Volume 1-4
Northeast Florida Region
Technical Data Report

EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

This Executive Summary is provided to state and local governments, volunteer organizations, the media and interested residents to highlight the results of the ***2010 Statewide Regional Evacuation Study (SRES)*** for the Northeast Florida Region and to quantify and illustrate the challenges of evacuation response in the Northeast Florida region.

A. DEMOGRAPHIC AND LAND USE ANALYSIS

Northeast Florida's seven county region, consisting of Baker, Clay, Duval, Flagler, Nassau, Putnam and St. Johns counties – and their 27 municipalities, encompasses 4,428 square miles of land area. Approximately 50 percent is dedicated to agriculture, 17 percent conservation/open space, 16 percent residential, five percent industry and commercial use, five percent mixed use and four percent institutional.

The region's population exceeds 1.5 million people according to 2009 estimates from the 2009 Florida Population Estimates from Bureau of Economic Research (BEBR). This illustrates a 23% increase in population for the region since 2000. Jacksonville is the population center of the region, with over 900,000 people. While not the most populated counties, Flagler and St. Johns Counties have seen the greatest percentage change in growth since 2000 with 90% and 49% respectively.

Geographically, the region is characterized by an abundance of natural resources and a diversity of habitats. The region's central feature is the lower St. Johns River and its tributaries. The regions eastern edge from Nassau County to Flagler abuts 140 miles of coastline and five barrier islands.

Jacksonville is the major urban center within the region and contains a good mix of industrial manufacturing, transportation, financial services, health care, and military employment. Surrounding counties are more rural in nature, relying on agriculture and service sectors, with a limited industrial base. However, the outlying counties are increasing in their rate of urbanization and are beginning to develop more economic diversity.

Chapter I provides a demographic profile of the region and the counties themselves. Specific socio-economic characteristics that may have an impact on evacuation vulnerability, response and mass care were identified using 2000 Census data including more recent American Community Survey data.

Information includes:

- Overall Population
- Group Quarters Population
- Housing Units by Type
- Occupied Housing Units (Households)
- Household Size
- Seasonal Dwelling Units

- Vehicles per Household
- Age Composition
- Race / Ethnicity
- Place of Birth and Citizenship
- Linguistic Isolation
- Labor Force
- Poverty Status
- Small Area Dwelling Unit and Population Data (TAZ)

The Northeast Florida Region Future Land Use Map is presented on **Map I-3** within Chapter 1. There are 11 categories identified which represent a consolidation of land use categories identified in the local government comprehensive plans in the region (See **Table I-17**).

- RL Residential Low (higher than AG < 1DU)
- RH Residential High (more than RM and > 12DU)
- RM Residential Medium (more than RL, < 13DU)
- CONS Conservation, natural and protected
- PUB Public/Semi-Public, government, institutional
- AG Agriculture - rural land, farms (< 0.5DU)
- REC Recreation/Open Space
- COM Commercial, office, tourism, marina
- MU Mixed Use, activity centers, urban village
- WAT Water bodies
- IND Industrial, extractive, transportation

B. REGIONAL HAZARDS ANALYSIS

The Hazards Analyses is the first step in the development of the regional evacuation study. The Hazards Analysis identifies type, extent and probability of those hazards which may confront our region and necessitate a regional evacuation. The Statewide Regional Evacuation Study took an "all-hazards" approach to this evacuation study. The hazards which could necessitate an evacuation at a regional level were identified as (1) tropical storms and hurricanes, (2) flooding, (3) hazardous materials and (4) wildfire.

1. Tropical Storms and Hurricanes

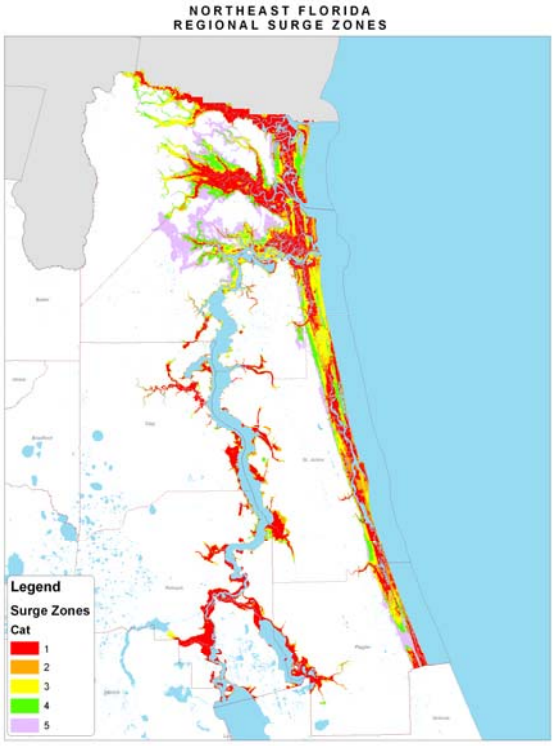
Risks from tropical storms and hurricanes include storm surge, high winds, tornadoes and inland flooding. Storm surge, considered the most deadly hazard, was quantified using the National Oceanic and Atmospheric Administration (NOAA) numerical storm surge model, SLOSH[1]. The SLOSH modeling system consists of the model source code and model basin or grid. SLOSH model grids must be developed for each specific geographic coastal area individually incorporating the unique local bay and river configuration, water depths, bridges, roads and other physical features. In addition to

[1]SLOSH stands for Sea, Lake and Overland Surges from Hurricanes

open coastline heights, one of the most valuable outputs of the SLOSH model for evacuation planning is its predictions of surge heights over land which predicts the degree of propagation of the surge into inland areas.

SLOSH provides the maximum amount of surge expected at approximately 3,500 points in the region considering different parameters of 1,800 hypothetical storms (strength, track and forward speed) and the topography and the bathymetry of the Northeast Florida basin.

