

ANNEX C TO HURRICANE PLAN
EVACUATION ZONES AND CLEARANCE TIMING

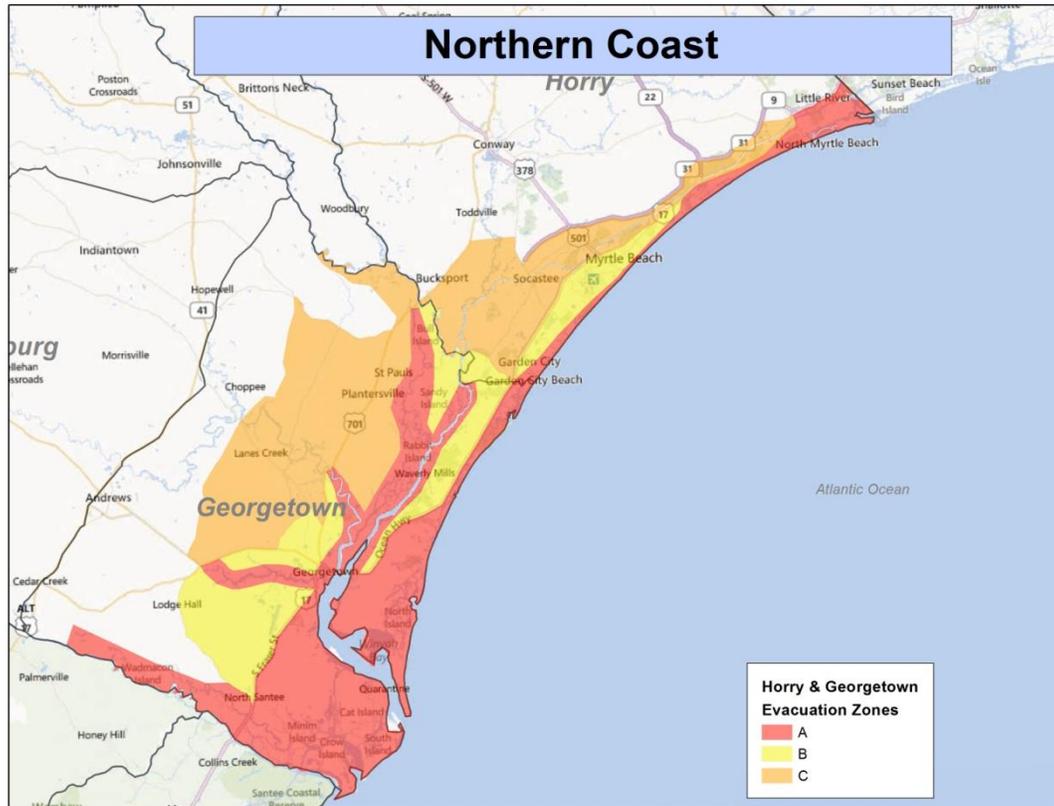
I. INTRODUCTION

- A. The State of South Carolina conducted a transportation analysis as part of the Hurricane Evacuation Study (HES) to assist in:
- Determining the time required to evacuate the threatened population (clearance times) under a variety of hurricane situations.
 - Evaluating traffic control measures that could improve the flow of evacuating traffic.
- B. The State used computer modeling techniques developed to simulate hurricane evacuation traffic patterns to conduct this analysis.
- C. The behavioral studies included work to estimate what portion of the evacuees would go to other inland Counties or seek safe haven in other States.

II. EVACUATION ZONES

- A. Evacuation zones are those areas that need to be evacuated to protect residents at risk from flooding or high winds. The parameters for the zones are:
1. Easily describable to the public over radio and television.
 2. Based upon easily identifiable roadway or natural features for boundary identification.
 3. Relate to storm surge limits based on the most recent SLOSH model.
 4. Be useable to enable coastal residents to determine if their home is in an evacuation area.
 5. Be useable for transportation modeling/clearance time calculations.
 6. Be related to census/traffic analysis zone boundaries for population and dwelling unit tabulations and calculations of vulnerable populations.

