

# FTA RESEARCH

FEDERAL TRANSIT ADMINISTRATION

## Evacuation and Return: Increasing Safety and Reducing Risk

OCTOBER 2019

FTA Report No. 0137  
Federal Transit Administration

**PREPARED BY**

Thomas P. Schrilla  
Office of Homeland Security and Emergency Preparedness  
City of New Orleans, Louisiana



U.S. Department of Transportation  
Federal Transit Administration

## COVER PHOTO

Evacuspot designation statue, © James Shaw 2014, courtesy of Evacuteer.org

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Office of Research, Demonstration and Innovation  
U.S. Department of Transportation  
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## Metric Conversion Table

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
<b>LENGTH</b>				
<b>in</b>	inches	25.4	millimeters	mm
<b>ft</b>	feet	0.305	meters	m
<b>yd</b>	yards	0.914	meters	m
<b>mi</b>	miles	1.61	kilometers	km
<b>VOLUME</b>				
<b>fl oz</b>	fluid ounces	29.57	milliliters	mL
<b>gal</b>	gallons	3.785	liter	L
<b>ft<sup>3</sup></b>	cubic feet	0.028	cubic meters	m <sup>3</sup>
<b>yd<sup>3</sup></b>	cubic yards	0.765	cubic meters	m <sup>3</sup>
NOTE: volumes greater than 1000 L shall be shown in m <sup>3</sup>				
<b>MASS</b>				
<b>oz</b>	ounces	28.35	grams	g
<b>lb</b>	pounds	0.454	kilograms	kg
<b>T</b>	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
<b>TEMPERATURE (exact degrees)</b>				
<b>°F</b>	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C

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## ABSTRACT

Evacuation represents an important strategy for preserving safety and minimizing the risks from disaster. However, a portion of the population face obstacles that prevent them from being able to evacuate on their own. In New Orleans, the local government maintains a plan to help these vulnerable residents to safely evacuate in the event they are not able to do so independently.

In the interest of improving cities' ability prepare for and execute an effective evacuation, New Orleans' City-Assisted Evacuation (CAE) plan was tested and evaluated to assess whether existing practices would adequately meet the needs of the vulnerable populations for whom they are intended. A comprehensive review of the CAE plan investigated multiple aspects of the process, from planning and design stages through implementation and execution.

The project concluded that some aspects of the process did not fully support the needs of New Orleans' vulnerable populations. Areas for improvement were identified and potential solutions proposed.

## EXECUTIVE SUMMARY

New Orleans, like many coastal communities, faces the risk of impacts due to tropical weather hazards such as hurricanes and tropical storms. These systems have the potential to cause significant damage, disruption, and loss of life to communities caught in their path. In the face of major storms, coastal evacuation historically has served as one of the primary strategies to mitigate these risks. In these cases, residents in the path of the storm are encouraged to temporarily flee the affected area until the danger has passed and conditions are safe for them to return. Though a majority of the population is able to evacuate and shelter independently, some are unable to do so. They may lack access to a vehicle or be unable to self-evacuate due to medical concerns or financial limitations. Whatever the reason, these individuals are unable to evacuate without assistance and, as such, are considered especially vulnerable to hurricane impacts.

Many of these individuals did not evacuate New Orleans prior to Hurricane Katrina in 2005, and the results were tragic. In the years following that disaster, the City of New Orleans developed a plan to help those in need and ensure that no person who wants to evacuate is left behind. New Orleans' City-Assisted Evacuation plan details a process by which the City will cooperate with State and Federal agencies to provide resources and facilitate the evacuation of all who are unable to leave on their own. This plan was put into action with some success prior to Hurricane Gustav in 2008. Since then, New Orleans officials have made continued efforts to further improve the plan and ensure that the process as designed meets needs of the populations whom it is intended to serve. This report represents another step forward in that effort.

Using New Orleans' City-Assisted Evacuation as a case study, this project sought to improve the ability of cities to implement effective evacuation planning and improve execution of the evacuation process. Much of this research focused on vulnerable populations and efforts to ensure that the evacuation process adequately supports their needs.

## Findings and Conclusions

The study found that, in many cases, the needs of New Orleans' vulnerable populations were not sufficiently met by the existing City-Assisted Evacuation process.

A series of exercises simulating the evacuation process revealed multiple areas in need of improvement. Though the process was functional, challenges related to coordination, staffing, training, and resource limitations resulted in a process that, without improvement, would likely not happen quickly enough to meet the demands of a limited evacuation timeframe. More specifically, the process became bogged down as staff struggled to accommodate the diverse medical and functional needs of evacuees while simultaneously navigating a complicated registration and tracking process. In some cases, a lack of access to



communications and inadequate information-sharing presented further challenges. These issues highlighted the importance of planning for the medical and functional needs of evacuees, ensuring that all staff are able to communicate effectively, and designing a registration and tracking process that prioritizes speed and efficiency.

Additionally, evaluation by the University of New Orleans and additional partners found that aspects of the City's evacuation planning process and public awareness campaign were not as efficient or accessible as they could be. An analysis of three transportation databases used for evacuation planning found that a lack of information-sharing resulted in significant overlap and redundancy, for which consolidation was recommended as a potential solution. Public outreach surrounding the City-Assisted Evacuation had not reached fully into the community, and many still were unaware of the option. To address this, an outreach strategy was developed that detailed multiple recommendations for increasing awareness. Furthermore, geospatial analysis suggested that the locations of the 17 pick-up points that constitute the backbone of the City-Assisted Evacuation process did not completely align with today's areas of vulnerability. This leaves coverage gaps, areas in which evacuees without transportation may need to walk long distances to the nearest pick-up location.

## Benefits

The research conducted under the scope of this project resulted in several actionable recommendations, many of which are already in the process of being implemented. Since completion in 2017, the City of New Orleans has taken steps to address identified areas for improvement and ensure that its City-Assisted Evacuation process is capable of meeting the needs of the city's population. These improvements include identifying a larger venue to support expanded staffing and coordination for the evacuation process, improving the evacuation database structure, expanding public outreach to raise awareness of the process, identifying more efficient ways to evacuate medical and special needs residents, and increasing support for the evacuation of pets and service animals. The result is an evacuation plan that officials believe is much more likely to be safe, accessible, efficient, and, most importantly, successful the next time it is needed. To them, each resident evacuated represents a potential life saved.

The insights and recommendations generated by this project may also provide inspiration and guidance to other communities across the U.S. who seek to evaluate and improve their own evacuation plans. Whereas New Orleans served as the testing ground, many of the challenges detailed in this report are common to jurisdictions throughout the country. As such, we believe that the solutions, recommendations, and lessons learned here may also prove to be applicable.

# Introduction

The City of New Orleans' "Evacuation and Return: Increasing Safety and Reducing Risk" project was undertaken in an effort to improve the ability of cities to implement effective evacuation planning and improve execution of the evacuation process. Although New Orleans served as the testing ground for this project, the fundamental issues and situations involved are not unique to this setting. It is hoped that the insights gained through this research may prove beneficial to communities throughout the country facing similar challenges.

The Federal Transit Administration (FTA) funded this project as part of an initiative to develop and showcase promising technologies, methods, practices and techniques that improve public transportation systems in the area of all-hazards emergency response and recovery [1]. The project was approached as a partnership among the City of New Orleans, the New Orleans Regional Transit Authority (NORTA), and the University of New Orleans Center for Hazards Assessment, Response & Technology (UNO-CHART). Emphasis was placed on improving the City's ability to ensure the safe and efficient evacuation of its most vulnerable residents.

## Background

Every community faces risks of damage and disruption due to natural and human-caused disasters. Throughout the United States, the effects of disaster claim numerous lives and cause billions of dollars in economic damages every year, including an estimated 3,278 deaths and more than \$300 billion in losses for 2017 alone [2]. Long-term social, economic, and environmental effects can linger for years.

Although the specific hazards faced may vary from location to location, threats posing a great enough danger to public safety may lead authorities to consider the large-scale evacuation of communities at risk. Over the past 10 years, such evacuations have been ordered in response to hurricanes [3], wildfires [4], dam or levee failures [5], hazardous materials releases [6], and other hazards with the potential to create a wide area of unsafe conditions.

Like many communities across the United States, the city of New Orleans faces a number of the hazards noted, with hurricanes and tropical storms being among the most prominent and well-documented [7]. In response to its vulnerability and the reality that conditions may occasionally necessitate the evacuation of the city and surrounding areas, the City of New Orleans works in partnership with local, State, and Federal agencies to develop and maintain plans for an emergency evacuation. In Louisiana, large-scale evacuations of the state's vulnerable coastline

are coordinated at the State level, with individual parish (Louisiana’s jurisdictional equivalent to counties) and city-level plans designed to integrate into the overall process.

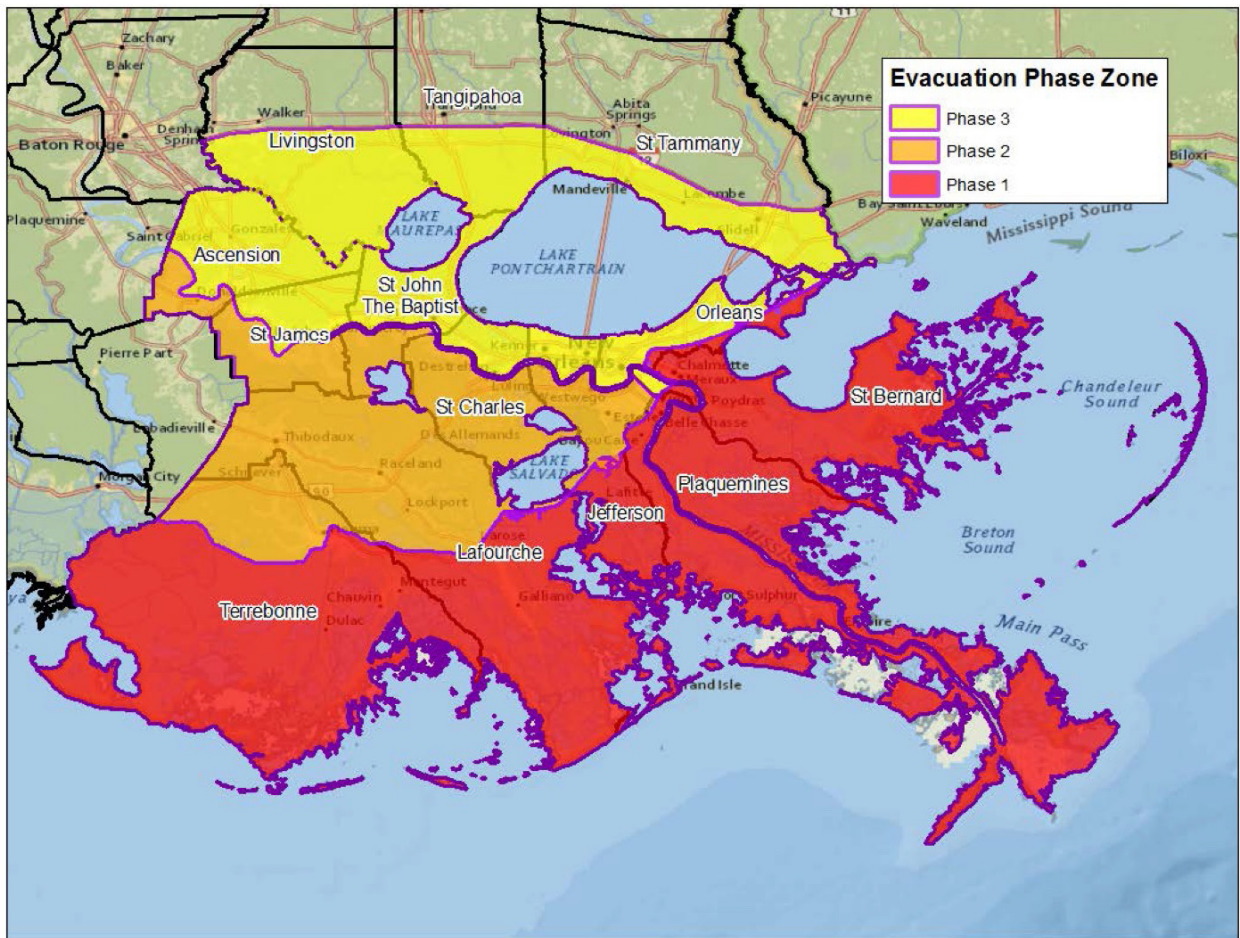
## Coastal Evacuation in Louisiana

In the event of an impending hurricane or similar circumstance requiring large-scale evacuations in southern Louisiana, it is likely that multiple communities across the state may be required to evacuate their residents concurrently within a shared, limited timeframe. To accommodate the rapid movement of such a large population over a limited transportation network, the State has employed two key strategies as part of its evacuation plans—division of the evacuation into timed phases and implementation of contraflow procedures.

