

ERDC

Engineer Research and
Development Center

R&D Supporting Sustainable Solutions

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E&C-R&D Webinar Discussion
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**US Army Corps
of Engineers®**



R&D Relevant to Sustainability Outline

- Energy conservation, alternative fuels
- Sustainability through *Engineering With Nature*
 - Tools: Efficiency, “Footprint”
 - Getting the most from natural processes
 - Getting the most from natural systems
 - EWN Action Projects
- Sustainability opportunities



Evaluation of the Viability of Using Alternative Fuels in USACE Floating Plant



• Process

- Preparatory Steps: Educate crew, conduct pretrial engine assessments, and develop vessel-specific action plans.
- Initially tested 4 vessels with (soybean-based) B100 for engine performance/maintenance and basic emissions.
- Based on successful results, expanded biodiesel testing (ranging from B5 to B100 and included a 2nd generation algae-based biodiesel provided by Navy on 10 additional floating plant and did detailed emissions testing on two of these).



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"Engineering with Nature" Promotes Triple-Win Outcomes 17

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"ENGINEERING WITH NATURE" PROMOTES TRIPLE-WIN OUTCOMES

ABSTRACT

The US Army Corps of Engineers' "Engineering With Nature" (EWN) initiative supports sustainable development of infrastructure by advancing technical and communication practices in order to intentionally align natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaborative processes. The tools and projects that have been developed through EWN support planning, engineering, and operational practices that beneficially integrate engineering and natural systems to produce more socially acceptable, economically viable, and environmentally sustainable projects.

The EWN initiative's focus on developing practical methods provides an achievable path toward an ecosystem approach to navigation infrastructure development. By combining sound science and engineering with advanced communication practices, the EWN initiative is providing a robust foundation for collaborative project development. Engineering With Nature is being pursued through innovative research, field demonstrations, communicating lessons learned, and active engagement with field practitioners across a wide range of organizations. The objectives of EWN are consistent with those communicated in the

"Working with Nature" philosophy of the World Association for Waterborne Transport Infrastructure (IAGLR) and the "Building with Nature" initiative of EcoShape Foundation, a public-private knowledge institute in the Netherlands.

INTRODUCTION

Pursuing the objective of sustainable development of navigation infrastructure poses both challenges and opportunities for the US Army Corps of Engineers (USACE). Advancing best practices will involve identifying the practical actions that can be taken to better align and integrate engineering and natural systems to produce more socially acceptable, economically viable and environmentally sustainable projects. Engineering With Nature (EWN) is a USACE initiative that supports more sustainable practices, projects, and outcomes by working to intentionally align natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaborative

processes (www.engineeringwithnature.org; Figure 1). The EWN initiative's focus on developing practical methods provides an achievable path toward an ecosystem approach to navigation infrastructure development and operations that is applicable across multiple USACE missions and business lines.

Science, engineering and demonstration projects within the EWN initiative illustrate the use of:

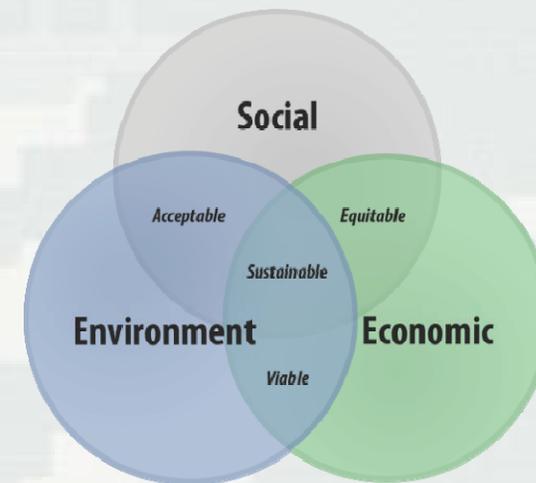
- 1) science and engineering to produce operational efficiencies supporting sustainable delivery of project benefits;
- 2) natural processes to maximum benefit, thereby reducing demands on limited resources, minimizing the environmental footprint of projects, and enhancing the quality of project benefits;
- 3) approaches that will broaden and extend the base of benefits provided by projects to include substantiated economic, social, and environmental benefits;
- 4) science-based collaborative processes to organize and focus interests, stakeholders, and partners to reduce social friction, resistance, and project delays while producing more broadly acceptable projects.

