

IMPLEMENTING ENGINEERING WITH NATURE® FOR ENABLING SUSTAINABILITY AND RESILIENCE IN THE ARID SOUTHWEST

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EWN Arid SW Workshop Briefing
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U.S. ARMY



US Army Corps
of Engineers®



ERDC





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



- Producing Efficiencies



- Using Natural Process



- Broadening Benefits



- Promoting Collaboration



COLLABORATE

- Within USACE (EWN Proving Grounds, Cadre)
- With others (Multi-Sector Network for EWN)

RESEARCH

- Innovation in practice
- Tools for delivery
- Taking the “long view”
- Establishing future targets and conditions

IMPLEMENT

- Across the spectrum of applications/missions
- From design and planning, to O&M

COMMUNICATE

- Publications (tech notes, reports, journal articles)
- Highly visual, collaborative products
- Education, e.g., academic curricula, training



EWN[®] ACROSS USACE MISSION SPACE



Navigation

- Strategic placement of dredged material supporting habitat development
- Habitat integrated into structures
- Enhanced Natural Recovery

Flood Risk Management

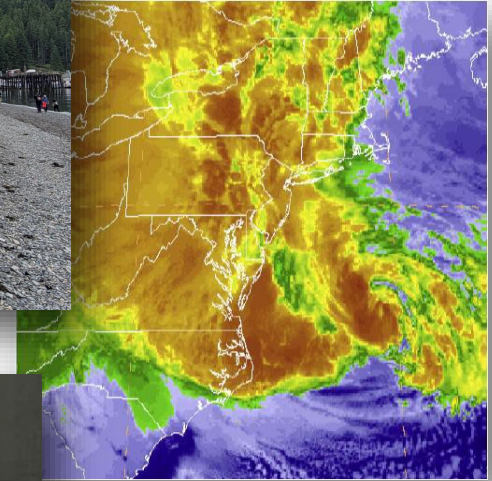
- Natural and Nature-Based Features to support FRM
- Levee setbacks

Ecosystem Restoration

- Ecosystem services supporting engineering function
- “Natural” development of designed features

Water Operations

- Shoreline stabilization using native plants
- Environmental flows and connectivity





SOME DEFINITIONS

NATURE-BASED SOLUTIONS (NBS)

- Actions to protect, sustainably manage, or restore natural or modified systems to address societal challenges, simultaneously providing benefits for people and the environment

ENGINEERING WITH NATURE (EWN)

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

NATURAL AND NATURE-BASED FEATURES (NNBF)

- Coastal, estuarine, and riverine landscapes that are naturally occurring or engineered to mimic some aspect of a natural condition while still providing flood risk reduction benefits

MULTIPLE LINES OF DEFENSE (MLD)

- Using multiple strategies to erect a system of comprehensive, resilient, and sustainable coastal storm risk management solutions

