LONG-TERM MANAGEMENT STRATEGY FOR THE PLACEMENT OF DREDGED MATERIAL IN THE SAN FRANCISCO BAY REGION

12-YEAR REVIEW PROCESS

BACKGROUND INFORMATION FOR JUNE 19, 2012, MEETING FOCUS: BENEFICIAL REUSE

Prepared by

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June 2012

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1 INTRODUCTION

The Management Plan for the Long-Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region (LTMS) program called for periodic review and/or modification to ensure that the program remains achievable and current in light of changing conditions over time (USACE et al. 2001). Specifically, the LTMS agencies were directed to complete basic reviews of the program every 3 years with input from interested parties. More comprehensive reviews occur every 6 years. A *Six Year Review Report* was issued in May 2006.

Because the beginning of 2013 will mark the end of the 12-year transition period, the LTMS agencies began the 12-year review process with the initial review of existing data, development of the first background report, and discussions held at a meeting on March 29, 2012. The process involves LTMS agencies collecting and disseminating basic data about the program's performance to date and holding a series of meetings with stakeholders (each focused on a different key topic suggested by stakeholders) culminating with a summary report. This process, the summary report, and recommendations coming out of the stakeholder meetings will form a basis for discussing whether changes to the program may be desirable in the future.

During the March 29 meeting, the LTMS agencies and interested parties reviewed the policies and implementation of the LTMS program over the past 12 years. Specifically, the program was reviewed in relation to evaluation criteria established in Chapter 8 of the Management Plan as well as in relation to the LTMS goals, which include:

- Maintain, in an economically and environmentally sound manner, those channels necessary for navigation in San Francisco Bay and Estuary and eliminate unnecessary dredging activities in the Bay and Estuary
- Conduct dredged material disposal in the most environmentally sound manner
- Maximize the use of dredged material as a resource
- Establish a cooperative permitting framework for dredging and dredged material disposal applications

At the March 29 meeting, stakeholders identified the following three topics for future meetings: beneficial reuse; costs and contracting; and policy and strategy development. This document presents information specific to the second LTMS 12-year review process stakeholder meeting that will occur on June 19, 2012, and focuses on beneficial reuse. Additional information requests from the March 29 meeting will be forthcoming in either topic-related pre-meeting background documents, as presentation material, or as part of the summary report. The following information is intended to answer specific questions on beneficial reuse under the LTMS program, provide background information for the upcoming meeting, and stimulate thoughtful and productive discussions.

The LTMS agencies recognize that over the past 12 years, certain overarching changes have influenced the program's implementation. Three specific items include the recent economic recession, a greater understanding of rising sea levels, and a decrease in the suspended sediment supply from the Sacramento-San Joaquin River Delta (Delta). The economic recession has both increased costs and reduced available funds for restoration projects and harbor maintenance. A rising sea level has lead the entire region to consider its vulnerability to more frequent storm surges, high tides, inundation, and erosion of shorelines. Decreasing suspended sediment supply from the Delta increases the importance of sediments from local tributaries to Bay habitat and shoreline stability, as well as the importance of wise use of other available sediment resources, including dredged material. Over time, the Bay is likely to experience a period of "bay clearing" as more light is able to penetrate the water column. This change will likely favor certain species and be detrimental to others. Over longer periods of time, the Bay's shorelines and deeper water shoals may erode. While sea level rise and decreasing sediment supply were both issues facing the region during implementation of the LTMS program, the acute effects and extent of these issues are more apparent now as revealed by recent research. The existing LTMS goal of maximizing beneficial reuse, particularly in marsh restoration projects, is an important component in building resilience in the region, both for the natural and built environments. Specifically, dredged sediment placement at restoration sites raises elevations and increases the rate at which marsh vegetation can colonize, making these sites more adaptable to sea level rise. And importantly, reusing dredged material for tidal restoration projects or on beaches retains this sediment within the system.

2 DETERMINING WHEN REUSE OF DREDGED MATERIAL IS "BENEFICIAL"

Maximizing the beneficial reuse[1] of dredged material is one of the LTMS's key goals. The starting point for discussing beneficial reuse is that its definition (both nationally and locally) is very broad, as the following references and excerpts show. The key aspects of whether any proposed reuse can be considered "beneficial" include: 1) that there is a need for the reuse project; 2) that the benefits clearly outweigh any environmental impacts or tradeoffs; and 3) that any impacts should be fully mitigated. Projects that satisfy these broad tests are at a minimum suitable for LTMS consideration, and several types of beneficial reuse projects have been approved under the LTMS program (see Section 3).

