Pursuing Community Resilience Over Time

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PRAIRIE RESEARCH INSTITUTE

ILLINOIS

topics

- Background and motivation for research
- Measuring Community Resilience
- Case studies

Federal Mitigation Grants Save $6 per $1 Spent

Benefit: $157.9 billion

43% – Casualties & PTSD: $68.1

37% – Property: $58.1

8% – Additional living expenses & direct business interruption: $12.9

7% – Insurance: $10.5

4% – Indirect business interruption: $6.3

1% – Loss of service: $2.0

billions 2016 USD

Cost: $27.4 billion

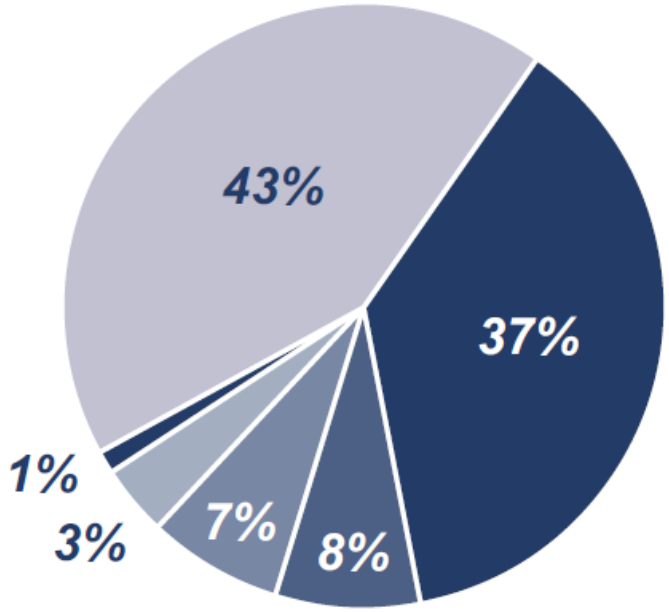
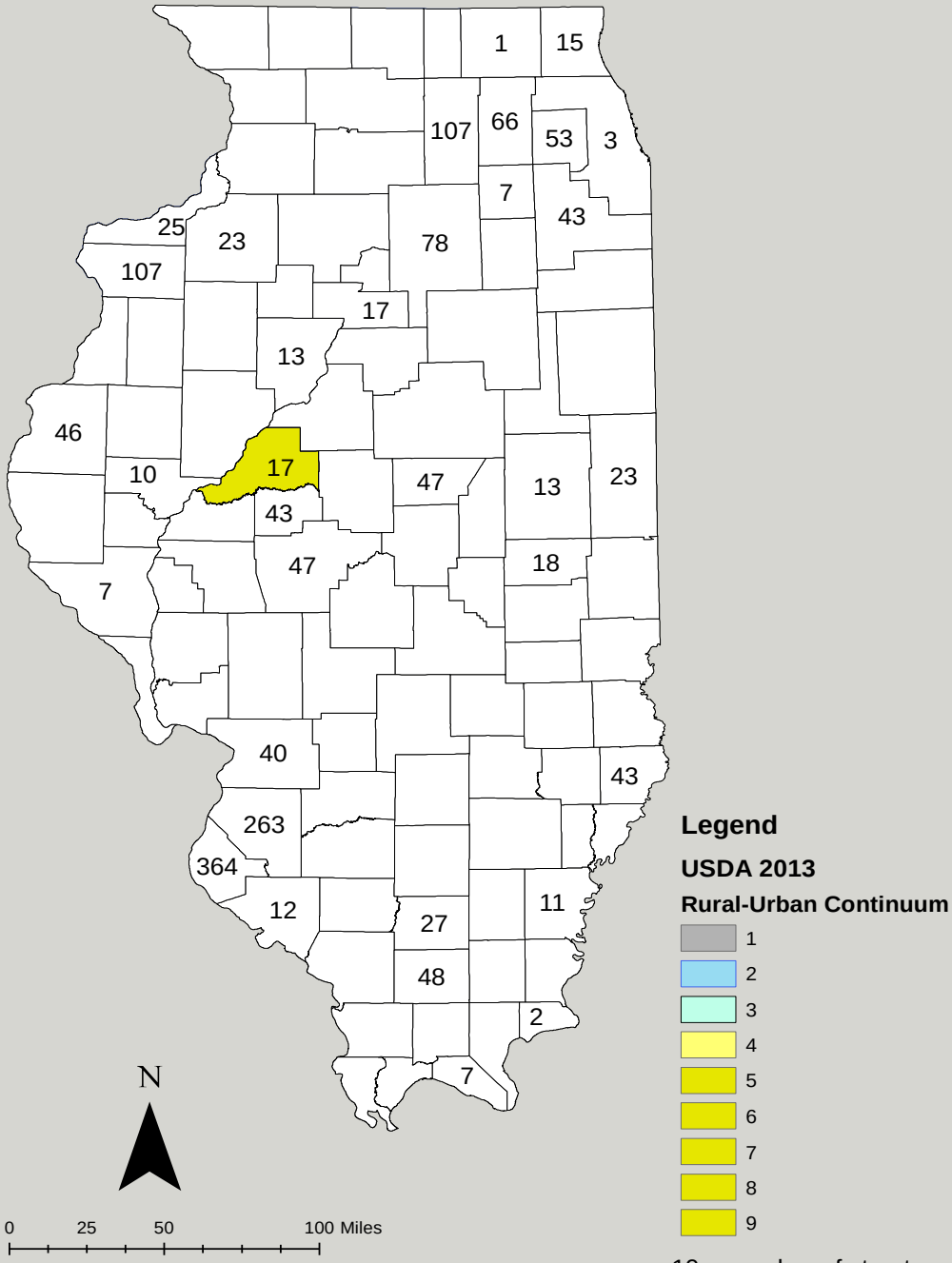


