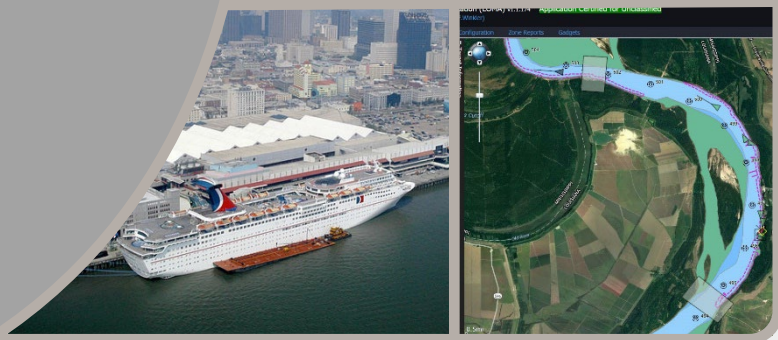




U.S. ARMY

Applications of Natural and Nature-Based Features (NNBF) for Inland Fluvial Environments

Jan 30, 2024



US Army Corps of Engineers

Chris Haring, PhD, P.G., CFM
Engineering Research & Development Center (ERDC)

US Army Corps of Engineers

ERDC

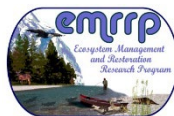
Engineer Research and Development Center

NNBF & Engineering With Nature®

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

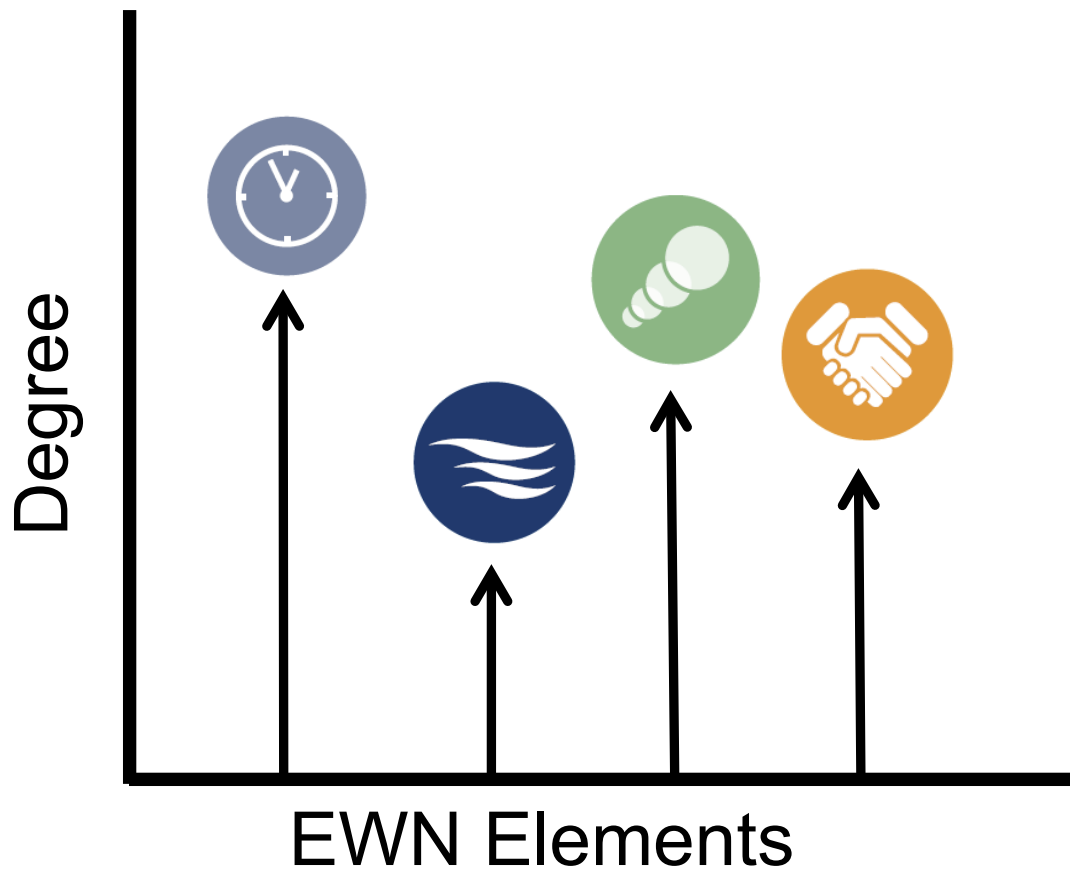
Key Elements:

- 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

NNBF-EWN Key Elements



EWN Elements

Four major elements are involved in applying EWN to develop infrastructure projects:

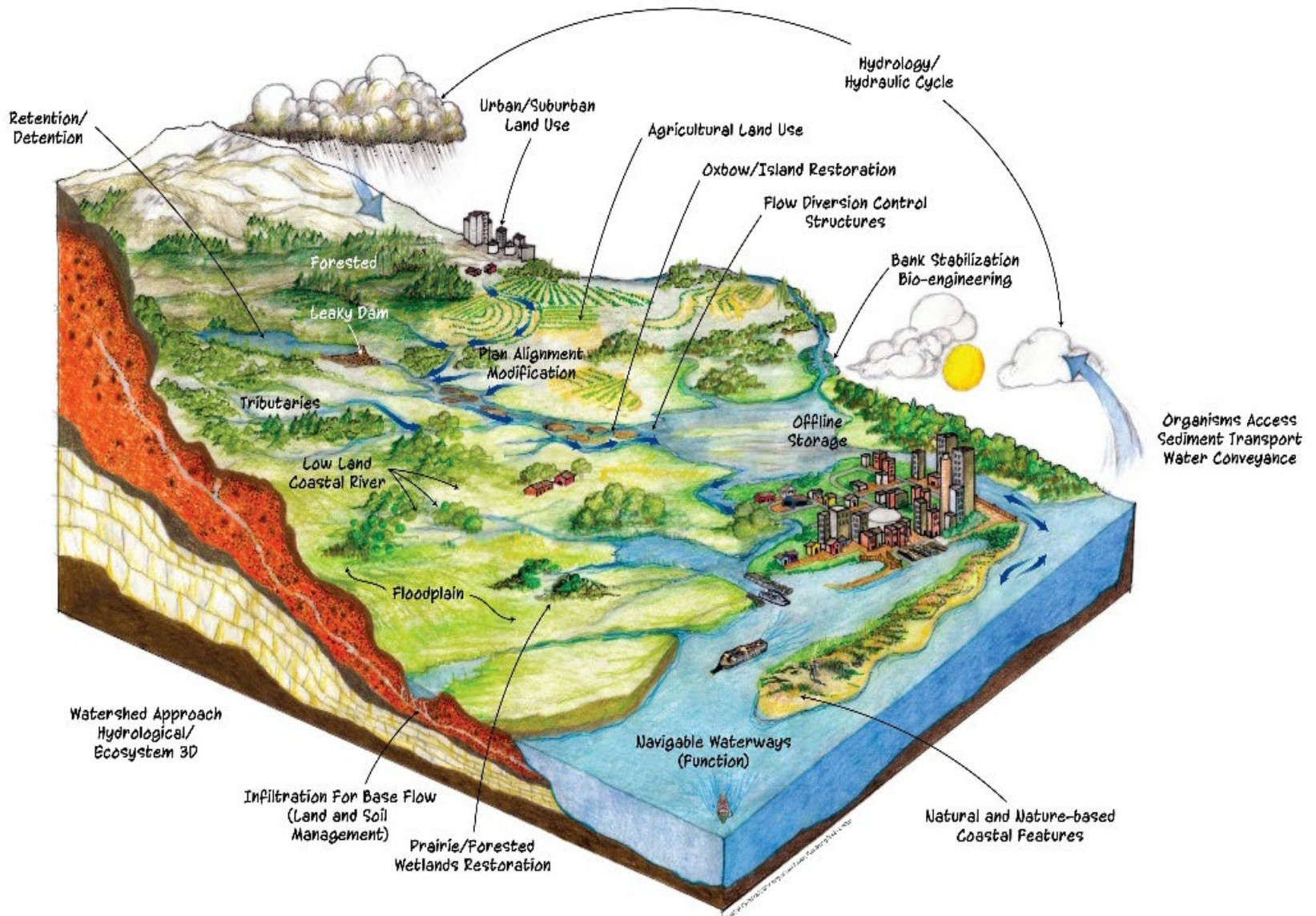
-  Using science and engineering to produce operational efficiencies
-  Using natural processes to maximize benefit
-  Increasing the value provided by projects to include social, environmental, and economic benefits
-  Using collaborative processes to organize, engage, and focus interests, stakeholders, and partners

200+ years of Human Activity on the Landscape

- Cleared the Timber
- Plowed the Prairie
- Drained the Wetlands
- Straightened the Streams
- Leveed and Constricted the Floodplains
- Built Cities with Large Areas of Concrete, Asphalt and Rooftops



