Resilient Cities 2018

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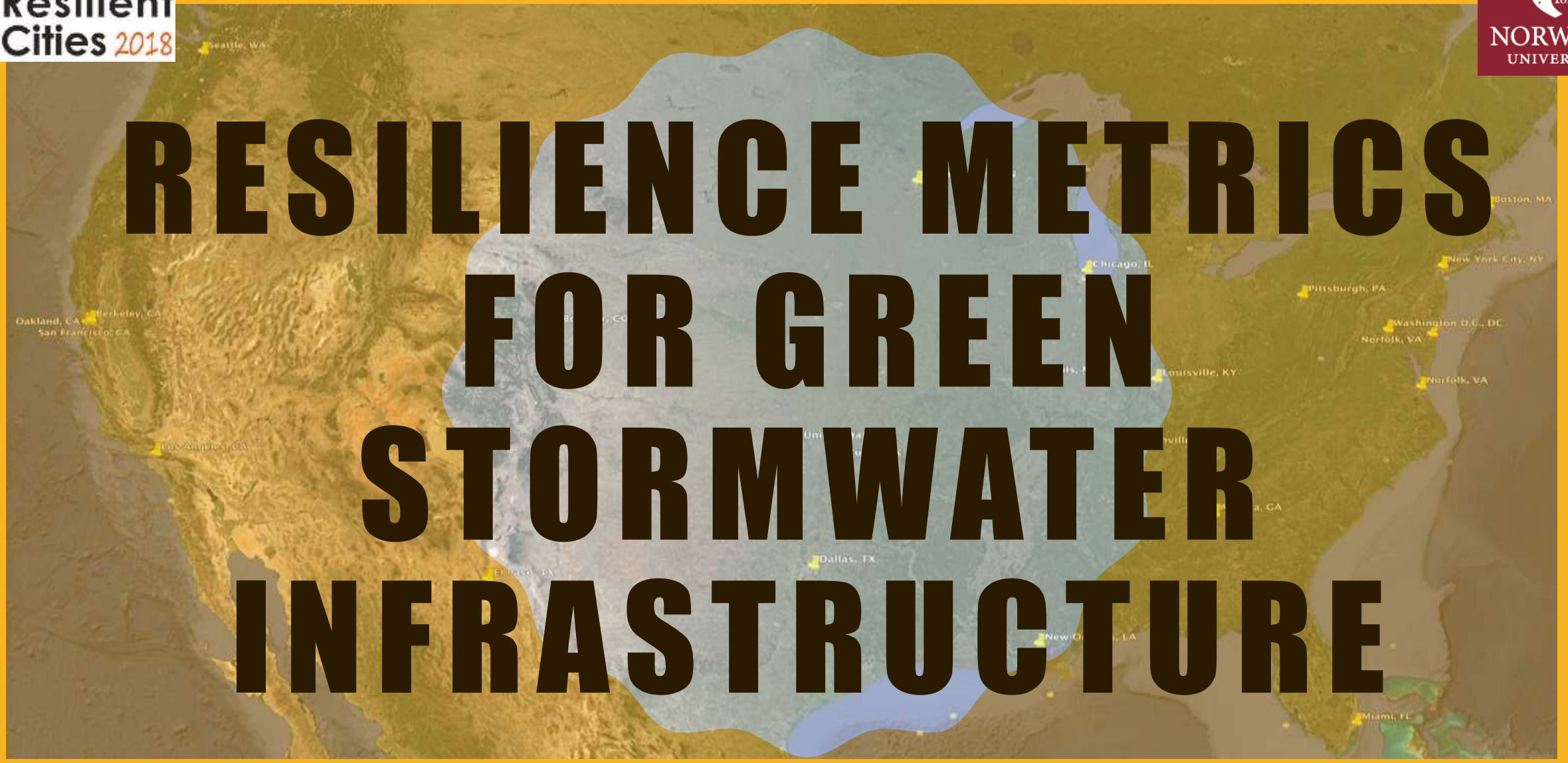

RESILIENCE METRICS FOR GREEN STORMWATER INFRASTRUCTURE

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GREEN STORMWATER INFRASTRUCTURE

Source: US Environmental Protection Agency

Source: Philadelphia Water Department

DEFINING RESILIENCE

- "Infrastructure resiliency is the ability to gracefully degrade and subsequently recover from a potentially catastrophic disturbance that is internal or external in origin
  - Source: American Society of Civil Engineers (ASCE) and National Science Foundation (NSF) researchers under the Resilient and Sustainable Infrastructure (RESIN)

- In the context of flooding, resilience is the capacity of a system (community, society, or environment), to adapt, resist, and/or recover from the flood in order to maintain or achieve an acceptable level of functioning.
  - Source, Pelling, (2003)

- In the context of resilience building: resilience is the potential to absorb and cope with impacts of climate shocks and extremes in the short-term, and to reorganize, and redevelop, preferably to an improved state in the longer term
  - Source: Engel, et. al. (2014)

FRAMEWORKS FOR RESILIENT INFRASTRUCTURE

- United Nations International Strategy for Disaster Reduction's (UNISDR) 2005 Hydogo and 2015 Sendai Framework:
- UNISDR's Making Cities Resilience campaign of 2013
- World Bank's Global Facility for Disaster Risk Reduction - 2013
- United Kingdom Department for International Development's resilience framework