Most recently, interested parties have questioned whether unconfined or non-engineered in-Bay placement could be considered beneficial reuse, especially in light of the decrease in suspended sediment supply. In order to determine whether and how these new concepts can meet the broad beneficial reuse tests, additional analysis may be required. The Clean Water Act, Rivers and Harbors Act, Porter-Cologne Water Quality Control Act, and the McAteer-Petris Act contain policies that address the placement of sediment, and would each need to be addressed in order to recognize unconfined placement of sediment in the Bay as a beneficial reuse. In particular, potential impacts to natural resources would need to be evaluated. In some cases, existing policies may need to be modified if such evaluations clearly indicate a beneficial reuse project would be valuable to pursue. As part of the 12-year review process, the LTMS is looking forward to input from interested parties on identifying and evaluating issues to address.

2.1 Beneficial Reuse References in the LTMS EIS/EIR and Management Plan

The LTMS Environmental Impact Statement/Environmental Impact Report (EIS/EIR; USACE et al. 1998) and Management Plan (USACE et al. 2001) discussed the beneficial reuse of dredged material in broad terms. The intent of these LTMS documents was to avoid unnecessarily restricting known or new potential beneficial reuse opportunities, while providing the public with the assurance that LTMS agencies would only approve projects that clearly offered net environmental benefits.

Relevant excerpts from the LTMS EIS/EIR include:

- **Section 2.1.2 (p. 2 – 4):** "To achieve [the LTMS] goals, the participating agencies have also formally adopted the following objectives for the San Francisco LTMS process

[1] The LTMS has used the term "beneficial reuse" of dredged material to differentiate it from the term "beneficial use," which relates directly to water quality standards in California.

[…] Promote the reuse of dredged materials whenever it is shown that there is a need for the material and the placement can be done in an environmentally acceptable manner."

- **Section 2.4.2.4 (p. 2 – 18):** "'Beneficial reuse' refers to managing dredged material as a valuable resource that can be used to create other benefits, rather than just as a waste product to be disposed of as efficiently as possible."
- **Section 2.6.1 (p. 2 – 20):** "Proposed habitat restoration projects using dredged material should be evaluated in the context of regional habitat goals developed independently[...] Only habitat restoration/creation projects having positive overall net benefits will be supported as LTMS projects."

The following is a relevant excerpt from the LTMS Management Plan:

- **Section ES-7 (p. ES – 17):** "For restoration projects using dredged material in areas not covered by regional habitat goals[…] the LTMS agencies will also encourage and authorize as legally appropriate, such projects which would clearly result in an overall net gain in habitat quality and would minimize loss of existing habitat functions. Whenever feasible, such projects will provide, as part of the project design, for a no net loss in the habitat functions existing on the project site or, where necessary, provide compensatory mitigation for lost habitat functions in accordance with state and federal mitigation requirements."

2.2 Engineer Research and Development Center Beneficial Uses Website

The U.S. Army Corps of Engineers' (USACE's) Engineer Research and Development Center (ERDC) in Vicksburg, Mississippi, maintains a national website that provides a variety of resources concerning the beneficial use of dredged material (USACE 2011). This website contains references to applicable national policies, discusses beneficial reuse case studies covering many categories of reuse, and provides technical information on reuse-related issues.

The website also emphasizes the broad array of project types that can use dredged material. It defines beneficial use of dredged sediment as an activity that "utilize(s) dredge sediments as resource materials in productive ways" and classifies reuse activities into the following seven categories:

- Habitat development
- Shore protection
- Parks and recreation
- Reclamation and remediation
- Construction and industrial

- Agriculture, forestry, horticulture, and aquaculture
- Emergency response actions

2.3 National Dredging Team's 2007 Beneficial Uses Planning Manual

The National Dredging Team (NDT) published its Beneficial Uses Planning Manual (Planning Manual) in 2007 (USEPA and USACE 2007). The Planning Manual discusses a number of practical considerations for planning reuse projects. It also references national policies that address funding and that encourage USACE to incorporate beneficial reuse into its dredging projects. Specifically, the Planning Manual notes:

> *USACE and EPA have long had general policies offering broad support for the use of dredged material for beneficial purposes. Throughout the years, these policies allowed USACE to incorporate to some extent beneficial use projects into its Civil Works dredging programs. In the past 20 years, Congress has provided new legislative authorities and funding that enable and encourage USACE to pursue beneficial use opportunities, particularly habitat restoration projects, on a much wider scale. Section 306 of the Water Resources Development Act (WRDA) of 1990, for example, requires USACE to include environmental protection as one of its principal missions. Section 1135 of WRDA 1986 authorizes USACE to modify the structures and operations of its existing water resources projects to redress environmental damage caused by those projects. Section 204 of WRDA 1992 and Section 207 of WRDA 1996 encourage USACE to incorporate beneficial uses of dredged material into constructing, operating, and maintaining its Civil Works navigation projects.*

2.4 Sediment Quality Considerations for Reuse Projects

Sediment quality is a key practical consideration for successful beneficial reuse projects. As noted in the NDT Planning Manual:

> *The composition and grain size distribution of dredged material is important in matching the material with the intended beneficial use. For simplification, dredged material is characterized as one of five sediment types: rock; gravel and sand; consolidated clay; silt/soft clay; and mixture (rock/sand/silt/soft clay). Numerous other factors must be evaluated when considering beneficial use options for dredged materials such as: contaminant status of materials; site selection; technical feasibility; environmental acceptability; cost/benefit; and legal constraints.*

Table 1 details dredged material types and related beneficial uses.

Table 1
Beneficial Uses Most Compatible with Dredged Material of a Given Composition

Material Type	Potential Beneficial Use
Rock	***Beach nourishment (offshore berms only)*** ***Construction/industrial development*** ***Habitat restoration and development*** Agriculture, forestry, horticulture, and aquaculture Parks and recreation Strip-mine reclamation/solid waste management
Consolidated Clay	***Agriculture, forestry, horticulture, and aquaculture*** ***Habitat restoration and development*** Construction/industrial development Parks and recreation
Mixture of Sand and Gravel	***Beach nourishment*** ***Construction/industrial development*** ***Habitat restoration and development*** ***Parks and recreation*** Agriculture, forestry, horticulture, and aquaculture Strip-mine reclamation/solid waste management
Mixture of Silt and Soft Clay	***Agriculture, forestry, horticulture, and aquaculture*** ***Habitat restoration and development*** Construction/industrial development Parks and recreation
Mixture of Rock, Sand, Gravel, Silt, and Soft Clay	Agriculture, forestry, horticulture, and aquaculture Beach nourishment (offshore berms only) Construction/industrial development Habitat restoration and development Parks and recreation Strip-mine reclamation/solid waste management

Note: Uses in bold italics text are generally considered to be the most suitable uses for the corresponding material type.
Source: USEPA and USACE 2007

Physical compatibility is especially important for beneficial reuse projects. Dredged material from the San Francisco Bay is, for the most part, fine grained—predominantly silt and clay with a high water content. A few projects generate fine sand, and deepening projects often encounter very dense material from different geological formations. Fine material from typical Bay maintenance dredging projects is often appropriate for the upper layers of tidal restoration projects, where the desired substrate is fine. However, sandier material is needed for certain habitat purposes—for example, the creation of tern nesting areas and beach nourishment projects. The process of matching dredging projects with specific habitat restoration projects should consider grain size appropriate to the need; in some cases, multiple material types may be needed for a single restoration project.

Chemical compatibility is also important for beneficial reuse projects. For certain uses, such as road base or other construction fill, moderate levels of contamination can be managed without significant concern. However, most habitat restoration work must be done with sediment that is non-toxic and no more contaminated than sediments that would settle in the location naturally. The Montezuma Wetlands Restoration Project is currently the only habitat restoration project in the Bay Area that can accommodate moderately contaminated sediments (as foundation material that will be contained and isolated from biological receptors) as well as clean cover material. The Bay Area is fortunate that the vast majority of material from maintenance dredging projects as well as much of the material from new work projects is non-toxic and chemically clean enough to be reused directly in many habitat restoration projects.

3 SUMMARY OF BENEFICIAL REUSE UNDER THE LTMS

The LTMS program initially identified the following categories of beneficial reuse as generally feasible and appropriate for consideration in the Bay Area:

- Tidal wetland restoration (habitat development)
- Rehandling facilities for landfill cover and other end uses
- Levee rehabilitation
- Beach nourishment
- Construction fill

All of these reuse types have occurred to varying degrees under the LTMS program, although to date, habitat development (particularly tidal and subtidal aquatic habitat restoration) has accounted for a larger volume of dredged material reuse than the other categories. Reuse of dredged material for levee rehabilitation is the category that has fallen shortest of the expectations outlined in the LTMS EIS/EIR. At the time the EIS/EIR was written, it was thought that up to approximately 2 million cubic yards (cy) per year could be reused on levees in the Delta alone. However, in practice, the lack of a large-scale multi-user regional rehandling facility, coupled with concerns about salt content in Bay-dredged material, has limited levee reuse almost entirely to the Bay Area and only as far east as Winter Island.