The best available SLOSH model basin for Northeast Florida incorporated in the ***2010 Statewide Regional Evacuation Study*** reflects major improvements, including higher resolution basin data and grid configurations. Storm tracks were run in eleven different directions. Eleven storm track headings (WSW, W, WNW, NW, NNW, N, NNE, NE, E, ENE, and Parallel) were selected as being representative of storm behavior in the Northeast Florida region, based on observations by forecasters at the National Hurricane Center. For each set of tracks in a specific direction, storms were run at forward speeds of 5, 15 and 25 mph. A total of 1,890 runs were made at varying direction, speed and intensity. All storms were modeled at high tide, which is now referenced to North American Vertical Datum of 1988 (NAVD88) as opposed to the National Geodetic Vertical Datum of 1929 (NGVD29).



SLOSH and SLOSH related products reference storm surge heights relative to the model vertical datum, in this case NAVD88. In order to determine the inundation depth of surge flooding at a particular location, the ground elevation at that location must be subtracted from the potential surge height. As part of the Statewide Regional Evacuation Study, all coastal areas, as well as areas surrounding Lake Okeechobee, were mapped using remote-sensing laser terrain mapping (LIDAR[2]) providing the most comprehensive, accurate and precise topographic data for this analysis. As a general rule, the vertical accuracy of the laser mapping is within a 15 centimeter tolerance.

The LIDAR data was incorporated into the SLOSH basin data and used to subtract the land elevation from the storm surge height to develop the storm tide limits. The result of this storm surge hazard analysis is graphically portrayed in the Storm Tide Atlas, which

[2] Light Imaging Detection and Ranging

illustrates the storm tide limits based on the maximum storm surge for landfalling categories 1, 2, 3, 4 and 5. The Atlas maps will be available online at www.nefrc.org.

While all residents would be susceptible to some extent from the effects of hurricane-force winds, mobile home residents are far more vulnerable than residents in site-built homes. Mobile home and RV Park data was updated using information from the State of Florida Department of Health, property appraiser data and county planning departments. This was augmented by additional data particularly due to the rural nature of several counties within the Region. The majority of mobile home residents live outside of designated mobile home parks.

Tornadoes are another hazard of tropical storm activity. Because it is impossible to identify where a tornado imbedded in the hurricane wind bands will strike, evacuation does not consider tornado activity, per se. It is recognized, however, that mobile home residents are much more vulnerable to this severe weather event. Therefore, with the evacuation of mobile homes for hurricane winds, it is anticipated that severe injury will also be reduced from any tornado activity. In addition, the public information campaign will include a recommendation that tornado safe rooms (see www.fema.gov) be considered by residents.

While inland flooding has not been considered to be life-threatening in the past, it has, over the last twenty years, become a leading cause of hurricane-related deaths until Hurricane Katrina in 2005. The 100-year flood zone, as designated by the Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP), is identified and addressed separately under the Flooding Hazard.

While counties in Florida do not typically evacuate for inland flooding for a hurricane, it is recognized that this may become a major problem during a hurricane evacuation, after a tropical storm passes or after prolonged rainfall. Evacuation routes within the flood zone are identified in an effort to find alternative routes, if necessary. Public information will stress that after the storm (1) residents do NOT attempt to drive on flooded roadways and (2) children are NOT permitted to swim or play in flood waters.

2. Flooding

Both coastal and inland flooding is addressed through FEMA's NFIP. The 100-year and 500-year floodplain was identified within the region to illustrate the regional and county-level vulnerability to the flood hazard. In addition, communities with repetitive loss properties were identified by building type to provide an overall assessment of the risk. The areas' risk, historical frequency and estimated population at risk were identified in the hazards and vulnerability analyses. Also identified were dams which could pose a risk to the population that lives below them.

3. Wildfires and the Urban Interface

Florida is home to millions of residents who enjoy the state's beautiful scenery and warm climate. But few people realize that these qualities also create severe wildfire conditions. Each year, thousands of acres of wildland and many homes are destroyed by fires that can erupt at any time of the year from a variety of causes, including arson, lightning and debris burning. Adding to the fire hazard is the growing number of people living in new communities built in areas that were once wildland. This growth places even greater pressure on the state's wildland firefighters. As a result of this growth, fire protection becomes everyone's responsibility (Florida Division of Emergency Management, 2008).

Wildfires have burned across the woodlands of Florida for centuries and are part of the natural management of much of Florida's ecosystems (Statewide Hazard Mitigation Plan, 2009). The risk of potential wildfire to the region's population was identified using the data provided by the Florida Division of Forestry (FlamMap) and the population living in the high/very high risk areas was estimated.

4. Hazardous Materials

A hazardous material is generally considered as any item or agent (biological, chemical, and radiological/nuclear) which has the potential to cause harm to humans, animals or the environment, either by itself or through interaction with other factors. Almost every community deals with hazardous materials on a daily basis through transport, use, storage and/or disposal. The benefits chemicals bring into our lives through their designed uses have become vital to our standard of living. Although major chemical emergencies are extremely rare, there always remains a chance that one will occur. In the State of Florida, the county emergency management agencies plan for hazardous material incidents and coordinate regionally for response through the Local Emergency Planning Committees (LEPCs). While the facilities with extremely hazardous materials were identified, the evacuation planning for incidents involving hazardous materials is addressed in the Regional Hazardous Material Emergency Response Plan.

No specific emergency sequence can be isolated as the model for which to plan because each emergency could have different consequences, both in nature and degree. As an alternative to defining a specified emergency, the regional plan identifies various parameters for planning which are based upon knowledge of the possible consequences, timing, and release characteristics of a spectrum of emergencies. The Regional Hazardous Materials Emergency Response Plan then establishes the appropriate

response for each level of threat. Therefore, the Statewide Regional Evacuation Study did not specifically address hazardous material incidents.

