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Benefit Assessment of Alternative Long-Term Management Strategies for the Disposal of Dredged Materials from San Francisco Bay

INTRODUCTION

Current practices of disposing of materials dredged from San Francisco Bay (Bay) have resulted in concerns about impacts on the aquatic environment. Because most dredging occurs in port and water-related industrial areas or at military facilities supporting past and present sources of toxic substances, concern has been expressed that disposing of dredged materials in the Bay would resuspend and redistribute contaminants buried in the sediments and affect Bay organisms. Among others, environmental concerns have been raised about adversely affecting commercial and sport fisheries; burying bottom-dwelling organisms at disposal sites; and increasing the turbidity of Bay water quality, thereby lowering productivity of aquatic Bay plants (San Francisco Estuary Project 1992).

These environmental concerns, as well as concerns about future capacity for dredged material disposal and the complexity of the existing permitting process led to the effort to develop a Long Term Management Strategy (LTMS) for dredged material in San Francisco Bay. The LTMS is being developed by the federal, state, and regional agencies overseeing dredging and dredged material management. The cooperating agencies have developed policy objectives and a range of policy alternatives to meet these objectives. The LTMS objectives are as follows:

- minimize cumulative and potential environmental impacts;
- provide adequate, diverse, and long-term capacity;
- promote beneficial reuse of dredged material;
- coordinate long-term site usage, management, and monitoring;
- promote greater timeliness and predictability in dredged material decision making;
- remove disincentives to alternatives to unconfined, open water disposal and promote cost-effectiveness; and
- manage dredged materials in a manner that protects public trust and health.

The LTMS is conducting a formal environmental analysis of regional options for dredged material management. In selecting a preferred LTMS policy, the economic costs and benefits of each policy option will be considered. Planning-level costs of implementing the policy alternatives have already been estimated (U.S. Environmental Protection Agency 1995). The benefits, however, are more difficult to evaluate because many benefits involve potential environmental improvements that present challenges for quantifying and monetizing. For example, the economic benefits of potential improvements in water quality from reducing disposal of dredged material in the Bay or of restoring tidal wetlands over the next 50 years are difficult to estimate in monetary terms.

The purpose of this assessment is to describe, quantify, and monetize, where possible, some of the key economic benefits associated with successfully implementing an LTMS for dredged materials from San Francisco Bay. Estimating benefits in monetary terms necessarily involves making assumptions about economic preferences that, although reasonable, often cannot be validated with the existing data. However, discussing the nature of the benefits and, where possible, approximating them in monetary terms, does provide needed information for comparing the relative magnitude of the benefits and costs of the options. This information, together with a description of the uncertainty of the data, where appropriate, is necessary to fully evaluate the options.

The types of benefits that are evaluated in this assessment are associated with the following activities and LTMS objectives:

- habitat restoration,
- promoting reuse opportunities,
- establishing regulatory certainty, and
- protecting ecosystem health.

The benefits associated with each of these activities are described in the following sections. The relative magnitude of benefits associated with different disposal options are then compared.

HABITAT RESTORATION

A key objective of the LTMS is to restore habitat that has been lost or damaged through urban and agricultural development in the San Francisco Bay/Delta. Restoration efforts will focus primarily on the restoration and enhancement of wetlands. More than 90% of the historic wetlands in and around the San Francisco Bay Estuary (Estuary) have been significantly altered or no longer exist (Gahagan & Bryant Associates 1994).

Wetland Functions and Outputs

Wetlands are lands that are periodically or seasonably wet. They include both large and small ecosystems, such as marshes, swamps, bogs, and potholes. Wetlands occur when the water table is at or near the land surface or when the land is periodically covered by shallow water. Wetlands are characterized by soils that are inundated for at least part of the year and support various types of aquatic and semiaquatic vegetation. (Scodari 1990.)

Wetlands can contribute to important ecological functions that ultimately determine their benefit to society:

- flood storage and desynchronization,
- groundwater recharge and discharge,
- shoreline anchoring and dissipation of erosive forces,
- nutrient retention and removal,
- aquatic food chain support,
- fisheries habitat support, and
- wildlife habitat support.

The contribution that wetlands make to these ecological functions has been studied extensively. For certain functions, such as fisheries and wildlife habitat support, scientific information is abundant regarding the specific role that wetlands play in the process. For other ecological functions, such as groundwater recharge and aquatic food chain support, information is limited concerning the contribution of wetlands to these functions.

