San Francisco Bay
Sediment & Soil Beneficial Reuse Action Plan

for Wetland Restoration Adaptation

Draft for Public Comment

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Contents

Executive Summary

This San Francisco Bay Sediment & Soil Beneficial Reuse Action Plan for Wetland Restoration Adaptation (Action Plan) is a foundational strategy for how the Bay Area can more effectively and efficiently beneficially reuse sediment and soil to sustain and adapt the Bay's wetlands in light of a changing climate.

Protecting, restoring and adapting the wetlands that fringe San Francisco Bay is critical to the region's approach to climate resiliency. Since the Gold Rush, the Bay has seen a significant decline in suspended sediment. With subsided Baylands and rising sea level, natural sedimentation processes alone cannot meet our wetland's current and future adaptation needs through 2100. Sediment and soil available naturally and collected from managed activities, including dredging, construction, and flood control, can and are being beneficially reused to elevate and nourish marshes. However, due to a range of impediments, beneficial reuse is not currently being maximized to the extent necessary.

For many years, resource managers engaged in sediment issues have discussed the many possible solutions to increase beneficial reuse, but implementation of these strategies has been slow and piecemeal. This Action Plan presents, for the first time, a cohesive approach that can guide coordinated regional action.

This Action Plan was developed by the San Francisco Bay Conservation and Development Commission (BCDC), in concert with a Core Team of partner agencies and organizations including the San Francisco Estuary Institute, the San Francisco Bay Joint Venture, the San Francisco Bay Regional Water Quality Control Board, the State Coastal Conservancy, and the U.S. Environmental Protection Agency Region 9. It incorporates actions identified through interviews, two stakeholder workshops supported by Catalyst Consulting Group, along with discussion and feedback from BCDC's Sediment and Beneficial Reuse Commissioner Working Group. Funding for the Action Plan was provided through a Wetlands Development Grant from the U.S. Environmental Protection Agency and from the State of California Ocean Protection Council.

The first section of the Action Plan introduces the challenges to restoration and beneficial reuse in the Bay Area, the Action Plan development process, and the foundational assumptions that underlie the Action Plan.

The second section outlines the goals to be achieved and the guiding principles that should inform action implementation. The goals are:

Goal 1. **Expanded Partnerships for Action.** Maintain and expand regional partnerships to improve coordination and advance sediment and soil reuse among government agencies, the restoration community, and industries involved in sediment management.

Goal 2. **Site Identification and Preparation.** Identify new restoration sites, and support and accelerate the readiness of restoration sites to receive soils and sediment.

Goal 3. **Coordination and Timing.** Enhance the coordination and timing of delivery of available sediment and soil, and restoration site needs.

Goal 4. **Policies and Regulations.** Identify, improve, and create programming, policy, and regulations that support beneficial reuse of sediment and soils.

Goal 5. **Funding.** Expand and secure federal, state, regional, and private funding for beneficial reuse of sediment and soils at wetland restoration projects.

The third section provides background information on the various sources of sediment that the region could use to facilitate beneficial reuse for wetland restoration.

The fourth section provides the actions identified through the planning process that the region needs to implement to meet its beneficial reuse goals, as summarized in the box above. The actions are organized by 8 focus areas. Each focus area includes an issue summary, objectives and specific actions. The actions included in each focus area advance the overarching goals of the Action Plan.

Action Plan Summary

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1. Introduction

This collaborative regional roadmap – the Sediment & Soil Beneficial Reuse Action Plan – focuses on identifying challenges and barriers and outlining solutions to accelerate the beneficial reuse of dredged sediment and excess construction soils for restoration and adaptation purposes. By doing so, the San Francisco Bay Area (Bay Area) will be on a path to more effectively reuse sediment from navigation dredging, flood-control channels, and excess soils from construction sites to meet the urgent need to preserve and restore wetlands, while also adapting to rising sea levels across the Bay Area.

a. The Sediment & Soil Challenge

Wetlands provide a transitional habitat between estuarine waters and upland areas, absorb flood waters, buffer waves along the shoreline, and can assist the region in adapting to rising sea levels. 90-95% of the wetlands that previously surrounded San Francisco Bay have been lost or deteriorated in the last 200 years due to human activities such as diking, draining, and development, which has caused large areas of the Bay Area to fall below sea level. These subsided areas need sediment to restore their elevations to above sea level to support colonization by native plants and regain resiliency to coastal flooding, storm surge, and erosion.

The San Francisco Estuary Institute (SFEI)'s 2021 Sediment for Survival report[1] determined that the Bay needs between 450 to 650 metric tons of sediment and soil to preserve, restore, and sustain wetland habitat, and adapt to rising sea levels through 2100. However, as sea levels continue to rise, the suspended sediment supply in Bay waters – which has decreased from the period following the Gold Rush – is not sufficient to restore the subsided Baylands and existing wetlands to marsh plain elevation. Without interventions to maximize the amount of dredged sediment and upland soils for beneficial reuse amidst rising sea levels, the Bay will lose its vital tidal marshes. Restoring the Baylands offers a nature-based flood protection strategy that will lessen wave action and coastal flooding where they exist, creating more resilient shorelines and serving as crucial habitat for fish, birds, and other organisms.

The Bay Area community has acted to restore many of these subsided areas under the guidance of the 1999 Baylands Habitat Goals Report[2] (updated in 2015 to address climate change) to restore 100,000 acres of wetland habitat by 2030. As of 2021, approximately 78,000 acres of wetland habitat has been or is actively being restored, leaving 22,000 acres left to be planned (San Francisco Bay Restoration Authority, April 2021). The "Long-Term Management Strategy for the Placement of Dredged Material in the Bay Region[3]" (LTMS) Management Plan, adopted in 2001, contributes to restoration efforts by maximizing the beneficial reuse of dredged sediment from navigation projects in the Bay region.

The primary beneficial reuse of dredged sediment in the region has been to raise the elevation of subsided Baylands to restore wetlands. Other beneficial reuses include using dredged sediment for

[1] Dusterhoff, S., McKnight, K., Grenier, L., and Kauffman, N. 2021. Sediment for Survival: A Strategy for the Resilience of Bay Wetlands in the Lower San Francisco Estuary. A SFEI Resilient Landscape Program. A product of the Healthy Watersheds, Resilient Baylands project, funded by the San Francisco Bay Water Quality Improvement Fund, EPA Region IX. Publication #1015, San Francisco Estuary Institute, Richmond, CA.

[2] Goals Project. 1999. Baylands Ecosystem Habitat Goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, San Francisco, Calif./S.F. Bay Regional Water Quality Control Board, Oakland, Calif.

[3] For more information regarding the LTMS Management Plan, see BCDC's website or visit the following link: https://bcdc.ca.gov/programs/sediment-management/long-term-management-strategy/.

construction fill, maintenance of un-engineered levees, and more. Under the LTMS, over 30 million cubic yards of sediment have been beneficially reused at five landscape-scale restoration projects, one large subtidal habitat restoration project, several other smaller habitat projects in region, and levee repair projects. Additionally, a significant volume of upland soil has been used to create ecotone and flood projection levees for the South Bay Salt Pond Restoration Project and South Bay Shoreline Project.

b. How this Plan was Developed

Beginning in 2023, the San Francisco Bay Conversation and Development Commission (BCDC) began working with its partner agencies and organizations – San Francisco Estuary Institute (SFEI), the San Francisco Bay Joint Venture (SFBJV), the San Francisco Bay Regional Water Quality Control Board (Water Board), the State Coastal Conservancy (Conservancy or SCC), and the Environmental Protection Agency Region 9 (EPA), supported by Catalyst Consulting Group, to identify challenges and barriers to the beneficial reuse of sediment and soils at wetland restoration sites, potential solutions to those challenges, and actions needed to accomplish them. Through this collaborative effort, the Sediment & Soil Beneficial Reuse Action Plan was created, which incorporates feedback from multiple interviews with experts and interested parties, two workshops with stakeholders, additional outreach with resource managers, and the help of a Core Team and BCDC's Sediment and Beneficial Reuse Commissioner Working Group.

c. Foundational Assumptions of the Action Plan

To understand the context of this Action Plan, it is important to acknowledge key facts and challenges that provide the basis for some of its actions and conclusions.

- Restoring wetlands and supporting existing wetlands with beneficial reuse of sediment and soil is sea level rise adaptation.
- Sediment and soils play a critical role in raising the elevations of both subsided Baylands and existing wetland habitats throughout the Bay. Additional management actions are necessary to increase sediment and soil supply to re-establish wetlands across the region and assist in their adaptation to rising sea levels in order to strengthen natural infrastructure.
- The development of a regional or state strategy that increases the beneficial reuse of sediment and construction soils is needed to restore wetland habitat and provide green infrastructure along the shoreline.
- Treating sediment and soils as a waste product and disposing it, rather than beneficially reusing it at restoration sites and/or existing marshes, should be a last resort.
- The Bay Area is dynamic – its sediment transport, species, history, politics, collaborative nature, funding, and policies continue to change, and thus unique solutions tailored to a multifaceted estuary and community are required.
- Vulnerable communities along the Bay shoreline face even greater risks due to existing burdens and inequities that limit their ability to respond to and recover from flooding. More research is needed to fully understand the impacts and benefits that dredging and beneficial reuse have on communities. The communities that would either be impacted by or benefit from these actions should have ample opportunity to be part of the effort, especially as they work to adapt to rising seas.

