Making Cities Resilient
NEW ORLEANS / GOTHENBURG
City-to-City Exchange
MAKING CITIES RESILIENT

NEW ORLEANS / GOTHENBURG

CITY-TO-CITY EXCHANGE

2015

FINAL REPORT

Prepared for:
The Swedish Civil Contingencies Agency
Risk and Vulnerability Reduction Department &
Research Department

Prepared by:
Mr. Brant Mitchell
Stephenson Disaster Management Institute
Louisiana State University
Business Education Complex
Baton Rouge, LA 70806

SEPTEMBER 2015

NEW ORLEANS – GOTHENBURG
** This Page Intentionally Left Blank **
Contents
Introduction .......................................................................................................................... 1
Background .......................................................................................................................... 2
Making Cities Resilient Exchange in New Orleans ............................................................. 7
Field Visits .......................................................................................................................... 7
Orleans Levee District Emergency Operations Center ...................................................... 11
The U.S. Army Corps of Engineers - Lake Borgne Surge Barrier Visit ............................. 17
U.S. Army Corps of Engineers 17th Street Canal Closure and Pump Station ................ 20
9th Ward Neighborhood ...................................................................................................... 22
The Mercedes-Bend Superdome ......................................................................................... 23
Implementing Research to Build Disaster Resilience in New Orleans ............................. 25
Mr. Karim Belhadjali, Coastal Protection and Restoration Authority ............................... 25
Dr. Brian Wolshon, Louisiana State University ................................................................. 29
Dr. Monica Farris, University of New Orleans ................................................................. 32
Dr. John Renne, University of New Orleans .................................................................... 35
Mr. Brant Mitchell, Louisiana State University ................................................................. 38
Dr. John Pardue, Louisiana State University .................................................................... 40
Mr. Casey Tingle, Louisiana Governor’s Office of Homeland Security and Emergency Preparedness (GOHSEP) ......................................................................................... 45
Making Cities Resilient Exchange in Gothenburg .............................................................. 49
Field Visits .......................................................................................................................... 50
Gothenburg River Room ..................................................................................................... 51
Urban Safety and Societal Security Research Center (URBSEC) ..................................... 51
Gothenburg Port ................................................................................................................. 55
Emergency Operations Center, County of Västra Götaland ........................................... 55
Dam of Lilla Edet ............................................................................................................... 56
Location of the Tuve Landslide .......................................................................................... 57
Hökålla Gård Wetland ....................................................................................................... 58
Implementing Research to Build Disaster Resilience in Gothenburg ............................... 61
Mr. Ulf Moback, Gothenburg City Planning Office .......................................................... 61
Mr. Lennart Bernram, City of Gothenburg ....................................................................... 66
Ms. Janet Edwards and Åsa Fritzon, Swedish Civil Contingencies Agency (MSB) .......... 69
Mr. Lars Westholm, County Administrative Board, Västra Götaland ............................ 73
Appendix B: Sweden Delegation to New Orleans B-1
Appendix C: Biographies of New Orleans Presenters C-1
Appendix D: Agenda for Making Cities Resilient Exchange in New Orleans D-1
Appendix E: Presentations from New Orleans E-1
Appendix F: New Orleans Delegation to Gothenburg F-1
Appendix G: Biographies of Swedish Presenters G-1
Appendix H: Agenda for Making Cities Resilient Exchange in Gothenburg H-1
Appendix I: Presentations from Gothenburg I-1
References R-1
Introduction

With disasters comes the opportunity to recover and rebuild. Following disasters, cities and communities look at their ability to not only begin the recovery process but implement new measures that will allow their communities to be more resilient to future disasters. The United Nations defines resilience as “the ability of a system, community, or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions” (United Nations, 2009). While the City of New Orleans demonstrated resiliency through its ability to recover from the devastating effects of Hurricane Katrina, the measures that have been taken and implemented since the catastrophic event have increased the city’s overall ability to be more resilient to future disasters.

Having endured and recovered from the costliest disaster in the history of the United States, the City of New Orleans serves as an ideal partner for other cities, both domestic and international, to learn from and in many cases emulate its efforts to increase their own resiliency (NOAA, 2014). Through partnerships with Federal and State agencies, and an infusion of federal recovery dollars, the City has been able to recover and is now stronger and more resilient than it has ever been. The single most important aspect of its new found resiliency is the building of the Hurricane and Storm Damage Risk Reduction System (HSDRR). The HSDRR represents a $15 billion/123 billion Swedish kronor investment and serves as the foundation in which the recovery has been built upon. Understanding the importance for a citizenry to be protected, President George Bush stated “we fully understand that New Orleans can’t be rebuilt until there’s confidence in the levees” (Washington Post, 2007). The HSDRR now provides the city protection from a 100 year storm surge and has provided the necessary assurances that the city is safe to reside. While the New Orleans population has not recovered from its pre-Katrina number of 455,000 people, the City continues to experience exceptional growth. Since 2007, the City has a growth rate of 28.2% making

<table>
<thead>
<tr>
<th>Top 10 Weather Disasters in U.S. History</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hurricane Katrina 2005 $151 Billion</td>
</tr>
<tr>
<td>2. Hurricane Sandy 2012 $67 Billion</td>
</tr>
<tr>
<td>3. Hurricane Andrew 1992 $45 Billion</td>
</tr>
<tr>
<td>4. Midwest Flooding 1993 $34 Billion</td>
</tr>
<tr>
<td>5. Hurricane Ike 2008 $33 Billion</td>
</tr>
<tr>
<td>6. Hurricane Ivan 2004 $26 Billion</td>
</tr>
<tr>
<td>7. Hurricane Wilma 2005 $23 Billion</td>
</tr>
<tr>
<td>8. Hurricane Charley 2004 $21 Billion</td>
</tr>
<tr>
<td>9. Hurricane Irene 2011 $14 Billion</td>
</tr>
<tr>
<td>10. Hurricane Frances 2004 $12 Billion</td>
</tr>
</tbody>
</table>

*Does not include drought.

Figure 1: Top 10 Weather Disasters According to NOAA’s NCDC.
it the fastest growing city in the United States with a 2012 population of 369,250 (Waller, 2013). Essential to that growth is the protection provided by the HSDRR.

While the HSDRR was paramount for the rebuilding of New Orleans, other measures that include wetland protection and restoration, hardening of homes and infrastructure, evacuation planning, advanced notification of hazards, urban planning and adult literacy education to name a few have all contributed to the increased resiliency of the City. These efforts were not only taken out of necessity but were possible through the creative thinking and ingenuity of people at all levels of government, academia, non-profits and the private sector who are passionate about the city and culture that make New Orleans truly one of the most unique cities in the United States. The efforts taken in New Orleans have resulted in the City being selected by the Rockefeller Foundation as one of 100 Resilient Cities.

Background

Understanding the value that can be provided through the exchange of information and ideas, the Swedish Civil Contingencies Agency (MSB) planned and financed an international exchange of knowledge for 5 practitioners from Gothenburg and 5 Swedish researchers as well as 5 practitioners from the City of New Orleans and 5 researchers from Louisiana State University. This effort expands upon a bilateral security research and development agreement signed in 2007 by the Swedish and American governments. The agreement is administered by MSB and the U.S. Department of Homeland Security, Science and Technology Directorate respectively.). The security research and development agreement has the goal of initiating and promoting lasting collaboration between the MSB and the DHS, Swedish authorities and their U.S. counterparts within the homeland security spectrum, as well as Swedish research organizations and their U.S. equivalents (MSB, 2014).

<table>
<thead>
<tr>
<th>United Nations Making Cities Resilient Campaign List of Essentials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Essential 1</strong>: Organize for disaster resilience.</td>
</tr>
<tr>
<td><strong>Essential 2</strong>: Identify, understand and use current and future risk scenarios.</td>
</tr>
<tr>
<td><strong>Essential 3</strong>: Strengthen financial capacity for resilience.</td>
</tr>
<tr>
<td><strong>Essential 4</strong>: Pursue resilient urban development and design.</td>
</tr>
<tr>
<td><strong>Essential 5</strong>: Safeguard natural buffers to enhance the protective functions offered by natural ecosystems.</td>
</tr>
<tr>
<td><strong>Essential 6</strong>: Strengthen institutional capacity for resilience.</td>
</tr>
<tr>
<td><strong>Essential 7</strong>: Understand and strengthen societal capacity for resilience.</td>
</tr>
<tr>
<td><strong>Essential 8</strong>: Increase infrastructure resilience.</td>
</tr>
<tr>
<td><strong>Essential 9</strong>: Ensure effective disaster response.</td>
</tr>
<tr>
<td><strong>Essential 10</strong>: Expedite recovery and build back better.</td>
</tr>
</tbody>
</table>

Figure 2: UN's List of 10 Essentials for Resilient Cities
In 2010, the United Nations International Strategy for Disaster Reduction (UNISDR) began the “Making Cities Resilient: My City is Getting Ready” campaign. The intent of the campaign is to work with cities, towns and local governments to increase their overall resiliency to disasters by implementing risk reduction strategies. This UNISDR campaign was originally developed for the Hyogo Framework for Action that was adopted in 2005. The campaign is meant to promote the implementation of the Hyogo Framework: 2005-2015 as well as the new Sendai Framework for Disaster Risk Reduction: 2015 – 2030, at the local level. One of the primary drivers behind this effort is the establishment of a ten-point checklist designed to provide cities with a list of ten essentials, as seen in figure 2, that serve as a guide for local governments and cities to implement and base future investments in an effort to enhance their resiliency (UNISDR, 2015). UNISDR encourages cities to exchange with each other in order to learn more about how to make their cities more resilient to disasters. The part of this two way exchange took place in New Orleans, Louisiana in February 2015. The second part occurred in Gothenburg, Sweden in May 2015.

Sweden has taken a very progressive posture towards implementing risk reduction activities as part of the Making Cities Resilient initiative. At the time of this publication, eleven Swedish cities participate in the campaign: Gothenburg, Arvika, Jokkmokk, Jönköping, Karlstad, Kristianstad, Malmö, Vansbro, Vellinge, Värnamo and Ängelholm. In comparison, the United States only has a total of 4 cities that are participating. The Secretariat of the Swedish National Platform (the Risk & Vulnerability Reduction Department of the Swedish Civil Contingencies Agency, MSB) supports Swedish municipalities in multiple ways that facilitates their participation in the Making Cities Resilient Campaign. Foremost among these efforts is the ability to
participate in international exchanges with other cities. In 2012 Gothenburg municipality initiated its participation in the Making Cities Resilient campaign and has been actively participating in national and international activities. Gothenburg has also taken a leadership role in the campaign by hosting one of the national meetings in the Making Cities Resilient Network (MSB, 2014).

For Sweden the opportunity to participate in an international exchange with the City of New Orleans provided an opportunity for the MSB to align the City of Gothenburg with an internationally known city with significant experiences in planning for, responding to and recovering from major disasters. The two cities also have significant similarities such as ports of national and international significance, similar natural vulnerabilities to flood due to their locations on major navigable waterways and proximity to the coast, and they serve as economic engines for their respective countries.

To help facilitate the exchange between the two cities, MSB has partnered with the City of New Orleans’ Office of Homeland Security and Emergency Preparedness, specifically the Hazard Mitigation Office. The role of the City is to focus participation of the exchange on efforts conducted since Hurricane Katrina that relate to recovery including protection of critical infrastructure as well as prevention and mitigation actions. To help understand the rebuilding process, the City coordinated specific field trips to highlight the HSDRR system and discussions with the U.S. Army Corps of Engineers, New Orleans District, who has been responsible for designing and building the levee protection system in New Orleans since first authorized by the U.S. Congress in 1965 following the devastation caused by Hurricane Betsy to the greater New Orleans area. Presentations by the National Weather Service and the local levee board were also coordinated by the City. Finally, a visit to one of the communities impacted in the 9th ward which has experienced a significant regrowth that includes new houses with modern and environmentally friendly design implementations was coordinated by the city.

While recognizing that many of the improvements and risk reduction strategies implemented in New Orleans were not restricted to just the cities programs, MSB has reached out to the Stephenson Disaster Management Institute (SDMI) at Louisiana State University to include research initiatives that have influenced and impacted the increased resiliency of the city. SDMI also was asked to introduce initiatives taken by the State of Louisiana that have facilitated the recovery process and improved the overall resiliency of the city. SDMI coordinated the participation of nationally renowned researchers and highly
respected state officials to share their research, initiatives, and programs that have been utilized and implemented in the recovery of New Orleans.

In an effort to synchronize the focus of the exchange on the UN’s Making Cities Resilient campaign, the MSB emphasized the necessity for the international exchange to be aligned with the United Nations list of 10 essentials for making a city resilient to disasters. The exchange between New Orleans and Gothenburg was planned in connection with MSB’s support to Swedish cities in the Making Cities Resilient campaign. During the implementation of this exchange, the Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted by the United Nations. Although UNISDR recognizes implementation of both frameworks, this exchange is affiliated with the Sendai Framework for Disaster Risk Reduction. While it isn’t necessary or practical to focus on all of the 10 essentials for an exchange, the partners agreed on 7 essentials that were of mutual interest. The partners also decided to focus the New Orleans and Gothenburg visits along areas of practice and research that have been undertaken to increase the resiliency of each of the cities. This Making Cities Resilient city-to-city learning exchange was designed according to the following Sendai Framework’s Making Cities Resilient Essentials:

- **Essential 1** – Organize for disaster resilience;
- **Essential 4** – Pursue resilient urban development and design;
- **Essential 5** – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems;
- **Essential 7** – Understand and strengthen societal capacity for resilience;
- **Essential 8** – Increase infrastructure resilience;
- **Essential 9** – Ensure effective disaster response;
- **Essential 10** – Expedite recovery and build back better.
Making Cities Resilient Exchange in New Orleans

Field Visits

Prior to the group’s departure, an opportunity was provided at the City Hall of New Orleans for the Sweden delegation and its New Orleans and SDMI hosts to introduce themselves and learn about the program. During this period there was sufficient time to provide background information to the group on the devastating effects of Hurricane Katrina on the City of New Orleans. Following introductions, Brant Mitchell, Director of Research and Operations at SDMI, provided the delegation an overview of Hurricane Katrina and its impacts to the City and region.

Some of the points emphasized during the briefing included the fact that over 80% of New Orleans was submerged due to levee failures and overtopping. There was also an excess of 1,500 casualties in Louisiana alone, along with over 200,000 homes that were substantially damaged or destroyed. 71,000 businesses were impacted which resulted in an immediate loss of over 300,000 jobs. One of the points illustrated during the briefing was the sheer size of the disaster and the understanding that Hurricane Katrina was a true catastrophic disaster. Its scope and magnitude would have challenged any emergency management apparatus in the world.

To illustrate the size and scope of Katrina, Mr. Mitchell provided a comparison graphic which showed the impacts along six axis that measured the total in damages; homes destroyed, homes damaged, number of people evacuated, number of people displaced, and the number of casualties. The impact of Hurricane Katrina was compared to Hurricane Ivan (the 5th most devastating hurricane in the U.S.), Hurricane Andrew (the 3rd most devastating hurricane) Hurricane Camille (the only other Category 5 Hurricane to impact the
U.S.) and Katrina, minus the City of New Orleans impact. The comparison of the six variables among those five events can be found in figure 5.

The remainder of his presentation focused on the preparations initiated by the State of Louisiana and the City of New Orleans to ensure that a Hurricane Katrina scenario could never have the same overwhelming consequences in the city of New Orleans again. The City and State have made several changes in how they prepare for and respond to a hurricane since Hurricane Katrina and due to its proximity to the Gulf of Mexico were able to actually test those new policies and procedures with another major storm bearing down on the city nearly three years after Hurricane Katrina. Hurricane Gustav made landfall in Louisiana just South of New Orleans. The City and State took significant measures to ensure that the citizens of New Orleans had limited exposure to risks associated with the approaching hurricane. Some of the efforts initiated included the following:

- An estimated 2 million people were evacuated along the entire coast of Louisiana;

*Figure 5: Comparing the impacts of Hurricane Katrina in New Orleans with other major hurricanes.*
• Over 26,000 people who did not have the means to evacuate themselves were evacuated with the assistance of the City and the State by coach buses, school buses, and para-transits.

• 11,000 of those people were sheltered within the State and over 15,000 were sheltered in four other states (Alabama, Arkansas, Oklahoma, and Texas);

• Another 6,000 people were evacuated by air to other states;

• 2,500 medical special needs were also evacuated and sheltered in Medical shelters across the state.

Mr. Mitchell also briefly discussed the planning cycle that is required to make decisions during hurricane scenarios in Louisiana which include a lead time of up to 102 hours prior to a storm making landfall. A brief overview of the evacuation process for the City of New Orleans was also provided. The state implements a process known as contraflow in which both sides of the interstate become outbound lanes in order to increase capacity and minimize clearance times. Finally, he touched on the City of New Orleans plan to assist its local citizens without transportation in evacuating from the city. Both topics were only briefly discussed as two researchers who were involved with the design and implementation of both programs were scheduled to present later during the visit.

Figure 6: Map depicting the contraflow process which is used to facilitate the evacuation of the New Orleans region.
Mr. Mitchell concluded his presentation by providing an overview of how the city flooded and a timeline of the flooding events during Hurricane Katrina. The New Orleans primary newspaper, the Times-Picayune created a web-based illustration that provides a detailed timeline and step-by-step location of major breaches and overtopping of the levee system that occurred during Hurricane Katrina. The flash based graphic is located at the following url: http://www.nola.com/katrina/graphics/flashflood.swf.

Also providing information during the opening session was Mr. Bradford Case, the Hazard Mitigation Officer for the City of New Orleans. Mr. Case provided the delegation with an overview of the geography of New Orleans and information on the city government. He also provided the delegation with information regarding many of the programs that have been implemented by the Hazard Mitigation Office that have enabled the city to recover.
Orleans Levee District Emergency Operations Center

Following the morning briefings, the delegation was transported to the Orleans Levee District main facility near the University of New Orleans and the Lakefront. The facility itself serves as a vast warehouse and is used to store necessary resources to maintain the levee system along the east bank of the Mississippi River. Located on the second floor of the facility is a safe room which contains the Emergency Operations Center for the Orleans Levee District. The Emergency Operations Center served as the location to host the first set of official briefings.

*Figure 8: The Delegation at the Orleans Levee District Safe Room & Emergency Operations Center. Photo by Mr. Mitchell.*

National Weather Service: Mr. Frank Rivette.

**United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response**

*Presentation Title: SE Louisiana Flood Protection Authority*

Mr. Rivette provided an overview of the National Weather Service, its organization, its role in alerting the public of severe weather, and introduced the group to some of the products that they provide to the public. The purpose of the National Weather Service is to provide “weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy” (NWS, 2015). According to Mr. Rivette there are 122 Weather Forecast Centers across the United States. Each of the forecasts offices are provided a geographic area in which they provide weather data to
governments and the public. In Louisiana there are three offices located in the State and they are also served by a fourth office located in the adjacent state to the east, Mississippi.

Along with the local offices there are 9 national centers that focus in specific areas such as Ocean Prediction, Environmental Modeling and Tropical Cyclones. The most prominent of these centers is the National Hurricane Center (NHC) which provides the “big picture” of the anticipated behavior of tropical cyclones. During active tropical cyclones, the NHC issues multiple text and graphic products including a public advisory, a forecast cone, and storm surge probabilities. Mr. Rivette stated the most significant hazard associated with a tropical cyclone is storm surge. Historically 9 out of 10 casualties during tropical cyclones have resulted from storm surge. Recognizing the potential damage storm surge can cause, the National Weather Service has worked on developing visual products that aid in

![Figure 9: Mr. Frank Rivette from the National Weather Service. Photo by Mr. Mitchell.](image)

![Figure 10: A sample version of the NWS Probabilistic Storm Surge model](image)
communicating the risk to the public. With the increased capacity of computing power, the NWS has been enabled to focus the necessary resources to develop the Probabilistic Storm Surge (P-Surge) graphic in a timely manner to the public. The P-Surge, as seen in figure 10, represents a compilation of different storm surge model runs that include varying intensity, forward speed, size, and direction based on past history of forecast error. The data is aggregated and a probability of various storm surge levels is developed.

Discussion Points:

1) One of the questions asked by the delegation was in response to the different levels of storm surge that were depicted to impact Louisiana and why the storm surge that was projected to impact the State of Mississippi was so much greater than in New Orleans. Mr. Rivette’s response indicated that this was a function of topography and bathymetry. These two elements are more favorable for storm surge to develop in Mississippi than in Louisiana which in large part is a result of the shallowness of the Gulf of Mexico as it approaches the Mississippi coast.

2) The delegation also asked how do people respond to the P-Surge product when their homes are in the red area (indicating areas that are anticipated to experience the most significant flooding)? Mr. Rivette stated that the maps were developed by social scientist and that there is a general acceptance that when areas are located in red, people understand they face the greatest risk. As a result, home owners who can clearly see that their homes are located in a red area are more likely to heed an order to evacuate.

3) The delegation also inquired about who the end users were for the NWS products. Mr. Rivette stated that the products are designed for government officials to aid in decision making. They are also designed for the public, and the NWS relies on local media outlets to distribute their products to the public.

The U.S. Army Corps of Engineers: Mr. Mike Park

United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience

Presentation Title: Hurricane and Storm Damage Risk Reduction System Overview

Mr. Park provided a brief background on the City of New Orleans and how land that is currently inhabited used to consist of swamps. As the city expanded, it was necessary to drain the swamps and convert the land to habitable space. In doing this, much of the area in which the Greater New Orleans areas is built
upon is experiencing significant subsidence. The City of New Orleans is often referred to as having the profile of a bowl, in which large portions of the city are actually below sea level. Mr. Park provided an overview of the structural failures of the levee system during Hurricane Katrina and some of its impacts to the system. He also covered the initial response and organization of the Interagency Performance Evaluation Task Force which consisted of academia, industry, state and federal agencies. The Task Force was designed to identify five questions in regards to the flood protection system, storms, performance, consequence and the actual risk.

![New Orleans Topography](image)

*Figure 11: Topography of New Orleans illustrating the bowl effect often used to describe the city.*

Mr. Park next transitioned to the building of the Hurricane and Storm Damage Risk Reduction System that was authorized by Congress in 2006. The intent of the new HSDRRS is to put in place by June 2011 a system that will provide 100-year level of risk reduction capable of withstanding the effects of a storm having a 1% chance of occurring each year. Included with the authorization was funding in the amount of
$14.4 billion/118 billion Swedish kronor. Unlike previous authorizations, the new HSDRRS was fully funded from its initial authorization.

Some of the challenges that had to be overcome included National Environmental Protection Agency Compliance, the system had to be a comprehensive system, and it had to be built under intense scrutiny and oversight. The building of the system was enabled due its full funding from its inception, complete commitment from Congress and the President, alternate arrangements made with NEPA, acquisition strategies, and a favorable bidding climate.

The system was designed as it was built and included many improvements over the previous system. New floodwalls were erected that provided significantly greater protection. Design improvements were also implemented that provided greater structural reinforcement. Flood walls were reinforced with armor plating that served as splash pads. During Hurricane Katrina overtopping of existing flood walls assisted in the eroding of the levee tops and weakened the foundation of the flood walls, causing failures. The splash pads will prevent this from happening in the future as water will now simply roll off the levee instead of eroding it.

Another major component was the addition of interim closure structures. These structures were built at the opening of the interior drainage canals into Lake Pontchartrain. The interior drainage canals served as a focal point where many of the breached occurred. The closure structures are designed to keep storm surge from the Lake out of the city. These temporary structures were built and in place by the 2006 hurricane system. They are currently being replaced by permanent closures and pumps.

Another major component of the new HSDRRRS was the construction of the Inner Harbor Canal Surge Barrier. This barrier crosses a 1.8 mile/2.9 kilometers span and is one of the largest surge barriers in the world. It is the largest ever design-build civil works project built by the U.S. Army Corps of Engineers. The cost of the surge barrier was approximately $1.3 billion/10.6 billion Swedish kronor.
Other investments of the new HSDRRS include the construction of 5 new safe houses and the hardening of 5 existing safe houses. The safe houses are designed to ensure the safety of personnel that remain within the city to operate the pump stations which are required to remove rain water from the interior drainage canals back into the Lake. The West Closure Complex ties in two levees and eliminated the need to maintain 26 miles/42 kilometers of levees and floodwalls from the first line of defense. Located at the West Closure Complex is the largest drainage pump station in the world. The West Closure Complex also has the largest sector gate in the United States with a width of 225 feet/69 meters. This structure was built with a cost of $1 billion/8.2 billion Swedish kronor.

![Figure 13: A holistic view of the HSDRRS.](image_url)

Discussion Points:

1) The delegation inquired about how the system was able to be built in the required time frame with the construction industry already overwhelmed with the rebuilding of other aspects from Hurricane Katrina. Mr. Park stated that there was actually a very favorable bidding climate due to the overall state of the national economy. They were releasing contracts from $100 million/822 million Swedish kronor to $1 billion/8.22 billion Swedish kronor during the rebuild process. They
also awarded these contracts while the design was still taking place. Another element that helped facilitate the rebuilding of the system was the fact that they bought their own steel.

2) Another member of the delegation asked if future considerations were included in the design phase to account for sea level rise. Mr. Park indicated that those considerations were included in the design phase and one of the ways they mitigated the potential future risk was the inclusion of splash pads. As sea level rise occurs the likelihood of overtopping increases. The splash pads were designed to take away the ability of the overtopping to erode the backside of the levee.

3) A question was asked about some of the other measures taken to improve the system. Mr. Park discussed the inclusion of wick drains, which allow water to come to the surface and allows gravity to carry it away. They also included grass/sod armoring which includes a turf reinforcement mat.

4) The delegation asked about the design requirements and risk reduction the system actually provides. According to Mr. Park the system was accredited in 2014 for a period of 10 years and is designed to protect against a 100-year flood.

5) The delegation inquired about the environmental and natural environments and how the Corps was able to work through some of the constraints. One of the ways the Corps accomplished this was by building the new system on top of the existing structure. They also broke the entire area into smaller areas which helped clear the way for environmental requirements. The Individual Environmental Reports were done in lieu of a comprehensive Environmental Impact Statement. They were able to save 3 to 5 years in completing the HSDRRS by reducing the requirements of the NEPA compliance. They also invested $20 million/16.4 billion Swedish kronor in achieving NEPA compliance. Another measure that was taken included the funding of projects to rehabilitate the natural environment as well as buy credits.

The U.S. Army Corps of Engineers - Lake Borgne Surge Barrier Visit

*United Nations Making Cities Resilient Essential 8 – Increase Infrastructure resilience*
To begin the second day of the visit, the delegation was taken to the Inner Harbor Navigation Canal Surge Barrier. The barrier stretches for 1.8 miles/2.9 kilometers and is located at the confluence of the Gulf Intracoastal Waterway and the Mississippi Gulf Coast Outlet, approximately 12 miles/19 kilometers east of downtown New Orleans. In addition to the barrier, the structure consists of a bypass barge gate and flood control sector gate at the Gulf Intracoastal Waterway (GIWW) along with a 56-foot-wide vertical lift gate at Bayou Bienvenue. The surge barrier has floodwall tie-ins to the New Orleans East risk reduction system on the north end and the St. Bernard risk reduction system on the south end. The entire structure is at an elevation of 25 and 26 feet /7 - 8 meters above sea level. The delegation was able to visit the north end of the barrier and tour the safe

Figure 14: Design of the Inner Harbor Canal-Lake Borgne Surge Barrier

Figure 15: An aerial view of the Inner Harbor Canal - Lake Borgne Surge Barrier with the City fo New Orleans in the back ground.
house which contained the operational component to close and open the GIWW Sector Gate (USACE, Inner Harbor Navigation Canal - Lake Borgne Surge Barrier, 2013).

Figure 16: Pictures from the Delegation Visits to the Lake Borgne Gate. Photos by Mr. Mitchell.
U.S. Army Corps of Engineers 17th Street Canal Closure and Pump Station

United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience

Following a cold and dreary visit to the Lake Borgne Surge Barrier, the delegation was transported to another Corps site to receive a presentation from the U.S. Army Corps of Engineers on the Closure and Pump Stations that were built to remove drain waters from the interior of the city and prevent storm surge from entering the city through Lake Pontchartrain. Before receiving a tour of the 17th Street Canal Closure and Pump Station, the U.S. Army Corps of Engineers provided an overview of the three temporary and permanent closures and pump stations that were being built by the Corps.

As part of the HSRDDS, the Corps has built temporary canal closures and pumps along the three main outfall canals, which serve as drainage conduits for most of New Orleans. Following the authorization of the rebuilding of the levee system, the Corps put in place three Interim Closure Structures in 2006. The Interim Closure Structures were built as an emergency structure to provide immediate protection to future storm surge events. To expedite the process, the structures were built above ground and did not include any aesthetic considerations. The new Permanent Canal Closures & Pumps began construction in 2013 and are designed to provide a permanent and more sustainable measure for reducing the risk of a

Figure 17: The delegation receiving a brief from the Army Corps of Engineers on the Canal Closures and Pumps. Photo by Mr. Mitchell.
100-year level storm surge from entering the canals (USACE, 2013). The new structures will be built mostly underground and are designed to have a more natural blending with the local community. The delegation was given a tour of the Interim Closure Structure.

Figure 18: Pictures from the Delegation’s Visit to the 17th Street Closure and Pumping Station. Photos by Mr. Mitchell and Mr. Westholm.
9th Ward Neighborhood

*United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems*

*United Nations Making Cities Resilient Essential 10 – Expedite recovery and build back better*

The final field visit included a stop at one of the most negatively impacted neighborhoods in New Orleans. The lower 9th Ward was completely devastated by flooding caused by a break of the levee system along the Industrial Canal. The City teamed with the Make It Right Foundation to provide new green sustainable housing for communities in need. The delegation was given an opportunity to conduct a street tour of one of the neighborhoods in which the new sustainable housing has been constructed.

*Figure 19: One of the houses viewed by the delegation in the lower 9th ward. Photo by Mr. Mitchell*
Figure 20: Some of the new architecture observed by the delegation in the lower 9th ward. Photo by Mr. Mitchell.

Figure 21: Ecological Project in 9th Ward. Photos taken by Dr. Hansson

The Mercedes-Bend Superdome

*United Nations Making Cities Resilient Essential 10 – Expedite recovery and build back better*
On the final day of the New Orleans exchange, SDMI was able to coordinate a private tour of the Mercedes-Bend Superdome. The delegation was met at the Superdome by Mr. Donald Paisant who provided an overview of the role played by the Superdome during Hurricane Katrina, the extensive damage that resulted from Hurricane Katrina and its use as a shelter, and finally the rebuilding of the Superdome. According to Mr. Paisant, the Superdome was opened up as a “shelter of last resort” in order to provide emergency shelter for citizens of New Orleans who still remained in the city. When Hurricane Katrina made landfall, it is estimated that approximately 9,000 citizens along with 550 Louisiana National Guardsmen, as a security/protection force, were taking refuge in the Superdome.

Once Hurricane Katrina passed out of the area and the city began to flood, citizens began to flock to the Superdome to seek some sort of refuge. An estimated 30,000 citizens arrived or were ultimately brought to the Superdome as a place of refuge after being rescued. In addition, the Superdome received large amounts of flooding in the lower levels and the roof was also damaged as large sections of the roof were last during the Hurricane. Despite the massive amount of damage that was received by the Superdome, Louisiana’s Governor Blanco felt it was imperative as a lasting symbol of New Orleans and its rebirth to restore the Superdome as soon as possible. After a cost of $336 million/2.7 billion Swedish kronor, the Superdome was reopened on September 25, 2006, less than 13 months after being devastated.
Implementing Research to Build Disaster Resilience in New Orleans
Mr. Karim Belhadjali, Coastal Protection and Restoration Authority

United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

Presentation Title: Overview of the State’s Coastal Master Plan and Its Importance to New Orleans

Mr. Belhadjali began his presentation by providing the delegation with some background on the Coastal Protection and Restoration Authority (CPRA). The basic mission of the CPRA is to establish priorities to achieve comprehensive coastal protection. The way in which CPRA prioritizes this crucial protection is through the development, implementation and enforcement of a comprehensive coastal and restoration Master Plan.

Mr. Belhadjali explained why coastal protection is not only a priority to Louisiana but the nation as a whole. This is in large part due to the critical role Louisiana plays in delivering goods and energy. Some of the areas highlighted by Mr. Belhadjali included the fact that Louisiana has the largest tonnage port in the nation, which also includes 5 of the top 15 largest tonnage ports. Louisiana represents 19% of the domestic waterborne commerce in the U.S and over 30 states depend upon Louisiana’s ports for imports and exports. Louisiana also plays a major role in seafood and wildlife with the state serving as the #1 producer in fisheries in the lower 48 states, #2 in oysters, #1 in blue crabs, #1 in crawfish, and #1 in shrimp. From an ecosystem standpoint, Louisiana has five million waterfowl and is the largest wintering habitat for migratory waterfowl and songbirds. Over 70 rare, threatened, or endangered species can be found in Louisiana and the wetlands serve as a vital component of the hurricane protection system for the City of New Orleans.

Another area of focus for Mr. Belhadjali included an explanation of what is causing so much land loss in Louisiana. One of the primary reasons is that man-made levees and dams have prevented sediment from replenishing the wetland through major floods. While the levee serves as a source of protection for the...
State’s citizens, it has also served as a primary root cause of the disappearance of the State’s wetlands.

**HOW BAD IS IT – Future Without Action**

More Extreme- Potential to lose an additional 1,765 square miles (4,571 sq. km) of land over the next 50 years.

Utilized 0.45 m of sea level rise over 50 years, Subsidence rates 0 to 25 mm per year

*Figure 24: Anticipated land loss if no actions are taken in the State of Louisiana.*

Louisiana also experiences a significant amount of subsidence which in conjunction with sea-level rise has allowed for the coast line to slowly get consumed by the approaching Gulf waters. Hurricanes have also weakened the wetlands and have accelerated their destruction. Finally, the oil and gas infrastructure that has been put in place has allowed salt water from the Gulf to creep into the wetlands and hastened their losses. All these factors have resulted in the loss of 3,030 miles/4,877 square kilometers of wetlands since the 1930s. The rate of loss today is equivalent to 25 miles/41 square kilometers. Without mitigation measures, models have predicted that there will be an additional loss of 2,840/4,571 square kilometers over the next 50 years.

The CPRA was established in 2005 following Hurricane’s Katrina and Rita. Their first Master Plan was published in 2007, and was updated in 2012. The document will continue to be updated every five years. The most recent Master Plan is built on world class science and engineering. The planning team
considered hundreds of existing project concepts and also sought extensive public input and review. The plan focuses on five primary objectives: 1) Flood Protection; 2) Natural Processes; 3) Coastal Habitats; 4) Cultural Heritage; and 5) a Working Coast. The plan also identified 9 types of Restoration Projects: a) Barrier Island Restoration; b) Hydrologic Restoration; c) Marsh Creation; d) Oyster Barrier Reefs; e) Ridge Restoration; f) Shoreline Protection; g) Bank Stabilization; h) Channel Realignment; and Sediment Diversion. Structural Protection Projects include: Earthen Levees; Concrete Walls, Floodgates and Pumps. Finally, nonstructural protection projects include: Elevated Housing; Floodproofing; and voluntary acquisition.

Mr. Belhadjali provided an overview of how they developed different scenarios to include the extensive modeling that was used to help determine multiple scenarios. Included in the modeling was continued subsidence, and sea-level rise. The team also developed a worst-case scenario and a moderate scenario of land loss without mitigating factors. The CPRA developed a computer-based decision support tool to help compare and rank individual projects. The tool also develops different combinations of projects for

![Louisiana’s 2012 Comprehensive Master Plan for a Sustainable Coast](image)

*Figure 25: Graphical Representation of the Projects found in the 2012 Coastal Master Plan*
a comprehensive strategy as well as interactive visualizations to display tradeoffs and support decision making.

To assess the different projects, the planning team focused on flood risk reduction and land building as the primary decision drivers. They also looked at investing $50 billion/411 billion Swedish kronor between land building and flood risk reduction. To determine priorities, both near and long term benefits were analyzed. Through the planning tool nearly 400 projects totaling over $200 billion/1.64 trillion Swedish kronor were analyzed and prioritized. The plan was then presented to the public and key industries for review and input. Mr. Belhadjali concluded his presentation by going over several of the approved projects of the 2012 plan and progress made in restoration and flood protection as a result of the implementation of the Coastal Master Plan.

Discussion Points:

1) The delegation inquired about how the CPRA coordinates all the different funding streams from the federal, state and local governments. The state has multiple sources of funding to implement the Coastal Master Plan at all levels of government. The state’s Coastal Protection and Restoration Authority Board has representation from state and local governments. The CPRA Board ultimately prioritized the different funding streams and ensure they are all coordinated with the Master Plan.

2) Several member of the delegation were very complimentary of the plan and stated that there was a definitely a need for the State to share its experiences so other could benefit from the progress that has been made.

3) One of the delegation members asked if the citizens and industry pay for the implementation of the Master Plan. Mr. Belhadjali stated that they do not pay directly as most of the funding comes from the Federal government; however, ultimately the money provided from the Federal government is generated from taxes paid by U.S. taxpayers and industries.

4) A member of the delegation asked about the benefit of restoring the Mississippi Delta in which Mr. Belhadjali stated that by doing so, the state is able to provide flood protection up to 100+ year flood event.
Dr. Brian Wolshon, Louisiana State University

*United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response*

*Presentation Title: Evacuation and Resilience Practice and Research*

Dr. Wolshon began his presentation by going over the theoretical framework in which disaster resiliency is being defined in the United States. In the U.S., resiliency is being evaluated by assessing functionality over a period of time. Essentially, a normal level of functionality exists prior to an event and immediately following the event, modification take place that disrupt normal functionality and a loss of functionality is experienced. Ultimately resiliency is defined by the amount of time in which functionality can be restored back to a normal level. As part of the functionality, resilience must also consider the interdependence of buildings and infrastructure, along with the relationships between individuals and organizations within the built environment. This relationship is being used a basis to develop the Disaster Resiliency Framework 1.0 in the United States.

After providing an overview of how we look at resiliency, Dr. Wolshon transitioned to his primary focus which was evacuation. He started by going over some of the basics of evacuations such as hazard characteristics, evacuee characteristics, transportation resources, and communications. In the U.S. the hazard that causes the most evacuations is actually wildfires, followed by flood events, and fixed site hazmat incidents. Also, the overwhelming evacuations in the U.S. are very localized and most often consist of less than 5,000 evacuees.

In Louisiana, there was no regional evacuation plan prior to 2000. There were also no designated evacuation routes. The first plan was developed in 2000 and included the concept of contraflow for the City of New Orleans. In 2004, prior to Hurricane Ivan making landfall it was implemented with questionable results. The plan was revised and implemented for a second time during Hurricane Katrina.
and by all measures of performance was considered very successful; however, the plan did not take into consideration low-mobility populations.

Dr. Wolshon stated his team was used to help in modeling the proposed alternatives to the evacuation plan following Hurricane Ivan. One of the proposed solutions was to actually limit the number of points in which citizens could access the evacuation routes. The modeling by his team validated this concept.

Dr. Wolshon also discussed examples of control devices to help facilitate and convert evacuation routes from normal operations to evacuation operations. Some methods include prepackaged evacuation kits such as barriers to help redirect traffic, variable message signs, and utilization of the shoulders to increase capacity. Dr. Wolshon, also briefly discussed plans that have been put in place to assist low-mobility evacuees.

Dr. Wolshon concluded by discussing some of the concepts involved in modeling evacuations. The primary model that is currently being used by his team is TRANSIMS, which can be used to model very large geographical regions with large number of travelers. With the availability of good data within Louisiana, his team was able to compare the model data with the actual observed data in both volume and speed. One of the areas that they have been able to demonstrate through their research is that TRANSIMS while not designed for evacuation modeling, can indeed be an effective tool for this purpose.
Discussion Points:

1) The delegation asked if describing an evacuation order as “Mandatory” serves as a way of telling citizens that the threat is serious. Dr. Wolshon stated that more often than not the term “voluntary” evacuations is used by local governments. However, certainly when the term “mandatory” is included in the evacuation order, it does convey an element of additional risk. The seriousness is also expressed by citizens being told that local emergency response personnel will not be dispatched as long as adverse weather conditions are still in the area. Essentially, citizens will be on their own through the duration of the event.
2) One member of the delegation inquired about some of the specifics of the model and the researcher’s ability to adjust some of the different variables. Following the presentation, a sidebar was held by Dr. Wolshon and the delegation member to provide some of the specifics of the model’s capabilities.

3) A question was asked about the crossover that were put in place to facilitate the contraflow process and how it impacts the speed of the evacuation. Dr. Wolshon stated that the crossovers were not put in place to slow down evacuees but enable an increase in the capacity of the existing road network to increase the number of people evacuating. One of the lessons learned with the crossovers was the first vehicles that begin the crossover essentially are not bound by speeding laws as it wouldn’t be feasible to pull them over and give them a ticket. To do so would create more traffic congestion. To alleviate this problem for future evacuations, state officials are now providing a pace vehicle to begin the contraflow process which ensures safe speeds are always maintained.

Dr. Monica Farris, University of New Orleans

*United Nations Making Cities Resilient Essential 4 – Pursue resilient urban development and design;*

*United Nations Making Cities Resilient Essential 7 – Understand and strengthen societal capacity for resilience*

*Presentation Title: Building Resilience in the Greater New Orleans Region*

Dr. Farris provided an overview of her center called the Center for Hazards Assessment, Response and Technology (CHART) which has a mission to assist residents, local and state officials, and communities in understanding and reducing risk to hazards. CHART is a multi-disciplinary and applied research center with emphasis on mitigation. Two of their primary focuses have been on the Repetitive Flood Loss program and the Community Education & Outreach (CEO). CHART has put a large focus on continuity planning for community organizations. Their program included a statewide outreach in which workshops were held. The workshops targeted small community
organizations, nonprofits, and faith-based groups. Through the use of focus groups and other workshops, CHART created a curriculum for community continuity and resilience. The curriculum included understanding hazards, community mapping, ideas for successful response and recovery and how to strengthen your community plan. The end result was the creation of a *Manual for Community Continuity and Resilience*.

