Florida Statewide Regional Evacuation Study Program

Regional Transportation Analysis Summary

This page intentionally left blank

Volume 1-9
Southwest Florida Region
Technical Data Report

CHAPTER VI

REGIONAL TRANSPORTATION ANALYSIS

This page intentionally left blank.

Table of Contents

List of Tables

List of Figures

Chapter VI
Regional Transportation Analysis

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 six county Southwest 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 Southwest Florida region. While the impact of other regions is included in the Southwest Florida analysis, it is important to note that the results of the transportation analysis presented in this document are only reported for the six counties included in the Southwest 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 SRESP transportation methodology and framework was developed during 2008 and 2009 in coordination with all eleven regional planning councils in Florida, along with the Division of Emergency Management, Department of Transportation, Department of Economic Opportunity (formerly the Department of Community Affairs), and local county emergency management teams with CDM Smith serving as the transportation consultant.

During the updates to SRESP in 2015, two meetings were held at the local and regional level to receive updated input from local county emergency management and the regional planning council. The two meetings held in the region included the following:

Regional Meeting No. 1 – Scenario Development Update Meeting
The first regional meeting for the Southwest Florida region was held on March 20, 2015 at 1:30 PM. The purpose of the scenario development update meeting was to review the Southwest Florida small area data, 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. 2 – Transportation Analysis Update Meeting
The second and final regional meeting for the Southwest Florida region was held on August 10, 2015 at 2:00 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.

D. Study Comparisons

It is important to note that this study contains significant updates and revisions in comparison to the 2010 SRESP study for the SWFRPC region. These revisions include updates to population projections based on the 2010 census, new evacuation zones based on updated topography data, modifications to the roadway network due to recently completed and planned construction projects, and changes to the location and size of available shelters. These revisions have significant impacts on evacuating vehicle behavior for the region and caused changes to the calculated clearance times in each county. These updates and revisions make comparisons to the previous 2010 study difficult.

E. 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 Southwest Florida RPC Evacuation Transportation Analysis is identical to the methodology used for all eleven Regional Planning Councils and includes the following components:

1. 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.

2. 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.

3. 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.

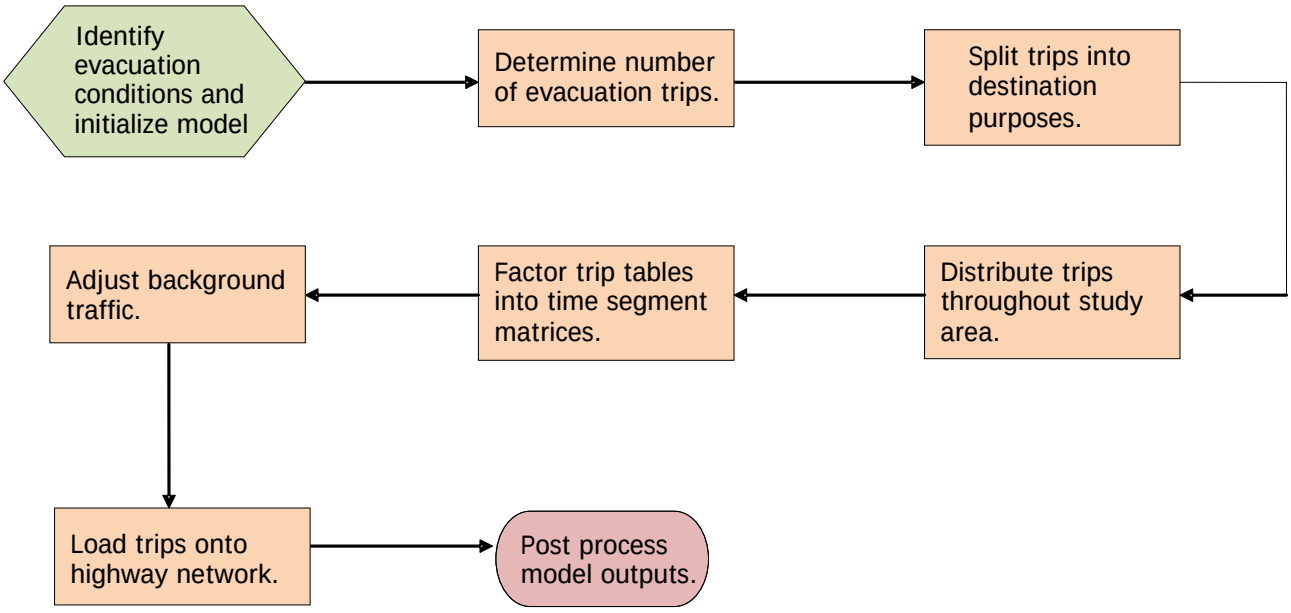
The second group of traffic is known as background traffic. Background traffic, as its name implies, is not the primary focus of an evacuation transportation analysis and is accounted for primarily to impede the movement of evacuation trips through the network. These trips represent individuals going 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.

4. 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 VI-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 VI-1: General Model Flow



5. 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.

6. Prototype Model Development

CDM Smith 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.

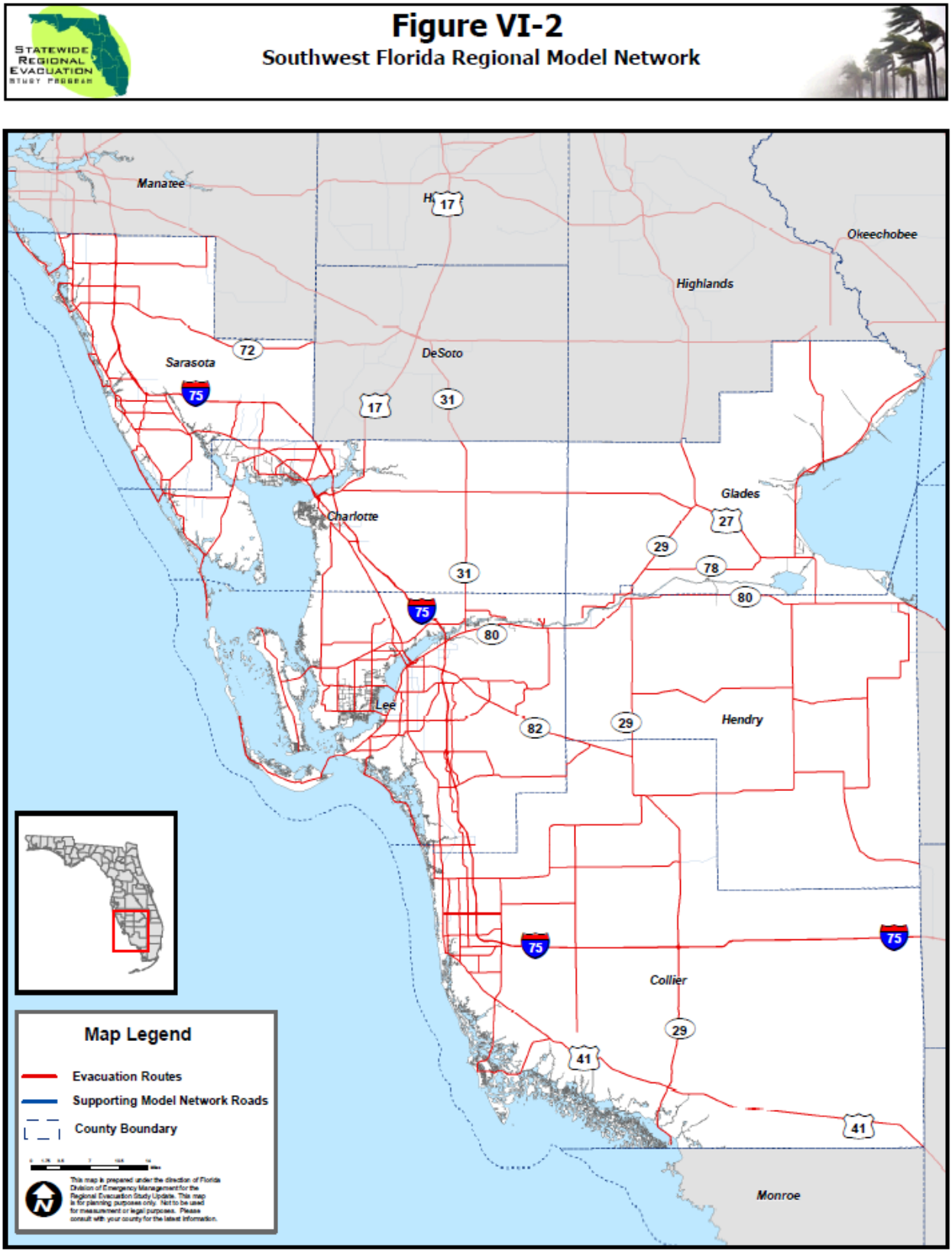
F. Regional Model Implementation

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

1. 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 Southwest 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 2015 conditions and is referred to as the base model network. **Figure VI-2** identifies the model network and evacuation routes for the SWFRPC. County level details of the regional model network are provided in the Volume 5-9 report. The regional model network for the Southwest Florida region includes key roadways within the six county region, including I-75, US 41, US 27, US 17, US 301, SR 29, SR 78, SR 74, SR 72, SR 31, SR 82 and US 80.