The benefits of wetlands can be viewed in terms of the services or outputs that they provide for society. As shown in Figure 1, wetlands either can function as production factors for other goods and services or can directly contribute to consumer or producer welfare. This description applies to wetlands in general, and some (e.g., commercially harvested natural resources, groundwater recharge and storage) would not apply to tidal wetlands in San Francisco Bay.

Wetlands as Factors of Production for Other Goods and Services

This category of outputs consists of wetlands serving as an intermediate factor in the production of goods and services. These goods and services include commercial goods available through markets and environmental services.

Commercial goods that potentially benefit from wetlands include the harvest of commercial and sport fisheries; other commercially harvested natural resources, such as timber, peat, and small fur-bearing animals; and water supply and storage. Coastal estuaries and their wetlands help to produce commercially important fish and shellfish by providing food and spawning and nursery grounds. Wetlands also can support and provide habitat for other commercially harvested flora and fauna, such as timber and small fur-bearing mammals. Wetlands groundwater recharge and water

Factors of Production for Other Goods and Services

Market Goods

- Support of commercial and sport fisheries
- Support of other commercially harvested natural resources (e.g., timber, peat, small fur-bearing animals)
- Water supply and storage
- Assimilation of wastes (e.g., for tertiary treatment of human wastes)

Environmental Services

- Pollution assimilation/water purification
- Flood control
- Erosion prevention

Direct Production of Consumer or Producer Welfare

Recreational Opportunities

- Consumptive uses (e.g., fishing and hunting)
- Nonconsumptive uses (e.g., camping, boating, bird watching, nature study)

Scenic

- Property value enhancement
- Public enjoyment

Educational

Ecosystem Protection

- Existence values
- Future use (option) values
- Avoided costs of future regulatory actions (e.g., listing of species, mitigation)

Jones & Stokes Associates, Inc.

Figure
General Wetland Outputs

storage functions are important factors in the availability of water for drinking and agricultural irrigation. (Scodari 1990.)

Environmental services that wetlands contribute to include pollution assimilation, water purification, flood control, and erosion prevention. These services typically reduce natural and human-induced damage to property and natural resources, thereby lowering the cost of producing a wide variety of commercial and noncommercial products. For example, wetlands often help to control flooding, thereby reducing the cost of flood control measures. By taking up, removing, or immobilizing nutrients, wetlands can effectively reduce heavy metals and toxic substances that are sources of water pollution. This water purification function reduces the cost of treating surface waters used for domestic water supplies. (Scodari 1990.)

Wetlands as Direct Producers of Consumer or Producer Welfare

Wetlands also serve to directly enhance consumer satisfaction by providing recreational opportunities, providing scenic and educational values, and serving as an important element of ecosystem protection. Recreational opportunities provided directly by wetlands include fishing, hunting, wildlife viewing, and camping activities, all of which generate welfare improvements that can be valued monetarily. Scenic values provided by wetlands include the value of their open spaces and flora and fauna to the general public and property owners. Educational values include the value associated with using them to educate the public about the environment.

Wetlands are valuable for maintaining a healthy and diverse ecosystem. This value is recognized by the public as evidenced by its willingness to pay to protect wetlands. Wetlands restoration also can contribute to reversing the decline of species populations, thereby avoiding the often significant costs of listing species as threatened or endangered. In addition, the greater availability of wetlands potentially reduces the costs of mitigating for project development.

LTMS Habitat Restoration

Habitat restoration under the LTMS program would focus primarily on restoring both tidal and non-tidal wetland resources. Most wetlands restoration is tidal restoration, including permanent and seasonal wetlands. To date, projects to expand wetlands in the San Francisco Estuary have focused on restoring tidal action to undeveloped properties that were previously diked off from the Bay. Agricultural practices at many of these sites, however, have caused subsidence so that current land elevations are far below the elevation necessary to support most tidal marsh vegetation. Placement of dredged materials can accelerate the tidal marsh restoration process by raising ground level to the appropriate height. (Gahagan & Bryant Associates 1994.)

