TECHNICAL SESSION 15: Agricultural Applications

Richard A. Price, Chair

USE OF DREDGED MATERIAL AS A SOIL AMENDMENT

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Navigable waterways play a vital role in the economy of this nation. River dredging is a necessary activity to maintain open transportation channels for river traffic. River dredging is a process where various machines equipped with scooping or suction devices are used to deepen waterways. The US Army Corps of Engineers is currently responsible for removing about 300 million cubic yards of sediments from these waterways by dredging to maintain navigable waters in the United States (Bartos 1977). Environmental problems of disposal of dredged material in open water associated with production of sediments which can be damaging to riverine habitat for various aquatic life. Thus, there is a need to find an environmentally optimal place to deposit this material. About 70 percent of dredged sediments are presently placed in open water. However, there is an increasing desire to investigate alternative disposal practices including land application. One possible alternative is to use the dredged material as an amendment to agricultural cropland.

About 16 million hectares of cropland in the United States could benefit from a greater depth of good soil (USDA 1967). Several million hectares of these soils with lower productivity are associated with flooding, high water or periodic wetness, and are conveniently located near US waterways. Coarse-textured dredged material can improve these fine-textured heavy clay soils by increasing soil aeration, water infiltration, and decreasing soil compaction. It also could help with costs through lowered horsepower requirement of tillage, less chemical needed for weed control, and faster warming of soil in early spring, and thereby increasing yields of crops.

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AGRICULTURAL USE OF YAZOO RIVER DREDGED MATERIAL

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The use of Yazoo River dredged material for improving marginal farmland was considered as an alternative to thick-layer confined disposal facilities (CDF). Large, thin-layer CDF's can be placed on marginal farmland making it more suitable to cotton (*Gossypium hirsutum L.)* production.

A study was conducted to demonstrate cotton production on Yazoo River dredged material. Dredged material was collected from an existing thick-layer CDF and cotton was grown in the greenhouse under various fertilizer treatments. Lint yields equivalent to 594 kg/ha ginned lint were obtained with an N rate of 168 kg/ha. After the greenhouse study, cotton was planted on the CDF using normal agricultural practices and N was applied at 78 kg/ha preplant and 78 kg/ha sidedress. The thick-layer CDF produced an average yield of 883 kg/ha of ginned lint.

Sediment core samples collected from a 1.6 km stretch of river, scheduled for dredging, were mixed with soil from the proposed site of a thin-layer CDF at 1:3 and 3:2 soil to sediment ratios. These sediment/soil mixes were subjected to the greenhouse test along with soil from a nearby productive cotton field.

Fertilizer rates recommended by soil tests produced 319 kg/ha in the 1:3 mix, 178 kg/ha in the 3:2 mix and 244 kg/ha in the cotton field soil. Results of this study indicate that Yazoo river dredged material can produce cotton yields comparable to yields in area cotton fields.

BENEFICIAL USES OF DREDGED MATERIAL: AGRICULTURE USE

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Beneficial uses of dredged material are being investigated by local, State, and Federal resource and regulatory agencies as a long-term, viable alternative for dredged material

placement. In the Chesapeake Bay region, beneficial uses of dredged material are crucial given the necessary maintenance dredging and the limited number of placement options. This presentation focuses on two areas. The first topic is the placement of dredged material on agricultural land and selected beneficial use projects. The second topic is a summary of research conducted in the United States on the use of dredged material as an amendment for agricultural soils.

Though the case studies presented are small-scale projects, the potential exists for larger-scale application of this technology. Given the availability of suitable placement sites and the institutional and public support, agricultural applications are a very feasible and economically practical application.

CURRENT AGRICULTURAL APPLICATIONS OF DREDGED MATERIAL IN WASHINGTON, NEW JERSEY, SOUTH CAROLINA, AND MISSISSIPPI

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During the Dredged Material Research Program in the 1970s, a number of productive and agricultural applications of dredged material were studied. These findings were published in Corps reports and have been encouraged as beneficial use applications since that time. The actual "count" on agricultural applications is uncertain; however, there are several states in which this is practiced on a wider scale than in other locations. The primary reasons that agricultural practices using dredged material as soil supplements are carried out now are varied, but generally involve private landowners who gave an easement to the Corps to allow dredged material to be placed on their property, then they farmed the disposal site. The other most common reason is a public or private conservation or natural resources office growing food crops in disposal sites for wildlife utilization in winter months and during migration, especially for waterfowl, turkey, and deer.

Washington. Along the Columbia River, dredged material is either placed in open water in the River, placed on natural or manmade islands such as Miller Sands, or placed upland above natural bank. This material is primarily sand, with some fines and some pumice and other small rock. When the material is placed in upland situations, it provides a different substrate for planting, and when placed in thin layers, can be readily mixed with clayey soils. Along the north bank of the Columbia between Longview and Portland, there are numerous fields of truck and field crops planted on dredged material. In addition, some of these areas with thicker deposits of sand are used as livestock feed lots because sand material is well-drained and provides a much healthier situation for growing out cattle for market. In addition to these uses of maintenance material, when Lake Vancouver (a silted-in ox-bow lake of the Columbia) at Vancouver, WA, was restored, the dredged material taken from the lake bottom was used for agricultural enhancement as well as for beach nourishment, island creation, a recreation park, and spillway construction.

New Jersey. The Philadelphia Corps District has 17 confined disposal facilities (CDF) along the east bank of the Delaware River near and south of the City of Philadelphia on the New Jersey banks. These sites are mostly privately owned, and the Corps had easements to place dredged material. Several sites that are more infrequently used have been farmed by landowners between dredging cycles. Crops grown include corn, soybeans, and hay for cattle. Crops appear to be thriving each year. At one CDF, the farmer bales *Phragmites australis* for his cattle to eat during dry summer months. At another, an oil company has purchased part of the CDF to develop it into a forested wetland mitigation bank. While these activities are occurring, wildlife utilization of these sites is both diverse and abundant, with pheasants, deer, songbirds, raptors, and waterfowl all observed on the CDFs.

South Carolina. Several of the largest CDFs in the Charleston, SC, area are privately owned, with easements granted to the Charleston Corps District. Between dredging cycles, some of the larger CDFs are planted in soybeans and corn after dewatering. It should be noted that these CDFs also contain waterbird nesting colonies and have other wildlife utilization as well.

Mississippi. In addition to the study conducted in the Yazoo Basin with thin layer disposal, there are a number of other disposal sites in Mississippi being farmed. These are primarily located in two areas. The first and least used as older disposal sites in the Upper Yazoo Basin, where landowners have breached Corps dikes between dredging cycles and grow winter wheat and soybeans in the CDFs. The second and much more abundant use is in the Tennessee-Tombigbee Waterway, where Mobile Corps District annually plants some of its CDFs in wildlife food crops for overwintering waterfowl, as well as for deer, turkey, quail, and other game and non-game wildlife.