As noted above, these are not the only categories of beneficial reuse that can be considered, or that have occurred around the nation. In fact, one kind of reuse not discussed in the LTMS EIS/EIR—using dredged sediment for agriculture—has also been approved (at Carneros River Ranch).

At the March 29 meeting, stakeholders requested that the LTMS agencies break out beneficial reuse volumes by new work versus maintenance dredging projects. This distribution is shown in Figure 1. It is worth noting that new work dredging projects represented 18% of projects from 2000 to 2001 yet account for more than 75% of volume for seven of those years.

Figure 1

Beneficial Reuse Volumes for New Work and Maintenance Dredging Projects

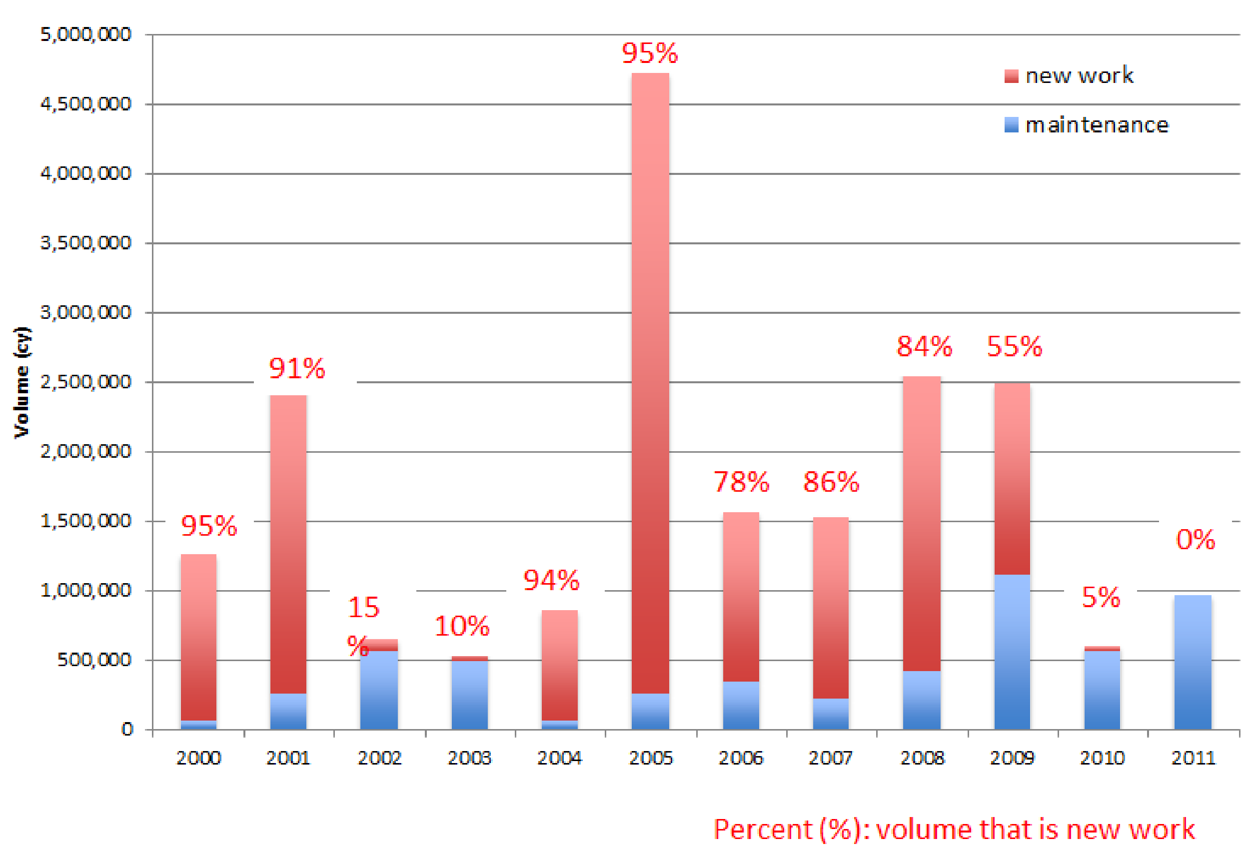


Table 2 shows the acreage of habitat restoration projects in the Bay that have been completed through beneficially reusing dredged material.

