

# ***Roles, Responsibilities, and Plans for Transportation Systems in Mass Evacuations***

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Transportation Resiliency***

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# **Background**

- ***Gulf Coast Research Center for Evacuation and Resilient Transportation***
  - *Jointly administered between LSU-UNO funded by the USDOT 4-years/\$4 million, research/teaching/tech transfer*
- ***National Academies Synthesis of Practice Reports***
  - ***Transportation's Role in Evacuation and Reentry & Convertible Lanes and Roadways***
- ***Regional Microscale Multimodal Simulation***
  - *(USDOT) New Orleans: Calibrate w/Katrina and test ideas & conditions then (DHS) apply to Houston-Galveston region*
- ***Planning Support Services***
  - *Louisiana DOT, Florida DOT, Sandia National Laboratory (NRC)*

# ***Transportation Roles***

- ***Planning***
- ***Traffic control and management***
- ***Communications***
- ***Assisted evacuations for low mobility individuals***
- ***Modeling and analysis***
- ***Reentry***

# ***Evacuation Basics***

- ***Hazard Characteristics***

- ***Scale (how “big?” -> How far to evacuate), amount of advanced notice, shelter-in-place options***

- ***Evacuee Characteristics***

- ***Who are they? Where are they? How many? How mobile? Behavior (if/when will they leave?), What are their needs?***

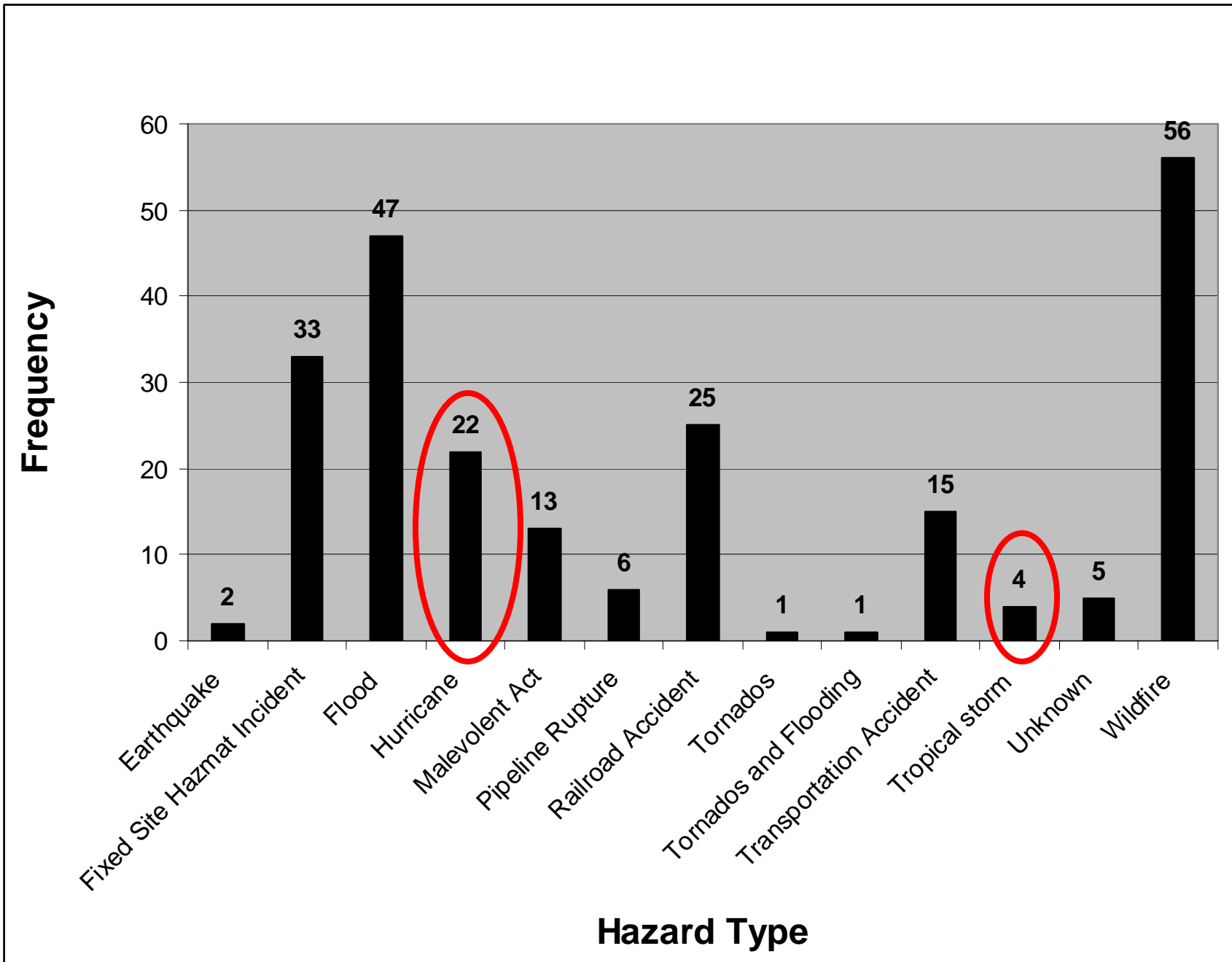
- ***Transportation Resources***

- ***Modes (highway, transit, air, water, etc.), traffic control, traffic management***