EXAMPLES OF RESILIENCE INDICES

1. Coastal Resilience Index
2. Argonne National Laboratory Resilience Index
3. Social Vulnerability Index
4. Baseline Resilience Indicator for Communities (BRIC)
5. Community Assessment of Resilience Tool (CART)
6. Resilience Capacity Index (RCI)
7. Community Disaster Resilience Index (CDRI)
8. Center for Risk and Economic Analysis of Terrorism Events Economic Resilience Index (CREATE – ERI)

1. United Nations Development Program (UNDP) Disaster Risk Index (DRI)
2. Inter-American Development Bank Disaster Deficit Index (DDI)
3. Interagency Standing Committee (IASC) In-Country Team Self-Assessment Tool for Natural Disaster Response Preparedness
4. United Nations University Institute for Environment and Human Security, World Risk Index

100 RESILIENT CITIES

Source: 100 Resilient Cities

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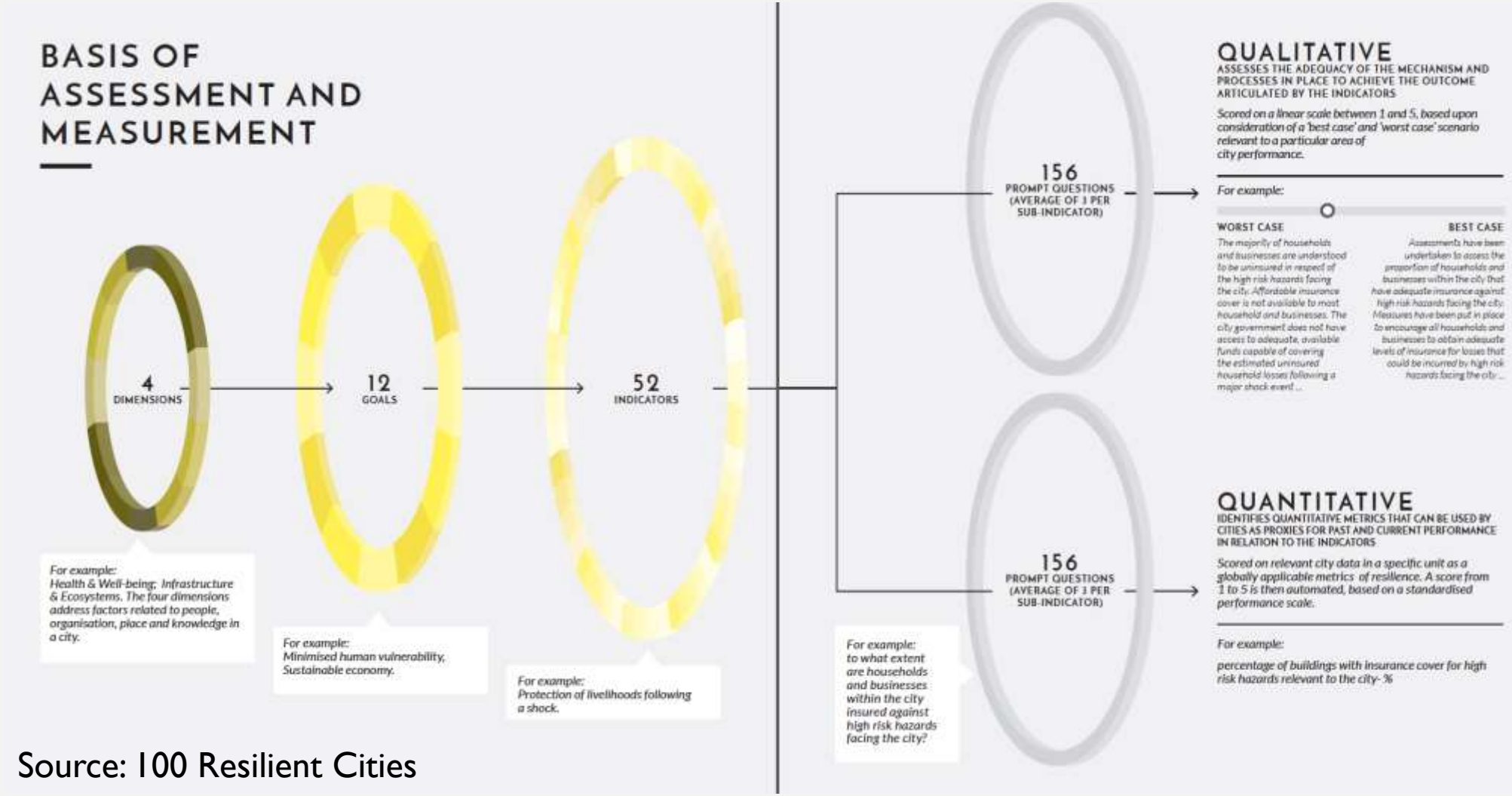
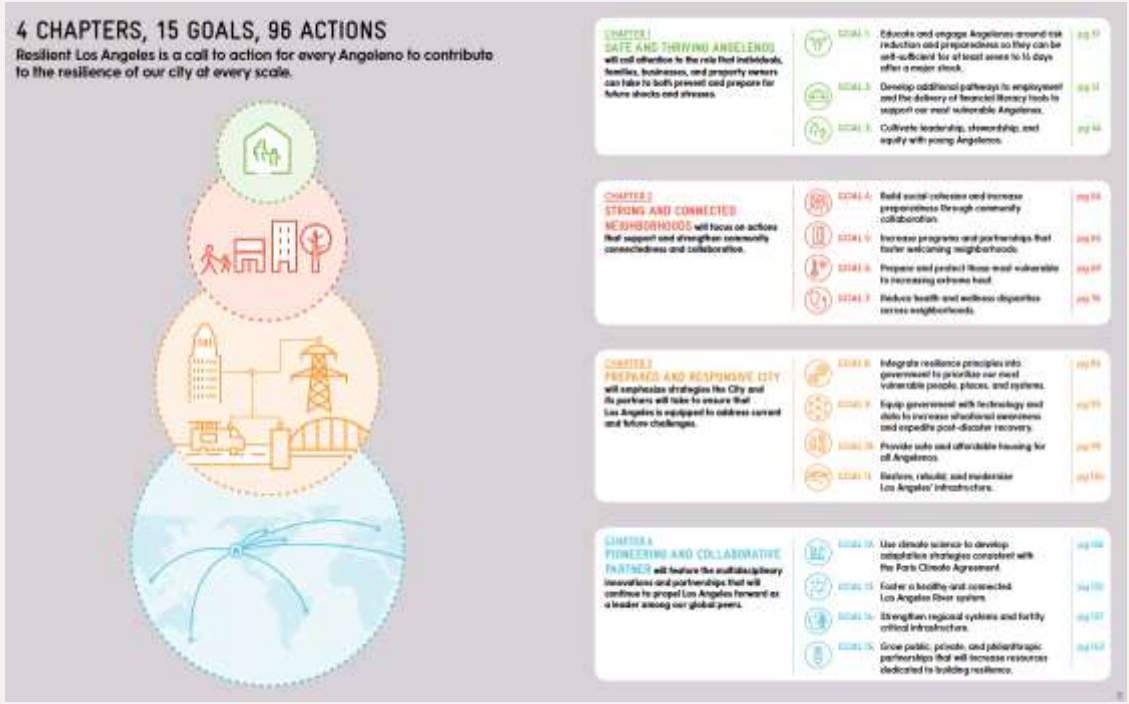
ARUP – CITY RESILIENCE INDEX

