FROM REFUSE TO REUSE

USACE

Beneficial Uses of Dredged Material

THOMAS R. PATIN

Dredged material is well suited to public parks and recreational areas such as Belle Isle on the Detroit River.

Dredged material is a manageable resource suitable for a wide variety of uses. Thousands of cases of such uses have been documented in North America. Urban managers, land use planners, and engineers recognize the contribution of this resource to the establishment of new parkland; expansion of ports, airports, and other infrastructure foundations; and availability of topsoil for parks, golf courses, and landfills. Conservationists see the benefits of dredged material in restoring degraded or lost habitat and in some cases creating new habitat. The opportunities for innovative uses by entrepreneurs are unlimited.

Commercial, Industrial, and Urban Uses

Dredged material has been used for thousands of years on the coasts, rivers, and lakes of Europe and Asia. In North America dredged material has been used in commercial, industrial, and urban settings since European settlement. All seafaring people have met the challenge of maintaining channels and boat harbors through dredging, and have used the recovered material as fill. Every major port in the world today has contributed dredged material to construct ports, airports, and shopping areas, among other projects. The foundations of many U.S. airports—including LaGuardia International Airport, New York City; Washington National Airport, Washington, D.C.; Portland International Airport, Oregon; San Francisco/Oakland Airport; and San Diego International Airport—are made from this material. Galveston, Texas, and Portland, Oregon, are among numerous cities that have used dredged material to develop land to support business districts. Coarse-grained materials such as those high in sand or gravel generally are more suitable for use in foundations and intensive land development.

Recreational Grounds and Beaches

The high demand for recreation areas has placed this use among the most prevalent for resources from dredging. Recreational sites require open space, and structures built on them are usually lightweight, suiting them to the weak-foundation conditions associated with fine-grained dredged silts and clays. The demand for public parks at aquatic sites also encourages development with dredged material. East Potomac Park and the Jefferson Memorial in Washington, D.C., are both constructed on dredged material. The park contains a golf course, tennis courts, and open space for picnicking, walking, and running. Mission Bay in San Diego and Belle Isle in the Detroit River between Detroit, Michigan, and Windsor, Ontario, Canada, are other good examples. Belle Isle includes a zoo, botanical gardens, a beach, ballfields, and picnic areas.

Beach nourishment is another traditional use of dredged material. Millions of cubic meters of dredged sand are applied each year to beaches throughout the coastal and inland areas of the world to prevent erosion, improve aesthetics, and enhance recreational use.

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East Potomac Park in Washington, D.C., is another example of creation of parkland with dredged material.

Berm construction is a relatively new use for dredged material. Stable offshore berms in deeper water protect beaches by reducing wave energy, and inshore feeder berms in shallower water serve as a sand source for beach nourishment. Berms have been constructed at Norfolk, Virginia, and Mobile, Alabama, among other places.

Natural Resources

Dredged material can be used to develop wetland, upland, and aquatic habitat, among other applications to protect and enhance the environment. Habitat development is the establishment and management of relatively permanent and biologically productive plant and animal ecosystems. Flexible placement techniques for dredged material make it an attractive and feasible alternative to more conventional material options for habitat development, especially for endangered species. Since 1974 thousands of hectares of wetland and upland habitat have been developed in this manner. Fine-grained materials such as silts and clays are the material of choice for this application.

Wetlands in every coastal state and most inland states have either been created, restored, or at least nourished with dredged material. Cordgrass marshes have been established in the the marshes of southern Louisiana; central Tampa Bay, Florida; Gaillard Island in Mobile Bay and Coffee Island in Mississippi Sound in Alabama; and at least 30 locations on the Gulf Intercoastal Waterway in Texas. More than 70 wetlands constructed on dredged material—from the Chesapeake Bay in Maryland and Virginia to Cape Canaveral, Florida—each range from 0.2 to more than 40 hectares (0.5 to 100 acres). Two Northwest dredged-material marshes at Jetty Island in Puget Sound, Washington, and Miller Sands in the lower Columbia River, Oregon, emphasize benthos and fish use. Dredged-material wetlands in California are often established with the goal of restoring habitat for endangered species. Successful California examples include Muzzi Marsh in Marin County, Salt Pond #3 and Warm Springs at Hayward, Boca Chica marsh near Long Beach, Donlin Island and Venice Cut marshes in the San Joaquin River intertidal reaches, and Batiquitos Lagoon at Carlsbad.

Upland habitat developers apply many construction and management techniques using dredged material to meet the needs of the targeted species. Approximately 5666 hectares (14,000 acres) of confined upland habitat placement sites on the Tennessee-Tombigbee Waterway are managed by the U.S. Army Corps of Engineers as waterfowl overwintering areas, bottomland hardwoods, mixed shrub and tree stands, or other wildlife habitat.

Although the use of dredged material in aquatic and marine habitat is probably the oldest development concept for naturally occurring habitat, it is considered relatively new because of limited historical documentation. Proven planning, construction, monitoring, and success criteria for this application did not exist until recently; compared with the number of instances of use in wetland and upland habitat, there are few documented cases of aquatic uses. However, oyster bars, clam flats, lobster beds, fishing reefs, and seagrass beds have all been successfully developed with dredged material at a number of sites in the Chesapeake Bay, Long Island Sound, the Gulf of Mexico, the Tombigbee and Ohio rivers, and other Atlantic and Pacific Coast locations.

