

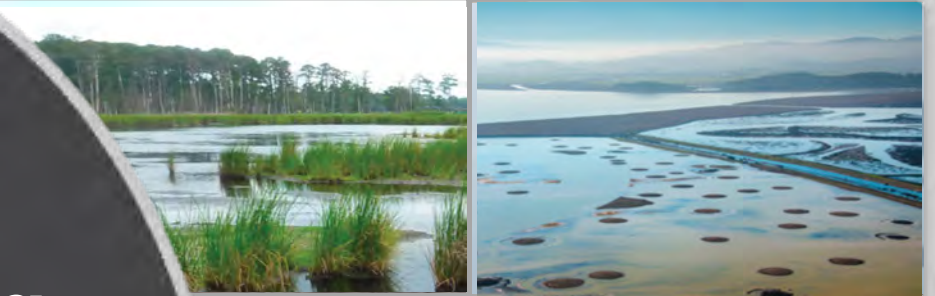


U.S. ARMY

Engineering With Nature[®]: Making the Most with What You've Got

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LC/LP-SG Science Day
March 31, 2021



US Army Corps of Engineers



Galveston Hurricane (1900): "Hard" Lessons

Galveston Hurricane (1900)

- Landfall 8 September 1900
- Estimated Category 4 Hurricane
 - ▶ 145 mph winds
- Estimated death toll: 6,000-12,000
- Response: Galveston seawall and island raising
 - ▶ >10-mile seawall, 1902-1963
 - ▶ Island raised with 16M cubic yds sand