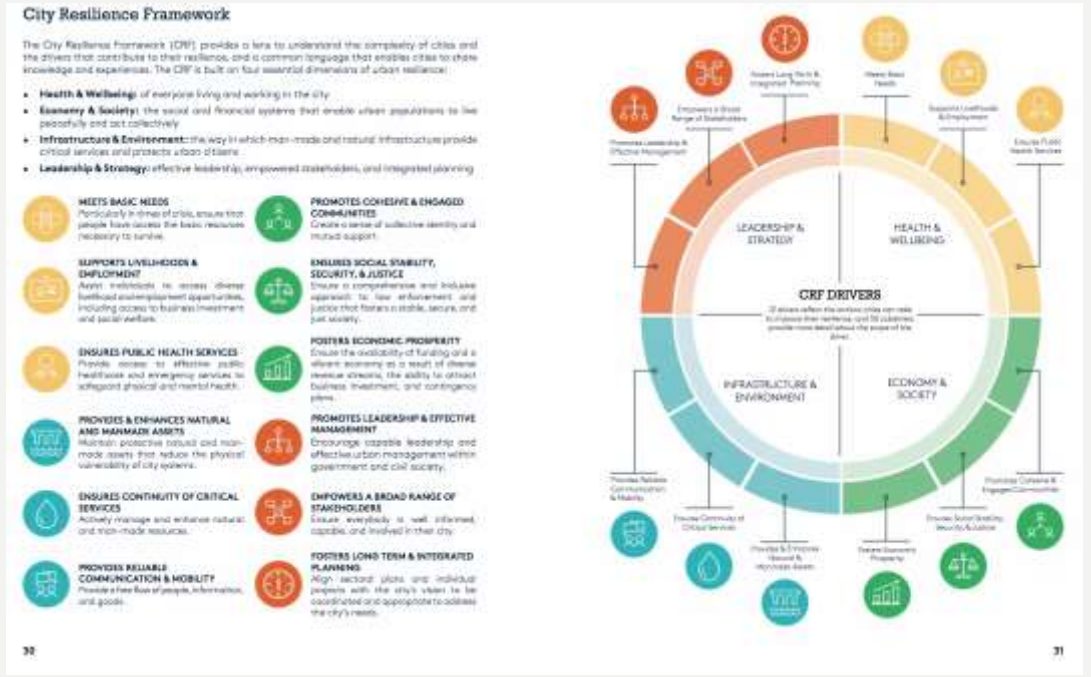


Source: 100 Resilient Cities

100 RESILIENT CITIES – EXAMPLES – LA, ATLANTA



Source: Resilient Los Angeles, March 2018



Source: Atlanta Resilience Strategy, 2017

EXAMPLES FROM 100 RC – ATLANTA

- Vision 3 – Building our future city - today

TARGET 3.4

Create 500 new acres of publicly accessible greenspace by 2022.

The City will create 500 new acres of publicly accessible greenspace by 2022. Public open spaces foster civic connection and build social capital while improving environmental health and increasing opportunity for physical activity. However, according to the 2009 City of Atlanta Project Greenspace assessment, only 41 percent of Atlantans live in areas where they can safely walk to a nearby park, and many of Atlanta's existing parks are smaller than the national threshold for a full-service park. Since Project Greenspace was published, the City has worked diligently to add new parks and greenspace but there is still a critical need for accessible greenspace. In Action 3.4.1, the City will construct the Proctor Creek Greenway trail to increase public greenspace and transit access, catalyze economic development, and create a healthy livable environment for an area of the city which faces considerable environmental and economic challenges. Action 3.4.2 creates a funding strategy to support and ensure a more equal distribution of greenspace throughout the city. Action 3.4.3 expands the functions of the City of Atlanta Tree Recompense Fund to better protect and grow Atlanta's tree canopy.