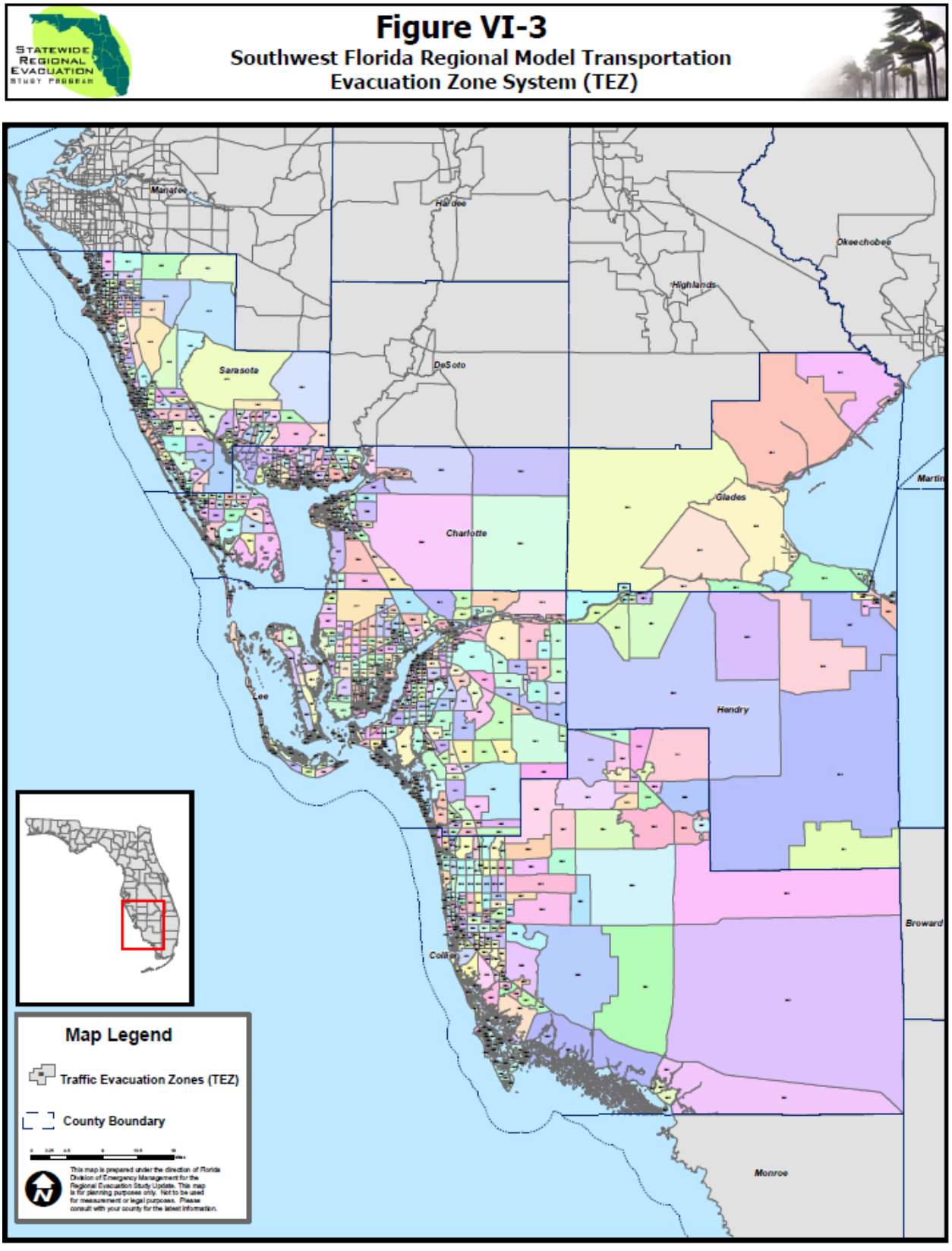
Figure VI-2: Southwest Florida Regional Model Network



2. 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 972 zones located within the six county Southwest Florida region, as illustrated in **Figure VI-3**. In the Southwest Florida region, Lee County has the largest number of TEZs with 337, and Sarasota County follows with 275 TEZs. Charlotte County contains 175 TEZs; Collier County, 156 TEZs. Hendry and Glades Counties have the lowest number of TEZs in the RPC with 21 and 8 zones, respectively. The larger number of TEZs generally reflects counties with denser urban structure and/or higher population densities.

Figure VI-3: Southwest Florida Model Transportation Evacuation Zone System



3. Regional Demographic Characteristics

Demographic data were developed for the following years: 2010, 2015 and 2020. A snapshot of the key demographic data for each county in the Southwest Florida RPC for 2010, 2015 and 2020 is summarized in **Table VI-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 many 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.

Lee County has the largest population in the region during all three time periods. The county is expected to reach over 762,000 people by 2020. Sarasota County has the second largest population in the region and is forecasted to have more than 415,000 people by 2020. Glades County has the smallest population in the region; the county is expected to have just more than 12,000 people by 2020.

Table VI-1: Southwest Florida Demographic Characteristic Summary

County	Characteristic	Year		
		2010	2015	2020
Charlotte	Occupied site-built homes	65,788	68,860	72,433
	Population in site-built homes	143,211	149,906	157,675
	Occupied mobile homes	7,582	7,937	8,345
	Population in mobile home	13,755	14,404	15,146
	Hotel/motel units	1,499	5,105	8,782
Collier	Occupied site-built homes	125,148	134,913	149,019
	Population in site-built homes	295,065	318,220	351,535
	Occupied mobile homes	8,031	8,646	9,551
	Population in mobile home	21,909	23,600	26,154
	Hotel/motel units	6,880	24,725	43,547
Glades	Occupied site-built homes	2,106	2,128	2,245
	Population in site-built homes	5,137	5,186	5,443
	Occupied mobile homes	2,427	2,455	2,587
	Population in mobile home	6,264	6,343	6,712
	Hotel/motel units	146	174	252
Hendry	Occupied site-built homes	7,433	7,301	7,548
	Population in site-built homes	21,702	21,320	22,044
	Occupied mobile homes	4,592	4,512	4,659
	Population in mobile home	15,496	15,224	15,721
	Hotel/motel units	384	917	1,549
Lee	Occupied site-built homes	234,977	259,284	293,723
	Population in site-built homes	563,518	621,873	704,312
	Occupied mobile homes	24,841	27,318	30,925
	Population in mobile home	46,748	51,473	58,496
	Hotel/motel units	11,487	33,810	58,158
Sarasota	Occupied site-built homes	161,390	168,313	179,553
	Population in site-built homes	350,438	365,473	389,893
	Occupied mobile homes	14,356	14,964	15,958
	Population in mobile home	23,388	24,374	25,992
	Hotel/motel units	4,778	18,943	33,587

Source: Southwest Florida Regional Planning Council

4. Planned Roadway Improvements

To correspond to the three different sets of demographic data, three model networks were ultimately developed. The base 2010 network and two future year networks to correspond to the 2015 demographic data and the 2020 demographic data. The 2010 base model network was updated to reflect roadway capacity improvement projects completed between 2011 and 2015 to create the 2015 network. The 2015 network was then updated to reflect planned roadway capacity improvement projects expected to be implemented between 2016 and 2020 to create the 2020 network.

The planned roadway improvements that were added to the network generally include only capacity improvement projects such as additional through lanes. **Table VI-2** identifies capacity improvement projects completed between 2011 and 2015 that were included in the 2015 network. Likewise, **Table VI-3** identifies capacity improvement projects planned for implementation between 2016 and 2020. The tables identify each roadway that will be improved as well as the extent of the improvement.

It is important to note that **Tables VI-2** and **VI-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 VI-2: Southwest Florida Roadway Improvements, 2011-2015

County	Roadway	From	To	Number of Lanes
Charlotte	Toledo Blade Blvd	US 41	Hillsborough Blvd	4
	US 41	Enterprise Dr	Flamingo Blvd	4
	Burntstore Rd	Notre Dame Rd	US 41	4
Collier	SR 82	Hendry County Line	SR 29	4
Hendry	SR 80	CR 833	US 27	4
	SR 80	Birchwood Pkwy	Dalton Ln	4
	SR 29	Spencer	N of Cowboy Way	4
Lee	I-75	S of Colonial Blvd	S of SR 82	6
	I-75	S of SR 82	S of Luckett Rd	6
	I-75	S of Luckett Rd	S of SR 78	6
	I-75 @ Alico Rd			N/A
	I-75 Airport Access @ Southwest Florida Int'l Airport CD System			N/A
	US 41	Corkscrew Rd	San Carlos Blvd	6
	Del Prado Pkwy	NE 7th St	S of Diplomat Pkwy	6
	SR 82	Hendry County Line	Homestead Rd S	4
	SR 82	Homestead Rd S	Shawnee Rd	6
Sarasota	SR 78 (Pine Island)	Burnt Store Rd	W of Chiquita Blvd	4

	I-75 (SR 93) @ University Pkwy			N/A
	I-75 (SR 93)	N of Sumter Blvd	N of River Rd (CR 777)	6

Sources: FDOT SIS First Five Year Plan, FDOT SIS Second Five Year Plan, Northeast Florida Regional Council
Note: Projects included in this table are roadway improvement projects completed between 2011 and 2015 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 2010.

Table VI-3: Southwest Florida Planned Roadway Improvements, 2016-2020

County	Roadway	From	To	Number of Lanes
Charlotte	I-75 (SR 93)	Lee County Line	S Tuckers Grade	6
	I-75 (SR 93)	S of Harborview Rd	N of Kings Hwy	6
Collier	I-75	SR 951	N of Golden Gate Pkwy	6
Hendry	SR 80	Dalton Ln	CR 833	4
	SR 82	Lee County Line	Collier County Line	4
Lee	SR 82	CR 884 (Lee Blvd)	Shawnee Rd	6
Sarasota	I-75 (SR 93)	Charlotte County Line	Sumter Blvd	6

Sources: FDOT SIS First Five Year Plan, FDOT SIS Second Five Year Plan, Northeast Florida Regional Council
Note: Projects included in this table are roadway improvement projects planned for completion between 2016 and 2020 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.

5. Behavioral Assumptions

For the Southwest Florida Region, all six counties within the region 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 VI-4** through **Figure VI-15**. 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 5-9.

Please note that the original behavioral response rates provided by SRESP in Volume 2-9 were modified to fit the evacuation zones created for Glades and Hendry Counties. The original rates for Glades and Hendry were based on the assumption that those counties were inland areas with no evacuation zones; however, for the purpose of the transportation analysis, both counties utilize five zones.

