

Then, Now, Forward! Design With Nature For Everyone and Everywhere

Moderator: Ed Gauvreau, FAIA, F.SAME, HQ USACE

Speakers:

- Wendi Goldsmith, Ph.D., F.SAME, Director, Green Infrastructure Foundation
- Todd Bridges, Ph.D., University of Georgia
- Susannah Drake, FAIA, FASLA, Principal, Sasaki

May 14, 2024, 1:30 p.m.



MAY 14-16, 2024
ORLANDO, FL

OPERATION:
COLLABORATION

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 conferences i/o



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Or scan the QR Code

- Find the session.
- The presenter will unlock the poll(s) during the presentation.
- Please complete a brief Evaluation Survey at the end of the session.

HOUSEKEEPING ITEMS

Take Note of Exits

Silence Your Mobile Devices

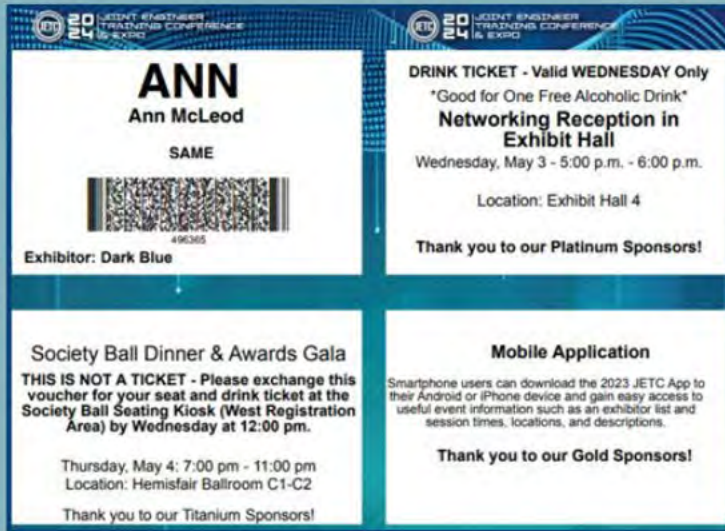
Presentations and Audio Recordings will be available in the Attendee Service Center until August 30, 2024

Download your PDH record in the Attendee Service Center before August 30, 2024



Opening Reception at Universal CityWalk

(Minimum age 18 - No Children)



Bring Your Name Badge
with Drink Tickets)
+ Your ID



Get Your Wrist Band
TODAY at the
Registration Help Desk
or SAME Booth



Buses depart Gaylord
& Caribe Royale,
beginning at 6:00 p.m.



Thank You to our Education Session Sponsors



Live Content Slide

Poll: Let's see who is in the audience...who do you represent?



MODERATOR



Edmond G. Gauvreau
FAIA, F.SAME
HQ US Army Corps of Engineers
Chief, Planning Branch

Fun Facts

- Notre Dame, Liverpool, Olympics
- Ireland, Iceland, Italy is next!
- Chaired both AIA Public Architects & SAME Architecture Practice COI
- Running, Reading, Agent for Change, Doggie Doorman

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SPEAKER



Wendi Goldsmith,
PhD, PG, F.SAME
Green Infrastructure Foundation
Director

Fun Facts

- Plan to go to Brisbane Olympics
- Completed 'EWN' Apprenticeship (Germany 1991)
- Book: *Bioengineering Case Studies*
- Editor for TME E&S News since 2013
- Volunteering, hiking, gardening

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SPEAKER



Todd Bridges, PhD

University of Georgia
Professor of Practice in Resilient and Sustainable Systems

Fun Facts

- Deepest Dive: 1,000m in the Atlantic
- Had tea with the President of Iceland
- Army Senior Research Scientist (ST) for Environmental Science for 17 years out of my 30-year career
- Founded the USACE Engineering With Nature Program

MAY 14-16, 2024
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SPEAKER



Susannah C. Drake,
FAIA, FASLA
Sasaki
Principal

Fun Facts

- Colorado Avalanche, Denver Nuggets
- Fiji and Vanuatu to study impacts of sea level rise
- I have a book called Sponge Park coming out Summer 2024
- Skiing, Hiking, Love dogs

MAY 14-16, 2024
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Live Content Slide

Poll: What are your thoughts about nature-based design solutions?

Examples: Conventional vs. with Nature

Concrete Seawall or Oyster Reef?



Riprap or Bioengineered Bank?



EWN in Planning & Design

Pros -- Why we want it

- Lower capital and O&M costs
- Low impact (to wetland, river, coastal ecosystems)
- Carbon footprint low or negative
- Self-repair and adaptation
- Regenerative and multifunctional

“MESSY” BUT RESILIENT

Cons – Why we resist it

- Beyond PE authority, requires diverse skills and communication
- Site-specific, variable, uncertain
- Less robust, especially at first
- Change/adaptation may differ from intentions/predictions

“SIMPLE” BUT BRITTLE

Conundrum: Design professionals seeking to improve their practice to achieve innovative sustainable outcomes face many hindrances

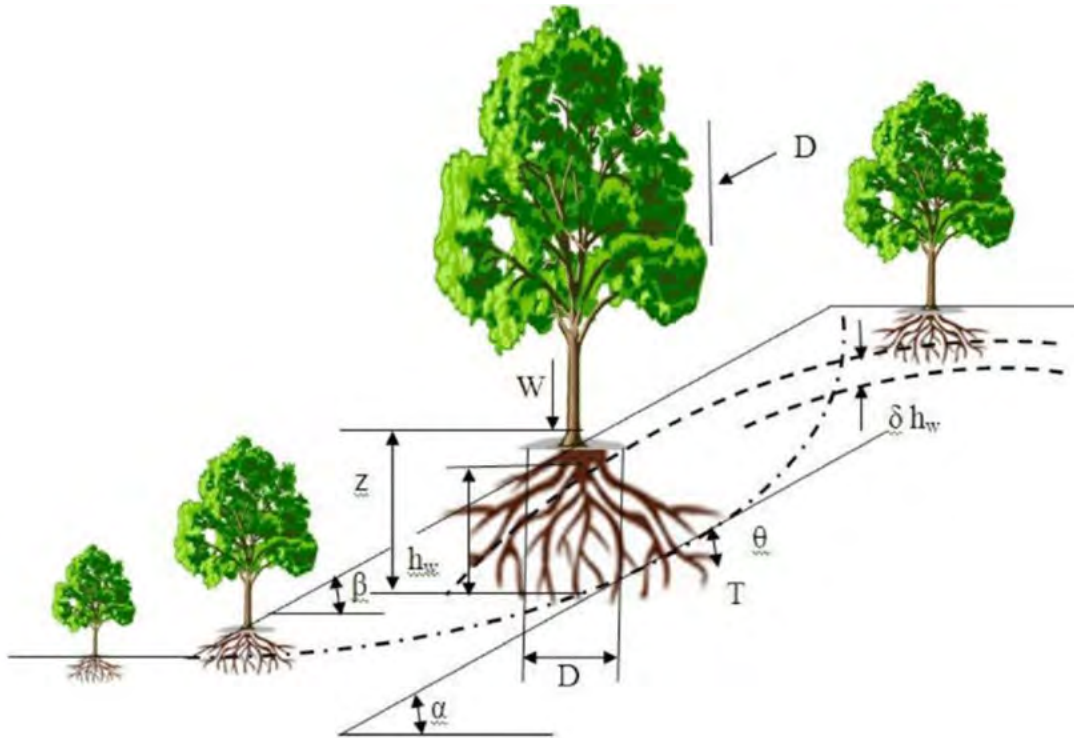
Assumption – Professionals are attentive to minimizing risk and improving methods

- Yes, but...
- Self-interest is easiest to address
- Standards are followed
- Novel approaches are unfamiliar
- Scenarios become guesswork
- “Community” or “environment” are highly abstract

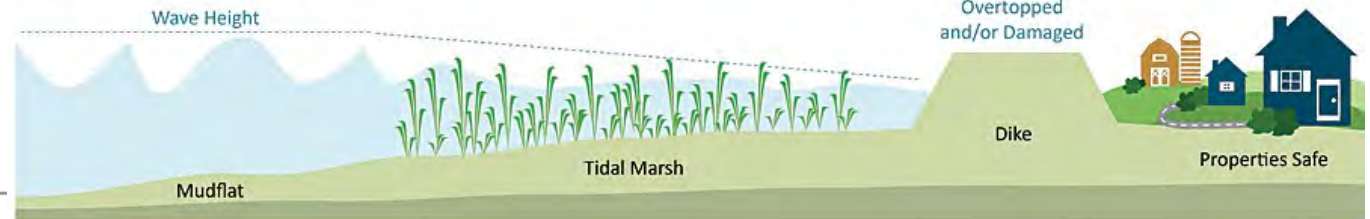
Multiple Functions

Roots reinforce soils/sediments

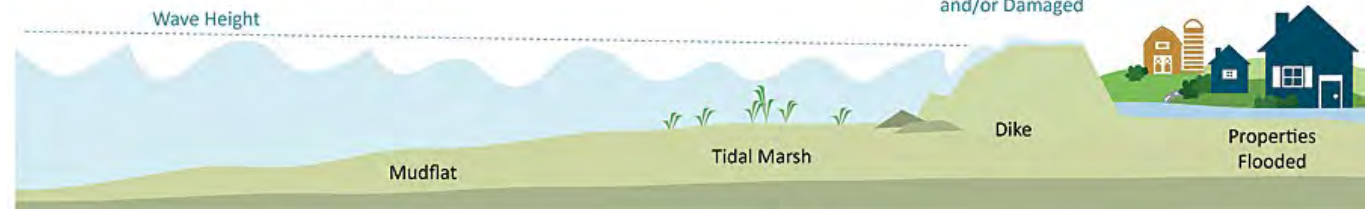
Stems dampen wave action



Wave attenuation with a healthy tidal marsh.



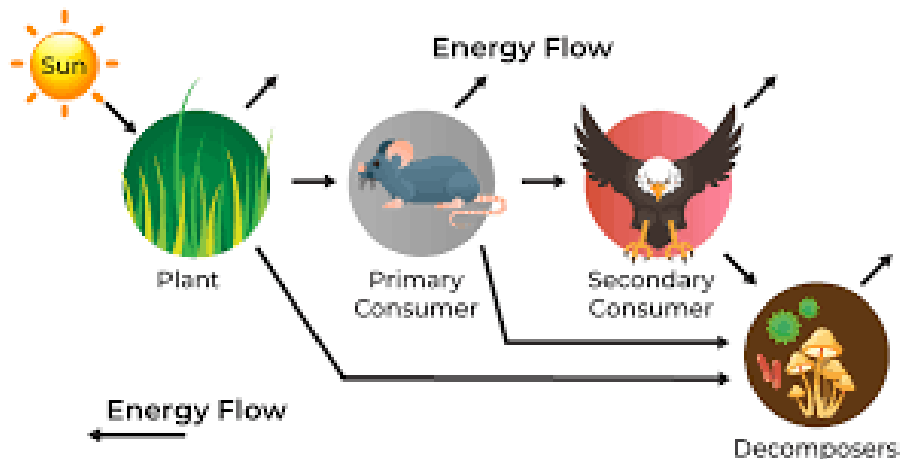
Wave attenuation with a degraded tidal marsh.



Sustainable Energy and Carbon Cycles

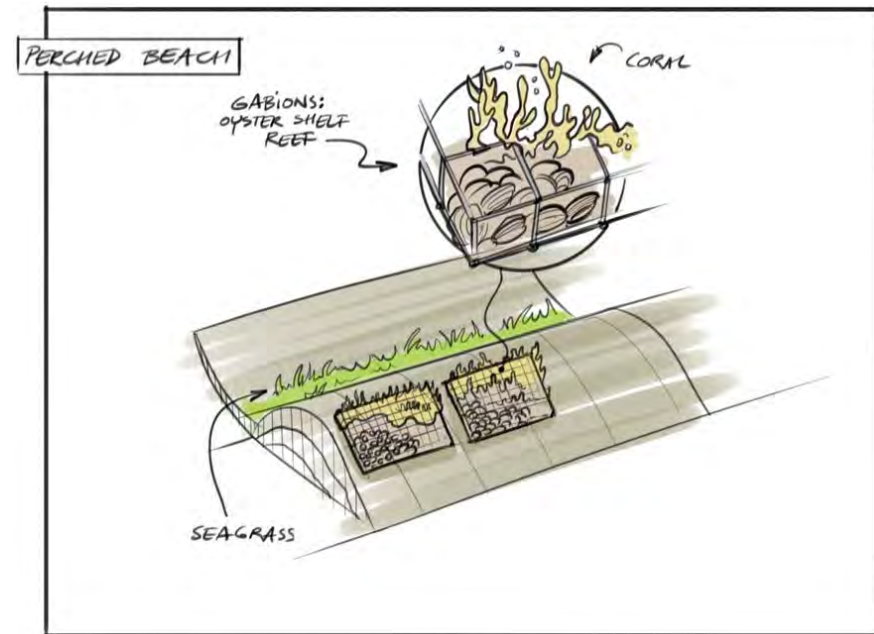
Energy Processing

- Harnessing On-Site Photosynthesis
- Dissipating Flow/Wave Energy
- Capacity for Self-Recovery/Repair
- Ability to Adapt



Carbon Processing

- Construction Phase
- Operation & Maintenance Phase
- Geologic and Climatic Timescale



