



## Use of Engineering With Nature® Concepts on the Savannah Harbor Navigation Project, Dredged Material Containment Areas, Savannah, GA

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**PURPOSE:** This document summarizes the management approach for the Dredged Material Containment Areas (DMCAs) (located in Jasper County, SCa) at the Savannah Harbor Navigation Project (SHNP) in the Savannah Harbor, Chatham County, GA. The management approach is detailed in the U.S. Army Corps of Engineers (USACE) Savannah District, Long Term Management Strategy (LTMS) (USACE 1996). The LTMS was initiated to mitigate wetland losses in Georgia and South Carolina from ongoing dredged material deposition, harbor deepening efforts, and normal operating activities from maintenance of the Savannah Harbor. Since the inception and implementation of the LTMS in 1996, USACE has recognized that engineering operations, particularly those that involve dredged material deposition, can provide opportunities for infrastructure enhancement by applying improved engineering practices, and by incorporating natural features in the final product, which yield additional environmental benefits. The Engineering With Nature® (EWN) initiative incorporates both infrastructure development and enhancement with environmental management (Banks et al. 2013, USACE 2013, Bridges et al. 2018). Many of the design and management features of the SHNP and implementation of the LTMS on the DCMAs have incorporated principles of EWN. The purpose of this technical note is to: (1) summarize the creation and management of the DMCAs from implementation of the LTMS, (2) identify and describe features of the LTMS in common with EWN principles, and (3) discuss how this approach improves USACE's ability to meet mission objectives while providing environmental benefits to the local and regional ecosystem.

**BACKGROUND AND PROBLEM:** Engineering With Nature® is defined as the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits associated with water resources projects. Essential features of the EWN approach include: (1) use of science and engineering to produce operational efficiencies that support sustainable delivery of project benefits, (2) incorporation of natural processes to maximize benefits and to thereby reduce demands on limited resources, (3) minimization of the environmental footprint of projects and enhancement of the quality of project benefits, (4) increasing the breadth and extent of the base of benefits that projects provide, including substantiated economic, social, and environmental gains, and (5) use of science-based collaborative processes to organize and focus interests, stakeholders, and partners, to reduce social friction, resistance, and project delays by producing more broadly acceptable projects (Bridges 2012, Bridges et al. 2018).



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Engineering With Nature is the alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaborative processes.



To promote greater application of the EWN approach, a portfolio of demonstration projects may be useful (Banks et al. 2013, Bridges et al. 2018). The implementation of the LTMS on the SHNP DMCAs provides an opportunity to present an approach that is rooted in EWN principles and that provides effective and efficient management of the SHNP while providing critical open water, wetland, mudflat, and island habitats essential for seasonal waterfowl and shorebirds in the region (Calver et al. 2016, Guilfoyle et al. 2020) (Figure 1). Also, as a confined disposal facility (CDF) the DMCAs provide a location for the deposition of contaminated sediments from the harbor. Contaminated sediments are often the result of municipal and industrial sources that may become concentrated in the sediments. Deposition of the sediments in locations that minimize exposure to human populations is required. CDFs may be beneficial in that they remove toxins from waterways and minimize contaminated discharged effluent that may might otherwise increase health risks to human or wildlife populations (USACE and USEPA 2003).



Figure 1. Implementation of the Long-Term Management Strategy on the Savannah Harbor Navigation Project, Dredged Material Containment Areas, has been effective in creating open water, wetland and mudflat habitats for seasonal shorebirds and waterfowl since 1996.

USACE is responsible for maintaining our coastal infrastructure, including ports, harbors, shoreline stabilization, and for maintaining the Intracoastal Waterway System (ICWW) along the Atlantic, Pacific, and Gulf Coasts. International and national commerce depends on facilities that provide the means to export and import goods. Waterway systems in and around ports and harbors require regular maintenance, typically through annual maintenance dredging operations that support sufficient depths for passage of large oceanic vessels. The process of deepening ports and harbors, in combination with associated shoreline stabilization efforts, often results in modification of existing current patterns that shift sediments away from navigation channels, and reduces or eliminates the natural meandering processes typical of coastal environments (Guilfoyle et al. 2019). These efforts often result in the reduction or degradation of sediment-based features including beaches, sandy shoals, sand spits, wetlands, islands, and inlets. Numerous species of native coastal floral and faunal communities depend on such sediment-based features, and many species, particularly seasonally-occurring waterfowl and shorebirds, are currently experiencing long-term population declines.

