

The N-EWN Knowledge Series

A Continuing Education Series about Engineering with Nature



Christopher Haring, PhD, PG, CFM
Research Physical Scientist
USACE Engineer Research and Development Center
River Engineering Branch – Coastal Hydraulics
Laboratory

Natural and Nature-Based Features (NNBF) for Inland Fluvial Restoration

Engineering With Nature (EWN®) and Natural and Nature-Based Features (NNBF) is a principal component to the U.S. Army Corps of Engineers (USACE) inland fluvial watershed, Flood Risk Management (FRM), Regional Sediment Management (RSM), and Ecosystem Restoration portfolio of programs. In a memo dated April 2024, the USACE Headquarters required all future USACE water resource projects to investigate and incorporate NNBF approaches. This includes applying NNBF approaches to studies, alternative analysis, design, construction, operation and maintenance, and adaptive management. This presentation will provide information and newly developed guidance addressing watershed studies, FRM, RSM, and ecosystem restoration projects.

Save the date!

Upcoming webinars will take place the 3rd Thursday of the month.

Feb. 20
12:30pm ET

Dr. Christopher Haring, US Army Corps of Engineers
Natural and Nature-Based Features (NNBF) for Inland Fluvial Restoration

Mar. 20
12:30pm ET

Mary-Margaret S. McKinney, Native Shorelines, a Davey Company
Leveraging Partnerships for Living Shoreline Implementation at Scale

Apr. 17
12:30pm ET

Glen Delaney & Carson Risner, Earth Economics
Making the Case for Nature-Based Solutions: Ecosystem Services, Benefit-Cost Analyses, and Storytelling

Register here: <https://bit.ly/3gR9ADL>

or scan:



1 Continuing Education Credit (CEC) is available to attendees

Recorded webinars will be posted online at: <https://n-ewn.org/resources/n-ewn-knowledge-seminars/>

Presented by:



Questions? Please contact:
Sage Paris, LimnoTech
sparis@limno.com



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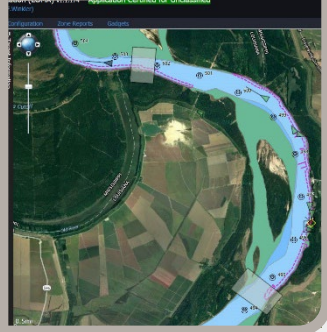
U.S. ARMY

N-EWN Knowledge Series: Natural and Nature Based Features (NNBF) for Inland Fluvial Restoration



N-EWN & ENGINEERING WITH NATURE® (EWN)

NNBF-STREAMBANK MANUAL PROJECT
FLOOD & COASTAL SYSTEMS PROGRAM

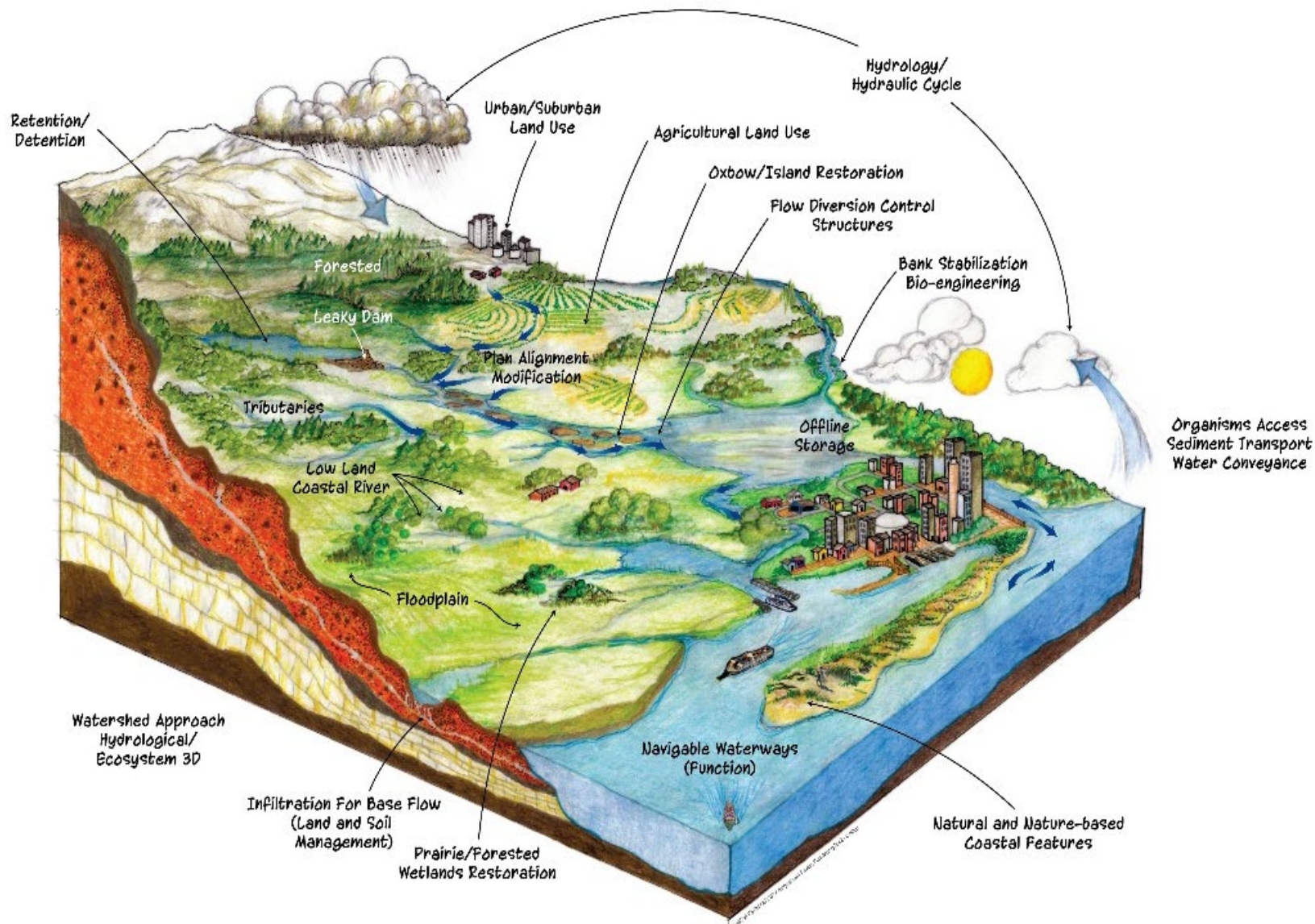


**US Army Corps
of Engineers**

Chris Haring, PhD, P.G., CFM
Engineering Research & Development Center (ERDC)
US Army Corps of Engineers

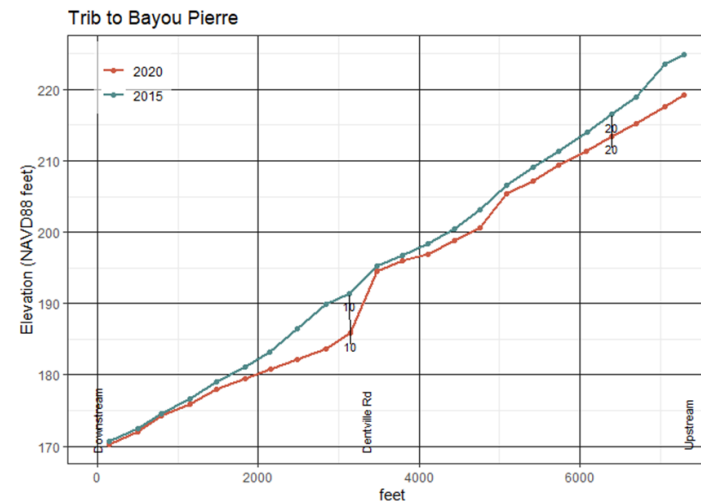
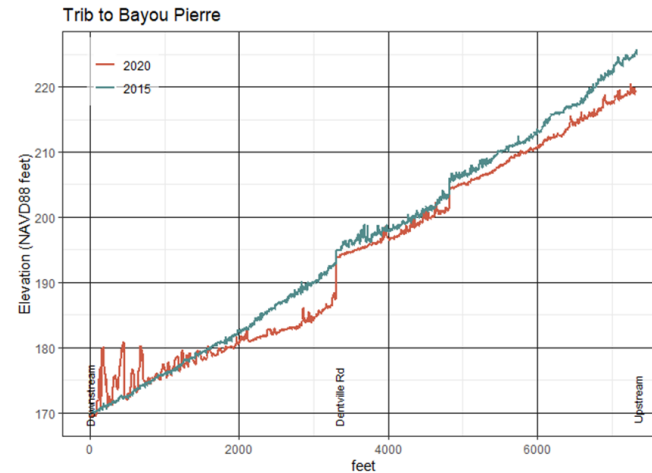
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NNBF: A SYSTEMS VIEW OF SOLUTIONS