B. Northern Conglomerate Evacuation Zones

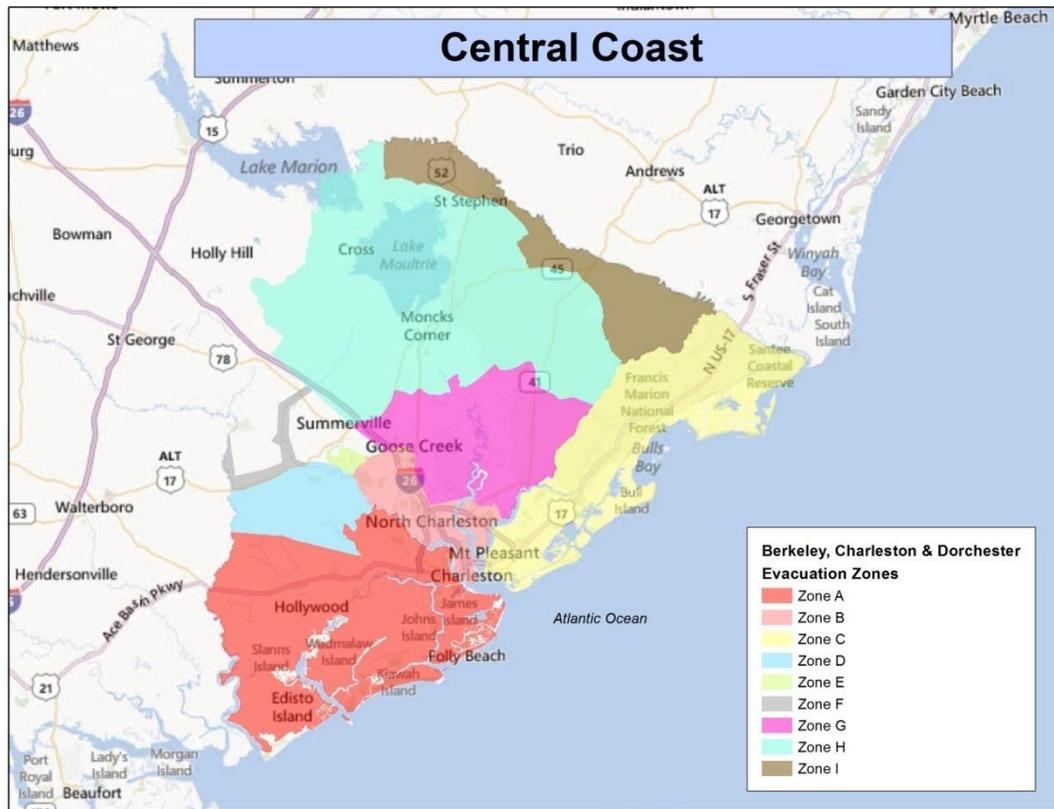


1. Horry County Evacuation Zones

- a. Scenario A (Cat 1-2) - All areas east of U.S. Business 17 (Kings Hwy), up to intersection with U.S. 17 (Kings Hwy) and then all areas east of US 17 (Kings Hwy) to the northern county line.
- b. Scenario B (Cat 3) - All areas south of Hwy 707 and Longwood Drive, including all areas in Longwood Plantation (Blackmoor) to the Waccamaw River and all areas east of U.S. 17 Bypass (Mark Garner Hwy) to U.S. 17 (North Kings Hwy) and all areas east of U.S. 17 (North Kings Hwy) to the northern county line.
- c. Scenario C (Cat 4-5) - All areas between Hwy 701 and Hwy 544, south of Brown's Chapel Avenue and Hwy 814, plus all areas east of Highway 31 (Carolina Bays Parkway) to Highway 90 and all areas east of Highway 90 to U.S. 17 to the northern county line.
- d. This also includes all flood prone areas along the Waccamaw River and the Great and Little Pee Dee Rivers, as well as all mobile home residents within Horry County.

2. Georgetown County Evacuation Zones
 - a. Scenario A (Cat 1-2) - Areas East of Highway 17 to the Atlantic Ocean from the South Santee River and North to the Horry County line, including Sandy Island; areas East of Dawhoo Lake and South of Walker Road and Powell Road to the South Santee River; all low-lying areas along the Waccamaw River, Great Pee Dee River, Black River, and Sampit River South of Highway 521 (17A), including Maryville; and all mobile home residents in the County.
 - b. Scenario B (Cat 3) - Areas East of Dawhoo Lake and South of Walker Road to Powell Road to the South Santee River; all areas on the Atlantic Ocean side of Powell Road to Alt. US 17 to Highway 521 to Brick Chimney Road to State Highway 51 to Black River Road ending at the Black River; all low-lying areas along the Waccamaw River, Great Pee Dee River, and Black River, and all areas east of them to the coast; and all mobile home residents in the County.
 - c. Scenario C (Cat 4-5) - Areas East of Dawhoo Lake and South of Walker Road to Powell Road to the South Santee River; all areas on the Atlantic Ocean side of Powell Road to Alt. US 17 to Highway 521 to Sawmill Road to Indian Hut Road to Carvers Bay Road (State Highway S-22-4) to Plantation Hill Road (State Highway 261) to Old Pee Dee Road to the northern county line; and all mobile home residents in the County.