Another major effort currently underway is their Risk Literacy program. The program is designed to reach vulnerable populations and is focused on constructing risk messages with awareness of literacy issues. A national planning process is currently used to reach citizens; however, it’s a program that is geared towards high-level readers. Recognizing a gap, the CHART program is focused on two separate yet critical tasks: 1) learning to read and 2) understanding risk. CHART has an ongoing collaboration with adult literacy groups and literacy providers. Through this partnership they have had the ability to review materials, enhance content and improve the programs structure.

![Image of a literacy sample on preparedness from UNO's CHART Risk Literacy Program.](image)

One of the components of the program was the creation of a literacy manual. The manual is written in easy to understand plain language and provides content that is clear and easy to comprehend the information which is focused on reducing risk. It takes a step by step approach in responding to and preparing to natural disasters. Dr. Farris provided some samples of the information from the manual which was well organized, easy to read, and provides important messaging on how to prepare for disasters. Some of the examples include education on what is contraflow, sheltering, supply kits, and cost
considerations for a family to consider when evacuating. The manuals also include checklists for its readers and include both English and Spanish versions.

Dr. Farris then moved on to discuss CHART’s work in the Repetitive Flood Loss area. In the United States, repetitive flood losses are defined as properties that have had two or more claims for more than $1,000/8,220 Swedish kronor within a ten year period. There are also structures which are considered Severe Repetitive Loss which have four or more claim payments of more than $5,000/41,100 Swedish kronor each and the cumulative amount of claims exceeds $20,000/160,000 Swedish kronor or two separate claims that cumulatively exceed the building’s market value. The project included a deliverable of a repetitive loss database and web portal, an area analysis, and outreach.

The analysis component of the project included the identification of the source of repetitive flooding, the development of mitigation measures to combat the flooding and included resident participation. The project focused on a study area in St. Bernard Parish which there were over 50 repetitive losses that included 185 claims and over $8 million/65.7 million Swedish kronor in loss payments. The other major deliverable included the Repetitive Flood Portal, which serves as a tool for public information. The portal also has a secured area which contains a database for all the repetitive flood loss structures.

The final program Dr. Farris introduced was the Community Rating System (CRS) User’s Group. The CRS is a voluntary program that provides incentives for going beyond the minimum National Flood Insurance Program requirements. The CRS provides a rating of 10 different classes which have the ability to lower home owners insurance for communities that are active participants. In Louisiana there are 42 communities that participate in the program. The benefits of the CRS User’s group is that it provides an avenue for participants to share information, work on joint projects, and attract new communities. More importantly, it serves as an avenue to provide feedback on the CRS program back to its FEMA administrators.

Discussion Points:

1) One of the delegation members asked how they recruited members for their continuity outreach program. Dr. Farris stated this was accomplished by going to existing meetings for businesses and non-profits to ensure they were aware of the program. They also reached out to the different literacy groups in the area to reach at risk populations who had limited reading capabilities to expand their risk literacy program.
2) The question of how women were affected by disasters in New Orleans was asked by the group. Dr. Farris commented that there are significant studies that show that women are disproportionately affected by disasters. This is compounded in New Orleans which also has a lack of day care opportunities for single mothers.

3) In regards to the repetitive loss structures, a question was asked why are they raising structures when the HSDRRS has been built. Dr. Farris commented there was still a threat to interior flooding and the elevation of houses was a mitigation program that would reduce this risk.

4) The delegation also asked why didn’t the state just purchase properties that experienced repetitive flooding? Dr. Farris explained that property procurement was actually one of the tools that the state and local governments had available to them. However, it is not often used because the program regulations require that any property purchased as part of this program has to be converted to green space with no option of ever building upon it again. Due to this limitation, it wasn’t often used.

5) A delegation member asked how CHART was funded. Dr. Farris stated that the University of New Orleans pays approximately 20% of her salary and that all other funding for CHART is raised through research projects and federal, state and local grants.

Dr. John Renne, University of New Orleans

United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response

Presentation Title: Resilience and Vulnerable Populations

Dr. Renne discussed one of the issues that tend to plague emergency managers in planning and response, which is their tendency to work in silos and not fully integrate their plans with other agencies that have similar responsibilities. This presents a problem because disasters don’t recognize these artificial silos, nor do they recognize political boundaries. These issues are compounded as the world prepares to address rising sea levels.
Dr. Renne’s research is focused on transportation of vulnerable populations. Transportation is important because of the sheer number of disasters that impact not only the United States but the world. Transportation issues can be looked at as a combination of single and multiple modes along with single and multiple jurisdictions where the complexity of the evacuation grows as you introduce larger populations and multiple modes that are available for evacuations.

Dr. Renne not only has focused his research in the United States but has also looked at disasters in Europe as well. Europe has its own problems due to the population density of the geographical area. According to the United Nations, economic loss per capita is high in Europe due to this density.

A primary focus of Dr. Renne’s research involves carless populations. Nationwide in the U.S., approximately 3% of the homes do not have their own transportation. This is more prevalent in the cities that have the most advance public transit system such as in New York, where nearly 27% of the population do not have their own transportation. In the City of New Orleans, approximately 8% of the population lack the ability to transport themselves.

Of the 1,800 people who lost their lives during Hurricane Katrina, a large portion were elderly. Of those that perished, 71% were older than 60 and 47% were older than 75 years old. Having plans that deal with this segment of the population is becoming more important as the trend of elderly populations is growing. In 2009, 12.9% of the U.S. population was older than 65. By 2030, this segment of the population is expected to represent 19% of the U.S. population.

A major initiative of the post-Hurricane Katrina planning efforts was the establishment of the New Orleans City Assisted Evacuation Plan (CAEP). The CAEP is a mechanism in which the City had established the necessary infrastructure to pick up citizens who do not have the physical or economic means to evacuate themselves. The plan calls for 17 different pick-up locations that citizens can walk to and are then
transferred to the Union Passenger Terminal. From there, the State safely evacuates them out of the city to shelters both in and out of State. The plan also has components that evacuate those with functional needs as well has hospitals and nursing homes. A major component of the CAEP is a group of volunteers that help pickup and transfer individuals who need the assistance of the CAEP program. This organization is known as Evacuteers and are a non-profit whose primary mission is to help implement the CAEP when it is activated.

Dr. Renee also completed a national study on Carless and Special Needs evacuation planning with emphasis on 5 large cities (Chicago, Miami, New Orleans, New York, and San Francisco). The study resulted in several publications. One of these publications is the *Mobilizing Your Community for Emergency Evacuations: Vulnerable Populations Guidebook*. The guidebook provides information on the planning process, plan-making, process evaluation, and recommendations.

His presentation was concluded by talking about the recovery of New Orleans. The primary lead of the Recovery was Dr. Ed Blakely, an international renowned urban planner with vast experiences in helping large cities recover from disasters. He was named the Recovery Czar and was responsible for all elements of the recovery. Having limited resources, the city focused on putting into effect a targeted recovery. The principle driver of the recovery was the Master Plan called *A Plan for the 21st Century*. The recovery was enabled by a local economic boom immediately following Hurricane Katrina. It was also disrupted by the impact of the Deepwater Horizon Oil Spill. New Orleans continues to experience a revitalization that is enabled by its successful economic growth. However, while New Orleans has seen its population recover to 86% of its Pre-Katrina size, the City currently only has less than half of its transit services.

Discussion Points:

1) One of the delegation members asked if there was a correlation between public transit and carless populations. Dr. Renee’s indicated that there was a direct correlation and offered New York City and Washington D.C. as examples. Both cities have some of the most advanced public transit systems in the world and in the United States, these two cities have in excess of 20% of their populations without vehicles.

2) The delegation asked if there are dedicated bus lanes for evacuations. Dr. Renee stated he would like to see a dual purpose lane that is dedicated to public transit and emergency vehicles. However, the State of Louisiana’s contraflow plan does not have this feature.
Mr. Brant Mitchell, Louisiana State University

*United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response*

*Presentation Title: SDMI Overview of for the Swedish Delegation*

Mr. Mitchell began the presentation by providing some background information about Louisiana State University (LSU). Mr. Mitchell noted that LSU has been considered a first tier university by the U.S. News and World Reports; that it is one of the 25 most popular universities; and that it was one of the few universities that had land-grant, sea-grant and space-grant status. LSU also has more than 120 research centers, institutes, labs and programs while conducting more than 2,500 sponsored research projects and accounting for $140 million/1.15 billion Swedish kronor in external grants. Mr. Mitchell also noted that LSU was nationally noted for its sports program which includes national championships by its men’s football and baseball teams. He also pointed out that their most successful program was the women’s track and field team with 25 national championships.

Mr. Mitchell transitioned into an overview of SDMI including its organization, mission and goals. SDMI was originally founded by a large donation from its founders, Toni and Emmet Stephenson. They both watched the horrors unfold during Hurricane Katrina and as successful business owners, felt there were business principles that could be applied to disaster management and improve the practice. One of SDMI’s primary purposes is to leverage the research taking place on LSU’s campus and apply that to enable the disaster management community to make better decisions and improve their practice. One of SDMI’s major initiatives is the hosting of the State’s Business Emergency Operations Center (BEOC). The BEOC serves as a conduit between the private sector and the state during emergencies. It also works to provide the state with needed resources from the Louisiana business community during disasters. SDMI also has a Center for Business Preparedness which is designed to help businesses prepare for and emerge unharmed from disasters by emphasizing the necessity of having business continuity plans.
SDMI is involved in a wide range of activities both on the domestic and international front. Domestically SDMI has provided research for the National Emergency Management Agency, has conducted a seminar on evacuation for New York City, as well as host the National Evacuation Conference. Internationally, SDMI has hosted the United States Agency for International Development, conducted seminars for the Philippines following Typhoon Haiyan, and participated in the United Nation’s Rise Program.

SDMI also provides a robust planning capability and in the past has written the State’s All Hazard Preparedness Strategy, the Contingency Plan for the State’s Legislature, as well as a Community Engagement Strategy for Shell. SDMI also maintains a very enhance GIS program in which it has developed a GIS portal for the State and is currently building a comprehensive infrastructure geodatabase for the entire state. SDMI is also involved with developing mobile apps for the emergency management community as well.

One of the ways in which SDMI applies research to practice is through the development of its storm surge consequence model. LSU runs a very powerful and accurate high resolution storm surge model. Once the model has been published, SDMI provides a full consequence by city of the expected impacts of the storm surge, thus enabling decision makers to make better decisions in regards to evacuations. SDMI has also developed an enhanced school safety plan that enables first responders to have detailed interior maps and response plans for any type of event, including an active shooter event. Mr. Mitchell concluded his brief by giving an overview of SDMI’s latest program which is the development of a Joint Cybersecurity
Training Lab with the Louisiana National Guard. The lab will serve as a training venue to teach cyber warriors how to defend networks that are being attacked.

Dr. John Pardue, Louisiana State University

United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience

Presentation Title: Flood Control, Risk Reduction and Preparedness 10 Years After Katrina and Critical Infrastructure Resilience

Dr. Pardue gave a bit of his background and some of his research activities that he participated in immediately after Hurricane Katrina. He conducted early environmental sampling of Katrina floodwaters/sediments. He also took air samples adjacent to debris piles. Another aspect of his research included analysis of debris handling procedures and techniques. Finally, he conducted analysis and prediction of bulk chemical storage problems during flooding events.
Dr. Pardue briefly went over the Hurricane and Storm Damage Risk Reduction System with the delegation since it had already been thoroughly covered. He did discuss how they were able to build the full HSDRRS in five years. Chief among the hurdles that had to be overcome was the National Environmental Policy Act which establishes environmental review processes that apply to government actions. The act requires the government to seek reasonable alternatives to actions that harm the environment. In doing so an Environmental Impact Statement is prepared, followed by public comment and review, and a review by the Environmental Protection Agency. The process is very cumbersome and moves at a very sluggish pace. The Corps was able to expedite this due to the alternative arrangement, which is authorized in an emergency. The Corps was able to break the impact studies into smaller pieces directed at individual sections. Despite being broken down into individual segments, the Corps still had to have substantial alternatives discussed and mitigation efforts reviewed and it still required an extensive public comment period.

Figure 35: Individual Segments in which the Corps created environmental impact statements.

Dr. Pardue briefly discussed the Coastal Master Plan and reviewed some of the projects that were currently underway as part of the Master Plan. He finished his first portion of his presentation by discussing debris following Hurricane Katrina. Following Hurricane Katrina, over 100 million cubic yards
of debris had to be removed. Some of the issues that arose from the debris removal was the fact that there was no plan to the diversion of arsenic-treated lumber. The potential impacts included contamination of groundwater. Another issue that had to be dealt with is that there was no diversion of wallboard. Potential impacts from this hazard include a generation of hydrogen sulfide that could contaminate the landfill. The debris handling system had inefficient household hazardous waste diversion which also had the potential to contaminate the groundwater. Finally, there was a lot of criticism of the utilization of C & D landfills for disposal, which like some of the other issue, could lead to contaminated groundwater.

In transitioning to Critical Infrastructure Resiliency, Dr. Pardue provided an overview of the crude oil production network model for the Gulf of Mexico. Part of Dr. Pardue’s research includes the effects of severe storms on bulk chemical storage. To illustrate the impact of Hurricane Katrina, a graphic was shown that demonstrated Hurricane Katrina was in fact a 400 year storm for the Mississippi Gulf Coast, a 250 year storm for St. Bernard Parish, and a 150 year storm for the City of New Orleans.
During Hurricane Katrina, there were nine chemical releases along the lower Mississippi River corridor. Dr. Pardue provided several examples of the actual releases from the chemical plants. The primary issue with the chemical releases is that the bulk tanks are designed to float when it floods. However, during storms the tanks are usually shifted off of their foundation and thus tend to leak their contents when the flooding recedes. Regulations require the companies to build a secondary containment wall which assumes only one failure of a single container within the storage area. The walls must be designed to handle 100% capacity of the largest tank within its boundaries. These walls were never designed to handle multiple tanks spilling at the same time.

Dr. Pardue also discussed another major release that occurred during Hurricane Isaac at Stolthaven, just to the southeast of New Orleans. At Stolthaven, 68 storage tanks were in service on the terminal before the storm, and 14 tanks were damages after the storm made landfall. The containment system captured much of the released products. In addition, 142 railcars were derailed by the storm.
Dr. Pardue concluded by presenting some potential solutions that they are currently working on to minimize the impact of future releases. These include developing worst case scenarios and educating first responders on the worst case scenario impacts. Developing structural solutions to common failure mechanisms and improving reporting and assessment capabilities post-spill. The structural solutions include developing barriers that would allow the tanks to float but prevent them from being moved away from the foundation.

Discussion Points:

1) The delegation asked about spillage occurring from connections versus the tanks. Dr. Pardue stated that this does occurs and they try to mitigate this through stop valves. Stop valves are common in plants; however, they are not common in fuel stations where spillage is likely to occur from the connections.

2) One of the members of the delegation asked if chemical companies were motivated on their own to take precautionary measures to ensure that spillage does not occur within their own tank farms. Dr. Pardue said unfortunately they are not. While the consequences of these spills are enormous, the probability of them actually happening are fairly low, thus many of the companies are willing to take a chance that it will not happen to them instead of spending the necessary dollars to ensure that this doesn’t happen.

3) Another member asked if there were contaminants left in the soil? During Katrina there were very thorough about recovering any contaminants; however, during the BP Oil Spill there are still recovering areas of soil where contaminants are present. Dr. Pardue also said more than anything from Hurricane Katrina, they are concerned about higher levels of lead.

4) The question was asked if there was any consideration for new regulations that would prevent the storage of different chemicals in the same containment area. Dr. Pardue said this was not being considered. The primary reason for this is because companies store chemicals for other companies. The decision to store chemicals is based on need from other plants nearby and usually involve multiple chemicals as they feed different plants.

5) A member of the delegation asked if there were any restrictions on the height of the storage structures. Currently there are not. As long as the secondary containment wall is built to the required regulation, then they can build them as high as they desire.
Mr. Casey Tingle, Louisiana Governor’s Office of Homeland Security and Emergency Preparedness (GOHSEP)

*United Nations Making Cities Resilient Essential 10 – Expedite recovery and build back better*

**Presentation Title: Recovery Funding Overview**

Mr. Casey provide an overview to the group of the Recovery Framework. The recovery process is a complicated and collaborative process. To enable communities to recovery more efficiently, the federal government is trying to establish a more structured and multi-layered approach. The framework assigns various recovery support functions to different agencies to ensure a comprehensive recovery effort.

GOHSEP’s mission is to lead and support Louisiana and its citizens in the preparation for, response to and recovery from all emergencies and disasters. In the United States based on guidance provided in the National Response Framework, there are five primary functions in the emergency management cycle: Preparedness, Prevention, Response, Recovery and Mitigation. Louisiana has become very adept in implementing this cycle as the State overall is a high risk for emergencies and disasters. In Louisiana, being able to respond effectively and efficiently is compounded by the fact that the state is home to critical supply routes and energy production resources. GOHSEP serves as the lead agency coordinating with FEMA in two critical areas: Public Assistance Grant Program and the Hazard Mitigation Grant Program.

The Public Assistance Grant Programs becomes available to the states when a disaster declaration is approved by the President. The program authorizes activities that include debris removal, emergency protective measures, and repair/replacement/restoration of disaster-damaged publicly owned facilities. The purpose of the Hazard Mitigation Program is to reduce or eliminate future risk to people and property from natural and man-made disasters. Mitigation is breaking the cycle of disaster: damage – reconstruction – repeated damage. FEMA requires communities to have a Hazard Mitigation Plan in order to receive funding from the hazard mitigation program. The mitigation plan includes a comprehensive risk assessment that also includes a vulnerability analysis and the impact of different hazards to the
community. It also severs a blueprint for mitigating disaster losses by including possible actions and priorities for future funding. Prior to receiving funding, projects must demonstrate that they are cost-effective and substantially reduce risk for future hazards. Hazard mitigation projects include elevated dwellings, storm water management, acquisition of flood-prone property, retrofit, and community safe-rooms.

Figure 38: An example of an elevated home funded by the State’s Hazard Mitigation Program.

Mr. Tingle concluded his presentation by providing an overview of the current recovery dollars being managed by GOHSEP. In the public assistance arena, the state is administering over $13.6 billion/111 billion Swedish kronor to assist in the rebuilding process. In an effort to mitigate future losses, the State is overseeing more than $2.1 billion/17.2 billion Swedish kronor in hazard mitigation dollars. Just to provide a little bit of scope on the size of the recovery, GOHSEP has dealt with over 1,586 sub-grantees, managed over 35,800 projects and has reimbursed nearly $100 million/822 million Swedish kronor a month for the last ten years. He wrapped up by stating that some of the slowdowns from the recovery include the complexity of the programs and the overall recovery effort, the sheer capacity of the program, and the speed of the reimbursement process which involves great risks for the state in the terms of having to pay back any overpayments.

Discussion Points:

1) A delegation member asked how do you demonstrate cost benefit analysis. Mr. Tingle stated that FEMA has a process in which the overall costs are accessed based on the amount of risk that will be reduced if the project is approved.
2) The delegation asked if the Safe Rooms could be used for alternate uses beside a safe room. The answer provided by Mr. Tingle was essentially yes; however, it does have one major caveat. The room must be able to be restored to a full safe-room status in very short order. The program was originally designed for tornadoes, which typically means they have to be ready with short notice.

3) A question was asked regarding whether or not mitigation funding supported community outreach and education. Mr. Tingle stated absolutely and the state has invested a significant amount of dollars in this effort to educate its citizens.

4) A member of the delegation asked what kind of criticism they have faced. Mr. Tingle stated that the biggest criticism is that payments aren’t processed fast enough. The states uses a system called Express Pay, which allows the recipient to be reimbursed 90% of the cost up front. This allow for the funding to be transferred quickly but doesn’t cover the full cost of reimbursement. The remaining 10% of funding is paid when all the documentation has been verified and approved. This serves as an expedited way to issue the funding but also minimizes the states exposure to risk by withholding a portion to ensure everything is eligible for reimbursement.
**This Page Intentionally Left Blank**
Making Cities Resilient Exchange in Gothenburg

Prior to departing from New Orleans, the Swedish delegation along with its hosts from New Orleans and SDMI conducted a brief after action review to discuss lessons learned from the New Orleans portion of the exchange and to integrate any of those lessons into the initial planning for the return trip to Gothenburg. While a logistical mishap adjusted the initial plan of immediately beginning the Making Cities Resilient Exchange in New Orleans with field visits, the mishap allowed for an overview that was planned for later in the trip. It was determined that the overview was important in laying the foundation on what happened to New Orleans as a result of Hurricane Katrina and provided perspective on the necessity to implement such drastic changes in how the city and state have made tremendous efforts in protecting its citizens. As a result of the after action review, the delegation also determined that having the opportunity to conduct field visits throughout the duration of the visit would provide more benefit as it broke up the monotony of listening to briefs for an entire day. Based on the feedback provided by the delegation and its hosts, the Making Cities Resilient Exchange in Gothenburg was planned by providing an initial overview of the city, county and state for the New Orleans delegation and would integrate field visits throughout the three day visit. The official visit to Gothenburg took place from May 26 – 28, 2015.
Field Visits

Figure 40: Mr. Moback provides the delegation with an overview of the Gothenburg Mapping Room. Photo by Dr. Meyer.

While not listed as an official visit, the Making Cities Resilient Exchange in Gothenburg began with an introduction to Gothenburg’s own map room which was developed by the city at a low cost utilizing high resolution imagery protected by clear laminate to create the entire city and its surrounding areas as a floor mural that could be used by planners to help visualize and provide perspective on existing and future projects. The quality of the imagery and the utility of the tool was a huge hit with the delegation and provided many opportunities throughout the duration of the project for the Swedish and New Orleans delegation to have personal discussions about different aspects of the city and some of the issues that it faces.
Gothenburg River Room

The first official field visit for the New Orleans delegation included a tour of the Gothenburg River Room, or the Älvrummel. The River Room was developed and operated by the City and serves as an area in which citizens of Gothenburg can view a comprehensive 3D model and participate in debate about future urban development in and around the City of Gothenburg with particular emphasis along the river shores. Here new proposals and developments can be visualized and give the citizens of Gothenburg an idea of what the impacts of these new proposals may have on the cities inhabitants. This approach also allows the citizens to provide feedback to the City on any new proposals that are being presented. One of the themes that became perfectly clear while visiting Gothenburg is that they go through great lengths to have a transparent government and provide the citizens with many opportunities to provide direct feedback to the city government. The Gothenburg River Room provides a great example of this effort.

Urban Safety and Societal Security Research Center (URBSEC)

The New Orleans delegation was given an opportunity to take a quick trip by boat along the Göta Älv River to visit the URBSEC located at the Lindholmen Science Park. While visiting the Center, the New Orleans delegation was provided three presentations that included an overview of Lindholmen Science Park, Urban Safety and Societal Security Research Center (URBSEC), and an area of research about securing seaports that is currently being pursued by URBSEC. The delegation was given time to ask questions following the three presentations.
Lindholmen Science Park: Mr. Bosse Norrhem

**United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience**

**Presentation Title: Lindholmen Science Park**

The first presentation was provided by Bosse Norrhem, who is the program manager of the Science Park. The Science Park was built in 2000 and represents an initial collaborative effort by Chalmers University of Technology, the Volvo Group and Ericksson. Since its initial conception it has grown to include additional government, business and academic partners. Ericksson is the single largest tenant in the park with nearly 3,000 employees currently working there. Overall, there are over 23,000 people who work in the Science Park, which includes 9,000 students and 1,000 residents. Over 350 companies have space at the park.

According to Mr. Norrhem, the Park is managed by academia, the public and private sector partners. The primary goal of the park is to fill the gap between research and the application of the new research that is being developed. Some of the innovative areas in the park include an advanced driving simulator, security arena, and testing for traffic safety, electric mobility/cars and transportation efficiency. Some of

---

*Figure 42: Lindholmen Science Park. Photo by Dr. Meyer.*
the factors that have contributed to the success of the park include an excellent organization and infrastructure, a very high commitment from the city; a stable board of directors, strong industrial interests and the integration of knowledge clusters that lead to innovation.

**URBSEC: Dr. Michael Landzelius**

**United Nations Making Cities Resilient Essential 1 – Organize for disaster resilience**

**Presentation Title: Urban Safety and Societal Security Research Center**

Mr. Norrhem was followed by Dr. Michael Landzelius, who is the current Director of URBSEC. URBSEC is a collaborative effort between the University of Gothenburg and Chalmers University of Technology with three core missions that include 1) increased research collaboration between the two universities; 2) building a network with private and public sector actors along with civil society; and 3) the belief that research should be focused on known practice relevant knowledge gaps and challenges. Dr. Landzelius’s charge as Director is to find the relevant research to meet the needs of potential gaps that have been identified. URBSEC is considered a soft center in that the researchers are based in the home departments and only work on specific projects as needed and funding is available. There are eighteen different departments between the two universities that comprise URBSEC and they work in various constellations to address gaps for specific projects.

Dr. Landzelius explained to the delegation that URBSEC’s core activities are organized into four functions which include a Steering Committee, a Director, Priority Area Leaders, and Research Teams. The Steering Committee consists of 7 members who represent various departments between the two campuses. The Steering Committee has decided to focus the center’s efforts on four priority research areas which include: Politics and Governance; Communication and Interaction, Infrastructure and Interdependencies, and Sustainability and Resilience. Appointment of Priority Area Leaders is contingent on increased funding. As they are appointed, their aim is to increase the capacity to build projects and draft applications, respond quickly to new opportunities, and organize project partnerships. The center is currently engaged in trying to secure two European Union Horizon 2020 application in the area of secure societies.
URBSEC: Dr. Maria Stern

*United Nations Making Cities Resilient Essential 1 – Organize for disaster resilience*

*Presentation Title: Securing Seaports: Interrogating Security Governance at the Port of Gothenburg and the Port of New York and New Jersey*

The final presentation was provided by Dr. Maria Stern, who serves as the Chair of the URBSEC Steering Committee. She provided the delegation an overview of one of the center’s proposed research topics. The research project is focused on analyzing how port security is governed in practice between the two port systems through combinations of social and technological arrangements. It also anticipates researching how security is imagined and enacted can be based on who actually governs the seaport. Global ports are characterized by a mix of global, regional and national interest as well as public, private and a combination of public-private security actors with their own self interests. The research is focused on the two port systems because they both serve as landlord ports that have a diverse range of private-public actors engaged with the security apparatus of each port.

Discussion Points

1. The New Orleans delegation asked a question on how intellectual property is managed at the Science Park. Intellectual Property developed follows the directives of the EU commission established by Horizon 2020. Parties have to participate in an agreement on who will be responsible for any intellectual property developed through a project. This has typically not been a problem as a large portion of the research conducted at the park is focused on different challenges in the early phase of a project so intellectual property doesn’t become an issue.

2. A member of the delegation asked what industries they see establishing the market space at the Science Park. Mr. Norhemm responded that Volvo has its own customer base within the park. Many companies come to the park because they want to work with Volvo and the park in some cases gives them access that they otherwise might not have. Companies are also coming to the park because it makes it easier for them to recruit students as many of the university students are working on specific projects.

3. Dr. Stern was asked if she thought there would be significant differences between how ports operate in American versus the European Union. Dr. Stern did believe that once the research is conducted they do anticipate finding different practices and policies between the two.
Gothenburg Port

The delegation was afforded the opportunity to take a river cruise to gain a full appreciation of the size, beauty and importance of the Gothenburg Port to the region and the country. The Port of Gothenburg is not only the largest port in Sweden, but the largest international harbor in all of Scandinavia. Annually there are over 11,000 vessels that make calls to the port each year. The trade that moves through the port represents almost 30% of all foreign trade for Sweden. The port also provides access to different modes of transportation to include rail and highways. The port contains a diverse capability to handle multiple types of cargo and includes containers, roll-on/roll-off cargo, cars, passengers, and petroleum products (Port of Gothenburg, 2015)

![Port of Gothenburg](image)

*Figure 43: Port of Gothenburg. Photo by Dr. Meyer.*

Emergency Operations Center, County of Västra Götaland

Upon the completion of the tour of the Göta Älv River, the delegation was taken to the Västra Götaland County Emergency Operations Center to visit the hub of where the county conducts its coordination to facilitate emergency support efforts to the different jurisdictions within the county.
Figure 44: Visiting in the Västra Götaland EOC. Photo by Dr. Meyer.

Dam of Lilla Edet
The final day of field visits included a trip outside the city for an opportunity to view the Lilla Edet Lock. The lock was the first floodgate opened in Sweden. Construction initially began in 1580 and the lock became operational in 1607. The lock was destroyed several times during its existence as a result of wars with the Danes. The lock currently in place today was constructed in 1916. In addition to the lock, the site also contains a hydro power station. The site serves an important environmental role with the construction of two salmon ladders within the complex. The ladders serve as a way of improving the salmon population by helping them swim upstream. The ladder is also equipped with a counter which allows salmon counts to be taken as they migrate up the ladder.
Location of the Tuve Landslide

One of the more common hazards that Sweden faces is the possibility of a landslide occurring. Landslides can be relatively minor occurrences or they can result in significant loss of life and property. Such an occurrence occurred north of Gothenburg in Tuve on November 30, 1977. Following heavy rains, which caused the groundwater levels to rise to normal heights after being relatively low for several years, strength of the clay in the area was weakened and may have caused the initial failure of a roadway embankment (Duncan & Lefebvre, 1980).

The resulting landslide lasted approximately 6 minutes and destroyed 65 houses and resulted in the evacuation of 700 people from the area. Eight people in the area of the landslide were killed and approximately 60 others were injured. Approximately 1.6 kilometers/1 mile of the road that ran through

Figure 46: Mayor Malm and Mr. Moback explaining the Tuve Landslide. Photo by Dr. Meyer.
the landslide was destroyed as can be seen in figure 48. Figure 47 contains an aerial image of the area today. During the field visit, the delegation was joined by Lord-Mayor Lena Malm, the Mayor of Gothenburg who grew up in the area and had vivid memories of the landslide that she shared with the delegation.

Hökälla Gård Wetland

The final field visit for the Making Cities Resilient Exchange in Gothenburg included a walking tour of the Hökälla Gård Wetland. This 63 acre natural wetland is located on the Island of Hisingen, which is directly north of Gothenburg. Two ponds were created in the wetland to serve a diverse bird population and wildlife. There are also over 200 sheep and 20 cattle that graze in the wetlands (Webb, 2010).
Figure 49: Multiple view of Hökälla Gård Wetlands and wildlife that it supports. Photos by Dr. Meyer.
Implementing Research to Build Disaster Resilience in Gothenburg
Mr. Ulf Moback, Gothenburg City Planning Office

United Nations Making Cities Resilient Essential 4 – Pursue resilient urban development and design;

United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

United Nations Making Cities Resilient Essential 7 – Understand and strengthen societal capacity for resilience

United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response

Presentation Title: Gothenburg: Orientation of Sweden and the City

Following a tour and overview of the map room, Mr. Moback formally welcomed the delegation to the City of Gothenburg. After an introduction of both Swedish and American participants, Mr. Moback began his presentation by providing some basic information on Sweden such as that it is the fifth largest country in Europe and that it is sparsely populated with approximately 9,700,000 inhabitants. The number of people per square kilometer is only 22, which is considered low for densely populated Europe. Nearly 85% of the inhabitants live in the southern half of the country. Gothenburg has also approximately 60 public companies, which is considered very large for Sweden. The city including districts and companies employ 49,000 people which make it the largest employer in Gothenburg, approximately 9,000 people work directly for city in authorities. Sweden has 21 counties and 290 municipalities. Sweden is also a constitutional monarch, in which King Carl XVI Gustaf has been King since 1973. The Swedish monarchy is a representative and ceremonial role with no political powers. The country is governed by executive ministries and a parliament, called the Riksdag. The regional level of government is composed of the 21 counties which tend to be weak politically. Most power in Sweden is concentrated at the municipality level.
After providing an overview of Sweden, Mr. Moback proceeded to give an overview of Gothenburg which consists of 10 city districts each with its own council. Gothenburg also has approximately 60 public companies, which is considered very large for Sweden, that employ 49,000 people. The city is the largest employer with approximately 9,000 people working directly for the city. The annual budget for Gothenburg is 34 billion Swedish kronor/$413 million a year. Nearly 85% of all costs are associated with providing healthcare, education and social care.

The City of Gothenburg consists of approximately 533,000 residents and is the second largest city in Sweden. It is strategically located between Oslo and Copenhagen and contains Scandinavia’s largest port. The city is growing rapidly with most of the growth coming from areas outside of Sweden. Today, 23% of Gothenburg’s population is born outside of Sweden. The city is currently preparing for an additional 150,000 people by the year 2035.

The city first began being built in 1619 and received its charter in 1621. The city was built and organized by the Dutch and Germans and developed into a prosperous shipping and trading city in large part due to the success of the Swedish East India Company. In the 19th century the city developed into an industrial city with the technology and expertise from England and Scotland. In the 20th century, Sweden maintained a status of neutrality during World War II and their economy was left intact following the conclusion of the war which allowed Sweden to prosper.

Figure 50: Mr. Moback explaining areas susceptible to flooding due to climate change. Photo by Dr. Meyer.
Gothenburg has many strengths and opportunities and is experiencing rapid growth. Its economy is among the best in the world for growth. The city has a thriving industrial sector which benefits from well-established clusters and networks. Industries in Gothenburg include automotive, information and communication technology, logistics, medical technology, environmental technology and maritime industries. Gothenburg also benefits with its strategic location and access to water, along with its green space and efforts to build a sustainable city, its strong industry base, its innovation, creativity and entrepreneurship.

Älvstaden is an area that includes large areas of the north and south shore of the city along the Göta River and was adopted by the City Council in 2012. The city is developing a vision for the future of Älvstaden which includes an additional 15,000 homes and 45,000 jobs. The ultimate goal is to build a sustainable city that is open to the world. The effort has been collaborative and has included dialogue from the Gothenburg community. The city is also working with the Volvo Corporation and the county to build an all-electric bus route that is expected to start this year. One of the goals of the program is to build noiseless buses that will actually be able to pick up and drop off people indoors. A second major project the city is embarking on with Volvo is an effort that will include 100 self-driving Volvo vehicles that will be driven and tested on Gothenburg’s public roads in 2017.

After completing a comprehensive background and future direction for the city, Mr. Moback turned his attention to the natural hazards that are impacting and influencing the city’s growth. The city has expanded over wetlands. The river was dredged and the sediment from the dredging was used to add additional lands. The city sits on soft sediments as the rock bottom of the area is nearly 140 meters below the river. Subsidence is a large problem for the city and the region. Other areas of concern involve an extreme weather event that would involve a large amount of precipitation and flooding from the river. The city is also bracing for a 1 meter rise in sea level by 2100. To help determine the impacts of any future events, the city has invested and developed a comprehensive flood model. The model simulates future water levels, flows, rainfalls, and high sea level. The model allows the city to evaluate different protection measurements, and determine a cost benefit analysis. The model also serves as a basis for climate adaptation strategies. Data inputs for the model include bathymetry, elevation data, below ground drainage, bridges and structures in or on water, existing hydraulic models, land use, aerial photography, building contours, and functions important to society and damage costs.
Figure 51: A visual showing the potential for flooded areas in Gothenburg.

The hydro model was used to conduct 48 simulations in which the city was able to derive some important conclusions on the impacts of future weather events and sea level rise. Today Gothenburg has a current planning level for flooding of 1.8 meters in the city center. Based on the increased occurrences of expected extreme weather and sea level rise, the city has determined it will need to base its long term planning efforts to increase the base level of flood planning to 2.6 meters by the year 2100. Based on the hydro model, the city has determined it can manage up to 2.3 meters, a storm surge barrier would be needed. However, for the long term requirements to mitigate 2.6 meters or more, the city will be required to build a storm surge barrier. Currently the city is looking at two proposed barrier to be located at the entrance of the Göta Älv. The Alvsborg Storm Surge barrier option 1 is to build a sinkable segment gate, while option 2 is to build a horizontal sector gate. In addition to the Alvsborg Storm Surge Barrier, a second submerged barrier would be required at Nordre Alv, the waterway that forms the northern boundary of the Island of Hisingen. The total cost for both barriers would be approximately 5.2 billion Swedish kronor/$632 million. There are still issues that will have to be overcome, including environmental constraints. Also, who should bear the burden and costs of building the barriers? The state or the municipalities? In Sweden they are hampered because there is no national level policy on flood
governance. While there is significant strength in the municipalities, not having a strong national level policy is a weakness. Mr. Moback concluded his presentation by stating that for Gothenburg more water is in their future. However, they have good tools through their hydro model and they still have plenty of time to make long term decisions. By being proactive and looking at long term climate change impacts, Gothenburg is well positioned to mitigate any potential impacts based on the information that they have been able to develop to date.

Discussion Points

1. Mr. Moback provided a slide that showed the breakdown of the city’s budget. The slide didn’t indicate there was a separate budget category for infrastructure improvements such as road maintenance. A question was asked where funding for road and infrastructure was contained within the budget. Mr. Moback pointed out that there was a category of “Other” which contained 11% of the total budget and that is where funding for roads was included.
2. When pointing out that landslides were a major hazard for Sweden, a participant asked where the most vulnerable areas near Gothenburg were. Mr. Moback stated the area north of Gothenburg was the greatest concern.

3. Another question regarding hazards was based on the areas susceptible to flooding and how many people lived in the areas most prone to flooding. According to Mr. Moback he estimated that there were approximately 100,000 people, or nearly 20% of the population that lives in areas susceptible to flooding.

4. In regards to limited national guidance for flooding, a delegation member asked if there was anything similar to the National Flood Insurance Program which are based on flood maps provided by FEMA. Mr. Moback stated that was a gap in Sweden and something that should be addressed.

Mr. Lennart Bernram, City of Gothenburg

United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response

Presentation Title: Crisis Management in the City of Gothenburg

Mr. Bernram started his presentation by providing some background information about himself. He started working for the city at Gothenburg Energy, where he was an electrical engineer. He eventually became the Chief of Security and Operations Manager. He is now a senior advisor to the Gothenburg Executive Office. Transitioning to the formal part of his presentation, Mr. Bernram provided the delegation an overview of the City of Gothenburg’s organization. The city is governed by a City Council which is elected by the people and it also contains a Chief Executive. The City Council determines which committees to establish and elects who will serve on each committee. The committees are responsible for the day-to-day operations of the city. The committees work on various issues that are presented to the City Council and ultimately implement any decisions that are made by the Council.

One of the major committees is the Goteborgs Stadshus AB, which represents the city interest in companies that are partially or fully owned and operated by the City. This committee is the City of Gothenburg’s Group Company and therefore, the owner of all City of Gothenburg companies. The City’s
publicly owned companies include Energy, Housing, Commercial, Tourism, Ports, Public Transport, Internal, and Businesses.

Following an overview of the city government, Mr. Bernram introduced the three basic principles of Swedish crisis management. The three are as follows: 1) Principle of Responsibility – which states that an authority having responsibility for activities under normal conditions shall also have it during a crisis situation; 2) Principle of Similarity or Conformity – which states that during a crisis the activities shall conform as much as possible to the normal daily procedures; and 3) Principle of Proximity – which states that a crisis should be handled where it occurs and by the people who are most concerned. These three principles are practiced at all levels of government.

The next topic area covered by Mr. Bernram involved how the city conducts emergency management operations. According to Mr. Bernram, all committees and companies have their own responsibility and shall plan and practice to be able to handle a crisis situation. Typically when a crisis occurs, police, rescue services, and emergency care can quickly arrive on site. As warranted based on the size of the response, other public services can be called as needed. From the City of Gothenburg, a staff of police, county administrative board, and rescue services will coordinate the information within themselves and to the public. Figure 54 provides an illustrations of the cities Crisis Management Board.

![Diagram of the City of Gothenburg's Organizational Structure for Emergencies.]

The City Chief Executive on Duty is responsible for making sure that all actors are active and on the go. This individual is also responsible to inform and make proposals for decisions to the elected officials and
the municipal executive committees. The Chief Executive on Duty ensures that all responding agencies are following the three guiding principles and that the Committees and the municipal companies are working together. Finally, this individual is responsible for ensuring that the citizens and media are informed of the latest information pertaining to an event.

The final component of Mr. Bernram’s presentation involved risk management and vulnerability analysis. The purpose of the vulnerability analysis is to provide increased knowledge of risks and consequences; important activities; and critical functions. Having this increased knowledge allows the city to create preconditions to institute the correct arrangements. Through the risk and vulnerability analysis, the City of Gothenburg has identified the following nine areas of risk:

1) Extreme Weather Event – rising sea levels, water in the river, rain and/or snowfall
2) Energy, Water, and Telecom/IT – shortage of power, drainage issues, prioritization of restoration
3) Transportation – 3 bridges and a tunnel cross the river; however, only one services rail
4) Manufacturing – accidents which can cause uncontrolled spillage
5) People not Coming to Work – more than 50% of the workforce absent due to illness or other reason
6) Gang Crime, Organized Crime, Sabotage, and Terrorism – unauthorized influence on the democratic process and when normal life for the citizens is disturbed
7) Information Security – feasibility to maintain
8) Social Imbalance – when established guidelines are sidelined by the citizens
9) Unpredicted event - ???

