



Post Storm Response and Recovery at the Texas Medical Center

Including a Comparison with Ike at UTMB

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Post Allison Response and Recovery at the Texas Medical Center

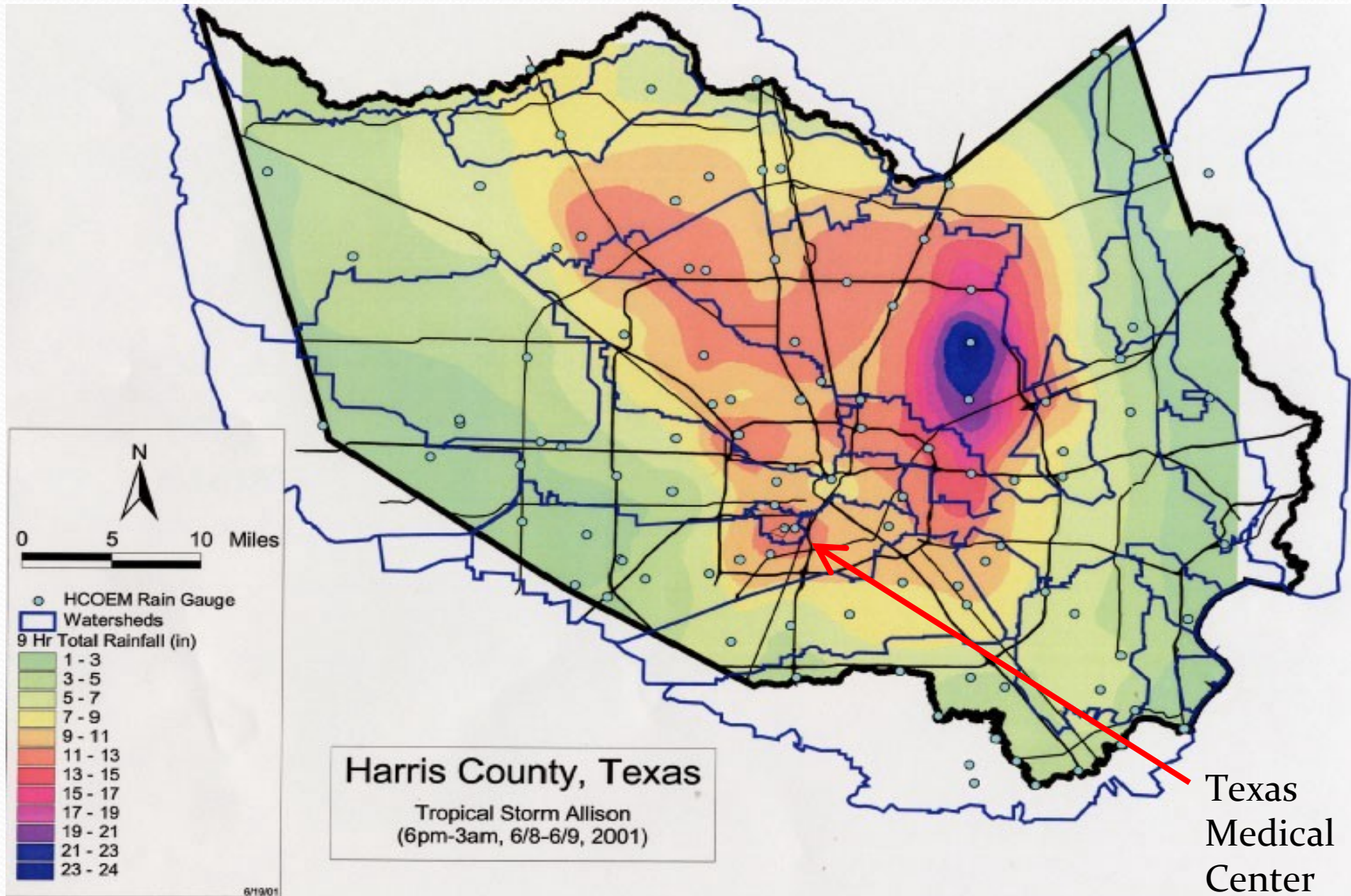
- The Event
- Comparison to Ike at UTMB Galveston
- The Response
- Disaster Mitigation Planning
- Policy Review and Modifications
- Status Today
- Ideas and Thoughts for Tomorrow