- ***Communication***

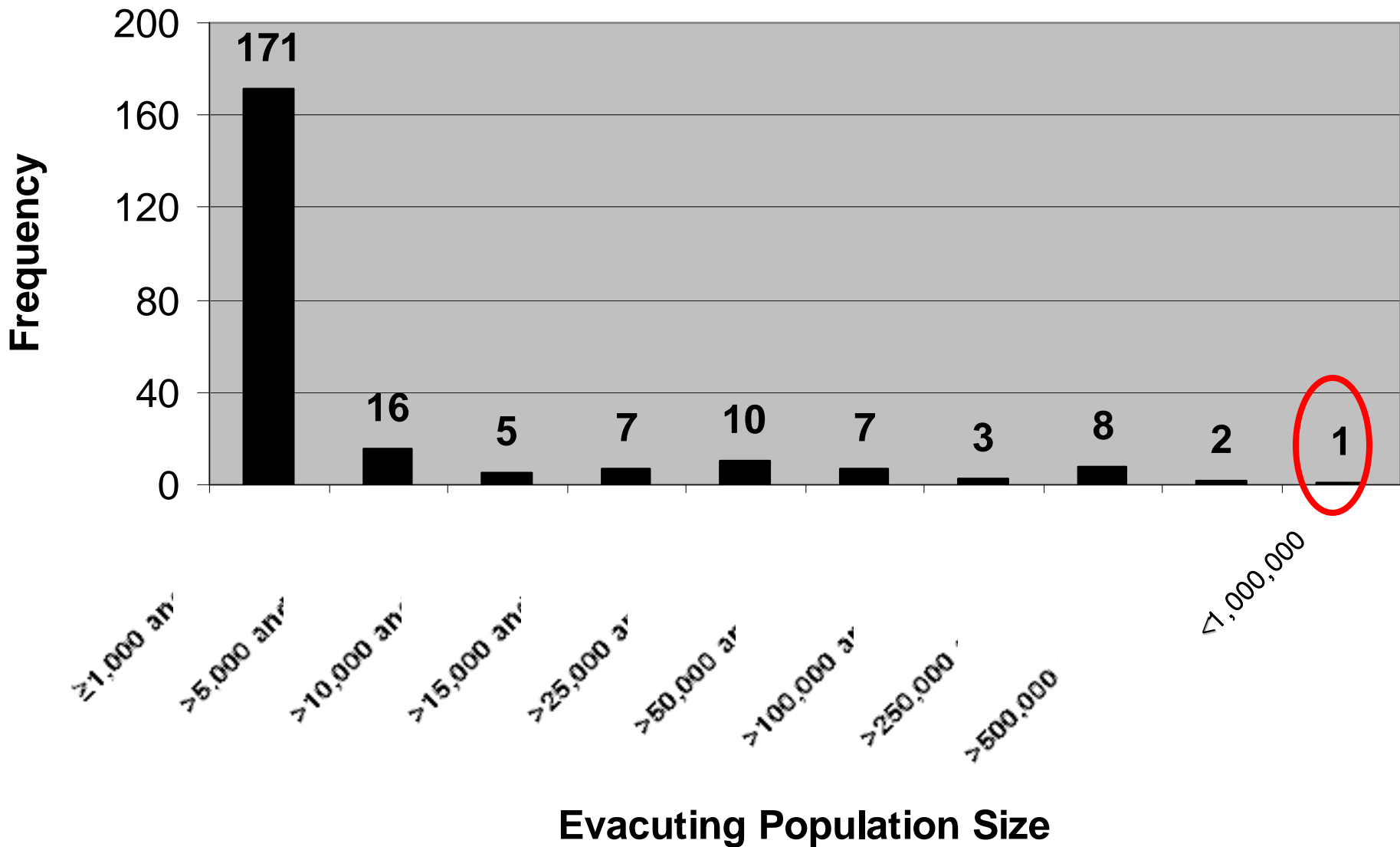
- ***To/from, across and between all levels, jurisdictions, agencies, and evacuees, need for situational awareness***





n=230, 1993-2003

(Source: F. Walton, Sandia National Laboratory)



(Source: F. Walton, Sandia National Laboratory)

# Planning

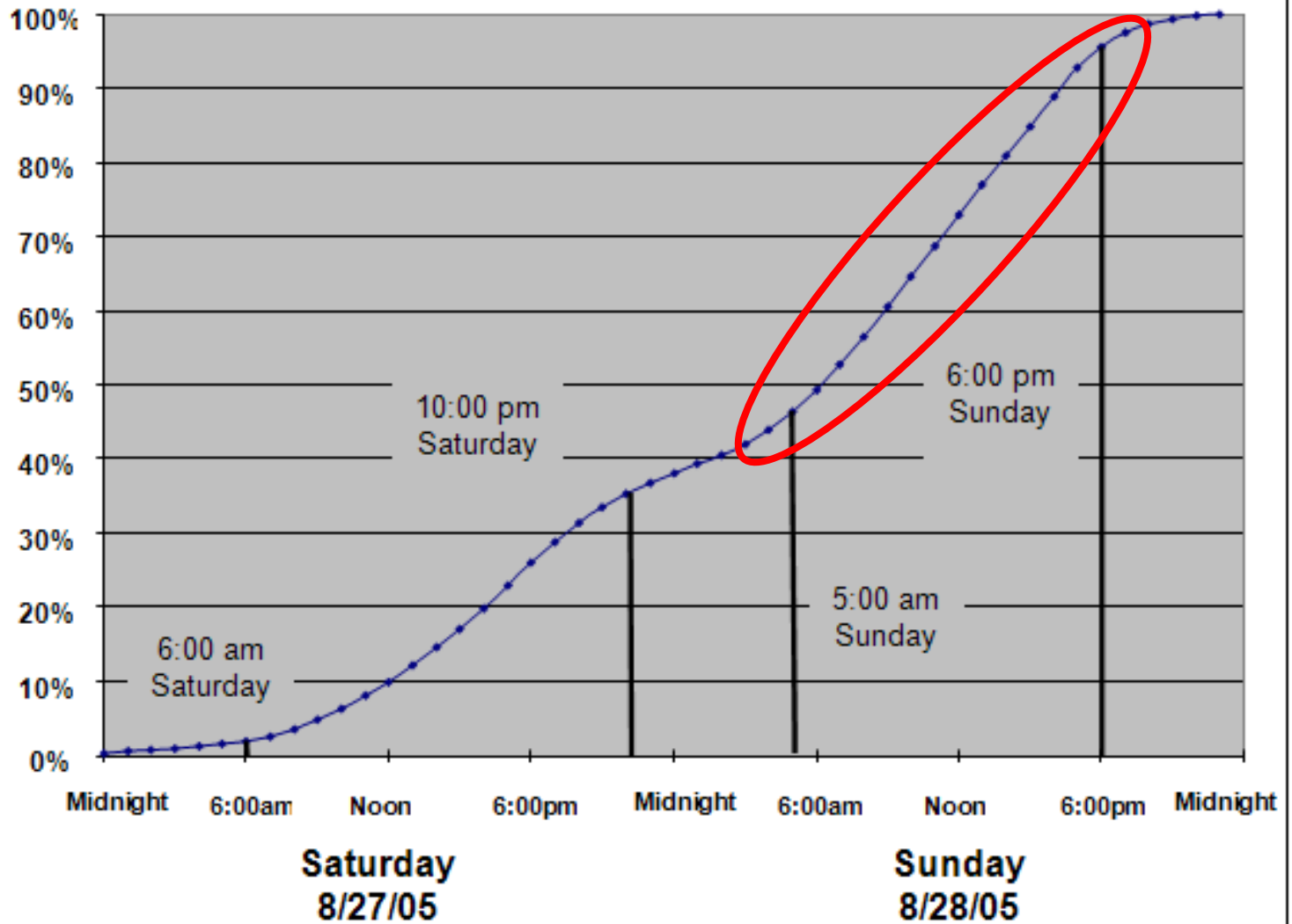
- **Hazard analysis**
  - *Identify areas to be evacuated based on hazard*
- **Vulnerability analysis**
  - *# of households/people susceptible to threat*
- **Behavioral analysis**
  - *project how people will respond*
- **Transportation analysis**
  - *assess network capacity, identify bottlenecks and vulnerable links and estimate the time required to evacuate*
- **Shelter analysis**
  - *evaluate capability of buildings and their suitability as refuges*
- **Assess if and when an evacuation is warranted**
- **Regulate growth/development that impacts evacuation**