Dredged material can also be used to create or restore seasonal wetland habitats by raising and modifying topography and thus improving wetland hydrology. Seasonal wetland habitats within the Estuary include diked salt marsh and brackish marsh, vernal pools, and other emergent freshwater habitats, farmed wetlands, and abandoned salt ponds. (Gahagan & Bryant Associates 1994.)

The policy options for the LTMS program include different targets for use of dredged materials for wetlands restoration. The targets that specifically apply to wetlands restoration range from about 9% (No-Action Alternative) to 25% of total dredged material suitable for unconfined aquatic disposal (Katz pers. comm.). (Non-suitable material may be used in wetland restoration, but was not included in this analysis.) Based on an estimated total volume of 237 million cubic yards (mcy) of materials, the amount of material that would be allocated for wetland restoration purposes is between approximately 20 mcy and 59 mcy.

Based on research conducted by the San Francisco Bay Conservation and Development Commission and Gahagan & Bryant Associates, the capacity of sites in the Bay region to accommodate tidal wetland restoration with high restoration potential is approximately 87.9 mcy. This capacity includes 67.9 mcy at 23 new sites that have either very high or moderately high restoration potential and 20 mcy for the Montezuma Wetlands project. The number of acres potentially available for constructing tidal wetlands with high restoration potential is estimated at 11,090 acres, of which 1,823 acres would be at the Montezuma site (Olejniczak pers. comm.). Based on this estimate, this analysis assumes that 126.2 acres of wetlands can be created for every million cubic yards of material.

Economic Benefits of Wetlands Restoration

Valuation Techniques

The economic benefits of restoring tidal wetlands in the Estuary can be evaluated using two approaches. The first approach places an economic value on the different outputs that these wetlands would provide. (The possible outputs are identified in Figure 1.) A second approach would be to directly estimate the total value that the public places on this wetlands restoration program. Both approaches attempt to measure the net economic value of restoring wetlands.

The "output" approach relies on estimating a dollar value per acre of wetlands created. This approach requires identifying an appropriate set of unit values for the outputs of wetlands restoration and applying these unit values to the quantities of wetlands outputs to obtain an overall value for an acre of wetlands. Measurement techniques include the net income method, revealed preference approaches such as the travel cost and hedonic methods, and replacement cost approach (Scodari 1990). Ideally, marginal values for wetlands, rather than average values, would be used.

The "direct value" approach relies on estimating the public's total willingness to pay (WTP) for the wetland restoration program. The contingent valuation method is typically used to assess these values through public surveys. Because data on the public's WTP for the wetlands restoration alternatives in the LTMS are unavailable, these values can be estimated only by inference from values for similar programs and resources.

Estimated Value of Restoring Wetlands under the LTMS Program

For this assessment, the output approach is used to estimate the value of restoring wetlands under the LTMS program. This approach is considered superior to the direct value approach because with little information available about the nature of the tidal restoration program, transferring benefit estimates from other wetland protection studies is considered speculative.

Because little is known about the specific functions and outputs that would result from restoring tidal wetlands under the LTMS program, a conservative approach is used to estimate the related economic benefits. It is assumed that the "outputs" resulting from the LTMS wetlands restoration program would include only support of the commercial fishery, sport fishery, shell fishery, and general recreation opportunities. Other possible wetland outputs, such as water supply recharge, pollution assimilation, and flood control, are not included because these are not outputs associated with the wetlands under consideration by the LTMS.

Table 1 provides estimates of values per acre derived from the literature on the wetland outputs evaluated in the assessment. As indicated, the resources evaluated are located in other states; therefore, the per acre values must be considered only approximations of the benefits associated with tidal wetlands restoration for the Estuary.

The value of the LTMS wetlands restoration program was estimated based on the aggregate value of the outputs. For outputs for which more than one study is available, the mean value of all values is used. The aggregate annual value per acre is estimated at $1,146 (in 1995 dollars), which includes benefits to general recreation, commercial fishing, sportfishing, and shell fishing activities. When multiplied by the estimated 11,090 acres of high potential wetland capacity, the annual value of wetlands restoration at buildout is estimated at $12.7 million.

The objective of this assessment was to evaluate potential benefits resulting from creating new tidal wetlands under the LTMS program. Because wetlands provide a wide range of ecological functions that benefit society, the values assigned to wetlands creation should be linked closely to the ecological functions of the wetlands program. In the case of the wetlands created under the LTMS program, the location and characteristics of the specific wetlands that would be restored are unknown at this time; consequently, the values attributed to wetlands restoration in this assessment should be considered only a rough approximation and should be used with caution. More information about the specific wetland areas that would be restored is needed to refine these approximations.