C. VULNERABILITY ANALYSIS & POPULATION-AT-RISK

Depending upon the strength of the storm, the regional evacuation study calls for the complete evacuation of successively more surge-vulnerable zones further inland in addition to all mobile home residents. Using information from the Metropolitan Planning Organizations (MPOs) and the local planning commissions/departments, the population, dwelling unit counts and vehicle data for each zone was developed (see Chapter IV Regional Vulnerability and Population Analysis). The population-at-risk for the years 2010 and 2015 are presented in **Tables ES-1** and **ES-2** below.

Table ES-1
Vulnerable Population from Hurricanes by Evacuation Level, 2010

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Clay County					
Site-built Homes	278	4,862	15,457	140	1,392
Mobile/Manuf. Homes	67	575	2,581	66	212
TOTAL	344	5,438	18,039	206	1,604
Duval County					
Site-built Homes	54,027	55,076	129,409	26,444	88,227
Mobile/Manuf. Homes	2,433	1,623	6,447	2,423	8,227
TOTAL	56,460	56,698	135,856	28,868	96,453
Flagler County*					
Site-built Homes	13,584	16,730	1,481	10,925	
Mobile/Manuf. Homes	674	794	62	233	
TOTAL	14,258	17,524	1,543	11,158	
Nassau County					
Site-built Homes	27,074	102	5,275	8,976	567
Mobile/Manuf. Homes	930	11	734	1,678	86
TOTAL	28,004	112	6,009	10,654	653
Putnam County*					
Site-built Homes	5,070	2,100	638		
Mobile/Manuf. Homes	3,304	1,430	437		
TOTAL	8,373	3,530	1,075		
St. Johns County*					
Site-built Homes	52,161	57,632	4,747	9,451	
Mobile/Manuf. Homes	6,310	7,001	381	2,764	
TOTAL	58,471	64,633	5,128	12,214	

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.

** Flagler County has a combined D/E zone, Putnam County has a combined C/D/E zone and for analysis purposes, in this Study, St. Johns County has a combined D/E zone.*

Table ES-2
Vulnerable Population from Hurricanes by Evacuation Level, 2015

	Evacuation Zone A	Evacuation Zone B	Evacuation Zone C	Evacuation Zone D	Evacuation Zone E
Clay County					
Site-built Homes	315	5,514	17,530	158	1,579
Mobile/Manuf. Homes	78	738	3,285	77	251
TOTAL	393	6,252	20,815	236	1,829
Duval County					
Site-built Homes	58,329	59,458	139,711	28,550	95,251
Mobile/Manuf. Homes	2,433	1,623	6,447	2,423	8,227
TOTAL	60,762	61,081	146,158	30,974	103,478
Flagler County*					
Site-built Homes	17,004	20,937	1,852	13,604	
Mobile/Manuf. Homes	674	794	62	233	
TOTAL	17,679	21,731	1,913	13,837	
Nassau County					
Site-built Homes	30,346	114	5,913	10,061	635
Mobile/Manuf. Homes	930	11	734	1,678	86
TOTAL	31,276	125	6,646	11,739	721
Putnam County*					
Site-built Homes	5,377	2,229	677		
Mobile/Manuf. Homes	3,304	1,430	437		
TOTAL	8,681	3,659	1,114		
St. Johns County*					
Site-built Homes	61,924	68,420	5,637	11,220	
Mobile/Manuf. Homes	6,310	7,001	381	2,764	
TOTAL	68,234	75,421	6,017	13,984	

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.

** Flagler County has a combined D/E zone, Putnam County has a combined C/D/E zone and for analysis purposes, in this Study, St. Johns County has a combined D/E zone.*

If everyone who was ordered to evacuate did so and those who were not ordered to evacuate, secured their homes and stayed put, emergency management could use the population-at-risk statistics. This, however, is not the case.

Post-hurricane behavioral studies conducted along the Atlantic and Gulf coasts illustrate that many people ordered to evacuate will not and, conversely, people who live in site-built homes far outside the coastal areas will pack up and try to "outrun" the storm (*"shadow evacuation"*). How we quantify this behavior is key to an accurate transportation analysis. This study used the general response model (HMG, 2010) as well as the surveys conducted in 2009 (see Chapter III, Regional Behavioral Analysis Summary). Volume 2 of the Statewide Regional Evacuation Study Program provides the Regional Behavioral Assumptions based upon the General Response Model and the survey results presented in Volume 3 Behavioral Survey Report.

Using the behavioral assumptions discussed in Chapter III, two scenarios were developed. The **Base Scenario** population scenario assumes that 100% of the population-at-risk evacuates plus the anticipated "shadow evacuation" from outside the surge vulnerable areas. The scenario is considered the most "conservative" estimate and will be used for growth management purposes. Tables **ES-3** and **ES-4** present these evacuation population estimates for 2010 and 2015.

The second **Operational Scenario** population estimates apply the participation rates presented in the regional behavioral assumptions. These estimates do not assume that 100% of the population at risk evacuates but do include the "shadow evacuation" expected, depending on the strength of the hurricane. **Tables ES-5** and **ES-6** present the evacuation population estimates and projections for 2010 and 2015.

