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Financing Natural Infrastructure: South Bay Salt Pond Restoration Project, California

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PURPOSE: This technical note is part of a series collaboratively produced by the US Army Corps of Engineers (USACE)–Institute for Water Resources (IWR) and the US Army Engineer Research and Development Center (ERDC). It describes the funding and financing process for the South Bay Salt Pond Restoration Project in San Francisco Bay, California and, like the other technical notes in this series, documents successful examples of funding natural infrastructure projects. The research effort is a collaboration between the Engineering With Nature® (EWN®) and Systems Approach to Geomorphic Engineering (SAGE) programs of USACE. A key need for greater application of natural infrastructure approaches is information about obtaining funds to scope, design, construct, monitor, and adaptively manage these projects. As natural infrastructure techniques vary widely by location, purpose, and scale, there is no standard process for securing funds. The goal of this series is to share lessons learned about a variety of funding and financing methods to increase the implementation of natural infrastructure projects.

BACKGROUND: The South Bay Salt Pond Restoration Project (SBSPRP) comprises 15,100 ac (6,110 ha)[1] of historically tidal wetland, which encompasses the southern extent of San Francisco Bay (Figure 1), San Francisco, California. Much of that area had been converted during a long history of industrial salt production in the region, resulting in the loss of 85% of the dominant predevelopment ecosystem. Following acquisition of the land from Cargill Salt in 2003, the SBSPRP has been restoring it to tidal marsh. The restoration seeks a state that can support and increase native plant and animal diversity and abundance, maintain or improve flood protection, provide public access and recreation, protect or improve water and sediment quality of the bay, control non-native invasive species, promote special status species, and protect existing infrastructure services (SBSPRP 2004).

The project is planned over a 50-year time horizon and implemented in phases. An adaptive management plan guides the process of transforming those former salt-production areas to a

1. For a full list of the spelled-out forms of the units of measure and unit conversions used in this document, please refer to *US Government Publishing Office Style Manual*, 31st ed. (Washington, DC: US Government Publishing Office, 2016), 248–52 and 345–47, https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf.

mosaic of tidal marshes and managed ponds that support shorebirds as well as the use of applied science and monitoring to address uncertainties and adjust project implementation accordingly. Many milestones have already been achieved to date, including preliminary transformation via salt-pond dilution, extensive public engagement, finalization of the restoration plan, extensive habitat enhancement, addition of multiple public-access amenities, completion of the Phase 1 project actions, and advancement of Phase 2 through planning, design, and construction initiation. Specifically, 3,040 ac (1,230 ha) of salt marsh have been restored (40% of goal); 707 ac (286 ha) of wildlife habitat have been enhanced (44% of goal); and 6.7 mi (10.8 km) of recreational trails, 7 viewing platforms, and 1 kayak launch have been opened to the public (SBSPRP [2019?]).

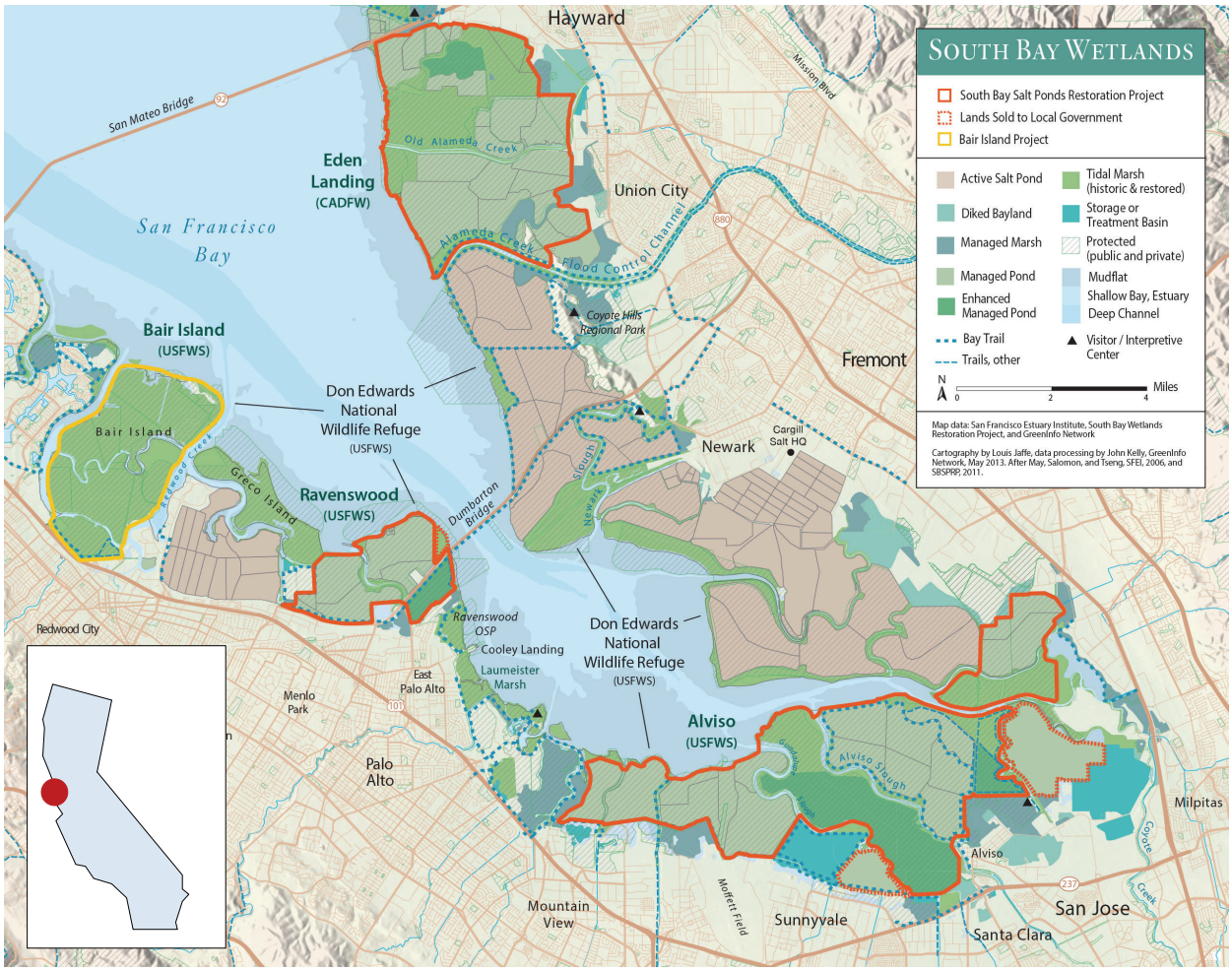

Figure 1. Map of restoration project area in South San Francisco Bay, California. *Inset*, map indicates the project location.