Table 2

Bay Habitat Restored Through Beneficial Reuse of Dredged Material

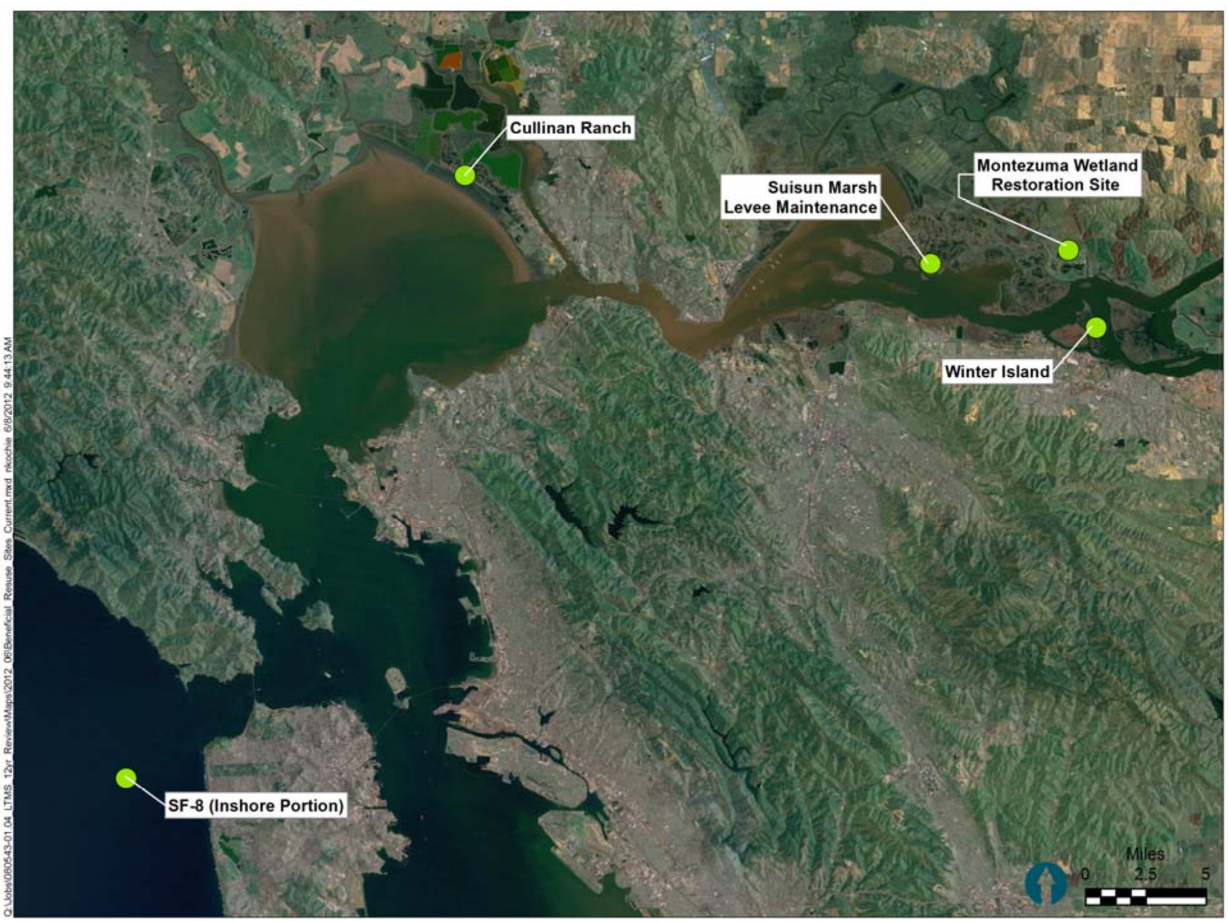
Project	Acreage and Type of Habitat to Be Restored	Acreage of Habitat Restored for Threatened and Endangered Species	Dredging Project Type	Project Status
Port of Oakland, Middle Harbor Enhancement Area	180 acres of subtidal habitat including eelgrass beds	180 acres of restored habitat including 161 acres shallow water and eelgrass beds, 5 acres of salt marsh, and 0.5 acres of avian high tide refugia (green sturgeon, longfin smelt, salmonids, and least tern)	New Work	Dredging/placement complete; regrading and eelgrass planting incomplete
Inner Bair Island, Area D	33 acres of tidal wetlands	33 acres of tidal wetlands (habitat for salt marsh harvest mouse and California clapper rail	Maintenance	Incomplete; currently inactive
Hamilton Wetland Restoration Site	962.4 acres of tidal and seasonal wetlands, transitional uplands	360 acres of tidal wetlands (habitat for California clapper rail, salt marsh harvest mouse, longfin smelt, and salmonids)	New Work and Maintenance	Dredging/placement complete; levee breach scheduled for 2013
Montezuma Wetland Restoration Site Phase I	1,880 acres tidal and seasonal wetlands planned for Phases 1 – 4 Currently in Phase 1 with 561 acres tidal marsh planned	Phase 1 will include: 332 acres low tidal marsh; 198 acres high tidal marsh; 32 acres subtidal channels; 28 acres seasonal wetlands; 6.6 acres intertidal ponds; 29 acres Clank Hollow; and 19 acres refugial and nesting island for birds for a total of 644.6 acres, plus 220 acres of upland transition and buffer zone habitat (salt marsh harvest mouse, least tern, snowy plover, longfin smelt, Delta smelt, green sturgeon, and salmonids)	New Work and Maintenance	Incomplete; accepted 3 million cy 2003 – 2006 from Oakland 50-foot project and 630,000 cy in 2012 to date from maintenance dredging projects; 280 acres of Phase 1 complete
Sonoma Baylands	322 acres of tidal wetlands	322 acres tidal wetlands (habitat for California clapper rail, salt marsh harvest mouse, longfin smelt, and salmonids)	Maintenance and New Work	Completed; Phase 1 material came from Petaluma River maintenance dredging; Phase 2 came from the Port of Oakland 42-foot deepening project