In an attempt to reduce traffic bottlenecks and ensure that the most vulnerable communities are given ample time to evacuate, the State of Louisiana’s evacuation plans divide the process into three phases based upon geography and community vulnerability:

- *Phase I* of the evacuation includes areas nearest to the coast of the Gulf of Mexico, extending northward to the Gulf Intracoastal Waterway. These areas generally exist outside of major levee protection systems. Communities in these locations are often highly vulnerable to impacts from tropical systems and are the first to evacuate ahead of a storm.
- *Phase II* involves evacuation of communities further inland from the Phase I areas, between the Gulf Intracoastal Waterway and Interstate 10. These communities are largely protected by levees but remain vulnerable to impact from major storms. Plans call for Phase II to begin approximately 10 hours after the start of Phase I.
- *Phase III* expands to communities on the east bank of the Mississippi River, extending north to Interstate 12 and includes the New Orleans metropolitan area. Although these locations are mostly within levee protection systems or at higher elevations than Phase I and II areas, they remain vulnerable to impact and may need to evacuate in advance of major storms. Plans call for Phase III to begin approximately 10 hours after the start of Phase II.

Figure I-1 shows the geographical extent of the three evacuation phases for the area of southeast Louisiana [8].

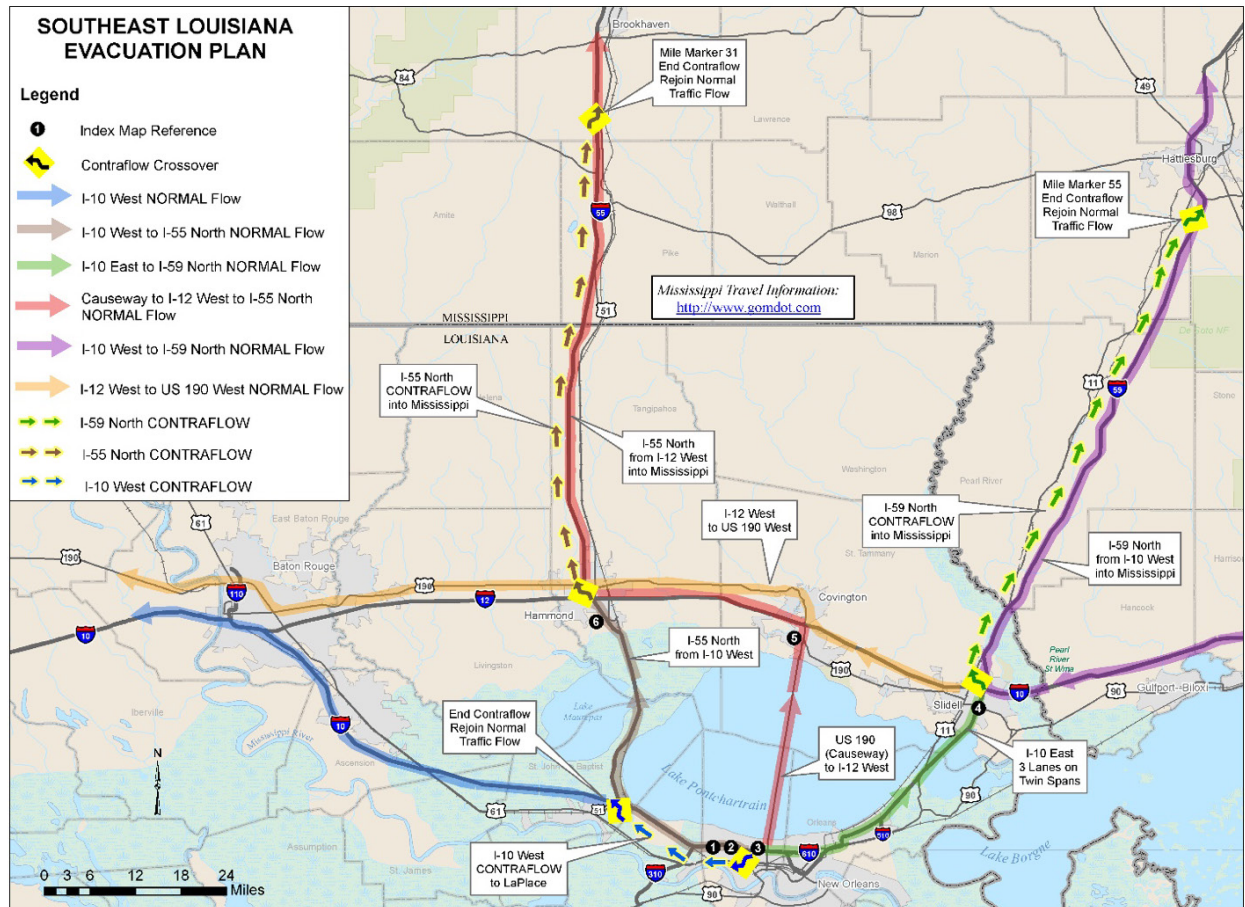


**Figure 1-1**

*Evacuation phase map for Southeast Louisiana region*

Despite the phased approach, the increase in traffic volume due to evacuating vehicles risks creating congestion on area highways. In an effort to address the demands of traffic flow likely to result under a major evacuation, Louisiana evacuation plans call for the implementation of contraflow lane reversal in selected segments of the area's major highways. For these stretches of roadway, some or all of the normally inbound lanes will be temporarily diverted to accommodate additional outbound traffic. Under these conditions, flow of evacuation traffic is enhanced by access to additional lanes and movement of all vehicles in the same direction, away from the evacuating communities. Figure 1-2 details planned contraflow procedures for highways in southeastern Louisiana [9].





**Figure 1-2**

*Evacuation contraflow routes, Southeast Louisiana and Southern Mississippi*

The majority of residents leaving evacuating areas are able to provide for their own transportation and shelter for the duration of the evacuation. Polling efforts following the Hurricane Gustav evacuation indicated that approximately 94% of evacuees traveled using privately-owned vehicles (POVs), and most stayed with relatives or friends (53%) or in hotels and motels outside of the affected area (34%) [8]. By virtue of their access to a POV, these evacuees have the freedom to determine when to leave, which route(s) to take, and where to stay.

Although most will evacuate and shelter on their own, many individuals and families are unable to do so. This could be for a variety of reasons—they may not own a vehicle or be unable to drive one, they may suffer from medical or other conditions that complicate travel, or perhaps they lack the financial means to pay for gas, food, and lodging for the duration of an evacuation period. Whatever the reason, this portion of the population is unable to participate in the standard state evacuation process by POV and are considered as having Critical

Transportation Needs (CTNs). For these individuals, the State and respective parish and city governments across Louisiana make arrangements to provide assistance and ensure that none are left behind. These plans, developed in an effort to help vulnerable individuals evacuate, represent the primary focus of this project.

## New Orleans' City-Assisted Evacuation Process

### History

Following lessons learned from the tragedies of Hurricane Katrina in 2005, New Orleans City officials recognized the need to ensure that individuals and families who were unable to evacuate on their own would not be left behind in future disasters. This led to the development of a plan by which the City, in partnership with State and Federal agencies, would facilitate the evacuation of CTNs who would otherwise be unable to evacuate themselves. The final result of this process, the New Orleans City-Assisted Evacuation Plan, would be implemented for the first time during the 2008 Atlantic hurricane season.

On August 25, 2008, a tropical depression formed in the Caribbean, south of the island of Hispaniola. Less than 24 hours later, the storm had strengthened into a Category I hurricane, now named Gustav. Hurricane Gustav had already begun to impact Haiti and the Dominican Republic and appeared on track to make landfall on Haiti's southern coast.

At this time, forecasters with the National Hurricane Center (NHC) were already predicting that Gustav could travel north through the Gulf of Mexico and make landfall somewhere in Louisiana within the next 4–5 days. Officials in Louisiana met as early as August 26 to discuss the potential for evacuations [10] and continued to plan and monitor the storm's progress, which remained on course for a Louisiana landfall. Evacuation was deemed likely, and the City and State activated their evacuation plans. New Orleans began the City-Assisted Evacuation (CAE) process on Friday, August 29, and then-Mayor C. Ray Nagin publicly ordered the mandatory evacuation of New Orleans on Saturday evening, effective the following morning [11]. The CAE operation continued until Sunday afternoon following a deadline extension to accommodate last-minute evacuees.

The activation in advance of Hurricane Gustav was the first—and, to date, remains the only—time that the CAE has been put into effect in New Orleans. By 3:00 PM on August 31, the CAE had transported roughly 18,000 people [12] by bus from New Orleans to shelters in northern Louisiana and neighboring states of Alabama, Arkansas, Oklahoma, and Texas [13]. Although largely

successful, lessons learned from observations during the Gustav activation have shaped the continued improvement and further development of the CAE process ever since.

Between the initial implementation of the CAE in 2008 and the execution of this study in 2017, the New Orleans area experienced significant population growth and demographic changes. In 2005, Hurricane Katrina resulted in the evacuation and long-term displacement of a large portion of the city's population, the effects of which were still evident at the time the CAE was implemented in advance of Hurricane Gustav. U.S. census estimates placed the population of Orleans Parish in 2008 at approximately 301,842, just over 60% of its pre-Katrina population of 494,294 [14]. By 2017, following years of continued repopulation and rebuilding, the total population estimated by the Census had increased to 393,292.

