Dredging Research

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Beneficial Uses of Dredged Material: Meeting the Challenges Ahead

by Richard A. Price, U.S. Army Engineer Research and Development Center, and David Bowman and Carl Platz, U.S. Army Engineer District, Detroit

Issue

The U.S. Army Corps of Engineers executes the never-ending mission of removing sediments from the bottom of the Nation's rivers, lakes, and coastal waterways to maintain Federal navigation channels. As long as the natural processes of erosion and deposition of soil into waterways continue and as military and commercial shipping needs continue to grow, the Corps' dredging mission will remain. However, there has been a creeping change in the manner in which that mission has been executed over the years. Prior to the 1970s, sediments were simply dredged from the navigable waterways and disposed of where natural processes would eventually deposit sediment anyway; in the open water. Recognition of the environmental and human health impacts of contaminants in our waterways resulted in legislation that not only impacted industrial polluters but also the way the Corps executed the dredging mission. Contaminated sediments were identified and testing methods and assessment protocols were developed to determine the environmental suitability of dredged material disposal options. Most dredged materials were still clean enough for open-water disposal, while those that were tested and determined unsuitable for open-water disposal were placed in confined disposal facilities (CDFs). As analytical chemistry methods improved and the suite of contaminants of concern (COC) increased, aquatic disposal options for dredged material decreased. In addition, an increasing number of states began to prohibit any open-water disposal resulting in the disposal of even cleaner dredged material in CDFs. After over 30 years of disposal into CDFs, the realization is that simple disposal is not a sustainable management option.

Thinking Outside the Box

In the Great Lakes Area (GLA) of responsibility 'thinking outside the box' can be taken quite literally. During the 1970s and the 1980s Public Law 91-611

Figure 1. Phytoremediation testing at the Jones Island CDF, Milwaukee, WI

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allowed the GLA Corps Districts to construct CDFs for navigation projects where the dredged material was unsuitable for in-water disposal. The Corps' CDF focus has generally been to ensure confinement of dredged material, with treatment and management efforts focused mainly on dewatering and meeting water quality standards. Now the Great Lakes Districts are dealing with the fact that most CDFs constructed under the original authority are filled to capacity. Constructing new CDFs is often a difficult challenge because of the loss of valuable shallow-water habitat and other environmental regulations and increased construction costs, which now must be partially provided by the local ports. In many instances the Corps or the ports have identified ways to use the dredged material beneficially. However, funding is simply not available to try these new and innovative concepts. Under O&M authority, the Corps cannot expend funds to remove dredged material from CDFs once it has been disposed of and other stakeholders are not yet willing to invest in unproven technologies. In addition, once dredged material is moved outside of the CDF, it is subject to State regulations that in many cases are not specific for dredged material or are in continuous development.

Research Supports Implementation

With the help of the Corps' Dredging Operations and Environmental Research (DOER) Program and the USEPA's Great Lakes National Program Office (GLNPO), the Detroit District is evaluating ways to manage the dredged material as a resource, with the hope of converting existing CDFs from disposal facilities into treatment and recycling facilities. The GLNPO office of the USEPA has provided funding in support of DOER efforts to reduce contaminant concentrations in dredged material using low-cost, innovative technologies such as bioremediation and phytoremediation (Figure 1) at the Jones Island CDF in Milwaukee, Wisconsin. Reduction of some contaminants may be necessary to meet State criteria for beneficial reuse. Removal of dredged material from the Jones Island CDF is a critical requirement to meet future navigation dredging needs in the Milwaukee AOC. Quality soil products (Figure 2) can be produced from the dredged material in the Jones Island CDF once remediation efforts meet the criteria on contaminant concentrations established by the Wisconsin Department of Natural Resources.

The DOER Program is also providing research and testing support to help develop and promote beneficial products from dredged material. For example, dredged material from Grand Haven Harbor was tested and determined by the State of Michigan to be suitable for unrestricted use. The ERDC conducted greenhouse tests to evaluate potential use as topsoil when blended with various ratios of composted leaf litter. Greenhouse testing showed that the addition of 10-20 percent by volume of leaf compost to the dredged material produced a high-quality soil material for turf and bedding plants (Figures 3 and 4). A demonstration, supported by ERDC, the Grand Haven Office of the Detroit District, and local business and civic leaders, was held on August 20, 2004. A group of local citizens attended the event and heard from the Corps, local industry, utility and civic leaders why they should support beneficial uses: dredging is vital to commerce in Grand Haven and there simply is no space for disposal of dredged material. Over 35,000 yd^3 of dredged material and leaf compost has been blended (Figure 5) and over 1,200 yd^3 was delivered and placed at a local school for a new landscaping project (Figure 6). Approximately 40,000 yd^3 needs to be removed from the temporary storage site to provide space for the next dredging cycle (cycles occur every three years). With the