Project	Acreage and Type of Habitat to Be Restored	Acreage of Habitat Restored for Threatened and Endangered Species	Dredging Project Type	Project Status
Chevron Remediation Site at Castro Cove	18.5 acres of subtidal and 1.5 acres of salt marsh	18.5 acres of restored subtidal habitat (green sturgeon and steelhead); 1.5 acres of restored salt marsh (habitat for salt marsh harvest mouse, California black rail, and California clapper rail)	Maintenance	Dredging and placement of dredge material complete, tidal action to be restored by fall 2012
Yosemite Slough Remediation Project	7 acres of tidal wetlands	7 acres tidal wetlands (habitat for California clapper rail, salt marsh harvest mouse, and longfin smelt)	Maintenance	Dredging and placement in Phase I complete; Phase II will include an additional 5 acres of tidal wetland
Port of Richmond Shipyard 3 Remediation Project	1 acre intertidal and shallow baylands	1 acre restored intertidal and shallow baylands (least tern foraging; salmon, steelhead, and longfin smelt)	Maintenance	Complete
Stege Marsh/UC Richmond Field Station Remediation Project	3 acres tidal marsh	3 acres tidal marsh (habitat for California clapper rail and salt marsh harvest mouse)	Maintenance	Complete
Peyton Slough Remediation Project	14.6 acres tidal wetland	14.6 acres tidal marsh (habitat for California clapper rail and salt marsh harvest mouse)	Maintenance	Complete

4 BENEFICIAL REUSE SITES CURRENTLY IN OPERATION

Currently, five beneficial reuse sites are permitted and open for accepting dredged sediment in the San Francisco Bay Area. Each site is operated by a different entity who should be contacted for project specific information and needs. These sites are considered multi-user sites and together represent several million cy of capacity within the region. In addition to these multi-user sites, a number of private sites associated with specific dredging projects are currently in operation, such as the Schoellenberger Ponds in Petaluma or the City of Martinez's drying ponds at the Martinez Marina. While these sites are used by individual dredging projects, restoration projects that are in need of sediment many consider these private sites a source of sediment because they need to be routinely emptied to facilitate additional upland placement. The five multi-user beneficial reuse sites are shown on Figure 2 and described in the following sections.

Figure 2
Beneficial Reuse Sites Currently in Operation



4.1 Cullinan Ranch

Location: North of Highway 37, along Dutchman Slough
Capacity: 400,000 cy
Costs: No tipping fee
Contact: Renee Spenst, Ducks Unlimited; 916.852.2000; rspenst@ducks.org
Comments: This beneficial reuse site is permitted and available. The current offloading area is off of Dutchman Slough. Offloading equipment, potentially a Toyo pump and piping, must be provided by the contractor. However, Cullinan Ranch has recently received a State Lands lease to use an offloader at Napa River, which will allow access by larger scows.

