# Climate Change Benefits from the Horseshoe Bend Engineering with Nature Project

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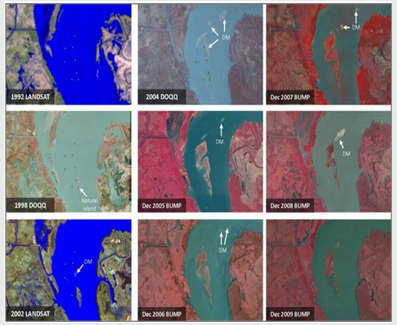
## Project Description

During the 1990s, placement of shoal material dredged from Horseshoe Bend occurred at eight wetland development sites located along the river's banklines adjacent to the channel. Capacity of these placement sites was nearly exhausted by 1999. Thus, to meet the anticipated disposal requirements for future channel maintenance, the US Army Corps of Engineers New Orleans District evaluated three placement alternatives: (1) convert the wetland development sites into upland disposal areas; (2) open water placement of dredged material via a long-distance pipeline into the open waters of Atchafalaya Bay; and (3) mounding of material at mid-river open water placement sites within a 350-acre (142 ha) area immediately adjacent to the navigation channel and upriver of a small naturally forming island. The third alternative was selected on a demonstration basis to investigate the impacts of mid-river placement on shoaling trends downriver of the site. Beginning in 2002, strategic placement of the sediment dredged from Horseshoe Bend occurred at the mid-river open water placement area. Placement of between 0.5 to 1.8 million cubic yards of sediment was conducted every 1 to 3 years which influenced and contributed to the development of an approximately 35 ha island mid-river. The practice of strategically placing dredged sediments upriver of a naturally-occurring island was conducted to aid the island's growth to produce greater environmental benefits than otherwise would be present using more conventional placement practices.

Behind the dredge California, the river island at Horseshoe Bend on the lower Atchafalaya River, Louisiana is being self-designed by dredged sediment strategically placed upriver (lower right), allowing the river's energy to disperse the sediment. The dispersed sediment contributes to the island's growth, thus creating environmental and other benefits (Photography by Wings of Anglers, courtesy of Great Lakes Dredge and Dock).

## Goals

The initial goal was to understand why the island was formed. To this end, the USACE conducted studies to better understand the hydrology of the river used to transfer the mounded material onto the island. Information regarding ecosystem classification and mapping and floral and faunal composition of the island were conducted to document environmental benefits. Since 2015, the project team conducted additional analyses to identify and quantify climate change, navigation, environmental, and economic benefits.




## Objectives

The objective was to identify and quantify the various climate change and other benefits being realized by applying best practices of beneficial use, demonstrating how dredged material can be used to nourish a naturally forming river island. Climate change, navigation, environmental, and economic benefits were quantified that are enhancing the coastal Louisiana landscape.

## Climate Change Benefits

Services produced through the creation of Horseshoe Bend Island included carbon sequestration, nutrient sequestration, emissions reductions, research opportunities, and navigation (Table 1). It was estimated that Horseshoe Bend Island will sequester an average of 5,220 kg of carbon per year assuming that this section of the river remains relatively stable well into the future. Emissions reduction realized per year given the amount of fuel saved per trip and the number of trips made each year by tugs and ships is 186 million metric tons of carbon dioxide equivalent (MTCO2e; U.S. Environmental Protection Agency's conversion of a gallon of diesel fuel to MTCO2e - 0.010217). The island's sediments are reducing the annual load of nitrogen delivered to the Gulf of Mexico by 0.059%, potentially reducing the annual hypoxic zone. The most quantifiable economic value realized is navigational service and maintenance expressed as the reduction in dredging requirements. The three year cost of dredging prior to island creation is valued at $22.9M, and the three-year estimated cost of dredging after island creation is $9.9M. The estimated $12.9M savings translates into $4.3M per year. Sediments and plants on the island sequester carbon. The nutrients sequestered in the islands sediments reduce the load delivered to the northern Gulf of Mexico, where hypoxia is a significant problem. In 2013 the island was estimated to remove 1,645 kg of nitrogen (Berkowitz et al., 2016).

| Service | Horseshoe Bend Amount | Conversion | Value | Units (per year) |
|---|---|---|---|---|
| **Carbon sequestration** | 6.15 ha (15 ac) emergent wetlands | 86 g-C/m$^2$ each year over 100 years | 5,220 kg | Average C |
| **Nutrient sequestration** | 35 ha (85 ac) wetlands | 7% reduction estimated for 10,093 acres | 0.059% | Nitrogen reduction in Gulf |
| **Emission reductions** | 49 liters (13 gal)/trip fuel savings each year | 49 liters (13 gal)/trip and 1,400 trips/year made by tugs and cargo ships | 186 | Metric tons of carbon dioxide equivalent (MTCO2e) |
| **Research opportunity** | 4FY research support range $125K - $250K | $850K/4 yrs | $213K | 2015 US$ |
| **Navigation support and maintenance** | $22.9M -$10M over 3 yrs | $12.9M/3 yrs | $4.3M | 2015 US$ |

## Innovation

Engineering With Nature (EWN) is a USACE initiative that seeks to support more sustainable practices, projects, and outcomes. The four key elements of EWN include: (1) use of science and engineering to produce operational efficiencies supporting sustainable delivery of project benefits, (2) use of 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) broaden and extend the base of benefits provided by projects to include substantiated economic, social, and environmental benefits, and (4) use science-based collaborative processes to organize and focus interests, stakeholders and partners to produce more broadly acceptable projects. The Atchafalaya River island project exemplifies what can be achieved through the application of EWN concepts and practices. Sediment dredged from the adjacent Federal navigation channel during routine maintenance was strategically placed in mounds upriver of the island over a 12-year period. The mounded material dispersed by the river's currents is continuing to self-design the island.

## Outreach and Education


Berkowitz, J.F., Green, L., VanZomeren, C.M. and White, J.R. 2016. Evaluating soil properties and potential nitrate removal in wetlands created using an Engineering With Nature based dredged material placement technique. Ecological Engineering. 97:381-388.

Suedel, B., Berkowitz, J., Kim, S., Beane, N., Summers, E., Evans, D, and Corbino, J. 2015. Creating Horseshoe Bend Island, Atchafalaya River, Louisiana. Terra Et Aqua. 140:26-31.

Berkowitz, J.F., Beane, N.R., Evans, D.E., Suedel, B.C. and Corbino, J.M. 2015. Ecological Survey of a Dredged Material-supported Wetland in the Atchafalaya River, Louisiana: An Engineering with Nature Case Study. Wetland Science and Practice. 32(1):14-18.

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