C. Central Conglomerate Evacuation Zones



1. Berkeley County Evacuation Areas

a. Zone G

(1) Hanahan

- North of Woods Avenue from end of road at east edge of rail yard to its intersection with Remount Road
- North of Remount Road from its intersection with Woods Ave to its intersection with the railroad tracks just west of Dutton Avenue
- East of the railroad tracks from their intersection with Remount Road to crossing over the Goose Creek (just south of Middle Earth Nursery and Infinger Furniture)

(2) Goose Creek/Ladson/Summerville

- Including all homes and businesses northeast of the intersection of Hwy 52 and Camelot Drive, continuing along Ryan Drive and Holly Avenue across to

Westview Blvd (includes buildings on both sides of Camelot Drive, Ryan Drive and Holly Avenue)

- Crowfield Plantation from Westview Blvd near Holly Avenue across I-26 along Ancrum Road to its intersection with Hwy 78
- Northeast of Hwy 78 from its intersection with Ancrum Road (Ladson Road) to its intersection with Hwy 17A (Main St) in Summerville
- Southeast of Hwy 17A (Main Street/S Live Oak Drive) from its intersection with Hwy 78 to its intersection with Cypress Gardens Road

(3) Whitesville/Pimlico/Cordesville

- South of Cypress Gardens Road from its intersection with Hwy 17A (S Live Oak Drive) to its intersection with Pimlico Blvd
- South of Pimlico Blvd from its intersection with Cypress Gardens Road through to its end
- The area east of Wappaolah Plantation and west of the Cooper River, north of Pimlico Blvd and south of Mepkin Abbey
- Southeast of the railroad tracks from the Cooper River by Pimlico to its intersection with Hwy 402

(4) Huger/Cainhoy/Wando

- South of Hwy 402 from its intersection with the railroad tracks near Cordesville to its intersection with Hwy 41 (Hwy 402 becomes Steed Creek Road)
- Southwest of Steed Creek Road from its intersection with Hwy 41 to its intersection with Halfway Creek Road
- West of Halfway Creek Road from its intersection with Steed Creek Rd to its intersection with Guerins Bridge Road
- West of Guerins Bridge Road from its intersection with Halfway Creek Road to its intersection with Wando River (just after Drew Lane)
- Northwest of the Wando River from its intersection with Guerins Bridge Road to its intersection with

Nowell Creek, with the addition of Patterson's Academy

- North/northeast of Nowell Creek from its intersection with the Wando River to its intersection with Rebellion Farms Place
- Northeast of Rebellion Farms Place from its intersection with Nowell Creek to its intersection of Clements Ferry Road
- Northeast of Yellow House Place from its intersection with Clements Ferry Road to the Cooper River (across from the Goose Creek)

b. Zone H

(1) Huger, Cordesville, Pimlico

- Northeast of Steed Creek Road from its intersection with Halfway Creek Road and its intersection with Hwy 41.
- North of Hwy 402 from its intersection with Hwy 41 (Steed Creek Rd becomes Hwy 402) and its intersection with the railroad tracks near Cordesville.
- Northwest of the railroad tracks from its intersection with Hwy 402 to its intersection with the Cooper River.
- North of Pimlico Blvd from its beginning near the Cooper River to its intersection with Cypress Gardens Road with the following exception: the area east of Wappaolah Plantation and west of the Cooper River, north of Pimlico Blvd and south of Mepkin Abbey is in ZONE G

