Resilience Week 2015
2nd National Symposium on Resilient Critical Infrastructure
August 19, 2015

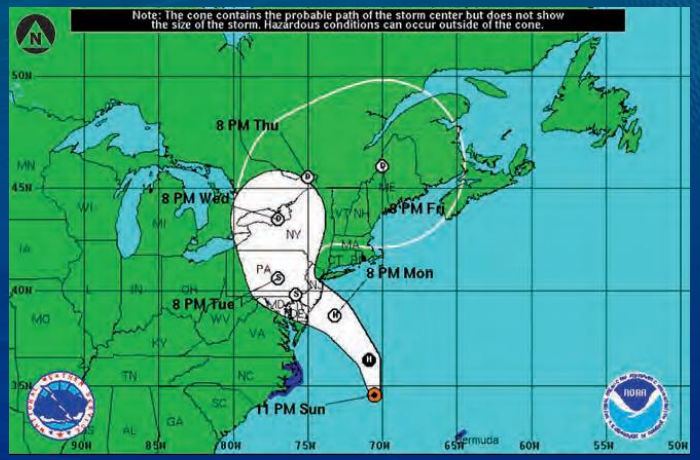
Community Disaster Resilience

Stephen A. Cauffman
Manager, Community Resilience Program
Materials and Structural Systems Division
Engineering Laboratory

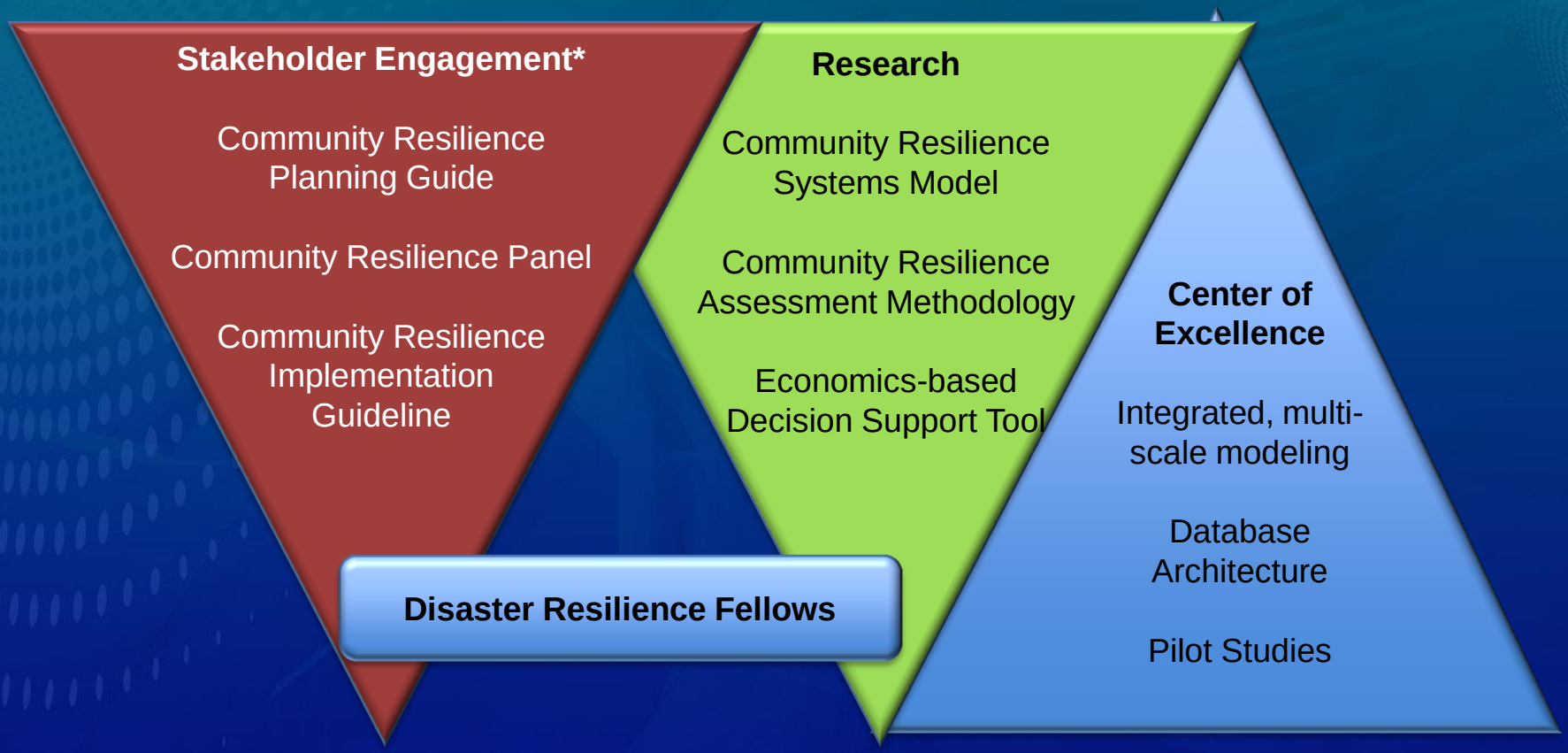
NIST
National Institute of Standards and Technology
U.S. Department of Commerce