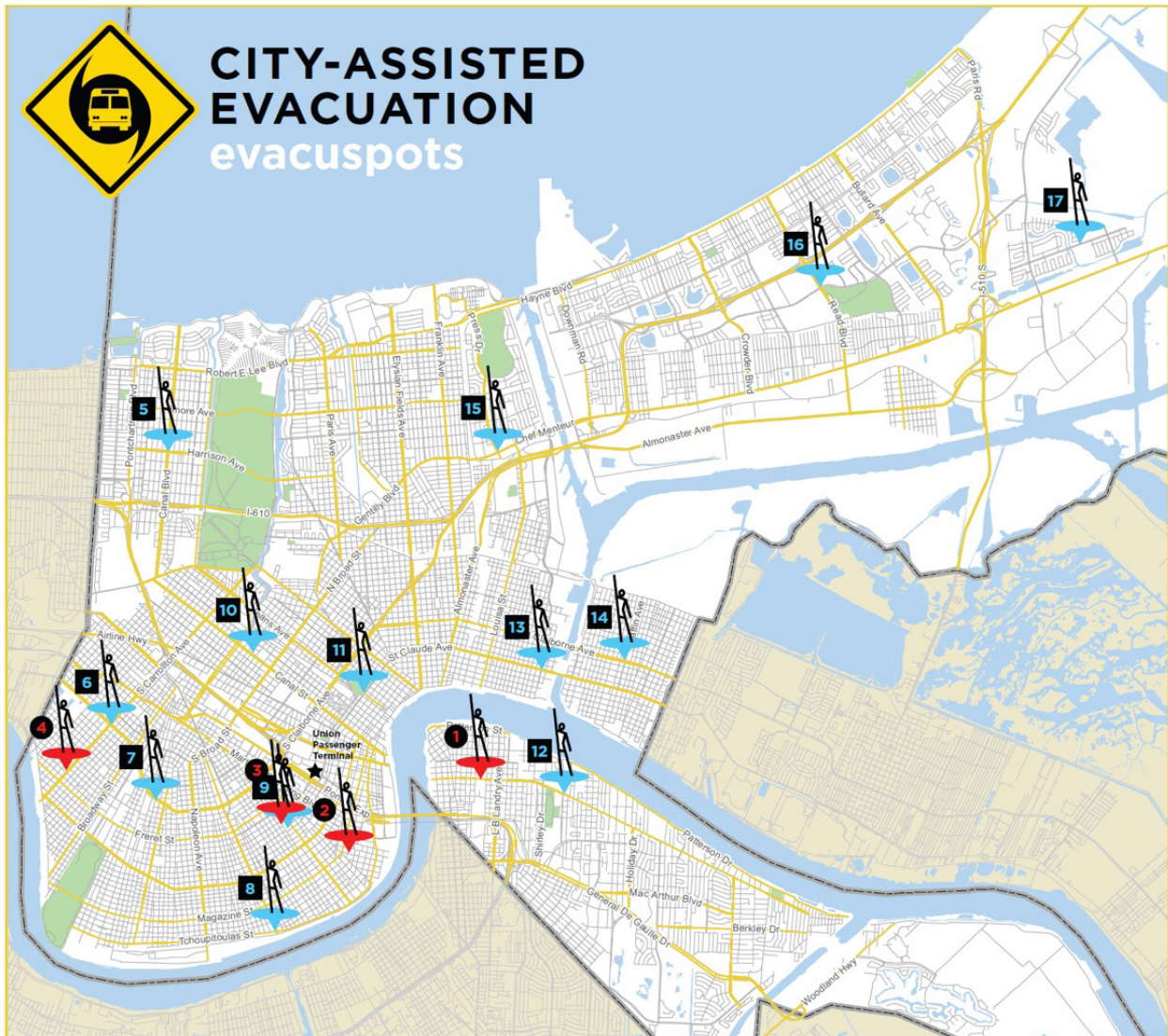
As the city's population continues to grow, so, too, does the need for evacuation assistance. Emergency planners' estimates of the number of residents who will use the CAE increased from the 18,000 observed during Gustav to nearly 40,000 expected if the CAE were implemented in 2017. These increasing demands have forced City officials to reevaluate the model used in 2008 in an effort to ensure that the process will be able to successfully evacuate all individuals needing assistance and to identify more efficient and effective ways to accommodate a growing population in need.

### Concept

To access CAE, residents are asked to report to one of 17 pre-designated pick-up points, locally referred to as Evacuspots. These Evacuspots are spatially distributed throughout the city in an effort to provide coverage within reasonable distances from the majority of CTNs who may need to use them. Figure I-3 shows a map of these locations.

From the Evacuspots, evacuees board a city bus (NORTA or contracted) bound for New Orleans' Union Passenger Terminal (UPT), which serves as the central collection and processing point for evacuees. At the UPT, evacuees complete a brief registration process before ultimately being directed to State-provided coach buses bound for a shelter outside of the at-risk area.





**Figure 1-3**  
New Orleans CAE Evacuspots

### Situation and Assumptions

Design and development of New Orleans' CAE Plan has primarily focused on a hurricane scenario—specifically, a “major” hurricane, defined as one measuring Category 3 or above on the Saffir-Simpson Hurricane Wind Scale, which appears on course to directly impact New Orleans. This is thought to represent the most likely situation under which the CAE would be implemented.

Although every tropical cyclone presents a unique threat with regard to track, timing, and nature of hazards and must be evaluated as such, the general rule-of-thumb used by local officials is that the City will typically plan to shelter-in-



place for lower-level storms (Category 2 or below) and evacuate for “major” hurricanes of Category 3 or higher. This represents a guideline only, with the final determination for each storm being made by City officials based upon the unique hazards and risks anticipated. Dependent on circumstances, it is possible that the CAE could be implemented for weaker storms or for a non-tropical event altogether.

The CAE Plan is based upon several key assumptions. Although these assumptions may not hold true under all circumstances, City officials believe they are reasonable and likely to be valid for the majority of situations in which the CAE might be implemented.

To successfully implement the CAE, the City of New Orleans requires extensive support from local, State, and Federal partners, non-profit groups and the private sector. The process is truly a team effort, as the City does not have the resources to accomplish such an undertaking unilaterally. New Orleans relies on external entities to provide critical resources, including evacuation buses, key buildings and facilities, staffing at CAE facilities, law enforcement and security services, pet evacuation support, and a wide variety of other elements essential to the overall process.

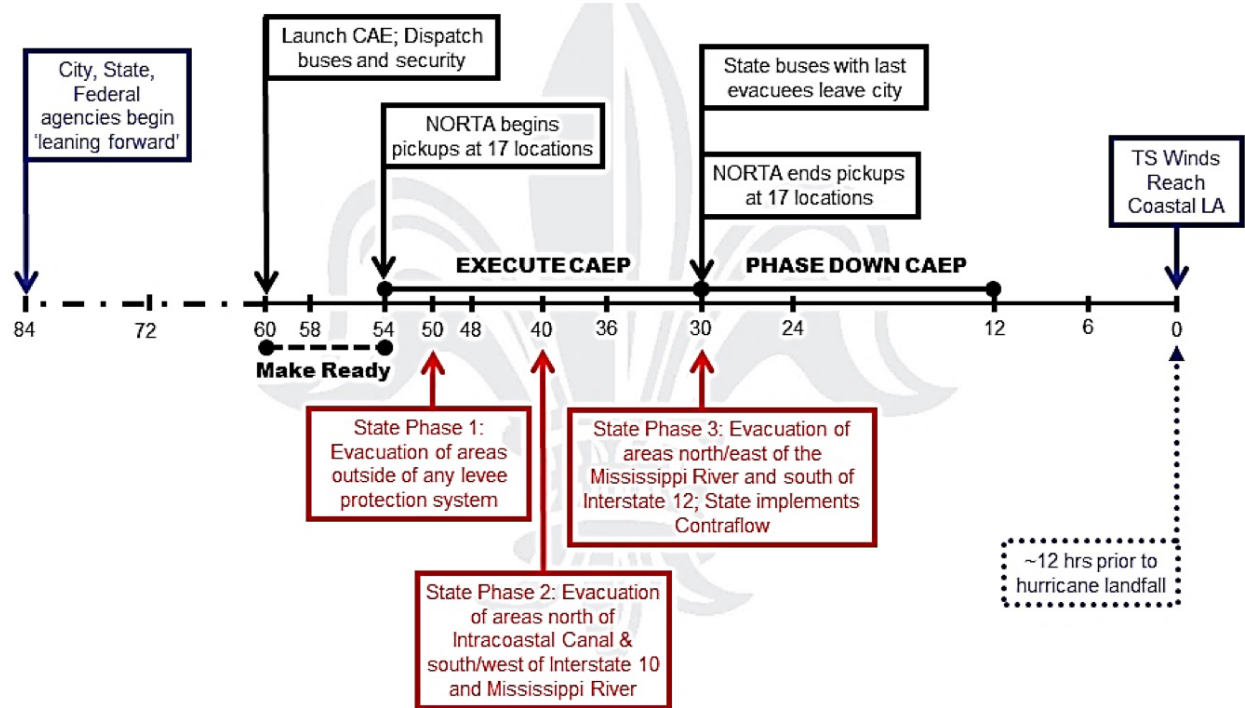
Emergency officials assume that these resources will be available in the event of an evacuation and conduct extensive planning and coordination efforts yearly to verify readiness for the upcoming hurricane season. If unforeseen external factors were to limit or prevent access to these resources, the efficacy of the CAE could be impacted until contingencies are identified.

The CAE timeline as planned assumes that the initial steps of New Orleans’ CAE process will begin approximately 84 hours prior to the onset of tropical storm-force (39 mph, or 63 km/h) winds.

Planners use the “H-Hour” concept to communicate this timeline in relation to storm landfall, with “H-Hour” representing the time at which tropical storm-force winds are anticipated to reach the coast. In this context, the phrase “H minus X” denotes the time X hours prior to onset of tropical storm winds. As an example, “H-24” signifies the time 24 hours prior to onset of tropical storm winds.

Local, State, and Federal agencies plan to begin “leaning forward” by coordinating and pre-staging resources at approximately H-84, with the ultimate decision whether or not to implement the CAE being made the following day, at approximately H-60. Following a 6-hour “make ready” period, the CAE is expected to run for 24 hours before winding down at H-30 when contraflow procedures begin on area interstate highways.

Figure I-4 details the planned timeline of events during an execution of the CAE. Changes to this timeline are likely to have significant impacts on the timing and availability of resources necessary to implement the CAE successfully.



**Figure 1-4**

*Expected timeline of events for New Orleans evacuation scenario*

In New Orleans, a city with an estimated population of nearly 400,000, emergency planners predict that roughly 10% of residents (35,000–40,000 people) will require assistance from the City to evacuate safely. This figure is based on experience from prior evacuations, phone surveys completed by residents regarding anticipated evacuation plans, and data from the City's Special Needs Registry (SNR), a database maintained by the New Orleans Health Department that contains information on city residents with documented medical, functional, and access needs.

Many evacuees will require additional assistance in dealing with these special needs, in addition to other complicating factors such as evacuation of pets and service animals. The City has plans in place to provide additional support to accommodate these individuals. Based on the sources above, planners estimate that the total population needing evacuation assistance will include roughly 30,000 members of the general population, 5,000–10,000 older adult and special needs individuals, and 1,000 to 2,000 pets.

# Project Outline

## Purpose

The City of New Orleans proposed a multi-faceted project with the purpose of improving the evacuation of the city's most vulnerable populations. For the purpose of this project, the term "vulnerable populations" refers to include those who are not able to access or use the standard resources offered in disaster preparedness, planning, response, and recovery. Dependent on the type of emergency, factors such as poverty, health, age, race, language, and other social, cultural, economic, and psychological factors may contribute to individuals' vulnerability and ability to take care of themselves during an emergency.

## Scope

In an effort to identify ways to better serve the city's vulnerable populations in an evacuation scenario, this research project was developed as a collaborative effort among the City of New Orleans, NORTA, and UNO-CHART. The project included a two-part exercise series focused on the CAE process as well as a thorough analysis and evaluation of the city's existing Evacuspote locations and outreach strategy relative to vulnerable populations.

## Participants

The City of New Orleans, as the primary entity responsible for coordinating the development and implementation the CAE, served as the lead agency for this project. The New Orleans Office of Homeland Security and Emergency Preparedness (NOHSEP), the City's emergency management agency, led the effort on behalf of the City. NOHSEP was responsible for coordinating the exercise series, which included both a Tabletop Exercise and Full-Scale Exercise on the CAE process. Additionally, NOHSEP, as the coordinating agency for public safety in New Orleans, was responsible for securing involvement of additional City departments and external partner organizations (State and Federal agencies, non-profit and private sector groups) in support of the project.

The New Orleans Regional Transit Authority is the designated provider of public transportation for Orleans Parish. Although the City is responsible for leading the evacuation effort, it does not possess the substantial mass transit resources needed to accomplish this operation without support. As such, it relies heavily on NORTA to provide transportation assets and expertise necessary for successful implementation of the CAE.