(2) Whitesville, Summerville

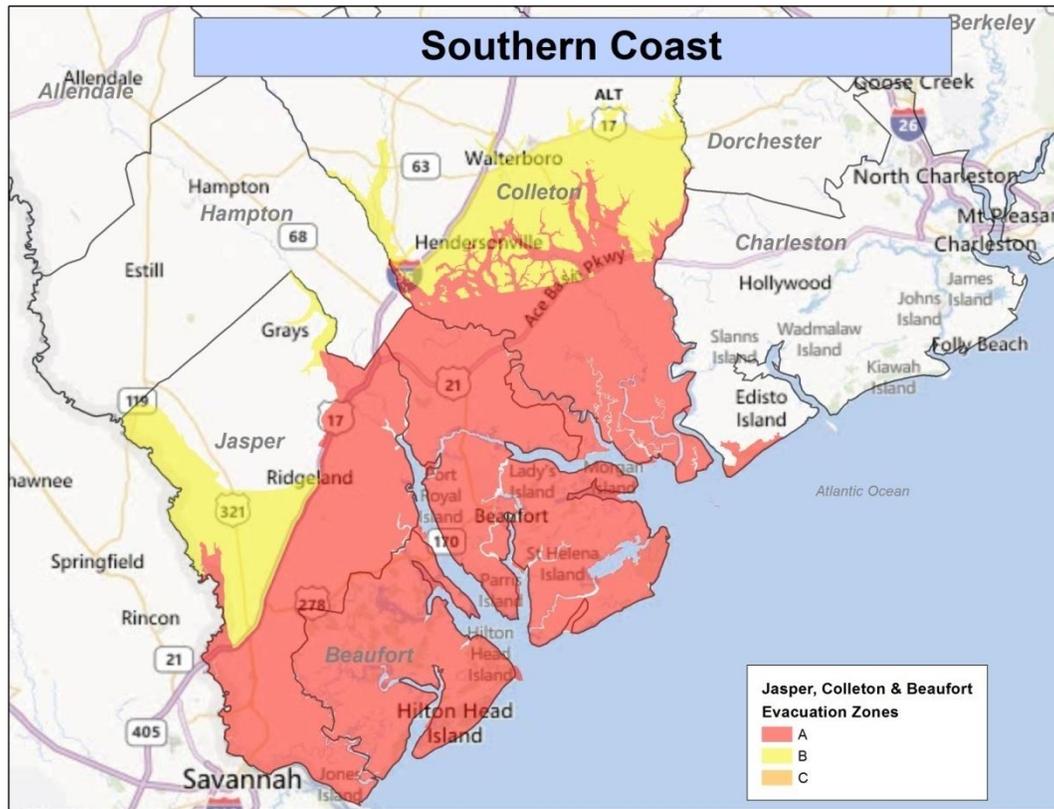
- North of Cypress Gardens Road from its intersection with Pimlico Blvd to its intersection with Hwy 17A (S Live Oak Drive)
- Northwest of Hwy 17A (S Live Oak Drive/Main Street) from its intersection with Cypress Gardens Road to the edge of the County

- (3) Summerville, Lebanon, Pringletown
 - Northeast of the Berkeley-Dorchester county line from Hwy 17A (Main Street) in Summerville to the western county line
- (4) Pringletown, Sandridge, Cross, Eadytown
 - East of the Berkeley-Dorchester county line and Berkeley-Orangeburg county line from Pringletown to Lake Marion
 - Southeast of the Santee River from Lake Marion to Belle Isle Road
 - West of Belle Isle Road from the Santee River to its intersection with Hwy 45
- (5) Pineville, Russellville, St Stephen, Alvin, Jamestown, Shulerville
 - Southwest of Hwy 45 from its intersection with Belle Isle Road to its intersection with Schurlknight Road
 - North of Schurlknight Road from its intersection with Hwy 45 to its intersection with Peaceful Woods Road
 - West of Peaceful Woods Road (becomes Greenwood Drive) from its intersection with Schurlknight Road to its intersection with Hwy 17A
 - South of Hwy 17A from its intersection with Greenwood Drive to its intersection with Tiger Corner Road
 - Southwest of Tiger Corner Road from its intersection with Hwy 17A to its intersection with Horse Island Road
 - West of Horse Island Road from its intersection with Tiger Corner Road to its intersection with Yellow Jacket Road
 - South of Yellow Jacket Road from its intersection with Horse Island Road to its intersection with Slash Road
 - West of Slash Road from its intersection with Yellow Jacket Road to its intersection with Halfway Creek Road