SYSTEMS APPROACH TO WATERSHED ASSESSMENTS AND NNBF APPLICATIONS

FluvialGeomorph (FG) Profile and cross-sections: Bayou Pierre Tributary, west-central MS

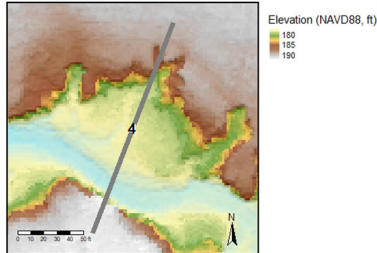


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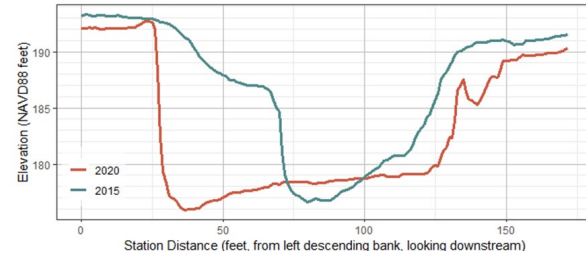
FG APPLICATIONS

Profile and cross-sections: Bayou Pierre Tributary, west-central MS

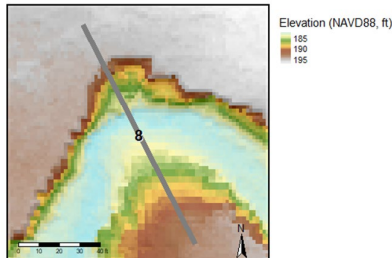
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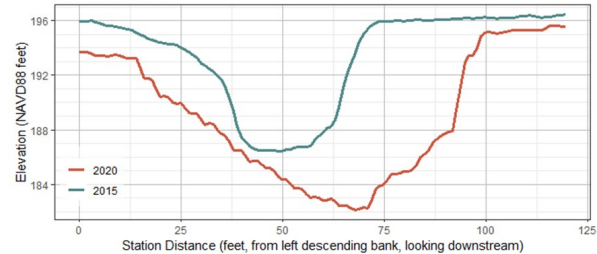
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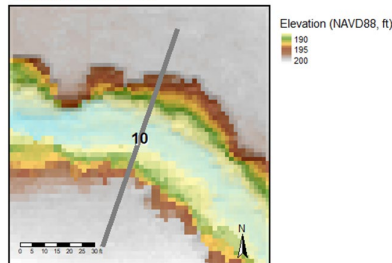
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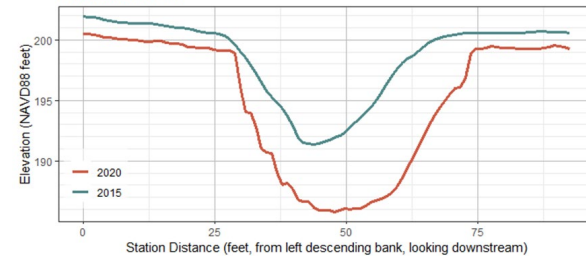
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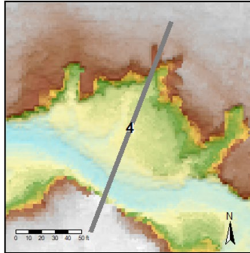
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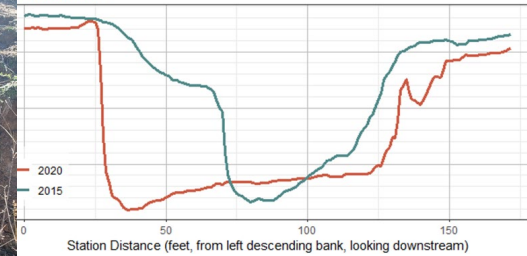
FG APPLICATIONS

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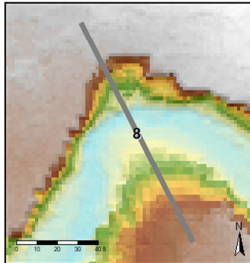
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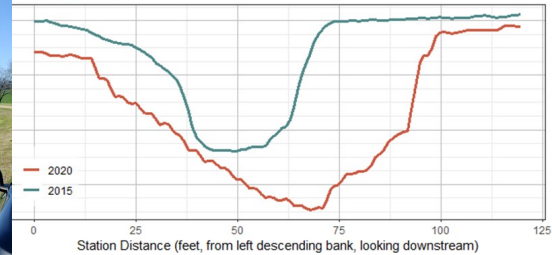
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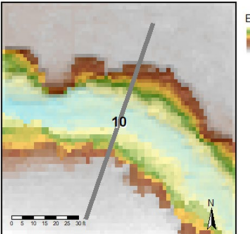
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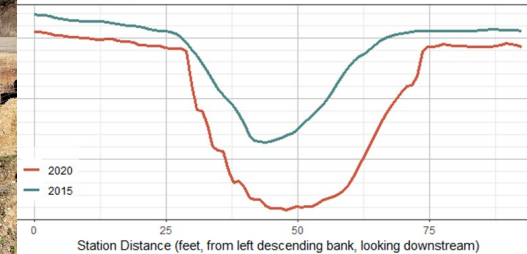
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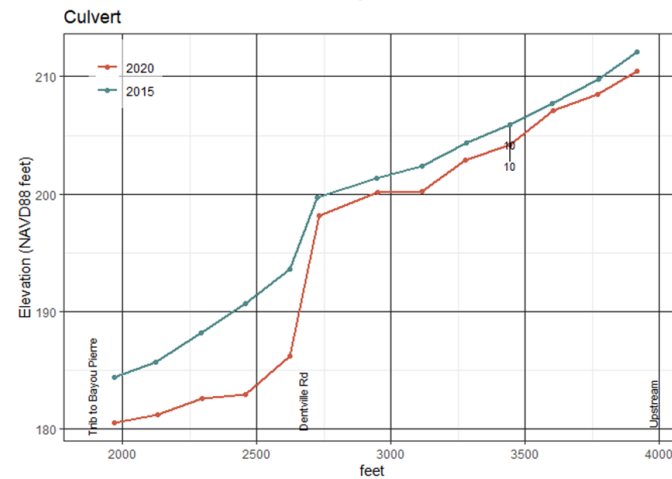
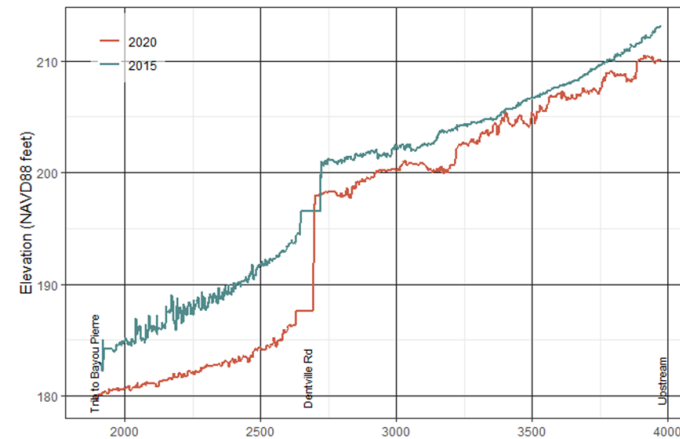
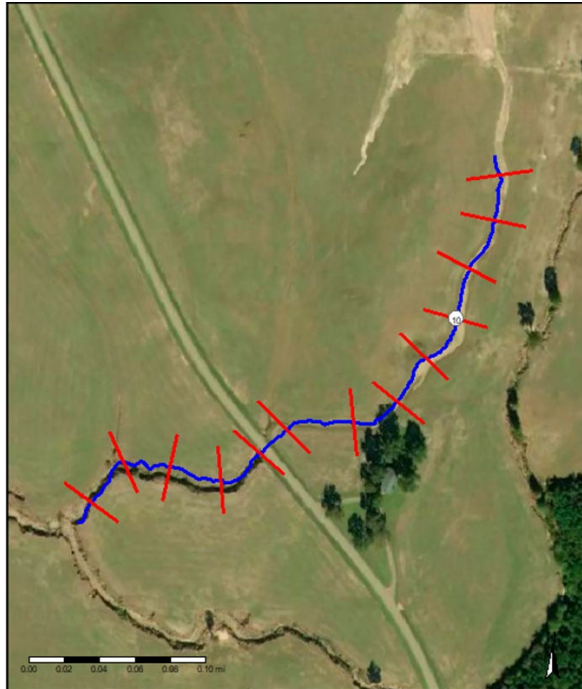


