

Crescent City Crisis: Recounting a Large Scale, Urban Emergency Evacuation

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ESRI Health GIS Conference

Goal

To estimate and map the number of persons exposed to flood waters in Greater New Orleans following Hurricane Katrina.

To assess the preparations and response to this urban catastrophe.

To verify claims of public officials.

Why?

Approximately 500 people died as a direct result of exposure to flood waters.

What is the **flood fatality rate**???

Flood Fatality Rate =
Direct Flood Deaths / Persons Exposed



Approach

Utilize a variety of records, hope for consistency.

- Map flood extent over non-evacuated population.
- Review search and rescue reports.
- List shelters, drop-off points, and collections points.
- Count people during final evacuation.

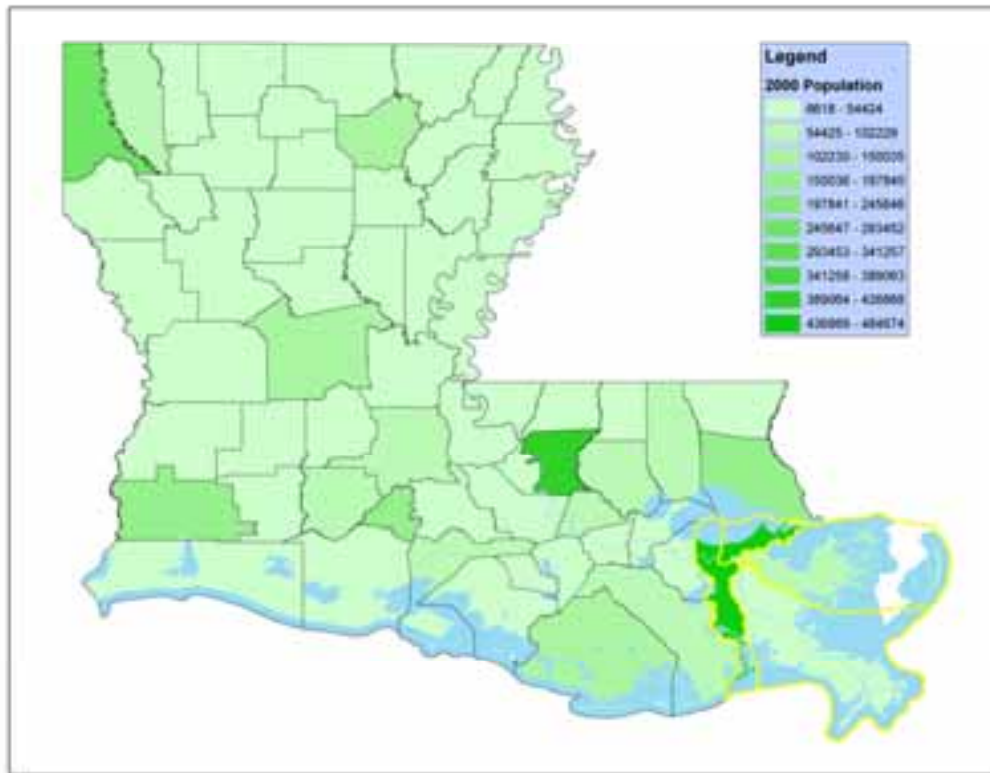
Work still in progress.

Quick Overview

“Considering the catastrophic nature of Hurricane Katrina, the benchmarks for success in the response to Katrina are reflected in the numbers: 1.3 million evacuated pre-landfall; 62,000 water, roof and attic rescues; 78,000 evacuated by bus and aircraft, including 12,000 hospital patients and their caregivers; 40,000 triaged at the LSU Pete Maravich Assembly Center TMOSA emergency room facility; another 2,000 triaged at Nicholls State TMOSA; no incidence of major secondary disease or health problems among evacuees; 40,000 housed at the Super Dome, all provided with food, water and shelter; 1,000 EMAC deployments; located shelter for 25,000 within 24 hours; and the first use of the National Disaster Medical System in U.S. history.”

Lessons Learned: Hurricane's Katrina and Rita
Louisiana Office of Homeland Security and
Emergency Preparedness

Welcome to Louisiana



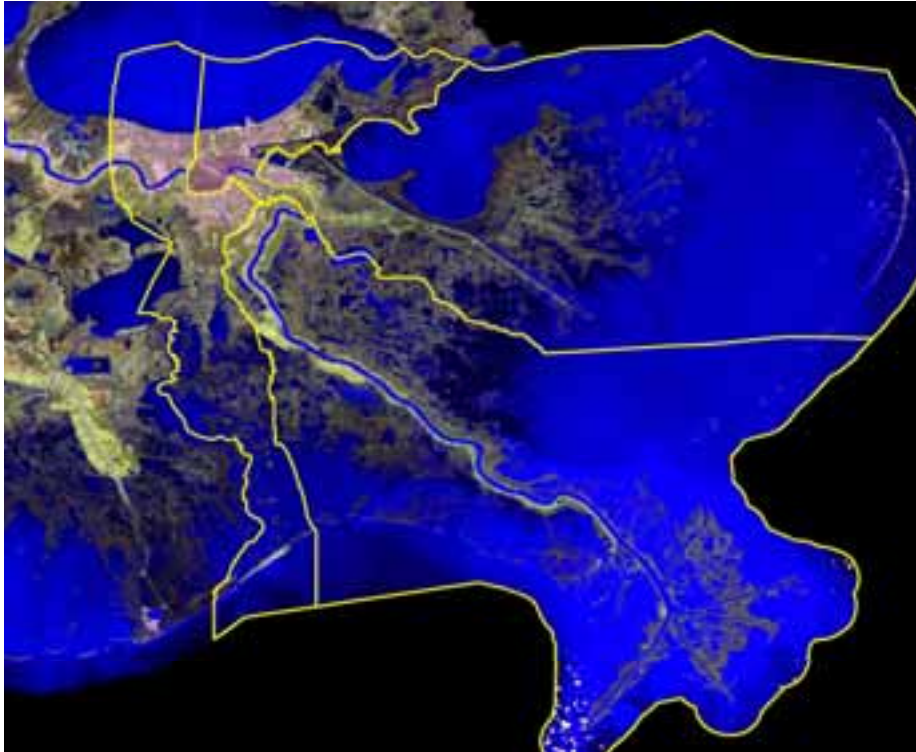
2000 Population =
4.5 million

Divided into 64 parishes

Population most
concentrated in
Southeast region

“75% of population and 90% of economy is behind levees.”