Figure 1. Total costs and benefits of 23 years of federal mitigation grants.

Multihazard Mitigation Council (2017) *Natural Hazard Mitigation Saves 2017 Interim Report: An Independent Study.* Principal Investigator Porter, K.; co-Principal Investigators Scawthorn, C.; Dash, N.; Santos, J.; Investigators: Eguchi, M., Ghosh., S., Huyck, C., Isteita, M., Mickey, K., Rashed, T.;P. Schneider, Director, MMC. National Institute of Building Sciences, Washington.

Structures Removed from the Floodplain in Rural and Urban Counties, IL



Community Resilience to Natural Hazards

- provides a framework to examine the impact of mitigation (buyouts) on communities beyond monetized benefits to society
- change in resilience as a measure of impact
- increasing resilience as a goal

Community Resilience

- *Definition:* "Community Resilience is the capability to anticipate risk, limit impact, and bounce back rapidly through survival, adaptability, evolution, and growth in the face of turbulent change." *Definitions of Community Resilience: An Analysis*, published by the Community and Regional Resilience Institute (CARRI) 2013.

Community Resilience

- Social Resilience
- Economic Resilience
- Institutional Resilience
- Infrastructure Resilience
- Community Capitol
- Environmental Resilience

Measuring Community Resilience Requirements

- measure changes in resilience *over time*

- based on data that is preserved and discoverable; variables efficiently and readily calculated across a large sample without prohibitive expense