Figure VI-4: Evacuation Participation Rates: Charlotte County Site-Built Homes

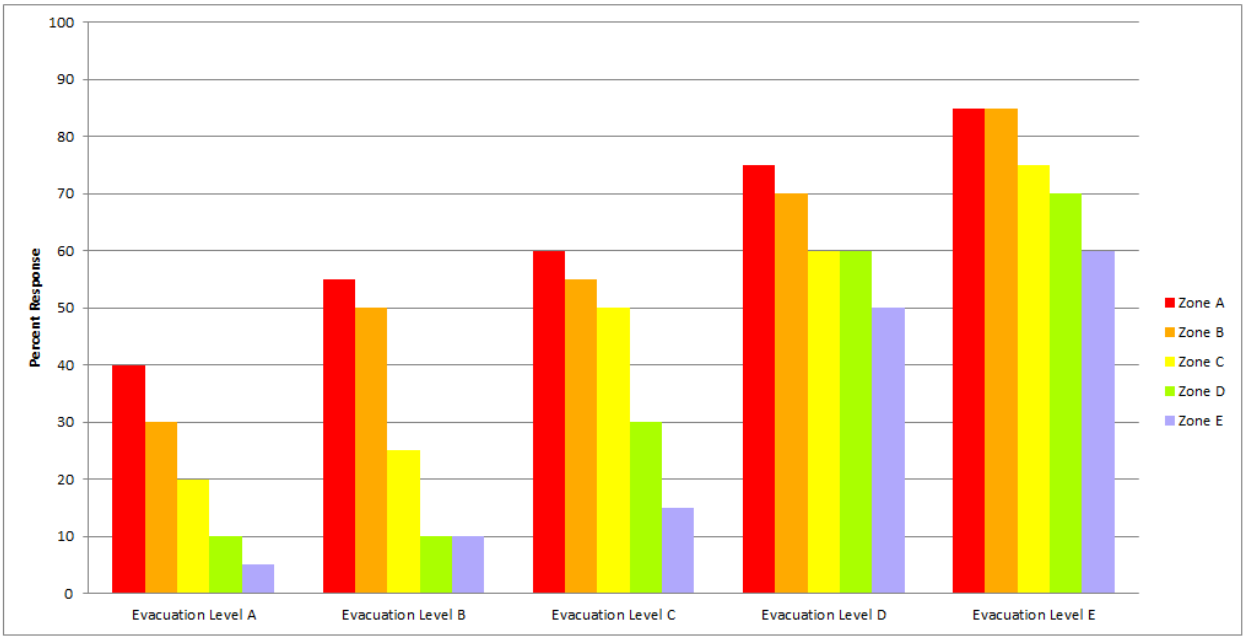


Figure VI-5: Evacuation Participation Rates: Charlotte County Mobile Homes

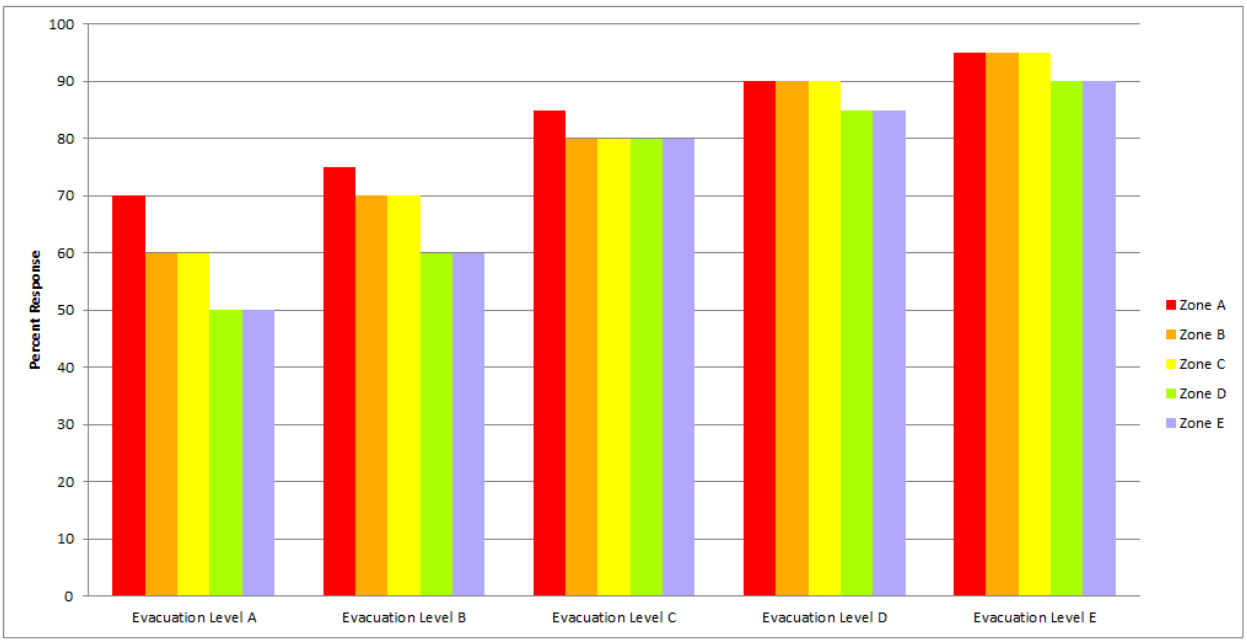


Figure VI-6: Evacuation Participation Rates: Collier County Site-Built Homes

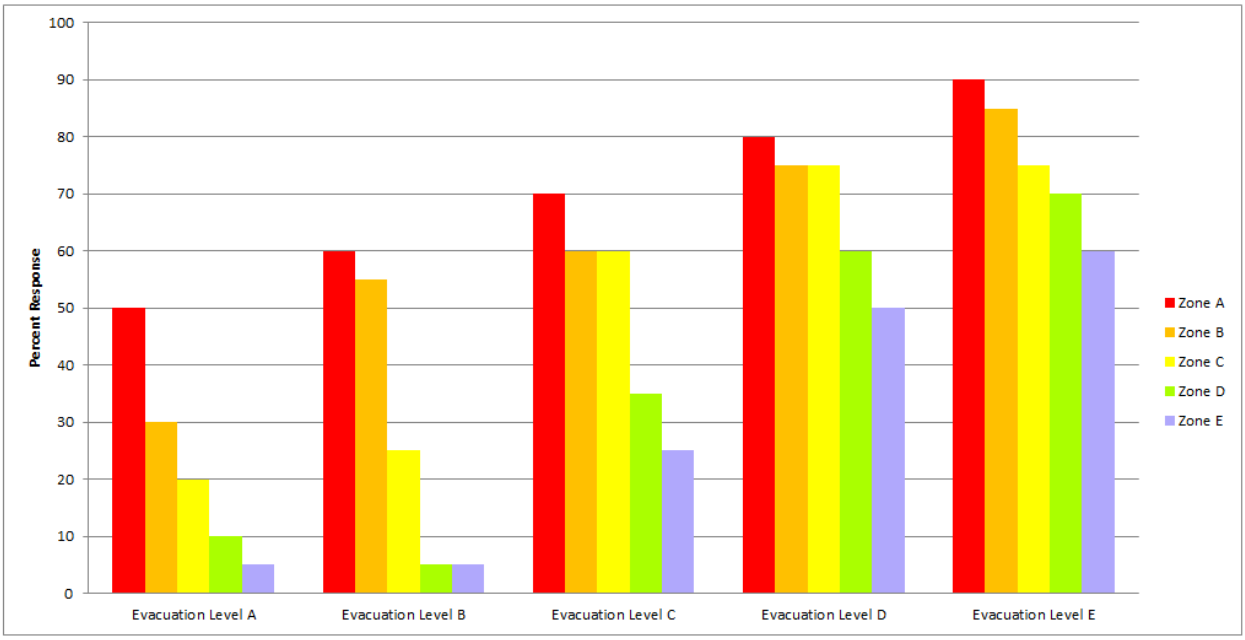


Figure VI-7: Evacuation Participation Rates: Collier County Mobile Homes

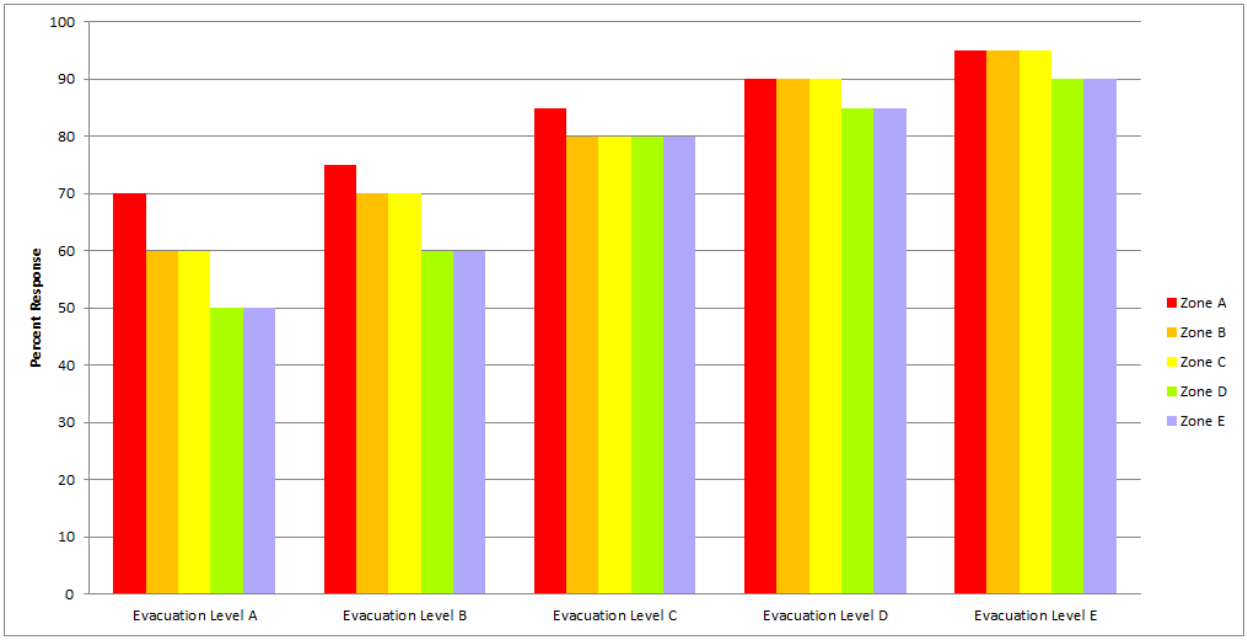