That concluded Mr. Bernram’s presentation from which he took questions.

Discussion Point:

1. A question was asked on how long that their crisis response organization had been in place and whether there was a similar structure in other cities in Sweden. The response was that the structure was developed following a tram wreck in 1991. The organization itself is unique to Gothenburg as there is no national standard in Sweden. It is up to each municipality to organize in a manner in which they see fit.

2. One of the delegation members asked if they exercised their command group and if so how often? Mr. Bernham stated that they do have exercises but it has been some years since they have involved the full command group; however, the individual committees exercise each year.
3. A delegation member asked what is their message to their citizenry for being prepared in which Mr. Bernham said they ask their citizens whether or not they can survive without assistance for 72 hours. They ask them if they have sufficient food and drinking water. This allows the city to focus its efforts towards people that they are responsible for and not waste resources on the general population.

4. The last question focused on the different interdependencies the sectors have among each other and whether or not they have a model to determine these interdependencies. Mr. Bernham stated that they have discussed a model but to date have not moved forward with implementing.

Ms. Janet Edwards and Åsa Fritzon, Swedish Civil Contingencies Agency (MSB)

*United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response*

*Presentation Title: MSB’s Roles, Responsibilities and Interaction*

Ms. Edwards began her presentation by providing the delegation the Swedish Government’s Objectives for Safety and Security. The primary objective of MSB is to protect the following: 1) life and health of the population; 2) functionality of society; and 3) their ability to maintain their fundamental values such as democracy, law and order, and human rights. MSB provides support to a full range of emergencies from every day accidents to catastrophes. They provide special programs for elderly and children for any type of accident with a high probability and low consequences. Ms. Edwards also pointed out that they don’t typically have emergencies that cause a lot of casualties, and none large enough in scope to be included in the international database.

MSB considers a full spectrum of events that can be considered civil contingencies to include flooding, landslides, storms, drownings, fires, attacks on IT, and fires to name a few. MSB has contributed significant resources towards the prevention of fires and has generated a lot of success in this area. The Country has a number of fires every year and large fires about every 5 to 10 years, but not so large that they cannot be contained. However, in 2014 there was a large fire in Västmanland that lasted for three months. Sweden received assistance from Italy and France through the European Union’s Civil Protection Mechanism by which EU countries help each other during a crisis. In this case their airplanes helped with the water bombing of the Västmanland forest fire. In 2015 MSB requested a few forest fire researchers and prevention experts from Spain and Portugal to view the fire site in Västmanland and share their expert knowledge. This was financed by the EU Civil Protection Exchange of Experts program. The fire was
attributed in part due to climate change. The most prevalent risk in Sweden is flooding, which in large part is a result of the vast number of rivers and lakes and spring snow melt. Even heat waves in the summer are emerging as a risk in Sweden.

Ms. Edwards proceeded to explain the organizational structure of MSB which includes a Director General and Deputy Director General. MSB consists of an Administrative Department and four major departments as seen in figure 55. MSB also participated in the 3rd World Conference on Disaster Risk Reduction in Sendai, Japan. During the conference a new framework that was built upon the Hyogo Framework for Action 2005 – 2015, was adopted by the United Nations. The new framework consist of four priorities for action at the local, national, regional, and global levels: 1) Understand disaster risk; 2) strengthen disaster risk governance to manage disaster risk; 3) investing in disaster risk reduction for resilience; and 4) enhancing disaster preparedness for effective response, and to “Build Back Better” in recovery, rehabilitation and reconstruction. The Sendai agreement also updated the 10 Essentials. The new essentials are:

1. Organize for disaster resilience;
2. Identify, understand and use current and future risk scenarios;
3. Strengthen financial capacity for resilience;
4. Pursue resilient urban development and design;
5. Safeguard natural buffers to enhance the protective functions offered by natural ecosystems;
6. Strengthen institutional capacity for resilience;
7. Understand and strengthen societal capacity for resilience;
8. Increase infrastructure resilience;
9. Ensure effective disaster response;
10. Expedite recovery and build back better.
As part of the UN’s Making Cities Resilient Campaign, Sweden currently has ten cities participating in the program.

Additional legislation was passed in 2014 which addressed Climate Change. The Climate Change Adaptation allowed municipal agencies to receive funding to help address and mitigate climate change impacts. The legislation authorized 150 million Swedish kronor/$18 million to be used to help fight climate change.

Ms. Edwards also discussed the different levels of responsibilities in case of emergencies which can be seen in figure 56.

Since Sweden is a member of the European Union (EU), it is also required to implement directives in their own national laws. As an example, the EU passed a Flood Directive which gives MSB a mandate to assist local and regional level governments with flood mapping. In addition the EU has directives on Critical Infrastructure Protection, Civil Protection Act which includes Disaster Prevention, and Climate Change Adaptation. Another international agency that Sweden is affiliated with is the North Atlantic Treaty Organization (NATO). While not a member of NATO, Sweden has participated in the Partners for Peace program since 1994.

The final part of the MSB presentation revolved around research and was given by Ms. Fritzon. MSB has developed a Research for Safer Society Strategy which is designed to lay the foundation for the MSB’s research activities from 2014 – 2018. MSB primarily supports applied, needs-oriented research that will benefit societal security as a whole. The aim is to generate practical applicable research findings that will lead to an increased ability to solve societal problems. The program involves multiple agencies that work to identify knowledge gaps. To help facilitate new research initiatives, MSB provides 120 Swedish kronor/$18.2 million to allocate towards research. The funding can be used for large projects, centers of excellence, small projects as well as post doctorates.

Research for a Safer Society has 5 research areas: 1) individual and public safety; 2) protection from fire, emergencies and hazardous substances; 3) societal continuity and resilience; 4) strengthened emergency preparedness and civil defense; and 5) information security. Sweden has also worked closely with other

| Municipal 290 | risk inventory and analysis, prevention, preparedness & response (first responders), education and training, land use planning , climate change adaptation, building permits, environmental protection, civil protection, social welfare, lessons learned |
| County 21 | Support and supervision of local level and can "take over" responsibility for response |
| National | Support with training, exercises, materiel support from national level (flood barriers, forest fires modules). Finance research and development of methods and technology |
| European/International | Resources from neighbouring countries and other EU countries - MIC and NATO/EARDRCC |
countries to enhance research initiatives. In 2007, the Swedish and American governments signed a bilateral security research agreement. The agreement is administered by MSB and the U.S. Department of Homeland Security Science and Technology Directorate respectively. The general goal of the agreement is to initiate and promote lasting collaboration between the MSB and the DHS, between Swedish authorities, and their counterparts within the DHS sphere as well as between public and private Swedish research organizations and the American equivalents.

Discussion Points:

1. One of the delegation members asked if there was a single building code that the municipalities had to follow? Ms. Edwards stated there is a single code; however, municipalities have the ability to make it more stringent. Also in 2010 a law was passed that now requires them to consider flooding and erosion.

2. A question was asked if there was a single standard and/or system in Sweden for interoperable communications. In Sweden they are working on a single standard but currently have multiple systems.

3. In regards to funding for research provided by MSB, one of the university delegation members asked if universities received the funding directly from MSB? Ms. Fritzon explained that absolutely they do and in fact are the largest beneficiary of the program. She also went on to explain that private entities can apply for and receive funding as well.

4. As a follow up question, the delegation was curious to know if MSB has seen a trend since the implementation of the program towards seeing more programs being added on resiliency at the university level and if they have in fact seen better prepared students. Ms. Fritzon replied that there are more resiliency programs being added and the trend is certainly moving towards seeing better prepared graduates.
Mr. Lars Westholm, County Administrative Board, Västra Götaland

*United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response*

*Presentation Title: Västra Götaland Emergency Management Unit*

The presentation began with Mr. Westholm giving the delegation some background on his work with the county which includes serving as a Project Manager for the County Emergency Management Unit. The county of Västra Götaland consists of 1.5 million citizens and stretches for 240 kilometers/149 miles from north to south. The county employs approximately 800 employees and works with 49 municipalities which are within the geographic boundaries of the county. An area of interest in regards to Västra Götaland, was that originally it was 4 counties that later merged into a single county which has created minor issues due to the vast size of the county.

The country conducts civil emergency planning for before, during and after an incident. The counties planning efforts are focused on: 1) protect people’s life and health; 2) protect critical functions in the society; and 3) prepare for emergencies and try to reduce consequences. Like all other levels of government, they incorporate the three basic principles of responsibility, parity, and proximity. The counties do not conduct a lot of operational work but instead focus on strategic planning. They provide guidance and advice for the municipalities. They also maintain operational control of the dams so they can coordinate and adjust their usage as necessary.

The County Administrative Board and all its municipalities have to develop their own risk assessments. To facilitate the assessments, MSB provides difference scenarios in which municipalities determine whether or not they have the necessary capabilities to properly respond. On a daily basis, the county has an assigned duty officer for 24/7 operations. The counties responsibilities during an emergency include: 1) initiate command group; 2) coordinate and support different actor’s response; 3) coordinate confirmed

*Figure 57: Mr. Westholm providing an overview of Västra Götaland County.*
information; 4) coordinate governmental and international resources; and 5) report to the government offices of Sweden. The county is also responsible for complex rescue operations if needed as well as an response for a radioactive substance release from a nuclear power plant.

Mr. Westholm next focused on the River and Valley of Göta Älv. There are many vulnerabilities of the area due to the critical functions that are provided by the navigable water ways. The area provides drinking water for 800,000 people. There are also important transportation routes through the valley by road, train and boats. The area is also densely populated in some areas. Some of the threats faced in the county include being the most landslide prone area in Sweden. There are also concerns from potential failures from large dams as well as major flooding from extreme weather events. Finally, there is significant potential to experience contaminated industrial sites due to the large number of abandoned sites that still have contaminated materials.

The county also has a very large coastline which has had frequent oil spills, although Mr. Westholm was quick to point out that none of these were anywhere near the size of the BP oil spill off the Gulf Coast. The area is also susceptible to category 1, 2 and 3 storms which not only bring the potential for flooding but also extreme wind hazards. Other risks include disruption to the counties strategic transportation system, a nuclear power plant 60 kilometers/37 miles south of Gothenburg and potential social unrest. The area is also strategically important to Sweden as 90% of Sweden’s fuel requirements are refined in the county. Mr. Westholm concluded his brief by going over some of the disasters that have impacted the county including a fire that killed 63 young adults in 1998, a fire at Sea on M/S Scandinavian Star in 1990 which resulted in 159 deaths, as well as the 2006 E6 landslide of Småröd.

**United Nations Making Cities Resilient Essential 4 – Pursue resilient urban development and design;**

**Presentation Title: Risk Management Physical Planning**

After completing his first presentation, Mr. Westholm immediately transitioned into his second presentation on physical planning. The Planning and Building Act addresses participating, ecological and environmental concerns. Through the zoning process, municipalities have a monopoly on planning. Municipalities work diligently to create a comprehensive plan to guide future growth. From the comprehensive plan, municipalities also derive a detailed development plan. To help facilitate the development of large areas and address environmental concerns, the government can create a special area regulation which will expedite the process of issuing building permits. Ultimately only municipalities can develop these plans. It is possible for the national government to take over the process but to date
that has not happened. During the plan development, the county advises, supplies information such as boundaries or new information in the system. They also are required to conduct a review of the plan and serve as the national governments representative. The planning process is depicted in figure 58.

Figure 58: Legal Framework for the Swedish Planning System.

When plans are not up to codes, the county can conduct a special review, and in the worst case scenario, they can actually revoke the plan. When the counties review the plan they are looking at several things. They will review the impact on areas of national interest, such as the Gothenburg Port. They also look at border issues, particularly if the planning process may impact Norway. They will look at environmental issues to ensure the protection of water. Another area they focus on is to ensure municipalities are not blocking access to the shore. Finally they look at health and safety issues to include: noise; air quality; dangerous goods; dangerous enterprises; erosion; landslides and flooding.

Discussion Points:
1. Part of the flood review includes areas being built on a 100 year floodplain. A delegation member asked if the 100 year flood plain model was develop using modeling, in which Mr. Westholm acknowledged that it was.

2. A follow up question in regards to the modeling was asked. Specifically one of the delegation members wanted to know if the county did real time assessments to validate the model. According to Mr. Westholm, not at this time. Instead, they rely on technical reports as well as information from MSB.

3. A question was asked on whether or not there was a standard that there must be community involvement in the development of these plans. Mr. Westholm responded that yes, there is a requirement to allow the public to participate which includes publishing adds to inform the public as well as allowing them to review and comment on the plans. He said some areas are more organized than others and are more successful in getting their voices heard because of their organization.

4. A final question was asked on whether or not there was planning outside the municipal areas. Mr. Westholm stated that there are rural areas that have zoning and planning; however, it costs money to develop these plans and planning costs prohibit the development of plans in some areas.

Dr. Bo Lind, Swedish Geotechnical Institute

*United Nations Making Cities Resilient Essential 4 – Pursue resilient urban development and design;*

*United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems*

*United Nations Making Cities Resilient Essential 7 – Understand and strengthen societal capacity for resilience*
Dr. Lind stated one of his responsibilities includes mapping landslide hazards. He is also working on risk assessments and climate impact. Dr. Lind has conducted extensive research on landslides and presented an overview of this hazard to the delegation. The Swedish surface is a glaciated landscape with soft sediments. There are large amounts of marine clay covering up to 8% to 10% of the land surface. The depth of the clay can extend to 100 meters before it reaches rock. This type of landscape causes a challenge for buildings. Rivers are eroding the soft clay which creates steep river banks and makes the land prone to landslides. In any given year they have 2 landslides which are significant enough to record. Most are not significant enough to cause any serious consequences.

The clay that is most susceptible to landslides is referred to as “quick clay”. It begins to fail because it loses its strength. Through leaching, salt has been removed through the clay making it more sensitive. Landslides can be extent up to a distance over a 1.6 kilometers/1 mile as it can experience retrogression as depicted in figure 60. The quick clay can also be found interbedded with regular clay.
Landslides are expected to increase over the next 30 years due to increases prediction of rainfall. Some estimates regarding precipitation are as high as an increase of 25% over the next 70 to 80 years. Recognizing the increased potential for landslides, the Swedish government commissioned a study for “the improvement and production of landslide analyses and stability mapping along the Göta River.” To conduct the study, the government provided a 100 million Swedish kronor/$12.1 million.

Landslides are affected by three factors, two which are directly related to climate change. First among them is the increased groundwater pressure. As the groundwater level rises, this can cause the clay to

Figure 60: A sample of retrogressive landslides.

Figure 61: A sample of SGI's final mapping products shows vulnerability and the consequences of landslides.
lose strength. The other climate factor contributing to landslide is flow and river erosion. Finally, landslides can also be affected by the loading of houses and infrastructure, which is a development factor.

Dr. Lind’s team conducted over 20,000 soil samples which were analyzed in the lab. They developed 100 meter grid squares along the entire valley. Consequences for each square were calculated along with the probability of a landslide occurring. They combined the probability and the consequence to create a risk score for each square. Areas with significant development and high probability were viewed as the most at risk. The result is the entire valley has been mapped and this may have an impact on property values.

Dr. Lind concluded his presentation by reviewing the conclusions of his study. Overall there are many areas throughout the valley that have high risks. The high risks areas are also associated with the built up areas. The largest areas with poor stability are closest to the river where conditions for landslide are the greatest. Climate change means this risk will increase. Areas with the highest level of risk may increase by 10% due to climate change.

Discussion Points:

1. A delegation member asked if the 10% increase in risk is for severity or frequency, or both. According to Dr. Lind the 10% increase represents the growth of the area at risk by 10%.
2. A question was asked on how the maps are interpreted. Dr. Lind stated that the maps use color to visualize the risks but they also contain a numerical value so you can see the probability and consequence separately.
3. When asked when the study was completed, Dr. Lind stated it was completed in 2012.
4. One of the delegation members asked if there has been any landslides in the areas that have been mapped since it was published. Dr. Lind stated nothing of any major consequences.
5. In regards to the public’s awareness of the issue, has the study been highly publicized? Yes but this isn’t something that rises to the attention as a daily concern for Swedes.
6. One delegation member asked if some of the red areas were marked as such because they contained properties with higher values versus properties with low income housing which would not have as a high consequence score due to lower property values. Dr. Lind noted that this was certainly possible.
7. A question was asked on whether or not the bank angle was included in the probability measurement. Dr. Lind stated that was a variable that was used along with type of clay to determine strength and stability.
8. The last question asked was whether or not a value for life was used in the consequence calculation. Dr. Lind stated they did use a value for each life, with variation due to movability and time spent at each location. The value was taken from a standard formula used in traffic analysis.

Dr. Per Danielsson, Swedish Geotechnical Institute

*United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems*

*Presentation Title: Biological Bank Protection*

Dr. Danielsson presented the first of his two presentation by covering his research in biological bank protection. He began his presentation by going over one of the more commonly used traditional methods of bank protection called riprap construction. Riprap construction is essentially a way of armoring river beds through the use of natural rock. However, this method isn’t always environmentally friendly. Dr. Danielsson’s research is focused on looking at more environmentally friendly ways of shorting up river banks using natural biological resources in order to minimize erosion.

Realizing new methods and techniques are already in place, Dr. Danielsson reviewed the literature to see what was already being implemented in Sweden, Europe and North America. The concept of a biological bank protection system began to evolve. To determine what works and makes the most sense, his research is focused on looking at what plants provide the most benefit, what are the construction requirements, the most desired slope of the bank, the preferred soil type, and the environmental impact. The goal of the research is to identify existing bank protection methods and classify them according to use. His research is being funded by the Swedish Agency for Marine and Water Management, the Swedish Environmental Protection Agency, and the Swedish Transport Administration.

Water flow and ship generated waves serve as the primary means of erosion for river banks. Erosion can also be caused by ice. There is also the question of whether or not you want to prevent erosion, as some erosion is also good for vegetation and animals. Dr. Danielsson stated his research is based on three different methods: biological bank protection; technical-biological bank protection; and hard structures,
integrated with riprap. The biological bank protection is focused on using just different types of vegetation to minimize the amount of erosion. There are several areas throughout Sweden in which this method is being implemented. The second method, tech-biological, is a cross between the riprap and biological plants. The difference is that the riprap is used predominantly at the base of the slope, while as it moves towards being separated from the river’s surface, it begins to be intermixed with natural vegetation. Other similar methods as of this are focused on geotextile and additional vegetation. The final method is integrating a geotextile surface prior to mixing the biological protection. A method conducted is the State of Washington’s use of old wood and logs as part of the tech-biological system. Like the previous method, there would be rocks at the base of the slope and mixed throughout the bank as seen in figure 63.

![Figure 63: A sample of a biological bank reinforced with naturally wood.](image)

*United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems*

*Presentation Title: Coastal Vulnerability Index*

In addition to biological bank protection, Dr. Danielsson has conducted extensive research on mapping coastal vulnerabilities to erosion. Dr. Danielsson noted that coastal erosion is happening all over the world and is not a problem that is unique to Sweden. To determine the areas along the coast that are at most risk to coastal erosion, Dr. Danielsson utilized a multi scale Coastal Vulnerability Index (CVI) that had been
successfully developed and deployed for Northern Ireland. The CVI’s parameters can be adjusted to determine a local, regional, or national impact. The CVI is based on multiple variables from three considerations: coastal characteristics, socio-economic, and coastal forcing. Collectively, the three variables provide the overall vulnerability to coastal erosion. Dr. Danielsson has taken the Northern Island model and adjusted the model to emphasize variables that are more relevant to Sweden. The model takes the three variables and ranks them into three categories with the lowest category representing soils that have very little sensitivity to erosion, the second category which represents medium sensitivity to erosion, and the final category which represents soils that are easily erodible. The maps features in figure 64 depict the results of the model with the map on the left showing the overall vulnerability, while the map on the right shows the consequence based on the socio-economic status of the areas that are inhabited. Dr. Danielsson concluded his presentation by showing the model that he developed in ArcGIS’s model builder to visualize the socio economic and coastal characteristics.

**Parameter: CC1 - geology**

![Figure 64: A sample of the geology and vulnerability of coastline to erosion.](image)

**Discussion Points:**
1. In regards to the bank erosion protection research conducted by Dr. Danielsson, a question was asked in regards to the natural wood (logs) that is being used to shore the banks on whether it would deteriorate over time? Dr. Danielsson said quite possibly since the wood was natural and untreated; however, the idea is that by the time that happens, over time the system would be naturally hardened through additional vegetation.

2. Another member asked a question regarding the CVI. The question was focused on many of the social vulnerability characteristics in the US were based on indicators such as minorities and income levels. In regards to the CVI, did the socio-economic factors use income levels and specific value criteria? According to Dr. Danielsson, the CVI considered all houses equal in value and doesn’t take into consideration the socio-economic variables for a particular house.

Dr. Hans Hansson, Lund University

United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

Presentation Title: Water Levels in Skanör/Falsterbo – Present & Future, Impacts & Measures

The final presentation for day 2 was provided by Dr. Hansson and focused on combating sea level rise through beach nourishment. Dr. Hansson began his presentation by reviewing the expected outcomes and consequences of climate change. For Sweden, climate change is expected to cause sea levels to rise and more severe weather events, particularly storms. The expected impacts from climate change include bigger waves, more storm damage, more coastal erosion and more flooding. The rising sea levels can
have a devastating impact on shorelines as increasing levels ultimately can have a drastic impact on a shoreline that will be receding as seen in figure 65.

When sea level rises, the impact will depend on the type of shoreline. For a rocky shoreline, the rising

![Figure 65: An illustration of a relatively small rise in sea level can have a devastating impact on the loss of a shoreline in shallow water.](image)

level will have minimal impact as the rocky shoreline is less susceptible to erosion. However, for a sandy shoreline, the rising sea level rise causes an actual recession of the beach resulting in loss lands. With an expected sea level rise of 1m, a beach is expected to erode by 100m. Based on the anticipated loss of the beach front, governments are beginning to look at how they can prevent the loss. One of the solutions currently being implemented is the building of sea walls; however, sea walls don’t stop the erosion, they
just move it to the edges of the sea wall, in effect, creating a problem for whatever properties the seawall stops its protection. Figure 66 illustrates the weakness of a sea wall solution.

As alternative to sea walls, Dr. Hansson’s research if focused on using soft measures for beach stabilization which primarily includes adding more sand to increase the depths of beaches. The get the necessary sand, sand can be gathered from the sea bottom. To validate the concept of stabilizing shorelines by adding beaches, Dr. Hansson noted that in Hurricane Sandy, areas that had extensive beaches such as Brant Beach, experienced no over wash or wave damage. He also noted that the sea wall that was built to provide protection for Ft. Lauderdale, FL was destroyed by Hurricane Sandy. It was replaced by beach nourishment and this is expected to provide protection from a 100 year storm. To help validate the concept of beach nourishment, Dr. Hansson also looked at the value of a beach vs the relative cost of beach nourishment. According to a study, Florida’s beaches have an estimated value of 411 Swedish kronor/50 billion and the cost of providing beach nourishment for a single beach is approximately 8.2 million Swedish kronor/1 million a year. Dr. Hansson concluded his brief by noting that expected sea level rise for Skanör/Falsterbo in Sweden is expected to result in a 67% land loss of the area with a 1m rise in sea level; however, with beach nourishment that total amount of land loss would by 0%.

Discussion Points:

1. One of the delegation member asked if communities believed him when they are told that they have to replace concrete structures with a sandy beach. Dr. Hansson stated it took approximately 15 years to demonstrate the viability of a sandy beach as an alternative to sea walls but now other communities are looking at adding beaches as an alternative.
2. Another question was asked if there is any sustainable way to capture the sand in which Dr. Hansson responded that you should not intercept sand. The preferred solution is dredging and moving the sand from the sea bottom.

Dr. Eva Liljegren, The Swedish Transport Administration (STA)

United Nations Making Cities Resilient Essential 5 – Increase infrastructure resilience

Presentation Title: Overview of the Swedish Transport Administration
Dr. Liljegren provided the delegation with an overview of the Swedish Transport Administration and their efforts to manage the country’s state-owned transportation resources and their efforts to protect it against climate change. STA’s mandate is to oversee roads, rail, air, and shipping modes of transportation for Sweden. They also maintain responsibility for the construction, operation, and maintenance of State roads and railways. As part of the infrastructure they maintain, STA oversees 11,900 kilometers/7,394 miles of railway tracks; 40 ferry lines; 16,000 bridges (including 3,781 railway bridges), and 98,400 kilometers/61,142 miles of state roads. To accomplish this, STA has an employee force of approximately 6,500 people.

As a country, Sweden faces many naturally occurring hazards. They currently have permafrost in the northern part of the country that is thawing, which causes potential stability issues. In the south their primary concern is focused on sea level rise. In April 2013, the European Union adopted a strategy on adaptation to climate change. The strategy focuses on three key objectives: 1) promoting action by member states; “climate-proofing” action at EU level; and better informed decision-making by addressing gaps in knowledge about adaptation. Sweden currently does not have its own strategy; however, STA has developed its own. As part of the STA’s climate change adaptation strategy they have three primary objectives: 1) create the conditions for efficient climate change adaptation work; 2) prevent negative consequences of climate impact through the creation of robust systems; and 3) manage the effects of climate impact. The STA has developed an action plan for each of the three primary objective which Dr. Liljegren briefly went over with the group.

Recognizing the need to create efficient climate change adaptation work, Dr. Liljegren explained their primary focus here is on the acquisition and analysis of information and data concerning natural hazards. As an example, she mentioned the Norrala railway tunnel flooding in August 2013. Following the event they learned this occurred as a result of the size of catchment areas which were 20 times larger than any of the five other tunnel entrances. Understanding why it occurred will help them mitigate it from
happening again. The second part of the strategy is creating a new robust system that is adaptable to climate change. Recognizing that there is not sufficient funding to climate proof everything, they are developing a risk identification method that will allow them to establish a priority of effort. The final part of the strategy is aimed at managing the effects of climate change. This includes emergency response and planning. One example Dr. Liljegren mentioned is that Sweden has deployable bridges that can be used in an emergency.

Discussion Points:

1. A delegation member asked if resiliency work is strictly focused to climate change or is it adopted for other hazards as well. According to Dr. Liljegren, the strategy only covers climate change; however, it can be used for anything.

2. Another question asked by the delegation was geared to learn if there were resiliency efforts being initiated at the local level. Dr. Liljegren stated to some extent yes. As an example she mentioned a project that involved backup power generation for the tramway.

3. As a follow up question, a delegation member asked how are they prioritizing what they work on first. The method for prioritization is currently being developed by STA. One of the components of that process is availability of funding. They are looking at ways to leverage existing funding.

Mr. Mikael Ivari, Urban Transport Administration

United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience

Presentation Title: Traffic Gothenburg
Mr. Ivari’s presentation to the delegation focused on traffic issues facing the city over the next 20 years as it is expected to grow while also dealing with the continuing threat of climate change. Mr. Ivari stated one of the long term visions of the region is the development of the 8 million city which strives to link Oslo, Gothenburg, Malmo, and Copenhagen together by advanced rail as part of a new European future region. The benefit of connecting Gothenburg, other than the obvious geographical alignment, is Gothenburg is already connected to Stockholm and that brings Stockholm into the region. As part of the plan, a new line called the Göta land line would also be added between Stockholm and Gothenburg.

![Figure 68: Mr. Ivari discussion traffic in Gothenburg. Photo by Mr. Mitchell.](image)

Mr. Ivari went on to explain that Gothenburg’s plans are to grow the city by shortening distances via new roads, bridges, cycle paths and expanded public transportation; however, the growth will not be conducted at the expense of the environment. The goal is to be able to reach at least half the work places in the city within 45 minutes. In the last three years, Gothenburg has reduced its reliance on car as a travel mode by 3% while growing public transportation and biking. They accomplished this by introducing

![The 8 million city](image)
congestion charges in the city. The target goal of modal split by 2035 is to increase public transportation, walking and biking by 50% while reducing car usage by 25%. Gothenburg’s participation in the West Swedish Agreement has the potential to boost the shift in modal split. The agreement calls for approximately a 49 billion Swedish kronor/$6 billion investment in new infrastructure. The agreement calls for expanding public transportation, a new bridge over the Göta Älv, a new tunnel, and the West Link Railway. While everyone agrees that future growth outside the city should be near train stations, in reality, that doesn’t always happen.

The next topic covered by Mr. Ivari was focused on climate change and its expected impacts to the city. A significant portion of the expected city growth is located in low-lying areas which are more prone to flooding. In addition, major highways, such as E45 and E6, to include the Tingstad Tunnel, are already at risk. Overall, the city contains approximately 740 kilometers/460 miles of roads and 193 kilometers/120 miles of tramway that are at risk to flooding. Mr. Ivari concluded his presentation by stating the city is currently planning how to secure the functionality of the infrastructure to ensure the safe evacuation is possible if or when it is needed.

Discussion Points:

1. One of the delegation members asked how growth in other parts of Sweden compared to Gothenburg. According to Mr. Ivari, only Gothenburg and Stockholm are experiencing significant growth. One of the reasons that Gothenburg is planning on adding so much new infrastructure is because they want to remain competitive and relevant and one way to accomplish that is through growth.

Ms. Camilla Nordström, City of Gothenburg

United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience

United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response

Presentation Title: The Future Traffic Management Center of Gothenburg
Ms. Nordström’s presentation focused on how the City of Gothenburg is focusing on the development of a traffic management center to help coordinate, respond and alleviate traffic issues for the city. Ms. Nordström pointed out to the delegation that the city is changing as a result of it being a leader in the regional labor market. In order to support this growth, it’s critical to have an effective transportation system. She also noted that their citizens have high expectations which include having correct and relevant traffic information 24/7, as well as being able to deal with accidents quickly and efficiently. The City is expected to begin a major infrastructure expansion project over the next three years. Among the new projects are a new bridge, a new rail bridge and a new tunnel. Large residential areas are also being built which is expected to increase traffic congestion.

One of the ways to mitigate the growth is through the addition of a traffic control center. According to Ms. Nordström they can manage the growth by being able to provide high quality information and quickly and efficiently resolve traffic problems. The center will serve as a collaboration center and ensure appropriate strategies are developed. Prior to 2013 only the Swedish Transportation Administration had a well-established traffic management center; however, it is only limited to state roads. The city was unable to take calls from citizens who wanted to report such basic things as pot holes, nor could they resolve problems. The city was limited to a contact center which had limited hours.

To begin working on a long-term solution, the city developed a pilot program to plan for the establishment of a permanent common traffic management center. The pilot program has resulted in four traffic leaders that are engaged with the STA traffic leaders. They now have traffic management for the city 24/7. They also have a traffic editor which distributes information about future traffic disruptions. The traffic information center serves as a coordinated effort to distribute information. Any emergency calls get routed to the traffic center and if cameras are available, they will be able to provide immediate surveillance and observations. The center can also dispatch road assistance vehicles as well as manage signage from the center. Base on lessons learned from the pilot, they are currently working towards a
permanent Common Traffic Management Center. In order to accomplish this they have entered into a 10 year agreement with the State Traffic Administration and the Public Transportation Authority to establish common goals. The agreement will add future improvements such as the ability to manage traffic signals from the center.

Discussion Points:

1. One of the delegation members asked if Gothenburg was utilizing social media to allow the public to provide information. According to Ms. Nordström they are not currently utilizing social media as a tool to conduct crowd sourcing as it would require additional staffing. Mr. Johan Jansson, The Swedish Transport Administration (STA). The experience shared from Västtrafik, the local public transportation authority, is that answering social media requires a lot of personnel. They have, to her knowledge, at least 4 people that manage social media.

**United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience**

*Presentation Title: Extreme Weather and The West Link Project*

The purpose of Mr. Jansson’s presentation was to provide the New Orleans delegation an overview of the West Link Project and how they are mitigating the project against sea level rise and climate change. The overall goals of the West Link project include 8 kilometers/5 miles of new railway, 6 kilometers/3.7 miles in tunnels and three new stations. Construction is expected to begin in 2017 with an anticipation of it being completed by 2026. Mr. Jansson explained that this is necessary as the current rail system has reached its capacity.
Some of the areas in which the components of the new system are being built already experience some level of flooding with a heavy rain event. This will only be magnified with the expected sea level rise. As part of the consideration in building the new components, they are accessing at what heights new construction needs to take place to ensure it isn’t susceptible to flooding. The current flood protection levels are designed to protect against 2.5 meters of flooding; however, in order to ensure the long term viability of the project, they are estimating that they will need to build above 4 meters by 2100. Mr. Jansson concluded his brief by stating that their goal is to have a dry tunnel when it is completed by 2026 and for that tunnel to continue being dry by 2100.

Dr. Anna Jonsson, Linköping University

United Nations Making Cities Resilient Essential 7 – Understand and strengthen societal capacity for resilience

Presentation Title: Vulnerability and Adaption to Heat in Cities: Perspective and Perceptions of Adaptation Decision-Makers in Sweden, case Gothenburg

Dr. Jonsson’s presented a research project to the delegation that study the perceptions and adaptation to heat in cities. Swedes are well adapted to dealing with the cold. Emergency response, clothing and housing is designed to protect people from the cold in Sweden. Experiencing is lacking in dealing with a warming climate. In the present climate, heat causes approximately 200 deaths a year in Sweden. This is only expected to increase as temperature continue to rise.
There are several drivers that make Swedes vulnerable to climate change. Elderly are recognized as being vulnerable to high temperatures which is problematic for Sweden as the population is getting older. Heat can also impact children whose bodies have a more difficult time in regulating their temperature. In addition, they are not responsible enough on their own to ensure they are drinking sufficient water. Individuals with mental illness are also more susceptible to heat as studies have indicated there is a correlation to increased suicides during higher temperatures. Finally, the well-educated, permanently employed tend to be more focused on performance and can also be susceptible as they aren’t as focused on maintaining their health. An earlier effort to identify areas within cities that are vulnerable to extreme heat involved mapping cities to visualize where the most vulnerable were located. The primary issue with these maps is that it didn’t tell you specifically why people that were shown vulnerable were actually vulnerable.

Another research method that was developed by Dr. Jonsson involved the use of a vulnerability factor card game. The game was utilized with five focus groups in the city of Gothenburg. Focus groups included: hard planners; soft planners; staff in child care; staff in elderly/health care; and the elderly. The purpose of the vulnerability card game was to study the perspective and perceptions of adaptation for decision-making.

Figure 74: An overview of drivers, response, vulnerability and impacts resulting from rising temperatures and heat.
makers. Ultimately it is meant to be an educational game. The basic structure of the game is to create two people, expose them to a heat wave, analyze the effects of the heat wave; and identify adaptation measures. The potential impacts to an individual due to exposure to the heat could include death/hospitalization, loss of income and/or assets, and reduced well-being. According to the results of the study, the distribution of impacts showed they disproportionately impacted women and the elderly.

Discussion Points:

1. One of the delegation member noted that in the United States many cities had a registration system in place that allowed them to register to let the city know that they may be vulnerable or have a disability. The member asked if there was a similar system in Sweden. Dr. Jonsson stated that if there was anything like that in Sweden, she was not aware of one. She did state that only one city in Sweden had detailed mapping for vulnerable populations to heat.

2. A question was asked on whether air conditioning was common in Sweden? According to Dr. Jonsson, air conditioning is available and used. She also stated approximately 33% of energy usage is for cooling, while 66% is used for heating in Sweden. She also stated that they expect those numbers to reverse over time as a result of climate change.

Dr. Lars Nyberg, Karlstad University

United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

Presentation Title: Sustainability Aspects of Water Regulation and Flood Risk Reduction in Lake Vänern

The final presentation for the exchange was provided by Dr. Nyberg and focused on looking at the sustainability aspects of water regulation and flood risk reduction in Lake Vänern. The lake is located north of Gothenburg. There are flood risks associated with the lake and most tributaries that it feeds. There are also landslide risks associated with the Göta Älv and the Klarälven rivers. The lake also serves as a source of hydropower through the use of dams. The lake is an area that include a heavy
industrial component which has also led to polluted soils. Finally, the lake serves as constant supply of drinking water.

In all of Europe, the lake is considered the third largest. Sweden also has the 6th and 8th largest lakes in Europe as well. The lake also has several risks that are associated with it beyond the expected flooding issues. In addition, there are discharge issues and they increase the risks of potential landslides throughout the Göta Älv. There is also a regulation regime which is meant to protect the landscape and ecosystem. Finally there is the protection of cities with the desire to balance existing settlements and new developments. There are currently 30 municipalities that desire to develop near the lake. Prior to regulation, there was significant variance in the water levels; however, it has since stabilized as a result of new regulations. The lake is continuing to evolve and change its shape as a result of the changing water levels. This has also been impacted by the 22,000 islands that are contained within the lake.

Values and interests

<table>
<thead>
<tr>
<th>Ecology och landscape</th>
<th>Economic values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landscape</td>
<td>Hydropower</td>
</tr>
<tr>
<td>Unique habitats and species</td>
<td>Fishery</td>
</tr>
<tr>
<td>Recipient</td>
<td>Agriculture</td>
</tr>
<tr>
<td></td>
<td>Shipping</td>
</tr>
<tr>
<td><strong>Social values</strong></td>
<td><strong>Tourism</strong></td>
</tr>
<tr>
<td>Life quality in 13 municipalities</td>
<td>Critical infrastructure</td>
</tr>
<tr>
<td>Recreation</td>
<td>Industry</td>
</tr>
<tr>
<td>Drinking water</td>
<td></td>
</tr>
</tbody>
</table>

Figure 76: Different attributes measured and analyzed in the Vänern lake.

Dr. Nyberg’s research assessed the ecology, social values, and economic values of the lake in order to assist in finding a balance. Each of the three valuables have conflicting interest on the water levels of the lake. The attributes within each value were accessed to determine whether there was a positive or negative impact on flood levels and the consequence of lowered water levels. His research concluded
that there were indeed varying desires on the water level. The preference for flood protection is based on low water levels along with low amplitude discharge; while the preference for hydropower and shipping is average level and low amplitude; and for the natural landscape and ecosystem the preference is focused on a larger amplitudes with seasonal variations in water heights.

Discussion Points:

1. A question was asked on the role of the National government on decision making in regards to the water levels. According to Dr. Nyberg, municipalities often try to push their interest while the government tries to contain them. The county can have special review and revoke the plan and tries to find a balance of all interest in regards to regulating the water levels. Dr. Nyberg also stated that if the national government is going to impose on a municipality, they have to provide the legislation and the funding to address the national governments concerns. Overall, the national government isn’t too involved.

A ten-point checklist and the building block for disaster risk reduction, developed in line with the four priorities of the Sendai Framework for Disaster Risk Reduction: 2015-2030.

- **Essential 1**: Put in place an organizational structure and identify the necessary processes to understand and act on reducing exposure, its impact and vulnerability to disasters.

- **Essential 2**: Identify, understand and use current & future risk scenarios

- **Essential 3**: Understand the economic impact of disasters and the need to strengthen financial capacity for resilience.

- **Essential 4**: Pursue resilient urban development and design for new infrastructures, hazard-resistant buildings, flood drainage, green areas, etc.

- **Essential 5**: Safeguard natural buffers to enhance the protective functions offered by natural ecosystems and anticipate changes from climate trends, urbanization and planning to enable ecosystem services to withstand these.

- **Essential 6**: Strengthen capacity of all institutions relevant to a city’s resilience to discharge their roles in five key DRR areas of understanding, prevention, mitigation, response and recovery planning.

- **Essential 7**: Strengthen societal capacity for resilience

- **Essential 8**: Increase resilience of infrastructure to cope with disasters.

- **Essential 9**: Ensure effective disaster response.

- **Essential 10**: Expedite recovery and build back better after any disaster.
Appendix B: Sweden Delegation to New Orleans

Ms. Lena Malm, Lord Mayor of the City of Gothenburg was elected Lord Mayor of Gothenburg in April 2012 by the City Council of the City of Gothenburg and was re-elected in 2014. Ms. Malm has been a member of the City Council (Social Democrats) since 1998. As of 2011, she is a member of the Traffic Committee at the City of Gothenburg. In 2014 she was appointed as the Second Deputy Chair of the Public Transport Committee at the Region Västra Götaland. Her political commitment at the Region Västra Götaland also includes a membership in the Regional Council and in the Sustainable Development Advisory Committee as well as being a Deputy Member of the Regional Executive Board.

Ms. Malm was the Chairperson of the District Committee of Lundby 2003-2014. She is a former member of the Environment Committee (1998-2002) and of the Construction and Housing Committee (2007-2010). Furthermore, she was City Political Secretary at the Executive Committee of the City Council 1997-2002, and Region Political Secretary at the Region Västra Götaland 2003-2005.

Professionally, Ms. Malm is a Communications Officer at the Health Secretariat in Gothenburg. She has a university degree in Sociology, Administration, and Media/Communication Science. Ms. Malm is married with one adult daughter.

Mr. Ulf Moback, Head of Delegation is a landscape architect educated at the Swedish Agricultural University in Ultuna and Alnarp. He has been employed by the City of Gothenburg (Göteborg) since 1979 first at the Park Administration where he left as head over planning and building parks and green areas in Gothenburg. 1991 he started at City Planning Authority working at first with detailed plans for the regeneration of the shipyard areas, later with the comprehensive plan for the whole of Gothenburg, ÖP 93, ÖP99 and the current comprehensive plan. Parallel with that he has been working with
environment issues like methods for environmental impact studies, nature reserve, storm water treatment, polluted areas etc. During 2 years he was head of strategic planning at City Planning Authority. He has also been involved in EU projects, like Water City international, Pure North Sea and Greenscom as well as Swedish International Development Cooperation Agency (SIDA) projects in South Africa. He is also coordinator of the climate adaptation group of Gothenburg.

Within the framework of Mistra Urban Futures, he was one of the project leaders for the pilot project “A City Structure Adapted to Climate Change: Scenarios for Future Frihamnen” and involved in another research project “Adapting cities to climate induced risks – a coordinated approach”.

