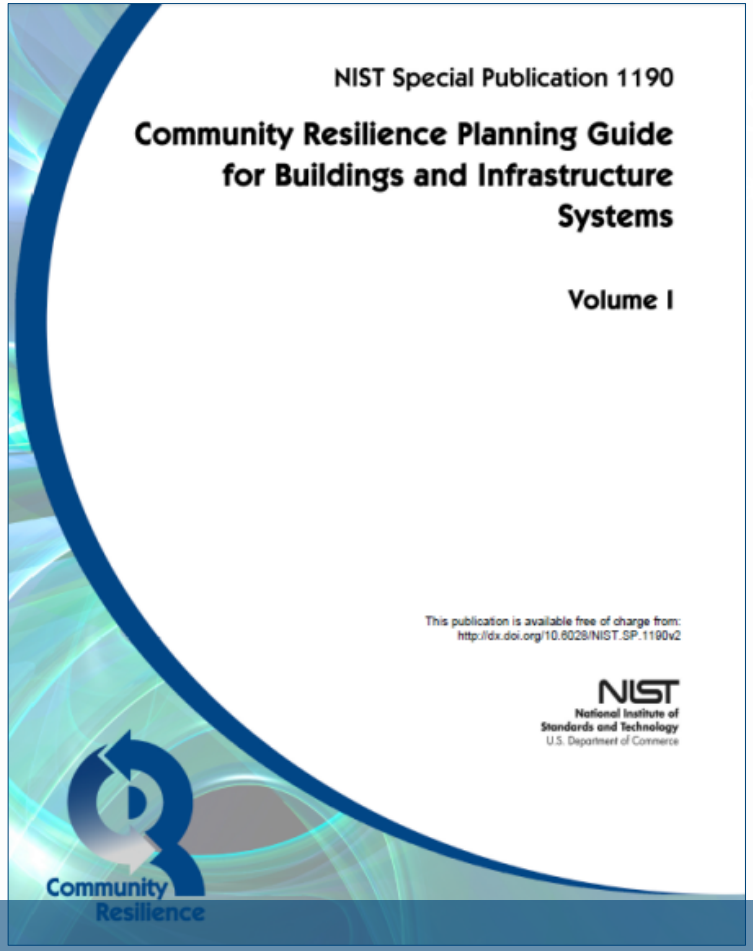
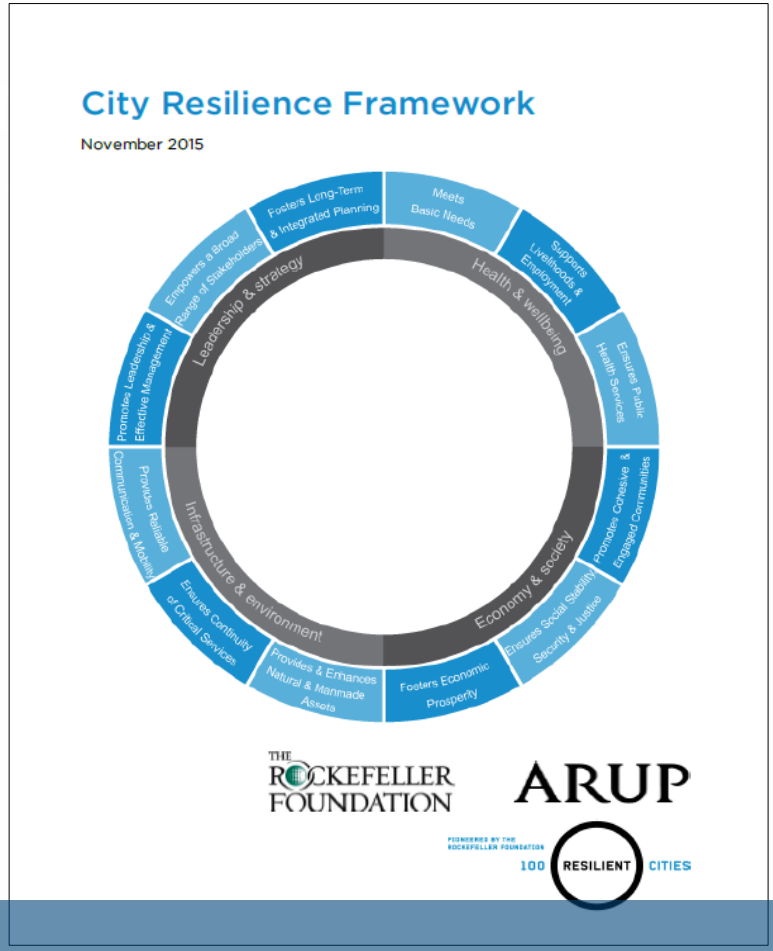




Community Resilience Planning

PEER Annual Meeting

January 28, 2016

Core Activities to Develop and Implement a Community Resilience Plan

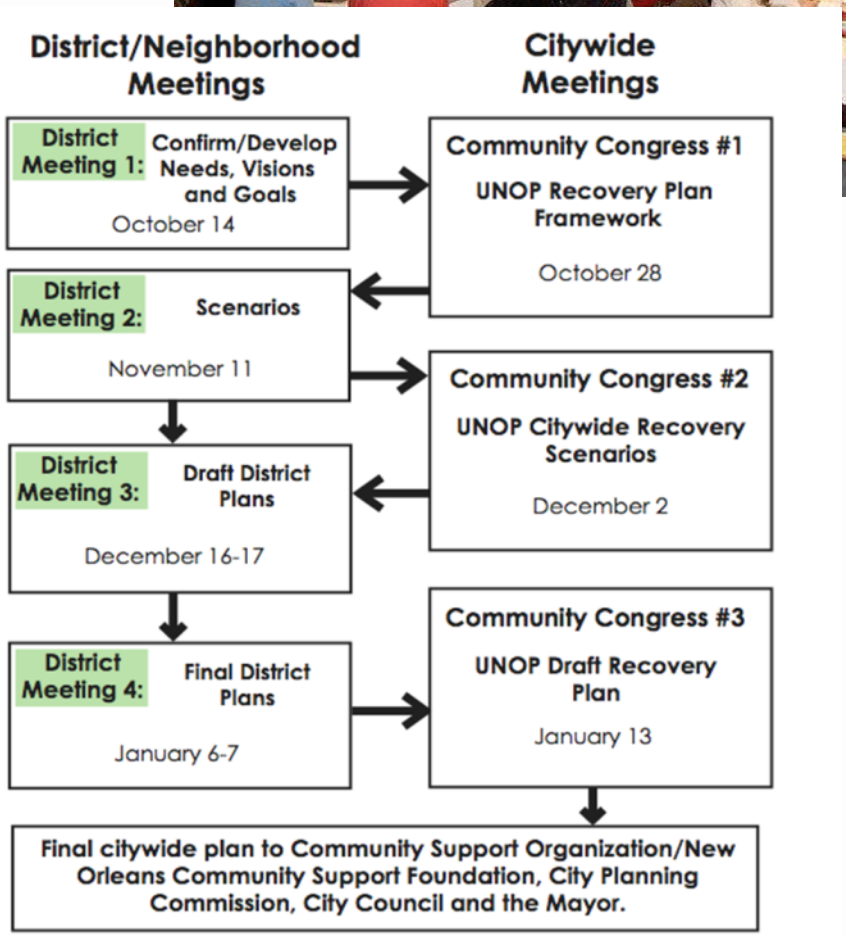
- Form a Planning/Advocacy Team
- Conduct Inventories and Assessments