TARGET 3.5

Install sustainable energy- and water-efficient infrastructure improvements in public spaces as well as around 500 homes and businesses each year.

The City will work with local organizations, businesses, and private-property owners to install water-and energy-efficient systems in order to manage drought, stormwater flooding, and rising energy costs to ensure a sustainable future for the city. For instance, most commercial entities, such as restaurants, are billed primarily at Tier 3-usage rates, so every gallon of water conserved would produce savings of $21.85 per gallon of water.[38] Action 3.5.1 develops a restaurant water-efficiency program to reduce waste and water costs. Action 3.5.2 recommends the creation of a stormwater utility fee to fund green infrastructure improvements. Action 3.5.3 increases the use of solar improvements through bulk purchasing options. Action 3.5.4 educates and encourages homeowners to adopt energy-saving techniques. Action 3.5.5 supports a resilient infrastructure demonstration project on Ted Turner Drive to encourage innovation and greater use of resilient infrastructure across Metro Atlanta.

Action 3.5.2: Create a stormwater utility fee to develop and fund a comprehensive stormwater management program

Establish a stormwater utility fee to fund the City's stormwater management plan, which is designed to reduce surface flooding, address aging infrastructure, and improve the quality of water in our streams. This initiative will include funding projects identified in the City's Watershed Improvement Plans, leveraging partnerships through the Green Infrastructure Strategic Action Plan, and providing incentives for customers to install green infrastructure best management practices (BMP's) on private property to help manage on-site stormwater runoff. The Department of Watershed Management has proposed a comprehensive Stormwater Management Program to be supported by a sustainable stormwater utility fee established through the standard practice of billing property owners based on the amount of impervious surface present on a property. The program will be modeled after a combination of national best practices and programs from neighboring jurisdictions. Atlanta's stormwater utility fee will be designed to specifically address equity concerns by providing grant programs to ensure low-income residents are neither adversely affected by the cost of the fee nor unable to participate in BMP implementation programs.

Resilience Value to Atlantans:

Primary Driver
Ensures Continuity of Critical Services

Secondary Driver
Provides & Enhances Natural & Manmade Assets

Lead Implementing Partners:
CoA Department of Watershed Management, CoA Mayor's Office of Resilience, The Conservation Fund, American Rivers, West Atlanta Watershed Alliance

Potential Metrics/Measures of Success:

- Volume of pollutants captured by installed Green Infrastructure Best Management Practices (BMPs)
- # of BMPs installed
- # of flooding incidents citywide and at U.S. Federal Emergency Management Agency recognized flood-prone areas
- $ collected through stormwater utility fee

Partner Spotlight

Green Infrastructure Taskforce

In 2013, the City of Atlanta convened relevant City agencies, as well as partner groups, to promote and support the integration of green infrastructure into all types of public infrastructure investments. This Green Infrastructure Task Force has developed a Strategic Action Plan to address the challenges associated with managing stormwater runoff that leads to flooding, degraded water quality, and property damage. The Plan, which the Atlanta City Council unanimously approved in 2017, suggests actions for removing institutional barriers to green infrastructure construction; increasing cost-effectiveness of green infrastructure; and engaging multiple City departments, citizens, developers, and environmental groups in working towards the goal of reducing stormwater runoff by 225 million gallons annually. Numerous projects have been completed, including Southeast Atlanta Permeable Pavers, Adair Park Rain Garden, and Historic Fourth Ward Park. Upcoming initiatives include Proctor Creek Greenway, Boone Park West with the Atlanta Urban Ecology Center @ Proctor Creek, and Rodney Cook, Sr. Park.

