PERKINS + WILL

RESILIENCY

ANNUAL RESILIENCE WORKSHOP| FT WORTH TX| 06.19.2017

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AGENDA

What is resilient design?

Why resilient design?

What is the RELI Action List?

Case Study – OU Medical Center

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WHAT IS...

RESILIENT DESIGN /

Pursues Building + Communities that can survive, recover, grow and thrive when facing acute shock events or long-term stressors, through a combination of diversity, foresight and the capacity for self-organized and learning.

A RESILIENT SOCIETY /

Can withstand shocks and rebuild itself when necessary. It requires people to embrace their capacity to anticipate, plan and adapt for the future.

WHERE DOES RESILIENCY FIT?

ECOLOGICAL DESIGN

(5) CORRELATED LENSES THAT EMBODY EACH OTHER >

Alphabetical

•

Regeneration
Resiliency
Restoration
Sustainability
Wellness

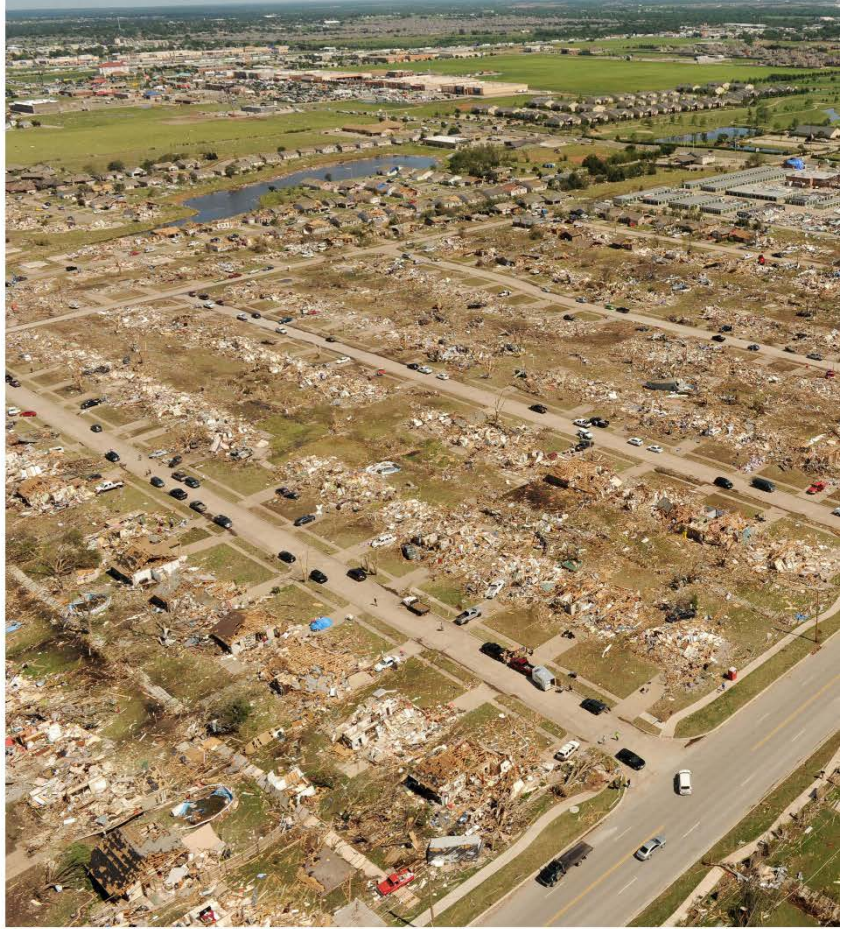
WHY RESILIENT DESIGN?

- **INCREASED OCCURRENCE /**
  of extreme natural events, acute events and chronic issues.

- **INCREASED AWARENESS OF AND DEMAND /**
  for resilient solutions by residents, business owners, and leaders at all levels in areas recently affected by acute events and those most likely to be affected in the future.

- **INCREASED PRESSURE ON CITIES AND BUSINESSES /**
  to protect populations and investments.

- **INCREASED AWARENESS /**
  of the link between climate change and population health.



NEWS

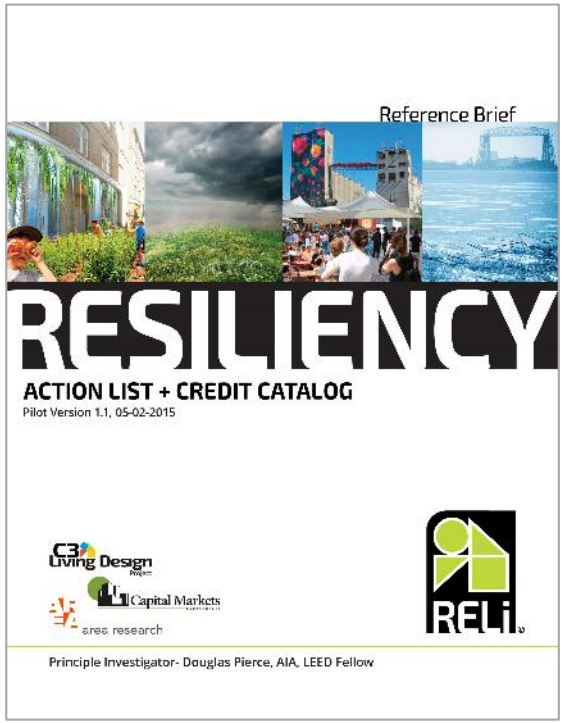
Chicago Tribune Farmer's Insurance filed 200 class action lawsuits against governments for failure to take aggressive resiliency actions from climate intensified storms causing damages to Farmer's from insurance claims paid.

New York Times *"The accelerating rate of climate change poses a severe risk to national security and acts as a catalyst for global political conflict"*

NBC *"Climate change is likely to be one of the global mega-trends impacting sovereign credit worthiness, in most cases negatively."*

Federal mandate to integrate resiliency strategies into all capital projects

RELi RESILIENCY ACTION LiST



NEW / December 1, 2014

National Consensus Standard

RELi <*Rely*>

REsiliency Action List

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C3LivingDesign.org / RELi

Balloted Standard READY FOR PILOTS

National Consensus Standard Using ANSI Approved Process

Referenceable By Governments

Consensus avoids Constraint of Trade Issues

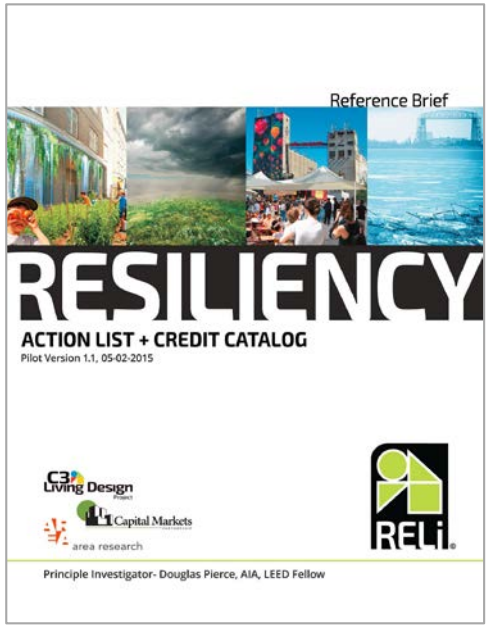
Process Administration

- Capital Markets Partnership / MTS
- 6,500 E-mails + Publications
- Public Meeting, Comment Period, Balloting: Fall 2014

Standard Available Mid-2015 at:

- ANSI Standards Store / Under MTS

RESILIENCY ACTION LIST / CATALOG
FILLING THE GAP



Unique Areas

- Hazards, extreme events, adaptation
- Strong ties to financing, regional economics
- Expanded social cohesion
- Expanded community + local self-reliance

Comprehensive

- Designed for scale-jumping
- City + Region → Campus + Site → Organization + Building
- Facilitates Correlated Risk + Co-benefits

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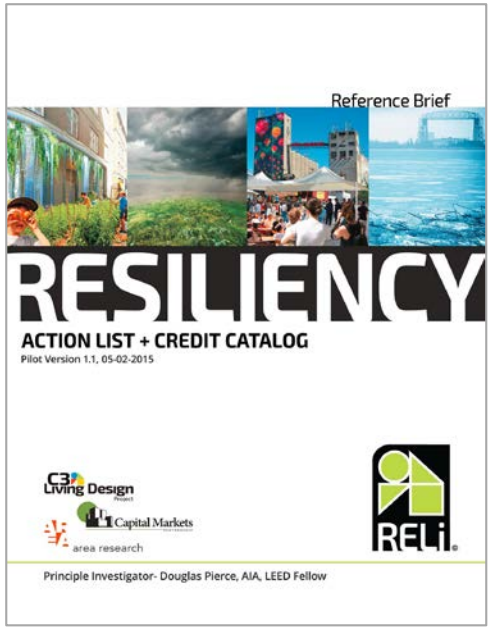
RESILIENCY ACTION LIST / CATALOG
DESIGNED FOR RAPID UPTAKE



Builds From Existing Knowledge

Compatible + Complimentary With:

- LEED, Envision, Living Building Challenge and More
- Urban Design + Architecture + Interior Design

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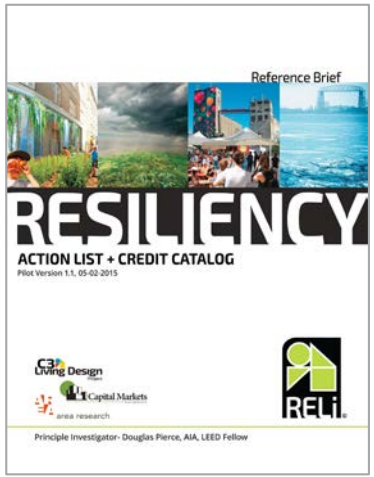
RELi REFERENCED ACTIONS



Unique RELi Prerequisites / Credits
Hazard Preparedness, Social Cohesion, Regional Economics

ANSI Integrative Process Standard (MTS Developed)
Integrative Living Design Planning Process (University of Minnesota)

Red Cross Ready Rating Program for disaster preparedness
FEMA 141 Guide: Emergency Management Guide for Business + Industry
U.S. Small Business Administration + Prepare My Business.Org

Fortified for Safer Business Standard V1.0
Urban Green Building Resiliency Task Force, June 2013 Proposals (NYC)
EPA Vulnerable Zone Indicator System + EnviroFacts
Nuclear Regulatory Commission / Academy Of Sciences

Envision Sustainable Infrastructure Rating System V2.0
Center for Active Design
Sustainable Sites Rating System V2
LEED V4 and V2009 / NC, ND + Schools
Energy Star / 2030 Palette

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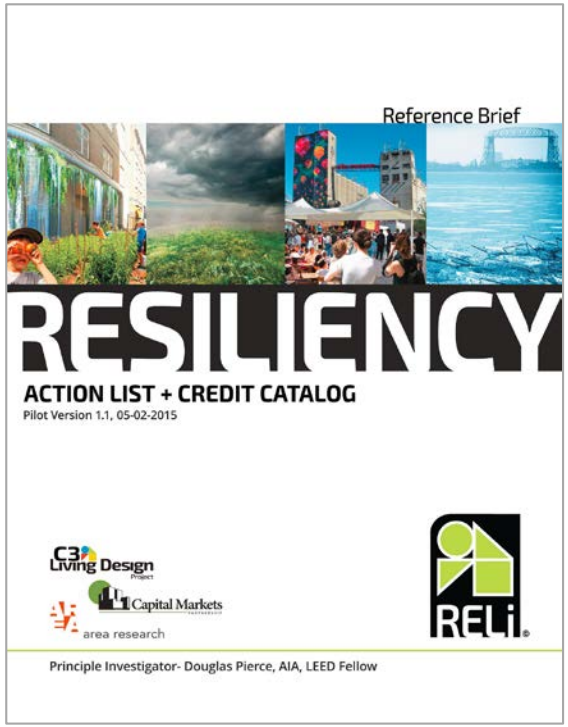
RELi RESILIENCY ACTION LIST



SCALES INCLUDED

Structures

- Infrastructure
- Buildings
- Homes

Communities

- Neighborhoods + Districts
- Campus

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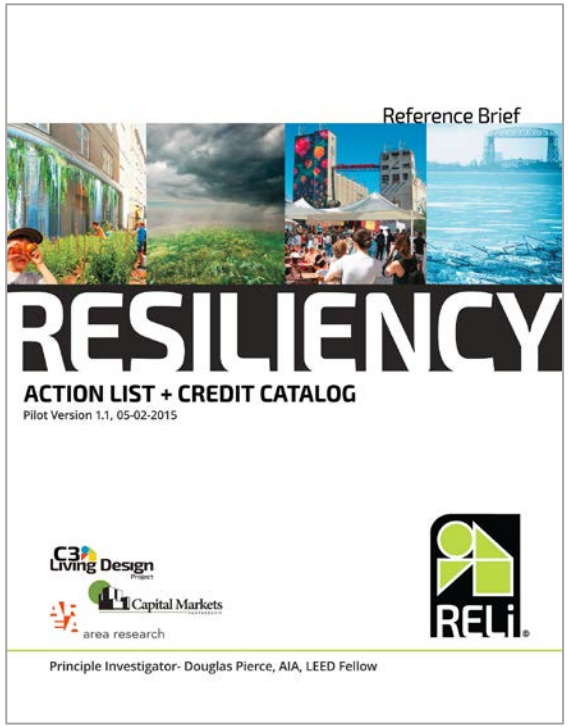
RELi RESILIENCY ACTION LIST



(8) Categories:

PA Panoramic Approach

Risk Adaptation + Mitigation: Acute Events

HP Hazard Preparedness (Readiness)

HA Hazard Adaptation + Mitigation

Comprehensive Adaption + Mitigation

CV Community Vitality

PH Productivity, Health + Diversity

EW Energy + Water

MA Materials + Artifacts

Innovation + Creativity

AC Applied Creativity

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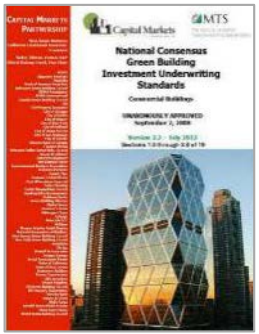
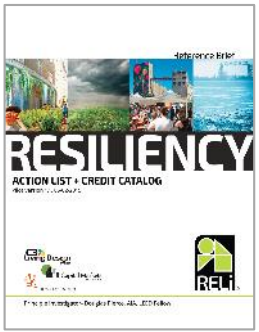
GREEN + RESILIENT VALUE SCORE©





20 TANGBILE ACTIONS

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PANORAMIC APPROACH / PLANNING + OPERATIONS

- Short-Term Hazard Preparedness
- Integrative Process (IP)
- Commissioning

RISK ADAPTATION + MITIGATION

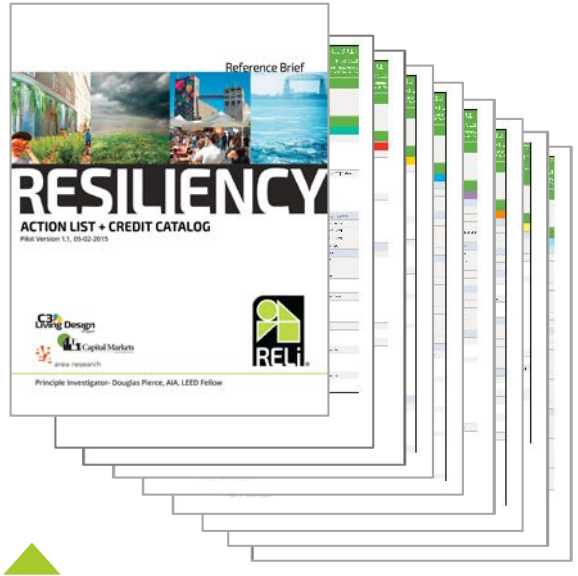
- Extreme Events Planning
- Back-up Power or Access / Thermal Safety
- First Aid, Communications, Food, Potable Water
- Avoid Flood Plains (500 YR), Storm Surge + Sea Rise
- Safer Design for Extreme Weather, Wildfire, Fire + Seismic Events
- Extreme Stormwater and Flood Management
- Transit + Transportation Connectivity + Protection

COMPREHENSIVE ADAPTATION + MITIGATION

- Protect Wetlands + Avoid Steep Slopes and Adverse Geology
- Resilient Food Production Access, Edible Landscapes / Urban Ag
- Legally Logged Wood Certification
- No Pesticide or Herbicides (Integrated Pest Management / Native + Adapted)

- Density / Connectivity
- Heat Island Effect
- Water Efficient Landscaping / Water Use Reduction
- Energy Efficiency / On-Site Renewable Energy
- IEQ: Outdoor Air Monitoring / Increased Ventilation / VOC's + Daylight & Views

RELi RESILIENCY ACTION KIT



3 PART KIT

C3livingdesign.org / RELi

ACTION LIST
Summary /
60+ Actions

PROJECT TALLY
Tracking /
Excel Spreadsheet

CREDIT CATALOG / On-Line Reference Brief
Comprehensive /
200+ Actions and How-To-Use