The Event

Tropical Storm Allison

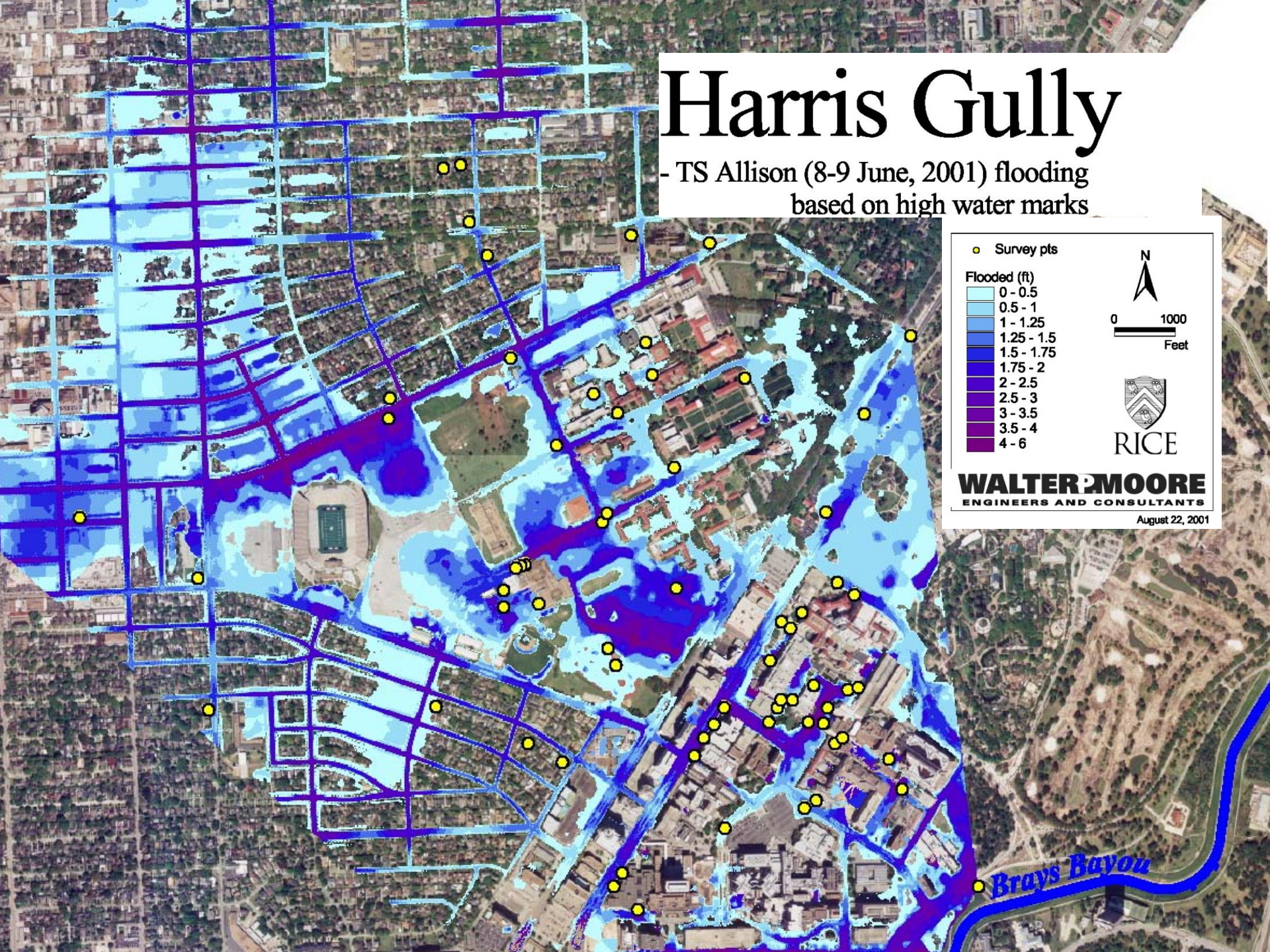
June 8 & 9, 2001

Rainfall Totals in Harris Co.