Source: Resilient Atlanta: Actions to Build an Equitable Future

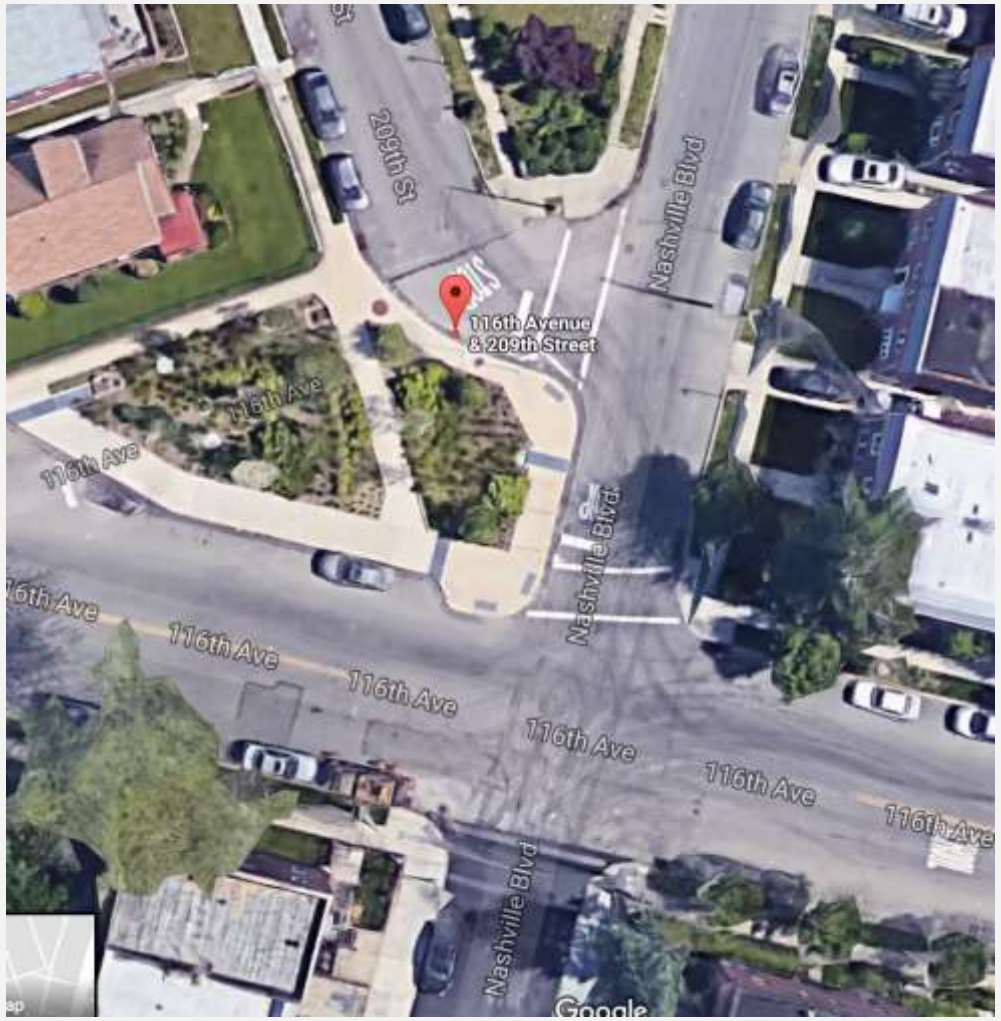
EXAMPLES FROM 100 RC - NEW YORK CITY

At the stormwater greenstreet located on Nashville Boulevard between 116th Avenue and 209th Street in Queens (Nashville), 100% of stormwater runoff entered local catch basins and ultimately the combined sewer system prior to installation in 2011

Over our 2012 monitoring season (April - November), we found that 21 out of 24 storm events were 100% retained within the site.

Furthermore, our data suggests that the Nashville site can retain 100% of the flow directed to it during all storms with less than 1.6 inches of rainfall.

In addition, Nashville was closely monitored during both Hurricane Irene and Superstorm Sandy, and it captured much more stormwater runoff than anticipated.



Source: Google Maps

Source: Landscape Architecture Foundation News

100 RESILIENT CITIES - NYC

NYC GREEN JOBS CORPS

New York City continues to be a leader in reducing the greenhouse gas emissions that contribute to catastrophic climate change and is the largest city on the globe to have committed to an 80 percent reduction in emissions by 2050. Achieving this goal requires significant investments across the city's energy supply, buildings, transportation, and solid waste sectors. At the same time, we are committed to providing New York City residents with greater economic opportunities and pathways to good-paying jobs.

At the 2017 State of the City address, Mayor de Blasio announced the NYC Green Jobs Corps, a partnership with industry and labor to train 3,000 New Yorkers with the skills needed to participate in the emerging clean energy economy over the next 3 years. This new program builds upon the successful efforts after Hurricane Sandy to connect New Yorkers to pre-apprentice training programs leading to apprentice programs, creating a pathway well-paid middle-class careers in the construction industry, and other related training programs.

NYC *COOLROOFS

NYC *CoolRoofs is a partnership with the Department of Small Business Services (SBS), the Mayor's Office of Sustainability, the Mayor's Office of Recovery and Resiliency, and Sustainable South Bronx connects New Yorkers with training and work experience installing energy-saving reflective rooftops. By developing professional skills and receiving industry-relevant certifications, participants complete the program prepared for entry-level jobs in the construction industry. Seventy New Yorkers will participate this summer.

Since its launch in 2009, the program has coated over 6.7 million square feet of rooftops across the city, resulting reductions to energy consumption and mitigating the city's urban heat island effect. The City aims to coat one million square feet of rooftops annually to support the City's 80x50 goals.

DEP GREEN INFRASTRUCTURE MAINTENANCE TRAINING

Thomas Arrington recently joined DEP as part of the agency's green infrastructure maintenance unit. Thomas is currently studying environmental science at Queens Community College and has a clear passion for the natural environment. Thomas is also very active in his community and is a member of the Friends of Idlewild Park in Queens.

"Previously, I've worked in landscaping and for the Parks Department and I hope this job at DEP will lead to a career in forestry in New York City's public sector."

DEP's green jobs will help to maintain the City's investment in green infrastructure and provide workers with basic skills in horticulture and green infrastructure maintenance. DEP will also provide opportunities for seasonal employees to become permanent staff, allowing for further professional advancement within the agency. DEP continues to hire additional employees for green jobs as it constructs new green infrastructure assets across the City.