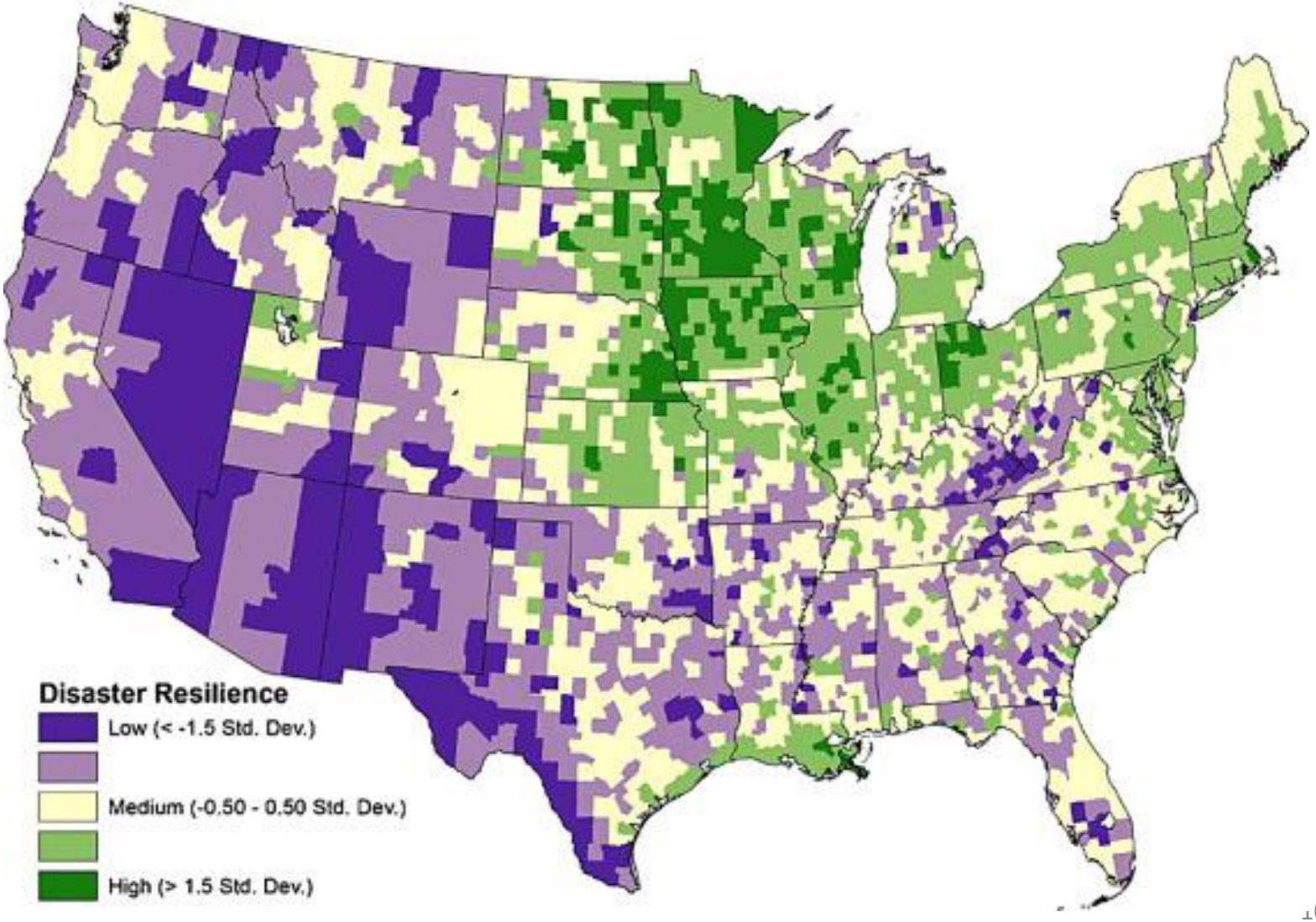
Baseline Resilience Index for Communities (BRIC)

Susan L. Cutter, Christopher G. Burton, and Christopher T. Emrich (2010) "Disaster Resilience Indicators for Benchmarking Baseline Conditions," *Journal of Homeland Security and Emergency Management*: Vol. 7: Iss. 1, Article 51.

Disaster Resilience of Place (DROP)

Social Resilience	Economic Resilience	Institutional Resilience	Infrastructure Resilience	Community Capital	Ecological Resilience

Cutter, Susan L., Kevin D. Ash, and Christopher T. Emrich. 2014. “The Geographies of Community Disaster Resilience.” *Global Environmental Change* 29: 65–77. http://dx.doi.org/10.1016/j.gloenvcha.2014.08.005.