The objectives of EWN are consistent with those communicated in the Working with Nature (WwN) philosophy of the World

Above: Aerial photo of the wetlands at the Mississippi River Gulf Outlet taken in November 2013 as part of the Beneficial Use of Dredged Material Monitoring Programme.

Triple-Win Solutions: From "s" to "S" Sustainability

- Current focus is on energy conservation
- The concept of Sustainability addresses the full distribution of benefits and costs

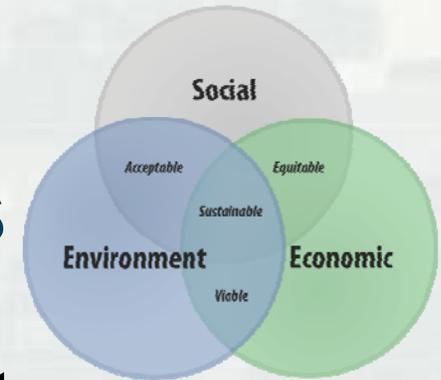


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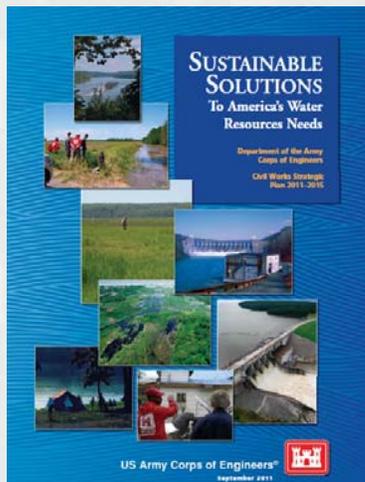
Engineering with Nature for Sustainable, Resilient Systems



Engineering With Nature

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

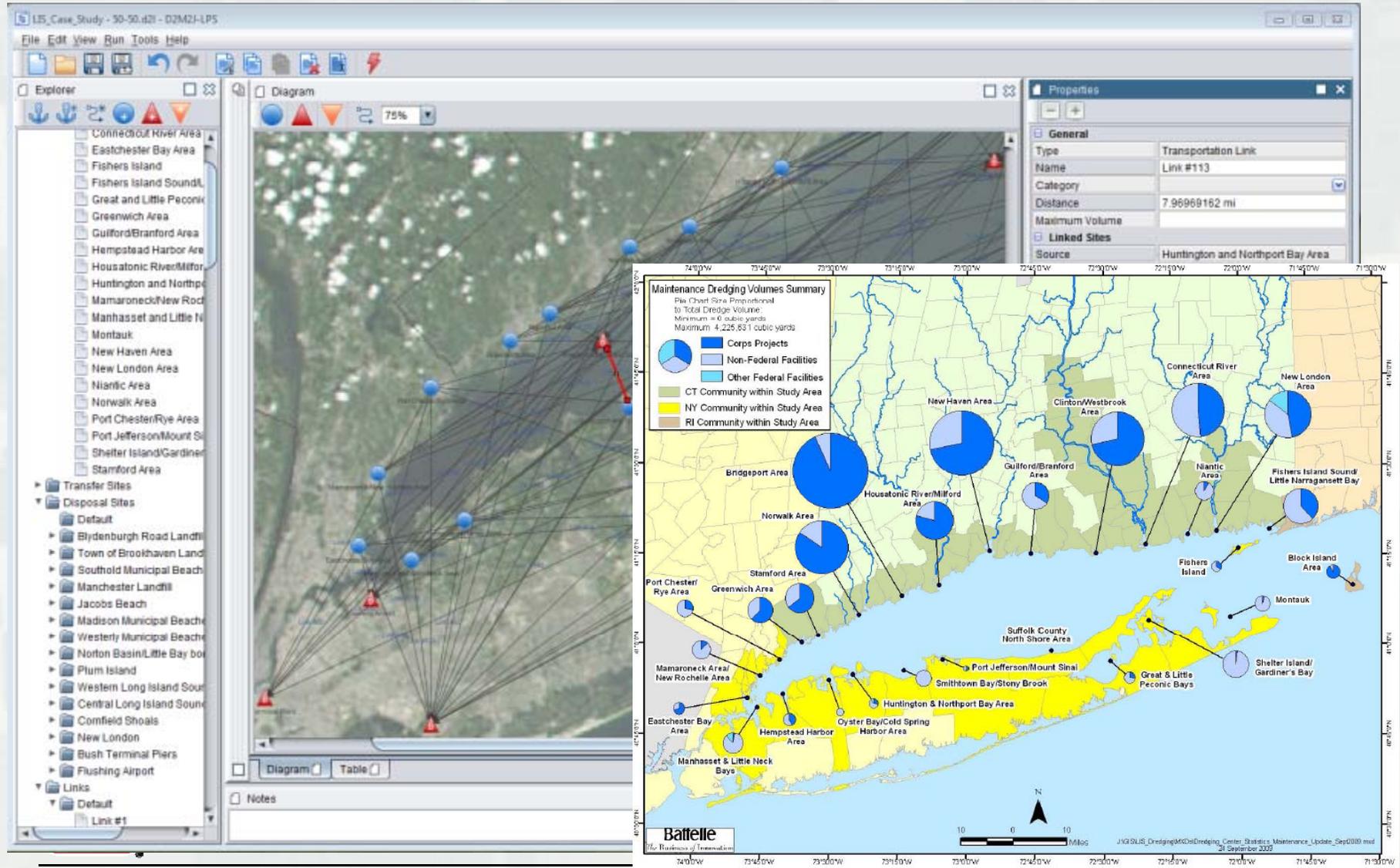
- Science and engineering that produces operational efficiencies
- Using natural process to maximum benefit
- Expanding the benefits provided by projects
- Science-based collaboration