A SYSTEMS VIEW OF SOLUTIONS



NNBF ENGINEERING PERFORMANCE



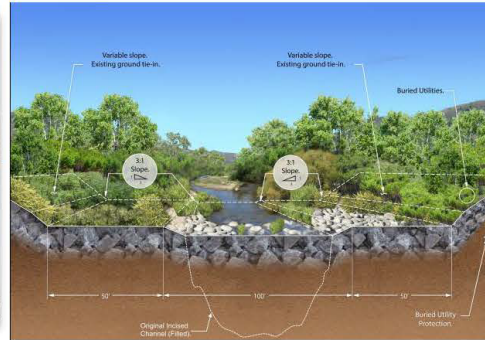
Levee Setbacks

Benefits/Processes

- decreased flood levels and velocities
- reduced frequency of maintenance and repair on levee
- reduced navigational maintenance
- reduction in erosion/scour and O&M costs
- increased recreational, cultural, and educational opportunities

Performance Factors

- amount of new floodplain affects hydrologic loading
- alignment options for improved hazard mitigation
- ecological goals of project with increased floodplain connection
- collaboration with stakeholders and other Federal agencies



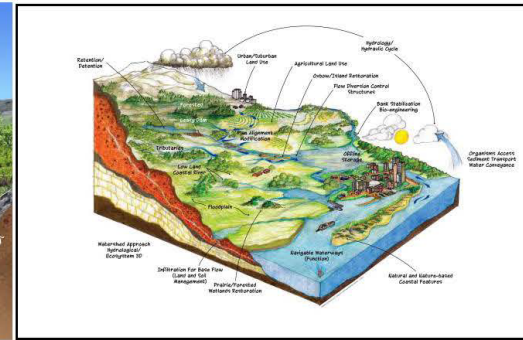
Naturalization of Channel Design

Benefits/Processes

- reduced frequency of maintenance on levee and restoration projects
- naturalization of flow regimes and floodplain reconnection
- ecological benefits to floodplain habitat
- reduction in erosion/scour and O&M costs
- increased recreational, cultural, and educational opportunities

Performance Factors

- type of practice determines hydrologic loading
- practice determines options for improved hazard mitigation, erosion control, and streambed and bank stability
- collaboration with stakeholders and other Federal agencies
- sediment management options