Initiative 3: Expand green infrastructure and smart design for stormwater management in neighborhoods across the city

(Source: OneNYC 2015)

Initiative/ Supporting Initiative	Lead Agencies	Initiative/ Funding Status	Progress Since April 2016	Milestones to complete by December 31, 2016	2016 Milestone Status	Milestones to complete by December 31, 2017
3.5.3 Continue the NYC Green Infrastructure Program in areas served by the combined sewer system to reduce CSO, and expand the use of green infrastructure to other parts of the city	DEP	In Progress/ Funded	The City, through DEP, continued its green infrastructure program as a part of a $1.5B commitment by 2030. Ongoing program areas include right-of-way rain gardens, stormwater green streets, and porous pavement. To date, 3,800 green infrastructure assets are either completed or in construction.	› Submit the CSO Performance Metrics Report and the Green Infrastructure Contingency Plan to NYS DEC	Completed	› Submit Green Infrastructure Annual Report (April 30, 2017), and continue to make progress toward the next CSO Consent Order milestone in 2020 › Complete construction of Springfield Lake Bluebelt

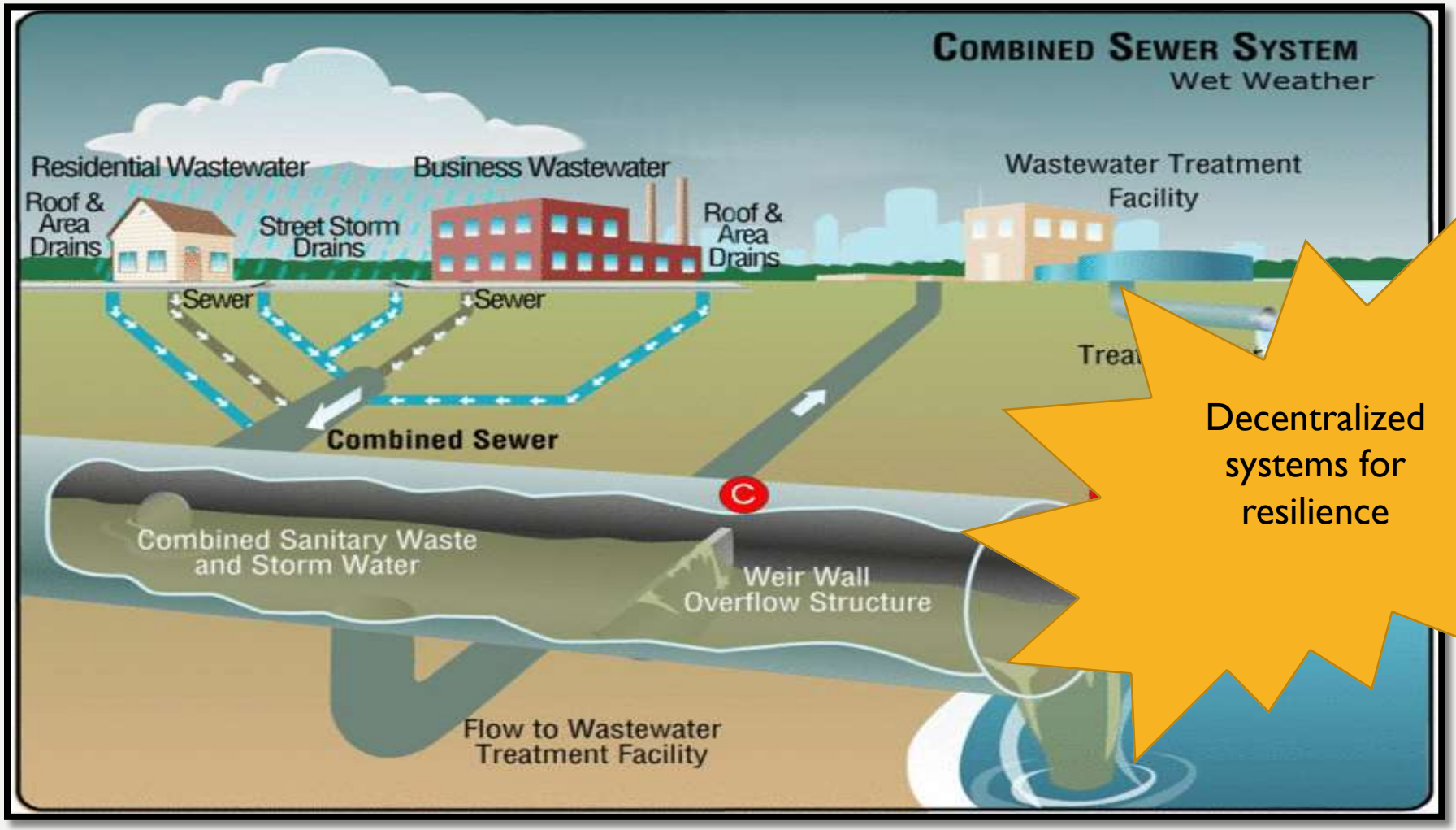
Initiative 3: Expand green infrastructure and smart design for stormwater management in neighborhoods across the city

(Source: OneNYC 2015)

Initiative/ Supporting Initiative	Lead Agencies	Initiative/ Funding Status	Progress Since April 2016	Milestones to complete by December 31, 2016	2016 Milestone Status	Milestones to complete by December 31, 2017
3.5.3A, Alleviate flooding in southeast Queens	DEP	In Progress/ Funded	The City, through DEP, completed an engineering study of the 50 hardest hit flooding grids and identified site-specific solutions. The City also began the design of 200 rain gardens in southeast Queens and expects construction to begin in the summer of 2017. In addition, DEP launched design for green infrastructure retrofits at three parks, while construction is underway for green infrastructure at two schools and on the Baisley Pond Bluebelt. Planning and design for green infrastructure on NYCHA properties in the area is expected to begin summer of 2017.	› Initiate design of green infrastructure on public land	Completed	› Issue RFP for green infrastructure construction on public land
				› Complete an engineering study to assess the 50 hardest hit flooding grids and identify site-specific solutions for each grid	Completed	› Initiate construction of right-of-way green infrastructure
				› Begin construction on Baisley Pond Bluebelt	Completed	› Continue construction on Baisley Pond Bluebelt