Generalized Riprap vs EWN Lifecycle Inputs and Outputs

Energy to quarry
and ship



Displaced
riparian buffer



Photo Courtesy NRCS



Lost soil carbon
storage



Lost shade
and cover

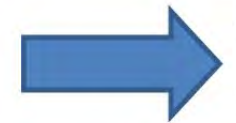
Local materials
collection



Photo Courtesy Bioengineering Group

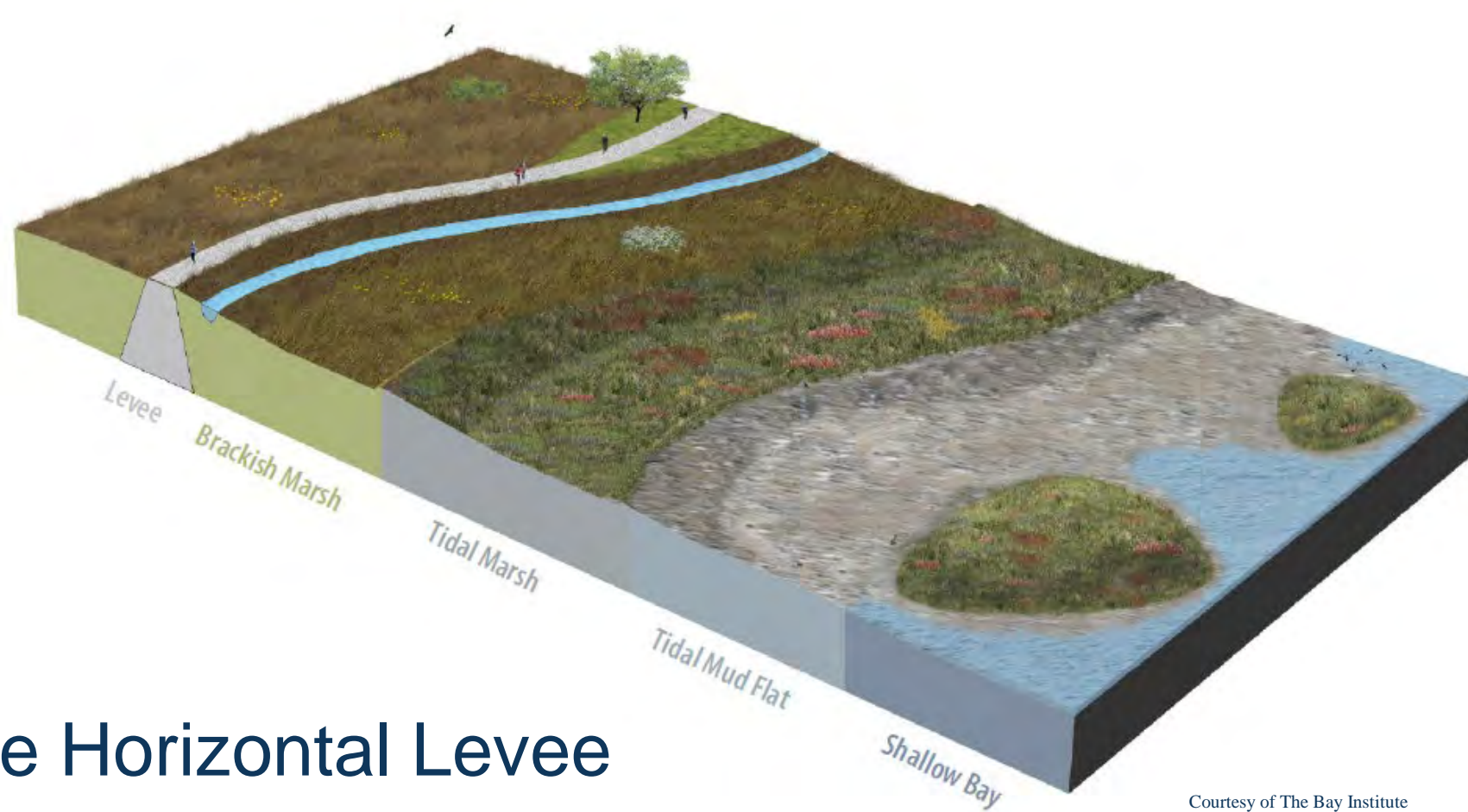


Water quality
and habitat



Ongoing Carbon
capture/storage

Multiple Lines of Defense Approach



The Horizontal Levee

Courtesy of The Bay Institute



2024 JOINT ENGINEER TRAINING CONFERENCE & EXPO

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"SOCIETY OF AMERICAN MILITARY ENGINEERS"

Global History

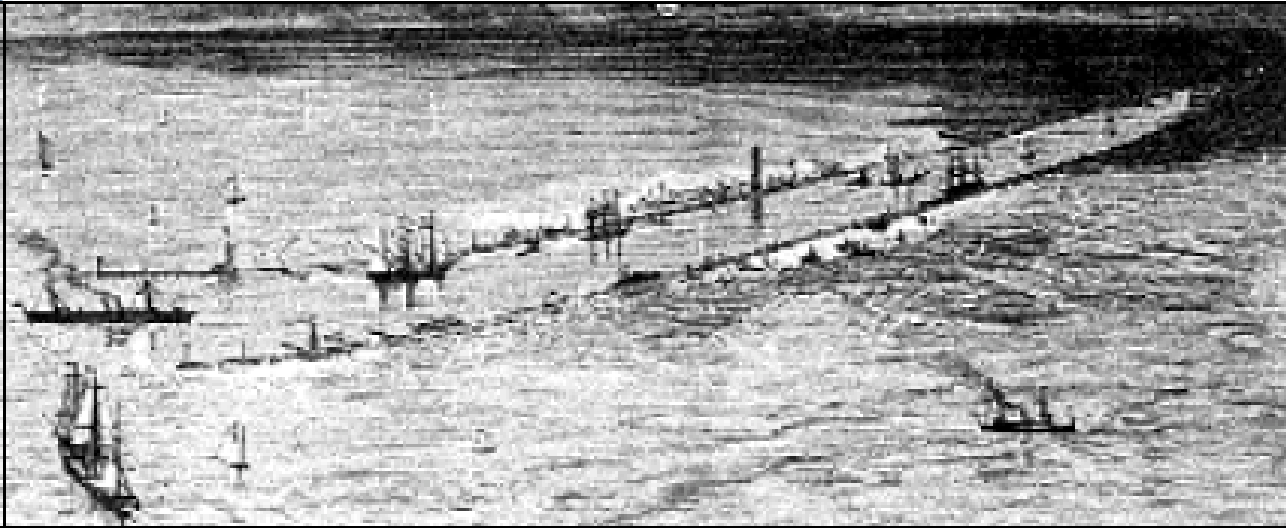
Images courtesy of European Bioengineering Federation



USACE Early History

1875 Lower Mississippi River Birdsfoot Delta – Captain Eads

Images courtesy of USACE Archives



USACE Recent History

ERDC's Hollis Allen and international exchange



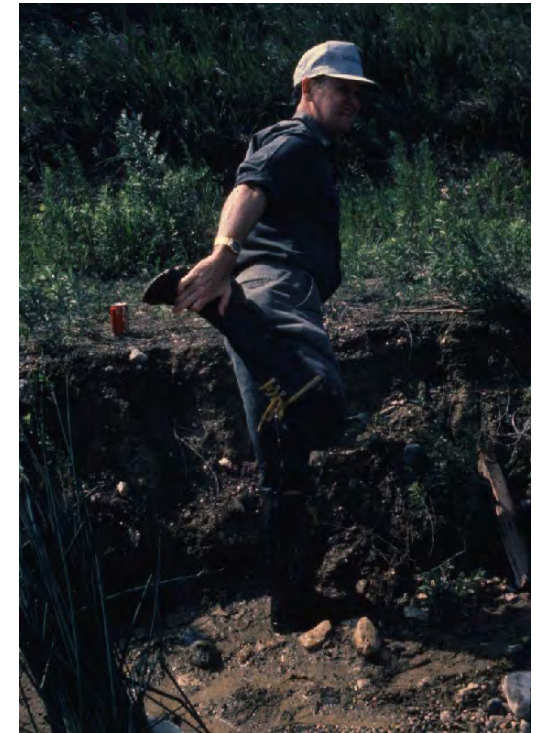
US Army Corps
of Engineers
Waterways Experiment
Station

Environmental Impact Research Program

Bioengineering for Streambank Erosion Control

Report 1 Guidelines

by Hollis H. Allen, James R. Leech



Recent Policy Developments

- 1996 WRDA -- National Ecosystem Restoration Planning
- Catastrophic losses to DoD installations and civil works
- EWN as R&D → EWN embedded in federal decision-making
- NGOs including Green Infrastructure Foundation advocating for locally policy adoption
- Applications: coastal, riparian, slopes, stormwater, etc.

Climate Change as Forcing Factor

- Sustainability objectives transformed into resilience mandates
- Changing conditions pose risk and uncertainty
- Impacts to/from projects become intrinsically evaluated
- Project service life performance displace initial design focus
- Pentagon defines resilience to Climate Change as:
“Ability to anticipate, prepare for, and adapt to changing conditions; and to withstand, respond to, and recover rapidly from disruptions”
- Translation into design criteria?
- Incorporation into design process?

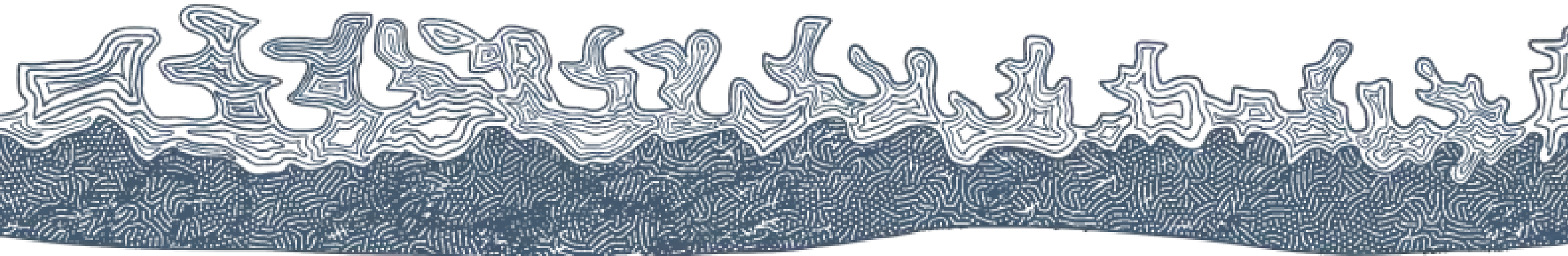


UNIVERSITY OF
GEORGIA

*Institute for Resilient
Infrastructure Systems*

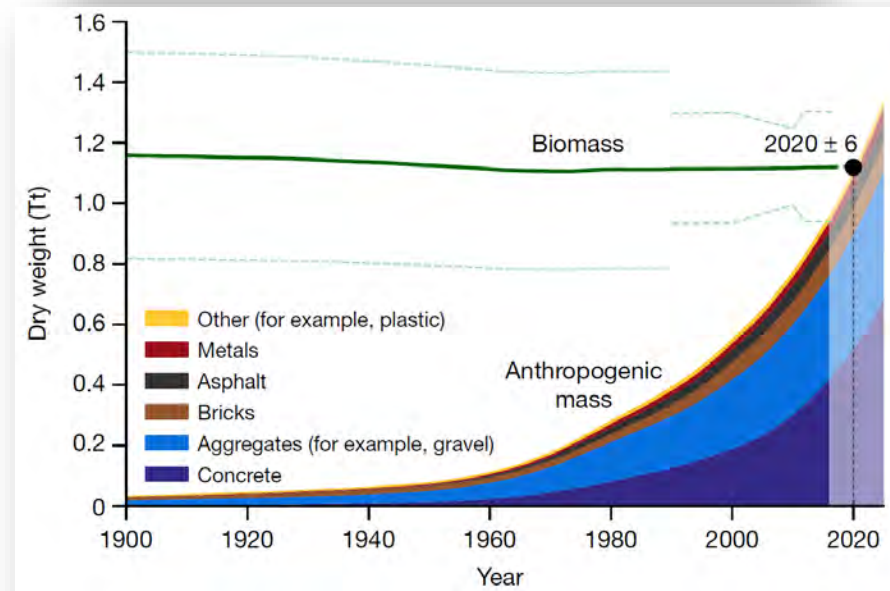
Nature-based Solutions and Military Resilience and Readiness

Dr. Todd S. Bridges
College of Engineering
University of Georgia

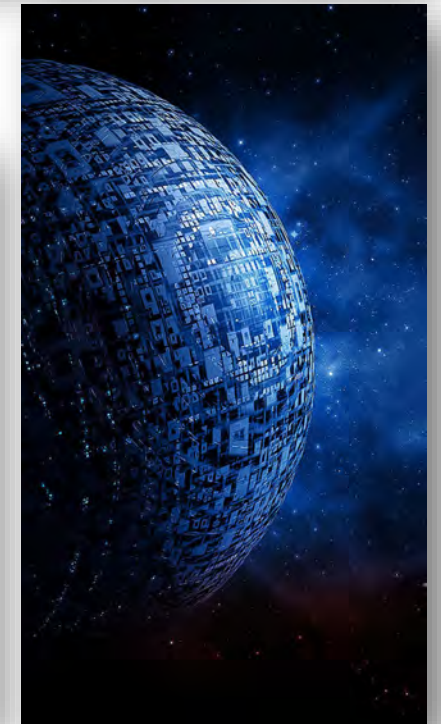


1900-2000: *The Century of Infrastructure (US)*

- 4,071,000 miles of roadway
 - 47,182 miles in the Interstate system
- 149,136 miles of mainline rail
- 640,000 miles of high-voltage transmission lines
- 614,387 bridges
- 90,580 dams
- >30,000 miles of flood levee
- 155,000 public drinking water systems
- ~5,000 military installations
- 926 ports, 25,000 miles of navigation channel



Elhacham et al. 2020. Global human-made mass exceeds all living biomass. Nature 588:442-444