- Plan Development and Adoption
  - Establish Resilience Goals and Objectives
  - Develop Resilience Strategies
- Plan Adoption
- Plan Implementation
  - Policy Formulation and Adoption
  - Sustained Financing and Leadership

Community/ Stakeholder Engagement

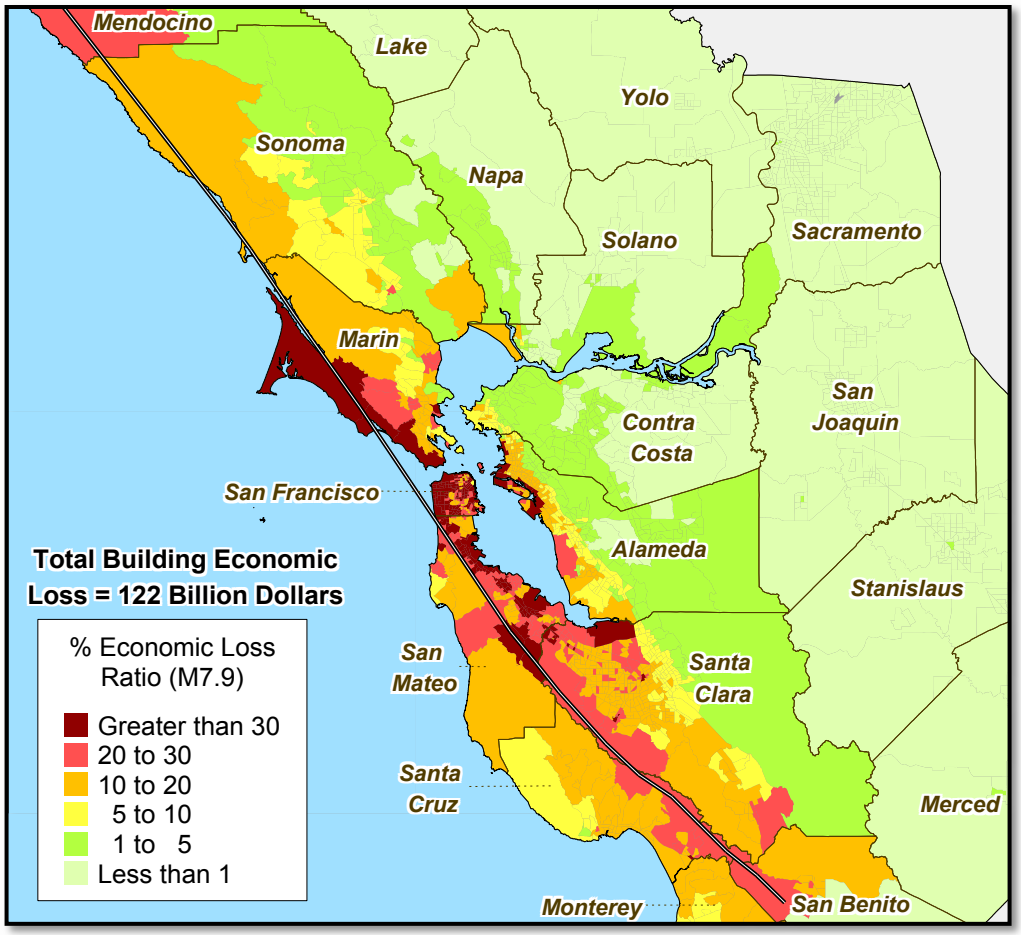
(NIST 2015)

Collaborative Planning: Unified New Orleans Plan



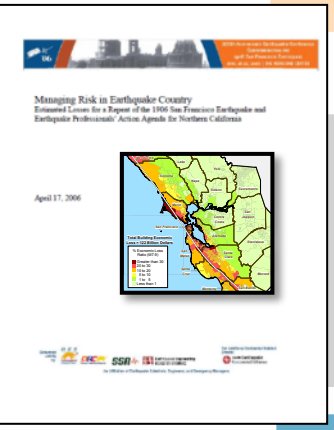
M7.9 San Andreas Earthquake Scenario (2006)

Direct Economic Building Loss due Ground Shaking/Failure (M7.9)	
County	**Loss Ratio**
Alameda	**7.4%**
San Francisco	**25.9%**
San Mateo	**24.6%**
Santa Clara	**11.9%**
Other Counties	**2.7%**
All 19 Counties	**9.0%**

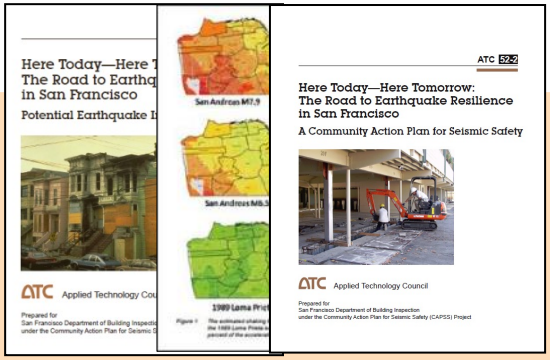


- Fire - Plus 5% - 15%
- Lifelines - Plus 5% - 15%
- Total Loss: **$150 billion**

Kircher & Associates Consulting Engineers



'06 Scenario



Reinvigoration of CAPSS (2008)

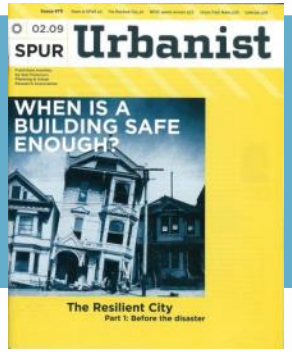
ESIP Workplan (2012)

Soft-story Retrofit Program (2013)

Launch of City/County Disaster Recovery and Resilience Initiative (2008)

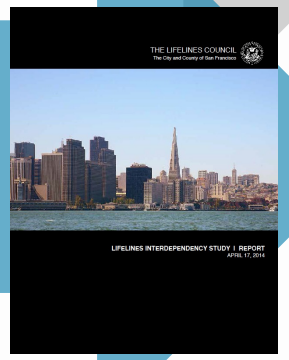
Earthquake "czar" (2012)

100 Resilient Cities and CRO (2014)



SPUR "Resilient City Initiative (2007)

City and County of San Francisco
LIFELINES COUNCIL
Launched (2009)