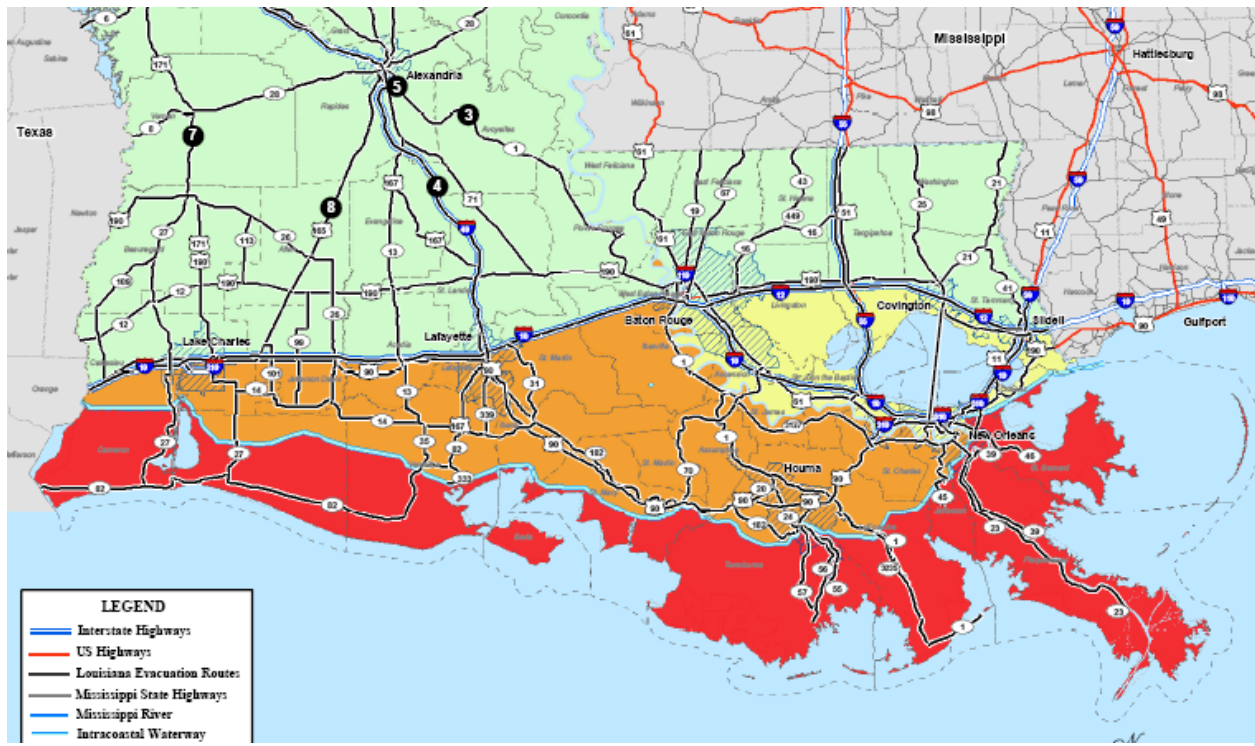
# ***Transportation Analysis***

- ***Define evacuation transportation zones under threat***
  - ***origins and destinations of the analysis.***
- ***Dwelling unit data***
  - ***Population characteristics, # of dwelling units, and # of vehicles***
- ***Roadway inventory and characteristics***
  - ***Capacities, contraflow, intersection and link segment bottlenecks***
- ***Travel demand estimate***
  - ***Forecast the number of expected evacuation trips based on behavioral analysis. # of evacuees to public shelters, homes of friends and relatives, local hotels, motels, churches, and other types of local destinations, and all destinations outside the local area.***
- ***Trip distribution***
  - ***Matching the origins and destinations***
- ***Temporospatial assignment of evacuation trips to network***
  - ***Dynamic, iterative processes***



### Cumulative Percentage of Total Evacuating Vehicles





## Phased Evacuation

During a threat of a hurricane, a phased evacuation will be based on geographic location and time in which tropical storm winds are forecasted to reach the affected areas.

- Phase I** - 50 Hours before onset of tropical storm winds. Includes areas south of the Intracoastal Waterway. These areas are outside any levee protection system and are vulnerable to Category 1 and 2 storms. These areas are depicted in **RED** on the Evacuation Map. During Phase I there are no route restrictions.
- Phase II** - 40 Hours before onset of tropical storm winds. Includes areas south of the Mississippi River which are levee protected but remain vulnerable to Category 2 or higher storms. These areas are depicted in **ORANGE** on the Evacuation Map. During Phase II there are no route restrictions.
- Phase III** - 30 Hours before onset of tropical storm winds. Includes areas on the East Bank of the Mississippi River in the New Orleans Metropolitan Area which are within the levee protection system but remain vulnerable to a slow-moving Category 3 or any Category 4 or 5 storm. These areas are depicted in **YELLOW** on the Evacuation Map. During Phase III, certain routes will be directed and the Contraflow Plan implemented.

Phased evacuation procedures are for traffic management purposes only. Consult your local Office of Emergency Preparedness Director for further evacuation information.

# ***Traffic Control and Management***

- ***Traffic control devices***
  - ***Barricades, signs, markings***
- ***Contraflow***
  - ***Planning, design, analysis, operation***
- ***Infrastructure assessment & repair***



# ***Examples of Control Devices***



# ***Examples of Control Devices***



# *Examples of Control Devices*



# ***Hurricane Rita Evacuation - Interstate 45 (north of Houston)***



**Photo Source: Lt. John Denholm  
Harris Co. (TX) Sheriff's Office**

# *Hurricane Ivan Evacuation - Interstate 10 (west of New Orleans)*



Photo Source: A. Caterella-Michel  
Urban Systems, Inc.