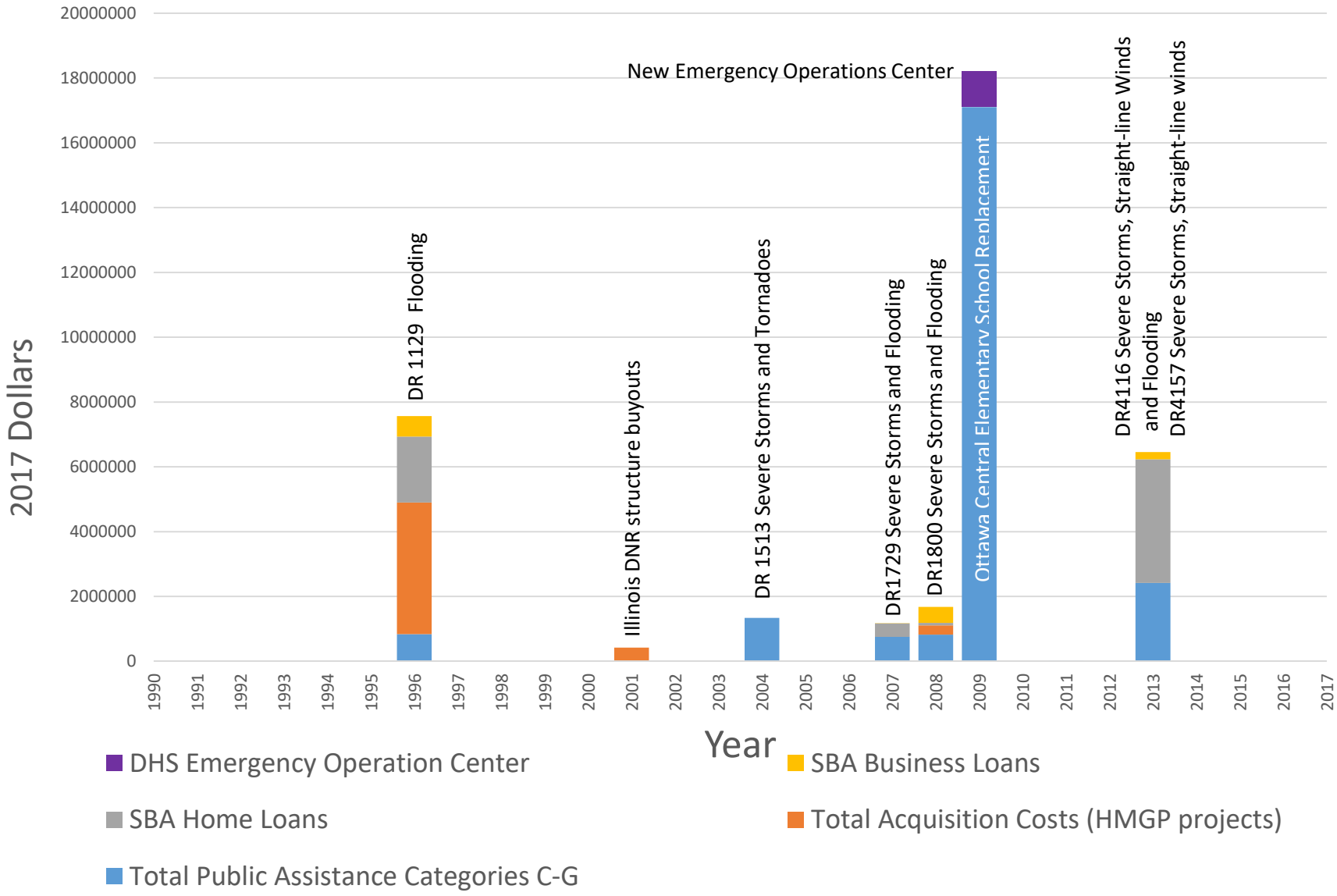
Project Objectives

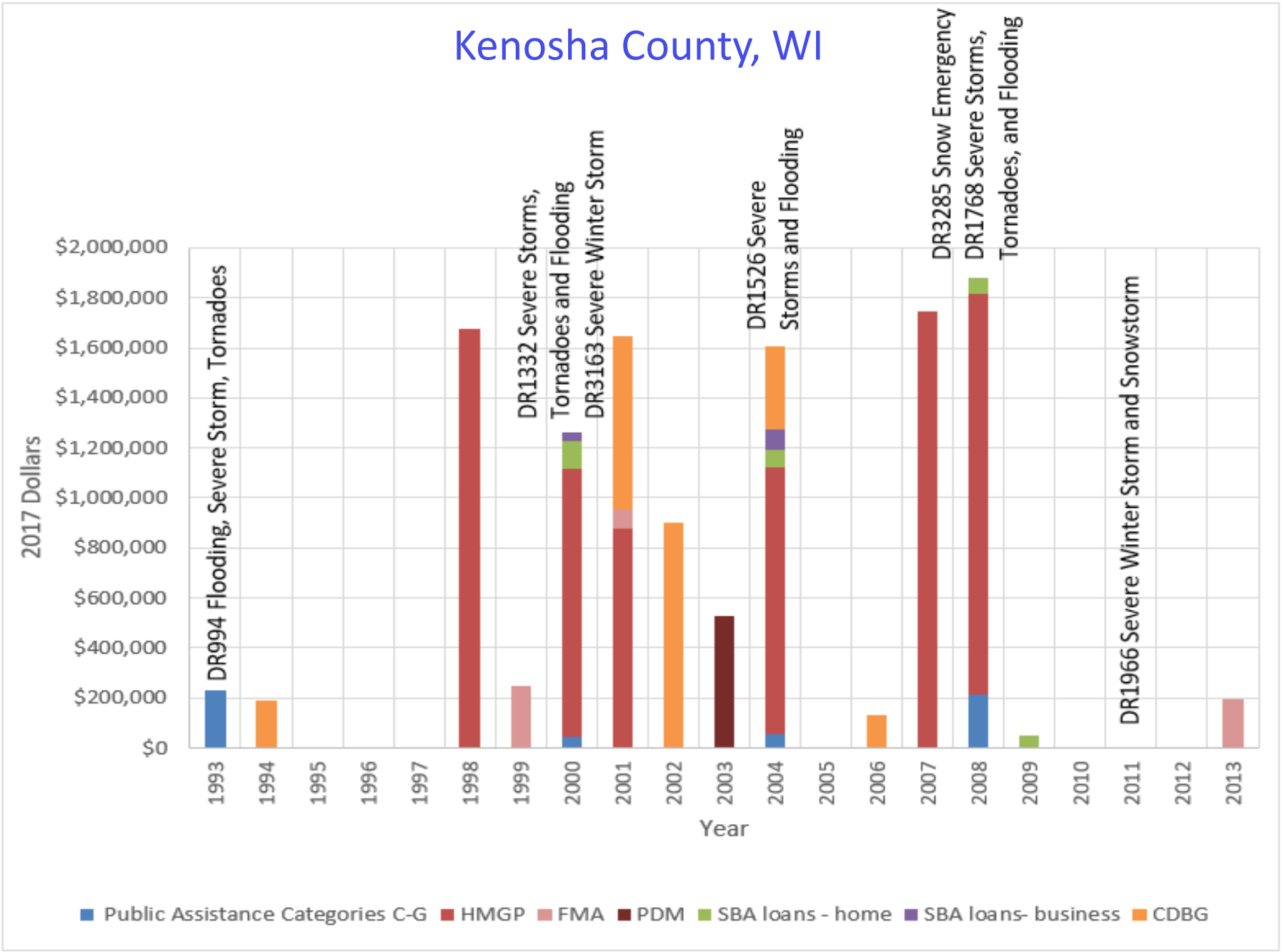
- use an index to measure community resilience to natural disasters *over time*
- assess the index's ability to provide a relevant measure of community resilience
- evaluate specific measures used to compute the index and possible alternatives
- provide local decision makers with qualitative & quantitative information on community resilience

FEMA REGION 5
Two Case Studies

LaSalle County, Illinois
Kenosha County, Wisconsin

Time period: 1990 to present


LaSalle County, IL
2017 Dollars
20000000
18000000
16000000
14000000
12000000
10000000
8000000
6000000
4000000
2000000
0
New Emergency Operations Center
DR 1129 Flooding
Illinois DNR structure buyouts
DR 1513 Severe Storms and Tornadoes
DR1729 Severe Storms and Flooding
DR1800 Severe Storms and Flooding
Ottawa Central Elementary School Reolacement
DR4116 Severe Storms, Straight-line Winds and Flooding
DR4157 Severe Storms, Straight-line winds
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Year
DHS Emergency Operation Center
SBA Business Loans
SBA Home Loans
Total Acquisition Costs (HMGP projects)
Total Public Assistance Categories C-G