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FG APPLICATIONS

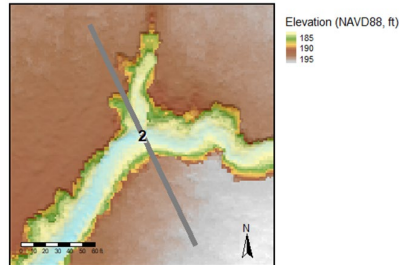
Profile and cross-sections: Bayou Pierre Tributary, west-central MS



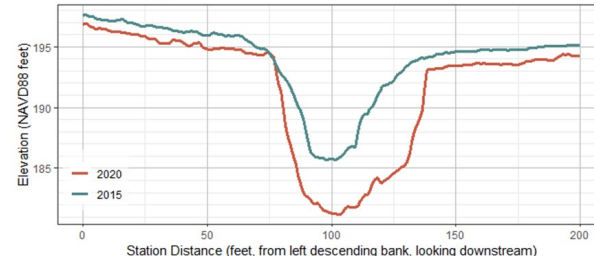
FG APPLICATIONS

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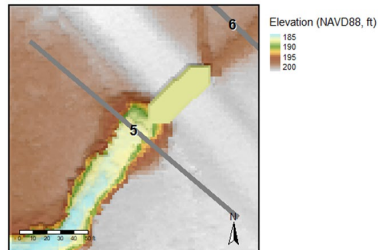
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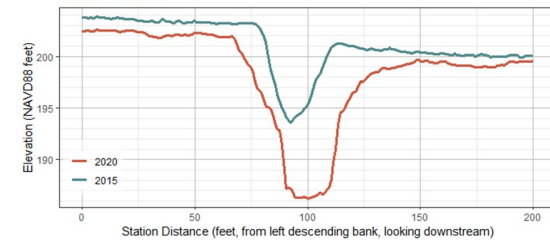
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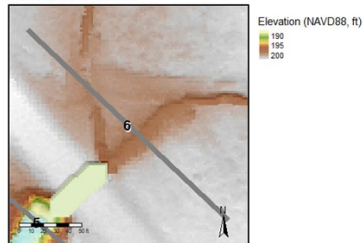
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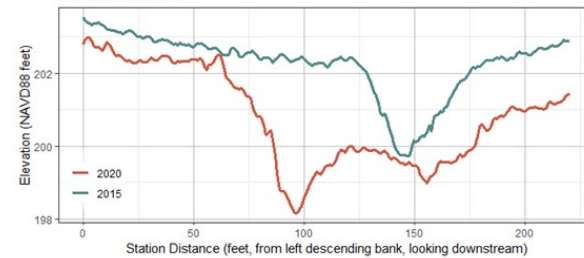
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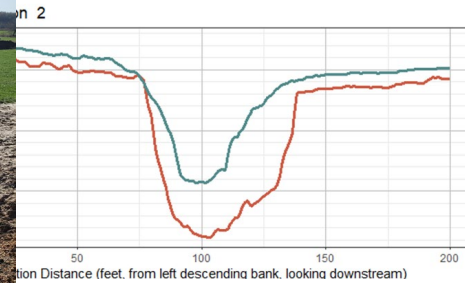
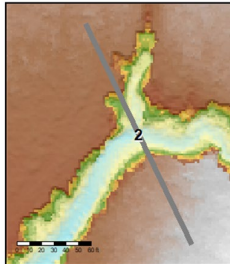
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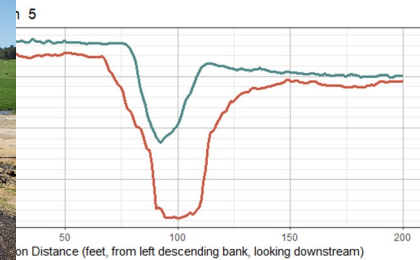
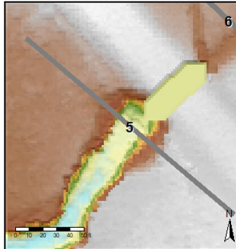
FG APPLICATIONS

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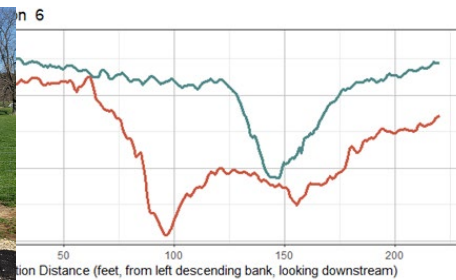
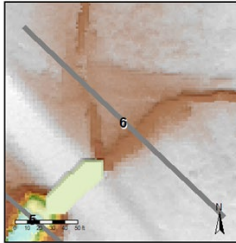
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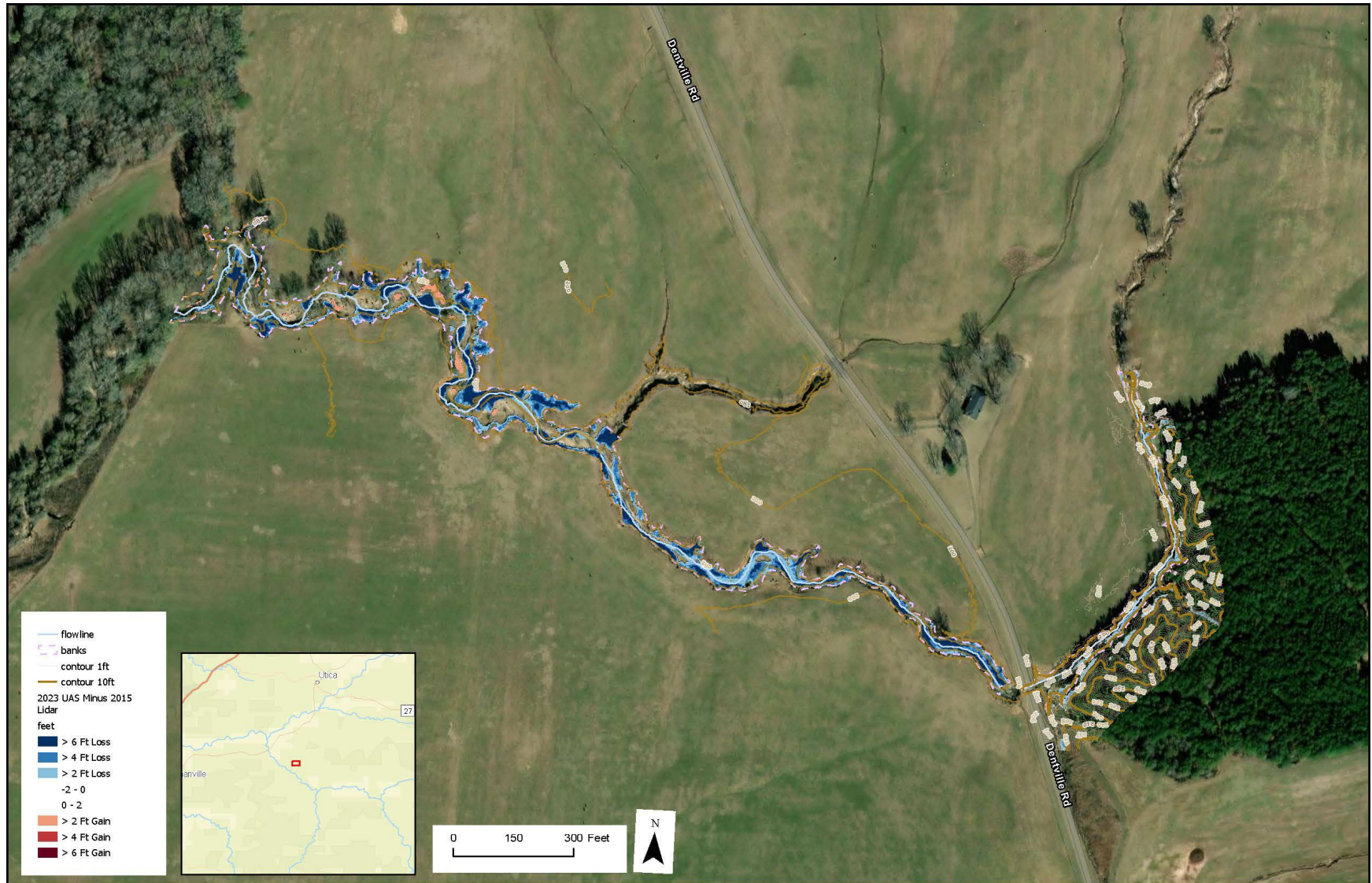