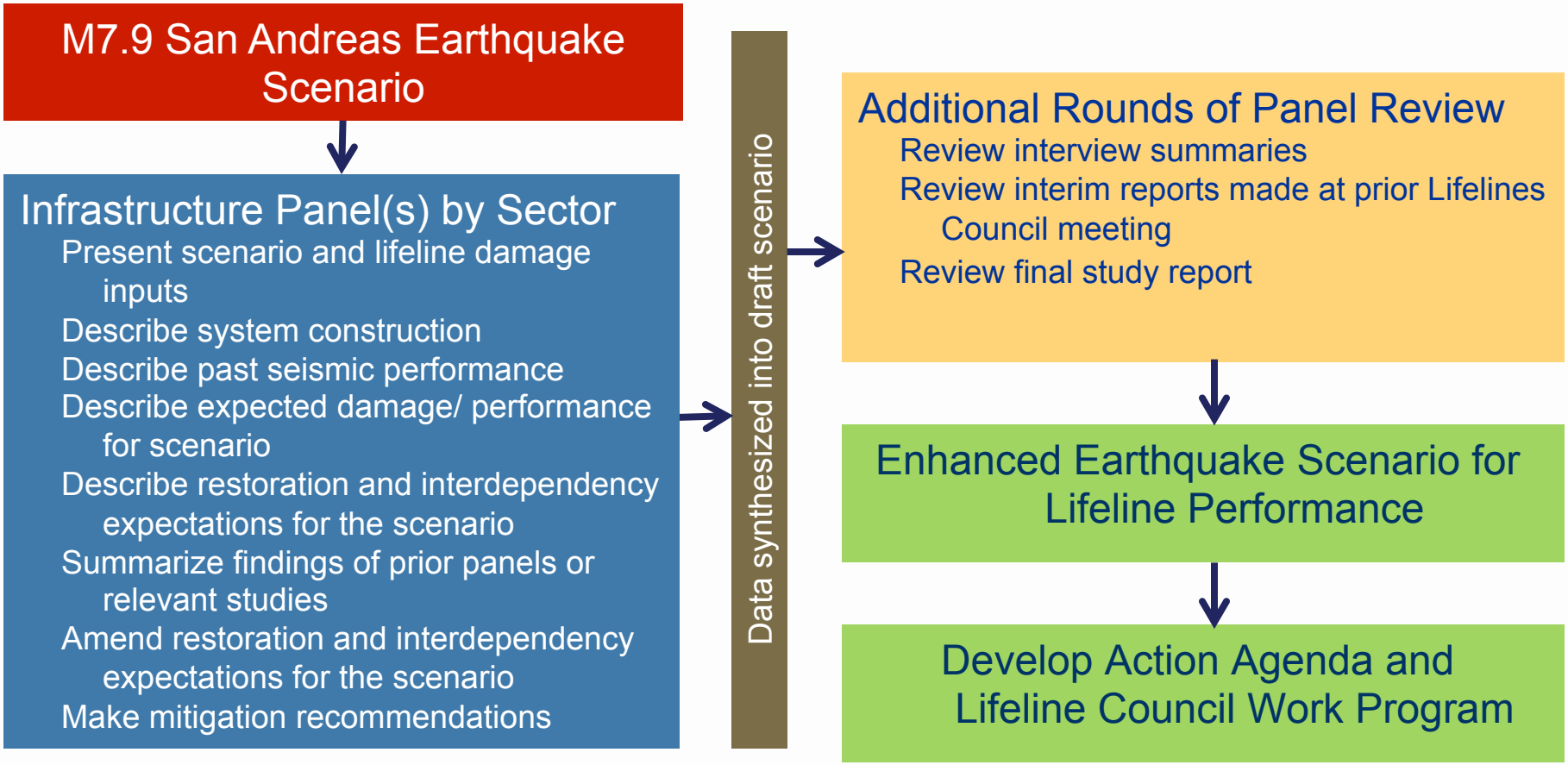


Lifeline Interdependency Study (2014)

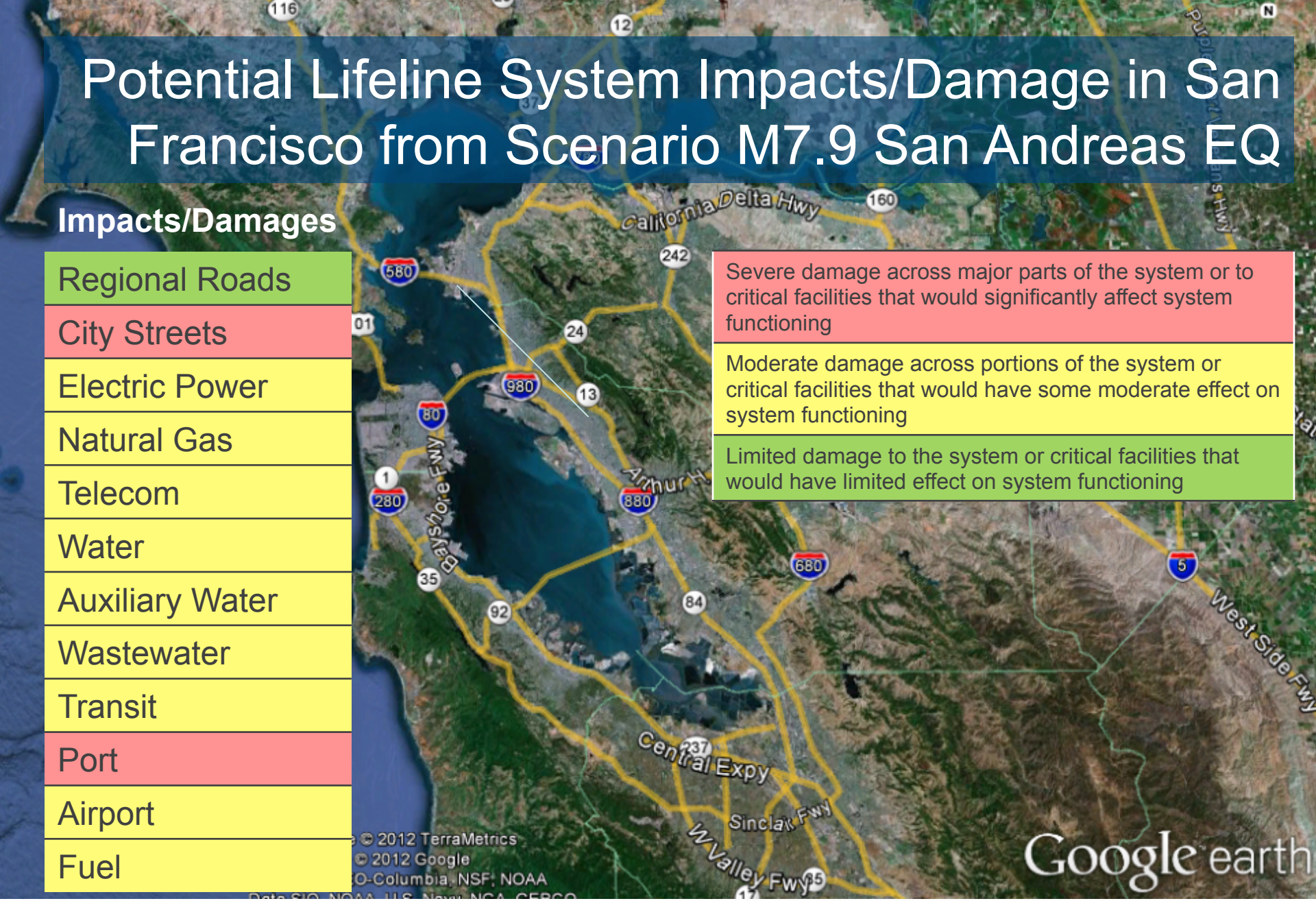
2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