Dr. Hans Hansson, PhD, is full professor in Coastal Engineering at Lund University where he has been for almost 40 years. He has worked on contract for US Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS, for almost 30 years. The main focus of this work was the development of computer models for simulation of coastal erosion and flooding. He is the main developer of the GENESIS model and has also, to some extent, been involved in the SBEACH model.

On the more practical side, he has done numerous projects in most coastal municipalities in south Sweden dealing with coastal planning, protection and climate change adaptation. Many of these projects have been done as a part of his part-time employment at the consulting firm Sweco Environment, where he has been working since 1988. He has international project experience from Liberia, Mozambique, Egypt, Sri Lanka, Indonesia, Vietnam, Mauritius, Seychelles, USA, Portugal, Brazil, Italy, Spain, Japan and British Guyana.

He is author of more than 230 Technical Reports, Conference Papers, and Journal Articles. He has been invited visiting researcher/professor at: US Army Coastal Engineering Research Center (USA), Texas A & M University (USA), James Cook University (Australia), Ministry of Public Works (Australia), University of Queensland (Australia), Ministry of Public Works (Spain), Universidad de Granada (Spain).
Dr. Anna Jonsson, PhD, Linköping University, is Associate Professor, Department of Environmental Change, Centre for Climate Science and Policy and Research, Linköping University. Dr. Jonsson uses qualitative social science methods to investigate institutional and social aspects of water management and climate adaptation issues in Sweden and abroad. The past 8 years she has been involved in vulnerability and adaptation research with the city of Gothenburg as the study object. She has also been part of developing a Guidebook for integrated assessment and management of vulnerability to climate change based on research in Sweden, Bolivia and India.

Dr Lars Nyberg, PhD in Hydrology, is Associate Professor in Risk Management as well as research leader at the Centre for Climate and Safety at Karlstad University (www.kau.se/ccs). In recent years his research has mainly been focused on natural disasters and climate adaptation. Special focus is on societal vulnerability and how to reduce climate-related risks. He is the leader for several projects and networks, for example as principal investigator for the Centre for Natural Disaster Science (www.cnnds.se). He is also the leader for master courses on integrated flood risk management and sustainable development from a safety perspective. As the director for the Centre for Climate and Safety during 2008-2014, Lars Nyberg has initiated and actively contributed to an extensive societal collaboration. He is a member of the Scientific Council at the Swedish Civil Contingencies Agency.

Dr. Philip Thörn, PhD, Head of the Policy and Economy Group, Swedish Environmental Research Institute (IVL). Philip has long experience of working with climate change adaptation and preventing natural disasters. Before joining IVL Philip was working for the Swedish Government’s Commission on Climate and Vulnerability. In recent years Philip has been working with climate change adaptation on the local level, e.g. analyzing how Swedish municipalities can be affected by climate change and natural disasters. Philip was one of the project leaders for the pilot project “A City Structure Adapted to Climate Change: Scenarios for Future
Frihamnen”. The project investigated how different climate change adaptations strategies can affect the sustainable development in the urban district of Frihamnen in Gothenburg.

Mr. Mikael Ivari, City of Göteborg, Traffic & Public Transportation Authority, Deputy Head of Traffic Planning Department, has a master’s degree in civil engineering from Chalmers University of Technology and exams in economics and economic statistics from Gothenburg School of Business, Economics and Law. He has more than 15 years of experience from traffic and land-use planning in a local and regional perspective.

Mr. Johan Jansson, Swedish Transport Administration, Business Area Investments has a master’s degree in Civil Engineering. His work areas include providing large reconstruction works and new investments with technical expertise on dewatering and drainage. His work involves development of the regulatory framework that governs the design of road and rail infrastructure drainage. He has great interest in rain, urban runoff, flooding, extreme weather events and drainage as well as pumping stations.

Dr. Bo Lind, PhD, Associate Professor, Swedish Geotechnical Institute, is an experienced leader of expert organisations and research groups. He has worked within the field of applied geo-science in the built/developed environment since the late 1970’s. He is responsible for the national planning support to communities regarding geotechnical safety and responsible for the mapping of landslide hazards along the Göta river valley (the most landslide-frequent area in Sweden). He is also working on risk assessments and climate impact on geotechnical safety, such as landslides and severe settlements.
Mr. Lars Westholm, County Administrative Board, Västra Götaland has a MSc in environmental science and have been working with public health and environmental protection for more than 23 years. His experience ranges from drafting policy documents, conducting inspections to environmental monitoring. As an environmental planning officer he prepares the basis for detail or comprehensive plans or setting up projects or monitoring activities. During this work he assesses and performs risk analysis concerning transports and handling of hazardous materials, risk of flooding and environmental health issues. He has also conducted studies in societal risk management and also been a CBRN expert in the national Interagency working group (Transport). As an Associated Field Officer (WASH) at the Field Office in Tyre, Lebanon, for UNHCR, he gained thorough experience in working in a refugee emergency.

As a result of his MSc in Environmental Health and his local management of a European Union project. He has participated internationally in Cyprus, Lebanon, Somalia, Liberia, Kenya and Haiti working within complex environments. He has also completed UN, EU and MSB courses related to risk management.

Ms. Janet Edwards, Swedish Civil Contingencies Agency (MSB), has a bachelor’s degree in geography from the University of California in Los Angeles and a master’s degree in geography from California State University. She has worked with risk management issues in Sweden since 1995. As the international coordinator for the Swedish National Platform for Disaster Risk Reduction, she promotes various types of international exchanges. She leads the UNISDR Making Cities Resilient campaign in Sweden and has experience with risk management tools and methods including geographic information systems.

Ms. Åsa Fritzon, Swedish Civil Contingencies Agency (MSB), has a master’s degree in political science and international relations from Södertörn University College. She works as a research coordinator at MSB’s Research Management Section as Program Advisor to the U.S. Department of Homeland Security (DHS) Science & Technology agreement and as expert to the Programme Committee for Secure Societies within the EU Research and Innovation programme Horizon 2020.
** This Page Intentionally Left Blank *
Appendix C: Biographies of New Orleans Presenters

Karim Belhadjali, Deputy Chief, Planning and Research Division, Coastal Protection and Restoration Authority (CPRA)

Karim Belhadjali specializes in the long-term planning of complex coastal ecosystem restoration and storm flood risk reduction projects, in adaptation to various scenarios of climate change. He is the program manager for the preparation of the State of Louisiana’s Master Plan for a Sustainable Coast. The master plan identifies specific projects and policies to be implemented over 50 years, to increase the resilience of coastal communities and ecosystem over the coming decades. Karim also directs the research program within CPRA, to address critical knowledge gaps, develop and improve comprehensive, integrated conceptual and forecasting models; and develop tools and data to support technical assessment of program and project performance against integrated objectives and goals. He has been engaged with the state’s coastal restoration and protection program since 2000, serving as the lead ecologist for the state on a dozen large scale wetland restoration projects constructed with federal partners. Prior to his current position, he served in the US Peace Corps as the Marine Fisheries Advisor to the government of Tuvalu, Central Pacific. He formulated fisheries policy including regulatory reform and fisheries management plans, to protect and conserve the marine resources of Tuvalu.

Mr. Bradford Case, Director of Hazard Mitigation, City of New Orleans

The City’s Hazard Mitigation Office was created in 2006 in the aftermath of Hurricanes Katrina and Rita in order to guide the City in its new philosophy of building a resilient future. Brad has been with the City of New Orleans since 2008 and has been in his current position since 2009. As one of the two branches of the Office of Homeland Security and Emergency Preparedness, Mr. Case is responsible for leading the planning process to formulate the City’s policies toward reduction of risk from natural and manmade hazards and for implementation of these policies throughout the city.
Past efforts of the mitigation office have resulted in numerous major changes in how the City recovers from Hurricane Katrina while avoiding similar disasters, as well as how the City develops for its future in a changing risk environment. One example of a change spearheaded by the office has been establishing a permanent internal capacity to develop projects and initiatives for the changing risk environment. This included increasing floodplain managers on staff from zero to over ten and establishing a dedicated office for floodplain administration, which is now responsible for maintaining the City’s participation in the NFIP. Current initiatives include continued administration of hundreds of millions of dollars in FEMA mitigation grant programs. These programs include risk reduction measures for infrastructure and private property as well as outreach projects to advance the awareness of mitigation concepts and practices for communities, businesses, and individuals. The mitigation office has sought since its inception to adapt the external public conversation and internal bureaucratic processes from a reactionary, wait-and-see approach relying purely on response to a proactive and innovative culture of resilience.

**Dr. Monica Farris, Executive Director, Center for Hazard Assessment, Response & Technology**

Dr. Monica Farris is an Associate Professor-Research and the Director of the Center for Hazards Assessment, Response and Technology (CHART) at The University of New Orleans (UNO). She earned her MA degree from Louisiana State University and PhD degree from the University of New Orleans, both in Political Science, the latter with a public administration/public policy specialization. Her current applied research includes the examination of local repetitive flood loss data to assist communities in the identification of appropriate mitigation strategies and education and outreach focusing on mitigation. She currently serves as principal investigator for the UNO Disaster Resistant University Project. Dr. Farris has published on the subject of building internal capacity for disaster resilience and has presented multiple times on hazard risk reduction and disaster planning. She is also recognized as a Certified Floodplain Manager by the Association of State Floodplain Managers.
Brant Mitchell, Director of Research and Operations, Stephenson Disaster Management Institute

Brant Mitchell currently serves as the Director of Research and Operations of the Stephenson Disaster Management Institute (SDMI) at Louisiana State University. Prior to joining SDMI Brant worked for the Louisiana Governor’s Office of Homeland Security and Emergency Preparedness as the Deputy Director for Management, Finance and Interoperability. From July 2008 through February 2012 Brant served as the Chairman of the Statewide Interoperability Executive Council (SIEC), which is responsible for providing governance of the Louisiana Wireless Information Network (LWIN), one of the nation’s first statewide digital 700 MHz radio systems. Today LWIN is the largest digital radio system in the country providing voice communications to over 70,000 users across the State. In 2011, Brant was selected as a member of the Federal Communications Commission’s Public Safety Advisory Committee for the Emergency Response Interoperability Committee in which he assisted in developing technical specifications for the eventual nationwide build out of a broadband network. Brant is also a Lieutenant Colonel in the U.S. Army Reserves where he is assigned to the U.S. Department of Homeland Security National Cyber and Communication Integration Center as an operations officer. He is a recipient of the Bronze Star and a veteran of Operation Iraqi Freedom where he commanded an Infantry company in Baghdad, Iraq. Brant received his Master’s in Public Administration from LSU and is currently pursuing his PhD in Geography.

Dr. John Renne, Director, Merritt C. Becker Jr. Transportation Institute

John is a Senior Visiting Research Associate at the Transport Studies Unit, which is part of the School of Geography and the Environment (SoGE) at the University of Oxford. He is also the Director of the Merritt C. Becker Jr. Transportation Institute and Associate Professor of Planning and Urban Studies at the University of New Orleans, USA. John is also the Managing Director of The TOD Group, a private real estate investment, development and consultancy firm based in the United States. John’s research focuses on sustainable transport, land use and transportation planning with a focus on transit-oriented development, travel behaviour and emergency transportation planning for vulnerable populations. He has co-edited two books, including Transport Beyond Oil: Policy choices for a multimodal future (Island Press, 2013)
and Transit Oriented Development: Making it happen (Ashgate, 2009). John was appointed as a Senior Visiting Research Associate at TSU in 2013. He has worked at the University of New Orleans since 2005 and has been involved in promoting sustainable transport in the recovery of the city following Hurricane Katrina that same year. He is the Chair of the New Orleans Sustainable Transportation Advisory Committee to the City Council and he served as Vice President of Bike Easy, New Orleans' bicycle advocacy non-profit organization. John has been invited to speak about sustainable transport and transit-oriented development by President Bill Clinton and U.S. DOT Secretary Ray LaHood, respectively.

**Frank Revitte, Warning Coordination Meteorologist, National Weather Service – New Orleans/Baton Rouge Area Weather Forecast Office,**

Frank is a graduate of the University of Oklahoma, with a Bachelor of Science Degree in Meteorology. Nearly all of his 35 year career with the National Weather Service has been in coastal areas of the Atlantic and Gulf of Mexico. He began his full-time career with the National Weather Service at the Weather Forecast Office in Miami, Fl. Frank was a forecaster and lead forecaster at the New Orleans Area – Weather Forecast Office in Slidell from 1986 thru 1994, and has been in his current position as Warning Coordination Meteorologist since 1994. Frank’s primary job responsibility is working with local, state and federal emergency management agencies in southeast Louisiana and south Mississippi assisting them in hazardous weather preparedness. He is actively involved in briefings to state and local emergency managers during tropical storm and hurricane threats to Louisiana and Mississippi.

**Dr. John Pardue, Director, Hazardous Substance Research Center**

Dr. John Pardue is the Elizabeth Howell Stewart Professor of Civil & Environmental Engineering at Louisiana State University. He directs the Hazardous Substance Research Center at LSU. Dr. Pardue’s research group investigates the fate and transport of chemicals in the environment focused primarily on chemicals in wetlands and aquatic systems, environmental impacts of disasters and shoreline restoration techniques. Currently he is performing research on the fate and remediation options for the Deepwater Horizon oil spill in Louisiana marshes and barrier islands. He has published over 70 peer-reviewed papers and conducted research for federal agencies such as EPA, NSF, NOAA, and DOD. His

In addition, his research group works closely with international collaborators including the Environmental Engineering program at UCLAS at the University of Dar es Salaam in Tanzania, West Africa providing research opportunities for future faculty and working to further development of the environmental engineering in developing areas.

**Dr. Brian Wolshon, Director, Gulf Coast Center for Evacuation and Transportation Resiliency**

Brian Wolshon, Ph.D. P.E., PTOE, is the Edward A. and Karen Wax Schmitt Distinguished Professor of Civil Engineering at Louisiana State University and the founding Director of the Gulf Coast Research Center for Evacuation and Transportation Resiliency. His teaching and research activities encompass a range of areas related to highway design, safety, and traffic operations – most notably the planning, design, operation, and management of transportation systems for emergency and major event conditions. In 2001, Dr. Wolshon founded and has since chaired Transportation Research Board of the National Academies Task Force on Emergency Evacuation. He has authored numerous federal reports related to evacuation planning and engineering and served as an expert consultant to dozens of federal, state, and local government agencies; national laboratories; and engineering firms throughout the United States. He also been interviewed by more the 100 media outlets including *The Discovery Channel, CNN, CNBC, MSNBC, Fox News, NPR, The New York Times, USA Today*, and the *Times of London* among many others.
** This Page Intentionally Left Blank *
Appendix D: Agenda for Making Cities Resilient Exchange in New Orleans

Agenda

Swedish National Platform for Disaster Risk Reduction
The Swedish Civil Contingencies Agency (MSB)
Gothenburg – New Orleans

Tuesday, February 24, 2015

8:30 a.m. Gather at City Hall (1300 Perdido St.) to meet each other and board the bus.

11:00 a.m. Meet at Orleans Levee District, 6920 Franklin Avenue, for Hurricane and Storm Damage Risk Reduction System (HSDRRS) presentation and lunch.

1:30 p.m. Meet at U.S. Corps of Engineers’ construction trailer at 6800 Bellaire Drive for the presentation on Permanent Canal Closures & Pumps (PCCP) site along the 17th Street Canal.

4:00 p.m. Back at City Hall
Agenda

Swedish National Platform for Disaster Risk Reduction
The Swedish Civil Contingencies Agency (MSB)
Gothenburg – New Orleans

Day 2: Wednesday, February 25, 2015

8:00 a.m. Board the bus at Sheraton on Bourbon St.

9:00 a.m. Meet at the Gulf Intracoastal Waterway (GIWW) East Closure Sector Gate

10:30 a.m. Lower 9th Ward
Make it – Right
Pervious pavement pilot
Florida Ave levee and wetlands

12:00 p.m. Return to City Hall
via Gentilly Blvd > Desaix > Bayou St. John
Lafitte Greenway
Gothenburg – New Orleans City Exchange on Disaster Risk Reduction and Making Cities Resilient
February 25, 2015

Agenda

1:00 PM    Welcoming Remarks
            Brant Mitchell
            Director of Research and Operations of LSU-SDMI

1:10 PM    Overview of the State’s Coastal Master Plan and its Importance to New Orleans
            Karim Belhadjali,
            Deputy Chief
            Coastal Protection and Restoration Authority

2:20 PM    Break

2:30 PM    Overview of SDMI
            Brant Mitchell
            Director of Research and Operations
            Stephenson Disaster Management Institute
            Louisiana State University

3:00 PM    Contraflow and Evacuating the City of New Orleans
            Dr. Brian Wolshon
            Director
            Gulf Coast Center for Evacuation and Transportation Resiliency
            Department of Civil & Environmental Engineering
            Louisiana State University

4:30 PM    Adjourn
Gothenburg – New Orleans City Exchange on Disaster Risk Reduction and Making Cities Resilient
February 26, 2015

8:00 AM  Building Sustainability and Resiliency in New Orleans
Dr. Monica Farris
Executive Director
Center for Hazard Assessment, Response & Technology
University of New Orleans

9:20 AM  Break

9:30 AM  Resiliency and Vulnerable Populations
Dr. John Renne
Director
Merritt C. Becker Jr. Transportation Institute
University of New Orleans

11:00 AM  Communicating Risk to the Public and Storm Surge Modeling
Brant Mitchell
Director of Research and Operations, LSU-SDMI

12:00 PM  Lunch

1:00 PM  Infrastructure Resiliency
Dr. John Pardue
Director, Louisiana Water Resources Research Institute
Department of Civil & Environmental Engineering
Louisiana State University

2:20 PM  Break

2:30 PM  Enabling Recovery through Expediting Recovery Dollars
Casey Tingle
Assistant Deputy Director for Recovery
Governor’s Office of Homeland Security and Emergency Preparedness

4:00 PM  Closing Remarks and Adjournment
Appendix E: Presentations from New Orleans

In addition to being available in this document, all presentations can be viewed and downloaded at the following website:

http://sdmi-resilient-cities.com
Hurricane Katrina & Hurricane Response in Louisiana

February 24, 2015

Pre-Katrina

- No State pre-event assisted transportation plan
- No State run General Population Shelters (Superdome considered “last resort”)
- Shelter Task Force coordinated sheltering parish shelters primarily above I-10
  - Citizens transported themselves to Information Points along the evacuation routes
  - Information Points provided shelter location info to evacuees

Pre-Katrina

- State was prepared to open several Medical Special Needs Shelters
- No pet plans or pet shelters
- Parishes provided shelters within their own jurisdictions citizens seeking safety from wind and/or water

Hurricane Katrina

- Overall area impacted - 108,456 square miles
- 80% of New Orleans submerged
- 1500+ Louisiana casualties
- 200,000+ Louisiana homes substantially damaged or destroyed
- 71,000+ Louisiana businesses impacted
- 300,000+ job losses in Louisiana
Understanding the Impact of Hurricane Katrina

Post-Katrina

- State begins growing shelter capacity with "mega-shelters" located in Central & North Louisiana
  - 1st State owned shelter built on LSU-A campus
- Post Katrina plans used during Hurricane Gustav were successful but improvements necessary, areas of focus included evacuee tracking & reentry

Louisiana August/September 2008 Hurricane Gustav/Ike

Hurricane Gustav

- Approximately 2 million people evacuated
- 1st time in State history mandatory evacuations called for entire coastal area of Louisiana
- 1st time State conducted dual contra flow for both Southwest & Southeast Louisiana

Gustav Motor Coach Evacuation

- 8/30/08 - 8/31/08
- Transported 11,000 CTNS & MSN to in-state shelters by coach buses, school buses & para-transits
- Transported 15,611 CTNS population to out-of-state shelters by coach buses
- Total - 26,611

Gustav Air Evacuation

- Hurricane Gustav Air Evacuation

<table>
<thead>
<tr>
<th>Destination</th>
<th>Flights</th>
<th>Evacuees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ft Smith, AR</td>
<td>15</td>
<td>1,744</td>
</tr>
<tr>
<td>Knoxville, TN</td>
<td>10</td>
<td>1,513</td>
</tr>
<tr>
<td>Louisville, KY</td>
<td>8</td>
<td>1,098</td>
</tr>
<tr>
<td>Nashville, TN</td>
<td>13</td>
<td>1,105</td>
</tr>
<tr>
<td>Totals</td>
<td>46</td>
<td>6,050</td>
</tr>
<tr>
<td>Support Personnel (i.e., FEMA, FAA, TSA, DOD, etc)</td>
<td>10</td>
<td>1,054</td>
</tr>
<tr>
<td>Grand Total</td>
<td>56</td>
<td>6,104</td>
</tr>
</tbody>
</table>
Critical Transportation Needs Shelters

- Shreveport
- Bossier City
- Lake Charles
- Intramural Sports Center
- Hammond - SLU
- Baton Rouge
- Hammond - LA
- Lake Charles-Bossier
- Hammond - GL
- Baton Rouge
- Hammond - SW
- Bossier City
- Lake Charles-Bossier

CTNS
Sex Offenders
Unaccompanied Minors

Total 10,100
Total 120
Total 60

State of Louisiana Hurricane Scenario

Medical Special Needs

- Shreveport
- Bossier City
- Lake Charles
- Shreveport
- Baton Rouge
- Hammond - SLU
- Lake Charles-Bossier
- Hammond - GL
- Baton Rouge
- Hammond - SW
- Bossier City
- Lake Charles-Bossier

MSNS Total 1,450
FMS Total 1,150

H-96 Anticipated Shortfalls

- CAF plus – partial EOC activation
- Unified Command recommends State Declaration of Emergency
- Task Force (SW, SE, Shelter & partner states) conference calls begin – initiate emergency declaration & evacuation discussions
- STREPs for Governor, Cabinet, Parish EOCs, State ESFs, & FEMA Region VI
- Review contracts for deliverables, fuel, Port, A-lets, etc.
- Feds begin work on AMTRAK & air carriers for potential evacuation
- Request FEMA Region VI forward deploy FEMA Liaison to State EOC

H-96

- CAF plus – partial EOC activation
- Unified Command recommends State Declaration of Emergency
- Task Force (SW, SE, Shelter & partner states) conference calls begin – initiate emergency declaration & evacuation discussions
- STREPs for Governor, Cabinet, Parish EOCs, State ESFs, & FEMA Region VI
- Review contracts for deliverables, fuel, Port, A-lets, etc.
- Feds begin work on AMTRAK & air carriers for potential evacuation
- Request FEMA Region VI forward deploy FEMA Liaison to State EOC

H-120

- DHSSEP Crisis Action Team (CAT/activated following notification)
- Initiate State Unified Command conference call
- Prepare State Emergency Declaration

H-102

- Develop & Request Presidential Emergency Declaration (PED/2001)
- Activate contracts for commercial transportation for assisted transportation
- Activate contracts for trucks - Pet Transportation Plan
- Activate Transportation Staging Areas

H-96

- CAF plus – partial EOC activation
- Unified Command recommends State Declaration of Emergency
- Task Force (SW, SE, Shelter & partner states) conference calls begin – initiate emergency declaration & evacuation discussions
- STREPs for Governor, Cabinet, Parish EOCs, State ESFs, & FEMA Region VI
- Review contracts for deliverables, fuel, Port, A-lets, etc.
- Feds begin work on AMTRAK & air carriers for potential evacuation
- Request FEMA Region VI forward deploy FEMA Liaison to State EOC

Mr. Brant Mitchell
Louisiana State University

July 2015
E-4
H-96
- Feds activate Incident Management Assistance Teams (IMAT)
- Prepare to support Special Needs Shelters & Medical Evacuation
- Prepare to support Phased Evacuation Plan & prison population evacuation

H-94
- Transportation Staging Areas operational
- Fuel modifies air charter aircraft to assemble fleet

H-72
- State EOC at Level III or II depending on threat
- Setup to support Contra-Flow
- Parishes initiate Declarations of Emergency
- Submit pre-scripted ARFs to FEMA
- JOC activated
- Joint Information Center (JIC) opens
- Launch host state LNOs

H-72 Anticipated Shortfalls
- Paratransit / Ambulances
- Hospital Spaces
- Aviation Support

H-66
- Initiate setup of Special Needs Shelters
- Initiate dissemination of public information on early evacuation & shelter operations
- Initiate prison population evacuations
- Establish Regional Staging Area (RSA) operations

H-50
- GDHSEP EOC at Level II or Level I based on threat
- Phase 1 evacuation begins
- Pet truck convoy moves with buses
- Begin setup of Contra-Flow
- Request closure of public schools
- Execute LANG Security Anti-Looting Plan

H-40
- State EOC at Level I (if not already at this level)
- Begin evacuation of the Phase II area
- Begin movement of commodities forward

H-30
- Begin evacuation of the Phase III area
- Support Phase III Contra-Flow
- Contra-Flow coordination with Mississippi

Mr. Brant Mitchell
Louisiana State University
July 2015
**City of New Orleans Citizens Assisted Evacuation Plan**

**Goal 1:** Create & maintain an environment where the decision to evacuate becomes more desirable than remaining behind

- In conjunction with state officials, enhance the sheltering plan to make it more “user friendly”
- Provide more information early in the season to enable citizens to better formulate their own evacuation plans

**Goal 2:** Provide greater support to citizens who need special assistance

- Medical “special needs” citizens.
- Elderly, hospital cases
- No self evacuation transportation available

**Goal 3:** Implement measures to greatly enhance the security of city resources

- To include:
  - Accounting for and providing safety measures to city employees
  - Comprehensive plans to protect vehicles and other equipment items
  - Anti-looting plan
New Orleans City Assisted Evacuation Plan Timeline

June 1, 2007

EXECUTE CAEP

Launch CAP; Dispatch buses and security

State Phase 1: Evacuation of areas outside of any levee protection system

State Phase 2: Evacuation of areas north/west of Interstate 10 and Mississippi River

State/Feds lean forward with Evacuation buses

RTA begins pickup at 17 locations

Amtrak continues operations

Launch CAP; Dispatch buses and security

State Phase 3: Evacuation of areas north/east of the Mississippi River and south of Interstate 12; State implements Contraflow; Mayor orders Mandatory Evacuation

Declaration Process

PRESIDENTIAL Authorities use of Federal Resources

STATE Authorities use of State Resources

PARISH Authorities use of Local Resources

The Emergency Management Process

Mr. Brant Mitchell  Louisiana State University  E-8
Greater New Orleans Hurricane and Storm Damage Risk Reduction System

Mike Park
Chief
Task Force Hope
U.S. Army Corps of Engineers

February 24, 2015

New Orleans Topography

City of New Orleans Ground Elevations

From Canal St. at Mississippi River to the Lakefront at U.N.O.

New Orleans Maximum Flooding Depth

New Orleans Levee and Floodwall Breaches

Hurricane Katrina
Aug 29, 2005

• One of America’s largest natural disasters
• Cat 5 less than 12 hrs before landfall
• 127 MPH wind at Louisiana landfall
• Maximum surge of 28 to 30 feet along Mississippi coast
• 80 percent of the city of New Orleans flooded

Hurricane Rita
Sep 24, 2005

• Cat 4 less than 12 hrs before landfall
• 175 MPH max sustained winds in Gulf of Mexico
• 120 MPH max sustained winds at landfall
• Cat 3 strength at landfall
**Effects of Hurricane Katrina**

- Levee Erosion
- Transition Erosion

**Katrina Floodwall Breaches**

- Inner Harbor Navigational Canal
- London Ave. Canal
- 17th St. Canal

**IPET – Interagency Performance Evaluation Task Force**

- Over 150 members: academia, industry, state and federal agencies
- Charged to answer 5 Questions:
  - Flood Protection System
  - Storm
  - Performance
  - Consequences
  - Risk
- Peer review by National Academy of Sciences and ASCE
- Draft report June 2006
- Final report released spring 2009

**Hurricane Protection Decision Chronology**

- **Key Decision Influences**
  - Tyranny of Incremental Decisions
  - Loss of Vision for an Integrated System
  - Lack of Dynamic Use of New Information
  - Organizational Decision-Making Issues
  - Shared Sensitivity to Cost Concerns

**USACE’s Actions for Change**

- Comprehensive systems approach
- Risk-informed decision making
- Communication of risk to the public
- Professional and technical expertise

**Mr. Mike Park**

**US Army Corps of Engineers**

**E-10**
HSDRRS: Our Mission and Commitment

- Repair the damages, making what was there before whole again.
- By 1 June 2011, strengthen and improve the system and provide 100-year level of risk reduction capable of withstanding the effects of a storm having a 1% chance of occurring each year.
- Current funding level $14.48 B (fully funded).

HSDRRS Authorization

4th Emergency Supplemental (June 2006)
- Authorized to raise, as appropriate, levee heights and otherwise enhance the existing Lake Pontchartrain and Vicinity project and the existing West Bank and Vicinity project to provide the levels of protection necessary to achieve certification required for participation in the National Flood Insurance Program.

HSDRRS Funding Breakdown

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>$ (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SELA (Interior Drainage)</td>
<td>1.155</td>
</tr>
<tr>
<td>WBV 100-year Level of Protection</td>
<td>2.010</td>
</tr>
<tr>
<td>LPV 100-year Level of Protection</td>
<td>1.650</td>
</tr>
<tr>
<td>Repair Existing System</td>
<td>1.483</td>
</tr>
<tr>
<td>Restore to Design Height</td>
<td>1.010</td>
</tr>
<tr>
<td>Complete Authorized System</td>
<td>1.643</td>
</tr>
<tr>
<td>Permanent Pump Stations</td>
<td>854</td>
</tr>
<tr>
<td>IHNC</td>
<td>1.603</td>
</tr>
<tr>
<td>Selective Armoring</td>
<td>414</td>
</tr>
<tr>
<td>Storm-proof Existing Pump Stations</td>
<td>340</td>
</tr>
<tr>
<td>Incorporate non-Fed Levees in Plaquemines Parish</td>
<td>671</td>
</tr>
<tr>
<td>Reinforce or Replace Floodwalls</td>
<td>1,491</td>
</tr>
<tr>
<td>Other</td>
<td>110</td>
</tr>
</tbody>
</table>

HSDRRS Funding Breakdown

TOTAL APPROPRIATED FUNDS: $14.48 B

NEPA Alternative Arrangements

- Alternative Arrangements Approved by CEQ – to facilitate expedited construction of the 100-year level HSDRRS to abate extreme risk to life and property
- NEPA Environmental Review – achieved through concurrent development of multiple Individual Environmental Reports (IERs) for segments of the system in lieu of comprehensive Environmental Impact Statement (EIS)
- Consolidated Environmental Document – compilation of IERs into a single document assessing cumulative environmental impacts of HSDRRS

NEPA Compliance Schedule Impact

Estimated NEPA Compliance and Construction Times

- ~3 years saved in completion of 100 yr System
- Total spent on achieving NEPA compliance: ~$20 million.
- 38 Individual Environmental Reports (IER), 22 Supplemental IERs.
- Hosted 200+ public meetings.

# Parishes: 5
- 150 Miles of Levee/Floodwall
- 130 Miles of 100-year Perimeter
- 78 Pumping Stations (Fed & Non-Fed)
Deliver the Greater New Orleans HSDRRS Mission

Challenges
- Mandate to deliver $14.6B construction program within budget and on schedule
- Form design criteria, program cost estimate, acquire funding
- Intense scrutiny / oversight
- New governances
- NEPA compliance
- Deliver a comprehensive system

Enablers
- Administration / Congressional commitment
- Fully funded program
- National / Regional Corps capabilities
- Local partners and stakeholders capabilities
- NEPA Alternate Arrangements
- Full host of acquisition strategies
- Favorable bidding climate

Hurricane Paths Considered in the Risk Analysis
- 3 HSDRRS Geometries
  - Pre-Katrina
  - Current (1 June 07)
  - 100-year LOP (~2011)
- 152 storms
  - 25 yr to 5,000+ yr
- 350+ features
  - Floodwalls
  - Levees
  - Pumps Stations
  → 62,928 Hurricane Hydrographs

HSDRRS 100YR Design Elevation Criteria
- Elevation set to higher of:
  - That required to limit wave overtopping associated with a 100-yr storm surge to 0.01 cfs/ft with 50% confidence of non-exceedance
  - That required to limit wave overtopping associated with a 100-yr storm surge to 0.1 cfs/ft at 90% confidence of non-exceedance
  - The 500-yr still water elevation with a 50% confidence of non-exceedance

A Stronger System Than Ever Before
- Developed new HSDRRS hydraulic, geotechnical and structural design criteria.
- Floodwalls and hardened structures built for 2057 hydraulic conditions
- Pre-Katrina system: 200 miles
- Post-Katrina 100-yr system: 130 miles
  → 35% shorter perimeter exposed to surge

Design Improvements
- T/I wall design
- Scour protection
  - Before
  - After

New Orleans East
Surge Barrier Tie-In
Interim Closure Structures

- Orleans Ave. Canal
- London Ave. Canal
- 17th St. Canal

- All structures completed June 2006
- Provide interim 100-yr level of risk reduction

Permanent Canals Closures and Pumps

- 17th St. Canal
- London Ave. Canal
- Orleans Ave. Canal

IHNC Lake Borgne Surge Barrier

- 1.8 mile span
- 150 ft sector gate and barge gate
- 54 ft vertical lift gate

- $1.3 B Delivery cost
- Design-Build Cost Reimbursable

Seabrook Gate Complex

- 95 ft sector gate
- Two 50 ft vertical lift flow control gates
- ~$200 M Delivery cost
- Early Contractor Involvement (ECI)

Pump Station Fronting Protection

Bayou Segnette Pump Station

Completed Safe House

- 5 new safe houses built
- 5 existing safe houses improved / hardened
West Closure Complex

- Largest drainage pump station in the world – 19,140 cfs
- Largest sector gates in US – 225 ft clear width
- Removed 26 miles of levees and floodwalls from the first line of defense
- ~$1 B Delivery cost
- Early Contractor Involvement (ECI)

West Closure Complex Pump Station

- 5400 hp diesel engines drive 11 flowerpot pumps

New Orleans East Deep Soil Mixing

- Largest ever deep soil mixing application in US
- ~1.7 million cubic yards of land treated
- ~500,000 tons of cement used
- ~5.3 mile stretch
- ECI

New Orleans East Levee

- 2 ft. thick sand blanket with 9 in. layer of gravel on top
- ~1,000,000 total cubic yards of sand

Bayou Sauvage National Wildlife Refuge

- Over 1 Superdome of Clay (4.9 mil cu yd) Required
- ~1 Football Field

Wick Drains

- Largest ever wick drain application in USA
- ~250,000 wicks
- ECI

St. Bernard Floodwall, near the IHNC Tie-In

- Top of Floodwall: EL +32'
- Katrina Storm Surge: EL +23'
- 500-yr Still Water Elevation*: EL +22'
- 100-yr Still Water Elevation*: EL +16'

* Still water elevation does not include waves

DESIGNED FOR A 100-YR STORM SURGE EVENT

Katrina Storm Surge: EL +25'

July 2015

Mr. Mike Park
US Army Corps of Engineers

E-14
St. Bernard Floodwall

- 3 contracts
- ~$1 B
- 23 miles (2 mi completed per month at peak of construction)
- ECI

St. Bernard Floodwall Construction – Southern Reach

HSDRRS Remaining Work

- SELA Interior Drainage
- Permanent Pump Stations
- Mississippi River / HSDRRS Co-located Levees
- Armoring
- Environmental Mitigation
- New Orleans to Venice / Non-Federal Levees

HSDRRS Environmental Mitigation

- Impacts (2,295 acres)
  - LPV – 1,179 acres
  - WBV – 1,116 acres
- Current Plan
  - 3 Mitigation Bank projects
  - 10 Corps constructed projects
- Challenges
  - Lack of in-basin mitigation bank credits for all impacted habitats
  - Some Corps Constructed projects potentially require condemnation for investigation/construction

Value: $190 M

Project Construction

- Swamp
- Marsh
- Bottomland Hardwoods Wet
- Bottomland Hardwoods Dry

Mr. Mike Park
US Army Corps of Engineers
In 2007, you had a 1% chance every year of flooding this deep from Hurricanes.

With the 100-year level of protection, you have a 1% chance every year of flooding this deep from Hurricanes.

With the 100-year level of protection, you have a 0.2% chance every year of flooding this deep from Hurricanes.

Buying Down Risk

Discussion / Questions
**NHC Tropical Cyclone Products**

NHC provides the “big picture” that complements and guides local NWS forecast office products, and provides guidance for international partners.

**NHC Text Products**
- Public Advisory
- Forecast Advisory
- Forecast Discussion
- Wind Speed Probabilities
- Tropical Cyclone Update
- Tropical Weather Outlook
- Tropical Cyclone Reports
- Monthly Tropical Weather Summary

**NHC Graphical Products**
- Track Forecast Cone
- Surface Wind Field
- Surface Wind Speed Probabilities
- Cumulative Wind History
- Graphical Tropical Weather Outlook
- Storm Surge Probabilities
- Storm Surge Inundation Graphic (Experimental)
- Podcasts (Audio)
**NHC Forecast Cone**
- Represents probable track of tropical cyclone center.
- Formed by connecting circles centered on each forecast point (at 12, 24, 36 h, etc.).
- Size of the circles determined so that, for example, the actual storm position at 48 h will be within the 48-h circle 67% of the time.

**Storm Surge Products**
- **SLOSH Model – Sea Lake Overland Surge from Hurricanes**
  - Synthetic tracks of hurricanes of similar intensity and similar track grouped together to show vulnerability.
- **Probabilistic Storm Surge – Real time during event**
  - Run SLOSH model numerous times varying intensity, forward speed, size and direction based on past history of forecast error.
  - Developed probability of various surge levels.

**Forecast Error and Impact on Storm Surge**
- Run SLOSH model numerous times varying intensity, forward speed, size and direction based on past history of forecast error.
- Developed probability of various surge levels.

---

Mr. Frank Revitte  
National Weather Service  
E-18
Storm surge probabilities based on NHC official advisory
Available roughly 48 hours prior to arrival of TS winds
Accounts for meteorological uncertainty in:
- Track
- Size
- Forward speed
- Intensity
Uncertainties based on historical errors
Version 2.0 (2014) also accounts for the tide and is above ground level
**NHC Experimental Inundation Graphic**

- Driven by psurge2.0 (includes tides) 10% exceedance
- Grids
  - Latest SLOSH basins updated to NAVD88
- Topography/DEM
  - NOAA CSC Sea-level rise DEM
    - Resampled to smoother resolution
  - Augmented with USGS NED
- Processing
  - Locally using ArcGIS for Server and Desktop
  - Working toward leveraging NWS integrated dissemination program (IDP) for 2015 season

**Potential Storm Surge Flooding Map**

- Based on P-Surge 2.0 – 10 percent exceedance (90% percent at this depth or lower)
- “Reasonable” worst case scenario
- Available when P-surge 2.0 is running
  - Watches/Warnings in effect within 48 hours of the onset of Tropical Storm force winds
- Will be available approximately 80 minutes after the Public Advisory issuance
- New map generated for each advisory – so some subtle change is possible
- Risk Reduction System is included but at current time does not show overtopping
- Inside the system is hatched

**NHC Experimental Inundation Graphic**

- Available during the 2014 hurricane season experimentally via the NHC website
  - For 2014 season, will be static graphic only
  - No GIS data dissemination during experimental phase
- Interactive map with zoom capability that is available roughly 20-30 min after P-Surge 2.0
- P-Surge 2.0 post-processed to produce a user-friendly graphic of potential storm surge depth
- Marketing/outreach efforts underway
  - Fact sheets, examples, website, video, etc.
OVERVIEW OF THE STATE’S COASTAL MASTER PLAN AND ITS IMPORTANCE TO NEW ORLEANS

Karim Belhadjali, Coastal Protection and Restoration Authority

Feb 25, 2015  Gothenburg - New Orleans City Exchange on Disaster Risk Reduction

Single state entity with authority to articulate a clear statement of priorities to achieve comprehensive coastal protection for Louisiana.

Mandate is to develop, implement, and enforce a comprehensive coastal protection and restoration Master Plan.

Louisiana’s National Role

• Top tonnage port in the nation
• Five of the top 15 tonnage ports in the US
• One of the largest cargo port complexes in the world
• 19 percent of all domestic waterborne commerce
• Over 30 states depend upon Louisiana’s ports for imports and exports.....

Annual Tons of Freight by Water

Ports - Cargo
**Seafood and Wildlife**

- #1 producer in fisheries in the Lower 48 States
- #2 producer of oysters
- #1 producer of blue crabs
- #1 producer of crawfish
- #1 producer of shrimp
- #1 habitat for migratory waterfowl and songbirds

**Ecosystem Services**

- Five million waterfowl
- 25 million songbirds
- America’s largest wintering habitat for migratory waterfowl and songbirds
- 70 rare, threatened, or endangered species
- Top source of wild seafood in the continental United States
- Wetlands serve as part of the hurricane protection system
Petroleum Refineries
[Purple Squares]

Natural Gas Processing Facilities
[Green Diamonds]

Active Offshore Oil/Gas Platforms
[Pink]

Coastal Louisiana: oil & gas infrastructure

Mississippi River Watershed

Sustainable?
Our Coastal Crisis

- Two-thirds of the continental United States
- 42% of the contiguous land mass of North America
Main Causes of Land Loss

- Levees/Dams
- Subsidence
- Sea-level Rise
- Hurricanes
- Oil and Gas Infrastructure
- Oil Spill

Louisiana is Experiencing a Coastal Crisis

1,883 square miles lost since the 1930s (4,877 sq. km)

Currently losing over 16 square miles per year (41 sq. km)
Our Coastal Crisis Will Continue

Current 2020 2030 2040 2050 2060

With No Action Over the Next 50 Years

HOW BAD IS IT - Future Without Action

More Extreme - Potential to lose an additional 1,765 square miles (4,571 sq. km) of land over the next 50 years.