Sustainable Solutions Vision: "Contribute to the strength of the Nation through innovative and environmentally sustainable solutions to the Nation's water resources challenges."



Optimizing Operations: Dredged Material Management Decisions (D2M2)



Understanding “Footprint”: Life Cycle Assessment

1. Goal and Scope Definition
2. Inventory Analysis
3. Impact Assessment
4. Results and Interpretation

Definition

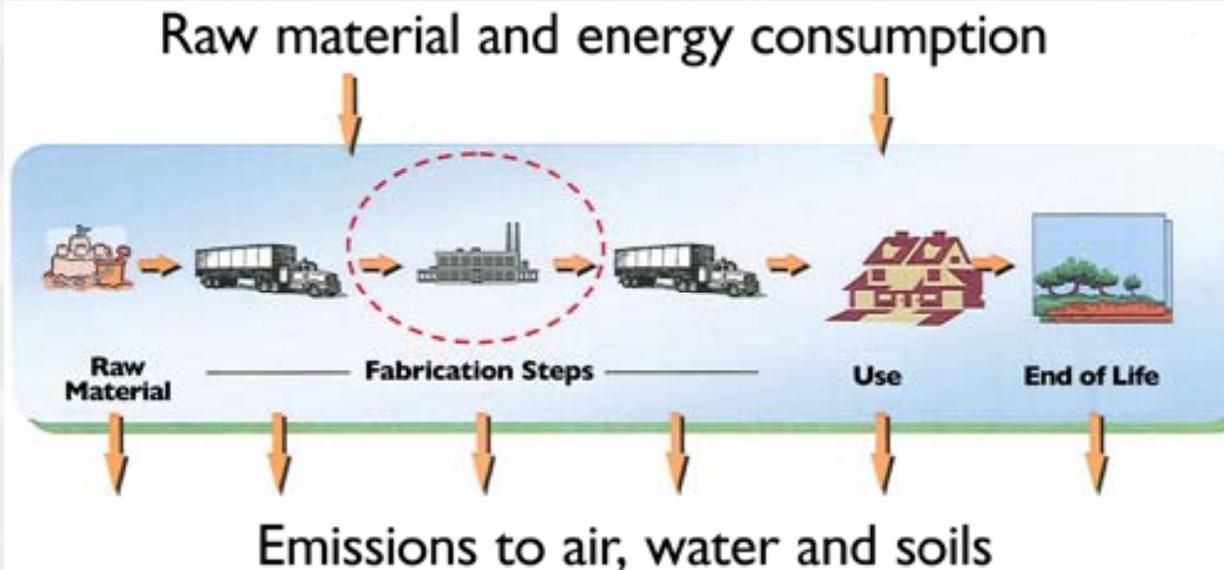
- Define goal and scope
- Collect data

Inventory

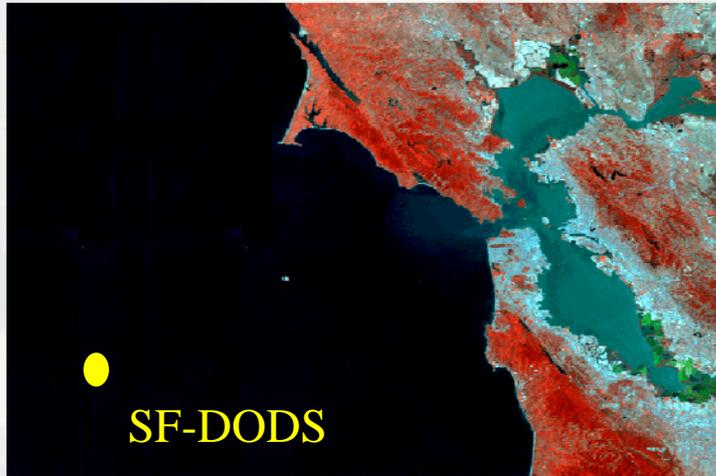
- Create/import flows
- Process inventory
- Implement characterisation factors

Results

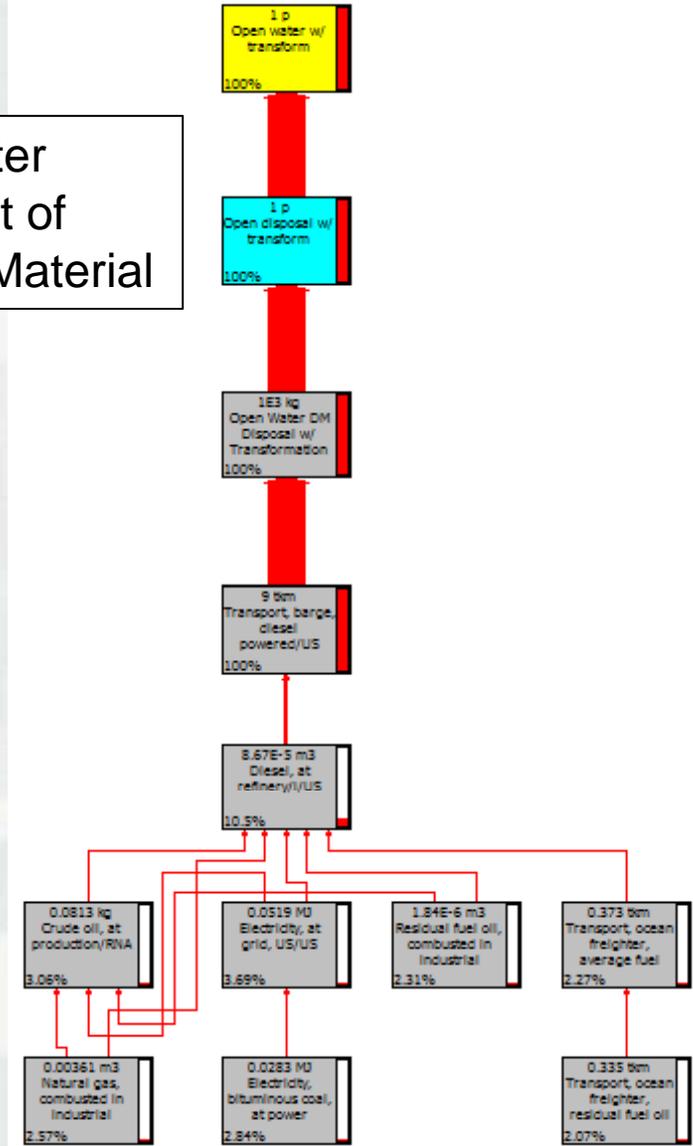
- Choose LCIA method
- Compare alternatives
- Sensitivity analysis



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Open-Water Placement of Dredged Material