During daily operations, NORTA provides service via 34 bus routes, 5 streetcar lines, and 2 ferries across the Mississippi River, as well as paratransit services for

individuals with disabilities. During the CAE, everyday service may be reduced or suspended, as NORTA buses and paratransit vehicles are used to provide evacuation support. Under the CAE Plan, NORTA is tasked with providing transportation from the 17 Evacuspots to the central processing facility at the UPT. Additionally, NORTA paratransit resources support the evacuation of residents with special needs. NORTA was responsible for providing these services on a limited scale for the exercise series and for contributing transit-related subject matter expertise to all aspects of the project.

The Center for Hazard Assessment, Response & Technology (UNO-CHART) is an applied social science research center housed within the University of New Orleans. UNO-CHART supports research into sustainability and resilience efforts as they relate to natural, technological, and environmental risks. Through applied research, the faculty, staff, and students of UNO-CHART work to assist area residents, community groups, and government officials in understanding and reducing their risk to hazards. As a partner in this project, UNO-CHART was responsible for incorporating the latest in academic research and best-practice study into an analysis of existing local databases pertaining to evacuation, mapping of the spatial distribution of Evacuspots relative to vulnerable demographics, and evaluation of the of the City's outreach efforts surrounding the CAE. In accordance with the goals of the project, this research focused especially on the needs of vulnerable populations in New Orleans.

These three organizations represented the primary participants in the execution of this project. However, participation from numerous other supporting organizations was essential to a successful implementation. These included a wide array of City, State, and Federal agencies, regional partners from neighboring jurisdictions, community non-profit and volunteer organizations, private-sector stakeholders, and City-contracted service providers.

# Methodology

City-Assisted Evacuation is a complicated process, with many disparate factors playing a role in its success or failure. To address as many of these factors as possible, the project partners opted to approach the evaluation of the CAE with a multi-faceted methodology. The basic operational, technical, and coordination elements of the CAE were tested via a two-part exercise series, conducted in compliance with the federally-developed Homeland Security Exercise and Evaluation Program (HSEEP). Additional factors such as public awareness, accessibility, and geographic distribution of resources related to the CAE were evaluated through comparison to published academic research, accepted best practices, stakeholder interviews and focus groups, and analysis of social vulnerability indicators across the city. Through this approach, project partners hoped to gain a more complete understanding of the effectiveness of the CAE in the areas of public awareness and outreach, planning, and execution.

## CAE Exercise Series

The City arranged to conduct two public safety exercises in advance of the 2017 hurricane season to test and evaluate the CAE process. The first exercise was planned as a tabletop exercise, in which representatives from various agencies involved in the CAE gathered and participated in facilitated discussion of a hypothetical hurricane evacuation scenario. This discussion was to serve as a preparation for the second exercise, a full-scale test of the CAE. This full-scale exercise involved real-world operation of multiple Evacuspots and the central processing center using real personnel, locations, and equipment. Ideally, exercise planners hoped to verify that plans on paper could be put into practice successfully and to identify potential areas for improvement.

### CAE Tabletop Exercise

The first step of the exercise series was a tabletop exercise. As defined by HSEEP, tabletop exercises are “typically held in an informal setting intended to generate discussion of various issues regarding a hypothetical, simulated emergency ... aimed at facilitating conceptual understanding, identifying strengths and areas for improvement, and/or achieving changes in attitudes” [15]. This exercise was intended to allow participants to talk through decisionmaking processes, discuss agency procedures, work through a hypothetical timeline of actions and events, and identify priorities for evaluation during the full-scale exercise.

### *Tabletop Objectives*

The exercise planning team identified the following four objectives for the tabletop exercise:

1. Assess whole-community decisionmaking processes and the ability to respond to a mandatory evacuation hurricane by implementing the CAE Plan and the City Emergency Operations Plan (CEOP).
2. Discuss strategy and methods to deliver coordinated, prompt, reliable evacuation information to the whole community.
3. Identify improvements that could enhance the CAE and CEOP.
4. Discuss strategy and processes to conduct a tiered re-entry and reunification of affected population post-hurricane.

Exercise participants were instructed to keep these objectives in mind, and the exercise facilitator and moderators worked to guide the group's discussions toward topics in alignment with accomplishment of the objectives.

### *Modules*

The exercise was divided into four modules, each comprising a different phase of the evacuation process:

1. Make Ready (H-60 to H-54)
2. Execution (H-54 to H-30)
3. Phase Down (H-30 to H-6)
4. Re-Entry (post-storm)

Due to the significant situational and operational differences from each phase to the next, discussion was intended to focus on only one phase at a time. Participants worked through each phase chronologically, moving on to the next phase only after the objectives for the previous phase had been sufficiently addressed.

### *Participation*

Participation drew from a wide spectrum of local, State, and Federal agencies, all of which play a significant role in the execution of the CAE. In addition to whole-group discussion of the scenario, participating agency representatives were divided into nine functional groups, each focused on a specific functional area or subtopic within the entire process. Each agency representative's functional group was assigned based upon his/her respective organization's response role and area of expertise. The nine functional groups included:

- Local Unified Command and Emergency Management
- Local Public Health and Medicine
- Regional/State Emergency Management and Public Health
- Transportation

- Firefighting, Sheltering, and Volunteer Organizations
- Communications, Tourism, and Hospitality
- Law Enforcement and Security
- Schools, Universities, and Private Sector
- Federal Support

Each functional group was assigned its own dedicated moderator, whose role was to guide the group's internal discussions. For each module, group members were given the opportunity to discuss the actions that would hypothetically occur within their respective area during the evacuation phase in question.

## CAE Full-Scale Exercise

### *Overview*

On May 17, 2017, several weeks after completion of the tabletop exercise, participants were asked to reconvene for a full-scale exercise. As defined by HSEEP, full-scale exercises “are usually conducted in a real-time, stressful environment that is intended to mirror a real incident. Personnel and resources may be mobilized and deployed to the scene, where actions are performed as if a real incident had occurred” [15]. In this case, the exercise was designed to simulate the operation of two pick-up points and the evacuee processing center at the Union Passenger Terminal. During the course of the exercise, players attempted to guide a large number of simulated evacuees through the entire CAE process using the actual personnel, facilities, and equipment that would be used in a real event.

To simulate the conditions of an actual implementation of the CAE, the project team recruited a large number of volunteers to serve as actors in the exercise. These volunteer actors were to represent New Orleans residents in need of assistance evacuating. Volunteers acting as evacuees reported to one of two pre-determined pick-up points, where exercise players helped them to complete the registration process before loading the evacuees onto NORTA buses. Once on the bus, the evacuees were transported to a re-creation of the UPT processing center. There, evacuees arriving from the pick-up points went through a medical triage process (ensuring that all were healthy enough to make the trip) before being directed onto buses bound for safety. For most, the simulation ended at this point, prior to any actual transport to shelter locations. A limited number of volunteers traveled by bus to Louis Armstrong New Orleans International Airport for a concurrent exercise to test the airport's evacuation procedures.

### *Full-Scale Exercise Objectives*

As with the tabletop exercise, the planning team devised a number of objectives they hoped to accomplish as part of the full-scale exercise:

1. Assess key agencies' ability to appropriately execute the processing of evacuees within a simulated UPT in accordance with the CAE Plan.
2. Assess information sharing practices for Residential Evacuation Assistance Pick-up between 311 call takers, New Orleans Health Department (NOHD) liaisons, and the Transportation Support Coordination Center (TSCC).
3. Validate information sharing and coordination processes between NORTA, contracted bus operations, and the TSCC.
4. Assess the processes identified in the Pet Evacuation Plan to efficiently register, track, and transport small and large pets from identified pick-up locations during a mandatory evacuation.
5. Validate ability to effectively apply UPT Transportation Triage Criteria.
6. Identify improvements that could enhance the CAE Plan.
7. Identify information technology (IT) needs within the UPT.
8. Assess the processes for identifying and transferring evacuees who are unable to be evacuated with the general population due to behavioral health and/or physical issues between New Orleans Emergency Medical Services (NOEMS) staff at the UPT, the Louisiana Department of Health (LDH) staff at the UPT, and the hospital staff controlling the Medical Institution Evacuation Plan (MIEP).
9. Evaluate the Joint Information Center's (JIC's) ability to receive and respond to inquiries research, develop the appropriate response, and provide timely and accurate information during execution of the CAE Plan.
10. Validate the information collection and manifest development process by the Department of Children and Family Services (DCFS).

These objectives were used to guide the development of the exercise's scope and scenario as well as the actions of exercise controllers and the evaluation team.

### *Participation*

Participation in the full-scale exercise drew primarily from the same agencies present for the tabletop exercise. However, it also needed to expand beyond agency representatives and key decisionmakers to include the multitude of additional operational personnel necessary to implement actions in the real world. Table 3-1 shows the key participating agencies present for the exercise.



**Table 3-1**  
*Participating Agencies for  
 CAE Full-Scale Exercise*

<b>Federal</b>
FEMA Region VI
<b>State</b>
Louisiana State Police (LSP)
Louisiana Department of Transportation and Development (DOTD)
Louisiana Department of Health (LDH)
LDH Bureau of Emergency Medical Services (EMS)
Louisiana Governor’s Office of Homeland Security and Emergency Preparedness (GOHSEP)
Louisiana National Guard (LANG)
Department of Children and Family Services (DCFS)
Regional Transit Authority (RTA)
Region I EMS
<b>Local</b>
Greater New Orleans Hotel & Lodging Association (GNOHLA)
New Orleans Health Department (NOHD)
New Orleans Fire Department (NOFD)
New Orleans Police Department (NOPD)
New Orleans Emergency Medical Services (NOEMS)
New Orleans Office of Homeland Security and Emergency Preparedness (NOHSEP)
New Orleans Metropolitan Convention and Visitors Bureau (NOMCVB)
Orleans Parish Sherriff’s Office (OPSO)
Mayor’s Office of Communication
Metropolitan Human Services District
Schools and Universities
<b>Non-Government Organizations</b>
Evacuteer
American Red Cross (ARC)
Society for the Prevention of Cruelty to Animals (SPCA)

## Evaluation Process

To capture as much useful information as possible over the course of the exercise series, exercise planners provided multiple avenues for exercise participants to offer feedback on observed strengths and weaknesses as well as areas for improvement. Feedback from participants and dedicated evaluation staff was ultimately incorporated into the development of an After-Action Report that summarized the observations and outlined steps for improvement.

### *Hot Wash*

At the conclusion of each exercise, exercise staff facilitated a post-exercise debriefing, known as a “Hot Wash.” Held immediately following the end of the exercise, this took the form of a brief, open forum discussion, allowing all participants the opportunity to voice their observations although still fresh in

their memory. This also presented exercise evaluators with the opportunity to seek clarification regarding player actions and decision-making processes.

### *Feedback Forms*

Following the Hot Wash, exercise participants were asked to complete and turn in Participant Feedback Forms. These paper forms offered a second option to submit feedback to the evaluation team, particularly issues that may have been too specific, sensitive, or time-consuming for group discussion during the Hot Wash. In an effort to encourage candid responses, participants were permitted to submit these forms anonymously.

### *Evaluation Staff*

Some exercise staff were assigned to the evaluation team; they did not participate in the exercises and were responsible solely for evaluating exercise player success or difficulty in accomplishing exercise objectives. To support the evaluation process, the exercise planning team developed exercise evaluation guides (EEGs) to provide guidance to evaluation staff by documenting the exercise objectives, capability targets, and critical tasks to look for when evaluating exercise conduct. Although observing the exercise, evaluation staff were instructed to use these guidelines to document and justify their assessments.

### *After-Action Meeting*

A few weeks after the conclusion of the exercise series, decisionmakers and policymakers from participating organizations gathered for an After-Action Meeting. Members of the exercise planning team and evaluation staff were also present. The purpose of this meeting was to debrief following the exercise, discuss and validate observations, and determine corrective actions for the After-Action Report.

### *After-Action Report*

Key information and outcomes related to exercise evaluation were documented through the development of an After-Action Report (AAR). The AAR included an overview of performance related to each exercise objectives that highlighted strengths and areas for improvement. The report also included an Improvement Plan that detailed proposed courses of action to address areas identified as needing improvement and assigning agencies responsibility for implementing change.