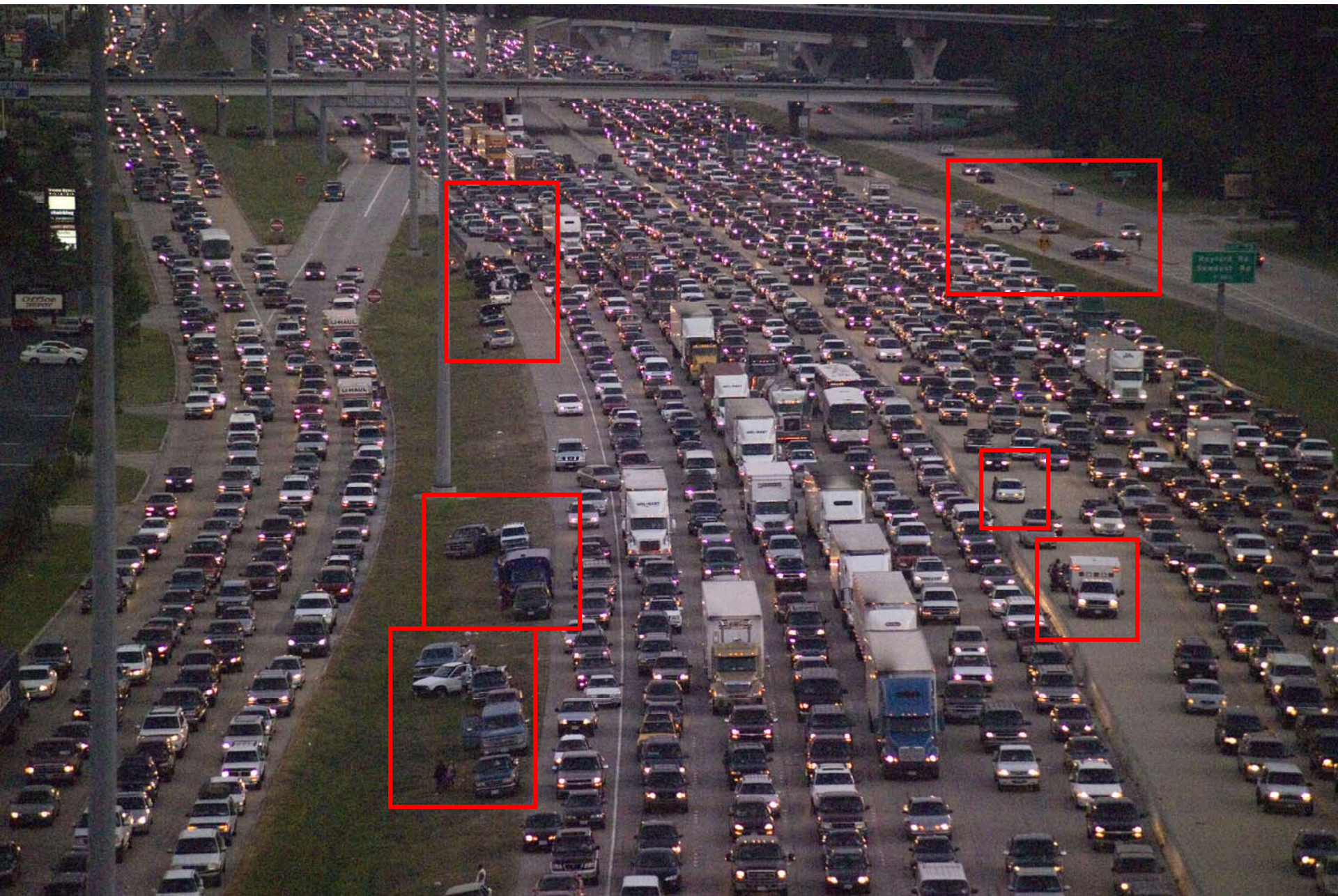
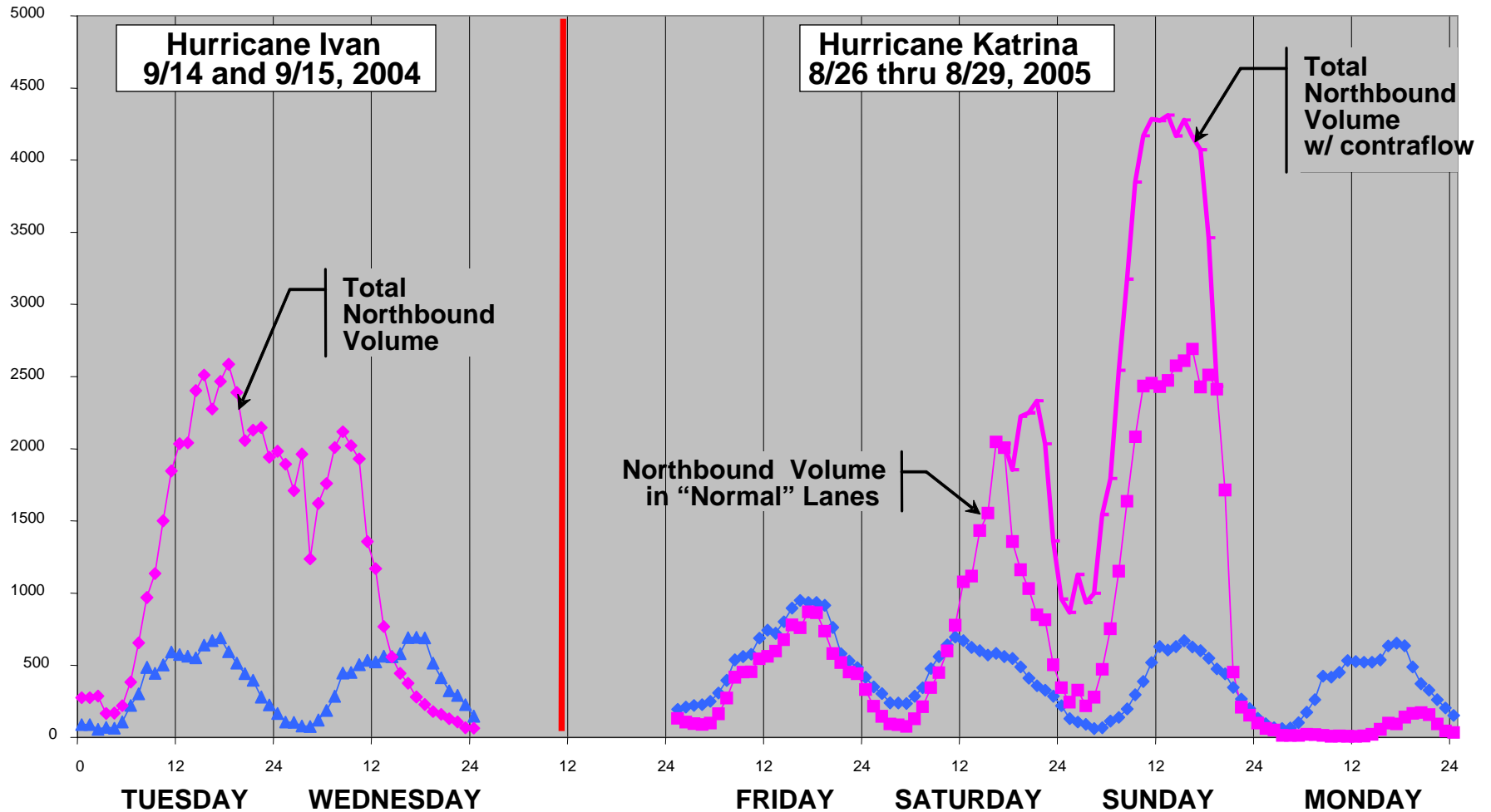