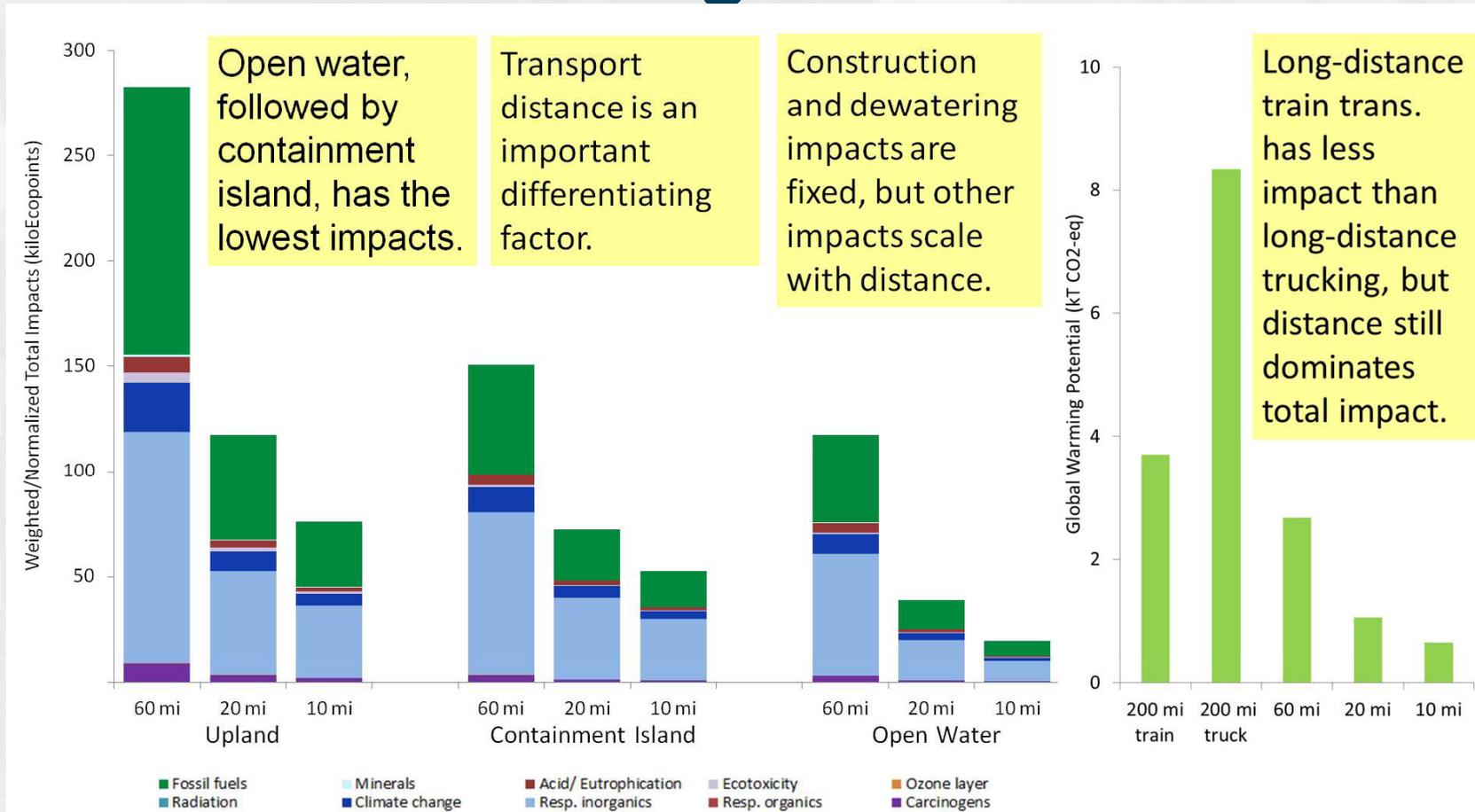


Databases of Inputs and Outputs

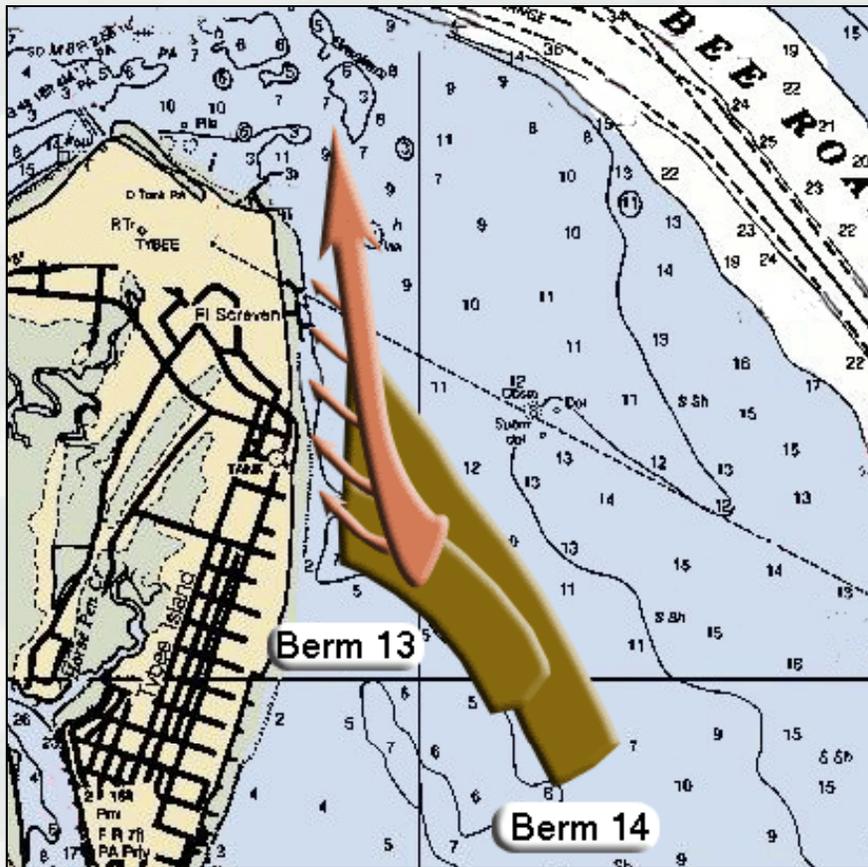
Flow	Category	Flow property	Amount	Unit	Star
Aluminium, 24% in b...	Elemen...	Fr Mass	5.24E-8	kg	
Anhydrite, in ground	Elemen...	Fr Mass	3.26E-12	kg	
Barite, 15% in crude o...	Elemen...	Fr Mass	2.85E-6	kg	
Basalt, in ground	Elemen...	Fr Mass	9.17E-8	kg	
Borax, in ground	Elemen...	Fr Mass	2.22E-10	kg	
Bromine, 0.0023% in ...	Elemen...	Fr Mass	3.65E-13	kg	
Cadmium, 0.30% in s...	Elemen...	Fr Mass	5.89E-11	kg	
Calcite, in ground	Elemen...	Fr Mass	8.93E-6	kg	
