



U.S. ARMY

# Engineering With Nature® for Great Lakes Coastal Systems – Application to NNBF and Development of the Playbook

Jeff King, PhD, PE  
Deputy National Lead and Program Manager

Burton Suedel, PhD  
Research Biologist



US Army Corps  
of Engineers



# Engineering With Nature®

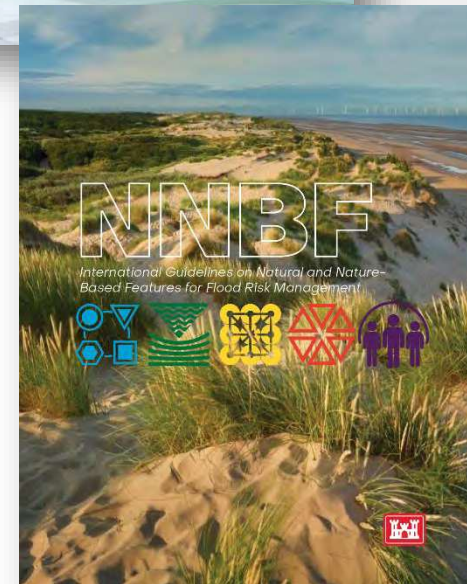


*...the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaboration.*

## Key Elements:

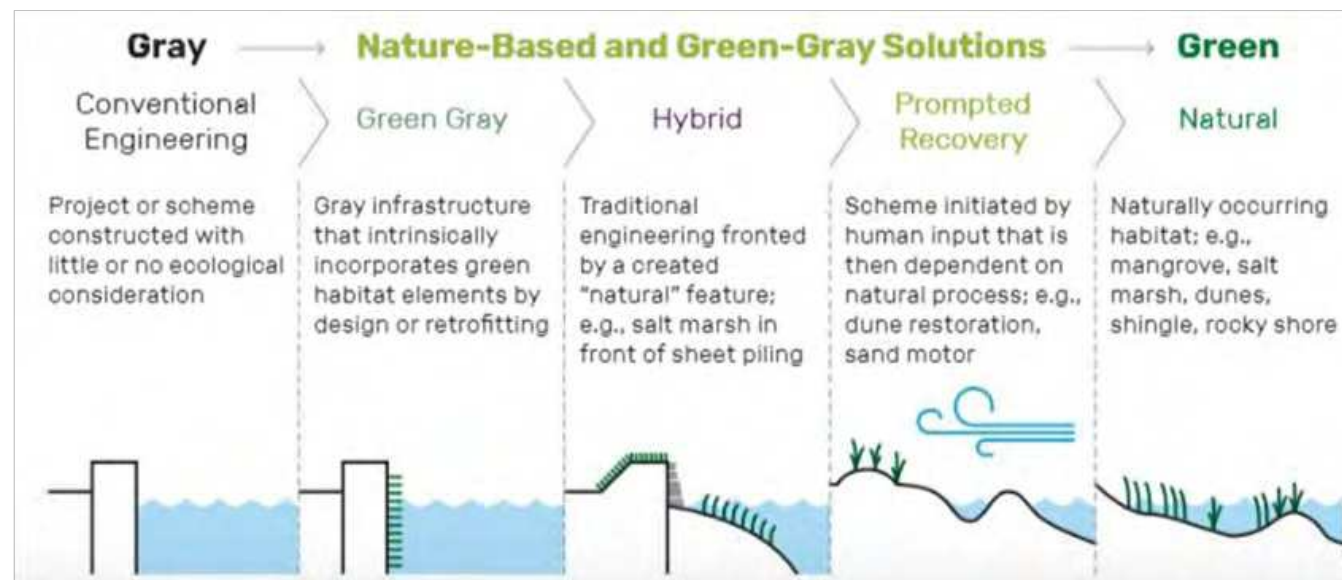
- Science and engineering that produces operational efficiencies
- Using natural process to maximum benefit
- Broaden and extend the benefits provided by projects
- Science-based collaborative processes to organize and focus interests, stakeholders, and partners

[www.engineeringwithnature.org](http://www.engineeringwithnature.org)