Other States. Texas farmers and ranchers regularly pasture livestock in CDFs along the Gulf Intracoastal Waterway. In Minnesota, Maryland, Louisiana, Alabama, and Mississippi, CDFs have been planted in trees for development as pine or pulpwood plantations. In California's Delta leading from the Central Valley (American, San Joaquin, and Sacramento Rivers), farmers vie for rights to dredged material because they use it for either dike regrading and repair or for agricultural enhancement of their peaty soils. Competition is so keen there for the material that it is difficult to put it to other beneficial use such as wetland restoration.

TECHNICAL SESSION 16: Aquatic and Marine Habitats A

Jan Brooke, Chair

THE RESPONSE OF BENTHOS TO OPEN WATER DISPOSAL

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Macrobenthos quickly recolonized an area 1 by 5 k following the spring 1987 open water disposal of approximately 3.7x106 cy of sediments dredged from the Rappahannock Shoals section of the Baltimore navigation channel, during the deepening of the channel to 50 feet. The disposal site was located west of the channel at about 13 m depth in the mesohaline-polyhaline transition zone of Chesapeake Bay. Sediments at the disposal site were initially mud (median phi of 6.5) with the dredged material being slightly sandier (median phi of 6.0).

The success of the macrobenthos in recolonizing the disposal site was related to the flexible life histories of the species that allowed a rapid recovery of populations that was independent of the timing of disposal (Spring or Summer) and the slightly sandier grain size of the dredged material. While the macrobenthos that dominate this area of Chesapeake Bay are primarily estuarine opportunists there was a progression through time in the recolonization relative to size of organisms and sediment reworking.

Over a period of four years the dredged material disturbed areas maintained a higher secondary productivity relative to nearby reference sites.

DESIGN OF A SUBMERGED DREDGED MATERIAL ISLAND AS HABITAT MITIGATION IN DRAYTON HARBOR, WASHINGTON

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Port of Blaine, Washington was created in the early 1950's to support a commercial fishing interest on the Pacific Northwest and Alaskan Waters. The Harbor was initially dredged from a broad tidal flat, and enclosed with a rubble mound breakwater. To accommodate future growth of the harbor, the breakwater was aligned to capture and protect some additional virgin intertidal area.

As a consequence of the sheltering by the breakwater, the now protected tidal flat became higher biologically active. Although always intended as an area for future expansion, the permitting agencies were very reluctant to permit dredging and loss of the mud flat without significant mitigation. Adjacent shoreline areas were already classified as highest quality, so loss mitigation and disposal of dredge material in the immediate area was precluded.

A twofold strategy was devised to maximize the value of the dredging from an environmental perspective and to use the dredged material for project benefit. First, the behavior of the local ecosystem was described. The biological value of the site was determined, not as mere acreage to be removed, but rather as linear feet of "edges", or all the small rivulets in the intertidal zones which supported biological activity. A dredge plan was then developed which created terraces to support various intertidal communities, and fingers of land intended to maximize the total amount of edges that could occur.

The residual dredged material was used to construct a submerged disposal island in the biologically less active center of the bay. The material was used to raise the bottom elevation to a depth of greater biological activity. The island was shaped to conform with prevailing tidal currents, and armored at strategic points to ensure island stability without totally encasing the disposal mound. Poor quality material was placed inside berms of competent material, and then capped. Select substrate was used in the capping material to promote certain types of biological recolonization. The long term value of the disposal island is to have created new habitat with commercial harvest value.

EXPERIMENTAL DISPOSAL OF DREDGED MATERIAL IN THE SNAKE RIVER, IDAHO/WASHINGTON

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Completion of the Lower Granite Lock and Dam Project on the Snake River in 1975 provided electrical power production, flood control, navigation, and recreation to eastern Washington and west-central Idaho. Several of those uses are being threatened by annual inflows of about 2.3 million cubic yards (2.1×10^6 m^3) of fine sediment to the upstream end of Lower

Granite Reservoir. Dredging was conducted in 1986 with land disposal on dedicated wildlife habitat.

Because of limited land disposal options, experimental in-water disposal was initiated in 1988. Three in-water disposal options were evaluated: in 1988, a mid-depth site, originally 6.1 to 12.1 m (20 - 40 ft) deep was modified to a depth of 1.8 to 3.6 m (6-12 ft), thereby creating an underwater plateau; an island was created in 1989 immediately downstream of the underwater plateau; and in 1992, the third type of in-water disposal alternative, a deep (> 60 ft) water disposal site was built.

Monitoring of fish and benthic communities began in 1988 and continued annually through 1993. We compared fish and benthic invertebrate metrics between disposal and reference sites with similar habitat characteristics (depth, velocity, macrophytes, etc.). Shallow, low gradient shorelines with sandy substrate were created along the island with dredged material. This habitat is preferred rearing habitat for subyearling chinook salmon *(Oncorhynchus tshawytscha)* and became a significant rearing area in the middle reservoir. One concern expressed at the inception of the project was that the created habitat could be overly attractive to downstream juvenile salmonid fishes. We saw no evidence that residualization of chinook salmon and steelhead *(Oncorhynchus mykiss)* occurred as a result of the in-water disposal.

The second major concern was the potential to attract salmonid fish predators such as smallmouth bass *(Micropterus dolomieu)* and northern squawfish *(Ptychocheilus oregonensis)*. Generally, numbers of juvenile anadromous fish predators in shallow waters were higher at reference stations than at disposal stations. Fish community composition at disposal stations was similar to that at reference stations and did not exhibit significant variability in species abundance and composition during 1989 through 1993. We found no evidence that species richness and the percent tolerant species were different between disposal and reference stations.

Fish community abundance and composition were more variable among shallow disposal and reference stations than mid-depth and deep stations, possibly reflecting the susceptibility of shallow water fishes to environmental disturbances. Disposal of in-water sediments to create shallow water habitat in Lower Granite Reservoir has potential for increasing localized fish diversity. Creating more shallow water habitat could increase fish species richness, increase availability of food items to outmigrating yearling salmonids, and increase available rearing habitat for subyearling chinook.

If managers have concerns for increased species richness, dredged material can be disposed in mid-depth to deep habitats with no apparent adverse ecosystem effects. These disposal stations were represented by few fish species and low overall abundances.