Figure 2. Blending composted wood chips with dredged material, Jones Island CDF

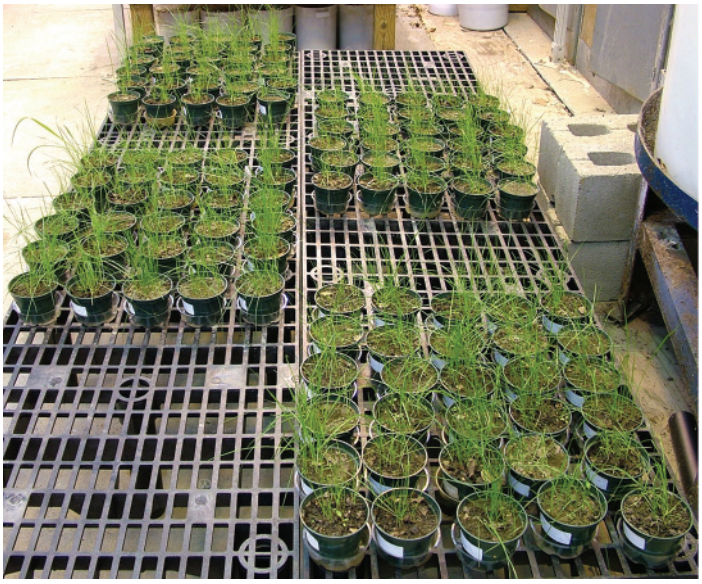

Figure 3. Greenhouse testing of dredged material/leaf compost blends

Figure 4. Landscape plants in 90/10 blend of dredged material and leaf compost

Figure 5. Blending dredged material and leaf compost in Grand Haven, MI

continued support and participation of the local community, recycling of the soil material produced will create a sustainable program and will ensure that future dredging needs in Grand Haven are met without delays.

Expanding the Guidance

Current guidance on beneficial uses of dredged material is primarily focused on 'clean' material that can be used beneficially during the dredging process. Little guidance is available on removing and utilizing dredged material from CDFs or on addressing the stigma of associating CDFs with contaminated material. DOER is working with Corps Districts and interested parties on these types of projects and evaluating the successes and failures of each so that guidance can be developed to standardize the decision process and help facilitate sustainable recycling programs. This will include guidance on determining potential beneficial

Figure 6. Turfgrass established on dredged material topsoil

use opportunities for each dredged material and working through the necessary testing and evaluation processes to provide State and local parties all the information they need to become willing stakeholders.

Related/Supporting Publications

Technical Note DOER-C2 "Dredged Material Characterization Tests for Beneficial Use Suitability" (May 1999) http://el.erdc.usace.army.mil/elpubs/pdf/doerc2.pdf

Technical Note DOER-C3 "Evaluation of Dredged Material for Phytoreclamation Suitability" (May 1999) http://el.erdc.usace.army.mil/elpubs/pdf/doerc3.pdf

Technical Note DOER-C4 "Screening Tests for Assessing the Bioreclamation of Dredged Materials" (May 1999) http://el.erdc.usace.army.mil/elpubs/pdf/doerc4.pdf

Technical Note DOER-C6 "Manufactured Soil Screening Tests" (May 1999) http://el.erdc.usace.army.mil/elpubs/pdf/doerc6.pdf

For additional information, contact Richard A. Price, 601-634-3636, Richard.A.Price@erdc.usace.army.mil

Dredging Operations Decision Support System (DODSS)

by Gary Howell and Janean Shirley, U.S. Army Engineer Research and Development Center

The Corps of Engineers has made significant progress in developing databases and simulation tools to support its dredging mission. Reliable databases are the enabling technology for modern enterprise management. However, for a complex, process-based industry such as dredging, realizing the full benefits of lower cost and improved performance can be frustrated by the difficulty of assimilating all of the information required to make management decisions. Decision-makers rarely have the time required to fully master a single tool, much less the many tools and models required for informed decisions. Good decision-making also depends on the hard-learned lessons of the past. Capturing the experience of District experts is an essential part of preserving our corporate knowledge. Operations managers need decision support for scheduling maintenance dredging, optimizing cost performance, planning emergency response dredging, and evaluating alternatives for new work dredging. Stressed by environmental restrictions, manpower reductions, and the demands of increasing transportation infrastructure, the Corps is investing in technology that will automate access to vast amounts of information associated with dredging projects. This technology has taken the form of a decision support system called the Dredging Operations Decision Support System (DODSS).