GREEN INFRASTRUCTURE

- When nature is harnessed by people and used as an infrastructural system

GRAY INFRASTRUCTURE

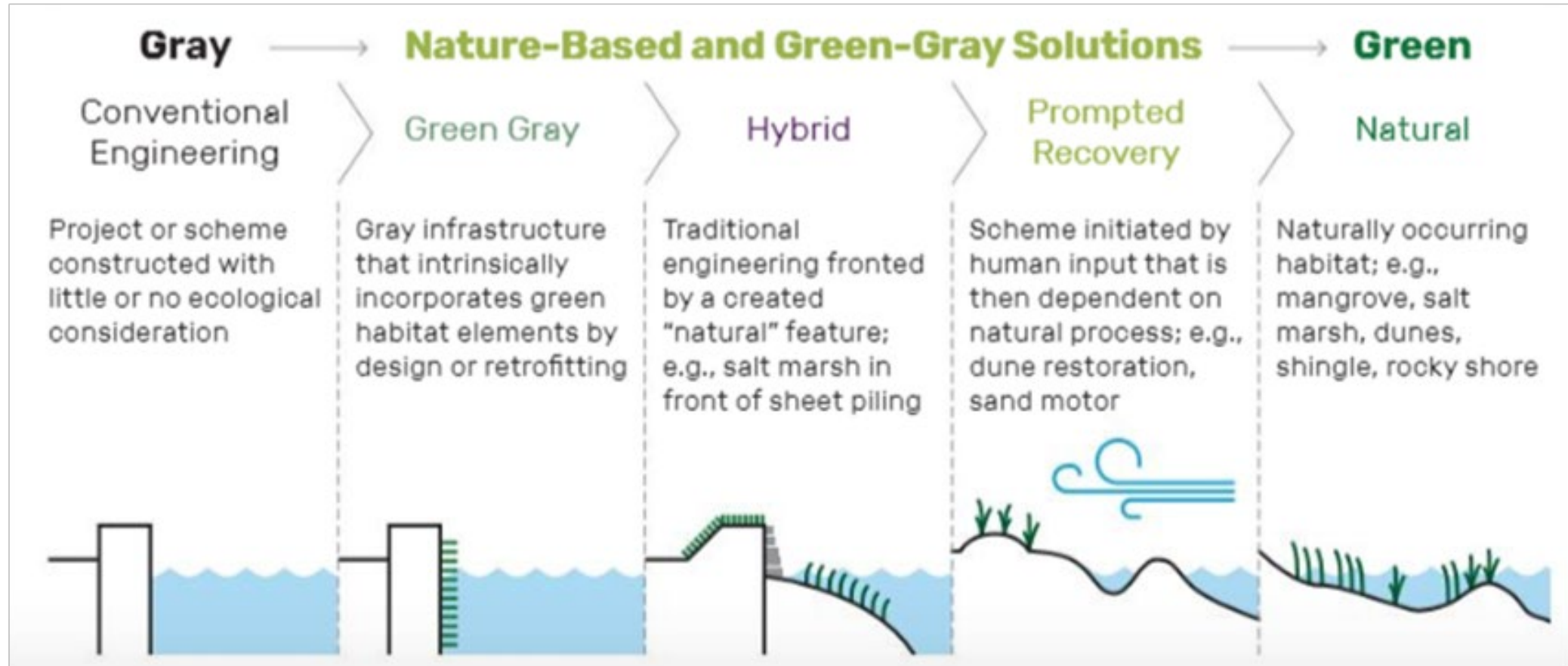
- Human-engineered conventional approaches to water resources management such as pipes and hard surfaces made from concrete, steel, and large rock

NATURAL INFRASTRUCTURE (NI)

- Natural infrastructure uses natural processes and ecosystem services to support engineering objectives, such as reducing flood damages or securing safe and ample water supplies (e.g., marshes, dunes, maritime forests, **dredged material**)



SPECTRUM OF NATURE-BASED TECHNIQUES





EWN Collaboration

Engagement, Partnering and Teaming



USACE EWN Proving Grounds



- Galveston District
- Buffalo District
- Philadelphia District
- Mobile District
- San Francisco District
- St. Louis District
- Los Angeles District
- South Pacific Division
- South Atlantic Division
- Northwest Division
- Mississippi Valley Division

"The mission of US Army Corps of Engineers is to deliver vital public and military engineering services; partnering in peace and war to strengthen our nation's security, energize the economy and reduce risks from disasters. Engineering With Nature supports this mission which is why it will always be an important initiative for the Corps."

LTG Scott A. Spellman, 55th Chief of Engineers



DEPARTMENT OF THE ARMY
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CENWD-ZA (800B-11)

14 June 2024

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Expanding Consideration of Nature-Based Solutions within Northwestern Division and Strengthening Collaboration with the Engineering With Nature® Program

1. Reference Northwestern Division Nature-Based Solutions Cadre Statement of Purpose.
2. The purpose of this memorandum is to establish an integrated Division and District level regional interdisciplinary cadre to expand consideration of Nature-Based Solutions in our work. The purpose and goals of the cadre are described in the reference Northwestern Division Nature-Based Solutions Cadre Statement of Purpose document. Additionally, Northwestern Division seeks to strengthen collaboration with Engineering With Nature (EWN) and become established as an EWN Proving Ground.
3. To support this effort, each District Commander will provide two to three individuals from the engineering, planning, and operations disciplines to serve on the cadre no later than 15 July 2024. In some instances, districts may already have staff who are involved in related assignments who would be suitable candidates.
4. The points of contact for this request are Ms. Angela Duren, Senior Hydrologist, at angela.m.duren@usace.army.mil, and Mr. Jesse Granet, Environmental Team Lead, at jesse.j.granet@usace.army.mil.

Geoffrey R. Van Epps
GEOFFREY R. VAN EPPS
Brigadier General, USA
Commanding

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An important step toward making Nature Based Solutions a routine and integral component of NWD programs!