Carbon dioxide, in air	Elemen...	Fr Mass	2.15E-6	kg	
Carbon, in organic m...	Elemen...	Fr Mass	5.8E-10	kg	
Chromium, 25.5% in ...	Elemen...	Fr Mass	4.75E-8	kg	
Chrysotile, in ground	Elemen...	Fr Mass	6.96E-12	kg	
Cinnabar, in ground	Elemen...	Fr Mass	6.24E-13	kg	
clay occupation	Ztest	Fr Volume	6.26E-4	m3	
Clay, bentonite, in gr...	Elemen...	Fr Mass	3.19E-7	kg	
Clay, unspecified, in ...	Elemen...	Fr Mass	2.08E-6	kg	



LCA Results Applied to DM Management



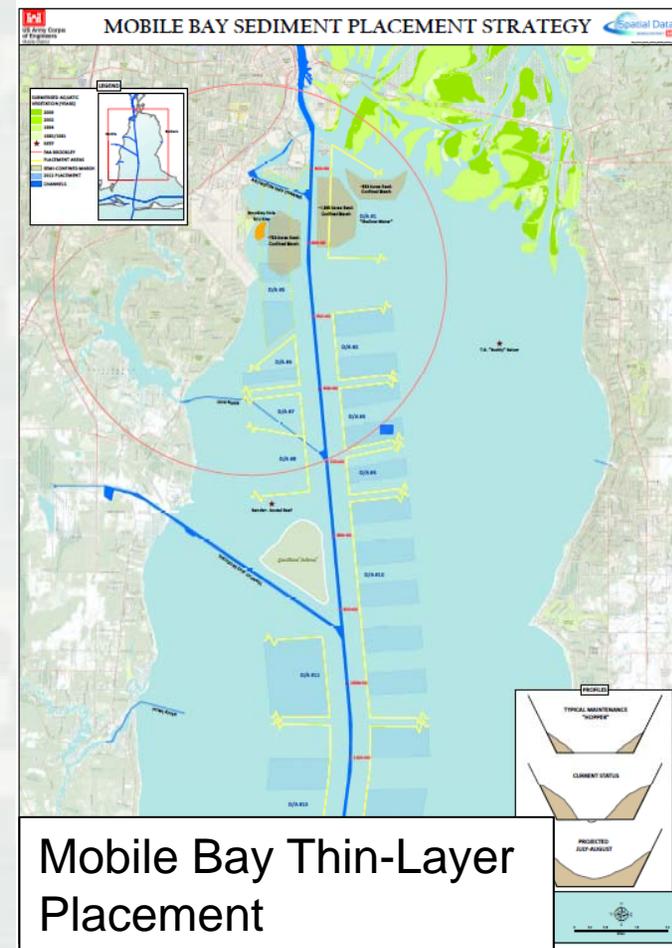
Sustainable Solutions: *Strategic Sediment Placement*



