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Beneficial Uses of Dredged Material

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BEACH NOURISHMENT AND SHORELINE STABILIZATION:
THE USE OF DREDGED MATERIAL FROM THE HAMPTON ROADS DEEPENING PROJECT

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Introduction

The construction of the 55-foot channel for Hampton Roads will ultimately require the removal of approximately 60 MCY of dredged material, and the construction of the Virginia portion of the 50-foot channel to Baltimore will require dredging approximately 25 MCY (Figure 1). Substantial quantities of dredged material, suitable for beach nourishment and construction fill, will be excavated during construction of these projects. In accordance with applicable laws and Federal policies, the beneficial use of dredged material was thoroughly investigated during the preparation of the General Design Memorandum (GDM) for the Norfolk Harbor and Channels Deepening. These design investigations confirmed that substantial quantities of beach quality sand would be removed from the channels during some phases of construction, and that beach areas were located within navigation project areas which appeared to be suitable candidates for beach nourishment. Other beneficial uses for the dredged material that were also evaluated included construction fill for the island construction phase of the I-664 Hampton Roads Crossing, other construction and fill work, perimeter dike stabilization for the Craney Island Federal Disposal Area, and the construction of an offshore underwater berm in the Atlantic Ocean.

During the engineering and design of the Norfolk Harbor and Channels project, the Commonwealth of Virginia was advised of the opportunity presented by the anticipated excavation of large quantities of good quality material and advised as to the procedures and State requirements that would have to be accomplished in order to realize the benefits from this opportunity. Favorable responses from the Commonwealth and several local governments resulted in the development of preliminary beach fill plans for beach sites along the lower Chesapeake Bay and the Atlantic Ocean. These preliminary plans addressed the quality, quantity, and recoverability of the dredged material and evaluated the compatibility of the dredged material with the native material on the beaches. Comparative cost estimates were developed which provided a means for analyzing the expected cost change attributable to the beneficial use of the material when compared with the primary disposal plan. This information was intended to provide a rational basis for the Commonwealth and interested local governments to make the necessary policy and funding decisions required for the actual implementation of the beneficial use of the material.

The implementation of a successful beach fill plan or other beneficial use of dredged material requires the resolution of many complex issues involving lands, easements, utilities, local cooperation agreements, funding

agreements, and environmental protection. It should be emphasized that the successful resolution of these issues requires comprehensive and accurate engineering and design information. ~~There is no substitute for accurate information regarding the location, type, quantity, and recoverability of the material to be dredged.~~ Similarly, the specific beach area to be filled must be thoroughly investigated and incorporated into the construction plan for the parent navigation project. The beneficial use of dredged material for beach nourishment depends on the development of a practical, economical, and environmentally acceptable construction plan which results in the use of dredged material being more cost-effective than alternative sources of material for beach fill.

Policy Issues

Although the primary function of navigation project construction and maintenance is to provide safe and efficient navigation, Congress has also directed that the dredged material from such projects be made available to the states for placement on state beaches. The basis for Federal policy is the WRDA of 1976 (PL 94-587). Section 145 of that Act states, "The Secretary of the Army acting through the Chief of Engineers, is authorized upon request of the state, to place on the beaches of such state beach quality sand which has been dredged in constructing and maintaining navigation inlets and channels adjacent to such beaches, if the Secretary deems such action to be in the public interest and upon payment of the increased cost thereof above the cost required for alternative methods of disposing of such sand." The above language was modified by the WRDA of 1986 (PL 99-662) to insert after the word "payment" the words "by such state of 50 percent".

Several key words have been underlined which merit further discussion. It is important to note that action on this beneficial use of dredged material usually will require a "request from the state." This would imply that a local government wishing to use dredged sand under the provisions of this law must first obtain the concurrence and sponsorship of the State. This is in fact the District position that has been submitted to the Commonwealth of Virginia. This policy enables the Commonwealth to resolve conflicting local government requests for sand and establish State priorities before requesting Federal assistance. The requirement that the dredged material be "beach quality sand" places the responsibility on the CE to determine the character of the material to be dredged and its suitability for beach nourishment. The material is normally evaluated in accordance with the engineering and design procedures for beach nourishment contained in the Shore Protection Manual (US Army Corps of Engineers 1984a).