- Beneficial reuse of sediment and soils requires additional equipment, time, and energy to accomplish, which means additional funding is necessary to support these efforts.
- This large and multifaceted effort requires a regional approach with organizations and entities at varying levels of government leading and contributing to different actions.
- The timeframe for the actions contained herein is expected to be approximately five years to ensure that near-term results can be realistically achieved. The actions must be reasonable and implementable, and support both the beneficial reuse of sediment and soils and wetland restoration and adaptation.

2. Goals and Principles

a. Goals

The actions for each focus area contribute to meeting one of the Action Plan's goals, as provided below. By working toward the following goals, BCDC and its partners will progress toward the project's overarching objective of increasing beneficial reuse of sediment and soil to support wetland habitat across the region.

Goal 1. **Expanded Partnerships for Action.** Maintain and expand regional partnerships to improve coordination and advance sediment and soil reuse among government agencies, the restoration community, and industries involved in sediment management.

Goal 2. **Site Identification and Preparation.** Identify new restoration sites, and support and accelerate the readiness of restoration sites to receive soils and sediment.

Goal 3. **Coordination and Timing.** Enhance the coordination and timing of delivery of available sediment and soil, and restoration site needs.

Goal 4. **Policies and Regulations.** Identify, improve, and create programming, policy, and regulations that support beneficial reuse of sediment and soils.

Goal 5. **Funding.** Expand and secure federal, state, regional, and private funding for beneficial reuse of sediment and soils at wetland restoration projects.

b. Principles

The principles listed below will help guide a unified coalition that can effectively complete the described actions that will ultimately increase beneficial reuse of sediment and soil for wetland restoration and adaptation. The actions identified within this Action Plan should embody these principles.

Principle 1. **Coordination and Collaboration** to organize the many entities working in this space.

Principle 2. **Equity** to ensure community input in restoration planning and the use of sediment and soil.

Principle 3. **Environmental Stewardship** to support existing and restored wetlands as sea levels rise and resiliency becomes key.

Principle 4. **Transparency** to ensure that all stakeholders can track progress and provide input.

Principle 5. **Speed and Agility** because there is limited time to restore wetlands and capture available sediment and soil as sea levels rise.

Principle 6. **Capitalizing on Other Work** in this space and building off existing progress.

3. Sources of Sediment & Soil for Wetlands

Wetlands in the Bay provide a range of ecological services, including carbon sequestration, water purification, flood water absorption, wave and storm surge reduction, and fish and wildlife habitat. But as is the case with many coastal areas, their survival and the essential services they provide are threatened by rising sea levels.

Existing and restored wetlands continue to receive sediment through natural transport processes, and current and future wetland restoration projects will need sediment and soil to support them. Long-term studies indicate that wetlands require a consistent supply of sediment to keep pace with sea level rise and room to migrate. However, development landward of wetlands and reduction in natural sediment supply from watersheds and the Bay has limited the ability of wetlands to migrate over time as sea level rises. After the sediment load from the Gold Rush and the replumbing of the Delta, there was a reduction in the amount sediment entering the Bay from Sacramento-San Joaquin Rivers. With this reduction, local tributaries are now the primary contributor of suspended sediments to the Bay (Schoellhamer, 2011).

The Bay Area faces several challenges in reaching its target of restoring 100,000 acres of wetlands, including minimal sediment supply, limiting placement strategies, and the unavailability of restoration sites that are augmented with sediment and soil. The changing climate plays a significant role, with wet and dry years influencing the volume of sediment entering the Bay in any given year (SFEI, Dusterhoff et. Al, 2021). With deeply subsided Baylands rimming the Bay, restoration and support of existing wetlands are the primary focus of beneficial reuse efforts in the region so that wetlands and their essential services can survive and thrive into the next century. These factors as well as others limit the effectiveness of beneficially reusing sediment and soil. Thus, it is critical that we understand potential sources of sediment and soils for beneficial reuse, and challenges associated with their use.

a. Excess Construction Soils

Construction projects around the Bay Area often have excavated soil that is not needed on site. Traditionally, this soil gets trucked to a landfill where it is either disposed of or used as daily landfill cover. These soils can be used in wetland restoration projects such as levee construction, berms, ecotones, or general fill, depending on their geotechnical composition and soil quality. Currently, larger restoration sites in the South Bay are working with companies that assist in identifying upland soils and supplying them to projects.

General grading and the removal of soil to create below-grade spaces such as parking garages, basements, building foundations, roadways and other features produce significant quantities of excess soil. Once removed, soil is loaded into 10 cubic yard trucks or larger rail cars (when available) and brought directly to restoration sites.

Restoration site readiness to receive soil when it is available is a key issue. When construction soils cannot be transported directly from the source site to the restoration site, either the soil is disposed of or the project delayed. There are no stockpiling sites available other than at large projects where on site soil can be managed. While **storing soil** is important to facilitating beneficial reuse, there are many barriers. Excavated soil takes up valuable space at project sites if it is available at all, soil from different sources may need to be managed separately due to the quality or characteristics of the soil, identifying land and entities willing to provide a stockpile location can be challenging, and if stockpiled, the soil would need to be double-handled to bring it to the restoration site when it is ready, increasing the cost of beneficial reuse.

Assessment of construction soils is necessary to determine whether its quality and proposed use is protective of the plants and animals that would be exposed to the soil. Human activities and land uses, such as pesticide use, dumping of chemicals, leaky storage tanks, street run off, and historic military activities have been known to contaminate soils and watersheds. For these reasons, soil must

be assessed to determine if it is appropriate for use in a wetland restoration project. Depending on the quality of the soil, the restoration design, groundwater connection, and placement methodology, some soils can be used as surface quality. Surface quality soil is in contact with plants and animals living on, in, or feeding on plants and animals that live on or in the soil. These soils will also be in contact with Bay water, and therefore must be clean. Soils with minor exceedances of some contaminants may also be useful in restoration projects and can be used as foundation soils, which are buried beneath approximately 3 feet of clean soil.

To address this issue, projects that import upland soils are required to develop either a Sampling and Analysis Plan (SAP) or a Quality Assurance and Projection Plan (QAPP). These documents contain information about the number of samples, collection and testing methods, and quality assurance protocols. QAPPs often contain specific soil handling and tracking protocols, detailing the how the soil is managed from excavation to placement. QAPP development is most common for sites that accept soil from multiple contractors.

The Don Edwards Wildlife Refuge and the Eden Landing Ecological Reserve (South Bay Salt Ponds and South San Francisco Bay Shoreline Project) have the most developed and detailed QAPP in the region and are considered models for other projects considering a QAPP or SAP. Work to further improve these QAPPs is currently underway in an effort lead by the South Bay Salt Pond Restoration Project working in conjunction with the Water Board and BCDC. Further standardizing and sharing protocols can remove barriers to construction soil use.

b. Flood Management and Streambed Maintenance Sediment & Soil

In the Bay Area, most rivers and streams have been channelized and/or realigned to move water off the land quickly during storms, with less than 40 of the 353 natural streams and creeks remaining in the region (SFEI, Changing Channels, 2017). In part due to watershed development reducing flow and the channelization and rerouting of rivers and creeks, sediment builds up and needs to be periodically removed to prevent adjacent flooding and maintain water flow requirements. In addition, some areas require bank stabilization or setbacks. Regionally, these projects can provide approximately 300,000 cubic yards of sediment and soil annually, but in a localized fashion (SFEI, 2017).

Flood protection and watershed managers remove sediment most often with mechanical equipment such as **a long-reach excavator from the shoreline**. Sediment removed from a channel edge is often placed directly on flood protection levees for levee maintenance purposes, stockpiled nearby, or trucked offsite, in some cases to restoration sites.

Removal of sediment through dredging can occur with either a clamshell or hydraulic dredge and occurs in larger rivers and creeks. The USACE is responsible for shallow draft federal navigation channels which sometimes overlap with flood protection channels, while the cities and counties are responsible for maintenance of flood protection channels. Hydraulic dredges have been used and can pump sediment to immediately adjacent sites. However, hydraulic dredging in rivers and creeks has been used sparingly due to species concerns, such as entraining endangered and threatened species. Clamshell dredges have fewer species concerns but require an offloader to transfer sediment to a restoration site.

Restoration sites that are closer to flood protection or streambed maintenance projects are considered “optimal locations” to partner with a restoration project, particularly those that need

relatively small volumes. However, this kind of partnering has been limited to a few projects, including those undertaken by the Marin County Flood Control District and the Santa Clara Valley Water District.

Urban runoff from developed areas and roadways can contain contaminates that pose a risk to sensitive wildlife found in wetlands. Therefore, this sediment and soil should be **assessed for contaminants** before being beneficially reused. However, not all flood control agencies test their sediment for ecological risks because of the traditional disposal of the sediment and soil. Testing protocols and guidance for this work are not well established or uniform across the region, leading to lack of knowledge on the sediment and soil quality in some channels, and thereby the potential for beneficial reuse. In some flood control programs, the sediment is well tested, but contaminants limit use at restoration sites.

c. Navigation Dredged Sediment

Dredging federal navigation channels, ports, oil terminals, recreational marinas and docks provides the largest volume of sediment in the region. Between 2 and 3.5 million cubic yards of maintenance dredging happens annually (2022 DMMO Annual Report[4] in prep.), with more dredging occurring when a new or deepening project occurs. Through the LTMS program, approximately 40 percent has been beneficially reused in the last twenty years, amounting to 31 million cubic yards to date. Sediment from navigation dredging is appropriate for general fill at wetland restoration sites as it is too fine to be used in structural elements. The large quantities produced from dredging projects make it ideal for wetland restoration projects that need to raise site elevations.