Why Community Resilience?

- All communities face potential disruption from natural, technological, and human-caused hazards.
- Disasters take a high toll in lives, livelihoods, and quality of life that can be reduced by better managing disaster risks.
- Planning and implementing *prioritized* measures can strengthen resilience and improve a community's ability to continue or restore vital services in a more timely way – and to build back *better*.
- The built environment exists to serve a social function (e.g., a hospital provides healthcare services). Therefore, social and economic needs and functions should drive the goals for performance of buildings and physical infrastructure.
- New tools and guidance are needed to measure resilience and plan and implement measures to enhance resilience.



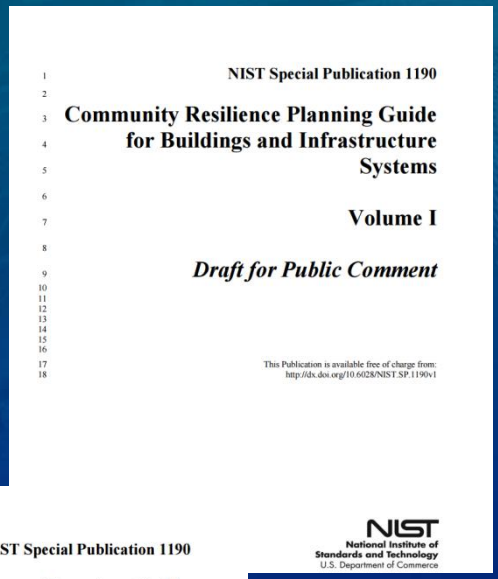
NIST Community Resilience Program



*Stakeholder Engagement component is called out in the President's Climate Action Plan

Community Resilience Planning Guide

- The target audience for the Guide is local government as a “logical convener.”
- The term “community” refers to a place that:
  - Is designated by geographical boundaries
  - Functions under the jurisdiction of a governance structure, such as a town, city, or county.
- Each community has its own identity based on its location, history, leadership, and available resources.
- Some systems (e.g., electric power) often extend beyond the boundaries of the community.


NIST Special Publication 1190

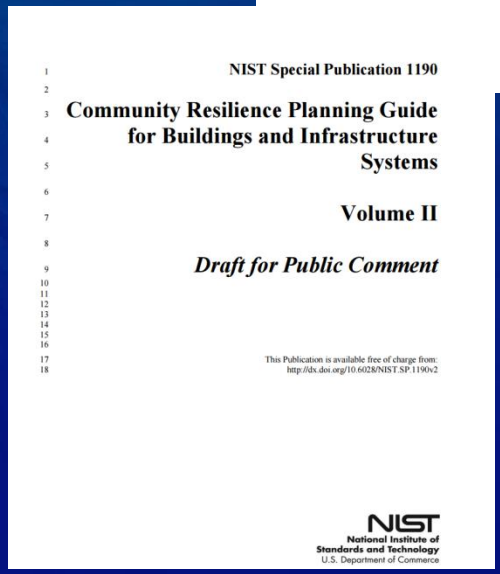
Community Resilience Planning Guide for Buildings and Infrastructure Systems

Volume I

Draft for Public Comment

This Publication is available free of charge from: http://dx.doi.org/10.6028/NIST.SP.1190v1

NIST National Institute of Standards and Technology U.S. Department of Commerce


NIST Special Publication 1190

Community Resilience Planning Guide for Buildings and Infrastructure Systems

Volume II

Draft for Public Comment

This Publication is available free of charge from: http://dx.doi.org/10.6028/NIST.SP.1190v2