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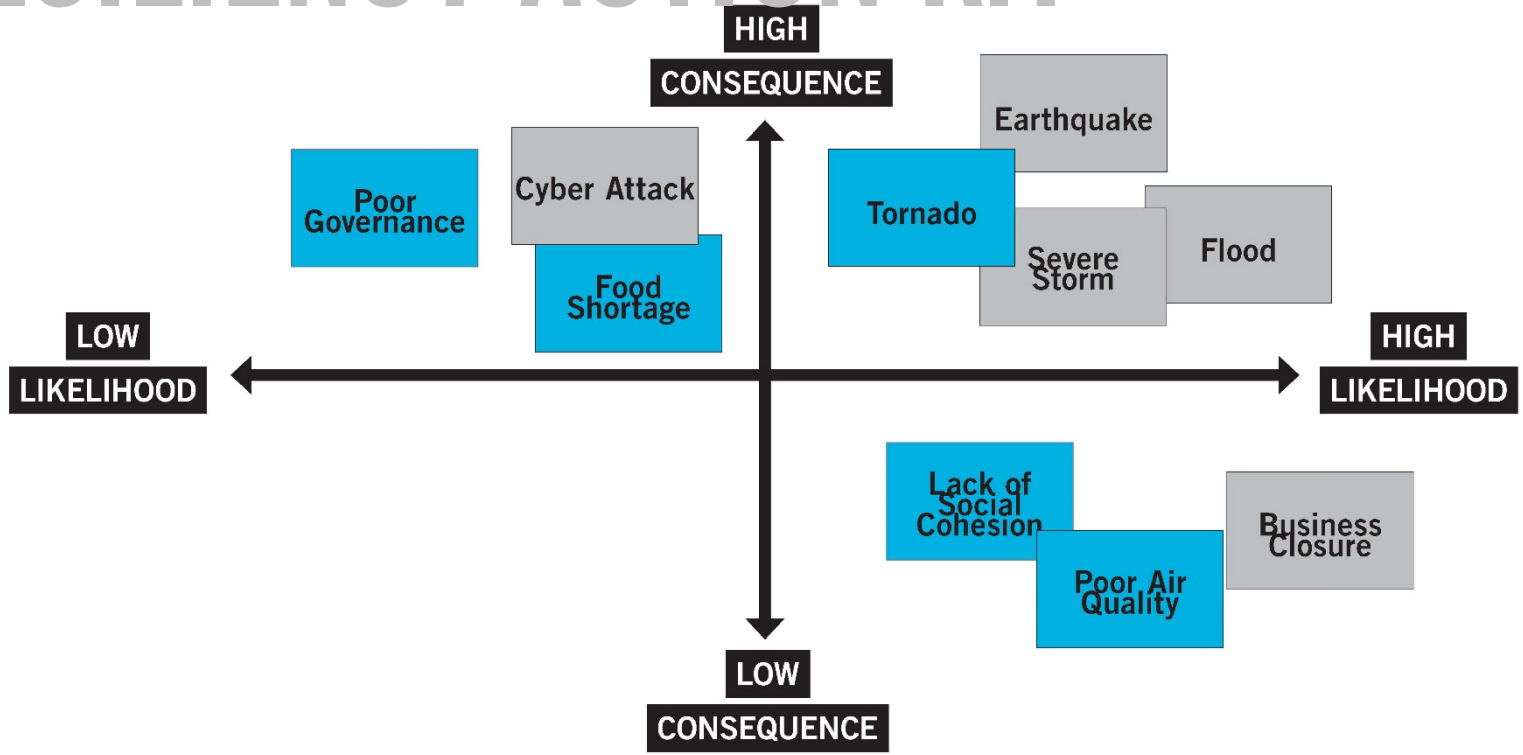
RESILIENCY ACTION KIT



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CASE STUDY
OU MEDICAL CENTER

PROJECT SCOPE

- 10 story tower addition
- Dock, central plant
- Public functions/education space
- Nursing units with areas of respite
- 2 surgical floors
- Mechanical interstitial floor

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OU Medical Center

SHOCKS+STRESSORS
OKLAHOMA CITY

UNDERSTANDING CHALLENGES:

ACUTE SHOCKS /

Quick impacts from extreme social, environmental, and economic events

SOCIAL /

- Bias crime
- Civil unrest
- Terrorism
- Infrastructure failure
- Disease outbreak
- Fuel supply disruption
- Blackout

ECONOMIC /

- Cyber attack
- Regulatory Changes
- Business closure
- Stock market crash
- War

ENVIRONMENTAL /

- Tornadoes
- Extreme rainfall
- Flood
- Severe storm
- Earthquake
- Extreme heat or cold
- Wildfire
- Snow/Blizzard
- Severe ice storm
- Freezing

UNDERSTANDING CHALLENGES:

CHRONIC STRESSORS /

Lingering impacts from repeated exposure to social, environmental, and economic problems

SOCIAL /

- Aging
- Disability
- Disease
- Homelessness
- Low education
- Language barrier

ECONOMIC /

- Debt
- Poverty
- Recession
- Unemployment

ENVIRONMENTAL /

- Air pollution
- Coastal erosion
- Deforestation
- Drought
- Species engagement
- Water scarcity

ENVIRONMENTAL

SHOCKS:

Tornadoes

- 7% increase from 1950

Earthquakes

- 23% increase from 2015

Extreme Heat Days

- 9% increase since 1978

Extreme Rainfall

- 16% increase from 1958

Ice Storms

STRESSORS:

Air Pollution

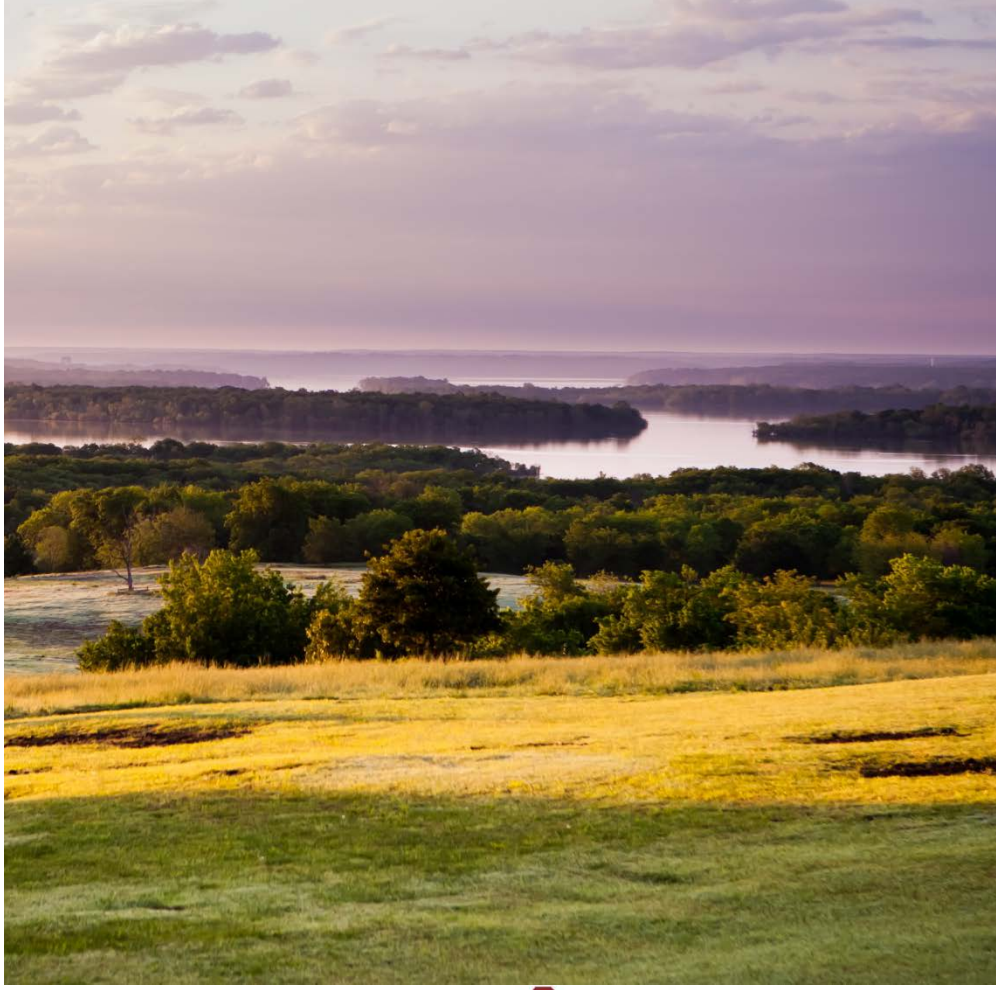
- 15th worst city (ALA)

Drought

- 23% increase from 2015

Water Scarcity

Deforestation



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ECONOMIC

SHOCKS:

Business Closure

Regulatory Changes

STRESSORS:

Unemployment

- 4.3% (approx. 28,000 people)

Poverty

- 16.1% Ranked 38th

Loss of Low-Skill Labor

Increasing Debt

SOCIAL

SHOCKS:

Pandemic

Civil Unrest

Regional Violence

Terrorism

Infrastructure Failure

STRESSORS:

Poor Health

- 22% uninsured (139,828 people)
- 6th highest % of uninsured in the United States