There are two types of dredges used for navigation dredging in the Bay Area: mechanical and hydraulic dredging. Mechanical dredging is most frequently used because it is readily available and less likely to entrain sensitive fish species. Sediment that is removed mechanically is loaded onto a scow and transported to its final location, whether an aquatic disposal site or beneficial reuse site. If taken to an aquatic disposal site, sediment is released directly from the scow into the water above the disposal site. If taken to a beneficial reuse site, it is unloaded either with a clamshell or backhoe, or with an offloader, which pumps the sediment through a pipe to the site.

Hydraulic dredges remove sediment by suctioning the sediment through a drag or cutter head and pumping it onto a scow, or into the hold of a hopper dredge. Hopper dredges transport the dredged sediment from the dredging site to the disposal or beneficial reuse site if they have pump off capability. If they do not, the dredge releases sediment over an aquatic disposal site much like a scow releases it, by opening the bottom of the vessel to allow sediment to fall out. A cutter pipeline dredge's rotating blades break up the sediment and inject water into it, creating a slurry that is then drawn into a pipe. If the site is nearby, the sediment can be discharged directly to the site.

Dredging projects routinely test the sediment for contaminants of concern in coordination with the Dredged Material Management Office (DMMO), and this data from the last 23 years is publicly available. Sediment quality **assessments** are completed through the well-established process described in the DMMO's Inland and Ocean Testing Manuals, modified to be applicable to regional contaminant concerns. Once tested, the sediment is given a suitability determination by the DMMO

[4] Dredge Material Management Office. (2022 in prep.). Annual Report 2022. https://www.spn.usace.army.mil/Missions/Dredging-Work-Permits/Dredged-Material-Management-Office-DMMO/Annual-Reports/.

for all potential beneficial reuse and disposal options that were tested for. Some restoration sites have specific sediment acceptance criteria while others rely on the Water Board's Beneficial Reuse of Dredged Material Guidelines (updated in 2020).

The LTMS Management Program established goals that reduced in-Bay disposal to 1.25 million cubic yards annually[5] and seek to maximize beneficial reuse of sediment. The dredging community voluntarily seeks to maximize beneficial reuse and manages the volumes placed at different disposal or beneficial reuse sites on a three-to-five-year basis. The options available to the dredging community include two multi-user beneficial reuse sites (Cullinan Ranch and Montezuma Wetlands), individual restoration sites, one of four in-bay disposal sites, and the San Francisco Bay Deep Ocean Disposal site. The LTMS Agencies determine if a project proponent's proposal is appropriate and approves plans based on sediment quality, equipment availability, site availability and capacity, and funding.

Storage options for dredged navigation sediment are limited. Dredging projects can result in a large amount of material, often with significant volumes of water, which makes stockpiling a challenge. If sediment was stockpiled on land, it would require drying and trucking to the restoration site, which is less efficient and more expensive than transport by barges. The concept of storing or transferring dredged sediment into an aquatic basin has been discussed as an option that would allow the bottom dumping of sediment that would be re-dredged later and pumped to a restoration site through a hydraulic dredge. This concept was investigated in the mid-2000's by the USACE but was not pursued primarily due to habitat loss and listed species concerns.

d. Restoration Sites

Currently, four restoration projects in the Bay Area are actively receiving sediment or soil as part of the project, and another is in the planning stage. These are large, multi-user beneficial reuse sites that employ different strategies for obtaining sediment and soil.

In the South Bay, where access to dredged sediment is limited by the shallowness of the Bay, the South Bay Salt Pond and South Bay Shoreline projects are using free soil primarily from the construction industry, and to some limited extent from a local flood protection and stream maintenance agency. While the "free dirt market" can produce large volumes of soil, it also is tied to the cycling of development, making both planning and managing the anticipated levels of soil, and thus the construction of the restoration site, challenging. Further, as developers work to increase sea level rise resilience for the built environment, this source of soil will become more competitive.

In the North Bay, the restoration projects work with the dredging industry, accepting both surface and foundation quality sediment that can be pumped onto the site. Montezuma Wetlands has a dedicated offloader that can accept sediment from most dredging projects, and the use of this offloader includes a significant "tipping fee" that is charged to the dredging project on a per-cubic yard basis, increasing the cost of the dredging project. Cullinan Ranch does not have a dedicated offloader and therefore the contractor must bring an offloader to the site when beneficially reusing the dredged sediment. Until about seven years ago, there was no contractor in the region that had its own offloader, but now there are three dredging companies (Curtin Maritime, Lind Marine, and Mason Construction Company) that can bring an offloader to the site. At Cullinan Ranch, if another dredging

[5] 250,000 cubic yards of the 1.25 million cubic yards is a small dredger set aside, with the total available for large and medium sized dredges of 1 million cubic yards annually. See the LTMS Management Plan for more details.

contractor wants to bring sediment to the site, a tipping fee is required to cover the cost of the offloader and the management of the dredged sediment. Cullinan Ranch is anticipated to be completed within two years, while Montezuma Wetlands has significant capacity for more sediment, and there is another project in planning stages that is anticipated to come online in three years.

Beyond these sites, currently there are few restoration sites planning to import sediment and/or soil. This creates a challenge in promoting beneficial reuse, but more importantly it means many restoration sites will be solely dependent on natural sedimentation which may take many decades to reach elevations sufficient for vegetation to colonize. There is growing concern that restoration projects that do not augment the sediment supply will not reach marsh plain development in advance of rising seas. Work by SFEI is underway in its resilient landscape program to develop tools to identify important restoration sites and their sediment and/or soil needs.

Compared to natural sedimentation at subsided sites, the beneficial reuse of dredged sediment and soils has been very successful at raising site elevations, allow vegetation to recolonize sites relatively quickly (Sonoma Baylands, Bair Island, Montezuma Phase 1 and Hamilton Wetlands). Each year the sediment and/or soil that is not used puts the region further behind sea level rise and creates a greater deficit in restoration and adaptation projects.

However, reusing sediment and soil has its challenges. Site designs must consider a construction and design that anticipate and plan for imported sediment and soil, water and equipment management, the time necessary to bring in the volumes needed to raise elevation, and the cost that this entails. Restoration site practitioners need information to support decision making around the need for sediment. Site assessments would assist in understanding rate of sedimentation and the need for augmentation during construction. This knowledge informs design and prioritization of sediment and soil needs. As more restoration sites assess the need for sediment, best practices for beneficial reuse of sediment and soil can be developed and shared.

Most restoration site managers or practitioners are not primarily engaged in searching and identifying sediment and/or soil that can be brought to the site, or developing the infrastructure to make it possible, and do not have the staff to undertake this work. Therefore, support is needed in the form of coordination with regional and local governments and communities, technical support, identifying and creating collaborative partnerships between restoration sites and local sediment and soil management projects, and in educating funders to support changes to project design and management to allow for beneficial reuse.

In addition to supplying sediment and soils to deeply subsided sites, existing and restored wetlands will need additional sediment as sea level rises. Methods, best practices, and appropriate timing need to be developed. Having the ability to support existing and restored wetlands over time through sediment augmentation will allow for adaptation rather than drowning.

Pilot projects are being tested to determine their efficacy with special attention given to protected and native wildlife that depend on the limited existing wetlands. Marin County Flood Control District piloted a thin layer placement of flood protection sediment from Novato Creek at Deer Basin, a subsided site in 2016. This project identified some challenges in placing sediment but found flexibility with the regulatory agencies and was able to accomplish the first phase of the project. In 2023, the USACE piloted the “Strategic Shallow Water Placement Project” that deposited 90,000 cubic yards of dredged sediment from Redwood City federal navigation channel two miles offshore of Whale’s Tail

Marsh in the South Bay, to assess whether tides and currents can transport suspended sediment to the adjacent mudflats and marshes. Monitoring is underway, though more pilot projects are needed identify successful methods of augmenting sediment supply.

4. Focus Areas

The eight Focus Areas in this Action Plan are detailed below and have accompanying objectives and specific actions that can be accomplished by organizations wishing to further support beneficial reuse. The focus areas are Governance and Regional Coordination; Regional Planning and Research; Federal, State and Regional Policy and Communication; Regulations and Permitting; Pilot Projects; Sediment and Soil Quality; Coordination of Sediment and Soil Availability and Placement; and Costs and Funding.

Each focus area includes an "issue summary" that provides a general overview of the considerations related to each focus area, and an "objectives" section which includes the context and actions. The actions included in each focus area are aligned with the overarching goals of the Action Plan. Some focus areas include more general actions, while some include actions that are very specific. Some focus areas include only a few actions, while others have many. This Action Plan is intended to document solutions identified by the sediment community, and guide future work by the various agencies, resource managers, and stakeholders. As a result, it was important to ensure that actions of different scales be included.

Focus 1. Governance and Regional Coordination

Issue Summary

To increase beneficial reuse of sediment and soils, expanded and strong collaboration is required. There is an established, interconnected, and well-coordinated network of partners that support beneficial reuse in the Bay Area, working to increase funding, reduce policy hurdles, and improve processes at the federal and regional level. The partnership has included federal and state agencies, and non-profit organizations representing the restoration and environmental community and construction (both marine and terrestrial) industry. The LTMS program has led to successful efforts to beneficially reuse navigation dredged sediment but is limited in scope and community. The regional partnership needs to grow to include leaders from other sectors of sediment management. This Action Plan includes a focus on building partnerships that will in turn support achievement of additional actions that will remove barriers to beneficial reuse.