Utilized 0.45 m of sea level rise over 50 years, Subsidence rates 0 to 25 mm per year.

Increasing Vulnerability to Livelihoods

Could experience 10x more damages than today
Responding to the Crisis

**2005** • Hurricanes Katrina and Rita
  • CPRA Board Established
**2007** • Original Master Plan Developed
**2008** • Hurricanes Gustav and Ike
**2009** • CPRA Implementation Office Established
**2010** • Deepwater Horizon Oil Spill
**2011** • Mississippi River High Water Event
**2012** • Master Plan Updated

Coastal Master Plan

Guiding document of CPRA and our efforts to protect and restore the Louisiana coast.

Revised every 5 years.
Building on the 2007 Master Plan

2012 Coastal Master Plan

- Built on world class science and engineering
- Evaluated hundreds of existing project concepts
- Incorporated extensive public input and review
- Resource constrained
  - Funding, water, sediment
- Identified investments that will pay off, not just for us, but for our children and grandchildren

Master Plan Objectives

- **Flood Protection**: Reduce economic losses from storm-based flooding
- **Natural Processes**: Promote a sustainable ecosystem by harnessing the processes of the natural system
- **Coastal Habitats**: Provide habitats suitable to support an array of commercial and recreational activities coast wide
- **Cultural Heritage**: Sustain Louisiana’s unique heritage and culture
- **Working Coast**: Support regionally and nationally important businesses and industries

Evaluation of Hundreds of Existing Projects

Nearly 400 Projects Evaluated Across the Coast

Restoration Projects

- Barter Island Restoration
- Hydrologic Restoration
- Marsh Creation
- Oyster Barrier Reefs
- Ridge Restoration
- Shoreline Protection
- Bank Stabilization
- Channel Realignment
- Sediment Diversion

Mr. Karim Balhadjali
Coastal Protection and Restoration Authority
Protection Projects: Structural Protection Projects

Earthen Levee  Concrete Wall  Floodgate  Pumps

2017 Coastal Master Plan  49

Protection Projects: Nonstructural Protection Projects

Elevated Housing  Floodproofing  Voluntary Acquisition

2017 Coastal Master Plan  50

Using New Tools, Breaking New Ground

Coastal Louisiana Risk Assessment (CLARA) Model Estimates Economic Damage from Coastal Flooding

Estimates flood depths across the coast  Determines direct economic damage

• Builds on post-Katrina flood modeling efforts
  – LACPR
  – IPET Risk and Reliability
  – FEMA HAZUS-MH
• Provides balanced resolution for future risk estimates
  – Estimates damage reduction from many structural and nonstructural options
  – Considers many scenarios

2017 Coastal Master Plan  51

CLARA Proceeds in Three Calculation Steps

Statistical Pre-Processing Module  Flood Depth Module

Damage Dollars

Damage is estimated for the following types of assets:

• single-family residences
• manufactured homes
• small multifamily residences (e.g., duplex, triplex)
• large multifamily residences (e.g., apartment building, condominium)
• commercial properties
• industrial
• public facilities
• transport infrastructure (e.g., roads, bridges, rail)
• vehicles
• agriculture structures and properties
• agricultural crops

2017 Coastal Master Plan  53
Risk Reduction Projects Evaluated Using CLARA Included Structural Projects...

- Earthen levees
- Concrete T-walls
- Floodgates
- Pumps

...and Non-Structural Projects

- Elevation
- Floodproofing
- Voluntary acquisition

Predictive Models Team

<table>
<thead>
<tr>
<th>Predictive Model</th>
<th>Lead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecosystem Services</td>
<td>Andy Nyman, PhD, LSU + 8 members</td>
</tr>
<tr>
<td>Wetland Morphology</td>
<td>Greg Steyer, PhD, USGS + 6 members</td>
</tr>
<tr>
<td>Storm Surge</td>
<td>Joe Suhayda, PhD, Arcadis + 3 members</td>
</tr>
<tr>
<td>Storm Damage/Risk</td>
<td>Jordan Fischbach, PhD, RAND + 7 members</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Jennieke Visser, PhD, ULL + 8 members</td>
</tr>
<tr>
<td>Barier Island Morphology</td>
<td>Mark Kulp, PhD, UNO + 6 members</td>
</tr>
<tr>
<td>Uncertainty Analysis</td>
<td>Emad Habib, PhD, ULL</td>
</tr>
<tr>
<td>Technical Advisor</td>
<td>Denise Reed, PhD, UNO</td>
</tr>
<tr>
<td></td>
<td>Ehab Meselhe, PhD, PE, ULL + 9 members</td>
</tr>
</tbody>
</table>

Future Scenarios

Moderate Scenario

- 771 square miles lost

Less Optimistic Scenario

- 1,763 square miles lost

Variation in Sea Level Rise (Eustatic)

- On-going analysis is incorporating new research and evaluating a scenario of 0.78 m over 50 years

Variation in Subsidence Rates

Subsidence Advisory Panel Members: Louis Britsch, PhD, PG, USA CE-MVN; Roy Dokka, PhD, LSU; Joseph Dunbar, PG, USACE-BRDC; Mark Kulp, PhD, UNO; Michael Stephen, PhD, PG, CEC; Kyle Sraub, PhD, Tulane; Torbjorn Tomvqvist, PhD, Tulane
The Analytical Challenge

- Complex coastal environment
  - Wetlands, bays, barriers/Rural, urban, industry
- Planning horizon
  - 50 years – need to consider change over time
- Multiple future scenarios
- Projects
  - 210 restoration projects
  - 34 Structural protection projects
  - 112 Non-structural protection projects
- Diverse community needs, competing stakeholder preferences

There is No Optimal Solution – Tough Decisions Must Be Made

- Risk reduction
- Use of river diversions
- Near term benefits
- Restoration
- Maintenance of current salinity gradients
- Long term sustainability

The Planning Tool Is a Computer-Based Decision Support Tool

1. Compares and ranks individual projects
2. Develops different combinations of projects for comprehensive strategy
3. Uses interactive visualizations to display tradeoffs and support decision making

Key Decision Points

- Flood Risk Reduction and Land Building as Decision Drivers
- Funding Allocation – $50 Billion, 50/50 split
- Near Term and Long Term Benefits – 50/50 split
- Selecting Projects for an Uncertain Future
- Use of Decision Criteria and Ecosystem Services
- Land Building Experiments

Explored Funding Scenarios and Allocation Between Risk Reduction and Restoration Projects

Evaluated Balance Between Near Term and Long Term Benefits
Planning Tool Evaluates Hundreds of Restoration and Risk Reduction Projects

- 43 Sediment diversion
- 101 Marsh creation
- 96 Other restoration
- 34 Structural risk reduction
- 112 Non-structural risk reduction

Implementing all projects would cost more than $200 billion

Planning Tool Compares Individual Projects
Near and Long Term Land

Group 20 001.D1.17 Diversion Caernarvon Diversion: 250,000 cfs capacity (70% Mississippi/30% Atchafalaya)

Operation at capacity when Mississippi River exceeds 900,000 cfs; operation at 50,000 for flows from 900,000 cfs to 600,000 cfs; operation at 8% of river flow for river flows from 600,000 cfs down to 200,000 cfs, no operation below 200,000 cfs

10 times average discharge of Göta River (575 m³/s)

Grounded in Science

Decision Criteria and Ecosystem Services
- Oyster
- Shrimp
- Freshwater Availability
- Alligator
- Waterfowl
- Saltwater Fisheries
- Freshwater Fisheries
- Carbon Sequestration
- Nitrogen Removal
- Agriculture/Aquaculture
- Other Coastal Wildlife
- Nature-Based Tourism

Year 50 Change in Percent Land Compared to FWOA
Scenario B

Expected Annual Damages

Restoration

Land Area
Planning Tool Assembles Different Project Combinations to Meet Louisiana’s Objectives

- Uses constrained mixed integer program to select combinations of projects that maximize land building and risk reduction

Objective Function:
Let $d_j$ represent the weight for decision criterion $j$.

Max \[ d_1 \left( \text{Alternative Near-term Reduction in EAD} \right) + d_2 \left( \text{Alternative Long-term Reduction in EAD} \right) + d_3 \left( \text{Alternative Near-term Coast wide Land Area} \right) + d_4 \left( \text{Alternative Long-term Coast wide Land Area} \right) \]

Planning Tool Assembles Different Project Combinations to Meet Louisiana’s Objectives

- Choices are constrained by funding, available sediment, and river flow

\[
\sum_{p \in P} \left( \text{Cost}_{p,t} x_{p,t} \right) \leq \text{Restoration Funding}_t, \quad \forall t; \\
\sum_{p \in P} \left( \text{Cost}_{p,t} x_{p,t} \right) \leq \text{Risk Reduction Funding}_t, \quad \forall t; \\
\sum_{p \in P} \left( \text{Sediment Required}_{p,t} x_{p,t} \right) \leq \text{Sediment Available}_{t,s}, \quad \forall t, s; \\
\sum_{p \in P} \left( \text{River Flow Diverted}_{p,t} x_{p,t} \right) \leq \text{River Flow}_{t,z}, \quad \forall t, z; \\
\sum_{p \in P} \left( \text{River Reach Indicator}_{p,k} x_{p,t} \right) \leq \text{Allowable Number of Diversions}_{t,k}, \quad \forall t, k.
\]

Louisiana’s 2012 Coastal Master Plan
Max Land/Max Risk Alternative

Coastal Protection and Restoration Authority

E-33
Science and Engineering Board

Ecosystem Science / Coastal Ecology
- William Dennison, PhD, University of Maryland
- Edward Houde, PhD, University of Maryland
- Katherine Ewel, PhD, University of Florida

Engineering
- Robert Dalrymple, PhD, PE, Johns Hopkins University
- Jos Dijkman, MsC, PE, Dijkman Delft

Geosciences
- Charles Groat, PhD, University of Texas at Austin

Social Science and Risk
- Greg Baecher, PhD, PE, University of Maryland
- Philip Berke, PhD, University of North Carolina – Chapel Hill

Climate Change
- Virginia Burkett, PhD, U.S. Geological Survey

Environmental/Natural Resource Economics
- Edward Barbier, PhD, University of Wyoming

Technical Advisory Committees

Predictive Models
- Steve Ashby, PhD, USACE Eng. Res. Dev. Center
- John Callaway, PhD, University of San Francisco
- Fred Sklar, PhD, South Florida Water Mgmt. District
- Si Simenstad, MS, University of Washington

Planning Tool
- John Boland, PhD, PE, John Hopkins
- Ben Hobbs, PhD, John Hopkins
- Len Shabman, PhD, Virginia Tech

Cultural Heritage
- Don Davis, PhD, Louisiana State University
- Maida Owens, LA Dept. of Culture, Recreation, and Tourism
- Carl Brasseaux, PhD, University of Louisiana Lafayette

Grounded in Science

Decision Criteria and Ecosystem Services
- Distribution of flood risk across socioeconomic groups
- Flood protection of historic properties
- Flood protection of strategic assets
- Operation and maintenance costs
- Sustainability
- Support for navigation
- Use of natural processes
- Support for cultural heritage
- Support for oil & gas

Restoration
- Land Area

Risk Reduction
- Expected Annual Damages

Responsive to the Needs of Our Coastal Communities

Outreach and Engagement Groups

Incorporating Citizen & Stakeholder Knowledge into the Planning Process

Responsive to the Needs of Our Coastal Communities

Framework Development Team

Over 30 Federal, State, NGO, Academic, Community, and Industry Organizations

Mr. Karim Balhadjali
Coastal Protection and Restoration Authority
Focus Groups

- Key industries are impacted by land loss and large scale protection and restoration efforts
- Created three focus groups:
  - Navigation
  - Fisheries
  - Oil and Gas
- Expanding membership to:
  - Landowners
  - Community groups

Extensive Public Outreach and Review

- Open house and public hearings held to receive feedback on draft plan: New Orleans, Houma, and Lake Charles
- Attendees at the public hearings
- Public comments received on draft plan at public meetings
- Public comments received on draft plan
- People visited the plan website during the public comment period

Louisiana’s 2012 Comprehensive Master Plan for a Sustainable Coast

A Closer Look: Southeast Coast

Keystone of the 2012 Master Plan: Reconnecting the River
Keystone of the 2012 Master Plan: Reconnecting the River

The projects in the plan would use up to 50% of the Mississippi River’s peak flow for sediment diversions, in addition to using water and sediment from the Atchafalaya River.

What the Master Plan Delivers

Potential Annual Rates of Land Change Over the Next 50 Years

2012-2021 2022-2031 2032-2041 2042-2051 2052-2061

Implementing the Plan

Since 2007, we have

26,000+ acres of land benefitted
250+ miles of levee improved
45 miles of barrier islands constructed
95.4 million cubic yards of fill placed

$18B secured for restoration and protection projects
Progress on the Ground
Projects 2007-present

Restoration Projects

- Barrier Island Restoration: $1,024
- Marsh Creation: $457
- Shoreline Protection: $362
- Hydraulic Restoration: $92
- Freshwater Diversion: $40
- Oyster Barrier Reefs: $2
- Other Restoration Projects: $29
- Total: $2,124,000,000

$ Millions

Protection Projects

- Greater New Orleans Hurricane Protection System: $8.7
- Other Protection Projects: $2.4
- Infrastructure Projects: $0.55
- Total: $11,184,000,000

Before and After

Restoring Barataria Basin

2017 Coastal Master Plan

BEFORE AND AFTER

Chaland Headland

Sept 2010
Oct 2014

BEFORE AND AFTER

Shell Island East

May 2013
Dec 2013

BEFORE AND AFTER

Scofield Island

Nov 2013
Dec 2014

Mr. Karim Balhadjali
Coastal Protection and Restoration Authority
Caminada Headland Beach and Dune Restoration – Increment I
January 2014

Status: Headed to Construction
Estimated Project Cost: $147M

Long Distance Sediment Pipeline & Bayou Dupont
June 2014

Biloxi Marsh
January 2014
Flood Protection

Major Components

- Levees
- Floodwalls
- Pump Stations
- Sector Gates & Barge Gates
- Locks

Role of CPRA

- Design and Review
- Construction Oversight & Review
- Levee Inspections
- Emergency Response Teams

Projected FY16 Expenditures

By Project Phase

- Total Expenditures $773 Million
- Construction (568.9 million)
- Engineering and Design (573.7 million)
- Planning (25 million)
- Operation, Maintenance and Monitoring (58.3 million)
- Ongoing Programs and Initiatives (38.1 million)
- Operating Costs (57.6 million)

Construction includes Beneficial Use ($4 million)

O&M includes BMIP ($61.5 million), Repair/Rehabilitation of Projects ($1.1 million), Marine Debris Removal ($1.6 million), and Isaac Beach and Dune Recovery ($45.4 million)

Ongoing Programs includes Project Support ($4.1 million)
Projects Scheduled for Construction in FY16

Mississippi Sediment Diversions
Building On What We Know

Center for River Studies
The Water Campus

2012 Coastal Master Plan
Freshwater and Sediment Diversions

Mississippi River Sediment Diversions: Process

Implementing the Master Plan
Monitoring and Reporting our Progress
Implementing the Master Plan

Adaptive Planning Built In

The Louisiana Legislature requires that the Master Plan be updated every five years with the latest science and technical information.

Advancements and Updates

- Implementation of the model improvement plan
- Potential for project list modification
- Public input and political acceptance
- Development of Flood Risk and Resilience Program
- Socio-economics and fisheries distribution analysis for areas in Breton, Barataria and Terrebonne

Advancing our Technical Analysis

2017 Model Improvement Plan

Collaborative Team of over 70 Experts

Modeling Decision Team
Directs and coordinates model improvements and analysis

Subtask Leaders and Members:
2017 Model Improvement Plan
Integrated Compartment Models (ICMs)

- Expand study region further inland to reflect an expanding floodplain
- Develop a higher-resolution spatial unit of analysis
  - Previous: U.S. Census block centroids
  - New: At least 1x1 km grid
- Update
  - Data on individual structures/parcels (selected parishes)
  - Strategic assets and critical infrastructure
  - 2010 Census updates
- Validate CLARA with Hurricane Isaac flood and damage data

Geospatial Improvements
Expanding the Study Region

- CLARA v1.0 included ~35K census block centroids

Geospatial Improvements
Developing a New Spatial Unit

- CLARA v2.0 includes ~114,000 grid points
  - Note: ~90K points in LA, ~14K in MS, ~10K in TX

THANK YOU
coastal.la.gov
Karim.Belhadjali@La.Gov
What is Disaster Resilience?

- The term “resilience” means the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions*
- In the context of community resilience, the emphasis is not solely on mitigating risk, but implementing measures to ensure that the community recovers to normal, or near normal function, in a reasonable timeframe.
  
  *As defined in Presidential Policy Directive 21.

Resilience Concept

- Maintain acceptable levels of functionality during and after disruptive events
- Recover full functionality within a specified period of time

Attributes of Resilience

- Functionality – Resilience should be based on the ability of social systems to resume function within a prescribed period of time following an expected event. Buildings and infrastructure must be functional to support these social systems.
- Interdependence – Resilience must consider the interdependence of buildings and infrastructure (functionality) and the relationship of individuals and organizations with the built environment.

Performance Levels for After-Event Evaluations

<table>
<thead>
<tr>
<th>Category</th>
<th>Infrastructure System Performance Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Resume 100% service within days</td>
</tr>
<tr>
<td>II</td>
<td>Resume 90% service within weeks and 100% within months</td>
</tr>
<tr>
<td>III</td>
<td>Resume 90% service within months and 100% within years</td>
</tr>
</tbody>
</table>

Disaster Resilience Framework 1.0

- The Disaster Resilience Framework 1.0 will focus on the role that buildings and infrastructure lifelines play in ensuring community resilience.
- The Framework will:
  - Establish types of performance goals and ways to express them
  - Identify existing standards, codes, and best practices that address resilience
  - Identify gaps that must be addressed to enhance resilience
  - Capture regional differences in perspectives on resilience
- The Disaster Resilience Framework will be informed through a series of stakeholder workshops.
Evacuation Basics

• TEMPORAL AND SPATIAL
• Hazard Characteristics
  – Scale (how “big?” -> How far to evacuate), Amount of advanced notice, Shelter-in-place options
• Evacuee Characteristics
  – Who are they? Where are they? How many? How mobile? Behavior (if/when will they leave?), What are their needs?
• Transportation Resources
  – Modes, Highway Transit, Traffic Control, Traffic Management
• Communications
  – To/from, Across and between all levels, jurisdictions, agencies, and evacuees, Need for situational awareness

Hazard Type

Evacuating Population Size

Recent History in Louisiana
Recent History in Louisiana

- Prior to Hurricane Georges in 2000, there was no regional traffic management plan in LA
- No “designated” evacuation routes
- 1st plan was developed in 2000 and included contraflow in New Orleans
- Used for the first time in 2004 for Hurricane Ivan - with questionable results
- “Revised plan” was developed in 2004-2005 and implemented for the first time for Hurricane Katrina
- Evacuation was quite effective for those with the desire and means to evacuate
- Plans for the evacuation of low-mobility populations were obviously “lacking”

Problems Identified in Ivan

- An over-reliance on the westward movement of traffic
- Confluence congestion created by the confluence of major evacuation routes in Baton Rouge, Hammond, Lafayette, Covington, and Slidell
- Inefficient loading of contraflow in New Orleans
- Inability to access up-to-date traffic information and provide timely and accurate traveler information to evacuees

New Orleans Contraflow Initiation Point

Hurricane Ivan Evacuation - Interstate 10 (west of New Orleans)
Proposed Solutions

- Maximize the available routes out of the New Orleans area
- Improve the loading of contraflow segments in New Orleans
- Mitigate (eliminate?) the congestion in Baton Rouge
- Inability to access up-to-date traffic information and provide timely and accurate traveler information to evacuees
Duration of Evacuation Volume

Effect of Contraflow on Traffic Volume

Examples of Control Devices

Evacuation Traffic Control
Examples of Control Devices

Texas EVACULANE Shoulders

US 290
Houston to Hempstead

Examples of Control Devices

Variable Message Signs

Assisted Evacuations

“Low Mobility” Evacuees

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

Problems of Low Mobility Evacuation Planning

- Existing traffic/transportation simulation systems are not created to model evacuation conditions
  - Scale (e.g., number of vehicles)
  - Scope (e.g. duration, geographic area)
- Existing models do not permit the modeling and simulation of multiple modes of transportation simultaneously
- Most models are not able to give analysts the MOE’s they’d like or decision-makers the answers to questions they pose
- Limited understanding and development of underlying behaviors of evacuation travel for different evacuee and mode types

Recognized Limitations

- Existing traffic/transportation simulation systems are not created to model evacuation conditions
  - Scale (e.g., number of vehicles)
  - Scope (e.g. duration, geographic area)
- Existing models do not permit the modeling and simulation of multiple modes of transportation simultaneously
- Most models are not able to give analysts the MOE’s they’d like or decision-makers the answers to questions they pose
- Limited understanding and development of underlying behaviors of evacuation travel for different evacuee and mode types

Evacuation Modeling

Evacuation Modeling Spectrum

From: “Structuring Modeling and Simulation Analyses for Evacuation Planning and Operations”

By: Hardy, Wunderlich, Bunchand, and Smith
Current Research

- Application of the TRANSIMS system
- Can be used to model very large geographical regions and large numbers of travelers
- Effort and expertise required to code and run
- Issues of verification, validation, and calibration
- Hardware and software requirements
- History, experience, and acceptance within the professional transportation community
- Not developed for the purpose of evacuation

Evacuation Traffic Simulation

- Has proven value
- Permits bottlenecks to be identified and potential solutions to be analyzed before they become problems
- Gives quantitative MOE results to decision-makers
- Allows effects of alternative strategies and adverse conditions to be assessed without consequence

Recognized Limitations

- Existing traffic/transportation simulation systems are not created to model evacuation conditions
  - Scale (e.g., number of vehicles)
  - Scope (e.g., duration, geographic area)
- Existing models do not permit the modeling and simulation of multiple modes of transportation simultaneously
- Most models are not able to give analysts the MOE’s they’d like or decision-makers the answers to questions they pose
- Limited understanding and development of underlying behaviors of evacuation travel for different evacuee and mode types

TRANSIMS Project

TRANSIMS System

- Incorporates aspects of planning and operations
- Model large geographical regions and large numbers of travelers
- Model populations, travel activities, routing, and analyses it with a microsimulator
- Open source and available
- Effort and expertise required to code and run
- Issues of verification, validation, and calibration
- Hardware and software requirements
- History, experience, and acceptance within the professional transportation community
- Not developed for the purpose of evacuation

TRANSIMS Structure

- Network Input
  - Structure and characteristics of the transportation network (control, capacity, etc.) and activity locations
- Population Synthesizer
  - Creates a disaggregate synthetic population based on aggregate census zonal information
- Activity Generator
  - Travel surveys or observation of past evacuations
- Router
  - Spatial and temporal travel behavior and route assignments
- Microsimulator
  - Tracks and compiles movements and statistics of each agent (vehicles & peds)
- Visualizer
  - 3rd party developer Balfour Technologies Inc.
LSU Study - Approach

- Step 1 – Network development
- Step 2 – “Base Model” validation and calibration based on 2005 Katrina evacuation
- Step 3 – Code “New” New Orleans multimodal plan
- Step 4 – “Base Model” validation and calibration based on 2005 Katrina evacuation
- Step 5 – Code and test alternative plans and ideas
Westbound I-10 Traffic Speed

Volume and Speed
EB I-10 in Slidell
Prior to NB US Contraflow Entry

Volume and Speed
WB US 190 in Baton Rouge

Network Link 56039 (Near DOTD Station 67 – 1 mile S of I-12, I-59 Jct)

Network Link 57784 (DOTD Station 18 – 1.1 miles E of O’Neal Ln Jct)
Conclusions

• Evidence that TRANSIMS can be an effective tool for evacuation modeling and planning
• Constituent models can be useful in whole or when used separately
• Development of the TRANSIMS model has added benefits beyond evacuation
• User interface for coding and output results was cumbersome

Assisted Evacuation Modeling

Assisted Evacuations

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

Study Questions

• Proof-of-Concept - Can TRANSIMS be used for evacuation analysis? Are its results reasonable?
• Develop a variety and range of hazard-response scenarios
• How many buses might be needed for various scenarios? What routes should they take?
• Potential to estimate the number of location of evacuees
• Examine the potential of alternate plans

Research Methodology

• Model Development
  – Spatial distribution, loading, and temporal movements 40,000 assisted evacuees (including 10,000 tourists)
• Scenario Development (8 cases)
  – Routing: I-10 vs. US-61
  – Response “Urgency”: 24, 32, 36, 48 hours
• MOE’s
  – Total evacuation time and average travel time
• Develop and Evaluate Alternative Management Strategies
  – “Off-peak” movements
  – “Forced” routing
Quantitative Results

<table>
<thead>
<tr>
<th>Evacuation Scenario</th>
<th>Total Evacuation Time (hr)</th>
<th>Percent Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I-10</td>
<td>US-61</td>
</tr>
<tr>
<td>A</td>
<td>34.95</td>
<td>32.79</td>
</tr>
<tr>
<td>B</td>
<td>47.27</td>
<td>46.44</td>
</tr>
<tr>
<td>C</td>
<td>29.89</td>
<td>25.76</td>
</tr>
<tr>
<td>D</td>
<td>41.35</td>
<td>36.49</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evacuation Scenario</th>
<th>Average Travel Time (hr)</th>
<th>Percent Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I-10</td>
<td>US-61</td>
</tr>
<tr>
<td>A</td>
<td>4.81</td>
<td>2.55</td>
</tr>
<tr>
<td>B</td>
<td>5.03</td>
<td>2.84</td>
</tr>
<tr>
<td>C</td>
<td>4.54</td>
<td>2.20</td>
</tr>
<tr>
<td>D</td>
<td>4.80</td>
<td>2.61</td>
</tr>
</tbody>
</table>

Conclusions

- Evidence that TRANSIMS is an effective tool for multimodal evacuation modeling and planning
- Constituent models can be useful in whole or when used separately
- Quantify Process and Evaluate Alternatives

<table>
<thead>
<tr>
<th>Management Strategy</th>
<th>Total Evacuation Time</th>
<th>Average Travel Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off Peak Evacuation</td>
<td>45%</td>
<td>10%</td>
</tr>
<tr>
<td>Alternative Routing</td>
<td>14%</td>
<td>52%</td>
</tr>
</tbody>
</table>

Gulf Coast Center for Evacuation and Transportation Resiliency

http://www.trb.org/
Florida Keys Evacuation Planning

Evacuation Planning in The Florida Keys: Unique Challenges and Emerging Knowledge
Brian Wolshon, Ph.D., P.E., Louisiana State University

Discussion Topics

• Background on the unique nature of The Florida Keys and the challenges they present to evacuation
• Transportation network in The Keys
• Social and political concerns influencing evacuation
• Transportation analyses and emerging knowledge
• Applicability to other locations

Unique Nature of The Florida Keys

• High risk potential
• Effectively one route out
  • Susceptible to traffic and roadway incidents
  • Use of contraflow is problematic
• Approximately 80,000 resident and tourists evacuees
  • Highest concentration in the Lower Keys
• Long travel distance
• Potential effects of “mainland” traffic

Unique Nature of The Florida Keys

• Designated as a Florida “Area of Critical State Concern”
  • Unique nature and value of the area makes The Keys important to the State as a whole
  • State, rather than local government, has authority over many key civil issues
• Evacuation
  • Must be able to undertake a full evacuation in 24 hours
• Growth and Development
  • New construction is limited by the ability to serve water, sewer, evacuation, etc.

(Map source: 2001 Florida Keys Hurricane Evacuation Study)
Transportation Analysis History

- Long history of traffic analysis and modeling in The Keys
- 2001 Florida Keys Hurricane Evacuation Study (aka “The Miller Model”)
  - Linear model of link flows
- More complex models as part of the Florida Statewide Study
- The models rely on estimates of roadway capacity

General Modeling Process

- Spatial and temporal generation of travel demand
  - Who leaves, when do they leave, where do they come from, where do they go, what route(s) do they take?
- What is the carrying capacity of the road network?
- What are the travel conditions?
  - Speed, travel time, delay, congestion
- Convert to a clearance time

Model Findings 2001

- 2001 Florida Keys Hurricane Evacuation Study
  - Examined clearance time under numerous scenarios including existing road configuration and various lane and intersection capacity improvements
- Existing (no-build) condition would result in an clearance time of 25hr 58min
- Through various improvements, it was suggested that this could be lowered to just under 19 hours
  - Lane additions where expected flow were highest – Upper Keys
  - FDOT implementing these improvements since

Research Findings

- Numerous major evacuations (1999 – 2008) afforded the opportunity to collect and analyze flow patterns and characteristics
- The observed data showed consistent patterns that actual flow during events were not consistent with prior assumptions
  - They also vary at different times
- Research suggests the use of “Maximum Sustainable Evacuation Traffic Flow Rates” for modeling and analysis

Maximum Sustainable Evacuation Traffic Flow Rates

- The anticipated highest vehicle flow rates that can be practically sustained over an extended period of time during an evacuation
- Although Maximum Sustainable Evacuation Traffic Flow Rates are similar to the “capacity” of the road segment, they are quite different
- They vary by segment – and will also vary based on specific conditions that exist at the time of the event
Louisiana Observations

Northbound Evacuation (2-lane) Traffic Volume - US-61 LaPlace, Louisiana

Westbound Evacuation (2-lane) Traffic Volume - US-190 (Mississippi River departure) Port Allen, Louisiana

Louisiana Observations

Westbound Evacuation (2-lane) Traffic Volume - US-190 (Mississippi River departure) Port Allen, Louisiana

Westbound Evacuation (2-lane) Traffic Volume - US-190 Port Allen, Louisiana

Florida Observations

Westbound SR-528 Traffic Volume Data

Eastbound SR-528 Traffic Volume Data
Florida Keys Observations

Northbound US-1 Traffic Volume Data at Cow Key Bridge
Hurricane Ivan (top) and Hurricane Frances (bottom)

Maximum Observed Flows

<table>
<thead>
<tr>
<th>Event</th>
<th>Cow Key Bridge MM 4 (vphpl)</th>
<th>Big Pine Key MM 28 (vphpl)</th>
<th>Key Largo MM 106 (vphpl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricane Charley</td>
<td>1,125*</td>
<td>1,100*</td>
<td>725*</td>
</tr>
<tr>
<td>Hurricane Francis</td>
<td>800*</td>
<td>595*</td>
<td>450*</td>
</tr>
<tr>
<td>Hurricane Ivan</td>
<td>600*</td>
<td>810*</td>
<td>625*</td>
</tr>
<tr>
<td>Hurricane Wilma</td>
<td>650*</td>
<td>590*</td>
<td>650*</td>
</tr>
<tr>
<td>Hurricane Dennis</td>
<td>650*</td>
<td>1,180*</td>
<td>748*</td>
</tr>
<tr>
<td>Trap. Storm Fay</td>
<td>855</td>
<td>1,030</td>
<td>874</td>
</tr>
<tr>
<td>Trap. Storm Ike</td>
<td>584</td>
<td>680</td>
<td>502</td>
</tr>
<tr>
<td>Highest Hrly Vol. of 2010</td>
<td>1,092</td>
<td>1,066</td>
<td>903</td>
</tr>
<tr>
<td>2nd Highest Hrly Vol. 2010</td>
<td>1,061</td>
<td>1,065</td>
<td>869</td>
</tr>
<tr>
<td>3rd Highest Hrly Vol. 2010</td>
<td>1,058</td>
<td>1,063</td>
<td>849</td>
</tr>
<tr>
<td>4th Highest Hrly Vol. 2010</td>
<td>1,055</td>
<td>1,059</td>
<td>824</td>
</tr>
<tr>
<td>Maximum Sustainable Evacuation Traffic Flow Rates</td>
<td>900 – 1,100</td>
<td>1,050 - 1,100</td>
<td>900 - 1,200</td>
</tr>
</tbody>
</table>

* Denotes approximate value based on graphical data

Model Findings - 2010

- 2010 Statewide Regional Evacuation Study Program Models
  - More than 30 scenarios
  - Using FDOT recommended MSETFR’s
- Will be used by the State of Florida to set policy
- Enormous range of clearance times from 12 - 47 hours, based on amount of population, behavioral response, downstream traffic, etc., etc., etc.
  - Comparable assumptions to 2001 (using MSETFR’s is now about 26 hours)

Conflicting Concerns and Needs

- Improvements would be needed most in Upper Keys to serve Lower/Middle Keys populations
- Additional road capacity would bring more traffic, diminishing the quality of life and the existing nature of The Keys
- Building prohibitions would amount to government “takes” of private property, involving of hundreds of millions
- Compromise?

Current Research

Gulf Coast Center for Evacuation and Transportation Resiliency

Gulf Coast Center for Evacuation and Transportation Resiliency

Dr. Brian Wolshon
Louisiana State University

E-58
**Behavioral Modeling**

Forecast time-dependent evacuation demand

![Graph showing observed and predicted number of evacuations over time](image)

**Scenario Testing and Evaluation**

Analysis of “variable” hazards and responses

- Temporal –
  - More/less time to evacuate
  - Implementation of phasing strategies
- Spatial –
  - Storm size and direction of approach
  - Network management

**Future Modeling**

- Police enforcement control
- MegaRegion evacuation network analysis

**Acknowledgements**

- Financial support for this project provided by the United States Department of Transportation through the Federal Highway Administration’s Transportation Model Improvement Program
- Additional technical support provided by the New Orleans Regional Planning Commission, Louisiana Department of Transportation and Development, Louisiana State University, and the LSU-UNO UTC
- Continuing work is currently being funded by the United States Department of Homeland Security through the DHS Centers of Excellence Program

**Acknowledgements**

- Financial support for research provided by the United States Department of Transportation through the Federal Highway Administration’s University Transportation Centers Program
- Technical assistance and data provided by:
  - Florida Department of Transportation, District Six
  - TrafTech Engineering, Inc.
  - Stanley Consultants, Inc.
Building Resilience in the Greater New Orleans Region

Monica Farris, PhD, CFM
2/26/2015

UNO-CHART

- Mission:
  - To assist residents, local and state officials, and communities in understanding and reducing risk to hazards
- Applied Research with focus on mitigation
- Multi-disciplinary
- Established in 2001
- www.uno.edu/chart

Applied Projects

- Repetitive Flood Loss
  - Community Rating System (CRS) Users’ Groups
- Sci-TEK
- Community Education & Outreach (CEO)
  - Continuity Planning for Community Organizations
  - Risk Literacy
  - Executive Risk Management
  - Resilience Curriculum
  - Disaster Resistant University Workshops

Community Education & Outreach

Outreach

1. Continuity Planning for Community Organizations
2. Hazards Resiliency Curriculum
3. Risk Literacy
4. DRU Workshop
5. Executives Program in Risk Management

Continuity Planning for Community Organizations
Project Background

- Held statewide continuity workshops
- Targeted small community organizations, nonprofits, and faith-based groups

Curriculum Development

➢ Through focus groups and workshops, created a curriculum for community continuity and resilience
  - Community Resilience
  - Understanding Your Hazards
  - Community Mapping
  - Ideas for Successful Response and Recovery
  - Strengthen Your Continuity Plan

Creation of a Manual

- So that agencies and communities can tra themselves

Inside the Manual

- Defining resilience

Inside the Manual

- An in-depth look at hazards

Inside the Manual

- Understanding your role in the community

Dr. Monica Farris
University of New Orleans
E-61
Inside the Manual

• Responding to and recovering from events

Inside the Manual

• Making a plan

Sharing Resources

• Online Disaster Toolkit:

Outreach

1. Continuity Planning for Community Organizations
2. Hazards Resiliency Curriculum
3. Risk Literacy
4. DRU Workshop
5. Executives Program in Risk Management

Literacy, Risk and Mitigation

• Difficulties with vulnerable populations

| Constructing risk message with awareness of literacy issues

| National planning process geared toward high-level readers

Risk Literacy

Dr. Monica Farris
University of New Orleans
E-62
Separate Yet Critical Tasks

- Learning to Read
- Understanding Risk

Overview of the Manual

- Plain Language—writing that delivers clear and easy to understand information
  - With actions, deconstruct step by step
  - Graphics and text that are accessible to

Hazard Mitigation

Hazard mitigation is any action possible to protect your life and property from future disaster damages.

Retrofitting

Retrofitting is a change you make to your home to strengthen it from flooding and high winds. Retrofitting is an example of hazard mitigation.

Insurance

- Flood insurance helps cover the cost of damages from floods. Only flood insurance covers flood damage from storms. There is a 30-day waiting period on new policies.
- Homeowners insurance helps cover the cost of wind damage. Homeowners insurance does not cover flood damage.

Key Words

- Flood Insurance
- Hazard Mitigation
- Retrofitting

Flood Insurance:

- Long-term protection
  - What does hazard mitigation mean?
  - What does flood insurance mean?
  - How can you protect your home from flooding?


Dr. Monica Farris University of New Orleans E-63
Plan ahead for evacuation costs.

Tip 1: Leave early to avoid traffic.
Keep your car in good shape.
Keep your gas tank full.
Check tire pressure.
Check windshield-wiper blades.
Check condition of engine oil.
Rave enough to:
- Fill your gas tank 4 times.
- Pay for 3 nights at a hotel ($80-$120/night).
- Eat 3 meals a day at a restaurant for 3 days.

Sample Cost:
A New Orleans family of four evacuates to a Shreveport hotel for 3 days. The cost is around $750.

Average Price of a Meal:
- Fast Food: $5-$15/ person
- Chain Restaurants: $$ $15-$25/ person
- Fine Dining: $$$ $25-$50/ person

Tip 2: Stay at hotels with microwaves and refrigerators so you can cook your own meals.
Ways to Save:
- Bring food from home.
- Shop at grocery stores.
- Cook your own meals.

Driving from New Orleans, LA:

<table>
<thead>
<tr>
<th>City</th>
<th>Average Time</th>
<th>Average Price*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexandria, LA</td>
<td>1.5 hours</td>
<td>$210</td>
</tr>
<tr>
<td>Austin, TX</td>
<td>8.5 hours</td>
<td>$345</td>
</tr>
<tr>
<td>Baton Rouge, LA</td>
<td>1 hour</td>
<td>$30</td>
</tr>
<tr>
<td>Dallas, TX</td>
<td>5.5 hours</td>
<td>$390</td>
</tr>
<tr>
<td>Houston, TX</td>
<td>3.5 hours</td>
<td>$215</td>
</tr>
<tr>
<td>Jackson, MS</td>
<td>3.5 hours</td>
<td>$230</td>
</tr>
<tr>
<td>Lake Charles, LA</td>
<td>1.5 hours</td>
<td>$75</td>
</tr>
<tr>
<td>San Antonio, TX</td>
<td>6 hours</td>
<td>$410</td>
</tr>
<tr>
<td>Shreveport, LA</td>
<td>3 hours</td>
<td>$210</td>
</tr>
</tbody>
</table>

Driving from Lafayette, LA:

<table>
<thead>
<tr>
<th>City</th>
<th>Average Time</th>
<th>Average Price*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexandria, LA</td>
<td>3.5 hours</td>
<td>$220</td>
</tr>
<tr>
<td>Atlanta, GA</td>
<td>7.5 hours</td>
<td>$480</td>
</tr>
<tr>
<td>Baton Rouge, LA</td>
<td>1.5 hours</td>
<td>$80</td>
</tr>
<tr>
<td>Birmingham, AL</td>
<td>5 hours</td>
<td>$185</td>
</tr>
<tr>
<td>Dallas, TX</td>
<td>8 hours</td>
<td>$160</td>
</tr>
<tr>
<td>Houston, TX</td>
<td>5 hours</td>
<td>$165</td>
</tr>
<tr>
<td>Jackson, MS</td>
<td>3 hours</td>
<td>$190</td>
</tr>
<tr>
<td>Lake Charles, LA</td>
<td>3 hours</td>
<td>$75</td>
</tr>
<tr>
<td>Shreveport, LA</td>
<td>5.5 hours</td>
<td>$340</td>
</tr>
</tbody>
</table>

Lesson 9
Parish Assistance for Evacuation, Know Your Rights, Shelter Basics
(Page 23,24 and 25 of the Preparing for Storms in Louisiana student manual)

Reading Comprehension Strategy:
Think Aloud

Framework:
- مستوى موقع العناصر الساخنة، وijk identif, إلى معلومات عن مكان الامتحانات.
- هذا المستوى يتضمن نموذج الامتحانات الذاتي، مما يساعد الطالب على الاستعداد.
- تعلم الطالب لنفسه نموذج الامتحانات الذاتي.
- لمسة الطالب لنفسه نموذج الامتحانات الذاتي.

Learning Objectives:
The students will:
- Review their personalized list of important words or phrases for Section III.
- React verbally and in writing to evacuation buses and shelters.
- Engage with a passage by vocalizing questions.
- Learn where to find help during an evacuation.
- Learn their rights in a shelter.
- Learn basic tips for staying at a shelter.