NIST National Institute of Standards and Technology U.S. Department of Commerce

Guide Outline

Volume 1 - Methodology

Executive Summary

Ch 1. Introduction

Ch 2-6. Methodology and Planning Steps

Ch 7. Future Directions

Appendix: Planning Example – Riverbend, USA

Volume 2 - Reference

Executive Summary

Ch 9. Social Community

Ch 10. Dependencies and Cascading Effects

Ch 11. Buildings

Ch 12. Transportation Systems

Ch 13. Energy Systems

Ch 14. Communications Systems

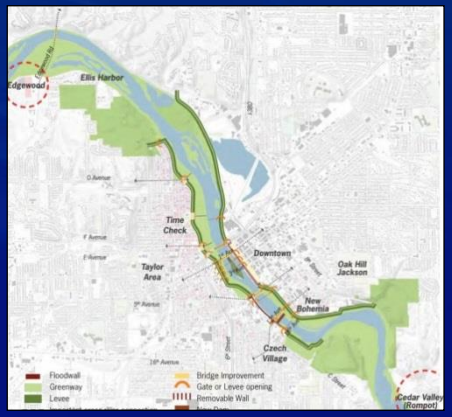
Ch 15. Water & Wastewater Systems

Ch. 16 Community Resilience Metrics

Planning Steps for Community Resilience

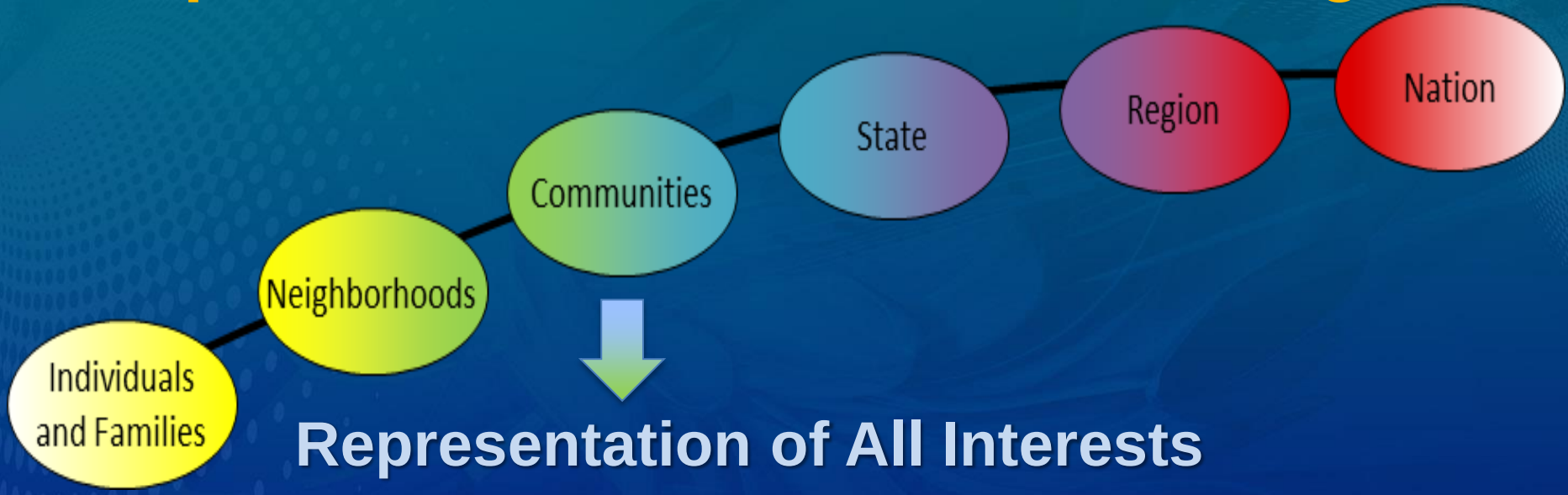
1. Form a collaborative planning team
2. Understand the situation
   - Social Dimensions
   - Built Environment
3. Determine goals and objectives
4. Plan development
5. Plan preparation, review, and approval
6. Plan implementation and maintenance