THE NETWORK FOR ENGINEERING WITH NATURE (N-EWN)



- Large scale network is needed for innovation / knowledge acceleration
- Driven primarily by research community
- Aligning research with the needs of practice
- Grounding research in real projects
- EWN education: curricula and training
- Experiential learning for students – systems thinking, cross-disciplinary training
- Types of partners
 - Research – academic, private
 - Industry practitioners
 - Users and project owners
- Freely flowing communication and knowledge sharing
- Shorten road to implementation



<https://ewn.el.erdcdren.mil/n-ewn.html>

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



Seven Mile Island Innovation Laboratory

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- Collaboration and partnership that is building first-of-their-kind NbS projects in coastal New Jersey
 - Began as conversation
 - Accelerated by a storm (Sandy)
 - Progressed through piloting
 - Now in full-scale implementation



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EWN Research & Development



EWN[®] R&D PROJECTS



1. EWN Atlas Volume 1, 2...and 3!
2. Remote sensing research for EWN Design and Application
3. Developing Engineering Guidance for Natural and Nature-Based Features – (Post **International Guidelines!**)
4. Wave Attenuation of Coastal Mangroves During Extreme Water Levels at Near Prototype Scale (see photos)
5. EWN Hydrodynamic Modeling Toolkit – The expansion pack!
6. Reproducible Framework - Development of Standardized Methods to Calculate, Compare & Score Social & Ecological
7. Building an Engineering With Nature Business Case for Natural and Nature Based Features
8. EWN through Landscape Architecture
9. Performance Metrics for Nature-Based Solutions: Leveraging 25 Years of USACE and Partner Remote Sensing Data
10. Beneficial Use of Dredged Material in Mangrove Restoration Projects to Increase Resilience
11. Testing Efficacy of Remote Sensing to Measure Multiple Environmental Benefits of Water Level Management: A Case Study at Wilson Lake, Kansas
12. And more at <https://ewn.erdcdren.mil/research/status/active/>



EWN ARID SOUTHWEST PLAYBOOK

Objectives

- Develop guide (a.k.a. playbook) for NNBF and multiple-lines-of-defense strategies to support future efforts to improve resilience in arid southwest
- Identify NNBF that are appropriate to arid SW region of US, substantively advancing understanding of their potential performance
- Improve confidence of federal, state, and local agencies to plan, design, and implement sustainable, adaptable, and cost-effective NNBF measures

Other Playbooks

- Great Lakes, supporting Great Lakes Coastal Resilience Study (GLCRS)



NON-NATIVE SPECIES AS NATURAL INFRASTRUCTURE

Flood Risk Reduction using Natural Infrastructure Materials

Challenges

- Non-native species often growing along stream and riverbanks
- May choke waterways as debris following storms or floods
- Nuisance and hazard at bridges and other infrastructure

Opportunities

- Locally-available source of NI material for building check dams for erosion control
- Peak flow attenuation along the watershed
- Reduced nutrient runoff

Invasive bamboo thickets are abundant along sections of the Añasco River, Mayagüez. Photo: Burton Suedel.



Example bamboo check dam, Belford Natural Flood Management Scheme, England, UK. Image: Nicholas Barber, Newcastle University.