Materials:
In addition to the materials listed on page 7 of this guide, the instructor will need:
- The lesson 9 previewing video:
  - http://bit.ly/1giRMKG (0:41 in length)

Preparation para tormentas en Louisiana

Preparaci6n para tormentas con personas mayores o con discapacidad

- Recetas adicionales de alimento de medicina
- Silla de ruedas o andador
- Dispositivos médicos personales
- Fuente de energía de reserva para los dispositivos médicos
- Plan de respuesta para servicios de salud

Repetitive Flood Loss
Project Background

- Repetitive Loss (RL): two or more claim payments of more than $1,000
- Severe Repetitive Loss (SRL): four or more claim payments of more than $5,000 each and the cumulative amount of claims exceeds $20,000 or two separate claims that cumulatively exceed the building’s market value.
- Privacy Act of 1974: restricts the release of certain types of data to the public

Project Background

- FEMA funded (Region VI)
- Project Partners: Solutient, French Wetmore, RL Communities
- Deliverables
  - Rep Loss database and web portal
    - www.floodhelp.uno.edu
  - Area analyses
  - Outreach

The Repetitive Loss Area Analysis (RLAA)

- Flood mitigation plan
  - Identifies the source(s) of repetitive flooding
  - Offers mitigation measures to combat that flooding
  - Includes resident participation

RLAA Process

- Step 1: Advise all property owners in the RL area
- Step 2: Contact agencies/organizations that may have information
- Step 3: Visit each building and collect data
- Step 4: Review potential mitigation measures
- Step 5: Document the findings

Selection of Study Area

- 52 RLs
- 185 Claims
- $8,336,635.74

Dr. Monica Farris
University of New Orleans
E-65
Step 1

Step 2

- Identifying Agencies/Organizations
- Making Contact
  - Floodplain Manager
  - Permits
  - Stormwater Manager
  - Levee District/flood control
  - Engineers

Step 3 – Field Data

<table>
<thead>
<tr>
<th>Structure</th>
<th>Building use</th>
<th>Neighborhood</th>
<th>Occupied?</th>
<th>EC Diagram</th>
<th># of Stories</th>
<th>Elevated above grade</th>
<th>Elevated above street</th>
<th>Structure type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexander Arabi Area</td>
<td>yes</td>
<td>8</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>adequate vents, foundation, HVAC, retrofit</td>
</tr>
<tr>
<td>Alexander Arabi Area</td>
<td>yes</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Masonry only 2 vents visible</td>
</tr>
<tr>
<td>Alexander Arabi Area</td>
<td>yes</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>red barn</td>
</tr>
<tr>
<td>Alexander Arabi Area</td>
<td>yes</td>
<td>1A</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Masonry tan brick, blue trim</td>
</tr>
<tr>
<td>Alexander Arabi Area</td>
<td>yes</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 blue house four bushy columns</td>
</tr>
<tr>
<td>Alexander Arabi Area</td>
<td>yes</td>
<td>8</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>pale yellow brick steps ?</td>
</tr>
<tr>
<td>Alexander Arabi Area</td>
<td>yes</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>raised AC green house wood door</td>
</tr>
<tr>
<td>Alexander Arabi Area</td>
<td>yes</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>green closed shutters, big wreath</td>
</tr>
</tbody>
</table>

Step 4 – Review Mitigation Measures

- Acquisition
- Elevation
- Barriers to floodwaters
- Dry Floodproofing
- Wet Floodproofing
- Utility Improvements
- Maintaining Flood Insurance

Step 5 – Document Findings

- Summary of process
- Problem statement and map
- Building information
- Mitigation options reviewed
- Action Items
What is the CRS?

- Voluntary Program
- Provides incentives for going beyond minimum NFIP requirements
- Administered for FEMA by the ISO since 1991

CRS Rating Scale

<table>
<thead>
<tr>
<th>Class</th>
<th>Points</th>
<th>SFHA</th>
<th>Non-SFHA</th>
<th>PRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4,500</td>
<td>45%</td>
<td>10%</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>4,000</td>
<td>40%</td>
<td>10%</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>3,500</td>
<td>35%</td>
<td>10%</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3,000</td>
<td>30%</td>
<td>10%</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>2,500</td>
<td>25%</td>
<td>10%</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>2,000</td>
<td>20%</td>
<td>10%</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>1,500</td>
<td>15%</td>
<td>5%</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>1,000</td>
<td>10%</td>
<td>5%</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>500</td>
<td>5%</td>
<td>5%</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>&lt; 500</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

CRS Communities in Louisiana

- 42 Communities
  - Policies in Force: 391,362
  - Premiums $284,871,427
  - Savings: $35,071,512
CRAFT

- Ascension Parish (8)
- East Baton Rouge Parish (6)
- West Baton Rouge Parish (8)
- City of Denham Springs (8)
- City of Walker (8)
- City of Gonzales (8)
- City of Zachary (7)
- City of Central (8)

FLOAT

- City of Mandeville (7)
- Orleans Parish (8)
- St. Bernard Parish (*Not yet in CRS*)
- St. John the Baptist Parish (8)
- St. Tammany Parish (7)
- City of Covington (*Not yet in CRS*)
- City of Slidell (8)
- Tangipahoa Parish (9)
- Terrebonne Parish (6)

Jefferson Parish

- Jefferson Parish (6)
- City of Gretna (8)
- City of Westwego (8)
- Town of Jean Lafitte (*Not yet in CRS*)
- City of Kenner (7)
- City of Harahan (8)
- City of Grand Isle (*Not yet in CRS*)

SWIFT

- Calcasieu Parish (8)
- Cameron Parish (*Not yet in CRS*)
- Vermilion Parish (*Not yet in CRS*)
- City of Lake Charles (8)
- City of Sulphur (*Not yet in CRS*)
- Town of Iowa (*Not yet in CRS*)
- City of Abbeville (*Not yet in CRS*)
- Iberia Parish (*Not yet in CRS*)

Benefits of a CRS Users Group

- Share information
- ISO
- CECs for CFMs
- Joint projects
- Attract new communities
- Provide feedback on CRS

For more information
www.fema.gov
http://crsresources.org/
Questions?

Thank you.

Contact Information

- Monica Farris – mateets@uno.edu
- Tara Lambeth – tlambet1@uno.edu
- Online Resources – www.uno.edu/chart
- Follow UNO-CHART

LSU-SDMI

New Orleans-Gothenburg Exchange

July 2015

Dr. Monica Farris

University of New Orleans
Resilience and Vulnerable Populations
John L. Renne, Ph.D., AICP
Associate Provost, Director and Associate Professor
University of New Orleans
Senior Visiting Research Associate
Transport Studies Unit, School of Geography and the Environment
University of Oxford

Disasters Don’t Care About Silos
They Also Don’t Care About Political Boundaries

Why Transportation Planners Should Plan for Disasters
From 1989 – 2009, 953 disasters killed 88,671 people in Europe, affected more than 29 million others and caused a total of $269 billion (USD) in economic losses. Compared to the rest of the world, economic loss per capita is high in Europe partly because it is very densely populated.

–United Nations

### CARLESS & VULNERABLE POPULATIONS

From 1989 – 2009, 953 disasters killed 88,671 people in Europe, affected more than 29 million others and caused a total of $269 billion (USD) in economic losses. Compared to the rest of the world, economic loss per capita is high in Europe partly because it is very densely populated.

–United Nations

### Single Jurisdiction vs. Multiple Jurisdictions

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>Local emergency planning and response; low level of planning and response complexity. Example: Localized flooding evacuation using only automobiles.</td>
</tr>
<tr>
<td>Multiple</td>
<td>Regional emergency planning and response; moderate level of planning and response complexity. Example: Large-scale hurricane evacuation using only automobiles.</td>
</tr>
</tbody>
</table>

From 1989 – 2009, 953 disasters killed 88,671 people in Europe, affected more than 29 million others and caused a total of $269 billion (USD) in economic losses. Compared to the rest of the world, economic loss per capita is high in Europe partly because it is very densely populated.

–United Nations
Evacuation accessibility is mandated under the Americans with Disabilities Act.

Executive Order 13347 in 2004 requires federal agencies to address the needs of the disabled in their emergency preparedness plans and assist state, local, and tribal governments in doing the same. It also created the Interagency Coordinating Council on Emergency Preparedness and Individuals with Disabilities, and charged it with “ensuring that the Federal government appropriately supports safety and security for individuals with disabilities in situations involving disasters.”

Growing Trend of Elderly Populations

<table>
<thead>
<tr>
<th>Year</th>
<th>Persons 65+</th>
<th>Percentage of Americans</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>39.6 million</td>
<td>12.9%</td>
</tr>
<tr>
<td>2030</td>
<td>72.1 million</td>
<td>19%</td>
</tr>
</tbody>
</table>

Source: [CDC](http://www.cdc.gov/aging/emergency/planning_tools/index.htm)
Chapter on Evacuation Planning for Vulnerable Populations: Lessons from the New Orleans City Assisted Evacuation Plan

New Orleans

- New Orleans Office of Homeland Security and Public Safety
- New Orleans Office of Emergency Preparedness
- New Orleans Police Department (NOPD)
- New Orleans Fire Department (NOFD)
- New Orleans Mayor’s Office of Technology (MOT)
- New Orleans Health Department (NOHD)
- New Orleans Council on Aging (NOCA)
- Jefferson Parish (JP)
- Plaquemines Parish (PP)
- Port Authority Harbor Police
- St. Bernard Parish (SBP)
- Louisiana Office of Homeland Security and Emergency Preparedness (LOHSEP)
- Louisiana Department of Transportation and Development (LOTD)
- Louisiana Department of Social Services (LDSS)
- Louisiana Department of Health and Hospitals (LDHH)
- Louisiana National Guard (LNG)
- Louisiana State Police (LSP)
- AMTRAK
- Union Passenger Terminal (UPT)
- Lakefront Airport (LA)
- Regional Transit Authority (RTA)
- Louisiana Society for the Prevention of Cruelty to Animals (SPCA)
- American Red Cross (ARC)
- Citizens Emergency Response Team (CERT)

New Orleans

For those that were registered for CAEP:

Would you use CAEP again?

Source: Kiefer, Jenkins and Laska, 2009
The objective of this study was to research how state Departments of Transportation (DOTs), metropolitan planning organizations (MPOs), transit agencies, and local governments are considering, in the context of their emergency preparedness planning, the unique needs of carless individuals and people with specific and/or special needs.

National Study on Carless and Special Needs Evacuation Planning

1. Chicago
2. Miami
3. New Orleans
4. New York
5. San Francisco

Purpose and Overview

Purpose
The purpose of Mobilizing Your Community for Emergency Evacuation: Vulnerable Populations Guidebook provides background on planning issues. The guidebooks follow the general outline provided in the guidebook with sections on:

- Planning Process
- Plan-Making
- Process Evaluation
- Recommendations
CREATING A PLANNING PROCESS FOR SPECIAL NEEDS AND CARLESS POPULATIONS

Creating a Planning Process

- Partners and Roles
  - Counties, Local Utilities, Municipalities, Transit Agencies, MPOs, State Agencies, Emergency Management Agencies, Special Needs Providers, Private Bus Companies, Community Emergency Response Teams (CERTs), Community Transportation Providers, Non-English Speaking Community Leaders, Area Agency on Aging, Other Advocates
Planning for Recovery

- The Urban Land Institute Plan – November 2005
- FEMA’s ESF 14: Long-term Recovery Planning
- Louisiana Recovery Authority
- The Bring New Orleans Back Commission
- The New Orleans City Planning Commission
- The Lambert Plans
- The Unified New Orleans Plan
- Office of Recovery Management – Ed Blakely
- New Orleans Master Plan for the 21st Century

Unified New Orleans Plan

Implementation

UNOP DISTRICT

UNOP DISTRICT and NEIGHBORHOOD PLANNING

Recovery Czar

On Jan. 8, 2007, Dr. Ed Blakely appointed Director of the Office of Recovery Management

Recovery Strategy:
1. Healing and consultation
2. Improving safety and security
3. 21st century infrastructure reconfiguration
4. Economic diversification
5. Develop a sustainable settlement pattern
To put this in the context of the Deepwater Horizon disaster, imagine that seventy percent of the 68,000 square miles of oil that was floating in the Gulf of Mexico was destined to be consumed by America’s transportation sector. The area covered by the oil intended for the transportation sector would cover an area slightly larger than the entire state of Pennsylvania (47,600 square miles). Perhaps more shocking is that despite the massive amount of oil spilled in Gulf of Mexico, the quantity used just by the transportation sector would be consumed in just under 3 days.
“By 2012, New Orleans had less than half the amount of transit service that was available pre-Katrina – while our population had rebounded to 86% of its pre-Katrina size.”
Thank You

Contact Information:
John L. Renne, Ph.D., AICP
jrenne@uno.edu
(504) 717-1744
Flood control, risk reduction and preparedness 10 years after Katrina

John H Pardue
Louisiana State University

- Conducted early environmental sampling of Katrina floodwaters/sediments
- Air sampling adjacent to debris piles
- Analysis of debris handling procedures and techniques
- Analysis and prediction of bulk chemical storage problems during flooding events

Where are we?

- Flood control and surge attenuation
  - Structural elements (Greater New Orleans Hurricane and Storm Damage Risk Reduction System)
  - Non-structural elements (Louisiana Coastal Master Plan 2012)
- Environmental Risk
  - Debris removal, landfills and contaminated soil

Total cost: $14.6 billion

IHNC Surge Barrier
The criteria for commencing IHNC gate closure operations are:

1. Water elevations of 3 ft or greater in Lake Borgne
2. A storm is predicted to make landfall in the 'area' within three days

The general procedure is as follows:

- Closure of the Seabrook Gate by USACE, approximately 20 min;
- Closure of the Bayou Bienvenue Gate by USACE, approximately 20 min
- Closure of the GIWW Sector Gate by USACE, approximately 2 hours for sector gate and 7 hours for barge gate.
- Closure of the IHNC Navigation Lock by USACE.

Storm occurs

- GIWW Sector gate opened first (when maximum water elevation differential is ~3 ft) by USACE, approximately 2 hrs.
- Bayou Bienvenue Gate is opened by USACE, approximately 2 hrs.
- Once Lake Pontchartrain has drained, Seabrook Gate opened by USACE, approximately 2 hrs.

Total cost: 14.6 billion

Dr. John Pardue
Louisiana State University
July 2015
How do you build a system in 5 years?

- NEPA (allowed USACE to to break up comprehensive Environmental Impact Statements (EISs) into smaller units of assessment)
- Contracts (Design-build; early contractor involvement)
- Non-traditional techniques (deep soil mixing, wick drains)

NEPA

- National Environmental Policy Act
  - Establishes environmental review processes that apply to governmental actions
  - Seek reasonable alternatives to actions that harm the environment
  - An Environmental Impact Statement is prepared, public comment and review, followed by review by the Environmental Protection Agency
  - Very long process

NEPA (alternative arrangement)

- In an emergency, an alternative arrangement is possible for compliance with NEPA
  - Implemented in consultation with the Council on Environmental Quality, state and federal resource agencies
  - Breaks impact studies up into smaller pieces directed at each individual action
  - Still substantial alternatives discussed and mitigation efforts, still a significant public comment period

Coastal Land Loss

Over 2300 square miles lost since 1930
DeWitt Braud, LSU Coastal Studies Institute

Landsat TM 1998

Terrebonne Land/Water Change 1988-2005

Dulac
Chauvin
Kerri Bays
Cocodrie
Point Barre

50 million dollar—estimated costs of all projects

Caminada Headland Beach (Fourchon Beach and Elmer’s Island)

5.1 million cubic yards for the beach/dune
5.36 million cubic yards for the marsh
Data and knowledge gaps

- How do structural and non-structural flood control/surge attenuation work together as a system to minimize damage?
- How do non-structural elements of the system mitigate surge?
- How resilient are the non-structural elements after storm impacts?

Depth-dependent roughness

- Cypress-tupelo and bottomland hardwood forest dominated by vegetation that is on the scale of relevant surges, marshes by vegetation much shorter than relevant storm surges

Debris Handling System

- Housing contents to curbside by resident
- Environmental and disposal teams circulate through neighborhoods and remove visible wastes targeted for segregation
- Remaining debris to C&D landfill
- Staging area followed by proper disposal
  - [14.3 M lbs HHW 794,891 White goods 5 M orphan containers 940,000 e-waste]
- Inspection at tower and by spotters assigned to landfill face
- Disposal

Analysis and critique of Katrina debris-handling system

- No diversion of arsenic-treated lumber
  - Potential impacts: arsenic contamination of groundwater
  - LWRRI White Paper “Anticipating environmental problems in landfills in New Orleans East”
  - Quantities of Arsenic-Treated Wood in Demolition Debris Generated by Hurricane Katrina; B. Dubey, H. M. Solo-Gabriele, and Timothy G. Townsend; Environ. Sci. Technol.; 2007; 41(5) pp 1533 – 1536
- No diversion of wallboard
  - Potential impacts: generation of H2S in landfill
  - SWANA analysis of Katrina debris plan (2005)
  - LWRRI White Paper

Dr. John Pardue
Louisiana State University
Analysis and critique of Katrina debris handling system

- Inefficient household hazardous waste diversion
  - Potential impacts: contamination of groundwater by HHW
  - LWRRI White Paper “Anticipating environmental problems in landfills in New Orleans East”
  - LSU pile sampling and air sampling

- Utilization of C&D landfills for disposal
  - Potential impacts: groundwater contamination
  - NISTAC (FEMA) Draft Report, 2006
  - Criticized by a very wide range of constituencies

New Gentilly Monitoring Well Data

- Maximum metal concentrations:
  - As: 1.4 mg/L
  - Zn: 6,850 mg/L
  - Ni: 0.97 mg/L

“Old Gentilly Landfill Not the Disaster Once Feared” 2012

- Limited sampling for limited set of analytes
- No air sampling for H₂S (of primary concern due to deposition of very large volumes of gypsum wallboard)
- Nearly zero information to inform future events (Joplin tornado using very similar debris handling methodology)

Soil contamination issues continue

- Lead, PAH contamination remain extremely common
- Katrina dropped blood lead levels in children (Mielke, ES&T) presumably due to a fresh layer of soil covering
- Very large soil removal action underway at B.F. Cooper housing development

Questions??
Critical Infrastructure Resilience

John Pardue, Ph.D., P.E.
Hazardous Substance Research Center
Louisiana State University
jpardue@lsu.edu

Network Model of Gulf of Mexico Crude Oil Production

Network Model of Bay Area Transit System

Severe storms and bulk chemical storage

John H Pardue, LSU

\[
\text{criticalNodes} = \frac{n}{r} \\
\text{criticalLinks} = n - \frac{2n}{l}
\]
Outline

• Katrina chemical spills
• Mechanisms of hurricane-induced spills
• Hurricane Isaac and Stolthaven
• Possible solutions
Outline

- Katrina spills
- Mechanisms of hurricane-induced spills
- Hurricane Isaac and Stolthaven
- Possible solutions

Secondary Containment Regulations

- Designed or operated to contain 100% of the capacity of the largest tank within its boundary.
- Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient excess capacity to contain run-on or infiltration. Such additional capacity must be sufficient to contain precipitation from a 25-year, 24-hour rainfall event.
- Free of cracks or gaps.
- Designed and installed to surround the tank completely and to cover all surroundings likely to come into contact with the waste if the waste is released from the tank(s) (i.e., capable of preventing lateral as well as vertical migration of the waste)

Meraux Oil Spill (Murphy Refinery, 2005)
Outline

- Katrina spills
- Mechanisms of hurricane-induced spills
- Hurricane Isaac and Stolthaven
- Possible solutions
• 68 storage tanks were in service on the terminal before the storm.

• 14 tanks and piping systems were damaged.

• Several of the tanks have lost product. The containment system around the tanks captured much of this and protective booms were placed around the tanks and the entire terminal to collect any spilled product and keep it contained within the terminal.

• 142 railcars were derailed by the storm. All of those rail cars have been re-railed, and are being inspected and repaired.
Outline

- Katrina spills
- Mechanisms of hurricane-induced spills
- Hurricane Isaac and Stolthaven
- Possible solutions

Possible solutions

- Determine worst case scenarios and educate first responders
- Develop structural solutions to common failure mechanisms
- Improve reporting and assessment post-spill

\[ N_{A0} = k\frac{P_{\text{wax}}}{R \cdot T} \cdot x_s \cdot \exp(-K_{\text{wax}} \cdot t) \]

\[ C_{A,\text{air}} = 27 \cdot \frac{N_{A0}}{V_{10}} \]

Table 2.5. Time for total evaporation of gasoline (minutes).

<table>
<thead>
<tr>
<th>Slick Height (mm)</th>
<th>0.1</th>
<th>0.25</th>
<th>0.5</th>
<th>1.0</th>
<th>1.5</th>
<th>2.0</th>
<th>5.0</th>
<th>10.0</th>
<th>20.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18.3</td>
<td>17.4</td>
<td>16.3</td>
<td>14.0</td>
<td>12.4</td>
<td>11.2</td>
<td>7.2</td>
<td>5.2</td>
<td>3.2</td>
</tr>
<tr>
<td>2</td>
<td>38.9</td>
<td>34.1</td>
<td>31.5</td>
<td>27.3</td>
<td>24.1</td>
<td>21.6</td>
<td>13.4</td>
<td>8.5</td>
<td>5.4</td>
</tr>
<tr>
<td>3</td>
<td>57.5</td>
<td>50.8</td>
<td>46.9</td>
<td>40.5</td>
<td>35.8</td>
<td>32.0</td>
<td>19.7</td>
<td>12.3</td>
<td>7.3</td>
</tr>
<tr>
<td>4</td>
<td>71.2</td>
<td>67.5</td>
<td>62.2</td>
<td>53.3</td>
<td>47.4</td>
<td>42.4</td>
<td>26.1</td>
<td>16.1</td>
<td>9.3</td>
</tr>
<tr>
<td>5</td>
<td>88.8</td>
<td>84.2</td>
<td>77.6</td>
<td>67.1</td>
<td>59.1</td>
<td>52.9</td>
<td>32.4</td>
<td>19.9</td>
<td>11.3</td>
</tr>
</tbody>
</table>
Possible solutions

- Determine worst case scenarios and educate first responders
- Develop structural solutions to common failure mechanisms
- Improve reporting and assessment post-spill

Questions?
Governor’s Office of Homeland and Emergency Preparedness (GOHSEP)

Recovery Funding Overview
Casey Tingle, Assistant Deputy Director
February 2015

Recovery Framework
- Recovery is complicated and collaborative
- Federal government is trying to establish a more structured and multi-layered
- Various Recovery Support Functions assigned to different agencies
- Link: https://www.fema.gov/national-disaster-recovery-framework

Mission
To lead + support Louisiana and its citizens in the preparation for, response to + recovery from all emergencies + disasters.

Emergency Management Cycle
- Preparedness
  Emergency managers develop plans of action to manage & counter their risks & take action to build the necessary capabilities needed to implement such plans
- Prevention
  Prevention happens when property and lives are protected by those that identify, deter or stop an incident from occurring
- Response
  Response includes the mobilization of necessary emergency services & first responders in the disaster area
- Recovery
  Recovery efforts are primarily concerned with actions that involve rebuilding destroyed property, re-employment & the repair of other essential infrastructure
- Mitigation
  Mitigation efforts are attempts to prevent hazards from developing into disasters or to reduce the effects of disasters

Risk
- Louisiana is a high-risk State for emergency events + disasters.
Risk (Continued . . .)

✓ We are home to critical supply routes + energy production resources.

What do we do?

✓ GOHSEP is the lead agency coordinating with the Federal Emergency Management Agency (FEMA) in two critical areas:
  • Public Assistance Grant Program
  • Hazard Mitigation Grant Program

Public Assistance Grant Program

Supplemental grant assistance for disasters declared by the President for:

✓ Debris Removal
✓ Emergency Protective Measures
✓ Repair/Replacement/Restoration of disaster-damaged, publicly owned facilities

Hazard mitigation defined

Hazard Mitigation (HM) is any sustained action taken to reduce or eliminate future risk to people and property from natural and man-made disasters.

Mitigation is breaking the cycle of disaster –
damage – reconstruction – repeated damage.
Hazard Mitigation Planning + Your Community

A Hazard Mitigation Plan (HMP) is required to receive FEMA hazard mitigation funding.

Risk Assessment: Identify Hazards

✓ Describe all natural hazards that effect the jurisdictions in the planning area.

- Flood
- Hurricane
- Tornado
- Winter storm
- Thunderstorms
- Coastal land loss
- Storm surge
- Subsidence
- Wildfire
- Dam failure
- Levee failure

Determine vulnerability + impact

✓ Vulnerability
  ▪ Demonstrated through past occurrences.
  ▪ Characteristics of the community’s assets that make jurisdictions susceptible to damage.

✓ Impact
  ▪ Consequences or effects of past occurrences on the community assets.

Mitigation Strategy

Blueprint for mitigation disaster losses

✓ State goals:
  ▪ Improve education + outreach efforts.
  ▪ Improve data collection . . .

✓ Possible actions:
  ▪ HM workshops.
  ▪ Mitigation projects.
  ▪ Other . . .

✓ Prioritize actions to guide how you implement funding.

Cost Effectiveness Requirement

Demonstrate cost-effectiveness.

  ▪ Must be cost-effective + substantially reduce the risk of future damage, hardship, loss or suffering resulting from a major disaster.
  ▪ Should be demonstrated by performing a Benefit Cost Analysis - BCA.

Examples of eligible activities
Prepare + Prevent + Respond + Recover + Mitigate

Elevated dwelling

Acquisition of flood-prone property

Before After

Storm water management
Culvert upgrade

Retrofit (Shutter protection)

Safe room - Community

Louisiana open disasters

<table>
<thead>
<tr>
<th>DISASTER</th>
<th>PUBLIC ASSISTANCE (PA) TOTAL ELIGIBLE DAMAGES</th>
<th>HAZARD MITIGATION (HM) LOCK-IN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricane Katrina</td>
<td>$11,465,229,557</td>
<td>$1,722,818,666</td>
</tr>
<tr>
<td>Hurricane Gustav</td>
<td>$773,747,138</td>
<td>$225,071,189</td>
</tr>
<tr>
<td>Hurricane Rita</td>
<td>$666,433,725</td>
<td>$137,903,000</td>
</tr>
<tr>
<td>Hurricane Isaac</td>
<td>$411,610,083</td>
<td>$66,975,168</td>
</tr>
<tr>
<td>Hurricane Ike</td>
<td>$384,423,454</td>
<td>$84,014,258</td>
</tr>
<tr>
<td>2011 Floods</td>
<td>$47,992,762</td>
<td>$2,026,125</td>
</tr>
<tr>
<td>2006 Floods</td>
<td>$12,948,427</td>
<td>$0</td>
</tr>
<tr>
<td>2009 Floods</td>
<td>$8,652,405</td>
<td>$895,384</td>
</tr>
<tr>
<td>Tropical Storm Lee</td>
<td>$7,816,226</td>
<td>$900,000</td>
</tr>
<tr>
<td>2013 Floods</td>
<td>$4,456,613</td>
<td>$456,668</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$13,663,310,390</td>
<td>$2,211,060,458</td>
</tr>
</tbody>
</table>

NOTE: Three (3) are on FEMA's Top 10 U.S. Disaster list: Katrina, Rita and Ike.

### By the numbers

<table>
<thead>
<tr>
<th>PUBLIC ASSISTANCE (PA)</th>
<th>HAZARD MITIGATION (HM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,586 obligations</td>
<td>120 unique Subgrantees</td>
</tr>
<tr>
<td>35,860 projects</td>
<td>848 projects</td>
</tr>
<tr>
<td>Over $13.6 billion Federal funds</td>
<td>Over $2.2 billion Federal funds</td>
</tr>
<tr>
<td>Average $1 billion per year or nearly $100 million per month</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** [www.louisianaPA.com](http://www.louisianaPA.com) and [www.louisianaHM.com](http://www.louisianaHM.com), dated 1/16/15.

### Recovery Slowdowns

- **Complexity – processes**
- **Capacity - volume**
- **Speed - risk**
SDMI Overview for Swedish Delegation

25 February 2015

LSU Research

- Home of more than 120 research centers, institutes, labs and programs
- Each year, LSU conducts more than 2,500 sponsored research projects funded by more than $140 million in external grants from sources including:
  - National Science Foundation
  - National Institute of Health
  - NASA
  - National Endowment for the Humanities
  - Department of Homeland Security

Louisiana State University

- Ranked in the first tier for Best National Universities
  - U.S. News and World Report
- One of the Nation’s Top 25 Most Popular Universities
  - U.S. News and World Report
- Land-grant, sea-grant, and space-grant status
- LSU’s recognized leadership during Katrina and BP Oil Spill
**Mission**

- The mission of the Stephenson Disaster Management Institute is to save the lives of people and animals by continuously improving disaster management through thought leadership, applied research, and executive education.

**Goals**

- Bring business principles and research to bear on disasters
- Produce applied research and disseminate best practices to the business and practitioner communities
- Build partnerships between academic scholars, emergency management practitioners, and the private sector

---

**SDMI Bench of Experts**

<table>
<thead>
<tr>
<th>Staff</th>
<th>Research Affiliates</th>
<th>Senior Fellows</th>
<th>WAEs</th>
<th>Consultants</th>
<th>PhDs</th>
<th>Board of Experts</th>
<th>LSU (Add Comp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>1 PAMCA</td>
<td>&gt;7</td>
<td>24</td>
<td>6</td>
<td>5</td>
<td>1+</td>
<td>1</td>
</tr>
</tbody>
</table>

**Full-Time Staff**

- Retired LTC, Deputy Superintendent of LSP
- 2 Former Deputy Director of GOHSEP
- 2 Former Chairman of SIEC
- 1 Member of FEMA’s NAC
- 3 U.S. Army Reserve LTCs
- 2 w/Top Secret Security Clearance
- 1 w/Secret Security Clearance
- 3 PhD Candidates
- 1 JD
- 9 Masters Degrees
- Red Cross Board Member
- 1 Master Exercise Practitioner
- 1 CISSP
- 2 GISP / 9 GIS Technicians

**Board of Experts**

- 2 Harvard MBAs
- 1 Retired LTG of U.S. Army
- 1 Retired CAPT, USCG
- 1 Current Director of GOHSEP
- 1 Former Directors of GOHSEP
- 1 FEMA Technical Hazards Director
- 3 Chief Executive Officers

---

**LSU-SDMI**

**New Orleans-Gothenburg Exchange**

**July 2015**
SDMI’s Center for Business Preparedness

- **GOALS**
  - Bridge the gap between academic research, business preparedness, and continuity of operations
  - Apply proven business management techniques to the challenge of disaster preparedness and community resilience
  - Create a cultural shift in the value of preparedness by creating a central point of collaboration for:
    - Enhance and evolve private sector resilience
    - Research
    - Knowledge sharing
    - Outreach
  - Global collaboration with academic institutions, private sector organizations, public entities:
    - Connect, collaborate, and share smart practices
    - Gain insight, knowledge, and support
    - Serve as a source for the latest tools and research

---

**GOHSEP / SDMI Small Business Initiative**

**Does your business have a written emergency response plan?**

<table>
<thead>
<tr>
<th>Number of Respondents</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>45%</td>
<td>55%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

7/22/2015

**GOHSEP / SDMI Small Business Initiative**

**Were your normal operations interrupted following Hurricane Katrina/Gustav?**

<table>
<thead>
<tr>
<th>Number of Respondents</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>85%</td>
<td>15%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

7/22/2015

**GOHSEP / SDMI Small Business Initiative**

**For how many days did Hurricane Katrina/Gustav disrupt normal operations?**

<table>
<thead>
<tr>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1 to 3 days</th>
<th>4 to 7 days</th>
<th>1 to 2 weeks</th>
<th>2 to 4 weeks</th>
<th>More than 4 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>18%</td>
<td>20%</td>
<td>6%</td>
<td>17%</td>
<td>37%</td>
</tr>
</tbody>
</table>

7/22/2015

**GOHSEP / SDMI Small Business Initiative**

**Did your business make any changes following Hurricane Katrina/Gustav to become better prepared for future disasters?**

<table>
<thead>
<tr>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>55%</td>
<td>45%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

7/22/2015

---

Mr. Brant Mitchell
Louisiana State University
E-104
Did these changes reduce Hurricane Isaac’s impact on your business?

![Bar graph showing the number of respondents.]

**Expanding Domestic Applications**
- Partnered with LSU Civil Engineering and UNO to sponsor the National Evacuation Conference
- Participated in a New York City Evacuation Planning Meeting with LSU Civil Engineering and UNO
- Working with the National Emergency Management Association to conduct a study on state to state support for private sector resources and volunteer organizations
- Participating with FEMA on a Hurricane Evacuation Study for Southeast Louisiana

**International Influence**
- Working with the Japanese Consulate
- Hosting a Swedish Delegation on Resiliency
- Collaborating with UN on R!SE
- Invited to Speak at the Following Conferences:
  - Australian Association of Professional Communication Officials
  - Melbourne Fire Brigade
  - Keynote for 13th Annual Emergency Management Conference
- Conducted a Webinar for PASIA following Typhoon Haiyan
- Hosting Latin American University Delegation for USAID

**SDMI Disaster Lab & Research**
Research, simulation, and training facility for the state and the nation’s efforts of advancing crisis leadership education for emergency managers and the private sector.

**Current / Previous SDMI Projects**
- State Homeland Security Strategy
- Capitol Emergency Response Plan
- Capitol Continuity of Operations Plan
- 9-1-1 Mapping
- Critical Infrastructure Mapping
- Small Business Disaster Preparedness Initiative
- Shell Oil Company Oil Response Outreach Initiative
- State Exercise and Training Program
- Cyber Security Initiative
- Consequence Modeling for Storm Surge

**SDMI GIS Based Projects**
GIS Emphasis on
- Vector Data
- Raster Data
- Data for the Public
- Data for Emergencies

Mapping 9-1-1 for Rural Parishes
Mapping the State’s CI/KR
SDMI School Safety Program
Joint CyberSecurity and Training Lab (JCTL)

- Developed in partnership with the Louisiana National Guard
- Objectives
  - Objective 1 – Provide capabilities for LANG CPT to train/validate METL
  - Objective 2 – Establish an controlled environment to train/validate CND, IA, exploitation and attack cyber events
  - Objective 3 – Conduct CIKR Incident Response Exercises
  - Objective 4 – Develop CIKR and Industry Specific Cybersecurity and Standards and Certification Coursework
  - Objective 5 – Research, Testing and Evaluation of New Cyber Capabilities
- The JCTL will also be integrating Industrial Control System environments
  - Partnership with FBI and Louisiana State Analytical and Fusion Exchange (LA-SAFE)

Capabilities
- Train as We Fight – Simulated operational networks to safely test capabilities
- Closed network to allow real force on force attacks in a controlled environment
- Immersive training, tactics, techniques and procedures development and validation
- Tier I through Tier III environment for simulation and modeling
- LANG CPT Mobile Response Cart

Mr. Brant Mitchell
Louisiana State University
Appendix F: New Orleans Delegation to Gothenburg

Mr. Bradford Case, Director of Hazard Mitigation, City of New Orleans

The City’s Hazard Mitigation Office was created in 2006 in the aftermath of Hurricanes Katrina and Rita in order to guide the City in its new philosophy of building a resilient future. Brad has been with the City of New Orleans since 2008 and has been in his current position since 2009. As one of the two branches of the Office of Homeland Security and Emergency Preparedness, Mr. Case is responsible for leading the planning process to formulate the City’s policies toward reduction of risk from natural and manmade hazards and for implementation of these policies throughout the city.

Past efforts of the mitigation office have resulted in numerous major changes in how the City recovers from Hurricane Katrina while avoiding similar disasters, as well as how the City develops for its future in a changing risk environment. One example of a change spearheaded by the office has been establishing a permanent internal capacity to develop projects and initiatives for the changing risk environment. This included increasing floodplain managers on staff from zero to over ten and establishing a dedicated office for floodplain administration, which is now responsible for maintaining the City’s participation in the NFIP. Current initiatives include continued administration of hundreds of millions of dollars in FEMA mitigation grant programs. These programs include risk reduction measures for infrastructure and private property as well as outreach projects to advance of the awareness of mitigation concepts and practices for communities, businesses, and individuals. The mitigation office has sought since its inception to adapt the external public conversation and internal bureaucratic processes from a reactionary, wait-and-see approach relying purely on response to a proactive and innovative culture of resilience.

Mr. William Gilchrist, Head of Place-based Planning, City of New Orleans
William Gilchrist is Director of Place-Based Planning for the City of New Orleans overseeing the administration’s initiatives in planning and urban design. Prior to this appointment, he directed the urban design studio in the Atlanta office of EDAW/AECOM, having served previously as the Director of the Department of Planning, Engineering, and Permits for Birmingham, AL, where the work of his department was recognized by the American Institute of Architects (AIA), the American Planning Association (APA), and the National League of Cities. He has developed local community plans throughout the US, taught the APA course on urban design for AICP continuing education, and worked internationally in establishing planning processes in Romania and Ukraine.

He has served on advisory committees to MIT, Carnegie Mellon University, and Auburn University. An advocate for the quality of the public realm, he is a former member of the board of the National Association of Olmsted Parks. Bill served on the Executive Committee of the Urban Land Institute, and chaired ULI’s Public/Private Partnership Council. He is a member of the College of Fellows of the American Institute of Architects and was first Chair of the AIA Committee on Design Assistance overseeing the AIA Regional/Urban Design Assistance Team (R/UDAT) and Sustainable Design Assessment Team. He is an alumnus of MIT’s School of Architecture and Planning and Alfred P. Sloan School of Management, as well as Harvard University’s Kennedy School of Government.

**Ms. Kerri Kane, J.D., Representative of Council District C, New Orleans Sewerage & Water Board**

Ms. Kane was appointed by Mayor Mitchell J. Landrieu and approved by the New Orleans City Council to represent Council District C as a member of the Board of Directors of the Sewerage & Water Board of New Orleans in July 2012. She is also a board member of the Louisiana Society for the Prevention of Cruelty to Animals, serving as their vice president and legal committee chair. Kerri practices law in the areas of pharmaceutical and medical device litigation, products liability, and casualty. She also has extensive experience in complex document reviews and productions. Kerri is a member of the Louisiana Bar Association, the New Orleans Bar Association, and the Federal Bar Association. She is admitted to practice before all Louisiana state courts, the United States Court of Appeals for the Fifth Circuit, and the United States District Court for the Eastern, Middle, and Western Districts.
Kerri received a B.A. (2000) from Louisiana State University, where she majored in Political Science and Psychology. She received her J.D. (2004) from Loyola University School of Law, where she graduated cum laude. While at Loyola, Kerri worked as the Substance and Citation Editor of the Loyola Maritime Law Journal, was a member of Phi Alpha Delta Law Fraternity, and received the Civil Law Donations and Trusts Excellence Award.

Kerri was named a 2013 Woman of the Year by New Orleans CityBusiness. She was among the 50 honorees selected based on her professional and community contributions to the New Orleans area.

Dr. Michelle Meyer, Assistant Professor of Sociology, Louisiana State University

Michelle Annette Meyer is an Assistant Professor of Sociology at Louisiana State University. She is a current Fellow in the Next Generation of Hazard and Disasters Researchers Program sponsored by the National Science Foundation. Her research and teaching interests include disaster resilience and mitigation, climate change displacement, environmental sociology and community sustainability, quantitative and qualitative research methods, and the interplay between environmental conditions and social vulnerability. She has worked on a variety of projects related to disasters and environmental sociology, such as analyzing organizational networks in long-term recovery for six communities; comparing disaster recovery between small towns affected by technological and natural disasters; an electronic survey about hazard mitigation policies and practices in Atlantic and Gulf Coast jurisdictions; understanding hurricane risk perception along the U.S. Gulf and Atlantic Coasts; analyzing the inclusion of disability in emergency management planning; studying the implementation of energy efficiency practices in local communities; analyzing social capital and collective efficacy for individual and community resilience and social vulnerability in hurricane-prone communities; among others. Her research has been funded by the National Science Foundation, National PERISHIP Dissertation Fellowship, Midwest Sociological Society, and the Rural Sociological Society. She completed a Ph.D. in Sociology at Colorado State University, and a BA in Sociology from Murray State University.

Brant Mitchell, Director of Research and Operations, Stephenson Disaster Management Institute
Brant Mitchell currently serves as the Director of Research and Operations of the Stephenson Disaster Management Institute (SDMI) at Louisiana State University. Prior to joining SDMI Brant worked for the Louisiana Governor’s Office of Homeland Security and Emergency Preparedness as the Deputy Director for Management, Finance and Interoperability. From July 2008 through February 2012 Brant served as the Chairman of the Statewide Interoperability Executive Council (SIEC), which is responsible for providing governance of the Louisiana Wireless Information Network (LWIN), one of the nation’s first statewide digital 700 MHz radio systems. Today LWIN is the largest digital radio system in the country providing voice communications to over 70,000 users across the State. In 2011, Brant was selected as a member of the Federal Communications Commission’s Public Safety Advisory Committee for the Emergency Response Interoperability Committee in which he assisted in developing technical specifications for the eventual nationwide build out of a broadband network. Brant is also a Lieutenant Colonel in the U.S. Army Reserves where he is assigned to the U.S. Department of Homeland Security National Cyber and Communication Integration Center as an operations officer. He is a recipient of the Bronze Star and a veteran of Operation Iraqi Freedom where he commanded an Infantry company in Baghdad, Iraq. Brant received his Master’s in Public Administration from LSU and is currently pursuing his PhD in Geography.

**Dr. John Pardue, Director, Hazardous Substance Research Center**

Dr. John Pardue is the Elizabeth Howell Stewart Professor of Civil & Environmental Engineering at Louisiana State University. He directs the Hazardous Substance Research Center at LSU. Dr. Pardue’s research group investigates the fate and transport of chemicals in the environment focused primarily on chemicals in wetlands and aquatic systems, environmental impacts of disasters and shoreline restoration techniques. Currently he is performing research on the fate and remediation options for the Deepwater Horizon oil spill in Louisiana marshes and barrier islands. He has published over 70 peer-reviewed papers and conducted research for federal agencies such as EPA, NSF, NOAA, and DOD. His research has led to development of a number of innovative technologies including the sustainable constructed wetland approach for treating contaminated groundwater. His group published the first peer-reviewed scientific paper on Hurricane Katrina (Pardue, J.H., W.M. Moe, D. McInnis, L.J. Thibodeaux, K.T.