The natural infrastructure features in the SBSPRP area are tidal wetlands and managed ponds. Restored tidal wetlands and the addition of enhancements (for example, nesting islands) to managed ponds) are yielding a mix of habitat types, including salt and brackish tidal marsh, mudflats, subtidal flats and channels, marsh ecotones, upland transitional zones, and salt pannes

and pools. This diversity of habitats has resulted in growing species richness (H.T. Harvey and Associates 2008). The appearance of specific endangered species, such as Ridgway's rails (Figure 6) indicates success toward the habitat restoration goal (Krieger 2015). Transformation of the land to a more natural and productive ecosystem comes with various services, or *ecosystem services*. Of particular interest from the perspective of natural infrastructure is coastal-storm risk management. For example, the SBSPRP is "providing a critical natural buffer against the effects of global climate change and sea level rise" (SBSPRP, "Climate Change," n.d.). Tidal wetlands serve as natural protective buffers for people and built coastal infrastructure by absorbing tidal waters and wave energy. As tidal wetlands become established, dense vegetation efficiently traps sediment and organic matter, which allows the land surface to accrete (build in height), thereby potentially keeping pace with sea level rise naturally. Sediment flows into the wetlands, introducing much-needed nutrients that support the growth of vegetation that, in turn, provide aquatic habitats. Because of high primary productivity, tidal wetlands can sequester and store large amounts of carbon and therefore contribute to climate mitigation (SBSPRP, "Climate Change," n.d.).

A multiagency project management team (Figure 2) oversees the restoration planning process; the key entities are the California State Coastal Conservancy (SCC), the California Department of Fish and Wildlife (CADFW), and the US Fish and Wildlife Service (USFWS). The latter two agencies own the project lands, with the USFWS owning 9,600 ac (3,884 ha) and the CADFW owning 5,500 ac (2,225 ha) (H.T. Harvey and Associates 2008). The SCC is a nonregulatory state agency that directs funds, provides technical support, and contributes project management to communities and projects along the coast of California and within San Francisco Bay. It was established "to protect and improve natural lands and waterways, help people get to and enjoy the outdoors, and to sustain local economies along California's coast" (SCC 2020) As the primary funder and contract manager of the SBSPRP, they manage and track grant-recipient performance as well as set contracts with the engineering and environmental firms and contracting companies. The management team also includes multiple other agencies and individuals, such as the Santa Clara Valley Water District (SCVWD), Alameda County Flood Control and Water Conservation District (ACFCWCD), USACE, and the lead scientist and collaborative-process coordinator. Private companies, academia, and citizens also have a role in the SBSPRP.

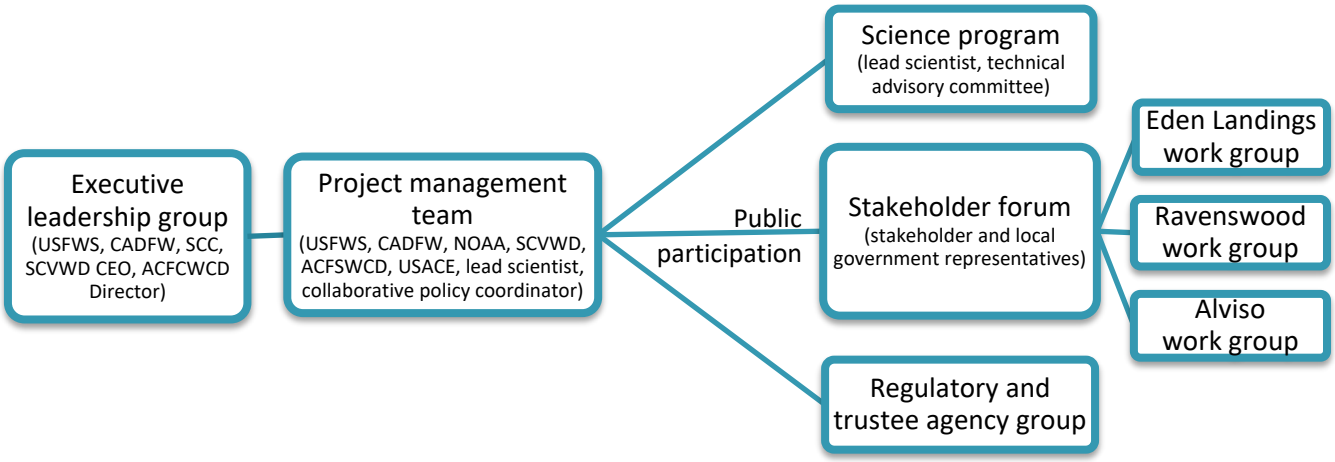

Figure 2. The SBSPRP management structure (SBSPRP, "Who We Are," n.d.).

Funding process. As the largest wetland restoration project on the West Coast, located in an economically important and populous area, the SBSPRP is technically difficult, expensive, and high profile. Although these factors complicate the project, they also provide an opportunity for innovation and progressive action. The SCC sustains funding for the project by pursuing grants from federal, state, and local agencies, with the help of the SBSPRP landowners, contractors, and nonprofits. Other sources of funding include private-foundation donations, mitigation fees, litigation payouts, and voter-supported parcel taxes. The SCC has decades of experience finding grant opportunities and is skilled at winning funding. The project estimates that implementation could require funding in the range of hundreds of millions of dollars over many decades (SBSPRP, "Frequently Asked Questions," n.d.).