Watershed Treatments

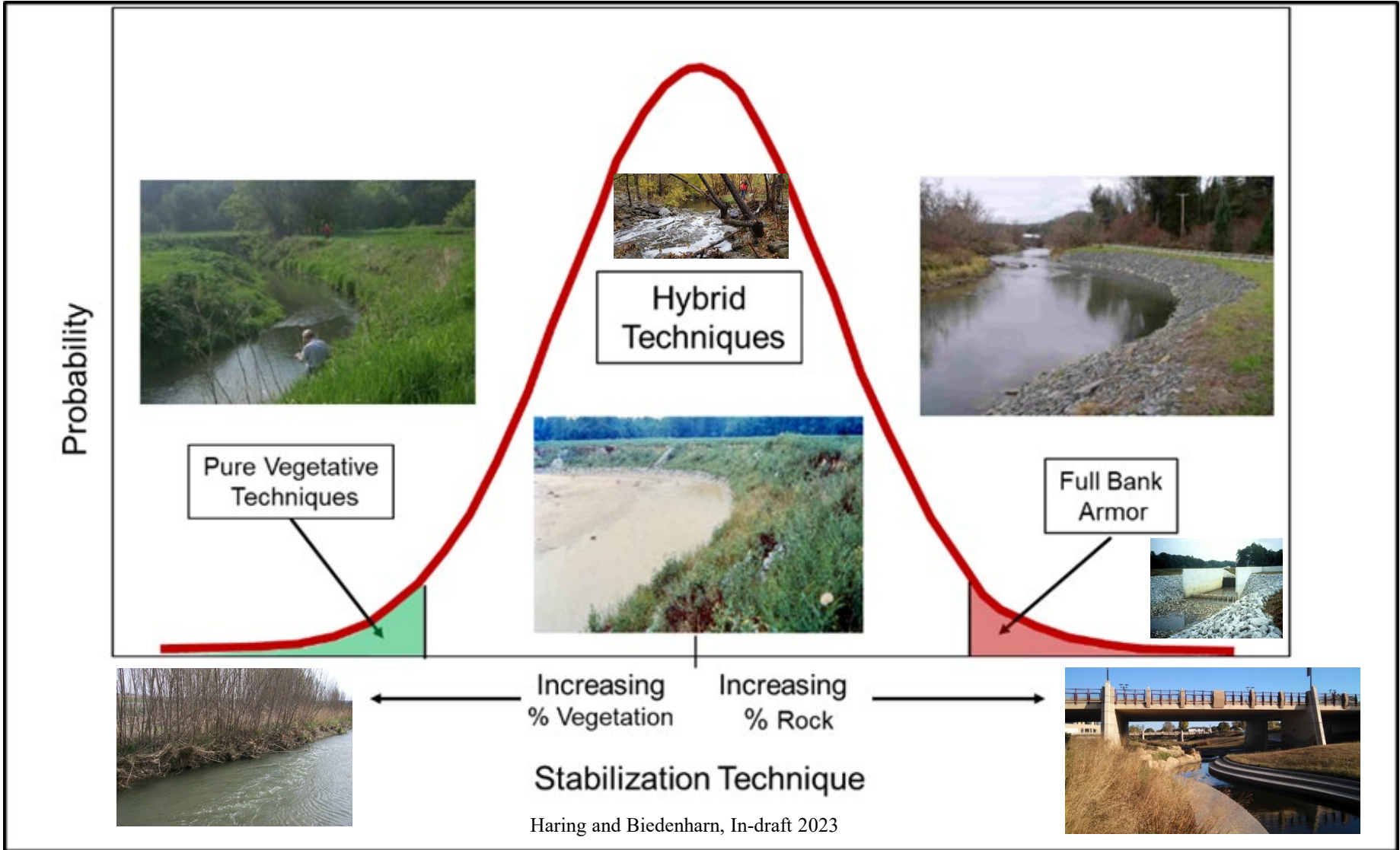
Benefits/Processes

- naturalization of hydrologic watershed regimes
- reduced navigational maintenance
- reduction in O&M costs
- increased recreational, cultural, and educational opportunities
- reduced frequency of maintenance and repair on levee and restoration projects

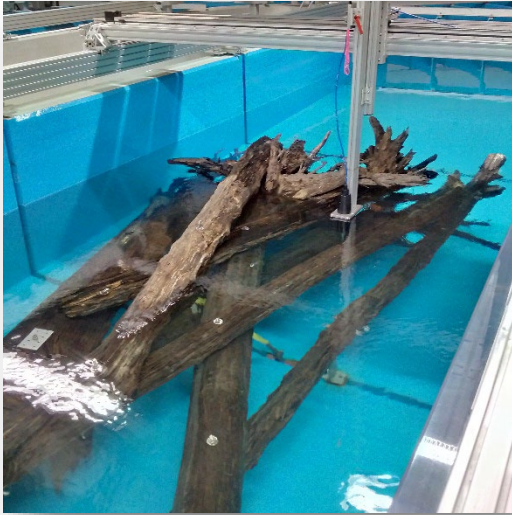
Performance Factors

- watershed management options determine effects on hydrologic loading
- practice options for improved hazard mitigation, upland erosion control, and groundwater recharge
- sediment management options
- collaboration with stakeholders and other Federal agencies

NATURAL & NATURE BASED FEATURES SCALE (NNBF)



NNBF AND NATURAL MATERIALS





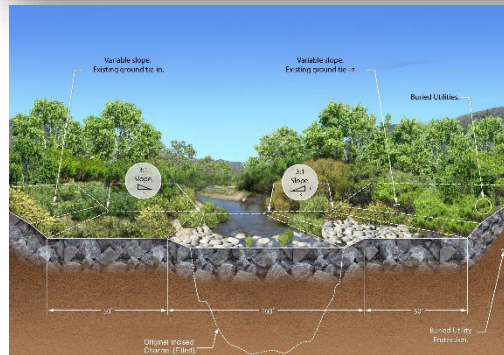
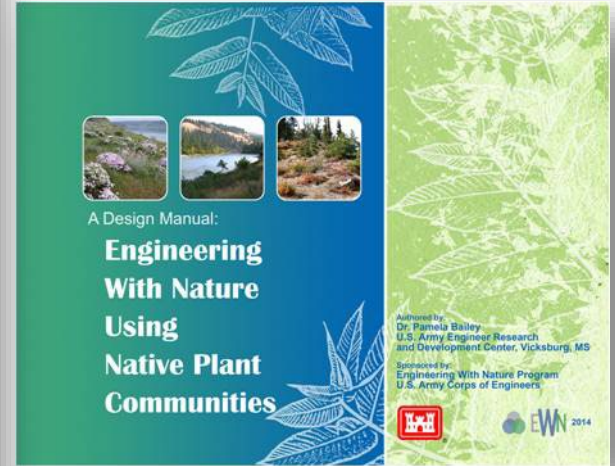
National Large Wood Manual

Assessment, Planning, Design, and Maintenance of Large Wood in Fluvial Ecosystems: Restoring Process, Function, and Structure