Table ES-3
Hurricane Evacuation Population by Evacuation Level, Base Planning Scenario 2010

Level	Baker County	Clay County	Duval County	Flagler County	Nassau County	Putnam County	St. Johns County	Northeast Region
A	11,962	57,752	254,303	30,552	43,378	39,013	101,163	538,123
B	12,702	70,153	333,117	45,501	45,401	40,820	147,891	695,585
C	13,441	89,888	471,973	51,187	52,420	45,350	155,234	879,493
D	14,181	103,436	521,923	65,011	58,621	47,308	165,621	976,101
E	14,921	110,999	626,394	70,734	61,355	51,224	169,881	1,105,508

Table ES-4
Hurricane Evacuation Population by Evacuation Level, Base Planning Scenarios, 2015

Level	Baker County	Clay County	Duval County	Flagler County	Nassau County	Putnam County	St. Johns County	Northeast Region
A	12,051	65,489	270,342	37,251	47,767	39,584	115,716	588,200
B	12,880	79,564	355,537	55,950	50,029	41,501	170,900	766,361
C	13,709	101,952	505,406	63,045	57,885	46,299	179,599	967,895
D	14,538	117,325	559,330	80,246	64,817	48,374	191,942	1,076,572
E	15,367	125,908	672,247	87,388	67,874	52,523	197,007	1,218,314

Table ES-5
Hurricane Evacuation Population by Evacuation Level, Operational Scenarios, 2010

Level	Baker County	Clay County	Duval County	Flagler County	Nassau County	Putnam County	St. Johns County	Northeast Region
A	7,463	39,374	206,890	22,227	30,731	23,169	66,847	396,701
B	8,774	51,602	267,281	30,466	34,604	26,062	91,524	510,313
C	10,635	71,726	361,110	39,693	42,873	36,403	113,108	675,548
C (2)	10,635	71,726	361,110	39,693	42,873	36,403	113,108	675,548
D	11,936	92,310	464,471	53,387	49,884	41,511	142,677	856,176
E	13,799	102,701	565,002	65,166	56,616	47,679	160,161	1,011,124

Table ES-6
Hurricane Evacuation Population by Evacuation Level, Operational Scenarios, 2015

Level	Baker County	Clay County	Duval County	Flagler County	Nassau County	Putnam County	St. Johns County	Northeast Region
A	7,562	44,684	220,967	27,208	33,952	23,554	76,567	434,494
B	8,952	58,582	285,964	37,416	38,226	26,518	105,313	560,971
C	10,903	81,348	386,594	48,808	47,350	37,153	130,343	742,499
D	12,293	104,730	497,898	65,824	55,134	42,464	165,062	943,405
E	14,245	116,515	606,376	80,498	62,642	48,916	185,696	1,114,888

Chapter IV also presents the vulnerability of critical facilities within the region to (1) tropical storms and hurricanes; (2) flooding (100-year and 500-year); and wildfire (high and very high). The County Appendices provide more detailed data and maps for selected critical facilities including health care facilities (hospitals, nursing homes, etc.), assisted living facilities (ALFs), fire and police stations, and other identified facilities.

D. PUBLIC SHELTER DEMAND

As part of the Regional Evacuation Study, the anticipated demand for public shelters was quantified. The public shelter inventories and the capacities within each county were identified and a comparison was made to determine the status within both the county and the region.

The general response model, post-hurricane behavioral surveys of residents in the Northeast Florida region and past experience was used to determine public shelter demand. The number of evacuees who choose public shelter as their evacuation destination is based on demographic characteristics of the population including income and age, risk area and housing (mobile home vs. site built homes). The planning assumptions regarding anticipated shelter use were presented in the Regional Behavioral Analysis (See Chapter III, Appendices III-A, III-B, III-C, III-D), and were applied to the projected Hurricane Evacuation Population estimates for both the *Base Planning Scenarios* as well as the *Operational Scenarios*.

As discussed in Chapter IV, the Base Planning Scenarios assume 100% compliance of the vulnerable populations (surge-vulnerable and mobile home residents) plus the "shadow evacuation". The Operational Scenarios use the participation rates from the behavioral analysis to determine the evacuation rates.

Table ES-7
Public Shelter Demand for Hurricane Evacuation
Base Scenarios 2010

Level	Baker County	Clay County	Duval County	Flagler County	Nassau County	Putnam County	St. Johns County	Northeast Region
CAPACITY*	**2,600**	**4,290**	**32,814**	**8,815**	**4,325**	**2,276**	**7,200**	**62,320**
A	2,357	829	22,664	2,738	3,319	5,093	5,929	42,929
B	2,461	5,750	28,299	4,114	3,417	5,267	8,233	57,541
C	2,566	7,302	40,672	4,730	3,768	5,876	8,719	73,633
D	2,670	8,804	45,532	6,207	4,077	6,151	9,590	83,031
E	2,773	9,483	55,263	6,847	4,203	6,701	10,012	95,282

**Capacity based on Primary Risk ARC4496 Compliant shelters.*
Numbers in Red represent a shelter deficit.

Table ES-8
Public Shelter Demand for Hurricane Evacuation
Base Scenarios 2015

Level	Baker County	Clay County	Duval County	Flagler County	Nassau County	Putnam County	St. Johns County	Northeast Region
CAPACITY*	**2,600**	**4,290**	**32,814**	**8,815**	**4,325**	**2,276**	**7,200**	**62,320**
A	2,368	5,459	24,857	3,275	3,517	5,158	6,531	51,165
B	2,461	6,505	31,250	4,999	3,622	5,343	9,207	63,387
C	2,566	8,266	45,332	5,768	4,013	5,987	9,774	81,706
D	2,670	9,970	50,881	7,611	4,355	6,279	10,791	92,557
E	2,773	10,739	61,818	8,410	4,492	6,862	11,281	106,375

**Capacity based on Primary Risk ARC4496 Compliant shelters.*
Numbers in Red represent a shelter deficit.

Table ES-9
Public Shelter Demand for Hurricane Evacuation
Operational Scenarios 2010

Level	Baker County	Clay County	Duval County	Flagler County	Nassau County	Putnam County	St. Johns County	Northeast Region
CAPACITY	**2,600**	**4,290**	**32,814**	**8,815**	**4,325**	**2,276**	**7,200**	**62,320**
A	1,456	3,306	18,189	2,085	2,183	3,075	3,981	34,275
B	1,672	4,294	23,112	2,847	2,451	3,424	5,302	43,102
C	2,002	5,911	31,617	3,748	3,056	4,797	6,606	57,737
C (2)	2,002	5,911	31,617	3,748	3,056	4,797	6,606	57,737
D	2,220	7,870	40,445	5,102	3,484	5,448	8,342	72,911
E	2,549	8,767	49,249	6,299	3,857	6,268	9,420	86,409