A simple breakdown of the funding picture according to major categories of items to date is as follows: land acquisition ($100 million); development and implementation of an initial stewardship plan ($22 million); development of a visioning plan ($25 million); process of securing necessary permits (for example, National Environmental Policy Act[2] [NEPA], California Environmental Quality Act[3] [CEQA], and wildlife agencies); Phase 1 implementation ($37 million); Phase 2 planning ($7 million); some of Phase 2 implementation ($25.5 million) (expect to rise to $60 million or more); and execution of public-access infrastructure (<$5 million), monitoring, and science (<$10 million). See Figure 3 for the project time line.

2. National Environmental Policy Act of 1970, 42 U.S.C. § 4321 et seq. (2020). https://www.govinfo.gov/content/pkg/USCODE-2020-title42/pdf/USCODE-2020-title42-chap55-sec4321.pdf.
3. California Environmental Quality Act of 1970, Cal. Pub. Res. Code § 21000 et seq.

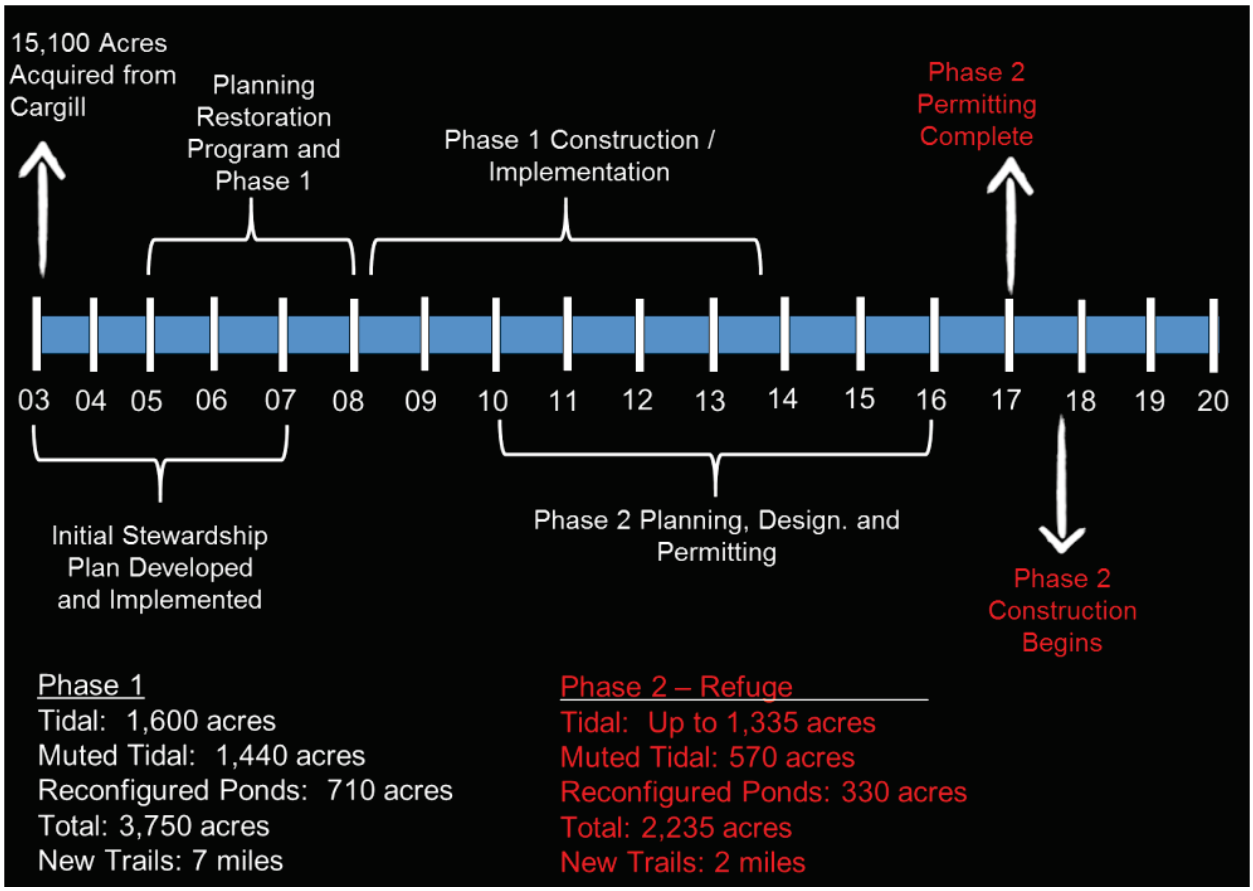

Figure 3. Project timeline.

Land acquisition. Land for the SBSPRP was acquired by state and federal wildlife agencies from Cargill in 2003 for $100 million. Prior to the formal purchase of the land, there had been great public, private, and political interest in such a restoration project, including from the nonprofits Save the Bay and the Bay Institute and from Senators Dianne Feinstein and Byron Sher (WCB 2003). This interest culminated in the signing of a framework agreement in May 2002 and funding approval in 2003. The exact reasons as to why Cargill was interested in selling the land is not fully clear, but a declining economic efficiency of salt production because of sea level rise and regulation may have been a factor.

The largest portion of funding ($72 million) came from state funds, in the form of Proposition 50,[4] a $3.4 billion voter-approved water bond (Rogers 2002). The bond language specified that $750 million would be appropriated to the Wildlife Conservation Board (WCB) for acquisition, protection, and restoration of coastal wetland lands in or adjacent to urban areas, including $200 million available to be granted to the SCC for the Bay Area (CNRA 2004). The WCB voted to use bond funds to acquire the SBSPRP land under its primary responsibility to select and fund the

4. Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002, Cal. Wat. Code § 79500 et seq.

purchase of land for wildlife habitat. In addition to funding land acquisition, the WCB operates, through its many programs, to allocate resources to restore habitat and develop wildlife-oriented public-access facilities. Projects are prioritized with the help of CADFW's biological expertise (WCB n.d.).