DODSS was begun with the idea that while a dredging DSS would be technically feasible, it would require long-term commitment from the R&D community, Corps senior management, and District experts. To reduce the risk of long-term development, a scenario-based design approach was used. The scenario-based design focuses on early prototype solution to a small number of specific user problem scenarios. The prototype interfaces with existing databases such as Silent Inspector, Dredging Information System (DIS), eCoastal, OMBIL, and P2. Supporting models include MDFATE and published analytical models. DODSS is guided by a rule-based expert system that encapsulates expert knowledge and site-specific heuristics. The system accesses and understands the historical data contained in the databases, compares current and future needs to the project's experience, and ranks recommendations based on project goals. A model of the dredging process as conducted by the different types of dredges is combined with knowledge of historical performance to compare alternatives. Available environmental and disposal site constraints are incorporated. Resource conflicts between schedules and plant capability are flagged.

Figure 1 is a block diagram of the major components of the DODSS software infrastructure. The system runs continuously as a server. It communicates with external data sources that provide updated meteorological events, surveys, and dredge assignments. It accesses its own historical database of dredging events and external databases such as Silent Inspector and the Dredging Information System. It can request the execution and access the results of model runs such as MDFATE. The system communicates with project managers and users via email and automatically generated web pages.

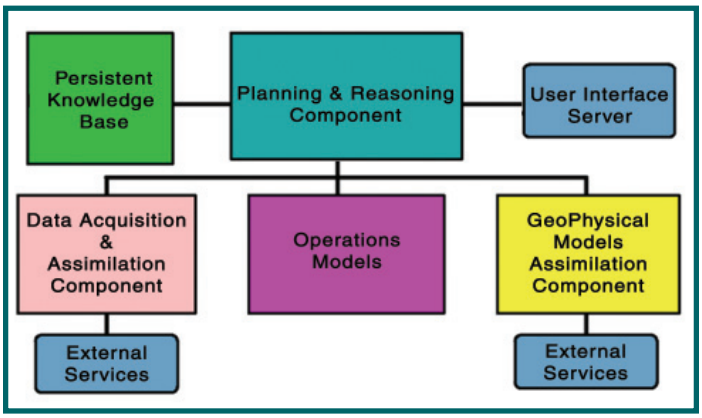

Figure 1. Block diagram of DODSS major components

The operations managers website is a portal named Goethals in honor of Gen. George Goethals (1858-1928), the Corps of Engineers officer who built the Panama Canal. Goethals will be an interactive community-style site. Operations managers can customize their personal view as well as project and systemwide views.

The project uses a scenario design methodology where the system is designed and implemented for real dredging scenarios. Modules developed for scenarios include pipeline optimization, dredge type selection, and dredging requirements neural network estimator.

Capacity optimization modules for confined disposal sites and open-water sites are under development. Rutgers University is teaming with the Portland District in the development of an open-water disposal optimization program that will be a component of the Goethals DODSS. Goethals will be capable of capturing Silent Inspector data to provide information on dumping activity and vessel tracking. This capability will allow the optimization to be run on a daily or weekly basis to upgrade dredging plans. The MDFATE simulation will

be used by the optimization procedure as a "black box" to provide output on changes to bathymetry as additional placements occur. The initial development effort under Goethals has focused on the offshore disposal site at the mouth of the Columbia River. The Goethals DODSS receives information on vessel track lines from the Silent Inspector system. Rutgers will explore how information on vessel track lines can be incorporated in the optimization process to prevent patterns of repeated behavior by barges dumping material.