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FG APPLICATIONS

CHANGE DETECTION



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Functional Assessment

Stream functions described by Fischenich (2006)

System Dynamics

- Maintain stream evolution processes
- Energy management processes
- Provide for riparian succession

Geomorphology

- Sediment continuity
- Maintain substrates and structural processes
- Quality and quantity of sediments

Biology

- Support biological communities and processes
- Provide necessary aquatic and riparian habitats
- Maintain trophic structure and processes

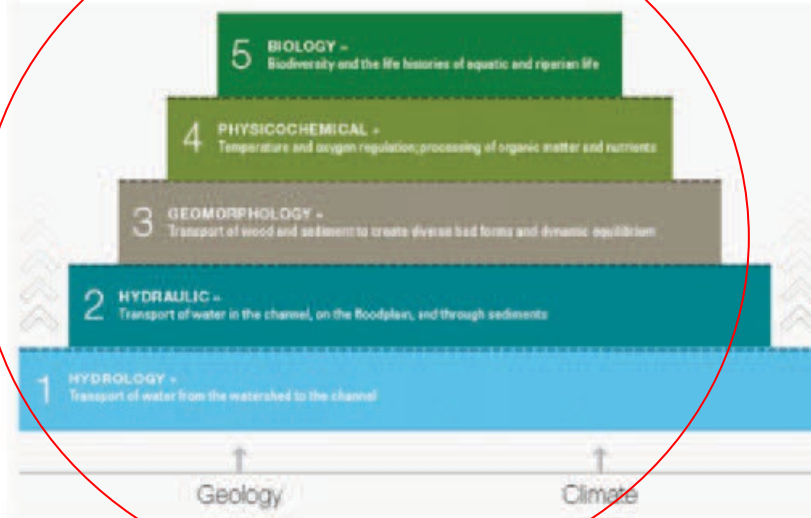
Hydrology

- Surface water storage processes
- Maintain surface/subsurface connections and processes
- General hydrodynamic balance

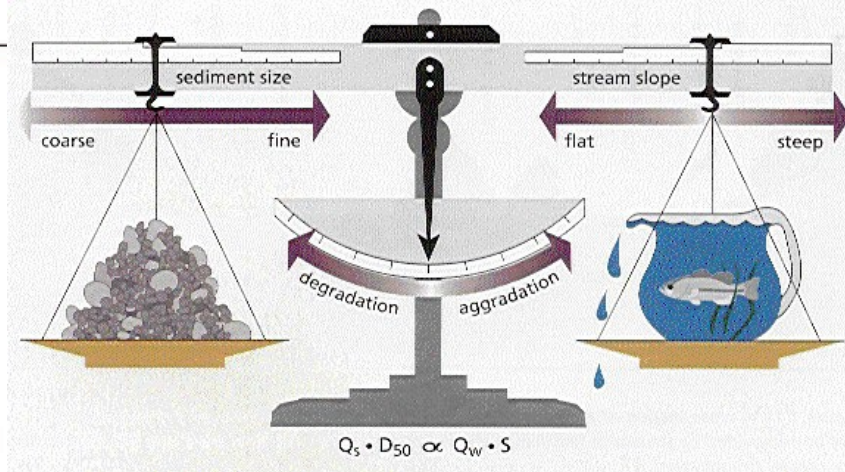
Physiochemical

- Maintain water and soil quality
- Maintain chemical processes and nutrient cycles
- Maintain landscape pathways

Stream functions pyramid from Harman et al. (2012)