Downtown Cedar Rapids, Iowa, during the 2008 floods



Recovery and Reinvestment Plan

Step 1. Form a Collaborative Planning Team



Representation of All Interests

Public

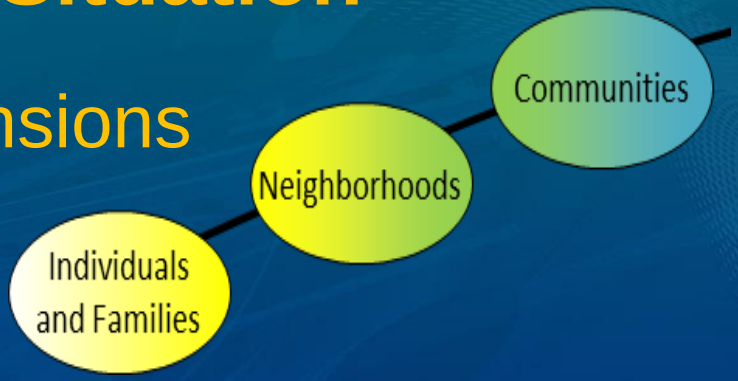
- Elected Officials
- Local Government
- Community Members

Private

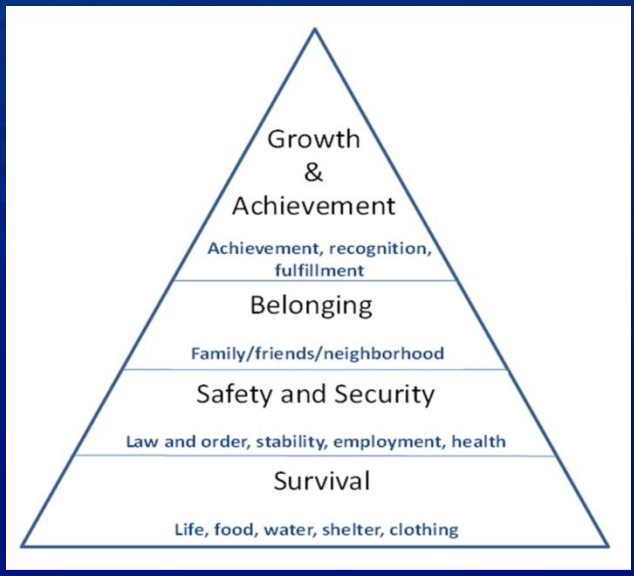
- Business and Services
  - Banking, Health care
  - Utilities
  - Media
- Organizations
  - NGOs (VOAD, Relief)

Step 2. Understand the Situation

Characterize the Social Dimensions



- Community members
  - Present and future needs
  - Demographics and economic indicators
  - Social Capital/Social Vulnerabilities
- Social institutions
  - Social functions
  - Gaps in capacity
  - Dependencies on other institutions
- Community metrics



Characterize the Built Environment

Buildings

Individual structures, including equipment and contents that house people and support social institutions

Building Clusters

A set of buildings that serve a common function such as housing, healthcare, retail, etc.

Infrastructure Systems

Physical networks and structures that support social institutions, including transportation, energy, communications, water and waste water systems.

Dependencies

Internal and External, Time, Space, Source

Characterize

Location, number, construction, demands and use, etc.

Link Social Dimensions and Built Environment

Some rely more on the built environment

Emergency Rooms

Industrial Plants

Some functions change

Schools ⟶ Shelters

Identify how services are supported

- Services provided to meet needs
- Dependency on other services and systems
- Dependency on built environment
- Consequences of loss

Step 3. Determine Goals and Objectives

Establish Long Term Community Goals

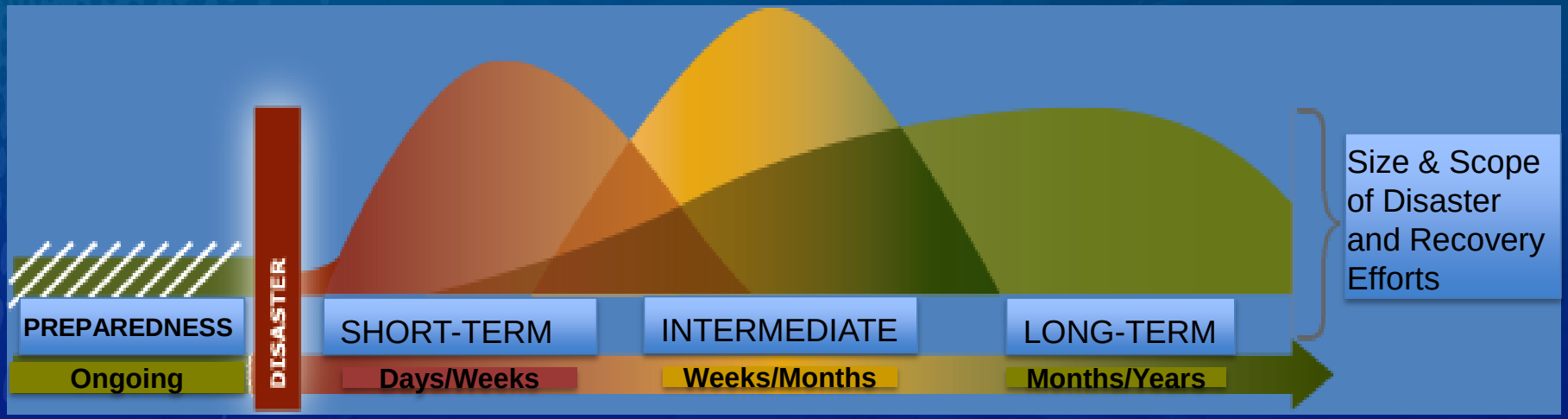
- Long term goals to improve the community can guide the prioritization and implementation process.
  - Improve reliability of infrastructure systems
  - Enhance community functions
  - Reduce travel time impacts to residents and businesses
  - Revitalize an existing blighted area
- Community resilience is achieved over time
  - Resilience can be achieved with resources for current maintenance and capital improvements