# Continuum of Nature-Based Techniques



# The EWN<sup>®</sup> Approach: Innovation in Practice



- Policy development
  - Engagement with policymakers
  - Policy/procedure “modernization”
- Engagement, partnering, and teaming
  - Within USACE, e.g., EWN Proving Grounds
  - With other organizations inside and outside government
- Innovation
  - Creating a vision of the future
  - Establishing goals, targets and conditions
  - New science and engineering and tools for delivery
- On-the-ground projects and demos
  - Across the spectrum of applications and project development (i.e., from planning to operations)
  - Scaling up nature-based solutions
- Strategic communications
  - Individual research papers
  - Communication tools, e.g., EWN Atlas Vol 1 and 2
  - Education, e.g., academic curricula, training







# Policy Directives and Supports

# Nature-Based Solutions: A White House Priority



BRIEFING ROOM

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

APRIL 22, 2022 • PRESIDENTIAL ACTIONS



BRIEFING ROOM

Executive Order on Tackling the  
Climate Crisis at Home and Abroad

JANUARY 27, 2021 • PRESIDENTIAL ACTIONS



OFFICE OF SCIENCE AND TECHNOLOGY POLICY

## WHITE HOUSE ROUNDTABLE – “KNOWLEDGE IN NATURE: HOW NATURE CAN HELP GROW A BETTER FUTURE”

- 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



# Military Installation Resilience: Built + Natural Infrastructure



## ARMY CLIMATE STRATEGY

### Implementation Plan



Fiscal Years 2023-2027

Objective 1.j.1: **Develop Roadmap for incorporating EWN tools and techniques** into MILCON planning and design processes

Objective 1.j.3: **Incorporate nature-based solutions**, risk-based climate science, tools, technology, and adaptation measures into installation land management plans and disaster preparations.

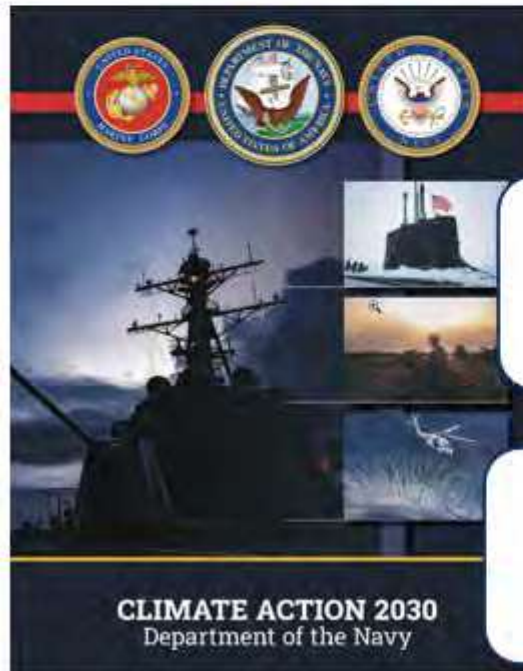
The DON will also deploy **nature-based solutions** to mitigate shoreline erosion, protect mission-critical assets, and improve natural assets that are key to achieving resilient infrastructure and operations.

Over the past three years, the DON has updated criteria to reflect extreme weather events, including higher winds from hurricanes, increased seismic activities, storm surge, and flooding, and is **now developing new criteria for implementing nature-based climate resilience measures**.



Line of Effort 3: Resilient Built and Natural Installation Infrastructure

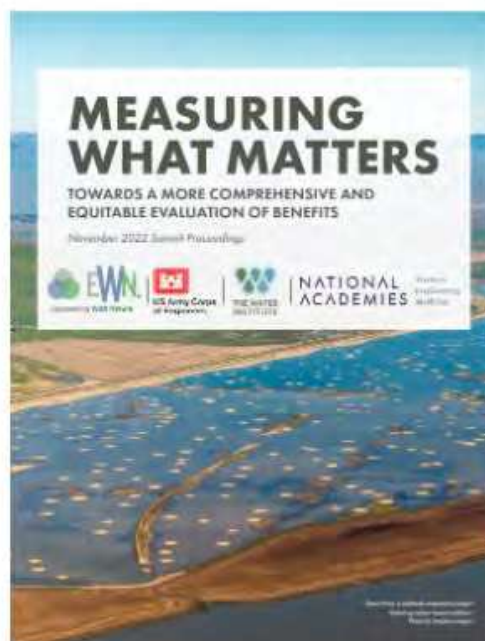
"Built and natural infrastructure are both necessary for successful mission preparedness and readiness."