- Northwest of Halfway Creek Road from its intersection with Slash Road to its intersection with Steed Creek Road
- c. Zone I - Shulerville, Honey Hill, Jamestown, Alvin, St Stephen
- East of Halfway Creek Road from its intersection with Forest Road 200 (on the Berkeley-Charleston county line) to its intersection with Slash Road.
 - East of Slash Road from its intersection with Halfway Creek Road to its intersection with Yellow Jacket Road.
 - North of Yellow Jacket Road from its intersection with Slash Road to its intersection with Horse Island Road.
- d. In all cases, residents living in low-lying areas along rivers, streams, and creeks, and all manufactured housing should evacuate when announced.
1. Dorchester County Evacuation Areas
- a. Scenario A (Cat 1-2)
- (1) Zone B - Central Charleston - From the tip of the Peninsula to Ladson Road; from the Ashley River to the Wando River. This includes the cities of Charleston, North Charleston, Lincolnville, and Daniel Island. Also Thomas Island and unincorporated areas of Dorchester County.
- b. Scenario B (Cat 3)
- (1) Zone D - Sand Hills Area - West of the Ashley River, 17A to the Colleton County line and all areas bordering Charleston County.
- (2) Zone E - Miles Jamison/Oakbrook Area - Miles Jamison Road, between Ladson Road, to Bacons Bridge Road. Includes the Lakes of Summerville, Newington Plantation, Crestwood Subdivision south to Orangeburg Road, and South Main Mobile Home Park.
- (3) Zone F - The Swamp - Any other low-lying areas including the Cypress Swamp area, the Edisto River area and the Twin Lakes Subdivision.

- c. In all cases, residents living in low-lying areas along rivers, streams, and creeks, and all manufactured housing should evacuate when announced.
2. Charleston County Evacuation Areas (all zones are in Scenario A - Cat 1-2)
- a. Zone A - West of the Ashley River - Unincorporated areas of Charleston County from the Ashley River to the Colleton County line; Atlantic Ocean to the Dorchester County line. This includes the towns of Hollywood, Meggett, Ravenel, Folly Beach, Rockville, Kiawah Island, and Seabrook Island, Johns Island, Wadmalaw and unincorporated Charleston County.
 - b. Zone B - Central Charleston - From the tip of the Peninsula to Ladson Road; from the Ashley River to the Wando River. This includes the cities of Charleston, North Charleston, Lincolnville, and Daniel Island. Also Thomas Island and unincorporated Charleston County.
 - c. Zone C - East of the Wando River - Unincorporated areas of Charleston County from the Atlantic Ocean to the Berkeley County line; Wando River to the Georgetown County line. This includes the towns of Mt. Pleasant, Isle of Palms, Sullivan's Island, Awendaw and McClellanville. Also Dewees Island, Capers Island and Goat Island.
 - d. In all cases, residents living in low-lying areas along rivers, streams, and creeks, and all manufactured housing should evacuate when announced.

D. Southern Conglomerate Evacuation Zones



1. Colleton County Evacuation Zones
 - a. Scenario A (Cat 1-2) - All areas south of the CSX Railroad, and all mobile homes and other floodplain areas in the County.
 - b. Scenario B (Cat 3-5) - All areas east of I-95 from the southern county line to Walterboro and all areas south of Alt. US17 from Walterboro to the northern county line plus all mobile homes and other floodplain areas in the County.
2. Beaufort County Evacuation Zones
 - Scenario A-B (Cat 1-5) - All residents and tourists are to evacuate.
3. Jasper County Evacuation Zones
 - a. Scenario A (Cat 1-2) - All areas east of I-95 and all mobile homes and other floodplain areas in the county.
 - b. Scenario B (Cat 3-5) - All areas east of I-95 and all areas south of Sand Hills Road (Hwy 119) and Tillman Road (Hwy 336), plus all mobile homes and other floodplain areas in the county.

III. CLEARANCE TIME MODELING ZONES FOR TRANSPORTATION ANALYSIS

- A. Coastal counties have several clearance time modeling zones based on the hurricane surge flooding. This information is a key element of the transportation analysis.
- B. Due to the error in forecasting the strength of hurricanes, consideration will be given to evacuating for one (1) category higher storm than predicted.
- C. The following table shows the clearance time modeling zones and the hurricane categories for each county.
- D. Two (2) of the Northern Conglomerate counties have clearance time modeling zones based on the hurricane surge flooding.

Northern Conglomerate Clearance Time Modeling Zones	
County	Clearance Time Modeling Zones
Georgetown	Evacuation Zone Cat. 1-2 Evacuation Zone Cat. 3 Evacuation Zone Cat. 4-5
Horry	Evacuation Zone Cat. 1-2 Evacuation Zone Cat. 3-4 Evacuation Zone Cat. 5

- E. Three (3) of the Central Conglomerate counties have clearance time modeling zones based on the hurricane surge flooding.