PARTNERED FEASIBILITY AND DESIGN FOR AQUATIC AND WETLAND HABITAT RESTORATION IN THE INTERTIDAL HUDSON RIVER, NEW YORK

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The Hudson River Habitat Restoration Project (HRHR) is an extensive, partnered, and cost-shared (with the State of New York) restoration effort to bring back emergent freshwater tidal wetlands, improve native aquatic plant communities, control exotic vegetation, enhance fisheries, and manage the existing 11 million cubic yards of dredged material and maintenance dredging as the need arises in an environmentally-acceptable, beneficially useful manner. This work is occurring in more than 100 miles of the Hudson River between New York City and the lock and dam at Troy, NY.

The Hudson was historically intertidal upriver of Troy, and had numerous meandering shallow channels and braided-stream wetlands, small islands, and widely fluctuating water levels. By the mid-1700's, the river was being trained and managed for boat traffic and commerce, and locks and dams were built in its upper reaches to stabilize water levels. The City of Albany and other towns along the banks were built in or adjacent to wetlands and river bank forest. By the mid-1800's, the river had been constrained on both sides by railroad corridors, and within the River by training dikes and rock/timber cribs constructed by the US Army Corps of Engineers. In addition, the Corps dredged approximately 11 million cubic yards of primarily sandy material from the navigation channel and placed it on and between river islands behind the rock/timber cribs. In recent years, dredged material has been placed on island uplands which are authorized disposal sites. This early dredged material placement, coupled with the training constraints on the channel, caused many of the river islands to merge into higher and larger islands, to disappear entirely, and/or to attach themselves to the river banks.

Resulting cumulative impacts of all of the above activities include loss of most islands and wetlands as they once existed, a more stable (and navigable) river level, loss of migratory fish passages, introduction of exotic species, proliferation of native pest species, and increased industrialization and urbanization along the entire river. Since little historic biological data exist except maps, sketches, and figures of islands, wetlands, and river topography and hydrology from more than 150 years ago to the present, it is difficult to assess impacts quantitatively; however, all agencies and private organizations involved in the HRHR acknowledge that significant impacts have occurred and are currently working to gather any existing data and fill the gaps.

The Corps completed a 3-year reconnaissance study in the HRHR in 1995, in which it identified willing partners and assessed the potential for restoration work in the Hudson River floodplain. The Corps and the State of New York are currently working on a 3-year cost-shared feasibility and design study, in which prioritized wetland sites on dredged material islands and/or other impacted areas are being evaluated from both engineering and environmental standpoints. Preliminary designs are being made for restoration at Schodack-Houghtling Island Complex, Manitou Marsh, and Hudson Bay South. Site-specific data sets and designs are being completed, and will be implemented in the next phase of the HRHR. In addition, a Hudson River hydrogeomorphology (HGM) model compatible with the Corps' HGM research is being developed.

TECHNICAL SESSION 17: Confined Disposal Facilities

Donald F. Hayes, PhD, PE, Chair

THE LONG-TERM STUDY OF POINTE MOUILLEE CDF AND ITS WETLAND AND AQUATIC HABITATS

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Pointe Mouillee is a major restoration project funded and constructed in the late 1970's by the US Army Corps of Engineers (Corps), and is part of a Michigan wildlife management area. The site was jointly designed and sponsored by the Corps and the State of Michigan. The Corps Waterways Experiment Station participated in the interagency design and long-term management plan development, and has conducted long-term environmental monitoring on the site since 1979. The 900-acre confined disposal facility (CDF) was built in the configuration and location of an eroded barrier island in western Lake Erie that had protected the 3700-acre management area which had been rapidly eroding after the loss of the protective barrier island. The total site size is 4600 acres.

The CDF was designed to hold contaminated dredged material from the Lake, protect the overall site, and provide upland and wetland habitats and recreational facilities. The long-term management plan signed by partnering agencies in 1979 includes wetland restoration and creation, waterfowl nesting islands, beneficial uses of dredged material, a marina, a visitors center, hiking and jogging trails, bike paths, fishing piers and year-round fishing, hunting in season, nature education, and a number of natural resource recreational activities such as duck decoy contests and fishing rodeos.

After construction was completed in 1983, Pointe Mouillee was initially monitored without a comparison natural wetland site because there was no other wetland left in that part of Lake Erie (the rest had eroded away or been filled). Vegetation and wildlife were the major parameters measured due to the low level of funding from 1979-1989. In addition, informal surveys of fishermen and other site users were made to determine how and why they used the site. The five cells of the CDF are still being filled, in a 50-year project life. The first cell filled with dredged material colonized in *Phragmites australis*, a native pest plant, but due to continued filling and water level manipulation, this species has since been replaced by a diverse mixture of young cottonwoods, willows, and other woody species, and fresh water marsh. Other cells are colonizing with submerged aquatic vegetation fringed by *Typha*, *Scirpus*, and a number of other desirable wetland species as they are being filled. The projected conclusion of the CDF island in 50 years is to be a mixture of upland habitat interspersed with wetlands and shallow water ponds. It was originally intended to be capped with two feet of clean sediment to prevent any biomagnification by contaminants in the sediment. However, due to the large quantities of sand in the dredged material, this capping will probably not be necessary.

The 3700-acre management area protected by the CDF is being actively managed by the Michigan Department of Natural Resources for multiple habitat purposes, recreation, and education. The recovery of vegetation inside the protected area was initially slowed by lake level rises in the 1980's, but is now revegetating with emergents and floating marsh species. The colonization in the 1990's by zebra mussels and purple loosestrife, and a very high carp population inside the management area is being controlled by manipulating water levels on a seasonal basis. The shallow open water areas in the management area receive very high fish nursery utilization.

In 1990, during the Corps Wetlands Research Program, a comparison wetland was located in Ontario, Canada, at Pointe Pelee National Park, and an arrangement was made with the Canadian Park Service for cooperation and data sharing. Since vegetation and wildlife had been the primary data collected in past years, it was decided to concentrate available resources and research on fisheries and aquatic invertebrates, with continued wildlife observations. Light traps were used to measure abundance and diversity of larval fishes and macroinvertebrates, and seines were used to quantify juvenile fishes. Fish assemblages differed significantly between the two wetlands. At Pointe Mouillee, both larval and juvenile fishes were more abundant, speciose, and diverse than at Pointe Pelee, the natural wetland. Assemblages at Pointe Mouillee were dominated by common carp, yellow perch, sunfishes, and gizzard shad, while Pointe Pelee was dominated by sunfishes, large-mouth bass, black bullhead, and golden shiners. Black bullhead, large-mouth bass, sunfishes, and yellow perch also constituted a recreational fishery at Pointe Mouillee, but were not the dominant larval or juvenile species.