National Security Infrastructure: Military Installations

~5,000 military installations

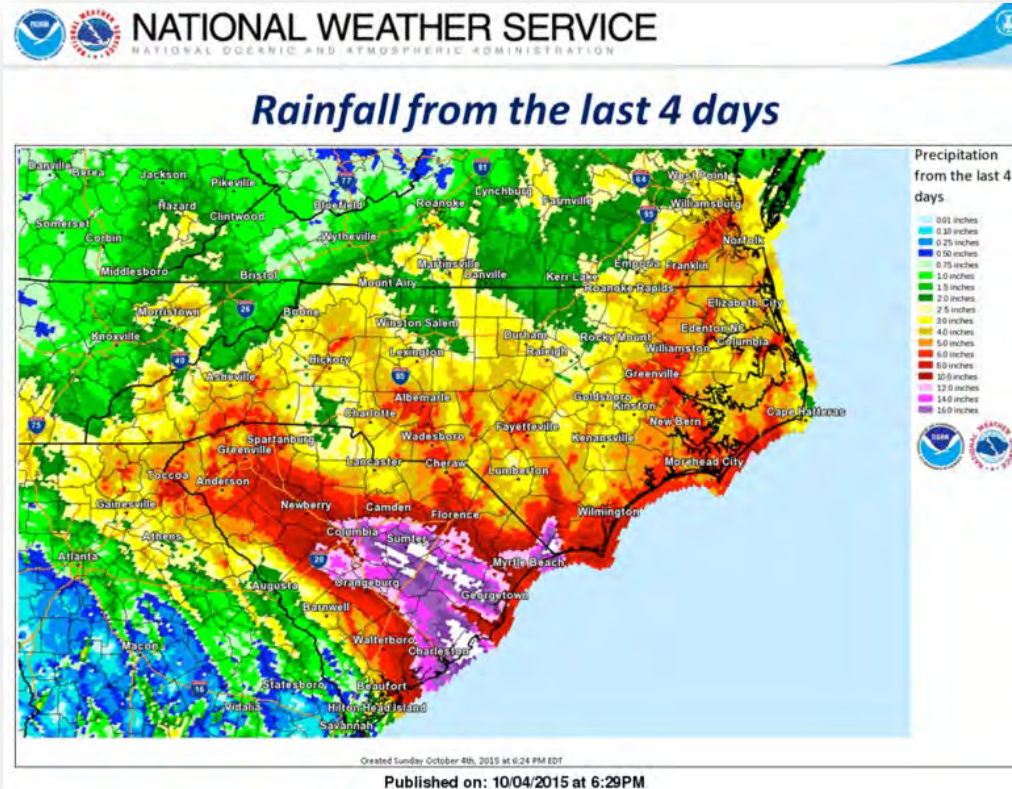
~25,000,000 acres

~3 million service members and DoD civilians

\$ Billions in infrastructure investment



Fort Jackson, SC; October 2015



Your Army

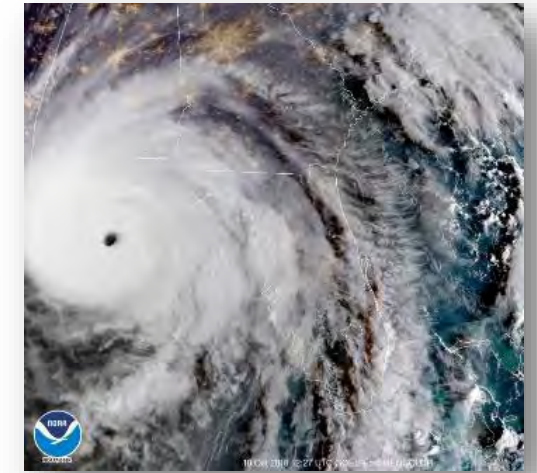
Homeowners sue Army base after dam fails in massive South Carolina flood

By: [The Associated Press](#)

May 10, 2016



Tyndall Air Force Base: Hurricane Michael, October 10-11, 2018



Offutt Air Force Base 2019

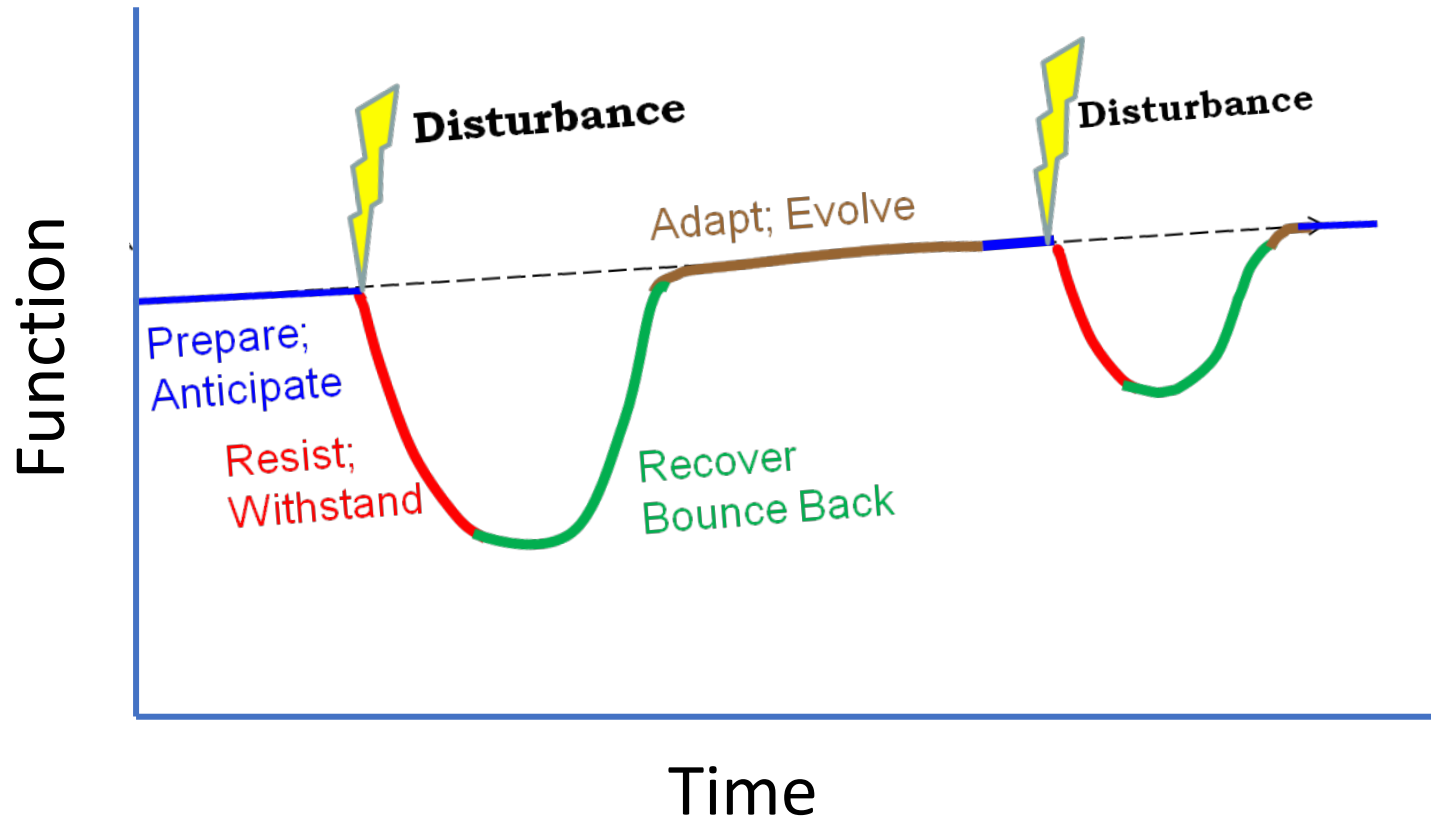
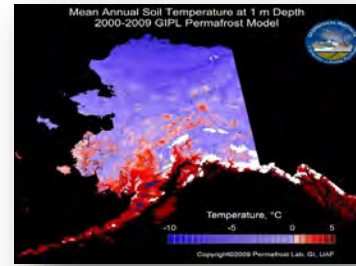
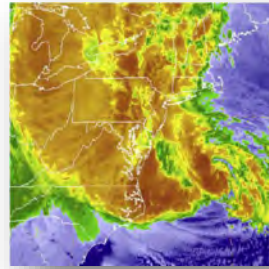


U.S. military knew the flood risks at Nebraska's Offutt Air Force Base, but didn't act in time

Extreme weather is threatening bases across the nation, but preparations for the changing future have often been too slow.



Resilience



Resilience: the ability of a *system* to **Prepare for**, **Resist**, **Recover**, and **Adapt** to achieve functional performance under the stress of disturbances through time.

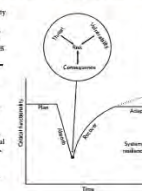
opinion & comment

COMMENTARY Changing the resilience paradigm

Igor Linkov, Todd Bridges, Felix Creutzig, Jennifer Decker, Gata For-Lant, Wolfgang Kolger, James H. Lambert, Anders Levermann, Benoît Monteau, Latin Nathwan, Raymond Nyer, Ortwin Renn, Benjamin Scharte, Alexander Scheffels, Miranda Schreurs and Thomas Thiel-Clemen

Resilience management goes beyond risk management to address the complexities of large integrated systems and the uncertainty of future threats, especially those associated with climate change.

The human body is resilient in its ability to preserve through infections or trauma. Even through severe disease, critical life functions are sustained and the body recovers, often adapting by developing immunity to further attacks of the same type. Our society's critical infrastructure — cyber, energy, water, transportation and communication — lacks the same degree of resilience, typically being essential functionality following adverse events. Although the number of climate extremes may increase as climate warms, there is currently no scientific method available to precisely predict the long-term evolution and spatial distribution of tropical cyclones, atmospheric, Meckage and extratropical storm surges, nor are the impacts on society's infrastructure in any way quantified. In the face of these unknowns, building resilience becomes the optimal course of action for large complex systems.



associated with the vulnerability of these systems, combined with the unpredictability of climate extremes, challenge our ability to understand and manage them. To address these challenges, risk analysis should be used where possible to help prepare for and prevent consequences of foreseeable events, but resilience must be built into systems to help them quickly recover and adapt when adverse events do occur.

A roadmap for enabling the development of such capability should include: (1) specific methods to define and measure resilience; (2) new modeling and simulation techniques for highly complex systems; (3) development of resilience engineering; (4) approaches for communication with stakeholders. Strategies for communicating with policy makers are needed to support the shift to resilience management by legislative, regulatory and other means.

The National Academy of Sciences (NAS) defines resilience as “the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.” Conceptually, risk analysis quantifies the probability that the system will reach the lowest point of the critical functionality profile. Risk management helps the system prepare and plan for adverse events, whereas resilience management goes further by engaging the temporal capacity of a system to absorb and recover from adverse events, and then adapt (Fig. 1). Resilience is not a substitute for principled system design or risk management. Rather, resilience is a complementary attribute that uses strategies of adaptive and navigative to improve traditional risk management. Strategies to build resilience can take the form of flexible response, distributed decision making, modularity, redundancy, ensuring the independence of component interactions or a combination of adaptive strategies to

FIGURE 1 | A resilience management framework includes risk analysis as a central component. Risk analysis quantifies the probability that the system will reach the lowest point of the critical functionality profile. Risk management helps the system prepare and plan for adverse events, whereas resilience management goes further by engaging the temporal capacity of a system to absorb and recover from adverse events, and then adapt (Fig. 1). Resilience is not a substitute for principled system design or risk management. Rather, resilience is a complementary attribute that uses strategies of adaptive and navigative to improve traditional risk management. Strategies to build resilience can take the form of flexible response, distributed decision making, modularity, redundancy, ensuring the independence of component interactions or a combination of adaptive strategies to

Linkov, Bridges, Creutzig, et al. 2014. Changing the Resilience Paradigm. *Nature Climate Change* 4: 407-409.

Sustainability, NEPA (1969): “create and maintain conditions under which humans and nature can exist in **productive harmony**, that permit fulfilling the social, economic and other requirements of present and future generations.”



Engineering With Nature®



...the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaboration.

Key Elements:

- Science and engineering that produces operational efficiencies
- Using natural process to maximum benefit
- Increase and diversify infrastructure value
- Science-based collaboration to organize and focus interests, stakeholders, and partners



“We absolutely want to do more engineering with nature everywhere we work across the Corps, you have my commitment.”

— LTG Scott A. Spellmon, 55th Chief of Engineers, to the House Committee on Transportation & Infrastructure, Water Resources & Environment Subcommittee (24 June 2021)

Nature-Based Solutions: A White House Priority

2022
Earth Day EO



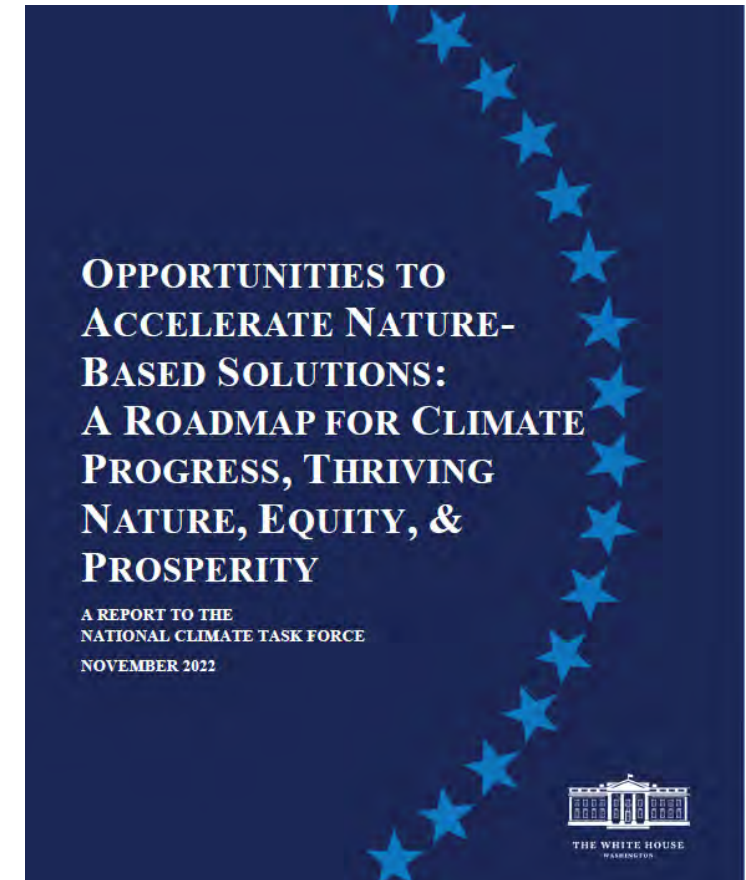
BRIEFING ROOM

Executive Order on Strengthening the Nation's Forests, Communities, and Local Economies

APRIL 22, 2022 • PRESIDENTIAL ACTIONS

EO 14072, Sec. 4. Deploying Nature-Based Solutions to Tackle Climate Change and Enhance Resilience: *“To further amplify the power of nature, including its ability to absorb climate pollution and increase resilience in all communities, today’s Executive Order calls for the following:”*

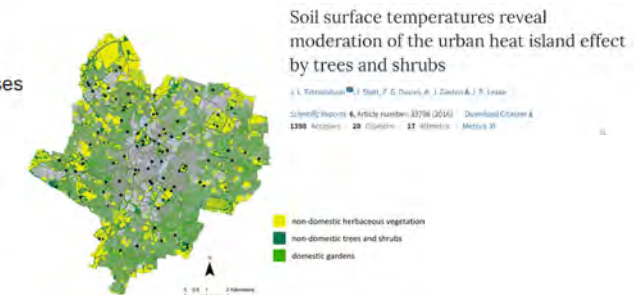
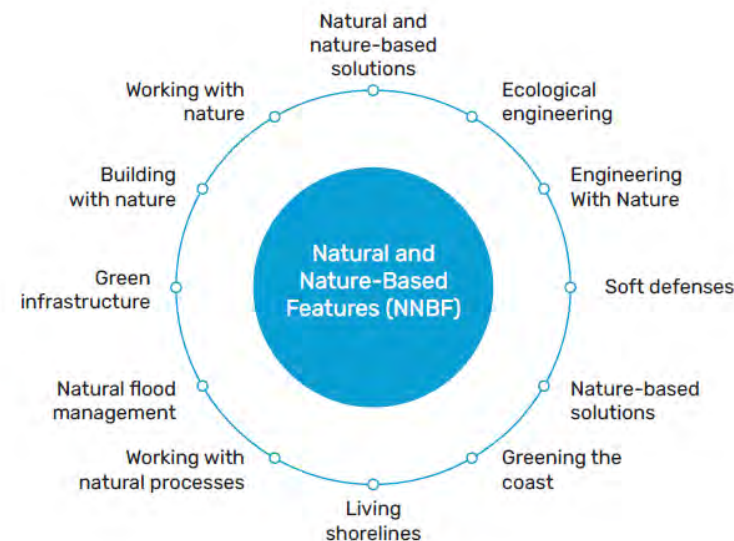
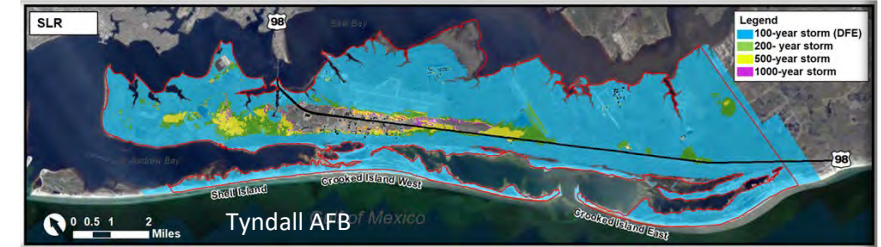
- 1) **Report on Nature-Based Solutions**
- 2) **Guidance on Valuing Nature**
- 3) **First U.S. National Nature Assessment**



Nature-based Solutions: “Actions to protect, sustainably manage, or restore natural or modified ecosystems to address societal challenges, simultaneously providing benefits for people and the environment.”