Table 1. Estimates of Annual Values per Acre for Wetland Outputs

Activity	Resource Location	Annual Value per Acre
General recreation		
Bergstrom (1990)	Louisiana	$10.61
Costanza et al.	Louisiana	$133.03
Mean value		$71.82
Commercial fishing		
Gosselink et al. (1974)	Georgia	$247.79
Raphael and Jaworski (1979)	Michigan	$68.93
Bell (1989)	Florida	$43.68
Costanza et al. (1989)	Louisiana	$35.16
Mean value		$98.89
Sportfishing		
Raphael and Jaworski (1979)	Michigan	$657.18
Bell (1989)	Florida	$96.47
Mean value		$376.82
Shell fishing		
Bell (1989)	Florida	$37.02

Notes: The studies in this table were identified from a review of the following two sources: Hazen and Sawyer 1992 and Allen et al. 1992.

All values are expressed in nominal dollars (i.e., current dollars as of the year indicated for each study).

PROMOTING REUSE OPPORTUNITIES

Dredged material is a valuable resource when properly used. Bay Area reuse opportunities exist in the areas of tidal wetland restoration (discussed above), levee rehabilitation, landfill cover and construction fill, and beach nourishment. Current practices and potential benefits of using dredged material for these activities are described below.

Levee Rehabilitation

Historically, material used for levee rehabilitation has been dredged from adjacent slough channels. However, material from Delta channels is not sufficient to meet the projected need for levee rehabilitation, and there is concern about the effect of channel dredging on endangered species in the Delta (San Francisco Bay Conservation and Development Commission 1994, Steve Goldbeck pers. comm.). Currently, material for levee rehabilitation is excavated from upland quarries or Delta islands (Ross pers. comm.).

Potential cost savings from using dredged materials could occur in the form of reduced transportation costs associated with the replacement of imported upland excavation material with locally available dredged material. Upland excavation material used for levee rehabilitation currently costs between $8 and $13 per cubic yard (Neudeck pers. comm.). Based on an estimated cost of $9.64-14.84 per cubic yard for delivery of dredged materials from major dredgers, some cost savings could potentially be achieved by using dredged materials as a substitute for materials transported from upland quarries.

Potential environmental benefits also could occur by reducing the noise and air pollution associated with the truck traffic transporting upland excavation materials from distant sites. A potential disadvantage in using dredged material from the Bay for Delta levee rehabilitation is the potential effect of adding contaminants, particularly heavy metals, to the freshwater environment and increasing salinity. This impact could be mitigated by reducing contaminants at the rehandling facilities that provide end-product material (San Francisco Bay Conservation and Development Commission 1994).

Landfill Cover and Construction Fill

A second reuse opportunity for dredged material is as landfill cover or construction fill. A current source of landfill cover is mining materials; some rehandling facilities generate materials for fill cover by extracting material from an onsite mine (Ross pers. comm.). Alternative sources of fill material are upland quarries.

Landfill cover and related uses typically require a large amount of material for daily cover and for capping when landfill operations cease. Potential savings could occur through the replacement of expensively excavated and transported upland materials with readily available dredged material. Redwood Sanitary Landfill Company, which sells fill material to other contractors, recently offered excavated fill cover for a price of $15.50 per cubic yard (Apa pers. comm.). This price includes all permitting, dredging, and transportation costs for delivery up to 12 miles. This price falls within the estimated cost range of $11.01-24.79 per cubic yard for using dredged material from major dredgers for landfill cover and indicates a potential cost savings.

Potential environmental benefits of using dredged materials as landfill cover and related uses are reduced noise and air pollution associated with truck traffic from upland excavation sources. Environmental benefits from reducing the excavation of upland materials would be limited because quarries are permitted mining areas and are specifically used for excavation.

Disadvantages associated with using dredged materials as landfill cover or construction fill involve the high moisture content of dredged materials. Waste management units at landfills generally cannot accept dredged material with greater than a 50% moisture content (Gahagan & Bryant Associates 1994).