Objective 1.1: Align Regional Coordination and Action Plan Oversight

BCDC is partnering with the San Francisco Estuary Institute, San Francisco Bay Joint Venture, San Francisco Bay Regional Water Quality Control Board, State Coastal Conservancy and U.S. Environmental Protection Agency to guide the development of the Action Plan, and these entities will continue working together to track progress on the Action Plan tasks. Once a governance structure is established, this effort can be transformed and transferred to that forum. The objective of this set of actions is to align and create broader regional coordination and establish a governance structure to oversee the implementation of the Action Plan.

Index #	Action	Status
1.1.1	Convene a working group of agencies, restoration project sponsors, dredgers, and core stakeholders in beneficial reuse to explore and ultimately select a preferred governance model and entity to implement this Action Plan. The working group will provide direction to identify and create authority for entity to oversee this work and establish regular check-ins to track progress.	In Progress
1.1.2	Explore the potential for a regional beneficial reuse coordinator to develop a better system to work with sediment and soil source providers and sites.	Not Yet Started

Focus 2. Federal, State, and Regional Policy and Collaboration

Issue Summary

A committed program is needed at every level of government to maximize the beneficial reuse of sediment and soil throughout the Bay Area. The state and regional agencies involved in sediment and restoration must consider whether their policies and regulations hinder beneficial reuse. The US Army Corps of Engineers (USACE) is the largest dredger and constructor of flood risk management systems in the region. USACE's leadership has recognized the importance of beneficially reusing dredged sediment from its navigation program and set goals to significant increase it nationally. However, USACE's "Federal Standard" regulation requires it to choose the least costly sediment disposal alternative[6], which poses an obstacle to achieving beneficial reuse of dredged sediment unless additional funding is provided, or the beneficial reuse option is the least cost alternative. Because beneficial reuse is often not the least cost option, the USACE disposes of sediment either at dispersive in bay disposal sites or the deep ocean disposal site where it is not available for restoration or adaptation.

The US EPA along with the USACE manage the San Francisco Deep Ocean Disposal Site (SFDODS). Decisions regarding whether a project can use SFDODS are considered per the Marine Protection, Research, and Sanctuaries Act (MPRSA), which includes an alternative disposal site analysis, that considers cost, among other factors.

At the State level, while policies and regulations favor beneficial reuse, they too include alternative disposal analysis that considers cost. The State has contributed significant funds through the State Coastal Conservancy, either through site preparation or direct funding to the USACE on a limited basis.

There is no dedicated permanent funding program at the federal or state level that supports the beneficial reuse of sediment and soil, though additional efforts at the federal level are underway through the Water Resources Development Act. The laws, regulations, and programing that focus on the cost of rather than the need for beneficial reuse of sediment are barriers to increasing beneficial reuse.

[6] The Federal Standard means the dredged material disposal alternative or alternatives identified by the Corps which represent the least costly alternatives consistent with sound engineering practices and meeting the environmental standards established by the 404(b)(1) evaluation process or ocean dumping criteria. 33 CFR 335.7 "Federal standard"

Objective 2.1: Align Federal Standard with Maximizing Beneficial Reuse

In 2023, two USACE memoranda directed the Corps to increase beneficial reuse of the navigation sediment they dredge from 30-40% to 70% by 2030[7][8]. The actions in this Objective would assist the USACE in achieving this goal but does not provide funding or changes to the "Federal Standard". To meet their goal, the USACE and its partners must work together to refocus the Federal Standard, identify funding sources, develop a long-term plan and identify various least cost alternatives for sediment disposal that support beneficial reuse.

Index #	Action	Status
2.1.1	Identify the elements of the federal standard that encourage or impede beneficial reuse. Consider and support changes to the USACE federal standard regulation to allow beneficial reuse of dredged sediment to be selected as an option for a project or region, even if it is not the least cost alternative.	Not yet started
2.1.2	Further evaluate and implement the Water Resources Development Act of 2020 (WRDA) Section 125 guidance and General Spellmon's directive to beneficially reuse 70% of dredged sediment by 2030.	In progress
2.1.3	Work with the Bay Area Congressional delegation to identify and promote federal actions through WRDA to further increase beneficial reuse and decrease ocean disposal, and provide appropriate funding to support restoration and enhancement of marshes.	In progress (WRDA 2024)

Objective 2.2: Support Regional Dredged Material Management Plan and USACE Beneficial Reuse Programming

In 2020, the USACE initiated its first 20-year Regional Dredged Material Management Plan (RDMMP), a planning document required by USACE to evaluation the San Francisco District's dredged sediment disposal capacity over the next 20 years. The USACE engaged with stakeholders in the development of this document to maximize beneficial reuse through this process. WRDA 2020, Section 125 included new ways for the USACE to incorporate beneficial reuse in its program, new cost sharing options, a requirement to update the RDMMP every five years with ways to streamline that effort, including annual changes to the program. In addition, the San Francisco District has been designated an Engineering with Nature proving ground, putting more emphasis on nature-based solutions to sea level rise and other flooding risks.

[7] "Beneficial Use of Dredged Material Command Philosophy Notice," USACE LTG Scott Spellman (January 25, 2023).
[8] "Expanding Beneficial Use of Dredged Material in the USACE," USACE Civil Works Director Edward E. Belk, Jr. (August 28, 2023).

Index #	Action	Status
2.2.1	Continue to collaborate with USACE's RDMMP and Engineering with Nature team to assess internal agency processes for improving indirect and direct placement pilot projects and related actions. Develop information and guidance on different tools that can be applied to further fund USACE's beneficial reuse strategy such as (i) RDMMP yearly evaluation; (ii) WRDA 2020, Section 125a guidance , which uses a Beneficial Use Decision Document Integration (BUDDI) system to revise the "federal standard" or base plan; (iii) WRDA 2020, Section 204 which combines habitat restoration and coastal enhancements with federal navigation projects ; and (iv) other policy and funding tools.	In progress
2.2.2	Analyze the Federal Operations and Maintenance program as a regional approach (e.g., USACE RDMMP effort). Use benefits analyses, regional resilience metrics, and other means to quantify benefits to support and complete section 125a BUDDI documents.	Not yet started

Objective 2.3: Improve State & Regional Coordination

Through the Ocean Protection Council's 2020-2025 Strategic Plan, the State of California recognizes the need for a state-wide beneficial reuse program with a focus on the coast and the San Francisco Bay estuary. The LTMS Management Plan's goal of maximizing beneficial reuse of navigation dredged sediment can be further expanded to achieve more than forty percent beneficial reuse of sediment. State and regional programs should expand their programming to emphasize the need to increase beneficial reuse of dredged and flood protection sediments, as well as construction soils.

Index #	Action	Status
2.3.1	In coordination with the Ocean Protection Council (OPC), the California Natural Resources Agency (CNRA), and Cal EPA, develop regional recommendations on a state-wide beneficial use policy and implementation structure. Work with other regions and state agencies to establish these beneficial reuse recommendations.	Not yet started
2.3.2	Work with CNRA, EPA, and other state agencies, as well state legislators, to develop a funding and state-wide legislation strategy focused on supporting beneficial reuse of sediment and soils for sea level rise adaptation, habitat benefits, and recreation. Formalize the existing coalition to pursue legislative approaches/opportunities in the interest of the San Francisco Bay region.	In progress

Objective 2.4: Update State and Regional Policies

While federal and state partners should collaborate to improve federal policy or state and regional coordination, all agencies should review their own policies and plans.

Index #	Action	Status
2.4.1	Assess regional plans and policies from state, federal, and regional agencies that may require updates to encourage beneficial reuse of sediment and soils.	In progress
2.4.2	Identify and propose amendments to San Francisco Bay Plan findings and policies regarding sediment supply and beneficial re-use.	In progress
2.4.3	Examine and communicate the consequences of limited beneficial reuse at wetland restoration sites in combination of rising seas among federal, state, local agencies, and organizations.	Not yet started

Focus 3. Regional Planning and Research

Issue Summary

The stakeholder process for this Action Plan indicated that there is limited information about the needs of planned and candidate restoration sites. However, since the workshops, SFEI has released its Baylands Resilience Metrics Web Map. The region should us this tool and other information to determine the sediment needs potential restoration sites, what it means for a restoration site to be "ready to receive" sediment and/or soil; and what actions are required to connect a sediment and/or soil source to a candidate restoration project.

Objective 3.1: Solidify Regional Priorities and Strategy

Much has been done to improve our understanding of the conditions of existing marshes, subsided Baylands, and restoration activities. Most recently, SFEI and the Wetlands Regional Monitoring Program (WRMP) updated the Baylands Habitat Map which is now publicly available and can be found at https://www.sfei.org/projects/baylands-change-basemap. This new map along with the Bay Resilience Framework and mapping tool (SFEI) can be used to further analyze the Baylands and restoration projects' need for sediment to create elevation capital and be adaptive to rising seas.

Index #	Action	Status
3.1.1	Evaluate active and candidate restoration sites, as well as existing marshes, to determine whether they need sediment from navigation channels, stream beds, and/or construction soils.	In progress

3.1.2	Continue to use the Baylands Habitat Ecological Goals Project and the Adaptation Atlas to identify and characterize additional restoration sites at a regional scale.	In progress
3.1.3	Prioritize restoration or existing marshes that need sediment/soil to ensure best possible use of available sediment/soil regionally and sub-regionally.	Not yet started
3.1.4	Identify site restoration limitations and needs associated with species, weather, transportation, and local permits.	Not yet started

Objective 3.2: Assess Site Conditions for Beneficial Reuse

The existing conditions at restoration sites vary depending on the prior use of the site, which in the Bay Area range from former military bases to salt production to agricultural lands. These prior uses may influence the quality of the sediment or soil on the site. If the site has contamination issues, beneficially reusing sediment and soil on site would improve the site. With this construct in mind, consideration can be given as to whether beneficial reuse at a challenged site would be a net improvement, and thereby reduce or eliminate the need mitigation.