**Capacity based on Primary Risk ARC4496 Compliant shelters.*
Numbers in Red represent a shelter deficit.

Table ES-10
Public Shelter Demand for Hurricane Evacuation
Operational Scenarios 2015

Level	Baker County	Clay County	Duval County	Flagler County	Nassau County	Putnam County	St. Johns County	Northeast Region
CAPACITY	**2,600**	**4,290**	**32,814**	**8,815**	**4,325**	**2,276**	**7,200**	**62,320**
A	1,469	3,743	20,147	2,518	2,327	3,121	4,403	37,728
B	1,698	4,866	25,680	3,458	2,612	3,480	5911	47,705
C	2,041	6,690	35,193	4,564	3,256	4,890	7,378	64,012
D	2,268	8,915	45,186	6,246	3,719	5,565	9,368	81,267
E	2,612	9,931	55,108	7,739	4,124	6,423	10,615	96,552

**Capacity based on Primary Risk ARC4496 Compliant shelters.*
Numbers in Red represent a shelter deficit.

Recognizing the trend toward a reduced reliance on public shelters, the emergency management community remains concerned that the assumption of such as drastic reduction in anticipated need does not take into consideration that many vulnerable residents will choose not to evacuate until there is no longer sufficient time to reach other destinations. This could logically result in a surge of evacuees to the public shelters in the closing hours of the evacuation. In addition, if a major hurricane were to impact the region, there would be less capacity in public shelters for those residents who have no home to which to return.

Local emergency management may use different assumptions for both public and special needs shelters within the operational plans as reflected in the County Comprehensive Emergency Management Plans (CEMPs).

E. EVACUATION TRANSPORTATION ANALYSIS

The evacuation transportation analysis discussed in Chapter VI 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.

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.

1. Transportation Methodology

The methodology used in the Northeast Florida RPC Evacuation Transportation Analysis is identical to the methodology used for all eleven Regional Planning Councils and includes the following components:

- **Behavioral Assumptions**
- **Zone System and Highway Network**
- **Background Traffic**
- **Evacuation Traffic**
- **Dynamic Traffic Assignment**

2. Clearance Times

Based on the analysis, the Clearance Times for the Base Planning Scenario and Operational Scenarios for 2010 and 2015 are provided below.

- **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.

- **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.

- **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.

- **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 the point in time when the evacuation order is given to the point in time when the last vehicle assigned an external destination exits the region.

Table ES-11
2010 Clearance Times 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
Clearance Time to Shelter					
Baker County	12.0	13.0	13.0	12.0	12.0
Clay County	13.5	14.0	16.0	16.5	23.0
Duval County	14.5	17.5	21.5	33.0	36.0
Flagler County	12.5	12.5	12.5	12.5	13.0
Nassau County	13.0	15.0	18.5	24.0	28.0
Putnam County	13.5	15.0	16.5	18.0	18.0
St. Johns County	13.0	13.0	14.5	18.0	23.5
In-County Clearance Time					
Baker County	13.0	13.5	13.5	13.0	13.0
Clay County	14.0	15.0	20.0	27.5	34.0
Duval County	14.5	17.5	21.5	33.0	36.0
Flagler County	12.5	12.5	12.5	13.0	13.5
Nassau County	14.0	15.0	18.5	24.5	34.5
Putnam County	13.5	15.0	16.5	18.0	22.0
St. Johns County	13.5	13.5	14.5	24.0	28.0
Out of County Clearance Time					
Baker County	17.0	20.0	28.0	39.0	38.5
Clay County	14.5	18.0	22.5	34.0	37.0
Duval County	15.0	18.5	23.0	33.5	37.5
Flagler County	14.0	14.0	14.5	24.0	28.0
Nassau County	16.5	19.0	28.0	34.0	40.0
Putnam County	14.0	15.5	20.0	28.0	35.0
St. Johns County	13.5	14.0	14.5	24.0	28.0
Regional Clearance Time					
Northeast Florida	17.0	20.0	28.0	39.0	40.0

Table ES-12
2015 Clearance Times 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
Clearance Time to Shelter					
Baker County	12.5	12.0	12.5	12.0	22.5
Clay County	13.0	14.0	17.5	29.5	46.0
Duval County	13.5	18.0	24.0	35.0	46.0
Flagler County	12.5	12.5	12.5	12.5	17.0
Nassau County	14.5	16.5	23.5	29.5	32.5
Putnam County	13.5	16.5	18.5	18.0	23.0
St. Johns County	13.0	13.0	15.0	15.5	32.5
In-County Clearance Time					
Baker County	13.0	13.0	13.5	13.0	23.5
Clay County	13.5	17.0	19.0	35.0	47.0
Duval County	14.5	18.0	24.0	35.0	46.0
Flagler County	12.5	12.5	12.5	13.0	17.0
Nassau County	14.5	16.5	24.0	38.0	43.0
Putnam County	13.5	16.5	18.5	23.5	37.0
St. Johns County	13.5	14.0	15.5	28.0	35.0
Out of County Clearance Time					
Baker County	22.5	22.5	29.5	43.5	48.0
Clay County	18.0	17.5	22.5	42.5	47.5
Duval County	19.5	20.5	28.0	43.0	47.5
Flagler County	14.0	14.5	16.0	28.5	34.5
Nassau County	19.5	21.0	29.0	40.0	48.5
Putnam County	14.5	17.0	20.5	32.0	45.0
St. Johns County	14.0	14.0	18.0	28.0	35.0
Regional Clearance Time					
Northeast Florida	22.5	22.5	29.5	43.5	48.5