Central Conglomerate Clearance Time Modeling Zones	
County	Clearance Time Modeling Zones
Charleston	Evacuation Zone Cat 1 Evacuation Zone Cat 2 Evacuation Zone Cat 3 Evacuation Zone Cat 4-5
Dorchester	Evacuation Zone Cat 1-3 Evacuation Zone Cat 4-5
Berkeley	Evacuation Zone Cat 1-3 Evacuation Zone Cat 4-5

- F. Three (3) of the Southern Conglomerate counties have clearance time modeling zones based on the hurricane surge flooding.

Southern Conglomerate Clearance Time Modeling Zones	
County	Clearance Time Modeling Zones
Jasper	Evacuation Zone Cat 1-2 Evacuation Zone Cat 3-5
Beaufort	Evacuation Zone Cat 1 Evacuation Zone Cat 2 Evacuation Zone Cat 3-5
Colleton	Evacuation Zone Cat 1 Evacuation Zone Cat 2-5

IV. EVACUATION PLANNING

- A. The South Carolina Department of Public Safety (SCDPS) maintains detailed Incident Action Plans (IAP) which detail the specific plans, resource and manning requirements, and command and control structure to execute the hurricane evacuation plans.
- B. SCDPS conducts annual coordination, update, and exercise of the plans/IAPs with participant counties, municipalities, SC National Guard and state agency participants.

V. EVACUATION CLEARANCE TIMES

A. General.

1. Clearance times and arrival of sustained tropical storm winds are the two major considerations involved in issuing an evacuation order or advisory. The clearance times were developed by storm scenario and by behavioral characteristics for each Conglomerate.
2. Clearance time begins when the first evacuating vehicle enters the road network and ends when the last evacuating vehicle reaches an assumed point of safety.
3. Clearance time includes the time required by evacuees to enter the road network (referred to as mobilization time) and the time spent by evacuees traveling along the road network due to traffic congestion (referred to as queuing delay time).
4. Clearance time does not relate to the time any one vehicle spends traveling on the road network and does not include time needed for local officials to assemble and make a decision.
5. Clearance times generally fall below 24 hours for most of the scenarios. However, due to the limited road network and large numbers of tourists and permanent residents who would have to evacuate, times could potentially exceed 40 hours for a Category 4-5 hurricane, high tourist occupancy scenario.

B. The HES calculated clearance times for normal and reverse flow.

1. While the I-26 Reversal Plan is anticipated to significantly reduce conglomerate clearance times, the reverse flow plans for US 278, US 501, and US 17 may not produce the desired conglomerate time reductions due to controlling traffic bottlenecks.
2. The bottleneck in the Southern Conglomerate is the merge intersection of US 278 and SC 68 in Hampton County. The US 278 reverse flow road segment is upstream of this bottleneck and will not influence the clearance time. However, it may reduce clearance times for the US 278 road segment, thus enabling traffic to more quickly exit Hilton Head Island.
3. The controlling bottleneck in the Northern Conglomerate is US 501 between US 17 Bypass and Conway.

C. The clearance time calculated for each scenario (category of storm) was based on three criteria: evacuation zone participation rates, population response rate, and level of tourist occupancy.

1. Evacuation Zone Participation Rates.
 - a. Participation rates for by zones within a county for each scenario are part of the clearance time model.
 - b. Evacuated zones are assumed to have 100% participation rate. Even though these rates should be lower, the calculated clearance times allow for 100% evacuation.
 - c. All mobile home residents in conglomerate counties are assumed to evacuate.
 - d. The model assumes a portion of the non-vulnerable population will also evacuate. This percentage could be higher particularly for more intense hurricanes (1%-15%), but will be balanced out with the less-than-100% of surge threatened residents who will participate in an actual event.

2. Response Rate
 - a. A critical behavioral aspect considered for the transportation analysis was the speed/rate of evacuation response of the evacuating population.
 - b. Behavioral data from past hurricane evacuations shows that mobilization and actual departures of the evacuating population can occur over a period of many hours or over a very brief time.
 - c. During Hurricanes Bertha and Fran, evacuees were slow to evacuate. During Hurricane Floyd, evacuees were quick to evacuate.

