbound	200	100	300	1,700	400
SR 70 Eastbound	0	0	900	7,100	500
FL Turnpike SB	1,500	1,000	400	800	1,900
FL Turnpike NB	0	8,100	19,500	15,400	18,000
US 441 Northbound	0	0	7,600	8,700	6,600
Polk County					
US 17 Southbound	400	400	200	600	1,400
US 27 Southbound	300	300	200	700	600
SR 60 Eastbound	700	500	300	700	500
US 17 Northbound	0	100	100	200	100
I-4 Eastbound	20,100	10,900	10,300	42,400	5,700
US 27 Northbound	1,800	3,100	9,800	17,400	7,800
SR 33 Northbound	1,200	700	1,100	3,000	400
SR 471 Northbound	2,800	2,600	5,700	8,600	3,000
US 98 Northbound	100	200	400	1,000	1,500
I-4 Westbound	100	1,100	3,100	6,700	5,900
SR 60 Westbound	0	400	600	700	600

Table IV-27 – Evacuating Vehicles Leaving Each County by Evacuation Route for the 2015 Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
DeSoto County					
US 17 Southbound	0	0	0	0	0
SR 31 Southbound	300	400	800	200	400
SR 70 Eastbound	1,200	0	1,600	0	100
US 17 Northbound	6,100	0	0	400	0
SR 70 Westbound	100	300	0	3,700	1,100
SR 72 Westbound	2,700	200	0	500	500
Hardee County					
US 17 Southbound	300	700	1,300	500	800
SR 64 Westbound	0	0	0	100	100
SR 62 Westbound	500	2,100	0	100	400
US 17 Northbound	9,100	400	4,000	10,500	2,700
SR 64 Eastbound	300	0	1,900	100	100
SR 66 Eastbound	200	0	1,100	100	300
Highlands County					
SR 70 Westbound	0	1,000	0	4,200	2,400
SR 66 Westbound	200	600	0	7,900	2,300
US 27 Southbound	100	200	300	200	300
SR 70 Eastbound	2,700	0	1,600	200	200
US 98 Eastbound	200	0	400	200	400
US 27 Northbound	8,500	1,100	1,500	26,000	6,200
SR 64 Westbound	0	0	0	4,900	100
Okeechobee County					
US 98 Westbound	0	700	0	9,600	4,200
SR 70 Westbound	0	1,200	0	10,400	3,200
SR 78 Southbound	0	600	0	7,400	1,200
US 98 Southbound	0	100	100	700	100
SR 710 Eastbound	200	200	1,200	300	600
SR 70 Eastbound	4,500	100	500	1,300	700
FL Turnpike SB	400	1,400	4,600	800	1,900
FL Turnpike NB	500	13,800	0	23,700	16,300
US 441 Northbound	1,900	1,900	0	10,500	5,900
Polk County					
US 17 Southbound	300	800	1,500	400	700
US 27 Southbound	200	500	1,100	300	500
SR 60 Eastbound	200	400	5,100	800	600
US 17 Northbound	0	100	3,100	300	100
I-4 Eastbound	18,900	3,200	800	16,500	16,800
US 27 Northbound	5,200	3,300	11,100	15,200	8,300
SR 33 Northbound	1,200	400	8,900	1,600	900
SR 471 Northbound	4,300	3,000	10,800	7,300	3,900
US 98 Northbound	300	400	1,300	500	600
I-4 Westbound	1,100	2,500	1,200	4,900	4,200
SR 60 Westbound	200	500	100	900	700

Table IV-28 – Evacuating Vehicles Entering Each County by Evacuation Route for the 2010 Operational Scenarios