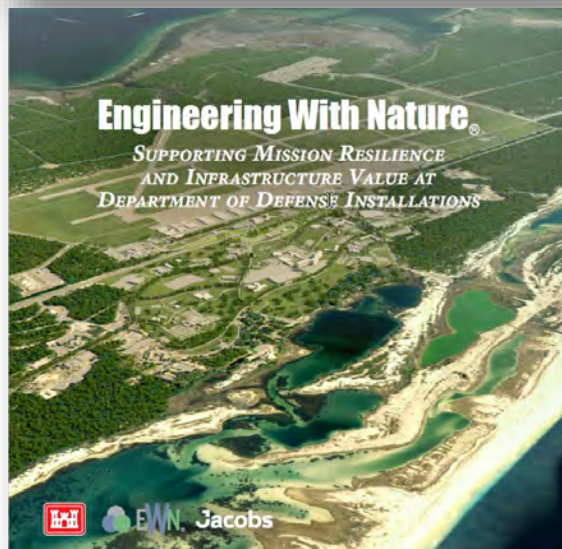
Nature-Based Solutions: *Conserving, restoring, and engineering nature for the benefit of people and nature*

- **Coastal Storm Risk Management;** e.g., an island-wetland complex that attenuates storm surge and waves.
- **Inland Flood Risk Management;** e.g., a restored inland floodplain that provides space for high flows.
- **Surface Heat Reduction;** e.g., creation of green space, forest restoration.
- **Drought and Wildfire Resilience;** e.g., restored native vegetation + grazing + ‘slow-water’ interventions + ecological forest management.
- **Water Resilience;** a constructed freshwater wetland that absorbs excess nutrients and recharges depleted groundwater aquifers.
- **Climate Change Mitigation;** e.g., restored native grasslands / plant communities that sequester carbon in soils.

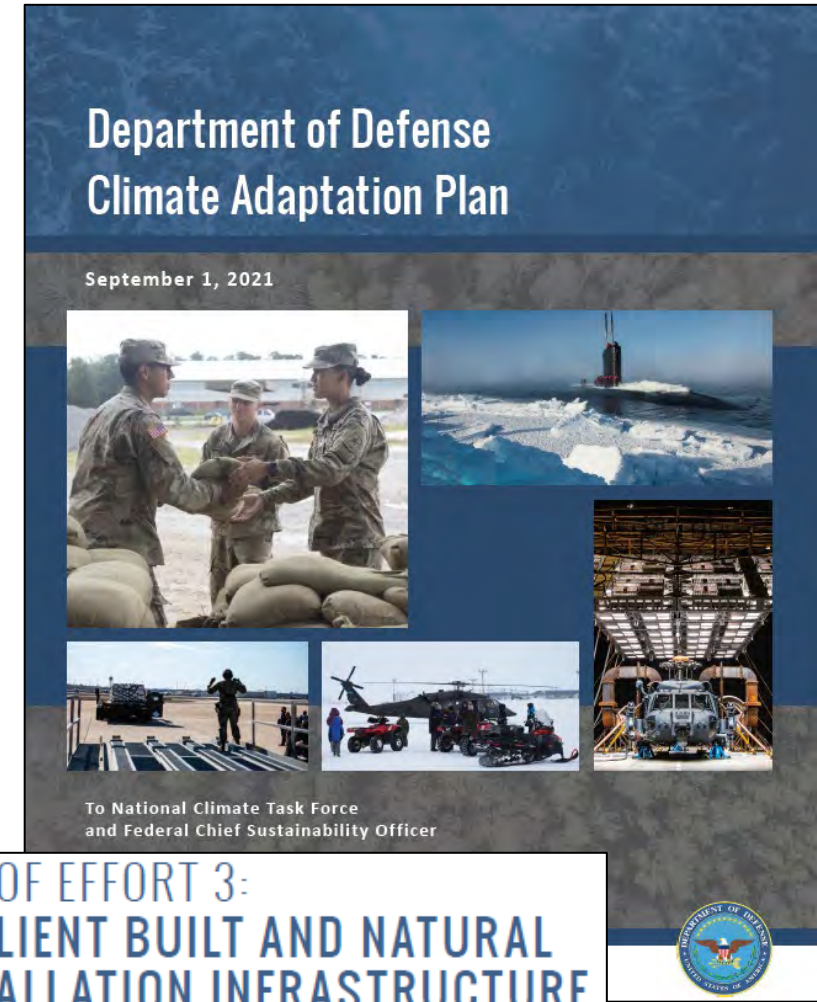


Military Installation Resilience: Built + Natural Infrastructure

“Built and natural infrastructure are both necessary for successful mission preparedness and readiness.”



www.engineeringwithnature.org » About



LINE OF EFFORT 3:
RESILIENT BUILT AND NATURAL
INSTALLATION INFRASTRUCTURE

The Army Climate Strategy

ARMY CLIMATE STRATEGY

Implementation Plan



Fiscal Years 2023-2027

"Climate change poses an immediate and serious threat to U.S. national security and affects how and where the Army trains and operates. As the Secretary of the Army (SecArmy) stated in the United States Army Climate Strategy (ACS), "For today's Soldiers operating in extreme temperature environments, fighting wildfires, and supporting hurricane recovery, climate change isn't a distant future, it is a reality."


The Total Army must train, modernize, and remain ready to deploy, fight, and win the nation's wars. Extreme weather events, soaring average temperatures, and other hazards caused by climate change are increasing the risk to military operations and forces at home and in many parts of the world. Adapting the Army to climate change will return significant, lasting advantages in training, readiness, and capabilities at strategic and operational levels.

1.j.1
[C]

Develop a roadmap for incorporating 1) use of sustainable building materials and 2) Engineering with Nature tools and techniques into MILCON planning and design processes

1.j.3
[C]

Incorporate nature-based solutions, risk-based climate science, tools, technology, and adaptation measures into installation land management plans and disaster preparations.

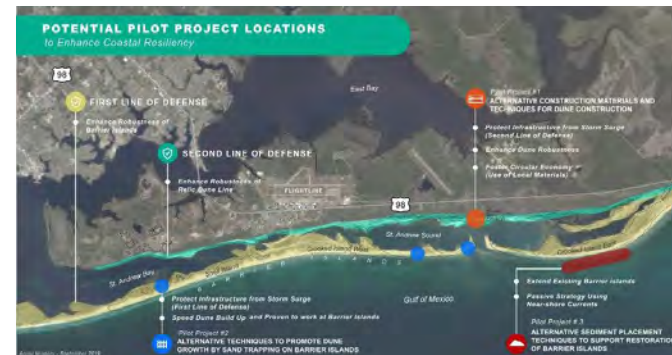
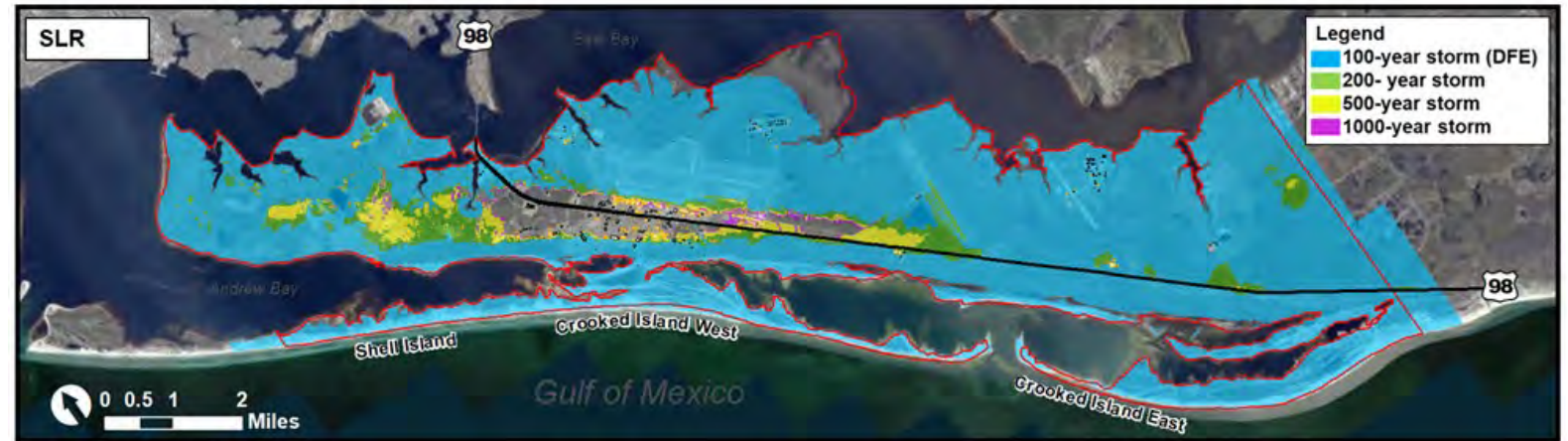

RACHEL JACOBSON
Assistant Secretary of the Army
Installations, Energy and Environment


DANIEL M. KLIPPSTEIN
Acting Deputy Chief of Staff, G-9

EWN[®] Applied to Tyndall Air Force Base for Coastal Resilience

“By exploring a diverse menu of nature-based solutions we are in a better position to sustain, restore, and modernize natural infrastructure, ensuring the capability of Air Force lands to support the mission of the installation.”

- Lieutenant Colonel Brandy Smart, Commander of the 325th Civil Engineer Squadron



Tyndallcoastalresilience.com

Winner of 2021

UK Environment Agency Flood & Coast International Excellence Award



Fort Moore, GA; Laundry Creek



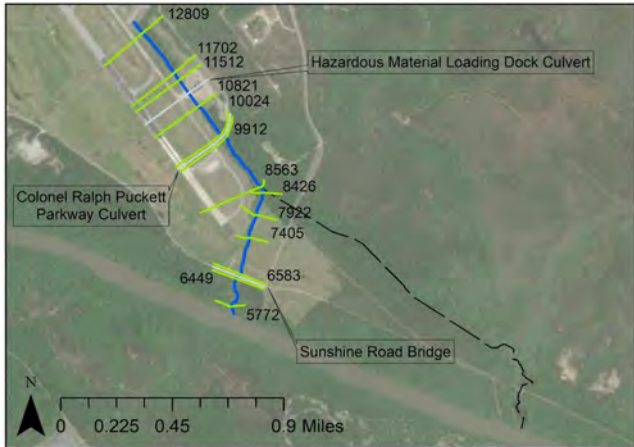
Hydraulic Analysis – RAS Mapper

Comparison: 200-yr Future Event



No Significant impact

Existing Conditions Model



- Existing Culvert Cross Sections
- Existing Cross Sections
- Existing Reach Alignment
- Design Reach Alignment



Fort Moore
Columbus, Georgia

Project Model



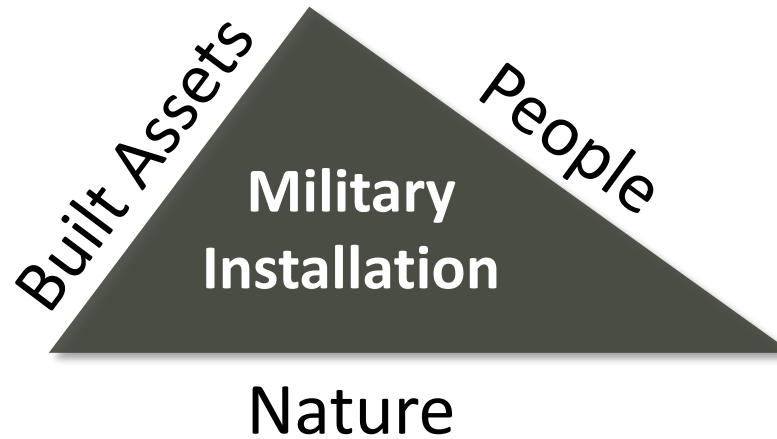
- Design Cross Sections
- Design Culvert Cross Sections
- Design Reach Alignment
- Existing Reach Alignment



Fort Moore
Columbus, Georgia



Comprehensive Resilience



- 1. Partner with nature*
- 2. Prioritize solutions that value nature*
- 3. Pursue integration with nature*