## S5 E2 – Nature-Based Solutions from the Halls of the Exec Office of the President

What happens when a nation focuses on addressing the critical challenges posed by climate change by investing in nature? That's what we're talking about in Season 5, Episode 2, of the Engineering With Nature® Podcast.

[MORE](#)

[Final Proceedings](#) (pdf)

### Summit Proceedings

The Summit Proceedings capture the summary and highlights from keynote messages, panel discussions, and breakout sessions.

A capstone report, summarizing the EWN and The Water Institute's policy research effort, will be released in early 2023 and will reflect the study team's findings and recommendations.

**RECORDED SUMMIT**

## OPPORTUNITIES TO ACCELERATE NATURE-BASED SOLUTIONS: A ROADMAP FOR CLIMATE PROGRESS, THRIVING NATURE, EQUITY, & PROSPERITY

A REPORT TO THE  
NATIONAL CLIMATE TASK FORCE  
NOVEMBER 2022







# EWN Research & Development



# Example EWN<sup>®</sup> R&D Projects:

- EWN Atlas Volume 1 and 2
- Engineering Guidance for Natural and Nature-Based Features – International Guidelines!
- Remote sensing research for EWN Design and Application
- Incorporating EWN into Existing Infrastructure
- Synthesizing Beneficial Use of Dredge Material (BUDM) Efforts Undertaken by USACE into EWN ProMap
- Maximizing the Long-Term Function of Coastal Islands Derived from EWN Efforts
- Characterizing Engineering Performance of NNBF Combined with Conventional Measures
- Wave Attenuation of Coastal Mangroves During Extreme Water Levels at Near Prototype Scale
- EWN CSTORM Modeling Toolkit
- Implementing Sustainable Dredged Sediment Management Practices for Supporting Coastal Wetlands
- Coastal Carbon Capture via Beach Nourishment: Pilot Deployment of Olivine Sands as a Tool for Mitigating Climate Change
- Quantifying Engineering With Nature<sup>®</sup> (EWN<sup>®</sup>) Benefits Associated with Large-Scale Levee Setback Projects
- Quantifying the Efficacy of Floating Vegetated Canopies for Shoreline Protection
- Computational Modeling of Manmade Oyster Reefs: Life-cycle, Wave Attenuation, Performance, and Reliability
- Engineering With Nature<sup>®</sup> (EWN<sup>®</sup>) Jekyll Island “Sand Motor”
- Guidance for Modeling EWN<sup>®</sup> Watershed Management Methods using GSSHA
- Remote Sensing of Back-Bay Establishment Following Sediment Nourishment
- Comprehensive Benefits Evaluation for Nature-Based Solutions
- Identification of Opportunities for Beneficial Use of Dredged Material Within Atlantic Intracoastal Waterway
- And more...

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# Engagement, Partnering and Teaming



# Supporting Education and Progress: The Network for Engineering With Nature (N-EWN)



- Multi-sector network supporting innovation
  - Types of partners: public and private sector
  - Research – gov't, academic, private
  - Industry practitioners
  - Project owners
- Aligning research with the needs of practice
- Grounding approach in real projects
- EWN education: curricula and training
- Experiential learning for students – systems thinking, cross-disciplinary training
- Freely flowing communication and knowledge sharing
- Accelerate implementation