Kenosha County, WI
2017 Dollars
$2,000,000
$1,800,000
$1,600,000
$1,400,000
$1,200,000
$1,000,000
$800,000
$600,000
$400,000
$200,000
$0
DR994 Flooding, Severe Storm, Tornadoes
DR1332 Severe Storms, Tornadoes and Flooding
DR3163 Severe Winter Storm
DR1526 Severe Storms and Flooding
DR3285 Snow Emergency
DR1768 Severe Storms, Tornadoes, and Flooding
DR1966 Severe Winter Storm and Snowstorm
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Year
Public Assistance Categories C-G
HMGP
FMA
PDM
SBA loans - home
SBA loans- business
CDBG

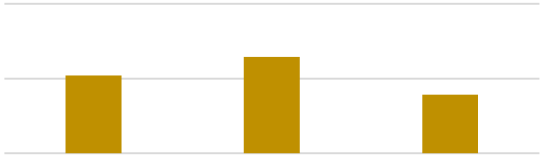
Disaster Resilience of Place (DROP)

Social Resilience	Economic Resilience	Institutional Resilience	Infrastructure Resilience	Community Capital	Ecological Resilience

LaSalle County

Year	1990	2000	2010
Social Resilience			
Education equity ratio (% population with college education / % population with less than high school education)	2.72	4.38	6.94
Age (% population under 65 years old)	82.68%	83.49%	83.42%
Transportation (% population with a vehicle)	92.35%	93.60%	94.32%
Communication (% population with a telephone)	96.25%	99.98%	99.97%
Language (% population speaking English)	99.99%	99.10%	97.30%
Special Needs (% population without special needs)	99.98%	87.00%	91.40%
Health Insurance Coverage (% population with health insurance)	85.77%	87.60%	93.50%
Heath Access (number physicians per 10K persons)	40.31	38.20	84.88

LaSalle County



Year	1990	2000	2010
Economic Resilience			
Housing Capital (% owner occupied)	68.96%	77.51%	74.47%
Employment (% of total population employed)	42.52%	47.82%	46.11%
Income and Equality (1- Gini coefficient)	0.594	0.590	0.589
Employment (% females employed)	37.62%	55.90%	76.10%
Business Size Ratio of large to small	0.0210	0.0202	0.0204
Large Retail Distribution (number stores per 10K persons)	75.95	70.49	36.69
Non-poverty (% population above poverty level)	90.60%	91.10%	87.50%
Single Sector Employment Dependence (% population not employed in 3 biggest industries)	24.74%	25.69%	28.14%
Federal Employment (% population)	0.513%	0.532%	0.415%

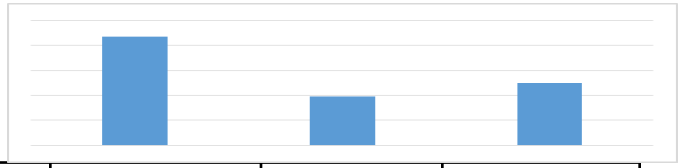
LaSalle County

Year	1990	2000	2010
Institutional Resilience			
Mitigation (% population in covered by HMP)	0	97.60%	93.40%
Flood Coverage (number policies in place)	115	340	434
Municipal Services (% of budget on police, fire, EMS)	6.12%	7.24%	12.62%
Mitigation (% population in CRS communities)	0	0	48.70%
Previous Disaster Experience (disaster declarations in prior 10 years)	2	1	3
Mitigation and Social Connectivity (Citizen Corps)	0	0	1

LaSalle County

Year	1990	2000	2010
Infrastructure Resilience			
Housing Type (% HU not mobile homes)	94.27%	94.54%	95.32%
Shelter Capacity (% vacant units)	5.80%	6.50%	8.92%
Housing Age (% housing units built before 1950 and after 1979)	59.57%	63.89%	64.52%
Sheltering Needs (number hotels/10K population)	1.68	1.97	2.28

LaSalle County



Year	1990	2000	2010
Community Capital			
Place Attachment (% population originally from USA)	98.13%	98.40%	96.40%
Percent of population born in the state of residence	85.12%	83.72%	83.10%
Political Engagement (number votes/population over 18)	0.577	0.568	0.580
Social Capital (number religious participants/10K population)	7,111	6,249	4,701
Social Capital (civic organization/10K)	2.99	2.42	3.16