Figure VI-8: Evacuation Participation Rates: Glades County Site-Built Homes

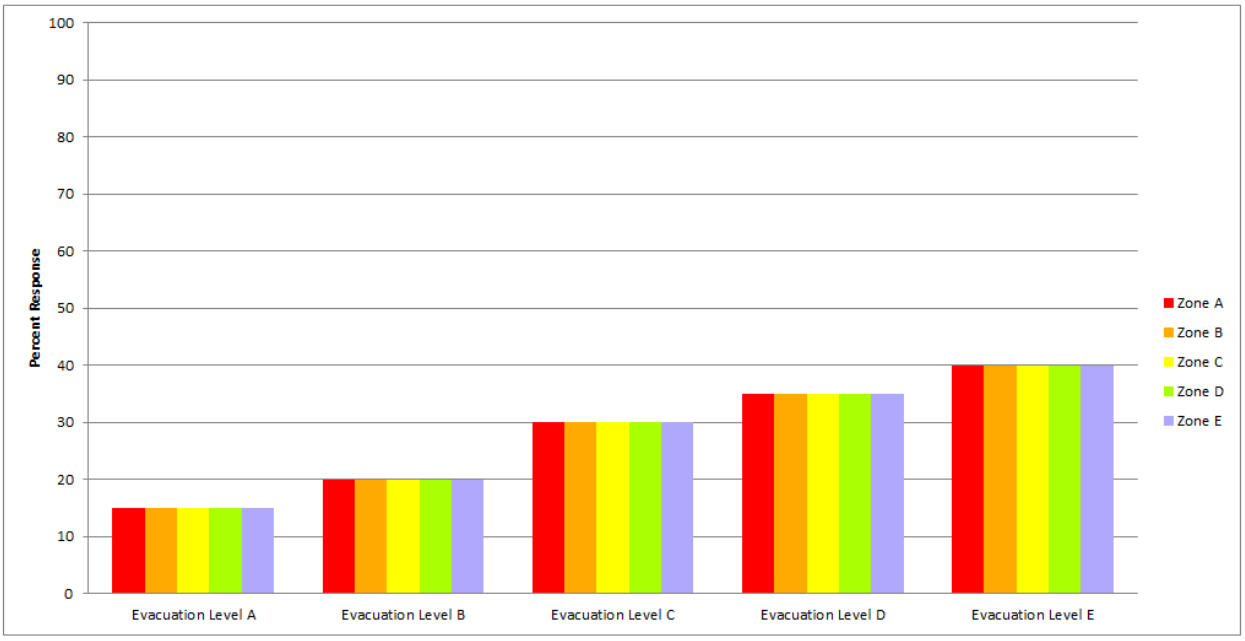


Figure VI-9: Evacuation Participation Rates: Glades County Mobile Homes

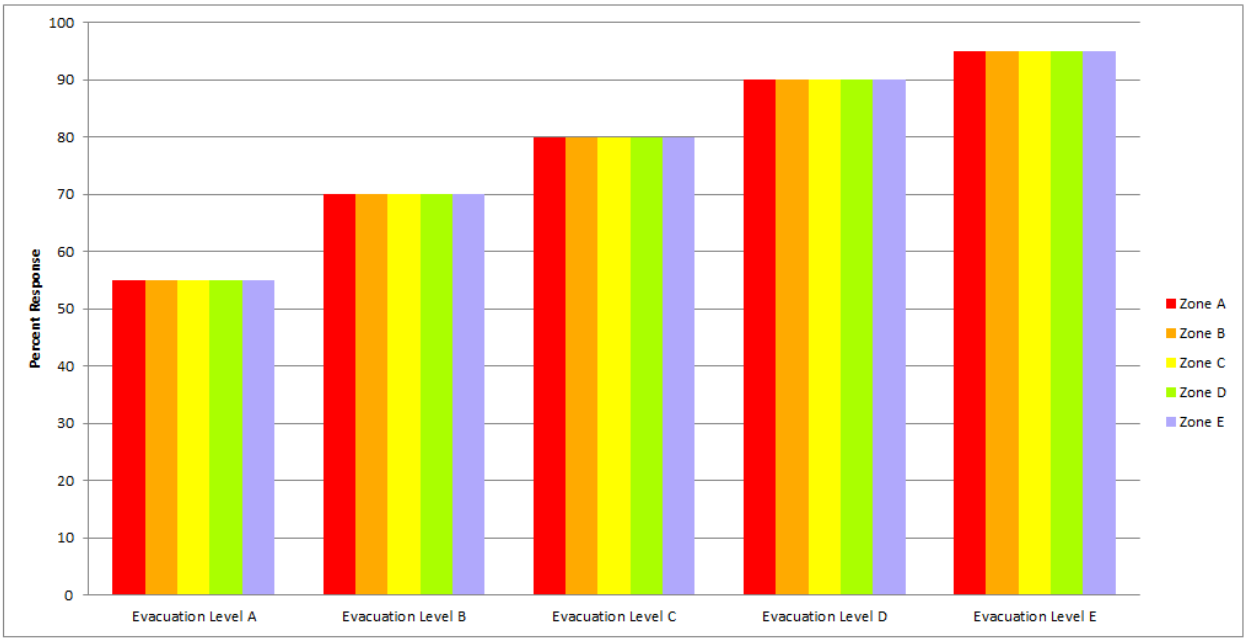


Figure VI-10: Evacuation Participation Rates: Hendry County Site-Built Homes

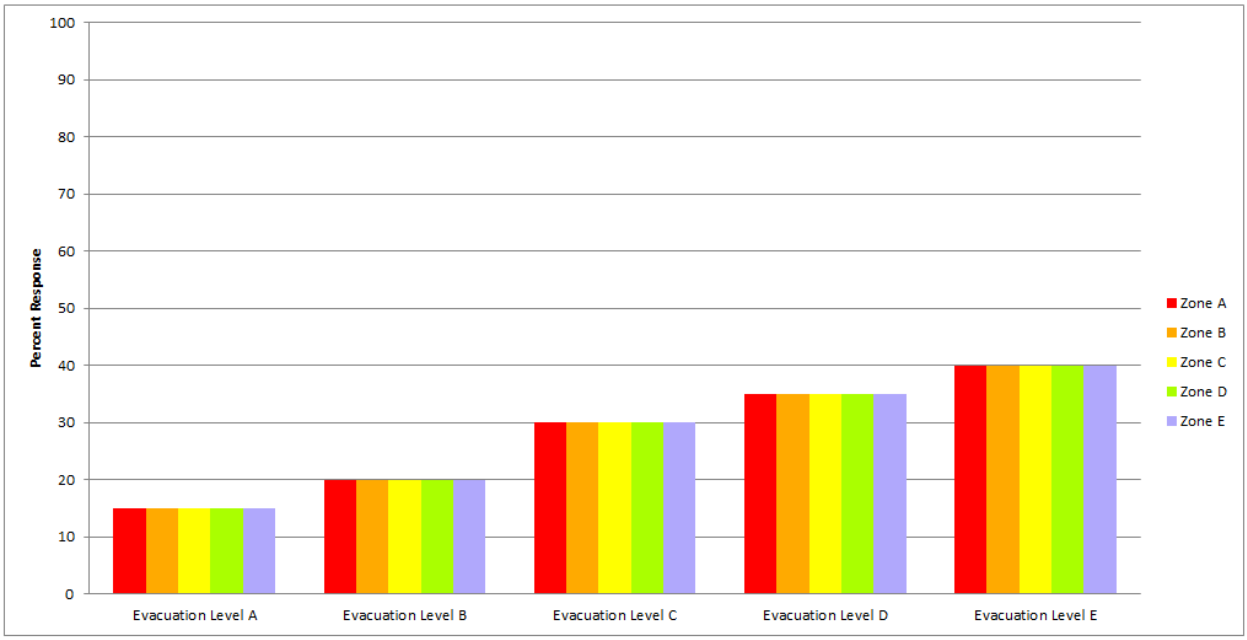


Figure VI-11: Evacuation Participation Rates: Hendry County Mobile Homes

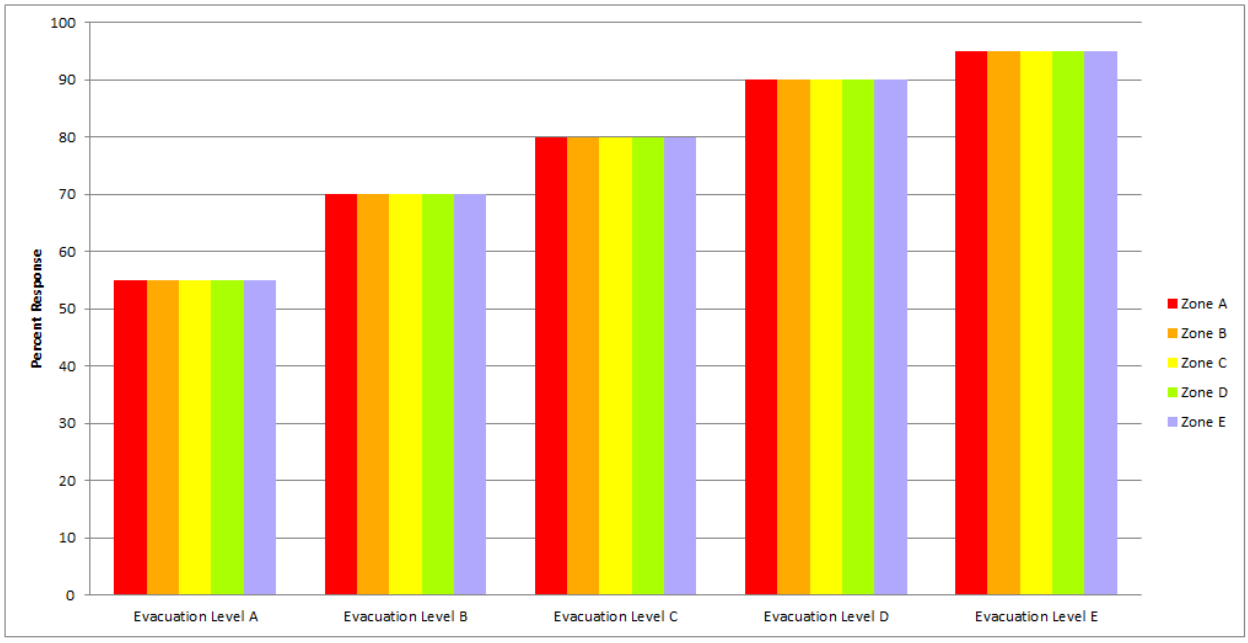