Macroinvertebrate species richness and diversity were comparable between the two wetlands, but abundance was lower at Pointe Mouillee. Assemblages at Pointe Mouillee were dominated by water boatmen, while assemblages at Pointe Pelee were dominated by water fleas, seed shrimp, and scuds. All of these species are prey items for fishes and waterfowl.

In addition to the comparable fisheries and macroinvertebrate communities, Pointe Mouillee is attracting large populations of birds and other animals. The large site is a major migratory stopover point for shorebirds, waterbirds, raptors, waterfowl, and songbirds, and provides nesting habitat for several waterbird colonies, numerous songbirds, mute swans, Canada geese, black ducks, and mallards. Over 200 species of birds have been recorded since the CDF was completed. Birders from Canada and a six-state area frequent the site, especially during migration. Bird migratory use at Pointe Mouillee is greater for shorebirds, waterbirds, and waterfowl than at Pointe Pelee.

Pointe Mouillee is less than 20 years old---a very young wetland system, dynamic and changing. Pointe Pelee is a documented 4500 years old. When the comparison studies began, it was not anticipated that results would be so similar due to the great age differences. Rather, it was intended that Pointe Pelee would serve as a guide for further natural resource refinement at

Pointe Mouillee, and it is continuing to do so. In addition, due to its location in a urban area sandwiched between Detroit, MI, and Toledo, OH, it has become a prime destination place for natural resource recreation. Long-term information will continue to be gathered at Pointe Mouillee as funds become available, and data information exchange will continue with the Canadian Park Service and Environment Canada.

MANAGEMENT OF THE TIMES BEACH CONFINED DISPOSAL FACILITY FOR BENEFICIAL USE

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The Times Beach Confined Disposal Facility (CDF) located in Buffalo, New York was left partially filled 20 years ago, in response to the presence of avian wildlife at the site. The material placed in the site was dredged from the Buffalo River. This dredged material had significantly high concentrations of PAHs, PCBs, and metals. The site has been primarily unmanaged for the last 20 years.

Over this time period a significant data base of contaminant mobility has developed. This collective 20 year study consists of surveys and collections of the vegetation, invertebrate, earthworm, and avian species present. There is also a data base of chemical analyses addressing the change in soil and water contaminant concentrations over this time period.

This presentation will address the observed changes in contaminant mobility and the species at the site, and how accurate the predicted ecological risk assessment was on the site. Current work at the site involves: (1) addressing the need for active management plans involving management with native American plant species, and the role of contaminant mobility changes in a native ecosystem, and (2) development of a model to predict and manage relevant environmental impacts and risks inherent in using similar areas as nature preserves.

BENEFICIAL USE OF A CONFINED DISPOSAL FACILITY AS A COMMERCIAL RACETRACK

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Once a confined disposal site was filled and returned to the sponsor, the concept of the development of a commercial racetrack evolved. The sponsor coordinated with all the appropriate interested parties and all agreed to move forward with the concept. After much discussions and considerations, a plan was prepared and proposed. Sufficient dredged material was removed from the site and a sandier dredged material was brought in from a second disposal site to provide the proper soil properties to compact into the racetrack road base. The participating interested parties successfully coordinated the construction and final completion of the project. The first ever commercial NASCAR race in Savannah occurred in May 1997 on the confined disposal facility.

MANAGEMENT OF CONFINED DISPOSAL FACILITIES FOR BENEFICIAL USES

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Confined dredged material disposal facilities (CDFs) can be managed for beneficial uses. Although CDFs generally contain contaminated dredged material, the transient aquatic and wetland ecosystems as well as the ultimate upland ecosystem can be valuable wildlife habitat if a risk-based management plan is applied. The ecosystems that sequentially occur on the CDF must be accurately predicted and/or established to limit contaminant mobility while providing stable, conservative and diverse plant and animal communities. Ecosystem management for beneficial uses at CDFs is not limited to post-operational phases. During the operational stages management for beneficial uses may include establishment of vegetative types that exclude sensitive species during periods when colonization is inappropriate, while habitat is provided for species at low risk. The application of beneficial uses of CDFs such as production of manufactured soil may also depend on ecosystem management to limit plant and animal colonization in reuse areas.

TECHNICAL SESSION 18: Aquatic and Marine Habitats B

William Muir, Chair

BENEFICIAL USE INTEGRATED WITHIN AN ECOSYSTEM APPROACH TO FISHERIES HABITAT RESTORATION AT THE HOBOKEN RAIL TERMINAL, HOBOKEN, NEW JERSEY

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New Jersey Transit's need to expand rail facilities at the Hoboken Terminal in Hoboken/Jersey City, NJ provided an opportunity to create over 20 acres of interpier finfish habitat and to effect improvements that benefit the entire estuary. To create fish habitat, a system-oriented approach designed to produce sustainable improvements in water quality, circulation, and opportunities for shelter and food was developed. The key component of this effort is the development of a confined disposal facility (CDF) within an existing canal. Several measures to improve local water quality, particularly summer levels of dissolved oxygen (DO), comprise the other components. Species such as striped bass, tomcod, white perch, tautog, cunner and other species are expected to utilize this interpier habitat.

Long Slip canal is an abandoned 100 by 2,000-foot long waterway separated from the main channel of the Hudson River by a 1,500-foot wide interpier area that contains nearly ten acres of piles, the abandoned remnants of two former commercial piers. The canal bulkheads are highly deteriotated. Two combined sewer overflows (CSO) discharge into the canal, depositing organic debris and sediments. Summer canal waters are characterized by chronic extreme anoxia, high salinity, density stratification, and methane blooms. Tidal circulation within the canal is poor. Canal waters reaching the interpier area degrade those waters because circulation is restricted by a shoal along the main river channel. Field studies determined that plant and animal life are absent from the canal in the summer and depauperate during other seasons. The low DO levels in the interpier area preclude otherwise valuable habitat for several juvenile and adult species.

To correct these problems, about 100,000 cy will be dredged from the entrance basin shoal and placed in the CDF. This will create 4.5 new acres for rail yard expansion and make available an additional 4 acres that are currently isolated by the canal. There is additional capacity in the CDF to accept off-site dredged materials not suitable for ocean disposal, partially offsetting construction costs. The CDF will eliminate the oxygen demand of canal waters and canal and entrance basin sediments. Numerical modeling found that the dredging and realigned shoreline eliminated stagnation and stratification, raising DO levels within the entire inlet. The CSO's can not be eliminated, but will be improved and extended into areas of better circulation. Rip rap armor fronting the containment dike will diversify available shelter for juveniles and substrate for food species to attach. Finally, a walkway along the containment berm crest will introduce public access and may yield revenue-generating opportunities that could further offset the costs to sustain the habitat area.