FEMA PrepTalks: Social Capital in Disaster Mitigation and Recovery
Dr. Daniel Aldrich

https://www.fema.gov/preptalks/aldrich

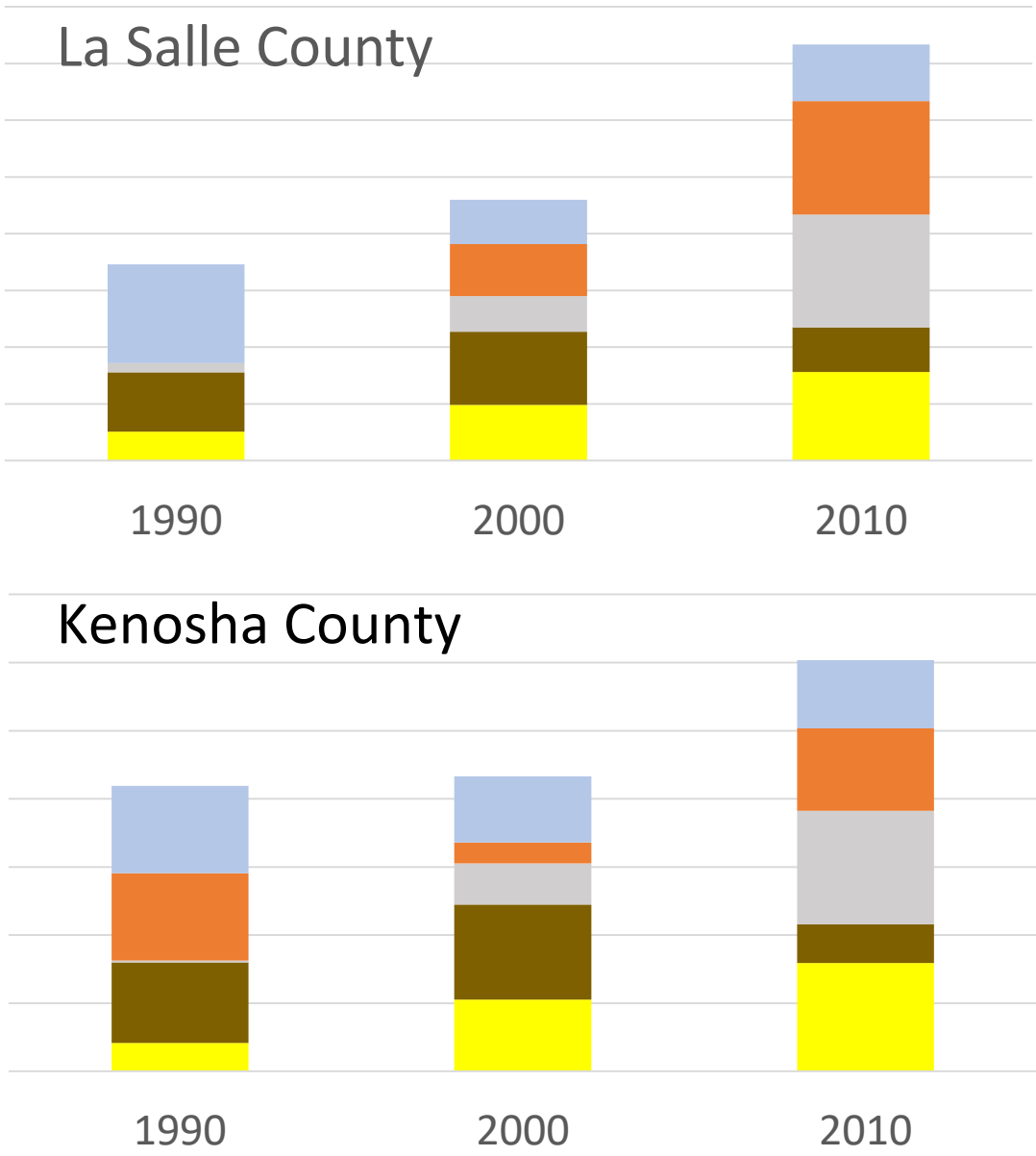
Community Actions

- Adoption of higher floodplain regulatory standards
- Adoption / updates of building codes
- Adoption of zoning ordinances
- Emergency response collaboration
- Comprehensive plans & Regional planning
- Trends in median income
- Losses avoided
- Impact of State and National policy