North Tybee Island
Savannah, Georgia



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Mobile Bay Thin-Layer
Placement



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Sustainable Solutions: *Using Large-Scale, Natural Forces*

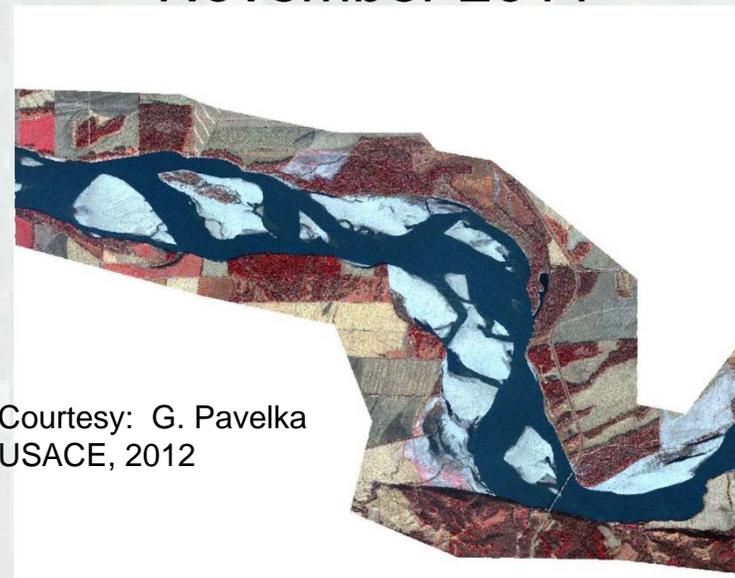
Missouri River:

- \$25 Million to construct 650 acres of sandbar
- 16,000 acres created by the flood of 2011

July 2009



November 2011



Courtesy: G. Pavelka
USACE, 2012



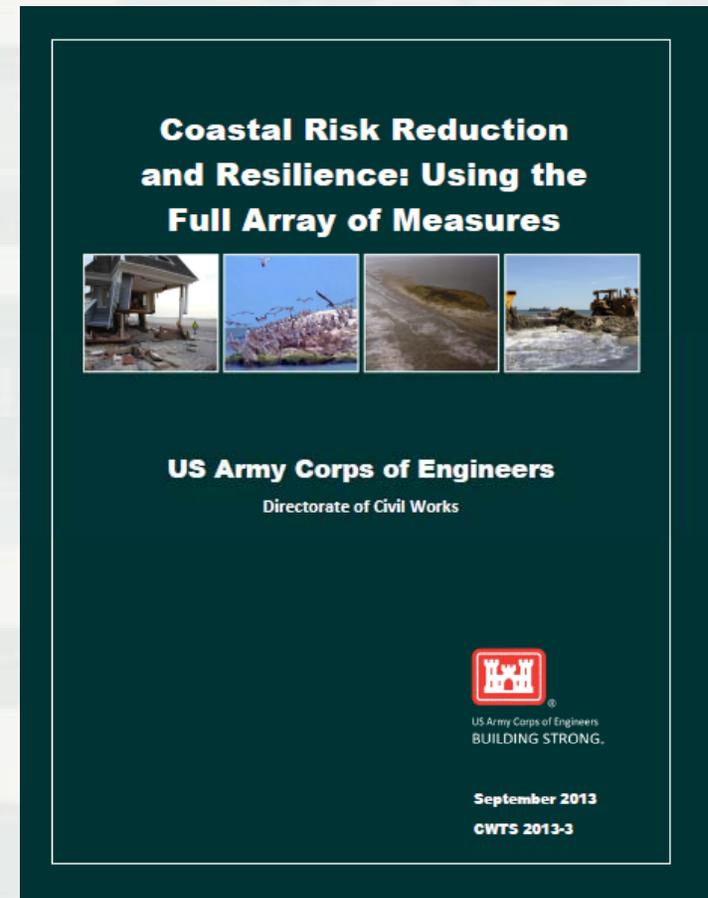
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Systems: Coastal Risk Reduction and Resilience