Although some dredged materials may be unsuitable for aquatic disposal, their "contamination" level is rarely high enough to require containment at a Class I landfill. Consequently, most dredged materials could be used at a Class II or III landfill sites and for various construction purposes (Gahagan & Bryant Associates 1994).

Beach Nourishment

Reuse of dredged material for beach nourishment is practiced to prevent beach erosion, mostly in southern California, where beach erosion is a more significant problem. Dredged materials used for this purpose must meet requirements for grain size compatibility and sand percentage.

Successful use of dredged material for beach nourishment is contingent on compatibility of grain size with the target beach site and on the sand content of the material, which must be predominantly sand or it will wash away (Raieves pers. comm.). Most Bay Area-dredged materials are clay and silt and are incompatible with most beach nourishment activities. However, the San Francisco Bar Channel, an area west of the Golden Gate Bridge, is one of the few dredge locations with a sand content greater than 90% (Ross pers. comm.). This site is a potential source of material for sand dune restoration at Ocean Beach.

Potential cost savings from using dredged materials for beach nourishment are associated with the reduced transportation costs compared to using materials from upland quarries for this purpose.

ESTABLISHING REGULATORY CERTAINTY

Five state and federal agencies are responsible for regulating the disposal of dredged materials from San Francisco Bay: the Corps, U.S. Environmental Protection Agency, State Water Resources Control Board, San Francisco Regional Water Quality Control Board, and Bay Conservation and Development Commission. Each agency is responsible for regulating different aspects of dredged material disposal according to its legislative mandate.

Conflicting policies of these agencies concerning the priorities given to different disposal placement environments have contributed to permitting difficulties. Other factors contributing to permitting difficulties include capacity constraints at in-Bay sites and unique environmental conditions requiring site-specific evaluations associated with the permitting of the wide range of upland, wetland, and reuse (UWR) projects. These constraints often result in delays in obtaining the necessary permits for disposing of dredged material. Project delays increase dredging costs because additional staff time is needed to obtain the required permits and equipment is idled, which increases the overall cost of operations.

A key objective of the LTMS is to develop a comprehensive set of goals, policies, and guidelines that would be followed to streamline the process for obtaining required permits from the jurisdictional agencies. A coordinated review of proposed projects, especially UWR projects, would reduce the delays associated with conflicting policies of the federal and state agencies with authority over permitting. Streamlining the permitting process would require extensive cooperation between local, state, and federal jurisdictional agencies and could involve a wide range of changes to existing authorities and procedures.

Streamlining the permitting process would increase the regulatory certainty for disposing of dredged materials and result in less time and lower costs for obtaining necessary permits. This outcome would contribute to maintaining the competitiveness of Bay Area ports and harbors and provide continued opportunities for local maritime activities. The value of these benefits can be evaluated in terms of the economic resources at risk.

The Bay Area economy accounted for $182.7 billion in regional economic activity in 1990 (Association of Bay Area Governments 1994). Of this amount, approximately $7.5 billion is associated with the maritime industry. Although the impact of reducing the competitiveness of Bay Area industries by increasing dredging costs cannot be quantified, business site location decisions are affected by the relative cost of doing business in the Bay Area. The cost of dredging is certainly one of many factors that influence these decisions, especially for the maritime industry.

PROTECTING ECOSYSTEM HEALTH

The San Francisco Estuary, which encompasses the Bay/Delta, is a rich, complex ecosystem that has been highly altered by human activities and has undergone a series of historical declines in populations of species and reduced diversity as a whole (San Francisco Estuary Project 1992). As a result of habitat change and other human-induced impacts, the Estuary's ability to support a diverse ecosystem with large populations of important commercial, recreational, and heritage species has declined. Commercial herring and salmon fisheries have sharply declined in recent years. The starry flounder and striped bass sport fisheries attract many fewer participants than they did 20 years ago. Some species have not merely suffered a decline in abundance but are now at such low levels that they are listed or are proposed for listing under the federal Endangered Species Act as endangered or threatened. Three native species of the Estuary are already extinct. The ecosystem as a whole is often described as being in a state of collapse (U.S. Environmental Protection Agency 1994).