Harris Gully

- TS Allison (8-9 June, 2001) flooding
based on high water marks



US 59



- Approximately 300 Acre Feet of Storage
- Water Held until after Medical Center streets were dry

M.D. Anderson Cancer Center Construction Site



Fannin at Holcombe



The Methodist Hospital



Debris Line High
Water Mark

TMC Garage #17 - West
Facing Faculty Center
6/9/01 - 1:42 AM





Fannin Northbound at Texas
Children's Hospital
6/9/01 - 6:11 AM



Fannin Southbound at St. Luke's
Medical Tower 6/9/01 - 6:11 AM



Moursund at Jesse Jones Library
6/9/01 - 6:47 AM



You Must Enter

TMC Garage #3
6/9/01 - 10:40 AM



Holcombe East of Bertner
6/9/01 - 6:15 AM



Lamar Fleming Northbound
6/9/01 - 6:44 AM



Baylor College of Medicine
6/9/01 - 6:47 AM



Bertner & John Freeman.
6/9/01 - 6:47 Am



Methodist Wilkins Ave.
6/9/01 - 6:49 Am



Favrot Hall Basement Elevator
6/9/01 - 5:28 PM

Tropical Storm Allison

- **12+ inches of rain in 9 hours**
- **Over \$5B in structural damages**
- **One hospital evacuated for 30 days**
- **8 major TMC institutions with significant damages affecting operations**
- **Loss of Significant Medical Research**

Comparison

Hurricane Ike

September 12 & 13, 2008

Hurricane Ike – Sept. 13, 1:07 AM



Statistics

Formed September 1, 2008

Dissipated September 16, 2008

Highest winds 145 mph (230 km/h) (1-minute sustained)

Lowest pressure 935 mbar (hPa; 27.62 inHg)

Fatalities 126 direct, 38 indirect, 202 missing

Damage \$31.5 billion (2008 USD)

(Third costliest tropical cyclone in U.S. and Atlantic basin history)

Areas affected Turks and Caicos, Bahamas, Haiti, Dominican Republic, Cuba, Florida Keys, Mississippi, Louisiana, **Texas**, Mississippi Valley, Ohio Valley, Great Lakes region

Hurricane IKE

September 13, 2008



- **Size**–Ike's tropical storm force winds stretched over 510 miles, about 70 percent larger than an average Hurricane.