In addition, his research group works closely with international collaborators including the Environmental Engineering program at UCLAS at the University of Dar es Salaam in Tanzania, West Africa providing research opportunities for future faculty and working to further development of the environmental engineering in developing areas.

**Ms. Prisca Weems, Stormwater Manager, City of New Orleans**

As Stormwater Manager for the City of New Orleans, Prisca Weems holds an inter-agency role focused on co-ordinating and implementing green infrastructure and other stormwater related projects. This role includes the development of progressive policy, financing mechanisms, and partnerships to support catalytic projects across Orleans Parish. Prisca holds a MArch from Tulane University School of Architecture, an MSc in Advanced Environmental and Energy Sciences from the Centre for Alternative Technology in Wales/University of East London, and has been working in the sustainable development arena since 1997.

**Ms. Ann Wilson, Chief, Environmental Affairs, New Orleans Sewerage & Water Board**

Ms. Wilson has been employed by the Sewerage and Water Board of New Orleans since November 2012. Prior to her employment with the SWBNO, Ms. Wilson was the Superintendent of Environmental Services for the City of Alexandria for 25 years. Responsibilities with the Sewerage and Water Board include overseeing environmental compliance for the Board’s Municipal Separate Storm Sewer Permit, Pump and Power operation with Title V Air Permit, Drainage Pump Stations Emergency Engine Air Permits, East and West Bank Sewer Treatment Plants’ LPDES Permits, Pretreatment Program, Risk Management Plans for Ammonia and Chlorine storage and Underground Storage Tanks compliance.
Ms. Wilson is a graduate of Louisiana State University with a Bachelor of Science degree in Food Technology. Ann is a Class 4 Wastewater and Water Operator and Level A Solid Waste Operator in the area of incineration of biosolids.

Ms. Wilson is a former board member of Keep Louisiana Beautiful has received several national and state awards with her work with Keep America Beautiful and Keep Louisiana Beautiful, including the Mrs. Lyndon B. Johnson Award and the President Bush Volunteer Service Award. Since moving to New Orleans, Ann has become active with Keep New Orleans Beautiful.

Ms. Wilson is interested in how other communities educate and engage the public about green infrastructure and how the private and commercial customers can incorporate these concepts on their private property.

**Dr. Brian Wolshon, Director, Gulf Coast Center for Evacuation and Transportation Resiliency**

Brian Wolshon, Ph.D. P.E., PTOE, is the Edward A. and Karen Wax Schmitt Distinguished Professor of Civil Engineering at Louisiana State University and the founding Director of the Gulf Coast Research Center for Evacuation and Transportation Resiliency. His teaching and research activities encompass a range of areas related to highway design, safety, and traffic operations – most notably the planning, design, operation, and management of transportation systems for emergency and major event conditions. In 2001, Dr. Wolshon founded and has since chaired Transportation Research Board of the National Academies Task Force on Emergency Evacuation. He has authored numerous federal reports related to evacuation planning and engineering and served as an expert consultant to dozens of federal, state, and local government agencies; national laboratories; and engineering firms throughout the United States. He also been interviewed by more the 100 media outlets including *The Discovery Channel, CNN, CNBC, MSNBC, Fox News, NPR, The New York Times, USA Today,* and the *Times of London* among many others.
Appendix G: Biographies of Swedish Presenters

**Dr. Per Danielsson**, The Swedish Geotechnical Institute (SGI) is the Swedish governmental authority commissioned to have a coordinative role in reducing the risks of damage caused by erosion along the coast, along rivers and in lakes. Per Danielsson’s work as National Coordinator for Coastal Erosion is focusing on activities aiming to reduce the risk caused by erosion. He is coordinating a network of 9 governmental agencies, all with activities related to erosion along the coast, rivers and lakes. He is responsible for the Coastal meeting arranged annually by SGI, focusing on coastal erosion, coastal management, and how to handle the problems in an integrated way. He is also involved in various research projects; to develop a tool for vulnerability mapping that could be used by coastal managers, to look into possibilities to use bio-engineering for coastal and river bank protection, to use satellite images and air photos for monitoring coastal morphology and changes. Before joining SGI he has been working as a consultant within the field of integrated coastal zone planning and management, and coastal resources, with working experience from Africa, Asia and Latin America.

**Ms. Janet Edwards**, Swedish Civil Contingencies Agency (MSB), has a bachelor’s degree in geography from the University of California in Los Angeles and a master’s degree in geography from California State University. She has worked with risk management issues in Sweden since 1995. As the international coordinator for the Swedish National Platform for Disaster Risk Reduction, she promotes various types of international exchanges. She leads the UNISDR Making Cities Resilient campaign in Sweden and has experience with risk management tools and methods including geographic information systems.
Ms. Åsa Fritzon, Swedish Civil Contingencies Agency (MSB), has a master’s degree in political science and international relations from Södertörn University College. She works as a research coordinator at MSB’s Research Management Section as Program Advisor to the U.S. Department of Homeland Security (DHS) Science & Technology agreement and as expert to the Programme Committee for Secure Societies within the EU Research and Innovation programme Horizon 2020.

Dr. Hans Hansson, PhD, is full professor in Coastal Engineering at Lund University where he has been for almost 40 years. He has worked on contract for US Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS, for almost 30 years. The main focus of this work was the development of computer models for simulation of coastal erosion and flooding. He is the main developer of the GENESIS model and has also, to some extent, been involved in the SBEACH model.

On the more practical side, he has done numerous projects in most coastal municipalities in south Sweden dealing with coastal planning, protection and climate change adaptation. Many of these projects have been done as a part of his part-time employment at the consulting firm Sweco Environment, where he has been working since 1988. He has international project experience from Liberia, Mozambique, Egypt, Sri Lanka, Indonesia, Vietnam, Mauritius, Seychelles, USA, Portugal, Brazil, Italy, Spain, Japan and British Guyana.

He is author of more than 230 Technical Reports, Conference Papers, and Journal Articles. He has been invited visiting researcher/professor at: US Army Coastal Engineering Research Center (USA), Texas A & M University (USA), James Cook University (Australia), Ministry of Public Works (Australia), University of Queensland (Australia), Ministry of Public Works (Spain), Universidad de Granada (Spain).
Mr. Mikael Ivari, City of Göteborg, Traffic & Public Transportation Authority, Deputy Head of Traffic Planning Department, has a master’s degree in civil engineering from Chalmers University of Technology and exams in economics and economic statistics from Gothenburg School of Business, Economics and Law. He has more than 15 years of experience from traffic and land-use planning in a local and regional perspective.

Mr. Johan Jansson, Swedish Transport Administration, Business Area Investments has a master’s degree in Civil Engineering. His work areas include providing large reconstruction works and new investments with technical expertise on dewatering and drainage. His work involves development of the regulatory framework that governs the design of road and rail infrastructure drainage. He has great interest in rain, urban runoff, flooding, extreme weather events and drainage as well as pumping stations.

Dr. Anna Jonsson, PhD, Linköping University, is Associate Professor, Department of Environmental Change, Centre for Climate Science and Policy and Research, Linköping University. Dr. Jonsson uses qualitative social science methods to investigate institutional and social aspects of water management and climate adaptation issues in Sweden and abroad. The past 8 years she has been involved in vulnerability and adaptation research with the city of Gothenburg as the study object. She has also been part of developing a Guidebook for integrated assessment and management of vulnerability to climate change based on research in Sweden, Bolivia and India.
**Dr. Michael Landzelius**, PhD in Conservation of Built Environments, Associate Professor, and Director of the Urban Safety and Societal Security Research Center (URBSEC), Gothenburg University and Chalmers University of Technology. URBSEC offers an interface between academia and practice where needs and problems as experienced by various social actors can be transformed into research projects that involve both technological and social innovation aspects. Researchers from more than a dozen departments are involved in the four Priority Research Areas: Politics and Governance; Communication and Interaction; Infrastructures and Interdependencies; and Sustainability and Resilience. In relation to the Gothenburg-New Orleans collaboration, it might be mentioned that Critical Infrastructure Protection is one field within which the center has prioritized developing European collaboration through applications to the European Union H2020 research program. Dr. Landzelius’ research before taking on leadership for URBSEC was oriented towards Urban Geography with a focus on urban meaning-making and conflicts; he did part of his PhD-studies in Cultural Geography at University of Syracuse, and at University of California, Berkeley; and did also a Postdoc at University of Cambridge, UK. As director of URBSEC, his role is, in short, to manage the center, build networks, initiate projects, and facilitate collaboration between diverse actors.

**Dr. Bo Lind**, PhD, Associate Professor, Swedish Geotechnical Institute, is an experienced leader of expert organisations and research groups. He has worked within the field of applied geo-science in the built/developed environment since the late 1970’s. He is responsible for the national planning support to communities regarding geotechnical safety and responsible for the mapping of landslide hazards along the Göta river valley (the most landslide-frequent area in Sweden). He is also working on risk assessments and climate impact on geotechnical safety, such as landslides and severe settlements.
Mr. Ulf Moback, is a landscape architect educated at the Swedish Agricultural University in Ultuna and Alnarp. He has been employed by the City of Gothenburg (Göteborg) since 1979 first at the Park Administration where he left as head over planning and building parks and green areas in Gothenburg. 1991 he started at City Planning Authority working at first with detailed plans for the regeneration of the shipyard areas, later with the comprehensive plan for the whole of Gothenburg, ÖP 93, ÖP99 and the current comprehensive plan. Parallel with that he has been working with environment issues like methods for environmental impact studies, nature reserve, storm water treatment, polluted areas etc. During 2 years he was head of strategic planning at City Planning Authority. He has also been involved in EU projects, like Water City international, Pure North Sea and Greenscom as well as Swedish International Development Cooperation Agency (SIDA) projects in South Africa. He is also coordinator of the climate adaptation group of Gothenburg.

Within the framework of Mistra Urban Futures, he was one of the project leaders for the pilot project “A City Structure Adapted to Climate Change: Scenarios for Future Frihamnen” and involved in another research project “Adapting cities to climate induced risks – a coordinated approach”.

Dr Lars Nyberg, PhD in Hydrology, is Associate Professor in Risk Management as well as research leader at the Centre for Climate and Safety at Karlstad University (www.kau.se/ccs). In recent years his research has mainly been focused on natural disasters and climate adaptation. Special focus is on societal vulnerability and how to reduce climate-related risks. He is the leader for several projects and networks, for example as principal investigator for the Centre for Natural Disaster Science (www.cnds.se). He is also the leader for master courses on integrated flood risk management and sustainable development from a safety perspective. As the director for the Centre for Climate and Safety during 2008-2014, Lars Nyberg has initiated and actively contributed to an extensive societal collaboration. He is a member of the Scientific Council at the Swedish Civil Contingencies Agency.
Mr. Lars Westholm, County Administrative Board, Västra Götaland has a MSc in environmental science and have been working with public health and environmental protection for more than 23 years. His experience ranges from drafting policy documents, conducting inspections to environmental monitoring. As an environmental planning officer he prepares the basis for detail or comprehensive plans or setting up projects or monitoring activities. During this work he assesses and performs risk analysis concerning transports and handling of hazardous materials, risk of flooding and environmental health issues. He has also conducted studies in societal risk management and also been a CBRN expert in the national Interagency working group (Transport). As an Associated Field Officer (WASH) at the Field Office in Tyre, Lebanon, for UNHCR, he gained thorough experience in working in a refugee emergency.

As a result of his MSc in Environmental Health and his local management of a European Union project. He has participated internationally in Cyprus, Lebanon, Somalia, Liberia, Kenya and Haiti working within complex environments. He has also completed UN, EU and MSB courses related to risk management.
Appendix H: Agenda for Making Cities Resilient Exchange in Gothenburg

Gothenburg & New Orleans Making Cities Resilient Exchange
Gothenburg, Sweden
26 – 28 May 2015

Tuesday, May 26, start 9.00
Venue: Infosalen, City Planning Authority, Köpmansgatan 20

1st Block: 1.5 hour

1. Orientation about Gothenburg and the Swedish System
2. Orientation of how the city is planning to prevent damages from extreme weather events, specifically flooding.
3. Infrastructure, critical for the society and influence from extreme weather events.

Presenter: Mr. Ulf Moback, architect, City of Gothenburg Planning Office

2nd Block: 0.5 hour

1. Orientation from the municipalities’ crisis risk group

Presenter: Mr. Lennart Bernram, Protection and preparedness for the community, City of Gothenburg

3rd Block: 0.5 hour

2. Orientation to MSB and its roles and responsibilities in regards to interacting with local government and the EU

Presenters: Ms. Janet Edwards, Risk and Vulnerability Department, MSB and Ms. Åsa Fritzon, Research Department, MSB

12:15 Lunch at Opera

Field visits

1. River Room
2. Walk along riverside
3. Ferry to Lindholmen
4. Kuggen and URBSEC
5. Ferry back to the city
Wednesday, May 27, start 9.00
Venue: Sessionssalen, City Planning Authority

4th Block: 1 hour

1. Risk Management in Spatial Planning
2. Emergency Management

Presenter: Mr. Lars Westholm, Environmental Planning Officer, County Board of Administration, Västra Götaland

5th Block: 0.5 hour

1. The Challenge of Building on Soft Soils
2. Landslide Risks in the Göta River Valley in a Changing Climate

Presenter: Dr. Bo Lind, Associate Professor in geoscience, Gothenburg University and researcher at Swedish Geotechnical Institute

6th Block: 0.5 hour

1. Alternative Technical-Biological Bank Protection
2. Coastal Vulnerability Mapping

Presenter: Dr. Per Danielsson, National Coordinator for coastal erosion, Swedish Geotechnical Institute

7th Block: 0.5 hour

Water Levels in Skanör/Falsterbo - Present and Future - Impact and Measures

Presenter: Dr. Hans Hansson, Professor in coastal engineering, Lund University

Field visits

12.15 Boat trip on the river, lunch on boat

The harbor and Marieholm tunnel
After boat trip there will be visit to the county’s emergency room.

18:00 Meet in the Lobby at Royal Hotel, Drottninggatan 67. We will walk to the restaurant.

18.30 Joint dinner in the evening at Restaurant Wernerska villan, Parkgatan 25
Thursday, May 28, start 8.30
Venue: Sessionssalen, City Planning Authority

8th Block: 1.5 hour

1. Gothenburg Traffic
2. Climate Change Adaptation Strategy for Transportation Administration
3. Other Ongoing Transportation Administration Projects

Presenters: Mr. Mikael Ivari, Deputy Head of Traffic Planning Department, Traffic and Public Transportation Authority, City of Gothenburg
Mr. Johan Jansson, Business Area Investments, Swedish Transport Administration
Ms. Eva Liljegren, Infrastructure and Spatial Planning, Swedish Transport Administration

9th Block: 1 hour

1. Vulnerability and Adaption to Heat in Cities: Perspective and Perceptions of Adaptation Decision-Makers in Sweden, Local Environment
2. Long Range of Research/Projects that Ultimately led to the Guidebook for Integrated Assessment and Management of Vulnerability to Climate Change

Presenter: Dr. Anna Jonsson, Associate Professor, Dept. of Environmental Change, Centre for Climate Science, Policy and Research, Linköping University

10th Block: 0.5 hour

1. Sustainability Aspects of Water Regulation and Flood Risk Reductions in Lake Vänern

Presenter: Dr. Lars Nyberg, Karlstad University, Centre for Climate and Safety

12.15 Field visits by bus:

Lunch at Lüdöse museum
Valley Göta Älv up to the Dams of Lilla Edet (slides)
Tuve Landslide
Hökälla gård, a created wetland
Appendix I: Presentations from Gothenburg

In addition to being available in this document, all presentations can be viewed and downloaded at the following website:

http://sdmi-resilient-cities.com
Sweden

- Fifth largest country in Europe. The size of California and Oregon together
- 9,700,000 inhabitants, sparsely populated, 22 people/sq.km
- 85% in the southern half
- 21 counties and 290 municipalities

Constitutional monarchy

- King Carl XVI Gustaf
- King since 1973
- No political power
- Representative /ceremonial

Levels in the administration

City of Gothenburg – in brief

10 city district committees

Approx. 20 specialist administrations

Approx. 60 public companies

Approx. 49,000 employees

Of which 30,000 in the city district committees

34 billion SEK turnover

1,175 politicians

Approx. 1,300 – 1,400 assignments
Where does the money go?

Health, schools and social care account for 85% of the City of Gothenburg’s costs.

- Pre-schools and childcare: 16%
- Care of the elderly: 18%
- Other: 11%
- Compulsory schooling: 14%
- Upper secondary and adult education: 7%
- Culture and leisure: 4%
- Disabilities: 13%
- Individual and family care: 17%
- Care of the elderly: 14%
- Individual and family care: 17%
- Compulsory schooling: 7%
- Upper secondary and adult education: 4%
- Culture and leisure: 13%
- Disabilities: 5%

Gothenburg – an evolving city of the future

- 533,300 residents
- 1,111,000 residents in the Gothenburg labour market region today
- 10 districts
- Majorna-Linné the largest
- 23% born outside of Sweden
- 1,750,000 million residents in the Gothenburg region in 2030

A city open to the world

18th century
Built by Dutch and Germans. Developed into a shipping and trading city, partly thanks to the Swedish East India Company.

19th century
The industrial city evolves thanks to expertise from England and Scotland.

20th century
The economy grows with workers from countries like Italy, Greece, the former Yugoslavia, and Finland.

21st century
Migration from around the world and diversity among residents of Gothenburg. 7,200 new residents in 2013.

Great strengths and opportunities

- Green
- Creativity
- Entrepreneurship
- Good food
- Close
- Together
- Water
- Industry
- Entertainment
- Events

Gothenburg is growing – but the aim is to shorten distances

- New roads, bridges, cycle paths and expanded public transport will make it easier to get around in the city, both for private individuals and the business sector.
- Better public transport and new hubs will make it easy for local people to travel in a sustainable way – within the city, in the wider region and to the world beyond.
- We will continue to grow – but not at the expense of the environment.

Mr. Ulf Moback
City of Gothenburg
A close city – Gothenburg 2035

680,000 residents of Gothenburg in 2035
70–80,000 new homes, including 50,000 in the existing city, of which 25,000 in River city
80,000 more jobs of which 50,000 in River city

Source: Expansion planning 2013

River city – inclusive green dynamic

ElectriCity – a collaboration for sustainable public transport

- New bus route from 2015: noiseless, emission-free electric buses from Volvo will run between Johanneberg Science Park and Lindholmen Science Park.
- The buses can drive in places in the city that are not currently accessible – the bus route therefore also opens up new opportunities for how cities and densely-populated areas are planned.
- It is also a way for the Volvo Group to test new technology. For the City of Gothenburg it is about contributing to sustainability, and developing services that can benefit residents.

DriveMe – self-driving cars for sustainable mobility

Gothenburg is also an arena for the world’s biggest large-scale pilot project in autonomous driving. It involves 100 self-driving Volvo cars which will be driven on public roads in Gothenburg in 2017.

In addition to improving traffic safety, self-driving cars are considered an eco-friendly choice.

2021 – more than an anniversary

In 2021 Gothenburg will be 400 years old, and we are celebrating by making our city into an even better place, together. All the way up to the anniversary. And far beyond.

Close to the water
Building bridges
Open spaces

A sustainable city – open to the world
The city is expanding over low land
Future extreme weather means consequences
Hydromodel
Strategy and protection
Lack of national level

The City has expanded over wetlands

A future extreme weather event

From www.goteborg.se

Climate change Rising sea levels
- Mean water level 2100 + 0.7 m (0.98 m)
- Land rise effect about 0.3 m

RCP 8.5
- Carbon dioxide emissions three times today.
- Methane emission rises sharply
- Earth population is 12 billion
- Slow technology development
- High dependence on fossil fuels
- No additional climate policy

High water levels
- +2.4 m above today’s MW
- 200 years value 2100 according to SMHI
- +1.35 m above today’s MW

Gudrun
Water level meters

Egon

Vulnerability communication

Damage costs for traffic standing still

Expansion plans

Planning levels

Central City
Criteria for selection of protection - current planning levels

- High water +1.5 m
- Normal +0
- Marginal 0.5 m
- Climate marginal 0.5 m
- Functions important for the society

Hydro model - parts

1. Central GBG - heavy rainfall and high sea levels
2. Mölndalsån and Säveån - high water from sea and high flow
3. River side protection and local dams year 2100
4. Storm surge barriers year 2100
5. CBA

Input - data

- Bathymetric data
- Elevation data
- Pipes under the ground
- Bridges/structures in water
- Existing hydraulic models
- Land use
- Aerial photographs
- Contour of buildings
- Functions important for the society
- Damage costs

Current work

- Risk assessment for a robust society
- Tools for administration and make the hydromodel available
- Decision process
- Lobbying against the national level
- Deepend comprehensive plan on the theme water

The hydro model

- Simulates future water levels
- Flows, rainfall, high sea levels etc.
- Evaluate protection measurements
- Basis for climate adaption strategies

Heavy rain fall 500 year return time

- LSU-SDMI
- New Orleans-Gothenburg Exchange
- July 2015
High sea level, combined with high flow in the stream

Important conclusions

Storm surge barrier requires river side protection
Large utility regulation Säveån, the Göta River
Long periods of closure - requires pumping
Closing criteria controlled by frequency
Flood Level behind barrier
Pump capacity
Control Ability
Prediction Ability
Example +1.5 m
2014: 1.6 years
2100: 14 times / year

Strategy

Critical time

Mid term

Long term

Strategy mid long term

New buildings
Apply existing levels of planning
Basic principle protection through elevation
Function based approach
Deviations require risk assessment
Technical protection – possible to build 1 m higher level
Set aside land for future protection

Existing buildings
Risk assessment
Risk Picture determines the need for object protection

Principal solution for river side protection

Storm surge barrier

Mr. Ulf Moback
City of Gothenburg
**Älvsborg storm surge barrier**

- "Robust" alternative:
  - Segment gates (Thames barrier)

- "Navigational alternative:
  - Horizontal sector gates (Maeslant-barrier)

**Technical specification**

- 3 submerged segment gates
- Connecting levee between gates and pumping station
- 11 pumps 115 m long

**Second option**

- 2 sector gates
- Each gate ~ 75m long
- Total span 150 meters
- Pumping station integrated with abutment (but complex)
- Abandoned in view of cost and complex integration of pumping station
- Preferred option for maritime navigation

**Visitor centre**

- Visitors centre close to the barrier
- Example Maeslantbarriären in Netherlands

---

**Barrier Älvsborgsbron**

**Barrier Älvsborg**
Barrier Nordre Älv

Location 3 is adopted (at existing Ormoskärmen). Existing salinity control barrier can be replaced and the function taken over by the new barrier.

Locations 1 and 2 are of limited added value in view of flood protection, but are within protected habitat.

Nordre Älv

Submerged segment gate located in the river bed
Pumping station at floodplains
Levees on the floodplains

Costs million Swedish Crowns

- Älvsborgbron
  - Barrier: 1940 (1360–2920)
  - Pumping station: 1100 (775 – 1650)
- Barrier Nordre älv
  - Barrier: 790 (550 – 1190)
  - Pumping station: 1410 (990 – 2120)
- Total: 5259 (3680 – 7870)
Risks and uncertainties

- Geotechnical information is scarce, especially at Älvsborgbron (possible consequence: increased cost of foundation)
- Projections of future sea levels and discharges
- Discharge from the smaller streams
- Political decision-making process
- Permitting (especially related to environmental aspects)

Experiences from the Netherlands

- Decision-making on (large) storm surge barriers is complex
- Historic examples show decades of decision-making (several “false starts”)
- Transparency/traceability is crucial in all studies undertaken

On the national level

- Laws and regulations need to be adapted; roles and responsibilities as well as strategies and goals should be made clearer.
- There is a need to outline how the costs of adaptation should be distributed among actors and how resources for prioritized measures can be guaranteed.

No distinct flood governance policy domain on national level

Fragmented flood risk governance
Municipalities and private persons as main actors
Support from the state
Dispersed legislation
EC, PBL, LAV, LSO, LXH, etc.

Division of responsibilities between national and local level

- Strengths and weaknesses with municipal self-government:
  - + Flexibility to account for local risks and conditions
  - - Lack of resources

Remarks

- Growing national concern – local level forerunner
- Fragmented across policy areas (discourses, actors, rules and resources)
- Strengths and weaknesses with the municipal self-government
- The lack of coordination and integration on the national level may limit the adaptive capacity of the country as a whole
  - limited guidance from the national level (authorities, private actors and the general public)
  - investments in permanent defence structures costly also for large municipalities
  - public awareness is low while expectations on public authorities are high
• More water in the future
• We have got the tools
• We still have some time

Contact: Ulf Moback
City Planning Authority
ulf.moback@sbk.goteborg.se
Crisis Management in the City of Gothenburg

Lennart Bernram

May 26, 2015

- The world from our point of view
- How the city is organized
- The three golden rules
- Risk- and vulnerability analysis
- Connections
- The nine areas at risk
- Our challenges

The City of Gothenburg’s organisation

City Council
- Nominations Committee
  - City Executive Board
  - Delegations
  - City Executive Office
  - The City Audit Office
  - Election Committee

Committees
- Göteborgs Stadshus AB

The City of Gothenburg’s organisation

Committees
- City district committees
- Leisure
- Education Committee
- Technical Provision
- Environment
- Land & Housing
- Planning Committee
- Commercial Premises Committee
- Transport Mobility Committee
- Transport Committee
- Sports & Associations Committee
- Park & Nature Committee
- Education Committee
- Ecocyc & Water Committee
- Environment
- Climate Committee
- Culture
- Culture Committee
- Archive Committee
- Committee for Consumers
- Citizen Services
- Intraservice Committee
- Chief Guardian Committee
- Committee for Allocation of Social Welfare
The City of Gothenburg’s organisation

Göteborgs Stadshus AB

- Energy
  - Göteborg Energi AB
  - +18 subsidiaries
- Housing
  - Förvaltnings AB Förrånden
  - Bostads AB Föreningen
- Commercial premises
  - Avästeroch AB
  - Förvaltnings AB Göteborgslokaler

Göteborgs Stads Parkerings AB

- Göteborgs Stads bostads AB
- Göteborgs Hamn AB
- Störningsjouren i Göteborg AB
- Förvaltnings AB Framtiden
- Förvaltnings AB Göteborgslokaler

Störningsjouren i Göteborg AB

- Göteborgs Spårvägar AB
- Göteborgs Tekniska College AB
- Göteborg Energi AB
- Göteborgs Egnahems AB
- Kommunleasing i Göteborg AB

Göteborg & Co Kommunintressent AB

- Göteborg & Co Träffpunkt AB
- Renova AB, Gryab AB, GREFAB
- Göteborg & Co Kommunintressent AB
- Göteborg & Co Träffpunkt AB

Göteborgs Stadsteater AB

- Göteborgs Spårvägar AB
- Göteborgs Tekniska College AB
- Göteborg Energi AB
- Göteborgs Egnahems AB
- Kommunleasing i Göteborg AB

Göteborg Energi AB

- Göteborgs Tekniska College AB
- Göteborgs Spårvägar AB
- Göteborgs Egnahems AB
- Kommunleasing i Göteborg AB

Rysåsens Fastighets AB

- Bostads AB Poseidon
- Göteborgs Hamn AB
- Störningsjouren i Göteborg AB
- Förvaltnings AB Göteborgslokaler
- Göteborgs Egnahems AB

Göteborg & Co Kommunintressent AB

- Göteborg & Co Träffpunkt AB
- Renova AB, Gryab AB, GREFAB
- Göteborg & Co Kommunintressent AB
- Göteborg & Co Träffpunkt AB

Göteborgs Hamn AB

- Göteborgs Hamn AB
- Störningsjouren i Göteborg AB
- Förvaltnings AB Göteborgslokaler
- Göteborgs Egnahems AB
- Kommunleasing i Göteborg AB

Göteborgs Stads Parkerings AB

- Göteborgs Hamn AB
- Störningsjouren i Göteborg AB
- Förvaltnings AB Göteborgslokaler
- Göteborgs Egnahems AB
- Kommunleasing i Göteborg AB

Göteborgs Egnahems AB

- Göteborgs Hamn AB
- Störningsjouren i Göteborg AB
- Förvaltnings AB Göteborgslokaler
- Göteborgs Egnahems AB
- Kommunleasing i Göteborg AB

Housing

- Förvaltnings AB Förrånden
- Bostads AB Föreningen
- Förvaltnings AB Göteborg
- Göteborgs Hamn AB
- Göteborgs Egnahems AB
- Förvaltnings AB Göteborgslokaler

Principle of Similarity

During a crisis the activities shall proceed as normal as possible. It shall also take place on the normal premises, if possible.

Principle of Proximity

A crisis should be handled where it occurs and by the people who are most concerned.

### Risk Management

**Emergency Management**

**City Executive Board/Crisis Management Board**

- Political decisions, overall level
- Inter-departmental coordination

**Support functions**

- Communication Dept
- Coordinator
- IT & telecom support
- Maintenance
- Logistics

**Basic staffing**

- City director
- Rescue Services
- Traffic
- Energy
- Water
- Waste
- Environment
- Sewerage
- Parks and Nature
- Others dep. on situation

**District Committees Staff**

- 10 district committees

**Field Unit (staff for KSG)**

- Coordination, joint action
- Departments and companies, situation-specific activities under responsibility principle

**Cooperating agencies**

- Police
- Health services
- County Admin. Board
- Swedish Church
- Swedish Armed Forces
- SOSAlarm
- Göteborgs Lokaler
- SAB

**Other depart-**

- Other depart-ments, ca 20
- Companies, ca 60

Mr. Lennart Bernram
City of Gothenburg

July 2015
The City Chief Executive on Duty

- Make sure that all actors are active and on the go
- Inform and make proposals for decisions to the politicians, the municipal executive committee
- To vouch for information to the participating actors
- Surveil that the Golden Rules are followed
- Control that the Committees and the Municipal Companies are cooperating
- Ensuring information to citizens and media

Risk management

Emergency Management

Why Risk- and vulnerability analysis

It gives increased knowledge of:
- Risks and consequences
- Important activities
- Critical functions

Crisis preparedness postulates an accomplished risk study

How is it all linked together?

Risk- and vulnerability analysis for the City of Gothenburg

Nine areas at risk
No. 1 Extreme Weather Situations

Depending on air pressure
Raising sea levels
Increased or decreased amount of water in the river
Rain or snowfall

"Storm 1969"
Berit – Dagmar – Emil!

No. 2 Energy – Water – Telecom/IT

Shortage of power
Only 50% of electricity!
Prioritization – Styrel!

Water/drainage
Old water- and drainage pipes
Muddy water in the river, Göta Älv

No. 3 Transportation

Road, train/tram
Tunnels, bridges
Shipping
Harbour, fairway
Aeronautical

No. 4 Manufacturing, transport and use of hazardous substances

Accidents can cause uncontrolled spillage

No. 5 People not coming to work

50% of the workforce can not come to work due to illness or other reasons!

No. 6 Gangcrime, organized criminality, threat against persons and elected representatives, sabotage and terrorism

Unauthorized influence on the democratic process and when normal life for the citizens is disturbed!

- Armed robbery in the Postterminal 2008!
- Bomb scare "Nordstan" Christmas 2010!
No. 7 Information Security

Feasibility to maintain
- Availability
- Integrity
- Confidentiality
- Accountability

No. 8 Social imbalance

When established guidelines are sidelined by the citizens!

No. 9 Unpredictable Events

? ?
? ?
? ?
? ?

One of the challenges is...

You need a complete new way of thinking to solve the problems you have created with the old way of thinking!
Albert Einstein

Gothenburg, the Gateway to the World

Mr. Lennart Bernram
City of Gothenburg
CONTACT:
Samhällsskydd och Beredskap

Lennart Bernram
lenart.bernram@stadshuset.goteborg.se
**MSB’s roles, responsibilities, and interaction**

Janet Edwards  
Risk and Vulnerability Reduction Department  
and  
Åsa Fritzon  
Research Department  

*Making Cities Resilient International Exchange with  
City of New Orleans and Louisiana State University  
26-28th of May, 2015  
Gothenburg*

---

**Swedish Government objectives for safety and security**

To protect:  
- Life and health of the population,  
- Functionality of society, and  
- Our ability to maintain our fundamental values, such as democracy, law and order, human rights.

---

**Range of Emergencies**

Every day accidents  
Large emergencies  
Catastrophes

---

**Civil Contingencies**

Falls  
Drowning  
Power cuts  
Pandemics  
Fires in buildings  
Transport accidents  
Incidents involving flammables and explosives  
Large scale chemical emergencies  
Landslides  
Woodland fires  
Storms  
Flooding  
Disruptions to vital societal functions  
Attacks on IT  
The unexpected

---

**IT HAPPENS IN SWEDEN**

In Sweden extreme weather and natural events have caused several serious emergencies and crises. Marked on the map are examples of events in recent years, which have led to damage and injury and to disruptions in society and to the lives of individual citizens.

1. Forest fire, Bräkenäs, Norrkoping, August-September 2006  
2. Spring flood, Norland, April-May 2011  
3. Storms, Jämtland, December 2010  
4. Torrential rain, Kalmar, January 2009  
5. Forest fire, Hassela, Hälsingland, June 2008  
7. Forest fire, Säffle, Uppsala, Västmanland, June 2007  
8. Floods, Arboga, Västmanland, August 2004  
10. Forest fire, Västmanland, October 1997  
13. Storms, Jönköping, Småland, July 2013  
15. Storms, Västmanland, February 2014  
16. Storms, Södermanland, October 2013  
17. Coastal erosion, Southern coastal, ongoing

---

**Management**

Director general  
Deputy director general

**Management Support and Strategic Management**

Manager  
Manager of IT coordination

**Internal Audit**

---

**Administration Department**

**Risk & Vulnerability Reduction Department**

**Emergency Management Development Department**

**Coordination & Operations Department**

**Evaluation & Monitoring Department**

---

Ms. Janet Edwards & Åsa Fritzon  
Swedish Civil Contingencies Agency
FOUR PRIORITIES FOR ACTION AT THE LOCAL, NATIONAL, REGIONAL AND GLOBAL LEVELS

1. Understanding disaster risk
2. Strengthening disaster risk governance to manage disaster risk
3. Investing in disaster risk reduction for resilience
4. Enhancing disaster preparedness for effective response, and to “Build Back Better” in recovery, rehabilitation and reconstruction

Sendai’s New 10 Essentials

1. Organise for disaster resilience
2. Identify, understand and use current and future risk scenarios
3. Strengthen financial capacity for resilience
4. Pursue resilient urban development and design
5. Safeguard natural buffers to enhance the protective functions offered by natural ecosystems
6. Strengthen institutional capacity for resilience
7. Understand and strengthen societal capacity for resilience
8. Increase infrastructure resilience
9. Ensure effective disaster response
10. Expedite recovery and build back better

10 Swedish Cities in the Campaign

1. Gothenburg
2. Malmö
3. Karlstad
4. Kristianstad
5. Jönköping
6. Arvika
7. Vellinge
8. Jokkmokk
9. Ängelholm
10. Vansbro

Swedish legislation

<table>
<thead>
<tr>
<th>Civil Protection Civil Protection Act 2003:778</th>
<th>Civil protection for the whole country</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Emergency response</td>
</tr>
<tr>
<td></td>
<td>Municipal action plans for prevention and mitigation</td>
</tr>
</tbody>
</table>

Crisis management Act on municipal and county council measures prior to and during extra ordinary events in peacetime and during periods of heightened alert 2006: 544

Risk and vulnerability assessments at national, county and local levels

Crisis management systems plans at county and local level in peacetime

Rules for heightened alert (risk for war)

Swedish legislation (continued)

Crisis management Emergency Management and Heightened Alert Ordinance 2006:942

Appropriated 2:4 funds for crisis preparedness action

Environment Environmental Code 1998

Environmental impact assessment

Land use planning Planning and Building Act 2010

Building codes and consideration of flood risk and erosion risk
Government Appropriations

Climate Change (Proposition 1:10 Climate Change Adaptation 2014) Gov. Dept. of Environment

- MSB, Dept. of Justice: Funds can be used for risk maps, consequence analyses, risk management plans
- Swedish Geotechnical Institute: Landslide, slope failure, erosion risk maps
- Swedish Land Survey Office: elevation data and digital maps
- Swedish Meteorological and Hydrological Institute: Knowledge enhancement
- County: coordination with local authorities

Fundamental principles for emergency preparedness

- Responsibility
- Equality / Conformity
- Proximity


Local Level Crisis Management

An incident or emergency always happens in some municipality.

Level of responsibility in case of emergencies

<table>
<thead>
<tr>
<th>Level</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal</td>
<td>Risk inventory and analysis, prevention, preparedness &amp; response (first responders), education and training, land use planning, climate change adaptation, building permits, environmental protection, civil protection, social welfare, lessons learned</td>
</tr>
<tr>
<td>County</td>
<td>Support and supervision of local level and can &quot;take over&quot; responsibility for response</td>
</tr>
<tr>
<td>National</td>
<td>Support with training, exercises, materiel support from national level (flood barriers, forest fires modules). Finance research and development of methods and technology</td>
</tr>
<tr>
<td>European/International</td>
<td>Resources from neighbouring countries and other EU countries - MIC and NATO/EADRCC</td>
</tr>
</tbody>
</table>

European Union Action

EU Floods Directive

18 areas identified in Sweden

- Human life and health
- Environmental impact
- Cultural heritage
- Economic activity
More European Union Action

- EU Seveso Directive (Safety at industrial plants)
- EU Information Security
- EU CBRN

European Union’s Disaster Management

- Prevention is part of the EU Civil Protection Act
- National Risk Assessments
- Assess Capacity to Manage Risks
- Emergency Operation Assistance (MIC)
- Exchange of Experts Program
- Training Courses
- Exercises

European Union’s Disaster Management

- EU Peer Review on HFA and other topics
- EU Financed Projects
- Capacity Building outside Europe

NATO

- Sweden not a full member of NATO
- North Atlantic Treaty Organisation
- But a member of Partners for Peace since 1994
- 28 countries
- Sweden participates in EADRCC exercise
- Euro-Atlantic Disaster Response Coordination Centre
- Sweden participates in CEPC
- Civil Emergency Planning Committee
- National cooperation (15 agencies) for the purpose of effective use of resources and humanitarian operations in conjunction with a catastrophe
- MSB member of expert group on industrial resources
- civil protection group

Research for a safer society

- New knowledge for future challenges

MSB Research Funding

- MSB is both a research funding agency as well as a stakeholder
- Research with the purpose to generate practical applicable results aiming to solve societal problems
- MSB is funding research on its own and in cooperation with others, nationally and internationally
  - EU
  - US Department of Homeland Security
  - Nordic countries
Research for a safer society
- New knowledge for future challenges
  - Individual and public safety
  - Protection from fire, emergencies and hazardous substances
  - Societal continuity and resilience
  - Strengthened emergency preparedness and civil defense
  - Information security

Areas of cooperation and joint research projects
- CBRN Forensics
- Explosives Detection & Defeat
- Strategic Decision making
- Effective communication during crisis
- Strengthened abilities of first responders
- Cyber Security

Bilateral Science & Technology
Homeland Security Agreement signed in Washington D.C. April 13, 2007
Our role is to stimulate innovation and growth through the Triple Helix concept:

- University
- Business
- Government

Partners

Mechanisms driving the process
Open Arena Lindholmen
Our concept for collaboration

Transport
- Test Site Sweden
- GLOB
- SAFER
- Lighthouse

ICT
- Security Arena
- TUCAP
- Vehicle ICT Arena
- Software Center

Media
- Visual Arena
- Internationalization

CLOSER
SAFER
TUCAP
Vehicle ICT Arena
Lighthouse Software Center
Visual Arena
Internationalization
GLOB Sweden

Test and Demo Projects
We initiate and develop test and demonstration environments

Success factors
- Organization and infrastructure
- Strong industrial interest
- Nationally and internationally prioritized focus areas
- Complementary collaboration partners
- Flexible way of working
- Neutrality and “non-profit”
- Knowledge-intensive clusters -> more innovations


Mr. Bosse Norrhem Lindholmen Science Park
URBSEC was established in 2011 as a joint strategic initiative by University of Gothenburg and Chalmers University of Technology. URBSEC has three core missions:

1) Increase research collaboration within and between the two universities, expand research volume on center topics
2) Build network with public and private sector actors as well as civil society, establish URBSEC as a platform for such collaboration
3) Academic research collaboration should be combined with taking-on practice relevant knowledge-gaps and challenges

URBSEC is a “soft” center...:
Researchers are positioned at their home departments and work together in various constellations for the duration of a particular project.

Collaborating departments:
- Applied Information Technology (Chalmers and GU)
- Architecture (Chalmers)
- Computer Science and Engineering (Chalmers and GU)
- Energy and Environment (Chalmers)
- Global Studies (GU)
- Journalism, Media and Communication (GU)
- Law (GU)
- Occupational and Environmental Medicine (GU)
- Philosophy, Linguistics, and Theory of Science (GU)
- Political Science (GU)
- Psychology (GU)
- Public Administration (GU)
- Social work (GU)
- Sociology and Work Science (GU)
- Technology Management and Economics (Chalmers)

...a ‘soft’ center with a small core of activities:
Being a soft center without permanent research staff, URBSEC’s core activities are organized with an objective to:
- reflect the center’s multi-disciplinary scope
- enable well-rounded strategic decision-making
- optimize capacity to build research projects
- create capacity for fast and flexible response to opportunities

In terms of formal organization, URBSEC has four “functions”:
- Steering Committee
- Director
- Priority Area Leaders
- Research Teams

URBSEC - Priority Research Areas
The Steering Committee has decided on four Priority Research Areas:
- Politics and Governance
- Communication and Interaction
- Infrastructures and Interdependencies
- Sustainability and Resilience

With an increased budget, the appointment of Priority Area Leaders is ongoing. They will form an operative management team together with the director. The aim is to:
- strengthen strategic focus and URBSEC’s profiles
- increase the capacity to build projects and draft applications
- increase the capacity of immediate response to opportunities
- increase the capacity to organize project partnerships

Appointment of Priority Area Leaders and EU-applications
URBSEC is presently engaged as Swedish partner in two European Union, Horizon 2020-applications, in the area “Secure Societies”.