## CAE Research

### *Overview*

As noted, the ultimate goal of the Evacuation and Return project was to improve the evacuation of vulnerable populations. As part of this mission, project partners identified a need for a more comprehensive assessment regarding the

effectiveness of the CAE and to get a better understanding of the vulnerable populations and their needs. To further these goals, UNO-CHART conducted a number of research projects aimed at analyzing elements of the CAE process and the characteristics of the vulnerable populations for whom the CAE was intended.

The project team planned to complete multiple separate but interrelated projects that would support a greater understanding of the various facets of the CAE. The insights gained from these projects would ultimately contribute to the development of recommendations for its improvement. Descriptions of the projects included in this effort are included below.

### Evacuation Database Analysis

The project team examined three databases related to the CAE—the City’s CAEP database, maintained by Emergency Management; the Special Needs Registry (SNR), maintained by the Health Department; and the paratransit database, maintained by NORTA.

The CAEP database represents a record of all individuals and households who indicated to the City in advance that they intend to use the CAE to evacuate. Residents can contribute to this database by calling 311 or using a web-based input form on the City website. Information collected for this database includes household address, number of individuals, number of pets, and anticipated Evacuspot for pick-up. These data are used for planning purposes only; the database is semi-anonymous and does not include any names or contact information. As such, residents with information in the database do not receive any additional follow-up or special treatment and remain responsible for transporting themselves to the nearest Evacuspot.

The SNR is a database of individuals who require extra assistance during emergencies due to medical conditions or mobility limitations. For the purposes of the CAE, the SNR identifies individuals who are unable to walk to their closest Evacuspot and require additional transportation assistance. As with the CAEP database, individuals can register for the SNR by calling 311 or using the City’s website. Registrants answer several questions pertaining to their conditions, which are ultimately used by Health Department staff to determine what, if any, type of transportation assistance is needed. Individuals on the SNR are informed of the type of assistance they can expect and are contacted annually to ensure that their information is up-to-date.

The third database is the paratransit database used by NORTA. Registrants requesting rides through the NORTA paratransit service are required to have Americans with Disabilities Act (ADA) eligibility associated with a disability that prevents them from using regular fixed-route bus services. This database contains

names, addresses, phone numbers, and mobility needs for active paratransit riders, as well as identifying information (date of birth, social security number), medical information, and ride history.

The team examined the information contained in these databases, as well as the conditions of their use and maintenance, and used this information to make recommendations on how to improve each database and the system as a whole.

### Review of Academic Literature and Best Practices

To identify ways to improve public outreach and communication surrounding the CAE, the project team conducted a literature review on the topic of best practices in risk communication. Through this process, researchers examined the existing academic work in the field of risk communication, particularly those studies with a focus on vulnerable populations. Following a comprehensive review of the current academic literature published on the subject, researchers identified common trends and accepted best practices. This information was incorporated into an evaluation of the City's existing outreach strategy and used to develop recommendations for improving the program.

### Mapping of Vulnerable Populations

As part of the comprehensive assessment of the CAE process, City emergency planners sought to gain a better understanding of the spatial distribution of vulnerable persons throughout the city. To support this, the UNO-CHART team used Geographic Information Systems (GIS) tools and available socioeconomic data to map community vulnerability in New Orleans, which was then compared with the locations of Evacuspots to assess whether the existing locations of services sufficiently address the geographical distribution of residents in need. These data were used to identify potential neighborhoods lacking coverage and inform future decisions to relocate or add new Evacuspots.

To quantify community vulnerability, the project team used the Social Vulnerability Index (SoVI) model established by the University of South Carolina [16]. This basic model was adapted to suit the New Orleans community as it relates to evacuation needs. The project team identified the following nine distinct variables as factors that could make it difficult for populations to evacuate. These variables were assigned weight multipliers, placing greater emphasis on variables that present greater obstacles to evacuation. The variables and their respective assigned weights are as follows [17]:

- High Impact (multiplier of 3)
  - Disabled population
  - Population without vehicles
  - Population age 60 or older

- Medium Impact (multiplier of 2)
  - Population in poverty
  - Population who earn less than \$25,000 per year
  - Population with less than a high school diploma
  - Minority population
- Low Impact (multiplier of 1)
  - Single-parent households
  - Population who speak a language other than English

After deriving these nine variables to the Census Tract level from the American Community Survey (ACS) [18], the components were summed to determine a single numerical value that should reflect the social vulnerability of each respective tract. Using GIS, the spatial distribution of these values could be displayed visually on a map of the New Orleans area.

The next step was to compare this mapped vulnerability data with the locations of Evacuspots. Each Evacuspots location was mapped and displayed with a quarter-, half-, and one-mile buffer (0.4, 0.8, and 1.6 kilometers, respectively) to denote areas within reasonable walking distance of that location. This visualization was then used to identify areas of the city with high social vulnerability metrics that may not be adequately covered by the existing Evacuspots.

### Interviews and Focus Groups

In an effort to gather community input on the CAE process and ways that it might be improved, the project team conducted multiple interviews and semi-structured focus groups. The interviews involved one-on-one discussions with individuals, both in-person and by telephone. Participants included members of the general public as well as individuals on the City's SNR. Interviewers asked participants questions regarding their perceptions of and experience with the CAE, NORTA, and/or the SNR, as applicable.

Focus groups consisted of in-person group discussions among 6–8 participants. Three focus groups were conducted in total, with participation drawing from local non-profit organizations that work with vulnerable populations throughout the city. As with the individual interviews, focus group discussion topics centered on the CAE, NORTA, and the SNR. Participants were also asked to comment on the City's web page dedicated to educating residents about the CAE.

The project team recorded and transcribed participant responses during the interviews and focus groups. Researchers used systematic methods and software tools to code the text from these responses, synthesize the resulting data, and

analyze the total content in an effort to identify common themes. For each theme, interview and focus group participant responses were incorporated into a summary of the key insights, details, and recommendations that arose from the discussions.

# Results and Recommendations

## CAE Exercise Series

As noted, the purpose of the New Orleans CAE Exercise Series was to validate and improve the CAE Plan by providing responsible organizations with the opportunity to test and evaluate their policies and procedures in a simulated environment. The overall outcome, following completion of the full-scale exercise, was that staff could execute the CAE process, but they faced significant challenges in doing so. Additionally, the speed at which evacuees were processed through the system was well below the rate necessary to meet expected demand within the limited timeframe of a real evacuation.

After the conclusion of the tabletop exercise, full-scale exercise, and subsequent after-action meetings, the observations and findings gained throughout the evaluation process were collected for the After Action Report and Improvement Plan. The following is a summary of the key findings resulting from the exercise series.

### Accommodations for Special Needs Population and Pets

During the full-scale exercise, players were generally able to move members of the general population through the CAE process effectively. CAE staff encountered difficulty when working with individuals who required additional accommodations for themselves (by virtue of medical and special needs) and/or their pets. Although the process was designed to fully accommodate these needs, determining and executing the correct course of action often took more time and manpower than planners had anticipated. The range of circumstances, exhibited by evacuees with both real-world and simulated special needs, presented a multitude of unique and challenging situations with which staff had to deal. The paragraph below, an excerpt from the exercise After Action Report, describes the difficulty in greater detail:

Exercise participants noted a shortage in available manpower to manage and track [participants with special needs] with the amount of semi-personalized care necessary to meet medical and behavioral needs of the participants.... Tracking the elderly population presented a particular challenge, as the participants became easily disoriented, either because they could not fully hear instructions or because of medical conditions that may cause a

tendency to become disoriented or easily tired. Staff noted that individuals with physical and/or mental challenges often required a dedicated person to assist them through the shelter registration and transportation processes, and that there were not sufficient numbers of dedicated exercise staff ... to meet this need. In some cases, several staff members were needed to determine how to handle a single issue, which took time and resources away from processing other evacuees and slowed the evacuation process down considerably [19].

Difficulty with the pet evacuation process also produced delays. It should be noted that for the purposes of the exercise, live animals were not used to fill the role of pets, but were instead simulated using toy stuffed animals. As such, the aforementioned real-world complications observed with the special needs population could not be tested for the pet evacuation process. In a true emergency scenario, however, it is reasonable to anticipate that some portion of the pets passing through the CAE will present complications (and associated delays in processing) due to behavioral issues, medical concerns, and other factors.

Uncertainty surrounding the process for registering and tracking pets created further delays. Exercise players were unfamiliar with the separate registration processes for pets and their owners, which created problems when staff who should have been responsible only for pet registration began registering humans as well. This led to confusion downstream in the process, which resulted in significant processing delays. In this case, the process described in the plan was deemed to be adequate, but additional training for staff was recommended.

Perhaps the greatest difficulties occurred when exercise players were presented with families containing both pets and family members with medical needs. Although staff make every effort to avoid separating families, the designated pet-friendly shelter is unable to accommodate major medical needs, and the medical shelter is unable to accommodate pets or large families. The CAE Plan described procedures for directing members of the general population, pets and their owners, and medical/special needs populations separately, but it did not address situations where one family might contain multiple classifications. Lacking any previously-agreed-upon guidance, staff were forced to push the issue further up the chain of command, where higher management ultimately made judgment calls on a case-by-case basis. This process produced significant delays; one instance fully occupied two staff members for approximately 45 minutes, delaying further processing [19]. Following the exercise, planners identified the need to address this oversight by developing clear guidelines and training for staff regarding how to manage these types of situations.



The observations described above highlight the importance of planning for the needs of special populations. Accommodating the diverse needs of these individuals requires substantial commitment of time and resources, both of which can represent scarce commodities for the average emergency management agency. However, as the CAE exercise series demonstrated, the consequences of not dedicating sufficient planning, resources, and training to these mission areas can result in major delays in processing, with the potential to drastically reduce evacuee throughput.

### Communications and Information-Sharing

An operation as complex as the evacuation of a major city requires extensive coordination and cooperation among a wide variety of response agencies at the local, State, and Federal levels. To execute the process successfully, it is essential that participating agencies are able to effectively communicate with each other to share situational awareness and operational information pertaining to the evacuation in progress. These communications occur through various methods, including email, phone calls and text messaging, handheld radio, shared software platforms, and face-to-face conversation.

During the exercise, evaluators and players noted that internal agency communication was strong and generally allowed for effective information-sharing among personnel within each agency. As expected, staff who work together frequently and have established practices for doing so had little difficulty communicating among themselves during the event. On the other hand, interagency communication, especially between agencies whose personnel do not work together on a regular basis, presented greater challenges. Important information regarding evacuee processing and transportation was not always shared when it should have been. In cases where information-sharing did occur, the processes were inconsistent and did not always occur in a timely fashion. In some cases, information had become outdated by the time it reached its designated recipient. For example, exercise players staffing the command post noted that although they were generally notified when buses departed pick-up points for the processing center, that notification did not consistently provide other important elements of information such as the number of evacuees on board, bus number, or estimated time of arrival. Access to this information would have improved these players' ability to anticipate demands and manage the flow of evacuees through the processing center. After-action discussions resulted in a recommendation to develop a standardized information-sharing plan, which would identify certain Essential Elements of Information (EEI) in the evacuation process and specify with whom those EEIs need to be shared.