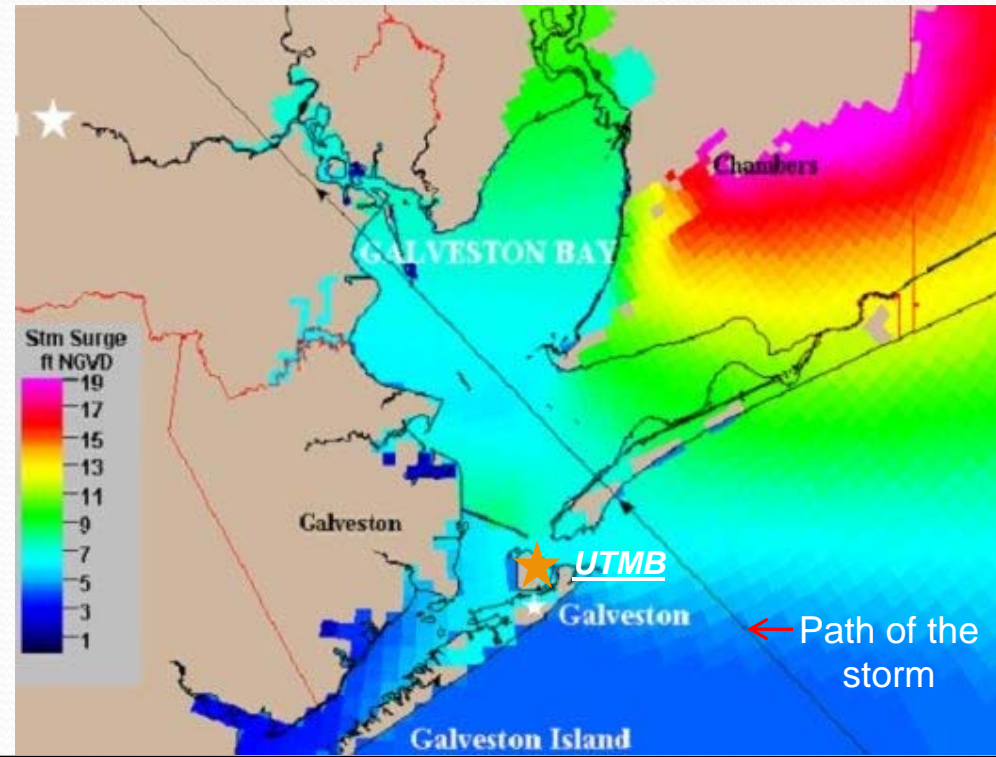
Wind Speeds

Before landfall and at landfall, Ike's winds ranged from 92-110mph based on NOAA/NWS Galveston's report.



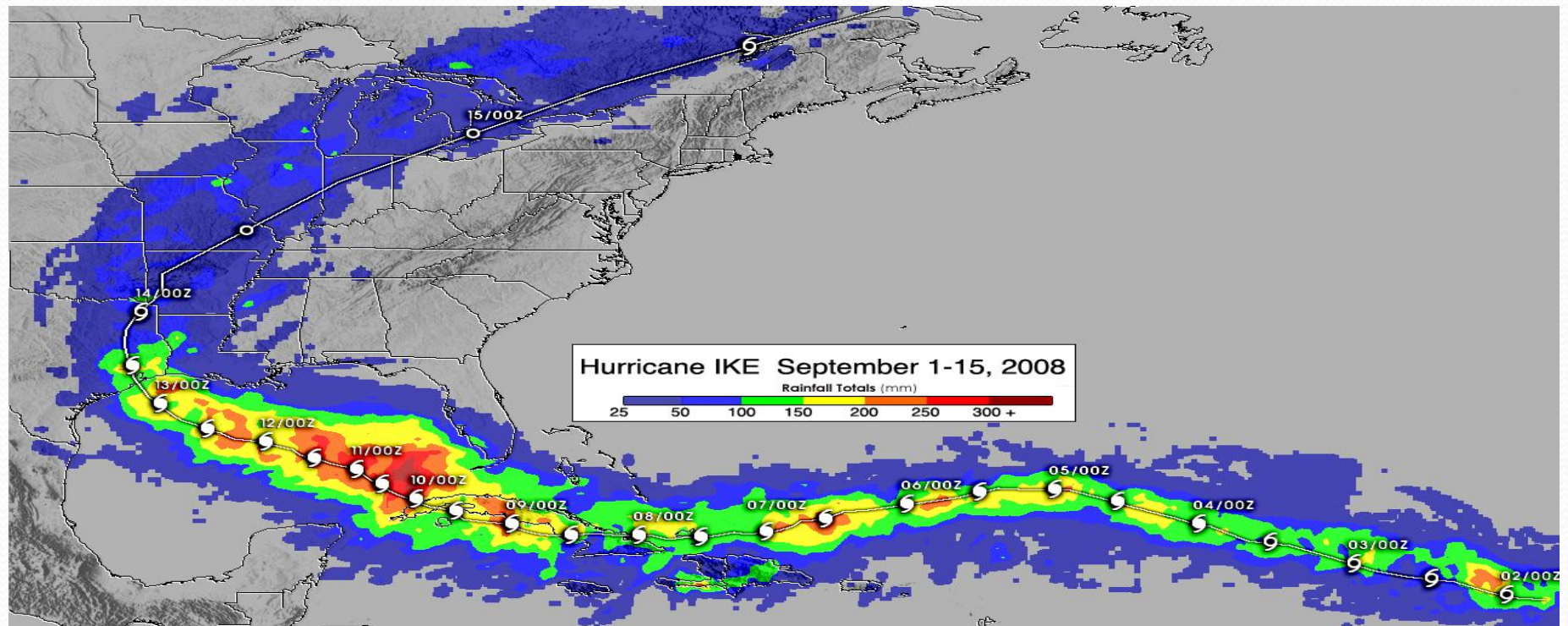
Storm Surge

- **Water/Storm Surge** – Approximately 17ft to 18 ft based on the information gathered to date. NOAA
- **Timing at High Tide** –landfall at approximately 2:10 AM, 2 hours and 4 minutes before the scheduled morning high tide on September 13, 2008 at 4:14am.