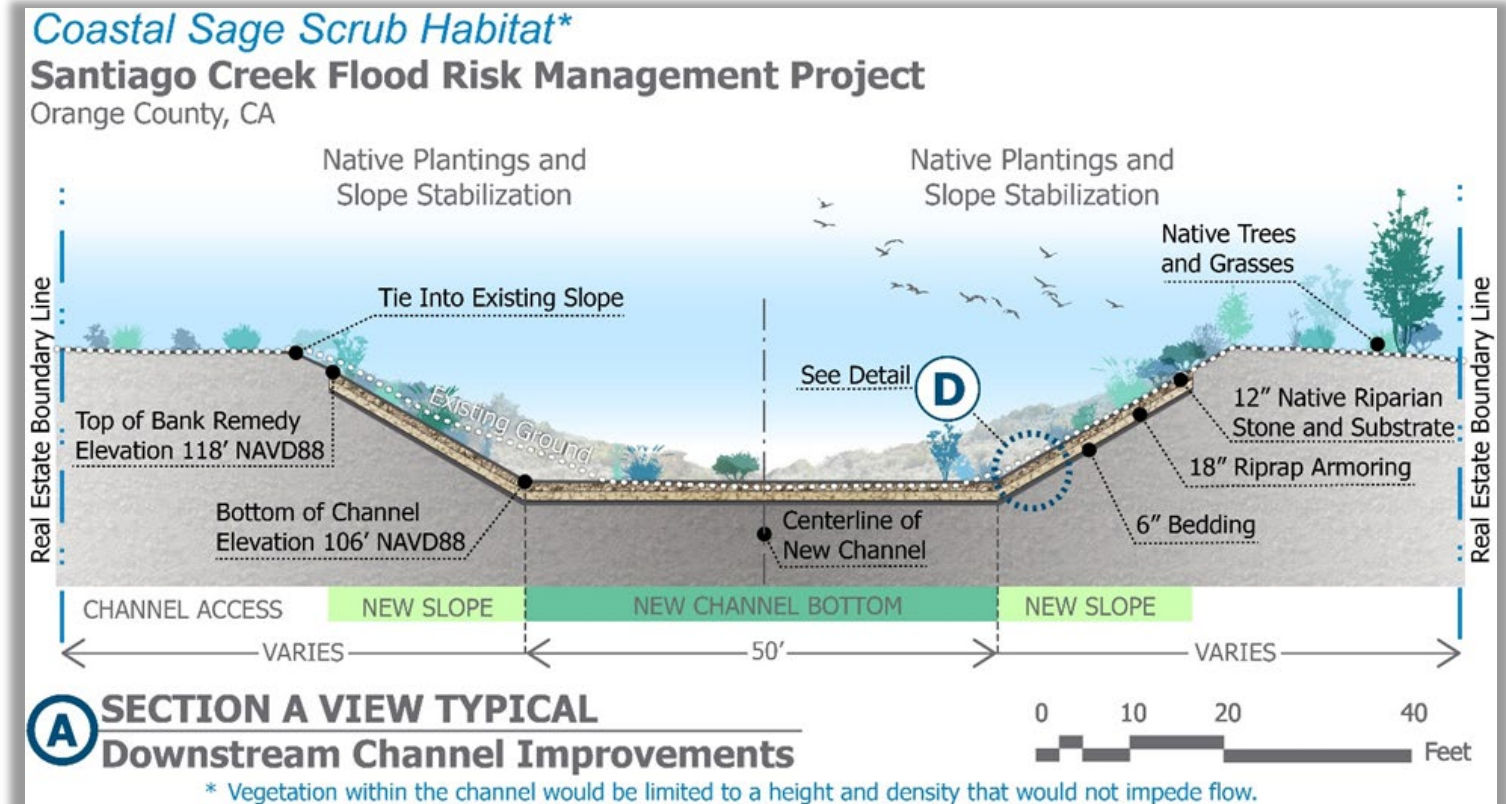


EWN IN ARID URBAN ENVIRONMENTS

SANTIAGO CREEK FRM PROJECT

EWN Solution:

- LRC, MVN, ERDC supporting SPL
- Rip-rap alternatives
- Low maintenance
- Low growing/low density to maintain flow
- Native grass mix habitat
- Native stone substrate
- Target native species
- Built **AND** nature-based infrastructure features (hybrid design)



Hybrid design alternative to rip rap (Jack Milazzo, MVN)



LARGE-SCALE WILDFIRES: EQUITABLE APPLICATION OF EWN TO ADDRESS EROSION

- USACE navigation and reservoir management missions threatened by large-scale wildfires
- Wildfire threats are expected to continue in the future
- Santa Clara Pueblo (NM) designed and constructed thousands of structures built from natural infrastructure (NI) materials
- Erosion control incorporating low-cost and readily available materials (logs, mulch, vegetation, local rock) to stabilize highly erodible soils
- Integrated Traditional Ecological Knowledge about flood history, wildlife migrations, and historical vegetation occurrence
- Highly collaborative, involving multiple partners
- Resulted in holistic and sustainable approach



Headcutting Erosion Control Measure



Sedimentation Control as Intended

Haring et al. (2021). IEAM 17(6):1194-1202.