LANES BALANCE



NNBF ENGINEERING PERFORMANCE



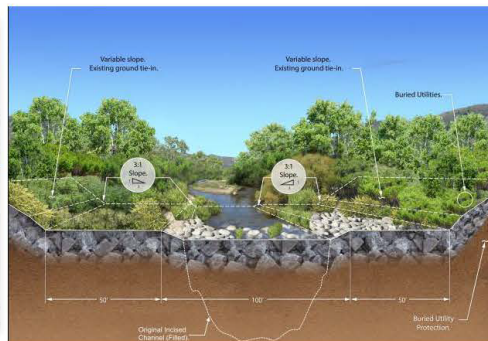
Levee Setbacks

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



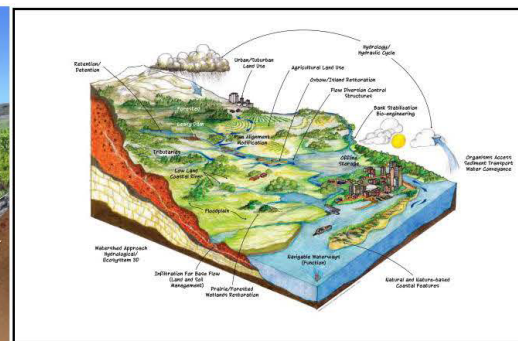
Naturalization of Channel Design

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

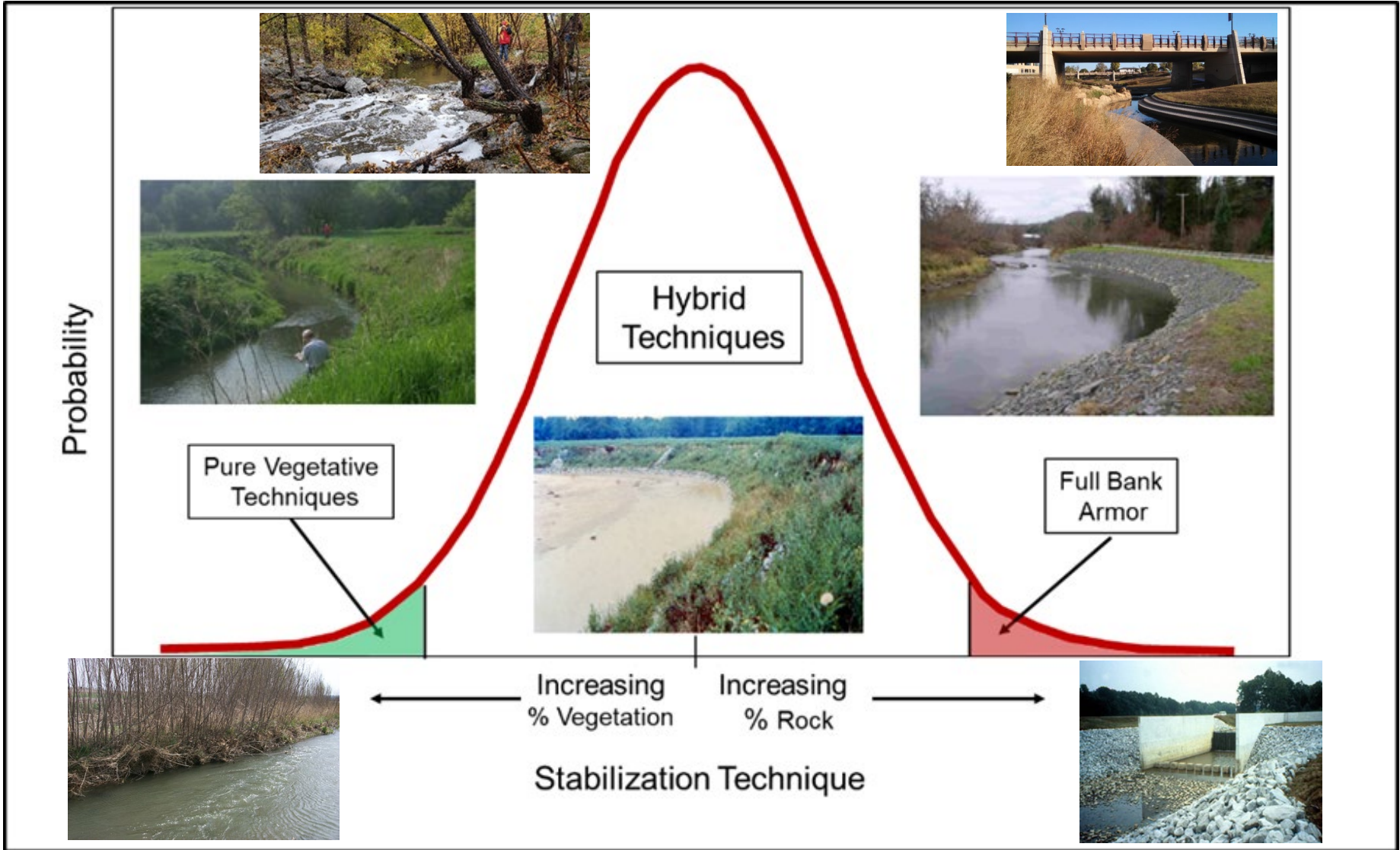
Benefits/Processes

- 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

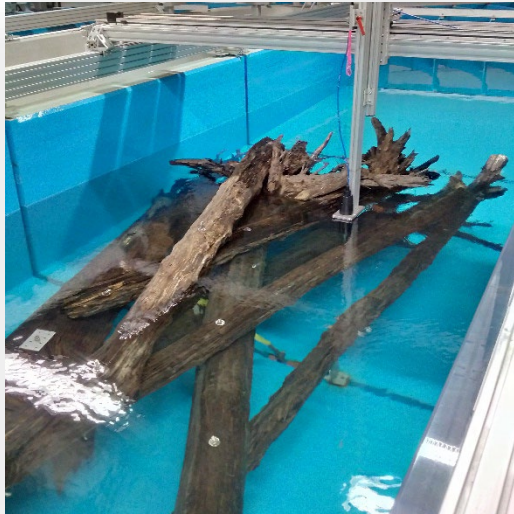
Performance Factors

- 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

NNBF APPROACH



NNBF AND NATURAL MATERIALS





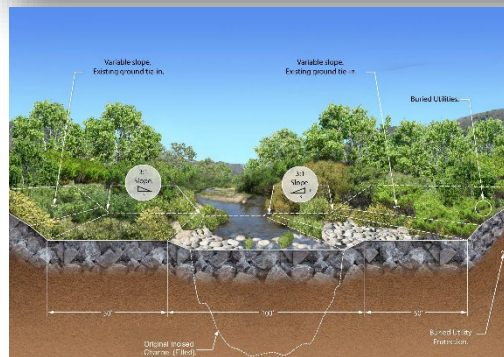
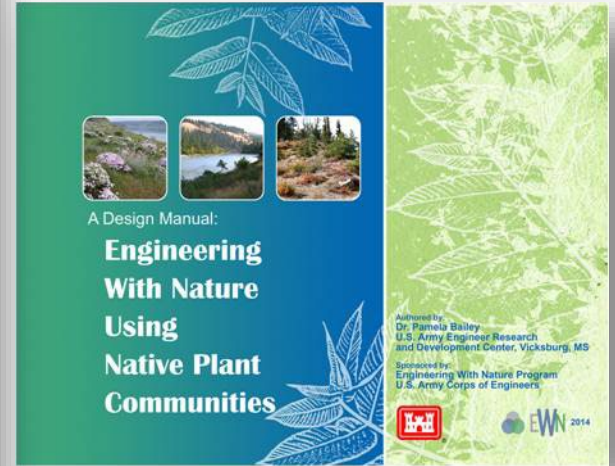
National Large Wood Manual

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

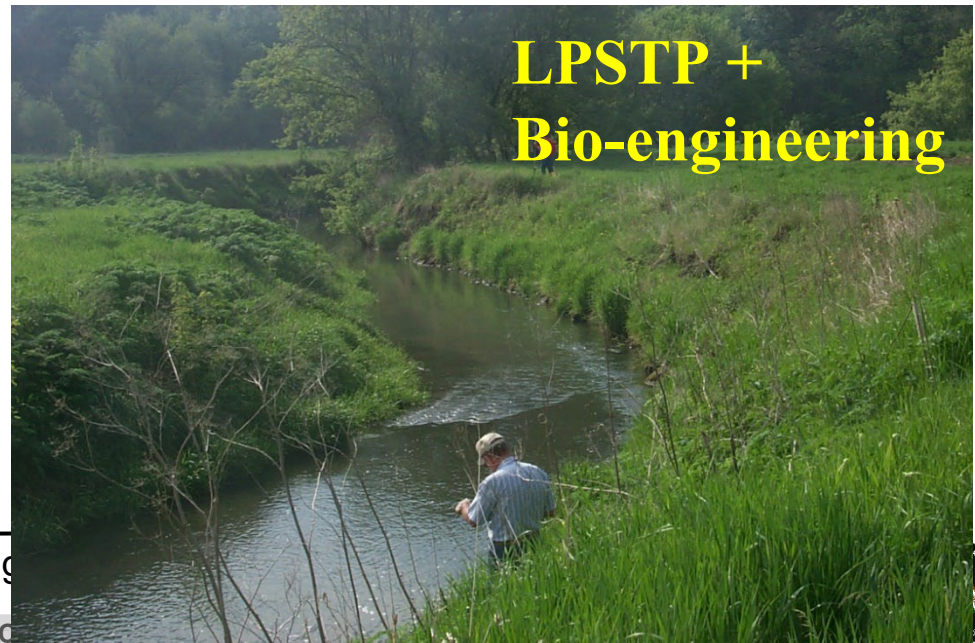
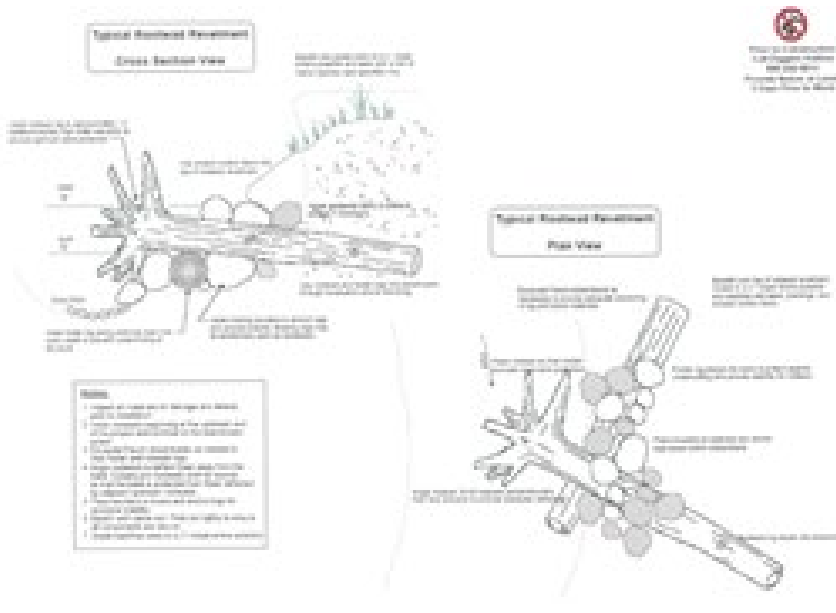


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VEGETATION & LIMITED TOE-PROTECTION TO RESTORE NATURAL PROCESSES



TOE PROTECTION TO RESTORE NATURAL PROCESSES



RE-DIRECTIVE AND BANK ALTS TO RESTORE NATURAL PROCESSES



Picture 29: The photo is taken standing on the bridge facing downstream after construction in May 2001.