Greater New Orleans



Four Parish Region –

Orleans, Jefferson, St.
Bernard, Plaquemines

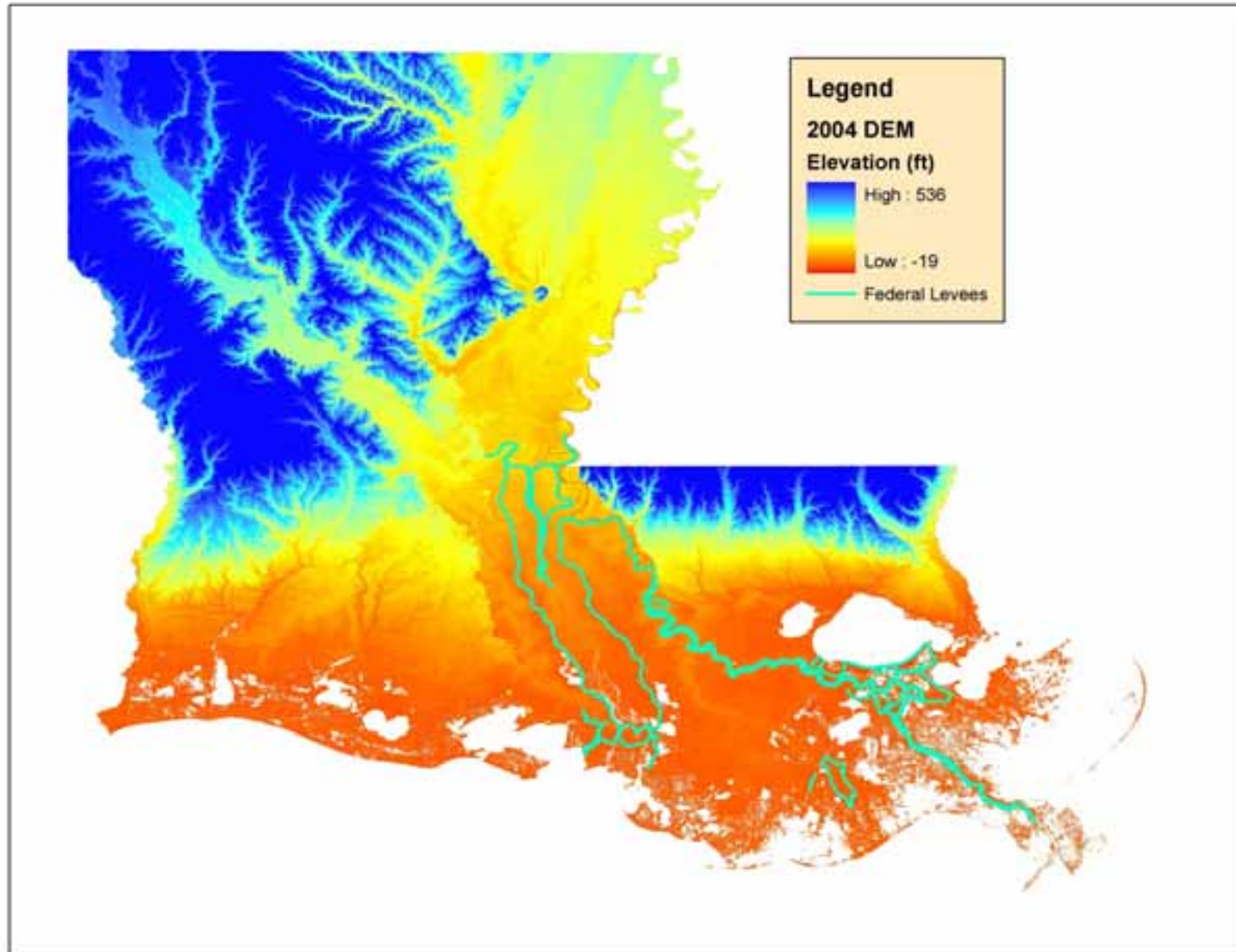
2000 Population =
1 million

2005 ACS:
6% population decrease

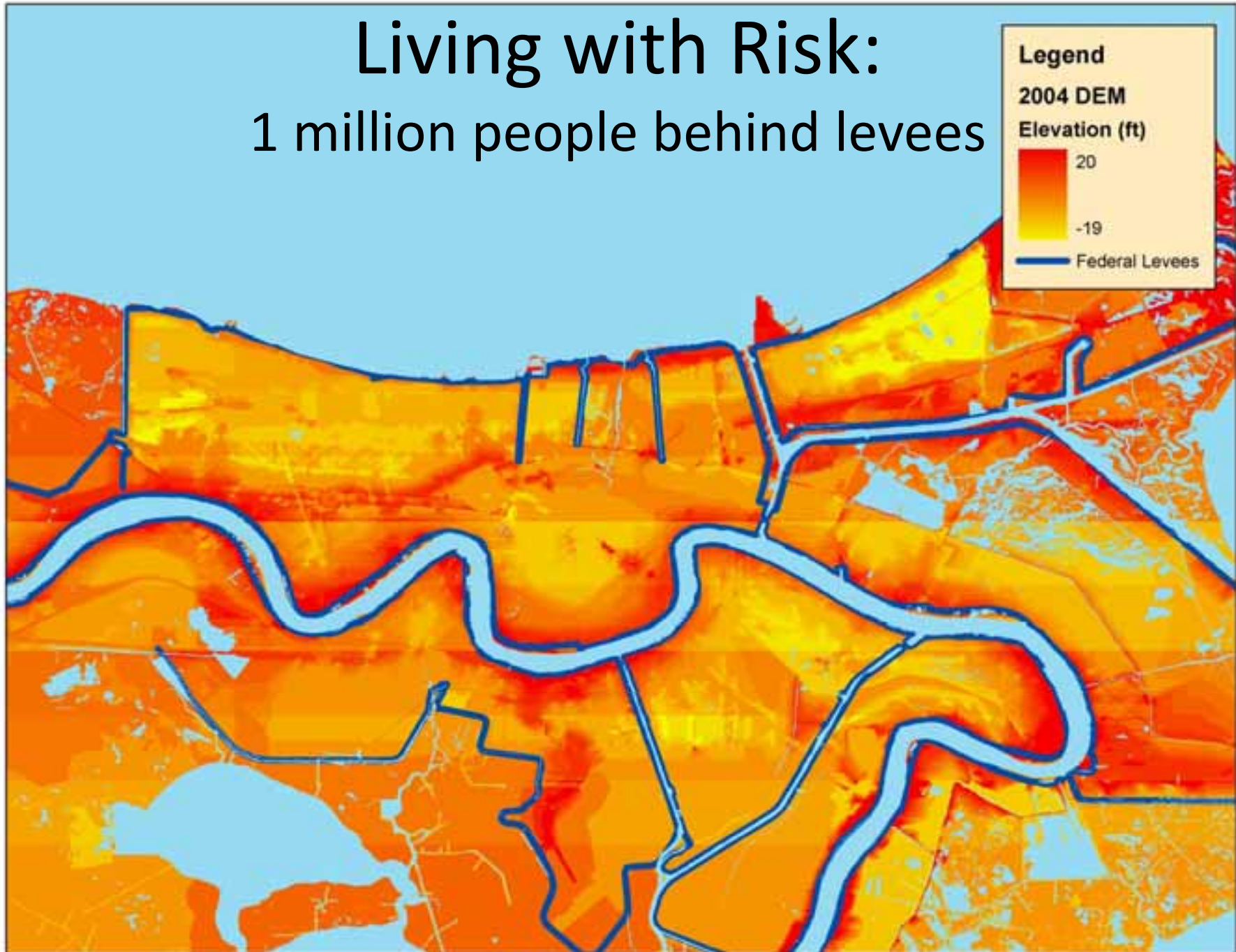
Low lying and wet

Experienced the worst flooding during Katrina

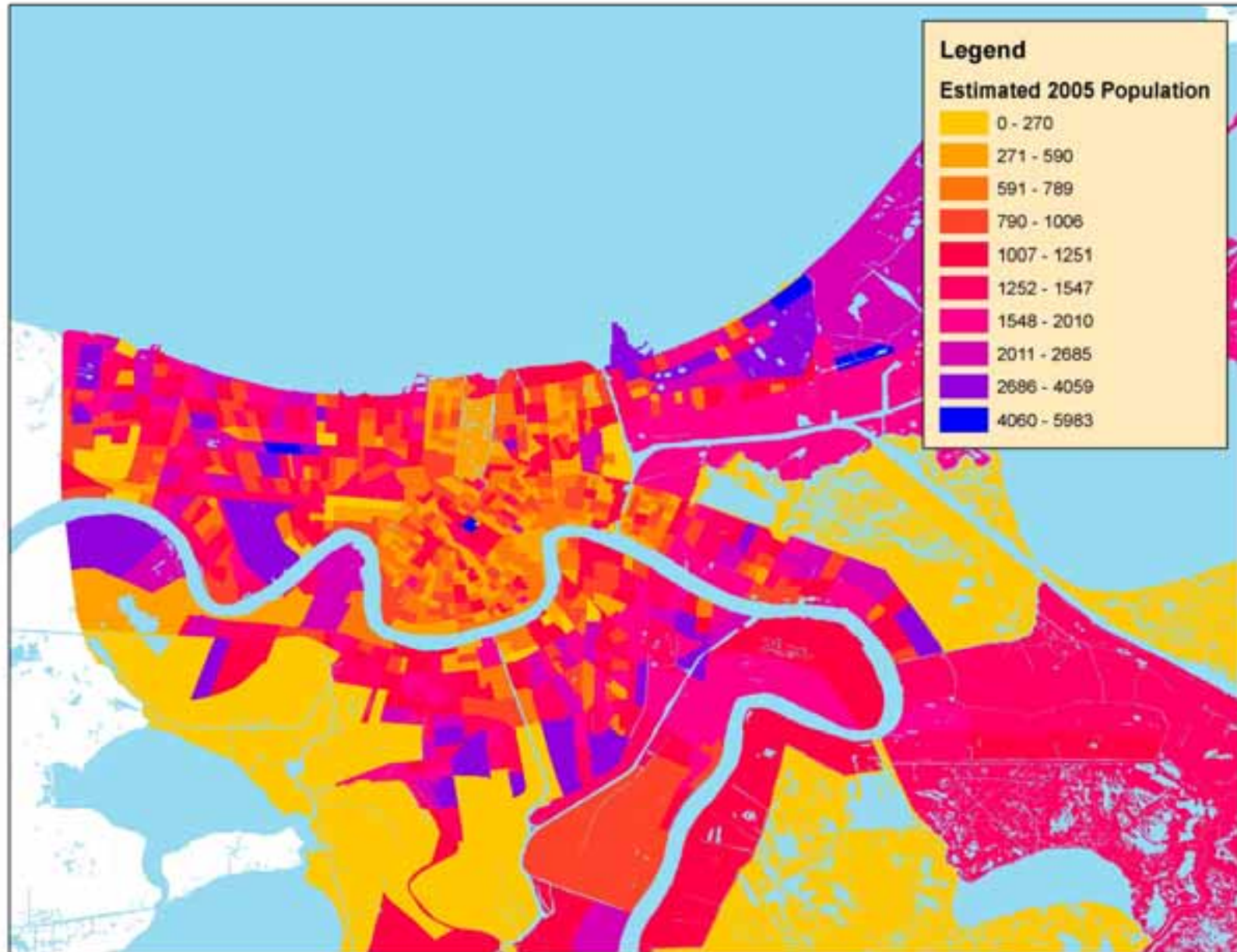
Living with Risk



Living with Risk: 1 million people behind levees



Estimated 2005 Population



Vulnerable Population

- Poverty: 205,873 persons with 1999 income below poverty line
- Education: 30,979 persons without High School Degree
- Carless: 71,283 households without access to personal vehicles
- Disabled: 297,392 disabled persons
- Elderly: 122,923 persons age 65 and older