January 2016





 U.S. Department of the Interior
 Bureau of Reclamation
 US Army Corps of Engineers
 Engineer Research and Development Center



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NNBF – TO RESTORE NATURAL PROCESSES REVETMENT & VEGETATIVE APPLICATIONS



Existing Condition: Copperas Creek



Construction: Hells Branch



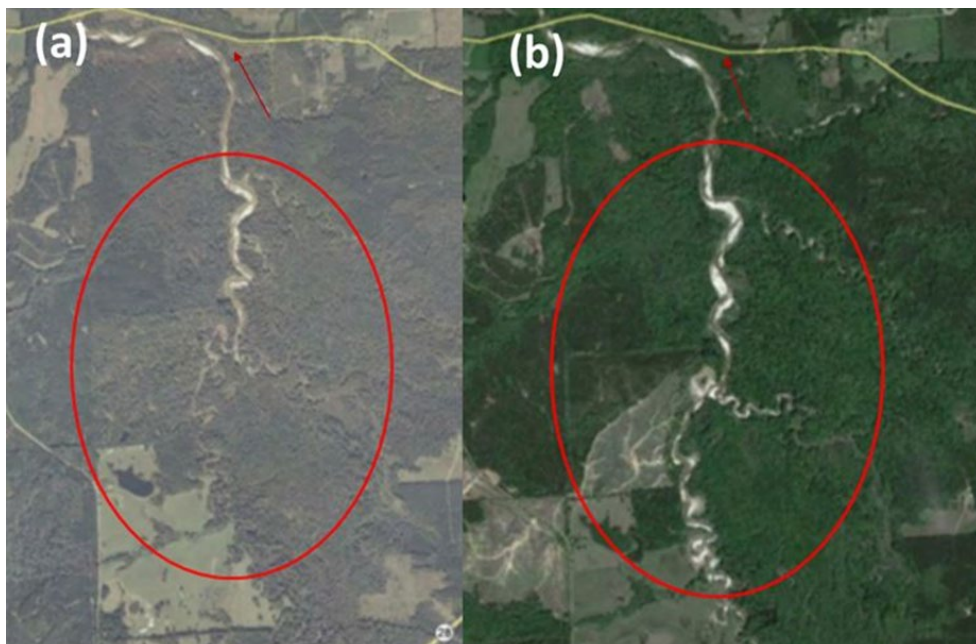
Post Project Stabilization: Copperas Creek