Source: One NYC 2017 Update

MAJOR MOTIVATIONS FOR GSI -LEGAL

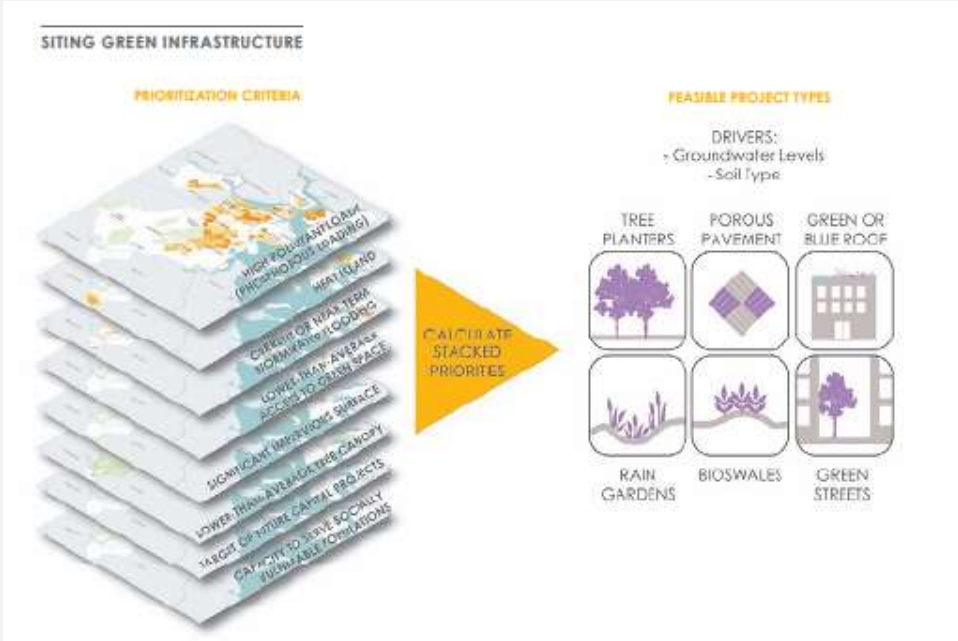


Sewage and stormwater management

Source: St. Louis, MO – Clean Rivers Healthy Communities Program Illustration

MAJOR MOTIVATIONS FOR GSI - ECONOMY

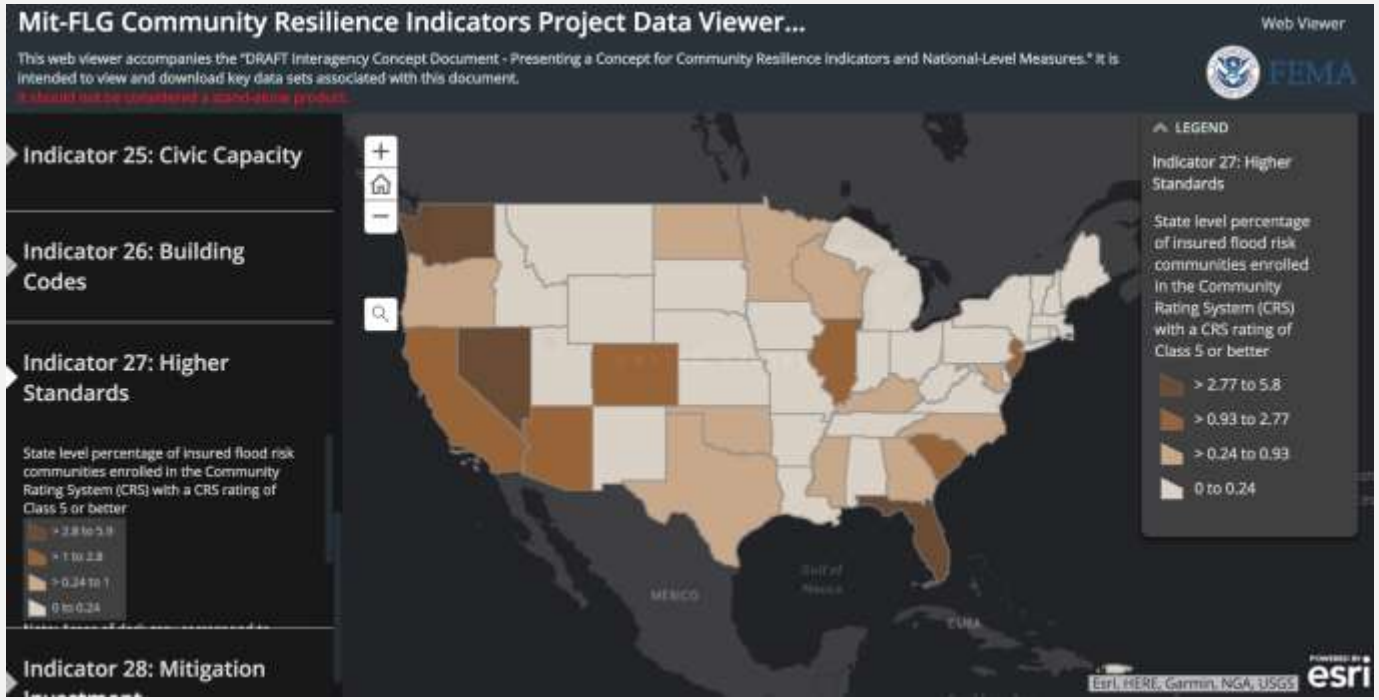
Source: Resilient Greater Miami and the Beaches