In a specific scenario, the DODSS has teamed with the Savannah District to develop a confined disposal facility (CDF) utilization optimization tool for the Kings Island Turning Basin (KITB) in Savannah Harbor, Georgia. The tool optimizes CDF sequencing through use/rest requirements, dredging requirements, and CDF capacity. The optimization tool incorporates applied knowledge associated with dredging operations in KITB, data analysis, and a rules-based scheduling program. The CDF optimization tool schedules CDF's, compares the schedule to dredge requirements in KITB, and determines the resulting CDF capacity. Figure 2 shows the long-term schedule for CDF using the *process view.*

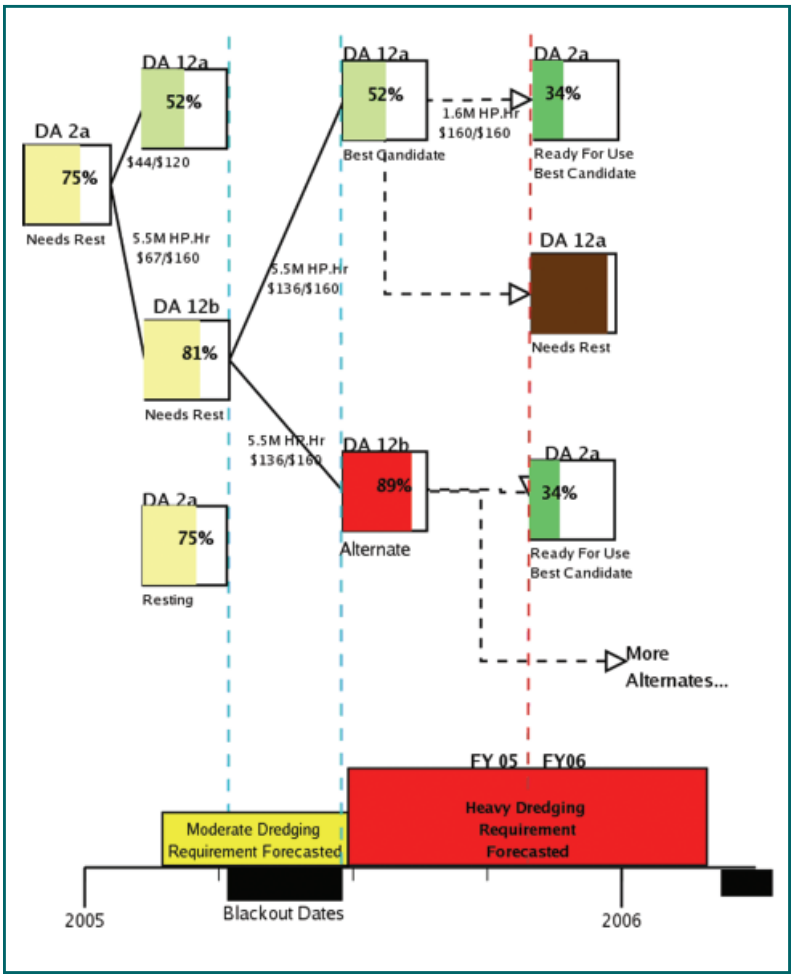

Figure 2. Process diagram view

DODSS PDT members:

Sheryl Carrubba - Portland District
KC Clark - New Orleans
Heather Jennings - New Orleans(A)
Mike Cox - Rock Island District
Tom Fredette - North Atlantic Division
Joe Hrametz - Galveston District
Jim Jeffords - Jacksonville District
Dan Krumholz - St. Paul District
Bill O'Donoghue - Detroit District
Johnny Rozsypal - Galveston District(A)
Wade Seyle - Savannah District
John Tavolaro - New York District
Howard Varnam - Wilmington District

ERDC developers:

Gary L. Howell - CHL
Bernard Hsieh - CHL
Jay Rosati - CHL
Derek Wilson - CHL

ERDC coordinating members:

Jim Clausner - CHL Assoc TD Navigation
Joe Gailani - CHL
Denise Martin - ITL Assoc TD Informatics

DODSS is not intended to replace human experts and decision makers, but is designed to improve their productivity and reduce the tedium of data assimilation. As with human decision makers, DODSS results depend on the quality and accessibility of input data. Future plans for DODSS include adding modules to Goethals. A dredge contract award monitor module will be added and a dredge availability module is being designed. Longer-term efforts are focused on systemwide dredge requirements and optimization of multi-FY project schedules and budgets.

For more information on DODSS, contact any member of the project delivery team (PDT) or the PDT leader, Gary Howell (Gary.L.Howell@erdc.usace.army.mil). The DODSS project maintains a Wiki with up-to-date information about the project. It is available on the Corps network at https://dodss.wes.army.mil/.