Table ES-13
2010 Clearance Times for Operational Scenarios

	Evacuation Level A Scenario 1	Evacuation Level B Scenario 2	Evacuation Level C Scenario 3	Evacuation Level C Scenario 4	Evacuation Level D Scenario 5	Evacuation Level E Scenario 6
Clearance Time to Shelter						
Baker County	12.0	12.0	15.0	12.0	12.0	12.5
Clay County	12.5	13.5	14.0	14.0	16.0	19.0
Duval County	12.5	12.5	13.5	20.5	21.0	24.5
Flagler County	12.5	12.5	12.5	12.5	12.5	12.5
Nassau County	12.5	13.0	18.0	20.0	23.0	21.5
Putnam County	12.5	13.0	14.0	14.5	17.0	17.0
St. Johns County	13.0	13.0	13.0	13.0	13.5	14.5
In-County Clearance Time						
Baker County	13.0	13.0	16.0	13.0	13.0	13.5
Clay County	13.0	13.5	14.0	14.0	20.0	22.0
Duval County	14.5	14.0	14.5	20.5	21.0	24.5
Flagler County	12.5	12.5	12.5	12.5	13.0	13.0
Nassau County	14.5	14.5	18.0	20.0	23.0	23.5
Putnam County	12.5	13.5	14.0	14.5	17.0	17.0
St. Johns County	13.0	13.5	14.0	13.5	14.0	15.0
Out of County Clearance Time						
Baker County	16.0	16.5	20.0	24.0	34.5	29.5
Clay County	13.5	14.5	14.5	20.0	29.0	27.0
Duval County	14.5	14.5	18.5	22.5	29.5	27.0
Flagler County	14.0	14.0	14.0	14.0	14.0	15.5
Nassau County	14.5	17.0	23.0	22.5	29.5	33.0
Putnam County	14.0	14.0	14.5	15.0	19.0	22.0
St. Johns County	13.5	13.5	14.0	13.5	17.5	15.0
Regional Clearance Time						
Northeast Florida	16.5	17.0	23.0	24.0	34.5	33.0

Table ES-14
2015 Clearance Times for Operational Scenarios

	Evacuation Level A Scenario 7	Evacuation Level B Scenario 8	Evacuation Level C Scenario 9	Evacuation Level D Scenario 10	Evacuation Level E Scenario 11
Clearance Time to Shelter					
Baker County	12.0	12.0	15.5	12.0	12.5
Clay County	12.5	13.0	14.0	18.5	36.0
Duval County	12.5	13.0	16.0	25.0	45.5
Flagler County	12.5	12.5	12.5	12.5	15.0
Nassau County	13.0	13.5	16.0	26.0	45.0
Putnam County	13.0	13.0	14.5	17.0	20.5
St. Johns County	13.0	13.0	13.0	13.5	16.0
In-County Clearance Time					
Baker County	13.0	13.0	16.5	13.0	13.0
Clay County	13.0	13.5	14.0	22.5	45.0
Duval County	14.5	14.5	16.0	25.0	45.5
Flagler County	12.5	13.0	12.5	13.0	15.0
Nassau County	14.5	14.5	16.0	26.0	45.0
Putnam County	13.0	13.5	14.5	17.0	20.5
St. Johns County	13.5	13.5	13.5	16.0	20.0
Out of County Clearance Time					
Baker County	15.5	17.5	19.5	36.0	47.5
Clay County	14.0	14.5	16.0	26.0	47.0
Duval County	14.5	16.0	17.0	26.0	47.0
Flagler County	14.0	14.0	14.0	14.5	18.0
Nassau County	15.5	16.5	22.0	33.5	47.0
Putnam County	14.0	14.5	15.0	23.0	46.0
St. Johns County	13.5	13.5	13.5	17.0	20.0
Regional Clearance Time					
Northeast Florida	16.0	18.0	22.0	36.0	47.5

3. 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.

It is anticipated that the regional planning council and local governments will be able to use the TIME User Interface to simulate additional scenarios varying behavioral assumptions, reflecting proposed growth in coastal areas, new transportation improvements, etc.

F. GLOSSARY

The Glossary at the back of the Technical Data Report contains the definitions of the terms used throughout the document. In many cases, it represents the legal consensus of the definition of terms in statute pertaining to growth management. The Statewide Regional Evacuation Study Program represents a consistent and coordinated approach to provide tools for both the emergency management as well as the planning community in the State of Florida.

G. CONCLUSIONS AND RECOMMENDATIONS

Obviously, the implementation of a successful hurricane evacuation in the Northeast Florida Region will be complex and challenging. It will require a team effort - not just on the part of the emergency management and response personnel - but of the entire community.

The update of the *Northeast Florida Regional Hurricane Evacuation Study* illustrates that there have been improvements in hurricane evacuation planning including increased public shelter capacity, assistance for the transit dependent, alternatives for evacuees with pets, special needs shelters, route improvements and growth management mitigation strategies helping to reduce the population-at-risk. However, there remain serious challenges in this region if we are to avoid the loss of life and property and human suffering witnessed in the 2005 hurricane season in Mississippi, Louisiana and Texas.

The State of Florida, County Emergency Management agencies, the American Red Cross and many other agencies have worked together to prepare regionally for a disaster – not just the inevitable strike of a hurricane but the impacts of flooding, hazardous material incidents and terrorist attack.

Recent events have tragically demonstrated the power of nature and the horrific results if government and citizens fail to respond appropriately. As public servants and elected officials, it is imperative to address the concerns of our citizens and leaders regarding our ability to manage a major disaster.

1. Public Education

Our citizens' knowledge and understanding of personal risk and appropriate evacuation response remains a serious challenge. The behavioral surveys indicated that many residents – even those in the most surge-vulnerable areas and mobile homes – believe their home would be safe in a major hurricane, do not have a family disaster plan, and many will not evacuate regardless of the intensity of the storm or government actions. This fact means that those who choose to stay behind in mobile homes and areas vulnerable to storm surge and velocity wave action might not survive a storm.