Design with Nature

SAME JETC

- Adaptation
- Migration
- Equity
- Security

Susannah C. Drake FASLA FAIA

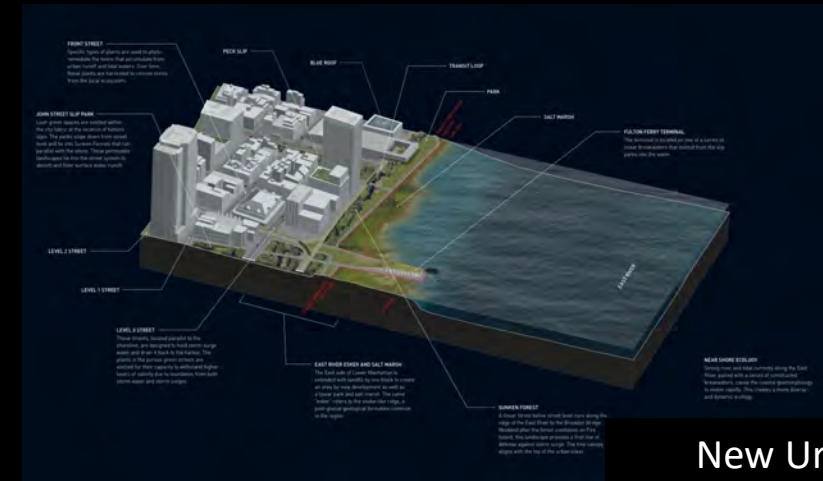
Principal SASAKI

Professor Cooper Union

sdrake@sasaki.com



ADAPTATION



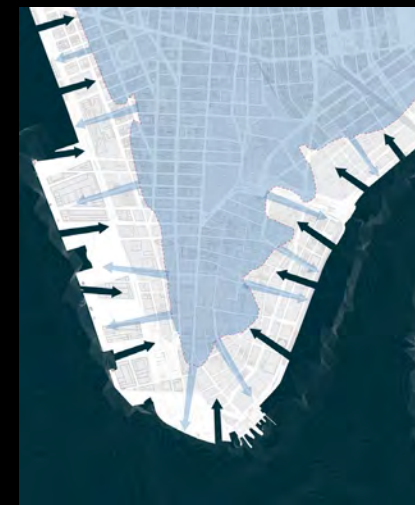
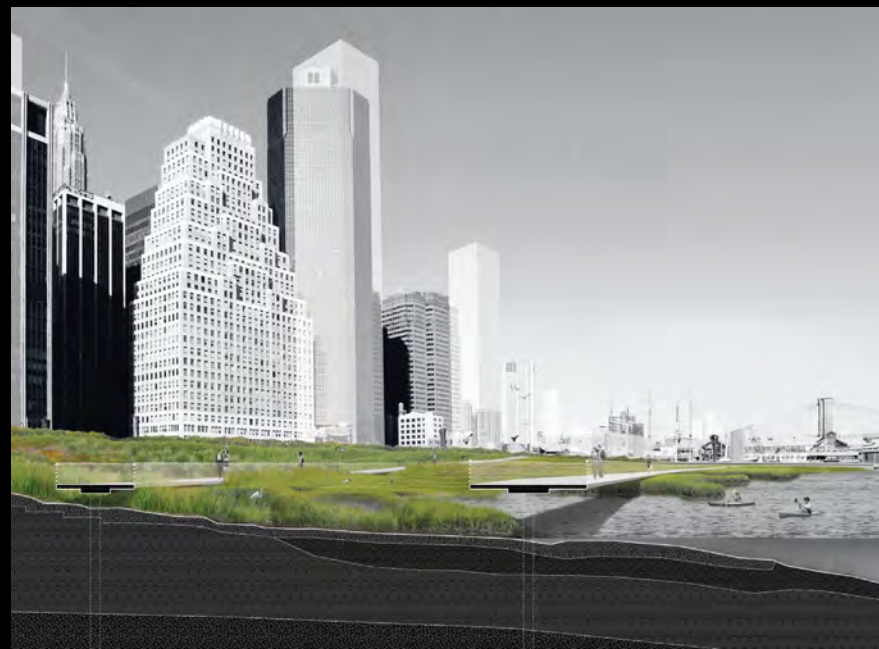
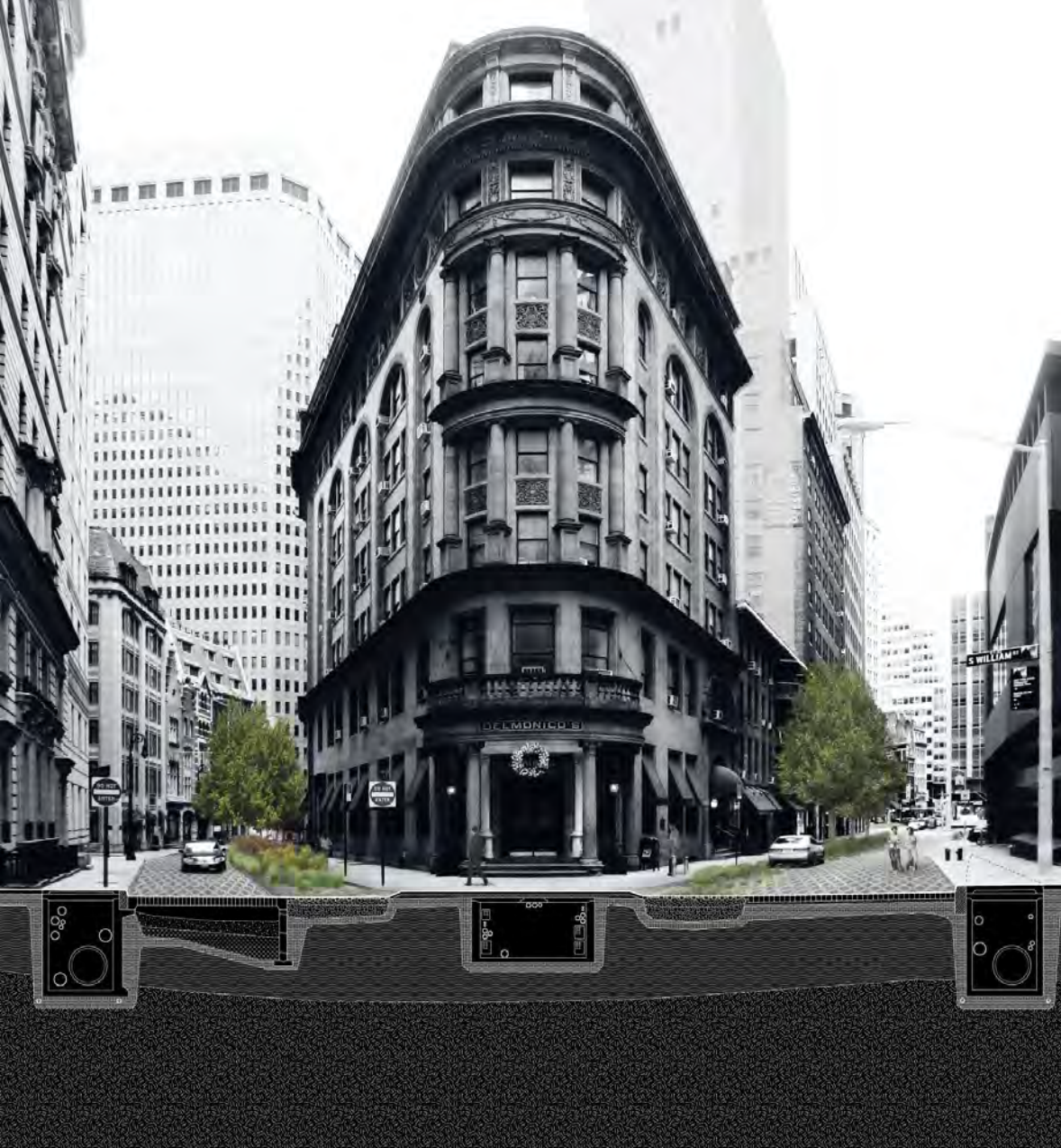
New Urban Ground



2010 - Before the BIG U there was MoMA Rising Currents

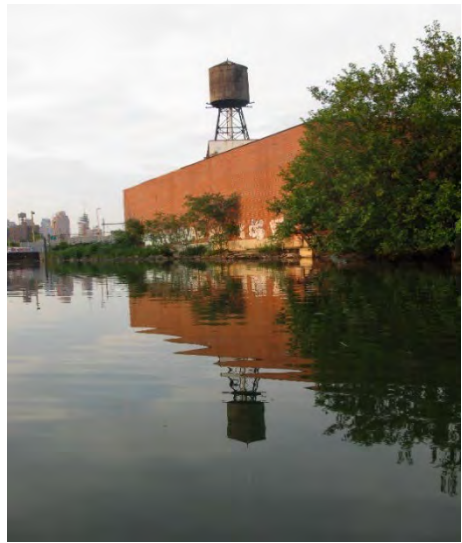


Transformation of coastline for economic advantage



2012
Superstorm
Sandy

Protected infrastructure and edge buffer parks



1766

1855

1891

2007

ADAPTATION

Hydrology: swamp to canal

WYANUS CANAL SPONGE PARK
Master Plan

WYANUS SPONGE PARK
North Street End

LAND BIOSWALES

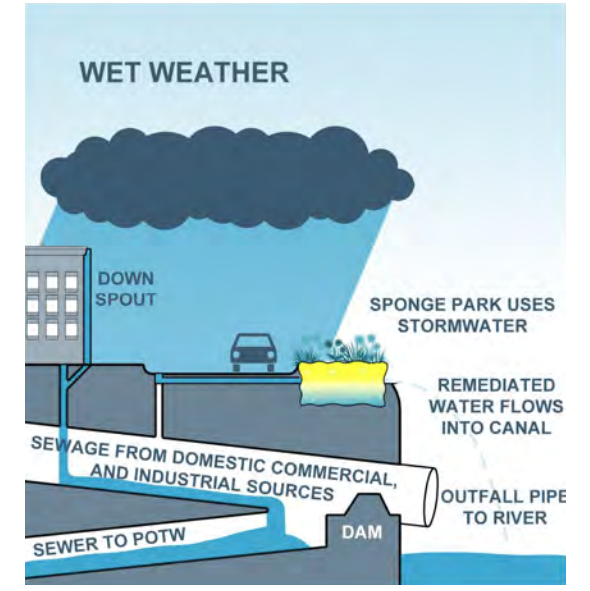
T POWERHOUSE
Planning and Zoning

DEP CSO FACILITY Red Hook-03
Open Space Design

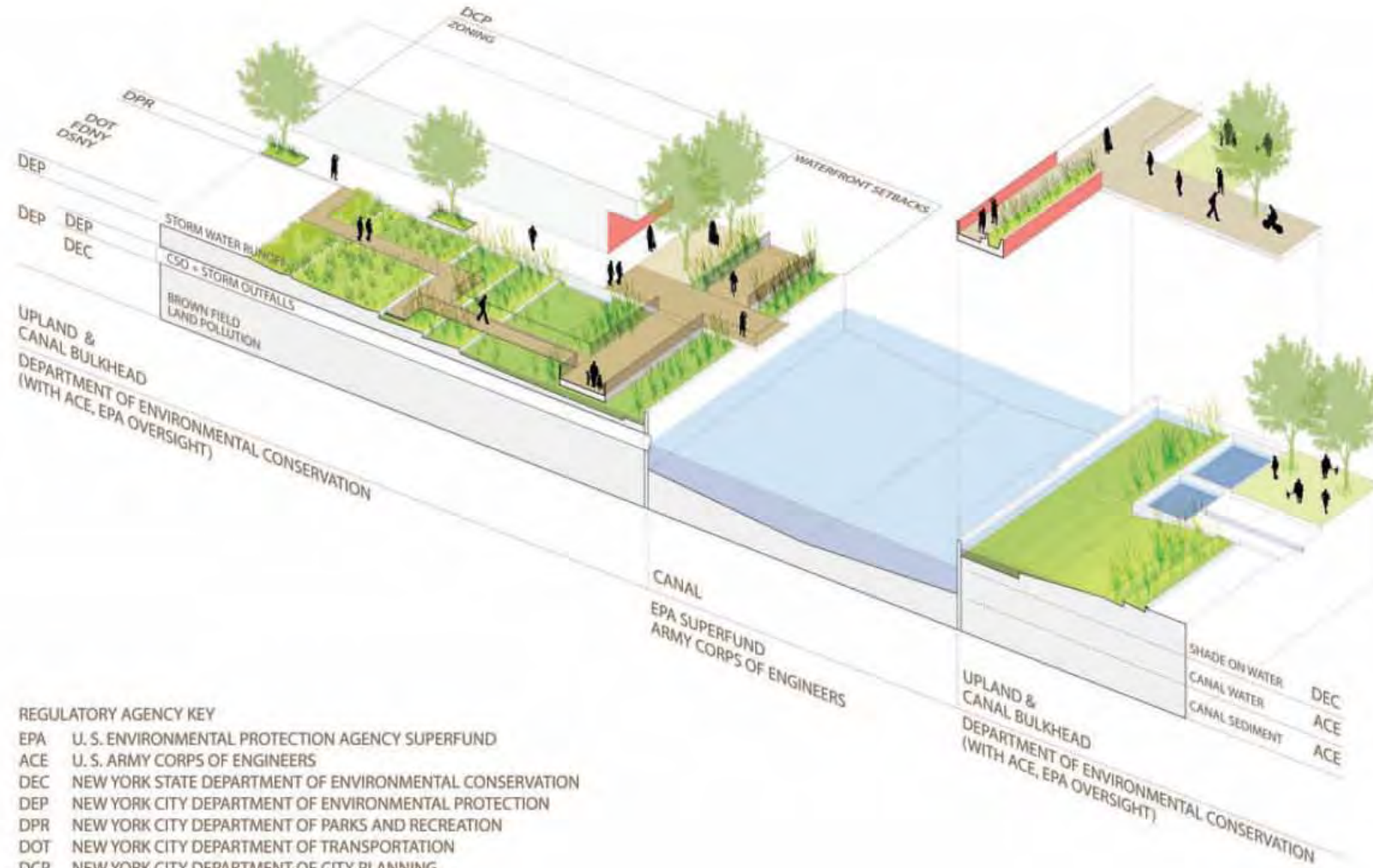
DEGRAW STREET EAST
Open Space Design

DEP CSO FACILITY Red Hook-04
Open Space Design

DEP CSO FACILITY Owls Head-007



Sponge Park - Urban Stitch Masterplan



- REGULATORY AGENCY KEY
- EPA U. S. ENVIRONMENTAL PROTECTION AGENCY SUPERFUND
 - ACE U. S. ARMY CORPS OF ENGINEERS
 - DEC NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
 - DEP NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION
 - DPR NEW YORK CITY DEPARTMENT OF PARKS AND RECREATION
 - DOT NEW YORK CITY DEPARTMENT OF TRANSPORTATION
 - DCP NEW YORK CITY DEPARTMENT OF CITY PLANNING
 - FDNY NEW YORK CITY FIRE DEPARTMENT
 - DSNY NEW YORK CITY DEPARTMENT OF SANITATION