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
DeSoto County					
US 17 Southbound	400	300	300	500	1,300
SR 70 Westbound	0	500	2,600	100	2,700
US 17 Northbound	0	0	0	13,900	0
SR 31 Northbound	0	0	300	12,600	0
Hardee County					
US 17 Northbound	0	0	0	16,300	0
SR 66 Westbound	0	100	5,800	2,700	3,700
SR 64 Westbound	0	0	2,300	0	100
US 17 Southbound	400	400	200	600	1,400
US 27 Southbound	300	300	200	700	600
Highlands County					
SR 70 Eastbound	200	100	0	7,000	0
SR 64 Eastbound	200	100	100	1,100	0
SR 66 Eastbound	300	200	100	900	100
US 98 Westbound	0	100	7,100	0	5,600
SR 70 Westbound	0	500	6,900	0	4,600
US 27 Southbound	300	300	200	700	600
Okeechobee County					
SR 70 Eastbound	200	100	100	7,200	100
US 98 Eastbound	100	100	100	2,800	200
SR 710 Westbound	0	0	6,200	0	2,500
FL Turnpike SB	0	8,100	19,500	15,400	18,000
FL Turnpike NB	1,500	1,000	400	800	1,900
Polk County					
US 17 Northbound	500	600	7,200	22,700	3,000
US 27 Northbound	100	1,000	16,900	28,300	7,000
SR 60 Eastbound	200	100	0	100	0
I-4 Eastbound	23,400	9,300	0	21,000	0
I-4 Westbound	1,800	2,300	1,100	2,600	6,000
SR 60 Westbound	0	1,200	1,000	0	3,700

Table IV-29 – Evacuating Vehicles Entering Each County by Evacuation Route for the 2015 Operational Scenarios

	Evacuation Level A Base Scenario	Evacuation Level B Base Scenario	Evacuation Level C Base Scenario	Evacuation Level D Base Scenario	Evacuation Level E Base Scenario
DeSoto County					
US 17 Southbound	300	700	1,300	500	800
SR 70 Westbound	0	1,000	0	4,200	2,400
US 17 Northbound	6,200	0	0	0	0
SR 31 Northbound	4,400	0	0	1,000	0
Hardee County					
US 17 Northbound	6,100	0	0	400	0
SR 66 Westbound	200	600	0	7,900	2,300
SR 64 Westbound	0	0	0	4,900	100
US 17 Southbound	300	800	1,500	400	700
US 27 Southbound	200	500	1,100	300	500
Highlands County					
SR 70 Eastbound	1,200	0	1,600	0	100
SR 64 Eastbound	300	0	1,900	100	100
SR 66 Eastbound	200	0	1,100	100	300
US 98 Westbound	0	700	0	9,600	4,200
SR 70 Westbound	0	1,200	0	10,400	3,200
US 27 Southbound	200	500	1,100	300	500
Okeechobee County					
SR 70 Eastbound	2,700	0	1,600	200	200
US 98 Eastbound	200	0	400	200	400
SR 710 Westbound	0	200	0	9,600	0
FL Turnpike SB	400	1,400	4,600	800	1,900
FL Turnpike NB	500	13,800	0	23,700	16,300
Polk County					
US 17 Northbound	9,100	400	4,000	10,500	2,700
US 27 Northbound	8,500	1,100	1,500	26,000	6,200
SR 60 Eastbound	0	0	7,600	0	200
I-4 Eastbound	9,400	0	63,100	0	12,800
I-4 Westbound	2,100	3,900	5,400	1,500	3,100
SR 60 Westbound	0	2,800	0	1,400	3,800

Clearance Times

Clearance times for each of the operational scenarios are summarized in **Table IV-30** and **IV-31**, as well as **Figures IV-24, IV-25,** and **IV-26**. Clearance time includes several components, including the mobilization time for the evacuating population to prepare for an evacuation (pack supplies and personal belongs, load their vehicle, etc.), the actual time spent traveling on the roadway network, and the delay time caused by traffic congestion.

In-county clearance times for the 2010 operational scenarios range from 0 hours to 27 hours depending upon the scenario. Counties that were not included in the evacuation scenario will have an in-county clearance time of 0 since no one within the county is evacuating. Clearance Time to Shelter shows a similar pattern, with clearance times for the operational scenarios ranging from 0 hours to 20.5 hours depending upon the county and the scenario.

In 2015, in-county clearance times for the operational scenarios vary from 0 hours to 18.5 hours for the level D evacuation in Okeechobee County. Clearance Time to Shelter shows a similar pattern that depends upon the scenario, with clearance times for the base scenarios ranging from 0 hours to 14.5 hours.

Out of county clearance times for the 2010 operational scenarios range from 9 hours to 33.5 hours for the evacuation level D scenario. Out of county clearance times for all counties in 2015 range from 12.5 to 23.5 hours depending upon the scenario. Regional clearance time for the five county CFRPC region ranges from 11 hours to 33.5 hours in 2010 and between 15 and 23.5 hours in 2015.