The CE must also evaluate the location of the dredging with respect to the reasonable definition of being "adjacent" to the navigation project. If the above criteria are met, then the CE must also make a general evaluation of the project to determine if it is in the "public interest." This public interest determination may be complicated by uncertainties regarding the ownership of the beach or determining the expected benefits to be derived from the beach nourishment. With regard to establishing the "increased

cost" for placing sand on the beach above the cost for alternative methods, the CE must perform the necessary cost engineering studies to accurately estimate such cost. Other pertinent policy information may be found in CE publications (US Army Corps of Engineers 1981a, 1983a, 1983b).

Subsequent to a thorough policy review for the Hampton Roads deepening, the Norfolk District conveyed a summary of the beach disposal policy to the Commonwealth and interested local governments. The Commonwealth in turn has developed State policies and procedures and provided guidance to the local governments.

Many of these so-called "policy issues" are in fact fundamental engineering questions. These items include the quality of the material and its compatibility for beach fill and the issue of the beach being "adjacent to the channel." Lastly, the question of the increased cost can be answered only after adequate engineering and cost analysis of the alternatives. The successful use of a dredged material for beach fill depends upon the willingness and ability of the Federal and State officials to develop a suitable plan in conformance with the appropriate policies and laws.

Engineering and Design Objectives

The resolution of many of the policy, real estate, and environmental issues depends upon comprehensive and accurate engineering and design. A primary engineering objective for the construction of channels and the design of beach fill projects is the collection of adequate soil information from the dredging area as well as the beach. If beach nourishment is incorporated into a dredging project, it is likely that a more comprehensive subsurface investigation plan for the channel will be required than if dredging were the only consideration. Sufficient borings must be made and analyzed to develop a clear picture of the vertical and horizontal limit of the sand deposits in the dredging area. Beach investigations must determine the characteristics of the native material, the location of utilities, structures, outfall pipes, property lines, long-shore sediment transport, and other basic engineering data. This information must, in turn, be analyzed to determine such items as the acceptable grain-size range of the material, the design berm height, width, and length, the probable fate of the material, expected loss rates, and the resulting maintenance requirements.

The ability to meet the desired engineering objectives will generally be constrained by the engineering and design budget and by the project construction schedule. The engineering and design studies for the Hampton Roads project were favored by an adequate design budget and schedule. For this reason, the engineering efforts on behalf of the beach nourishment alternatives represent an optimum approach to achieving the engineering objectives. Engineering and design work was governed by the engineering criteria set forth in ER 1110-2-1484 (US Army Corps of Engineers 1981b) and EM 1110-2-1613 (US Army Corps of Engineers 1983c). The District was also able to conduct a very comprehensive soil investigation program which used soil borings (Figure 2), seismic profiling and laboratory testing to develop

both the vertical and horizontal extent of sand deposits (Figures 3-4). A full geotechnical report appendix (in five volumes) for the final GDM (US Army Corps of Engineers 1986a) was prepared and later used as part of the actual contract documents.

As comprehensive as this soil information is, the actual implementation of a beach project may require supplemental investigations depending upon the type and scope of beach projects that may be developed by the Commonwealth. These investigations were further supported by specific field investigations of the candidate beach areas, hydrographic surveys essential for determining quantities, and analysis of the available construction plant and methods.

Specific engineering and design studies for the candidate beach sites were accomplished by contract, and individual reports for each beach alternative were prepared (US Army Corps of Engineers 1984b, 1984c, 1984d, 1986b, 1986c). The purpose of these reports was to evaluate the use of dredged material from a specific channel to nourish a specific beach area, in accordance with the general guidance contained in the Shore Protection Manual. These reports used a beach fill "scenario" representative of an optimum beach nourishment project for the particular beach. These reports, while not providing specific designs, do provide the kind of information needed by the State and local officials to compare alternatives. The beach nourishment reports were further supplemented by a cost engineering report (US Army Corps of Engineers 1986d) which provided an analysis of construction equipment, methods, relative costs for the various beach disposal alternatives when compared with the primary ocean disposal plan construction cost. These investigations were aided by previous local beach nourishment projects which used dredged material and by Murden (1978) and the US Army Corps of Engineers (1976, 1981c, 1981d).