Figure VI-12: Evacuation Participation Rates: Lee County Site-Built Homes

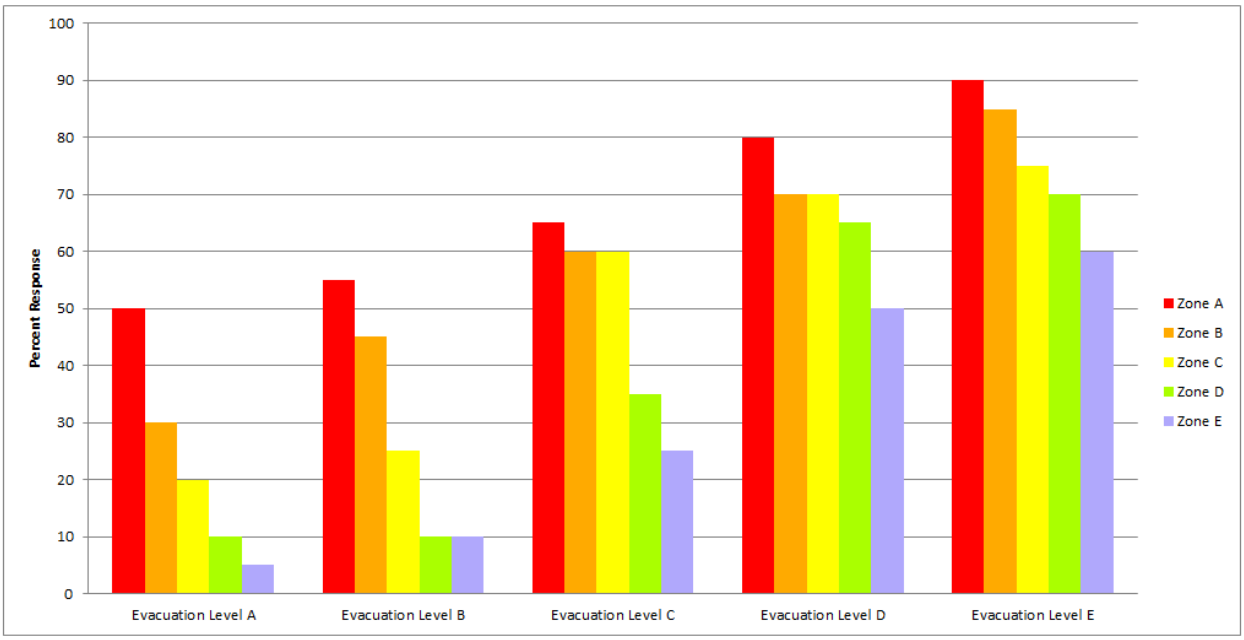


Figure VI-13: Evacuation Participation Rates: Lee County Mobile Homes

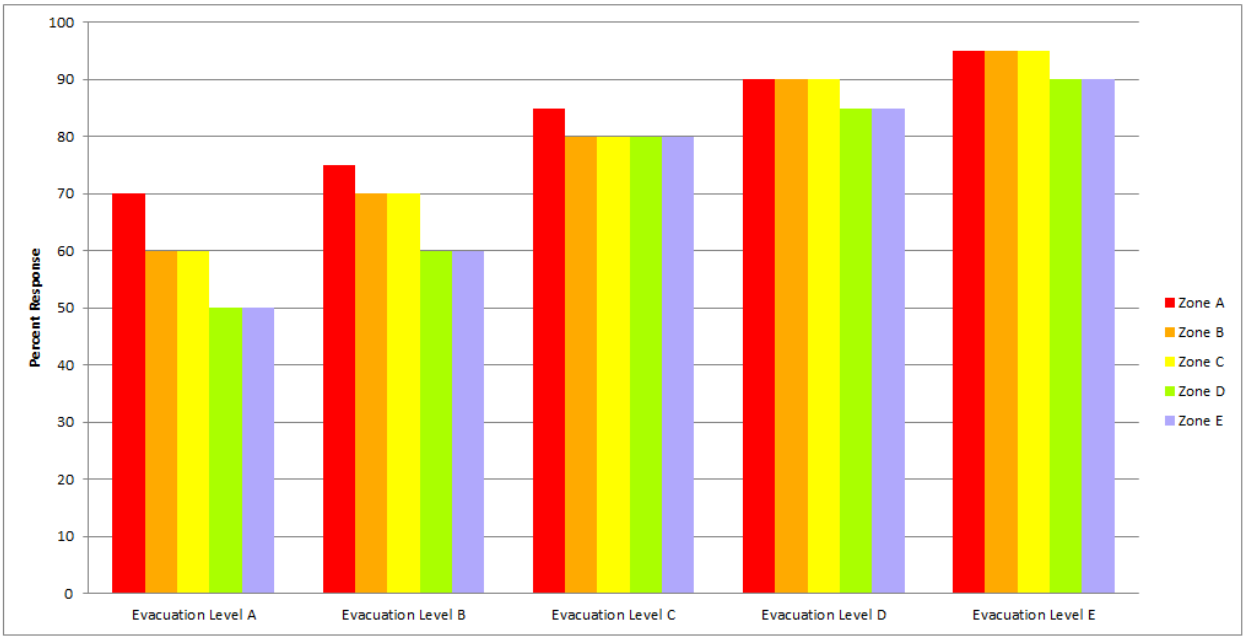


Figure VI-14: Evacuation Participation Rates: Sarasota County Site-Built Homes

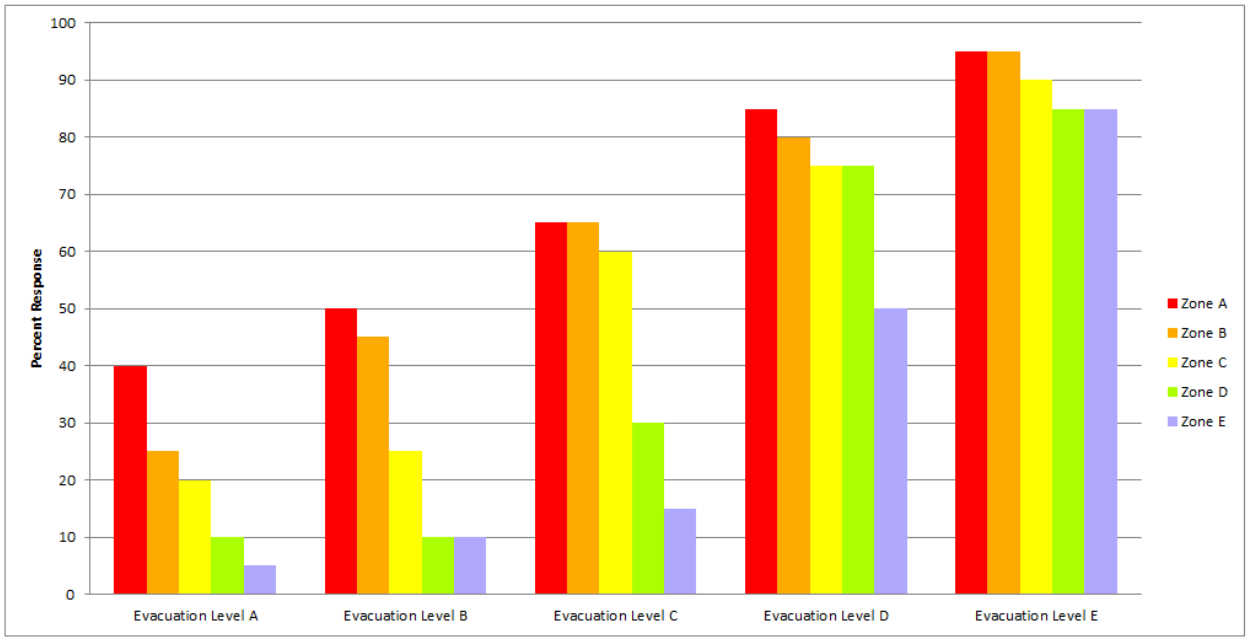
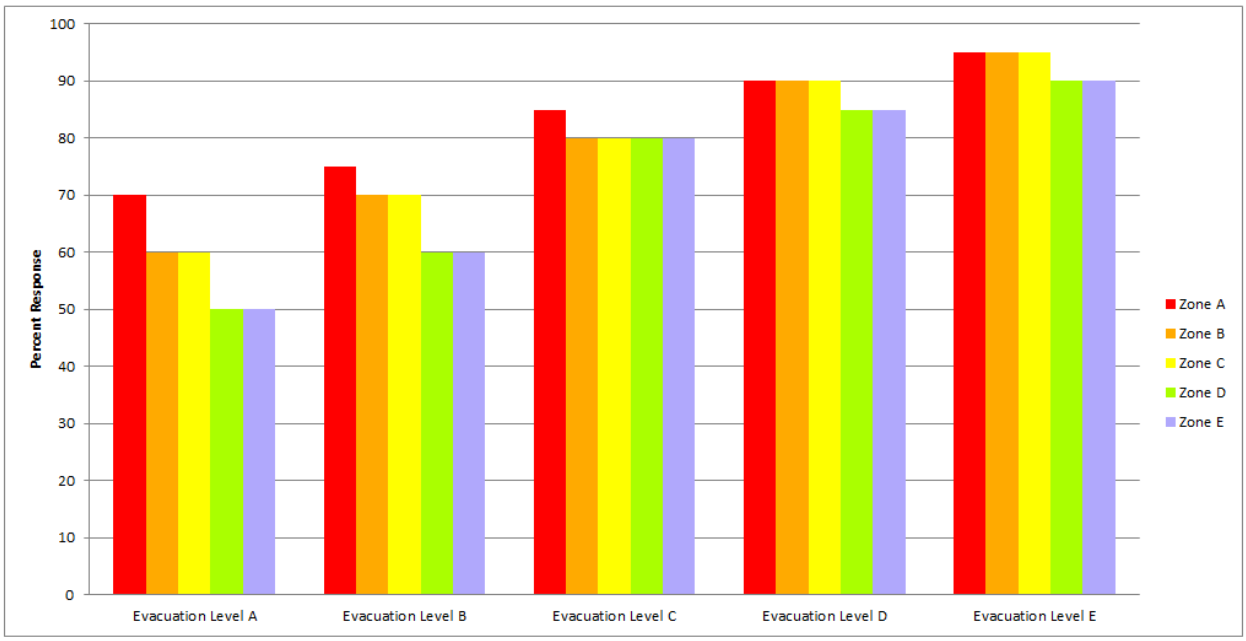


Figure VI-15: Evacuation Participation Rates: Sarasota County Mobile Homes



6. 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.