The next-highest proportion of the acquisition funds ($20 million) came from private foundation contributions: the Hewlett, Moore, and Packard Foundations and the Goldman Fund through the Resources Legacy Fund (RLF). The RLF partners with donors to "protect ocean, land, and water resources, generate public funding and smart policies and engage diverse interests in conservation, climate change adaptation, and healthy communities" mainly in the western United States (RLF, n.d.).

The remaining $8 million came from the USFWS, which is the federal landowner in the SBSPRP. Despite contributing the least amount of funds for acquisition, the USFWS owns most of the project area, because it was better situated to provide the long-term funding, management, and staffing that would be needed to fully restore and operate the ponds and salt marshes.

Planning and design. The SBSPRP has a phased execution, where planning, design, and implementation follow an adaptive process that moves its focus between batches of specific salt-pond sites as phases progress. The project can generally be divided into three complexes that are geographically discrete. USFWS owns Ravenswood (1,600 ac, 647 ha) and Alviso (8,000 ac, 3,237 ha), and CADFW owns Eden Landing (5,500 ac, 2,225 ha). These three areas comprise 56 former salt-production ponds. Decisions about where and how to take restoration actions are informed by field work, data collection, modeling, and analysis, with portions of each of the three complexes being advanced simultaneously. Complicated and degraded geomorphology (for example, subsided land, aging pond berms), multiple restoration goals, and potential risk associated with coupled socio-technical systems (that is, the proximity of critical infrastructure and developed land) have necessitated careful and intense planning and design. Two major activities initiated after acquisition were the development of an initial stewardship plan and a long-term restoration plan.

The initial stewardship plan was developed and implemented as a transitory step between industrial salt production and tidal-marsh restoration. This step cycled bay water through the salt ponds, gradually reducing salinity to more natural levels to prevent adverse impacts to the bay on the full opening of the ponds to tidal flows (Figure 4). This transition stage was a project in itself, involving planning, design, and construction. Over the course of the three-year, $22 million project, 50 water-control structures were built to circulate water, landward levees were shored up to protect communities, and some bayside levees were breached to restore tidal flows (SBSPRP 2009). Funding came from a combination of private, state, and federal sources (Table 1).

Table 1. Overview of the funding sources to complete the initial stewardship plan.

Source	Amount (USD)
Foundations	6,423,893
Federal (USFWS[a], NAWCA[b])	8,200,000
State (WCB[c])	5,000,000
Mitigation (SCVWD[d])	2,000,000
Total	21,623,893

[a] US Fish and Wildlife Service
[b] North American Wetlands Conservation Act[5]
[c] Wildlife Conservation Board
[d] Santa Clara Valley Water District

Figure 4. Ponds in the project area are breached to connect them with the bay and begin natural salt-marsh restoration. (Photo credit. Judy Irving, Pelican Media)

5. North American Wetlands Conservation Act of 1989, 16 U.S.C. § 4401 et seq. (2020). https://www.govinfo.gov/content/pkg/USCODE-2020-title16/pdf/USCODE-2020-title16-chap64.pdf.

The long-term restoration plan lays out the SBSPRP vision to restore 50%–90% of the ponds to salt marsh and to use an adaptive-management process to guide restoration. The plan provides a rationale for how the first batch of ponds was chosen and for a process by which subsequent batches would be chosen. The long-term restoration plan development took place over the course of four years and at a cost of $25 million. The visioning process gathered the landowners, the SCC, a science panel of experts, and a 25-to-35-member stakeholder group that included neighboring landowners, utilities, government agencies, advocacy groups, and community groups. In addition to many process-oriented activities integral to successful management and decision-making, the process of developing the plan included draft and final versions of a programmatic environmental impact statement and report (meeting NEPA and CEQA requirements) as well as design, environmental clearance, and permitting of the Phase 1 project actions. See Table 2 for the funding breakdown for these activities.

Phase 1 construction. Phase 1 construction took place over the course of many years (years 8 through 14), and applied science and monitoring is ongoing. Through construction activity at 6 locations, 1,600 ac (647 ha) of tidal marsh were restored and 2,150 ac (870 ha) of ponds reconfigured to support wildlife, achieve various types of habitat, and create public access (SBSPRP 2018a). See Table 3 for the funding breakdown of Phase 1 construction by project and agency.

Funding for Phase 1 was not secured as a single batch; individual ponds or combinations were funded, each with a combination state, federal, local and regional, and private sources. For example, state and federal sources were used to jointly execute the plan for ponds A16 and A17 in the Alviso Complex. Funds went to USFWS for contractors, project management, SCC staff costs, and monitoring. The restoration created 16 islands for nesting birds and 240 ac (97 ha) of shallow-water habitat for shorebird foraging (A16) and 130 ac (52 ha) of tidal wetlands (A17). It additionally increased wildlife-compatible public access and education. For other ponds, Phase 1 construction leveraged nonfederal and state funders as well. See Table 4 for the funding breakdown for one pond complex undertaken in Phase 1 and Table 5 for Phase 1 and applied-science funding contributions by source.

Table 2. Funding sources for Phase 1 restoration plan, design, and permitting.

Source	Amount (USD)
Foundations (RLF[a])	6,586,270
Federal (USFWS, USGS[b], NMFS[c])	1,008,776
State (SCC[d], WCB)	15,264,326
Local (SCVWD, ACFCWCD[e])	1,963,846
Total	24,823,218

Note: Includes the environmental compliance, science program, and stakeholder process.
[a] Resources Legacy Fund
[b] US Geological Survey
[c] National Marine Fisheries Services
[d] California State Coastal Conservancy
[e] Alameda County Flood Control and Water Conservation District

Table 3. Funding sources for construction, by agency and project type.