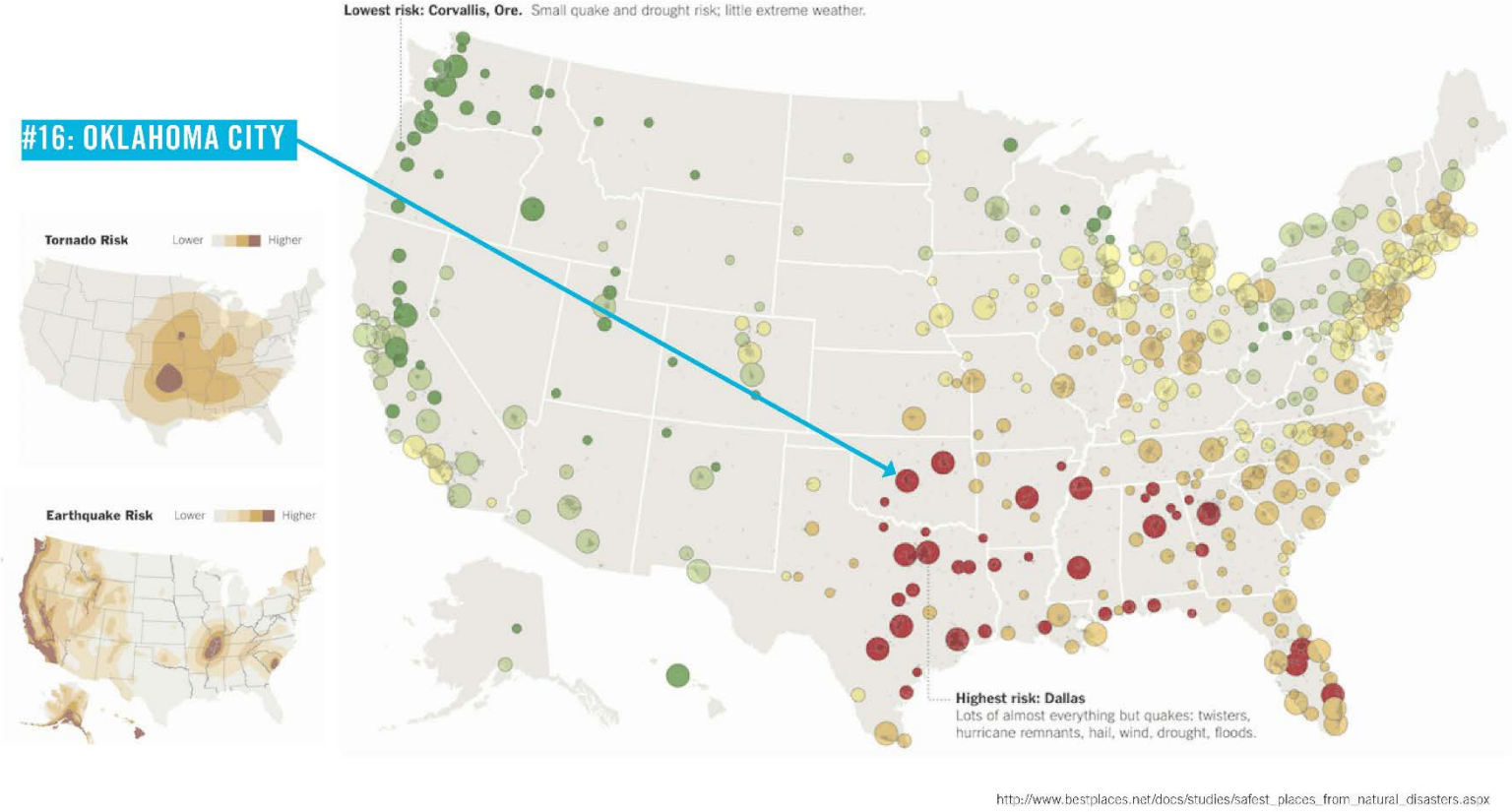
Social Inequality

Unequal Education System

Homelessness

Aging + Disability

CLIMATE PROJECTIONS
OKLAHOMA CITY



http://www.bestplaces.net/docs/studies/safest_places_from_natural_disasters.aspx

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May 20, 2013, an intense and destructive **EF5 tornado** struck Moore, OK., killing 24 people and injuring 377.

The storm travelled at **34** mph for 17 miles

WIND SPEED

Tornado top winds +200 mph

Hurricane Katrina estimated top winds

175 mph

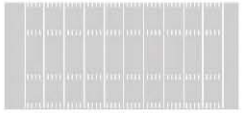
Avg. speed of Daytona 500 winner

153 mph

WIDTH

The 1.3 mile wide path is equal to

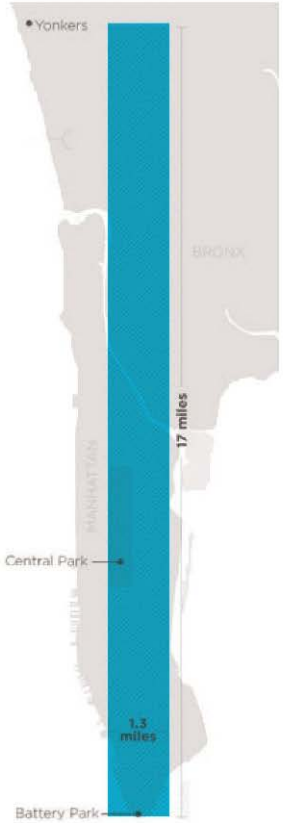
19 Football fields side by side



AREA

The square miles that the Moore tornado's path covered is equal to

96% of Manhattan



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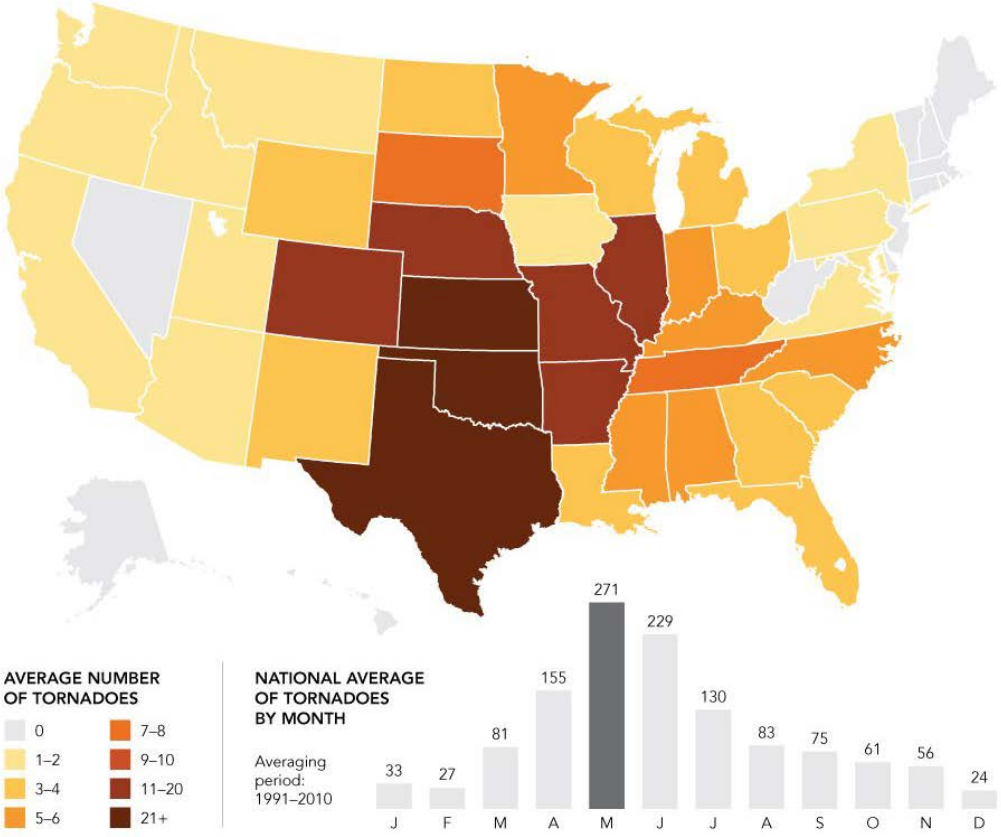

Source: National Oceanic and Atmospheric Administration National Climatic Data Center