Source: 2000 Census SF 3

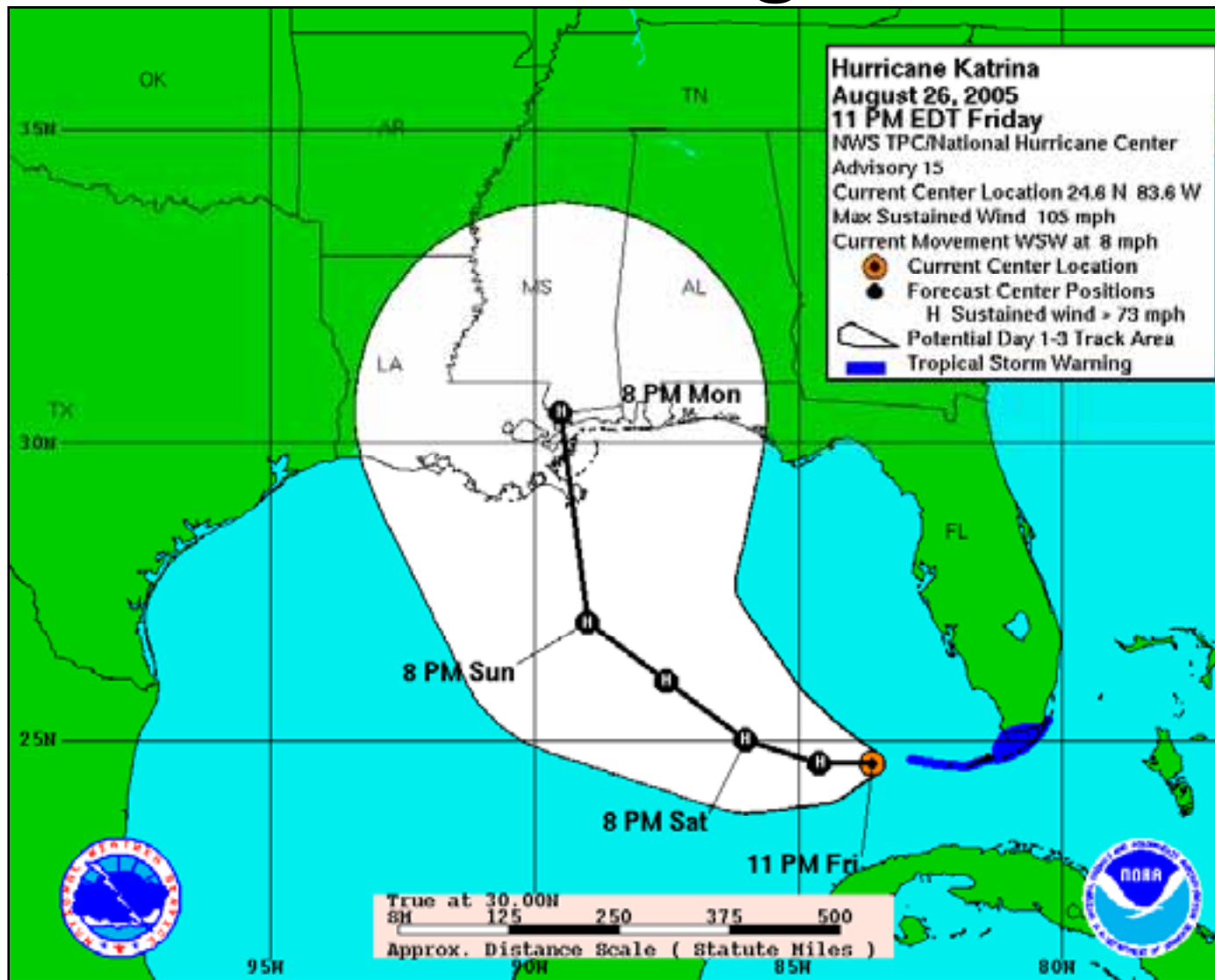
Vulnerable Population

“This state of affairs left government officials the complicated task of tirelessly offering hope to a citizenry that was, in many respects, hopeless.”

Sally Forman

N.O. Communications Director

Hurricane Katrina: Warning



Evacuation:

Over 1 million people in under 48 hours

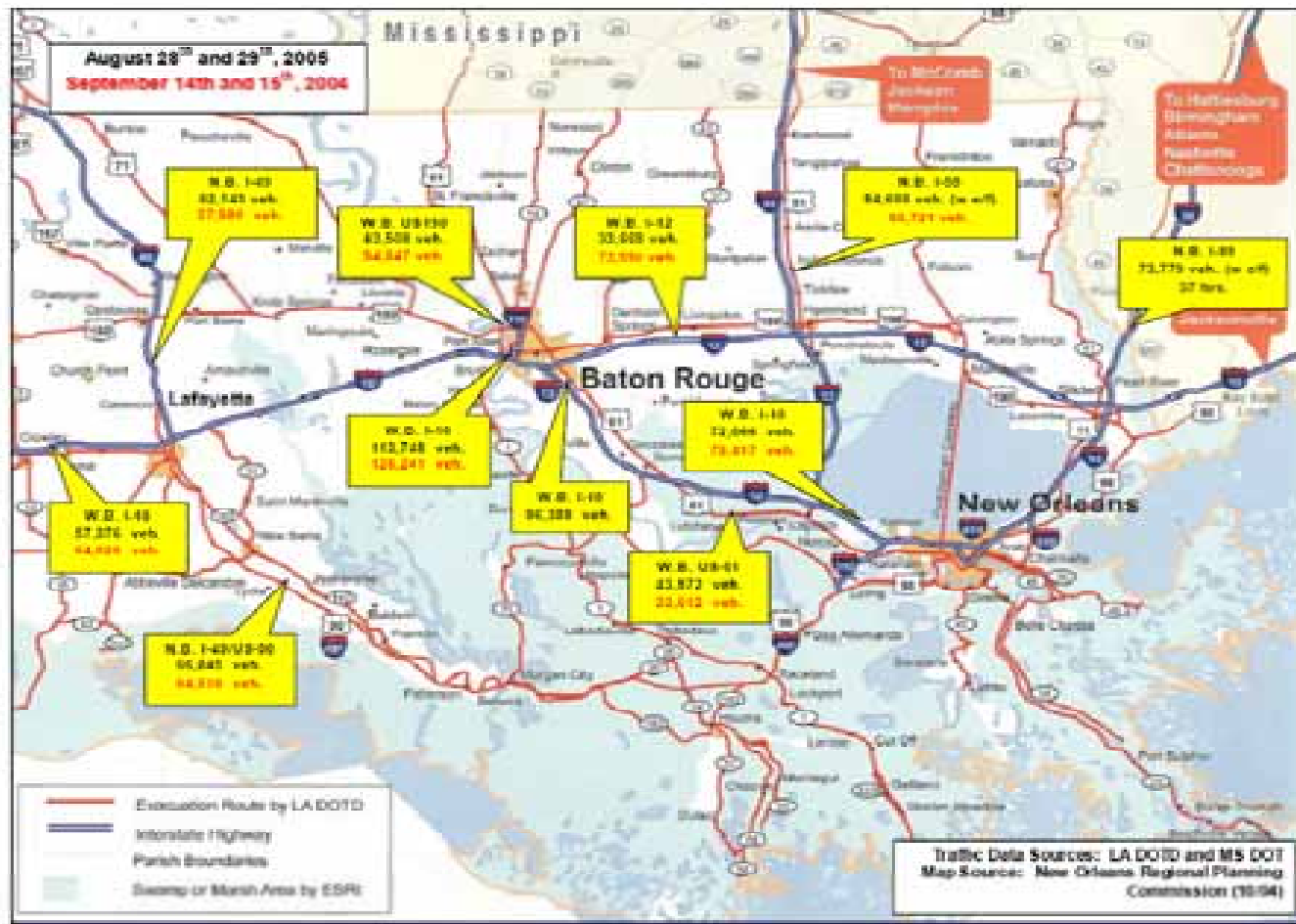


Figure 4. 48-hour Traffic Volume During the Katrina and Ivan Evacuations

Source: Brian Wolshon and Ben McArdle. "**TEMPOROSPATIAL ANALYSIS OF HURRICANE KATRINA REGIONAL EVACUATION TRAFFIC PATTERNS**"

Evacuation

Parish	Evacuation Calls	Evacuation Effectiveness (*)	Number Evacuated	Sheltered	Non-Evac & Non-Sheltered
Orleans	Mandatory Evacuation called Sunday morning	82%	358,484	11,000	67,692
Jefferson	Voluntary for most of Parish, Mandatory for coastal areas	75%	336,476	56,000	56,079
St Bernard	Voluntary	92%	59,438	800	4,369
Plaquemines	Mandatory	97%	25,954	0	803
Totals			780,353	67,800	128,942