Lack of access to interoperable radio communications presented an additional obstacle to effective information-sharing. Radio communications, used

extensively in the public safety field, represent a major portion of the operational information-sharing that occurs during the evacuation process. Although Louisiana's state-of-the-art system, the Louisiana Wireless Information Network (LWIN), is among the nation's largest and most robust statewide radio networks [20], several players in key positions were unable to access communications on the network due to a lack of access to compatible, interoperable radios. Although most public safety personnel are assigned radios in their day-to-day roles, several key partner agencies, such as social service agencies and volunteer organizations, either lack their own radios or have devices that are not compatible with the LWIN system. Although the City of New Orleans maintains a cache of additional radios to lend in such occasions, there were not enough radios available to meet the need observed. Staff without radios, some of whom were in key positions, were effectively left "out of the loop" or received delayed and potentially inaccurate information secondhand. This led to a lack of situational awareness and made it challenging for staff to respond to requests for information. When determining communication procedures in light of such shortages, planners may need to consider identifying and addressing gaps in available communications equipment or look toward implementing an alternative communications method in cases where access to the primary method is limited or unavailable.

Additionally, when assigning radios to evacuation staff who do not typically use them in their day-to-day roles, additional training may be required to ensure that they can use their assigned radio effectively. Some exercise players, most notably but not limited to those in the voluntary organizations, were provided with radios but were not instructed on their use. In these cases, communications delays and challenges arose when players unfamiliar with the equipment, protocols, and appropriate talk channels were forced to learn on the job.

Effective communication and information-sharing represents one of the most critical components of a successful evacuation. In a mission of this nature, in which time is of the essence, jurisdictions cannot afford the time-consuming mistakes and obstacles that result from poor communication and coordination. New Orleans' CAE full scale exercise demonstrated the importance of establishing a formalized information-sharing structure that ensures that personnel at all levels of the operation get the information they need when they need it. A need for extra caches of interoperable communications equipment to meet a need well beyond the average day-to-day use was also noted, as was training for evacuation staff who do not use this equipment regularly. By reducing the potential for delays and inefficiencies that inevitably occur when personnel are unable to communicate effectively, improvements such as these could significantly increase the rate at which evacuees are processed and transported safely out of harm's way.

## Manifesting and Tracking of Evacuees

One of the primary goals of the evacuee processing that takes place at the central processing facility is maintaining accountability for all evacuees by producing a passenger manifest for every bus that departs the city. Agencies responsible for assisted evacuation need to keep track of who they evacuated and the shelter location to which they were transported. This information is used to facilitate family reunification and wellness checks from concerned relatives and to ensure that nobody is left behind at any point between evacuation and post-storm reentry.

The manifest process begins when evacuees arrive at one of the 17 pick-up points and fill out an evacuation ticket, a carbonless copy paper form that contains four duplicates. As evacuees arrive at the processing center and move through the evacuation queue, these copies are provided to the state DCFS, the City (or Parish), and the driver of the evacuation bus, with the final copy remaining in the evacuee's possession. For each departing bus, forms for each passenger are collected and combined to produce a complete manifest.

During the exercise, players encountered difficulty in maintaining accountability and accuracy throughout the manifest process. Use of paper forms allows for the risk that copies may be lost, damaged, or misfiled, putting the reliability of these records in question. At one point, delays ensued when staff lost count of the manifests collected and ceased embarkation efforts until a correct total could be reestablished. After-action review attributed this event to "unfamiliarity with the plan, lack of technological solutions, and a complex documented process" [19]. The process in place was not sufficiently clear, simple, or efficient to support successful implementation, and it appeared to change multiple times during the exercise as staff tried to find better solutions. Several participants suggested that investing in a technological solution for tracking evacuees, such as a mobile app and/or a "smart" wristbanding system, might alleviate some of these issues.

Additionally, evaluators noted that the manifest process was, in many respects, viewed as a flexible or non-essential component of the evacuation. The primary objective of the CAE is to quickly move individuals out of the city. Manifesting takes valuable time, and staff members were generally of the consensus that if evacuees were not being processed quickly enough, the manifest process would likely be limited or even scrapped altogether to expedite the evacuation effort. This was the case during the Hurricane Gustav evacuation in 2008 [19]. Prioritizing life safety by evacuating the maximum number of individuals will always take precedence over keeping up proper documentation, and rightfully so. However, lack of such documentation would likely result in significant challenges later on, when agencies are unable to account for the individuals whom they have evacuated. Ideally, the two should not be mutually exclusive.

Maintaining accountability for evacuees is an important priority during the evacuation process, but only as long as it does not get in the way of the higher priority of keeping people safe. Registration and manifest processes, if used, must be designed to be simple, quick, and easy, as any processes that are slow or overly cumbersome risk being discarded for causing unacceptable delays. Training and exercising staff on these processes is essential as well, as unfamiliarity with the plans may result in poor performance and derail even the best-designed process. Finally, technological solutions to this process may also offer significant potential for improvement, but they were not included within the scope of this project.

## CAE Research

Concurrent with the evacuation exercise series, the team at UNO-CHART completed a suite of research projects geared toward improving New Orleans' ability to evacuate its most vulnerable residents. The results of these projects were incorporated into a complete, comprehensive final product, the Final Report and Outreach Strategy, which details the researchers' findings and recommendations. Following its completion, this document was made available to public safety agencies involved in planning the evacuation and to additional CAE stakeholders to support their continued improvement of the CAE process. The results of these projects, as included in the Final Report and Outreach Strategy, are summarized here.

### Database Optimization

UNO-CHART's assessment of the City's three transportation-related databases revealed a disparate range of information and level of maintenance between each database. The SNR and paratransit databases were maintained and updated rigorously, although maintenance of the general population CAEP database was significantly less so. Although all three contain unique and valuable information, a substantial portion of the information collected is redundant between multiple platforms.

Researchers found that many NORTA paratransit riders with special needs believed that they did not need to register on the Health Department's SNR; they assumed that "the City knows where I am" and was already aware of their needs due to their paratransit ridership with NORTA [21]. In reality, the City and NORTA did not exhibit that level of coordination, and data from each entity's respective database(s) were not routinely shared with the other party. Evacuation staff use the SNR when coordinating paratransit evacuation, and if individuals do not register in that database and indicate their intention to use the CAE, the City is not likely to be aware of their needs or plan accordingly. This leaves these riders at risk of being left behind if they expect to be picked up in an evacuation based purely on their paratransit use through NORTA.

Based upon these findings, researchers recommended exploring the possibility of consolidating the three databases into a single, shared system. In theory, this would eliminate the redundancies observed and ensure that all parties have access to the information collected. Additionally, a single, consolidated database potentially would require fewer overall resources and less maintenance when compared to the three separate systems currently in use. UNO-CHART also recommended integrating this consolidated database with GIS to provide emergency managers with up-to-date, geographical data on where the city's most vulnerable populations are located. These data could also be used to identify new or more optimized locations for Evacuspots.

### Public Awareness and Outreach

One of the challenges associated with the CAE is making the city's most vulnerable residents aware that the assisted evacuation exists as an option for them. Through a combination of interviews, focus groups, and review of previous case studies and best practices, researchers sought to provide recommendations on how to best conduct outreach to these communities and raise public awareness surrounding the CAE.

Discussion with community members revealed that many residents were not aware of the city's plan to help evacuate residents who cannot get out on their own. Some had noticed the distinctive statues located at Evacuspots around the city (as shown on the cover of this report) but did not understand their significance. Researchers identified several obstacles that might limit government ability to communicate to vulnerable populations, including but not limited to functional and access needs, language barriers, literacy concerns, and lack of trust. The proposed recommendations addressed methods for attempting to overcome these obstacles.

To target communities that may not be reached by traditional outreach methods, researchers suggested partnering with local faith-based and secular non-profit organizations who work with these groups frequently. These community-based organizations have the benefit of being familiar and trusted sources of information to the people they serve. Additionally, they have experience meeting the needs of the populations they serve and will likely know how to deliver information in ways that are appropriate for the intended audience.

Researchers also recommended expanding outreach efforts to be more accessible to individuals who may encounter difficulty with standard English-language outreach materials. Many, including those who are visually impaired, print impaired, or have limited English proficiency, may not be served by traditional printed media such as flyers and brochures. Suggestions included revising printed and online outreach materials to be accessible at a lower reading level, promoting alternatives to text such as television and radio advertisements,

and expanding the availability of outreach materials in languages other than English.

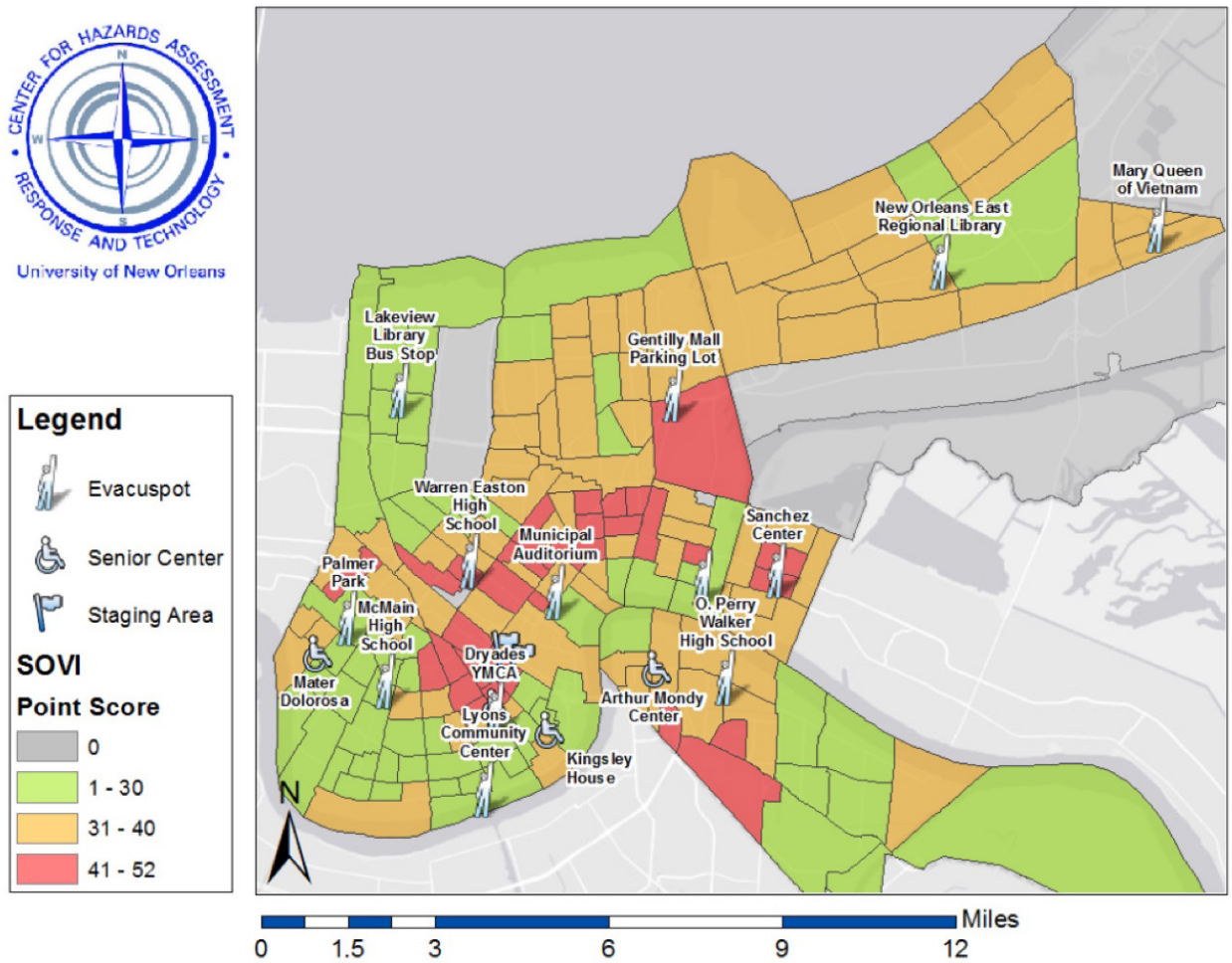
Finally, the report recommended raising awareness by installing signage at the 17 pick-up points detailing the locations' role within the CAE. Residents frequently noticed the statues at these locations, which resemble a figure hailing a ride, and indicate that the location serves as an Evacuspote. However, residents unfamiliar with the CAE process in many cases did not understand their purpose. By including informative signage, residents who pass by and investigate these landmarks will understand their significance and may be directed to additional CAE-related resources to learn more.