Throughout the region, county emergency management officials prepare various educational materials and opportunities to reach out to the public concerning hurricane preparedness and evacuations. Many of these outreach initiatives include local (printed) information, web sites, citizen information lines, public speaking engagements, and information relayed in schools, newspapers, the broadcast media and neighborhood associations throughout the season.

In order to elicit an immediate evacuation response, the population-at-risk must be clearly and conclusively convinced that (1) they are indeed residing in a vulnerable area and (2) that a decision not to leave could well mean their loss of life or injury. Post-hurricane studies have shown that the most vital piece of information is the information received from the emergency management personnel and local officials. For the most part, people will respond based upon the urgency and seriousness of the threat as conveyed by the emergency response personnel (HMG, 1999 and 2006).

Three key messages have been identified:

- Know your risk (evacuation zone/ mobile homes)
- Make a family plan.
- Obtain emergency supplies for at least 3-5 days.

The accurate formulation and comprehensive dissemination of these critical pieces of information to the public in a simple and understandable form is essential for implementation of an effective hurricane evacuation plan.

Irrational emergency decision-making on the part of the population can be decreased if they determine their vulnerability to a hurricane before the emergency occurs. Residents in the Northeast Florida region are encouraged to become familiar with the county plans for evacuation and to make their "family plans" and business plans ahead of time. The State of Florida has partnered with the Florida Broadcasting Association to encourage the “culture of preparedness”, including PSAs and billboards. Partnering at the local level is also needed.

Additional notification procedures (of evacuation level) is implemented and repeated throughout the season. The local governments in the region do have programs which provide these services to their residents so it is unclear why so many residents do not know their evacuation level or understand their risk. Some programs throughout the state and region include, but are not limited to:

- Notification on utility bills (zone designation)
- Notification on tax bills (zone designation)
- Special mailings and deliveries
- Interactive Web sites (zone look up)
- Citizen Information lines (zone look up)

Perhaps the answer lies in a continued strengthen initiative to partner with all levels of government, the private sector, civic and business associations and non-profit/volunteer agencies and the media to "get the word out" about preparedness and mitigation. Businesses have been increasingly active in developing continuity plans and providing information to their employees. Churches and civic associations, neighborhood associations, crime watch and Community Emergency Response Teams (CERT) can provide direct contact and face-to-face communication.

2. Special Needs

Providing shelter for residents with special needs is a critical issue. Partners including the Dept. of Health, home health agencies, hospitals and skilled nursing facilities, to name just a few, must work with local agencies to (1) register and determine the appropriate level of care and appropriate shelter alternative for each resident and (2) provide the facility, staff, equipment and supplies and transportation assistance in an effective manner in a disaster situation.

Again, we need to develop strong partnerships with those entities in the community that work with our citizens with special needs on a daily basis to ensure that they receive the information and support they need before, during and after a disaster.

3. Mitigation Message

As identified, the results of the ***Statewide Regional Evacuation Study for the Northeast Florida Region*** highlight the challenges of the emergency management community. If people do not respond correctly when an evacuation order is given, there will be serious implications on the entire emergency response. For example, if residents who live in low-lying surge vulnerable areas or mobile homes do not evacuate, they are putting their safety at risk. Conversely, if residents who live in site-built homes outside the surge-vulnerable areas try to evacuate in significant numbers, the resulting traffic congestion may prevent anyone from reaching safety.

The answer is comprehensive consistent public education which focuses on encouraging our residents to do the following (1) know their risk, and (2) plan ahead. Again, key messages include:

- Individual Responsibility – Be disaster resilient. Know your risk, plan ahead and obtain needed supplies.
- Encourage residents to *"Flee from Flood; Hide from Wind".* Obviously, coastal residents in surge vulnerable areas and mobile home residents must evacuate; however, the key message is to seek refuge within "tens of miles, not hundreds of miles."
- Strongly encourage all residents who live in site-built homes outside the surge vulnerable areas to call and invite friends or relatives who must evacuate to come and stay with them if there is a hurricane threat. Once they have committed by inviting their friends or relatives, we will also encourage residents to prepare their homes and mitigate for the potential winds, i.e. window and door protection, braced gable end roofs, and garage doors.
- It is assumed if inland residents take action to protect their homes from wind, they will be less likely to try to "outrun" a hurricane.

4. The Coastal High Hazard Area (CHHA)

In 2006, the Florida Legislature passed a bill changing the definition of the Coastal High Hazard Area (CHHA) from the evacuation zone to the "area defined by the SLOSH model to be inundated from a category one hurricane." This change was welcomed as the definition was more defensible, tying the land use regulations to a scientific model rather than the zone delineated by roadways and familiar landmarks. However, the limitations of the model must be recognized by the local governments now responsible for its regulation.

As discussed, the SLOSH model does not address wave height and other local processes. It also does not incorporate the danger of isolation in areas surrounded by storm surge with limited access, such as barrier islands. These two issues are of serious concern and it is recommended that local governments address them within their comprehensive plans and land development regulations.

H. USE OF SRES DATA IN GROWTH MANAGEMENT

While this study is primarily designed for the local emergency management agencies to utilize in the preparation of emergency response, evacuation, sheltering and mitigation plans, Chapter 163.3178 of the Florida Statutes directs growth management planners to this study to identify exceedances when determining the impacts of growth on the safety of the public. Therefore, this study is also designed with many features to address growth management issues. Key items included are Coastal High Hazard Areas (CHHA), clearance times, shelter capacity, and tools for determining impacts of growth.

1. Storm Tide Limits and the Coastal High Hazard Area

The Statewide Regional Evacuation Study (SRES) contains data which is directly referenced in growth management legislation in the State of Florida and coastal/conservation elements of the Local Government Comprehensive Plans. The Storm Tide Atlas (Volume 7) and the storm tide limits it portrays for each county define the Coastal High Hazard Area (CHHA)[3]. Section 163.3178(9)(c), Florida Statutes requires local governments to amend their future land use map and coastal management element to include the new definition of the Coastal High Hazard Area and to depict the CHHA on the County's Future Land Use Map.