Table IV-30 – 2010 Clearance Times for Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Clearance Time to Shelter					
DeSoto County	0.0	0.0	0.0	20.5	0.0
Hardee County	5.0	6.5	5.5	10.5	0.0
Highlands County	0.0	12.5	9.5	12.5	12.5
Okeechobee Co.	0.0	0.0	0.0	0.0	0.0
Polk County	10.0	13.0	10.0	13.0	13.0
In-County Clearance Time					
DeSoto County	0.0	0.0	0.0	27.0	0.0
Hardee County	8.5	10.5	8.5	12.5	0.0
Highlands County	0.0	13.0	10.0	13.0	13.0
Okeechobee Co.	0.0	0.0	14.5	0.0	14.5
Polk County	10.5	13.5	10.5	13.5	13.5
Out of County Clearance Time					
DeSoto County	10.0	12.5	14.0	27.5	13.5
Hardee County	10.0	11.5	15.0	27.5	13.5
Highlands County	9.0	13.0	15.0	27.0	15.0
Okeechobee Co.	9.0	13.5	14.0	26.0	14.0
Polk County	11.0	15.0	19.0	33.5	17.0
Regional Clearance Time					
Central Florida	11.0	15.0	19.0	33.5	17.0

Table IV-31 – 2015 Clearance Times for Operational Scenarios

	Evacuation Level A Operational Scenario	Evacuation Level B Operational Scenario	Evacuation Level C Operational Scenario	Evacuation Level D Operational Scenario	Evacuation Level E Operational Scenario
Clearance Time to Shelter					
DeSoto County	11.5	0.0	0.0	0.0	0.0
Hardee County	6.0	0.0	9.0	9.0	9.5
Highlands County	9.5	12.5	0.0	9.5	12.5
Okeechobee Co.	0.0	12.5	0.0	3.0	0.5
Polk County	10.0	13.0	14.5	10.0	13.0
In-County Clearance Time					
DeSoto County	14.5	0.0	0.0	0.0	0.0
Hardee County	8.5	0.0	11.5	9.5	12.0
Highlands County	10.0	13.0	0.0	10.0	13.0
Okeechobee Co.	0.0	13.5	0.0	18.5	15.0
Polk County	10.5	13.5	15.0	10.5	13.5
Out of County Clearance Time					
DeSoto County	14.5	12.5	13.0	19.0	13.5
Hardee County	14.5	12.0	14.0	20.5	14.0
Highlands County	14.0	14.0	13.5	20.0	14.0
Okeechobee Co.	12.5	14.0	18.0	18.5	14.5
Polk County	16.5	15.0	23.5	23.5	15.5
Regional Clearance Time					
Central Florida	16.5	15.0	23.5	23.5	15.5