<https://n-ewn.org/>



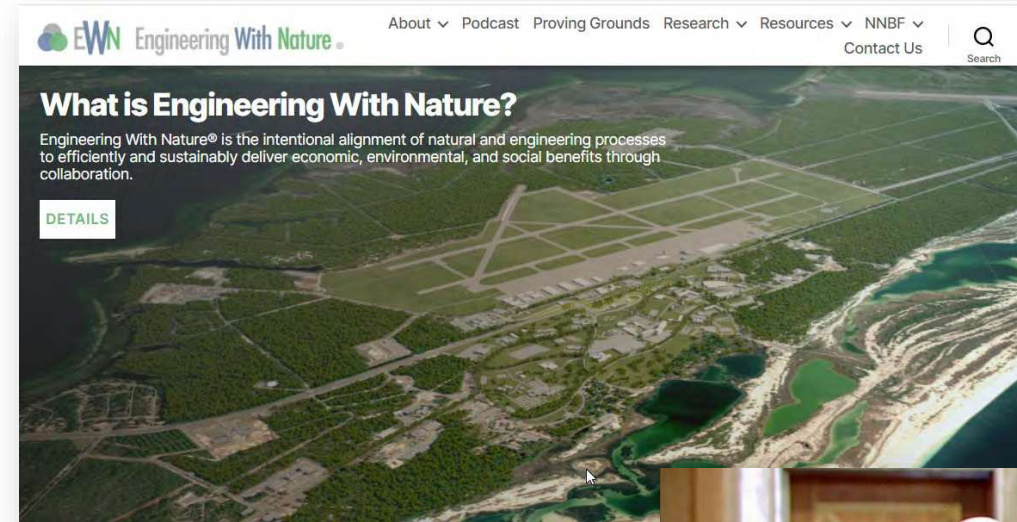
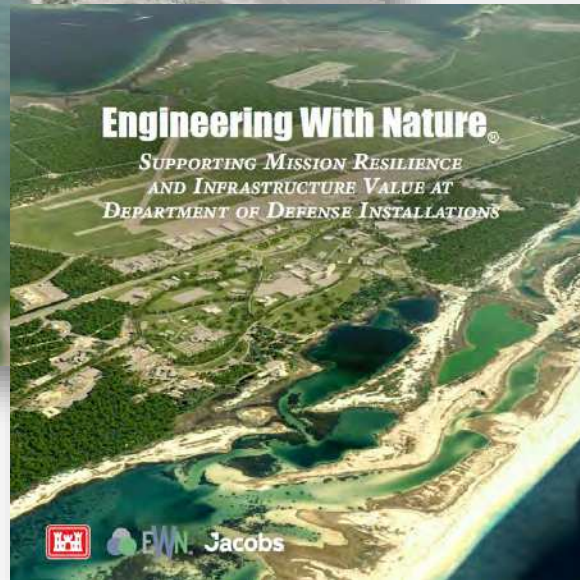
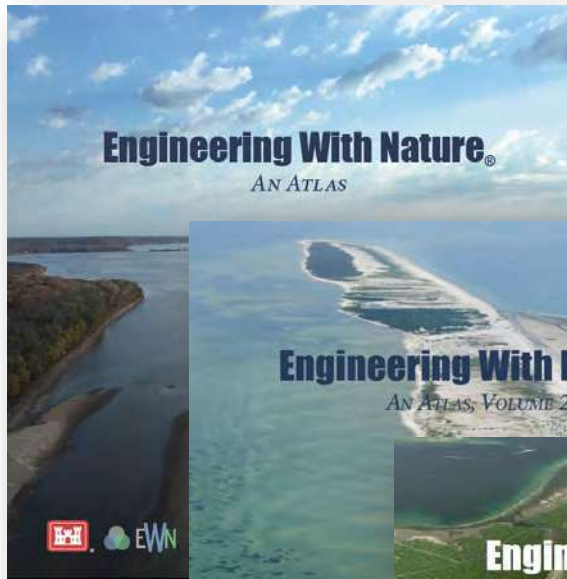