The project is a model of isolating areas of pollution, reducing chronic pollutant loading, realigning the shoreline and bottom topography to improve circulation, and diversifying the habitat structural components applicable to many situations. It provides the preponderance of long-term benefits essential to the approval process.

LONG-TERM EFFECTS OF DREDGING ON FISH COMMUNITIES: A CASE STUDY OF THE LYNNHAVEN ESTUARY

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A comparative study was made of the structure of demersal fish and benthic communities in two sections of a back bay in the lower Chesapeake Bay. This study was an attempt to assess the possible impacts that might occur due to changes in the benthic communities caused by dredging and how that would effect the long-term changes in fisheries populations. Over the past ten years there has been a significant increase in dredging of small channels for non-commercial boating due to the massive increase in development in the coastal zone.

The Chesapeake Bay has been subjected to this type of growth while at the same time there seems to be ever dwindling fisheries resources. While reviewing a request to dredge a small channel in the Lynnhaven Bay, it became evident that there was not sufficient literature relating the effects of dredging. Specifically, we were concerned with the changes that occur to benthic communities and the subsequent changes in fisheries that rely on benthic infauna and epifauna.

This study was designed to compare the changes that have occurred in the Lynnhaven estuary where there are two similar channels, one dredged only five years ago and one dredged over twenty years ago. The assumption being that both channels would have recolonized to similar benthic populations and would have similar fisheries communities within the five year period.

The study was conducted during the winter and spring of 1997 using otter trawl samples for fisheries and a Young benthic grab sampler for the benthic infaunal and epifaunal communities. In comparing the differences in the two areas, the area that had been dredged only five years ago showed a marked decrease in the total number of fish and the diversity of fish species. Further, the benthic community showed a significant decrease in diversity but had a comparable overall biomass to the channel dredged twenty years ago.

The ability of both the fish and benthic communities to recover would appear to take significantly more than five years to recover. This is evidenced by the differences that are shown to occur in diversity and abundance of the fish communities present in the two comparative dredged areas. It is therefore concluded that there are significant long-term effects caused by dredging to the fisheries communities in Lynnhaven Estuary.

DAN-NY: A MANAGER-FRIENDLY GIS FOR VIEWING MARINE ENVIRONMENTAL DATA AND MANAGING DREDGED MATERIAL DISPOSAL IN COASTAL WATERS

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The US Army Corps of Engineers, New York District (NAN) is responsible for management and monitoring of the regional dredged material ocean disposal site known as the Mud Dump Site located 6 miles offshore New Jersey. The Site's proximity to commercial and recreational fishing areas, historic disposal sites, and heavy shipping within the approaches to New York Harbor create a unique set of circumstances in terms of disposal site management.

Information, in the form of project-specific details, sediment testing, and environmental monitoring data have been collected for numerous dredged material projects over the past ten years. This vast database currently exists at NAN in a non-electronic, report-style format which has been the typical means/mode of data storage. Access to the information is both limited and a labor intensive process. Recently, the NAN and the US Environmental Protection Agency, Region II have conducted marine environmental surveys in the New York Bight to acquire additional, site-specific data to assess environmental conditions within a broad area termed the Historic Area Remediation Site, which encompasses the Mud Dump Site. Management of these recent data and developing a capability for accessing both new and historic data from the region will be critical for designation and subsequent management of the expanded disposal area in the years to come. A system designed with the user/project manager in mind which incorporates elements of relational databases and geographic information systems (GISs) would, at both staff and management levels, improve the efficiency of dredged material disposal site management.

NYD funded SAIC for the development and implementation of the Disposal Analysis Network for the New York District (DAN-NY) which shall provide the NYD with the following capabilities to aid disposal site management:

(1) User-friendly access to and display of multi-disciplinary marine environmental data (seafloor photographs, bathymetric surveys, sidescan sonar images, tabular results from chemical, biological, and geological analyses of seafloor samples, etc.)

(2) Archiving of data from individual dredged material disposal events (from NYDISS units, as described in another paper of this workshop)

(3) Information-based siting of disposal projects in the New York Bight

(4) Numerical modeling to simulate dredged material disposal, mound creation, and potential consolidation and/or erosion (as described in second paper of this session)

(5) Real-time management of disposal projects (access to scow logs, disposal marker buoys, monitoring results, etc.)

Although not intended to be an exclusive system for dredged material management in the New York region, DAN-NY is initially being tailored for the NYD ocean disposal site manager. In later iterations and once the system has been utilized by the NYD and the U.S. Army Engineer Waterways Experiment Station (WES), the goal is to broaden the capabilities of DAN-NY for use in other applications and within other Corps Districts.

WILMINGTON HARBOR OCEAN BAR CHANNEL DEEPENING PROJECT: WILMINGTON OFFSHORE FISHERIES ENHANCEMENT STRUCTURE

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The dredging of substantial quantities of rock from the Wilmington Harbor Ocean Bar Channel in southeastern North Carolina provided a unique opportunity to use dredged material beneficially, that is, used in a way that is economically and environmentally acceptable and accrues natural resource benefits to society. Approximately 1.6 million yds^3 of dredged material has been used to construct a marine structure offshore in the Atlantic Ocean to the southeast of the Wilmington ocean dredged material disposal site. The new structure was designed to be a bathymetric anomaly which provides habitat diversity and attracts fish.

About 1.0 million yds^3 of the material to be dredged was rock, while the remainder was a mixture of sand, silt, clay, and shell fragments. Samples of the rock indicated four different fossiliferous limestones. Dredging was accomplished by a hydraulic pipeline dredge with a rock cutterhead. The rock cutterhead broke and ground the rock into pieces that were lifted hydraulically into a scow moored alongside the dredge. The resulting dredged material was predominantly golf ball to softball sized rock pieces mixed with sands and smaller pieces. Some rock pieces were as big as volleyballs. The scow transported the dredged material to the placement location about 3 nautical miles from the dredging location.

Factors considered in the design of the structure included type of material used, shape, orientation to currents, vertical relief, side slopes, and general size. The rock dredged material provided excellent marine habitat material because of its durability and stability, rugosity, the habitat complexity it provides, and its availability. This presentation will the project planning process, construction issues and environmental monitoring conducted to date.