Photo Source: Yi-Chang Chiu, University of Arizona

# Effect of Contraflow on Traffic Volume



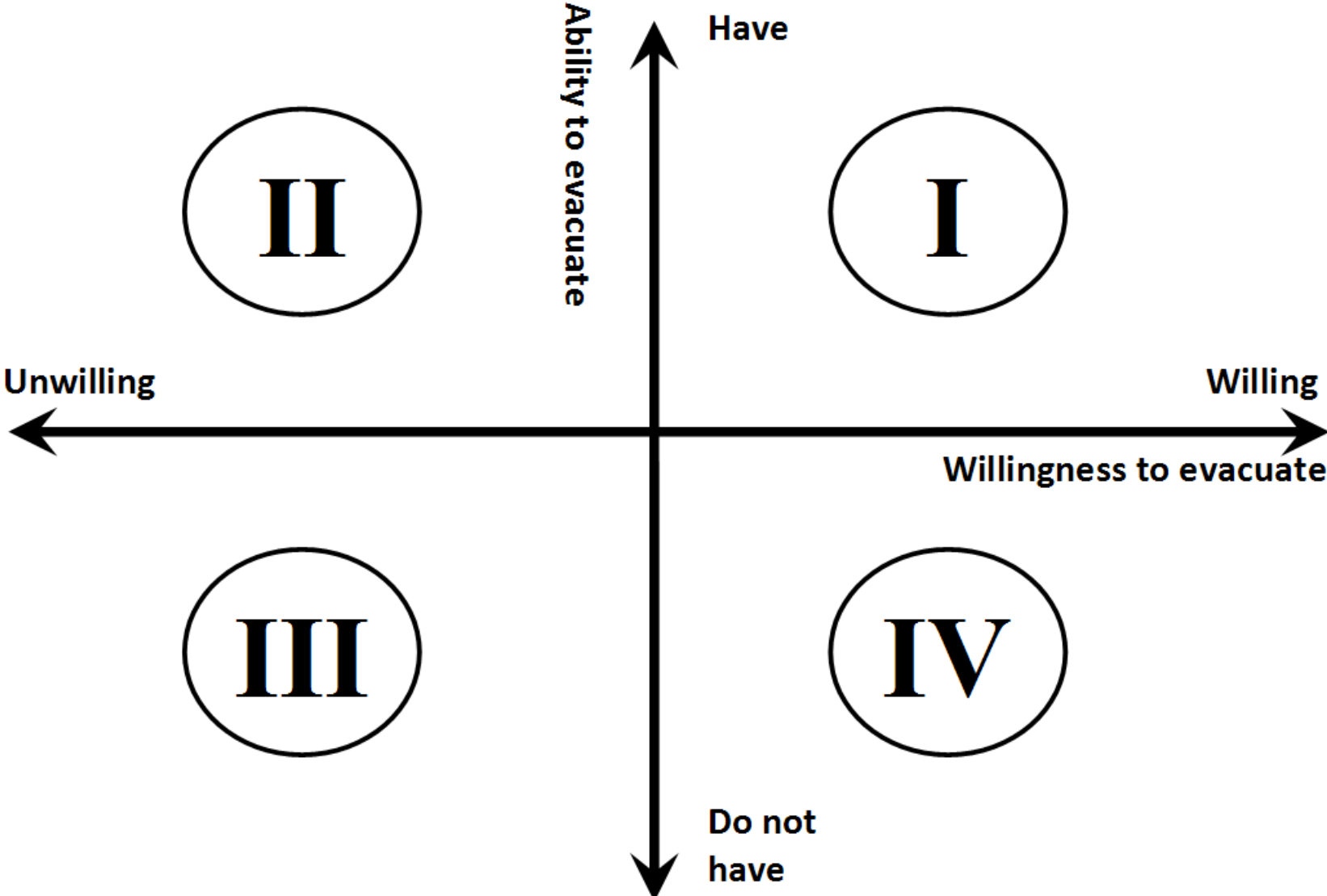
(Data source: LA DOTD)



# ***Assisted Evacuation***

- ***Individuals without personal transportation, elderly, infirm, tourists, economically disadvantaged, prisoners, homeless, etc.***
- ***How many persons fit these description?***
- ***Where are they located?***
- ***Who are they and what are there needs? medicine, oxygen, dialysis, etc.***
- ***Who is responsible for them if they are unable to take of themselves?***
- ***Where do they go? How do they come back?***

# ***Evacuee Categorization***





# ***Assisted Evacuation Planning Issues***

- ***Evacuation planning has historically been targeted at persons with personal vehicles***
- ***A substantial percentage of potential vulnerable populations do not have personal vehicles***
- ***Plans to evacuate “carless” populations in many locations have been created relatively recently or are currently in development***
- ***Few activations to gain knowledge and experience, nor tests, drills or simulations to evaluate potential weakness and needs***

# ***Reentry***

- ***Issues and challenges***
  - ***Managing access, desire to return, safety and security***
- ***Who is in charge?***
  - ***Emergency management agencies, law enforcement***
- ***Transportation agency roles***
  - ***road inspections, traffic management, debris removal, restoration of traffic control***
- ***Reentry options***
  - ***Credentialing & placards, tiered reentry, look & leave***