New Jersey community "pines" for beach season

by JoAnne Castagna, Ed.D., U.S. Army Engineer District, New York

It's below 30 degrees on a February day on Bradley Beach in New Jersey. Locals are walking their dogs along the snow-covered shore, riding bicycles on the promenade and even sporting wetsuits and surfing the ice-cold waves.

It was obvious to a group of earmuffed U.S. Army Corps of Engineers personnel that the residents of Bradley Beach are pining for beach season as they walked along the shore with local and state officials surveying the dune work created by the community.

The residents are also literally "pining" for beach season. For the past five years they've been donating their used Christmas pine trees to the town to create dunes along the mile-long Bradley Beach shoreline to maintain the sand nourishment work completed by the Corps in 2001.

The Bradley Beach shoreline had experienced erosion due to previous storms and was in need of sand nourishment. In July 1999 the U.S. Army Corps of Engineers, New York District began a sand nourishment project on Bradley Beach, in Monmouth County, NJ, as part of the Corps' Sandy Hook to Barnegat Inlet Beach Erosion Control Project.

The Corps contracted Weeks Marine to place 3.1 million cubic yards of sand on the shore, which added over 200 feet of beachfront, and to create seven groin notches and four outfall extensions.

"Dune creation was not a part of the Corps' project because they are not needed in this project area for protection because the area has a naturally high backshore. If dunes were needed the Corps certainly would have added this feature," said Lynn Bocamazo, Senior Coastal Engineer, USACE, New York District, who designed and monitored the completed beach nourishment project.

Figure 1. Dunes are laid out in a saw-tooth design

After the project was completed in January 2001, a local effort arose. The Bradley Beach residents wanted to take an additional step to protect the Corps' work, so they decided to create beach dunes. Beach dunes control beach erosion by limiting wind-blown sand loss.

"We wanted to protect the beach's promenade from future storms and give it a new look, like no other town has," said Richard Bianchi, Operating Supervisor of Public Works for Bradley Beach, who designed the dune project and has been a lifelong resident of Bradley Beach.

"We also wanted to block out the noise for sunbathers on our beaches. The only noise that you hear now is the sound of the waves and birds. The dunes also protect beach residents' homes and provide them a beautiful ocean front and privacy."

Figure 2. Donated Christmas trees being used to create dunes on Bradley Beach

Bocamazo said, "Bradley Beach is not the first community along the 21-mile Sandy Hook to Barnegat Inlet Beach Erosion Control Project area to create dunes. Manasquan Beach and Monmouth Beach created dunes using fencing or dune grass, or a combination of planting and fencing. Bradley Beach is the first to use Christmas trees."

Every January Bradley Beach residents leave their used Christmas pine trees on the curbside where a truck from the Bradley Beach Public Works Department picks them up.

So far an estimated 20,000 trees have been used to create a stretch of 4- to 9-ft-high dunes along the mile-long oceanfront. This past holiday season, an additional 3,000 trees were added.

On the beach the trees are placed on the ocean side of the dune system. They are placed on their sides where they can capture sand blowing inland from the beach and eventually form permanent dunes.

The community is designing the dune system in what is called a saw-tooth design. "Snow fences are being placed on an angle along the promenade side of the dune to support the dune system. This also makes the beach look appealing from the shore side," said Bianchi.

Dune grass is being planted on the dunes. "When the project began the town planted 50,000 plugs of dune grass on the dunes to keep the dunes anchored," said Bianchi. "We are in the process of receiving a grant for an additional 25,000 to 50,000 plugs of dune grass."

The beach dunes have proven to be successful. "The placement of Christmas trees in combination with snow fencing and dune grass has proven to be very effective in capturing windblown sand that results in the growth of the height and width of the dunes," said Bianchi.

The dunes have been shown to be beneficial to the environment because they provide a more diverse habitat than just sand alone. "The dunes create a sanctuary for sparrows. They also attract all kinds of insects that all wild birds eat," said Bianchi.

The public also finds the dunes appealing. "Everyone is excited about the dunes. They think it is a wonderful project and they love the feeling of the beautiful dunes and scenery," said Bianchi.

Bianchi adds that the public now has a personal connection with their beach that draws 20,000 residents every beach season. "Their donated trees will be there forever. They don't rot. The residents are now a part of the beach."