A major engineering objective that must be achieved is the determination of how much of the available sand can actually be recovered using standard dredging practices and contract specifications. Dredging is primarily for producing an acceptable navigation channel, not for mining a particular deposit of sandy material. In other words, the recovery of the sand deposits must be designed in conformance with the channel construction specifications. Acceptance sections or dredging areas must be selected to result in maximum sand recovery but still be consistent with normal channel dredging practices whenever possible. The use of special dredging equipment requirements or recovery specifications ~~could have an adverse impact on the~~ total channel dredging costs and should be avoided. This is particularly important if the navigation channel produces very high benefits and the benefits of beach nourishment are marginal.

Real Estate Issues

The inclusion of a beach fill disposal alternative in a Federal construction contract requires that all necessary easements and rights-of-way needed for construction be conveyed to the Federal government. This can become a complex and difficult task due to the often uncertain issue of ~~property lines and rights along the coast.~~ These requirements must be identified and addressed in appropriate local cooperation agreements. The determination of property interest may also influence the overall assessment

of the "public interest" of the beach fill alternative. If the eroding beach is held by private interest, it may preclude the use of State or Federal funds for the nourishment of the beach. Because of the length of time that may be required to resolve these real estate matters, close coordination and information exchange between the engineering and real estate staffs are necessary if construction schedules are to be met. In summary, beach areas which are unquestionably "public beaches" and have previous histories of beach nourishment are ideal candidates for inclusion in the navigation channel construction contract, whereas "private beaches" may present problems which cannot be resolved within the available time.

Environmental Issues

The use of dredged material for beach nourishment has been a common practice for many years and in most cases has resulted in little discernible environmental impact to the coastal environment. The general lack of adverse impacts reflects the adaptability and resilience of the resident species which have adapted themselves to the dynamic beach environment. In some cases, however, the beach environment may not be fully compatible with a beach fill project due to the existence of nearby sensitive coral reef structures or the nesting habits of sea turtles or seabirds. The highly developed shoreline of the lower Chesapeake Bay is generally free of these environmental concerns and has routinely used beach fill from both upland borrow sources and dredged material with no apparent adverse impacts.

If specific environmental protection or mitigation measures are applied to the use of the channel material for beach nourishment, the project constructability must be carefully evaluated. Specific time restrictions or limitations on the type of construction equipment or procedures may preclude the inclusion of beach nourishment in the channel dredging contracts. In most cases, this can be avoided if the environmental studies and engineering design are accomplished concurrently and is fully coordinated.

The use of dredged material for beach nourishment should be engineered in a manner which results in the least environmental impact while still providing an efficient and cost-effective construction plan. If this is not done, the demands of the navigation project construction schedule will override the desire to use the dredged material in a beneficial manner.

Funding Requirements

PL 94-587 and 99-662 require the State to provide 50 percent of the increased costs associated with the use of dredged material for beach nourishment. The State, in turn, may require the local governments with beaches to participate in the funding. The added cost for beach nourishment normally results from the need for additional plant and equipment and the additional construction time required for transporting material to the beach.

Adequate cost engineering is necessary at a point in time which allows both the Federal and State budget process requirements to be met. Sufficient funds must be budgeted for the construction year to permit the beach nourishment work to be included in the channel dredging contract. The cost engineering and analysis must compare the least cost approved disposal plan with the estimated costs for the beach disposal plan. It is the increased cost which must be shared in accordance with the applicable laws.

The cost-sharing must be provided for in an appropriate funding agreement between the State and Federal governments. ~~These agreements must be consummated~~ before the work can be advertised in accordance with normal procurement practices.

Project Execution

The actual execution of the use of dredged sand for beach nourishment is accomplished as an integral part of the channel dredging contract. As a part of the Federal dredging contract, routine CE contract supervision and administration are used.

It is the successful resolution of the policy, engineering, real estate, environmental, and funding issues which allows project execution. Failure to adequately resolve any of these issues will probably result in the loss of the opportunity to use the dredged material in a beneficial manner.

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