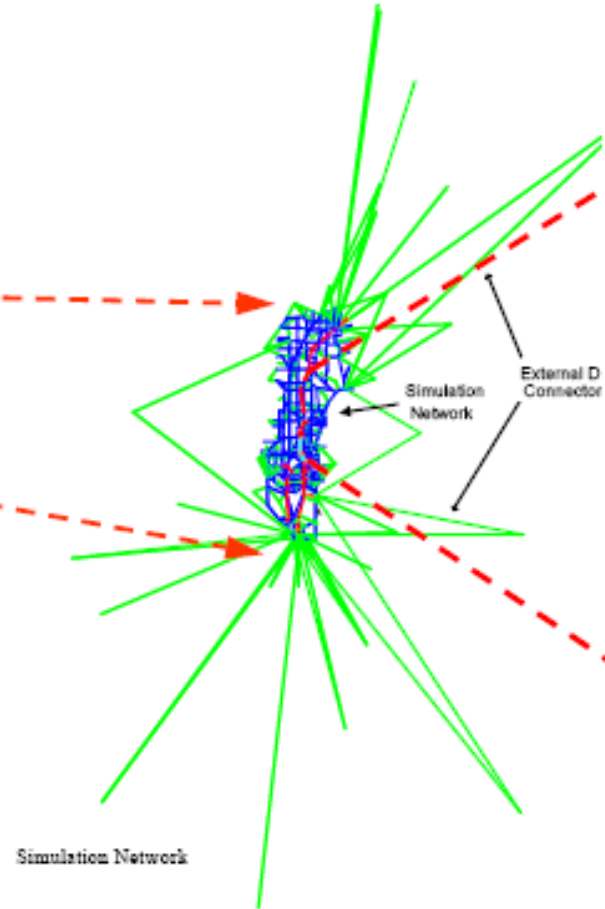
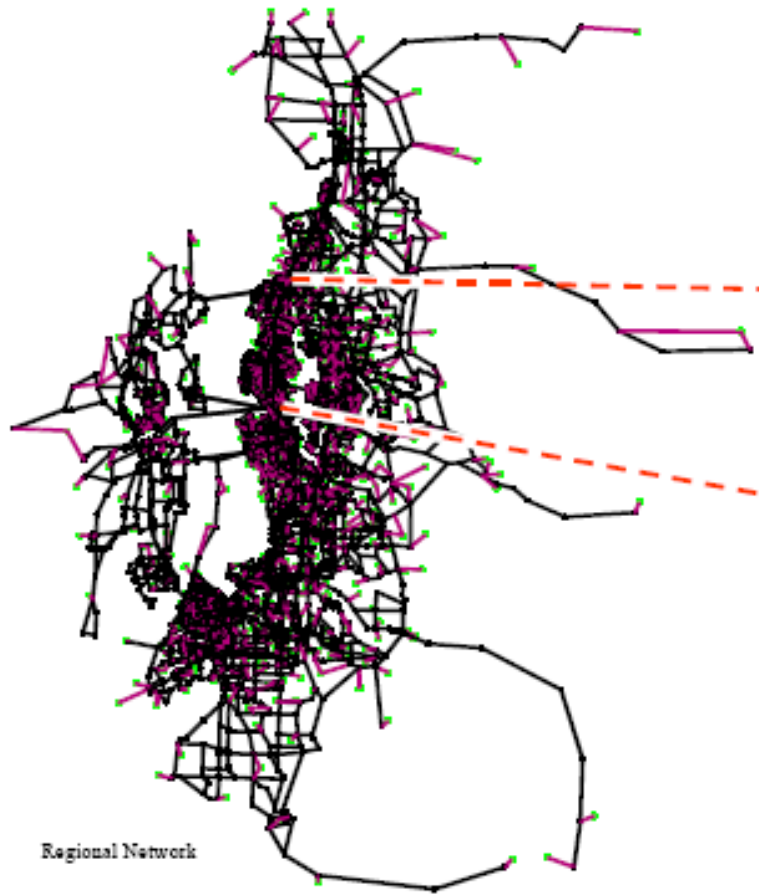
# ***Evacuation Traffic Modeling***

- ***Existing traffic/transportation simulation systems are not created to model evacuation conditions***
  - ***Scale (e.g., number of vehicles)***
  - ***Scope (e.g. duration, geographic area)***
- ***Existing models do not permit the modeling and simulation of multiple modes of transportation simultaneously***
- ***Most models are not able to give analysts the MOE's they'd like or decision-makers the answers to questions they pose***