TECHNICAL SESSION 19: Coastal Case Studies A

Ram K. Mohan, PhD, PE, Chair

MODELING WITH DREDGED MATERIAL AND EXPERIMENTING WITH DIFFERENT TECHNIQUES IN THE NETHERLANDS

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The Lake IJsselmeer area consists of a series of smaller and larger lakes (totally 2000 sq km) with an artificial origin. The whole area used to be an estuary called the Zuiderzee. With the building of the Afsluitdijk (barrierdam) in 1932, a large freshwater basin was created. The purpose of this ambitious project was, amongst others to enable the reclamation of land. At this moment about 150.000 ha of land is reclaimed. The construction of the dam and the reclamation of the land deprived the area of its natural morphological dynamics that characterize a natural delta area. The remaining water is characterized as fairly shallow (1 to 4 meters) with dikes at its shores, leaving little space for the swamp areas one should expect at the shores of natural lowland lakes. Water levels are strictly managed, preventing any natural wetland development.

In order to create a more complete ecosystem nature development is carried out, focusing on the construction of the basic morphology of the missing swamp areas. *Phragmites australis* is the plant species used as a major structurizer in the so created areas. It consolidates the newly built shores, defending it against wave exposure. It serves as shelter and spawning area for fish and it's used for feeding by several species of waterfowl if growing in water. The use of *Phragmites* is not without risk. In areas that are too dry, it easily becomes a monoculture with little ecological value. On the other hand, it needs to have root connection with an area that is (at least temporary) not inundated and it will not expand much into areas that are permanently inundated.

Above mentioned characteristics of *Phragmites* demand specific features of the created basis for ecologically interesting wetlands. The most favorable situation is one in which there is lots of relief in the terrain, varying between 20 cm above to ca. 1 meter below water level. Most of the terrain must be under water.

The techniques for modeling dredging material into such an area vary with the characteristics of the material. Lately, three projects were prepared, experimenting with different techniques for different kinds of material.

Sandy Material: The Abbert Project. In a small area of ca 15 ha. One hundred small isles with a diameter of ca 10 meters were created using sandy soils coming from the dredging of the adjacent fairway. The material was transported from the dredged fairway, as a sand-and-water-slurry in a 12 inch flexible pipeline attached to a caterpillar. With its broad tracks it could ride on the shallow lake bottom, replacing the mouth of the pipeline every few hours. Modeling with sand is fairly easy and we didn't encounter many difficulties with the implementation. However, the lakebottom was not always trustworthy and it was grace to the skills of the caterpillar driver that the machine didn't go under into a unexpected peat layer. It must be noted that since we were in no hurry with the dredging job, we could afford to shut down the pump in order to move the pipe. If ships are waiting to become unloaded or there is time pressure on the dredging job for other reasons this technique might cause a capacity problem. In ecological sense the technique is not very favorable.

Sand is naturally low in nutrients and with the pumping water most of the nutrients are washed out. So vegetation development is slow. This forced us into planting Phragmites whereas we preferred a natural development of *Phragmites.*

Dry Clay: The Lake Vossmeer Project. In order to create a more rich environment we developed a project over about 150 ha, making use of dry clay, coming from the digging of canals. In the shallow water (80 cm.) 120.000 m3 was transformed into about 450 little heaps, just above water level. The area is protected from the heavy wave influence by a broad sand dam. When starting the implementation we thought we would be able to drive into the lake with large dumpers with wide tires. The bottom of the lake was to silty however. Walking goes fine but as soon as the dumpers drive twice over the same place, the structure of the soil is disturbed and it becomes almost fluid. So we decided to close the protection dam all around the project and pumped out most of the water. We made pathways of sand over the lake bottom, transporting the clay into the field with ordinary transport means. The heaps are constructed by long-arm-caterpillars taking up the clay from the pathways. Modeling with this method is easy. One can almost literary mold the wanted structure. Due to the richness of the soil we do expect quick development.

The method is very costly and unfit for larger areas. It was also risky. The protection dam was constructed as a temporary wavebreaker, not as a polder dike. On several occasions it broke through with all the surrounding water flushing into the working area.

Wet Clay and Peat: The Ijsselmonding Project. In waters too deep to drive but to shallow to go by boat, materials can best be brought in as a slurry by pipes. At this moment we are preparing a 500 ha project making use of large quantities of clay and peat originating from large dredging jobs. The slurry is brought in between dams in several compartments, together shaping an artificial delta area. A pilot is yet under construction. Modeling with clay slurry is impossible. The -at best-yogurt-thick material takes years for consolidation and will always float out into one layer of equal levels. In order to create the wanted relief, the underground is first manipulated. By creating structures with sand, somewhat the same as in the Abbert project, we try to manipulate the consolidation. In the end we expect the clay layer to follow the shapes of the underground.

This can be reinforced by pumping out water at certain places, thereby stimulating the consolidation process. We hope to find a economically and ecologically viable way to deal with the large amounts of dredging materials that will come available in the coming years.

AN OVERVIEW OF BENEFICIAL USES OF DREDGED MATERIAL IN A HIGHLY URBAN ENVIRONMENT

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As part of the US Army Corps of Engineers New York District's Dredged Material Management Plan (DMMP) and harbor expansion and restoration projects, the beneficial use of clean and contaminated dredged material is being examined in some detail. These uses include:

(1) Creation and enhancement of habitat (wetland, upland, and aquatic);

(2) Capping of landfills;

(3) Improvement of water quality through wetland construction at the base of landfills and combined sewer outfalls;

(4) Creation and enhancement of artificial reefs through addition of blast rock from new work dredging;

(5) The restoration (capping) of the New York ocean "Mud Dump" site which is scheduled to be closed in Autumn 1997;

(6) The creation and enhancement of shellfish beds and submerged aquatic vegetation habitat with appropriate dredged material; and

(7) The "recontouring" of certain areas of the harbor, primarily by the deposition of dredged material in manmade depressions to restore approximate ambient bathymetric conditions.

Potential markets in the New York\New Jersey Metro region will also be explored for processed or treated dredged material from New York\New Jersey Harbor. Most likely beneficial uses would include landfill cover, construction fill, mine and quarry reclamation, and capping of brownfields. Promising end-products include blended cement and manufactured soil.

THE BENEFICIAL USE OF DREDGED MATERIAL IN NEW JERSEY

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Dredged material can be considered a resource, and the New Jersey Department of Environmental Protection strongly supports its beneficial use. It is also essential to develop and evaluate emerging beneficial use strategies to ensure a multi-faceted and integrated dredged material management program.

The Department's guidance manual "The Management and Regulation of Dredging Activities and Dredged Material in New Jersey's Tidal Waters" (in draft, March 1996) discusses its approach to evaluating and regulating proposed beneficial use alternatives. In general, these alternatives are evaluated by the Department on a case-by-case basis, in a process similar to that used to evaluate proposed beneficial uses of non-hazardous solid waste. This evaluation includes an analysis of contaminant levels present in the dredged material *vis-a-vis* thresholds for environmental and human exposure at the proposed use site.