Dr. Isaac Cline,
1861-1955



The Multi-Hazard World



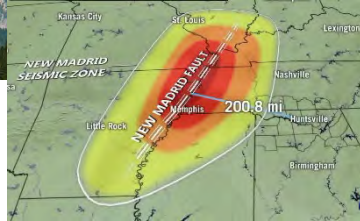
David Johnston, USGS



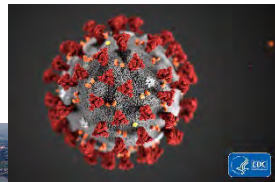
Mt. Saint Helens, 1980



San Francisco, 1906



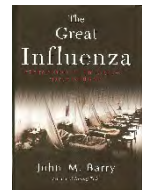
New Madrid Seismic Zone



COVID-19, 2020-X



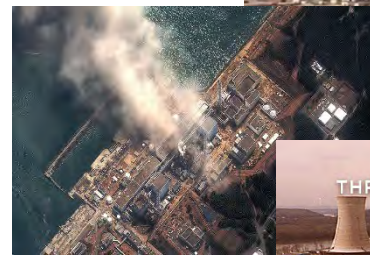
HABs, Lake Erie; 2008-2017



H1N1, 1918-1919



Beirut, Lebanon; 2020



Fukushima, 2011



Three Mile Island, 1979



Deepwater Horizon, 2010



9/11



Civil unrest, 2020



Medfly "bio-attack"; CA, 1989



Camp Fire; CA 2018



Banqiao dam failure; China, 1975



Hurricane Katrina, 2005



Flood of 1927; Tallulah, LA



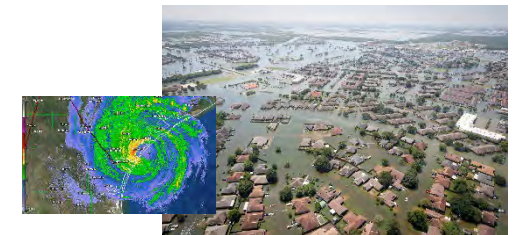
Dust Bowl, 1930s



Offutt AFB, 2019



2020 record-setting storm season

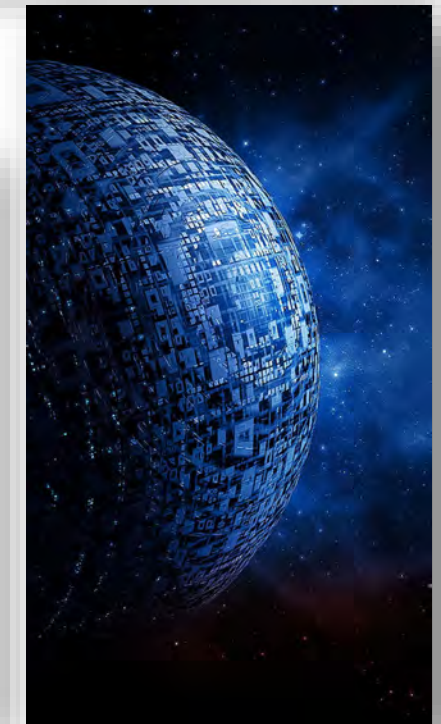
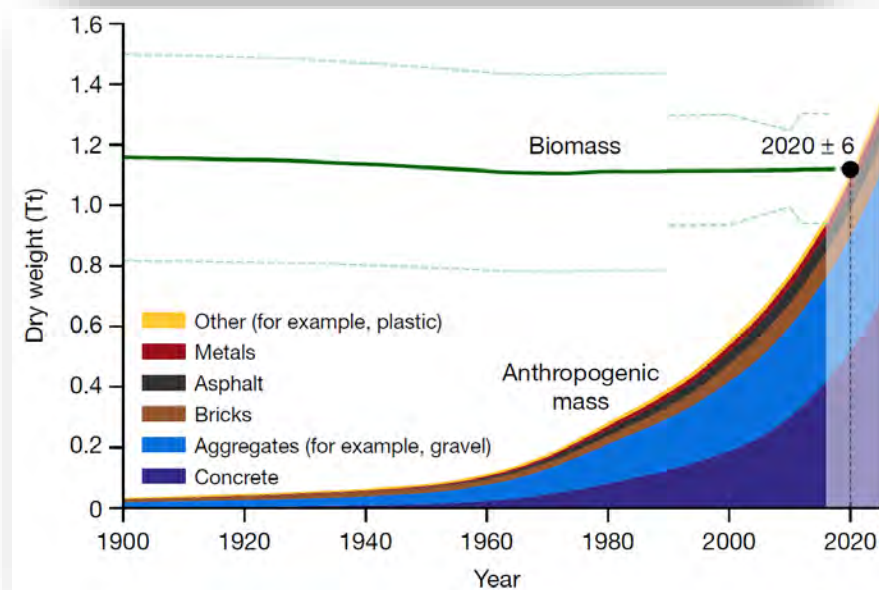


Hurricane Harvey; landfall and Houston, 2017

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

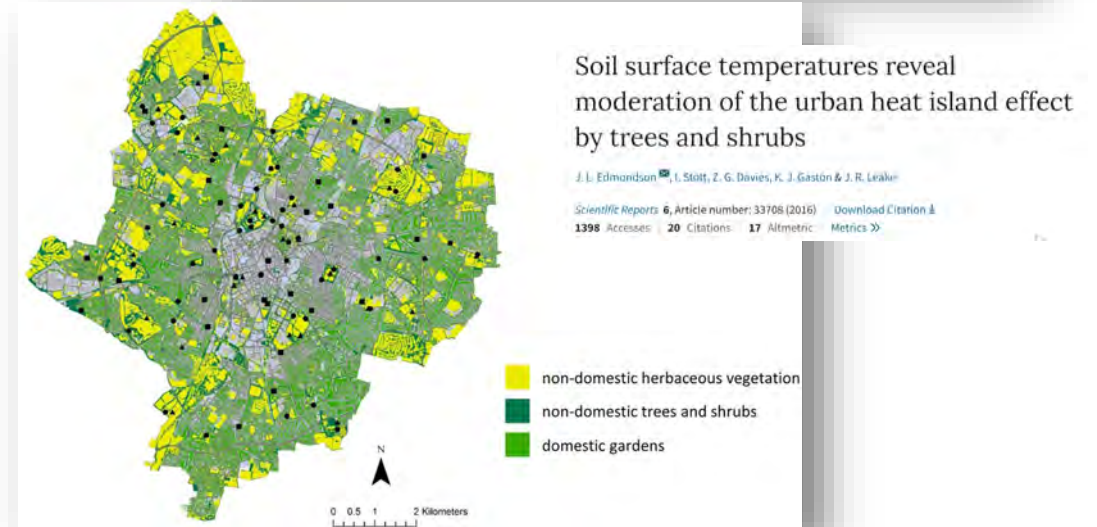


Nature-Based Solutions:

Conserving, restoring, and engineering nature for the benefit of people and nature

An Example: Trees as Infrastructure!