Figure IV-24 - Clearance Time to Shelter Operational Scenarios

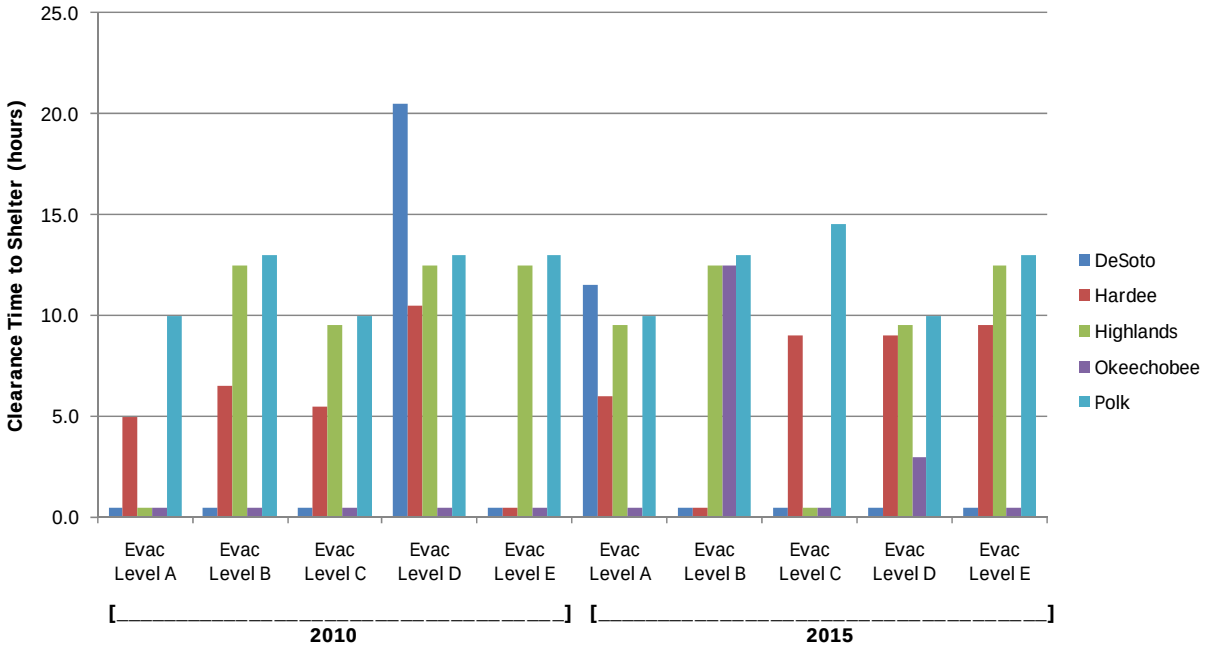
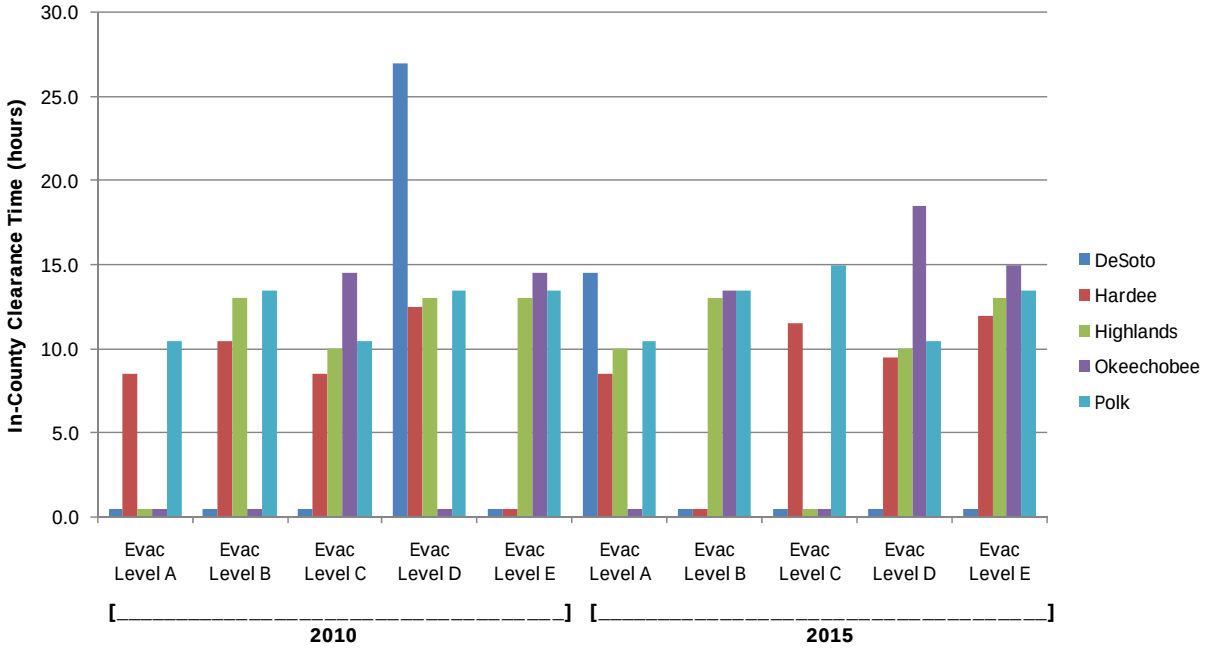