Index #	Action	Status
3.2.1	Consider developing a protocol for placement site condition assessment (including contaminants or other parameters) to determine whether placement of sediment/soil would result in sufficient improvement of site conditions.	Not yet started
3.2.2	Investigate and determine appropriate uses for sediment/soils with elevated levels of contaminants to ensure resulting site conditions would be satisfactory to all agencies and surface and groundwater would be unimpaired.	In progress

Objective 3.3: Foster Outreach and Advocacy

While understanding restoration site conditions is key to matching a sediment and soil source to their final location, fostering outreach and advocacy regarding restoration and beneficial reuse is also important. Many entities are not familiar with the benefits of beneficially reusing sediment and soils as a tool for sea level rise adaption and habitat restoration, nor with the challenges of transporting these resources to a site. Since beneficial reuse is unfamiliar to many, local entities may have concerns that need to be addressed. By creating partnerships with local governments, construction firms, and communities, a better understanding of beneficial reuse in restoration and sea level rise can be attained. This work could make sediment and soil reuse in wetland projects more efficient and effective.

Index #	Action	Status
3.3.1	Develop an outreach targeting sediment/soil source managers, so they gain a greater insight on the need for additional sediment or soil, site-specific demands, and resource quality and quantity.	Not yet started
3.3.2	Continue advocacy and education to stakeholders and the public on the connection between reuse and climate resiliency – and the need to increase funding and accelerate implementation.	In progress
3.3.3	Provide education, support, and guidance to project proponents and local governments on permitting restoration/adaptation that beneficially reuse sediment/soils.	Not yet started
3.3.4	Improve communication and coordination between (local) agencies, flood protection managers and private dirt brokers to create feedback opportunities and incentivize beneficial reuse of sediment and soils over landfill.	Not yet started

Focus 4. Regulations and Permitting

Issue Summary

The region's ability to source, transport, store, and place sediment and soil can be improved by developing actions to further coordinate and streamline regulatory and permitting processes. With an established agreement on practices and procedures, agencies can address beneficial reuse projects in a consistent manner, allowing project proponents to plan their restoration with more certainty.

Objective 4.1: Evolve Permitting Regulations and Practices

The actions under this objective require project proponents, permitting agencies, and the public to develop creative approaches and evolve processes and practices. Some entities may need to review their internal processes; others may reconsider how they work together to support successful wetland restoration projects requiring sediment and soil.

Index #	Actions	Status
4.1.1	Simplify the permitting process so restoration sites can receive sediment and/or soil more efficiently.	In progress
4.1.2	Require restoration project proponents to meaningfully consider beneficial reuse of dredged sediment during the project design and permitting process.	Not yet started
4.1.3	Develop guidance for restoration site development and beneficial reuse, and the associated permitting process.	Not yet started
4.1.4	Consider whether beneficial reuse of sediment and/or soil at wetland restoration sites can mitigate for project impacts.	In progress

4.1.5	Develop concurrence among regulatory agencies on how stream maintenance sediment should be categorized and reviewed.	Not yet started
4.1.6	Improve interagency coordination (with the USACE/BCDC/EPA/Water Board) on alternative disposal or placement site analysis.	In progress
4.1.7	Evaluate dredge placement methods, including hydraulic and clamshell methods, to determine improved beneficial reuse placement methods and outcomes are possible. Work with federal and state resources agencies to study and develop conditions for use of hydraulic dredges.	In progress
4.1.8	Assess whether monitoring of discharges would be required at restoration sites. If so, project proponents can create a treatment plan during the design phase to reduce additional burdens.	Not yet started
4.1.9	Require project proponents to input information about available sediment, soil, or restoration sites into a database, such as SediMatch or EcoAtlas, to improve visibility of available sediment and soils for beneficial reuse.	Not yet started
4.1.10	Require each restoration project that imports sediment or soil to have a Quality Assurance Project Plan (QAPP).	Not yet started
4.1.11	Consider the applicability of in-Bay testing protocols for indirect placement as its use expands.	Not yet started

Focus 5. Pilot Projects

Issue Summary

Presently, the Bay Area relies heavily on a combination of placement strategies (i.e., mechanical equipment, pipeline transfer, and truck delivery) to supply subsided Baylands with dredged sediment and/or soils. Sediment placement methods are selected according to the design and location of the restoration site and the material available. While these direct placement strategies are well recognized and successful particularly for providing large quantities of dredged sediment, the variability of depth and width of mudflats, and the cost additional equipment, along with additional site management, has prevented them from being regionally applicable.

There is limited data on the effectiveness of direct and indirect placement strategies in the region. Within the past couple of years, only a few pilot studies testing the use of thin-layer and shallow-water placement strategies in the region. In other regions in the nation, additional pilot projects have been undertaken and while conditions may vary, they provide valuable data and experience to build on.

Objective 5.1: Support Indirect Placement Pilot Projects

Indirect placement strategies utilize natural processes such as wind-wave action and currents to transport sediment onto wetland restoration sites. While other parts of the United States have conducted and implemented some of these strategies with varying levels of success, the Bay Area has tested only one nearshore placement project, the shallow-water placement at Eden Landing Ecological Reserve in Hayward) and is waiting for monitoring results to determine whether a significant amount sediment has reached the targeted area. This objective seeks to learn from other regions who have piloted such work and support additional pilot projects that would likely succeed within our estuary system.

Index #	Action	Status
5.1.1	Evaluate regional and national indirect placement pilot project data to determine appropriate indirect placement pilot project for the Bay Area. Working with experts outside the region, establish short, medium, and long-term success criteria for indirect placement projects.	Not yet started
5.1.2	Identify and collaborate with interested entities on pilot projects. Conduct modeling studies to evaluate indirect placement strategies across diverse sites, seasons, and tidal cycles in the region. Create a central location for compiling data/information, make it accessible/available, and use it to evaluate what is being learned. Share data from indirect placement modeling scenarios publicly and among scientists, policymakers, and stakeholders to identify optimal strategies for indirect placement projects at existing marshes.	In Progress
5.1.3	Communicate existing and ongoing information regarding indirect and direct placement studies by creating a specialized task force/subcommittee within permitting organizations.	Not yet started
5.1.4	Expand research and development efforts, create opportunities for scientists, utilize new technologies, and foster collaboration between regulatory and scientific communities to apply learnings and determine the region's most effective indirect placement restoration strategies.	Not yet started

Objective 5.2: Support Direct Placement Pilot Projects

Direct placement involves placing sediment and/or soil onto a restoration or existing marsh using a variety of techniques, including mechanical equipment, pipeline transfer, spraying/rainbowing, thin-layer placement, and truck delivery. This objective supports pilot studies that evaluate the benefits and disadvantages of different direct placement strategies to fully understand their applicability and impact on restoration efforts. With a greater understanding of these alternate

direct placement approaches, the region will be able to design and implement cost efficient and effective initiatives with wetland restoration partners that need more sediment.

Index #	Action	Status
5.2.1	Assess regional and national direct placement project scientific/technical data/findings to assist in determining appropriate new approaches for the region. Working with experts inside and outside the region, define short, medium, and long-term success criteria for direct placement projects.	Not yet started
5.2.2	Evaluate and address constraints for dredged sediment direct placement methods. Review the completed projects and consider appropriate application for different types of sediment sources. Use existing information to develop better pilot projects.	In progress
5.2.3	Conduct thin lift and other direct placement pilot projects at sites needing sediment augmentation based on site prioritization, regional data gap analysis and periodic modeling.	In progress
5.2.4	Determine appropriate work windows and/or conditions for sediment thin-layer placement to address consistently present species. Identify alternatives for cutting vegetation to the ground, such as control site flooding, for fully protected species avoidance when doing thin-lift placement.	Not yet started

Focus 6. Sediment and Soil Quality

Issue Summary

Understanding whether the sediment or soil proposed for use at a restoration would impact the plants and animals that would inhabit it is critical for the ecological health of the region. Regulatory agencies require the testing of sediment and soil that is imported because understanding potential presence of contaminants of concern is critical to these protections.

Testing protocols for dredged sediment are standardized throughout the region and applied through the DMMO. Testing for soils and flood-control sediment, however, are not standardized through the region, nor is there an entity like the DMMO that supports the testing and decision-making process. While recently some standardization has been underway, it is not well understood, discussed, or distributed in the region. Optimizing testing protocols across the region would lead to more efficient sediment and soil characterization and allow for faster and more consistent management decisions.

Objective 6.1: Coordinate Testing Requirements for Upland/Flood Control Soils and Sediment

Sediment and soil from upland sources, including watersheds and flood protection projects, may have different contaminants of concern than dredged sediment due to the historic and current human activities. Upland soils, typically from construction projects, are tested but there is some variability in the protocols used. Similarly, flood-control and streambed maintenance sediment assessments are not consistent across the region. Decision-making becomes more challenging when different methods of an analysis are used for similar purposes, which leads to slower response times. Standardizing testing protocols and developing transparent decision trees can improve the ability to use sediment and soil.