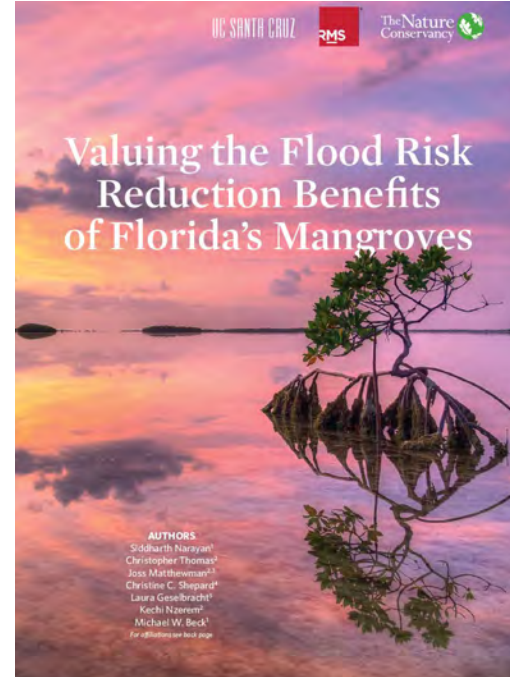
- Shaded surfaces can be 20-45°F cooler
- Evapotranspiration plus shading can reduce peak summer temperatures by 2-9°F
- Reducing wind speed and winter heat loss from buildings by 10-50%
- Improve local air quality
- Increase water infiltration, reducing surface water run-off



Leveraging Nature for Engineering Value: *Mangroves*

Florida Mangroves Study:

- Used an insurance industry catastrophe model to quantify the flood reduction benefits of mangroves across Florida
- During Hurricane Irma:
 - Mangroves averted \$1.5 billion dollars in flood damages to properties
 - 25% savings in counties with mangroves
 - >600,000 people living behind mangrove forests saw reduced flooding across Florida



Menendez et al., 2020. *The Global Flood Protection Benefits of Mangroves*.
<https://www.nature.com/articles/s41598-020-61136-6>

International Guidelines on Natural and Nature-Based Features for Flood Risk Management

NNBF Guidelines Table of Contents

- Chapter 1. Introduction
- Chapter 2. Principles, Frameworks, and Outcomes
- Chapter 3. Community Engagement
- Chapter 4. Systems Approach
- Chapter 5. Performance
- Chapter 6. Benefits and Costs of NNBF
- Chapter 7. Adaptive Management
- Chapter 8. Introduction to Coastal Systems
- Chapter 9. Beaches and Dunes
- Chapter 10. Coastal Wetlands and Intertidal Areas
- Chapter 11. Islands
- Chapter 12. Reefs
- Chapter 13. Plant Systems
- Chapter 14. Environmental Enhancements
- Chapter 15. Introduction to Fluvial Systems
- Chapter 16. Fluvial Systems and Flood Risk Management
- Chapter 17. Benefits and Challenges of NNBF in Fluvial Systems
- Chapter 18. Fluvial NNBF
- Chapter 19. Fluvial NNBF Case Studies
- Chapter 20. The Way Forward



https://ewn.ercd.dren.mil/?page_id=4351

NNBF Guidelines

- >1,000 pages, 5-year effort
- >70 multi-sector organizations
- >170 authors and contributors

“The guidelines do not contain or represent the policy commitments or policy positions of the organizations that participated in their development. Policy development is the sole purview of each organization and the laws and procedures that govern their activities.” Pages xi-xii.