Community officials are also very supportive of the project and think it's beneficial to the public. "When you walk through the dunes to get to the beach from the promenade psychologically it provides the illusion that you are leaving one world for another," said Stephen Schueler, Mayor of Bradley Beach who is a strong supporter and the financer for the project. Schueler will be funding the project till 2008, the year the dune project is expected to be completed.

It's this type of community involvement that the Corps likes to see. Bocamazo said, "A pro-active municipal public works department is a beneficial addition to any Federal or State beach erosion control project. Bradley Beach is trying to aggressively maintain the sand that was placed there and is an active participant in the project's success."

For more information about the Corps' various beach erosion control projects, please contact the author at Joanne.castagna@usace.army.mil. Dr. JoAnne Castagna is a technical writer for the U.S. Army Corps of Engineers in New York City.

Dredging Calendar

October 24-28
London Convention Meeting (Convention on the Protection of the Marine Environment from the Dumping of Water and Other Matter). International Maritime Organization (IMO), London, UK.

October 25 - 27
The Second Regional Workshop on Dredging, Beach Nourishment, and Bird Conservation
Islandia Marriot, Eastern Long Island, New York
POC: Richard A. Fischer 502-315-6707
Richard.A.Fischer@erdc.usace.army.mil
http://el.erdc.usace.army.mil/05oct-birdwksp.pdf

May 14-18
31st PIANC World Congress, Portugal, Estoril
pianc2006@Inec.pt; Estoril, Portugal

June 25-28
WEDA XXVI, San Diego, California; Western Dredging Association, email: WEDA@COMCAST.NET

ERDC EL DOTS Program holds significant seminar

The Dredged Material Assessment and Management Seminar was held on 26-28 April 2005 in Boston, MA. This training is held at least once a year by the Dredging Operations Technical Support (DOTS) Program and is hosted by a Corps Division or District office. This seminar focuses on assessment and testing for waters regulated under the Marine Protection, Research, and Sanctuaries Act and the Clean Water Act. Approximately 20 lecturers spoke on topics such as Regulations and Policies; Inland, Ocean, and Upland Testing Manuals; Sediment Quality Guidelines; Innovative Technologies; Contaminated Sediment Remediation; Risk Assessment Applications; Nearshore/Aquatic Placement Models; and other dredging-related subjects. The seminar was open to all stakeholders involved in dredged material testing, assessment, and management including Federal and State regulatory personnel directly involved in managing dredged material and contaminated aquatic sediments. Approximately 175 attendees at the seminar represented Corps, State, and other Federal agencies, as well as universities and private industry. All lecture presentations can be found at http://el.erdc.usace.army.mil/dots

POC: Dr. Robert M. Engler, 601-634-3624 or Robert.M.Engler@erdc.usace.army.mil.

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Articles for *Dredging Research* requested:

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Articles from non-ERDC authors are solicited for publication, especially if the work described is tied to the use of ERDC-generated research results. Research articles that complement ERDC research or cover wide field applications are also accepted for consideration. Manuscripts should use a nontechnical writing style and should include suggestions for visuals and an author point of contact. Point of contact is Janean Shirley at Janean.C.Shirley@erdc.usace.army.mil.

Dredging Research

This bulletin is published in accordance with AR 25-30 as an information dissemination function of the Environmental Laboratory of the U.S. Army Engineer Research and Development Center. The publication is part of the technology transfer mission of the Dredging Operations Technical Support (DOTS) Program and includes information about various dredging research areas. Special emphasis will be placed on articles relating to application of research results or technology to specific project needs. The contents of this bulletin are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or the approval of the use of such commercial products. Contributions are solicited from all sources and will be considered for publication. Editor is Janean Shirley, Janean.C.Shirley@erdc.usace.army.mil. Mail correspondence to the Environmental Laboratory, ATTN: DOTS, Dredging Research, U.S. Army Engineer Research and Development Center, Waterways Experiment Station (CEERD-EM-D), 3909 Halls Ferry Road, Vicksburg, MS 39180-6199, or call (601) 634-2349. Internet address: http://el.erdc.usace.army.mil/dots/drieb.html.

James R. Houston, PhD
Director

DEPARTMENT OF THE ARMY
ENGINEER RESEARCH AND DEVELOPMENT CENTER
WATERWAYS EXPERIMENT STATION, 3909 HALLS FERRY ROAD
VICKSBURG, MS 39180-6199

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