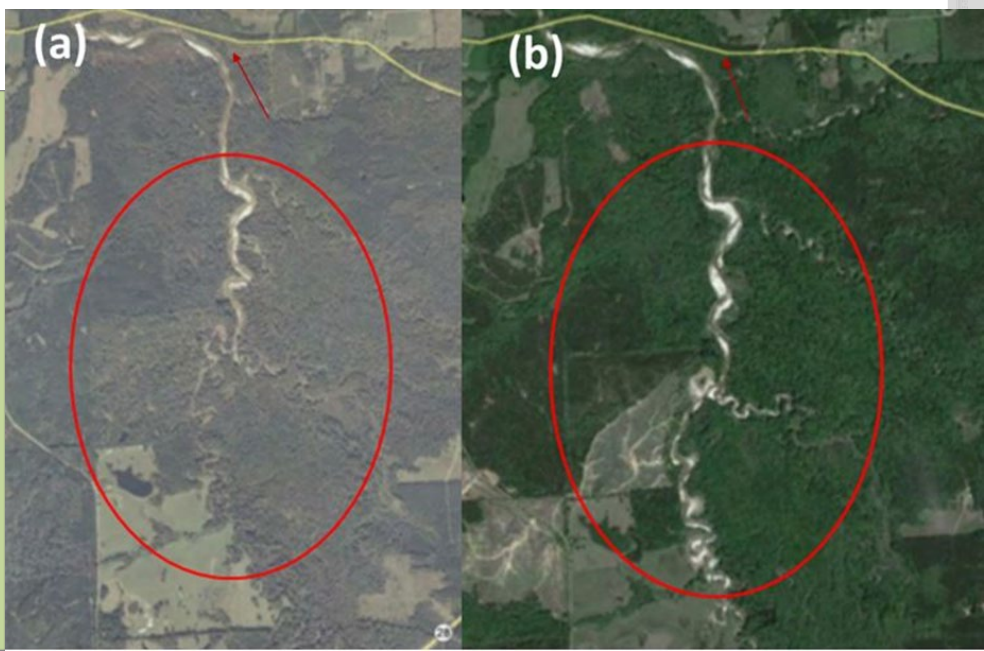
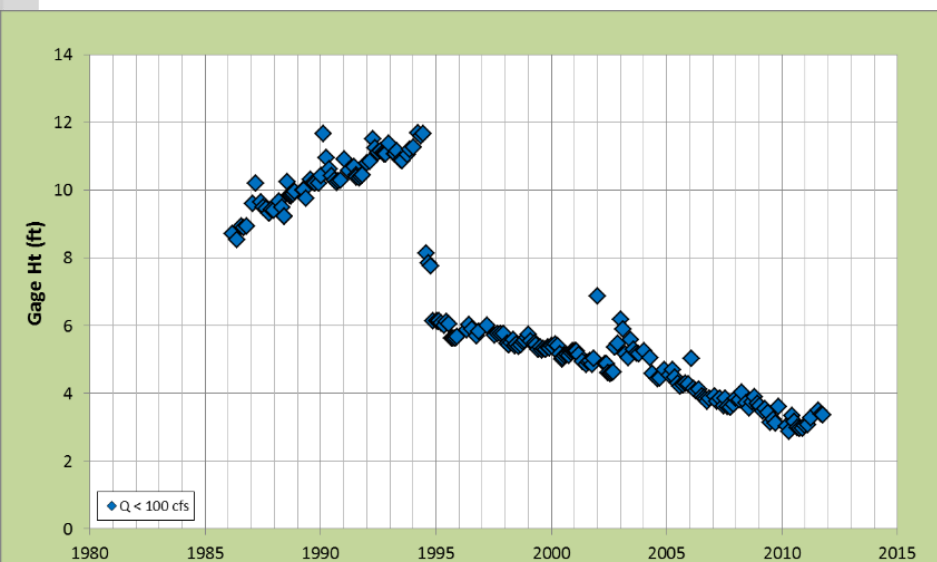
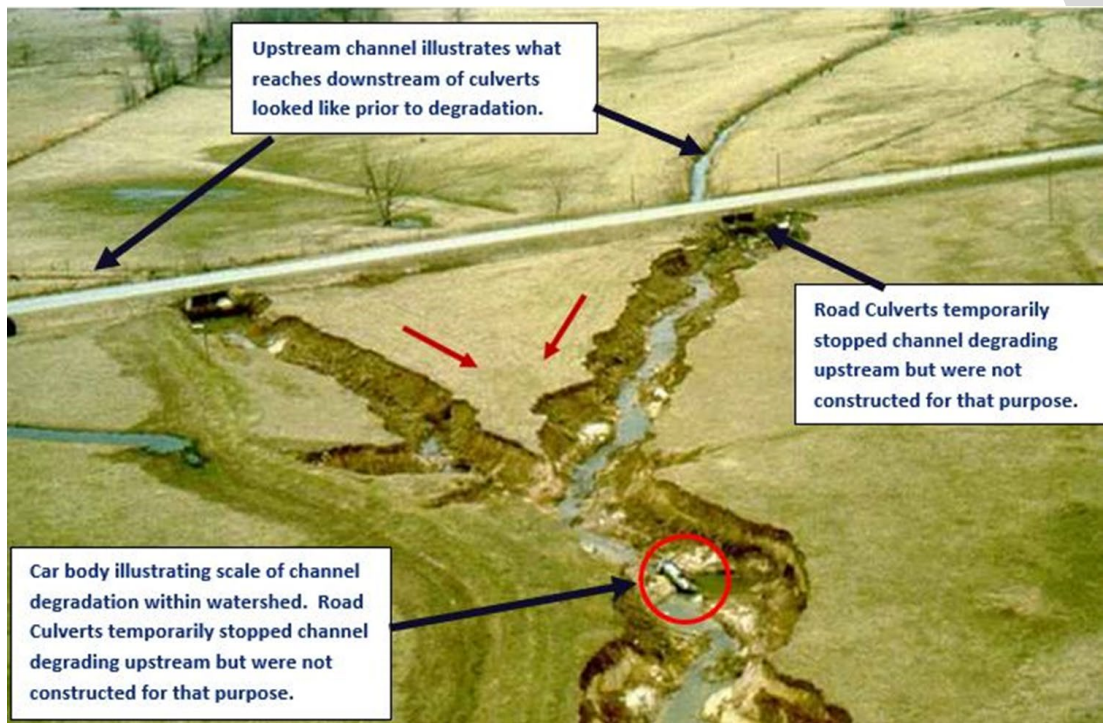


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UNCLASSIFIED



GRADE CONTROL TO RESTORE NATURAL PROCESSES TO DEGRADING CHANNELS

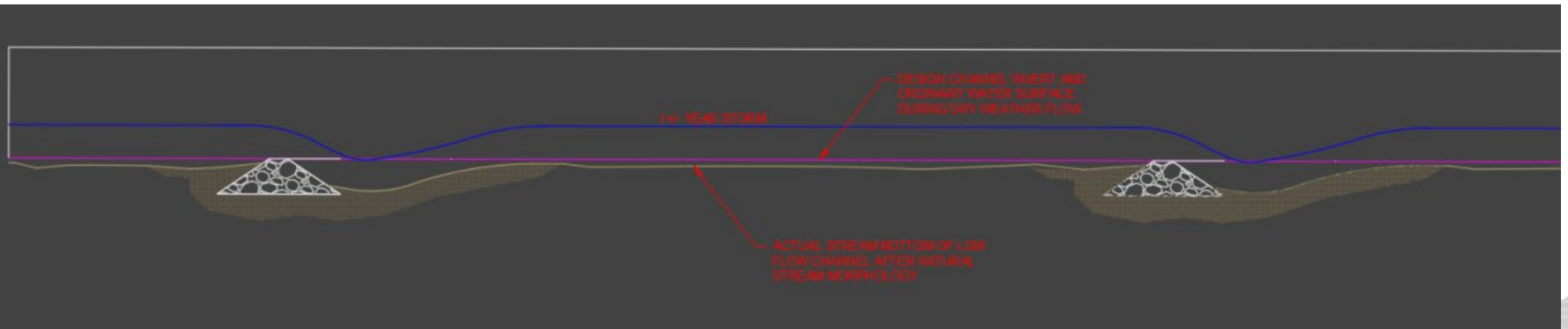
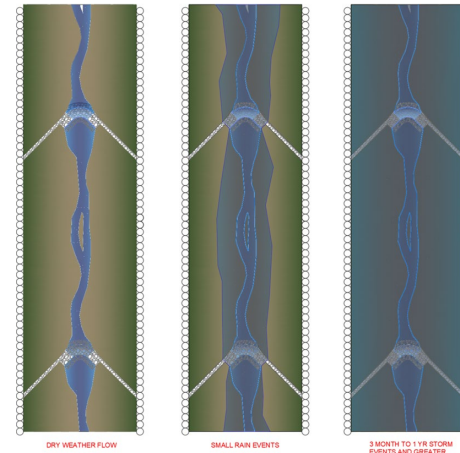
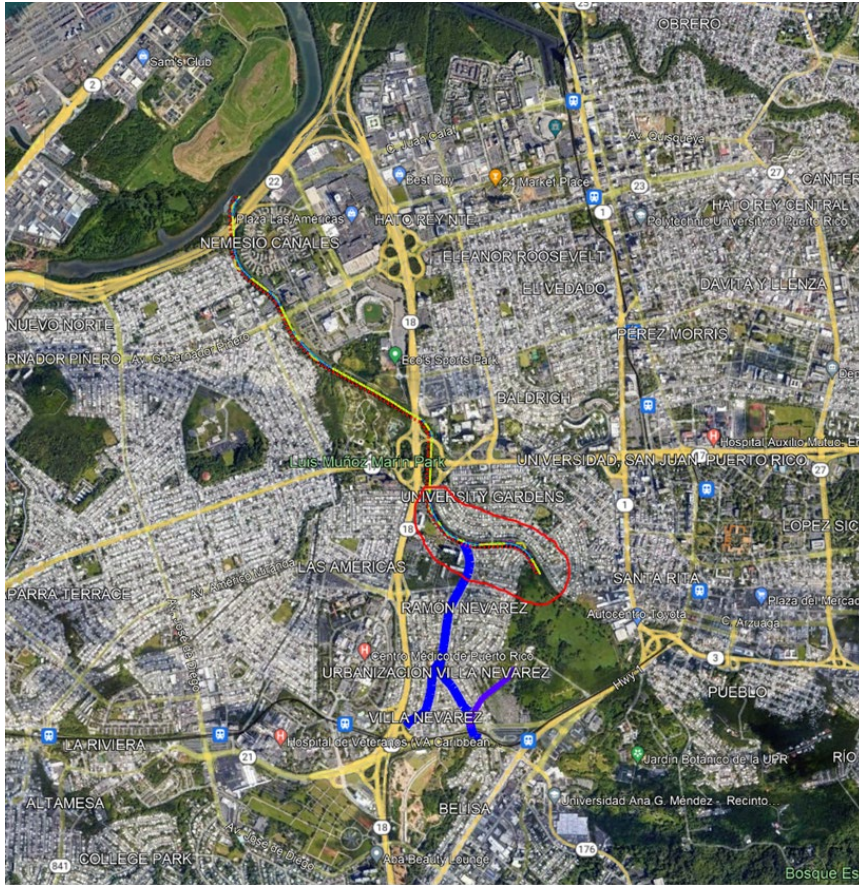