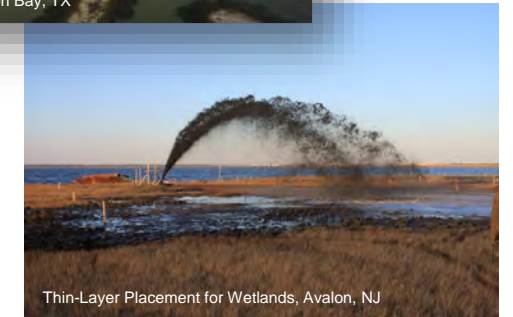
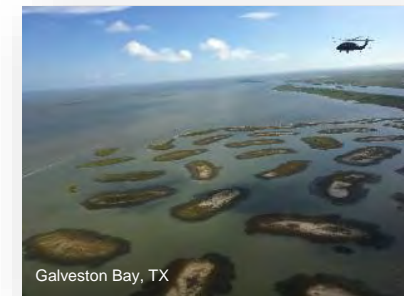
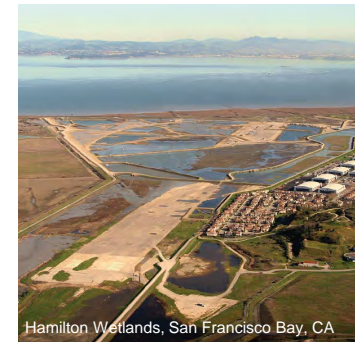
www.engineeringwithnature.org



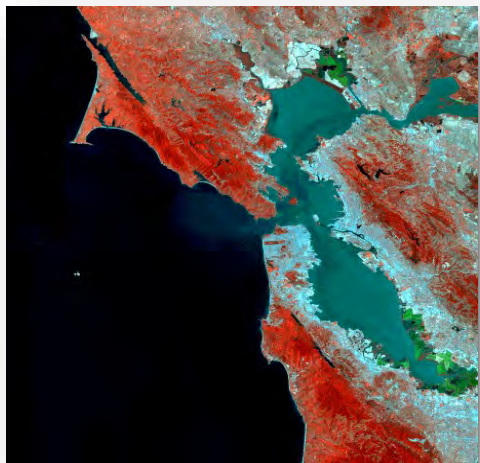
Beneficial Use: *Status and Opportunities*

“Beneficial use” is using dredged sediment to achieve additional benefits beyond its removal from a channel/waterway, including other economic, environmental or social benefits.

- USACE has a long track record of BU
 - ~30% of dredged material beneficially used over last 20 years (60 out of 200 mcy/yr)
 - >1.5 billion cy used in beach construction over last 100 years
 - >25,000 acres of wetlands created in south Louisiana since 1970s
- BU supports:
 - Climate change adaptation thru *Engineering With Nature*®
 - Habitat for fish and wildlife
 - Tribal equities, Threatened and Endangered Species
 - Social value to enhance resilience of communities and vulnerable/underserved populations
- BU challenges:
 - Budget constraints
 - Federal policies/regulations/business practices
 - State policies/regulations/business practices
 - Advancing the ‘technology’
 - Synchronizing government and the private sector



Hamilton and Sears Point Wetlands; San Francisco Bay, CA



COASTAL WETLANDS AND FLOOD DAMAGE REDUCTION

Using Risk Industry-based Models
to Assess Natural Defenses in the Northeastern USA