THE HUFFINGTON POST

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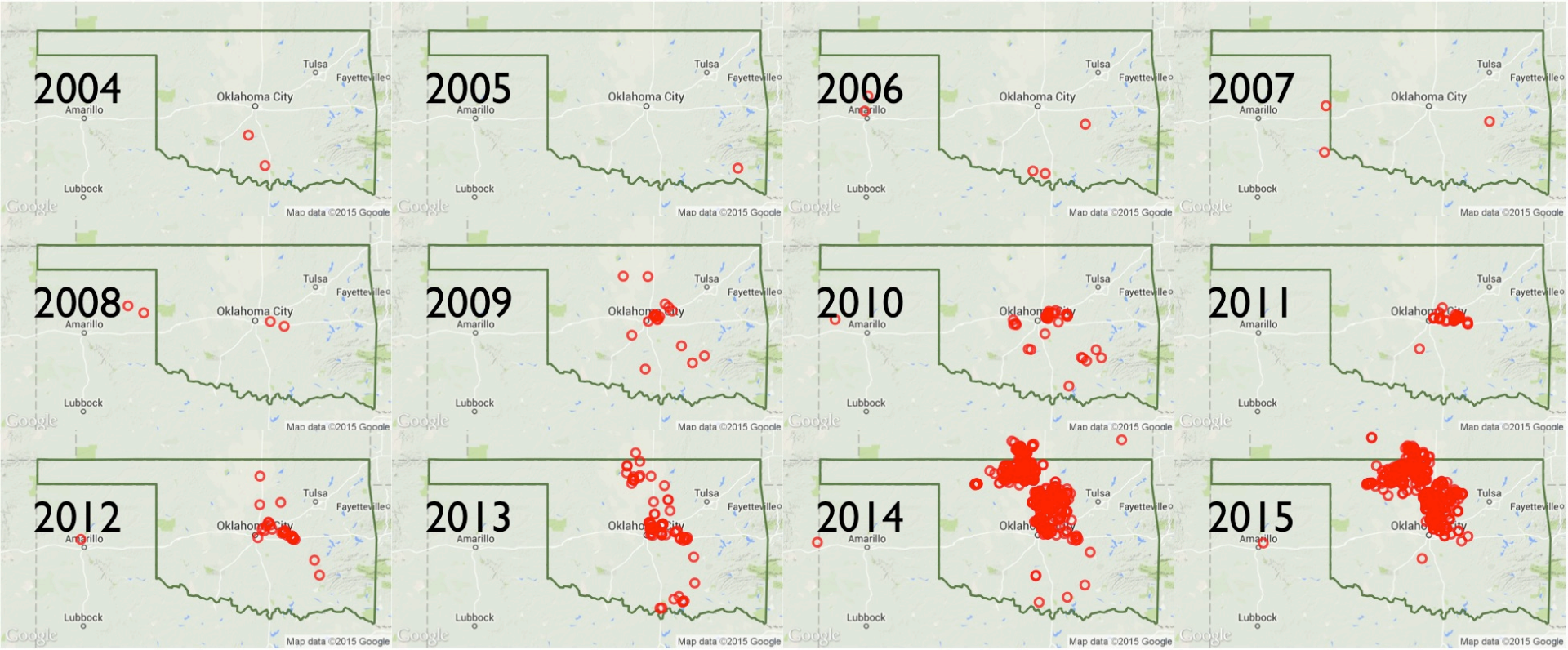

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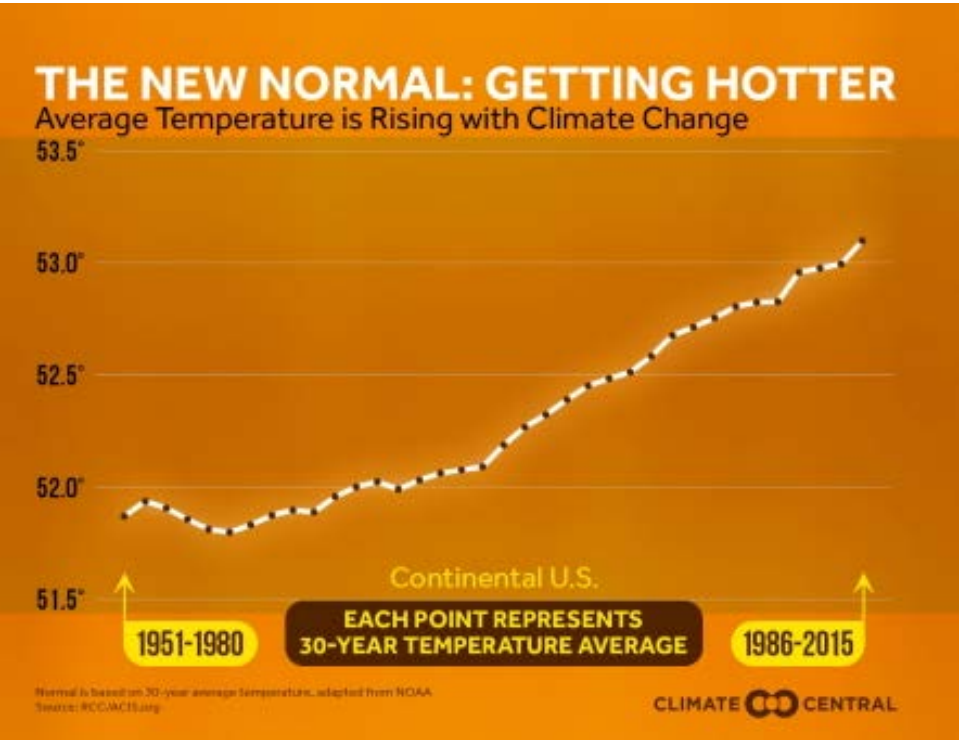

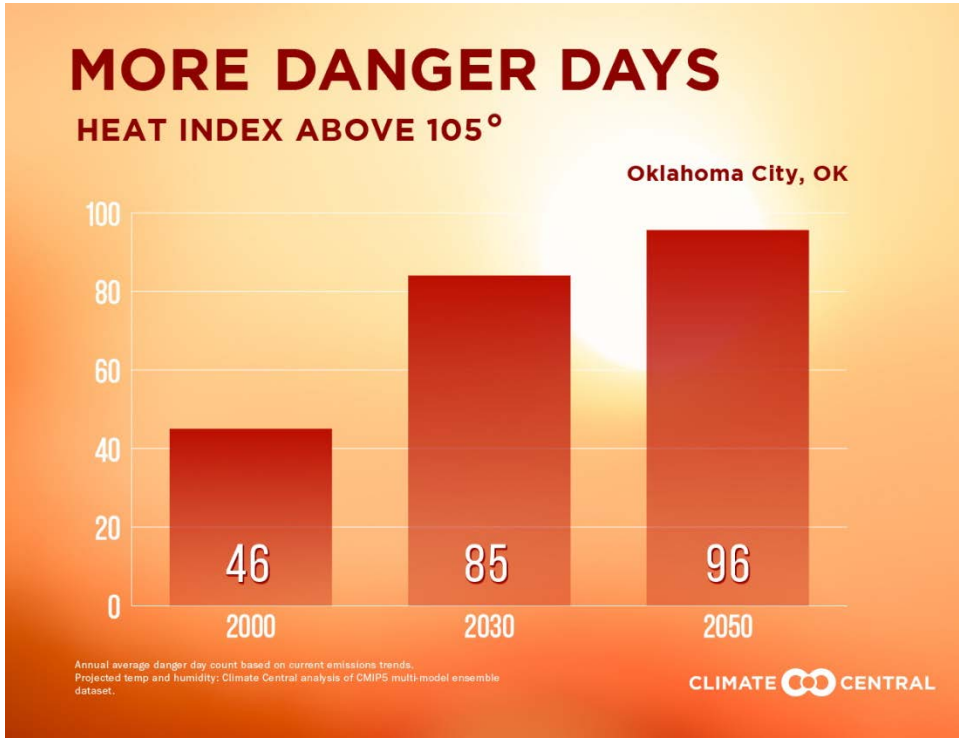

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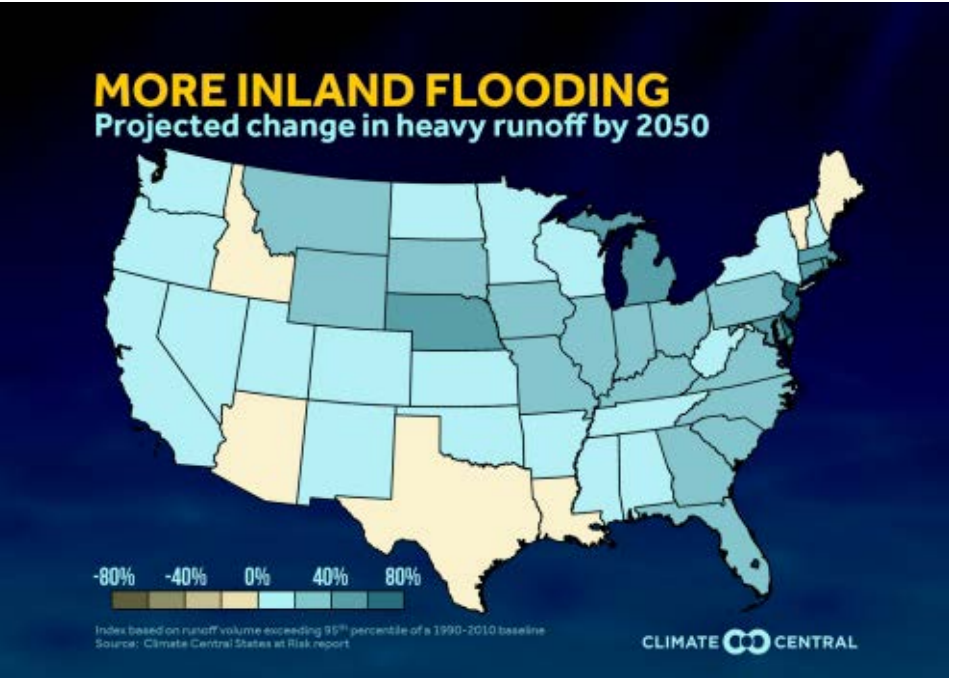