Figure IV-25 - In-County Clearance Times Operational Scenarios



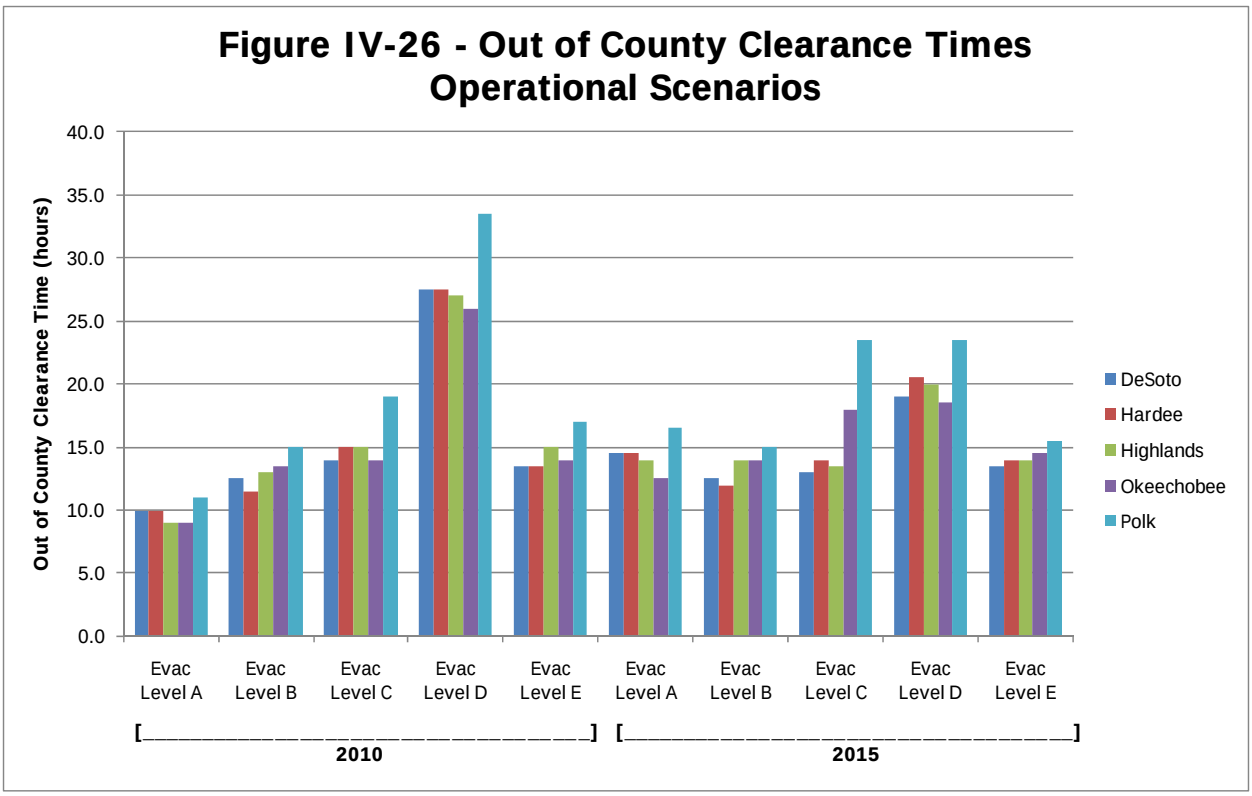


Figure IV-26 - Out of County Clearance Times
Operational Scenarios
Out of County Clearance Time (hours)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Evac Level A
Evac Level B
Evac Level C
Evac Level D
Evac Level E
Evac Level A
Evac Level B
Evac Level C
Evac Level D
Evac Level E
2010
2015
DeSoto
Hardee
Highlands
Okeechobee
Polk

H. Maximum Evacuating Population Clearances

From an emergency management standpoint, it is important to get an understanding of the maximum proportion of the evacuating population that can be expected to evacuate at various time intervals during an evacuation. Should storm conditions change during an evacuation, emergency managers will need to be able to estimate what portion of the evacuating population is estimated to still remain within the county trying to evacuate.

Using the base scenarios, which assume 100% of the vulnerable population is evacuating, along with shadow evacuations and evacuations from adjacent counties, an estimate was made of the evacuating population actually able to evacuate out of each county by the time intervals of 12, 18, 24, and 36 hours. The estimated maximum evacuating population by time interval for 2010 is identified in **Table IV-32** and for 2015 in **Table IV-33**.