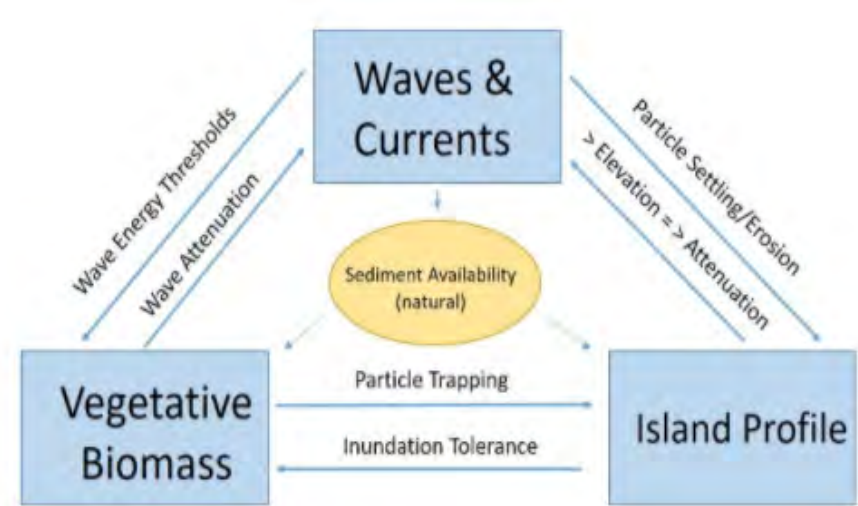
October 2016



Hamilton Army Airfield; 6 mcy BU, 500 acres
Sonoma Land Trust; 1,000-acre tidal restoration

<https://www.nature.com/articles/s41598-017-09269-z>

The Power of Partnership: *Swan Island*

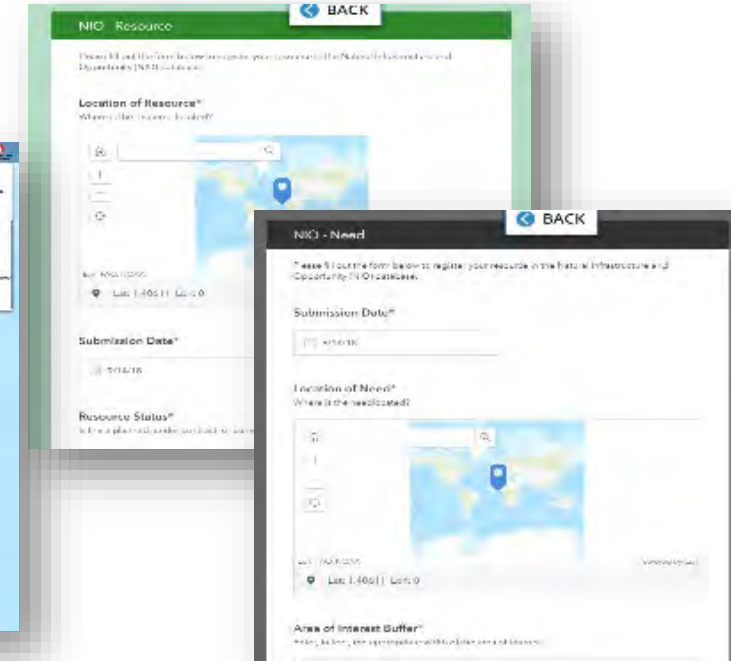
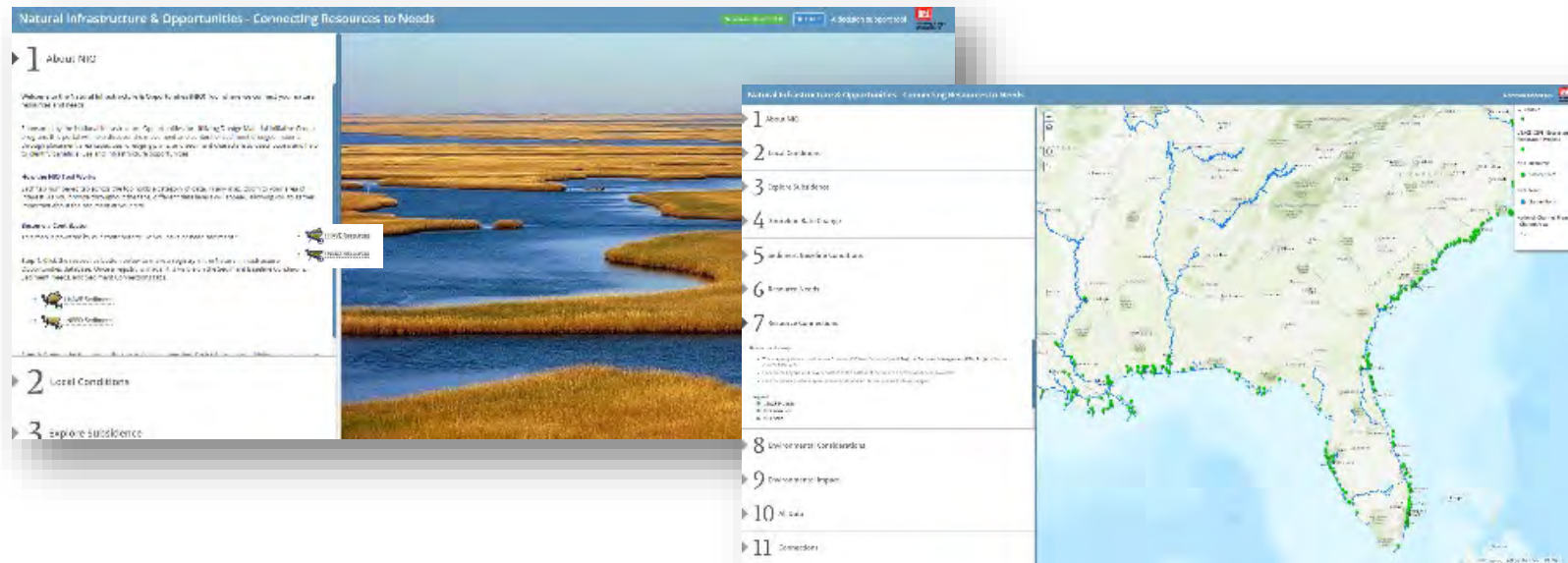