Index #	Action	Status
6.1.1	Standardize sampling and testing protocols, as well as the acceptance criteria/guidance for beneficial reuse of (1) streambed and/or flood-channel maintenance sediment, and (2) construction soil to improve placement decision making. Identify and resolve data or protocol gaps in existing QAPPs for the beneficial reuse of sediment and soil.	Not yet started
6.1.2	Emulate DMMO process to construct a “tier-testing” system for suitability determinations amongst agencies managing flood control, stream maintenance, and construction soil. Identify grain size of sediment/soil above which sediment quality tests could be waived (i.e., sand, gravel). S ek agency agreement to pull together and document the known guidance for the region in one document.	Not yet started
6.1.3	Formalize coordination between the LTMS/DMMO and the BRRIT and other restoration projects to expand support for beneficial reuse of sediment and soils due to their expertise.	Not yet started
6.1.4	Establish and improve communication among parties when further clarification of a suitability determination is needed/desired. Develop technical documents that highlight flood control and construction soil’s suitability determination and rationale.	In progress

Objective 6.2: Improve Data Management and Use

There is a need for consistent and available data regarding sediment and soil quality around the region. The DMMO has a publicly available database that contains all dredged sediment quality data for projects from 2000 to the present day. Flood control and upland construction soils have no similar database. SediMatch is a geographic database that seeks to identify and match sites that need sediment and soil and those that have it available. A noted desire for SediMatch is for it to also provide sediment quality data so that it is easily accessible and connected to the source material. Other efforts such as the Wetlands Regional Monitoring Program (WRMP) is developing a publicly available database with

monitoring data from Benchmark, Reference, and Project site monitoring and is potential database that could store and share sediment and soil data.

Index #	Action	Status
6.2.1	Develop a centralized database to collect all sediment characterization and suitability data, including leveraging existing sediment monitoring data where available.	In Progress
6.2.2	Include dredged sediment and streambed sediment monitoring in restoration and enhancement projects in SediMatch, WRMP and/or other existing efforts to inform conservation actions and reduce monitoring costs for projects.	Not yet started

Focus 7. Coordination of Sediment and Soils Availability and Placement

Issue Summary

The disconnect between readiness of sites and availability of material has been an ongoing barrier to the beneficial reuse of sediment for some restoration projects. Both restoration sites and projects that generate sediment and soil operate under discrete timelines that are influenced by planning processes, construction schedules, environmental work windows, and permitting. A delay or change in any timeline can cause misalignment, resulting in sites missing out on sediment or soil that would have furthered restoration goals.

A potential solution to this issue is developing offsite temporary storage facilities of sediment or soil, or stockpiles, for restoration projects. If well-managed stockpiling facilities were available, sediment availability would not necessarily need to align with restoration site timing. Stockpile facilities should be located centrally to restoration sites and as well as in areas where delivery of dredged sediment is challenging. Currently, some limited stockpiling occurs from flood protection and stream maintenance projects, but the practices are not well known or connected to restoration sites. In addition, a strategy can be developed to focus on distributing sediment and soils more efficiently with respect to location and restoration sites.

Objective 7.1: Assess Stockpiling Feasibility and Address Management Requirements of Stockpile Applicability

There is no regional system of stockpiling for restoration projects. Challenges include the ownership and location of stockpiles, funding, site management, and material quality management. Implementing a system of sediment and soil stockpiles throughout the region may be a way to address the misalignment in timing of available sediment and soil resources and the readiness and availability of restoration sites able to take them.

Index #	Actions	Status
7.1.1	Evaluate the benefits and detriments of stockpiling compared to the "free dirt" model.	Not yet started
7.1.2	At the subregional level, identify available and potential stockpiling sites (both for upland and dredged materials) or a network of stockpiling sites near restoration sites for temporary, one-time, or long-term use. Identify funding for purchasing or leasing sites.	Not yet started
7.1.3	Working with construction companies, identify best haul routes and practices, analyze hauling impacts associated with upland soil delivery from source to beneficial reuse site (traffic, air quality, greenhouse gases, road conditions, recreational facilities etc.), and evaluate appropriate haul distances from restoration site to source material.	Not yet started
7.1.4	Identify willing owners and operators/managers, including public agencies (public works), for stockpile sites and collaborate with them on the development of "incentives." Consider available land owned/operated by public agencies.	Not yet started
7.1.5	Create a sediment/soil trading hub that addresses geographic constraints of hauling and helps project proponents recruit sediment/soils from within appropriate haul distances. Match restoration sites and project sponsors with construction and/or flood protection projects within appropriate haul distance to reduce long haul routes with GHG, traffic, and community impacts.	Not yet started
7.1.6	Develop an adaptive process for working with construction soil providers that supports testing, screening, and hauling of dirt to stockpiles or restoration sites. Investigate, document (via guidance), and share successful model agreements and best practices between soil providers and restoration sponsors. Guidance should also clarify when liability is transferred to dirt brokers.	Not yet started
7.1.7	Identify regulatory concerns and document protocols for land-based sediment/soils storage and the permitting process for stockpiling for beneficial reuse so there is a clear understanding of how stockpiled-sediment sites are to be effectively managed.	Not yet started
7.1.8	Assess feasibility of sorting, and mixing of stockpiles to improve management, quality, and use of sediment/soils. Develop a regional strategy and protocols to support implementation of materials mixing if determined feasible.	Not yet started

Objective 7.2: Improve Flood Protection Programming

Between 2010 and 2100, it is estimated that about 100 metric tons of sediment and soils will be removed from all Bay Area flood control channels. This represents an underutilized resource that could be put to good use in nearby wetlands. Each stream reach is different, and more information is needed about streambed sediment's physical, quantitative, and qualitative characteristics before it can be reused. Standardized beneficial reuse guidelines and testing protocols are also needed for sediment coming from flood control projects.

Index #	Actions	Status
7.2.1	Coordinate with Bay Area Flood Protection Agencies Association (BAFPAA) to facilitate change in practices and create opportunities to link beneficial reuse and flood protection and channel realignment.	Not yet started
7.2.2	Work with USACE flood protection team to better understand perceived or actual federal barriers to reconnecting creeks to marshes or Bay.	Not yet started
7.2.3	Assess appropriate actions in watersheds to identify potential sources of contamination within flood-control channels and determine whether there is potential for sediment/soil reuse.	Not yet started
7.2.4	Work with flood protection managers to (1) assess stream conditions using geomorphology, historic conditions, and information, including rate of accretion in high, low, and "normal' years, (2) assess and measure erosion control issues in upper watershed/source areas, and (3) populate Bay Area watershed models with existing and new data to inform beneficial reuse throughout the region.	Not yet started
7.2.5	Create a coarse-grained sediment reuse strategy to address upper watershed flood protection maintenance needs.	Not yet started

Focus 8. Costs and Funding

Issue Summary

Analysis and experience have established that aquatic disposal of sediment dredged for navigation is less expensive compared to the beneficial reuse of sediment because more equipment, staff, and energy are required, and some restoration sites charge a "tipping fee" to receive the sediment. Sediment dredged or excavated from flood channels and stream maintenance projects may also require additional funding due to haul distances to restoration sites. However, the reuse of excess construction soils may be a cost-saving option for contractors because the landfills often charge for disposal.

Beneficial reuse of sediment and soil requires additional funding for restoration sites that may need added infrastructure to manage it on site, or to defray the incremental costs over simple disposal. To seek and obtain additional funding, it is important to understand the additional costs, the difference between available funding and the need, and to explain the value of the benefits gained. Actions in this section evaluate different aspects of funding needed, benefits delivered, and strategies for obtaining additional funds.

An important issue to consider is how the costs and benefits are evaluated, and whether current and future benefits such as flood water absorption, sea level rise resiliency, habitat creation, water quality improvements, and other benefits are considered. As these benefits are acknowledged, additional funding sources and opportunities arise.

Objective 8.1: Address Funding Gaps

There are gaps in funding for beneficial reuse of sediment and soil, when compared to sediment disposal. By examining more closely the costs inherent in beneficial reuse of sediment and soils, a better understanding of potential efficiencies may arise. Having a clear understanding of costs, and the ability to explain them in a clear way may lead to resonance with potential funding sources and the ability to advocate more successfully.

Index #	Actions	Status
8.1.1	Analyze the funding needed for sediment/soil suppliers and incorporate and control cost for suppliers.	Not yet started
8.1.2	Identify potential funding sources, mechanisms, and programs (federal, State, local, private) for beneficial reuse (dredging, flood and stream maintenance, construction).	Not yet started
8.1.3	Identify potential incremental cost share partners (federal, state, private) in accord with WRDA 2020, Section 125 and explore procurement of matching grants to fund placement of dredged sediment at beneficial reuse sites.	Not yet started
8.1.4	Provide a summary of funding strategies to increase beneficial reuse by engaging BCDC's Financing the Future Commissioner Working Group.	Not yet started
8.1.5	Secure commitment to fund beneficial reuse through fact-based advocacy, lobbying, or education efforts.	Not yet started
8.1.6	Work towards the creation of a San Francisco Bay regional fund source or set aside for beneficial reuse and resilience. Incorporate and align with Bay Adapt and the Bay Area Regional Collaborative (BARC) agencies sea level rise Memorandum of Understanding (MOU) actions around funding.	Not yet started

Objective 8.2: Evaluate Costs and Benefits

There currently a lack of understanding and documentation of the full value of the benefits of restoration and adaptation projects that reuse soil and sediment. Documentation is critical to support projects in requesting and receiving funding, as well as messaging to the public and legislators. A series of analyses would support different discussions and aspects of restoration and beneficial reuse.