Dredging and waterway modification (including dredged material disposal) has been identified as one of five critical issues facing the Estuary (San Francisco Estuary Project 1992). Environmental concerns that have been raised about disposing of dredged materials in the Bay include concern that contaminants buried in the sediments would be resuspended and redistributed, thereby affecting Bay organisms. Anglers allege that Bay disposal has adversely affected commercial and sport fisheries. Concern also has been raised that dredged materials bury bottom-dwelling organisms at disposal sites and reduce sandy and rocky areas that provide habitat for commercially valuable fish species. Finally, increased turbidity resulting from aquatic disposal is also suspected of physically harming organisms by abrasion, clogging gills and mouths, and causing mortality during sensitive life stages. (San Francisco Estuary Project 1992)

Many of the benefits identified previously for restoring wetlands also apply to improving Bay water quality by reducing the amounts of dredged materials disposed of in the Bay. Although the scientific data are inconclusive on the relationship between disposal of dredged materials and the effects on physical processes and biological resources, some ecological (and therefore economic) benefits of reducing the amount of dredged material disposed of in the Bay are likely. These benefits would be in addition to (or enhance) those achieved from restoring wetlands.

As described in the administrative draft environmental impact statement/environmental impact report, one of the reasons for developing a regional strategy for managing the placement of dredged material in the San Francisco Bay region is to address agency and public concern over the environmental impacts of dredging and placement of dredged material at existing disposal sites. An important benefit expected to result from the LTMS is contributing to the protection of estuarine and nursery habitat that should result in an increase in ecosystem health. An ecosystem is generally considered healthy if it is stable and sustainable--that is, if it is active and maintains its organization and autonomy over time and is resilient to stress (Costanzo 1992). Resiliency is particularly important because it reflects a decreased likelihood of species extinction. Increased ecosystem health also should lead to increased abundance of each of the populations constituting the ecosystem, although individual species will necessarily show different degrees of response.

The economic importance or benefit from contributing to the health of the San Francisco Estuary ecosystem can be evaluated in terms of the resource at risk. As indicated, the Estuary helps support an important commercial and sport fishery. More than 200 species of fish, shrimp, and crabs are known to inhabit the Estuary (California Department of Fish and Game 1992). Several commercial fisheries depend on the Estuary, including chinook salmon, starry flounder, bay shrimp, and Pacific herring fisheries. The value of commercial fish landed in the San Francisco region was $29 million in 1992, and the salmon that migrate through San Francisco Bay contribute significantly to commercial landings along the north coast. Fish processing is also an important industry in the Bay Area that depends on a healthy commercial fishery.

Important recreational fisheries in the San Francisco Bay estuary include salmon, striped bass, and rockfish. These and other recreational fisheries contribute significantly to the regional economy. The recreation salmon and striped bass fisheries generate approximately $139 million in angler spending annually in the Bay/Delta region.

Contributing to a healthy ecosystem also has benefits by avoiding the costs associated with the continued decline and possible listing of species. As indicated above, the health of the Estuary has declined to the point where the listing of certain species for federal and state protection was needed. This listing incurs costs on landowners and local operators to avoid affecting the listed species. Improving the ecosystem health, and thereby avoiding potential future costs associated with listing, is a potential benefit of the LTMS.

Finally, the San Francisco Bay serves as a receiving water body for industrial discharge of treated wastewaters from industries and public treatment facilities located around the Bay. Jeopardizing the capacity of the Bay to perform this function would have major implications for industry and the regional economy in the Bay Area.

COMPARATIVE BENEFIT ASSESSMENT OF LTMS DISPOSAL OPTIONS

This section evaluates how the types of benefits discussed in the previous sections differ among alternative LTMS disposal options. The disposal options differ with respect to the volume of dredged materials to be disposed of in three placement environments: ocean, in-bay, and UWR.

The analysis focuses on the incremental benefits of implementing two disposal options. These two options are referred to as the "low" and "medium" scenarios and are characterized by the volume of dredged material that would be allocated to the UWR placement environment for different reuse opportunities (e.g., wetlands restoration, levee rehabilitation, and landfill cover). The benefits of the scenarios are evaluated relative to a baseline condition, which for purposes of this assessment, is the No-Action Alternative.

The projected distribution of dredged material that would be allocated among reuse opportunities for the No-Action Alternative and two scenarios is shown in Table 2.