# Communications





# Communicating Nature-Based Solutions



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



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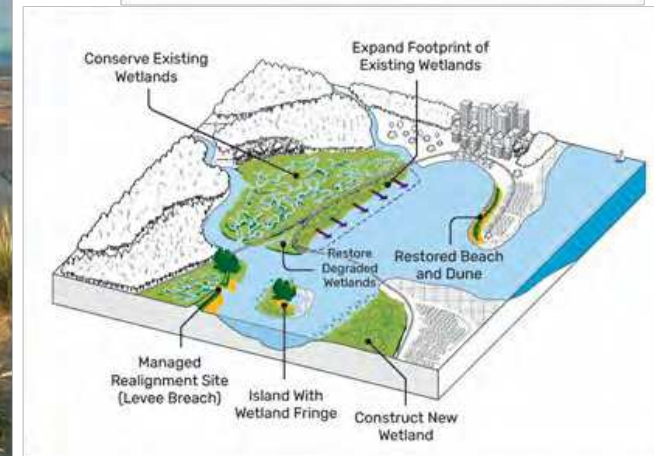
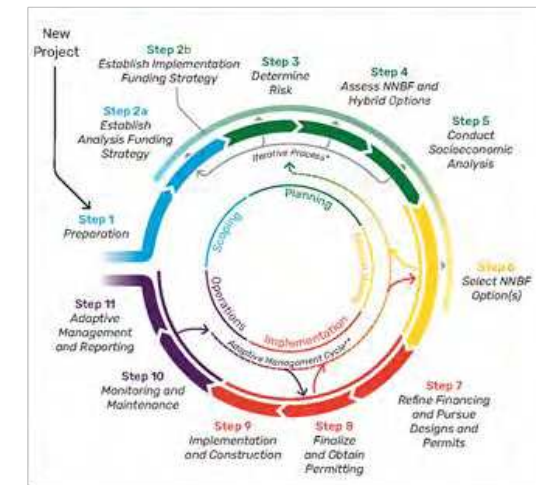
# International Guidelines on the Use of Natural and Nature-Based Features for Flood Risk Management

## NNBF Guidelines Table of Contents

- Chapter 1. Introduction
- Chapter 2. Principles, Outcomes, and Frameworks
- Chapter 3. Engaging Communities and Stakeholders in Implementing Natural and Nature-Based Features
- Chapter 4. Planning and Implementing Natural and Nature-Based Features Using a Systems Approach
- Chapter 5. NNBF Performance
- Chapter 6. Benefits and Costs of NNBF
- Chapter 7. Adaptive Management
- Chapter 8. Introduction to NNBF in Coastal Systems
- Chapter 9. Beaches and Dunes
- Chapter 10. Coastal Wetlands and Tidal Flats
- Chapter 11. Islands
- Chapter 12. Reefs
- Chapter 13. Plant Systems, Submerged Aquatic Vegetation, and Kelp
- Chapter 14. Enhancing Structural Measures for Environmental, Social, and Engineering Benefits
- Chapter 15. Introduction to Fluvial Section
- Chapter 16. Fluvial Systems and Their Influence on Flood Risk Management
- Chapter 17. Challenges and Benefits of Natural and Nature-Based Features in Fluvial Systems
- Chapter 18. Description of Fluvial Natural and Nature-Based Features
- Chapter 19. Fluvial Natural and Nature-Based Features – Case Studies
- Chapter 20. The Future

### NNBF Guidelines

- Publication SEP 2021
- >900 pages
- >150 authors and contributors from >70 organizations and 10 countries





# EWN Podcast



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## Ep 1 – Evolution of Nature Infrastructure Policy

Tackling the Climate Crisis at Home and Abroad, emphasizes the urgency of officially calls for the inclusion of nature-based solutions. Combined with the approved by the US Senate in August, 2021, which describes major



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## Ep 2 – Considering and Evaluating the Benefits of Natural Infrastructure

In Episode 1 we discussed the unprecedented opportunity presented by President Biden's January 2021 Executive Order, Tackling the Climate Crisis at Home and Abroad, to incorporate Engineering With Nature approaches into major infrastructure and climate resilience projects. Factoring the benefits and costs of nature-based solutions into decisions about infrastructure

MORE



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## Ep 3 – The Next Generation Makes the Future of EWN Even Brighter