Establish Desired Performance Goals for the Built Environment

- Performance goals are independent of hazard events.
  - Community functions are needed during recovery, such as acute health care, 911 call centers, emergency response
  - Consider role of a facility or system that impacts others outside the community.
- Define goals in terms of '*time needed to restore functionality*'.
- Use goals to help prioritize repair and reconstruction efforts.
- Goals may suggests criteria for new construction and retrofit of existing construction.

Recovery of the Built Environment

Organize around restoring functionality over time



When is each system needed for recovery?

Determine and Characterize Hazards

- Identify prevalent hazards
  - Wind, Earthquake, Inundation
  - Fire, Snow, Rain
  - Human-caused or Technological
- Evaluate 3 hazard levels
  - Routine — Level expected to occur frequently
  - Expected — Level used to design buildings
  - Extreme — Maximum considered possible

Anticipated Performance of Existing Built Environment

- Anticipated performance (restoration of function) during recovery depends
  - Damage level - Condition and capacity of structural and nonstructural systems
  - Recovery time - Materials, equipment, and labor needed for restoration
  - Dependencies on other systems that may be damaged

Hurricane Irene

Hurricane Katrina

Example Summary Resilience Matrix

Infrastructure	Recovery Time								
	Days 0	Days 1	Days 1-3	Wks 1-4	Wks 4-8	Wks 8-12	Mos 4	Mos 4-24	Mos 24+
Critical Facilities									
Buildings	90%							X	
Transportation		90%	X						
Energy		90%	X						
Water			90%		X				
Wastewater				90%				X	
Communication		90%		X					
Emergency Housing									
Buildings				[illegible]					
Transportation				X					
Energy				X					
Water					X				
Waste Water				[illegible]					
Communication				90%	X				
Housing/Neighborhoods									
Buildings						90%			X
Transportation			90%	X					
Energy			90%	X					
Water				90%				X	
Waste Water					90%			X	
Communication				90%			X		
Community Recovery									
Buildings								90%	X
Transportation				90%	X				
Energy			90%	X					
Water				90%				X	
Waste Water							90%	X	
Communication				90%			X		

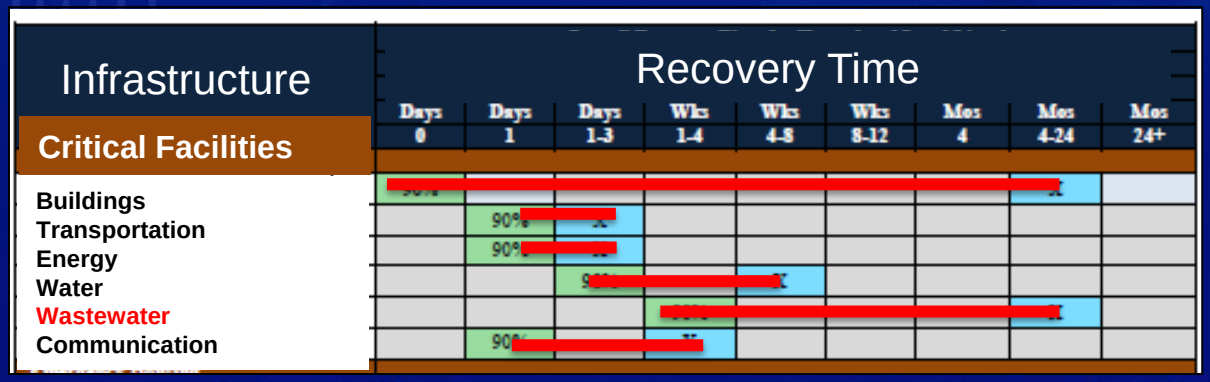
Desired Performance

Anticipated Performance

Superstorm Sandy

Step 4. Plan Development
Evaluate Gaps and Identify Solutions

- Prioritize gaps
  - Long-term community goals
  - Social needs during recovery
- Identify alternative solutions
  - Multiple stages
  - Temporary and permanent
  - Administrative
  - Construction