The creation of an operative management team will increase the capacity to participate in EU-calls, which tend to be more time-consuming and labor-intensive than national calls.

Both calls concern Critical Infrastructure Protection:
- DRS-14: Critical Infrastructure resilience indicator - analysis and development of methods for assessing resilience
- DRS-15: Protecting potentially hazardous and sensitive sites/areas considering multi-sectorial dependencies
EU-applications on CIP: Consortium

Germany
1. University of the Federal Armed Forces (UniBw, Munich)
2. Federal Institute for Materials Research and Testing (BAM, Berlin)
3. CreaLab GmbH (Consulting firm in scenario-analysis and risk

France
1. The French Institute of Science and technology for Transport, Development and Networks (IFSTTAR)
2. Center for Research and Expertise on Risk, the Environment, Mobility and Land-use Planning (CEREMA)

The Czech Republic
Czech Technical University in Prague (CVUT)

Examples of partners in collaboration
• Security Arena Lindholmen
• The County Board of Västra Götaland
• Region Västra Götaland
• The Police Authority of Västra Götaland
• The Greater Gothenburg Rescue Services
• The City of Gothenburg
• Carmenta AB
• Ericsson AB
• The SAAB Group
• Volvo Technology

Open Activities
• Open seminars in the Kuggen building, Speakers Corner, Chalmers Lindholmen
• Yearly research conference with and for URBSEC researchers with invited external participants
• Contact: Director: michael.landzelius@chalmers.se
  michael.landzelius@gu.se
  +46 709 522 610

… and THANK YOU!
Securing Seaports: Interrogating Security
Governance at the Port of Gothenburg and the Port of New York and New Jersey
(URBSEC) Maria Stern, Mark Elam, Joakim Berndtsson

Harbor Security?
• Border protection has become an area of increasing global importance and technological sophistication.
• Port security has undergone substantial change; the threat of ships being used as means to deliver weapons of mass destruction or terrorist operatives has prompted increased security measures.
• The International Maritime Organization’s (IMO) International Ship and Port Facility Security (ISPS) Code (2004) makes the assessment of risks to shipping and port facilities a mandatory activity for all international seaports.

Bethann Rooney (2012:2), Port Security Manager in New York and New Jersey: ‘Shippers want their goods moved in the fastest, most reliable, cheapest and most secure method. The challenge for the past ten years has been to integrate security into the efficient and economic flow of commerce’.

• Ports are simultaneously sites of institutionalized security and transnational mobility, interaction and exchange which must be committed to ‘distinguishing between good and bad global mobilities.
• Under researched within social sciences (security studies)

Proposed Project: Security Governance at the Seaport
• Focus on mapping and understanding security work - at the Port of Gothenburg, Sweden (SEGOT) and the Port of New York and New Jersey, USA (USNYC)
• SEGOT is the largest port in Scandinavia through which approximately 30% of Swedish foreign trade passes
• USNYC six major port facilities comprise the third largest port in the United States and the largest on the East Coast.
• Critically compare how the optimization of security is pursued.

Research Questions
• How is port security governed in practice today at the Port of Gothenburg and the Port of New York and New Jersey through novel combinations of social and technological arrangements?
• Who governs seaport security determines how security is variably imagined and enacted.
• The question of how security is governed becomes a matter of how a competing range of security projects are articulated and defended in relation to each other.

Theoretical Framing
• Security as a discursive– security logics
• Security as a technological and technocratic practice that is integral to the work of governing populations, regulating flows, mapping dangers, managing risks and contingency.
Theoretical Framing

- Security Risk Management.
- Risk (and disaster, emergency) management necessitates techniques of calculation and analysis and preemptive security work so as to manage risks associated with the onset or the aftermath of danger or catastrophic events.
- Adjusting to sudden change requires the building up of resilience.

Global security assemblages (Abrahamsen and Williams)

- Characterized by a unique mix of global, regional and national, as well as public, private, and public-private security actors and interests;
- they are governed by competing, intersecting and coinciding security logics or rationalities.
- Actors in the assemblage are continuously involved in shaping the ways in which risks and threats are perceived, acted upon, or framed.
- Architectural, scientific, technological and administrative arrangements.

Security Assemblages: Landlord Ports

- Both SEGOT and USNYC are ‘landlord ports’ hosting a wide array of public-private actors involved in the security work of the seaports
- SEGOT: Responsibility for coordinating port activities is shared between the Gothenburg Port Authority (Göteborgs HamnAB, owned by the City of Gothenburg), which owns the land and infrastructure and a number of international terminal operators who only handle the freight.
- The Energy Port remains in the hands of the Port Authority.

To be explored:

- To what extent have the security concerns emphasizing terrorist-related threats and scenarios outlined in ISPS code come to impact on the commercial and environmental imperatives otherwise ruling over contemporary seaport governance?
- What different security projects have emerged (and are emerging) at the harbour, and how do they coexist, collude, or clash?
- How are the security logics, techniques, and temporal and spatial scope of port security projects governed in the different ports in light of the enactment of the ISPS code?
- How can we understand—and what can we learn from—the discrepancies or similarities?

Methodology

- 1) Query the logics that can be identified as underlying and framing different security projects.
- 2) Map the diverse techniques and combined processes of social and technological innovation rendering security projects operable. (E.g. Practices connected to the training of security personnel; The introduction of new screening and surveillance technologies—A focus on the ‘chain of technology’)
- 3) Interrogate the temporal and spatial scale and scope of port security projects encompassing crucial issues of jurisdiction over security governance. (The zoning of port time/space?)
Thank You!
Emergency Management Unit
Charlotte Källerfelt
Deputy Emergency Management Director
(represented by Lars Westholm, Project Manager)

County of Västra Götaland
• 1.5 million citizens
• 49 municipalities
• 240 km from south to north
• 800 employees

The civil emergency planning – before – during – after –
1. Protect peoples life and health
2. Protect critical functions in the society
3. Prepare for emergencies and try to reduce consequences

From everyday accidents to major disasters!

Basic principles
The principle of responsibility
Whoever is responsible for an activity during normal conditions should assume the same responsibility during emergencies

The principle of parity
During major emergencies authorities should, as far as possible, be organized in the same way as they are during normal conditions

The principle of proximity
Emergencies should be managed at the nearest decision making level

Geographic area responsibility
290 municipalities
21 counties
Government & authorities

The work of county administrative board before an emergency
• Risk management in spatial planning
• Training, exercises and information
• County Risk- and Vulnerabilities Analysis
• Auditing and follow-up
  - Municipalities duties within CEPS
  - Local Fire and Rescue Services
• Civil-Military Cooperation
• Responsible for planning
  - For rescue operation after release of radioactive substances from NPP
  - Complex rescue operations

Mr. Lars Westholm
County of Västra Götaland
During an emergency

- Duty Officer 24/7
- Responsibilities during an emergency
  - Initiate Command group
  - Coordinate and Support different actors response
  - Coordinate confirmed information
  - Coordinate governmental and international resources
  - Report to the Government offices of Sweden

Accidents with foreign casualties

- Duty Officer receives information about major accidents from SOS Alarm (911 system)
- IF involving information about foreign casualties the Duty Officer informs the President of the Consular Corps of Western Sweden (CCWS)
- The Swedish Police is responsible for registration of casualties. They inform the Ministry for Foreign Affairs.

River and Valley of Göta Älv

- Critical functions
  - Drinking water for 800,000 people
  - Important transportation routes by road, train, and boats
  - Densely populated area

- Threats
  - Most landslide-prone area in Sweden
  - Failures of big dams
  - Major flooding
  - Contaminated industrial sites

A long coast line

Storms, flooding and natural disasters

- Conferences for coordination of actions and information
- Weather warning system – indication of wind speed and consequences
- Landslides

Mr. Lars Westholm
County of Västra Götaland
Transport system

- Ringhals Nuclear Power Plant 60 km south of Gothenburg
- Epizootic and Zoonosis
- “Social risks”

Other risks

- Important to protect Sweden’s functionality
  - The Port of Gothenburg (largest port in Scandinavia) 30% of foreign trade 11,000 ships/year
  - Important transportation routes through the County
  - Refinery of raw oil at the west coast Approx. 90% of Sweden’s fuel request
  - Petrochemical centre of Sweden in Stenungsund

- Important transportation routes through the County

- Refinery of raw oil at the west coast
  - Approx. 90% of Sweden’s fuel request

- Petrochemical centre of Sweden in Stenungsund

Fires with many causalities


- Fire at sea M/S Scandinavian Star (1990) 159 dead. Capacity of smaller municipalities to receive ships during emergencies. RITS (Rescue Operations at Sea) was established.

Landslide of E6 Småröd (2006)

- 500 x 200 m and affected road and railway
- Approx. 10 vehicles (one truck with HS) in the area but no severe injuries.
- It was difficult for the Fire and Rescue Service to overview the area when arriving to the scene.
- Dangerous to rescue victims from their vehicles.
- Good cooperation after to restore road and railway in the planning process.

Exercise Gothia Cup April 2014

- Gothia Cup
  - Football tournament
  - 37,000 participants
  - 70 nations

- Organized by the municipalities in the Gothenburg region.
- Major accident during a disco at a football arena
- Great international interest
Thank you!
Risk Management
Physical planning

Lars Westholm, Samhällsbyggnad, Länsstyrelsen Västra Götaland

Swedish Planning

- Planning and Building Act, PBA
  - Sets the demands on physical planning
  - Addressing several issues; participating, ecological, environmental
  - Municipalities have monopoly on planning (zoning)

Comprehensive plan
Detailed plan


Figure 3: The detailed development plan for Östra Exby, Göteborg, 2010. Source: http://www.mal,org/sv/aktiv/vedtagenplaner</ref>
The Planning process

The municipality does all the planning.

The county administrative board reviews and advice!

If the plan is not up to codes:
Special review and worst case:
Revoking the plan

What are the Länsstyrelse looking at?

- Objectives and guidelines from the government
  - Sustainable development
  - Social aspects
  - "Wishing list"
- Especially important issues:
  - Areas of National interest
  - Cross border issues
  - Environmental quality
  - Shore protection
  - Health and safety

Health and safety

- Noise
- Air quality
- Dangerous goods
- Dangerous enterprises
- Erosion
- Landslides
- Flooding

Environmental impact assessment and/or
Risk analysis

Health and safety

- Dangerous goods
  - Recommended roads

Health and safety

- Erosion, landslides
  - Geotechnical surveys
Planeringsmodell

Riskbedömning
Kartläggning av översvämningsrisk

Exempel: Vänern

Risk = sannolikhet x konsekvens
(probability)

Översvämningsarter

Markanvändning
Lämplig markanvändning vid riskbedömning

Riskbedömning + Konsekvenshandling = Riskreducering
Funktionskrav

Upprätthålla funktionen och kunna ta sig till och från

eller

Tillfälligt överge…

Funktionskrav

During floods take road 160 towards Uddevalla and take left at Nöteviken.

Jetty coffe shop

LSU-SDMI

New Orleans-Gothenburg Exchange July 2015

Mr. Lars Westholm County of Västra Götaland
Landslide risks in the Göta River Valley in a changing climate

Bo Lind, Swedish Geotechnical Institute

Exchange New Orleans - Gothenburg

Glaciated landscape with soft sediments (silt-clay)

Valleys and Low-lands

Post-glacial rebound – Erosion and landslides

Landslides and mudflows in Sweden

Dynamic landscape of landslide scars

The Göta river valley

Run-off area

- Large run-off area
- Source of water supply for 8% of the population
- Important infrastructure and settlements
- Sensitive to landslides
Catastrophic consequences of landslides

Relative change in precipitation for a period of 30-years in the Vänerns runoff area (moving average)

Landslide retrogression in areas with highly sensitive clay

Mapping of landslide risks - The Government’s commission

“In order to address forthcoming climate changes and handle increased flow in the Göta River, greater understanding is required of the stability conditions along the entire Göta River. The funding is to be used for the improvement and production of landslide analyses and stability mapping along the Göta River.”

Landslides in a changing climate

- Driving forces affected by:
  - Increased groundwater pressure – climate related
  - Flow and river erosion – climate related
  - Loading by houses and infrastructure – development
**Methodology**

- Extension of quick clays
- Geometry of the river
- Groundwater modelling
- Erosion
- Consequences

**Stability calculation**

- Stability calculation
- Probability categories
- Consequence categories

**Probability categories**

- P5 (Unstable)
- P4
- P3
- P2
- P1 (Negligible)

**Consequence categories**

- Areas with a low landslide risk
- Areas with a medium landslide risk
- Areas with a high landslide risk

**Conclusions**

**Current conditions:**
- Many areas with high risk (red)
- High risk also in built-up areas
- Large areas with poor stability closest to the river and conditions for large landslides

**Future conditions:**
- Climate change means that the risks increase
- The area with the highest risk level (red) increases 10%
- The probability of landslides further increases in high-risk areas unless action is taken

---

Dr. Bo Lind
Swedish Geotechnical Institute
Suggestions

- Necessary to take actions to reduce the current landslide risks which also provide opportunities for increased flows in the future
- The estimated cost for the entire Gota River and the Northern River:
  - 4-5 billion SEK at today’s maximum flows
  - 5-6 billion SEK for increased maximum flows

Example of what can be done

GIS platform

Thank you
Biological Bank Protection

Per Danielsson
per.danielsson@swedgeo.se

Rip rap construction

Biological bank protection

- Sweden
- Europe
- US / Canada

Biological bank protection

- Material, plants, etc.
- Construction requirements,
- Design, slope, etc.
- Soil type
- Resistance
- Environmental impact

Goal

- Existing bank protection methods
- Classify according to use
- Joint work between:
  - Swedish Agency for Marine and Water Management
  - Swedish Environmental Protection Agency
  - Swedish Transport Administration

Water flow

Hjulström diagram
Ship generated waves

Ice induced erosion

Biological bank protection

Technical-biological bank protection

Hard structures, Rip-rap

Methodology
Biological bank protection

Natural vegetation Rönne å

Natural vegetation Suseån

Salix

Salix

Tech-biological bank protection

Illustration: K. Gellerstam

Photo: SGI

Photo: SGI

Photo: SGI

Illustration: K. Gellerstam
Rip-rap and vegetation

Foto: BAW

Rip-rap and plants

Foto: SGI

Geotextile and vegetation

Foto: SGI

Geotextile and vegetation

Foto: SGI

Gabions and vegetation

Foto: SGI

Tech-biological bank protection
Lerårn, Lerum

Foto: Norconsult

Dr. Per Danielsson
Swedish Geotechnical Institute
Logs and roots

Photo:
Washington State Aquatic Habitat Guidelines Program
Integrated Streambank Protection Guidelines, 2003

Roots and logs, Ätran

Illustration: Swedish Agency for Marine and Water Management

Thanks!

Dr. Per Danielsson
Swedish Geotechnical Institute
Coastal vulnerability index

Per Danielsson
per.danielsson@swedgeo.se
Multi Scale CVI

- Multi Scale CVI, A Cooper and S. McLaughlin, (University of Ulster, N. Ireland)

- Work in different scales
  - National level
  - Regional level
  - Local level

- Different parameters at different scale

Vulnerability = $f$ coastal characteristics + coastal forcing + socio-economic

Value for Coastal Characteristics, CC

<table>
<thead>
<tr>
<th>Parameter/Värde</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology</td>
<td>Solid material or very little sensitivity for erosion. (solid rock, moraine, hard clay)</td>
<td>Medium sensitivity for erosion. (gravel, coarse sand, silty moraine, clay, silt, silty clay and peat)</td>
<td>Easily erodible material. (medium and fine sand, silt and alluvium)</td>
</tr>
<tr>
<td>Topography elevation (m)</td>
<td>&gt;3 MSL.</td>
<td>1-3 MSL.</td>
<td>0-1 MSL</td>
</tr>
<tr>
<td>Distance to the beach</td>
<td>&gt;200 m</td>
<td>50 – 200 m</td>
<td>0 – 50 m</td>
</tr>
<tr>
<td>Ongoing erosion</td>
<td>Presented as a line on the map</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sea defence</td>
<td>Presented as a line on the map</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ArcGIS Model Builder

CC1 → Raster Calculator (1) → CC sub index
SE1 → Raster Calculator (2) → SE sub index

CC1 sub index → Raster to Polygon

Sub-indices CC och SE

CVI-map

Interactive Web Map

Dr. Per Danielsson
Swedish Geotechnical Institute
LECTURE OVERVIEW

- Sea Level Rise
- Protective Measures
- Beach Nourishment
- Sand as Storm Protection
- Value of Beaches
- Water Levels and Consequences in Skanör/Falsterbo

EXPECTED CLIMATE CHANGE ISSUES ‘OF INTEREST’

- Rising sea levels!
- Increased storminess?
- Bigger waves
- More storm damages
- More coastal erosion
- More flooding

CLIMATE CHANGE vs. VARIABILITY

Time

Max/Min Annual Water Level

Climate Change (SLR)

Climate Variability

Short term (yrs): Rise and fall around trend

Long term: Multi-decadal to century trends

FUTURE SEA LEVELS! – WE THINK!

Global average sea level rise (1990 - 2100) for the six SRES Scenarios

SMHI 2009 estimation 100 cm for The Baltic Sea

CONSEQUENCES OF SEA LEVEL RISE
SEA LEVEL RISE! WHAT HAPPENS TO THE BEACH?

Rocky shore

Present Sea Level

Present Bottom Level

Future Sea Level

Future Bottom Level

SEA LEVEL RISE! WHAT HAPPENS TO THE BEACH?

Sandy shore

Present Sea Level

Present Bottom Level

Future Sea Level

Future Bottom Level

Sandy shore

Brunn rule: An increase S of MSL ⇒ coastal erosion R = S/bottom slope.

If bottom slope = about 1/100 ⇒
A sea level rise of 1 m ⇒ erosion R = 100 m.

PERMANENT COASTAL RETREAT IN YSTAD 2100?

Legend

Coast line today

Coast line 2100

Legend

Coast line today

Coast line 2100

LSU-SDMI

New Orleans-Gothenburg Exchange

July 2015

Dr. Hans Hanson

Lund University
SEAWALL – AN APPROPRIATE ALTERNATIVE?

What can we do? What should we do?

EXPECTED SLR! SOLUTION? SEAWALL?
SEAWALL – AN APPROPRIATE ALTERNATIVE?

Maybe not so good!

STABILIZING – SOFT MEASURES

Beach fills
Construction, reinforcement & vegetation of dunes
Vegetated earth dams

SOFT MEASURES AGAINST RISING SEA LEVELS?
**SOFT MEASURES AGAINST RISING SEA LEVELS?**

\[ S \sim 1 \text{ m year} 2100 \]

Added volume \( V = S \cdot L = 300 \text{ m}^3/\text{km} \sim 3.300 \text{ m}^3/\text{km per yr} \sim \$33,000/\text{km/yr over 90 yrs}! \]

**BORROW SAND – FROM SEA BOTTOM TO NOURISHED BEACH**

**NEW BEACH IN YSTAD – PIER 0 EAST**

Before

\[ 100,000 \text{ m}^3 \times \$10 = \$1M \]

Normal main't \sim \$0.3M/yr

After

\[ 100,000 \text{ m}^3 \times \$10 = \$1M \]

Normal main't \sim \$0.3M/yr

**SAND FOR STORM PROTECTION?**

In Atlantic City, NJ, with wide nourished beach, tourist industry working again 4 days after hurricane Sandy 2012.

In Ortley Beach, NJ, without wide nourished beach, the coast was still in shreds 6 months after Sandy.

6 miles N, Brant Beach, NJ, "No overwash or wave damage"

Holgate, NJ, "Complete destruction – it's like a war zone" - USACE nourished beach

Mayor Mancini estimated that if the entire Long Beach coast (18 miles) had had the same beach as Brant Beach they would have saved ~$500M.

Concrete seawall in Ft. Lauderdale, FL, destroyed by hurricane Sandy 2012.

Concrete seawall replaced by beach nourishment to hold for the 100-yr storm.
WHAT IS A BEACH WORTH?

Calculations according to the 'Halmstad model' showed Ystad beaches sales 2010 ~ $44M!

VALUATION OF TURISM IN YSTAD

Tax income from inhabitants in Ystad:
Total taxation ~ $115M/yr
Assume 20% because of its beaches ⇒ $23M/yr!!
Of these, assume 2/3 refer to 10 summer weeks ⇒ 1.5 $M/week.

Turist income Ystad:
Income ~ 12% of sales = $5.5M/yr
Assume 80% over 10 summer weeks = $430 000/week.

Thus, total beach income = $28.5M/yr!!
During summer $2M/week!

BEACH INCOME YSTAD 2010

Florida’s beaches have an estimated annual value of $50 billion (Houston, 2013).
For every $ in annual cost for beach nourishment, the return is $1800 per yr from international tourists alone in Miami Beach (Houston, 2013).

WATER LEVELS IN FALSTERBO CANAL

ANNUAL HIGH WATER LEVELS (CORRECTED FOR MSL CHANGE)

Trend: 0.073 cm/yr (or 0.006 cm/month)
166 000 data points!
**SKANÖR/FALSTERBO — FLOODED REAL ESTATE FOR DIFFERENT SEA LEVELS**

- **Level relative present MSL (m):**
  - 2010: 0%
  - 2050: 67%
  - 2100: 18%

**Cost dams/dunes (50 yr):**
- About 0.6 MEuro/km = $10M = $0.2M/yr

**Cost sand (~10 km):**
- $15M over 50 yrs = $0.3M/yr

**Protected values (c:a) (2012):**
- $6,000M
  - Cost ~ 0.4% ~ 0.008%/yr

**Home insurance premiums 2012 ~ $450/yr/house (avg SE) ~ $1.5M/yr**

**Living expenses 2011 (avg SE) ~ $12,000/month/house ~ $37M/yr**

**Total number of houses ~ 3,100**

**Commute cost (10 000 out, 3 000 in, 1.5 pers/car, 15 km*2) ~ $0.1M/day!**

**NL: Protective measures $1,600M/yr ~ 0.1%/yr**

**IS IT ECONOMICALLY DEFENDABLE?**

- Cost dams/dunes (50 yr):
  - $10M = $0.2M/yr
- Cost sand (~10 km):
  - $15M over 50 yrs = $0.3M/yr
- Protected values (c:a) (2012):
  - $6,000M
    - Cost ~ 0.4% ~ 0.008%/yr

- Home insurance premiums 2012 ~ $450/yr/house (avg SE) ~ $1.5M/yr
- Living expenses 2011 (avg SE) ~ $12,000/month/house ~ $37M/yr
- Total number of houses ~ 3,100
- Commute cost (10 000 out, 3 000 in, 1.5 pers/car, 15 km*2) ~ $0.1M/day!
- NL: Protective measures $1,600M/yr ~ 0.1%/yr

Questions?

Dr. Hans Hanson
Lund University

I-57
Eva Liljegren, PhD
The Swedish Transport Administration (STA)
The Maintenance Division

The STA`s mandate

- To be responsible for the long-term planning of the traffic system for road and rail transport, shipping and aviation.
- To be responsible for the construction, operation and maintenance of State roads and railways.

The STA`s responsibilities

- 11 900 km (7 400 miles) of State railway tracks
- 98 400 km (61 000 miles) of State roads
- 16 000 bridges (3 781 railway bridges)
- 40 ferry lines
- 6 500 employees
- 98 400 km (61 000 miles) of State roads

EU`s strategy on adaptation to climate change

In April 2013 the European Commission adopted an EU strategy

- Promoting action by Member States
- `Climate-proofing` action at EU level
  - e.g. ensuring that Europe's infrastructure is made more resilient.
- Better informed decision-making
  - by addressing gaps in knowledge about adaptation.

The STA`s Climate Change Adaptation Strategy

1. Create the conditions for efficient climate change adaptation work.
2. Prevent negative consequences of climate impact through the creation of robust systems.
3. Manage the effects of climate impact.
Create the conditions for efficient climate change adaptation work

- A clear mandate and responsibility for climate change adaptation work within the STA.
- Continuous acquisition of knowledge about climate impact on roads and railways, through monitoring, research and development.
- Regional, national and international cooperation.
- Dissemination of information on climate impact and climate change adaptation throughout the organization.
- Planning takes into account the need of resources for work on climate impact on roads and railways.
- Acquisition and analysis of information and data concerning natural hazards.
- Stocktaking and documentation of those component parts of the road and rail infrastructure that are pertinent to work on climate change adaptation.
- Development of methods to determine when and where various measures are cost-effective as regards to climate change adaptation.

One example of natural hazard related events

The flooding of the Norrala railway tunnel, August 2013

Why was the tunnel flooded?

The catchment area for the service tunnel was 20 times larger than the catchment areas for any of the other five tunnel entrances.

Prevent negative consequences of climate impact through the creation of robust systems.

- A written policy and framework that takes climate impact into consideration.
- Adapting new construction work and conversions to the present and future climate.
- Stocktaking and assessment of places and sections at risk in the existing road and rail infrastructure.
- Increasing the resilience of existing road and rail infrastructure to climate stress.
- Addressing systematic weaknesses, such as inadequate culverts.
- Adjusting maintenance practices to changes in climate impact.
- Adapting supervision practices and safety inspections to climate impact.

Risk identification methods

- Blue Spot
- Robustness planning
- Historical data from events

Manage the effects of climate impact

- Maintaining a high state of readiness and expertise for managing acute effects of climate impact.
- Provision of traffic information and rerouting.
- Emergency response planning that takes account of climate impact.
- Emergency-drills for climate-related scenarios.
- Using depot equipment, e.g. emergency bridges, in urgent situations.
Thank you for listening!
Gothenburg – an evolving city of the future

533,300 residents – 23% born outside of Sweden
1,1 million residents in the Gothenburg labour market region today
+10,000 residents in the Gothenburg labour market region today
1,75 million residents in the Gothenburg labour market region 2030

Gothenburg’s labour market region – potential

1,1 million residents 2010
1,75 million residents including Borås, Trollhättan och Uddevalla 2030

A close city – in the middle of Scandinavia

The 8 million city
The Götaland line (Gothenburg – Stockholm)

Gothenburg is growing – but the aim is to shorten distances

- New roads, bridges, cycle paths and expanded public transport will make it easier to get around in the city, both for private individuals and the business sector.
- Better public transport and new hubs will make it easy for local people to travel in a sustainable way – within the city, in the wider region and to the world beyond.

We will continue to grow – but not at the expense of the environment.

Modal split in Gothenburg

<table>
<thead>
<tr>
<th>Travel Mode</th>
<th>2014</th>
<th>2013</th>
<th>2012</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>41%</td>
<td>41%</td>
<td>44%</td>
<td>44%</td>
</tr>
<tr>
<td>PT</td>
<td>28%</td>
<td>28%</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td>Biking</td>
<td>7%</td>
<td>7%</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Walking</td>
<td>24%</td>
<td>24%</td>
<td>25%</td>
<td>25%</td>
</tr>
</tbody>
</table>
Target modal split by 2035

Travel
Future Modal Split

Climate change challenges

Together we are developing a close city!

Contact:
Development & International Affairs
Urban Transport Administration
Mikael Ivari
mikael.ivari@trafikkontoret.goteborg.se
Gothenburg - a City in Change

From a "Big Little City" to a "Little Big City"

- Increased urbanization
- Gothenburg is the engine of the regional labor market
- More people walking, cycling and using public transport
- Effective goods transport will be necessary

Higher expectations from citizens

Expectations:

- Correct and relevant traffic information particularly in relation to road works 24/7
- Accidents and disturbances to the road network should be dealt with effectively.
- Regional and multi-modal traffic information.
- Prioritized Public Transport
- One point of contact for information. This is preferable regardless of who operates the road (The City or The State)
- Effective Goods Transportation network

Increasing demand for information

Mayor infrastructure projects starting 2016-2018

- A Common Traffic Management Centre with the road users in focus

Trafik Göteborg
The Situation before 2013-01-02

Swedish Road Administration (Traffic Management Road West - TLVV)
- Traffic information
- Traffic management and coordination
- Traffic control
- Road side assistance (Vägassistance)
- Manned 365 days a year 24/7

Gothenburg City
- A Contact Centre (150017) office hours Monday to Friday
- No established function for traffic control and information for the City’s roads

How to create “Trafik Göteborg”

1. Learning by doing – a pilot
2. Plan for the establishment of a permanent Common Traffic Management Center

Step 1: Learning by doing- the pilot started 2013-01-02

Learning by doing - The pilot

Has resulted in:
- 4 Traffic leaders engaged by the City sit together with the SRA traffic leaders.
- Traffic management for the City’s roads 24/7.
- Connecting the PTA (Västtrafik) customer information center (KIC), the City’s Customer Contact Center (KC) and the Traffic Management Center (TLVV).
- General editorial information about future road works are distributed through our common Traffic editor.
- Connecting administrative systems for road works.
- Adding road cameras and connecting the two systems.
- Distributing traffic information about the municipalities roads using SRA existing channels to road users.

Traffic Management Center

Establish a permanent Common Traffic Management Center

Step 2

Ms. Camilla Nordström
City of Gothenburg
An overall consensus between the Swedish Transport Administration (Trafikverket), Gothenburg City (Trafikkontoret) and the Public Transport Authority (Västtrafik) has been created through:

– User expectations through interviews
– Defining Common Goals using our users expectations as a basis.

NB: All municipalities within the Gothenburg Region (GR) are also invited to join this joint venture.

**Common Goals**

1. Publish traffic information for all disturbances or events that have an impact on the transport network.
2. Resolve any disturbances or obstacles effectively and efficiently that have an impact on the transport network.
3. Inform users of planned traffic restrictions so that re-routing of goods or transport is possible.
4. Ensure that critical freight routes work and prioritize public transport during major disruptions.
5. Help to ensure reliable journey times on defined routes.

**Funktion areas Trafik Göteborg**

Road Traffic management  
Traffic Editorial office  
Traffic Analysis  
Management, administration and Development

**Next steps**

• Agreement for 10 years is about too be signed  
• Establishing the new “organization” from the pilot with a common agreed management, and the name Trafik Göteborg by December 2015.  
• Further organizational development, routines etc  
• Further development, implementation of technical systems  
  – Traffic signals  
  – More kameras, more information signs  
  – Better information channels  
  – Including traffic management systems for the new Hisingen bridge  
  – Etc.  
• More partners

**To Sum up with a Swedish expression:**

_How do you eat an Elephant?_  
_The Answer is; One bit at a time_

This is, and has been a huge job!

It requires a lot of work within the organisations:

– New routines regarding road work sand contractors  
– Technical systems needed to be connected together  
– Internal cultural differences need to be dealt with

This needs to be worked in within all three organisations requiring and should not be underestimated.

**Thank you for listening!**

**Questions?**
Extreme weather in project
The West Link
Johan Jansson
2015-05-28

Project “The West Link”
• 8 km (5 miles) new railway
• 6 km (4 miles) in tunnel
• Three new stations
• Construction 2017/2018
• Traffic 2026

Sea water levels in Stockholm in years 1774-2012

Water level

Mr. Johan Jansson
Swedish Transport Administration
Levels at station Haga

- High scenario
- Uncertainty
- Todays extreme events
- Future rise in sea level

Protection level
Water level for train service
Prepared higher level

The West Link level (m)

<table>
<thead>
<tr>
<th>Year</th>
<th>Construction 2018-2028</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>2018 - 2028</td>
</tr>
<tr>
<td>2100</td>
<td></td>
</tr>
<tr>
<td>2150</td>
<td></td>
</tr>
</tbody>
</table>

Högt scenario
Generell osäkerhetsnivå
Variationer i dagens klimat
Havsnivåhöjning

Protection level
Water level for train service
Prepared higher level

Rain event 150 mm på 2 timmar in centre of Gothenburg

Water levels from short rain

Rain event 150 mm på 2 timmar in centre of Gothenburg

Water finds its way

High sea level + rain?
Not at the same time

Sea level [m]
Rainfall [mm/h]

Risk from high flows in river Mölndalsån and high sea level

Göta Älv: +4.0 m
Olskroken: +4.3 m
Station Haga: +4.8 m
Station Korsvägen: +4.9 m
Station Centralen: +4.3 m
Almedal: +5.1 m
Gothenburg is looking forward

Year 2026

Year 2100
1. Vulnerability and Adaption to Heat in Cities: Perspective and Perceptions of Adaptation Decision-Makers in Sweden, case Gothenburg

2. Guidebook for Integrated Assessment and Management of Vulnerability to Climate Change

Anna C. Jonsson
Dept. of Environmental Change

Some drivers of (climate) vulnerability

Demography
Locality
Health
Socio-economy

adaptive capacity ...

sensitivity ...

Income distribution
Lundby, Gothenburg
2009, 20-64 years

Illness indicator
Lundby 2010
16-64 år
Wilhelmi and Hayden (2010)

Are Swedes vulnerable to heat?

Climate change effects in Sweden: wetter, warmer, wilder

Daily mean temperatures above 68 F
→ increased mortality
(Rocklöv et al 2008)

Adaptation to heat in Sweden?

Earlier approaches
Epidemiology, GIS, statistics and manuals

sensitivity ...

Earlier approaches
Epidemiology, GIS, statistics and manuals

... and adaptive capacity

Income distribution
Lundby, Gothenburg 2009, 20-64 years

Dr. Anna Jonsson
Linköping University
**Earlier approaches**

Epidemiology, GIS, statistics and manuals

(Parry et al., 2011)

**THE VULNERABILITY FACTOR CARD GAME**

- Used in research: (Jonsson and Lundgren, 2014).
- Tried out in five focus groups in City of Gothenburg
  - “Hard planners”
  - “Soft planners”
  - Staff in child care
  - Staff in elderly/health care
  - Elderly

**Structure and basic idea of the tool**

- Tool to study the Perspective and Perceptions of Adaptation Decision-Makers
- Boundary object to facilitate bottom-up deliberations on vulnerability and adaptation strategies
- Educational game

Create two vulnerable persons, Expose them to heat wave, Analyze effect of heat wave, Identify adaptation measures

Results

- Svea, Sven and the others

<table>
<thead>
<tr>
<th>Focus group</th>
<th>&quot;Hard planners&quot;</th>
<th>&quot;Soft planners&quot;</th>
<th>Staff in child care</th>
<th>Staff in elderly health care</th>
<th>Elderly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>Bertil***</td>
<td>Vesa***</td>
<td>June***</td>
<td>Anna***</td>
<td>Raija***</td>
</tr>
<tr>
<td>Age</td>
<td>Above 80 years</td>
<td>Above 80 years</td>
<td>45-65 years</td>
<td>Above 80 years</td>
<td>45-65 years</td>
</tr>
<tr>
<td>Health and Lifestyle</td>
<td>Limited mobility, Cardiovascular disease</td>
<td>Limited mobility, Cardiovascular disease</td>
<td>Dependency on healthcare</td>
<td>Dependency on healthcare, Cardiovascular disease</td>
<td>Dependency on healthcare, Cardiovascular disease</td>
</tr>
<tr>
<td>Impact</td>
<td>Reduced wellbeing</td>
<td>Mortality, Morbidity</td>
<td>Hospitalisation, Mortality</td>
<td>Mortality, Morbidity</td>
<td>Mortality, Morbidity</td>
</tr>
</tbody>
</table>

| Males        | Harald***       | Sven***        | John***          | Svea***          | Richard*** |
| Age         | Above 80 years | Above 80 years | Above 80 years   | Above 80 years   | Above 80 years |
| Health and Lifestyle | Cardiovascular disease | Cardiovascular disease | Dependency on healthcare | Dependency on healthcare, Cardiovascular disease | Dependency on healthcare, Cardiovascular disease |
| Impact | Reduced wellbeing | Mortality, Morbidity | Loss of income, Reduced wellbeing, Mortality | Mortality, possibly hospitalisation | Mortality, possibly hospitalisation |

* Person gets ill during heat wave  ** Person becomes ill and is hospitalised during heat wave  *** Person dies during heat wave
Results: distribution of vulnerability drivers

Harriet
Svea
Astrid
Raija
Sture
Sven
Jane
Harald
John
Richard
female
old
homeless
child
male
middle age

Results: impacts

Death
Hospitalization

Harriet
Svea
Astrid
Raija
Sture
Sven
Jane
Harald
John
Richard
Loss of income
Loss of assets
Reduced wellbeing
Illness

Results: adaptation strategies at different levels

Harriet
Svea
Astrid
Raija
Sture
Sven
Jane
Harald
John
Richard

- water, ice cream, salt, clothing
- open window, fan/AC, shades
- adjust medication, remind about drink and food, stay indoors, keep moving/keep still
- increased support from care sector, special heat-person at each elderly care institution, increase knowledge, access to hostel
- plan city for cool places

- Play with water or “slow” activities
- Develop emergency plans for heat
- Design playgrounds for shade
- Plant greenery

- water, clothing
- AC/Fan, shades, take car to nice location, search for shade and cool place
- better local planning for heat

Results: learning through talking

- Enthusiastic! “like a Hollywood movie”
- A lot of knowledge is already there: discussions articulate the problem area
- Numerous suggestions of measures
  - Short and long term
  - For individuals, operational and strategic level of municipality
  - From personal and professional experience

Discussion

- Victims and heroes(?)
- Moral judgements
- Budget restrictions
- Blind spots
- Because of overlay of vulnerability drivers: Relevance of inter-sectionality perspective
Thank you!

anna.c.jonsson@liu.se

Jonsson and Lundgren (2014).
Vulnerability and adaptation to heat in cities: Perspectives and perceptions of local adaptation decision-makers in Sweden.

Local Environment.
Sustainability Aspects of Water Regulation and Flood Risk Reduction in Lake Vänern

Lake Vänern
- 50,200 km² catchment
- Lake area 5,600 km²
- Flood risk in the lake and most tributaries
- Flood 2000/2001
- Landslide risks along Göta älv and Klarälven
- Hydropower dams
- Heavy industry/Polluted soil
- Drinking water supply

Europe's largest natural lakes

<table>
<thead>
<tr>
<th>Rank</th>
<th>Lake</th>
<th>Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Ladoga (Russia)</td>
<td>17 670</td>
</tr>
<tr>
<td>2.</td>
<td>Onega (Russia)</td>
<td>9 670</td>
</tr>
<tr>
<td>3.</td>
<td>Vänern (Sweden)</td>
<td>5 648</td>
</tr>
<tr>
<td>4.</td>
<td>Saimaa (Finland)</td>
<td>4 400</td>
</tr>
<tr>
<td>5.</td>
<td>Peipus (Estonia/Russia)</td>
<td>3 555</td>
</tr>
<tr>
<td>6.</td>
<td>Vättern (Sweden)</td>
<td>1 893</td>
</tr>
<tr>
<td>7.</td>
<td>Vygozero (Russia)</td>
<td>1 285</td>
</tr>
<tr>
<td>8.</td>
<td>Mälaren (Sweden)</td>
<td>1 122</td>
</tr>
<tr>
<td>9.</td>
<td>Ilmen (Russia)</td>
<td>1 120</td>
</tr>
<tr>
<td>10.</td>
<td>Beloje (Russia)</td>
<td>1 119</td>
</tr>
</tbody>
</table>

Lake Vänern risk topics
- Flood risks
- Discharge limitations
  - Landslide risks Göta älv
- Regulation regime
  - Landscape and ecosystem effects
- Protection of cities
  - Existing settlements
  - New developments

Water level 1850-2013

## Values and interests

### Ecology och landscape

<table>
<thead>
<tr>
<th>Ecology och landscape</th>
<th>Economic values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landscape</td>
<td>Hydropower</td>
</tr>
<tr>
<td>Unique habitats and species</td>
<td>Fishery</td>
</tr>
<tr>
<td>Recipient</td>
<td>Agriculture</td>
</tr>
<tr>
<td></td>
<td>Shipping</td>
</tr>
</tbody>
</table>

### Social values

<table>
<thead>
<tr>
<th>Social values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life quality in 13 municipalities</td>
</tr>
<tr>
<td>Recreation</td>
</tr>
<tr>
<td>Drinking water</td>
</tr>
</tbody>
</table>

### Flood consequences

<table>
<thead>
<tr>
<th>Values and interests</th>
<th>Flood consequences</th>
<th>Conseq. of lowered water level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social values</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life quality in 13 municip.</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Recreation: fishing, boat life, swimming, summer houses</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Drinking water for 800,000 people</td>
<td>–</td>
<td>+ –</td>
</tr>
</tbody>
</table>

### Economic values

<table>
<thead>
<tr>
<th>Economic values</th>
<th>Flood consequences</th>
<th>Conseq. of lowered water level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydropower</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Fishery</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Agriculture</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Shipping</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Tourism</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Critical infrastructure</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Industry</td>
<td>–</td>
<td>+</td>
</tr>
</tbody>
</table>

---

Conflicting interests

<table>
<thead>
<tr>
<th>Interest</th>
<th>Preferences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood protection</td>
<td>Low level and low amplitude</td>
</tr>
<tr>
<td>Hydropower, shipping</td>
<td>Average level and low amplitude</td>
</tr>
<tr>
<td>Nature and landscape protection</td>
<td>Larger amplitudes and seasonal variation</td>
</tr>
</tbody>
</table>

Thanks for your attention!

Lars Nyberg
lars.nyberg@kau.se

www.kau.se/klimat-och-sakerhet
www.cnds.se
References