“The USACE planning approach supports an **integrated approach** to reducing coastal risks and increasing human and ecosystem community resilience through a combination of **natural, nature-based, non-structural and structural measures**. This approach considers the engineering attributes of the component features and the dependencies and interactions among these features over both the short- and long-term. It also considers the **full range of environmental and social benefits** produced by the component features.”



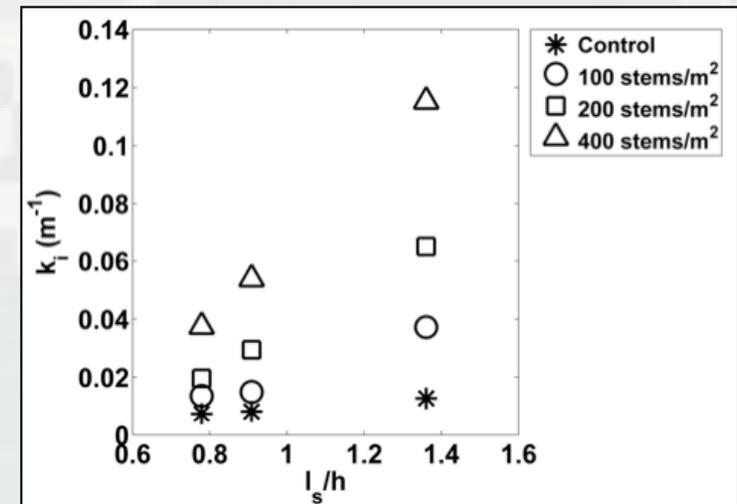
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Wave Attenuation by Wetlands

- What are the engineering benefits of wetlands of waves?
- Flume studies being performed in the 10 ft flume
 - Complemented by examination of sediment processes and field studies
- Wave attenuation was found to:
 - increase with stem density
 - increase with submergence ratio
 - slight increase with incident wave height
- Results used to update STWAVE



82nd Annual Conference of Mayors

June 20-23, 2014; Dallas, TX

Conference Resolution on Natural Infrastructure

BE IT RESOLVED, that The United States Conference of Mayors encourages its members to prioritize **natural infrastructure** and supports the funding and implementation of **natural solutions** to protect freshwater supplies, **defend the nation's coastlines**, maintain a healthy tree and greenspace cover and protect air quality, and create a new generation of environmental leaders, which ensures cities can support a growing population and prepare for the future; and

BE IT FURTHER RESOLVED, that The U.S. Conference of Mayors believes partnerships developed between local governments and non-profit organizations are an effective way to identify and implement opportunities for **green infrastructure**.



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EWN Action Projects

- Sediment Retention Engineering to Facilitate Wetland Development (San Francisco Bay, CA)
- Realizing a Triple Win in the Desert: Systems-level Engineering With Nature on the Rio Grande (Albuquerque, NM)
- Atchafalaya River Island and Wetlands Creation Through Strategic Sediment Placement (Morgan City, LA)
- Portfolio Framework to Quantify Beneficial Use of Dredged Material (New Orleans and New England)
- Engineering Tern Habitat into the Ashtabula Breakwater (Ashtabula, OH)
- Living Shoreline Creation Through Beneficial Use of Dredged Material (Duluth, MN)
- A Sustainable Design Manual for Engineering With Nature Using Native Plant Communities



Sustainability Opportunities

- “Sustainability” provides an opportunity for USACE to remold regulatory paradigms and constraints
 - Balancing consideration of environmental risks with project **benefits**
- Combining the goals of engineering / operational efficiency with production of broader range of benefits is a stronger argument for infrastructure



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