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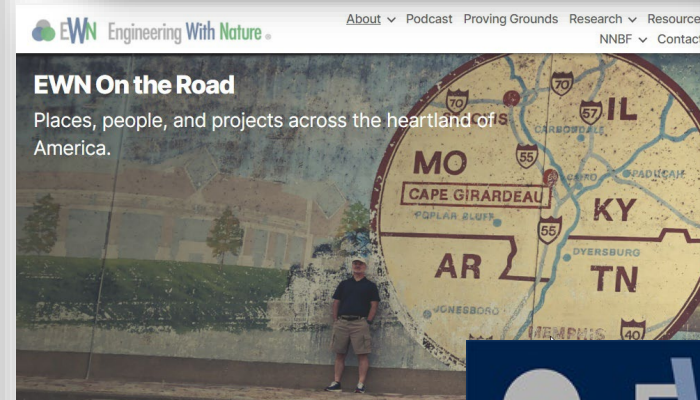
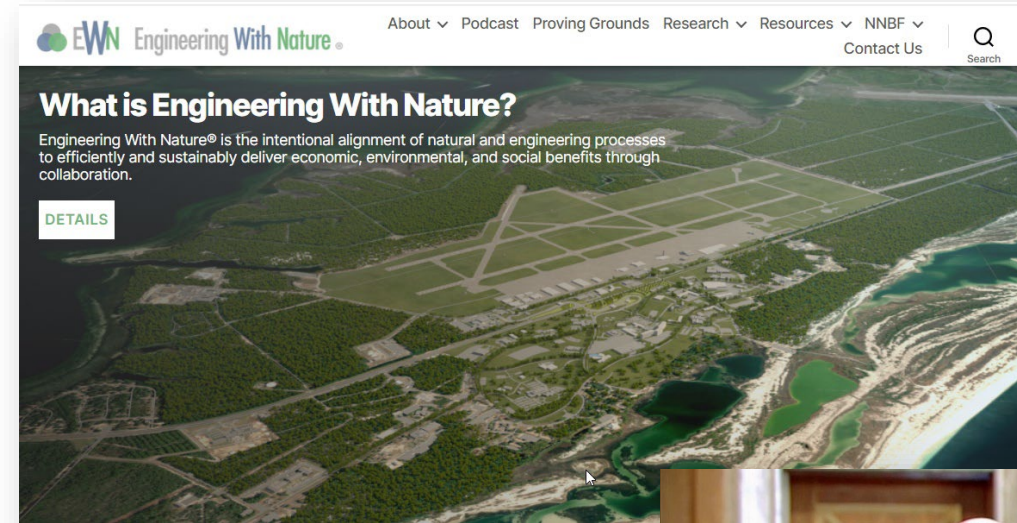
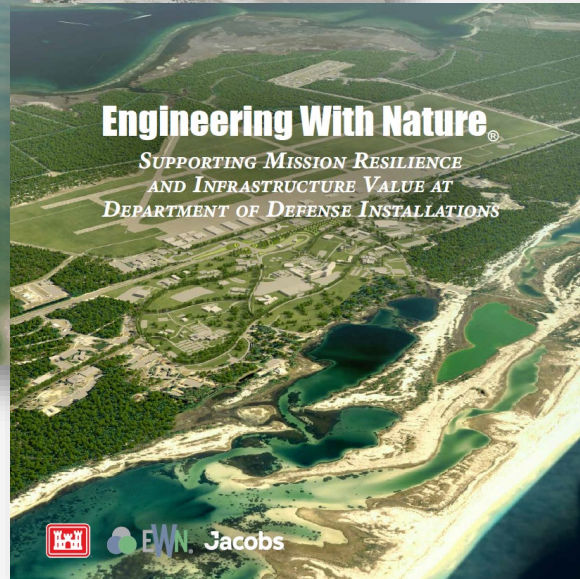
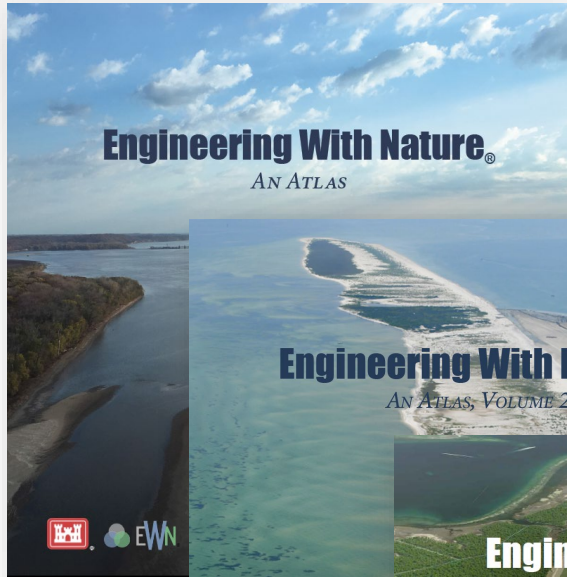