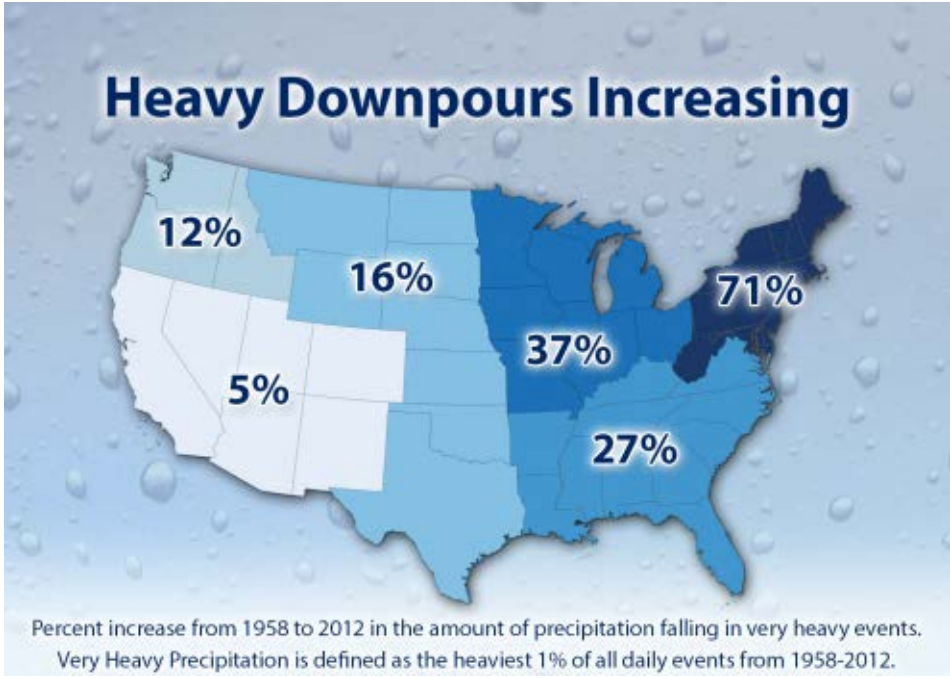

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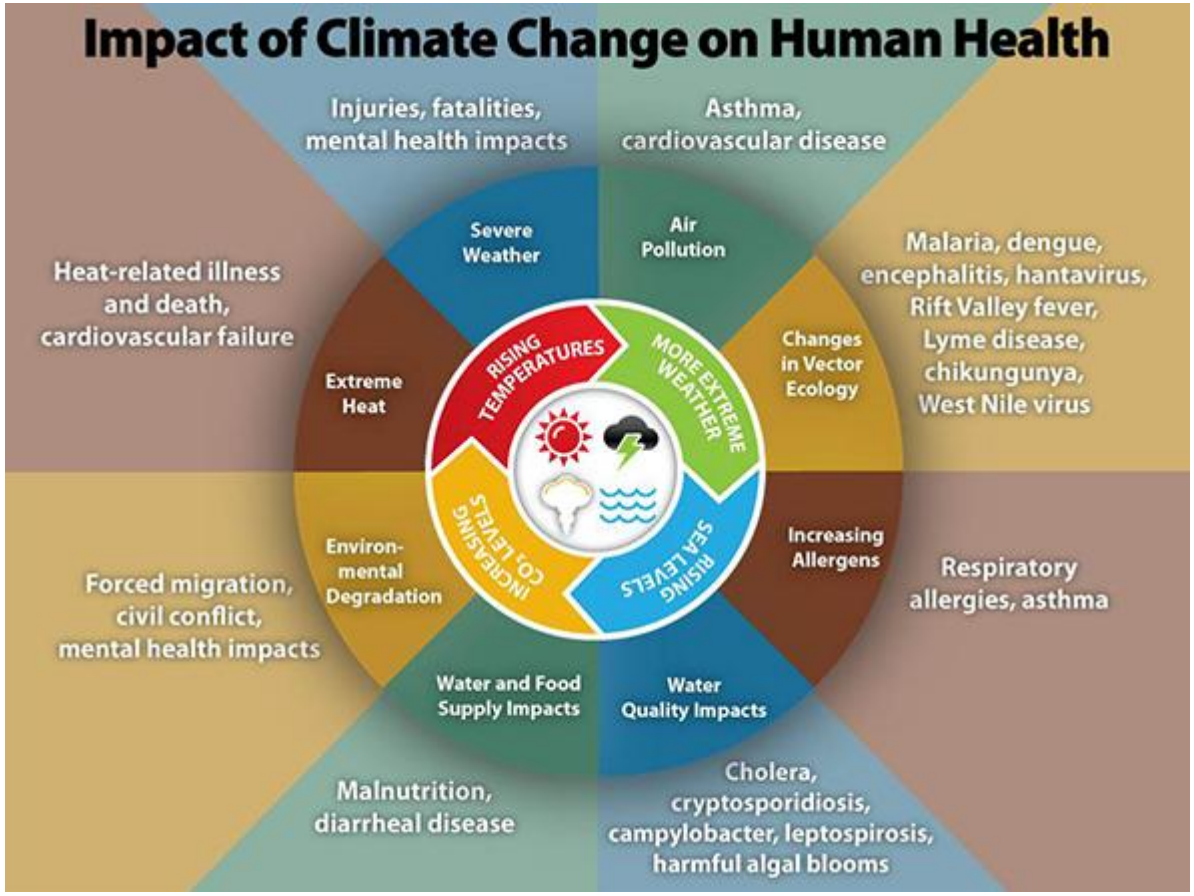

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PROJECT GOALS + STRATEGIES

HAZARD PREPAREDNESS /HAZARD ADAPTATION + MITIGATION /

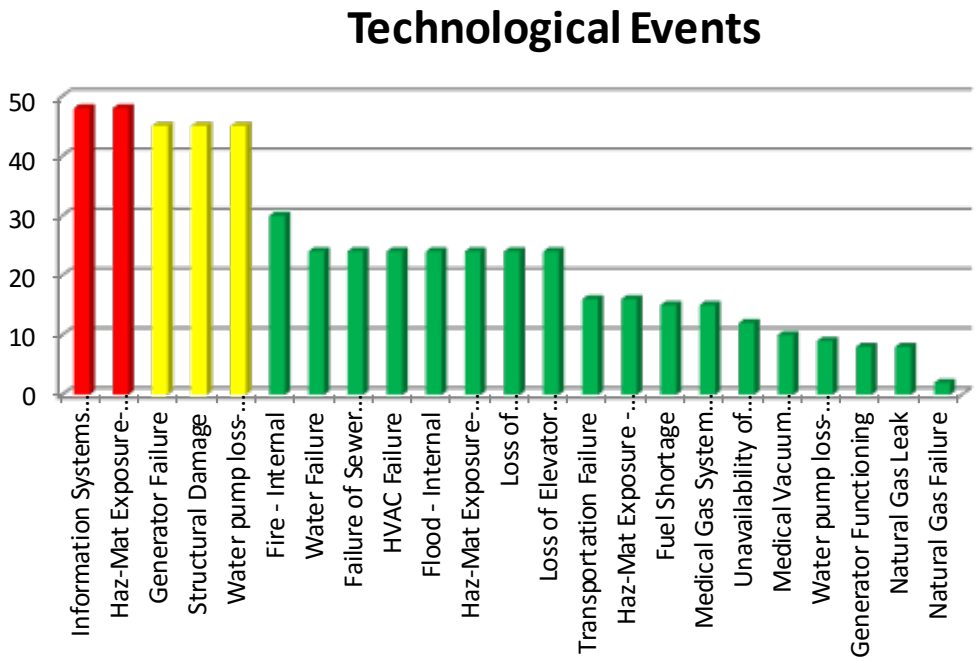
Information System Failure
- System Redundancy/Redundant Conduit
- Controlled access to the server room/secure barrier
- Cooling

Haz-Mat Exposure - External
- Evacuation Plan/Map oil piping locations
- Carbon filters

Generator Failure
- Thermal safety – level of cooling/level of Back-Up Power A3

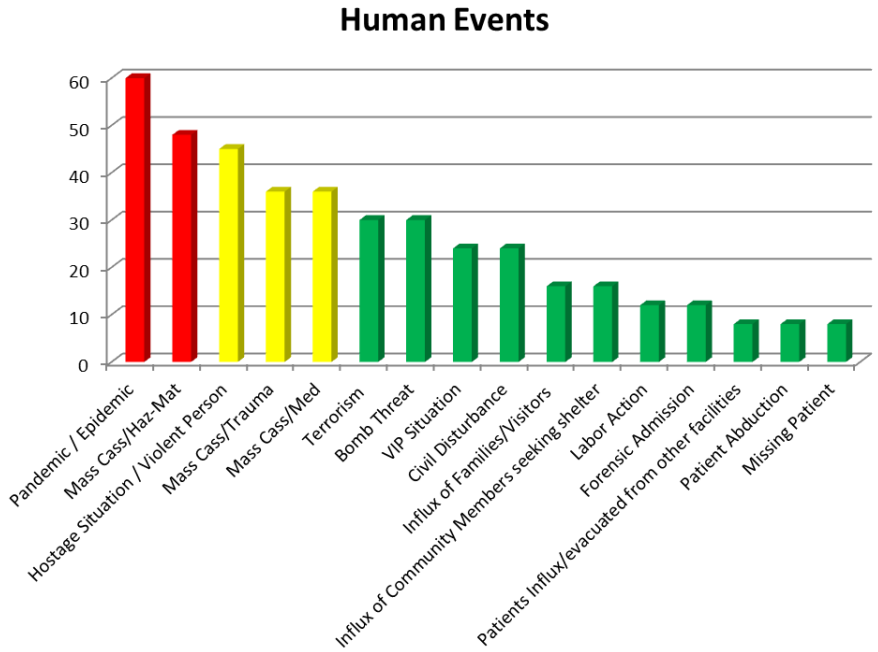
Structural Damage
- Core hardening A3
- Primary structure to be studied by engineer