4.2 Montezuma Wetland Restoration Site

Location: Collinsville, Suisun Bay
Capacity: 14,000,000 cy
Costs: $7.00 – $12.00 per cy tipping fee for cover material, higher for foundation depending on volume, timing, and other project details
Contact: Doug Lipton; 707.433.2094; docterre@sonic.net
Comments: Montezuma is the only beneficial reuse site that accepts both cover and foundation quality sediment. This site is currently accepting sediment and has an offloader in place and operating. Montezuma can accommodate most scows with a light draft height of less than 24 feet from the waterline to the top of the combing. It cannot guarantee complete offloading of flat bottom scows or scows with capacity less than 1,000 cy. Pocket scows are not allowed because the compartments are typically too small for the snorkel pump arrangement of the Liberty.

4.3 Winter Island

Location: Suisun Bay
Capacity: 353,265 cy under existing permits
Costs: $1.00 per cy tipping fee
Contact: Robert Calone; 925.759.5599; robertcalone@att.net
Comments: Offloading equipment, typically a crane or drag arm offloading device, must be provided by the contractor. Placement of sediment on levees requires wetland cover quality material. Winter Island has depth limitations and can only accept smaller to moderate sized scows.

4.4 SF-8 (Inshore Portion)

Location: Approximately 3 miles offshore of Ocean Beach
Capacity: No specific volume limitation
Costs: No tipping fee
Contact: Brian Ross, USEPA; 415.972.3475
Comments: Beneficial reuse at SF-8 is focused on increasing sand in the littoral cell to promote sustainable beaches on the outer coast; sand is the only material accepted at this site. Material placement requires concurrence from the California Coastal Commission and certification from the Regional Water Quality Control Board.

4.5 Suisun Marsh Levee Maintenance

Location: Suisun Marsh Islands/Managed Wetlands
Capacity: Limited; varies by location
Costs: No tipping fee
Contact: Steve Chappell, Suisun Resource Conservation District; 707.425.9302; srcd@suisunrcd.org
Comments: There are many levees in the Suisun Marsh that are in need of sediment for maintenance activities. Most of these levees would be accessed through shallow sloughs, which limits scow size. If interested in this type of reuse, contact the Suisun Resource Conservation District to identify individual projects.

4.6 Van Sickle

Location: Van Sickle Island, Suisun Marsh
Capacity: 19,000 cy/year
Costs: No tipping fee
Contact: Chris Lanzafame, Van Sickle Island Reclamation Number 1607; 925.432.4757
Comments: Van Sickle is a levee repair/maintenance effort. Each contractor must bring its own offloading equipment to the site (likely a crane or drag arm bucket).

5 NEAR-TERM BENEFICIAL REUSE OPPORTUNITIES

At the March 29 meeting, Beth Huning (San Francisco Bay Joint Venture [Joint Venture]) stated that approximately 20 restoration projects are in need of sediment. The Joint Venture has tracked wetland restoration projects for several years. Their database includes a field where project managers can enter specific sediment needs and qualifications. In addition, the Joint Venture has participated in the USACE's San Francisco Bay Regional Dredged Material Management Plan (RDMMP) planning process, which is focused on identifying and developing potential beneficial reuse opportunities for the next 20 years.

The LTMS agencies are currently working with the Joint Venture to bring forward restoration projects currently in need of sediment to discuss further at the June 19 meeting. In addition, several reuse opportunities are currently in the active planning stages. Some or all of the efforts described in this section may result in new active beneficial reuses sites over the coming few years.

5.1 USACE's Regional Dredged Material Management Plan

The USACE, as part of the LTMS program, initiated work on RDMMP to develop a placement plan for USACE-dredged material through 2035. The RDMMP fulfills the USACE dredged material management planning requirements based on the Water Resources Development Act of 2007 and is a major component of the implementation phase of the LTMS for dredging and the placement/use of dredged material. The RDMMP is tiered under the LTMS based on the Record of Decision signed in 1999. The objective of the RDMMP is to develop an economically justified plan that identifies beneficial use opportunities to accommodate necessary USACE dredging in the San Francisco Bay while supporting regional ecosystem restoration, flood control, and sediment transport goals. Funding for the RDMMP was available through the USACE LTMS budget until fiscal year 2011. As a result, funding set aside in contracts was re-prioritized and some of the final RDMMP deliverables were postponed until a later date.