San Francisco Lifeline Interdependency Study Approach (Agreed to in August 2011)

(Modeled after Chang et al (Vancouver) and Porter et al (Southern California))

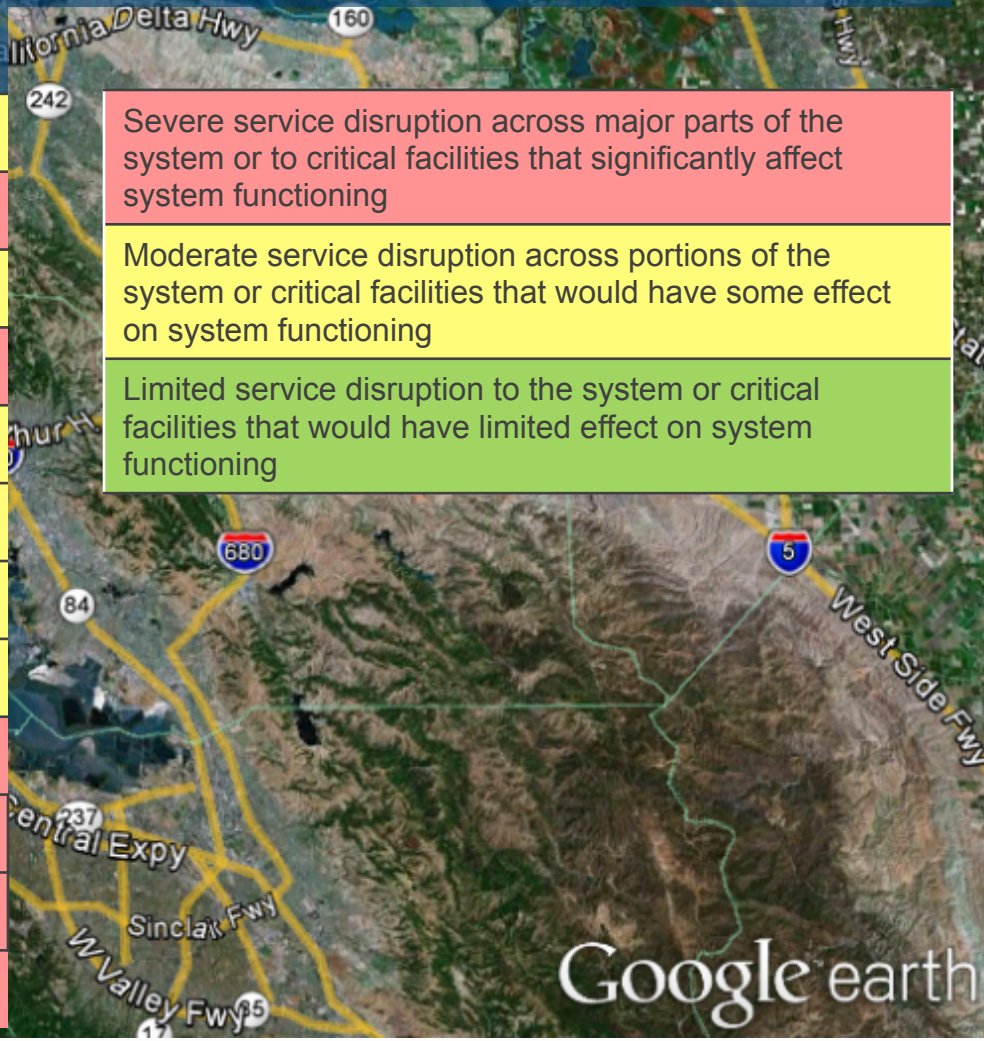


Potential Lifeline System Impacts/Damage in San Francisco from Scenario M7.9 San Andreas EQ

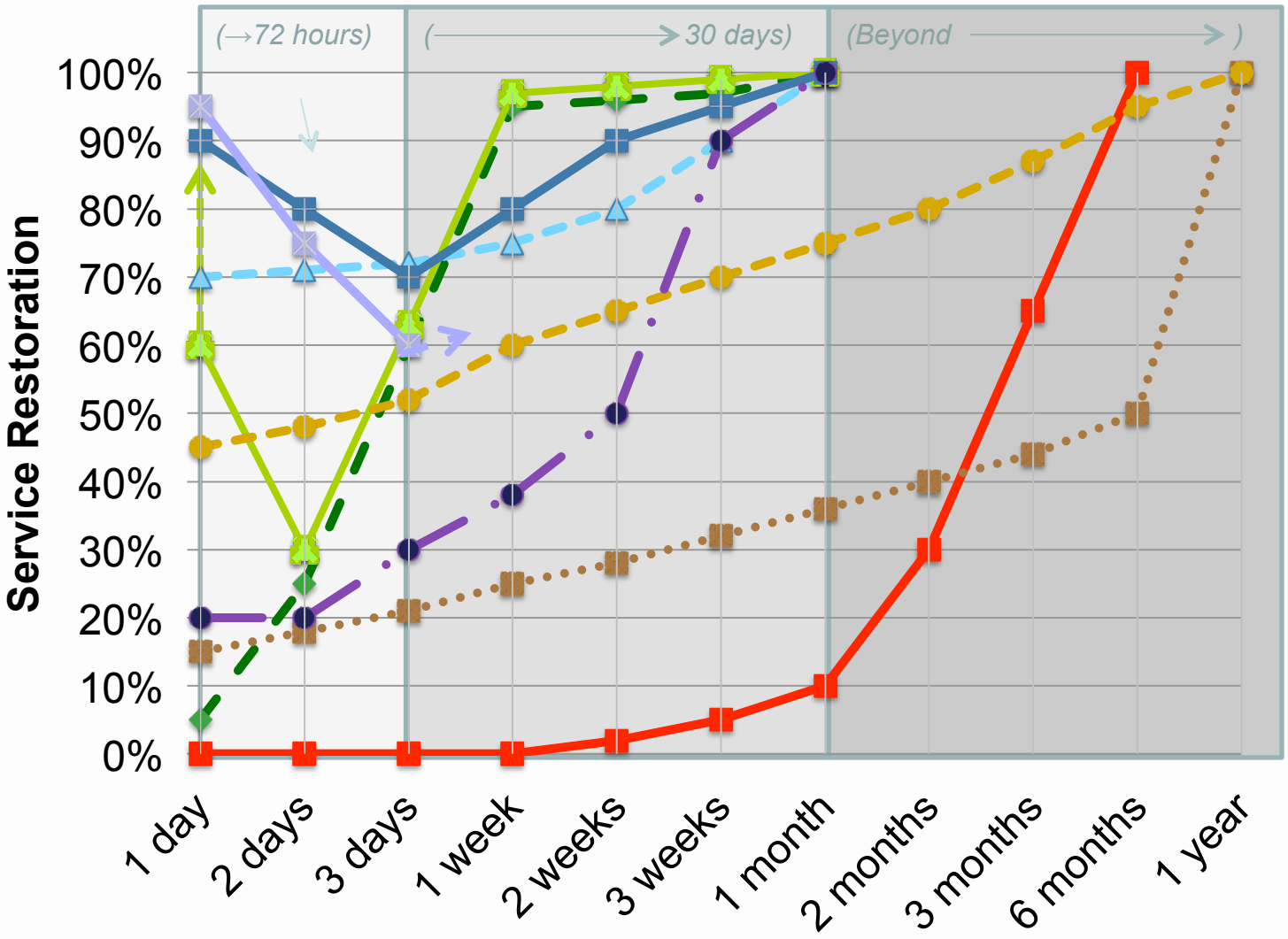


Potential Lifeline System Restoration Issues following a Scenario M7.9 San Andreas EQ