Index #	Actions	Status
8.2.1	Evaluate thin-lift project costs by reviewing USACE and other entities estimates and actual costs for completed thin-lift projects.	Not yet started
8.2.2	Conduct a cost-benefit analysis of the loss of marsh compared to adapting it through management actions (short-term impacts, long-term gains), delays in vegetation establishment as sea levels rise, etc., Study and assess the net long-term habitat restoration and flood protection benefits gained from the temporary loss of species or habitat from sediment placement. Identify tradeoffs and benefits of proposed actions.	Not yet started
8.2.3	Reassess power supply and emission regulations for hydraulic offloading and truck/train delivery of sediment/soils (diesel/electric).	Not yet started
8.2.4	Evaluate whether wetland restoration and beneficial reuse can offset greenhouse gases and other emissions impacts over time.	In Progress
8.2.5	Provide the cost-benefit analysis to key stakeholders and coalitions to increase support by local, state, and federal entities for beneficial reuse opportunities.	Not yet started

Additional Topics for Future Discussion

This Action Plan was developed through interviews, workshop participation, the Core Team, and the BCDC project team. Some proposed actions were included as part of the workshop outcomes, but upon further evaluation were not within the scope of this Action Plan. To be included in the Action Plan, an action had to be focused on increasing beneficial reuse of sediment and soil, be achievable in one to five years, have an identifiable champion or champions, and have regional support. Some actions were not included due to the acknowledged difficulty of accomplishing it within a reasonable timeframe. Additionally, some actions may have been removed from the list due to legal constraints that may make them infeasible at this time.

The following actions are not included in the Action Plan. Not being included in the Action Plan does not preclude an entity from working on the proposed action or seeking partners; it is understood that these concepts may persist as discussion topics to be explored further.

Topics for Future Discussion

Dam Removal: Dams stop the natural flow of sediment down a watershed and trap sediment in the reservoirs behind them. Removing dams or releasing the sediment trapped behind them downstream, more sediment may be added back into the system.

Dam removal efforts are multiple year and multi-million dollar efforts that require significant study on how watersheds, flooding, water supply, and downstream impacts would be managed. While dams hold significant sources of sediment, they have not been assessed for the purpose of beneficial reuse of sediment in the Bay Area wetlands, nor is there a mechanism for bringing the sediment to the wetlands thought out. Entities with specific interest in dam removal can work towards these goals outside of this Action Plan.

Aquatic Storage or Transfer Facility: Having an in-water storage or transfer facility for dredged sediment would allow dredge scows to bottom dump sediment into a large basin to be stored and re-dredged when large volumes of sediment are available. This could economize the beneficial reuse of sediment but would also cost several million dollars to plan and undertake (see previous planning efforts). In studying this potential project in the past, there were several concerns over impacts to listed species and essential fish habitat, as well as the destruction of a large area of previously undisturbed subtidal habitat. These issues remain, and like dam removal other entities may want to work on this issue outside of this Action Plan.

Expand the BRRIT: The Bay Restoration Regulatory Integration Team (BRITT) was designed to review restoration projects that meet the Measure AA guidelines, and therefore restoration projects that need dredged sediment could be included in its program review. The BRRIT has limited sediment and beneficial reuse expertise, but other actions regarding coordination on this issue are included. An expansion of the BRRIT to include new types of projects or additional personnel would be considered by the Policy Management Committee and the funders of the BRRIT program. Recommendations can be made directly to the Policy Management Committee for consideration.

Update Endangered Species Act and Endangered Fish Habitat Regulatory Language: Currently there is nothing in either of these Acts that prevents beneficial reuse of sediment or soils in restoration projects, therefore, this item is not included in the Action Plan.

Regional Sediment Management Plans by Subembayment: The development of a regional sediment management plan (RSMP) has long been a goal of the region and can contribute to increasing beneficial reuse of sediment and soil. BCDC created one for Central Bay that needs updating and has the beginnings of two additional plans. The effort to develop subregional RSMP is more globally focused on management of human activities that affect sediment supply in the region and would involve a different focus than this Action Plan's focus of removing barriers to beneficial reuse. Actions that can lead to subembayment RSMPs include: (1) develop specific management actions at the operational landscape unit scale. (2) Study sources of shoaling and differences from year to year, (3) identify crossover with sand mining industry and regulatory groups, (4) coordinate closely among watershed and shoreline management agencies and shoreline and Baylands restoration communities, (5) increase scientific understanding of sediment transport from entire bay and subembayments to discrete units for easier sediment management (the Regional Monitoring Program Sediment Workgroup is working on this currently), and (6) educate community on concept and connections, especially the scientific basis for this approach.

5. Conclusion

This Action Plan, developed through the dedicated collaboration of BCDC's several partner agencies and diverse stakeholders, is an important step for the Bay Area toward more resilient shorelines that respond to rising sea levels. This Action Plan is intended to guide subsequent actions by state, federal, and local agencies, the dredging community, stakeholders, and others to accelerate beneficial reuse for wetland restoration. The region will develop a governance structure to identify each action's leaders, guide the Plan, and monitor its progress. As a result, the important work to coordinate the region and implement this action plan will be ongoing.

6. Appendices

Appendix A: Sediment and Soil Archetypes Glossary and Acronyms

Glossary

Dredging – the removal of sediment from water channel using mechanical (clamshell or barge-mounted excavator) or hydraulic (drag head, pipeline, or cutterhead) equipment. The most common form of dredging in the San Francisco Bay Area is navigation dredging, but also includes flood protection channels.

Excavation – removal of soil from a dry environment, usually for development, or changes to shoreline or upland areas. This is usually done with a long- or short-range excavator, or other digging equipment.

Sand Mining – in San Francisco Bay, using dredging equipment (primarily hydraulic drag head and pipeline dredging) to obtain sand for the construction industry. Primary uses are concrete and asphalt creation, but also for backfilling trenches and other areas where stable materials are needed. This work is not to maintain safe navigation.

Disposal of dredged sediments/soils – can be either aquatic disposal, such as an authorized in-Bay disposal site, an authorized ocean disposal site, an upland disposal site, at a landfill or other facility where the sediment/soil is treated as a waste product rather than a resource.

Beneficial reuse of dredged sediments/soils – is generally using it as a resource and in a way that is beneficial to habitat or other uses such as levee maintenance. The sediment or soil is not being "wasted." Most beneficial reuse of dredged sediment occurs through wetland restoration due to its fine grain properties. Upland soils are used for restoration, often in ecotone and levee maintenance/ construction, but have also been used for raising site elevations. Construction soils can also be used to raise site elevations for development projects.

Dredged Sediment – sediment removed from tidal, brackish, or freshwater systems. Sediment can contain contaminants based on previous uses, movement of contaminants from nearby sources, or runoff from urban environments.

Construction Soils – terrestrial soils that are excavated during a construction project. It could be wet when exposed to groundwater. Construction soils can contain contaminants from previous site uses or the movement of contaminants from nearby sources. These soils are generally a waste product of construction projects that can be captured and used.

Quarry Soils – soil, rock, or gravel that is excavated from a quarry, specifically for use for development (could also be used in a wetland restoration project).

Natural Sedimentation – sediment naturally depositing on a site. Wetland restoration projects that open to the Bay or a tributary, allowing water to bring suspended sediment onto the site and deposit it without human intervention. This also applies to existing wetlands that are open to aquatic systems.

Direct Placement – a method where dredged sediment or soil is directly placed into a site, either mechanically or hydraulically onto a restoration site or an existing marsh. There are many methods for directly placing sediment or soil, some immediate examples are provided below:

1. **Hydraulic placement** – sediments (usually dredged sediment) are slurried with water and pumped from a barge via an offloader directly onto a site. The site is generally a subsided

restoration site in which the sediment is used to raise the elevation of the site either through open filling or in cells. The equipment is a hydraulic offloader of various sizes (snorkel, pumps) and pipelines.

2. **Trucking** – the transport and placement of sediment and soils by trucks directly onto a site, often to raise subsided site elevations or construct project features, such as ecotones and levees.
3. **Thin-lift placement** – a process where sediment is applied onto a site generally in thin layers (up to 10-14 cm) through various methods described further below, often to mimic natural events such as storm surges that deposit sediment naturally on a site.
4. **Marsh Spraying** – spraying slurred dredged sediment directly onto a vegetated marsh to add a thin layer of sediment to raise marsh elevation. The sediment layer targeted is generally 10-14 cm to allow vegetation to emerge after placement. An example can be found in Southern California at Seal Beach Refuge.
5. **Shallow-water placement** – using dredged sediment or other materials to create islands or wetlands. Pumping sediment into an area, often contained by berms or other barriers to adapt or create habitat (e.g., wetlands). Marker Wadden is an example in the Netherlands (2014) – construction of an island wetland using dredged sediment.

Indirect Placement – methods that do not place sediment within the project site, but use other mechanisms, such as tides or currents to transport the material to the site.

1. **Water-column seeding** – the slow release of sediment into the water column near the entrance of a marsh channel during a flood tide using a hydraulic pipe with the goal of the sediment entering the site and depositing within it.
2. **Nearshore aquatic placement** – a method that places sediment in shallow water near a target wetland and utilizes wind waves and tidal action to resuspend the sediment and transport it onto the marsh.

Terrestrial Stockpiling – placing soils and sediment at a site for later use. Stockpiling can occur within a project site for later more discrete use, or at a multi-user site offsite that can be shared by project proponents or single use. Wet soils/sediments can also be dried in these locations. Requires double handling of soils/sediments.

Aquatic Transfer Facility – the creation of an in-water basin that would allow sediment to be deposited, and then when a restoration site is ready to receive sediment, sediment is dredged from the transfer facility and pumped to the site. Requires dredging the same sediments twice. An aquatic transfer facility would need to be located proximal to the project site to reduce pumping distances.

Legacy Sources – a source that once contributed or supplied the Bay with sediment but has now been blocked off.