Calculating the Baseline Resilience Metric (BRIC)

- Variables are expressed so that increasing numerical value indicates increase in resilience
- Values transformed to non-dimensional or relative scales:
  - Percentage
  - per capita
  - density
- Normalized to range 0 to 1
- Category Average
- Category Averages summed = BRIC

BRIC Index / DROP model



Observations

- Consistency in data a challenge over time
- Some variables appropriate for place to place comparisons do not inform temporal comparison of place
- Data was not available for environmental resiliency variables for all time periods
- Regional modifications to variables are necessary
- High potential to use a resilience metric in state and countywide mitigation plans

Questions?

Social Resilience

Educational equity	Ratio of the pct. population with college education to the pct. population with no high school diploma
Age	Percent non-elderly population
Transportation access	Percent population with a vehicle
Communication capacity	Percent population with a telephone
Language competency	Percent population not speaking English as a second language
Special needs	Percent population without a sensory, physical, or mental disability
Health coverage	Percent population with health insurance coverage
Mental health support	Psychosocial support Facilities per 10K persons
Food Provisioning capacity	food insecurity rate
Physician Access	Number of physicians per 10,000 population

Economic Resilience

Housing capital	Percent homeownership
Employment	Percent employed
Income and equality	GINI coefficient
Single sector employment dependence	Percent population not employed in farming, fishing, forestry, and extractive industries
Non-dependence on primary/tourism sectors	Percent of employees not in farming, fishing, forestry, extractive industry, or tourism
Employment	Percent female labor force participation
Gender income equality	Negative absolute difference between male and female median income
Business size	Ratio of large (>100) to small (<10) businesses
Large retail-regional / national geographic distribution	Large retail stores per 10K persons
Federal employment	Percent of labor force employed by federal government

Institutional Resilience

Mitigation	Percent population covered by a recent hazard mitigation plan
Flood coverage	Percent housing units covered by NFIP policies
Municipal services	Percent municipal expenditures for fire, police, and EMS
Mitigation	Percent population participating in Community Rating System for Flood (CRS)
Political fragmentation	Number of governments and special districts
Previous disaster experience	Number of paid disaster declarations
Mitigation and social connectivity (Local disaster training)	Percent population covered by Citizen Corps programs
Mitigation	Percent population in Storm Ready communities
Performance regimes - state capital	Proximity of county sear to state capital
Performance regimes - nearest metro area	Proximity of county seat to nearest county seat within a Metropolitan Statistical Area
Nuclear plant accident planning	Percent of population within 10 miles of nuclear power plant
Crop insurance coverage	Crop insurance policies per square mile

Infrastructure Resilience

Housing type	Percent housing units that are not mobile homes
Shelter capacity	Percent vacant rental units
Medical capacity	Number of hospital beds per 10,000 population
Access/ evacuation potential	Principle arterial miles per square mile
Evacuation routes	number of major roads that cross a county boundary per 10K persons
Housing age	Percent housing units not built before 1970 and after 1994
Temporary shelter availability	hotels/motels per 10K persons
School (recovery)	Public schools per 10K persons
Industrial resupply potential	Rail miles per square mile
High-speed Internet infrastructure	Percent population with access to broadband Internet service

Community Capital

Place attachment	Net international migration
Place attachment	Percent of population born in the state of residence
Political engagement	Percent voter participation
Social capital- religion	Number of religious adherents per 10,000 population
Social capital – civic involvement	Number of civic organizations per 10,000 population
Social capital – advocacy	Number of social advocacy organizations per 10,000 population
Social capital - disaster volunteerism	Red Cross volunteers per 10K persons
Citizen disaster preparedness and response skills	Red Cross training workshop participants per 10K persons

Environmental Resilience

Local food suppliers	Farms marketing products through community-supported agriculture per 10K persons
Natural flood buffers	% land in wetlands
Efficient energy use	Megawatt hours per energy consumer
Pervious surfaces	Average percentage perviousness
Efficient water use	Inverted Water Supply Stress Index