It is important to note that these estimates take into account many variables, including roadway capacity, in-county evacuating trips, out of county evacuating trips, evacuating trips from other counties, and background traffic that is impeding the evacuation trips. For this reason, the maximum evacuation population by time interval will vary slightly between evacuation level and either increase or decrease from one evacuation level to the next.

I. Sensitivity Analysis

As discussed previously, there are literally thousands of possible combinations of variables that can be applied using the evacuation transportation model, which will result in thousands of possible outcomes. As part of the analysis process, a sensitivity analysis was conducted using the prototype model to evaluate the effect of different response curves on the calculated evacuation clearance times. Calculated clearance times will never be lower than the designated response time, since some evacuating residents will wait to evacuate until near the end of the response time window. For example, using a 12-hour response curve in the analysis means that all residents will begin their evacuation process within 12-hours, and some residents will choose to wait and begin evacuating more than 11.5 hours from when the evacuation was ordered. This will generate a clearance time of more than 12 hours.

The sensitivity analysis identified that clearance times will vary by scenario and by any of the numerous parameters that can be chosen in a particular scenario model run (demographics, student population, tourist population, different counties that are evacuating, response curve, phasing, shadow evacuations, etc.). A few general rules of thumb did emerge from the sensitivity analysis that can provide some guidance to the region regarding the sensitivity of the response curve to the calculated clearance times:

- For low evacuation levels A and B, clearance time will vary by as much as 40 percent depending on the response curve. Low evacuation levels A and B have fewer evacuating vehicles that can be accommodated more easily on the transportation network. In most cases, clearance times typically exceed the response curve by one to two hours. Thus, a 12 hour response curve may yield a clearance time of 13 or 14 hours while an 18 hour response curve may yield a clearance time of 19 or 20 hours. This leads to a higher level of variability than larger evacuations;

Table IV-32 – Maximum Evacuating Population by Time Interval for 2010

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Estimated Evacuating Population Clearing DeSoto County					
12-Hour	13,537	14,055	12,103	10,165	7,934
18-Hour	15,229	16,398	18,155	15,247	11,900
24-Hour				20,329	15,867
36-Hour					21,156
Estimated Evacuating Population Clearing Hardee County					
12-Hour	10,171	10,171	8,245	6,380	5,093
18-Hour	11,442	11,442	12,367	9,570	7,639
24-Hour				12,760	10,185
36-Hour				13,292	14,217
Estimated Evacuating Population Clearing Highlands County					
12-Hour	19,230	19,230	16,936	16,310	13,067
18-Hour	23,236	23,236	25,405	24,465	19,600
24-Hour			26,816	32,620	26,134
36-Hour				33,979	37,567
Estimated Evacuating Population Clearing Okeechobee County					
12-Hour	19,006	21,782	23,705	18,127	13,207
18-Hour	23,757	29,043	35,557	27,191	19,810
24-Hour			38,520	36,254	26,414
36-Hour				38,520	38,520
Estimated Evacuating Population Clearing Polk County					
12-Hour	75,248	64,670	67,710	51,836	48,516
18-Hour	90,925	97,005	101,565	77,754	72,775
24-Hour		113,173	135,420	103,672	97,033
36-Hour				155,508	145,549

Note: These estimates take into account many variables, including roadway capacity, in-county evacuating trips, out of county evacuating trips, evacuating trips from other counties, and background traffic that is impeding the evacuation trips. For this reason, the maximum evacuation population by time interval will vary between evacuation level and either increase or decrease from one evacuation level to the next.

Table IV-33 – Maximum Evacuating Population by Time Interval for 2015

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
Estimated Evacuating Population Clearing DeSoto County					
12-Hour	14,525	14,676	10,825	8,711	6,862
18-Hour	16,341	17,734	16,238	13,066	10,293
24-Hour			19,846	17,422	13,724
36-Hour				22,503	20,587
Estimated Evacuating Population Clearing Hardee County					
12-Hour	11,227	10,066	7,335	5,613	4,632
18-Hour	12,163	12,163	11,003	8,419	6,948
24-Hour			13,448	11,225	9,264
36-Hour				14,733	13,896
Estimated Evacuating Population Clearing Highlands County					
12-Hour	19,730	19,072	14,946	13,648	12,331
18-Hour	23,840	23,840	22,419	20,472	18,496
24-Hour			28,024	27,296	24,662
36-Hour				36,395	36,993
Estimated Evacuating Population Clearing Okeechobee County					
12-Hour	20,150	23,198	21,177	15,638	12,706
18-Hour	25,187	30,931	31,765	23,457	19,059
24-Hour			42,353	31,276	25,412
36-Hour				42,353	38,118
Estimated Evacuating Population Clearing Polk County					
12-Hour	69,932	76,784	53,816	57,820	47,944
18-Hour	93,243	115,177	80,723	86,730	71,916
24-Hour		118,376	107,631	115,640	95,888
36-Hour			143,508	168,641	143,832