GRADE CONTROL TO RESTORE NATURAL PROCESSES



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GRADE CONTROL TO RESTORE NATURAL PROCESSES



GRADE CONTROL TO RESTORE NATURAL PROCESSES



Beaver Dam Analogy (BDA) Structures



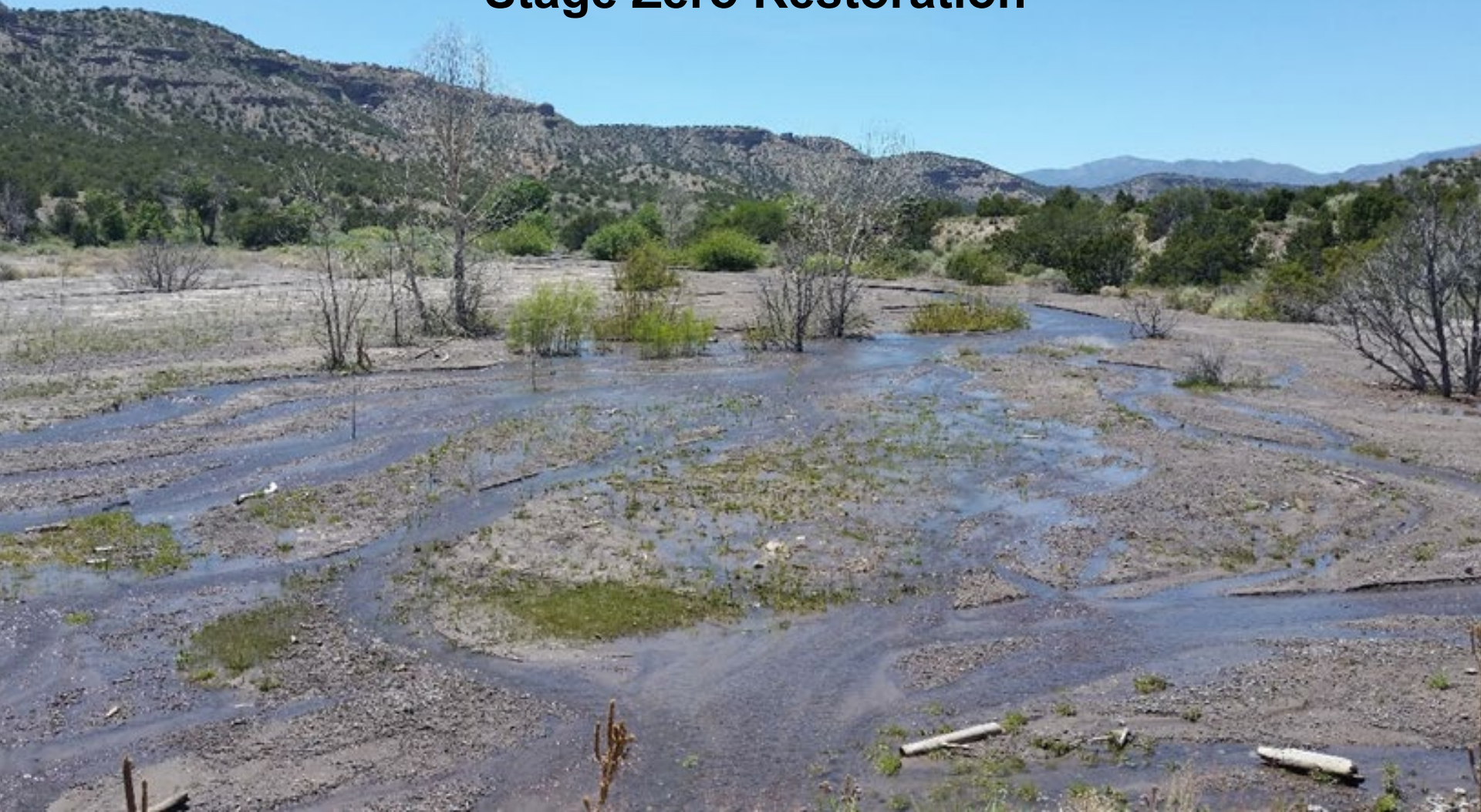


WILDFIRE RECOVERY: GRADE CONTROL TO RESTORE NATURAL PROCESSES



WILDFIRE RECOVERY: GRADE CONTROL TO RESTORE NATURAL PROCESSES

Stage Zero Restoration



WILDFIRE RECOVERY: TO RESTORE NATURAL PROCESSES

- Wetland & Erosion Control
- Bottomless Culvert
- Traditional Ecological Knowledge (TEK)



EWN FY22
Wildfire Recovery
(ERT 21-10)