Impacts/Damages	Restoration
Regional Roads	Regional Roads
City Streets	City Streets
Electric Power	Electric Power
Natural Gas	Natural Gas
Telecom	Telecom
Water	Water
Auxiliary Water	Auxiliary Water
Wastewater	Wastewater
Transit	Transit
Port	Port
Airport	Airport
Fuel	Fuel



System Restoration Estimates for a Scenario M7.9 San Andreas Earthquake



Not included:

- Regional roads
- Citywide water distribution
- Auxiliary water supply system
- Port and seawall

Functional/cascading interdependencies

Lifeline Interdependencies

Significant interaction and dependency on this lifeline system for service delivery and restoration efforts

Moderate interaction and dependency on this lifeline system for service delivery and restoration efforts

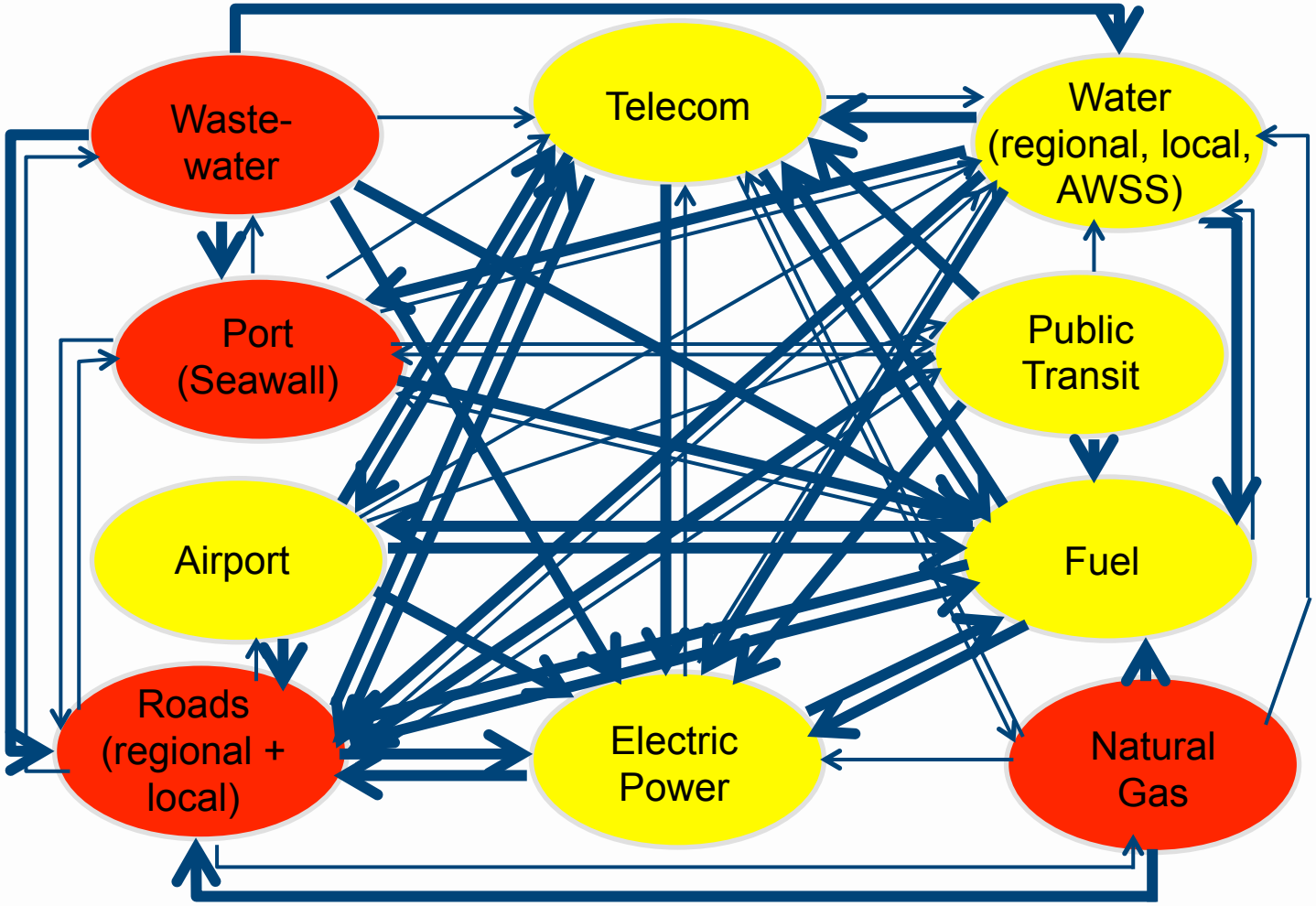
Limited interaction and dependency on this lifeline system for service delivery and restoration efforts

The overall interaction and dependency on a particular system (read down each column)

Lifeline operators' dependency on other lifeline systems (read across each row)

	Regional Roads	City Streets	Electric Power	Natural Gas	Telecom	Water	Auxiliary Water	Waste-water	Transit	Port	Airport	Fuel
Regional Roads	General	Restoration Substitute	Restoration	Restoration	Restoration	Restoration		Restoration	Substitute		Restoration	Restoration
City Streets	Substitute, Restoration	General	Collocation, Restoration	Collocation, Restoration	Collocation, Restoration	Collocation, Restoration	Collocation, Restoration	Collocation, Restoration	Collocation, Substitute, Restoration	Collocation, Restoration		Restoration
Electric Power	Restoration	Collocation, Restoration	General		Restoration	Collocation, Restoration	Collocation, Restoration	Collocation, Restoration		Collocation	Restoration	Restoration
Natural Gas	Restoration	Functional, Collocation, Restoration	Substitute	General	Restoration	Collocation, Restoration	Collocation, Restoration	Collocation, Restoration		Collocation	Restoration	Restoration
Telecom	Restoration	Collocation, Restoration	Functional, Restoration	Restoration	General	Collocation, Restoration	Collocation, Restoration	Collocation, Restoration			Restoration	Restoration
Water	Restoration	Restoration	Restoration		Restoration	General				Collocation		Restoration
Auxiliary Water	Restoration	Functional, Restoration	Restoration		Restoration	Functional, Restoration	General			Collocation, Restoration		Restoration
Waste-water	Restoration	Collocation, Restoration	Functional, Restoration		Restoration	Functional, Restoration		General		Collocation, Restoration		Restoration
Transit	Substitute, Restoration	Functional, Substitute, Collocation, Restoration	Functional, Restoration		Restoration	Collocation, Restoration	Collocation, Restoration	Collocation, Restoration	Collocation, General	Collocation, Restoration		Functional, Restoration
Port	Restoration	Collocation, Restoration	Collocation, Restoration		Collocation, Restoration	Collocation, Restoration	Collocation	Collocation	Collocation	General		Restoration
Airport	Restoration		Restoration		Restoration	Restoration		Restoration	Collocation, Restoration		General	Functional, Restoration
Fuel	Restoration	Restoration	Functional, Restoration		Restoration	Restoration				Restoration	Restoration	General