	Project	Agency	Project type[a]	Amount (USD)	Total amount (USD)
Alviso	A16/17	Federal (EPA[b], USFWS)	Habitat	4,701,659	6,969,659
			Public access	378,000	
		State (CADWR[c], SCC)	Habitat	1,890,000	
	A6	Federal (NOAA[d], NAWCA)	Habitat	940,911	940,911
	A8	Federal (NOAA)	Habitat	890,700	3,329,271
		State (SWRCB[e])	Habitat	1,125,000	
		Local (SCVWD)	Habitat	1,313,571	
	Bayfront Trail	Federal (USFWS)	Public access	25,000	25,000
	Moffett Bay Trail	State (SCC)	Public access	100,000	100,000
Eden Landing	E12/13	State (CADFW[f], WCB)	Habitat	6,200,000	7,900,000
			Public access	1,700,000	
	E8A/9/8X	Foundation (NFWF[g])	Habitat	580,000	6,904,416
		Federal (USFWS, NOAA)	Habitat	4,189,864	
		State (SCC)	Habitat	1,334,552	
		Local (ACFCWCD)	Habitat	800,000	
Ravenswood	SF2	Federal (USFWS)	Habitat	6,800,000	9,200,000
			Public access	800,000	
		State (CalTrans[h])	Mitigation	1,100,000	
		Local (Menlo Park)	Mitigation	500,000	
				Total	35,369,257

[a] *Habitat* projects restored tidal marsh or reconfigured ponds; *public access* projects created sources of public access, such as walking paths; and *mitigation* projects compensated for adverse environmental impacts.
[b] Environmental Protection Agency
[c] California Department of Water Resources
[d] National Oceanic and Atmospheric Administration
[e] State Water Resources Control Board
[f] California Department of Fish and Wildlife
[g] National Fish and Wildlife Foundation
[h] California Department of Transportation

Table 4. Sample breakdown of funding sources for Phase 1 actions at Ponds A16/17.

Funder	Source	Amount (USD)
SCC	Appropriation of Proposition 84[a]	625,000
CADWR	Integrated Regional Water Management Program	1,232,500
EPA	San Francisco Bay water quality	700,081
USFWS	Matching funds from federal appropriations for DESFB[b] Wildlife Refuge	4,800,000
	Total	7,357,581

[a] Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002, Cal. Wat. Code § 79501 et seq.
[b] Don Edwards San Francisco Bay

Table 5. Overview of the sources of funding for Phase 1 construction and applied scientific studies.

Construction	Amount (USD)
Foundations (NFWF)	580,000
Federal (USFWS, NOAA, NCWC, NAWCA, EPA)	18,726,134
State (SCC, SCRCB, CADWR, WCB, DFW)	13,577,552
Local (SCVWD, ACFCWCD)	2,113,571
Mitigation (CalTrans, Menlo Park)	1,600,000
Total	36,597,257
Applied scientific studies	
Foundations	1,000,000
Federal (USFWS, USGS, USEPA, SFEP, NOAA)	2,880,900
State (SCC)	2,834,328
Local (SCVWD)	2,550,000
Total	9,265,228

Phase 2. Phase 2 initiates the planning, design, and execution of the next set of pond restorations envisioned in the long-term restoration plan. The activities of Phase 2 planning and design include a design charette, evaluation of pond complexes, stakeholder engagement, preliminary design, environmental reviews, regulatory permitting, launch of new applied studies, and, of course, construction (SBSPRP 2018b). Plans for two of the three complexes (Alviso and Ravenswood) were finalized in 2016, and the last (Eden) was finalized in 2019. Construction for Phase 2 projects began in 2019 and is described in Table 6 (SBSPRP 2018c; SBSPRP 2019).

Federal funding for Phase 2 planning came from the EPA ($1.296 million), and state funding came from the SCC and WCB ($5.765 million) (SBSPRP 2018c). As of April 2018, committed funds for Phase 2 construction totaled $25.673 million and came from federal, state, and local contributions:

- $2.67 million from the EPA
- $3 million from NOAA's Coastal Resiliency Grant Program
- $1 million from USFWS (NAWCA)
- $2.705 million from the SCC
- $1 million from USFWS (National Coastal Wetlands Conservation)
- $4.9 million from CADFW
- $4.68 million from CADWR
- Estimated $2.5 million each from the City of Mountain View and SCVWD (SBSPRP 2018c)

Table 6. Phase 2 projects planned and finalized, with expected benefits.

Pond complex	Benefits
Ravenswood (R3, R4, R5, S5)	• 294 ac (119 ha) of new tidal marsh • 67 ac (27 ha) of ponds improved for ducks and shore birds • Public-access trail and viewing platform • Improved All-American Canal levee to protect 270 ac (109 ha) for threatened species nesting area
Alviso (A19/A20)	• Improve tidal circulation in 330 ac (133 ha) to accelerate development of tidal marsh habitat
Alviso (A1, A2W)	• 710 ac (287 ha) of tidal-marsh restoration • Dozens of acres of habitat-transition zones and islands • 2 public access trails with viewing platforms
Alviso (A8)	• Two large habitat-transition zones in preparation for future tidal restoration and to provide erosion protection to adjacent landfill and levees
Eden Landing (Ponds E1, E2, E4, E7, E5, E6, E1C, E2C, E4C, E6C)	• 1,400 ac (566 ha) of fully tidal marsh restoration • 445 ac (180 ha) of enhanced managed pond habitat • 450 ac (182 ha) of muted tidal restoration • 3–4 mi (4.8-6.4 km) of new public-access trails with viewing platforms • Multiple levee enhancements and habitat-transition zones

San Francisco Bay Restoration Authority. An important source of funding for Phase 2 is the San Francisco Bay Restoration Authority (SFBRA), which awards grants to projects that restore and protect coastal habitats and improve public access to them. The SFBRA, created by the state legislature in 2008, is a regional agency funded through a variety of sources, including gifts, grants, and state and local bonds.[6] A significant source is the Measure AA parcel tax, the 20-year, $12 tax on parcels in the nine-county Bay Area included in the San Francisco Bay Clean Water, Pollution Prevention and Habitat Restoration Measure, which went into effect in 2017. The ballot measure will raise $500 million over 20 years and was supported by 70% of voters (SFBRA n.d.).