### Location, Spacing, and Logistics of Pick-up Points

For most of the population, the CAE relies on residents transporting themselves to one of the 17 Evacuspotes before being picked up, transported to the central processing facility, and evacuated out of the city. These 17 locations are distributed geographically throughout the city in an effort to provide accessible pick-up points within a reasonable distance of most neighborhoods. However, in a city with a land area of more than 169 square miles (437 square kilometers), there are not enough transportation and staffing resources to manage pick-up points covering every neighborhood within easy walking distance. As a result, some areas are further from the nearest pick-up point than others and may require individuals to walk long distances to reach them.

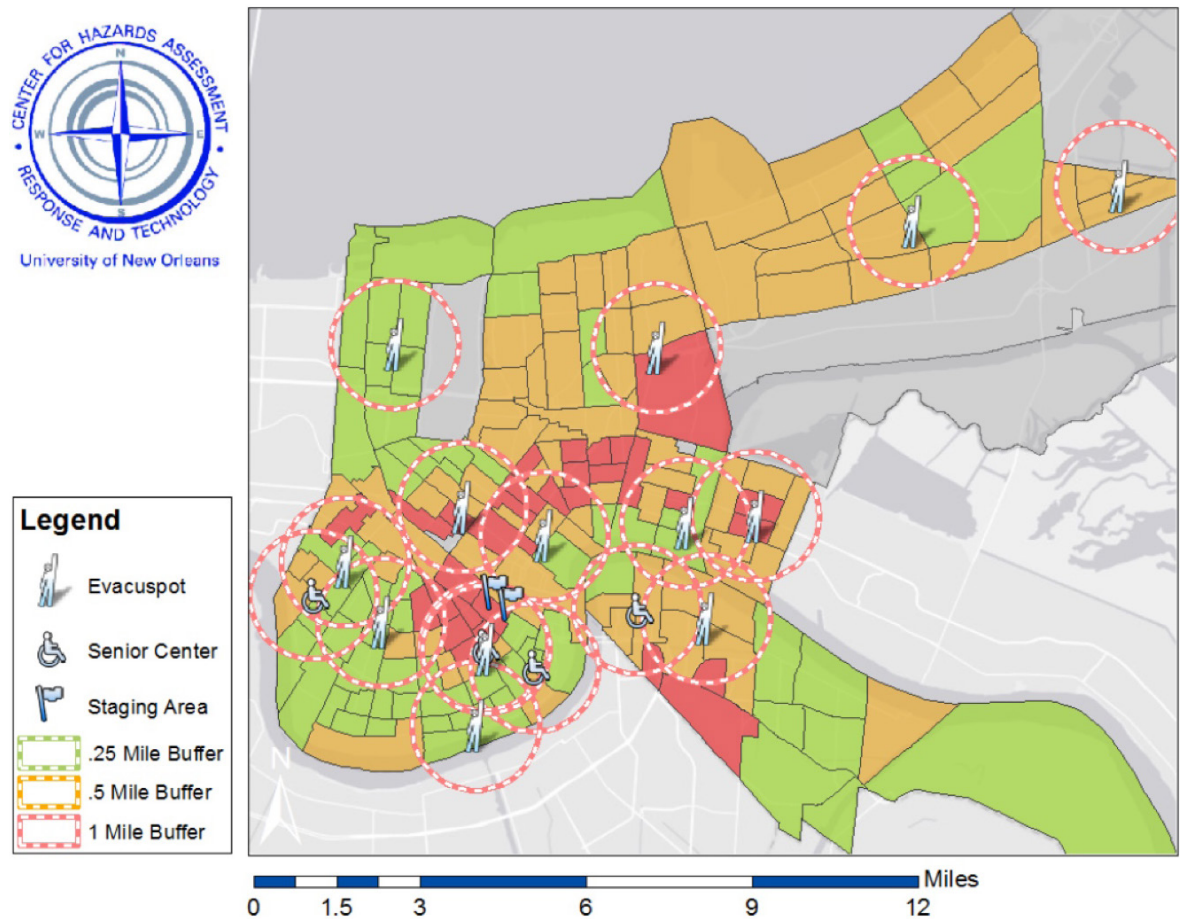
Using GIS and the SoVI derived from demographic data, the team at UNO-CHART analyzed the relationship between existing pick-up locations and areas of community vulnerability where the need for assistance is likely to exist. This analysis served to identify coverage gaps and recommend changes or additions if necessary. Figure 4-1 shows a map of Evacuspote locations over census tracts, color-coded by their respective SoVI score. Figure 4-2 displays the same map, but includes a one-mile buffer surrounding each location, indicating areas within one mile of the nearest Evacuspote [17].





**Figure 4-1**

*Map of Social Vulnerability Index values for census tracts in New Orleans*



**Figure 4-2**

*Map of Social Vulnerability Index with 1-mile Evacuspot buffer*

By comparing pick-up point locations with areas of moderate to high social vulnerability, researchers were able to identify parts of the city in which residents are more likely to need help evacuating, but who are not within a reasonable walking distance from existing pick-up points. In these cases, residents may desire to evacuate but, without access to transportation, could be deterred by the prospect of walking distances of more than a mile to the nearest location. This becomes a greater burden when considering hauling children, pets, and belongings, all potentially under Louisiana’s characteristic summer heat and humidity.

Spatial analysis revealed multiple neighborhoods in which pick-up point coverage was lacking. Most notably, areas such as the 7th Ward, St. Roch neighborhood, lower Algiers, and large parts of New Orleans East exhibited moderate to high levels of social vulnerability but were at least a mile from the nearest pick-up point. In contrast, some neighborhoods with low vulnerability enjoyed coverage



from multiple pick-up points situated nearby. In short, the spatial distribution of pick-up points did not fully align with the areas where their functions were most needed.

To address these discrepancies, it was recommended that the City reassess the Evacuspot model and consider rearranging or expanding upon the existing framework. The status quo could be improved by relocating select pick-up points to more optimal locations or by adding new ones in previously underserved neighborhoods. Either option would serve to reduce walking distances for evacuees and better align availability of service with areas of vulnerability. As an alternative option, a shuttle service was proposed to provide residents from vulnerable neighborhoods lacking coverage with transportation their nearest pick-up point.

## Conclusion

From its inception, the purpose of this project has been to support cities in their efforts to implement effective evacuation planning and improve execution of the evacuation process. With New Orleans serving as both a laboratory and a starting point, the research conducted through the scope of this project has already begun to impact the City's evacuation plans in a positive way. The results and recommendations described in the previous section suggested a number of methods through which New Orleans officials could improve their evacuation process. To date, many of these changes have been implemented in some capacity, and others represent work in progress or opportunities for future improvement. This section details the positive changes already observed as a result this project, as well as a number of avenues for continued development moving forward.

### Changes in Progress

Since the completion of the CAE Exercise series and the release of UNO-CHART's Final Report and Outreach Strategy in late 2017, the City of New Orleans has implemented several changes designed to improve the CAE and related programs that support the evacuation process. Described in further detail in the following pages, these changes were informed and motivated by the results and recommendations produced through the course of this project.

#### Larger Processing Venue

The results of the Full-Scale Exercise indicated that without significant changes, the rate of throughput of evacuees would not be sufficient to meet expected demands within the time available. Emergency planners recognized that a larger operation would be necessary to meet the anticipated throughput requirements. However, the existing venue for the central processing center, New Orleans' Union Passenger Terminal, was already being used at or near capacity and was limited in the space and facilities it could offer to support expanded operations.

City and State personnel began searching for a larger, more suitable facility, one that could support the CAE process at a greater scale while still being able to accommodate the diverse needs of the evacuating population. After considering several options, officials ultimately settled on a large sports arena within the city. With a substantially larger footprint compared to the UPT, this facility will be able to support additional registration and boarding lanes, more space for staging of buses, ample work space for staff, and larger, specialized processing areas with accommodations for individuals with special needs and pets.

The expanded setup offered by this new facility is expected to significantly improve evacuee throughput. Planners increased the number of bus launch queues from 3 at the UPT to up to 10 lanes at the arena. Additionally, the ability to divert individuals with special needs and/or pets to pre-designated areas designed to accommodate their needs should prevent any complications (such as those observed during the exercise) from causing delays among general population evacuees. Furthermore, the robust seating capacity, restroom facilities, information technology/communications infrastructure, and other amenities of a stadium intended to host thousands of guests during events are expected to accommodate the large population of evacuees much more comfortably than the previous setup.

Although planning remains in progress, the City of New Orleans expects to officially implement this change for the 2019 hurricane season.

### Database Consolidation and Upgrades

Following the analysis by UNO-CHART, City emergency planners sought to improve the way they use database systems throughout the planning and execution of the CAE. The decision was made to prioritize improvement of the New Orleans Health Department's SNR, as this database was the most developed and best maintained of the three existing options.

NOHD identified and procured a web-based database service that offered greater customization and reporting capability compared to the existing platform. Working with the product vendor, NOHD ensured that all current SNR data were migrated over to the new system. The new platform enables Health Department staff to quickly add or edit records, run reports and analyses, and automate routine maintenance processes. Additionally, multiple user accounts could be created, allowing key stakeholders from partner organizations such as emergency management, emergency medical services, and transportation services to access the SNR database. Individuals or their family members or caregivers can also opt to create an account and update their own information online, significantly reducing the data entry burden on Health Department staff.

In the interest of consolidation, staff made the decision to archive and discontinue use of the CAEP database, which held non-attributed location data of households that had reported the intention to use the CAE. Due to its reliance on self-reporting and lack of regular maintenance, planners were hesitant to rely on it as an accurate source of information. In another cause for concern, contributing to this database was found to give some residents a false belief that they had signed up for an evacuation service and would be given special treatment in the event of an evacuation. As a result, the database was discontinued and its functions were rolled into other services. The planning functions that formerly used the CAEP database are now informed by a combination of the upgraded SNR database and geographic vulnerability analyses such as those included in this report.

## Expanded Outreach Efforts

To ensure that residents were aware of the CAE option and would be able to access emergency public information, the City supported a major expansion of outreach efforts through NOLA Ready, the City's public-facing source for emergency information. Using lessons learned through the exercise series, focus groups, and UNO-CHART's recommendations, the City took several steps to ensure that its outreach efforts were comprehensive, effective, and accessible to all, including vulnerable populations who had not been adequately served previously.

One of the City's first steps was complete overhaul of the NOLA Ready website. The website (<http://ready.nola.gov>) was rebuilt with emphasis on an all-hazards approach, going beyond hurricane preparedness to focus on other area hazards as well. Content of the website was revised to be easier for individuals with limited English proficiency to understand, with a goal of being readable at a 5th grade comprehension level. Additionally, a web translation service was integrated into the site's toolbar to provide streamlined access to content in languages other than English.

Printed outreach materials such as pamphlets and flyers were also revised to improve clarity. Many of these documents were already available in multiple languages but were updated to be more easily-understandable and provide a better explanation of the options for hurricane evacuation. New materials were also developed, including calendars focusing on seasonal preparedness and branded items intended to promote awareness of the City's NOLA Ready program as an official source for reliable emergency information.

Embracing the recommendation to use partnerships with community-based organizations, the City greatly expanded outreach to these groups. In many cases, this included offering in-person presentations on preparedness topics, providing printed materials for distribution to the populations they serve, and working to build lines of communication for improved cooperation during both day-to-day operations and emergencies. During the course of this push, the number of community outreach events hosted or attended by City emergency preparedness personnel increased significantly, from 27 events in 2016 to 146 in 2017 [22] and 353 in 2018 [23]. City officials attributed this increase to a greater focus on outreach, better coordination of outreach efforts among City agencies and community groups, and an improved process for tracking and documenting these events.