Table 2. Volume of "Clean" Dredged Material Designated for Tidal Wetlands, Levee Rehabilitation, and Landfill Cover (in million cubic yards)

Option	Tidal Wetlands	Levee Rehabilitation	Landfill Cover
No-Action Alternative	20.3	15.3	0
Low scenario	27.0	20.4	0
Medium scenario	59.3	20.7	15.1

Note: "Clean" dredged material is material suitable for unconfined aquatic disposal.

Source: Katz pers. comm.

Benefits Common to Both Scenarios

Common to both the low and medium scenarios are the benefits of regulatory certainty. Implementation of either option would provide a significant improvement in the level of regulatory certainty associated with the permitting of dredging and disposal activities compared with that of current conditions (No Action). This improved condition would result in reductions in the delays that dredgers presently face and would continue to face if no action is taken. Cost savings of reduced delays include reduced staff time (both agency and the regulated community staff) devoted to permitting and more efficient use of dredging and disposal equipment.

Both the low and medium scenarios also are expected to contribute to protecting ecosystem health by reducing the volume of dredged materials that would otherwise be disposed of in the aquatic environment. The magnitude of this benefit is uncertain, however, because scientific data concerning the relationship between the disposal of dredged material in the Bay or ocean and the effect on biological resources are inconclusive.

Low Scenario

In addition to the benefits of regulatory certainty and ecosystem health, the low scenario would have increased volumes of dredged material available for reuse opportunities. As shown in Table 2, the low scenario would result in an increase of an estimated 6.7 mcy of dredged material for restoring wetlands over the 50-year planning horizon compared with that of the No Project Alternative. Assuming that 126.2 acres of tidal wetlands can be restored for every million cubic yards of material, this volume of dredged material could support restoration of an estimated 845 acres of tidal wetlands based on the volume of material (87.9 mcy) needed to restore 11,090 acres of high-restoration-potential wetlands. Based on an average annual value of $1,146 per acre for outputs from tidal wetlands restored under the LTMS program, the low scenario would generate approximately $968,000 annually in benefits.

The low scenario also would provide an estimated 5.1 mcy of dredged material for levee rehabilitation. The availability of this material for levee rehabilitation could result in cost savings to agencies and operators of levee rehabilitation projects, depending on site-specific characteristics of the project. Existing information is insufficient to estimate the magnitude of the potential cost savings.

Medium Scenario

Implementation of the medium scenario would result in an increase of an estimated 39 mcy of dredged material for restoring wetlands over the 50-year planning horizon compared with that of the No Project Alternative. Assuming that 126.2 acres of tidal wetlands can be restored for every million cubic yards of material, the additional volume of dredged material from the medium scenario would support restoration of an estimated 4,922 acres of tidal wetlands. Based on an average annual value of $1,146 per acre, the medium scenario would generate approximately $5.6 million annually in benefits compared with that of the No Action Alternative.

Implementing the medium scenario also would result in an estimated 5.4 mcy of dredged material available for levee rehabilitation and an estimated 15.1 mcy of dredged material for landfill cover. As indicated above for the low scenario, existing information is insufficient to estimate potential cost savings associated with using dredged material as a substitute for materials currently used for levee rehabilitation or landfill cover.

Summary

The results of this comparative assessment are summarized in Table 3. Both quantitative and qualitative indicators of expected benefits of the low and medium scenarios are presented.

Table 3. Annual Benefits of the Low and Medium Scenarios
Compared with that of the No-Action Baseline Condition

Scenario	Regulatory Certainty	Reuse Opportunity: Levee	Reuse Opportunity: Landfill	Wetlands Restoration	Ecosystem Health
Low scenario	+	NC	NC	$968,000	+
Medium scenario	+	NC	NC	$5,600,000	+

Notes: Plus sign (+) denotes a positive (unquantified) benefit relative to the No-Action baseline condition.
NC = Not calculated because of the potential for either positive or negative benefits.

As previously indicated, both scenarios would improve regulatory certainty concerning the permitting of disposal of dredged material and can be expected to contribute to protecting ecosystem health. These improvements are indicated qualitatively in Table 3.

The low scenario would generate an estimated $968,000 annually in benefits from restoring tidal wetlands and potentially some cost savings associated with levee rehabilitation. The medium scenario would generate an estimated $5.6 million annually in wetland restoration benefits and potentially some cost savings from levee rehabilitation and landfill cover. The monetary estimates are approximations that are based on general assumptions about wetland functions and outputs and inferences about consumer preferences and values.

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