An example recipient of SFBRA funds is Ducks Unlimited. The organization requested a grant for the construction of Phase 2 projects in the Alviso and Ravenswood Ponds and were disbursed $6.2 million, which originated from a combination of federal, state, and local contributions. A portion of the funds is designated for grant management and administrative costs. Ducks Unlimited also directly secured $5.68 million in federal grants for Phase 2 (SBSPRP 2018c).

Operations and maintenance, monitoring, applied science, and adaptive management. Most operations and maintenance costs are not borne by the SBSPRP itself, but by the landowners (USFWS and CADFW) out of their own operating budgets. Public-access features are an exception, as they are sometimes funded by park districts. Volunteer groups play a role in various maintenance activities, such as weed removal.

6. San Francisco Bay Restoration Authority Act of 2008, Cal. Gov. Code § 66702 and 66705.5.

Monitoring serves multiple purposes and is not guided by a single, unified plan. The two landowners must conduct certain monitoring in compliance with their respective agency's goals and under the permits issued to them. The SBSPRP also funds other monitoring and reporting that serves the larger project goals, the adaptive management plan, and NEPA and CEQA requirements. As of 2018, over $9 million had been spent on monitoring and applied science.

The adaptive management plan lays out how the project relies on applied science and monitoring to reduce key uncertainties, adapt project management and decisions, and avoid adverse impacts (SBSPRP 2007). This feedback loop is at the heart of the adaptive management plan. Through the adaptive management plan, the project can determine whether current conditions are moving toward or meeting restoration targets. Restoration actions should ideally enable conditions to evolve toward an improved state, as indicated by traceable indicators. Example targets include the following:

- sufficient sediment is settling in restored areas (accreting) to support increase in vegetated marsh area and be sufficient for a 50-year time frame (Figure 5)
- methylmercury levels in ponds and sentinel species do not increase above baseline
- achieve specified amount of target bird, fish, and mammal species
- avoid negative new water-quality impacts such as low dissolved oxygen and algal blooms
- provide high-quality public access that does not have significant impact on target species (SBSPRP 2018a)

The array of applied studies that have been conducted to understand progression toward restoration targets were funded through many sources, including the SCC, USACE, USGS Science Support Program, EPA, USFWS, and SCVWD (SBSPRP 2015).

During Phase 1, a multimillion-dollar scientific research and monitoring effort engaged a variety of academic, government, nonprofit, and private sector researchers for more than 20 studies on key scientific questions (see Valoppi 2018 for overview of findings). Later, work funded by the SFBRA led to refinement of those uncertainties to inform the monitoring and applied science for Phase 2 (Wood et al. 2019). This system of refinement helps keep the project on track toward its objectives. The California Wildlife Foundation, which works with the SBSPRP management team but secures funding for this work and also contributes matching funds of their own, received $1.2 million from the SFBRA for science and monitoring and contributed a $75,000 match for administrative costs. The California Wildlife Foundation can acquire funding from a variety of sources and can disburse them and provide oversight to advance wildlife and habitat projects.

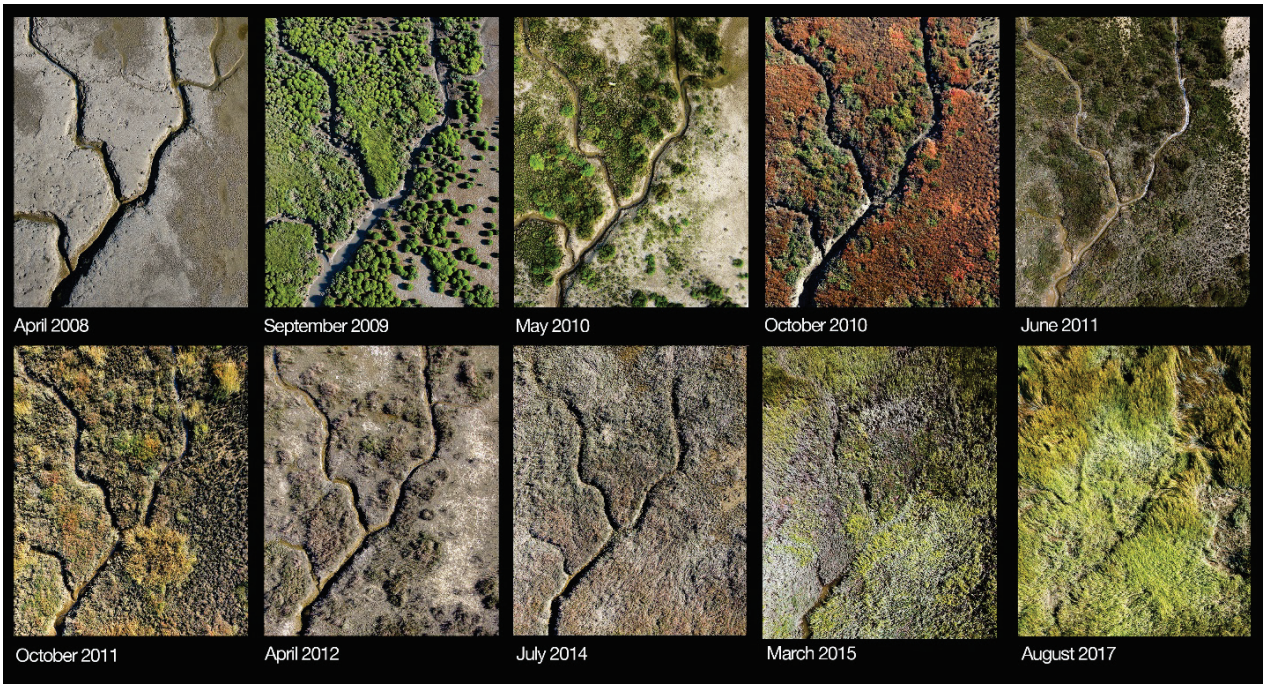

Figure 5. Restoration of vegetation on pond A21 mudflat (2008–2017). (Photo credit: Cris Benton)

LESSONS LEARNED—ENABLERS: A number of factors heavily contributed to the successful funding of the SBSPRP to date. These include that the land to be restored was acquired from a single landowner, there was and is strong political and public support for the project, partners of the project are knowledgeable of or specialized in grants, and grants come from a range of sources.