Combined Effects of Damage and Service Disruption that May Cause Delays and Interdependencies in a Scenario M7.9 San Andreas Earthquake



Legend

- Color for overall level of system disruption and restoration delays (red- severe, yellow-moderate, or green-slight)
- Lines point to the system dependency and a heavy or light width illustrates the level of dependency

CCSF Lifelines Council 5-year Work Program (launched in 2014)

- **More Detailed and Coordinated Study (Choke Points)**

  Port of San Francisco seawall, Financial district/Market Street corridor, and
  Mission Creek/Southeast city

- **Coordinated Mitigation Efforts**

  Prioritize mitigation projects for CCSF capital planning and funding, and private sector; advocate as needed

  Common resilience (level of service) and restoration standards; common standards/plan for "smart" system monitoring and communications

- **Coordinated Planning/ Preparedness**

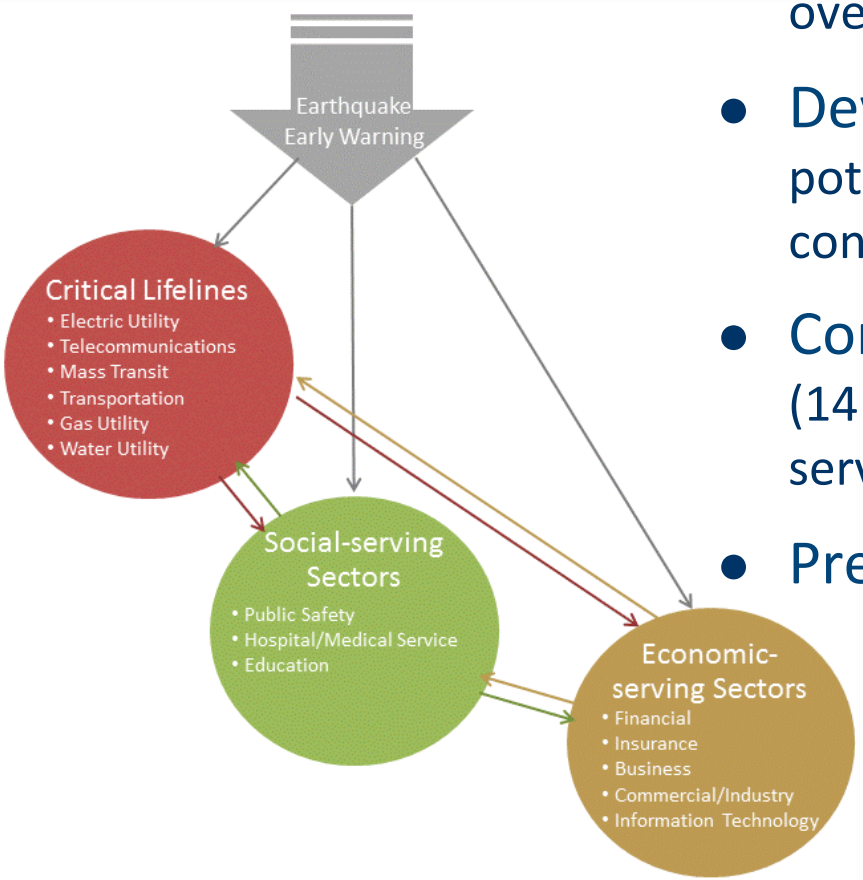
  Interdependency tabletop exercises; training on utility repair/restoration financing and federal regulations; mutual aid agreements;

  Enhanced telecommunications and back-up; fuel supply; emergency communications and priority setting among operators

  Access, temporary staging and equipment storage and basic services/shelter/ security for utility inspectors and repair personnel

  Public emergency drinking water and sanitation

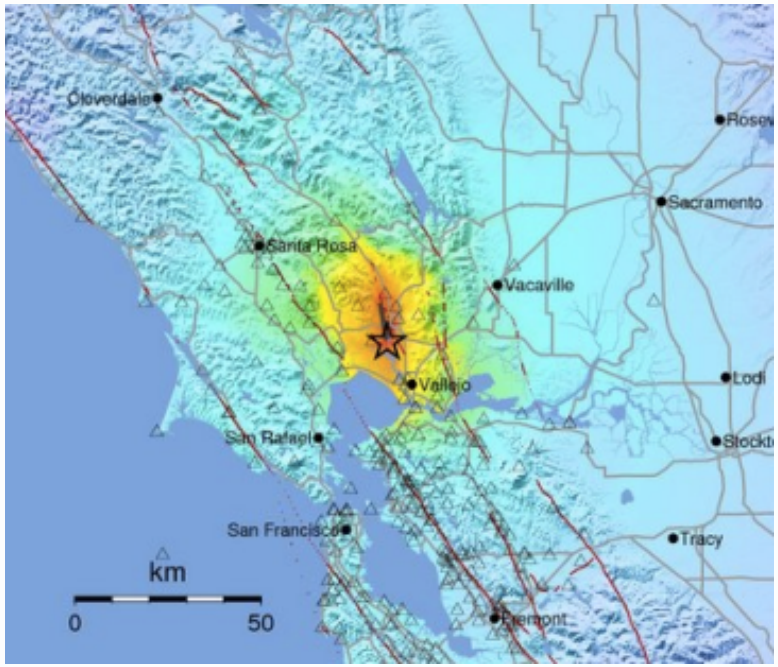
Qualitative Assessment of CA Earthquake Early Warning System (PEER 2016)



- Develop CA EEWS Brief (CA system overview; summary of other systems)
- Develop Interview Questionnaire (value, potential risks, specific applications, and consideration of other sector input)
- Conduct Structured Series of Interviews (14 lifeline, social-serving, and economic serving sectors)
- Prepare Assessment Report