Post Project Stabilization: Hells Branch

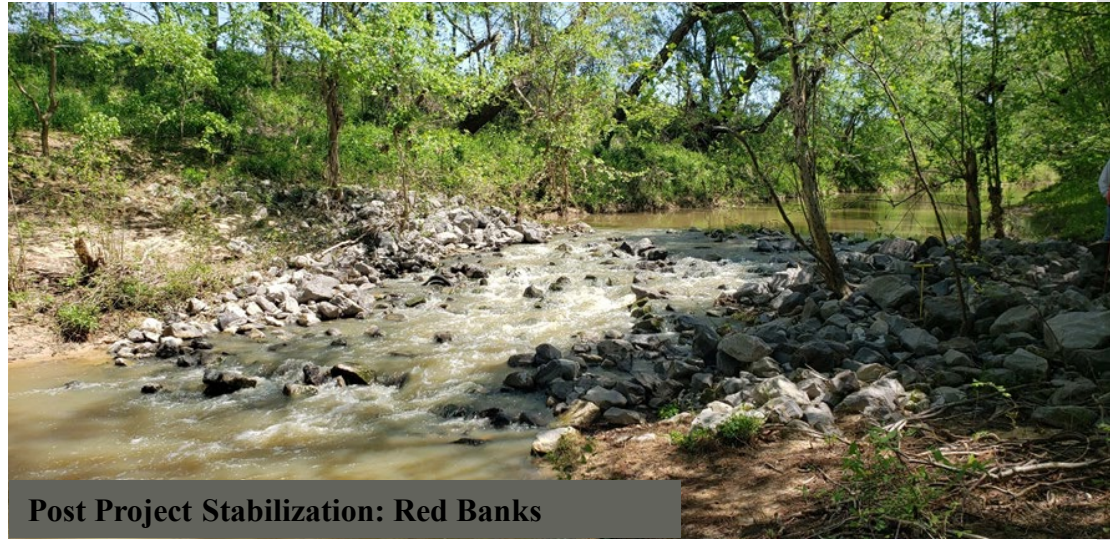


NNBF - RESTORE NATURAL PROCESSES TO DEGRADING CHANNELS



US Army Corps of Engineers • Engineer Research and Development Center

NNBF - RESTORE NATURAL PROCESSES WITH GRADE CONTROL



Post Project Stabilization: Red Banks

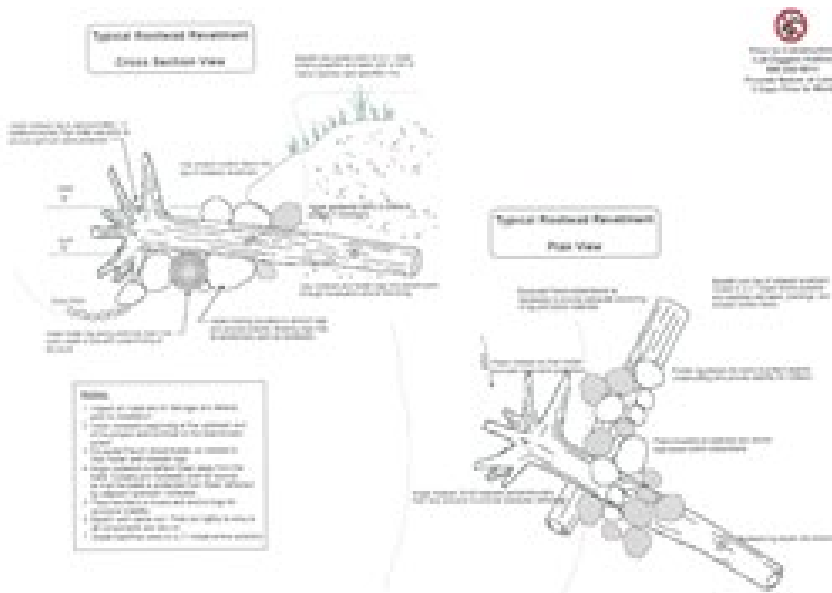


neers



Post Project Stabilization: Red Banks

NNBF - RESTORE NATURAL PROCESSES WITH VEGETATION & REVETMENTS



NNBF WILDFIRE RECOVERY: USACE ALBUQUERQUE DISTRICT SANTA CLARA PUEBLO WATERSHED

Producing Efficiencies



Working with natural processes using local materials to stabilize the watershed and stream channels; reduced time and cost of importing materials, ecological and aesthetics benefits.

Using Natural Processes



Uses local material in system vs. introducing riprap; placement of materials in situ with native vegetation to re-establish natural channel tendencies.

Broadening Benefits



New options to place existing materials; habitat created; restoration of channel and reduction of sediment delivered to channels and reservoirs.

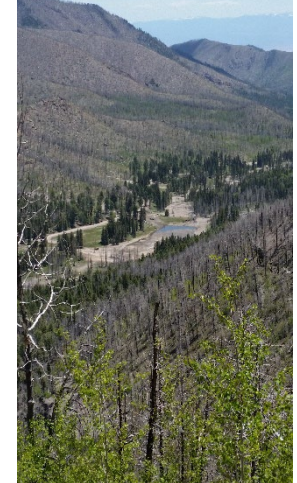
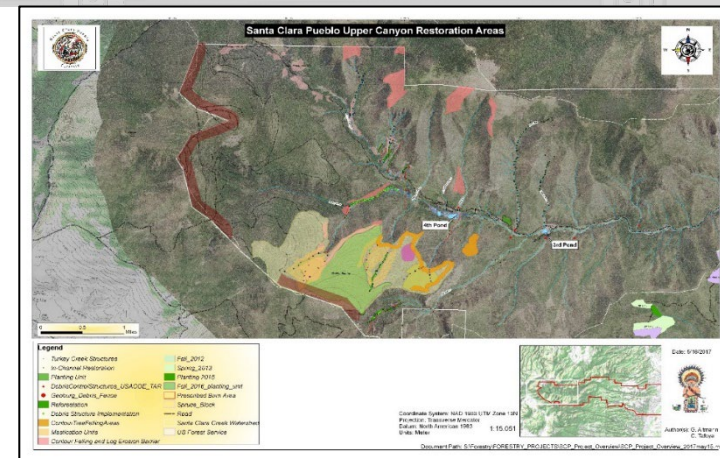
Promoting Collaboration



Partnering with Santa Clara Pueblo, USGS, USFS, BIA, NMDOT, and NRCS

R&D: Implement, study and long-term performance of NNBF; Offers opportunities to determine appropriate performance metrics aligned with ecosystem and engineering services.