Acquisition from a single landowner. Acquiring land for a natural infrastructure project, or any project, will become more complicated as more landowners are involved. Fortunately, the SBSPRP acquired over 15,000 ac (24,140.16 ha) of historical tidal wetland from a single landowner, Cargill. Much of this acreage was bought, but a portion was also donated by Cargill. However, the acquired land had been in salt production for approximately 150 years and includes some of the most subsided and difficult-to-restore land of Cargill's holdings (Siegel and Bachand 2002). There have been conversations about acquiring new areas to include in a public-lands system, but none have come to fruition.

Political, partner, and public support. Starting this project required the initial backing by political appointees, including Senator Dianne Feinstein, Representative Don Edwards, and a number of local politicians to start the project's coalition and direct state and federal funds towards the project. The project, which is big, innovative, and important, quickly gained public support and has been able to sustain that support through public outreach and engagement. This engagement includes a partnership with the Center for Collaborative Policy out of the California State University, Sacramento (SCC 2003); a website and social media accounts; public talks and

tours; outreach with local wildlife-focused entities and nonprofits, friends groups, and Audubon chapters; and partnering with local water districts, flood agencies, and park districts. Maintaining these important relationships and engagements brings its own cost, but they all contribute to ongoing support that can additionally aid funding requests. Existing public-outreach efforts can satisfy requirements of some grant programs, and letters of support from a diverse array of local stakeholders makes applications more competitive.

Partner scientific organizations. A number of private consulting firms and public scientific organizations are key actors for sharing expert knowledge and scientific understanding of tidal wetlands, land and water management, and interdisciplinary collaboration. Over the years, the partners involved in the project's science program have varied, but major contributions have been from USGS; the University of California, Davis; the San Francisco Bay Bird Observatory; Point Blue Conservation Science (formerly Point Reyes Bird Observatory); the San Francisco Estuary Institute; and staff from resource or management agencies at many city, county, regional, state, and federal agencies.

Partners specializing in grants. Opportunities for funding are usually numerous, but identifying funding sources, setting aside time and resources to complete competitive applications, and tracking funds after they are won can be difficult. The SCC, a nonregulatory grant-giving state agency and SBSPRP partner, has institutional knowledge of applying for and managing grants and has greatly contributed to the long-term success of this effort. The SCC has been a pivotal player in successfully securing the funding. Ducks Unlimited, an international nonprofit organization actively engaged in wetland restoration and conservation, has also used their institutional knowledge of grant seeking to assist the project and even acquire funds directly for the project. Similarly, the San Francisco Bay Bird Observatory secures a lot of its own funding from grants to conduct bird surveys and other data collection and analysis on the project. While coordination among grant-seeking entities is loose, they do share ideas about which grants to pursue and help each other with letters of support, technical reviews, and more.

Varied sources of grants. The project has received grants from a variety of sources, including federal grants from the EPA and NOAA; state grants from the CADWR and WCB; regional and local grants from the SFBRA and SCVWD; mitigation dollars (for example, money paid by a shipping company to mitigate an oil spill); money from foundations; grants from local flood, park, or water agencies; and funds from voter-passed tax measures. A list of partners can be found on SBSPRP's website (SBSPRP, "Our Partners," n.d.). Overall, California has a number of funding programs that make the state an ideal location for this project.

Foundation and private funding. Private funding has been important to the initiation and sustainment of the SBSPRP: as already mentioned above, $20 million of the project's land-acquisition money came from the Hewlett, Moore, and Packard Foundations and the Goldman Fund through the RLF. The private foundations additionally provided $15 million toward the cost of initial stewardship and long-term restoration planning. Foundations with missions particularly well suited to the project, such as the National Fish and Wildlife Foundation (NFWF), have provided ongoing support for the project. In addition to increasing the pool of funds the project

can draw from, different sources of funds can and have been used to fulfill match requirements of other funds and grants.

LESSONS LEARNED—BARRIERS: The SBSPRP has also encountered barriers that have complicated the process of securing and, to a greater extent, using funding. These barriers, described in more detail below, include limitations of how grant money can be used and when, environmental permitting, operating in developed areas, and the maintenance cost of envisioned work.

Grant-specification constraints. Grants have specific requirements for how they can be used, such as planning, permitting, or construction. More funding is available for construction, with less for planning and permitting, and much less for science programs and ongoing monitoring, which is often required by environmental permits. Monitoring is also central to the SBSPRP adaptive management plan. This imbalance creates a corresponding asymmetry in the project implementation pipeline. Grants must be carefully targeted and used to cover the appropriate costs. Though some grant programs will award funds for the initial scientific studies required to establish a baseline for permits and CEQA analyses, the lack of funding for ongoing scientific studies, management, operations and maintenance, and monitoring is the most challenging to overcome. The SBSPRP has had to seek other funds with the help of the SCC and Ducks Unlimited and partner with landowners and contractors already working on the project to complete ongoing monitoring. Additionally, most grant programs require that funds be used within a specified number of months or years after they have been awarded. This requirement means that if a permit is unexpectedly delayed or a city unexpectedly requests more flood modeling, for example, it hinders the project's ability to be delivered within the required time frame. This reality can force project proponents to either make suboptimal decisions or lose their funding.

Environmental permitting. The permitting processes for all environmental regulatory agencies involved in a project of this nature is challenging, expensive, and lengthy. Projects aimed at improving the environment (for example, restoration and environmental-enhancement projects) are held to the same regulatory processes and standards as projects that would degrade the environment (for example, building a new subdivision). Despite the clear differences between the two, the statutes, regulations, and policies are not set up in a way that differentiates between them. The permitting process has, at times, delayed the project; for example, the duration between when the permit applications for Phase 2 of the SBSPRP were submitted and when the permits were issued was 18 months.