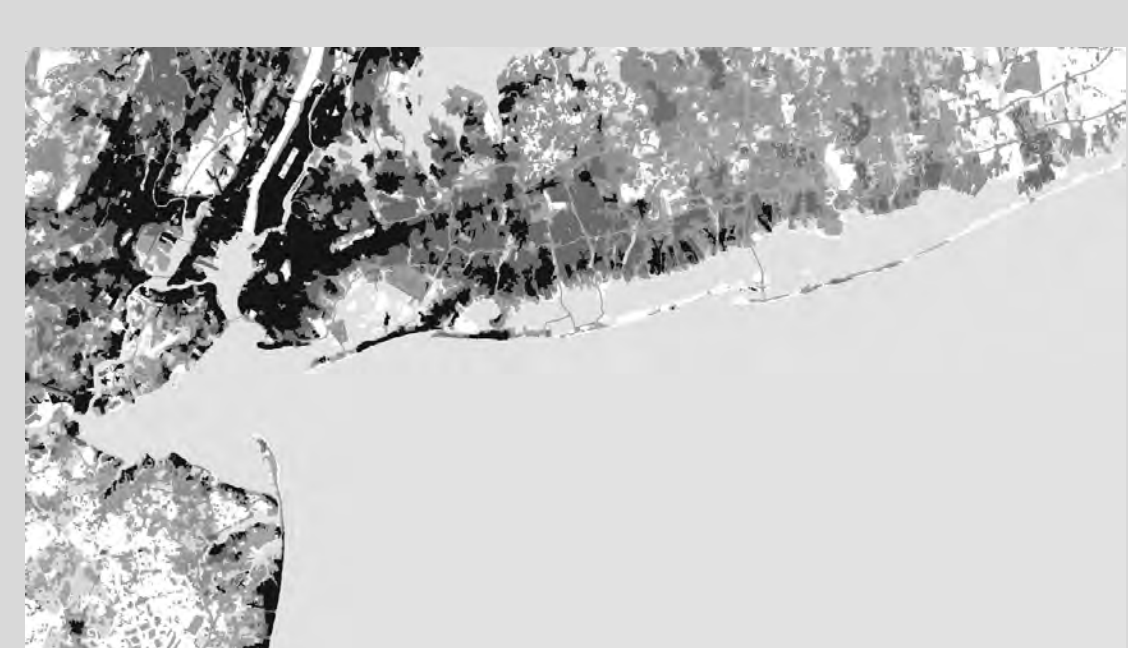
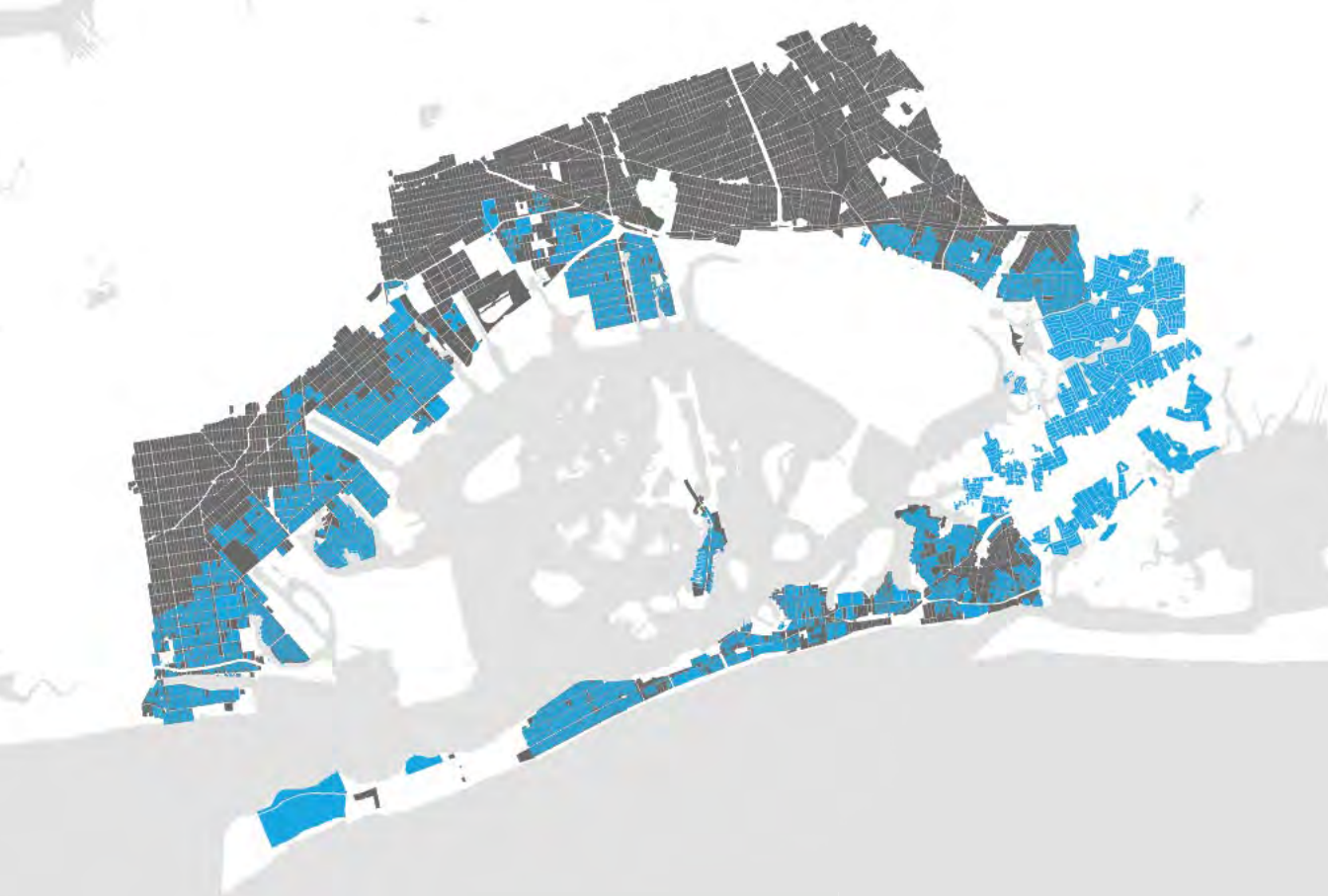
INFORMATION PROVIDED BY DAN WILEY



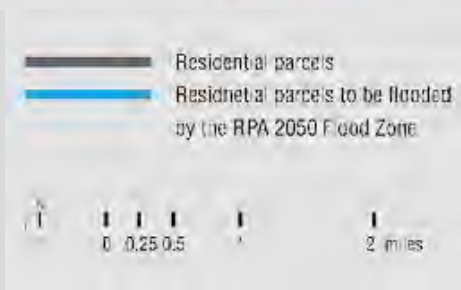
Empower community with graphic communication



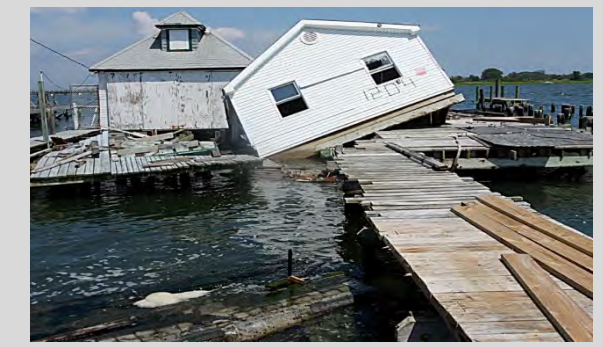
Before 'Sponge Cities' there were Sponge Parks



Unrealized urban potential



	Total population 2017	Flooded population by 2050 based on current housing condition	Total population 2067	Natural population growth	Housing need
# people	1 million	408K	1.2 million	186K	472K
# units	375K	158K	*444K	69K	180K
Area(sqft)	403,602,000	183,736,350	538,051,916	134,449,916	263,065,361

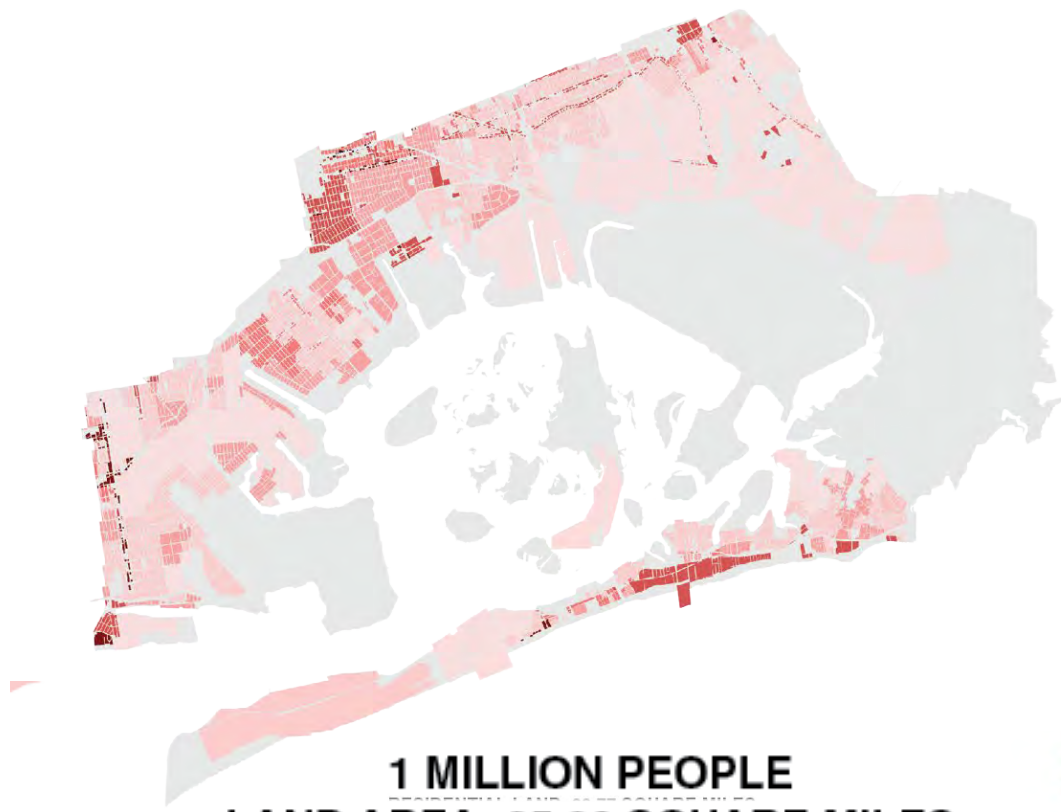


Vulnerability exposed

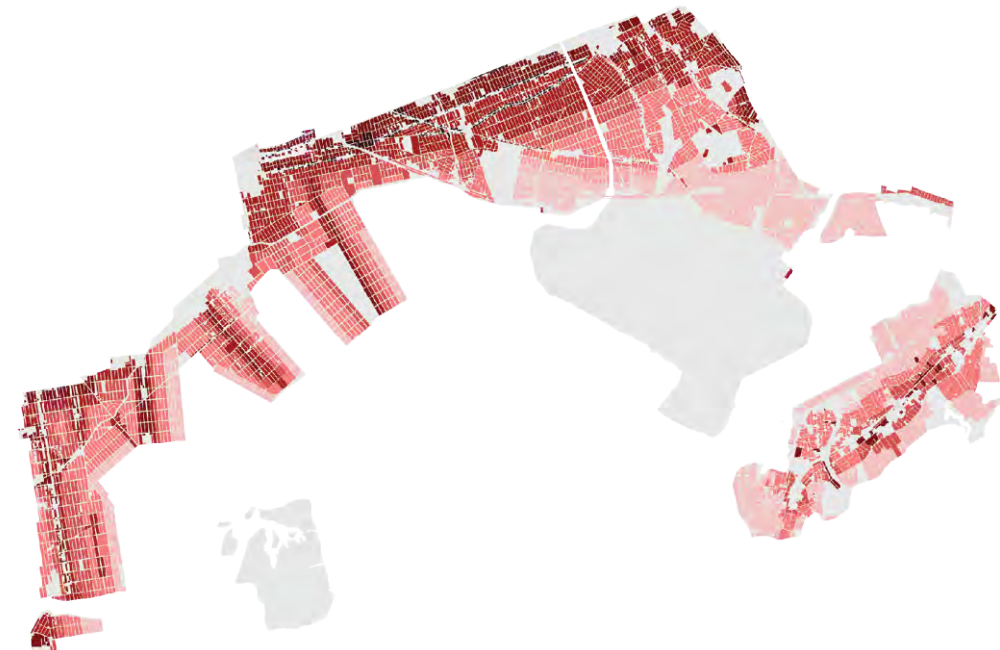
L – Jamaica Bay - Flooded housing

2017

2067



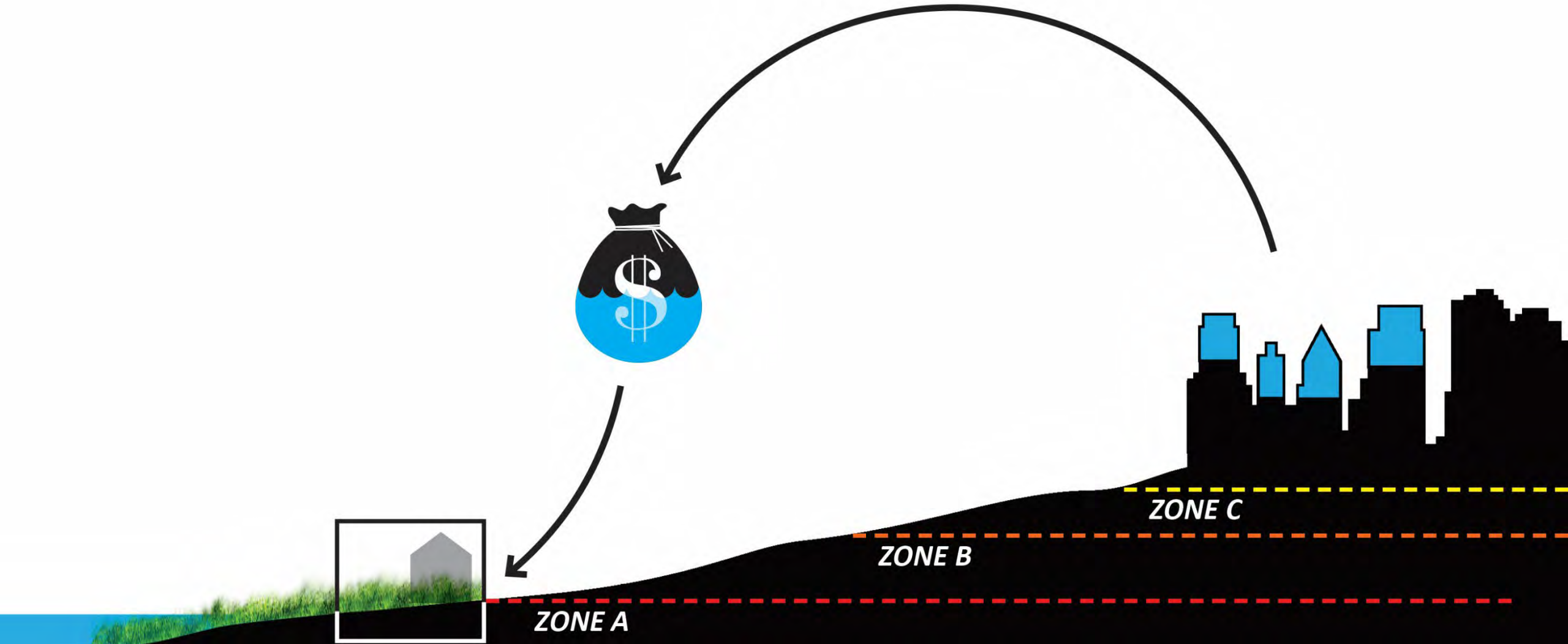
1 MILLION PEOPLE
LAND AREA: 65.89 SQUARE MILES
RESIDENTIAL LAND: 20.77 SQUARE MILES
AVERAGE FAR: 0.86