ERDC

tions for a safer, better world

WILDFIRE RECOVERY: RESTORE NATURAL PROCESSES

- ❑ Wood, rock, vegetative structures
- ❑ Rock onsite
- ❑ Combination



RESERVOIR SUSTAINABILITY: TO RESTORE SHORELINE STABILITY



Existing Condition



Post Project Stabilization



Construction



Constructed Project



Post Project Stabilization

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RESERVOIR SUSTAINABILITY: TO RESTORE SHORELINE STABILITY



Additional Sites



Additional Sites



Construction with new materials



Vegetation management and new materials



Vegetation from Management areas to stabilize shorelines



Natural Bank Protection (Soil-Filled Riprap): To Restore Natural Processes



US Army Corps of Engineers • Engine



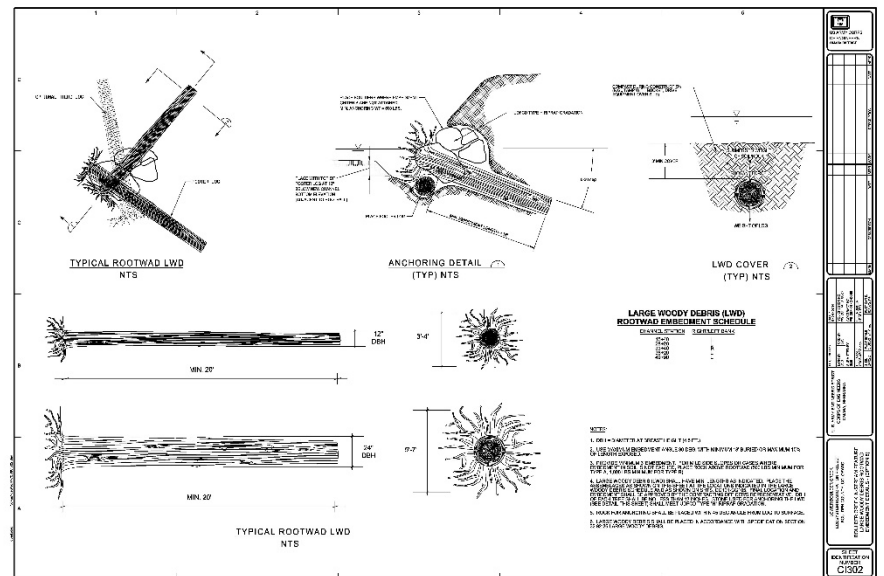
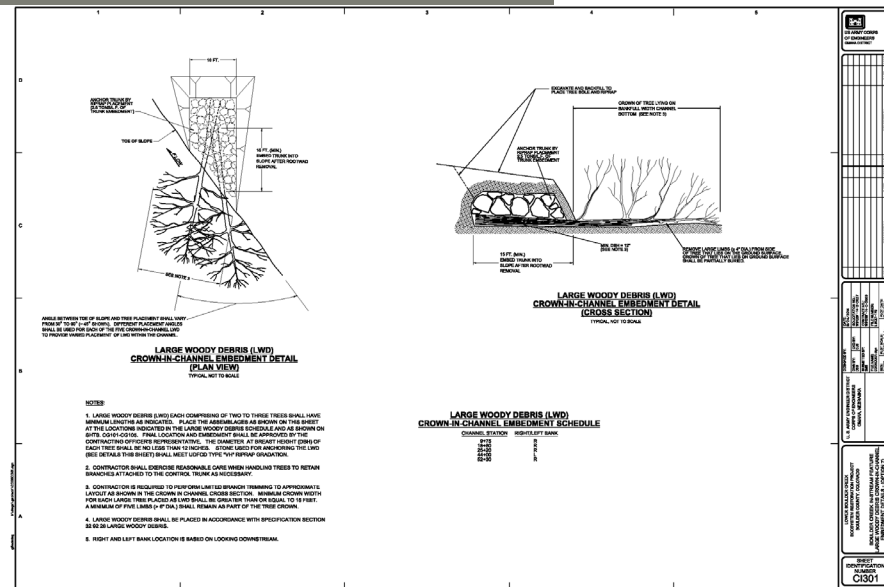
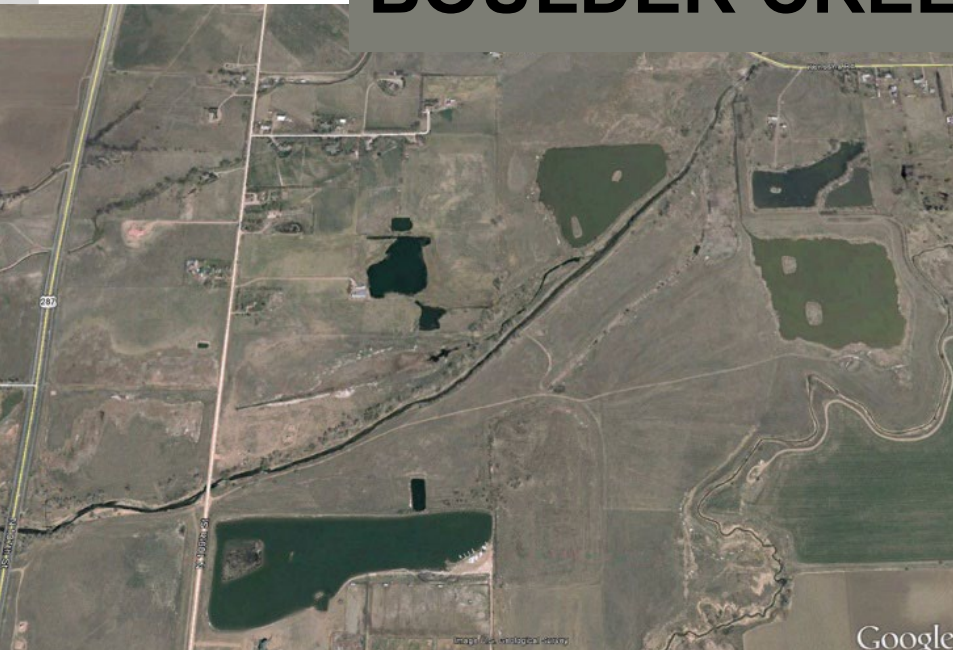
Floodplain Benching & Re-connection: To Restore Natural Processes

Floodplain Restoration Advantages

- Access of flows (Hydraulically reconnected)
- Areas for sediment deposition
- Dissipates flow energy
- Nutrient Recycling
- Reconnection (groundwater recharge)
- High quality riparian corridor: (>70% of all terrestrial species)
- Riparian corridor: to be fully functional need a large buffer width
- Aquatic species (flood flows)



FLOODPLAIN RECONNECTION BOULDER CREEK PROJECT



BOULDER CREEK PROJECT



AD TO RESTORE NATURAL PROCESSES



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

AM: ECOSYSTEM RESTORATION NATURAL PROCESSES



0 175 350 700 1,050 1,400 Feet





TNC - Nachusa Wetlands



TNC - Nachusa Wetlands



FUTURE FOCUS OF EWN-NNBF APPROACHES

ERDC-CHL RIVER ENGINEERING

- Expand the “vision” to diversify project benefits
- Increase collaboration and cross-sector partnerships
- Commit to innovation
- Ensure understanding of underlying restoration principles.
- Document the value created
- Coordinate communication across partnering organizations for maximum impact
- Provide technical assistance & R&D-Water Resource Issues. (WOTS-DOTS-WRAP-other District, Military, and Sponsor request).



Questions



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

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Innovative solutions for a safer, better world

References

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- Burgess-Gamble, L., C. Haring, R. Schielen, J. Guy, D. Ramsbottom, B. Woods Ballard, M. Roca Collell, R. Glover, and F. Van Zoest, 2021. **“Chapter 18: Description of Fluvial NNBf.” International Guidelines on Natural and Nature-Based Features for Flood Risk Management.** Edited by T.S. Bridges, J.K. King, J.D. Simm, M.W. Beck, G. Collins, Q. Lodder, and R.K. Mohan. Vicksburg, MS: U.S. Army Engineer Research and Development Center. <https://issuu.com/powerofercd/docs/nbf-guidelines-2021/800>
- Burgess-Gamble, R. Schielen, L., C. Haring, J. Guy, R. Glover, R. Mandel, B. Woods Ballard, and M. Roca Collell, 2021. **“Chapter 19: Fluvial NNBf Case Studies.” International Guidelines on Natural and Nature-Based Features for Flood Risk Management.** Edited by T.S. Bridges, J.K. King, J.D. Simm, M.W. Beck, G. Collins, Q. Lodder, and R.K. Mohan. Vicksburg, MS: U.S. Army Engineer Research and Development Center. <https://issuu.com/powerofercd/docs/nbf-guidelines-2021/800>
- **Engineering With Nature**, U.S. Army Engineer Research and Development Center. <https://ewn.ercd.dren.mil/>
- Federal Interagency Stream Restoration Working Group, 1998. **Stream Corridor Restoration: Principles, Processes, and Practices.** National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia
- Haring, C., R. Schielen, J. Guy, and L. Burgess-Gamble, 2021. **“Chapter 15: Introduction to Fluvial Systems: Key Themes, Objectives, Gaps, and Future Directions” International Guidelines on Natural and Nature-Based Features for Flood Risk Management.** Edited by T.S. Bridges, J.K. King, J.D. Simm, M.W. Beck, G. Collins, Q. Lodder, and R.K. Mohan. Vicksburg, MS: U.S. Army Engineer Research and Development Center. <https://issuu.com/powerofercd/docs/nbf-guidelines-2021/800>
- Haring, C., R. Schielen, J. Guy, L. Burgess-Gamble, and B. Bledsoe, 2021. **“Chapter 16: Fluvial Systems and Flood Risk Management.” International Guidelines on Natural and Nature-Based Features for Flood Risk Management.** Edited by T.S. Bridges, J.K. King, J.D. Simm, M.W. Beck, G. Collins, Q. Lodder, and R.K. Mohan. Vicksburg, MS: U.S. Army Engineer Research and Development Center. <https://issuu.com/powerofercd/docs/nbf-guidelines-2021/800>
- Schielen, R., C. Haring, J. Guy, L. Burgess-Gamble, B. Bledsoe, and R. Mandel, 2021. **“Chapter 17: Benefits and Challenges in the Application of NNBf in Fluvial Systems” International Guidelines on Natural and Nature-Based Features for Flood Risk Management.** Edited by T.S. Bridges, J.K. King, J.D. Simm, M.W. Beck, G. Collins, Q. Lodder, and R.K. Mohan. Vicksburg, MS: U.S. Army Engineer Research and Development Center. <https://issuu.com/powerofercd/docs/nbf-guidelines-2021/800>