*Initial Funding from 2017 Dredging Operations Tech Support (DOTS)



Structures



NNBF – TO RESTORE NATURAL PROCESSES (TEK)

- Traditional Ecological Knowledge
- Wetland & Erosion Control
- Bottomless Culvert



Post Wildfire Watershed Restoration for Flood Risk Management (FRM)



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Special Series

Using Engineering With Nature® (EWN®) principles to manage erosion of watersheds damaged by large-scale wildfires

Christopher P. Haring,¹ Garrett L. Altmann,² Burton C. Suedel³ and Stephen W. Brown⁴

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²Santa Clara Pueblo, Forestry Department, Espanola, New Mexico, USA

³US Army Engineer Research and Development Center, Vicksburg, Mississippi, USA

⁴US Army Corps of Engineers-Albuquerque District, Albuquerque, New Mexico, USA

EDITOR'S NOTE:

This article is part of the special series "Ecological consequences of wildfires." The series documents the impacts of large-scale wildfires in many areas of the globe on biodiversity and ecosystem condition in both terrestrial and aquatic ecosystems, the capacity for systems to recover, and management practices needed to prevent such destruction in the future.

Abstract

The US Army Corps of Engineers (USACE) manages hundreds of reservoirs and thousands of miles of navigation channels that provide invaluable flood control, commercial transport of materials, water supply, recreation, and stream flow regulation. This capability is being threatened by the continued occurrence of large-scale wildfires across the western United States. The wildfires damage watersheds in part by denuding landscapes, reducing infiltration rates, and increasing runoff rates, thereby dramatically increasing the potential for the erosion of denuded slopes, destabilizing stream channels, increasing the infling potential of reservoirs and, hence, reducing their capacity. The increased erosion rates highlight the need to develop innovative solutions to reduce erosion of watersheds laid bare after wildfires engulf the area. The Santa Clara Pueblo in northern New Mexico extends from the top of the eastern Jemez Mountains to the floodplains of the Rio Grande River. The Pueblo designed and constructed thousands of structures built from natural materials, consistent with Engineering With Nature (EWN) principles for erosion control incorporating low-cost and readily available materials such as logs, mulch, vegetation, and local rock to stabilize highly erodible parts of the watershed. The watersheds where these natural structures were constructed were monitored after construction to assess their effectiveness, guiding a series of recommendations for broader implementation. As part of a continued emphasis on updating USACE engineering guidance, research, and development, funding has been focused on developing sustainable and resilient project designs using natural materials like those implemented by the Santa Clara Pueblo. This paper focuses on the innovative EWN-based watershed stabilization practices that were implemented in the upper section of this wildfire affected canyon and tributary streams. Recommendations for future implementation based on lessons learned from the project are also provided. *Integr Environ Assess Manag* 2021;00:1-9. Published 2021. This article is a US Government work and is in the public domain in the USA.

KEYWORDS: Equity, Las Conchas Wildfire, Nature-based solutions, Reservoir, Santa Clara Pueblo

INTRODUCTION

The US Army Corps of Engineers (USACE) manages hundreds of reservoirs and thousands of miles of navigation channels that provide invaluable flood control, commercial transport of materials, water supply, recreation, and stream flow regulation. This capability is being threatened by the

continued occurrence of large-scale wildfires across the western United States. The wildfires damage watersheds in part by denuding landscapes and destabilizing stream networks, thereby dramatically increasing the potential for erosion of denuded slopes, hence increasing the infling potential of reservoirs and reducing their capacity. The reduced reservoir capacity decreases the availability of drinking water and increases the management costs of having to dredge the reservoirs to restore that capacity. The increased erosion rates highlight the need to develop innovative solutions to reduce erosion of watersheds, laid bare after wildfires engulf the area, and to reduce threats to mission capability.

This article contains online-only Supporting Information.

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Published 18 May 2021 on onlinelibrary.wiley.com/journal/1151

NNBF TO RESTORE NATURAL PROCESSES

- ❑ Wood structures
- ❑ Rock onsite
- ❑ Combination



NNBF - SHORELINE EROSION CONTROL PROJECTS



Existing Condition

Reservoir
Sedimentation and
Sustainability
(ERT 21-12)

2017 NRL Moutardier
Point Bank Stabilization
Project



**Constructed
Project**



Construction



Post Project Stabilization

NNBF - SHORELINE EROSION CONTROL PROJECTS



Reservoir
Sedimentation and
Sustainability
(ERT 21-12)