1.2 MILLION PEOPLE
LAND AREA: 38.64 SQUARE MILES
RESIDENTIAL LAND: 19.97 SQUARE MILES
AVERAGE FAR: 1.66



Add population, increase density, reduce risk



Use FAR value to fund migration and coastal maintenance

TYOLOGIES

DRY SEMI-WET WET

BUILDINGS



FAUNA FLORA



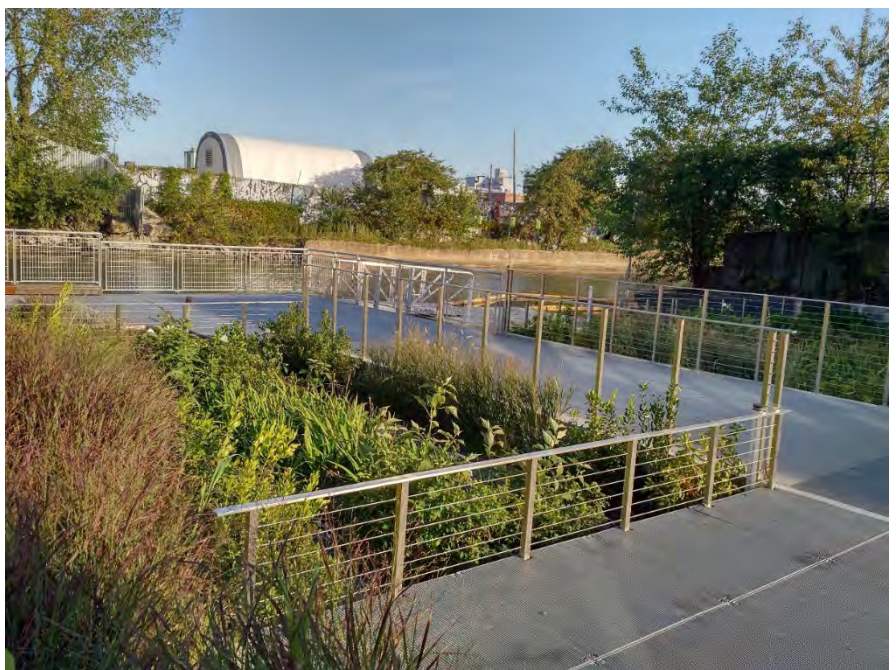
WATER



ZONES



Urban Estuary at Liberty Street

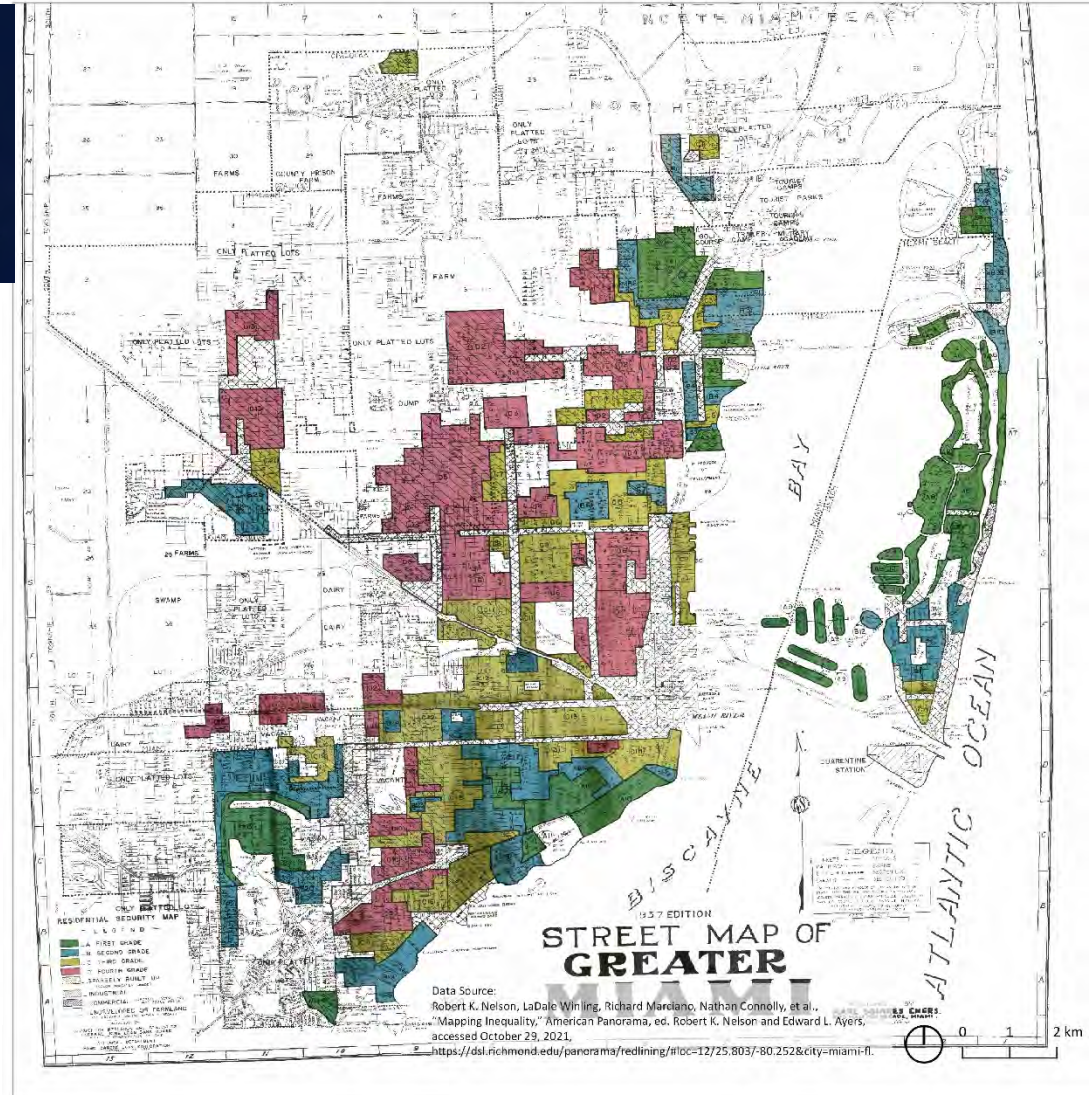
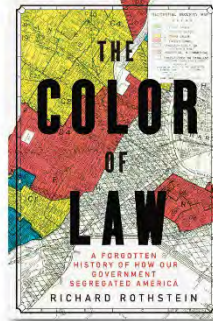
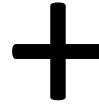




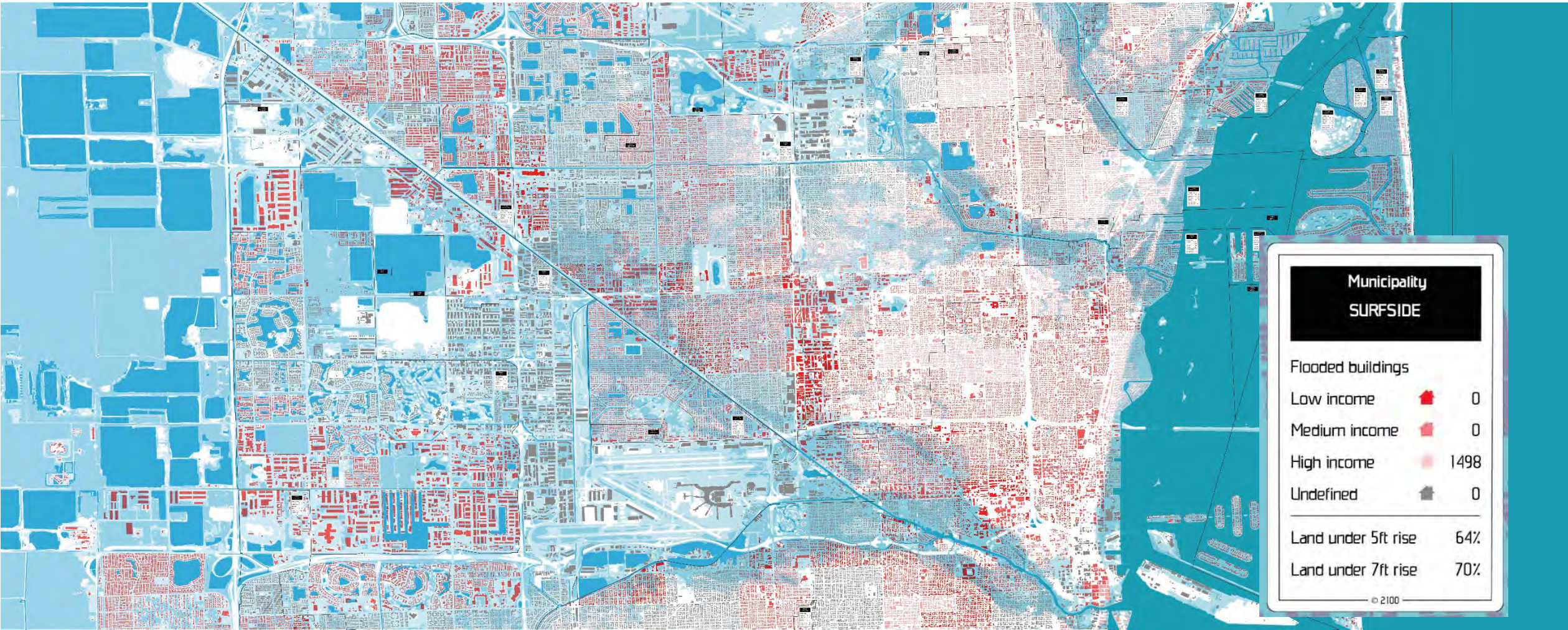
BIGHT CITY – New Anticipatory Urban Strategy



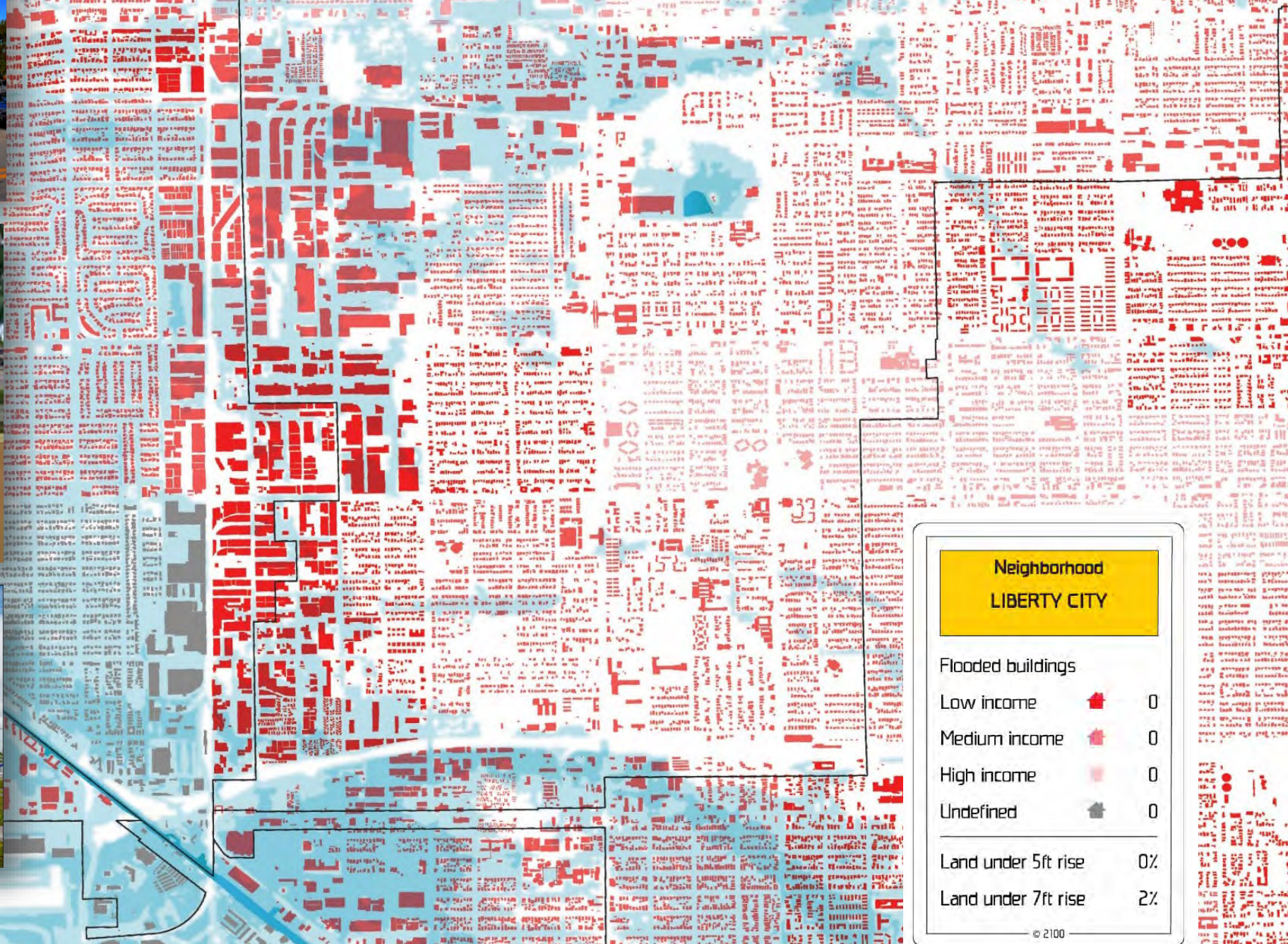
Liberty City Exhibition European Cultural Centre at FIU