Water Pump Loss
- Provide a secondary service A3
- 7000 gallon domestic storage & a fire water storage tank in the basement
- KHA studying a second water well
- Back-up fire water storage at code minimum – 2012 code
- New fire pump room likely



HAZARD PREPAREDNESS /HAZARD ADAPTATION + MITIGATION /

- Pandemic/Epidemic
  - Isolation of a half or whole floor A3
    - Typically top floor with exhaust on roof and isolated dampers
    - Special attention to skin type with an entire floor on negative pressure
- Hostage Situation/Violent Person
  - Segregate units for gang violence
  - Access control
  - Lockdown - cameras/zoned areas
  - Security guard at 1st floor public elevator lobby to document all visitors
  - Secured wait/toilets off of public elevator lobby on each unit with a window to address the unit clerk
  - Ballistic proof reception desk with a safe room adjacent
  - Controlled access to the fire command & elevator control rooms
- Mass Cass Trauma/Medical
  - Community Gathering Space on first floor
  - Ballards



HAZARD PREPAREDNESS /HAZARD ADAPTATION + MITIGATION /

Tornado/High Winds

- Glazing quantity/placement/strength A3
- Shelter in Place strategy/core hardening A3
- Operable windows A3
- Location of 4 day supply of first aid, emergency supplies, food, water and communication

Ice Storm

- Essential heating on emergency power
- Avoid falling ice at entries – soffit
- Redundant roof drains
- Radiant heating at walks
- Landscaping planned for ice to eliminate falling limbs or hazardous situations

Earthquake

- Engineers to study primary structure in comparison to OSHPD (California Seismic Code)
- Interiors to plan for cabinetry fasteners, etc./Bracing of piping for critical items

Blizzard

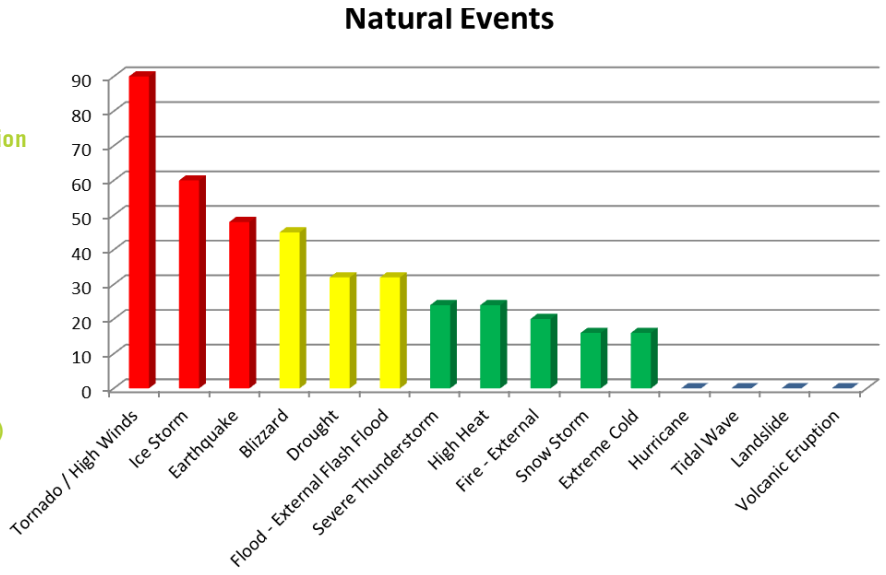
- Internal wind study to study snow drift impacts
- Canopies eliminated with large soffits in place

Drought

- Low flow fixtures
- Native plants/Roof garden

Flood – External Flash Flood

- Slope away from entries/basements with area ways/add trench drains and gravel swells to landscaped areas



BENCHMARK / RESILIENCY + SUSTAINABILITY

- Health + Wellness
- Seamless Operations
- Resilient Construction
- Climate Adaptation
- Design for Tornado and Wind Effects
- Regional Response
- Community Connection
- Reduce energy + water Consumption
- Increase Permeable Surfaces
- Passive lighting + cooling techniques


THANK YOU!

APPENDIX

A3

Emergency Power Capacity

Objective:
To evaluate the appropriate level of emergency power.

Background:
A hospital structure, as designed by code, achieves a common level of safety found in all hospitals built in the same region of the country. However, there are additional features beyond code minimum that can be considered.

Attribute of each system:

A. Existing Design Proposal (Three 2500KW Generators + Two 20,000 gallon fuel tanks:
Pros:
- Provides N+1 generator coverage of emergency power.
- Tanks provide 96 hours fuel coverage.

Cons:
- If travel is shut down for more than 96 hours, the facility could run out of fuel.
- Only emergency power is covered. Normal power would be down and hamper operations.

B. Add a 3rd fuel tank:
Pros:
- Adds 50% more fuel capacity to generator design.
- Would be adequate coverage to handle a future generator added to the mix.
- There is adequate space for a 3rd tank in the loading dock driveway.
- With 3 fuel tanks, 3 generators could run emergency power for 141 hours.
- With 3 fuel tanks, 4 generators could run for 106 hours, covering emergency power and normal power.

Cons:
- Additional cost of an additional fuel tank.

C. Add a 4th generator and switchgear to the design, to cover normal power:
Pros:
- The hospital would essentially have it's own generator plant for full operation capacity.

Cons:
- Additional engineering cost, and additional construction hours.
- Careful coordination required to the existing facility in making modification to the normal power system.

System Diagrams:.

Cost & Schedule Implications:
TBD

Conclusion:
The risk team recommends adding a 3rd fuel tank now, while the truck drive is under construction. This will add valuable hours to emergency power, and will also be ready to adapt to a 4th generator longer term – if consideration is given to a long term plan to implement normal power backup.

Approval of Option:
OU/MC/UHAT: _____
Perkins+Will: _____
Turner: _____

OU MEDICAL CENTER HOSPITAL EXPANSION
02/28/2017

OU Medical Center

PERKINS+WILL
Turner

A3

Domestic Water Resiliency

Objective:
Plan for providing the code required dual water service to the expansion, creating a back feed for the existing hospital to provide a redundant service and a domestic water storage plan for loss of service.

Background:
The existing portion of OU Medical Center does not currently have a second domestic feed to the building and also does not have water a centralized water storage to meet their resiliency goals. A dual service is code required for the new tower expansion. In 2014 WSP+ccrd provided a study showing how a second service could be brought in to the existing hospital and benefit the new tower. Additional centralized water storage is also requested.

Drawings & Diagrams:
- Pictures from the 2014 report on tie in to existing.

Photo # 1 – Existing water service meter

Photo #3 – South wall of lower level mechanical room, location of two new reduced pressure backflow preventers

Attributes:
- Bringing a new service to the tower and back feeding the existing service meets the intent of the code for the new project, as well as providing redundancy for the existing deficiency.
  - The existing water meter is currently out of calibration and cannot be replaced or serviced due to a lack of the second service. The hospital domestic water charges are currently in-accurate.
- On-site domestic water storage as a contingency plan for a Level 1 Trauma center is a best practice for many hospitals and code required by some states, but not Oklahoma.
  - WSP+ccrd has recommended 12 gallons per bed of on site storage and confirmed this is acceptable by the facility. Space for the 7200 gallons of storage is currently allocated in the basement MEP area.

Cost & Schedule Implications:
TBD - Turner

Conclusion:

Approval of Option:
OUMC/UHAT:_____
Perkins+Will:_____
Turner:_____

OU MEDICAL CENTER
HOSPITAL EXPANSION

Medical Center

02/28/2017

PERKINS+WILL

Turner

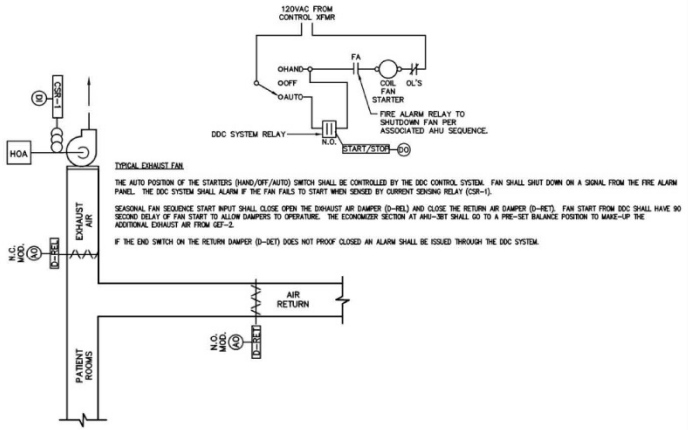
A3

Isolation Floor

Objective:
Determine the resiliency need for a full patient floor that can be converted to from normal HVAC operation to full isolation exhaust for use during pandemic or epidemic needs to isolate a larger patient population.