As indicated in the Hazards Analysis chapter (Volume 1: Technical Data Report, Chapter II), the ultimate amount of storm surge at any given coastal location is determined by a number of factors. It has been demonstrated that storm parameters including the wind speed and profiles, angle of approach, size of radii of maximum winds and the forward speed of the system will have a complex and inter-related affect on the amount of surge at a particular site. For example, Hurricane Ike, which struck the Galveston, Texas area in 2008, was classified as a Category 2 hurricane on the Saffir Simpson Hurricane Wind Scale yet it produced a 24 – 26 foot storm surge (often associated with a Category 5 Hurricane) due to its large wind field (radius of maximum winds) and angle of approach.

2. Storm Tide Limits and Evacuation Zones

Emergency management officials use many factors in determining County Evacuation Zones, with storm tide limits being a major component. However, it is important to note that storm tide boundaries are not the only data used in this determination. Local officials use their knowledge of the area and other data such as areas of repetitive loss, surge depth, freshwater flooding, isolation issues, and debris hazards, and typically choose known landmarks to identify boundaries for public warning and information.

[3] Section 163.3178(2) (h), F.S. "the area below the elevation of the Category 1 storm surge line as established by a Sea, Lake and Overland Surge from Hurricanes (SLOSH) computerized storm surge model."

As a result, the evacuation zones largely correspond to the storm tide limits of the Category 1 – 5 hurricanes on the Saffir-Simpson Wind Scale. However, the degree to which any specific zone corresponds to storm tide limits is directly related to the other data factors utilized in the final determination of County Evacuation Zones by local officials. These factors may lead local officials to consolidate zones, add additional zones, expand or contract zones to ensure those threatened by the hazards are appropriately included.

The 2010 SRES introduces alphabetic Evacuation Zones/Levels (A-E) across the State for the first time. A map (**Figure IV-2**) of these zones is located in Chapter IV: Regional Population and Vulnerability Analysis of Volume 1. For purposes of growth management planning, the reference to areas to be evacuated from a Category 1 hurricane should use Evacuation Zone/Level A, reference to evacuation areas to be evacuated in advance of a Category 2 hurricane should use Evacuation Zone/Level B, and reference to areas to be evacuated from a Category 3 hurricane should use Evacuation Zone/Level C. Similarly, in policies which refer to evacuation areas from a Category 4 or 5 hurricanes, Evacuation Zones/Levels D or E should be used respectively. Where there are consolidated zones or evacuation levels please refer to the detailed reference information (Chapter IV).

3. Transportation

Two types of scenarios (Base and Operational) were defined in the Evacuation Transportation Analysis (Volume 4) for use in the Regional Evacuation Model to derive the evacuating population, evacuation vehicles, clearance times and critical congested roadways. Most pertinent to Growth Management are the base scenarios, which were developed to estimate a worst case scenario in which 100% of the vulnerable population (those found in evacuation zones) evacuates plus the addition of shadow evacuation. The standard assumptions utilized as the baseline were identified by the Division of Community Planning (DCP) as best suited for use in Growth Management analysis. The base scenarios (**Table VI-9**, Chapter VI: Evacuation Transportation Analysis Summary in Volume One) are provided to supply the anticipated time needed to evacuate <u>all</u> vulnerable populations (clearance times are found in **Tables VI-11** and **VI-12**, Chapter VI: Evacuation Transportation Analysis Summary in Volume One).The base scenarios also supply the baseline data for planning purposes (maximum evacuation population found in **Tables VI-15** and **VI-16**, Chapter VI: Evacuation Transportation Analysis Summary in Volume One). This allows for the evaluation of growth management strategies and provides a consistent statewide measure for clearance time calculations.

The ability to alter scenarios is also available, allowing a planner to increase or decrease population, roadway capacities, shelter availability and more; then measure the variations to determine impacts of population, land use or

infrastructure changes. The Transportation Interface for Modeling Evacuations (TIME) is the tool developed to allow users to run further scenarios. Built on the Cube Voyager and Cube Avenue software, this interface is a user- friendly interface which provides the ability to run variations on the transportation scenario, without being transportation planners. If needed, a transportation planner familiar with the model's underlying software can provide a more complex analysis.

4. Definitions

In addition to the data provided, the SRES also defines terms (Volume One: Technical Data Report, Glossary) that are referenced in Florida legislation including various Evacuation Clearance Times (Clearance Time to Shelter, In-County Clearance Time, Out-of-County Clearance Time and Regional Clearance Time). These Clearance Time definitions better clarify the criterion in determining the compliance of Comprehensive Plan Amendments with State coastal high hazard provisions as prescribed in Section 163.3178(9), Florida Statutes. Using the uniform assumptions from the Base Scenarios, the SRES supplies the information to provide a consistent statewide methodology to assess current conditions as well as quantify impacts that may need to be mitigated.

5. Sheltering

As indicated in the Hurricane Preparedness Policy Rule (Rule 9J-2.0256 (4), F.A.C.), shelter space surplus and deficits are utilized to determine impacts of Developments of Regional Impacts (DRI). Chapter 5: Regional Shelter Analysis of Volume One provides general information on sheltering (general population, special needs and pet friendly), listings of all county shelters and their capacity as well as specific public shelter demand (**Table V-9** through **V-12**). Shelter surplus and deficits are outlined in these tables as well.

Important to note: shelters listed in the study are divided in two categories, 'primary' and 'other' shelters. Primary shelters are ARC 4496 compatible and may meet other requirements as well (Enhanced Hurricane Protection Areas). It is these primary shelters upon which the assessment of a County's shelter deficit is based. Each study may list 'other shelter resources' that are within each County, but these shelters may or may not be utilized during an event.

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