Additionally, the City partnered with University of New Orleans, Evacuteer.org, and a local non-profit to develop a five-minute educational video in both English and Spanish that explains the CAE process. Although serving as a useful tool for social media messaging and use during outreach presentations, the video was also developed with the intention of targeting regular users of public

transit who might be expected to use the CAE. With cooperation from NORTA, a condensed version of this video can be shown on NORTA vehicles prior to hurricane season or in advance of a potential evacuation.

### Evacuation of Assisted Living Facilities

In an effort to streamline the evacuation of those with medical and special needs, New Orleans' emergency planners have turned their attention toward several large assisted-living facilities throughout the city. Through experience from prior disasters and analysis of the SNR database, planners have observed that these facilities are home to a large number of SNR evacuees. With many special needs individuals concentrated in single locations, the City began to evaluate options in search of a more efficient solution.

State and local officials have suggested pursuing "point-to-point" sheltering agreements for the largest of these facilities, an arrangement that would allow evacuees to board a bus directly from their facility to a predetermined shelter location and would be managed and populated by familiar staff and residents from their home facility. As an added benefit, this would enable these groups to bypass the pick-up points and processing center and alleviate some of the demand previously placed on the CAE system.

At the time of this report, these arrangements had not yet been finalized or tested. However, planners believe they represent a promising step forward and may be worth pursuing in other jurisdictions with similar challenges. New Orleans hopes to have initial agreements in place prior to the 2019 hurricane season, with potential for further expansion in the future.

### Support for Pet Evacuation

City officials recognized a need for additional staff and resources to support of the evacuation of pets. Although live animals were not used during the exercise series, planners acknowledged the staffing challenges, limited resources, and potential for delays resulting from issues with pet evacuation.

City agencies had previously maintained a very limited supply of pet carriers, crates, and kennels, counting on pet owners to provide their own containers. Recognizing that many residents, including those from vulnerable populations, may not own or otherwise would be unable to bring suitable containment, the City invested in additional pet containers and handling equipment to better align with anticipated needs. This presented a safer and more reliable option than relying on last-minute emergency purchases or hoping for support from animal advocacy organizations and shelters, which are likely to be stretched for resources although dealing with their own preparations for an evacuation.

Additionally, City and State partners began to look for opportunities to augment pet evacuation staff. Recognizing that local professional and volunteer organizations were already being used at or near capacity, officials needed to look outside of the New Orleans area for support. To this end, they began working with the Louisiana Department of Agriculture and Forestry (LDAF) to pursue mutual aid agreements with animal control authorities in other jurisdictions within Louisiana. If successful, these types of intrastate mutual aid agreements could bring trained animal handling staff from communities in non-impacted parts of Louisiana to New Orleans to assist in the pet evacuation process.

## Future Projects

With several positive changes already implemented or currently in motion, New Orleans appears better positioned to execute a large-scale evacuation compared to years past. However, the work is far from over. To keep pace with a rapidly-changing environment and ensure that the City remains prepared to meet emerging needs, New Orleans' emergency planners have a number of additional projects on the horizon. These areas of research represent longer-term efforts to further improve the City's plans and continue to increase its capacity to quickly, efficiently, and safely evacuate its most vulnerable residents.

### Refining the Evacuspot Model

New Orleans currently relies on a network of 17 geographically-dispersed pick-up points—Evacuspots—at which residents intending to evacuate can board a bus and ultimately be transported out of harm's way. Although this approach works well in many areas of the city, the level of coverage provided by the 17 locations leaves some neighborhoods distant from the nearest Evacuspot, requiring evacuees without transportation to walk long distances to the closest site. Others may be cut off from direct access their nearest location by highways, canals, or other obstacles to pedestrian traffic. Researchers have suggested a few approaches to remedy these issues. One would be to improve coverage by rearranging or adding additional Evacuspots. Decisions regarding new locations could be informed by observed needs, spatial analyses of demographic data, and input from the community. However, additional locations would also require commitments of additional staffing and transportation assets, resources that are limited in the current environment. Other potential alternatives include shuttle services or transportation “micro-grids” in selected areas that would transport evacuees to the nearest pick-up location. A final proposal would eliminate the 17 pick-up points altogether and rely on NORTA's existing bus stops and service routes, although redirecting several major routes to the central evacuation facility.

These discussions remain in the early phases, and additional research is needed to identify which courses of action might prove most effective. However, they

represent potential steps forward in the effort to better accommodate the needs of all New Orleans neighborhoods.

### Technological Solutions for Tracking and Accountability

The majority of the data collection and recordkeeping associated with the CAE relies on paper evacuation tickets. Although the content of these tickets is eventually digitized and entered into an electronic database, the use of paper forms can be cumbersome and allows for records to be easily lost, damaged, or misfiled during the complicated CAE process. Digitizing these forms also represents a significant data entry burden for agency staff.

City emergency planners have shown interest in researching potential opportunities to use technology to improve the evacuation process. Technologies such as web-based data services, mobile apps, and “smart” wristbanding and tracking through use of barcodes or Radio-frequency Identification (RFID) represent innovations with the potential to significantly alter how evacuees are registered and tracked throughout the evacuation process. Using the right combination of technologies, evacuees could fill out their evacuation ticket on a web-enabled mobile phone or tablet and upload the information directly to a City- or State-owned database. Scannable wristbands and luggage tags could also link directly to this database, providing evacuation staff with instant access and helping to maintain accountability for all evacuees and their belongings.

Whether developed in-house, contracted via the private sector, or some combination thereof, technological solutions such as these offer a range of possibilities for further streamlining the CAE process.

### Impact of Ride Sharing Services

New Orleans’ CAE Plan was initially developed following Hurricane Katrina, years before the emergence of ride-sharing services. These services connect individuals seeking transportation to nearby drivers offering rides, typically through the use of a mobile phone application and GPS. However, services of this nature were not widely available in New Orleans until several years after the initial development of the CAE Plan, beginning with the launch of Uber in the New Orleans area in September 2014 [24], followed by the arrival of Lyft in March 2016 [25]. The availability of these services has significantly expanded the range of transportation options for individuals without access to a vehicle. However, since no major evacuations have occurred in New Orleans since the advent of ride-sharing services, it remains to be seen how their availability might alter the landscape of transportation in an evacuation scenario.

New Orleans’ evacuation plans do not specifically account for ride-sharing services at this time. However, City officials recognize that they will likely play a role in future evacuations. As such, planning efforts moving forward will



seek to evaluate the potential impacts of these services and identify avenues for coordination and improvement. Future efforts, for example, could seek to establish designated drop-off areas at pick up points or near the evacuation center. Another approach might potentially involve partnering with ride sharing companies to offer free or discounted rides for evacuees traveling to those locations. Although the exact nature of its effects on emergency transportation remains uncertain, it is likely that the ride-sharing model will be a factor in future evacuation planning.

### Use of Rail Transport in Mass Evacuations

As noted, New Orleans' CAE currently relies primarily on road-based transportation by bus. However, the operation also supports an air-based evacuation component that facilitates departures by plane from Louis Armstrong New Orleans International Airport. These modes of transport represent the bulk of the population departing the city through the CAE process.

In addition to these two main components, previous incarnations of the plan, including the 2008 implementation in advance of Hurricane Gustav, have also used evacuation by rail as a supporting element. Multiple passenger and freight railways pass through New Orleans, and the city serves as a major terminus point for Amtrak, with three long-distance train routes (City of New Orleans, Crescent, and Sunset Limited) arriving in and departing from the city's UPT [26]. Of an estimated 18,000 evacuees departing the city in 2008, approximately 2,025 left via Amtrak train [27].

In recent years, concerns regarding resource shortages, decisionmaking timelines, and logistical challenges have limited the role of rail-based evacuation in local evacuation plans. Although the infrastructure exists, it is uncertain whether additional rail assets can be mobilized quickly enough to substantially expedite an evacuation of the New Orleans area given the aforementioned constraints. The City currently includes rail evacuation in its planning efforts as a contingency but does not rely on a large-scale rail component. Future research might serve to investigate the potential use of rail transit for evacuation purposes, both in the New Orleans area and nationwide, and evaluate the extent to which such initiatives warrant further discussion and investment.

## Final Thoughts

For communities exposed to the risk of major natural or technological disasters, emergency evacuation represents a critical, common-sense response strategy. When presented with a hazardous situation that puts residents' lives and livelihoods in danger, the safest course of action often will be to minimize the population's exposure to risk by evacuating the affected area until the threat has passed. Unfortunately, although a majority of the population are able to evacuate themselves, many do not have the ability or the resources necessary to do so.

For these vulnerable individuals, the community may need to identify ways to assist in their evacuation and ensure that they are not left behind.

After the nationwide impacts and national media spotlight generated by Hurricane Katrina in 2005, New Orleans bears the well-known but unfortunate distinction of having significant firsthand experience with disaster. As tragic as that period was, the experience has afforded the City with an opportunity to learn from past mistakes. With the benefit of hindsight, many of the tragedies observed following Hurricane Katrina might have been avoided if evacuation efforts available at the time had been more comprehensive and more accessible. In the years since, New Orleans officials have taken steps to ensure that a similar situation does not happen again.

This project has led to significant improvements in New Orleans' ability to support the evacuation of its most vulnerable residents. The activities and initiatives detailed in this report have fostered a positive change to local evacuation practices, resulting in a process that better accommodates the needs of all evacuees. Although substantial progress has been made, the City's evacuation plans continue to evolve year after year. And the research and data products generated through this project will continue to inform future efforts as they move from the initial development and planning phases into implementation.

Although New Orleans' unique history, geography, and culture make it an undeniably one-of-a-kind American city, many of the challenges faced by local government officials, public safety personnel, and the community as a whole stem from common issues that affect communities nationwide. With this in mind, it is our belief that many of the approaches detailed here and the resulting lessons learned regarding evacuation in New Orleans will prove applicable to jurisdictions throughout the United States.

We sincerely hope that other communities will benefit from the work done here to protect our people. All too often, the effects of disaster disproportionately impact those who are least able to respond to them. Readers of this report are encouraged to examine their own jurisdiction's plans for the evacuation of vulnerable populations and evaluate whether they are adequately prepared to meet the needs of those at risk. It may not be an easy task, but it is well worth the effort.

## GLOSSARY

<b>AAR</b>	After-Action Report
<b>ADA</b>	Americans with Disabilities Act
<b>CAE</b>	City-Assisted Evacuation
<b>CAEP</b>	City-Assisted Evacuation Plan
<b>CEOP</b>	City Emergency Operations Plan
<b>CTN</b>	Critical Transportation Needs
<b>DCFS</b>	Department of Children and Family Services
<b>EEG</b>	Exercise Evaluation Guide
<b>EEI</b>	Essential Element(s) of Information
<b>FTA</b>	Federal Transit Administration
<b>HSEEP</b>	Homeland Security Exercise and Evaluation Program
<b>JIC</b>	Joint Information Center
<b>LDAF</b>	Louisiana Department of Agriculture and Forestry
<b>LDH</b>	Louisiana Department of Health
<b>LWIN</b>	Louisiana Wireless Information Network
<b>MIEP</b>	Medical Institution Evacuation Plan
<b>NOEMS</b>	New Orleans Emergency Medical Services
<b>NOHD</b>	New Orleans Health Department
<b>NOHSEP</b>	New Orleans Office of Homeland Security and Emergency Preparedness
<b>NORTA</b>	New Orleans Regional Transit Authority
<b>POV</b>	Privately Owned Vehicle
<b>RFID</b>	Radio-frequency Identification
<b>SNR</b>	Special Needs Registry
<b>TSCC</b>	Transportation Support Coordination Center
<b>UNO-CHART</b>	University of New Orleans Center for Hazards Assessment, Response & Technology
<b>UPT</b>	Union Passenger Terminal

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