Note: These estimates take into account many variables, including roadway capacity, in-county evacuating trips, out of county evacuating trips, evacuating trips from other counties, and background traffic that is impeding the evacuation trips. For this reason, the maximum evacuation population by time interval will vary between evacuation level and either increase or decrease from one evacuation level to the next.

- For mid-level evacuations such as C and sometimes D, clearance time varied by as much as 25 percent during the sensitivity analysis. The number of evacuating vehicles is considerably higher than for levels A and B, and lower response curves tend to load the transportation network faster than longer response curves. The variability in clearance times is less in these cases than for low evacuation levels; and,

- For high-level evacuations such as some level D evacuations and all E evacuations, clearance time variability is reduced to about 10 to 15 percent. Large evacuations involve large numbers of evacuating vehicles, and the sensitivity test identified that clearance times are not as dependent on the response curve as lower level evacuations since it takes a significant amount of time to evacuate a large number of vehicles.

The counties within the Central Florida Region are encouraged to test additional scenarios beyond what has been provided in this study. Each model run will provide additional information for the region to use in determining when to order an evacuation. Due to advancements in computer technology and the nature of the developed transportation evacuation methodology, this study includes a more detailed and time consuming analysis process than used in previous years studies. Counties interested in testing various response curves for each scenario can easily do so using the TIME interface to calculate clearance times for different response curves.

J. Summary and Conclusions

Through a review of the results of the 20 different scenarios (10 base and 10 operational), several conclusions could be reached regarding the transportation analysis, including the following:

- Critical transportation facilities within the CFRPC region include I-4, US 17, SR 64, SR 70, SR 62, US 98, US 27, US 441, US 92, and US 17. For large storm events, such as level D and E evacuations, other State facilities also play an important role in evacuations;

- During the level A and B evacuation scenarios, the roadway segments with the highest vehicle queues are primarily concentrated along the major Interstate and State Highway system. During these levels of evacuation, State and County officials should coordinate personnel resources to provide sufficient traffic control at interchanges and major intersections along these routes;

- In contrast, for the higher level C, D, and E evacuation scenarios, many other roadway facilities, both within and outside of the region, will require personnel resources for sufficient traffic control at interchanges and major intersections;

- CFRPC counties play a major role even when evacuations occur in other parts of the State, as seen in operational scenarios that assumed either Gulf Coast area storm events or East Coast area storm events. For example, evacuation traffic from the Treasure Coast area travels through Okeechobee and Highlands Counties, while evacuation traffic from the Southwest area greatly impacts Hardee, DeSoto, and Polk Counties. CFRPC counties should continue their coordination efforts with the State and provide assistance for a variety of storm events;

- The Florida Department of Transportation should continue to work with local counties on implementing intelligent transportation system (ITS) technology, which will provide enhanced monitoring and notification systems to provide evacuating traffic with up to date information regarding expected travel times and alternate routes;

- The State can use the data and information provided in this report (specifically the evacuating vehicle maps in Volume 5-7) to estimate fuel and supply requirements along major evacuation routes to aid motorists during the evacuation process;

- For major evacuation routes that have signalized traffic control at major intersections, traffic signal timing patterns should be adjusted during the evacuation process to provide maximum green time for evacuating vehicles in the predominate north and east directions; and,

- The counties within the Central Florida Region are encouraged to test additional transportation scenarios beyond what has been provided in this study. Each model run will provide additional information for the region to use in planning for an evacuation. Counties interested in testing various response curves for each scenario can easily do so using the TIME interface to calculate clearance times for different evacuation conditions, such as different evacuation levels, different behavioral response assumptions, and different response curves.

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