The Department is also currently developing criteria to establish categorical regulatory thresholds for contaminants and any associated beneficial use criteria or limitations. At the present time, potential beneficial use options in New Jersey include beach nourishment, habitat development, construction material/fill, landfill cover, agricultural uses, and capping open water dredged material disposal sites. A number of approved beneficial use projects will be discussed, including the use of (1) a stabilized dredged material product for landfill closure/brownfield development at the OENJ site in Elizabeth, and (2) dredged material from Strawbridge Lake (Moorestown, Burlington County) for landfill cover.

THE DELAWARE RIVER DEEPENING PROJECT: MANAGEMENT OF UPLAND CONFINED DISPOSAL FACILITIES AS WETLAND/WILDLIFE HABITATS

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The proposed Delaware River Deepening project provides for a full width channel deepened from -40.0 to -45.0 feet MLW. from the Delaware Bay to the Philadelphia/Camden waterfront, a distance of about 102.5 miles. Approximately 33 million cubic yards of dredged material would be removed for initial construction over a four year period. Over the 50 year project life approximately 300 million cubic yards of maintenance dredging will occur. Dredged material from the river would be placed in confined upland disposal areas. Material excavated from the Delaware Bay would be primarily sand and would be used for beneficial purposes including wetland environmental restoration and underwater sand stockpiling.

In order to provide capacity for the dredged material from the Delaware River, four new upland disposal areas ranging in size from 275 to 350 acres, will be constructed. Each area will be divided into two cells which will enable the District to manage the areas to provide wetland and wildlife habitat. By rotating the disposal of dredged material between the cells, in addition to rotation of the new areas with existing sites, individual cells will be maintained as undisturbed wetland habitat for four to five years. After the initial construction of dikes and installation of drainage structures both cells will initially receive approximately 3 to 6 feet of predominantly fine grained, nutrient rich dredged material. One cell will continue to receive dredged material over a 7 to 8 year period; the other cell will be managed for wetland/wildlife values over a 3-4 year period.

Desirable wetland vegetation will not become established unless the water in the wetland cell is drawn down to bare substrate. After the initial filling the active cell would be dewatered and managed in a conventional manner. The water in the wetland cell would be drawn down after dredging is completed, and the area would be seeded from a helicopter with a combination of desirable wetland species. After the plants have become established (i.e.,. after one growing season), water would be diverted from the active dredged material disposal cell into the wetland cell, to levels of 1 to 2 feet deep . These species should become established during the first growing season and remain during the 3 to 4 year period until more dredged material is placed on the cell, when this procedure would be repeated to establish wetland vegetation on the other cell.

An important aspect of this wetland creation is Phragmites control. There is a risk that Phragmites would become established during the drawdown of the cells for planting by invading rhizomes from adjacent plants. To minimize this risk, impoundment berms would be sprayed with herbicide in the late summer, prior to the drawdown. After the area is reflooded, an appropriate fish species would be introduced to the flooded cell to control mosquitos. If due to climatic reasons additional water is needed in the wetland cell, it will be diverted from the active dredged material disposal cell during future dredging activities.

By utilizing a combination of conventional management measures combined with careful environmental control it is envisioned that these new upland areas can serve the Corps dredging needs and provide beneficial wetland habitat for the life of the project.

TECHNICAL SESSION 20: DREDGED MATERIAL MANAGEMENT AND RE-USE A

Richard Della, Chair

RE-USING DREDGED MATERIAL IN THE SACRAMENTO-SAN JOAQUIN DELTA

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The California Senate passed the Delta Flood Protection Act (SB34) in March 1988. The bill legislated the appropriation of $12 million annually for special flood protection projects on the Sacramento-San Joaquin Delta islands for ten years, beginning in July 1988. SB34 directed the California Department of Water Resources (CADWR) to develop and implement flood protection projects on eight western Delta islands to protect public infrastructure, urban areas, water quality, and other public benefits. SB34 also directed CADWR to seek partnering opportunities with owners and operators of island levees; Federal agencies with flood protection missions; and other potential beneficiaries.

Coincidentally, environmental agencies and organizations in the San Francisco Bay region had been calling for beneficial re-use of dredged material, rather than continuing in-bay disposal practices. So cooperative efforts were made by the CADWR, the US Army Corps of Engineers San Francisco District, and local reclamation districts to demonstrate safe re-use of dredged material in the Delta. The Corps would be able to use the project as a case study for the Long-Term Management Strategy (LTMS) program. The CADWR would be able to further its efforts to streamline the permit process for future projects in the Delta, with the California Environmental Protection Agency.

A pilot project was first completed at Sherman Island in 1990, using 2500 cy of dredged material. In February 1993, the CADWR wanted to implement a larger-scale project. The Corps identified the Suisun Bay Channel dredging project as a source of material. The CADWR identified Jersey Island, owned by Oakley Sanitation District, as the levee site. A work plan was developed, dividing activities and costs among the project participants.

In Fall 1994, 50,000 cy of dredged material from Suisun Bay and New York Slough were placed at the Jersey Island site. The Corps provided funding, and services to dredge and transport the material to Jersey Island. The Oakley Sanitation District assisted with costs for offloading, rehandling, and placing the material onto the levees. The CADWR also provided funding and obtained the necessary permits. The project demonstrated that the Delta island levees are suitable for re-using dredged material, having a long-term capacity of 3.5 million cubic yards.

In-situ PROCESSING OF DREDGE SEDIMENTS FROM THE PORT OF NEW YORK AND NEW JERSEY: CASE STUDIES OF LARGE VOLUME UPLAND PLACEMENT FOR USE AS STRUCTURAL FILL AND BROWNFIELD REMEDIATION

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A joint project of ECDC Environmental and ITEX has established a fully operational Dredge Sediments Recovery and Recycling Facility at Port Newark, New Jersey. The facility treats dredged sediments at dockside before removing them from the barge. Proprietary mixing equipment mixes specially prepared cement-based additives to improve the material's compressive and supportive strengths. The process also reduces leachability of any contaminants that may be present in the dredged material.

The facility is currently processing 4000 cubic yards per day of material from dredging projects in the New York Harbor area and has capacity to expand to 12,000 cubic yards per day production. Processed material is being used for structural fill at a local shopping mall development site and a second beneficial use location will open in August or September 1997.

TECHNICAL SESSION 21: Capping

Michael R. Palermo, PhD, PE, Chair

BENEFICIAL USE OF DREDGED MATERIAL FOR SUBAQUEOUS CAPPING

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Subaqueous capping is the placement of a subaqueous covering or cap of clean isolating material over contaminated sediment. Capping is an option for dredged material placement and for in-situ remediation of contaminated sediments. Beneficial use of dredged material as capping material is a common component of many capping projects. Both sandy and fine-grained material can be suitable for use as capping material, depending on site conditions and other factors. This paper briefly describes the technical requirements for capping, beneficial use of dredged material for capping, and a summary of recent case studies.