This episode exemplifies our theme for Season 3 – Creating the Future with EWN. Host, Sarah Thorne, and Jeff King, Deputy Lead of the Engineering With Nature program at the U.S. Army Corps of Engineers, are talking with three PhD students who are doing truly groundbreaking work: Matt Chambers from the University of Georgia; Joseph Holway from Arizona State

MORE



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## Ep 4 – Engineering With Nature for Safe and Livable Cities

How can Engineering With Nature approaches make urban landscapes more livable? In this episode, host Sarah Thorne and Todd Bridges, the Army's Senior Research Scientist for Environmental Science and National Lead for U.S. Army Corps of Engineers' Engineering With Nature Program, are talking with planners from two very different cities—New York City and Fort

MORE



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## Ep 5 – Applying EWN strategies at National Parks and Refuges

Climate change and the imperative to take action now is top of mind following the COP26 United Nations Climate Change Conference in Glasgow. The effects of climate change – rising sea levels, changing temperature and precipitation patterns, wildfires, and many other changes impact vulnerable natural resources, including national parks and wildlife refuges.

MORE



# Example Effort at Military Installations

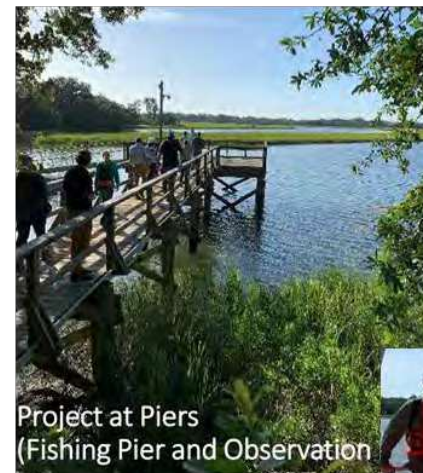


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# MCAS Beaufort

- EWN host onsite workshop at MCAS Beaufort w/ Marine Corps Leadership and stakeholders (~ 60 participants) July 26-27, 2022
- Documentation of workshop discussions around topics such as:
  - Descriptions/sketches of “scaled-up”-integrated opportunities
  - Potential additional studies and resources
  - General timelines
  - Current or planned initiatives occurring on installation
  - Permitting and NEPA considerations
  - Potential partnerships and stakeholders including roles, responsibilities, lead entities





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# Great Lakes Playbook



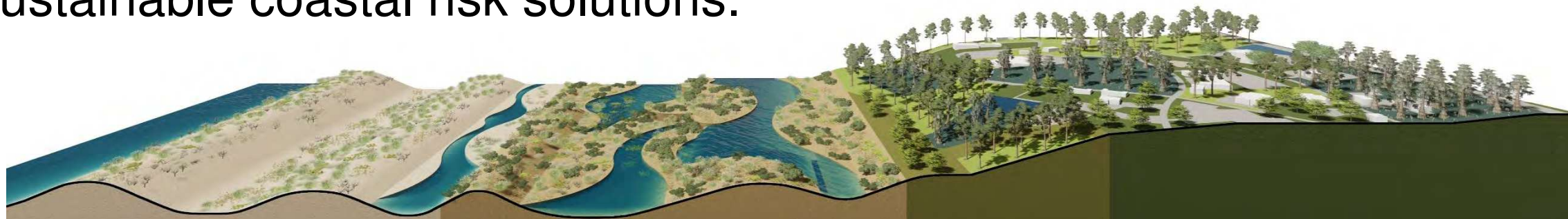
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# Background

There are 4,530 miles of U.S. coastline for the five Great Lakes, more than double the coastline along the U.S. Atlantic Ocean, and more than three times the coastline on the U.S. West Coast, further underlining the need for Great Lakes specific NNBF guidance.

NNBF integrates naturally with the concept of Multiple Lines of Defense (MLD), whereby multiple strategies are used to erect a system of comprehensive, resilient, and sustainable coastal risk solutions.