# Seattle Area

# North Corridor

I-5

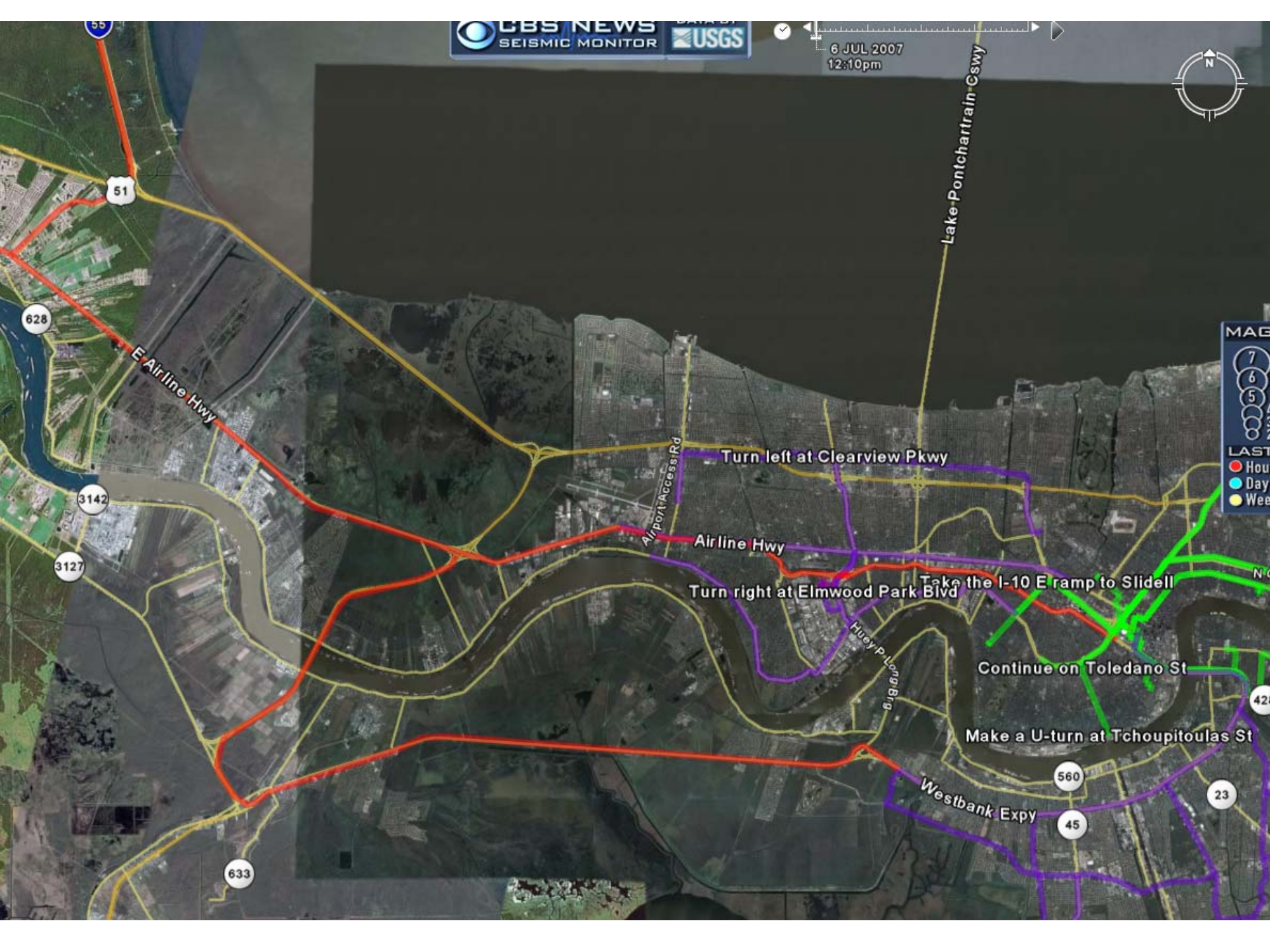


**MACRO**

**MESO**

**MICRO**





MAG

7  
6  
5  
4  
3  
2  
1

LAST

- Hour
- Day
- Week

Turn left at Clearview Pkwy

Airline Hwy

Turn right at Elmwood Park Blvd

Take the I-10 E ramp to Slidell

Continue on Toledano St

Make a U-turn at Tchoupitoulas St

Westbank Expy

Lake Pontchartrain Cswy

Airport Access Rd

Huey P. Long Blvd

E Airline Hwy

633

560

45

23

421

3142

3127

628

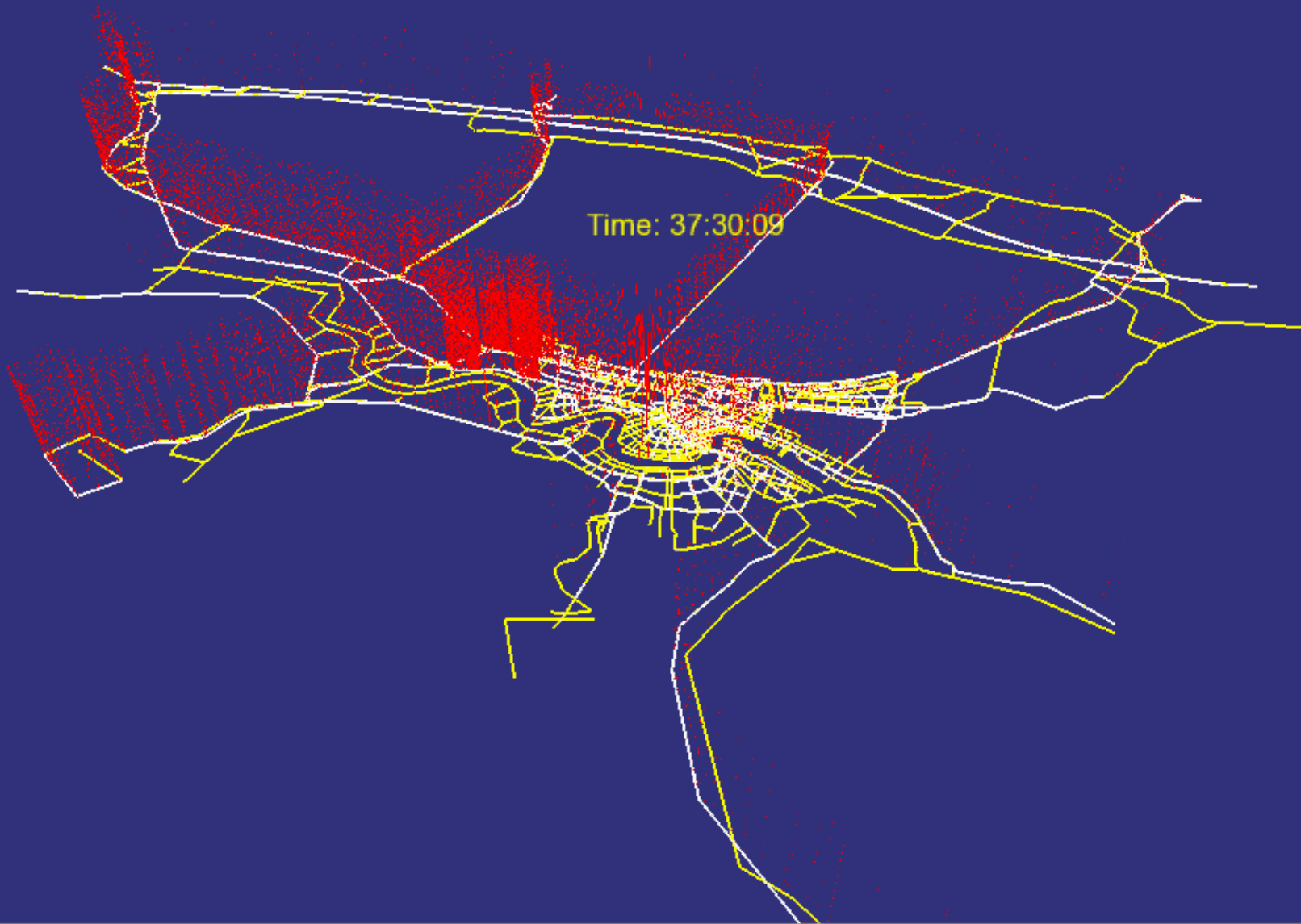
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55