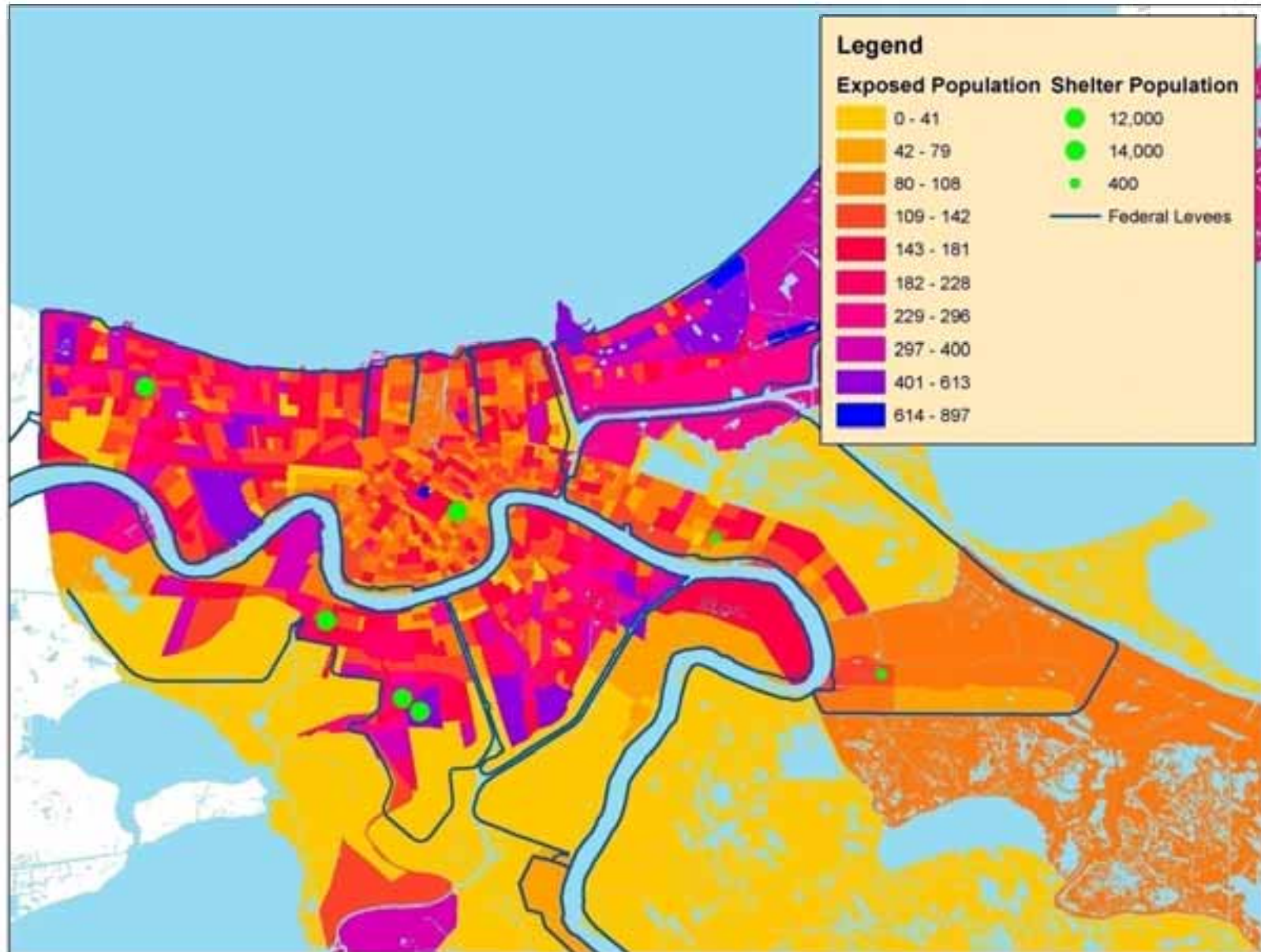
* Based on statements from public officials.

Shelters

Name	City	Parish	Population
Superdome	New Orleans	Orleans	10,000-12,000
Alfred T. Bonnabel	Kenner	Jefferson	~14,000
Stella Worley	Westwego	Jefferson	~14,000
Harry S. Truman	Marrero	Jefferson	~14,000
C.T. Janet Elementary	Marrero	Jefferson	~ 14,000
Chalmette High School	St Bernard	St Bernard	~ 400
St Bernard High School	St Bernard	St Bernard	~ 400

* Except for the Superdome, population estimates are based on the total sheltered within the parish divided by number of shelters.

Non-evacuated, non-sheltered



Why people didn't evacuate?

Results of a survey conducted in Houston Shelters:

25% did not hear of the an evacuation order

55% did not have access to a car

22% did not physically have a way to leave

64% did not believe it would as bad as it was

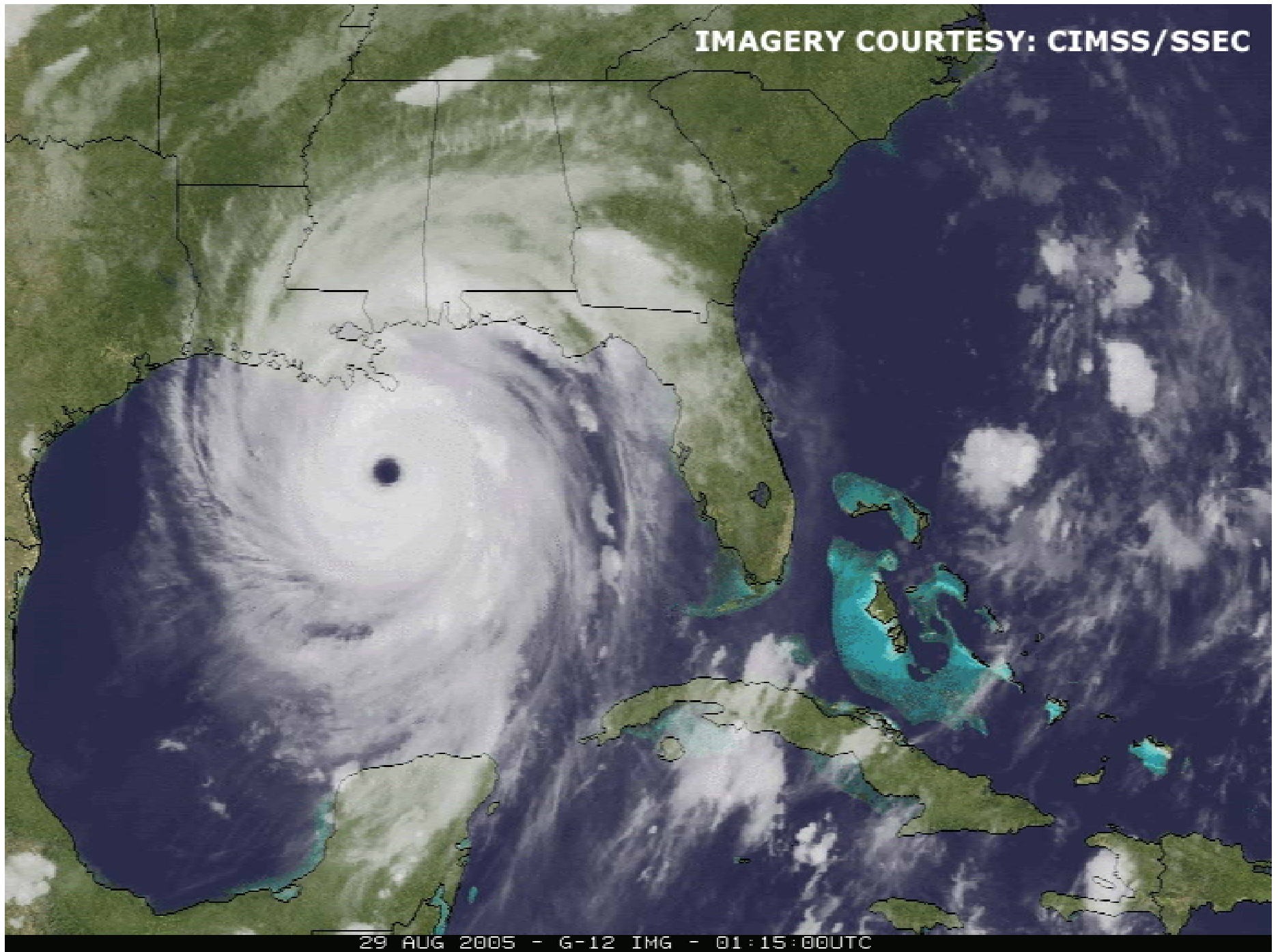
37% did not want to leave

56% said that they could have found a way to leave

Source: Washington Post, Kaiser Foundation, Havard University

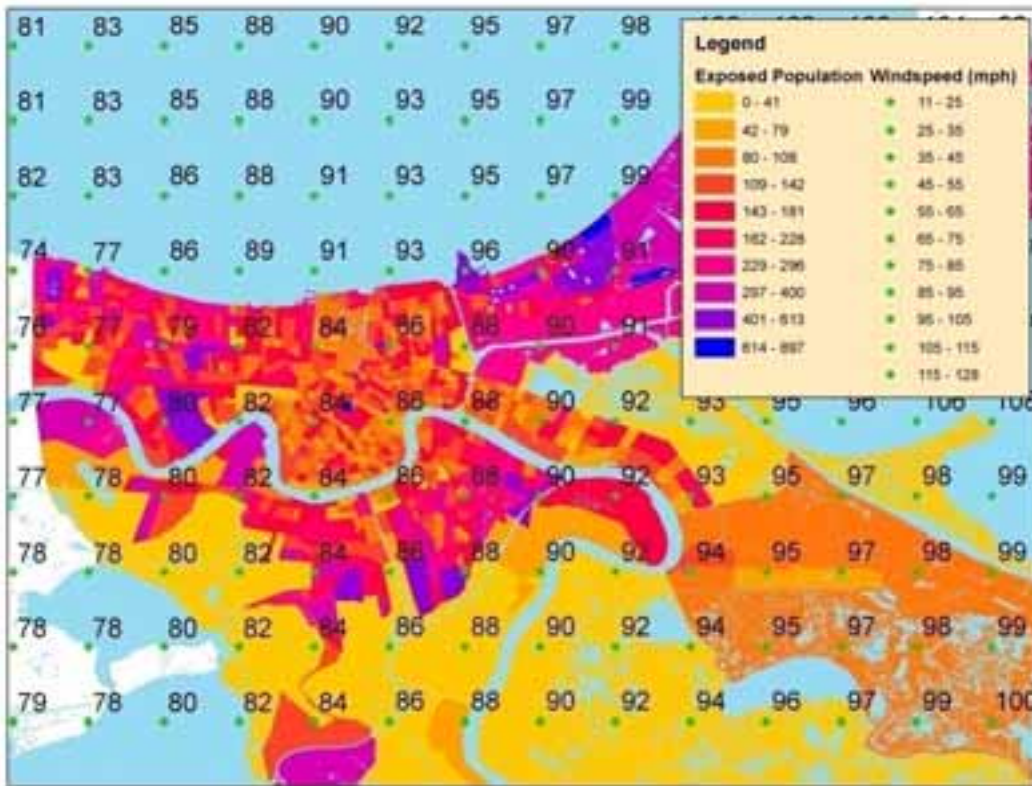
Survey of Hurricane Katrina Evacuees

IMAGERY COURTESY: CIMSS/SSEC



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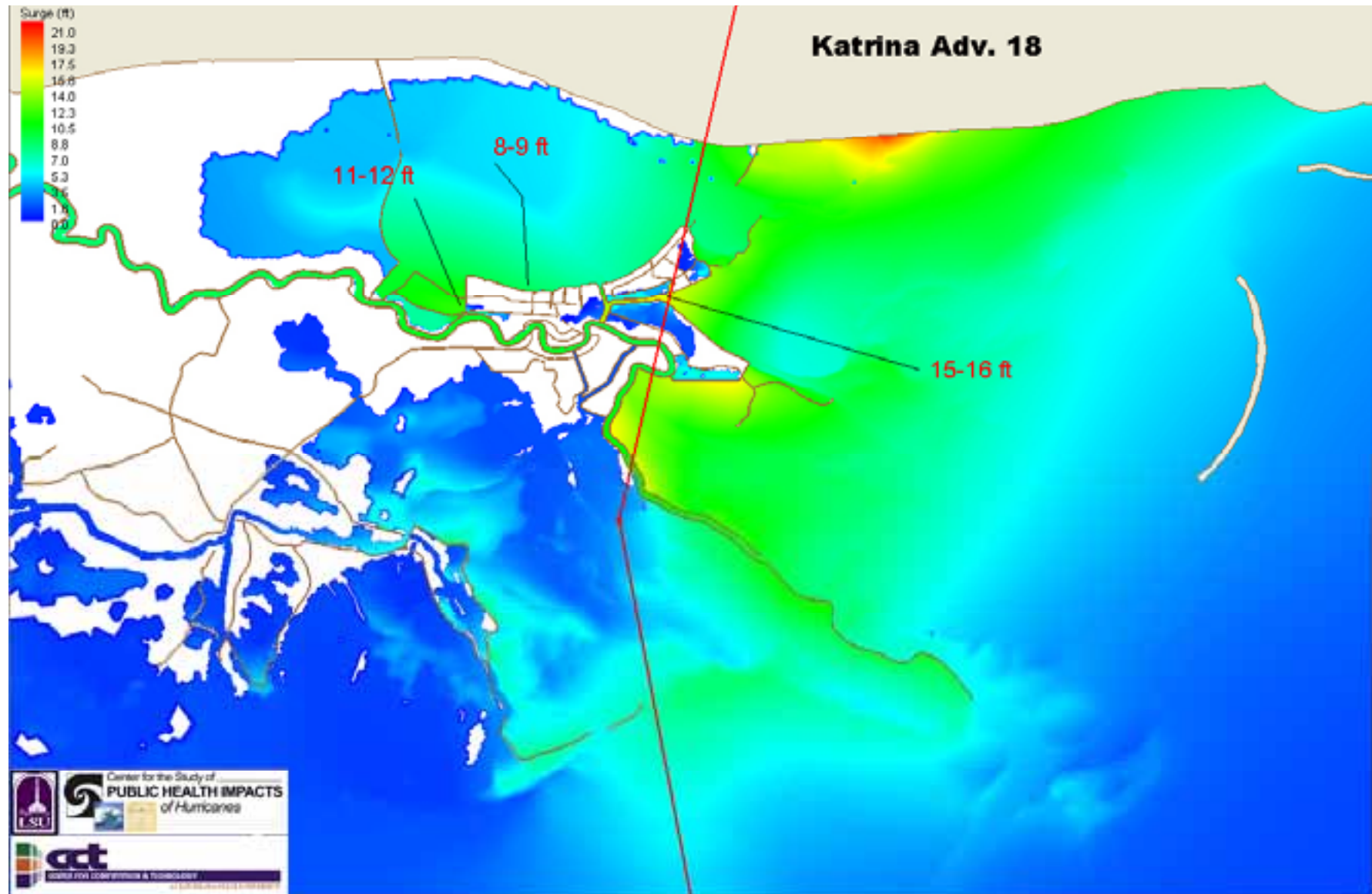
Moderate Winds



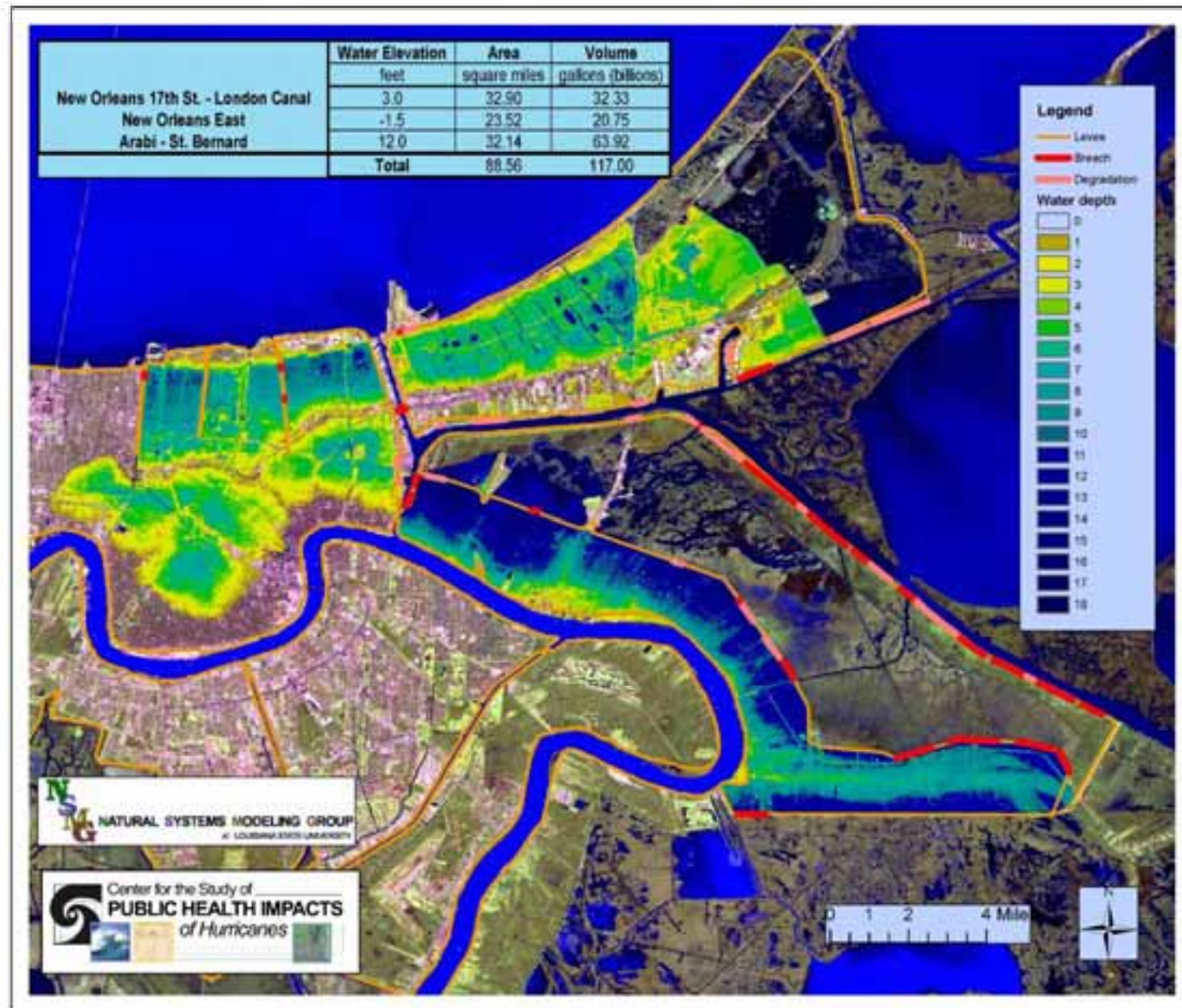
Source: NOAA's Hurricane Research Division

Windspeed (mph)	Persons Exposed
70-80	21,734
80-90	95,959
90-100	11,186
100-110	343
110-120	1

Extreme Tidal Surges



Over 50 Levee Failures



“ We’ve got people on rooftops and clinging to trees. Even though the storm took a slight turn to the east, we’ve still got water topping a levee at the Industrial Canal, water in the Ninth Ward, and water in New Orleans East. At least one building has collapsed. We have at least five fires, and at Charity Hospital windows have blown out.”

Col. Terry Ebbert

N.O. OEP Director

“600 9-11 calls within the first few hours.”