Surface Quality Sediment – "the upper layer of sediment that is placed on top of contaminated sediment and does not require isolation from the biotic zone, often minimally 3 feet.[9]"

Foundation Quality Sediment – "sediment with elevated levels of contaminants such that it is not suitable for in-bay disposal, it is placed in specifically authorized areas with institutional controls and isolated from water bodies to prevent contaminants from entering the water column or wetlands increasing exposure to wildlife or plants.[10]"

[9] "LTMS Dredger's Handbook", San Francisco Bay Region's Long-Term Management Strategy Program, January 2021
[10] Ibid.

Acronyms

BAFPAA – Bay Area Flood Protection Agencies Association

BARC – Bay Area Regional Collaborative

BCDC – San Francisco Bay Conservation and Development Commission

BUDDI – Beneficial Use Decision Document Integration

BRITT – Bay Restoration Regulatory Integration Team

CDFW – California Department of Fish and Wildlife

CNRA – California Natural Resources Agency

cy – cubic yards

DMMO – Dredged Material Management Office

LTMS – Long-Term Management Strategy for the Placement of Dredged Material in the Bay Region

MOU – Memorandum of Understanding

OPC – Ocean Protection Council

QAPP – Quality Assurance and Protection Plan

RDMMP – Regional Dredged Material Management Plan

RSMP – Regional Sediment Management Plan

SCC – California State Coastal Conservancy

SFBJV – San Francisco Bay Joint Venture

SFEI – San Francisco Estuary Institute

SWAP – Sediment to Wetland Adaptation Project

USACE – United States Army Corps of Engineers

US EPA – United States Environmental Protection Agency

WRDA – Water Resources Development Act of 2020

Appendix B: Background on Task Development Process

Process to Develop the Action Plan

Overview

In 2021, the Commission was awarded a Wetlands Development Program Grant from the EPA through a competitive process. Additional funding was provided by the Ocean Protection Council through an interagency agreement with the Commission. The project, called the Sediment for Wetland Adaptation Project, includes three phases: (1) a stakeholder process to create a beneficial reuse action plan and a coalition of stakeholders with agreed actions to support beneficial reuse of sediment/soil at wetland restoration sites; (2) a potential San Francisco Bay Plan Amendment to address emerging sediment issues, including those addressing wetland and climate adaptation needs; and (3) a financing strategy to support beneficial reuse of sediment/soil.

As part of the first phase of the project, the Commission hired a consulting firm, Catalyst Group, to provide guidance, development, and facilitation for the workshops and the Action Plan.

Planning Meetings

Core Team. BCDC established a Core Team of partners for the Sediment to Wetland Adaptation Project. The Core Team included the San Francisco Bay Regional Water Quality Control Board, the San Francisco Estuary Institute, the San Francisco Bay Joint Venture, the California State Coastal Conservancy and the United States Environmental Protection Agency.

The Core Team met monthly to review and discuss the activities associated with the EPA grant. Catalyst provided updates and reviewed draft materials related to the issues, actions, agendas, and presentations, and discussed Core Team roles in workshop discussions. The Core Team members were important leaders in framing and guiding the workshop discussions.

Sediment and Beneficial Reuse Commissioner Working Group. BCDC staff initiated a series of meetings with a working group of Commissioners to establish an understanding of the science, policy, and current activities for dredging and beneficial reuse. The Working Group has met every two months since January 2023 and received informational briefings from experts and project updates at each meeting. This working group will continue to meet as the project proceeds to phase two, initiating a potential Bay Plan Amendment.

Stakeholder Interviews

The Catalyst Group interviewed 25 leaders involved with Bay Area sediment management and wetlands restoration. Catalyst worked with the BCDC team to identify the important stakeholder categories, including restoration practitioners, watershed and flood protection managers, federal agencies, dredging project proponents and managers, estuary-scale collaborators and coordinators, and environmental advocacy groups. These interviews helped identify more than 40 issues and challenges with increasing sediment and soil reuse in the Bay Area. These issues were summarized and organized in a matrix, along with potential actions gathered from interviews and prior beneficial reuse discussions.

Workshop Plan Development

A two-day workshop was developed to bring together stakeholders from the sediment and soil management worlds to discuss the issues and potential actions that could address the sediment challenge. The workshop plan, agenda, activities, and presentations were designed to feed into the Action Plan development process.

Issue Papers

The BCDC team developed four issue papers to lay the groundwork for workshop participants. The topics included an overview of wetland restoration and adaptation, sources of sediment and soil, placement methods, and challenged sediment (sediment that does not meet certain testing or placement standards). Catalyst reviewed these papers to improve the framing and presentation of beneficial reuse content for workshop participants. Ultimately, the issue papers were deferred to be included in the Action Plan.

Workshop

Agendas and Preparation

The Catalyst team facilitated two stakeholder workshops on January 23 and February 13, 2024.

Workshop 1 focused on barriers and actions for sediment and soil sources, storage, and placement. The agenda for Workshop 1 was as follows:

- Review the Plan for the Day
- Review the Project Purpose, Framework, Roadmap
- Morning Breakouts – Sediment and Soil Sources
    - Construction Soil
    - Flood Management Sediment/Soil
    - Dredged Sediment
- Afternoon Breakouts – Storage and Placement
    - Direct Placement
    - Strategic/Indirect Placement
    - Restoration Site Availability/Readiness
- Summary and Close

During the morning breakout groups, Core Team members presented a brief overview of each potential source of sediment and soil and introduced 18 important issues with initial actions (5 to 7 issues per breakout group). Furthermore, discussions regarding the issues with initial actions allowed the participants to review, clarify, and adjust the existing language to better reflect the steps needed to address these obstacles.

The afternoon breakout groups followed a similar format and focused on the placement of sediment and soil, including direct and indirect placement, and site availability. Core Team members presented an overview of each placement topic and introduced 15 important issues for discussion. These issues were discussed by the participants, which allowed for the existing language to be reviewed and adjusted, so appropriate actions were implemented to resolve these matters.

Between the workshops, the BCDC team compiled the revised issues and actions, then grouped the actions into 10 categories for discussion at Workshop 2:

1. Policy
2. Process Improvements
3. Communication/Coordination/Education
4. Placement Sites
5. Costs and Funding
6. Testing Protocols
7. Stockpiles for Sediment and Soil
8. Species/Materials/Methods Concerns

9. Pilot Projects for Placement Methods
10. Data and Information

Workshop 2 was designed for further discussion and refinement of the actions identified in Workshop 1 to inform the content of the Action Plan. The agenda for Workshop 2 was as follows:

- Workshop 1 Review and Plan for the Day
- Source and Placement Action Pathways
    - Summary and Revisions since Workshop 1
    - Poster Board Activity to Prioritize Categories and Note Comments
- Governance Models, Coordination, and Coalition Building
    - Breakout Strategy Sessions – Governance
- Afternoon Breakout Strategy Sessions – Actions
- Funding Pathways Panel Discussion
- Summary and Close

The morning breakout activity included a poster session on the 10 action categories, during which participants reviewed the topics and actions, then later identified the most important to be included in the Action Plan. Furthermore, participants also added comments regarding the potential candidates for each action, as well as offer additional feedback on the refinements. The most-voted categories were later discussed in afternoon breakout discussions.

Also in the morning session, Core Team members presented the coordination and governance needs for the SWAP Action Plan and examples from other programs. Participants then divided into two breakout discussions regarding how government agencies, non-governmental organizations, and businesses could organize to move the Action Plan forward.

The afternoon breakout groups reviewed and refined the following actions, which were listed as the most critical categories: (1) Policy, (2) Process Improvements, and (3) Communications, Coordination, and Education. The workshop concluded with a presentation on the steps needed to develop the SWAP funding strategy. As well as a moderated panel discussion regarding the funding needs and sources with representatives from the USEPA, USACE, SCC, and SFBJV.

Workshop Comments

In total, 65 stakeholders participated in some portion of the two workshops (approximately 50 in each workshop). The BCDC team documented and organized all the submitted comments and discussion topics regarding issues (barriers and opportunities), actions, priorities, roles, governance, and funding. This input was synthesized and used to form the basis of this SWAP: Action Plan.

Issues and Actions Management Framework

As noted during initial interviews, stakeholders are very interested in an action plan to advance the beneficial reuse of sediment and soil. Stakeholders confirmed this interest as they were highly engaged in workshop activities to clarify and develop the important opportunities, barriers, and actions for increasing beneficial reuse.

Beneficial reuse in San Francisco Bay, however, is a highly complex activity as it involves hundreds of potential sediment and soil sources; placement sites in various stages of development and readiness; dozens of intersecting state, regional, and local policies and regulations; complex governance and coordination needs; and the need for multiple stakeholder perspectives and interests to collaborate in addressing these many challenges.

This complexity is reflected in the diversity of the 45 important issues identified (Workshop 1) and 128 actions developed (Workshop 2).

To address this complexity, Catalyst developed a framework asking all stakeholders to review the issues and actions appropriately, so the beneficial reuse of sediment and soil can proceed efficiently. The framework is organized in four "verticals:"

1. **Planning.** Regional planning issues and actions for beneficial reuse in San Francisco Bay, which include sediment availability, site prioritization, research, and future obstacles were not addressed in the development of this SWAP: Action Plan.
2. **Sources and Placement.** Identifies the issues and actions related to expanding the availability of sediment, soils, and placement sites, and improving the coordination between sources and restoration locations.
3. **Costs and Funding.** Identifies the issues and actions related to increasing available funding for all beneficial reuse activities, specifically those that can reduce the cost differential between reuse and disposal.
4. **Governance and Regional Coordination.** Describes the issues and actions related to leading, coordinating, and implementing Action Plan items among organizations and stakeholders.

The following graphic represents the conceptual view of the issues and actions incorporated into this Action Plan.