Rainfall

Rainfall – ranged from 3.94 inches to 7.87 inches



Impact to Galveston Island

Damage to Galveston Island included the loss of the famous Balinese Room and many homes on Galveston and the Bolivar Peninsula.



The Storm

- Friday morning – rising water in low lying areas



The Storm

- Galveston Yacht Club Fire closes Emergency Department



Aftermath

- The estimated cost to UTMB - \$710 million, including:
 - patient evacuation,
 - student relocation,
 - building damage,
 - campus cleanup,
 - infrastructure and equipment replacement, and
 - business interruption



Comparison

- Allison
 - Rainfall Event
 - Significant overbank flooding
 - No significant impact to Galveston
- Ike
 - Wind and Storm Surge event
 - No significant overbank flooding outside of surge influence
 - No significant impact to the Texas Medical Center

The Response

Post Tropical Storm Allison

June 9, 2001 to June 2002

The Response – Stabilize Facility and Patients

- Move patients to safe areas
 - Shuttle between hospitals
 - Move to areas with power
 - Bring essential staff in as quickly as possible
- Stabilize the facilities
 - Attend to emergency generators
 - Begin water removal
 - Block off unsafe areas
- Review supplies

The Response - Restore operations to the extent possible

- Review situation with Management
- Activate Emergency Procedures and Policies
- Address the staff and the public
- Contact FEMA
- Acquire Critical equipment
 - Generators
 - Pumps
 - Medical Supplies

Damages in TMC Garage #1



Damages to Basement Offices



Water Pressure Blowouts



The Response – Evaluate the Situation

- Assess damages
- Operations and Facilities personnel review
- Professional Consultants familiar with the facilities brought in to assist
- FEMA contacted and brought in to assist
- Construction Community supplied workers to provide necessary labor

St. Luke's ER Ramp



The Response – Interim Repairs

- Temporary Generators
- Temporary Chillers
- Clean up
 - Pump water
 - Restore Power Equipment
 - Repair facilities

Flood Gate Testing



Flood Door Installation



The Response – Facility Restoration

- Evaluation of best practices
- Replacement of critical equipment above 0.2% flood elevation
- Flood protection of exposed areas constructed
- Backflow valves on all gravity systems serving ground floor and below

Ike's Response

- The same scenarios are underway today
- Different set of concerns
 - Wind
 - Surge
- Go forward lessons from Allison should serve respondents well

Disaster Mitigation Planning

Post Tropical Storm Allison
June 2002 to June 2008

Disaster Mitigation Planning

- Stafford Act – DMP funding for communities
 - 20% available with DMP
 - Addresses all types of potential disasters
 - Eligible for funding for improvement grants
 - Eligible for improvement grant money from other disaster pools
- Allowed each institution to prepare a DMP
- Coordinated individual plans with overall TMC plan

Policy Review and Modifications

Tropical Storm Allison
June 2002 to Present

Notifications from TMC

No Action
Required

- Named storm enters the Gulf of Mexico**
 - **2nd notification 24 hours from land fall**
 - **Continual notification every 6 hours**
- National Weather Service Storm Alert**
- Office of Emergency Management gauge at Brays Bayou**
- National Weather Service Storm Warning**
- Judgment Calls**
- 7' elevation at Harris Gully Box Culvert**
- 10' elevation at Harris Gully Box Culvert**
- Main Street gauge reaches 36'**
- Braeswood Bridge gauge reaches 31'**

Action
Required

Policy Revisions

- Changed covenants establishing minimum flood protection elevation to index to current FEMA Maps
- Required institutions to provide isolation switch on electrical service
- Created agreements between institutions connected below grade
- Adopted a master plan policy promoting sky bridges between institutions

Status Today

June 23, 2008

Berm Protected Area



Active Exterior Protection



Then and now



Status Today

- All Texas Medical Center Institutions have installed flood protection in excess of the 0.2% (500-year) flood
- All new construction is being protected to the 0.2% flood, even during construction
- Disaster Mitigation Plans are filed with FEMA
- City constructed FEMA funded improvements to Harris Gully in place
- Updated Flood Alert System in Place
- Major expansion of the institutions underway
- No significant impact from Ike