EWN Communications

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COMMUNICATING NATURE-BASED SOLUTIONS



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

www.engineeringwithnature.org





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.erd.c.dren.mil/?page_id=4351

NNBF Guidelines

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



16 September 2021

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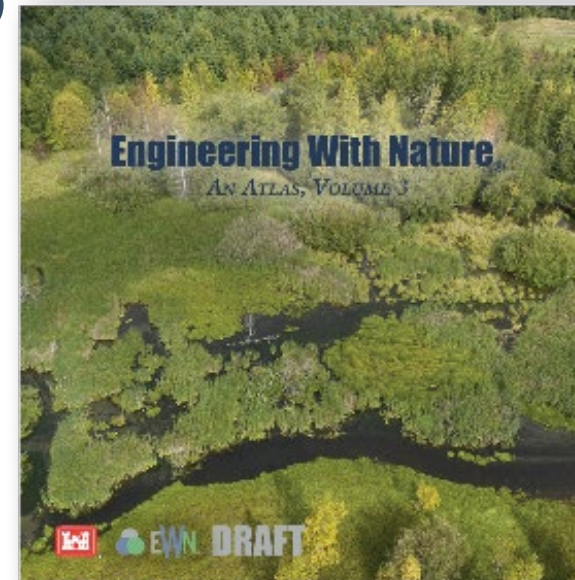
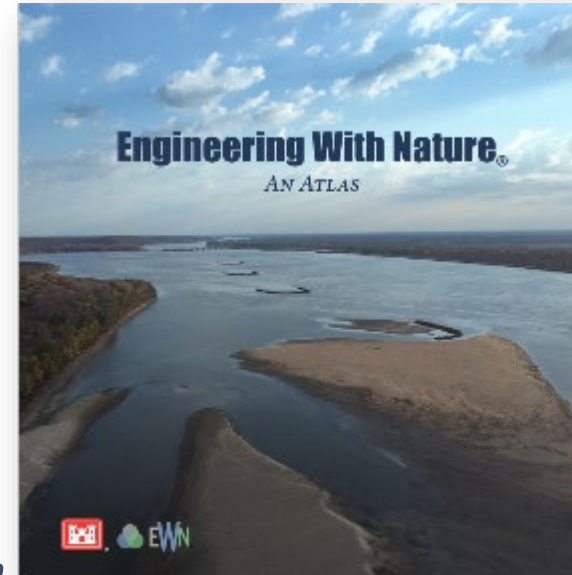




Engineering With Nature *The Atlas Series*

EngineeringWithNature.org

- **Volume 1**
 - 56 Projects, 27 USACE
- **Volume 2**
 - 62 Projects, 23 USACE
- **Volume 3**
 - 58 Projects, 15 USACE



EWN. PODCAST

▶ Read Summary



S5 Trailer – The Engineering With Nature® Podcast

Realizing the Value of Nature Length: 18 minutes, Air Date: November 16, 2022 Season 5 of the Engineering With Nature® Podcast launches on November 30. Host Sarah Thorne recently talked about highlights from Season 4 and what's ahead for Season 5 with Todd Bridges, Senior Research

[View Episode](#)



S5 E1 – ERDC Labs Collaborating on Leading Edge 3D Printing Nature-Ba...

In the premier episode of Season 5 of the Engineering With Nature® Podcast, host Sarah Thorne, and Burton Suedel, Research Biologist at the Engineer Research and Development Center (ERDC), are talking with two ERDC colleagues – Alan Kennedy, who is in the Risk Branch of the Environmental

[View Episode](#)



S5 E2 – Nature-Based Solutions from the Halls of the Exec Office of the P...

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.

[View Episode](#)



S5 E3 – What do You Want to Know about Nature? The National Nature A...

The first ever National Nature Assessment (NNA) is currently underway to better understand how nature is faring in the United States and what it means to all our lives. That's the focus of our discussion in Season 5, Episode 3, of the Engineering With Nature® Podcast.

[View Episode](#)



S5 E4 – Measuring What Matters

How do we measure what's most important to us? And how do we translate those values into decisions about infrastructure projects so that they can deliver a diverse set of economic, environmental, and social benefits? That's the focus of our discussion in this episode of the

[View Episode](#)



S5 E5 – Accelerating NBS Progress through N-EWN Multisectoral Collabo...