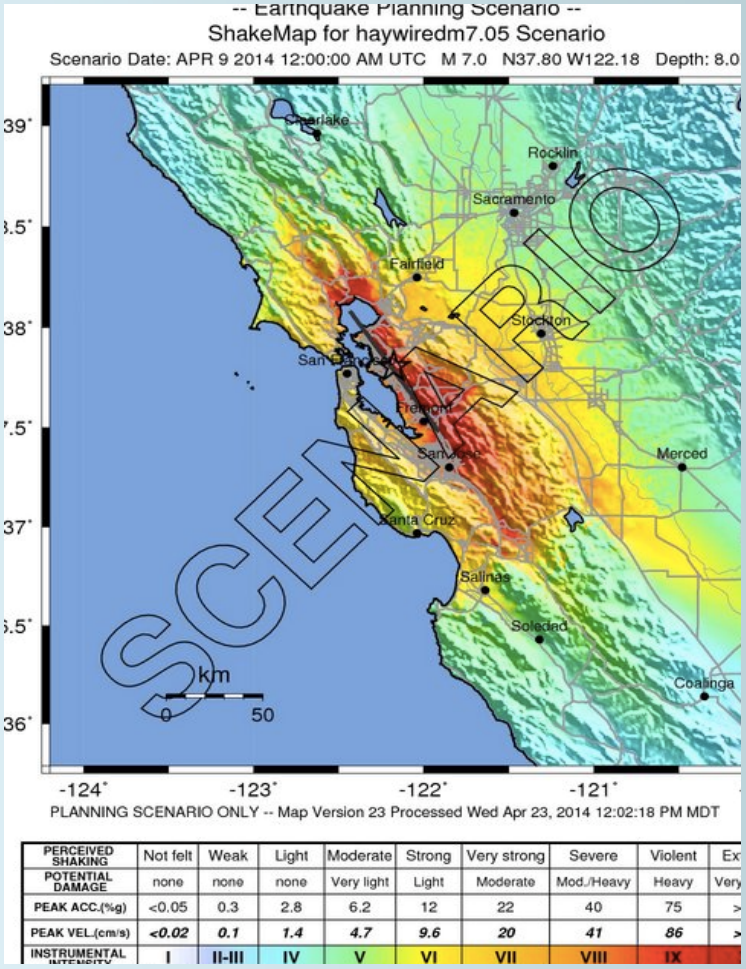
M6.0 South Napa Earthquake, August 24, 2014 Findings and Recommendations

(PEER project for CA Seismic Safety Commission, 2015-2016)

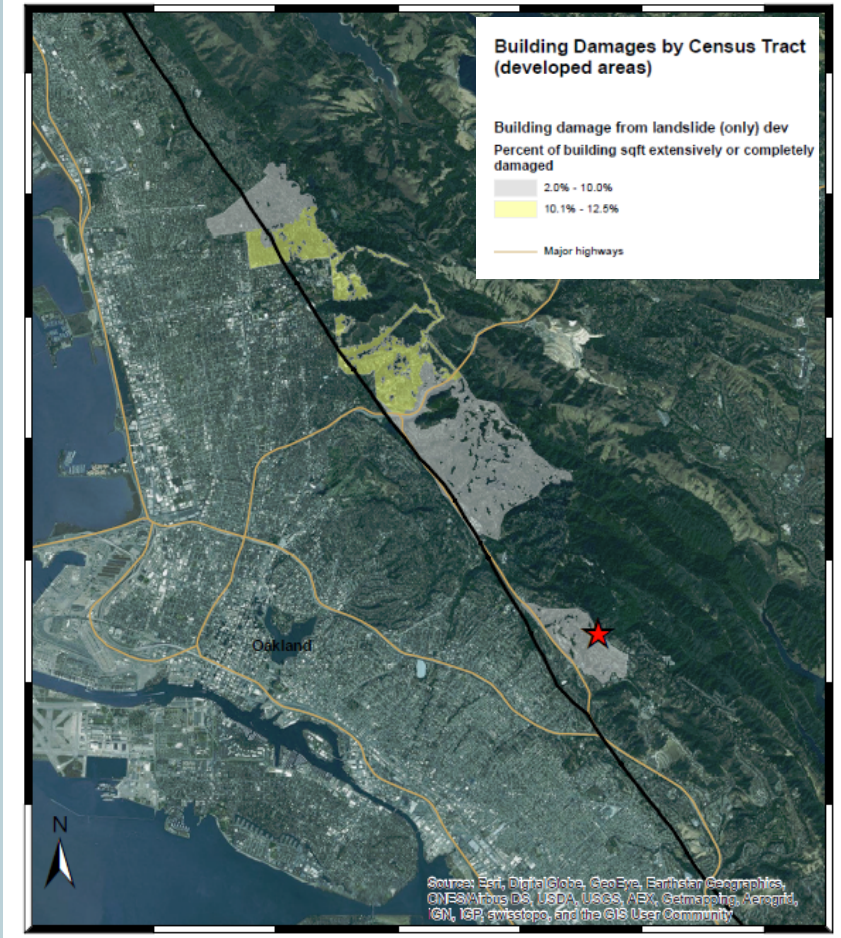


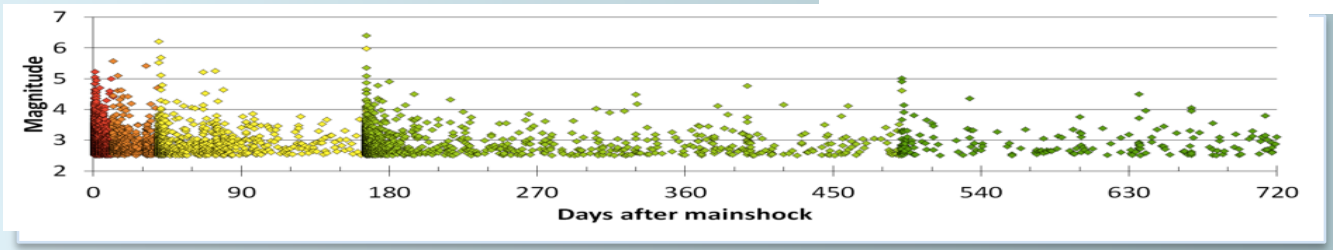
- Synthesize and analyze post-earthquake studies, after-action reports, and popular media
- Consider key lessons from other recent earthquakes and scientific, engineering and technological advances
- Interview key federal, state, local, and private/non-profit sector stakeholders
- Identify priority findings and recommended actions (Geosciences, Infrastructure, Structures, People and Businesses, Government and Other Institutions) to be considered by the Commission in advance of the next damaging earthquake in CA