<https://coastalscience.noaa.gov/project/evaluating-efficacy-of-island-restoration-and-enhancement-for-coastal-protection/>

US Army Corps of Engineers • Engineer Research and Development Center

Natural Infrastructure Opportunities Tool (NIOT)

The public facing *Natural Infrastructure Opportunities Tool*, developed in collaboration with the Natural Infrastructure Initiative, focuses on identifying natural infrastructure and beneficial use opportunities. Through map-based visualizations of environmental, geomorphic and sediment conditions, as well as upcoming USACE projects, and an interface for users to add their resource needs and resource availability, this portal will help discover natural infrastructure connections and inspire innovative opportunities.



Partners:



The Nature Conservancy



https://ewn.erdcdren.mil/?page_id=601

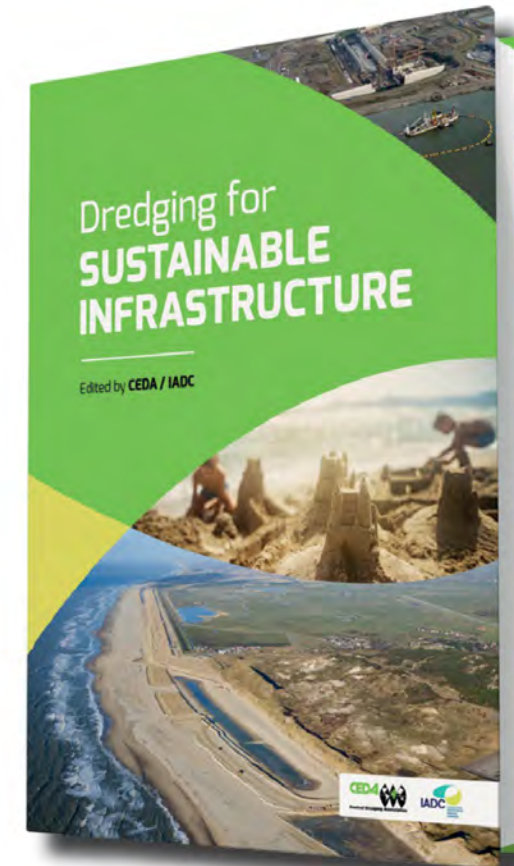
Dredging for Sustainable Infrastructure

Integrating Dredging with Sustainable Development

By Todd Bridges and Tiedo Velinga

Guiding Principles

- 1. *Comprehensive consideration and analysis of the social, environmental and economic costs and benefits of a project is used to guide the development of sustainable infrastructure.***
- 2. *Commitments to process improvement and innovation are used to conserve resources, maximize efficiency, increase productivity, and extend the useful lifespan of assets and infrastructure.***
- 3. *Comprehensive stakeholder engagement and partnering are used to enhance project value.***