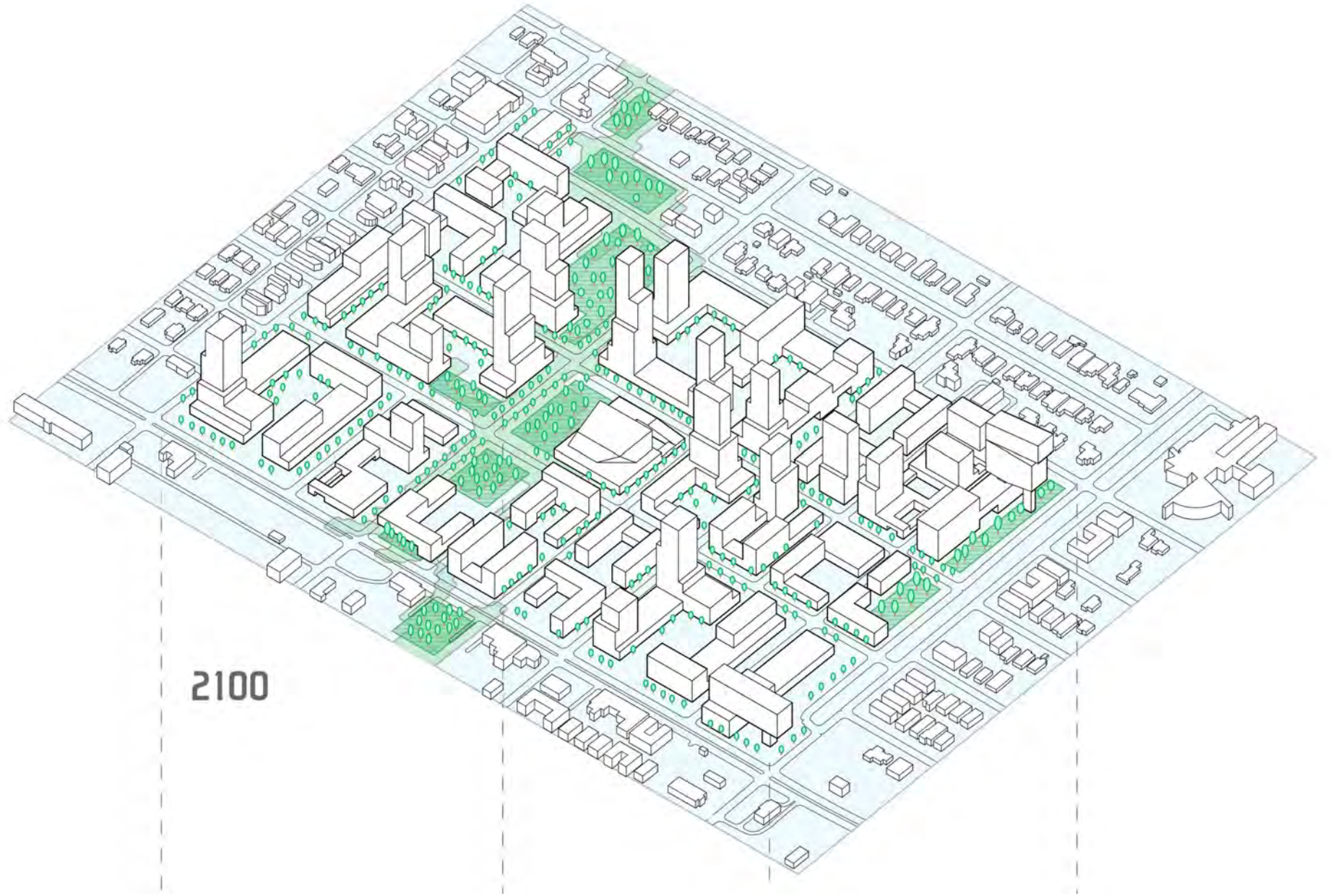
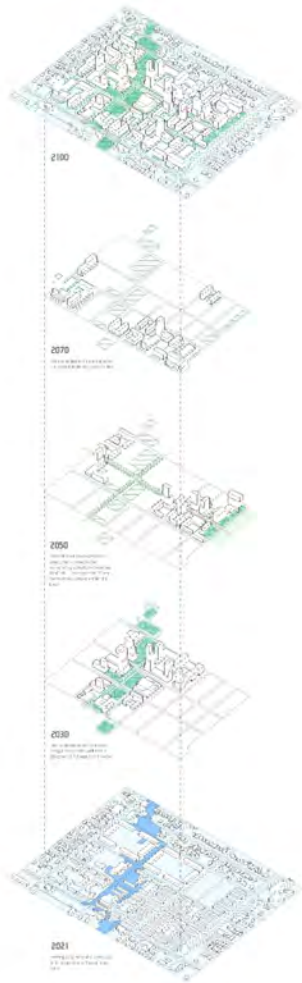
Equity and Environmental Risk, Liberty City, Miami 2100



From Redlining to Blue Zoning



Community-based Back Development is a process of development that is driven by the community and focused on the needs of the community. It is a process that is designed to create a more equitable and sustainable future for the community.



2100 Equity, community, and wealth generation



Tidal Basin Ideas Lab

HISTORY SECURED

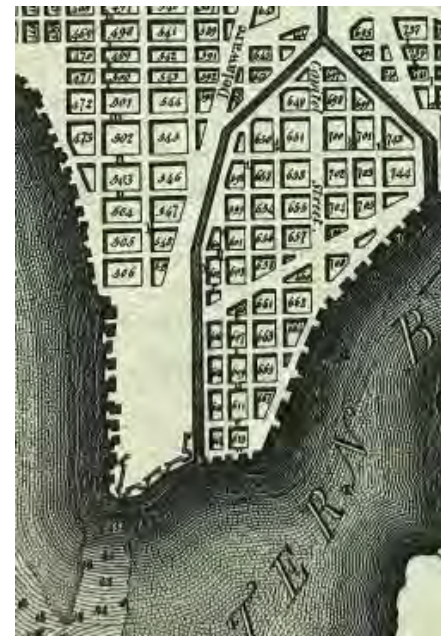
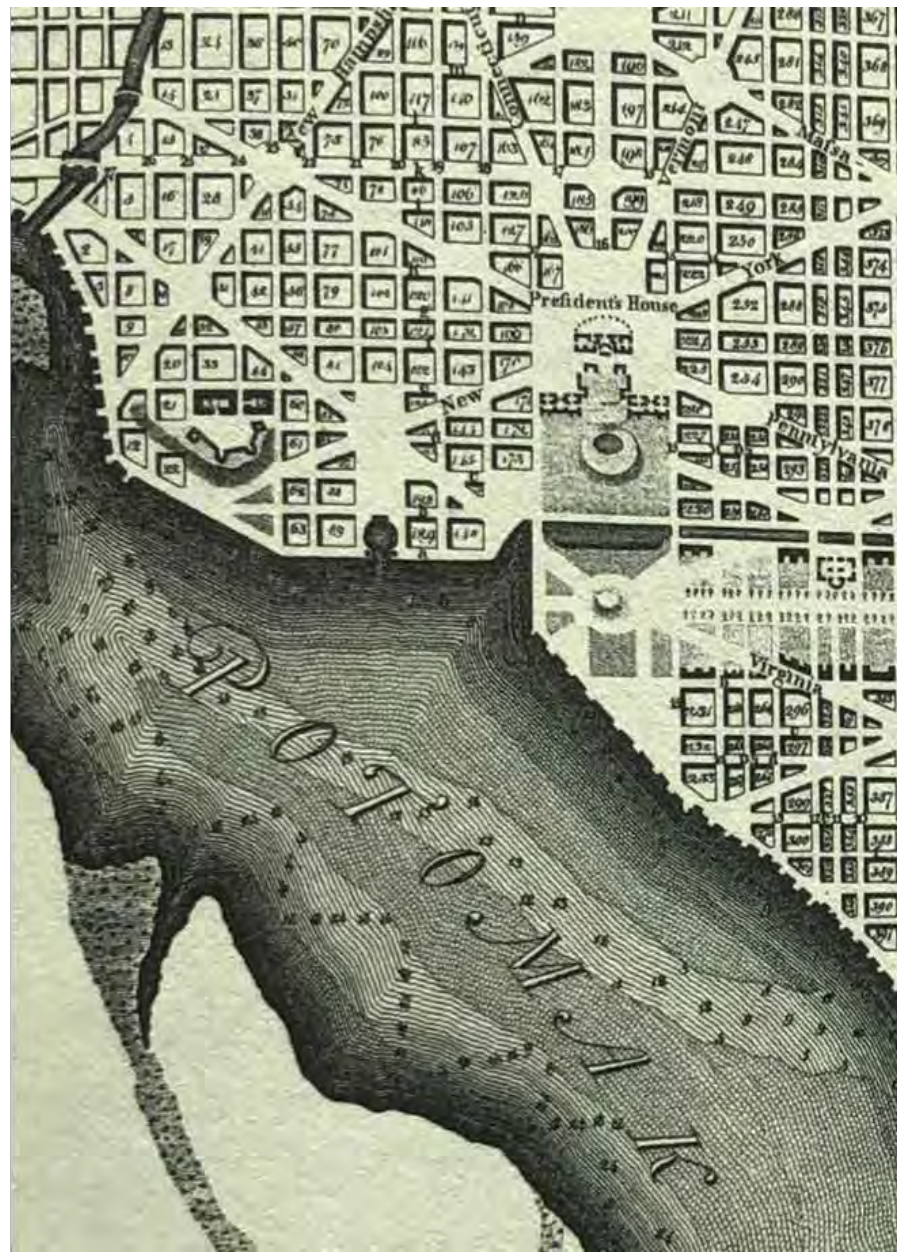
Sponsored by the National Trust for Historic Preservation
National Park Service
Trust for the National Mall
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Susannah C. Drake FAIA FASLA



HISTORY SECURED

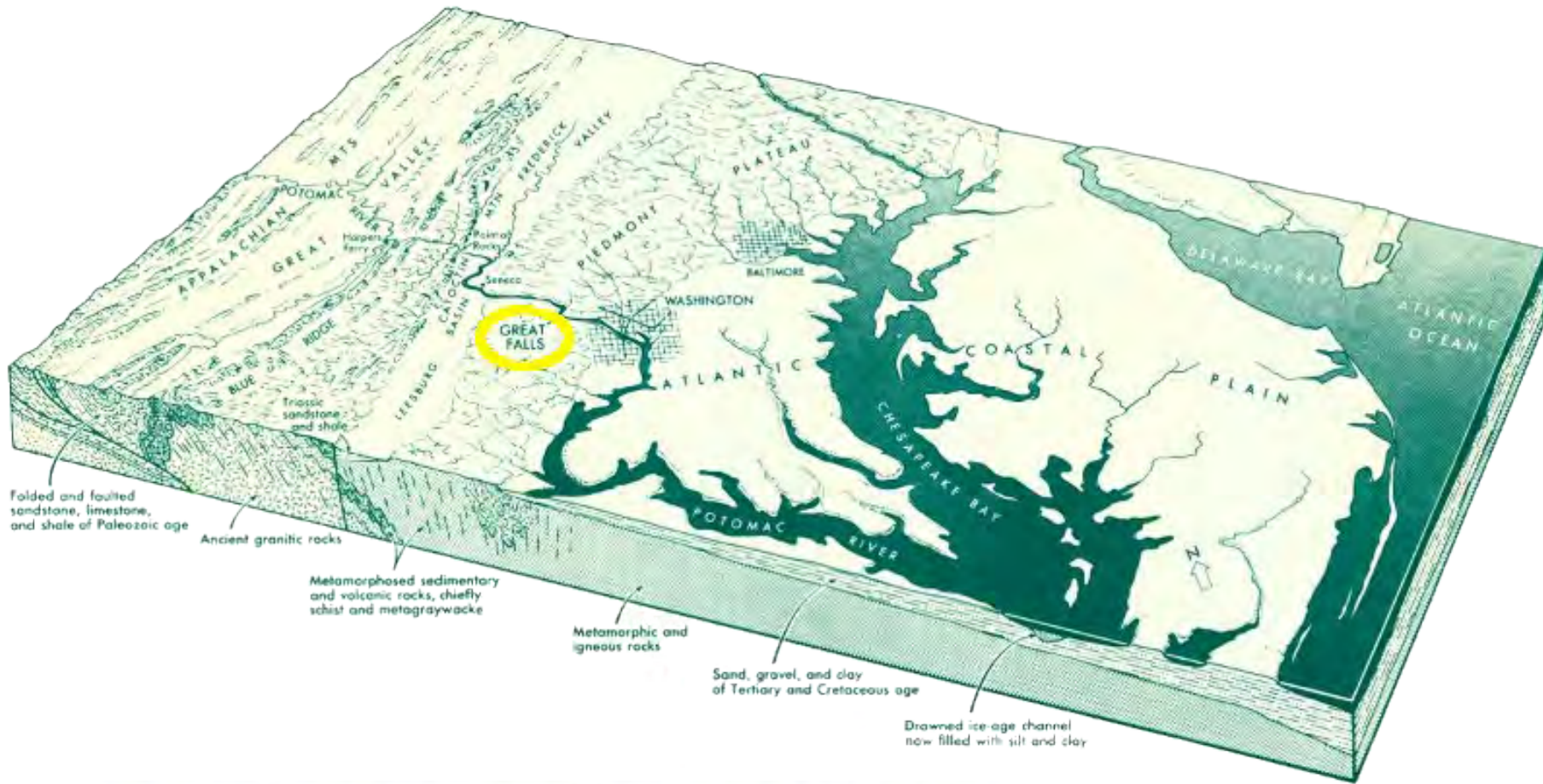
Susannah C. Drake FAIA FASLA DLANDstudio | ARCHITECTURE + LANDSCAPE ARCHITECTURE



1700s Representation, military fortification and natural security



1793 Waterline and projected "100-year" flood zone as of 2019



Source: Library of Congress | Research and cartography: Gene Thorp - The Washington Post. Published May 11, 2012.

12% of the 15,000 square mile Potomac Watershed is now paved



Elevated edge, secured memorials, reflecting pool and weir,
and lots of space on higher ground for cherry trees.



Section looking west across cherry lined meadow at the Jefferson Memorial.



Reflecting plaza and green security wall

Then, Now, Forward! Design With Nature
For Everyone and Everywhere

THANK YOU

Please take a few minutes to complete a short survey about this session. Your feedback will help us improve future programming for JETC.

 **conferences i/o**



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jetc.cnf.io

Q&A

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