As part of the RDMMP development, a working group consisting of representatives from state and federal agencies, as well as contingencies from environmental, industry, and citizens groups with experience and/or expertise with beneficial uses of dredged material met periodically to assess and compare the environmental aspects of dredged material placement options. From 2010 through March of 2011, the group met on five occasions to assess the consultant team's screening of the potential beneficial use options and to compare potential environmental benefits associated with each option under consideration.

During the development of the RDMMP, the team identified a strong potential project in the South Bay, and in turn developed a more specific implementation plan for this called the South Bay Dredged Material Management Implementation Plan (DMMIP). The three main components of the South Bay DMMIP are as follows:

- Reconnaissance level investigation of potential dredged material placement sites within the South Bay, including identification of sites recommended for more detailed analysis
- Project Management Plan, which describes and provides costs estimates for feasibility level investigation of the recommended dredged material placement sites
- Preliminary Ecosystem Restoration Benefits Analysis with Preliminary Plan Formulation

The reconnaissance level investigation for the South Bay DMMIP was completed in June 2011. The remainder of the program associated with the DMMIP is investigating the potential to provide beneficial use material to the South Bay Salt Ponds Restoration Project. The Project Management Plan and Preliminary Ecosystem Restoration Benefits Analysis with Preliminary Plan Formulation are expected to be complete by the end of June 2012.

5.2 South Bay Salt Ponds Phase II

In May 2012, the South Bay Salt Ponds project sent the USACE a letter of intent stating their potential interest in receiving up to 25 million cy of dredged sediment to support the restoration project, both for use in the transitional ecotone and potentially within ponds. While this opportunity represents great potential, technical analysis is needed both to define the reuse opportunities, methods of transportation and delivery of sediment to the project, and how to move sediment within the Salt Pond project to the different areas within the larger project. To this end, the Salt Pond project is developing a comprehensive plan to beneficially reuse dredged material at the site.

6 LONG-TERM: REGIONAL SEDIMENT MANAGEMENT

Due to the decreased sediment loading from the Delta, local tributaries have become a more important source of sediment supply for the Bay. This change, as well as increased sea level rise associated with climate change, has caused scientists and coastal managers to reconsider assumptions and their understanding of sediment supply and transport into, within, and out of the Bay system. This is important because sustainable shorelines, marshes, beaches, and subtidal habitats depend on sediment type, transport, and quantity.

Bay sediment dynamics control many estuarine processes, such as the location of tidal flats and marshes, habitat variability, and the productivity of the Bay's waters. The net flux of sediments into and out of discrete portions of the Bay determines whether erosion or accretion occurs and creates features such as shoals and channels as well as specific habitat environments such as fine-grained or sandy bottoms. The tributaries feeding the Bay, along with tides, currents, and winds, are the main drivers in sediment transport and distribution. High concentrations of suspended sediment can reduce light penetration and lower biological productivity, but can also help prevent harmful algal blooms. An adequate supply of sediment is needed to maintain the dynamic equilibrium of rivers, wetlands, shorelines, tidal flats, and shoals within the Bay system, while excessive volumes of sediments can silt in creeks and channels and degrade riverine and open-water habitats. Adequate sediment supply is particularly important to the Bay and its watersheds for adapting to sea level rise and other effects of global climate change. Sediment feeds shorelines, tidal flats, and wetlands and allows them to maintain their elevation in the tidal frame while minimizing erosion and inundation. Decreases in local or regional sediment supply can exacerbate erosion and inundation resulting in submerged shorelines and marshes that no longer provide their ecosystem services for wetland habitat, floodwater absorption, or storm surge buffering.

Regional sediment management is an approach to manage sediments within the context of the entire system, including sediment sources, movement and sinks within the system, and exchange with the ocean. Sediment processes are important components of estuarine systems and are integral to the environmental and economic vitality of the Bay Area. While dredged sediment is clearly a very important component in managing sediment in the Bay system, it is not the only consideration. Aggregate mining on an annual basis can equal the volume of sediment dredged for maintenance projects in the Bay. In addition, large quantities of sediment are dredged or excavated from flood control channels every year. While these numbers have not yet been tallied for the region, it is anticipated that together they may equal or surpass the amount of sediment dredged for navigational purposes.

Addressing the decrease in sediment supply may mean facing a Bay with less suspended sediments in the future. However, reconnecting sediment supplies to the system where they have been diverted is another possibility. While dredged sediment is transportable to areas of need, the placement of dredged sediment does not in itself increase the amount of sediment in the system.

The LTMS program is clearly at a transition point but is aware of the potential innovative and synergistic opportunities that exist. The Bay community is committed to an environmentally and economically healthy Bay.

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