The SHNP LTMS has developed a management approach designed to accommodate annual dredged material deposition during maintenance activities in a series of DMCA's located in the Savannah Harbor (Figure 2), while providing wetland, open water, mudflat, and island habitat for seasonally-occurring waterfowl and shorebirds. The habitats provided represent mitigation for habitat lost during SHNP maintenance and deepening efforts. The creation and persistence of these habitats through the LTMS provide an opportunity to ensure that these habitats are available for seasonal bird communities in quantity and quality comparable to coastal areas that have not been subjected to long-term dredging, shoreline stabilization, and urban infrastructure development. Moreover, the Savannah District implemented a long-term, bimonthly monitoring of the seasonal waterfowl and shorebird communities to document the benefits to local and regional bird species (Calver et al. 2016). Monitoring of the bird communities began in 1994 and continues to the present. An introduction to the seasonal bird communities on the DMCA's from 1994 to 2012 can be found in Calver et al. (2016), and long-term trend and habitat analyses of these data can be found in Guilfoyle et al. (2020).

**FEATURES OF THE LONG-TERM MANAGEMENT STRATEGY:** The engineering, design and construction of the DMCA's, in combination with the implementation of a specific management approach, have been successful in providing consistent year-round availability of wetland, mudflat, open water, and island habitat for waterfowl and shorebirds, and are thus representative of the EWN approach. During the development of the LTMS, the mitigation process required the maintenance of approximately 204.4 ha (505 acres) of flooded open water habitat and 266.7 ha (659 acres) of wetland/mudflat habitat (USACE 1996). Specific features of the LTMS that ensure availability of these habitats, plus suitable bird nesting areas include:

1. A 3-year rotational use of the DMCA's, where some DMCA's receive dredged material ("on") and other areas do not ("off") (Figures 3-5).
2. Construction of eight 2-ha islands within the four DMCA's, and one 4 ha island in DMCA (13A) used in the rotational program (see Figure 2, 12A, 13A, 13B, 14A, 14B). For DMCA's receiving dredged material, these islands provide nesting sites that are surrounded by open water and separated from the shoreline, a characteristic that provides some protection against mammalian predators (Figure 5).
3. Availability of the DMCA's to receive dredged material provides a cost-effective nearshore option for disposal of dredged material during maintenance operations.
4. Rotational use of DMCA's and periodic enhancement of DMCA levees provide a means to increase the life-span of the DCMA's while ensuring that the Savannah District's future dredged material deposition needs are met.
5. Other additions to the DMCA's include new pipe ramps; installation of weir/discharge pipes; engineered bank, dike, and levee rebuilding (to continually update and increase DMCA capacity for future uses); and installation of underdrains to permit faster drying of sediments, which promotes the settling of sediments and extends the life of the DMCA (USACE 1996).



Figure 2. Dredged Material Containment Areas located in the Savannah Harbor, SC. (showing DMCA sections 12A, 13A, 13B, 14A, and 14B).



Figure 3. A view of one Dredged Material Containment Area receiving dredged material in the Savannah Harbor Navigation Project, Savannah Harbor, USACE Savannah District, GA. The material deposited in this area was later repositioned to create bird habitat.



Figure 4. A Dredged Material Containment Area in the Savannah Harbor that is not receiving dredged material during an "off" year. Such areas retain some water for much of the year and provide wetland and mudflat habitat used seasonally by shorebirds.



Figure 5. A Dredged Material Containment Area not receiving dredged material during an “off” year. One of the islands constructed using dredged material is visible in the background. Although not a stated objective, the DMCAs are also providing habitat for native plant species (foreground).