Deputy Chief Warren Riley

New Orleans Police Department

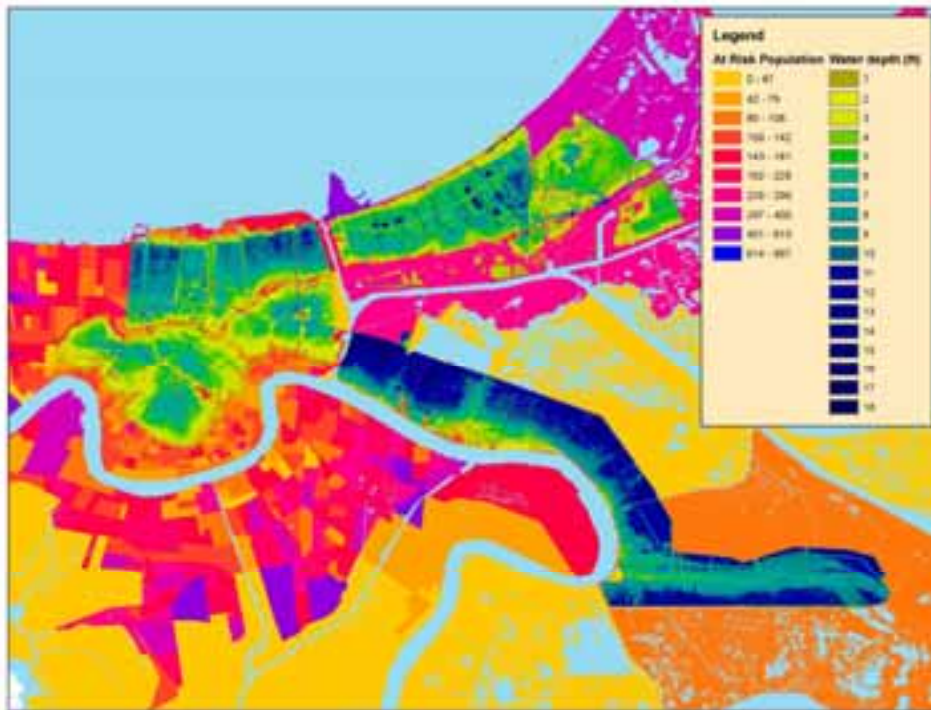
“As I drove up onto the Interstate toward the city’s center, I suddenly began weaving around people stranded on the elevated expressway to seek higher ground... I knew we had to help these people, but wondered if we had enough resources to effectively respond.”

Sally Forman

N.O. Communications Director



Person Exposed to Floodwaters



Median Flood Depth (ft)	Flood Exposed Population
1 to 5	35,298
5 to 10	25,517
10 and above	5,341
Total	66,157

Does not reflect flooding in Jefferson or Plaquemines.

Search and Rescue

Multiple Agencies:

Louisiana Wildlife and
Fisheries

US Coast Guard

Louisiana National Guard

New Orleans Police
Department

New Orleans Fire
Department

Numerous S&R Task Forces

Citizen Volunteers



Search and Rescue

Multiple step-process for flooded residents:

- Initial rescue

- Drop Off Point

- Secondary Rescue

- Collection Point/Emergency Shelter

- Final Evacuation



STAFF PHOTO BY ALEX BRANDON

NINTH WALL: An elderly resident is rescued from chest-high floodwaters by two New Orleans police officers.

Source: The Times-Picayune

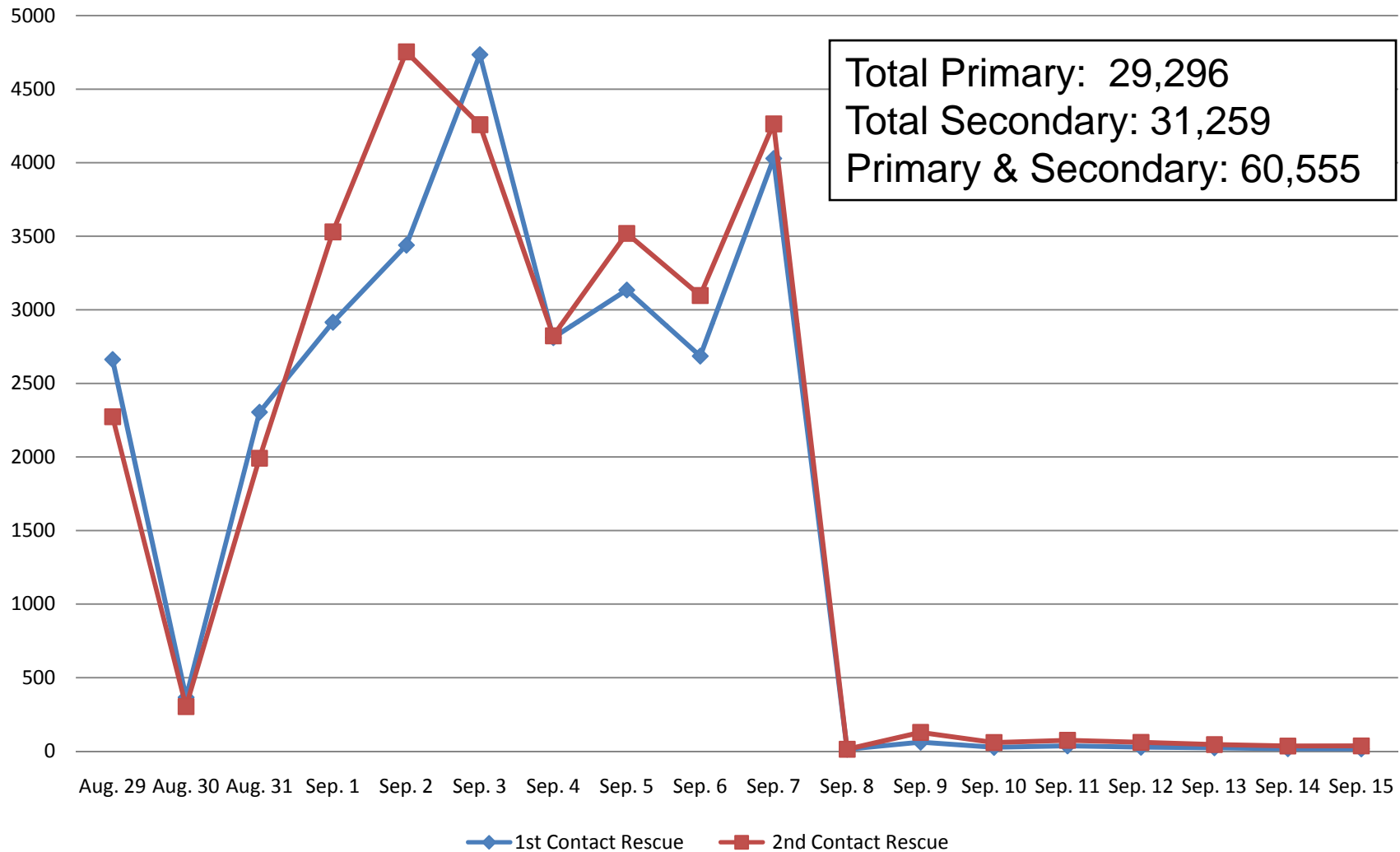
Search & Rescue

Agency	Total Primary Rescues
Coast Guard	24,135
La Wildlife and Fisheries	22,000
Louisiana National Guard	9,313
Search and rescue personnel deployed under EMAC	6,582
NOFD	Hundreds
NOPD	Thousands
Plaquemines Parish Sheriff	300
USGS	594
Bossier City Fire Department	750
Vancouver USAR	119
Others	?????
Total	65,000-75,000

S&R By Location

Location	Number of People Rescued
Lower Ninth Ward	2,000
Elysian Fields Exit of I-10	1,800
St. Bernard Ave Exit of I-10	
I-10/I-610 Split	
Guste Homes	700
American Can Apartment Complex	Over 200
St. Roch Cemetery and Elysian Fields Avenue	
I-10/610 merge	368
Tulane Avenue (near I-10)	
St. Bernard Parish	6,000
School near I-10 Elysian Fields Exits	300

Louisiana National Guard/ Wildlife and Fisheries Rescues



Source: Louisiana National Guard, *Timeline of Significant Events*

Drop-Off Points, a.k.a 'Lilly Pads'



Source: The Guardian

Drop-Off Points

Gathering Point	Number of People
Lakefront Airport	thousands
Zephyr Field	
University of New Orleans	3,200
St. Claude Bridge	2,000
Danziger Bridge	
Chalmette Ferry Landing	6,000
I-10 Elysian Fields Exit	
I-10 St. Bernard Exit	
I-10/I-610 Split	
Jackson Barracks	