Source: Climate Ready Boston, 2014

MAJOR MOTIVATIONS FOR GSI – THE "RESILIENCE DIVIDEND"

1. Greenhouse gas emissions ∆🔥
2. Temperature (urban heat island effect) ∆T
3. Flooding ∆V☐ ∆$
4. Real estate ∆$
5. GW recharge - ∆H
6. Economy (jobs created/added) - ∆J
7. Water use/reuse - ∆V, ∆$
8. Building energy costs - ∆☐☐
9. Wildlife habitat - ∆☐🐾
10. Recreation - ∆🏄☐
11. Soil erosion/subsidence ∆⌥
12. Water quality ∆💧 ∆$



Source: Department of Homeland Security

MEASURING METRICS

- Citizen participation (similar to lay monitoring programs)
- Public private partnerships
- Partnering with universities
- Real time sensor based data collection and analysis to develop trends

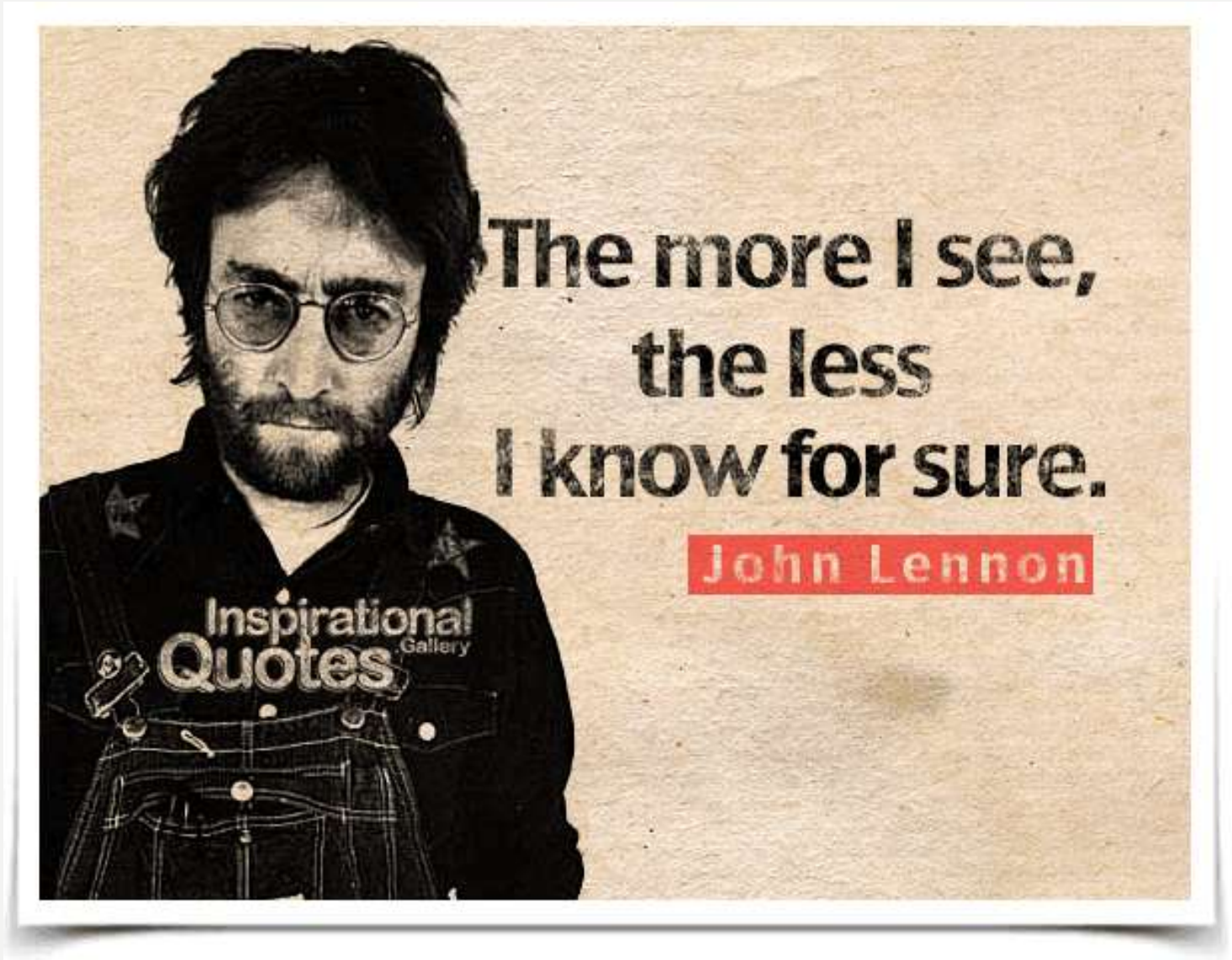
CONCLUSIONS

- GSI practices are true examples of a "resilience dividend" – one feature, multiple benefits
- Designing for resilience rather than risk allows not only robustness and redundancy – but also increases flexibility
- GSI practices allow progress toward Sustainable Development Goals – offering more metrics

ACKNOWLEDGEMENTS

- Norwich University Board of Fellows Faculty Development Prize
- Center for Global Resilience and Security at Norwich University

QUESTIONS ?


The more I see,
the less
I know for sure.
John Lennon
Inspirational
Gallery
Quotes