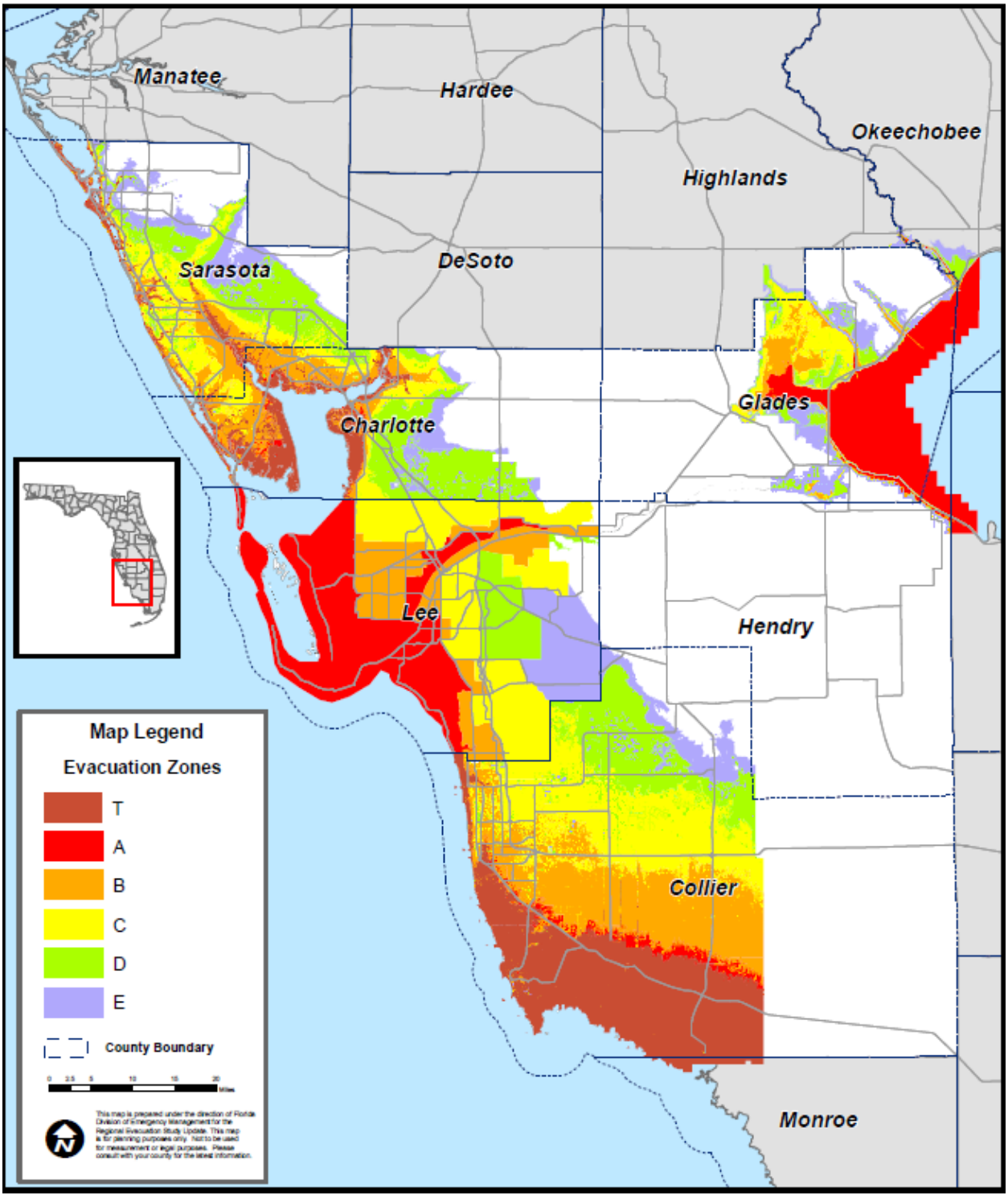
In the six county region there are a total of 113 shelters, including 4 in Charlotte County, 37 in Collier County, 8 in Glades County, 11 in Hendry County, and 30 in Lee County, and 23 in Sarasota County. The total number of shelters for Southwest Florida includes other shelters as well as those shelters compliant with ARC standards/risk shelters.

All together, the 113 shelters located within the six county region can host more than 126,000 persons during an evacuation event. Detailed lists of the primary and other shelters used in the transportation analysis are included in Volume 5-9. It is important to note that the shelter list used in the transportation analysis was developed early in the study process and may not match the latest available list of primary and other shelters from each county.

7. 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 Southwest Florida region, Charlotte, Collier, Glades, Hendry, Lee and Sarasota 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 Southwest Florida Region are illustrated in **Figure VI-16.** County level evacuation zones are included in Volume 5-9.

Figure VI-16
Southwest Florida Regional Evacuation Zones



Sources: Southwest Florida Regional Planning Council, CDM Smith

G. TIME User Interface

CDM Smith 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:

1. Analysis time period;
2. Highway network;
3. Behavioral response;
4. One-way evacuation operations;
5. University population;
6. Tourist occupancy rates;
7. Shelters;
8. Counties evacuating;
9. Evacuation level;
10. Response curve hours; and,
11. Evacuation Phasing.

H. 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 Southwest Florida Region for 2015 is identified in **Table VI-4**, summarized by evacuation zone and split between site-built homes and mobile/manufactured homes. Vulnerable population for 2020 is summarized in **Table VI-5**.

Table VI-4: Vulnerable Population in the Southwest Florida Region for 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Charlotte County					
Site-built Homes	30,919	84,890	28,602	3,556	113
Mobile/Manuf. Homes	3,655	5,651	2,066	2,556	32
TOTAL	34,574	90,541	30,667	6,112	145
Collier County					
Site-built Homes	69,979	144,597	82,683	6,492	4,332
Mobile/Manuf. Homes	7,500	7,112	929	709	2,191
TOTAL	77,479	151,709	83,612	7,200	6,524
Glades County					
Site-built Homes	441	273	541	696	193
Mobile/Manuf. Homes	205	392	450	883	285
TOTAL	646	666	991	1,578	478
Hendry County					
Site-built Homes	742	139	248	63	0
Mobile/Manuf. Homes	1,388	155	32	9	0
TOTAL	2,130	294	280	71	0
Lee County					
Site-built Homes	156,881	234,537	136,168	38,822	39,155
Mobile/Manuf. Homes	15,266	9,962	23,379	1,039	1,164
TOTAL	172,146	244,499	159,546	39,861	40,320
Sarasota County					
Site-built Homes	30,841	50,075	94,991	57,427	38,794
Mobile/Manuf. Homes	2,653	6,782	3,866	2,610	1,405
TOTAL	33,493	56,858	98,857	60,037	40,199

Note: Vulnerable population 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 VI-5: Vulnerable Population in the Southwest Florida Region for 2020

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Charlotte County					
Site-built Homes	32,515	89,286	30,083	3,750	119
Mobile/Manuf. Homes	3,847	5,946	2,172	2,679	34
TOTAL	36,362	95,232	32,255	6,429	153
Collier County					
Site-built Homes	77,283	159,736	91,349	7,179	4,785
Mobile/Manuf. Homes	8,325	7,893	1,035	777	2,424
TOTAL	85,608	167,629	92,384	7,956	7,209
Glades County					
Site-built Homes	463	287	570	723	198
Mobile/Manuf. Homes	218	414	474	941	307
TOTAL	681	702	1,045	1,664	504
Hendry County					
Site-built Homes	767	143	256	65	0
Mobile/Manuf. Homes	1,434	160	34	9	0
TOTAL	2,201	304	290	74	0
Lee County					
Site-built Homes	177,728	265,694	154,091	43,980	44,347
Mobile/Manuf. Homes	17,290	11,288	26,655	1,176	1,329
TOTAL	195,018	276,982	180,746	45,155	45,676
Sarasota County					
Site-built Homes	32,899	53,420	101,337	61,265	41,383
Mobile/Manuf. Homes	2,831	7,234	4,124	2,784	1,500
TOTAL	35,730	60,654	105,461	64,049	42,883

Note: Vulnerable population 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.

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 Southwest Florida Region are identified in **Table VI-6** for 2015 and in **Table VI-7** for 2020.

Table VI-6: Vulnerable Population by Destination for 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Charlotte County					
To Friends and Family	19,381	50,363	17,074	3,617	83
To Hotel/ Motel	8,461	22,353	7,564	1,400	33
To Public Shelter	2,656	7,074	2,495	682	18
To Other Destination	4,076	10,752	3,535	412	11
Collier County					
To Friends and Family	44,890	88,969	49,102	4,173	3,644
To Hotel/ Motel	19,235	37,574	20,544	1,804	1,610
To Public Shelter	5,810	14,532	8,199	835	838
To Other Destination	7,544	10,635	5,767	389	432
Glades County					
To Friends and Family	377	380	572	903	273
To Hotel/ Motel	75	86	122	202	62
To Public Shelter	97	100	149	237	72
To Other Destination	97	100	149	237	72
Hendry County					
To Friends and Family	0	192	171	44	0
To Hotel/ Motel	144	22	0	7	0
To Public Shelter	426	59	0	14	0
To Other Destination	144	22	0	7	0
Lee County					
To Friends and Family	0	146,201	93,390	23,812	24,075
To Hotel/ Motel	43,037	61,125	39,887	8,024	8,064
To Public Shelter	8,607	12,225	9,146	4,762	4,873
To Other Destination	17,978	24,948	17,124	3,262	3,307
Sarasota County					
To Friends and Family	0	33,436	57,346	35,761	23,979
To Hotel/ Motel	8,241	11,372	20,404	12,007	8,040
To Public Shelter	1,940	5,362	9,005	7,413	4,936
To Other Destination	1,940	6,687	12,102	4,855	3,244

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 VI-7: Vulnerable Population by Destination for 2020

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Charlotte County					
To Friends and Family	20,384	52,972	17,958	3,804	87
To Hotel/ Motel	8,898	23,511	7,955	1,473	35
To Public Shelter	2,794	7,440	2,624	718	19
To Other Destination	4,287	11,309	3,719	434	11
Collier County					
To Friends and Family	49,598	98,304	54,252	4,612	4,027
To Hotel/ Motel	21,255	41,519	22,700	1,993	1,779
To Public Shelter	6,419	16,055	9,059	922	927
To Other Destination	8,336	11,752	6,373	430	477
Glades County					
To Friends and Family	398	400	603	951	287
To Hotel/ Motel	79	91	128	214	66
To Public Shelter	102	105	157	250	76
To Other Destination	102	105	157	250	76
Hendry County					
To Friends and Family	1,464	198	177	45	0
To Hotel/ Motel	148	22	0	7	0
To Public Shelter	440	61	0	15	0
To Other Destination	148	22	0	7	0
Lee County					
To Friends and Family	116,146	165,625	105,782	26,976	27,273
To Hotel/ Motel	48,755	69,246	45,186	9,090	9,135
To Public Shelter	9,751	13,849	10,370	5,395	5,521
To Other Destination	20,366	28,263	19,407	3,695	3,747
Sarasota County					
To Friends and Family	22,800	35,669	61,177	38,151	25,580
To Hotel/ Motel	8,791	12,131	21,767	12,810	8,577
To Public Shelter	2,070	5,720	9,607	7,909	5,266
To Other Destination	2,070	7,134	12,910	5,180	3,461

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.