A “Sustainability Ledger” for Sediment Management: A Mindset

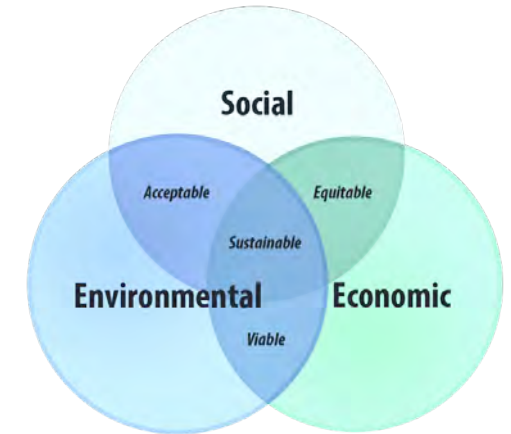
Sustainability is achieved by efficiently investing resources to create present and future value

Efficiency

- Reducing sedimentation in channels & reservoirs
- Reducing transport distances for dredged material
- Reducing dredging time
- Expanding operational flexibility
- Linking multiple projects
- Reducing resource consumption and impacts

Value Creation

- Restoring natural sediment processes to sustain landscapes
- New nature-based features that reduce flood risks
- New habitat for fish and wildlife
- New features that provide recreational and other social value
- Budget space for additional infrastructure work



Applying the Full Range of Beneficial Use

Sediment "Recharge" via
Dredging



Direct Wetland
"Nourishment"



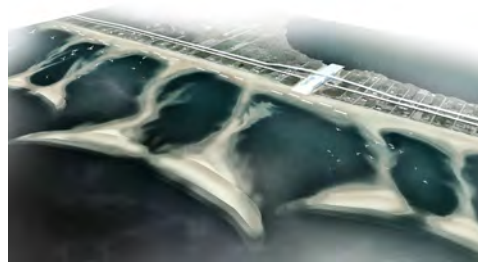
Wetland Creation



Island Enhancement or
Restoration



Engineering / Operational Effort



Strategic Placement



Thin-Layer Placement
for Bottom Contouring



Beach and Dune
Construction



New Island Construction

- A Call to Action -

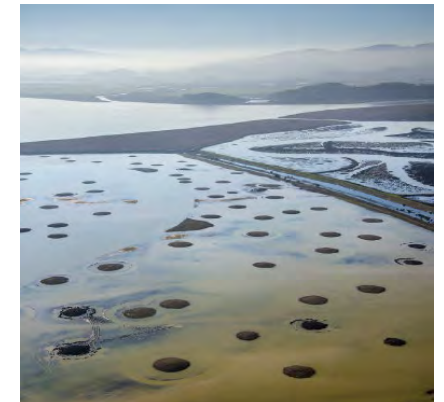
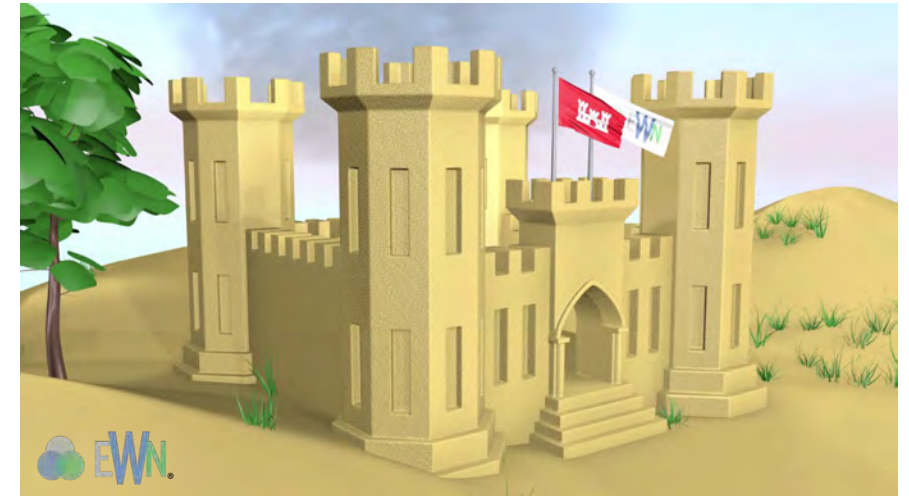
An Imperative for the 21st Century:

100% Beneficial Use

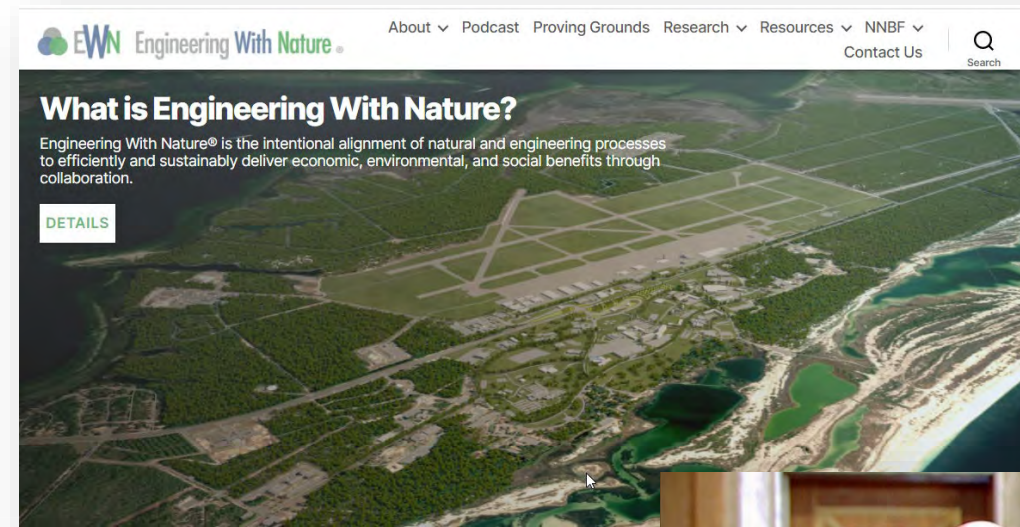
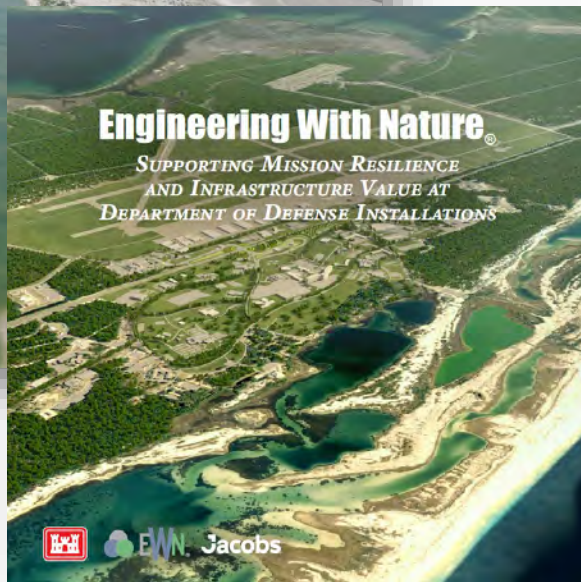
Beneficial Use Innovation: *There's something for everyone to do!*

- **Government Agencies Doing Dredging:** Doing business differently
- **Ports / Navigation Sector:** Multi-purpose projects
- **Regulatory Agencies:** Efficiently pursuing win-wins
- **Dredging / Engineering Companies:** Innovative engineering and operations
- **Environmental NGOs:** Facilitating P3s

The Key: Affordability, Affordability, Affordability



Communicating Nature-Based Solutions



<https://ewn.erdcdren.mil/?p=3586>

www.engineeringwithnature.org



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Comprehensive Resilience: Economic, Environmental, Social