3. Level Of Tourist Occupancy
 - a. Tourist population varies throughout the season. Clearance times are estimated for low and high tourist populations.
 - b. High tourist population calculations use 90% occupancy rates, and low tourist population calculations are based on 30% occupancy rates.

D. Evacuation Tables

1. General
 - a. The times displayed on the following charts for the Conglomerates are the result of the 2014 study and reflect 2010 census estimates.

- b. Several hundred clearance time runs were done based on differing intensities of hurricanes, evacuation area assumptions, rapidity of evacuees’ response, and differing tourist seasons.
- c. All times are expressed in hours.

2. Northern Conglomerate Hurricane Evacuation Clearance Times

Hurricane Category & Evacuation Response	Northern Normal Lane Use		Northern US 501 Reversed Lanes	
	Occupancy		Occupancy	
	Low	High	Low	High
Category 1-2 - Scenario A				
Rapid	12	25	8	14
Medium	13	26	9	15
Slow	15	28	11	17
Category 3 - Scenario B				
Rapid	17	32	11	18
Medium	18	33	12	19
Slow	20	35	14	21
Category 4-5 - Scenario C				
Rapid	25	40	19	26
Medium	26	41	20	27
Slow	28	43	22	29

Note: The US 501 reversal included time savings as a result of the SC 544 enhancement plan.

3. Central Conglomerate Hurricane Evacuation Clearance Times

Hurricane Category & Evacuation Response	Central Normal Lane Use		Central I-26 Reversed Lanes	
	Occupancy		Occupancy	
	Low	High	Low	High
Category 1-2 - Zones A & B				
Rapid	12.00	14.00	9.00	11.00
Medium	14.00	17.00	12.00	14.00
Slow	17.00	19.00	14.00	16.00
Category 1-2 - Zones B & C				
Rapid	10.00	13.00	8.00	10.00
Medium	13.00	16.00	11.00	13.00
Slow	15.00	18.00	13.00	15.00
Category 1-2 - Zones A, B & C				
Rapid	15.00	18.00	12.00	14.00
Medium	17.00	21.00	14.00	17.00
Slow	20.00	23.00	17.00	19.00
Category 3-5				
Rapid	35.00	39.00	27.00	30.00
Medium	37.00	41.00	30.00	33.00
Slow	40.00	44.00	32.00	35.00

Note -These times reflect the use of most restrictive times based on Folly Road south of the James Island Connector.

4. Southern Conglomerate Hurricane Evacuation Clearance Times

Hurricane Category & Evacuation Response	Southern Normal Lane Use		Southern US 278 Reversal	
	Occupancy		Occupancy	
	Low	High	Low	High
Category 1-2				
Rapid	8.00	13.00	5.00	8.00
Medium	11.00	15.00	8.00	11.00
Slow	13.00	18.00	10.00	13.00
Category 3-5				
Rapid	14.00	19.00	9.00	12.00
Medium	17.00	22.00	12.00	14.00
Slow	19.00	24.00	14.00	17.00

Note: Controlling traffic bottleneck is the road segment US 278 from Burnt Church Road to Buckwalter Parkway. Clearance times not displayed for US 21 reversals (Potential local savings only).

VI. LANE REVERSAL PLANS

- A. In addition to dedicated evacuation routes, South Carolina currently plans to execute the specific lane reversals at the beginning of the evacuation to assist in clearing the evacuation zones.
- B. Incident Action Plans (IAP) For Lane Reversals
 - 1. The South Carolina Department of Public Safety (SCDPS) maintains detailed Incident Action Plans (IAP) which detail the specific plans, resource and manning requirements, and command and control structure to execute the planned lane reversals plans.
 - 2. SCDPS conducts annual coordination, update, and exercise of the plans/IAPs with participant counties, municipalities, SC National Guard and state agency participants.
- C. Planned Lane Reversals
 - I-26 from I-526 in Charleston westbound to I-77/I-26 interchange in Columbia (four lanes).
 - US 501 in Horry County from SC 22/US 501 interchange west of Conway to the SC 576/US 501 and US 501 Bypass in Marion County (four lanes).

- US 501 in Horry County east of Conway from SC 544/SC 544 Connector to the US 501/US 378 intersection in Conway (four lanes).
- US 21 in the City of Beaufort from the US 21/US 21 Business intersection to the US 21/US 17 intersection in Gardens Corner (three lanes).
- US 278 off of Hilton Head Island from the Cross Island Parkway to Moss Creek Drive on the mainland.