The vulnerable shadow population is provided in **Table VI-8** for both 2015 and 2020. 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 VI-8: Vulnerable Shadow Evacuation Population

	Evacuation Level A	Evacuation Level B	Evacuation Level C	Evacuation Level D	Evacuation Level E
2015					
Charlotte County	44,568	18,158	11,469	8,210	8,213
Collier County	84,160	58,445	43,836	43,522	39,149
Glades County	6,835	6,626	6,512	5,590	5,454
Hendry County	17,069	17,916	19,855	20,836	21,843
Lee County	164,910	103,600	77,561	75,793	57,725
Sarasota County	72,099	62,098	63,503	60,589	48,115
2020					
Charlotte County	48,291	23,017	16,955	10,526	13,506
Collier County	97,728	85,901	72,701	64,745	65,142
Glades County	7,228	7,007	6,893	5,229	5,423
Hendry County	17,661	18,537	20,539	20,465	21,551
Lee County	201,095	138,185	117,618	72,463	70,752
Sarasota County	81,705	72,084	77,980	13,932	34,186

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

I. 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:

1. 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 Southwest Florida region are identified in **Table VI-9**; and,

2. 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 Southwest Florida region are identified in **Table VI-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 Southwest Florida RPC to continue testing combinations of options and provide additional information to emergency managers.

J. Clearance Time Results

Each of the ten base scenarios and ten operational scenarios were modeled for the Southwest 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 VI-9: Base Scenarios

	Scenario 1 Level A 2015	Scenario 2 Level B 2015	Scenario 3 Level C 2015	Scenario 4 Level D 2015	Scenario 5 Level E 2015	Scenario 6 Level E 2015
Demographic Data	2015	2015	2015	2015	2015	2015
Highway Network	2015	2015	2015	2015	2015	2015
One-Way Operations	None	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary	Primary
Response Curve	12-hour	12-hour	12-hour	12-hour	12-hour	36-hour
Evacuation Phasing	None	None	None	None	None	None
Behavioral Response	100%	100%	100%	100%	100%	100%
Evacuation Zone	A	B	C	D	E	E
Counties Evacuating	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)

	Scenario 7 Level A 2020	Scenario 8 Level B 2020	Scenario 9 Level C 2020	Scenario 10 Level D 2020	Scenario 11 Level D 2020	Scenario 12 Level E 2020	Scenario 13 Level E 2020
Demographic Data	2020	2020	2020	2020	2020	2020	2020
Highway Network	2020	2020	2020	2020	2020	2020	2020
One-Way Operations	None	None	None	None	None	None	None
University Population	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring	Fall/Spring
Tourist Rate	Default	Default	Default	Default	Default	Default	Default
Shelters Open	Primary	Primary	Primary	Primary	Primary	Primary	Primary
Response Curve	12-hour	12-hour	12-hour	12-hour	36-hour	12-hour	36-hour
Evacuation Phasing	None	None	None	None	None	None	None
Behavioral Response	100%	100%	100%	100%	100%	100%	100%
Evacuation Zone	A	B	C	D	D	E	E
Counties Evacuating	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)	Charlotte Collier Glades Hendry Lee Sarasota Manatee Monroe (ML)

ML – includes mainland portion of Monroe County only.

Table VI-10: Operational Scenarios

	Scenario 1 Level A 2015	Scenario 2 Level B 2015	Scenario 3 Level C 2015	Scenario 4 Level D 2015	Scenario 5 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	18-hour	18-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	Collier Lee Monroe (ML) Hendry Glades Okeechobee Highlands	Sarasota Charlotte Lee DeSoto Glades (A) Hendry (A) Collier (A) Highlands (A)	Collier Lee Charlotte Sarasota (B) Monroe (ML-B) Glades (B) Hendry (B) Highlands (B) DeSoto (B)	Collier Lee Charlotte Sarasota (C) Monroe (ML-C) Glades (C) Hendry (C) Highlands (C) DeSoto (C) Okeechobee (B)	Collier Lee Charlotte Sarasota Monroe Manatee (D) Glades (D) Hendry (D) Highlands (C) DeSoto (C) Okeechobee (C) Hardee (C) Polk (C)
	Scenario 6 Level A 2020	**Scenario 7 Level B 2020**	**Scenario 8 Level C 2020**	**Scenario 9 Level D 2020**	**Scenario 10 Level E 2020**
Demographic Data	2020	2020	2020	2020	2020
Highway Network	2020	2020	2020	2020	2020
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	18-hour	18-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	Sarasota Lee Charlotte Manatee DeSoto Highlands Glades	Collier Charlotte Lee DeSoto Glades (A) Hendry (A) Sarasota (A) Highlands (A)	Sarasota Lee Charlotte Collier (B) Manatee (B) Glades (B) Hardee (B) Highlands (B) DeSoto (B) Hendry (B)	Sarasota Lee Charlotte Collier (C) Manatee (C) Glades (C) Hendry (C) Highlands (C) DeSoto (C) Hardee (C)	Broward Palm Beach Martin Highlands (D) Glades (D) Hendry (D) Okeechobee (D) Lee (C) Sarasota (C) Charlotte (C) DeSoto (C) Hardee (C) Collier (B)

(ML) – includes the mainland portion of Monroe County only.

1. 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.

2. 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.

3. 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.

4. 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 VI-11** and **VI-12**, while clearance times for each of the operational scenarios are summarized in **Table VI-13** and **Table VI-14.** Clearance time includes several components, including the mobilization time for the evacuating population to prepare for an evacuation (pack supplies and personal belongings, load their vehicle, etc.), the actual time spent traveling on the roadway network, and the delay time caused by traffic congestion.

5. Base Scenarios

In-county clearance times for the base scenarios range from 14.5 hours in Hendry County for the evacuation level A scenario 1 to 95.5 hours in Charlotte County for evacuation level E scenario 5 in 2015. Clearance Time to Shelter shows a similar pattern, with clearance times for the base scenarios ranging from 14 hours in Hendry County for the evacuation level A scenario 1 to 84 hours for Lee County for evacuation level E scenario 5 in 2015.

In 2020, in-county clearance times for the base scenarios increase slightly to between 15 hours in Hendry County for the evacuation level A scenario 7 and 105.5 hours for Charlotte County for the evacuation level E scenario 12. Clearance Time to Shelter shows a similar pattern, with clearance times for the base scenarios ranging from 14.5 hours in Hendry County for the evacuation level A scenario 7 to 93 hours for Lee County for evacuation level E scenario 12 in 2020.

In 2015, Out-of-county clearance times for the base scenarios range from 20.5 hours in Collier County for the base evacuation level A scenario 1 to 95.5 hours in Charlotte County for the evacuation level E scenario 5. Out-of-county clearance times remain relatively constant in 2020, with Collier County at 26 hours for evacuation level A scenario 7 and Charlotte County at 105.5 hours for evacuation level E scenario 12.

Regional clearance time for the six county SWFRPC region ranges from 40 hours to 95.5 hours in 2015 and from 45 to 105.5 hours in 2020.

Table VI-11: 2015 Clearance Times for Base Scenario

	Evacuation Level A Base Scenario 1	**Evacuation Level B** Base Scenario 2	**Evacuation Level C** Base Scenario 3	**Evacuation Level D** Base Scenario 4	**Evacuation Level E** Base Scenario 5	**Evacuation Level E** Base Scenario 6
Clearance Time to Shelter						
Charlotte County	16.5	19.0	28.0	39.5	64.5	60.0
Collier County	19.0	34.0	53.0	55.5	73.0	66.5
Glades County	16.5	18.0	17.0	14.5	14.5	37.0
Hendry County	14.0	14.5	15.5	15.5	15.5	37.5
Lee County	28.0	40.5	60.0	68.0	84.0	73.0
Sarasota County	15.5	21.0	29.5	42.0	67.5	48.5
In-County Clearance Time						
Charlotte County	26.5	51.0	66.0	71.5	95.5	86.5
Collier County	20.0	34.0	58.5	64.0	74.5	67.5
Glades County	17.0	19.0	44.5	56.0	83.0	72.0
Hendry County	14.5	39.5	55.0	66.0	82.0	71.0
Lee County	28.0	40.5	60.0	68.0	84.0	73.0
Sarasota County	37.5	44.0	57.5	69.5	94.0	76.5
Out-of-County Clearance Time						
Charlotte County	40.0	51.0	66.0	71.5	95.5	86.5
Collier County	20.5	37.0	58.5	66.5	75.5	68.5
Glades County	29.5	41.5	59.0	75.0	83.0	72.5
Hendry County	26.5	41.0	60.0	75.0	82.0	71.5
Lee County	28.0	40.5	60.0	68.0	84.0	73.0
Sarasota County	38.0	44.0	58.0	70.0	94.5	76.5
Regional Clearance Time						
Southwest	40.0	51.0	66.0	75.0	95.5	86.5

Table VI-12: 2020 Clearance Times for Base Scenario

	Evacuation Level A Base Scenario 7	**Evacuation Level B** Base Scenario 8	**Evacuation Level C** Base Scenario 9	**Evacuation Level D** Base Scenario 10	**Evacuation Level D** Base Scenario 11	**Evacuation Level E** Base Scenario 12	**Evacuation Level E** Base Scenario 13
Clearance Time to Shelter							
Charlotte County	20.0	20.5	42.0	52.0	61.0	89.5	62.0
Collier County	22.0	44.5	58.5	74.5	74.5	87.0	76.0
Glades County	15.5	19.0	17.0	14.5	37.0	16.5	39.5
Hendry County	14.5	14.5	15.5	15.5	38.0	15.0	37.5
Lee County	31.0	46.0	70.0	84.0	81.0	93.0	74.0
Sarasota County	15.0	22.0	46.5	49.5	48.5	90.0	52.0
In-County Clearance Time							
Charlotte County	34.0	60.5	73.0	97.0	94.0	105.5	94.5
Collier County	25.5	44.5	68.0	76.0	75.5	87.0	78.5
Glades County	16.0	20.0	53.5	72.0	75.5	73.0	65.5
Hendry County	15.0	45.0	70.0	83.0	81.0	92.5	81.5
Lee County	33.5	46.0	70.5	84.5	82.0	93.0	82.5
Sarasota County	44.0	50.0	72.0	91.5	87.5	99.0	88.0
Out-of-County Clearance Time							
Charlotte County	45.0	60.5	73.0	97.0	94.0	105.5	94.5
Collier County	26.0	45.0	70.0	78.0	75.5	87.0	79.0
Glades County	31.5	46.5	71.0	91.5	82.5	93.5	82.0
Hendry County	32.0	45.5	71.5	91.5	81.5	92.5	81.5
Lee County	33.5	46.0	70.5	84.5	82.0	93.0	82.5
Sarasota County	44.5	50.0	72.0	91.5	87.5	99.0	88.5
Regional Clearance Time							
Southwest	45.0	60.5	73.0	97.0	94.0	105.5	94.5

6. Operational Scenarios

In-county clearance times for the 2015 operational scenarios range from 0.5 hours to 56 hours depending upon the scenario. Clearance Time to Shelter shows a similar pattern, with clearance times for the operational scenarios ranging from 0.5 hours to 51.5 hours depending upon the county and the scenario.