Image © 2007 TerraMetrics  
Image © 2007 DigitalGlobe

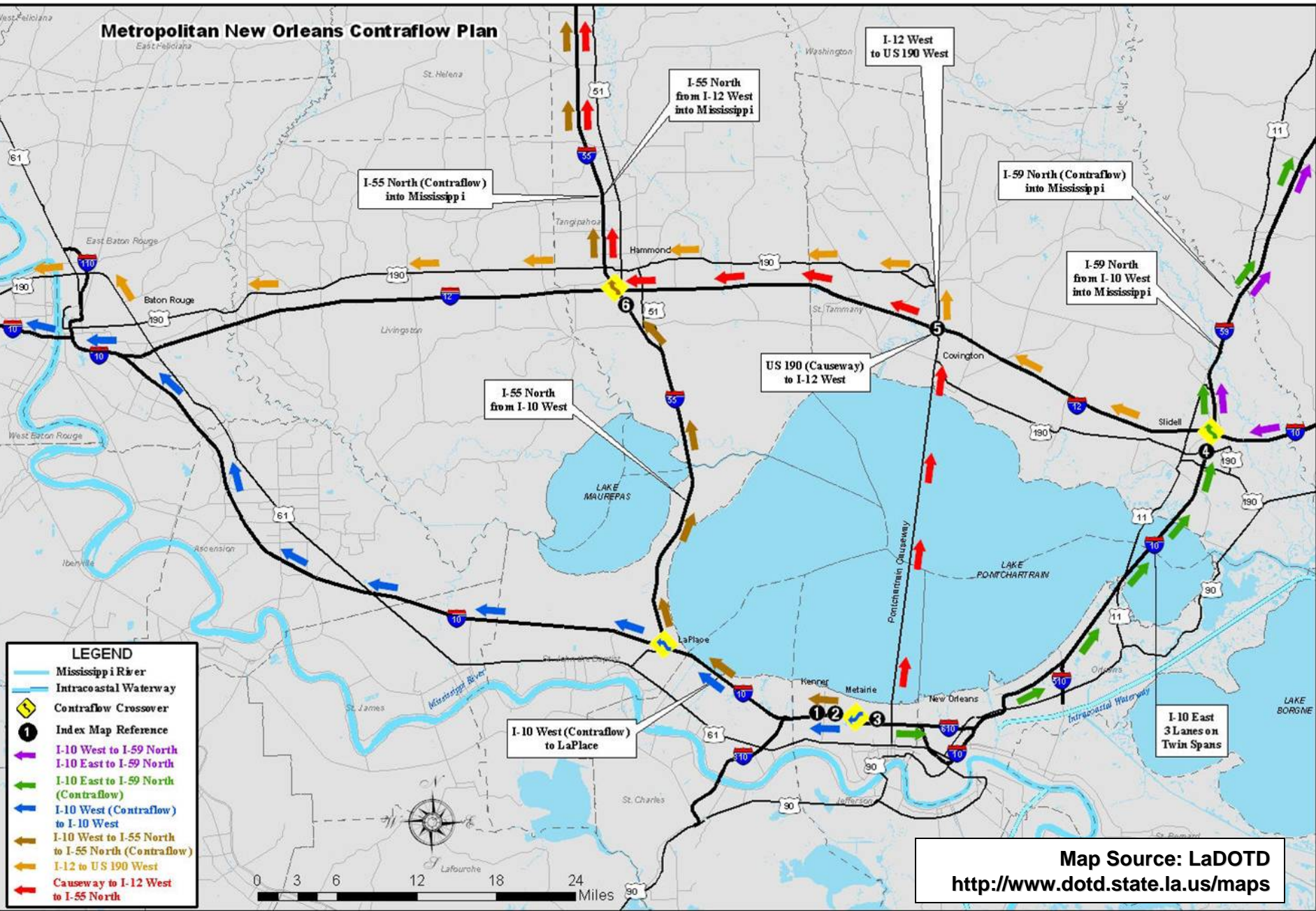
Google™



# ***Video #2***

***Post-Gustav  
Traffic Issues (?)***

# Metropolitan New Orleans Contraflow Plan



**LEGEND**

- Mississippi River
- Intracoastal Waterway
- Contraflow Crossover
- Index Map Reference
- I-10 West to I-59 North
- I-10 East to I-59 North
- I-10 East to I-59 North (Contraflow)
- I-10 West (Contraflow) to I-10 West
- I-10 West to I-55 North to I-55 North (Contraflow)
- I-12 to US 190 West
- Causeway to I-12 West to I-55 North

**Map Source: LaDOTD**  
<http://www.dotd.state.la.us/maps>



# Key Concepts - General

- **An evacuation of New Orleans will have consequences throughout the region**
  - **Impacts will be felt throughout Louisiana (particularly Baton Rouge) and Mississippi**
- **Regardless of what actions are taken, some degree of congestion is inevitable**
  - **Evacuations typically result in “too much” demand over “too short” a period**
- **Demand may be lowered by:**
  - **Encouraging the use of all available routes, not just interstate freeways**
  - **Temporally and spatially spreading out the loading of contraflow segments**
  - **Dispersing traffic in all “useable” directions (i.e., north in addition to west in Ivan)**
  - **Encouraging the “early” closure public offices in New Orleans and Baton Rouge**

# ***Key Concepts - General***

- ***“Forced” movements are more likely to keep traffic moving***
  - ***Plans should seek to eliminate or at least reduce decision points and their associated merging/weaving (and made clear to evacuees well in advance)***
  - ***A policy should be: “Leave early and go where you want. Leave late and go where you are told.”***
  - ***Suggest everyone evacuate with a full tank of gas and a map in the car as a part of seasonal hurricane preparedness messages.***

# **Key Concepts - Contraflow**

- **Contraflow will not “solve” all evacuation problems**
  - **It is only one tool to help address the problem**
- **Decisions at origins and destinations (particularly for contraflow) are linked**
  - **Routes without efficient loading points and unloading points will not operate effectively**
  - **Plans must consider what “goes in” and “what comes out” in tandem**
  - **For instance, a New Orleans evacuation will require actions in Baton Rouge**
  - **Routes such as the Causeway are not viable reversible candidates because they do not have adequate outflow capacity**

# ***Key Concepts - Contraflow***

- ***“Split” terminations work better than “Merge” Terminations***
  - ***Merge configurations can be effective if enough traffic is removed prior to the termination using intermediate exits***



# ***Key Concepts - Policy***

- ***Define and prioritize the goals of future evacuations and develop plans consistent with these goals***
  - ***Get people outside of the threat zone?***
  - ***Minimize travel time to destinations?***
    - ***Maximum flows are likely occur at lower than free flow speed***
  - ***Maintain a high degree of flexibility (route options) for evacuations***
- ***Plans must maintain flexibility***
  - ***Anticipate (and be prepared for) changes as conditions change***

# ***Key Concepts - Policy***

- ***It was apparent in this effort that we know much less than what we do not know***
- ***States should consider more comprehensive regional O-D studies that integrate evacuation behavior, travel demand modeling, and operational analyses***
  - ***This can be used to identify:***
    - ***Areas of likely congestion***
    - ***Underutilized routes***
    - ***Susceptible populations***
  - ***This information can then be used to develop best policies to address these issues***