The Network for Engineering With Nature (N-EWN), which we introduced in Season 1, Episode 10, is a community of researchers, practitioners, and educators who are working together to advance the practice of Engineering With Nature (EWN). We're back in Season 5, Episode 5, to talk with N-EWN's

[View Episode](#)



S5 E6 – A Conversation about EWN, Innovation, and Leadership with LTG ...

In this episode, Lieutenant General Scott Spellmon joins Todd Bridges, Senior Research Scientist for Environmental Science and National Lead for the Engineering With Nature (EWN) Program, and host, Sarah Thorne, as their special guest. Lt. Gen. Spellmon is the 55th Chief of Engineers and the

[View Episode](#)



S5 E7 – Celebrating the 30-Year USACE Career of Todd Bridges

This very special episode of the EWN Podcast features Todd Bridges, Founder and National Lead of the Engineering With Nature Program. We're celebrating his 30-year career and retirement from the US Army Corps of Engineers (on February 28, 2023), and discussing his visionary leadership of EWN

[View Episode](#)

S5 E4 – Measuring What Matters

How do we measure what's most important to us? And how do we translate those values into decisions about infrastructure projects so that they can deliver a diverse set of economic, environmental, and social benefits? That's the focus of our discussion in this episode of the Engineering With Nature® Podcast. Host Sarah Thorne

[MORE](#)



ENHANCING BENEFITS EVALUATION FOR WATER RESOURCES PROJECTS: TOWARDS A MORE COMPREHENSIVE APPROACH FOR NATURE-BASED SOLUTIONS

Evolution of Benefits Evaluation and Prioritization of Water Resources Projects

JUSTIN R. EHRENWERTH, S. BEAUX JONES, EVA WINDHOFFER, JORDAN R. FISCHBACH, SUSAN HUGHES, THOMAS HUGHES, SCOTT PIPPIN, MATTHEW SHUDTZ, AND SHANA JONES

Produced for and funded by: U.S. Army Corps of Engineers' Engineering With Nature Program

July 2022

Season 8 Happening Now

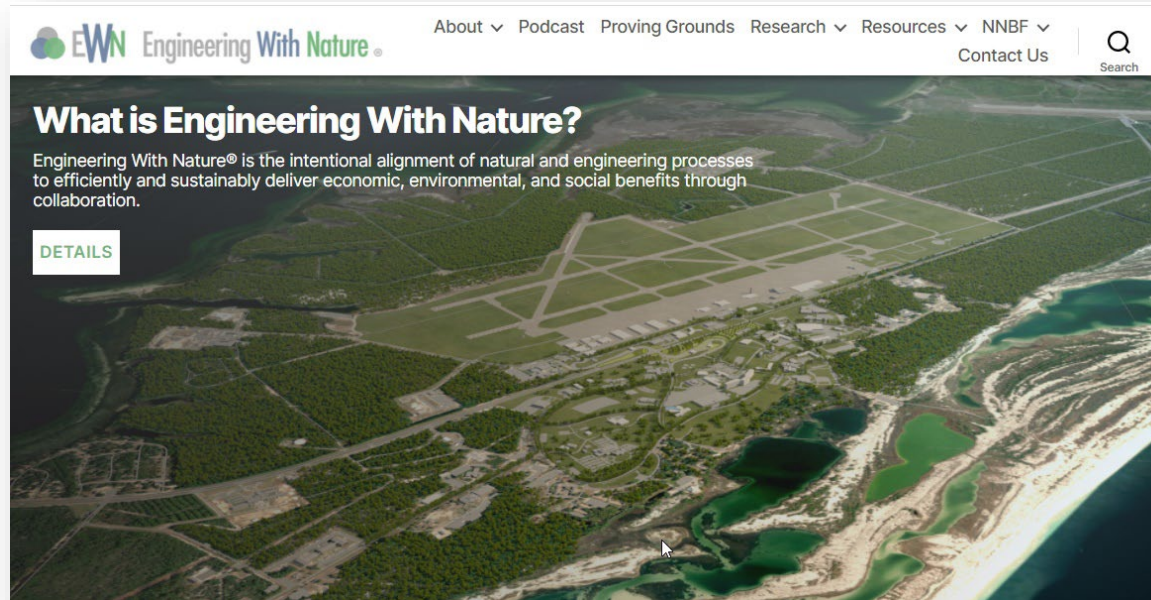


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Questions?



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