SUBAQUEOUS CAPPING IN NEW ENGLAND: WISE USE OF DREDGED MATERIALS

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Disposal of dredged materials at selected ocean disposal sites has been carefully monitored and managed in New England as part of the Disposal Area Monitoring System (DAMOS) for twenty years. Throughout this history, the goals of the program have been to minimize adverse impacts on the marine environment and to wisely manage the disposal of dredged materials. As part of the management approach, dredged materials deemed suitable for open water disposal (determined through testing and comparative evaluation) have been used as a resource.

Through the evolution of the program, level-bottom capping was initiated to manage the disposal of sediments deemed unsuitable for open water disposal. These sediments have been

successfully isolated from New England waters through the placement of cleaner dredged materials.

As our knowledge of capping as a management tool has increased, several important factors have emerged: managers need evaluative tools for determining what dredged materials are suitable for use in capping finer-grained sediments; the careful placement of disposal mounds at a site can create confined depressions that substantially reduce cap volume requirements; consolidation of capped material, caps and underlying sediments needs to be factored in to design and monitoring requirements; accurate, verified placement of materials is critical to project success; self armoring of cap surfaces from erosion can be enhanced by selection of the cap materials and the sequence of disposal.

The DAMOS program has continued to test and evaluate the use of a variety of dredged materials for use in capping projects at a range of depths from 10-90 m. As yet, no material or depth has proven unsuitable but each project has been evaluated individually. An empirical effort to define geotechnical requirements for cap materials has provided promising results and may lead to more general guidelines.

The use of dredged materials to build confined mounds on the seafloor, provides an important management option for disposal of large volumes of contaminated sediments. The materials suitable for open ocean disposal effectively constitute the raw materials to engineer containment structures. Placing a series of disposal mounds (capped or not) in a ring can create a topographic depression to contain project materials that require capping. These mounds need not be constructed of a homogeneous material such as sand, but can themselves contain capped sediments. When sediments are precisely disposed at a taut-wire moored buoy, distinct mounds are formed in water depths to at least 90 m. The gravitational forces on falling sediments are, however translated into lateral density flows when loose material hits the bottom or slopes of the mound. By confining the lateral spread of disposed project material the need for cap material can be cut in half in some cases.

Even slight changes in slope can restrict the fine sediment apron of mounds sufficiently to require substantial reductions in cap requirements. While the use of dredged materials for capping has not been seen traditionally as a beneficial use, it is one of the wisest options available to resource managers.

USE OF DREDGED MATERIAL FOR CAPPING SOLID WASTE LANDFILLS

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Increased environmental awareness of the public, coupled with the enactment of stricter state and federal regulations, has resulted in the requirement that solid waste disposal facilities be capped with clean uncontaminated material upon closure. The capping of landfill disposal areas restricts potential upward contaminant migration from within the site and provides for a zone of clean material at the surface. Typically, compacted clays have been used for such applications due to their inherent low permeability, thus reducing surface water infiltration and contaminant transport, while maximizing the surface run-off. In many cases, clean maintenance dredged sediments from rivers and harbors can usually meet the physical requirements of such caps and offer several advantages: (1) *economic:* this provides a placement site for maintenance dredged material, (2) *environmental:* the low permeability of the silty and clayey dredged material minimizes surface infiltration and potential upward transport of contaminants, and (3) *beneficial:* this provides a beneficial use of clean dredged material from maintenance dredging.

Effective capping of solid waste landfills requires careful and well-planned geo-environmental design and subsequent monitoring to evaluate performance. In general, solid waste landfills can be classified as follows, based on the nature of the waste product: (1) *hazardous and toxic waste landfills:* are those that contain wastes defined by the Code of Federal Regulations, paragraph 40, (2) *Class I Waste Landfills:* are landfills which accommodate solid wastes, which after defined testing, contain specific constituents which equal or exceed listed levels or are ignitable or corrosive, (3) *Class II Waste Landfills:* are those that contain non-hazardous solid wastes which cannot be classified as Class I or III, and (4) *Class III Waste Landfills:* are landfills that contain inert and essentially insoluble wastes that are not readily decomposable. Depending on the classification of landfills and applicable environmental regulations, they may require closure by specific capping layers and thicknesses. However, such caps typically consist of one or more layers of the following: barrier soil liner (low permeability layer, clay or equivalent), geomembrane liner, lateral drainage layer (sand), and vertical percolation barrier (topsoil for vegetation).

Design requirements of various caps and potential use of various fractions of dredged material as part of such capping layers will be described in the presentation. Desired dredged material for such use (including water content, consistency, permeability, texture, pH, organic content, and soluble salt content) and potential techniques that will aid in such use (including direct placement and dewatering, dredged material rehandling/reuse facilities, particle separation techniques, and treatment chains for contaminated sediments), will be identified. In addition, experimental, analytical, and field simulation techniques for evaluating the effectiveness of maintenance dredged material for use in such caps will also be discussed. Finally, case studies of pilot-scale and full-scale projects where dredged material has been used for capping solid waste landfills (or is being planned for such use) will be presented.

THE 1997 CAPPING PROJECT IN THE MUD DUMP SITE

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Based on an agreement between the White House, EPA, and the Army during the summer of 1996, the Mud Dump Site (6 miles east of Sandy Hook, NJ) will be closed to Category II (mildly contaminated) dredged material on 1 September 1997. Thus, the summer of 1997 will be the last opportunity to place Category II dredged material in the Mud Dump site, at present the only open water site available to New York Harbor. The New York District (NAN) requested that the U.S. Army Engineer Waterways Experiment Station (WES) design a Category II mound and cap that will be placed during the spring and summer of 1997 (hereafter referred as the 1997 mound or 1997 capped mound).

During this effort, an estimated 960,000 cy (barge log) of Category II dredged material from 5 projects (1 federal and 4 permit), will be placed in the Mud Dump site followed by capping with in excess of 3,000,000 cy of sand. Part of the capping material may be sand removed from Sandy Hook channel as part of the normal maintenance dredging, i.e., a beneficial use.

WES work on this project has consisted of computing site capacity, predicting mound stability, consolidation, and Category II mound placement and cap placement. The presentation will provide an overview of the entire project, and focus on the design of the contaminated sediment mound placement using the MDFATE model. Also, we are using NY District's site management software - Disposal Analysis Network for New York (DAN-NY), as part of the design, and would include some information on that in the talk.