**LONG-TERM MONITORING OF THE SEASONAL BIRD COMMUNITIES:** The Savannah District began regular monitoring of the DMCAs in 1994. Between 1994 and 2012, over 700 days of surveys were performed. This included over 3,600 hours of effort to survey seasonal waterfowl and shorebird species (Calver et al. 2016). During these surveys, over 5.7 million detections of 299 species were recorded, including species regionally ranked by the South Atlantic Migratory Bird Initiative (SAMBI) (Watson and Mallory 2008) as Highest Priority Species (22 such species detected), High Priority Species (70 such species detected) and Moderate Priority Species (40 such species detected) (Calver et al. 2016). These data show that the LTMS strategy management of the DMCAs has been successful in supporting large numbers of seasonal waterfowl and shorebird species, including species of local and regional concern. In addition, long-term trends have shown that most populations are stable or increasing, including increasing species richness during the monitoring period. Seasonal habitat availability is an important factor correlated to abundance and richness metrics for many species and species groups (Guilfoyle et al. 2020). Finally, the islands constructed within the DMCAs have been successful in providing important nesting habitat for the American Avocet (*Recurvirostra americana*), Sandwich Tern (*Thalasseus sandvicensis*), Least Tern (*Sternula antillarum*), Gull-billed Tern (*Gelochelidon nilotica*), and Royal Tern (*Thalasseus maximus*) (Calver 2006, Guilfoyle et al. 2020). The DMCAs also support the largest breeding populations of Black-necked Stilts (*Himantopus mexicanus*) in Georgia (Calver 2006).

**MEETING USACE MISSION OBJECTIVES IN THE SAVANNAH HARBOR:** The construction and operation of the DMCAs, along with the implementation of the LTMS, provide a cost-effective means for USACE Savannah District to meet maintenance dredging obligations in

the Savannah Harbor. The construction of the DMCAs provides a nearshore option for disposal of dredged material during maintenance dredging operations. Without the DCMAs, dredged material would have to be disposed at a much greater cost and inefficiency either offshore or farther away from the harbor. The DMCAs are also suitable for deposition of contaminated sediment that may be present in the harbor from pollutants and other contaminants from nearby industry. Implementation of the LTMS provides a means for USACE to increase the operating life span of the DMCAs by alternating deposition operations on a 3-year rotation. This rotation permits drying and settling of the sediments and allows for additional future deposition. Moreover, in the LTMS, levees in the individual DMCAs can be raised periodically to increase capacity (USACE 1996). The large size of the DMCAs (approximately 2,000 ha [4,960 acres]), permits long-term use of the site, while rotational operations permit availability of designated habitats for seasonal waterfowl and shorebirds (Calver et al. 2016, Guilfoyle et al. 2020). This alignment of engineering of the DMCAs, along with a specific management approach to increase environmental benefits and the efforts to document benefits with long-term monitoring of the sites, are reasons why the SHNP and DMCAs represent a EWN approach to the management of CDFs. The design and implementation of the LTMS on the SHNP DMCAs should be recognized as an example for the management and operation of other CDFs around the country.

**SUMMARY:** This document provides details about EWN principles and how those principles have been used on the SHNP by the construction and management of the DMCAs. Since the inception of coastal engineering operations, USACE has recognized the potential beneficial uses of dredged material, and many of these USACE efforts have incorporated EWN principles. The description of EWN principles applied on SHNP DMCAs not only provides a demonstration of EWN principles in action, but also provides an example of how other CDFs could be managed to enhance environmental benefits by providing important habitat for regional and local floral and faunal communities. The approach used on the SHNP DMCAs focuses on seasonal waterfowl and shorebirds, and the benefits to these populations were described through long-term monitoring by USACE Savannah District personnel (Calver et al. 2016, Guilfoyle et al. 2020). Future efforts on the DMCAs or other CDFs could focus on other native communities, including wetland plants, pollinators, and regional reptile and amphibian populations, or any other local or regional native populations recognized as rare or sensitive. By managing these areas to benefit a broad spectrum of plant and wildlife species, CDFs in urban landscapes can increase seasonal habitat availability for many different species. By specifically designing and managing these areas to provide seasonal open water, wetland, mudflat, and island habitats, these efforts serve to provide habitats that normally would have been available had not the area been altered and degraded for municipal and industrial purposes. While such efforts may not always be able to mitigate for the quality and quantity of habitats lost in urban areas around many ports and harbors, proper management and application of EWN principles can have demonstrable benefits for many species and species groups. Providing clear and measurable benefits to local and regional plant and wildlife populations incorporates the EWN approach by reducing the environmental footprint of projects, and extends the base of benefits beyond simply economic and social gains. Moreover, implementing science-based long-term monitoring as a means to demonstrate these environmental benefits promotes long-term population sustainability of rare and sensitive wildlife species, while encouraging stakeholder involvement and public support of these projects.

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