- Flood plain management
  - Reduce threat: relocate, elevate
- Wind and seismic preparedness
  - Strengthen: retrofit, redundancy
- Recovery Plans
  - Mutual aid agreements
  - Improvement plans

Prioritize Solutions and Develop Implementation Strategy

- Select solutions for prioritized performance gaps
  - Determine how alternative solutions can be combined to meet community goals.
  - Consider collaborative projects.
- Develop implementation strategies
  - Quantify benefits of impact on public safety and social needs.
  - Evaluate economic impacts on community - costs and savings.
  - Consider short- and long-term benefits versus costs.
- Determine preferred implementation strategy

2013 Mandatory Soft Story Retrofit program for all older, wood-framed, multi-family buildings ensures the safety and resilience of San Francisco.

North Texas 2050 plan integrates land use, natural resources, transportation, housing, water and wastewater infrastructure, parks and open spaces.

Step 5. Plan Preparation, Review, and Approval

Plan Approval

- Document proposed implementation strategy and supporting assessments and solutions.
- Share with all stakeholders and community members
  - Public Meetings, review and comment period.
- Finalize and approve community plan.

APPROVED

Final Community Plan: Implementation Strategy

Step 6. Plan Implementation and Maintenance

Implementation

- Formally adopt community plan to guide local government and agencies
- Identify and obtain resources to implement solutions
- Track and *communicate progress* to stakeholders

Plan Maintenance

- Review strategy and solutions on a regular basis
- Modify or update as needed

Next Steps

- Public Comment and Version 1.0
  - Update Guide based on comments with planned release in September 2015
- Community Resilience Panel
  - Focus on identifying gaps in practice and knowledge
  - Inform the development of Implementation Guidelines to help users of the Guide.
  - First meeting planned for Fall 2015
- Support Use of the Guide
  - Developing a plan to work with pilot communities implementing the Guide
  - Plan to develop training tools and user forum to support implementation
  - Collect data on implementation of resilience planning to inform future versions of the Guide and other products.

Research Plans

- Develop a methodology to assess resilience at the community-scale based on community functions, supported by buildings and infrastructure systems and time required for those systems to recover after disruption.
- Develop first-generation, science-based tools to assess resilience at the community scale.
- Develop a first-generation economic analysis tool to facilitate cost-effective resource allocations that minimize the economic burden of disasters on communities.
- Economic analysis tools, combined with the resilience assessment tools, will provide decision makers at the community/regional level a means to evaluate alternate investment decisions.

Community Resilience Center of Excellence

- Awarded to 10 institution team led by Colorado State University.
- $4M/year program funded through a cooperative agreement.
- Objectives are to:
  - Develop an integrated, multi-scale, computational modeling environment to accelerate development of systems-level models to enable new standards and tools for enhancing Community Resilience
  - Foster the development of data architectures and data management tools to enable disaster resilience planning for emergency and decision-making officials, code and standards professionals, engineering design experts, and researchers.
  - Conduct studies to validate resilience data architectures, data management tools, and models for a variety of hazard events including:
    - Tornado, hurricane, earthquake, flood, Wildland-Urban Interface (WUI)
    - Effects of climate change, and effects of aging infrastructure

Concluding Remarks

- Improving resilience does not have to be prohibitively expensive
- Measures to improve resilience can be implemented over many years and as part of long-term community development plans
- The Guide will help communities with prioritizing buildings and infrastructure and with planning to improve resilience
- Implementation Guidelines will provide guidance in the form of standards, codes, and best practices, to implement resilience measures
- Resilience assessment tools and economics-based decision support tools will aid communities aid communities with identifying needs and prioritizing actions

NIST Contact

Website:

http://www.nist.gov/el/building_materials/resilience/

Guide:

http://www.nist.gov/el/building_materials/resilience/guide.cfm

Or google “NIST Resilience Planning Guide”

General E-mail: resilience@nist.gov

Questions?