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Flexible placement techniques make dredged material attractive for wetland restoration and habitat development, especially for endangered species.

More than 1 million waterbirds annually nest on 2,000 islands built by USACE with dredged material during the past century. These islands are generally used during migration and overwintering by 37 colonial species, many of which are threatened or endangered. Mammal and amphibian use is also significant. Explicit engineering and environmental criteria for meeting the life requirements of the various target species have been published and are providing worldwide guidance for the design and management of the islands.

Agriculture Uses

Numerous interior upland dredged-material placement sites to which material is no longer being added are now being used for forestry, horticulture, and agriculture. Horticultural and truck-crops include cabbage, sweet corn, and other commercial garden crops; these are growing on dredged material adjacent to the Columbia River in Oregon and the Atlantic Intracoastal Waterway in New Jersey. Pulpwood plantations, bottomland hardwoods, and riparian forests have been planted on sites on the Tennessee-Tombigbee Waterway, the Ohio River Valley, and the Mississippi River Valley. Soybeans, cotton, other row crops, and hay are grown in suitable dredged-material placement sites in South Carolina, Mississippi, and other southern states.

Recent Development

Use of dredged material as a soil is common, but efforts to use it to create manufactured soil are relatively new. Approaches include mixing dredged material with cellulose in the form of either yard waste or sawdust and adding organic-nutrient waste such as reconditioned biosolids from sewage sludge or cow manure. Dredged material serves as the soil base in the mixture, yard waste or sawdust supplies organic material and nutrients, and the biosolids supply slow-release organic nutrients. The right mixture will yield fertile soil of good tilth. Screening tests are being developed by USACE at its Waterways Experiment Station in cooperation with private developers to evaluate the productivity of different mixtures. Four cultured plants—tomatoes, marigolds, ryegrass, and vinca—are used to test productivity. The most productive mixtures can be used as landscaping topsoil for parks, roadsides, homes, and housing developments.

Dredged material from each source is different and will have its own best mixture. For example, screening tests showed that the most productive manufactured soil mixture using material obtained from Toledo Harbor, Ohio, was 60 percent dredged, 30 percent locally available sawdust, and 10 percent reconditioned biosolid from sewage sludge. This mixture was selected for field demonstration.

USACE and interested commercial firms have recently developed a use for dredged-material silt as an ingredient of bagged soil. The dredged material from Toledo Harbor has also been tested by a commercial company and found suitable for its bagged-soil product. Approximately 3.06 million cubic meters (4 million cubic yards) of silt are needed for bagged soil each year. The manufacture of soil is a productive means of managing generated waste that could prove to be a partial solution to disposal problems associated with dredging and organic-waste production.

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Reevaluate, Research, Renew
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The North Carolina Department of Transportation will monitor the performance and evaluate the potential for transportation applications of various solid wastes and recycled products. Research will continue into the best methods to incorporate these products in highway construction and maintenance. Engineering considerations, marketing potentials, availability of products, and cost considerations are integral to the department's efforts to implement state and federal legislative initiatives. Additional projects requiring the use of various solid wastes and recycled products will be identified, designed, and let to contract. Scrap tires, roofing shingles from the manufacturing waste stream, plastics, vegetative debris, shingles, fly ash, and demolition debris will remain the focus of research, testing, and use by North Carolina.

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Summary

Dredged material has many common uses, and new uses continue to be identified. In general, coarse-grained materials lend themselves to industrial and commercial development and beach nourishment. Fine-grained materials are more suitable for recreational, natural resource, or agricultural uses. Legal, regulatory, and economic constraints are more likely than technical feasibility to limit these uses. When beneficial uses are considered in project strategy, they should be incorporated into the early stages of project planning.

Acknowledgement

Permission was granted by the Chief of Engineers, U.S. Army Corps of Engineers, to publish this information.

Numerous reports, workshop proceedings, and manuals on the topic of reclaiming dredge material are available from the Waterways Experiment Station U.S. Army Corps of Engineers. The American Society of Civil Engineers has accumulated and published additional information. The Permanent International Association of Navigation Congresses has recently published a practical guide on the topic that is accessible to a wide audience.

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Profiles

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Florida and has actively promoted engineering education, placing particular emphasis on the need for professionalism. He has served on or chaired educational committees for the American Society of Civil Engineers, the Florida Engineering Society, and the Accreditation Board for Engineering and Technology. He has written many research papers for FDOT that have been published in numerous professional journals.

At the national level Smith has represented FDOT through his membership on three AASHTO committees: the Subcommittee on Materials, the Standing Committee on Research, and the Research Advisory Committee. He has served as president of both the local branch and state section of ASCE. He has been named Engineer of the Year by both the local and state sections of ASCE, and he received the same honor from the North Central Chapter of the Florida Engineering Society. His other awards include the 1990 Annual Award from the Geotechnical and Materials Engineer Council of the Florida Institute of Consulting Engineers, and the Distinguished Service Award from the University of Florida in 1992.

Smith is currently leading a national initiative to respond to recent changes in the Federal Aid Policy Guide that relate to materials acceptance and certification on federal-aid projects. He hopes to achieve consensus among AASHTO's relevant committees on a course of action to expand the scope of laboratory certification programs, to provide a smooth transition to the implementation of new federal guidelines for construction materials.