# GL Handbook Need

- **Current understanding of NNBF and MLD coastal resiliency measures is mostly limited to ocean coast, resulting in lack of confidence on the applicability and cost-benefit of these measures in the Great Lakes.**
- **Engagements and discussions with Great Lakes Communities revealed the need for NNBF guidance specific to the Great Lakes.**
- **Without greater understanding and guidance, a paradigm shift from traditional flood risk management (FRM) practices to NNBF will not occur.**
- **USACE also needs this guidance to confidently consider these types of measure as part of the Great Lakes Coastal Resiliency Study (GLCRS) and related spin-off studies.**



# Project Objectives

- Develop a Great Lakes specific guide (“playbook”) to Natural and Nature Based Features (NNBF) and Multiple Lines of Defense (MLD) to improve future coastal resiliency.
- The guide will significantly advance the understanding of NNBF and MLD emerging technologies as applied to the entire Great Lakes region.
- The guide will provide additional needed confidence to federal, state, and local government agencies to plan, design, and implement sustainable, adaptable and cost-effective NNBF measures, either instead of, or in addition to, traditional structural and non-structural flood risk management (FRM) practices.



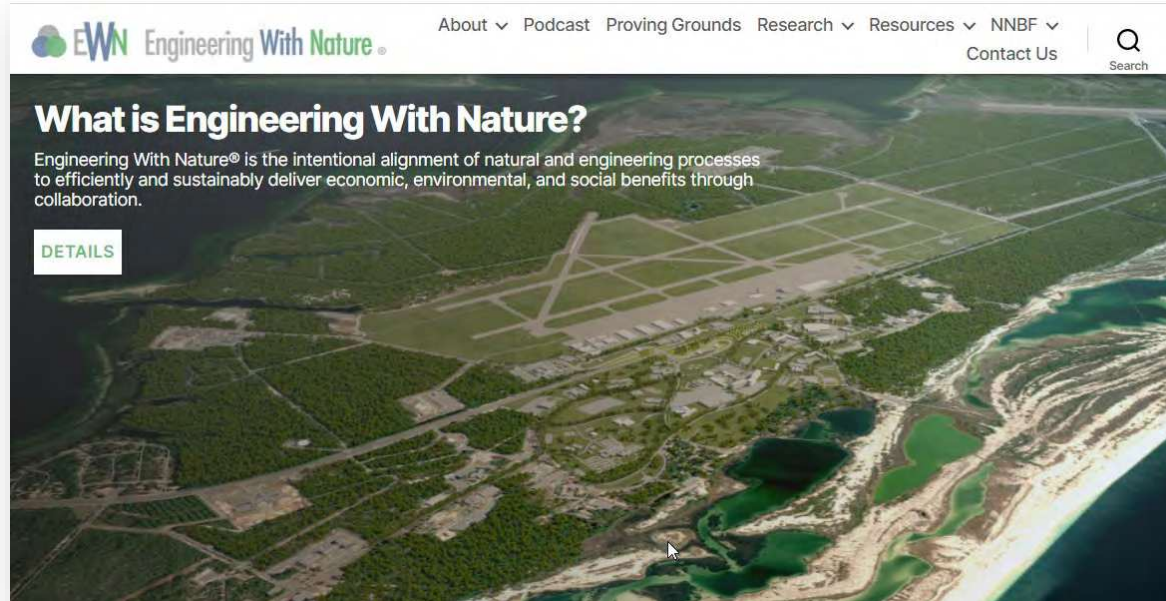
# Approach

- **Work with partners to identify existing NNBf and MLD projects within the Great Lakes region and performance / cost under range of conditions.**
- **Utilize Engineering with Nature (EWN) principles to develop new conceptual designs specific to the Great Lakes that achieve greater resiliency / adaptability than conventional designs.**
- **Estimate adaptive capacity, failure tipping points and planning-level cost/benefit performance outputs of conceptual designs under range of current conditions and future climate scenarios.**



# Engineering With Nature®

## Questions?



[jeffrey.k.king@usace.army.mil](mailto:jeffrey.k.king@usace.army.mil)  
[burton.suedel@usace.army.mil](mailto:burton.suedel@usace.army.mil)

[www.engineeringwithnature.org](http://www.engineeringwithnature.org)