New Bank Stabilization
Application Projects at
Nolin River Lake, KT

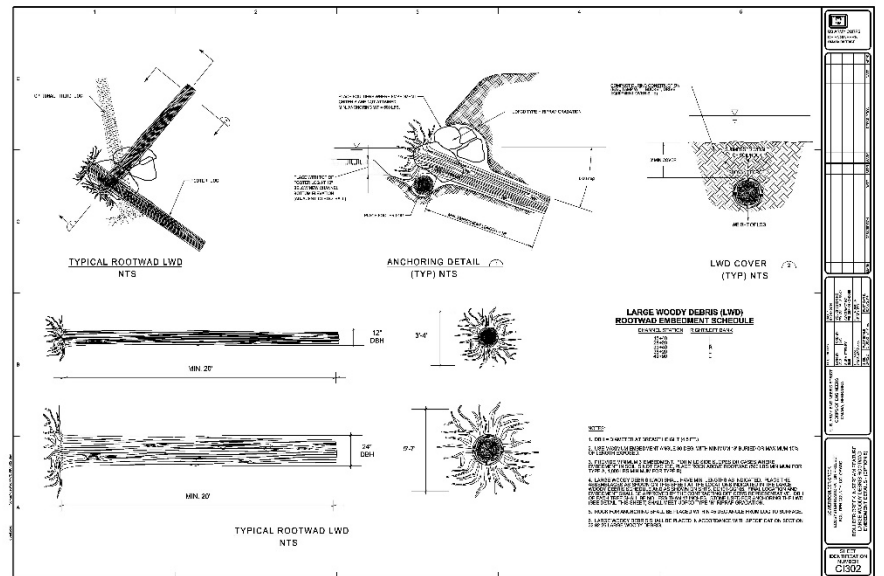
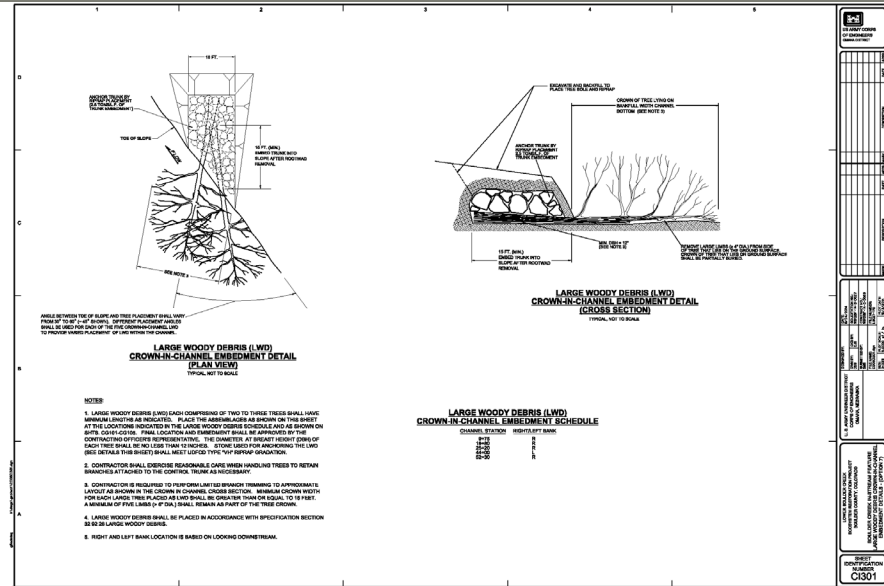


BUILDING STRONG®



Innovative solutions for a safer, better world

NNBF - FLOODPLAIN RECONNECTION BOULDER CREEK PROJECT



NNBF - FLOODPLAIN RECONNECTION BOULDER CREEK PROJECT



Existing Condition



Construction



Post Project Stabilization



Post Project Stabilization



NNBF – NACHUSA GRASSLANDS WETLAND RESTORATION PROJECT



TNC-Nachusa Grasslands
Wetland Restoration Site Map
Ogle County, Illinois



TNC - Nachusa Grasslands/Wetlands



TNC - Nachusa Wetlands



<https://www.nature.org/en-us/newsroom/returning-buffalo-to-tribal-lands/>

BUILDING PROGRESS

- Expand the “vision” to diversify project benefits
- Increase collaboration and cross-sector partnerships
- Commit to innovation
- Pursue realistic and affordable projects
- Document the value created
- Coordinate communication across partnering organizations for maximum impact



NATURAL AND NATURE-BASED FEATURES (NNBF) STREAMBANK MANUAL

Purpose: Provide engineering guidelines for using NNBF to increase function to flood risk management and water resource projects while producing additional economic, environmental and social benefits.

- NNBF Manual Release scheduled for mid-2026:
 - ▶ USACE led document with partner inputs.
 - ▶ Addressing new applications design concepts
 - Inland Fluvial Applications focused



US Army Corps
of Engineers®



<https://usace.dps.mil/sites/INTRA-CHL/SitePages/Streambank%20and%20Channel%20Stabilization.aspx>



Questions



<https://ewn.erdcdren.mil/>

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