Background:
Seasonal flu isolation and local epidemics can require isolation and monitoring of a patient population greater than the code minimum required isolation rooms provided in new hospital construction. As a level 1 Trauma Center it is being studied to provide flexibility in the HVAC system to provide isolation on a single patient floor to accommodate the larger population and allow nursing staff to treat them in the same unit.

Drawings & Diagrams:



02 GEF-2 - SEASONAL EXHAUST CONTROLS DIAGRAM
SCALE: NTS

Attributes:

- A single patient floor can be converted to isolation using additional motorized dampers to isolate the return duct system from the remainder of the building served by the same air handling unit and adding an isolation exhaust fan that would use the isolated return duct.
- The air handling unit will need to be capable of cooling the additional outside air required from this exhaust system.
- The general exhaust system serving toilets, soiled utility rooms, etc. would still continue to serve the proposed seasonal isolation floor.
- The most cost effective floor to be used for seasonal soletion would be the 8th floor.

Cost & Schedule Implications:
TBD - Turner

Conclusion:

Approval of Option:
OUMC/UHAT:_____
Perkins+Will:_____
Turner:_____

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A3

Increased Envelope Impact Resistance

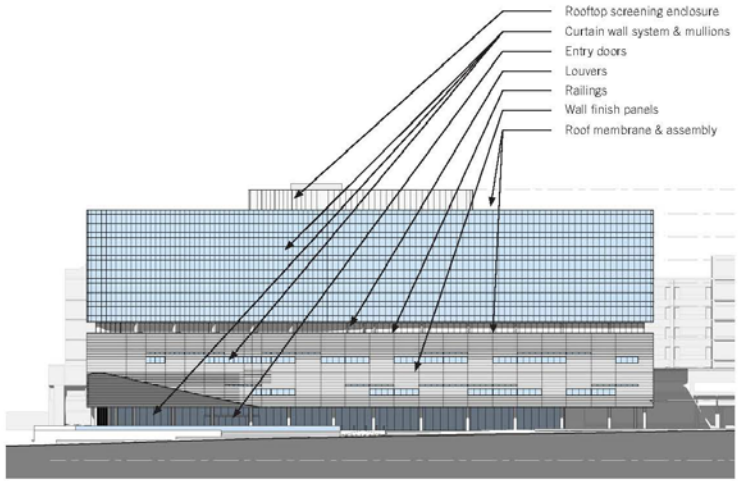
Objective:

To evaluate the benefits of increased impact resistance for facade components in order to mitigate the risk of damage due to extreme weather events.

Background:

Due to the potential for high winds, tornadoes, and hail storms in Oklahoma City, along with their increasing frequency due to climate change, improving the level of impact resistance of envelope components may be prudent. The potential benefits will be weighed against cost and schedule implications. No aesthetic implications are anticipated.

Drawings:



Exterior Envelope Components to Consider for Enhanced Impact Resistance

Referenced Standards:

- Exterior envelope components to meet standards for Large and Small Missile Impact Tests per Florida Building Code Section 1626 and Testing Application Standard 201-94.
- If additional precaution is desired, exterior envelope components to meet standards for Wind Load Pressure Tests per Florida Building Code Testing Application Standard 203-94.

Exterior Envelope Components to Consider:

A number of components may be considered if a more robust exterior envelope is desired, including but not limited to:

- Curtain wall systems & mullions
- Entry doors
- Roof membranes & assemblies
- Rooftop screening enclosures
- Railings
- Wall finish panels
- Metal panels
- Louvers

Cost & Schedule Implications:

Cost:

- Cost premiums for specific exterior envelope components are to be determined.

Schedule:

- Specifying more robust exterior envelope components is not anticipated to impact design schedule. Impacts to construction schedule may arise from required testing of assemblies or procurement of specific products certified to meet the given standards.

Conclusion:

To be determined upon discussion.

Approval of Option:
OUMC/UHAT: _____
Perkins+Will: _____
Turner: _____

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Emergency Operable Windows

Objective:

To evaluate the value of providing operable windows which will automatically open in case of prolonged loss of HVAC functionality. This would prevent overheating of building inhabitants.

Background:

Pertaining to heat loads, healthcare facilites tend to be internally loaded. In the case of prolonged HVAC functionality loss, heat loads build up and cannot be exhausted which can cause distress or serious health issues for patients and staff. By providing select windows which open automatically in the case of HVAC loss, this can be avoided.

Images & Diagrams:

Similar Condition Shown at Spaulding Rehab Hospital, Boston, MA

Potential North Elevation Operable Window Layout

Attributes:

- Operable windows in the bed tower may be designed such that they will be mostly indistinguishable from the surrounding fixed glazing, or they can be expressed. If expressed, the pattern of operable panes may serve to modulate the rhythm of the facade.
- The windows may be detailed such that they are not manually operable in order to prevent unintended use by patients and/or staff. To function automatically, an electronic control system would be provided which ties into a larger building management system. This would activate the window operation via emergency power in case of a prolonged loss of standard electrical power.
- Providing operable windows in the patient rooms would allow patients to remain in place for longer periods of time in the case of HVAC loss.

Cost & Schedule Implications:

Cost:

- The cost premium for introducing automatically operated windows in the bed tower is to be determined.
- The cost premium for introducing automatically operated windows at the O.R. levels is to be determined.

Schedule:

- Specifying automatically operated windows is not anticipated to impact design schedule but may impact the construction schedule due to the installation of an automated window control system.

Conclusion:

To be determined upon discussion.

Approval of Option:

OUMC/UHAT: _____

Perkins+Will: _____

Turner: _____

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Perimeter/Core Hardening for Storm Safety

Objective:
To evaluate the appropriate level of safety during a tornado impact event.

Background:
A hospital structure, as designed by code, achieves a common level of safety found in all hospitals built in the same region of the country. However, there are additional features beyond code minimum that can be considered.

Attribute of each system:

A. Code Minimum Design:
Pros:
- Provides a floor structure that should be able to safely withstand any tornado event with little to no damage.
- Patients could be moved to rooms away from perimeter walls where they would have additional layers of protection from flying projectiles that might come through windows. Projectiles would have to go through an exterior wall, then pass through an interior stud partition (typically 20' or more from the exterior wall in the bed tower). Or wind pressure would have to knock down both systems in order to endanger the next space.
- On surgery floors, the rooms are typically not along exterior walls, so the patients will already have at least 2 partitions protecting them from exterior elements.
- Least expensive option.

Cons:
- In the most severe of events, potentially all interior walls could be blow out of the floor, even though the floor slabs of this structure type are rarely affected by severe weather.
- Pre-OP and PACU spaces would need to delay scheduling patients along perimeter bed locations during a severe weather warning.

B. Reinforced Stud Wall Construction: Exterior heavy gauge studs spaced 8" on center instead of the typical 16" on center.
Pros:
- System remains lightweight, without affecting loads on the floor slab.
- System remains more flexible under wind pressure, which can be safer from collapse, and safer from becoming a projectile.
- Relatively inexpensive.
- Will combine nicely with hurricane grade window construction (presented in a separate A3 report).

Cons:
- Difficult to validate effectiveness in the unpredictable nature of severe wind events using metal framing. But definitely a signification strength increase from the base design.

C. Concrete masonry unit wall cores:
Pros:
- Maximum impact protection from flying objects.

Cons:
- Additional cost and additional trade on the job site (slower construction).
- If the masonry wall fails, it is more dangerous as more weight is falling.
- The heavier load might require a slight increase in slab reinforcing.
- Thicker walls take away functional space from the building footprint (20-40 SF minimum from each bed tower floor).
- Makes modification to the floor much more difficult.

System Diagrams:.

Cost & Schedule Implications:
Cost:
TBD

Conclusion:
The risk team recommends consideration of Option B, increasing stud spacing in critical areas. This is a cost effective way to buy more strength to the product beyond code minimum.

Approval of Option:
OUMC/UHAT: _____
Perkins+Will: _____
Turner: _____

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COMMUNITY COHESION, SOCIAL + ECONOMIC VITALITY /

Req 1 Improve Community Quality of Life

Expand Citizen Participation: Public Amenities, Organizations, Communications

- Actively Participate in Local Disaster Recovery Programs
- Organize and Develop a Community Communication Toll (CART)

Community Connectivity

- Access to Quality Transit