M7.05 Hayward Fault Scenario



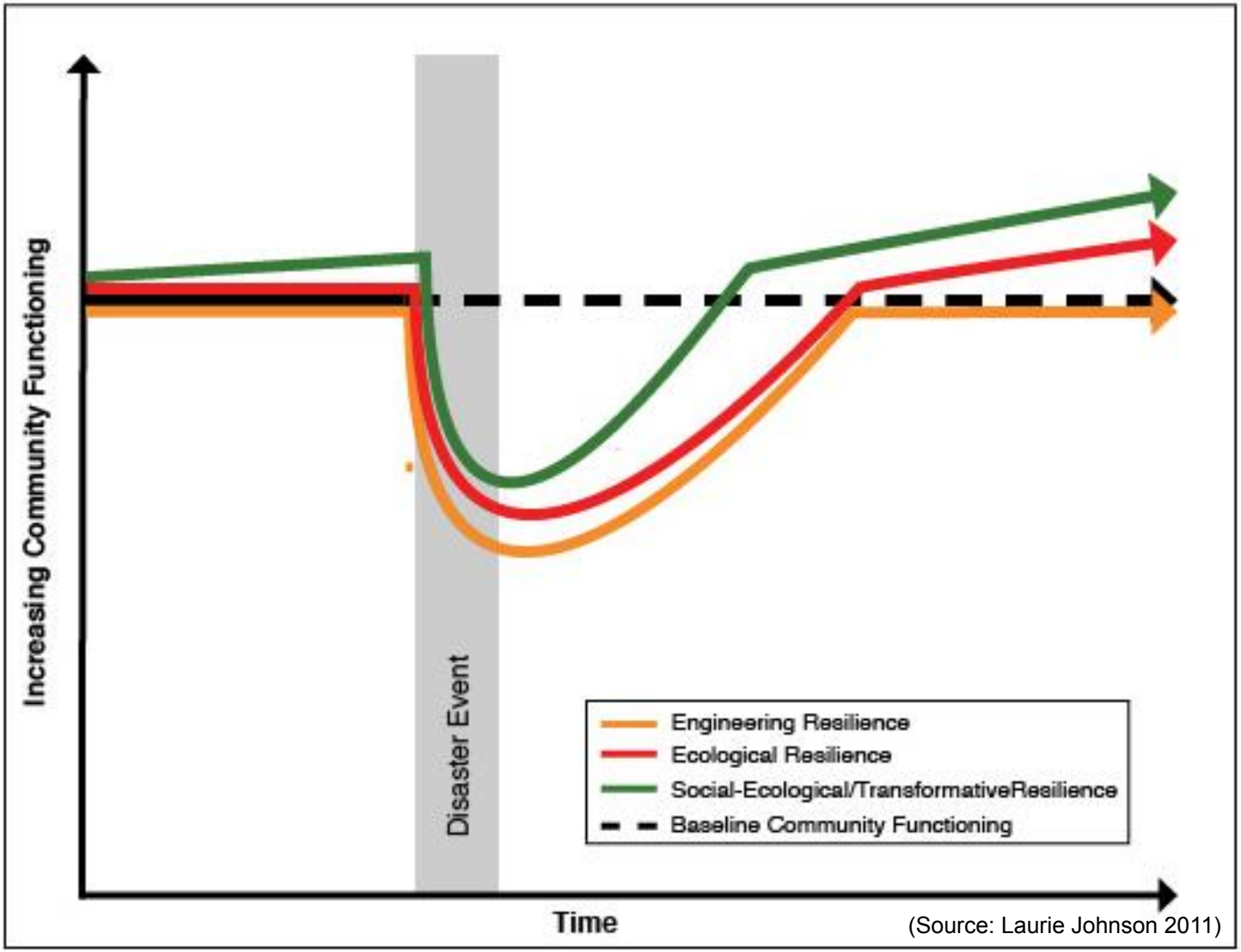
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Ex
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>
PEAK VEL.(cm/s)	*<0.02*	*0.1*	*1.4*	*4.7*	*9.6*	*20*	*41*	*86*	>
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	



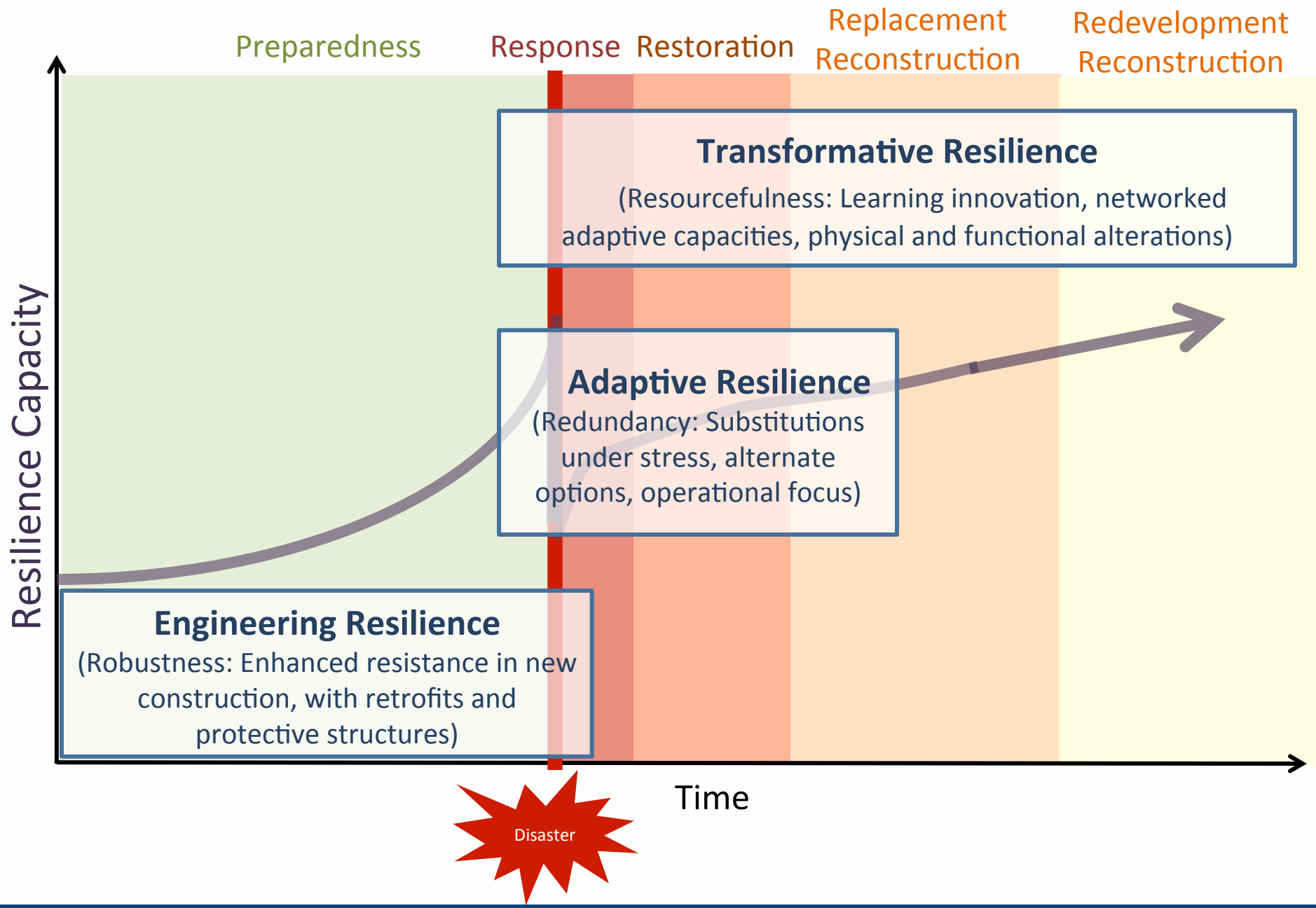


USGS
science for a changing world

Types of Resilience Concepts



(Source: Laurie Johnson 2011)


Preparedness
Response
Restoration
Replacement Reconstruction
Redevelopment Reconstruction
Transformative Resilience
(Resourcefulness: Learning innovation, networked adaptive capacities, physical and functional alterations)
Adaptive Resilience
(Redundancy: Substitutions under stress, alternate options, operational focus)
Engineering Resilience
(Robustness: Enhanced resistance in new construction, with retrofits and protective structures)
Resilience Capacity
Time
Disaster

“Holistic” Community Resilience Model

Thank you!

Email: laurie@lauriejohnsonconsulting.com

(Source: Laurie Johnson 2011)