In 2020, in-county clearance times for the operational scenarios vary from 0.5 hours to 54.5 hours for the level D evacuation in Charlotte County. The 2020 level E evacuation includes vehicle trips evacuating from the Treasure Coast region, which is why clearance times within the Southwest region are lower for the operational level E scenario than the operational level D scenario. Clearance Time to Shelter shows a similar pattern, with clearance times for the base scenarios ranging from 0.5 hours to 43 hours depending upon the scenario.

Out-of-county clearance times for the 2015 operational scenarios range from 17 hours to 56 hours for the evacuation level E scenario. Out-of-county clearance times for all counties in 2020 range from 14 to 54.5 hours depending upon the scenario. Regional clearance time for the six-county SWFRPC region ranges from 22 hours to 56 hours in 2015 and between 25 and 54.5 hours in 2020.

Table VI-13: 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					
Charlotte County	0.5	17.0	15.0	19.5	30.0
Collier County	12.5	16.5	28.5	34.5	48.0
Glades County	10.0	15.5	15.5	19.0	21.0
Hendry County	12.5	13.5	15.0	19.5	21.0
Lee County	20.5	20.5	28.0	32.5	51.5
Sarasota County	0.5	14.0	15.5	20.5	38.5
In-County Clearance Time					
Charlotte County	0.5	21.5	37.0	46.0	52.5
Collier County	17.0	17.0	28.5	34.5	49.0
Glades County	10.5	16.0	16.0	32.5	56.0
Hendry County	13.0	14.0	27.5	36.0	55.0
Lee County	20.5	20.5	28.0	38.0	55.0
Sarasota County	0.5	22.5	30.5	40.5	53.0
Out-of-County Clearance Time					
Charlotte County	22.0	21.5	37.0	46.0	52.5
Collier County	17.0	17.0	28.5	34.5	50.0
Glades County	19.5	24.5	29.5	38.0	56.0
Hendry County	19.0	21.5	29.0	37.5	55.5
Lee County	20.5	20.5	28.0	38.0	55.0
Sarasota County	22.0	22.5	31.0	41.0	53.5
Regional Clearance Time					
Southwest	22.0	24.5	37.0	46.0	56.0

Table VI-14: 2020 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					
Charlotte County	11.5	18.5	19.5	23.0	19.0
Collier County	0.5	25.0	32.5	40.0	33.5
Glades County	10.5	14.5	17.0	19.0	23.5
Hendry County	0.5	15.5	15.5	20.0	26.0
Lee County	16.5	26.5	35.5	43.0	40.5
Sarasota County	10.5	14.5	19.0	27.5	21.5
In-County Clearance Time					
Charlotte County	16.5	36.0	40.0	54.5	48.5
Collier County	0.5	25.0	33.0	42.5	33.5
Glades County	11.0	15.0	17.5	42.0	45.0
Hendry County	0.5	16.0	35.5	44.5	42.5
Lee County	18.0	27.5	36.0	44.5	42.0
Sarasota County	19.5	34.5	39.0	47.5	47.5
Out-of-County Clearance Time					
Charlotte County	18.5	36.0	40.0	54.5	48.5
Collier County	14.0	25.0	33.5	42.5	33.5
Glades County	21.0	32.0	36.5	45.5	45.5
Hendry County	17.0	26.0	36.0	44.5	43.5
Lee County	18.5	27.5	36.0	44.5	42.5
Sarasota County	25.0	36.0	39.0	47.5	47.5
Regional Clearance Time					
Southwest	25.0	36.0	40.0	54.5	48.5

K. 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 2015 is identified in **Table VI-15** and for 2020 in **Table VI-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.

Table VI-15: Maximum Evacuating Population by Time Interval for 2015

	Evac Level A (Scenario 1)	Evac Level B (Scenario 2)	Evac Level C (Scenario 3)	Evac Level D (Scenario 4)	Evac Level E (Scenario 5)	Evac Level E (Scenario 6)
Estimated Evacuating Population Clearing Charlotte County						
12-Hour	23,743	33,711	30,409	28,549	21,393	23,619
18-Hour	35,614	50,567	45,614	42,824	32,090	35,428
24-Hour	47,485	67,423	60,819	57,098	42,786	47,238
36-Hour	79,142	143,273	167,251	170,105	170,253	170,253
Estimated Evacuating Population Clearing Collier County						
12-Hour	94,618	93,286	73,156	65,598	58,120	64,060
18-Hour	141,927	139,930	109,734	98,397	87,180	96,089
24-Hour	161,639	186,573	146,312	131,196	116,240	128,119
36-Hour		287,633	356,636	363,522	365,673	365,673
Estimated Evacuating Population Clearing Glades County						
12-Hour	3,043	2,295	1,793	1,515	1,419	1,624
18-Hour	4,565	3,443	2,689	2,273	2,128	2,436
24-Hour	6,086	4,590	3,585	3,031	2,837	3,248
36-Hour	7,481	7,937	8,814	9,471	9,813	9,813
Estimated Evacuating Population Clearing Hendry County						
12-Hour	8,694	5,953	4,512	3,778	3,603	4,132
18-Hour	13,041	8,930	6,768	5,667	5,404	6,198
24-Hour	17,388	11,906	9,024	7,556	7,205	8,263
36-Hour	19,199	20,340	22,559	23,611	24,618	24,618
Estimated Evacuating Population Clearing Lee County						
12-Hour	144,453	154,147	130,750	122,090	102,014	117,386
18-Hour	216,679	231,220	196,126	183,135	153,021	176,079
24-Hour	288,905	308,293	261,501	244,181	204,028	234,772
36-Hour	337,056	520,245	653,752	691,845	714,097	714,097
Estimated Evacuating Population Clearing Sarasota County						
12-Hour	33,345	41,577	52,285	53,114	42,865	52,950
18-Hour	50,017	62,366	78,428	79,672	64,297	79,426
24-Hour	66,690	83,154	104,570	106,229	85,729	105,901
36-Hour	105,592	152,449	252,711	309,834	337,559	337,559

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 VI-16: Maximum Evacuating Population by Time Interval for 2020

	Evac Level A Scenario 7	Evac Level B Scenario 8	Evac Level C Scenario 9	Evac Level D Scenario 10	Evac Level D Scenario 11	Evac Level E Scenario 12	Evac Level E Scenario 13
Estimated Evacuating Population Clearing Charlotte County							
12-Hour	22,574	30,667	29,721	22,368	23,081	20,922	23,357
18-Hour	33,861	46,000	44,582	33,551	34,622	31,383	35,036
24-Hour	45,148	61,333	59,443	44,735	46,163	41,843	46,714
36-Hour	84,653	154,611	180,805	180,805	180,805	183,937	183,937
Estimated Evacuating Population Clearing Collier County							
12-Hour	84,617	90,437	71,712	64,357	66,488	58,749	64,698
18-Hour	126,925	135,655	107,569	96,536	99,732	88,123	97,047
24-Hour	169,233	180,874	143,425	128,714	132,977	117,497	129,396
36-Hour	183,336	339,138	418,322	418,322	418,322	425,928	425,928
Estimated Evacuating Population Clearing Glades County							
12-Hour	3,013	2,165	1,575	1,222	1,356	1,286	1,466
18-Hour	4,519	3,247	2,363	1,833	2,033	1,929	2,199
24-Hour	6,026	4,330	3,150	2,445	2,711	2,571	2,932
36-Hour	7,909	8,389	9,320	9,320	9,320	10,018	10,018
Estimated Evacuating Population Clearing Hendry County							
12-Hour	7,448	5,549	3,916	3,060	3,436	3,168	3,595
18-Hour	11,172	8,324	5,874	4,590	5,153	4,752	5,393
24-Hour	14,897	11,099	7,832	6,120	6,871	6,336	7,191
36-Hour	19,862	21,041	23,333	23,333	23,333	24,419	24,419
Estimated Evacuating Population Clearing Lee County							
12-Hour	141,891	159,179	131,126	109,401	112,736	105,075	118,448
18-Hour	212,837	238,768	196,689	164,101	169,105	157,612	177,672
24-Hour	283,782	318,358	262,252	218,802	225,473	210,150	236,896
36-Hour	396,113	610,186	770,365	770,365	770,365	814,330	814,330
Estimated Evacuating Population Clearing Sarasota County							
12-Hour	31,668	40,432	46,638	36,698	38,376	41,571	46,503
18-Hour	47,502	60,648	69,956	55,048	57,564	62,357	69,755
24-Hour	63,336	80,865	93,275	73,397	76,752	83,143	93,007
36-Hour	117,435	168,468	279,825	279,825	279,825	342,963	342,963

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.

L. 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.

- 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 Southwest 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.

M. Summary and Conclusions

Through a review of the results of the 23 different scenarios (13 base and 10 operational), several conclusions could be reached regarding the transportation analysis, including the following:

- Critical transportation facilities within the SWFRPC region include I-75, US 41, US 27, US 17, US 301, SR 29, SR 78, SR 74, SR 72, SR 31, SR 82 and US 80. 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;

- The SWFRPC counties, in coordination with the State, should continue public information campaigns to clearly define those that are vulnerable and should evacuate versus those who choose to evacuate on their own. Shadow evacuations in inland areas of the counties impact the ability of the vulnerable population to evacuate;

- 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 5-9) 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 Southwest 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.

Funding was provided by the Florida Legislature with funding from the Federal Emergency Management Agency (FEMA) through the Florida Division of Emergency Management. Local match was provided by Southwest Florida Regional Planning Council and the counties of Charlotte, Collier, Glades, Hendry, Lee and Sarasota.

Florida Division of Emergency Management
Bryan Koon, Director
2555 Shumard Oak Boulevard, Tallahassee, Florida 32399
Web site: www.floridadisaster.org

Prepared and published by
Southwest Florida Regional Council, 1926 Victoria Avenue,
Fort Myers, Florida 33901
Tel: (239) 338-2550, Fax: (239) 338-2560, Web site: www.swfrpc.org