Figure 6. Endangered Ridgway's rails were found for the first time at restored salt marsh A21 in 2014. (Photo credit: Julie Kitzenberger)

Operating in highly developed areas. The SBSPRP must take care to avoid undue impacts to the surrounding developed areas, which includes evaluating the risk of soil erosion, groundwater seepage into closed landfills, flooding, corrosion of metal infrastructure, and more. While support for the project is high, concerns are consistently raised by local communities and organizations, requiring the project to assess the risk of damage on an ongoing basis and to work with the concerned parties to protect built resources from potential damage. Sea level rise also causes the project to constantly revisit these questions with neighboring communities to work through any new or existing concerns. Delays to the project may affect the success of the restoration, because sea level rise poses a challenge for achieving the elevation that marshes require to establish themselves.

Maintenance costs. Individual components of the project can be costly to implement and costly to maintain, requiring the envisioned plan to be altered to fit the funds that can be reasonably raised for both the initial cost and future maintenance. For example, culverts must be replaced every 10–20 years, so it is prudent to limit their use. In another example, the plans to build a spur trail at one project site were abandoned because the long-term maintenance was deemed too costly, since many culverts or bridges would have been required. Partnerships with local park districts can bring

plans to fruition if park districts agree to maintain trails once they have been built, but these partnerships are not a guarantee.

NEXT STEPS: The SBSPRP is 20 years into its 50-year time line and is progressing through its second phase of restoration-project implementation. Other projects have emerged in recent years that may have some spatial overlap with SBSPRP, and projects might have some degree of coevolution (for example, overlaps in shoreline projects within the national wildlife refuge).

The SBSPRP is the first of its kind in the Bay Area and has led the way in realizing land conversion to achieve habitat restoration and prepare for sea level rise. Like other Bay Area tidal-marsh projects, the SBSPRP requires a significant volume of fill to counteract substantial subsidence and raise the land to tidal-marsh elevation as well as to keep pace with sea level rise. As such, the SBSPRP has supported requests that the San Francisco Bay Conservation and Development Commission's *Bay Plan Amendment No. 1-17 to Update of the Bay Plan Fill for Habitat Policies* better enable projects to use dredged sediment in ecological restoration efforts (SFBCDC 2019). A new report from the San Francisco Estuary Institute describes the necessity of sediment to build and enhance the resilience of wetlands in the region (Dusterhoff et al. 2021).

Given the SBSPRP's proximity to San Francisco Bay and the benefits large, wealthy technology companies and their employees already receive from the restored marshes and newly constructed trails, the project may be able to attract increasing private investment. The success of SBSPRP and overwhelming public support of the project give it a favorable position to continue to secure public funding.

ADDITIONAL INFORMATION: Mr. David Halsing, the current executive project manager for the SBSPRP, was interviewed in January 2021. This technical note summarizes the information he provided during the interview, through his comments on draft versions, and supplemented by additional background research.

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APPENDIX A: ABOUT THE NATURAL-INFRASTUCTURE FINANCING CASE STUDY SERIES: This research effort is a collaboration of the Engineering With Nature® (EWN®) and Systems Approach to Geomorphic Engineering (SAGE) initiatives, undertaken in response to an identified information gap about how to secure the funds necessary to scope, design, construct, monitor, and adaptively manage natural infrastructure.

The project development team identified initial case studies through team members' professional networks. Projects must include natural infrastructure features, have progressed at least partially through construction, and have a knowledgeable point of contact willing to communicate relevant details about the project and financing process. For the purpose of this effort, *natural infrastructure* is defined as an area or system that is naturally occurring, naturalized, or constructed to mimic naturally occurring features and then intentionally managed to enhance ecosystem value and provide social and economic benefits (DiFrancesco et al. 2015; Roy 2018). Examples include river floodplains, setback levees, forested water-supply watersheds, freshwater and coastal wetlands, living shorelines, dune and beach systems, living breakwaters, and reefs. Natural infrastructures are dynamic, with landscape-level interactions occurring among different features as well as in tandem with conventional infrastructure (Sharifi 2020).

For each case study, a semistructured interview of the project's point of contact was conducted to obtain pertinent information about the project, with emphasis on the process for securing funding for each stage. The project team developed a questionnaire to elicit information about a project's time line, funding sources and how they were obtained, and the barriers and enablers of successful financing. The standardized questionnaire will help facilitate consistent collection of pertinent information and potentially independent authorship of case studies for inclusion in the evidence base for natural infrastructure.

The library of case studies will increase as additional projects are identified by the EWN-SAGE team or are nominated by the network surrounding the project or by natural infrastructure practitioners themselves. Practitioners can nominate projects by contacting the project leads, Bari Greenfeld (bari.n.greenfeld@usace.army.mil) and Margaret Kurth (margaret.h.kurth@usace.army.mil). The project intends to showcase a diversity of project types and funding and financing mechanisms.

EWN is developing the science and practice of intentionally aligning natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaborative processes. EWN is led by the US Army Engineer Research and Development Center, or ERDC, and brings together a growing international community of practitioners, scientists, engineers, and researchers from a wide range of disciplines to understand how best to harness the power of nature to innovate, solve problems, and create sustainable solutions. More information can be found at www.engineeringwithnature.org.

The SAGE community of practice advances coastal community, ecosystem, and shoreline resilience by promoting a spectrum of green (natural and nature-based) and gray (structural) techniques. Organizations across many different sectors are investing in the research,

development, and implementation of natural infrastructure solutions. The SAGE community of practice improves coordination among these entities and provides a forum to share information and collaborate on innovative projects. Through SAGE, the Institute for Water Resources, or IWR, engages with a diverse suite of multidisciplinary partners, including federal and state agencies, nongovernmental organizations, academic institutions, and the private sector. More information can be found at www.sagecoast.org.