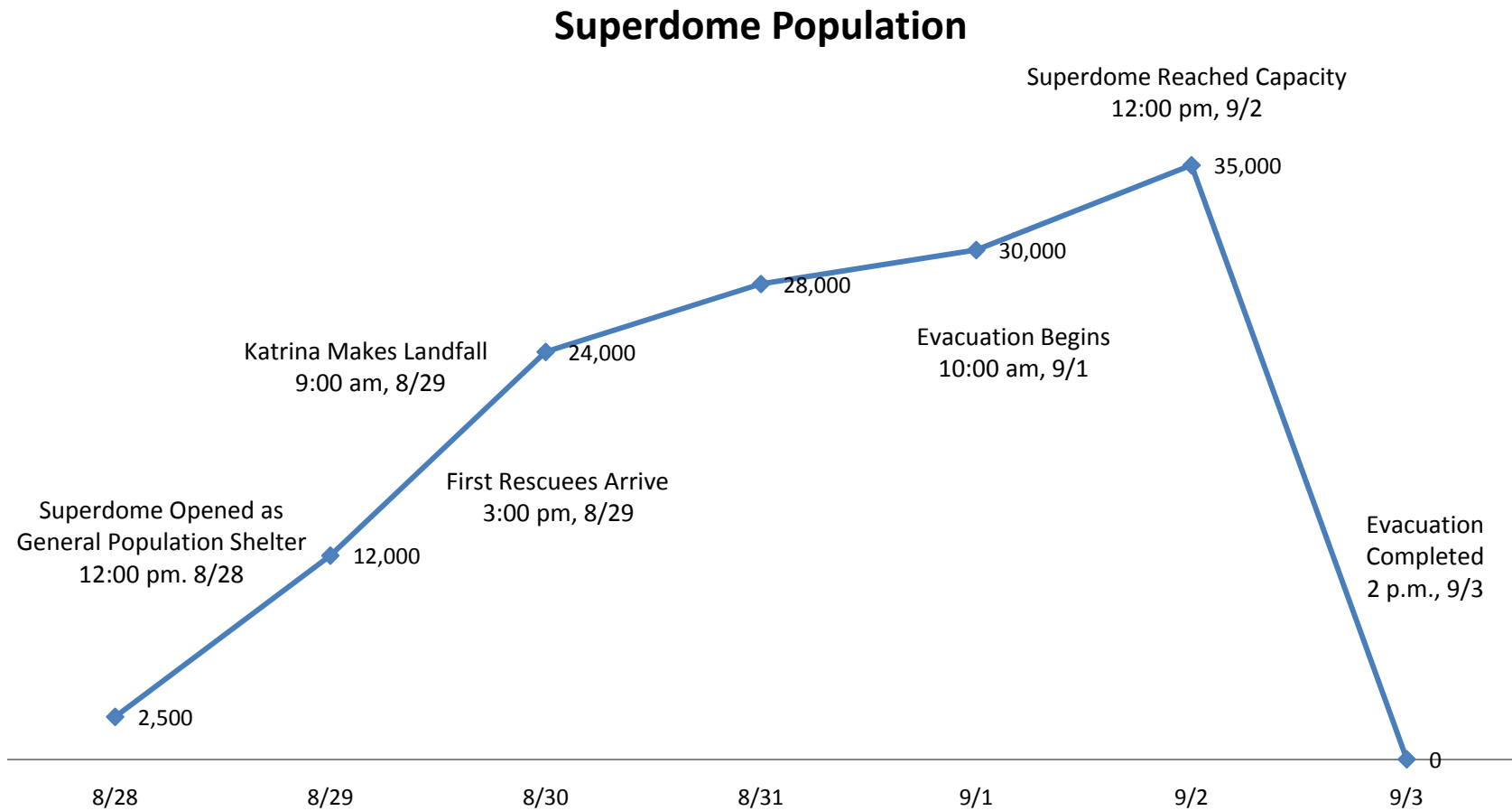
Parking lot at the University of New Orleans



Collection Points / Emergency Sheltering

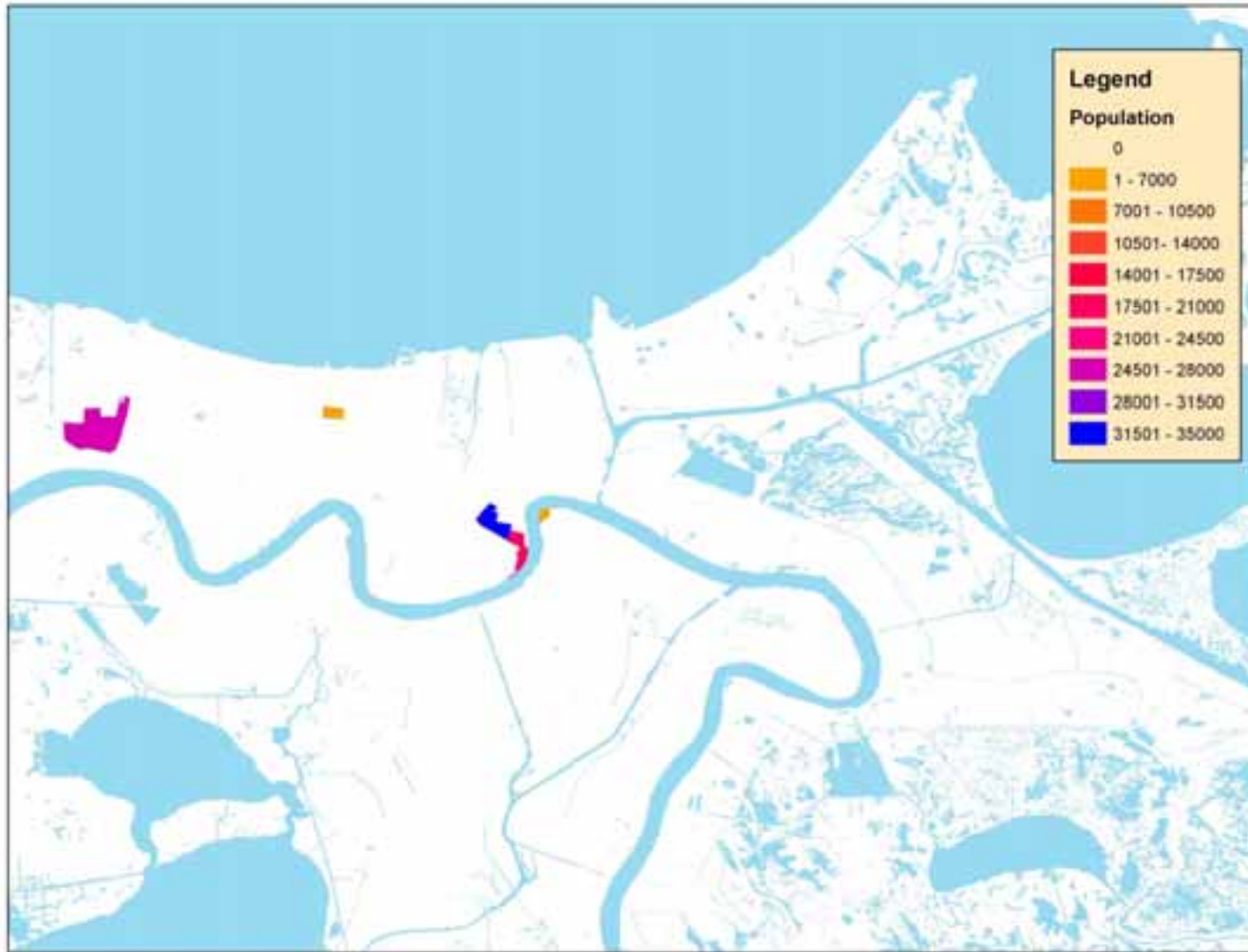
Gathering Point	General Population
Superdome	35,000
Convention Center	19,000
Clover Leaf	7,000
Armstrong Airport	26,000
Algiers Point	7,000
Total	99,000

Superdome Population Timeline



Source: Louisiana National Guard, *Timeline of Significant Events*

Map of collection points



Final Evacuation

Over 2000 buses, 129 airplanes, & 4 ferries

First buses arrive at the Cloverleaf on the afternoon of Aug. 31 and complete evacuation that night.

Evacuation of Superdome begins 10:00 a.m. on Sep. 1 and ends 2:00 p.m. on Sep. 3

Convention center secured 12:30 p.m. on Sep. 2. Evacuation begins 10:00 a.m. on Sep.3 and ends at 6:00 p.m.

Air evacuation of airport begins on Sep 2 and lasts through Sep. 9.

September 7, 2005

Approximately 10,000 people remain in
Orleans Parish

Source: FEMA Hot Wash

Results

Out of a population of 1 million people:

- 780,000 evacuated and 68,000 sheltered before landfall

=> 129,000 remain in homes

- Estimated that 66,000 people exposed to flood waters

=> 65,000 – 75,000 rescued

- 100,000 people sheltered and evacuated

=> 30,000 people either self-evacuated after storm or never left.

Results: Lower Ninth Ward

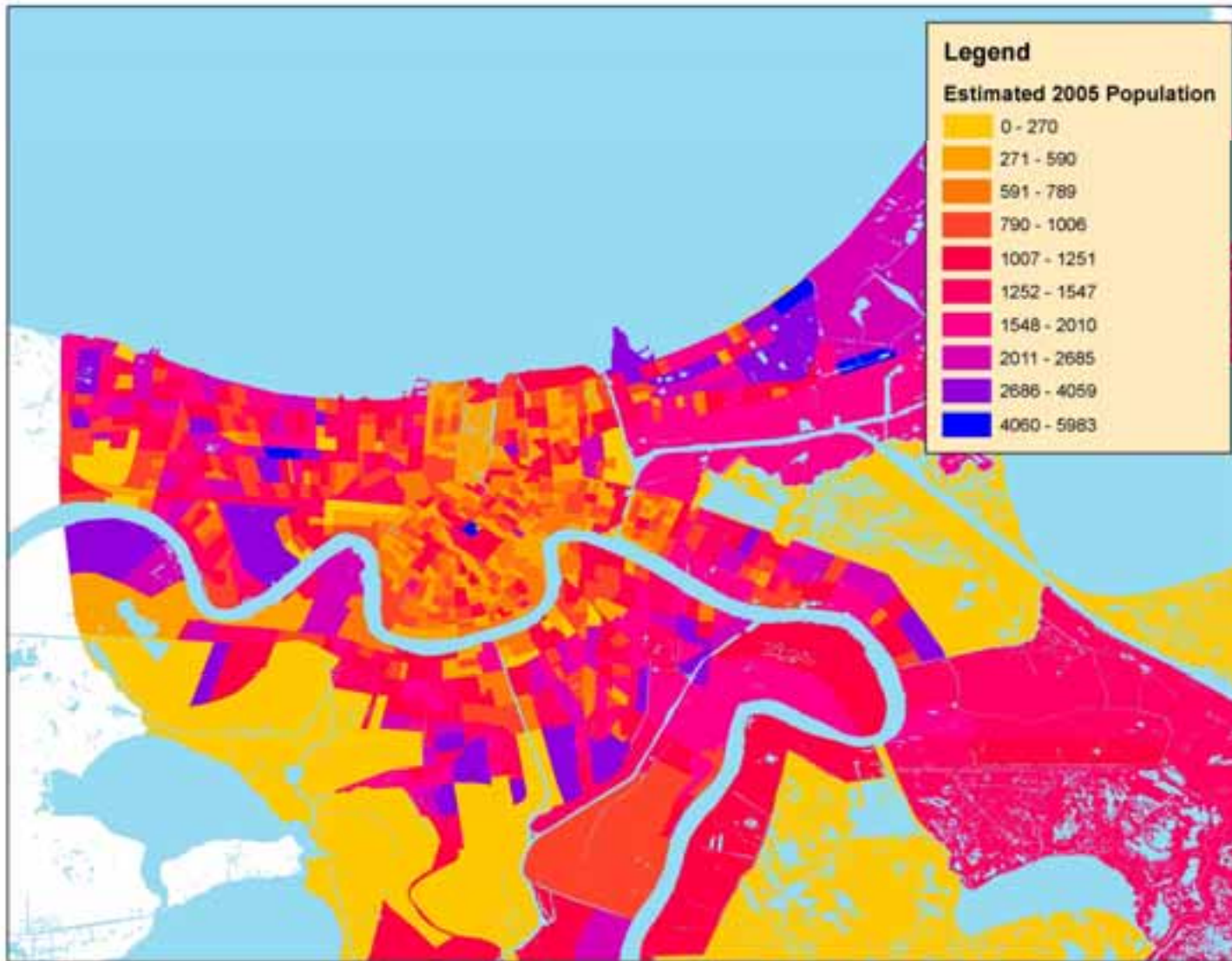
Based on estimated 2005 Census, Stated
evacuation rate for Orleans parish, and the
extent of flooding:

2,643 Trapped in flood water

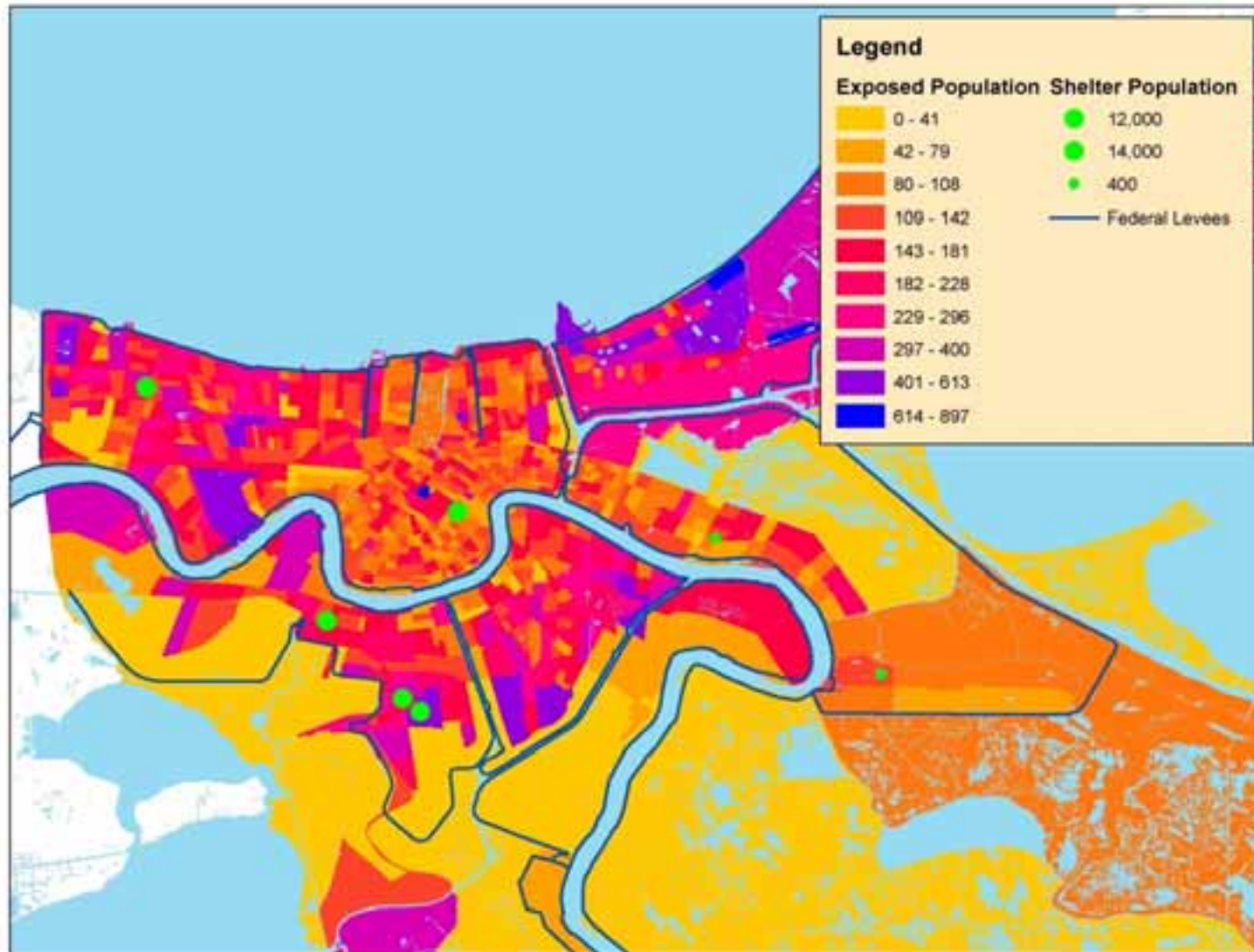
Louisiana Wildlife Fisheries Activity Report:

2,000 Rescued

August 2005 Population



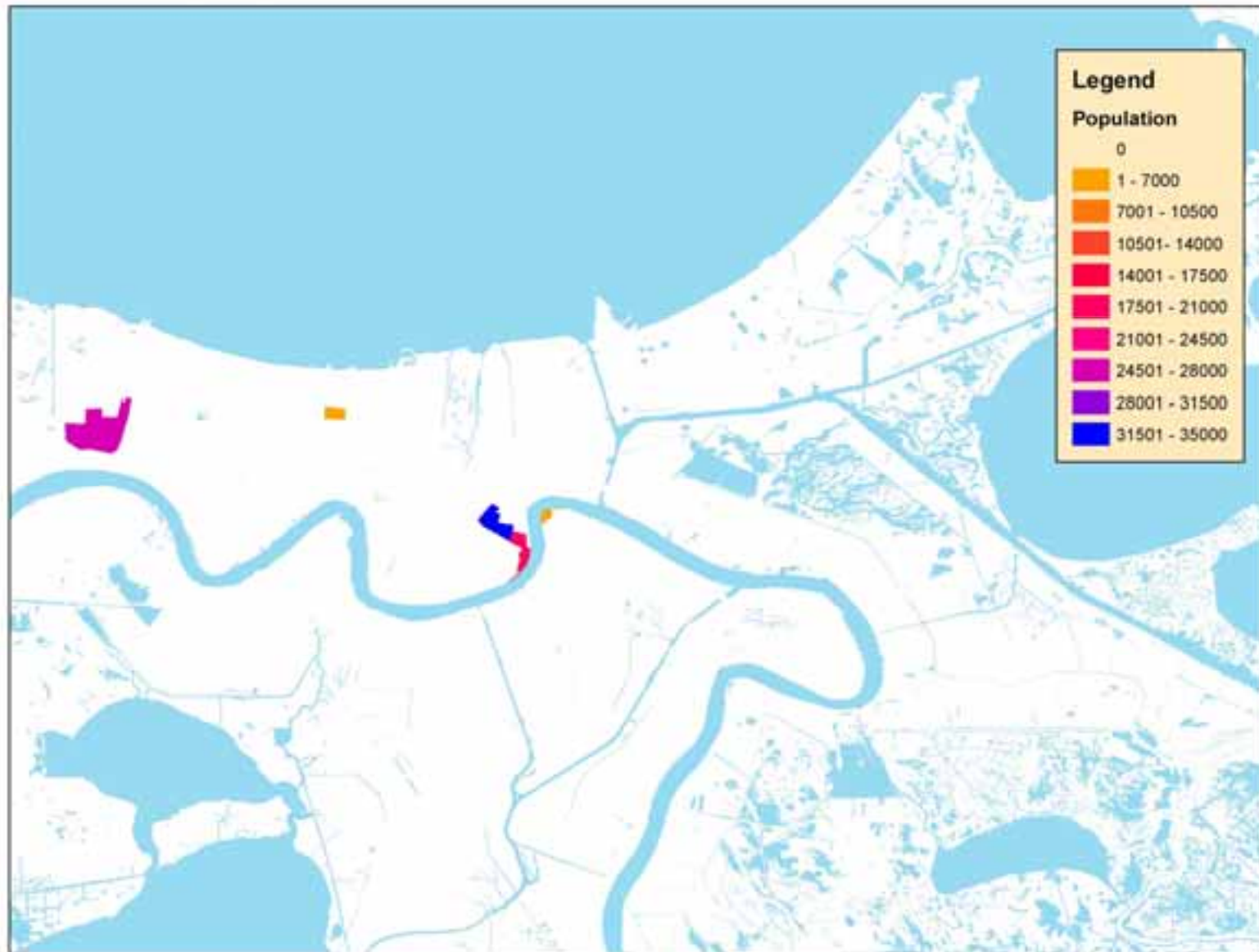
Aug. 28 Population



Rescues & Drop-Off Points

Dr. Vangy Franklin:
“You’ll figure it out”

Emergency Shelter Population



The Next Chapters

